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A BIOLOGICAL STUDY ON THE SPARID FISH OBLADA MELANURA L., IN THE EGYPTIAN MEDITERRANEAN WATERS

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ABSTRACT

The length-weight relationship and condition factor were studied for the obtained length range. Age-determination and growth studies were made from the examination and measurements of the scales. The spawning season was appointed and the probability of fractional or prolonged spawning was discussed. The size and age at first maturity were studied. The absolute and relative fecundity were estimated according to fish length, weight and age.

INTRODUCTION

Inspite of the wide distribution of **Oblada melanura** (L.) on the Mediterranean and on the eastern Atlantic coasts (Fisher, 1973), the biology of this species has received very little studies. The present work was conducted to investigate some biological characteristics of this species along the Egyptian Mediterranean coasts which may be useful for the improvement of its fishery.

MATERIAL AND METHODS

The materials used in the present study were obtained from the commercial catch of the Anfoushi and Abu-Kir fish markets, Alexandria. All possible care was taken to ensure the random sampling which extended over a period of 13 months from July 1969 to July 1970. 487 fish ranging in total length from 80 to 280 mm, were examined fresh in the laboratory. Total length and weight, as well as gutted weight were recorded to the nearest millimeter and gram respectively. Stage of gonad maturity was determined according to Cassie's Code (1956).

Fish age was determined from the annuli on the scales. Scales were cleaned in 10% solution of Ammonium hydroxide and mounted dry between two glass slides. Scale examination and measurements were carried out under a binocular microscope at a magnification (x 40).

For fecundity estimation, both ovaries were removed intact and placed in 10% neutral formalin solution, after hardening for at least 24 hours, the ovaries were thoroughly washed in water. Both lobes were then dried to constant weight. The number of eggs in both lobes were estimated by counting a weighed sample of ova then adjusting the count to the total ovary weight.

A known portion (by weight) from the formalin preserved mature ovary were taken and gently spread over a glass slide; the diameter of all yolky ova were measured with the aid of an eye piece micrometer (x 17). The measurements were then converted to millimeters.

RESULTS AND DISCUSSION

I- Length-Weight Relationship and Condition Factor

(A)- Length-Weight Relationship:

The length-weight relationship of fish has been described by the general equation ($W = C\ L^n$) where W = fish weight in grams and L = fish length in millimeter, C and n are constants, whose values are determined from the available data by applying the statistical least squares method.

The average observed weights for every 10 millimeter length interval for sexes combined and for all size groups are calculated and the fitting of straight lines (by least squares) to the logarithms of lengths and observed weights led to the equation:

$$\text{Log } W = -4.9302 + 3.0113 \log L$$

It is obvious that, the weight of fish increase as the cube of its length and the agreement of the calculated and the empirical weights (given in Table 1) are quite satisfactory.

(B)- Condition Factor:

For the purpose of comparing the condition of a fish speacies the cube relationship of length and weight ($K = W \times 100/L^3$), is usually used. Comparison of the condition factor 'K' of **Oblada melanura** in the Egyptian Mediterranean waters is given according to different length groups in Table 1, and in different months in Table 2. It ranged from 1.15 to 1.42 with an average of 1.24, but they generally show no particular trend.

II- Age Determination and Growth Studies:

Accessory marks are frequently deteced in the scales of **Oblada melanura,** these may be result of spawning or any other unusual circumstances in the life or environment of fish. Sometimes the accessory annulii resemble the true ones so closely as to make accurate age determination difficult , but knowledge of the spawning time and time of annulus formation may help in the differentiation between the accessory and actual rings.

Table (1)

Relation between length and weight, and condition factor of *Oblada melanura*.

Mean total length (T.L) (mm)	Number of Fish	Average observed Wt. (gram)	Calculated Wt. (gram)	K
80	2	7.25	6.32	1.42
90	5	8.40	9.00	1.15
100	7	11.71	12.37	1.17
110	6	16.00	16.11	1.20
120	12	20.46	21.42	1.18
130	21	26.43	27.25	1.20
140	21	34.81	34.07	1.27
150	21	42.33	41.95	1.25
160	31	51.48	50.93	1.26
170	37	60.36	61.12	1.23
180	45	71.85	72.64	1.23
190	64	86.89	85.49	1.27
200	46	100.73	99.72	1.26
210	45	118.60	115.24	1.28
220	43	132.41	132.89	1.24
230	33	147.18	151.92	1.22
240	21	179.26	172.70	1.30
250	14	195.14	200.27	1.25
260	7	224.86	219.84	1.28
270	3	231.67	246.33	1.18
280	3	273.33	274.85	1.24

TABLE (2)

Monthly variation of the average condition factor of *Oblada melanura* during 1969 / 1970.

