AGE, GROWTH AND MORTALITY OF THE WHITE GRUNT, *HAEMULON PLUMIERI* LACÉPÈDE (PISCES: POMADASYIDAE), FROM NORTH CAROLINA AND SOUTH CAROLINA

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ABSTRACT

Scales and otoliths of the white grunt, Haemulon plumieri, *sampled from the North Carolina and South Carolina headboat fishery were examined to determine if they could be used to age the species. Both structures were satisfactory, 76% of the fish examined could be aged by scales and approximately the same percentage by otoliths. Agreement for a given age between otoliths and scales taken from the same fish was 75%. The oldest fish collected was XIII; 589 mm total length. Growth occurred from about mid-March to November. Back-calculated mean lengths ranged from 97 mm at end of year 1 to 550 at end of year 13. The Bertalanffy equation describing theoretical growth in length is:* $^{l}t = 640\ (l - e^{-0.1084\ (t\ +\ 1.007)})$*. Total mortality estimates, based on catch curves from over 5,000 fish, ranged from 37% to 51% varying between years and geographical area. The length-weight relationship is described by the equation* $W = 0.00001426L^{3.0229}$*;* $W = 0.00001201L^{3.0503}$ *for males, and* $W = 0.00001452L^{3.0214}$ *for females.*

The white grunt, *Haemulon plumieri,* is a demersal marine fish found in a variety of temperate to tropical habitats in the western Atlantic from Virginia and Bermuda to Brazil, including the Gulf of Mexico and Central American coast (Bohlke and Chaplin 1968). Both Evermann and Marsh (1900) and Jordan and Evermann (1902) mention rocky or irregular bottom as quality habitat. Manooch (1975) identified two demersal fish communities off the Carolinas, one inshore over "live-bottom", and the other in deeper water at the Continental Shelf break zone. Inshore, the white grunt was the third most commonly occurring carnivorous species after black sea bass, *Centropristis striata* and red porgy, *Pagrus pagrus.* It is harvested commercially throughout much of its range and by recreational fishermen off the southeastern United States, usually at depths ranging from 18 to 46 meters (Huntsman 1976). Over 475,000 white grunt weighing approximately 329 metric tons and composing approximately 22% of the total number of fish harvested were landed in North Carolina and South Carolina from 1972 to 1975 by the headboat[1] fishery (Huntsman 1976; Huntsman personal communication[2]).

There have been several studies concerned with various aspects of its life history. Courtenay (1961) described their systematics and juvenile pigmentation; Erdman (1956), Moe (1966), and Munro et al. (1972) discussed spawning; Carr and Adams (1973) identified foods of juveniles; and Saksena and Richards (1975) described eggs and larvae.

In 1972 the National Marine Fisheries Service, Atlantic Estuarine Fisheries Center, Beaufort, North Carolina initiated life history, creel census, and tagging studies of demersal fishes occurring on the outer Continental Shelf of the Carolinas. The overall objective of the study was to define the demersal fish resources of the southeastern United States. A specific objective was to investigate various methods of aging the different species that are important to the recreational fishery.

In this paper I determined that the white grunt can be aged by the number of rings appearing on scales and on otoliths. I also describe the length-weight relationship, estimated absolute, calculated, and theoretical growth, and estimated total mortality rates for the different fishing areas.

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[1] A boat for hire which charges on a per person basis.
[2] G. R. Huntsman, NMFS, Atlantic Estuarine Fisheries Center, Beaufort, N.C. 28516.

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COLLECTION OF MATERIALS

From 1972 to 1975 we sampled 5,135 white grunt from the North Carolina and South Carolina headboat hook and line fishery, recording total length of fish in millimeters and weight in tenths of pounds which later were converted to grams. Three geographic locations were represented: Cape Lookout, area 1; Cape Fear, area 2; and Cape Romain, area 3 (Fig. 1). Scales were taken from beneath the tip of the posteriorly extended pectoral fin. After they were removed, scales were soaked in a one-tenth aqueous solution of phenol and rubbed between the fingers to remove chormatophores and integument. Six scales per fish were mounted dry between two glass slides and viewed on microprojector at 40X magnification.

