RESULTS OF STOCKING YOUNG LARGEMOUTH AND SPOTTED BASS IN SEVERAL RATIOS IN OKLAHOMA PONDS

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Young-of-the-year northern and Florida largemouth bass (*Micropterus salmoides salmoides* and *M. s. floridanus*) and spotted bass (*M. punctulatus*) were stocked in various ratios at a single density in small (mostly 0.1 ha) Oklahoma ponds in each of two years. Samples of the bass were seined periodically and their size (weight) and food were estimated. Survival and standing crops were measured when ponds were drained. Mean weight of bass was generally greatest in polytypic ponds, but standing crops there were lower in one of the years owing to greater mortality. During one of the years, all three basses ate a wider variety of foods when stocked polytypically, although the total amount of food eaten did not vary. Two strain-specific differences appeared to be independent of the stocking combination: (a) survival of Florida largemouth bass was lower than that of northern largemouth bass, and (b) average weight, survival, standing crop, and diversity of diet were lower for spotted bass than for either subspecies of largemouth bass. Judging by total standing crops in the ponds, stocking of spotted bass appeared to be most promising for augmenting native populations of northern largemouth bass.

INTRODUCTION

Spotted bass, *Micropterus punctulatus*, and Florida largemouth bass, *Micropterus salmoides floridanus*, have been widely introduced into the southern portions of the natural range of the northern largemouth bass, *M. s. salmoides* (1, 2, 3). One rationale for these introductions is that competitive interaction within, rather than among, species and subspecies of *Micropterus* is more intense. If so, variation in environmental tolerance and reproductive and trophic requirements could result in fuller use of the total habitat by polytypic populations (3, 4). This rationale is supported by findings that the standing crop of largemouth bass in reservoirs is positively correlated with the standing crop of spotted bass (5). Also, Florida largemouth bass may be better suited than northern largemouth bass to portions of lakes that receive heated effluents (4).

It has not been shown empirically that an introduction of additional strains of *Micropterus* into a given body of water containing only northern largemouth bass has increased long-term yield, production, or standing crop. The nearest approach appears to have been the introduction, beginning in 1961, of Florida largemouth bass into reservoirs in southern California that contained naturalized populations of northern largemouth bass (6). Total fishery yields were apparently increased through the development of hybrid populations. Catch per angler did not increase in 1965-77, however, because of a concurrent increase in the number of anglers. In many waters, production of Florida largemouth bass and spotted bass introduced into the range of the northern largemouth bass appears to be limited by high mortality (2, 7, 8), and the Florida subspecies has questionable potential for management in Missouri and Oklahoma.

The purpose of this study was to determine whether ponds containing young-of-the-year of more than one species or subspecies of *Micropterus* (polytypic ponds) maintained higher standing crops than ponds with only one species or subspecies (monotypic ponds). The ponds were similar in morphology, location, and water supply, and they were assumed to be nearly identical in terms of habitat provided for the spotted and northern and Florida largemouth bass stocked.

METHODS

Nine similar 0.1-ha and two similar 0.5-ha rectangular earthen ponds located below Lake Carl Blackwell dam, a 1400-ha reservoir in Payne and Noble Counties, Oklahoma, were used for these experiments. Water was piped from the reservoir into each pond. Maximum depth of the pond was 2 m.

About two months before stocking, ponds were drained to remove the resident fish populations. Then, from 6 August to 7 September 1976 (several days after being refilled), each of the nine small ponds was stocked: three with 200 Florida largemouth bass ($\overline{wt}$ = 2-15 g), three with 200 northern largemouth bass ($\overline{wt}$ = 3-11 g), and three with 100 of each subspecies. The stocking density in all ponds was 2000 bass/ha. A right or left pelvic fin was removed from all fish for identification of subspecies. No prey species were stocked. The ponds were partly drained three times (11-15 October and 18-24 November 1976 and 12-18 April 1977) and samples of 3 to 50 (usually 15 to 30) bass of each subspecies were collected with a 16.2-m bag seine (6.4-mm mesh). All bass collected were weighed to the nearest gram and stomach contents were removed by suction with a glass tube (9) and preserved in 70% alcohol. The glass tube was also used to visually examine the inside of the stomach and verify that all food had been removed. Fish were returned to the ponds immediately after they had been weighed and their stomachs had been evacuated. Handling mortality was not apparent during these operations. The ponds were drained on 24 May-2 June 1977 and all surviving bass were removed and weighed and their stomach contents examined.

