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Comparative morphology on some sclerectanian corals in Arabian Gulf and the Egyptian Coast of the Red Sea

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ABSTRACT

The present study aimed to examine the morphological variations occur in the same species of some sclerectinian corals inhabiting Red Sea and Arabian Gulf to establish basic understand the lineage between scleractinian coral species in such geographic region. 126 specimens of the most abundant sclerectinian corals inhabiting the Egyptian coasts along Red Sea and Gulf of Aqaba and Arabian Gulf were collected. Mico- and macro-morphological identification was used to identify and investigate coral species at selected sites. Eight species were recorded (*Acropora pharaonis, Acropora humilis, Acropora digitefra, Pocillopora verrucosa, Stylophora pistillata, Porites harrisoni, Platygyra daedalea, Favia pallida)* belong to six genera. Analysis of variance (ANOVA) has been made for the corallite and branch measurement with sites. The preset study revealed that corallite diameter are highly influenced by geographic distribution in all species except corallite of *Stylophora pistillata.* Branch diameter are highly influenced (p<0. 05) by geographic distribution only in *Acropora humilis and Acropora digitefera*, while *Acropora pharaonis, Pocilliopora verrucosa and Stylophora pistillata* did not vary among sites. Comparing specimens collected from Arabian Gulf with those from Red Sea and Gulf of Aqaba, corallite and branch measurements of *Stylophora pistillata, Platygyra deadalea* were very near and morphological characters were identical. Corallite and branch measurements of *Favia pallida* were very close at all locations. Only in Red Sea specimens (Fanous), costa and paliform was absent.

INTRODUCTION

Although coral reefs are the most diverse ecosystems in the marine environment, many coral species showed unclear taxonomic state or remain undescribed (Neigel *et al*. 2007). Therefore, without appropriate species, genus and family delineation; errors in estimates of diversity are inevitable (Knowlton and Jackson 1994; Agapow *et al*. 2004; Isaac *et al*. 2004). For coral reef, understanding the diversity of corals is considered a critical issue in coral reef conservation. Also, understanding of speciation and biogeographic events that shaped the distribution of scleractinian corals may also help predict responses of reefs to oceanographic modifications resulting from climate change (Pandolfi 1992; Palumbi 1997; Barber *et al*. 2006).

In term of coral taxonomy and distribution, the closest faunistic proximity in Indo-Pacific region is the Arabian Gulf and Red Sea (Sheppard and Sheppard 1991; Wallace 1999; Veron 2000). This is due to the sharing in paleoceanographic history of restriction during the last sea-level stand and simultaneous flooding during the Holocene transgression (Sheppard and Sheppard 1991; Acosta and Uchupi 1996). In contrast to the Red Sea that has 18 endemic coral species, Arabian Gulf has no endemic species according to many authors (Sheppard and Sheppard 1991; Wallace 1999) except *Porties harrisoni* that is considered regionally endemic coral species at the Arabian Gulf by Veron (2000). The aim of this study was to examine the morphological variations occur in the same species of some sclerectinian corals inhabiting Red Sea and Arabian Gulf to establish basic understand the lineage between scleractinian coral species in such geographic region.

MATERIALS AND METHODS

Study area

In the Egyptian coast of Red Sea and Gulf of Aqaba, five sites were selected to cover a wide geographical range (Fig. 1a). Two sites were selected from southern Arabian Gulf (Abu Dhabi coast) represent extreme harsh habitat for coral (Fig. 1b), the coordinates of selected sites are represented in Table 1.

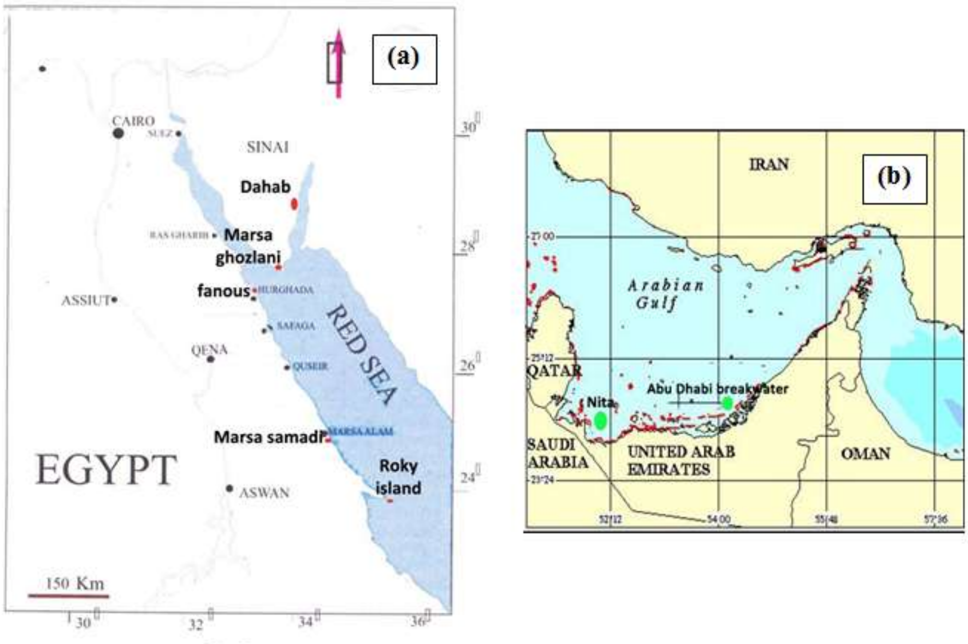

Fig. 1: Locations of selected sites in a) the Egyptian Red Sea and Gulf of Aqaba coasts, red dots and b) southern coast of Arabian Gulf, green dots.

