International Journal of Fisheries and Aquatic Studies 2015; 3(1): 239-243

ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2015; 3(1): 239-243

www.fisheriesjournal.com
Received: 06-07-2015
Accepted: 09-08-2015

MA El-Drawany
Department of Zoology, Faculty of science, Zagazig University, Egypt.

Correspondence
MA El-Drawany
Department of Zoology, Faculty of science, Zagazig University, Egypt.

Age, growth and mortality of *Rhabdosargus haffara* in Lake Timsah, (Suez Canal, Egypt)

MA El-Drawany

Abstract
This study was carried out from May 2013 to April 2014 in the Lake Timsah, Egypt. A total of 400 specimens were collected by monthly sampling. The age of *Rhabdosargus haffara* was estimated by examining scales and it was found out that the maximum age was IV years. The main total length and total weight values were calculated as 16.7± 2.21 cm to 91.31±20.15 g. respectively and the calculated length-weight relationship was $W = 0.01756\ L^{3.101}$. The von Bertalanffy growth parameters were $L\infty$ = 27.4 cm. K = 0.1125 year^{-1} and t_o = -1.34298 year. The instantaneous rate of total mortality (Z) was 1.3375, the natural mortality (M) was 0.40259 and the fishing mortality (F) was estimated to be 0.9349. The exploitation rate (E) was calculated as about 0.70 using value of M and F. Therefore, the population of Rhabdosargus *haffara* off Lake Timsah was under the threat of over fishing.

Keywords: Age, growth, mortality, *Rhabdosargus haffara,* Lake Timsah, Suez Canal, Egypt

Introduction

The Suez Canal is stretching from Port Said in the north, and continues southward for 162.5 km, crossing Lake Timsah and the Bitter Lakes on its way to the Gulf of Suez.

Lake Timsah, also known as Crocodile Lake, is a lake in Egypt on the Nile delta. It lies in a basin developed along a fault extending from the Mediterranean Sea to the Gulf of Suez through the Bitter Lakes region (Gmirkin, 2006) [8]. In 1800, a flood filled the Wadi Tumilat, which caused Timsah's banks to overflow and moved water south into the Bitter Lakes about nine miles (14 km) away (Hoffmeier, 2008) [12]. In 1862, the lake was filled with waters from the Red Sea.(Stanley,1895) [20] The lake covers about 15Km2 between 300 32\ and 300 36\ north latitude and 320 16\ and 320 21\ east longitude, and is located near the middle of the Suez Canal, at a point 80 Km south of Port Said (Hamed *et al*. 2012) [10].

Rhabdosargus haffara is a fish belonging to family Sparidae, commonly known as sea breams, are widely distributed in the western Indian Ocean, Red Sea and especially common in the North. It inhibits shallow waters, mainly around coral reefs, and over sandy or mud-sandy bottoms. Feeds chiefly on molluscs and to a lesser extent on crustaceans which are crushed with its developed molars. Its common size is 10 - 20 cm and the maximum is 35 cm Fischer and Bianchi (1984) [7].

Sparids are small to medium-sized fishes, diverse in general form, varying in shape from elongate to deep-bodied, with a dorsal profile from very steep to gentle sloping. Generally, the species of family sparidae are very important commercially and constitute an important part of the artisanal and industrial fisheries (Al Mamry *et al.,* 2009 and Siddiqui *et al.,* 2014) [3, 18].

Sparid fishes are an important component of the small-scale fisheries (gill net, trammel net and hand line) in the Northern Gulf of Suez (Suez Bay). They are represented by three species namely, *Rhahdosargus haffara, R. sarha* and *Diplodus nod* from which *R. haffara* is the most dominant species (Mehanna, 2001) [14]. The only work found in literature is that of Ahmed & El-Ganainy (2000) [2] and Mehanna (2001) [14]. The authors studied the population dynamics of three Sparid species from South Sinai coast of the Gulf of Suez. In spite of the economic importance of this species, information on its biology and dynamics are very rare and this work presents the study on its age, growth, spawning season and mortality rates.

Materials and Methods

About 400 specimens of sea breams, *Rhabdosargus haffara,* were collected monthly from May 2013 to April 2014, from the landing site at the Lake Timsah. Fishes were put immediately in crushed ice and transported to the laboratory, where they were subjected investigation.

