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THE ISLAND BANJOLE — A TYPE REGION OF RECENT MARINE ECOSYSTEMS ON NORTH ADRIATIC SHELF

(Figs. 35, Tab. 1)

Abstract: The submarine slopes of the island Banjole in the region of the town Rovinj on Istria are representing a classical infra- and circalittoral ecosystem type of the North Adriatic Shelf. In the presented paper the author describes and graphically presents 10 submarine profiles traced in all directions from this island into maximum depth of the shelf.

Резюме: Подводные склоны острова Банйоле в области города Ровинь на Истрии представляют собой один из классических типов инфра- и циркаллитторальных экосистем Североадриатического шельфа. В настоящей статьи автор описывает и графически изображает 10 подводных профилей ведущих во всех направлениях из этого острова в максимальную глубину шельфа в этих местах.

The island Banjole lies west of the town Rovinj on the peninsula Istria. Its submarine slopes fall relatively steeply down to the circalittoral of the North Adriatic Shelf. The bio- and lithofacies around the island are representing a majority of typical ecosystems which can be applied in environmental reconstruction of fossile, especially Tertiary marine sediments.

The geographical situation of the island, its origin (as well as that of other islands in the studied region of North Adriatic Shelf), the bathymetric, hydrographic and sedimentological conditions as well as the applied method of research including the alphabetical and numerical denotation of recent facies have been presented in an earlier work of Seneš (1988a). The paper Seneš (1988b) contains a list of leading and other species of individual biozones, or facies, which are necessary for the understanding of this one and following contributions concerning the description of profiles on North and South Adriatic Shelf.

Three long inter-island profiles denoted as XXI, XXVI and XXVII were traced from Banjole on the sea-floor; one profile was directed westward towards open shelf (denoted by No. XXXIV); 12 short (130—240 m) auxiliary profiles were denoted by Nos. B-1 to B-12. The total length of all these profiles was 7350 m.

Since the lithological character of biotopes (and their biocenoses and thanatocenoses), their alternation and dependence on the substrate, as well as bathymetric conditions are best expressed by the enclosed graphs (Figs. 1—15), I have limited the text only to a brief description of the profiles and a few notes.

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Profile XXI, Banjole-Crveni Otok (1500 m). (The Banjole section was studied in the year 1968 and controlled in 1970 for possible changes in the populations of organisms and for alternations in sediments in the shallower environment). It reached a depth of —35 m in a distance of 630 m from the shore. It falls steeply from 0 to —23 m (30 m from the shore), moderately to the depth —33 m (95 m from the shore) and then it continues almost horizontally towards the island Crveni in depths of —33 to —36 m (Figs. 2, 3). The current is rather moderate and occurs only near the island. Down to a depth of —23 m there is a steep, organogenously incrustated karst relief, varied by sections with boulders or by unsorted

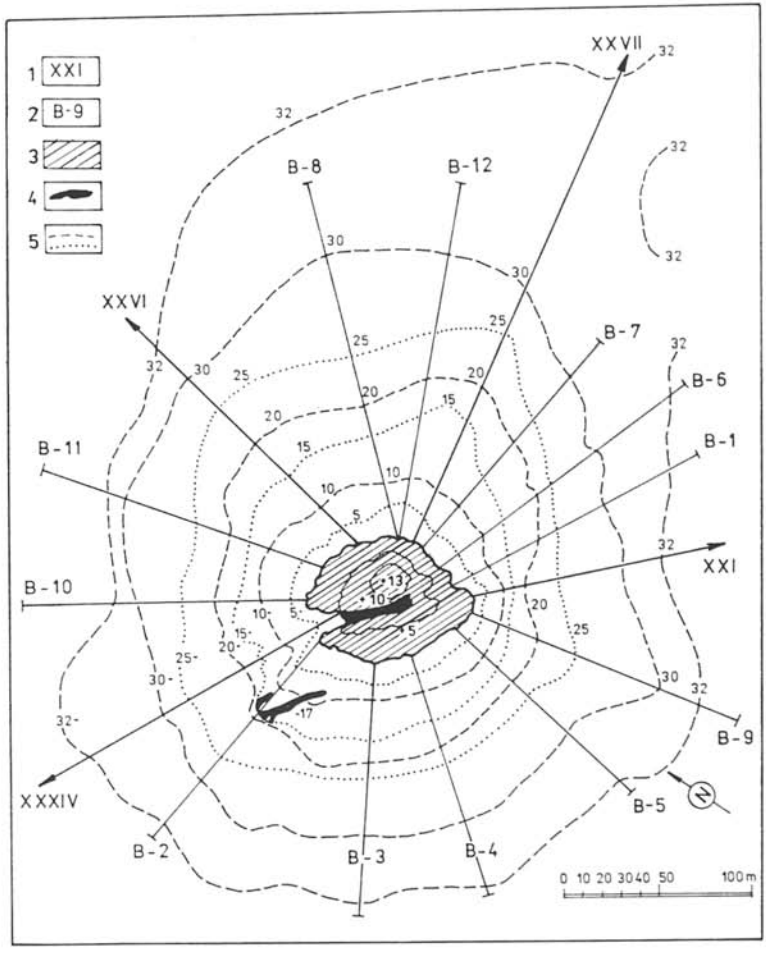

Fig. 1. The situation of submarine profiles traced from the island Banjole. *Explanations:* 1 — inter-island profiles; 2 — auxiliary profiles; 3 — the island Banjole; 4 — submarine caves; 5 — depth isolines around the island.

coarse-arenaceous material on straighter parts. It represents the facies I-1c, d, e, I-2a (for alphabetical and numerical denotation of the facies — see Seneš, 1988b) with dense incrustations of *Rhodophyta* (above all *Lithothamnium lenormandi*) and on more sandy sections with a growth of *Sargassum linifolium* and to a lesser extent with *Cystoseira barbata* and C. *abrotanifolia*. With the station No. 1 (—8) and the quadrant No. 2 (—11) it serves as a type for the *Sargassum* Facies. The station No. 1 is characterized, except by *Sargassum* and *Cystoseira*, by the leading species *Alvania montagui, Bittium reticulatum;* by characteristic species *Lithothamnium lenormandi, L. philippi, Gibbula divaricata, Alvania cimex, Rissoa similis, R. variabilis, R. ventricosa, Odostomia conoidea, Serpula vermicularis, Cellopora pumicosa*. The faunistic character of the biocenosis, or thanatocenosis, is significantly affected by a large number of herbivorous and to the *Sargassum* and *Cystoseira* growth attached organisms the ecology of which is not in contrast with the present calciferous algae or with infauna attached to the

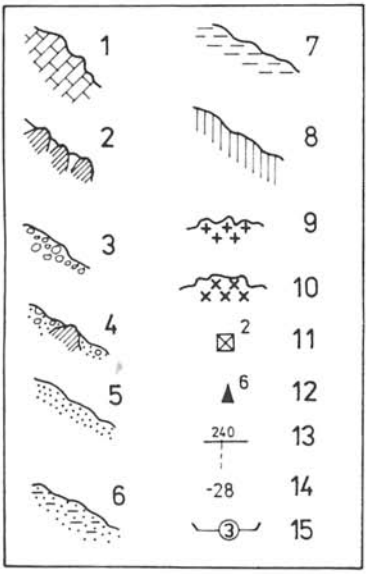

Fig. 2. Explanations of the denotations for the submarine profiles.
1 — solid rock of the shore or infralittoral wall (mostly Mesozoic limestones); 2 — rock boulders from rocky shore on infralittoral slope; 3 — coarse fragments and pebbles of infralittoral slope; 4 — slope with fragments or infralittoral platforms from coarse-grained sand with pebbles; 5 — coarse- to medium-grained sand, partly detrital, mostly badly sorted; 6 — coarse- to medium-grained, frequently organogenic detrital sand, muddy sand; 7 — strongly muddy organogenic sand, sometimes organogenic sandy mud; 8 — slightly sandy organodetrital mud - mud; 9 — bioherms with *Cladocora cespitosa;* 10 — eucoralligene; 11 — number of the sampled quadrant on the profiles; 12 — number of the sampled station or point; 13 — distance from the shore in m; 14 — depth of quadrant or sampled point in m; 15 — distribution of biotopes (thanatocenoses, ecosystems, bio- or lithofacies) on the profiles.

hard-detrital substrate of the *Sargassum* Facies and infracoralligene. The occurences of the foraminifers *Miniacina miniacea*, *Ammonia beccari*, *Elphidium crispum* and *Cibicides boueanus;* ostracods: *Cypridina mediterranea* and *Krithe similis*, are negligible. The material from the quadrant No. 2 contained except *Sargassum* and *Cystoseira* exceptionally large quantites of photophillic *Spongiaria*, further *Diodora graeca*, *Lithophaga lithophaga*, *Ophiotrix fragilis*, *Sphaerechinus granularis* and *Holothuria tubulusa*. In depths from —11 to —18 m, a marked littoral wall represents a typical infracoralligene with incrustations of *Lithothamnium philippi*, *L. lenormandi*, *Peyssonnelia polymorpha*, with a large quantity of photophillic and in the lower, overhanging part of the wall also sciaphillic *Spongiaria*. *Serpula vermicularis* and *Spirorbis pagenstecheri* occur frequently as well, but above all there are bryozoans: *Retepora beaniana* and *Myriozoum truncatum*. This development corresponds approximately to the facies I-2a. The sorted, partly organodetrital sand in the depths from —23 to —30 to —31 m is characterized by the presence of *Pecten jacobaeus*, *Arca noae*, *Glycymeris glycymeris*, *Cardium tuberculatum*, *Venus fasciata*, *Pitaria rudis*, *Tapes aureus* and representatives of the genus *Astropecten*. It represents a typical development of the facies I-5a with *Pecten jacobaeus*, even though this large form is not the most frequent representative of the biocenosis. However, a more extensive islet of eucoralligene (C-4) occurs in the section between the depths —25 and —28 m. It is formed by *Pseudolithophillum expansum*, with a quantity of *Peyssonnelia*, with photophillic and sciaphillic growth accompanied by mollusc in- and epifauna of deeper rocky infralittoral horizons, and further by the occurence of a wide assortment of bryozoans. In depths from —30 to —33 m, in organogenic arenaceous-muddy environment, in all sampled quadrants (Nos. 3, 7, 6) as well as on the stations Nos. 4, 5, there is a prevalance of fauna with predominant bryozoans, the leading species being *Hippodiplosia foliacea* and with characteristic species (which by their quantity frequently exceed *Hippodiplosia) Cellaria fistulosa*, *Myriozoum truncatum;* further molluscs: *Fusus*

