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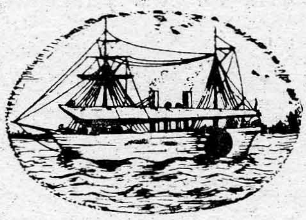

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PRINCIPLES OF SPONGE DISTRIBUTION IN INDO-PACIFIC CORAL REEFS: RESULTS OF THE AUSTRIAN INDO-WESTPACIFIC EXPEDITION 1959/60

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ABSTRACT

By using the diving method it has finally become possible not only to collect sponges from coral reefs but also to take quantitative samples and to make *in situ* observations on the ecological conditions of the environment. A systematic and quantitative ecological study on the sponge fauna of a fringing reef in the NW of Madagascar revealed some of the principles of sponge distribution in this habitat.

(1) Light and fish grazing confines the majority of species to cave-like habitats, either under coral rock or between coral branches. Either of these factors might act differently on different species. Some species resist the influence of both factors.

(2) Water movement and sedimentation are interactive forces. Sponges are adversely affected either by abrasion or by burying and choking. They are therefore usually restricted to vertical or subvertical surfaces some distance from the sediment bottom.

(3) Stable substrates are a necessity for sponge growth. In the coral reef dead coral rock is abundant and preferentially colonized. The larvae of some species are able to settle and survive on the exposed living surface of corals, in spite of slime production and stinging action of the coral polyps which is obnoxious to most smaller organisms. Under favorable conditions, over-population on limited substrate surfaces can take place and result in selection of species.

INTRODUCTION

Numerous large and small expeditions working in the Indo-Pacific during the past century have resulted in important contributions to our knowledge of the sponge fauna of this region. Only recently, however, when modern diving methods began to be an accepted tool in marine biology it became possible not only to collect but also to study the distribution pattern of sponges in the coral reef environments which were not accessible before with common shipboard collecting techniques (Bakus, 1964; Vacelet and Vasseur, 1965; Bakus, 1968).

During the Austrian Indo-Westpacific Expedition sponsored by the Zoological Institute of the University of Vienna, Dr. Ernst Kirsteuer and I had the opportunity to study the systematics and ecology of sponges (Rutzler, in preparation) and nemerteans (Kirsteuer, 1965; in press-*a*) in a fringing reef off the island of Tanikely, NW Madagascar (48°14' East, 13°28.8' South). In addition the Polychaeta, Sipuncula, Ophisthobranchia and Enteropneusta were preserved for distribution to various specialists.

The reef fringed a shallow bay approximately 270 m wide, where our field laboratory was established. A sandy beach 25 m wide with half-buried beach rock was followed under mean tide level by a seagrass zone and a *Cymodocea* meadow. About 15 m from shore there followed a zone of characteristic *Millepora tenella* (Hydrozoa), then zones with predominantly *Acropora pharaonis* (20-30 m) and *Seriatopora angulata* (30-45 m) (Anthozoa). The reef extended further to approximately 130 m from shore where it was bordered by a sandslope of about 8 m depth. The outer reef consisted of coral patches of various size and density with sand and coral rock in between.

Methods

It is quite obvious that organisms of such diverse habits as sponges and nemerteans require different sampling methods. For the nemerteans, six species of abundant corals of various growth-types were collected along a 70 m profile through the reef, perpendicular to the shore. The corals were carried to the shore in a burlap bag and after removal of sponges and other conspicuous organisms they were further processed for the extraction of the meiofauna (Kirsteuer, in press *b*).

Exclusively for the study of sponge distribution two more cross-sections of 70 m length were marked in widely separated parts of the reef where corals and coral rock (i.e. solid substrate) were abundant. Every 10 m along these profiles squares of 0.25 m^2 (50x50 cm) were (marked out as samples) (Fig. 1) and photographed *in situ*. All sponges were then removed and the conditions of the environment noted. In the field laboratory the sponge species were separated and the volume of all specimens was measured; external features were noted and documented in colour photographs; representative fractions were preserved.

After the return of the expedition the samples were sorted according to type and intensity of the ecological parameters. The sponge species contained in the samples and their biomass were then determined and compared. A statistical method called the "homogenity calculation" which had been adapted for this purpose* (Riedl, 1953; Rützler, 1965) aided in the study by giving quantitative data for qualitative differences in the faunal assemblage. This was done with the assumption that differences in composition of the sponge faunas would reflect long-term effects of the exogenous conditions in the environment. Judgment of these conditions had to be based on estimates since no suitable

* I am most grateful to Dr. James A. Peters for programming the Smithsonian Institution's time share computer for this method.

measuring devices were available at the time of the expedition. However, this study among others has stimulated recent work on development of instruments for the *in situ* measurement of environmental factors (Forstner and Rützler, in press).

Results

A systematic study of the collected sponges revealed that 61 species are present in the Tanikely reef (Rützler, in preparation). Their distribution was restricted to the solid substrates (corals, coral rock) of the sublittoral zone. The deepest sample was taken in 8 m (m.t.l.) at the outer edge of the reef. Since some environmental factors (e.g., light) reach extreme values only in shallow water, interesting results could be expected in this zone. Comparative samples from deeper water would have been of great interest but they could not be obtained during this expedition. Some observations on deeper reef areas, although not of quantitative nature, were made later during the International Indian Ocean Expedition (Rützler, 1964).

Because of the well mixed waterbody and the distance of the reef from large land masses neither temperature nor salinity, oxygen nor chemical factors exceeded average values in any part of the reef. Therefore we can concentrate upon the following environmental conditions: light and predation, water movement and sedimentation, substrate and competition for space.

