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# EFFECT OF PHYSICO-CHEMICAL FACTORS AND HUMAN IMPACTS ON CORAL DISTRIBUTION AT TOBIA KEBIR AND SHARM EL LOLY, RED SEA-EGYPT

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## ABSTRACT

Using SCUBA equipment and the line intercept transect (LIT), the effect of physical factors and human impacts on coral distribution were studied in two Red Sea sites (Sharm El Loly and Tobia Kebir) throughout the period from September, 2003 to October, 2004. The percentage cover of coral species in Northern Sharm El Loly was higher than in Tobia Kebir which might be attributed to optimum temperature and better light intensity. Diving, swimming, boat anchoring and fish feeding by divers are the main human impacts decreasing the percentage cover of corals at Tobia Kebir but fishing seems to have no role due to its limited level. The lower recorded amount of dead corals at Sharm El Loly though it is highly affected by fishing boats, is due to the fact that these boats anchor on the Sharm terminal, away from the reef and go to open water through the middle of the Sharm. Massive corals, especially *Porites* sp., were more abundant than branching corals in Tobia Kebir as they can tolerate turbidity and less susciptible to breakage caused by trampling, diving and swimming. However, the hydrocoral *Millepora dichotoma* was most dominant in Sharm El Loly as it prefers high illumination. A total of eleven species of corals were recorded in Tobia Kebir, compared to thirty-five species in Sharm El Loly. Besides, the diversity values were lower at Tobia Kebir than at Sharm El Loly, especially on the reef flat and 1-5 m depth zone, due to the higher sedimentation rate in the former site.

## 1. INTRODUCTION

Several authors have studied the Red Sea coral reefs and their associated communities. Mergener (1984) studied the general description and distribution of the reef in Hurghada area reporting the common genera of both hard and soft corals. Sheppard *et al*. (1992) studied the Red Sea coral reefs and compared their results on both regional as well as biographical perspective. Ammar and Nawar (1998) studied the quantitative distribution of reef building corals at Abu-Galawa, Hurghada, recording eighty-eight scleractinian and three reef building but non scleractinian coral species. Ammar (2004) studied the zonation of coral communities and environmental sensitivity offshore a resort site at Marsa Alam, Red Sea, Egypt. Ammar and Emara (2004) studied the population of corals and other macrobenthic invertebrates in two flooded sites and a sheltered site around Ras Baghdadi, Red Sea, Egypt.

Light is an important factor affecting the distribution of corals on the reef (Fricke and Schuhmacher, 1983). Sohn (1977) reported that light affects the growth forms of corals. Sediments are the main factors affecting the distribution of corals in the Red Sea (Hodgson and Carpenter, 1995). Temperature also has been known to be of the most important factors affecting coral distribution and controlling the growth of corals (Wellington and Dunbar, 1995). On the other hand, high salinity causes bleaching and reduces growth of corals, thus affecting the coral distribution (Glynn, 1993). The biotic environmental factors such as competition, predation and grazing may have significant impact on the reef structure (Wood, 1983 and Ammar, 1998b). Coral reefs worldwide are subjected to extensive human impacts caused by snorkelers and SCUBA divers (Ammar, 1998a; Zakai and Chadwic-Furman, 2002). Wielgus *et al*. (2004) found that SCUBA divers are significant causes of coral partial mortality. Predation by fishes is a biotic factor which may affect the distribution of corals (Glynn *et al*., 1996). The aim of this study was to survey the distribution of coral reef species in two Red Sea sites namely; Tobia Kebir (Safaga) and Sharm El Loly (Marsa Alam). Some ecological factors like temperature, salinity, dissolved oxygen, pH, turbidity and sedimentation rate were measured, discussing their effects on coral distribution. In addition, possible human impacts on the coral distribution in the two studied sites like predation, fishing, swimmers, and divers were studied.

## 2. MATERIALS AND METHODS

### 2.1. Area of study

Two sites were selected in the Red Sea, Egypt, namely; Tobia Kebir (Safaga) and Sharm El Loly (Marsa Alam) (Figs.1-3). Tobia Kebir lies between 26˚ 48` 431`` N and 33˚ 59` 767`` E at a distance of about 5 km offshore and contains small patches of small reefs rising from the seabed to about 11 m. The biggest reef is long, irregular with a semi gentle slope, dominated by large *Porites* heads, which is up to 10 meters diameter. The northern Sharm El Loly (Marsa-Alam) lies between 24˚ 36` 50.460``N and 35˚ 06` 56.248``E, about 75 km south to Marsa-Alam City. The intertidal zone is 50 m offshore, then the reef flat is 50 meters wide, and finally the slope has coral reefs growing until 18 m depth.