Date of capture, total fish length (mm) and total fish weight (0.1 g) were recorded for each fresh specimen. Fishes were dissected to define their sex and gonad maturity stages. Gutted fish were weighed to the nearest 0.1 g and gonads were weighed to the nearest 0.0lg.
Age was determined by counting the annual rings on the scales using micrometer eye pice. Counts of rings and measurements were always performed in the same direction, from the nucleus to the edge of the scale. Back-calculation of total length, were obtained by Lee's equation (Lee, 1920) [13].
The growth parameters L∞, k and t_0 of *R. haffara* were estimated by means of von Bertalanffy plot and application of von Bertalanffy equation (von Bertalanffy, 1938) [4]

$$L_t = L\infty\,(1 - e^{-k\,(t - to)})$$

Where L_t is the total length at time t; k is a growth constant; L∞ is the asymptotic length; and t_0 describes the theoretical age where L_t is zero (Ricker 1975) [17].
The length weight relationships were estimated from the allometric equation, $W = a\,L^b$ (Ricker, 1973) [16] where W is total body weight (g), L the total length (cm), a and b are the coefficients of the functional regression between (W) and (L) and they were obtained using the Newton algorithm from the Microsoft® Excel Solver routine.
The spawning season was determined by the curvilinear average values of monthly Gonadosomatic index (GSI) where:
GSI= 100 [gonads weight (g)/gutted weight (g)]
Total mortality rate (Z) was estimated based on the length at first capture methods evaluated by Beverton and Holt (1957) [5].

$$Z = K\,(L\infty - Lm/\,Lm - Lc)$$

Where: Lm = the average total length of the entire catch.
Lc = the length at which 50% of the fish entering the gear
Natural mortality rate (M) was estimated by using the equation derived by Ursin (1967) [21] based on the mean total length where:

$$M = W^{-(1/b)}$$

W = mean total length.
b = constant of length weight relationship.
Fishing mortality rates (F) were calculated as the difference between Z and M where Z = F + M.
The annual exploitation rate (E) was obtained according Sparre *et al.* (1989) [19] where: E = F/Z
The total mortality coefficient "Z" was estimated using the method of Pauly (1983) [15].

Results
Growth in Length
Body length-scale radius relationship
The result of a plot of scale radius against total length is shown in Fig. (1). It is obvious from the figure that a linear relationship exists between the radius of the scale and the body length and can be expressed as follows:

$$L = 3.6585 + 1.35286\,S \quad (r = 0.999)$$

Where L is the total length in cm and S is the scale radius in mm.

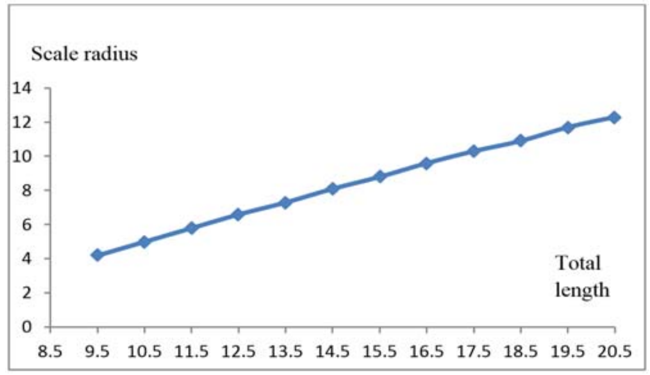

Fig 1: Total length scale radius relationship of *Rhabdosargus haffara*

Back-Calculations
The following formula was derived to obtain the back-calculated total length at the end of each year of life for *R. haffara*

$$Ln = (L - 3.6585)\,Sn / S + 3.6585$$

Where: Ln is the length at the end of n^{th} year, Sn is the radius of the scale to n^{th} annulus, S is the total radius of the scale and L is the total length at capture.
From the data given in tables (1), it is obvious that, *R. haffara* attains its highest growth rate in terms of length during the first year of life, after which a gradual decrease in growth increments was noticed with further increase in age.

Table 1: Average back-calculated lengths (cm) of *Rhabdosargus haffara* from the Bitter lakes, Egypt.

Age group	Mean number	Observed length(mm)	Back calculated lengths in mm 1 2 3 4
I	178	12.5	12.43
II	119	15.8	11.82 15.79
III	82	18.6	12.59 15.46 18.75
I V	21	20.5	12.64 14.93 17.87 20.40
Average total	400		12.37 15.39 18.31 20.40
Increment of length			12.37 3.02 2.92 2.09

Length-weight relationship
The total length of *R haffara* varied from 9.0 to 21.0cm and while the total weights ranged between 18.5 to 205.29 g. The equations were extracted for describing the relationship between weight and length as follows:

$$W = 0.017562 * L^{3.101} \quad (r^2 = 0.992) \text{ or } \log W = -1.75543 + 3.101 \log L$$

Where: W is the total weight (gm), L is the total length (cm) and r is the correlation coefficient. The high values of r^2 indicate a good measure for the strength of these equation and closeness of observed and calculated values of fish weight. The length and weight measurements of the analyzed specimens used to describe the length-weight relationship are given in figures (2).