Light and predation:

Although there are many data available about the light conditions in the open sea (Holmes, 1957) we have no information about its effect on benthic animals. The light climate in the different habitats of the coral reef depends on the sunlight reaching these habitats after following the laws of reflection, absorbtion and scattering on its way through the air-water interface and through the waterbody itself. It is further a function of the topography and orientation of the substrate. We still know little about how the visible spectrum of solar radiation might influence the distribution of sponges. Studies in the Mediterranean have shown (Rützler, 1965) that algae can be successful competitors for space, confining the majority of sponges to the shaded zones of overhanging walls, caves and lower surfaces of rocks. On the other hand, some species flourish and become large size by profiting from a symbiosis with blue-green algae (zoocyanelles) or zooxanthelles (Sarà, 1964). Such observations, however, do not apply to the reef in Tanikely nor to other Indian Ocean reefs visited by me in the past. Only a red alga (*Gracilaria* sp.) and occasionally *Halimeda* sp. were abundant on coral rocks; only a few specimens of sponges were found associated with symbiotic algae.

Some authors (Randall, 1967, Bakus, 1968) have recently demonstrated that fish grazing rather than light could be considered the important factor for sponge distribution in reefs. Also I have observed fishes chopping off sponges from overturned rocks but in many cases it is difficult to decide whether the fishes or directly or indirectly the light might have caused the restriction of distribution. Some species become more abundant outside of sheltering corals and rocks in a water depth below 15 meters although spongegrazing fish species are present. It also remains a fact that in very shallow water there are a number of sponges which can survive in full exposure to light (as well as to fish grazing); some of them can never be found in shaded areas. Hopefully, future field and laboratory experiments will contribute to solving such questions in each particular case.

The following tables (Tables 1, 2 and 3 illustrated by graphs (Figs. 2, 3 and 4) show the degree of similarity between the sponge composition of light exposed, shaded and obscure areas in the Tanikely reef. Only samples which were not affected by sedimentation have been used for comparison.

The dominant species in light are *Siphonochalina* sp., *Petrosia testudinaria* (Lam.) and *Phyllospongia madagascarensis* (Hyatt). *Petrosia testudinaria* (Lam.), *Axinella* sp. and *Callyspongia subarmigera* (Ridley) can be found in light but are better developed and more frequent in the shade. *Strongylophora durissima* Dendy, *Acanthella carteri* Dendy and *Axinosia incrustans* Burton are typical dominant species of the dark environment.

Since the species growing in full light could be chemically protected against fish grazing and those flourishing in shaddow are not readily accessible to fishes it can not be decided whether the light or the predation factor, or a combination of both, govern the distribution pattern.

Water movement and sedimentation:

The reef under study was well protected against heavy sea by the nearby islands of Madagascar (East), Nossi Be (North) and Tanikely (West). In spite of occasional storms there was no extreme water agitation noticeable during the time of observation (two periods of 6 weeks, 4 months apart). Only in very shallow water waves and tide currents prevented sponge growth by rolling unstable rock substrates or by abrasion if coarse sediments were present. In deeper water table acroporas (*Acropora corymbosa*), weakened by boring sponges in the stem, were frequently overturned by swell. Those usually provided small cave habitats for sponges if they came to lie across other corals or coral rock.

In some protected areas below 6 m depth, e. g., in the current shade of large coral groups, a high rate of sedimentation took place, at least temporarily. This was frequent enough to adversely affect sponge growth by clogging the channels or by burial of the whole animal. Only four tall or massive species were found to surveiv almost buried in sediment: *Axinella* sp., *Petrosia testudinaria* (Lam.), *Cribochalina olemda* Laub. and *Callyspongia* sp. Similar observations on the selective effect of sedimentation on sedentary invertebrates were made by Bakus (1968) in the Pacific and were supported by field experiments. This explains why even in shaded habitats like caves the majority of species occur on vertical or overhanging substrates, or on the lower surfaces of horizontal substrates.

Substrate and competition for space:

As has been mentioned above sponges are usually restricted to solid substrates. In shallow water only a few specialized species, none of which occur in Tanikely can survive anchored in sand or other sediment bottoms with the help of rootlike structures. Occasionally vagile benthic organisms (e.g., *Dromia* among the crustaceans) carry sponges for camouflage.

One of the peculiarities of the reef environment is that a certain percentage of the available stable structures, depending on the coral species, is covered by the living parts of the corals. How this might affect the economy of organisms associated with the dead skeleton bases remains to be studied. Nevertheless, slime development and stinging action of the living polyps usually inhibits colonization by larvae or small organisms. In spite of this 9 species of sponges have been observed to grow on healthy living parts of corals. The dominant three species are *Tedania anhelans* (Lieberk.), *Damiriana schmidti* (Ridley) and *Phyllospongia madagascarensis* (Hayatt). *Cliona vastifica* (Hanc.) flourishes in the limestone skeleton, and only the papillae show on the living coral surface. The larvae of these species must have some protective mechanism, presumably of chemical nature and so also must the adult specimens, because they seem to be unaffected by fish-grazing even in such exposed positions.

A very distinct and favourable habitat I found to be the dead bases of three loosely branching coral types: *Millepora tenella* (Hydrozoa), *Porites* cf. *P. nigrescens* and *Acropora pharaonis*. The branches provide solid substrate and shelter from strong illumination and fish grazing; sufficient but not extreme water movement is maintained as well as safe distance from accumulating sediment. Samples from these corals contained 27 species of sponges and compared closest with obscure cave habitats in deeper water (Tables 4, 5; Figs, 5, 6).

Occasionally, if the environmental conditions for sponge growth are very favourable and if the available substrate is limited, competition for space will occur. In the wickerwork of branching corals the multiplication of suitable surfaces prevents this. However, on the lower surfaces of overturned table Acroporas effective competition can be observed: faster growing or obnoxious species overgrow their neighbours and frequently cause their death.

