SOME BIOLOGICAL STUDIES ON THE GOATFISH *(MULLUS SURMULETUS L.)* IN THE EGYPTIAN MEDITERRANEAN WATERS

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INTRODUCTION

The Goatfishes are littoral marine fishes of warm seas. As demersal fishes, they are widely caught by trawlers. In the last few years these fishes constituted a considerable part of the commercial catch of A.R.E. Inspite of the decrease of the fishing area during the Middle-East conflict, the average annual catch of Mullidae has increased from 904 tons in 1962-1964 to 1354 tons in 1965-1970 (Egyptian Fishery Statistics, 1962-1970). This indicates that the regulation of the Nile flood seems to be in favour of these fishes.

Unfortunately, the catch of Mullidae from the Egyptian Mediterranean waters is not differentiated into fish species. But, generally speaking, the Red mullet (Mullus barbatus L.) is the most common, while the Striped mullet (Mullus surmuletus L.) occupies the second position in the catch of this Family. However little knowledge is available about the biology of this latter species, although the biology of the first one has been studied in many areas. So, the present study on the age, growth and maturity of M. surmuletus will add some information to the biology of that species. In addition, it is hoped that this information will be of interest and use in managing the trawl fisheries of the Mediterranean.

MATERIALS AND METHODS

The present study is based on the examination of 438 fish, ranging in total length from 5.0 to 29.0 cm. Of these, 350 fish, ranging in length from 10.0 to 29.0 cm were obtained from the Alexandria fish market in the period from March to June, 1970. The other fishes, especially the small ones, were obtained from the bottom trawling survey carried out in Abu-Kir Bay during the autumn of 1969 (Hashem, 1972).

In the laboratory, the total length, total and gutted weights, as well as sex and stage of maturity were recorded for every fish. All fishes were used in the study of length-weight relationship, while only 350 of these were used in the study of the condition and maturity. For age determination and growth studies, the scales of 312 fish, ranging in total length from 12.0 to 29.0 cm, were taken mostly from the region of the pectoral fin. The scale examination was made with a binocular microscope at a magnification of ($\times$ 10) and ($\times$ 40), while scale measurements were made with an ocular micrometer at a magnification of ($\times$ 10).

LENGTH-WEIGHT RELATIONSHIP

It is well known that the length-weight relationship in fishes is not constant throughout the year. It is affected by such factors, as the availability of food, rate of feeding, development of the gonads, spawning, etc.

So, a length-weight equation to be most useful, should include fishes of both sexes, sampled at various times of the year.

Unfortunately, the length-weight computation in the present study is based on samples covering only part of the year, and so it imposes strict limitations on the use of the relationship so derived. But, the use of length-weight relationship from samples limited in time coverage, is permissible only if this limitation is kept stricktly in mind.

The examination of the data obtained for the total body weights of M. surmuletus revealed no serious differences between sexes in case of immature fishes (less than 11.0 cm in total length), but in case of mature fishes, there was a slight difference in the length-weight relationship. The females were somewhat heavier than the males (Table 1).

TABLE (1).—LENGTH-WEIGHT RELATIONSHIP OF THE DIFFERENT SEXES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS.

Length-Range (mm)	Males		Females		Sexes combined		
	No. of fish	Av. Wt. (gm)	No. of fish	Av. Wt. (gm)	No. of fish	Av. Emp. Wt. (gm)	Cal. Wt. (gm)
51 — 60	1	1.8	1	1.8	9	1.8	1.50
61 — 70	1	2.4	1	2.4	11	2.4	2.55
71 — 80	1	4.0	1	4.0	3	4.0	4.02
81 — 90	1	5.5	1	5.5	8	5.5	6.01
91 — 100	1	7.3	1	7.3	8	7.3	8.57
101 — 110	1	12.5	—	—	2	12.2	11.80
111 — 120	1	16.50	—	—	1	16.50	15.78
121 — 130	9	18.78	—	—	9	18.78	20.59
131 — 140	14	26.07	1	28.0	17	26.59	26.33
141 — 150	16	33.63	8	34.68	26	33.90	33.08
151 — 160	20	40.05	27	44.07	47	42.36	40.92
161 — 170	24	48.08	27	53.67	51	51.04	49.96
171 — 180	23	59.26	39	62.30	63	60.88	60.20
181 — 190	34	70.23	22	74.36	56	71.85	71.98
191 — 200	17	84.11	26	85.88	43	85.18	85.15
201 — 210	9	95.22	31	102.16	40	100.60	99.88
211 — 220	3	119.33	12	123.33	15	122.53	116.30
221 — 230	4	134.75	4	138.00	8	136.38	134.46
231 — 240	—	—	7	159.14	7	159.14	145.49
241 — 250	—	—	2	180.00	2	190.00	176.48
251 — 260	—	—	4	198.25	4	198.25	200.50
261 — 270	—	—	1	212.00	1	212.00	226.72
271 — 280	—	—	4	250.50	4	250.50	255.15
281 — 290	—	—	3	291.67	3	291.67	285.69

