GROWTH COMPARISONS AND CATCHABILITY OF THREE LARGEMOUTH BASS STRAINS

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ABSTRACT

Florida largemouth bass, Micropterus salmoides floridanus *(Le Sueur), northern largemouth bass,* M.s. salmoides *(Lacepede), and their* F_1 *hybrid were stocked in a 3.64-hectare pond, and their growth rates and catchability compared. The hybrid and Florida bass were found to achieve the best growth over a 3-yr period, apparently due to genetic influences rather than environmental factors. Differences in catchability were not observed among the three strains of largemouth bass.*

Since the two subspecies of largemouth bass were first recognized by Bailey and Hubbs in 1949, fisheries workers have attempted to measure the differences between them. Sasaki (1961) compared the growth rates of newly introduced Florida bass (*Micropterus salmoides floridanus* (Le Sueur) to the northern subspecies (M.s. salmoides [Lacepede]) in California and found no significant difference in their first year's growth. He also stated the capture of the Florida bass by hook and line was extremely difficult. Clugston (1964) stocked northern bass from Iowa into Florida ponds and reported the northern subspecies grew more rapidly than the Florida bass during a 15-month study, but temperature differences of the ponds may have accounted for the differences in growth. Miller (1965) compared the growth rates of Florida and northern largemouth bass stocked in the same 10-acre impoundment in California. Growth rates did not differ significantly over a 1-yr period. Addison and Spencer (1971) evaluated the growth of these subspecies and their hybrid in separate Alabama ponds. There was little difference in growth at Age I, but the hybrid and Florida bass were found to have grown larger and faster than the northern bass after 27 months.

The objective of this study was to evaluate the growth of three strains of largemouth bass (the Florida strain, the northern strain, and their F, hybrid [male northern X female Florida]) under the same environmental conditions. Catchability of the three strains was also evaluated.

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MATERIALS AND METHODS

Cain Lake is a 3.64-hectare lake located in northcentral Anderson County, Texas. The lake has a maximum depth of 6 m, with gently sloping banks. During construction (1962) timber was left standing along the creek channel, providing abundant cover. The lake receives runoff from a Coastal Bermuda pasture and all overflow escapes through a 20 cm vertical overflow pipe. There were no ponds on the watershed. Water was slightly alkaline and low in chlorides, with turbidity varying from 48 to 91 cm secchi. Aquatic vegetation was limited to the immediate shoreline, with no submerged plants present.

The fish community was eradicated from Cain Lake in September 1972 by treatment with 5% rotenone at a rate of 2 ppm. Several forage species were stocked following

eradication. Florida, northern, and hybrid largemouth bass were stocked in March, 1973 (Table 1). Florida and hybrid bass were 12 months old at time of release. Northern bass were similar in size, but their exact age was not known. Northern bass were obtained by electrofishing from two nearby impoundments having established fish populations. Florida bass were secured by electrofishing from another experimental lake, while the hybrids were obtained from the Jasper State Fish Hatchery.

Table 1. Stocking Records for Cain Lake, 1972-1976.

Scientific Name	*Common Name*	*Date Stocked*	*Number Stocked*
Lepomis cyanellus	Green sunfish	10/72	10,000
L. cyanellus X *microlophus*	Hybrid sunfish	10/72	1,000
Pimephales promelas	Fathead minnow	10/72	6,000
Gambusia affinis	Mosquitofish	10/72	3,000
Dorosoma petenense	Threadfin shad	2/73	655
D. cepedianum	Gizzard shad	2/73	17
Menidia audens	Mississippi silverside	2/73	30
Notemigonus crysoleucas	Golden shiner	2/73	13
M. salmoides floridanus	Florida largemouth bass	3/73	74
M. salmoides X *floridanus*	F_1 hybrid bass	3/73	74
M. salmoides salmoides	Northern largemouth bass	3/73	75
Tilapia aurea	Blue tilapia	4/74	254
D. petenense	Threadfin shad	4/74	2,475

Prior to release, bass were anesthetized with quinaldine to prevent injury and reduce stress while measuring, weighing and marking. Fish were marked by injecting a dye (National Fast Blue 8 GXM) into the dentary membrane of the lower jaw. Hybrid bass were marked on both membranes, while Florida bass were marked on the right and northern bass on the left membrane.

No fishing was permitted during the first 24 months of the study. Thereafter, fishing for the progeny bass by ranch personnel was allowed; however, a creel record was kept by the ranch foreman and marked bass were returned to the water.

