PREDATOR-PREY RELATIONSHIPS OF THE FLATHEAD CATFISH IN PONDS UNDER SELECTED FORAGE FISH CONDITIONS[1]

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ABSTRACT

Flathead catfish (*Pylodictis olivaris*), ranging in size from 1.5 to 26 inches in length, were placed in experiments involving one or more forage species. Survival of 1.5 to 2.0-inch flathead fingerlings stocked into six ponds containing adult sunfishes and flathead minnows (*Pimephales promelas*) was low, ranging from 0 to 1.5 percent. Experiments conducted in plastic-lined pools to determine the vulnerability of four test species to predation by flathead catfish indicated a selection in order of decreasing vulnerability of largemouth bass (*Micropterus salmoides*), white catfish (*Ictalurus catus*), green sunfish (*Lepomis cyanellus*), and goldfish (*Carassius auratus*). Similar tests conducted in earthen ponds revealed an order of decreasing vulunerability of white catfish, largemouth bass, green sunfish, and goldfish although in neither experiment were all separations statistically significant.

Adult flathead catfish (14 to 16-inch) stocked at a rate of 50 per acre into a pond containing a stunted bluegill (*Lepomis macrochirus*) population reduced but did not correct crowding within a 320-day period. Two ponds stocked with *Tilapia spp.* and large flathead catfish did not result in desirable populations as, at the time of draining, fish larger than the 5-inch group comprised less than 13.4 percent by weight of the tilapia populations.

INTRODUCTION

The flathead catfish (*Pylodictis olivaris*) has been of considerable interest to investigators since discovery of its piscivorous nature. However, because of difficulty in producing the numbers of stocking-size flatheads necessary for adequate evaluation of predatory habits, much of the work conducted with the species has dealt with spawning and rearing techniques (Snow, 1959; Sneed et. al., 1961; Giudice, in press[3]; Henderson, in press[3]). Swingle (in press[4]) reported experiments indicating that the species relies heavily on a fish diet, seemingly preferring larger fish since most of the adult bluegills (*Lepomis macrochirus*) were apparently eliminated from several experimental populations.

In the bass-bluegill populations typical of Southeastern ponds that receive heavy fishing pressure, it is often difficult to maintain or restore balance once it is lost. Consequently, the need of an auxiliary predator to buffer or correct crowding by sunfish in such populations has long been recognized. Many observers have hoped that the flathead catfish would prove suitable for this role.

The primary objectives of this study were to determine: (1) feasibility and results of stocking flathead fingerlings into ponds containing expanding sunfish populations; (2) vulnerability of selected fishes to predation by the flathead catfish; (3) potential of the flathead in

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[4] Presented at the 18th Annual Conference of the Southeastern Game and Fish Commissioners, October 18-21, 1964, Clearwater, Florida.

correcting crowding by sunfish; and to (4) conduct preliminary investigations on the use of flathead catfish in combination with *Tilapia spp.* as a possible sport and/or commercial fishery.

FINGERLING FLATHEAD CATFISH-FORAGE FISH COMBINATIONS

The fingerling flatheads used in this segment of the investigation were reared in troughs to a length of 1.5 to 2.0 inches from sac-fry obtained from the Marion Fish Cultural Station (Alabama) of the U. S. Bureau of Sport Fisheries and Wildlife and from a spawn produced at Auburn.

Four fertilized ponds were stocked with combinations of flathead minnows (*Pimephales promelas*), bluegill, 1.5-inch largemouth bass (*Micropterus salmoides*) and flathead catfish fingerlings. Each pond was stocked per acre with 1,000 flathead minnows on January 31, 1964, and 1,500 bluegills on February 21. Flathead catfish fingerlings were stock on June 8 at rates of 64, 48, 32 and 16 per acre; the following day, largemouth bass were added inversely at identical rates making a total of 80 predatory fish per acre. Periodic seining indicated that flatheads had disappeared from the populations, a conclusion borne out by draining October 29, 1964, when none were recovered. The bass fingerlings fared much better than the young flatheads, with survivals ranging from 75 to 100 percent, averaging 87.5 percent.

In another experiment, two 1.0-acre ponds were stocked with fingerling flatheads and fed Auburn No. 2 pelleted fish feed. Neither pond was cleared of wild fish since it was anticipated that these would serve as food for the young catfish. In one pond stocked with 593 two-inch flatheads on August 9, 1963, and 2,000 flathead minnows on March 3, 1964, only one 11-inch flathead was recovered on draining June 17, 1964. In the other pond stocked with 1,307 flatheads (1.5-inch) June 19, and 20 brood Nile tilapia (*Tilapia nilotica*) July 1, ninteen flatheads ranging from 3 to 8 inches in length were recovered on draining October 21, 1964. Large numbers of adult green sunfish (*Lepomis cyanellus*) were recovered from both ponds in addition to numerous other nonstocked species. Six yearling bass were present in the pond where the greatest survival of fingerling flatheads was recorded (1.5 percent), indicating that bass may not have been the major factor responsible for disappearance of the flatheads in the four ponds of the previous experiment.

