YELLOW PERCH[(5)]

Project Termination Report for the Period
September 1, 1998 to August 31, 2001

NCRAC FUNDING LEVEL: $92,370 (September 1, 1998 to August 31, 2001)

PARTICIPANTS:

Christopher Starr[(6)]	Bay Port Aquaculture Systems, Inc., West Olive	Michigan
Donald L. Garling	Michigan State University	Michigan
Michael D. Libbin[(6)]	Paragon Aquaculture, Oshkosh	Wisconsin
Harvey Hoven	University of Wisconsin-Superior Sea Grant Institute	Wisconsin
Industry Advisory Council Liaison:		
Harry Westers	Aquaculture Bioengineering Corporation, Rives Junction	Michigan
Extension Liaison:		
Donald L. Garling	Michigan State University	Michigan

REASON FOR TERMINATION

Objectives were completed or participants withdrew from the project.

PROJECT OBJECTIVES

(1) Evaluate recirculating aquaculture technology to optimize yellow perch growth, performance (survival, health, feed conversion), and water quality considering such factors as feed management, water replacement, flow rates, and density.

(2) Conduct "break-even analysis" for raising yellow perch in a recirculating aquaculture system on a commercial scale with a minimum recirculating system size of 18,927 L (5,000 gal) per biofilter, capable of producing a minimum of 11,340 kg/yr (25,000 lb/yr).

PRINCIPAL ACCOMPLISHMENTS

OBJECTIVE 1

Research at Bay Port Aquaculture (Bay Port), Paragon Aquaculture (Paragon), and Michigan State University (MSU) was designed to evaluate the effects of multiple versus single-size cohort culture of yellow perch in recirculating systems using a common standardized protocol. Bay Port and Paragon were to have raised single-size and multiple-size cohorts in commercial-sized tanks, respectively. MSU research was designed to compare the growth of single- and multiple-sized cohorts of yellow perch in smaller replicated experimental tanks.

Bay Port was unable to begin their growth studies in 1998. An investor withdrew from the project which delayed construction of their recirculating aquaculture system, however, they provided fish for experiments at Paragon and MSU as called for in the common standardized protocol.

Paragon began their multiple cohort growth trials in October 1998. A cohort of 5,000 fish, approximately 50 mm (2.0 in) total length were marked with a left ventral fin clip at Bay Port so their growth rate in the multiple cohort system at Paragon could be followed throughout the project. The fish were transported to Paragon and stocked 10 days after marking.

MSU researchers visited Paragon in October 1998 and April 1999 to determine relative size distribution, ratio of marked to unmarked fish, and sex ratio in the culture tanks. Paragon provided bi-monthly survival data of marked and unmarked fish.

Paragon received a second cohort of fish in February 1999. Fish mortality was significantly higher than normal for the facility and continued throughout the first six months of the project. Eventually all of the fish in Paragon's facility died and soon thereafter (late summer 1999) the company went out of business.

The MSU recirculating system was designed and constructed during the fall of 1998. Yellow perch were obtained from Bay Port in January 1999. The fish experienced high mortality rates within days after stocking into a holding tank supplied with 12.5°C (54.5°F) well water. A second group of perch was obtained from Bay Port in February 1999 which also experienced high rates of mortality after transport and stocking into a holding tank at MSU.

The high level of mortality that occurred at MSU and Paragon in yellow perch that had been obtained from Bay Port also occurred at other yellow perch culture facilities which had received fish from Bay Port from the same stock of fish. Fish from MSU were sent to the MSU Animal Health Diagnostic Laboratory for evaluation. Necropsy, histopathology, bacteriology, and parasitology results were inconclusive. Fish from Paragon were evaluated by the Division of Animal Health by the State Aquaculture Veterinarian Dr. Myron J. Kebus and virology samples were submitted to Dr. Scott LaPatra, Clear Springs Foods, Idaho for diagnostics. Dr. Kebus also consulted with Dr. Michael Vander Klok (Michigan Department of Agriculture), Dr. Gerald Johnson (Atlantic Veterinary College Fish Diagnostic Laboratory), Dr. Fred Rommel (Pennsylvania Department of Agriculture Fish Diagnositic Lab), and Dr. Hamish Rogers (University of Pennsylvania Fish Diagnostic Lab). No definitive diagnosis was reported by any of the laboratories involved in performing diagnostics on the affected yellow perch from any of the locations that had been received from Bay Port.

Bay Port never experienced elevated levels of mortality at their facility of that stock of yellow perch which had served as the source of fish supplied to Paragon, MSU, and several other facilities. However, as a safeguard, Bay Port destroyed all of that remaining stock and sterilized all portions of their facility where those fish had been cultured.

Bay Port finally completed construction of its recirculating aquaculture system (RAS) in May 2000. The system consisted of five, 18,100-L (4,782-gal) rearing tanks with associated filtration systems. They followed the original work plan to determine the growth and performance of yellow perch reared to market size (approximately 115 g; 4.1 oz) employing single-cohort management practices. Fish were stocked in the summer of 2000 but chemical contamination (chlorine) of Bay Port's source water (which is obtained from a power company along the shoreline of Lake Michigan) killed most of the fish in Bay Port's facility in mid-November. Any surviving fish, most of which were in the RAS, had to be sold to keep the company solvent, terminating the NCRAC-funded research. Eventually Bay Port brought a law suit against the power company for the loss of their fish but this did not preclude them from having to cease all operations, closing their facility, and terminating their employees at the beginning of 2001. Thus, the research that was planned for both Paragon and Bay Port was never completed.

