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A REPORT ON
" SOME ECOLOGICAL ASPECTS OF SANGANEB ATOLL "

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Some ecological aspects of Sanganeb Atoll

Introduction :

Within the framework of Unesco's goal to encourage bilateral research programmes between oceanographic institutions in the Arab States this project has been suggested in which both the Faculty of Marine Science, King Abdelaziz University and the Institute of Oceanography, National Council for Research would participate. Unesco has offered a financial support to enable the Institute of Oceanography to participate in this project. Accordingly a brief meeting was held at Jeddah comprising researchers from the two institutions in which Sanganeb atoll was decided to be the study site. The aspects to be investigated included coral distribution, algal cover, chlorophylla and nutrients level, sediment and plankton in addition to some physical aspects. However, the Saudi team did not show up at the fixed date and the staff of the Institute of Oceanography has conducted the suggested research work at the chosen site.

Study Area

Sangeneb Reef is located at about 30 km NE Port Sudan with a total length of 6 km and an average width of 2 km (Fig 1. & Plate 1). The atoll rises from a sea-floor of more than 500 m depth. It is characterized by steep slopes on all sides. The outer rim encloses three lagoons with depths varying from 5 to 28 fathoms. As a biological entity the reef is characterized by some different bio-physiogeographic reef zones each providing typical coral reef assemblages. Sanganeb reef was suggested to be the study site because the entire atoll is almost unaffected by threats such as coastal, industrial or port pollution. Thus such a reef could be a standard against which other coral reefs may be meaured as, for instance, the coral reef at Farasan Island on the Saudi coast which is affected by black-band disease or the fringing reef at Port Sudan which is likely to be affected by thermal pollution, oil pollution or pollution resulting from port activity.

Methods

Two transects were chosen at the northern and the southern side of the atoll as shown in Fig. (2). The transects were marked by floats with the help of an aerial photograph and a line was set up along these transects. Various oceanographic aspects were investigated along each transect using the methods indicated:

i) Coral distribution and algal cover: by direct observation.

ii) Sediments for grain size analysis and carbonate content: were collected randomly with hands on the reef flat and with a grab in the lagoon.

iii) Plankton : for quantitative analysis, sea water samples were collected at fixed stations in 250 ml glass bottles. For qualitative analysis two nets with mesh sizes 55μ and 300μ were towed at the surface at the rear of a fiberglass boat for phytoplankton and zooplankton collection respectively.

iv) Salinity: by using Knudsen method as cited in Strickland and Parsons (1965).

v) Transparency: by Secchi Disc (30 cm dia.).

vi) Temperature: by using normal thermometer.

vii) Dissolved oxygen: according to the classical Winkler Method and as described by Strickland and Parsons (1965).

viii) Nutrients (nitrate, phosphate and silicate): using spectrophotometer An 72 Type UFB - 8.

ix) Chlorophyll-a: by filtering two litres of samples through millipore filter (pore size 0.45 μ). After extraction in 90% acetone, chlorophyll-a content of the samples was measured using spectro-photometer An 72 Type UFB - 8.

Results

A) Coral distribution:

The general bathymetry of the northern transect (TN) and the southern transect (TS) is shown in Fig (3). The two transects showed some sort of similarity regarding the distinction of certain zones as, for instance, the presence of reef crest, reef flat and back reef. However the reef crest zone is absent on the western side of the southern transect (TS) where the reef flat starts from the drop-off to the back reef. The coral distribution in various zones along the two transects was as follows:

i) The southern transect (TS):

On the western side of this transect-the shoreward side- the reef edge with a depth of 30 cm terminates into a drop-off. The substrate at this reef edge consisted of hard well cemented reef rock. The coral cover is very rich and healthy consisting mainly of Millipora and Acropora in addition to some Favia, Porites and Pocillopora. Such rich and healthy coral cover in this area is expected because of very good water movement although strong wave action is absent. This may explain the absence of reef crest zone in this area.

