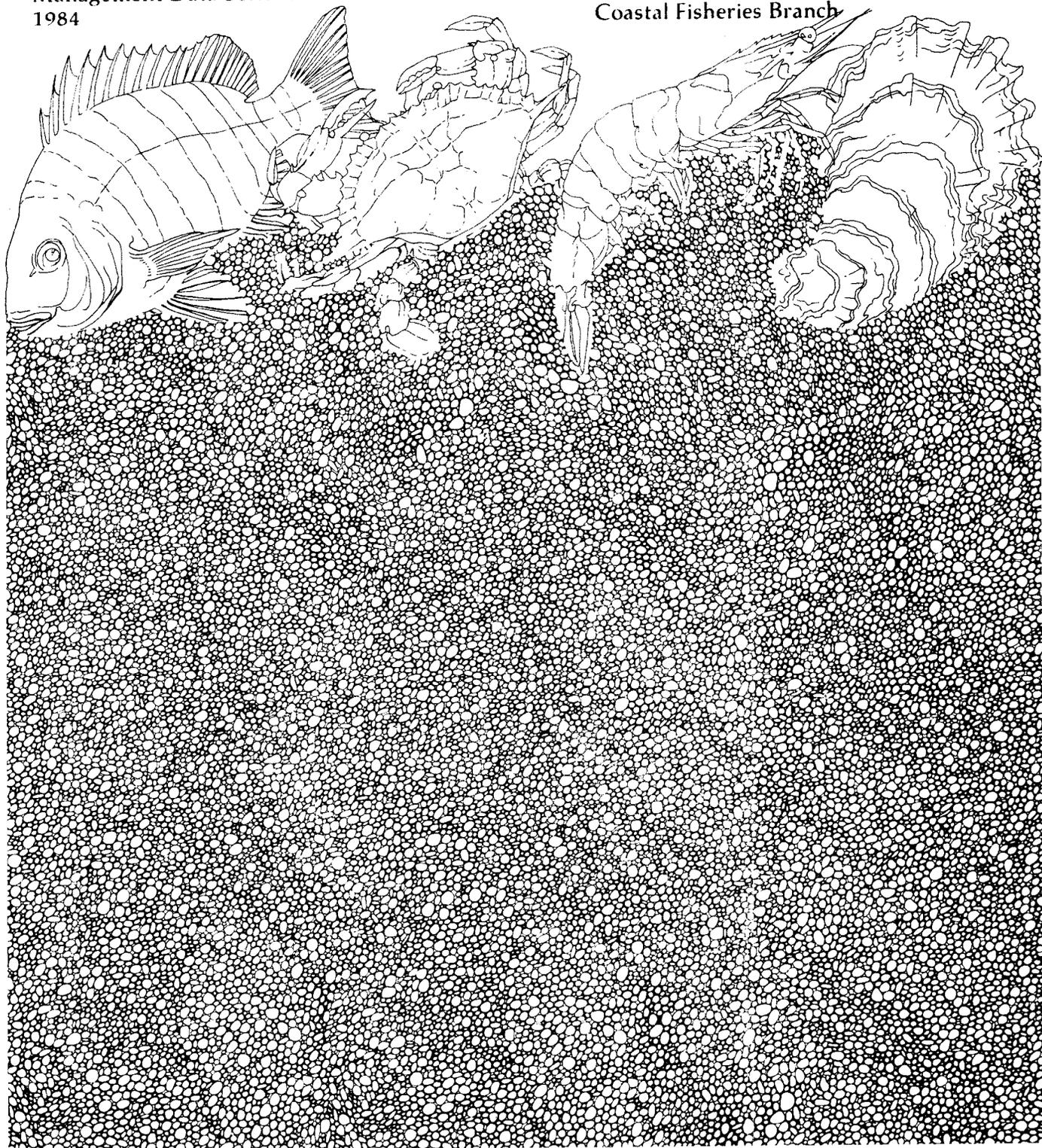


**PRELIMINARY EVALUATION OF THE SCALE METHOD
FOR DESCRIBING AGE AND GROWTH OF
SPOTTED SEATROUT (*Cynoscion nebulosus*) IN THE
MATAGORDA BAY SYSTEM, TEXAS**

