




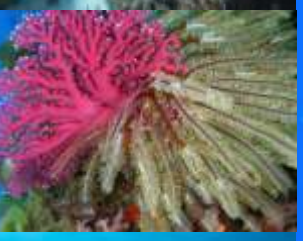


Majuro Atoll

long-term monitoring guide

coral reef communities
and marine debris

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WHY monitor ?

Monitoring is important to measure change and enables an interpretation of the success of conservation actions. Change can be natural or forced by disturbance events. Change may be gradual and difficult to detect so quantitative data is needed.

The method for measuring change in coral reef communities is the BACIR approach

- BEFORE
- AFTER
- CONTROL
- IMPACT
- REPLICATION.

Changes are detected by measuring conditions *before* and *after* an impact. To detect changes with a necessary level of certainty requires *control* (unaffected) sites. To account for natural variation, *replication* is needed at the level of transect and site.

Survey Methods

2 depths @ each site

3-5m & 8-10m

Reef FISH

3 x 50m (2m wide belts – small reef fish)

3 x 50m (5m wide belts – large reef fish)

CORAL & RUBBISH Diversity

3 x 50m (2m wide belts)

*** Includes inventory of rubbish within belts**

Large reef FISH

3 x 250m (5m wide belts)

BENTHIC Cover

3 x 50m Point-intercept transects

(100 points, record every 50cm)

***includes counts of rubbish**

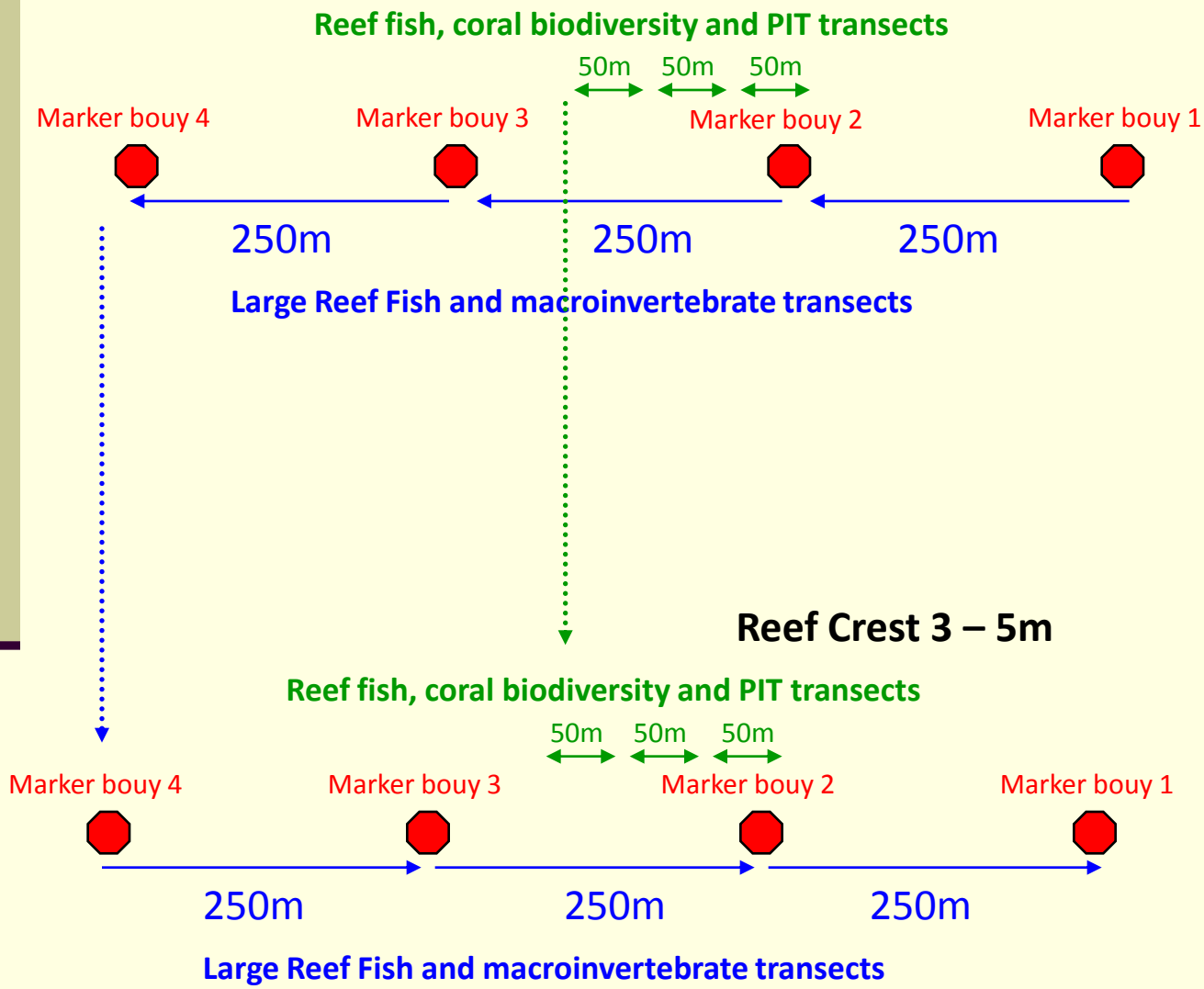
MacroINVERTebrates

3 x 250m (5m wide belt)

***** Remember 2 depths surveyed at each site = 6 transects per site for all taxa.***

Reef Slope 8 – 10m

The deep sites are always surveyed first to ensure dive safety. **Four weighted marker bouys** are deployed every 250m using a GPS to measure the distance. The coral and fish surveyor begin surveying first starting at the second marker bouy and the large fish and invertebrate surveyor then being their surveys at the first marker bouy. This strategy minimizes the disturbance of sharks and large reef fish.



NOTE: The reef fish biodiversity surveyor swims first while deploying the 50m transect tapes and is followedby the coral biodiversity surveyor. After 3 transects, the coral surveyor swims first back along the transect conducting point-intercept transects and the fish surveyor follows winding up the tape.

Counting Fish

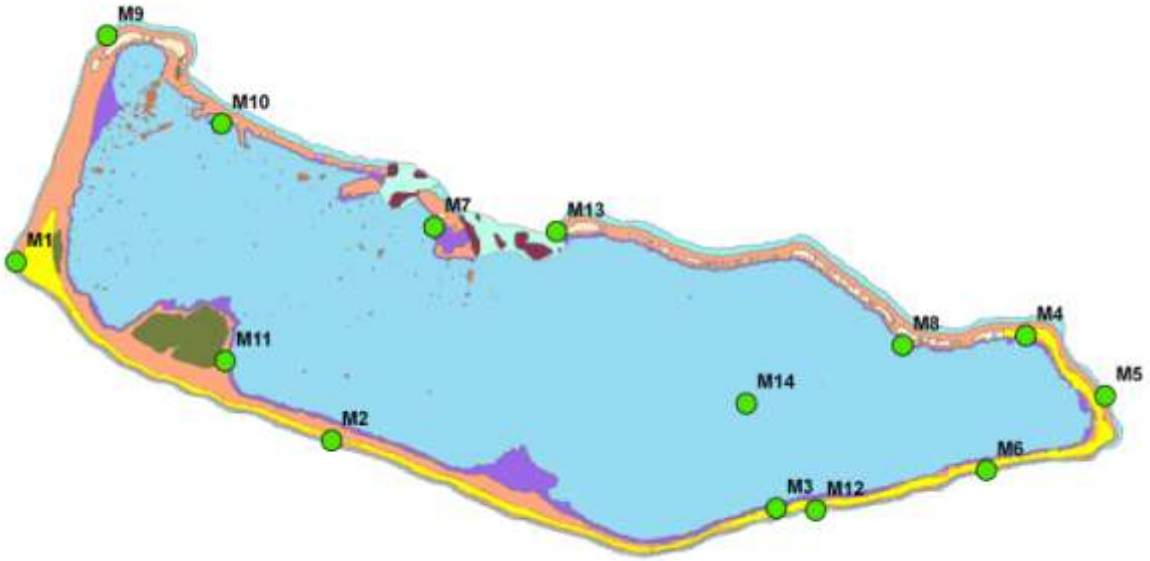
Reef Fish Biodiversity

The abundance and size of all non-cryptic fish species is documented on 3 replicate 50m transects per habitat. Larger mobile fishes such as Wrasses, Parrotfishes, Emperors, Snappers, Surgeonfishes, Groupers, Butterflyfishes, Angelfishes are recorded on a 5m wide, and smaller site attached fishes (damselfish, small wrasses, etc.) on a 2m belt. This approach will ensure very rigorous assessments of fish biomass and density, which is crucial for temporal and spatial comparisons.

