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Growth and food habits of micropterus salmoides in Westhampton Lake, Richmond, Virginia

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GROWTH AND FOOD HABITS OF *MICROPTERUS SALMOIDES* IN WESTHAMPTON LAKE, RICHMOND, VIRGINIA

BY

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GROWTH AND FOOD HABITS OF <u>MICROPTERUS</u> <u>SALMOIDES</u>

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BY

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Table of Contents

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Abstract

Age, growth, and food habits of the population of *Micropterus salmoides* (largemouth bass) in Westhampton Lake were studied from September to November, 1978. Two year classes (0 and I) were identified by determining numbers of annuli on the scales of the fish. Growth data indicated that the bass attain a size of 254 mm (10 in.) near the end of their second summer. The length-weight relationship was $\log W = -4.6829 + 2.9153 \log TL$. The Fulton condition factor for the population was 1.40. Food habits were described by numerical and frequency of occurrence methods. Young of the year sunfish were the primary forage for the bass (range 105 to 269 mm). Values attained for growth and condition factors were intermediate to similar values for largemouth bass populations from northern and southern states, indicating Westhampton Lake is a favorable largemouth bass habitat.

Introduction

Micropterus salmoides (Lacépède), largemouth bass, is native to the Mississippi River drainage, the Atlantic Ocean drainages from Virginia to Florida, and the Gulf of Mexico drainages from Florida to Texas. After the melting of the last Pleistocene glaciers, connections with the Great Lakes and its drainages allowed the species to spread northward and eastward. Largemouth bass, through introductions by fisheries commissions, now occur in most of the natural and artificial waters of the United States and other countries where thermal and nutrient levels will sustain populations (Robbins and MacCrimmon, 1974).

The ultimate objective of recreational fishery management is to establish and maintain maximum numbers and sizes of a particular species acceptable to anglers (Royce, 1972). In Virginia, largemouth bass receive the most attention as they are the foundation of the freshwater sportfishery (Robbins and MacCrimmon, 1974). The Commonwealth of Virginia annually spends over 250 thousand dollars for the culturing and stocking of this species in public waters (pers. commun., W. E. Neil, Va. Game and Inland Fish.). It is difficult to assess the total commercial value of the species because of the many economic parameters; however, freshwater anglers in Virginia, most of whom fish for largemouth bass, spent over 400 thousand dollars for fishing license fees alone in the 1977-78 season (Unpubl. Rept., Va. Game and Inland Fish., 1978). For the 48 contiguous states, the U. S. Fish and Wildlife Service (1977) stated that more than 17 million people sought this premium gamefish in 1975.

Westhampton Lake, an urban impoundment, provides a recreational outlet including fishing, for the surrounding community. Fishes from such small bodies of water are often stunted because of poor environment and crowded populations. As stunted fishes are of limited value due to their poor angling quality, it should be determined if the habitat is supporting a population of desirably sized bass by collecting age, growth, and food habit data (Lagler, 1956; Royce, 1972; Carlander, 1977). Such data from the population of largemouth bass in Westhampton Lake were tabulated and compared with data from various populations throughout the United States. It is proposed that this will demonstrate the comparative growth of this population of largemouth bass and hence suitability of Westhampton Lake as a largemouth bass habitat.

Description of Area

Westhampton Lake, located on the University of Richmond campus, is a small eutrophic body of freshwater formed approximately 70 years ago by the damming of Westham Creek. In 1969, the surface area was about 5.5 ha; mean and maximum depths were 1.5 and 4.3 m, respectively (Bishop, 1971). Due to heavy silting, it has been drained and dredged four times, most recently in the spring of 1974. The drainage basin for the lake covers an area approximately 5.3 km^2 (Moore, 1973). Most of the basin is within a residential area (total population approximately 10,000) in Henrico County, Virginia (Woolcott, 1974). Sources of water are direct precipitation, runoff from the surface of the watershed, and ground water from springs in its basin. Much of the immediate area around the perimeter is covered by a pine, mixed-deciduous forest, which contributes organic debris to the water.

