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Variability in the Sponge *Phyllospongia foliascene* Populations from Coastal Areas of Iligan City

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Abstract

Morphological variability in the sponge, ***Phyllospongia foliascence*** *collected from different localities along the coastal areas of Iligan Bay was determined. Resemblance was determined using cluster analysis. Variability was correlated with the distribution pattern and some physico-chemical factors in the sampling sites.*

Instroduction

Sponges are marine animals that are mostly attached to underwater sea substrates. They are considered to be most primitive of the multicellular animals and comprised more than 500 species under Phylum Porifera.

Recent studies revealed that some marine organisms are possible sources of novel bioactive compounds. Sponges were among the studied marine organisms which were reported to be potential sources of these bioactive substances.

Sponges in the genus *Phyllospongia* have gained popularity in the marine natural products research because they contain bioactive metabolites of cardionic constituents. Many were observed to have antibacterial, and antitumor activities. Others were found to possess vasodilators and *in vivo* central nervous system activity.

There has been a number of studies to reevaluated the existing classification of sponges. Many have concentrated in using the presence of a particular metabolite within the Porifera to resolve taxonomic problems. While such studies have yielded valuable results, many problems in the classification of Porifera still remain.

In this current study, *Phyllospongia foliascence*, a marine sponge, was investigated in

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order to understand variability in selected populations based on known morphometric characters.

The general objective of the study is to conduct an investigation to determine the varibility in the marine sponge *Phyllospongia foliascence* collected from three sites along the coastal area of Iligan Bay.

For this study to be completed, specific objectives were made.

First specific objective was to conduct external and internal morphological examination of the sponges. External morphology like growth form, surface feature, and the presence or absence of a dermal protrusions were examined. Sponge color was also considered. Prior to internal morphological examinations, preparation of spicules and of tissue sections were made.

Secondly, morphometric variatuions on the spicules of the sponges were also evaluated.

The physical characteristics of the environment. such as, total suspended solids (TSS), water pH, temperature, salinity, and the type of substrate in the sampling sites were also determined to decribe the environment of the sampled sponges.

The pattern of dispersion of the sponge individuals in the sampling sites were also considered.

Significance of the Study

The result of the study will provide an initial information on the extent of variability in *Phyllospongia foliascence*.

This study will contribute to our knowledge on the species delimitation in the sponge and to solve taxonomic problems.

Materials and Methods

I Collection of Samples

Sponge samples were collected from each of the sub-sampling areas at nine locations along the coastal regions of Iligan Bay: Dalipuga, Paitan, Mapalad, Montanier, Mago-ong, Samburon, Luga-it, Maputi, and Initao, Misamis Oriental (see Figure 1). The samples were removed from their substratum by simply hand-picking. Samples collected were placed separately in a plastic bag and properly labeled. Samples were preserved by refrigeration.

II. Methods of Data Collection for Distribution Pattern

A 50m line transect was laid parallel to the shoreline. With the use of the Distance Method that includes the T-square Distance Sampling, the distribution of the sponge in the sampling area was determined. Sampling points were selected randomly along the transect line within the sampling site. The two distances were measured at each random sampling points. First, the distance from the sampling point to the nearest individual was made and secondly, by the distance from that individual to its nearest neighbor. The random point selected was at every 10m, and for every sampling point, the first sponge was regarded as sample 1 and the second individual was regarded as sample 2.

From the 50m line transect, five random sampling points and about ten sponges were sampled. Two other 50m transect replicates were made along the same depth making a total of 15 random sample points and 30 sampled sponges.

III. Procedure for Sample Characterization

External Morphological Observation

The external morphology of the collected samples were observed by measuring their diameter and determining their growth form, color, consistency and surface features.

Internal Morphology Examination

Preparation of Tissue Sections. Both cross and longitudinal sections of sponge tissues were made by freehand sectioning using a sharp scalpel blade No.20. The sections were placed in a clean slide and immediately fixed for two minutes using Bouins' reagent. After fixation, sections were dehydrated using graded ethyl alcohol solutions at increasing concentrations: 10%, 20%, 30%, 40%, 50%. The tissues were immersed into the respective solutions for 2 minutes and stained with fuchin dye for another two minutes. The dehydration process was continued to 60%, 70%, 80%, 90%, and finally 100%. The prepared sections were allowed to dry and movated using Canada Balsam Microscopic investigations and photography of the tissues were done.

Preparation of Spicules for Microscopic Examination

A small portion of the sponge was washed thoroughly with filtered sea water and placed in a clean test tube containing concentrated HNO_3. The sponge was boiled using alcohol lamp. The tissues were allowed to disintegrate homogenate was centrifuged at 1000 RPM for 5 minutes. The supernatant was decanted and the sediments were washed with distilled water and recentrifuged. The sediments were finally washed with and resuspended in ethanol. A drop or two were placed in a clean slide and then allowed to dry. Enough amount of Canada balsam was added over the spicules and a cover slip was securely and slowly placed over the balsam to avoid trapping of bubbles. The prepared slide was examined under light microscope and photomicrographed.

Spicules Measurement

Measurements of spicules were made using a calibrated microscope. The process made use of a micrometer eyepiece and an Olympus micrometer slide with a calibration constant of 0.01mm per division. Three spicules in each kind were measured and the average was taken.

IV. Statistical Analysis of Data

Distribution Pattern. The spatial distribution pattern of the sponges was determined by obtaining the distances in between sponge samples. The method made use of the T-square distance sampling method. Date gathered was analyzed with the computation of the T-square index of spatial pattern and the distance index of dispersion with the use of the TSQUARE QBASIC program.

Classification Technique. Morphometric characters, was analyzed using the CLUSTER.BAS QBASIC program.

V. Determination of Physico-Chemical

Sample of seawater was brought to the laboratory for salinity analysis. Using a refractometer. Average salinity value in parts per thousand ($^{o}/_{oo}$) was obtained from three trials. Water pH was taken per sampling using a pH indicator. The average pH reading from three trials made was determined. Water temperature (°C) in the sampling areas was taken with the aid of mercury thermometer. The instrument was immersed in the seawater for one to two minutes prior to reading. There were three trials made and the average was taken as the water temperature. Turbidity of water is represented in terms of the net weight of suspended solids in seawater. This was done by subjecting the water samples to filtration method. Five hundred (500ml) was filtered with the use of previously weighed filter papers. filtrates were dried in an oven kept at 100 °C for 5 hours. The weight of suspended solids was then taken by getting the difference between the weights of the oven dried or used filter paper and its initial weight before filtration. The turbidity of water is expressed in grams per 500 ml.