Table 1: The coordinates of selected sites

sites	coordinates
Dahab (Gulf of Aqaba)	28° 29' 10" N, 34° 29' 10" E
Marsa Ghozlani (Red Sea)	27° 49' 20" N, 34° 49' 20" E
Fanous (Red Sea)	27° 15' 57" N , 33° 15' 57" E
Marsa Samadai (Red Sea)	25° 00' 50" N, 34° 00' 50" E
Rocky Island (Red Sea)	23° 33' 47" N, 36° 33' 47" E
Nita (Arabian Gulf)	24° 28' 41.9" N, 51° E
Abu Dhabi breakwater (Arabian Gulf)	24° 31' 42" N, 54° 17' 50" E

Sample collection and identification

Specimens of scleractinian corals (about 5cm to10cm from colony) were collected for morphological examination by SCUBA diving following PADI instruction from January 2012 to March 2013. Colonies of selected corals were photographed by underwater camera and Specimens were labelled. Specimens were identified using field recognizable features (colony form, color and corallites form, etc.) according to veron (2000). Later, identification was confirmed by analysis of skeletal traits in the laboratory.

The skeleton was bleached in 5ppt sodium hypochlorite, and the specimens were let to dry. Macro- and micro- morphology characters were examined using Dino-lite AM-311 digital microscope (10X, 20X) according to the terminology and measuring procedures that was suggested by many authors (Wallace 1978; Veron and Wallace 1984; Riegl 1995; Wallace 1999; Veron 2000; Wolstenholme *et al*. 2003; Budd *et al*. 2012). Vernier caliper has been used for distance measurement. Identification of samples was confirmed by M. Pichon (personal communication). Variance of significant (ANOVA) among corallite measurements of the same species at different sites was calculated by SPSS (V.16).

RESULTS

In the present study, 126 specimens have been collected and identified to species level. Of them, 63 specimens were collected from Red Sea, 42 from Gulf of Aqaba and 21 from Arabian Gulf. They were identified by using macro- and micro-morphological characters. Eight species belong to six genera (*Acropora*, *Pocillopora*, *Stylophora*, *Porites*, *Platygyra* and *Favia*) and four families were identified. For each species, all morphological variations between specimens of the same species at different sites were described as follow:

Family Acroporidae (Verill 1902)
Genus *Acropora* (Oken 1815)

Acropora pharonis (Milne Edwards and Haime 1860) (Fig. 2)

Materials examined:

Dahab, Marsa Ghozlani, Fanous, Marsa Samadai and Rocky reef.

Diagnosis:

Branches are pointed and sometimes have branchlets. The main branch is up to 1.2cm in diameter. The axial corallite is small, conspicuous. Outer diameter 1.3-1.9mm, inner diameter 0.025-0.07mm. Primary septa to 1/2R, secondary septa to 1/4R. The radial corallite is nariform. Outer diameter 1.4mm, inner diameter 0.07mm. Coenosteum a dense arrangement of laterally flattened spinules. Color pale brown.

Remarks:

In Rocky reef samples, the radial corallites were long, thin, and dense. In Ras Mohammed samples, the radial corallites were short, and one side has dense corallites than other side. In Dahab samples, radial corallites were thick. Outer diameter of axial corallite and inner diameter of axial corallite were found to be highly influenced significantly by sites ($p<0.05$), while for main branch diameter, insignificant influence with sites was found ($p>0.05$).

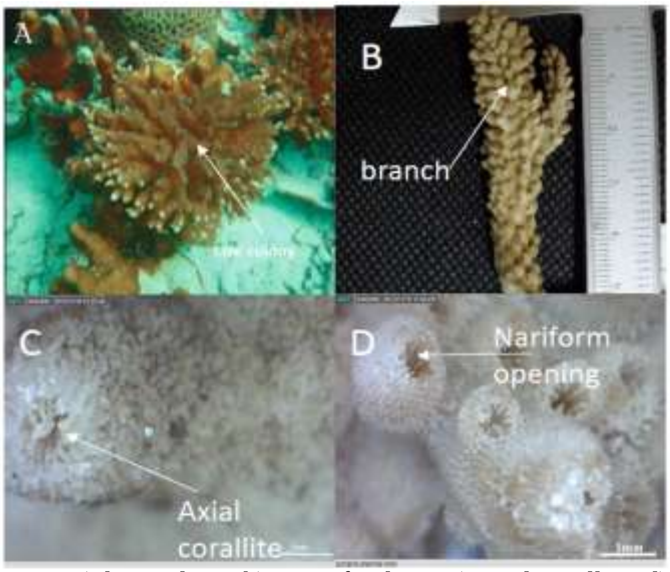

Fig. 2: *Acropora pharonis*; a) live colony, b) part of colony, c) axial corallite, d) nariform opening radial corallites.