Large Reef Fishes and Sharks

The biomass and abundance of larger, wide-ranging fish species with larger territories can be more accurately assessed on long swim transects. Large fishes are recorded at each site and depth on 3x250 m belt transect of 5 m width. Many of the species recorded in these counts occur at such low densities that estimates based on smaller transects are imprecise and unreliable for on-going monitoring.

Long-term monitoring sites in Majuro Atoll



a). SCUBA sites on the reef crest and reef slope.

b). SNORKEL sites from shallow lagoon sites.
Specifically conducted to record marine debris.

ID	LAT: N	LON: E
M1	7.147326	171.026506
M2	7.089044	171.129486
M3	7.066964	171.274774
M4	7.123253	171.35631
M5	7.103624	171.38224
M6	7.079354	171.343472
M7	7.158668	171.163085
M8	7.123253	171.35629
M9	7.221025	171.056227
M10	7.192273	171.093613
M11	7.114926	171.094738
M12	7.066318	171.28767
M13	7.157113	171.203093
M14	7.101144	171.265011

GPS co-ordinates of long-term monitoring dive sites at Majuro

ID	LAT: N	LON: E
RU1	7.086766	171.373531
RU2	7.088113	171.378002
RU3	7.092751	171.379386
RU4	7.113357	171.366963
RU5	7.111748	171.367668
RU6	7.10811	171.371193
RU7	7.101758	171.377096
RU8	7.078722	171.33149
RU9	7.076408	171.322287
RU10	7.074649	171.318014
RU11	7.074649	171.318

GPS co-ordinates of rubbish snorkel sites in Majuro Lagoon

Australian museum
nature culture discover

museum of tropical queensland
queensland museum

Coral Identification Training Manual

Hard Corals of the Marshall Islands

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Cover photos by Silvia Pinca, Maria Beger, Giles Winstanley and Jim Maragos

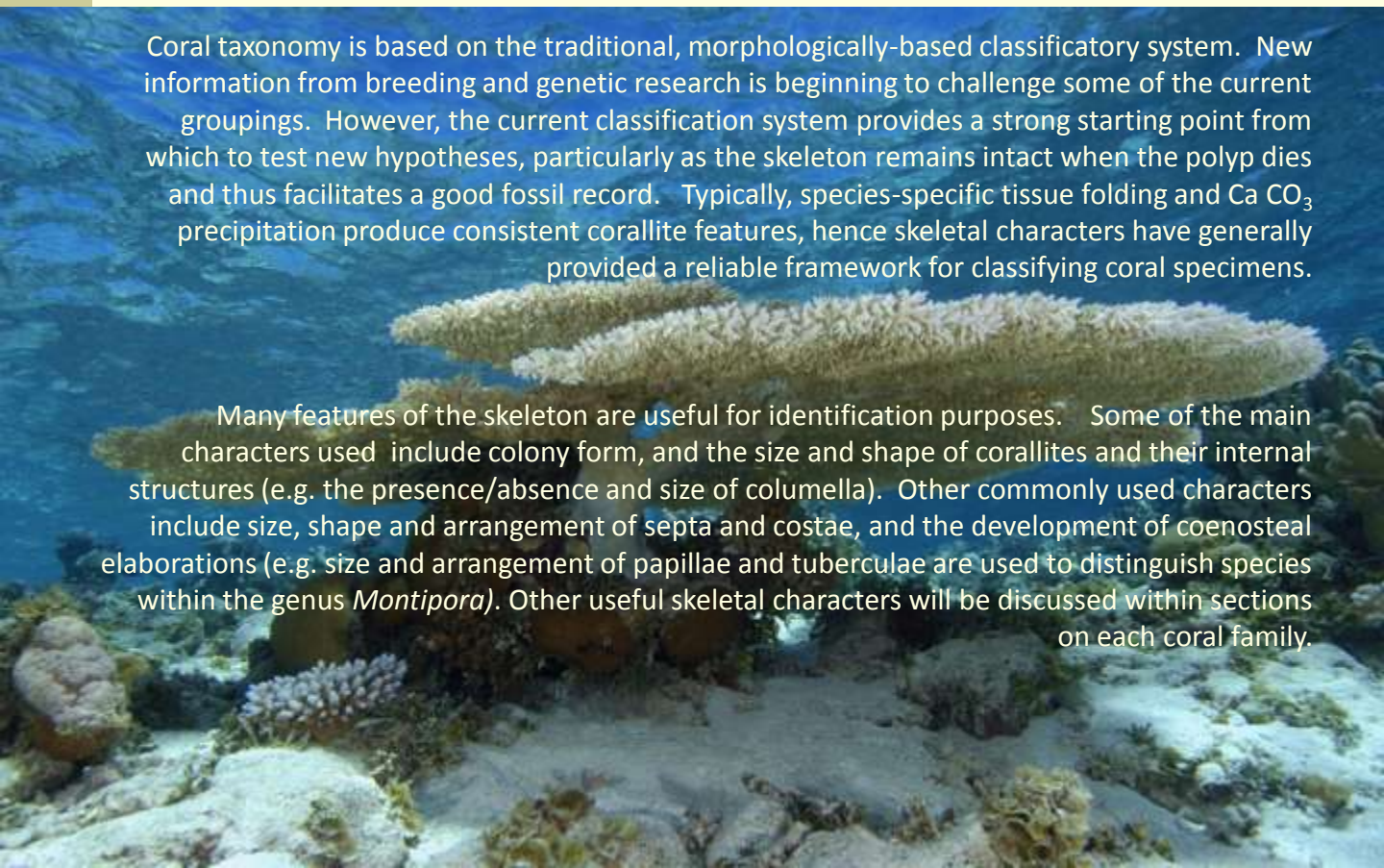
Introduction

This coral identification training manual provides an introduction to the characteristics used to identify scleractinian corals. It provides key-like summary descriptions of the most useful characters used to distinguish between morphologically similar species. It includes a summary and pictures of corals known to occur in the Marshall Islands. This manual is for teaching purposes only and should be used in conjunction with other taxonomic sources (see reference list, inside front cover).

Identifying corals using this manual

This manual will guide the identification process, however, decisions about species boundaries should always be made with reference to type or skeletal reference collections, as well as supplementary texts such as the AIMS Monograph Series (Veron et al. 5 Volumes 1976-1984), Corals of the World (Veron, 2000) and Staghorn Corals of the World (Wallace, 1999). When identifying corals, it is most important to make consistent judgments about species boundaries and to be aware of the extent of variation that can occur within a species, particularly in different habitats. Examples of extreme morphological divergence may ultimately warrant classification of taxa as new species, however such decisions should be made in the light of rigorous morphological, biological, ecological and molecular analyses.

AN INTRODUCTION TO CORAL TAXONOMY



Coral taxonomy is based on the traditional, morphologically-based classificatory system. New information from breeding and genetic research is beginning to challenge some of the current groupings. However, the current classification system provides a strong starting point from which to test new hypotheses, particularly as the skeleton remains intact when the polyp dies and thus facilitates a good fossil record. Typically, species-specific tissue folding and Ca CO_3 precipitation produce consistent corallite features, hence skeletal characters have generally provided a reliable framework for classifying coral specimens.