The equation ($W = c L^n$) is used in the study of length-weight relationship, where c & n are constants, whose values are calculated from the logarithms of the total length and actual weight (Beckman, 1948). Using the grouped lengths and the corresponding weights of 180 males, ranging in total length from 5.0 to 23.0 cm, and of 223 females, ranging in total length from 5.0 to 29.0 cm, led to the following equations.

For males : $\log W = -5.3255 + 3.1635 \log L$

For females : $\log W = -5.3786 + 3.1941 \log L$

The values of the exponent (n) show that the weight of M. surmuletus increase to a power more than the cube of length, and in case of females the exponent is slightly greater than that of males.

When the two sexes are combined, the following general equation would be the most usable record for the length-weight relationship of M. surmuletus during the time of investigation. The length-range used (from 50 to 290 mm) covers the greatest possible range of lengths:

$$\text{Log } W = -5.3805 + 3.1924 \log L$$

As most of our material was collected during the time of spawning (March-June), it seems that the ripe ovaries add weights to the mature fish. But after the fish has spawned, this weight is lost without any change in length. Moreover, the amount of food eaten may have an effect upon the total fish weight. To check the effect of the weights of the alimentary tract and ripe gonads upon the length-weight relationship, these organs were removed from the fish, and the gutted weights (weight without viscera) of the mature fishes covering the range from 110 to 290 mm in total length were obtained for both males and females as well as for the combined sexes (Table 2).

The examination of the data obtained for the gutted weights of mature fishes revealed no serious differences between the sexes. This means that beside the difference which may be present in the food content of the different sexes, the ripe ovaries are no doubt heavier than the ripe testes, and this was responsible for the difference in the total body weight between the different sexes.

The general eqtation of length-gutted weight for the combined sexes of lengths ranging from 110 to 290 mm. is ;

$$\log W \text{ (gutted)} = -5.0054 + 3.0170 \log L.$$

while that of length-total weight of the combined sexes and for the same length range (110-290 mm) is;

$$\log W_{(total)} = -5.3598 + 3.1844 \log L.$$

From these two equations it is clear that the ripe fish acquire heavier weights and consequently the exponent (n) in the length-weight relationship of ripe fish is higher than that for the unripe ones.

TABLE(2).– LENGTH-GUTTED WEIGHT RELATIONSHIP OF THE DIFFERENT SEXES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS. DURING MARCH-JUNE 1970.

Length-group (mm)	Males		Females		combined Sexes		
	No. of fish	Av. Emp. Weight (gm)	No. of fish	Av. Emp Weight (gm)	No. of fish	Av. Emp. Weight (gm)	Calc. Wt. (gm)
111 — 120	1	15.00	—	—	1	15.00	16.28
121 — 130	2	18. 0	—	—	2	18.00	20.94
131 — 140	4	24.75	1	24.00	5	24.00	26.41
141 — 150	14	32.79	5	32.20	19	32.63	32.77
151 — 160	16	38.13	24	39.38	40	38.88	40.07
161 — 170	21	46.19	26	48.00	47	47.19	48.38
171 — 180	20	56.25	39	55.68	58	55.87	57.28
181 — 190	31	66.03	22	66.10	53	66.06	68.33
191 — 200	16	77.31	25	77.53	41	77.44	80.09
201 — 210	9	89.33	31	90.60	40	90.31	93.13
211 — 220	3	103.67	12	1 2.92	15	103.07	107.55
221 — 230	4	121.75	4	121.25	8	121.50	123.34
231 — 240	—	—	7	140.86	7	140.86	140.63
241 — 250	—	—	2	157.50	2	157.50	159.48
251 — 260	—	—	4	179.75	4	179.75	179.93
261 — 270	—	—	1	189.00	1	189.00	202.54
271 — 280	—	—	4	216.25	4	216.25	225.99
281 — 290	—	—	3	270.00	3	270.00	251.72

