SOME BIOLOGICAL CHARACTERS OF MUGIL CAPITO (CUV.) IN LAKE BOROLLUS

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ABSTRACT

The length distribution of *M. capito* in lake Borollus was followed throughout the year according to age and sex, especially in the spawning season, and the length-weight relationship for the different sexes was made. It was found that the spawning period affects the weight and consequently the condition factor of the fish, they have low values for the spent fish (late winter and early spring), and high values during late spring and summer.

The formula of length-weight relationship was estimated for seperate sexes and for both sexes combined;

For males : $\log W = -4.5647 + 2.7612 \log L$

For females : $\log W = -4.9029 + 2.9392 \log L$

For both sexes : $\log W = -4.4244 + 2.8071 \log L$

The exponent (n) was high for the ripe females in the period from October to December and the formula was as follows:

$$\log W = -5.2224 + 3.0464 \log L$$

It was found that a fry ring was present in most of the scales examined for fishes longer than 70 mm in length. The winter ring is usually formed during April. The discrepancy in the calculated lengths of different age groups are not very large, and the maximum annual increase in legnth takes place during the first year of life. The calculated weights for females are higher than for males, and the maximum addition in weight is achieved in the third year of life.

Net selectivity is the main factor that can affect the length distribution of *M.* capito in Lake Borollus. The population is dominated by fishes of age group I as a result of intensive fishing with nets of illegal mesh sizes. This also affected the life span of the fish in the lake rendering it short, not exceeding four years of life.

The length frequency of *M. capito* in the catch of Lake Borollus ranges between 100 and 340 mm, with a distinct peak at lengths 140-240 mm., which represent fishes of age group I. As regards the sex ratio, the percentage of female exceeds that of males for all collections except in two months (February and November). For the whole period of investigation an average ratio of 1.6 females to one male was recognised.

INTRODUCTION

The brackish water lakes, Mariut, Edku, Borollus, and Manzala (Fig. 1), located at the northern part of the Nile Delta, are considered as the most important fishing resources in Egypt. Despite the fact that the area covered by these lakes constitutes less than 15% of all the fishing grounds in the country, they contribute from 50 to 60 percent of the total fish catch of A.R.E.

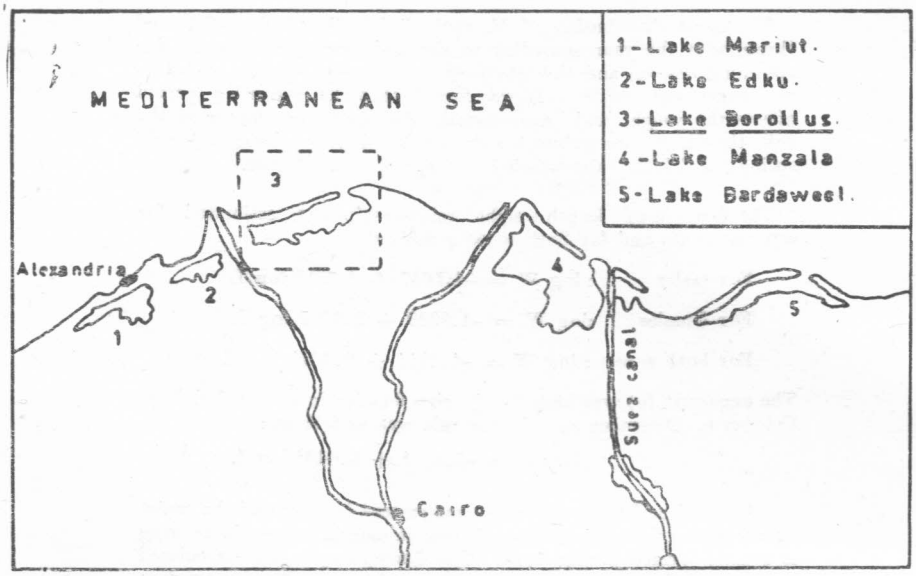

Fig. (1).— A Map, showing Lake Borollus and the other Coastal Lakes of Egypt.

The Egyptian lake fishery is mainly composed of *Tilapia* species, which constitute about 70% of the catch. Second in importance is the mullet fishery, which contributes about 20% of the catch. During the period from 1962 to 1968, the grey mullet contributed with from 15 to 29% of the total catch of Lake Borollus, while for Lake Manzala the mullet contributed with from 6 to 17%, and for Lake Edku it was from 6 to 7% (Egyptiant Fishery Statistics 1962-68).

In 1967, the total fish yield of Lake Borollus had reached 13,500 tons, of which the grey mullet constituted 16% (2125 tons), of this *M. capito* was 1564 tons (73.5%), *M. cephalus* was 550 tons (26%), and *M. saliens* was 11 ton (0.5%). Other mullet species were insignificantly represented is the catches of the lake.

Owing to the importance of *Mugil capito* in the lake fishery, the present study deals with some biological characters of this speices in lake Borollose in order to gain more information necessary for the management and development of this fishery resource.

MATERIALS AND METHODS

All materials used in this study were obtained from lake Borollus during the period from January 1967 to March 1968. Fishes were mainly caught by trammel nets of different mesh sizes (14, 16, 18 & 20 mm.).

For age determination, the scales of 2131 fish, ranging in total length from 130 to 340 mm., were taken from the left side of the fish from the region under the pectoral fin. The examination and measurements of the scales were made by means of a binocular microscope at a magnification (X 10).

The total fish length was measured to the nearest centimeter, and the body weight was recorded to the nearest gram. The sex and stage of maturity were also determined. All measurements were carried out on fresh materials obtained directly from the fishing boats.

LENGTH-WEIGHT RELATIONSHIP

The relation between the length and weight of a fish is one of the most studied biological characters of fish biology. It is known that the weight of a fish increases as a function of its length. Previously the length-weight relationship of a fish had been described by the cube law ($W = c\ L^3$) where c is a constant. This law, however, can be applied only if the form and specific gravity of the fish remain constant throughout life. These requirements are so rarely met with. However, the general equation ($W = c\ L^n$) was successfully used by several authors to describe the length-weight relationship of fishes.

The length-weight relationship of *M. capito* in Lake Borollus was calculated by using the general equation ($W = c\ L^n$) where W = weight of the fish in grams, L = total fish length in centimeters, c & n are constants, whose values are calculated from the statistical least square methods (Beckman, 1948).

The length-weight relationship of *M. capito* in Lake Borollus shows a distinct fluctuation from season to season. Moreover, this variation is quite distinct between fishes of different sexes and different stages of maturity. Thus an equation based on a particular collection of fish captured at a certain time is satisfactory to describe the length-weight relationship at this

period. But, it is important to have an equation that can describe this relation for the whole year. So, the derivation of length-weight relation formula of *M. captio* was based on the data of length weight collected throughout the year 1967. The size range was from 130 to 340 mm. This procedure gave the most practical formula for the relation between length and weight.