Water quality and limnological data are limited for Westhampton Lake. Tests by Commonwealth Laboratory (1974) on water and sediment samples from the lake prior to the 1974 drainage revealed pesticides and heavy metals. Except for the pesticide endrin, which was concentrated in the sediment, none of the pesticides (DDT, lindane, heptachlor, aldrin, dieldren, and epoxide) or heavy metals (copper, lead, zinc, and mercury) occurred in concentrations that exceeded minimal criteria for freshwater organisms (pers. commun., R. E. Bowles, Va. St. Water Cont. Bd., 1979). Productivity studies by Moore (1973) demonstrated nutrient levels for nitrate and orthophosphate of 2.5 and 0.46 mg / L, respectively. Turbidity ranged from 12 to 186 JTU during that study. Bishop (pers. commun., 1979) reported that the lake becomes thermally stratified during the summer with surface waters supersaturated with O_2 and the hypolimnion with less than 1 mg / L of O_2. Usually there is a bloom of blue-green algae during the late summer. The pH range has been recorded as 7 to 8 and alkalinity 40 to 50 ppm $CaCO_3$ (pers. commun., Bishop, 1979). Conyers (pers. commun., 1979) stated that surface temperature ranged from 88° F in August to 36° F in December in 1978.

After remaining dry for about one year, the lake was refilled in 1975. In 1976 and 1977 the impoundment was stocked with the following fishes from Harrison Lake National Fish Hatchery, Charles City, Virginia:

Species	Stocked	No.	L (mm)
Lepomis macrochirus (Bluegill)	9/28/76	11,000	25
Ictalurus punctatus (Channel catfish)	9/28/76	500	102
Micropterus salmoides (Largemouth bass)	5/25/77	1,375	25

Other species in the lake are there as a result of indiscriminate stocking by well-intentioned anglers, or possibly some fishes survived in pools while the lake was drained.

Materials and Methods

Collecting Methods and Procedures

Seven collections of largemouth bass were made in Westhampton Lake from 27 September to 2 November, 1978. Collections were taken approximately once a week for about two hours each in the afternoons before 1800 hr. All sampling was done with 220 V, 1 - 3 amps D. C. electrofishing gear from a 4.88 m (16 ft.) jon boat powered by an outboard motor. Although a two-man crew could handle the equipment, the most efficient sampling was with a three-man crew that consisted of a boat operator, an anode net collector in the bow, and a mid-boat non-electric net collector. The entire shoreline, including the island but excluding the dam, was sampled. The electric field covered a radius of about 3 m to a depth of almost 2 m. As the boat traveled at idling speed (approximately 10 m / min.), the anode net was held .3 to 1 m from shore and 3 m from the cathodes hanging from the stern of the boat. Fish tetanized by the current were netted, transferred to water-filled styrofoam buckets, and transported to shore. No attempt was made to retrieve fishes other than bass unless for identification.

Wet weight was recorded to the nearest gram after excess water was drained from the fish; total length (TL) was determined to the nearest millimeter on a fisheries measuring board. The length recorded was total length as described by Hile (1948), which is the distance from the tip of the tail (with the lobes of the fin compressed) to the end of the snout so as to give the maximum possible measurement. Scales were removed from the right side of the fish posterior to the pectoral fin and below the lateral line, then stored in scale envelopes. Data recorded on each envelope included date, length, weight, and a code number that corresponded with that in the field notes. No attempt was made to determine sex as young largemouth bass do not show dimorphism (Beckman, 1949).

Fifty-two specimens of the 215 collected were kept, numbered with tags, and placed in jars containing 10 percent formalin. A 3 cm slit was cut in their bellies and back muscles to insure adequate preservation. The other fish (163) were released after they were marked by clipping a pelvic fin near its base.

<u>Age and Growth</u>

Scales were prepared for an age study by placing them in 5 percent KOH solution to remove the epidermis. Cleared scales were mounted in light Karo syrup, the slide placed on a microprojector (100 X), and the number of annuli determined. Scales were read twice, and if the two readings agreed age was recorded by year class (e. g., a year class I fish has lived through one winter). Where it was difficult to determine age, verification of the number of annuli was made by my thesis advisor, William S. Woolcott.

Two hundred fifteen fish were used in the calculation of a length-weight relationship. The standard equation (Lagler, 1956) used to show the relationship of weight to length for most fishes is

$$W = c\ L^{n\ =\ 3\pm}$$

where

W = weight in grams
L = length (TL) in millimeters
c and n are constants

As coefficient "c" and the value of exponent "n" are empirically determined, fisheries biologists reduce the power form of the equation to the linear form logarithmically:

$$\log W = \log c + n \log L$$

The method of Beckman (1949) was followed where lengths were grouped in 5 mm intervals and the mean for each group computed. The same format was used for corresponding weights. After acquiring the length-weight equation generated from the data, estimated weights were calculated for each of the 5 mm length interval groups. Logs of actual lengths vs. logs of calculated weights were plotted on linear graph paper. To observe the 'closeness' of fit, logs of actual weights were plotted around the regression line.