Standing crop was estimated by multiplying the mean weight times the number of bass in the pond. Survival was based on a single interval — the duration of the experiment. Because the density and standing crops of bass could be determined only at the beginning and end of the experiments, relative success of the three forms was estimated on the basis of size increase and food ingested during the experiment. Replicated mean weights and survival rates of the subspecies in several ponds were tested for significant differences (P = 0.05) by using the Mann-Whitney U test (10) and standing crops were tested with the *t*-test. Food items in each stomach were counted and identified to the lowest taxon practical, usually genus or family. Individual stomach samples for each subspecies in each pond were then combined and weighed to the nearest 0.01 g (blotted wet weight).

Beginning on 13 July 1977, I repeated part of the 1976-77 experiments and included spotted bass in the study. Eight 0.1-ha ponds were stocked — three with 100 northern largemouth ($\overline{wt}$ = 4 g) and 100 spotted bass ($\overline{wt}$ = 3 g), three with 100 Florida largemouth ($\overline{wt}$ = 2 g) and 100 spotted bass, and two with 67 of each of the three forms. On 4 August 1977 monotypic populations of the three basses were stocked in five sections of two 0.5-ha ponds that had been divided longitudinally with wire fencing 1.2 m deep (13 mm mesh). Four 0.167-ha sections were each stocked with 333 bass — two with spotted bass and one each with Florida largemouth and northern largemouth bass; one double section (0.333-ha) was stocked with 667 northern largemouth bass. The stocking density for all ponds in both years was 2000 bass/ha. Bass were sampled by seining during 15-17 August 1977 (0.1-ha ponds only), 14-22 September 1977, and 14-18 November 1977 and the ponds were drained and the fish were counted and weighed during 6-20 March 1978. Bass were marked and sampled and the data processed as during the 1976-77 experiments with three exceptions: (1) only half of a right pelvic fin was removed from the spotted bass; (2) all stomach contents from fish of a given species or subspecies in each pond were combined before analysis; and (3) the Kruskal-Wallis one-way analysis of variance (10) was used to test for differences in replicated mean weights and survival of the three basses. (Because of muskrat burrowing, some bass escaped from the fenced segments used as monotypic ponds into adjacent segments. The escapees — which in March 1978 constituted 34% of the total number of spotted bass, 13.5% of the Florida largemouth bass and 16.5% of the northern largemouth bass in monotypic ponds — were not used in calculations of mean weight but were added to the biomass of bass in the section originally stocked with that strain to determine standing crops in monotypic ponds.) All ponds, with one exception, were stocked with young-of-the-year golden shiners (*Notemigonus crysoleucas*) at a density of 5000/ha at the same time bass were stocked. (The 0.333-ha section was stocked with fewer forage fish over a longer period of time.)

RESULTS

Survival

A total of 900 northern and 900 Florida largemouth bass were stocked in August 1976. Of these, 237 northern (or 26.3%)

and 166 Florida (or 18.4%) largemouth bass survived to June 1977 (Table 1). Range of survival was 0 to 60.5% for northern and 0 to 44% for Florida largemouth bass. Survival did not differ significantly either within or between subspecies.

During July 1977-March 1978, however, survival differed significantly among species and subspecies (Kruskal-Wallis H = 13.6, P < 0.01; Table 1). Mean survival was 82.0% for northern largemouth bass (range, 70.1 to 92.0%), 64.9% for Florida largemouth bass (range, 31.3 to 82.0%), and 49.9% for spotted bass (range, 25.3 to 65.0%). Survival did not differ signif-

TABLE 1. *Number and mean weight of northern largemouth bass (NLMB), Florida largemouth bass (FLMB), and spotted bass (SB) stocked in ponds, percentage that died, gain in weight, and standing crop determined when ponds were drained, August 1976 to March 1978.*