By: Robert L. Colura, Catherine W. Porter, and
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Management Data Series Number 57
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Texas Parks and Wildlife Department
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ABSTRACT

Inconsistent literature and inadequate methods validation data prompted a pilot study to evaluate the use of scales to estimate age and growth of spotted seatrout (Cynoscion nebulosus) in Matagorda Bay, Texas. Scale impressions were read with 80 percent agreement between examiners on the first reading. Time of annulus formation appeared prolonged, but too few data were available to conclude whether this was characteristic or the result of marginal increment variability and small sample sizes. Preliminary growth estimates indicated females were significantly larger than males through age IV. Comparison of Matagorda Bay back calculated lengths with averaged values obtained in Florida investigations indicated age I males and females through age IV were 16 to 20 percent longer, although <10 percent differential growth was evident for remaining age groups. The scale method has the potential to reliably estimate spotted seatrout age and growth, but conclusive demonstration that annuli are formed once per year is necessary before it can be incorporated into Texas management plans.

INTRODUCTION

Reliable age and growth information is essential for the development of effective fisheries management strategies. Various estimation procedures are available (Lagler 1956, Tesch 1971), but each requires verification of methodological assumptions with the population under study. Methods validation data are currently inadequate for Texas spotted seatrout (Cynoscion nebulosus). Further, the spotted seatrout age and growth literature is ambiguous regarding the reliability of commonly employed methods.

Spotted seatrout age and growth in Texas have been examined by length frequency distributions in conjunction with scales (Pearson 1929), otoliths (Miles 1950, 1951), and limited tagging returns (Texas Parks and Wildlife Department, unpublished data). However, growth rate calculations from length-frequency data of spotted seatrout are difficult due to extensive age group overlap caused by extended spawning (Guest and Gunter 1958). Additionally, difficulties have been encountered in interpreting scales of Texas spotted seatrout. Scale marks of spotted seatrout collected near Corpus Christi were presumed to be true annuli, but were frequently indistinct (Pearson 1929). Other investigators have stated that true annuli do not form on spotted seatrout from the lower Texas coast (Miles 1950), and that a high degree of false annulus formation occurs in summer (Chech and Wohlschlag 1975).

Effective application of the scale method assumes formation of a distinct annulus coincident with an annual scale increment that correlates to an annual increment in total body length (Van Oosten 1929). Although unsubstantiated for Texas spotted seatrout, this assumption has been verified for Florida specimens (Klima and Tabb 1959, Tabb 1961, Moffett 1961), and the scale method is the accepted age and growth procedure for other sciaenids (Viliyamer 1973). As such, the scale method was viewed as potentially useful in managing Texas spotted seatrout, provided inconsistencies in the literature could be resolved for logical populations. Therefore, a pilot study was conducted to determine if scale impressions of Matagorda Bay spotted seatrout could be interpreted and used to characterize their age and growth.

MATERIALS AND METHODS

Spotted seatrout were collected monthly from various Matagorda Bay system locations February through December 1978. Capture methods included trammel nets, experimental gill nets, and hook and line. Net construction and sample set procedures were those of Matlock and Weaver (1979) and Hegen and Matlock (1980). Total length (TL), sex, and sexual development stage (Tabb 1961) were determined for each specimen. Scales were taken immediately ventral to the lateral line beneath the distal end of the left pectoral fin.

Scales were washed in soapy water and impressed on cellulose acetate slides with a roller press (Smith 1954). Slides were examined at 40 diameters magnification with a microprojector (Eberbach Corporation, Ann Arbor, Mich.). Annuli were counted separately by two authors until agreement was achieved. Distances from the scale focus to successive annuli and the scale margin were measured along a diagonal line to the right antero-lateral scale corner (Klima and Tabb 1959, Tabb 1961).

