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# Abundance and ecological observations of the Black-lip pearl oyster, *Pinctada margaritifera* (L.) (Bivalvia: Pteriidae), in Red Sea Egyptian Waters

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## Abstract

The pearl oyster, like other shell fish and many other marine animals (e.g., abalone), has a long history of exploitation throughout the world. The black lip pearl oyster *Pinctada margaritifera* (Linnaeus, 1758) has long been an important species in the Indo-Pacific region including the Red Sea. During the last decade in Egypt, the collection of shells of pinctada increased to a great extent causing a sharp decrease in the density of the animals in the reefs. This decrease motivated the Egyptian Environmental Affairs Agency (EEAA) to add *P. maragaritfera* to the list of the threatened species by (IUCN). The present survey covered more than 600 km of the proper coast of the Egyptian Red Sea and the studied species was recorded in 29 stations out of the surveyed 65 which demonstrate the current distribution of 44.6% of the sites. Mostly found in the sub-tidal zone to depth of about 15 m, with habitat comprises dead corals and weeds (64%). Both sandy and living coral habitats included lower percentage being 14 and 20% respectively. The species were found in considerable numbers in the northan and southern part of the surveyed area, however, the density is one individual per 31.33 $m^2$ in northern area while it was one individual per 10.7 $m^2$ in southern area and the area in-between them along the coast had very small numbers of individual due to the high fishing potential. The number recorded of this internationally distributed species during the present study in considered very low compared to other areas of the world.

*Keywords:* Distribution, ecology, *P. margaritifera*, Red Sea, Egypt.

## 1- Introduction

Family Pteriidae is one of the most unique bivalve families in the fauna of the Indo – pacific area. The family comprises about 225 different species belonging to 15 genera world wide. The most famous genera of this family are the pearl oysters belonging to the genus *Pinctada*.

The black-lip pearl oyster *Pinctada margaritifera* (Linnaeus, 1758) has long been an important species in the Indo – pacific region including the Red Sea because of its beautiful shell, which is lined with a shiny and iridescent coating called nacre.

Pearl oysters have been exposed to exploitation due to the considerable value of the pearls and the nacre, as "mother of pearl" of the shell, and because of the animal's sessile nature and tendency to occur in sufficient densities at shallow depths where easy collection of these animals is possible.

The Red sea coast was one of those areas which host a considerable reasonable population of this species.

Despite the long numbers of studies carried out on the molluscs of the Red Sea, a very few on the bivalve and even fewer on this species were done. The records from the previous studies did not discuss the abundance of such species but in most cases they recorded its presence.

Recent publications recorded *P. margaritifera* as a part of the Red Sea molluscan fauna (Oliver, 1992 and Mary Lyn, 2008) or as apart of the fauna associated with corals (Kleemann, 1992; Zuschin and Piller, 1997; Zuschin *et al*., 2001 and Mohammed and Yassien, 2008).

The last intensive survey conducted on the Coast of the Egyptian Red sea by the world Bank Project (GEF, 1998) which reported the presence of *P. margaritifera* on 20 locations in the coast but considered it as a rare species.

Also few studies were conducted on the closely related species *P. radiate* (Yassin, 1998; Abdel Razek, *et al*., 1998 and Mohammed *et al*., 2000).

During the last decade, the collection of shells of *Pinctada* species increased to a great extent causing a

sharp decrease in the destiny of the animals in the reefs. This decrease motivated the Egyptian Environmental Affairs Agency (EEAA) for suggesting the black-lip pearl oyster *Pinctada margaritifera* to be added to the list of the threatened species in the red data book published by the International Union for Conservation of Nature (IUCN).

Despite its appearance in most of the molluscan lists of the old expeditions to the Red Sea area in the Egyptian coasts, these information did not indicate density or abundance of this species.

The present study was designed to investigate the current status of this species in the reefs of the Egyptian Red Sea Coast as an attempt to fill the gap of information about this endangered species.

## 2- Materials and Methods

In order to determine the distribution of *P. margaritifera* over the intertidal zone, coastal fringing reefs, offshore reefs and lagoons along the Coast of Red Sea, a coastal survey was carried out during the period from March 2005 to April 2007.