When the two sexes were considered separately, the following equations were obtained :

For males : $\log W = -4.5647 + 2.7612 \log L$

For females : $\log W = -4.9029 + 2.9392 \log L$

When both sexes were combined, the equation expressing the length-weight relationship was as follows :

$\log W = -4.4844 + 2.8071 \log L$

The agreement between the empirical and calculated weights obtained from this general equation is shown in Table (1) and graphically represented in Fig. (2), where the smooth curve represents the calculated weights and the dots represent the empirical ones. The agreement between the two values were quite satisfactory throughout the length range considered (130-340 mm).

During the breeding season, which extends from October to December, a special collection for the ripe females were made to estimate the length-weight relationship at this interval. The equation estimated is as follows :

$\log W = -5.2224 + 3.0464 \log L$

It is clear that the fully ripe females aquire heavy weights. It seems that the ripe ovaries add weights to the fish and consequently the exponent (n) in the length-weight relationship of ripe females of *M. capito* is higher than that calculated for fish during the whole year.

The average empirical and the calculated weights of the fully ripe females, derived from its length-weight formula, are given in Table (2).

The length-weight relationship of M. capito in other regions :

Rafail (1968) estimated the length-weight relationship of *M. capito* captured from the Egyptian Mediterranean waters by the equation : ($\log W = -1.9567 + 2.9142 \log L$).

TABLE 1.—LENGTH-WEIGHT RELATIONSHIP OF *M. capito* FROM LAKE BOROLLUS DURING THE PERIOD RFOM JANUARY 1967 TO MARCH 1968.

(LOG W = —4.6844 + 2.8071 LOG L)

Length (mm.)	Empirical weight (gm.).			Calculated weight
	male	female	both	
120	—	—	—	—
130	21.88	—	21.88	18.78
140	25.40	—	25.40	22.81
150	26.50	—	26.50	27.64
160	30.30	—	30.30	33.50
170	35.80	42.10	38.95	38.10
180	39.90	45.10	42.50	43.60
190	47.60	55.10	51.35	52.77
200	62.00	67.80	64.90	64.01
210	69.50	74.20	71.85	72.93
220	75.20	81.10	78.15	81.49
230	87.30	98.40	92.85	94.48
240	94.20	119.60	106.90	100.80
250	116.20	123.30	119.65	114.80
260	128.90	137.30	133.10	130.50
270	139.80	153.90	146.85	148.60
280	151.00	166.90	158.95	158.50
290	161.00	185.50	177.25	189.00
300	186.60	210.80	198.20	192.50
310	—	209.50	209.50	218.80
320	228.22	247.50	237.85	238.80
330	—	—	—	—
340	271.70	289.34	280.72	285.10

El-Maghraby and Bishara (1972) found that the equation expressing the length-weight relationship is the same for both the fry (20-80 mm. in length) and larger fishes (bigger than 80 mm.) in Lake Mariut. It is expressed by the equation :

log W = -4.8715 + 2.8715 log L.

The calculated weights recorded by El-Magharby & Bishara 1972 are approximately similar to our results. While those calculated by Rafail (1968) gave higher values.

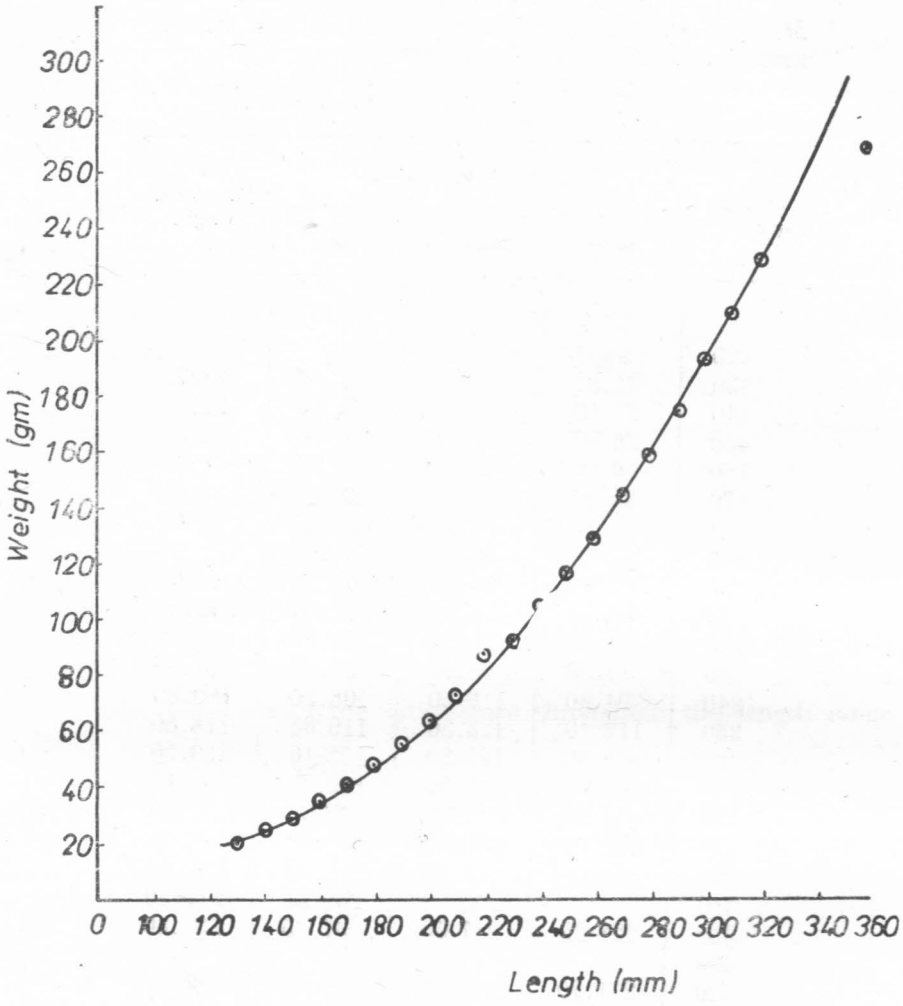

Fig. 2.—Length-Weight Relationship of *Mugil capito* in Lake Borollus during the period of investigation.

THE CONITION FACTOR

The condition factor (k) is usually calculated from the formula ($K = 100\ W/L^3$) where W = fish weight in grams and L = fish length in centimeters. It is however preferable to use the exponent (n) calculated from the length-weight relationship equation rather than to use the cube of length. The exponent (n = 2.8), was calculated for lengths ranging between 130 ad 250 mm. which are the most frequent sizes of *M. capito* in Lake Boroullus. The values of the condition factor (k) of *M. capito* were calculatld monthly in the period from January 1967 to March 1968. This is shown in Table (3) and is graphically represented in Fig. (3) for both sexes combined.

