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Fisheries status of the common species of family Mullidae in the Southern Red Sea, Hurghada, Egypt

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ABSTRACT

The population structures and stock status of the goatfish (Family; Mullidae) were investigated from Hurghada, Red Sea, Egypt to reach the optimum exploitation. fish samples were monthly collected from the Hurghada harbor during 2016. As a result, the goatfish was mainly caught by gillnet and trammel nets in the study area, and they were classified into seven species; *Mulloidichthys flavolineatus* (Lacepède, 1801); *M. vanicolensis* (Valenciennes, 1831); *Parupeneus forsskali* (Four-manoir & Guézé, 1976); *P. macronema* (Lacepède, 1801); *P. cyclostomus* (Lacepède, 1801); *P.rubescens* (Lacepède, 1801) and *P. heptacanthus* (Lacepède, 1801). Measurments and information were collected for different species, while data anylysis was conducted for the most abundant ones (earlier three species). The catch composition by number showed that *M. flavolineatus* was the most abundant (43%), followed by *P. forsskali* and *M. vanicolensis* (19 %, and 12% respectively). Hence, the obtained data on these species were as follows; their average lengths were 20.04 ±2.86, 22.07±3.592 and 19.52 ±3.144 for *M. flavolineatus, M. vanicolensis* and *P. forsskali.* The length classes of *M. flavolineatus* ranged from 11-11.9 cm to 33-33.9 cm TL. The majority of lengths were 16 to 24 cm with the highest frequency at 19cm TL (16.92%). *M. vanicolensis*, ranged from 15 to 31 cm TL, and the most occurred lengths were from 17 to 28 cm with the highest frequency at 19 cm TL (16%). The length range of *P. forsskali* (11 to 27 cm), showed the highest frequencies at length groups (18 to 20 cm) with the highest one at 18-18.9 cm TL (14.93%). The over all sex ratio, gave the females predomination of *M. flavolineatus* (53.75%) and *M. vanicolensis* (68%) with ratio (1:0.86 and 1:0.47 respectively). *P. forsskali* showed slightly the parity between females (49.87%) and males (50.13 %) with sex ratio of 1:1.01. Gonado-somatic indices reflected the spawning season from May to August for *M. flavolineatus* while it extended from April to August for *M. vanicolensis* and *P. forsskali***.** The length at first capture (Lc) was 14.9, 15.53 and 11.98 cm for c. sexes of *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* respectively. The length at maturity (L_m) was 17cm, 19.2 cm and 16 cm for the same species respectively, and these were higher than those of Lc. The mean total mortality coefficients "Z," were found to be 1.49, 1.43 and 1.09 year^{-1} for three species respectively. Exploitation rate "E" was computed as 0.68, 056 and 0.49 respectively. These values were higher than the optimum expoitaions and other reference points for relative yield per recruit confirming their over exploitation status. So, the fisheries status of goatfishes need to more studies, its stock need to be reduced in to the suitable exploitaions from 0.68 to 0.33 ≈ 49% and 0.56 to 0.35 ≈ 39% and from 0.49 to 0.33 ≈ 32% for *M. flavolineatus, M. vanicolensis and P. forsskali* respectively combined with well management plan to be enhanced, recovered and to maintain a sufficient spawning biomass.

INTRODUCTION

The Red Sea fishes comprise the most diverse and abundant assemblages among its vertebrates and ecosystem. They have high social and economic values as the basis for subsistence and artisanal life styles of coastal communities in many tropical countries. They also support significant commercial fisheries (McClanahan *et al*., 2005; Sadovy, 2005). In Egypt, the Red Sea catch represented 47.94% of the total marine fisheries and 14.8% of the total natural fisheries (GAFRD, 2016). Goatfish (Family: Mullidae), one of the important fish families among the Red Sea fisheries, contains at least thirteen species recognized in 3 genera. They have an elongated and compressed body, with two long unbranched barbels on chin. They inhabit muddy and sandy bottoms in shallow water areas (Fischer and Bianchi, 1984). All species of family Mullidae are benthic carnivores, which use their sensory barbells to drive out prey.

Goatfish species have received an attention in different fields of scientific work, by different authors (1987; Wahbeh, 1992 a & b; Mehanna, 2009 a & b; Sabrah, 2015; Hamamm, 2017; Mehanna *et al*., 2017; Osman *et al*., 2018). The other sectors of interest like economic, turism and biodiversity are known and considered for the conservation of such fishes in different Red Sea areas. However, its catch has been declined in the Red Sea from 214 tonns during 2013 to 70 tonnes during 2016 (GAFRD, 2016). Hurghada is among the important areas in the Red Sea for tourism, economic and social purposes. However, it deosnt receive the enough attentions regarding the diversity and fisheries of goatfish species. So, these species need an intensive studies and continuous monitoring, particularly in such areas. The present work aimed to present recent information about Mullid fisheries status particularly in Hurghada, Red Sea, Egypt, to conserve and share the better management plan of the economic fishes.

MATERIALS AND METHODS

Study area and sample collection

The investigated area is located in Hurghada, the northern part of the Red Sea coast, Egypt (27^{o} 10' N– 27^{o} 30' N and 33^{o} 70' E–33^{o} 85' E) (Fig. 1).Goatfish samples were monthly collected from the commercial landings in Hurghada fishing harbor during the 2016 fishing season.The questionnaire of fishermen during sampling time considered the following items: landing day, fishing vessel and owner name, skipper name, crew number, length and width of fishing vessel, motor horse power, length and high of net and mesh size.The fish samples were transferred to the lab at the NIOF, Hurghada. After the separation of different species, the measurements of total lengths, standard lengths (mm) and total weight (g) were recorded for each fish specimen. The length frequency distribution was applied for the common species **(***M. flavolineatus, M. vanicolensis,*and *P. forsskali***),** to estimate the number of fish in each class group by the length. The sex ratio as the percentage of males to females (M: F) was determined, Chi-square test at 0.05 significance level was computed according to Snedecor (1956). The monthly Gonado somatic index (GSI= Gonad weight *100 / W) was calculated according to Sokal and Rohlf, (1969), where the W is the weight of fish (g).

For population structure, the total mortality coefficient (Z) was estimated by two different methods: the analysis of the cumulative catch curve of Jones & Van Zalinge, (1981) and the analysis of the length converted catch based on the length frequency data.The natural mortality coefficient (M)was estimated by means of the following

methods: Taylor's method (1960) as M = 3/tmax & Pauly's (1980) as Log M = - 0.0066 - 0.279 log L∞+ 0.6543 Log K + 0.4634 Log T