Many features of the skeleton are useful for identification purposes. Some of the main characters used include colony form, and the size and shape of corallites and their internal structures (e.g. the presence/absence and size of columella). Other commonly used characters include size, shape and arrangement of septa and costae, and the development of coenosteal elaborations (e.g. size and arrangement of papillae and tuberculae are used to distinguish species within the genus *Montipora)*. Other useful skeletal characters will be discussed within sections on each coral family.

Scleractinian corals are Cnidarians, hence they share three characteristics with their close relatives the anemones and jellyfish. First, they have tissue grade construction, whereby specialized cells are grouped into tissues that perform functions (e.g. mesenterial filaments digest prey), but tissues are not grouped into organs. Secondly, Cnidarians exhibit a diploblastic arrangement of tissues, whereby two epithelial cell layers (endoderm and ectoderm) are separated by a connective layer called the mesoglea. Thirdly, unique to Cnidarians are cnidae or stinging cells in the epidermis. These cells contain everting intracellular organelles capable of stinging and entangling prey.

Corals are modular organisms, hence they grow in size through replication of the module, known as the polyp. Polyps replicate through budding and form colonies when daughter polyps remain attached. Because of the modular nature of colonies, corals are able to reproduce asexually through fragmentation, as well as through a variety of other mechanisms. Consequently, coral life cycles generally include both sexual and asexual phases. Spawning is the most common mode of sexual reproduction and involves the release of eggs and sperm into the water column for external fertilisation. In hermaphroditic species, gametes (eggs and sperm) are bundled into packages held together by mucus in the hours before they are released. Once released, egg-sperm bundles ascend towards the sea surface, where they break apart and fertilisation occurs. Embryogenesis produces larvae called planulae. After an obligate 3-4 day period of planktonic development, larvae settle on appropriate substratum and metamorphose into the coral polyp, which founds a new colony. Scleractinian corals have a diverse range of growth forms, from single polyps to very large colonies that can live for hundreds of years.

Most scleractinian corals form a symbiotic relationship with unicellular algae called zooxanthellae. Zooxanthellae live within coral tissues and provide a number of benefits for the coral host. One important benefit is the conversion of light energy into nutrients, some of which supplement the nutrition of the coral host.

Tissue connections and within-colony communication

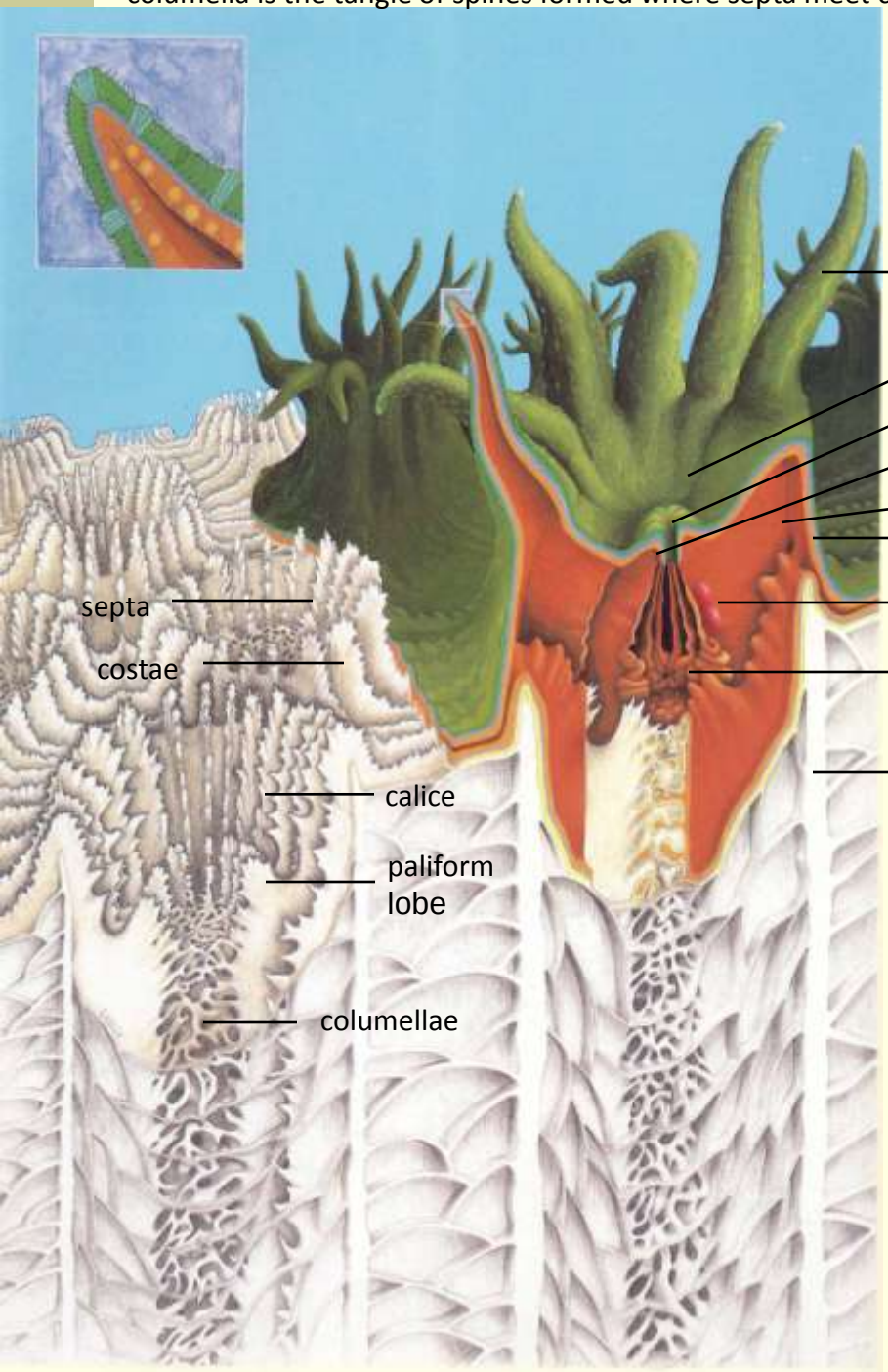
The polyps within a coral colony are highly interconnected. In some corals, such as massive species in the genus *Porites* (below left), only a thin layer of living tissue covers the surface of coral colonies. In other groups, such as species of *Acropora* (below right), polyps communicate through a network of tissue connections that penetrate throughout the skeleton.

***Acropora* polyp.** Transverse section of a coral polyp with the skeleton removed. Notice the tissue connections between polyps that enable communication and resource sharing.

Anatomy of the Coral Polyp and Structure of the Coral Skeleton

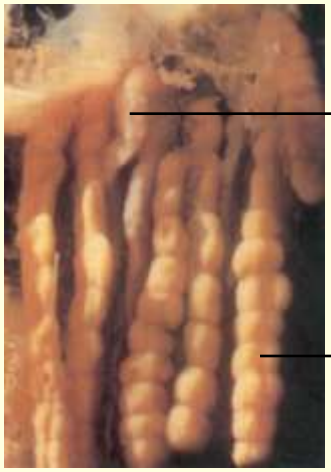
A coral polyp is a sac-like animal that has a single opening, the mouth, which is surrounded by tentacles. The stomodeum connects the mouth to an internal space, the coelenteron, which is where digestion occurs. Inside the coelenteron, mesenteries radially divide the polyp and represent the surfaces over which nutrients are assimilated. Mesenterial filaments are developed along the inner margin of the mesenteries and fulfill both a digestive function within the polyp and a protective function when they are extruded outside of the polyp. Most scleractinian corals are hermaphroditic, thus they contain both male and female gametes within the same polyp.