The mean marginal increment (mean distance from the last formed annulus to the scale margin) was determined for each male and female age group in each monthly collection to determine annual growth patterns and time of annulus formation. Growth rates were determined through age group VII by a computer program based on the Lee method of back calculating lengths (Lagler 1956). Growth curves were constructed with a modification of the Rafail (1973) von Bertalanffy growth model. The von Bertalanffy growth parameters and 95% confidence intervals were determined for the oldest age group (age VI) represented by both sexes in the collections, and compared with the t-test.

RESULTS

Scales taken from 35 spotted seatrout were regenerated and could not be read. The remainder ($n = 379$) were aged with 80 percent agreement between authors on first reading. Of 154 mean marginal increment categories (2 sexes x 7 age groups x 11 months), no representative specimens were captured for 60 combinations, and 36 contained <3 specimens (Appendix A). As such, conclusive determinations of annual growth patterns and time of annulus formation across age groups could not be made. Some indication of annual marginal increment growth trends were provided by age III, IV, and V females which constituted 43 percent of the total collection. Annual growth trends of age III to V females suggested most annulus formation had occurred by late spring as indicated by the rapid decline in mean marginal increment length (Figure 1). However, marginal increment ranges were extremely wide and some annulus formation may have occurred throughout the sampling period.

The percentage of ripe fish in the monthly collections indicated spawning occurred from April through October (Figure 2). Females were more abundant than males for all months sampled except June. The latter collection consisted of small fish averaging 289 mm TL that were presumably schooling at capture. Male gonadal development was pronounced in that all specimens collected during the spawning period were flowing. The percent occurrence of ripe females increased from April through June, achieved 100 percent only for July and August, and declined during September and October.

Female spotted seatrout were larger than males in all age groups (Table 1; Figure 3). The von Bertalanffy growth parameters (Table 2) demonstrated that maximum expected length (L_{∞}) for females was significantly greater than that for males ($P < 0.05$). Annual growth increments were greater for females than males through age VI, with the greatest difference occurring at age I.

DISCUSSION

Distinctive growth marks were evident on Matagorda Bay spotted seatrout scale impressions and resembled annuli described by earlier investigators (Pearson 1929, Klima and Tabb 1959). Time of annulus formation appeared to be extended, and may be related to prolonged spawning of spotted seatrout in Texas (Pearson 1929, Gunter 1945, Miles 1951). Fishes that begin reproducing in spring grow rapidly only after spawning is completed (Chugunova 1963). Early spawning spotted seatrout presumably begin annual growth sooner than later spawning individuals, which may account for the marginal increment ranges among age groups. Whether extended annulus formation is truly representative of Matagorda Bay specimens, or simply the result of marginal increment variability and small sample sizes cannot be conclusively determined from available data. However, the latter appears more likely in that extended spawning and marginal increment variability were characteristic of Florida specimens which form true annuli once per year (Klima and Tabb 1959, Tabb 1961, Moffett 1961).

Back calculated total lengths and annual scale growth increments for Matagorda Bay spotted seatrout differed from estimates for Florida specimens (Table 1). Females through age IV and age I males from Matagorda Bay were 16 to 20 percent larger than comparably aged Florida fish. However, differential growth between areas averaged less than 5 and 10 percent, respectively, for remaining female and male age groups. Female spotted seatrout were larger than males in Matagorda Bay and this finding concurs with earlier studies (Pearson 1929, Klima and Tabb 1959, Tabb 1961). Moffett (1961), found no differential growth of sexes near Cedar Key and Fort Meyers, Florida, but attributed this similarity to a lack of older year classes in the collection.

