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GROWTH, SURVIVAL, AND REPRODUCTION OF BLUEGILL X GREEN SUNFISH HYBRIDS [1]

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ABSTRACT

Growth rates, survival rates, and reproduction of male bluegills x female green sunfish hybrids were determined in three small, natural lakes from which other fish had been removed. Reproduction of F_1 hybrids was also determined in six experimental ponds. In the three lakes, survival rates of hybrids, starting with 25-mm fingerlings, over a 2-year period ranged from 7.7 to 33.5%. Growth of hybrids compared favorably with that of bluegills. Survival of F_2 hybrids in the three natural lakes and six experimental ponds was extremely limited. Thirty-two man hours of angling removed 273 fish, or 39% of the estimated hybrid population (704 fish) in one test lake.

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Introduction

Overabundance of slow-growing panfish is of major concern to fisheries managers working on inland waters. The prolific nature of some sunfishes, especially the bluegill, Lepomis macrochirus Rafinesque, adds to the stunting problem. Panfish with a limited reproductive potential would help alleviate this problem. Some hybrid sunfishes such as crosses between male green sunfish Lepomis cyanellus x female bluegill, male bluegill x female green sunfish, and male redear Lepomis microlophus (Günther) x female green sunfish, have shown promise of retaining desirable growth characteristics and yet having reduced fecundity (Lewis and Heidinger, 1971). In the present study, I measured growth rates, survival rates, and reproduction rates of the male bluegill x female green sunfish hybrid in three small natural lakes and six artificial ponds.

Since 1969 more than 2 million hybrid sunfish have been stocked in Michigan waters. These hybrids were crosses of either male bluegill x female green sunfish or male redear x female green sunfish. The hybrids used in the present study, and those for stocking in other Michigan waters, were produced naturally in ponds at the Wolf Lake State Fish Hatchery under the supervision of James A. Copeland.

Methods

Lakes

Natural lakes used for the experimental stocking of hybrids were: Ford Lake, Otsego County (T. 32 N., R. 1 W., Sec. 8); Sand Lake No. 2, Grand Traverse County (T. 27 N., R. 9 W., Secs. 23, 26); and Sand Lake No. 3, Grand Traverse County (T. 27 N., R. 1 W., Sec. 26). They were closed to public fishing during the experiment Physical and chemical characteristics of each are given in Table 1.

The lakes were treated in May 1969 with 1 ppm of rotenone (Pro-noxfish) to eradicate existing fish populations. On September 17, 1969, hybrids about 25 mm total length were stocked at the rate of 1,235 fish per hectare. In August of 1970, the yearling hybrids were sampled by angling to determine growth rates and sex ratios. Then in October 1971, trap nets were used to collect fish for a mark-and-recapture population estimate (Ricker, 1958).

We seined the shoreline of Ford Lake in May 1972 to collect information on reproduction of F_1 hybrids. In September 1972 the lakes were treated again with rotenone. After the treatment, I walked the entire shoreline of Ford Lake and Sand Lake No. 2 to collect young fish and to look for F_2 hybrids.

Four persons fished a total of 32 man hours on Ford Lake from May 22 to June 14, 1972, to determine vulnerability of hybrids to angling.

Ponds

The reproductive potential of bluegill x green sunfish hybrids, in the absence of other fish, was further evaluated in six ponds at the Saline Fisheries Station. The ponds are about 0.2 ha in area, and have a mean depth of approximately 1 m. On May 17-19, 1972, 428 hybrids were removed from Ford Lake, and 374 of these were stocked in the ponds. The remaining 54 fish were held in a live crate for subsequent egg counts. Two ponds received 107 adults each, two ponds received 53 adults each, and the remaining two ponds received 27 fish each. The sex ratio among these hybrids was 85% males; thus, theoretically, the three sets of ponds received 16, 8, and 4 females, respectively. These particular stocking rates were selected to match rates used in previous studies of reproduction of bluegills in the Saline Ponds.