The shallow reef flat zone extended to a distance of about 150 m to the reef back zone. The substrate consisted generally of eroded reef rock with some coral debris but towards the end of the zone it changed to sand where patch massive corals were scattered. The coral cover in this zone was very irregular varying in genera and in degree of healthiness as one moved from the reef edge towards the back reef. The corals observed included the genera Millipora, Stylophora, Seriatopora, Pocillopora, Acropora, Fungia, Porites, Favia, Favites, Goniastrea, Leptastrea and Echinopora. The soft corals such as Xenia sp., Lobophytum sp. and

Sinularia sp. were abundant especially in coral patch area using dead coral heads as substrates. A mong the stony corals only Stylophora was dominant along the entire reef flat zone followed by Porites. The latter formed micro-atolls in the coral patch area where the central part of the colony dies due to sedimentation while the edges continue to grow. The degree of healthiness seemed to be greater in the areas adjacent to the reef edge and reef back while the central protected portion of the reef flat consisted of 50 % dead corals being smoothered by grey sponges or grown over by soft corals.

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The reef back zone in this part of the transect varied considerably from other reef back zones facing the lagoon. Almost all the coral genera observed in this zone were healthy and perfoming a rich good coral coverage. This might be attributed to the fact that this zone lies close to the entrance to the lagoon where it is always subject to gentle wave action creating a good water movement with less suspended sediment. Among the corals observed were the genera: Millipora, Stylophora Seriatopora, Pocillopora, Acropora, Porites, Favia, Echinopora and Lobophyllia. The soft corals were represented by Xenia sp. and Lobophytum sp.

Unlike this zone, however, the reef back facing the lagoon on the eastern side of the same transect showed some difference regarding the healthiness of the corals themselves. The genera observed included Millipora, Stylophora, Seriatopora, Pocillopora, Acropora, Fungia, Porites, Favites, Platygyra, Hydnophora and Cyphostrea. Among the soft corals Xenia, Sarcophyton and Paralemnalia were observed. As shown above there were a good variety of coral forms in this zone, yet about 50% of these forms were dead. The majority were massive Porites about one meter in diameter. Most of them were eroded and covered with algae or soft corals or young other coral colonies such as Porites, Stylophora and Favia which took them as suitable substrates. Some of these massive forms below 40 cm depth were well developed but those living above this level formed micro-atolls probally due to sedimentation and to exposure of the central portion during low tide (Vine 1986). These massive corals formed a cliff of about two meters high from the sandy slope of the lagoon.

The eastern reef flat in this southern transect showed some sort of similarity to that of the western side in that it also consisted of eroded reef rock with coral debris and sandy bottom in areas where massive Porites and Favites coral patches formed some sort of micro-atolls. Young Stylophora, Pocillopora and Echinopora were found growing on dead Porites. Some of these Porities were covered with the soft coral Xenia sp. and Lobophytum sp. Beyond these massive Porites the substrate continued as eroded reef rock with coral debris and some depressions where coarse sediments accumulated. The area adjacent to the reef crest was subject to strong water movement caused by strong wave action. The majority of corals in this area were perforated by vermetus mollusc or covered with Xeniid soft corals showing about 50 % coral death in the zone. The corals represented in this zone in addition to the above mentioned ones included Millipora, Seriatorpora Acropora, Pavona, Fungia, Favites, Goniastrea, Platygyra and Oulophyllia while Sinularia sp. and Dendronephthya sp. were among the soft corals in the zone.

The reef crest zone was exposed to a very strong wave action. The shallow bottom showed a very well cemented hard substrate with a good coral cover and some coral debris. However these ramose corals were dead and completely covered with Xeniid soft corals. Very few Stylophora showed sign of life. This area of reef crest zone is followed by a special zone occupied almost exclusively by live Millipora and very few Stylophora and Echinopora. As one moved towards the reef edge along a very gentle slope, the dominant cover of Millipora was broken by Echinopora, Acropora and the soft corals Paralemnalia and Lobophytum. These genera continued to the reef edge where a variety of Millipora, Acropora and Porites decorated the drop-off.

ii) The Northern transect (TN):

