

NOTES ON THE BIOLOGY OF TARPON, *TARPON ATLANTICUS* (CUVIER & VALENCIENNES), FROM COASTAL WATERS OF CEARÁ STATE, BRAZIL ⁽¹⁾

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The biology of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes), is not well-known, in spite of the extensive literature existing upon that fish, which has shown to be extremely difficult in obtaining accurate biological information (Breder Jr., 1944; Randall & Moffett, 1958). This results from the fact that tarpon, in spite of its vast area of geographic distribution (Briggs, 1958; Sadowsky, 1958; Carvalho, 1964), is generally considered as a sport fish, rarely being an object of commercial fishery.

Fish-weir is one of the most constant characteristics along the coast of Ceará State (Brazil), concentrating around the Acaraú county (figure 1), where it becomes a dominant complex in fishing activity (Seraine, 1958).

Tarpon is the main product in the fisheries at the fish-weirs of the Acaraú county (Seraine, 1958). Its fishery is traditional, serving as a basis for one the most important economical activities of that county.

With the purpose of having a better knowledge upon the biology of tarpon, we decided to collect systematic biological data on that fish in the area of the Acaraú county, starting 1962, of which the first results will be presented in this paper.

INFORMATION ON THE FISHERY

Detailed description of fish-weirs of Ceará State, as well as the methods used in the fishery, are given by Seraine (1958).

Fish-weirs are fixed traps seawardly disposed in single file (figure 2). Canoes enter in its inner side, where the nets are thrown and, for larger fish, the tarpon among them, harpoons and clubs are used.

Since March 1962, we control the catches of tarpon in a line of fish-weirs located in front of Almofala beach, Acaraú county. Data obtained since then, till the end of 1964, are presented in table I and figure 3.

From the data already referred to, what first call our attention is the brutal reduction of tarpon catches, followed by a decrease in its mean weight. We do not know whether it is due to purely natural factors or to a process of overfishing acting on the exploited stock. These facts strengthen much more the urgent need of studies on the biology of that species being proceeded.

Another aspect that calls our attention is the remarkable seasonality of tarpon catches. The time of harvest corresponds to the months of October/November to January, with a likely between-harvest in the month of July. In the rest of the months tarpon catches are very low or even non-existent at all.

INFORMATION ON MIGRATIONS

We know that tarpon is a fish that makes large migrations (Randall & Moffett, 1958), and is not commonly found in open sea, at far-away distance from the coast (Breder Jr., 1944).

During the months of October/November of each year, large schools of tarpon arrive to the coastal waters of Ceará State (table I; figure 3). Skilled fishermen believe that such schools come from coastal waters of Pará and Maranhão States (figure 4), swim close to the coast and reach the coastal waters of Ceará State for the purpose of making a reproduction station, returning to the waters

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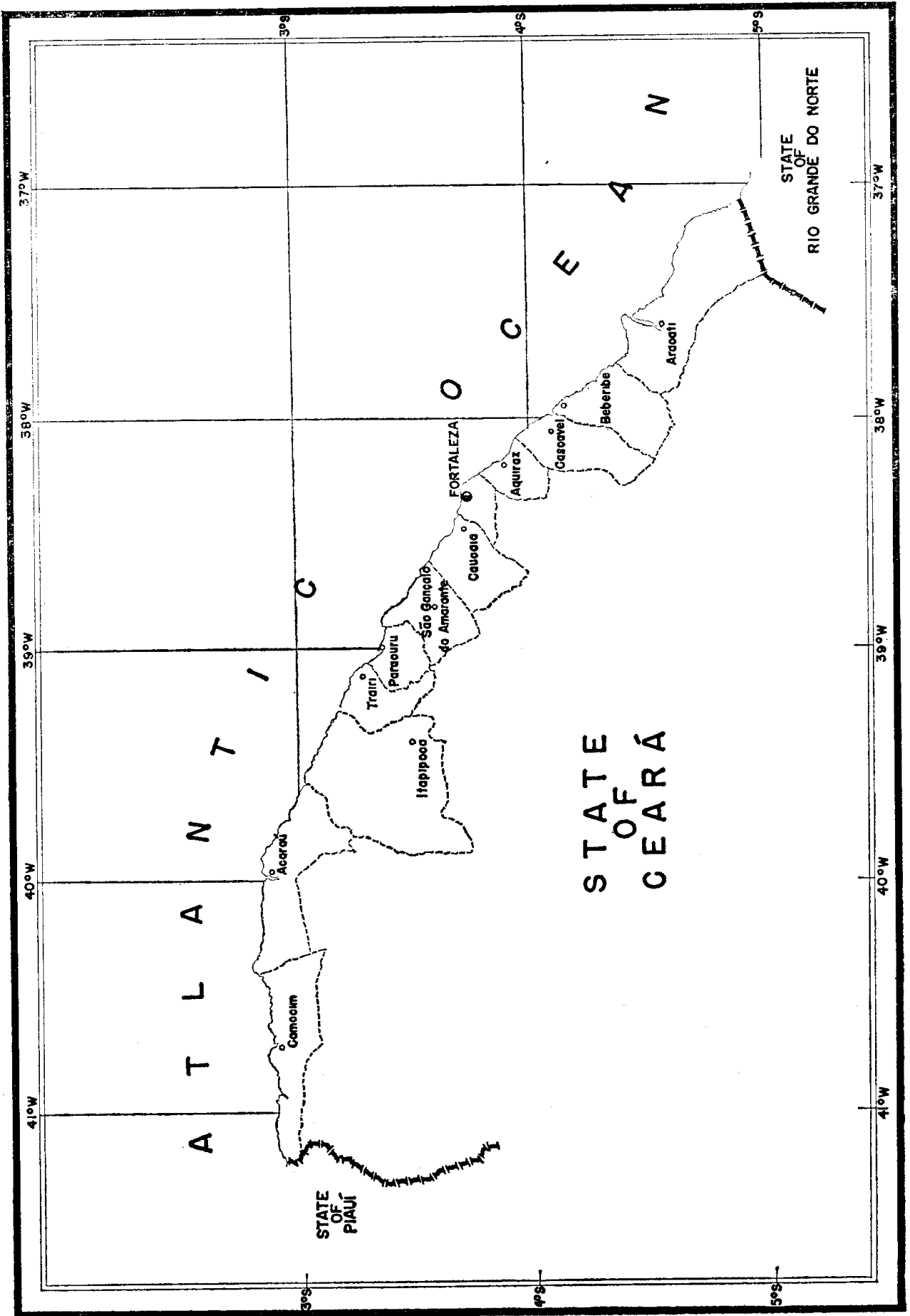


Figure 1 — Coastal counties of the State of Ceará, Brazil.

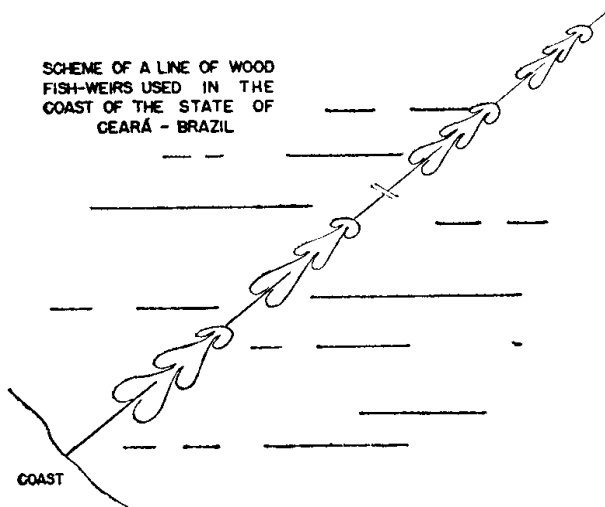


Figure 2 — Scheme of a line of wood fish-weirs used in the coast of the State of Ceará, Brazil.

of its origin in the beginning of the month of February, swimming more in offshore waters, where they are captured by trolling lines. Spotting such schools is easy, for they swim near the surface for making atmospheric breathing, which is compulsory in the species Breder Jr., 1942). Tarpons reaching the coastal waters of Ceará in the last quarter of each year show a brass color, proving that they come from waters of low salinity (Breder Jr., 1944).