Condition factors are used by fishery biologists to describe robustness or 'well being' of a fish. Actual condition factors for total length (K_{TL}) were obtained for individual fish and the mean K_{TL} determined. The Fulton condition factor method described by Ricker (1968) was applied:

$$K_{TL} = \frac{W \times 10^5}{L^3}$$

where

W = weight in grams
L = length in millimeters
10^5 = factor to bring the value of K_{TL} near unity

The method is based on the length-weight relationship ($W = c\ L^{n\ =\ 3\pm}$) previously described, but the exponent (n) is assigned a value of 3.

A change in shape or plumpness of a fish will be reflected in a change of K_{TL}.

A back calculation of growth was determined for year class I fish using the Dahl-Lea method (Carlander, 1977), which assumes a direct ratio between body length and scale growth. Scales were prepared as in the age study and read from a microprojector (10 X). Increments were measured (mm) from the midpoint of the focus to the margin, and along the same radius to the annulus. Values were inserted into the formula presented in Carlander (1977) and solved for Ln:

$$\frac{Sn}{Sc} = \frac{Ln}{Lc}$$

where

Sn = scale measurement to a given annulus, N
Sc = scale measurement to edge
Ln = length of fish at the time of annulus, N, formation
Lc = length of fish at capture

Tables were constructed to compare length-weight relationships, growth rates, back calculation of growth, and condition factors between the largemouth bass population in Westhampton Lake with those from various waters in the United States.

Food Habits

A food habit survey was made on 52 largemouth bass. Examination was limited to stomach contents and did not include those of the intestine. Stomachs were excised at the esophagus and pyloric valve; contents were removed from each fish and placed in appropriately numbered plastic jars that contained 10 percent formalin. Stomach items were classified to the lowest possible identifiable taxonomic category and recorded for each fish. A dissecting scope

(20 or 40 X) was used as an aid in identification of specimens. Following the format of Flemer and Woolcott (1966), digested matter and plant material were not counted individually (e. g., algal filaments were considered as one item). Standard numerical and frequency methods were used to describe food habits.

Results

In the seven collecting trips 215 largemouth bass were captured. Other fishes caught and identified were *Lepomis macrochirus* (bluegill), *L. gibbosus* (pumpkinseed), *L. gulosus* (warmouth), *L. auritus* (redbreast sunfish), *Pomoxis nigromaculatus* (black crappie) and *Notemigonus crysoleucas* (golden shiner).

Age and Growth

The number of annuli on scales indicated that there were two year classes in the largemouth bass population. This was substantiated by length frequency tabulations, which exposed a bimodal distribution (Table 1), and stocking date information. There were 203 fish in year class 0 and 12 in year class I.

Specimens ranged in length from 105 to 383 mm. In year class 0, lengths were from 105 to 197 mm ($\bar{x}$ 155 mm) and in year class I, from 226 to 383 mm ($\bar{x}$ 272 mm). Overall weights for the population ranged from 21 to 1021 g: in year class 0 from 21 to 92 g ($\bar{x}$ 51 g); and in year class I from 142 to 1021 g ($\bar{x}$ 295 g) (Table 1). Beckman (1949) reported that discrepancies between mean calculated and actual weights may be a result of small numbers of fish at some intervals and that no separation is made for the data concerning maturity, sex, or season of capture. Means for lengths and weights were well within the range of those recorded from other states; higher than values from northern states (e. g. New York and Pennsylvania) and lower than those from southern states (e. g. Louisiana and Florida) (Table 2).

Combined data from measurements of year classes O and I (Table 1) produced the following length-weight relationship: $\log W = -4.6829 + 2.9153 \log TL$. As logs of actual weights approximate logs of calculated weights computed from the length-weight relationship (Fig. 1), either length or weight of a largemouth bass in Westhampton Lake can be obtained if only one of the values is known. The length-weight relationship was slightly lower than values from other states (Table 3).

