USE OF HYBRID SUNFISH IN PONDS OR SMALL IMPOUNDMENTS

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ABSTRACT.

Growth of hybrids of redear and green sunfish, in their first two growing seasons, compared favorably with that of the parental species raised in the same ponds. The redear ♀ x green♂ hybrid showed somewhat greater weight gain than its reciprocal hybrid, in at least the first year. This accelerated growth suggests the utility of establishing populations of these particular hybrids in situations where they are isolated from the parent species. Work is underway to estimate the likelihood of backcrossing in mixed hybrid and nonhybrid communities.

INTRODUCTION

In a common situation in the management of small waterbodies, largemouth bass is stocked as the primary gamefish, with some species of sunfish stocked as forage and as an alternative gamefish. Because the reproductive ability of sunfish is so high, we often witness the development of dense populations of stunted fish. Management practices aimed at reducing the density of such populations are generally ineffective and waste the production of fish removed from the system. It would be advisable from a management viewpoint, to affect the concentration of production in a smaller number of fish by preventing overpopulation.

The attractiveness of stocking hybrid sunfish stems from their highly skewed sex ratios, and hence reduced reproductive potential, and from their often-accelerated growth rates. This study considers one set of reciprocal hybrids, those of green sunfish (Lepomis cyanellus) and reader sunfish (Lepomis microlophus). These hybrids will be designated as redear-greens for the redear♀ x green♂ hybrid, and green-redear for the green♀ x redear ♂ hybrid.

Early work on these particular hybrids, and on sunfish hybrids generally, was done by Childers (1967) and Bennett (Childers and Bennett, 1961, 1967). Use of hybrid sunfish in management schemes was extensively studied by Lewis and Heidinger (1971, 1978; Heidinger and Lewis, 1972; Ellison and Heidinger, 1978).

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PROCEDURES

Production of Crosses: Crosses were produced 31 May and 1 June, 1979, in the laboratory at the Illinois Natural History Survey, using a manual stripping and artificial fertilization procedure. A given female's eggs were stripped into two petri dishes, each lot fertilized by milt of either her own or of the other species. Because the offspring of both crosses are half-siblings, maternal inheritance will not be at issue when later comparing the performance of straight and hybrid crosses.

Growth of the Crosses Through Their First Growing Season: About ten days after hatching, the free-swimming larvae were stocked out in experimental ponds at the Aquatic Research Field Laboratory in Urbana, Illinois. Two quarter-acre ponds were stocked with 500 fry of each of the four crosses.

On 14 October, 1979, the ponds were sampled by seining. Approximately 360 fish were removed from each pond. These were sorted and counted in the field as green sunfish, as hybrids collectively, or as redears. About half of each kind were then returned to the pond. The rest were weighed, measured, and frozen for subsequent electrophoresis and dissection.

Growth of the Crosses Through Their Second Growing Season: In the Spring of 1980, the experimental ponds were drained. Most of the fish were moved and stocked in two-acre Arrowhead Lake at Allerton Park, Monticello, Illinois. In October, 1980, the population was sampled by electrofishing.

Distinction of Crosses by Electrophoresis: It is not possible to positively distinguish the two types of hybrids visually, nor was it practical to mark the fish as larvae. The technique of starch gel electrophoresis was used to identify certain isozymes, or forms of biochemical enzymes, of individual fish. Because possession of given isozymes is genetically determined, and because the parent species each had distinct isozymes, it was possible to use knowledge of an individual's isozymes to infer the parentage of that fish.

Backcrossing of Hybrids and Parent Species: Because most hybrids are males, most backcrosses would involve females of the parent species. In the Spring and Summer of 1980, four one-tenth-acre ponds were stocked, one pond for each type of hybrid male, in combination with each type of parent species female.

RESULTS

Growth of Crosses Through Their First Growing Season: Assuming comparable collection efficiency for each type, the numbers of each cross collected in the Fall seine sample (Table 1) provide an indication of relative survival rates through the first growing season. Significant chi-square values indicate departure from 1:1:1:1 expectation, with survivorship of the hybrid crosses equaling or exceeding that of the straight crosses.

In pond 3, growth of the redear-green (Figure 1A) was significantly greater than that of the green-redear ($p = 0.05$), green sunfish ($p = 0.01$), and redear sunfish ($p = 0.001$). Growth of redear was significantly less ($p << 0.001$) than that of all other crosses.

