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FINAL SCIENTIFIC REPORT

RESEARCH ON BENTHIC FAUNA OF SOUTHERN ADRIATIC ITALIAN COAST

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MICHELE SARÀ

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ABSTRACT

A coralligenous bank populated by a very rich benthic fauna has been discovered along the Adriatic coast of Puglia (Italy), occupying an area estimated at 500 square km, and representing the most continuous and important structure of this kind ever recorded. It forms a belt about 1 mile wide within the isobaths of 10 m and 30 m (average) and reaches the thickness of 2.5 m above the surrounding sediment. The study of these coralligenous formations indicate that the maximum of light intensity suitable for their development is much higher than previously recorded; it also suggests that they do not originate from concretioning of loose material on a soft bottom, but have their base on hard bottom. The structure of the coralligenous conglomerate and of the main elements giving origin to it are described. The meaning of the term "coralligenous" is discussed in regard to its origin and its use by the authors. The elements constituting the coralligenous population are not exclusive of it, but may be found also in other biotopes: lists including 360 species are given and Porifera are discussed in particular detail. Quantitative data obtained through the analysis of the abundance of some species at different stations and depths are recorded.

INTRODUCTION

Our researches on the benthos of the Adriatic Sea have found a focal point of interest in the existence, along the coast of Puglia, of a belt of coralligenous formations having some peculiar characteristics. The present report, which follows a previous one covering the period April 1966-March 1967,deals with further and more conclusive results obtained in studying these formations, which represent for extension and complexity the most important hard-bottom communities of the South Adriatic Italian coast.

THE CORALLIGENOUS FORMATIONS - ORIGIN AND MEANING OF THE TERM "CORALLIGENE"

The existence of "rocky" conglomerates which are not quite "rock", near the coast, must have been known since the oldest time by the fishermen, in the Mediterranean area, because it is the nature of the bottom which determines the kind of fishing and of the fishing-gear to be employed. However, besides some vague mention of a zone of corallines and nullipores to be found in the works of the older conchologists, only in 1883 we find in the scientific literature a description of these structures. In this year Marion published an important work on the benthos of the Gulf of Marseille, in which he described the zone comprised between the Posidonia beds and the muddy bottoms - the "broundo" of the local fishermen - as "graviers coralligènes" and "graviers à Bryozoaires". This zone was characterized by the abundance of corals and bryozoa and by the presence of massive concretioned formations. It must be noted that Marion, while describing these formations so well as to leave no doubt about their nature, did not make a clear distinction between them and the surrounding gravel bottom. In fact, in the course of his paper, he uses the terms "graviers à coralliaires", "graviers coralligènes", "graviers à Bryozoaires", "fonds coralligènes" as equivalent; in particular, he states that "Dans les graviers à Bryozoaires, se trouvent compris les fonds rocheux coralligènes...". It may be observed that to associate hard and bulky conglomerates with "graviers" seems hardly appropriate, but to those who have a direct, visual experience of these bottoms, it seems apparent that Marion's dredge would collect in a single haul both gravel from the channels which separate the blocks and patches of rocky conglomerates, and massive fragments of the latter.

A few years later Pruvot (1894, 1895, 1897) adopts the term "fonds coralligènes" to describe the massive, concretioned formations found near Banyuls. In 1918 Issel writes about the same kind of bottom he finds on the coast east of Genoa, using the expressions "fondo a Coralline" and "fondi coralligeni",and describes concretioned formations exactly corresponding to those of Marion and Pruvot. Joubin (1928) deals with the Mediterranean "fonds coralligènes", describing again their characteristic concretioned massive formations, not in connection with a given area, but in a general work.

In 1951 Pérès and Picard introduce the concept of a coralligenous biocoenosis, applying it not only to the coralligenous bottoms as intended by the earlier authors, but also to two different kinds of biotope, lower littoral rock and submerged littoral caves, the three kinds of stations having in common a certain number of species (among which no calcareous algae are included). Marion's "fonds coralligènes" become the "coralligène de plateau", distinguished from the other two kinds of "coralligène" for being formed by gravel and fragments of calcareous algae which various organisms, including the latter, tend to cement together, and for being never in contact with the littoral rock, from which it is separated by littoral sand or grass beds.

In subsequent works Pérès (1961, 1967) and Pérès and Picard (1964) separate the "coralligène" of submerged caves as a distinct biocoenosis having an animal predominance as opposed to the coralligenous biocoenosis characterized by a vegetal predominance. The distinction between "coralligène de plateau" and "coralligène d'horizon inférieur de la roche littorale" is maintained; both types being bound to a hard substrate, the former is characterized by the fact that the hard bottom derives from the concretioning of an originally soft bottom.

The most important work on the coralligenous formations is due to Laubier (1966), who for the first time studies these formations in detail on the coast near Banyuls. An important result of his work is the essential notion of the originality of the concretioned structures. The term "coralligène" is employed in connection with these structures, and not, as in Pérès and Picard, to define a much wider biocoenosis.

Mention of coralligenous bottoms is to be found in the works of many other Mediterranean authors, but it would be beyond the limits of this paper to cite them all.

It has been affirmed by the modern authors that the word "coralligène" derives from the presence of <u>Corallium rubrum</u>. But Marion says: "Nous avons cru devoir adopter la désignation de graviers coralligènes... pour indiquer que dans ces fonds se multiplient principalment les Coraux...". There is no indication that Marion by "Coraux" intended the red coral; on the contrary, it is apparent that he employed the word coral in the common wider acception. In other words, "coralligène" has indeed its root in the Greek korallion, Latin corallium, names which originally indicated what was to receive the scientific name of *Corallium*, but the derivation is not direct: it has passed through the extension of meaning applied in connection with marine organisms producing a hard,calcareous deposit(madreporarians, hydrocorals, lime-fixing algae, bryozoa and even tube-secreting annelids). It appears that Marion, by "coraux" intended in particular madreporarians (*Cladocora cespitosa* and *Balanophyllia italica*) and calcareous algae.

It must be pointed out that *Corallium rubrum* definitely belongs to a different community, and may be found on coralligenous formations only occasionally, at a suitable depth, where it may use hard concretions as a substrate for fixation as it would use bare rock. We have never found it in our dredge, nor observed while diving.

In spite of the imprecision of Marion's definition, there is no doubt that the term "coralligène" must be applied to the conglomerates which are the object of this study. When these formations are sufficiently developed, we call them coralligenous bank, where the term "bank" is taken in its geomorphological acception of constructed relief and the term "coralligenous", in the sense of Marion and of Laubier, refers to a construction not exclusively but essentially deriving from the growth and accumulation, and from the concretioning and cementing activity of calcareous algae.

GENERAL MORPHOLOGY OF THE CORALLIGENOUS BOTTOMS ALONG THE ADRIATIC COAST OF PUGLIA

Our investigations have covered more intensely an area having its northern limit at Giovinazzo and its southern one at Polignano, that is 28 miles of coast. Two other stations have been added, at a certain distance from this area, Barletta which lies 29 miles north of Bari and Porto Tricase, 110 miles south, because of the presence of different morphological conditions of the coast.

Geologically the coast between Giovinazzo and Polignano is mainly constituted by Aptian and Cenomanian limestone (Cretaceous), with outcropping Pleistocene tufa, absent at Polignano. At Porto Tricase we find the same calcareous frame with important tufaceous outcrops. The Barletta bottom is alluvial, resulting from sandy-argillaceous deposits brought by the river Ofanto.

Between Giovinazzo and Polignano the sea bottom continues the profile of the land, with an inclination of about 1 %, the 10 meters isobath running at about 0.4 miles from the coast and the 30 meters one at about 1.4 miles. At Polignano the coast becomes steeper, with the 30 meters isobath at a distance of about 0.4 miles. At Barletta we find these two isobaths respectively at 1.5 and 5.5 miles from the coast. The coast at Porto Tricase is steep, with the 30 metres isobath to be reached 0.5 miles offshore.

The survey of the bottom has led to the following findings as to its general aspect:

- A belt of coralligenous formations runs more or less continuously along the coast between Giovinazzo and Polignano, that is it occupies the entire stretch which has been more thoroughly investigated. It is also present at Barletta and Porto Tricase. According to the informations we obtain from the fishermen,it may be assumed that there is no relevant discontinuity in this belt between Porto Tricase and Polignano and between Giovinazzo and Barletta.

- The coralligenous constructions generally begin at a depth of about 10 meters, sometimes even at 7 or 8 meters; at one station, Barletta, we found them in 4 meters of water. They do not seem to go beyond a depth of 35 meters, and often they are limited to the 20 meters isobath. Outside Bari we have found, beyond the muddy bottom which follows the coralligenous one, hard bottom again at 50 meters: the material brought by the dredge was so scarce that we are not in a position to say what kind of bottom we striked. Small fragments appear as representatives of a coralligenous concretioning, very hard and mineralized. It might be assumed that this is a rocky bottom with a thin coralligenous superficial layer.

- The coralligenous formations are not quite continuous: they appear as heads, blocks, patches or banks. More sparse at the lower depths, they tend toward a bank formation as depth increases and end rather abruptly at their limit toward the open sea. The solutions of continuity are often represented by more or less wide channels.Where it is not occupied by the coralligenous conglomerates, the bottom is flat and soft, made of organogenic gravel, or sand, or mud, or of these elements mixed in various degree; sometimes, at the lower depths, it is colonized by Posidonia or by Cymodocea. In general, the formations are separated from the coastal rock by flat sandy bottom, with or without the presence of grass beds, but this is not a constant rule.

