Research Article

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COMMUNITY STRUCTURE OF CORALS IN MASSAWA AND DAHLAK ARCHIPELAGO

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Abstract:

The coral community structure of Green Island and Resimedri from Massawa, Shumma and Nacura from Dahlak archipelago were studied and compared using 10-meter line transect method. There is a clear distinction in coral community structure at least between two islands. Both Nacura and Shumma show significant difference when compared to Resimidri. These two islands are part of the Dahlak archipelago and show no significant difference between them. There is also no significant difference in coral community structure between Resimedri and Green Island. All of the islands are dominated by a very few coral genera. The same coral genera are dominant both in Green Island and Resimidri despite the difference in rank order and percentage coverage. But the dominant ones of Nacura are quite different from those of Shumma.This is a good indication that Green Island and Resimidri are more similar than Nacura and Shumma do. In spite of the fact that there is a difference in coral richness, diversity, and evenness between the islands, the values are still low. The highest values of richness and diversity of coral genera is obtained from Shumma relative to the rest of the islands.

Key Words:

Coral community structures, Green island, Dhalak archipelago, Snorkeling gear, Tape measure, Slate and pencil, Coral identification book

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Introduction

Corals are typically associated with warm, shallow area which roughly coincides with the 20°C isotherm (Wood, 1983). The geographical limits of coral reef formation

generally fall with in the band delineated by the northern and southern tropics 30°N to 30°S. Within this range of latitude the Caribbean and Indo-Pacific are believed to be the centers of coral origin, which are colonized by greatest variety of coral species as well. Red Sea is part of western Indo-Pacific, so has a number of coral species to concern. It is generally accepted by ecologists that biodiversity increases from northern latitude to ward the equator.

Red Sea is a long narrow body of water which separate northeast Africa from the Arabian Peninsula. Very high surface sea temperature coupled with extreme salinities make the water unique. The maximum depth recorded in Red Sea is 2850m,which is small compared with the great oceans, but large for a body of water of its size. Red Sea is biogeographically divisible in to northern, central, and southern regions. Because of the nutrient input from Indian Ocean to the southern part of the Red Sea diversity of coral species in this region is low (Tickell, 1998). (Spalding et al 2001) added that the water entering the Red Sea from the Gulf of Aden is relatively rich in nutrient and plankton, contributing to the turbidity which appears to restrict reef development in the southern Red Sea. The northern and central regions are rich in coral diversity. However, higher diversity in the central Red Sea is consistent with its higher ambient water temperature compared with the north (Edward and Head, 1987). But many other factors such as productivity, wave energy, and geographical history may also be important.

Materials and Methods

The line intercept transect method was used for recording the morphological description of the reef community. This line transect methodology has till been used by reef scientists throughout the world for measuring the qualitative and quantitative diversity of coral reef and living cover (Loya *et al*.1995).

The following methods were used for the study of coral morphology.

- Snorkeling gear
- Tape measure
- Slate and pencil
- Coral identification book (Veron 1996 vol. 1-3), (Wood 1983), and (Vine 1986)

Study site:

Nacura (15° 42.175' N; 39° 57.174'E) is one of the inner part of the archipelago, which is found almost connected to the north west of Dahlak kebire.

Shumma (15° 31' N; 40° 00’ E) is an island nearly 30miles south west of Dahlak kebir, which is considered to be one of the outer islands of the Dahlak archipelago.

Green Island, interchangeably called sheik said island (15° 35' N; 39° 29'E) is about 1.5km south east of the city massawa.

Resi midri (15° 36'N; 39° 28'E) is part of massawa city, where the main port is situated. The study was conducted south east of this island. This is contiguous to Green Island with the deference of about 1km.

Data analysis

Species diversity applied to an ecosystem may simply mean a certain measurable characteristics of the organisms found there. This measure can refer to the number of species in a certain collection studied (Khalf and Kochzius 2002).Or area coverage for sessile organisms. Some of these indices are based on a theoretical relationship between the area cover of genera and individuals in a sample. The other group of indices is derived from information theory. Information theory provides the basis for measuring diversity of animal population.

Community indices such as coral abundance, genera richness (number of genera), Shannon-wiener diversity (H'), and Pielou's evenness (J') were used to analyze and compare the coral community with in and between sites.