Condition factors (K_{TL}) for largemouth bass from Westhampton Lake ranged from .97 to 2.72. The mean of the population was 1.40 and is intermediate between condition factors from other states (Table 4).

Growth of fish in year class I was compared with that in year class O. Calculated length (TL) at the first annulus for 12 bass of year class I ranged from 147 to 299 mm ($\bar{x}$ 172 mm) whereas the mean length for year class O was 155 mm. Calculated lengths of largemouth bass in Westhampton Lake approximately two years after stocking are similar to those for bass from southern states, but superior to those of bass from northern states and the average North American largemouth bass (Table 5).

Food Habits

Fifty-two stomachs from 49 year class O fish (105 - 190 mm TL) and three year class I fish (250 - 269 mm TL) were examined. Twenty-nine stomachs (55.8 percent) contained exclusively vertebrates (fish or tadpoles), 17 (32.7 percent) a combination of animal (arthropods and digested material) and plant material, 2 (3.8 percent) plant material only, and 4 (7.7 percent) were empty.

Fish comprised the major part of the diet (57.3 percent) and also accounted for the highest percentage of stomachs with item (67.3 percent). All of the fish food items (10 - 46 mm TL) belonged to the genus *Lepomis* although only *L. macrochirus* was positively identified. Six fish were the most found in any bass stomach. One bass contained a tadpole (43 mm TL) of *Rana catesbeiana* (bullfrog).

Insects made up 13.5 percent of the total items and were found in 15.3 percent of the stomachs. The greatest number of insects in any stomach was six. Ephemeropteran nymphs were the most abundant insect item (8.7 percent) and predominated in percent of stomachs (5.8 percent). The single hymenopteran was a member of Formidae (ants) and all hemipterans belonged to the family Corixidae (water boatmen). Other invertebrate food items included a spider that was mutilated and the cheliped of a crayfish.

Plant material was divided into allochthonous detritus and algae. Terrestrial material consisted of twigs, seeds, and leaf fragments, whereas lake material was dominated by the green alga, *Spirogyra*. Plant material formed the second highest percent of stomachs with item (32.7 percent) and total items (16.5 percent); however, 11 (57.9 percent) of the stomachs with plant material contained only one twig or a piece of leaf or a few filaments of algae.

Discussion

Electrofishing is a standard sampling technique used by fisheries biologists throughout the world for collecting fishes. It can provide useful data on the presence of a species, fish growth, and fish feeding habits (Lagler, 1956); however, electrofishing has some limitations. Lewis et al. (1961) stated that depth of the electrical field limits the success of electrofishing. Geldren (1971) elaborated on the fact that obstructions on or near shore (overhanging trees, brush piles, and sunken logs) hinder boat maneuverability and therefore fish capture. Sufficient numbers of largemouth bass were obtained for age, growth, and food habit studies for Westhampton Lake, but as collecting was concentrated near shore, the part of the population occupying deeper water was not sampled. This precluded use of data for a size estimate of the largemouth bass population.

Aging

The scale method is the most widely used routine for determining age of many fishes becauses of its simplicity and accuracy (Lagler, 1956). Validity of annuli as year marks for largemouth bass have been established through tagging and recapturing experiments, and by correspondence between number of annuli and known age (Pratter, 1967). Annulus-like markings (false annuli) which may be caused by harsh environmental conditions, and interruption of growth by bodily injury, disease, or spawning sometimes lead workers to an incorrect assessment of age. In the present study, three specimens (year class I) had false annuli.

Growth

Robbins and MacCrimmon (1974) stated "the largemouth bass has the greatest capacity for growth of all the blackbasses." Carlander (1977) after reviewing literature, concluded that no genetic differences for growth potential are apparent among largemouth bass populations (e. g., the growth of southern and northern stocks when introduced into California waters were almost identical). Growth is determined primarily by the thermal and nutrient levels of a body of water: i. e., larger, faster growing largemouth bass occur in warmer eutrophic waters of southern states whereas smaller, slower growing ones occur in colder oligotrophic waters in the north. Largemouth bass in Westhampton Lake reach a size of 254 mm (10 in.) near the end of their second summer. In Louisiana, largemouth bass attain a similar length in one year (Viosca, 1952) whereas in Massachusetts three years are required (Grice, 1959). Environmental factors that have been correlated with increased growth are saturated levels of O_2, high levels of P, low turbidity, water temperature between 26 - 28^{o} C, pH between 5 and 10, abundance of vulnerable prey, and low bass population densities (Carlander, 1977).

