GROWTH COMPARISON OF TWO SUBSPECIES OF LARGEMOUTH BASS IN TENNESSEE PONDS

ROBERT P. SMITH, Department of Forestry, Wildlife, and Fisheries, University of Tennessee, Knoxville, TN 37901
J. LARRY WILSON, Department of Forestry, Wildlife, and Fisheries, University of Tennessee, Knoxville, TN 37901

Abstract: A study was conducted to determine if any growth rate differences occurred between two subspecies of largemouth bass during the first 6 months of growth. Two ponds near Lenoir City, Tennessee, were partitioned into equal halves by a nylon fish barrier. Northern strain fingerlings *(Micropterus salmoides salmoides)* were stocked in one side of each pond and Florida bass *(M. s. floridanus)* in the other sides. *Micropterus salmoides salmoides* showed a significantly faster rate of growth (1.0% level) than *M. s. floridanus*. Mean coefficients of condition (K) and specific growth rates (G) were consistently higher for *M. s. salmoides* during the study period. Since the subspecies were grown in the same water under apparently similar environmental conditions but separated by a barrier, growth differences observed from the fingerling state (1 month old) to 5 months of age were thought to be genetic in nature.

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Few fishes have provided as popular and dependable sport fishery as the largemouth bass. Still fewer have the proven potential for intensive management within natural and man-made waters. Because of its growth capacity (compared to the other black basses), the largemouth has received considerable attention from fishery management and related fields (Bryan 1964, Clugston 1964, Bottroff 1967, Robbins and MacCrimmon 1974, and Thrasher 1974). Results from length-weight studies within its native range show the general trend is for shortest mean total lengths in colder waters, and longest lengths in warmer waters. Weight follows a similar trend (Robbins and MacCrimmon 1974).

Two subspecies of largemouth bass are known to exist. The Florida subspecies has a restricted natural range and differs from the more widely distributed northern form in coloration, size and number of scales along the lateral line (Buchanan 1968, and Thrasher 1974), and a larger maximum size (Bailey and Hubbs 1949). Within its natural range, the Florida bass (hereafter referred to as *floridanus)* often attains a weight of 6.4 to 7.3 kg, and occasionally an individual will exceed 9 kg (Buchanan 1968). The northern largemouth (hereafter referred to as *salmoides)* rarely reaches 5.4 kg (Gresham 1966).

In recent years the fact that *floridanus* attains a consistently larger size on the average than does *salmoides* has come to the attention of fishery biologists as well as bass angling organizations. In the interest of possibly increasing the genetic potential for size, several states have started stocking programs for the introduction of *floridanus* with varying degrees of success. Graham (1973) reported high mortality among *floridanus* and superior overall growth by *salmoides* when the subspecies were compared in Missouri ponds. Working in Florida, Clugston (1964) concluded, "There is very little evidence to indicate that the southern subspecies of largemouth bass is genetically superior to the northern form as far as growth is concerned." In an Alabama study, Thrasher (1974) concluded that no genetic differences in growth potential seem to exist, but that there appears to be a significant difference in catchability between the two subspecies, with *floridanus* being the most difficult to catch. Another study in southern Alabama by Addison and Spencer (1971) showed fastest growth from *salmoides* X *floridanus* hybrids. Zolczynski and Davies (1976) found that *salmoides* grew faster than *floridanus* or the hybrid during the first summer of life. Since their study utilized similar pond environments, observed differences in growth rates were attributed to genetic factors.

The primary objective of this study was to compare growth rates of the 2 subspecies in Tennessee ponds under as similar conditions as possible. It was hoped that the results of such a study can be of some aid in arriving at a rational decision concerning the future of *floridanus* introductions.

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METHODS

Two ponds located in the Hines Valley area near Lenoir City, Tennessee, were utilized for the study. The ponds had formerly been used for commercial catfish production by Harrison Poultry Farms. They were arranged in a stair-step fashion and were equipped with standpipes and 6-inch drains. The upper pond (Pond A) was 0.54 ha (1.34 acres) and the lower pond (Pond B) was 0.47 ha (1.15 acres). These measurements were taken while the ponds were completely full with winter rains and spilling water out the emergency spillways. Water supply to the ponds was dependent entirely on runoff from a pasture watershed.