Species or subspecies of bass stocked and pond number[a]	Stocking			Draining			
	Month and year	No.	Wt. (g)	Days after stocking	Percent Mortality	Gain in wt. (g/fish)	Standing crop (kg/ha)
Monotypic Ponds							
NLMB 9	Aug. 76	200	3	293	58	12	12.5
10	Aug. 76	200	10	281	100	5	0
13	Aug. 76	200	10	280	39	21	37.5
1M	Aug. 77	333	4	229	11	23	53.4
2S	Aug. 77	667	4	229	30	23	39.3
FLMB 8	Aug. 76	200	3	207	98	15	0.9
12	Aug. 76	200	15	280	76	14	13.6
15	Aug. 76	200	12	278	56	18	26.4
1N	Aug. 77	333	2	229	29	17	27.7
SB 1S	Aug. 77	333	3	229	46	22	21.5
2N	Aug. 77	333	3	229	56	14	14.2
Polytypic Ponds							
NLMB and FLMB							
NLMB 6	Sept. 76	100	11	223	93	7	1.3
11	Sept. 76	100	10	248	75	30	10.0
16	Sept. 76	100	11	253	99	45	5.6
FLMB 6	Sept. 76	100	6	223	100	11	0
11	Sept. 76	100	11	248	77	28	9.0
16	Sept. 76	100	13	253	97	27	12.0
NLMB and SB							
NLMB 6	July 77	100	4	239	8	44	44.2
11	July 77	100	4	238	19	43	38.1
12	July 77	100	4	239	19	66	51.0
SB 6	July 77	100	3	239	55	18	9.5
11	July 77	100	3	238	52	19	10.6
12	July 77	100	3	239	37	21	15.1
FLMB and SB							
FLMB 7	July 77	100	2	241	38	31	20.5
15	July 77	100	2	247	30	44	32.2
16	July 77	100	2	245	18	30	26.3
SB 7	July 77	100	3	241	50	14	8.5
15	July 77	100	3	247	35	19	14.3
16	July 77	100	3	245	57	22	10.8
NLMB, FLMB, and SB							
NLMB 10	July 77	67	4	237	9	34	23.2
13	July 77	67	4	239	30	66	32.9
FLMB 10	July 77	67	2	237	69	33	7.4
13	July 77	67	2	239	27	49	25.0
SB 10	July 77	67	3	237	75	15	3.1
13	July 77	67	3	238	39	24	11.1

[a]Ponds 1N, 1M, 1S, and 2N = 0.167 ha each
Pond 2S = 0.333 ha
Ponds 6-16 = 0.1 ha each

icantly within a given form, however, and was independent of whether bass were stocked singly or in polytypic combinations.

Standing Crop

Equal numbers of largemouth bass were stocked per unit of area in all ponds in August 1976 and mean standing crops in monotypic and polytypic ponds by June 1977 were not significantly different (t = 1.04, df = 7; Table 1). Standing crops were 0-37.5 kg/ha (mean, 16.6) for northern largemouth bass-only populations, 0.9-26.4 kg/ha (mean, 13.6) for Florida largemouth bass populations, and 1.3-19.0 kg/ha (mean, 7.3) for polytypic populations.

This pattern was not evident in March 1978, however, when standing crops in polytypic ponds containing Florida largemouth and spotted bass (29.0-46.5 kg/ha) invariably exceeded crops in monotypic ponds containing the same two forms (14.2-27.7 kg/ha; t = 2.56, df = 4, 0.05 < P < 0.10; Table 1). In ponds containing northern largemouth bass, standing crops in polytypic populations also exceeded crops in monotypic populations, although only by an average of 17% (54.2 vs. 46.4 kg/ha; Table 1). The average standing crop of 31.2 kg/ha in all monotypic ponds was 65% of the average of 47.9 kg/ha in all polytypic ponds (t = 1.90, df = 11, 0.05 < P < 0.10).

Mean Weight

Because of relatively great variation among ponds, replicate mean weights were significantly different in only three instances during 1976-77. All Florida largemouth bass were larger than all northern largemouth bass in October (Mann-Whitney μ = 7, P < 0.05) and November 1976 (μ = 5, P < 0.05); northern largemouth bass in polytypic ponds were larger than those in monotypic ponds in April 1977 (μ = 0, P = 0.05). In general, the unweighted mean weight of all northern largemouth bass in monotypic ponds was consistently lowest throughout August 1976-June 1977 (Experiment 1; Table 2). Unweighted mean weight of Florida largemouth bass in monotypic ponds was greatest until spring, when it was exceeded by those of both Florida and northern largemouth bass in polytypic ponds.

During November 1977 and 1978 (Experiment 2), the replicate mean weights of the three species and subspecies were consistently different (H = 14.6 and 13.2, respectively; P < 0.01). Spotted bass were the smallest, followed by largemouth bass in monotypic ponds, Florida largemouth bass in polytypic ponds, and northern largemouth bass in polytypic ponds. As in 1976-77, the northern largemouth bass in polytypic ponds were largest and northern largemouth bass in monotypic ponds were smallest; the weights of Florida bass in both polytypic and monotypic populations were intermediate (Table 2). Weight of a given species or subspecies stocked alone did not differ significantly from the weight of that species or subspecies stocked in other combinations.

