JÁN SENEŠ*

RECENT FACIES OF GUANABO SHELF (CUBA)[1]

(Textfigs. 1—10)

Abstract: Investigations of recent coral environment facies were carried through with respect to their application in geology. The investigation method consisted of qualitative und quantitative estimations of fossilizable organisms, first of all of the molluses. Thus the common base for comparison of the recent with the fossil was found. The object of investigations was lagoonal and reef belt near Rincon de Guanabo in the shelf area of the Florida strait. In the profile from the coast to the shelf margin the characteristic assemblages were determined, viz. in the lagoon the assemblage *Turbo castaneus — Codakia orbiculata*, inner lagoonal subassemblage with *Chione cancellata*, outer lagoonal subassemblage with *Lucina pennsylvanica*, thalassic subassemblage with *Batillaria minima*; reef assemblage with *Arca zebra — Cyphoma gibbosum* and in the outer shelf — the assemblage with *Glycymeris undata*.

Preface

by Dr. Dario Guitart Manday, the director of the Oceanologic Institute of the Cuban Academy of Sciences in Havana.

The great importance that for Cuba have the researches being made in its platform, have taken our Academy of Sciences into patronizing several expeditions of both, national and international character, headed to that aim.

As a result of this patronage, during the Summer of 1965, a mutual work between Cuba and Czechoslovakia was developed in the „Rincon de Guanabo", situated approximately 20 Km to the East of Havana. The actuopaleontological, ichtiological, litological and submarine profiles investigationes, already performed have greatly contributed to raising the knowledges on those subjects in our country. This fact, in addition to the logical development of our groups, has made us increase even more those researches, organizing new expeditions which complete the studies already made.

The science is nourished continuously of new methods and proceedings that try to solve the obscure points that still remain, due to the application of classical methods. The modern notion of paleontology, looked upon through the light of recent data, is another step ahead in the conquest of knowledge. Its use in Cuba will give us, undoubtedly, new conceptions about the complex geological problems that developed in our platform.

The task fulfilled by Dr. J. Seneš and his Czechoslovakian and Cubans colaboratiors has been remarkable. Working on condition not at all ideals, they overcomed all the difficulties and obtained a rich collection of data that will certainly throw a new light over the problems established by the proper Expedition.

Introduction

The investigations represent a part of the task of the Geological Institute of the Slovak Academy of Sciences, „Study of the relation of facies to environment on the

* Doc. Dr. J. Seneš CSc., Geological Institute of the Slovak Academy of Sciences, Bratislava, Obrancov mieru 41.

[1] The investigations were carried through in 1965 by the „Cuban-Szechoslovak Expedition for Submarine Research", organized by the Oceanologic Institute of the Cuban Academy of Sciences and by the Group for the Underwater Research at the Zoological Society of the Slovak Academy of Sciences.

ground of biofacial analyses", that is to follow the knowledge of fossil facies, their reconstruction by means of biofacial research of recent biotopes. After investigations in intracontinental brackish European seas (J. Seneš 1964) and after starting of such investigations on our part in the Mediterranean area (J. Seneš 1966), in the shelf area of Rincon de Guanabo the typical biotopes in tropical coral environment have been determined. The biotopes have been characterized first of all by such benthonic species components that have been theoretically fossilizable. This method is a guarrantee of their application in the reconstruction of fossil marine facies.

As the object of the research the shelf belt on the Cuban side of the Florida strait near Rincon de Guanabo has been chosen. In the straightforward profile of 355° direction between the coast (the supralittoral) and the shelf margin 20 submarine observation stations were established on the distance of 1500 m. Sampling and measurements necessary were done by means of aqualungs directly on the sea floor. Samples and dates from the station Nr. 1490 were gained by the equipments of the researching ship Xiphias. Sampling of the fossilizable benthonic species was done in each station on the surface of 1 m^2; from the soft floor from the average depth of 0.5 m. The estimation concerned also the percent ratio of the living exemplars of benthonic species to the extinct representatives of the same species. Chemical analyses necessary were carried through by the labs of the Oceanologic Institute of the Cuban Academy of Sciences in Havana, while the working-up of the material and estimation of the results were done in the Geological Institute of the Slovak Academy of Sciences in Bratislava.

Morphology and Structure of Studied Area

In the Rincon de Guanabo area the whole shelf is formed essentially by fossil and subfossil coral reefs. This rock with well-preserved organic remains forms also the proper coast where it occurs in the form of several abrasive terraces. In the area of researches lies the shelf margin in the 1500 m distance from the presentday coast, in the depth of 42 m. The enclosed sonar record proves that the shelf margin is terminated by steep slope to the sea floor, that in the 1.6 km distance from the coast lies in depth below 650 m. The steep shelf margin is evidently of tectonic origin and represents the continuation of the fault system Sierra de Jatibonico, or the border of the tectonic unit Habana—Matanzas in the North. At the rise of such a steep shelf margin must have been evidently active also the increasing prediluvial marginal reefs leaning in the North on older Cuban rocks in the tectonic unit Habana—Matanzas as a consequence of intense subsidence of the territory at the end of the Pliocene and at the beginning of the Pleistocene. After the extinction of coral barriers in the Antill area in the Pleistocene (N. D. Newell 1955, C. M. Yonge 1963), in the consequence of later differenciated movements the extinct barrier was several times uplifted, overflown by new transgressions and abraded. In the present the old barrier has been overflown up to 1.5 km in the area of researches. In addition there is a distinct forming of a new coral reef in 800 m distance from the coast as well as sedimentation of predominantly organogenous foraminiferal sand in a lagoon formed between the coast and the recent reef, and in some places of the outer shelf. Now it seems that from the tectonic standpoint the shelf shows immobility, stagnation, manifested by gradual filling of the lagoon with sediments resedimented in consequence of the increase and destruction of the recent barrier, in direction from the reef to the coast (fig. 1).

In the profile line, the supralittoral is formed by mild slope of beach sands covering

the fossil coral limestones. They outcrop in the West, in the turn of the bay in the direction to Matanzas and form a steep terrace coast. In the continuation of the profile line there is still 300 m wide lake overgrown with mangroves, in direction to the continent. Now it is a dessicating superhaline environment proving the greater extension of the lagoon in the past. The original coast of the lagoon was behind the mangrove environment on the foothill of the fossil coral terraces. The presentday dessication of

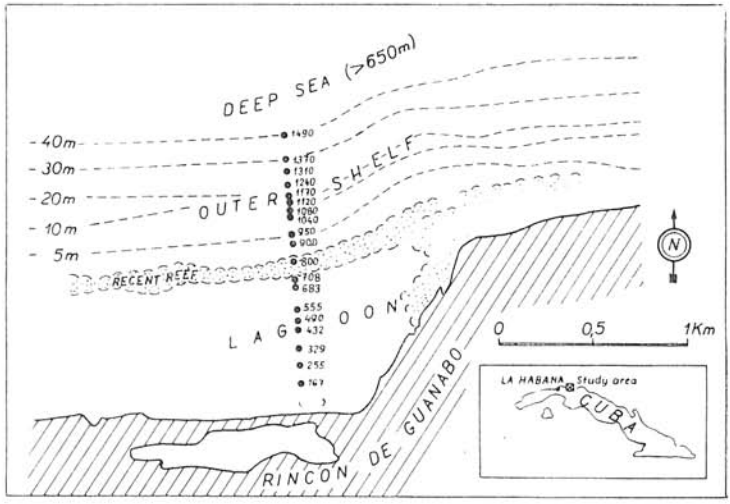


Fig. 1. Situations in separate observation stations placed in the Guanabo shelf.

the mangrove environment has been partially caused artificially. (The existence of the superhaline environment behind the coastal line of the lagoon offers a theme for a discussion about the regressive tendency of the sea in this place. However, researches in the area of the rocky supralittoral in the East of our profile have not proved any special emergency of this area.) Eulittoral with the average height of 0.60 m is an independent biologically provable zone in the West of our profile in the environment of limestone coast.

