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AGE, GROWTH, AND MORTALITY OF THE BANDED DRUM, *Larimus fasciatus* (SCIAENIDAE) IN NORTH CAROLINA

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ABSTRACT: Age, growth, and mortality were examined for *Larimus fasciatus* collected off North Carolina from September 1975 through September 1976. Fish were aged using length-frequencies, scales, and to a lesser extent otoliths. Problems encountered with aging a rare, short lived, temperate fish were discussed. The maximum size observed was 182 mm SL, and 86% of the specimens were < 128 mm SL. The oldest banded drum reached age 4. Mean weighted back-calculated sizes (scale data) for age classes 1-4 were 75.2 mm, 145.4 mm, 161.8 mm, and 170.8 mm, respectively. The von Bertalanffy growth equation was: $L_t = 178 (1-e^{-0.98(t + 0.38)})$, which predicted sizes at ages 1-4 of 132 mm, 161 mm, 172 mm and 176 mm SL, respectively. Observed, back-calculated, and von Bertalanffy growth curves agreed closely and indicated the fastest growth was in young fish during the spring and summer. The von Bertalanffy growth coefficient (K = 0.98) suggested that maximum size was attained quickly. Instantaneous (Z) and total annual (A) mortality rates were 1.44 and 76%, respectively. Weight-length and total length-standard length conversions were derived.

The banded drum, *Larimus fasciatus* Holbrook, although frequently encountered along the southeastern United States, is one of the less abundant and less studied of the Sciaenidae. It occurs as far north as Massachusetts, but is most abundant in nearshore oceanic waters from Chesapeake Bay to southeastern Florida and along the northern Gulf of Mexico from Florida to Mexico (Chao, 1978). *Larimus fasciatus* seldom grows larger than 160 mm (Chao, 1978) and has little commercial or recreational value except that it was reported in the North Carolina (Wolff, 1972) and Gulf of Mexico (Gutherz *et al.*, 1975) industrial fisheries.

Data on the biology of *L. fasciatus* are limited. Hildebrand and Cable (1934) reported spawning, growth, and juvenile descriptions in North Carolina, and Powles (1980) described larvae and spawning areas and season in the South Atlantic Bight. Feeding habits were briefly examined by Welsh and Breder (1923) and Chao and Musick (1977). Ross (1984) described the reproductive biology of banded drum in North Carolina. The most detailed published study documents age, growth, reproduction, and distribution of *L. fasciatus* in the northwestern Gulf of Mexico (Standard and Chittenden, 1984).

This study describes the following aspects of *L. fasciatus* life history in North Carolina: (1) ages determined by length-frequencies, scales, and otoliths, 2) growth, 3) mortality, 4) weight-length relationship, and 5) standard length-total length relationship.

METHODS

Most banded drum were collected in the ocean 4-6 km off the mouth of the Cape Fear River, North Carolina in depths of 4-14 m (Figure 1). The bottom was flat with sediments of fine sand and mud. Hydrography was heavily influenced by discharge from the Cape Fear River (Ross, 1978). This area was sampled weekly from September 1975 through September 1976, except monthly samples were taken during January and