The survey included all the accessible areas between Ras El-Behar 60 km north of Hurgada (Lat. 27° 43` 45`` and long. 33° 32` 58``) to Wadi – Elhour south of Shalatein (Lat. 22° 43` 14.0`` and Long. 35° 54` 57.8``). covering a total of 65 sites. (Figure 1).

During the survey, the collected data about *P. mararitifera* were recorded in special sheets of informations included = station name, latitude and longitude, number of individuals, abundance, distribution of the species, average length, depth (mm),type of habitat, human activities and pollution status. At each of the sites snorkeling and / or SCUBA diving were used for two hours of swimming in a Zigzag pattern over the reef. The location, density and status of each of *P. mararitifera* shell were recorded in underwater sheets prepared for this purpose. In each of the visited stations the available habitat characters (e.g. reef, sea grasses bads and sea weeds) were examined. The data of the field sheets where transferred to the laboratory computer where they were recorded and used for further analysis.

## 3. Results

### 3.1. Abundance and habitat preference

The current survey covered more than 600 km of the proper coast of the Egyptian Red Sea. The surveyed species *P. margaritifera* was recorded in 29 stations out of the surveyed 65 stations which demonstrate the current distribution of the species along the coast being represented in 44.6% of the sites. The results of the survey also showed that total number of individuals recorded was 481 individuals in all sites, 416 of them were living and 65 were dead.

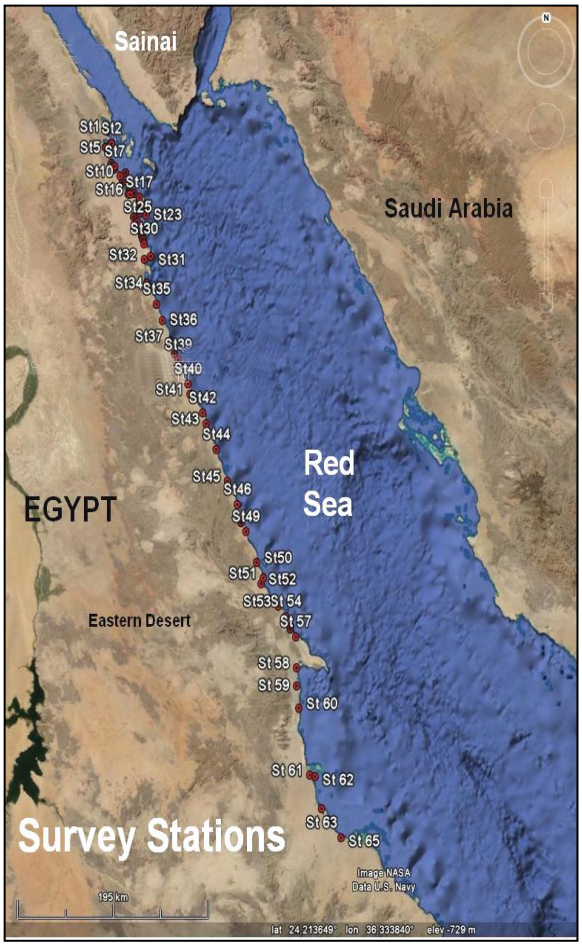


Figure 1. Map showing the surveyed Stations at the Coast of the Egyptian Red Sea.

The examination of the field data sheets revealed that *P. margaritifera* species were recorded from different types of habitat during the survey and each of these habitats have a unique character. Shells of *P. margaritifera* were commonly found attached to hard substrate such as living or dead corals and in the second case it is always surrounded by seaweeds. The presence of the shells in this habitat was recorded in Eash Elmalaha, Malaha2, Shoab El-dair, Marine Station, Abou Sadaf, Marsa Shaab, Kalawi, Abou Gnena, and Umm Elabus (Figure, 2 A&B). In some sites, the shells were also found in the space separating two different species of hard corals (Figure, 2 C).

In areas with sandy bottoms or seagrass meadows the shells were found embedded in sand (Figure, 2D) and/or in between leaf of the seagrass (Figure, 3A) to about one third of its size. However the color of the mantel could be easily recognized. This was recorded at Eash Elmalaha, Malaha2, South El-Malaha, Abu galawa, Marine Station, Abu Monkar, North Safaga, and Marsa Alam and in the southern stations.

