DYNAMICS OF HYBRID SUNFISH IN SOUTHERN ILLINOIS FARM PONDS

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ABSTRACT

Control of population density in southern Illinois farm ponds was achieved by stocking F_1 hybrid sunfish of the male bluegill (Lepomis macrochirus) *X female green sunfish* (L. cyanellus) *and the male redear sunfish* (L. microlophus) *X female green sunfish with largemouth bass* (Micropterus salmoides). *Four of 30 ponds sampled were contaminated by nondesirable species from the watershed. Little or no recruitment of the F_2 generation occurred in ponds containing largemouth bass. In those populations where the hybrids were supplementally fed and bass were present, the F_1 bluegill X green sunfish hybrid averaged 159 g at annulus 3, and 199 g at annulus 4. In nonfed populations with bass this hybrid averaged 148 g at annulus 4. The F_1 redear sunfish X green sunfish hybrid averaged 127 g at annulus 4 in nonfed populations with bass. Multiple regression analysis revealed that the presence of largemouth bass and supplemental feeding had a high positive correlation (0.001 probability level) to growth of both F_1 hybrids. Pond owners considered the hybrid sunfish to be much more vulnerable to angling than the channel catfish* (Ictalurus punctatus). *Owners who stocked largemouth bass into their ponds were satisfied and would stock hybrid sunfish into another pond, although a majority of the owners without bass in their ponds were disappointed and would not stock hybrid sunfish into another pond.*

One of the most important considerations in the selection of stocking combinations for farm ponds is the control of population density. If density can be controlled, then control over the size of individual fish is possible. Only limited control has been obtained with the classical largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) stocking combination in farm ponds. Management techniques that involve population reduction by the addition of a predator or by partial poisoning have in general been unsuccessful in increasing the growth of the bluegill. The reason for these failures is obvious when one considers the magnitude of reduction required to increase growth. In a stunted bluegill population, assuming that food supply remains constant, a reduction in biomass in the order of 50% is necessary to obtain a 2.5 cm increase in length (Hackney 1974). Thus it is evident that a method to prevent overpopulation is needed, rather than methods that attempt to reduce overpopulation after it occurs.

Some of the hybrid sunfish have produced up to 99% males and have low reproductive rates (Ricker 1948; Childers 1967; Childers and Bennett 1967; Heidinger and Lewis 1972). These reduced reproductive rates are often correlated with excellent growth rates.

Some hybrid sunfish can be supplementally fed. Lewis and Heidinger (1971) found that the male bluegill X female green sunfish (*L. cyanellus*) F_1 hybrid readily utilized supplemental food, but the male redear sunfish (*L. microlophus*) X female green sunfish F_1 hybrid does not.

Most studies with hybrid sunfish have been carried out under "controlled" conditions in ponds that were preselected by the investigator. Evaluation of hybrid combinations has not been undertaken in ponds that were not preselected by the investigator and thus subjected to normal conditions.

Since 1972, the Fountain Bluff Fish Farm, located at Gorham, Illinois, has sold F_1 hybrid sunfish and channel catfish (*Ictalurus punctatus*) to midwest farm pond owners. Fingerling F_1 hybrids of the male bluegill X female green sunfish (B X G F_1) and the male redear sunfish X female green sunfish (R X G F_1) have been stocked in ponds at various densities with fingerling channel catfish.

The objectives of this study were to: (1) evaluate the success of hybrid sunfish stockings in southern Illinois, (2) define biological and environmental variables related to growth, and (3) evaluate the quality of fishing provided by the hybrid sunfish.

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METHODS

The dynamics of hybrid sunfish populations were investigated in 30 southern Illinois ponds. The total alkalinity of the ponds had a median value of 30 ppm with a range of 10 to 175 ppm. Surface area of the ponds averaged 0.52 ha with a range of 0.02 to 1.86 ha.

All ponds were stocked once with fingerling B X G F_1 hybrid sunfish and channel catfish. Nineteen of these ponds were also stocked with the R X G F_1 hybrid, and adult or fingerling largemouth bass were stocked by the owners into nine ponds.