Acropora humilis (Dana 1846) (Fig. 3)

Material examined:

Dahab, Marsa Ghozlani, Fanous, Marsa Samadai and Rocky reef.

Diagnosis:

Branches up to 1.2cm diameter. Axial corallite conspicuous, outer diameter 3-4.25mm, inner diameter 0.2-1mm, primary septa to1/2R, secondary septa to1/4R. Radial corallite outer diameter 1-2.4mm, inner diameter 0.35-1mm. evenly distributed, short tubular with dimidiate opening, thickened walls. Primary septa to 1/3R, secondary septa incomplete, to1/4R. Radial corallites have two sizes. Coenosteum a dense arrangement of laterally flattened elaborated spinules. Color pale brown.

Remarks:

Main branch, inner diameter of axial corallite were found to be highly influenced significantly by sites ($p<0.05$), while outer diameter for axial and radial corallite, inner diameter for radial corallite had insignificant influence with sites ($p>0.05$).

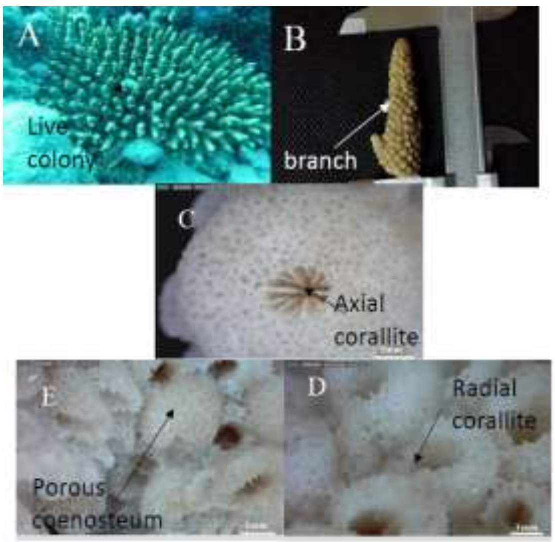

Fig. 3: *Acropora humilis;* a) live colony, b) part of colony, c) axial corallite, d) radial corallite, e) porous coenosteum.

Acropora digitefra **(Dana 1896) (Fig. 4)**

Materials examined:

Dahab, Marsa Ghozlani, Fanous, Marsa Samadai and Rocky reef.

Diagnosis:

Main branch diameter is up to 1cm. axial corallite outer diameter 2-3.65mm, inner diameter 0.3-0.6mm, primary septa to 2/3R, secondary septa incomplete to 1/4R. Radial corallite dimidiate arranged closely together with thickened wall, lower wall looks like a lip, primary septa to 3/4R, secondary septa incomplete 1/4R. Coenosteum a dense arrangement or laterally flattened spinules. Color pale brown.

Remarks:

Main branch and outer diameter of axial corallite illustrated significant variation between sites ($p<0.05$), while outer diameter of radial corallite and inner diameter of axial corallite showed non-significant variation among sites ($p>0.05$).

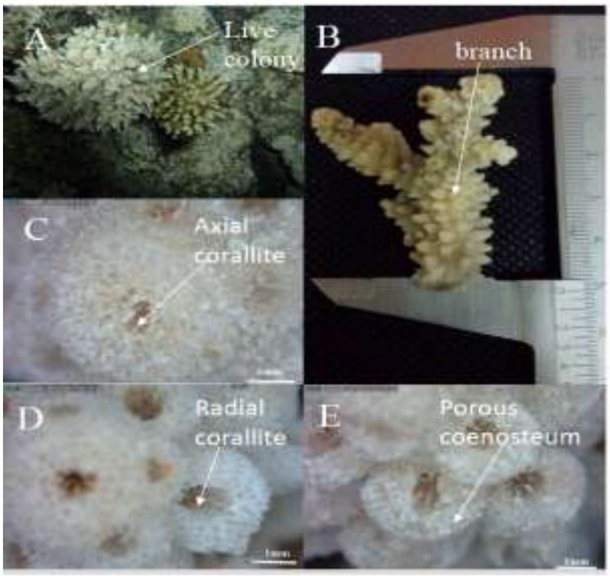

Fig. 4: *Acropora digitefra*; a) live colony, b) part of colony, c) axial corallite, d) radial corallite, e) porous coenosteum.

Family Pocilloporidae (Gray 1842)

Genus *Pocillopora* (Lamarck 1816)

Pocillopora verrucosa (Ellis and Solander 1786) (Fig. 5)

Material examined:

Dahab, Marsa Ghozlani, Fanous, Marsa Samadai and Rocky reef.

Diagnosis:

Colonies are ramose and composed of uniform upright branches that is result in bushy clumps. Branches diameter to 1.7cm. Verrucae are prominent, give the colony rough or rigged surface. Verrucae are irregular or conical in shape. Lateral verrucae often incline towards the distal end of branches. Calice diameter 0.4-1.5mm. Calices are polygonal or circular in shapes, respectively, in the distal and basal parts of branches. Septa is simple vertical ridges covered by fine denticales. Columellae is absent. Coenosteum is granules. Color is pale brown or pink.