In some of the stations, especially where only rocky substrates were available, the shells were found attached by its byssal threads or even cemented to the

rocks by one valve. Some shells were found in small crevices with large coralline rocks while others were found in close proximity with soft corals (Figure 3 B, C, D).

Figure (4) shows that the highest percentage of animals was found associated with a habitat that comprises dead corals and weeds (64%). Both sandy and living coral habitats included lower percentages being 14 and 20% respectively.

The lowest percentage was recorded within crevices and attached to rocky substrate where it did not exceed 1% of the recorded number of individuals. The examination of the records also demonstrated that despite the high number of individuals recorded in the dead coral and weeds habitat the highest percentage of dead shells compared to the living individuals was recorded in sandy habitat Figure (5). Both living and dead corals have the lowest percentage of dead shells while those occurred in crevices were always found alive.

### 3.2. Distribution and Zonation of *P. margaritifera*

Figure (6) represents the distribution of *P. margaritifera* over the study sites from zonation point of view.

The data in Figure (6) showed that the majority living of P. *margaritifera* were recorded from zone number 4 or the back reef area. Also considerable numbers were recorded from the seagrass and reef edge area (zones 2 and 5). However, in sites representing the offshore reefs both leeward and seaward sides have individuals more than the reef table.

The data also indicated that the highest percentage of dead shells was recorded in the reef wall and edge (zone 6) where most of the diving and snorkeling occurred. However, as a general trend, most of the shallow reef area contains higher percentages than the offshore reefs where the lowest percentage of dead animals (shells) were recorded (2%) Figure (6).

### 3.3. Coastal Abundance of *P. margaritifera*

The distribution of the *P. margaritifera* species along the coast of the studied area is presented in Figure 7. As indicated that *P. margaritifera* is found in a considerable numbers in the northern and southern parts of the examined area. However the area -between them along the coast have a very small number of individuals.

Despite the fact that the most northern stations seem to have higher number of individuals compared to the southern ones. The examination of the number recorded and the area surveyed revealed the opposite. The maximum number of individuals recorded for this species was at the area 60 km north of Hurghada which included 7 stations. In this area 241 individuals were recorded inside area of 7550 $m^2$ which means that the density of this species is one individual per area of 31.33 $m^2$. Meanwhile, the total number of individuals recorded in the southern three stations was 140 individuals in an area of 1500 $m^2$ which means that one individual of this species could be found every 10.7 $m^2$. This comparison indicated a higher density in the south than north.

### 3.4. Coastal Density of *P. margaritifera*

The results of the surveyed data revealed differences in the density of the shells of *P. margaritifera* allover the studied areas. The density calculated as number of individuals divided by the area surveyed in each site or to the number of individuals per square meter is presented in Figure (8).

The data in Figure (8) indicate that the density of *P. margaritifera* ranged from 0 to 0.15 individuals/$m^2$ with an average of 0.030 $\pm$ 0.045 individuals/$m^2$. in other word, the intensity of individuals ranged from one individual per 6.7 meters in station number 3 (South El-Malaha) to about one individual per 2000 meters in station number 12 (Kalawi). Despite the fact that most of the visited sites were expected to have a higher number of individuals the survey showed that the species was completely removed from the reef. The only areas where the living shells were found the areas inside the protected places in the north and the south.

## 4-Discussion

Pearl oysters have been exposed to high exploitation due to the considerable value of the pearls and the nacre, or "mother of pearl", of the shell, and because of the animal's sessile nature and tendency to occur in sufficient densities at shallow depths for relatively easy collection. They are found attached to hard substrates as deep as 40 m, usually in association with reef habitats.

With the advent of international trade and "western contact," demand for the shell increased rapidly for use as buttons and decorative inlay. Such was their popularity that over-fishing to meet this foreign demand for the shell rapidly depleted the abundance of Black-lip pearl oysters in many places especially the Red Sea. As a result of this over-fishing, many areas of the Indo-Pacific still have very low populations of Black-lip pearl oysters today (Ellis and Haws, 1999).