CONDITION FACTOR

The condition factor (K) is a coefficient which is commonly used for measuring variations in fish weight which are not associated with length. For the purpose of comparing the condition of a fish species the cube relationship of length to weight ($K = WX100/L^3$) is usually used. This formula assumes that growth in length and weight is isometric, otherwise (K) will tend to increase or decrease with fish length (Le Cren, 1951).

Actually in nature, the value of (K) is not constant for a species or population, but it is subjected to a wide variation. So, the values of (K) can be used as measures of individual or average seasonal and regional differences in the condition or "degree of well-being" of fishes.

Fulton (1902) was the first to calculate the coefficient of condition by using the whole body weight. But using the whole body weight, it is impossible to exclude the effect of the gonads and also the weight of the gut contents, which in many fishes may account for a considerable portion of the total fish weight. The weight of the gonad and the intestinal contents might often alter the value of the coefficient of condition and mask the true dynamics of the condition of the fish.

Inorder to exclude the effect of the weight of the gonads and intestinal contents, Clark (1928) suggested calculating the condition factor (K) from the body weight of fishes without the internal organs. However, the use of this method has the disadventage of excluding the internal fat, the amount of which in many fishes is subjected to great changes, and is to a significant extent connected with the condition of the fish.

Many fishery investigators find it better to use both coefficients (Fulton & Clark) together to express the condition of fish with regard to the degree of well-being, relative robustness, plumpness ...etc, in numerical terms. These coefficients, although naturally give only a first approximation to the actual condition of the fish, are quite suitable for comparative analyses and practical purposes (Nikolsky, 1963).

Table 3 was obtained by computing the average values of (K), by both Fulton & Clark, for the mature males and females of M. surmuletus in each 10 millimeter interval of body-length. It is clear that, for the same length-group, the values of (K) by Fulton for the males are smaller than that for females. At the same time the values of (K) by Clark are more or less equal for both sexes. Also, it has to be mentioned that the average values of (K) in general show a slight trend of increase with the increase of length.

Comparing the condition factor (K), by both Fulton and Clark, for the mature males and females of M. surmuletus in the different months (Table 4), the values indicate that the condition factor for the females are generally greater than that for the males.

TABLE(3).—THE CONDITION FACTOR (K), BY FULTON AND CLARK, FOR MALES AND FEMALES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS, DURING MARCH-JUNE, 1970.

Length-range (mm)	Males			Females		
	No. of fihs	F.	Cl.	No. of fish	F.	Cl.
111 — 120	1	1.085	0.986	—	—	—
121 — 130	2	0.962	0.871	—	—	—
131 — 140	4	1.000	1.006	1	1.138	0.976
141 — 150	14	1.103	1.075	5	1.137	1.056
151 — 160	16	1.075	1.024	24	1.183	1.057
161 — 170	21	1.070	1.028	26	1.195	1.068
171 — 180	20	1.106	1.050	39	1.163	1.039
181 — 190	31	1.109	1.043	22	1.174	1.044
191 — 200	16	1.134	1.043	25	1.158	1.046
201 — 210	9	1.105	1.037	31	1.186	1.052
211 — 220	3	1.201	1.043	12	1.241	1.036
221 — 230	3	1.183	1.069	4	1.211	1.064
231 — 240	—	—	—	7	1.226	1.085
241 — 250	—	—	—	2	1.224	1.071
251 — 260	—	—	—	4	1.196	1.084
261 — 270	—	—	—	1	1.139	1.016
271 — 280	—	—	—	4	1.205	1.040
281 — 290	—	—	—	3	1.260	1.166

TABLE (4).—MONTHLY VARIATION OF THE CONDITION FACTOR FOR THE DIFFERENT SEXES OF M. SURMULETUS (110-290 mm.) FROM THE EGYPTIAN MEDITERRANEAN WATERS DURING THE SPAWNING PERIOD OF 1970.

