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FISHERY ASSESSMENT OF THE COMMON SILVER BIDDY *GERRES OYENA* FROM THE GULF OF SUEZ, RED SEA, EGYPT.

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ABSTRACT

The common silver biddy *Gerres oyena* is one of the most commercial fish species in the Gulf of Suez. Some population parameters of the species were studied from samples collected from the trawl fishery in the Gulf of Suez during 2015-2017. Age determinations based on otolith readings showed that the growth of females is higher than that of males; where the maximum age attained by males was 4 years while that of females was 5 years. The von Bertalanffy growth equation was $L_t = 20.2 (1 - e^{-0.267 (t + 3.281)})$ for males and $L_t = 22.831 (1 - e^{-0.210 (t + 1.940)})$ for females. The fish grows allometrically (b = 3.1102 for both sexes combined) and relatively rapid, achieved about 40% of the growth during the first year of life. The total mortality rate "Z" was estimated as 1.08 $year^{-1}$. The natural mortality rate was found to be M =0.310 $year^{-1}$. The estimated current exploitation rate (E = 0.71) and the analysis of the relative yield per recruit indicate that the population of the silver biddy *Gerres oyena* in the Gulf of Suez is overexploited. The fishing effort must be reduced by about 30% of its current level; this can be achieved by reducing the number of fishing days or the number of trawling trips and changing the gear characteristics (mesh size) to catch larger fish to maintain the stock productivity and its sustainability.

INTRODUCTION

The common silver biddy *Gerres oyena* (Gerreidae) is a species of mojarra inhabits shallow coastal sandy beaches and muddy areas and also occurs in the mouth of estuaries (Miyanohara *et al*., 1989). Juveniles often found in small groups along beaches, while solitary adults prefer deeper waters. It feeds on small organisms and benthic invertebrates living on sandy bottoms (Lieske & Myers, 2004).

The common silver biddy is widely distributed in the Indo-West Pacific region along the east coast of Africa to the Red Sea and the Arabian Gulf, southern Asia, Polynesia, Australia and China (Iwatsuki *et al*., 1999; Lieske & Myers, 2004). It is commercially important popular low-cost species, which is caught mainly with bottom trawls and seines in the Gulf of Suez. Its catch declined from 33 tons in 2008 to 6 tons in 2018 (GFARD, 2018).

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Despite the high abundance as well as the economic and commercial importance of the common silver biddy *Gerres oyena* in the Gulf of Suez, they are one of the least investigated species in the region. Thus previous studies on age, growth, and reproduction and population structure of this species are scarce and this is the first documented attempt to study some biological and dynamical aspects of the species in the Gulf of Suez. The biology and population structure of *Gerres oyena* were investigated by El-Agamy (1988) in the Arabian Gulf; Yeeting (1990) in Tarawa Lagoon, Kiribati; El-Boray and El Gharabawy (1999) and El-Boray (2001) in the Suez Bay; Lamtane *et al*., (2007) and Kanak and Tachihara (2006 and 2008) in Japan.

This study, principally aims to give the essential biological and dynamic information for one of the common silver biddy species *G. oyena* in the Gulf of Suez. This information would help in the proper management of the Gulf trawl fishery and in the achievement of its optimum sustainable yield.

MATERIALS AND METHODS

Samples used in this study were collected from the catches of the commercial trawlers operating in the Gulf of Suez and landed in the Attaka landing harbor. A total of 759 specimens were measured to study the length frequency distribution, being arranged into size groups of I cm intervals. Total length in cm, total weight in gm and sex were recorded for each specimen. The otoliths were removed, cleaned and kept in special envelopes for using in age determination, and then they were viewed with incident light of a stereo microscope at a magnification of 40 X while immersed in a clearing fluid of equal volumes of glycerol and alcohol.

The von Bertalanffy growth equation was fitted to the mean back calculated lengths-at-age using the method of least squares (Sparre & Venema, 1998). The total mortality coefficient (Z) was estimated by applying the length converted catch curve method developed by Pauly (1983). The natural mortality coefficient (M) was estimated according to Hoenig (1983) predictive equation that relating the maximum age in the stock (*tmax*) to *M*:

$$\ln (M) = 1.44 - 0.982 \times \ln (t_{\max})$$

Exploitation rate was estimated using the formula E = F/Z. The length at which 50% of the population represented in the catch, was estimated by using the cumulative length frequency curve (Pauly, 1984).

