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REPRODUCTIVE BIOLOGY OF MUGIL CAPITO
(EGYPT)
(With 4 Tables and 5 Figures)

By

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بيرلوجية التكاثر لأسماك الطوبارة في مصر

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تعتبر أسماك الطوبارة من الأسماك ذات القيمة الاقتصادية العالية في مصر· وقد تناولت هذه الدراسة تناسل هذه الأسماك والتي تعيش في بحيرة ادكو والمياه العذبة للمزارع السمكية· وقد تمت دراسة كل من الخصوبة الجنسية ، الطول عند بداية الخصوبة الجنسية ، دليل المناسل ومقياس قطر البيض· وقد تمت دراسة درجة خصوبة أسماك الطوباره وكذلك تم دراسة أطوال الأسماك عند أول نضوج جنسي ولقد وجد أن ذكور واناث هذه الأسماك والتي تعيش في المزارع السمكية تصل الى بداية النضج الجنسي عند أطوال ٢٠، ٢٥ سم على التوالي والتي لها عمر أكثر من عام واحد· ووجد أن ذكور واناث هذه الأسماك والتي تعيش في بحيرة ادكو تصل الى بداية الخصوبة الجنسية عند أطوال ١٣ ، ١٧ سم على التوالي· وجد أن دليل المناسل يكون أعلى مايمكن عند درجة النضج الذى يمتد من شهر اكتوبر حتى شهر مـــــارس بعدما يحدث عملية امتصاص للمناسل نتيجة للظروف غير المناسبة مثل الملوحة وعوامل بيئية أخرى (اسماك المزارع السمكية) · وتبين أن عدد البيض الذى تنتجه اناث أسمـــاك الطوبارة يتراوح بين ٥٧٠، الى ٩٢٣١١٩ للاسماك التي لها أطوال من ٢٣ الى ٣٧ سم وتزن من ١١٠ الى ٦٠، جرام هذا بالنسبة للاسماك التي تتواجد في المزارع السمكية بينما الأسماك التي تعيش في بحيرة ادكو فنجد أن أعداد البيض الذى تنتجه هذه الأسماك تتراوح بيـــن ٥٥٦٨، الى ٣١٦٨٢٥ والتي لها أطوال من ١٧ الى ٣٤ سم وتزن ٥ر٥٥ الى ٥ر٢٦٥ جرام علـــى التوالـــي·

SUMMARY

To throw light on the reproduction cycle of Mugil capito which live in lake Edku and Fresh water fish farm, the sexual maturity, length at first sexual maturity, gonadosomatic index and the analysis of egg diameters have been studied.

Fecundity as an important item in the study of reproductive biology of a fish was also investigated.

The result indicated that males and females Mugil capito first mature at length more than 20 cm and 25 cm. respectively for fish from fish farm, this corresponds to age group I[+], while for the fish from lake Edku, they reach first sexual maturity at length about 13 cm. & 17 cm. for

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male and female respectively.

The seasonal gonadal cycle as indicated by gonadosomatic index and egg diameter at different states of maturity revealed that Mugil capito has a prolonged fractional breeding season extending from the ripening in October to March after that the gonads begin resorption due to unfavorable conditions such as salinity and other environmental factor.

The number of egg spawned by female ranged from 45760 to 933119 egg for length group from 23 cm. to 37 cm. and for weight ranged from 110 gm. to 460 gm., while for the fish from lake Edku these figures ranged between 45568 and 316825 for length group from 17 cm. to 34 cm. and for weight ranged from 55.5 to 265.5 gm.

The relationship between fecundity and the two parameters (length and weight) have been proposed.

INTRODUCTION

Reproduction is the link in the life cycle of a fish which, in connection with other links, ensures the continuation of the species. The specific peculiarities of reproduction in every species are a result of the particular conditions of reproduction and the development of its larvae, which provides the replenishment so essential for the preservation of the species and its abundance.

The maturation of the sexual products and the development of the gonads occupies a variable length of time according to the species. The rate and period of development of gonads varies according to the species. The determination of size at first sexual maturity has its application in fishery biology since knowledge about this size may be needed to protect an adequate spawning stock and to ensure at least one spawning for the mature individuals.