### 2.2. Survey methods

All the fieldwork was performed using SCUBA equipment, throughout the period from September, 2003 to October, 2004. The line intercept transect (LIT) method (English *et al*., 1997) was used to estimate the percent cover of corals and other taxa in the selected sites, using a 20 m long graded tape as a transect. Two transects were surveyed at each depth, with an interval of 2 m wide between them. Accordingly, a total of 60 m long were surveyed at each depth.

Coral diversity was calculated by Shannon-Wiener formula (Shannon and Wiener, 1948). The evenness index as adapted by Pielou (Pielou, 1966) was calculated to show the equitability of individuals distribution among species. The statistical cluster analysis for the percent cover of different coral species was performed by the computer program STATISTICA, to show the degree of similarity between different coral species.

### 2.3. Human impacts on coral reef communities

Level of impacts was determined and classified according to the collected data concerning the number of boats, divers and snorkelers that were recorded for five different days and the mean was estimated for each site. In cases where a diver makes two dives, he was counted as two divers and the same for snorkelers and boats. As for diving and fishing boats, the low means estimates were counted as 1-3 boats per day, moderate of 4-6 boats per day and heavy means more than 8 boats per day. For swimming, low means 10-24 swimmers per day, moderate means 25-40 swimmers per day and heavy means more than 45 swimmers per day.

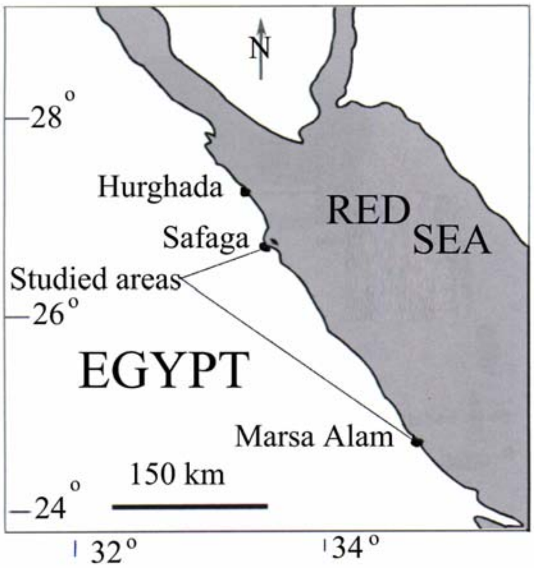


Fig. (1). Location map of the selected areas along the Red Sea coast, Egypt.

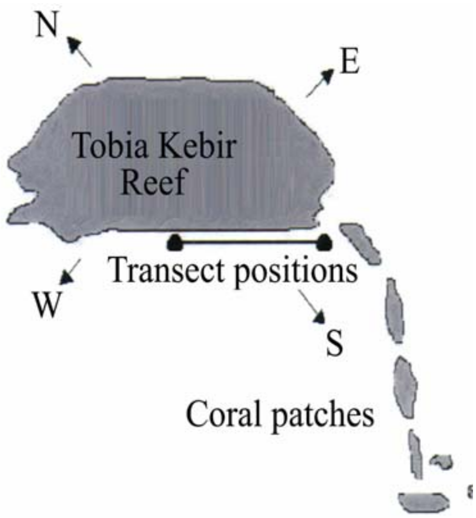


Fig. (2). A sketch map of Tobia kebir reef to show the position of transects.

