

Abundance of the groupers fish (Teleostei: Serranidae) along Gulf of Aqaba

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ABSTRACT

The groupers abundance was studied in sixteen stations representing four sites along the Gulf of Aqaba. Sixteen species belonging to five genera of groupers were recorded across the four sites. The mean abundance of all groupers species in Ras Mohamed NP and Sharm El Sheikh City were found to be higher than that of Nabq and Abu Galum MRPA. The highest abundance of groupers were recorded in Ras Nasrani (76 SE±2.08) and Ras Um Sid (71 SE±2.0). There was no significant difference of groupers abundance between depths of 5 m and 15m in all of the studied sites. Based on their ecological behavior, groupers were divided into separate groups, and abundance was investigated for each group. Abundance of the cryptic and roving groupers was higher than that of the large mobile groupers, in all of the studied sites. While cryptic and roving grouper included both abundance and rare species, large mobile groupers species were all rare. The pattern of occurrence for the three different groups was repeated in all sites, except for Abu Galum MRPA where no large mobile grouper was recorded, probably due to over fishing. Diversity of groupers in all of the studied sites increased with the increase of abundance.

Keywords: Coral reef, Epinephelinae, fish abundance, Groupers, Gulf of Aqaba, Red Sea, Serranidae, South Sinai protectorates.

INTRODUCTION

Studies of community structure in coral reef systems are of increasing importance at present and directly beneficial to managers of reef fisheries and reefs management for tourism and other purposes. Groupers (Family: Serranidae) are one of the largest groups of tropical fish with over 400 known species (Wolf, 1999). They are considered as one of the top level of predators and has a high market value, that cause this group became the most important around the world (JEFRI *et al.*, 2015). This property makes it an important component of reef ecosystems, helping to maintain the ecological balance of complex coral reef communities (Sluka *et al.*, 1996). Because of their trophic position near the top of the food chain, they can act as health indicators of the reef ecosystem. Consequently, the reliable data on the abundance and distribution of Groupers is important for sound management of these fishes as well as to provide a foundation for understanding groupers distribution and reef fish life history strategies (Pogonoski *et al.*, 2002). Little information exists on patterns of abundance for the majority epinepheline species (Pogonoski *et al.*, 2002). The main exception is for *Plectropomus leopardus* on the Great Barrier Reef, as considerable information has been collected on patterns of abundance for this commercial species since 1980 (Ayling *et al.*, 2000; Mapstone *et al.*, 2004).

Groupers are less studied than many other fish (Parrish 1987). Furthermore, known to consume a broad range of prey including fish, crabs, shrimps and other benthic crustaceans although there is considerable variation among species. Groupers are generally associated with hard bottoms, while juveniles are found in seagrass beds, and adults of smaller number species prefer silty or sandy areas (Prokop, 2002). Some species such as *Variola* spp. occur in depths of 100 to 200 m,

however, the majority inhabit areas less than 100 m in depth (Heemstra and Randall, 1993). Although the popular of groupers are widespread, they face several threats including habitat destruction and over fishing (Sullivan and Sluka, 1996; Dalzell, 1996; Birkeland, 1997).

Habitat dependence among fish families has shown to be stronger in Groupers, which lead a relatively sedentary life (Parish, 1987; Lindberg *et al.*, 2006). Groupers make use of shelters and even when visually exposed, often remain close to large masses of hard substrate (Ormond, 1980). Reef complexity and habitat features a strong influence on the success of predatory strategies either directly by altering the effectiveness of the ambush strategies (Samoilys, 1997; Auster, 2005). Otherwise, indirectly by changing the density of the resources of small fish, crustaceans and other types of prey (Almany, 2004). In addition, their slow growth rates, long life and relatively low fertility (Grandcourt 2005), that put them in danger due to both natural and human impact (Sadovy *et al.*, 2012). So, all these characteristics make groupers mostly exposed to declines in reef habitat as a result of climate change and associated disturbances.

From the previous works it is become clear the grouper fish in the Gulf of Aqaba (Shipgl, 1985) or over all the world (Zapelini *et al.*, 2017) become under threaten. However, information about their biological and ecological studies in the Gulf of Aqaba is scarce. Basic information on reproduction, food, and feeding as well as distribution and abundance and the territory of each species, are very important elements to know how preparing for management and conservation the population of grouper fishes in coral reef ecosystem.

The aim of this study was to explore spatial patterns of abundance, distribution for groupers along the Gulf of Aqaba at different depths. In addition to examining the degree to which the presence of Groupers are related

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to various physical and biotic habitat features of the coral reef ecosystem. The survey will include all protectorates in South Sinai (Ras Mohamed, Nabq, Sharm El-Sheik City and Abu Galum), which were established in the gulf of Aqaba.