Remarks:

Rocky reef samples have conical verrucae. Other samples are irregular. Calice diameter was found to be influenced significantly by sites ($p<0.05$), while branches were found non-significant influence with sites ($p>0.05$).

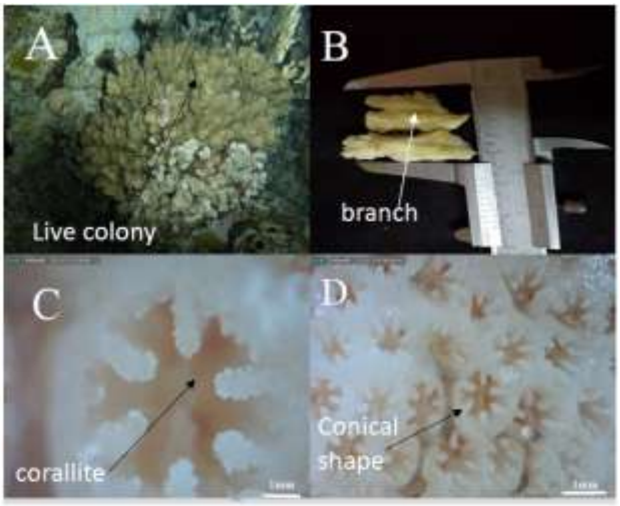

Fig. 5: *Pocillopora verrucosa*; a) live colony, b) part of colony, c) corallite, d) conical shape corallite.

Genus *Stylophora* (schweigger 1819)

Stylophora pistillata (Esper 1797) (Fig. 6)

Material examined:

Dahab, Marsa Ghozlani, Fanous, Marsa Samadai, Rocky reef and Abu Dhabi breakwater.

Diagnosis:

Colonies are ramose with digitiform branches. Branches diameter up to 1.5cm. calice diameter 0.7-1.2mm, being smaller toward the base of branches, larger toward braches tips. Coralittes have thin -wall. Calices are inclined and form a hooked structure. Septa unequal and arranged in 2 cycles. Primary septa extend toward to pinnacle-like columellae. Secondary septa are incomplete, weak developed. Calices become thinner and the internal structure thicker than this in the distal end of branch. Calices surrounded by fine coenenchyme ornamented with numerous fine spinules. Color pale brown, pink.

Remarks:

Calice diameter and branches demonstrated non-significant influence with sites ($p>0.05$).

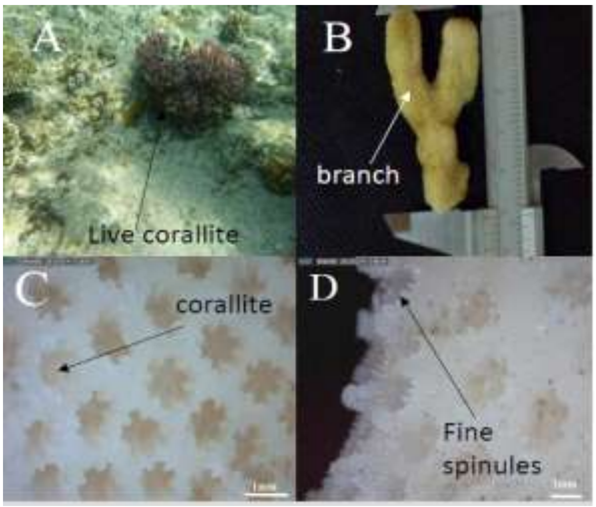

Fig. 6: *Stylophora pistillata*; a) live colony, b) part of colony, c) corallites, d) fine spinules around calices.

Family Poritidae (Gray 1842)
Genus *Porites* (Link 1807)
Porites harrisoni (Veron 2000) (Fig. 7)

Materials examined:
Nita and Abu Dhabi breakwater.

Diagnosis:
Colonies are columnar or encrusting. Corallites diameter1-1.5mm. Corallites have angular walls, one denticale, triplet not fused, 5-8palli and small columella. Coenosteum is porous and narrow. Colony color is pale brown.

Remarks:
This species was dominant in southern Arabian Gulf (Abu Dhabi coast). Corallite diameter was be influenced significantly by sites ($p<0.05$).

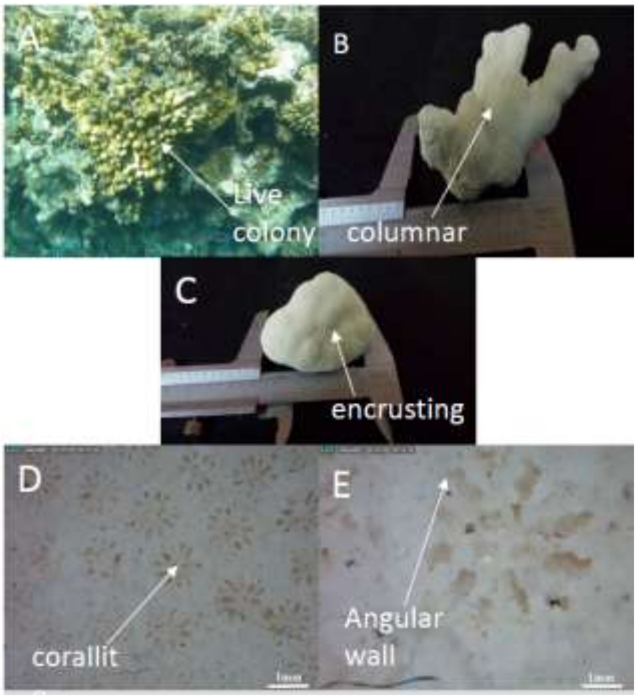

Fig. 7: *Porites harrisoni*; a) live colony, b) part of colony (columnar), c) part of colony (encrusting), d) single corallite, e) corallite show angular wall.