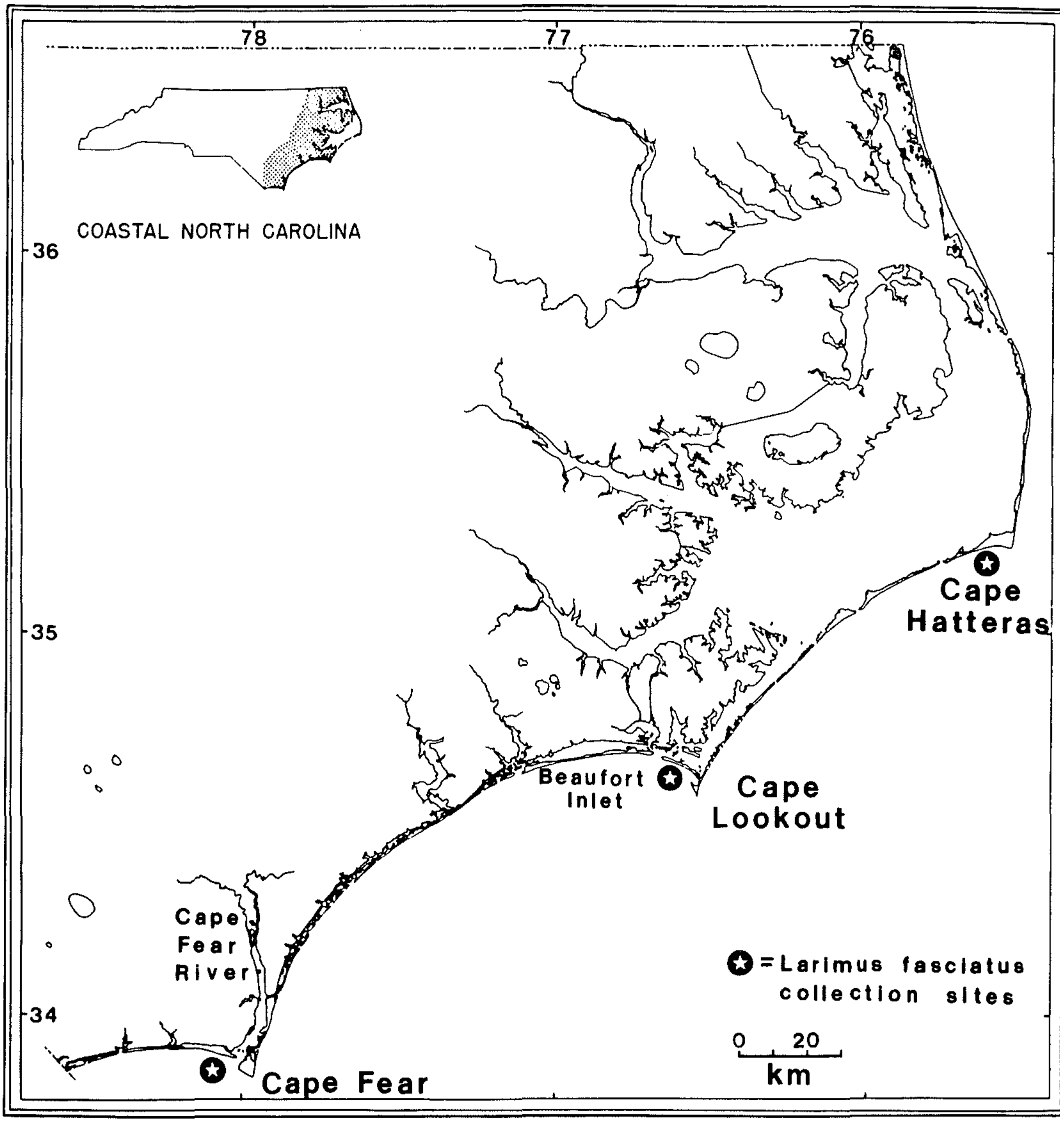

Figure 1. Collection sites for *Larimus fasciatus* in North Carolina.

June through August. Each sample consisted of repetitive (4-12) 30 min trawls with a 12.4 m semi-balloon otter trawl of 3.85 cm stretched mesh during daylight hours.

Additional specimens were collected from September 1975 through September 1976 during twice monthly, daylight sampling between Beaufort Inlet and Cape Lookout, North Carolina (Figure 1), except there was no sampling in December and only monthly sampling in January and February. Repetitive trawls in this area using the above described gear and tow times sampled the flat, sand bottom in a depth range of 2-12 m. Specimens were also collected by trawl near Cape Hatteras (9-17 m depth) in November and December 1975 and April 1976 by the North Carolina Division of Marine Fisheries (Figure 1).

Most *Larimus fasciatus* were initially preserved in 10% formalin and later stored in 40% isopropanol. Irregularly, subsamples of banded drum to be aged by otoliths were frozen to pre-

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vent damage to otoliths by formalin. Total length (TL) and standard length (SL) were measured to the nearest mm. Body weights were recorded to the nearest 0.1 g.

Scales were removed from the left side between the lateral line and the first dorsal fin, placed in envelopes and dried until analysis. Using stratified subsampling (Ketchen, 1950; Ricker, 1975) I aged up to 25 fish from each 10 mm SL group. Six scales from each fish were cleaned, mounted wet between microscope slides, and projected by an Eberbach projector at a magnification of 63X. Distances to marks and overall scale sizes were measured on one representative, unregenerated scale along an axis from the focus to the middle of the anterior field. Marks were recognized by standard criteria (Bagenal and Tesch, 1978; Everhart and Youngs, 1981): cutting over of circuli in the lateral field, crowding of circuli in the anterior field, placement of secondary radii relative to anterior field circuli, and consistency of these characteristics among the six scales examined per fish. Most scales were read at least twice.

