An overview on the fisheries population of Arabian scad, *Trachurus indicus* Nekrasov, 1966 (F: Carangidae) caught by two different fishing methods from the Gulf of Suez, Red Sea, Egypt.

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ABSTRACT

Trachurus indicus is a semi pelagic species caught by the bottom trawl and purse seine gears adopted in the Gulf of Suez, Red Sea. The objective of this study was to demonstrate and compare the fish size, length frequency, ages and length-at-age of *T. indicus* in the two fishing gears. The average *T. indicus* catch percentage constituted about 20% of the total trawl catch during the period from Sep. 2010 to Nov. 2011, while it formed about 50% of the total purse seine catch. The lengths and age compositions of *T. indicus* were varied between sexes in the two gears. Length ranged from 10.0±0.85cm to 26.5±1.82cm in the trawl fishery; however it ranged from 6.5±0.66 to 22.0±1.45 cm in the purse seine fishery. The maximum life span of *T. indicus* was estimated at 5 and 7 years in purse seine and trawl respectively. The growth parameters were evaluated as K= 0.37/year, L_∞ 23.9 cm and K= 0.39/year and L_∞ = 22.6 cm for males and females respectively in purse seine gear. While, in the trawl gear K= 0.42/year, L_∞ 24.6 cm and K=0.34/year, L_∞= 27.9 cm for males and females respectively. Also, the instantaneous total, natural and fishing mortality rates were investigated in the two gears. Results indicated that, *T. indicus* is exactly different in length composition, age composition and mortality rates in the two fishing gears under study. As *T. indicus* is the most abundant commercial species in the Gulf, its production was exploited mainly by the two gears and the exploitation rates were approximately the same over 0.7.

Keywords: *Trachurus indicus,* Gulf of Suez, Red Sea, trawl and purse seine, fishery characteristics, exploitation rate

INTRODUCTION

Trachurus indicus is a member of family carangidae that called jacks, trevallies or scads; they are widely distributed along tropical and subtropical marine water of the world (Western Indian Ocean: Pakistan and the Persian Gulf to the Gulf of Suez and southward to Somalia) and some could occur in temperate regions. Arabian scads are among the most economically important pelagic and demersal fisheries of the world (Laroche *et al*. 1984 and Baranes & Golani, 1993). It is a migrant species via the Suez Canal, it is recorded for the first time in the Mediterranean Sea, Turkey coast in 2004 (Dalyan and Eryilmaz, 2009). In the Gulf of Suez Scads are represented by three different species: *Trachurus indicus, Decaperus russelli* and *Decapterus macrosoma*. *T. indicusis* is the most common, abundant and distributed in the Gulf of Suez; it is mainly exploited by the trawl and purse seine fishing gears and constitute (20%) and (50%) of their total catch respectively. It is a schooling semi-pelagic species, marine reef associated and it most commonly found at about 20-100 m depth with maximum length of 35.0 cm (Smith, 1984 and Sommer *et al.* 1996). Arabian scads are generally described as fast-swimming carnivores and pursuit predators, they have a vertical diel migration, feed mainly on a variety of zooplankton, pelagic

crustaceans and small fish (Shiota, 1986; Souza, 1988 and Dalzell, 1992). It has a special distribution concern its feeding pattern (Hobson, 1974 and Thomas, 2005). The biological characteristics and the stock dynamics evaluation of *T. indicus* in the Gulf of Suez were subjected by many authors (Sanders and Kedidi, 1984; Sanders & Morgan, 1989 and Tharwat, 1990; Mehanna, 1999), besides Mehanna *et al.* (2013) in Omani waters, Govender (1994) in South Africa and Welch *et al*. (2002) in Australia.

Until now, no studies have done to compare the fisheries stock of the Arabian scads caught by trawl and purse seine fishing methods in the Gulf of Suez. So, the goal of the present investigation is to provide an insight study to the population characteristics of Arabian scads caught by two industrial fishing methods and give reasons in why and how this is the only species caught by two types of fishing methods in a reasonable ratio.