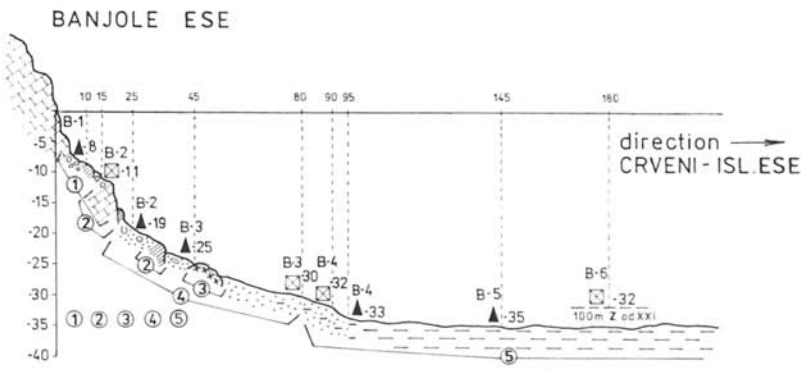

Fig. 3. Profile XXI, Banjole — Crveni Otok (Banjole section).
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — eucoralligene (C-4); 4 — *Pecten jacobaeus* (I-5a); 5 — *Hippodiplosia foliacea* (C-1a).

rostratus, Nucula nitida, Leda fragilis, Arca lactaea, as well as a large number *from the genera Amphiroa* and *Ophiotrix.* Foraminifers are characterized by the benthic forms *Ammonia beccari, Elphidium advenum, E. crispum, Reussella spinulosa, Textularia conica, Cibicides lobatulus* and from ostracods there are *Cythereis antiquata* and *C. jonesi.* The whole association corresponds already to the zone C-1a, although it contains *Amphiura* and *Ophiotrix.* The presence of the last two mentioned genera indicates a possibility of mixing or a transition to the facies C-1c with *Arca noae — Hippodiplosia foliacea* occuring on other profiles in a very typical development.

Profile XXVI, Banjole — Mala Figarola (2400 m). The profile shows the situation in the year 1970, the section of Banjole has been controlled also in the year 1972. It reaches a depth of —35 m; on the Banjole section —32 m (Fig. 4). The current near the island Banjole is weak. Rocky infralittoral falls steeply into a depth of —11 m in a distace of 21 m from the shore. The slightly developed supralittoral (S-1) is represented by *Chthamalus stellatus* and *Patella lusitanica.* The atypical mediolittoral (M-1a, b) contains *Rivularia atra, Lithophyllum incrustans, Neogoniolithon notarisii, Balanus tintinnabulum, Patella coerula, P. lusitanica, Lithophaga lithophaga, Mytilus galloprovincionalis.* The station No. 1 in a depth of —10 m displays a sparse growth with *Sargass*um (I-1d), in sections of higher infralittoral the prevalent facies is I-1e, with the leading species *Lithothamnium lenormandi, Lithophyllum incrustans, Halimeda tuna* and *Amphiroa rigida.* In depths from —10 to —20 m the sea-floor is mostly coarse-arenaceous, slightly sloping; on the station No. 2 (—15) and on the quadrant No. 1 (—18), in a sparse *Cymodocea* growth, typical organisms of this facies have been found, especially *Alvania cimex, Rissoa variabilis, Bittium reticulatum, Cardium tuberculatum, Venus gallina* and from echinodermates: *Psammechinus microtuberculatus* and *Holothuria tubulosa.* From foraminifers, except *Ammonia beccari,* there are only various species of *Elphidium* and *Nonion* sp., from ostracods *Falunia turbida* and *Krithe similis.* On a slightly inclining, coarse-arenaceous slope from —20 to —28 m, a typical facies with *Pecten jacobaeus* (I-5a) has been found, on the quadrant No. 2 (—23 m) accompanied especially by *Arca noae, Venus fasciata* and *Cardium tuberculatum.* From the depth —30 m an atypical facies C-1c prevails on the total length of the Banjole section of the profile

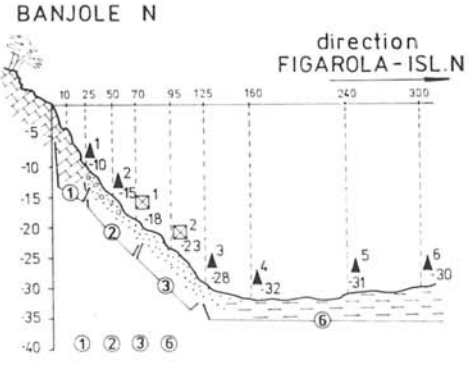

Fig. 4. Profile XXVI, Banjole — Mala Figarola (Banjole section).
1 — *Cytoseira-Sargassum* (I-1c, d); 2 — *Cymodocea* (I-7a); 3 — *Pecten jacobaeus* (I-5a); 6 — *Hippodiplosia* (C-1a).

(stations Nos. 3, 4, 5, 6; —28, —30, —31, —32 m), with small *Hippodiplosia foliacea* and *Arca noae*. (The rest of the characteristic species is identical with the findings on the profile XXI. although without *Ophiotrix quinquemaculata.)*

Profile XXVII, Banjole — Sta. Katharina (1100 m). The work on the profile was carried out in the years 1969 and 1970 and it was controlled in 1972. The Banjole section has from the depth —5 m down to —30 m a very slightly inclined infralittoral. In a distance of 60 m from the shore it reaches only a depth of —12 m. In spite of this, the coarse-clastic, debris-covered, partly bouldery sea-floor reaches as far as this depth (Fig. 5). It represents the facies with *Cystoseira* and *Sargassum* (I-1c, d), on boulders with additional *Amphiroa rigida, Lithothamnium lenormandi* and *L. philippi.* Molluscs are represented above all by *Alvania montagui, Bittium reticulatum, Certhium vulgatum* and *Nassa mutabilis*, from bryozoans the most frequently occuring one is *Cellopora pumicosa.* The prevailing species on the stations Nos. 1 to 6 and in the quadrant No. 6, in finer sand, are, except microgastropods attached to *Cymodocea nodosa*, the organisms *Cardium tuberculatum, C. paucicostatum* and *Venus gallina.* The material on the sea-floor is mixed with finer sand until the depth of —17 m, with a similar community of molluscs. From —17 to —30 m, the sandy substrate represents a typical biotope (thanatotope) with *Pecten jacobaeus* (I-5a), with all other characteristics and accompanying species of this facies, including isolated islets with *Cymodocea nodosa.* In a distance of 145 m from the shore (—30), colonies of the coral *Cladocora cespitosa* appear in a width of approx. 25 m (stations Nos. 14, 15, 16). The fauna and flora between the bioherms is roughly identical with the facies containing *Pecten jacobaeus*, however, there are additional more frequent occurences of red algae: *Peyssonnelia polymorpha, Fauchea repans, Lamentaria linearias,* and *Pseudolithophyllum expansum.* From bryozoans, except Hippo*diplosia foliacea,* there are also *Cellaria fistulosa, Retepora beaniana, Myriozoum truncatum* and *Porella cervicornis.* From molluscs, except the forms of the facies C-1a and I-5a, additionally occuring ones are *Chiton corallinus, Vermetus*

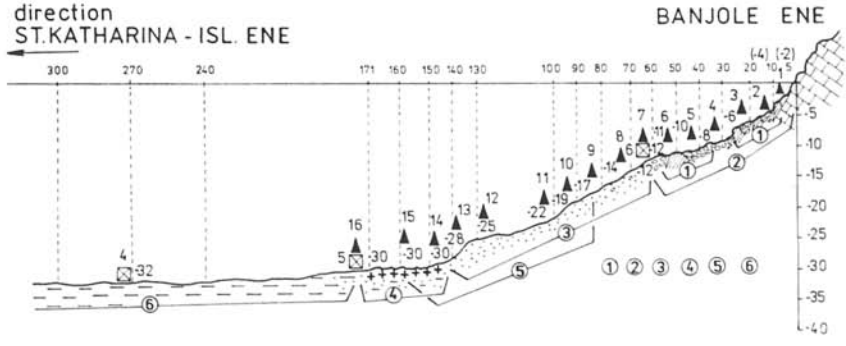

Fig. 5. Profile XXVII, Banjole — St. Katarina (Banjole section).
1 — infracoralligene (I-2a, b); 2 — *Cystoseira-Sargassum* (I-1c, d); 3 — *Cymodocea nodosa* (I-7a, b); 4 — *Cladocora* (I-5b); 5 — *Pecten jacobaeus* (I-5a); 6 — Hippodiplo*sia* (C-1a).

arenarius, Modiolus barbatus, Lima lima and *Lithophaga lithophaga.* From 170 to 300 m, in depths between —31 and —32 m, the almost level sea-bottom is formed already by arenaceous-muddy sediments; the quadrants Nos. 4 and 5 contained a typical facies with *Hippodiplosia foliacea* (C-1a).

