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THE MARINE MOLLUSCAN ASSEMBLAGES OF PORT SUDAN, RED SEA

by

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With one text-figure and one table

Abstract

This study summarizes field observations and collections of the molluscan fauna of the coastal and offshore reefs in the area of Port Sudan, Central Red Sea. In spite of the fact that some families of this group were described from several areas of the Red Sea, there exists only little information on the entire faunal composition of this region. 282 species of Amphineura, Gastropoda, and Bivalvia, collected and studied in nine localities are listed according to their habitats. Moreover, descriptions of the prominent members of typical molluscan assemblages are given for 13 habitats and microhabitats which differ in their morphological structures and in their hydrographic and physiographic conditions. Emphasis is placed on further studies on the trophic interactions within certain habitats.

Introduction

Although there is a considerable number of taxonomic literature on some molluscan families in the Indo-West-Pacific (Abbott, 1960; Burgess, 1970; Cernohorsky, 1967; Habe, 1964; Kira, 1962; Powell, 1964; Rosewater, 1965), there is comparatively scarce information for the Red Sea. After the extensive surveys and descriptions of Issel, 1869, Hall & Standen, 1907, Jickeli, 1874, Shopland, 1902, and Sturany, 1901, 1903, in more recent times only a few studies were published on the entire faunal composition of molluscs in this region. Most of these publications deal with certain families, sometimes they also give information about their zoogeographical distribution in the Red Sea: Thus the cypraeids seem to yield the best information on their occurrence throughout the region (Foin, 1972; Mienis, 1971b; O'Malley, 1971; Schilder, 1965). Further knowledge about the distribution of littoral molluscs in Red Sea areas is given for chitons (Leloup, 1960), strombids (Mienis, 1971a), conids (Kohn, 1965), terebrids (Bratcher & Burch, 1967; Mienis, 1970), and several families of bivalves (Lamy, 1916-1930). Besides these studies

there are publications on the faunal composition of the Suez Canal region (Barash & Danin, 1972; Moazzo, 1939), of the Gulf of Suez (Lamy, 1938), and of the Masirah Islands (Biggs, 1969), as well as those on the results of the 'Manihine'-Expedition to the Gulf of Aqaba (Rees & Stuckey, 1952) and the French expedition of the 'Calypso' to the Saudi-Arabian coast (Franc, 1956).

A field study in October 1977 on the coastal and offshore reefs at Port Sudan gave the opportunity to contribute to our knowledge of the distribution and relation to certain habitats of the most common littoral molluscs in this part of the Central Red Sea, and also to conduct preliminary surveys on the ecology and local abundance of certain species.

The outlines of this study together with a further publication on extensive investigations in the Northern Gulf of Aqaba by the author should contribute to a general knowledge of the zoogeographical distribution of molluscs in the entire Red Sea.

METHODS AND INVESTIGATED AREAS

In October 1977, a total of 16 reef areas in the region of Port Sudan, Democratic Republic of Sudan, were surveyed in regard to their molluscan assemblages. Collections and pilot observations were conducted both by snorkling and SCUBA diving. On several locations estimates about the abundance and specific distributional patterns were made by counting all individuals within an area of 0.25 m^2 measured with the help of a foldable frame, and by recording the type of substratum and the typical features of the assemblage in situ. A list of the molluscs recorded from all the reef areas is compiled in Tab. 1, containing all available data on the occurrence of each species in the different reef areas. The table also includes the specimens I identified from the collections at the Institute of Oceanography, Port Sudan [1]), and the Marine Laboratory of Suakin. The collected material was mainly identified by comparison with the comprehensive material of the northern Red Sea near Aqaba, Jordan, sampled by Mastaller from 1975 to 1977. The collections of both regions are transfered to the Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands.

The investigated reef areas (fig. 1) concentrate mainly on four localities along the coast of the Sudanese Red Sea:

1. Port Sudan: The harbour area comprises a fjordlike channel whose shallow fringes are covered partly by muddy and coarse sediments, partly by seagrass meadows. The coral growth in this channel is poor, probably a fact

1) Collected by D. H. Nasr and K. Bandel.