The current survey covered more than 600 km of the proper coast of the Egyptian Red Sea. *Pinctada margaritifera* was recorded in 29 stations out of the surveyed 65 which demonstrate the current distribution of the species along the coast being represented in 44.6% of the sites. The results of the survey also showed that total number of individuals recorded was 481 individuals in all sites 416 of them were living and 65 were dead. The pearl oysters were found from wading zones to depths of about 1 m to 15 m. *P. margaritifera* species were recorded from different

types of habitat each of unique characters which support the potential of this species for culturing in different areas of the Egyptian Red Sea coast.

Despite the presence of the current species in different habitat types, the highest percentage of these animals were found associated with habitat that comprises dead corals and weeds (64%). This result come in agreement with that of Gervis and Sims, (1992) where they reported that *P. margaritifera* is typically found in coral reef waters characterized by oligotrophy and low turbidity. It lives attached by byssal threads to hard substrata on the coral reef. The same habitat characters were also recognized for *P. margaritifera* by Yukihira *et al.*, (1999).

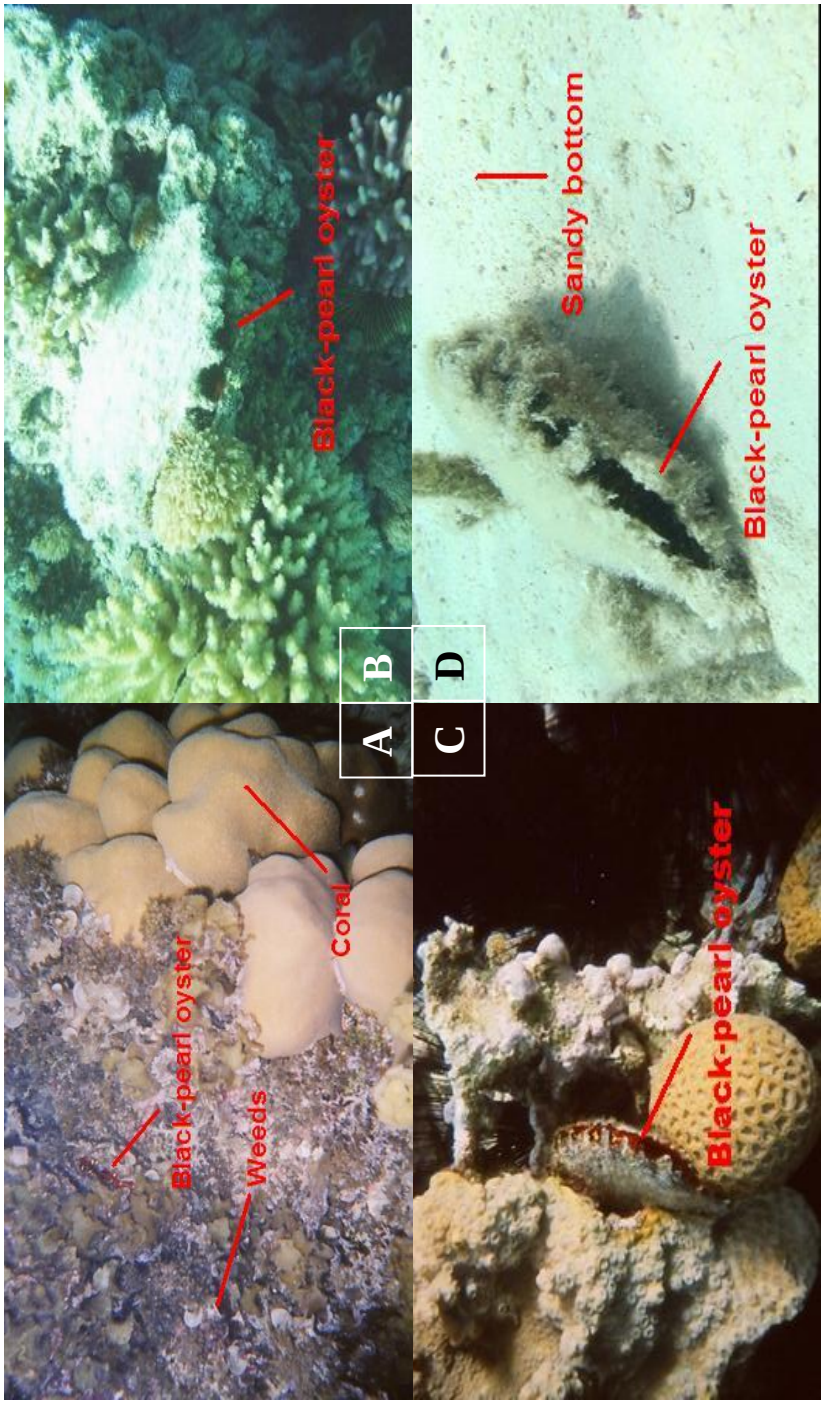


Figure. 2. Underwater photos of *P. margaritifera* in its different habitats.