The whole shelf in the wide region of the Guanabo area belongs to the sublittoral. The neritic zone is practically indeterminable, since it falls already into the region of the steep continental slope. The shelf area may be divided with respect to the morphology of the original solid floor (fossil destructed reef zone) into: a) depression covering the coastal area practically from the lowermost coastal abrasion terrace up to the average distance 800 m from the coast. There is running the ridge of the fossil reef zone upon which the presentday Holocene coral reef has been formed; b) the ridge of the fossil reef; c) the fore-reef slope extending to 1100 m from the coastal line, forming undoubtedly a higher subfossil terrace, lying now in average 6—10 m below the sea-level; d) terrace scarp falling into the depth about 20 m; e) the lower, most likely subfossil terrace terminated in 1500 m distance from the coast, in the depth 42 m, passing by relatively sharp fault into continental slope.

The „a" zone represents the presentday lagoon, i. e. the i n n e r s h e l f, the „b" zone — the p r e s e n t d a y c o r a l r e e f. Zones „c" to „e" represent in our profile

the outer shelf. In the space of the inner shelf i. e. of the lagoon, the fossil underlier of coral limestones except some points (in the area of station Nr. 50 and between stations Nr. 555 and 683) is covered with 0.5 to 6 m thick sediments of foraminiferal-skeletal sand. In the reef zone the recent sedimentation in the form of the increase of hexacorals may be observed, while in its inner side there is a contemporary process of covering the recent corals with sand. In the area of outer shelf the old reef is covered with foraminiferal-skeletal sands of thickness over 0.5 m, only on the lower terrace between stations Nr. 1170 and Nr. 1370. The shelf margin shows again the absence of recent sediments. In the space of the higher terrace and its bottom wall there is again just mild sedimentation of organogenous type in the form of products of some corals and calcareous algae.

Chemical and Physical Properties of Environment

Since the shelf morphology in the area of the profile shows rather shallow character with the maximum depth of 42 m and the area is not influenced by any larger affluents of fresh water, and since the lagoon itself is not isolated but connected with the open sea, chemical properties of the environment are almost unaltering. Salinity, pH and 0_2 volume show just small fluctuations. Opposite to that there are remarkable differences in physical properties in various points of the studied profile manifested and changes in the lithological composition of the sea floor. Therefore the biologic characteristics of the sea floor in the given environment is affected first of all by three factors: lithological nature of the sea floor, water movements and depth of environment.

Salinity. The average salinity of environment is 35,5 ‰, measured near the floor in May 1965. The maximum salinity was measured at the station Nr. 255, viz. 36,09 ‰, the minimum salinity — at the station Nr. 1170 (the top margin of the lower shelf terrace), viz. 34,7 ‰. Expressive leap in the decrease of salinity roughly from 36 to 35 ‰ may be observed along the slope between two terraces of the outer shelf. In the lagoon the salinity is higher as well as on the top shelf terrace, while on the lower terrace there is lower salinity. Reasons for higher concentration in the lagoon are to be seen in the possibility of higher evaporation. The leap in the outer part of the shelf is in that part of the floor where depth is changed from 11 to 21 m. Change in salinity in this segment may be evoked either by temperature alteration (see lower) or by the fact that in depth below 15—20 m there is weak influence of turbulency caused by water undulation and by mixing of the surface layers of water. It is necessary to consider the fact that measurements were carried through in the Spring time, in the time of still strong northern wind, that could cause certain anomalies and inversions in chemism of the sea water of the shallow shelf, by bringing surface waters from the open sea (fig. 2).

Aeration. The 0_2 volume measured in samples from the separate stations shows in average rather high values, which corresponds with the littoral character of the environment. The average volume is that of 4,8 ml/l. The maximum volume, viz. 6,04 was found in the inner margin of the lagoon near the station Nr. 50, the minimum — at the stations 1310 and 1490, viz. 4,1 ml/l. General decrease of 0 content is on the outer shelf in the depth below 25 m. In the major part of the lagoon the average is 4,8 ml/l. High volume of 0_2 is shown by the fore-reef segment in depths from 1 to 11 m, viz. 6,6—5,8 ml/l, evidently in consequence of the surf and remarkable mixing of waters.

Values of pH are constant all over the profile, exceeding 8. Decrease to 7,6 may be observed just at the proper shelf margin in depth below 30 m.

Temperature. Water temperature near the bottom was measured in May at the average temperature of the surface water level of 26,8 °C. The average water temperature at the lagoon floor was that of 26,5 °C, in the forereef area near the upper terrace — 25,2 °C. Temperature in the lower shelf terrace was higher again, reaching 26,4 °C,

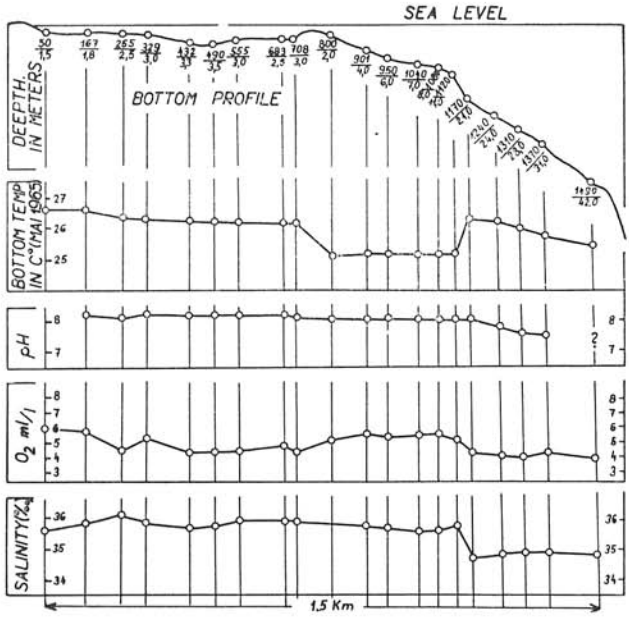


Fig. 2. Chemical and physical profiles of the Guanabo shelf measured near the floor.

while in the shelf margin, in the depth of 42 m it was 25,7 °C. Higher temperature in depths below 20 m may be explained by intactness of water levels there, while lower temperature of shallow waters on the upper terrace — by the flow of waters from the open sea in consequence of northern winds. The mean temperature of the lagoonal water levels is conditioned by the possibility of normal warming of the extensive and shallow environment which is only slightly touched by streams from the outer side of the reef.

Depth of the shelf in the profile area — as it may be seen — is conditioned by morphology of fossil and subfossil coral reefs. The depth is reduced only by sediments in the lagoon and in the outer shelf terrace. The average lagoon depth is 2,5 m, its maximum depth is 4,2 m; the recent reef runs to 0,5—0,8 m below the sea-level; the forereef slope, i. e. the upper subfossil shelfterrace gradually subsides to 2—11 m depth. The slope between the upper and the lower terraces falls into the depth of about 23 m on the distance about 60 m. The lower terrace terminated by the shelf margin, falls to 25—42 m depth (tab. 1).

Water streaming. The studied area does not fall directly to the sphere of the Gulf Stream (because of its closeness to the coast as well as the shore morphology).

