AGE, GROWTH AND MATURITY OF THE GOAT-FISH *(MULLUS BARBATUS* L.) IN ABUKIR - ROSETTA REGION DURING 1969-1970.

BY

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INTRODUCTION

The Goat-fishes are among the most important food fishes of the Mediterranean Sea. During the last few years (1966-1970) these fishes contributed by a considerable percentage of the commercial catch of A.R.E. (Hashem, 1973). The regulation of the Nile flood, resulting in a serious change of the ecological conditions in the South-Eastern part of the Mediterranean Sea seems to be in favour of the fishery of these fishes. The average annual catch of Mullidae has increased from 904 tons in 1962-1964 (before the Nile regulation) to 1354 tons in 1965-1970 (after regulation), inspite of the decrease in the fishing area during the period 1967-1970 as a result of the Middle-East conflict, (Egyptian Fishery Statistics, 1962-1970).

The biology of Goat-fishes, especially that of *Mullus barbatus*, L. has been studied in many areas of the Mediterranean and adjacent Seas. However, in Egypt little is known about these fishes. So, the present study of age, growth and maturity of *Mullus barbatus* L. will add some information to the biology of that species in the Egyptian Mediterranean waters.

MATERIALS & METHODS

Four seasonal cruises of bottom trawling were conducted in Abukir-Rosetta region by the research vessel "Faras-el-Bahr" of the Alexandria Institute of Oceanography and Fisheries during the period from May 1969 to January 1970 (Hashem,1972). The catch of M. *barbatus* was kept in the refrigerator and was taken to the laboratory after every cruise for individual biological measurements (length, weight, age, and sex).

Beside the above mentioned four cruises, further fishing operations were carried out in April, May and June 1970, for the determination of sexual maturity and sex ratio of this species during the spawning season. All the biological data concerning length, age, sex and maturity for the fish obtained from these last fishing operatinos, were taken from fresh materials, immediately after each haul.

For age determination, the scales of 707 fish were taken from fresh materials, on board the ship, immediately agter each haul. The scales were mostly taken from the area beneath the distal part of the pectoral fin. The examination and measurements of the scales were made by means of a binocular microscope at a magnification of (x 10).

AGE DETERMINATION

The scale examination of M. barbatus revealed some difficulties in the interpretation of age determination, and so age reading of some scales was repeated several times. Accessory marks are usually formed in the central zone. Careful examination of the first annual growth revealed the presence of either one or two accessory marks. The first one,

that near the center is the more frequent and clearly appears in nearly all the examined scales. The second one, just before the first true annulus is not necessarily present on the scales of all fishes.

By back calculation, it was possible to determine the length of the fish at the time of formation of the first accessory mark. The average value showed little variation between the different sexes and ranged from 4.8 to 5.1 cm (Table 1). This may coincide with the length at which the fish changes its habitat from the pelagic to the demersal life in coastal waters. So this first assessory mark must be the larval ring described by Gottlieb (1956) in the otoliths of resd mullet.

The length of the fish at the second accessory mark was also determined by back calculation. The average value also showed some variation between the different sexes and ranged from 7.6 to 8.3 cm. (Table 1). This second accessory mark, formed as a result of fish migration from coastal into deeper waters (Zeid Haidar, 1970), was considered by some authors as the first annual ring. That is why some differences were found in the interpretation of growth by different authors.

The lengths of red mullet caught from Abukir-Rosetta region in 1969-1970 varied between 4.5 and 24.0 cm in total length. The maximum age found in the catch was VIII, but the VII and VIII age groups were seldom encountered. In 1966, the maximum age found was also VIII and fishes older than VI were also of rare occurrence (Pavlov skaya & Budnichenko, 1970).

TABLE 1.—The average length of M. barbatus at the time of formation of the accessary marks, calculated by different authors.