In pond 13, growth of all crosses (Figure 1B) was less than in pond 3. Growth of green sunfish was not significantly greater than that of the redear-green, but was greater than that of the green-redear ($p = 0.005$), and of redear ($p = 0.001$). Growth of the redear-green was greater than that of its reciprocal hybrid ($p = 0.001$). Again, growth of redear was much less than that of all other crosses ($p << 0.001$).

Sex Ratio and Spawning Activity of 0+ Fish: Hybrids collected from pond 3 were dissected for sexing. Forty-five of 50 (90%) redear-greens were males, most having well developed male coloration. Of the five females, two had developing eggs. Of the twenty-six green-redears, twenty-four (92%) were males. Similarly, male coloration was well developed. Neither female had developing eggs.

Table 1. Comparative Survivorship of Crosses through first growing season.

Pond 3		Pond 13	
Cross	No. Collected	Cross	No. Collected
G ♀ x G ♂	55	G ♀ x G ♂	41
G ♀ x RE ♂	91*	G ♀ x RE ♂	105**
RE ♀ x G ♂	171*	RE ♀ x G ♂	108**
RE ♀ x RE ♂	45	RE ♀ x RE ♂	106

* Significance of χ^2 $p<<.001$
**Significance of χ^2 $.025>p>.01$

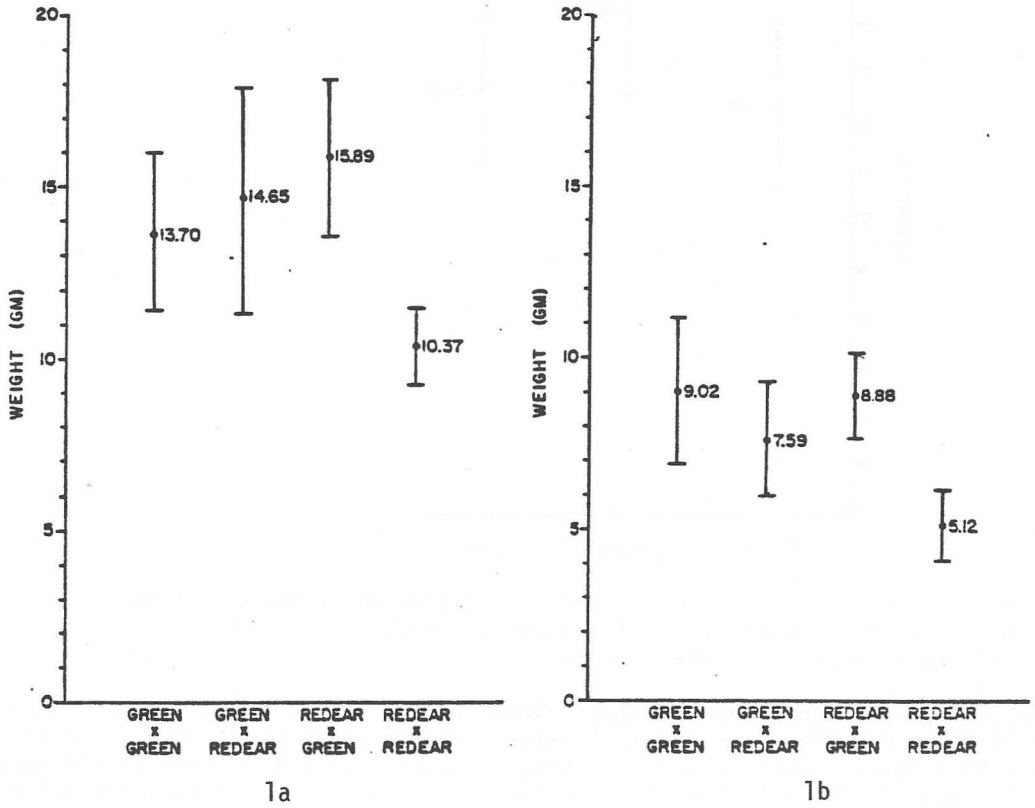

Figure 1. Growth of the crosses through the first growing season in Ponds 3 (fig. 1a) and 13 (fig. 1b). Brackets indicate one standard deviation about the mean.

In the Fall of their first year, a number of males built and guarded small nests. It was not possible to positively identify these individuals as representing any one cross. Fry were produced in both ponds, but were not collected for identification by electrophoresis.

Growth of Crosses Through Their Second Growing Season: Not all of the fish collected in the Fall of 1980 have yet been analyzed electrophoretically, and so the hybrids must be considered collectively.

A total of 286 were collected, which included 61 green sunfish, 142 hybrids, and 83 redears. Numbers collected of each type do not differ significantly from a 1:2:1 chi-square expectation. Assuming similar collection efficiency for each type, survivorship of the hybrids in the second year is intermediate to that of the straight crosses.