- The height of the formations in relation to the surrounding sediment is variable; always scarce at the minor depths, it may reach 2.5 meters, as far as we have observed. As an average, to be found at 20 meters depth, we may indicate 1.5 meters.

- The formations have always a very irregular profile, even when they form a continuous bank, with large fissures, pits, caves, tunnels, pinnacles. Where they border on the sediment, their walls are always overhanging.

These findings must be compared whith what has been recorded by previous authors. We shall firstly observe that extension and bathymetric limits of coralligenous bottoms, as indicated in the literature, with the exception of the precise data of Laubier (1966), must be taken with reserve, as we cannot be sure, in most cases, whether they refer to coralligenous formations in a strict sense or to a biocoenosis as conceived by Pérès and Picard. However, the upper bathymetric limit is generally indicated as 30 meters, with a minimum of 18 meters recorded by Laubier. It is therefore very interesting to find that Puglia's formations begin at an average depth of 10 meters and may exist even at 4 meters, and that at a depth which is the lowest ever recorded - 18 meters - they already form quite massive constructions. The lower bathymetric limit, generally indicated as 60 meters in the Western Mediterranean and 120 meters in the Eastern Mediterranean, is recorded as 28 meters for the coralligenous formations at Banyuls, that is at the average limit of Puglia's formations.

An impressive feature of the coralligenous bottoms along our coast is their extension. We may estimate that within the area we have surveyed they cover 500 square kilometers. This datum can be compared only with that recorded with precision by Laubier for his two stations at Banyuls: 0,92 square kilometers; with regard to other data we find in the literature, there is no indication that they refer to continuous massive formations. We may, however, observe that before the present observations, coralligenous conglomerates have been thought to occupy only limited extensions of the sea bottom. In the most recent work dealing with this subject (1967) Pérès says: "In the Western Basin the true coralligenous bank (on a flat bottom) is rather rare and generally occurs only in patches, but in the Eastern Basin one often finds the second type (superposed layers) covering very large areas - on thousands of square metres...".

With regard to the thickness of the conglomerates, again our data can be compared only with those given by Laubier: a maximum of 4.5 meters for Banyuls and 2.5 meters, as far as abserved, for Puglia's formations. No other information is available, except the mention, in the work by Pérès quoted adove that "the thickness of this mass is no more than a few tens of centimetres".

The general morphology of a coralligenous bank has been for the first time described in Laubier's work. It is noteworthy how closely alike are the Banyuls' conglomerates and those observed by ourselves. There are the same channels separating blocks and patches, the same abrupt ending of the bank where it borders on the coastal mud. It was assumed before the observations by Laubier that the "coralligène de plateau" was distinct from the "coralligène d'horizon inférieur de la roche littorale" and separated from it by a strip of sandy bottom. Laubier showed that such a scheme could not be maintained in regard to the Banyuls' conglomerates. As to Puglia's coast, it would appear that, as a rule, the coralligenous formations do begin at a certain distance from the coast, from which they are separated by flat sandy bottom, bare or with posidonia beds, but also that morphological variations of the coast profile may entrain such aspects of the conglomerates as not to allow a simple schematization. At all our stations the actual extensive bank begins only after a strip more or less wide of sandy bottom, which in turn nearly always borders, at a depth of only a few meters, on the rocks of the littoral. No coralligenous concretioning is to be found on such rocks. However, we found at Barletta, on flat sandy bottom only 4 meters deep, patches of large rocks sparsely covered with coralligenous conglomerates undistinguishable from the concretions taken from the offshore bank at 10 or 20 meters depth. Still different conditions we found at Castro. Here the profile of the coast is very steep and irregular, with an average inclination of about 100 %, down to about 20 meters depth, where it borders on flat, bare sandy bottom. This is only a few tens of meters wide and is followed by the coralligenous flat bottom. The interesting point about this station is that the coralligenous concretioning is to be found also on the cliff, where it begins at less than 10 meters. The two formations have an identical aspect; only the cutting away of a fragment from the cliff reveals the underlying rocky substrate. The indications arising from these findings appear to agree with Laubier's view that the two types of coralligenous conglomerates cannot be neatly separated.

An important point raised also by Laubier was that at Banyuls at least, the coralligenous formations seem to rest on solid rock, and not to have been originated by the consolidation of an originally soft bottom (which is the definition of the "coralligène de plateau"). We have mentioned above that we found some conglomerates fixed on hard substrate: we have no proof that this is the case also when formations appear surrounded by soft bottom, but we are inclined to think so. In the course of our researches, through diving, that is through direct observation, we have searched for some evidence that the conglomerates have their base on soft bottom, as postulated by Pérès and Picard and quite recently (1967) again by Pérès, but we have not found any. Of course, a geological prospection with coring operations would be required in order to obtain some certitude, but our observations indicate:

- that the sediment from which the blocks outcrop is at all stations (with the exception of Barletta) light and loose, being composed almost entirely by fragments of coralline algae, bryozoa and echinoderms, small gastropods and brachiopods, spicules of sponges, not bound by terrigenous clay; owing to the limited depth, this sediment is easily displaced by currents and waves;

- that on the sediment no trace of a concretioning at the starting stage was to be found, and that even small heaps of larger shells and rhizomes of Posidonia accumulated by the currents showed no sign of consolidation;

- that smaller boulders, in order to be pulled out from the sediment, had to be broken from an underlying foundation;

inside they had the same degree of compactness as the larger blocks, not giving any indication that they were of more recent origin.

We incline to think that the coralligenous masses visible above the sediment continue below it till they reach the originary rock and that the sediment shall not be interpreted as an originary soft bottom in the sense of Pérès and Picard, but as detritus deriving from the degeneration of the coralligenous formation itself. As to the stations at Barletta, where a highly cohesive mud brought by the river Ofanto fills the channels between the coralligenous masses, we found no indications either that at its surface a concretioning process may start.

THE STRUCTURE OF THE CORALLIGENOUS CONGLOMERATES

As mentioned above, the classic concept that coralligenous masses result from loose material as pebbles, broken shells and corals etc. cemented together by concretioning does not receive confirmation by our observations, as it did not by Laubier's study. The various components of the coralligenous conglomerates might be grouped as follows, bearing in mind that this is an artificial scheme, having the only purpose to give a fundamental picture of the construction.

A. Vegetal elements, necessary for building the calcareous frame and cementing together other elements: lime-fixing algae.

B. Animal elements, not necessary but always present, contributing both to mineral mass increase and to cementation: incrusting bryozoa and serpulids.

C. Animal elements without cementing action but with direct or indirect relevance in mass increase: gastropods, bivalves and sponges.

D. Elements non biologic or of secondary biological origin: sand, mud, organogenic sand.

A.

This group, represented by a limited number of species of Squamariaceae and Corallinaceae, predominates both for the calcareous mass it produces and for its capability of binding together the most diverse materials. We might emphasize its importance by affirming that a coralligenous conglomerate could exist, theoretically, without animal contribution, but not without the cementing action of algae. The most abundant species we found in our area are Neogoniolithon mamillosum and Peyssonnelia polymorpha, the fist one adhering to the substrate or at least following strictly its contours, the second one often growing in very large, flat, thin laminae having only a few points of contact with the substrate. To these species are generally associated, but seem to play a minor role, Pseudolithophyllym expansum, Peyssonnelia rubra and Lithophyllum racemus. Still lesser importance seems to have Mesophyllum lichenoides. The predominance of one or another species, because of their diverse growth form, leads to structures which appear more or less compact. At Porto Tricase, at a deph of 20 to 30 meters, we have observed the highest degree of development of Peyssonnelia polymorpha,which seem to be in connection with the purity of the water and the stronger illumination. As a consequence, large fragments of the upper strata of the formations could be detached by hand without effort. An opposite condition, that is compact conglomerates difficult to break, was found where Neogoniolithon mamillosum is predominant and P.polymorpha grows in smaller and more closely-set laminae. It must be observed, however, that this diversity regards mainly the exterior aspect of the formations and the density of its outer strata because the progressive filling-up of the spaces between the laminae by sedimentary and animal contribution and by further algal concretioning leads to an about equivalent compactness in the inside of the masses.

The systematic position of the principal algae involved in the construction of the conglomerate is as follows:

THALLOPHYTA
RHODOPHYCEAE
CRYPTONEMIALES
SQUAMARIACEAE
Peyssonnelia polymorpha (Zanard.)
Peyssonnelia rubra (Grev.)
Peyssonnelia squamaria Decne
CORALLINACEAE
Lithophyllum dentatum Fosl.
Lithophyllum incrustans Phil.
Lithophyllum racemus Fosl.
Mesophyllum lichenoides Lemoine
Pseudolithophyllum expansum (Phil.)
f. strictaeformis Areschoug
Lithothamnion philippi Fosl.
Lithothamnion validum Fosl.
Melobesia lejolisii Rosanoff
Neogoniolithon mamillosum (Hauck)

B.