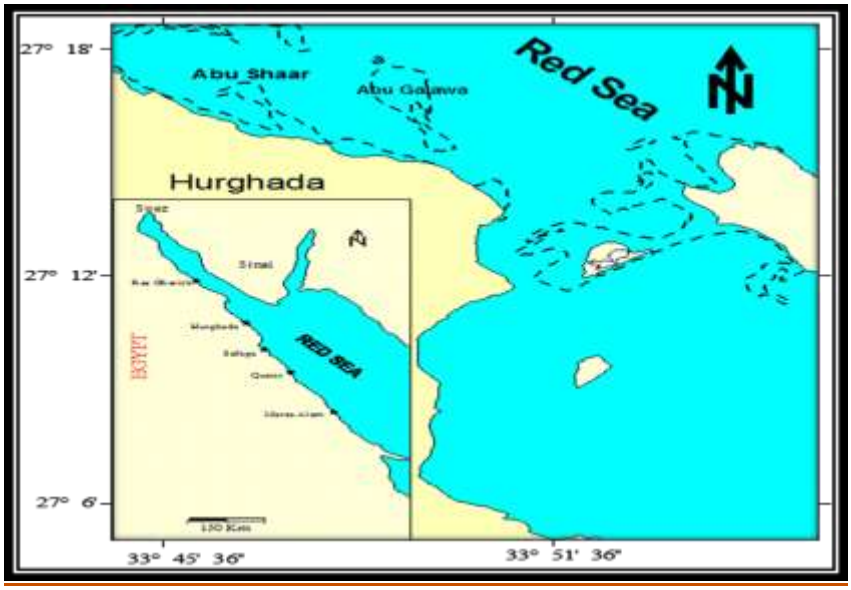

Fig. 1. Map shows the study area of Hurghadam, Red Sea, Egypt

Fishing mortality coefficient (F) was estimated as F= Z – M (Beverton and Holt, 1957). The length at first capture L_c (the length at which 50% of the fish at that size are vulnerable to capture) was estimated by the method of Pauly (1984) while the length at recruitment (L_r) was determined as the smallest fish in the catch. The length at first maturity (L_m) (the length at which 50% of fish become mature) was estimated accordingto (Pitt, 1970). Exploitation ratio (E= F / Z) was calculated according to Gulland (1971). The relative yield per recruit "Y/R`" was estimated by using the model of Beverton and Holt (1956) as modified by Pauly and Soriano (1986) and incorporated in the FiSAT software package as follows:

RESULTS

Description of Fishing gears used

The present study revealed that the goatfish were caught mainly by gillnet and trammel nets. The vessels used for the nets ranged from 5.5 to 16 m (25 to 80 horsepower). Usually they are woody boats with a crew number (3-12 persons). In addition, the net length ranged from 60 to 100 m and from 50 to 2500 m respectively. Their fishing season from September to the end of June of the following year and the trip duration is about 7- 10 days.

Gill nets consist of a single layer and narrow mesh size (1-1.5cm), normally joined together to form 10–100 units. The float line (float rope) is usually made by materials such as polypropylene. The distance between each floating piece is 20 cm with a diameter of 5 cm and is 3 cm thick. The ground line (foot rope) has solid lead pieces mounted externally. The lead weight is about 16.5 gram and the distance between each lead is about 25 cm. Sometimes, it is used to catch needlefish, squirrelfish, goatfish and barracuta. While the trammel nets consist of three successive layers; central (inner panel) layer with narrow mesh size (1.5-2.5 cm), located between two outer layers characterized by a wider mesh size (5-8 cm- outer panel). In the float line (float rope), there are cutting cork (diameter of 6 cm and is 4 cm thick) that the distance between each of them is 30 cm. The lead rope (foot rope) found in the lower rope, the distance between each lead is about 40 cm and hand 180 cm high. It is used in fishing goatfish, mullet and rabbitfish.

Species diversity

In the present work, the goatfishes (Family Mullidae) collected from Hurghada were classified into seven species namely *Mulloidichthys flavolineatus* (Lacepède, 1801); *Mulloidichthy svanicolensis* (Valenciennes, 1831); *Parupeneus forsskali* (Fourmanoir & Guézé, 1976); *Parupeneusmacronema* (Lacepède, 1801); *Parupeneuscyclostomus* (Lacepède, 1801); *Parupeneus rubescens* (Lacepède, 1801); and *Parupeneusheptacanthus* (Lacepède, 1801) (Figure 1). From this figure, there were some specific features for each species that vary in color and morphometrics.

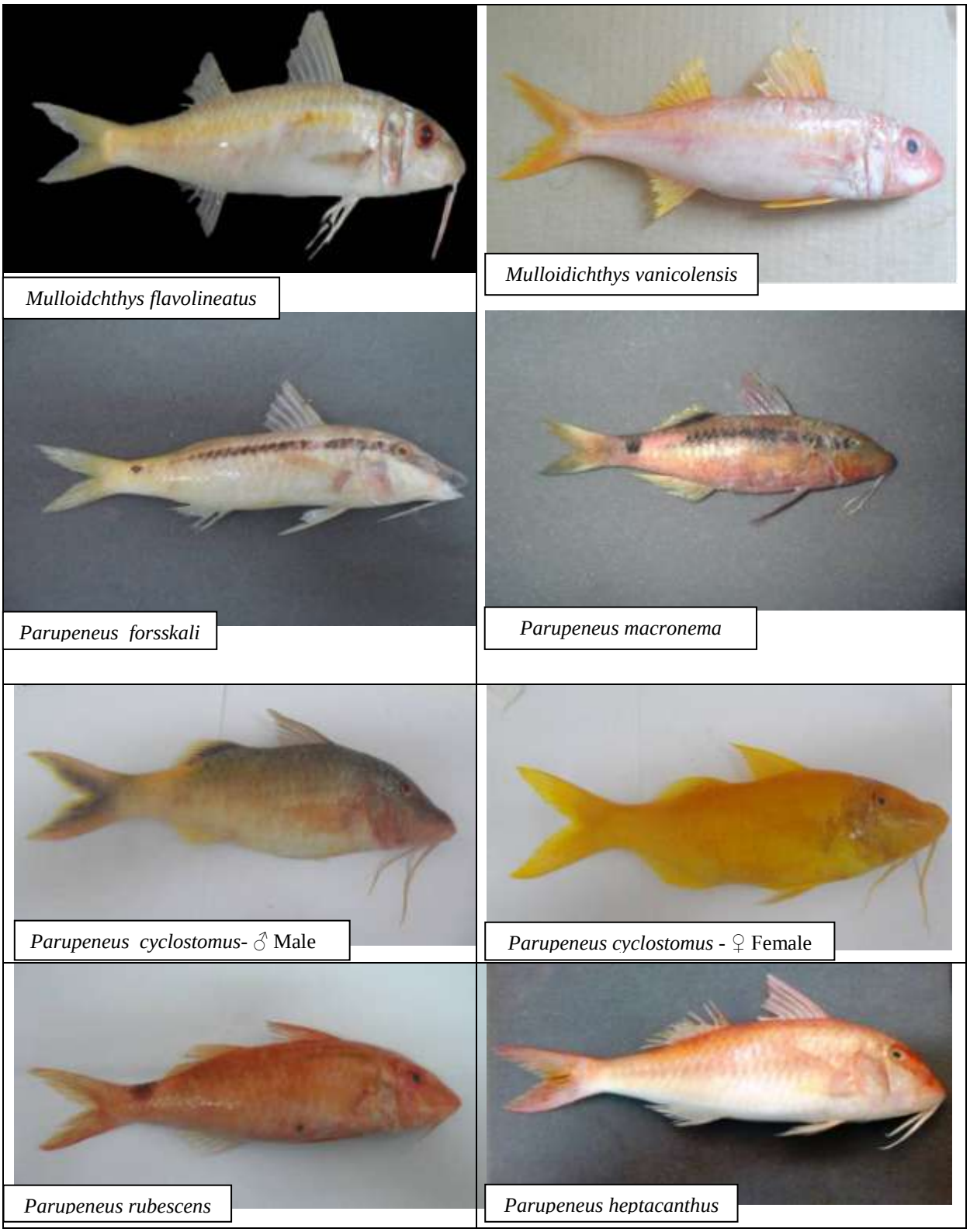

Fig. 2: The goatfish species collected from the Hurghada fishing landing during this study.