MATERIALS AND METHODS

The following section outlines the procedure for undertaking visual census surveys at the permanent monitoring sites after the Australian Institute of Marine Science (AIMS) fish monitoring protocol (Halford and Thompson 1994). The survey carried out in four sectors, namely Ras Mohammed National Park, Sharm El Sheikh City, Nabq Managed Resource Protected Area and Abu Galum Managed Resource Protected Area. Each sector includes four stations during October, November and December 2006 (Fig. 1) (Table 1). The sector location determined by using a GPS. Two divers cooperate to carry out the survey. One diver (observer) was equipped with a slate, identification sheet, pencil and data sheets. The observer conducts the 200 meter transect with width 10 meters. The transects were

carried out at two depths 5 meters and 15 m. The observer swims in a zigzag pattern (zigzag pattern used to ensure cover all the areas of transect) over the transect and counts the number of individuals of each grouper species sighted within the area of 5 meters on either sides. The location of the transects were selected at 5m and 15m depth for the reason that they could be cover depth ranging between 1 meters to 20 meters. The other diver follows the observer approximately five meters behind. Fish identification during this study follows Randall's guide in Red Sea Reef Fishes (1983). Also consider the characteristic behavioral groups into three (after Samoilys and Carlos, 2000) based on foraging pattern, crypticity and body size inferred from published literature and underwater observations. The behavioural groups are "*cryptic serranids*", "*roving serranids*", and "*large mobile serranids*". In an attempt to reduce variability in fish densities (due to diurnal influences on behavior) sampling excludes the high activity periods of early morning and late afternoon. Sampling has been limited between 0900 and 1600. This time window also excludes periods of poor visibility caused by the low sun angle.



Figure (1): South Sinai Peninsula with Study area, 1 = Ras Mohammed National Park, 2 = Sharm El Sheikh, 3 = Nabq Managed Resource Protected Area and 4 = Abu Galum Managed Resource Protected Area.

Table (1): The latitude and longitude for all stations of the surveyed sectors.

Sectors	Stations	North	East
Ras Mohamed NP	Marsa Ghozlany	27.84436°	34.27585°
	Old Quay	27.73745°	34.23954°
	South Berika	27.77529°	34.21061°
	Shark observatory	27.73227°	34.25915°
Sharm Al Sheikh	Ras um Sid	27.84745°	34.31324°
	Ras Nasrany	27.964158°	34.418334°
	Jakson Reef	28.005461°	34.471445°
	Gordon Reef	27.984750°	34.452062°
Nabq MPRA	Naklteltal	28.145388°	34.444444°
	Elmonkataa	28.20616°	34.41908°
	wadi ghorabi	28.230795°	34.415859°
	Kaber elbent	28.392340°	34.447161°
Abu Galum MPRA	Ras Mamleh	28.730477°	34.627104°
	Dehila south	28.610714°	34.552363°
	Dehila noth	28.614322°	34.560475°
	Lagoona	28.639646°	34.583178°

RESULTS

Distribution of groupers (Serranids)

Occurrence of the Groupers

The following species of Grouper were observed, which were found in the 16 stations, where 16 species related to five genera of groupers were recording as follows; Genus *Cephalopholis*: *C. oligosticta*, *C. sexmaculata*, *C. argus*, *C. hemistiktos*, and *C. miniata*; Genus *Variola*: *V. louti*; Genus *Plectropomus*: *P. maculatus* and *P. areolatus*; Genus *Anypserodon*: *A. leucogrammicus*; Genus *Aethaloperca*: *A. rogae*; Genus *Epinephelus*: *E. fasciatus*, *E. polyphekadion*, *E. fuscoguttatus*, *E. malabaricu*, *E. taurina*, and *E. areolatus*. The most common species recorded at all sectors were *C. miniata*, *C. hemistiktos*, *C. argus*, *V. louti*, and *E. fasciatus*, which recorded in 12, 11, 10, 9, and 9 stations respectively. However only *C. miniata* and *C. argus* recorded in all station of the Ras Mohammed and Sharm El-Sheikh. *C. oligosticta*, *A. leucogrammicus*, *E. polyphekadion*, *E. fuscoguttatus*, *E. malabaricu* and *E. areolatus* were represented only in one station.