From these experiments it was evident that small fingerling flathead catfish were unable to survive in satisfactory numbers in the presence of relatively high concentrations of adult sunfishes. Therefore stocking flatheads of 2.0 inches in length or less into sunfish populations as is done with bass was unsuccessful; their use in this capacity would necessitate rearing larger sized fingerlings.

VULNERABILITY OF SELECTED FISHES TO PREDATION BY FLATHEAD CATFISH

Three-inch fish of four species [Largemouth bass, green sunfish, white catfish (*Ictalurus catus*) and goldfish (*Carassius auratus*)] were subjected to predation by flatheads ranging from 11.7 to 16.1 inches in length in a series of vulnerability experiments conducted in both plastic-lined pools and earthen ponds. Five fish of each test species were stocked into 10 plastic-lined pools 9 feet in diameter and 3 feet deep. Eight pools were stocked randomly with one flathead catfish, the two remaining pools receiving none. After a predation exposure period of 14 days, the pools were drained, mortalities ascertained for each test species, and the experiment repeated. Results of both replications are summarized in Table 1.

The difference in survival of test fish in control pools versus those stocked with flathead catfish was highly significant ($P<.005$) as expected. Othogonal comparisons indicated the rates of disappearance for both largemouth bass ($P<.005$) and white catfish ($P<.01$) as being significantly higher than that of either green sunfish or gold-

TABLE 1. RESULTS OF VULNERABILITY STUDIES CONDUCTED IN PLASTIC-LINED POOLS

Species	Average percent missing per pool	
	Control[5]	Flathead[6]
Goldfish	6.7	33.8
Green sunfish	0.0	45.0
White catfish	10.0	57.5
Largemouth bass	13.3	70.0

[5] Average of 3 pools, 1 control pool was lost.
[6] Average of 16 pools.

fish. The remaining comparison of green sunfish vs. goldfish was not significant.

In earthen pond experiments, test species were stocked at rates of 2,000 per acre in eight ponds. Flatheads were stocked at per acre rates of none, 100, and 200. The ponds were drained after a predation exposure period of 30 days and survival of the test fish determined. Again the survival of forage fish in control ponds was significantly higher ($P<.005$) than in ponds containing flatheads. However, a comparison between survival rates of the test species in ponds stocked with 100 vs. 200 flatheads per acre was not significant. The rate of disappearance of white catfish from the populations was significantly higher ($P<.005$) than all other test species. Further comparisons were not significant. Results of this experiment are present in Table 2.

TABLE 2. RESULTS OF VULNERABILITY STUDIES CONDUCTED IN EARTHEN PONDS

Species	Average percent missing per pond		
	Control[7]	Flatheads per acre	
		100[8]	200[9]
Goldfish	17.8	17.5	29.0
Green sunfish	10.9	22.5	43.5
Largemouth bass	9.7	36.0	41.5
White catfish	14.0	48.3	73.5

[7] Average of 2 ponds.
[8] Average of 4 ponds.
[9] Average of 2 ponds.

Although these experiments did not establish a statistically indicated vulnerability order, they did reveal that there were differences in susceptability of the test species. The significantly greater vulnerability of white catfish to predation by flathead catfish would seemingly be correlated with a greater chance of encounter by these two bottom-dwelling species. Inasmuch as the bass was one of the more vulnerable species, because possibly they are apparently less wary of other predators than are forage species, it is conceivable that stocking flatheads into a bass-bluegill population might, at least temporarily, result in a less desirable bass-bluegill ratio. However, in the case of a crowded sunfish population, it is probable that the sunfish would be eaten most frequently.

FLATHEAD CATFISH-CROWDED BLUEGILL POPULATION

A 2.7-acre pond was stocked with 30 adult bluegill (6 to 7-inch) during March 1963. The pond was fertilized with 0-8-0 (N-P-K) and no other fish were added during the ensuing 11 months. On February 21, 1964, large flathead catfish (14 to 16-inch) were stocked at a rate of 50 per acre. The pond was drained on January 7, 1965.

Periodic seining, conducted after addition of the flatheads at 2-week intervals, indicated a progressive reduction in the number of intermediate bluegills. Recruitment to larger sizes was also apparent as 2-inch fish completely disappeared from the seine samples after June 20.

