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SOME BIOLOGICAL CHARACTERS OF CHUB MACKEREL (*SCOMBER JAPONICUS*, HOUTTUYAN, 1782) FROM THE MEDITERRANEAN WATERS OF EGYPT

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ABSTRACT

Fishes of chub-mackerel (*Scomber japonicus*, Houttuyan, 1782) are mainly caught by purse-seine nets using light attraction. The structure of *S. japonicus* catch in the Egyptian Mediterranean waters showed that this species attains ages not exceeding more than four years. Fishes of age group II dominated the catch, whereas those having age groups 0 (juveniles) and I were absent. The length of *S. japonicus* reached 25.9 cm during its second year of life. This was followed by a slight increase in length during the third and fourth years reaching 29.6 cm and 32.2 cm respectively. The back calculated weight for *S. japonicus* showed gradual increase in weight as the fish gets older, where weight at the fourth year (252.56 g) was nearly twice that obtained during the second year (133.36 g). The theoretical length (L_∞) and weight (W_∞) calculated by von Bertalanffy equations were 39.42 cm and 453.24 g respectively. The values of condition factor, hepato-somatic and gonado-somatic indices were minimum in August following the end of the spawning season which extends from May to July. The shoals of *S. japonicus* were characterized by lacking immature fishes, so the length and age at the first sexual maturity cannot be determined. The relative fecundity of this species showed that a female produces from 382 to 625 eggs per gram of body weight.

INTRODUCTION

Fishes of chub-mackerel (*Scomber japonicus*, Houttuyan, 1782) are widely distributed in warm and temperate waters (Fischer & Bianchi, 1984 and Limbong *et al.*, 1988). Hureau and Monod (1979) and Collette and Nauen (1983) pointed out that this species is considered as a primarily coastal pelagic one occurring to about 250 meters depth and is characterized by shoaling in size especially with those of adult fishes. Faltas (1983) mentioned that *S. japonicus* is mainly caught in the Egyptian Mediterranean waters by purse-seine nets using light attraction and found among catches of other pelagic fishes such as jack-mackerel, sardines, anchovies, bogues and barracudas.

The purpose of the present study is to throw light on some biological aspects of *S. japonicus* in the Egyptian Mediterranean waters.

MATERIAL AND METHODS

Samples of *Scomber japonicus* were randomly collected from purse-seine catch of Alexandria fishing center during the period from March to November, 1994. The total length range of 110 specimens varied from 26.0 to 34.0 cm. For each specimen the following information were recorded: date of capture, total length to the nearest 0.1 cm, total and gutted weights to the nearest 0.1 g and sex. For age determination, the first vertebra was taken, cleaned and examined under binocular microscope at magnification (X10). Distances from the focus of the vertebra to the successive annulii as well as total radius were determined.

Length-weight relationship was determined using the formula of Le Cren (1951) $W = cL^n$, where W gutted weight in gram and L total length in cm.

Th theoretical growth was calculated by the von Bertalanffy's growth equations developed by Beverton and Holt (1957) and their parameters (L_∞ W_∞ K & t_o) were calculated by Gulland's method (Gulland, 1965).
Maximum length (L_{max}) was calculated using the formula:
$L_{max} = 0.95\ L_\infty$)(Beverton, 1963).

Fatness of fish was described by calculating the coefficient of condition (K) from the formula $K = 100 X W/L^3$ where W = gutted weight (g) and L = total length (cm).

Hepato-somatic index was given by using the following formula:
$HSI=100 x W_i / W$ where W_i=liver weight (g) and W=gutted fish weight (g).

Gonado-somatic index was calculated using the following equation according to Anderson and Gutreuter (1983):
$GSI = 100 X W_g / W$ where W_g = gonad weight (g) and W = gutted fish weight (g).

Statistical analyses such as correlation coefficient (r), "t-distribution" test and covariance analysis were applied in the present work according to Snedecor and Cochran (1982).