Barrier Construction

It was planned to construct fish barriers bisecting each pond, thus converting the two ponds into four sections. Pond B was drained and the bottom allowed to dry. A line was taken across the shortest distance of the pond that would divide it into equal halves with approximately the same amount of shallow and deep areas per side. The barrier line went from the center of the levee on Pond B to the center of the Pond A levee, and was 65.9 m in length. Metal poles were sunk into the pond bottom at 10 m intervals to lend vertical support to the nylon fish barrier. A 0.7 m extension of these poles above the water line was deemed adequate to prevent mixing of the subspecies by individuals jumping the barrier. Two steel cables were stretched along the poles and anchored into the levee at each end to provide horizontal support for the mesh netting. With poles firmly positioned and cables stretched, the next step was to hang the barrier itself. A single piece of 6-mm mesh nylon seine material which measured 70 m in length and 3 m deep was clipped to the top and middle cables with copper hog rings. The excess netting was then rolled on to metal fence posts and buried in the pond bottom.

Water from Pond A was drained into Pond B in order that Pond A could dry. A similar barrier was constructed in Pond A. Again, care was taken to insure that not only the halves were of equal size, but also that each side contained the same amount of deep and shallow substrate. Since there was no pond above Pond A, runoff water was relied on to refill the pond.

Prey Organisms

Prior to barrier construction, both ponds were rich with fishes considered acceptable as food for largemouth. Once both partitioned ponds had refilled to an acceptable level, additional prey organisms for the fingerling bass were collected from local pond sources. Bluegill were first proposed as the food fish, but because of the time of year they were unavailable. It was decided to use the 3 species that occurred not only in the 2 study ponds but in other adjacent ponds. These were the mosquito fish *(Gambusia affinis)*, fathead minnow *(Pimephales promelas)*, and green sunfish *(Lepomis cyanellus)*. Pond B already had a substantial population of all 3 species, because water from Pond A which contained fish was drained into Pond B. Some forage fish from B were transferred into A, and other forage of the same species composition were transferred from nearby ponds into Pond A. By the time the young bass arrived, both ponds had thriving populations of all 3 forage species, with reproduction evident among the mosquito fish.

In addition to fishes, both ponds had abundant populations of aquatic invertebrates that could have supplemented the bass diet. Odonate nymphs frequently used the fish barrier as a surface to crawl out of the water and emerge, as evidenced by cast exuviae left clinging to the mesh. Dragonflies of the genera *Anax*, *Tetragoneuria* and *Aeschna* were collected, as well as damselflies of the genus *Agrion*. Mayflies of the genus *Caenis* were observed in both ponds. Microcrustaceans of the genera *Cyclops*, *Daphnia*, and *Cypridopsis* were collected in plankton samples, as well as a few tardigrades. The variety and abundance of aquatic food in both ponds contributed to adequate growth conditions for young largemouth bass.

Stocking and Sampling

Fingerlings of *floridanus* were flown to Knoxville from Richloam Fish Hatchery near Tampa, Florida, on May 23, 1974. They were packaged in oxygen filled plastic bags nested in styrofoam coolers. There were no mortalities attributed to shipping. Since both ponds received runoff from a heavily used pasture, it was decided to stock at fertilized rates, adding an extra 10 percent for mortality. Seventy-four *floridanus* fingerlings were acclimated and stocked in one side of Pond A, and 64 in a partitioned half of Pond B. Average length for the *floridanus* fingerlings was 47 mm, and the average wet weight per fish was 1.15 g. The fish were approximately one month old.

The *salmoides* fingerlings arrived the next day and were stocked in the same numbers in the remaining side of each pond. During the acclimating process, the young *salmoides* were observed actively feeding on tiny *Gambusia* fry that entered the styrofoam coolers along with pond water. The *salmoides* fingerlings came from Cohutta National Fish Hatchery, Cohutta, Georgia, and had an average length of 30 mm, average wet weight of 0.25 g, and were about 1 month old.

At weekly intervals after the fish were stocked, the barriers were examined using mask and snorkel to make sure they were intact. Young fish of all 3 forage species were observed passing freely back and forth through the barrier. The fingerling bass were much too large to go through 6-mm mesh.

Beginning at the end of June, 1974, and at 30 day intervals thereafter for the next 5 months, a random sample of at least 14 fish was taken from each side of each pond by seining. In June, a 3-m minnow seine with 9-mm mesh was used. In July, a 20-m bag seine with 12-mm mesh was used, and for the last 3 months of the study fish were collected with a 30-m bag seine with 25-mm mesh. Each fish in a sample was weighed with hospital grade spring scales accurate to $\pm$ 5 g, and total length in mm was taken using a measuring board. The water temperature was recorded for each pond during sampling. Fish were returned to their respective pond compartments after sampling.