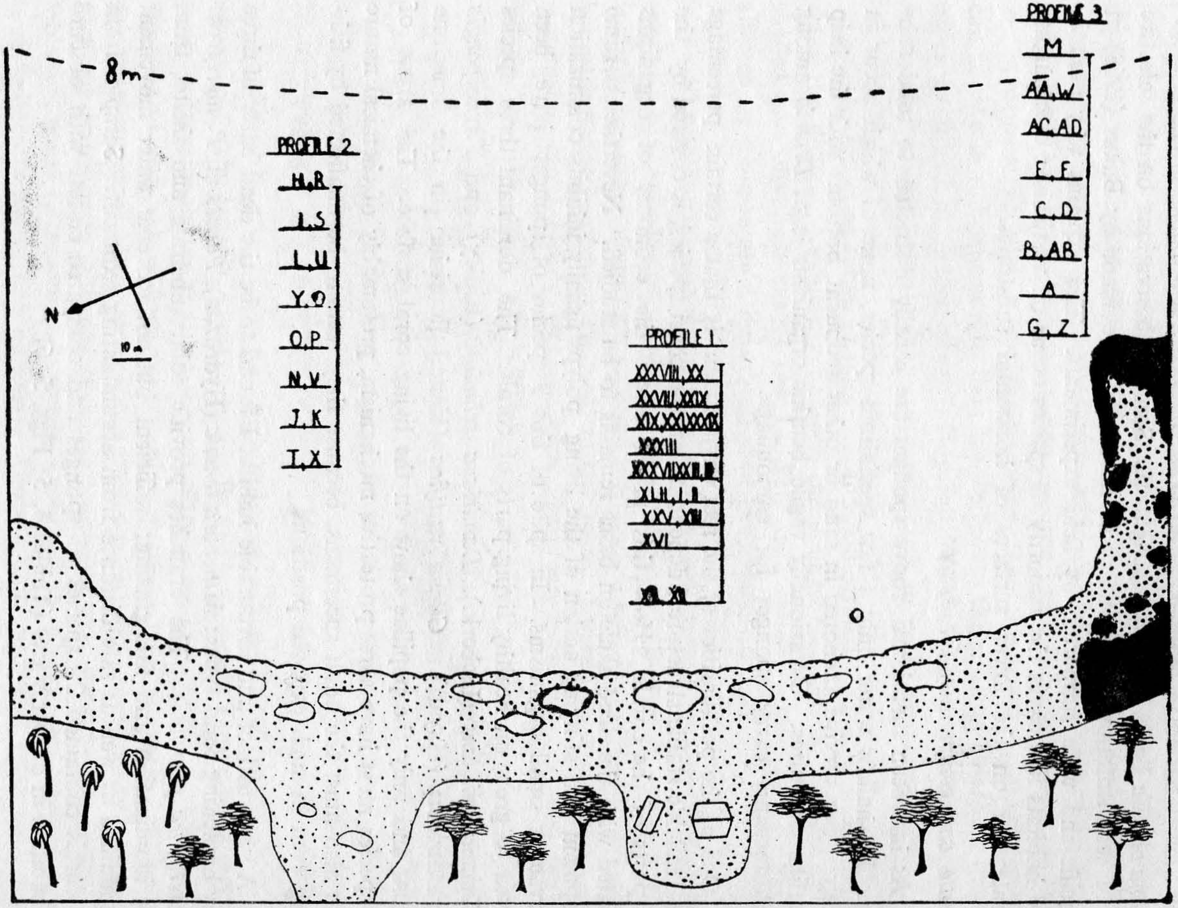

FIG. 1. Location of profiles in the Tanikely fringing reef. Roman numerals: general samples for interstitial organisms; capital letters: sponge samples.

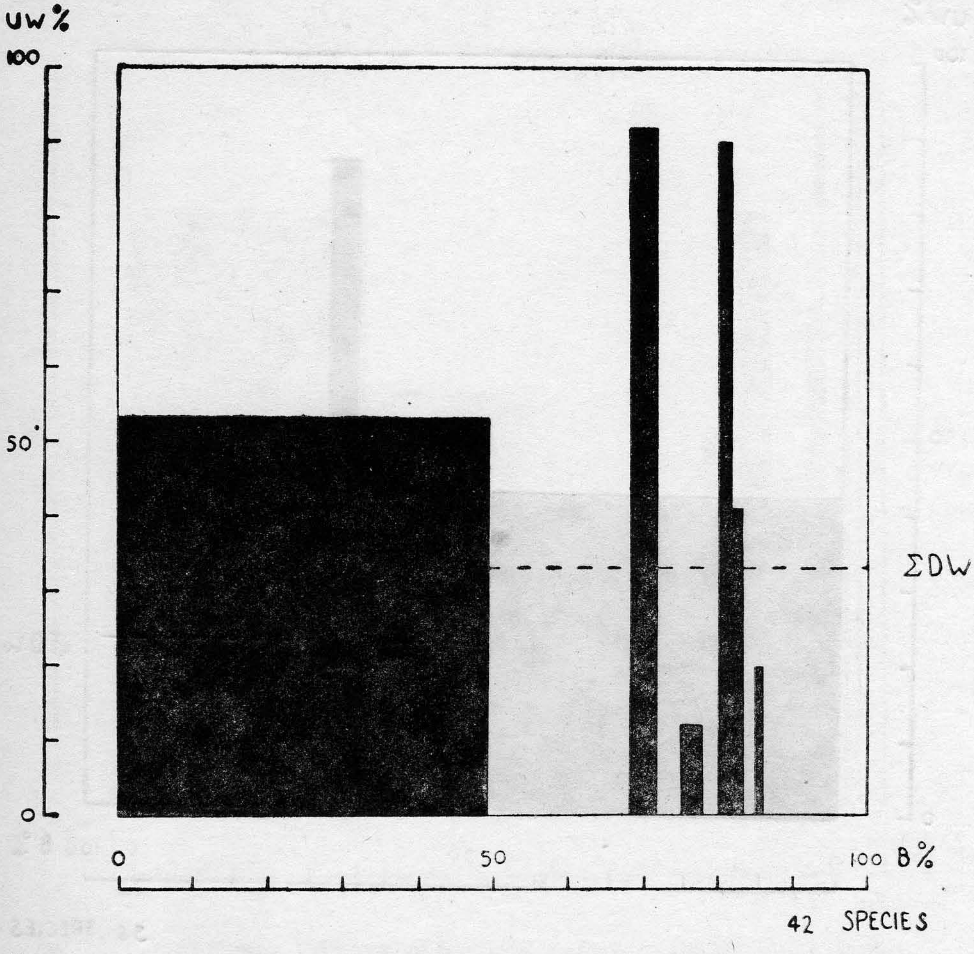

FIG. 2. Graph showing the degree of homogenity of sponge faunas between lighf exposed and shaded areas (compare Table 1).