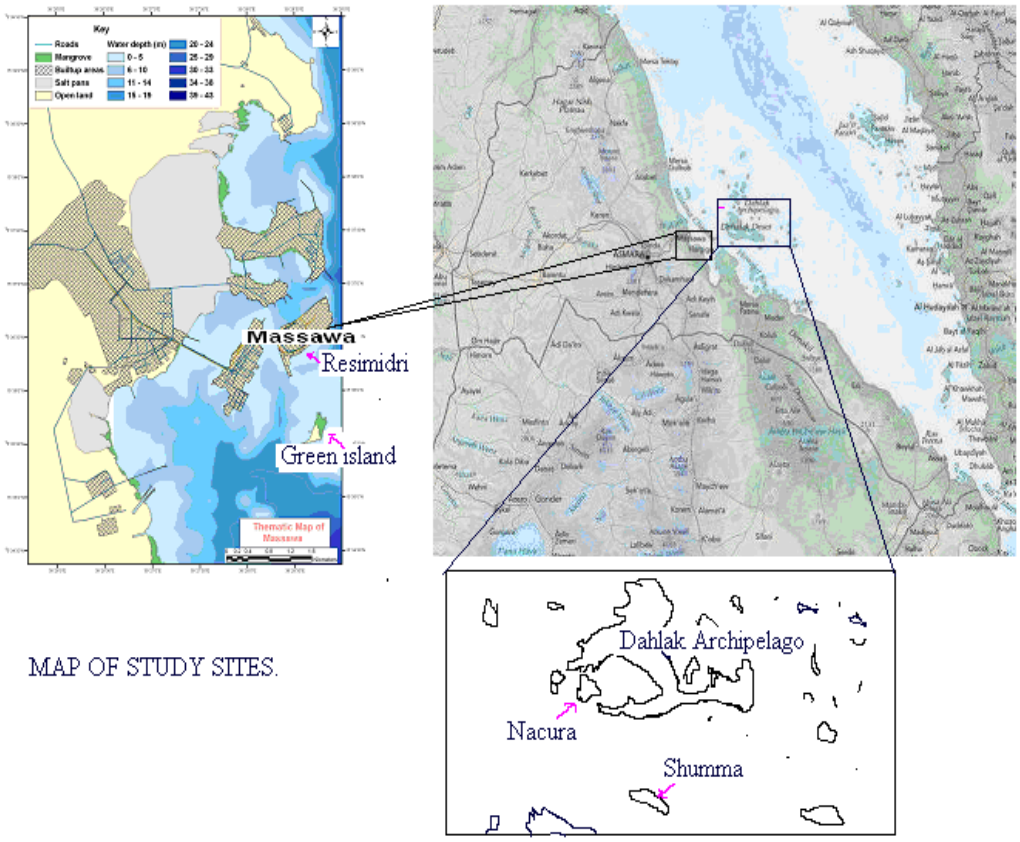
In which, Genera richness is computed by Margalef's index

$$R = S - \frac{1}{\log N}$$

R = Genera richness

S = Number of genera

N = Total cover of individuals



MAP OF STUDY SITES.

Diversity (H') is computed by Shannon diversity index

$$H' = -\Sigma P_i \log P_i$$

where $P_i = \frac{n_i}{N}$

n_i = area coverage of the i^{th} genera

N = Total area coverage

Evenness is also computed by Pielou's evenness index

$$J' = \frac{H'}{\log S}$$

Homogeneity of variances was tested with the F-test and, if necessary, data were, Log (1+x) transformed to obtain homogeneity of variance (Khalaf and Kochzius 2002).

Results

Mean live coral coverage of all sites (Nacura, Shumma, Resi medri, Green Island) were compared using Tukey HSD method (table 1) and the results were summarized in table 2.