Table 1. Depth, temperature and chemical dates of separate stations

Zone	Substrate	Station Nr.	Depth m	Temperature at floor °C	Salinity at floor ‰	O_2 p. d. ml/l	pH
LAGOON	Skelet. sand	50	1,5	26,8	35,68	6,04	8,0
	Skelet. sand	167	1,8	26,8	35,93	5,93	8,2
	Skelet. sand	255	2,5	26,6	36,09	4,70	8,1
	Skelet. sand	329	3,0	26,6	35,93	5,26	8,2
	Skelet. sand	432	3,3	26,4	35,85	4,59	8,2
	Skelet. sand	490	3,5	26,4	35,88	4,70	8,2
	Skelet. sand	555	3,0	26,4	35,90	4,60	8,2
	Skelet. sand	683	2,5	26,4	35,92	4,92	8,2
	Skelet. sand	708	3,0	26,4	35,93	4,48	8,1
REEF	Reef limestone	800	2,0	25,0	35,80	5,16	8,1
UPPER TERRACE	Reef limest.	900	4,0	25,1	35,80	5,26	8,1
	Reef limest.	950	6,0	25,2	35,62	5,56	8,1
	Reef limest.	1040	7,0	25,2	35,69	5,61	8,1
	Reef limest.	1080	8,0	25,2	35,61	5,79	8,1
	Reef limest.	1120	11,0	25,2	35,83	5,08	8,1
	Skelet. sand	1170	21,0	26,4	34,72	4,62	8,1
LOWER TERRACE	Skelet. sand	1240	24,0	26,3	34,86	4,36	7,9
	Skelet. sand	1310	28,0	26,0	34,93	4,17	7,7
	Skelet. sand	1370	31,0	25,8	34,93	4,43	7,6
	Reef limest.	1490	42,0	25,7	34,91	4,12	—

The Gulf Stream is felt only about 500 m in the North of the shelf margin in the continuation of the profile line. Nevertheless, the stream causes minor local and slight return currents and currents of cyclonal character, in the forereef zone. There is remarkable movement of the surface water levels in consequence of predominating northern wind directions. In the forereef zone it is manifested as undulation effects perceivable in average to 10 m depth, at stronger winds — to 18—21 m depth. To this corresponds also strength of the surf on the reef. In the time of stronger wind turbulency reaches always the floor.

Intensity of light measured by photoexposure in various depths gives only relative values for the seasons of the year (in dependance upon the given state of undulation, angle of sun rays and density of plankton). At the light intensity to the 5 m depth where the target number is 100, the lightness decreases to 80 in the depth of 12 m at sandy floor, while at the floor overgrown by gorgonias — lightness decreases to 60. In 20 m depth, at sandy floor, the target number is about 15—20, in the depth of 30 m it falls to minus 20 — minus 30 which, however, still corresponds with horizontal visibility at noon in the lenght of over 15 m of dim environment.

Character of sediments. In the profile there occurs a type of solidified

sediments in the form of the limestones of coral reef, and unsolidified sediments in the form of finegrained organogenous sand.

a) *Coral limestones* occur in the lagoon near the station Nr. 50 in the form of banks and form a compact rock. In the space between stations Nr. 555 and 683 they are overgrown by recent corals as well as between stations Nr. 708 and 800, where the presentday reef is being formed on them. The solid underlier is further denuded on the whole forereef, the so-called upper, terrace and on the next terrace wall between stations Nr. 800 and 1120. Recent organogenous limestone arises on this segment by growth of isolated coral tufts and by incrustation of calcareous algae. In the sinkholes of the floor on this segment also slight sedimentation may be observed of organogenous sand. In the vicinity of the station Nr. 1490 the solid floor is denuded again.

b) *Finegrained sandstone* consists in average of 60—70 % of calcareous skelets of organisms. Foraminifers represent about 20 %, the rest of 40—50 % are fragments of other organisms with calcareous and aragonitic skelets. Anorganic component consists of fine carbonatic grains. Generally, sand covers the lagoon floor (the space between stations Nr. 50 and 708) as well as the lower shelf terrace between stations Nr. 1170 and 1490.

Sedimentation and Transport

In the profile area and in the narrower Rincon de Guanabo bay, sedimentation of the terrigenous material is just the minimum. It is distinctive only farther in the west, in the vicinity of the Guanabo river estuary. From here, in the rainy weather, the terrigenous material just slightly reaches the lagoon area, and still lesser extent — the lower terrace of the shelf margin. Origin of the material is to be sought in the fossil and subfossil reef limestones as well as in Tertiary marls, and in limestones of the coastal area. Sand — except the component of primary organic nature (skelets and shells of recent forms) arises in the lagoon by desintegration of the fossil and recent reefs in the shelf region. The question is in the destruction by organisms (to remarkable extent also by coral fish — J. E. Bardach 1961) as well as in destruction in consequence of the surf. Most frequently, the material is transported in direction from the recent reef into the lagoon. In the proper recent reef and in its outer foreland, there is no sand sedimentation, in consequence of the undulation direction and of the surf activities. The lagoon area is gradually covered with sand, as well as the inner side of the recent reef, in many places. Sedimentation of sand on the lower shelf terrace, as far as it is not concerned with the primary organic component, originates most likely from the destruction of the recent reef, too, and is carried down by return currents of the surf in the channels of the upper terrace, up to the shelf margin. However, the channels are rather undistinctive in the area under study. No typical marks of submarine slides were observed there.

Sedimentation on the lower shelf terrace in the depth below 25 m was generally uninterrupted. Thus it offers an intact system of fossilizable benthonic species. Regularly, the rise of local thanatocenoses in this deeper area is a consequence of the activity of organisms (e. g. the floor grooved by certain species of rays *Rhinoptera* in depth below 25 m).

Sedimentation in the lagoon is destructed in the whole area by the undulation effects. Movements of sand along the lagoon floor as well as movements of all solid organic remnants forming just thanatocenoses in all places, is to remarkable degree retarded by the presence of dense thalassia fields *Thalassia testudinum*). Observations show

that transport of sediments evoked by the turbulence of the floor, as well as transport of larger organic remnants does not proceed along the whole lagoonal space. Thanatocenoses are in spite of the continuous resedimentation present roughly within the area of the original occurrences of organisms. It may be clearly seen on the analysis of benthonic species from the separate stations, or on the ratio of the living forms quantity to the quantity of extinct forms (tab. 2). Mass occurrences of the species *Antigona listeri* in the form of extinct valves are only there where there are living forms covered with sand, i. e. they are most abundant on stations 167, 255, 432, 490 and 683, while on the rest of stations where no living forms were found, there are just poor occurrences of extinct exemplars, too. The phenomeon is yet more expressive with the species *Tellina interrupta, Lucina pennsylvanica* or *Chione cancellata*. Such localizations of thanatocenoses offer the possibility to determine zonality of benthonic species associations even in the proper lagoon, in this case affected by mild turbulence — by means of observation of qualitative and quantitative occurrences of the respective living forms.

Character of Fossilizable Benthonic Species and Zonation

The above described chemical and physical properties of the profile environment predetermine its biological content, especially as far as benthonic species are concerned. Basing on the general character of assemblages, three distinct biotopes may be determined, the existence of which is predetermined first of all by the solidity of the substratum and by depth. Other agents being present just in the minimum in this profile environment, do not effect decisively the changes of benthonic biocenoses. Dependence upon the distance from the shore is important, too. Its influence is visible in the benthonic fauna of the lagoon. The agent, however, is not dependent upon the depth, yet rather upon possibilities of changes in salinity fluctuation in respective seasons of a year, upon the influence of the floor turbulency on the possibility of settlement of certain benthonic species, or upon certain biologic factors that are specific for coastal or outer parts of the lagoon (Similar phenomenon of the lagoonal foraminiferic fauna has been found in the Mississippi river delta — Upper and Lower Lagoon Fauna, F. B. Phleger 1964.) (Tab. 3.)