Several factors may account for the growth differential between Matagorda Bay and Florida. Florida estimates were based on two to five times more specimens than those for Matagorda Bay, suggesting greater methodological precision for the former studies. However, different ecological conditions between areas may have affected growth. Additionally, differential growth may reflect genetic variability of distinct subpopulations of spotted seatrout from different coastal areas (Iverson and Tabb 1962, Weinstein and Yerger 1976).

Despite reported difficulties in interpreting scale marks of Texas spotted seatrout (Miles 1950, 1951; Chech and Wohlschlag 1975), scale impressions of Matagorda Bay specimens were easily aged using annulus criteria for Florida populations (Klima and Tabb 1959, Tabb 1961). Further, preliminary growth estimates of Matagorda Bay spotted seatrout were in reasonable agreement with more comprehensive Florida studies (Klima and Tab 1959, Tabb 1961, Moffett 1961). The above observations infer that the scale method has the potential to reliably estimate age and growth of spotted seatrout in Texas bays. However, available data were insufficient to conclusively demonstrate that annulus formation occurs once per year. As such, additional data regarding time of annulus formation is required before the scale method can be incorporated into a management plan for this species.

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Table 1. Calculated total lengths and annual growth increments () of spotted seatrout from Matagorda Bay, Texas, 1978, Fort Myers and Cedar Key areas, Florida (Moffett 1961), and northwest Florida (Klima and Tabb, 1959).

Sampling location	Sex	n	Total length (mm) at year							
			I	II	III	IV	V	VI	VII	VIII
Matagorda Bay system, Texas	males	151	182	250(68)	302(68)	344(42)	392(48)	431(39)		
	females	228	236	308(72)	367(59)	414(47)	456(42)	491(35)	520(29)	
Fort Myers, Florida ^a	males	720	157	246(89)	307(61)	365(58)	415(50)	509(94)		
	females	1253	161	250(89)	315(65)	378(63)	434(56)	477(43)	502(25)	510(8)
Cedar Key, Florida ^a	males	242	159	246(87)	311(68)	379(68)	444(65)	507(63)		
	females	636	160	253(93)	318(65)	379(61)	448(69)			
Northwest Florida ^a	males	353	143	225(82)	296(71)	358(62)	400(42)	432(32)		
	females	568	145	229(84)	305(76)	370(65)	435(58)	493(58)	509(16)	

^aTotal lengths (TL) were calculated from standard lengths (SL) using the formula $TL_{mm} = 11.804 + 1.138 SL_{mm}$ (Harrington, et. al., 1979).

Table 2. von Bertalanffy growth model parameters and 95% confidence intervals (growth coefficient, K ; maximum expected length, L_{∞} ; age at length 0, t_0) to age VI for male and female spotted seatrout, Matagorda Bay, Texas, 1978, compared by the t -test.

Parameter	Male	Female	t
K	0.33 ± 0.11	0.42 ± 0.15	1.17
L_{∞}	486.83 ± 16.41	524.84 ± 20.10	3.58*
t_0	-0.08 ± 0.22	-0.07 ± 0.29	0.78

* $P < 0.05$

Figure 1. Monthly marginal increment means and ranges for age III-V female spotted seatrout from Matagorda Bay, Texas, 1978.

