# SOME EARLY LIFE HISTORY OF FLORIDA'S INLAND STRIPED BASS, *MORONE SAXATILIS*

*by*

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## ABSTRACT

Striped bass, *Morone saxatilis*, were successfully established in Florida's fresh water lakes during the summer of 1968. Populations are presently known in at least six separate bodies of water. Lake stocking rates have ranged from 43 fish per acre to 5 fish per acre. All stocks were obtained from Moncks Corner Striped Bass Hatchery, South Carolina, as one to four day old fry and reared to approximately 2 inches (TL) at State hatcheries prior to stocking.

Growth has been rapid but variable between populations. The average first year of growth was 11.1 inches (TL). Maximum growth for age I fish was 13.6 inches (TL). Age II striped bass averaged 18.1 inches (TL), weighing 2.35 pounds. Measurements of physical condition, K-factor (Hile), varied between 1.31 and 2.79. Values of K below 1.80 were indicative of poor condition and mortalities were associated with K-factor values below 1.70. Stomach analyses revealed a preponderance of threadfin and gizzard shad, *Dorosoma petenense* and *D. cepedianum*, in the diet, although other fishes were frequently utilized. Striped bass smaller than 6 inches (TL) fed predominately on mosquitofish, molly, and freshwater shrimp. Parasite caused mortalities occured in two striped bass populations. The causal organism was a marine nematode of the genus *Goezia*.

## INTRODUCTION

Florida's interest in the striped bass, *Morone saxatilis* (Walbaum), as a potential fresh water introduction began with the establishment of the species in Santee-Cooper Reservoir, South Carolina. Barkuloo (1967) spent seven years studying and culturing the Florida races of striped bass known to occur in limited numbers in the St. Johns and Apalachicola Rivers. Although he was able to culture the species for the first time in Florida, efforts to establish striped bass in inland fresh waters were largely unsuccessful.

The first notable success of striped bass introductions in Florida occurred on June 5, 1968, when 15,500 fingerlings were stocked into Lake Hollingsworth, located in the city of Lakeland. These fish were obtained as fry from the Moncks Corner Striped Bass Hatchery, South Carolina, and raised to fingerling size at State hatcheries as were fish for all subsequent stockings. During the same month populations were also established in Lake Talquin, near Tallahassee, and Lake Underhill at the city of Orlando.

The following year, 1969, additional stockings of striped bass were successful in Lakes Parker and Hunter near Lakeland. Another population was also established in Lake Bentley at Lakeland, by the downstream movement of fish out of Lake Hollingsworth.

It is from these populations that the information in this study was obtained. The data is restricted to the first two years of life of the striped bass.

## LAKE DESCRIPTIONS

Lakes Hollingsworth, Parker, and Hunter have surface areas of 356, 2,200, and 100 acres, respectively. These natural lakes are all eutrophic, supporting dense algae blooms, are relatively shallow, and contain heavy accumulations

of organic muck and detritus within their bowl-shaped basins. Vegetation is limited to a marginal growth of emergent maidencane and cattail. Their fish populations can be characterized as poor quality, dominated by gizzard and threadfin shad, *Dorosoma cepedianum* and *D. petenense,* brown bullhead, *Ictalurus nebulosus,* and stunted panfishes, principally bluegill, *Lepomis macrochirus.*

Lakes Bentley and Underhill have similar environmental and biological characters as those described above, except Bentley is a mined out phosphate pit and therefore deeper, while Underhill has greater water transparency and is not as advanced in its eutrophic state. The surface area of Lake Bentley is 100 acres and Lake Underhill is 147 acres.

Lake Talquin is a 8,800 acre reservoir, created by the impoundment of the Ochlockonee River. It is moderately fertile and supports a substantial sport fishery. Dominant game fishes include largemouth bass, *Micropterus salmoides,* black crappie, *Pomoxis nigromaculatus,* redear sunfish, *Lepomis microlophus,* and bluegill. A large population of threadfin shad is also present. Talquin is one of the few Florida lakes that may possibly satisfy the spawning requirements of striped bass.