The *M. flavolineatus* is characterized by a body with 1-2 longitudinal yellow bands, and a dark blotch below the first dorsal fin.The *M. vanicolensis* has a chin with a pair of slender barbels which reaches beyond near margin of preopercle. The *P. forsskali* has a broad black stripe is present from the side of upper lip through eye along the upper side of the body. The *P. macronema* has a long dorsal spine, a body is grayish red dorsally, with a black stripe from the eye along lateral line to the anterior part of caudal peduncle. The barbels of *P. cyclostomus* are much longer than the head, its color is yellowish grey. The *P. heptacanthus* has the posterior end of maxilla evenly convex, a small reddish brown spot on the upper side of the body just below the seventh and the eighth lateral-line scales. The *P. rubescens*is color variable, with or without a black saddle on caudal peduncle.

Species composition by weight and number

Catch composition of the goatfish species by number and weight (Figs. 3A, B) showed that *M. flavolineatus* was the most abundant species in number, constituting 43%; followed by *P. forsskali; M. vanicolensis; P. macronema; P. cyclostomus; P. heptacanthus* and *P. rubescens*, constituting 19 %, 12%, 10%, 9 %, 5%, and 2%, respectively. Regarding the weight, *M. flavolineatus* was the dominant species, also constituting 34%; followed by *P. cyclostomus, M. vanicolensis, P. macronema, P. heptacanthus* and *P. rubescens*, constituting 16 %, 14 %, 13 %, 12 %, 6 % and 5 %, respectively. The Maximum length and weight, minimum length and weight and mean of seven goatfish species are shown in Table (1). From this table and their seasonal occurrence (Figure 4), it is noticed that the most dominant species were *M. flavolineatus*, *P. forsskali*; *M. vanicolensis*, starting with *M. flavolineatus*, followed by the other ones respectively. Therefore, the continuous studies deal with those three species.

Length frequency

The length frequency of *M. flavolineatus, M. vanicolensis* and *P. forsskali* fluctuated during the whole year, their average lengths were determined as 20.04 ±2.86, 22.07±3.592 and 19.52 ±3.144 cm TL for three species respectively. The length classes of *M. flavolineatus* varied between 11-11.9 cm and 33-33.9 cm TL. The lowest frequency was at 11-12 (0.48%) and 28–33 cm (0.24-0.24%), while the most dominant length classes were from 16 cm to 24 cm with the highest frequency at 19cm TL (16.92%). In respect to *M. vanicolensis*, the length ranged between 15 and 31 cm TL, and the lowest observed frequency was at 15– 16 cm TL (0.44-0.89%), while the most occurred lengths were from 17 to 28 cm with the highest frequency at 19 cm TL (16%). On the other hand, the length frequencies of *P. forsskali* were ranged from 11 to 27 cm, the lowest observed frequency was at group 11-12 cm (0.27-0.27%), while the highest frequencies were at length groups 18 to 20 cm with the highest one at 18-18.9 cm TL (14.93%) (Figure 5).

Table 1: Data descriptions of the seven goatfish investigated during the study period.

Species	*M. flavolineatus*	*M. vanicolensis*	*P. forsskali*	*P. cyclostomus*	*P. macronema*	*P. heptacanthus*	*P. rubescens*
Total No. samples.	839	225	375	175	184	88	47
Total sample W. (g)	73270.98	29110.71	35108.92	29750.00	27126.81	13760.00	11426.00
Min- Max. TL(cm)	11- 33.4	15.3- 31.2	11.5- 27.9	14.4- 35.43	13.1- 27.1	12.8- 32.7	14.9- 34.6
Min- Max. W (g)	11.85- 423.26	36.72- 361.25	16.67- 257.28	141.87- 486.65	41.30- 243.20	44.3- 239.8	57.93- 234.54
Average TL(cm)	20.0± 2.86	22.1± 3.592	19.5±3.144	24.2± 2.36	20.1± 2.58	21.11± 2.73	22. 78± 3.75
Average W (g)	87.331± 45.14	129.381± 76.199	93.624± 49.051	246.7±282.34	97.04 ± 25.34	110.36± 33.30	152.196± 72.84

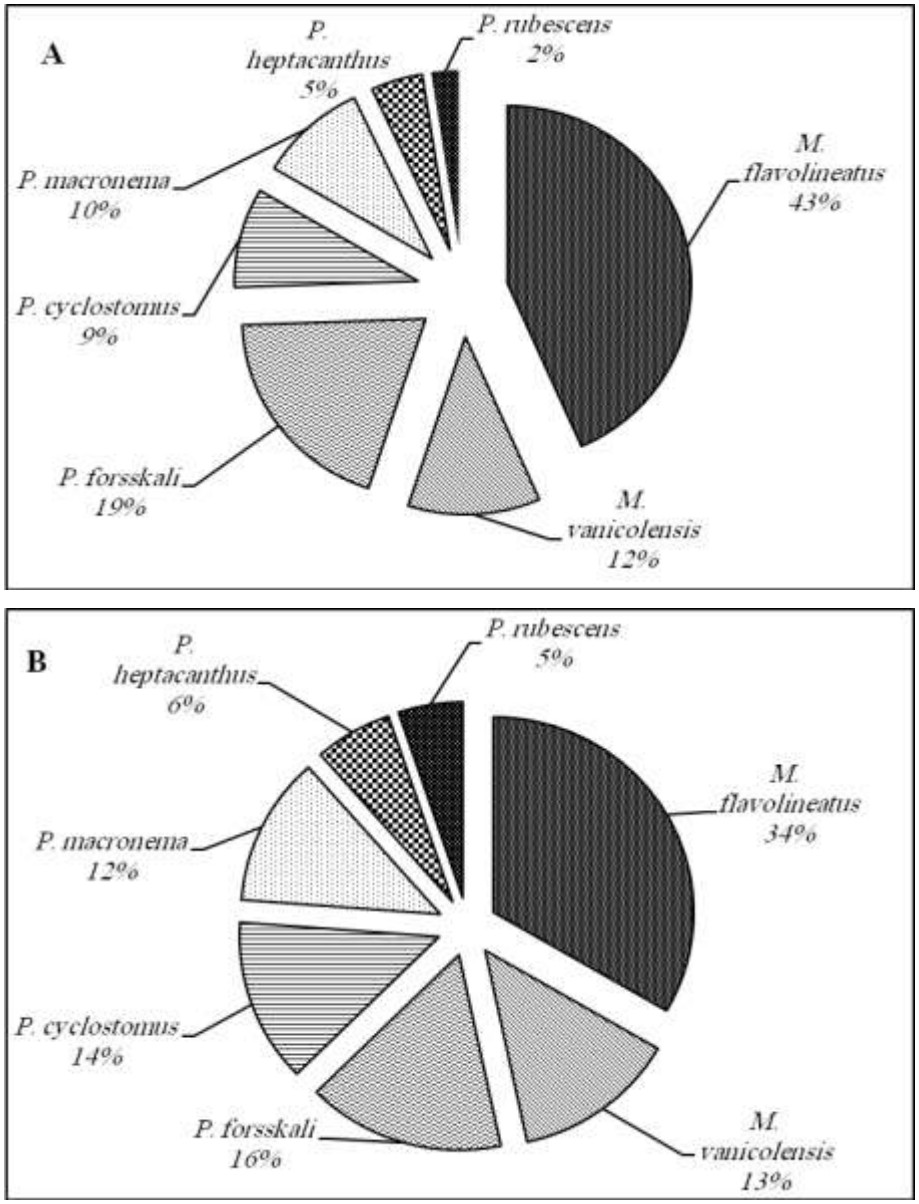

Fig. 3: Species composition of the seven goatfish according to (A) number and (B) weight per gram during the study period.