Year class I largemouth bass in this study attained a greater length during their first year of growth ($\bar{x}$ 177 mm) than did year class 0 specimens ($\bar{x}$ 155 mm) in their first year. These data agree with those reported by Carlander (1977) who stated that bass initially introduced into ponds or lakes usually have a higher growth rate than later year classes because carrying capacity of the impoundment has not been reached.

Large differences in lengths of largemouth bass from Westhampton Lake existed within the year classes, especially within year class I (range 226 - 383 mm). The extensive range may be a reflection of a few larger fingerlings in the original stock.

Larger fingerlings exploit the food supply, limiting growth in smaller specimens. As the discrepancy in size increases, larger fish become cannibalistic and have an even greater rate of growth with an additional food supply (Cooper, 1936).

Bass growth also can be described by the length-weight relationship ($W = c\ L^{n = 3\pm}$). The empirical exponent (n = 2.9153) for the bass population in Westhampton Lake approximated the norm (n = 3). The slightly lower weight / unit of length is a result of the young age of the fish in the sample, i. e. young fish are slimmer bodied than older fish. Length-weight relationship of the population in Westhampton Lake will change with the exponent (n) equaling or exceeding 3 as older bass become more plump.

Carlander (1977) said that slow growth rates and low condition factors of fishes are indicators of over population in a body of water. He further stated that K_{TL} combined with growth data is an indicator of whether population density is below or above carrying capacity. When compared with growth data and condition factors of largemouth bass populations throughout the United States as listed in Carlander (1977), the values for those in Westhampton Lake were above average. This suggests that the lake can support a larger largemouth bass population with growth rates suitable for the angler than it does at present.

Fishery biologists feel that comparison of growth values in tables for different bodies of water are more reliable for evaluating populations of fishes than numerical statistical testing of differences. Growth data varies as a result of physical and chemical factors inherent to the body of water, sexual dimorphism, sexual maturity, age, feeding habits, and season of sampling. Consequently, unless all variables are included, statistical testing of growth between populations in various bodies of waters is not pertinent.

Food Habits

Food habits of largemouth bass change from smaller to larger organisms with an increase in the length of the bass. Krammer and Smith (1960) working in Minnesota reported that 3 to 6 mm sac fry utilize yolk, and fingerlings up to 32 mm feed on zooplankton. Synthesizing information from several studies, Carlander (1977) concluded that insects and cladocerans were selected by bass from 30 to 50 mm long, with insects becoming the main food item when fingerlings reached 40 mm. McCammon et al. (1964) reported that the diet of 50 to 90 mm largemouth bass from California was almost exclusively fish. Carlander (1977) said fishes are the predominant food items for juvenile and adult bass; however, if forage fishes, e. g. small centrarchids or minnows, are scarce, largemouth bass will prey on large insects, crayfish, frogs, salamanders, birds, turtles, and mammals.

Largemouth bass (105 to 229 mm TL) sampled in Westhampton Lake definitely conform to the pattern of food selection described by Carlander (1977) for largemouth bass over 100 mm TL as approximately 68 percent of the stomachs contained fish. In the present study bluegills were the predominant fish in the diet. Whether this was due to their availability or selection on the part of the largemouth bass was not determined; however, others believe that availability and size are more important. For example, Murphy

(1951) found that Orthodon microlepidotus (Sacramento blackfish) was the primary food item in the diet of largemouth bass in Clear Lake, California. A few years later McCammon, et al. (1964) reported that L. macrochirus was the major food item in the same lake. They concluded that species preference may play a role in selection of a food organism by largemouth bass, but availability and size are more important. Next to fishes, insects (13 percent) and plant material (16 percent) were the major food items in the largemouth bass stomachs from Westhampton Lake. The amount of plant material in the stomachs in the present study was excessive when compared with that from other studies. Only one reference (Cooper, 1936) was found that reported plant material (trace of algae) in stomachs of largemouth bass. Plant debris from deciduous trees was prevalent in Westhampton Lake during the season of sampling. Bass might have ingested it accidentally while capturing animal prey or in spasmodic gulping due to electric shock.