Left sagittae were removed from 117 frozen fish and stored in 100% glycerin. Since marks were not apparent externally, otoliths were cut in half sagitally, mounted dry and observed with reflected light under a microscope at 15X magnification. Measurements were made along an axis from the outer edge of the focus to the center of the medial edge. Otolith marks appeared as narrow, dark, opaque rings between wide, translucent bands. Since the otolith sample size was small and restricted to 7 months, otolith data were used for supporting age assignments from other methods and not for growth or mortality analyses.

Banded drum were aged through their first year using length-frequencies (Petersen method, Bagenal and Tesch, 1978). Since cohorts within a year class usually could not be distinguished, June, the chronological mid-point of the spawning season (Ross, 1984), was used as a birth date when fish were assigned to the next highest age class. Scale and some otolith analyses supplemented length-frequency aging of young-of-the-year and yearling banded drum. Older fish which were not abundant in all months were aged with scales and otoliths, and age assignments for these fish were based on the number of hard part marks, marginal increment spacing, back-calculated size at last mark formation, and size comparisons to monthly length-frequencies.

Geometric mean regressions of fish SL on scale size did not intercept the origin; therefore, the positive intercept of the SL axis was used as a correction factor in the direct proportion method of back-calculating size at time of mark formation (Everhart and Youngs, 1981). Growth was modeled with the von Bertalanffy theoretical growth curve (Ricker, 1975) fitted to back-calculated lengths (scale data) at age (time) using nonlinear regression (Vaughan and Kanciruk, 1982).

Total instantaneous mortality rate (Z) was derived from a catch curve (Robson and Chapman, 1961; Gulland, 1983) based on the total sample. Age class percentages of fish aged by scales and length-frequencies were used to calculate the total number of fish of each age by 10 mm group. Total annual mortality rate (A) equaled $1-e^{-Z}$.

RESULTS

Age Determination

The 1975 year class dominated the samples as young-of-the-year from

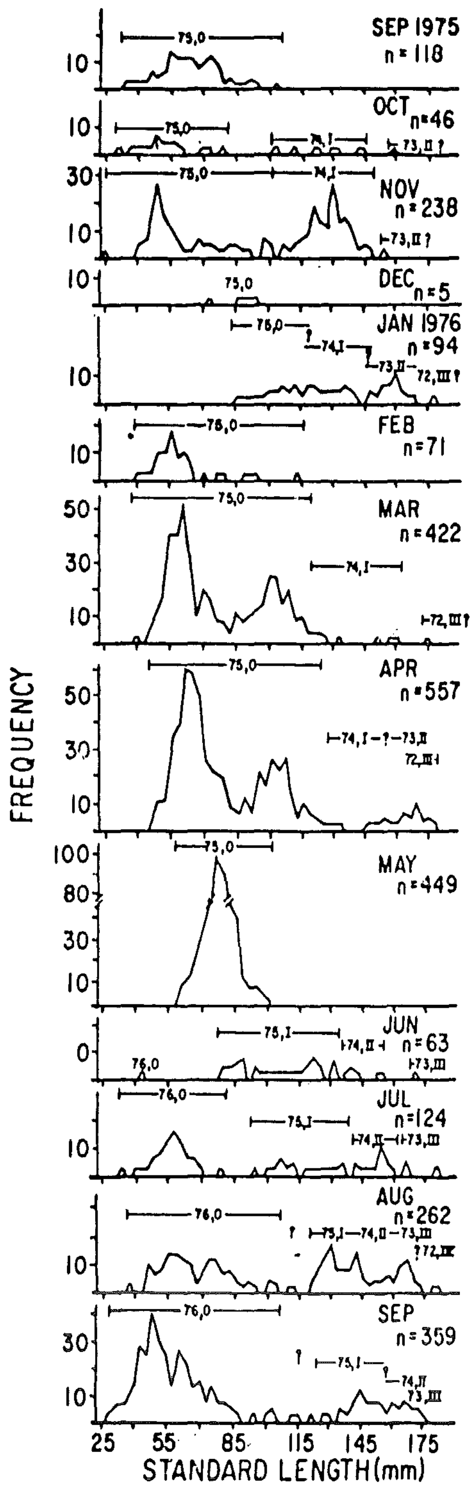

Figure 2. Monthly length-frequencies of *Larimus fasciatus* collected in North Carolina from September 1975 through September 1976. Bars indicated range of age groups. Within each bar the first two numbers depict the year class which is followed by the age designation.