Shoreline seining, bag seining and electrofishing were used to sample the fish populations. Individual fish were identified, sexed, the total length measured (± 1 mm) and weighed (±2g). A scale sample for age and growth analysis was taken from the right side of each fish at the tip of the pectoral fin just below the lateral line. All scales were examined with a scale micro-projector (42 X). The direct-proportion method with a Fraser correction of 30 mm was used to calculate lengths at each annulus.

Length-weight regression equations were computed for both F_1 hybrid crosses in each pond. These equations were used to calculate the average weight at each annulus from the average calculated total lengths at each annulus. Although the extrapolation of regression equations beyond the data used to generate the equation is not desirable, this technique was used because the ponds contained only one year class.

Multiple regression analyses were conducted to identify relationships of biological and environmental variables to growth (length) of hybrid sunfish in ponds not contaminated with other fish. Stepwise multiple regression was used to order seven independent variables in models for both F_1 hybrids at each annulus. The variables considered were: presence of the largemouth bass, supplemental feeding, total alkalinity, mean pond depth, stocking rate of B X G F_1, stocking rate of R X G F_1, and stocking rate of channel catfish. All calculations were run on an IBM 370 computer.

A questionnaire was distributed to each pond owner to obtain information on fishing effort, catchability, and pond owners' satisfaction with hybrid sunfish and channel catfish.

RESULTS

The B X G F_1 hybrid was collected from 28 of the 30 ponds and the R X G F_1 hybrid was collected from 17 of the 19 ponds in which they had been stocked. Only 14 of these 17 ponds yielded sufficient R X G F_1 hybrids for age and growth analysis. Four of the 30 ponds (13%) were contaminated with other species of fish from the watershed, and four ponds (13%) were stocked with other species after the introduction of hybrid sunfish. After 2 years from time of stocking, F_2 recruitment occurred in 19 of the 22 noncontaminated ponds. Little or no recruitment occurred in the nine ponds stocked with largemouth bass, although 11 of the 13 ponds without bass had abundant F_2 recruitment.

A disproportionate sex ratio was attained by both F_1 hybrids. In all ponds where hybrids were collected, 80% of 580 B X G F_1 hybrids and 98% of 353 R X G F_1 hybrids examined were male. Although parental identification of the F_2 generations was not possible, F_2 recruitment did occur in ponds with only the B X G F_1 hybrid present.

In general, the growth of both F_1 hybrids was greater in ponds containing largemouth bass and lacking contamination by other species, and when the hybrids were supplementally fed (Tables 1 and 2). Using 110 g for a minimum harvestable size, the B X G F_1 hybrid reached harvestable size by annulus 3 (2 years after stocking) in fed populations (Table 3). In nonfed populations they exceeded harvestable size by annulus 4 in ponds with bass, but did not reach harvestable size by annulus 4 in ponds without bass. The R X G F_1 hybrid reached harvestable size at annulus 4 in populations with largemouth bass but not in ponds without bass (Table 4).

Channel catfish growth was well below the potential growth rate. After 3 years from time of stocking only 6 of the 30 ponds contained fish averaging 500 g or more. Four of these ponds contained bass. The fish in three of the ponds were supplementally fed at an average rate of 225 kg/ha per year.

Multiple regression analyses were used to gain further insight into the relationships of biological and environmental variables to growth (length) of the hybrids (Table 5).

Table 1. Calculated total length of B X G F_1 hybrid sunfish in 28 southern Illinois farm ponds

	Calculated average total length at each annulus (mm)							
	Fed populations				*Nonfed populations*			
	1	*2*	*3*	*4*	*1*	*2*	*3*	*4*
Noncontaminated ponds with bass								
Number of ponds	5	5	5	2	4	4	4	2
Number of fish	97	97	97	25	122	122	122	21
Average total length	66	147	190	202	59	126	161	187
Standard deviation	9.5	21.1	16.0	12.3	8.9	17.3	17.6	12.9
Range in length	48–92	112–200	148–224	177–230	44–89	86–165	118–203	164–207
Noncontaminated ponds without bass								
Number of ponds	7	7	6	3	6	6	6	5
Number of fish	199	199	159	39	90	90	90	76
Average total length	60	131	172	187	63	122	155	168
Standard deviation	11.7	21.0	20.4	24.7	11.5	15.0	16.5	19.5
Range in length	41–96	85–182	115–211	138–227	42–99	80–158	105–180	119–194
Contaminated ponds without bass								
Number of ponds	1	1	1	1	5	5	5	4
Number of fish	50	50	50	50	22	22	22	18
Average total length	84	159	190	200	70	118	144	162
Standard deviation	13.3	14.9	13.5	12.5	20.7	19.8	16.7	15.8
Range in length	51–116	128–189	165–212	174–226	44–102	75–151	113–168	126–186

