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## ADRIATIC MOLLUSKS OF THE SPLIT AREA

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JADRANSKI MEKUŠCI OKOLINE SPLITA

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# ADRIATIC MOLLUSKS OF THE SPLIT AREA

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By

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The data presented in this paper were collected from 3rd through 6th September 1960 at Split, where I had the honour to be the guest of the Institute of Oceanography and Fisheries. I am glad to have this opportunity to thank the Institute for the generous invitation and hospitality, and particularly for making it possible for me to use its facilities, as well as for the kind assistance of the staff.

The exploration and collection covered the coastal area stretching over a few kilometres between the northern precincts of the town and the Institute and, very often, the sea lying off that area. Numerous grab samples were taken from depths measuring up to 8 metres. Better results are obtained, in my opinion, when a smaller area is properly studied than when a larger one is desultorily explored.

In this area, as everywhere, the spreading of mollusks is adjusted to the environmental conditions. The coast of the searched area consists of limestone full of crevices while rocks lie scattered all along it. The bottom is either rocky, in many places covered with rubbles, or there are rocky patches alternating with patches of sand mixed with pebbles. The grab samples were taken from stony-sandy substratum. The algae vegetation is luxuriant because the clear water is penetrated by the sunshine to the very bottom. There are also rocky patches, however, particularly in the deeply shaded areas among the rocks.

The results of my researches, grouped according to the distribution and the way of life of the examined species, are summarized in the following lines.

## SUPRATIDAL ZONE

This zone is not covered with water but it is wetted by the splashing and vaporization of the sea water. The *Littorina neritoides* (L.) lives in masses in the crevices. This species is the characteristic dweller of the zone. Single specimens are rarely found below the low water mark. The species feeds on monocellular algae growing on the rocks. Only some empty shells, washed ashore, were found of species to be dealt with later on.

## SUBTIDAL ZONE

All the other collected species live below the low water mark. Two zones should be distinguished, the ebb-and-flow zone, lying more or less above the water surface during the ebb-tide, and another one, lying below the ebb-line and being constantly covered with water. The limit between the above two zones, however, is not sharply defined as the range of the tide is slight, and some water remains in the cavities even while the tide is out and the surf wets the area even above the subtidal line. At any rate, the greater part of the collected species live mostly below the low water mark. The species occurring below the subtidal line are distributed as follows.

## ROCK-DWELLERS

1. *Sessiles*. Living burrowed in the bottom or clinging to it, these species are not at the mercy of the surf and cannot be smashed to pieces on the rocks. Their food consists of detritus and small living creatures swirling through the water.

A. Rock-borers. These species live in the holes they themselves bore into the rocks. The searched area yielded three species of this kind. *Lithophaga lithophaga* (L.) is very frequently found in the coastal shallow waters where it bores the rocks making them resemble a sieve. Smaller quantities could be hauled from depths ranging between 6 and 8 metres. *Pholas dactylus* (L.) Frequently found at the same depth as the foregoing species but in considerably smaller numbers. Although occurring with the above-mentioned species, *Petricola lithophaga* (Retz.) could only sporadically be found at some distance (9 metres) from the shore.

B. Species attached to rocks or stones. They occurred everywhere in the investigated depths: *Vermetus triqueter* (Bivona) is very frequent. *Vermetus subcancellatus* (Bivona) is frequent. *Vermetus cristatus* (Biondi) is fairly frequent. *Vermetus arenauris* (L.) is not rare but only young specimens could be found alive, while only empty broken shells of adult ones occurred. *Chama gryphoides* (Lm.) clings to the substratum with one half of its shell only. Although it is not rare, only young individuals were found at the investigated depth. Its proper place, in my opinion, must be somewhat deeper, C. Species clinging by means of byssus. *Mytilus galloprovincialis* (Lm.). Specimens of different age are frequent at low water; they may occur somewhat deeper too, but few were found in the grab. The species is common in algae spots. Young specimens of *Modiolus barbatus* (L.) often occurred at the examined depths, while rather scattered individuals of *Musculus sulcatus* (Risso) could be observed. *Arca lactea* (L.) is not rare and can be found at any depth on rocky, stony, or stony-sandy bottom. A single adult specimen occurred. Its proper dwelling may be situated deeper. *Arca Barbata* (L.), sporadically spread below the low water line, was found on bottoms similar to that of the foregoing species, even in a hole bored by *Lithophaga*. Young