Epilogue

Although the growth of largemouth bass was favorable in Westhampton Lake during the first two years, it is difficult to predict future growth. Small lakes stocked predominantly with largemouth bass and bluegills often contain stunted fishes due to an overpopulation by the bluegills. Most lakes support a certain poundage of fish / acre (Bennett, 1962); therefore, when fish are numerous, the result will be a smaller average size. Largemouth bass predation on bluegills is not sufficient to reduce the excessive numbers caused by the bluegills fecundity (Bennett, 1962). Corrective measures to reduce the bluegill population are increased fishing pressure, seining, electrofishing, and rotenone poisoning (Lagler, 1956). All of these methods, with the exception of rotenone poisoning, are applicable as management procedures in Westhampton Lake.

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Figure 1. Total length-weight relationship of _Micropterus salmoides_ captured in Westhampton Lake, Richmond, Virginia (Fall, 1978). Actual weights are plotted around the regression line.

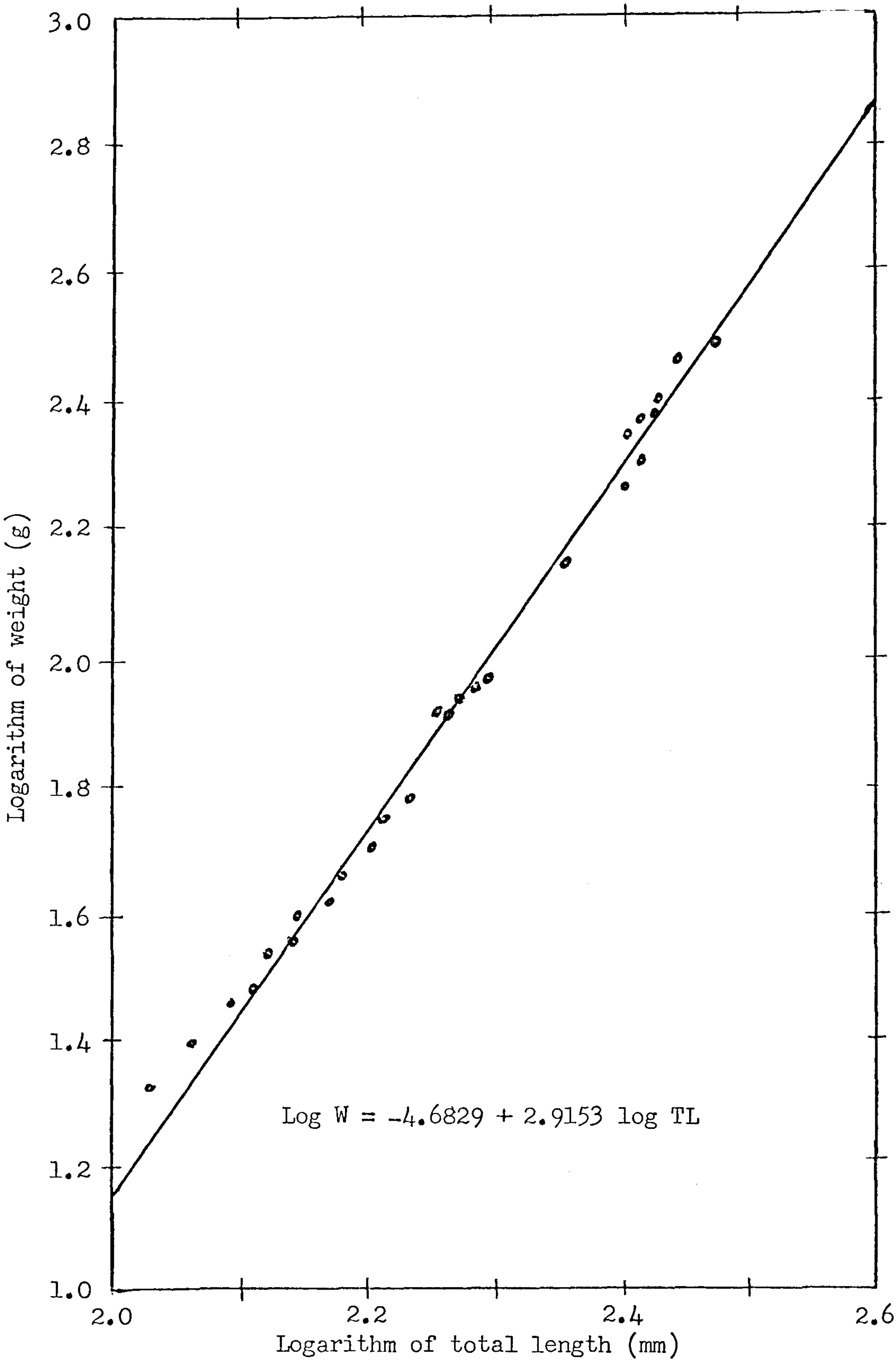
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
Logarithm of weight (g)
Log W = -4.6829 + 2.9153 log TL
2.0
2.2
2.4
2.6
Logarithm of total length (mm)