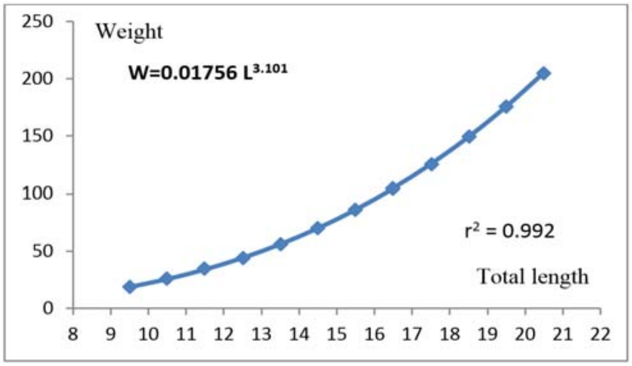

Fig 2: Length weight relationship of *Rhabdosargus haffara* Growth in weight

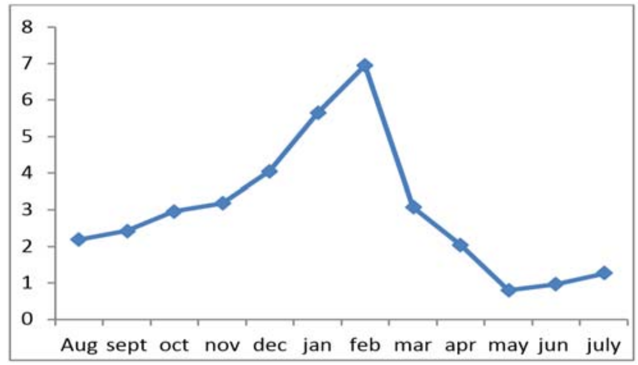

Fig 3: Monthly variations in the Gonadosomatic index of *Rhabdosargus haffara*

The calculated weights for each year of life were computed by applying the corresponding length - weight relationship to the estimated lengths (Table 2). It was obvious that, the growth in weight was very slow during the first year of life and the annual growth increment increased with the increase in age until it reaches its maximum value at age group III after which a drop in the growth increment in weight was noticed in the fourth year of life.

Table 2: Average back-calculated weights (g) of *Rhabdosargus haffara* from the Bitter lakes, Egypt.

Age group	Mean number	Observed Weight(g)	Back calculated lengths in mm 1 2 3 4
I	178	44.27	43.50
II	119	91.54	37.22 91.36
III	82	151.82	45.26 85.57 155.65
I V	21	205.26	45.82 76.80 134.09 202.18
Average total	400		42.95 84.58 144.87 202.18
Increment of length			42.95 41.63 60.29 57.31

Mathematical description of growth

The mathematical description of growth is very important in the field of fisheries management, since the obtained growth parameters ($L\infty$, K and t_o) are the basic inputs of various models used for assessing the status of an exploited stock. The most frequently used model is that of von Bertalanffy (1938) [4] which can be represented by the following equation;

$$L_t = L\infty\ (1 - e^{-k\ (t-to)})$$

Where: Lt is the total length at age t,
$L\infty$ is the asymptotic length,
K is the growth coefficient
t_o is the age at which length is theoretically zero.

In the present study, the growth parameters of the von Bertalanffy growth model were $L\infty$ = 27.4 cm. K = 0.1125 year^{-1} and t_o = -1.34298 year. The resultant von Bertalanffy growth equations for *R. haffara* from Lake Timsah were:
For growth in length: $L_t = 27.4\ (1 - e^{-0.1125\ (t + 1.34298)})$
For growth in weight: $W_t = 505\ (1 - e^{-0.1125\ (t + 1.34298)})^{3.101}$

Gonadosomatic Index (GSI)

The monthly changes in GSI values of individuals of *Rhabdosargus haffara* is given in figure (3). It was observed that the GSI values were low during May, June, and July 2014. Index values began to increase after October to reached maximum values in February 2013 and then began to decrease indicating that its breeding season is in February.

Mortality Rates

By using the cumulative curve of *R. haffara* (Fig.) illustrating length at first capture at 50 % and applying the method of Sparre *et al.* (1989) [19] the total mortality coefficient (Z) was estimated. This coefficient was found to be 0.8840 year^{-1}. But the Natural mortality coefficient "M" which obtained from the mean total length was 0.2214 year $^{-1}$. Using the estimated (M) and (Z) the fishing mortality (F) was obtained (0.6626 year^{-1}), where Z = M + F.