The reef edge at the western side of the northern transect (TN) was characterized by a sharp drop-off with a depth of 170 m. Most of the corals at the drop-off were Millipora and Acropora with a few Porites, Favites and Platygra. The depth abruptly changed to 230 m in the area

lying adjacent to the reef edge with eroded reef rock covered mainly by the soft corals Paralemnalia, Lobophytum, Sinularia, Nephthea and Dendronephthya sp. These soft corals were mixed gradually with small colonies of Millipora, Stylophora, Pocillopora, Porites, Favites, Platygyra, Echinopora and Tubipora. A considerable number of vermetus molluscs perforated these corals. The number of Millipora increased as one approached the crest together with Xenüd soft corals and young Stylophra. The coral debris in the crest contained the coral Psammocora in the form of"corallith" which is a nodule of a living coral not attached but continues to grow while being moved about (Schroeder and Nasr 1983).

The reef flat that followed the reef crest zone more or less, resembled the two reef flats of the southern transect being formed of eroded reef rock with coral debris and coarse sediment accumulating in some depressions. The massive Porites and Favites formed similar micro-atolls. The coral distribution was not different from those described in the southern transect.

However, both reef backs facing the lagoon in this transect were different from those described in the southern transect (TS). They lied in a very calm protected area facing a shallow lagoon where constant sedimentation caused part of the colonies to die and thus many mussels were found attached to the dead parts of the Porites colonies. Those massive Porites living in a depth less than 110 cm formed micro-atolls with a large portion of the centre of the colony being dead. It seemed that sedimentation in this protected area physically interfered with feeding and respiration and drained energy in cleansing activities of these corals (Dahl, 1981) thus leading to the formation of micro-atolls. Those Porites living below 40 m depth were partly covered by soft corals Xenia sp. During this investigation only one Acanthaster Planci was found on the eastern reef back in this transect.

The comparatively very short reef flat in the eastern part of this transect showed some difference from those described above in the absence of massive coral forms and the shallow nature of the zone. It was characterized by eroded reef rock with coral fargments and covered by Stylophora, Porites and Favites together with Xenud soft corals. About 80 % of these stony corals were dead or partly dead. The Porites formed small micro-atolls.

The eastern reef crest zone in this transect extended from 20 cm depth to 230 cm depth at the reef edge. It is the zone receiving the highest wave action in the Atoll. This very gentle slope showed exclusive Millipora zone near the shallowest region but towards the reef edge this Millipora zone was gradually interrupted by a variety of soft and stony corals comprising Xenia, Sinularia, Dendronephthya, Stylophora, Porites, Favites and Platygyra. About 90 % of these corals were living in dense populations. However the population density decreased gradually towards the reef edge where only Styoplhora, Millipora and Porites being scattered in the area adjacent to the reef edge. The entire substrate of this zone consisted of eroded reef rock without any sediment or coral debris but with a dense population of vermetus molluscs.

At the reef edge, however, Acropora and Millipora were found to be the dominant forms before the drop-off.

B) Algal cover;

i) Algal composition:

Various macro-and filamentous algae were encountered during the present investigation. They gave a total of 76 genera and species belonging to 16 Chlorophyta (green algae), 12 Phaeophyta (brown algae), 41 Rhodophyta (red algae) and 7 Cyonophyta (blue-green algae) as indicated in the algal list. (P. 18/19) These benthic forms consist of macro-foliose or frondose

(i.e. Laurencia (red), Turbinaria (brown), Coralline (Jania & Galaxauria), Calcarious green (Halimeda sp), tall and microfilamentous (blue-green, green and red) algae.

ii) Algal distribution :

Survey of the benthic algae made along the two transects, the southern (TS) and the northern (TN) transect, revealed various algal associations at the different zones in both transects (Fig. 1 & 3).

Southern transect:

Algal cover (based on observation) on the coral reef flat that marked the beginning of this transect at the western side of the atoll (Fig. 3) was sparse. Because this reef area is very shallow & semiexposed to wave action, few algae were observe mainly: Laurencia& Polysiphonia (red), Turbinaria sp & Dictyota sp. (brown), Halimeda opuntia & Dictyosphaeria sp (green).