Table 1. Monthly percentage of scale aged young banded drum (1975 year class) with one mark.

Month	% with 1 mark	size range (mm SL)	N
Sep 75	0	35-115	13
Oct	0	30-100	12
Nov	0	40-100	22
Dec	0	70-100	5
Jan 76	0	85-110	9
Feb	0	40-115	11
Mar	0	40-115	21
Apr	42	40-115	19
May	100	55-100	15
Jun	100	75-129	23

September 1975 through May 1976, after which as yearlings they could be traced into September 1976 (Figure 2). This year class displayed a wide size distribution which was bimodal in November, March, and April (Figure 2). The distinct larger group (modal length ≅100 mm SL) of young-of-the-year in March and April may have resulted from spawning early in the previous year. These fish were not always present and neither their origin nor growth could be determined separately from other 1975 year class banded drum. Scales of this year class from September 1975 through June 1976 indicated that the majority of individuals formed a mark between April and May (Table 1). A single minimum scale marginal increment occurred in April (Figure 3) and supported both the formation of a first mark during late spring and the formation of only one mark during the first year.

Young-of-the-year from the 1976 year class appeared in the samples prominently from July through September 1976 and also exhibited the large initial size range characteristic of fish with a long spawning season (Figure 2). No banded drum in this group had scales with marks. The September 1976 size distribution and modal length of the 1976 year class was very similar to the September 1975 distribution of the

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Table 2. Frequency distribution of observed standard lengths (SL) of banded drum by age class, and back-calculated SL distribution of fish with 1 to 4 scale marks.

	Observed SL at Capture									Back-calculated SL			
	Scales					Otoliths							
SL (mm)	0	1	2	3	4	0	1	2	3	1	2	3	4
10- 19	1												
20- 29	2												
30- 39	11									1			
40- 49	23					8				19			
50- 59	25					9				23			
60- 69	25					1				21			
70- 79	24	1				1				26			
80- 89	17	8				3				13			
90- 99	22	3				4				8			
100-109	14	11				4				14	1		
110-119	12	13				2	5			7	2		
120-129		25					16			8	4		
130-139		20	5				17			1	17		
140-149		19	5				8	2			17	1	
150-159		3	19	2			3	5			29	12	
160-169			10	14				9	4		10	21	5
170-179				19	2			1	11			5	6
180-189					2								
Totals	176	103	39	35	4	32	49	17	15	141	80	39	11

previous year class (Figure 2).

Banded drum year classes prior to 1975 were more difficult to age. I considered the fish between 100-150 mm in November (Figure 2) to be yearlings (1974 year class). They were well separated from the majority of the 1975 year class and their modal length of 130 mm was quite close to that attained by the 1975 year class at a similar age in September 1976 (Figure 2). I expected scales and otoliths from these fish to have one mark with a large marginal increment. However, only 35% of the scale-aged fish (n = 20) in November (100-150 mm) had such a mark. Seventy-two percent of the otolith aged fish in this group had 1 mark (n = 29), but there was only a 35% agreement in mark formation between fish aged with both hard parts (n = 17). Apparently many fish in this group did not form a mark the first year, especially on scales. No banded drum between 100-150 mm in November had scales or otoliths with more than 1 mark, and all hard parts with annuli exhibited large marginal increments consistent with the hypothesis that marks were annual and formed the previous spring.

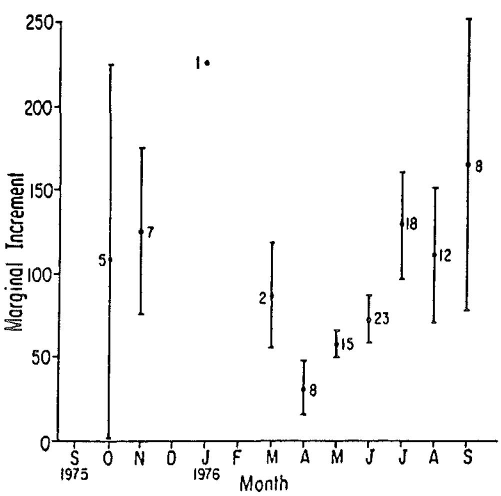

Figure 3. Monthly mean scale marginal increments of banded drum with 1 annulus. Closed dots are means, lines are 95% confidence intervals, and sample sizes are beside each dot.