Profile XXXIV, Banjole — W (1400 m) was situated towards the open shelf of North Adria. It was worked out gradually and it was controlled several times in the years 1969, 1970 and 1971. A relatively strong „descendent" current was observed in the western, inclined part of the island, in N-S direction. The upper part of the profile beginning near the entrance of the so-called „Upper Banjole cave", is until a depth of —30 m in a distance of 150 m from the island formed by a debris cone with boulders, in some parts varied by unsorted sandy planes (stations Nos. 1 to 5). They have the character of a typical infracoralligene (I-2), and of the facies *Cystoseira (Sargassum),* known from the previous profiles (Fig. 6). Islets with *Cymodocea* (I-7a, b) occur here less frequently, in the lower part with a colony of *Cladocora cespitosa* and with an atypical facies with *Pecten jacobaeus.* This whole section from 0 to —30 m represents a typical infralittoral. The circalittoral has to a distance of approx. 500 m (to a depth of —34 m) almost level floor, with deviations only in the range of 1—3 m. According to the evidence from the stations Nos. 6 (—32) and 7 (—34), it is represented by the facies C-1c, with a prevalence of *Arca noae* and less frequent occurence of *Hippodiplosia.* Typical muddy-organodetritic facies of the North Adriatic circalittoral with *Chlamys opercularis* and *Ophiotrix quinquemaculata* (C-1e) — occur to a distance of 1400 m from the island, on quadrant No. 2. The living material collected from this locality contains, except the mentioned *Ophiotrix* and *Chlamys,* also a considerable amount of tunicates, especially *Phallusia mamilata, Microcosmus sulcatus.* Characteristic forms of the biocenosis are except sciaphillic sponges also *Arca noae, Modiolus barbatus, Lima hians, Cardium papillosum, Pitaria*

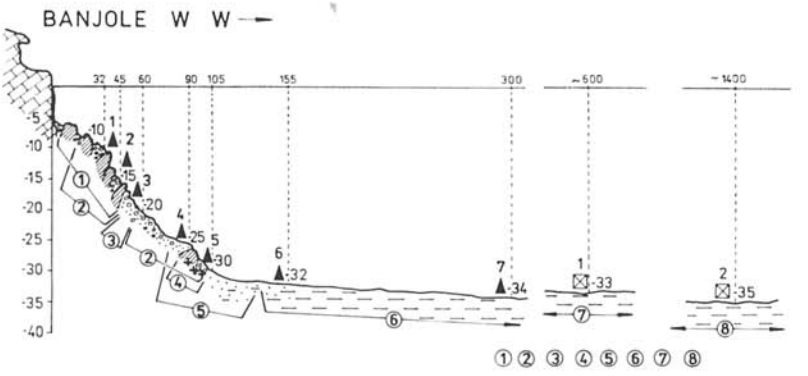

Fig. 6. Profile XXXIV, Banjole — W.
1 — *Cytoseira-Sargassum* (I-1c, d); — 2 infracoralligene (I-2a, b); 3 — *Cymodocea* (I-7a); 4 — *Cladocora (I-5b); 5 — Pecten jacobaeus* (I-5a); 6 — *Arca noae-Hippodiplosia (+Ophiorix)* (C-1c — C-1e); 8 — *Chlamys opercularis — Ophiotrix quinquemaculata* (C-1e).

rudis and *Psammechinus microtuberculatus*. Accompanying forms are on this quadrant molluscs from the genus *Diodora*, the species *Natica millepunctata*, *N. hebraea*, *Dentalium* div. sp., representatives of the genera *Nucula*, *Arca*, further *Chlamys varius*, *Aloidis gibba*, *Cuspidaria cuspidata* and a considerable amount of endobiotic forms the genera *Tapes*, *Tellina*, *Ensis* and *Thracia*. From foraminifers, besides *Rotalia*, *Elphidium* and *Nonion* div. sp., there are *Planorbulina mediterranensis*, *Cibicides lobatulus*, *Reussella spinulosa*, *Rosalina obtusa*, *Textularia calva* and *T. conica*. From ostracods we have determined *Cythereis antiquata*, *C. jonesi* and *Loxoconcha decipiens*. Quadrant No. 1 lying nearer to the island (approx. 600 m) shows a gradual transition between the facies *Arca noae — Hippodiplosia foliacea* (C-1c) and the facies *Chlamys opercularis — Ophiotrix quinquemaculata* (C-1e).

From the *auxiliary profiles* I would like to mention a 200 m long section *B - 1*, since it is characterized not only by a variety of facies, but also by the occurence of a biomass so far rare on the North Adriatic Shelf - *Sabella pavonina — Spirographis spallanzanii* (facies C-1d) - determined by the station No. 7 in depths between —31 and —32 m, as well as by eucoralligene between the stations Nos. 5 and 6 in the depth —28 m (Fig. 7). The facies *Sabella — Spirographis*, with the presence of these leading species, causes by its density a considerable reduction in the occurence of other, especially endobiotic organisms. The molluscs *Polynices guillemi*, *Nucula nitida* and *Venus ovata* can be considered characteristic. Less frequently occuring ones are *Nucula nucleus*, *Leda pella*, *Leda fragilis*, *Kellya suborbicularis*, *Myrtea spinifera*, *Tellina pulchella* and *Aloidis gibba*. The leading and constituting form of the eucoralligene which makes this profile more varied is *Pseudolithophyllum expansum*. The characteristic forms are in varying quantities occuring *Mesophyllum lichenoides*, *Neogoniolithon mamillosum*, *Peyssonnelia polymorpha*, *P. squamaria*, *P. rubra*; further the anthozoans *Parazoanthus axinellae*, *Balanophyllia italica*, *Caryophillia clavus* and the molluscs *Clanculus carollinus*, *Vermetus arenarius*, *Cerithium vulgatum*, *Cypraea lurida* and *Arca noae*.

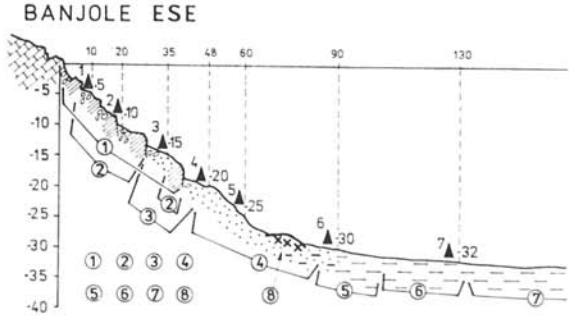

Fig. 7. Profile Banjole B—1.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — *Glycymeris glycymeris-Arca noae* (I-4b); 4 — *Pecten jacobaeus* (I-5a); 5 — *Arca-Hippodiplosia* (C-1c); 6 — *Sabella pavonina-Spirographis spallanzanii* (C-1d); 7 — *Hippodiplosia* (C-1a); 8 — eucoralligene (C-4).

The *auxiliary profile B-2* in the direction W of the island, only about 150 m long, is mentioned only because it is intersecting the „Lower Banjole caves", with openings in —17 and —20 m. These caves are very rich in sponges the spicules of which accumulate not only on their bottom, but they are washed to the whole area, especially of the circalittoral. A typical deeper infracoralligene is developed in depths between —25 and —30 m. In the depth —30 m a colony of *Cladocora cespitosa* has been found as well. There in the lower part adjacent circalittoral (station No. 7) is in depths —31, —32 m formed by muddy organogenic sand in the development C-1c *(Arca noae — Hippodiplosia foliacea* (Fig. 8).

I describe the *auxiliary profile B-6* because it is, like the profile B-1, facially very varied, with the presence of the community *Sabella — Spirographis* and eucoralligene. In addition, a typical coral facies with *Cladocora cespitosa* occurs on this profile as well (Fig. 9). Its benthonic association does not differ substantially from the profile B-1.

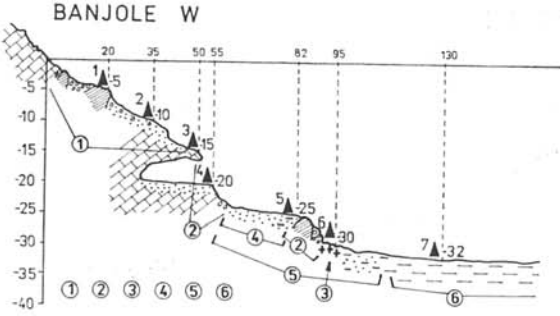

Fig. 8. Profile Banjole B—2.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — *Cladocora* (I-5b); 4 — *Cymodocea* (I-7b); 5 — *Pecten jacobaeus* (I-5a); 6 — *Arca-Hippodiplosia* (C-1c).