specimens of the species *Anima ephippium* (L.) were not rare at the examined depths, but only one adult specimen occurred. *Cardita calyculata* (L.) has a sporadic occurrence on stony-sandy bottom, not far from the low water line. It may be mentioned here that the young specimens of the *Lithophaga* rock-borers cling to rocks by means of byssus before boring into them, and their moderate occurrence on the rock surface is, naturally, a not unfrequent one. The *Pectinidae* family belongs to this group due to its way of life because the individuals, at least in their young age, also cling by means of byssus. This family yielded only a few specimens of *Clamys flexuosa* (Poli), *Chlamys varia* (L.), and *Pecten maximus* (L.) occurring on gravelled sand bottom at a depth of 8 metres. They seem to live in deeper water.

2. *Vagilis forms*. The species belonging to this group crawl about on the bottom feeding on algae or watching for prey.

A. Algae-eating species clinging to rocks with their wide soles. Some of the species that can be included here hardly ever move, clinging fast to rocks, their broad and flat shells being easily rolled by waves. *Haliotis lamellosa* (L.m.) is very likely a smaller and slender variety of *Haliotis tuberculata* (L.) sporadically clinging to rocks below the low water mark. *Fissurella graeca* (L.), found in the same zone as the foregoing species, is much more scattered. *Patella caerulea* (L.) occurs frequently, clinging to rocks hardly above the low water mark. Several specimens were collected at the pier in front of the Institute. It is often covered with algae. *Patella scutellaria* (L.m.) lives in the subtidal zone, clinging to rocks. It is less frequent than the former species. Some other species belonging to this group are more mobile, their soles less wide and, although clinging to rocks, they defend themselves against the waves by means of their shells but, if needed, they can roll in the surf like pebbles. They usually occur in the subtidal zone, favouring the areas rich in algae. *Monodonta turbinata* (Born.) is very frequent in the subtidal zone. *Monodonta articulata* (L.m.) is not rare in stony and gravelled substratum at the low water level, but it is also found below the low water mark. Some specimens occurred in the samples taken with the grab. *Gibbula divaricata* (L.) is frequent on rocky and stony bottoms in the subtidal zone.

B. Species with narrower soles, defending themselves against the surf by withdrawing into crevices. Their thick and suitably formed shells add to their defence. They are both mobile and carnivorous. *Neritula (Nassa) neritea* (L.) occurs sporadically at low water level and even below it, in the rock crevices and on stony-sandy substratum. A few young specimens of *Conus mediterraneus* (Brug.) were found at depths ranging between 6 and 8 metres, on stony-sandy bottom.

#### DWELLERS OF ALGAE SPOTS

The following species find suitable, essential conditions for their existence only in algae covered spots, but can grow well among the algae in the rocky areas, too. The snails, with their towerlike shells, move easily among the algae