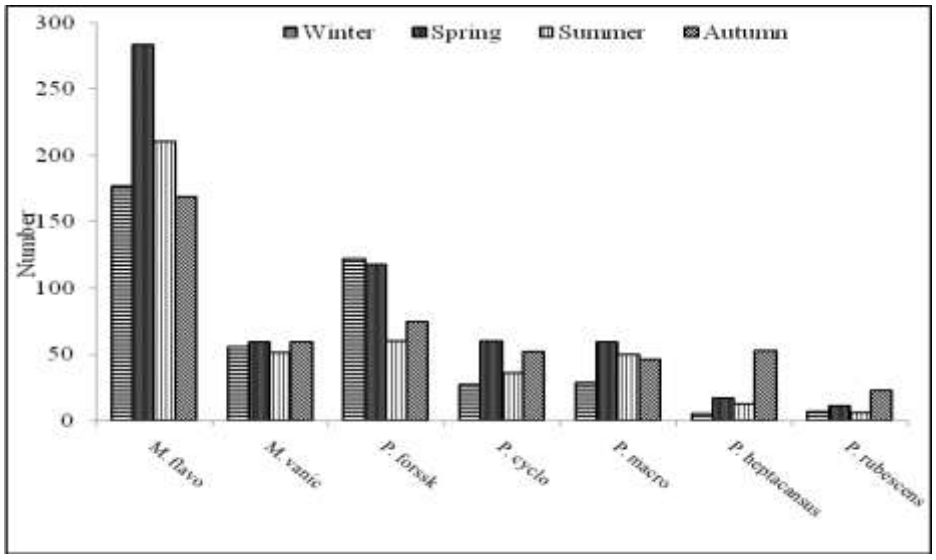

Fig. 4: The seasonal occurrence of the species of goatfish during this study.

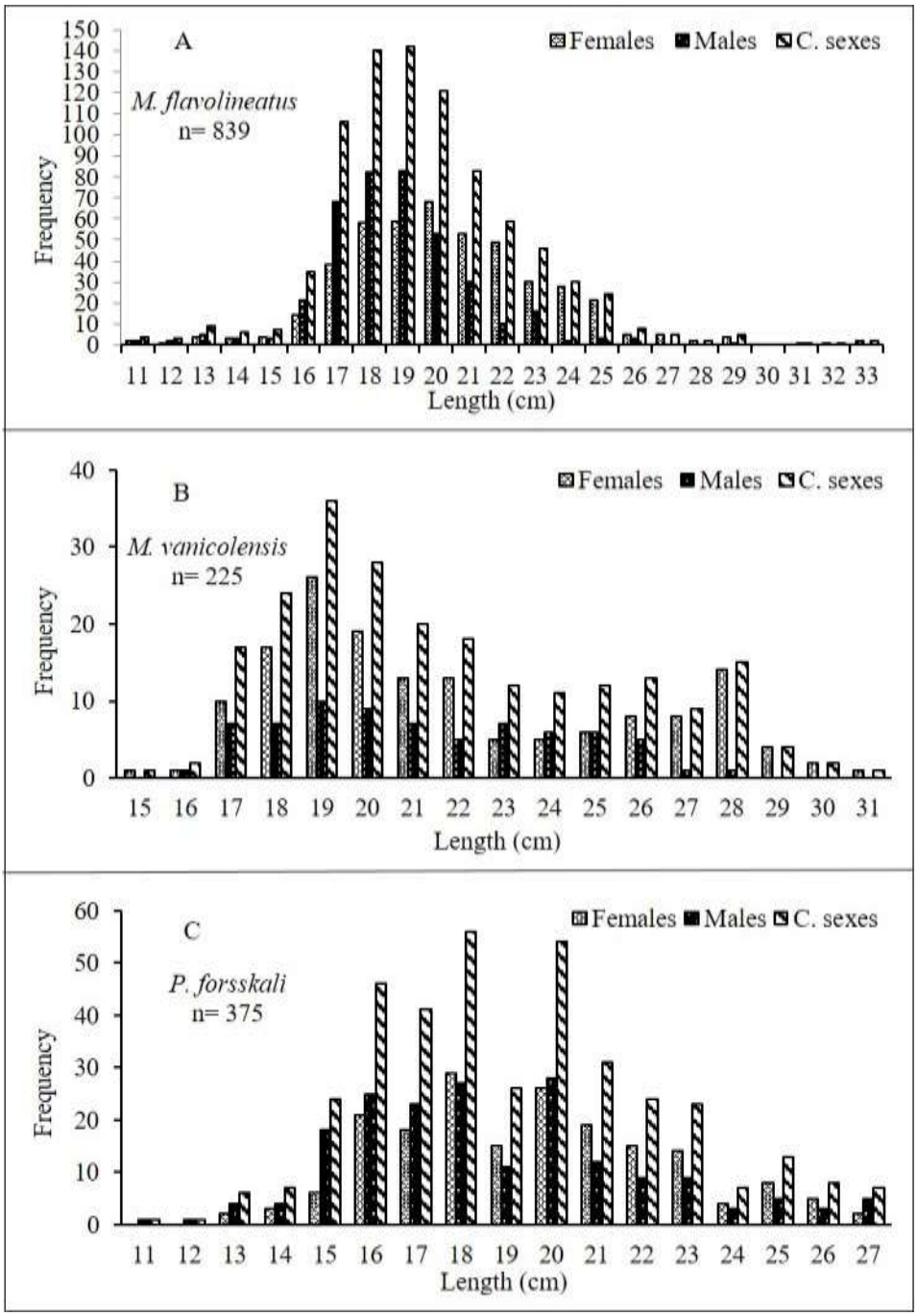

Fig. 5: Length frequency distribution of (A) *M. flavolineatus,* (B) *M. vanicolensis* and (C) *P. forsskali,* n= total sample size for each species.

Gonado-somatic index (GSI).

The monthly gonado-somatic indices (GSI) were estimated for the three investigated species (Figure 6 A- C). The values of GSI of females and males of *M. flavolineatus* started to increase in May with values of 2.78±3.97 and 1.48±0.58, respectively, reaching its maximum in June (5.08±2.88 and 2.75±1.13 respectively). Then, it is sharply decreased in September (0.34±0.59 and 0.12±0.08) for females and males, respectively. For *M. vanicolensis*, GSI values of C. sexes started to increase in April (1.07± 1.74), reaching its peak in June (2.85± 2.06). Then, it declined at the end of August with a value of 0.99± 51. Regarding *P. forsskali*, GSI values sexes started to increase in April with values of 1.27±1.90 and 0.97±1.00 for females and males, respectively, reaching the peak in June (5.33±3.77 and 1.81±1.20 respectivel). Then,

decreased at the end of August with values of (0.47±0.23 and 0.39±0.08) for females and males, respectively. These results illustrated that the spawning season extended from May to August for *M. flavolineatus* while it extended from April to August for *M. vanicolensis*and *P. forsskali.*