MATERIALS AND METHODS

Samples of *Trachurus indicus* were collected monthly from the commercial purse seiner and trawler fishing harbors adopted in the Gulf of Suez. Specimens were taken randomly during the period from September 2010 to November 2011. The Gulf of Suez fishery is seasonal, generally starts from September throughout the end of April every year. Samples were brought to the laboratory and data on total length, weight and sex were obtained. The total annual catch statistics of purse seines and trawls within the annual catch of *T. indicus* were collected from GAFRD from the fishing seasons 2000/2001 to 2013/2014 to follow the catch fluctuation and catch trend. Otoliths were removed, cleaned and kept in special vials for using in age determination. Later, they were examined under a stereo microscope with transmitted light to reflect the otolith rings. The Von-Bertalanffy growth model (1938), $L_t=L\infty\ (1-e^{-K[t-t_0]})$ was used to describe the fish growth in length, where L_t is the length at age t, $L\infty$ the asymptotic length, K the growth coefficient and t_0 is the hypothetical age at which a fish would have zero length. The values of $L\infty$ and K were estimated by applying the Ford (1933), Walford (1946) method. T_0 was computed by the rearranged of the Von-Bertalanffy equation: $-\ln \{1- (l_t/L\infty)\}= - Kt_o + Kt$, this a straight line equation relating the age (t) and $\{-\ln(1-(L_t/L\infty)\}$having a slope (a) and intercept (b) then $t_o= -a/b$. The growth performance of the different stocks was compared using (Ø) index according to Pauly and Munro (1984) as $Ø = \text{Log } K + 2\text{Log } L\infty$. The instantaneous total mortality rate (Z) was investigated by analysis of the catch curve method of Pauly (1983) and Ricker (1975), using the age composition data. The instantaneous natural mortality rate (M) was calculated according to Hewitt & Hoenig, (2005): $M = 2.996/t_{max}$, where t_{max} is the maximum age observed in the stocks. The instantaneous rate of fishing mortality (F) was extracted as F = Z-M. However the rate of exploitation (E) was done using the equation of Beverton &Holt (1957) and Ricker (1975): $E = F\ (1-e^{-(F+M))}/F+M$.

Statistical analysis

Differences were tested for significance using t-test, analysis of variance (ANOVA in SPSS), and test at the $p<0:05$ levels. Data were given as means ± standard deviation.

RESULTS AND DISCUSSION

1- Fishery Description

The purse seine and the trawl fisheries in the Gulf of Suez are operating seasonally; trawl starts in the first of September, while the purse seine starts in the first of October and they are close at the end of April. Table (1) summarizes the fishery characteristics and the fishing effort of the trawl and purse seine operating in the Gulf. The most important fishing effort adopted were the number of shots, time per each shot, net length, horse power and net depth in case of purse seine net.

Table 1: Fishery description of Trawl and Purse seine fishery adopted in the Gulf of Suez

Items	Trawl fishery	Purse seine fisher
No. of fishing boats	79	84
Fishing trip	5 to 10 days	10 days/month
No. of crew	10 to 15 person	25 to 30 persons
vessel length	20 -30 m	20 - 25 m
HP	400- 600 hp	400 - 600 hp
Fishing time	day and night	in full moon
No. of shots/day	around 10	4 to 6
Time of each shots	1 - 2 h	1 - 2 h
Net length	40 m	300- 500 m
Net depth	1 - 2 m	up to 100 m
Vessels equiped	nets are hauld by winches	nets are hauld manually

- No. : numbers HP: horse power

Awadallah (1983), Sanders & Kadidi (1984), Sanders, *et al*. (1984) and El-Ganainy (1992). studied the fishery description of the two fishing methods in the Gulf of Suez and reported that the purse seiner is powered by 200 h.p., number of shots are around 2-3 shots/day, the duration of each shot is around 2-3 hours and the net length 200-300 m with depth around from 50 to 80 m. However, the trawler was powered by 200-250 h.p., the net length 25 m, shots were around 7 shot/day with duration of 3 hours. Nowadays, Mehanna &El-Gammal (2007), El-Sherbeny (2009) and Abd-El-Mawla (2014) concluded that the horse power was raised, the number of shots/day was increased, the shot duration became shorter, the trawl net length has increased. The purse seiner net depth became up to 100 m caused a fishing impact on the water column species. It is clear that the recorded current fishing effort performs a higher load and high pressure on the fishery ground.

The total and *T. indicus* annual landings were observed for the trawl and purse seine during the fishing period from 2000/ 2001 to 2013/2014. Figures (1) and (2) showed the annual total and *T. indicus* catches trend for trawler and purse seiner respectively. The annual total trawler catch fluctuated between the maximum value of 18422 ton during 2004/ 2005 and minimum value of 2460 ton in 2013/2014 with a mean of 4710 ton. The Arabian scad catch fluctuated from maximum 8111 ton in 2004/ 2005 and minimum 196 ton in 2002/2003 with an average of 971 ton. *T. indicus* catch was represented by 20% of the total trawl landing. The annual total purse seine

catch fluctuated between a maximum of 15082 ton during the fishing season 2000/2001 to minimum of 2846 ton in 2010/2011 and the Arabian scad catch trend varied between maximum of 9785 ton in 2001/2002 and minimum of 1141 ton in 2008/2009. The Arabian scad was represented by 51% of the total purse seine landings. This indicated that *T. indicus* is of major importance in the pelagic and demersal fisheries in the Gulf of Suez. It is observed that the annual total and scads catches showed marked variation from year to year. These may be contributed to the variation in the environmental condition as the most of pelagic and the semi pelagic species are correlated to the climatic changes and to the species interaction (Nakken, 1994; Niermann, *et al.*, 1999; and Gubanov & Serobaba, 2005), as well as the economic factors which represented by the increasing of the fishing effort.

