Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 24(2): 135 – 145 (2020)
www.ejabf.journals.ekb.eg

The influence of trammel net fishing on the Rabbit fish (*Siganus rivulatus*) stocks in Suez Gulf, Red Sea, Egypt.

Mahmoud A. Saber[1] and Ahmed G. A. Gewida[2,*]

1-National Institute of Oceanography and Fisheries, NIOF. PO Box 182 Suez, Egypt.
2-Department of Animal production, Faculty of Agriculture in Cairo, Al-Azhar University, Egypt.

[*]Corresponding Author: A.gewida@azhar.edu.eg

ARTICLE INFO
Article History:
Received: March 16, 2020
Accepted:March 24, 2020
Online: March 26, 2020

Keywords:
Trammel nets,
Rabbit fish
Mesh size,
Siganus rivulatus,
Gulf of Suez
Red Sea

ABSTRACT

Trammel nets are commonly used to sample Rabbit fish (*Siganus rivulatus*) in Suez Gulf, Red Sea, Egypt. The present work was carried out to study the effect of trammel net fishing on Rabbit fish (*Siganus* rivulatus) stocks in Suez Gulf. The total 566 individuals of *S. Revulatus* were sampled by trammel net during October 2018, January 2019 and September 2019. The total length and total weight (TL&TW) relationship equation was obtained to be $W = 0.0124\ L^{3.0097}$, and total length with total girth (TL&TG) relationship equation was assessed to be G = 0.587L+1.026. The life span was estimated as 3 years. The total, natural and fishing mortality coefficients were 1.76, 0.6 and 1.16/year, respectively. The exploitation rate was estimated as 0.66. The parameters of probability of capture ensured that (25%, 50 % and 75% of fish escaped by trammel net were estimated to be L_{50}= 15.59 cm while L_{25} = 14.79 cm and L_{75} = 16.42 cm. The results of the present study revealed that there is a marked effect of fishing on the Rabbit fish (*Siganus rivulatus)* stock in the Gulf of Suez, It is suggested that reducing the number of fishing trips and changing the gear characteristics (mesh size) to catch larger fish to maintain the stock productivity and its sustainability.

INTRODUCTION

Passive nets, trammel nets, gill nets and long-lines are the dominant fishing gears used in Suez Bay. In general, passive gears are selective for certain species and sizes of fish. Consequently, commercial fishers apply their knowledge of gear selectivity to enhance the efficiency of catching the targeted species at specific sizes (Hubert *et al.*, 2012; El-Ganainy *et al*., 2018 and Osman *et al.*, 2019).

The Siganidae have a worldwide distributed family in the Indo-West Pacific Ocean. The *Siganus rivulatus* is small to moderate in size and belong to family Siganidae. The species *Siganus rivulatus* is one of the major commercial Siganidae species of the world. They are of economic importance for the fishery production in several countries in the Indo Pacific and Middle East regions. Siganids occupy a wide range of habitats in the coastal waters of the Gulf of Suez Red Sea (El-Gammal 1988; El-Ganainy 2002; and Mehanna & Abdallah 2002). This species inhabits shallow sandy areas, lagoons, around rocks and coral reefs, mainly found in shallow water, usually less than 15 meters (Tharwat & Al-Owafeir 2003; Gabr and Mal 2016). This shallow depth should be predictable for species that is almost entirely herbivorous where algae are the more widespread at these depths. Fishes begin their life as a phytoplankton feeder on many small diatoms, then ingest zooplankton consisting of copepods species. There are 30 species recorded the world over, and are distributed in reefs among sea grasses, mangroves, and estuaries and also in shallow lagoons of tropical and subtropical coastal environments (Woodland 1999). This species found in both Mediterranean and Red Seas but most common and diverse in the Red Sea (El-Far, 2008 and Gabr & Mal 2016).