The importance of some bryozoa is due to their capability of superposing incrusting strata of calcareous matter in the same way as incrusting algae, and to enclose with a mineral wall spaces temporarily occupied by not permanent structures, as sponges, by incrusting their surface. Among the species we have separated, Schizomavella auricolata, Rhynchozoon sp. and Cellepora pumicosa appear to play the most important role. Serpulids are more or less abundant in our samples; always present, they are in so many cases represented by only their tube, empty or occupied by foreign elements, that their identification is often impossible. We have often found Vermiliopsis infundibulum and Vermiliopsis langerhanzi and, more often, Serpula vermicularis. It is not unusual to find fragments of conglomerate in which the tubes of serpulids exceed in volume all other elements.

C.

Gastropods and bivalves are abundant; either having penetrated in the internal cavities or having died fixed on its surface,they are eventually conglobated. The species we have more frequently found are Vermetus gigas, Astralium rugosum, Trochus exasperatus, Clanculus corallinus, Chama spp., Spondylus gaederopus, Arca lactea and the perforating Lithodomus lithodomus. The role of some sponges is important. The insinuating Fasciospongia cavernosa may bind together material made loose by destructive actions and leave at its death cavities with consolidated walls which will be occupied by other elements; the same result may be obtained by the boring Cliona viridis which, in its gamma stage,appears here to be much more constructive than destructive. Massive sponges living on the surface of the conglomerate, as Spongia virgultosa and Spongia officinalis have been observed to support incrustations of bryozoa and algae. In this way these sponges, serving as a scaffolding for the construction of a roof enclosing the space they occupy, will make eventually this space available to more permanent calcified elements, will be, in other words, the originary factor of an increase of the conglomerate mass. Some other sponges contribute to the construction in a less apparent way: under a low-power microscope, most microcavities of the conglomerate appear lined with thin incrusting sponges, with long spicules fixed perpendicularly to the substrate. Such spicules are suited for trapping the finer floating sediment. Another sponge of interest in this regard is Jaspis johnstoni. Not conspicuous, but ubiquitous, infiltrating, it has a very dense skeleton of spicules which will be left as a siliceous contribution to the conglomerate.

D.

The intricate structure resulting from vegetal and animal activity as outlined above has originally scarce compactness, but the innumerable cavities and interstices are subjected to a progressive filling-up due not only to the same biological processes which continue to take place, but also to the contribution of a large quantity of sediment brought by the water which permeates the entire mass. We have measured the content of mud (grain size less than 100 microns) of a series of samples coming from all stations and found the rather striking figures of 20 % to 46 %. In the deeper strata of the conglomerate, say 30 or 40 cm deep, the mud tends to fill every space left available; still deeper, we may find neither cavities nor mud, but a compact metamorphosed conglomerated rock.

TEMPERATURE AND ILLUMINATION

About the temperature requirements of a coralligenous formation, we have only two sets of data to be found in the literature: those by Pérès and Picard (1951) and those by Laubier (1966). According to the former, coralligenous species are stenothermic. Laubier ascertained that this was not the case with the coralligenous formations of Banyuls which, on the contrary, appear markedly eurythermic. The same may be said for Puglia's bank which, because of its low depth, must necessarily be subjected to seasonal climatic conditions which on this coast, receiving strong insolation during the summer and exposed to very cold north-eastern winds in winter, are rather extreme.

Coralligenous formations are considered to be strictly bound to a diminution of light intensity, which is obtâined on flat bottoms through depth and turbidity of the water and on littoral rock also in dependence of the inclination of the substrate. Laubier (1966) explained the presence of coralligenous bottoms at only 18 meters depth (which at that time was considered exceptional) with the high turbidity of Banyuls' waters. Our observations indicate that the maximum of light intensity tolerated is much higher than it was assumed. We have found massive conglomerates on flat bottom at a depth of 10 meters not only at stations where the normal turbidity is high, as Barletta, but also at localities, as Torre a Mare and S. Vito, where, owing to the absence of rivers, the turbidity is only occasional.

At Porto Tricase (and only there), between 15 and 30 meters, we have observed an aspect of the upper surface of the coralligenous formations which exactly corresponds with the "précoralligène" of the French authors: the surface of the bank is characteristically covered with Halimeda platydisca and Udotea desfontaini, two non concretioning algae considered as typical of a biotope subjected to a degree of illumination which is moderate, but higher than that required by a coralligenous population. The "precoralligène" has been interpreted in various ways in its relation with the "coralligène": as an indipendent biocoenosis, as a seasonal aspect involved in a cycle, as a preceding factor preparing the conditions for the establishment of a true "coralligène". In Laubier's opinion, which is the most recent one, the "précoralligène" is a separate biocoenosis having distinctly different light requirements. The important aspect of the coralligenous formations at Porto Tricase is that we find there an exceptionally luxuriant growth of both the coralligenous concretioning (at 20 meters the height of the bank is more than 2 meters) and of the precoralligenous algae on its surface. These are contrasting data which may be only partially explained admitting that the population of erect, non concretioning algae shades the underlying coralligenous formations from excessive illumination.

An even more surprising indication is given by our finding of coralligenous concretioning at a depth of only 4 meters. Most samples we collected there show a predominance of the madreporarian Cladocora cespitosa which appears to be, in a more or less important way, a shadowing factor in regard to the concretioning to be found underneath or within its colonies. However, we also observed patches of conglomerate sparsely concretioning otherwise bare rocks, fully illuminated. They had a thickness of 5 to 7 centimeters; consisting of algae, bryozoa, serpulids, shells and sediment, they were rather compact, not different from the hardest formations found on the bank proper. The bottom here belongs to the infralittoral zone, and there is no question of interpreting the presence of this coralligenous concretioning, fully illuminated, as an enclave of the circalittoral zone. Now, it is an accepted fact that the coralligenous formations belong to the circalittoral zone (as defined by Pérès and Picard) and we ourselves, while having ascertained that the illumination limit suitable for such formations is higher than till now recorded, do not dispute the fundamental scheme according to which coralligenous formations are sciaphilous. For these reasons this finding (which unfortunately occurred at the very last station we studied before preparing this report) is not readily explainable.

THE FAUNA OF THE CORALLIGENOUS BANK

When we look at the coralligenous bank as a whole, we observe that its characteristic structure creates a serie of complex biotopes: micro-caves, inclusions of sediment, surfaces having every degree of inclination and therefore of illumination. Furthermore, it forms a permanent, anfractuous rocky substrate also where, without the coralligenous constructive activity, we should probably find a leveled sedimented bottom. The consequence of this peculiarity is that the resulting biotope is not homogeneous and that its population is not a homogeneous community. As a matter of fact, we have not been able to recognize any species as exclusive of it (with the possible but improbable exception of four sponges new for science), not even the main builders, the Corallinaceae and Squamariaceae, which may be