The effect of fishing on the common silver biddy fish stock in the Gulf of Suez was examined by applying the model of yield per recruit derived by Beverton and Holt (1966) and modified by Pauly and Soriano (1986), as incorporated in FiSAT software (Gayanilo *et al*, 1995).

RESULTS AND DISCUSSION

A total of 759 individuals from *G. oyena* were collected. In males the total length varied between 10.2-18.5 cm with an average of 12.989 cm while in females the total length varied between 10.7 and 20.2 cm with an average of 13.325 cm. The weight ranged between 13.9 to 110.9gm with an average weight of 30.39 gm.

1. Age and growth

The otolith examination of 300 specimens, showed that the otolith (Fig 1) is a reliable hard structure for the determination of age of *G. oyena*. Alternating hyaline and opaque bands were observed in the otoliths. One growth increment consisting of one opaque and one hyaline band was formed on an annual basis. This observation is similar to that recorded by Kanak and Tachihara (2006).

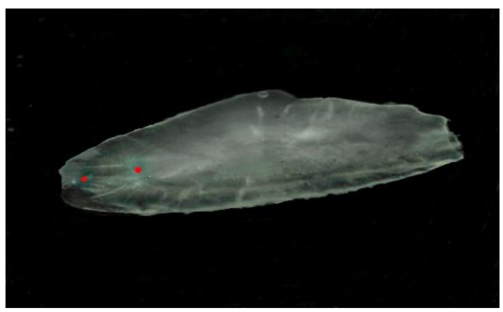

Figure 1. The otolith of *G. oyena* from the Gulf of Suez (length 12.5 cm) the red dots mark the position of opaque bands.

The maximum life span of *G.oyena* was four years for males and five years for females (Table 1). Most growth being achieved by the second year, after which there was little increase in size with age. During the first three years of life, the rate of increase of size with age was almost identical for both sexes then females grew to a significantly greater mean size at-age. The results revealed that the rate of growth of females is higher than that of males which is common in Gerreid species (El Agamy, 1988; Grandcourt et al, 2006; Abu ElNasr, 2017).

El Agamy (1988) recorded that the maximum age of *G.oyena* from the Arabian Gulf was seven years old and the maximum observed length was 30 cm which is higher than that recorded in our study in the Gulf of Suez (L_{max}= 20.0 cm). Kanak and Tachihara (2006) studied the age and growth for *Gerres oyena* on Okinawa Island, southern Japan and reported that Male fish age was estimated at up to 6^+ years, whereas females reached

8^+ years as estimated by sectioned otoliths which is higher than our estimates. The difference in the age estimates can be attributed to the different observed maximum length and to the different environmental conditions that affect the growth rate.

Table 1. Mean lengths at age of male, female and combined sexes of *G. oyena*

Age	Male		Female		All	
	No	Mean Length	No	Mean Length	No	Mean Length
I	16	11.51	32	11.44	48	11.48
II	54	13.50	108	13.51	162	13.50
III	24	15.22	50	15.32	74	15.40
V	4	1.33	8	16.71	12	16.60
IV			4	17.82	4	17.82

The mean observed lengths at age of all specimens of *G. oyena* were used for the estimation of the parameters of the von Bertalanffy growth model (L∞, K and to) (Table 2). Size-at-age relationships were asymptotic in form and there was no individual variability in growth (Fig. 2). The value of the growth performance index Φ for growth in length was 2.04, 2.039 and 2.025 for male, female and all specimens respectively. These results revealed that the silver biddy *G. oyena* is a short lived slow growth species (L∞ = 22.789 cm, K = 0.204 $year^{-1}$), this result is in a good agreement with that recorded by Kanak and Tachihara (2006) who estimated the growth parameters of the investigated species from south Japan as K = 0.181 and L∞ = 20.5. Benno (1992) estimated the growth parameters of *G. oyena* from Tanzania waters as L∞ = 18.2 and K = 1.1, but this results are doubtful because his observed maximum length is Lmax = 30.0 cm which is much smaller than the estimated asymptotic length.