Results and Discussions

All the collected sponges were fan-shaped, although some were cup-shaped, erect and possess a basal holdfast. The color is brown on its upper dermal area and dark brown to maroon on its lower dermal area. Oscula are very small and abundant in the upper portion. The dermal surface is uneven which has a regularly dispersed microconules or leathery and is marked off by narrow furrows which are distinctly larger and narrower in the lower than on the upper dermal portion. Dermal protrusions with sand and shell inclusions are present in upper dermal portion. Sample drawn has a diameter which ranges from 110-130mm and a height of 60-85mm. Some could grow up to 500mm or more in diameter and a height of 150mm or more. Thickness ranges from 3 to 5mm. The sponge is tough, compressible and difficult to tear (Figure 2-A)

Skeleton is composed of well developed spongin fibers which are irregularly branching. Spicules are dispersed irregularly. Ostia are prominent in tangential section which are dispersed evenly. Also present are foreign particles which are associated within spongin fibers (Figure 1-B to D)

Most of the spicules that composed the sponge are megascleres which are monaxonids and tetraaxonids. Microscleres are also ·present but in lesser number (Figure 2-E to F). Spicules are diverse but some spicules present maybe foreign. Spicule fragments were also found incorporated into the fibers (Oclarit 1987; Tomenio, 1998).

Table 1 shows the presence and absence of the noted taxonomic characters in the sponges collected from the different sites along the coastal area in Iligan Bay. In each site, three subsites were established and from each subsite three individuals were obtained. A total of 27 individuals were gathered. The frequency of the individuals exhibiting the observed characters is shown in Table 2. The result is best summarized in the histogram in Figure 3

As observed, the sponge have two growth forms-cup and fan shape. Of the two forms, cup shaped individuals are greater in number than fan shaped individuals. Most of the sponges in site 1 and 2 (Dalipuga, Paitan, Mapalad, Montanier, Mago-ong, and Samburon) have-cup shaped growth form while most of the sponges from site 3 have fan shape.

The dorsal surface of the sponges vary in color. Some have light brown, some have moderate, some are dark brown and others have maroon surface. Most of the samples, have moderate brown color on its dorsal portion. Site 2 was dominated with sponges having light and dark brown dorsal portion while site 2 and 3 dominated by moderate brown colored sponges. It was only in site 2 where sponges with maroon dorsal portion were observed. With respect to the ventral portion, most of the samples from site 3 have dark brown were observed to color.

It was also observed that only in site 1 where individuals with dark brown color dominate, Samples having moderate brown ventral potion dominate in sites 2 & 3. Individuals with maroon ventral portion were only found in site 1.

In this study it was that some sponges have leathery dermal surface while others have rough surface. It was found out that most of the samples collected from the 3 sites have leathery dermal surface (59%). Comparing the three sites, sites 1 and 2 are dominated with sponges having leathery surface while site 3 is dominated with sponges having rough dermal surface.

The number of dermal protrusions on the surface of the sponge, was observed to be less. It was observed that 67 % of the sponges have surface with less dermal protrusions. It was also observed that individuals with moderate and many dermal protrusions on the surface and were present only in sites 1 and 2.

Internal examination of the sponges includes morphometric measurements of their spicules. Morphometric analysis, according to Daly et al (1998), supports for regulatory identification of the samples although some of the groups of the species may resemble those of others. Likewise, variability in the collected samples could also be revealed. Tables 3-12 show the average length measurements of the spicules. Table 13 shows a summary of the presence and absence of spicules in sponges collected from the subsites in three localities along the coastal area of Iligan Bay.

It was observed that no individuals from different subsites or even in the same subsite were the same. No individuals were observed to have the same spicules composition. In fact, out of 27 types of spicules, there were only six spicules found to be common in all sponges collected from different localities. Added to these were the observations that spicules of the same kind vary in their measurements.

While were differences in the measurement of morphological characters (Table 14), the samples were observed to possess normal phenotypes. Normal phenotypes are the result of fairly tight controls built into development systems, so that most traits do not vary much among normal individuals (King et al., 1981).

CLUSTER ANALYSIS of the various characters of the sponge from the subsites in three localities was based on Percent Dissimilarity along with the flexible clustering strategy of $\beta = -0.25$.

The pattern of clustering for the 27 individuals is summarized in the dendrogram in Figure 4. Three arbitrary dashed lines at 0.35, 0.55 and 0.70 dissimilarity levels were used as reference points in identifying clusters.

At 0.70 dissimilarity level, it is shown in the figure that two clusters are formed. Individuals (1-9) obtained from site 1(Dalipuga, Mapalad, Paitan) and individuals (10-12) from site 2 (Montanier, Mogo-ong, and Samburon) joined together at level 0.58 to form one group. The 13th to the 27th individuals, which were obtained from the 2nd and 3rd sites joined together at 0.64 level of percent dissimilarity to form another cluster.

Bringing the reference point at a lower level at 0.55 percent dissimilarity, five distinct clusters emerged. Cluster I splits into two different clusters with samples in site 1 (1-9) joined together at 0.50 level forming one separate group supplementing their relatedness as they came from one locality. Samples 10,11,and 12 separate to form another cluster. Cluster II splits into 3 different clusters where individuals from Mago-ong (13-14) and Luga-it (19-21) joined together at level 0.51 to form one cluster, samples from Samburon (16-18), and Initao (26-27)connect at 0.60% dissimilarity to form another cluster and Maputi (22-24) separate as a distinct cluster.

Further lowering the reference point to 0.35 level results to the emergence of 9 clusters. It is shown in the figure that samples obtained from the same subsite belong to one group. It was also observed that even though they belong to one locality, they do not have the same level of percent dissimilarity, except in the group which is composed of the 7th, 8th, and 9th individuals in which all three samples joined together at one point that is 0.08%. Unlike others, samples from Mapalad have the same percent dissimilarity to each other. This implies that there is variability among individuals in a population of *P. foliascence.*

Variability among, between and within populations of *P. foliascence* is also evident as shown in Cluster II, which is from a single cluster at level 0.64%, segregates into three distinct clusters at level 0.55. This may be attributed to the fact that the individuals were collected from different sites and subsites and also in the difference of their morphology.