Fig. 1. Extension of the investigated area

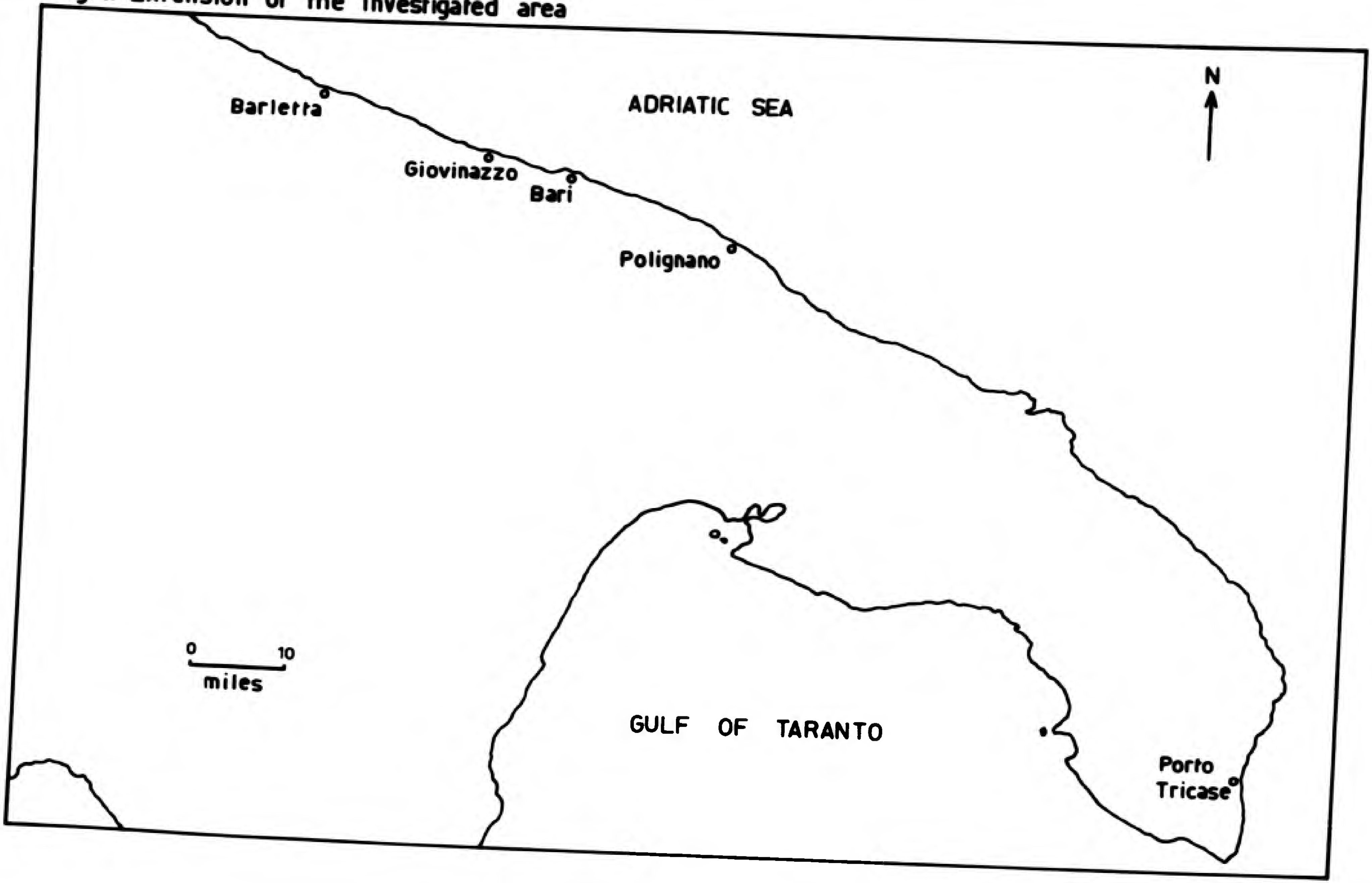
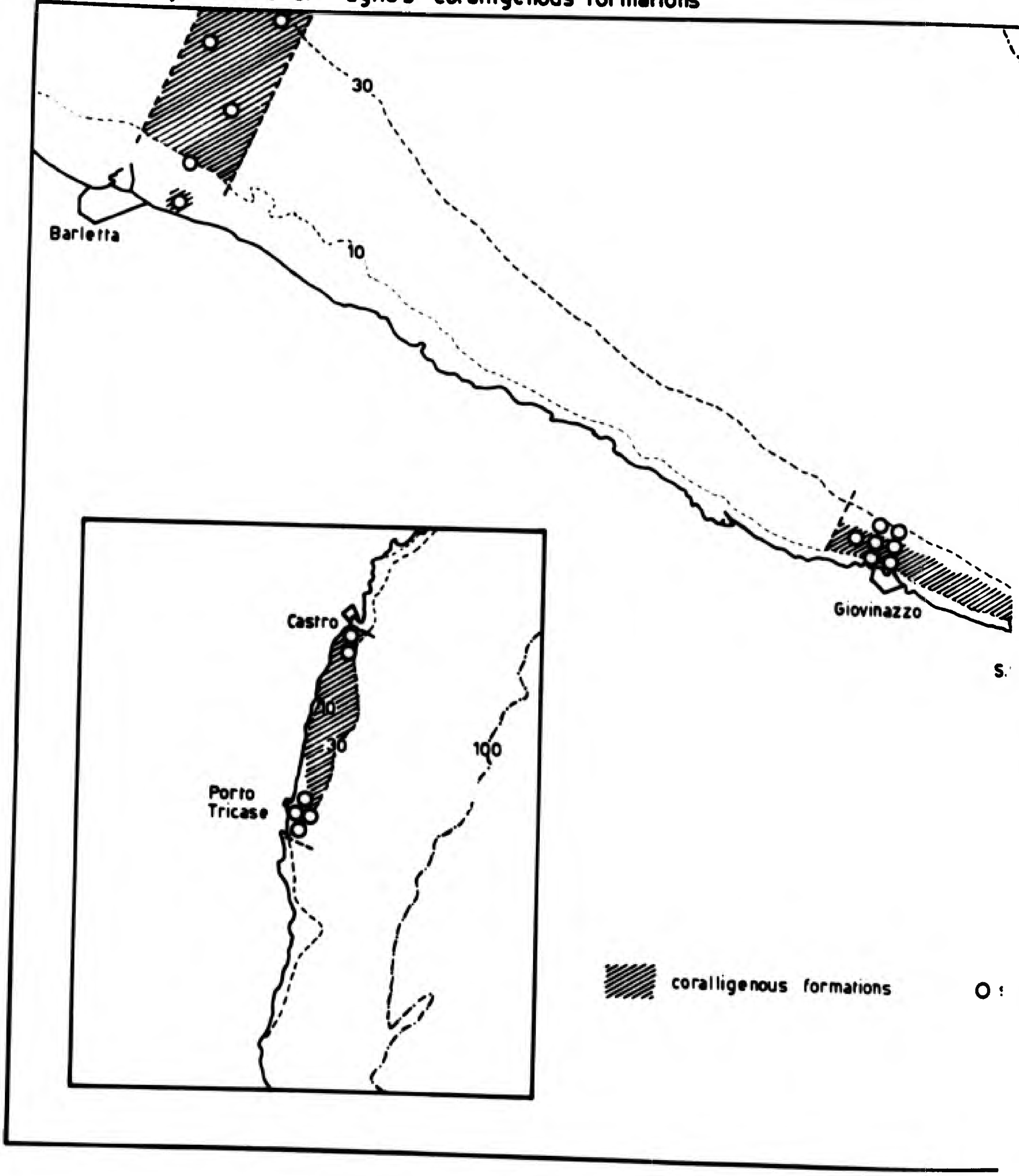
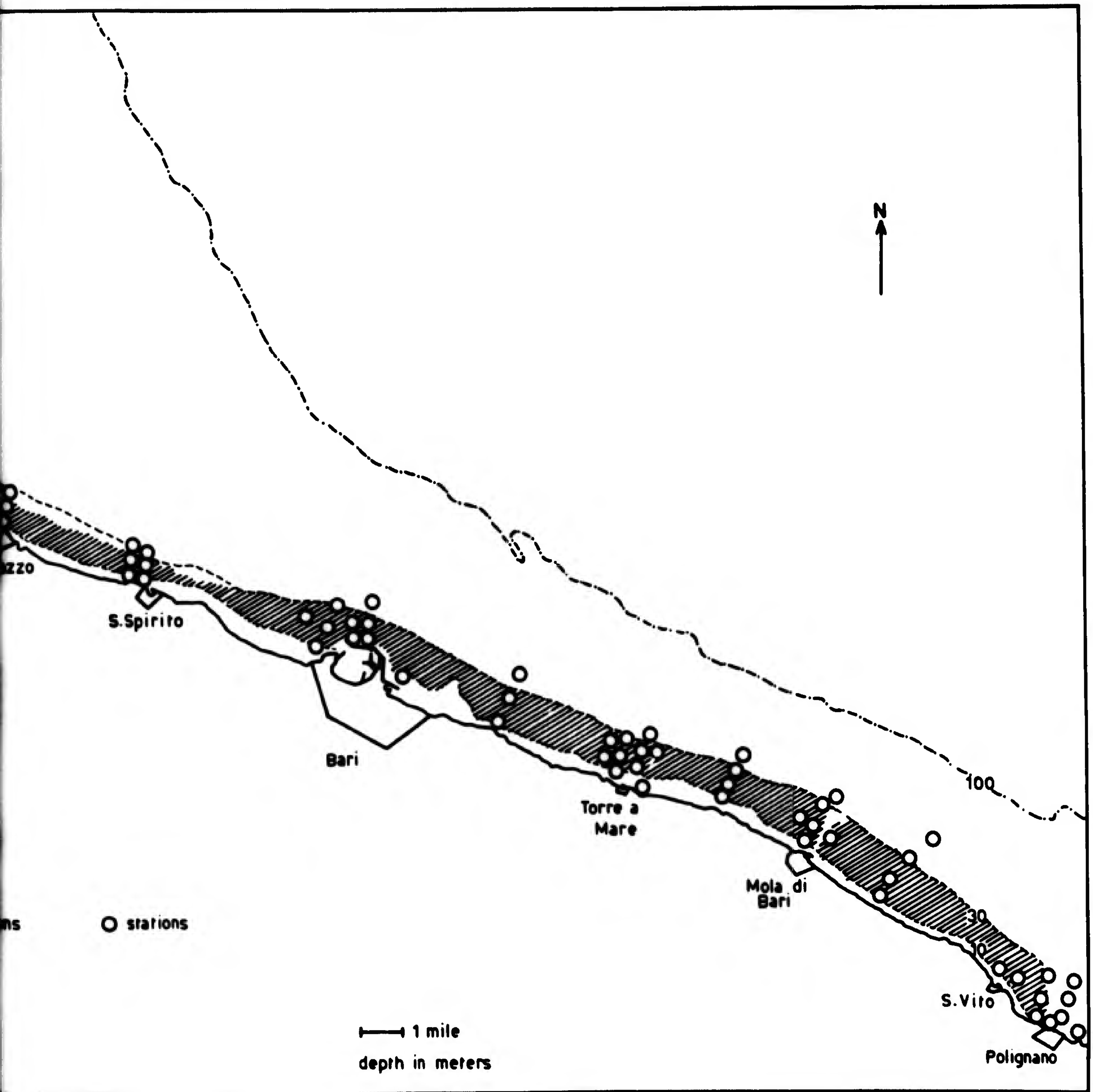


Fig.2. Surveyed areas of Puglia's coralligenous formations



A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10
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stations
1 mile
depth in meters

B

found on the littoral rock up to the surface, forming incrustations of no particular relevance (Hamel and Lemoine, 1952). The species to be found on the surface of the conglomerates are the same that live on the littoral rock at comparable depth or illumination gradient. But, in the same time, particular micro-habitats within the mass enable species belonging to different biotopes to bring their contribution to the population. As a result, we have a population composed of sciaphilous circalittoral elements belonging both to the hard substrates and to the soft ones.