Table 2. von Bertalanffy growth parameters of Gerres oyena from the Gulf of Suez

Parameter	Males	Females	All
K	0.267	0.210	0.204
L∞	20.260	22.831	22.789
t_o	-3.281	-1.940	-2.252
Φ	2.04	2.039	2.025

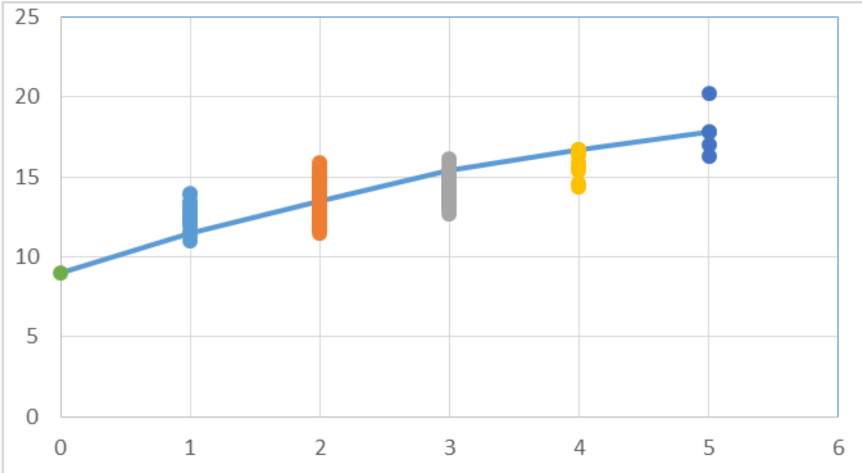

Figure 2. von Bertalanffy growth function fitted to size-at-age data for Gerres oyena.

The length-weight relationship provided a good fit to length and weight data for *G. oyena*. The results (Fig 3) showed that the growth of weight relative to length was positive allometric and the weight of fish increases in proportion slightly more than the cube of its length. The estimated a and b constants (Table 3) are very close to those estimated by El Agamy (1988) who calculated the relationship as $W=0.00812\ L^{3.13}$ from the Arabian Gulf and Letourneur *et al.,* (1998) who calculated the relationship as $W=0.0120\ L^{3.232}$ from New Caledonia. Kanak and Tachihara (2006), described the length weight relationship *G. oyena* from southern Japan as $WT= (3.5*10^{-2})\ L^{2.89}$ SL.

Table 3. Length weight relationship constants for male, female and combined sexes of *Gerres oyena*

Constant	Male	Female	All
a	0.0083	0.0092	0.0094
b	3.1220	3.1221	3.1102
r^2	0.9044	0.9172	0.9124
No.	253	506	759
Equation	$W=.0083\ L^{3.122}$	$W=.0092\ L^{3.122}$	$W=.0094\ L^{3.11}$

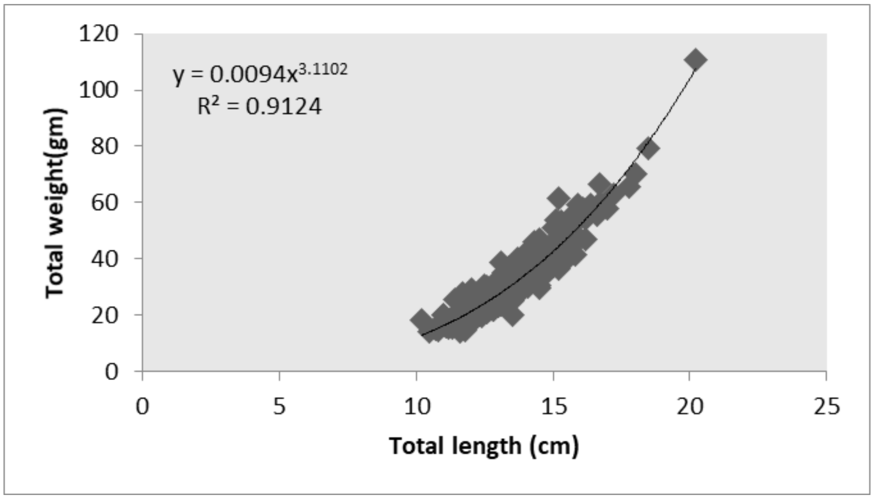

Figure 3. Length weight relationship of *G. oyena* from the Gulf of Suez

2. Mortality and Assessment

The overall length frequency distribution (Fig 4) indicated that More than 70.0% of the sample was represented in small lengths from 10.5 to 14.5cm. This coincided with the age composition (Fig 5) which revealed that age groups I and II have dominated the catch of *G. oyena* and formed together about 74% of the collected sample. Therefore, it is reasonable to assume that *G. oyena* is fully recruited to the fishery at an age of 3 years. Further, the occurrence of 1 year-old fishes in the catch suggests that recruitment is gradual.