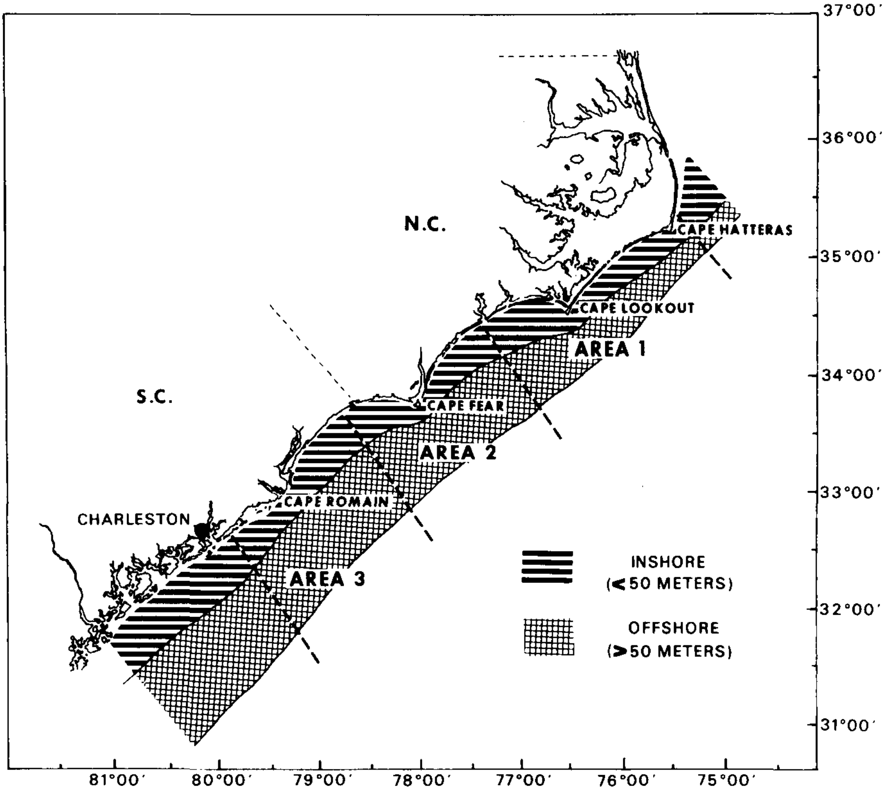

Figure 1. Location of the three major sampling areas, 1972-1975.

I removed otoliths (sagittae) from fish by cutting the cranium with a hacksaw midway between the posterior edge of the eye and the preopercle to the depth of the orbit radius. The skull was pried apart and the otoliths were removed with tweezers, washed in water and placed in labeled vials containing glycerin.

RESULTS

Annular rings, or marks, on scales or otoliths of fish from tropical and subtropical waters are often difficult to detect and interpret, since there is little annual fluctuation in water temperatures and thus little seasonal variation in growth. Although the white grunt is considered to be a tropical or subtropical species, inshore areas off the Carolinas where fish were collected, experience rather drastic changes in bottom temperature. Between November 1975 and February 1976 bottom temperature at one inshore (31 m) area dropped from 22.3° C to 7.8° C (Grimes 1976). Water temperatures offshore are more stable. At the shelf break, which is influenced by the Gulf Stream, there is only a 4° to 5° C variation in bottom temperatures between summer and winter (Newton, Pilkey and Blanton 1975). If white grunt remain inshore year round, the seasonal differences in bottom water temperature should produce a change in the rate of growth, thereby forming annual growth marks, or annuli, on scales and otoliths. It is highly probable that the species moves to warmer waters during extreme cold periods. If this is true, one would expect scales to have no annuli, or such a profusion of growth checks, or false annuli, that identifying the true annuli would be difficult. Chevey (1933), however, has shown that even small temperature differences may suppress growth long enough to cause annuli to form, and Menon (1953) and Iles (1974) have suggested that physiological rhythms associated with spawning may also be important in the retardation of somatic growth. Both Manooch and Huntsman (in press) and Grimes (1976) were able to age similar demersal species which occurred offshore in a more stable temperature environment.

White grunt scales, which are ctenoid and rectangular, had numerous rings or checks, some distinct and evenly spaced, others indistinct and irregularly spaced. I considered rings to be annuli only if they were relatively even spaced and were completely formed in the anterior and lateral fields. Distances along a line from the focus to each ring and margin of the projected scale image were measured in mm on Keysort cards having a metric scale along one end (Huntsman and Chapoton 1973). Each scale was read twice. Of the 1,191 fish examined, I was able to discern and measure rings on scales of approximately 76%. The percentage of illegible scales generally increased as fish length increased. Scales from fish 100 to 199 mm total length were 100% legible, 200-299 mm were 88% legible, 300 to 399 mm were 78% legible, and those 400 to 499 were 64% legible. Scales were illegible because of regeneration, indistinct or broken rings, or rings too close together to separate.

A White grunt otolith is elliptical, relatively thick, slightly concave, a mirror image of its mate, and is marked with opaque and hyaline bands. The convex surface of each sagitta is oriented in situ toward the central axis of the fish and possesses a deep groove, the *sulcus acousticus.* Each otolith, convex side up, was immersed in glycerin in a black-bottomed watch glass and viewed through a binocular dissecting microscope, with light shining directly onto the otolith from above. The opaque zones, which were evenly spaced and continuous, were interpreted as having been formed during the growing season, and therefore were counted as growth rings. Distances from the center of the otolith to each ring were not measured for back calculating length at age.

VALIDITY OF RINGS AS ANNULI

By calculating the mean distance from the last ring to the scale edge of 281 fish less than 300 mm TL collected from April to November, I was able to determine the approximate time of year when the rings were formed. This size group was chosen because rings were very distinct on these smaller fish and precise measurements could be recorded. Growth had already resumed when the first collections were taken in late April. The mean distance increased from 2.7 mm in April to 23 mm in November. Since I had no collections from December through March, I could not determine exactly when during that period growth rate resumed and the annulus was formed. Judging from the small amount of growth that was evident on scales of fish collected in April, I concluded that the annulus was formed sometime in March. The period of no growth, December to March, coincided with the time of lowest bottom water temperature.