Food

In general, the weight of food found in stomachs of northern and Florida largemouth bass in 1976-77 (Experiment 1) did not reflect differences in size between the subspecies stocked in various combinations (Table 2). Relative consumption of food (milligrams per gram of fish) was similar for northern largemouth bass in monotypic (4.7) and polytypic ponds (4.5), although the fish in polytypic ponds were larger. Consumption of food by Florida largemouth bass in monotypic ponds (6.3) was twice that in polytypic ponds (3.1). Florida largemouth bass in monotypic ponds not only consumed more food by weight, but also ate a greater variety of organisms — 25 taxa versus 18-20 taxa for other groups (Table 2).

In 1977-78 (Experiment 2) weight of food appeared to be independent of species or subspecies or stocking combination Table 2). Except for populations of only Florida bass (2.3), relative consumption by the 11 groups ranged only from 3.7 to 4.9. Considering the accuracy of the methods, these differences are probably not significant. During 1977-78 the number of taxa eaten by a given species or subspecies in monotypic ponds, however, was only half or less the number eaten by that species or subspecies in all polytypic ponds (8 vs. 16 taxa for northern largemouth bass, 6 vs. 17 for Florida largemouth bass, and 5 vs. 12 for spotted bass). Although relative consumption by weight was similar, largemouth bass consumed a wider variety of organisms, particularly vertebrates, than did spotted bass (Table 2).

TABLE 2. *Number of taxa and weight of food in stomachs of young northern largemouth bass (NLMB), Florida largemouth bass (FLMB), and spotted bass (SB) held in ponds alone or with one or both of the other basses, October 1976 to March 1978.*

Collection date[a]	Species or subspecies: Northern largemouth bass				Florida largemouth bass				Spotted bass			
	Fish		Food		Fish		Food		Fish		Food	
	No.	$\bar{x}$ wt. (g)	Taxa (no.)	Weight (mg) per gram of fish	No.	$\bar{x}$ wt. (g)	Taxa (no.)	Weight (mg) per gram of fish	No.	$\bar{x}$ wt. (g)	Taxa (no.)	Weight (mg) per gram of fish
	NLMB only				FLMB only				SB only			
Experiment 1												
Oct. 1976	65	16	9	1.6	49	27	17	2.0	—		—	—
Nov. 1976	56	13	11	6.7	38	24	6	2.0	—		—	—
April 1977	76	14	10	4.7	58	28	14	11.1	—		—	—
May 1977	34	16	13	7.5	24	30	11	10.6	—		—	—
Total	231		18	4.7[b]	169		25	6.3[b]				
Experiment 2												
Sept. 1977	30	17	6	4.5	14	21	3	1.1	29	18	4	4.1
Nov. 1977	29	29	6	2.1	15	23	6	1.0	27	24	3	1.3
March 1978	35	27	3	5.9	25	19	2	3.8	25	21	2	7.0
Total	94		8	4.3[b]	54		6	2.3[b]	81		5	4.1[b]
	With FLMB				With NLMB							
Experiment 1												
Oct. 1976	40	21	10	2.3	31	22	9	2.6	—		—	—
Nov. 1976	45	19	11	4.4	36	24	11	3.3	—		—	—
April 1977	22	25	8	5.5	45	33	9	3.6	—		—	—
May 1977	21	48	9	7.6	32	40	9	2.5	—		—	—
Total	128		20	4.5[b]	144		18	3.1[b]				
	With SB				With SB				With NLMB			
Experiment 2												
Aug. 1977	41	24	10	7.7	50	15	11	4.3	43	13	8	3.3
Sept. 1977	45	41	7	4.2	42	27	6	4.6	45	19	5	3.8
Nov. 1977	43	55	10	2.9	12	36	3	1.6	44	24	6	2.7
March 1978	25	53	3	4.9	45	37	7	4.3	29	22	3	5.4
Total	154		11	4.9[b]	149		13	4.2[b]	161		9	3.7[b]
	With FLMB + SB				With NLMB + SB				With NLMB + FLMB			
Experiment 2												
Aug. 1977	16	24	10	5.9	32	16	13	8.0	32	12	7	3.9
Sept. 1977	30	36	8	6.1	18	27	3	7.1	30	16	3	6.2
Nov. 1977	16	51	4	2.3	45	41	9	1.5	13	21	4	1.4
March 1978	33	54	5	3.4	30	43	6	3.7	24	23	2	2.4
Total	95		12	4.5[b]	125		15	4.5[b]	88		8	3.9[b]

