Age, growth and reproduction of the lizard fish *Saurida undosquamis* from the Gulf of Suez, Red Sea, Egypt

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ABSTRACT

The lizard fish *Saurida undosquamis* represents one of the most commercial fish in the Gulf of Suez. The growth and reproductive biology of the species were studied. The age was determined from otolith readings of the collected specimens from the Attaka Harbor through the period from September 2011 to April 2012. The results show that the life span of the sampled fish was seven years. The estimated von Bertalanffy growth equation was $L_t=51.252\ (1-e^{-0.131(t+1.45)})$, the calculated length-weight relationship was $W= 0.004\ L^{3.107}$. Seasonally distribution of gonado-somatic index (GSI) values showed that the main peak of GSI was in spring. The results of gonad development stages show that, *Saurida undosquamis* is a synchronous spawner. The size at which 50% of fishes are mature was 15.0 cm for males and 15.5 cm for females, which indicates that all individuals over one year of age were sexually mature**.** The results indicated that juvenile individuals are one of the targets of the fishery and the protection of the juveniles is probably the key factor for the sustainability of the resources.

Keywords: Age, growth, reproduction, *Saurida undosquamis*, Gulf Suez, Red Sea**.**

INTRODUCTION

The lizard fishes are worm-water fishes widely distributed in the Indopacific regions. They are the most commercially important species in the trawl fishery of the Gulf of Suez. The lizard fishes in the Gulf of Suez are represented by four species namely *Saurida undosquamis, Trachinocephalus myops, Synodus variegates* and *Synodus indicus* of which *S. undosquamis* is the most abundant species; comprise about 95% of the lizard fish catch (El-Ganainy, 2003). The landings of the lizard fishes constitute 31% of the total trawl catch in the Gulf. As one of the most important demersal fishes, the stock of the lizard fishes in the Gulf of Suez and Red Sea has experienced heavy exploitation (El-Ganainy 1992, 1997, 2003 and 2004).

The brush tooth lizard fish *Saurida undosquamis* is very abundant in the northern part of the Gulf of Suez and is usually fished at depths between 20-70 m and found mostly over sandy or muddy bottoms (Youssif, 2004). It is reported that the maximum size of this fish is about 50 cm (El-Ganainy (1997) however, in landings, the common size range was between 15 and 35 cm.

The reproductive biology and population structure of *S. undosquamis* were investigated by Shenouda (1976) and El Ganainy (1997 and 2004) in the Red Sea; Sanders & kedidi (1984) and El-Ganainy (1992, and 2003); Amin *et al.* (2007) and El Halfawy *et al.* (2007) in the Gulf of Suez. The species was the subject of many studies in the Indo-Pacific region, of which are: Xu *et al.* (1994); Pauly & Gayanilo (1996); Letourneur *et al.*(1998); Abdallah (2002); Yoneda *et al.* (2002); Chen (2003); Jianguo *et al.* (2011); Wang *et al.*(2o11); Metar *et al.* (2011); Xuehui *et al.* (2012); and

Kadhorsha *et al.* (2013). It was studied in the Mediterranean waters also by Faltas (1993); Ismen (2003); El-Greisy (2005); Cicek *et al.* (2006); Gokce *et al.*(2007); Manasirli *et al.*(2011); Cicek and Avsar (2011) and Edelist (2012).

The assessment of demersal fish like Lizard fish stock and the establishment of fishery management guidelines are urgently and continuously needed in the Gulf of Suez. The purpose of this study is to determine the age, growth, and the reproductive biology of *S. undosquamis*, in order to help in its proper management.

MATERIAL AND METHODS

Study area:

The Gulf of Suez extends about 250 km from Suez in the north (Lat. 29°56' N) to Shadwan Island in the south (Lat. 27°36' N). Its width varies between 20 and 40 km, and its depth throughout its axis is fairly constant with a mean depth of 45 m (Fig.1). Three main fishing methods are operating in the Gulf; trawl, purse-seine and artisanal fisheries; especially long and hand lines.