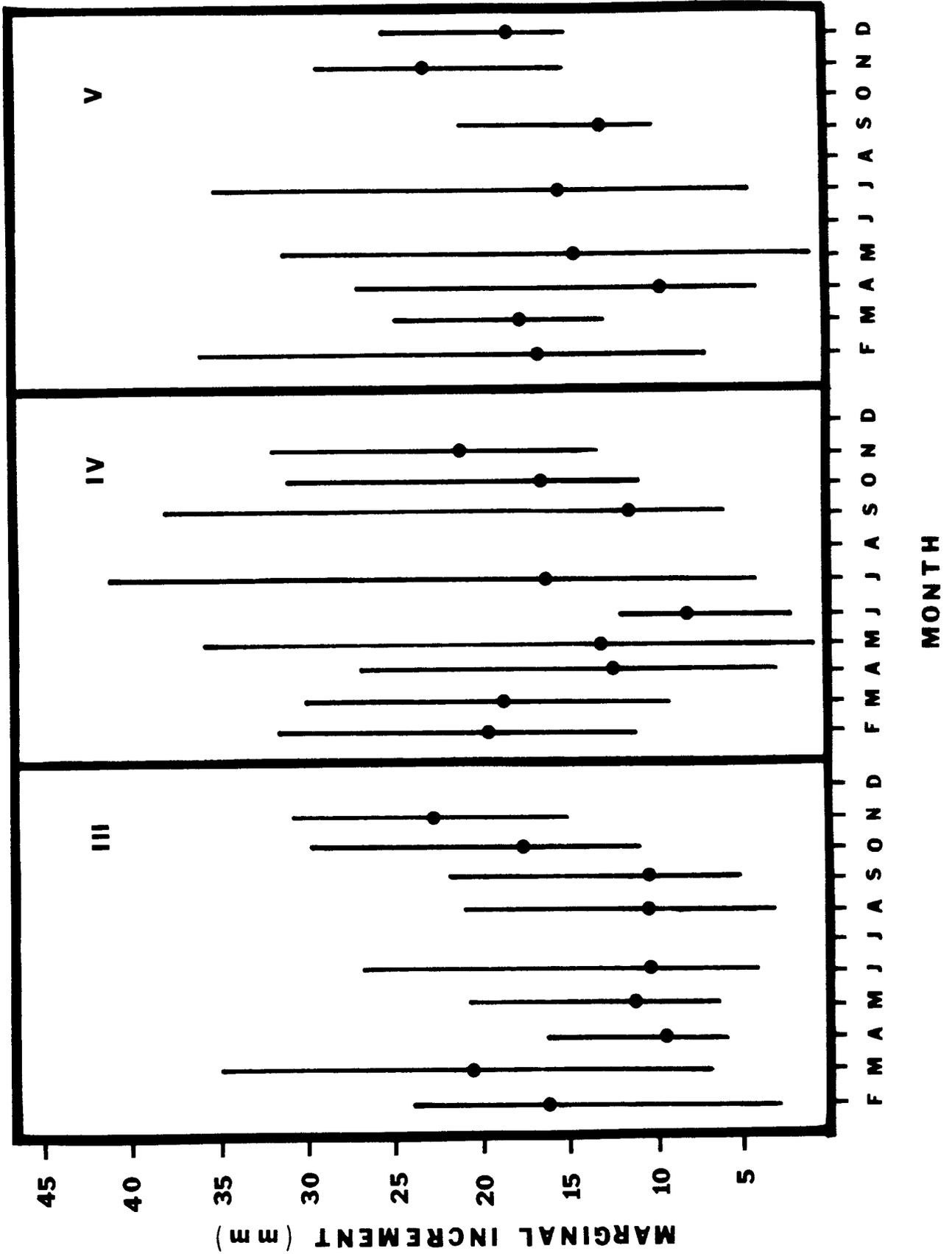


Figure 2. Number and percent of ripe male and female spotted seatrout collected in monthly samples from Matagorda Bay, Texas, 1978