The aim of this work, is to study of maturation and fecundity for Mugil capito which represents a very improtant aspect of reproductive biology for this species. The most important parameters which could be obtained from the study of maturation are gonadosomatic index of maturity coefficient, sex ratio, size or age at first maturity, number of mature fish at a given time, spawning season and number of ripening eggs prior to the spawning season.

MATERIAL and METHODS

For the present study about 1063 fish specimen covering size range between 20-48 cm. were collected during the period from April 1988 to March 1990. The specimen were collected from the commercial catch of different fish farms, fresh water fish farms "Nozha hydrodrome and Barceik fish farm" and Brackish water fish farm, Damietta fish farm and from lake Edku which is connected with the sea.

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Sampling was done three time a month. The date of capture, total length to the nearest mm & total weight to the nearest gm were recorded. The gonads were weighed and examined (the shape size and colour). Gonadosomatic index (GSI) was computed as the percentage of gonads to the gutted weight of the fish. Fecundity was determined.

Some fish collected from fresh water fish farm were acclimatized under laboratory condition and after that the salinity of water was raised. Injection after muscular C.G.H. [(Pregnyl) produced by the Nile Co. for Pharm] with dose ranged between 750-1000 Iu. male give positive result while female didn't give.

RESULTS

Maturity stage :

The maturity stage was usually determined either morphologically by investigating the gross examination of the gonads or microscopically by the evaluation of the gonadal tissue. The gross examination of the gonads was at first used and the maturity stage of Mugil capito were classified according to the change occurred in shape, size and colour of the gonads as follows:

Thread:

In this stage, sex is undetermined, gonads are filamentous and occupy a very small size of the body cavity.

Immature: (Stage I)

The differentiation between males and females could be easily determined. The ovaries of the females are rosy in colour, almost cylindrical with tapering ends and occupy nearly one-third of the body cavity. In males, the testes are thin.

Mature: (Stage II)

The ovaries are reddish yellow in colour and occupy nearly half the body cavity. In males, the testes increase in length and width and occupy two-fifths of the body cavity.

Nearly ripe: (Stage III)

The nearly ripe ovaries are yellow orange and increase in size to occupy about two-thirds of the body cavity, eggs are distinguishable to the naked eye and blood vessels are seen within the ovary. The testes increase in size and occupy more than Half of the body cavity, their colour is white creamy.

Ripe: (Stage IV)

The ovaries are slightly yellow or pale yellow in colour and occupy all the body cavity. The testes increase in size, their colour is pale creamy and occupy all the body cavity. At this stage, the ovaries and the testes reach their maximum development. The ovaries slightly began to decrease in size, due to the discharge of a considerable amount of ripe ovaries.

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The testes with small press on body milt discharge with white colour and the tests began to decrease slightly in size. The discharge of a considerable amount of sexual products, during the course of spawning, cause decrease in the weight of the gonads after which the gonads begin to increase slightly in weight. This is the character of gonads which were collected from Lake Edku, under natural condition of spawning. while in the fish which was collected from fresh and brackish waters fish farms, the gonads still at ripe stage for a long time until reach resorption stage.

Spent: (Stage V)

The ovaries are reddish in colour, flaccid and much reduced in size. The testes are empty, reduced in size. This is peculiar for fishes which was collected from Lake Edku.

Monthly distribution of maturity stages :

The monthly variation in the maturity stages of Mugil capito for males and females separately through the period from April 1989 to March 1990 is shown in table (1).

From the table, it is clear that all males and females are in the mature stage in the period from June to August. The nearly ripe and mature stage began in September. The ripe stage for males and females first appear in October. The percentage of ripe individuals in both males and females increse progressively towards the spawning season.

The peak percentage value of the ripe and spawning stage is attained in November, December and January for males and females. The result for fish collected from fresh and brackish water fish farms coincide with the result for fish collected from Lake Edku for the previous stages.

The spent females and males start appearing in January and extend to May with maximum in February and March. From March onward, the ripe females disappear, while the ripe male starts to disappear one month latter than females. This result for the fish which was collected from Lake Edku, while the fish which was collected from fresh and Brackish water fish farm, the gonads were still at ripening stage until the end of February when the resorption process began.

Concerning the male, during the period from October to February which was injected with chorionic gonadotropin hormone with one dose (750 IU) it gives response and give milt, while the female which was injected with one dose (about 1000 IU CGH), the hydration process for the yolk began and after injecting the second dose (1500 IU) with comulative dose about 2500 IU, the migration of nucleus to animal pole begin, while the fish died after that. The reason for this case is not known until now.

