SUNFISH[12]

Project Component Termination Report for the Period
June 1, 1990 to August 31, 1996

NCRAC FUNDING LEVEL: $280,557 (June 1, 1990 to August 31, 1996)

PARTICIPANTS:

Michael L. Hooe	Illinois Natural History Survey	Illinois
Robert J. Sheehan	Southern Illinois University-Carbondale	Illinois
Bruce L. Tetzlaff	Southern Illinois University-Carbondale	Illinois
James R. Triplett	Pittsburg State University	Kansas
David H. Wahl	Illinois Natural History Survey	Illinois
Extension Liaison:		
Joseph E. Morris	Iowa State University	Iowa

REASON FOR TERMINATION
The objective for this work on Sunfish was completed.

PROJECT OBJECTIVE
Determine optimum stocking densities and relationships between temperature and growth for crappie, crappie hybrids, and triploid crappie.

PRINCIPAL ACCOMPLISHMENTS
Hybrid and pure stock crappies were produced at the Sam Parr Biological Station during spring 1993 and 1994 (no black crappie were produced in 1994) by Illinois Natural History Survey (INHS) personnel with assistance from Southern Illinois University-Carbondale (SIUC) researchers. Diploid F_1 hybrid and triploid F_1 hybrid crappies were produced by crossing white crappie females with black crappie males. In spring 1994, ponds were drained and 1,300 - 1,500 fish of each stock (85-100 mm [3.3-3.9 in] total length) were provided for Pittsburg State University (PSU) and 400-500 of each stock were provided for SIUC. In early summer 1994, additional pure stock black and hybrid crappie were provided for SIUC (300-400 of each stock, 100-150 mm [3.9-5.9 inch] total length). Starch-gel electrophoresis for all brood fish confirmed genetic integrity of the fry.

Observations derived from PSU research are:

- Capture and post-transport mortalities were very high, but a small percent of the wild caught white crappie (2%) from summer 1993 survived and showed significant growth. These fish were moved indoors for further feeding trials in a recirculating system.
- Optimum stocking densities were not adequately determined for white crappie. In all cases (1.8 to 5.0 kg/m^3; 0.1-0.3 lb/ft^3) overall survivability in cages was poor. However, survival was high and growth was acceptable in indoor trials at densities of 4-5 kg/m^3 (0.2-0.3 lb/ft^3).
- The high mortalities (57-98%) related to capture and transport of wild caught white crappie during 1993 were reduced to 0% in 1994. Approximately 4,200 fish were transported from the Sam Parr Biological Station in Illinois to the PSU Research Reserve in Kansas in two hauls of eight hours (702 km; 436 mi) each, without any mortalities. The fish were handled and transported at night with temperatures less than 20°C (68°F) at 4-6 mg/L dissolved oxygen using oxygen diffusers and water treatments of 0.5% salt, PolyAqua™ (0.175-0.375 mL/L), and AmQuel™ (0.125 mL/L). Prior to handling for measurements, fish were anesthetized in Finquel™.
- White crappie, which were wild caught and fed in cages through the summer of 1993, were moved indoors in November and kept in two tanks in a recirculating system at a density of 4-5 kg/m^3 (0.2-0.3 lb/ft^3) for nearly 18 months. During the six feeding trials, only 17 of the 71 fish died; 16 of these were killed accidently by a single high chlorine event.

- Black crappie out-performed both white crappie and hybrid crappie in the second year of the cage culture trials. Black crappies showed the greatest growth rates, feed acceptance, uniformity, and survivability, with white crappies intermediate, and hybrid crappie showing poorest overall performance.
- Fish consumed and grew on 2.5-mm (0.1-in) Biodiet™ pellets in both cage trials and recirculating system trials. Examination of the abdominal cavity in all cases revealed fatty livers and the cavity packed with fat.
- Observations of feeding activity in recirculating tanks suggested the formation of feeding hierarchies. Separate feeding experiments in aquaria during the summer of 1994 as part of a National Science Foundation (NSF) research training academy confirmed the presence of a dominance hierarchy.