RESULTS

Body length-vertebral radius relationship

The relationship between the radius of the vertebra (R) and total body length (L) was found to be linear (Fig. 1) and expressed by the following equation:
$L = 0.3233 + 0.0903 R$ (N=70, r=0.8459)

By using "t-distribution" test, it was found that the correlation value (r=0.8459) is significant ($P<0.05$).

Growth in length

The back-calculated lengths for *S. japonicus* at different age groups indicate that this species have ages not exceeding more than four years (Table, 1). The catch was characterized by lacking of juveniles and fishes of age group one. The length of *S. japonicus* reached 25.9 cm during its second year of life. This was followed by slight increase in length during the third and fourth years

(29.6 and 32.2 cm, respectively).

Length-weight relationship

The equations of length-weight relationship for both sexes were as follows:

Males: Log W= - 1.7303 + 2.7310 Log L (N= 46, r= 0.9884).

Females: Log W= - 2.2443 + 3.0861 Log L (N= 64, r= 0.9726).

where W= gutted weight (g), L= total length (cm) and N= number of fish examined.

By using covariance analysis to test the significance between the data of both sexes no significant difference was found (F=0.0033, dF= 1, 12, P>0.05). Hence the length-weight data of males and females were pooled and the following equation was given for Combined sexes:

Log W= - 1.9978 + 2.9175 Log L (N= 110, r= 0.9853).

From Fig. 2, it is shown that the length-weight relationship is curvilinear and the calculated values are found to fit the observed ones.

Growth in weight

It was found that as a fish gets older, its weight increased markedly. The increase in weight during the fourth year (252.56 g) was nearly twice than that obtained during the second year of life (133.36 g).

Theoretical growth rate

The von Bertalanffy's growth formula was used to describe the growth rate of fish. The growth equations obtained for combined sexes were:

$$L_t = 39.42\,[1 - e^{-0.3134\,(t + 1.39)}]$$

$$W_t = 453.24\,[1 - e^{-0.3182\,(t + 1.44)}]^{2.9175}$$

The results indicate that the lengths and weights obtained by von Bertalanffy's growth equations nearly coincide with those obtained from the back calculated ones (Table, 1). The estimated length and weight for the missing

age group I which is not represented in the catch are found to be 20.87 cm and75.07 g respectively.

Maximum length (L_{max})

Beverton (1963) declared that in nature, the oldest fishes of a stock grow to reach about 0.95 of their asymptotic length. Thus the expected maximum length of *S. japonicus* in the Egyptian Mediterranean waters will be 37.5 cm while the actual recorded one is 34.0 cm.

Condition factor (K)

The monthly changes in values of condition factor (Fig. 3) indicate that the maximum values of condition factor for males (0.78) and females (0.84) were observed in November i.e. before the maturation of gonads. Minimum values (males: 0.67 and females: 0.74) were recorded in August at the end of spawning season.

Hepato-somatic index (HSI)

Figure. 4 shows monthly changes in the values of hepato-somatic index for both sexes. It is obvious that females had generally higher values than males as they attain their maximum value in April (2.50), while for males their maximum values were observed in November (1.40). The minimum values for both sexes were recorded in August (males:0.34 and females: 0.72).

Gonado-somatic index (GSI)

The minimum values GSI for females and males (Fig. 5) were found during the period from August (female :0.16 and male :<0.01) to November (female : 0.50 and male : 0.07), whereas maximum ones were observed in May (female : 8.64 and male : 6.22) and July (female : 4.00 and male : 4.56). A marked drop in the value of GSI was noted in June (female : 2.1 and male : 1.09). It can be concluded that the spawning season of *S. japonicus* extends from May to July and spawning takes place more than once per season.

Maturity

As a result of the absence of fishes having lengths less than 26.0 cm in the catch, so age and length at the first sexual maturity could not be determined and all fishes examined during this work were entirely matured.