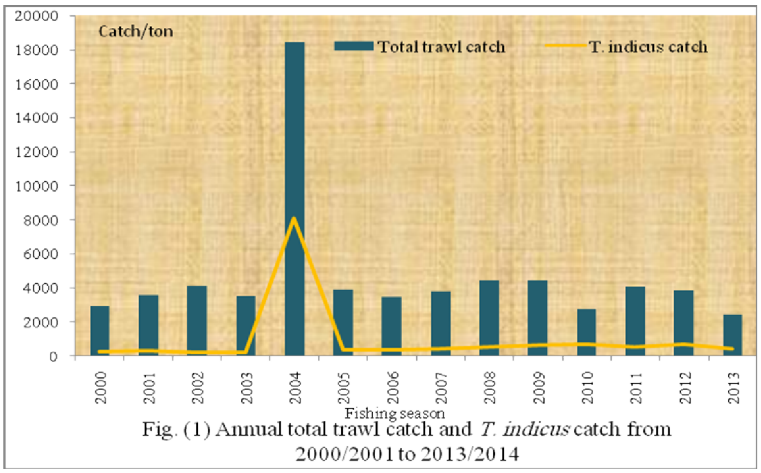

Fig. (1) Annual total trawl catch and *T. indicus* catch from 2000/2001 to 2013/2014

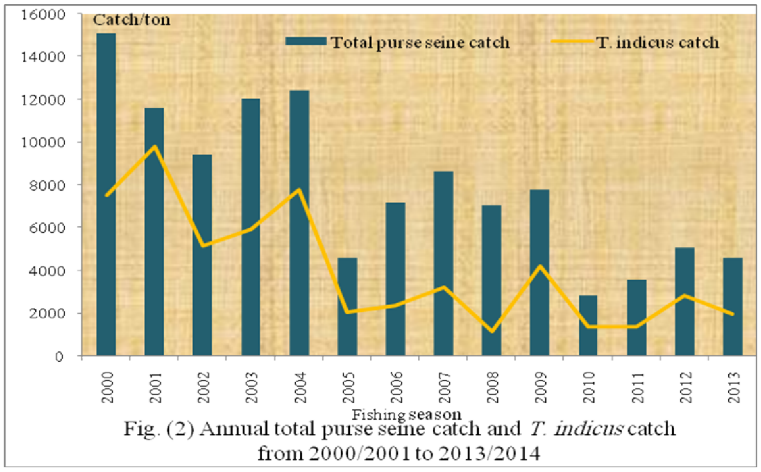

Fig. (2) Annual total purse seine catch and *T. indicus* catch from 2000/2001 to 2013/2014

2- Length composition

Table (2) clarifies the minimum, maximum and mean lengths with the stander deviation for males and females in each fishing method. Data analysis revealed that there was difference in length ranges between the two fishing methods; fishes from purse seiner are smaller in length than that in trawler. Also, there was difference in length range between males and females in each method. Statistical analysis of lengths using t-test assumed that the two sexes are identical with no statistical significant difference (t-test, $P > 0.05 = 0.21$) in each fishing method. According to the fishing methods, there was significant differences between sexes (t-test, $P < 0.05 = 0.009$). It was noticed that the sex ratio are approximately tend to be 1:1 in the two fisheries. Sanders & Kadidi (1984); El-Gammal, *et al*. (1995) and Mehanna (1999)

studied the purse seine *T. indicus* from the Gulf of Suez and recorded the differences in length range between males and females. Mehanna (2013) studied the size distribution of the trawl *T. indicus* from Oman Sea and reported, there were differences in size between male and females and the largest specimen observed was female.

Table 2: Descriptive analysis of *T. indicus* caught by two different fishing gears during 2010/2011

Parameters	Trawl fishery *T. indicus*		Purse seine fishery *T. indicus*	
	Males	Females	Males	Females
Min. Length (cm)	10.5	10.0	7.5	6.5
Max. length (cm)	23.5	26.5	22.0	20.0
Mean length (cm)	16.5	17.8	14.3	13.5
Stander Deviation.	2.8	2.7	2.1	3.1
Stander Error.	0.41	0.31	0.09	0.37
Sample Variance	7.2	7.7	4.4	9.7
No.	468	438	524	555

The length frequency distribution of *T. indicus* from the two fishing methods is based on the total length, that given in (Figures 3: a & b). Samples of 1079 were representative the length frequency of purse seine fishery (524 male and 555 female) and 905 samples for the trawl fishery (468 male and 438 female).