As already mentioned, MSU experienced high levels of mortalities in their initial experiment, but completed a comparison of single- and mixed-size cohort rearing strategies in 2001. Nine tanks were randomly assigned one of the three cohorts: 20 small fish (average weight 8.9 g [0.31 oz] and length 9.4 cm [3.7 in]), 20 large fish (average weight 15.9 g [0.56 oz] and length 11.5 cm [4.5 in]), or 20 mixed-sized fish (10 small and 10 large fish). Each cohort was stocked in triplicate tanks receiving water from a common RAS of similar design to the RAS used at Bay Port. A feeding rate of 2% body weight per day divided into three feedings was assigned to match feeding rates used by the commercial cooperators. Fish were weighed and feeding rates were readjusted every four weeks. Results of the nine-month grow-out experiment indicated:

- • Only a few fish reached market size by the end of the nine-month feeding trial, in part, because fish of the initial target size for large-size cohorts (16 cm; 6.3 in) were not available. Regression analysis of growth data indicated that the average size of large fish cohorts would have reached harvest size (20 cm [7.9 in] and 115 gm [4 oz]) in another 135 days assuming a continuous linear growth response .
- • Females grew better than males in all cohorts.
- • Large- and small-size female yellow perch reared in mixed-size cohorts grew at the same rates as large- and small-size females reared in single-size cohorts.
- • Large-size male yellow perch reared in mixed-size cohorts grew at the same rate as large-size males reared in single-size cohorts.
- • Small-size male yellow perch reared in mixed-size cohorts grew at a significantly higher rate than small-size males in single-size cohorts. The size of small males was not significantly different from the large-size males in the mixed-size cohort at the end of the grow-out period.

OBJECTIVE 2

This objective was designed to do the following:

- • Develop a systematic method to collect monthly financial operating data from producers using commercial yellow perch recirculating systems.

- Collect and evaluate monthly financial data from four commercial producers/ growers of yellow perch in a recirculating system.
- Construct an annual financial operating statement of total operating revenues and expenses, and calculate a break-even financial operating level based on the expenses of production and the sales prices of the production for each cooperator.

Work was completed in the fall of 1998 by the University of Wisconsin-Superior Sea Grant Institute for a method and system to collect financial operating data from active yellow perch commercial-scale producers. When the study was originally proposed and funded, four yellow perch commercial production facilities had agreed to cooperate by providing monthly financial operating data. Unfortunately, all of the original operators either terminated their operations or were unable to establish commercially-viable production levels. Both Paragon and Bay Port provided financial data but it was incomplete because no revenues were produced and, therefore, was not useful to conduct a break-even analysis. Hoven contacted other prospective or active RAS yellow perch producers seeking participation in the project. However, none were willing to become involved either because of insufficient size or unwillingness to participate.

IMPACTS

This research further demonstrated that female yellow perch grow at a faster rate than male perch. This research also demonstrated that females reared in mixed-size cohorts grew at the same rate as females reared in single-size cohorts. These preliminary results indicate that yellow perch aquaculturists using RAS may be able to use continuous loading, multiple-size cohort management strategies using an all-female stock of fish. However, if a mixed-gender stock is used, over time slower growing males may predominate the biomass. If the mechanism(s) causing the faster growth rate of the small-size male perch in the mixed-size cohort can be identified and used to increase the growth rate of all-male perch, culturists could use continuous loading, multiple-size cohort management strategies without obtaining an all-female stock.

RECOMMENDED FOLLOW-UP ACTIVITIES

The research objectives were developed to generate information to help aquaculturists using recirculating technology. Objective 1 was designed to compare the relative theoretical benefits of continuous loading (continuous harvest and utilization of the recirculating system near threshold design limits) against its potential drawbacks (reduced feed efficiency, increasing numbers/biomass of slow growing fish, and declining harvest rates over time).

Follow-up research should be conducted to determine the mechanism(s) causing small-size male perch in mixed-size cohorts to grow at a faster rate than their counterparts in single-size cohorts that was observed in the research system at MSU. A study to determine the effects of single- versus mixed-size cohorts should also be conducted with all-female stocks of yellow perch.

The calculation of break-even financial levels using actual costs of production and actual revenues received from product sales would have allowed current and prospective producers of yellow perch in a recirculating system to compare and forecast their financial results with some confidence. Each current or prospective producer could have compared their forecasted or actual production output, market prices received, and total operating costs against the actual financial results reported in this study. These studies should be conducted if commercial yellow perch aquaculturists using RAS who are willing to provide financial information can be identified.

PUBLICATIONS, MANUSCRIPTS, OR PAPERS PRESENTED

See the Appendix for a cumulative output for all NCRAC-funded Yellow Perch activities.

SUPPORT

YEARS	NCRAC-USDA FUNDING	OTHER SUPPORT					TOTAL SUPPORT
		UNIVER-SITY	INDUSTRY	OTHER FEDERAL	OTHER	TOTAL	
1998-01	$92,370	$82,496	$170,651[a,b]			$253,147	$345,517
TOTAL	$92,370	$82,496	$170,651[a,b]			$253,147	$345,517

[a] Paragon Aquaculture ($64,575); based on their original allocation for the project of $61,900 only $13,834 of which was actually expended.

[b] Bay Port Aquaculture Systems ($106,076); based on their original allocation for the project of $57,400 only $10,536 of which was actually expended.

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