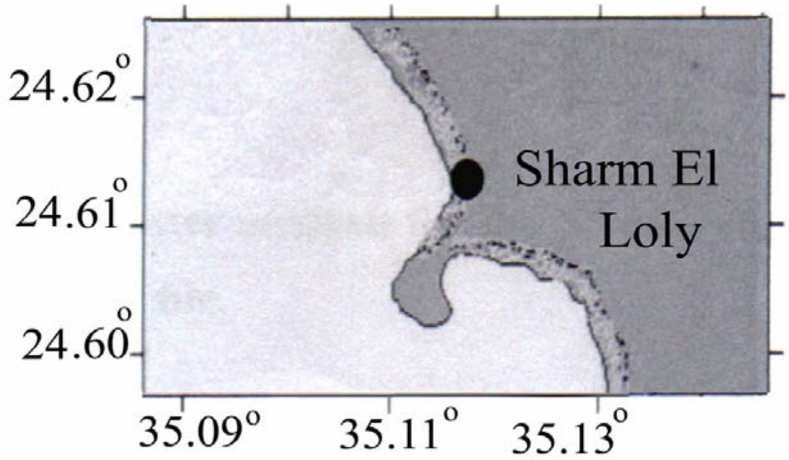


**Fig. (3). Location map of Sharm El Loly in Marsa Alam area**

### 2.4. Physico-chemical parameters measurements

Water temperature (˚C), salinity (%o), hydrogen ion concentration (pH), dissolved oxygen content (mg/L) and turbidity ($NTU_S$) were measured directly in the field, using the Hydrolab instrument. The sensor of the Hydrolab was hanged in water, whilst the measurements were taken directly from a small screen on the boat. The measurements were taken seasonally at the studied sites.

### 2.5. Sedimentation measurements

To test for difference in sediment deposition between sites, three sediment traps were deployed at each site, during one month-period, at the beginning of each season, starting of spring (22$^{nd}$ April), summer (17$^{th}$ July), autumn (22$^{nd}$ September) and Winter (22$^{nd}$ December.). Traps consisted of glass tubes, 16 cm in length with a mouth diameter of 7 cm, mounted on a metal base. The height to diameter ratio of the tube was approximately 2:3, which was considered optimal for preventing resuspension and measuring gross sediment input (Gardner, 1980). Following sediment trap collection, each tube was decanted, and the sediment rinsed with distilled water to remove salts. Sediment was filtered with a pre-weighed filter paper. The filters were dried at 60 ºC until a constant weight was attained, finally re-weighed to obtain the total weight of the dried sediments (Glynn, 1993). The mean weight for the sediments was calculated, and then sedimentation rate per day was calculated according to the following equation:

Sedimentation rate (g/cm$^2$/day) = Weight of sediments / No. of days * (л $r^2$)

л $r^2$ = area of jar opening, r = radius in cm

## 3. RESULTS AND DISCUSSION

### 3.1. Physico-chemical factors

Ecological factors at the studied sites are indicated in Table (1). In Tobia Kebir, temperature recorded it's highest value during summer (26.8 °C) while salinity was highest in spring (39.9‰). Dissolved oxygen content (D.O) recorded a mean value of 6.04 ± 0.19 mg/L throughout the year, while hydrogen ion concentration (pH) was 8.25 ± 0.06 and turbidity was 6.5 ± 1.4 $NTU_S$. In Northern Sharm El Loly, temperature was highest in summer (29.9 °C) and so was salinity (40.1‰). Dissolved oxygen (D.O) content had a mean value of 5.6 ± 0.3 mg/L while hydrogen ion concentration (pH) was 8.3 ± 0.1 and turbidity was 4.9 ± 0.2 $NTU_S$. Sedimentation rate recorded some seasonal variations in the two studied sites (Table 2). Tobia Kebir recorded it's maximum value in winter (0.0294 g/cm$^2$/day) and the minimum one in summer (0.0101 g/cm$^2$/day), with a mean of 0.0201 ± 0.003 g/cm$^2$/day throughout the year. In Northern Sharm El Loly, sedimentation rate ranged from 0.0073 to 0.0191 g/cm$^2$/day, with a mean of 0.012 ± 0.002 g/cm$^2$/day throughout the year. It is obvious that, values of sedimentation rate in northern Sharm El Loly were lower than those in Tobia Kebir.

### 3.2. Human impacts

Human impacts that appeared during the last ten years in the area of study are shown in Table (3). Tobia Kebir is exposed to diving activity, boat anchoring, swimming and fish feeding by divers, while Northern Sharm El Loly is exposed to fishing, which is well organized and does not affect the reef.

### 3.3. Coral distribution

Data concerning the percent cover and number of species of corals as well as other groups and substrates at different depth zones of Tobia Kebir are shown in Table (4). A total of eleven species of corals were observed, nine of which were reef-builders and two were soft corals, seven species of the reef-builders were scleractinians and two species (*Millepora dicotoma* and *Millepora platyphyla*) were non scleractinian. The massive coral *Porites solida* was the most abundant species at all depth zones (covering 9%, 15% & 13% on the reef flat, 1-5m and 5-