In the months of June to August, with maximum normally in July (table I; figure 3), smaller schools of tarpon also come close to the coast of Ceará State. Such schools are made out of fatty individuals, silvery-white colored, suggesting that they come from waters of high salinity (Breder Jr., 1944).

TABLE I

Wood fish-weirs catches of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes), in front of Almofala beach, Acaraú county (State of Ceará — Brazil), during the years from 1962 to 1964.

Years	Months	Catches				Average weights (kg)	
		individuals		weights			
		n	%	kg	%		
1962	March	14	0.3	372.0	0.2	26.6	
	April	1	0.0	43.0	0.0	43.0	
	May	1	0.0	45.0	0.0	45.0	
	June	49	0.9	1,151.0	0.7	23.5	
	July	179	3.4	5,149.5	3.3	28.7	
	August	34	0.6	1,004.0	0.6	29.5	
	September	23	0.4	671.0	0.4	29.2	
	October	522	9.9	15,123.0	9.8	29.0	
	November	1,891	35.7	56,961.0	36.8	30.1	
	December	2,582	48.8	74,741.0	48.2	28.9	
	Total		5,296	100.0	155,260.5	100.0	29.3
	1963	January	574	14.1	12,240.5	15.3	21.3
February		78	1.9	2,340.0	2.9	30.0	
March		14	0.3	390.0	0.5	27.8	
April		—	—	—	—	—	
May		1	0.0	29.0	0.0	29.0	
June		1	0.0	7.0	0.0	7.0	
July		18	0.4	335.5	0.4	18.6	
August		22	0.6	454.0	0.6	20.6	
September		66	1.6	1,293.0	1.6	19.6	
October		840	20.6	15,850.0	19.8	18.7	
November		1,938	47.6	37,183.0	46.5	19.2	
December		526	12.9	9,885.0	12.4	18.8	
Total		4,078	100.0	80,007.0	100.0	19.6	
1964	January	270	39.8	5,083.0	32.4	18.8	
	February	—	—	—	—	—	
	March	1	0.1	40.0	0.2	40.0	
	April	—	—	—	—	—	
	May	1	0.1	54.0	0.3	54.0	
	June	35	5.2	1,098.0	7.0	31.4	
	July	122	18.0	3,337.0	21.3	27.4	
	August	23	3.4	443.0	2.8	19.3	
	September	—	—	—	—	—	
	October	5	0.7	149.0	0.9	29.8	
	November	108	15.9	2,834.0	18.1	26.2	
	December	113	16.8	2,663.0	17.0	23.6	
Total		678	100.0	15,701.0	100.0	23.2	

Remarks: 1) We have no records of catches during the months of January and February, 1962.
 2) Catches reporting the years 1962, 1963 and 1964 refer to 15, 18, and 13 wood fish-weirs, respectively.

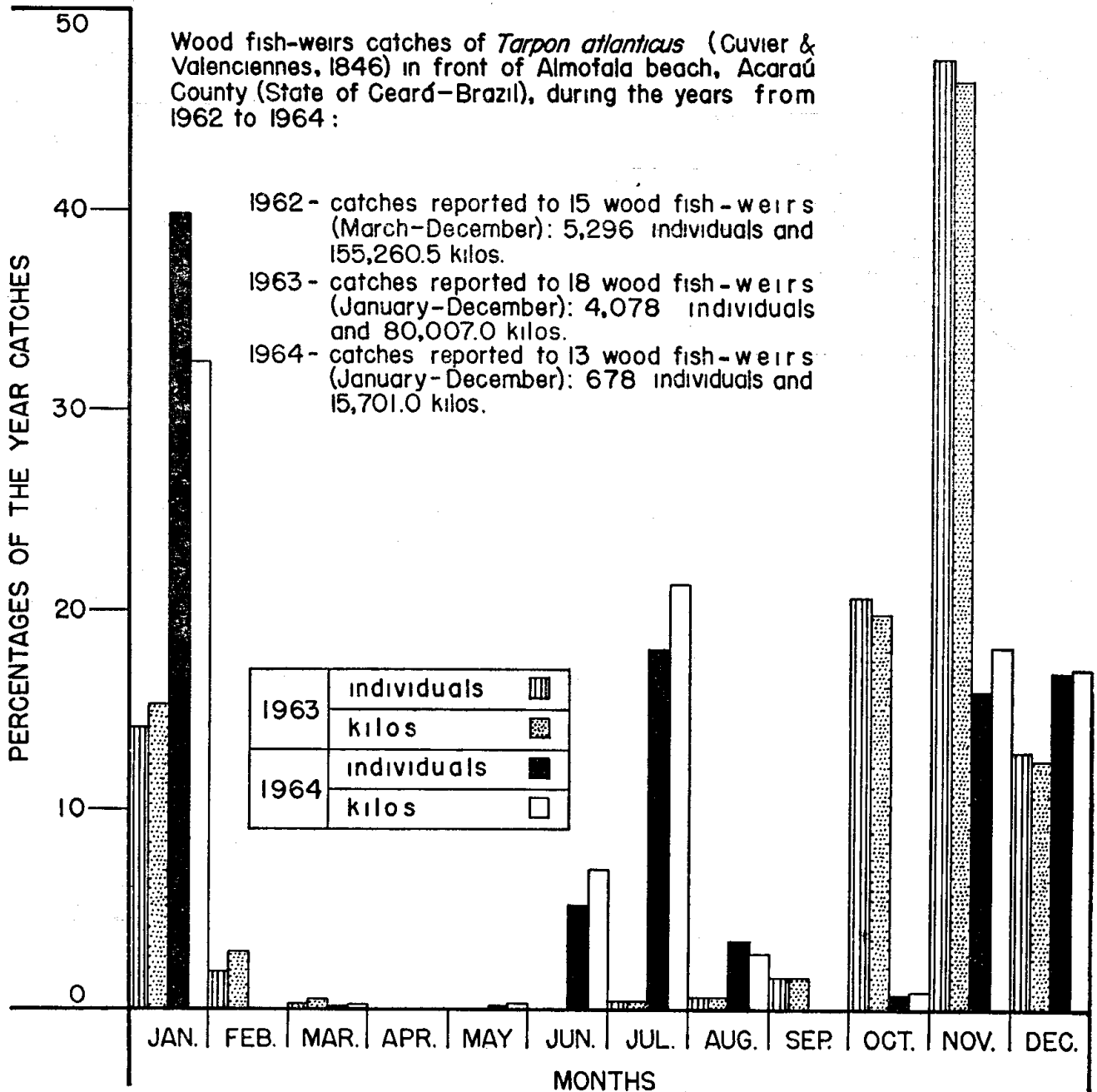


Figure 3 — Wood fish-weirs catches of tarpon, in front of Almofala beach, Acaraú county (State of Ceará — Brazil), during the years from 1962 to 1964.

INFORMATION ON REPRODUCTION

With the purpose of studying tarpon reproduction we tried to identify, macroscopically, the maturity stages of the individuals caught in coastal waters of Ceará State. It is worthwhile to point out that there is a common classification among Ceará's fishermen, which we analysed under the scientific point of view.