Table 1. Length and weight of 215 Micropterus salmoides from Westhampton Lake, Fall 1978.[1]

No. of Specimens	Total Length (mm) Range	Total Length (mm) $\bar{x}$	Actual Wt. (g) Range	Actual Wt. (g) $\bar{x}$	Calculated Wt. (g) $\bar{x}$
A. Year class 0					
1	105 - 110	105	21	21	16
4	116 - 120	118	21 - 28	25	23
4	121 - 125	123	28	28	26
12	126 - 130	128	28 - 35	29	29
17	131 - 135	133	28 - 64	34	30
21	136 - 140	138	28 - 42	35	36
13	141 - 145	143	35 - 46	39	41
18	146 - 150	148	35 - 49	41	44
16	151 - 155	153	35 - 57	46	47
17	156 - 160	158	42 - 57	50	54
17	161 - 165	163	42 - 64	54	58
12	166 - 170	168	49 - 64	60	66
17	171 - 175	173	57 - 75	69	70
13	176 - 180	179	68 - 78	73	75
7	181 - 185	183	64 - 85	80	80
9	186 - 190	187	76 - 92	86	86
5	191 - 195	192	78 - 96	89	92
1	196 - 200	197	92	92	98
B. Year class I					
1	226 - 230	226	142	142	147
1	246 - 250	250	184	184	206
1	251 - 255	253	218	218	206
1	256 - 260	256	198	198	220
3	261 - 265	263	227 - 234	232	236
1	266 - 270	269	234	234	252
1	271 - 275	272	248	248	252
1	276 - 280	276	291	291	269
1	291 - 295	293	312	312	339
1	381 - 385	383	1021	1021	690

[1]Year class based on number annuli / scale (year class I fish have lived through one winter).

Table 2. Comparison of the growth of *Micropterus salmoides* in Westhampton Lake, Virginia, with that of *M. salmoides* from other states.[1]

State	Date	No. of Specimens	Total Length (mm) Range	Total Length (mm) $\bar{x}$	Weight (g) Range	Weight (g) $\bar{x}$
A. *Year class 0*						
NY, PA	Oct - Dec	36	47 - 150	106	14 - 28	17
MN, WI	Oct - Dec	690	41 - 208	109	3 - 51	20
IA	Sept	57	53 - 300	131	24 - .82	45
IL	Oct - Dec	818	99 - 206	134	4 - 109	45
OK	Aug	38	66 - 109	85	6 - 20	11
VA[2]	Sept - Oct	203	105 - 197	155	29 - 92	51
NC, SC	Sept	—	185 - 229	200	90 - 227	136
AL	Oct - Dec	214	157 - 208	183	156 - 292	225
LA	Sept	21	282 - 315	300	363 - 553	—
TX	Oct - Dec	19	76 - 208	141	14 - 102	35
FL	Oct - Dec	132	250 - 295	266	242 - 441	—
B. *Year class I*						
NY	—	80	81 - 241	156	14 - 191	75
OK	—	562	64 - 391	204	37 - 954	137
VA[2]	—	12	226 - 383	272	142 - 1021	295
NC	—	364	107 - 279	189	15 - 350	114
AL	—	241	245 - 356	313	23 - 680	272
LA	—	76	178 - 330	224	113 - 992	335
FL	—	830	78 - 327	234	142 - 1043	354

[1]Carlander, 1977.

[2]Westhampton Lake, Fall 1978.