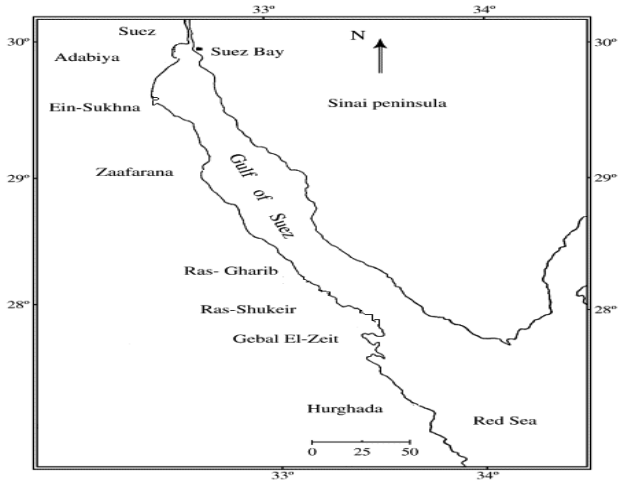

Fig. 1: Map of the study area

Collection of data:

Data of the catch of the lizard fishes were studied from the records of the General Authority of Fish Resources Development (GAFRD).

Monthly random samples (965 fish from 10.5- 36.1 cm TL) were collected from the Attaka Harbor during the period from October 2011 to September 2012. The total length to the nearest millimeter and total weight to the nearest 0.1g was measured. Sex, maturity stage and gonad weight for each sampled specimen were recorded. The length frequency distributions were determined at 1.0 cm length intervals.

Data analysis:

Age was determined by counting the annual rings on the otolith of *S. undosquamis* as the otoliths contain concentric growth band pairs, including translucent and opaque bands. The growth band pairs on the otoliths were examined under a binuclear stereomicroscope. The assigned ages at each length group-were used for the estimation of the growth parameters (L_∞, K and t_o) according to von Bertalanffy (1938) growth formula:

$$L_t = L_\infty (1 - e^{-K(t-t_0)})$$

Where L_∞ is the asymptotic length in cm, K is the growth coefficient and t_0 is the length at age 0.

The spawning season was determined by estimating the average seasonal gonado-somatic index (GSI) for both male and female as a percentage of the gonad weight to the total body weight of the fish.

$$GSI = Gwt / Twt \times 100$$

The seasonal variations of different maturity stages were determined for each individual and classified into six maturity stages according to the scale of Gunderson's (1993) with some modifications. Length at first sexual maturity Lm50 was estimated according to king (1995) for each length group.

RESULTS

Statistics of catch and effort:

The annual total trawl catch and lizardfish catch (ton) landed at Atakka Harbor during the last twelve years from fishing season 2000/2001 to 2011/2012 (Fig. 2) showed that the lizard fish catch fluctuated between a maximum value of 2014.48 ton and a minimum value of 771.58 ton representing an average of 28.7% of the total trawl catch. The lizardfish catch per landing fluctuates between the highest value (1174 Kg/landing) recorded during the fishing season (2011/2012) and the lowest value (365 Kg/landing) recorded during the fishing seasons (2004/2005), represented graphically in Fig (3).

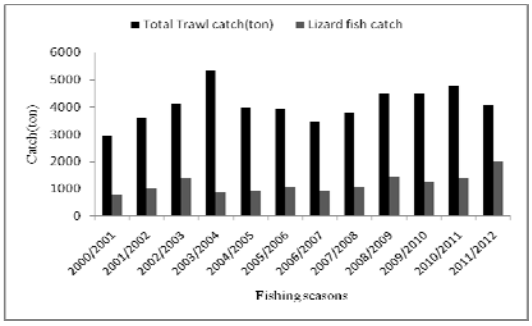

Fig. 2: Seasonal total trawl catch and lizard fish catch in the Gulf of Suez during the fishing seasons; 2000/2001to 2011/2012.

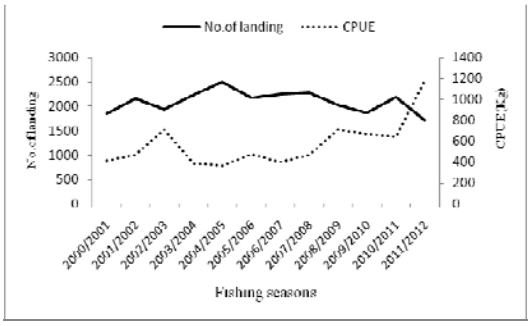

Fig. 3: Seasonal total catch per unit effort of lizard fish and Number of landings in the Gulf of Suez during the fishing seasons; 2000/2001 to 2011/2012.

Length-Weight Relationship:

The total length of *Saurida undosquamis* ranged from 10.2 to 36.1 cm with an average of 18.23±3.40 while the total weights ranged from 7 to 304 g with an average of 43.91±32.2.

