

SUNFISH^{1[6]}

Progress Report for the Period
September 1, 1999 to August 31, 2003

NCRAC FUNDING LEVEL: \$32,000 (September 1, 1999 to August 31, 2003)

PARTICIPANT:

Robert S. Hayward University of Missouri-Columbia Missouri

Industry Advisory Council Liaison:

Curtis Harrison Harrison Fish Farm, Hurdland Missouri

Extension Liaison:

Joseph E. Morris Iowa State University Iowa

Non-Funded Collaborator:

Curtis Harrison Harrison Fish Farm, Hurdland Missouri

PROJECT OBJECTIVE

Evaluate grading strategies to enhance grow out of F₁ hybrid sunfish (female green sunfish ♀ male bluegill) in commercial systems to market size (♂ 227 g; 0.5 lb), including the culture potential of discards.

ANTICIPATED BENEFITS

This study will indicate whether stocking the larger half (upper 50th percentile) of spring-available age-1 hybrid sunfish in ponds will result in higher growth rates and reduced grow-out times to food-market weights, versus when full size ranges of available fish are stocked. The study will also provide much needed information on the potential to rear hybrid sunfish to food-market weights within two years in mid-latitude ponds.

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

This study represents a field test of findings from a previous North Central Regional Aquaculture Center (NCRAC)-funded laboratory study wherein age-1 hybrid sunfish ranging in lengths from 8.2B10.2 cm (3.2B4.0 in) were held individually and reared with unrestricted feeding at 24.0°C (75.2°F) for 112 days. Laboratory results showed that age-1 fish that were initially larger consumed more food, grew faster, and had better feed conversion than counterparts that were initially smaller. The indication that poorer performing hybrid sunfish reveal themselves early on (by being smaller than same-age counterparts) suggested that stocking fish in the upper end of available size ranges may lead to faster growth and shorter grow-out times to food-market sizes. Also, by stocking upper-end, presumably better performing fish, size variation among individuals at harvest

might be less (because of less disparate growth rates) than when full size ranges of available fish are stocked.

In April 2000, age-1 hybrid sunfish were collected from a single production pond at Flower's Aquaculture in Dexter, Missouri and graded into two size groups: smaller half (mean length = 4.1 cm [1.6 in], length range = 3.3-5.3 cm [1.3-2.1 in]; mean weight = 1.03 g [0.04 oz] wet weight), and larger half (mean length = 6.3 cm [2.5 in], length range = 5.4-7.7 cm [2.1-3.0 in]; mean weight = 3.94 g [0.14 oz] wet weight). The fish were transported to Harrison's Fish Farm in Hurdland, Missouri on April 17, 2000 and stocked into 7, 0.20-ha (0.5-acre) ponds. Three ponds (designated AL") received only larger-half fish (3,231 fish/pond), three ponds (designated AS-L") received 3,000 smaller-half plus 3,000 larger-half fish, and one pond (designated AS") received 14,000 smaller-half fish. Stocking densities (dry biomass/surface area) were matched in the ponds receiving large only and large plus small fish; stocking density was lower in the pond receiving only small fish.

Fish were fed twice daily with a floating commercial diet. Partial seining of each pond was done six times from 1 month post-stocking through early October 2001 (approximately every 3 months) to monitor hybrid sunfish weights and lengths; samples of 30-50 fish from each pond were measured and weighed on each outing. In January 2001, a broken drain pipe caused the loss of all fish in one of the three AL" ponds. In June 2001 it was decided that fish biomass in all ponds had become too high to allow desired growth rates. Therefore, to improve growth conditions, an attempt was made to remove all hybrid sunfish from each pond by multiple seine hauls. Only the larger 33% (by length) were re-stocked; the harvested smaller fish were sold by the producer.

The pond experiment was ended in June 2002, 26 months after the hybrid sunfish were stocked. Overall, the 26-month pond study provided further evidence that stocking larger-end, age-1 hybrid sunfish will lead to higher growth rates with less development of size variation. It is expected that there would be similar benefits from using upper-end age-1 hybrid sunfish when rearing these fish in indoor recirculating tanks as well. It is emphasized that larger fish were likely produced in the ponds that were stocked by upper-end fish, not simply because the fish were larger to begin with, but because they grew faster than counterparts that were initially smaller. These findings also provide much needed information on time periods required to rear to food-market sizes in ponds. Even when stocking larger-end, age-1, upper quartile fish reached only 65% of the minimum food-market weight of 227 g (0.5 lb). This finding suggests that for middle-latitude ponds, at least three years of rearing is probably needed to get significant numbers of hybrid sunfish to food-market sizes.

In addition to the pond experiment, several laboratory studies were conducted at the University of Missouri-Columbia (UMC) from 2001 through 2003 supported, in part, by NCRAC funding. Though not described in the original Sunfish project outline, the results from one of those studies is described here because it relates to and holds potentially important implications for the broad objective of developing approaches to rear Lepomid sunfish to food-market sizes within two grow-out years.