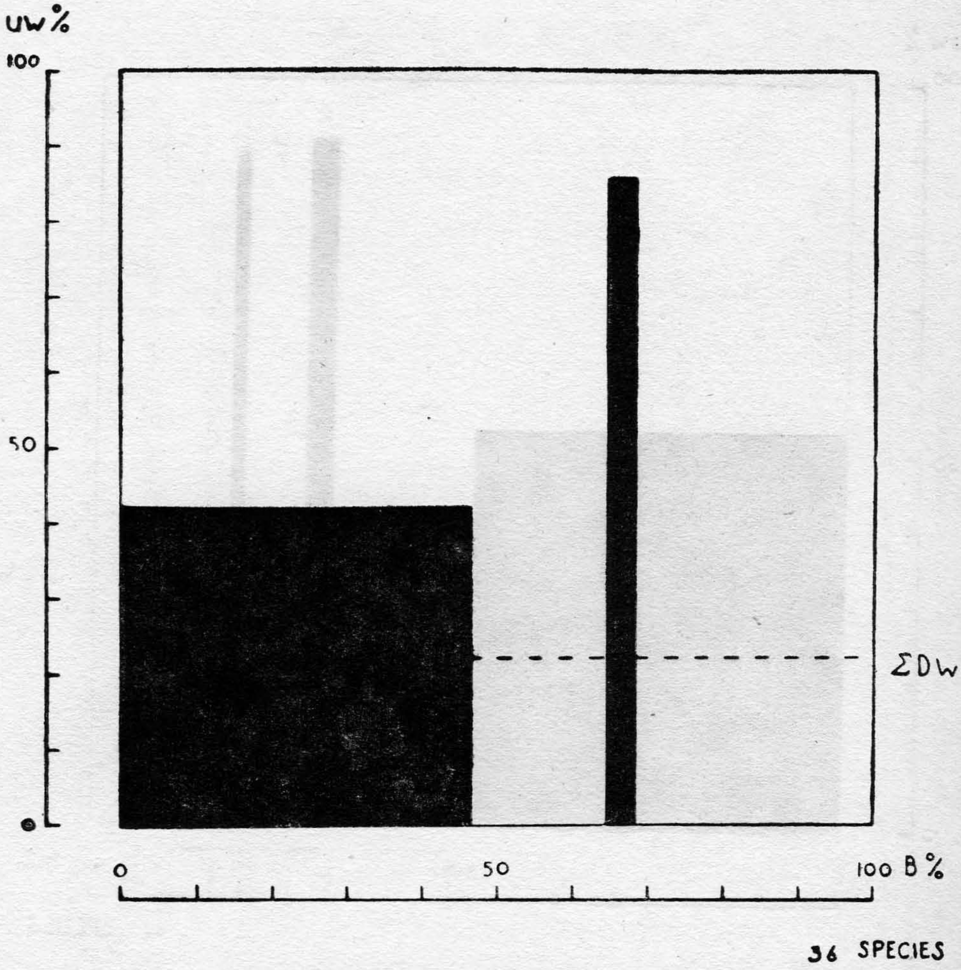

FIG. 3. Graph showing the degree of homogenity of sponge faunas between light exposd and obscure areas (compare Table 2.)