Month	Males			Females		
	No. of Fish	F.	Cl.	No. of Fish	F.	Cl.
March	38	1.227	1.148	44	1.374	1.208
April	84	1.223	1.147	124	1.306	1.197
May	17	1.184	1.113	36	1.276	1.175
June	1	1.074	1.052	6	1.219	1.143
Average . . .	—	1.218	1.142	—	1.313	1.194

The table also shows that the condition factor for the different sexes has maximum values in March. This is associated with the prespawning growth of the gonads. The values of (K) start to decrease in April and the reductoin continued during May, reaching minimum values in June. The subsequent fall in the values of (K) are associated with spawning and the continuous loss of weight of the gonads. This is clearly shown in Table 5, where the condition factor is computed for the ripe and spent fishes caught during the month of May, when some fishes were spent, while others were still in the IVth and Vth stages of maturity

TABLE (5).—THE CONDITION FACTOR OF THE RIPE AND SPENT FISH (M. SURMULETUS) DURING MAY 1970.

Stage of Maturity	Males			Females		
	No. of Fish	F.	Cl.	No. of Fish	F.	Cl.
IV-V	12	1.189	1.115	22	1.290	1.178
Spent	5	1.171	1.107	14	1.254	1.170
Average . . .		1.184	1.113		1.276	1.175

Another factor that should not be overlooked, is the fact that spawning causes not only a direct loss of weight through the emission of sex products, but also places a physiological strain upon the fish. It is quite probable that reserves are drawn upon to a considerable degree during this period, contributing to the decline in the values of the condition factor.

AGE-DETERMINATION

The examination of the scales of M. surmuletus, like that of M. barbatus, revealed some difficulties in the age interpretation. Accessory marks (false rings) are usually found in the central zone of the scales within the first annual growth. Careful examination of the central zone of the scale of M. surmuletus revealed the presence of at least two of these accessory marks, sometimes three, in the first annual growth before the onset of the first true annulus.

The first accessory mark has been observed 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 that mark. The average value was 4.9 cm for males and 5.2 cm for females (Table 6). This calculated length is nearly equal to the length at which the fish changes its habitat from the pelagic to the demersal life in coastal waters. So, this first accessory mark can be regarded as the larval or fry ring, similar to that described by Gottlieb (1956) for M. barbatus.

TABLE (6).—AVERAGE CALCULATED LENGTH (mm.) OF M. SURMULETUS AT THE TIME OF FORMATION OF THE DIFFERENT ACCESSORY MARKS.

Sex	Accessory Marks		
	First	Second	Third
Males	49.1	79.4	90.7
Females . . .	52.2	83.1	93.8

The second accessory mark is present at a short distance behind the larval ring and was found in nearly all the scales. Also, a third accessory mark was sometimes detected on the scales of some fishes, at a small distance just before the first true annulus. These last two accessory marks are mostly a result of fish migration from the shallow coastal into deeper waters. Such explanation was given by zeid Haider (1970) for the accessory marks of M. barbatus.

Body-Scale Relationship :

For M. surmuletus, fishes of every 10 mm length interval were grouped together. The mean lengths and the average scale radii for each length group were calculated (Table 7). The calculated values of the body-scale ratio (L/S) are found to be nearly constant and do not show any trend with change of length. Therefore, the body-scale relation could be represented by a straight line passing through the origin at a slope equal to the average L/S value of 4.00 (Fig.1).

CALCULATED GROWTH IN LENGTH

The growth at the end of each year of life was calculated for M. surmuletus 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 (Van Oosten, 1953).