A growth trial was conducted at SIUC using black, white, and hybrid crappie. White crappie used in the trial had been subjected to a pressure shock; about 66% of them were triploids. Ten 550-L (145.3-gal) circular tanks, each equipped with biofiltration, aeration, and heating and cooling systems, were used in the growth trial. The circular tanks were partitioned into three compartments, with each compartment receiving equal amounts of the inflow water. All three taxa were evaluated in each tank, one taxon per compartment constituted a replicate, 20 fish per replicate. Despite a protracted training period, feed acceptance was poor during the growth trial and none of the taxa grew well at any of the test temperatures. In most cases, test fish actually lost weight during the trial.

A second growth trial was designed so that growth of black and hybrid crappie would be evaluated against hybrid *Lepomis* sunfish (female green sunfish × male bluegill), a sunfish taxa known to be a good performer in recirculating systems under a variety of water temperatures. In this trial, a more protracted period of time was used to attempt to habituate black and hybrid crappies to prepared diets. The initial mean weight of the hybrid sunfish (60.1 g; 2.1 oz) was considerably greater than the black crappie (26.5 g; 0.9 oz) and hybrid crappie (30.4 g; 1.1 oz), but this was largely due to differences in body conformation and condition; there were only small differences in mean initial total length among the hybrid sunfish (14.7 cm; 5.8 in), black crappie (12.5 cm; 4.9 in) and hybrid crappie (13.0 cm; 5.1 in).

The growth trial was terminated at the end of 56 days when it became evident that hybrid crappie were not growing at some of the test temperatures. The extended training period appeared to be successful for black crappie in this trial. Black crappie grew at all test temperatures and had weight gains ranging from about 20 to 45%; hybrid sunfish had weight gains of 48 to 75% at 10 to 18°C (50.0 to 64.4°F). At test temperatures of 10 and 14°C (50.0 and 57.2°F), the hybrid crappie lost weight and showed the poorest growth in comparison to either the black crappie or hybrid sunfish at the other test temperatures. The best growth during the trial was shown by the hybrid sunfish at 18°C (64.4°F). Percent weight gains for black crappie were the highest among the three taxa at 22 and 26°C (71.6 and 78.8°F). However, instantaneous growth rate for black crappie was not better than that for hybrid sunfish at the two highest tested temperatures. Mean survival rate was high for all three taxa with all of the hybrid sunfish and 97% of the other two taxa surviving the trial.

Hybrid sunfish showed their best growth at temperatures of 18°C (64.4°F) or less whereas black and hybrid crappie showed their best growth at temperatures of 18°C (64.4°F) or more. This may be significant, since farmers in our region would have more of an advantage over southern producers with culture animals that grow better at lower temperatures.

Although effective procedures for inducing triploidy in *Lepomis* are available (see the 1994-95 Annual Progress Report), methods developed for crappie have not proved to be as successful. Prior to this study, the best triploid induction rate obtained at SIUC with crappie, using pressure shocks similar to those effective in *Lepomis*, was 66%.

A study conducted at SIUC was designed to develop more effective methods for inducing triploidy in crappie and to test the hypothesis that the temperature at which fertilized eggs are incubated may influence the effectiveness of shocks. The approach used by SIUC researchers was to hold the magnitude (6,000 psi) and duration (3 min) of the pressure shock constant while varying postfertilization shock initiation time (2 to 7 min, tested at 1 min intervals) and the incubation temperature (17, 20, and 23°C; 62.6, 68.0 and 73.4°F) of the developing embryos prior to and during the shock treatment.