Abundance of the grouper fishes

There was a very significant difference in the average abundance of groupers fish observed at each of the study sectors (P-value = 0.001). Average abundance was highest at Sharm El-Sheikh sector 54.125 (SE±0.83) / 2000m³ and lowest at Abu Galum 3.12 (SE±0.61) / 2000m³. Although no significant difference was found between Nabq and Abu Galum, (Fig. 2). However, the average abundance in Ras Mohamed and Nabq were recorded with 28.38 (SE±0.39) / 2000m³ and 3.13 (SE± 0.10) / 2000m³.

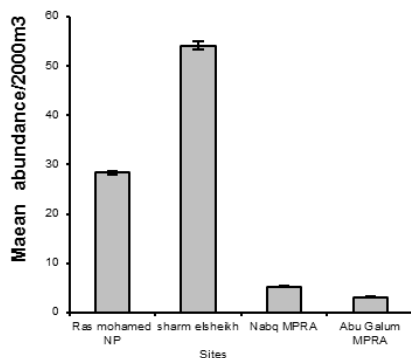


Figure (2): Mean abundance of groupers in all studied sectors.

The groupers abundance was studied in sixteen stations represented four sectors along the Gulf of Aqaba. One way analysis of variance showed a highly significant difference (P-value= 0.0001) between all stations which indicated that the mean Groupers abundance varied from one station to another. Whereas the maximum mean abundance was recorded in the Ras Nasrany and Ras Um Sid with mean groupers abundance 76 (SE±2.08) / 2000m³, 71 (SE±2.0) / 2000m³ respectively (Fig. 3). On the other hand the lowest mean abundance was found in Elmonkataa and Lagoon stations where

mean grouper abundance were 2.0 (SE±0.74) / 2000m³ and 1.5 (SE±0.94) / 2000m³ respectively (Fig. 3).

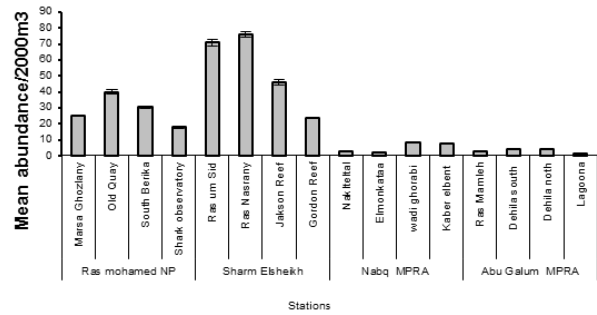


Figure 3: Mean abundance of groupers in all studied stations.

No significant difference was found for abundance of groupers (P-value =0.59) with depth, regardless of sit. With regard to mean abundance of different grouper species, regardless of the sites and depth (Fig. 4), there was a very significant difference (P-value =0.0001) between *C. miniata*, *C. hemistiktos*, and *V. louti* species. There was no significant difference in the mean groupers abundance between all other species. The *C. miniata*, *C. hemistiktos*, and *V. louti* had mean abundance 11.16 (SE±2.9), 4.75 (SE±1.16) and 2.1 (SE±0.49) respectively. While the lowest mean abundance recorded for *E. polyphekadion*, *E. fuscoguttatus*, *E. malabaricus* and *E. areolatus* with same value 0.03 (SE±0.1) (Fig. 4).

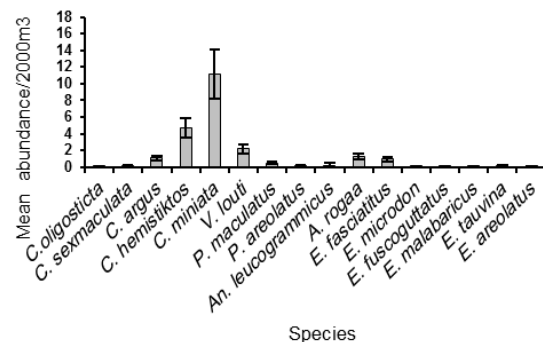


Figure (4): Mean abundance of different groupers species, regardless of sectors.

The mean abundance of grouper species was studied in two different depths (15m and 5m) for all stations. Two way ANOVA showed that there is no significant difference between mean abundance for all groupers species and depth (P-Value = 0.999), but there was a marginally higher in depth 15m more than 5m (Fig. 5). Whereas the heights mean abundance recorded for *C. miniat* were 11.3 (SE±4.22) and 11 (SE±4.3) at depth 15m and 5m respectively. However, there is a highly significant difference in mean value for all groupers species between sites (P value = 0.0001) and stations (P value = 0.0001). As seen in figures 6, the mean value for all species very high in Ras Mohamed NP and Sharm Sheikh when compare to the other two sites Nabq MPRA and Abu Galum MPRA.