11m respectively). Cluster analysis for the percent cover of different coral species of Tobia Kebir is shown in Fig. (4). *Porites solida* and *Porites lutea* are clearly separated into one cluster, having the highest cover and space monopoly among all corals and other groups. Meanwhile, *Porites (synaraea) undula* and *P. (synaraea) iwayamaensis* are separated into one group that is clearly dominating the reef flat zone. Each of the other species are separated into one group, that is considerably distributed in most depth zones. Maximum percent cover of live hard corals was found at 1-5m depth zone, while the lowest value was found at 6-11m depth zone (Table 5). Contrary to that result, dead corals occupied the highest bottom area at 6-11m (25%), while soft corals were maximum on the reef flat (5%). Each of the diversity ($H'_N$) and Evenness index (J') attained the maximum value at 1-5m depth zone (Table 5).

Data concerning percent cover and number of corals species as well as other groups and substrates at different depth zones of Sharm El Loly are shown in Table (6). A total of thirty-five species of corals were observed, thirty-three of which were reef-builders and two were soft corals. Thirty-one of the reef-builders were scleractinians and two (*Millepora dichotoma* and *Millepora platyphylla*) were non scleractinians. The hydrocoral *Millepora dichotoma* was the most abundant species on each of the reef flat, and 1-5m depth zone (covering 19% and 20% respectively). However, the soft coral *Xenia* sp. was the second predominant species, at each of 12-15 and 16-18m depth zones (covering 17% and 20% respectively). It was reported that branching corals decrease with depth having a maximum value on the reef flat (41%) and a minimum value at 16-18m depth (8%). Cluster analysis for the percent cover of different coral species of Sharm El Loly is shown in Fig. (5). It is clear that, *Xenia* sp. is separated into one cluster, having the highest cover among all corals and other groups. Meanwhile, *Millipora dichotoma and Pocillopora verrucosa* are separated in one group, that is clearly dominating the reef flat and 1-5m depth zone. *Stylophora pistillata, Favia speciosa* and *Lobophyllia hemperich*i are separated in one group, each of these species was considerably distributed in most depth zones. Maximum percent cover of live hard corals was found at 1-5m depth zone, while that of dead corals (16%) was reported on reef flat (Table 7). The highest soft coral cover (25%) was found at 12-15m depth zone. Recorded values of diversity and evenness index were higher than those of Tobia Kebir except at 6-11m depth zone.

### 3.4. Effect of physico-chemical parameters on coral reefs distribution

Higher levels of percentage cover of coral species in Northern Sharm El Loly than in Tobia Kebir are associated with an average value of temperature that was more optimum and favourable for coral growth in the former site. This agrees with the statement of Vine (1986) that the most optimum temperature for coral growth is 25-29 $^{o}$C. Dramatic variations of temperature from the optimum value cause severe mortality of corals (Brown, 2000). Salinity values recorded in both sites are nearly similar to the optimum range of salinities suitable for coral growth. Therefore, salinity was not a distinguishing factor between the two sites. High salinity of 34-36‰ is considered optimum for coral growth (Vine, 1986), while stressed salinity is among the factors causing coral bleaching (Glynn, 1993). The higher values of dissolved oxygen content at Tobia Kebir than that at Sharm El Loly may be due to the high hydrodynamic action of water by divers and touristic boats. In addition, fish feeding and other wastes thrown from the boats to water may increase eutrophication and growth of phytoplankton increasing the primary productivity in water. In contrast, the clearance of water in Sharm El Loly favours the development of zooplankton, which in addition to the high diversity of corals lead to more oxygen consumption from water. The better light intensity at Sharm El Loly, as indicated by the lowest turbidity, is another important factor increasing live coral cover at Sharm El Loly than those at Tobia Kebir (Yap *et al*., 1998).

### 3.5. Effect of human impacts on coral reefs distribution

It is obvious that, diving, swimming, fish-feeding divers and anchoring were the main reasons for decreasing the percentage cover of corals at Tobia Kebir, but fishing seems to have no role as the fishing level is low. This result agrees with that of Hawkins and Roberts (1992) who found more significantly damaged colonies, loose coral fragments, and partially dead corals in areas used by divers in the Red Sea. Wielgus *et al*. (2004) found that SCUBA divers were significant explicative variables of coral partial mortality. Coral eating fishes such as parrot fish, surgeon fish, trigger fish and butterfly fish appeared frequently at Tobia Kebir, having respective abundances of 12%, 9%, 16% and 21% of the total existing fishes (personal observation). These fishes beside the divers who enjoy and practice feeding them represent marginal factors increasing coral mortality in that site (Glynn *et al*., 1996). The lower recorded amount of dead corals at Sharm El Loly though it is highly affected by fishing boats, is due to the fact that these boats anchor on the Sharm terminal, away from the reef and go to open water through the middle of the Sharm.