## PROCEDURES

Striped bass fingerling stocking rates varied between lakes as follows: Lake Hollingsworth - 43 fish/acre; Lake Hunter - 30 fish/acre; Lake Parker - 10 fish/acre; Lake Talquin - 5 fish/acre; and Lake Underhill - 22 fish/acre. Average stocking size was 2.0 inches (TL).

Collection gear employed for sampling striped bass included a 20-foot minnow seine, 50-foot bag seine, otter trawl, and gill nets. The bag seine was most effective during the early months, while gill nets were superior after striped bass advanced above 6 inches in length. Seining was performed along the shoreline by making enough hauls to collect 3-5 fish, where possible. Gill nets were set perpendicular to the shoreline and fished overnight. Net specifications were: Length - 50 yards; fishing depth - 5 feet; stretch mesh sizes from 1½ inches to 4 inches. Two nets totaling 100 yards were used. Sampling frequency approximated monthly intervals.

Recovered striped bass were measured in millimeters for total and standard length and weighed to the nearest tenth of a gram. The coefficient of Condition, K(Hile), was computed for each fish. Stomach analyses were performed and food items recorded for frequency of occurrence by inch group. A total of 506 striped bass were examined.

Parasite analyses were provided by Dr. W. A. Rogers and staff of Auburn University, Auburn, Alabama.

## FINDINGS

*Growth and Condition*

Growth of striped bass varies widely from different areas of North America. Goodson (1966) summarized some of the known growth rates by age groups as follows (total and fork length in inches): Sacramento - San Joaquin Delta, Calif. — age I - 4.1, Age II - 9.8 (FL); Millerton Lake, Calif. — age I -5.2, age II - 11.8 (TL); Atlantic Coast — age I - 4.9, age II - 9.3 (FL); Kerr Reservoir, N. C. — age I - 5.1, age II - 11.1 (TL); and Santee-Cooper Reservoir, S. C. — age I - 8.5, age II - 15.7 (TL). Only the first two year classes are shown here, in order to compare growth with the same age Florida fish.

Figure 1 presents the average, maximum, and minimum growth in total length of Florida inland striped bass during the first two years of life. The discrepancy that appears in the graph between age 0 and age I fish, a drop in the

growth rate, was due to the loss of two populations from parasite mortality at the end of their first year. Age I data represents only one population, Lake Bentley, whereas age 0 data summarizes the growth of four populations. This also explains the wide growth differential of age 0 fish as opposed to age I fish, i.e., the growth between populations of the same age varied greater than within a single population and is depicted by the extremes between maximum and minimum growth at the same point in time.

The average annual first year of growth of Florida striped bass was 11.1 inches (Fig. 1). Maximum growth achieved at age I was 13.6 inches. The growth differential was broad at the end of the first year with some fish growing twice as rapid as others. The age I size range was 6.7 inches to 13.6 inches, a difference of 6.9 inches.

At age II striped bass averaged 18.1 inches (Fig. 1). The largest specimen of the age group was 19.0 inches and weighed 3.1 pounds. Size range of two year olds was from 17.3 inches to 19.0 inches, with the smaller variation probably due to sample and the monitoring of only one population (Lake Bentley).

There was a second group of age II striped bass in Florida at Lake Talquin, but growth data was not available from the population. However, field observations of creel returns indicated that the majority of the 2-year-olds measured between 17 and 18 inches (F. G. Banks, personal communication).

Growth of Florida striped bass was more rapid during the cooler months of late fall and winter (Fig. 1). Accelerated growth was also apparent with age 0 fish after sufficient size was attained to utilize shad as food; about 6 inches in total length.

Based on these data and the literature available to the author, it appears that Florida's inland striped bass have achieved a higher growth rate during their fish was too small to be conclusive, the growth trend established through time up to age II appears to be superior (Fig. 1). The growth rate presented for age I is believed to be relistic since a larger sample size was available and several populations involved. If only the slowest growing Florida population was selected, Lake Parker, the first year average growth was 9.25 inches and is above the highest reported by Goodson (1966).