Fecundity

According to Bagenal and Braum (1968), the number of ripe ova in female prior to next spawning period was determined. In twenty ripe females, the absolute fecundity varied from 65,000 to 174,908 eggs for fishes having average length range of 28.3 - 32.8 cm with body weights of 170 - 280 g i.e. female *S. japonicus* produces from 382 to 625 eggs per gram of body weight.

DISCUSSION

Scomber japonicus in the Egyptian Mediterranean waters is found in shoals among the catches of purse-seine nets using light attraction. The structure of these shoals showed that this species attained ages not exceeding more than four years and age group II was the dominant one, whereas juveniles and fishes having age group I were completely absent. This result indicates that *S. japonicus* usually shoals by size. Such phenomenon not only characterizes this species in the Mediterranean but also for the same species in the Pacific Ocean (Kramer, 1969).

The present study revealed that growth of *S. japonicus* is very rapid during its second year of life, where its length reaches 25.9 cm. Slight increase was observed in the following successive years reaching 29.6 cm in the third year and 32.2 cm in the fourth one. Comparable results were recorded by Lorenzo and Pajuelo (1996) as they noted that the mean length of *S. japonicus* in the Canary Islands during the second, third and fourth years were: 25.9, 30.8 and 34.8 cm, respectively. The present result also agrees with that given by Kramer (1969) as he observed that the growth in length for the Pacific mackerel is very rapid at about two years of age then decreases somewhat in older fishes.

In the present work, the length-weight relationship shows non-significant difference between the data of both sexes. A similar observation was given for *S. japonicus* in the Canary Islands (Lorenzo and Pajuelo, 1996).

By comparing the value of L_∞ (39.42 T.L) in the present study with that given in other localities after converting this parameter into forked length using the morphometric equation given by Faltas and Rizkalla (1995), it was found that L_∞ (35.95 F.L) of *S. japonicus* in the present study is relatively less than that given by Ouchi (1978) for the same species in West of Kyushu and East of Tsushima Islands (L_∞= 38.05 F.L). The maximum length of *S. japonicus* in the Egyptian Mediterranean waters (L_{max}: 37.45 cm) calculated by Beverton formula (1963) was found to be less than that obtained by Lorenzo and Pajuelo (1996) for the same species in the Canary Islands (L_{max}: 49.78 cm).

The present results on the gonado-somatic index revealed that the spawning season of *Scomber japonicus* in the Egyptian Mediterranean waters extends from May to July. The sudden drop in the value of gonado-somatic index in June indicates that this species spawns more than once per season. Such phenomenon agrees with that given by Dickerson *et al.* (1992) as they noted that females *S. japonicus* of Southern California are characterized by the presence of more than one spawning stage in their ovaries. The spawning period given in the present work coincides with that mentioned in other localities as Muzinic (1981) pointed out that Spanish *S. japonicus* spawns in late spring and summer. Fry (1936), Kramer (1960) and Dickerson *et al.* (1992) noted that the maximum spawning of *S. japonicus* off Southern California takes place from late April to August with maximum spawning from May to early July. Also in the South-western Sea of Japan and East China the spawning season of *S. japonicus* mostly occurs in April (Iizuka and Hamassaki, 1986). The only exception from the previous studies ones is that given by Habashi and Wojciechowski (1973) and Lorenzo & Pajuelo (1996) for the same species in the Canary Islands where the spawning period extends from November to March i.e. spawning takes place during winter.

The present study revealed that it was so difficult to determine the size at the first sexual maturity due to the absence of individuals less than 26.0 cm length in the catch. Fishes with age group II and successive age groups were found to be mature. This coincides with that given by Kramer (1969) who observed that fishes of age group I do not spawn but most fishes having age group II and older ones spawn. It seems that fishes in the shoal are all mature and that they are undergoing spawning migration.