Exploitation Rate (E)

According to Gulland (1971) [9] which suggested that the optimum exploitation rate in an exploited stock should equal approximately 0.50. The current exploitation rate "E" was estimated at about 0.70. Accordingly, the high value of the current exploitation rate indicates that the stock of *R. haffara* in the Lake Timsah is subjected to overfishing.

Length at First Capture (Lc)

The length at first capture L50% (the length at which 50% of the fish are first exposed to capture) was estimated as a component of the length converted catch curve analysis (FiSAT), was found to be 15.8 cm which corresponds to an age of 2.14 years.

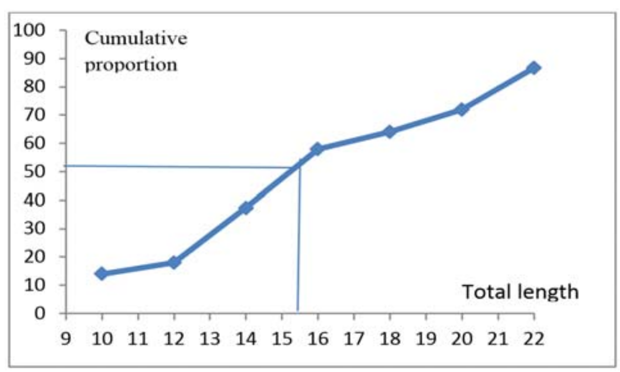

Fig 4: Cumulative curve from which length at first capture was determined.

Discussion

The maximum ages of *R. haffara was* observed at four years in the present study. These results are similar to those reported by Mehanna (2001) [14]. However, Ahmed and EI-Ganainy (2000) [2] determined the maximum age of *R. haffara*, *R. sarba* and *Diplodus noct* from Southern Sinai Coast and found that *R. haffara* reaches three years old while the longevity of *R. sarba* and *Diplodus noct* was three and four years, respectively

Growth in Length

Body length-scale radius relationship

The result of a plot of scale radius against total length is expressed as L = 3.6585 +1.35286 S (r = 0.999) while, Ahmed *and El-Ganainy* (2000) [2] and Mehanna (2001) [14] estimated the total length-scale radius relationship for *R. haffara* from South Sinai Coast and Suez Bay as follows: L - 4.1555 + 0.1077 (r = 0.8448) and L = 2.4057 +3.5197 S (r-0.9895) respectively.

Back-Calculations

Ahmed and El-Ganainy (2000) [2] found that *R. haffara* from South Sinai Coast of the Gulf of Suez reached a total length of 10.5cm at the end of the first year of life, 16.21cm at the end of the second year and 19.33cm at the end of the third year of life. It is obvious that *R. haffara* in the Lake Timsah are characterized by a higher growth rate in length than those from South Sinai Coast where they attain 12.37,16.39,19.31 and 21.40 cm total length at the end of 1st, 2nd, 3rd and 4th year of life, respectively and probably agree with those obtained by (Mehana,2001) [14] in the Suez Bay where they attain 12.7, 17.8,21.6 and 23.3 cm total length at the end of 1st, 2nd, 3rd and 4th year of life, respectively

Length-weight relationship

The length – weight relationship of *R. haffara* is expressed as:

$W = 0.017562 * L^{3.101}$ ($r^2 = 0.992$) or Log W = - 1.75543 + 3.101 Log L

Which indicates their isometric growth (b =3.101) while Mehanna, (2001) [14] indicated that the growth was negative allometric ($W = 0.01742\ L^{294013}$). Such variation in the type of growth may be attributed to environmental changes and difference in the time of study.

Growth in weight

It was obvious that, the growth in weight was very slow during the first year of life and the annual growth increment increased with the increase in age until it reaches its maximum value at age group III after which a drop in the growth increment in weight was noticed in the fourth year of life this pattern is in an agreement with the findings of Mehanna (2001) [14].

Spawning season

The monthly changes of gonadosomatic indexe value of R. *haffara* are shown in Figures (3). The indexes showed no obvious changes during summer. A slightly increase observed in autumn. Maximum increase (spawning season) occurred during winter. A significant decrease occurred in spring. These results agree with that of Ibrahim, 1999 [11] on *R. haffara* in the South Sinai and also with that of Abdalah and Faltas, 1998 [1] and Elboray, 2004 [6].

Mortality Rates

The value of total mortality obtained from the present study (Z = 1.3375 $Year^{-1}$) is agree with that reported by (Mehana, 2001) [14] in the Suez Bay where Z = 1.22 $year^{-1}$. However, natural mortality coefficient "M" (0.40 $year^{-1}$) is nearly equal to that estimated by Mehanna (2001) [14] where (M = 0.29 year-1). On the other hand, the fishing mortality coefficient "F" was computed using the relationship Z = F + M.