Family Faviidae (Gregory 1906):
Genus *Platygyra* (Ehrenberg 1834)
Platygyra deadalea (Ellis and Solander 1786) (Fig. 8)

Material examined:
Nita, Abu Dhabi breakwater, Marsa Ghozlani and Fanous.

Diagnosis:
Colonies are massive (rounded or flattened). Valleys are long and meandriod, in some colonies short, or mixture. The walls are narrow. Septa is exsert, dentate, unequal teeth. Septa has scattered irregular granules. Paliform is poorly developed if found. Columella is conspicuous, spongy. Color is pale brown.

Remarks:
Colonies from Fanous sample were spherical, Marsa Ghozlani, while those from Nita and Abu Dhabi break water were flattened.

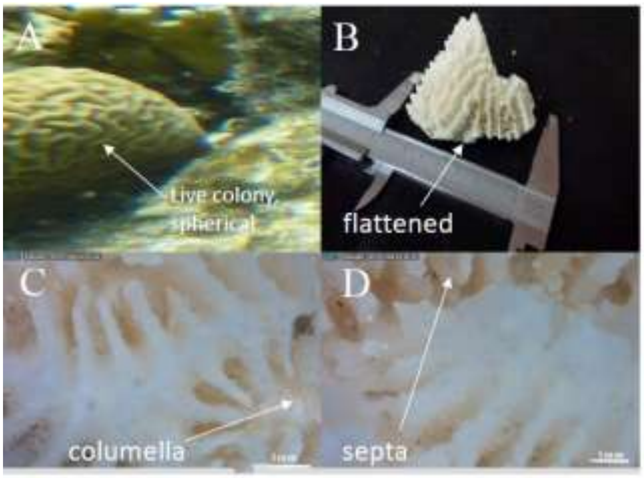

Fig. 8: *Platygyra deadalea*; a) live colony, b) part of colony (columnar), c) columella, d) septa dentate and granules.

Genus *Favia* (Oken 1815)

Favia pallida (Dana 1846) (Fig. 9)

Material examined:

Nita, Abu Dhabi breakwater, Marsa Ghozlani and Fanous.

Diagnosis:

Colonies are massive. Some colonies have intracalicular budding. Corallites are irregular, ploco-ceriod or ceroid. Calice diameter average 3.57-4.35mm. Septa arrange in three cycles. First septa cycle is more exert than second and third cycles. All septa are dentate. Septa cycles are unequal. Teeth have elliptical base, paddle-shape with regular tip. Granules scattered, irregular shape. Teeth shape and size are equal. Costae present, may be continues or not between corallites, equal and dentate. Paliform are present or may absent. Columellae present, compact. Color is pale brown.

Remarks:

Specimens from Fanous have no costae. Granules in septa thinner. Columellae in Abu Dhabi break water specimen was loose. Calice diameter showed highly significant differences between sites ($p<0.05$).

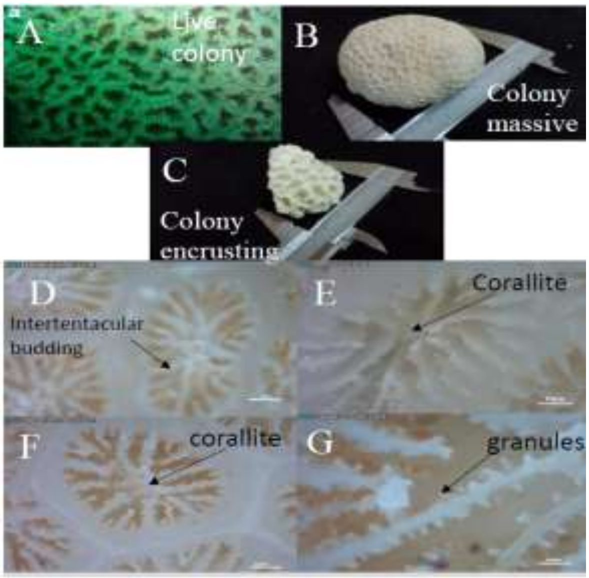

Fig. 9: *Favia pallida*; a) live colony, b) massive colony, c) encrusting colony, d) intertentacular budding, e) corallite (Fanous), f) corallite (Marsa Ghozlani), g) granules on septa.