Study of the condition factor and hepato-somatic index of *S. japonicus* revealed that the higher values of condition factor for both sexes were obtained in November, while higher ones of hepato-somatic index were observed in November and April for males and females respectively (i.e. before the beginning of the spawning period). Minimum values of condition factor and hepato-somatic index for both sexes were observed in August (i.e. at the end of the spawning period). The higher values of hepato-somatic index can be attributed to the physiological changes which take place in the digestive tract resulting in the enlargement of the liver due to the swollen of hepatocytes with glycogen where such changes usually occur during the cyclical periods of starvation, migration or spawning (Ellis *et al.*, 1978). Also Roberts (1978) showed that such increase in the hepato-somatic index may be due to the increase in the activities of the sexual hormones.

As regard to the relative fecundity of *S. japonicus* in the Egyptian Mediterranean waters, it was found that female produces from 382 to 625 eggs per gram of body weight. This number is clearly higher than that given by Mac Gregor (1976) for the Pacific mackerel (284 eggs/g) and Pena *et al.* (1986) for the Peruvian *S. japonicus* (278 eggs/g).

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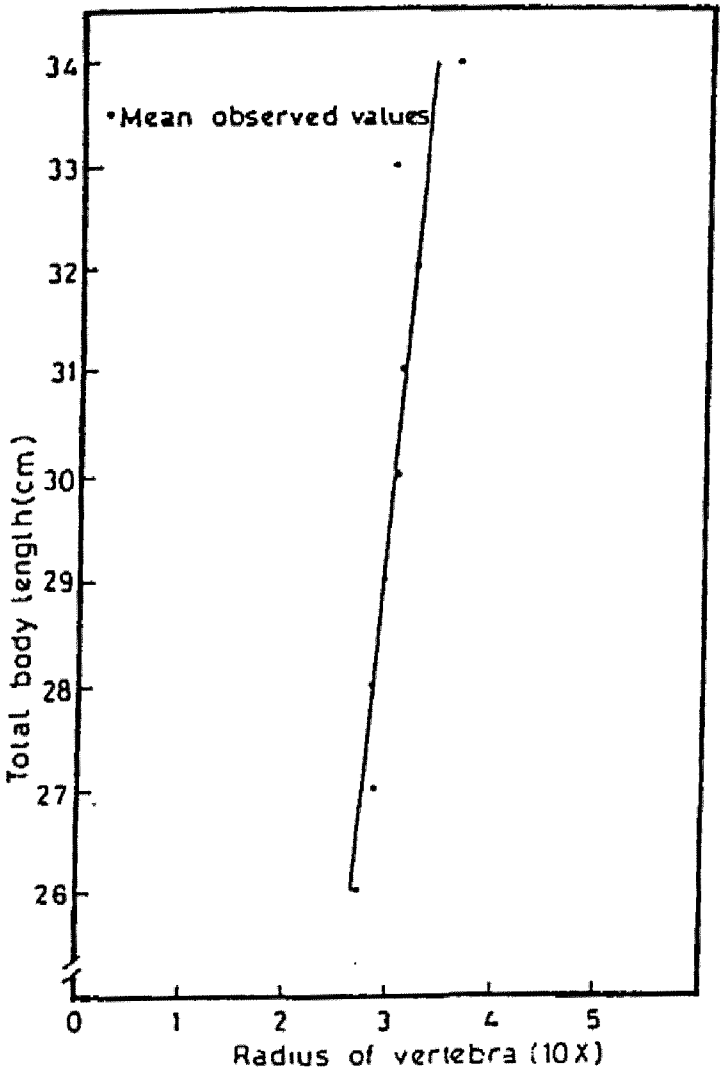

Fig. (1): Relation between average length and vertebral radius of *Scomber japonicus* in Egyptian Mediterranean waters.