Table 3. Comparison of the length-weight relationship of *Micropterus salmoides* in Westhampton Lake, Virginia, with that of *M. salmoides* from other states.[1]

State	No. of Specimens	Total Length (mm)	Length-weight relationship
PA	688	56 - 551	log W = -5.287 + 3.163 log TL
IA	257	97 - 445	log W = -5.199 + 3.136 log TL
MO	---	125 - 410	log W = -5.121 + 3.094 log TL
OK	65	---	log W = -5.550 + 3.280 log TL
VA			
Westhampton Lake[2]	215	105 - 383	log W = -4.683 + 2.915 log TL
Back Bay	378	---	log W = -5.089 + 3.187 log TL
AL	5984	51 - 254	log W = -4.800 + 2.960 log TL

[1]Carlander, 1977.

[2]Westhampton Lake, Fall 1978.

Table 4. Comparison of the condition factors of *Micropterus salmoides* in Westhampton Lake, Virginia, with those of *M. salmoides* from other states.[1]

State	No. Specimens	Total length (mm)	Range K_{TL}	$\bar{x}$ K_{TL}
MD	43	—	—	1.19
IA	257	97 - 445	.75 - 2.30	1.19
IL	2080	—	1.05 - 1.58	1.24
	621	—	1.05 - 1.50	1.18
OK	189	—	1.11 - 1.67	1.24
	624	—	1.28 - 1.53	1.41
VA[2]	215	105 - 383	.97 - 2.72	1.40
NC	195	—	.80 - 3.30	1.58
AL	5795	76 - 254	1.19 - 1.39	1.27

[1]Carlander, 1977.

[2]Westhampton Lake, Fall 1978.

Table 5. Comparison of the mean calculated total lengths at each annulus of *Micropterus salmoides* in Westhampton Lake,[1] Virginia, with those of *M. salmoides* from other states.[2]

State	No. of Specimens	$\bar{x}$ calculated TL (mm) at each annulus 1	2
NY	—	56	91
MN	9	99	190
NJ	263	89	193
OK	1166	140	279
VA Westhampton Lake[3]	12	172	272
Claytor Lake	48	114	257
Back Bay	378	130	274
NC			
Kitty Hawk	12	175	335
Kerr Lake	65	178	279
LA	170	218	318
CA	111	152	278
North American	—	118	215

[1]Dahl-Lea method.

[2]Carlander, 1977.

[3]Westhampton Lake, Fall 1978.

Table 6. The stomach contents of 52 Micropterus salmoides from Westhampton Lake, Fall 1978.[1]

Items	Tot. no. items	No. stom. with items	$\bar{x}$ no. items	Percent: Stom. with item	Percent: Tot. items
Inseta					
Ephemeroptera (N)[2]	9	3	.17	5.8	8.7
Hemiptera (N,A)	2	2	.04	3.8	1.9
Hymenoptera (A)	9	1	.02	1.9	1.0
Unident. (L)	2	1	.04	3.8	1.9
Arachnida					
Araneae	1	1	.02	1.9	1.0
Crustacea					
Decapoda	1	1	.02	1.9	1.0
Osteichthyes					
Perciformes	59	35	1.13	67.3	57.3
Amphibia					
Anura	1	1	.02	1.9	1.0
Digest. Anim. Matter	10	10	.19	19.2	9.7
Plant Material	17	17	.33	32.7	16.5
Total	103				

[1]The four empty stomachs were included in the calculations.

[2]N = nymph, A = adult, L = Larva.

Vita

Charles Holland Rawls, Jr. was born in Suffolk, Virginia on April 11, 1955. He attended public school in Suffolk, Virginia, being graduated from Suffolk High School in 1973. In the fall of 1973 he entered the College of William and Mary and was graduated in 1977 with a B.S. in biology. In September 1977 he was admitted to the Graduate School of the University of Richmond as a candidate for the M.S. degree in biology, which he received in August, 1979. While at Richmond he received a Graduate Service Assistantship. He assisted in classes for general biology and vertebrate zoology. He was inducted into Beta Beta Beta honorary society in September, 1978. In August, 1978 he married Susan Jane Brinkley. He will begin studies at the Dental School of the Medical College of Virginia in September, 1979.

Addendum

First Report of *Ergasilis* sp., a Copepod, from Westhampton Lake

Incidental to the growth and food habit study, a cursory examination for parasites was made on gills of 42 *Micropterus salmoides*. The gills were excised, prepared as dry mounts, and the lateral surfaces of each (right and left sides) examined with a dissecting microscope (20 or 40X). The number of *Ergasilis* sp. / fish ranged from 17 to 265 ($\bar{x}$ 89.7).