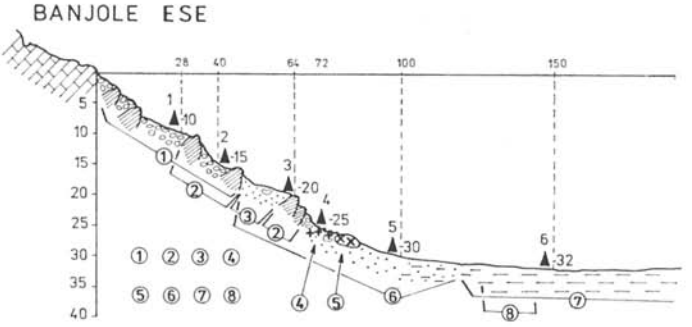

Fig. 9. Profile Banjole B—6.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — *Cymodocea* (I-7a); 4 — *Cladocora* (I-5b); 5 — eucoralligene (C-4); 6 — *Pecten jacobaeus* (I-5a); 7 — *Hippodiplosia* (C-1a); 8 — *Sabella-Spirographis* (C-1d).

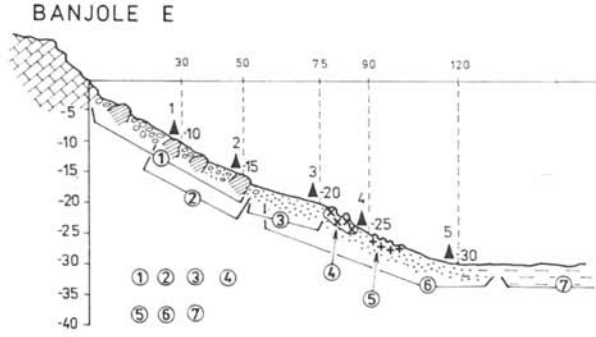

Fig. 10. Profile Banjole B—7.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — *Cymodocea* (I-7a); 4 — eucoralligene (C-4); 5 — *Cladocora* (I-5b); 6 — *Pecten jacobaeus* (I-5a); 7 — *Hippodiplosia* (C-1a).

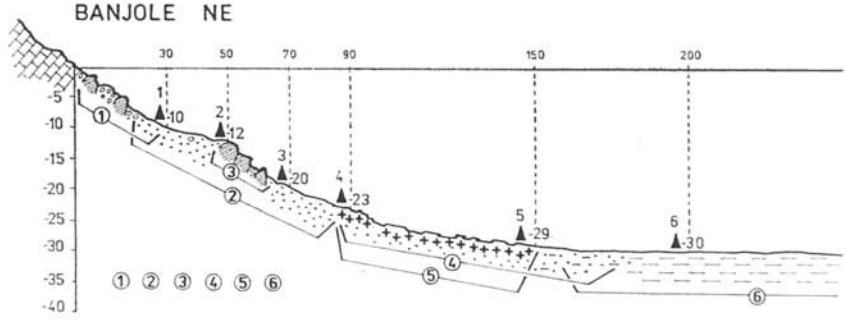

Fig. 11. Profile Banjole B—8.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — *Cymodocea* (I-a); 3 — infracoralligene (I-2a, b); 4 — *Pecten jacobaeus* (I-5a); 5 — *Cladocora* (I-5b); 6 — *Hippodiplosia* (C-1a).

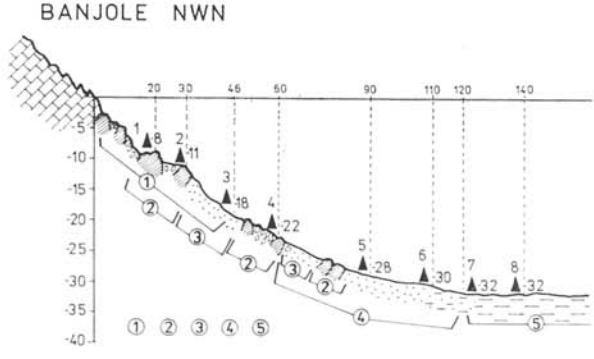

Fig. 12. Profile Banjole B—11.
1 — *Cystoseira-Sargassum* (I-1c, d); 2 — infracoralligene (I-2a, b); 3 — *Cymodocea* (I-7a, b); 4 — *Pecten jacobaeus* (I-5a); 5 — *Hippodiplosia* (C-1a).

The *auxiliary profile B-7* is interesting not only by the presence of eucoralligene and the bioherm from *Cladocora*, but above all by its very moderate inclination and thus by wider dimensions of the communities *Cystoseira/Sargassum*, with exceptionally rich vagile and sessile benthos as well as with a considerable extent of the facies with *Pecten jacobaeus* (Fig. 10).

The *auxiliary profile B-8* has even more moderate inclination of infralittoral than B-7 and the depth —29 m is reached only in a distance of 150—160 m from the shore. Bioherms with *Cladocora cespitosa* are developed on this profile in a large distance 85 to 150 m, while their clusters attain exceptional size in depths between —25 and —27 m (Fig. 11).

I mention the *profile B-11* only because it contains a classical type development of the most frequent facies of the Banjole infralittoral. The biotopes and thanatocenoses are roughly identical with the profile XXVI, but they are richer in sessile and vagile benthos.

As a conclusion of this contribution, a few notes to some of the facies:

A more detailed evaluation of the biotope of the lower caves of the island on the profile B-2 has not been the subject of our studies, since all accessible submarine caves and their biocenoses including spaeleophilic species have already been analysed by Riedl (1966) in his book which exhaustingly presents all spaeleo-objects of the Mediterranean region including the submarine caves in the Rovinj region. However, we have made a routine survey and a spare collection of flora and fauna; at the same time, in the southern, longer cave an earlier known fact has been confirmed, that in the area of the opening and the surrounding still illuminated parts of the cave photophillic species occur abundantly, while in the inner, not illuminated, or in our case by a single, upward, to the sea-floor reaching gloup sparsely illuminated parts of the cave sciaphillic species prevail or occur exclusively. These species live on the open parts of the profiles mostly only in dark cavities, in greater depths, or on lower overhanging surfaces in a considerably dusty environment. Already during a routine examination of the upper, but especially northern and southern lower cave (Fig. 1), the presence of the rhodophyts: *Peyssonnelia polymorpha*, *P. rubra*, *Lithothamnium philippi*, *Melobesia farinosa*, *Pseudolithophyllum expansum*, *Jania rubens*, *Ceramium codii*, has been determined. Poriferas are prevailing in the whole extent of the caves on the side walls as well as on the ceiling. Various species of *Calcispongiae* and *Desmospongiae*, cause the incredibly varied colouring of the caves. Even without a detailed laboratory research we could determine the species *Crambe crambe*, *Clione* div. sp., *Vergonia* sp., *Cocaspongia scalaris*, *Hemimiscale columella*, *Petrosia ficiformis*, *Axinella verrucosa*, *Spirastrella cunctatrix*, *Diplostrella bistellata*, *Hliclona cratera*. (Approximately the same species have been found also in the submarine caves on South Adriatic Shelf in the region of Žuljana, which nevertheless lies outside the lines of our profiles). Anthozoans are represented richly. A very large specimen of *Cerianthus membranaceus* was found on the bottom of the northern lower cave. More frequently occuring are further *Parazoanthus axinellae*, occuring frequently also on an overhanging wall on the begining of the profile B-2, then *Alcyonum palmatum*, *Alcyonaria* sp.,

Eunicella cavolinii, *Paramuricea chamaeleon*. Interesting is also the occurence of *Actinia equina* in this depth, since it occurs usually in the highest horizons of mediolittoral, on lower, not illuminated parts of large pebbles or blocks. Molluscs are represented by *Lithodomus lithophagus*, *Discodorus cavernae*, *Vermetus arenarius*, *Mytilus galloprovincionalis*, with small specimens in the proximity of the opening of the cave. From bryozoans, the genera *Scrupocellaria* sp., *Hippodiplosia* sp. (on opened parts of the profile occuring mostly only in depths under —30 m), *Porella* sp., *Retepora* sp., *Myriopora* sp..have been determined. From echinodermates, undoubted is the occurence of *Ophiaetis virens*.

As far as the communities *Sabella-Spirographis* are concerned, (profiles B-1, B-6), this facies represents a rare type of circalittoral on the North Adriatic Shelf (Fig. 29).*

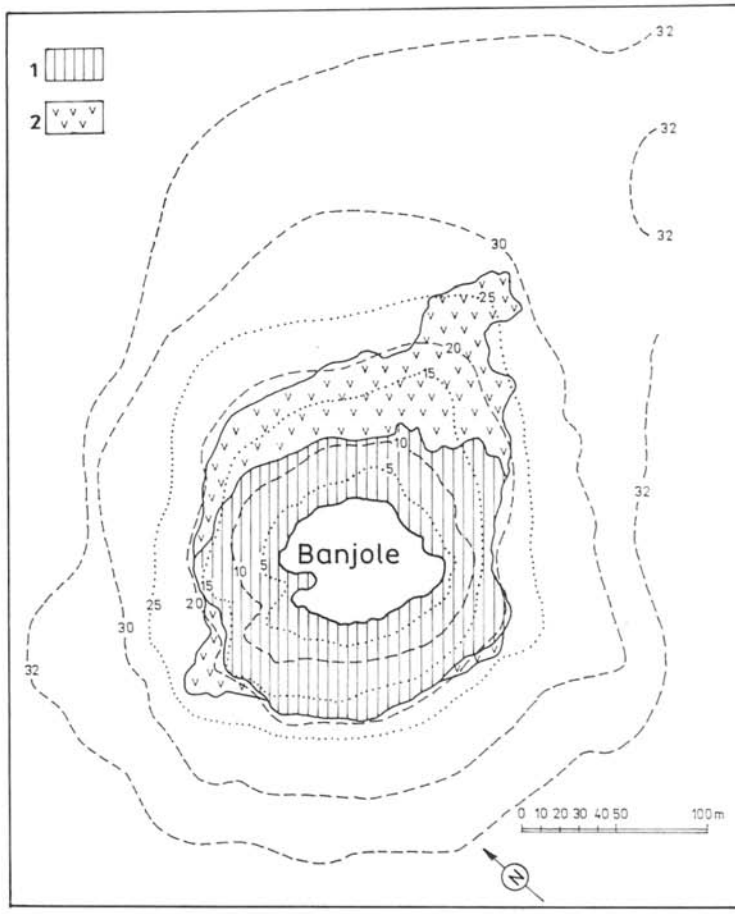

Fig. 13. Distribution of phytal infralittoral around the island Banjole.
1 — *Cystoseira-Sargassum* facies; 2 — *Cymodocea* facies.