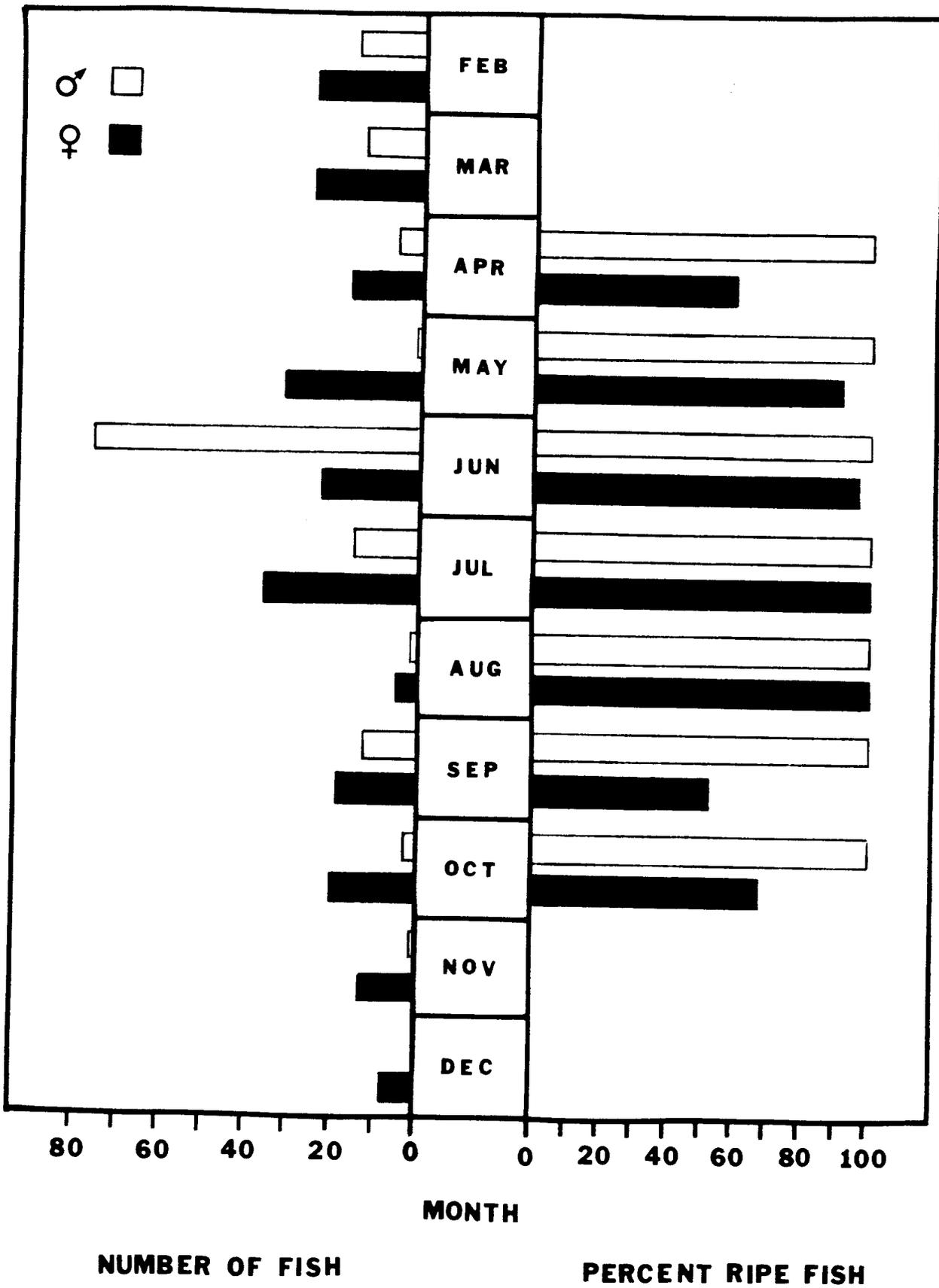