Annual surveys were conducted in April, 1974 through 1976. Electrofishing was used exclusively in the afternoon and evening hours during the 1974 survey. In 1975 and 1976, hook and line fishing was employed during the day, while electrofishing was conducted after dark and the following morning. Marked bass were held overnight in a 0.64 cm nylon mesh live-net. After anesthetizing with quinaldine, the bass were identified by the dye mark, measured, weighed, re-marked and returned to the water. Growth trends for each strain were analyzed, using the Von Bertalanffy growth model (Rafail 1973). The model describes growth by the relationship:

$$l_t = L\infty\,(1 - e^{-K(t-t_0)})$$

where l_t = length at age t

$L\infty$ = the maximum (predicted) length for the population

e = base of the natural log (2.7183)

K = growth coefficient

t_o = time when length would theoretically be 0.

Length-weight relationships (Everhart, et al. 1975) were used to study the condition of the fish.

Standing crop was estimated by the Petersen mark and recapture method (Lagler 1969). Unmarked bass (progeny) taken by hook and line during the catchability test in April, 1975 and 1976 were fin-clipped and released randomly prior to electrofishing.

Four catchability tests were employed to determine if the Florida bass was harder to catch than the northern subspecies. Tests were conducted in April and August, 1975, and January and April, 1976, to determine the effect of water temperature on the catchability

of the bass strains. During each 8-h test, four fishermen, fishing independently, recorded their catch after each 2-h period. Identical artificial lures were used by each fisherman during the first test, while in subsequent tests two fishermen used spinner baits and two used plastic worms the entire day. Due to the variability between fishermen, bait type, and time of day, the total number of marked fish of each strain caught for each test was used for analysis. These totals were tested for significant differences, using the G-Statistic (Sokal and Rohlf 1969).

RESULTS

All originally stocked bass retained their identifying marks to some degree during the 3-yr study. During the initial phase of the study, the northern strain was found to have the greatest individual size variance; however, as the study progressed it became obvious the Florida, and especially the hybrids, possessed the greatest degree of length (and weight) variability (Table 2).

Table 2. Length-frequency distributions of three strains of largemouth bass. Numbers of Florida (F), northern (N), and hybrid bass* (H), from Cain Lake, 1973-76.

	Year											
	1973 (stocking)			*1974*			*1975*			*1976*		
Length Increment (mm)	*F*	*N*	*H*	*F*	*N*	*H*	*F*	*N*	*H*	*F*	*N*	*H*
130												
		2										
140												
		8										
150												
	1	7										
160												
	4	4										
170												
	30	6	3									
180												
	19	3	15									
190												
	13	6	21									
200												
	6	4	27									
210												
	1	17	5									
220												
		10	2									
230												
		6	1									
240												
		2		1								
250												
				4								
260												
				4	4	2						
270												
				1	4	3						
280												

Table 2. Length-frequency distributions of three strains of largemouth bass. Numbers of Florida (F), northern (N), and hybrid bass* (H), from Cain Lake, 1973-76.

	Year											
	1973 (stocking)			1974			1975			1976		
Length Increment (mm)	F	N	H	F	N	H	F	N	H	F	N	H
290				6	1	3	4	2				
300					1	7	2	1				
310					1	3	2	2		3	2	
320							2	1	3	2		1
330					1					1	2	1
340									3	1	1	
350							1		1	1	2	3
360									1	2		
370									1	2		
380									1	1		
390									1			2
400										1		
410												
420										1		

*Male Northern largemouth bass X Female Florida largemouth bass

Table 3. Sample sizes (N), mean lengths (mm), mean weights (g), and yearly increments of the three strains of largemouth bass in Cain Lake, 1973-1976. ( ) indicates standard errors.

	Largemouth Bass Strain								
	Northern Bass			Florida Bass			Hybrid Bass*		
Year	N	Length	Weight	N	Length	Weight	N	Length	Weight
1973 (Stocking)	75	193(3.6)	173(8.3)	74	182(1.3)	129(2.9)	74	198(1.4)	168(4.1)
Increment		+87	+363		+87	+322		+89	+386
1974	12	280(5.3)	536(30.7)	16	269(3.5)	451(19.2)	18	287(2.8)	554(18.6)
Increment		+17	+209		+32	+357		+57	+642
1975	7	297(4.8)	745(38.1)	11	301(5.4)	808(40.9)	11	344(7.3)	1196(85.0)
Increment		+20	+162		+43	+268		+6	+113
1976	7	317(6.5)	907(60.1)	15	344(8.6)	1076(79.9)	7	350(10.2)	1309(141.2)

*Male northern largemouth bass X Female Florida largemouth bass

Growth

Length increments for the three strains one year after stocking (Age II), were similar (Table 3). Changes in growth rates were more apparent two years after stocking (Age III). Hybrids showed excellent growth—almost three times greater than the northern subspecies, and Florida bass grew almost twice as much as the northern bass.