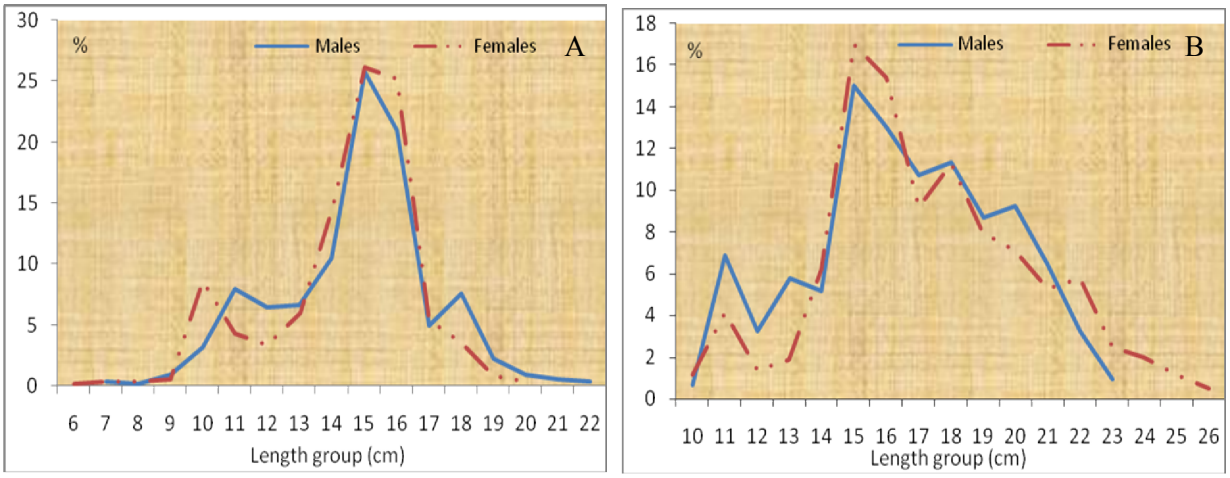

Fig. (3:A&B): Length frequency distributions of purse seine and trawl *T. indicus* from the Gulf of Suez

In purse seine fishery the largest percentage of male constituted (25.8%) and that for female (26.0%) was within the length classes of 15 cm. The highest percentages of trawl fishery male and female lengths were observed within the length class 15.0 cm by 15 % and 17% respectively. It can be concluded that the length class 15.0-15.9 cm is the more vulnerable length to the stock; it is represented the 2nd age group in the two fishing types. Generally, according to the length frequency distribution the majority of the caught scads were ≤16.0 cm long; this implies that the small individuals are targeted to the fishery and the stock would be seriously.

Age determination and growth in length

Otoliths were used for age determination of the trawl and purse seine *Trachurus indicus* from the Gulf of Suez. Otoliths readings were separated into males, females and pooled data. The estimated lengths at ages and their correspondent increments were calculated and represented in Tables (3&4) for purse seine and trawl respectively. The analyzed data for the purse seine fishery revealed that the maximum life span of males and combined sexes were five years, while that for female was four years.

Table 3: Lengths (cm) at ages for males, females and total samples of purse seine *T. indicus* from the Gulf of Suez

	Age groups (Y)					
Sexes	I	II	III	IV	V	Total No.
Males						
Lengths±SD	11±0.95	14.9±1.21	18±1.45	19.5±2.05	21±2.21	
Increment	11.0	3.9	3.1	1.5	1.3	
No.	112	244	88	64	16	524
Females						
Lengths±SD	11.3±1.1	15±1.5	17.3±1.85	19.1±2.24		
Increment	11.3	3.7	2.3	1.8		
No.	118	298	127	12		555
Total sample						
Lengths±SD	11.1± 1.06	15.7±1.72	17.8±1.68	19.6±2.15	20.9±2.65	
Growth increment	11.1	4.6	2.1	1.8	1.3	
No.	230	542	215	76	16	1079

Table 4: Lengths (cm) at ages (year) for males, females and total samples of trawl *T. indicus* from the Gulf of Suez

	Age groups (Y)							
Sexes	I	II	III	IV	V	VI	VII	Total No.
Males								
Lengths±SD	11.2± 0.75	15.8±1.25	18.9±1.82	20.9±1.66	22±2.24	23±1.93		
Increment	11.2	4.6	3.1	2	1.1	1		
No.	80	196	110	62	14	6		468
Females								
Lengths±SD	11±1.13	15.7±1.54	18.8±1.96	21.4±1.88	23.3±2.35	24.5±1.22	25.4±1.1	
Increment	11.0	4.7	3.1	2.6	1.9	1.2	0.9	
No.	49	210	90	50	32	4	3	438
Total sample								
Lengths±SD	11±1.05	16±2.28	19±1.98	21.5±2.0	23.5±2.42	24.6±2.47	25.4±1.1	
Growth increment	11.0	5.0	3.0	2.5	2	1.1	0.8	
No.	126	406	200	115	46	10	3	906

In respect to the trawl fishery the life span was recorded as six and seven years for males, females and combined data. Results indicated that males, female and pooled data in both of the two methods attain their highest growth rate during the first year of life and then a gradual decrease in growth increment was observed as the fish getting older. It is noticed that males in purse seiner were larger in length and age than females, while in the trawl fishery female gets larger in length and age than the male. El-Gammal *et al*. (1995) and Mehanna (1999) studied the growth in length of the

purse seine *T indicus* and they reported that the life span of males were older than that of females; males 4 years and females 3 years in El-Gammal *et al*. (1995), while in Mehanna (1999) males and females attain 5 and 4 years respectively. According to the present study the trawl fishery differed from the previous studies as males are smaller than females and attain 6 years while females attain 7 years.