A. The Lagoon Area

Micro- and macrobenthonic faunas are particularly abundant here. The proper sediment is formed by 70 % of organic material. 20 % of sand originates in foraminiferal shells with predominance of *Discorbis mirus* Cush. and *Archais angulatus* (Ficht. et Moll.). From among further fossilizable representatives of benthonic species there are mas occurrences of the worms from the family Sabellidae (*Sabellaria vulgaris* Verill.?) in some parts of the lagoon. From among echinoides there are representatives of irregular forms (especially *Clypeaster subdepressus* Gayl, *Echinanthus rosaceus* (L.), *Mellita sexiesperforata* (Leske) and *Mellita testudinata* Klein]. In the outer segment of the lagoon there are some coral representatives from among which rather abundant occurrence shows *Manicina aureolata* (L.), *Porites* sp., too. The most numerous fossilizable benthonic species representatives are molluscs with predominance of pseudosessil lamellibranchiates, also with present gastropods, in the areas of thalassial and algal fields (*Thalassia testudinum, Udotea* sp., *Penicillus* sp., *Halimeda* sp.). From the standpoint of the possibilities of application in geology, the work in evaluation of

Table 2. Ratio of living molluscs to their representatives in thanatocenoses

Station Nr.	50	167	255	329	432	490	555	683	708	800
Arca zebra	3 (8) = = 11	= (9) = 5	—	—	—	—	—	—	(21) = = 21	4 (10) = = 14
Divaricella quadrisulcata	10 (25) = = 35	4 (5) = = 9	(5) = = 5	2 (5) = = 7	2 (6) = = 8	2 (4) = =6	—	—	—	—
Lucina pennsylvanica	—	(3) = = 3	1 (6) = = 7	2 (3) = = 5	(5) = = 5	(4) = =4	12 (26) = = 38	16 (30) = = 46	8 (20) = = 28	—
Codakia orbicularis	—	(3) = = 3	(2) = = 2	(3) = = 3	(3) = = 3	(12) = = 12	(8) = = 8	4 (11) = = 15	3 (7) = = 10	—
Codakia orbiculata	(2) = = 2	3 (15) = = 18	17 (21) = = 38	(9) = = 9	13 (30) = = 43	26 (18) = = 44	(15) = = 15	12 (20) = = 32	10 (25) = = 35	—
Chione cancellata	—	7 (13) = = 20	5 (20) = = 25	(3) = = 3	(1) = = 1	(4) = = 4	1 (4) = = 5	(2) = = 2	(1) = = 1	—
Tellina radiata	(1) = = 1	(16) = = 16	10 (21) = = 31	(3) = = 3	(5) = = 5	5 (8) = = 13	(6) = = 6	10 (18) = = 28	10 (21) = = 31	—
Tellina interrupta	—	(3) = = 16	4 (10) = = 14	3 (13) = = 16	(3) = = 3	(4) = = 4	(4) = = 4	3 (8) = = 11	(4) = = 4	—
Batillaria minima	(5) = = 5	(5) = = 5	(12) = = 12	26 (70) = = 96	(8) = = 8	(21) = = 21	14 (17) = = 31	(7) = = 7	—	—

Figures in brackets indicate number of extinct exemplars

Table 3. Distribution and abundance of Mollusca in Guanabo profil (m^2)

Station No.	S RL 50	S 167	S 255	S t 329	S a 432	S a 490	S t 555	S a 683	S ac 708	c RL 800	RL c 900	RL ac 950	RL ac 1040	ac RL 1080	RL ac 1120	S 1170	S 1240	S 1310	S 1370
Arca zebra	11x	5	—	—	—	—	—	3	21	14x	13x	2x	1	—	—	—	—	—	—
Anadara ovalis	—	2	1	1	8x	12x	3	4	6x	3x	1	—	1	—	—	—	—	—	—
Barbatia candida	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Barbatia cancellaria	—	—	—	—	—	—	—	6x	2	4x	2x	—	1	—	—	—	—	—	—
Glycymeris undata	—	—	—	—	—	—	1	2	—	—	—	—	—	—	3	28x	17x	12x	19x
Modiolus americanus	—	—	1	2	1	1	6x	—	—	—	—	—	—	—	—	—	—	—	—
Brachidates recurvus	1	—	—	—	—	—	—	—	—	4x	2	3	—	1	—	—	—	—	—
Pteria colymbus	—	—	—	—	—	—	—	—	—	1x	3x	2x	—	1x	—	—	—	—	—
Lima scabra tenera	2	—	—	—	—	—	—	—	2	2x	3x	1	4	3x	3	1	—	1	—
Lucina pennsylvanica	—	3	7x	5x	5	4	38x	46x	28x	—	—	—	—	—	—	—	—	—	—
Phacoides pectinatus	—	1	1	—	3	1	3	2	3	—	—	—	—	—	—	—	—	—	—
Codakia orbicularis	—	3	2	3	3	12	8	15x	10x	—	—	—	—	—	—	3x	1	—	—
Codakia orbiculata	2	18x	38x	9	43x	44x	15	32x	35x	—	—	—	—	—	—	11x	6x	7	3
Divaricella quadrisulcata	35x	9x	5	7x	8x	6x	—	—	—	—	—	—	—	—	—	—	—	—	—
Trachycardium muricatum	—	2	1	1	3	1	4x	2x	3	—	—	—	—	—	—	1	—	—	—
Trachycard. egmontianum	—	3	1	2	2	1	1	2x	2	—	—	—	—	—	—	—	—	—	—
Papyridea soleniformis	—	3	4x	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—
Trigonicardia media	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Laevicardium laevigatum	—	3	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Antigona listeri	5	14x	23x	10	13x	17x	3	12x	6	—	—	1	—	—	—	3x	1	—	—
Chione intapurpurea	—	4	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chione cancellata	—	20x	25x	3	1	4	5x	2	1	—	—	—	—	—	—	1	—	—	—
Tellina radiata	1	16	31x	3	5	13x	6	28x	31x	—	—	—	—	—	—	3x	12x	7x	4x
Tellina laevigata	—	—	—	1	1	—	3	—	5x	—	—	—	—	—	—	1	1x	—	—
Tellina interrupta	—	3	14x	16x	3	4	4	11x	4	—	—	—	—	—	—	—	—	—	—
Arcipagia fausta	—	2	6x	1	4	1	3	8x	1	—	—	—	—	—	—	1	—	—	—
Semele bellastriata	—	—	2	7x	1	2	4	4x	—	—	—	—	—	—	—	—	—	—	—
Abra lieica	—	—	—	3	—	2x	3	—	—	—	—	—	—	—	—	—	3	1	4
Heterodonax bimaculatus	—	—	—	4	1	—	11x	—	—	—	—	—	—	—	—	—	—	—	—
Poromya granulata	—	—	1	3	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—
Fissurella barbadensis	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	—	—
Acnaea pustulata	—	—	—	2	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—