A qualitative and a quantitative survey of a fauna of such an extent and complexity are both difficult, the former because of the enormous number of species to be isolated and determined, the latter because of its heterogeneity. However, faunistic lists revised and adjourned in respect to those included in a previous paper are reported below. Porifera are dealt with separately, having been subjected to a more detailed elaboration. A quantitative study of some species follows.

CNIDARIA

- HYDROZOA
  - HYDROIDA
    - Eudendrium ramosum (L.)
    - Aglaophenia pluma (L.)
- ANTHOZOA
  - ALCYONACEA
    - Alcyonium acaule Marion
    - Sarcodyction coralloides
  - GORGONACEA
    - Eunicella cavolinii (Koch)
    - Leptogorgia sarmentosa (Esper)

ACTINIARIA
- Anemonia sulcata (Penn.)
- Cereus pedunculatus (Penn.)
- Phellia elongata (D. Ch.)

MADREPORARIA
- Cladocora cespitosa (L.)
- Balanophyllia italica Mich.
- Caryophyllia clavus Sacchi
- Biflabellum anthophyllum (Ehr.)

ZOANTHIDEA
- Parazoanthus axinellae (O. S.)

CERIANTHARIA
- Cerianthus membranaceus (Spall.)

<u>NEMATODA</u>

ADENOPHORA

CHROMADORIA

ARAEOLAIMIDA
- Axonolaimus setosus Filipjev

MONHYSTERIDA
- Metalinhomoeus obtusicaudatus De Man

DESMODORIDA
- Acanthopharinx rigida Schuurmans Stekhoven
- Epsilonema sp.
- Bathepsilonema sp.

CHROMADORIDA
- Paracanthoncus stekhoveni Schuurmans Stekhoven
- Halichoanolaimus robustus Bastian
- Euchromadora striata Eberth

DESMOSCOLECIDA
- Desmoscolex minutus Claparende
- Desmoscolex parafalklandiae Allgen
- Tricoma sp.

ENOPLIA

ENOPLIDA
- Anticoma sp.
- Thoracostoma sp.
- Pontonema sp.
- Symplocostoma bandaense Micoletzky
- Enoplus sp.
- Enoplolaimus vulgaris De Man

ANNELIDA

POLYCHAETA

ERRANTIA

Pontogenia chrysocoma Baird
Lagisca extenuata Grube
Euphrosyne foliosa Audouin and Milne Edwards
Hesione pantherina Risso
Dalhouisiella carpenteri Mc Intosh
Goniada emerita Audouin and Milne Edwards
Eunice harassii Audouin and Milne Edwards
Eunice siciliensis Grube
Eunice torquata Quatrefages

SEDENTARIA

Amphitrite cirrata Muller
Vermiliopsis infundibulum Linnaeus
Vermiliopsis langerhansi Fauvel

ECHIURIDA

ECHIURINEA

Bonellia viridis Rolando

SIPUNCULIDA

Physcosoma granulatum Leuck.

MOLLUSCA

GASTROPODA

ARCHEOGASTROPODA

Calliostoma conulus L.
Calliostoma zizyphinum L.
Cantharidus striatus L.
Jujubinus exasperatus (Pennant)
Clanculus corallinus Gmelin
Clanculus cruciatus L.
Turbo sanguineus L.
Astraea rugosa L.
Tricolia pullus (L.)
Tricolia speciosa (von Muhlfeld)
Smaragdia viridis (L.)

MESOGASTROPODA

Littorina neritoides (L.)
Alvania costata (Adams)
Alvania montagui (Payr.)
Alvania lineata Risso
Alvania reticulata (Mont.)
Alvania cimex (L.)
Alvania subcrenulata (Schwartz)
Alvania carinata (Da Costa)
Alvania cancellata (Da Costa)
Alvania pagodula (B. D. D.)
Rissoa parva (Da Costa)
Rissoa ventricosa Desmarest
Rissoa violacea Desmarest
Rissoa auriscalpium (L.)
Rissoa guerini Récluz
Rissoina bruguieri (Payr.)
Adeorbis subcarinatus (Mont.)
Turritella communis Risso
Vermetus triqueter (Bivona)
Vermetus arenarius (L.)
Cerithium vulgatum Bruguière
Cerithium rupestre Risso
Bittium reticulatum (Da Costa)
Cerithiopsis tubercularis (Mont.)
Cerithiopsis bilineata (Hornes)
Cerithiopsis minima Brusina
Triphora perversa (L.)
Scala communis (Lamk.)
Melanella polita (L.)
Kleinella humboldti (Risso)
Odostomia conoidea (Brocchi)
Eulimella sp.
Turbonilla lactea (L.)
Turbonilla scalaris (Phil.)
Capulus ungaricus (L.)
Calyptraea chinensis (L.)
Crepidula unguiformis Lamk.
Aporrhais pes-pelecani (L.)
Natica dillwini Payr.
Natica millepunctata Lamk.
Natica hebraea (Martyn)
Polynices alderi (Forbes and Hanley)

Polynices josephinia (Risso)
Velutina velutina Muller
Trivia pulex (Solander)
Simnia spelta (L.)
Erato laevis Donovan
Erronea pyrum (Gmelin-Linn.)
Talparia lurida (L.)
Cassidaria echinophora (L.)
Cassis undulata (Gmelin)
Charonia reticulata (Blainv.)
Dolium galea (L.)

NEOGASTROPODA

Murex trunculus L.
Murex brandaris L.
Typhis sowerbyi Broderip
Muricidea blainvillei (Payr.)
Muricidea diadema (Aradas and Benoit)
Tritonalia corallina (Scacchi)
Tritonalia edwardsi (Payr.)
Tritonalia erinaceus (L.)
Pseudomurex meyendorffii (Calcara)
Pseudomurex lamellosus (Jan.)
Pyrene scripta (L.)
Pyrene gervillei (Payr.)
Pyrene minor (Scacchi)
Columbella rustica (L.)
Euthria cornea (L.)
Pisania maculosa (Lamk.)
Pisania d'orbignyi (Payr.)
Donovania turritellata (Desh.)
Nassa mutabilis (L.)
Nassa corniculum (Olivi)
Nassa neritea (L.)
Nassa reticulata (L.)
Nassa costulata Renieri
Nassa incrassata Muller
Nassa pygmaea Lamk

BIVALVIA

TAXODONTA

Arca noae L.
Arca barbata L.
Arca lactea L.

ANISOMYARIA
Modiolus barbatus (L.)
Lithophaga lithophaga (L.)
Pinna nobilis L.
Spondylus gaederopus L.
Hinnites multistriatus (Poli)
Lima lima (L.)
Lima hians (Gmelin)
Anomia ephippium L.
Ostrea edulis L.
EULAMELLIBRANCHIA
Beguinea calyculata (L.)
Coralliophaga lithophagella (Lamk.)
Chama griphoides L.
Chama griphina (Lamk.)
Saxicava arctica (L.)
Gastrochaena dubia (Pennant)
Pholas dactylus L.

BRYOZOA
GYMNOLAEMATA
CYCLOSTOMATA
Frondipora reticulata
Lichenopora sp.
CHEILOSTOMATA
Scrupocellaria reptans L.
Scrupocellaria scruposa (L.)
Scrupocellaria bertholetti (Aud.)
Scrupocellaria scrupea Busk
Schizomavella auricolata (Hassall)
Schizomavella linearis (Hassall)
Schizomavella linearis var. mamillata Hincks
Celleporina caminata (Waters)
Electra pilosa (L.)
Mollia patellaria (Moll)
Caberea cfr. boryi (Aud.)
Chorizopora brognarti (Aud.)
Schizoporella longirostris Hincks
Schizoporella sp.
Hippaliosina depressa (Busk)
Microporella violacea Johnston
Myriapora truncata (Pall.)

Calpensia nobilis (Esper)
Cryptosula pallasiana (Moll)
Smittina landsborovii (Johnston)
Sertella sp.
Rhynchozoon sp.
Costazia costazii (Aud.)
Margaretta cereoides (Ell. & Sol.)
Cellepora pumicosa L.
Cellaria fistulosa Auctt.
Hippodiplosia foliacea Ell. & Sol.
Porella cervicornis Pall.
Escharella variolosa (Johnst.)

CTENOSTOMATA

Amathia vidovici (Heller)

ECHINODERMATA

CRINOIDEA

ARTICULATA

Antedon mediterranea (Lam.)

HOLOTHURIOIDEA

ASPIDOCHIROTA

Holothuria forskali D. Chiaje
Holothuria tubulosa Gm.

DENDROCHIROTA

Cucumaria planci (Brandt)
Cucumaria kirschbergi Hell.

ASTEROIDEA

SPINULOSA

Asterina gibbosa (Pennant)
Echinaster sepositus (Retz.)

OPHIUROIDEA

OPHIURAE

Ophiomyxa pentagona (Lam.)
Amphiura chiajei Forbes
Amphipholis squamata (D. Ch.)
Ophiotrix fragilis (Abildg.)
Ophiotrix quinquemaculata (D. Ch.)
Ophiopsila aranea Forbes
Ophioderma longicaudum (Retz.)

ECHINOIDEA

DIADEMATOIDA

Psammechinus microtuberculatus (Blv.)

Paracentrotus lividus (Lam.)
Sphaerechinus granularis (Lam.)
Arbacia lixula (L.)
CLYPEASTROIDA
Echinocyamus pusillus (O. F. Muell.)