Yearlings of the 1974 year class became increasingly difficult to separate from older and younger fish in the length-frequencies (Figure 2), and were difficult to age with hard parts because some fish were missing a first annulus. By June these fish were 2 year olds, having 1 or 2 scale marks. Most June banded drum ⩾ 130 mm with 1 scale mark (n = 8) had back-calculated sizes much larger than those expected for one year old fish from the 1975 year class. I considered these fish to be part of the group not forming a first annulus, thus, their single mark was a second year annulus. All aged fish ⩾ 130 mm SL from June through September 1976 had at least 1 mark on scales and otoliths. There was no indication that banded drum missed forming marks other than the first.

Aging banded drum relied increasingly on hard parts for larger fish. Individuals that were probably more than 1 year old did not occur in all months, and when present, were not abundant. This and the tendency for length-frequency modes to converge in older fish complicated age class determination by the Petersen method. Banded drum > 156 mm SL were most evident in January, April, and July-September 1976 (Figure 2) and all had 2-4 scale or otolith marks. Many of these banded drum appeared not to have formed a first annulus. The first observed mark was considered the second annulus if the fish exhibited the mark a large distance from the focus and had a back-calculated SL to this mark much larger than expected for fish ⩽ 1 year old. Forty-four percent of the banded drum ⩾ 150 mm aged by scales appeared not to have formed a first mark.

The major problem with aging banded drum by hard parts was determining if marks formed only once a year. The evidence indicated that if a mark was formed during the first 1 or 2 years, it was an annual event occurring in the spring (Figure 3, Table 1). Although the minimum mean scale marginal increment of banded drum with 2-4 marks was also during April and was followed by a much larger June increment, the small monthly sample sizes and a lack of 2-4 mark fish in 5 months did not allow conclusive determination that marks 2-4 were annuli. Since the number of marks increased with increasing fish length, since otolith and scale readings from the same fish were usually similar (78%

Table 3. Average back-calculated and observed standard lengths (mm) at age and length increments for *Larimus fasciatus* using scales, September 1975 — September 1976.

Age Class	N	Average Observed SL	Average SL Calculated for Previous Annuli			
			1	2	3	4
0	176	71.8	62.5*	—	—	—
1	103	123.0	80.2	—	—	—
2	39	152.8	67.8	143.3	156.2*	—
3	35	168.8	81.7	146.1	162.2	169.9*
4	4	175.8	94.1	157.3	166.3	172.3
Total N	357		141	75	45	11
Mean weighted calculated SL			75.2	145.4	161.8	170.8
Mean annual calculated increments (based on age classes 1-4)			75.2	70.2	16.4	9.0

*Since fish had annuli before their June birth date, in several cases the fish had one more scale mark than the age indicated.

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agreement excluding fish not forming a first mark), since length-frequency modes closely agreed with observed monthly mean SL of aged fish, and since the mark formed during the first year was an annulus, I propose that marks 2-4 are annuli also. Thus, ages > 1 year old were mainly assigned based on the number of scale marks and the month of capture. The high linear correlations between scale size (SR) and SL [SL = 5.76 + 0.36 (SR), r = 0.98] and otolith size (OR) and SL [SL = 46.79 + 4.22 (OR), r = 0.93] provided basic support for hard part aging.

Back-calculated size at age

Standard lengths at first annulus formation agreed closely with modal sizes of the 1975 year class in April and May (Figure 2). The weighted mean size at first annulus formation (April-May) was 75.2 mm SL (Table 3). Mean lengths at annulus formation for ages 2-4 were 145.4, 161.8, and 170.8 mm, respectively, coinciding with a single April length-frequency group (Table 3, Figure 2). The mean back-calculated sizes at ages 1-4 (Table 3) were similar regardless of the age class from which they were calculated. A slight trend toward reverse Lee's phenomenon (Ricker, 1975) was evident in all age classes. The back-calculated SL ranges (Table 2) for age classes 1-4 were 35-137 mm, 104-165 mm, 150-174 mm, and 165-179 mm, respectively.

Table 4. Mean annual growth (G)[1] in standard length by age of *Larimus fasciatus* from North Carolina based on scale aged individual fish back-calculated lengths, September 1975 — September 1976.