Increased massive corals especially *Porites* sp. than branching corals at Tobia Kebir, is associated with increased turbidity in that site. Sheppard (1985) referred to the occurrence of *Porites* sp. in abundant cover in turbid water compared to *Acropora* sp. Ammar and Emara (2004) indicated that *Porites* sp. is the most fast growing one on the flood sediments area and recommended using such species as a successful recruit in areas denuded by the effect of flood. In addition, the susceptibility of branching corals than massive corals to breakage caused by trampling, diving and swimming (Schleyer and Tomalin, 2000) is another reason for increasing massive corals in Tobia Kebir (diving) and branching corals in Sharm El Loly (no diving). Generally, branching corals in the present study were reported to decrease with depth until they reach their minimum value, as explained by Frick and Schuhmacher (1983) that branched colonies usually decrease with depth and are replaced by encrusting and flattened colonies which have a great ability to entrap light. Todd *et al.* (2004) suggested a relationship between corallite morphology and light, where the corallites expand, extend and deepen in light conditions. The highest percentage cover of the hydrocoral *Millepora dichotoma* at Sharm El Loly (the site having high illumination) agrees with the finding of Ammar (2004) that, *Millepora* sp. prefers high illumination and has a strong skeletal density to tolerate strong waves.

Diversity values were lower at Tobia Kebir than at Sharm El Loly, especially on the reef flat and 1-5 m depth zone, due to the higher sedimentation rate in the former site. The depth zone 6-11 m gave a different result as it is a steep zone, which does not allow the accumulation of sediments. Porter (1972) found that reduction in diversity is partially caused by high sedimentation rate.

## 4. CONCLUSIONS

1- The more optimum physico-chemical factors of water, lower sedimentation rate, higher water transparency and scarcity of recreational activities in Sharm El Loly are the main reasons responsible for the higher coral cover and diversity in that site compared to Tobia Kebir.

2- Massive corals, especially *Porites* sp., were more abundant than branching corals in Tobia Kebir, as they can tolerate turbidity and less susceptible to breakage caused by trampling, diving and swimming, however the hydrocoral *Millepora dichotoma* was the most dominant in Sharm El Loly as it prefers high illumination.

## RECOMMENDATIONS

1- Behavior of fish-feeding divers and boat anchoring at Tobia Kebir should be strictly guarded and stopped. In addition, the number of divers should be controlled as not to exceed the divers carrying capacity.

2- Sharm El Loly is still virgin and declared as a protected area. It needs more capacity building and guarding the fishing boats to keep that site always pristine.

**Table (1): Seasonal values of Physico-chemical parameters measurements in the studied sites.**

| Sites | Seasons | Temperature °C | Salinity ‰ | D.O. mg/L | PH | Turbidity $NTU_S$ |
|---|---|---|---|---|---|---|
| Tobia Kebir | Autumn | 24.5 | 39.4 | 6.4 | 8.3 | 10.6 |
| | Winter | 16.6 | 39.6 | 6.13 | 8.2 | 6.6 |
| | Spring | 23.3 | 39.9 | 5.5 | 8.4 | 5.6 |
| | Summer | 26.8 | 39.7 | 6.13 | 8.1 | 3.5 |
| | X' ± S.E | 22.8 ±2.1 | 39.6 ±0.1 | 6.04±0.19 | 8.25±0.06 | 6.5 ±1.4 |
| Northern Sharm El Loly | Autumn | 24.8 | 39.09 | 4.54 | 8.85 | 4.2 |
| | Winter | 20.2 | 38.9 | 6.03 | 8.1 | 5.6 |
| | Spring | 25.66 | 39.42 | 5.77 | 8.28 | 4.9 |
| | Summer | 28.9 | 40.1 | 6.2 | 8.2 | 5.01 |
| | X' ± S.E | 25.14 ±1.6 | 39.1 ±0.3 | 5.6 ±0.3 | 8.3 ±0.1 | 4.9 ±0.2 |

**Table (2): Sedimentation rate ($gm/cm^2/days$) in different seasons at the studied sites.**

| Sites | Autumn | Winter | Spring | Summer | X' ± S.E |
|---|---|---|---|---|---|
| Tobia Kebir | 0.0201 | 0.0294 | 0.0211 | 0.0101 | 0.0201 ± 0.003 |
| Northern Sharm El Loly | 0.0152 | 0.0191 | 0.0091 | 0.0073 | 0.012 ± 0.002 |

