

# Aquaculture Food and Marketing Development Project. Progress Report, January 2003

## **Progress Report**

### ***Developing the Mine Water Resource***

Much of the research supported by the Aquaculture Food and Marketing Development Project has involved production and processing of cool water food fish. A long term objective is to develop modifications to the proven raceway system design .

Production of rainbow trout in a modular raceway utilizing water from an Acid Mine Discharge Treatment Plant. Research was completed to determine the technical feasibility of raising rainbow trout at Dogwood Lake. A four step raceway system utilizing water from the polishing pond of an Acid Mine Discharge treatment plant has been installed about 15 miles west of Morgantown. The system was stocked with three strains of trout from the National Center for Cool and Cold Water Aquaculture (NCCCWA) in October of 2002. Various parameters including water quality, flow rate, fish growth, stress, metal content of the flesh, flesh quality, etc. are being tested. A control group of fish are maintained at NCCCWA.

These are the first raceways ever to be manufactured from Honeycomb Fiber-Reinforced Polymer (HFRP) sandwich panels. At this site, comparative studies are being carried out utilizing the side-by-side HFRP raceway construction, which has shown to be effective both for research and potentially for aquaculture producers in West Virginia. Lessons learned at Dogwood Lake has led to a modified design for a four-tank raceway system which is being installed at the WVU Reymann Memorial Farms in Wardensville, WV. This project was funded by the State's Competitive Research Challenge Grant. These two sites with HFRP raceway systems have offered the opportunity to focus research on utilization of mine-waters (Dogwood Lake) in relation to a bench mark using spring water, where both locations constitute large-scale field laboratories that provide data which will translate to commercial applications.

Studies are underway to optimize the composite material architecture (fibers and resins) to provide best performance in strength and stiffness for minimum weight, which is directly related to cost. We are conducting a survey of existing systems to have a better understanding of costs, including life-cycle, and explore market opportunities for HFRP raceways.

Effluent Characterization Sites involved in the West Virginia aquaculture effluent study were visited at approximately six- to eight-week intervals. Field measurements of flow, pH, conductivity, temperature, dissolved oxygen, and turbidity were made of both influent and effluent waters. Grab samples of influent and effluent waters were collected and analyzed to determine settleable solids, total suspended solids, 5-day biochemical oxygen demand (BOD5), nitrogen species (NH<sub>3</sub>, NH<sub>4</sub>, NO<sub>2</sub>, NO<sub>3</sub>), and total phosphorus concentrations. Mass loadings of water quality constituents were calculated using flow and concentration data and were compared with current regulatory requirements. Data at two of the sites are being used to obtain an NPDES permit.

Assessing Yield. Production was measured in representative units at two commercial farms growing rainbow trout. The tank based system captured ground water as it flowed from a coal mine. Average exchange rates were 0.19 and 0.32 exchanges/hour. Production at this farm was destined for a processing plant. Management focused on growing as many pounds of fish as possible. The raceway based system captured spring water as it flowed from the base of a mountain. Average exchange rates were between 6 and 10 exchanges/hour. Production from this farm was destined primarily to the recreational market. Labor was a limiting commodity. Management focused on growing adequate volume to fill orders while minimizing the required labor. Fish in the raceway system were harvested or split when density approached 4 lb/cubic foot, whereas fish in the tank system were harvested as density approached 2 lb/cubic foot. Average production was 107 and 5.8 lb/gpm/yr for tank and raceway systems, respectively. Production rates were higher in the tank based system. This is consistent with management objectives at the two facilities.

Health Survey Current results complemented previous results in demonstrating that certifiable pathogens (e.g., IPNV, *Aeromonas salmonicida* and *Myxobolus cerebralis*) that are endemic in the northeastern U.S. are detectable at low prevalence proportions in the WV salmonid industry. These results present an opportunity to the industry to quickly benefit from the implementation of a state-wide biosecurity and fish health management program.

Resource Economics: According to the WV Department of Agriculture, commercial food fish sales (mostly sales of trout to processors) across the state amounted to over \$800 thousand in 2001, a 35% increase from the previous year. An additional \$1.4 million of trout was stocked for conservation and recreation, making the aquaculture production sector in WV an over \$2 million annual activity. By virtue of its linkages with other sectors of the economy, we find through an input-output analysis that a \$1 million increase in annual aquaculture production increases total output in the state by an estimated \$2 million annually, generates an additional \$1 million in income and business taxes, and adds 55 jobs.