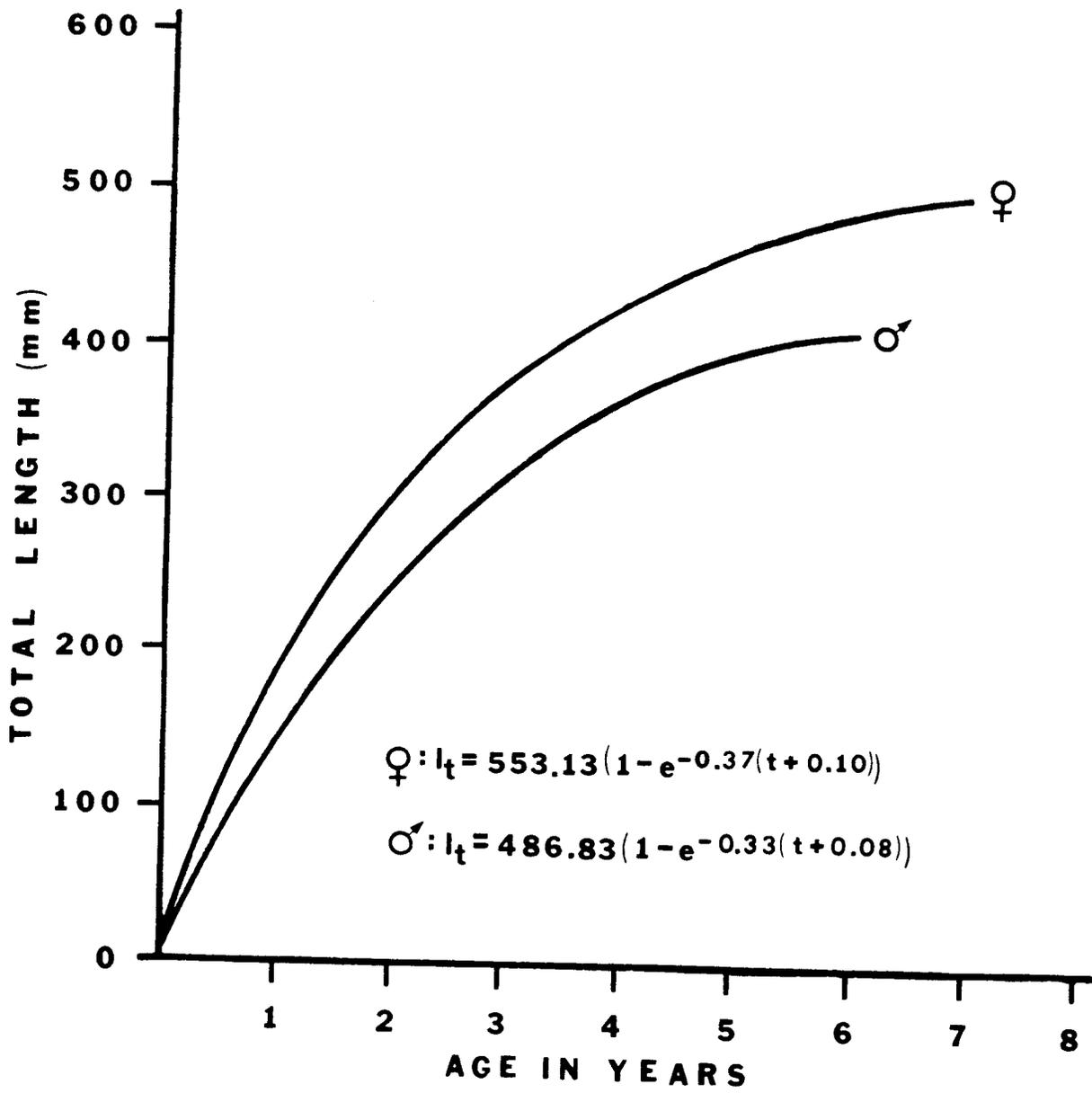