The growth rate of the hybrids declined considerably during the third year (Age IV). Their length increased only 6 mm, while the Florida bass continued to grow rapidly (43 mm gain). The average northern bass increased 20 mm over the same period.

Von Bertalanffy growth curves (Figure 1) show the general trends of growth over the 3-yr study. Tests on the Von Bertalanffy curve parameters (Table 4) showed a difference

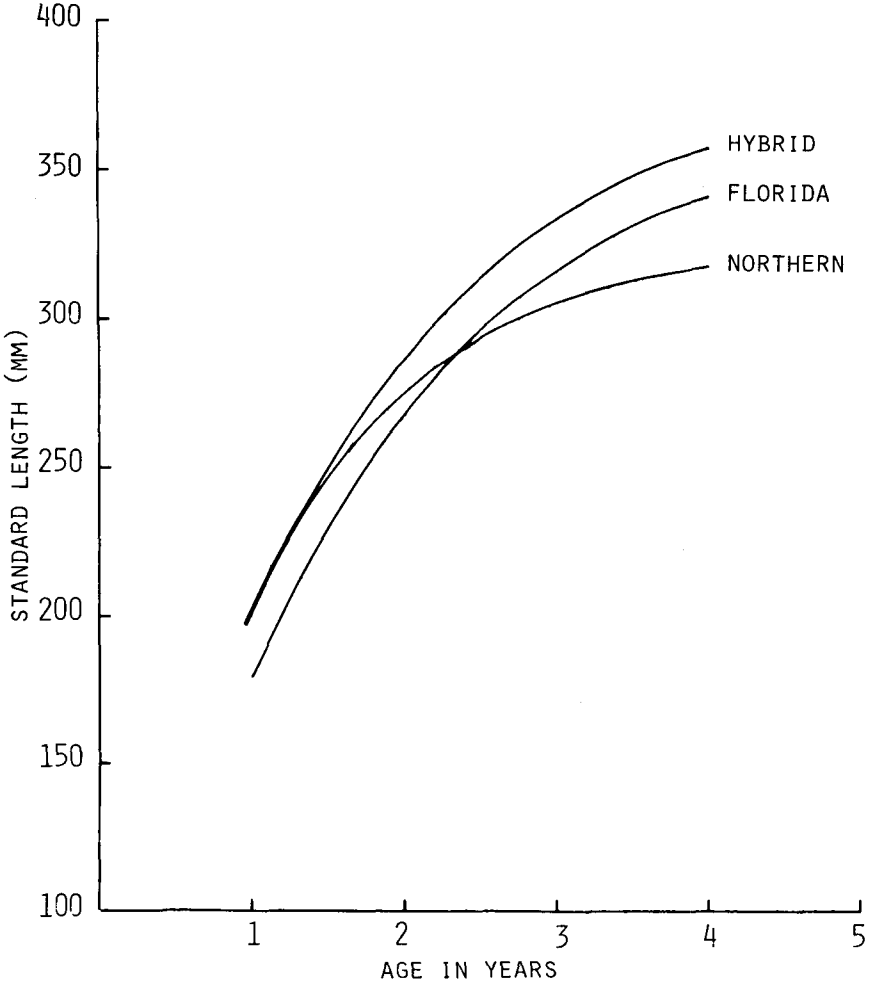

Figure 1. Von Bertalanffy growth curves for Florida largemouth bass—$L_t = 370.90 (1 - e^{-0.6234 (t + 0.0129)})$, northern largemouth bass—$L_t = 323.71 (1 - e^{-0.9197 (t + 0.0081)})$, and the northern X Florida largemouth bass hybrid—$L_t = 382.30 (1 - e^{-0.6516 (t - 0.1184)})$, Cain Lake, 1973-1976.

Table 4. Von Bertalanffy growth model parameters, maximum predicted length ($L\infty$), growth coefficients (K), and theoretical time at length 0 (t_o), for the three strains of largemouth bass, Cain Lake 1973-1976. ( ) indicates standard error.*

Parameter	*Subspecies*		
	Florida	*Northern*	*Hybrid*
$L\infty$	370.9 (0.19)	323.7 (0.27)	382.3 (0.26)
K	0.6234 (0.0782)	0.9197 (0.1082)	0.6516 (0.1058)
t_o	−0.0129 (0.1105)	−0.0081 (0.1530)	0.1189 (0.1496)

* Four degrees of freedom associated with these standard errors.

between the growth curves ($P<.05$). Both hybrid and Florida bass grew faster than the northern strain. Growth curves for hybrids and Florida bass are nearly identical, with the main difference being in growth prior to stocking in Cain Lake.