Age Class	Mean instantaneous yearly growth at age		
	1	2	3
2	0.80	0.08	
3	0.64	0.11	0.04
4	0.46	0.06	0.04
N	36	45	11

[1]$G = \log_e L_{(i+1)} - \log_e L_i$, where G = instantaneous yearly growth rate in SL for age i fish, L_i = back-calculated SL at age i, and $L_{(i+1)}$ = back-calculated SL at age i + 1.

Growth

Observed and calculated growth increments for scale aged fish varied most from each other in ages 0-2. Empirical annual growth increments were 0-1, 52.1 mm; 1-2, 29.8 mm; 2-3, 16.0; and 3-4, 7.0 mm (Table 3). Mean annual growth increments from back-calculated length at age data (Table 3) indicated rapid growth in the first year with an increment of 75.2 mm. Mean annual growth increments were also large in age class 2, 70.2 mm, but were greatly reduced by age classes 3, increment of 16.4 mm, and 4, increment of 9 mm (Table 3). Annual

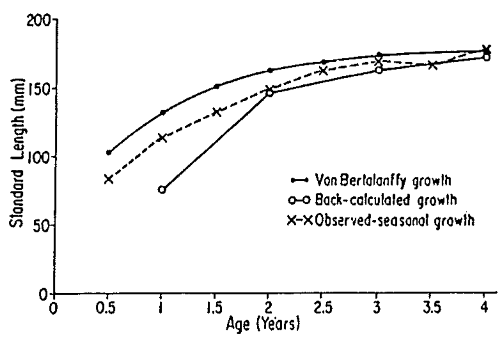

Figure 4. Growth curves of North Carolina banded drum using observed sizes at age, back-calculated sizes at age and the von Bertalanffy model fitted to back-calculated lengths at age.

instantaneous growth rates (G) (as opposed to population growth presented above, Ricker, 1975) calculated from scale aged individual fish declined with increasing age (Table 4).

The von Bertalanffy growth equation based on mean weighted back-calculated SLs for ages 1-4 was:

$$L_t = 178 [1 - e^{-0.98 (t + 0.38)}].$$

This growth model (Figure 4) predicted

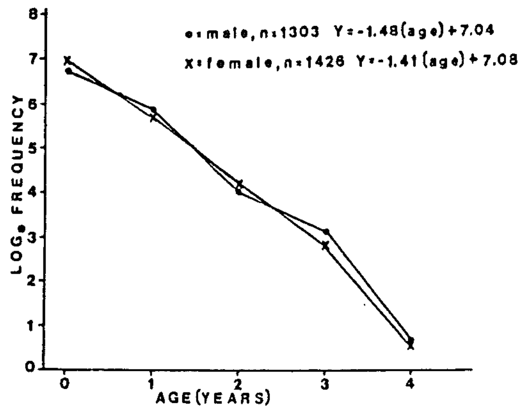

Figure 5. Catch curves by sex of trawl collected *Larimus fasciatus* from North Carolina, September 1975 - September 1976. Numbers at age were expanded based on aged subsamples.

that banded drum reached sizes of 132 mm, 161 mm, 172 mm, and 176 mm at ages 1-4, respectively. The calculated theoretical maximum SL, 178 mm, was very close to the largest banded drum observed (182 mm). Banded drum reached 74% of the theoretical maximum size by age 1, 90% by age 2, 97% by age 3, and 99% by age 4.

Growth curves plotted from von Bertalanffy, observed, and back-calculated data agreed closely except during the first 1.5 years. Mean observed lengths of 1 year olds were larger than the back-calculated lengths because of rapid growth of June-August fish. The seasonal growth curve (Figure 4), scale increment changes (Figure 3), and the monthly change in length-frequency peaks (Figure 2), indicated that the fastest growth was in young fish during spring and summer. Growth rate slowed the most after age 2 (Figure 4).

Mortality

Larimus fasciatus appeared to be fully vulnerable to the collection gear in this study at all sizes > 25 mm SL. Mortality rates exhibited very little difference between sexes (Figure 5). Overall instantaneous mortality rate (Z) was 1.44

Table 5. Expanded frequency distribution of banded drum age classes by sex and 10 mm size interval derived from scale aged fish, September 1975 — September 1976. M = male, F = female, and T = total.