Recruitment into the 6-inch and larger groups was apparently negligible or nonexistent during the interim between flathead stocking and draining the pond as a gradual decrease in the number taken per seine haul was recorded. A heavy bluegill spawn was recorded July 14; however, a length-frequency histogram prepared from a sample of this group taken at draining revealed a positively skewed distribution

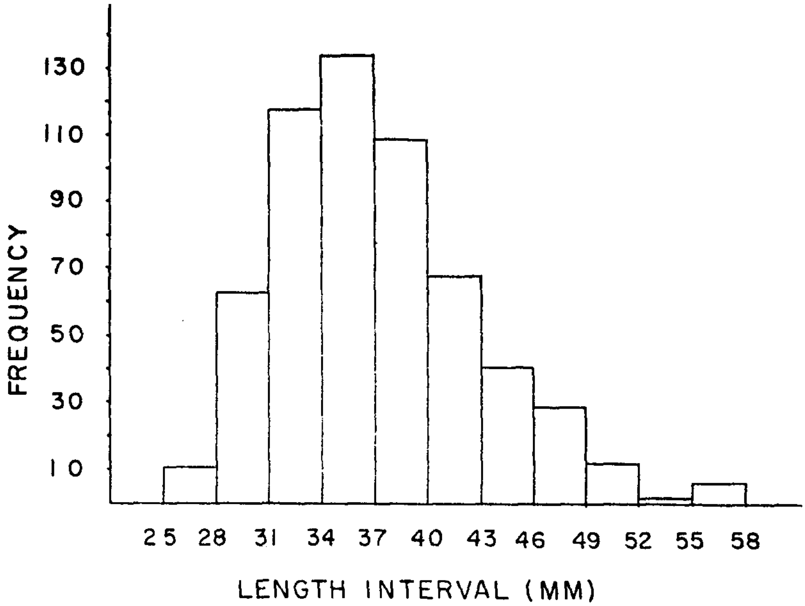

FIGURE I. LENGTH FREQUENCY DISTRIBUTION OF BLUEGILL-FRY RECOVERED ON DRAINING, JANUARY 7, 1965

(Figure 1), indicating they were not vulnerable to predation by the flatheads present.

At draining the pond was supporting 404.6 pounds of fish per acre. Standing crop of flathead catfish was 117.1 pounds per acre, a 68.8-pound or 142-percent increase over stocking weight. Survival was high with a total recovery of 134 of the 135 flatheads stocked. No young flatheads were produced. Bluegill standing crop was 287 pounds per acre. Only 14.6 percent or 41.9 pounds per acre was composed of bluegills larger than the 5-inch group with 22 of the original brood bluegill weighing 19.0 pounds, accounting per acre for 7.9 pounds of this weight.

A total of 5,131 of the 1963 hatch bluegills remained per acre, indicating that the crowding by this group had been alleviated although not corrected. A heavier rate of flathead stocking might have given better results since it appears that a longer experiment would have produced larger flatheads that could have resulted in poorer control for the smaller bluegills and further reduction of the sparse stock of harvestable bluegills.

FLATHEAD CATFISH TILAPIA POPULATIONS

Two ponds, 2.1 acres in size, were stocked with *Tilapia spp.* and large flatheads and fed with Auburn No. 2 pelleted fish feed. One pond was stocked with 165 brood Nile tilapia June 1 and 30 adult flathead catfish weighing 54.3 pounds June 11, 1964. Goldfish were known to be at least moderately abundant in this pond since an average of about

10 per quadrant-haul were taken with a 15-foot seine in April. Periodic seining indicated increasing abundance and average size of the tilapia until August 11, after which a decline in both size and abundance was noted. Only 451.3 pounds of Nile tilapia were recovered per acre on draining September 24, 1964, despite the addition per acre of 900 pounds of supplemental feed. It appeared that the flatheads were stocked too soon, thereby curtailing expansion of the forage population. There was an apparent drastic reduction in the goldfish population since only 50 (approximately 24 per acre) were recovered. This was surprising in view of earlier experiments that indicated relative nonvulnerability of the goldfish to predation by flathead catfish.

At the relatively low stocking rate of approximately 14 per acre, flathead growth was rapid, with an increase in average weight of 1.8 to 5.0 pounds during the 105-day period. Twenty-nine of the 30 flatheads stocked were recovered, yielding a net production of 43.2 pounds of catfish per acre.

Higher production of both catfish and tilapia was obtained in the second pond used in the flathead-tilapia experiments. This pond was stocked with 215 brood Java tilapia (*Tilapia mossambica*) June 1, 1964, and a total of 132 flatheads weighing 316.3 pounds that was added gradually during the period of June 25 to September 24. It was anticipated that the staggering of flathead stocking dates would result in a greater initial escapement of the tilapia, thereby increasing production of both the catfish and tilapia. A total of 766.7 pounds of feed was supplied per acre and the experiment was terminated November 19, 1964. Results of both tilapia experiments are presented in Table 3.