**Table (3): Type and level of impacts in the studied sites.**

| Sites | Human activities | Impact level |
|---|---|---|
| 2-Tobia Kebir: (Safaga) | Diving, Boat anchoring<br>Swimmers<br>Fish feeding by divers<br>Fishing | Moderate<br>Heavy<br>Heavy<br>Low |
| 3-Northern Sharm El Loly: (Marsa Alam) | Fishing | Heavy |

**Table (4): Percent cover (%) of different species of corals and other benthos at different depth zones of Tobia Kebir.**

| Categories | Species name | Depth | | |
|---|---|---|---|---|
| | | Reef flat | 1 -5m | 5 -11m |
| Branching | *Acropora corymbosa* | 1.5 | 2 | 1.5 |
| | *Acropora nobilis* | 0.5 | 1 | 0.5 |
| | *Acropora hemprichii* | 2 | 2 | 1.5 |
| | Total | 4 | 5 | 3.5 |
| Massive | *Porites solida* | 9 | 15 | 13 |
| | *Porites lutea* | 7 | 13 | 11 |
| | *Porites (synaraea) undulata* | 5 | * | 0 |
| | *P .(synaraea) iwayamaensis* | 4 | 1 | 0.5 |
| | Total | 25 | 29 | 24.5 |
| Hydrocorals | *Millepora dichotoma* | 3 | 4 | 1.5 |
| | *Millepora platyphylla* | 2 | 3 | 2 |
| | Total | 5 | 7 | 3.5 |
| Soft corals | *Xenia* sp. | 3 | 3 | 2.5 |
| | *Sarchophyton* sp. | 2 | 1 | 1 |
| | Total | 5 | 4 | 3.5 |
| Other categories | Algae | 3.5 | 0 | 0 |
| | Mollusca shells | | | |
| | *Tridachna* sp. | 2.5 | 1 | 1 |
| | *Cyparaea* | 0 | * | * |
| | Sea urchins | | | |
| | *Diadema sestosum* | 2.5 | 1.5 | 3 |
| | *Echinometra mathaei* | 1.5 | 1 | 2 |
| | *Prinocidaris baculosa* | 1 | 0.5 | 0 |
| | Rocks | 10 | 12 | 6 |
| | Rubbles | 12 | 13 | 4 |
| | sediments | 8 | 10 | 24 |
| | Total | 41 | 39 | 40 |

*=observed but not intercepted

**Table (5): Number of species, Percent cover (%), Diversity ($H'_N$) and Evenness index (J') at Tobia Kebir.**

| | Reef flat | 1-5m | 6-11m |
|---|---|---|---|
| No. sp.(intercepted) | 11 | 10 | 10 |
| No. sp.(non intercepted) | 0 | 1 | 0 |
| % Live hard corals | 34 | 41 | 31.5 |
| % Live soft corals | 5 | 4 | 3.5 |
| % Dead corals | 20 | 16 | 25 |
| H'N | 1.4 | 1.6 | 1.4 |
| J' | 0.5 | 0.7 | 0.6 |