Table 1.Multiple comparison of mean live coral cover between sites

	(I) SITE	(J) SITE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	GREEN ISLAND	NACURA	5.547	4.6822	.640	-7.018	18.111
		RESIMIDRI	-7.320	3.9053	.256	-17.799	3.159
		SHUMA	10.547	5.5229	.241	-4.273	25.367
	NACURA	GREEN ISLAND	-5.547	4.6822	.640	-18.111	7.018
		RESIMIDRI	-12.867*	4.6822	.043	-25.431	-.302
		SHUMA	5.000	6.0971	.845	-11.361	21.361
	RESIMIDRI	GREEN ISLAND	7.320	3.9053	.256	-3.159	17.799
		NACURA	12.867*	4.6822	.043	.302	25.431
		SHUMA	17.867*	5.5229	.013	3.047	32.687
	SHUMA	GREEN ISLAND	-10.547	5.5229	.241	-25.367	4.273
		NACURA	-5.000	6.0971	.845	-21.361	11.361
		RESIMIDRI	-17.867*	5.5229	.013	-32.687	-3.047

Based on observed means.

*. The mean difference is significant at the .05 level.

Table 2.Summary of comparison of mean live coral cover of islands

	SITE	N	Subset 1	Subset 2
Tukey HSD[a,b]	SHUMA	5	24.500	
	NACURA	8	29.500	29.500
	GREEN ISLAND	15	35.047	35.047
	RESIMIDRI	15		42.367
	Sig.		.184	.073

Alpha = .05.

	GREEN ISLAND	RESIMIDRI	NACURA	SHUMMA
Hard coral	35.05	42.37	29.5	24.5
Soft coral	0	0	4.61	51.46
Dead coral	39.09	27.25	–	–
Rubble	7.58	20.65	–	–
Coralline algae	0.06	6.18	–	0.08
Sponge	0	0	2.78	0.78
Sand	19.94	3.24	–	–

Table 3: Percentage covers of different corals in the four sites. (-) indicates missing data.

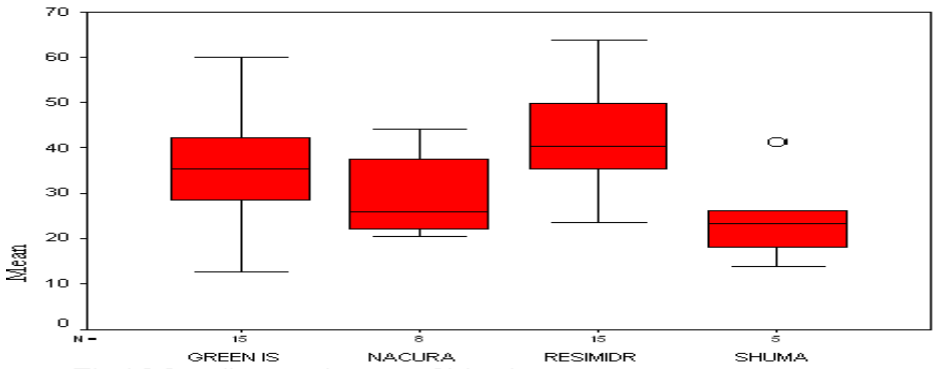


Fig 1.Mean live coral cover of islands.