DISCUSSION

Reef building corals are notoriously difficult to identify at the species level. Scleractinian taxonomy has traditionally relied on skeletal morphology, which is often highly variable (Veron 1995, 2000). The present study revealed that corallite diameter are highly influenced by geographic distribution in all species except corallite of *Stylophora pistillata* ($p>0.05$). Branch diameter are highly influenced by geographic distribution only in *Acropora humilis* and *Acropora digitefera*, while *Acropora pharaonis, Pocilliopora verrucosa* and *Stylophora pistillata* did not influence by sites ($p>0.05$). This was coincident with Chen *et al*. (2011) who stated that skeletal characters of corallite of *Oulastrea crispate* influenced by spatial distribution. Also, significant phenotypic plasticity of *Montastrea annularis* was found between different depths and localities of Curacao (Klaus *et al*. 2007).

In southern Arabian Gulf sites, *Pocillopora verrucosa* and *Acropora* spp. did not exist. Many of *Acropora* populations have suffered severe dieback since 1996 (Sheppard *et al*. 2010). *Acropora* has significantly disappeared as an ecologically important species from most of Bahrain, Qatar and western Abu Dhabi, while large stands remain in Kuwait (Benzoni *et al*. 2006). In 2010, *Acropora* has been regenerated in some areas for Abu Dhabi (Riegl and Purkis 2012).

Acropora and *P. harrisoni* bleached to comparable levels and were significantly affected by diseases. Since mortality in *Acropora* was several-fold higher than in *Porites,* these dense *Porites* assemblages may be vestiges of previous mortality events that eradicated *Acropora* and subsequently *Porites* have taken all available space. In western Abu Dhabi, eastern Qatar and Bahrain, *P. harrisoni* tends to dominate clearly in the hottest and most saline (43–45 %**O**) regions with dense coral growth (Sheppard and Sheppard 1991). Corallite and branch measurements of specimens from Gulf in the present were very close to those previously recorded in Arabian Gulf specimens (Riegl and Purkis 2012).

Platygyra deadalea was found in all habitats throughout Arabian Gulf (Riegl and Purkis 2012). *Platygyra deadalea* is nearly similar to *Platygyra lamellina*, the thecae in the second species is thicker than the first species, therefore the walls between the valleys more rounded and wider. Colonies of Gulf specimens were flattened. Gulf specimens description is similar to those described by Riegl and Purkis (2012) and Hodgson and Carpenter (1995).

Stylophora pistillata from Arabian Gulf showed different appearance from Indian Ocean specimens (Riegl and Purkis 2012). According to Riegl and Purkis (2012), Gulf specimens have a well-developed single cycle of six smooth septa. Our Gulf specimens, septa unequal and arranged in 2 cycles. Primary septa is developed while secondary septa is incomplete, weak developed. In most Gulf specimens, this may be not very obvious; the entire corallite wall is not raised. It was not recognized in our Gulf specimens. Corallite and branch measurements of Gulf specimens in the present study is very close to that registered in previous study on the Gulf (Riegl and Purkis 2012).

Favia pallida is very common and regular throughout the entire gulf and all habitats (Riegl and Purkis 2012). Colonies of Arabian Gulf were flattened, spherical. Gulf specimens is very obviously plocoid and corallite is crowded and polygonal (Riegl and Purkis 2012). Kuwait specimens had the two form, plocoid that can be confused to *Favia favus* and the cerioid form that has irregularly exert septo-costae (Hodgson and Carpenter 1995). Corallite of Arabian Gulf specimens was irregular and had two forms; ploco-ceriod or ceroid. Columella present and compact in Nita specimens in accordance with Riegl and Purkis (2012) fiding. In Abu Dhabi breakwater specimens, columella was loose. Septa sides in our Gulf specimens has scattered granules with irregular shape. Gulf specimens (Riegl and Purkis 2012) septa sides has fine granules. In Kuwait was not mentioned. Coastae is well developed in study samples and gulf specimens, in study specimens may be continues or not between corallites, equal and dentate, gulf specimens differentiated into a first and a second order which can differ in size, or not and dentate. Calice diameter average in our Gulf specimens is 4.21mm±0.23mm. Gulf specimens (Riegl and Purkis 2012), calice diameter average is 8-12mm.

Porites harrisoni was not recoded in the Red Sea and Gulf of Aqaba. Corallite and branch measurements of *Acropora humilis, Acropora digitifera,* Pocillopora *verrucosa*, *Stylophora pistillata* and *Platygyra deadalea* specimens in Red Sea and Gulf of Aqaba is very near and morphological characters is identical. In addition, they are closely similar to measurements recorded by Scheer and Pillai (1983).

Acropora pharaonis specimens from Gulf of Aqaba and Red Sea have very small differentiation in skeleton and corallite measurement, but Rocky Island (Red Sea) specimens show significant morphological difference as radial corallite is thin, long and dense. In other samples (like in Dahab and Gulf of Aqaba), radial corallite is thick and short. Samples in the present study showed skeletal measurements closely similar to measurements recorded by Wallace et al. (1991) and Scheer and Pillai (1983) at the Red Sea.