Month	No. of Fish	K	Month	No. of Fish	K
July 1969	51	1.27	January,70	20	1.29
August	26	1.20	February	4	1.31
September	33	1.23	March	40	1.39
October	43	1.24	April	29	1.26
November	16	1.28	May	6	1.30
December	20	1.24	June	6	1.34
			July	29	1.21
			Total No. of fish	323	

The scales have another type of accessory marks which belong to "fry ring" that could be seen not far from the focus. The formation of such rings might be related to the change of food during the early life of the fish.

Time of annulus formation:

The procedure adopted to know time of annulus formation was by examining scale samples collected in the different months of the year. The time of annulus formation in 1969 and 1970 was determined from samples collected between April and June. A marginal annulus was evident in 10% of the fish examined in April. This increased to 80% of the fish collected in May and in few individuals the annulus had a later appearance in June and July.

Body-scale Relationship:

Fish at ten millimeter length interval were grouped together and the corresponding anterior scale radius measurements were obtained at a magnification of (x 40). The mean fish lengths and average scale radii for each length group were calculated and are given in Table 3; thay are nearly constant and do not show any trend with change of length.

TABLE (3)

Relation between total length and scale redius (x 40) of

Oblada melanura.

Mean total length mm	No. of Fish	Scale radius (magnified)	L/S
80	2	45.50	1.76
90	5	46.20	1.95
100	7	55.14	1.81
110	6	62.67	1.70
120	12	66.75	1.80
130	21	71.81	1.81
140	21	79.38	1.76
150	21	85.38	1.76
160	31	90.23	1.77
170	37	94.05	1.81
180	45	98.67	1.82
190	63	102.16	1.85
200	47	107.47	1.86
210	45	110.29	1.90
220	38	114.95	1.91
230	32	122.09	1.88
240	22	129.27	1.86
250	14	130.29	1.91
260	9	132.75	1.96
270	4	140.00	1.93
280	2	160.50	1.74
No. of Fish	484	Grand average L/S ratio	1.84

Growth in Length:

The linear relationship between the total fish length and its scale radius (Table 3), suggested the validity of the direct proportional method of Dahl - Lea :

$$Ln = Sn / S \times L$$

for the calculation of lengths at previous years of life, where:

L = fish length at capture,
Ln = fish length at the n year of life,
S = total scale radius,
and Sn = scale radius at the n^{th} year of life.

The calculated lengths at the end of different years of life are given in Table 4. It is evident that the calculated and the corresponding actual lengths show fairly well agreement. It is obvious that, the highest growth takes place in the first year of life, after which the annual increment gradually and progressively decreases with further progress in age.

Growth in Weight:

The calculated growth in weight at the end of each year of life was estimated by applying the length-weight equation to the calculated lengths at each year of life. The percentage increase in weight at the successive years in relation to the weight reached at the end of life span was also given in Table (5). It is clear that growth in weight is much slower in the earlier ages and the annual increment of weight increases in the successive years reaching maximum values during the 3^{rd}, 4^{th} and 5^{th} years of life, after which a marked decline is observed with further increas of age.

III- Reproduction

Time of Spawning

The percentage distribution of different maturity stages of the species under investigation is given in Table (6), according to different months. It is evident that the spawning season, as indicated from the first appearance of ripe individuals in the catch, is during spring and early summer, extending from April thorugh May and ends in June. The same results were arrived at by Breder and Rosen (1966) working on **Oblada melanura** off the Algerian coast.

Gonadosomatic Index:

In the present work the percentage of gonad weight to gutted fish weight is referred to as gonadosomatic index and is used as an indication to the spawning season.