Statistical Procedure

Growth differences were evaluated using analyses of covariance (Snedecor, 1956). A two-way analysis of covariance was computed from data for both ponds for the first 2 months of the study, and a one-way analysis of covariance for the entire study period on Pond B. Both procedures incorporated time (X) and weight (Y) in an effort to determine any significant differences in growth rates between the subspecies.

Coefficients of condition (K) (Lagler 1956) were calculated for each fish sampled; mean K values were computed each month. Specific growth rates (G) (Brown 1957) were computed using mean weights at the beginning and end of each 30-day sampling period.

RESULTS AND DISCUSSION

Adequate data were available for both ponds only for the first 2 months; data from Pond B fish were obtained for the entire 5-month period. Pond A data for the last 3 months were deemed unreliable due to several breaks in the fish barrier below the water line, introducing the possibility of the sub-species mixing. The subspecies could not be separated with certainty because meristic counts needed from parent stock were unavailable. Therefore, it was decided to terminate Pond A after the July sampling.

A two-way analysis of covariance was computed from the June and July data for both ponds. Significant differences between subspecies and between ponds were obtained ($F = 4.89$ and 16.30; $P > 0.01$), with interaction not significant. The subspecies grew at significantly different rates in each pond, and did so independently of differing pond conditions. Pond differences can be explained, at least in part, by low water levels encountered in Pond A. As stated earlier, stocking rates for the 2 ponds were determined at a time when both were at full pool. It was fully expected that, after the barriers were constructed, both ponds would refill to their maximum levels with spring rains. Pond B reached full pool, because water from Pond A was drained into B during barrier construction. However, Pond A never filled completely due to extremely dry conditions during the spring and summer. As a result, bass introduced into Pond A were overstocked for the amount of water actually present. Such crowded conditions were no doubt less than optimum for growth, at least relative to Pond B.

A one-way analysis of covariance was computed for the entire 5-month study for Pond B. For each subspecies, the rates of growth as well as the relationship between growth and time were significantly different.

In both ponds during the first 2 months of study, *salmoides* showed a significantly faster rate of growth than *floridanus*. This trend continued through the entire 5 months in Pond B, with rate differences being even more pronounced in the later months. The young *salmoides* fingerlings were considerably smaller (on the average) than *floridanus* at stocking, but exceeded *floridanus* in average weight after 60 days (Table 1).

Table 1. Mean weights (g) and corresponding standard deviations for the largemouth subspecies at each sampling time.

	Pond A		Pond B	
Month	*floridanus*	*salmoides*	*floridanus*	*salmoides*
June	10.1	10.2	12.4	12.2
	± 2.6	±10.8	± 3.4	± 3.6
July	32.00	41.3	50.7	63.8
	± 6.29	±10.6	± 7.9	± 12.6
August	--	--	96.3	132.0
	--	--	± 15.2	± 26.8
September	--	--	139.8	214.9
	--	--	± 28.2	± 44.3
October	--	--	154.9	261.1
	--	--	± 34.9	± 42.6

Coefficients of condition (K) were computed for each fish sampled, and a mean value arrived at for each month (Table 2). The northern subspecies were found to be consistently more robust, as evidenced by their higher K value each month. In Pond B, *floridanus* increased in condition for the first 2 months, and then steadily decreased for the remaining 3. On the other hand, *salmoides* increased in condition throughout the study.

Table 2. Mean K[1] values for the largemouth subspecies at each sampling time.

Month	Pond A *floridanus*	Pond A *salmoides*	Pond B *floridanus*	Pond B *salmoides*
June	1.37	1.60	1.20	1.33
July	1.34	1.52	1.41	1.55
August	--	--	1.45	1.58
September	--	--	1.43	1.64
October	--	--	1.37	1.64

[1]From Lagler (1956) $K = \frac{W \times 10^5}{L^3}$.

Specific growth rate (G) was computed from mean weights for both subspecies. G values characteristically decrease with age during any 1 growth cycle in fishes, thus conforming to Medawar's fourth and fifth laws of growth (Brown 1957). As was the case with coefficient of condition, G values were consistently higher for *salmoides* for all months (Table 3).

Table 3. Specific growth rates for the largemouth subspecies at each sampling time.

