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POPULATION DYNAMICS OF *Nemipterus japonicus* (BOLCH, 1791) IN SUEZ GULF, EGYPT

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Abstract

The population dynamics of the *Nemipterus Japonicus*, in Suez Gulf waters, was studied based on monthly samples collected between Jan 2016- Dec 2016 from El-Atkaa harbor. Age and growth studies based on scales revealed that this species has a maximum lifespan of five years and the mean back-calculated total lengths were 14.3, 18.4, 21.9,24.5 and 26.3 cm at the ages I, II, III, IV and V respectively. Growth was described by the von Bertalanffy growth model as Lt= 27.3 ($l\text{-}e^{-0.57(t+0.177)}$). Estimates of total, natural and fishing mortality were 1.38, 0.57 and 0.81 $year^{-1}$, respectively. The high value of exploitation ratio (E= 0.59) indicates that this species was harvested at a higher level than the optimum fishing mortality and this fishing pressure should be reduced to obtain MSY. The yield per recruit analysis suggests that the *Nemipterus Japonicus* stock in Suez Gulf waters needs regulatory measurements to achieve its sustainable development.

Keyword: *Nemipterus japonicus*, Suez Gulf, Population dynamics, length-weight relationship, growth, mortality.

INTRODUCTION

Egypt drives its fish yield from three main fishery resources; marine (Red and Mediterranean Sea), inland (Delta and coastal lakes and River Nile with its tributaries) and aquaculture. The family Nemteridae popularly Known as Thread breams which is considered as a highly important group of demersal fish. It is a Red Sea immigrant in to the Mediterranean Sea. *Nemiptreus Japonicus* is very abundant in coastal water, found in mud or sand bottoms, usually in Schools. Feeds mainly on small fish, crustaceans, mollusks (mainly cephalopods), Polychaetes and echinoderm. It is one of major species in the Gulf of Suez. The stock assessment of *Nemiptreus Japonicus* in the Gulf of

Suez was studied by (Breikaa, 1992 and 1996). And (Joshi, 2010) Population dynamics of *Nemiptreus Japonicus* in trawling grounds of Cochine. (Khan and Mustafa 1989) studied Length – frequency based population analysis of threadfin bream *Nemiptreus Japonicus* of Bangladesh Coast. The present study was made to determine different parameters of population dynamics on *Nemiptreus Japonicus* i.e. an asymptotic Length (L_t), growth coefficient (K), natural mortality (M), fishing mortality (F), recruitment patterns, length at first capture (Lc), relative yield per recruit and exploitation rate (E).

MATERIAL AND METHODS

Collection data:

Monthly samples of *Nemiptreus Japonicus* were collected during the period between Jan - Dec 2016. 681 specimens of both sexes (402 male and 279 female) were caught by bottom trawlers catches in Attaka harbor. The measurements are total length to the nearest 0.1 cm and total weights to the nearest 1 gm of fish were recorded for each specimen. Age determination of *Nemiptreus Japonicus* using scales from the fish left side in the area just below the lateral line and behind the pectoral fin. They were kept in special envelops with full information (date of capture, length, weight, sex, and maturity stage) for further reading. The scales were preserved in solution of 10% of NH_4OH for 24 hrs, then washed with distilled water, dried on filter paper and mounted between two glass slides, examined using optical system of "Nikon Zoom stereomicroscope focusing block, Heidehain's electronic bidirectional read out system VRX 128", under transmitted light. The total radius of each scale "R" (the distance between the focus and to the margin) as well as the distance between the focus of the scales and the successive annual, measured to the nearest 0.01 mm. The body length-scale radius relationship was determined using the least square regression. The lengths at the end of each year of life were back-calculated from scale measurements using Lee's equation (1920).

Length – Weight relationship:

The relationship between length and weight was described by the potential equation ($W = a L^n$). Where W is the total weight (g), and L is the total length (cm), "a" and "n" the constant. The coefficient of determination (r^2) was used as an indicator of the quality of the linear regression (Scherrer, 1984). The condition factor or the coefficient of condition was calculated by two different methods

Fulton's (1902) condition factor "Kc".

$Kc = 100 (W/L^3)$

Relative condition factor "Kn"

$Kn = W/\bar{W}$

Where "W" is the observed weight in gram and "$\bar{W}$" is the calculated weight in gram.