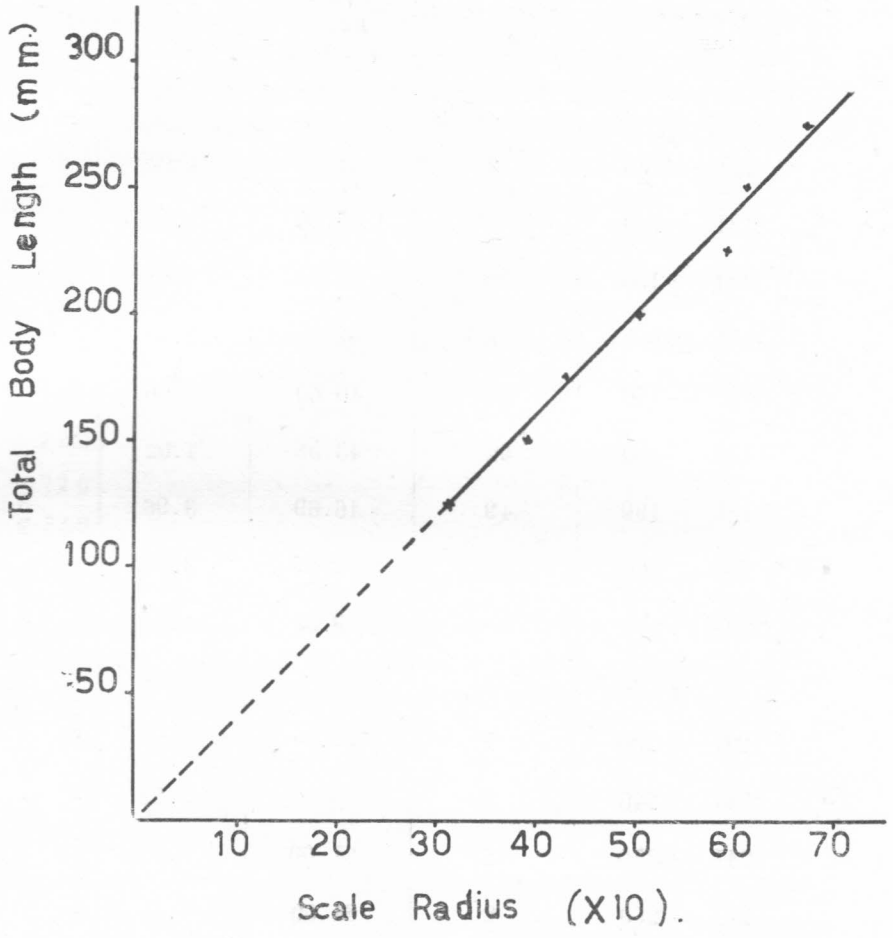

Fig. 1.—Body-Scale Relationship of Mullus surmuletus in the Egyptian Mediterranean Waters.

Age groups are designated by Roman numerals corresponding to the number of annuli found on the scales. But since our materials were collected in spring, the average length at capture for fishes older than age group II, is considered as the calculated legnth at the end of the particular year.

TABLE (7).—LENGTH-SCALE RELATIONSHIP OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS.

Length-Range (mm.)	No. of Fish	Average Scale Radiu (× 10)	L/S Ratio
121 — 130	2	31.00	4.03
131 — 140	5	35.20	3.84
141 — 150	19	35.53	4.08
151 — 160	38	39.19	3.95
161 — 170	38	40.60	4.06
171 — 180	52	43.58	4.02
181 — 190	49	46.69	3.96
191 — 200	40	49.27	3.96
201 — 210	32	49.85	4.11
211 — 220	13	54.07	3.98
221 — 230	7	58.14	3.87
231 — 240	7	60.43	3.89
241 — 250	2	61.00	4.18
251 — 260	2	64.00	4.14
261 — 270	1	64.00	4.14
271 — 280	2	67.50	4.07
281 — 290	3	68.66	4.15
Grand Average L/S Ratio ---------- =			4.00

The data on lengths at capture, calculated lengths and annual increments at the end of each year of life are given for the males in Table 8 and for the females in Table 9. The grand average length attained at the end of each year of life, the grand average annual increment of length as well as the sum of increments were also given in these tables.

From the tables, it is clear that the average calculated lenghs of males were smaller than that of the females. It was also obvious that for both sexes, the growth increment in length for the first year is very high (113.6 and 120.6 mm for males and females respectively). The growth increment was markedly decreased in the second year and for older ages a regular decrease was observed (Fig.2).