Author	Region	Length at formation of accessory marks			
		First		Second	
		Male	female	Male	female
Gottlieb (1956)	Israel	5.0	5.3	7.9	8.6
Kutaygil (1967)	Turkey	—	—	7.4	7.6
Zeid Haidar (1970) . . .	Adriatic	5.5		7.7	
Our results	Egypt	4.8	5.1	7.6	8.3

Body-scale relationship :

The relationship between the total body length and the magnified scale radius (x10) of M. barbatus was studied to find out if there is necessary correction for the direct proportion calculated lengths. But since the correction factor was found negligible, so the straight line of Fig. (1) was drawn through the origin at a slope equal to the average L/S value of 4.06 for M. barbatus (Table 2). Therefore the calculations of lengths at times of completion of annuli were made from the scale measurements by the direct proportion method.

Age groups are designated by Roman numerals corresponding to the number of annuli found on the scale. All fishes were considered to have passed into the next age group on January 1.

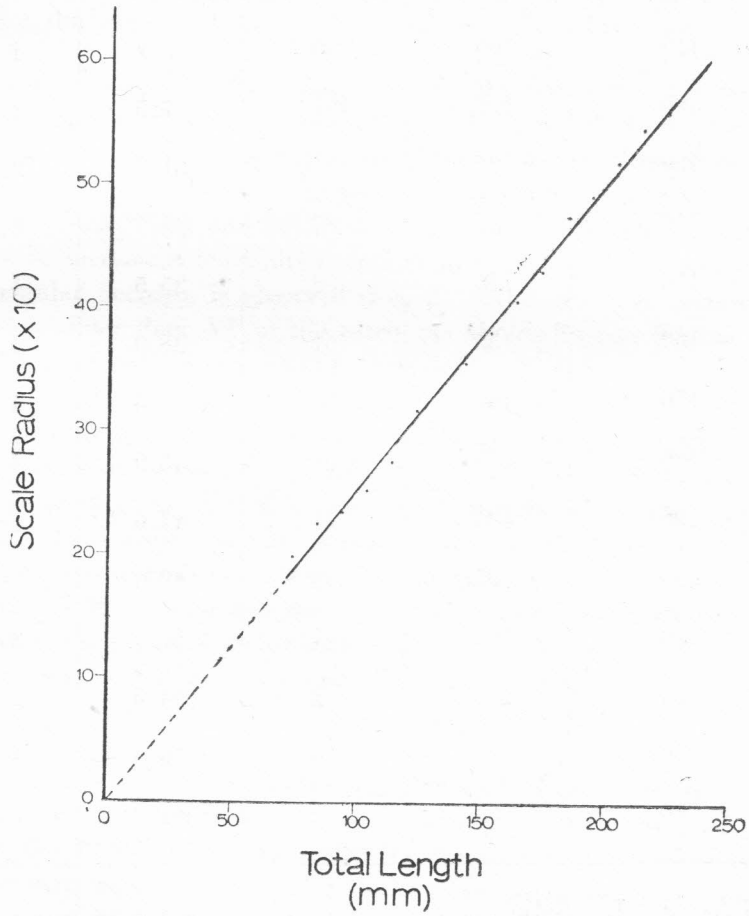

FIG. 1.—Body-Scale Relationship of Mullus barbatus from Abukir-Rosetta Region during 1969–1970.

TABLE 2.—Body-scale Relationship of M. barbatus from Abukir-Rosetta Region druing 1969–1970.

Length-range (mm.)	Mid-Point (mm)	No, of Fish	Av. Scale radius (x10)	L/S Ratio
71 — 80	75	3	19.9	3.77
81 — 90	85	7	22.7	3.74
91 — 100	95	29	23.4	4.05
101 — 110	105	73	25.2	4.17
111 — 120	115	121	27.5	4.18
121 — 130	125	84	31.8	3.93
131 — 140	135	87	33.7	4.01
141 — 150	145	82	35.5	4.08
151 — 160	155	51	38.0	4.08
161 — 170	165	33	40.5	4.07
171 — 180	175	21	43.0	4.07
181 — 190	185	21	47.6	3.89
191 — 200	195	19	49.0	3.98
201 — 210	205	7	51.9	3.95
211 — 220	215	2	54.5	3 95
221 — 230	225	4	56.0	4.02
231 — 240	235	2	61.0	3.85
Grand Average L/S Ratio . . . . . =				4.06