SL (mm)	Age Class														
	0			1			2			3			4		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
10- 19															
20- 29	2	-	2												
30- 39	13	7	20												
40- 49	116	61	177												
50- 59	211	237	448												
60- 69	234	250	484												
70- 79	199	220	419	19	-	19									
80- 89	73	89	162	42	39	81									
90- 99	42	70	112	24	6	30									
100-109	26	72	98	52	33	85									
110-119	14	36	50	31	24	55									
120-129				50	70	120									
130-139				44	47	91	8	16	24						
140-149				23	40	63	9	9	18						
150-159				3	6	9	31	28	59	-	5	5			
160-169							12	16	28	12	28	40			
170-179										11	15	26	1	1	2
180-189													1	1	2
TOTAL	930	1042	1972	288	265	553	60	69	129	23	48	71	2	2	4

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and the total annual mortality rate (A) was 0.76. Expanded numbers by sex and total in each age class by 10 mm size groups which were used in the catch curve are presented in Table 5.

Weight-length and standard length-total length relationships

The relationship between SL and weight (W) for all banded drum was: $W = 0.193 \times 10^{-4} (SL)^{3.08}$, $r = 0.99$, $n = 2808$, SL range 19-182 mm. There was little difference in the weight-length relationship between the sexes. The equation for females ($n = 1310$) was: $W = 0.180 \times 10^{-4} (SL)^{3.09}$, $r = 0.99$ and for males ($n = 1318$) was: $W = 0.189 \times 10^{-4} (SL)^{3.08}$, $r = 0.98$. Standard and total lengths were highly correlated ($r = 0.99$, $n = 2440$), and linear regressions yielded the conversion formulae, $SL = 0.848 (TL) - 7.81$ and $TL = 1.167 (SL) + 10.26$.

DISCUSSION

This study is the only known attempt to age banded drum with hard parts. Standard and Chittenden (1984) used length-frequencies. Although the first scale mark can be validated as an annulus, succeeding marks cannot be conclusively validated as annuli. The highly recommended annulus validation procedure of mark-recapture (Beamish and McFarlane, 1983) is very difficult to use for most marine fishes. Since banded drum are relatively rare and not directly targeted in a fishery, the mark-recapture technique is nearly impossible. Aging techniques applied in this study are most useful during initial fast growth (Beamish and McFarlane, 1983), which includes most of the banded drum life span.

Noteworthy complications in aging banded drum were: 1) general rarity of specimens in most months, 2) lack of larger fish with more than one scale or otolith mark in many months, 3) fast growth and the long spawning season, and 4) failure in some fish to form a first annulus. Lack of first annulus formation is not unexpected in a fast growing, temperate fish, but it is difficult to detect without several years of sampling to follow all year classes (Buchholz and Carlander, 1963). Length-frequency analysis as recommended by Carlander (1974) and Bagenal and Tesch (1978) and comparison of observed sizes to back-calculated lengths at first marks helped resolve the degree of first mark failure. It would be difficult to more adequately treat the first two problems listed above. Thirteen months of intensive sampling along the North Carolina coast (see Methods) produced 2808 *L. fasciatus*. Preliminary sampling during 1973 and 1974 in the Cape Fear area (using same methods and effort as described here) yielded only 678 small banded drum (Ross, 1978). Rare species such as banded drum are always difficult to age regardless of the aging technique.

Rapid growth especially in the first year is characteristic of most sciaenids (*e.g.* Pacheco, 1962; Schaefer, 1965; Mercer, 1983). My results agree with the suggestion of Hildebrand and Cable (1934) that banded drum grew rapidly their first year, possibly attaining 120-125 mm TL (=94 – 98 mm SL). Their proposed age 1 length is similar to the 1975 year class June modal length presented here (Figure 2) and the mean age 1 length in September-October (106-117 mm SL) from the northwestern Gulf of Mexico (Standard and Chittenden, 1984). The von Bertalanffy growth coefficients from North Carolina ($K = 0.98$) and Texas (1.15-1.34, Standard and Chittenden, 1984) indicated that banded drum reached maximum size early in life

Table 6. Von Bertalanffy growth coefficients (K), theoretical maximum lengths (L_∞), and maximum ages for several Western North Atlantic Sciaenidae.