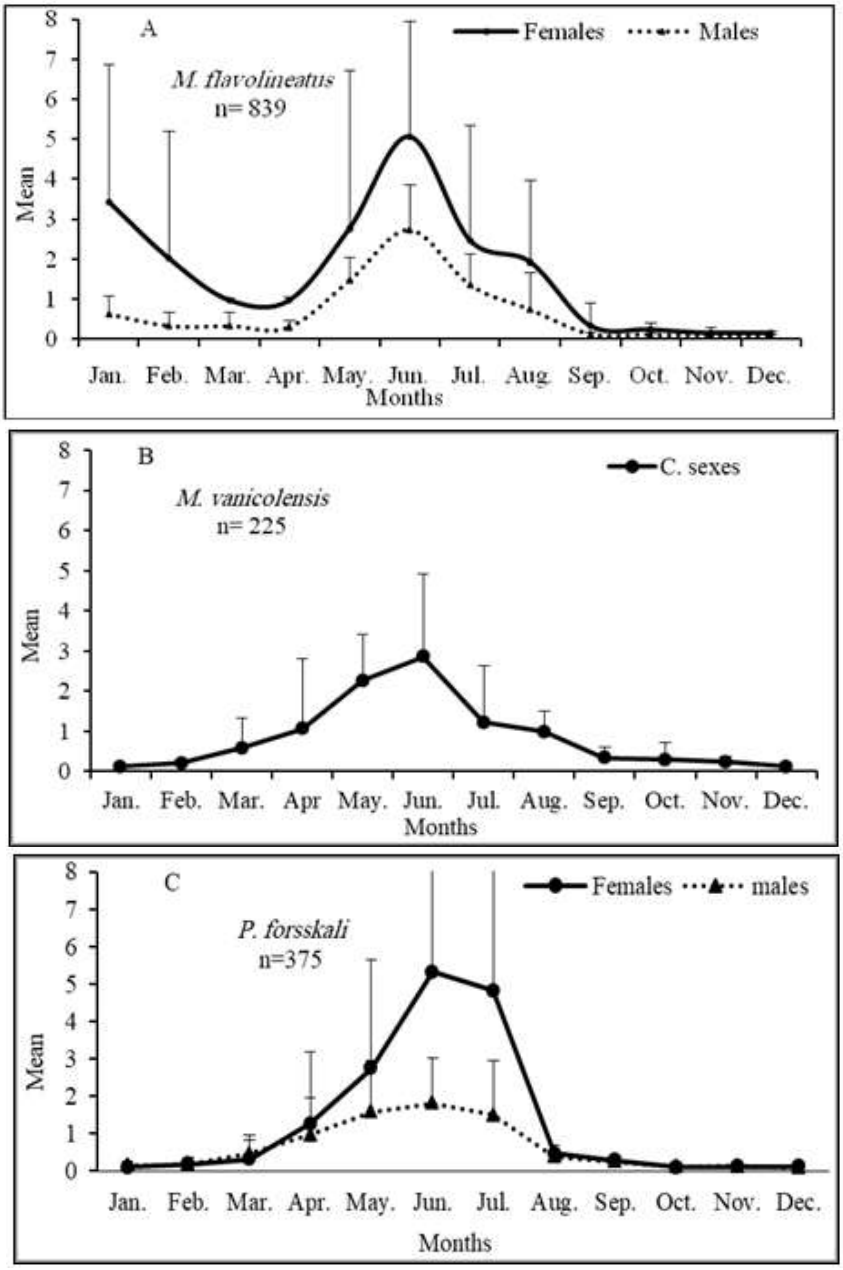

Fig. 6: Monthly variations in GSI of the (A) *M. flavolineatus*, (B) *M. vanicolensis* and (C) *P. forsskali*, n = total sample size for each species.

Population structure of the common three species

Sex ratio

Monthly variations in sex ratio of *M. flavolineatus*, *M. vanicolensis,*and *P. forsskali* were investigated. It is noticed that the females of *M. flavolineatus* predominated fish samples (53.75%), while the males formed 46.25% of the total sampled fish. For *M. vanicolensis,* females also were in domination (68%) and male accounted 32 % of the total collected sample. The third species (*P. forsskali*) showed slightly the parity between females (49.87%) and males (50.13 %) of the total collected fish. Regarding the length

variations, there was a great fluctuation in sex ratio with length groups. But, the overall sex ratio showed the same domination of females (1:0.86 and 1:0.47) for *M. flavolineatus* and *M. vanicolensis* respectively. While the *P. forsskali* showed slightly parity between males and females over all lengths as overall months with sex ratio of 1:1.01 (M:F).

Length (L_c) at first capture, Length (L_r) at recruitment and Length ($L_{m)}$ at first maturity

According to catch curve, the C. sexes showed that the length at first capture (Lc) was 14.9, 15.53 and 11.98 cm for *M. flavolineatus, M. vanicolensis* and *P. forsskali* respectively (Figure 7 A-C). The lengths at recruitment (L_r) of *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* were estimated as 11, 15.3 and 11.5 cm for all samples respectively. Based on the maturation curve (Figure 8 A- C), the length at maturity (L_m) was estimated as 17cm for *M. flavolineatus,* while it was 19.2 cm for *M. vanicolensis* and 16 cm for *P. forsskali*.

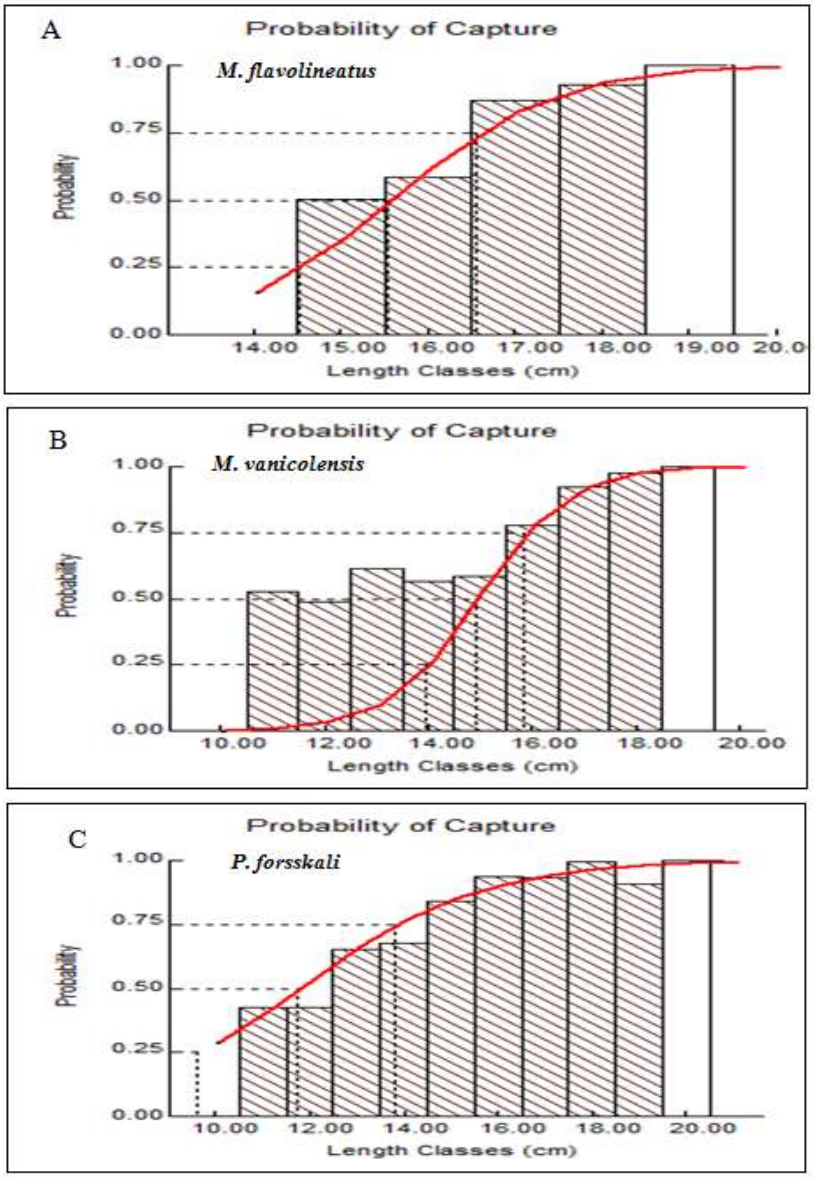

Fig. 7: length at first capture for (A) *M. flavolineatus*, (B) *M. vanicolensis* and (C) *P. forsskali*, (N = total sample size for each species).