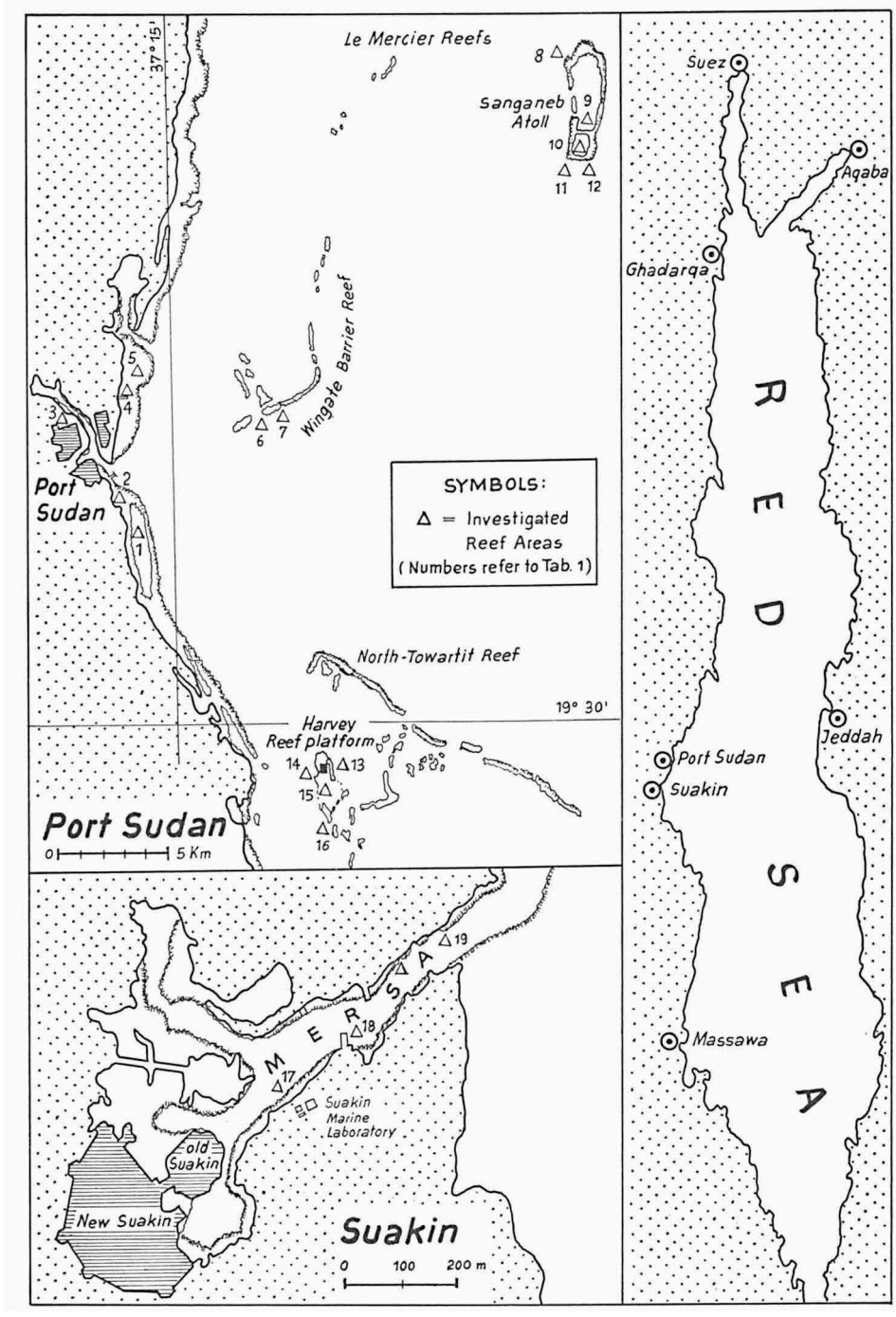

Fig. 1. The investigated reef areas at Port Sudan and Suakin. (From Deutsche Seekarte Nr. 331, modified, after Mergner & Wedler, 1977).

due to the low water exchange. Other study areas in the neighbourhood of the harbour were the extensive lagoons form characteristic reef zones each with its typical feature of fine and coarse sands, organogenic sediments and coral rubble. Single dead coral rocks of large size enrich the prevailing uniform appearance of extensive seagrass flats, thus yielding a further ecological niche in this biotope. A jetty in the northern lagoon of Port Sudan (fig. 1, no. 4) served for studies of the littoral molluscan fauna living both on beachrock and concrete blocks.

2. Suakin: This area is situated 55 km south of Port Sudan. The former harbour is now a narrow channel fringed by moderate coral growth; however, there is no distinct reef zonation between the fossil limestone and muddy bottom of the channel. In general, the site is characterized by faunal elements which are typical for turbid waters and reduced water movements.

3. The Wingate Reef (19°37'N 37°18'E) and the North Towartit Reef, "Harvey Reef Platform" (19°28'N 37°19'E) are two offshore barrier reefs comprising a great variety of habitats between the cemented reef platforms, the reef crests with luxuriant coral growth and the lower fore reef with its vast areas of coral rubble and coarse sand. On the south-west sides of both reef systems there are unique biotopes differing in the exposure to certain hydrological parameters ;the reef slope, formed predominantly by *Porites lutea,* is partially interrupted by steep vertical canyons of different widths. At depths between 15 and 25 m the slope proceeds abruptly in horizontal terraces. These terraces are characterized by coral rubble and coarse sand. Within this area there is again an enrichment in the availability of micro-habitats by dense growth of hermatypic corals down to depths of 50 m and more.

4. Sanganeb: The Sanganeb Reef (19°45'N 37°26'E) is situated about 15 miles off Port Sudan. Since this reef area represents a genuine atoll system with a great variety of different physiographical zones and habitats, this area proved to be the richest area in regard to species diversity.

It is tried to present all abailable details about the occurrence of all species listed in Tab. 1. However, a number of specimens could not be observed alive, either because they were found only as fragments or because they could be determined only from the local collections. In these cases no data are recorded in Tab. 1 about their relation to certain reef zones.

Results

This study gives brief descriptions of the typical molluscan assemblages which were found in different reef zones. The faunal results of certain habitats shall always be reviewed according to the characteristic hydrographic parameters, substratum and available food in the biotype.

1. Littoral fringe and offshore concrete ramparts.

One of the most striking features of the hydrographic conditions of the Central Red Sea are the low tidal movements. Apart from seasonal changes in the sea level the tidal effects of the whole region are minimal (Crossland, 1907). Therefore, molluscan assemblages including a typical vertical zonation hardly can be observed. The main littoral species, like the littorinids *Littorina scabra, Nodilittorina millegrana,* and *Planaxis sulcatus* as well as the neritid *Nerita undata* are restricted to a few localities at moderately exposed shore regions: One of these localities is for example the jetty at Port Sudan (fig. 1, no. 4) or fossil beachrocks near the outlet of the harbour (fig. 1, no. 2). However, the most abundant 'littoral community' can be observed in the offshore reefs of Port Sudan: The concrete ramparts around the lighthouse basements at Sanganeb and North Towartit offer the most suitable substratum for *Littorina scabra* and *Plaxanis sulcata.* Here, in the open sea, the breakers supply the winkles with sufficient splash water. It is there where the animals show their conspicuous aggregation and migration behaviour by living in a narrow fringe about 20 cm above the mean sea level.

Assemblages which can be considered to belong to littoral communities are formed also on top of the large boulders along the jetties (fig. 1, nos. 4, 10, 18) or under the pier of the lighthouse of Sanganeb. These boulders — mainly blocks of fossil limestone or concrete — often are densely covered by lawns of filamentous algae (Ectocarpaceae). Thus, this biotope provides suitable food for a number of grazers like *Acanthopleura haddoni, Cellana rota, Nerita albicilla* and *Nerita undata.* Some carnivorous molluscs too enter this biotope, among them the mitrid *Mitra litterata* and the cones *Conus taeniatus* and *Conus musicus.* Suspension feeders, cemented on top of littoral rocks, as *Ostrea* sp. and dense aggregations of *Brachidontes variabilis* occur only locally at those biotopes which are influenced by breakers.

However, the common feature of the molluscan fauna in the Port Sudan Area is that a typical littoral fauna is only poorly developed.

2. Boulder zone.

Large submersed boulders and concrete blocks in the very shallow water, like in the reef areas nos. 4 and 10, show the highest species diversity of macromolluscs among all the investigated reef zones. Regarding the spherical shape of a boulder it is evident that sometimes a few square centimeters of the total surface are characterized by different microclimatic conditions: It is because of the structural complexity and the varying exposures of the microhabitats to physical parameters, that there is developed a wide range of all kinds of trophic levels including special adaptations to the conditions. We

have to distinguish between those species which mainly show a preference to any hard substratum — these forms are widely distributed all over the reef flat — and those which are more or less restricted to this biotope.

Food preference for a number of filamentous algae which grow on top of the boulder seems to be the main factor for a number of species. Among these grazers of the microalgal lawns the most frequent are the limpet *Cellana rota*, the pulmonate *Siphonaria* cf. *sipho*, the chiton *Acanthopleura haddoni* and two species of cerithids, *Cerithium nesioticum* and *Clypeomorus morus*. In general, the molluscan fauna observed on top of the boulders or rocks consists of members of typical eulittoral assemblages found elsewhere in the Red Sea, where a well defined littoral fringe is marked by a vertical zonation of its molluscs as a result of tidal influences (Mergner & Schuhmacher, 1974; Mastaller, in prep.).