UMC researchers conducted a study of bluegill growth in indoor tanks with the objective of comparing growth rates towards food-market weight (≈227 g; 0.5 lb) between tanks with bluegill sex-ratios close to 1:1, and those with higher proportions of male fish in a true culture setting. The basis for this study was the earlier finding at UMC (using individually-held fish) that bluegill have substantially greater growth capacity than hybrid bluegill despite the fact that the hybrids grow faster in ponds. Follow-up work showed that the male bluegill's growth capacity is markedly greater than that of the female bluegill. Although sexually-dimorphic growth is known to exist in Lepomid sunfish, the extent of the male bluegill's marked growth capacity advantage over female bluegill is not well known, and exceeds the difference between male and female hybrids.

The capacity to effectively size-separate male and female bluegill once fish reach about 7.6 cm (3.0 in) has been developed at UMC. This approach was used in the present study to form bluegill groups with different sex ratios. However, the UMC researchers did not have enough project funds to secure an adequate number of bluegill to form groups comprising a very high percentage of males.

Three hundred bluegill of mean weight 16.3 g (0.6 oz) were stocked into each of four 1,000-L (264-gal) tanks. The two mixed-sex tanks contained 56.7 and 50.7% male bluegill while the two tanks intended to have higher male sex ratios had 69.9 and 66.3% males. Fish were reared at 25°C (77°F) and fed 1.5% of body mass daily via seven feedings between 06:00 and 08:00 with an automatic feeder. The feed was Aquamax7 Grower 400 (45% crude protein). High water quality was maintained by siphoning (twice weekly) and water replacement (33% weekly). Fish were reared under a summer-like photo-regime (14-h light/10-h dark) for 234 days (7.8 months) from January 10 to August 29, 2003. On a monthly basis, 30B50 fish were sampled from each tank and individually measured for length and weight. All mortalities were recorded.

Combining across the four tanks and both sexes, bluegill reached 50th, 75th, and 100th percentiles of weight that were equivalent to 22, 40, and 86% of the low-end food market weight of 227 g (0.5 lb) within 7.8 months. However, mean growth rates of male and female bluegill across the four tanks were 0.30 g/day (0.010 oz/day) and 0.09 g/day (0.003 oz/day), respectively, and were significantly different (paired t-test; P<0.05). After 7.8 months of rearing, 50th, 75th, and 100th percentile weights of male bluegill were 35, 49, and 86% of 227 g (0.5 lb), while those for female bluegill were 12, 19, and 54%. In a previous 26-month study where hybrid bluegill (predominantly male fish) were provided commercial feed in northern Missouri ponds, fish in the 87.5th percentile of weight reached only 65% of 227 g (0.5 lb). In contrast, male bluegill in the 87.5th percentile of weight in the present study reached 67.6% of 227 g (0.5 lb) after only 7.8 months of tank rearing.

Despite relatively modest differences in sex ratios between the control tanks containing mixed sex ratios of bluegill (50.7 and 56.7% male fish) and treatment tanks (66.3 and 69.9% male fish), mean weight gain of fish in the treatment tanks was significantly higher than in the control tanks (paired t-test; P<0.05) by approximately 10 g (0.35 oz).

Overall, study results indicate that the capacity to rear sunfish to food-market sizes within two years of grow out is much greater when predominantly male bluegill are grown in indoor tanks, relative to pond rearing hybrid bluegill in ponds in the middle latitudes of the Midwest region. Studies where much higher percentages of male bluegill are reared in indoor tanks are warranted as the present results suggest that even higher growth rates than those observed can be achieved. UMC researchers note that the mean mortality rate across the four tanks was only 5.8%; however, feed conversion ratios averaged only 2.74. It is believed that this low feed conversion was related to high social costs among bluegill in tanks where subordinated fish ate relatively little. Developing methods to reduce agonistic social interaction among bluegill in tanks may be important both for improving feed conversion and growth rates.

WORK PLANNED

A termination report will be produced in 2003.

IMPACTS

- The work at UMC, based on rough projections of growth rates, indicate that male bluegill possess the inherent capacity to grow to food-market weights within two years while female bluegill and both sexes of the hybrid sunfish fall substantially short of this benchmark even under the best of growing conditions. This data provide evidence that efforts to rear *Lepomis* species to food-market weights within the established two-year benchmark for grow out, should focus on male bluegill.
- The pond study also indicates whether size grading of hybrid sunfish will effectively reduce grow-out times to food-market size. These results should add significantly to a scant data base that will indicate the feasibility of rearing hybrid sunfish in food-market aquaculture.
- The laboratory study indicates that much reduced growth times to food-market weights would be possible by rearing male bluegill and this finding may substantially improve the economic feasibility of rearing sunfish for food markets.

PUBLICATIONS, MANUSCRIPTS, AND PAPERS PRESENTED

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

SUPPORT

YEARS	NCRAC- USDA FUNDING	OTHER SUPPORT					TOTAL SUPPORT
		UNIVER- SITY	INDUSTRY	OTHER FEDERAL	OTHER	TOTAL	
1999-03	\$32,000	\$10,765				\$10,765	\$42,765
TOTAL	\$32,000	\$10,765				\$10,765	\$42,765