Calculrted Growth in Length

The growth at the end of each year of life was calculated from the relationship of the scale measurements to the total body length. For each age group, the average measurements were computed for the distance from the focus of the scale to each annulus, the length of the scale radius and the total length of the fish at the time of capture. Then the direct proportion calculation was made to find the average length for each age group at the end of each year of life.

The records of sex for the fishes made it possible to study sex differences in growth rate. The calculated lengths of different sexes revealed higher values for the females (Table 4) than for the males (Table 3).

The study of annual fluctuations in growth rate of the different sexes of M. barbatus as determined from the analysis of growth increments of the various year classes are also given in Tables (3 & 4). From these tables, it is clear that for both sexes the growth increment in length for the first year is very high (97.0 and 104.5 mm. for male and female respectively). The growth increment markedly decreases in the second year and in older ages a regular decrease is observed (Fig. 2). Also it has to mention that age groups older than VI in the catch of Abukir-Rosetta Region during 1969-1970 were only represented by females.

To give clear picture of the grand average calculated lengths at the end of each year of life, the changes in growth rate are represented in percentage to the total sum of increments during the whole life of the fish (Table 5). It is clear that M. barbatus made its best growth in length during the first year of life, where the annual increment is represented by 52.52 and 43.96 percent for the male and female respectively. In the second year, the growth rate for both sexes sharply decreases and the annual increment was less than one fourth that of the first year. The growth during older years continued to decrease, but gradually.

The growth rate of M. barbatus calculated from materials collected from the Egyptian Mediterranean waters in August, 1966 (Pavlovskaya and Budnichenko, 1970), when compared with our results, shows some increase in the growth rate of this species during the last years. This indicates the creation of favourable living conditions for M. barbatus in the Egyptian waters after the regulation of the Nile flood.

TABLE 3.—Growth rate in length (mm.) of the males of M. barbatus caught from Abukir-Rosetta Region during 1969–1970 (Increment in Parenthesis).

Age Grou	No. of Fish	Length at capture (mm.)	Calculated length at end of year of life					
			1	2	3	4	5	6
I	18	118	98.5 (98.5)	—	—	—	—	—
II	14	133	97.4 (97.4)	120.1 (22.7)	— —	— —	—	—
II	15	142	96.8 (96.8)	117.9 (21.1)	135.9 (18.0)	—	—	—
IV	22	161	96.2 (96.2)	116.3 (20.1)	137.6 (21.3)	155.1 (17.5)	—	—
V	6	175	95.4 (95.4)	116.5 (21.1)	138.1 (21.6)	155.3 (17.2)	170.8 (15.5)	—
VI	1	185	94.8 (94.8)	116.0 (21.2)	137.4 (21.4)	156.2 (18.8)	171.6 (15.4)	15.80 (13.4)
Grand average Length			97.0	117.6	137.1	155.2	170.9	185.0
Grand average increment.			(97.0)	(21.1)	(20.2)	(17.5)	(15.5)	(13.4)
Sum of increments.			97.0	118.1	138.3	155.8	171.3	184.7

TABLE 4.—Growth rate in length (mm.) of the females of M. barbatus caught from Abukir-Rosetta Region during 1969–1970 (Increment in Parenthesis).