In the interstices of the boulders and on the exposed surface *Arca plicata*, *Chama* sp. and *Brachidontes variabilis* are living; the latter species is often heavily attacked by muricid predators as *Morula anaxeres* and *Morula granulata*.

A complete different fauna occupies the underside of the boulders; thereby the size of the rock plays an important role, since the larger it is the greater is the diversity of the cryptic fauna of the underside, mainly composed of encrusting forms like red algae and bryozoans, but also sponges and sedentary Polychaeta. Thus, this specific microhabitat gives not only shelter from predators and physical stresses in the littoral zone, but also provides many food specialists with their diet. Therefore, the greater part of this molluscan assemblage belongs to carnivorous species, or is found among the carrion feeders. Only the most common species can be cited here as the muricids *Thais tuberosa*, *Nassa serta*, the buccinids *Cantharus fumosus*, *Cantharus* cf. *rubiginosus*, the fasciolariids *Peristernia incarnata*, *Peristernia nassatula* and *Latirus turritus*, the bursid *Bursa affinis* and the pyramidellid *Pyramidella* cf. *sulcata*. Further predatory species which live at least during the daytime in this microhabitat are the mitrids *Mitra cucumerina* and *Vexillum amabile*, and several cones like *Conus achatinus*, *Conus fulgetrum* and *Conus lividus*. Among the grazers the most abundant gastropods are *Haliotis pustulata*, *Trochus erythraeus* and *Clanculus pharaonis*. The most conspicuous members of this assemblage, however, are a vast number of cowries. Most of the listed cypraeids originate from this habitat. Locally the pyrenid *Pyrene testitudinaria* occurs in dense clusters of 10 to 15 individuals. The bivalve fauna is represented mainly by *Pinctada vulgaris* and the partly cemented *Arca plicata* and *Cardita variegata*.

In general, the boulders which are located in reef areas with high physical

stress, i.e. low water exchange, high sedimentation rates and turbid waters (as it is the typical situation in the Mersa of Suakin, fig. 1, nons. 17, 18), show reduced species diversity and lower numbers of individuals than boulder areas which are more exposed, like the rampart constructions at the lighthouse of Sanganeb (fig. 1, no. 10).

3. Seagrass flats.

Throughout the investigated coastal reef areas extensive seagrass flats of the two angiosperm genera *Halodule* and *Halophila* are a common feature of the shallow lagoons (fig. 1, nos. 1, 2, 5). The eelgrasses often occupy the entire width between the muddy beach zone and the reef platform. Furthermore, they are patchy distributed in the inner lagoon of the Sanganeb Atoll.

Although there is quite a uniform appearance in those biotopes, a detailed investigation proves that it is possible to distinguish different molluscan assemblages here. This is due to the fact that this habitat can be divided into three microhabitats, each comprising its characteristic composition of species.

First, the foliage of the angiosperms support a great number of micromolluscs grazing either directly on the leaves or on the epiphytic fauna. It is not possible by now to give comprehensive taxonomic data about those species since their identification it not completed yet. Typical gastropods of the foliage are *Smaragdia souverbiana* and *Rhinoclavis kochi.* In this context it seems to be remarkable that there was a mass development of a small turrid living on the leaves of *Enteromorpha* and *Halodule* during the summer months (Moore, personal communication). Other species, living partly on the foliage and partly on the second microhabitat of the seagrass flat, i.e. among the stems on the fine sediments, are *Nassarius albescens gemmuliferus, Ancilla acuminata,* and *Phasianella lineolata.* Molluscs which seem to be restricted only to the latter habitat belong to all trophic levels: There are grazers like *Cerithium nodulosum erythraeonense* and cypraeids like *Cypraea turdus, Cypraea tigris* and *Monetaria moneta.* Predominantly here are the strombid species *Strombus tricornis, Strombus gibberulus albus,* and *Strombus mutabilis.* Among the scavenging molluscs *Nassarius arcularia plicatus, Polinices mamilla,* and *Vasum turbinellum* are regularly found. Furthermore, typical for this habitat are the cones *Conus spirogloxus, Conus tessulatus* and *Conus textile.*

The third of the microhabitats is the sandy and silty substratum on which the seagrasses grow and which they influence down to the tips of their roots. This sediment layer, often extending 10 to 15 cm deep, is characterized both by burrowing and more sedentary members of the molluscan infauna; among the first group there are mainly naticids like *Natica marochiensis,* and

Polinices melanostoma, and the terebrid *Terebra crenulata.* The main part of this assemblage, however, consists of bivalves which are partially buried like *Atrina vexillum* and *Pinna muricata,* and the large ark shell *Arca antiquata.* Further investigations should support the observations that the species diversity within the seagrass flats increases with the higher silt content and the finer particle size of the sediment; this fact seems to be the reason why most of the listed lamellibranchs are found among the infauna of the Port Sudan Harbour area (fig. 1, nos.), 4), both in partial presence of seagrass flats and silt.

4. Soft bottoms without vegetation.

Sandy areas of different particle size are widespread in all the sheltered reef areas throughout the region; there are vast sandy zones between the beach zones, the seagrass flats and the reef platform in all the lagoons at Port Sudan and Suakin. Similar sandy environments extend in the inside of the Sanganeb Atoll (fig. 1, no. 10) and near the Harvey Reef Platform (fig. 1). The species composition within the latter areas differs somewhat from the assemblage in the coastal sandy areas since, due to a stronger exposure to water movements, the particle size of the grains is bigger.

It is difficult to depict a typical molluscan assemblage of the soft bottoms in the region because the biotope is variable in regard to its sedimentological composition in sand, mud, silt and coral rubble. Other differences result from the presence or absence of a thin layer of mud and silt on the surface of coarser sand. The surface of these soft bottoms is often coated by lawns of filamentous green algae. In this case, the underlying strata are mostly blackened, thus indicating reduction conditions; thereby a peculiar microhabitat is created which sustains a few highly adapted deposit feeders like *Asaphis violascens, Laevicardium orbita, Tellina virgata, Pharaonella aurea, Lucina dentifera, Bellucina* sp., *Lioconcha picta,* and *Tapes litterata.* The typical species scavenging in this biotope is *Strombus fasciatus.*

In sandy areas where the ratio of coarse grain particles is higher, the oxygenated layer is thicker; this is partly due to the shifting movements by wave and current actions, partly to a number of burrowing species in this kind of habitat (fig. 1, nos. 10, 15). Thus, the number of typical deposit feeders like in the latter biotope is reduced and the number of burrowing gastropods is increased. Especially in the sandy areas of the fore reefs (fig. 1, nos. 6, 9, 14, 16), which are spacially interrupted by colonies of stony corals and dead coral rocks, additional species penetrate into this biotope. Again, the molluscan fauna there is predominantly infaunal; the only gastropods which can be observed on the surface of the sediment (mostly during

their nocturnal activities) are large scavenging or predating species, among them *Conus arenatus, Conus striatus, Tonna perdix, Casmaria ponderosa, Fasciolaria trapezium, Mitra fissurata, Terebra affinis, Terebra babylonia, Terebra dimidiata,* and *Terebra subulata.* None of these species, however, occurs in great numbers, except *Terebra affinis* and *Terebra babylonia,* and two cerithids, *Rhinoclavis aspera* and *Cerithium rueppelli.*

In remote reef areas, like on the Harvey Reef Platform (fig. 1, no. 13), where human interference is fortunately low, spider shells of *Lambis truncata sebae* are very common. In spite of suitable substratum this species is very rare along the coastal lagoons of the Port Sudan region. On the other hand, one may find piles of fragments of this species, together with *Strombus tricornis* and *Murex ramosus* on the beach. Each shell has been cracked from the body whorl in the same manner. Questioning local fishermen at Suakin and Towartit revealed that these people collect preferably those three species to increase their scarce food supply.