Regarding to males, we considered only two maturity stages: the first one corresponds to spermless testicles (virgins, immatures and spent), and the second one corresponds to testicles with sperm (maturing and matures).

Regarding to females, the classification of the several maturity stages was made pur-

suant to field observation, adjusted to Naier's table, according to Bückmann (1929). Four maturity stages were considered: the first one corresponds to immature ovaries (virgin and maturing virgin, according to Naier's table), the second one corresponds to maturing ovaries (developing and developed, according to Naier's table), the third one corresponds to mature ovaries (gravid and spawning, according to Naier's table), and the fourth one corresponds to spent ovaries (spent and resting, according to Naier's table).

Gonads of 1,186 males and 1,283 females were analysed during the years 1962 to 1964, belonging to tarpons caught in coastal waters of the Acaraú county. Table II shows fork

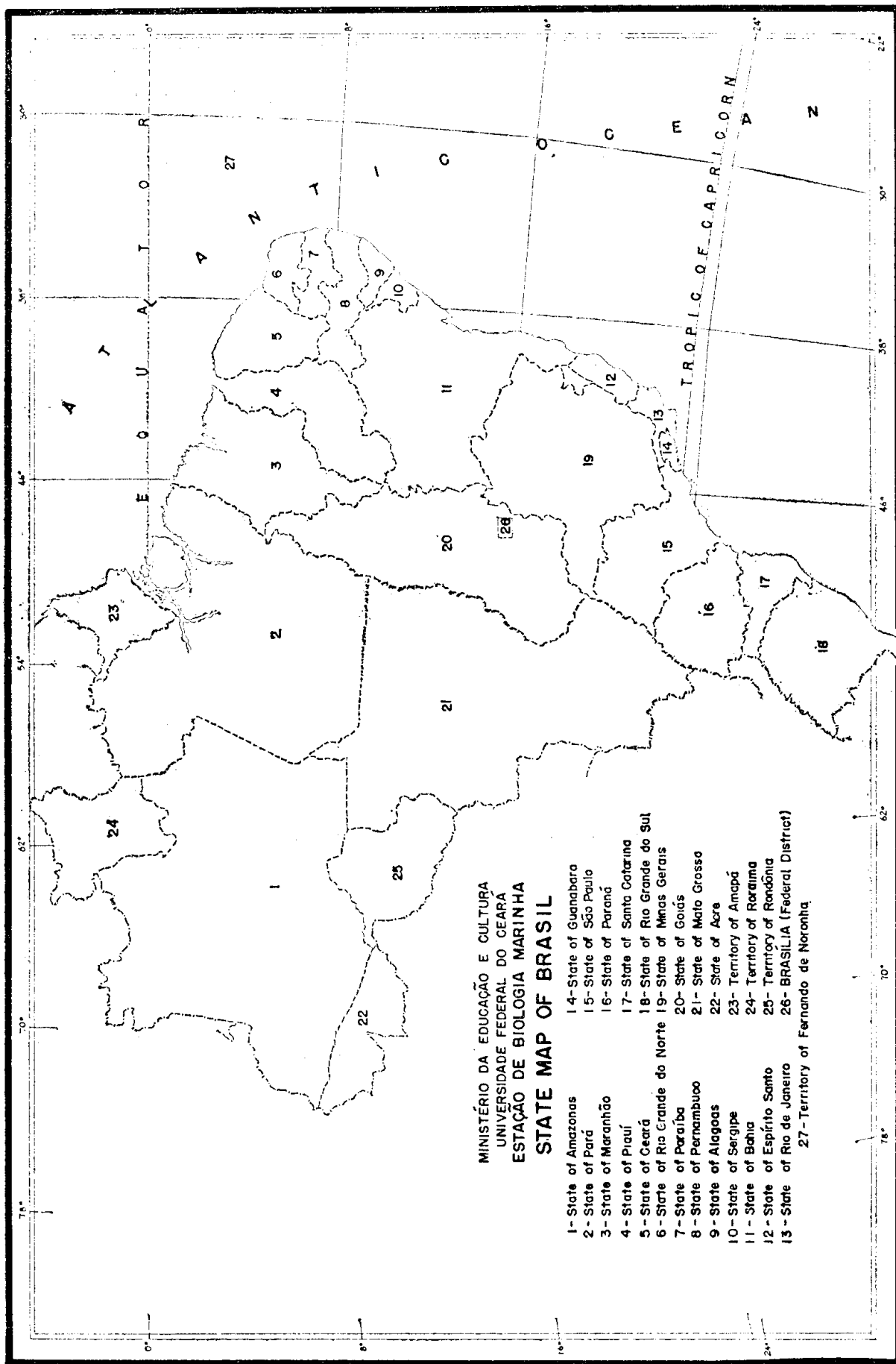


Figure 4 — State map of Brazil.

T A B L E I I

Absolute frequencies of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes), by fork length classes, sexes and gonad stages. Material caught in front of Acaraú county (State of Ceará — Brazil) during the years from 1962 to 1964.

Fork length classes (cm)	Males				Females				Total
	gonad stages		total	gonad stages		total			
	spermless	with sperm		immature	maturing		mature	spent	
55.0 — 59.5	—	—	—	1	—	—	—	—	1
60.0 — 64.5	—	—	—	—	—	—	—	—	—
65.0 — 69.5	—	—	—	—	—	—	—	—	—
70.0 — 74.5	1	—	1	—	—	—	—	—	2
75.0 — 79.5	—	—	—	2	—	—	—	—	2
80.0 — 84.5	—	—	—	1	—	—	—	—	1
85.0 — 89.5	1	—	1	1	—	—	—	—	2
90.0 — 94.5	1	—	1	1	—	—	—	—	2
95.0 — 99.5	—	4	4	—	—	—	—	—	4
100.0 — 104.5	3	17	20	1	—	—	—	—	21
105.0 — 109.5	3	57	60	3	—	—	—	—	63
110.0 — 114.5	12	200	212	5	—	—	—	—	217
115.0 — 119.5	25	322	348	8	—	—	—	—	356
120.0 — 124.5	31	254	285	9	1	—	—	—	295
125.0 — 129.5	45	79	124	14	3	—	—	—	142
130.0 — 134.5	50	32	82	9	12	2	—	—	108
135.0 — 139.5	26	11	37	20	21	5	3	—	86
140.0 — 144.5	3	2	5	20	37	34	15	—	111
145.0 — 149.5	3	2	5	23	79	85	25	—	217
150.0 — 154.5	—	1	1	9	76	116	51	—	253
155.0 — 159.5	—	—	—	4	58	126	49	—	237
160.0 — 164.5	—	—	—	2	28	120	35	—	185
165.0 — 169.5	—	—	—	3	14	51	19	—	87
170.0 — 174.5	—	—	—	1	4	33	16	—	54
175.0 — 179.5	—	—	—	—	—	13	4	—	17
180.0 — 184.5	—	—	—	—	—	3	2	—	5
185.0 — 189.5	—	—	—	1	—	1	—	—	2
Total	205	981	1,186	138	333	590	222	1,283	2,469

length classes established by us, associated with the frequencies of individuals examined at each maturity stage.

In coastal waters of Ceará State, sexual maturity begins at 95.0 and 125.0 centimeters fork length, respectively, for male and female tarpons. These data are very close to those presented for tarpons caught in offshore waters of Florida (Breder Jr., 1944).

Most frequent sizes of mature individuals were comprised between 110.0 and 125.0 centimeters fork length for males, and between 150.0 and 165.0 centimeters fork length for females, based on material caught in coastal waters of Ceará State.