Colonies of *Favia pallida* in Gulf of Aqaba were flattened, spherical while in Red Sea were Dome shape. In Red Sea samples, Colony massive, *rounded*, flat or encrusting (Scheer and Pillai, 1983). Our Red Sea and Gulf of Aqaba specimens had two-form ploco-ceriod or ceroid, corallite is irregular while in In Red Sea samples corallite is often oval, septa 18 to 36 (Scheer and Pillai, 1983). Paliform lobes mostly present. In our Red Sea and Gulf of Aqaba specimens, columella is present and compact. Septa sides in study specimens has scattered granules with irregular shape, Red Sea (Fanous) specimens, granules in septa thinner. Coastae is well developed, in our Red Sea and Gulf of Aqaba specimens may be continues or not between corallites, equal and dentate. Specimens from Fanous have no costae and paliform.

Comparing specimens collected from Arabian Gulf to Red Sea and Gulf of Aqaba, Corallite and branch measurements of *Stylophora pistillata*, *Platygyra deadalea* specimens is very near and morphological characters are identical. Corallite and branch measurements of Gulf of Aqaba, Red Sea and Arabian Gulf *Favia pallida* specimens is very close. Only Red Sea specimens (Fanous) costa and paliform is absent. In Arabian Gulf (Abu Dhabi breakwater) specimens, columella is loose.

Our corallite and branch measurements of *Acropora humilis*, *Acropora digitifera*, Pocillopora *verrucosa*, Porites *harrisoni* and *Platygyra deadalea* specimens are very near and morphological characters are identical to Arabian Gulf specimens (Riegl and Purkis 2012), Taiwan specimens (Dai and Horng 2009a), Red Sea samples (Scheer and Pillai 1983).

Comparing our *Acropora pharaonis* specimens to Arabian Gulf specimens (Riegl and Purkis 2012), the radial corallites is tubular with dimidiate to oblique or rounded openings, in our specimens and wallace specimens, the radial corallite has nariform opening. This may be as coral show morphological plasticity in response to habitat and environment variables (Foster 1979, Lang 1984) as from ANOVA analyses, corallite show effect by sites ($p<0.05$), this may explain the change in radial corallite. Our *Stylophora pistillata* specimens, Taiwanspecimens (Dai and Horng

2009a) and Red Sea samples (Scheer and Pillai 1983), Septa unequal and arranged in 2 cycles. Primary septa is developed. Secondary septa is incomplete, weak developed. In Gulf (Riegl and Purkis 2012) specimens have a single cycle of six smooth septa are very developed, also this may be not very obvious; the entire corallite wall is not raised.

Corallite of our specimens, Kuwait specimens (Hodgson and Carpenter 1995), Taiwan specimens (Dai and Horng 2009b) is plococeriod or ceroid while in Gulf specimens (Riegl and Purkis 2012) is very obviously plocoid. Coastae is well developed in our specimens may be continues or not between corallites, equal and dentate, Gulf specimens (Riegl and Purkis 2012) differentiated into a first and a second order which can differ in size, or not and dentate. In Taiwan specimens costae is equal when present and dentate. Specimens from Fanous have no costae.

Investigate the differences in the morphological characteristics between the same species collected from geographically isolated locations, from our finding there were minor differences in some species, otherwise some species have morphotypes with more morphological differences which influence by sites.

Further research is required on both the Red Sea and the Arabian Gulf in order to understand coral genetic diversity and most importantly corals resistance and resilience to climate change and global warming. In the study, we provided basic understanding for the under-investigation species in both areas.

REFERENCES

Acosta, J. and E. Uchupi (1996). Transtensional tectonics along the south Scotia Ridge, Antarctica. Tectonophysics, 267(1): 31-56.

Agapow, Paul-Michael, *et al*. (2004) The impact of species concept on biodiversity studies. The quarterly review of biology, 79(2): 161-179.

Barber, P.H.; Erdmann, M.V. and Palumbi, S.R. (2006). Comparative phylogeography of three codistributed stomatopods: origins and timing of regional lineage diversification in the coral triangle. Evolution, 60(9): 1825-1839.

Benzoni, F.; Pichon, M.; Al Hazeem, S. and Galli, P. (2006). The coral reefs of the Northern Arabian Gulf: stability over time in extreme environmental conditions. Proc 10th Int Coral Reef Symp.

Budd, A.F.; Fukami, H.; Smith, N.D.; and Knowlton, N. (2012). Taxonomic classification of the reef coral family Mussidae (Cnidaria: Anthozoa: Scleractinia). Zoological Journal of the Linnean Society ,166(3): 465-529.

Chen, K.S.; Hsieh, H.J.; Keshavmurthy, S.; Leung, J.K.L.; Lien, I.T.; Nakano, Y. and Chen, C. A. (2011). Latitudinal gradient of morphological variations in Zebra Coral *Oulastrea crispate* (Scleractinia: Faviidae) in the West Pacific. Zool Stud., 50: 43- 52.

Dai, C.f. and Horng, S. (2009). Scleractinia fauna of Taiwan. II." The robust group. National Taiwan University, Taipei.

Foster, A. B. (1979). Phenotypic plasticity in the reef corals *Montastraea annularis* (Ellis & Solander) and *Siderastrea siderea* (Ellis & Solander). Journal of experimental marine Biology and Ecology, 39(1): 25-54.

Hodgson, G. and Carpenter, K. (1995). Scleractinian corals of Kuwait.

Isaac, Nick JB, James Mallet, and Georgina M. Mace. (2004) Taxonomic inflation: its influence on macroecology and conservation.Trends in Ecology & Evolution, 19(9): 464-469.