Variations in characters of the sponges maybe are due to the different environmental factors influencing the expression of genes. In this study, while environmental parameters like water pH, temperature, salinity, TSS, substrate and the depthness where the samples were collected were considered, it was observed that there was a considerable difference in water salinity and TSS among sampling sites. For sponges which are filter feeders, differences in total suspended solids in water among sampling sites may be the determining factor in the variation observed. According to Winchester (1979), environmental factors such as light, temperature, diet and hormones, and the adaptation of the organism to the different habitats and modes of life affect gene expression resulting to diversity among organisms. For example, the availability of important elements such as silicon and calcium which are required by sponges for its normal functioning and in its synthesis of spicules may contribute to the differences in the total spicule biomass and sizes among individuals of sponges.

As reported by Desqueyrous-Faundez (1990), elements in water like silicon is a factor because sponges utilize these elements to produce skeletal materials such as spicules. Therefore, in the variations observed, it can be agreed made that sponges collected from the same locality may have different uptake of these substances found in water. Subtle changes in the morphological characteristics of a species, according to Bey-Bienko (1958) frequently follows after changes in its ecological and physiological traits. Morphology is an end product of physiological activities initiated by the genome and modified by the environment.

Using the BASIC program TSQUARE to compute the distribution pattern of the sponges (Table 16), it was found out, that sponges are randomly distributed in Dalipuga, Mapalad, and Montanier. (Table 17) However, in other subsites, sponges are clumped and the clusters generated are uniformly patterned. The pattern of dispersion of individuals may reflect characteristics of the organisms, thus, it is important to be considered to explain variability. Characteristics may be influenced by the positive and negative interactions between individuals. Lucas (1947) postulated that some organisms produce external metabolites that could influence other organisms in either beneficial or detrimental way. As a response or defensive mechanism, organisms will tend to adapt to the selecting pressures of the environment, thus, expression of characters are influenced. As Atkins (1980) stated, geographic speciation occurring in the organism as a result of the evolution of reproductive barriers between geographically separated populations may have produced the variation between areas. It was also supported with the findings of Hexter and Yost (1976) that most speciations occur in geographic or allopatric populations. These mechanisms might be working in this species of the sponges.

Summary and Conclusion

Variability among, between, and within populations of *Phyllospongia foliascence* was observed based on cluster analysis, of morphometric data, and the difference in their gross morphology. The result of the study showed that variability is evident in samples collected from different localities but only to a minimal extent. Result of the cluster analysis revealed that samples collected from the same locality group together in one cluster and ,to some degree, samples from different localities have also shown similarity. Morphometric analysis on the different samples collected revealed that, not even two individuals have exactly the same measurement on their spicules. The variations in the sponge, though occur naturally, could be due to the difference in their age, for the samples were collected at large from the normal population. *P. foliascence* differ morphologically between and among the populations in Iligan Bay in their growth form, color, surface feature, in the number of dermal protrusions in their surface, and in the measurement of their spicules.

Due to the observed differences in their environment, speculation was made that environmental factors such as the difference in their TSS, salinity and distribution pattern may have contributed to their variability. Thus, variability may have been brought about by the capacity of the organism to adapt to the selecting pressures of the environment both internal and external were the curse of evolution.

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Table 1. Presence or Absence of the Morphometric Characters obsrved in P. foliascene.

	1									2									3								
	Dalipuga			Paitan			Mapalad			Montanier			Mago-ong			Samburon			Luga-it			Maputi			Initao		
individual	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2.	3	1	2	3	1	2	3
Taxonomic Characters																											
Growth Form																											
Cup shape	1	1	0	1	0	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	0	0	0	0	0	1	0
Fan shape	0	0	1	0	1	0	0	0	0	1	1	1	0	0	0	1	0	1	0	0	1	1	1	1	1	0	1
Color*																											
Ventral surface																											
light brown	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
moderate brown	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	1	1
dark brown	0	1	1	0	0	0	1	1	1	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	1	0	0
maroon	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0·	0	0	1	0	0	0	0	0	0
Dorsal surface																											
light brown	1	0	1	0	1	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0
moderate brown	0	1	0	1	0	0	1	1	1	1	0	0	0	0	0	0	1	0	1	1	0	1	1	0	1	1	1
dark brown	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
maroon	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Surface feature																											
:leathery	1	1	1	1	1	0	0	1	0	0	1	1	0	1	1	1	1	1	1	0	1	0	0	1	0	0	0
Rough	0	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	0	1	1	1
Dermal Protrusions																											
Few	0	0	0	1	1	1	1	0	1	0	0	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1
Moderate	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Many	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0

***Table 2**. Number of sponges exhibiting the characters being studied.*

Site	Growth Form		Color: Dorsal Surface				Color: Ventral Surface				Surface Feature		Dorsal Protrusions		
	Cup shape	Fan shape	Light brown	Moderate brown	Dark brown	Maroon	Light brown	Moderat e brown	Dark brown	Maroon	Leathery	Rough	Few	Moderate	Many
1	7	2	4	5	0	0	2	2	5	0	6	3	5	3	1
2	5	4	3	2	3	1	2	4	3	0	7	2	4	1	4
3	3	6	1	7	0	1	1	4	3	1	3	6	9	0	0
TOTAL	15	12	8	14	3	2	5	10	11	1	16	11	18	4	5
Average	5	4	2.7	4.7	1	0.7	1.7	3.3	3.7	.33	5.33	3.7	6	1.3	1.7
Percentage	56	44	30	52	11	7	18	37	41	4	59	41	67	14	19