Eucoralligene is developed on the eastern part of the island Banjole considerably less than on the South Adriatic Shelf. However, it undoubtedly affects the composition of the surrounding facies by its growth as well as by its biological erosion (Fig. 14).

The bioherms *Cladocora cespitosa* almost surrounds the island in depths between —24 and —32 m. They occur predominantly on sandy-detrital sea-

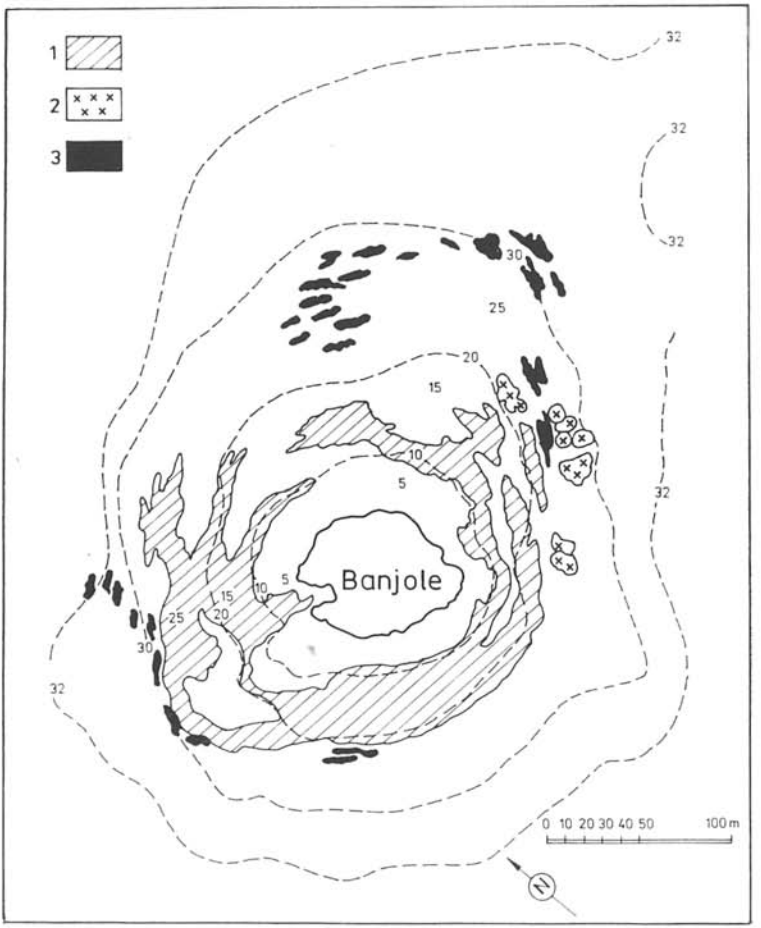

Fig. 14. Distribution of coralligene around the island Banjole.
1 — infracoralligene; 2 — eucoralligene; 3 — *Cladocora cespitosa* bioherms.

* The facies C-2c occuring on the South Adriatic Shelf (eastern regions) - *Sabella pavonina* — *Venus casina* - is considerably more frequent especially in greater depths, while the individuals have larger dimensions and they form fields severals hectars large.

-floor, on the lower boundary of the facies with *Pecten jacobaeus*, or on the boundary of this environment with the circalittoral facies containing *Hippodiplosia foliacea*. From the viewpoint of ecology, this is a species with sciaphillic inclination, otherwise it would occur also in lesser depths and it would from, similarly as in tropical conditions, coral reefs around the island. However, its occurence localized in a circle around the island Banjole is even so an unique, hitherto undescribed phenomenon on the North Adriatic Shelf (Fig. 14). The similarity of this bioherm with eucoralligene is stressed by the frequent occurence of rhodophyts, especially *Peyssonnelia polymorpha*, *Fauchea repans*, *Lamentaria linearis* and *Pseudolithophyllum expansum*.

Translated by K. Janáková

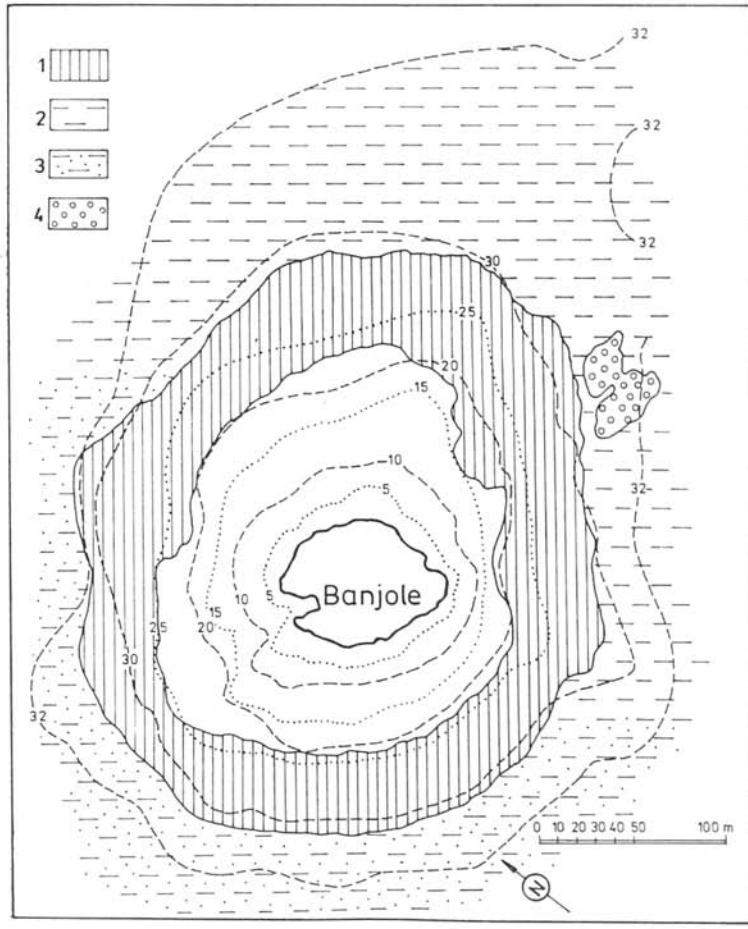

Fig. 15. Distribution of detritic facies-ecosystems around the island Banjole.
1 — *Pecten jacobaeus* facies; 2 — *Hippodiplosia foliacea* facies; 3 — *Arca noae*-*Hippodiplosia* facies; 4 — *Sabella pavonina*-*Spirographis spallanzanii* facies.

Table 1

Textural and mineralogical composition (Fejdiová, 1972)

composition \ sample		profil XXI		profil XXVII		
		Kv. 3	Kv. 7	Kv. 1	Kv. 2	Kv. 3
mean	M	0.4	4.6	—0.63	1.13	3.13
sorting	σ_I	1.5	2.8	2.22	2.25	4.31
asymetry	Sk_I	0.17	0.19	0.44	0.23	—0.22
kurtosis	K_G	1.3	1.4	0.57	1.15	0.80
$CaCO_3$		77.71	73.80			
Mineral composition	chlorite	+	+			
	biotite	+	+			
	muscovite	+	+			
	garnet	+	+			
	rutile	+	+			
	epidote	+	+			
	amphibole	+	+			
	pyroxene	+	+			
	glauconite		+			
	ilmenite	+	+			
	leucoxene					
	apatite					
	chromite					
	cinnabarite					
	bauxite	+	+	+	+	+
	zircon					
	corundum					
	tourmaline					
	magnetite					
	mocryt, quartz					
	carbonates					
resulting sediment		coarse sand	clay	gravel coarse sand	medium grained sand	fine sand

Photos in depository of the Geological Institute of the Centre of Geoscience Research, Slovak Academy of Sciences

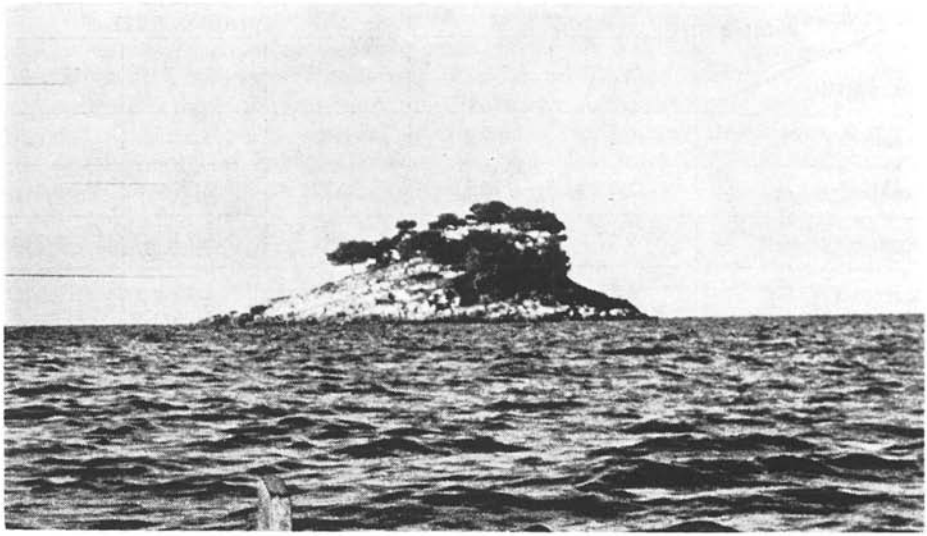

Fig. 16. Island Banjole near Rovinj on North Adriatic Shelf.