However, the growth of algae was relatively rich and diverse after the shallow reef area although the corals became patchy. Algal growth was restricted mainly to coral heads particularly the massive type forming microatolls. On the other hand, the loose sandy substratum at the bottom does not support much growth of these plants. The main encrusting algae included: Polysiphonia sp, Laurencia spp, Turbinaria spp & Jania (red); Dictyota spp. (brown); Halimedatuna, Boodlea sp, Cladophora sp. (green) and Lyngbya & Schizothrix spp. (blue-green). Inconspicuous red algae such as Spyridia spp., Martensia sp., Dasya, Tolypiocladia sp, Herposiphonia sp and Leveillea sp were observed in crevices or as epiphytes on larger algae.

At the back reef where the water became shallow again and slightly turbulant, the algal cover was less dense and less diverse but the same above algal assembly could be noted with few species missing. However, little or virtually no algal growth was observed at the back reef slope facing the deep lagoon where the water movement was relatively strong.

At the back reef facing the deep lagoon on the eastern side of the same transect (Fig 3),light algal cover was observed with less diverse macro-flora, similar to the back reef on the western side. The main encresting algae were Turbinaria sp, Dictyota sp., Jania spp. Laurencia spp, Caulerpa serrulata and Halimeda tuna.

In the coral patch reef which extended for more than 100 metres, seaweeds exhibited more luxuriant and diverse growth. They were found growing on and among corals especially the truncate heads of Porites as well as on the relatively hard substratum. Red algae predominated over other macro and filamentous algae particularly Laurencia (L. obtusa) and Acanthophora sp (red alga) followed by Turbinaria spp. The former two frondose red algae formed distinct zone growing on corals surfaces and on the hard bottom. Within this zone interspreaded other rodophycean algae such as Gracilaria sp., Spyridia sp, Martensia sp, Dasya sp, Tolypiocladia Herposiphonia & Leveillea spp. Polysiphonia was growing mainly on dead corals & rocky surfaces thus establishing its own zone. Within the red-brown algae intermingling zones, green algae (Boodlea sp & Cladophora sp and some few blue-green filaments (Lyngbya & Schizothrix spp.) were noticed to form scattered patches among dead and alive corals and on the hard bottom.

In the reef flat which is relatively narrow (60 meter long) and shallow, less dense cover of algae was recorded compared to the patch reef. Nevertheless, similar algal zones with some difference in composition were noted. The main algae available in terms of degree of abundance constituted: Polysiphonia spp, Laurencia spp (L.obtusa), Turbinaria sp (T.decurrens & T.ornata) Dictyota (D. friabilis), Jania sp., Boodlea (B.composita), Microdictyon sp, Halimeda tuna Halimeda opuntia, Dictyosphaeria cavernosa; Lyngbya sp & Schizothrix sp. However, the algal growth showed a general decline towards the end of the reef flat particularly Laurencia obtusa. On the other

hand, Turbinaria spp, Dictyota sp, Halimeda opunta, Halimeda tuna and Dictyosphaeria cover, relatively increased.

At the reef crest a remarkable decrease in algae as well as number of species was noticed. Growth was only limited to Halimeda opuntia, Turbinaria decurrens, Halimeda tuna and Dictyosphaeria cavernosa; growing among soft and small hard corals. The area here is shallow with loose coral fragments and more exposed to wave action. These factors might be the reason for the limit in algal cover at this area compared to that on the western side. However, the density of the green and brown algae diminished further down the crest slope till they became insignificant.

b) Northern transect:

At the start of this transect in the western side of the atoll (Fig.3), algae were not diverse a feature, more or less, similar to that observed on the southern transect at the same side. The major algae reported were: Acanthophora sp, Polysiphonia spp, Turbinaria (T.decurrens & T.ornata) & Dictyota sp. These macrophytes have well developed holdfasts or discs that enable them to attach firmly to rocky substratum and, therefore, can withstand the strong wave action. It was noted that Turbinaria (both species) showed more dense growth at the shallow crest reef area than on the western and eastern side of the southern transect. At the reef flat which stretched for about 180 metres and relatively protected, more algae appeared covering huge coral surfaces, crevices and on the hard substratum at the bottom. Red algae predominated forming 60-70% of the species recorded with Polysiphonia sp, Jania sp, Laurencia (L. obtusa) and Acanthophora sp. being the most important. This was followed by brown algae: Turbinaria decurrens, Turbinaria ornata in addition to Pocockiella sp; green algae: Boodlea sp, Microdictyon sp, Cladophora sp. and blue-green: Lyngbya & Schizothrix spp. Algal density as well as diversity increased till the back reef,

particularly Turbinaria spp. Dictyota sp Jania sp, Boodlea, Cladophora and Schizothrix spp. This feature was not observed at the reef flat on the same side of the southren transect.