Table 3. Morphometric measurments of spicules from three sponges collected from three subsites in Dalipuga, Iligan City.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	30	27	40	32.3	11	27	52	30	19	23	25	22.3
2. tylostyle	30	25	21	25.3	25	40	24	29.7	41	45	39	41.7
3. oxeas	27	12	15	18	15	11	13	13	15	15	10	13.3
4. anatriane	20	23	19	20.7	18	17	13	16	15	14	20	16.3
5. strongyle	0	0	0	0	0	0	0	0	0	0	0	0
6. tylote	26	12	23	20.3	12	9	18	13	15	20	15	16.7
7. acanthostyle	10	11	14	11.7	15	11	13	13	15	14	12	13.6
8. protriane	0	0	0	0	0	0	0	0	0	0	0	0
9. trachystyle	12	11	13	12	9	13	10	10.7	14	13	11	12.7
10. subtylostyle	23	15	19	19	27	20	21	22.7	29	30	25	28
11. tetracts	13	15	9	12.3	11	15	14	13.3	12	14	13	13
12. tetralopes	16	19	20	18.3	19	18	17	18	21	19	18	19.3
13. phyllotriane	16	15	14	15	11	15	17	14.3	13	19	10	14
14 A	12	12	13	12.3	15	12	18	15	15	15	16	15.3
15. B	5	9	10	8	7	6	4	5.7	7	6	5	6
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	4	5	6	5	5	10	5	5	5	4	5	4.7
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	4	3	3	3.3	5	8	8	7	5	4	3	4
22. triod	0	0	0	0	0	0	0	0	0	0	0	0
23. spheraster	4	2	3	3	2	3	2	2.3	5	4	5	4.7
24. microoxeas	6	7	8	7	6	5	4	5	8	6	5	6.3
25. C	8	7	12	9	7	13	9	9.7	12	13	14	13.5
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Morphometric measurements of spicules from three sponges collected from three subsites at Paitan, Iligan City.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	27	26	20	24.3	15	19	21	18.3	28	32	27	29
2. tylostyle	35	34	35	34.3	18	15	30	21	28	23	20	23.7
3. oxeas	14	20	21	18.3	17	14	12	14.3	15	25	26	22
4. anatriane	25	20	27	24	30	22	23	25	29	29	28	28.7
5. strongyle	13	14	15	14	14	13	15	14	19	18	12	16.3
6. tylote	11	14	11	12	10	14	16	13.3	22	23	12	19
7. acanthostyle	13	16	21	16.7	14	15	20	16.3	23	14	10	15.7
8. protriane	35	25	30	30	23	25	28	25.3	23	27	30	26.7
9. trachystyle	13	15	16	14.7	18	19	20	19	11	16	20	15.7
10. subtylostyle	17	15	12	14.7	13	20	14	15.7	15	16	17	16
11. tetracts	18	25	20	21	21	21	15	18.7	14	12	18	14.7
12. tetralopes	17	14	13	14.7	18	15	15	16	16	20	12	16
13. phyllotriane	27	20	23	23.3	28	24	23	25	20	15	14	16.3
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	0	0	0	0	0	0	0	0	0	0	0	0
16. isochella	6	5	4	5	6	5	6	5.7	5	5	4	4.7
17. c- sigma	9	6	5	6.7	7	8	7	7.3	9	5	4	6
18. s-sigma	4	3	5	4	4	4	4	4	4	4	5	4.3
19. amphiaster	8	3	4	5	5	7	8	6.7	4	3	4	3.7
20. anisochella	4	3	3	3.3	4	5	5	4.7	3	5	6	4.7
21. spirastort	3	3	4	3.3	5	5	4	4.7	5	5	4	4.7
22. triod	4	3	4	3.7	5	5	4	4.7	5	3	4	4
23. spheraster	6	7	5	6	5	6	7	6	4	3	2	3
24. microoxeas	5	4	6	5	7	8	5	6.7	4	6	7	5.7
25. C	0	0	0	0	0	0	0	0	0	0	0	0
26. D	0	0	0	0		0	0	0	0	0	0	0
27. E	0	0	0	0	0	0	0	0	0	0	0	0

Table 5. Morphometric measurements of spicules from three sponges collected from in three subsites at Mapalad, Iligan City.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	25	24	19	22.7	20	25	25	23.3	15	23	20	19.3
2. tylostyle	17	19	20	18.7	17	18	23	19.3	21	25	25	23.7
3. oxeas	35	32	25	30.7	20	30	30	26.7	27	27	28	27.3
4. anatriane	20	19	18	19	24	24	23	23.7	25	21	18	22.7
5. strongyle	15	19	19	17.7	14	15	20	16.3	17	16	15	16
6. tylote	20	15	17	19	23	12	23	16	15	13	14	14
7. acanthostyle	19	20	23	21	24	15	16	18.3	18	19	20	19
8. protriane	0	0	0	0	0	0	0	0	0	0	0	0
9. trachystyle	12	14	15	13.7	13	13	15	137	16	17	18	17
10. subtylostyle	0	0	0	0	0	0	0	0	0	0	0	0
11. tetracts	12	14	15	13.7	15	12	14	13.7	17	14	13	14.7
12. tetralopes	17	15	16	16	17	20	23	20	17	15	16	16
13. phyllotriane	13	10	17	13.3	15	14	14	14.3	16	17	13	15.3
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	10	8	9	9	7	8	7	7.3	6	8	10	8
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	4	5	5	4.7	6	5	6	5.7	7	6	6	6.3
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	4	3	6	4.3	5	5	4	4.7	7	6	5	6
21. spirastort	0	0	0	0	0	0	0	0	0	0	0	0
22. triod	4	4	3	3.7	3	5	4	4	4	4	5	4.3
23. spheraster	6	5	6	5.7	4	5	7	5.3	2	3	4	3
24. microoxeas	3	3	3	3	4	3	5	4	3	4	3	3.3
25. C	4	3	3	3.3	4	5	5	4.7	3	3	4	3.3
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	3	4	3	3.3	4	5	4	9.7	3	5	4	4

Table 6. Morphometric measurements of spicules from three sponges collected from three subsites in Montanier, Linamon .