and their movement is rendered easy by the lengthy form of the shell. This is particularly important in their vertical crawling. Being more or less strong, their shells offer shelter against the surf, and adjustment is not needed. Some of the snails are algae eaters, but others, moving more briskly, are carnivorous. Algae eaters: *Gibbula adamsoni* (Payr.). Young specimens are frequent among the algae in the rocky areas near the low water mark. Young individuals of *Gibbula magus* (L.) and *Gibbula richardi* (Payr.) live in the same habitat as the foregoing species but in smaller numbers, while young specimens of *Gibbula varia* (L.) occur only sporadically. *Tricolia* (*Phasianella*) *pullus* (L.) is sporadically represented by young individuals found in the zone below the low water mark. An empty shell of a young specimen of *Scala communis* (L.) was found at a depth of 8 metres on pebbled sandy algae substratum; another empty shell, washed ashore, was found in good condition. Specimens of *Truncatella truncatula* (Drap.) lay scattered on stony-sandy algae bottom, 8 metres off shore. *Rissoa variabilis* (Mühlfeldt) was frequent in shallow water, on stony bottom covered with algae. It also occurred, in limited numbers, in samples taken with the grab from stony-sandy bottom rich in algae. Specimens of *Alvania cimex* (L.) were found together with the foregoing species but in considerably smaller quantities. The species *Bittium reticulatum* (Da Costa), frequent on stony-sandy bottom covered with algae, occurred in places up to 8 metres off shore. *Cerithium vulgatum* (Brug.) is similarly distributed but, while living specimens could not be observed above the low water mark, their occurrence increased and was frequent below it. The species *Cerithium rupestre* (Risso) was observed on rocks covered with algae. Its occurrence increased downwards and was frequent below the tidal line. Specimens of *Triphora per-versa* (L.) were sporadically present below the low water mark, mostly under stones covered with algae. *Lima inflata* (Chemn.) was rare below the low water mark. Its habitat is likely at greater depths which could not be examined. Carnivorous snails: the species *Tritonalia* (*Muricopsis*) *blainvillii* (Payr.) is not rare in the vicinity of the shore, on stony-sandy places covered with algae. *Columbella rustica* (L.) is sporadically found on stony bottom among the algae at a depth of 8 metres measured from the low water mark. Its occurrence increases downwards. *Pisania maculosa* (Lm.) is fairly frequent on stony-sandy bottom covered with algae and situated in the neighbourhood of the low water mark. A few specimens were found even at depths ranging from 6 to 8 metres. Specimens of *Nassa incrassata* (Müll.) were sporadically found on stony bottom covered with algae in shallow water along the shore.

#### SAND-DWELLERS

Most of these species live burrowed in sand, feeding on detritus, and sheltered by their shells. The shells are more or less thin as the creatures have not to defend themselves against the surf, and in case of necessity they can burrow into the bottom. Occasionally, however, specimens with thick shells are also found. Predatory snails may also occur among the sand-dwellers. They are mobile and live on other animals, including shells. The places where the

essential conditions seemed favourable to sand-dwellers were very few in the examined area. The species occurred in samples taken at a depth of several metres and in the patches of accumulated sand lying along the shore. The sand is usually mixed with pebbles and stones. The frequency of occurrence of individual species is closely related to sandy areas.

