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2011 report on

The Littoral and Coral Reef Mapping Project

Beau Vallon Bay, Mahé

Contents

None of the original data presented here have been published so far. Some are taken from an unpublished diploma thesis (J. Macken 2011). J. Macken compiled the Catalogue of corals (pp. 37-59)

Summary of study goals

The project name relates to former projects of the author and its research team both in marine and terrestrial environments, i.e. detailed biotope mapping in order to trace developments both on long-term and short-term scales. Detailed biotope maps have served for securing ecologically important areas even in urban areas. Maps include distribution patterns of single species, mussel colonies, patches of algae etc. Detailed biotope maps from tropical marine realms in such detail have not, to our knowledge, been conducted so far with the aim of repeated close investigation in order to document their dynamics.

Detailed maps of small sections of the reefs near Beau Vallon/Mahé and exact maps of rock pools and their fauna further north could be first steps for a long term program which shall help to understand faunal dynamics in short term and long term levels. Studies such as these go far beyond cursory checks, as one element in short-term comparisons may include daily or weekly dynamics, for example with respect to the vagility of certain species or individuals. Tracing the fate of certain species in small areas may shed light on the background of changes, be they natural or caused by climate change or through more immediate human impact.

Understanding the communities and their dynamics require studies of the species composition. These studies should be combined with research on species abundance and studies on various aspects of the biology of selected taxa (e.g. of echinoderms, molluscs, crustaceans).

In 2010 and in Mai-June, 2011, five transects were mapped in detail. Maps show the distribution and exact location of coral specimens. From two transects, 54 species have been identified until now. Additional species are to be expected from the remaining three transects and portions of transects 1 and 2 of which data have been gathered (over 20 000 photographs) but not yet examined.

Methods.

Two initial studies on two different biotope types have been planned in order to trace faunal: a. on a shallow-water reef section and b. on an area of rock pools. These biotopes shall be mapped according to the standards of detailed biotope mappings. The studies include specification the faunal composition and estimating the numbers of individuals per species in the selected areas. Many relevant non-biotic parameters shall be documented, too (water temperature, tidal impact, salinity changes [in rock pools] etc.).

A survey of the species occurring in nearby areas will help to understand biological dynamics and future changes in species composition in the study areas.

Studies are non-invasive, i.e. by mere observation in the field. Determination of species abundance will be done by counting individuals in a given area. Species composition and species vagility studies require re-mapping of their distribution which in turn results from repeated, and in cases of mobile species, of continuous documentation of their position in their habitat.

During the initial studies as outlined here, no samples were be taken and species identification will be done in a non-invasive manner as well (based on photographs). If removal for identification was inevitable, the respective organism was put back to its original place immediately. However, exact determination of certain coral species requires the examination of skeletal structures and/or molecular studies. Therefore, a few taxa have not been identified down to species level.

All our data and result will be freely available on the internet.

Study areas

A. Mapping a selected shallow-water reef section and surrounding habitats along the north-western coast of Mahé near Beau Vallon.

Methods: To gain an overview impression of the study area, the initial step has been the drawing of maps of selected sites. Sites are described such that they can be easily re-identified in the future.

Biotope mapping should include

- detailed hand-drawn maps according to standard biotope maps, showing organic and inorganic components (e.g. sea floor structure, sediment, sea grass patches, sites of sessile species such as sponges, cnidarians; etc.)
- full photographic documentation
- determination of species based on observation and photos.
- information on the state of reef components
- information on behavioural dynamics: vagility and home range of echinoderms, fishes etc.
- information on physical parameters (tides, influence of currents and waves)

While mapping of five transects (plus a transect for a census of echinoderms) was conducted during the first year (2010/2011, including a full photographic documentation) some of the other tasks remain for future field work.

By ‘shallow water’ a depth ranging from 1-5 m is meant, pending on water level.

A parallel study at the south- eastern coast of Mahé for comparison (e.g. near Pointe au Sel) might be advisable.

B. Mapping rock pools using a site north of Glacis, Mahé as an example

The fauna of a rock pool area shall be mapped in its entirety. Detailed study of its faunal composition includes

- preparation of maps at different scales, full photographic documentation,
- studies of species composition
- census of individuals of selected species (preferred taxa: echinoderms and molluscs)
- distribution maps of selected species
- range use of selected species and behaviour, pending on opportunities.

Outlook

In the future, the initial studies as outlined above may be completed both in terms of extensions of the mapped area but especially with respect to a detailed survey of the fauna. It is, however, especially important to re-study the areas both on a short term scale (e.g., after 3 years) and in long-term intervals (after ten, twenty etc. years). Accuracy of the studies may make them models for biotope surveys in marine realms.

It should be noted that many species of the fauna of Seychelles are not well known with respect to their ecology, their functional morphology and their evolutionary background. Even the taxonomy and systematic position of many is not well known. This reflects the state of taxonomy and systematics in many animal groups in general. Morphological and systematic work on species from Seychelles may, if done properly, become examples of such studies. In this context it should be noted that “The Study of Species in the Era of Biodiversity” (title of a much discussed paper; Diversity 2, 2010), though of utmost importance, has become a neglected field, which shows wide-spread ignorance or a deplorable lack of responsibility for life, for nature and our environment. Expertise of the Centre for Biodiversity Research and Ecology of Goettingen University is exactly in this area.

Field work was conducted by Marcia Adler Yanez, Kai Butzelar, Elena Jeß, Julia Loth, Jessica Macken, Hendrik Urbanke, Sophia Willmann and the author.

Our thanks go to Maya Bode, who assisted in field work in 2010. Christine Khan, Mike Bambochee and the team of Ocean Dream Divers have always and substantially contributed to our efforts in many ways. Technical assistance in Goettingen was provided by Dr Gert Tröster, the department's artist Bernd Baumgart who introduced Jessica Macken into the secrets of finalising the computerized drawings and to the institute's mechanics for metal works.

Abbreviations

A	*Acropora*	
aA	dead *Acropora*	
Ae	*Acanthastrea echinata*	
aK	dead coral, not identified	
aP	dead *Pocillopora*	
Cm	*Cyphastrea microphthalma*	
Eh	*Echinopora hirsutissima*	
F	Faviidae	
Fp	*Favites pentagona*	
Ga	*Galaxea astreata*	
Gf	*Galaxea fasicularis*	
G	*Goniastrea edwardsi* oder *G. retiformis*	
NW	Niedrigwasser	
P	*Porites lutea* or *P. lobata*	
Pd	*Pocillopora damicornis*	
Ps	*Psammocora contigua*	
Pex	*Pavona explanulata*	
Pde	*Pavona decussata*	
Pdu	*Pavona duerdeni*	
Pve	*Pavona venosa*	
Pm	*Pocillopora meandrina*	
Pt	*Palythoa tuberculosa*	
Pv	*Pocillopora verrucosa*	
sp.	species (unidentified)	
St	*Stylophora pistillata*	
Tab.	table	
T1	transect 1	
T2	transect 2	
T2 162l	identification code of a quadrant:	
	T2	transect 2
	162	distance from selected fixed point on the shore (in this case:162 m)
	l	position immediately left of the line (from 0 to 1 m left of the line)
T2 162.2l	identification code of a quadrant:	
	T2	transect 2
	162	distance from fixed point on the shore (162 m)

	2l	position from 2to 3 m left of the line, i.e. between the second and the third quadrant
	l	left hand side of the line
T1 153.1r	identification code of a quadrant:	
	T1	transect 1
	153	distance from selected fixed point on the shore
	1	distance from line (1 m),i.e . between the first and the third quadrant
	r	right hand side of the line

1 Introduction

Species diversity is highest in the tropics. This applies both to terrestrial and marine realms. In marine environments, coastal areas play a crucial role. Here, very many species occur, being dependent on each other. However, in comparison to other areas the flora and fauna of coastal realms are especially vulnerable, as natural dynamics is high, as processes in neighbouring and even distant terrestrial ecosystems influence coastal biota and as man`s activities are particularly severe.

Approximately 16% of the coastlines are fringed by coral reefs. Over 35% of marine fishes occur there (more than 4000 species), along with an enormous number of sponges, molluscs, echinoderms (about 1200 species) and others, making it one of the most important ecosystems from an ecological point of view and one of the most important economic natural resources. More than 3800 species of corals have been described, of which about 1300 species are hermatypic stone corals. Estimates go as far as several millions of animal species, plants and kinds of microorganisms, of which only about 100 000 species have been recovered (Birkeland 1997, Brümmer et al. 1997).

Natural pressure on coral communities results from bioerosion for which echinoids, certain fishes, bivalves, sponges and green algae are responsible, and competition for space. Soft corals may overgrow stone corals causing their death. Competition for space includes occurrence of species preventing the successful settlement of coral larvae. Generally speaking, however, corals live in a dynamic equilibrium with other organisms. If, however, other factors are added, corals and coral reefs may easily become threatened. Such factors may be overfishing, influx of nutrients, land use causing increase of sedimentation, mechanic destruction of reef areas by touristic activities, fishery etc. Climatic change adds to these factors. All this applies to the coastal biota of Seychelles as well as to those of many other areas (Goreau et al. 2000, Jennings et al. 2000, Bellwood, 2004). Species-poor communities dominated by algae may be the final stage. The greenhouse effect and its relationship to coral bleaching has been described innumerable times even in popular publications. According to some authors, the coral bleaching event of 1998 resulted in a reduction of average coral coverage by 90% around the islands of Seychelles (e.g. Goreau et al. 2000), but we are uncertain if the respective studies have been conducted over representative areas and in sufficient detail. Possibly, the percentage mentioned above applies for selected coral reef communities only.

Studies on coral species and coral communities of Seychelles were reviewed by Taylor 1968, Stoddard 1984 and Jennings et al. 2000. Stoddard and Jennigs et al. stated that the reefs of Seychelles are not as well studied as those of some other areas. Moreover, Jennings et al. (2000) wrote saying that many marine taxa of Seychelles are still in need of thorough investigation.

There are, however, two areas where comparatively detailed studies have been undertaken, these being Aldabra in the South and the granitic islands.

A reef belt along the Northwest coast of Mahé, the largest of the granitic islands, is in the focus of our studies.

Study goals

In marine coastal realms, only few studies have been conducted that are detailed enough to trace both short term and long term biological changes down to the species level or to local species communities. Examples come from areas such as the North Sea or the Baltic Sea, where especially Swedish, Danish, German, Dutch and English research groups have worked for more than 150 years, or from the neighbourhoods of marine laboratories from all around the world. However, knowledge is still missing on the dynamics and succession of almost all marine biotope types, especially from the tropics. For example, comparative studies have rarely been conducted over several or many years. Thus it is hardly ever possible to say anything about changes in local and regional species compositions and to relate them to environmental factors. However, only detailed investigations may lead to reliable comments on the vulnerability of life communities and why they are endangered, if so.

Having current and future developments in mind such as increasing building activities, increasing tourism and the effects of an increasing population, the fates of the reefs along the coastal lines of Seychelles may provide a good example for different nature conservation activities. There are both coastal sections which are severely affected by man as well as others which have remained almost natural. Some of the latter may stay so if nature management allows. Sustainable use of biological marine systems is the key: From a healthy environment both nature and economy will benefit on a long term scale. Fortunately, Seychelles is one of the few countries which is well aware of its natural treasures and has developed one of the best nature conservation programs worldwide.

For comparative studies, the first and most important step to be taken is to gather what is there. While working out biotope maps (even – or especially – in urban areas) has become a standard for terrestrial areas, detailed maps of marine local areas are scarce. They are, however, the basics for comparisons with the situation in the future, i.e. for the study of any development of the respective communities.

Mahé. Fringing reefs are shown in red. The study area is the Northern reef of the North-West Bay (Beau Vallon Bay) (Turner et al., 2000).

Study area

The islands of Seychelles are situated far from any continent, which implies that no influences from large landmasses on the reefs will be observed here. Mahé is the largest of the granitic islands of Seychelles, it is densely populated, industry is concentrated in some places, tourism is developing in others, while large National Park areas are protected from major human activities. Reefs around Mahé reflect these differences, and their future development will certainly be related to future developments on the island. All this combined makes the factors influencing reef development better calculable than in many other areas. Moreover, there is a number of publications on former studies on marine coastal life communities around Mahé (Taylor 1968, several contributions in Stoddard 1984, Jennings at al. 2000 and others).

The reef-associated fish fauna in Seychelles consists of about 400 species. There are few, if any, endemics (Jennings et al. 2000). Reefs protect the coasts, they are important for fishery, and their biological diversity now attracts tourists. However, the reefs of the Inner Islands are threatened by sedimentation, eutrophication (Jennigs et al. 2000) and, one should add, modern touristic activities such as the use of jet ski and boats.

For summaries of the climatic conditions see Taylor 1968, Walsh 1984 and Jennings 2000. Surface water temperature ranges from 26 to 31°, while temperatures may be much higher temporarily in tidal pools (Taylor 1968 recorded values up to 41°). Tides have a maximum range of about 1.8 m. High nutrient concentrations in Beau Vallon Bay (Jennings et al. 2000) are possibly related to more rainfall than in the outer Seychelles and to forests. Due to rainfall or evaporation, salinity differences may be considerable in tidal pools.

Large scale biotope map of the Northern portion of littoral Beau Vallon Bay

In order to put detailed coral biotope maps into a topographic framework, a section of the Northern portion of Beau Vallon Bay was investigated using traditional methods (i.e. a 50-m-measuring tape and compass), beginning with the street which runs along the coast and the beach. Noticeable trees and rocks were used as benchmarks. Major biological systems such as eelgrass, algae and the reef itself were mapped.

Measurements at land and the beginning of eelgrass areas were taken at low tide. Measurements in deeper water (end of eelgrass –reef edge) were taken with a compass at high tide while snorkeling along their borders. Measured points were later brought together in a map.

However, due to the techniques used and due to water conditions (waves and currents), not all measurements were exact. Furthermore, it was not possible to bear more precisely than 5° with the compass which is another source of error. For further research one should improve measurements by using an accurate GPS or by taking a lot more measurements of the same area so that errors can be minimized.

For the distribution of the major biotope types, see the figure below

Beau Vallon Bay

Bearbeiter/in: J. Loth (2011) Quellen: ESRI MAPS, eigene Daten Karten Projektion: EPSG: 3395

2 Corals and reef types

Corals may reproduce both sexually and asexually, sexual species may be bisexual or hermaphrodites. In sexually reproducing species, mass releases of eggs and sperm may occur. After fertilisiation, a free swimming planula larva develops, which grows into a polyp after a time span of a few hours to several days. A polyp develops into a new colony. Coral reefs develop best at temperatures above 22°, while many species tolerate much lower temperatures. Corals are plankton feeders.

Knowledge of reproductive cycles is decisive for understanding the recovering of coral reefs after damaging events. The importance of water currents is obvious, as currents may act as transport media as well as barriers. Good distribution mechanisms provided, damaged reefs or reef sections may recover as long as intact colonies are present in nearby areas.

The Octocorallia are comprised of the Stolonifera, Helioporida (just one species:The Blue coral *Heliopora coerulea*), the Alcyonaria, Gorgonaria and Pennatularia. In the Hexacorallia belong the Ceriantharia, Antipatharia, Zoantharia, Actinaria, Corallimorpharia and the Scleractinia (stone corals), which is the most speciose group of the taxon.