TUNICATA
ASCIDIACEA
APLOUSOBRANCHIA
Didemnum maculosum (Milne Edw.)
Didemnum sp.
PHLEBOBRANCHIATA
Ascidia virginea (Muell.)
Ascidia sp.
STOLIDOBRANCHIATA
Halocynthia papillosa L.
Microcosmus sulcatus Cocq.

VERTEBRATA
CHONDRICHTHYES
SQUALIFORMES
Scyliorhinus canicula (L.)
Mustelus mustelus (L.)
ANGUILLIFORMES
Muraena helena L.
Conger conger (L.)
GADIFORMES
Phycis blennioides (Brunn.)
Phycis phycis (L.)
Onos tricirratus (Brunn.)
PERCIFORMES
Mugil cephalus L.
Mugil auratus Risso
Dicentrarchus labrax (L.)
Epinephelus guaza (L.)
Serranus scriba (L.)
Serranus cabrilla (L.)
Serranus hepatus (L.)
Dentex dentex (L.)
Sparus auratus L.
Pagrus pagrus (L.)

Lithognathus mormyrus (L.)
Puntazzo puntazzo (Cetti)
Diplodus annularis (L.)
Diplodus sargus (L.)
Diplodus vulgaris (Geoffr.)
Diplodus trifasciatus (Raf.)
Boops boops (L.)
Boops salpa (L.)
Oblada melanura (L.)
Maena maena (L.)
Maena smaris (L.)
Mullus barbatus L.
Mullus surmuletus L.
Argyrosomus regius Asso
Umbrina cirrosa (L.)
Sciaena umbra L.
Chromis chromis (L.)
Labrus turdus L.
Labrus merula L.
Crenilabrus mediterraneus (L.)
Crenilabrus tinca (L.)
Coris julis (L.)
Thalassoma pavo (L.)
Xyrichthys novacula (L.)
Trachinus draco L.
Tripterygion tripteronotus Risso
Scorpaena porcus L.
Scorpaena scrofa L.

THE POPULATION OF PORIFERA

In the following list we have recorded the species till now found on the coralligenous bank, with an indication of their bathimetric distribution and frequency at the various localities.

For the bathimetric distribution, the data of the collections have been subdivided in three groups with regard to the three zones of 10-19 m (8 stations, 13 dredgings); 20-29 m (9 stations, 17 dredgings); 30-35 m (3 stations, 5 dredgings). The frequency of the species is represented by a segment proportional to the number of stations where, at a certain depth, each species is present.

depth in meters	10-19	20-29	30-35
number of stations	--------	---------	---
CALCAREA			
1-Clathrina contorta (Bow.)		-	
2-Sycon raphanus (O.S.)		--	
3-Leuconia solida (O.S.)	-		
TETRACTINELLIDA			
4-Craniella cranium (Muller)		-	
5-Geodia conchilega (O.S.)	-----	------	
6-Geodia cydonium (Jameson)	--	------	-
7-Erylus discophorus (O.S.)	-	-	
8-Erylus euastrum (O.S.)			-
9-Penares helleri (O.S.)		--	-
10-Stelletta grubii (O.S.)	-		
11-Stryphnus mucronatus (O.S.)	-		-
12-Corticella stelligera (O.S.)	-		-
13-Dercitus plicatus (O.S.)	-	----	-
14-Pachastrella monilifera O.S.		-	
15-Triptolemus simplex Sarà		-	
16-Triptolemus sp.		-	-
HOMOSCLEROPHORIDA			
17-Plakina trilopha Schulze	-		
18-Plakortis simplex Schulze		-	-
19-Chondrilla nucula (O.S.)	---	------	--
20-Chondrosia reniformis Nardo	--	----	-
HADROMERINA			
21-Cliona copiosa Sarà	------	------	-
22-Cliona janitrix Topsent		-	-
23-Cliona sarai Melone	-		
24-Cliona schmidti Ridley	-----	---	--

depth in meters	10-19	20-29	30-35
number of stations	--------	---------	---
25-Cliona viridis (O.S.)	----	--	--
26-Cliona sp.	-		
27-Tethya aurantium (Pall.)	-----	-	
28-Tethya citrina Sarà & Melone	-	--	
29-Diplastrella bistellata (O.S.)	---	--	-
30-Spirastrella cunctatrix O.S.	---	----	-
31-Spirastrella minax Topsent		--	-
32-Timea fasciata Topsent		-	
33-Timea stellata (Bow.)	--	-	
34-Timea unistellata Topsent	-	-	
35-Aaptos aaptos O.S.	-	---	
36-Prosuberites epiphytum (Lam.)		-	
37-Suberites carnosus (Johnst.)			-
38-Terpios fugax Duch. & Mich.	--	----	-
39-Jaspis johnstoni (O.S.)	-	----	--
HALICHONDRINA			
40-Axinella cannabina (Esper.)		---	-
41-Axinella damicornis (Esper.)	-	---	-
42-Axinella polipoides O.S.		-	
43-Axinella verrucosa O.S.		---	
44-Acanthella acuta O.S.		----	---
45-Rhaphydostyla incisa (O.S.)	-	-	
46-Halichondria aurantiaca Topsent	-		
47-Halichondria convolvens Sarà		-	
48-Halichondria panicea (Pall.)		-	-
49-Halichondria sp.			-
50-Topsentia genitrix (O.S.)	--	-	-
51-Eubaris vermiculata (Bow.)	--	-	-
POECILOSCLERINA			
52-Mycale lingua (Bow.)			-
53-Mycale massa (O.S.)	--	-----	-
54-Desmacidon sp.n.			-
55-Lissodendoryx cavernosa Topsent			-
56-Crambe crambe (O.S.) Thiele	-	-	
57-Coelectys insinuans Topsent			-

depth in meters	10–19	20–29	30–35
number of stations	--------	---------	---
58-Histodermella sp.n. 1			-
59-Histodermella sp.n. 2			-
60-Crella sp. n.		-	-
61-Crella sigmata Topsent		-	
62-Hymedesmia sp.	-	-	
63-Anchinoe fictitius (Bow.)			-
64-Anchinoe tenacior Topsent	-	-	
65-Acarnus tortilis (Topsent)	-		-
66-Rhabderemia indica Dendy	-	-	-
67-Eurypon coronula (Bow.)		-	
68-Eurypon major Sarà & Siribelli		-	
69-Eurypon sp.	-		
70-Raspaciona aculeata (Johnst.)	-		-
71-Antho involvens (O.S.)			-
72-Agelas oroides (O.S.)	-----	-------	---
HAPLOSCLERINA			
73-Gellius dubius Babic		-	--
74-Haliclona cratera (O.S.)	-	-	
75-Haliclona viscosa Sarà		-	-
76-Haliclona sp.	-	-	-
77-Pellina semitubulosa (Lieb.)	-		
78-Petrosia ficiformis Poiret	--------	--------	---
79-Calyx nicaeensis (Risso)		-	
KERATOSA			
80-Halisarca dujardini Johnston		-	
81-Dysidea fragilis (Mont.)		-	--
82-Dysidea tupha (Martens)		-	
83-Cacospongia scalaris (O.S.)			-
84-Fasciospongia cavernosa (O.S.)	-	---	
85-Ircinia fasciculata (Pall.)			-
86-Ircinia oros O.S.		-	-
87-Ircinia variabilis O.S.	-	------	--
88-Oligoceras collectrix Schulze			-
89-Spongia virgultosa (O.S.)	------	-------	--
90-Spongionella pulchella (Soverby)		-	