However, few seaweeds mainly Turbinaria sp, Polysiphonia sp, Laurencia sp. Jania sp, and Caulerpa serrulata could be detedted at the back reef edge facing the shallow lagoon. The latter green alga was also found growing on rocky-sandy bottom of the lagoon (4 - 5m deep) adjacent to the reef. The same limited number of algae though slightly different in composition, was also encountered at the corresponding back reef facing the lagoon on the eastern side of the transect (Fig.3). The algal cover composed of : Jania sp, Laurencia sp, Polysiphonia sp. Turbinaria sp, Dictyota sp, Lyngbya sp. and Cladophora sp. The reef flat harboured a relatively much less diverse macroflora compared to that on the western side of the transect and the reef flat on both sides of the southern transect. It is worth mentioning that the reef flat in this side of the northern transect is very short (about 10m long), relatively exposed and shallow (almost 60 cm deep). It, therefore, offers a limited space and probably, an infavourable environment, for proliferation of more macroalgae. The important encrusting algae found constituted: Polysiphonia (mainly on dead corals), Jania sp. Turbinaria spp, Diclyota sp. Pocockiella sp. Laurencia sp., Dictyosphaeria sp. Halimeda tuna & Halimeda opuntia. It was noted that Turbineria spp and Dictyota sp, became prominant towards the reef crest (10-20 cm) and beyond it where the area is much exposed to oceanic waves. Halimeda spp and Dictyosphaeria cover also increased while the red algae cover was much reduced and only confined to Jania sp. and Polysiphonia sp. The algal cover generally declined further down the reef crest and only few Turbinaria sp. Dictyota. Dictyosphaeria, Halimeda sp & Jania sp. were noticed.

C) Sediments :

Three sediment samples were collected from the northern transect (TN); at the eastern reef flat (TNE), the lagoon (TNL) and the western reef flat (TNW). Similar samples were collected from the southern transect(TS); at the eastern reef flat (TSE), the lagoon (TSL) and the western reef flat (TSW).

Grain-size analysis was made for the Six Samples by seiving representative subsamples using a standard set of seives at one phi interval. Cumulative curves and histograms were drawn for the six samples on asithmatic ordinates. Graphical-statistics was computed using Folk and Ward's (1957) formulae, where the graphic mean M_Z = $(\phi 16 + \phi 50 + \phi 84)/3$, inclusive standard deviation (or sorting) = $(\phi 84 - \phi 16)/4 + (\phi 95 - \phi 5)/6.6$, inclusive skewness SK_1 = $(\phi 84 + \phi 16 - 2\phi 50)/2 (\phi 84 - \phi 16) + (\phi 95 + \phi 5 - 2\phi 50)/ 2 (\phi 95 - \phi 5)$ and graphic Kurtosis $KG = (\phi 95 - \phi 5)/2.44 (\phi 75 - \phi 25)$. Chemical analysis for carbonate percentage was made by simple volumetric techniques.

Processes that considerably contributed to the formation of sediments at Sanganeb atoll included mechanical destruction by waves, accumulation of fragments of dead corals and crushed shells, destruction due to biological activities, in addition to chemical precipitation which may have some role in the accumulation of sediments especially in the lagoon.

Cumulative curves and histograms are shown in Fig (4),(5) and (6), while the results of graphical statistics are Listed in Table (1) and (2). Carbonate percentages in sediments are Listed in Table (3).