4- Growth parameters and growth performance

The growth parameters ($L\infty$, K and t_o) of the von Bertalanffy growth equation were estimated for male, female and combined sexes in both trawl and purse seine fisheries as given in Table (5). The obtained results showed that the annual growth rate K/y and (t_o) were nearly at the same range in the trawl and purse seine. $L\infty$ of females were different in the two fishing methods. This may attributed to the large size of *T. indicus* which are closer to the bottom in aggregated shoals during the day (Hobson, 1974; Sommer, *et.al.,* 1996 and Gulle *et al.,* 2010). The growth performance (Ø) was used to compare different fish stocks. The growth performances of *T. indicus* were within the recommended ranges (2-3) for fish growth in the two fishing methods.

Table 5: Growth parameters of trawl and purse seine *T. indicus* from the Gulf of Suez

Parameters	Trawl fishery T. indicus			Purse seine fishery T. indicus		
	Males	Females	Pooled	Males	Females	Pooled
$L\infty$ (cm)	24.6	27.9	27.4	23.9	22.6	23.9
K/y	0.42	0.34	0.35	0.37	0.34	0.36
t_o year	-0.42	-0.52	-0.502	-0.49	-0.45	-0.507
ø	2.41	2.42	2.42	2.32	2.24	2.31

5- Mortality and the rate of exploitation

The annual total mortality (Z) of *T. indicus* caught by the trawl fishery. (Fig.4) was computed as 1.49±0.067/year (CI: 1.33-1.65 and r^2=0.98). Natural (M) and fishing (F) mortalities were calculated as 0.37/year and 1.12/year respectively.

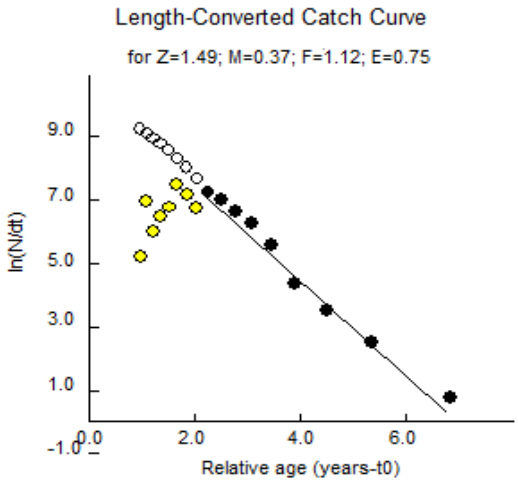

Fig. 4: Estimated total mortality rate for the trawl *T. indicus* from the Gulf of Suez using catch curve

The exploitation ratio (E) was estimated at 0.75. In respect to the mortality rates of *T. indicus* from the purse seine fishery (Fig.5), Z, M and F were estimated to be 1.35±0.134/year with (CI: 1.0-1.69 and r^2= 0.95), 0.38/y and 0.97/y respectively. The exploitation rate was recorded as 0.72.

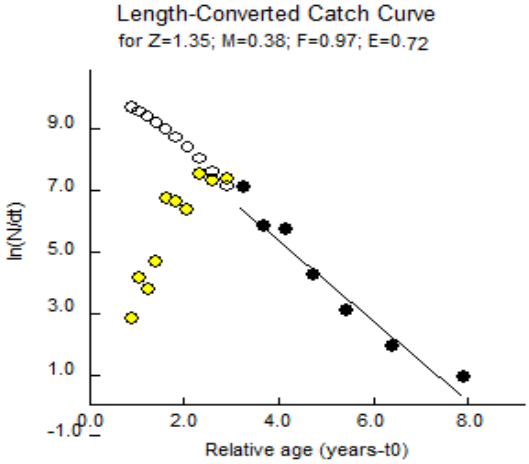

Fig. 5: Estimated total mortality rate for the seiner *T. indicus* from the Gulf of Suez using catch curve

Results indicated that F> 65% >M and E > 0.70 in both fishing methods and according to Gulland (1971) the maximum catch production is obtained at F = M and E is 0.50. Higher fishing mortality versus the natural mortality observed for *T. indicus* in the present study indicates the unbalance position of the stock. Accordingly, the Arabian scads caught by the two different methods from the Gulf of Suez are fully exploited and exposed to high fishing pressures, as a result of increasing in fishing efforts; whereas *T. indicus* is caught and exploited by the demersal and pelagic fisheries.

Table (6) summarized the previous studies on growth, mortality and exploitation level of trawling and seining *T. indicus* from the Gulf of Suez. Most of the previous works are in agreement with the present study and if there were any difference, it could be attributed to the difference in environmental conditions and to difference in length range or to the longevity of the species.