The reefs of Seychelles belong to three (of four) major types: Fringing reefs, platform reefs and atolls. Barrier reefs do not occur here. The reef along Beau Vallon Bay is a fringing reef. The vertical extent of fringing reefs is most often limited to 15 to 20 m by the shallow depths on the Seychelles Bank (Jennings et al. 2000). Jennings et al. reviewed studies on reef development, nutrients and water movement, e.g. that of Rosen (1971).

Fringing reefs

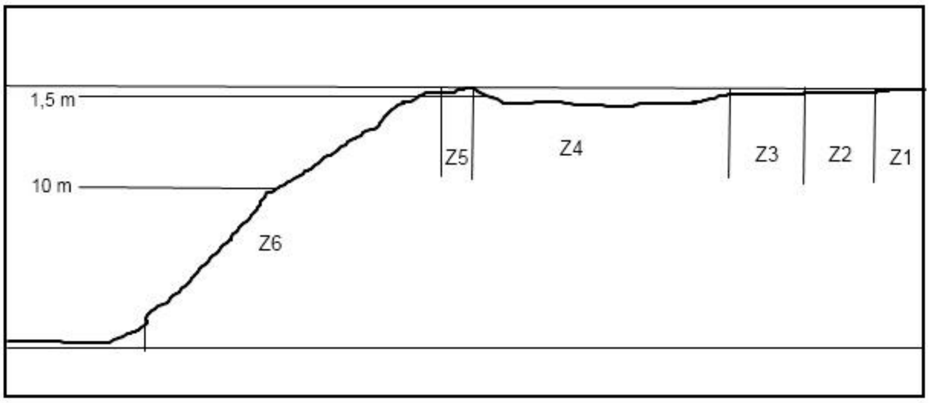
Fringing reefs develop near-shore at low tide sea level and grow seaward. Their upper parts are close to the water surface. Some are many kilometers long, their width is usually less than 100 m.

Fringing reefs occur around the granitic islands, and they are most extensive around Mahé and Praslin where they occupy areas of 20 and 27 km² respectively. Reefs on the southeast coast of Mahé are exposed to the trade winds and are more or less continuous whereas they are sheltered and irregular in northwest Mahé, with many gullies and channels. On the west coast, the granitic slopes between bays plunge steeply into the sea and true fringing reefs have only developed in the sheltered bays such as Baie Ternaie and Port Launay. In exposed areas corals grow directly on granite (Taylor, 1968, Stoddart, 1984, Jennings et al., 2000).

In Beau Vallon Bay, a diverse coastal section can be found. Sandy beaches and rocky sections provide the basis for a high biological diversity.

Zonation of the fringing reef in Beau Vallon Bay

In a fringing reef, six zones have been distinguished (Taylor 1968).



Zonation of a fringing reef. Zone 1 (Z1): Beach, Zone 2 (Z2): Sand with ripples, Zone 3 (Z3): Seagrass, Zone 4 (Z4): Reef flat, Zone 5 (Z5):Reef marin/reef edge, Zone 6 (Z6): Reef front. After Taylor, 1968 and Pillai, 1973.

1. Zone: Beach

Beach sand consists mainly of detritical carbonate grains and land-derived quartz grains. The fauna is poor in species. The crab *Ocypode ceratopthalma* is common on Mahé. Abundant bivalves are *Donax-cuneatus* und *D. faba* (Taylor, 1968; own observations). In transects 1 and 2, the beach is about 20 m wide at low tide. In transect 3 it is about 30 m wide.

2. Zone: Rippled sand zone

This is a belt of mobile sand which is often about 5-10 m wide (Stoddart 1984). However, in transects 1 and 2 it is 30 m wide. It is always covered with water. Here, a lot of coralline material can be found which is overgrown by algae.

3. Zone: Marine grass beds

Around the granitic islands, sea grass beds may attain a width of 300 m (Stoddart, 1984), but they may be missing at locations with strong currents. In T 1, T 2 and T 4 it has a width of about 45 m, while it is about 60 m wide in T 3. Six sea grass species were found, with *Thalassia hemprichii* being the dominating form (Taylor, 1968). Holothurians are abundant, especially *Holothuria atra* (Taylor, 1968; and see below). At low tide, parts of the sea grass beds are exposed to the air. Corals are rare as solid substrate hardly occurs where their larvae could settle. However, some coral species, e.g. *Porites lutea*, may stand these conditions and live in sea grass areas (Taylor, 1968, own observations).

4. Zone: Reef flat

The reef flat lies immediately below low water stand. It consists of coralline rock which contains holes filled with sand and channels. On Mahé, reef flats are largely covered by the brown algae *Sargassum* und *Turbinaria* (Stoddart 1984; Taylor 1968). Living coral colonies are rare, however, towards the reef edge coral numbers increase and macroalgae decrease. For detailed faunal information see Taylor 1968; Stoddart 1984; Schuhmacher 1991; Jennings, 1995 and below [echinoderms]. In T 1 and 2, the reef flat is about 70 m wide, in T 3 80m, in T 4 65 m. It should be noted, however, that the reef edge is irregular which results in varying widths of the reef flat.

5. Zone: Reef edge

This is a narrow (up to 20 m wide) zone between reef flat and reef slope. The morphology of the reef edge is irregular. Water movement is strong. The reef edge is characterized by many caves and niches which are particularly used by sea urchins (Stoddard 1984 and others). In T 2, large portions of the reef edge are covered by *Discosoma* and *Alveopora*. Usually, *Pocillopora, Goniastrea, Palythoa* and *Protopalythoa* are the dominating taxa.

6. Reef slope

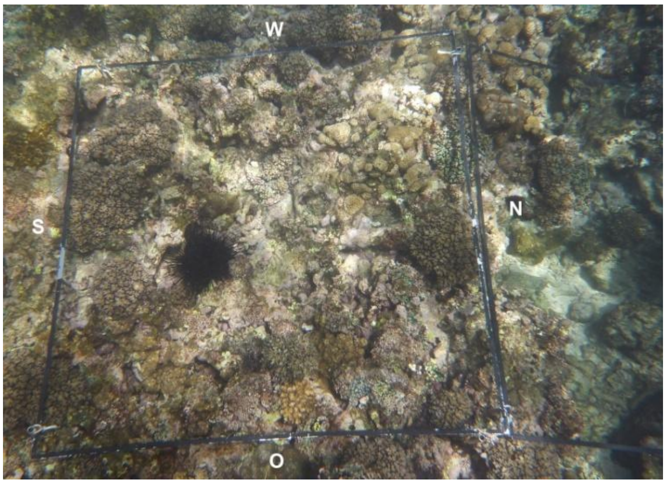
Here, only little water movement occurs. Coral growth is active over the upper 6 m, but coral numbers decrease rapidly below 10 m. On exposed coasts, the *Acropora* association is dominant, and species occurring here are, for example, *A. divaricata*, *A. irregularis* and *A. humilis*. Massive corals such as *Porites*, *Favia* and *Leptoria* are common on the lower slope. The fish fauna is very diverse (Taylor, 1968; Stoddart, 1984; Schumacher, 1991). – The reef slope was not investigated in our studies.

3 Methods

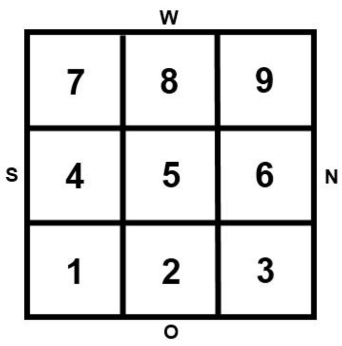
The examined reef sections lie in shallow water areas down to about 5 m water depth (snorkeling depth). So far we have not worked in greater depths, partly due to safety reasons but also because reef areas in shallow water are the most vulnerable ones.

Investigations of reefs along transects are a common method, especially for coral reef monitoring (Lam et al, 2006). In order to provide detailed maps, we have used metal frames of 1 m² which were put down at the bottom of the sea along a line. The metal frames had to be blackened because otherwise reflecting sunlight would have spoilt the photographs. The line was marked at intervals of 1 m in order to double check distances and positions. Stones were used as anchors for the line(s). With the exception of one, transects run from East to West (water proof compasses were used). For localizing the starting points of the transects on land were, GPS was used. Measurements with a compass may have led to inaccuracies.

The photographs include two overviews of each square meter (one fron the East, one from the West) and nine photos showing details (for their arrangement, see the figure below). For determination of coral species, additional detailed photos were taken. The photos were numbered and secured on computers. Equipment was removed completely after field work. Thus, we have combined the photo line intercept transect method (PLIT) and the photo-quadrate method (PHOTS) (Nakajijma, 2010; Hill et al., 2004).



Overview photograph of a quadrant from transect 2. The identification code of the quadrant is: T2 162.2l. This means that the quadrant is from transect 2 (T2), that it lies at a distance of 162 m from the fixed point at the beach and 2 m left of the line (2l).

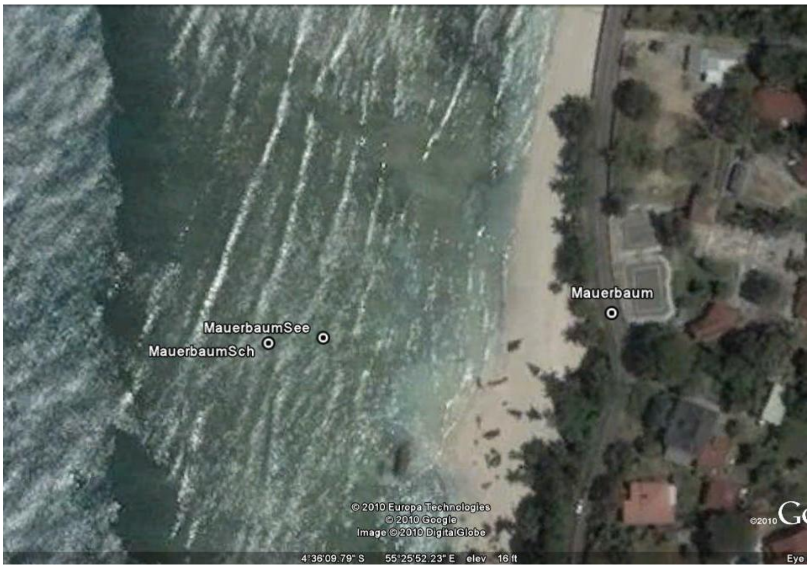


Scheme of a quadtrant (1 m²) showing the sequence of standard photographs.

In species-rich reef sections, life communities were not only mapped immediately to the North and South of the line. Here, large areas were mapped in detail. – At low tide, work had to be interrupted for more than five hours as water depth made snorkeling impossible.

Fig. 3.4: Positions of transects 1-5

Until now, the data from two of five transects have been studied in detail, but final results and comparisons will not be available until 2012. A sixths transect was studied with respect to the occurrence of echinoderms (see below).



Positions of transects 1 und 2. Transects begin at a tree near the beach wall (in German: Mauerbaum). Indicated are the beginning of the sea grass beds (Mauerbaum-See) and the diverging point of transect 1 from T 2.Google earth.

Position of transect 5 (horizontal line near middle of map)

In order to visualize the distribution and abundance of corals, four major methods were used: (1) photos; (2) silhouettes on the basis of photographs, (3) symbols for each species, indicating the position and number of corals per quadrant and (4) graphs summarizing the occurrence of species and the number of specimens per species from near-shore quadrants to the reef edge. Here again, symbols for the species were used. As different computer programs had to be used

(Illustrator and Excel), the symbols used under (3) and (4) are slightly different. - Symbols as used under (3) do not reflect the size of colonies accurately. Examples are given below.

Results

Four transects were studied in 2011 (964 m^2), another one in 2011. Their fauna and flora was documented as photographs (more than 20.600 photos in 2010, another few thousand in 2011). Due to the amount of material only part of the data has been investigated until now in detail, i.e. transects 1 and 2. Transects1 and 2 lie close to each other and cover an area of 479 m^2 (T1: 160 $m^{2,}$ T2 319 m^2).

List of coral species

From transects 1 and 2 54 species (32 genera) of corals have been identified. A few species occur with one specimen only (this applies tot he transects, they may be more abundant outside the study areas). A few species have not been identified with certainty, and in a few cases, two similar species had to be grouped as one taxon as their exact determination using photographs was not possible (e. g. *Goniastrea edwardsi* oder *G. retiformmis*).

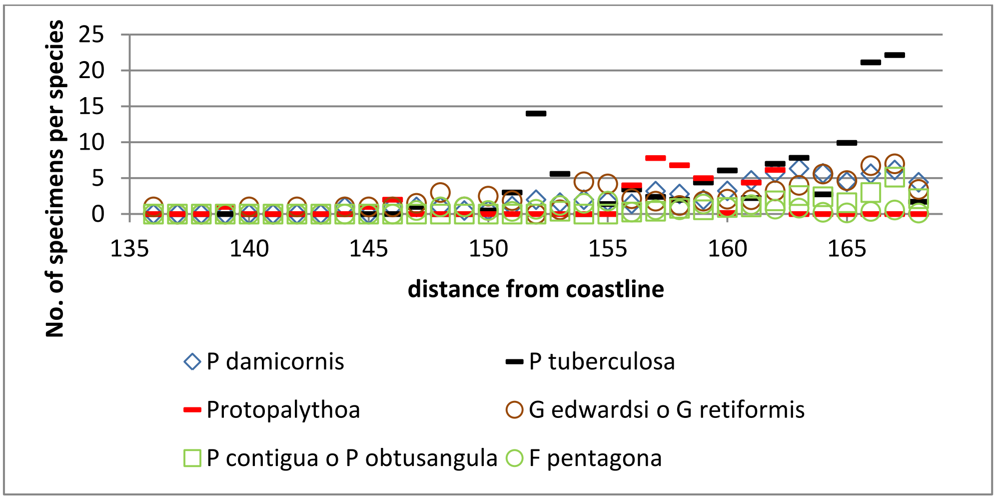
Tabelle 4.1: List of corals found in transects1 and 2.

Pocillopra damicornis
Pocillopora eydouxi
Pocillopora meandrina
Pocillopra verrucosa
Stylophora pistillata
Stylophora subseriata
Montipora efflorescens
Montipora venosa
Acropora sp.
Acropora digitifera
Acropora divaricata
Acropora formosa
Acroproa irregularis
Acropora nobilis

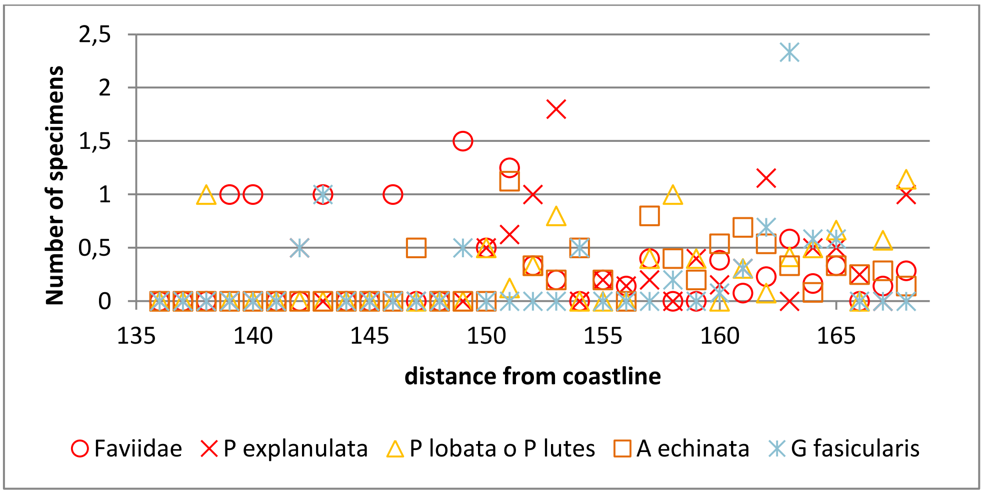
Acropora pinguis
Porites lobata oder *P. lutea*
Goniopora minor
Goniopora cf. Planulata
Alveopora sp.
Alveopora allingi oder *Discosoma* sp.
Psammocora contigua oder *P. obtusangula*
Pavona duerdeni
Pavona explanulata
Pavona frondifera
Pavona varians
Pavona venosa
Fungia sp.
Galaxea astreata
Galaxea fasicularis
Acanthastrea echinata
Hydnophora microconos
Faviidae gen. sp.
Favia speciosa
Favites abdita oder *F. complanata*
Favites pentagona
Goniastrea edwardsi oder *G. retiformis*
Goniastrea pectinata
Platygyra acuta
Leptoria Phrygia
Montastrea valenciennesi
Leptastrea purpurea
Leptastrea transversa
Cyphastrea microphtalma
Echinopora hirsutissima
Physiogyra lichtensteini
Turbinaria irregularis oder *T. stellulata*
Tubastrea oder *Dendrophyllia*
Zoanthus sp.
Palythoa tuberculosa
Protopalythoa sp.