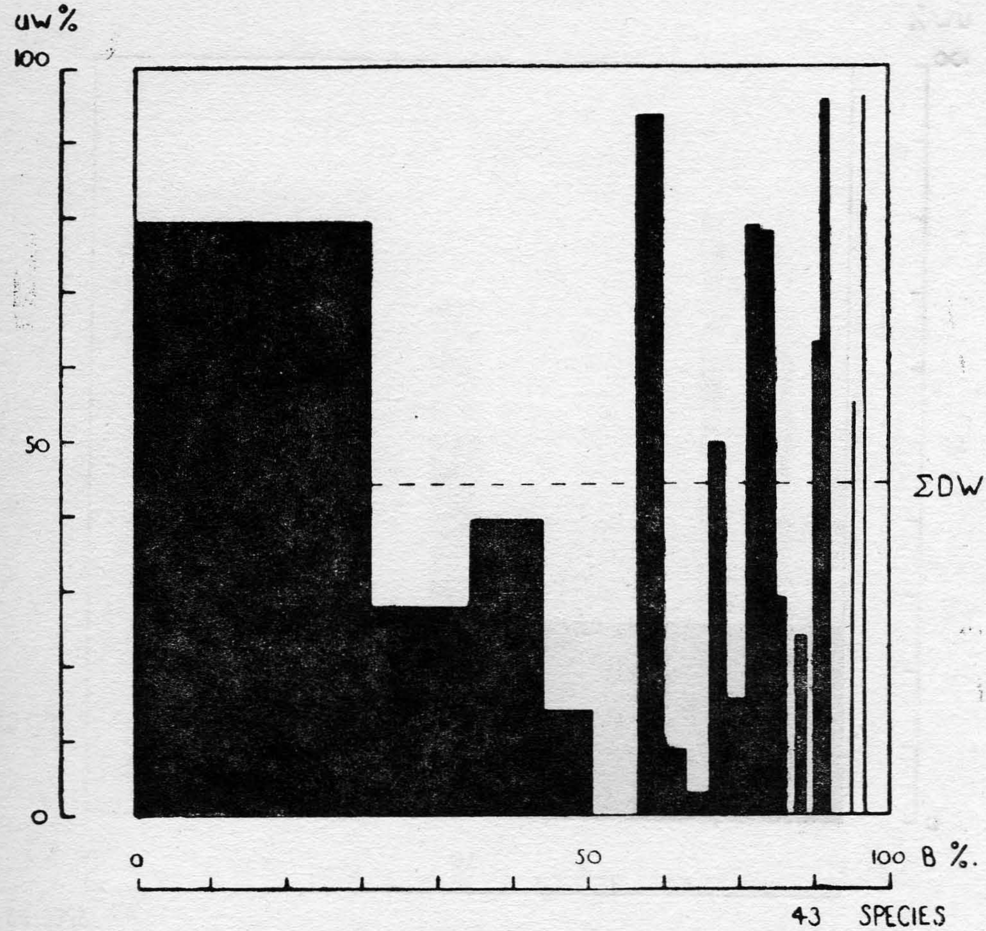

FIG. 4. Graph showing the degree of homogenity of sponge faunas between shaded and obscure areas (compare Table 3.)

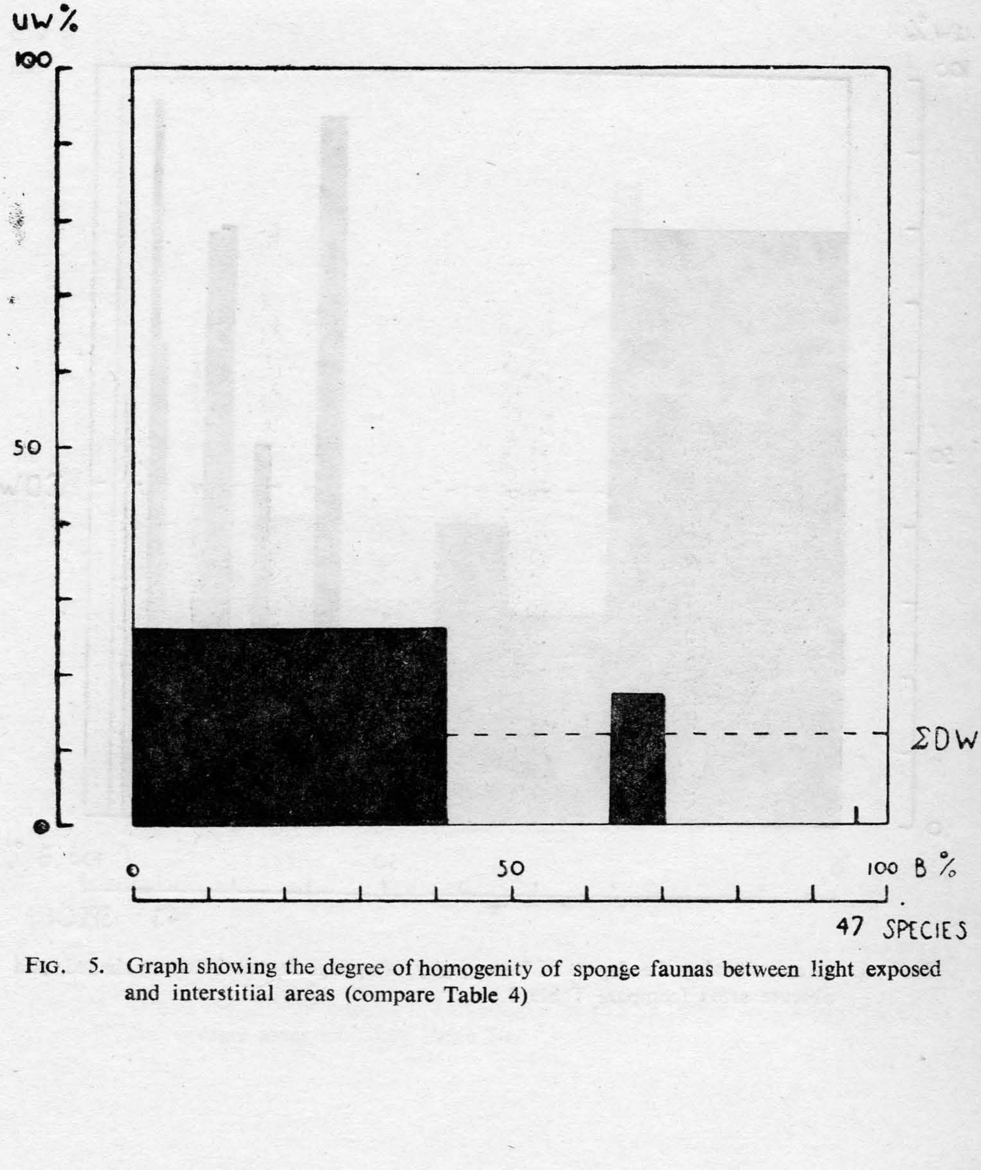

FIG. 5. Graph showing the degree of homogenity of sponge faunas between light exposed and interstitial areas (compare Table 4)