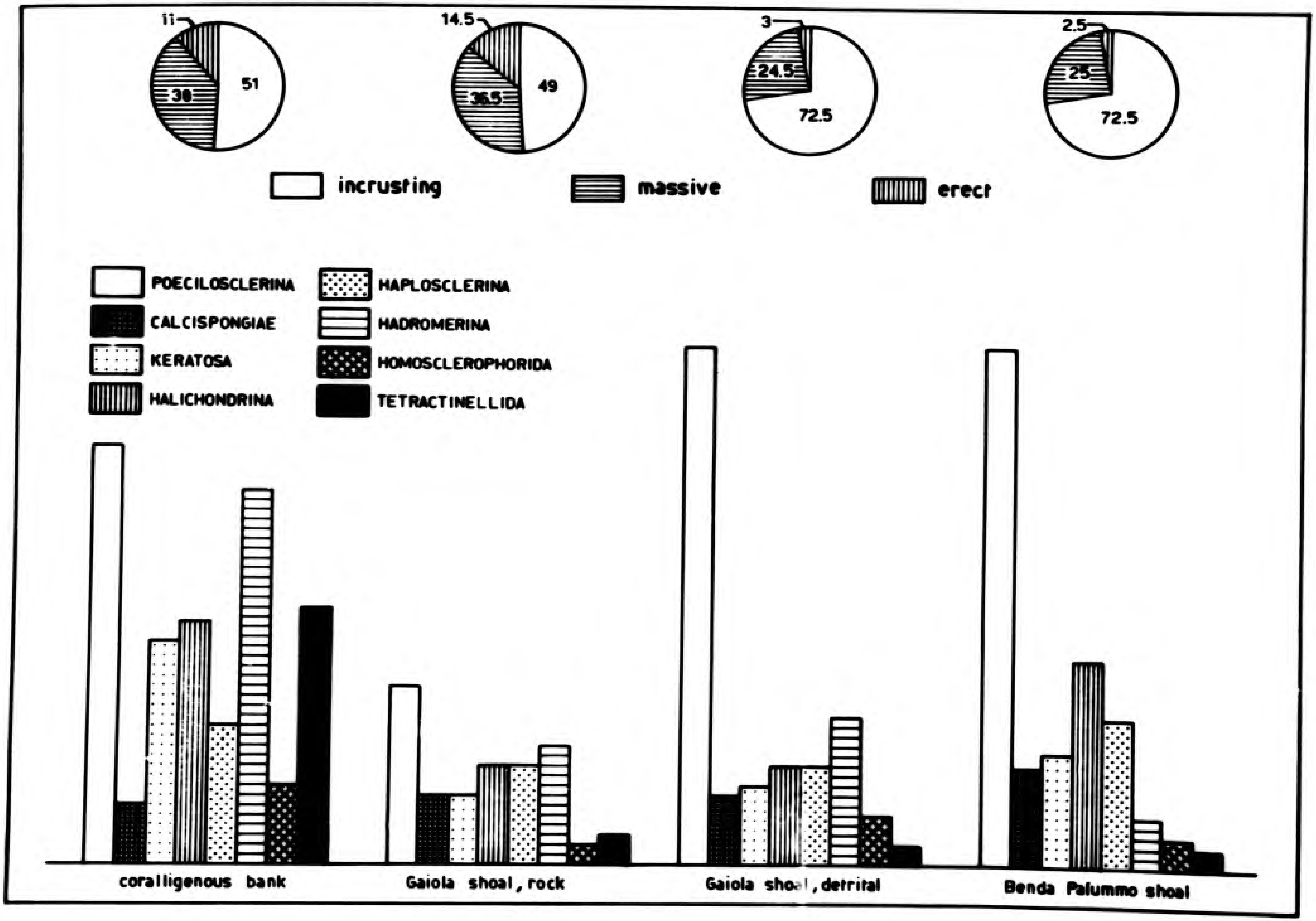
The fauna of Porifera is very rich as to number of species. The total of 90 species, no doubt still incomplete, is in itself remarkably significant, the more so if we consider that the coralligenous bank of Puglia is a biotope rather uniform on the whole. We may point out, for instance, that the number of sponges for the Gajola shoal (detrital zone) is 60, and that for the Benda Palummo shoal it is 68. Furthermore, the 90 sponges listed concern a limited stretch of the coralligenous bank, that between Giovinazzo and Monopoli. The population is rich also as to number of specimens. A remarkable part of the species live as incrustations and sometimes in massive or erect form on the surface of the conglomerates. But other species are found in the interior of the substrate. To the latter belong cementing Keratosa as Fascispongia cavernosa, boring Clionids as Cliona copiosa and Cliona viridis, sponges which occupy secondarily the galleries of Clionids, as Jaspis johnstoni. This results in an ecological stratification of the sponges which recalls that observed by us in the biotope of superficial caves. There are namely two fundamental strata: a stratum of basal species (covering the substrate) and a stratum of boring species. Between the two strata, the third stratum of hypobiotic species insinuates itself and sometimes the epibiotic species settle on the basal species, constituting in this way the fourth ecological stratum of the population. There is no species clearly dominating on the other ones, as it often happens in superficial biotopes for Crambe crambe. On the contrary, a certain number of species prevail both as to abundance and as to frequency, but its dominance varies according to locality and depth. Among these species we mention in particular Geodia conchilega, Geodia cydonium, Dercitus plicatus, Chondrilla nucula, Chondrosia reniformis, Cliona copiosa, Cliona schmidti, Cliona viridis, Diplastrella bistellata, Spirastrella cunctatrix, Jaspis johnstoni, Mycale massa, Agelas oroides, Petrosia ficiformis, Ircinia variabilis, Spongia virgultosa and Fasciospongia cavernosa. Some quantitative data on the variations of abundance of some species of Porifera in relation to bathymetry and to the different stations are tabulated below. The analysis of variance which follows indicates that many of these variations are statistically significant. As to the bathymetric distribution in the whole, the largest number of species has been found in the zone of 20-29 m, but the number of species found in the deeper zone, between 30 and 35 m, must be considered as much elevated and perhaps more in relation to the number of dredgings. We may therefore conclude that the number of species increases with the increase of depth, that is in relation to light diminution.

Table 1. Bathymetric distribution of Porifera
of the coralligenous bank

<table>
<tr><th>Bathymetric stage in meters</th><th>10-19</th><th>20-29</th><th>30-35</th></tr>
<tr><td>Number of stations</td><td>8</td><td>9</td><td>3</td></tr>
<tr><td>Number of dredgings</td><td>13</td><td>17</td><td>5</td></tr>
<tr><td rowspan="7">Number of species</td><td>8</td><td></td><td></td></tr>
<tr><td></td><td>15</td><td></td></tr>
<tr><td></td><td></td><td>13</td></tr>
<tr><td colspan="2">13</td><td></td></tr>
<tr><td></td><td colspan="2">13</td></tr>
<tr><td></td><td>← 4 →</td><td></td></tr>
<tr><td colspan="3">20</td></tr>
<tr><td>Total</td><td>45</td><td>61</td><td>50</td></tr>
</table>

In the whole, the fauna of Porifera of the coralligenous formations of Puglia is not clearly individualized in comparison with the same fauna of rocky bottoms situated at the same depth. Of the 84 species which have been determined, 4 are new for science and hitherto known only from coralligenous bottoms (they are two species of Histodermella, one of Crella and one of Desmacidon, and will be described in a separate paper). All other species have been found also on other types of bottom. In comparison with the Adriatic Sea, although the coralligenous bottom of Puglia is the only one of this kind on which the sponges have been studied, the number of species in common is relevant: 72 out of 84. Very interesting is the record of the genus Histodermella for the first time in the Mediterranean Sea. It is also noteworthy to have found in the Adriatic Sea Spongionella pulchella. For its general aspect the fauna of Porifera of the coralligenous bottoms of Puglia is more like that of a rocky bottom than that of a detrital bottom, even if concretioned. This appears clearly if we compare the diagrams of Puglia's coralligenous bottoms showing the distribution of the species according to orders and the distribution according to the three fundamental aspects, incrusting, massive, erect, with the diagrams previously obtained from another locality, the Bay of Naples (Siribelli, 1963). These localities are a rocky bottom at 20-25 m (walls and rocks of tufa, Gaiola shoal), a loose detrital bottom (30-50m, Gaiola shoal), a detrital bottom partially consolidated by coralline algae and by concretioning animals (45-70 m, Benda Palummo shoal). We note on the coralligenous bottoms of Puglia, with regard to the distribution of species according to order, a number relatively very low of Poecilosclerina and, on the contrary, a number relatively high of Hadromerina and, above all, of Tetractinellida; as to the percentages of the three morphological aspects, the number of erect species and especially of the massive ones appear elevated if compared with the number of incrusting forms.

Fig.3. Number of species of Porifera according to orders (below) and to morphological types (above, in per cent) from the coralligenous bank and from other biotopes.



A QUANTITATIVE SURVEY OF SOME SPECIES OF THE CORALLIGENOUS BOTTOMS

In a previous report (30 April 1967) we have recorded some quantitative data on the surface covering of samples taken by hand. We have also used another method. By means of a series of dredgings, we have drawn samples of benthic material at eight stations and at three different depths (10 m, 20 m, 30 m). The material brought by each haul was divided at random in four samples of the same volume (filling a cubic container of 25 cm side). For each sample we have valued in cubic centimeters the quantity of eight species (four sponges, three bryozoa, one cnidarian and one alga) and in number of specimens the quantity of two other species (one tunicate and one echinoderm). The choice of these species has been based upon their abundance and frequency on the coralligenous formations as a whole, and also on the practical possibility to isolate and measure them with sufficient facility. The stations we have chosen comprise various facies of the coralligenous bottoms, including the two extreme ones of Porto Tricase and Barletta, strongly diverging from the average in respect of light conditions.

Table 2. Sampling on coralligenous bottom

Station: Barletta

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Chondrilla nucula	12	14	27	85	138										
Acanthella acuta									0.1	0.1					
Agelas oroides											1				1
Petrosia ficiformis						15	13	5	5	38	85	205	38	70	398
Hyppodiplosia foliacea							0.1			0.1	0.1	0.2			0.3
Myriapora truncata						4	1	3	3	11	0.1	1	0.2		1.3
Retepora cellulosa	0.2				0.2						0.2				0.2
Eunicella cavolinii						4				4					
Halimeda platydisca						0.2	1	1	0.2	2.4					
Species (number of specimens)															
Halocynthia papillosa	4	4	3	5	16						1	5	1	1	8
Ophiotrix sp.	19	66	72	33	190	27	11	10	6	54	20	22	38	26	106

Table 3. Sampling on coralligenous bottom

Station: Giovinazzo

Species (volume in cc)	10 m sample 1	2	3	4	Tot.	20 m sample 1	2	3	4	Tot.	30 m sample 1	2	3	4	Tot.
Chondrilla nucula			3		3	2			0.2	2.2					
Acanthella acuta									0.4	0.4					
Agelas oroides								1		1					
Petrosia ficiformis	1	8	14	25	48	90	120	75	75	360					
Hyppodiplosia foliacea									0.5	0.5	non coralligenous				
Myriapora truncata						1	1	2		4					
Retepora cellulosa				0.1	0.1										
Eunicella cavolinii															
Halimeda platydisca			1		1										
Species (number of specimens)															
Halocynthia papillosa	3	1		1	5	1	2	6	3	12	non coralligenous				
Ophiotrix sp.	2	12	9	9	32	15	14	9	13	51					