The mean length of fish progressively increased as the number of scale or otolith rings increased (Table 1, Fig. 2). For instance, if aged by scales, age II fish averaged 227 mm, age-V fish 329 mm, and age-X fish 450 mm; if aged by otoliths, age-II fish averaged 209 mm, age-V fish 328 mm, and age-X fish averaged 449 mm (Table 1).

Table 1. Comparisons of mean empirical length-age data obtained by reading white grunt scales and otoliths.

	Scales				Otoliths				
Age group	*Number*	*Mean total length*	*Range in length*	*Standard deviation*	*Number*	*Mean total length*	*Range in length*	*Standard deviation*	*Difference in means (mm)*
1	2	177.0	166-188	15.56	—	—	—	—	—
2	65	227.0	188-272	16.63	2	209.0	206-212	4.24	18.0
3	145	266.8	225-325	20.18	8	263.4	232-307	22.53	3.4
4	102	295.9	260-376	21.20	11	304.9	289-331	12.17	9.0
5	83	329.3	285-413	27.00	32	328.3	302-368	15.77	1.0
6	90	356.1	308-412	21.03	16	358.0	339-385	12.30	1.9
7	128	389.7	300-448	23.76	24	390.9	351-428	22.84	1.2
8	119	412.5	345-458	17.05	35	400.0	360-436	18.42	12.5
9	61	429.8	392-483	17.29	19	428.2	391-459	18.47	1.6
10	36	450.5	416-492	17.69	8	449.0	441-470	9.78	1.5
11	24	468.4	445-493	11.42	3	456.3	448-463	7.64	12.1
12	10	482.5	462-530	20.47	1	481.0	481	—	1.5
13	6	526.0	493-589	38.01	—	—	—	—	
TOTAL	871				159				

The length frequencies, in percent, of the distance from the focus of each ring, progressively increased with the number of rings (Figure 3). Significant features of the curves were the occurrence of one mode for each ring, the consistant location of a specific mode on the X-axis for fish of different ages, the increase in the amount of overlap for each additional ring, and the progressive decrease in the distance between the modes for each successive year, indicates less linear growth each year as the fish ages.

Both scales and otoliths from the same fish were examined to see of there was agreement between the two aging structures. Although I read otoliths from 159 fish, I had both aging structures from only 52 individuals. The number of rings on both scales and otoliths agreed for 39 out of the 52 (75%) for fish with 2 to 12 rings. Approximately 50% of the disagreements occurred for fish with 9 and 10 rings.

The evidence I believe, indicates that the rings on scales and otoliths are true annuli. Scales are preferred for aging the species since percent legibility is equal for the two aging techniques, and otoliths are more difficult to remove, prepare, and measure.

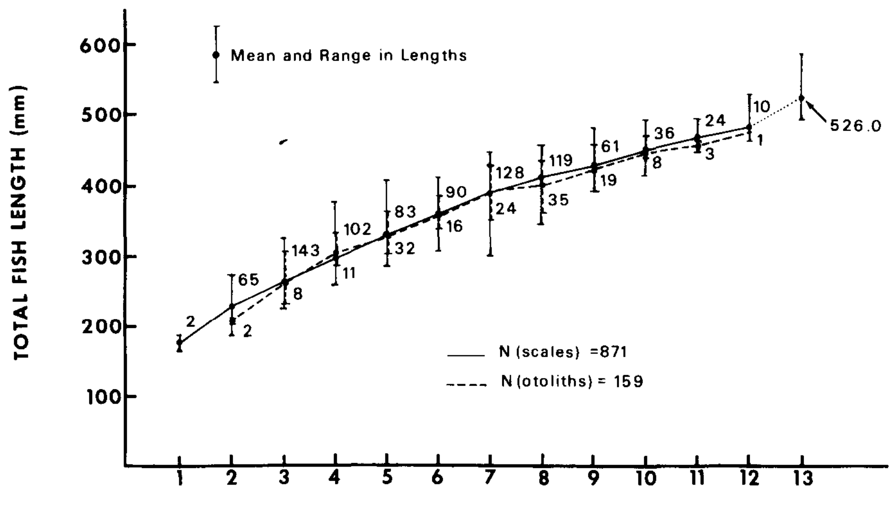

Figure 2. Absolute growth curves for white grunt from mean total lengths of each age group obtained by reading scales and otoliths. The number by each point on the curve represents the number of fish sampled.

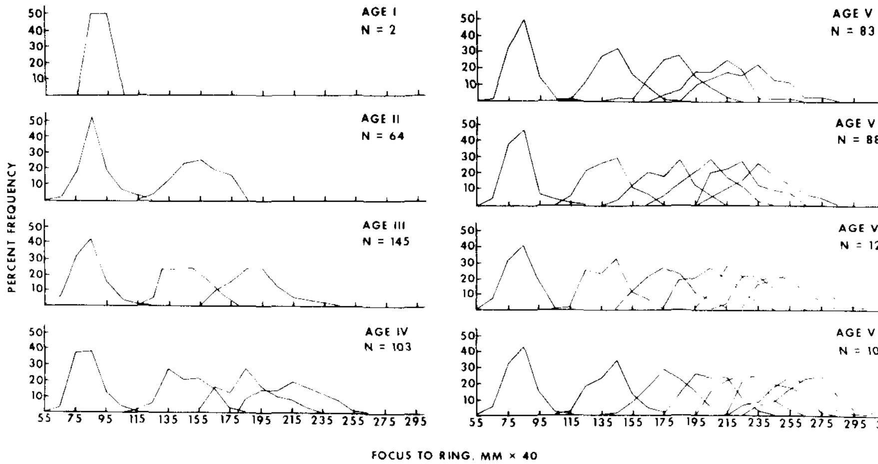

Figure 3. Frequency distributions (Y-axis) of measurements of scale lengths to each annulus (X-axis) for white grunt age I-VIII.