General conclusion

1- T. indicus is a semi pelagic species, has a vertical diel migration, feed mainly on zooplankton. Juveniles stock is in the mid water and adults are closer to the bottom in aggregated shoals during the day. At night, the small sizes of *T. indicus* are occasionally targeted in the sea surface and the shoals of large sizes lift from the bottom in the evening and descend up in the water column and become more dispersed at water surface. This is probably a reaction to feeding pattern and predator avoidance, as it is well known that zooplankton population features, is of vertical distribution (Dorak *et al.,* 2013), aggregated and collected at the water surface on the light of the purse seiner. Scads age, length and length-at-age in trawl catch were all significantly higher than observed in purse-seine catch, indicating that purse seine selects younger and smaller fish.

2- The investigated results indicated that the Arabian scad stocks from the trawl and purse seine are considered to be one stock, whereas:

- The growth rate (K), the natural mortality rate and the growth performance are approximately in the same range for the two fishing methods.

- The stocks are heavily exploited by the industrial trawling and seining fishery by over 0.7.

Table 6: Growth parameters, mortality and exploitation level of trawling and seining *T. indicus* from the Gulf of Suez conducted by previous studies.

Source	region	Net type	Sex	obser. Length (cm)	L∞ (cm)	K/y	t_o/y	Z/y	M/y	F/y	E
Sanders & Kedidi, 1984	Gulf of Suez	Purse seine	Combined	23.0	24.2	0.19	-1.82	1.96	0.85	1.11	**0.57**
Sanders *et al.*, 1984	Gulf of Suez	**Trawl**	Combined	25.0	**26.8**	0.14	-2.45	1.9	0.70	1.2	**0.63**
Tharwat, 1990	Gulf of Suez	Purse seine	M	17.5	20.3	0.29	-1.65				
			F	16.5	19.1	0.36	-1.41				
			compined		19.8	0.31	-1.58				
Mehana, 1999	Gulf of Suez	Purse seine	M	22.5	24.5	0.41	-0.35	1.024	0.34	0.68	0.67
			F	20.7	22.3	0.56	-0.19	1.144	0.35	0.79	0.69
			Compined		23.8	0.5	-0.20	1.25	0.36	0.89	0.71
Present work	Gulf of Suez	Purse seine	M	22.6	23.9	0.37	-0.49				
			F	20.4	22.6	0.39	-0.45				
			Combined		23.9	0.36	-0.51	1.35	0.38	0.97	**0.72**
		Trawl	M	23.5	24.6	0.42	-0.42				
			F	26.2	27.9	0.34	-0.52				
			Combined		**27.4**	0.35	-0.50	1.49	0.37	1.12	**0.75**

RECOMMENDATION

To attain the sustainability and stock balance of the Arabian scads inhibiting the Suez Gulf it should be:

1- Decreasing the fishing effort (no. of fishing days, no. of shots, the time of each shot) or increasing the closed season period.

2- Increasing the mesh size of the purse seine and the trawl net cod end.

3- Preventing the catch of the under size fish to maintain a sufficient spawning stock biomass for recruitment.

REFERENCES

Abdel-Mawla, M. S. (2014). Efficiency and selectivity of trawl net, its design characters and effect on demersal fish population at the Gulf of Suez. M.Sc. Thesis, Fac. Sci. Suez, University, Egypt, 150pp.

Awadallah, M. W. (1983). An incomes and costs study of the Egyptian trawl fishery operated in the Gulf of Suez and off the Red Sea coast during 1980/81. UNDP/FAO. RAB/ 81/002/4:37pp.

Baranes, A. and Golani, D. (1993). An annotated list of the deep-sea fishes collected in the northern Red Sea, Gulf of Aqaba. Isr.l J. Zool., 39:299-336.

Bertalanffy, L.von (1938). A quantitative theory of organic growth (Inquiries on growth laws.2). Hum. Biol., 10: 181-213.

Beverton, R.J.H. and Holt, S.J. (1957). On the Dynamics of Exploited Fish Population. U.K.Min.Agr.Food,Fish.Invest.19, 533pp.

Dalzell, P.J. (1992). Small Pelagic Fishes, Chapter 5. FFA Report 92/54, Pacific Islands Forum Fisheries Agency. http://www.ffa.in

Dalyan, C. and Eryilmaz, L. (2009). The Arabian scad *Trachurus indicus*, a new Indo-Pacific species in the Mediterranean Sea. J. Fish. Biol., 74 (7): 1615-1619

Dorak, Z.; Gaygusuz, O.; Tarkan, A. L. and Aydin, H. (2013). Diurnal vertical distribution of zooplankton in a newly formed reservoir (Tahtalı Reservoir, Kocaeli): the role of abiotic factors and chlorophylla. Turk J Zool., 37: 218-227

El-Gammal, R I.; Bebars, M. I. and Tharwat, A. A (1995). Age, growth and mortality of horse mackerel, Trachurus indicus from the Gulf of Suez. J. Appl. Sci., 10 (3): 420-430.