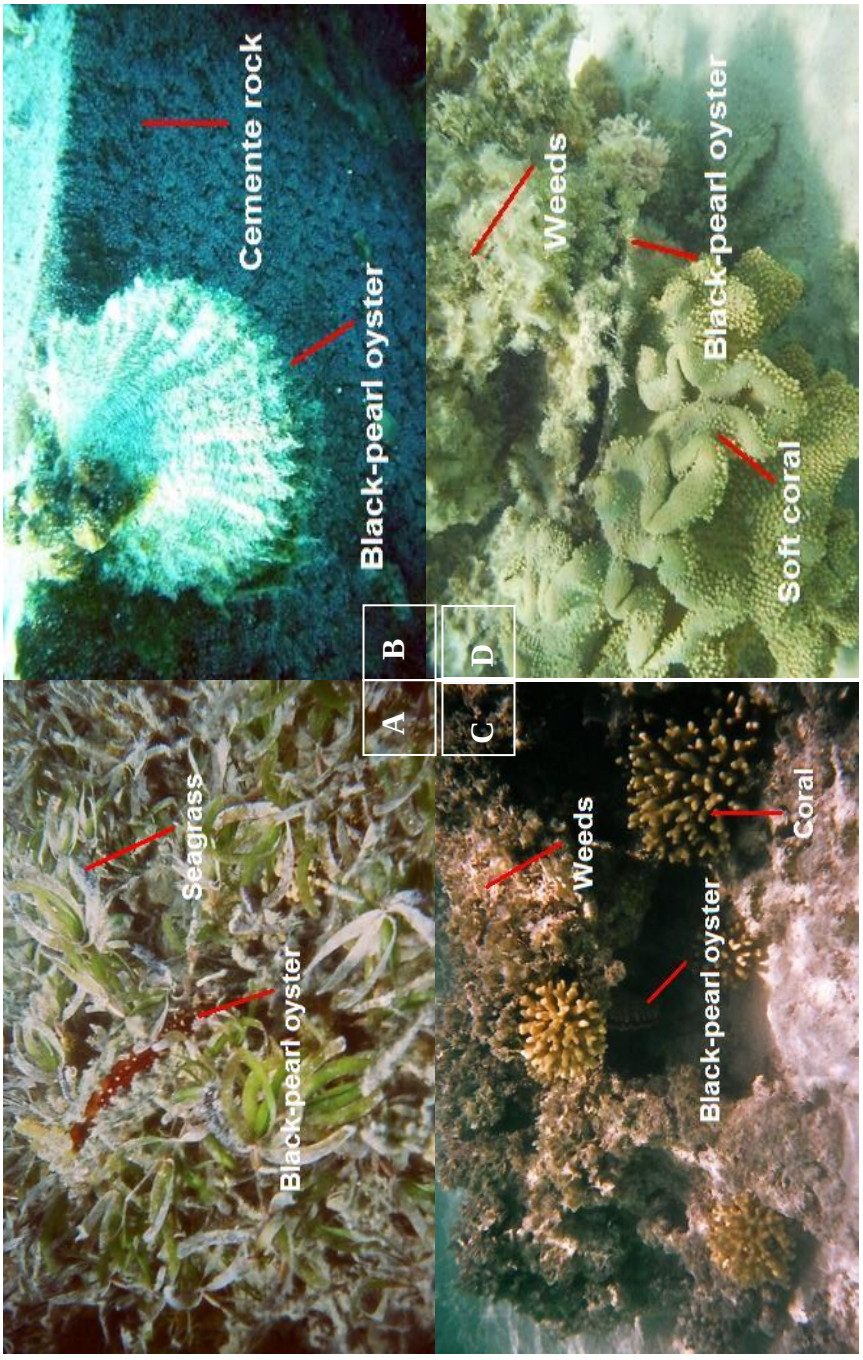


Figure. 3. Underwater photos of *P. margaritifera* in different habitats

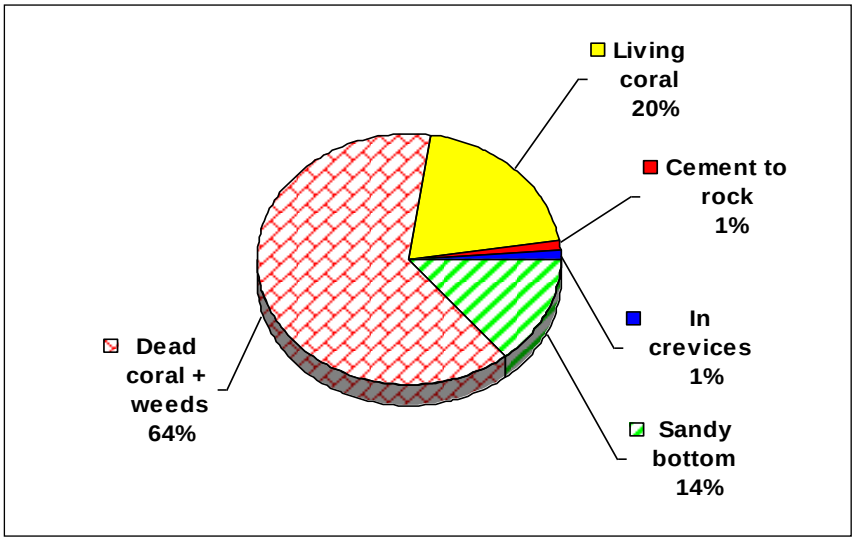


Figure 4. The abundance percentage of *P. margaritifera* in the different types of habitat.

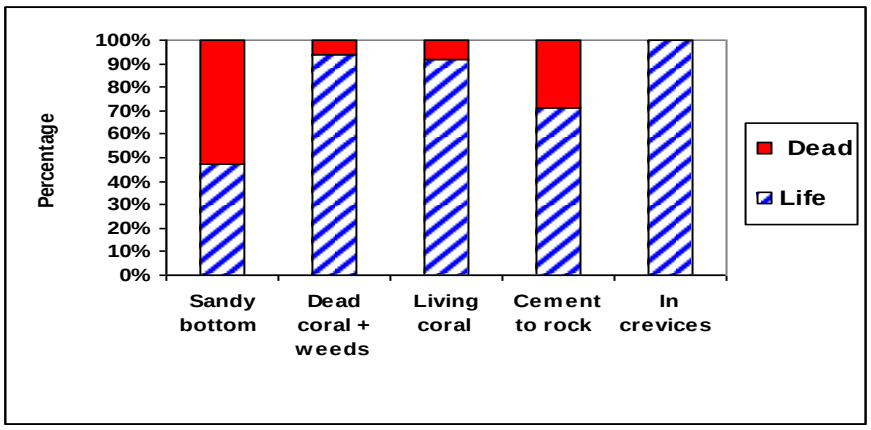


Figure. (5) The percentages dead shells and living individuals of *P. margaritifera* in the different types of habitat.

The results of the present study also showed that the majority of *P. margaritifera* were recorded from the back reef area. The data also indicated that the highest percentage of dead shells was recorded in the reef wall and edge. However, as a general trend most of the shallow reef area contains higher percentages than the offshore reefs where the lowest percentage of dead animals (shells) were recorded (2%).The previous results come in agreement with the findings of Gallager *et al.*, (1996) and Tomaru *et al.*, (1999) who stated that the abundance of pearl oysters is higher in the shallow sub-tidal depth range (1–5 m) and this is most probably because larvae of marine bivalves tend to be concentrated near the water surface**.**

The distribution of *P. margaritifera* along the Egyptian Red Sea coast revealed that *P. margaritifera* is found in considerable numbers in the northern and southern part of the examined area. However the area in-between them along the coast have a very small number of individuals. Such distribution is normal for many areas especially where fishing potential is high. The number of individuals inside the 100 $m^2$ transect in the current study ranged between 0 and 10.67 shell/100 $m^2$ with an average of 2.91 ± 3.67 shell/100 $m^2$. The same results were also obtained in Kenya coast by Kimani and Mavuti, (2002) where they reported a highest density of oysters to be 75/ 100 $m^2$ in certain areas and as low as 1/100 $m^2$ in other areas of the coast. Also similar results were reported from Cook Islands atoll lagoons, being 2.0 ± 4.0, and 0 per 100 $m^2$ (Sims, 1992) and in French Polynesia being 1.0 ± 0.8 per 100 $m^2$ (Zanini and Salat, 2000).