The length-weight relationship has number of important applications viz., in the fish stock assessment, in the estimation of biomass from the observed length, in estimation of the condition of the fish and for comparisons of life histories of certain species between regions (Goncalves *et al*., 1996; Froese & Pauly, 1998 and Odat, 2003). According to Le Cren (1951) the length-weight relationship (LWR) of fishes is calculated primarily to determine the mathematical relationship between the two variables, length and weight to measure the variation from the expected weight for length of individual fish or groups of fish as an indication of fatness. Mohammed (1991); El-Okda (1998); Bilecenoglu & Kaya (2002); Bariche (2005) and El-Far (2008) studied different biological aspects including age, growth, mortality and yield per recruit of this species in the Mediterranean.

However, there is still an urgent need to provide more information on life history of *S. Revulatus* and investigate the effect of fishing on population of the common species (*S. Revulatus*) family Siganidae in the Gulf of Suez.

MATERIALS AND METHODS

Fishing survey:

A total of 566 specimens of *S. Revulatus* (Figure 1) were randomly collected during October 2018, January 2019 and September 2019 from costal water of Gulf of Suez fisheries using trammel nets.

The experimental were carried out using a commercial vessel (length overall 7.5 m, engine power 40 hp) belonging to the small-scale fishery fleet of Suez Gulf. The most commonly used trammel nets in Suez Gulf fisheries are of the monofilament nylon (polyamide). Local fishermen usually use trammel nets of 34 mm inner-panel mesh size (stretched), and occasionally use trammel nets of 50 mesh in depth (Figure 2). The main dimensions of trammel net are described in Figure (3).

Figure (1): Siganidae (Rabbit fish) *Siganus rivulatus.*

Figure (2): Trammel net in Gulf of Suez fisheries.

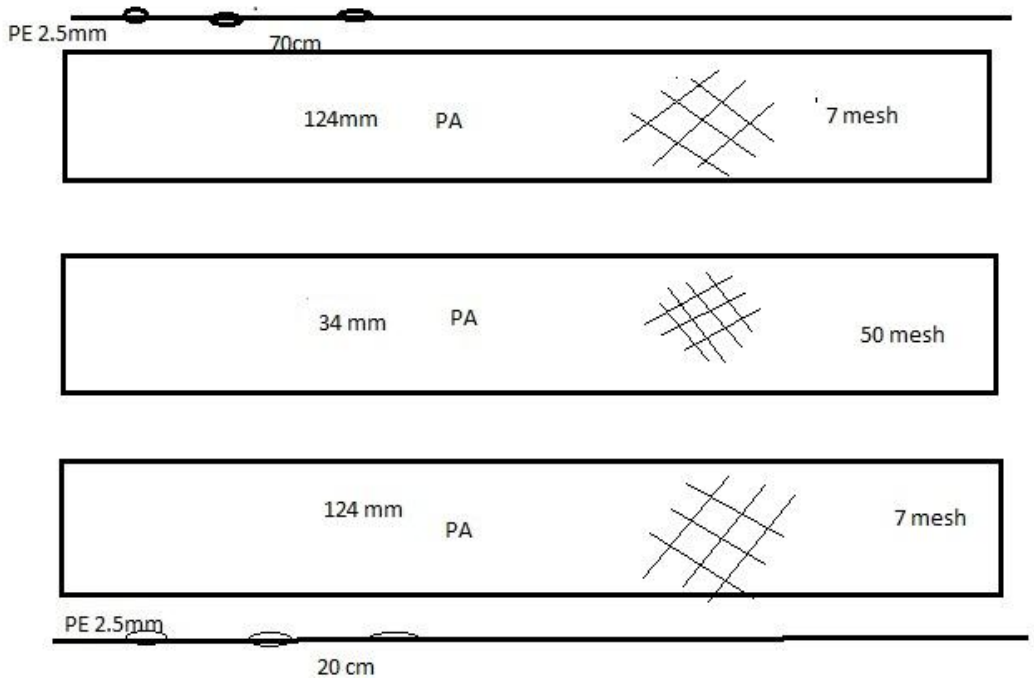

Figure (3): Specifications of trammel nets used in the Gulf of Suez.