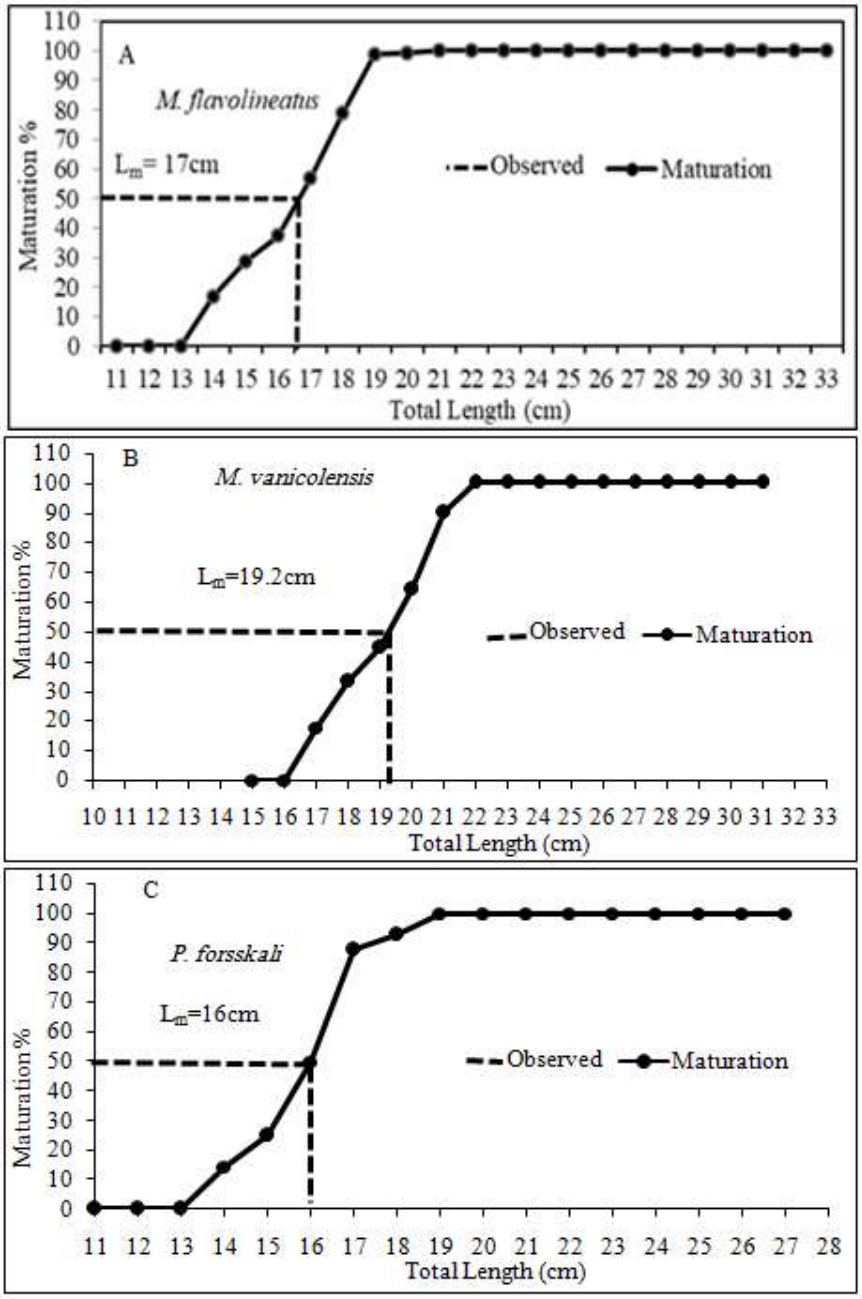

Fig. 8: length at first maturity for (A) *M. flavolineatus*, (B) *M. vanicolensis* and (C) *P. forsskali*.

Mortalities Coefficients (Z), (M), (F), (A) and Exploitation Ratio (E)

The mortalities coefficients are shown in (Table 2). The total mortality coefficients (Z) for *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* were estimated by two methods. The mean of values was calculated as 1.49, 1.43 and 1.09 years^{-1} for the three species, respectively. The mean values of the natural mortality coefficients (M) resulted from different methods were estimated as 0.48, 0.64 and 0.55 year^{-1} for *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* respectively. The fishing mortality (F) was estimated as 1.02, 0.80 and 0.53 years^{-1} for three species, respectively. In regard to the annual mortality rate (A), it was estimated as 0.78, 0.761 and 0.66 year^{-1} for *M. flavolineatus*, *M. vanicolensis*, and *P. forsskali*respectively. Furthermore, the survival rate (S) was calculated as 0.22, 0.239 and 0.40 year^{-1} for the same species respectively. The exploitation rates as preliminary indicators of stock exploitation for *M. flavolineatus*, *M. vanicolensis*, and *P. forsskali* were 0.68, 056 and 0.49 respectively.

Relative yield per recruit (Y/R)'.

The relative yield per recruit (Y/R)' of three species under different exploitatons as a reference points are presented in table (3). The maximum (Y/R)' was obtained at E_{max}.= 0.61, 0.74 and 0.60 for *M. flavolineatus* and *M. vanicolensis* and *P. forsskali* respectively), the calculated at 1/10 of the yield at $E_{0.1}$ (0.52, 0.61 and 0.51 for three species respectively). Moreover, the exploitation will result in areduction of the unexploited biomass by 50% ($E_{0.5}$) was estimated as ($E_{0.5}$ = 0.33, 0.35 and 0.33 for *M. flavolineatus*and *M. vanicolensis* and *P. forsskali* respectively). These present levels and maximum levels of exploitation (E_{max} = 0.61, 0.74 and 0.60 for *M. flavolineatus* and *M. vanicolensis* and *P. forsskali* respectively) were higher than the calculated reference points ($E_{0.5}$ =0.33, 0.35 and 0.33 for *M. flavolineatus*and *M. vanicolensis* and *P. forsskali* respectively).

Table 2: Total mortality coefficient and natural morality coefficient of *M. flavolineatus, M. vanicolensis* and *P. forsskali*

Method / Species	Total mortality			Natural mortality		
	Jones –Van Zaling	Length- converted catch curve	Mean	Pauly (1980)	Taylor (1960)	Mean
M. flavolineatus	1.38	1.60	1.49	0.67	0.28	0.48
M. vanicolensis	1.05	1.82	1.43	0.86	0.42	0.64
P. forsskali	1.04	1.13	1.09	0.74	0.37	0.55

Table 3: Current exploitation and other reference points of the exploitation for *M. flavolineatus, M. vanicolensis* and *P. forsskali*

Species	$E_{0.1}$	$E_{0.5}$	E_{max}	$E_{current}$	Decreasing %
M. flavolineatus	0.52	0.33	0.61	0.68	45
M. vanicolensis	0.61	0.35	0.74	0.56	39
P. forsskali	0.51	0.33	0.60	0.49	32

DISCUSSION

The present study introduced an important points to the stock status of the goatfishes from Hurghada, Red Sea water. They were mainly caught by trammel and gill nets. Golani and Ritte (1999) reported that the goatfish, caught from the Red Sea, by different gears,including beach seine and trammel nets. In the Mediterranean Sea, goatfish species are mainly collected by trawling (Mehanna, 2009a & b; Hammam, 2017; Mehanna, 2018). In fact, the topography and bottom habitats differ from region to another, like those in the Red Sea and the Mediterranean Sea. It is noticed that the Hurghada area in the Red Sea has a lot of reef regions. So, the suitable gears used are the artisanal gears, like trammels and gillnets. While, the sea bottom in the Mediterranean is flat and wider than the Red Sea and more suitable for bottom trawl activity.