The most abundant clam, *Tridacna maxima,* is certainly one of the pioneer species in this habitat in regard to the formation of hard bottom communities: It settles on any large solid substrate which is available in the sand (often dead shells of *Laevicardium* or *Cyclotellina*). Thereby it creates the preliminary aggregation point for a number of successive sedentary reef inhabitants, including hermatypic corals.

A detailed analysis of the soft bottoms concerning the morphological and sedimentological parameters, as well as differences between the shallow sandy areas and the fore reef has to be conducted in further studies. Especially in the bivalve infauna there are considerable differences in the faunal composition of both habitats. Thus, the most abundant species in the fore reef areas (fig. 1, nos. 7, 8, 11, 13, 14, 16) are *Glycymeris pectiniformis, Codakia divergens, Laevicardium orbita, Fragum* sp., and *Cyclotellina scobinata.*

5. Hard substrates: coral heads and dead coral rocks.

A major part between the littoral fringe and the reef platform is characterized by the occurrence of various hard substrates. Most of these can be described as coral heads or abraded rocks formed by dead corals. These substrates are either widely scattered within sandy areas or seagrass flats (fig. 1, nos. 1, 5, 10, 12, 15, 19), or form more or less continuous abraded rocky areas with craterlike pools, partly filled with organogenic sand and coral debris. Because of a structural complexity which in many regards is similar to the previous described boulder zone, these habitats must be subdivided into three main microhabitats:

The surrounding substratum in which the coral heads are located consists

of a mixture of sandy sediments, algal mats, coral debris and organogenic deposits. Therefore, the faunal elements of this habitat vary considerable since additional species which are adapted to certain microhabitats occasionally are living there. This might be true for molluscs which prefer this mixture of substrate or can find suitable food there without standing in the permanent need of hiding places. Those species are for example *Conus flavidus, Murex ramosus,* and *Vasum turbinellum.* Smaller species living between the fragments of corals and coral debris, belong to the hassariids (*Nassarius delicatus*), mitrids (*Mitra fasciolaris, Vexillum coronatum*) and pyramidellids (*Otopleura auriscati*), furthermore the bivalve *Hemicardium fragum.*

The coral heads and dead rocks themselves offer a variety of microhabitats; this results partly from the highly structured lateral and upper surfaces which are usually either overgrown by mats of filamentous Ectocarpaceae, or partly covered with branched or massive stony corals. Moreover, we have to distinguish between microhabitats of macroscopically bare rock, and the underside of coral heads which are often inhabited by a rich shade-loving fauna (see previous section: boulder zone). Finally, there is a conspicuous molluscan assemblage living either endolithic or having a strong association ot living corals. Into the group which lives byssate or partially cemented in the rocky substrate belong *Arca lacerata, Barbatia setigera, Notirus* cf. *macrophyllus, Cheilea tortilis, Chama* spp., *Spondylus gaederopus* and *Tridacna maxima.* The latter species shows its widest varieties in the coloration of the mantle in the very shallow water, while in the fore reef the predominant colour is only bluegreen.

The molluscan assemblage living on top of the knolls is dominated by the vermetids *Serpulorbis inopertus* hauling their mucus nets continuously over the rock. This net is occasionally ingested by *Drupa morum,* a fact that was not known yet concerning the feeding biology of that muricid.

The algal mats which cover the rocky surface are inhabited by molluscs of all trophic levels, as there are *Turbo argyrostomus, Clypeomorus morus, Cerithium echinatum, Drupa morum, Conus taeniatus, Conus musicus, Vexillum leucozonias,* and *Modiolus auriculatus.*

The species diversity in the cavernous microhabitats in the coral rocks and in crevices under the coral heads is particularly high; that is why only the most prominent members of this assemblage shall be specified here: *Haliotis pustulata, Diodora rueppelli, Clanculus kraussi, Gena varia, Heliacus variegatus, Cerithium nesioticum, Triphora* spp., *Cypraea* spp., *Cymatium pileare, Cantharus fumosus, Nassa serta, Conus fulgetrum, Ischnochiton* sp., *Pinctada vulgaris, Vulsella* cf. *vulsella, Plicatula plica, Cardium auricula.*

At the moment only general observations can be recorded about the molluscs which live in association with living corals; more details will be

published later by comparing this molluscan assemblage with the endolithic and coral related fauna from the Gulf of Aqaba. The massive coral *Porites lutea*, which forms in some areas monotypic reefs by its enormous extensions on the reef slope (fig. 1, nos. 14, 16), is regularly inhabited by the scallop *Pedum* sp. On the upper margins of the coral often several individuals of the coralliophilid *Coralliophilia violacea* are sitting in a row. Each individual is embedded partially in the living coral substrate indicating that it apparently does not move from its 'home place'. Another species of the same genus, *Coralliophilia costularis*, shows a similar aggregational behaviour on *Favia* spp., but it moves along the outer margin of the coral without any homing attitude.

Intensive predation on the polyps of stony corals can be recorded from the muricid *Mancinella echinata* which also occurs in groups of 3 to 8 individuals on *Acropora variabilis* and *Acropora scandens*.

Branched corals like *Pocillopora danae* and *Seriatopora angulata* are commonly inhabited by the coralliophilid *Quoyula madreporarum*. The growth form of the animal which lives partially embedded in the coral differs with the form of the branch of the host coral; furthermore, the shape of the shell of animals which live in the clefts of the branches is much narrower than of those living outside a cleft. Branched corals like *Acropora* spp., *Seriatopora* and *Pocillipora* give protection for several fragile bivalves as Pinna bicolor and *Streptopinna saccata*, and some scallops (*Pecten lividus*, *Pecten squamatus*) and *Ctenoides annulatus* are loosely attached to the corals.

A common feature in the branched corals of the last three genera are species of boring mytilids and gastrochaenids which preferably bore in the bases and the lower part of the branches. Other species, mainly *Gastrochaena cuneiformis* and *Gastrochaena deshayesi*, prefer the massive corals of the genera *Cyphastrea* and *Montipora*.