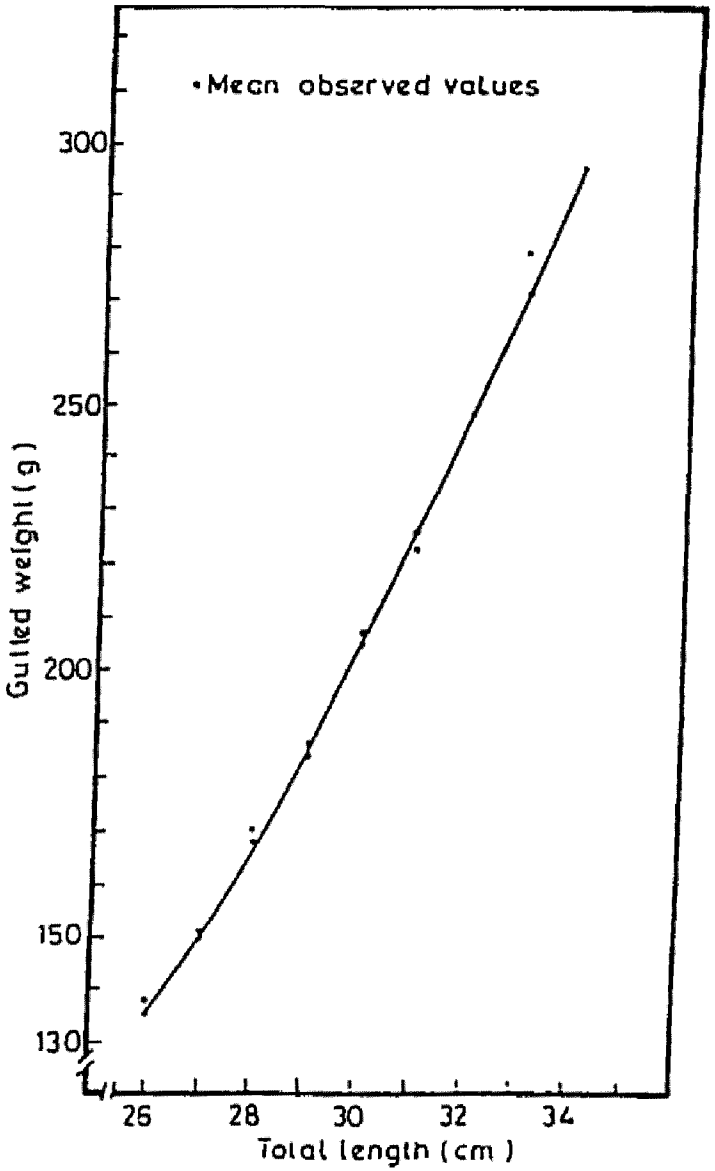

Fig. (2): Length-weight relationship of *Scomber japonicus* in the Egyptian Mediterranean waters.