It is clear that Mugil capito had long spawning season, extending from October to February with high breeding through November, December and January.

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Size and age at first sexual maturity :

Generally, the age at which fish firstly matures is a specific character which differs from one species to another. This age may also vary in the same species according to sex and locality.

In the present study, the percentage distribution of the mature and immature individual for each length groups was used in the determination of the size at first sexual maturity.

From our data which was collected from different body water (Fresh & Brackish water fish farm), it is clear that the males and females Mugil capito smaller than 20 cm. are all immature. For males the first sexual maturity is attained at the end of one year old and at a size more than 20 cm. while for the female when it reached a length more than 25 cm. Concerning the fish which was collected from Lake Edku they attain their maturity at length 13 & 17 cm. for males & females respectively. This fish belong to age group 1^+. The temperature, salinity and kind of food affected on the length at the time of onest sexual maturity.

Gonadosomatic index (GSI) :

In the present work, the gonadosomatic index was used to study the sexual cycle of fish.

The monthly variation in the G.S.I. value for fish which was collected from fresh and Brackish water fish farms and for fish from Lake Edku are shown in table (2), obviously the G.S.I. for both males and females have nearly the monthly fluctuation trend. The average G.S.I. showed low values from March to August. From september to end of October it increases progressively and the maximum value is attained in November and December after which falls gradually from January to end of February. This result for fish which was collected from lake Edku, is due to spawning of the fish. while for the fish which was collected from fish farm, the average G.S.I. showed low value from May to August. From September the average G.S.I. increased progressively to reach the maximum value in December after which it still more or less constant through January and February. Through March the G.S.I. decrease progressively due to resorption of the gonads. This idea due to the unfavorable condition for spawning.

Egg diameter and spawning :

The analysis of ova diameter was used in the present study to describe the frequency of spawning and the extent of spawning season in Mugil capito. On the whole, the ovary in maximum spawning contain yolky egg that fluctuated in diameter from 0.6 mm to 1.1 mm. The ova less than 0.5 mm. are un-yolky and immature while those ranging between 0.9 to 1.1 mm. are ripe.

The frequency distribution of ova diameters for the fish under study through six months from September to April for the fish which collect from fish farm is shown in Fig. 1, it is obvious that there is no sharp separation between the general egg

stock and the ripe eggs, and a greater succession of size is found between the ripe and the immature ones.

The analysis of ova diameter distribution of the species through the period from October to February revealed the presence of a series of peaked polygons which represent several modes of ova size frequency (Fig. 1). We conveniently consider that Mugil capito has a longspawning season and fractional spawning character.

Fecundity :

Fecundity is the biological item concerned with the number of eggs spawned by the females. In the present work, fecundity was estimated by adopting only the fully ripe ovaries with the highest G.S.I. that range between 10 to 22. All group of yolky eggs were counted depending on the expectance that all these groups have the chance to be spawned in the long spawning season.

Relation between Fecundity and fish length :

The relationship between length and fecundity is curvilinear. For the fish which were collected from fish farm, Fig. (2), Table (3) the relation between the two parameters being of the form:

$$F = a \, x^b$$

$$F = - \, 10.9817 \, L^{6.8355}$$

While the equation for fish which were collected from lake Edku Fig. (3), table (4) is the following:

$$F = - \, 4.2638 \, L^{2.9104}$$

Relation between Fecundity and weight :

The relation between Fecundity and weight of the fish is usually expressed by the formula: $Y = a \, x^b$ where Y = Fecundity and x = weight of the fish in gm. The value of b is usually around 1 (Bagenal, 1971).

For the fish collected from Fish Farm Fig. (4), table (5) the relation was found to be as follows:

$$F = 1.5061 \, W^{1.9404}$$

While the equation for fishes which collected from lake Edku Fig. (5), Table (6) as follows:

$$F = 6.3823 \, W^{1.0907}$$

It is clear that fecundity increase with increasing length and weight of the fish, it ranges between 45760 and 933119 eggs for length group from 23 cm. to 37 cm. and for weight from 110 gm. to 460 gm.