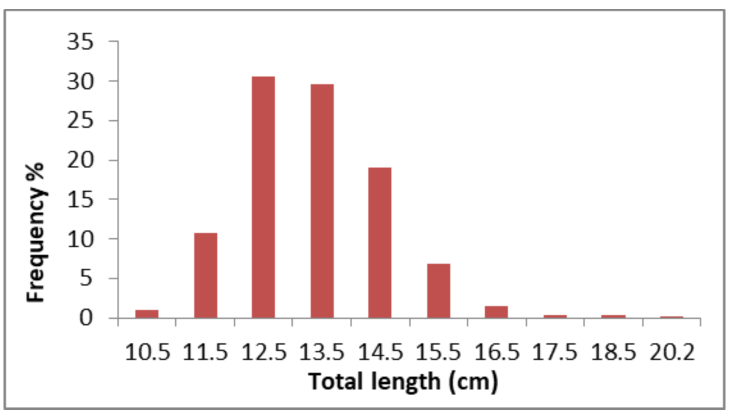

Figure 4. Length frequency distribution of *G. oyena* from the Gulf of Suez

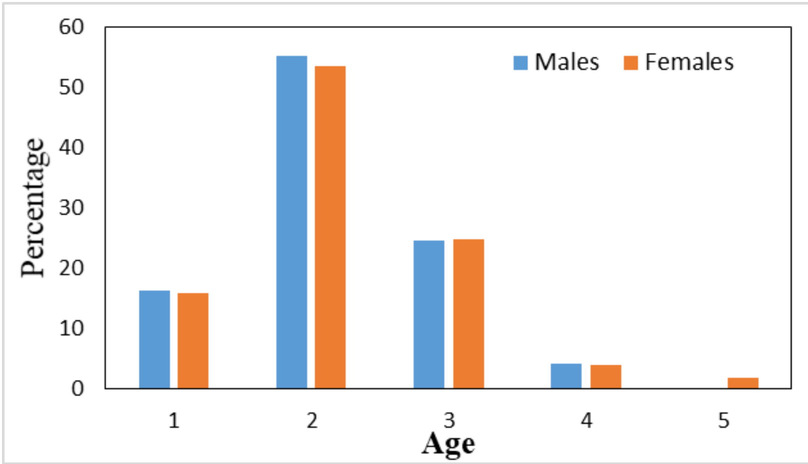

Figure 5. Age composition of male and female *G. oyena*

The rate of total mortality (Z) estimated by using linearized catch curve (Pauly, 1983) incorporated into FISAT II program, was 1.08 Y^{-1} (Fig. 6). The instantaneous rate of natural mortality (M) derived from the Hoenig (1983) equation was estimated at 0.31. The instantaneous rate of fishing mortality (F) was 0.77, and the exploitation rate (E) was 0.71.

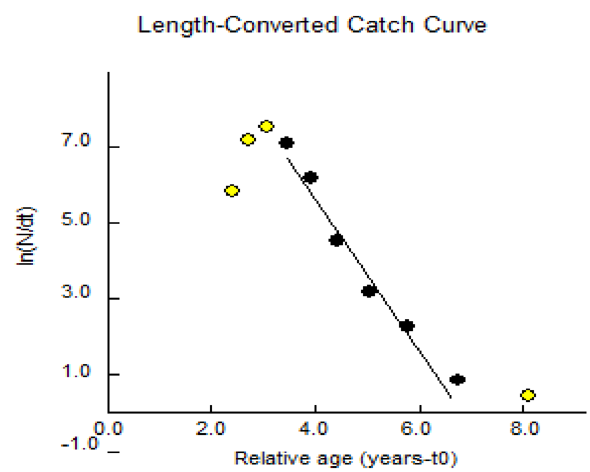

Figure 6. Length converted catch curve for estimation of total mortality (Z) of *G. oyena*

The length at which 50% of the population represented in the catch was estimated by using the cumulative length frequency curve, the value of Lc is 12.91 cm. The probability of capture of the species is L25 is 11.92cm, L50 is 12.91 and L75 is 13.70cm (Fig. 7). Age at first capture is estimated as Tc= 1.8 year.