Gorgonaria gen. sp.
Sinularia sp.
Lobophytum sp.
Distichopora violacea

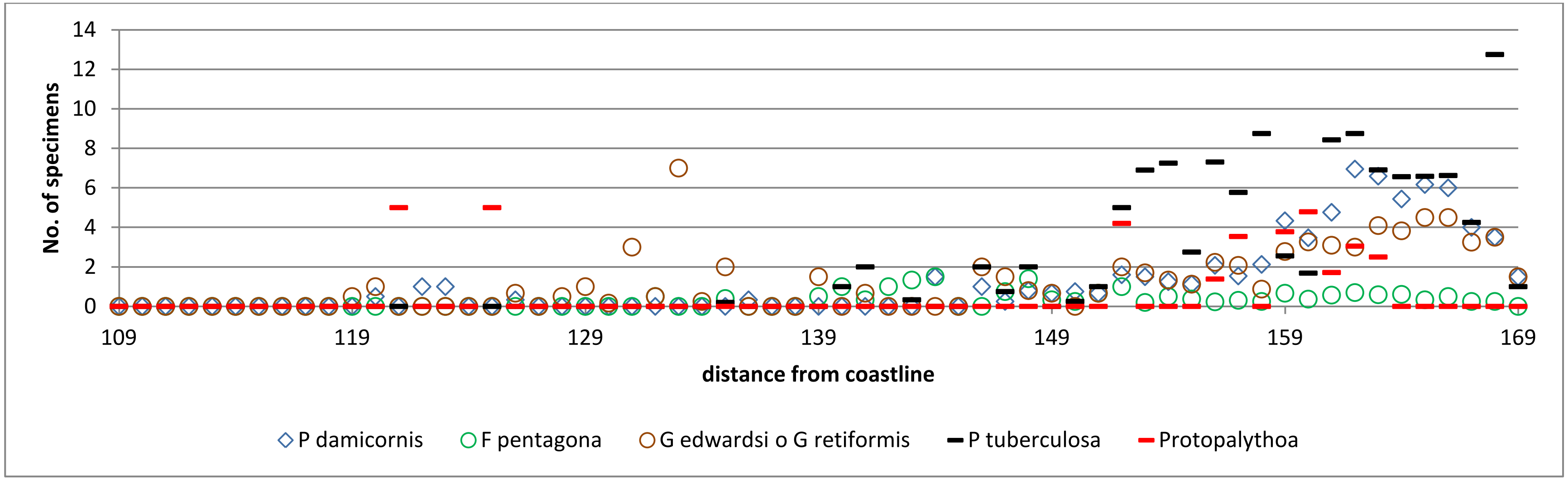
From the beginning of the reef flat to the reef edge, numbers in coral species and individuals increase continuously. The figures below visualize the increase for the more common species.



Abundance of six coral species in the quadrants of T1. For additional species, see the figures below



Abundance of six coral species in the quadrants of T1. For additional species, see the figures above and below



Abundance of six coral species in the quadrants of T2. For additional species, see the figures below

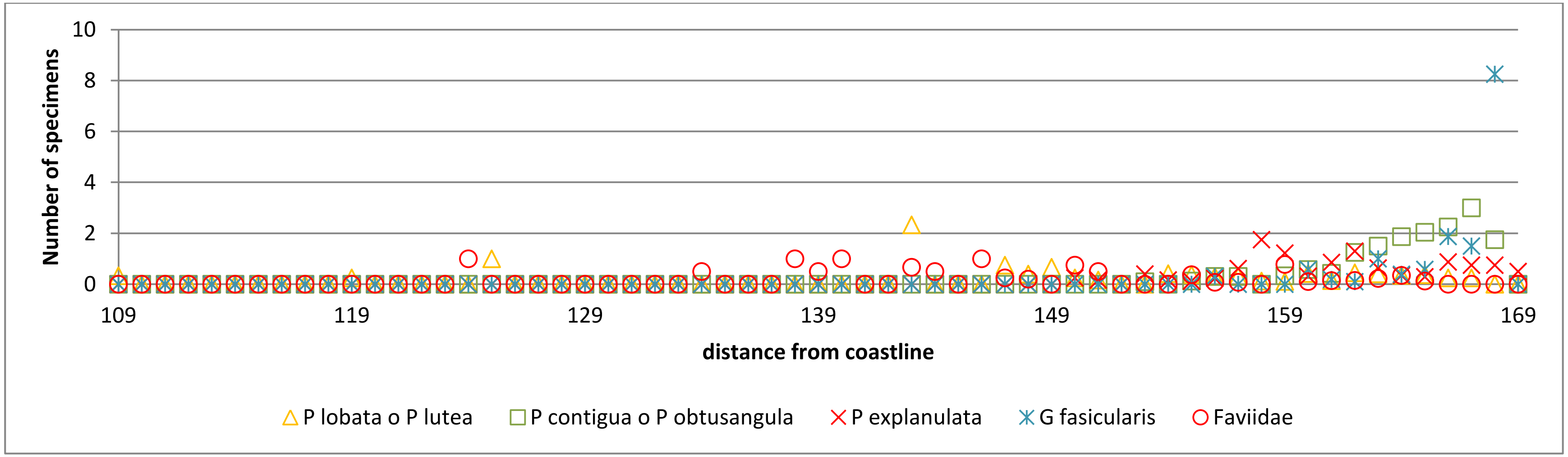


Fig Abundance of six coral species in the quadrants of T2. For additional species, see the figure above

Symbols as used in illustrations visualizing the occurrence of coral species within the quadrants of transects 1-5.

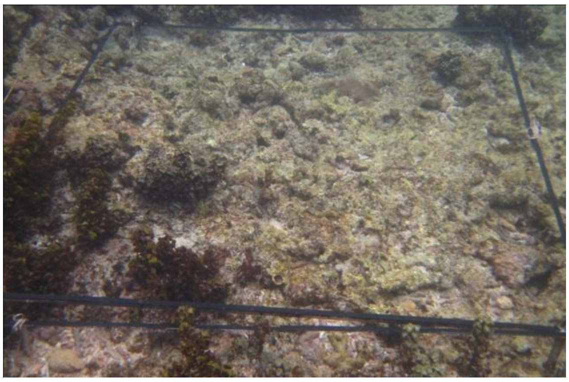
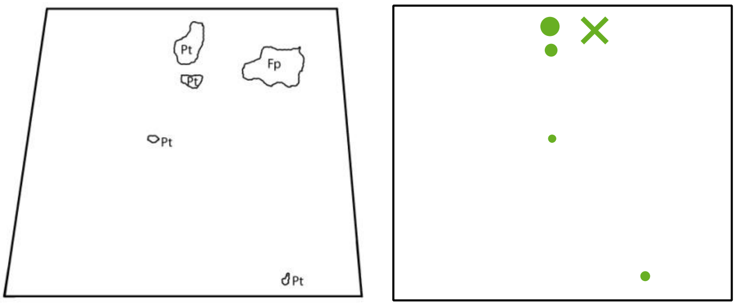
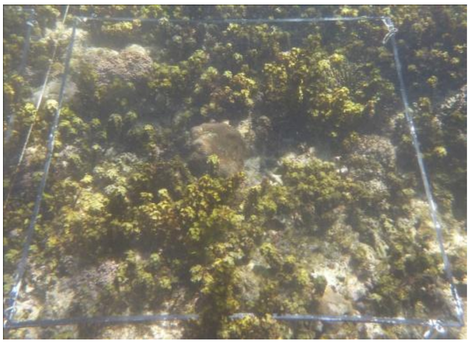


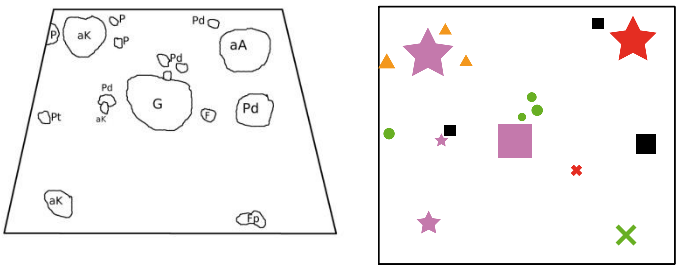
Fig. 4.68: Übersichtsfoto T2 141r



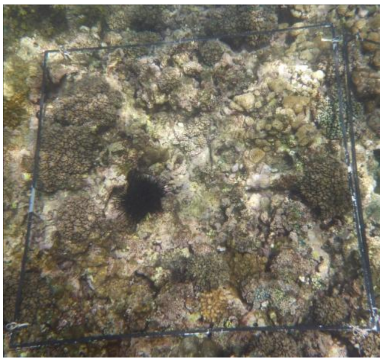
Left: T2 141r, silhouettes. For abbreviations, see above. Right: T2 141r, coral species indicated by symbols. For further examples, see subsequent fidures.



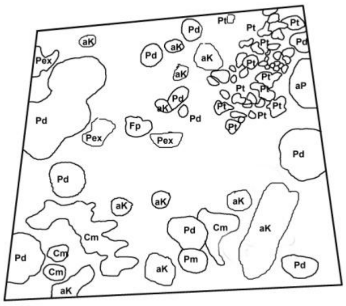
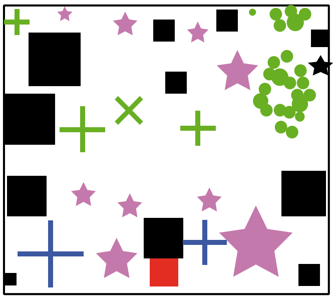
Overview photograph, T2 149.1r



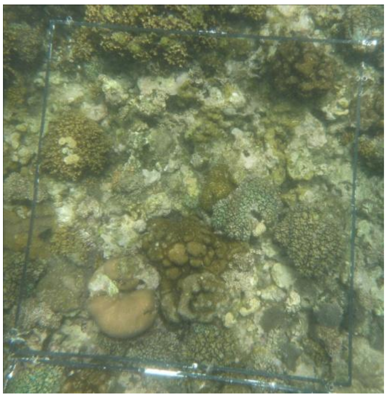
T2 149.1r, coral colonies as silhouettes and symbols

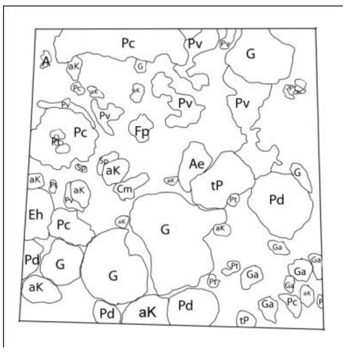
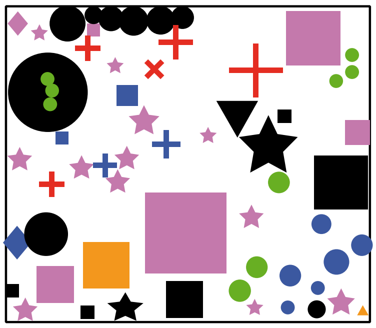


Overview photograph T2 162.2l

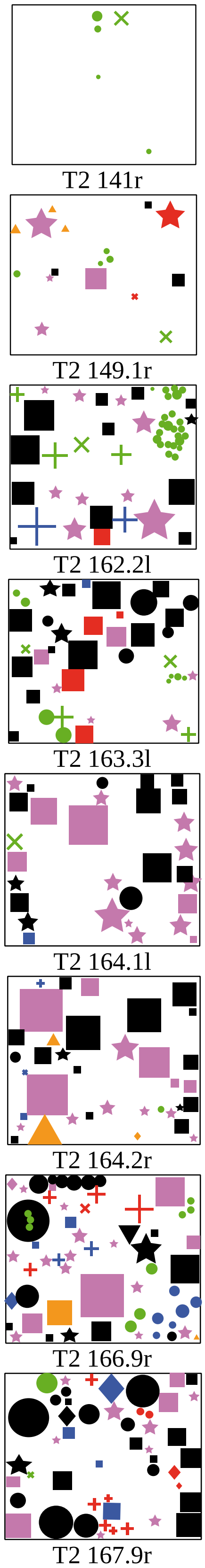



Silhouettes of coral colonies in T2 162.2l and visualization using symbols



Overview photograph, T2 166.9r, silhouettes and corals as symbols



Increasing species diversity from reef flat (above) to reef edge (below). Some quadrants are shown in previous figures together with photographs and silhouettes

Water level

The water level was measured at high tide (August, 6th, 2010) and low tide (August, 12th, 2010). The water depth was between 1,0 and 2,1 m and 0,4 and 0,9 m respectively. At low tide, some major coral structures are above sea level.