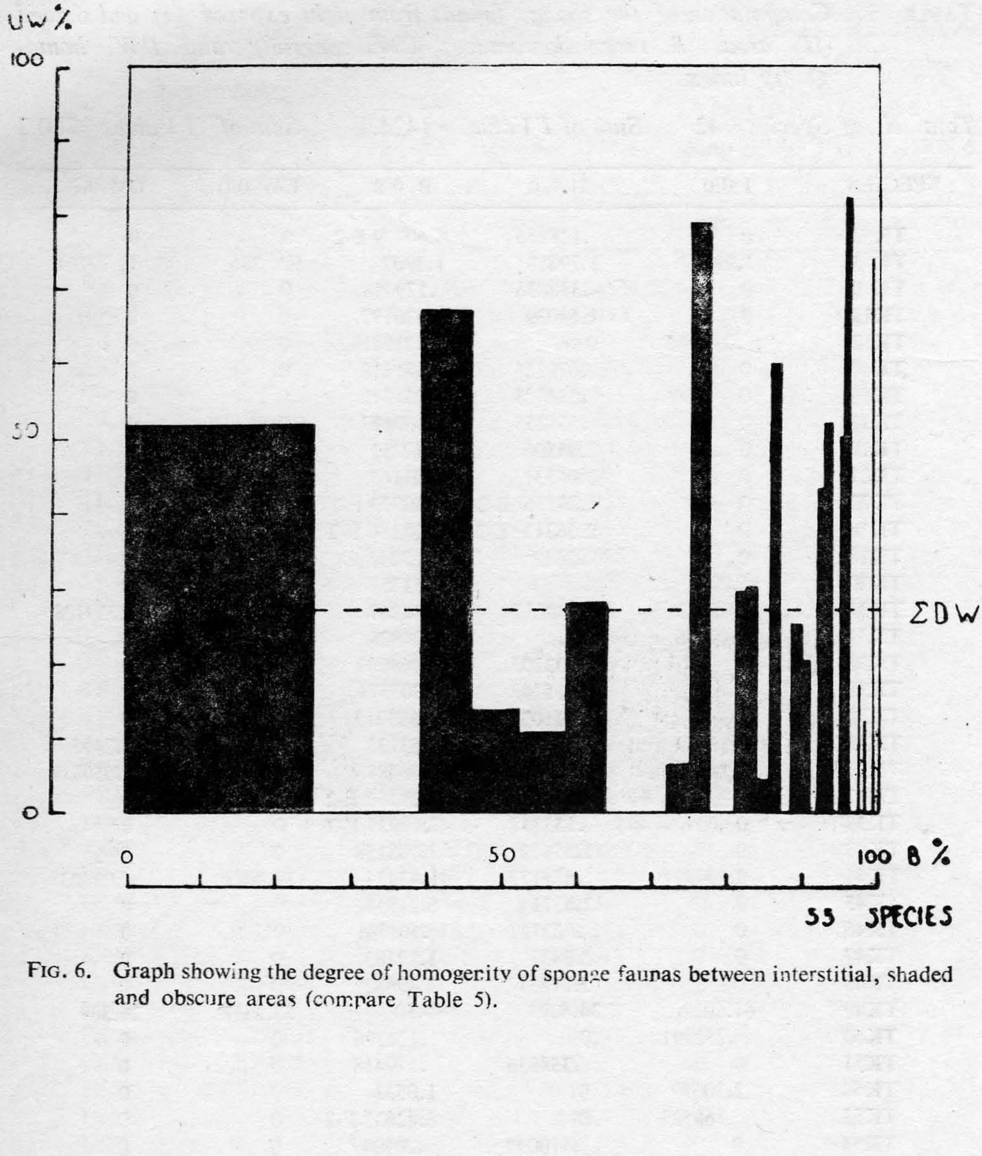

FIG. 6. Graph showing the degree of homogenity of sponge faunas between interstitial, shaded and obscure areas (compare Table 5).

TABLE 1. *Computation of the sponge faunas from light exposed (I) and shaded (II) areas. B, mean dominance; UW, congruity value DW, homogenity index.*

Total N. of Species=42 *Sum of I Values*=1424.1 *Sum of II Values*=780.3

SPECIES	I 0/0	II.0/0	B 0/0	UW 0/0	DW 0/0
TK 2	0	.128156	6.40779 E-2	0	0
TK 3	1.98722	1.79418	1.8907	90. 286	1. 70704
TK 4	0	.358836	.179418	0	0
TK11	0	1.64039	.820197	0	0
TK12	.014044	0	7.02198E-3	0	0
TK13	0	.679226	.339613	0	0
TK16	0	.512623	.256312	0	0
TK17	0	.538255	.269127	0	0
TK19	0	2.84506	1.42253	0	0
TK21	0	2.06331	1.03165	0	0
TK22	0	1.28156 E-2	6.40779 E-3	0	0
TK26	0	2.56312 E-2	1.28156 E-2	0	0
TK28	0	11.2649	5.63245	0	0
TK29	15.027	0	7.51352	0	0
TK30	5.05582	.589517	2.82267	11.6602	.329128
TK31	.49856	0	.24928	0	0
TK32	0	.333205	.166603	0	0
TK33	0	.615148	.307574	0	0
TK34	0	1.66603	.833013	0	0
TK35	3.38459	3.67807	3.53133	92.0209	3.24956
TK36	2.24703	.922722	1.58488	41.064	.650814
TK37	0	2.56312 E-2	1.28156 E-2	0	0
TK38	0	.153787	7.68935 E-2	0	0
TK43	0	1.57632	.788158	0	0
TK44	2.39449	.474177	1.43434	19.8028	.284038
TK45	0	12.4311	6.21556	0	0
TK46	0	.922722	.461361	0	0
TK47	0	2.3837	1.19185	0	0
TK48	0	5.79264	2.89632	0	0
TK49	64.6022	34.4098	49.506	53.2642	26.369
TK50	.252791	0	.126396	0	0
TK51	0	.358836	.179418	0	0
TK52	2.10659	0	1.0533	0	0
TK53	.168527	0	8.42637 E-2	0	0
TK54	0	.410099	.205049	0	0
TK55	0	.615148	.307574	0	0
TK56	0	1.67884	.839421	0	0
TK57	0	1.02525	.512623	0	0
TK58	0	5.42099	2.7105	0	0
TK59	0	.820197	.410099	0	0
TK60	2.26108	0	1.13054	0	0
TK61	0	1.83263	.916314	0	0

SUM OF DW 0/0 VALUES=32.5896

TABLE 2. *Computation of the sponge faunas from light exposed (I) and obscure (II) areas. B, mean dominance; UW, congruity value, DW, homogenity index.*