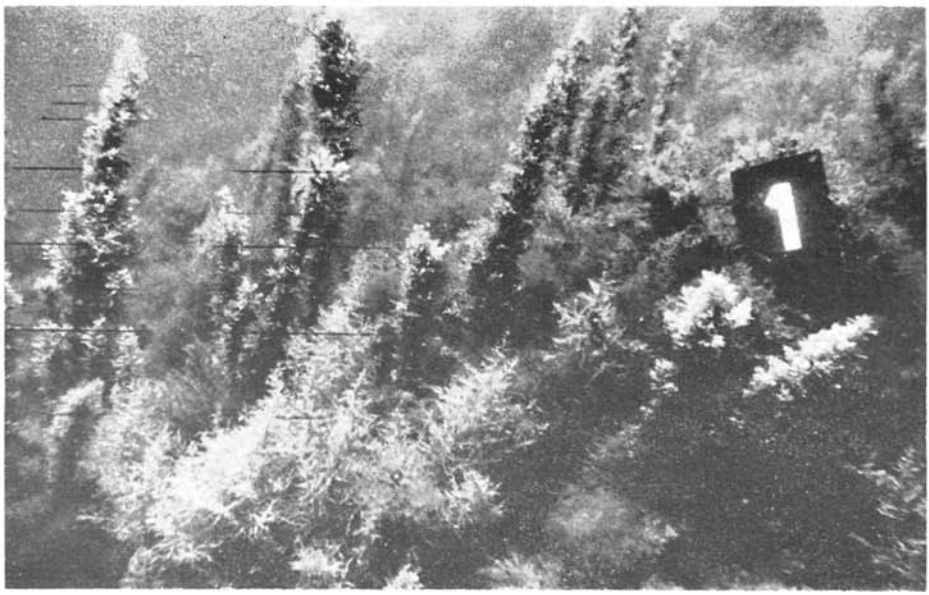

Fig. 17. Facies I-1d. Profile XXI, station Oo. B—1, —8 m. Typical phytal debris-sandy upper infralittoral with *Sargassum linifolium*. In foreground various species of brown algae from the genus *Cystoseira*.

Fig. 18. Facies I-1c, d, represented on upper sections of infralittoral slopes by a dense, often mixed growth of *Sargassum* and *Cystoseira*. Profile B—12, depth 7—8 m.

Fig. 19. Facies I-1c with a dense growth of various species of the genus *Cystoseira*. Profile B—12, in a depth of —5 m on infralittoral slope.

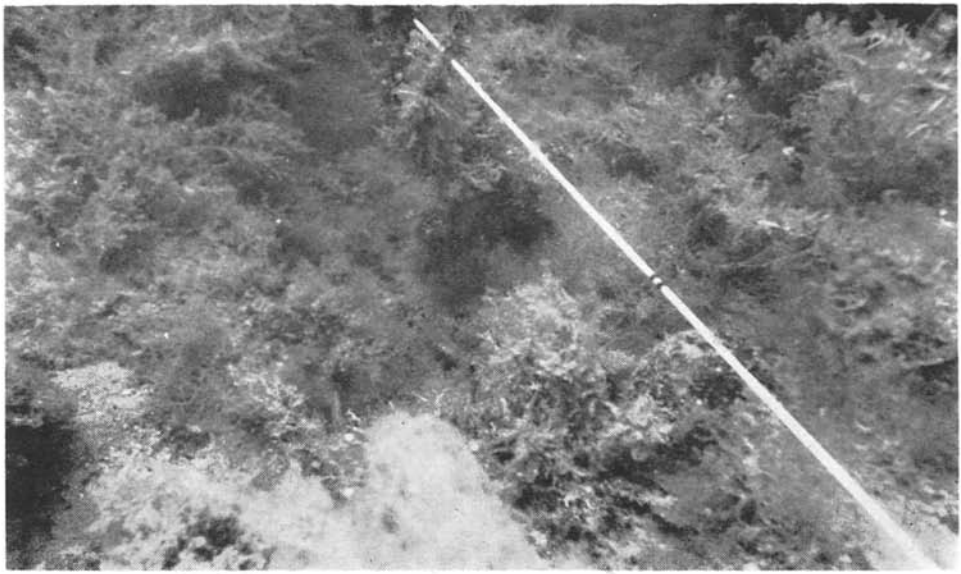

Fig. 20. A calibrated rope denoting the direction of the profile in its total length. Profile B—9 in the proximity of the station No. 2 in a depth of —10 m. *Cystoseira* growth (facies I-1c) overgrown by hydrozoans and especially by various small algae on the infralittoral slope.

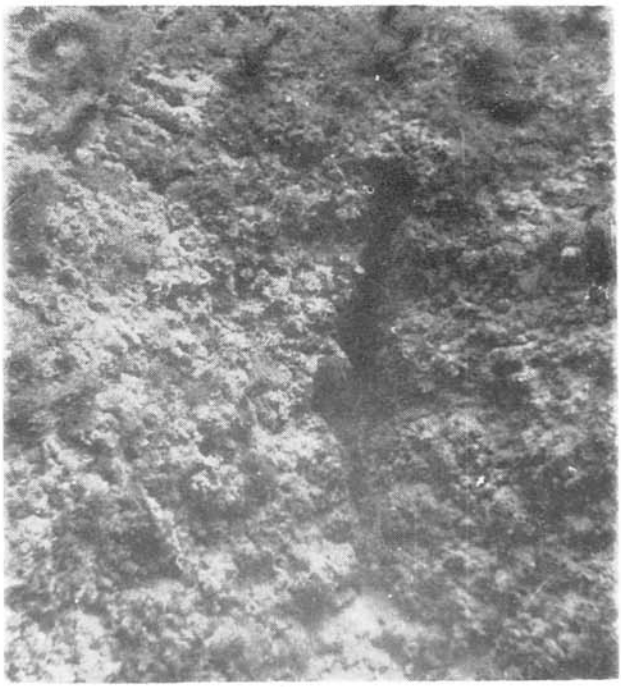

Fig. 21. Facies I-1, rocky phytal infralittoral with *Lithothamnium lenormandi*, with a transition to I-2a, b with *Lithophyllum philippi* and *Pseudolithophyllum expansum*, Above this typical infracoralligene, a thin growth of *Sargassum* can be seen. Profile XXVIII between stations Nos. 3 and 4, in the depth —8 m.

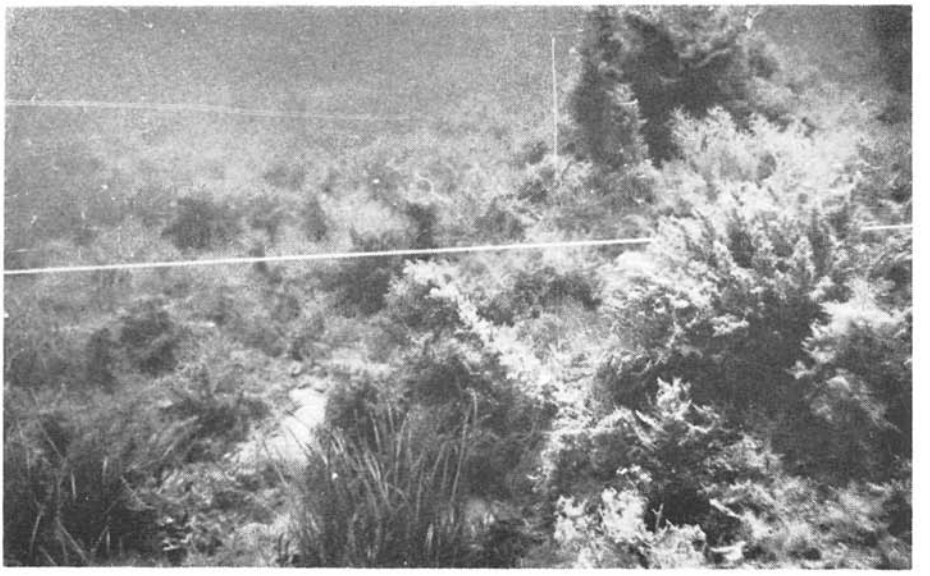

Fig. 22. The transition of the ecosystem *Cystoseira-Sargassum* (I-1c, d) into the *Cymodocea* zone in the depth —20 m of the profile B—12 near the station No. 18.

Fig. 23. The basis of lower infracoralligene (I-2b) with *Pseudolithophyllum expansum* near the ecosystem with *Pecten jacobaeus* (I-5a). On infracoralligene there are in some parts typical orange-red tunicates *Holocynthia papillosa* (on the photo black), in background *Cystoseira* branches overgrown by other algae and partly extinct. Profile B—11 near the station No. 5 in a depth of —27 m.

