AGE AND GROWTH OF SPOTTED SEATROUT AND RED SNAPPER IN ALABAMA

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Abstract: Total length-scale radius relationship equations and total length-weight equations were determined for spotted seatrout and red snapper in Alabama. Age was determined from scale readings. Rosa Lee's phenomenon was observed. Length frequency curves indicated that age group III+ (425 mm) represented the largest year class examined among spotted seatrout and age II+ (239 mm) represented the largest year class examined among red snapper.

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Spotted seatrout, *Cynoscion nebulosus,* and red snapper, *Lutjanus campechanus,* are among the more important fishes to the recreational and commercial finfish fisheries in coastal Alabama. Little scientific information has been published on the biology of these two species in Alabama. In recent years the Alabama Department of Conservation and Natural Resources (ADCNR) has experienced growing pressure from the public sector to regulate the fisheries for these 2 species. Lacking biological information for use in management regimes the ADCNR initiated an age and growth and a length-weight relationship study in the fall of 1978. The study funded in part by the National Marine Fisheries Service (National Oceanic and Atmospheric Administration under P.L. 88-309) and the ADCNR was conducted by personnel of the Alabama Marine Resources Division of the ADCNR. The study area included the coastal waters of Mobile and Baldwin counties, Alabama.

METHODS

Spotted seatrout were collected from the annual Baldwin County Speckled Trout Rodeo sponsored by the Gulf Shores and Foley Jaycees. All spotted seatrout specimens were taken by hook and line during November 1978. Red snapper specimens were taken by hook and line from a charter boat operated from Dauphin Island, Alabama during the months of October and November 1978.

All fish were measured for total length and weight. Scale samples were collected, and an attempt was made to sex each fish. Scales were mounted and read with the aid of an Eberback Scale Projector with 43× magnification under contract with the Department of Fisheries and Allied Aquaculture, Auburn University, Auburn, Alabama. The magnified distance from the scale origin to annuli and the scale margin were measured along the anterior field to the nearest millimeter. Computer analyses were used to determine total body length-scale radius relationship equations and to perform back calculations of lengths at each annulus for each age group.

A 3rd degree polynomial, where total length is a function of the linear quadratic and cubic expression of scale radius, was used to estimate the body length-scale radius relationship of both species. Fish were grouped by males, females, and unknowns and tested separately to determine effects of sex on the body length-scale radius relationship. Sexes were then combined to determine the body length-scale radius relationship for each species. Standard analysis of variance techniques indicated that in all cases the relationships of body-weight was best represented by a curvilinear function.

Back calculations of total lengths at the end of each year of life for individual fish were accomplished by substituting the magnified 43× scale radius measurements to each annulus into the approximate body length-scale radius equation. The average length is reported for each age group.

The equation used to calculate the length-weight relationship was $\log W = \log a + b \log L$, where W is the weight in grams and L is the length in millimeters. The equations are used to estimate weight when only length is known. Sexes were calculated separately to test differences existing between sexes and then combined to gain an overall length-weight relationship for each species.

Length frequency histograms were plotted by computer for both species.

RESULTS AND DISCUSSIONS

Spotted Seatrout

No significant differences in length-weight data (95% confidence level) were found between sexes, and therefore this discussion is limited to combined data.

From a total of 637 spotted seatrout measured for a length frequency study, 233 were selected to establish a sample group representing a 25 fish per inch group interval. These fish were utilized in determining total length-scale radius equations.

The following total length-scale radius equations were obtained where L is total length and S is scale radius:

(sexes combined) $L = 80.335 + 22.89S^2 - 0.189S^2 + 0.00472S^3$

(males) $L = 996.687 - 161.189S + 11.816S^2 - 0.251^3$

(females) $L = 418.399 - 33.77S + 2.914S - 0.049S^3$

The calculated growth of the 233 spotted seatrout is represented in Table 1. No significant difference was found between sexes with the exception that the older fishes were primarily females. Only a small percentage (13%) of the sample was comprised of these older fish. No males were identified that were more than III+ years old. The oldest fish sampled was VI+ years old. Thirty-three of the 233 fish used to generate data shown in Table 1 could not be identified to sex.

Rosa Lee's phenomenon is apparent in Table 1. Lee's phenomenon is characterized by the calculated lengths of older fish in the earlier years of life being systematically lower than those of younger fish at the same age. Many scientists believe that this phenomenon is due to faster growing fish being selected by natural mortality, fishing mortality or both.