Mean weight of the hybrids (Figure 2) significantly exceeded that of the parent species ($p = 0.001$). Mean weights of green sunfish and redears were comparable (p not significant).

Comparing the ranking of mean weights between years, the hybrids had, as a class, remained larger than the other crosses. Redears, which had had a poor showing in experimental ponds, grew rapidly in Arrowhead Lake, and had as a class become larger than green sunfish.

This experimental community remains in Arrowhead Lake and will continue to be sampled periodically.

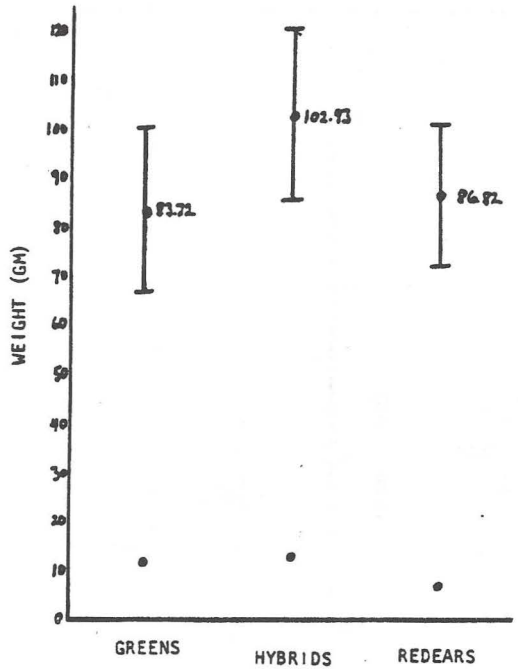

Figure 2. Growth of the crosses through the second growing season. Brackets indicate one standard deviation about the mean. Dots below indicate mean weights one year earlier.

Backcrossing of Hybrids and Parent Species: Green-redear hybrid males spawned successfully with both green sunfish and redear females. Redear-green hybrid males did not successfully backcross. However, these particular ponds were set up late in the spawning season, quite possibly too late for an otherwise successful spawn. These backcrosses will be attempted again in 1981.

DISCUSSION

Experimental fish communities discussed in this paper have been designed to compare, in a controlled way, the growth of the various crosses. In management situations we would not stock all the types together, but would recommend establishment of a particular hybrid in isolation from the parent species.

In ponds, movement of fish is easily controlled, but in reservoirs, both in-migration and out-migration might become problems. Infiltration of hybrid communities by individuals of the parent species is not disastrous, but merely undesirable, speeding up the

gradual onset of so-called hybrid breakdown in subsequent generations. Loss of hybrids to natural sunfish populations is likewise undesirable, but not disastrous. Natural hybridization does occur at low levels, and the likelihood of genetic swamping of parent species is not great.

The backcrossing experiment discussed here tells us that the hybrids can backcross with the parent species. What we had done was to force the hybrids to seek nonhybrid mates. In a management context, Arrowhead Lake, with a mix of hybrids and nonhybrids, is a more realistic situation. Young fish have been, and will continue to be, collected for electrophoresis to try to estimate the frequency of backcrossing when hybrid individuals have a choice of potential mates.

LITERATURE CITED

Childers, W.F. 1967. Hybridization of four species of sunfishes (Centrarchidea). Ill. Nat. Hist. Surv. Bull. 29(3):159-214.

_____ and G.W. Bennet. 1961. Hybridization between three species of sunfish (Lepomis). Ill. Nat. Hist. Surv. Biol. Notes, No. 46, 15 p.

_____ and G.W. Bennet. 1967. Hook-and-line yield of largemouth bass and redear x green sunfish hybrids in a one-acre pond. Prog. Fish. Cult. 29(1):27-35.

Ellison, D.G., and R.C. Heidinger. 1978. Dynamics of hybrid sunfish in southern Illinois farm ponds. Proc. 30th Annu. Conf. Southeastern Assoc. Game Fish. Comm. 1976:82-87.

Heidinger, R.C., and W.M. Lewis. 1972. Potentials of the redear sunfish x green sunfish in pond management. Prog. Fish Cult. 34(2):107-109.

Lewis, W.M., and R.C. Heidinger. 1971. Aquaculture potential of hybrid sunfish. The Amer. Fish Farmer 2(5):14-16.

_____., and R.C. Heidinger. 1978. Tailor made fish populations for small lakes. Southern Ill. Univ. Fish. Bull., No. 5, 22p.