Age Group	No. of Fish	Length at capture (mm.)	Calculated length at end of year of life							
			1	2	3	4	5	6	7	8
I	142	120	106.7							
			(106.7)	—	—	—	—	—	—	—
II	151	142	104.4	129.3						
			(104.4)	(24.9	—	—	—	—	—	—
III	77	160	103.8	128.4	152.3					
			(103.8)	(24.6)	(23.9)	—	—	—	—	—
IV	49	181	101.3	128.8	152.8	174.4				
			(101.3)	(27.5)	(24.0)	(21.6)	—	—	—	—
V	32	197	102.9	130.2	152.7	174.1	193.7			
			(102.9)	(27.3)	(22.5)	(21.4)	(19.6)	—	—	—
VI	11	215	100.7	129.2	152.4	173.9	194.8	212.5		
			(100.7)	(28.5)	(23.2)	(21.5)	(20.9)	(17.7)	—	—
VII		234	101.2	129.4	153.4	175.6	198.0	214.4	228.0	—
			(101.2)	(28.2)	(24.0)	(22.2)	(22.4)	(16.4)	(13.6)	—
VIII		239	101.0	129.0	152.3	175.0	197.2	213.6	228.0	239.0
			(101.0)	(28.0)	(23.3)	(22.7)	(22.2)	(16.4)	(14.4)	(11.0)
Grand Average Length			104.5	129.1	152.5	174.2	194.1	212.7	228.0	239.0
Grand Increment			(104.5)	(25.6)	(23.6)	(21.5)	(20.0)	(17.5)	(14.0)	(11.0)
Sum of Increments			104.5	130.1	153.7	175.2	195.2	212.7	226.7	237.7

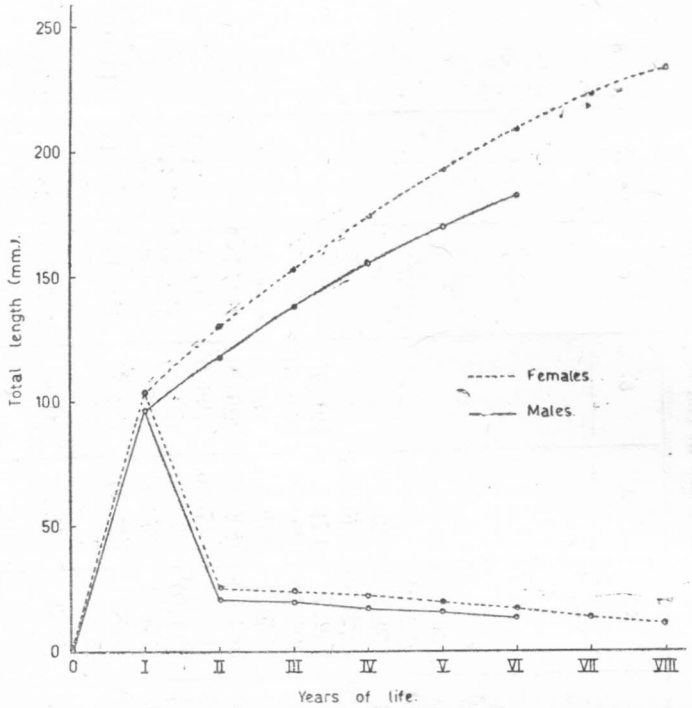

FIG. 2.—Growth Rate and Annual Increment. of growth in length for the males and Females of Mullus barbatus from Abukir-Rosetta Region during 1969–1970.

TABLE 5.– Annual increment of growth (in mm. and %) for different sexes of M. barbatus from Abukir-Rosetta Region during 1969–1970.

Age Group	Males				Females			
	No. of Fish	Av. calc. length	annual increment		No. of Fish	Av. calc. length	annual increment	
			(mm)	%			(mm)	%
I	18	97.0	97.0	52.52	142	104.5	104.5	43.96
II	14	118.1	21.1	11.42	151	130.1	25.6	10.77
III	15	138.3	20.2	10.94	77	153.7	23.6	9.93
IV	22	155.8	17.5	9.47	49	175.2	21.5	9.05
V	6	171.3	15.5	8.39	32	195.2	20.0	8.41
VI	1	184.7	13.4	7.26	11	212.7	17.5	7.36
VII	—	—	—	—	1	226.7	14.0	5.89
VIII	—	—	—	—	1	237.7	11.0	4.63