Length weight relationships:

The relationship between total length (TL) and body weight (BW) of the fish was estimated by fitting the data to a potential relationship in the form of $W = a L^b$ (LeCren 1951, Benedict *et al*. 2009), where W is the BW of fish in grams, L is the TL of fish in centimeters, a is a constant or intercept, and b is the length exponent or slope. The linear equation: $G_{max}=c+d L$ was used to describe the length-girth relationship, where G is the girth in centimeters, c is the intercept and d is the slope of the regression analysis.

Growth parameters:

The von Bertalanffy growth model was applied to describe the theoretical growth of *Siganus rivulatus*. The constants of the von Bertalanffy model ($L\infty$ and K) were estimated by using Ford (1933)-Walford (1946) plot.

Selectivity parameters (L_{25}, L_{50} and L_{75}):

The length at first capture (Length at which 50% of the fish at that size are vulnerable to capture) was estimated by the analysis of catch curve using the method of Pauly (1984).

Mortalities:

The total mortality coefficient (Z) was estimated as the mean of two different methods; linearized catch curve method of Pauly (1983) and cumulative catch curve of Jones & van Zalinge (1981), which based on frequency data. While, the natural mortality coefficient (M) was calculated as the geometric mean of three different methods; Taylor (1960), Ursin (1967) and Pauly (1980). Accordingly, the fishing mortality coefficient (F) was estimated by subtracting the value of natural mortality (M) coefficient from the value of total mortality coefficient (Z) as $F = Z - M$

Exploitation ratio (E):

The exploitation ratio or expectation of death from fishing during some specified period when all causes of death are affecting the population (Everhart *et al.*, 1976) was calculated according to the relation $E = F / Z$ (Gulland, 1971).

RESULTS

Length weight and length girth relationships:

In the present study, the total length of *Siganus rivulatus* ranged between 10.5 to 23.1cm, and the total girth ranged between 7.1 to 14.1cm, while the total weights are varied between 9.5 to 162g. The obtained length weight relationship equation was $W = 0.0124\ L^{3.0097}$ (Figure 4), and length girth relationship equation (Figure 5) was $G = 0.587L+1.026$.

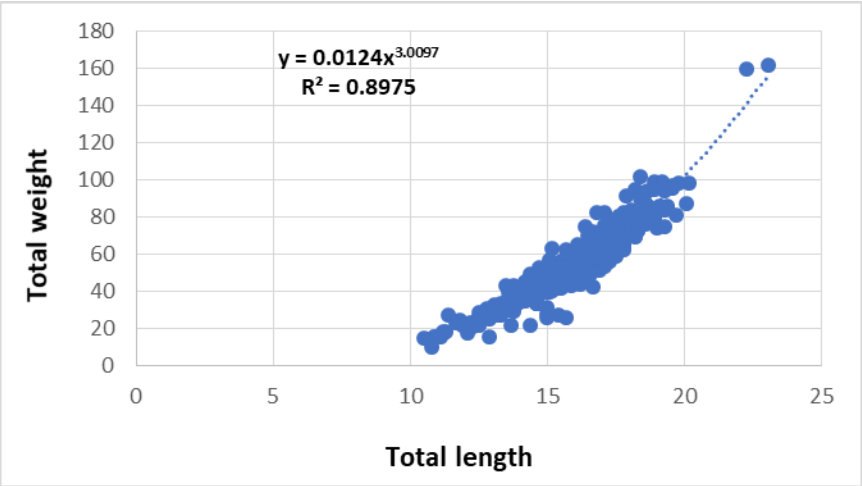

Figure (4): length weight relationships of *Siganus rivulatus* that catching by trammel net from the Gulf of Suez.