Tab. 4.2: Transect 2, water depth in different reef zones; high tide

distance from fixed point (m)	water depth (m)	reef zone
20	1 – 1,2	water line at low tide
40	1,5	rippled sand
60	1,4	seagrass bed
80	1,3 – 1,4	seagrass bed
100	1,3	reef flat
120	1,6	reef flat
140	2,1	reef flat
160	2,1	reef edge

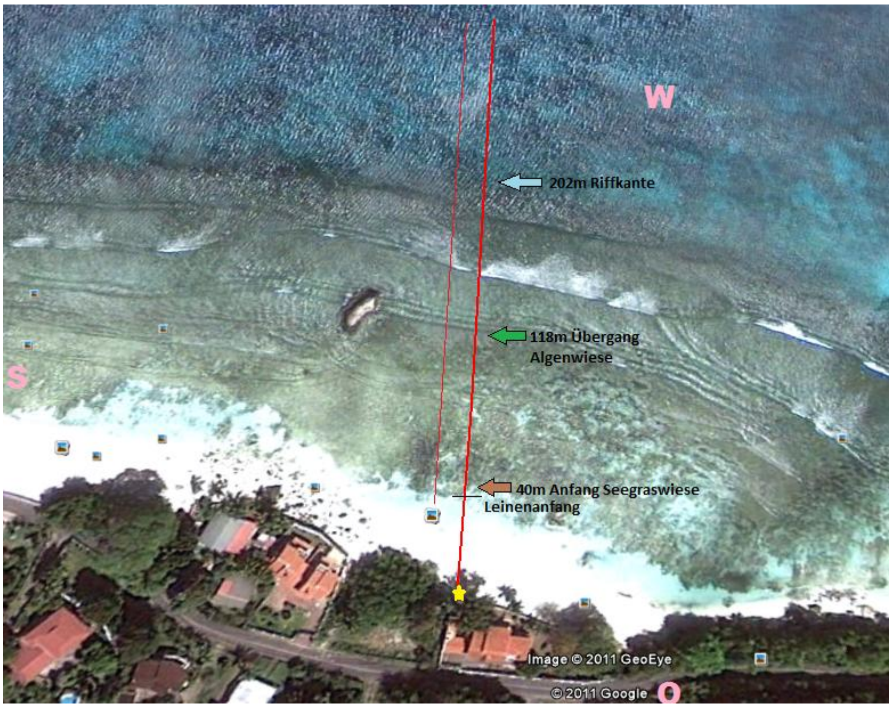
Tab. 4.3: Transect 2. Water depth in different reef zones, low tide.

distance from fixed point (m)	water depth (m)	reef zone
20	0,1	water line at low tide
40	0,5	rippled sand
60	0,4	seagrass bed
80	0,3	seagrass bed
100	0,3	reef flat
120	0,6	reef flat

Echinoderms of Beau Vallon Bay

Clark (1984) compiled a list of Echinodermata from the Seychelles (150 species), but details regarding their exact geographical occurrence are not given. In some instances, she wrote that certain species were collected from Aldabra only, others only from Mahé. This is certainly not enough information for tackling ecological questions on a regional or local scale, such as why a certain species occurs at a certain place but not anywhere else.

We aimed to create a distribution map of the echinoderms living in Beau Vallon Bay in the area between the shore and the reef edge. Data of an area of 1640 m^2, using the line transects methods were collected. Two parallel lines, with a distance of 10m from each other, were laid out from the beginning of the grass beds seawards to the reef edge, making our main transect.

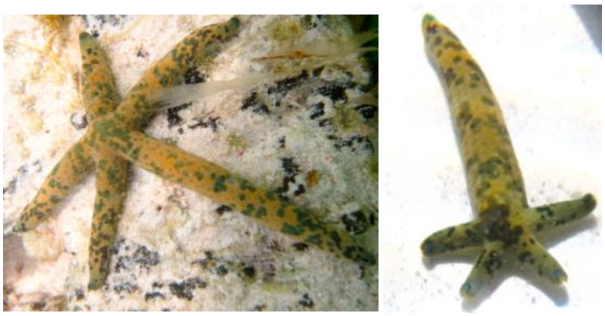


Position of transect for a census of echinoderms. The transect is 10 m wide. Marked are the beginning of the sea grass beds (orange), algal ridge (green) and the reef edge (light blue). Transect 5 (see map above) runs parallel to the transect shown here.

Subjects of our studies were starfish, brittle stars, sea cucumbers and sea urchins. The Echinoderms were determined as far as possible and their position documented. Although studies are far from finished, a few tendencies can already be mentioned:

Asteroidea: The genus *Linckia* was the most common in the studied area and it was the only genus seen in the transect. The majority of individuals was found at the grass beds and the beginning of the reef. Outside the transect, further species were found, for example *Culcita schmideliana*.

Linckia multiforma:



Culcita schmideliana:

Ophiuroidea: The brittle stars were the class most difficult to detect, hiding in crevices and under little rocks. *Ophiocoma scolopendrina* was the most common species, occurring in two colour types: brown to black banded white or white banded light brown. From 1,5m depth the black *Ophiocoma erinaceus* occurred, and it is much bigger than *Ophiocoma scolopendrina.* Additionally, there was one other genus and species present that could have been *Ophiactis savignyi*.

Ophiocoma scolopendrina:

Ophiocoma erinaceus:

Holothuroidea: *Holothuria atra* was the most common species in the transect up to the reef, but was mostly seen at the grass beds and the algae vegetation. More seawards, at the reef *Holothuria cinerascens* and *Holothuria impatiens* were relatively common. Also seen at the grass beds and the algae vegetation was the snake sea cucumber (*Synapta maculata*). Furthermore, various sea cucumbers were detected but we were unable to determine them so far. Other sea cucumbers such as *Stichoporus chloronotus*, *Thelenota ananas* and *Bohadschia marmorata* were observed outside the transect.

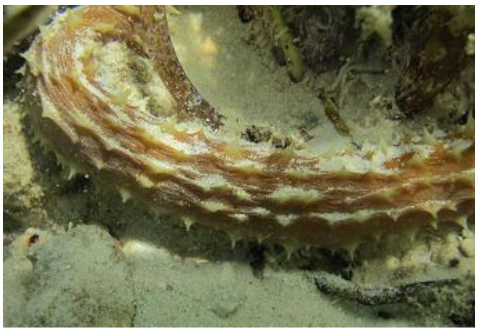
Holothuria cinerascens:

Holothuria atra:

Holothuria impatiens:

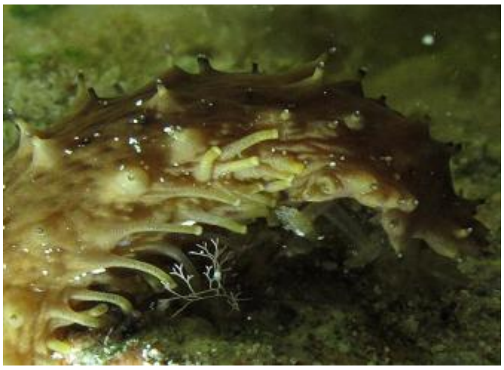
Holothuria leucospilota

Holothuria hilla:



Holothuria flavomaculata:


Holothuria difficilis:

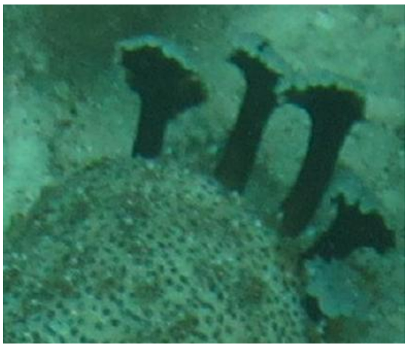



Synapta maculata:

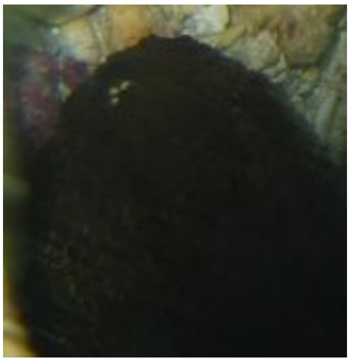


Thelenota ananas:

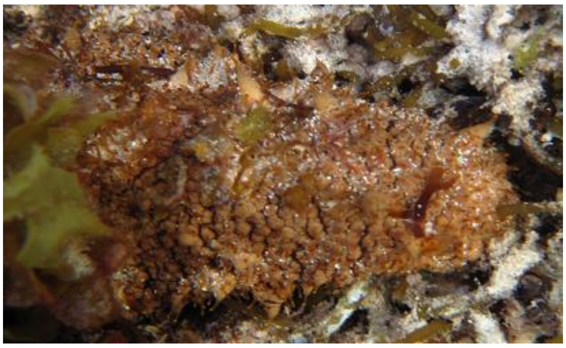

Bohadschia marmorata:

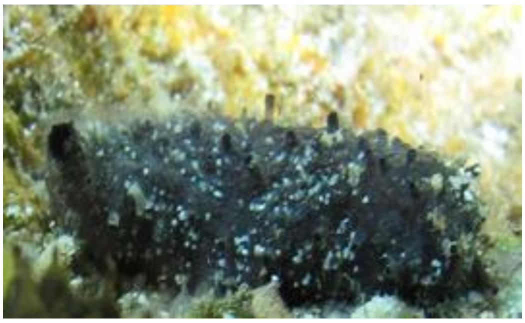
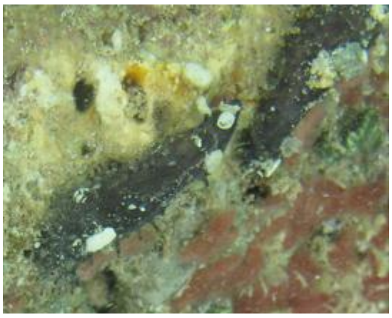
Actinopyga mauritiana:

Actinopyga echinites: *Stichoporus chloronotus:*

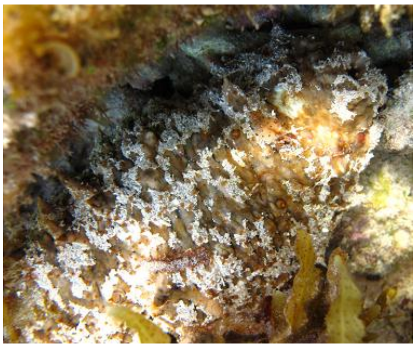
Afrocucumis africana:

Undefined species

Bohadschia sp.?:

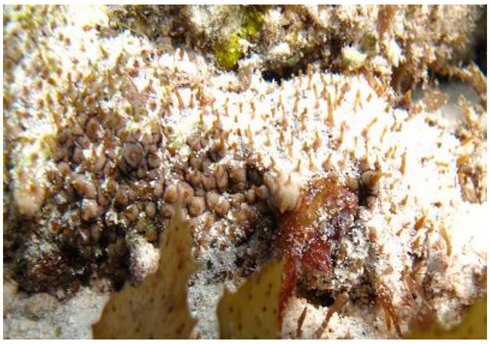

Actinopyga sp.:



Holothuria impatiens or H. pardalis or H. Arenicola:

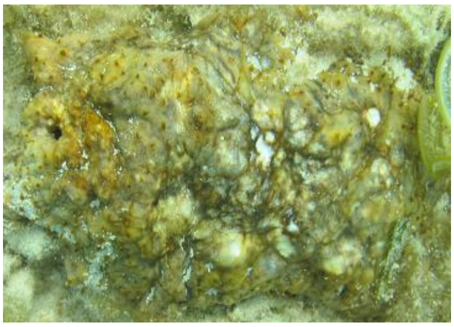
Holothuroidea:

Holothuroiidae gen. sp.:



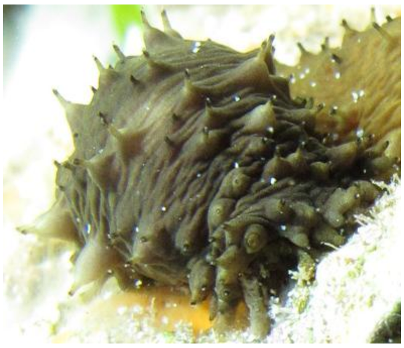

Actinopyga echinites?:

Stichopodidae gen. sp.?:



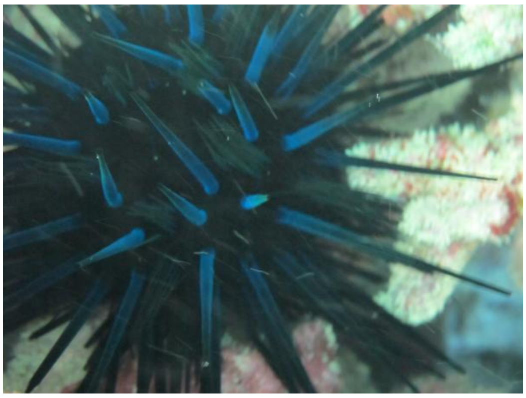
Actinopyga sp. or Bohadischia sp.:

Holothuria difficilis?:



Echinoidea: The most common species is *Echinometra matthaei*. It was seen along the whole transect. Also very common was *Stomopneustes variolaris* that wws seen a lot in the grass beds, but not so much on the reef. *Echinothrix diadema* and *Diadema savignyi* were almost only found on the reef. Another common species was *Tripneustes gratilla* that was also mainly discovered on the reef. We also saw a few *Heterocentrotus mammillatus*, and *Toxopneustes pileolus*, and possibly *Echinothrix calamaris*.

Echinothrix diadema:



Echinotrix calamaris:

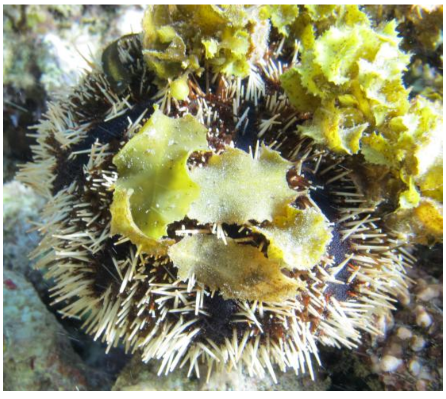
Stomopneustes variolaris:

Echinometra matthaei:

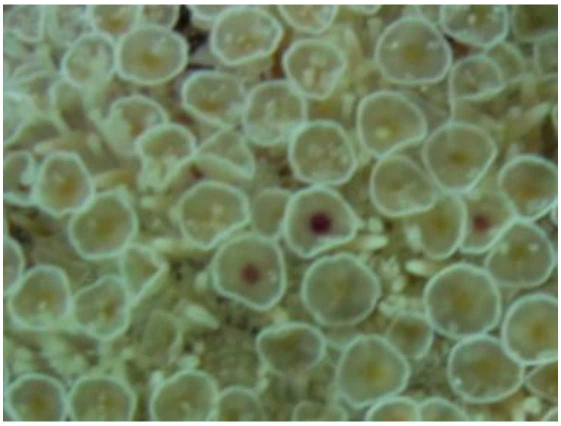
Heterocentrotus mammillatus:

Diadema savignyi or D. setosum

Tripneustes gratilla:



Toxopneustes pilleolus

Distribution of echinoderms along a transect in Beau Vallon Bay, number of specimens.

distance [m]	Echinoidea	Holothuroidea	Asteroidea	Ophiuroidea
153m-152m	7	2	-	2
152m-151m	10	-	-	-
151m-150m	13	9	2	6
150m-149m	9	3	-	6
149m-148m	17	2	-	1
148m-147m	9	1	-	6
147m-146m	5	3	-	3
146m -145m	4	1	-	5
145m-144m	12	3	2	8
144m-143m	16	3	-	7
143m-142m	11	6	-	7
142m-141m	12	5	-	6
141m-140m	21	4	-	9
140m-139m	17	7	-	6
139m-138m	19	2	-	11
138m-137m	18	1	-	9
129m-128m (10m^2)	69	4	-	-
124m-123m	48	3	-	4
123m-122m	23	3	-	4
122m-121m	37	1	2	-
121m -120m	27	4	2	-
119m-120m	31	2	3	1
110m-109m	15	2	1	3
109m-108m	23	2	3	5
108m-107m	19	2	1	-
107m-106m	34	-	-	-
106m-105m	35	3	-	3