The average size expected at any given age is probably best demonstrated by the "Grand Weighted Average Length" (Table 1) and the "Calculated Weight for the Grand Weighted Average Length" (Table 1); example, on the average, a trout would be expected to be approximately 439 mm TL and 793 g at the formation of

Table 1. Total length at annulus formation of spotted seatrout in coastal Alabama.

Year class	Back-calculated total length (mm)	sample size (number)	Age I	II	III	IV	V	VI
1977	254-336	81	295 (mm)					
1976	295-417	86	257	354				
1975	377-417	35	263	365	449			
1974	459-543	21	249	351	429	498		
1973	521-608	7	248	342	426	494	522	
1972	564-653	3	254	336	418	487	550	624
Grand Weighted Average Length (mm)			270	354	439	496	551	624
Calculated Weight (g) for Grand Weighted Average Length			175	407	793	1,159	1,607	

its third annulus. These are only averages and it should be clear that each year class will have its own characteristic growth.

The length-weight relationship equation for male spotted seatrout was $W = 4.67 \times 10^{-6} (L)^{3.1170}$, and females was $W = 5.52 \times 10^{-6} (L)^{3.085}$. Fig. 1 depicts the length-weight relationship for the sexes combined.

A length-frequency histogram for 637 seatrout is shown in Fig. 2. Curves were fitted to the histogram with the aid of back-calculated body length ranges shown in Table 1. A normal distribution was assumed. The use of these ranges enabled the investigator to better identify the peaks representing the various age groups. The histogram is primarily useful in graphically depicting the relative size of the various age groups in the catch. The grand weighted average back-calculated lengths do not exactly coincide with the peaks in the histogram since the length-frequency data were not collected at the time of annulus formation. However, the fit is close enough for purposes of this discussion. Clearly, the histogram is not intended to be used as a check against the back-calculated age groups. The peaks shown in the figure represent (+) age groups.

Alabama has a 12-inch (305-mm) minimum size limit on the harvest of spotted seatrout. The size limit biased the histogram by eliminating portions of the first two year classes from the figure. The peak shown at 425 mm is for fish in the III+ group (3 annuli) and represents the largest single year class in the population. Tatum (1980) found similar results in a length-frequency study taken from past catch records maintained by the Baldwin County Speckled Trout Rodeo Committee. Tatum used 20-mm intervals in a length-frequency study to fit curves to his data obtained from spotted seatrout rodeos held in November of each year. His data covered years 1964 - 1971 and 1973 - 1977. He estimated that the III+ age group would have a mean length of 415 mm (Table 2). This compares closely with the data in Fig. 2 in which the III+ age group peak is approximately at the 425 mm length. Tatum estimated body length in II+ fish to be 330 mm which compares closely with a peak located at 350 mm in Figure 2. Tatum's data do not compare