Tegula fasciata	—	6x	3	1	3x	3	1	—	1	—	—	—	—	—	—	—	—	—	—
Turbo castaneus	16	32x	27x	6x	21x	17x	43x	4	9x	—	—	—	—	—	—	—	—	—	—
Neritina virginea	21x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Modulus modulus	—	—	—	—	3	1	1	8x	4x	—	—	—	—	—	—	—	—	—	—
Melanella gracilis	—	—	7	13x	—	2	16x	—	—	—	—	—	—	—	—	—	—	—	—
Batillaria minima	5	5	12	96x	8	21	31x	7	—	—	—	—	—	—	—	—	—	—	—
Cerithium eburneum	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
Cerithium variabile	—	2	7	6x	1	—	11x	3	4	4x	7x	—	2	—	—	—	—	—	—
Cerithiopsis greeni	—	1	—	4x	—	2x	3x	—	1	—	—	—	—	—	—	—	—	—	—
Strombus costatus	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	2x	2
Strombus raninus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1x	—	1
Strombus gigas	—	—	1	1	—	—	1x	—	—	—	—	—	—	—	—	—	—	—	—
Trivia suffusa	—	—	—	2x	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Neosimnia acicularis	—	—	—	—	—	—	—	—	—	1	—	2x	4x	1x	—	—	—	—	—
Cyphoma gibbosum	—	—	—	—	—	—	—	—	—	3x	5x	2x	4	2x	—	—	—	—	—
Polinices lacteus	—	1	—	4x	—	3	2x	1x	—	—	—	—	—	—	—	—	—	—	—
Morum oniscus	—	—	—	—	—	2	—	—	2	1	—	—	—	—	—	—	—	—	—
Natica livida	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—
Natica pusilla	—	—	3	5x	7x	1x	4	3x	1	—	—	—	1	—	—	—	—	2	—
Cassis madagascarensis	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Cymatium cynocephalum	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—
Cypraea cervus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2x	—	—
Phalium granulatum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Murex pomum	—	—	1	—	1x	2	—	—	—	—	—	—	—	—	—	—	—	—	—
Columbella mercatoria	—	—	1	—	—	—	2	—	1	—	—	—	—	—	—	—	—	1	—
Nitidella ocellata	2	—	—	4x	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—
Nitidella nitidula	—	—	2	11x	2	—	7x	1	—	—	—	—	—	—	—	—	—	—	—
Busycon spiratum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1x	1x
Nassarius vibex	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
Nassarius ambiguus	—	1	—	4x	2	—	2x	—	—	—	—	—	—	—	—	—	—	—	—
Olivella jaspidea	—	—	3	3x	1	1	7x	—	—	—	—	—	—	—	—	—	—	—	—
Conus verrucosus	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—
Monilispira albomaculata	—	1	—	9x	—	4	3x	—	—	—	—	—	—	—	—	—	—	—	—

S = sand; RL = reef limestone; t = Thalassium; a = algae; c = living coral; x = presence of living forms

benthonic species was in the separate stations aimed first of all to the study of Molluscs. The foraminiferal occurrences followed by O. J e n d r e j á k o v á will be estimated in a separate paper (fig. 3).

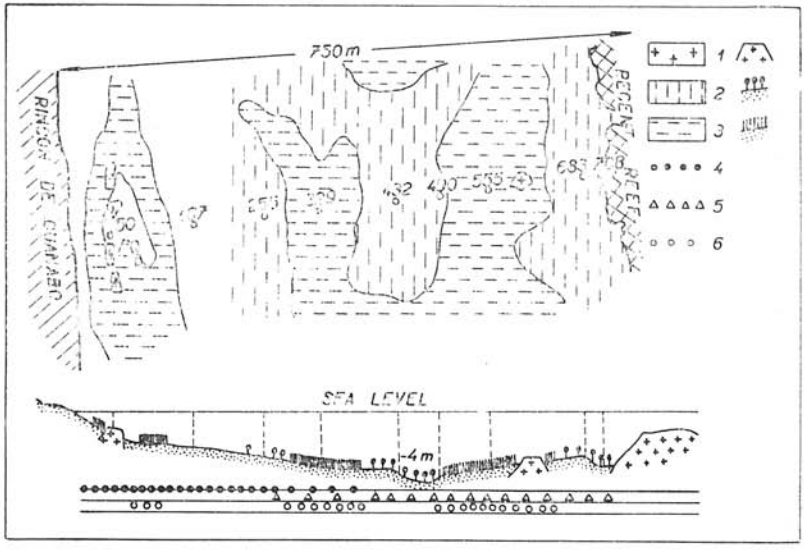


Fig. 3. Character and distribution of subassemblages of the fossilizable benthonic species in the lagoonal area of the Guanabo shelf Assemblage of *Codakia orbiculata — Turbo castaneus*. 1.Fossil reef (reef limestone); 2. Sandly floor, partly overgrown with algae (*Udotea, Penicillus, Halimeda* sp.); 3. Sandy floor with growth of *Thalassia testudinum;* 4. *Chione cancellata* subassemblage; 5. *Lucina pennsylvanica* subassemblage; 6. *Batillaria minima* subassemblage.

Station Nr. 50
Skeletal sand, isolated islands of fossil reef limestone, proximity of scarce thalassial growth.
Typical forms:
Divaricella quadrisulcata O r b.
Turbo castaneus G m e l.
Arca zebra S w a i n s
Neritina virginea L.

Station Nr. 167
Sand almost in permanent movement in consequence of turbulence.
Codakia orbiculata M o n t.
Divaricella quadrisulcata O r b.
Antigona listeri G r a y.
Tellina radiata L.
Tegula fasciata B o r n.
Turbo castaneus G m e l.

Station Nr. 255
Sand almost in permanent movement in consequence of turbulence. Rare algae *Udotea* sp. and *Penicillus* sp.
Lucina pennsylvanica L.
Codakia orbiculata M o n t.
Papyridea soleniformis B r u g.
Antigona listeri G r a y.
Chione cancellata L.
Tellina radiata L.
Turbo castaneus G m e l.
Batillaria minima G m e l.
Clypeaster sp.

Station Nr. 329
Sand to a great extent bound with very dense growth of *Thalassia testudinum*.
Lucina pennsylvanica L.
Turbo castaneus G m e l.

Codakia orbiculata Mont.
Divaricella quadrisulcata Mont.
Antigona listeri Gray.
Tellina interrupta Wood.
Semele bellastriata Conr.

Sabellaria sp.

Melanella gracilis Adams.
Batillaria minima Gmel.
Cerithium variabile Adams.
Ceranopsis greeni Adams.
Polinices lacteus Guild.
Natica pusilla Say.
Nitidella ocellata Gmel.
Nitidella nitidula Sow.
Nassarius ambiguus Pultn.
Monilispira albomaculata Adams.

Station Nr. 432

Sand partly bound, relatively dense algal growth of the species *Udotea* sp., *Penicillus* sp., *Halimeda* sp.

Anadara ovalis Brug.
Lucina pennsylvanica L.
Codakia orbiculata Mot.
Divaricella quadrisulcata Orb.
Antigona listeri Gray.
Tellina radiata L.
Turbo castaneus Gmel.
Natica pusilla Say.
Sabellaria sp.
Manicina areaolata L.

Station Nr. 490

Sand partly bound by dense algal growth, *Udotea* sp., *Penicillus* sp., *Halimeda* sp. The station is placed in the close nearness of Thalassial fields.

Anadara ovalis Brug.
Codakia orbiculata Mont.
Divaricella quadrisulcata Orb.
Antigona listeri Gray.
Tellina radiata L.
Turbo castaneus Gmel.
Batillaria minima Gmel.
Mellita sp.
Sabellaria sp.
Manicina areolata L.

Station Nr. 555

Sand to greater extent bound with very dense growth of *Thalassia testudinum*. In adjacent part there is an outcrop of coral limestone with recent hexacoral fauna.

Modiolus americanus Leach.
Lucina pennsylvanica L.
Codakia orbicularis L.
Codakia orbiculata Mont.
Trachycradium muricatum L.
Chione cancellata L.
Tellina radiata L.
Tellina interrupta Wood.
Heterodonax bimaculatus L.
Turbo castaneus Gmel.
Melanella gracilis Adams.
Batillaria minima Gmel.
Cerithium variabile Adams.
Nitidella nitidula Sow.
Olivella jaspidea Gmel.
Sabellaria sp.
Manicina areolata L.
Porites sp.

Station Nr. 683

Sand partly bound with denser algal growth, mainly *Penicillus* sp. and *Halimeda* sp. More rarely *Thalassium testudinum*. In the composition of Thanatocenoses the nearness of coral reef is noticeable.