105m-104m	15	2	-	-
104m-103m	8	2	2	2
103m-102m	11	3	3	-
102m-101m	16	2	5	-
101m-100m	20	10	1	2
100m-99m	9	3	2	2
99m-98m	24	2	4	5
98m-97m	22	5	2	1
97m-96m	11	4	-	1
96m-95m	17	1	1	-
95m-94m	12	2	-	1
94m-93m	14	1	-	1
93m-92m	17	-	-	-
92m-91m	18	1	2	-
91m-90m	38	2	1	-
90m-89m	6	1	3	3
89m-88m	8	4	1	1
88m-87m	12	2	1	6
87m-86m	21	2	6	-
86m-85m	8	-	-	-
85m-84m	13	1	3	2
84m-83m	11	-	2	-
83m-82m	5	1	1	-
82m-81m	3	2	3	3
81m-80m	6	2	2	-
80m-79m	3	1	1	6
79m-78m	6	-	1	4
78m-77m	18	2	6	2
77m-76m	14	1	2	4
76m-75m	3	1	1	2
75m-74m	8	1	-	2
74m- 73m	4	-	-	-
73m-72m	13	-	-	3
72m-71m	5	1	-	-
71m-70m	9	-	2	-
70m-69m	9	-	-	2
68m-67m	-	-	-	-
67m-66m	1	-	-	-
66m-65m	-	-	-	-
65m-64m	-	-	-	-
64m-63m	-	-	-	-
63m-62m	-	1	-	-
62m-61m	1	-	-	-
61m-60m	-	1	-	-
60m-59m	1	-	-	-
59m-58m	-	1	-	-
58m-57m	-	-	-	-
57m-56m	-	-	-	-
56m-55m	1	1	-	1

55m-54m	-	-	-	-
54m-53m	-	-	-	-
53m-52m	-	-	-	-
52m-51m	-	-	-	-
51m-50m	-	-	-	1
50m-49m	-	-	-	-
49m-48m	-	-	-	-
48m-47m	-	-	-	1
47m-46m	-	-	-	3
46m-45m	-	-	-	-
45m-44m	1	-	-	2
44m-43m	-	-	-	5
43m-42m	-	-	-	2
42m-41m	-	-	-	5
41m-40m	-	-	2	-
40m-39m	1	-	-	5
39m-38m	-	-	-	1
38m-37m	-	-	-	1
37m-36m	-	-	-	1
36m-35m	-	1	-	1
35m-34m	-	-	-	4
34m-33m	-	-	-	1
33m-32m	-	-	-	-
32m-31m	-	-	-	-
31m-30m	-	-	-	2
30m-29m	-	-	1	5
9m-28m	-	-	-	2
28m-27m	1	-	-	-
27m-26m	-	-	-	3
26m-25m	-	-	-	2
25m-24m	-	-	-	-
24m-23m	1	-	-	-
23m-22m	-	-	-	-
22m-21m	5	-	-	-
21m-20m	-	-	-	4
20m-19m	1	-	-	-
19m-18m	1	-	-	-
18m-17m	1	-	-	-
17m-16m	-	-	1	-
16m-15m	-	-	-	-
15m-14m	-	-	-	-
14m-13m	-	-	-	1
13m-12m	-	-	-	-
12m-11m	-	-	-	2
11m-10m	-	-	-	-
10m-09m	-	-	-	-
09m-08m	-	-	-	-

08m-07m	-	-	-	-
07m-06m	-	-	-	-
06m-05m	-	-	-	-
05m-04m	-	-	-	-
04m-03m	-	-	-	1
03m-02m	-	-	-	-
02m-01m	-	-	-	-
01m-00m	-	-	-	-

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4. Appendix: List of corals found in transect 2

The following descriptions are essentially based on Veron (2005). For morphological structures and skeletal elements, see Veron. For the major growth forms, see the figure below.

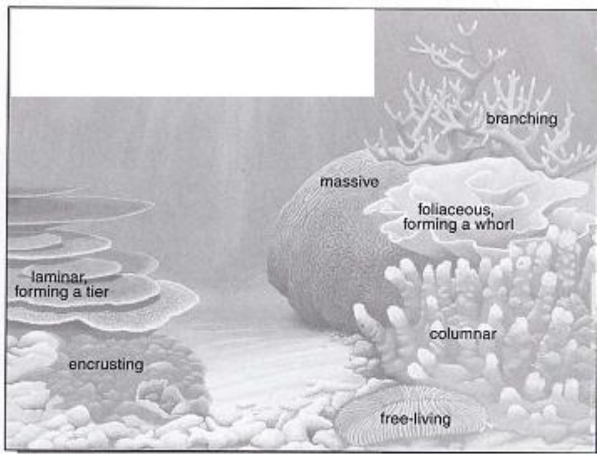

Fig. 4.1-4.6: The major growth forms of scleractinian corals (Veron, 2000).

Hexacorallia

Pocillopora

Colonies are submassive to branching. The branches are either flattened or fine and irregular. The surface of colonies are covered with verrucae. Tentacles are usually extendet only at night. There could be big differences in growth forms within species depending on the environment (wave washed reef edges, protected reef zones at the back of the reef), which may lead to identification problems.

Pocillopora damicornis (Linnaeus, 1758) (Fig. 4.7)

Colonies are compact clumps and can reach several metres across. Branches and verrucae are intergrade with each other. There is no clear distinction between these structures. Colonies are pale brown, greenish or purple. *P. damicornis* occurs in all shallow water habitats from exposed reef fronts to protected zones at the back of the reef.

Fig. 4.7: *Pocillopora damicornis*, T2 158.2l. Left: growth form of a colony, right: detail. Tentacles visible.

Pocillopora eydouxi (Milne Edwards und Haime, 1860) (Fig. 4.8)

Colonies are stout, upright, flattened branches and can be over one metre across. Branches may be widely separated. In habitats with strong wave action branches may be compact. Verrucae are uniform in shape and spacing. Colonies are usually pale to dark green or brown. *P. eydouxi* occurs in most reef habitats especially in zones of the reef where current and wave action is strong.

Fig. 4.8: *Pocillopora eydouxi*, T2 165l. Left: growth form of a colony, right: detail.

Pocillopora meandrina (Dana, 1846) (Fig. 4.9)

Colonies are small upright bushes. All branches start growing from the initial point of growth. Colonies are either flattened or being curved. Verrucae are neat and uniform. Colonies are usually cream, green or pink. *P. meandrina* occurs in shallow water environments, especially on exposed reef fronts.

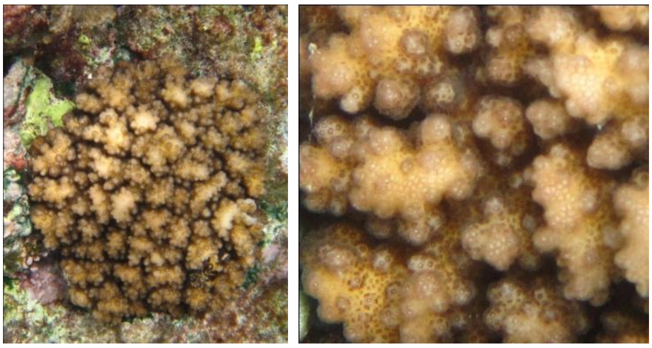

Fig. 4.9: *Pocillopora meandrina*, T2 163.4l. Left: growth form of a colony, right: detail.

Pocillopora verrucosa (Ellis und Solander, 1786) (Fig. 4.10)

Colonies are uniform upright branches. There is clear distinction between branches and verrucae. Verrucae are irregular in size. Branches are thick and compact in unprotected habitats like the reef edge and becoming open and thinner in protected zones of the reef. Colonies are seldom 0.5 metres across. Colonies usually are cream, brown or pink. *P. verrucosa* occurs in most shallow water environments from exposed reef fronts to protected zones in the back of the reef.

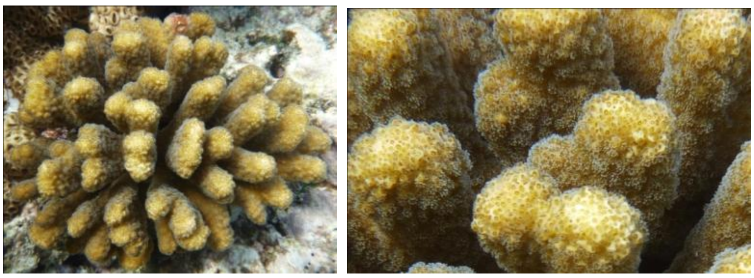

Fig. 4.10: *Pocillopora verrucosa*, T1 161.2l. Left: growth form of a colony, right: detail. Tentacles visible.

Stylophora

Colonies of Stylophora are submassive to branching. Branches are short and seldom fuse. Tentacles are often only extended at night. There are variations in growth-forms depending on the environment.

Stylophora pistillata (Esper, 1797) (Fig. 4.11)

Colonies are branched. Brunches end blunt and becoming thick and submassive. In zones of the reef exposed to strong wave action branches are thick and sturdy often irregular. In protected zones branches are less massiv. They are thin and fine branched. Tentacles may be extended at day and night. Colonies are cream often with pink tips, pink, blue or green. *S. pistillata* occurs in most shallow water environments from exposed reef fronts to protected zones further in the back of the reef.

Fig. 4.11: *Stylophora pistillata*, T2 162.9l. Left: growth form of a colony, right: detail.

Stylophora subseriata (Ehrenberg, 1834) (Fig. 4.12)

Colonies are branched. Branches are thin, irregular blunt-ended and often interconnected. Branches are more compact in exposed reef habitats than in protected zones. They are relatively straight and radiate from a central base. Tentacles are often extended during the day. Colonies are cream or pink. *S. subseriata* occurs in most shallow water environments from exposed reef fronts to protected zones further at the back of the reef.

Fig. 4.12: *Styllophora subseriata*, T1 167.1r. Growth form of a Colony.

Montipora

Colonies are submassiv, lmainar, encrusting or branched. Corallites are small. Tentacles are usually extended only at night. There are wide variations in growth-forms even within a single colony

Montipora efflorescens (Bernard, 1897) (Fig. 4.13)

Colonies are massiv or incrusting. The surface is flat or consisting of an irregular series of mounds or short columns. The coenosteum is covered with papillae which are usually elongate on mound and short on flat plates. There are although papillae on the theca, which are longer than coenosteum papillae. Colonies are usually bright. They are cream, brown or green.

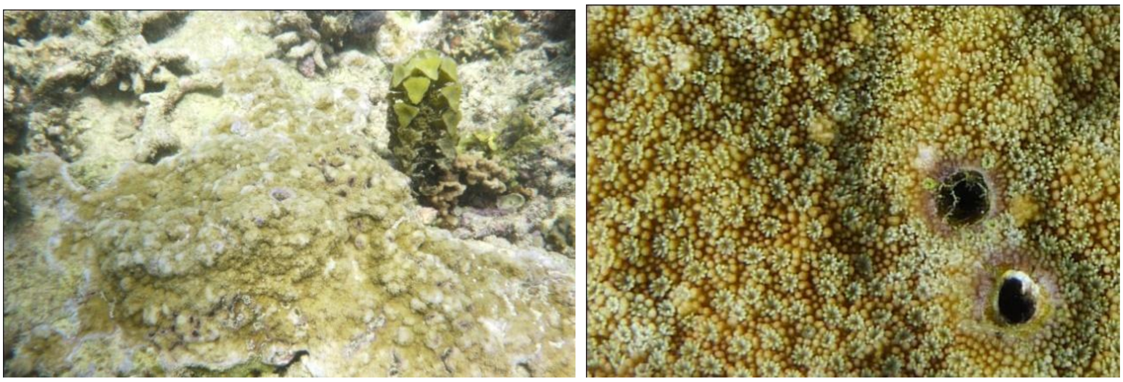

Fig. 4.13: *Montipora efflorescens*, T2 164.4l. Left: growth form of a colony, right: detail.

Montipora venosa (Ehrenberg, 1834) (Fig. 4.14)

Colonies are massive. Corralites are either thrust out or funnel-shaped. Tuberculae and papillae are absent. Colonies are brown, cream or greenish.

Fig. 4.14: *Montipora venosa*, T2 163.3r. Left: growth form of a colony, right: detail.

Acropora

Colonies are mostly branched, bushy or plate-like. They are rarely submassiv or encrusting. There are axial and radial corralites. They are important for identification of species. Tentacles are usually extended only at night. There are lots of growth-forms, which are helpful for identification. Some species are very similar in shape, but different in detailed structures. Others are similar in detailed structure, but different in shape.

Acropora digitifera (Dana, 1846) (Fig. 4.16)

Colonies are plate-like with digitate branches. The Plates can be over one meter across. Branches are small, cylindrical or tapered. Axial corallites are small. Radial corallites are tubular and uniform in size. Colonies are usually pale brown, crème or yellow with blue, creme or yellow branch tips. *A. digitifera* is found in wave washed back margins of the reef.

Fig. 4.16: *Acropora digitifera*. Top left: growth form of an older colony, T2 161r. Top right: detail. Bottom left: growth form of a younger colony, T2 159.3l. Bottom right: detail.

Acropora divaricata (Dana, 1846) (Fig. 4.17)

A divaricata has a wide range of growth-forms, from flattened plates to cushions. Colonies have interlocking basal branches. Radial Corallites are sharp edged and aligned along branches. They are different in form and shape. Corallites may be immersed to tubular or they are pressed closely to the surface of the branch. Colonies are brown or greenish brown often with brigthter tips. *A divaricata* often occurs on the upper reef slope.

Fig. 4.17: *Acropora divaricata*, T2 166.6r. Top: growth form of a colony, Bottom: detail.

Acropora formosa (Dana, 1846) (Fig. 4.18)

Colonies are large and staghorn-like. They are arborescent with cylindrical branches. In shallow water branches are short and compact. In deeper waters colonies have more open branches. Axial corallites are exsert. Radial corallites are tubular. They may be similar or varied in size and they may be uniformly or irregularly distributed. Colonies are usually brown or crème with bright branchtips. *A. formosa, A. nobilis und A. grandis* are often found together. It is difficult to differentiate them under water without attention on details. A Formosa occurs often on the upper reef slope.

Fig. 4.18: *Acropora formosa*, T1 163.4r. Detail.

Acropora irregularis (Brook, 1892) (Fig. 4.19)

Colonies are large and staghorn-like. They have horizontal fused branches. Branches may be upturned. They have encrusting bases. Colonies may form table or plates over 3 m across. The central part of the colony is solid, while the periphery is openly branched. Corallites have different length and are tubular to rasp-like. Colonies are grey. *A. irregularis* occurs especially in shallow water with strong wave action.

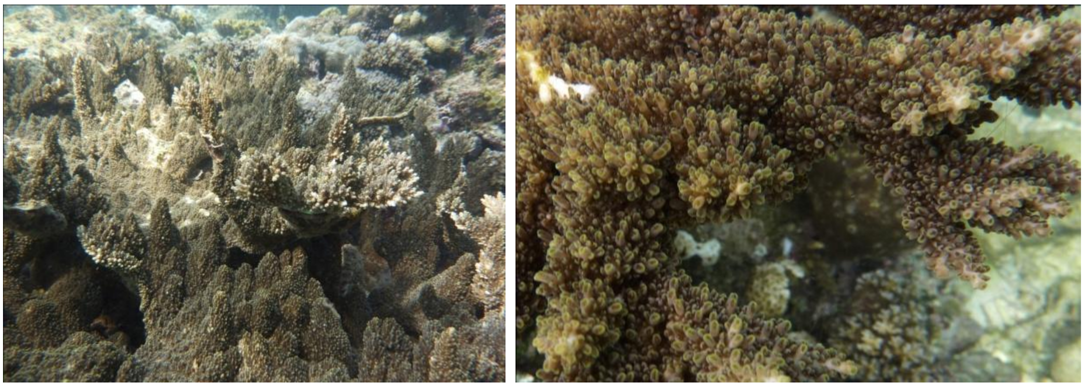

Fig. 4.19: *Acropora irregularis*, T2 164l. Left: growth form of a colony, right: detail.