The present goatfishes were classified into seven species, namely *M. flavolineatus, M. vanicolensis, P. forsskali, P. macronema, P. cyclostomus,P. rubescens,* and *P. heptacanthus.* For *M. flavolineatus.* The photos description of species was in agreement with other authors as Randall (2004); Fernandez-Silva *et al.* (2016), Saeed (2016) and Akel and Karachle (2017). The barbles of goatfish were considered as very important character to study the differences between species. According to Gosline, (1984) and Lombarte & Aguirre, (1997), the barbels have been found to considerably vary in structure, size, and sensory equipment. The present species of *P. cyclostomas* has the longest barbles while *P. forsskali* and *P. macronema* have the shortest ones.

The present study illustrated that three species, *M. flavolineatus, M. vanicolensis* and *P. forsskali,* were the most abundance and distribution all over year. The population

structures as sex ratio and length at first captureare are very important parameters in the fisheries management. In the present study, the females dominated males of *M. flavolineatus* (1: 0.86), and it was the most abundant in all length groups. For *M. vanicolensis* (1: 0.47) were females more abundant in all lengths. Regarding *P. forsskali* the sex ratio were (1: 1.01). This difference and predomination of females in the catches, in the present work, may be related to the difference in the availability of both sexes for the fishery and spatial segregation of sexes or different feeding behavior when a baited gear is used, this is in accordance with Mendonca *et al*. (2006) and Farrag (2014).

The spawning season, in the present study (May to August), for *M. flavolineatus* was in agreement with Boray (1969). While the spawning period reported by Cole (2009) for the yellowstripe goatfish (*M. flavolineatus*), was from April to June. Maaty (2015) mentioned that the Larvae of the *M. flavolineatus* species were collected during the warmer months of the year (March-August), which indicated that the spawning seasons were during the spring and the summer which may be due to different locations and their climatic changes.On the other hand, the spawning was extended from May to July for *M. vanicolensis* and *P. forsskali*, Jehangeer, (2003), it was slightly shorter than the present investigation (April to August). Cole (2009) stated that the yellow-fin (*M. vanicolensis*) had an extended spawning season, being reproductively active almost year-round, with the lowest female fecundity occurring in the months of November, December and January. These variations may reflect the probability to be an extended spawning which may agree with the closed season (October to February) in the Red Sea, Egypt by Egyptian Government.

In the present study, the fishing mortality coefficients (F) were estimated at 1.02, 0.80 and 0.53/ year^{-1} for*M. flavolineatus*, *M. vanicolensis* and *P. forsskali* respectively. The high values of fishing mortalities reflected the over-fishing condition for goatfish stock in Hurghada. It is also clear that *M. flavolineatus* were characterized by the highest rate of fishing mortality, followed by *M. vanicolensis* and *P. forsskali*.

Table 4: Mortality coefficients (Z, M, F and E) of goatfish species of this study and those of previous studies.

Species	Region	sex	Z (/year)	M (/year)	F (/year)	E (/year)	Authors
M. flavolineatus	Hurghada	C. sexes	1.49	0.48	1.02	**0.68**	Present study
M. vanicolensis	Mauritius Lagoon		2.64	1.17	1.47	**0.56**	Jehangeer, (2003)
	Hurghada		1.43	0.64	0.80	**0.56**	Present study
P. forsskali	Hurghada		2.76	0.9	1.86	**0.67**	Sabrah (2015)
			1.09	0.55	0.53	**0.49**	Present study

The values of the total, natural, fishing mortality and exploitation rates in the present study and those reported from other studies are represented in (Table 4). Sabrah (2015) estimated the "Z, M, F and E" for combined sexes of *P. forsskali*, they were higher than the present study. These differences may be due to fish size, length, and the number of samples and conditional factors. It was found to be 0.22, 0.239 and 0.40 year $^{-1}$ for *M. flavolineatus*, *M. vanicolensis*, and *P. forsskali* respectively. The lower value of survival rate confirmed the critical situation of the present investigated stock.

From another point of view, the present lengths of first sexual maturity, (L_m= 17cm) for the *M. flavolineatus*, (19.2 cm) for *M. vanicolensis* and (16 cm) for *P. forsskali*, were higher than the present lengths at first capture (L_c= 14.9, 15.53 and 11.98 cm) for the same species respectively. This indicated the difficulties the goatfish face to spawn at least once before reaching the maturation. So, prohibiting the fishing operation,

particularly during their spawning season, is recommended. Moreover, it must be raised to be around/more 18, 20 and 17.0 cm in order to give a chance for the species to spawn at least once. Therefore, the fishing methods adopted in this fishing area should be re-appraised to prevent cropping of small individuals ≤18.0, ≤ 20 and ≤ 17 cm for *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* respectively.

The other studies (Table 5) showed that L_m of *M. flavolineatus* in the present study were in agreement with Murty (2002) who estimated L_m at 17.5 cm. However, the present work attained higher L_m than that reported by Boray (1969) and less than that of De la Cruz (1986) where the later author estimated L_m at 19.8 and 20.8cm for males and females, respectively,in the Philippines. These differences might be due to the varied habitat, sampled sizes, different localities, and different conditions. Regarding the *M. vanicolensis*,L_m in this study disagreed with that one mentioned by Jehangeer (2003) since it was higher than that in the present study. For *P. forsskali*, the present L_m was higher than the one reported by Sabrah (2015) from the same area of the Red Sea.

Table 5: Compare the L_m in the present study with the different locations.

Scientific Name	Authors	L_m (cm)	Sexes	Country	Locality
M. flavolineatus	Boray (1969)	11 SL	Female	Egypt	Hurghada
		12 SL	Male		
	De la Cruz (1986)	19.8 TL	Male	Philippines	Guiuan, Samar (Dec 1983-Nov 1984)
		20.8 TL	Female	Philippines	Guiuan, Samar (Dec 1983-Nov 1984)
	Murty (2002)	17.5 TL	unsexed	India	Lakshadweep lagoons, 1993-97
	Present study	17TL	C. sexes	Egypt	Hurghada, Red Sea
M. vanicolensis	Jehangeer (2003)	24.0 TL	Male	Mauritius	Lagoon, 1988
	Present study	19.2TL	C. sexes	Egypt	Hurghada, Red Sea
P. forsskali	Sabrah (2015)	15.38TL	C. sexes	Egypt	Hurghada, Red Sea, Egypt
	Present study	16TL	C. sexes	Egypt	Hurghada, Red Sea,

The exploitation rates (E) of *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* were found to be 0.68, 0.56 and 0.49/ year respectively. These results were higher than the optimum exploitation E=0.5 and gave primary indicator for over exploitation. The relative yield at other different exploitations and reference points were E_{max}= 0.61, $E_{0.5}$= 0.0.33 and $E_{0.1}$= 0.52 for *M. flavolineatus*. It is obvious that the current point of exploitation (E = 0.68) was higher than $E_{0.5}$ that maintained 50% of the spawning stock biomass. For *M. vanicolensis*. the current point of exploitation rate (E= 0.56) was higher than E_{max}= 0.74, $E_{0.5}$= 0.0.35 and $E_{0.1}$= 0.61. Also, the the current point of exploitation rate (E) for *P. forsskali* is 0.49 was higher than the optimum exploitation $E_{0.5}$= 0.033.