Barbatia cancellaria Lamk.
Lucina pennsylvanica L.
Codakia orbicularis L.
Codakia orbiculata Mont.
Antigona listeri Gray.
Tellina radiata L.
Tellina interrupta Wood.
Acropagia fausta Pultn.
Semele bellastriata Conr.
Fissurella barbadensis Gmel.
Acmaea pustulata var.
Modulus modulus L.
Batillaria minima Gmel.
Sabellaria sp.
Manicina areolata L.

Station Nr. 708

Sand almost unbound, scarce algal growth and islands of thalassial fields. Close nearness of reef limestones and of recent coral reef. In Thanatocenosse the species of coral reef predominante.

Arca zebra Swains.
Anadara ovalis Brug.
Barbatia cancellaria Lamk.
Turbo castaneus Gmel.
Modulus modulus L.
Cerithium variabile Adams.

Lucina pennsylvanica L.
Codakia orbicularis L.
Codakia orbiculata Mont.
Tellina radiata L.
Tellina laevigata L.
Tellina interrupta Wood.
Manicuna arcolata L.
Porites sp.

B. Area of Recent Reef

From among fossilizable benthonic species there is noticeable quantitative predominance of hexacorals, first of all of *Acropora prolifera* (Lmk.), *Acropora palmata* (Lmk.), *Meandrina* sp., *Diploria* sp. and *Siderastrea* sp., *Montastrea annularis* (Ellis et Solander), *Agaricia agaricites* (L.) and *Millepora complanata* Lmk. To the second-rate existences of fossilizable organisms belong echinoides, represented by several regular forms, then vagile and sessile forms of molluscs. As to the plant component there is remarkable extension of *Lithotamnium* sp. incrustating the extinct coral growth, especially in the space of the outer reef slope (the upper terrace of the outer shelf).

Station Nr. 800
Fossil and subfossil reef limestone. Incrustation with *Lithotamnium* sp. Rare *Halimeda* sp. The station is placed on the outer margin of the recent reef. From among hexacorals there are not very dense amounts of *Agaricia agaricites, Montastrea annularis* and *Millepora complanata*, and from among octocorals — *Gorgonias*. No free sediments, turbulence strong.
Arca zebra Swains.
Anadara ovalis Brug.
Barbatia cancellaria Lamk.
Brachidontes recurvus Rafin.
Lima scabra tenera Sow.
Cerithium variabile Adams.
Cyphoma gibbosum L.

Station Nr. 900
Incrustated reef limestone with sporadic occurrence of hexa-and octocorals. Turbulence strong.
Arca zebra Swains.
Barbatia cancellaria Lamk.
Pterea colymbus Röd.
Lima scabra tenera Sow.
Cerithium variabile Adams.
Cyphoma gibbsum L.

Station Nr. 950 and Nr. 1040
Incrustated reef limestone with sporadic occurrence of hexa-and octocorals. Strong turbulence.
Arca zebra Swains.
Anadara ovalis Brug.
Brachidontes recurvus Rafin.
Pteria colymbus Röd.
Lima scabra tenera Sow.
Cerithium variabile Adams.
Neosimnia acicularis Lamk.
Cyphoma gibbsum L.

Station Nr. 1080 and Nr. 1120
Incrustated reef limestone with sporadic occurrence of hexacorals, especially of *Montastrea annularis* and *Siderastrea* sp. Numerous occurrence of octocorals in the form of various species of gorgonias. Relatively dense algal growth, especially *Halimeda* sp., Turbulence still noticeable.
Anadara ovalis Brug.
Pteria colymbus Röd.
Lima scabra tenera Sow.
Neosimnia acicularis Lamk.
Cyphoma gibbosum L.

C. Area of Outer Shelf

Stations Nr. 1170, 1240, 1310, 1370
Free sand, without turbulence effects. Scarce algal growth with predominating *Udotea* sp.

forming islands. Rarer occurrences of *Penicillus* sp. and *Lithotamnium* sp. The latter in places where from under the sand the solid substratum of fossil reef limestone emerges. There are only scarce hexacorals *Porites porites*, *Monastrea annularis* and *Millepora complanata*, rare gorgonias. Comparatively numerous representatives of echinoides. As to foraminifers, *Rotalia rosea* (Orb.) predominate.

Glycymeris undata L.
Codakia orbicularis L.
Codakia orbiculata Mont.
Antigona listeri Gray.
Tellina radiata L.
Abra lioica Dall.
Strombus costatus Gmel.
Natica pusilla Say.
Cyprea cervus L.
Busycon spiratum Lmk.

On the ground of what has been said above as to the evaluation of the mollusc fauna in the separate stations (detail enumeration of the species and of their quantity see on the plate enclosed), the following biofacial types (biotopes) might have been differenciated in the profile under study:

A. The Lagoon Biofacies

Organogenous sand with chemical and physical characteristics of the stations Nr. 167, 255, 329, 432, 490, 555 and 683.

Fossilizable assemblage: *Turbo castaneus — Codakia orbiculata.*

Leading species: *Codakia orbiculata*
Turbo castaneus

Characteristic species:

Lucina pennsylvanica
Antigona listeri
Tellina radiata
Tellina interrupta
Betillaria minima

Accompanying species:

Anadara ovalis
Phacoides pectinatus
Codakia orbicularis
Divaricella quadrisulcata
Trachycardium muricatum
Trachycardium egmontianum
Chione cancellata
Arcopagia fausta
Semele bellastriata
Tegula fasciata
Cerithium variabile
Natica pusilla

A_1. Inner Lagoon Biofacies

Organogenous sand with chemical and physical characteristics of the stations Nr. 167 and 255.

Fossilizable subassemblage: *Chione cancellata.*

Leading species: *Chione cancellata*

Characteristic species:

Divaricella quadrisulcata
Codakia orbiculata
Antigona listeri
Tellina radiata
Turbo castaneus
Batillaria minima

Accompanying species:

Anadara ovalis
Lucina pennsylvanica
Trachycardium muricatum
Trachycardium egmontianum
Argopagia fausta
Tegila fasciata
Cerithium variabile

A_2. Outer Lagoon Biofacies

Organogenous sand with chemical and physical characteristics of the stations Nr. 432, 490 and 683.

Fossilizable subassemblage: *Lucina pennsylvanica*
Leading species: *Lucina pennsylvanica*
Characteristic species:

Codakia orbicularis
Codakia orbiculata
Antigona listeri
Tellina radiata
Tellina interrupta
Arcopagia fausta
Turbo castaneus
Modulus modulus

Accompanying species:

Anadara ovalis
Thacoides pectinatus
Divaricella quadrisulcata
Trachycardium egmontianum
Chione cancellata
Semele bellastriata
Cerithium variabile
Natica pusilla

A_3. Thallasial and algal Biofacies

Organogenous sand with dense plant growth with chemical and physical characteristics of stations Nr. 329 and 555.
Fossilizable subassemblage: *Batillaria minima*
Leading species: *Batillaria minima*
Characteristic species:

Turbo castaneus
Melanella gracilis
Cerithium variabile
Nitidella nitidula
Monilispira albomaculata

Accompanying species:

Lucina pennsylvanica
Codakia orbiculata
Codakia orbicularis
Trachycardium muricatum
Antigona listeri
Chione cancellata
Tellina radiata
Tellina interrupta
Semele bellatistriata
Abrax lioica
Heterodonax bimaculatus
Cerithium greeni
Polinices lacteus
Natica pusilla
Nitidella ocellata
Olivella jaspidea

B. Reef Biofacies

Hard substratum formed by fossil incrustated coral limestone, with growth of recent hexa- and octocorals, with chemical and physical characteristics of the stations Nr. 800, 900, 1040, 1080, 1120.
Fossilizable assemblage: *Arca zebra — Cyphoma gibbosum.*
Leading species: *Arca zebra*
Cyphoma gibbosum
Characteristic species:

Anadara ovalis
Barbatia cancellaria
Pteria colymbus
Lima scabra tenera

Accompanying species:

Brachidontes recurvus
Cerithium variabile
Neosimnia acicularis

C. Outer Shelf Biofacies

Organogenous sand with chemical and physical characteristics of the stations Nr. 1170, 1240, 1310, 1370.
Fossilizable assemblage: *Glycymeris undata*
Leading species: *Glycymeris undata*

Characteristic species:

Codakia orbiculata
Tellina radiata
Abra lioica
Strombus costatus
Busycon spiratum

Accompanying species:

Lima scabra tenera
Codakia orbicularis
Antigona listeri
Tellina radiata
Strombus raninus
Cypraea cervus

At the estimation of distribution of other animal groups there is a quantitative difference in representation of some typical species with foraminifers in the separate assemblages. In the lagoon area *Discorbis mirus* and *Archaias angulatus*, while in the area of outer shelf of this profile rather *Rotalia rosea* are predominating. As for corals hexacoralia the lagoon area is unambiguously characterized by occurrences of solitary *Manicina areolata*, the area of recent reef in its inner side — by mass occurrence of *Acropora prolifera*, and on its summits — by *Acropora palmata*. For the whole structure of the recent reef the species *Millepora complanata*, *Meandrina* sp. and *Agaricia agaricites*, are characteristic. The latter however, together with *Motastrea annularis* and *Diploria* sp., and with *Siderastrea* sp. reach even greater depths in the foreland of the recent reef. Typical is the gorgonian assemblage, localized in our profile in depth from 8 to 16 m in the front of the coral reef, approximately on the slope between two fossil terraces of the outer shelf (fig. 4, 5, 6, 7).

Notes to Ecology of Some Mollusc Species

Mass populations and remarkable changes in sedimentation environment of the profile under study offer possibility to determine certain optimum for the quantitative occurrence of some mollusc species. Essentially the question is in the judgement of the connection between the number of occurrences and the settlement of *Thalassia* or algae on the floor, and its dependence upon the distance of the shore (population in the inner or outer part of the lagoon) and upon depth. No conclusions as to salinity, O_2 volume and pH could have been done because of relative constantness of these factors.

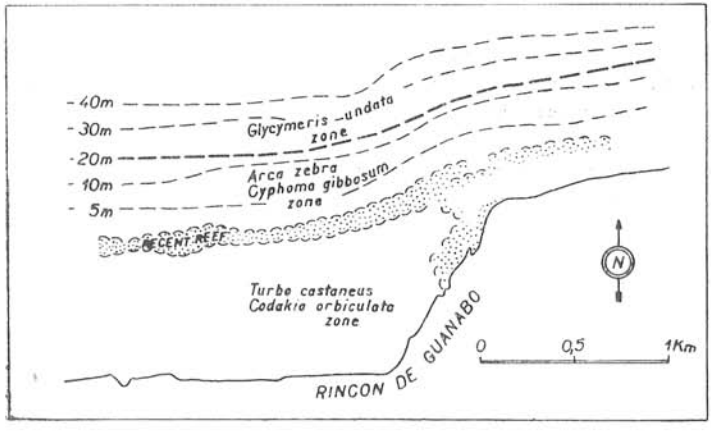


Fig. 4. Distribution of main benthonic bioassemblages zones of the Guanabo shelf.

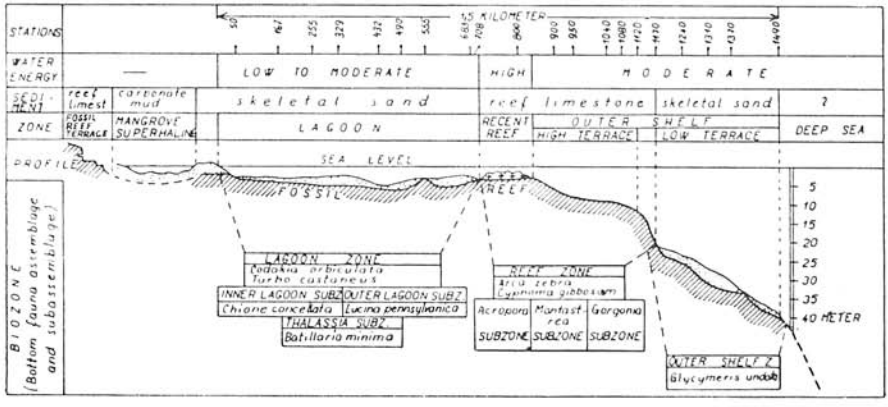


Fig. 5. General characteristics of the Guanabo shelf.

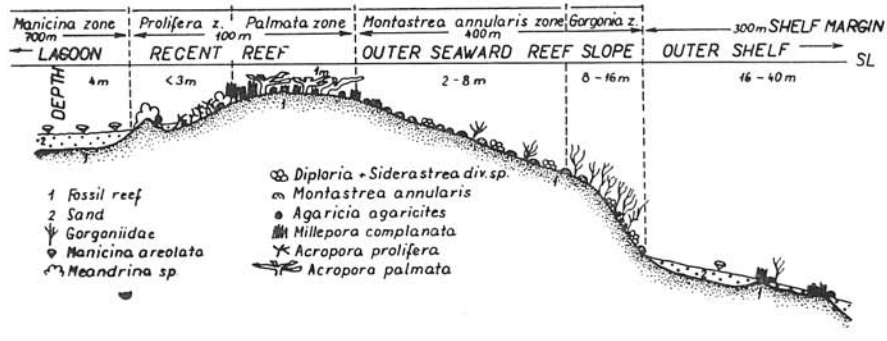


Fig. 6. Coral assemblages of the Guanabo shelf.

Glycymeris undata L.

Mass settlements in outer part of the lagoon, where it used to be covered with sand with sand, frequently in associations with *Tellina radiata*. In the area of Cayo largo in the Caribean Sea it was found also in more shallow parts of the lagoon; in coarser sand already in depth below 6 m, in finer sand usually only in depths below 10 m. It is evidently sensible to sediment turbulence (fig. 8).

Lucina pennsylvanica L.

Mass settlements in outer part of the lagoon, where it use to be covered with sand on the floor. No regular occurrences in greater depths than 10—15 m. Living forms near the shore are just rarely found (fig. 9).

Codakia orbicularis L.

In the area of the Guanabo and Cayo Largo profiles the mass settlements are found only on the outer part of the lagoon. It was found to occur in mass amounts in the wider area of La Mulata on the NW coast of Cuba in close nearness of the Cayo Paraiso Island. However, position of this island may be localized as an area belonging

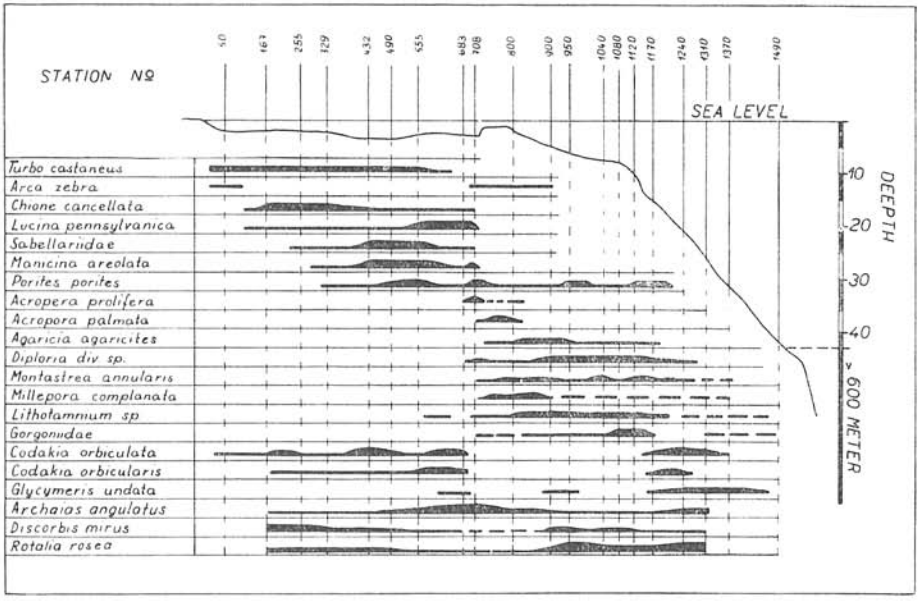


Fig. 7. Quantitative distribution of the main elements of fossilizable benthonic species on Guanabo shelf.

to the outer lagoonal space of the La Mulata reefs segment. Optimal depth of its distribution is that of about 5—10 m. It is rarely found below 20 m depths (fig. 9).