El-Ganainy, A. A. (1992). Biological studies on lizard fishes, Saurida undosquamis (Pisces: Synodontidea) from the Gulf of Suez. M. Sc. Thesis, Fac. Sci. Ain Shams University, Egypt, 330pp.

El-Sherbeny, A. S. H. (2009). Population dynamics and fisheries management of cuttlefish in the Gulf of Suez, Red Sea .M. Sc. Thesis, Mar. Biol. Dep., Fac. Sci., Suez Canal Univ., Ismailia, Egypt, 175pp.

Ford, E. (1933). An account of the herring investigations conducted at Plymouth during the years from 1924 to 1933. J. mar 146oil. Ass. U. K, 19 : 305-384,

GAFRD, (2013). Annual statistical report of the General Authority for Fish Resources Development, Egypt.

Govender, S. (1994). *Interculturalism and South African Indian Fusion Dance* scnc.ukzn.ac.za/doc/ARTS/dance/SURIA.htm

Gubanov, E.P. and Serobaba, I.I. (2005). The state of the ecosystem and rational utilization of living resources in the Azov-Black Sea basin. Rybnoe khozyaistvo Ukrainy, 1: 8-12

Gulland, J. A. (1971). The Fish Resources of the Ocean. West By fleet, Surrey, Fishing News Books, Ltd., for FAO, 255 pp.

Gülle, I; Turna, I.I.; Serkan, S. G. Gülle, P. and Güçlü, Z (2010). Zooplankton seasonal abundance and vertical distribution of highly alkaline Lake Burdur, Turkey. Turkish, J. Fish. Aqua. Sc., 10: 245-254

Hewitt, D. A. and Hoenig, J. M. (2005). Comparison of two approaches for estimating natural mortality based on longevity. Fishery Bulletin, 103(2): 433-437

Hobson, E. S. (1974). Feeding relationships of teleostean fishes on coral refs in Kona, Hawaii. Fish. Bull. 72(4): 915-1031.

Laroche, W.A.; Smith-Vaniz, W.F. and Richardson, S.L. (1984). Carangidae development. In: H.G. Moser et al. (Eds.), Ontogeny and Systematics of Fishes. Spec. Publ. No. 1, American Society of Ichthyolists and Herpetologists: pp.510-522.

Mehanna, S. F. (1999). Stock assessment of the horse mackerel *Trachurus indicus* in the Gulf of Suez, Egypt. Indian J. of Fisheries, 46 (4): 327-335.

Mehanna, S. F. and El-Gammal, F. I. (2007). Gulf of Suez Fisheries: Current status, assessment and management. JKAU: Mar. Sci., 18: 3-18.

Mehanna, S. F.; Al-Mamry, D. and Al-Bulush, N. (2013). Biological study, distribution and biomass of the Arabian scad Trachurus indicus (Nekarsov, 1966). In the Arabian Sea Coast of Oman. International Con. On" Oceanography & Sustainable Marine Production: A Challenge of Managing

Marine Resources under Climate Change, ICOSMaP", Kuantan- Malaysia, 28-30 October 2013.

Nakken, O. (1994). Causes of trends and fluctuations in the Arcto-Norwegian cod stock. ICES mar. Sci. Synlp., 198: 212-228.

Niermann, U., Kideys, A.E.; Kovalev, A.V.; Melnikov, V. and Belokopytov, V. (1999). Fluctiation of pelagic species of the open Black Sea during 1980-1995 and possible teleconnections. Environmental degradation of the Black Sea: challenges and remedies. –Kluwer Academic Publisher, Dordrecht: pp 147-173.

Pauly, D. (1983). Some Simple Methods for the assessment of Tropical Fish Stocks. FAO Fisheries Technical Paper 234, Food and agriculture organization of the United Nations, Rome, 52 pp.

Pauly, D. and Munro, J. L. (1984). Once More on the Comparison of Growth in Fish and Invertebrates. Fishbyte, (2) 21 pp.

Ricker, W. E. (1975). Computation and interpretation of biological statistics of fish population. Bull. Fish. Res. Bd. Can., 191:382pp.

Sanders, M.J. and Kedidi, S.M. (1984). Stock assessment for the horse mackerel (*Trachurus indicus*) caught by purse seine and trawl in the Gulf of Suez. Project for the Develpoment of Fisheries in the areas of the Red Sea and Gulf of Aden, FAO/UNDP RAB/81/002/20. Cairo. 47 pp.

Sanders, M.J.; Kedidi, S.M. and Hegazy, M.R. (1984). Stock assessment for the horse mackerel trachurus indicus caught by purse seine and trawl in the Gulf of Suez. FAO, Tech. Report 47pp. http://afrilib.odinafrica.org/handle/0/15857

Sanders, M.J. and Morgan, G.R. (1989). Review of the fisheries resources of the Red Sea and Gulf of Aden. FAO Fish. Tech. Rep. (304):138 pp.

Smith-Vaniz, W.F. (1984). Carangidae. In W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean fishing area 51. Vol. 1. [pag. Var.]. FAO, Rome.