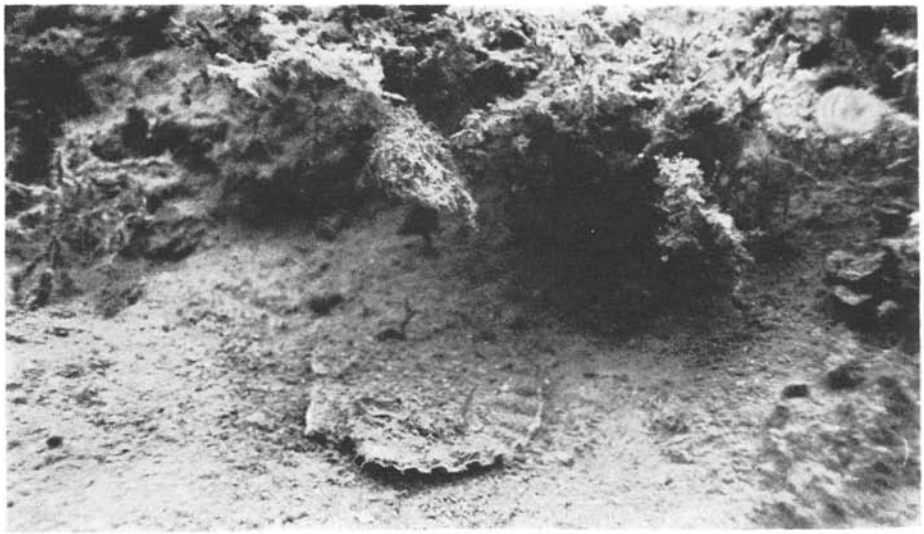

Fig. 24. Facies of detrital sand with *Pecten jacobaeus* (I-5a) on the boundary with an islet of eucoralligene. Profile B—11, near the station No. 5, —28 m.

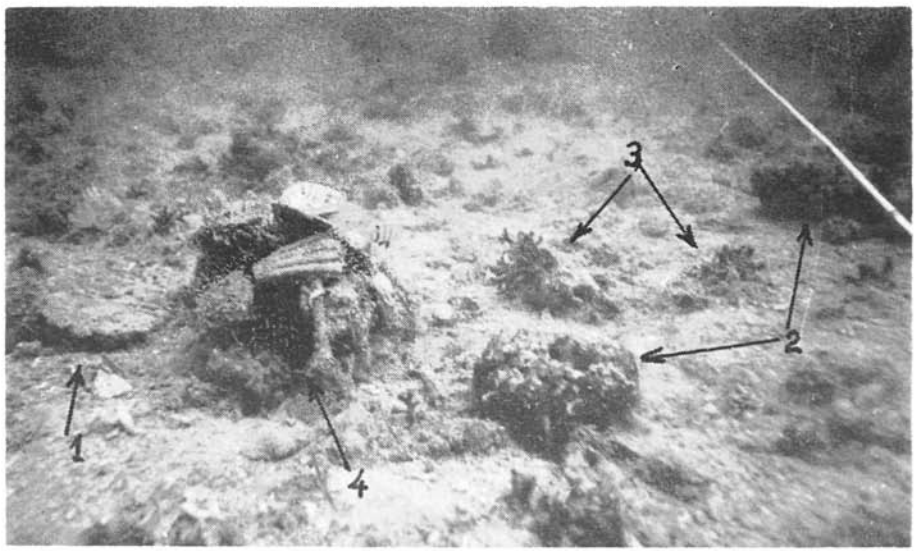

Fig. 25. Contact zone of the ecosystems *Pecten jacobaeus* (I-5a), *Cladocora cespitosa* (I-5b) and the appearance of first colonies of the bryozoans *Hippodiplosia foliacea* (typical in the ecosystem C-1a) on organodetrital arenaceous sea-floor. Profile B—8, station No. 5, —28 m.
1 — *Pecten jacobaeus;* 2 — bioherms of *Cladocora cespitosa;* 3 — *Hippodiplosia foliacea;* 4 — *Spaerechinus granularis* masked by fragments of molluscs.

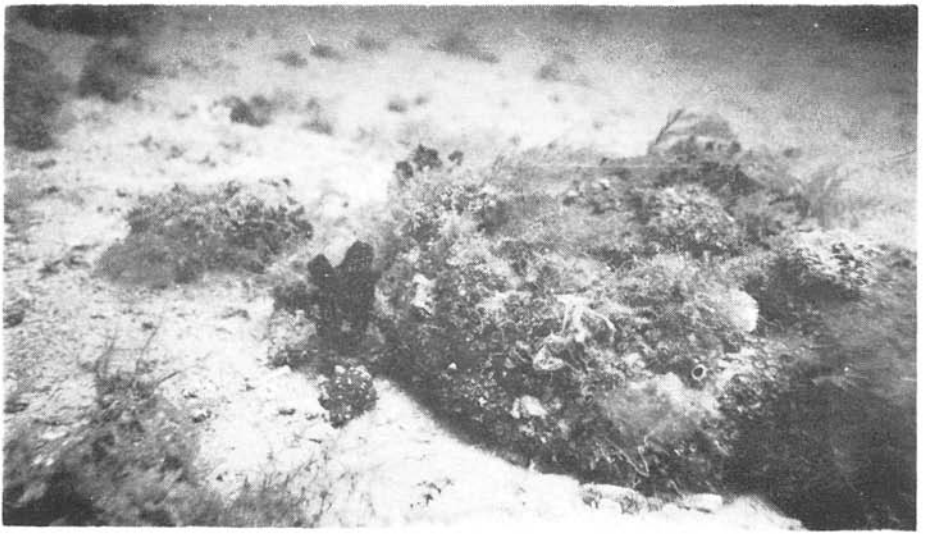

Fig. 26. Bioherm of *Cladocora cespitosa* overgrown mostly by brown and red algae as well as by various epi-and endofauna. On the left side of the colony the tunicate — *Holocynthia papillosa*. Ecosystem I-5b. Profile B—8, between the station Nos. 4 and 5, —25 m.

Fig. 27. Typical population of the facies I-5b with bioherms of *Cladocora cespitosa* densely overgrown by algae, hydrozoans and small bryozoans. Profile B—8, from the section between the stations Nos. 4 and 5, —26 m.

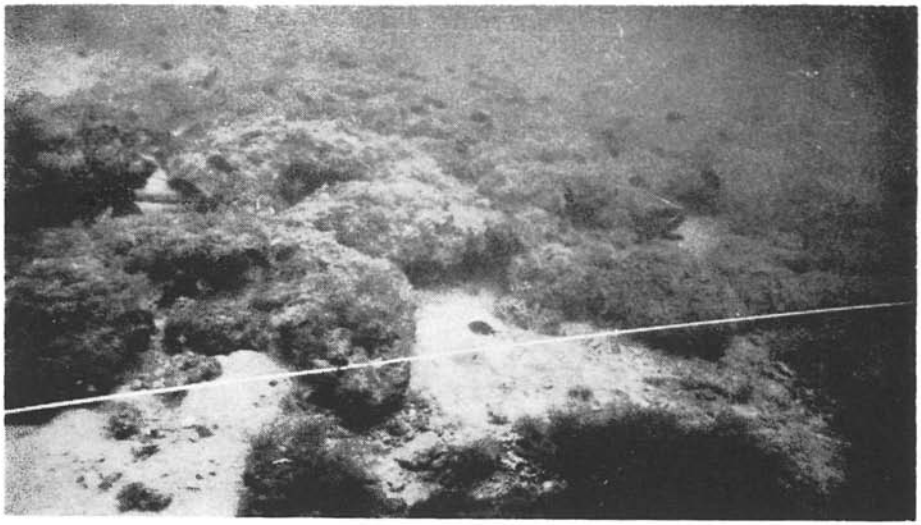

Fig. 28. Mass population of the ecosystem I-5b (bioherms from *Cadocora cespitosa*) near the island Banjole in depths between —23 and —29 m, on the profile B—8.

Fig. 29. Ecosystem with *Spirographis spallanzanii* and *Sabella pavonina* (C-1d) on North Adriatic Shelf. Profile B—1, station No. 7, —32 m.

Fig. 30. A small eucoralligene bioherm formed above all by *Pseudolithophyllum expansum* (C-4) overgrown by brown and red algae. It occurs on sandy sea-floor with atypically rare occurence of *Cymodocea nodosa* (I-7b), in a depth of —28 m, on the profile XXVII, near the station No. 13 (around the reef *Holothuria tubulosa*).

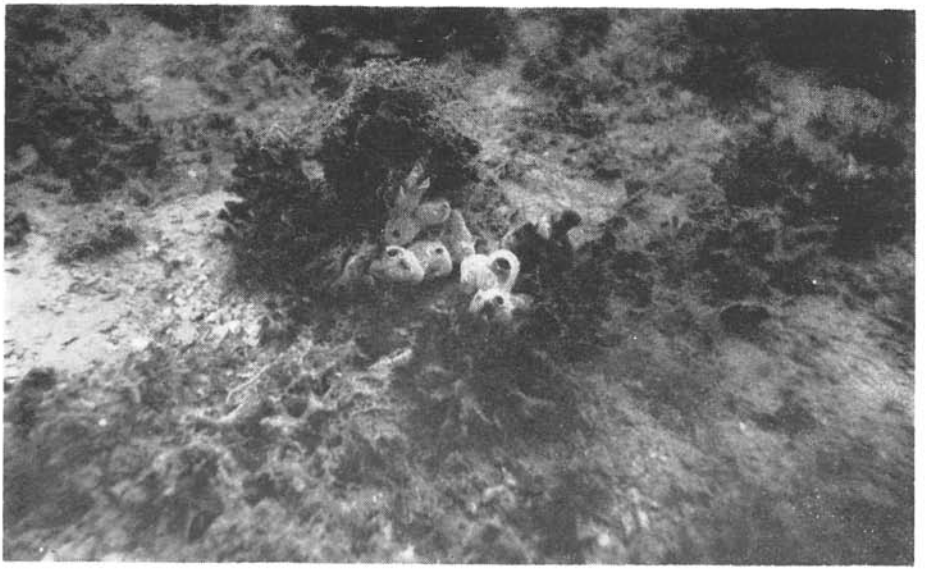

Fig. 31. Exceptionally dense population of the ecosystem C-1a by typically wide--leafed and thick-walled colonies of *Hippodiplosia foliacea*. In foreground probably extinct branches overgrown by red algae. In the centre of the picture a group of tunicates *Phallusia mamillata*. In background offeshoots of bioherms from *Cladocora cespitosa*. Profile B—8, in the proximity of the station No. 6, depth —30 m.