Preliminary results from a national household survey of aquaculture consumption preferences reveal that: (a) almost half of all households consume fish or seafood at least once a week; among the 9% of households who do not consume fish, the main reason given was taste; (b) two-thirds prefer eating ocean-caught fish (c) 61% prefer eating fish or seafood products at home rather than in a restaurant; (d) over half of the respondents reported reading the package label when purchasing fish, with over 60% of them indicating that information on such attributes as nutrition, production and processing techniques, location of production, and freshness was important; (e) 70% felt that fish and seafood should also have a country of origin label; (f) over two-thirds prefer buying their fresh fish "unprepared"; (g) half of all households would not consume genetically-modified (GM) fish; the likelihood of consuming GM fish would increase if it were found to be safer (52%), cheaper (37%), tastier (52%), environmentally friendlier (54%). These results are being used to formulate marketing strategies and guide industry development.

Food Science: Water velocity and harvest method studies have been completed and research summaries and peer-reviewed publications are forthcoming. Preliminary work to refine Vitamin E assay and establish a baseline for time and temperature effects on storage stability are complete. Vitamin E feeding trials will begin in March, 2003. Studies of the effects of transport,

water treatment (Aqui-S(r), CO<sub>2</sub>, ice, and control), and harvest method (CO<sub>2</sub> and Manual) on stress response and fillet attributes of Arctic Char are completed. Data analyses are underway and results will be summarized for publication in peer-reviewed journals. We will be assessing the effect of feed on fillet attributes of 4 groups of rainbow trout produced in acid mine drainage following treatment. We anticipate beginning these analyses by February, 2003. Activa(r), a cold-set technology that uses transglutaminase to increase protein-protein interactions, has been used for manufacture of restructured rainbow trout product. Because frozen storage is a necessary component of this process, the utility of this restructuring technology in the presence of cryoprotectants (trehalose, sucrose, sorbitol combinations) is under evaluation.

### ***Use of Farm Raised Fish in Recreation***

Customer Satisfaction and Appropriate Fee Structure for Fee Fishing Enterprises. Phase one data were collected at three West Virginia fee fishing businesses during the summer of 2002. Analysis suggests that rainbow trout (catch-and-keep) and channel catfish (tournament) fishing formats attract different customers who demand different recreational experiences. Rainbow trout anglers tend to travel as a family seeking fishing opportunities for their children. They were highly satisfied with catching and keeping a minimum of five fish per trip. The suggested minimum size of rainbow trout is two pounds. Channel catfish anglers travel in a wide range of groups, and they seek to catch large fish. The suggested acceptable channel catfish size is 6 pounds per fish. Demand for trout fishing experiences is less sensitive to changes in price (i.e., price inelastic). Demand for catfish fishing experiences is price elastic. Phase two data collection will begin in the summer of 2003 to examine hybrid bluegill fishing opportunities at two West Virginia study sites. Standards of quality for catch related standards will be determined for this underutilized species.

Hybrid Bluegill Production A study was designed to determine the effects of strain and diet on growth and efficiency of nutrient retention in hybrid bluegill. A diet containing 42% crude protein and 16% fat was determined to be the best of the five diets tested for both strains used in the study. Moreover, it was determined that the strain of bluegill known as the Georgia Giant grew faster than a commercial strain of hybrid bluegill. With respect to feed efficiency, the commercial hybrid bluegill and the Georgia Giant were not different. However, there were differences in the efficiency of retention for some amino acids. This suggests that different strains of fish use different amino acids with different efficiencies and that amino acid requirements probably differ within a species depending on the strain. That the 42/16 diet was the optimal diet for growth of bluegill is very important because this is not the diet the feed manufacturer typically suggests for bluegill production. A pond based study of production at stocking densities of five thousand, ten thousand, and twenty thousand fingerlings/acre will be harvested in late spring, 2003.

Resource Economics: In terms of recreational impacts, our results suggest that every 20,000 additional anglers -- or additional visits by existing anglers - will increase statewide output by \$2.5 million, income by \$1.5 million thousand, and add 59 jobs.

### ***Technology Transfer***

Output from the Aquaculture Food and Marketing Development project has resulted in numerous presentations and publications ranging from extension bulletins to refereed manuscripts. Approximately thirty refereed publications or presentations at scientific meetings have been created to date. Each January we host a state wide aquaculture meeting featuring latest information from this research project and speakers from the commercial aquaculture industry. Demonstrations and workshops include a bioassay of Arctic Char at a mine water source in McDowell County, development of an abandoned Acid Mine Drainage treatment plant as a fee fishing venue, and marketing arctic char. Numerous presentations on commercial aquaculture were conducted in response to requests from county agents and other groups.