Table 4. Sampling on coralligenous bottom
Station: S. Spirito

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Chondrilla nucula	20	5		5	30	1				1	non coralligenous				
Acanthella acuta						5		2		7					
Agelas oroides		1			1		0.3			0.3					
Petrosia ficiformis	12	19	100	80	211	35	245	45	120	445					
Hyppodiplosia foliacea						4	2	0.5	1	7.5					
Myriapora truncata						0.5				0.5					
Retepora cellulosa						0.1		0.1	0.1	0.3					
Eunicella cavolinii															
Halimeda platydisca		0.5	2	3	5.5										
Species (number of specimens)															
Halocynthia papillosa	1	1		1	3						non coralligenous				
Ophiotrix sp.	26	21	16	11	74										

Table 5. Sampling on coralligenous bottom
Station: Bari

Species	10 m					20 m					30 m				
(volume in cc)	sample 1	2	3	4	Tot.	sample 1	2	3	4	Tot.	sample 1	2	3	4	Tot.
Chondrilla nucula			2	4	6		0.2		2	2.2					
Acanthella acuta						0.1	0.1		0.1	0.3	2	0.1		0.3	2.4
Agelas oroides				1	1	1	2		13	16	1	9			10
Petrosia ficiformis	5	40	25	105	175	6	15	12	260	293	40	60	50	80	230
Hyppodiplosia foliacea									0.2	0.2					
Myriapora truncata						7	2	2	3	14		0.2	1		1.2
Retepora cellulosa									0.1	0.1	0.1		0.4		0.5
Eunicella cavolinii			0.4		0.4										
Halimeda platydisca		0.2			0.2		0.2		0.2	0.4					
Species (number of specimens)															
Halocynthia papillosa	2	4	8	3	17	6	5	3	4	18			3	1	4
Ophiotrix sp.	13	11	30	21	75	31	21	15	9	76	1				1

Table 6. <u>Sampling on coralligenous bottom</u>
<u>Station: Torre a Mare</u>

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Chondrilla nucula		1	1		2	22	10	7	5	44	14		3	10	27
Acanthella acuta							0.5			0.5				1	1
Agelas oroides	2	8		4	14	5	22		15	52	55	26	25	75	181
Petrosia ficiformis	750	320	350	360	1780	125	350	560	75	1110	680	315	440	125	1560
Hyppodiplosia foliacea		0.1		0.1	0.2				0.5	0.5	0.2				0.2
Myriapora truncata	3	4	6	11	24		3	0.5	3.5	6	3	1			4
Retepora cellulosa											0.3				0.3
Eunicella cavolinii								4		4					
Halimeda platydisca	0.3				0.3										
Species (number of specimens)															
Halocynthia papillosa	3	7	5	2	17	6	4	3	6	19	5	3	1	6	15
Ophiotrix sp.	32	34	30	31	127	19	28	21	23	91	2	2	4	4	12

Table 7. Sampling on coralligenous bottom

Station: Mola

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Condrilla nucula												25	3	9	37
Acanthella acuta												0.1			0.1
Agelas oroides						13	7		1	21	190	40	50	103	383
Petrosia ficiformis	1		1		2		21	0.3	19	40.3	10	35		20	65
Hyppodiplosia foliacea													0.2	1	1.2
Myriapora truncata						1	2	4	9	17	5	4	14	2	25
Retepora cellulosa							0.4			0.4					
Eunicella cavolinii							8	0.2	1	9.2		0.3			0.3
Halimeda platydisca		1			1										
Species (number of specimens)															
Halocynthia papillosa	3	1			4		1		1	2	3		3	1	7
Ophiotrix sp.	13	8			21	13	9	20	18	60	4	4	7	3	18

Table 8. Sampling on coralligenous bottom

Station: S. Vito

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Chondrilla nucula							1	0.1		1.1	non coralligenous				
Acanthella acuta															
Agelas oroides								5		5					
Petrosia ficiformis	275	410	425	370	1480	150	75	300	330	855					
Hyppodiplosia foliacea															
Myriapora truncata		2		0.5	2.5										
Retepora cellulosa			0.1		0.1		0.2		0.1	0.3					
Eunicella cavolinii															
Halimeda platydisca	7	10	10	9	36	7	3		1	11					
Species (number of specimens)															
Halocynthia papillosa	3	2		2	7	2	3		1	6	non coralligenous				
Ophiotrix sp.	1				1	1	3	8	7	19					

Table 9. Sampling on coralligenous bottom
Station: Tricase

Species	10 m					20 m					30 m				
	sample					sample					sample				
(volume in cc)	1	2	3	4	Tot.	1	2	3	4	Tot.	1	2	3	4	Tot.
Chondrilla nucula	non coralligenous					12	7	3	14	36	3	1	3	3	11
Acanthella acuta												0.1			0.1
Agelas oroides						205	175	40	60	480	150	43	50	3	246
Petrosia ficiformis						35	25	30	50	140	50	135	213	85	483
Hyppodiplosia foliacea												0.2			0.2
Myriapora truncata						3		7	2	12	3	2	2	1	8
Retepora cellulosa											1	1	0.3	0.1	2.4
Eunicella cavolinii															
Halimeda platydisca						362	425	684	329	1800	220	90	160	305	775
Species (number of specimens)															
Halocynthia papillosa	non coralligenous														
Ophiotrix sp.						3		5	4	12				1	1

Table 10. Sampling on coralligenous bottom
Quantitative distribution in percentage according to station (°)

Species	Barletta	Giovinazzo	S.Spirito	Bari	Torre a Mare	Mola	S.Vito	Tricase
Chondrilla nucula	41	1	9	3	22	10		14
Acanthella acuta	1	3	60	21	12	2		1
Agelas oroides				3	17	28		52
Petrosia ficiformis	4	4	7	7	46	2	24	6
Hyppodiplosia foliacea	8	10	30	5	18	24		5
Myriapora truncata	10	3		11	27	31	3	15
Retepora cellulosa	9	2	6	14	7	9	8	45
Eunicella cavolinii	23			2	22	53		
Halimeda platydisca							2	98
Halocynthia papillosa	15	11	2	24	32	8	8	
Ophiotrix sp.	34	8	7	15	22	10	2	2

(°) Quantity of each species from all stations = 100

Table 11. Sampling on coralligenous bottom
Quantitative distribution in percentage according to depth (°)

Species	10 m	20 m	30 m
Chondrilla nucula	53	25	22
Acanthella acuta		69	31
Agelas oroides	1	41	58
Petrosia ficiformis	38	34	28
Hyppodiplosia foliacea		60	40
Myriapora truncata	20	50	30
Retepora cellulosa		25	75
Eunicella cavolinii		100	
Halimeda platydisca	2	69	29
Halocynthia papillosa	43	36	21
Ophiotrix sp.	51	35	14

(°) Quantity of each species from all stations = 100

The quantitative data of the first nine species listed in Tables 2 to 9 (those measured according to volume) have been submitted to the analysis of variance, with the following results.

Table 12. Sampling on coralligenous bottom
Analysis of variance

Source	Degrees of freedom	Sum of squares	Mean squares	F
Total	215	10,345.667		
A effect	7	564.905	80.700	51.73(°)(°)(°)
B effect	2	61.579	30.789	19.73(°)(°)(°)
C effect	8	3,571.101	446.387	286.14(°)(°)(°)
AB interaction	14	573.325	40.951	26.25(°)(°)(°)
AC interaction	56	3,300.432	58.936	37.78(°)(°)(°)
BC interaction	16	201.149	12.571	8.06(°)(°)(°)
ABC interaction	112	2,073.176	18.510	11.86(°)(°)(°)
Deviations	648	1,010.954	1.560	

A = stations
B = depths
C = species

(°)(°)(°) = $P < 0.001$

All the effects due to the three components (stations, depths and species) and to their interaction result not casual. Namely, the differences found in the total quantities of the nine species between the stations (A), the depths (B) and each haul (AB), and the differences of the total quantities of each of the nine species in regard to each other (C), to the stations (AC), to depths (BC) and to each haul (ABC), are highly significant ($P < 0.001$). It follows from this that the species submitted to analysis are not uniformly distributed.

It appears that the quantitative analysis we have began offers good prospects for understanding the variations of the population and also for the study of the ecological requirements of the single species.

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A coralligenous bank populated by a very rich benthic fauna has been discovered along the Adriatic coast of Puglia (Italy), occupying an area estimated at 500 square Km, and representing the most continuous and important structure of this kind ever recorded. It forms a belt about 1 mile wide within the isobaths of 10 m and 30 m (average) and reaches the thickness of 2.5 m above the surrounding sediment. The study of these coralligenous formations indicate that the maximum of light intensity suitable for their development is much higher than previously recorded; it also suggests that they do not originate from concretioning of loose material on a soft bottom, but have their base on hard bottom. The structure of the coralligenous conglomerate and of the main elements giving origin to it are described. The meaning of the term "coralligenous" is discussed in regard to its origin and its use by the authors. The elements constituting the coralligenous population are not exclusive of it, but may be found also in other biotopes: lists including 360 species are given and Porifera are discussed in particular detail. Quantitative data obtained through the analysis of the abundance of some species at different stations and depths are recorded.

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