Measurements of physical condition or relative plumpness, K-factor, were made of 380 striped bass from five separtate populations. The data is shown in Table 1 and is presented by size groups for each population. To an observer, striped bass with a K-factor of 2.00 and above appears plump and is indicative of healthy fish, while K values between 1.80 and 2.00 will generally show the fish in fair or slightly poor physical condition. Below a K-factor of 1.80 striped bass will be lean in appearance with a concave ventral surface, and sometimes the head will be enlarged in proportion to the body. The fish will obviously appear to be in poor physical condition. The lowest K-factor observed by the author of an alive striped bass was 1.31. This fish was in extremely poor condition, having a very large head compared to the emaciated body. These generalized classifications are suggested only for striped bass between the sizes of 3 inches and 19 inches (TL).

K-factors of striped bass in Florida lakes ranged between 1.31 and 2.79 (Table 1). Average values by size groups varied between 1.83 and 2.30. There was no definite correlation of increased K with size, although such a trend might be expected. Two populations, Lakes Hollingsworth and Hunter, exhibited the widest variation of K (Table 1), and in both instances heavy mortality occurred (parasite-caused) when values dropped below 1.70.

*Parasites*

A marine nematode, identified as the genus *Goezia* (Dr. W. A. Rogers, personal communication), developed a high level of infection in four striped bass populations; Lakes Hollingsworth, Hunter, Parker, and Bentley. *Goezia* was first detected in Hollingsworth fish during June 1969, when a

sudden drop in physical condition was noted. These fish were 1-year-olds and heavy mortality occurred within the next 30 days. The reduction in number of striped bass was greater than one-half their former abundance based on catch per unit of effort with gill nets.

A similar mortality decimated the Lake Hunter population the following year, during June 1970. Again, the heavy loss occurred at age I and reduced the numbers of striped bass far below their former abundance.

Evidence of mortality was not found in the populations of Lakes Parker and Bentley, although a drop in physical condition was apparent during early summer, and perhaps striped bass were killed but undetected.

A definite correlation exists between the K-factor value of striped bass and parasite mortality. In a healthy condition, striped bass between the sizes of 3.0 and 19.0 inches (TL) will maintain a K-factor value of 2.00 or above. Between the K values of 1.80 and 2.00 the fish, although parasitized, have survived in good numbers. However, when a K-factor of 1.70 or below was recorded mortality was eminent. Most fish, immediately before a major die off, exhibited values between 1.41 and 1.78.

The nematode infection has been largely confined to the stomach wall in striped bass. It may first appear as a small cyst showing little inflamation or tissue damage. In severe cases, the cyst enlarges to about pea-size, becomes ulcerated with heavy tissue damage, sometimes penetrating the stomach wall into the body cavity. The infection level of dead or stressed fish has ranged from one to four cysts.

Very little information is known about the life history of *Goezia* (Dr. W. A. Rogers, personal communication), and the mode of entry into Florida striped bass has not been fully answered. It is believed the fish were infected by using a marine herring as a dietary supplement during our fingerling culture program at the hatchery.

*Food Habits*

The examination of 422 striped bass, ranging in size from 2 inches to 19 inches (TL), revealed 236 stomachs (55.9%) containing food. Results are presented in Table 2.

Fish were the major food of striped bass throughout the size range. Of the identifiable fish, shad species—principally, threadfin, were most frequently utilized, occurring in 46.6% of the stomachs containing food (Table 2). Shad dominated the diet of striped bass in the 6 inch-group and larger, appearing in 60% of the stomachs. Below a size of 6 inches shad were not found, probably because of size availability; the shad being to large for consumption by the small striped bass.

Other foods of striped bass included mosquitofish, *Gambusia affinis*, and mollies, *Mollienisia* (9.3%), contrarchids of the genus *Lepomis* (5.9%), freshwater shrimp, *Palaemonetes* (5.1%), seminole killifish, *Fundulus seminolis* (4.7%), *Notropis* (3.8%), tendipedid larva (3.4%), and brook silverside, *Labidesthes sicculus* (1.3%). Unidentifiable fish remains were found in 35.6% of the stomachs (Table 2).