Table 2. Calculated total length of R X G F_1 hybrid sunfish in 14 southern Illinois farm ponds

	Calculated average total length at each annulus (mm)							
	Fed populations				*Nonfed populations*			
	1	*2*	*3*	*4*	*1*	*2*	*3*	*4*
Noncontaminated ponds with bass								
Number of ponds	4	4	4	—	2	2	2	1
Number of fish	126	126	126	—	31	31	31	6
Average total length	62	145	172	—	59	134	164	186
Standard deviation	8.3	17.7	18.3	—	7.1	18.0	9.6	7.4
Range in length	46–87	100–196	135–222	—	49–80	108–162	144–177	173–193
Noncontaminated ponds without bass								
Number of ponds	5	5	4	2	3	3	3	2
Number of fish	127	127	61	13	52	52	52	11
Average total length	55	119	155	172	61	116	158	136
Standard deviation	7.2	14.2	12.1	10.2	9.4	16.9	20.1	5.5
Range in length	42–78	95–155	118–183	162–195	47–95	87–158	119–183	126–146

Table 3. Calculated weights of B X G F_1 hybrid sunfish in 28 southern Illinois farm ponds

	Average total alkalinity (ppm)	*Average stocking rate per hectare*	*Average weight (g) at each annulus*			
			1	*2*	*3*	*4*
Noncontaminated ponds with bass						
Fed populations	30	840	5	83	159	199
Nonfed populations	50	740	6	45	92	148
Noncontaminated ponds without bass						
Fed populations	70	1460	4	46	116	154
Nonfed populations	30	1600	5	35	72	92
Contaminated ponds without bass						
Fed populations	70	1350	8	72	132	157
Nonfed populations	60	900	5	28	52	77

Table 4. Calculated weights of R X G F_1 hybrid sunfish in 14 southern Illinois farm ponds

	Average total alkalinity (ppm)	*Average stocking rate per hectare*	*Average weight (g) at each annulus*			
			1	*2*	*3*	*4*
Noncontaminated ponds with bass						
Fed populations	40	750	4	60	93	—
Nonfed populations	30	720	3	46	91	127
Noncontaminated ponds without bass						
Fed populations	75	960	3	31	71	102
Nonfed populations	30	430	8	30	64	39

Table 5. Correlation of seven independent biological and environmental variables to hybrid sunfish growth in noncontaminated southern Illinois farm ponds. Positive, negative and no significant correlations are indicated with (+), (−) and (0), respectively at the 0.001 probability level

Variables	*Correlation of total length at each annulus*					
	B X G F_1			R X G F_1		
	2	3	4	2	3	4
Largemouth bass	+	+	+	+	+	+
Supplemental feeding	+	+	+	+[a]	+	+
Total alkalinity	−	−	0	0	−[b]	0
Mean depth	0	0	0	+	+	0
B X G F_1[c]	0	0	0	0	−	0
R X G F_1[c]	+	+	−	−	−	0
Channel catfish[c]	+	0	0	−[a]	0	0
(R^2)[d]	0.26	0.39	0.54	0.54	0.64	0.88

[a] Correlation at the 0.02 probability level.
[b] Correlation at the 0.01 probability level.
[c] Stocking rate.
[d] Proportion of total variability accounted for in growth at each annulus.