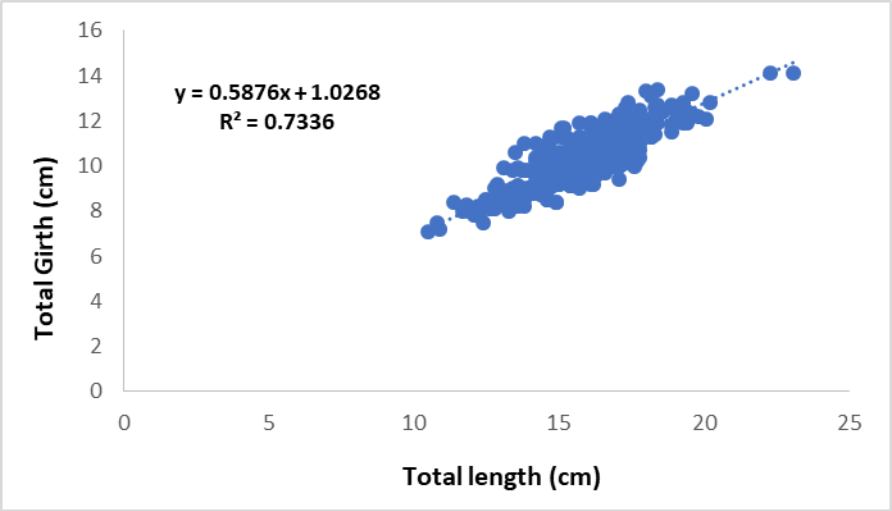

Figure (5): Length Girth relationships of *Siganus rivulatus* that catching by trammel net from the Gulf of Suez.

Age and Growth:

The results showed that, *Siganus rivulatus* in the Gulf of Suez attains 3 age groups and the age group two is the most frequent group forming up to 144.16 % of the total catch. The percentage occurrences of different age groups of this species are 31.84, 144.16, 29.43, I, II and III groups, respectively (Table.1). The resulting of the von Bertalanffy growth function (VBGF) parameters were $L\infty$= 28.31 cm, K= 0.226 year^{-1} and t_o= -0.321.

Table (1): Observed ageing of *Siganus rivulatus* collected from the Gulf of Suez using trammel net.

Mean age group (cm)	S.D.	Population	S.I.
12.96	1.10	31.84	-
16.07	1. 45	144.16	2.12
18.55	0.96	29.23	2.07

Selectivity parameters:

Probability of capture or length-at-first-capture (length at which 50% of *Siganus rivulatus* entering the gear are retained and Symbolized as L_c or L_{50}). The Probability of capture by length class of *Siganus rivulatus* estimated from the ascending arm of the catch curve (Figure 6) was L_{50}= 15.59 cm while L_{25} = 14.79 cm and L_{75} = 16.42 cm.

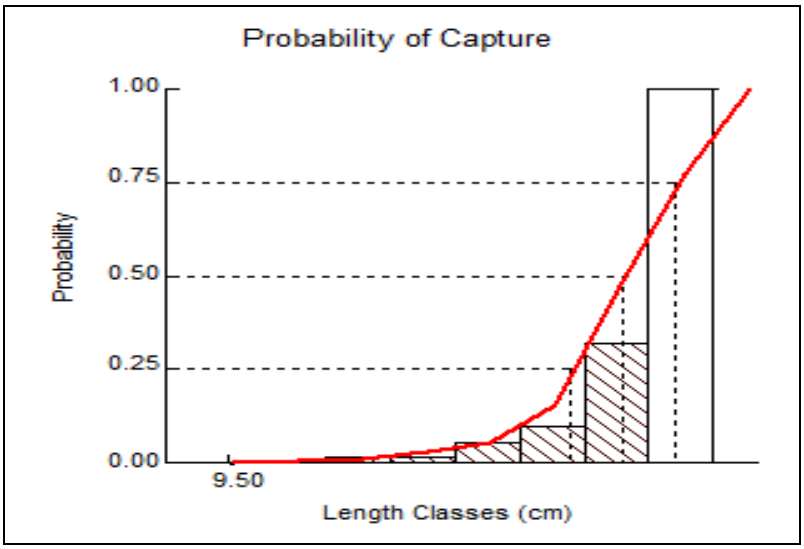

Figure (6): Probability of capture by length class of *Siganus rivulatus* that catching by trammel net from the Gulf of Suez.