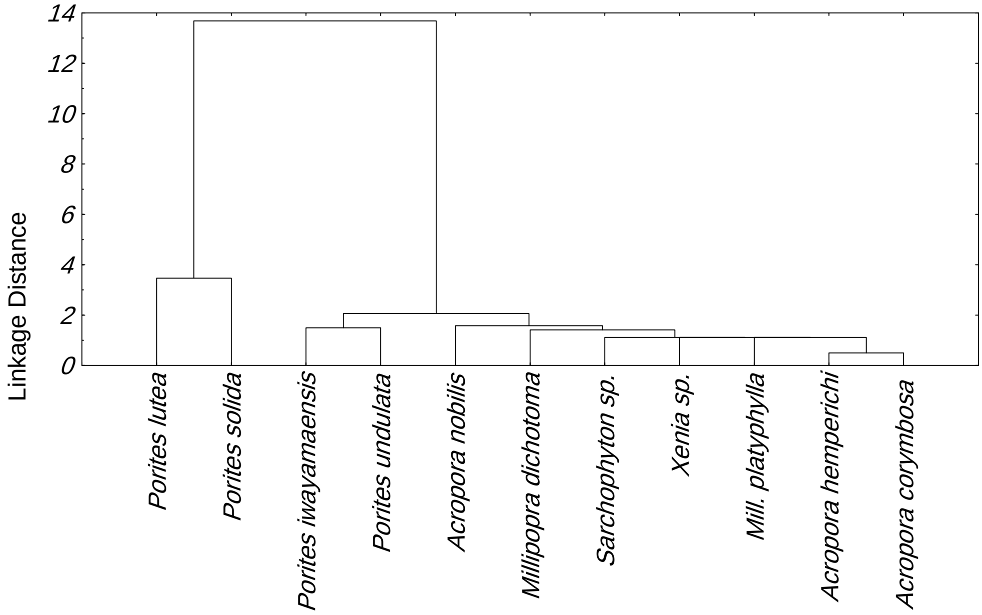


**Fig. (4): Cluster analysis for the percent cover of different species of corals of Tobia Kebir. *Mill.=Millepora*.**

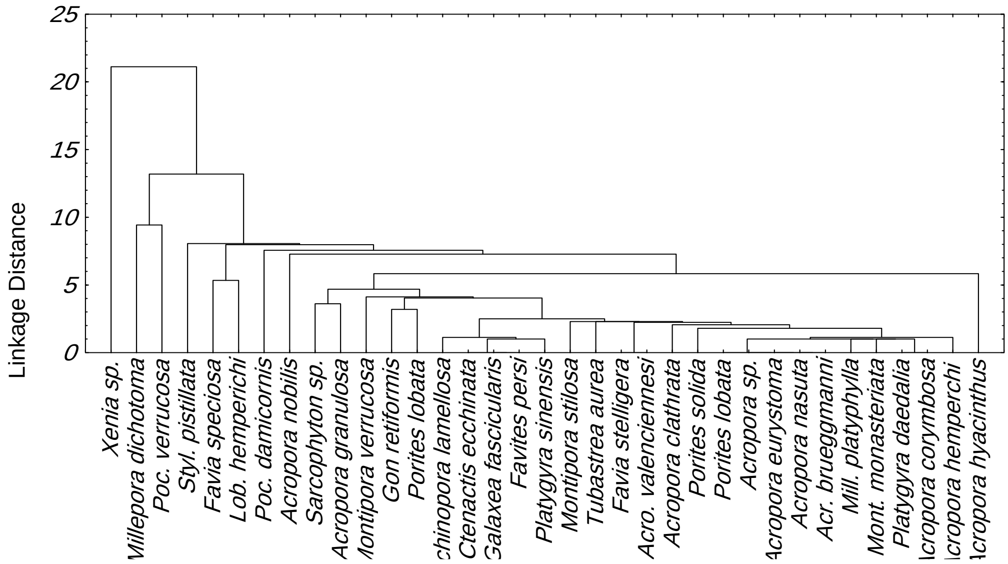


**Fig. (5): Cluster analysis for the percent cover of different species of corals of Sharm El Loly. Poc.=*Pocillopora*, Styl.=*Stylophora*, Lob.= *Lobophyllia*, Gon.=*Goniastrea*, Acr.=*Acropora*, Mont.=*Montipora*.**