Morta**lity rate:**

Total mortality (Z) was estimated by the linearized catch curve method by Richer (1975) based on Length – frequency data analysis. Natural mortality coefficient was estimated using the equation of Ursin (1967), $M = W^{-1/3}$. Fishing mortality coefficient (F) was estimated directly by subtracting the value of the natural mortality from the value of the mean total mortality as F = Z – M.

The back – calculated:

The back calculated lengths were used to estimate the growth parameter of the Von Bertalanffy growth model $Lt = L\infty (1 – e^{-k (t-t0)})$ by fitting the Ford (1933) and Walford (1964) plot. While (t_0) was estimated by the equation $T_0 = t + 1/k \ln (L\infty - Lt) / L\infty$. The back – calculated weight at the end of each year was estimated by length – weight equation.

The growth performance index (φ) was computed according to the formula of Pauly and Munor (1984) as $\varphi = \text{Log } K + 2 \text{ Log } L\infty$.

Mathematical models of growth:

The Von Bertalanffy models, 1938 and 1984, ($Lt = L\infty (1 - e^{-k(t-t0)})$) was used to describe growth in size, where, Lt is the length at age t, L∞ the asymptotic length, K the body growth coefficient and defines the growth rate towards L∞ and t0 the hypothetical age at which a fish would have zero length. The values of L∞, K and t0 were estimated by plotting Lt VS Lt+1 using the Ford (1933), Walford (1964), procedure (Jobling, 2002).

Reproduction:

The length at first sexual maturity L_{50} (the length at which 50% of fish reach their sexual maturity) was estimated by fitting the maturation curve between the observed points of mid – class interval and the percentage maturity of fish corresponding to each length, interval. Then L_{50} was estimated as the point on the X – axis corresponding to the 50% point on the Y – axis. The length at first capture Lc was estimated by the catch curve analysis as described by Puly (1984).

RESULTS

Length – Weight relationship:

For length weight relationship, both sexes (sample of 681 ranging from 10-26.6 cm total length and 10-230 gm observed total Weight) from Gulf of Suez coast between January to December, 2016. Was described by the equation W = 0.015 L 2.901 ($r^2 = 0.959$). Isometric growth was observed (Fig. 1).

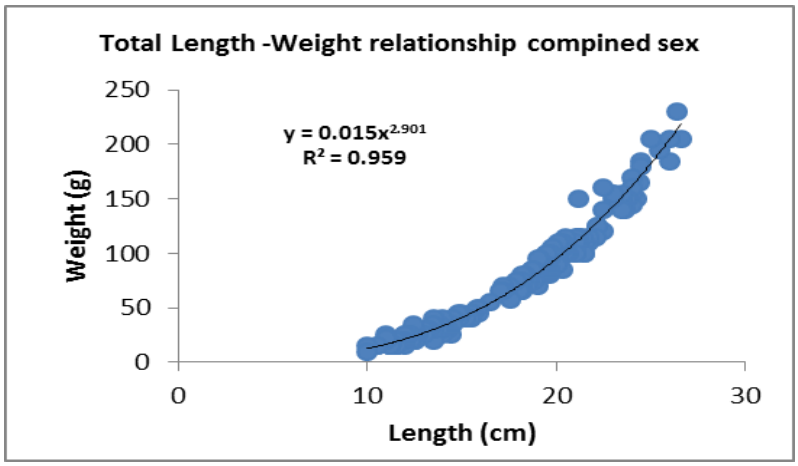

Figure 1. Length-weight relationship for combined sexes of *Nemiptreus Japonicus* from Gulf of Suez (2016).

Body Length – Scale radius Relationship:

681 specimens were collected from ageing growth analysis. Age estimated ranged between 1–5 year. The mean fish length and average scale radius per each length group were given by the ratio between fish length to scale radius size in (Fig. 2). Data from *Nemiptreus Japonicus* between fish and length and scale show a linear trend on their scatter diagram described by the equation: L= 5.40 + 6.489y and r^2 = 0.849.

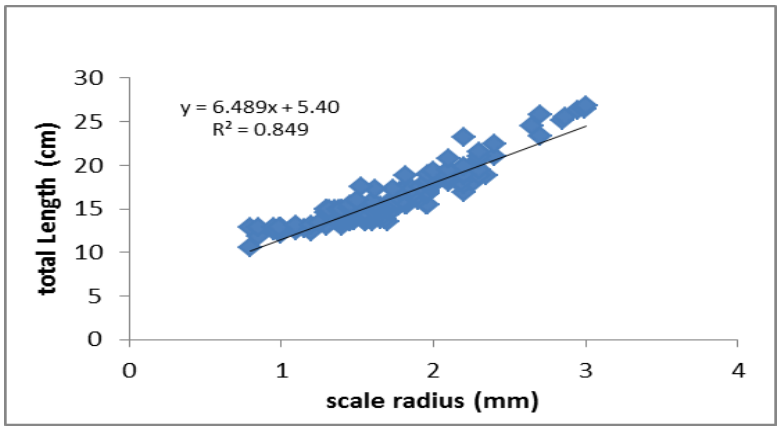

Figure 2. Relationship between total length and scale radius of *Nemiptreus Japonicus* from Gulf of Suez (2016).