Mortality:

The total mortality coefficient 'Z' of *Siganus rivulatus* was estimated using the linearized length converted catch curve graphically represented in Figure (7), the total mortality was found to be 1.76 year^{-1}. The natural mortality coefficient 'M' estimated to be 0.6 year^{-1}. The fishing mortality coefficient 'F' was equal to 1.16 year^{-1} which is the difference between total 'Z' and natural 'M' mortality coefficients. Hence, the exploitation rate of both sexes combined was estimated to be E = 0.66 year.

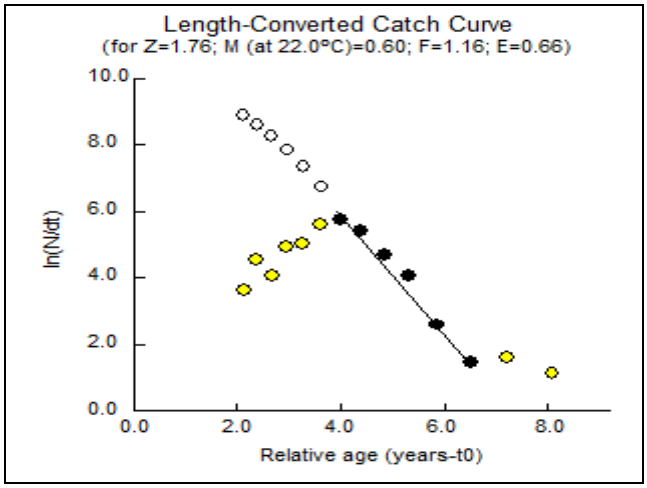

Figure (7): Length converted catch curve of *Siganus rivulatus* that catching by trammel net from the Gulf of Suez.

DISCUSSION

In the Gulf of Suez, Rabbit fish is caught by both trawls and trammel nets in areas where trawling is not prohibited and in other areas especially with trammel nets intensively. There is no study related to the impact of fishing by trammel nets in the Gulf of Suez on the population of rabbit fish. To the best of our knowledge, this study is the first one in this area and it will be useful for evaluating the impacts of trammel nets on target in small-scale fisheries. Fishing gear's mean trophic may be used as an indicator to measure the impact of fishing on an exploited ecosystem (Pennino *et al*., 2011).

In the current study, we provide new information on the morphometry, age and growth for *Siganus rivulatus* species which caught by trammel nets from the Gulf of Suez. The weight–size relationship is a useful tool for population status analysis and can provide information about the increase or decrease in weight of populations. This parameter could also be important for comparative studies between populations. In Suez Gulf, the power coefficient b (of the CW– TW power regression model) value is 3.009, showing slightly isometric growth in all populations in both sexes. Similar results were found for the Red Sea population (El-Gammal 1988) and in the southeastern Mediterranean Egyptian coast (Abdallah 2002).

Age is one parameter necessary to assess population dynamics and the state of exploited resources (Allain & Lorance 2000). The maximum age of *S. rivulatus* in this study was 3 years. Different results have been found in the Red Sea and Mediterranean Sea, which partly used different methods for catching this species. For example, Bariche (2005) reports a maximum age of 6 years for both siganid species from the Lebanese coast, based on annual ring counting. El-Gammal (1988) used Otolithometry to estimate the age of *S. rivulatus* in the Red Sea and found a maximum age of 4-5 years.