**Table (6): Percent cover of different species of corals and other taxa at different depth zones of Sharm El Loly.**

| Categories | Species name | Depth zone | | | | |
|---|---|---|---|---|---|---|
| | | **Reef flat** | **1-5m** | **6-11m** | **12-15m** | **16-18m** |
| **Branching** | *Acropora hyacinthus* | 6 | * | 0 | 7 | 0 |
| | *Acropora hemprichi* | 2.5 | 1 | * | 0 | 0 |
| | *Acropora corymbosa* | 2 | 0 | 0 | 0 | 0 |
| | *Acropora valenciennesi* | 3 | 0 | 0 | 2 | 0 |
| | *Acropora clathrata* | 2.5 | 0 | 0 | 0 | 2 |
| | *Acropora brueggmanni* | 0 | * | 0 | 0 | 0 |
| | *Acropora nasuta* | 0 | * | * | 0 | 0 |
| | *Acropora eurystoma* | 0 | * | 0 | 0 | 0 |
| | *Acropora pharaonis* | 0 | * | 0 | 0 | 0 |
| | *Acropora granulosa* | 0 | 2 | 0 | 6 | 3 |
| | *Acropora nobilis* | 0 | 0 | 0 | 15 | 0 |
| | *Stylophora pistillata* | 10 | 0 | * | 14 | 0 |
| | *Pocillopora verrucosa* | 13 | 13 | 0 | 2 | 0 |
| | *Pocillopora damicornis* | 0 | 12 | 0 | 0 | 0 |
| | *Lobophyllia hemperichi* | 0 | 1.5 | 9 | 0 | 0 |
| | *Tubastrea aurea* | 2 | 2 | 0 | 0 | 3 |
| | **Total** | **41** | **31.5** | **9** | **46** | **8** |
| **Massive** | *Montipora verrucosa* | 0 | 5 | 0 | 4 | 0 |
| | *Montipora monasteriata* | 2 | 0 | 1 | 0 | 0 |
| | *Montipora stilosa* | 0 | 1.5 | 0 | 0 | 2 |
| | *Platygyra sinensis* | 0 | 4 | 0 | 0 | 0 |
| | *Platygyra daedalia* | 2 | 0 | 0 | 0 | 0 |
| | *Porites lobata* | 0 | 0 | 0 | 0 | 9 |
| | *Favia stelligera* | 3 | 0 | 0 | 2 | 0 |
| | *Favia speciosa* | 3.5 | 2 | 13 | 0 | 0 |
| | *Favites persi* | 0 | 3 | 0 | 0 | 0 |
| | *Porites solida* | 3.5 | 0 | 2 | 0 | 0 |
| | *Goniastrea retiformis* | * | 0.5 | 1 | 0 | 6 |
| | *Galaxea fascicularis* | 0 | 3 | 0 | 0 | 0 |
| | *Psamocora haimaena* | 0 | * | 0 | 0 | 0 |
| | **Total** | **14** | **19** | **17** | **6** | **17** |
| **Encrusting** | *Echinopora lamellosa* | 0 | 4.5 | 1 | 0 | 0 |
| **Solitary** | *Ctenactis ecchinata* | 0 | 3 | 0 | 0 | 0 |
| **Hydrocoral** | *Millepora dichotoma* | 19 | 20 | 0 | 0 | 0 |
| | *Millepora platyphylla* | 1 | 0 | 0 | 0 | 0 |
| | **Total** | **20** | **20** | **0** | **0** | **0** |
| **Soft coral** | *Xenia* sp. | | 8 | 0 | 17 | 20 |
| | *Sarcophyton* sp. | 0 | 2 | 0 | 8 | 0 |
| | **Total** | **0** | **10** | **0** | **25** | **20** |

* = observed but not intercepted

**Table (6). Continued.**

| Categories | Species name | Depth zone | | | | |
|---|---|---|---|---|---|---|
| | | Reef flat | 1-5m | 6-11m | 12-15m | 16-18m |
| Other categories | Mollusca shells | 0 | 0 | 0 | 0 | 0 |
| | *Tridacna* sp. | 4 | 0 | 0 | 0 | 0 |
| | *Barbatia lacerta* | 0 | * | 0 | 0 | 0 |
| | Sponge | 0 | 0 | 0 | 0 | 0 |
| | *Strongylacidon* sp. (Red) | 0 | 2 | 0 | 0 | 0 |
| | *Placorttis* sp. (Black) | 0 | 1 | 0 | 0 | 0 |
| | Brown Algae | 0 | 0 | 0 | 0 | 0 |
| | *Actinotrichia fragilis* | 3 | 0 | 0 | 0 | 0 |
| | *Turbinia* sp. | 1 | 0 | 0 | 0 | 0 |
| | Sand | 1 | 0 | 55 | 13 | 40 |
| | Total | 9 | 3 | 55 | 13 | 40 |

* = observed but not intercepted

**Table (7). Number of species, Percent cover (%), Diversity ($H'_N$) and Evenness index (J') at Northern Sharm El Loly.**

| | Reef flat | 1-5m | 6-11m | 12-15m | 16-18m |
|---|---|---|---|---|---|
| No.sp.(intercepted) | 15 | 18 | 6 | 10 | 7 |
| No.sp.(non intercepted) | 1 | 6 | 3 | 0 | 0 |
| % Live hard corals | 75 | 78 | 27 | 52 | 25 |
| % Live soft corals | 0 | 10 | 0 | 25 | 20 |
| % Dead corals | 16 | 7 | 12 | 12 | 15 |
| H'N | 2.1 | 2.2 | 0.8 | 1.5 | 0.9 |
| J' | 0.8 | 0.8 | 0.3 | 0.5 | 0.5 |

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