Coral polyps secrete a calcium carbonate skeleton. The collective group of skeletal structures that house the polyp is called the corallite. The wall or theca defines the boundary of each corallite, though walls may be poorly developed in some coral families. The main structures within the corallite are the septa, which are radial skeletal partitions supporting and separating the mesenteries to facilitate nutrient assimilation. Paliform lobes may be developed on the inner edge of septa. Extensions of the septa outside the wall are called costae. When present, the columella is the tangle of spines formed where septa meet centrally in the corallite.



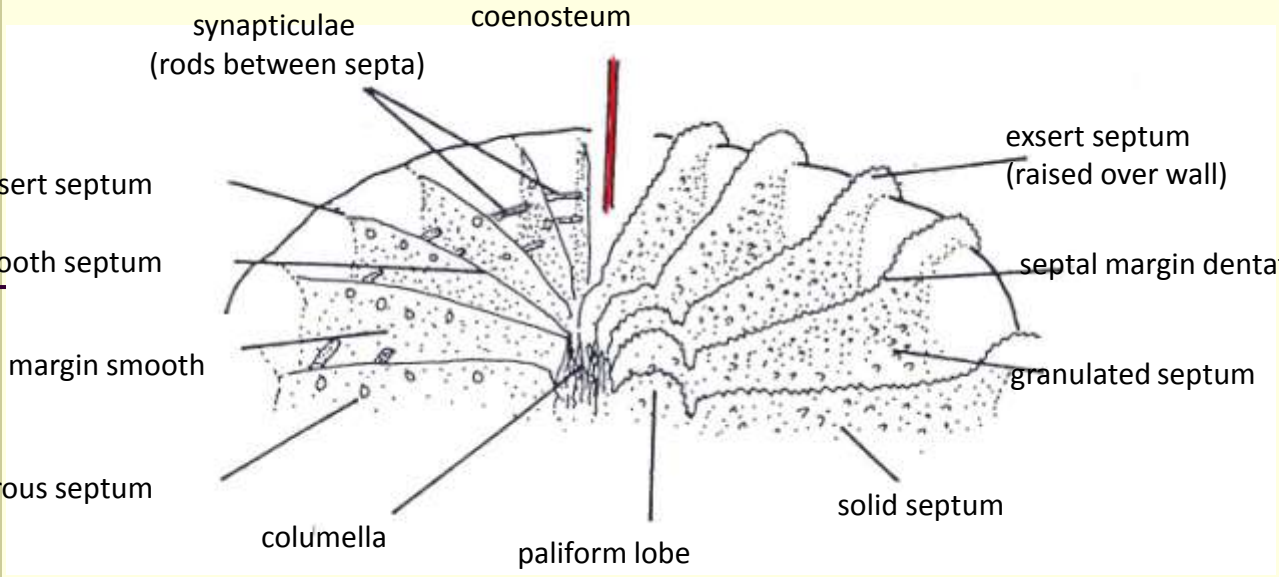
Eggs being released during spawning.

Sperm being released during spawning.



Dissected gonads within a coral polyp

Skeletal Elements of the Corallite (modified from Wood 1983)

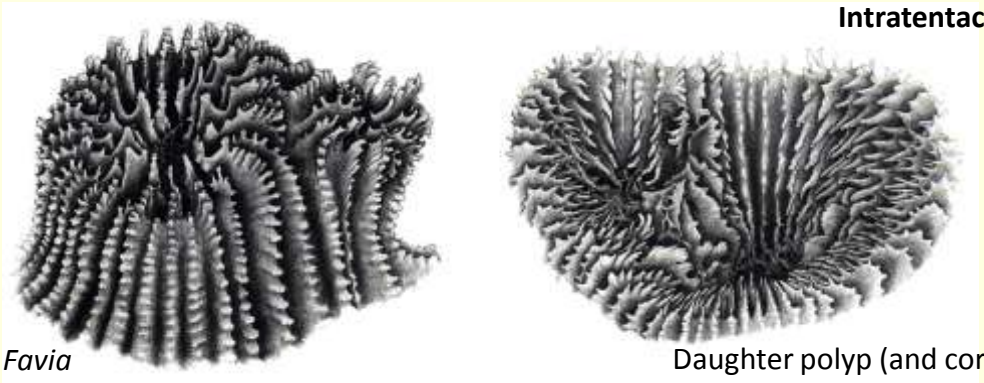


Septal characteristics are particularly useful for identifying some coral families. The number of cycles of septa and the thickness of septa are useful characters for identifying favid species. The presence of a paliform crown is diagnostic for the favid genus, *Goniastrea,* and the degree of paliform lobe development is useful for distinguishing other favid species. The extent of septal exsertion over the corallite wall and development of septal dentation are important features for distinguishing between species in some families. Similarly, the shape and development of the columella may also be diagnostic.

Polyp Budding ➡ Used to help identify favid corals

Extratentacular Budding:

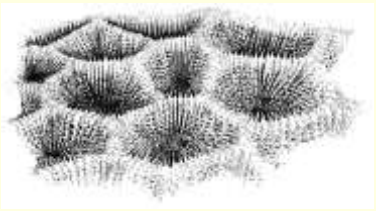
Daughter polyp (and corallite) budded from the side of the parent polyp
e.g. in the genera *Favia* and *Montastrea*



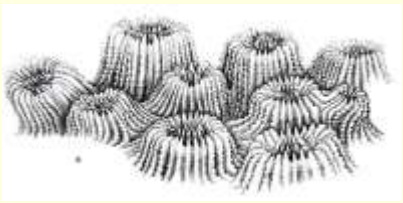
Intratentacular Budding:

Daughter polyp (and corallite) formed when parent polyp divides in two
e.g. genus *Favites*

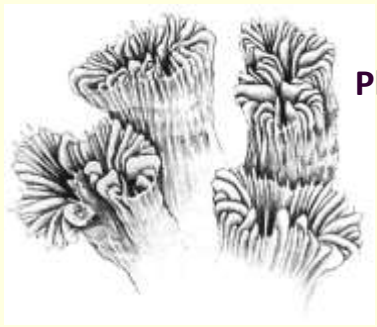
Colony Formation in Favid Corals



Cerioid: walls shared between corallites



Plocoid: corallites separate from each other - walls are not shared



Phaceloid: separate exsert polyps with extended walls

Meandroid: walls shared, valleys enclose many mouths

Flabello-meandroid: walls not shared; separate valleys enclose many mouths

Coral Growth Forms


massive


columnar


hispidose(bottlebrush)


encrusting


free-living


foliacious


arborescent

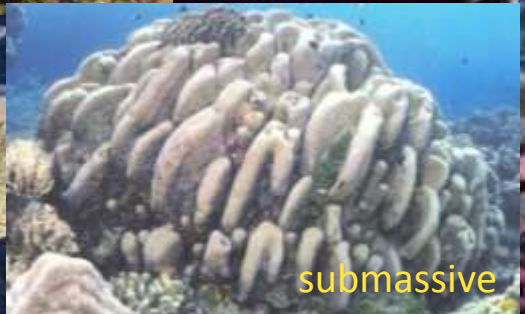

digitate


side-attached plate


corymbose (comb-like)