The ponds were completely drained in the fall of 1972. Young-of-year fish were preserved for later identification, and adult fish were saved for measurement of growth and determination of sex.

Egg counts on ovaries from seven hybrids were made by the volumetric method.

Results and discussion

It was intended that only hybrids would be present in the three study lakes. Collections showed, however, that there were two sources of contamination. The plantings of hybrids that went into the three lakes were contaminated with a few bluegills. Also, a complete kill was not obtained in Sand Lake No. 3 during the 1969 rotenone treatment, so that a few adult bluegills in this lake were able to establish a large year class of the same age as the planted hybrids. The resulting situation was that Ford Lake and Sand Lake No. 2 each contained a few bluegills of the same age as the hybrids, while Sand Lake No. 3 had a very large population of bluegills the same age as the hybrids.

Growth

The growth rate of hybrids compared favorably with that of bluegills (Table 2). There was virtually no difference in average size of 2-year-old hybrids and bluegills in Ford Lake. In Sand Lake No. 2, bluegills averaged 15 mm longer than hybrids, while in Sand Lake No. 3, the hybrids averaged 25 mm longer than bluegills. The least abundant species in each of the Sand lakes (Table 3) had the greatest growth rate. Growth rates of both hybrids and bluegills were slower in Sand Lake No. 3 than in the other two lakes, probably due to the high density of bluegills in Sand Lake No. 3.

Sex ratio

Ninety-one percent of 173 yearling hybrids sampled from the lakes in 1970 were males. A year later, dissection of 200 age-II

hybrids from the lakes showed 81% were males. Hybrids in Ford Lake, where fish were obtained at a later date for stocking in ponds, had a sex ratio of 85% males. Childers (1967) reported 97% males among F_1 bluegill x green sunfish hybrids. Hubbs and Hubbs (1933) reported 81% males among 43 bluegill x green sunfish hybrids raised in aquaria.

Survival

Planting records indicated that the hybrids planted in the three natural lakes had a 30-40% loss at time of stocking due to handling. I assumed a 35% loss at time of stocking, and made a corresponding downward correction in the number of fish planted. Subsequent estimates of survival started with these corrected figures. Survival of hybrids from time of stocking until 2 years later was 33.5% in Ford Lake, 15% in Sand Lake No. 2, and 7.7% in Sand Lake No. 3 (Table 3).

Angling

A total of 273 hybrids were caught in 32 man hours of fishing at Ford Lake. This represents about 8.5 fish per hour. An estimated 704 hybrids were present in the lake when fishing began. Thus, about 39% of the population was removed by angling. Also, nine bluegills were caught during this period of fishing; coincidentally, this also represented 39% of the estimated bluegill population. Although my data are too scanty to allow definite conclusions, they suggest that adult bluegills may be as vulnerable to angling as are hybrids, under conditions found in Ford Lake during the spawning season. On the other hand, Childers (1967) reported that F_1 hybrid sunfishes appeared to be highly vulnerable to angling.

Egg counts

Egg counts from ovaries of hybrids held in live crates ranged from 3,348 to 25,502, with a mean of 14,393 eggs per fish. Mean length of the fish examined was 171 mm. Bluegills of comparable size have about 7,000 more eggs per female (W. C. Latta, personal communication).

Reproduction

Successful reproduction by adult hybrids in 1971, and survival of F_2's would have resulted in yearling hybrids in the lakes in the spring of 1972. Examination of 341 yearling fish from Ford Lake showed that the yearlings were all bluegills. Identification was based on pigmentation and on the ratio of pectoral fin length to jaw length (Etnier, 1968). The yearlings presumably were progeny of the bluegills in the contaminated lot of fish stocked in 1969. I examined 275 fish from Ford Lake and 150 from Sand No. 2 picked up when the lakes were chemically treated the second time. One small hybrid was found from each lake. The two fish could have been either F_2 hybrids, or backcrosses between F_1 hybrids and bluegills.