GROWTH

There was relatively little difference in the mean lengths of fish aged by scales and the mean lengths of fish aged by otoliths (Table 1, Fig. 2). Annual growth of fish aged by scales for the first 12 years was: I-II, 50.0 mm; II-III, 39.8 mm; III-IV, 29.1 mm; IV-V, 33.4 mm; V-VI, 26.8 mm; VI-VII, 33.6 mm; VII-VIII, 22.8 mm; VIII-IX, 17.3; IX-X, 21.0 mm; X-XI, 17.9 mm; and XI-XII, 14.0 mm. A slight inflection point seems to occur at seven years and afterwards growth increment is erratic but generally levels off. Although white grunt were collected from three geographic areas, the data were combined since no significant difference between areas was expected. Manooch and Huntsman (in press) found no difference in rate of growth for red porgy collected from the same areas sampled in this study.

Length-at-age data for fish aged by otoliths were used to determine differences between the sexes. Fish aged by scales could not be used for this comparison because sex was not recorded in the field when scale samples were taken. From the relatively small sample size (N = 125) two points are presented. First, the older fish were always males; females were not aged older than nine years, while males were aged X, XI, XII and XIII. Second, females were smaller for each age compared. Results comparing ages IV-IX for males and females, respectively were: IV, 311 mm and 299 mm; V, 331 mm and 325 mm; VI, 365 mm and 352 mm; VII 400 mm and 377 mm; VIII, 410 mm and 391 mm; and IX, 430 mm and 420 mm.

Lengths by age for all years and areas combined were back-calculated from scale radius-fish length regression. The regression equation was derived by plotting projected (40X) scale length on total fish length. Since a majority of the projected scale radius measurements were between 200-275 mm due to fishing gear selectivity, I subsampled scale radius measurements after grouping them into 25 mm size intervals. The formula was:

$\text{Log TL} = -0.6577 + 1.1824 (\text{Log SR})$; $r = 0.93$ and $n = 300$,

or $\text{TL} = 0.5180\text{SR}^{1.1824}$ where TL = total length, and SR = scale radius.

I substituted the means of the distances from the focus to each annulus for SR in the above equation, calculated the mean fish length at the time of each annulus, and then calculated mean growth increment for each age group (Table 2).

Table 2. Calculated total lengths of 827 white grunt aged by scales.

Observed age	*N*	*Mean Calculated Total Length at End of Year* 1	2	3	4	5	6	7	8	9	10	11	12	13
I	1	104.5												
II	65	102.6	200.5											
III	145	98.3	193.4	258.0										
IV	102	97.9	190.6	254.8	298.7									
V	83	98.0	184.4	244.9	289.3	321.2								
VI	88	95.4	177.5	235.6	277.2	310.5	335.3							
VII	121	96.2	177.9	235.4	278.5	313.7	343.2	363.8						
VIII	107	95.6	180.7	237.6	279.0	312.8	341.9	366.0	383.6					
IX	56	93.8	178.9	235.1	276.4	309.6	340.0	367.3	391.1	407.7				
X	29	95.9	186.1	244.2	286.9	320.6	347.4	372.4	395.2	412.9	430.0			
XI	20	87.7	172.2	227.8	274.1	311.7	343.5	372.6	396.9	421.8	443.0	459.9		
XII	8	94.9	182.8	241.8	288.3	321.0	351.8	378.7	413.7	440.5	463.3	479.9	492.5	
XIII	2	102.5	192.3	253.9	290.9	328.7	357.9	382.4	401.9	429.4	472.9	502.0	527.8	550.1[5]
Total	827													
Weighted mean		96.9	185.2	243.9	283.4	314.2	341.3	366.7	389.3	413.9	439.2	465.5	492.5	
Increment		96.9	88.3	58.7	39.5	30.8	27.1	25.4	22.6	24.6	25.3	26.4	26.9	
Number of calculations		825	824	759	614	512	429	341	220	113	57	28	8	

[5] Age XIII not used in back-calculating means per age group.

Growth was most rapid for the first year and then gradually decreased. Weighted mean length increments for years I-XI were: 88.3, 58.7, 39.5, 30.8, 27.1, 25.4, 22.6, 24.6, 25.3, 26.4 and 26.9 mm (Table 2). Mean increment values for ages X-XII are of doubtful accuracy because of small sample sizes and because annuli on older fish are close together and difficult to measure accurately.

Relative growth was most rapid in the early years of life, especially for ages I and II, declined rather steadily for ages III to V, and then leveled off for ages VI through XI. Relative growth, or gain in size for each year in relation to the size at the beginning of the year, was determined from back-calculated lengths by the equation

$$h = \frac{\ell_{n+1} - \ell_n}{\ell_n}$$ (Everhart, Eipper and Youngs 1975)

where h = relative growth, ℓ_n = total length at age n, and ℓ_{n+1} = total length at next age (Fig. 4).