Total No. of Species=36 *Sum of* I *Values*=1424.1 *Sum of II Values*=408.6

SPECIES	I 0/0	II 0/0	B 0/0	UW 0/0	DW 0/0
TK 1	0	.122369	6.11845 E-2	0	0
TK 2	0	.122369	6.11845 E-2	0	0
TK 3	1.98722	0	.99361	0	0
TK 4	0	.342633	.171317	0	0
TK 6	0	1.66422	.83211	0	0
TK12	.014044	0	7.02198 E-3	0	0
TK16	0	6.19187	3.09594	0	0
TK18	0	.31816	.15908	0	0
TK21	0	.489476	.244738	0	0
TK24	0	.269212	.134606	0	0
TK28	0	1.51738	.758688	0	0
TK29	15.027	0	7.51352	0	0
TK30	5.05582	0	2.52791	0	0
TK31	.49856	0	.24928	0	0
TK32	0	4.2095	2.10475	0	0
TK33	0	2.1537	1.07685	0	0
TK34	3.38459	3.94028	3.66244	85.8972	3.14593
TK35	2.24703	0	1.12352	0	0
TK36	0	6.28977	3.14489	0	0
TK38	0	2.44738 E-2	1.22369 E-2	0	0
TK39	0	.587372	.293686	0	0
TK40	0	4.89476 E-2	2.44738 E-2	0	0
TK41	0	1.00343	.501713	0	0
TK42	2.39449	0	1.19725	0	0
TK44	0	1.46843	.734214	0	0
TK46	0	.685267	.342633	0	0
TK48	0	21.2922	10.6461	0	0
TK49	64.6022	27.2394	45.9208	42. 1647	19.3624
TK50	.252791	0	.126396	0	0
TK52	2.10659	0	1.0533	0	0
TK53	.168527	0	8.42637 E-2	0	0
TK5[illegible]	0	.293686	.146843	0	0
TK56	0	3.45081	1.72[illegible]4	0	0
TK58	0	13.9256	6.9628	0	0
TK60	2.26108	0	1.13054	0	0
TK61	0	2.34949	1.17474	0	0

SUM OF DW 0/0 VALUES=22.5083.

TABLE 3. *Computation of the sponge faunas from shaded (I) and obscure (II) areas. B. mean dominance; UW. congruity value. DW, homogenity index.*

Total No. of Species=43 *Sum of I Values*=780.3 *Sum of II Values*=408.6

SPECIES	I 0/0	II 0/0	B 0/0	UW 0/0	DW 0/0
TK 1	0	.122369	6.11845 E-2	0	0
TK 2	.128156	.122369	.125262	95.4846	.119606
TK 3	1.79418	0	.897091	0	0
TK 4	.358836	.342633	.350735	95.4846	.334898
TK 6	0	1.66422	.83211	0	0
TK11	1.64039	0	.820197	0	0
TK13	.679226	0	.339613	0	0
TK16	.512623	6.19187	3.35225	8.27897	2.277532
TK17	.538255	0	.269127	0	0
TK18	0	. 31816	.15908	0	0
TK19	2.84506	0	1.42253	0	0
TK21	2.06331	.489476	1.27639	23.7229	.302797
TK22	1.28156E-2	0	6.40779 E-3	0	0
TK24	0	.269212	.134606	0	0
TK26	2.56312E-2	0	1.28156 E-2	0	0
TK28	11.2649	1.51738	6.39114	13.47	.860883
TK30	.589517	0	.294758	0	0
TK32	.333205	0	.166603	0	0
TK33	.615148	4.2095	2.41232	14.6133	.352521
TK34	1.66603	2.1537	1.90986	77.3566	1.4774
TK35	3.67807	3.94028	3.80918	93.3454	3.55569
TK36	.922722	0	.461361	0	0
TK37	2.56312E-2	0	1.28156E-2	0	0
TK38	.153787	6.28977	3.22178	2.44503	7. 87736 E-2
TK39	0	2.44738 E-2	1.22369-E2	0	0
TK40	0	.587372	.293686	0	0
TK41	0	4.89476 E-2	2.44738E-2	0	0
TK42	0	1.00343	.501713	0	0
TK43	1.57632	0	.788158	0	0
TK44	.474177	0	.237088	0	0
TK45	12.4311	0	6.21556	0	0
TK46	.922722	1.46843	1.19558	62.8374	.751268
TK47	2.3837	.685267	1.53448	28.748	.441134
TK48	5.79264	21.2922	13.5424	27.2055	3.68428
TK49	34.4098	27.2394	30.8246	79.1615	24.4012
TK51	.358836	0	.179418	0	0
TK54	.410099	0	.205049	0	0
TK55	.615148	.293686	.454417	47.7423	.216949
TK56	1.67884	3.45081	2.56482	8.46507	1.2478
TK57	1.02525	0	.512623	0	0
TK58	5.42099	13.9256	9.6733	38.9282	3.76564
TK59	.820197	0	.410099	0	0
TK61	1.83263	2.34949	2.09106	78.0013	1.63105

SUM OF DW 0/0 VALUES=43.4995

TABLE 4. *Computation of the sponge faunas from light exposed (I) and interstitial (II) areas. B, mean dominance; UW. congruity value; DW, homogenity index.*