6. Reef platform.

A typical reef zone in almost all the reef areas of the Port Sudan region is a more or less abraded and smoothly cemented reef platform, extending 10 to 25 m wide, between the lagoon and the reef crest. This habitat seems to be the most uniform and poorest of all reef zones in regard to the few molluscan species which are observed there.

The continuous surf action, especially during the monsoon period in the month of these investigations, seems to prevent the penetration of most of the mobile species. The platform consists of flattened and abraded dead coral rock, most of the interstices and rugged structures are smoothened and cemented by encrusting red algae. Apart from channels and cavernous systems

TABLE 1

The molluscan species found in 19 reefs areas at Port Sudan and Suakin, with their distribution over different reef zones. Abbreviations used: RL = Rijksmuseum van Natuurlijke Historie, Leiden; PS = Institute of Oceanography, Port Sudan; SK = Marine Laboratory of Suakin; co = common; ra = rare; rf = regularly found; * dead, on the shore

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
AMPHINEURA																	
CHITONIDAE																	
Acanthopleura haddoni Winckworth	4	+	+		rf	co											
Callistochiton heterodon Pilsbry	5	+				ra											
ISCHNOCHITONIDAE																	
Ischnochiton sp.	1, 5, 9, 10	+										rf					
GASTROPODA																	
HALIOTIDAE																	
Haliotis pustulata Reeve	1, 2, 4, 5, 9	+	+	+		rf						co					
FISSURELLIDAE																	
Diodora rueppelli (Sowerby)	3, 15, 19	+				ra						rf					
Emarginula sp.	17	+				ra											
Hemitoma tricarinata (Born)	3, 4, 17, 18	+				rf					ra						
Clypidina notata (L.)	17 *																
Scutus unguis (L.)	1	+							ra								
PATELLIDAE																	
Cellana rota (Gmelin)	2, 4, 10	+	+		rf	rf											
cf. *Helcioniscus eucosimius* Pilsbry	4 *																

TROCHIDAE																			
Monodonta dama (Philippi)	10, 16	+			rf	ra													
Gibbula declivis (Forskal)	15	+													ra				
Clanculus kraussi (Philippi)	12, 15, 19	+										rf		ra					
Clanculus pharaonis (L.)	9, 12, 15	+	+	+		co						ra							
Clanculus cf. *puniceus* (Philippi)	10	+				ra													
Trochus dentatus Forskal	1, 2, 5, 6, 12	+	+	+							ra			co	rf	rf			
Trochus erythraeus Brocchi	4, 10, 15, 18	+	+			co						ra							
Trochus maculatus L.	8	+												ra	ra				
Trochus virgatus Gmelin	12, 13	+		+												ra			
PHASIANELLIDAE																			
Phasianella variegata Lamarck	1	+							co										
STOMATELLIDAE																			
Stomatia phymotis Helbling	6	+				ra													
Gena varia Adams	1, 3, 18	+				ra						co							
Gena auricula (Lamarck)	19 *																		
TURBINIDAE																			
Turbo argyrostomus L.	1, 5, 9, 16	+	+							ra	rf			rf					
Turbo coronatus Gmelin	6 *																		
Turbo petholatus L.	8, 11, 16	+	+	+												rf			
Turbo radiatus (Gmelin)	1	+	+			ra													
NERITIDAE																			
Nerita albicilla L.	3, 4, 17, 18	+			rf	ra													
Nerita undata quadricolor Gmelin	3, 4, 9, 18	+	+	+	co	rf													
Smaragdia souverbiana (Montrouzier)	5	+							rf										
Neritopsis radula (L.)	15 *	+																	
LITTORINIDAE																			
Nodilittorina millegrana (Philippi)	3, 10, 18	+			rf	ra													
Littorina scabra (L.)	2, 4, 10, 16	+	+	+	co														
Planaxis sulcata (Bruguière)	4, 10, 16, 18	+	+		co														
TURRITELLIDAE																			
Turritella maculata Reeve	9, 13	+						ra											rf

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse. sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
ARCHITECTONICIDAE																	
Heliacus variegatus (Gmelin)	10	+										rf					
Philippia radiata (Röding)	10	+										ra					
MODULIDAE																	
Modulus tectum (Gmelin)	10, 12	+												rf			
VERMETIDAE																	
Dendropoma maximum (Sowerby)	6, 7, 8, 12, 13													co	co		
Serpulorbis inopertus (Rueppell)	1, 3, 5, 10, 18	+				co					rf			rf			
CERITHIDAE																	
Rhinoclavis aspera (L.)	9, 15, 19	+	+					co									co
Rhinoclavis fasciata (Bruguière)	9, 10, 15	+						rf									rf
Rhinoclavis kochi (Philippi)	1, 2, 5	+	+				rf		co								
Cerithium caeruleum Sowerby	5	+				ra											
Cerithium columna Sowerby	1, 5, 10, 15	+	+					co									
Cerithium echinatum (Lamarck)	3, 5, 19	+	+	+		ra						rf					
Cerithium nesioticum Pilsbry & Vanatta	1, 10, 18	+				co						rf					
Cerithium nodulosum erythraeonense Lamarck	1, 3, 5, 17, 19	+	+	+					rf	ra							
Cerithium rueppelli Philippi	5, 15	+					rf										
Cerithium scabridum Philippi	2	+									ra	ra					
Cerithium tuberculatus (L.)	18	+			ra												
Clypeomorus morus (Bruguière)	1, 3, 18	+				rf					rf						
POTAMIDIDAE																	
Royella sinon (Bayle)	5	+								ra							

TRIPHORIDAE																	
Triphora tricincta Dunker	10	+									rf						
EPITONIDAE																	
Epitonium lamellosum (Lamarck)	2	+						rf									
HIPPONICIDAE																	
Hipponix conicus (Schumacher)	10, 15	+	+											ra			
CALYPTRAEIDAE																	
Cheilea tortilis (Reeve)	3, 5, 10	+	+								ra		ra				
TRICHOTEPIDAE																	
Amathina tricarinata (L.)	1 *																
STROMBIDAE																	
Terebellum terebellum (L.)	3, 5, 10, 15	+					ra		ra								
Tibia insulaechorab Röding				+													
Lambis truncata sebae (Kiener)	1, 13	+	+	+			rf	ra								rf	
Strombus dentatus L.		+															
Strombus erythrinus Dillwyn	19	+		+		ra											
Strombus fasciatus Born	1, 3, 5, 19	+	+	+		co			ra								
Strombus gibberulus albus Mörch	1, 2, 5, 19	+	+	+		rf		rf									
Strombus mutabilis Swainson	1, 3, 5, 15	+	+			ra		rf		ra			rf				
Strombus fusiformis Sowerby	17	+														ra	
Strombus terebellatus Sowerby	10						ra									ra	
Strombus tricornis Humphrey	1, 3, 5, 17	+	+	+		co	rf	rf	ra								
NATICIDAE																	
Natica cf. *hilaris* Sowerby	17 *																
Natica marochiensis (Gmelin)	1, 2, 3, 19	+	+					rf	rf		ra						
Natica onca (Röding)	15					ra											
Polinices mamilla (L.)	1, 5, 10, 19	+				ra	ra	rf									
Polinices melanostoma (Gmelin)	1, 3, 15, 19	+		+				rf									
TRIVIIDAE																	
Trivia oryza (Lamarck)	12	+									ra						
Erato sp.	13	+									ra						
Calpurneus lacteus (Lamarck)	13	+													ra		