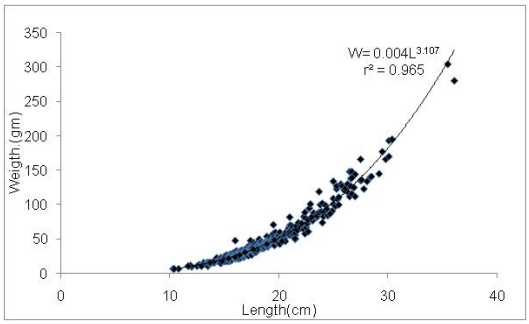

Fig. 4: length–weight relationship for combined sexes of *Saurida undosqumis*.

The result of the length weight relationship (Fig. 4) was $W = 0.004\ L^{3.107}$ (ANOVA, $F = 17285.28$, $P < 1.39$) by: ($r^2 = 0.965$, SEa = 0.247, SEb = 0.0099). The growth of weight relative to length was positive allometric ($b = 3.107$; 95% CI: 3.06-3.155.

Length frequency distribution:

The monthly length frequency distribution (Fig. 5) of about 965 sample showed that the small fishes (≤10 cm); About one years old or less; were caught during January and September referring that the recruitment to the fishing ground occurs during these months.

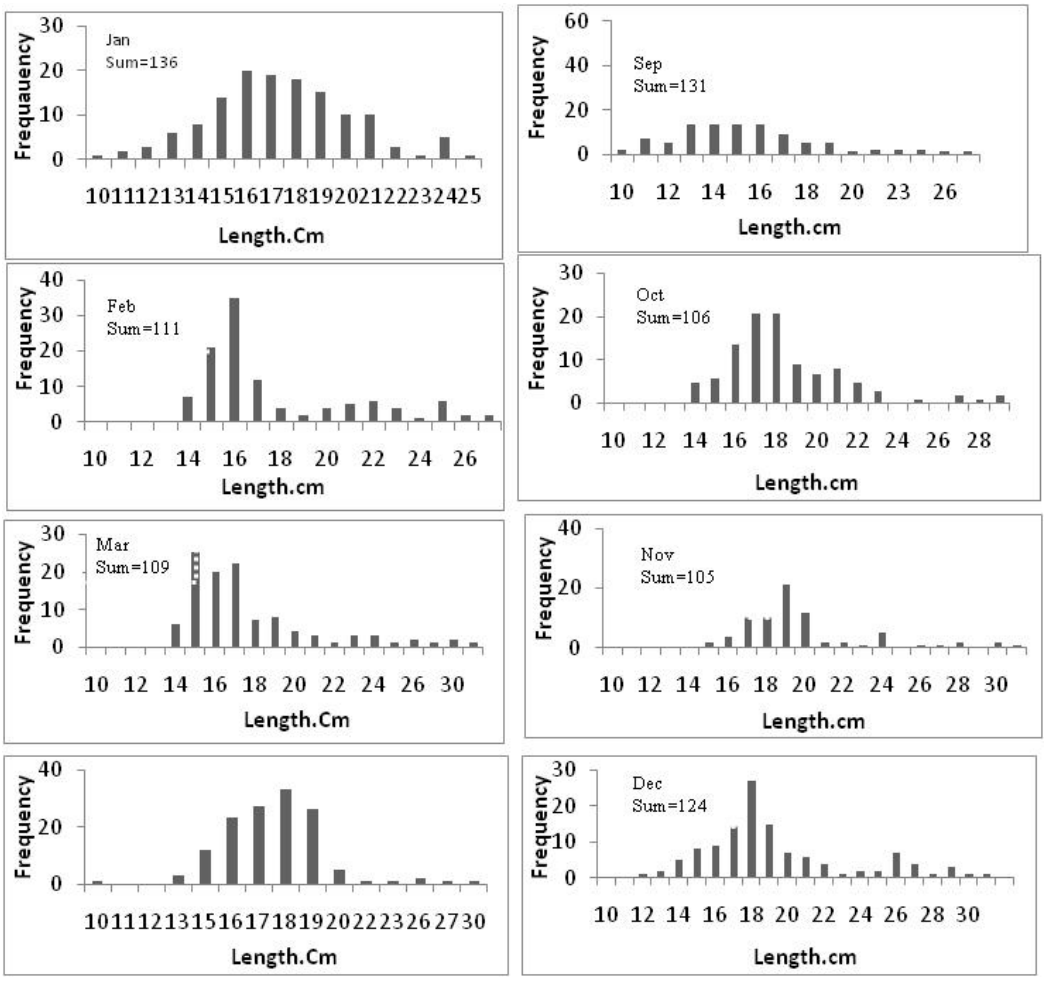

Fig. 5: Monthly length frequency distributions of Lizard fish (*Saurida undosquamis*).