ABLE (2).—LENGTH-WEIGHT RELATIONSHIP OF RIPE *M. capito* FEMALES IN THE PERIOD FROM OCTOBER TO DECEMBER 1967.

(LOG W = -5.2224 + 3.0464 LOG L)

Length (mm:)	Empirical Wt: (gm(	Calculated Wt. (gm.)	Length (mm.)	Empirical Wt. (gm)	Calculataed Wt. (gm.)
170	55	40.7	260	165	131.5
180	60	46.1	270	185	146.5
190	69	53.8	280	199	162.5
200	80	62.2	290	204	179.6
210	90	71.5	300	218	197.8
220	97	81.7	310	237	217.5
230	103	93.3	320	243	237.8
240	121	104.7	330	—	—
250	132	117.6	204	265	282.8

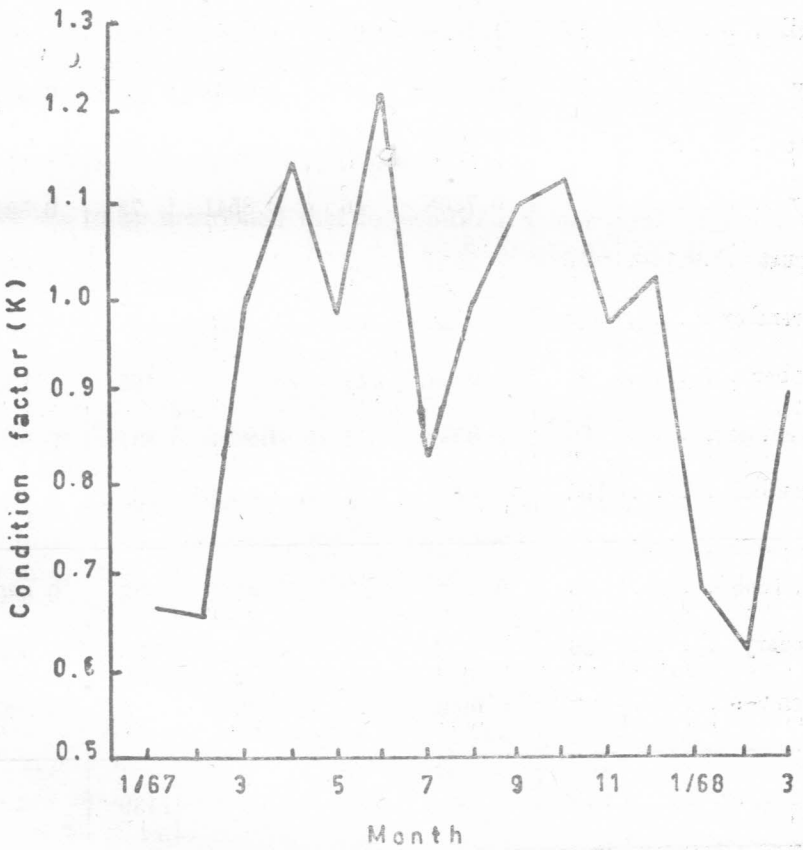

Fig. (3).—The monthly variation in the condition factor (K) of *Mugil capito* in Lake Borollus during the period of investigation.

TABLE 3.—CONDITION FACTOR (K) OF *M. capito* CAPTURED FROM LAKE BOROLLUS DURING THE PERIOD FROM JANUARY 1967 TO MARCH 1968.

Month	Male		Female		Sex Combined	
	No.	Value	No.	Value	No.	Value
January 1967 . .	2	0.6645	6	0.6405	8	0.6558
February	18	0.6700	16	0.6390	34	0.6537
March	40	0.8774	111	1.1337	151	1.0159
April	57	1.1446	103	1.2262	160	1.1958
May	14	0.9272	39	1.0205	53	0.9775
June	19	1.1596	40	1.3734	59	1.2772
July	27	0.7808	46	0.8541	73	0.8240
August	36	0.8954	45	1.1061	81	1.0083
September	33	1.0031	61	1.1622	94	1.0857
October	81	1.0294	114	1.2273	195	1.1307
November	80	0.8577	51	0.9680	131	0.9164
December	106	0.8902	147	1.0518	253	0.9724
Jan. 1968	6	0.6862	27	0.6589	33	0.6801
February	26	0.6191	84	0.5915	110	0.6092
March	1	0.6995	3	1.0602	4	0.8963
Total	546	—	893	—	1439	—

From the table it is evident that the lowest values of (k) were recorded in January & February. The population consisted of spent fish returning to the lake after spawning together with small size fishes. Rather low values of the condition factor continued throughout winter. In the beginning of spring, when the temperature begins to rise, the fish leave the vegetative areas and begin to wonder in the lake to feed. This was reflected on the good condition factor recorded in March (1.0159), which gradually increased to a maximum value in June (1.2772). The low values recorded in July may be due to the active swimming and moving of the fish. As a result of the change in the swimming activity, the fat content of the body decreased and this affect the values of the condition factor of the fish. Thomson (1957) reached to such conclusion in his study for the Yellow-eye mullet in Western Australia.

From August the fish begins to feed vigorously and this was reflected on its condition specially the females which recorded higher values in the period from August to September. Due to the fasting of the fish and the start of maturation of the reproductive organs, the fat content and the body decreased as the gonads increase in size. This was observed from the low values of (k) recorded in November and December.

It has to be mentioned that the condition factor of *M. capito* in Lake Borollus is higher than that recorded by El-Magharby and Bishara (1970) for *M. capito* of Lake Mariut for the same length range of 130-250 mm. This is mostly due to the use of the cube of length in their calculations.

AGE DETERMINATION

The scales of *M. capito* are of the ctenoid type. The regular deposition of the circuli on the scales of *M. capito* is broken by lines or breaks which are identified as annuli. These are more prominent in the anterior field than in the posterior one. It was also found that the scales taken from under the distil end of the pectoral fin are the most suitable scales for the estimation of age and the calculation of growth rate.

Body-Scale Relationship :

The relationship between the scale radius and the total body length of *M. capito* was based on the measurements of fishes with lengths from 40 to 340 mm. The available data (Table 4) were applied to have the values of L/S ratio for the total length and the average scale radius respectively. The relation between the two values gave a linear relation, which is graphically represented in Fig. (4).

TABLE 4.—BODY-SCALE RELATIONSHIP OF *M. cadito* IN LAKE BOROLLUS DURING OUR INVESTIGATION.