The variation of gonadosomatic index during the spawning season is shown in Table (7). It is obvious that the climax of breeding activity coincided

TABLE (4)

Calculated length at the end of different years of life of **Oblada melanura** (Increment between brackets)

Age group	No. of Fish	Average length	Length (mm) at the end of yaer						
			1	2	3	4	5	6	7
I	64	129.08	81.87						
II	93	166.69	80.49	139.03 (58.54)					
III	159	196.10	82.59	143.47 (60.88)	185.57 (42.10)				
IV	112	215.46	82.49	144.35 (61.85)	182.39 (38.04)	213.27 (30.88)			
V	36	238.50	82.62	143.40 (60.78)	184.71 (41.31)	214.94 (30.23)	235.17 (20.23)		
VI	10	251.25	79.91	141.01 (61.10)	184.52 (43.50)	209.60 (28.13)	229.85 (20.21)	243.01 (13.16)	
VII	4	276.25	82.86	145.93 (63.07)	187.42 (41.49)	216.70 (29.28)	236.23 (19.53)	251.12 (14.89)	255.88 (14.76)
Grand AV. Calculated length		82.01	142.35	184.35	213.50	234.50	234.19	245.33	255.88
Grand Av. incr. of length			82.01	60.64	40.63	30.53	20.17	13.65	4.76
Sum of Av. incr. of length			82.01	142.65	183.28	211.74	231.91	245.56	250.32

TABLE (5)

Calculated weights and increment of weight (mm & %) of

Oblada melanura at different years of life.

Age group	Calculated length (mm)	Calculated weight (gm)	Increment (gm)	of wt. %
1	82.0	6.8	6.8	3.4
2	142.7	36.1	29.3	14.5
3	183.3	77.5	41.4	20.5
4	211.7	122.5	45.0	22.3
5	231.9	160.8	38.3	19.0
6	245.6	189.9	29.1	14.4
7	250.3	201.6	11.7	5.8

in both sexes. The percentage distribution of gonadosomatic indices is in accordance with the percentage distribution of the different maturity stages previously given in Table (6) and so both results verify each other.

Probability of Fractional Spawning :

Egg diameter studies may throw some light on the maximum size and nature of spawning whether short or long. For **Oblada melanura,** the ripe ovaries contain yolked ova of two or more size groups with no sharp separation between them. The presence of two or more modes of the ova size frequency in the ovary, shortly before spawning has been accepted by Hickling and Rutenberg (1936); Higham and Nicholson (1964) and Yoshida (1966) as indicating a long spawning season or fractional spawning character.

Macgregor (1957) discussed the probability of multiple spawning in the Pacific Sardine **Sardinops caerulea** and pointed out that the presence of two or more modes in the size distribution of developing eggs may indicate that multiple spawning will occur but does not necessarily mean that all groups of eggs mature. Nikolsky (1963) stated: "the occurrence of small eggs together with large ones in the ovary does not always indicate fractional spawning and in many fish the small eggs remain in the ovary after spawning and are gradually resorbed".

On the basis of diameter measurements of ova in the fully ripe ovaries, the probability of fractional spawning was tested throughout the breeding period.

TABLE (6)

The percentage distribution of different maturity stages during the spawning season of ***Oblada melanura***

(fish number between brackets)

Month	Percentage (Females)					Percentage (Males)				
	Mature	N.ripe	Ripe	Spent	No.of Fish	Mature	N.ripe	Ripe	Spent	No.of Fish
March	11.36 (5)	88.63 (39)	-	-	44	74.28 (26)	25.72 (9)	-	-	35
April	33.92 (19)	46.42 (26)	19.64 (11)	-	56	44.74 (17)	39.47 (15)	15.79 (6)	-	38
May	2.41 (2)	-	97.59 (81)	-	83	5.88 (2)	-	94.12 (32)	-	34
June	5.26 (2)	-	26.31 (10)	68.43 (26)	38	10.34 (3)	-	20.68 (6)	68.98 (20)	29
July	91.00 (20)	-	-	9.00 (2)	22	95.00 (21)	-	- (1)	5.00	21
Total number of Fish					243					157

TABLE (7)

Variation of gonad-index during the spawning season of **Oblada melanura**

(fish number between brackets)

Month	G.I. (Females)			G.I. (Males)		
	Min.	Max.	Average	Min.	Max.	Average
March	1.04	3.50	2.72(4)	-	-	3.00(1)
April	2.24	3.94	3.06(6)	2.00	6.93	4.63(6)
May	3.04	9.71	5.74(82)	2.80	10.00	6.70(21)
June	2.31	5.45	4.38(4)	-	-	4.50(1)
July	1.65	3.51	3.31(4)	-	-	3.00(7)

The results obtained monthly during the spawning period are given in the histogram Fig. (1). Due to the difficulty in distinguishing between the modes in the histogram, it is more reasonable to say that this species is characterized by a prolonged spawning rather than a fractional spawning habits.