The value of(F) in the present study which equal to 0.93 $year^{-1}$ is agree with that obtained by Mehanna (2001) [14] where F = 0.90 $year^{-1}$.

Generally it can be concluded that the *Rhahdosargus haffara* stock in the Egyptian Lake Timsah is in a situation of overexploitation and to preserve this valuable fisheries resource some management measures, including reduction of the present level of fishing mortality and increase in the length at first capture should be useful.

References

1. Abdallah M, SN Faltas. Reproductive biology of Trigla lucerne and Trigloporous lasoviza in the Egyptian Mediterranean waters. Bull. Nat. Inst. Oceanogr. And Fish, ARE 1998; 24:285-304.
2. Ahmed AI, El-Ganainy A. On the population dynamics of three sparid species from south Sinaicoast of the Gulf of Suez, Red Sea. Egypt. J Aquat. Biol. & Fish. 2000; 4(4):235-264.
3. Mamry Al JM, McCarthy ID, Richardson CA, Meriem SB. Biology of the king soldier bream (Argyrops spinifer, Forsskål 1775; Sparidae), from the Arabian Sea, Oman. Journal of Applied Ichthyology. 2009; 25:559-564.
4. Bertalanffy von L. A quantitative theory of organic growth (Inquiries on growth laws, 2). Hum. Biol 1938; 10:181-213.
5. Beverton RJ, Holt SJ. On the dynamics of exploited fish populations. U. K. Min. Agric. Fish., Fish, Invest. (Ser. 2) 1957; 19:533.
6. El-Boray KF. Reproductive biology and histological characters of male *Rhabdosargus haffara* (teleostei, sparidae) from Suez Bay, Red Sea. Egyptian Journal of Aquatic Research 2004; 30(B):226-233
7. Fischer W, Bianchi G. FAO species identification sheets for fishery purposes. Western Indian Ocean (Fishing Area 51). Rome, Food and Agricultural Organization of the United Nations, 1984, 1-6.
8. Gmirkin Russell E. Berossus and Genesis, Manetho and Exodus: Hellenistic Histories and the Date of the Pentateuch (The Library of Hebrew Bible/Old Testament Studies) Hardcover – May, 2006, 15.
9. Gulland JA. The fish resources of the Ocean. West Byfleet, Surrey, *Fishing News (Books), Ltd., for FAO* 1971, 255.
10. Hamed MA, El-Halafawy MM, Ramadan AM, El-Sawy MA. Comparative study on the Levels of Heavy Metals in the Bitter Lakes and Lake Temsah, (Suez Canal) in Relation to the Reproductive Cycle of the Rabbit Fish *Rhabdosargus haffara*. Int. J Res. Chem. Environ. 2012; 2(3):175-185.
11. Ibrahim AEA. Biological and ecological studies on some sparidae fishes at Southern Sinai Coasts, Red Sea. Ph. D. Thesis, Faculty of Science, Suez Canal University, Egypt, 1999.
12. James K. Hoffmeier Major geographical issues in the accounts of the Exodus: the pitfalls and promises of site identification in Egypt, 2008, 43.
13. Lee RM. A review of the methods of age and growth determination in fish by means of their scales. *Fishery Invest. Lond. Ser* 1920; IIIV (2):1-32.
14. Mehanna SF. (Growth, mortality and yield per recruit of *Rhabdosargus haffara* (Sparidae) from the Suez Bay. Egypt J Aquat. Biol. & Fish. 2001; 5(3):31-46
15. Pauly D. Length-converted catch curves. A powerful tool for fisheries research in -tropics. Parti. ICLARM Fishbyte 1983; 2(1):17-19.
16. Ricker WE. Linear regressions in fishery research. Journal

of the Fisheries Research Board of Canada (1973-99); 30:409-434.
17. Ricker WE. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 1975; 191:1-382.
18. Siddiqui PJ, Amir SA, Masroor R. The sparid fishes of Pakistan, with new distribution records. Zootaxa 3857 2014; (1):071-100.
19. Sparre P, Ursin E, Venema SC. Introduction to tropical fish stock assessment. Part 1. Manual. FAO Fisheries Technical, 1989, 306.
20. Stanley, Henry Morto. My Early Travels and Adventures in America and Asia. C. Scribner"s son, 1895
21. Ursin E. A mathematical model of some aspects of fish growth, respiration and mortality. J Fish. Res. Bd. Can. 1967; 24:2355-2453.