	SUBSITES											
	1				2				3			
CHARACTERS	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	11	14	15	13.3	12	15	14	13.7	11	10	10	10.3
2. tylostyle	17	21	14	17.3	.15	12	18	15	21	20	15	18.7
3. oxeas	20	24	25	23	50	30	23	34.3	30	25	26	27
4. anatriane	17	15	16	16	18	19	15	17.3	17	18	15	16.7
5. strongyle	15	16	15	15.3	17	16	19	17.3	18	19	17	18
6. tylote	40	40	30	36.7	35	20	25	26.7	31	35	35	33.7
7. acanthostyle	8	5	9	7.3	10	10	10	10	8	7	6	77
8. protriane	25	20	35	26.7	23	25	30	26	32	31	30	31
9. trachystyle	6	7	10	7.7	9	8	10	9	8	7	6	77
10. subtylostyle	0	0	0	0	0	0	0	0	0	0	0	0
11. tetracts	14	15	12	13.7	13	13	15	13.7	15	12	13	13.3
12. tetralopes	15	15	14	14.7	13	12	14	13	15	14	13	14
13. phyllotriane	23	20	21	21.3	23	24	25	24	21	23	24	22.7
14 A	18	19	17	18	16	19	20	18.3	17	16	19	17.3
15. B	5	7	8	6.7	9	5	8	73	7	9	6	17.3
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	5	5	4	4.7	4	5	4	4.3	4	5	5	4.6
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	12	14	15	13.7	13	10	9	10.7	15	16	18	16.3
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	3	5	4	4	6	5	4	5	3	4	5	4
22. triod	3	4	4	3.7	4	3	5	4	3	3	3	3
23. spheraster	3	4	4	3.7	3	4	5	4	3	2	2	2.3
24. microoxeas	0	0	0	0	0	0	0	0	0	0	0	0
25. C	11	17	15	14.3	16	15	17	16	18	17	16	17
26. D	12	13	14	13	12	13	15	13.3	17	18	15	16.7
27. E	0	0	0	0	0	0	0	0	0	0	0	0

Table 7. Morphometric measurements of spicules from three sponges collected from three subsites in Luga-it, Misamis Oriental.

CHARACTERS	SUBSITES											
	1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	15	16	17	16	17	18	15	16.7	25	15	19	21.7
2. tylostyle	20	15	17	17.3	18	20	22	20	21	20	25	22
3. oxeas	30	20	23	24.3	25	15	18	19.3	23	25	30	26
4. anatriane	17	19	23	19.7	15	18	17	16.6	18	20	21	19.7
5. strongyle	19	24	23	22	26	15	28	23	31	32	30	31
6. tylote	19	17	23	19.7	25	28	25	26	20	28	26	24.7
7. acanthostyle	15	14	13	14	12	13	14	13	14	15	14	14.3
8. protriane	0	0	0	0	0	0	0	0	0	0	0	0
9. trachystyle	7	9	10	8.7	8	7	9	8	13	6	9	9.3
10. subtylostyle	17	15	19	17	20	21	20	20.3	15	20	18	17.7
11. tetracts	12	10	11	11	12	14	15	13.7	12	13	10	11.7
12. tetralopes	0	0	0	0	0	0	0	0	0	0	0	0
13. phyllotriane	0	0	0	0	0	0	0	0	0	0	0	0
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	8	9	7	8	6	12	5	7.6	7	6	5	6
16. isochella	5	6	5	5.3	7	8	4	6.3	8	9	7	8
17. c- sigma	4	5	6	5	3	4	4	3.7	5	6	5	5.3
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	4	3	4	3.7	5	5	6	5.3	4	3	3	3.3
22. triod	4	3	4	3.7	4	5	3	4	3	4	3	3.3
23. spheraster	3	4	3	3.3	3	4	4	3.7	4	4	3	3.7
24. microoxeas	4	5	6	5	7	5	4	5.3	4	4	6	4.7
25. C	15	7	4	8.7	5	18	18	13.7	10	10	7	9
26. D	15	13	14	14	10	11	14	11.7	10	11	12	11
27. E	7	9	10	8.7	8	7	5	6.7	8	8	6	7.3

Table 8. Morphometric measurements of spicules from three sponges collected from three subsites in Mago-ong, Linamon.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	35	25	20	26.7	15	16	22	17.7	30	24	25	26.3
2. tylostyle	25	20	24	23	27	28	32	29	25	26	28	26
3. oxeas	35	38	40	37.7	15	23	20	19.3	19	32	30	27
4. anatriane	20	18	23	20.3	24	20	15	19.7	28	22	24	24.7
5. strongyle11	11	10	12	11	15	16	13	14.7	11	17	9	12.3
6. tylote	0	0	0	0	0	0	0	0	0	0	0	0
7. acanthostyle	12	13	18	14.3	18	14	15	15.7	17	11	10	12.7
8. protriane	24	25	17	22	18	17	19	18	24	25	23	24
9. trachystyle	11	14	10	11.7	8	17	8	11	11	13	12	12
10. subtylostyle	17	19	15	17	16	20	23	19.7	16	19	23	19.3
11. tetracts	15	14	13	14	14	15	13	14	12	15	13	13.3
12. tetralopes	17	19	23	19.7	12	13	10	11.7	19	18	17	18
13. phyllotriane	10	23	12	15	20	12	17	19.3	15	13	14	14
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	0	0	0	0	0	0	0	0	0	0	0	0
16. isochella	6	8	11	8.3	10	5	6	7	8	6	5	6.3
17. c- sigma	0	0	0	0	0	0	0	0	0	0	0	0
18. s-sigma	4	6	5	5	7	5	5	5.7	3	3	3	3
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	3	3	3	3	4	4	5	4.3	4	3	4	3.7
22. triod	3	3	3	3	4	3	3	3.3	3	2	2	2.3
23. spheraster	6	5	7	6	8	6	4	6	4	6	5	5
24. microoxeas	4	4	5	4.3	6	5	4	5.3	6	5	5	5.3
25. C	9	5	4	6	6	7	10	7.7	7	5	8	6.7
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	7	5	8	6.7	9	6	5	6.7	8	7	7	7.3

Table 9. Morphometric measurements of spicules from three sponges collected from three subsites in Samburon.