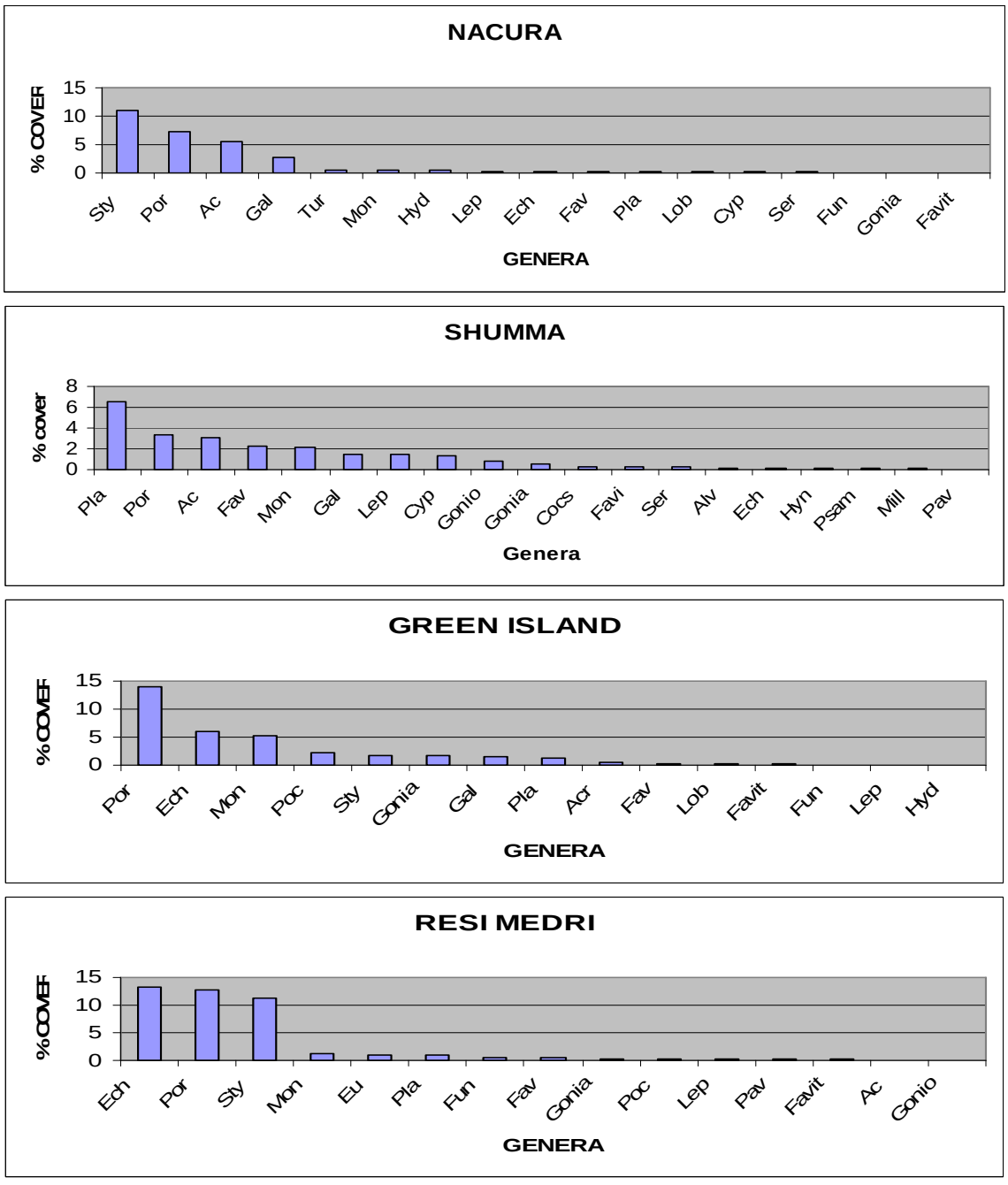


Fig 2. % Coral cover plotted against genera rank order of abundance for all Islands.

Table.4. Multiple comparison diversity between islands.
Where:Na-Nacura;Rm-Resimidri;Shu-Shumma;Gi-Green island.

(I) SITE	(J) SITE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GI	NA	-.23799	.133221	.295	-.59547	.11949
	RM	-.07281	.111114	.913	-.37097	.22535
	SHU	-.60356*	.157139	.002	-1.02522	-.18190
NA	GI	.23799	.133221	.295	-.11949	.59547
	RM	.16518	.133221	.606	-.19230	.52266
	SHU	-.36556	.173477	.169	-.83107	.09994
RM	GI	.07281	.111114	.913	-.22535	.37097
	NA	-.16518	.133221	.606	-.52266	.19230
	SHU	-.53075*	.157139	.009	-.95241	-.10909
SHU	GI	.60356*	.157139	.002	.18190	1.02522
	NA	.36556	.173477	.169	-.09994	.83107
	RM	.53075*	.157139	.009	.10909	.95241

*. The mean difference s significant at the .05 level.

Table 5 .Multiple comparison of Evenness between Islands

(I) SITE	(J) SITE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GI	NA	-.14360*	.052022	.042	-.28319	-.00400
	RM	-.06413	.043390	.460	-.18056	.05230
	SHU	-.10329	.061362	.346	-.26795	.06137
NA	GI	.14360*	.052022	.042	.00400	.28319
	RM	.07947	.052022	.431	-.06013	.21907
	SHU	.04030	.067742	.933	-.14147	.22208

*. The mean difference is significant at the .05 level.