Species	K	L_∞(mm)		Age max (years)	Reference
Larimus fasciatus	0.98	178	(SL)	4	this study
	1.15 - 1.34	201	(TL)	2	Standard and Chittenden (1984)
Cynoscion regalis	0.27 - 0.55	400 - 826	(TL)	4 - 11	Shepherd and Grimes (1983)
C. nebulosus	0.059	935	(TL)	12	Brown (1981)
Menticirrhus americanus	0.27 (♀)	477 (♀)			Smith and Wenner (1985)
			(TL)	6	
	0.64 (♂)	292 (♂)			
M. saxatilis	*0.56* (♀)	448 (♀)			Schaefer (1965)
			(TL)	4	
	0.70 (♂)	387 (♂)			
Micropogonias undulatus	0.311	590	(TL)	2	Chittenden (1977)
	0.27	419	(TL)	8	Barger (1985)
	0.20	645	(TL)	7	Ross (in press)
Pogonias cromis	0.16	1474	(TL)	10	Richards (1973)

especially in the northwestern Gulf of Mexico. Fast growth, high K value, is expected in fishes with short life spans (Pauly, 1980). Calculated growth rates published for other sciaenids vary, but are generally lower than those of *L. fasciatus* (Table 6). The von Bertalanffy K may be inversely correlated with trophic patterns (*i.e.* lower trophic position fish have high K values) (Grimes, 1978; Johnson, 1983; Mason and Manooch, 1985), and *L. fasciatus*, feeding on small crustaceans (Ross, 1978), seems to conform to this view. However, correlation of K values and trophic level, if any, may be indirect. The herbivore *Brevoortia tyrannus* exhibits K values of 0.20-0.484 (Henry, 1971; Reintjes, 1969), while the piscivores *Pomatomus saltatrix* (Lassiter, 1962), *Scomberomorus cavalla* (Johnson *et al.*, 1983), and *Prionace glauca* (Cailliet *et al.*, 1983) have similar K's of 0.103-0.342, 0.28, and 0.175-0.25, respectively. Pauly (1980) suggested that K is positively correlated with temperature and other stress causing factors.

North Carolina banded drum probably never complete a fifth growing season. Although banded drum larger than the maximum of this study (182 mm SL, 232 mm TL) have been reported, 305 mm TL (South Carolina, Holbrook, 1860), 271 mm TL (off Mississippi, Franks, 1970), they are uncommon larger than 200 mm TL (= 162 mm SL). The Sciaenidae generally display moderate longevity (Table 6) with *Larimus fasciatus*, *Leiostomus xanthurus* (Pacheco, 1962; DeVries ms.[1]), *Cynoscion nothus* (DeVries and Chittenden, 1982), and *Stellifer lanceolatus* (Thomas, 1971) at the lower end of the longevity scale.

There are numerous differences in the *L. fasciatus* population structure between North Carolina (this study) and the northwestern Gulf of Mexico (Standard and Chittenden, 1984). In the northwestern Gulf of Mexico banded drum are 24-29 mm and 16-31 mm SL smaller at ages 1 and 2, respectively. They attain smaller maximum size (145 mm) and age (2 years), and have a greater annual mortality rate (92-100%). Ninety-nine percent

[1]DeVries, D.A. Age and growth of spot, *Leiostomus xanthurus*, in North Carolina. unpubl. ms. N.C. Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557.

of the northwestern Gulf banded drum were < 128 mm SL as opposed to 86% off of North Carolina. Larger and possibly older banded drum occur in the north central Gulf of Mexico (Standard and Chittenden, 1984). The trend of larger, older specimens of many species to be more abundant in the north central Gulf (Gutherz and Thompson, 1977; Standard and Chittenden, 1984) is similar to the United States east coast pattern where the largest and oldest individuals of several warm-temperate species such as *Micropogonias undulatus*, *Leiostomus xanthurus*, and *Cynoscion regalis* occur abundantly from middle North Carolina to New Jersey (Gunter, 1950; Wilk, 1981). South of this area to Cape Canaveral, FL these species are most abundant as juveniles and yearlings.

Banded drum are commonly caught as a by-catch in nearshore trawling operations in the South Atlantic Bight (Bullis and Thompson, 1965; Anderson, 1968; Keiser, 1976). Although there are no directed fisheries for this relatively rare species, fishing mortality may be a significant part of the total annual mortality rate during the nearshore shrimping season, approximately April-December (Keiser, 1977), and the offshore winter trawl season, November-April (Pearson, 1932; *pers. obs.*).

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