Calculation of a theoretical growth curve mathematically describes growth of natural populations of fish. Growth parameters obtained such as maximum attainable size ($L\infty$), growth coefficient (K), and theoretical origin of the growth curve when growth is fully developed (t_o) may then be used in constructing population models. The most popular theoretical curve, the von Bertalanffy ($\ell_t = L\infty\,(1 - e^{-K(t-t_o)})$) was fitted to growth data derived from back-calculated size at age (Bertalanffy 1938; Ricker 1975; Everhart et al. 1975). The von Bertalanffy growth parameter, $L\infty$, was first obtained by fitting a Walford (1946) line: $\ell_{t+1} = L\infty\,(1 - k) + k\ell_t$ to back-calculated data where ℓ_t = total length at age t, and k = slope of the Walford line. The equation derived for the white grunt is $\ell_{t+1} = 73.85 + 0.893\,\ell_t$, r = 0.99 (Fig. 5). The slope (k) of the line is equal to e^{-k}, thus $K = -\ell_n\, 0.893$ or 0.113. A preliminary value of 688 for $L\infty$ was obtained by inspection, and by solving the equation: $L\infty = \frac{\text{y} - \text{intercept}}{(1 - k)}$. This value is not unrealistic since a 589 mm specimen was sampled by task personnel off South Carolina in June, 1974. To evaluate the $L\infty$ derived, I plotted $\log_e (L\infty - \ell_t)$ against t; the straightness of the line is dependent upon the value of $L\infty$. Using trial values of $L\infty$ ranging from 560 to 700 mm TL, I was able to determine that the best $L\infty$, the one with the straightest line, occurred for $L\infty$ of 640 mm. The K derived from this equation was −0.1084 and was used in determining t_o, 1.007:

$$t_o = \frac{\text{y} - \text{intercept of natural log line} - \log_e 640}{K}$$

Thus, the Bertalanffy equation describing theoretical growth in length of white grunt is:

$$\ell_t = 640\,(1 - e^{-0.1084\,(t + 1.007)}).$$

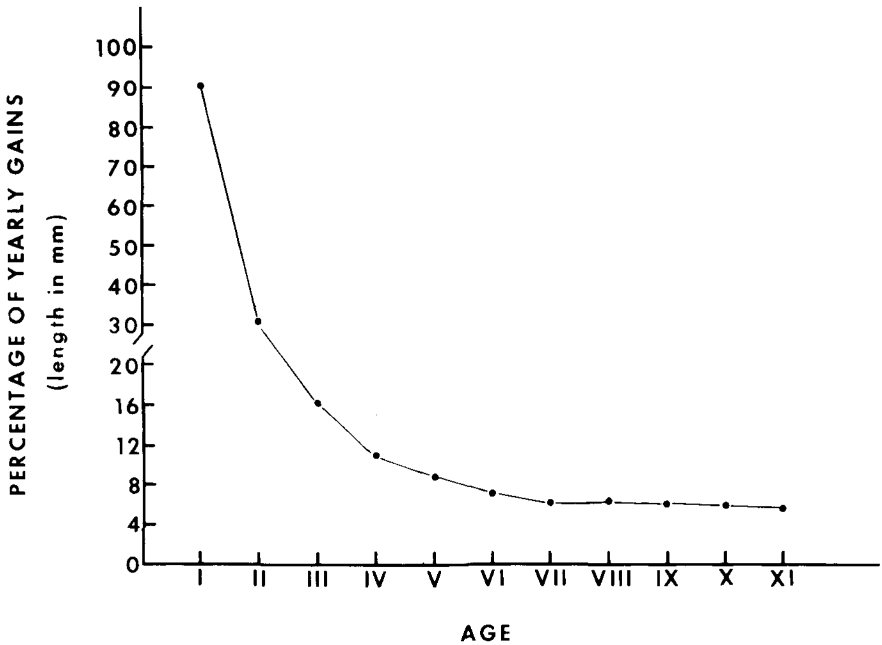

Figure 4. Curve of the relative growth rate of the white grunt.

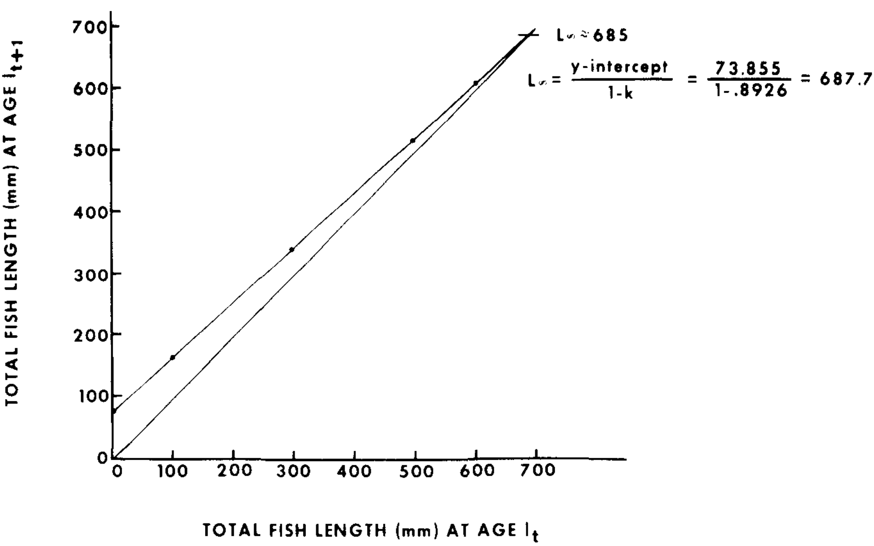

Figure 5. Walford growth transformation of the calculated growth curve for white grunt.