The back – calculations:

The average back – calculation length and annual increment of the combined sexes (Table 1) and (Figure 3) are 14.3, 18.4, 21.9, 24.5 and 26.3 cm for age I, II, III, IV and V respectively. The highest annual increment occurred during the first year of life, while a noticeable decrease is observed, reaching minimum value during the fifth year of life. The calculated weights and annual increment in weight for *Nemiptreus Japonicus* were given in (table 2) and represented graphically in (Figure 4). The calculated weights for each age group of *Nemiptreus Japonicus* were 33.71, 70.04, 116.07, 160.72 and 197.42 respectively for the1st, 2nd, 3rd, 4th and 5th year of life, respectively.

Table 1. back-calculated length at age for sexes combined of *Nemiptreus Japonicus* for Gulf of Suez (2016).

Age group	No. Fish	I	II	III	IV	V
I	60	14.3				
II	231	14.26	18.4			
III	159	14.21	18.35	21.9		
IV	138	14.19	18.28	21.73	24.5	
V	93	14.14	18.19	21.65	24.43	26.3
increment	681	14.3	4.1	3.5	2.6	1.8
%	100	54.37	15.59	13.31	9.89	6.84

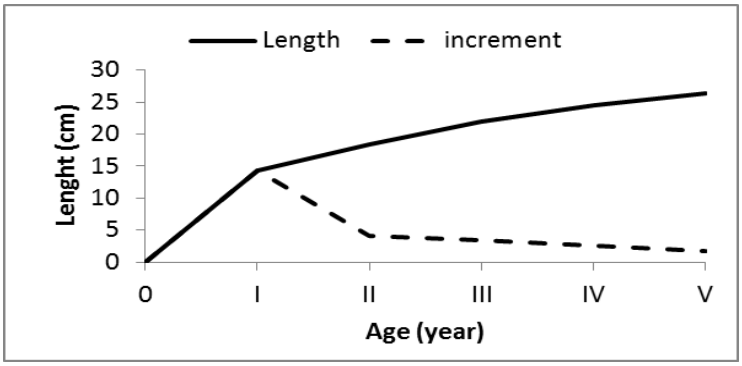

Figure 3. Growth in length and growth increment of *Nemiptreus Japonicus* from Gulf of Suez (2016).

Table 2. back-calculated weight at age for sexes combined of *Nemiptreus Japonicus* from Gulf of Suez (2016).

Age group	No. fish	I	II	III	IV	V
II	60	33.71				
II	231	33.43	70.04			
III	159	33.10	69.49	116.07		
IV	138	32.96	68.72	113.48	160.72	
V	93	32.62	67.74	112.27	159.39	197.42
Increment	681	33.71	36.33	46.03	44.65	36.70
%	100	17.08	18.40	23.32	22.62	18.59

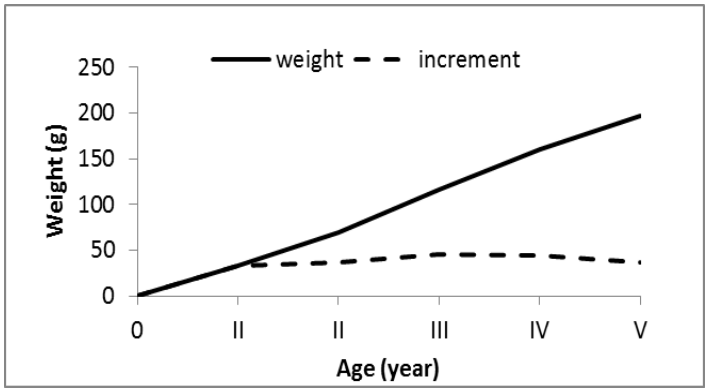

Figure 4. Growth in weight and growth increment of *Nemiptreus Japonicus* from Gulf of Suez (2016).