It appears that the flatheads used in stocking were too large. This was noted in the previously discussed crowded-bluegill experiment. Because of size of the flatheads used in these experiments, there was virtually no reduction in susceptibility to predation since the forage species failed to grow too large for the flatheads to swallow. This was indicated by the low productions of forage fish larger than the 5-inch-group.

At draining considerable weights of small forage fish remained in the ponds. Higher rates of flathead stocking probably would have reduced this weight and given increased production of the catfish. Also, the slower flathead growth rates obtained with heavier stockings would tend to confine predation to smaller forage fish, which should result in greater numbers of the forage species surviving to harvestable size.

TABLE 3. — RESULTS OF FLATHEAD CATFISH-TILAPIA COMBINATIONS

Items per acre	Nile tilapia combination	Java tilapia combination
Flathead catfish		
Stocked number	14.3	62.9
Stocked pounds	25.9	150.6
Recovered number	13.8	62.4
Recovered pounds	69.0	223.4
Net pounds	43.2	72.8
Tilapia		
Stocked number (5-7″)	78.6	102.4
Stocked pounds	5.2	6.2
Recovered number (6″+)	298.6	1,124.3
Recovered pounds	58.6	146.0
Recovered number (1-5″)	21,061.0	68,608.0
Recovered pounds	392.7	954.0
Net pounds	446.1	1,093.8
Goldfish		
Recovered number	23.8	—
Recovered pounds	7.7	—
Net total pounds	497.0	1,166.6
Pounds feed used	900	766.7

SUMMARY

1. Small fingerling flathead catfish (1.5 to 2.0-inch) were unable to survive (0 to 1.5%) in satisfactory numbers in the presence of relatively high concentrations of adult sunfishes.
2. Tests conducted in plastic-lined pools indicated an order of decreasing vulnerability to predation by flathead catfish of largemouth bass, white catfish, green sunfish, and goldfish.
3. Tests conducted in earthen ponds indicated an order of decreasing vulnerability to predation by flathead catfish of white catfish, largemouth bass, green sunfish, and goldfish.
4. Adult flathead catfish (14 to 16-inch) stocked at a rate of 50 per acre into a stunted bluegill population reduced but did not completely correct crowding within a 320-day period.
5. Two ponds stocked with *Tilapia spp.* and large flathead catfish did not result in desirable populations since at the time of draining fish larger than the 5-inch group made up less than 13.4 percent by weight of the tilapia.

LITERATURE CITED

Giudice, John J., Investigations on the propagation and survival of flathead catfish in troughs. Proc. Southeast. Assoc. Game and Fish Comm. 17: (in press).

Henderson, Harmon, Observations on the propagation of flathead catfish in the San Marcos State Fish Hatchery, Texas. Proc. Southeast. Assoc. Game and Fish Comm. 17: (in press).

Sneed, Kermit E., Harry K. Dupree and O. L. Green, 1961. Observations on the culture of the flathead catfish (*Pylodictis olivaris*) fry in troughs. Proc. Southeast. Assoc. Game and Fish Comm. 15:298-302

Snow, J. R., 1959. Notes on the propagation of the flathead catfish *Pilodictis olivaris* (Rafinesque). Prog. Fish Cult. 21:75-80.

Swingle, H. S., Experiments with the flathead catfish (*Pylodictis olivaris*) in ponds. Proc. Southeast. Assoc. Game and Fish Comm. 18: (in press).

PARAFORMALDEHYDE FOR CONTROL OF *GYRODACTYLUS* AND *DACTYLOGYRUS*

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The external worm parasites *Gyrodactylus* spp. and *Dactylogyrus* spp. are among the most frequent-occurring and damaging parasites that infect fishes produced under fish farming conditions in the United States. At many fish farms annual treatment for the control of these parasites is a necessity. Formaldehyde has been established as an effective control for *Gyrodactylus* spp. and is also recommended for the control of certain other external parasites including *Scyphidia, Costia, Chilodon, Trichodina,* and *Trichophyra.* To date the source for formaldehyde has been the 38-percent aqueous solution used in industry. As a pond treatment, not involving subsequent removal of the chemical by flushing, the 38-percent formaldehyde solution is effective at 25 ppm. (Lewis and Lewis, 1962).

The aqueous solution of formaldehyde has certain undesirable features. Its storage characteristics are poor, the volume required results in high shipping cost and the cost of the material itself is relatively high.

In the present work, the use of paraformaldehyde, a powder which when dissolved in water disassociates to yield an aqueous solution of formaldehyde, was investigated as a substitute for the commercial