laminar


table


submassive


caespitose

Glossary of terms used in coral taxonomy

arborescent	Branching growth form in which equal sized branches divide in a tree-like manner.
axial corallite	The skeleton of the polyp that runs through the central axis of an *Acropora* branch, and has its opening at the tip of the branch.
axial polyp	The polyp (living animal) that runs through the central axis of an *Acropora* branch and buds radial corallites.
basal plate	The skeletal base of the corallite that the polyp secretes and sits on.
budding	Division of a coral polyp to form daughter polyps, which modify or secrete new corallites; leads to colony formation.
calice	The opening of a corallite; defined by the wall.
cochleariform	A radial corallite shape in which the lower wall is expanded outwards and the upper wall is reduced.
coenosteum	The skeletal structures between corallites; modified to form the corallite wall in *Acropora* species.
columella	Central part of a corallite skeleton that can be rod-like or mesh-like.
costae	Skeletal elements that are continuations of septa outside the corallite wall.
corallite	The skeleton of an individual coral polyp.
corymbose	Shape of an *Acropora* colony in which the branches originate from a central growing point and end in the same plane.
costate	Form of coenosteum consisting of ridges.
dimorphism	The occurrence of two different forms of the same structure (e.g. axial and radial polyps are dimorphic polyps in the *Acropora*).
ecomorph	A habitat-related morphological variant of a species.
labellate	Shaped like a lip (in radial corallites).
nariform	A character state of radial corallites whereby they are shaped like an inverted nose.
papillae	Coenosteal structures on species of *Montipora* that are smaller than corallites.
radial corallite	The skeletons of polyps that are budded radially from the axial polyp, hence form the sides of an *Acropora* branch.
septa	The vertical partitions of skeleton that radially divide the corallite.
spinules	Minute spines on the coenosteum.
synapticulae	Horizontal rods or bars connecting opposed faces of adjacent septa and perforating the mesenteries between them.
taxonomy	The process of recognizing, describing and ordering taxa.
trabeculae	The spines of crystal aragonite that form the septa and other processes that make up the skeleton of a polyp.
tuberculae	Coenosteal structures on species of *Montipora* that are larger than corallites.

Family Pocilloporidae

This family contains abundant and widespread genera. Species are characterized by nodular growths on branches, corallite hoods or corallites aligned in rows. Internal skeletal structures of corallites are poorly developed. Often submassive or branching colonies. Common in all shallow reef environments.

3 genera in RMI - Pocillopora, Seriatopora, Stylophora

Genus *Pocillopora*

Stunted branches with knobby growths (verrucae) cover colony surface. Corallites cover verrucae. Septa and columella poorly developed. Often grown in disturbed habitats.

Verrucae and branches intergrade - ***P. damicornis***
Verrucae do not intergrade with branches
colony with short compact branches
verrucae distributed uniformly on branches
verrucae longer than wide - ***P. verrucosa***
colony with elongate branches
veruccae longer than wide - ***P. indiana***
verrucae not longer than wide - ***P. eudouxi***

P. damicornis


P. indiana


P. verrucosa (left) and *P.eudouxi* (right)

Genus *Seriatopora*

Fine branches, pointed tips - some branches fuse. No verrucae. Corallites in rows along branches. Coenosteum covered in fine spinules.

branches very fine (<5mm diameter) - ***S. dendritica***
branches >5mm diameter
pointed branch tips - ***S. hystrix***
rounded branch tips
branches uptright, corallites aligned in clear rows with corallite hoods - ***S. caliendrum***
branches prostrate, corallites aligned in indistinct rows an no corallite hoods - ***S. guttataus***

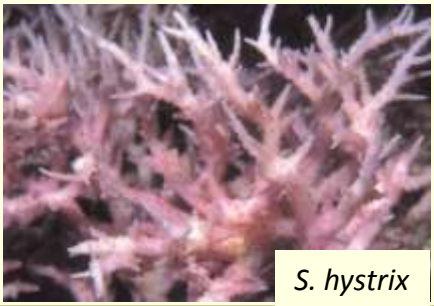
Genus *Stylophora*

Robust branches, seldom fusing. No verrucae. Corallites are hooded (only the upper wall is developed). Corallites in rows along branches


S.calendruim(left) & S. hystrix (right)

Elongate robust upright branches >5mm - ***S. pistillata***
Thin closely compacted branches < 5mm - ***S. madagascarensis***


S. pistillata


S. hystrix

The corallite hood is formed by the development of the upper wall

Pocilloporid corals can show an extreme range of growth forms depending upon exposure and depth (i.e. sturdy in exposed environments and thin in deep or protected habitats).

Family Acroporidae

Members of this family share the common feature of having few internal structures within corallites.

4 genera in RMI - *Acropora, Montipora, Isopora, Anacropora, Astreopora*

Genus *Acropora*

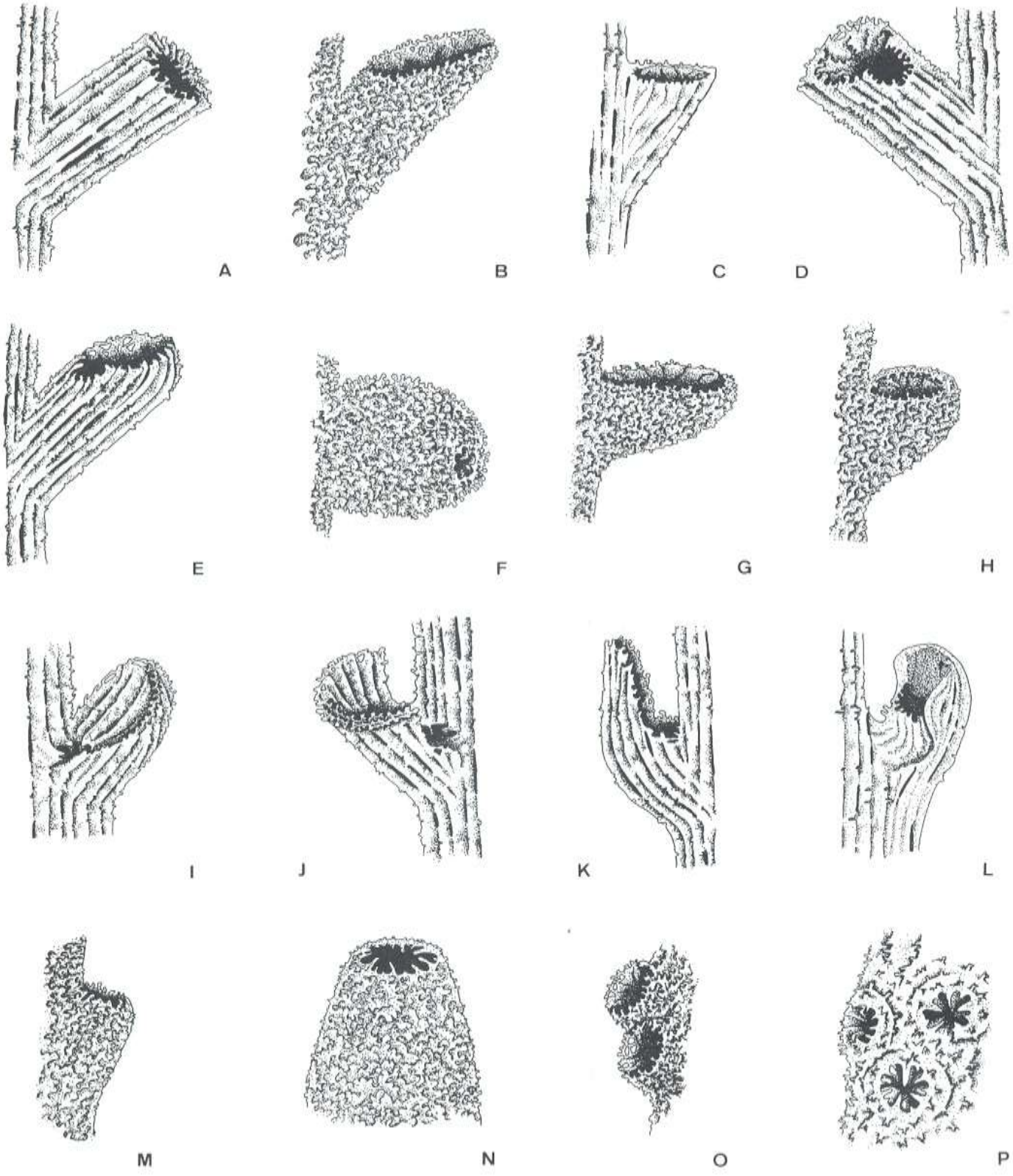
The axial corallite is a diagnostic character of the genus and variation in the axial corallite form due to differences in the number of synapticular rings can be used to distinguish between species. *Acropora* colonies develop from the extension of the axial corallite (or leading corallite) and the budding of radial corallites from the growing tip. The development of new axial corallites and subsequent radial corallites leads to branching. However a great deal of variety exists in morphological types. There are three basic categories used to identify Acropora colonies - the growth form; the shape, size and arrangement of corallites; and the structure of the coenosteum (wall of the axial and radial corallites and the spaces in between). The number and cycles of septa within the axial corallite and axial calice diameters are also useful characters.