Incubation temperature did not affect triploid induction rate but better triploid induction rates were obtained as postfertilization shock initiation times were increased. The most effective shocks for producing triploids in *Lepomis* were initiated at 2 to 3 min postfertilization. Based on frequencies of deformed larvae and triploidy induction rate, the longer postfertilization times were more successful with white crappie eggs. The highest triploidy induction rate SIUC researchers obtained (about 95%) occurred at a postfertilization time of 7 min and at an incubation temperature of 20°C (68.0°F). This suggests that longer postfertilization shock initiation times need to be investigated to optimize triploid induction procedures for white crappie.

IMPACTS

- Findings from PSU indicate survivability in cages is a major problem for cage culture of crappie, but this may be a function of cage design. Consideration of capture and transport methods is vital to minimizing initial mortality losses. PSU researchers determined that black crappie were the most suitable species for cage culture.
- PSU researchers have developed capture, transport and handling techniques that can markedly reduce mortality problems associated with crappie in aquaculture settings.
- Hybrid sunfish had their best growth at temperatures of 18°C (64.4°F) or less whereas black and hybrid crappie had their best growth at temperatures of 18°C (64.4°F) or more. This may be significant, since farmers in this region would have more of an advantage over southern producers with culture animals that grow better at lower temperatures.
- Pressure shock procedures for inducing triploidy in white crappie were developed which yielded more than 90% triploids; it appears that pressure shocks for inducing triploidy in the white crappie need to be applied at a much later time after fertilization, as compared to findings for *Lepomis*.

RECOMMENDED FOLLOW-UP ACTIVITIES

- Cage design needs to be modified and evaluated for crappie culture.
- Continue to evaluate black crappie in recirculating systems.
- Further study needed on transport and stress in crappie.
- Evaluate importance of acclimation in reducing stress.
- Develop feeding strategies that reduce the impact of feeding hierarchies and fat accumulation on growth.
- Re-evaluate density effects associated with stress conditions.
- Determine optimal temperatures for growth and feeding.
- *Lepomis* taxa have not required extended training periods to habituate them to prepared diets. Black, white, and hybrid crappie have been much more difficult to habituate to prepared diets, and they do not feed as aggressively, especially at lower temperatures. This is largely responsible for the poorer overall performance of crappies, as compared to *Lepomis* taxa, under tank culture conditions. There is a need to explore avenues to enhance the response of crappies to prepared diets.

PUBLICATIONS, MANUSCRIPTS, OR PAPERS PRESENTED

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

TOTAL SUPPORT FOR THE FIRST TWO PROJECTS

YEAR	**NCRAC-**		**TOTAL**

S	USDA FUNDING	OTHER SUPPORT					SUPPORT
		UNIVERSITY	INDUSTRY	OTHER FEDERAL	OTHER	TOTAL	
1990-92	$130,758	$96,710				$96,710	$227,468
1992-94	$149,799	$343,160	$500[a]	$10,000[b]	$4,200[c]	$357,860	$507,659
TOTAL	$280,557	$439,870	$500	$10,000	$4,200	$454,570	$735,127

[a]KOCH Industries - Koch Flexrings
[b]National Science Foundation - STARS Research
[c]$3,000 from Kansas Department of Wildlife & Parks - white crappie and hauling tanks and $1,400 from the City of Pittsburg Water Department - anthracite coal

SUNFISH

Publications in Print

Bryan, M.D., J.E. Morris, and G.J. Atchison. 1994. Methods for culturing bluegill in the laboratory. Progressive Fish-Culturist 56:217-221.

Miller, S. 1995. Tetraploid induction protocols for bluegill sunfish, *Lepomis macrochirus*, using cold and pressure shocks. Master's thesis. Michigan State University, East Lansing.

Mischke, C.C. 1995. Larval bluegill culture in the laboratory. Master's thesis. Iowa State University, Ames.

Montes-Brunner, Y. 1992. Study of the developmental stages of bluegill (*Lepomis macrochirus*) eggs using selected histological techniques. Master's thesis. Michigan State University, East Lansing.

Read, E.R. 1994. Cage culture of black, white and F_1 hybrid crappie (*Pomoxis* species). Master's thesis. Pittsburg State University, Pittsburg, Kansas.