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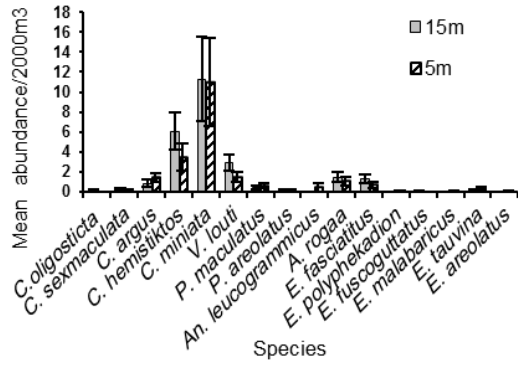


Figure (5): Mean Abundance of groupers species in different depth regardless to sectors.

The distribution of various species in all sectors showed that there were three sectors include most species, those sectors are Ras um Sid, Ras Nasrany and Jakson Reef. Also the presence of such species were with high abundance in the previously sites, especially the following six species, *C. argu*, *C. hemistiktos*, *C. miniata*, *V. louti*, *A. rogae* and *E. fasciatus*.

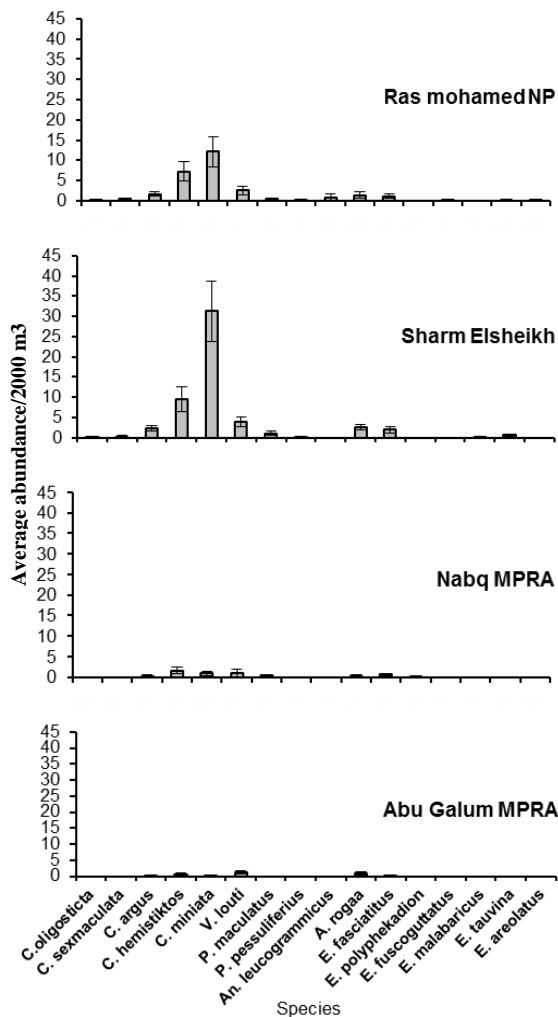


Figure (6): Comparison of mean Abundance of Groupers species in different sectors.

Abundance of the groupers fish according to ecological behavior.

During this study all groupers fish were reclassified according to the ecological behavior for each species (Samoilys and Carlos, 2000). One way analysis of variance (ANOVA) showed a highly significant difference (P-value= 0.00431) between cryptic, roving and large mobile groupers, indicating that the density was different within each sectors for all variables. Figure (7) A indicating that density pattern for all groupers was largely driven by patterns in abundance of cryptic groupers, which were the most abundance behavioural group in most sites. The cryptic, roving and large grouper had mean abundance of 29.1 (SE±0. 371), 2.5 (SE±0. 194), and 0.1 (SE±0. 017), respectively.