Total length (mm)	Number of Fish	Average scale radius (x 10)	L/S Ratio
40	12	14	2.8
50	19	18	2.8
60	12	23	2.6
70	13	27	2.5
80	19	36	2.2
90	9	43	2.1
100	6	50	2.0
110	2	58	1.9
120	20	64	1.9
130	59	75	1.7
140	136	80	1.7
150	214	88	1.7
160	299	96	1.6
170	306	104	1.6
180	209	112	1.6
190	249	120	1.6
200	109	125	1.6
210	104	133	1.6
220	85	140	1.6
230	93	151	1.5
240	80	155	1.5
250	22	163	1.5
260	21	168	1.5
270	12	178	1.5
280	4	186	1.6
290	4	192	1.5
300	5	200	1.5
310	4	206	1.5
320	2	214	1.5
340	2	240	1.4

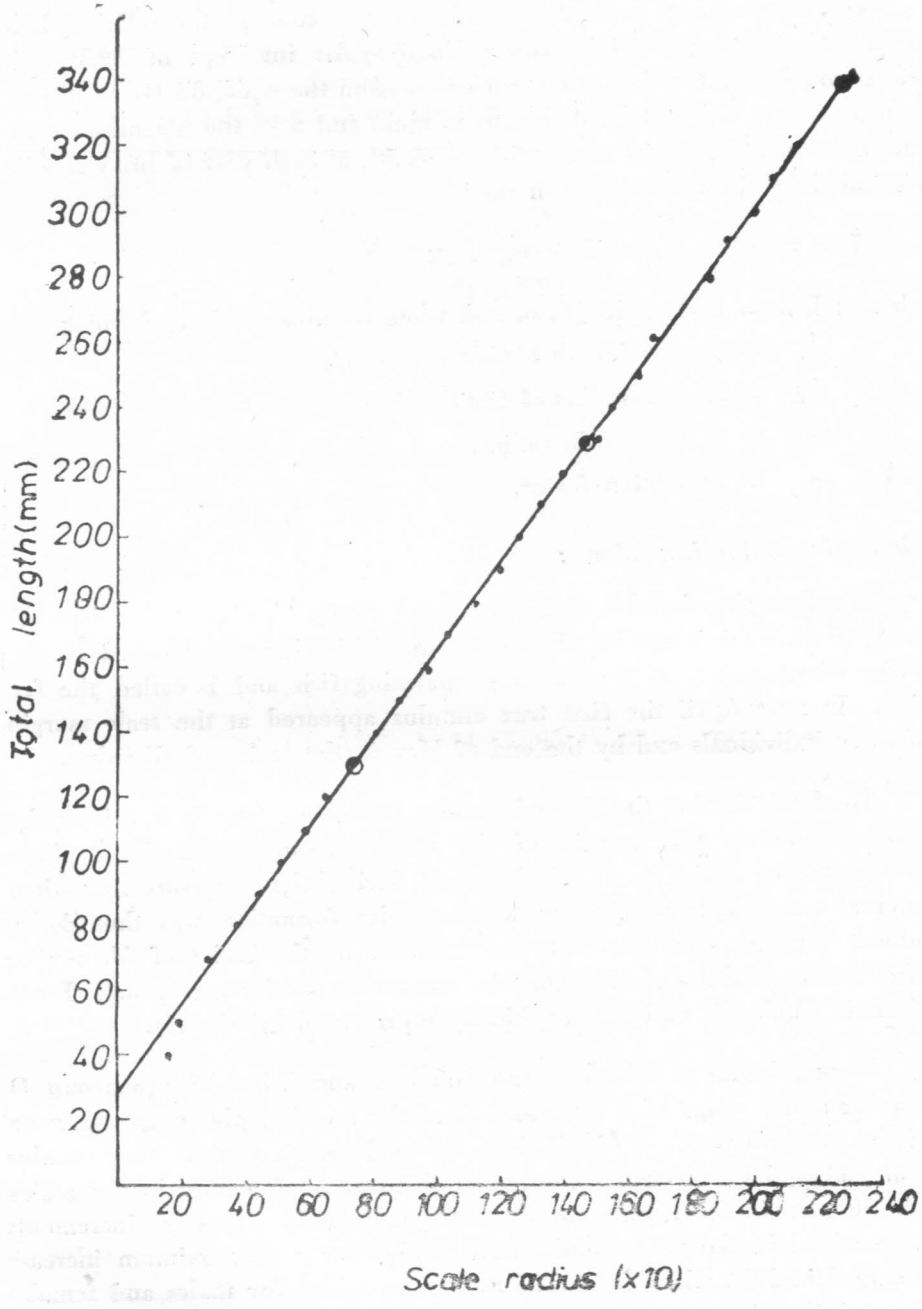

Fig (4).—Body-Scale Relationship of *Mugil capito* in Lake Borollus.

The least square method was applied to confirm the relation between the above mentioned two variables. An intercept of 30.8 mm. was found to coincide with that calculated from the equation (L = 30.8 + 1.36 S), where L = total fish length in mm., and S = the magnified scale radius (x 10). The back calculation of length at each year of life was thus computed by the following formula ;

$$L\,n = c + \frac{Sn}{S}\,(L - c)$$

where : L n = average length of fish when annulus (n) was formed,

L = average length of fish at capture,

Sn = average radius of annulus (n),

S = average scale radius,

and c = correction factor.

Time of annulus formation :

The first ring formed on the scales of young *M. Capito* was detected in April at a minimum length of 75 mm. This ring was detected on the scales of offsprings of the Autumn spawning fish and is called the fry ring. In next April the first true annulus appeared at the scale margin of some individuals and by the end of May in the scales of all fishes.

To clarify further the time of annulus formation, the distance from the last annulus to the margin of the scale was measured. From these measurements, the growth of the fish during the corresponding time interval was calculated. The time of annulus formation was thus determined from the monthly growth increments on the scales of *M. capito.* The average values of the monthly measurements for age groups I are given in Table (5) and are graphically represented in Fig. (5).

During January, February and March young fishes of age group O (having a size range of 130-170mm), had the fry ring plus a growth zone of the previous year. In April these fishes showed a distinct true annulus that marks the I-age-group. A growth increment of 9 mm. in the males and 10 mm. in the females were added in April. Further increments were added in the next months until September ; its maximum increase occurred in July, when 27 and 28 mm. were added for males and females respectively. The cessation of growth could be deduced from the nearly or almost equal increments on the scales collected from October to the next April, when the new winter ring appeared.

TABLE 5.—AVERAGE INCREMENT OF GROWTH IN mm. FOR THE FIRST YEAR COMPLETED BY *M. capito* AT DIFFERENT MONTHS OF CAPTURE IN LAKE BOROLLUS DURING THE INVESTIGATION.