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DISCUSSION

The analysis of the monthly distribution fo maturity stage revealed that Mugil capito has a long spawning period extending from October to February for males and females.

The size at first maturation was determined by the analysis of the percentage distribution of the mature and immature individuals for each length group.

According to the present study, it was found that male and female Mugil capito first mature at length more than 20 and 25 cm. respectively from fish collected from fish farm, and this corresponds to age group 1^{+}. while for the fish which was collect from lake Edku, they reach first sxual maturity at length about 13 cm. for male, and 17 cm. for female. This correspond to age group 1^{+}.

The gonadosomatic index by the variation of gonad condition in different months of the year is a more accurate indicator than other parameters in predicting the seasonal cycle of gonad growth and spawning activities.

The G.S.I of Mugil capito show an increase progressively towards the spawning season. The high value was recorded in October, November and December with slight decrease in January. The sharp decrease of the mean G.S.I. was recorded in February indicating the spawning has already taken place during this months. This result is in agreement with El-Sedfy (1971) and Fayek (1973).

The estimation of the egg diameter in the different periods of the year is of double benefit, at first this gives an idea about the maximum size of the mature egg, beside the growth channel of the egg on breeding towards the spawning season. At the second egg diameter estimation throw light on the peculiarity of fish spawning period whether long or short.

According to HICKLING and RUTENBERG (1936), the frequency polygone of the ova diameter are steep and well separated from each other is fish having a sharply demarcated spawning period, whereas those of a fish having an extended spawning period are characterized by a series of low-peaked polygons which are not trenchantly different.

YOSHIDA (1966) postulated that the presence of two or more modes of ova size frequency in the ovary shortly before the spawning indicate the long spawning season and the fractional spawning season.

The analysis of ova diameter distribution of the species under study through the period from September to March revealed the presence of a series of peaked polygons which represent several modes of ova size frequency.

Therefore, according to the present analysis and with reference to the postulation of HICKLING and RUTENBERG (1936), and YOSHIDA (1966), we could conveniently consider that Mugil capito has a long spawning season and fractional spawning character.

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Fecundity in our study of Mugil capito was found to incrase linearly with weight and exponentially with length. The number of eggs which spawned by the female from fish farm ranged between 45780 and 933119 egg for length group from 23 to 37 cm and for fish weight ranged from 110 to 460 gm. respectively. Concerning the fecundlty for the fish from lake Edku it ranged between 45588 and 316,825 for length group from 17 cm to 34 cm respectively.

According to FAOUZI (1937), the absolute fecundity for Mugil capito ranged between 581,000 - 243,000 ova/female for fishes of 44 - 33 cm, with average weight 1450 - 850 gm respectively.

EZZAT (1965) found that the absolute fecundity of Mugil capito ranged between 767,826 for fish length 38.5 cm. and 4, 502, 391. for fish of 46.0 cm.

EL-MAGHRABY et al. (1974) found that the absolute fecundity for Mugil capito in lake Borollus vary betwen 45.568 for fish measuring 17 cm. and 316,828 for fish measuring 34 cm.

In lake Manzalah, FAYEK (1973) gave the value of 61,500 egg for a fish measuring 19 cm. T.L. and 8, 536, 600 for fish measure 40 cm.

It is clear that the fecundity increase with length and weight, it may be due to a reduction in the reserve of yolk in the egg, and the consequent reduction of the passive feeding period of the embryo or by an increase in the density of the yolk or finally by an increase in the volume of the gonad. The individual fecundity is also increased by fractional spawning, when only part the egg present in the ovary together are ripe at any time.

From the previous data, it is clear that breeding season of Mugil capito in lake Edku started from late Octoer and continued through December & January and early February with a peak during early January. These variation in the period of spawning is probably due to temperature and salinity of lake. Concerning fish in fish farm, itreached maturity stage and didn't spawn due to unfavorable condition such as salinity. This observation agreement with PERSOV and SAKUN (1962), who reported that the mature eggs are formed and remain dormant until the suitable environmental condition prevail where the egg pass to the ripe condition, and this character necessitates the presence of males with viable sperms sometimes before the onest of such environmental conditions, and according to PITT (1966) which reported that the temperature might influence sexual evaluation in the fish.

Prolonged spawning season of Mugil capito may be considered as a direct influence of ecological factor (Temperature, Salinity, condition which is favorable for migration).