Growth Period of 30 Days	Pond	*floridanus* Weight at Start of Period (gms)	*floridanus* Specific Growth Rate	*salmoides* Weight at Start of Period (gms)	*salmoides* Specific Growth Rate
May	A	1.2		.3	
June	A	10.1	7.25	10.2	12.35
July	A	32.00	3.84	41.3	4.67
May	B	1.2		.3	
June	B	12.4	7.94	12.2	12.96
July	B	50.7	4.68	63.8	5.52
August	B	96.3	2.14	132.0	2.42
September	B	138.6	1.22	214.9	1.63
October	B	154.9	0.37	261.1	0.65

Since bass in Pond B were grown under the same environmental conditions but kept separate by the barrier, differences in growth observed over the 5-month period could be considered genetic in nature. The northern form grew at a significantly faster rate than did *floridanus*. Because of pond differences and the loss of data from Pond A, it would not be statistically sound to predict the same results anywhere in Tennessee. A longer study of perhaps 5 - 10 years would be needed to demonstrate any ultimate growth differences between the subspecies.

Differences in catchability, although not within the scope of this study, may be a key factor in explaining maximum sizes reached by the subspecies. A greater longevity achieved by a bass that resists fishing pressure may serve to explain the larger size attained by *floridanus* in other states. In mixed populations such as described by Bottroff (1967), intergradation seems likely. Catchability studies by Smith (1971) show that intergrades are more difficult to catch than pure-strain *salmoides*. Careful consideration should be given to the potential effects of decreased catchability before *floridanus* are stocked in waters where pure-strain *salmoides* already provide a suitable fishery.

LITERATURE CITED

ADDISON, J. H. and S. L. SPENCER. 1971. Preliminary evaluation of three strains of largemouth bass, *Micropterus salmoides* (Lacépède), stocked in south Alabama. Proc. Ann. Conf. S.E. Assoc. Game & Fish Comm. 25:336-374.

BAILEY, R. M. and C. L. HUBBS. 1949. The black basses *(Micropterus)* of Florida, with description of a new species. Univ. Mich., Mus. Zool., Occas. Pap. 516. 43pp.

BOTTROFF, L. J. 1967. Intergradation of Florida bass in San Diego County. M.S. Thesis. San Diego State College. 313pp.

BROWN, M. E. 1957. The physiology of fishes. Vol. 1. Academic Press, New York, N.Y. 447pp.

BRYAN, C. F. 1964. Growth and systematic relationships of *Micropterus punctulatus punctulatus* (Rafinesque) using meristic traits and serum electrophoresis. Ph.D. Thesis. Univ. of Louisville, Louisville, Ky. 184pp.

BUCHANAN, J. P. 1968. A meristic and morphometric comparison of Arkansas largemouth bass *Micropterus salmoides salmoides* (Lacépède), and the Florida subspecies *Micropterus salmoides floridanus* (Lesueur). M.S. Thesis. University of Arkansas, Fayetteville. 45pp.

CLUGSTON, J. P. 1964. Growth of the Florida largemouth bass. *Micropterus salmoides-foridanus* (Lesueur), and the Northern largemouth bass, *M. s. salmoides* (Lacépède), in subtropical Florida. Trans. Amer. Fish. Soc., 93 (2):166-154.

GRAHAM, L. K. 1973. The introduction of Florida largemouth bass in Missouri ponds. Dingell-Johnson Project F-1-R-22, Study No. 1-14, Job No. 2. 6pp.

GRESHAM, G. 1966. Complete book of bass fishing. 2nd ed. Harper and Row, New York, London. 264pp.

LAGLER, K. 1956. Freshwater fishery biology. 2nd ed. W. C. Brown Co., Dubuque, Iowa. 421pp.

ROBBINS, W. H. and H. R. MacCRIMMON. 1974. The black bass in America and overseas. Biomanagement and Research Enterprises. 196pp.

SMITH, G. 1971. Florida largemouth bass in southern California, Florida Wildlife. September:30.

SNEDECOR, G. W. 1956. Statistical methods. 5th ed. The Iowa State University Press, Ames, Iowa. 485pp.

THRASHER, D. R. 1974. A comparison of the northern largemouth bass *Micropterus salmoides salmoides* (Lacépède), the Florida subspecies *M. s. floridanus* (Lesueur), and their intergrades. M.S. Thesis Auburn University, Auburn, Ala. 63pp.

ZOLCZYNSKI, S. J. and W. D. DAVIES. 1976. Growth characteristics of the northern and Florida subspecies of largemouth bass and their hybrid, and a comparison of catchability between the subspecies. Trans. Amer. Fish. Soc., 105:240-243.