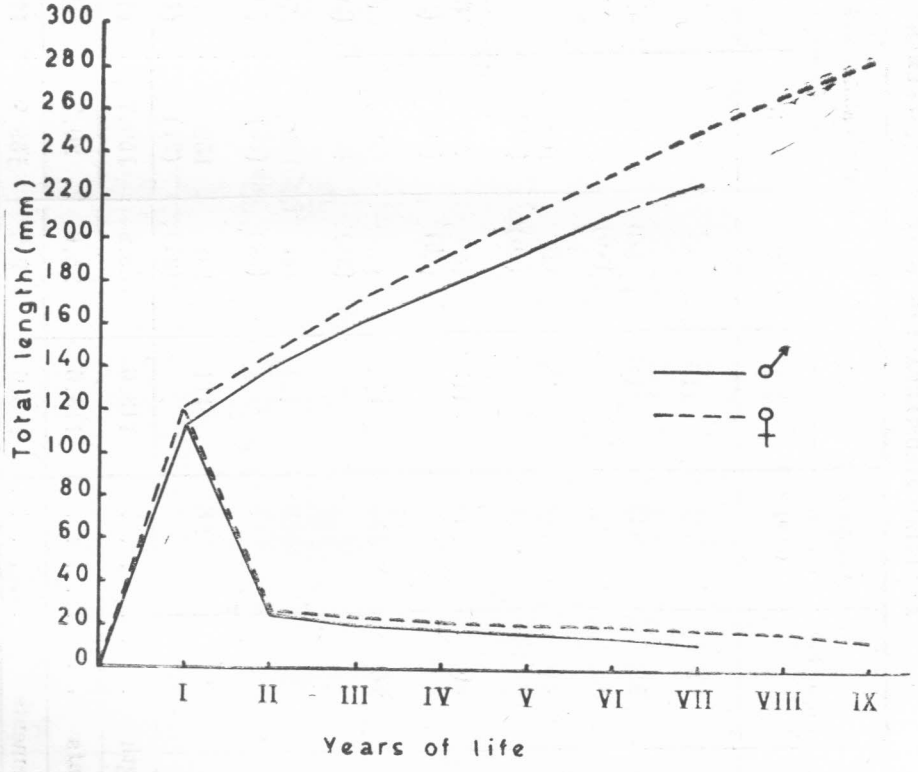

Fig. (2).—Growth Rate and Annual Increment of Length for the males and females of Mullus surmuletus in the Egyptian Mediterranean Waters.

TABLE 8 : GROWTH RATE IN LENGTH (mm.) OF THE MALES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS. (INCREMENT IN PARENTHESIS).

Age Group	No. of Fish	Lenght at capture (mm)	Calculated length at end of year of life						
			1	2	3	4	5	6	7
I	3	125	116	—	—	—	—	—	—
II	22	143	114	140 (26)	—	—	—	—	—
III	40	164	115	141 (26)	162 (21)	—	—	—	—
IV	30	178	113	139 (26)	159 (20)	162 (19)	—	—	—
V	26	195	112	136 (24)	157 (21)	177 (20)	195 (18)	—	—
VI	2	213	114	140 (25)	159 (19)	176 (19)	196 (18)	213 (17)	—
VII	2	228	111	138 (27)	159 (21)	178 (19)	197 (18)	214 (17)	228 (14)
Av. cal. length			113.6	139.2	159.7	177.5	195.1	213.5	228.0
Av. increments			113.6	25.6	20.7	19.4	18.0	17.0	14.0
Sum of increments			113.6	139.2	159.9	179.3	197.3	214.3	228.3

TABLE : GROWTH RATE IN LENGTH (mm.) OF THE FEMALES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS. (INCREMENT IN PARENTHESIS).