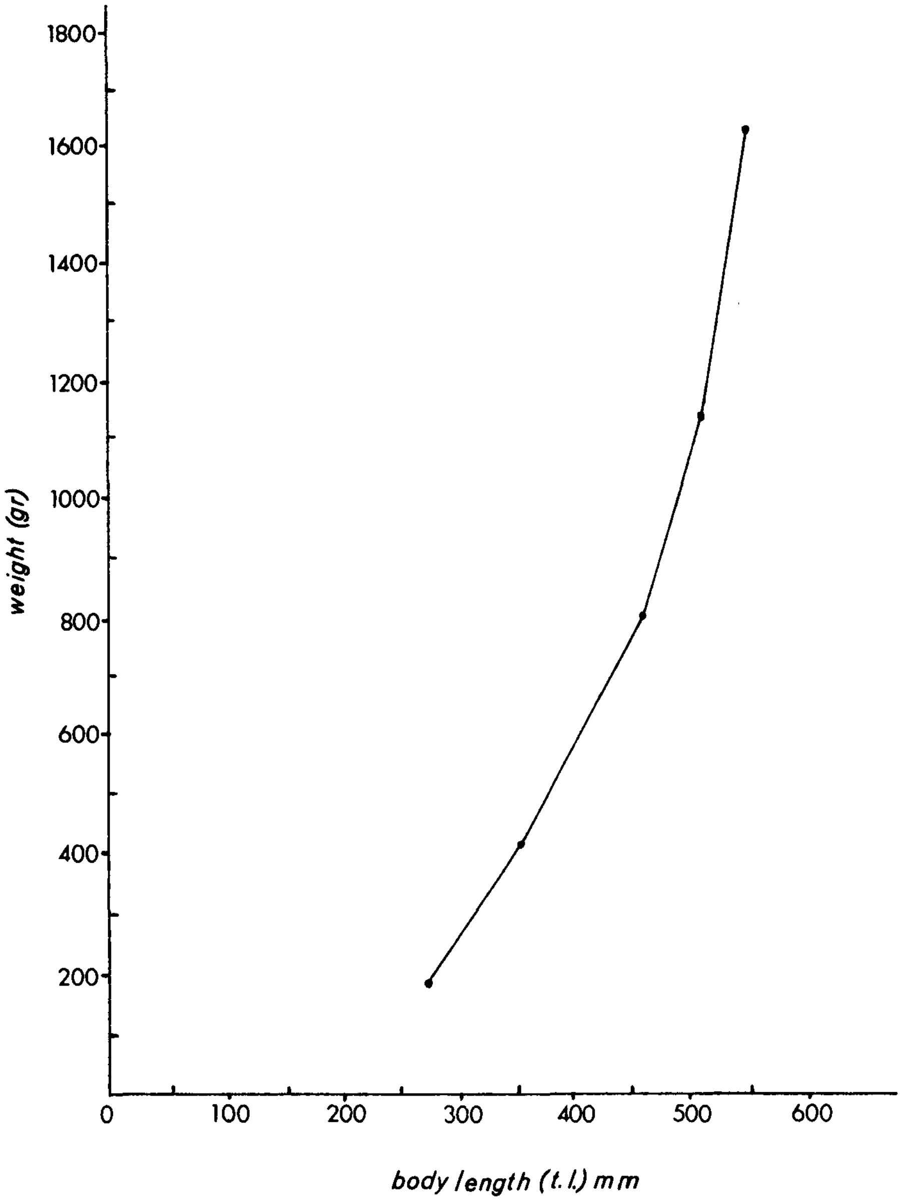

Fig. 1. Length-weight relationship of spotted seatrout from coastal Alabama.

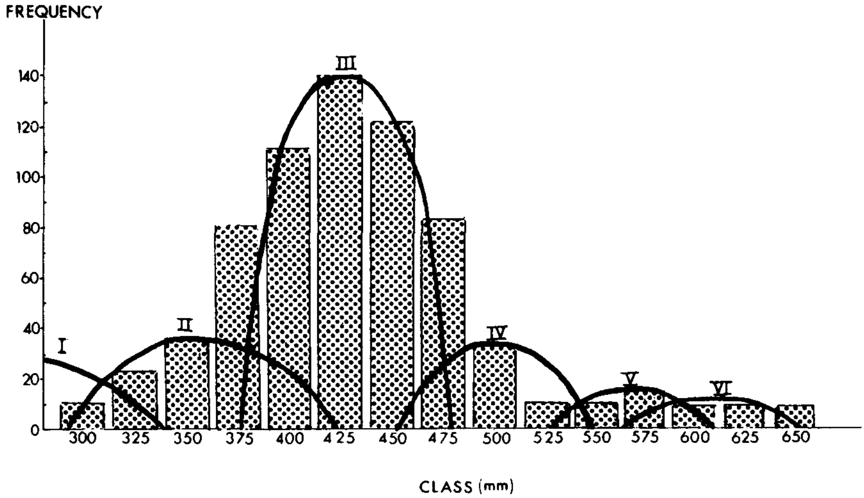

Fig. 2. Length-frequency histogram for spotted seatrout.

closely in the older year classes probably due to small sample size among older year classes in both studies. However, the overlap of age classes made separation of age groups (especially among older groups) difficult when the length-frequency method was used.

Table 2. Attained mean lengths (mm) for spotted seatrout landed in Alabama in November.

Study	I+	II+	III+	IV+	V+	VI+
Tatum (1978)[a]	225	330	415	450	480	525
Wade (from Fig 2)		350	425	500	560	615

[a] Years 1964 - 1971 and 1973 - 1977.

Virtually no other data are available on the age and growth of spotted seatrout from Alabama waters. The lack of age and growth data for spotted seatrout populations at any one locale within their range is common (Lorio and Perret 1980). Growth rates may vary from year to year within a population depending upon various factors including food supply, physical, chemical and meteorological parameters (Lorio and Perret 1980). Because of the different growth rates exhibited from one estuary to another age and growth data must be considered as separate entities (Tabb 1966). Data presented in this paper are pertinent to the Alabama spotted seatrout populations and more specifically to the Baldwin County populations since it is believed that most, if not all, fishes examined came from Baldwin County.

Red Snapper

No significant differences in length-weight data (95% confidence level) were found between sexes and therefore this discussion is concentrated on combined data.

From a total of 722 red snapper measured for length-frequency, 238 fish were selected to establish a sample group with 25 fish per inch group interval to be utilized in determining total length-scale radius equations.