Size and Age at Sexual Maturity:

A knowledge of size and age at first sexual maturity has its practical application in the determination of the minimum size and age that may be needed to protect an adequate spawning stock and to ensure at least one spawning for the mature individuals. However, according to Love (1970) many fish mature when they reach a critical size rather than a particular age. It is clear from Table (8) that, fish smaller than 155 mm. are always immature, while all fish over 185 mm. are sexally mature.

As regards age at first maturity, fish should pass their first year of life before being mature, and this is first attained in some fish during the second year of life and all fish are found to be sexually mature by their third year of life.

Fecundity:

In order to know the mean fecundity of any stock in any year, it is necessary, according to Simpson (1951), to know both relationships between fecundity and length on one hand, and fecundity and weight on the other hand, of the individual spawning females and their length or weight composition (in the stock) in that year.

Fecundity / Length:

Many investigators working on the fecundity of fish showed that in many species, fecundity increases with the size of fish. In Table (9) the mean

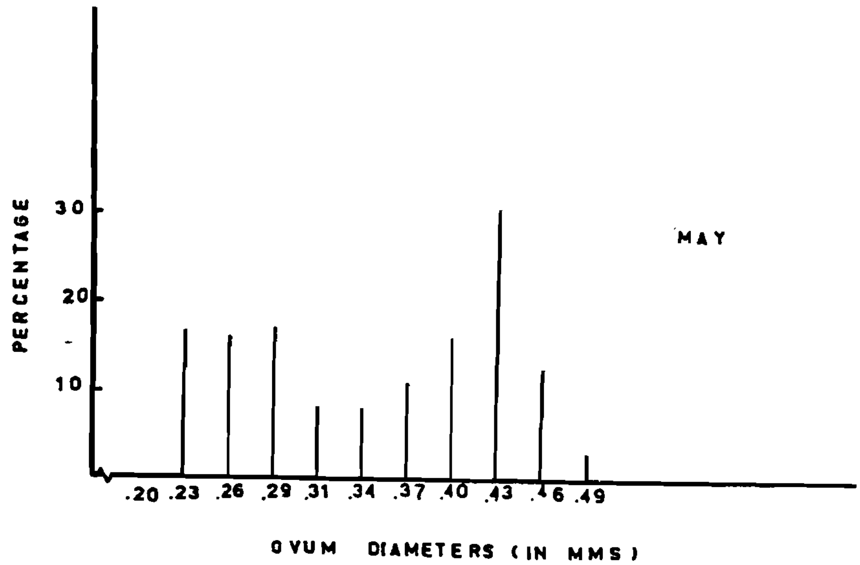

Fig. (1). Ovum diameter frequencies distribution during the spawning season of **Oblada melanura.**

observed and calculated number of eggs in different length groups of the species are given. It is obvious that the number of eggs produced increases with the increase of fish length.

The data of the absolute fecundity against fish length showed a linear trend and the following formula fits satisfactorly the relation:

$\text{Log } F_{A.} = -3.9960 + 3.8782 \log L.$

The relative fecundity in the different length groups are also given in Table (9) where a curvilinear relation is evident. Hence, the formula expressing this relation is as follows:

$\text{Log } F_{R.} = -2.9950 + 2.8778 \log L$

A good agreement between the observed and calculated values of the relative fecundity is obvious. It is evident that the relative fecundity differs in the different length groups and increases with the increase in fish length.

Fecundity / Weight:

The relationship between fecundity and weight is given in Table (10).

TABLE (8)

Length at first sexual maturity of **Oblada melanura.**

Length Range	Percentage (Females)			Percentage (Males)		
	No. of specimens	Immature	Mature	No. of specimens	Immature	Mature
135 - 144	2	100	-	4	100	-
145 - 154	6	100	-	3	100	-
155 - 164	3	66.67	33.33	7	71.43	28.57
165 - 174	10	30.00	70.00	4	50.00	50.00
175 - 184	13	15.38	84.62	8	12.50	87.50
185 - 194	27	-	-	11	-	100
195 - 200	23	-	-	10	-	100
205 - 210	12	-	-	8	-	100

It is clear that the number of eggs produced by the species rises with the increase of fish weight and a linear relationship was obtained having equation:

$$F_{A.} = -11210 + 957.0300\ W$$

The relative fecundity of the different weight groups is also given in Table (10), where a clear linear trend is obvious. Applying the least squares method, the following formula was obtained:

$$F_{R.} = 594.99 + 0.7159\ W$$

Comparison of the calculated values of the relative fecundity for the different weight groups, shows a slight increase with the increase of weight.