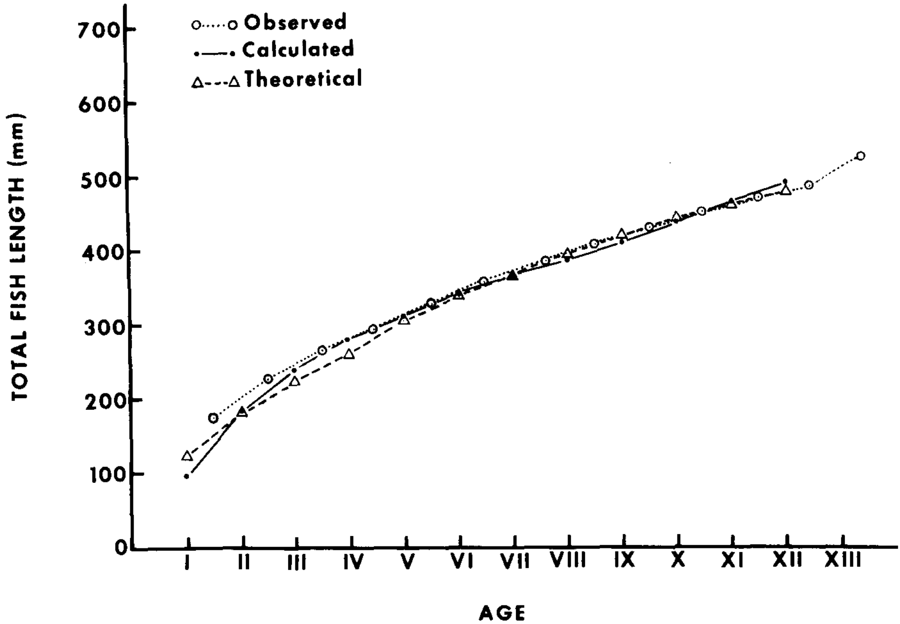

Figure 6. Comparisons of absolute, back-calculated, and theoretical growth curves for white grunt obtained from reading scales.

Growth curves for observed, calculated, and theoretical data agree closely with each other (Fig. 6).

MORTALITY ESTIMATES

White grunt are fully vulnerable to the hook and line fishery, the only important method of harvesting this species off the Carolinas, by age VII. Annual total mortality estimates from the catch curves, therefore, were usually based on fish age VII and older. If the $\log_e$ of the age frequency in the catch is plotted on age, the slope of the descending right limb is equal to the instantaneous total mortality rate (Fig. 7). To calculate mortality rates, I grouped fish of known age by 25-mm length intervals, calculated the percentage of fish of each age in each group, and used these percentages to estimate the number of fish of each age for each 25-mm length group of the 5,135 unaged fish. From the resulting catch curves, I estimated the annual total mortality rate for each year by the methods of Heinke (1913), Jackson (1939), Robson and Chapman (1961), Rounsefell and Everhart (1953), and by regression, Beverton and Holt (1957).

Mean total annual mortality estimates ranged from 37 to 51% depending on the year evaluated (Table 3). By area, for 1974 and 1975 combined, Cape Lookout had the lowest annual mortality rates while Cape Fear had the highest rates. Manooch and Huntsman (in press) found a similar pattern for red porgy mortality rates. The highest mean estimates for all areas combined were from the 1972 catch curves, the lowest from the 1975 catch curves. Although there was little difference in values, I considered the regression method of Beverton and Holt (1957) to be the best estimator, since it utilizes geometric rather than arithmetic means.