In conclusion, the results obtained indicated that males and females Mugil capito first mature at lengths more than 20 and 25 cm. respectively for fishes from fish farm and his corresponds to age group I while for fish from lake Edku at length

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13 & 17 cm. for male and female respectively. The seasonal gonadal cycle as indicated by gonadosomatic index and egg diameter at different states of maturity revealed that Mugil capito has a prolonged spawning season extending from October to February for fishes from lake Edku. Whilefor the fish from fish farm the ripening extend to March after that the gonads began resorption due to unfavorable condition such as salinity and other environmental factors.

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Table (1). Monthly distribution of maturity stages of females and males Mugil capito from lake Edku in the period from (April 1989 – March 1990).

Month	MALE				FEMALE			
	Mature Stage %	Nearly ripe stage %	Ripe Stage %	Spent Stage %	Mature Stage %	Nearly ripe stage %	Ripe Stage %	Spent Stage %
April 89	60.0	----	----	40.5	54.5	----	----	45.5
May	80.0	----	----	20.0	90.0	----	----	10.0
June	100.0	----	----	----	100	----	----	----
July	100.0	----	----	----	100	----	----	----
August	100.0	----	----	----	100	----	----	----
Sept.	90.0	10.0	----	----	85	15.0	----	----
October	12.0	55.0	33.0	----	100	55.0	35.0	----
Nov.	7.0	11.0	82.0	----	----	18.0	82.0	----
Dec.	----	5.9	94.1	----	----	7.7	92.3	----
Jan. 90	----	5.0	79.0	16.0	----	11.0	76.0	13.0
Feb.	----	----	35.0	65.0	----	----	16.7	83.3
Mar.	13.4	----	----	86.6	10.3	----	6.7	83.0

Table (2): Monthly variation of G.S.I. for both males and females Mugil capito in the period from (1989 to 1990).

Month	LOCALITY			
	Lake Edku		Fresh and brackish water fish farm	
	No. of fish	G.S.I.	No. of Fish	G.S.I.
June	50	0.35	40	0.40
July	50	0.40	27	0.60
August	49	0.45	49	0.60
September	39	6.50	23	1.1
October	49	12.50	50	10.5
November	61	14.0	30	16.6
December	57	13.90	54	22.0
January	75	8.50	50	20.2
February	100	1.50	30	18.0
March	60	0.50	50	10.0
April	30	0.45	40	2.0
May	25	0.45	29	0.75
Total	645		472	

Table.3. Regression analysis - Multiplication model $Y= ax^b$ for Mugil Capito From Fish Farm (1989-1990)

Dependent variable: fecundity			Independent variable: T.L(Cm).	
Parameter Estimate		Standard Error	T Value	Prob. Level
Intercept*-10.9817		2.21144	-4.96586	.00001
Slope	6.83558	0.639504	10.6889	.00000
*Note: The Intercept is equal to Log a.				
Analysis of Variance				
Source	Sum of Squares Df		Mean Square F-Ratio	Prob.Level
Model	21.10055 1		21.10055 114.2520	.00000
Error	7.202685 39		.184684	

Total (Corr.) 28.303236 40

Correlation Coefficient = o.863433   R-Squared = 74.55 Percent

Stnd. Error of Est. = 0.429749

Table.4. Regression analysis- Multiplicative model: $Y= a\, x^b$ for Mugil Capito from lake Edku (1989- 1990).

Dependent variable: Fecundity			Independant variable:T.L (mm.).	
Parameter	Estimate Error	Standard	T Value	Prob. Level
Intercept*	-4.26377 0.159976		-26.6526	.00000
Slope	2.91036 0.0290588		100.154	.00000
*Note: the Intercept is equal to Log a.				
Analysis of Variance				
Source	Sum of Squares Df	Mean Square	F-Ratio	Prob. Level
Model	5.847 1	5.847	10030.92	.00000
Error	.008743 15	.000583		

Total (corr.) 5.855348 16

Correlation coefficient =0.999253   R-squared = 99.8percent

Stnd. Error of Est.= 0.0241425

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Table. 5. Regression analysis - Multiplicative model: Y= a x^b for *Mugil Capito* From Fish Farm (1989-1990).