The analysis of capture probability indicated that the fish length at first capture (L_C or L_{50}) was 15.59 cm. The estimated length at first capture in the present study is lower than that determined by Mehanna and Abdallah (2002) (L_C =17.04 cm), and is closed to (L_C =15.6 cm) which determined in the Mediterranean Sea by El- Far (2008). The high fishing mortality (1.16) that occurred during the fishing by trammel nets indicates that there is a high pressure on fisheries of this species in the Gulf of Suez. The fishing mortality (F) of *S. rivulatus* was higher than that of the natural mortality (M), suggesting

that its population has been over exploited. The exploitation rate was estimated to be E=0.66, the Value of E was lower than that estimated by Mehanna and Abdallah (2002) (E = 0.80 year^{-1}), and in the Mediterranean Sea by (El- Far 2008) (E = 0.81 year^{-1}). These results indicate that, the stocks of the species under study is a target species and is suffering from a high rate of exploitation in the different geographic localities.

CONCLUSION

The stock of rabbit fish in the Gulf of Suez coast was assessed as in a status of overfishing. A reduction of fishing effort is advisable to reach the proposed of stock. reduction can be approached by fishing activity limitations, reducing the number of working days and the enforcement of the closed fishing season. Moreover, the improvement of the selection patterns of the trammel net is needed. We must develop the gear characteristics (mesh size and net materials) to catch larger fish to maintain the stock productivity and its sustainability.

ACKNOWLEDGMENT

The authors are grateful to the National Institute of Oceanography and Fisheries (NIOF) with the support of the Faculty of Agriculture in Cairo, Al-Azhar University for facilitating the data collection of the present study.

REFERENCES

Abdallah, M. (2002). Length-weight relationship of fishes caught by trawl off Alexandria, Egypt. Naga, The ICLARM Quarterly, 25(1): 19-20.

Allain, V. and Lorance, P. (2000). Age estimation and growth of some deep-sea fish from the northeast Atlantic Ocean. Cybium, 24(3): 7-16.

Bariche, M. (2005). Age and growth of Lessepsian rabbitfish from the eastern Mediterranean. Journal of Applied Ichthyology, 21(2): 141-145.

Benedict, O.O.; Yemi, A.S. and Isaac, T.O. (2009), "Length-weight relationship, condition factor and sex ratio of forty-six important fishes in a tropical flood river", Journal of Fisheries and Hydrobiology 4: 65-72.

Bilecenoglu, M., and Kaya, M. (2002). Growth of marbled spinefoot *Siganus rivulatus* Forsskål, 1775 (Teleostei: Siganidae) introduced to Antalya Bay, eastern Mediterranean Sea (Turkey). Fisheries Research, 54(2): 279-285.

El Ganainy, A. A.; Khalil, M. T.; El Azab, E. B.; Saber, M. A. and Abd El-Rahman F. A. (2018) Assessment of three nemipterid stocks based on trawl surveys in the Gulf of Suez, Red Sea. Egyptian Journal of Aquatic Research. 44(1):45-49.

El-Far, A. M. M. (2008). Artisanal fisheries along Alexandria coast area with special reference to the fishery biology of Siganus spp. M.Sc. Thesis. Department of Zoology, Faculty of Science, Zagazig University.

El-Gammal F.I. (1988). Age, growth and mortality of the rabbit fish *Siganus rivulatus* (Forsskål, 1775), from the Red Sea. Bulletin of the Institute of Oceanography and Fisheries, ARE; 14:13-21.

El-Ganainy, A., and Ahmed, A. (2002). growth, mortality and yield-per-recruit of the rabbit fish, *Siganus rjvulatus*, from the eastern side of the Gulf of Suez, Sinai coast, Red sea. Egyptian journal of aquatic biology and fisheries, 6 (1): 67-81.

El-Okda N.I. (1998). Comparative studies on certain biological aspects of Siganus in marine waters of Egypt. Ph. D. Thesis, Faculty of Science Benha Zagazig, University.

Everhart, W. H.; Eipper, A. W. and Yuoings, W. D. (1976). Principles of fishery science. Comstock Publ. Assoc. Ithaca, N.Y., 288 pp.