CHARACTERS	SUBSITES											
	1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	33	25	30	29.3	30	40	43	37.7	40	39	40	39.7
2. tylostyle	40	30	20	30	14	40	60	38.3	45	60	50	51.7
3. oxeas	25	21	23	23	22	14	12	16	33	30	90	51
4. anatriane	18	19	17	18	20	19	20	19.7	18	15	16	16.3
5. strongyle	20	21	21	20.7	23	22	20	21.7	24	20	21	21.7
6. tylote	25	20	30	25	40	38	30	32.7	20	25	30	25
7. acanthostyle	8	9	8	8.3	7	6	5	6	10	9	8	9
8. protriane	0	0	0	0	0	0	0	0	0	0	0	0
9. trachystyle	20	21	22	21	22	24	25	23.7	20	21	20	20.3
10. subtylostyle	20	20	35	25	30	30	26	28.7	27	28	35	30
11. tetracts	10	11	14	11.7	12	10	9	10.3	15	12	13	13.3
12. tetralopes	14	15	15	14.7	12	13	13	12.7	15	14	15	14.7
13. phyllotriane	15	16	15	14.7	14	16	17	15.7	18	16	15	16.3
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	0	0	0	0	0	0	0	0	0	0	0	0
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	4	8	5	5.7	6	7	4	5.7	6	7	5	6
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	5	6	5	5.3	5	4	6	5	6	7	5	6
22. triod	5	4	4	4.3	5	4	6	5	3	4	5	4
23. spheraster	5	5	5	5	4	6	5	5	5	6	5	5.3
24. microoxeas	4	5	4	4.3	3	4	5	4	3	4	5	4
25. C	0	0	0	0	0	0	0	0	0	0	0	0
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	4	5	5	4.7	6	5	7	6	5	7	7	6.3

Table 10. Morphometric measurements of spicules from three sponges collected from three subsites in Initao.

	SUBSITES											
	1				2				3			
CHARACTERS	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	30	54	30	38	32	33	40	35	30	33	34	32.3
2. tylostyle	30	25	30	28.3	26	23	20	23	30	30	28	29.3
3. oxeas	14	15	17	15.3	24	6	19	16.3	35	30	28	17.3
4. anatriane	19	20	21	20	22	20	19	20.3	14	20	18	17.3
5. strongyle	19	20	15	18	15	16	18	16.3	20	21	20	20.3
6. tylote	17	23	25	21.7	20	20	17	19	19	20	21	20
7. acanthostyle	4	9	5	6	10	7	8	8.3	11	12	10	11
8. protriane	0	0	0	0	0	0	0	0	0	0	0	0
9. trachystyle	15	19	18	17.3	17	20	15	17.3	18	17	20	18.3
10. subtylostyle	0	0	0	0	0	0	0	0	0	0	0	0
11. tetracts	17	19	20	18	21	22	25	22.7	20	20	17	19
12. tetralopes	25	20	23	22.7	21	20	27	22.7	23	24	18	21.7
13. phyllotriane	19.5	9	30	19.5	25	28	20	24.3	29	27	30	28.7
14 A	13	15	12	13.3	16	17	19	17.3	21	20	16	19
15. B	9	11	12	10.7	14	15	13	13.7	12	14	11	12.3
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	6	5	4	5	5	6	4	5	6	5	5	5.3
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	3	2	3	2.7	2	4	3	3	5	4	3	4
22. triod	4	3	4	3.7	4	3	5	4	3	4	3	3.3
23. spheraster	2	4	3	3	4	5	3	4	5	4	4	4.3
24. microoxeas	2	4	3	3	4	5	3	4	2	2	3	2.3
25. C	0	0	0	0	0	0	0	0	0	0	0	0
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	0	0	0	0	0	0	0	0	0	0	0	0

Table 11. Morphometric measurements of spicules from three sponges collected from three subsites in Montanier, Linamon.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	11	14	15	13.3	12	15	14	13.7	11	10	10	10.3
2. tylostyle	17	21	14	17.3	15	12	18	15	21	20	15	18.7
3. oxeas	20	24	25	23	50	30	23	34.3	30	25	26	27
4. anatriane	17	15	16	16	18	19	15	17.3	17	17	15	16.7
5. strongyle	15	16	15	15.3	17	16	19	17.3	19	18	17	18
6. tylote	40	40	30	36.7	35	20	25	26.7	31	35	35	33.7
7. acanthostyle	8	5	9	7.3	10	10	10	10	8	7	6	7
8. protriane	25	20	35	26.7	23	25	30	26	32	31	30	31
9. trachystyle	6	7	10	7.7	9	8	10	9	8	7	6	7
10. subtylostyle	0	0	0	0	0	0	0	0	0	0	0	0
11. tetracts	14	15	12	13.7	13	15	13	13.7	15	12	13	13.3
12. tetralopes	15	15	14	14.7	13	12	14	13	15	14	13	14
13. phyllotriane	23	20	21	21.3	23	24	25	24	21	23	24	22.7
14 A	18	19	17	18	16	19	20	18.3	17	16	19	17.3
15. B	5	7	8	6.7	9	5	8	7.3	7	9	6	7.3
16. isochella	0	0	0	0	0	0	0	0	0	0	0	0
17. c- sigma	5	5	4	4.7	4	5	4	4.3	4	5	5	4.6
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	12	15	14	13.7	13	10	9	10.7	15	16	18	16.3
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	3	5	4	4	6	5	4	5	3	4	5	4
22. triod	3	4	4	3.7	4	3	5	4	3	3	3	3
23. spheraster	3	4	4	3.7	3	4	5	4	3	2	2	2.3
24. microoxeas	0	0	0	0	0	0	0	0	0	0	0	0
25. C	11	17	15	14.3	16	15	17	16	18	17	16	17
26. D	12	13	14	13	12	13	15	13.3	17	18	15	16.7
27. E	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. Morphometric measurements of spicules from three sponges collected from three subsites in Maputi, Misamis Oriental.

CHARACTERS	SUBSITES 1				2				3			
	1	2	3	Average	1	2	3	Average	1	2	3	Average
SPICULE												
1. style	25	32	30	29	30	31	32	31	29	30	31	30
2. tylostyle	18	17	60	31.7	30	40	30	33.3	19	20	21	20
3. oxeas	25	22	40	29	30	35	40	35	35	40	25	33.3
4. anatriane	0	0	0	0	0	0		0	0	0	0	0
5. strongyle	17	19	20	18.7	25	15	20	20	25	26	30	27
6. tylote	19	23	20	20.7	23	24	25	23	29	30	31	30
7. acanthostyle	7	10	10	9	20	20	10	16.7	15	19	15	16.3
8. protriane	19	20	35	24.7	40	38	37	38.3	38	37	35	36.7
9. trachystyle	0	0	0	0	0	0	0	0	0	0	0	0
10. subtylostyle	0	0	0	0	0	0	0	0	0	0	0	0
11. tetracts	13	17	20	16.7	13	28	25	22	22	20	21	21
12. tetralopes	13	15	14	14	16	18	20	18	14	16	17	15.7
13. phyllotriane	20	25	15	20	17	15	20	17.3	19	20	24	21
14 A	0	0	0	0	0	0	0	0	0	0	0	0
15. B	6	5	4	5	3	5	6	4.7	5	5	6	5.3
16. isochella	4	3	4	3.7	5	4	5	4.7	54	4	5	4.7
17. c- sigma	7	6	5	6	4	6	5	5	5	7	6	6
18. s-sigma	0	0	0	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0	0	0	0
21. spirastort	17	16	12	15	10	11	15	12	15	12	14	13.7
22. triod	0	0	0	0	0	0	0	0	0	0	0	0
23. spheraster	12	7	8	9	8	12	5	8.3	7	8	8	7.7
24. microoxeas	0	0	0	0	0	0	0	0	0	0	0	0
25. C	7	5	6	5	5	5	6	5.3	8	9	5	7.3
26. D	0	0	0	0	0	0	0	0	0	0	0	0
27. E	2	3	3	2.7	4	5	4	4.3	3	4	2	3