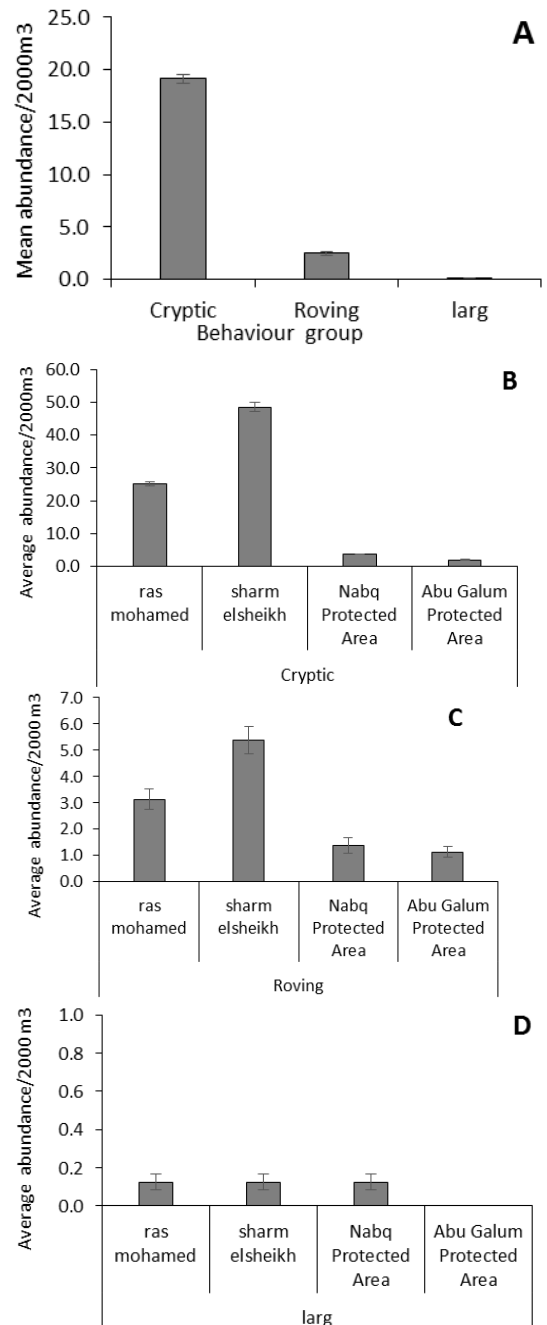


Figure (7): Mean abundance of ecological behavioural groups for all Grouper species at different Sectors

Cryptic and Roving groupers were more abundance in two sites, namely; Sharm El Shiekh and Ras Mohamed NP than other sites in either Nabq MPRA and Abu Galum MPRA. Whereas the cryptic groupers mean abundance, were 45.6 (SE±1. 29) and 25.1 (SE± 0.61) at Sharm El Sheikh and Ras Mohamed NP respectively. However the roving grouper mean abundance, were 5.4 (SE±0. 52) and 3.1 (SE± 0.401) at same site respectively (Figure 7 B and 7 C). In case of large mobile groupers, there was no clear difference in all, sectors, where the mean abundance was recorded with the same value, being 0.125 (SE± 0.416), in Ras Mohamed NP, Sharm Elsikh and Nabq MRAP. While the large mobile groupers was not recorded at all in Abu Galum MRAP (Fig. 7 D).

The sixteen station surveyed showed significant variation in mean abundance for cryptic groupers (P-value= 0.001). The highest mean abundance were recorded generally at Ras um Sid, Ras Nasrany and Jakson Reef, being 69.5 (SE±3.233), 67(SE±3.1) and 41(SE±2.47) and the relative abundance for same sites were 19.12%, 18.43% and 11.28 respectively (Fig. 8). While the lowest mean abundance were recorded at Elmonkata, Dehila north and Naklteltal being 0.5 (SE±0. 5), 1 (SE±0. 06) and 2.5 (SE± 0.14). The relatively abundance for the same sites were 0.14%, 0.28 and 0.69% respectively (Fig. 8). However, there was no significant difference for roving (P-value= 0.11) and large mobile groupers (P-value= 0.603) (Fig. 8).

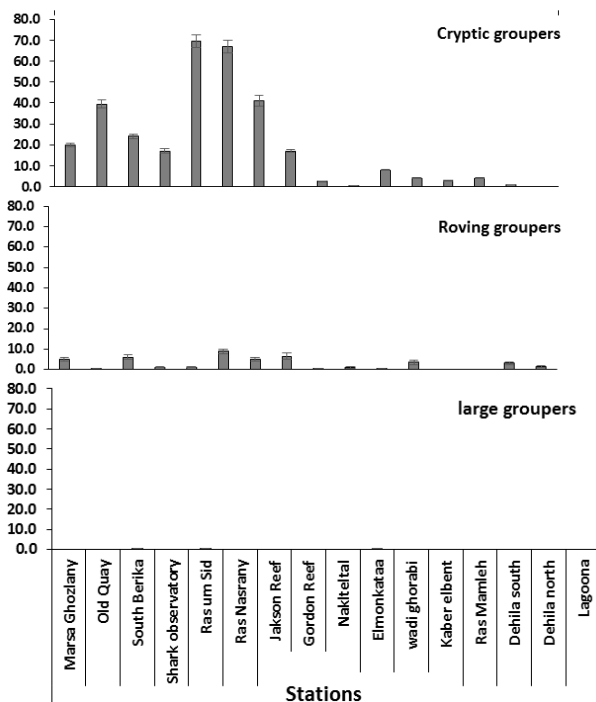


Figure (8): Mean Abundance of cryptic, roving and large Groupers in different stations.