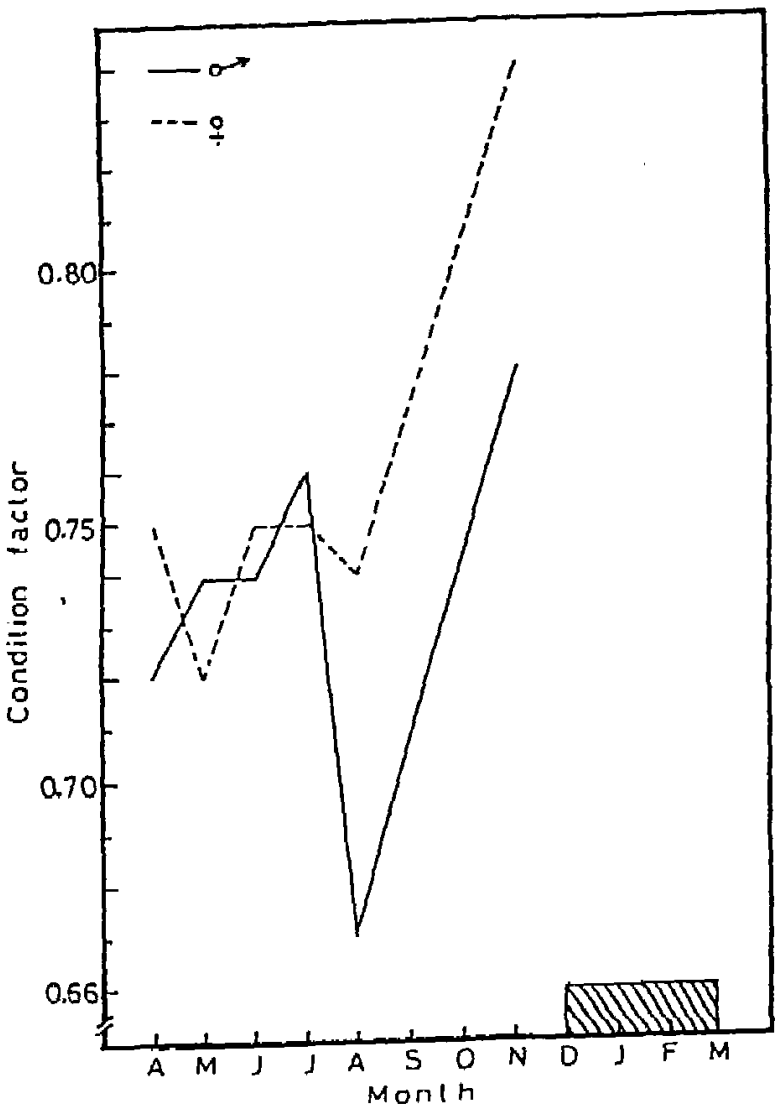

Fig. (3): Monthly changes in values of condition factor for males and females *Scomber japonicus* in the Egyptian Mediterranean waters.

▨ No fishing takes place during these months.

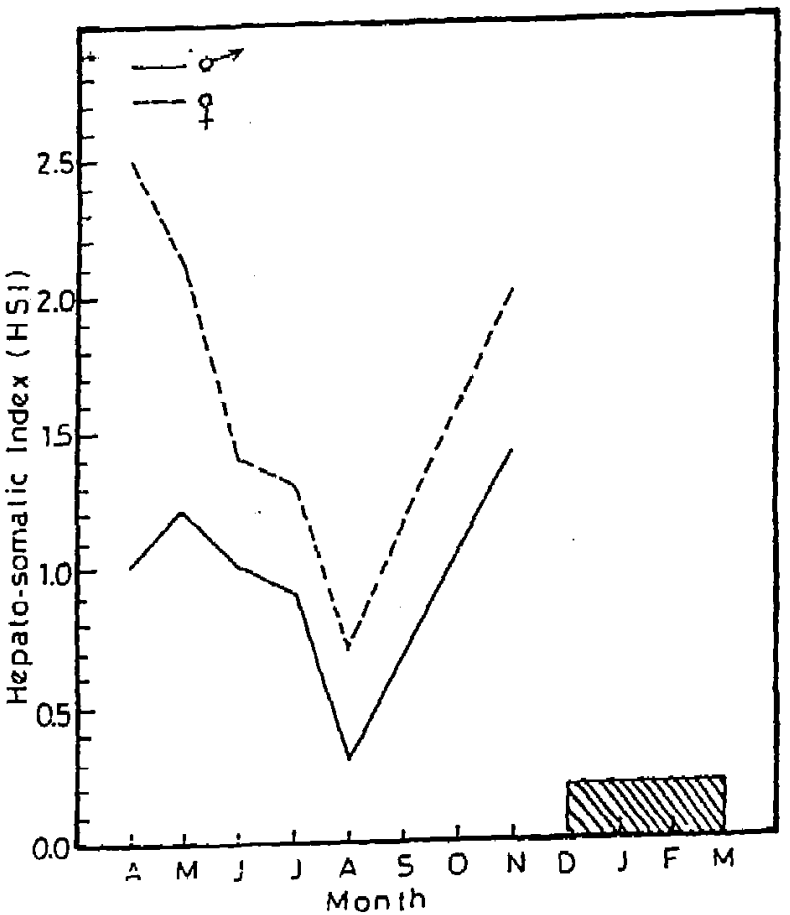

Fig. (4): Monthly changes in average hepato-somatic values of males and females *Scomber japonicus* in the Egyptian Mediterranean waters.