Table 6. Pond owner response to questionnaire of hybrid sunfish and channel catfish stocking combinations

		Ponds		
		With largemouth bass	*Without largemouth bass*	*Contaminated*
Number of pond owners		8	13	6
Fishing effort (man days/ha/year)[a]		80	70	60
Catchability				
Hybrid sunfish	Easy	5	9	2
	Difficult	1	3	4
Channel catfish	Easy	2	3	2
	Difficult	4	9	4
Average desirable size (g)				
Hybrid sunfish		225	225	200
Channel catfish		675	525	900
Satisfaction of species stocked				
Hybrid sunfish	Satisfied	7	5	2
	Disappointed	1	8	4
Channel catfish	Satisfied	7	9	3
	Disappointed	1	4	3
Species most desirable to stock in another pond[b]				
Hybrid sunfish		8	6	2
Channel catfish		8	12	5
Largemouth bass		7	10	6
Bluegill		—	1	1
Redear sunfish		—	3	1

[a] Average pond size = 0.52 ha.
[b] Number of pond owners indicated above.

The proportion of total variability (R^2) accounted for in growth of the R X G F_1 hybrid was 0.54, 0.64 and 0.88 at annulus 2, 3 and 4, respectively. The R^2 attained by the full model for growth of the B X G F_1 hybrid was 0.26, 0.39 and 0.54 at annulus 2, 3 and 4, respectively. Growth of both F_1 hybrids was positively correlated (0.001 probability level) with the presence of largemouth bass and supplemental feeding. Total alkalinity was negatively correlated and mean depth was positively correlated (0.001) with growth of the R X G F_1 hybrid.

The majority of pond owners considered hybrid sunfish easy to catch even at low stocking densities of 250 hybrids per ha. Channel catfish were considered difficult to catch from low (500 catfish per ha) to high (1,250 catfish per ha) stocking densities (Table 6). By annulus 4, neither the hybrid sunfish nor the channel catfish attained the minimum weight considered harvestable by the average pond owner. In general, owners with largemouth bass in their ponds were satisfied and stated they would stock hybrid sunfish into another pond. A majority of the owners without bass in the ponds were disappointed with the hybrid sunfish and would not stock them into another pond. Twelve of 13 pond owners who supplementally fed indicated that the channel catfish utilized most of the feed.

Three owners and their friends who swam in their ponds reported they were bitten by the hybrid sunfish. One owner stressed that his children were bitten to the extent that they would not swim in the pond.

DISCUSSION

The largemouth bass-hybrid sunfish stocking combination gave control over population density. Under the various environmental conditions the hybrids did not attain

what the authors considered to be their full growth potential, although the slowest growth of the hybrids still exceeded the average growth reported by Lopinot (1972) for bluegill in Illinois ponds. Multiple regression analysis revealed that the presence of largemouth bass and supplemental feeding were the most important variables related to growth. A completely meaningful evaluation of supplemental feeding was not possible since feeding was irregular and amount fed was minimal.

A comparison of sunfish hybrids and channel catfish for producing recreational fishing in farm ponds indicates that the hybrids have some advantages. They attained what the pond owners considered an acceptable catchable size in a shorter period of time than did the channel catfish. Of course, one must recognize that the catchable size for hybrid sunfish is less than that for channel catfish. Desirable size hybrid sunfish could be produced at two to four times the abundance of the channel catfish on the same food supply. The present study agrees with the finding of previous workers who reported that hybrid sunfish were highly vulnerable to angling (Childers 1967; Childers and Bennett 1967). Channel catfish were difficult to catch even at densities of 1,250 fish per ha. Because of slow growth at this density in infertile farm ponds, the fish did not attain the size the average pond owner considered desirable (525-900 g) within 3 years.

The hybrid sunfish should not be visualized as the solution to all farm pond management problems. They will not grow well where contamination by other sunfishes occurs. Since they are very aggressive and will bite swimmers, they are undesirable in ponds used primarily for swimming. It must also be recognized that the percentage of males, and thus the reproductive potential, is variable even for the same hybrid. The R X G F_1 hybrid produced 69% males in central Illinois ponds (Childers 1967), 99% males in southern Illinois ponds (Heidinger and Lewis 1972), and 88% males in Texas ponds (Henderson and Whiteside 1976).

Based on present information, hybrid sunfish are desirable in combination with largemouth bass under some farm pond conditions. Management of largemouth bass-hybrid sunfish populations consists of periodic stocking of F_1 hybrids. If maximum rate of growth is desired, supplemental feeding should be practiced, especially where infertile ponds are stocked.

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