Miscellaneous food items of interest included a striper fingerling recovered from the stomach of a 14 inch striped bass. Another striped bass had eaten eight fish lice, the parastic copepod *Argulus*. One *Tilapia aurea*, the recently established exotic, was found in a 9 inch striper.

Foods of small striped bass, those less than 6 inches, were chiefly mosquitofish and molly (35.3%) and freshwater shrimp (13.7%). There was some concern that the absence of consumable size shad at stocking time might result in poor survival. This did not appear to be the case, as all food item categories were represented in their diet except shad (Table 2), indicating small stripers may forage on whatever foods are available.

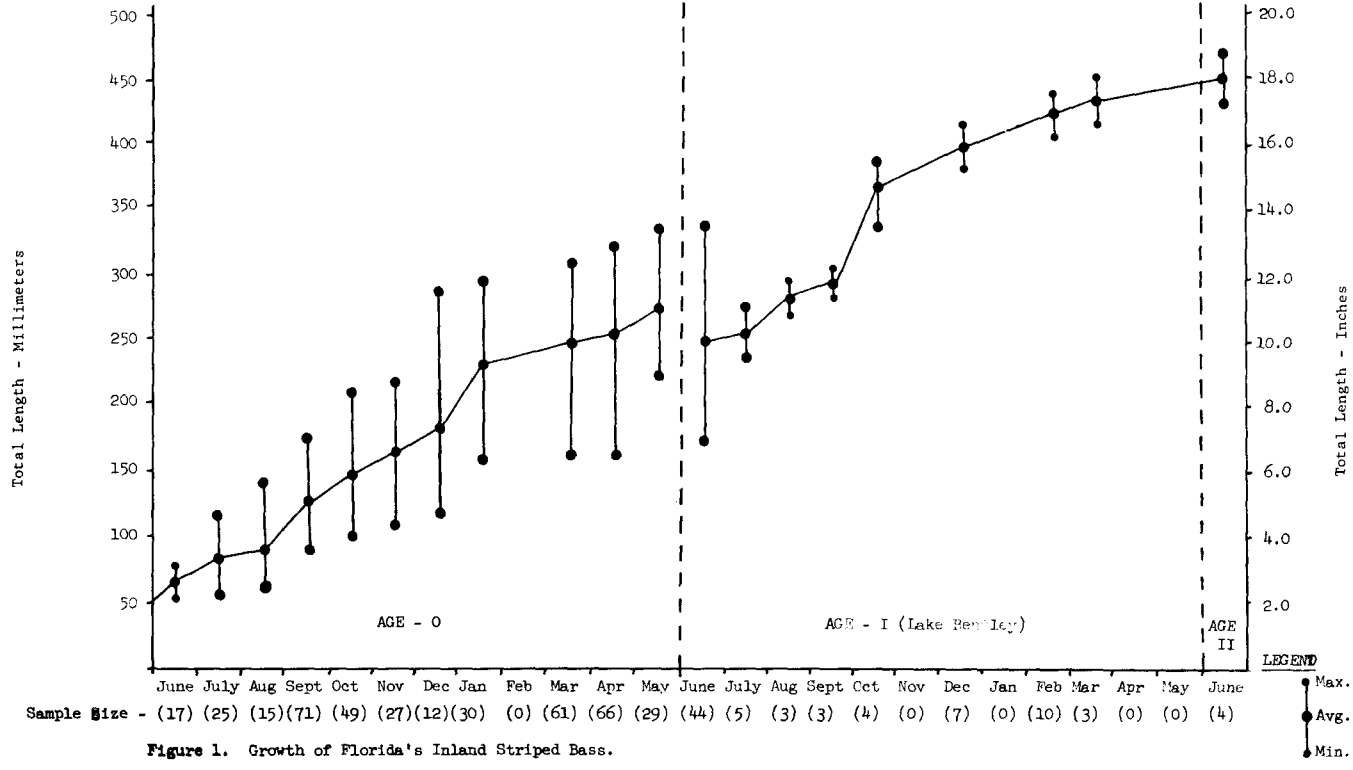


**Figure 1.** Growth of Florida's Inland Striped Bass.

TABLE 1
K-FACTOR VALUES OF STRIPED BASS BY SIZE GROUPS.