▨ No fishing takes place during these months.

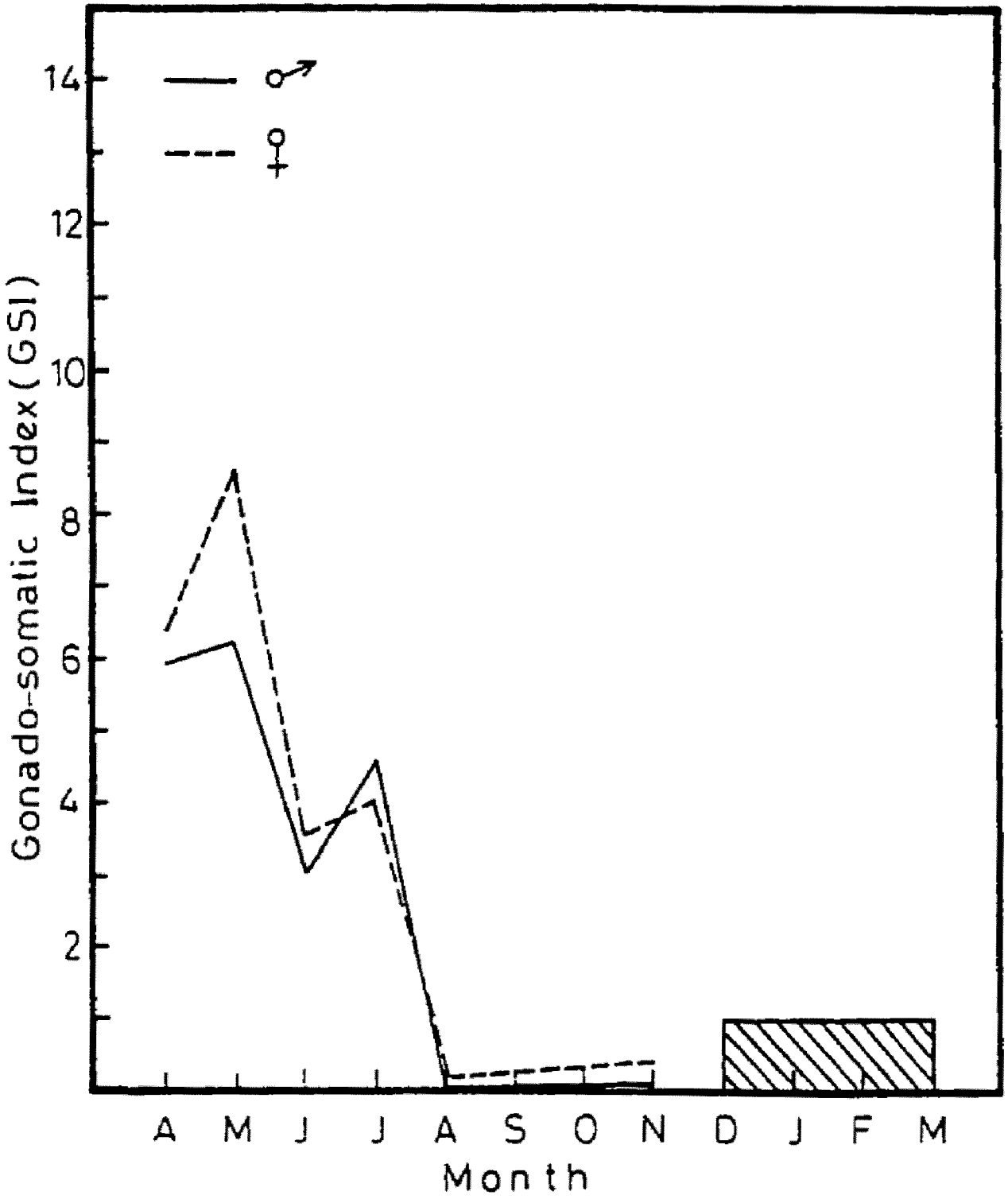

Fig. (5): Monthly changes in average gonado-somatic values of males and females *Scomber japonicus* in the Egyptian Mediterranean waters.