Expected number of F_2 hybrids in the ponds is based on egg counts of F_1 hybrids, and data on bluegill reproduction in the ponds (W. C. Latta, personal communication). Latta stocked the same Saline ponds at rates of 8, 16, and 32 adult bluegills. From egg counts of bluegills and the number of surviving females, he calculated that something in excess of 10 to 20 eggs per cubic meter of water was needed to guarantee some survival of fry from hatching time until fall, and that 120 to 130 eggs per cubic meter gave optimum fry survival. An increase in egg number above the optimum level resulted in an apparent decrease in fry survival. I assumed that survival from egg to fall fingerling would be the same for hybrids as in Latta's data for the bluegill. For the hybrids, I had the number of female spawners,

as recovered at fall drawdown, and counts on eggs per female. From these data I calculated the expected number of F_2 hybrids which should be present in the fall. These expected numbers ranged from 0 to 91,000 (Table 4). Fry were not expected in pond Nos. 8 and 10 because only two females were recovered from each of those ponds. A total of 285,000 fry was expected from the remaining ponds. However, only 105 F_2 hybrids were collected from the four ponds where the complement of eggs was sufficient to expect substantial numbers of fry. The paucity of F_2 fish appears to be due to lack of hatching success, for we failed to observe any fry at all during frequent observations throughout the summer. Childers and Bennett (1961) reported no F_2's when bluegill x green sunfish adult hybrids were stocked in a pond containing no other fish.

Adequate growth and survival of bluegill x green sunfish F_1 hybrids in small, reclaimed lakes, and their extremely limited reproduction, should make this a desirable fish when used under intensive management practices. The greatest potential use for this hybrid seems to be in ponds and small, reclaimed lakes where a fishery can be provided through annual stocking.

Table 1.--Physical and chemical characteristics of Ford Lake and Sand lakes Nos. 2 and 3

Lake	Size (ha)	Maximum depth (m)	Mean depth (m)	Surface alkalinity (ppm)
Ford	4.3	8.8	2.7	127
Sand No. 2	7.0	8.5	3.0	71
Sand No. 3	6.0	5.2	1.6	55

Table 2.--Growth of bluegill × green sunfish hybrids and of bluegills in lakes and ponds

All fish were young-of-year in 1969

Date, and lake	Species	Number of fish	Mean length (mm)	Mean weight (g)
August 1970				
Ford	Hybrid	70	121	---
Sand No. 2	Hybrid	70	127	---
Sand No. 3	Hybrid	33	91	---
Sand No. 3	Bluegill	46	89	---
October 1971				
Ford	Hybrid	195	179	146
Ford	Bluegill	15	181	138
Sand No. 2	Hybrid	91	168	107
Sand No. 2	Bluegill	10	183	135
Sand No. 3	Hybrid	69	120	31
Sand No. 3	Bluegill	50	95	12
October 1972				
Ponds	Hybrid	344	210	240

Table 3.--Population estimates and survival rates of fish in Ford and Sand lakes Nos. 2 and 3

Survival rates are from time of stocking in October 1969 until population estimates were made in October 1971

Lake, and species	Population estimates	95% confidence limits	Percent survival[1]
Ford			
Hybrid	1,232	977- 1,487	33.5
Bluegill	23	13- 55	---
Sand No. 2			
Hybrid	802	464- 1,140	15.0
Bluegill	44	29- 89	---
Sand No. 3			
Hybrid	446	253- 639	7.7
Bluegill	130,438	49,926-210,950	---

[1] After adjusting for an estimated 35% loss at time of stocking.

Table 4.--Number of young-of-year F_2 bluegill × green sunfish hybrids collected from the Saline ponds in the fall of 1972

Pond No.	Number of adult fish stocked	Number of females recovered	Expected number of F_2 hybrids[1]	F_2 hybrids recovered
16	107	12	85,000	98
7	107	13	91,000	1
15	53	10	74,000	6
8	53	2	0	0
14	27	5	35,000	0
10	27	2	0	0

[1] Based on egg counts of hybrids, and on survival rates for bluegills (see text).

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