Klaus, J.S.; Budd, A.F.; Heikoop, J.M. and Fouke, B.W. (2007). Environmental controls on corallite morphology in the reef coral *Montastraea annularis*. Bulletin of Marine Science, 80(1): 233-260.

Knowlton, N. and Jackson, J.B. (1994). New taxonomy and niche partitioning on coral reefs: jack of all trades or master of some? Trends in Ecology & Evolution, 9(1): 7-9.

Lang, J. (1984). Whatever works: the variable importance of skeletal and of non-skeletal characters in scleractinian taxonomy. Palaeontogram, 54: 18-44.

Neigel, J.; Domingo, A. and Stake, J. (2007). DNA barcoding as a tool for coral reef conservation. Coral Reefs, 26(3): 487-499.

Palumbi, S. (1997). Molecular biogeography of the Pacific. Coral Reefs, 16(1): S47-S52.

Pandolfi, J.M. (1992). Evolution and the fossil record.

Riegl, B. (1995). Effects of sand deposition on scleractinian and alcyonacean corals. Marine Biology, 121(3): 517-526.

Riegl, B.M. and Purkis, S.J. (2012). Coral reefs of the Gulf: adaptation to climatic extremes in the world’s hottest sea, Springer.

Scheer, G. and Pillai, C.G. (1983). Report on the stony corals from the Red Sea. Zoologica, 45(3): 1-198.

Sheppard, C.R. and Sheppard, A.S. (1991). Corals and coral communities of Arabia.

Sheppard, C.; Al-Husiani, M.; Al-Jamali, F.; Al-Yamani, F.; Baldwin, R.; Bishop, J. and Jones, D. A. (2010). The Gulf: a young sea in decline. Marine Pollution Bulletin, 60(1): 13-38.

Veron, J.E.N. (1995). Corals in space and time: the biogeography and evolution of the Scleractinia,. Cornell University Press.

Veron, J.E.N. (2000). New species described in Corals of the World, Australian Institute of Marine Science.

Wallace, C. (1999). Staghorn corals of the world: a revision of the genus *Acropora*, CSIRO publishing.

Wallace, C.C. (1978). The coral genus *Acropora* (Scleractinia: Astrocoeniina: Acroporidae) in the central and southern Great Barrier Reef province, Queensland Museum.

Wolstenholme, J.K.; Wallace, C.C. and Chen, C.A. (2003). Species boundaries within the *Acropora humilis* species group (Cnidaria; Scleractinia): a morphological and molecular interpretation of evolution. Coral Reefs, 22(2): 155-166.

ARABIC SUMMARY

مقارنه مورفولوجية لبعض الشعاب المرجانية في الخليج العربي والساحل المصري للبحر الأحمر

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تهدف الدراسة الحالية إلى دراسة الاختلافات المورفولوجية التي تحدث في نفس النوع من بعض الشعاب المرجانية الصلبة التي تعيش في البحر الأحمر والخليج العربي من أجل تحديد النسب بين الأنواع المرجانية الصُلِبة في هذه المنطقة الجغرافية. تم جمع ١٢٦ عينة من أكثر الشعاب المرجانية الشائعه التي تقطن السواحل المصرية على طول البحر الأحمر وخليج العقبة والخليج العربي. تم استخدام تحديد المايكرو- والماكرو-مورفولوجى لتعريف وتحديد أنواع الشعاب المرجانية والتحقق منها في المواقع المختارة. تم تسجيل ثمانية أنواع (*Acropora pharaonis*، *Acropora humilis*، *Acropora digitefra*، *Pocillopora verrucosa*، *Stylophora pistillata*، *Porites harrisoni*، *Platygyra daedalea*، *Favia pallida*) تنتمي إلى ستة أجناس. كشفت الدراسة أن بعض انواع المراجين تتأثر بشكل كبير بالتوزيع الجغرافي في جميع الأنواع ما عدا فى *Stylophora pistillata*. ويتأثر بشدة ($P \leq 0.5$) بالتوزيع الجغرافي فقط في *Acropora humilis* و *Acropora digitefera* ، في حين لم يتاثر فى *Acropora pharaonis* و *Pocilliopora verrucosa* و *Stylophora pistillata* بين المواقع. مقارنة العينات التي تم جمعها من الخليج العربي مع تلك من البحر الأحمر وخليج العقبة ، فان القياسات و الصفات المورفولوجيه لانواع *Stylophora pistillata* و *Platygyra deadalea* قريبة جدا تكاد تكون متطابقه. كانت قياسات المورفولوجيه فى *Favia pallida* قريبة جدا من جميع المواقع. فقط في عينات البحر الأحمر (فانوس)، تبين من الاختلافات في الخصائص المورفولوجية بين نفس الأنواع التي تم جمعها من المواقع المعزولة جغرافيا ان هناك اختلافات طفيفة في بعض الأنواع، هناك احتياج إلى إجراء مزيد من البحوث على كل من البحر الأحمر والخليج العربي لفهم التنوع الوراثي المرجاني والأهم من ذلك مقاومة الشعاب المرجانية لتغير المناخ والاحترار العالمي.