The mean abundance of cryptic, roving and large mobile grouper as well determined at 15m and 5m depth in all study sectors. ANOVA analysis showed no significant variation in mean abundance of cryptic, roving and large groupers with depth, regardless of the sectors (Fig. 9). The highest mean abundance for cryptic

groupers were estimated generally at depth 15 meters, being 21.3 (SE± 0.53) 4, where at depth 5 m it was 18.4 (SE± 0.51). While roving grouper recorded with mean abundance at depth 15m and 5m with 3.4 (SE± 0.32) and 2.1 (SE± 0.21) respectively (Fig. 9). However, the mean abundance for large mobile grouper recorded at the same rate in 15 and 5 m depth, by 0.1 (SE ± 0.2) (Fig. 9).

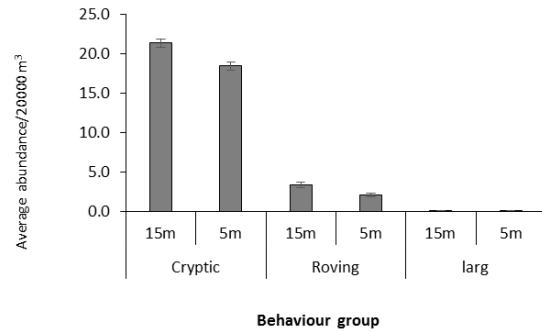


Figure (9): Mean Abundance of cryptic, roving and large groupers in different depths regardless to sectors.

DISCUSSION

This research was carried out to investigate the abundance of Groupers fish population (Family Serranidae) along the Gulf of Aqaba, inside four sectors within the marine protected areas of South Sinai (Ras Mohamed National Park, Sharm El-Sheikh City, Nabq Managed Resource Protected Area and Abu Galum Managed Resource Protected Area). Those protected areas along the Sinai coast, declared by the Egyptian Government, to effectively protect the entirety of Egypt’s Gulf of Aqaba littoral zone (Pearson and Shehata, 1998).

All of the reefs selected for the survey were similar in being continuous fringing reefs, with two exceptions; Jackson Reef and Gordon reef (in Sharm El Sheikh Sector), which are offshore reefs, in order to reduce habitat influences. Different substrates vary locally, which in turn may have influenced the fish communities to some extent. However, substrate composition did not vary over the regions or affect the fish communities largely. This suggests that factors such as fishing pressure and urban development are likely to be more responsible for observed differences in fish populations (Ashworth and Ormond, 2005).

Occurrence of the groupers

Randall (1983) recorded 19 grouper species belonging to the Subfamily Epinephelinae all over Red Sea. In the present study, 16 grouper species out of the 19 confirmed by Randall (1983) were recorded in the Gulf of Aqaba. This result is in agreement with El-Dawi (2000), who investigated reef fishes in the Protectorates of Southern Sinai: Ras Muhammed NP, Nabq MRPA and Abu Galum MRPA were surveyed between September 1994 and July 1995. All species recorded by El-Dawi (2000) are the same in this study except for *E. chlorostigma* and *E. microdon* which were mentioned

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only in El-Dawi study, while *E. polyphkadion* and *P. areolatus* were recorded only in this research. These differences may have been due to the difficulty of correctly identifying species. This difficulty is attributable to past taxonomic confusion, the similarity of colour pattern of some species, ontogenetic changes and other variations in colour patterns (Heemstra and Randall, 1993). The results obtained in the present study are mostly well matched with Ghorab *et al.* (1983) and El-Dawi (2000) who studied the abundance of grouper in the same study area. Whereas, the highest numbers of grouper species were recorded in Ras Mohamed NP and Sharm Elsheik sectors with 12 species for each, followed by Nabq MRPA and Abu Galum MRPA sectors with 8 and 6 species respectively. It was similarly evident that, the species number in Nabq is higher than in the previous studies, this can reasonably be explained by applying fisheries management in Nabq where fishing is prohibited in about 60% of the coastal line (Pearson and Shehata, 1998).

Abundance of the groupers fish.

Comparison of the groupers fish abundance in the four study sectors revealed an interesting trends, particularly when each sector was marked fished or unfished, as classified by Pearson and Shehata (1998) and Ashworth (2004), the abundance of groupers was found to be significantly greater within unfished area. Increases in density of targeted fishes in unfished area have frequently been seen, especially with major commercial species such as groupers (Galal *et al.*, 2002; Ashworth and Ormond, 2005; UNEP and WIOMSA, 2015).