DISCUSSION

The time of day when stomach samples were taken in relation to the preferred feeding time may have resulted in some differences in monthly food habits that were due partly to sampling the ponds in a nearly constant sequence. It is also possible that part of the monthly differences in food eaten within and among strains was due to differences between ponds in populations of benthic invertebrates (11), as well as to chance differences on several dates of collection.

Nevertheless, more taxa were consistently used for food by bass in monotypic ponds in 1976-77 and by bass in polytypic ponds in 1977-78 (Table 2). In the polytypic situation, expansion of the food niche (as in 1977-78) may occur if competition reduces food resource levels uniformly, but contraction of the niche (as in 1976-77) may result if resources are reduced in a patchy manner (12). It is not clear whether these variable results are caused by environmental differences between years or are related to the addition of spotted bass and 0.5-ha ponds to the experiment during the second year.

Analysis of instantaneous growth rates did not suggest any difference in growth patterns other than those indicated by the comparison of mean weights (Clady, unpublished data). Although during a 4-month period of the first experiment monotypic populations of Florida largemouth bass consumed more food and were the largest, young-of-the-year largemouth bass in polytypic populations generally attained a greater mean weight than did largemouth bass in monotypic populations (Table 2). This greater mean weight in polytypic ponds was reflected in greater standing crops in these ponds in March 1978 (Table 1). Greater growth and total biomass in polytypic than in monotypic populations is consistent with the hypothesis that competitive interaction is more intense within than among strains of *Micropterus.* Since mean weight was greater in polytypic than in monotypic ponds in May-June 1977, the smaller standing crops in these ponds was related to poorer survival, although the reasons for lower survival in polytypic ponds are obscure. The smaller standing crops and survival in all ponds in 1976-77, compared with those in 1977-78 (Table 1), were possibly caused by a lack of forage

TABLE 2. Continued

Collection date[a]	Species or subspecies											
	Northern laregmouth bass				Florida largemouth bass				Spotted bass			
	Fish		Food		Fish		Food		Fish		Food	
	No.	$\overline{\text{wt.}}$ (g)	Taxa (no.)	Weight (mg) per gram of fish	No.	$\overline{\text{wt.}}$ (g)	Taxa (no.)	Weight (mg) per gram of fish	No.	$\overline{\text{wt.}}$ (g)	Taxa (no.)	Weight (mg) per gram of fish
Experiment 2											With FLMB	
Aug. 1977	—	—	—	—	—	—	—	—	46	14	9	4.0
Sept. 1977	—	—	—	—	—	—	—	—	38	17	6	3.6
Nov. 1977	—	—	—	—	—	—	—	—	46	22	5	2.1
March 1978	—	—	—	—	—	—	—	—	44	21	4	8.4
Total									174		10	4.5[b]

[a]Collection dates (*shown by month and year*) were 11-15 October and 14-18 November, 1976; 12-18 April, 24 May — 2 June, 15-17 August, 14-22 September, and 14-18 November, 1977; and 6-20 March 1978. (No collection from monotypic ponds in August 1977.)

[b]Weighted mean

fish in the ponds, by sampling-related mortalities that were later reduced by experience, and by loss of bass during draining through deteriorated screens separating the catch basins from the drain pipes during the earlier period. (On the assumption that the subspecies were equally likely to be lost, the loss does not invalidate the data since comparisons were relative and were made within only one sampling period. New screens were in place during 1977-8).

Growth and survival of spotted bass were poorer than for either subspecies of largemouth bass, as also noted in Alabama ponds (13). On the basis of the number of fish stocked, northern largemouth bass produced the largest standing crops and spotted bass the smallest (Table 1). Even though size of spotted bass varied between monotypic and polytypic ponds during August-September 1977, size and standing crops of spotted bass were relatively consistent between ponds and treatments, and standing crops of spotted bass appeared to be somewhat additive to the standing crop of largemouth bass. Conversely, the presence of both subspecies of largemouth bass often reduced the individual standing crops of each subspecies, based on the number stocked, below those attained independently in monotypic ponds, suggesting that competitive interaction between the two subspecies of largemouth bass may be more intense than interaction between largemouth and spotted bass.