Sea-shells. Empty shells of a few young specimens of *Pectunculus glycymeris* (L.) were found below the low water mark. They might have drifted ashore. *Astarte fusca* (Poli) occurred only sporadically at depth ranging from 6 to 8 metres. *Divaricella divaricata* (Poli) was sporadically found below the low water mark, but was fairly frequent at depths ranging between 6 and 8 metres. *Loripes desmaresti* (Payr.) [Syn. *Lucina lactae* (Poli)], found in the same zone, frequently occurred at depths ranging from 6 to 8 metres. A single empty shell of the species *Myrtea spinifera* (Mont.) was found at a depth of 8 metres. *Lucina fragilis* (Phil.) [Syn. *Lucina lactae* (L.)] occurred sporadically at depths ranging between 6 and 8 metres. *Codokia (Jagonia) reticulata* (Poli) was not very frequent in the area. Young specimens of *Cardium edale* (L.) was not very frequent in the area. Young specimens of *Cardium edale* (L.) was sporadically present in shallow water. The species *Cardium exiguum* (Gmelin) and *Cardium papillosum* (Poli) were not rare in the low water zone, but their occurrence was more frequent below it. Only young specimens of the species *Cardium tuberculatum* (L.) were found although this species is not rare in the area. Empty shells of a single adult individual and of some young ones of the species *Pitar (Meretrix) chione* (L.) were collected. The shells might have drifted from a deeper place. Scattered adult specimens of the species *Venus verrucosa* (L.) and *Venus gallina* (L.) occurred in the area, but their young individuals were pretty frequent and their number increased below the low water mark. Although existing under similar circumstances, the species *Venus fasciata* (Da Costa) was very sporadically found. Young specimens of *Venus casina* (L.) sporadically occurred at depths ranging from 6 to 8 metres. Both young and developed individuals of the species *Gafrarium (Circe) minimum* (Mont.) were found in the examined area. *Tapes decussatus* (L.) was fairly frequent and its occurrence increased below the low water mark, with juvenile individuals prevailing. A limited number of the species *Tapes aureus* (Gm.) occurred at depths ranging between 6 and 8 metres. Sporadic occurrence of young individuals of *Macra subtruncata* (Da Costa) was observed at a depth of 8 metres below the low water mark. *Gastrana fragilis* (L.) was also represented by young specimens sporadically found off the coast, sometimes among the algae, and even in the holes of rock-boring shells. The species *Tellina distorta* (Poli) was frequently found, and its occurrence increased below the subtidal zone. *Psammobia ferroensis* (Chemn.), *Psammobia costulata* (Turton), *Corbula (Aloidis) gibba* (Oliv.), and *Thracia pubescens* (Pult), occurring at depths unknown to me, were hardly to be seen below the water mark.

In my collection, the *Scaphopoda* class is represented only by the species *Dentallium vulgare* (Da Costa). The empty shell of a single specimen was found at a depth of 8 metres. Snails are represented by two young specimens of the species *Crepidula unguiformis* (Lm.) and by an empty shell of an adult



one, washed ashore. Predatory snails are represented by the species *Murex trunculus* (L.), fragments of whose shells were not rare at depths ranging from 6 to 8 metres. Since these shells have never been found intact, the habitat of the species must be situated at a greater depth. The shells are used for ornamental purposes. The species *Nassa reticulata* (L.) and *Nassa mutabilis* (L.) occurred only sporadically on sandy and stony-sandy bottoms well below the low water mark. Empty shells of a few young specimens of *Natica alderi* (Forbes) were found in similar places as the foregoing species.

#### EMPTY SHELLS WASHED ASHORE

Empty shells can be found scattered everywhere along the coast, but they have never occurred accumulated in a considerable quantity. Biotopes and zone-dwellers are mixed in the alluvial deposits, and the waves group the shells according to their specific gravity. This regularity, however, cannot offer a basis for the scientific valuation. It is quite sure that the species whose empty shells were found must live in the vicinity, and that they must be frequent if there is an abundance of their empty shells. If there is a frequent occurrence of empty shells ashore, but few living specimens are to be found in the water, it means that the search has not been carried out under optimal circumstances. It was noticed in some cases, however, that fewer empty shells occurred ashore than in their original environment; in such cases, of course, they did not represent a particular piece of evidence. As a consequence of these considerations, my statements as to the frequency of a species were preceded by checking the amount of shells washed ashore whenever time and circumstances permitted it. The species occurring in the alluvial deposits were mentioned by their names but their exact habitat remained uncertain.

The species *Pectunculus pilosus* (L.) was represented by the broken shell of an adult specimen. Very few young individuals of the species *Cardium fasciatum* (Mont.) were found. The species *Cardium oblongum* (Gmelin) and *Donax venusta* (Poli) were represented by one specimen each, the former by a juvenile one. Very few and much worn fragments of some individuals of *Cassidaria echinophora* (L.) were found. Nicely developed specimens belonging to this species could be seen on ornamental pieces offered for sale in town. They are surely frequent at greater depths. Only utterly worn fragments of the species *Murex brandaris* (L.) occurred ashore, requiring me to walk a long distance to fetch them. A considerably larger amount of these specimens could be seen on ornamental pieces in town than of the preceding species. *Cythara taeniata* (Desh.) had a very sporadic occurrence. *Ostrea cochlear* (Poli) was found both ashore and in the water. A 5 millimetre shell occurred at a depth of 8 metres, and another one, 35 millimetres long, was found at a depth of 1 metre, on pebbled sandy bottom. The thin shells were quite fresh and intact. According to the literature, this species lives in the red coral zone, i.e. at considerably greater depths (70 — 150 metres). The inner calcareous skeleton (*os sepiae*) of *Sepia officinalis* (L.) was found ashore.