Codakia orbiculata M o n t.

Eurybath species living covered with sand, in large masses even in depth of 20—30 m. R. T. A b b o t (1963) presents its occurrence even from 110 m depth.

Divaricella quadrisulcata O r b.

Mass occurrences in the inner part of the lagoon. It is likely that it can bear also slight desalination of the lagoon. R. W. M i n e r (1950) quotes its occurrences in the Atlantic between 15 and 30 m. In the Guanabo area it is distributed just to depth of 5 m (fig. 9).

Antigona listeri G r a y.

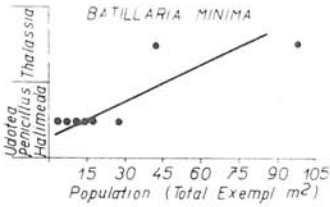
Mass occurrences to 10 m depth, below 20 m just scarcely found. Forms from the lagoon, from the shallower environment are characterized by more massive shells. It used to be covered with sand (fig. 10).

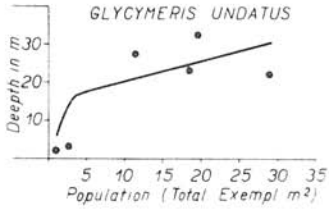
Chione cancellata L.

Mass occurrences were found in the inner shallower areas of the lagoons. Rare occurrences in depths below 20 m. Covered with sand.

Tellina radiata L.

A species typical for shallow sandy environment. Optimal occurrences in depths to 10 m, rare in depths below 30 or 40 m (fig. 10).





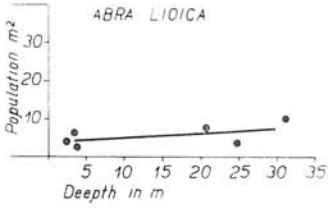
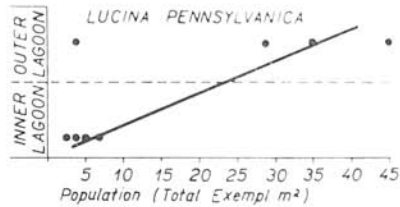
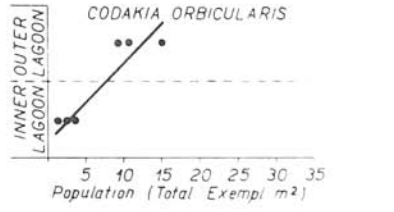


Fig. 8. Graph and Thalassial environments and dependence of the algal and Thalassial environments and dependence of the frequency of *Glycymeris undata* and *Abra lioica* upon the depth of environment.





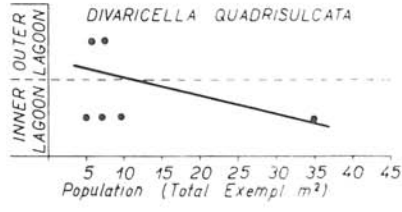


Fig. 9. Dependence of the number of *Lucina pennsylvanica, Codakia orbicularis* and *Divaricella quadrisulcata* upon their occurrences in the inner and outer areas of the lagoon.

Tellina interrupta W o o d.

Mass settlements in sands of shallow lagoons, rare in depths greater than 10 m.

Abra lioica D a l l.

Eurybath form of the shelf, with iclination to fine sandy to clayey environment. R. T. A b b o t (1963) presents the depth distribution of the species between 6 and 200 fathums. In the Guanabo area there were some exemplars found in finer sand already in depth of 3 m (fig. 8).

Turbo castaneus G m e l.

Living predominantly in shallow sandy floor overgrown with angiosperms of the genus *Thalassia*, with algae *Udotea, Penicillus* and *Halimeda* to the depth of 15 m. R. W. M i n e r (1950) gives the maximum depth distribution to 40 m. By its mass occurrences in the northern Cuban areas it is probably representing the biofacies with *Tegula fasciata* B o r n., which is more extensively distributed in the Caribean area (C. W. H o s k i n s 1964).

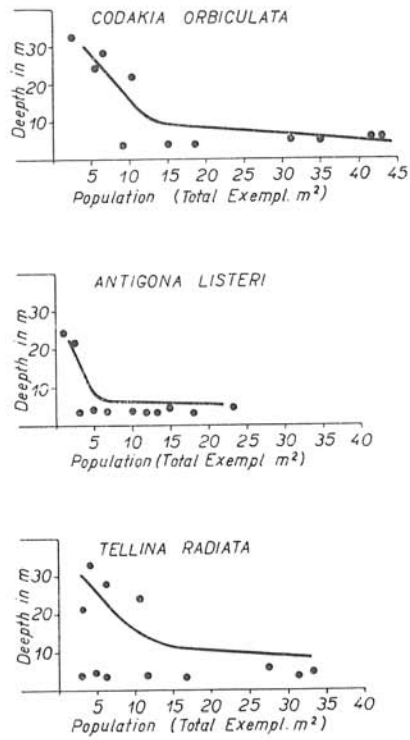


Fig. 10. Dependence of frequency of *Codakia orbiculata* and *Antigona listeri* occurrences as well as that of *Tellina radiata* upon the depth of environment.

Cerithium variabile A d a m s.

Occurs in the area of sandy and claystone floor, overgrown with Thalassias or algae. It forms the accompanying form of the mollusc association of coral reefs. Just scarce occurrences in depths below 15 m.

Batillaria minima G m e l.

Dense populations of this species are bound to Thalassial fields. In sandy or rocky environments overgrown with algae the populations are less numerous. It is a typical shallow-water species occurring also in eulittoral (fig. 8).

Importance of the Informations for Reconstruction of Fossil Facies

The above presented results of the research in Guanabo shelf are sufficient for their usage in reconstruction of some typical fossil facies. The research fulfilled the basic conditions for the geological aspects: characterization of the recent environment by fossilizable organisms (J. S e n e š 1964) and exclusion of unlocalizable Thanatocenose from the general evaluation.

1. With respect to bioprovincial belonging of the fauna, estimation of fossil sediments by method of d i r e c t c o m p a r i s o n is possible only in the narrower area of the Caribean region and of the Mexico Bay. It is necessary, however, to count with the differences of specific representation of littoral benthonic species in consequence of changes that took place in this area during the Pleistocene.

2. Wider possibilities are offered by the usage of the comparative method for the proper biotopes, viz. at the evaluation of sediments that originated in the geological past, essentially on the reef regions and in the tropic climate.

3. From the standpoint of their usage in the Mediterranean region, the ressults offer the comparative base for the estimation of resedimentation phenomena, for the morphological localization and for the study of relations between different partial environments of some reef facies in the Mesozoic and in the Eocene formations.

4. Application of the informations about the biotope of the lagoonal region and its relation to the barrier in the Mediterranean Miocene first of all in the relation to bryozoan, oyster and lithotamnian reefs, viz. in connection with occurrences of lucinids, venerids and herbivorous gastropods.

Translated by E. Jassingerová.

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Review by E. Köhler.