Month	Water Temp. °C	Male		Female		Sexes combined	
		No. of fish	Increment	No. of fish	Increment	No. of fish	Increment
January 1967	13.9	5	80	6	80	11	80
February	13.5	18	81	16	84	34	83
March	16.2	21	81	95	81	116	81
April	19.4	57	9	98	10	155	9
May	23.3	2	22	34	26	36	24
June	25.9	13	38	24	45	37	42
July	27.9	34	65	53	73	87	70
August	29	61	79	46	82	107	81
September	27.8	23	87	47	88	60	87
October	23.4	75	88	119	88	194	88
November	20.7	63	84	22	86	85	85
December	15.8	157	86	92	83	249	85
January 1968	14.6	6	84	27	83	33	83
February	14.2	26	82	87	83	113	83
March	16.6	1	81	2	82	3	81

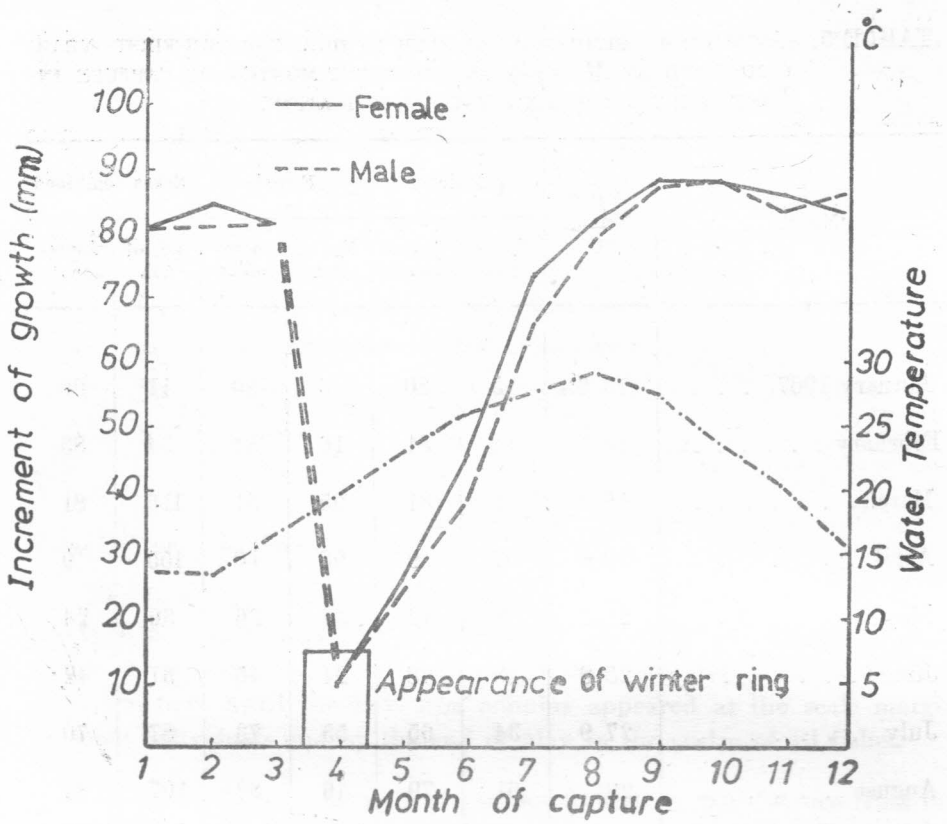

Fig. (5).—Average increment of growth in length at different months of capture for fishes of age group 1 during the year 1967

From the above observations, it could be concluded that the time of annulus formation on the scales of *M. capito* in Lake Borollus is the early days of April. Also, it has to be mentioned that the values of the average monthly increments in general are higher in the females than in males.

CALCULATED GROWTH IN LENGTH

The combination of data from all collections was done to obtain the growth histories of the different year classes, as well as the general growth for all age groups. This was made after careful examination of the data for the individual samples. The average calculated length of *M. capito* taken from the commercial catch in the period from January 1967 to March 1968 are shown in accordance to sex and age groups in (Table 6).

TABLE (6).—CALCULATED LENGTHS (mm.) OF MALE AND FEMALE *Mugil capito* FROM LAKE BOROLLUS DURING THE PERIOD OF INVESTIGATION (INCREMENT BETWEEN PARENTHESIS).

Age Groups	No. of Fish	Size at capture	Years of life		
			1	2	3
		MALES			
I	503	130	123	—	—
II	39	238	118	222 (104)	—
III	4	301	130	221 (91)	294 (73)
Gr . Av. Increment of length . . .			123	103	73
Sum. of Av. Increment			123	226	299
		FEMALES			
I	684	170	129	—	—
II	105	242	128	238 (110)	—
III	4	315	133	226 (93)	301 (75)
Gr . Av. Increment of length . . .			129	109	75
Sum. of Av. Increment			129	238	313

The growth curve that can best describe the growth patterns of a fish population depends on the presence of several age groups. Fishes older than age group III were rarely found in the catch of Lake Borollos. The construction of the growth curve based on the calculated lengths does not represent the true growth of the fish population especially for the older years of life. To avoid this, the graphical representation was based on the summation of grand average of annual increments of length (Fig. 6).