Ashworth (2004) studied the coral reef fish's abundance in south Sinai protectorates, and confirmed that, the fish abundance in unfished area is higher than that of the fished areas. A similar pattern was seen by Roberts and Polumin (1992) who additionally recorded significantly higher densities of some coral fishes in unfished areas than in lightly and heavily fished areas, which corresponds with result from this study. The mean abundances of all grouper species in Ras Mohamed NP and Sharm El Sheikh Sector are higher than in Nabq MRPA and Abu Galum MRPA sector. That may be due to the effect of fishing in Nabq and Abu Galum sectors and since the coral cover and structure of the habitat are approximately the same in all four sectors (internal report/South Sinai Protectorates 2005, 2006). The obtained results in present study agree with Ashworth, (2004) and El-Dawi (2002). As well, the obtained result mostly supported by Limmon *et al.* (2017) who pointed out, the importance of the management of the grouper fish by various ways, ranging from the declaration of marine protected areas, to the establishment of a non-taking zone and has been shown to be an effective management strategy to increase the population and help maintain and increase the grouper stock and diversity.

In recent decades, development pressure has been extremely high around the town of Sharm El Sheikh,

with development (mostly hotels) now stretching along the coast from the northern edge of Ras Mohammed NP to the southern edge of Nabq MRPA (Hawkins and Roberts, 1994; Pearson and Shehata, 1998). The development has been well managed and regulated by South Sinai Protectorates to avoid impacts, such as infilling and sewage discharge into the sea, prohibited (Hawkins and Roberts 1994; Pearson and Shehata 1998). SCUBA diving and snorkeling are a major industry in Ras Mohammed NP and around the towns of Sharm El Sheikh. These activities are known to cause damage to coral reefs (Medio *et al.*, 1997; Hawkins *et al.*, 1999). Nevertheless, tourism and its associated effects do not appear to have had large effects on fish populations around Ras Mohammed NP and Sharm El Sheikh Sectors, with few instances of significantly lowered density in these areas compared to Nabq MRPA sector which has much lower levels of tourism impacts. The findings of the present study are in agreement with studies mentioned above, where the relative abundance of groupers fish in Sharm El-Sheikh stations is represented by 59.6% from total groupers in all sectors. In addition, almost all of the hotels in Sharm El Sheikh control the fishing activity along the coast by allowing no recreational or commercial fishing boats in front of the hotels (personal observations).

Jones (1991) and Sluka *et al.* (2001) confirmed there was correlated fish abundance or biomass and structural features of reefs or between offshore and onshore reef. Each of these studies has shown that some features of a particular site, usually associated with structural complexity, influenced significantly the distribution or abundance of coral reef fishes (Sluka *et al.*, 2001). However, in the present study the results obtained are not well-matched with Jones (1991) and Sluka *et al.*, (2001), where the highest abundance of groupers fishes were recorded in inshore reef like Ras Nasrani (76 SE±2.08) and Ras Um Sid (71 SE±2.0) while offshore reefs like Jackson Reef (46 SE±1.5) and Gordon reef (23 SE±0.5) are lower in terms of Grouper fish abundance. In spite of the designation of some sites as unfished, some illegal fishing takes place in such sites (personal observations). That is because those sites do not undergo full control by the Ras Mohamed NP; however, as the recreational diving being practiced at both sites during most of the day, the fishing activities are limited.

Densities of each grouper species were also examined. Where all of the 16 species recorded in this study showed increased density in both Ras Mohamed NP and Sharm El Sheikh Sectors (unfished areas). The three most numerous groupers were *C. miniata*, *C. hemistiktos* and *V. Louti*. Three of them represented about 79.5% of the total recorded fishes in the present study, as confirmed by the previous study near Sharm El Sheikh, Ras Mohammed NP and Nabq MRPA (Ashwarth, 2004). *C. miniata* represented the highest percentage 49 % of the total counted fishes. The reason behind that might be explained by the occurrence of this species in social groups, where each group is composed of 4 to 6 individuals.

Abundance of the groupers fish according to ecological behaviour

There are a few studies that addressed the grouper abundance from the point of ecological view, one of them Pears (2005) described and compared characteristics of groupers abundance on the GBR and the Seychelles Islands, and provided abundance estimates for three behavioural groups (cryptic grouper, roving grouper, and large mobile grouper). He also found that the abundance of the cryptic and roving behavioural groups is higher than that of the large mobile grouper species in both regions.