Grouth Rate of Mullus barbatus in different regions

The comparison of our results with those obtained by different authors for the growth of M. barbauts in the Mediterranean and Adriatic (Table 6) shows that the results obtained by Scaccini (1947) are far away from that obtained by other authors. In my opinion, the data of Scaccini cincerned the growth of M. surmuletus and not that of M. barbauts. In favour of this, Scaccini pointed out that possible length of males was more than 25 5 cm and of females was more than 29.3 cm. However, our data, as well as that obtained by other authors (Bougis & Muzinc, 1958; zeid Haidar, 1970; and others) for the marimum length reached by M. barbatus in the Mediterranean and Adriatic are much less than that mentioned by Scaccini (1947).

Moreover, the minimum length of sexual maturity mentioned by Scaccini was 14 cm for males and 16 cm for females. But our data, as well as that obtained by other authors, are also much less than that mentioned by Scaccini. Bougis (1952) and zeid Haidar (1970) came also to the same conclusion and indicated that this was due to the possible error in the separation of the two species of Mullus.

Table (6) also shows a serious difference as regards the results obtained by Wirszubski (1953). This difference, from our point of view, arised from that Wirszubski had considered the second juvenile mark as true annual ring. Gottlieb (1956) & Zeid Haidar (1970) have also the same opinion, and so the interpretation of Wirszubski has to be one year younger at each annulus.

Length-Weight Relationship

The examination of the data obtained for the weights of M. barbatus revealed no significant differences between sexes in case of immature fishes (less than 9.0 cm in total length), but in case of mature fishes, there is a slight difference in the length-weight relationship. The females are somewhat heavier than the males (Table 7).

The equation ($w = c\ L\ n$) is used in the study of length-weight relationship, where c and n are constants, whose values are calculated from the logarithms of the total lengths and actual weights. Using the grouped lengths and corresponding weights of 418 males, ranging in total lengths from 4.5 to 19.5 cm and of 764 females, ranging in total lengths from 4.5 to 24.0 cm, led to the following equations :

For males : $\log W = -4.4785 + 2.7636 \log L.$
For Females : $\log W = -4.6656 + 2.8715 \log L.$

TABLE 6.—Calculated growth rate of M. barbatus from different water areas of the Mediterranean and Adriatic Sea.

Author	Region	Sex	Calculated length at end of year of life								Remarks
			1	2	3	4	5	6	7	8	
Scaccini (1947) . . .	Adriatic	M.	12.6	17.5	20.4	22.3	23.3	24.2	24.9	25.5	Scale measure-
		F.	12.7	20.3	23.9	25.9	27.0	27.9	28.7	29.3	ment
Bougis & Muzinic (1958)	Adriatic	M.	—	14.9	16.0	16.7	17.7	—	—	—	Scale
		F.	—	18.0	18.9	20.4	21.8	—	—	—	measurement.
Zeid Haidar (1970)	Adriatic	M.	10.1	12.9	14.2	15.1	15.7	—	—	—	Scale
		F,	12.2	15.2	16.5	17.5	18.3	—	—	—	measurement.
Ananiadis (1949). . .	Greece	M.	9.0	12.3	14.4	15.3	16.0	—	—	—	
		F.	9.9	13.5	16.8	18.4	19.8	21.1	21.9	22.5	
Bougis (1952)	France	M,	10.0	14.5	16.5	17.5	—	—	—	—	Scale
		F,	12.0	17.5	20.0	21.1	—	—	—	—	measurement.