Acropora nobilis (Dana, 1846) (Fig. 4.20)

Colonies are large and staghorn-like. They have large upright cylindrical branches. In shallow water colonies have horizontally fused basal branches. Radial corallites are rasp-like and are different in size and shape. Colonies are brown or cream with pale branchends. *A. nobilis* occurs on the reef flat or on the upper reef slope. *A. nobilis* und *A. formosa* have similar growth-forms. *A. robusta* and *A. nobilis* have similar corallites and growth-forms. It’s difficult to distinguish these species.

Fig. 4.20: *Acropora nobilis* or *A. formosa*, T1 142.3r. Growth form of a Colony.

Acropora pinguis (Wells, 1950) (Fig. 4.21)

Colonies are large and staghorn-like. They have encrusting bases with short thick tapered branches. Colonies may form table or plates over 2 m across. Central branches are conical, while periphal branches are irregularly prostrate. Radial corallites are small ans rasp-like. Colonies are green, grey or brown. It’s very difficult to separable small colonies of *A. pinguius, A. robusta* und *A. irregularis,* because of the incrusting base and similar growth-form. *A. pinguis* occurs on the reef flat exposed to strong wave action

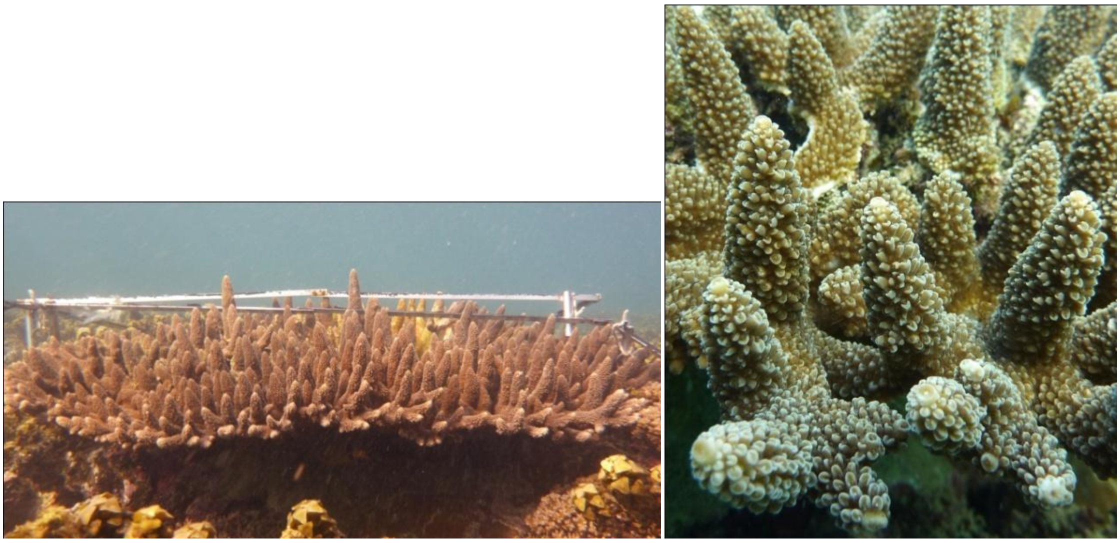

Fig. 4.21: *Acropora pinguis*, T2 164.12r. Left: growth form of a colony, right: detail.

Porites

Colonies are flat (laminar or encrusting), massive or branching. Small massive colonies are spherical or hemispherical. Large massive colonies are helmet or dome-shaped. They may be over 5 m across. Corralites are small and immersed with a lot of septa. Tentacles of most species are only extended at night. Porites is one of the most difficult genera to identify Massive colonies are difficult to differentiate under water. Corallite structures are commonly used for species identification. It’s hardly possible to separate them under water or on pictures.

Porites lobata (Dana, 1846) (Fig. 4.22 und 4.23)

Colonies are massive. They are hemispherical or helmet-shaped. They may be over 4 m across and form “micro-atolls” in intertidal habitats. The surface is smooth. Colonies are cream or pale brown. Sometimes they are blew or pink. *P. lobata* occurs on the reef flat and the reef margin.

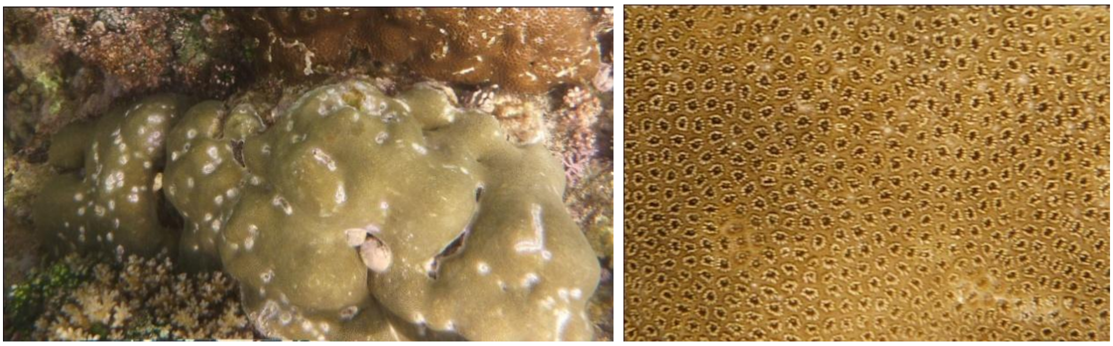

Fig. 4.22: *Porites lobata* or *P. lutea*, T2 164.2r. Left: growth form of a colony, right: detail.

Porites lutea (Milne Edwards und Haime, 1851) (Fig. 4.22 und 4.23)

Colonies are massive. They are hemispherical or helmet-shaped. They may be over 4 m across and form “micro-atolls” in intertidal habitats. The surface is smooth. Colonies are cream yellow. *P. lobata* occurs on the reef flat and the reef margin. It’s difficult to separable *P. lutea* and *P. lobata* under water or on pictures, because they are very similar in form and shape. Species identification is only possible based on detailed skeletal structures or DNS-samples. This is why we put them into one group.

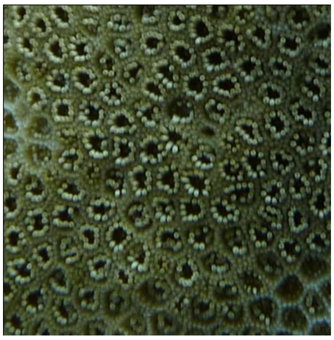

Fig. 4.23: *Porites lobata* or *P. lutea*, T2 160.1l. Detail.

Goniopora

Colonies are branched, columnar, massive or encrusting. Corallites are different in size depending on species. Polyps are long and fleshy and have 24 tentacles. Tentacles are usually extended day and night. Different species have polyps of different shapes and colours, which makes species identification underwater possible.

Goniopora minor (Crossland, 1952) (Fig. 4.24)

Colonies are massive, hemispherical or encrusting. Corralites are 3-5 mm in diameter. Calices are circular. There are six thick pali, which forming a crown. Colonies are cream with distinctively coloured oral discs and pale tentacle tips.

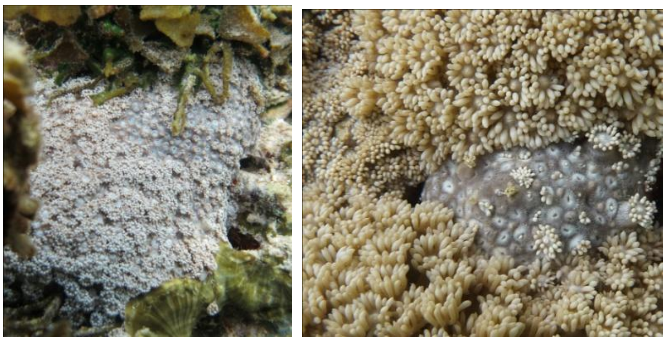

Fig. 4.24: *Goniopora minor*, T2 152.4r. Left: growth form of a colony, right: detail.

Goniopora planulata (Ehrenberg, 1834) (Fig. 4.25)

Colonies are submassive with small compacted columns or mounts. Corralites are 3-5 mm across. Polyps are short. The tentacles of the polyps are uniform in length. Colonies are dark grey-brown with white mouths. They occur in shallow water of the reef.

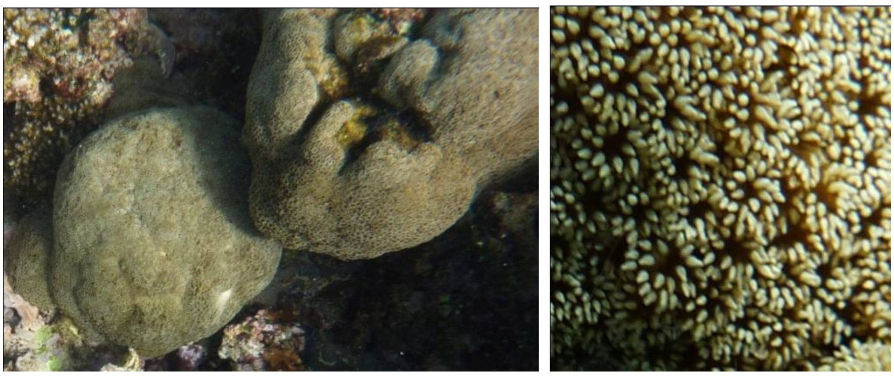

Fig. 4.25: *Goniopora planulata*, T2 165.1l Left: growth form of a colony, right: detail.

Alveopora sp. (Fig. 4.26)

Colonies are massive or branching. Polyps are long and fleshy with 12 tentacles. Tentacles are extended at day- and night times. They have swollen knob-like tips.

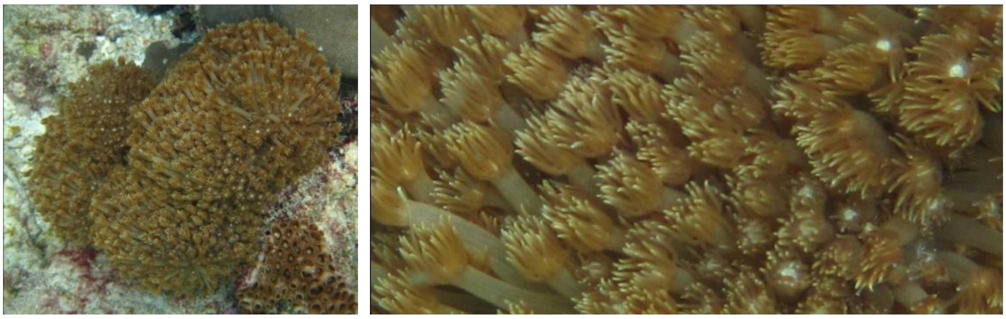

Fig. 4.26: *Alveopora* sp., T1 168.1l. Left: growth form of a colony, right: detail.

Discosoma sp. (Fig. 4.27)

Discosoma belongs to Corallimorpharia, which are closely related to stony corals. Disosoma are without a skeleton. Colonies have a broad disc with the mouth in the center. The discs are surrounded by short tentacles. The oral disc change in to a sack-like body with a horizontal base plate at the other end to fix on the substrate. Tentacles are brown. The body is bright (Erhardt und Knop, 2005). On the reef edge they may cover a wide surface.

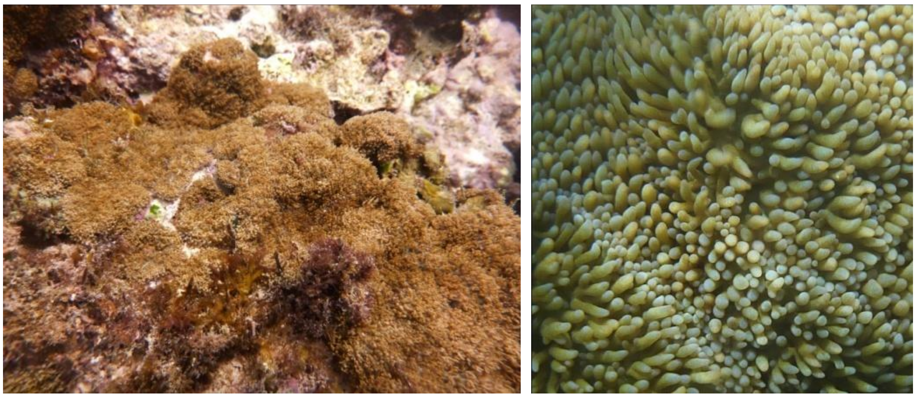

Fig. 4.27: *Dicosoma* sp., T2 165.3l. Left: growth form of a colony, right: detail.

Psammocora

Colonies are massive, columnar, laminar or encrusting. Corallites are small. Tentacles of polyps are extended at day and night.

Psammocora contigua (Esper, 1797) (Fig. 4.28)

Colonies are mixtures of flattened branches, columns and/or irregular nodules with a smooth surface. They are pale to dark grey-brown. P. contigua occurs in shallow water of the reef. Colonies are usually irregularly fused plates and branches. Large colonies have different branch shapes, determined by water movements. Colonies are pale to dark grey-brown. *P. contigua* occurs in shallow water of the reef

Psammocora obtusangula (Lamarck, 1816) (Fig. 4.28)

Colonies are nodular or form small flattened branches. They usually form a compact thicket of irregular branches. Tentacles are extended at day and night. Colonies are tan, grey or yellow-brown. *P. obtusangula* occurs in shallow water of the reef. It is difficult to distinguish *Psammocora contigua* from *P. obtusangula* under water or on pictures. This is why we put them into one group.

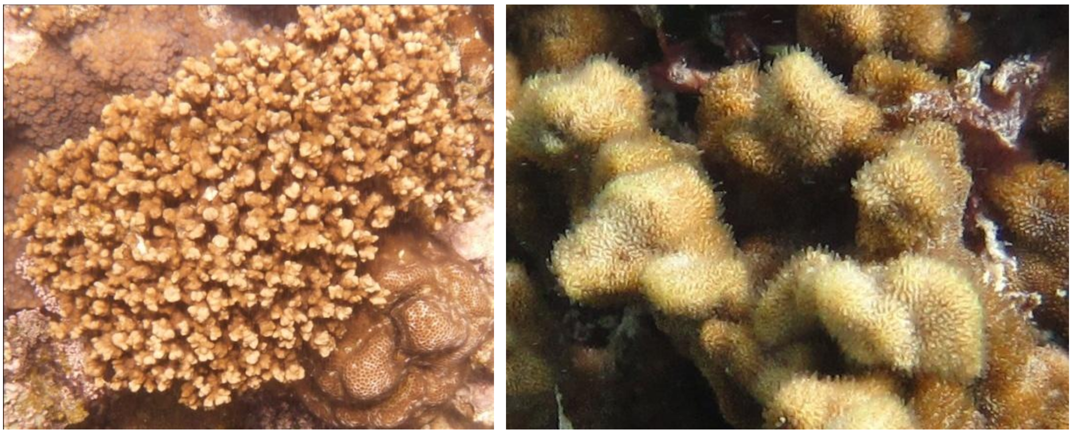

Fig. 4.28: *Psammocora contigua* or *P. obtusangula*, T2 167.9r. Left: growth form of a colony, right: detail.

Pavona

Colonies are massive, columnar, frond-like or laminiar. Corallites are small and have poorly defined walls. They are interconnected with by exsert septo-costae.

Pavona duerdeni (Vaughan, 1907) (Fig. 4.29)

Colonies are massive. They are divided into parallel or irregular ridges or hillocks. Corallites are small. They give colonies a smooth surface. Corallites have strongly alternating septo-costae. Colonies are bright, grey or brown. *P. duerdeni* occurs in most reef habitats.