| Lake | Number Examined | SIZE GROUPS - INCHES 0.0 —— 6.0 Range | Avg. | 6.1 —— 12.0 Range | Avg. | 12.1 —— 18.0 Range | Avg. |
|---|---|---|---|---|---|---|---|
| Bentley | 47 | — | — | 1.77-2.25 | 1.96 | 1.74-2.49 | 2.30 |
| Hollingsworth | 118 | 1.31-2.35 | 1.97 | 1.44-2.27 | 1.83 | 2.17-2.26 | 2.25 |
| Hunter | 135 | 1.83-2.79 | 2.05 | 1.46-2.56 | 2.12 | 1.69-2.41 | 1.98 |
| Underhill | 30 | 1.85(1 Fish) | | 1.84-2.41 | 2.06 | 2.11(1 Fish) | |
| Parker | 51 | 1.77-2.28 | 2.02 | 1.80-2.42 | 2.02 | — | — |

TABLE 2
FREQUENCY OF OCCURRENCE OF STRIPED BASS FOOD BY INCH GROUP.

| Inch Group | Number Examined | Stomachs with food | FOOD ITEMS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Shad Species | Centrarchids | Mollie & Gambusia | Seminole Killifish | *Notropis* | Brook Silverside | Fish Remains | Freshwater Shrimp | Tendipedid Larvae | Misc. Items |
| 2″ | 12 | 8 | | | 5 | | | | 3 | | | |
| 3″ | 25 | 12 | | 1 | 3 | 1 | 1 | | 4 | 1 | 1 | 1 |
| 4″ | 33 | 17 | | 2 | 7 | | | 1 | 7 | 4 | | |
| 5″ | 26 | 14 | | 1 | 3 | 1 | | 1 | 9 | 2 | | |
| 6″ | 27 | 16 | 11 | 2 | | 1 | | | 3 | 1 | | 1 |
| 7″ | 50 | 33 | 13 | 3 | 1 | 5 | | 1 | 13 | 2 | | 1 |
| 8″ | 30 | 16 | 9 | 2 | | | | | 3 | | 2 | |
| 9″ | 43 | 29 | 12 | | 1 | 1 | 2 | | 14 | 1 | 1 | 1 |
| 10″ | 69 | 35 | 25 | 1 | 1 | 1 | 4 | | 8 | 1 | | |
| 11″ | 50 | 25 | 17 | | 1 | | 1 | | 8 | | 2 | |
| 12″ | 25 | 7 | 6 | | | | | | | | 2 | |
| 13″ | 5 | 4 | 2 | | | 1 | | | 2 | | | |
| 14″ | 2 | 1 | | | | | | | 1 | | | 1 |
| 15″ | 6 | 5 | 3 | | | | | | 2 | | | |
| 16″ | 5 | 5 | 4 | 1 | | | | | 3 | | | |
| 17″ | 9 | 6 | 5 | 1 | | | 1 | | 3 | | | |
| 18″ | 4 | 3 | 3 | | | | | | 1 | | | |
| 19″ | 1 | | | | | | | | | | | |
| Total | 422 | 236 | 110 | 14 | 22 | 11 | 9 | 3 | 84 | 12 | 8 | 5 |
| % occurrence of stomachs with food | | | 46.6% | 5.9% | 9.3% | 4.7% | 3.8% | 1.3% | 35.6% | 5.1% | 3.4% | 2.1% |

*Sexual Development*

Gonadal development was evident in striped bass males at the age of 11 months. Testes were swollen, creamy white in appearance, although only a slight milt discharge could be stripped. Fish were not considered to be in spawning condition. No further development was evident until the following year.

At the age of 23 months males were considered gravid. Testes were greatly enlarged and generous quantities of milt were freeflowing with only a slight abdominal pressure. Testis at this time measured 126 millimeters in length, had a maximum width of 35 mm, and a paired testes weighed 84.5 grams.