Dependent variable: Fecundity			Independant variable:T.wt. (mm.).	
Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept*	1.50605	0.950279	1.58485	.12108
Slope	1.94038	0.165175	11.7474	.00000
*Note: the Intercept is equal to Log a.				
Analysis of Variance				
Source	Sum of Squares	Of	Mean SquareF-Ratio	Prob. Level
Model	22.06699	1	22.0669 138.0017	.00000
Error	6.236245	39	.159904	

Total (Corr)   28.303236 40
Correlation coefficient = 0.882985   R-Squared   =   77.9
Stand. Error of Est.=   0.39988

Table.6. Regression analysis - Multiplicative model- Y= a x^b for *Mugil Capito* from lake Edku (1989 - 1990).

Dependent variable: Fecundity			Independant variable:T.wt. (mm.).	
Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept*	6.38239	0.585407	10.9025	.00000
Slope	1.09073	0.118407	9.21172	.00000
*Note: the Intercept is equal to Log a.				
Analysis of Variance				
Source	Sum of Squares	Of	Mean SquareF-Ratio	Prob. Level
Model	4.975774	1	4.975774 84.85572	.00000
Error	.879571	15	.058638	

Total (Corr)   5.855345   16
Correlation coefficient =   0.921837   R-Squared = 84.98percent
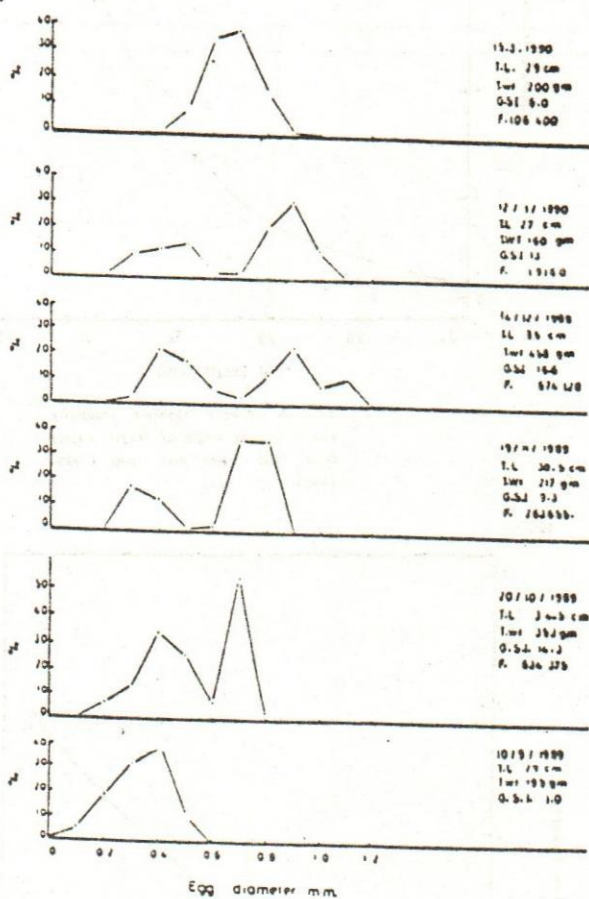Stand. Error of Est. =   0.242153

Fig.1. The frequency distribution of ova diameter for *Mugil capito* From Fish Farm (1989-1990)
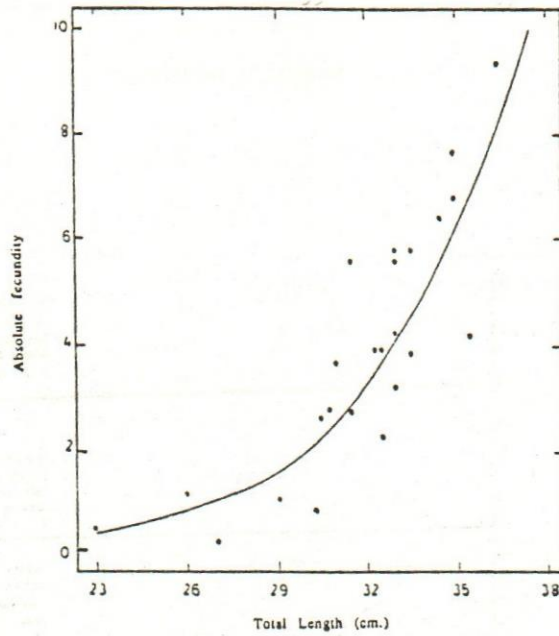
100000