▨ No fishing takes place during these months.

Table (1): Back-calculated lengths (cm) and weights (g) at different ages and those predicted by von Bertalanffy (v. B) equations for combined sexes of *Scomber japonicus* in the Egyptian Mediterranean waters.

Item	Age (year)			
	1	2	3	4
Number of fish	*	52	15	3
Mean length at capture (cm)	*	26.24	30.36	32.50
Back-calculated length (cm)	*	25.89	29.55	32.22
Lengths predicted from v. B (cm)	20.87	25.89	29.55	32.22
Back-calculated weights (g)	*	133.36	196.13	252.56
Weights predicted from v. B (g)	75.07	138.05	200.83	256.65

* Not included in the catch.

دراسة بعض الصفات البيولوجية لأسماك السكومبر فى المياه المصريه للبحر المتوسط

سمير إبراهيم رزق الله
المعهد القومى لعلوم البحار والمصايد

يتم صيد أسماك السكومبر فى المياه المصريه للبحر المتوسط بإستخدام شباك الشانشولا والضوء الصناعى الذى يعمل على جذب تلك الأسماك.

ولقد أثبتت الدراسة التى أجريت لقياس الأعمار من خلال قراءة حلقات النمو المختلفه التى تظهر على الفقرات أن أقصى عمر لأسماك السكومبر هو أربع سنوات والأسماك الصغيره ذات عمر سنه واحده وأقل من ذلك فهى غير متواجده فى المصيد على الاطلاق. واوضحت الدراسه ايضاً أن الأسماك ذات عمر سنتين هى السائده فى المصيد حيث بلغت أطوالها ٢٥,٨ سم أما الأسماك ذات عمر الثلاث سنوات فقد بلغت أطوالها ما يقرب من ٢٩,٦ سم والأسماك ذات الأربع سنوات فقد بلغت ٣٢,٢ سم وبحساب أوزان الأسماك فى الأعمار المختلفه وجد أنها تزداد بتقدم العمر فقد بلغ وزن السمكة ذات الأربع سنوات من العمر ٢٥٢,٢ جرام وهو ضعف وزنها فى السنه الثانيه (١٣٦,٣٦ جرام). ولقد وجد أن أقصى طول ووزن تصل اليها الأسماك هى ٣٩,٤ سم، ٤٥٣,٢ جرام على التوالى.

وأوضحت الدراسات التى أجريت على بعض الخصائص البيولوجيه المختلفه مثل معامل الحاله، معامل المناسل والمعامل الكبدى أن هذه المعاملات تصل الى اقل قيم لها فى شهر اغسطس بعد انتهاء موسم التكاثر (مايو-يوليو). وقد وجد أيضاً أن جميع العينات التى تم الحصول عليها ناضجه جنسياً. ولقد تعذر تحديد الطول والعمر عند أول نضج جنسى وذلك لعدم وجود الأسماك الصغيره فى المصيد.

ولقد أثبتت دراسة معدل الخصوبة المطلقه لأسماك السكومبر أن إناث تلك الأسماك تضع بيضاً يتراوح من ٥٦٠٠٠ الى ١٧٤٩٠٨ بيضه وذلك للأسماك التى تراوحت أطوالها من ٢٨,٣ سم الى ٣٢,٨ سم وأوزانها ما بين ١٧٠-٢٨٠ جرام وأن الخصوبه النسبيه لذلك النوع تتراوح من ٣٨٢ الى ٦٢٥ بيضه لكل جرام من وزن السمكه.