Table 13. Presence or Absence of Spicules

SPICULE	SITE 1			SITE 2				SITE 3	
	Kalubihon	Paitan	Mapalad	Montanier	Mago-ong	Samburon	Luga-it	Maputi	Initao
tyle	+	+	+	+	+	+	+	+	+
/lostyle	+	+	+	+	+	+	+	+	+
xeas	+	+	+	+	+	+	+	+	+
natriane	+	+	+	+	+	+	+	-	+
trongyle	-	+	+	+	+	+	+	+	+
/lote	+	+	+	+	-	+	+	+	+
canthostyle	+	+	+	+	+	+	+	+	+
rotriane	-	+	-	+	+	-	-	+	-
achystyle	+	+	+	+	+	+	+	-	+
subtylostyle	+	+	-	-	+	+	+	-	-
tetracts	+	+	+	+	+	+	+	+	+
tetralopes	+	+	+	+	+	+	-	+	+
phyllotriane	+	+	+	+	+	+	-	+	+
A	+	-	-	+	-	-	-	-	+
B	+	-	+	+	-	-	+	+	+
isochella	-	+	-	-	+	-	+	+	-
c- sigma	+	+	+	+	-	+	+	+	+
s-sigma	-	+	-	-	+	-	-	-	-
amphiaster	-	+	-	+	-	-	-	-	-
ánisochella	-	+	+	-	-	-	-	-	-
spirastort	+	+	-	+	+	+	+	+	+
triod	-	+	+	+	+	+	+	-	+
spheraster	+	+	+	+	+	+	+	+	+
microoxeas	+	+	+	-	+	+	+	-	+
C	+	-	+	+	+	-	+	+	-
D	-	-	-	+	-	-	+	-	-
E	-	-	+	-	+	+	+	+	-

Table 14. Average length measurement of spicules. (Data expressed in μ m.).

SITE 1									SITE 2								
Dalipuga			Paitan			Mapalad			Montanier			Mago-ong			Samburon		
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
388	360	268	292	220	348	272	280	232	160	164	124	320	212	316	352	452	476
304	356	500	412	252	284	224	232	284	208	180	224	276	348	312	360	460	620
216	156	160	220	172	264	368	320	328	276	34	324	452	232	324	276	192	612
248.4	192	196	288	300	344	228	284	272	192	208	200	244	236	296	216	236	196
0	0	0	168	168	196	212	196	192	184	208	216	132	176	148	248	260	260
144	156	200	144	160	228	228	192	168	440	320	404	0	0	0	300	392	300
140	156	162	200	196	188	252	220	228	88	120	92	172	188	152	100	72	108
0	0	0	360	304	320	0	0	0	320	312	372	264	216	288	0	0	0
144	128	152	176	228	188	164	164	204	92	108	92	140	132	144	252	284	244
228	272	336	176	188	192	0	0	0	0	0	0	204	236	232	300	384	360
148	160	156	252	224	176	164	164	176	164	164	160	168	168	160	140	124	160
220	216	232	176	192	192	192	240	192	176	156	168	236	140	216	176	152	176
180	172	168	280	300	196	160	172	184	256	288	272	180	232	168	176	188	196
148	180	184	0	0	0	0	0	0	216	220	208	0	0	0	0	0	0
96	68	72	0	0	0	108	88	96	80.4	88	208	0	0	0	0	0	0
0	0	0	60	68	56	0	0	0	0	0	0	100	84	84	0	0	0
60	60	88	80	88	72	56	68	76	56	52	55	0	0	0	68	68	72
0	0	0	48	48	52	0	0	0	0	0	0	60	20.5	36	0	0	0
0	0	0	60	80	44	0	0	0	164	128	196	0	0	0	0	0	0
0	0	0	40	56	56	52	56	72	0	0	0	0	0	0	0	0	0
40	84	48	40	56	56	0	0	0	48	60	48	36	52	44	64	60	72
0	0	0	44	56	48	44	48	52	44	48	36	36	40	28	52	60	48
36	28	56	72	72	36	68	64	36	44	48	28	72	72	60	60	60	64
84	60	76	60	80	68	36	48	40	0	0	0	52	64	64	52	48	48
108	116	162	0	0	0	40	56	40	172	192	204	76	92	80	0	0	0
0	0	0	0	0	0	0	0	0	156	160	200	0	0	0	0	0	0
0	0	0	0	0	0	40	116	48	0	0	0	80	80	88	56	72	76
15	16.5	14	19	10	12	18.5	17	8.5	16	12	10	9.5	7	8.5	7.5	12.5	8.5

Note: Average measurement was obtained from three individual spicules.