Table 6 . Multiple comparison of Richness between Islands

(I) SITE	(J) SITE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GI	NA	3.08419	1.323238	.108	-.46654	6.63493
	RM	1.31103	1.103657	.638	-1.65049	4.27254
	SHU	-7.11339*	1.560806	.000	-11.30161	-2.92518
NA	GI	-3.08419	1.323238	.108	-6.63493	.46654
	RM	-1.77317	1.323238	.544	-5.32390	1.77757
	SHU	-10.19759*	1.723084	.000	-14.82125	-5.57392
RM	GI	-1.31103	1.103657	.638	-4.27254	1.65049
	NA	1.77317	1.323238	.544	-1.77757	5.32390
	SHU	-8.42442*	1.560806	.000	-12.61264	-4.23620
SHU	GI	7.11339*	1.560806	.000	2.92518	11.30161
	NA	10.19759*	1.723084	.000	5.57392	14.82125
	RM	8.42442*	1.560806	.000	4.23620	12.61264

*. The mean difference is significant at the .05 level.

GENERA	SHUMMA	NACURA	RESI MIDRI	GREEN ISLAND
Acropora*	×	×	×	×
Alveopora	×			
Cocsinaria	×			
Cyphastrea	×	×		
Echinopora*	×	×	×	×
Euphillia			×	
Favia*	×	×	×	×
Favite	×	×		×
Fungia		×	×	×
Galaxea	×		×	×
Goniopora	×		×	
Goniastrea	×	×		×
Hydnophora	×	×		×
Leptastrea*	×	×	×	×
Lobophyllia		×		×
Millepora	×			
Montipora*	×	×	×	×
Pavona	×		×	
Platygyra*	×	×	×	×
Pocillopora			×	×
Porite*	×	×	×	×
Psammocora	×			
Seriatopora	×	×		
Stylophora		×	×	×
Turbinaria		×		

Table 7.Abundance of coral genera in the four islands.

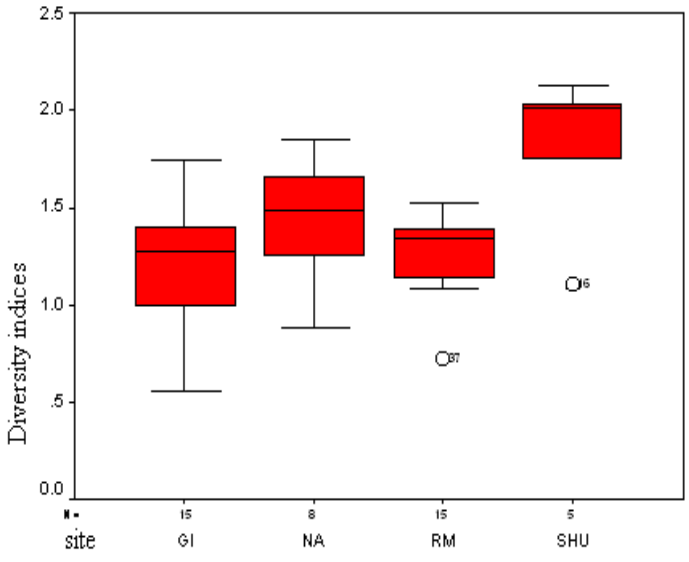


Fig.4.Shannon diversity index of the four islands'-diversity index plotted against number of replicas

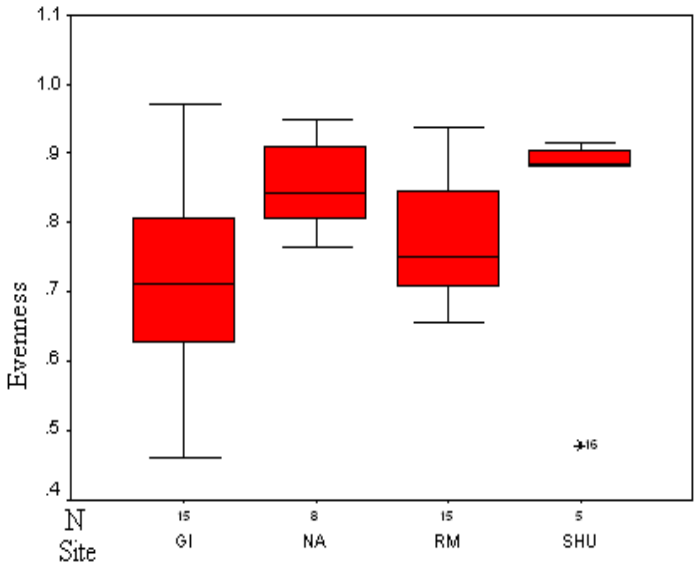


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Fig.5. Evenness of coral community structure of the four islands.