Data presented in table III show that tarpon schools reach the coastal waters of Ceará State, with the purpose of making reproduction. Most intense reproduction of tarpon corresponds to spring (October — December), thus confirming the observations of Ceará's fishermen.

Sex-ratio observed in tarpon catches at the fish-weirs of the Acaraú county (table III) shows that the schools composition varies very much, sometime predominating males, sometime predominating females.

Considering the Fortaleza county rainfall as representative for all the coast of Ceará State, we tried to find out whether exists or not dependency between it and the occurrence and/or reproduction of tarpon in coastal waters of Ceará State.

In the years considered in this paper, annual rainfall at Fortaleza county reached abnormal and high levels, which are: 1,236.4 millimeters in 1962, 2,085.1 millimeters in 1963, and 2,430.9 millimeters in 1964. In relative values of the annual total, rainfall distribution in the different months is shown in table IV, and figure 5 represents the general tendency in the triennial considered.

It is evident that occurrence of tarpon schools in coastal waters of Ceará State corresponds to the period of low rainfall level (June — December), concentrating when it reaches its minimum levels (October — December), seeing that in January and February, initial months of the period of high rainfall level (January — May), such schools leave the coastal waters of Ceará State (tables I and IV; figures 3 and 5). So, tarpon reproduction in coastal waters of Ceará State coincides with the period in which these waters present high salinity, since the rivers draining along the coast have temporary regime, not draining when the rainy season is over (tables III and IV; figure 5).

INFORMATION ON YOUNG TARPONS

Catch of young tarpons has been frequently referred to, and it is always done at

coastal lagoons, in which they enter after previous existence in the sea, at the time when connections with those lagoons with the sea were established (Breder Jr., 1944; Randall & Moffett, 1958).

Born at coastal waters of Ceará State, mainly in the last quarter, young tarpons reach the coastal lagoons when connections of those are established with the sea at the beginning of the first quarter of the following year. Such lagoons are of restricted size, are not much deep and have lots of aquatic grasses. In this environment they remain for about a year, returning to the sea when connections of the lagoons with it are re-established.

While they remain in coastal lagoons, they feed upon insects and, after reaching 15.0 centimeters fork length, they feed upon small crustaceans and fishes. The highly vascularized structure of the swimming bladder permits the young to jump out of the water, not only for catching insects which shares the same biocoenosis, as well as to support marshy waters with low oxygenation, mainly at times of great heat. Besides, this social and breathing behavior is known in the scientific literature (Shlaifer & Breder Jr., 1940).

When young tarpons reach 40.0 to 50.0 centimeters fork length, they need more abundant food and mineralization, searching for coastal waters as soon as the connections of the lagoons with the sea are re-established. Table II confirms the fact that, at the fish-weirs of Ceará State never occurs the catch of tarpon with less than 50.0 centimeters fork length.

INFORMATION ON GROWTH

With the purpose of studying the growth of tarpon that frequent the coastal waters of Ceará State, we collected scales of 50 males and 50 females caught in coastal waters of the Acaraú county during the years 1962 and 1963. Of each individual the fork length, sex, place and date of capture, were recorded, and then 10 scales of the anterior half of the body, above the lateral line, were taken. After being washed with the aid of a nylon bristle brush, were cleaned with a solution of oxygenated water, dried and, then, numbered. Scales reading was made by measuring the distance from the focus to the edge each annulus, directly on the scale (figure 6), with the aid of a steel calliper which allows the measurement of centesimal fractions of a centimeter.

From each individual we normally selected five scales, the reading of each of them being repeated three times, the last one with the aid of a binocular microscope. For each

T A B L E I I I

Absolute and relative frequencies of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes), by quarters and years, sexes and gonad stages, as well as sex-ratios corresponding to quarters and years considered. Material caught in front of Acaraú county (State of Ceará — Brazil), during the years from 1962 to 1964.

Years	Quarters	Males						Females						Total						Sex-ratio (males: females)
		spermless		with sperm		immature		maturing		mature		spent		males		females		both		
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
1962	1st	—	—	13	1.6	—	—	—	—	—	—	6	0.8	13	1.6	6	0.8	19	2.4	1.0 : 0.5 +
	2nd	2	0.2	7	0.9	11	1.4	—	—	4	0.5	1	0.1	9	1.1	16	2.0	25	3.1	1.0 : 1.8 +
	3rd	13	1.6	47	5.8	23	2.8	6	0.7	42	5.2	2	0.2	60	7.4	73	8.9	133	16.3	1.0 : 1.2 +
	4th	42	5.2	194	24.0	34	4.2	66	8.2	259	31.9	38	4.7	236	29.2	397	49.0	633	78.2	1.0 : 1.7 *
	Total	57	7.0	261	32.3	68	8.4	72	8.9	305	37.6	47	5.8	318	39.3	492	60.7	810	100.0	1.0 : 1.5 *
1963	1st	35	2.8	30	2.4	3	0.2	1	0.1	8	0.6	53	4.2	65	5.2	65	5.1	130	10.3	1.0 : 1.0 +
	2nd	1	0.1	—	—	2	0.2	—	—	—	—	—	—	1	0.1	2	0.2	3	0.3	1.0 : 2.0 +
	3rd	7	0.5	47	3.7	4	0.3	7	0.5	33	2.6	—	—	54	4.2	44	3.4	98	7.6	1.0 : 0.8 +
	4th	82	6.5	432	34.2	38	3.0	190	15.1	183	14.5	108	8.5	514	40.7	519	41.1	1,033	81.8	1.0 : 1.0 +
	Total	125	9.9	509	40.3	47	3.7	198	15.7	224	17.7	161	12.7	634	50.2	630	49.8	1,264	100.0	1.0 : 1.0 +
1964	1st	12	3.0	58	14.7	12	3.0	19	4.8	1	0.3	12	3.1	70	17.7	44	11.2	114	28.9	1.0 : 0.6 +
	2nd	—	—	13	3.3	2	0.5	—	—	13	3.3	—	—	13	3.3	15	3.8	28	7.1	1.0 : 1.1 +
	3rd	8	2.0	66	16.7	1	0.3	7	1.8	32	8.1	1	0.2	74	18.7	41	10.4	115	29.1	1.0 : 0.6 +
	4th	3	0.8	74	18.7	8	2.0	39	9.9	13	3.3	1	0.2	77	19.5	61	15.4	138	34.9	1.0 : 0.8 +
	Total	23	5.8	211	53.4	23	5.8	65	16.5	59	15.0	14	3.5	234	59.2	161	40.8	395	100.0	1.0 : 0.7 *

Remarks: *) The χ^2 test was significant at a 5.0% probability level.

+) The χ^2 test was not significant at a 5.0% probability level.

T A B L E I V

Relative distribution of rainfall at Fortaleza county (State of Ceará — Brazil) during the years from 1962 to 1964.

Months	Percentages			
	1962	1963	1964	1962 — 1964
January	5.0	10.6	12.1	9.2
February	8.1	11.9	20.7	13.6
March	25.4	29.8	16.0	23.8
April	30.8	28.1	23.0	27.3
May	14.0	5.4	12.8	10.8
June	7.5	2.0	3.9	4.5
July	0.5	0.2	6.0	2.3
August	2.3	0.0	1.1	1.1
September	2.5	0.3	3.2	2.0
October	1.2	0.1	0.4	0.6
November	1.0	1.6	0.1	0.9
December	0.9	10.0	0.7	3.9
Total	100.0	100.0	100.0	100.0

individual we considered only the means of the readings done.

In this way we used the direct proportionality method, and we tried to draw the growth curve through the back-calculation method, assuming that scale and body growth follow a linear regression.