According to Jehangeer (2003), the exploitation rates of *M. vanicolensis* were E=0.56, $E_{0.1}$=0.66 and E_{max}=0.71. While *P. forsskali* was estimated by Sabrah (2015) in the same area and the exploitation ratios were computed as E=0.67, E_{max}= 0.58, $E_{0.5}$= 0.34 and E_{10}= 0.597. These findings illustrated that the estimated values previously were higher than the optimum values and higher than the present one for *P. forsskali* in the same area. This recommended that precautionary prodedures for management with the reduction in the exploitation levels are needed. According to Sabrah (2015), the exploitation rate (E=0.67) was higher than that one given the utmost relative yield per recruit (E= 0.58) and the exploitation ratio must be decreased from 0.67 to 0.342 ≈ 50%. In conclusion, the fisheries status of goatfishes need more studies, its stock need to be

reduced in to the suitable exploitaions. To ascertain that at least 50% of the stock can keep the spawning stock, the current value of exploitation ratio must be decreased from 0.68 to 0.33 ≈ 49%, 0.56 to 0.35 ≈ 39% and from 0.49 to 0.33 ≈ 32% for *M. flavolineatus*, *M. vanicolensis* and *P. forsskali* respectively combined with well management plan to be enhanced and recovered.

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ARABIC SUMMARY

حالة المصايد للأنواع الشائعة من عائلة Mullidae فى جنوب البحر الأحمر، مصر

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تم دراسة حالة مصائد و نمط معيشة عشائر أسماك البربونى والمعروفه بالعنبر(فصيلة ملليدى) بالغردقه فى الجزء الجنوبى من البحر الاحمر, مصر، لما لهذه الأسماك من أهميه فى مجالات مختلفه منها المصائد الطبيعيه والسياحه وغيرها وذلك بهدف الوصول الى الاستغلال الامثل واستدامته بالاضافه الى المحافظه على الانواع. تم جمع عينات الأسماك شهريا من ميناء الصيد بالغردقة خلال عام ٢٠١٦. وكانت النتائج كالاتى . طرق الصيد الرئيسية المستخدمة بالغردقة لهذه الاسماك هى الشباك الخيشومية ذات الطبقة الواحدة وشباك الكنار او التلعبك ذات الثلاثة طبقات. كما تم تصنيف اسماك العنبر المصاده الى سبعة انواع خلال فترة الدراسه كالاتى:

Mulloidichthys flavolineatus (Lacepède, 1801); Mulloidichthys vanicolensis (Valenciennes, 1831); Parupeneus forsskali (Fourmanoir & Guézé, 1976); Parupeneus macronema (Lacepède, 1801); Parupeneus cyclostomus (Lacepède, 1801); Parupeneus rubescens (Lacepède, 1801); Parupeneus heptacanthus (Lacepède, 1801).

تم جمع القياسات والمعلومات للأنواع المختلفة بموقع الانزال والمعمل ايضا في حين أجريت الدراسات المكثفه على الانواع لأكثروفرة (الأنواع الثلاثة الاولى)

أظهرالتركيب النوعى للمصيد من حيث العدد أن *Mulloidichthys flavolineatus* كان أكثر الأنواع وفرة (٤٣ ٪) ، يليه *P. forsskali* بنسبة ١٩% و *M. vanicolensis* ١٢ ٪ على التوالي). وبالتالي تم تركيز الدراسه على الأنواع الثلاثه وكان متوسط أطوال الأنواع الثلاثة ٢٠.٠٤ ± ٢.٨٦ و ٢٢.٠٧ ± ٣.٥٩٢ و ١٩.٥٢ ± ٣.١٤٤ لـ *M. flavolineatus* و *M. vanicolensis* و *P. forsskali* على التوالى. و تراوح مدى الأطوال للنوع *M. flavolineatus* من ١١- ١١.٩ سم إلى ٣٣- ٣٣.٩ سم طول كلى. واكثرية الاطوال كانت من ١٦ حتي ٢٤ سم مع أعلى تكرار للطول ١٩ سم بنسبة ١٦.٩٢ % بينما تراوحت الاطوال للنوع *M. vanicolensis* من ١٥ إلى ٣١ سم TL ، وكانت الأطوال الأكثر حدوثا من ١٧ إلى ٢٨ سم مع أعلى تكرار للطول ١٩ سم بنسبة ١٦ ٪). وكان النوع الثالث P. forsskali يتراوح فى الطول من ١١ إلى ٢٧ سم مع أعلى تكرارات في مجموعات الطول (١٨ إلى ٢٠ سم) مع أعلى واحد في ١٨-١٨.٩ سم بنسبة ١٤.٩٣ ٪). كما تم دراسة نسبة الذكور للاناث على مدار العام وأظهر النوع *M. flavolineatus* اكثرية الاناث ٥٣.٧٥% بمعدل ١:٠.٨٦ اناث الى ذكور وايضا النوع *M. vanicolensis* بنسبة ٦٨% للاناث بمعدل ١:٠.٤٧اناث الى ذكور أما النوع الثالث (*P. forsskali*) فقد أظهر تبايًنا طفيفًا بين الإناث (٤٩.٨٧٪) والذكور (٥٠.١٣٪) مع نسبة الجنس ١: ١.٠١. عكست مؤشرات النضوج الجنسى للمناسل GSI ان موسم التزاوج من مايو إلى أغسطس للنوع *M. flavolineatus* بينما امتدت من أبريل إلى أغسطس للنوعين - *M. vanicolensis* و *P. forsskali*. كان الطول Lc عند الصيد والذى يكون عنده ٥٠% من الافراد معرضه للصيد ١٤.٩و١٥.٥٣و ١١.٩٨ سم لنفس الانواع الثلاثه على التوالى. كما كان الطول Lm عند النضج الجنسى١٧ و ١٩.٢ سم و ١٦ سم لنفس الانواع على التوالي. وكان اكبر من الطول المعرض للصيد. وجد أن متوسط معاملات الوفيات الكليه "Z" هو ١.٤٩ و ١.٤٣ و ١.٠٩ سنة $^{-1}$ لـ *M. flavolineatus* و *M.vanicolensis* و *P. forsskali* على التوالي.

تم حساب معدل الاستغلال "E" كـ ٠.٦٨ و ٠.٥٦ و ٠.٤٩ على التوالي للانواع الثلاثه. وكانت هذه القيم أعلى من قيم الاستغلال الأمثل ونقاط أخرى للمعطى النسبيى بالجرام لكل نوع مؤكدا حالة الاستغلال المفرط والعالى للأنواع محل الدراسه. لذا ، فإن وضع وحالة مصائد أسماك العنبر يحتاج إلى مزيد من الدراسات ،كما يجب تخفيض استغلال المخزون منها الى قيم مناسبة من ٠.٦٨ إلى ٠.٣٣ ≈ ٤٩٪ ومن ٠.٥٦ إلى ٠.٣٥ ≈ ٣٩٪ ومن ٠.٤٩ إلى ٠.٣٣ ≈ ٣٢٪ لـلانواع الثلاثه *M. flavolineatus* و *M. vanicolensis* و *P. forsskali* على التوالي جنبا إلى جنب مع خطة الإدارة الجيدة والتي سوف تعزز وتستعيد وتحافظ على الكتلة الحيوية لان تبقى فى استدامه وتكاثر كافى