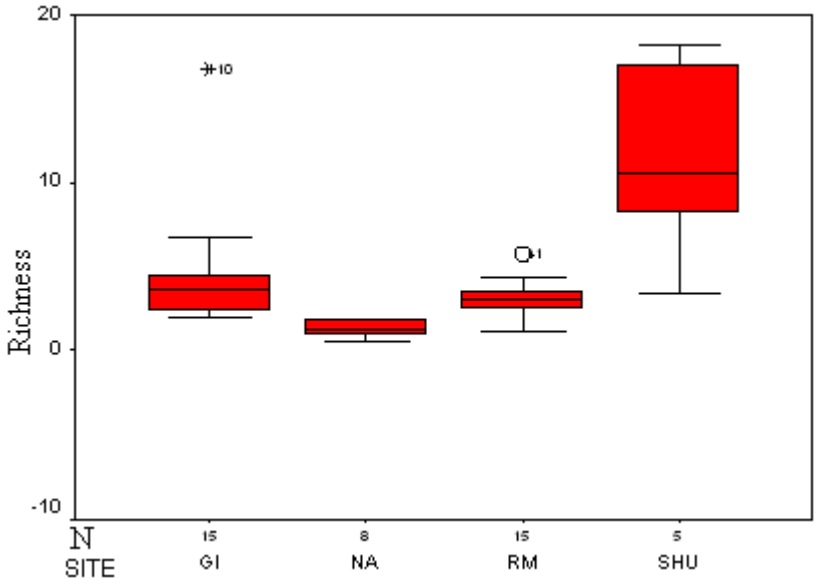


Fig.6.Richness of coral community of the four islands

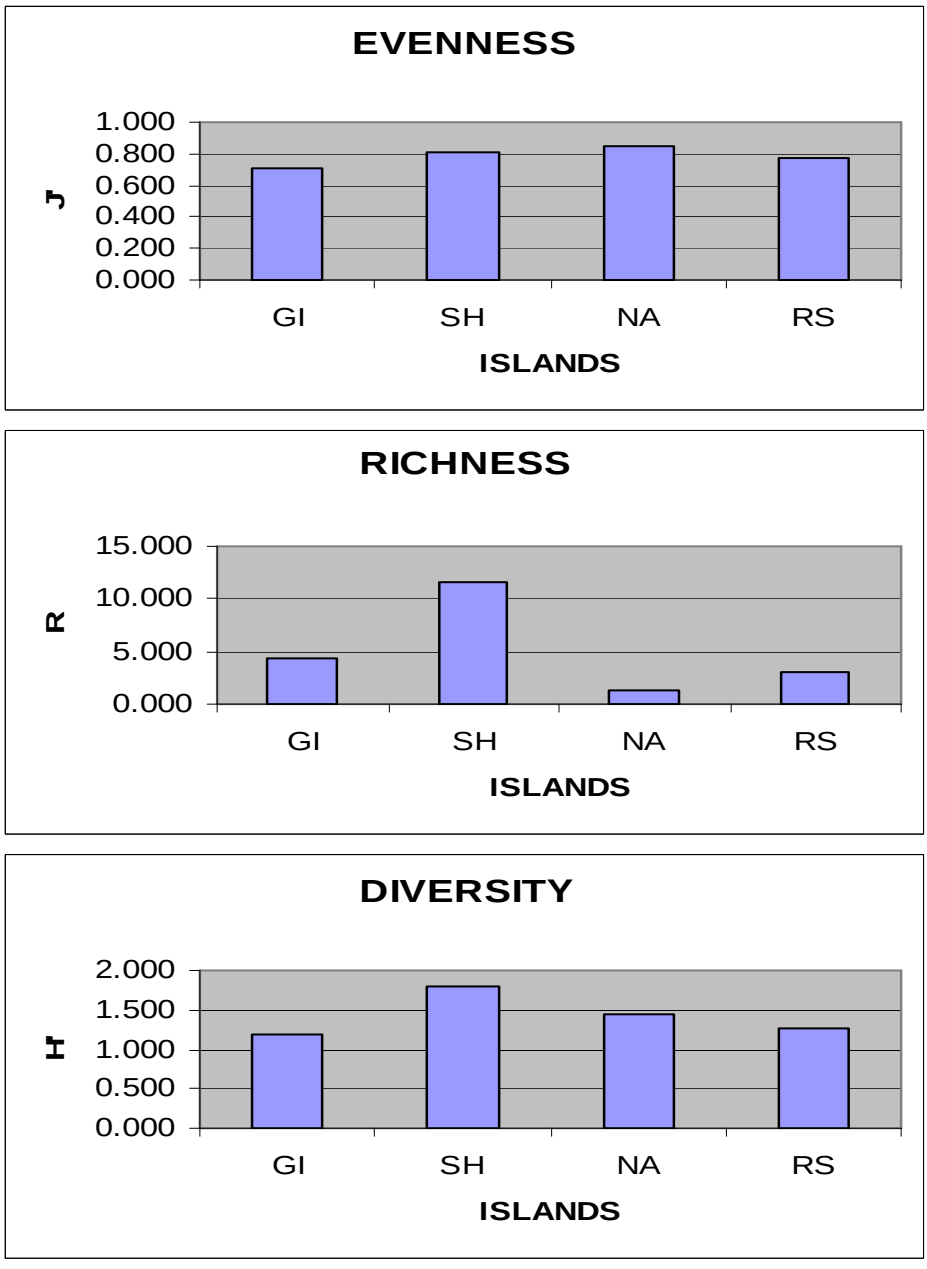


Fig.7 Coral community parameters (genera evenness, richness, and diversity) of the four islands.