Total No. of Species=47 *Sum of I Values* = 1424.1 *Sum of II Values*=390.5

SPECIES	I 0/0	II 0/0	B 0/0	UW 0/0	DW 0/0[1]
TK 1	0	.435339	.21767	0	0
TK 2	0	.614597	.307298	0	0
TK 3	1. 98722	11.5237	6.75545	17.2447	1.16495
TK 4	0	1.84379	.921895	0	0
TK 5	0	.768246	.384123	0	0
TK 6	0	.717029	.358515	0	0
TK 7	0	28.6812	14.3406	0	0
TK 8	0	1.02433	.512164	0	0
TK 9	0	3.17542	1.58771	0	0
TK10	0	.128041	6.40205 E-2	0	0
TK11	0	1.79257	.896287	0	0
TK12	.014044	.537772	.275908	2.61151	7.20536 E-3
TK13	0	1.84379	.921895	0	0
TK14	0	2.56082 E-2	1.28041 E-2	0	0
TK15	0	2.56082 E-2	1.28041 E-2	0	0
TK16	0	3.22663	1.61332	0	0
TK17	0	6.06914	3.03457	0	0
TK18	0	2.91933	1.45967	0	0
TK19	0	6.863	3.4315	0	0
TK20	0	5.12164 E-2	2.56082 E-2	0	0
TK21	0	.588988	.294494	0	0
TK22	0	.102433	5.12164 E-2	0	0
TK23	0	2.56082 E-2	1.28041 E-2	0	0
TK24	0	7.68246 E-2	3.84123 E-2	0	0
TK25	0	2.56082 E-2	1.28041 E-2	0	0
TK26	0	.153649	7.68246 E-2	0	0
TK27	0	.28169	.140845	0	0
TK28	0	5.45455	2.72727	0	0
TK29	15. 027	0	7.51352	0	0
TK30	5. 05582	0	2.52791	0	0
TK31	. 49856	0	. 24928	0	0
TK32	0	.102433	5.12164 E-2	0	0
TK35	3. 38459	0	1.6923	0	0
TK36	2. 24703	0	1.12352	0	0
TK38	0	.691421	.345711	0	0
TK41	0	2.56082 E-2	1.28041 E-2	0	0
TK43	0	.537772	.268886	0	0
TK44	2. 39449	0	1.19725	0	0
TK46	0	.588988	.294494	0	0
TK48	0	1.53649	.768246	0	0
TK49	64. 6022	16.8246	40.7134	26.0434	10.6031
TK50	.252791	0	.126396	0	0
TK51	0	2.56082 E-2	1.28041 E-2	0	0
TK52	2. 10659	0	1.0533	0	0
TK53	.168527	0	8.42637 E-2	0	0
TK56	0	.691421	.345711	0	0
TK60	2. 26108	0	1.13054	0	0

SUM OF DW/0/0 VALUES = 11.7753

TABLE 5. *Computation of the sponge faunas from interstitial (I) and shaded and obscure (II) areas. B, mean dominance; UW, congruity value; DW homogenity index.*

Total No. of Species=55 *Sum of I Values*=390.5 *Sum of II Values*=580.6

SPECIES	I 0/0	II 0/0	B 0/0	UW 0/0	DW 0/0
TK 1	.435339	5,16707 E-2	.243505	11.8691	2.89018 E-2
TK 2	.614597	.103341	.358969	16.8145	6.03589 E-2
TK 3	11.5237	1.20565	6.36467	10.4624	.665894
TK 4	1.84379	.361695	1.10274	19.6169	.216324
TK 5	.768246	0	.384123	0	0
TK 6	.717029	.585601	.651315	81.6704	.531932
TK 7	28.6812	0	14.3406	0	0
TK 8	1.02433	0	.512164	0	0
TK 9	3.17542	0	1.58771	0	0
TK10	.128041	0	6.40205 E-2	0	0
TK11	1.79257	1.06786	1.43022	59.5714	.852
TK12	.537772	0	.268886	0	0
TK13	1.84379	.465036	1.15441	25.2218	.291163
TK14	2.56082 E-2	0	1.28041 E-2	0	0
TK15	2. 56082 E-2	0	1.28041 E-2	0	0
TK16	3.22663	2.53186	2.87925	78.4677	2.25928
TK17	6.06914	.361695	3.21542	5.95957	.191625
TK18	2.91933	.120565	1.51995	4.12988	6.27721 E-2
TK19	6.863	1.91182	4.38741	27.8569	1.22219
TK20	5.12164 E-2	0	2.56082 E-2	0	0
TK21	.588988	1.37789	.983437	42.7458	.420378
TK22	.102433	1.72236 E-2	5.98282E-2	16.8145	1.00598 E-2
TK23	2.56082 E-2	0	1.28041E-2	0	0
TK24	7.68246 E-2	.103341	.090083	74.3406	6. 69682 E-2
TK25	2.56082 E-2	0	1.28041E-2	0	0
TK26	.153649	1.72236 E-2	8.54364E-2	11.2097	9.57713 E-3
TK27	.28169	0	.140845	0	0
TK28	5.45455	8.1123	6.78342	67.238	5.56104
TK30	0	.396142	.198071	0	0
TK32	.102433	.223906	.16317	45.7481	7.46469 E-2
TK33	0	.413365	.206683	0	0
TK34	0	1.11953	.559766	0	0
TK35	0	3.85808	1.92904	0	0
TK36	0	.620048	.310024	0	0
TK37	0	1.72236 E-2	8.61178E-3	0	0
TK38	.691421	2.32518	1.5083	29.7362	.448512
TK39	0	1.72236 E-2	8.61178E-3	0	0
TK40	0	.206683	.103341	0	0
TK41	2.56082 E-2	1.72236 E-2	2.14159E-2	67.258	1.44039 E-2
TK42	0	.361695	.180847	0	0
TK43	.537772	1.06786	.802816	50.3598	.404296
TK44	0	.327248	.163624	0	0

TABLE 5 (*Contd.*)

TK45	0	8.35343	4.17671	0	0
TK46	.588988	1.13676	.862872	51.8131	.447081
TK47	0	1.84292	.921461	0	0
TK48	1.53649	11.3848	6.46063	13.496	.871928
TK49	16.8246	32.7075	24.7661	51.4395	12.7395
TK51	2.56082 E-2	.24113	.133369	10.6201	1.41639 E-2
TK54	0	.275577	.137789	0	0
TK55	0	.516707	.258353	0	0
TK56	.691421	2.3424	1.51691	29.5176	.447756
TK57	0	.688942	.344471	0	0
TK58	0	8.54289	4.27144	0	0
TK59	0	.551154	.275577	0	0
TK61	0	2.0496	1.0248	0	0

SUM OF DW 0/0 VALUES=26.9128

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DISCUSSION

PICHON: Did you find species of sponges such as those of genera *Pharetronides* and *Astrosclero* in the darkest parts?

RÜTZLER: Not there, I think.