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
CYPRAEIDAE																	
Monetaria annulus (L.)	5, 15	+							ra			rf					
Monetaria moneta (L.)	5	+							rf								
Cypraea carneola (L.)	5, 6, 10, 18	+	+			co						ra					
Cypraea arabica grayana Schilder	1, 2, 5, 10, 18	+				co						ra					
Cypraea camelopardalis Perry			+														
Cypraea caurica L.	10					ra											
Cypraea cicercula L.	13											ra					
Cypraea erosa nebrites Melvill	1, 3, 5, 10, 18	+	+	+		co						ra					
Cypraea fimbriata Gmelin	9	+				rf											
Cypraea gracilis Gaskoin	10	+				ra											
Cypraea isabella L.	2, 10	+										rf					
Cypraea lynx L.	12	+				ra											
Cypraea macandrewi Sowerby	10	+				ra											
Cypraea punctata L.	18	+				ra											
Cypraea pulchra Gray			+														
Cypraea talpa L.			+														
Cypraea staphylea L.	2	+				ra											
Cypraea turdus Lamarck	3, 5	+	+				rf		rf			ra					
Cypraea tigris L.	1, 5	+	+				ra										
CASSIDAE																	
Phalium faurotis (Jousseaume)	16 *																
Casmaria ponderosa (Gmelin)	3						ra										
Casmaria erinaceus (L.)	8																ra
CYMATIIDAE																	
Apollon pusillus Broderip	9	+										ra					

Cymatium pileare (L.)	6, 12, 15	+	+							rf	rf					
Cymatium rubecula (L.)	7, 14	+														ra
Cymatium pyrum (Gmelin)	7	+	+											ra		
Distorsio anus (L.)	1	+				ra										
BURSIDAE																
Bursa affinis granularis (Röding)	3, 4, 10, 18	+		+		co					rf					
Lampadopsis rhodostoma (Sowerby)	13	+										ra				
TONNIDAE																
Tonna canaliculata (L.)	10 *		+				ra									
Tonna perdix (L.)	11	+														ra
Malea pomum (L.)	16	+														ra
PYRENIDAE																
Pyrene testitudinaria (Link)	10, 15, 19	+	+			co					co					
MURICIDAE																
Murex ramosus L.	1, 17, 18	+	+	+					ra	rf			ra			
Murex scolopax Dillwyn	11 *															
Maculotriton cf. *serriale* Deshayes	4, 10	+				co										
Drupa digitata (Lamarck)	12	+											rf			
Drupa morum Röding	6, 9, 12, 13	+	+	+						rf			co			
Drupa ricinus (L.)	12, 13	+	+										rf			
Mancinella echinata (Blainville)	7, 11	+										rf		rf	rf	
Homalocantha scorpio (L.)	17 *		+													
Morula anaxeres (Kiener)	4, 10, 18	+				rf					rf					
Morula granulata (Wood)	3, 10, 18	+				rf										
Morula uva (Röding)	9, 10, 15	+				rf				ra						
Drupella cf. *rugosa* (Born)	15	+				ra										
Thais tuberosa (Röding)	1, 2, 3	+				rf										
Nassa serta (Bruguière)	1, 3, 4, 5, 10	+				co					rf					
BUCCINIDAE																
Engina mendicaria (L.)	18 *		+			ra										
Cantharus fumosus (Dillwyn)	10, 15, 19	+				rf					co					
Cantharus cf. *rubiginosus* Reeve	9, 10	+				co					ra					
Phos senticosus (L.)	2	+									ra					
Pisania ignea (Gmelin)	1 *															

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Coarse sand, coral debris, fore reef	Reef slope	Reef crest	On cemented platform	Associated with living corals	Under coral heads, in crevices	On abraded dead rock	Coral rubble, organogenic sediments	Seagrass flats	Coarse sand, lagoon	Mud, fine sediments	Littoral rocks, boulders	Fossile beachrock, artificial ramparts
CORALLIOPHILIIDAE																	
Coralliophila cf. *bulbiformis* (Conrad)	13	+						ra	rf								
Coralliophila costularis (Lamarck)	5	+						ra	rf								
Coralliophila violacea (Kiener)	2, 5, 10, 15	+	+			ra	co		co								
Quoyula madreporarum (Sowerby)	10, 12, 13	+				ra	co		co								
Latiaxis cf. *idoleum* (Jonas)	16 *																
VASIDAE																	
Vasum turbinellum (Gmelin)	1, 2, 3, 18	+	+	+								rf	rf	ra	rf		
FASCIOLARIIDAE																	
Fasciolaria trapezium (L.)	14, 16	+	+	+	ra							rf					
Fusus polygonoides (Lamarck)	2	+										ra					
Peristernia incarnata (Kiener)	4, 10, 18	+														co	
Peristernia nassatula (Lamarck)	10									rf						rf	
Latirus polygonus Gmelin	18																ra
Latirus turritus (L.)	18															ra	
MELONGENIDAE																	
Volema pyrum nodosum (Lamarck)	17, 19														ra		
HARPIDAE																	
Harpa minor Lamarck	8 *													ra			
NASSARIIDAE																	
Nassarius albescens gemmuliferus (Adams)	3, 5, 17, 19	+											co		rf		
Nassarius arcularia plicatus (Röding)	3, 4, 19	+	+										rf		co		
Nassarius delicatus (Adams)	15	+									rf	rf					
Nassarius pauperus (Gould)	10	+								ra							