## SUMMARY

Eighty-eight species are presented in this paper, 48 *Bivalvia*, 39 *Gastropoda*, and 1 *Cephalopoda*. Of the above total, eighty species were present in the samples taken in the places of their origin, and of the remaining eight species only their empty shells were found. As to their way of life, the species can be distributed as follows: 1 supratidal, 28 rock-dwellers (19 sessile, 9 vagile), 18 algae-dwellers, 35 sand-dwellers. No sharp limit can be drawn on the basis of their way of life, however, since the rocks in the investigated area were partly covered with algae, and the sand-dwellers had to put up with gravelled-sandy substrata. As to the fauna, it certainly is the characteristic fauna of the rocky coast represented mostly by rock-dwellers. The modern nomenclature has been applied in this paper to the species collected along the Dalmatian coast. The species had earlier been identified by Brusina. So far, however, the modern nomenclature is still incomplete, and differences are still encountered even in recent publications. The list of species enumerated in this paper will certainly be extended as a result of investigations still to follow. In my opinion, it is both important and interesting to continue the investigations in the neighbourhood of Split as these animals, owing to their enormous quantities, play a significant part in "nature's household" and are, consequently, in practical correlation with life. Every research work brings forth new problems requiring further investigation. Owing to the shortness of its duration, my own work — which meant a real pleasure to me — will certainly leave a great deal still to be researched.

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## JADRANSKI MEKUŠCI OKOLINE SPLITA

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### KRATAK SADRŽAJ

Ova radnja sadrži prikaz 88 vrsta školjkaša — 48 *Bivalvia*, 39 *Gastropoda*, 1 *Cephalopoda*. Od ukupnoga broja vrsta, 80 ih je bilo u uzorcima uzetim na mjestu njihova porijekla, dok su se od preostalih 8 vrsta našle samo prazne ljušture. Što se tiče načina života ovih vrsta, one se mogu podijeliti kako slijedi: 1 supralitoralnih, 28 stanovnika kamena (19 sesilnih, 9 vagilnih), 18 stanovnika algi, 35 stanovnika pijeska. Ne može se, međutim, povući oštra granica na osnovu njihova načina života pošto su grebeni istraživanoga područja djelomično bili pokriti algama, a vrste, kojima je habitat u pijesku, morale su se adaptirati šljunkasto-pjeskovitom substratu. Što se faune tiče, ona je zaista karakteristična fauna kamenite obale i zastupljena je poglavito vrstama, kojima je habitat u stijenama. U ovoj radnji upotrebljena je savremena nomenklatura za vrste sakupljene duž dalmatinske obale. Ove vrste je ranije identificirao Brusina. Do sada, međutim, savremena nomenklatura nije još potpuna, pa se nailazi na razlike čak i u novijim publikacijama. Popis vrsta, navedenih u ovoj radnji, sigurno će se povećati nakon istraživanja, koja će još slijediti. Mislim, da je važno i interesantno da se nastave istraživanja u okolici Splita pošto ove životinje, uslijed svoga ogromnoga broja, igraju značajnu ulogu u »gospodarstvu prirode«, pa su, prema tome, u međusobnoj povezanosti sa životom. Svako istraživanje izazivlje nove probleme, koji traže novo istraživanje. Obzirom na kratkoću trajanja, moj istraživački rad — koji mi je bio pravo zadovoljstvo — sigurno će zahtijevati dalje istraživanje.