Age Groups	No. of Fish	Length at capture (mm)	Cal. lengeh at end of year of life								
			1	2	3	4	5	6	7	8	9
I	1	130	124	—	—	—	—	—	—	—	—
II	21	152	122	150 (28)	—	—	—	—	—	—	—
III	40	169	121	147 (26)	169 (22)	—	—	—	—	—	—
IV	66	191	120	146 (26)	169 (23)	191 (22)	—	—	—	—	—
V	30	212	121	147 (26)	170 (23)	192 (22)	212 (20)	—	—	—	—
VI	19	235	119	146 (27)	171 (25)	194 (23)	215 (21)	235 (20)	—	—	—
VII	5	258	122	150 (28)	175 (25)	198 (23)	219 (21)	239 (20)	258 (19)	—	—
VIII	4	279	120	149 (29)	174 (25)	197 (23)	219 (22)	240 (21)	260 (20)	279 (19)	—
IX	1	290	199	146 (27)	171 (25)	195 (24)	218 (23)	239 (21)	259 (19)	275 (17)	290 (15)
Av. calc. length			120.6	147.0	169.7	192.2	214.1	236.5	258.8	278.2	290.0
Av. increments			120.6	26.5	23.1	22.2	20.6	20.2	19.4	18.6	15.0
Sum of increments			120.6	147.1	170.2	192.4	213.0	233.2	252.6	271.2	286.2

To give a 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 10). It is clear that M.surmuletus made its best growth in length during the first year of life, where the annual increment is represented by 49.76 and 42.14 % for the males and females respectively. In the second year, the growth rate of both sexes sharply decreases and the annual increment was less than one fourth of that of the first year. The growth rate during older years continued to decrease, but gradually.

CALCULATED GROWTH IN WEIGHT

The calculated weights for the different age groups (Table 11) were computed for the respective sexes from the general length-weight equation. It is clear that the second year increment of weight, for either males or females is somewhat less than that of the first year's growth. The fact that M. surmuletus reaches sexual maturity during the second year of life may give some explanation of such decrease. For mature fish (older than age group 11) the annual increment of weight increases with the incsease of age. The largest increment of wight for males was in the 6*th* year, while for females it was in the 8*th* year of life. After these ages the increment in weight for both sexes begins to decrease with the increase of age.

SEXUAL MATURITY

Size and Age at maturity:

The examination of our data revealed that the first mature male of M. surmuletus appeared in the 110—120 cm length-group, and all males were found to be mature at lengths greater than 13.0 cm., whereas the first mature female appeared in the 13.0-14.0 cm length group, and all were mature at lengths greater than 15.0 cm. This means that the females of M. surmuletus attain first maturity at a body length greater (2 cm larger) than that of males.

As regards the age of maturity, it was found that sexual maturity was first attained at the end of the first year of life for the males and at the end of the second year for females. This means that the males of M. surmuletus attain maturity one year younger than females, a phenomenon which was also observed in case of M. barbatus (Hashem, 1973).

TABLE 10.—ANNUAL INCREMENT IN LENGTH (mm. & %) FOR THE DIFFERENT SEXES OF *M. surmuletus* FROM THE EGYPTIAN MEDITERRANEAN WATERS.

Age groups	Males				Females			
	No. of fish	Av. calc. length (mm)	Annual increment		No. of fish	Av. calc. length (mm)	Annual increment	
			(mm)	(%)			(mm)	(%)
I	3	113.6	113.6	49.76	1	120.6	120.6	42.14
II	22	139.2	25.6	11.21	21	147.1	26.5	9.26
III	40	159.9	20.7	9.07	40	170.2	23.1	8.07
IV	30	179.3	19.4	8.50	66	192.4	22.2	7.76
V	26	197.3	18.0	7.88	30	213.0	20.6	7.20
VI	2	214.3	17.0	7.45	19	233.2	20.2	7.06
VII	2	228.3	14.0	6.13	5	252.6	19.4	6.78
VIII	—	—	—	—	4	271.2	18.6	6.50
IX	—	—	—	—	1	286.2	15.0	5.24

TABLE(11).—ANNUAL INCREMENT IN WEIGHT (gm. & %) OF THE DIFFERENT SEXES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS.