The following equations were obtained where L is total length and S is scale radius:

(sexes combined) $L = 127.053 - 0.923S + 0.366S^2 - 0.003S^3$
(males) $L = 185.825 - 5.474S + 0.477S^2 - 0.004S^3$
(females) $L = 109.594 + 0.600S + 0.325S^2 - 0.003S^3$

The calculated growth of 238 red snapper is presented in Table 3. No significant differences were found between sexes. The average size expected at a given age is best demonstrated by the "Grand Weighted Average Length" and the "Calculated Weight for the Grand Weighted Average Length" (Table 3). Males and females appear to have equal longevity.

A length-frequency histogram was compiled from a sample of 722 red snapper and is shown as Fig. 3. The 1st year class is probably not shown due to a sample bias created by a minimum size restriction on fishes landed in Alabama (Alabama regulation limits red snapper to a minimum of 203 mm (8 inches) total length). Curves were fitted to the length-frequency histogram (Fig. 3) with aid of back-calculated body length ranges from Table 3.

The II+ age group dominated the hook and line catch of red snapper in this study (Fig. 3). The second most abundant year class was the IV+ group. The III+ age group was not as abundant as the IV+ age group which may indicate a recruitment or exploitation problem in that year class.

A comparison of back-calculated lengths in this study and those obtained by Futch and Burger (1976) in Florida are presented in Table 4. Futch and Burger used *otoliths* rather than scales in their age and growth study. Fork lengths were converted to total lengths using the formula TL = 1.0678FL + 3.4637 (Futch and Burger 1976).

The growth increment between age classes I and II for the Florida study is greater than those found in this study. With the exception of the lengths at annulus I formation, all of the Florida lengths were greater for a given age. Moseley (1966) reported that red snapper in the Gulf of Mexico grow approximately 90 mm between age classes II, III and IV. Beaumariage (1964) found that tagged fish grew approximately 80 mm between those classes which closely fits the data in this report. Increments of 82 mm and 80 mm were found between age classes II and III, and III and IV, respectively.

Data from this study indicated that red snapper may live 9 years, but fishes older than 5 to 6 years were rare in this study and apparently unavailable in either Mosely's (1966) or Futch and Burger's (1976) studies.

Lee's phenomenon is apparent from the data given in Table 3.

Table 3. Total lengths (mm) at annulus formation for red snapper in coastal waters adjacent to Alabama.

Year class	Back-calculated total length (mm)	Sample size (number)	I	II	III	IV	V	VI	VII	VIII	IX
1977	163-211	67	184								
1976	211-334	66	164	225							
1975	274-427	36	158	229	322						
1974	322-454	47	159	222	312	382					
1973	441-578	15	169	240	336	444	531				
1972	604-604	4	171	252	322	430	527	604			
1971	692-692	1	178	263	360	441	496	604	692		
1970											
1969	843-843	1	163	274	347	413	551	643	765	824	843
Grand Weighted Average Length (mm)			168	239	321	401	535	631	749	835	843
Calculated Weight (g) for Grand Weighted Average Length			70 g	202 g	490 g	956 g	2277 g				