Fig.2. Relation between absolute fecundity
and total body length of *Mugil capito*
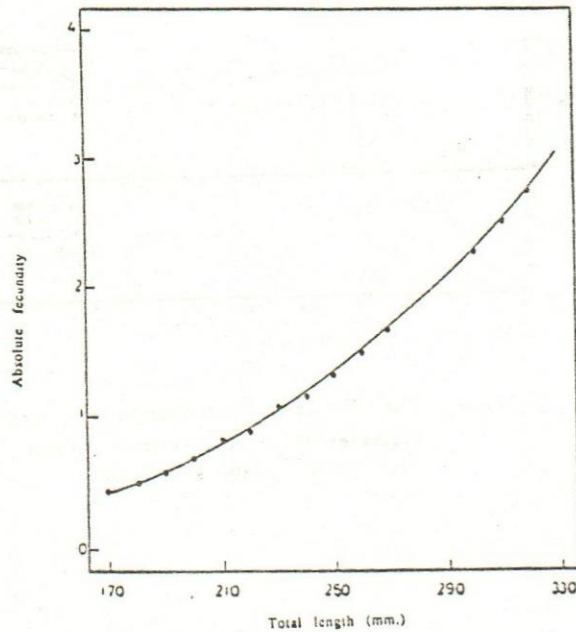from fresh water Fish farm (1989-
1990)

100000

Fig.3. Relation between absolute fecundity and
total body length of *Mugil Capito* from
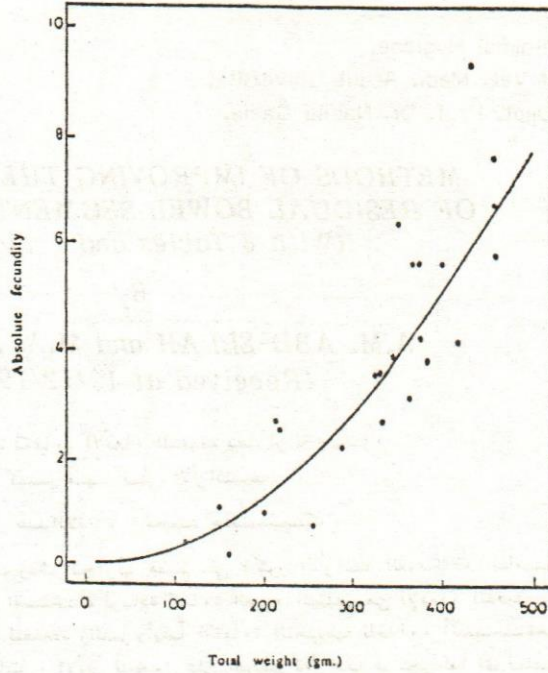lake Edku (1989 - 1990).

Fig.4 - Relation between absolute fecundity and
gutted body weight for *Mugil capito* from
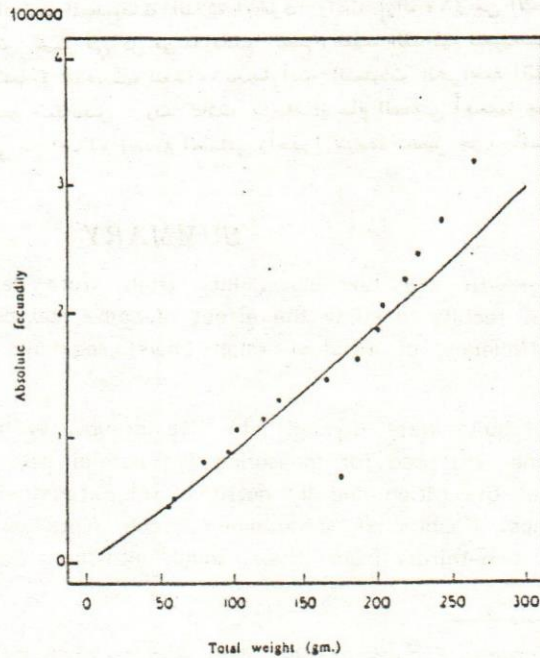Fresh water Fish farm (1989-1990).

Fig. 5. Relation between absolute fecundity and
gutted body weight of *Mugil capito* from
lake Edku (1989- 1990).