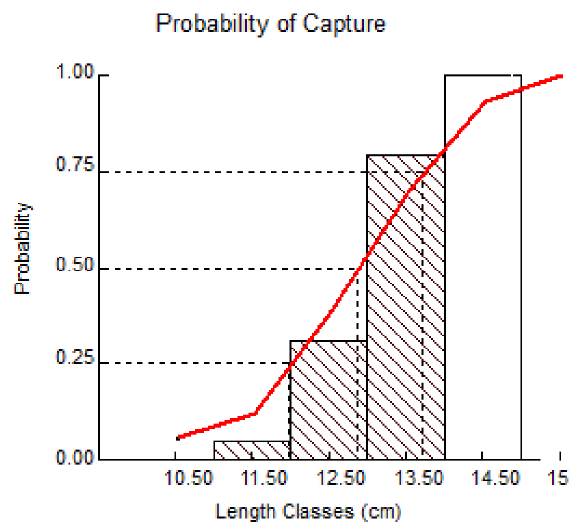

Figure7. probability of capture by trawling for *G. oyena* in the Gulf of Suez

Prediction of the yield and future state of *G. oyena* fishery from the Gulf of Suez was studied by applying the analytical relative yield per recruit model derived by Beverton and Holt (1966) and modified by Pauly and Soriano (1986)**,** as incorporated in FiSAT software (Gayanilo *et al*, 1995)**.**The fixed parameters used are M / K ratio = 1.53 and LC / L∞ ratio = 0.566 against a series of exploitation rates from 0.05 to 1.00 as a variable input parameter, the resulting relative yield per recruit (Y'/ R) and relative biomass per recruit (B'/ R) are given in Fig (40). The results indicate that at the present value of length at first capture (Lc = 12.91) and the current natural mortality (M = 0.31), the present value of the exploitation ratio is higher than that associated with the relative yield per recruit that maintains the stock biomass ($E_{0.5}$ = 0.385), indicating that the fishing pressure exerted in the Gulf of Suez has exceeded the critical level and the fishery needs some management regulations.

The results also show that the optimum relative biomass per recruit of *G. oyena* is achieved with an exploitation rate of about $E_{0.5}$ = 0.385. This results indicate that the current exploitation level of the silver biddy is higher than that associated with the optimum Y'/R and it must be reduced by about 27.7% to achieve the optimum yield per recruit. Also the length at which the fish is first liable to capture must be increased.

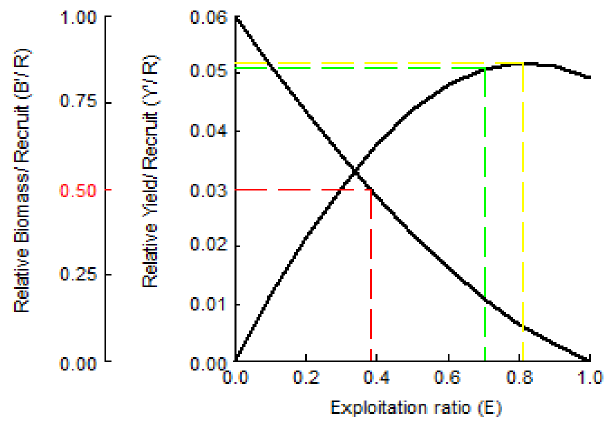

Figure 8. Yield per recruit and biomass per recruit of *G. oyena* in the Gulf of Suez

CONCLUSION

The results of this study indicated that the silver biddy *Gerres oyena* resources in the Gulf of Suez are overexploited and the fishery needs some management regulations for the improvement and development of its production. This is in agreement with most of the fisheries studies in the Gulf of Suez (Ahmed & El Ganainy, 2000; El Ganainy, 2003; El Ganainy & Sabrah, 2008; El Ganainy & Yassien, 2012; El Ganainy *et al.*, 2018; Osman et al., 2019). The fishing effort must be reduced by about 30% of its current level; this can be achieved by reducing the number of fishing days or the number of trawling trips and changing the gear characteristics (mesh size) to catch larger fish to maintain the stock productivity and its sustainability.

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