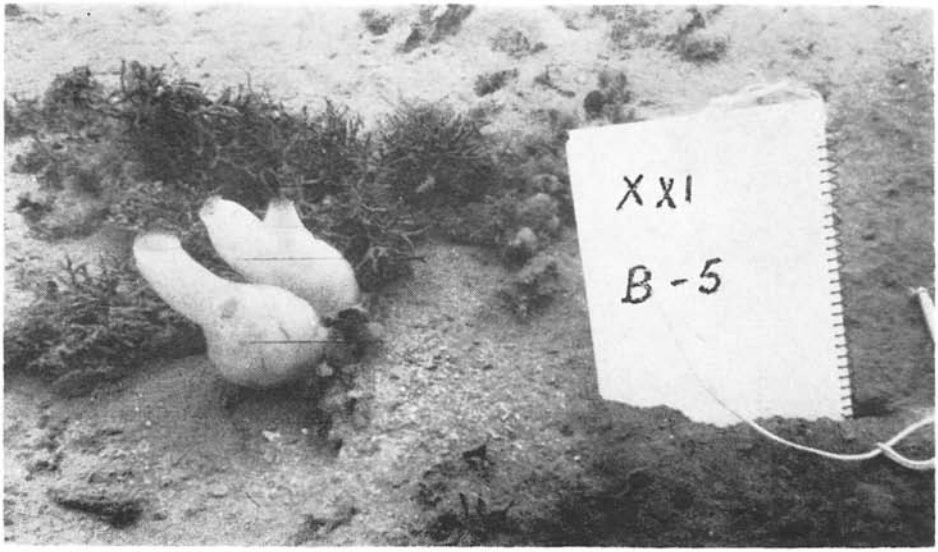

Fig. 32. Atypical composition of the ecosystem C-1a, where colonies of *Porella cervicornis* and *Hornera frondiculata* prevail over *Hippodiplosia*. Sciaphillic desmosponges as well as the tunicate *Phallusia mamillata* occur sporadically. Profile XXI, the place of the station B—5 before sampling in the depth —35 m.

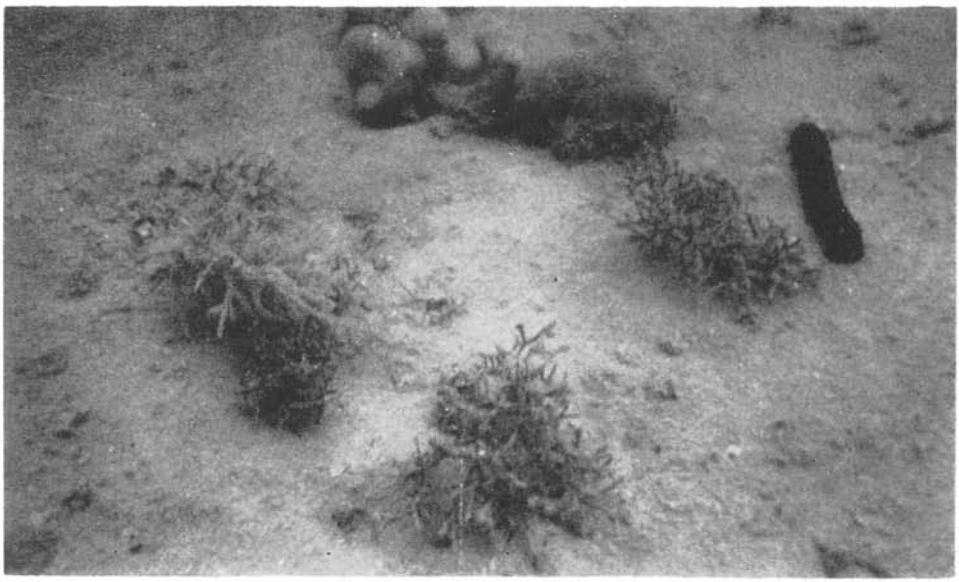

Fig. 33. *Hippodiplosia foliacea* on fine-arenaceous-muddy-organodetrital sea-floor (facies C-1a) on the profile B—9, near the station No. 9 in a depth of —32 m. (In backgroud sciaphillic tetractinellides, on the right site *Holothuria* sp.).

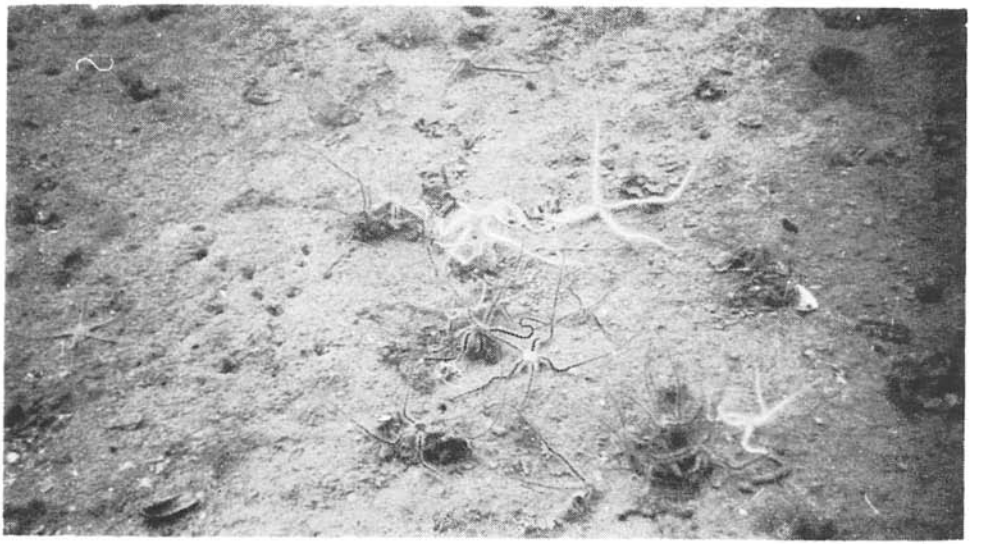

Fig. 34. Locality for sampling of type quadrant (q. No. 2) of the ecosystem with *Chlamys opercularis — Ophiotrix quinquemaculata* (C-1e) on the profile XXXIV in the depth —35 m. On the surface of detritus, except *Ophiotrix quinquemaculata* and *O. fragilis* there are numerous shells of extinct *Arca noae*, *Chlamys opercularis* and other molluscs, left in the centre of the picture there are siphonal holes of endobiotic lamellibranchiates.

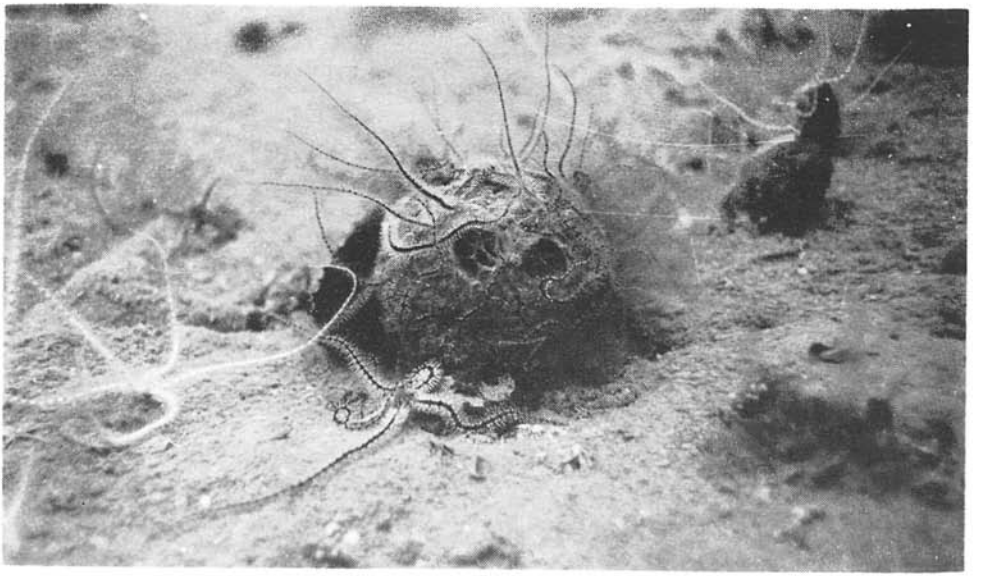

Fig. 35. Detail from the ecosystem C-1e *(Chlamys-Ophiotrix)* on the profile XXXIV near quadrant No. 2, in the depth —34 m. Except *Ophiotrix*, in the centre of the picture the sciaphillic silicasponge *Clione viridis*, immediatelly behind it *Holothuria tubulosa*. On the right side *Polycarpa pomaria*.

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Note: I would like to stress that the references are concerning the whole extent and subject of the paper, thus it was inconvenient to mention the authors in the text.

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