Condition factor (K):

Figure (5) Show the mean absolute condition factor (Kc) corresponding to The length groups in sexes combined stable from the beginning to l.26 cm in length group 12 cm and slightly down to 1.16 cm in length group 14 cm and increase to 1.27 in length group 17 cm then decrease slightly down to 1.16 in length group 23 cm and decrease after that 1.25 in length group 25cm. The relative condition factor (Kn) in Figure (5) shows that the decrease from 1 to 1.1 cm in length group 14 to 15 cm and stable again to slightly decrease to 1 cm

in length group 21 cm to stable to 1.1 cm in length group 25 cm and from this point stating down.

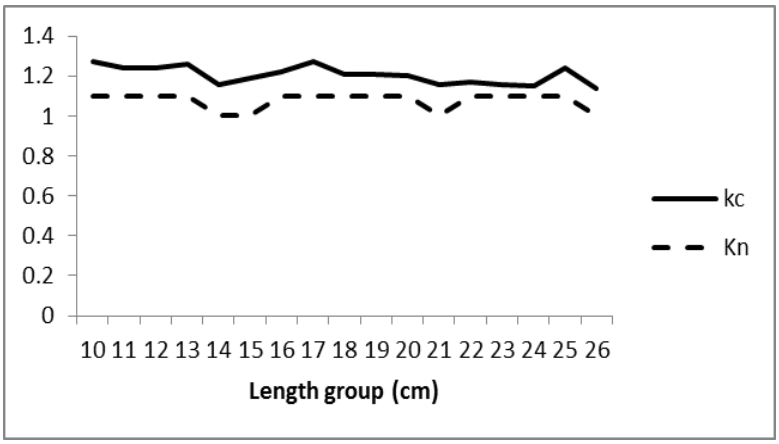

Figure 5. mean absolute condition factor (KC) and mean relative condition factor (Kn) for sexes combined of *Nemiptreus Japonicus* according to length in Gulf of Suez (2016).

Growth parameters:

The parameters of Von Bertalanffy growth were calculated as $L\infty = 27.3$ cm, $K = 0.57$ yr^{-1} and $T_0 = -0.177$. And obtained equation was $Lt = 27.3\ (e - 1^{-0.57\ (t + 0.177)})$ for the growth length. $Wt = 220\ (1 - e^{-0.57\ (t + 0.177)})^{2.901}$ for the growth weight. The *Nemiptreus Japonicus* growth performance index is approximately 2.44.

Mortality and Exploitation Rate:

The total, natural and fishing mortality coefficient of *Nemiptreus Japonicus* from Gulf of Suez shown in Figure (6). It was clear from the obtained data that value of Z, M and F were 1.38, 0.57 and 0.81 $year^{-1}$ respectively. From cumulated catch curve based on the length composition data of *Nemiptreus Japonicus* in Gulf of Suez, Exploitation rate (E) was computed as 0.59 as recorded by Gulland (1971).

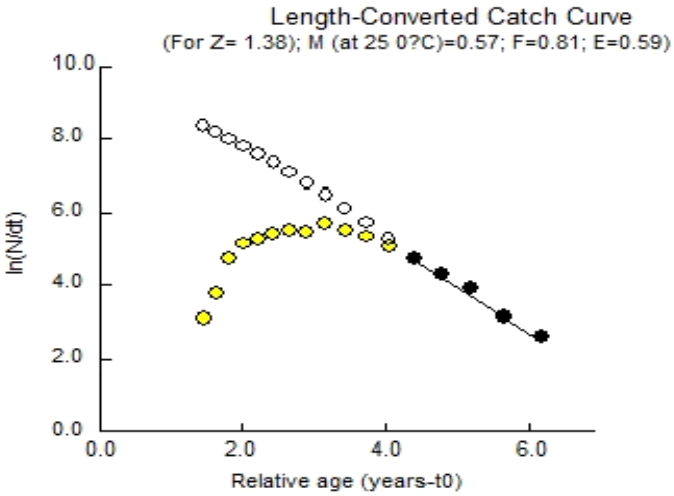

Figure 6. Cumulated catch curve based on length composition data of *Nemiptreus Japonicus* from Gulf of Suez 2016.