The peripheral radial corallites occur in a variety of shapes due to differences in wall development. A gradation in corallite form can often be seen throughout a single colony and often radial corallites on the colony margin and different from those in the centre of the colony. Some species are dimorphic (they have 2-sized radial corallites). The size, shape and inclination of the corallite and the corallite opening are diagnostic characters. The number of radial corallites per branch and their spacing are also useful characters.

The genus *Acropora* has been divided into 16 species groups according to their colony form and radial corallite shape

Species group	Colony form	Radial corallite shape
rudis	arborescent	thickened, rounded , small openings
humilis	digitate	thickened tubular, dimidiate openings
nasuta	corymbose	nariform or tubo-nariform
divaricata	plate, central or side attached	thickened nariform
muricata	arborescent or arb. table	tubular
florida	hispidose	thickened appressed tubular
robusta	subarborescent	dimorphic labellate
lovelli	various	appressed tubular, round openings
verweyi	caespito-corymbose	appressed tubular
selago	various	cochleariform
aspera	corymbose or arborescent	labellate
hyacinthus	tables or plates	labellate
latistella	corymbose	appressed tubular
horrida	various	tubular with round openings
loripes	hispidose or corymbose	rounded appressed tubular
echinata	hispidose	appressed tubular

Radial coralliteshapes of *Acropora* species



a. tubular with round opening;
b. tubular with oblique opening;
c. appresed tubular;
d. tubular with dimidiate opening;
e. tubular with nariform opening;
f. rounded tubular;
g. nariform with elongate opening;
h. nariform with round opening;
i. labellate with rounded lip;
j. labellate with flaring lip;
k..labellate with straight lip;
l. cochleariform;
m. appressed tubular;
n. conical;
o. subimmersed;
p. immersed.

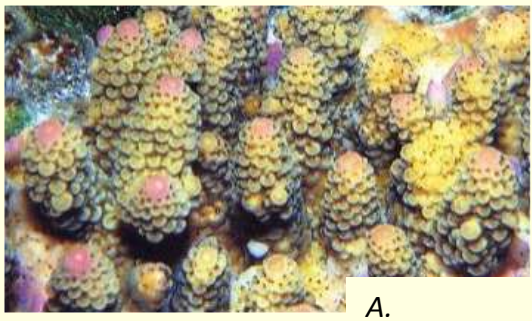
rudis group

austera - sturdy irregular arborescent colonies with medium-sized branches, obvious thick round radial corallites. May grow in thickets and 'fill in' space on reef tops and slopes. Occurs in shallow exposed locations especially upper reef slopes.

A. austera

humilis group

digitifera **-** small digitaate colonies with evenly sized and spaced branches. Radial coallites are lipped tubes radial corallites can be different sizes, branches thinnest of humilis group. Occurs on reef flats.



A. digitifera

gemmifera - sturdy corymbose colonies with conical tapering branches. Radial corallites have two sizes. Axial corallites are small. Occurs in shallow exposed locations..

A. gemmifera

humilis - corymbose colonies with terete conical branches. Radial corallites are evenly sized and the axial corallite is very large. Occurs in shallow locations.

A. humilis

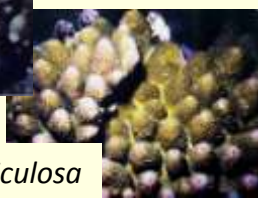
samoensis - irregular corymbose colonies with lots of branching. Well spaced radial corallites face outward from branch. Occurs in deeper habitats than other species from the humilis group.

A. retusa

monticulosa - sturdy corymbose colonies with conical branches that have square bases. Axial and radial corallites are all the same small size. Reef flats.

retusa **-** low sturdy corymbose colonies with radial corallites of mized sizes. Radial corallites are dimidiate or tubular with dimidiate openings and touching on the branch. Occurs on subtidal reef flats, usually brown in colouration.

A. samoensis



A. monticulosa

nasuta group

nasuta **-** flat corymbose colonies, branches taper, radial corallites even nariform. Reef edge and slope.

cerealis - corymbose colonies with thin terete branches. Radial corallites are long and tubular with an elongate opening and upward facing lip. There may be some anastomosis. Grows on reef flats, slopes and walls - usually one of the finest of the corymbose species.

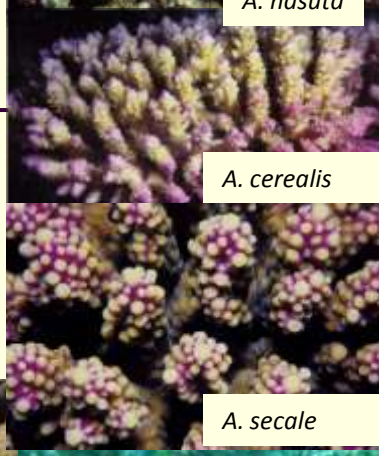
valida - corymbose colonies with thin branches and tubular radial corallites that are appressed to the branch. Often dull brown in colour. Common on the reef slope and crest.

kimbeensis **-** Fine branches, proliferating at the tip

secale **-** sturdy corymbose colonies with thick walled dimorphic corallites with elongate openings. Grows in shallow reef habitats.

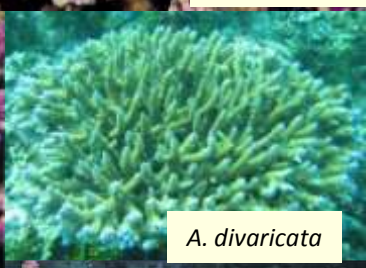
lutkeni **-** irregular sturdy branches, radial corallites irregular tubes. Often blue, Grows on reef flats.


A. nasuta


A. cerealis

A. secale


A. valida


A. divaricata

divaricata group

divaricata - Rounded or flat-topped clumps with a distinctive divergent branching pattern. Radial corallites are evenly sized and tubular with broad nariform openings. The upper surface of branches may be bare.


A. divaricata

clathrata

Flat tables with lots of flattened and fused branching. Radial corallites may be mixed sizes or nariform with appressed tubo-nariform corallites. Occurs on reef tops, slopes and walls to 20m.