Table (3) To Show The Carbonate Percentages of TS and TN

T S		T N	
Sample No	Carbonate %	Sample No	Carbonate %
TSW	90.7 %	TNS	69.77 %
TSL	82.95 %	TNL	86.82 %
TSE	62.02%	TNE	89.15 %

D) Physico-chemical aspects and chlorophyll a analysis

Results of the various physical and chemical factors in addition to chlorophyll a were as shown in Figs 7 and 8. Station numbers (St.I,II,III & Iv) can be explained as follows:

St. I : Open sea at western side of the atoll

St. II: The western reef flat of the two transects.

St.III: The Lagoon.

St. IV: The eastern reef flat.

The general trend regarding variations of physico-chemical analysis showed that the open sea (St.1) always revealed relatively lower values in temperature, dissolved oxygen and nutrients. But the values were almost comparable to those of other stations in the case of Chlorophyll a.

Table (1) To show The Results of The Graphical Statistics of TS

Sample No	M_z ϕ	Sorting		Skewness		Kurtosis	
		σ_I	Grade	Sk_1	Grade	KG	Grade
TSW	0.25	0.94	Moderately sorted	0.044	Near-Symmetrical	1.161	Leptokurtic
TSL	2.80	1.54	Poorly sorted	0.443	Strongly Coarse Skewed	0.956	Mesokustic
TSE	0.38	1.10	Poorly strted	0.001	Near-symmetrical	1.230	Leptokurtic

Table (2) To show The Results of The Graphical Statistics of TN

Sample	M_z ϕ	Sorting		Skewness		Kurtosis	
		σ_I	Grade	Sk_1	Grade	KG	Grade
TNW	0.10	0.93	Moderately-sorted	0.000	Symmetrical	7.095	Extremely-leptokurtic
TNL	1.13	0.76	Moderately-sorted	0.086	Coarse-skewed	1.100	Mesokurtic
TNE	0.50	1.04	Poorly-sorted	0.026	Near-symmetrical	1.166	Leptokurtic

E) Plankton :

i) Phytoplankton;

Results of microscopic observation of the net samples collected from open sea, lagoon in the pouthern (TS) and lagoon in the northern (TN) transect is shown in the Table below. However, no appreciable difference in phytoplankton composition in these bodies of waters could be observed. This might indicate a good water exchange between the open and the lagoons. Furthermore, diatoms papulation predominated over other groups followed by dinoflagellates and species or genera encountered in these waters are regarded as oceanic forms of cosmopolitan distribution.

Phytoplankton *	Open sea	TS lagoon	TN Lagoon
A. Diatoms;			
Asteromphalus (1)	+	+	+
Asterionella (2)	+	+	+
Biddulphia (3)	+	+	+
Chaetoceros (3)	+	+	+
Climacodium (1)			
Coscinodiscus (3)	+	+	+
Detenula (1)	+	+	+
Diptoneis (1)	+	+	+
Eucampia (1)	+	+	-
Fragilaria (1)	+	+	+
Guinardia (1)	+	+	+
Gyrosigma (1)	+	+	+
Hemiaulus (3)	+	+	+
Hemidiscus (1)	+	+	+
Leptocylindrus (2)	+	+	+
Licmophora (1)	+	+	+
Mastogloia (2)	+	+	+
Navicula (2)	+	+	+
Nitzchia (4)	+	+	+
Pleurosigma (1)	+	+	+

Table Cont.

Phytoplankton		Open sea	TS Lagoon	TN Lagoon
Rhizosolenia	(6)	+	+	+
Schroderella	(1)	+	+	+
Surirella	(2)	+	+	+
Synedra	(1)	+	+	+
Thalassionema	(1)	+	+	+
Thalassiothrix	(1)	+	+	+
Triceratium	(1)	+	+	+
B- Dinoflagellates:				
Ceratium	(15)	+	+	+
Ceratocorys	(1)	-	-	+
Dinophysis	(2)	+	-	-
Gonyaulax	(4)	+	+	+
Gymnodenium	(2)	+	+	+
Ornithocercus	(1)	-	-	+
Peridinium	(10)	+	+	+
Pyrophacus	(1)	+	-	+
C- Blue-greens				
Lyngbya	(2)	+	+	+
Oscillatoria	(3)	+	+	+
Spirulina	(2)	+	+	+
Trichodesmium	(1)	+	+	+

* Note :

Numerals in Parenthesis ( ) indicate number of species.