TABLE 6.—(*Continue*)

Wiszubski (1953) . .	Israel	M.	—	9.4	11.3	13.0	15.1	—	—	—	Direct & otoliths
		F.	—	10.7	13.7	16.4	19.0	21.4	23.0	—	measurement.
Gottlieb (1956) . . .	Israel	M.	9.9	11.7	13.5	15.5	—	—	—	—	Otoliths
		F.	10.6	13.2	15.4	17.7	19.5	—	—	—	measurement.
Numann (1955) . . .	Turkey	M.	9.3	10.4	11.4	—	—	—	—	—	Scale
		F.	10.1	11.7	13.1	—	—	—	—	—	measurement.
Kutaygil (1967) . .	Turkey	M.	10.3	12.8	14.0	14.6	15.1	—	—	—	Otolith
		F.	11.0	14.7	16.0	17.5	18.5	19.4	—	—	measurement.
Planas and Vives . .	Spain	M.	9.3	15.2	—	—	—	—	—	—	Scale
(1956)		F.	11.6	17.3	—	—	—	—	—	—	measurement.
Suau and Vives (1957)	Spain	M.	10.0	12.0	—	—	—	—	—	—	Direct
		F.	11.0	14.2	—	—	—	—	—	—	measurement.
Our Results	Egypt	M.	9.7	11.8	13.8	15.6	17.1	18.5	—	—	Scale
		F.	10.5	13.0	15.4	17.5	19.2	21.3	22.7	23.8	measurement.

TABLE 7.–Length-weight Rlationship of M. barbatus from Abukir-Rosetta Region druing 1969–1970.

Length Range (mm)	Males		Females		Both Sexes		
	No. of Fish	Av. emp. weight (gm)	No. of Fish	Av. emp. weight (gm)	No. of Fish	Av. emp. weight (gm)	Calculated weight (gm)
41– 50	1	1.5	1	1.5	7	1.5	1.2
51– 60	1	2.3	1	2.8	17	2.3	2.1
61– 70	1	3.0	1	3.0	28	3.0	3.4
71– 80	1	4.3	1	4.3	25	4.3	5.1
81– 90	5	7.0	3	7.0	30	6.5	7.3
91–100	15	9.8	22	10.9	69	10.0	10.0
101–110	14	12.3	77	13.9	155	13.2	13.4
111–120	45	16.2	119	17.4	295	16.7	17.4
121–130	139	19.6	130	22.3	304	20.7	22.1
131–140	78	24.0	156	27.8	283	26.3	27.6
141–150	55	30.8	102	33.8	158	32.9	33.9
151–160	30	38.4	54	42.4	84	41.4	41.1
161–170	20	45.0	27	51.8	47	50.1	49.2
171–180	9	53.7	21	59.2	30	58.2	58.3
181–190	3	66.0	18	69.6	21	69.4	68.4
191–200	1	78.0	14	80.6	16	80.5	79.6
201–210	—	—	8	95.9	8	95.9	91.9
211–220	—	—	5	106.8	5	106.8	105.4
221–230	—	—	3	128.0	3	128.0	120.2
231–240	—	—	1	149.0	1	149.0	136.3

The value of the exponent (n) shows that the weight of M. barbatus in Abukir-Rosetta Region increases to a power less than the cube of the length and in case of females the exponent is slightly greater than that of males.

A length-weight equation, to be most useful, should include fish of both sexes, sampled at various times of the year. Bias from seasonal variations, sex differences, maturity and state of organs is minimized by this procedure. The resulting general curve produces the most usable record. Taking the grouped lengths and the correspinding weights of 1586 fish, ranging in total length from 4.5 to 240 cm. led to the following general equation :

$$\log W = - 4.6943 + 2.8800 L.$$

The general length-weight data of Table (7) are graphically represented in Fig. (3). The smooth curve represents the calculated weights, while the dots represent the empirical weight. From the table and graph, it is clear that the agreement of the calculated and empirical weights is satisfactory.