A. clathrata


Storm-damaged *A. clathrata*

muricata group

muricata

arborescent colonies with many tightly packed narrow tubular radial corallites with oval openings.

grandis

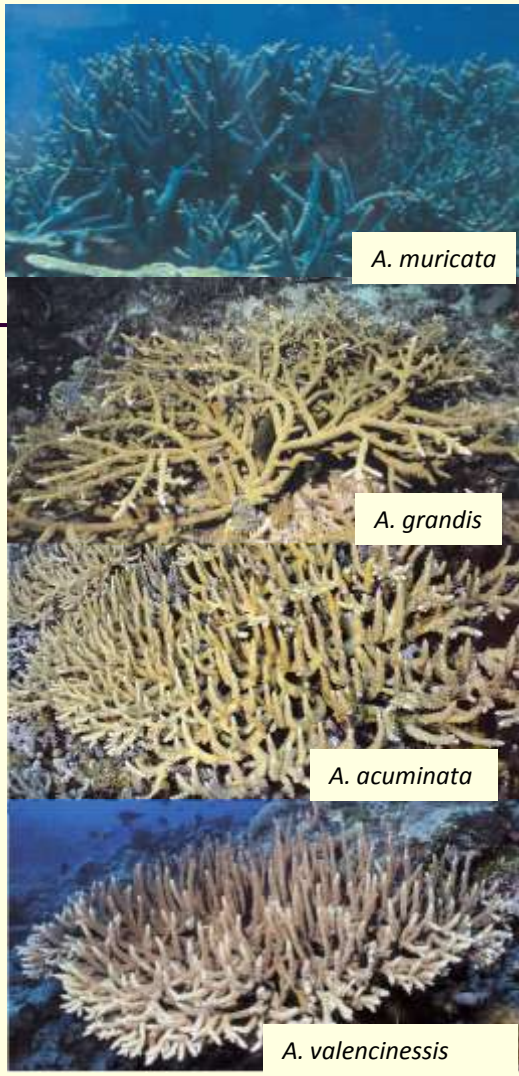
sturdy arborescent colonies with dimorphic radial corallites. Radial corallites are tubular with big round openings. Radial corallites can be longer at the tip and the skeleton of these corallites is very porus making the tips very delicate.

acumiata

arborescent table, usually small coloies with fused slender horizontal branches. Branches may curve upwards. Radial corallites lipped and some may be very long.

valencinessi

arborescent table with can form very large colonies. Branches are long widely separated and upwardly curving. Radial corallites are even giving the branch a smooth appearance.



A. muricata

A. grandis

A. acuminata

A. valencinessis

A. muricata- Drupella scars

florida group.

A. florida

florida

arborescent table with sturdy branches and small branchlets forming a rosette. Large radial corallites with round lips and small axial corallites. Grows in most coral reef habitats>20m.

A. sarmentosa

sarmentosa

'dinner plate' with sturdy branches and small branchlets forming a rosette. Large radial corallites with round lips and small axial corallites. Grows in most coral reef habitats>20m.

robusta group

robusta

irregular arborescent colonies with dimorphic radial corallites. Peripheral branches curving. Shallow exposed locations. Often distinctive green with pink tips.

A. robusta

abrotanoides

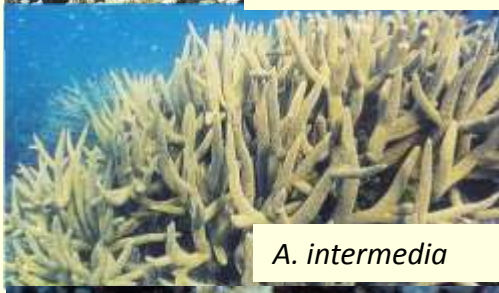
lots of branching at tip of arborescent colony, radial corallites are long, tubular and subimmersed. Grows on shallow reef tops and crest.

A. abrotanoides

A. abrotanoides

intermedia

arborescent colonies with clearly dimorphic corallites. Radial corallites tubular with dimidiate openings. Features straight branches that are borne at wide angles. All coral reef habitats to 18m.



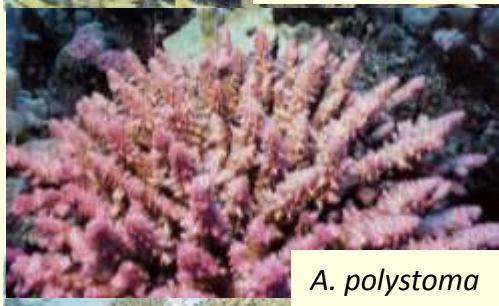
A. intermedia

polystoma

irregular short branches with tubular radial corallites with an elongate lip. Similar to *A. abrotanoides* and *A. isteri.*

listeri

irregular clumping and tapering branches. Radial corallites are dimorphic. Some branches may be very long. Grow on the reef crest.



A. polystoma

lovelli group

glauca

corymbose plates or clumps with terete branches with may flatten out as anastomosed plates. Radial corallites are evenly distributed, equal shapes and sides, appressed rounded tubular with large round openings. Quite strong septal development distinguishes this species from *A. solitaryensis.*

A. glauca

branchi

flat highly fused solid plates that may grow in tiers. Axial corallites are usually distinct, some colonies have short upright branchlets. Corallites have a thick wall. Usally dark green in colouration. Similar to *A. glauca* but this species usually has more branchlets.

A. branchi

verweyi group

verweyi

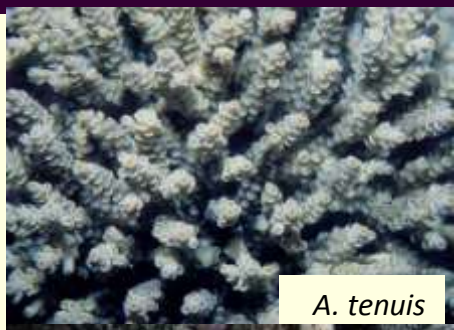
occurs in small clumps with short thin branches and large thickened radial corallites with roiund openings. Occurs on the reep top and crest.

A. verweyi

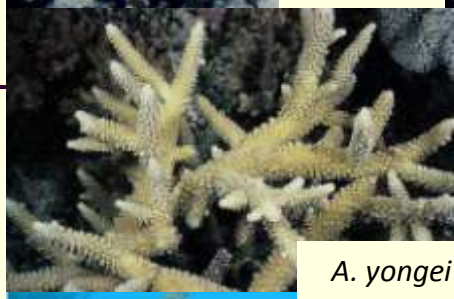
selago group

selago
fine corymbose colonies with even lipped radial corallites. The polyp has a dark centre when withdrawn during the day. Grows in lagoons and on slopes.

tenuis
corymbose colonies with compact branches, and radial corallites with even lips. Occurs in shallow coral reef locations.


A. tenuis

yongei
arborescent colonies with frequent branching, and lipped radial corallites. Occurs on reef tops and slopes.

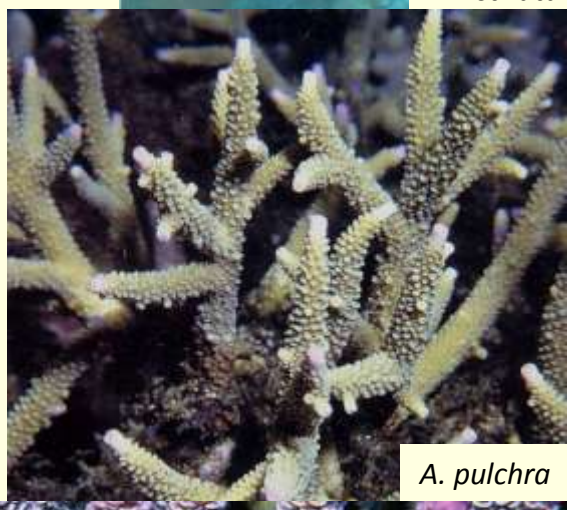

A. yongei

striata
upright hispidose colonies. The terminal branches may fan out. Radial corallites are lipped. May form large tree-like colonies. Occurs on slopes and in lagoons.


A. striata


A. millepora

aspera group


A. pulchra

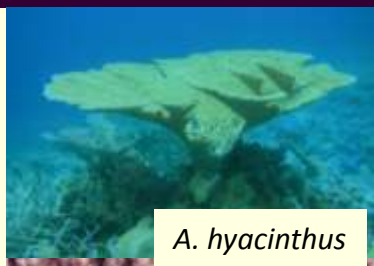
pulchra
arborescent colonies with radial corallites with a pointed lip, most not touching with a mixture of sizes. Inner reef flat.