OLIVIDAE																		
Oliva elegans Lamarck	8	+	+														ra	
Ancilla lineolata Adams	5	+				ra		rf										
MARGINELLIDAE																		
Marginella suezensis Issel			+															
Marginella sp.	3, 5	+				ra		ra										
MITRIDAE																		
Mitra cucumerina Lamarck	4, 10, 18	+			co													
Mitra fasciolaris Deshayes	2	+							rf								ra	
Mitra filaris L.	1	+								ra								
Mitra fissurata Lamarck	8, 14	+															rf	
Mitra litterata Lamarck	2, 4	+			rf					ra								
Mitra typha Reeve	19 *							ra										
Subancilla annulata (Reeve)	13	+															ra	
Vexillum amabile (Reeve)	4, 18	+			rf													
Vexillum coronatum (Helbling)	5	+							rf									
Vexillum leucozonias (Deshayes)	5	+								ra								
Vexillum pardalis (Küster)	10	+			ra													
Vexillum tusum (Reeve)	10 *								ra									
CONIDAE																		
Conus achatinus Gmelin	1, 10	+			rf													
Conus arenatus Hwass	3, 5, 10, 19	+	+	+		rf	rf											
Conus capitaneus L.	15 *				ra													
Conus catus Hwass	9	+			ra													
Conus coronatus Gmelin	2, 3, 10	+	+		rf					rf								
Conus flavidus Lamarck	1, 2, 5, 10	+	+						ra	co								
Conus fulgetrum Sowerby	4, 10, 18	+	+		co						rf							
Conus geographus L.	16 *						ra											
Conus lividus Hwass	4, 10, 18	+	+	+	rf						ra							
Conus musicus Hwass	10, 18	+			rf						rf			ra				
Conus nussatella L.	9, 11 *	+													ra			
Conus cf. *rattus* Hwass	1, 15	+			ra													
Conus spirogloxus Deshayes	5, 17, 19	+	+			ra		rf										
Conus striatus L.	16, 19	+	+	+			rf										rf	
Conus taeniatus Hwass	1, 2, 3, 5	+			ra co					rf								

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
Conus tessulatus Born	5	+	+	+				rf	rf								
Conus textile L.	2, 5	+	+	+			rf		rf	ra							rf
Conus vexillum sumatrensis Hwass	2, 12	+												co	rf		ra
Conus virgo L.			+														co
TURRIDAE																	
Xenoturris cingulifera Weinkauff	10	+						ra		ra							
TEREBRIDAE																	
Terebra affinis Gray	5, 9, 15	+	+	+				co									ra
Terebra areolata (Link)	11																
Terebra babylonia Lamarck	8, 14, 15	+						rf									
Terebra dimidiata (L.)	15	+						ra									
Terebra maculata (L.)	16 *		+														
Terebra nebulosa Sowerby	16	+						ra									
Terebra subulata (L.)	13, 15	+						rf									
Terebra crenulata (L.)	5	+						ra		ra							
Impages hectica (L.)	17 *																
ACETONIDAE																	
Aceton sp.	10	+						ra		rf							
BULLIDAE																	
Bulla ampulla L.	2 *	+	+						ra								
Atys cylindrica (Helbling)	10	+							ra			rf					
HYDATINIDAE																	
Hydatina physis Lamarck	17 *								ra								

PYRAMIDELLIDAE																	
Pyramidella acus (Gmelin)	17 *																
Pyramidella cf. *sulcata* Adams	18	+			rf												
Otoleura auriscati (Holten)	10	+							rf		rf						
SIPHONARIIDAE																	
Siphonaria sp.	4	+			rf												
SCAPHOPODA																	
DENTALIIDAE																	
Dentalium elephantinum L.	3	+				ra											
Dentalium longirostrum Reeve	3	+				ra											
Dentalium cf. *octangulatum* Donovan	5	+					ra										
BIVALVIA																	
ARCIDAE																	
Arca antiquata L.	3, 5, 17, 19	+	+			rf		co									
Arca lacerata L.	2, 10, 15	+	+		ra					rf	ra						
Arca plicata Chemnitz	1, 2, 4, 10, 18	+	+		co						rf						
Arca cf. *ventricosa* Lamarck	19	+									ra						
Barbatia setigera (Reeve)	2, 12	+								rf	ra						
GLYCYMERIDAE																	
Glycymeris heroicus (Melvill & Standen)	3	+				ra											
Glycymeris pectiniformis (Lamarck)	8, 11, 15	+	+				rf									co	
MYTILIDAE																	
Modiolus auriculatus (Krauss)	5, 10	+	+		ra					rf							
Musculus laevigatus (Gray)	13	+								ra							
Brachydontes variabilis (Krauss)	4, 18	+		co	rf												
Lithophaga hanleyana (Reeve)	12	+										rf					
PINNIDAE																	
Pinna bicolor Gmelin	13, 19	+										rf		ra			
Pinna muricata (L.)	5, 17	+				ra		rf									
Atrina vexillum (Born)	19	+	+					rf									
Streptopinna saccata (L.)	6, 10, 13	+						ra				co		ra			

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	REEF ZONES: Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
PTERIIDAE																	
Pteria crocea (Lamarck)	7, 8, 11, 14	+													rf	co	
Pinctada vulgaris (Leach)	10, 15	+									ra	co			ra		
Pinctada margaritifera (L.)	7	+	+													rf	
ISOGNOMONIDAE																	
Vulsella cf. *vulsella* (L.)	19	+										rf	ra				
MALLEIDAE																	
Malleus regulus (Forskal)	4, 5	+				rf						rf					
Pedalion attenuatum (Reeve)	19	+										ra					
PECTINIDAE																	
Pecten lividus Lamarck	15	+										ra					
Pecten squamosus (Gmelin)	15	+											ra				
Pedum sp.	8, 11, 14	+											co		co	co	
Chlamys cf. *irregularis* (Sowerby)	13	+											ra				
Chlamys pallium (L.)	16	+	+														ra
Chlamys sanguinolenta (Gmelin)	13	+															ra
PLICATULIDAE																	
Plicatula plica (L.)	7, 14	+										rf				rf	
SPONDYLIDAE																	
Spondylus aculeatus Schroeter	13, 16	+														rf	
Spondylus gaederopus L.	2, 12	+	+								co					rf	
LIMIDAE																	
Lima lima (L.)	8 *	+															ra
Ctenoides annulatus (Lamarck)	10	+											ra				

OSTRAEIDAE																
Ostrea sp.	4	+			rf											
Lopha cucullata (Born)	11, 14	+	+									rf			rf	
Lopha cristagalli (L.)	14	+		+								co			co	
Lopha folium (L.)	11, 19	+	+											ra	co	
CHAMIDAE																
Chama sp.	4, 5, 10, 15	+	+			co				co			rf			
Chama lazarus L.			+													
LUCINIDAE																
Lucina angulifera Martens	3	+					ra									
Lucina dentifera Jonas	3, 5	+				rf										
Lucina philippina Reeve	3 *							ra								
Bellucina sp.	1, 2, 5	+					rf		co							
Codakia divergens (Philippi)	10	+						rf								
Codakia tigerina (L.)	16	+	+					ra								ra
TRIDACNIDAE																
Tridacna maxima (Röding)	2, 5, 10	+	+	+					ra		co		rf			ra
Tridacna squamosa Lamarck			+								ra					
MACTRIDAE																
Mactra olorina Philippi	3	+					ra									
Mactra sp.	3 *	+					ra									
Mesodesma glabrata (L.)	3, 17	+	+				rf									
CARDITIDAE																
Cardita castanea Deshayes			+													
Cardita muricata Sowerby	10	+										ra				
Cardita variegata Bruguière	4, 10, 18	+				co										
CARDIIDAE																
Cardium auricula Forskal	15	+						ra				ra				
Cardium lyratum Sowerby	1	+						ra								
Laevicardium orbita (Sowerby)	3, 5, 10	+	+				rf	co								ra
Fragum sp.	1, 5, 10	+						co								
Hemicardium fragum (L.)	1, 2	+						rf		co						