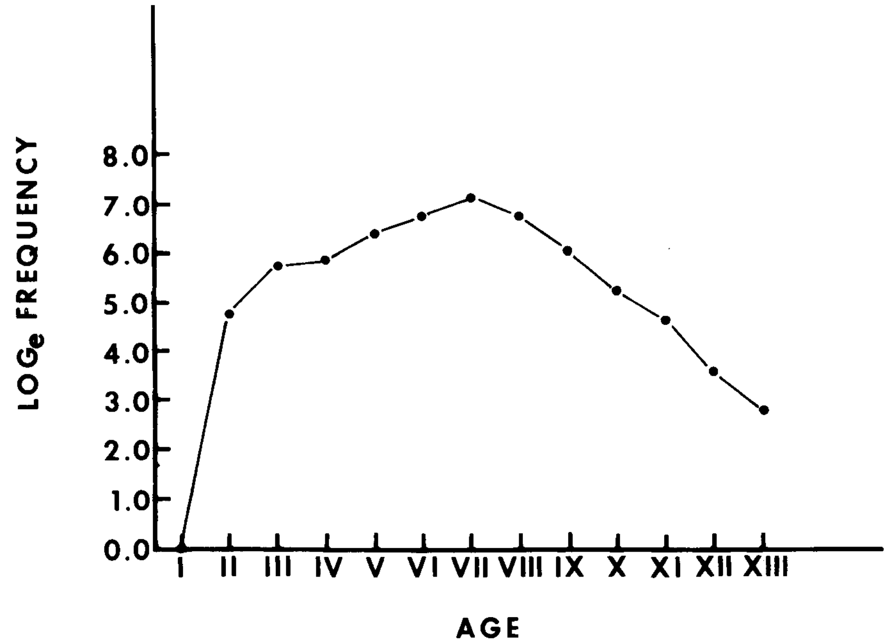

Figure 7. Catch curve for 5,135 white grunt sampled from the headboat fishery off North Carolina and South Carolina, 1972 to 1975, where b, the slope of the right descending limb of the curve, equals the instantaneous rate of mortality.

Table 3. Total annual mortality estimates for white grunt from North Carolina and South Carolina, 1972 to 1975.

					Method			
Year	*Area(s)*	*Sample size (VII-oldest)*	*Number of age classes*	*Robson and Chapman*	*Jackson*	*Heinke*[6]	*Beverton and Holt*	*Mean Mortality*
1972	all	1,126	7	0.52	0.46	0.46	0.55	0.51
1973	all	954	7	0.49	0.42	0.42	0.53	0.48
1974	all	398	7	0.48	0.40	0.40	0.53	0.47
1975	all	399	7	0.44	0.36	0.36	0.46	0.42
1972-1975	all	2,877	7	0.49	0.43	0.43	0.52	0.48
1974-1975	Cape Lookout	237[7]	8	0.38	0.29	0.29	0.43	0.37
1974-1975	Cape Fear	368	7	0.48	0.40	0.40	0.47	0.45
1974-1975	Cape Romain	332	7	0.42	0.33	0.33	0.42	0.39

[6] Heinke estimate not used in obtaining mean mortalities since method was almost identical to Jackson.

[7] Sample size was age V-XII.

LENGTH-WEIGHT RELATIONSHIPS

The relationship of weight to total length for 226 white grunt is described by the equation: $W = 0.00001426\ L^{3.0229}$, $r = 0.97$ (Fig. 8). Equations for the sexes were similar: $W = 0.00001201\ L^{3.0503}$, $r = .97$ for males; $W = 0.00001452L^{3.0214}$, $r = .97$ for females although females were slightly heavier than males. Theoretically, 100 mm, 300 mm and 500 mm fish would weigh 15 gm, 432 gm, and 2.052 gm if they were males, and 16 gm, 443 gm, and 2,073 gm if they were females.

DISCUSSION

Ages could be determined from either scales or otoliths, but scales were easier to obtain and measurements could be recorded quickly. Annuli on the scales that were not regenerated were generally easily distinguishable. Approximately 76% of the scales could be read and fewest regenerated scales were in those samples taken beneath the pectoral fin. Paul (1968) found this area to have the least variation in scale shape for the New Zealand sparid, *Chrysophrys auratus,* and Manooch and Huntsman (in press) and Grimes (1976) found fewer regenerated scales beneath the pectoral fins of the red porgy and