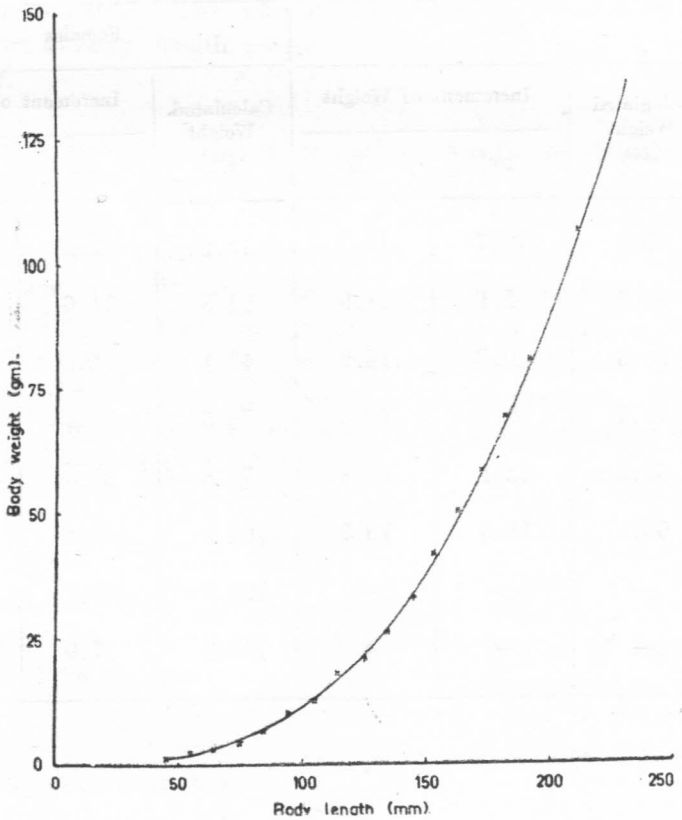

Fig. 3. Lengtb-weight Relationship of Mullus barbatus from Abukir-Roselta Region during 1969—1970.

Calculated growth in Weight

The calculated weights in Table (8) were computed from the general length-weight equation for the different age groups of both sexes. For different sexes the second year increment of weight is somewhat less than that of the first yeor's growth. This can be explained by the fact that M. *barbatus* reaches sexual maturity during the second yeat of life. For fishes older than age group II, the increment of weight increases with the increase of age, reaching big values in the *5th.* and *6th.* year of life. The largest increment of weight for either males or females was in the *6th.* year of life. After that age and in case of females, the increment in weight begins to decrease with the increase of age.

Table 8. Annual Increment in weight (in gm. and %) of the different sexes of *M. barbatus* from Abukir-Rosetta Region during 1969-1970.

Age Group	Males			Females		
	Calculated Weight (gm)	Increment of Weight		Calculated Weight (gm)	Increment of Weight	
		(gm)	%		gm	%
I	10.7	10.7	15.7	13.2	13.2	9.4
II	18.8	8.1	11.9	24.8	11.6	8.3
III	29.6	10.8	15.9	40.1	15.3	10.9
IV	41.7	12.1	17.8	58.5	18.4	13.0
V	54.8	13.1	19.2	79.8	21.3	15.2
VI	68.1	13.3	19.5	102.2	22.4	15.9
VII	—	—	—	122.9	20.7	14.6
VIII	—	—	—	140.8	17.9	12.7

Sexual Maturity

For the estimation of age and size at first maturity, it is more subjective to collect the data during the spawning season. So the collection of the data in this respect was made in the period from April, 18 to June, 20-1970. A total number of 400 fish ranging in total length from 9.5 to 22.0 cm. were caught from Abukir-Rosetta Region.

Among the different sexes of *M. barbatus* some variation are found in the age and size of first maturity. Sexual maturity was first attained at the end of the first year of life for males, and at the end of the second year for femals. This means that the males of M. barbatus attain first maturity one year younger than the females.

It was also found that the smallest male attained first maturity at a total body length of 10 cm, while the smallest female at 12 cm. This means that all the males smaller than 10 cm and all females smaller than 12cm were immature. This also indicates that the females attain sexual maturity at a body length greater (2 cm. longer) than that of males (Table 9).