	Number of reef area (see fig. 1)	Material in collection: RL	PS	SK	Fossile beachrock, artificial ramparts	Littoral rocks, boulders	Mud, fine sediments	Coarse sand, lagoon	Seagrass flats	Coral rubble, organogenic sediments	On abraded dead rock	Under coral heads, in crevices	Associated with living corals	On cemented platform	Reef crest	Reef slope	Coarse sand, coral debris, fore reef
		REEF ZONES															
PSAMMOBIIDAE																	
Asaphis violascens (Forskal)	1, 3, 5	+					co										
TELLINIDAE																	
Tellina staurella Lamarck	3 *	+						ra									
Tellina virgata L.	3	+	+				rf										
Telliniges ovalis Sowerby	3 *						ra										
Pharaonella aurea (Perry)	3	+					rf										
Cyclotellina scobinata (L.)	1, 3, 10	+					rf	co	ra								rf
Quidnipagus palatum Iredale	3, 15, 19	+					ra	ra									ra
TRAPEZIIDAE																	
Trapezium sublaevigatum (Lamarck)	12	+									ra						
SOLECURTIDAE																	
Solecurtus divaricatus (Lischke)	14 *																ra
VENERIDAE																	
Venus lamellaris (Schumacher)	3	+					ra										
Venerupis sp.	3	+					ra										
Notirus cf. *macrophyllus* (Deshayes)	5, 10, 18	+									ra	rf					
Timoclea marica (L.)	17	+						ra									
Lioconcha picta (Lamarck)	3, 5	+	+				co		ra								
Gafrarium divaricatum (Gmelin)	3	+					ra										
Tapes litterata (L.)	1, 3, 17	+					rf		ra								
Tapes sulcaria (Lamarck)	1, 3, 17	+					co										
GASTROCHAENIDAE																	
Gastrochaena deshayesi Spengler	12, 13	+											rf		ra		
Gastrochaena cuneiformis Spengler	12, 13	+											co		rf	co	

crossing this zone (which are inhabited by a fauna similar to the one described under the coral heads in the last section), only a few specialized species can sustain the physical stress on the upper surface of the platform: The gastropods living there usually possess a heavy shell (*Conus vexillum sumatrensis*) and are tightly attached while moving on the substrate, like *Trochus dentatus, Trochus maculatus, Modulus tectum, Drupa digitata* and *Drupa ricinus.* Another typical element of this assemblage is the embedded vermetid *Dendropoma maximum.* This species reaches in certain localities (fig. 1, nos. 7, 12) such high densities that neighbouring individuals overlap with their mucus nets.

7. Reef crest and reef slope.

Because of the luxuriant growth of hermatypic corals in this zone, the greater part of the molluscan assemblage of this habitat belongs to the fauna which is associated with corals. Typical for this biotope is again *Dendropoma maximum* which occupies here an additional 'substrate': Three species of hydrocorals, *Millepora exaesa, M. dichotoma,* and *M. platyphylla* are commonly inhabited by this vermetid. The shell is completely overgrown by the tissue of the coral, and the tube of the snail is continuously prolonged. It seems, that this prolongation of the tube follows exactly the longitudinal growth of the milleporid, because in each host coral where *Dendropoma* is found, the operculum of the animal is in the same plane as the upper margin of the coral. Only in *Millepora platyphylla* sometimes the tubes can be observed on the lateral surfaces of the coral, but in these cases the tube is protruding from the coral. Thus, the mucus net can always be hauled into the longreef currents.

Similar preferences for strong water movements is shown by several species of pteriids, spondylids and ostraeids along the reef slope: *Pinctada margaritifera, Lopha folium, Spondylus aculeatus* and *Plicatula plica* settle preferable on the vertical walls of steep and shady reef slopes (fig. 1, nos. 8, 11, 7, 14).

One step further in their exposure to the prevailing longreef currents go *Pteria crocea, Lopha cucullata* and *Lopha cristagalli*; all three species live epizoic on thorny corals like *Cirripathes* and *Antipathes,* two genera which grow preferably in deeper reef zones with strong currents (fig. 1, nos. 11, 14). The pteriid, however, can also be found along the upper reef slope attached to milleporids.

Among the assemblage which lives in the crevices and furrows of the reef slope the most prominent members are *Clanculus* cf. *puniceus, Trochus virgatus, Fasciolaria trapezium, Turbo petholatus,* and *Conus nussatella.*

Conclusion

This faunistic-ecological study records a general survey about the molluscan fauna of the Port Sudan area. A total of 282 identified species of chitons, gastropods and bivalves proves the very high species diversity in these shallow reef zones; however, a longer observation and collection period would certainly yield additional species. According to the available literature the total number of molluscan species (without nudibranchs and cephalopods) for this part of the Indo-West-Pacific region amounts to 595; however, this number includes the fauna of the Gulf of Aden plus many species of which the synonymies are not cleared up by now. Nevertheless it is believed that there is a need for a comprehensive comparison of the molluscan fauna both in the entire Red Sea and in its extremities, the Gulf of Suez, the Gulf of Aqaba and the adjoining Gulf of Aden.

Furthermore, there are characteristic hydrographical, metereological and geomorphological features in the different parts of the Red Sea which favour the local abundance or rarity of certain species. Although there are no real endemisms to observe in the Gulf of Aqaba, the species composition there and the abundance of several species is different in many regards from those of similar reef zones in the Port Sudan area (Mastaller, personal observation).

In this study it is tried to characterize the most typical molluscan assemblages with their prominent members.

Zonational patterns and specific adaptations are discussed for those assemblages which are mainly influenced by physical stresses rather than by biological interactions. In this context it is remarkable, that the littoral molluscan fauna, which is a typical feature in the Northern Red Sea, is very poorly developed here. This is due to the fact that there are almost no tidal movements in the Central Red Sea; additionally there is only little artificial substrate available for the establishment of littoral assemblages. It is interesting that many of the Red Sea 'littoral" molluscs occur in the Port Sudan region alternatively in other shallow water zones.

The assemblages which are predominantly biologically accommodated prove to have the highest species diversity. These assemblages are composed of members of all trophic levels. Characteristic for those species are narrow ecological niches according to spatial and feeding interactions within their habitat. Therefore the high number of the microhabitats which are furnished by the different hard substrates in the shallow water zones are subsequently occupied by more species than the rather uniform biotopes of soft bottoms.

This study should stimulate further extensive studies of the microhabitats of littoral molluscs, since there is still a vast number of species which are

commonly found in certain reef zones, and there is only little information or none about how they arrange their niche.

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