Shiota, P. M. (1986). Carangidae. In Fishery Atlas of the Northwest Hawaiian Islands. (R. Uchida and J. Uchiyama, eds.). National Marine Fisheries Service Technical Report 38. Pp. 98-99. United States Department of Commerce, National Oceanographic Atmospheric Administration.

Sommer, C.; Schneider, W. and Poutiers, J. M. (1996). FAO species identification field guide for fishery purposes. The living marine resources of Somalia. FAO, Rome. 376 pp.

Souza, M. I. (1988). Sources of bias in growth and mortality estimation of migratory pelagic fish stocks, with emphasis on Decapterus russelli (Carangidae) in Mozambique. In, Contributions to tropical fisheries biology. (S. C. Venema, J. M. Christensen and D. Pauly, eds.). Fisheries Report 389, 288-307. Food and Agricultural Organisation. Rome, Italy.

Tharwat, A. A. (1990). Physiological and biological studies on fish. MSc, thesis, Cairo Univ., Fac. Agri.

Thomas, A. (2005). Pelagic Fish Distribution and Dynamics in Coastal Areas in the Baltic Sea Proper. Department of Systems Ecology Stockholm University S-106 91 Stockholm Sweden. thomas@ecology.su.se

Welch, A.A.; Lund, E.; Amiano, P.; Dorronsoro, M.; Brustad, M. and Kumle, M. (2002). Variability of fish consumption within the 10 European countries participating in the European Investigation into Cancer and Nutrition (EPIC) study. Public. Health. Nutr., 5(6B): 1273–1285

Walford, L.A. (1946). A new graphic method of describing the growth of animals. Biol. Bull. Mar Biol. Lab., Woods Hole, 90(2): 141-147.

ARABIC SUMMARY

رؤية دراسية على مصايد تجمعات اسماك الجاك العربى "تيراكورس انديكس" نكراسوف ١٩٦٦ (عائلة: كارانجيدى) المصادة بحرفتين صيد مختلفتين من خليج السويس- البحر الاحمر- مصر

د. منال مصطفى صبره
المعهد القومى لعلوم البحار و المصايد - السويس
قسم المصايد- معمل بيولوجيا المصايد

تعتبر اسماك الباغة من اهم الانواع الاقتصادية فى خليج السويس، فهى اسماك محببة للعامة لجودة مذاقها و لسعرها المناسب. تصاد اسماك الباغة من الخليج بحرفتى صيد مختلفتين، حرفة الجر و الشانشولا الليلية. تناولت هذه الدراسة تقييم الانتاج وتعيين معدلات النمو والعمر وحساب معدلات النفوق والاستغلال لأسماك الباغة (تريكورس انديكس) فى كل من الحرفتين. تم تجميع ٩٠٦عينة من حرفة الجر و ١٠٧٨ عينة من الشانشولا عن طريق المراكب التجارية العاملة فى خليج السويس فى الفترة من سبتمبر ٢٠١٠ الى نوفمبر ٢٠١١. وتراوحت اطوال الاسماك من حرفة الجر بين ١٠.٥ و ٢٦.٥ سم بينما تراوحت الاطوال فى الشانشولا بين ٧.٥ و ٢٢.٠ سم. تم قراءة عظام الاذن الوسطى لتحديد اعمار هذه الاسماك ووجد انه يوجد فرق في العمر بين الذكور والاناث فى كل حرفة صيد. وتم تسجيل اقصى عمر فى حرفة الجر ٧ و٦ سنوات للاناث و الذكور على التوالى. بينما تراوح العمر فى حرفة الشانشولا بين ٥ سنوات للذكور و ٤ سنوات للاناث، و اظهرت النتائج ان اسماك الباغة من الجر اكبر من اسماك الشانشولا حجما و عمرا. وتم تعيين معاملات النمو لنموذج فون برتلانفى لكل من الذكور والاناث والتى لم تختلف احصائيا بين الجنسين و فى كلا من الحرفتين وعليه تم استخدام معاملات النمو لجميع العينات مجتمعة فى حساب معاملات النفوق الكلى والطبيعى والناتج عن عملية الصيد لكل حرفة على حدى. كما تم حساب معدلات الاستغلال لهذه الأسماك فى كل من الحرفتين ٠.٧ < =E ووجد أنه أعلى من المعدل المثالى (E=٠.٥). و عليه فأن اسماك الباغة تتعرض لجهد صيد جائر بنسبة متساوية تقريبا فى كلا من الجر و الشانشولا. و للحصول على اعلى انتاجية مستمرة من هذه الاسماك يجب خفض معدل الاستغلال بتقليل جهد الصيد بنسبة لاتقل عن ٤٠% فى كل من الحرفتين مع تصغير ماجة الشباك و التحكم بها بحيث لا تستهدف الاسماك الصغيرة كما يجب منع الصيد فى مناطق التبويض و التحضين و زيادة فترات الغلق للمصيد للحفاظ على الامهات و اعطاء الفرصة للاجيال الجديدة حتى تنمو.