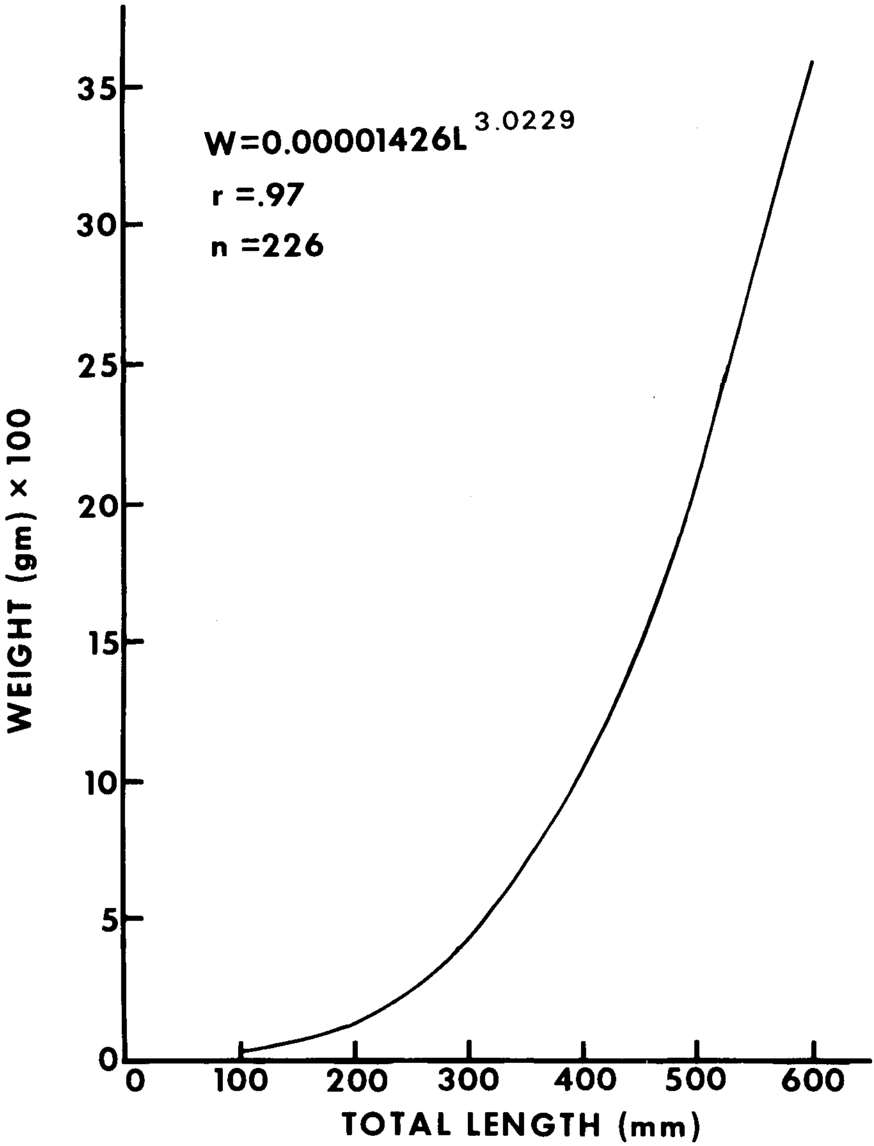

Figure 8. Length-weight relationship for 226 white grunt collected from North Carolina and South Carolina.

vermilion snapper, *Rhomboplites aurorubens,* respectively. Otoliths could be read easily, but they required considerable labor to prepare, could not be projected, and required a dissecting microscope and a calibrated ocular micrometer to be measured. I conclude that due to the relative ease of collecting, preparing and interpretation, scales should be used to age white grunt.

Scales and otoliths were used to determine absolute growth of white grunt; agreement between the two aging structures for determining age of the same fish was 75%. For scales, length at capture by observed age for ages II through XII were: 227.0, 266.8, 295.9, 329.3, 356.1, 389.7, 412.5, 429.8, 450.5, 468.4, and 482.5 mm. For otoliths, total lengths for the same ages were: 209.0, 263.4, 304.9, 328.3, 358.0, 390.9, 400.0, 428.2, 449.0, 456.3, and 481.0. Comparisons could not be made for ages I and XIII because only scale-age data were available for these two ages.

Total lengths at the time of annulus formation, calculated only for fish aged by scales, indicate a rather slow, steady growth throughout life, although it appears to be more rapid for the first three years. Relative rate of growth, or gain in fish size for each year in relation to size at the beginning of that year, was highest in the early years, especially ages I and II.

Theoretical growth as described by the von Bertalanffy equation predicts a maximum total length of 640 mm. The oldest fish examined was age XIII and measured 589 mm total length. The growth coefficient, K, for white grunt (0.108) compared with three sympatric species fish, indicates a slower growth rate than the vermilion snapper, 0.198 (Grimes 1976), a faster rate than the black sea bass, *Centropristis striata,* 0.088 (Cupka, Dias and Tucker 1973) and similar rate of growth to the red porgy, 0.096 (Manooch and Huntsman in press). By comparison, pelagic species have much more rapid rates of growth; king mackerel, *Scomberomorus cavalla,* 0.35 (Beaumariage 1973); yellowfin tuna, *Thunnus albacares,* 0.42 (Le Guen and Sakagawa 1973); and Atlantic menhaden, *Brevoortia tyrannus,* 0.391 (Schaaf and Huntsman 1972).

Thus, the white grunt, which is rather long-lived and relatively slow growing, reflects not only its genetic capabilities but also the type of environment in which it occurs. The three areas from which the fish were collected appear similar and show little temperature and salinity changes from one area to another. When drastic decline in bottom temperatures occur inshore, the species probably moves to warmer waters thereby maintaining residency in a fairly stable environment. Parker (personal communication)[3] has observed two seasonally different communities of demersal fish at the same inshore (29 m) study area in Onslow Bay, North Carolina. Divers documented numerous species of tropical and subtropical fish (serranids, lutjanids, sparids, labrids, pomadasyids, chaetodontids and pomacentrids) during the warmer months, replaced by a more temperate fish fauna during periods of cold weather. Competition for food and space are two factors which usually have pronounced effect on growth and may not be as critical for this species as for some others. I have found white grunt to feed on a tremendous variety of benthic invertebrates as well as small fishes, essentially utilizing whatever is available.

Total annual mortality estimates, which varied from 37% to 51% depending on year and method of estimating, are probably not greatly influenced by fishing. Rate of exploitation, as indicated by tag returns, is low and divers report the white grunt to be more reluctant to seize bait than other demersal species observed in the same area (Parker, personal communications)[3]. This situation should not change in the near future because: (1) gear selectivity excludes smaller individuals from catches; (2) large, expensive boats are required, and the long distances to prime fishing grounds limits the number of fishermen; (3) inclement weather and unusual currents limit fishing time; and (4) the species is widely distributed. Small geographically definable areas such as wrecks, rocks or coral patches, however, may be overexploited or temporarily depleted. Yearly mortality estimates reviewed with catch and effort data are needed to better describe the effect of the fishery on the white grunt population of North Carolina and South Carolina.

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