\+ recorded.

\- not recorded.

ii) Zooplankton:

Very few numbers of Oikopleura were found in each of the 250 ml sea water samples collected at the lagoon, reef flat and open sea in each transect. Only one copepod was found in all the samples. Similar

volumes of sea water collected in the shore at Port Sudan area revealed much greater numbers than those found at Sanganeb reef. This may be attributed to the action of the prevailing NE winds which drift plankton to the shore and to the high predation of the reef organisms at Sanganeb Atoll.

The quality of zooplankton organisms collected in the lagoon and open sea in the northern transect (TN) and the southern transect (TS) is shown in the following list.

Open sea		Lagoon	
TS	TN *	TS	TN
Globigerina	-	-	-
Tintinnide	Tintinnids	-	Tintinnids
Medusae	Medusae	Medusae	-
Calanoid Copepods	Calanoid Copepods	Calanoid Copepods	Calanoid Copepods
Cyclopoid Copepods	-	-	-
Amphipod larvae	-	-	Amphipod larvae
Anomuran larvae	-	-	-
Brachyuran larvae	Brachyuran larvae	Brachyuran larvae	Brachyuran larvae
Tunicate larvae	-	-	-
Oikopleura	-	-	-
Doliolum	-	-	-
Sagitta	Sagitta	-	-
Fish eggs	Fish eggs	Fish eggs	Fish eggs
-	Cladocerans	-	-
-	Cumaceans	-	-
-	Gastropod larvae	-	-
	* 80% of population were fish eggs.		lucifer

List of seaweeds encountered along southern (TS) and northern (TN) transects.

Algae *		TS	TN
A. Phaeophyta:			
Ectocarpus	(1)	+	+
Dictyota	(4)	+	+
Dictyopteris	(1)	+	+
Pocockiella	(1)	-	+
Padina	(1)	+	+
Choospora	(1)	+	-
Turbinaria	(2)	+	+
Sargassum	(1)	+	+
B. Rhodophyta:			
Centroceros	(1)	+	+
Spyridia	(2)	+	+
Martensia	(1)	+	+
Dasya	(1)	+	+
Polysiphonia	(4)	+	+
Tolypiocladia	(1)	+	+
Herposiphonia	(2)	+	+
Leveillea	(1)	+	+
Chondria	(1)	+	+
Acanthophora	(1)	+	+
Laurencia	(7)	+	+
C. Chlorophyta :			
Chaetomorpha	(1)	+	+
Cladophora	(3)	+	+
Microdictyon	(1)	+	+
Boodlea	(1)	+	+
Cladophoropsis	(1)	+	+
Dictyosphaeria	(1)	+	+
Bryopsis	(1)	+	+
Caulerpa	(2)	+	+
Halimeda	(2)	+	+
Codium	(2)	+	+

Algal list cont.

Algae		TS	TN
D- Cyanophyta:			
Lyngbya	(3)	+	+
Microcoleus	(1)	+	+
Phormidium	(1)	+	+
Schizothrix	(2)	+	+

* Note

Numerals in Parenthesis indicate number of species recorded.

+ : recorded .

- : not recorded .

Concluding remarks :

- Sanganeb coral reefs are generally reich, healthy and diverse. They are characterized by different bio-physiographic zones with each zone being typified by certain corals assemblae and different substrata.

- The death observed in some of the corals especially in the massive heads of Porites & Favia is natural and may most probably be due to increased rate of sedimentaion.

- The macroalgae responsible for the algal cover within the different reef zones are diverse and are typical coral reefs forms, of wide tropical & subtropical distribution.

- Sediments at the coral reefs zones and at the bottom of the lagoons which comprised mainly of coral fragments and coral sand of varying sizes, have high canbonate content.

- Nutrients and Chlorophylla levels plus plankton content in the atoll, are comparable to those of oligotrophic regions. Coral reefs flourish best under such conditions.

The above remarks may, therefore, show that Sanganeb Atoll presents a natural coral reefs' environment away from coast influences.

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