Age group	Males			Females		
	Calculated weight (gm)	Increment of weight		Calculated weight (gm)	Increment of weight	
		(gm)	%		(gm)	%
I	15.18	15.18	10.78	18.36	18.36	6.33
II	29.02	13.84	9.82	34.62	16.26	5.61
III	45.21	16.19	11.49	55.13	20.51	7.08
IV	65.15	19.94	14.16	81.58	26.75	8.12
V	88.99	23.24	16.50	112.90	31.32	10.80
VI	115.00	26.69	18.95	150.62	37.79	13.03
VII	140.86	25.78	18.30	194.49	49.80	15.11
VIII	—	—	—	244.12	49.63	17.12
IX	—	—	—	289.93	45.81	15.80

Spawning season :

The examination of the reproductive organs of M. surmuletus in the period from March to June 1970 was the means of following its state of maturity and its spawning season. It was found that the first spent fish from the Egyptian Mediterranean waters was caught in the second half of April. Some ripe fish were still observed in the first half of June. The peak of the spwning activity occurred during the month of May, when the fully ripe fish constituted about 45% and the spent fish about 42% of the examined samples (Table 12).

Sex Ratio :

The examination of the samples showed that the population of M. surmuletus in the Egyptian Mediterranean waters is characterised by a

monthly variation in the sex ratio. In the spawning run collections the females predominate the samples. The number of females exceeded that of males in each month, and the percentage of females increased progressivly from 53% in March to 60% in April and 68% in May. For all the collection periods (March-June) the percentage of females was 59%.

TABLE 12.—MONTHLY VARIATION IN THE PERCENTAGE OF FISH IN EACH MATURITY STAGE FOR SAMPLES OF M. SURMULETUS FROM THE EGYPTIAN MEDITERRANEAN WATERS DURING MARCH-JUNE, 1970.

Month	Sex	No. of Fish	Percentage of fish in each maturity stage			
			III	IV	V	VI (Spent)
March	M	39	36	51	13	—
	F	44	34	59	7	—
April	M	84	11	42	54	2
	F	124	7	52	41	—
May	M	17	—	12	47	41
	F	36	—	16	42	42
June	M	1	—	—	—	100
	F	5	—	—	20	80

It seems also possible to speak of trend in sex ratio with increase of age. A trend showing a decrease of the percentages of males with increased age is clearly apparent in the samples. It has also to be mentioned that age groups older than VII in the catch of the Egyptian Mediterranean waters during the period of investigation were only represented by females.

SUMMARY

During the available time of investigation (March-June, 1970) the length-weight relationships, for the males, females and both sexes were described satisfactorily by the following equations:

For males $\log W = -5.3255 + 3.1635 \log L$

For females $\log W = -5.3786 + 3.1941 \log L$

For both sexes $\log W = -5.3805 + 3.1924 \log L$

To check the effect of the weights of the ripe gonads upon the length-weight relationship, the gutted weights were used for computing these relations. This showed that the ripe ovaries are no doubt heavier than the ripe testis and this was responsible for the difference in the total body weight of the two sexes.

The condition factor (K) of the fish is also discussed by both Fulton and Clark methods. It was found that the average values of (K) show a slight trend to increase with the increase of fish length. It was also found that in the corresponding months the condition factor of the females were generally greater than that of males. Maximum values of (K) were found in March and this is mostly associated with the prespawning growth of the gonads. While minimum values were found in June, after spawining.

The examination of the scales of M. surmuletus revealed the presence of two types of accessory marks in the central zone within the first annual growth. The first is the larval ring and is formed when the fish changes its pelagic mode of living to the demersal one. The second type of accessory marks is found between the larval ring and the first true annulus. This is formed as a result of fish migration from shallow coastal to deeper waters.

Ages were determined and growth histroies were computed for different sexes. The species has the greatest growth in length during the firstyear (113.6 and 120.6mm for males and females respectively). In the second year a marked drop was observed in the growth rate, while for older years the annual increment of growth has a gradual trend of decreasing.

The calculated annual growth in weight during the second year of life is somewhat less than that of the first year's growth and this may be due to sexual maturation reached by this age. For fishes older than age group II, the calculated annual growth gradually increases with the increase of age, reaching maximum values for the males during the 6 *th* year and for females during the 8*th* year of life. After these ages, the annual increment in weight begins to decrease.

Sexual maturity was first attained by the males of age group I and the females of age group II. The smallest mature male appeared in the 11.0–12.0cm length group and the smallest mature females, in the 13.0–14.0 cm length group. The spawning season of the species usually starts in April and ends in June, with maximum spawning activity during the month of May. As concerning the sex ratio, the female predominate the samples in the spwaning run collections. It has also to be mentioned that in the samples, fishes older than VII were only represented by females.

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