Age and growth:

Age was determined by otolith reading of 310 specimens of *Saurida undosquamis.* Seven age groups were identified with mean lengths of 14.5, 19.2, 23, 26.4, 29.5, 32.1, and 34.6 for the age groups from one to seven respectively (Table 1 & Fig. 6). The maximum growth rate was recorded at the first year of life, and then the growth rate was gradually decreased with the increase of age. Age group II was dominating the catch.

The mean lengths at different ages were used for estimating the von Bertalanffy growth parameters. The estimated parameters were $L\infty = 51.252$ cm, K= 0.131 year and $t_o = -1.45$ years.

Table 1: Observed mean, maximum and minimum length with standard deviation of each age group of *Saurida unosquamis* estimated by otolith reading.

Age group	Number of fish	Average	Min .L	Max .L	S.D.
1	46	14.5	10.4	19.6	1.7
2	160	19.2	15.6	26.3	1.5
3	47	23	19.4	28.6	2.0
4	40	26.4	22.9	29.4	1.5
5	11	29.5	25.8	30.8	1.3
6	3	32.1	31.2	33.7	1.3
7	3	34.6	32.4	36.1	1.9

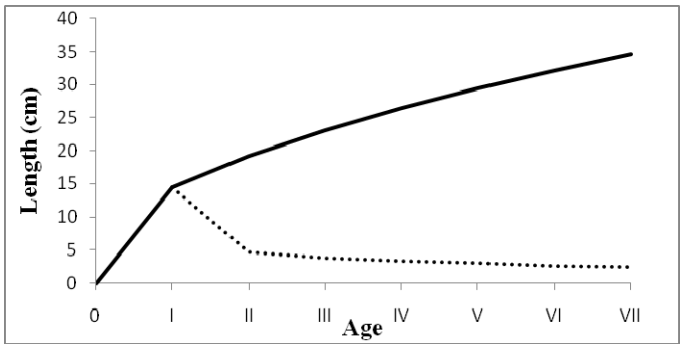

Fig. 6: Growth in length and length increment of *Saurida undosquamis*.

Gonado- somatic index (GSI):

Analysis of the seasonal variations of the GSI (Fig. 7) showed that the average values of gonad weight percentages increased substantially from autumn until spring. The maximum average values of GSI were recorded during spring for both males and females. This indicates that *Saurida undosquamis* has a prolonged spawning season from autumn to spring with an intensive spawning in spring.

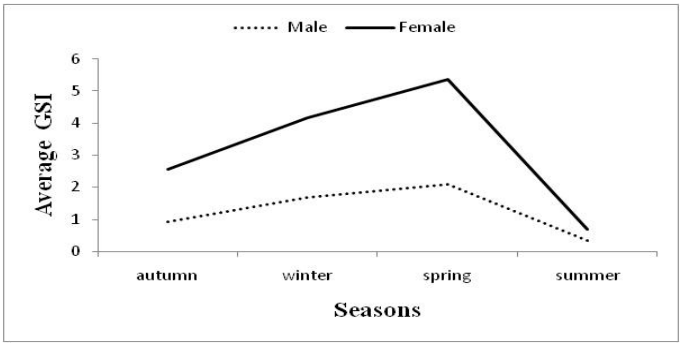

Fig. 7: Average values of males and females GSI of *Saurida undosquamis*

Length at first sexual maturity:

Analysis of the percentage of mature and immature fish in each length class showed that the minimum size of maturity was 10.5 cm for males and 11.5 cm for females, while the size at which 50% of fishes are mature were 15.0 cm for males (Fig. 8) and 15.5 cm for females (Fig. 9), thus all individuals over one years old were sexually mature.

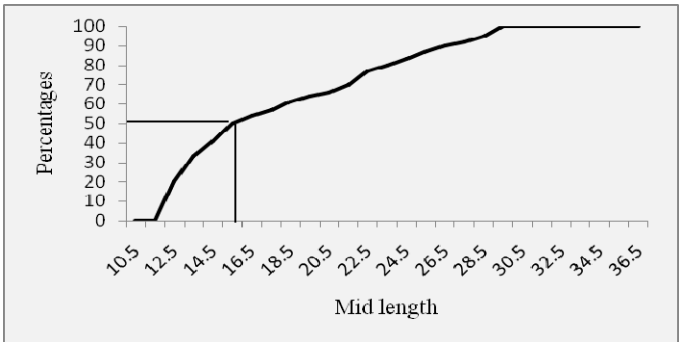

Fig. 8: The lengths of females *Saurida unosquamis* at 50% sexual maturity.