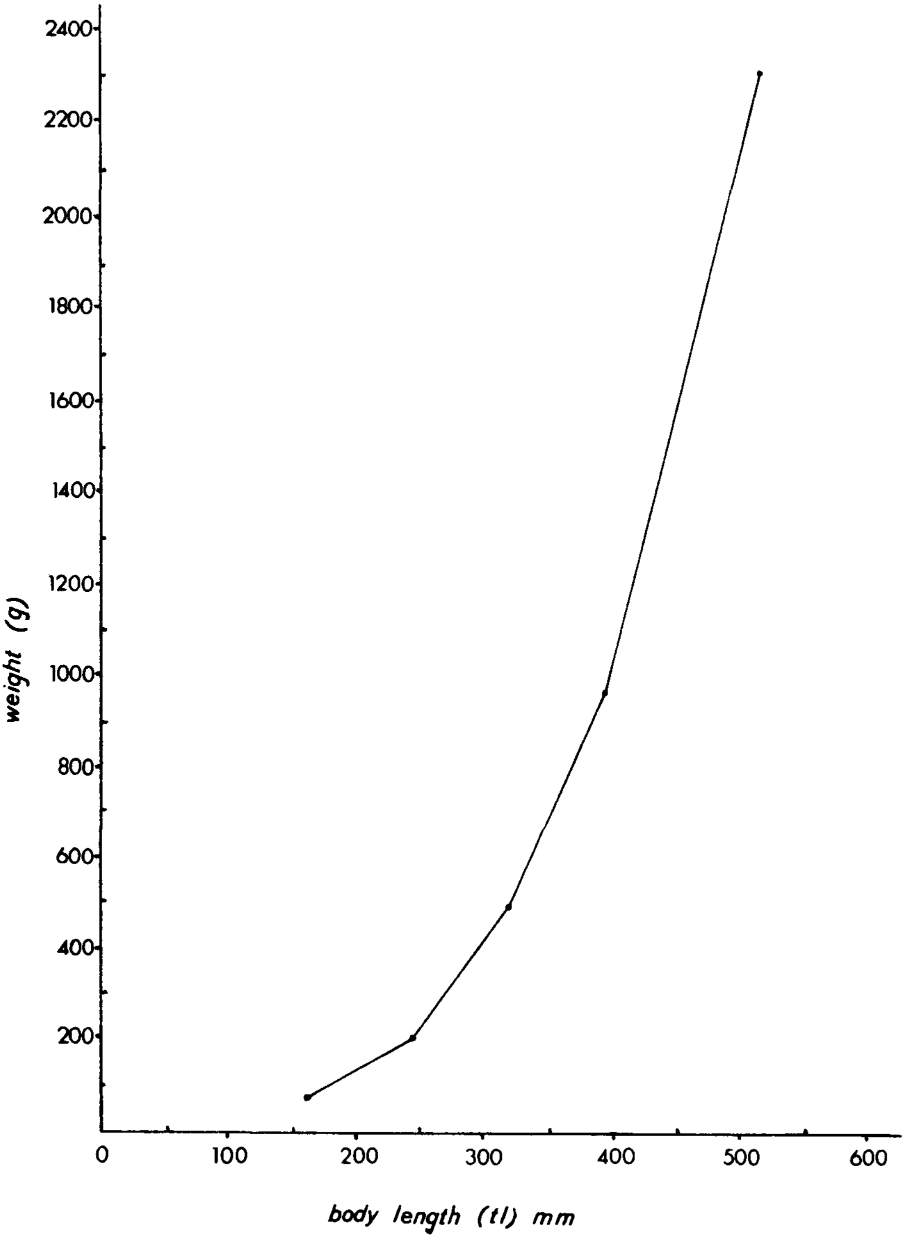

Fig. 3. Length-weight relationship of red snapper from Gulf waters adjacent to Alabama.

Table 4. Back-calculated total body length (mm) of red snapper from Florida and Alabama (Florida lengths converted from fork lengths).

Location	I	II	III	IV	V
Florida					
(Futch and Burger 1976)	152	317	399	478	554
Alabama					
(Wade)	168	239	321	401	535

The length-weight relationship equation for male red snapper was $W = 1.17 \times 10^{-5} L^{3.0399}$. For females, the equation was $W = 1.60 \times 10^{-5} L^{2.985}$. The length-weight equation for the sexes combined was $W = 1.40 \times 10^{-5} L^{3.0092}$. Fig. 4 depicts the length-weight relationship for the combined data.

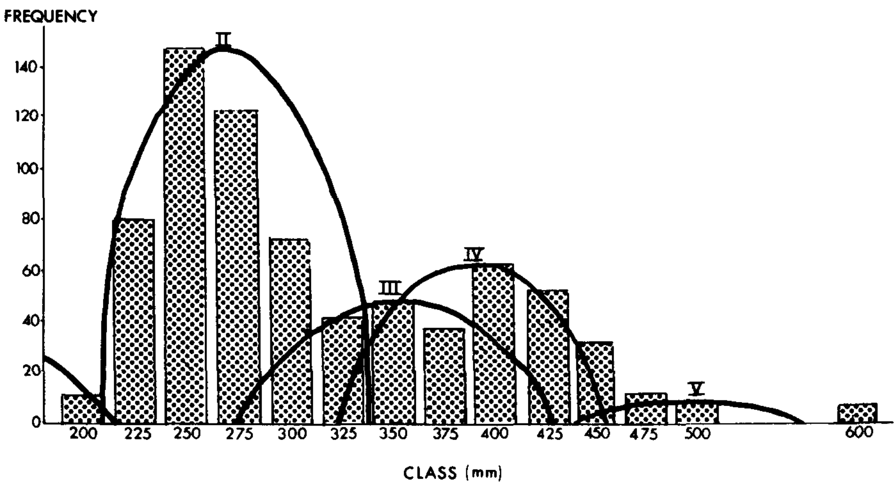

Fig. 4. Length-frequency histogram for red snapper.

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