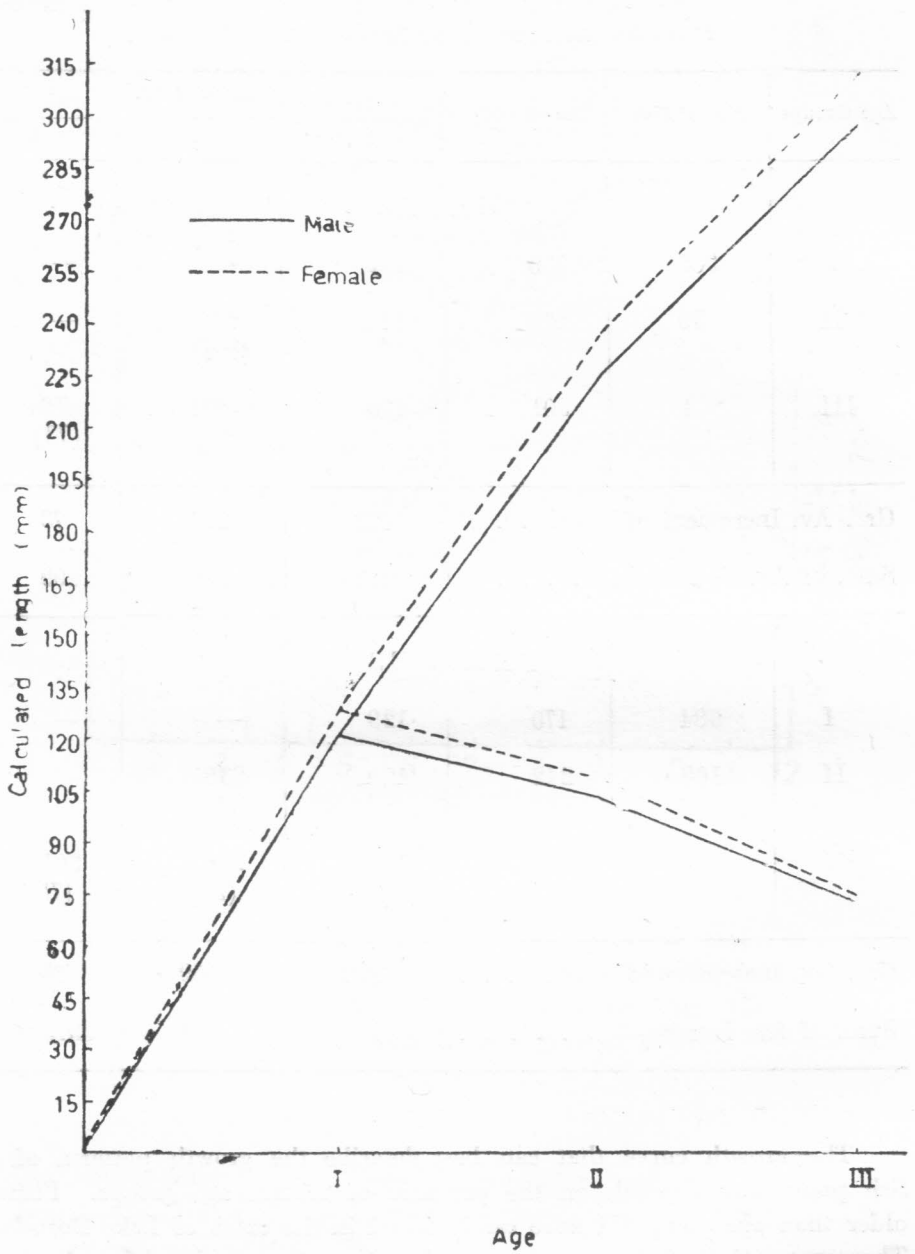

Fig. (6).—General growth in length and annual increment of growth of Mugil capito in lake Borollus during the period of investigation.

The discrepancies in the calculated lengths of the different age groups of *M. capito* were not very large, and may be due to different factors. Out of all the factors discussed by many workers, net selectivity is the main factor that can affect the length distribution of *M. capito* in Lake Borollus. Many kinds of nets are used for capturing mullet in this lake. Some nets, like the trammel nets, are used for capturing all mullet species present, while other nets are specialized for capturing *M. capito* during their migration. The swarming of *M. capito* in shoals at their spawning season affects the observed length distribution, and consequently the calculated lengths. The illegal nets used to catch the small sizes also affect directly the size distribution of the fish.

The calculated lengths of the different sexes revealed that the females grow faster than the males. At the end of the first year of life the females were larger than the males by 6 mm. This advantage of the females continued in the second year to give about 10 mm. excess in length. It is also observed that the growth in length for both sexes is somewhat parallel to each other in the first and second years of life and then the growth curve of the females diverges upward, indicating a higher increase in length at the third year of life. From the lower part of the curve, it is clear that the growth in length drops gradually as the fish increases in age.

From Table (7), it is clear that the fish adds the maximum increase in length (about 41.2%) in the first year of life. The percentage annual increase in length decreases steadily in both sexes to reach 24.3% of their total length in the third year of life.

TABLE (7).—GROWTH INCREMENT OF LENGTH (IN mm. & %) OF *M. capito* FROM LAKE BOROLLUS DURING 1967-1968.

Age Groups	Males		Females		Combined sexes	
	Increment (mm.)	%	Increment (mm.)	%	Increment (mm.)	%
I	123	41.1	129	41.2	126	41.2
II	103	34.4	109	34.8	106	34.6
III	73	24.5	75	24.0	74	24.3

CALCULATED GROWTH IN WEIGHT

The calculated weights of *M. capito* were determined by applying the calculated length values of the different age groups. These weights with their annual increments for the separate sexes are shown in Table (8) and graphically represented in Fig. (7).

TABLE (8) — CALCULATED WEIGHTS (gm.) OF MALES AND FEMALES OF *Mugil capito* FROM LAKE BOROLLUS DURING THE PERIOD OF IVESTIGATION (INCRCMENT BETWEEN PARENTHESIS).

Age group	No; of fish	Size at capture	Years of Life		
			1	2	3
		MALES			
I	504	130	16.40	—	—
II	39	238	15.29	84.63 (69.34)	—
III	4	301	19.86	83.58 (64.70)	180.9 (97.32)
Gr. Av. Increment of Weight . .			16.30	68.87	97.32
Sum. of Av. Increment			16.30	85.17	182.49
		FEMALES			
I	684	170	24.70	—	—
II	105	242	19.05	102.3 (83.25)	—
III	4	315	17.06	75.74 (61.14)	193.0 (114.26)
Gr. Av. Increment of Weight . .			20.02	82.50	114.25
Sum. of. Av. Increment			20.02	102.52	216.78