DISCUSSION

The length-weight relationship is an important factor in the biological studies and population dynamics of fishes (Abdurahiman *et al.*, 2004). This relationship is helpful for estimating the weight of a fish of a given length in which can be used in studies of gonad development, rate of feeding, metamorphosis, maturity and condition (Le Cren, 1951). Amal (2012) found that this value was 2.733 from Gulf of Suez waters. Manojkumar (2004) reported it 2.99 from Veraval waters, Gujarat, India. In the present study, slope (b) obtained for both sexes combined (2.901) indicating that this species has symmetrical or isometric growth. The validity of the growth studies using scales is based on the number of annual rings formed on the scales. The relationship between the scale radius and the total length Fig (2) was found to be linear and does not pass through the origin and can be represented by the following equation: L = 5.40 + 6.489y and r2 = 0.849. The values resulting from relating the scale radius and the fish body length were involved in the back – calculations of length at the end of each year of life (Desouky, 2016). The mean length of the fish combined sexes at the end of various life stages

were 14.3, 18.4, 21.9, 24.5 and 26.3 cm for the age groups from I to V respectively.

Based on this results it is clear that, the highest growth length rate of *Nemipterus japonicus* from Gulf of Suez is found to be at the end of the first group of life, after which the annual increment in length decreases with the age increase. The coefficient condition factor (k) is another way to relate the fish length and weight. The condition factor gives an idea about the relative robustness of the fish, fatness, and it's well being degree. This factor is based on a hypothesis relating the fish length to its condition (Desouky, 2016).

Growth parameters:

In this study the VBGF growth coefficient was estimated, using a non-parametric method commonly used in length frequency analysis of fish, which is basically ad hoc and does not depend on estimating the parameters of cohort distribution directly. So it makes only weak assumption about the distribution of sizes within the group. The model lengths of each group were fixed to lie upon a curve described by growth models such as Von Bertalanffy growth model, thus it makes a strong assumption about growth (Pitcher, 2002). The estimation of VBGF parameters of asymptotic length ($L\infty$) and growth coefficient (K) using the pooled data of *Nemipterus japonicus* from present study were compared with other studies in Table (3). These results were obtained using different data and different methods. Slight differences in Table (3) might be due to some variance in population structure and environmental conditions, different trawl methods, timing, area and environmental parameters are affecting on spawning, yield and recruitment of marine fish (Banse, 1959; Ramamirthan and Rao, 1974 and Jayaprakash, 2002). Overall the samples that we collected from those surveys can fully represent the length class in the Gulf of Suez waters. We can assume that our study is satisfactory because the results are almost same with previous studies from the world.

Table 3. Summary of parameters estimates of *Nemipterus japonicas* in different regions.

Location	L∞	K	t_0	φ	Source
India (Andra, Orissa)	30.50	0.314	- 1.107	2.740	Krishnamoorthi (1973)
India	20.90	0.648	-	2.450	Krishnamoorthi (1971)
Samar Sea, Philippines	26.50	0.600	-	2.620	Corpuz *et al.* (1985)
Gulf of Aden	29.10	0.310	0.048	2.420	Edward *et al.* (1985)
Pakistan	28.80	0.460	-	2.580	Iqbal (1991)
Gulf of Suez	28.64	0.495	- 0.122	2.609	Breikaa (1992)
Gulf of Suez	29.27	0.462	- 0.198	2.597	Breikaa (1996)
Gulf of Suez	28.35	0.630	- 0.435	2.794	El-Ganainy and Mehanna (2003)
Gulf of Suez, Egypt	33.65	0.450	- 0.123	2.710	Amal (2012)
Abu Quir-Alexandria, Egypt	34.4	0.15	- 0.260	-	El Haweet (2013)
Gulf of Suez	27.3	0.57	-0.177	2.44	Present study

Table 4. Estimation of mortality rate of *Nemipterus japonicus* from different areas and compared with the present study.

Area	Z	M	F	Source
Bangladesh Bay of Bengal	1.33	0.75	0.55	Mustafa (1994)
Cochin, India (male)	2.32	1.30	1.02	Joshi (2010)
Cochin, India (female)	2.06	1.30	0.76	Joshi (2010)
Cochin, India (pooled)	3.35	1.30	1.87	Joshi (2010)
Gulf of Suez, Egypt	1.75	0.529	1.22	Amal (2012)
Pakistan	0.96	0.74	0.22	Ali (2013)
Gulf of Suez, Egypt	1.38	0.57	0.81	present study

Gulland (1971) stated that when the exploitation ratio is above 0.5 then the fish stock is considered at an over-exploitation state and Patterson (1992) also stated that the exploitation ratio should be maintained at the 0.4 level. Since mortality of *Nemipterus japonicus* from Gulf of Suez is 0.59 which is an over-exploitation condition so the fisheries managers should take some steps to maintain the stock of this important fish in Gulf of Suez water.