The data also show a trend toward a decrease in the percentage of males with the increasing of age. On the other hand, the percentage of females increases with the increase of age. The sex ratio between males and females was nearly equal for fishes of about 15.5 cm in total length and belongs to age grup IV. In other words, the number of males exceeded that of females in younger age groups, while in older age groups (more than IV), the advatnage of females increased from 62% for age group V, to 80% for age group VI and perhaps to 100% for age groups VII and VIII if persent. For all age groups combined, the percentage of males to females was about 62 to 38 (Table 10).

Conclusion

Our results indicate that the growth of M. barbatus in the Egyptian Mediterranean waters is quite rapid in the first year of life. A large percentage of the fish were over 10 cm, (the least acceptable marketable size) by their first winter. So, the small fish would be best utilized if they could escape the trawl fishery during the growing season, and be taken during the winter months.

TABLE 9.—Sexual maturity of M. barbatus in accordance to length during the period from 18/4 to 20/6-1970.

Total body leugth (mm)	Total No of Fish	Immature Fish		Mature Fish			
				Male		Female	
		No.	%	No.	%	No.	%
91—100	1	1	100	—	—	—	—
101—110	3	1	33	2	67	—	—
111—120	22	10	45	12	55	—	—
121—130	91	8	9	74	81	9	10
131—140	97	6	6	70	72	21	22
141—150	67	—	—	38	57	29	43
151—160	65	—	—	33	51	32	49
161—170	32	—	—	15	47	17	53
171—180	9	—	—	3	33	6	67
181—190	6	—	—	1	17	5	83
191—200	3	—	—	—	—	3	100
201—210	2	—	—	—	—	2	100
211—220	2	—	—	—	—	2	100
Total	400	26	6.50 %	248	62.00%	126	31.50%

TABLE 10.—Sexual maturity of M. barbatus in accordance to age during the period from 18/4 to 20/6/1970.

Age roup	Total No. of Fish	Immature Fish		Mature Fish			
				Male		Female	
		No.	%	No.	%	No.	%
I	25	11	44	14	56	—	—
II	153	15	9	109	71	29	20
III	156	—	—	95	61	61	39
IV	48	—	—	24	50	24	50
V	13	—	—	5	38	8	62
VI	5	—	—	1	20	4	80
Total	400	26	6.50%	248	62.00%	126	31.50%

SUMMARY

The scale examination of M. barbatus revealed the presence of two types of accessory marks, the first near the center of the scale, and is formed when the fish changes its pelagic to the demersal life, and this happens at a calculated fish length of 4.8-5.1 cm. The second accessory mark, when present, is found just before the first true annulus, and is formed when the fish migrate from shallow coastal into deeper waters. This generally happens at total fish length of 7.6-8.3 cm.

Ages were determined and individual growth histories were computed for both sexes from the examination of the scales of 707 fish. The general growth data showed that M. barbatus made the greatest growth in length during the first year of life (97.0 and 104.5 mm for male and female respectively). In the second year, the growth rate sharply decreases for both sexes and the annual increment was less than one fourth that of the first year. The growth during older years continued to decrease, but gradually.

Over the length interval (4.5 — 24.0 mm), the length-weight relationship for both sexes was described satisfactorily by the equation $\log W = -4.6943 + 2.88 \log L$. The calculated annual growth in weight of the second year is somewhat less than that of the first year due to sexual maturation reached during that year. The increment of weight increases with the increase of age, reaching big values in the 5th, 6th and 7th years of life. The largest increment in weight (24.0 gm) was in the 6th year, after that the increment begins to decrease with the increase of age.

The sexual maturity was first attained at the end of the first year of life for males and at the end of the second year for females. The smallest size of maturation was found to be 10.0 cm for males and 12.0 cm for females. The number of males exceeds that of the females in younger age groups, while in older age groups (more than IV) the advantage of females increased. For all age groups combined, the percentage of males to females was about 62 to 38. Also it has to be mentioned that age groups older than VI were only represented by females in the catches of Abukir-Rosetta Region during 1969-1970.

As a conclusion for this work, our bottom trawls have to be carefully studied in order to find the most suitable mesh size able to release fishes of less than 10 cm., the acceptable marketable size.

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