Table 14. continuation

SPICULE	SITE 3								
	Luga-it			Maputi			Initao		
	1	2	3	1	2	3	1	2	3
1. style	192	200	260	348	372	360	456	420	388
2. tylostyle	208	240	264	380	400	240	340	216	352
3. oxeas	292	232	312	348	420	400	184	196	208
4. anatriane	236	199	236	0	0	0	240	244	208
5. strongyle	264	276	372	224	240	324	216	196	244
6. tylote	236	312	296	248	276	360	260	228	240
7. acanthostyle	168	156	172	108	200	196	72	100	132
8. protriane	0	0	0	196	460	440	0	0	0
9. trachystyle	104	96	112	0	0	0	208	208	220
10.subtylostyle	204	244	212	0	0	0	0	0	0
11. tetracts	132	164	140	200	264	252	216	272	228
12. tetralopes	0	0	0	168	216	188	272	292	260
13.phyllotriane	0	0	0	240	208	252	234	208	344
14 A	0	0	0	0	0	0	160	164	228
15. B	76	91	72	60	56	64	128	164	148
16. isochella	64	76	96	44	56	56	0	60	0
17. c- sigma	60	44.4	64	72	60	72	60	60	63.6
18. s-sigma	0	0	0	0	0	0	0	0	0
19. amphiaster	0	0	0	0	0	0	0	0	0
20. anisochella	0	0	0	0	0	0	0	0	0
21. spirastort	44	64	40	180	144	164	32	36	48
22. triod	44	48	40	0	0	0	44	48	39.6
23. spheraster	40	44	44	108	100	92	36	48	52
24. microoxeas	60	64	56	0	0	0	36	48	28
25. C	104	164	108	60	64	88	0	0	0
26. D	168	140	132	0	0	0	0	0	0
27. E	104	80	88	32	52	36	0	0	0
28. Diameter of sample	11.5	14	12	11	10.5	11	17.5	8.5	10

Note: Average measurement was obtained from three individual spicules.

Table 16. Point-to-nearest individual Distance (X) and Individual-to-nearest neighbor distance (Y) in each sampling site/subsite.

		DISTANCE (m)														
									POINTS							
SUBSITES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DALIPUGA 1	X	1.0	1.5	1.2	1.6	1.5	0.5	1.8	1.3	1.5	1.0	2.0	1.5	1.8	1.0	0.5
	Y	1.5	1.5	1.3	2.5	2.0	1.0	1.7	1.5	1.2	2.0	2.5	1.2	0.3	0.9	1.0
PAITAN	X	1.0	2.0	0.9	1.5	1.8	2.3	1.6	2.0	1.5	1.0	1.2	1.4	2.0	3.0	2.2
	Y	1.1	0.9	0.8	2.5	1.2	1.2	0.7	0.5	0.8	1.0	1.0	1.0	0.8	2.0	5.0
MAPALAD	X	1.0	1.0	2.0	1.0	0.8	0.5	1.5	1.0	0.5	3.0	3.2	2.2	1.5	3.0	1.0
	Y	1.0	2.0	2.0	1.5	1.2	2.0	3.0	0.5	4.0	3.5	2.5	2.75	3.0	1.5	4.0
MONTANIE R	X	4.0	3.0	5.0	4.0	6.0	1.0	0.25	1.0	3.0	2.0	4.0	5.0	5.0	4.0	3.0
	Y	2.0	5.0	3.0	5.0	6.0	7.0	4.0	1.0	4.0	3.0	4.0	3.0	2.0	1.0	5.0
MAGO-ONG	X	3.0	4.0	5.5	2.4	3.0	6.0	4.0	5.5	3.0	2.0	5.0	3.0	4.3	2.7	3.6
	Y	4.5	4.5	2.0	2.2	2.0	0.9	3.0	4.5	6.0	5.0	1.5	2.0	4.8	0.5	2.0
SAMBURON	X	3.0	2.0	4.0	1.0	1.2	1.0	3.5	4.0	2.0	2.0	2.5	3.0	2.0	4.0	3.0
	Y	4.0	5.0	2.0	3.0	2.0	1.0	2.0	3.0	3.0	0.5	1.0	5.0	2.0	3.0	0.5
LUGA-IT	X	5.0	6.0	7.0	4.0	3.0	1.0	4.0	5.0	7.0	4.0	6.0	5.0	4.0	7.0	2.0
	Y	4.0	5.0	3.0	4.0	3.0	6.0	4.0 ·	5.0	6.0	4.0	32.0	1.0	4.0	3.0	2.0
MAPUTI	X	5.0	6.0	5.0	5.0	4.0	3.0	2.0	5.0	4.0	1.0	4.0	4.0	5.0	6.0	5.0
	Y	1.0	3.0	4.0	6.0	5.0	1.0	3.0	4.0	6.0	1.0	5.0	4.0	3.0	2.0	6.0
INITAO	X	2.0	3.5	4.2	4.0	3.2	2.3	3.1	2.5	4.4	5.5	1.3	4.4	5.2	6.1	2.0
	Y	3.4	4.5	3.2	5.6	5.0	6.5	1.2	1.5	1.5	2.3	1.5	1.5	4.5	5.0	4.7

Table 17. Statistical results of the test on the Distribution Pattern of the sponge.

STATISTICAL	Dalipuga	Paitan	Mapalad	Montanier	Mago-ong	Samburon n	Luga-it	Mapalad	Initao
Mean point-to nearest individual distance	1.31	1.69	1.55	3.35	3.8	2.55	4.67	4.27	3.58
Mean individual-to nearest neighbor distance	1.47	1.37	2.30	3.67	3.03	2.47	3.80	3.60	3.346
Index of Clumping (C)	0.59	0.76	0.48	0.60	0.73	0.65	0.71	0.71	0.65
Interpretation	clumped	clumped	uniform	clumped	clumped	clumped	clumped	clumped	clumped
Test Statistics for C (z)	1.18	3.45	-0.24	1.27	3.02	2.04	2.82	2.85	2.07
Decision for H_o (random pattern)	accept	reject	accept	accept	reject	reject	reject	reject	reject
Johnson and Zimmer									
Index of Dispersion (I)	1.40	1.52	2.26	1.65	1.47	1.59	1.48	1.33	1.58
Interpretation	uniform	uniform	uniform	uniform	uniform	uniform	uniform	uniform	uniform
Test Statistics for I (z)	-1.41	-1.11	0.61	-0.83	-0.1 24	-0.96	-1.22	-1.57	-0.97
Decision for H_o (random pattern)	accept	accept	accept	accept	accept	accept	accept	accept	accept
Distribution Pattern	random	uniform clumping	random	random	uniform clumping	uniform clumping	uniform clumping	uniform clumpin g	uniform clumpin g

Figure 4. Dendrogram showing the degree of similarity among samples of sponges taken from the different subsites in 3 localities using Percent Dissimilarity and the flexible strategy $\beta = -0.25$.