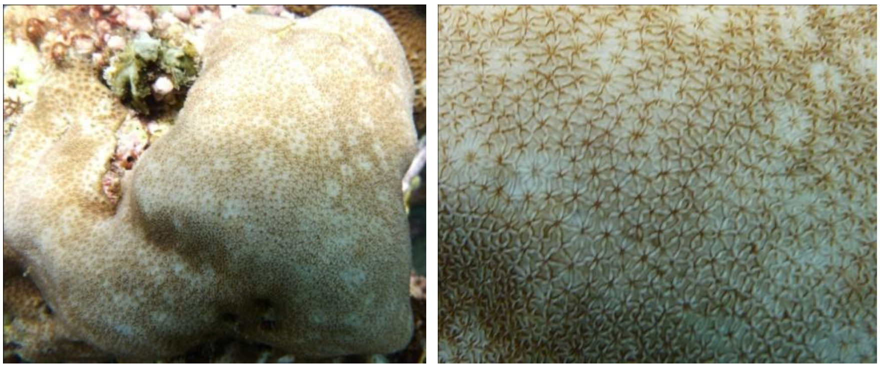

Fig. 4.29: *Pavona duerdeni* T2 163.1l. Left: growth form of a colony, right: detail.

Pavona explanulata (Lamarck, 1816) (Fig. 4.30)

Colonies are encrusting. Coralites are circular and widely spaced. Tentacles are often extended at night. They are brown, grey, blue, green or yellow or mottled. *P. explanulata* is common and occurs in most reef habitats.

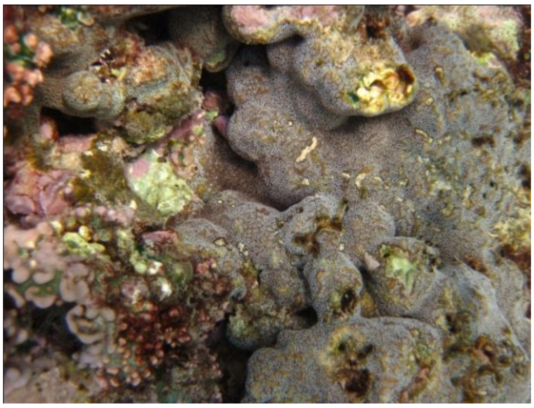 

Fig. 4.30: *Pavona explanulata*, T2 163.6l. Left: growth form of a colony, right: detail.

Pavona frondifera (Lamarck, 1816) (Fig. 4.31)

Colonies are thin plates and/or contorted fronds, which divide irregularly. Plates have radial ridges. These ridges are intergrade with the fronds. Corallites are alligned in irregular shallow valleys almost parallel to plate or frond margins. Colonies are pale or dark brown. *P. frondifera* occurs in shallow water of the reef.

 

Fig. 4.31: *Pavona frondifera*. Left: growth form of a colony, T1 161.2l. right: detail, T1 153.2r.

Pavona varians (Verrill, 1864) (Fig. 4.32)

Colonies are submassive, laminar o encrusting or they are a mixture of all three growth forms. Corallites either are in short irregular valleys or are aligned between ridges perpendicular to margin or are irregularly distributed on flat surfaces. Septo-Costae are in alternating orders. Colonies are brown, yellow or green. *P varinas* occurs in most habitats of the reef.

 

Fig. 4.32: *Pavona varians*, T2 164.5l T1 153.2r. Left: growth form of a colony, right: detail.

Pavona venosa (Ehrenberg, 1834) (Fig. 4.33)

Colonies are massive to encrusting. Corallites are in short valleys with acute walls. Colonies are yellow-brown or pink-brown. *P. venosa* occurs in shallow reef environments.

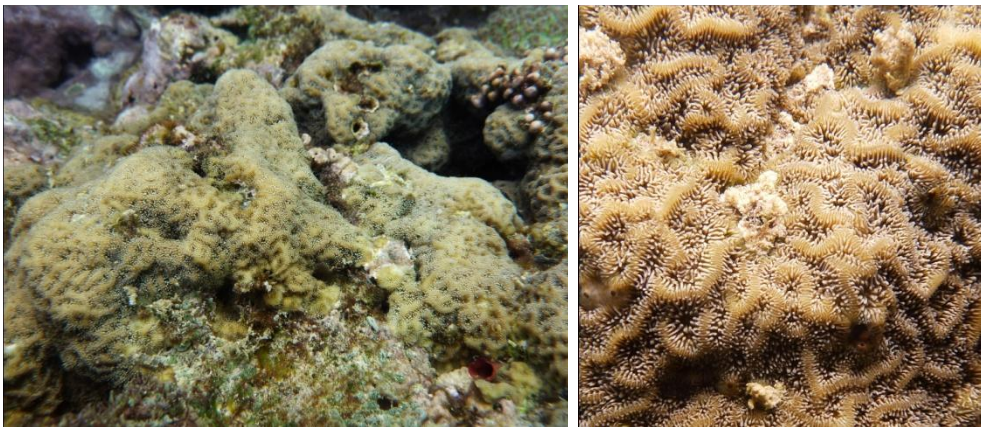

Fig. 4.33: *Pavona venosa,* T1 163.4r. Left: Growth form of a Colony, right: Detail.

Fungia sp. (Fig. 4.34)

Colonies are commonly solitary and free-living. They are flat or dome-shaped and circular or elongate in outline with a central mouth. Septa have small or large, rounded to pointed teeth. Tentacles may be extended during the day. They are short and widely spaced.

Fig. 4.34: *Fungia* sp., Growth form. Left: T2 162.4l, right: T2 162.5l

Galaxea

Colonies are massive, columnar, encrusting or cushion-shaped. Corallites are cylindrical. Septa are exsert.

Galaxea astreata (Lamarck, 1816) (Fig. 4.35)

Colonies are often submassive, sometimes columnar or encrusting. Corallites may vary in size depending on where they occur on the colony. Usually they are 3-5 mm in diameter. Tentacles are seldom fully extended during the day. Colonies are bright, grey or brown. *G. astreata* occurs in protected zones of the reef.

Fig. 4.35: *Galaxea astreata*, T2 166.9r. Left: growth form of a colony, right: detail.

Galaxea fasicularis (Linnaeus, 1767) (Fig. 4.36)

Colonies are cushion-shaped or low domes. Corallites are different in size. They are less than 10 mm diameter. Tentacles have white tips and are usually extended during the day. Colonies are green, brown or grey. Tentacles and septa have different colours. *G. fasicularis* occurs in most reef environments.

Fig. 4.36: *Galaxea fasicularis*. Top left: growth form of a colony, T1 162.4r. Top right and bottom: detail, T2 168l.

Acanthastrea

Colonies are massive or encrusting. They are flat. Corallites are cerioid or subplocoid. They are monocentric and either circular or angular. Septa have tall teeth. There is thick flashy tissue over the skeleton. Tentacles are extended only at night.

Acanthastrea echinata (Dana, 1846) (Fig. 4.37)

Colonies are encrusting or massive. They are flat or mound-shaped. Corallites are 15 mm diameter. They are circular with thick walls. Corallites may be cerioid or subplocoid. There are long pointed teeth on the septa. The

Skeleton is overgrown by thick flashy tissue and forms concentric folds. Colonies have a wide range of colours and surface texture. Textural differences and the thickness of the polyp flash is very important and helpful for species identification. Colonies are uniform or mottled dull brown, grey or green. *A. echinata* occurs in most reef habitats.

Fig. 4.37: *Acanthastrea echinata*, T2 162.9r. Left: growth form of a colony, right: detail.

Hydnophora

Colonies are massive encrusting or arborescent. Most species of the genus have conical mounds called monticules or hydnophores. Polyps are usually only extended at night. These hydnophores are sorounded by tentacles. Tentacles are short. One tentacle belongs to one pair of septa

Hydnophora microconos (Lamarck, 1816) (Fig. 4.38)

Colonies are massive. They are usually rounded with small uniform hydnophores on their surface. Hydnophores are 2-3 mm diameter. Polyps are only extended at night. Colonies are crème, brown or green. H. microconos occurs in all reef environments.

Fig. 4.38: *Hydnophora microconos*, T2 160.5r. growth form of a colony.

Favia

Colonies are massiv. They are flat or dome-shaped. Corallites are monocentric and plocoid. Tentacles are only extended at night. They are tapered often with coloured tips. Most of the species occurs in shallow environments as well as in deeper waters. There is a wide range of form and shape and colours between and within species, depending where in the reef they occur. That makes species identification difficult.

Favia speciosa (Dana, 1846) (Fig. 4.39)

Colonies are massive. Corallites are circular. They are 8-12 mm diameter. Septa are fine, numerous and regular. Colonies are brown. Calices are different coloured, usually green.

Fig. 4.39: *Favia speciosa*, T2 163l. Left: growth form of a colony, right: detail.

Favites

Colonies are massive. They are flat or dome-shaped. Corallites are monocentric and cerioid. Sometimes they are subplocoid. Adjacent corallites share common walls. Tentacles are taperes and only extended at night. There are same problems with identification like *Favia*.

Favites abdita (Ellis und Solander, 1786) (Fig. 4.40)

Colonies are massive. They are rounded or hillocky. Corallites are rounded with thick walls. They are 10-14 mm diameter. Septa are straight with exsert teeth. Colonies are pale brown with grey or green oral discs. F abdita occurs in most reef environments. *F. abdita* and *F. complanata* are taken together in one group, because species identification based on fotos is very difficult.

Favites complanata (Ehrenberg, 1834) (Fig. 4.40)

Colonies are massive. Corallites are slightly angular with tick rounded walls. Colonies are brown with grey or green oral discs. *F. complanata* occurs in most reef environments.

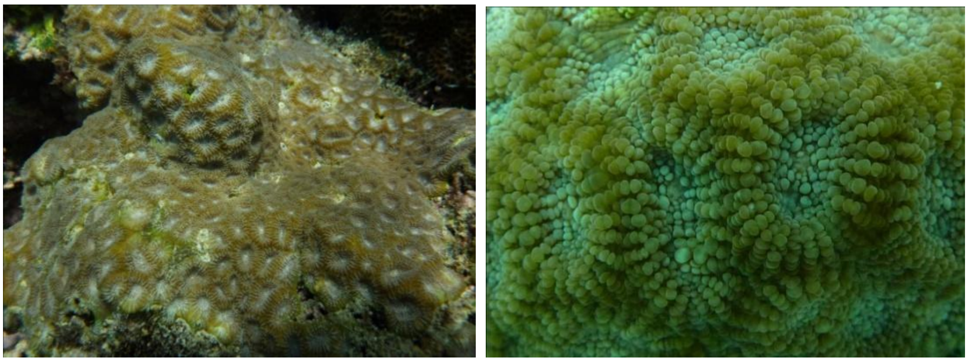

Fig. 4.40: *Favites abdita* or *F. complanata*, T2 164.2l. Left: growth form of a colony, right: detail.

Favites pentagona (Esper, 1794) (Fig. 4.41)

Colonies are submassive to encrusting. Corallites are angular with thin walls. They are 6-12 mm diameter. Septa are few in number. Paliform lobes are well developed. They form a conspicuous crow. Colonies are brown or bright with grey or green oral discs. *F. pentagona* occurs in shallow waters of the reef.

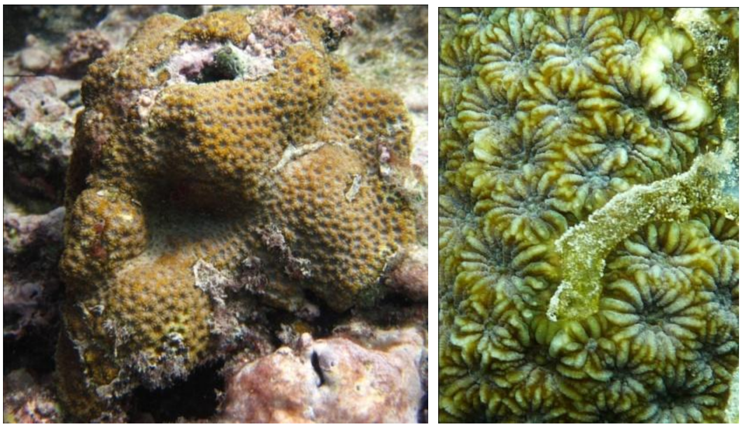

Fig. 4.41: *Favites pentagona,* T2 163.8r. Left: growth form of a colony, right: detail.

Goniastrea

Colonies are massive. They are spherical or form thick flat plates. Corallites are moncentric and cerioid to polycentric and meandroid. Paliform lobes are well developed. Tentacles are extended only at night.

Goniastrea edwardsi (Chevalier, 1971) (Fig. 4.42 und 4.43)

Colonies are massive and hemispherical. Corallites are slightly angular with thick rounded walls. Septa are irregular in length. They taper from the wall to the columellae. Columella is small. Paliform lobes are thick. Colonies are cream or brown. *G. edwardsi* is very common and occurs mostly in shallow reef habitats

Fig. 4.42: *Goniastrea edwardsi* or *G. retiformis*, T2 166.9r. Left: growth form of a colony, right: detail.

Goniastrea retiformis (Lamarck, 1816) (Fig. 4.42 und 4.43)

Colonies are massiv. They are hemispherical or flat. Corallites are four to six sided. Septa are thin and straight. Short and long septa alternate. Paliform lobes are well developed. Colonies are cream or pale brown. *G. retiformis* occurs mostly in shallow waters of the reef. G. *retiformis* and *G. edwardsi* look very similar in form and shape. G. edwardsi has thicker walls and septa and more irregular corallites. We put these both species together in one group, because species idendification is very difficult without skeletal preparation.

Fig. 4.43: *Goniastrea edwardsi* or *G. retiformis*, T2 159.4l. growth form of a colony.

Goniastrea pectinata (Ehrenberg, 1834) (Fig. 4.44)

Colonies are submassive or encrusting. Corallites are cerioid to submeandroid. Walls are thick. Paliform lobes are well developed. Colonies are pale brown. *G. pectinata* ocuurs often in shallow reef environments.

Fig. 4.44: *Goniastrea pectinata*, T1 146.2l. growth form of a colony.

Platygyra

Colonies are massive. They are flat or dome-shaped. Corallites are mostly meandroid, sometimes cerioid. Tentacles are only extended at night.

Platygyra acuta (Fig. 4.45)

Colonies are massive and meandroid. Walls form a sharp edge. Septa are uniformly exsert and have ragged margins. Walls are uniformly grey-brown with pale tops. Valley floors are green. *P. acuta* occurs mostly in shallow reef habitats.

Fig. 4.45: *Platygyra acuta*, T2 166.3r. Left: growth form of a colony, right: detail.

Leptoria

Colonies are massive or encrusting. They form sinuous valleys. Septa are equal and neatly arranged. There are no paliform lobes. Tentacles are only extended at night.

Leptoria phrygia (Ellis und Solander, 1786) (Fig. 4.46)
Colonis are massive, submassive or ridged. They have a smooth surface. Corallite valleys are sinuous and uniform. Septa are equal in size and uniformly spaced. Colonies are cream, brown or green. Walls and valley are of contrasting colours. *L. phrygya* occurs in most reef habitats.

Fig. 4.46: *Leptoria phrygia*, T2 167.10r. Left: growth form of a colony, right: detail.