Tetzlaff, B., and P. Wills. 1991. Current trends in the culture of hybrid sunfish. Pages 214-218 *in* Proceedings of North Central Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Thomas, G.L. 1995. Culture of white crappie *(Pomoxis annularis)* in a Recirculating System. Master's thesis, Pittsburg State University, Pittsburg, Kansas.

Westmas, A.R. 1992. Polyploidy induction in buegill sunfish (*Lepomis macrochirus*) using cold and pressure shocks. Master's thesis. Michigan State University, East Lansing.

Westmaas, A.R., W. Young, and D. Garling. 1991. Induction of polyploids in bluegills and chinook salmon. Pages 110-112 *in* Proceedings of North Central Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Wills, P.S., J.P. Paret, and R.J. Sheehan. 1994. Induced triploidy in *Lepomis* sunfish and hybrids. Journal of the World Aquaculture Society 25(4):47-60.

Manuscripts

Mischke, C.C., and J.E. Morris. In review. Comparison of growth and survival of larval bluegill in the laboratory under different feeding regimes. Progressive Fish-Culturist.

Mischke, C.C., and J.E. Morris. In review. Out-of-season spawing of bluegill in the laboratory. Progressive Fish-Culturist.

Papers Presented

Brown, P.B., and K. Wilson. 1994. Experimental and practical diet evaluations with hybrid bluegill. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-16, 1994.

Mischke, C.C., and J.E. Morris. 1996. Growth and survival of larval bluegill (*Lepomis macrochirus*) and hybrid sunfish (green sunfish, *L. cyanellus* H bluegill) in the laboratory under different feeding regimes. Iowa-Nebraska American Fisheries Society Meeting, Council Bluffs, Iowa, January 29-31, 1996.

Mischke, C.C., and J.E. Morris. 1996. Early spawning of bluegill. Midcontinent Warmwater Fish Culture Workshop, Council Bluffs, Iowa, February 7, 1996.

Mischke, C.C., and J.E. Morris. 1996. Growth and survival of larval bluegill, *Lepomis macrochirus*, in the laboratory under different feeding regimes. American Chapter of the World Aquaculture Society, Arlington, Texas, February 14-17, 1996. (Awarded Best Student Poster)

Morris, J.E. 1995. Hybrid bluegill culture update. Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Trade Show, Minneapolis, Minnesota, February 17-18, 1995.

Morris, J.E. 1995. Culture of bluegills under laboratory conditions. Nebraska Aquaculture Conference, North Platte, Nebraska, March 25, 1995.

Paret, J.M., R.J. Sheehan and S.D. Cherck. 1993. Growth performance of *Lepomis* diploid hybrids, triploid hybrids and parental species at five temperatures. Meeting of the Illinois and Iowa Chapters of the American Fisheries Society, Bettendorf, Iowa, February 16-18, 1993.

Read, E.R., and J.R. Triplett. 1994. Cage culture of crappie. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994.

Read, E.R., and J.R. Triplett. 1995. Cage culture of black, white and F_1 hybrid crappie (*Pomoxis* species). Kansas Commercial Fish Growers Association, McPherson, Kansas, February 2, 1995.

Sheehan, R.J., J.P. Paret, P.S. Wills, and J.E. Seeb. 1993. Induced triploidy and growth of *Lepomis* parental species, hybrid, and triploid hybrid at five temperatures, 8 to 28EC. Prospects for Polyploid Fish in Fisheries Management Symposium, 123rd Annual Meeting of the American Fisheries Society, Portland, Oregon, August 29 - September 2, 1993. (Invited paper)

Thomas, G.L., and J.R. Triplett. 1994-1995. Close-loop white crappie (*Pomoxis annularis*) culture. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994. Also presented at the Kansas Commercial Fish Growers Association Meeting, McPherson, Kansas, February 2, 1995 and Kansas Academy of Science Annual Meeting, Pittsburg State University, Pittsburg, Kansas, April 7, 1995.