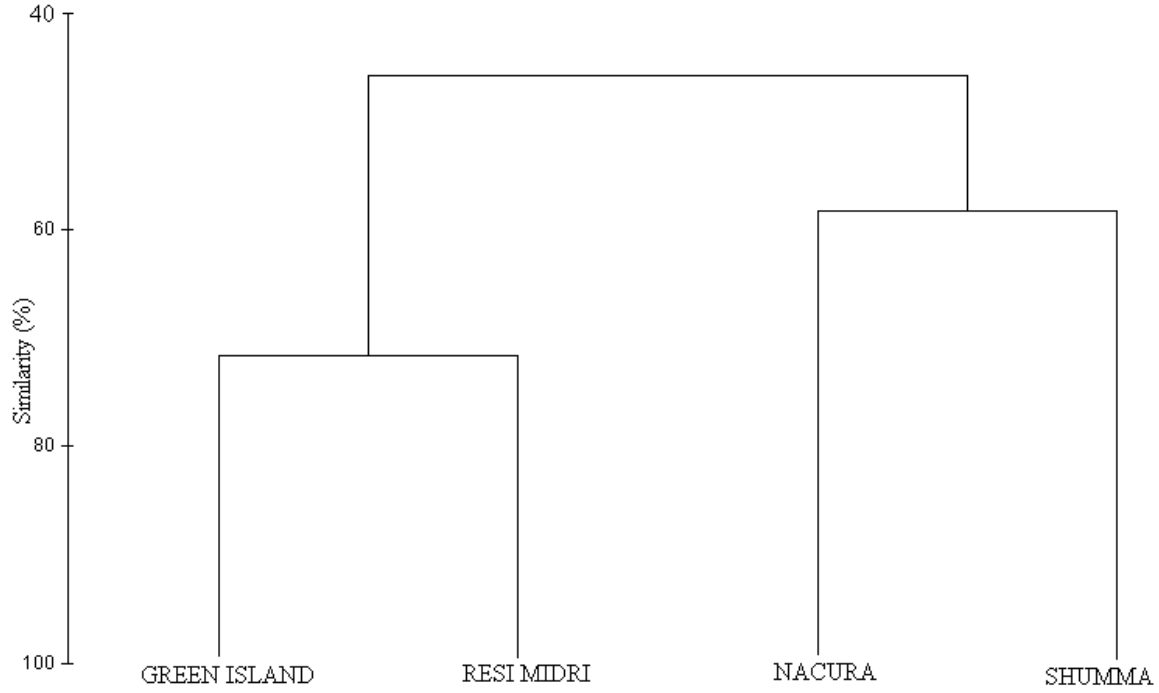
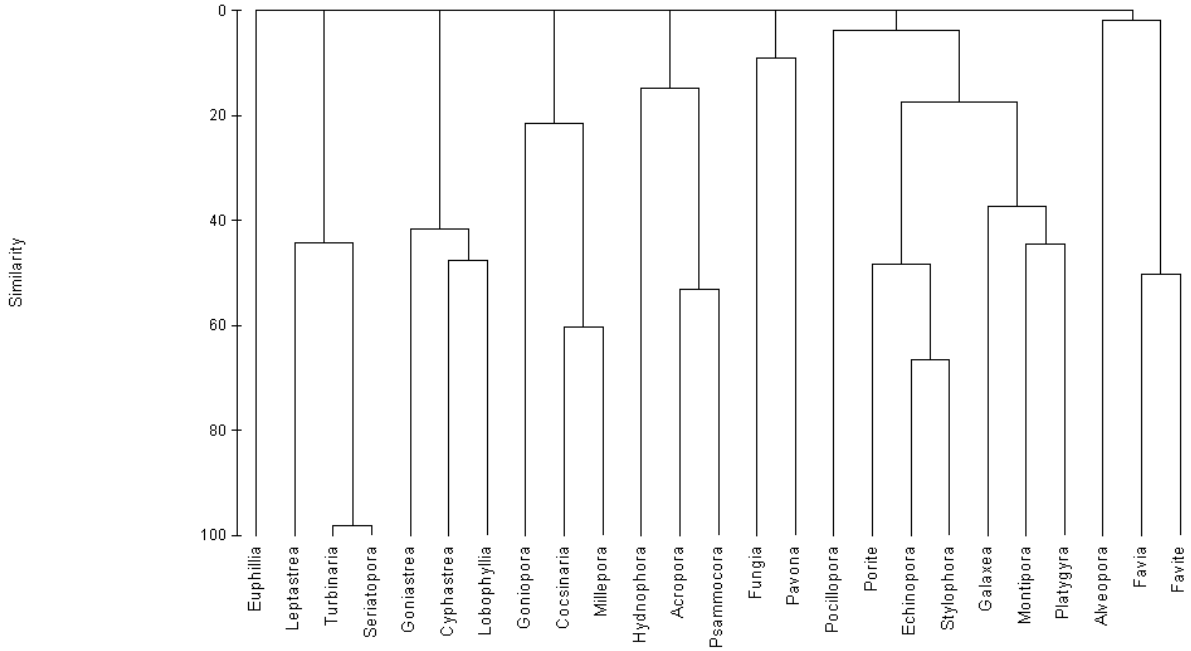


Fig.3.Dendrogram of the four islands based on their live coral cover.



Discussion

Out of the 25 genera recorded from the four islands only 8 coral genera are common to all (Table 7). This shows there is a difference in community structure at least between two islands. The above mentioned phenomenon applied to the islands in some what different way and this may have some contribution to the differentiation of the sites almost between islands found in Dahlak archipelago and Massawa area.

Compared to all sites the highest diversity and richness of coral genera were obtained in Shumma (1.8) and (11) respectively. Green Island and Resimidri are frequently visited by tourists and local people. Resimidri especially is more likely to be stressed by urban wastes. Further more, Nacura is also visited by tourists, and corals of this site may be stressed not only by human wastes but also by oil pollution from the maintenance of ships since the Italian colonization. Thus, all the above mentioned wastes may be some of the factors which might be responsible for the poorness of coral genera in Green island,Resimidri, and Nacura. Neverthless, Shumma is one of the outer islands of Dahlak archipelago which is inaccessible to human intervention. Therefore, Shumma has a better chance for the establishment of corals.

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