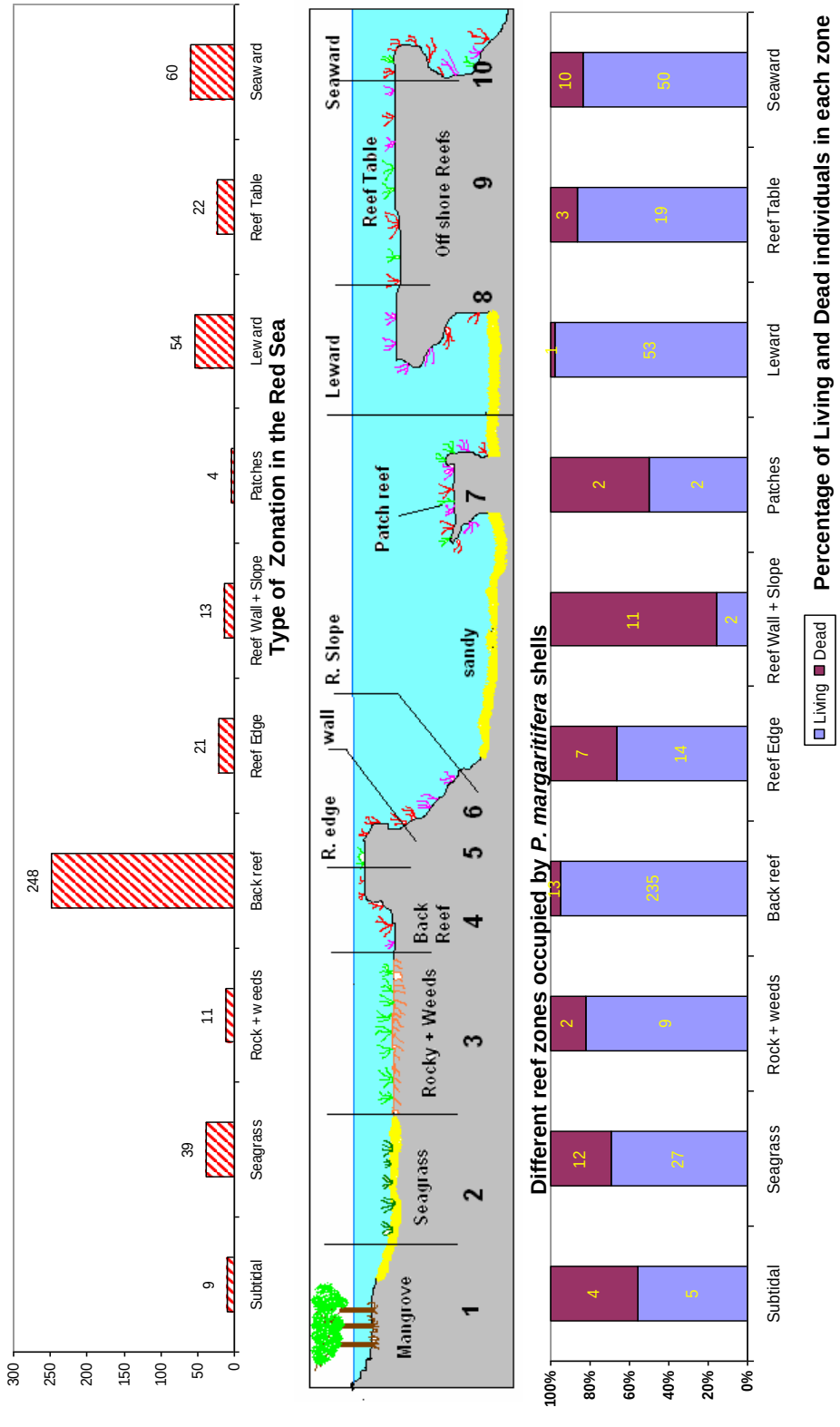


Figure 6. Distribution and Zonation of *P. margaritifera* over a typical Red Sea fringing reef area.