Montastrea
Colonies are massive. They are dome-shapes or flat. Corallites are monozentric and plocoid.

Montastrea valenciennesi (Milne Edwards und Haime, 1848) (Fig. 4.47)
Colonies are submassive to encrusting. Corallites are angular and uniformly serratd. They are 8-15 mm diameter. Long and short septa alternate. Colonies are brown, green or yellow. Septa are white. *M. valenciennesi* occurs in most reef habitats

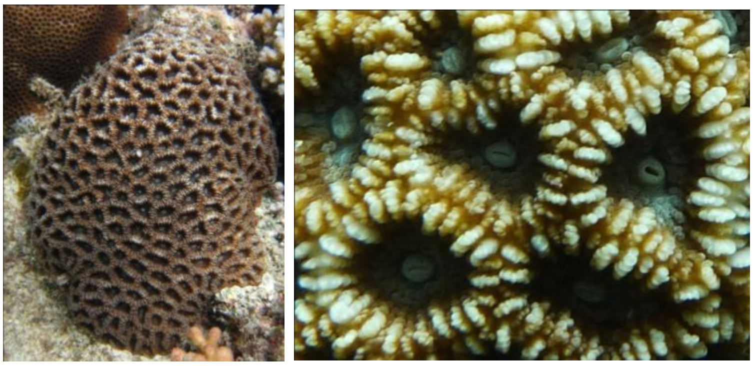

Fig. 4.47: *Montastrea valenciennesi*, T2 162.2r. Left: Growth form of a Colony, right: Detail.

Leptastrea

Colonies are massive. They are flat or dome-shaped. Corallites are cerioid to subplocoid. Septa have inward procecting teeth. The surface of a colony is bright. Tentacles may be extended during the day.

Leptastrea purpurea (Dana. 1846) (Fig. 4.48)

Colonies are flat. Corallites are different in size within a colony. They are cerioid with angular walls. Septa are tightly compact and similar in size. Septal margins slope uniformly towards the corallite centre. Colonies are cream or pale yellow on the surface with dark margins. *L. purpurea* occurs in most reef environments.

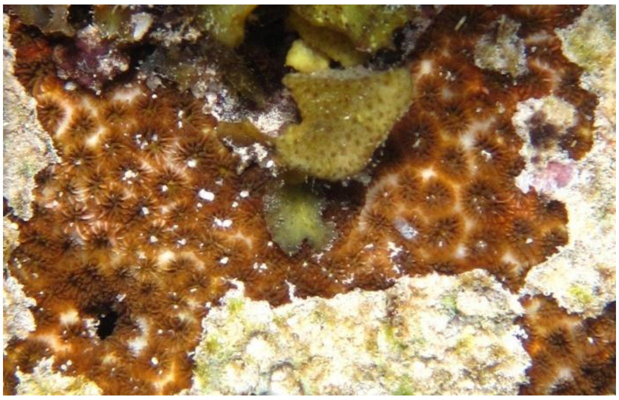

Fig. 4.48*: Leptastrea purpurea*, T2 148l. Growth form of a colony.

Leptastrea transversa (Klunzinger, 1879) (Fig. 4.49)

Colonies are flat. Corallites are angular and cerioid. Septa are not tightly compact. They plunge steeply near the corallite centre. Colonies are green, grey or yellow with dark sides. L. transversa occurs in most reef environments.

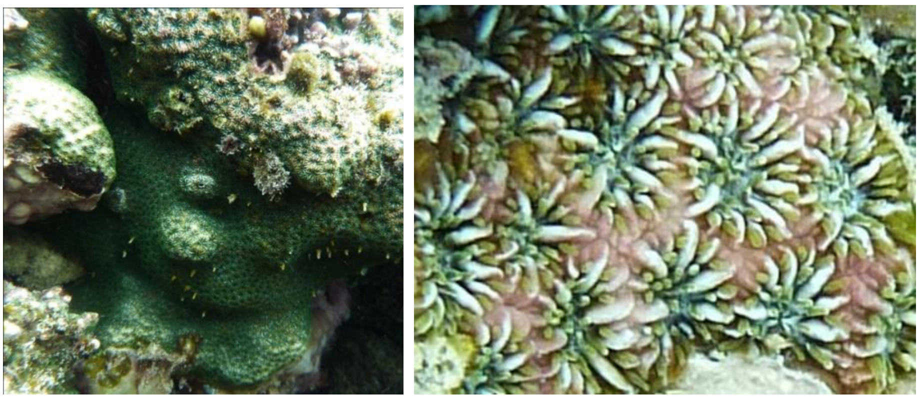

Fig. 4.49: *Leptastrea transversa*, T1 141.5l. Left: Growth form of a Colony, right: Detail.

Cyphastrea

Colonies are massive or encrusting. Corallites are plocoid with small calices. The coenosteum is granulated. Tentacles are usually extended only at night..

Cyphastrea microphthalma (Lamarck, 1816) (Fig. 4.50)

Colonies are massive to encrusting. Corallites are tall and conical. Corallites are compact in colonies exposed to strong light and widely spaced where light levels are low. Corallites have usually ten septa, which are visible under water. But this may be variable among corallites. Colonies are brown, cream or green. Septa are white. C. mycrophthalma occurs in most reef environments.

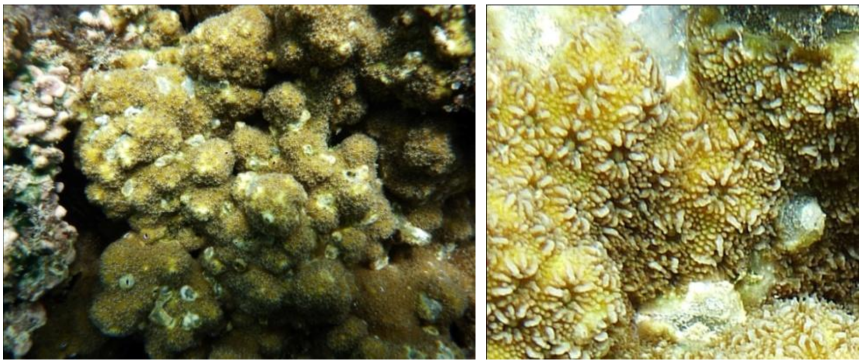

Fig. 4.50: *Cyphastrea microphthalma*, T2 162.2l. Left: Growth form of a Colony, right: Detail.

Echinopora

Colonies are massive, arborescent or laminar or a mixture of these three growth forms. Corallites are plocoid with calices up to 10 mm diameter. Septa are excert and irregular. The coenosteum is granulated. Tentacles are only extended at night.

Echinopora hirsutissima (Milne Edwards und Haime, 1849) (Fig. 4.51)

Colonies are submassive or encrusting. They often have irregular shapes. Corallites are 4-7 mm diameter. Walls are thick with prominent skeletal structures. Costae are strongly beaded. The coenosteum is granulated and densely covered with thick, finely elaborated spinules. Colonies are yellow, green, brown or purple often with bright septo-costae. *E. hirsutissima* occurs in mostly in shallow waters of the reef.

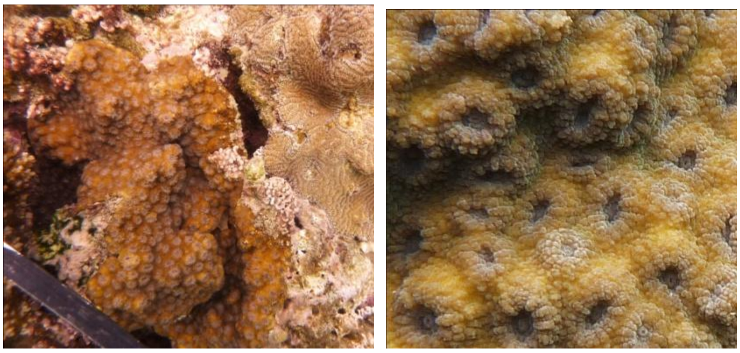

Fig. 4.51: *Echinopora hirsutissima*, T2 163.9r. Left: growth form of a colony, right: detail.

Physiogyra

This genus has only one species, *Physiogyra lichtensteini*.

Physiogyra lichtensteini (Milne Edwards und Haime, 1851) (Fig. 4.52)
Colonies are massive. They are meandroid with short widely separated valleys interconnected with light blistery coenosteu. Septa are large, exsert and widely spaced. Tentacles are only extended at night. During the day the whole surface of the colony is covered by lots of vesicles. The vesicles may be different in form and shape. Vesicles retract when disturbed. Colonies are pale grey or cream. *P. lichtenseini* occurs in protected reef habitats with turbid water and tidal currents such as crevices and overhangs ,

Fig. 4.52: *Physiogyra lichtensteini*, T2 165.5r. Left: growth form of a colony, right: detail.

Turbinaria (Oken, 1815)
Colonies are submassive, columnar or laminar. Corallites are round and immersed to tubular. Tenacles are usually only extended at night.

Turbinaria irregularis (Bernard, 1896) (Fig. 4.53)
Colonies consist of encrusting plate. Their Margins are free and irregular. Corallites are irregular and exsert. The coenosteum between corallites is smooth and uniform. Colonies are uniform or motteled dark-brown. *T. irregularis* occurs in all reef environments.. *T. irregularis* und *T. stellulata* are very similar in form and shape. We put these both species together in one group, because species idendification is very difficult without skeletal preparation or DNS-samples.

Turbinaria stellulata (Lamarck, 1816) (Fig. 4.53)
Colonies are encrusting. Corallites are conical and 2-3 mm diameter. Colonies are usually brown or green. The coenosteum between corallites is usually darker than the corallite wall. *T. stellulata* occurs in most reef environments.

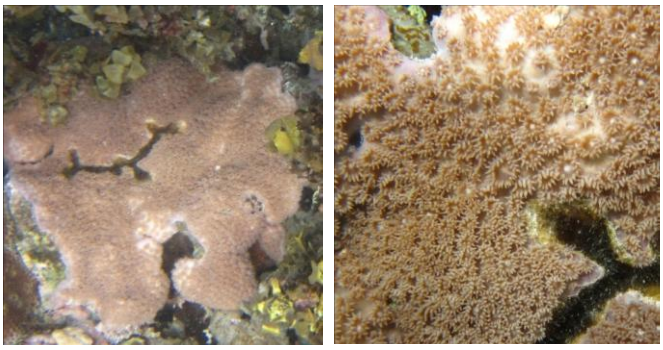

Fig. 4.53: *Turbinaria irregularis* or *T. stellulata*, T2 156.7r. Left: growth form of a colony, right: detail.

Dendrophyllia sp. und *Tubastrea* sp. (Fig. 4.54)

Colonies of these genera are solitary or colonial. Most of the species are azooxanthellate. They live on plankton. This is why they may colonize in zones where light levels are low such as cavities and overhangs. *Tubastrea* and *Dendrophyllia* are not distinguishable without examination of the pattern of septal fusion.

Fig. 4.54: *Tubastrea* sp. or *Dendrophyllia* sp., T2 164.1r. Growth form of a colony.

Zoanthus sp. (Fig. 4.55)

Colonies are encrusting. They build a thin layer on the reef surface. They don't have a skeleton. Polyps are columnar with extended tips. The oral discs are less than 1 cm diameter with a mouth in the center. They are surrounded by numerous short tentacles. Oral discs and mouths are of contrasting colours. *Zonthus* may occur in all reef environments (Erhardt and Knop, 2005).

Fig.4.55: *Zoanthus* sp., T1 165.4r. Growth form of a colony.

Palythoa tuberculosa (Klunzinger, 1877) (Fig. 4.56)

Colonies are encrusting. Polyps are nestled in the coenosteum. Polyps may be wide open and obscure the tissue between the polyps. Colonies are usually cream with dark oral discs. P. tuberculosa occurse in most reef environments (Erhardt und Knop, 2005)

Fig. 4.56: *Palythoa tuberculosa*, T2 162.2l. Left: growth form of a colony, right: detail.

Protopalythoa sp. (Fig. 4.57)

Polyps are 2 cm in diameter. The oral discs are bigger and the tentacles are longer than Zonthus. Tentacletips taper off. Oral discs are wide open during the day to capture light for photosynthesis. Polyps form radial furrows, which are similar to the septaof hard corals. The stenopeic-like mouth is located in the center of the oral disc and towers above latter (Erhardt und Knop, 2005).

Fig. 4.57: *Protopalythoa*, T2 162.7r. Left: growth form of a colony, right: detail.

Octocorallia

Gorgonaria gen. sp. (Fig. 4.58)

Gorgonians have a wide range of growth forms. They form arborescent branches to fans-like networks. Colonies may be over 3 m diameter, but in Beau Vallon they are just a few centimeter in diameter. The skeleton is formed from gorgonin, a flexible, horny substance. The horny skeleton may be supported by a skeleton of tightly grouped calcareous spicules. They form a basal disc to tack to the substrate. Branches radiate from the basal disc. Colonies are red, orange, yellow or white. Tentacles are white. You can find them in small cavities or under overhangs at the reef margin.

Fig. 4.58: Gorgonaria gen. sp., T2 163.1l. Growth form of a colony.

Sinularia sp. (Fig. 4.59)

Colonies are massive with digitate strucures in different size. *Sinularia* doesn't have a skeleton. Colonies have calcite spicules, called sclerite. Sclerite are important for species Identification. It's not possible to identify exactly species under water or on picures. Colonies are white or brwon (Erhardt und Knop, 2005).

Fig. 4.59: *Sinularia* sp., T2 147r. Left: growth form of a colony, right: detail.

Lobophytum sp. (Fig. 4.60)

Colonies are encrusting with costal-like structures on the whole surface. There two different types of polyps, Auto- and Syphonozoide. Syphonozoide are visible under water.They look like pores. Colonies are conspicuous yellow. *Lobophytum* looks similar to *Sacrophyton* (Erhardt und Knop, 2005).

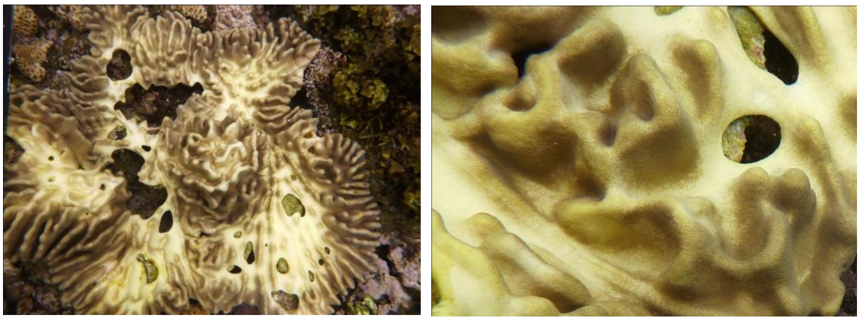

Fig. 4.60: *Lobophytum* sp., T2 156l. Left: growth form of a colony, right: detail.

Hydrozoa

Distichopora violacea (Pallas, 1766) (Fig. 4.61)

Colonies are upright and fan-like branched. They consist of Aragonit. Colonies are just a few centimeter diameter. Branches are purple with white tips. Colonies have two types of Polyps called Fress- or Wehrpolypen. Latter are visible under water as fine hairs. They are azooxanthelat and occurs especially in reef environments with low light levels and strong current (Erhardt und Knop, 2005). In Beau Vallon you can find *D. violacea* often in small cavities or under overhangs together with Gorgonaria.

Fig. 4.61: *Distichopora violocea*, T2 163.1l. Growth form of a colony.