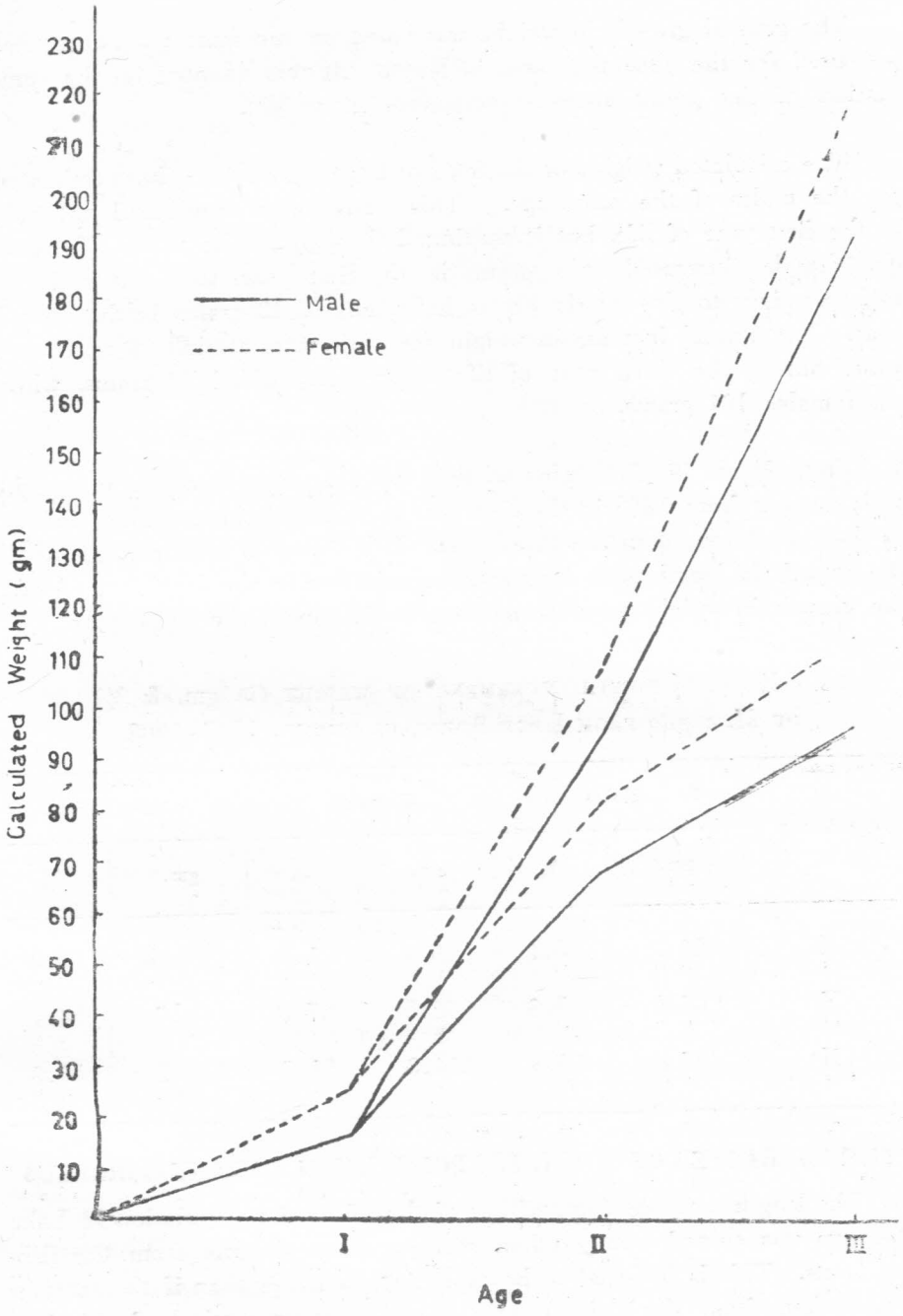

Fig. (7).—General growth in weight and annual increment of growth of Mugil capito in lake Borollus during the period of investigation.

The general growth in weight was based on the same procedure that was used for the general growth in length. It was adopted on the summation of the grand average increments of weight.

The calculated weights of the females were higher than those estimated for the males of the same age. This advantage continued not only in the first year of life, but it continued throughout the whole life span. The females increased by 9 grams in the first year, and still had the higher weight to give nearly excess in weight of 12 grams in the second year. The annual increase in weight for both sexes attaind its maximum value during the third year of life. The males added 97 grams, while the females 104 grams.

From Table (9) it is obvious that the percentage increase in weight rises steadily from 9.8% in the first year to reach maximum value (53.8%) of their total weight in the third year. It has also to mention that while the growth in length gave its maximum addition in the first year of life, the growth in weight gave its maximum addition in the third year.

TABLE (9).– GROWTH INCREMENT OF WEIGHT (in gm. & %) OF *M. capito* FROM LAKE BOROLLUS DURING 1967 - 1968.

Age Group	Males		Females		Combined sexes	
	gm.	%	gm.	%	gm.	%
I	16.3	8.4	20.0	11.2	18.16	9.8
II	68.9	35.8	82.5	37.0	75.7	36.4
III	97.0	55.8	114.3	51.7	105.2	53.8

THE CHARACTER OF *M. CAPITO* POPULATION IN LAKE BOROLLUS

The length and age composition of the *M. capito* population in Lake Borollus was gained from random samples taken directly from the fishing boats. This is believed to be more representable than if the samples were taken from the fish markets. In the latter, sorting of fish into different size grades do not allow an accurate estimation of the population characters.

Length frequency :

The length frequency of *M. capito* from the catches of Lake Borollus varies between 100 and 340 mm. Because of the intensive fishing and the use of illegal trammel nets, the majority of lengths in the catches lies between 140 and 240 mm. (Table 10).

TAPLE 10.—THE LENGTH FREQUENCY DISTRIBUTION OF *M. capito* IN LAKE BOROLLUS, COLLECTED FROM THE FISHING BOATS IN THE PERIOD FROM JANUARY 1967 TO MARCH 1968.

Length (mm)	No. of Fish	%	Length (mm)	No: of Fish	%
100	7	0.3	230	97	4.5
110	3	0.1	240	84	3.8
120	21	1.0	250	23	1.1
130	61	2.9	260	22	1.0
140	143	6.6	270	12	0.6
150	226	10.5	280	4	0.2
160	315	14.6	290	4	0.2
170	323	15.0	300	5	0.2
180	220	10.2	310	4	0.2
190	262	12.1	320	2	0.1
200	114	5.3	330	—	—
210	109	5.1	340	2	0.1
220	89	4.2	350	—	—

Age-Composition :

For any fish population, it is very important to study its age composition. Among the factors that affect the age composition of mullet population in lake Borollus are the fishing effort, the spawning migration, and the hiding of the fish in the vegetative areas during the cold months.

The age composition of *M. capito* was determined montly from January 1967 to March 1968. The number of fish collected and the percentage occurrence of the different age groups are given in Table (11) and graphically represented by histograms in Fig. (8).