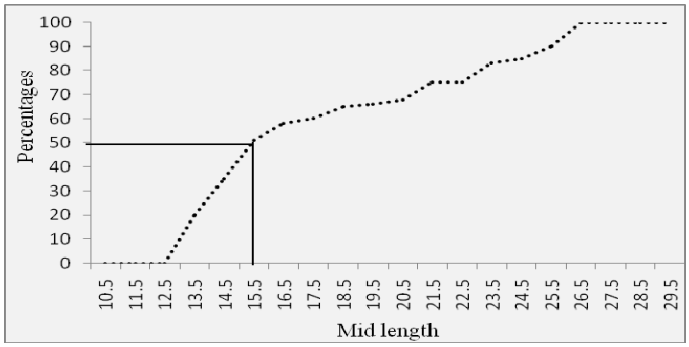

Fig. 9: The length of males *Saurida undosquamis* at 50% sexual maturity.

DISCUSSION

Lizard fishes are one of the most economically important fish groups in the catch of the Gulf of Suez fishery. The annual total trawl catch and lizardfish catch landed at Atakka harbor during the last twelve years showed that the lizard fish catch represented an average of 28.7% of the total trawl catch.

The regression coefficient value (b) in total length–weight relationship equation of *Saurida undosquamis* showed that the growth of weight relative to length was almost positive allometric (b = 3.107). This result is in a good agreement with the previous recorded results as shown in Table (2) except that of Cicek & Avsar (2011) who stated that the coefficient (b) is negative allometric (<3).

Studies on age determination of *Saurida undosquamis* was carried out by using otolith. Results showed that it is a fast growing species where the fish attained about 40% of its length during the first year of life. Age group one represented about 14.8% of the fishery, while the most dominant age class was age group II with a percentage of 51.6%. El-Ganainy (1992) estimated the life span of *Saurida undosquamis* in the Gulf of Suez as four years for males, and 6 years for females. The results of this study is in agreement with El-Ganainy (1992 and 2002); El-Halfawy *et al.* (2007); Amin *et al.* (2007); Çiçek and Avşar (2011) and Manaşırlı *et al.* (2011).

Results of the theoretical growth in length of *Saurida undosqumis* showed that $L\infty$=51.252cm, K=0.131 year and t_0= -1.45 years. These results are in a good agreement with most of the previous studies in different localities, but there are some variation with some authors such as Ambak *et al.*(1986), Boonwanish (1991), Cicek

et al. (2006), Gokce *et al.* (2007), Amin *et al.* (2007), El Halfawy *et al.* (2007), Metar (2011), Xuehui *et al.*(2012); these variations may be attributed to the different technique used in the age determination and the maximum recorded length in the different areas of study (Table 2).

Table 2: Growth parameters and Length weight constants for *Saurid undosquamis* collected from different regions compared with the present study.

Locality	Sex	Growth parameters			Length weight constants		Method of ageing	Source
		L	K	t	a	b		
Malaysia		49.25	0.25		0.0054	3.2421	L.F.	Ambak *et al.* (1986)
Thailand		41.8	0.6				L.F.	Boonwanish (1991)
Gulf of Suez	M	37.32	0.17	-2.09	0.0027	3.27	Otolith	El Ganainy (1992)
	F	55.56	0.11	-2.13	0.0033	3.196	Otolith	El Ganainy (1992)
Japan	M	44.2	0.162	-1.238			Otolith	Yoneda *et al.* (2002)
	F	51.8	0.16	-0.948			Otolith	Yoneda *et al.* (2002)
Red Sea	M	31.63	0.26	-1.38	0.0017	3.319	Otolith	El Ganainy (2004)
	F	41.72	0.17	-1.53	0.0044	3.109	Otolith	El Ganainy (2004)
Turkey					0.0039	3.165		Cicek *et al.* (2006)
Turkey		42	0.51	-0.29			L.F.	Gokce *et al.* (2007)
Gulf of Suez	M	31.03	0.44	-1.06	0.0042	3.131	L.F.	Amin *et al.*(2007)
Gulf of Suez	F	35.56	0.26	-1.059	0.003	3.167	L.F.	El Halfawy *et al.* (2007)
Taiwan		56.3	0.232	-0.558			Otolith	Jianguo *et al.* (2011)
China					0.0097	3.05		Wang *et al.*(2011)
Turkey		41.57	0.118	-1.895			Otolith	Manasirli *et al.* (2011)
India		34.6	0.87				L.F.	Metar (2011)
Turkey		38.05	0.124	-1.68	0.0083	2.879	Otolith	Cicek & Avsar (2011)
China		34	0.52	-0.3	0.0956	3.043	L.F.	Xuehui *et al.* (2012)
Gulf of Suez		51.25	0.131	-1.45	0.004	3.107	Otolith	Present study