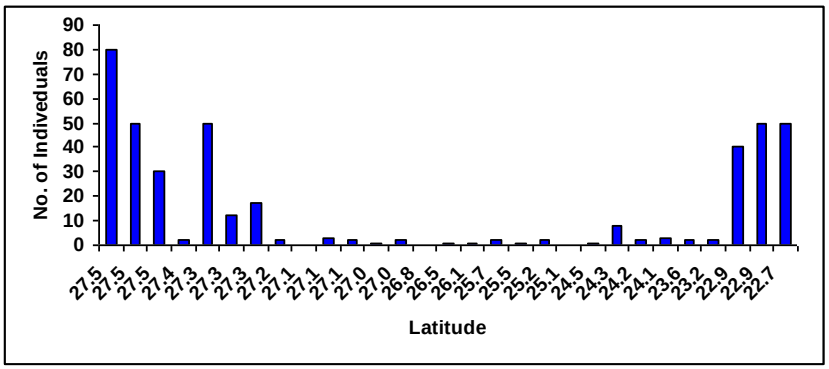


Figure 7. The distribution of *P. margaritifera* along the surveyed coastal area.

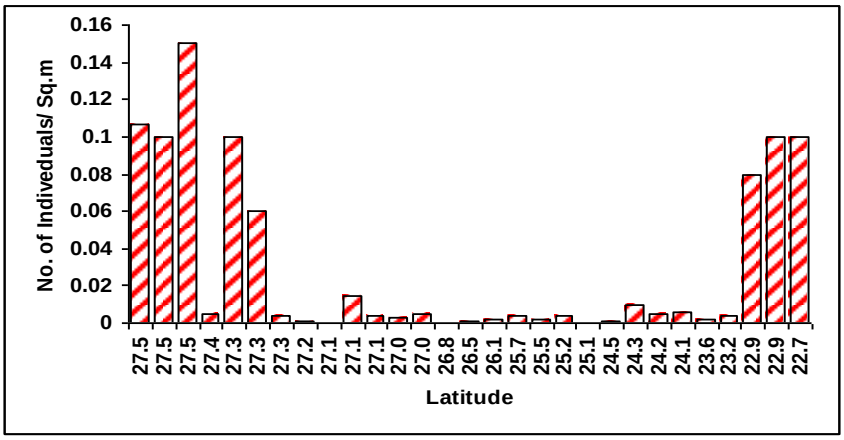


Figure 8. the density of *P. margaritifera* along the surveyed coastal area.

Such differences in the abundance of this species could be attributed to the collection of the species by the local fisherman for ornamental trade purposes. As most of the information obtained from the local fishermen in the area (Personal communication) indicated that large numbers of the *P. margaritifera* shells were collected and sold for its mother of pearl usage in hand crafts. Also some of the local collectors indicated that this species was over exploited during the period when the Egyptian Government restricted the import of Japanese Abalone shells.

Despite the fact that this species still exist in the area of the Egyptian coast of the Red Sea, the number recorded of this internationally distributed species during the present study is considered very low compared to other areas of the world. For example, Sims (1992) reported in his results of belt transects take across the lagoons at Cook Island Australia, the estimation of the stock for Manihiki lagoon as 2.0 million ± 3.2 million pearl oysters while for Penrhyn lagoon the number was 5.0 million ± 4.1 million and for Suwarrow lagoon around 400000 shells of *P. margaritifera* which were estimated from average densities.

Another factor which may be the cause of limiting the distribution of *P. margaritifera* is the substrate availability. Many authors have suggested that *P. margaritifera* is scarce or absent in some lagoons due to limited substrate availability Service de la Péche, (1970); Intes 1985a, 1988; Intes and Coeroli (1985b); Intes *et al*. (1986). In the present study, many of the areas which suffered from the impact of land filling and dredging have no records of such species. This may be due to the coverage of the available substrate by soft sediments which limit the ability of larval settlement. This assumption is supported by the findings of Nayar *et al*. (1978); Nayar and Mahadevan, (1987) where they reported a dense growth of pearl oysters in areas where large rocky surfaces were available.

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