Female striped bass showed no signs of gonadal development during the first two years of life. The largest ovaries observed (age II) measured 70 mm in length and 9 mm in width. Paired ovaries weighed 5.4 grams.

## SUMMARY AND DISCUSSION

Growth of inland striped bass has been rapid, possibly higher than growth rates previously reported for the first two years of life (Figure 1). The average first year of growth, determined from four populations, was 11.1 inches (TL). Maximum growth at age I was 13.6 inches (TL). Age II striped bass averaged 18.1 inches and the largest speciman from this age group was 19.0 inches (TL), weighing 3.1 pounds.

Measurements of relative plumpness, K-factor, have varied between 1.31 and 2.79, with size group averages between 1.83 and 2.30 (Table 1). Values of K below 1.80 were indicative of poor physical condition and mortalities were associated with K-factors below 1.70.

Food habit studies revealed a preponderance of threadfin and gizzard shad in the diet of striped bass that were 6 inches and larger (Table 2). Smaller fish fed predominately on mosquitofish, molly, and freshwater shrimp, although a variety of foods were utilized.

Sexual maturity was evident in male striped bass at the age of 23 months. Gondal development was not found in females during the first two years of life. Natural reproduction is not anticipated in any of our lakes, except possibly Lake Talquin.

Parasite caused mortialities occurred in at least two striped bass populations. The causal organism was a marine nematode of the genus *Goezia*. In both instances, population levels were reduced far below their former abundance based on catch per unit of effort with gill nets.

The successful establishment of striped bass in Florida's inland lakes offers considerable promise for a new game fish in the State's fresh waters. Following the put, grow, and take program as suggested by Stevens (1969) and adopted by many Southeastern States, the species could provide a spectacular fishery, at least on a "trophy" basis. Its superior growth in fresh water environments, as found in this study and concluded by Goodson (1966), lends itself to such a program. Secondly, the desirable food habits of striped bass, showing a preference for clupeoid fishes (Barkuloo, 1967; Goodson, 1966; Stevens, 1957, 1969), principally gizzard and threadfin shad in Florida, may afford some biological control of the troublesome gizzard shad. In addition, the conversion of shad flesh into an attractive sport fish by predation has significant merit.

The two years of evaluation in this study, although encouraging from the standpoint of growth rates and food habits, have not found substantial sport fishery benefits. Although frequent sportfishing catches have been reported from all populations, and especially Lakes Parker and Talquin, creel-monitored populations have not shown any significant yields. However, in both populations where creel programs were in progress, Lakes Hunter and Hollingsworth, extensive mortalities were sustained from the *Goezia* parasite

and at about the size that striped bass would have been attractive to fishermen, 12 inches and larger.


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# OBSERVATIONS ON THE STRIPED BASS, *MORONE SAXATILIS*, IN KEYSTONE RESERVOIR, OKLAHOMA

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## ABSTRACT


The Oklahoma Department of Wildlife Conservation initiated a program to establish striped bass in Keystone Reservoir in 1965. During the period 1965 to 1969, approximately 2.75 million striped bass ranging from fry to adults have been stocked.

A program to determine if a spawning population of striped bass had developed was started in March 1969. The search for natural reproduction utilized egg sampling, meter netting, shoreline shocking, and shoreline seining methods. Natural reproduction was not found in 1969.

A gill net survey of the striped bass population was conducted from October through December 1969. Thirty individuals ranging in size from 0.9 to 8.9 pounds were taken. Females accounted for 80 percent of the catch with the larger individuals carrying mature ovaries. Age and growth determinations were made on these fish plus 20 others. First year growth was calculated at 10.2 inches, second year at 17.9 inches, third year at 21.3 inches, and fourth year at 23.9 inches.

Egg sampling survey was repeated in 1970. Striped bass eggs were not identified from those taken. However, on June 18, the first six striped bass identified as natural reproduction were taken by shoreline seining. Primary spawning activity appeared to have taken place in the Arkansas River. Early survey results were negative in the Cimarron River. Using data collected in 1969, from seining rates and known stocking rates as an extrapolation base, the