Ford, E. J. (1933). An account of the herring investigations conducted at Plymouth during the years from 1924 to 1933. Journal of the Marine Biological Association of the United Kingdom, 19 (1): 305-384.

Froese, R. and D. Pauly. (1998). Fish Base 1998: Concepts, design and data sources. Manila, ICLARM. 293 p.

Gabr, M.H. and Mal, A.O. (2016). Size-Selectivity of Trammel Nets for Two Herbivorous Fish Species in Coral Reef Fisheries of Jeddah, Saudi Arabia. Turkish Journal of Fisheries and Aquatic Sciences 16:993-1002.

Goncalves, J.M.S.; L. Bentes; P.G. Lino; J. Ribeiro; A.V.M.Canario, and K.Erzini. (1996). Weight–length relationships for selected fish species of the small-scale demersal fisheries of the south and south-west coast of Portugal. Fish. Res. 30: 253-256.

Gulland, J. A. (1971). The fish resources of the Ocean West by fleet, Surrey, Fishing News, Ltd., FAO, 255pp.

Hubert, W.A.; Pope, K.L. and Dettmers, J.M. (2012) Passive capture techniques. In: Zale AV, Parrish DL, Sutton TM (eds) Fisheries techniques, 3rd edn. American Fisheries Society, Bethesda, pp 223–266

Jones, R and N.P. Van Zalinge (1981). Estimates of mortality rates and population size for shrimp in Kuwait waters. Kuwait Bull. Mar. Sci., 2:273-288.

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). The Journal of Animal Ecology, 201-219.

Mehanna, S.F. and Abdallah, M. (2002). Population dynamics of the rabbit fish Siganus rivulatus from the Egyptian sector of the Red Sea. Marine Scienes, *13*(1).

Mohammed, N.I. (1991). Biological and biochemical studies of some siganid fishes from the Mediterranean waters off Alexandria. M. Sc. Thesis, Faculty of Science, Alexandria University.

Odat, N. (2003). Length-weight relationship of fishes from coral reefs along the coastline of Jordan (Gulf of Aqaba). Naga, 26(1): 9-10.

Osman, H. M.; Saber, M. A. and El Ganainy, A. A. (2019) Population structure of the striped piggy *Pomadasys stridens* in the Gulf of Suez. Egyptian Journal of Aquatic Research 45 : 53–58.

Pauly, D. (1980). On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. ICES journal of Marine Science, 39(2): 175-192.

Pauly, D. (1983). Some simple methods for the assessment of tropical fish stocks (No. 234). Food & Agriculture Org.

Pauly, D. (1984). Fish population dynamics in tropical waters: a manual for use with programmable calculators (Vol. 8). World Fish.

Pennino, M. G.; Conesa, D. and López–Quílez, A. (2011). Trophic indicators to measure the impact of fishing on an exploited ecosystem. Animal Biodiversity and Conservation, 34(1): 123-131.

Taylor, C. C. (1960). Temperature, growth and mortality – the Pacific cockle. J. Cons. CIEM, 26: 117-124.

Tharwat A.A. and Al-Owafeir M.A. (2003) comparative study on the rabbit fishes Siganus canaliculatus inhabit the Arabian Gulf and Siganus rivulatus inhabit the Red Sea in Saudi Arabia. Egypt J. Aquat. Biol & Fish. 7:4:1-19.

Ursin, E. (1967). A mathematical model of some aspects of fish growth, respiration, and mortality. Journal of the Fisheries Board of Canada, 24(11), 2355-2453.

Walford, L. A. (1946). A new graphic method of describing the growth of animals. The Biological Bulletin, 90(2): 141-147.

Woodland, D.J. (1999). An examination of the effect of ecological factors, especially competitive exclusion, on the distributions of species of an inshore, tropical, marine family of Indo-Pacific fishes (Siganidae). In: Séret, B. & Sire, J.Y., (eds). Proceedings of the 5th Indo-Pacific Fish Conference, Nouméa, 1997 Paris: Société Franc aise ichthyology. pp. 553-562.