Length at first capture Lc:

The length at first capture (the length which 50% of the fish at size are vulnerable to capture) was estimated as 11.8 cm T.L cm this value is equivalent

to age 1 year. Both the estimated Lc and the observed length of fish capture indicated the growth and recruitment. Overfishing as the length at first sexual maturity was estimated as 14 cm T.L by (Samuel, 1986). In sight of these results, minimum size limit should be implemented for *Nemipterus Japonicus* in Golf of Suez water.

Per recruit analysis:

The current exploitation rate Ecur = 0.59 was higher than the required the maximum yield per recruit (Emax = 0.607) and also higher than the optimum exploitation rate (E_{50}=0.349) which maintain 50% of the stock biomass Figure (8). This indicates that *Nemipterus japonicus* in the Gulf of Suez are exposed to overexploitation, so that Ecur must be diminutive. These results confirm the results of Amal (2012) showing that Ecur must be reduced by about 28 %. Briekaa (1996) estimated the maximum sustainable yield and found that the fishing pressure extracted in the Gulf of Suez for Nemipterid catch must be reduced by about 44%.

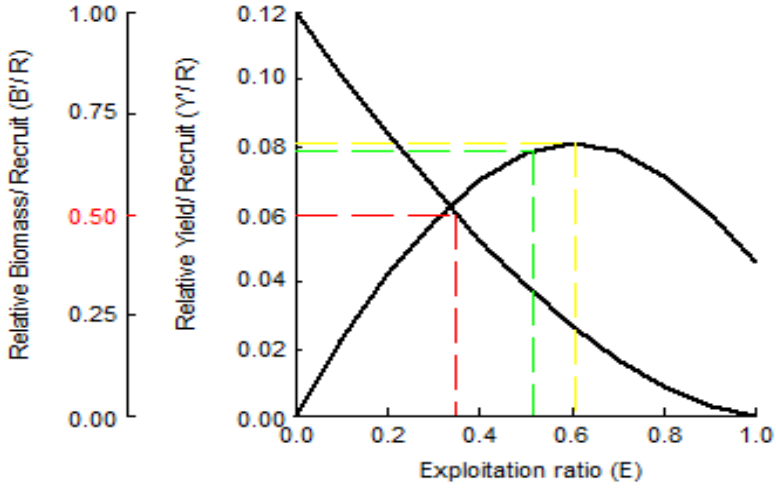

Figure 8. Relative yield per recruit analysis of *Nemipterus japonicus* from Gulf of Suez.

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ديناميكية العشائر لاسماك الصرع (*Nemiptrus Japonicus*) في خليج السويس، مصر

محمد جابر دسوقي ابراهيم

المعهد القومي لعلوم البحار والمصايد.

الملخص العربى

تتنوع مصادر صيد الاسماك في جمهورية مصر العربية الي العديد من المصادر منها مصادر البحار (البحر المتوسط – البحر الاحمر)، مصايد داخلية (نهر النيل وفروعة البحيرات) والاستزراع السمكي. وتعتبر اسماك الصرع واحد من اهم الاسماك الاقتصادية في مصر وخليج السويس والتي يتم صيدها بحرفة الجر. ويهدف البحث الي دراسة ديناميكية العشار السمكية لهذا النوع من الاسماك للحفاظ علي انتاجة وزيادة المخزون السمكي له، عن طريق تحليل البيانات لعدد 681 عينة من اسماك الصرع المصادة من خليج السويس من ميناء الاتكة خلال الفترة من يناير الي ديسمبر 2016 م تبين ان هذا النوع من الاسماك يصل عمره الي خمس سنوات في المياه الاقلمية المصرية وكان اقصي طول نظري له $L\infty = 27.3$ ومعدل اداء النمو $\phi = 2.44$ وتم حساب معدلات النفوق وكان النفوق الكلي ($Z= 1.38$ y^{-1})، والنفوق الطبيعي ($M= 0.57y^{-1}$) والنفوق عن طريق الصيد ($F= 0.18y^{-1}$) وبناءاً عليه كان معدل الاستغلال ($E= 0.59$) مما يدل ان هناك صيد جائر في منطقة خليج السويس لهذا النوع من الاسماك لذا نحتاج الي تنظيم جهد الصيد وتخفيض عدد مراكب الصيد او عدد مرات السروحات حتي نصل الي الانتاج الاقصي المستدام لاسماك الصرع.