Figure 3. von Bertalanffy growth curves for male and female spotted seatrout, Matagorda Bay, Texas, 1978.



Appendix A. Mean (\pm S.E.) marginal increments (mm) and ranges for male and female spotted seatrout age groups collected from Matagorda Bay, February through December, 1978.

Table 1.A. Mean (\pm S.D.) marginal increments (mm) and ranges for male and female spotted seatrout age groups collected from Matagorda Bay, February through December, 1978 (Numbers in parentheses denote sample size, ND = No Data).

Sex	Month	Age groups						
		I	II	III	IV	V	VI	VII
Male	Feb	ND	17 \pm 4 14 - 20 (2)	14 \pm 6 7 - 23 (5)	9 \pm 5 2 - 14 (9)	ND	ND	ND
		ND	13 -- (1)	12 \pm 7 3 - 26 (7)	15 \pm 6 10 - 23 (6)	ND	ND	ND
	Apr	ND	ND	13 \pm 6 9 - 17 (2)	12 \pm 10 5 - 24 (3)	14 -- (1)	ND	ND
May		ND	ND	21 -- (1)	ND	ND	ND	ND
June		32 \pm 12 14 - 57 (11)	17 \pm 11 3 - 47 (24)	9 \pm 6 2 - 26 (37)	8 \pm 4 5 - 14 (4)	11 \pm 7 6 - 16 (2)	ND	ND
		ND	33 -- (1)	10 \pm 6 6 - 17 (3)	8 \pm 4 5 - 15 (10)	5 -- (1)	6 -- (1)	ND
Aug		ND	ND	ND	30 -- (1)	14 -- (1)	ND	ND
Sep		ND	14 \pm 6 6 - 22 (8)	9 \pm 8 1 - 16 (3)	14 -- (1)	12 -- (1)	ND	ND

Table 1.A. (Cont'd.).

Sex	Month	Age groups							
		I	II	III	IV	V	VI	VII	
Male	Oct	ND	19	8	31	ND	ND	ND	ND
			-- (1)	-- (1)	-- (1)				
	Nov	ND	ND	ND	22	ND	10	--	
					-- (1)		-- (1)		
	Dec	ND	ND	ND	ND	ND	ND	ND	
Female	Feb	ND	15 ± 6 9 - 19 (3)	16 ± 8 3 - 24 (7)	13 ± 7 11 - 32 (8)	16 ± 11 7 - 36 (6)	ND	4	
								-- (1)	
	Mar	ND	20 ± 7 13 - 17 (3)	21 ± 9 13 - 17 (9)	19 ± 11 9 - 30 (3)	18 ± 5 13 - 25 (5)	17	12 ± 6 5 - 19 (4)	
								-- (1)	
	Apr	ND	ND	7 ± 3 4 - 10 (3)	12 ± 8 3 - 27 (12)	10 ± 10 4 - 27 (5)	9 ± 10 2 - 28 (6)	ND	
	May	34 ± 8 25 - 42 (3)	39 -- (1)	11 ± 5 5 - 21 (8)	13 ± 12 1 - 36 (6)	14 ± 15 1 - 31 (4)	2 -- (1)	ND	
	Jun	56 -- (1)	29 ± 12 15 - 41 (8)	10 ± 8 4 - 26 (8)	8 ± 5 2 - 12 (5)	ND	44 -- (1)	ND	

Table 1.A. (Cont'd.).

Sex	Month	Age groups						
		I	II	III	IV	V	VI	VII
Female	Jul	ND	16	15 ± 11 7 - 23 (2)	16 ± 10 4 - 41 (13)	15 ± 12 4 - 35 (10)	8 ± 4 4 - 14 (10)	10 -- (1)
		ND	ND	10 ± 10 3 - 21 (3)	14 ± 13 4 - 23 (2)	ND	ND	ND
	Sep	ND	26 ± 19 4 - 39 (3)	10 ± 6 5 - 22 (6)	12 ± 9 6 - 30 (6)	13 ± 5 10 - 21 (4)	13 ± 7 8 - 18 (2)	ND
		ND	27	18 ± 7 11 - 30 (9)	15 ± 3 11 - 21 (9)	11 ± 4 8 - 14 (2)	ND	ND
	Nov	ND	ND	23 ± 8 15 - 31 (3)	21 ± 8 13 - 32 (5)	23 ± 7 15 - 29 (3)	9 -- (1)	8 -- (1)
		ND	ND	21 -- (1)	13 ± 3 11 - 15 (2)	22 ± 8 15 - 32 (4)	20 -- (1)	ND

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