The data suggest that the introduction of other strains of *Micropterus* does not greatly increase overall standing crops of young-of-the-year bass through supplementation of naturally produced year classes of northern largemouth bass. Because of lower survival, attributed to handling stresses in pens in an adjacent pond (Clady, unpublished data) and in Missouri (7), Florida largemouth bass produced smaller standing crops than did northern largemouth bass. Also, although mean weight in polytypic ponds was greater, introduction of Florida largemouth bass appears to have had a negative effect on survival of northern largemouth bass, and overall standing crops in four of five ponds with northern and Florida bass combined were less than in ponds with northern largemouth bass only (Table 1). Total standing crops in ponds containing northern largemouth bass were increased by adding spotted bass, although only about 10 kg/ha or 20%. It is unlikely that such modest increases in standing crops would justify the cost of hatchery operations if polytypic populations relied on maintenance stocking. It could be justified, however, if spotted bass were vulnerable to angling at different times of the year so that total yield was increased significantly.

All polytypic ponds containing northern largemouth bass were well-seeded with 667 to 1000 young-of-the-year northern largemouth bass per hectare. The greatest potential of polytypic *Micropterus* populations, however, may be in bodies of water, such as Lake Carl Blackwell (14), in which northern largemouth bass fail to reproduce in some years. Other strains of *Micropterus* with different spawning and rearing requirements might then recruit a year class that would partly use the food and space not used by northern largemouth bass in that particular year.

ACKNOWLEDGMENTS

I thank the members of the Oklahoma Cooperative Fishery Research Unit for collecting much of the data on which this paper is based, and O. E. Maughan for reviewing the manuscript. The Unit is jointly supported by the Oklahoma Department of Wildlife Conservation, Oklahoma State University, and the U.S. Fish and Wildlife Service. This study was funded by Federal Aid to Fish Restoration Project F-36-R, Oklahoma.

REFERENCES

1. W. D. DAVIES, *Florida largemouth bass in Alabama waters as a management tool,* Ann. Rep. Fisheries and Allied Aquacultures Dep., Auburn Univ. Agric. Exp. Sta. Vol. 14, 1973.
2. O. R. FAJEN, Proc. Ann. Conf., Southeast. Assoc. Game Fish Comm. 29:28-35 (1976).
3. L. K. GRAHAM, *The introduction of Florida largemouth bass in Missouri ponds,* Missouri Dep. Conserv., D-J Final Rep., Proj. No. F-1-R-21, Study 1-14, Job. No. 2, 1972.
4. P. W. RIEGER and R. C. SUMMERFELT, Proc. Ann. Conf., Southeast. Assoc. Game Fish Comm. 30:48-57 (1978).
5. R. M. JENKINS, *in:* R. H. STROUD and H. CLEPPER (eds.), *Black Bass Biology and Management,* Sport Fishing Inst., Washington, D. C., 1975, pp. 114-124.
6. L. J. BOTTROFF and M. E. LEMBECK, Calif. Fish Game 64:4-23 (1978).

7. D. L. JOHNSON, A *Comparison of Florida and Northern Largemouth Bass in Missouri*, Ph.D. Thesis, Univ. of Missouri, Columbia, 1975.
8. D. A. NIEMAN, *Some Aspects of the Ecology of Florida and Northern Largemouth Bass in a Thermally Enriched Reservoir*, M.S. Thesis, Okla. State Univ., Stillwater, 1978.
9. J. L. FORNEY, J. Fish. Res. Board Can. 34:925-932 (1977).
10. S. SIEGEL, *Nonparametric Statistics for the Behavioral Sciences*, McGraw-Hill, New York, 1956.
11. W. C. LATTA and J. W. MERNA. Mich. Acad. 9:483-502 (1977).
12. E. R. PIANKA, in: R. M. May (ed.), *Theoretical Ecology: Principles and Applications*, W. B. Saunders Co., Philadelphia, pp. 114-141.
    R. O. SMITHERMAN, *in:* R. H. STROUD and H. CLEPPER (eds.), *Black Bass Biology and Management*, Sport Fishing Inst., Washington, D. C., 1975, pp. 76-84.
14. R. C. SUMMERFELT, *in:* R. H. STROUD and H. CLEPPER (eds.), *Black Bass Biology and Management*, Sport Fishing Inst., Washington, D. C., 1975, pp. 166-174.