Data resulting from scales reading are shown in table V, properly analysed under the statistical point-of-view.

Detailed study of Breder Jr.'s paper (1944) suggest with certainty that annuli found on tarpon scales are formed annually.

Fork length means for male tarpons with 6, 7 and 8 annuli on the scales, and for female tarpons with 8, 9 and 12 annuli on the scales, during each quarter of an annual cycle (table VI; figure 7), were calculated. In spite of the small number of individuals available, it can be concluded that annuli are formed in the last quarter of the year, and hence, with annual periodicity.

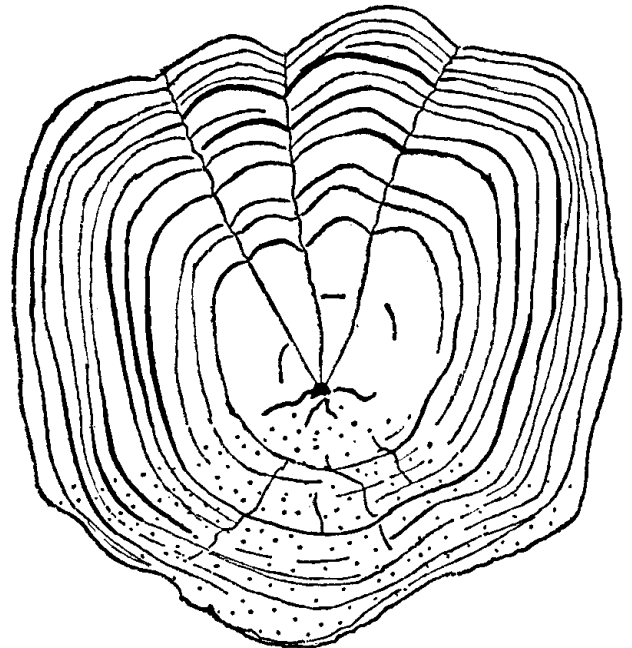


Figure 6 — Female tarpon scale having eleven annuli, from an individual measuring 164.5 cm fork length.

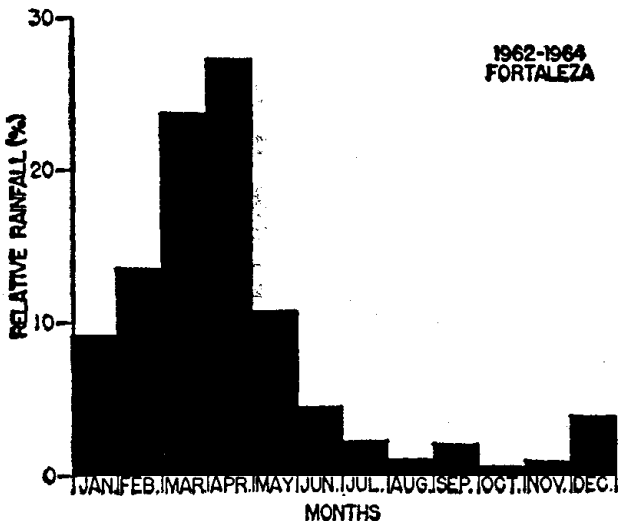


Figure 5 — General tendency of the rainfall distribution at Fortaleza county (State of Ceará — Brazil), during the years from 1962 to 1964.

Data already presented on tarpon migrations and reproduction in coastal waters of Ceará State, as well as those referring to the life of young tarpons in coastal lagoons of Ceará State adjusts well with the annual periodicity of the formation of scale annuli of that species.

Based on data collected and just analysed, we conclude that the periodicity of scale annuli formation is annual, due to change in food and salinity, posteriorly coinciding with the annual spawning time, until further observations prove the opposite.

Figures 8 and 9 show the growth curves for males and females, respectively, of the tarpon from coastal waters of Ceará State.

T A B L E V

Data concerning the fork lengths obtained by back-calculation, for the several groups of scale rings of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes). Material caught in front of Acaraú county (State of Ceará — Brazil) during the years of 1962 and 1963.

Sexes	Number of scale rings														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
males	number of individuals studied		49	49	48	47	35	22	11	2	1	—	—	—	
	number of scales read		244	244	239	234	174	109	54	10	5	—	—	—	
	fork length (cm):														
	minimum length		39.40	49.40	83.20	92.40	96.90	110.90	119.20	125.40	—	—	—	—	—
	maximum length		65.60	78.70	103.90	119.70	129.20	136.20	141.40	150.70	—	—	—	—	—
	arithmetic mean		50.60	63.50	95.50	103.60	111.50	119.49	127.30	138.09	154.50	—	—	—	—
	standard error of the mean		0.89	0.92	0.92	0.95	1.15	1.36	2.22	—	—	—	—	—	—
	standard deviation		6.34	6.50	6.38	6.52	6.80	6.40	7.37	—	—	—	—	—	—
	coefficient of variation (%)		12.52	10.23	8.46	6.29	6.10	5.36	5.78	—	—	—	—	—	—
	rate of increase (cm)		50.60	12.90	11.50	10.70	9.80	8.10	7.90	7.90	7.90	16.50	—	—	—
females	number of individuals studied		50	49	43	43	40	35	29	24	13	10	4	1	
	number of scales read		248	243	213	213	198	173	143	118	63	49	19	4	
	fork length (cm):														
	minimum length		35.50	54.30	88.40	93.20	101.20	109.00	115.60	125.90	147.90	151.80	163.30	—	—
	maximum length		71.00	85.40	118.10	126.50	133.30	143.00	152.80	161.00	167.00	172.40	176.50	—	—
	arithmetic mean		56.80	71.20	103.00	111.50	119.60	129.30	139.20	148.40	157.20	162.70	170.20	181.30	—
	standard error of the mean		1.23	1.24	1.12	1.39	1.60	1.72	1.90	1.64	1.56	2.07	—	—	—
	standard deviation		8.73	8.71	7.55	7.63	8.05	9.14	10.15	10.18	10.23	8.08	—	—	—
	coefficient of variation (%)		15.36	12.23	9.00	8.14	8.48	7.87	7.34	5.45	3.56	4.01	—	—	—
	rate of increase (cm)		56.80	14.40	11.80	10.70	9.30	8.50	8.10	9.70	9.90	8.80	5.50	7.50	—

TABLE VI

Fork length means (cm) for male and female tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes), in numbers of annuli on the scales, by sexes and quarters of an annual cycle. Data based on material caught in front of Acaraú county (State of Ceará — Brazil) during the years of 1962 and 1963.

Annuli on the scales	Quarters 1962 — 1963							
	1st quarter		2nd quarter		3rd quarter		4th quarter	
	n	\bar{x}	n	\bar{x}	n	\bar{x}	n	\bar{x}
Males								
6	5	109.9	—	—	7	110.3	14	107.4
7	5	114.9	2	111.5	10	115.7	8	110.3
8	10	122.3	3	119.0	4	121.0	1	117.5
Females								
8	—	—	3	125.3	5	133.9	—	—
9	1	135.5	5	138.5	4	155.0	—	—
12	2	164.5	2	160.8	1	166.5	—	—

With the data on scales reading the theoretical growth of tarpon was calculated with the formula of Brody-Bertalanffy,

$$L_t = L_{\infty} (1 - e^{-K(t - t_0)}),$$

resulting, for males:

$$L_t = 206.2 (1 - e^{-0.084t - 0.20}),$$

being $t_0 = -2.38$;

and, for females:

$$L_t = 263.3 (1 - e^{-0.065t - 0.17}),$$

being $t_0 = -2.70$.

Figures 8 and 9 also present the respective growth curves calculated according to the formula of Brody-Bertalanffy.