Fecundity / Age:

In the majority of fishes according to Nikolsky (1963), the number of eggs at first gradually increases with age, and then it usually begins to decrease as the individual approaches senility. However, Orton (1929) concluded that some fish become less fertile as they grew older. For **Oblada melanura** the relation between fecundity and age (given in Table 11) shows that the fecundity increases with the increase of age the formula which best express this relation is:

$$\text{Log } F = 4.7296 + 0.1393 \log \text{Age}$$

TABLE (9)

Relation between fecundity and length of **Oblada melanura.**

Mean T.L (mm)	No. of Fish	Absolute Fecundity		Relative Fecundity	
		Observed	Calculated	Observed	Calculated
160	1	29,310	35,637	1831.87	2227.9
170	3	44,994	45,113	2646.71	2794.4
180	9	62,976	56,300	3498.67	3128.3
190	19	67.703	69,440	3563.32	3655.1
200	20	92,343	84,664	4617.15	4234.5
210	7	112,280	102,330	5346.67	4873.0
220	10	119.708	122,450	5441.27	5570.5
230	5	167.809	145,580	7296.04	6331.5
240	2	172,073	171,760	7169.71	7156.6
250	2	202,244	201,140	8089.76	8048.3
260	1	223,313	234,360	8588.96	9013.7
270	2	249,685	271,330	9247.59	10048.0
280	1	293,336	312,390	10476.29	11158.0

However, it has to be noticed that the increase of fecundity with the increase of fish age, may be better represented with the increase in fish length or fish weight.

SUMMARY

1- The length-weight relationship was determined satisfactorily by the following mathematical equation:

$$\log W = -4.9302 + 3.0113 \log L$$

This means that the increase of fish weight with length follows the cube law.

TABLE (10)

Relation between fecundity and weight of **Oblada melanura.**

Average weight (gm)	No. of Fish	Absolute Fecundity		Relative Fecundity	
		Observed	Calculated	Observed	Calculated
54.00	1	29,310	40,469	542.78	633.65
65.33	3	44.994	51.313	688.72	641.76
77.33	9	62,976	62,797	814.38	650.35
91.11	19	67,703	75,985	743.09	660.22
108.50	20	92,343	92.628	851.09	672.67
123.29	7	112,280	106,782	910.70	683.25
129.20	10	119,708	122,009	859.97	694.64
150.80	5	167,807	133,110	111.28	702.95
185.50	2	172,073	166,319	103.97	727.79
227.50	2	202.244	206,514	888.98	757.86
260.00	1	223,313	337,618	858.89	781.12
265.00	2	249,685	242,403	942.21	784.70
235.00	1	293.336	299,825	902.57	827.66

TABLE (11)

Relation between fecundity and age of **Oblada melanura**

Age Group	Number of Fish	Absolute Observed	Facundity Calculated
1	3	31,322	
2	32	73,946	73,942
3	27	100,035	101,880
4	14	144,371	140,440
5	3	193,741	193,730
6	3	264,235	266,750
Total number	82		

The condition factor "K" of the different size groups ranged from 1.15 to 1.42 with an average of 1.24 and has no particular trend either with size groups or with different months.

2- Age determination and growth studies were made from the examination and measurements of the scales, although accessory rings contributed some difficulties in age determination.

3- Computations of the growth histories were made. The highest increase in length generally occurs at the end of the first year of life, then the rate gradually decreases with futher increase in age.

As regards the growth in weight, the highest percentage increase is recorded during the third, fcurth, and fifth years of life, after which a marked decrease is observed with further increase in age.

4- Spawning season of **Oblada melanura** in the South-eastern Mediterranean starts in April and continues to the end of June.

Examination of ripe ovaries revealed the presence of more than one size group of eggs. The probability of fractional spawning was discussed, however the probability of prolonged spawning is more reliable.

5- **Oblada melanura** exert their first sexual maturity at length of 185-194 mm. By referring those lengths to age groups, it was clear that fishes become mature during their second year of life.

6- A study of fecundity showed considerable variation according to fish length or fish weight. Using the method of least squares, regression equations were derived to exress the fecundity-length and fecundity-weigth relationship. As for the fecundity-age relatioship it was also found that fecundity increases with the increase of fish age. However, this increase may be due to the increase of fish length or fish weight.

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