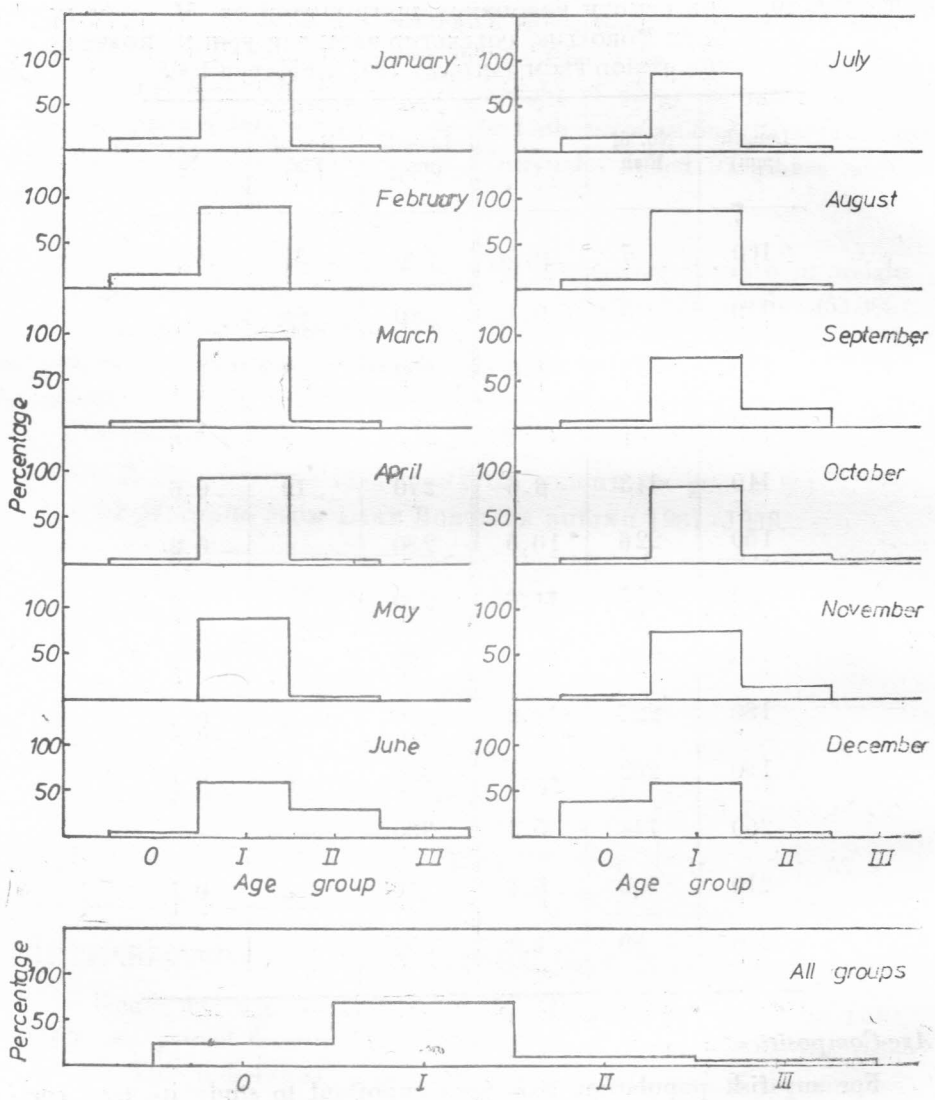

Fig. (8).—Age composition of Mugil capito in lake Borollus collected from the fishing boats during the period of investigation.

TABLE 11.—AGE COMPOSITION OF *M. capito* IN LAKE BOROLLUS COLLECTED FROM THE FISHING BOATS IN THE PERIOD FROM JANUARY 1967 TO MARCH 1968.

(Percentage between parentheses)

Month	Total No.	Years of life			
		0	1	2	3
January 1967	50	7 (14)	41 (82)	2 (4)	—
February	106	15 (14)	91 (86)	—	—
March	186	9 (4)	175 (94)	2 (2)	—
April	162	1 (1)	154 (95)	7 (4)	—
May	62	—	57 (91)	5 (8)	—
June	62	2 (4)	37 (59)	19 (30)	4 (7)
July	99	13 (13)	83 (84)	3 (3)	—
August	132	16 (12)	110 (83)	6 (5)	—
September	94	5 (6)	71 (74)	10 (20)	—
October	238	6 (2)	201 (84)	27 ((11)	4 (3)
November	131	6 (5)	104 (79)	21 (16)	—
December	271	99 (36)	166 (61)	6 (3)	—
January 1968	70	41 (58)	29 (42)	—	—
February	212	122 (57)	90 (43)	—	—
March	125	101 (80)	24 (19)	1 (1)	—
Total	2000	442 (22)	1433 (71)	117 (5)	8 (2)

The analysis of the monthly collection of the separate sexes showed no appreciable difference in their age composition and hence, the sexes were combined. This analysis gave a clear picture for the age composition of the fish in the lake. The monthly percentage of the different age groups showed that the fishes of age group I were dominant in the catch. An appreciable increase in the percentage of age group II was observed in June and September, and to a less extent in October and November. Age group III appeared only in the catches of June and October.

From the study of the age composition of such a heavily exploited population of *M. capito*, three results can be distinguished :

1. Fishes of age group I dominated the population of *M. capito* in lake Borollus.
2. The intensive fishing does not allow the majority of fishes to pass its normal life span, and so the population of *M. capito* in lake Borollus is a very short-lived one.
3. The swarming of the large fishes (and hence their capture) during the spawning migration, does not allow them to appear in the population for long time intervals.

Sex ratio :

The sex ratio was studied for 1439 fish ranging in total length from 130 to 340 mm. The monthly ratio during the period from January 1967 to March 1968 are given in Table (12).

For the whole period of investigation, an approximate ratio of 8 females for 5 males (i.e 1.6 : 1) were found in lake Borollus. The females were dominant in the catch throughout the year except in two months (February and November). The scarsity of females in the day catch during the shoaling migration may be the reason for the dominance of males in November. Also the males return earlier to the lake after spawning and so become dominant in February.

The sex composition according to the different age groups is shown in Table (13). It is clear that the females were dominant in age group I and more dominant in age group II, while in age group III the sex ratio was 1 : 1. The general sex ratio for the females and males in the three age groups was 1.6 : 1. Thomson (1967) during his work on the yellow-eye mullet (*Aldrichetta foresteri* C. & V.) in Western Australia reached to a nearly similar result and the sex ratio was 1.2 females for each male. Also a

similar result had been estimated by El-Zarka & El-Sedfy (1967) on the *M. saliens* in lake Qurun which was 1.4 females for each male. Hussein (1969) found that the ratio for *M. salines* of lake Edku was 6.6 females for each male.

TABLE 12.—SEX RATIO OF *M. vapito* FOR LENGTH RANGE BETWEEN 150 AND 340 mm. IN LAKE BOROLLUS IN THE PERIOD OF INVESTIGATION.

Month	No. of Fish	Male		Female		Sex Ratio
		No.	%	No.	%	
January 1967 . . .	8	2	25	6	75	3.00
February	34	18	52.9	16	47.1	0.88
March	151	40	25.6	111	74.4	2.77
April	160	57	35.6	103	64.4	1.70
May	53	14	26.4	39	73.6	2.78
June	59	19	32.2	40	67.8	2.10
July	73	27	36.9	46	63.1	1.70
August	81	36	44.4	45	55.6	1.25
September	94	33	35.1	61	64.9	1.84
October	195	81	41.5	114	58.5	1.40
November	131	80	61.0	51	39.0	0.63
December	253	106	41.8	147	58.2	1.38
January 1968 . . .	33	6	18.1	27	81.9	4.50
February	113	26	23.0	84	77.0	3.34
March	4	1	25.0	3	75.0	3.00
Total	1439	546	—	893	—	1.64

TAPLE (13).– SEX RATIO OF *M. capito* ACCORDING TO AGE GROUPS IN LAKE BOROLLUS DURING THE PERIOD FROM JANUARY 1967 TO MARCH, 1968.

Age group	Total No. of fish	Average length (mm)	No. of male	No. of females	Sex ratio
I	1287	142	503	784	1.55
II	144	240	39	105	2.69
III	8	315	4	4	1.00
Total . .	1439		546	893	1.64

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