Mean annual growth rate of male tarpons (table V; figure 8) decreases till the sixth year, becoming practically uniform henceforth.

Mean annual growth rate of female (table V; figure 9) practically always decreases.

Regarding females with 10 or more annuli on the scales, now that the number of males studied that presented that characteristic is very small, it can be said that annual growth rate is very close to 2.5 inches, value already referred to by Randall & Moffett (1958).

There is an increasing overlapping of fork length variation (figures 10 and 11), in proportion to the progressively larger age classes for both sexes. With a regular margin of error, however, its is possible to estimate

the fork length variation, expressed in centimeters, by age classes and sexes (table VII) for tarpons from coastal waters of Ceará State.

Associating the data of sexual maturity with those of growth (tables II and V; figures 8 to 11), it was found that tarpons from coastal waters of Ceará State reach sexual

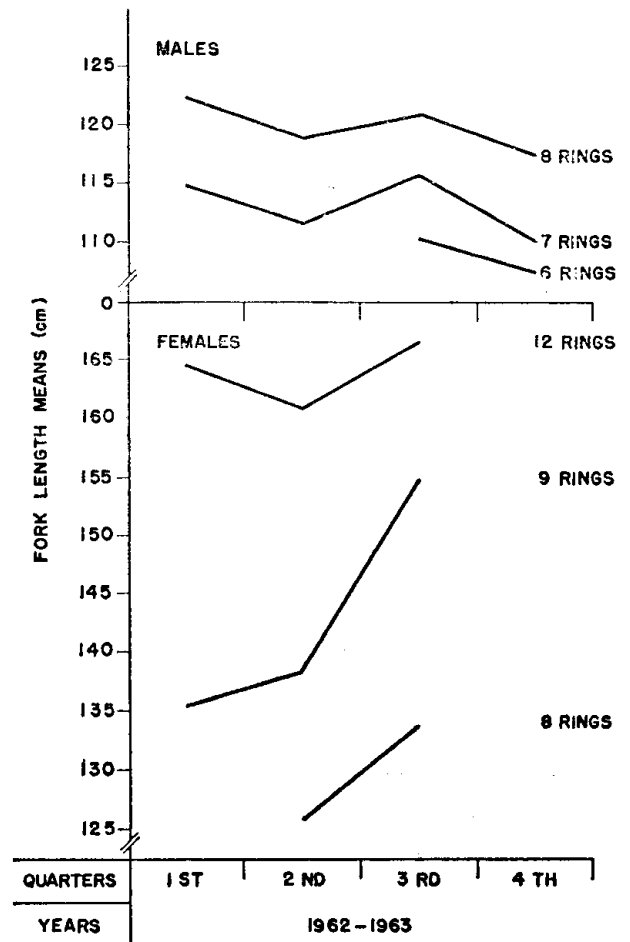


Figure 7 — Fork length means for males and females tarpon, based on scale readings, by quarters of an annual cycle.

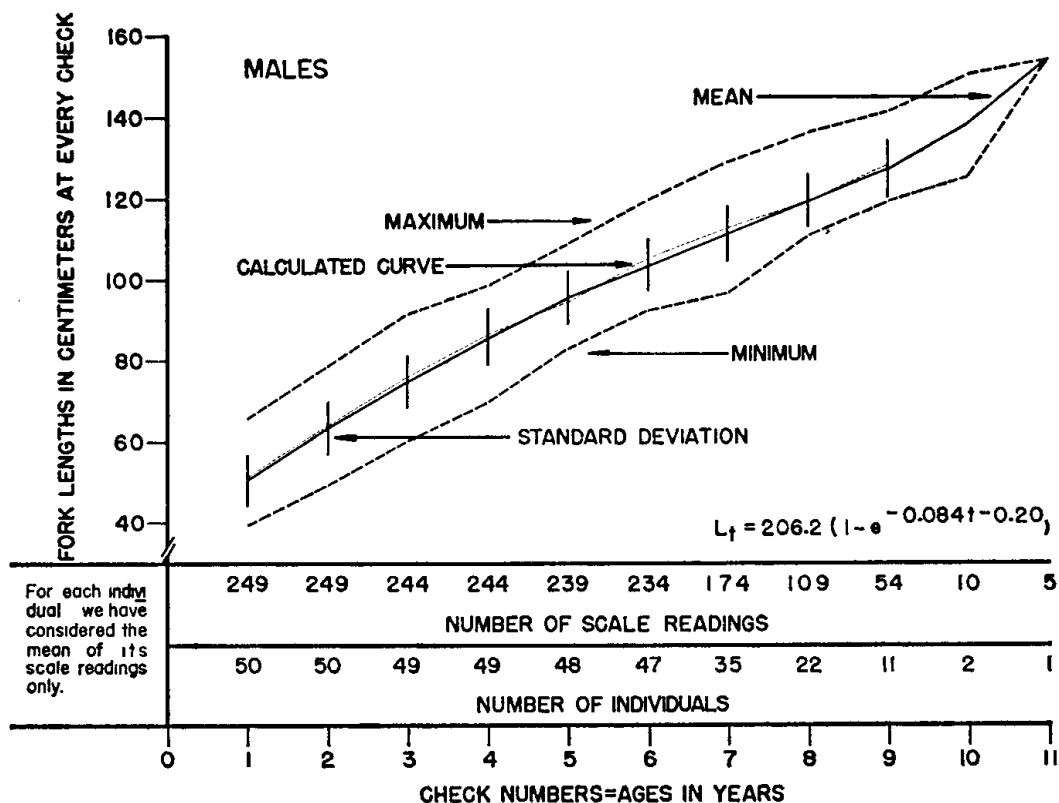


Figure 8 — Growth curve for tarpon males from coastal waters of the State of Ceará, Brazil.