The study of the seasonal variation of maturity stages and gonado somatic index of *Saurida undosquamis* revealed that this species is a spring spawner. These results are in a good agreement with El-Ganainy (1992). Kadharsha *et al*. (2013) found high gonado-somatic index values during October-December, suggesting spawning activity during this period. {This species was found to be a total spawner in the Parangipettai waters (Kadharsha *et al.* (2013)

Knowledge of the length at first sexual maturity is important in fishery management. In the present study, the minimum size of sexual maturity of female of *Saurida undosquaamis* was 12.2 cm while the size at 50% maturity was 15.5 cm; the minimum size at the sexual maturity of male was 13.5 cm while the size at 50% maturity was 15 cm; These results agreed with those of EL-Ganainy (1992) who estimated the length at 50% of female by 15.5 cm and 14.5cm for males in the Gulf of Suez.

CONCLUSION

The estimated length at first sexual maturity 15.0-16.0 cm and the observed length range of age group I is 10.4-19.6. The estimated length at first capture of the species is 18.0 cm (El-Ganainy (1992). This implies that juvenile individuals are the target of the fishery, and the stock dynamics of this species would be seriously affected. The high vulnerability of juvenile fish to capture by trawling would result in the reduction of the future yield of this species. Thus, the protection of juveniles is probably the key factor for the sustainability of the resource; through periodic spatial closure of the spawning and nursery areas. This may be achieved through the establishment of certain reserves in the Gulf of Suez to protect the spawning stock biomass, and then monitoring their effects as a management strategy. In this context, a map for the

spawning and nursery grounds for all fishes in the Gulf of Suez should be prepared on the basis of sound biological research.

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ARABIC SUMMERY

العمر و النمو والتكاثر لسمكة الحارت (***Saurida undosquamis***) من خليج السويس - البحر الأحمر، مصر

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تعتبر سمكة الحارت من اهم الاسماك الاقتصاديه فى خليج السويس حيث يمثل انتاج هذا النوع حوالى ٣١% من انتاج حرفة الجر فى خليج السويس. ولقد تم تجميع العينات لهذا النوع من ميناء الاتكه خلال الفترة من شهر سبتمبر ٢٠١١ حتى شهر ابريل٢٠١٢. وعن طريق استخدام عظمة الاذن تم تقدير عمر السمكه الذى وصل الى ٧ سنوات وتصل السمكه الى حوالى ٥٠% من معدل نموها فى الطول فى السنه الاولى من عمر السمكه . وايضا تم استخدام معادلة فون برتلانفى لتحديد معدل نمو السمكة وكانت النتيجة كالتالى:

$Lt=51.25(1- e^{-0.131(t+1.4)})$. وعن طريق تحديد مراحل النضوج الجنسى لهذا النوع تم تحديد موسم التكاثر حيث تبين ان موسم التكاثر لهذا النوع يكون ممتد طوال العام الا ان اعلى نسبه للتكاثر تكون فى موسم الربيع وايضا تبين ان اطوال الا سماك عند اول نضوج جنسى.

كالاتى: L50=15 cm للذكور و للاناث L50=15.5cm ومن تتبع التردد الطولى للسمكه شهريا تبين ان الاجيال الجديده ترد الى المصيد خلال موسم الخريف وطبقا لهذه الدراسة فقد تبين أن معظم الاسماك الصغيرة التى تدخل المصيد قبل النضوج الجنسى تتعرض لصيد جائر وان هذه الافراد هى العامل الاساسى فى تنمية المصيد فلابد من الحفاظ عليها حتى تصل الى سن النضوج وتغذى المصيد بجيل جديد من أجل التنمية المستدامة لهذا النوع .