The results obtained in the present study, regarding the abundance of the different ecological group of groupers, completely agree with Pears (2005). Similarly, the abundance of the cryptic and roving groupers is higher than large mobile groupers, which are ranked rare in all the studied sectors. While cryptic and roving grouper included both abundance and rare species, the large mobile groupers species were all rare. Current research are well-matched with Pears (2005), where the cryptic groupers are considered the most dominant in all of the studied sectors, where it represented 87.5% followed by roving groupers estimated at 12% of the total species, and large mobile occurred in very low percentage (0.4%) thus considered rare species. Most species of cryptic grouper in particular are small-bodied and are not a highly targeted fishing species compared to the roving and large mobile grouper. The pattern of occurrence for each of the three different groups was similar in all sectors, except for Abu Galum MRPA sector where no large mobile grouper was recorded, this is mostly attributed to the effect of overfishing. These results are considered serious and need furthermore scientific research to be conducted and better management measures, which decline in the abundance of large grouper species may affect the ecological role of species in the ecosystem as a major predator, as well as an impact on the community structure (Britten *et al.*, 2014; Mat Piah *et al.*, 2018).

There are several possible reasons for this pattern. First, it is possible that roving and large grouper are more susceptible to fishing pressure by line and spear fishing than cryptic grouper (Ashworth, 2004; Zapelini *et al.*, 2017). Second, because of large territory and long-distance spawning migration of roving and large grouper (Bolden, 2000). Therefore, the species that migrate to spawn will certainly spend some period outside of the reserve boundaries. The longer the time spent outside the reserve, the more vulnerable fish become to fishing mortality (Chapman and Kramer, 1999). The second argument is more acceptable. Many aggregation sites for spawning of *Pelctopomus maculatus*, *Epinephelus Fuscoguttatus* and *Epinephelus Malabricus* are known to local fisherman and recreational fishing outside the boundaries of protectorates. This finding is in full agreement with Tupper (2002) who found large grouper (Nassau grouper) spawning aggregation roughly 40 km from the reserve area. In contrast, cryptic groupers are known to aggregate just 200 - 340 m outside the eastern boundary of the park, at the southeastern tip of South Caicos.

Thus, because of the roving and large grouper spend longer periods outside the reserve boundaries; they will receive lesser benefit from the reserve than cryptic species. The third reason is related to an effectively damaging fishing technique, such as hand-lining from the reef edge or from a boat (Galal *et al.*, 2002) and trawling by line and artificial bites (personal observations), both of which are highly selective for high predators especially grouper fishes. In addition to increasing demand for fish by the restaurants of the tourist resorts of South Sinai until recently a seasonal fishery was allowed in Ras Mohammed NP sector for the lethinid *Lethrinus nebulosus* (local name 'Shour') but is now prohibited to safeguard stocks (Salem, 1999), nevertheless, frequent incidences of illegal fishing within reserve boundaries have been reported (personal observation).

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دراسة توزيع كثافة أسماك الجروبر في منطقه خليج العقبة

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الملخص العربى

تمت دراسة كثافة توزيع أسماك الجروبر (عائلة السرنيدي) في ستة عشر موقعاً تمثل أربع مناطق بامتداد خليج العقبة. حيث كان العدد الكلي للأنواع المسجلة من كافة المواقع هو ستة عشر نوعاً من أسماك الجروبر التي تنتمي لخمسة اجناس. سُجلت أعلى كثافة لجميع أنواع أسماك الجروبر في كل من محمية رأس محمد و مدينة شرم الشيخ وتلتها في الكثافة محميتي نبق و أبو جالوم على التوالي. أما على مستوى المواقع فقد تصدر الترتيب العام لكثافة أسماك الجروبر كل من موقعي رأس نصراني $(76/2000m^3)$ و رأس أم السيد $(SE\pm 2.001)$. و لم يكن هناك اختلاف كبير في توزيع الكثافة بين عمقي 5 أمتار و15متراً في جميع المواقع التي شملتها الدراسة. تم تقسيم أسماك الجروبر وفقاً للسلوك الإيكولوجي لكل نوع، و تحديد كثافتها وتوزيعها على المواقع المختلفة. حيث سجلت كثافة أسماك الجروبر الخفي والمتنقل بمعدل أكبر من الجروبر الكبير النقال في جميع المواقع التي شملتها الدراسة. اتسمت أنماط توزيع كثافة أسماك الجروبر المقسمة وفقاً للسلوك الأيكولوجي، في جميع المناطق بالتشابه باستثناء محمية أبو جالوم حيث لم يسجل بها أي من الجروبر الكبير النقال. و هو ما نعزوه لما تتعرض له المحمية من عمليات صيد مرتفعة نسبياً. أظهرت هذه الدراسة أن ازدياد كثافة أسماك الجروبر كان دائماً ما يصاحبه ارتفاع في تنوع تلك الأسماك بشكل عام في جميع المواقع.