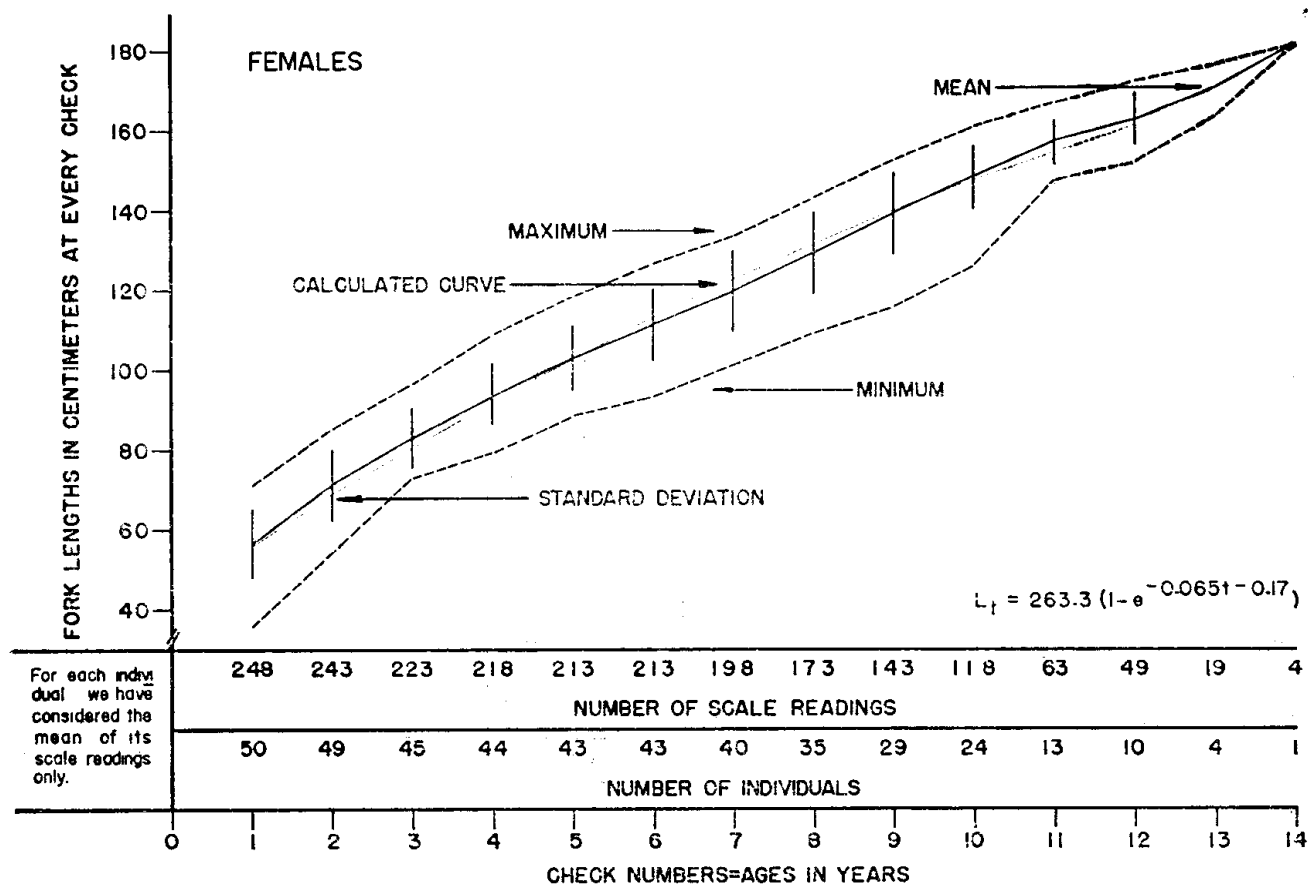


Figure 9 — Growth curve for tarpon females from coastal waters of the State of Ceará, Brazil.

TABLE VII

Estimation in fork length variation (cm) by age classes and sexes of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes). Data based on material caught in front of Acaraú county (State of Ceará — Brazil) during the years of 1962 and 1963.

Age classes (years)	Males	Females
0 — 1	until 44.0	until 47.0
1 — 2	45.0 — 57.0	48.0 — 63.0
2 — 3	58.0 — 69.0	64.0 — 77.0
3 — 4	70.0 — 80.0	78.0 — 87.0
4 — 5	81.0 — 91.0	88.0 — 97.0
5 — 6	92.0 — 100.0	98.0 — 106.0
6 — 7	101.0 — 107.0	107.0 — 115.0
7 — 8	108.0 — 115.0	116.0 — 125.0
8 — 9	116.0 — 123.0	126.0 — 134.0
9 — 10	124.0 — 132.0	135.0 — 144.0
10 — 11	133.0 — 150.0	145.0 — 154.0
11 — 12	—	155.0 — 162.0
12 — 13	—	163.0 — 175.0
above 13	—	176.0 ahead

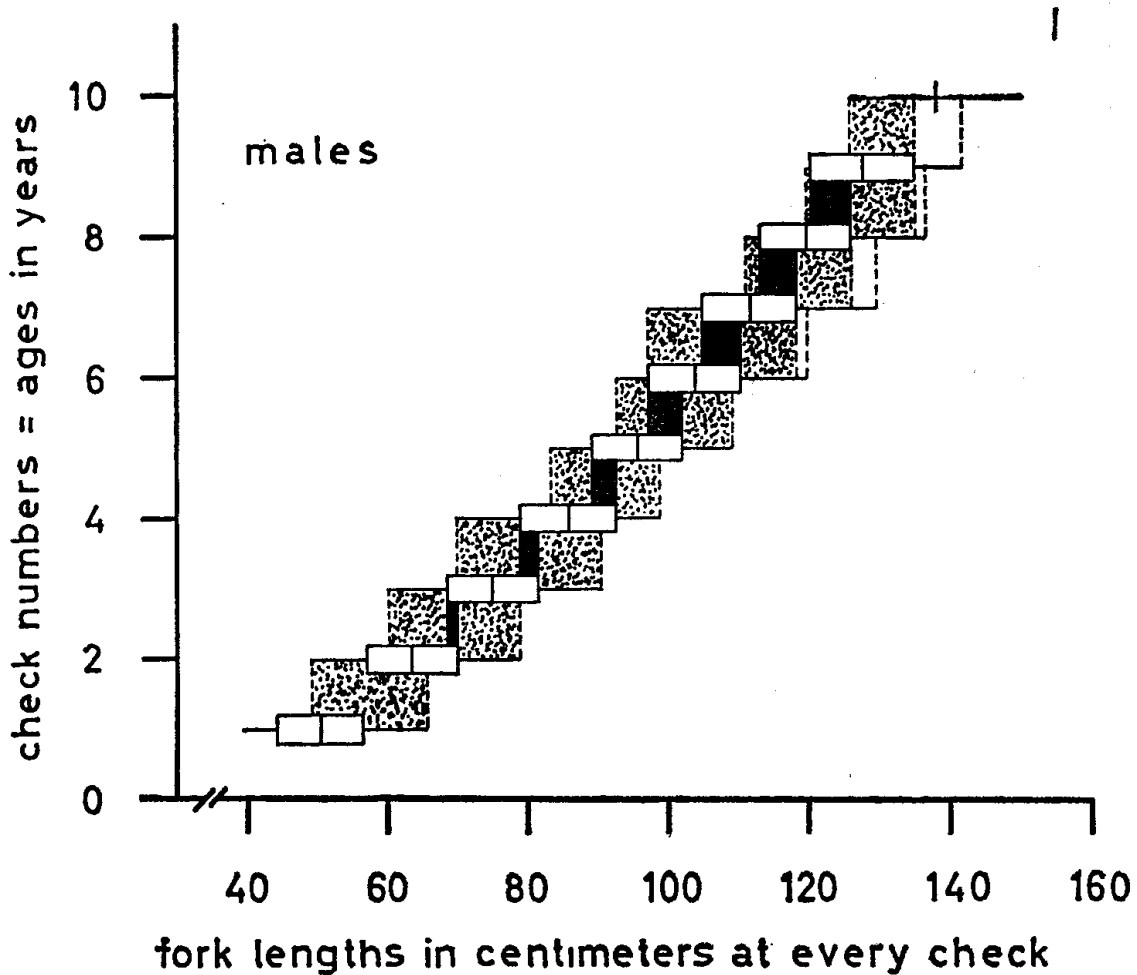


Figure 10 — Overlapping of fork length variation by age classes for male tarpon from coastal waters of the State of Ceará, Brazil. The white rectangles show the length variation for each class, based on the standard deviation.