Length-Weight Relationships

Length-weight data collected during the four years revealed the following relationships:

FLORIDA BASS $\text{Log}_{10}(\text{wt}) = -5.4339 + (3.3375)\,\text{Log}_{10}(\text{lt})$
NORTHERN BASS $\text{Log}_{10}(\text{wt}) = -4.9409 + (3.1349)\,\text{Log}_{10}(\text{lt})$
HYBRID BASS $\text{Log}_{10}(\text{wt}) = -5.7019 + (3.4491)\,\text{Log}_{10}(\text{lt})$

Covariance analysis of these regressions revealed the length-weight relationships of the three strains were different ($P<.01$). Northern bass were heavier at the shorter lengths (<Age II) than either hybrid or Florida bass. As the fish grew in length the hybrids and Florida bass surpassed the northern fish in weight gained per unit gain in length (condition). Relationships for hybrid and Florida bass differed ($P<.01$), with the hybrids showing a slightly better condition. The heaviest Florida and hybrid bass recovered was an identical 1861 g. The largest northern bass collected during the study weighed 1771 g.

Standing Crop Estimates

The mark and recapture population estimate in 1975 was 957 adult bass (>157 mm, SL), or 263 bass per hectare. In 1976 the population estimate was 910 adult bass, or 250 per hectare. Adding these figures to the number of bass removed by fishermen, the largemouth bass population in Cain Lake may have exceeded 280-290 adult bass per hectare during the last two years of the study.

Catchability

No apparent difference in the catchability of Florida and northern bass was found in Cain Lake. Fifty marked fish were among the 202 bass caught by fishermen during the four catchability tests (Table 5). Florida bass accounted for 42% of the marked fish

Table 5. Numbers of marked largemouth bass of each strain caught during the four catchability tests, Cain Lake, 1975-1976.

Test Period	*Largemouth Bass Strain*			
	Florida	*Northern*	*Hybrid**	*Unmarked*
April, 1975	5	5	4	42
August, 1975	7	4	4	29
January, 1976	3	3	5	26
April, 1976	6	3	1	55
Total	21	15	14	152

* Male Northern largemouth bass X Female Florida largemouth bass

recovered by hook and line, compared to 30% for the northern strain and 28% for the hybrids. The test of independence showed no significant difference in the number of each strain caught ($G = 4.33$, 6 d.f.). Although more Florida bass were taken during the catchability tests, the catch-ratio between Florida and Texas bass was noted to be exactly the same as recovered by electrofishing during the initial survey in 1974, prior to any fishing in the lake. Catch-rate for all bass during the four tests was 1.84 fish per man-hour. The only seasonal difference observed was an increased catch of Florida bass during summer. Florida and hybrid bass were caught equally well during morning and afternoon, while 80% of the northern bass were caught in the afternoon. There was no apparent difference in catch location (water depth, cover preference, etc.) for the three bass strains.

DISCUSSION

The greater degree of length and weight variability found in this study for the Florida genotype was also observed by Addison and Spencer (1971) and Chew (1975). The F_1 hybrids exhibited the best growth of the three bass types, followed closely by the Florida strain. Northern bass showed comparable growth between Age I and Age II but were surpassed by both hybrid and Florida bass after Age II. The smaller average size of the Florida bass at stocking in Cain Lake may have limited their growth during the first year of observation. While the growth-rate for all three strains slowed between Age III and Age IV, probably due to reduced forage and increased competition, the decrease was especially pronounced for hybrids. Florida bass, during this same period, achieved the best growth. Although largemouth bass standing crop estimates exceeded 250 adult bass per hectare and no unusually large specimens were recovered, average growth for all strains exceeded that reported by Houser and Bross (1963) for largemouth bass in Oklahoma waters. Gizzard shad, threadin shad and bluegill were the principal forage supporting this heavy bass population in Cain Lake.

Comparisons of length-weight regression slopes showed the hybrid and Florida bass increased in weight faster than northern bass. Florida and hybrid bass were heavier than northern bass at comparable lengths. Since the three strains were exposed to identical environmental conditions, the superior growth of the Florida genotype in Cain Lake appeared genetically rather than environmentally controlled.

Numbers of the three strains collected by all methods throughout the study indicate mortality of northern bass was higher in response to handling, electrofishing, or other unknown factors. Also, considerably more Florida and hybrid bass survived three or more captures. During the study, 12 hybrids and 10 Florida bass were re-marked, compared to only three northern bass. Other researchers have also found Florida bass hardier than the northern subspecies (Bottroff 1971, Miller 1965). This characteristic could have important management implications in terms of survival of stocked fingerlings and larger fish returned to the water by fishermen. Improved survival would enlarge the predator base, aiding in control of sunfish and other troublesome species, while increasing the numbers of available sport fish.

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