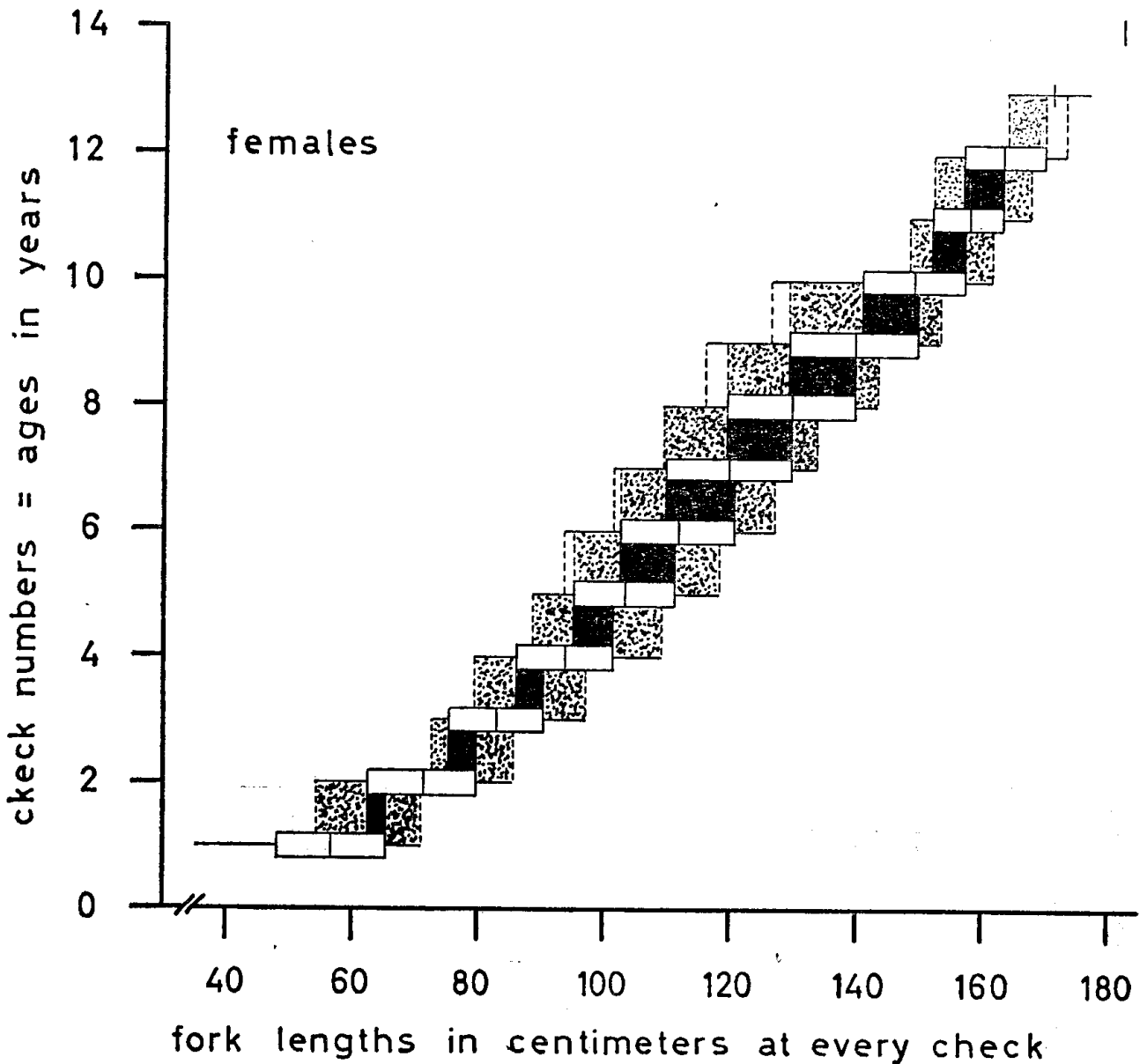


Figure 11 — Overlapping of fork length variation by age classes for female tarpon from coastal waters of the State of Ceará, Brazil. The white rectangles show the length variation for each age class, based on the standard deviation.

maturity after the fifth and the eighth years of life, respectively, for males and females. So, it may be also concluded that males are much more premature than females.

Breder Jr. (1944) refers to indications that sexual maturity of tarpon occurs after the sixth to seventh winter, which agrees partially with our data, once reference to sexes is not made.

There are evidences that longevity of tarpon from coastal waters of Ceará State (tables V and VII; figures 8 to 11) is less in males than in females. At least, this is what our data suggest.

INFORMATION ON WEIGHT AND LENGTH

Table I shows the monthly mean variation of tarpons caught at the fish-weirs of Almofala, Acaraú county, as well as its corresponding annual means. As to the first, it varies much and has an irregular distribution, not allowing to know a defined annual cycle. As to the second, reference to its brutal reduction occurred in 1963 was already made, and it was a little weakened in 1964.

Due attention deserve the simultaneous fall of mean weight and annual yield by each fish-weir at Almofala, indicates that some factor(s) of natural and/or fishery order is(are) acting unfavorably upon the stock of tarpon from coastal waters of Ceará State.

T A B L E V I I I

Data concerning the fork lengths of tarpon, *Tarpon atlanticus* (Cuvier & Valenciennes). Material caught in front of Acaraú county (State of Ceará — Brazil) during the years from 1962 to 1964.

Years	Quarters	Number of individuals			Fork lengths (cm)											
		males	females	total	males				females				total			
					arithmetic mean (\bar{x})	standard deviation (s)	coefficient of variation (C.V.)	arithmetic mean (\bar{x})	standard deviation (s)	coefficient of variation (C.V.)	arithmetic mean (\bar{x})	standard deviation (s)	coefficient of variation (C.V.)			
1962	1st	13	6	19	118.9	8.41	7.07	158.4	13.50	8.52	131.4	21.30	16.21			
	2nd	9	16	25	122.8	10.66	8.68	128.9	27.72	21.50	126.7	22.95	18.11			
	3rd	60	73	133	121.0	7.56	6.24	148.2	19.56	13.20	135.9	20.47	15.06			
	4th	236	397	633	117.6	7.22	6.14	152.2	13.52	9.01	139.3	20.36	14.61			
	Total	318	492	810	118.5	7.56	6.38	151.0	15.74	10.42	138.2	20.61	14.91			
1963	1st	65	65	130	121.7	6.23	5.12	152.7	11.20	7.33	137.2	17.99	13.11			
	2nd	1	2	3	73.0	—	—	126.3	—	—	108.5	—	—			
	3rd	54	44	98	117.8	7.00	5.94	151.4	9.00	5.94	132.9	18.57	13.97			
	4th	514	519	1,033	118.8	7.60	6.40	153.2	9.34	6.09	136.1	19.22	14.12			
	Total	634	630	1,264	118.9	7.68	6.46	152.9	9.89	6.47	135.9	19.20	14.12			
1964	1st	70	44	114	121.5	7.15	5.88	155.9	9.07	5.81	134.8	18.58	13.78			
	2nd	13	15	28	126.3	7.62	6.03	159.5	11.39	7.14	144.1	19.44	13.49			
	3rd	74	41	115	123.8	10.14	8.18	155.1	6.57	4.24	135.0	17.54	13.00			
	4th	77	61	138	117.3	6.78	5.78	154.0	9.78	6.35	133.5	20.07	15.03			
	Total	234	161	395	121.1	8.60	7.10	155.3	9.08	5.85	135.1	18.99	14.05			
1962 — 1964		1,186	1,283	2,469	119.2	7.89	6.62	152.5	12.46	8.17	136.5	19.66	14.40			

During the years considered in this paper, fork length measurements of tarpons caught at the fish-weirs of Almofala, Acaraú county, were made, but did not comprise the total of individuals caught. Such data, properly analysed, are shown in table VIII, though we present it with a certain reservation due to possible sampling bias, for mean annual fork lengths showed a slight increase, discording with the observed decrease in mean weight.

Large variations of mean fork lengths among the quarters were not observed for each sex as well as for both together. A defined

annual cycle for such variations is also not evident.

Mean fork lengths of tarpon caught at the fish-weirs of Almofala, Acaraú county, showed to be always inferior for males than for females.

Associating the growth data with those of mean fork lengths (tables V and VIII; figures 8 to 11), we find out that the mean age of tarpons caught at the fish-weirs of Almofala, Acaraú county, corresponds to eight and ten years, respectively, for males and females.

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