A. millepora

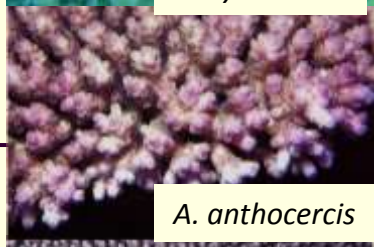
millepora
even corymbose colonies with densely packed slender branches that appear smooth dure to the large lipped radial corallites. Occurs in a variety of colours depending upon symbionts. Occurs on reef flats.

hyacinthus group

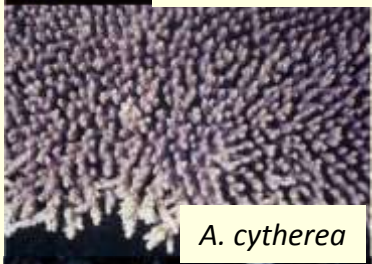
hyacinthus
plate coral with upright branchlets that form a rosette-like pattern. Radial corallites have a flaring lip and the axial corallite is short. Grows on the reef top or slope.


A. hyacinthus

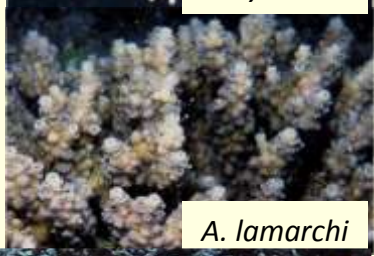
anthocercis
plate with an irregular colony surface due to exsert incipient axial corallites. Radial corallites have a flaring lip. Grows intertidally and on exposed outer flats and patch reefs.


A. anthocercis

cytherea
plate with a flat-top and radial corallites that are elongate with an upward pointing lip. Crumbly to the touch due to lightly calcified radial corallites Axial corallites are elongate. Occurs on slopes or submerged reefs.

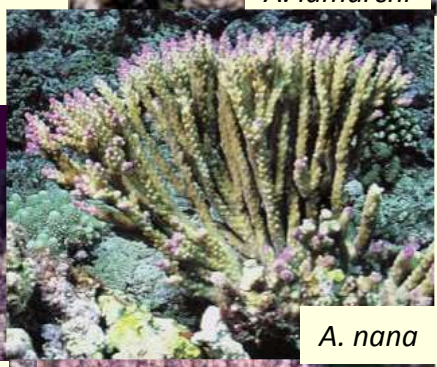

A. cytherea

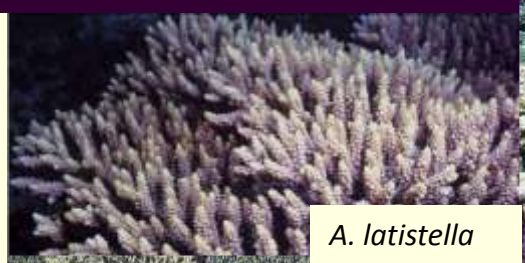
lamarchi
(New species in Veron 2000 - not a formal member of hyacinthus group). Plating colonies with thick tapering branches that are longer and inclined towards the colony margin. Often grows as tiered plates. Axial corallites slightly exsert and radial corallites tubular and pressed against the branch with an open lip. Distinct from A. *hyacinthus* because it lacks a distinct axial corallite and 'rosette' pattern of radial corallite arrangement. Separated from *A. cytherea* due to the thick and inclined branches. Grows on the uppper
reef slope.


A. lamarchi

latistella group

latistella
flat corymbose colonies or thick plates with short thin vertical branches that are closely compact. Can be a range of colours. Occurs in silty locations.


A. nana


A. latistella

aculeus
flat corymbose colonies, short slender vertical branches, radial corallites tubular, round, appressed to branch. Grows to 20m on slopes, walls and on bommies in soft sediment. Similar to *latistella*, can look like a prostrate (flattened) *horrida*.


A. aculeus


A. subulata

subulata
large tables with stalk. Very neat appearance, Branchles are well spaced with little lateral branching. Delicate texture.

nana
rounded small colonies with even slender terete branches. Radial corallites even, tubular, pressed against the branch. Reef flats.

With depth, colonies become flatter, with narrower branches and radial corallites are more widely separated on branches.

horrida group

horrida

arborescent hispidose colonies with slender branches, radial corallites are scattered with round openings. The walls of radial corallites is thin making them delicate. Healthy colonies are a distinct blue colour and polyps are extended during the day. Occurs in protected locations and sandy slopes.

A. horrida

vaughnai

arborescent tending towards hispidose colonies with sturdy thick-walled radial corallites that are tubular with a round opening. Occurs in the sand in sheltered locations.

A. vaughnai

micropthalma

slender compact branching colonies, radial corallites are even with round openings and densely packed on the branch. Grows in all coral reef habitats >15m.

A. micropthalma

copiosa

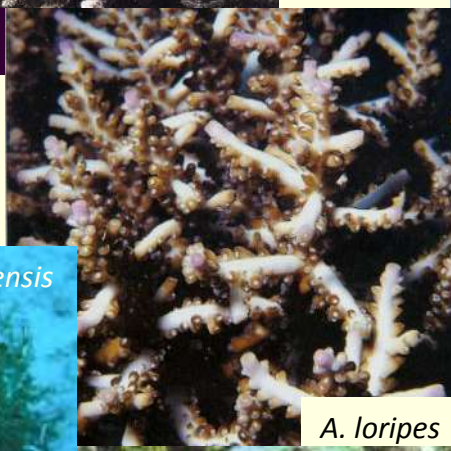
(Veron, 2000 - not a formal member of horrida group). Clumps of upricht branches with frequent secondary branching. Small axial corallites, radial corallites are appressed tubular and irregular in size and shape. Resembles *A. micropthalma* but distinguished by more branching and irregular corallites.

A. copiosa

loripes group

loripes

clumpy or irregular hispidose colonies with large obvious radial corallites with thickened walls, upper branches may be bare of radial corallites. Common on flats and slopes >10m.



A. loripes

granulosa

side attached plates with long round axial corallites. There are few radial corallites giving the colony a bare appearance. Occurs on deep slopes and walls to 15-25m.

A. rongelapensis

rongelapensis

Side attached branching plate with laterally flattened branches and bare axial. Occurs on lagoonal bommies >15m.

A. granulosa

appressa

(from Veron, 2000 - not a formal member of loripes group). Corymbose colonies or side attached plates. Axial corallites are very large and conspicuous. Radial corallites may be elongate and form incipient axial corallites. Radial corallites are tubular with nariform openings.

A. appressa

echinata

delicate hispidose colonies, with equal branchlets surrounding a central branch, axial corallites are open tubes. May occur as large sprawling patches. Sheltered slopes and lagoons.

elseyi

patches of fine hispidose colonies, branches upright with small and thick radial corallites with a tubular shape with a round opening. Grows on the reef flat.

longicyathus

sturdy hispidose colonies with equal branchlets. Radial corallites are shall and thickened with rounded walls. Often grows in clumps on sandy slopes and lagoons.

Genus *Isopora*

Multiple axial corallites leading to club-shaped (cuneiform) branches.
Members reproduce sexually via internal fertilization followed by the development of brooded larvae.

cuneata

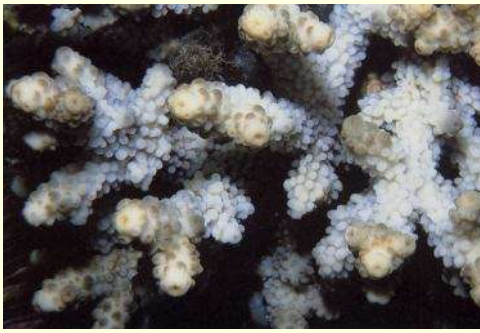
club-shaped branches with small radial corallites that have a conical shape and round openings. Often found inshore on shallow reef flats, upper slopes and lagoons.

palifera

club-shaped branches with large tubular appressed corallites with horseshoe-shaped openings. Shallow reef top, crest, slope.

brueggmanni

cylindrical branches with appressed radial corallites and multiple axial corallites on some branches. Grows on reef flats, crests and slopes up to 15m.

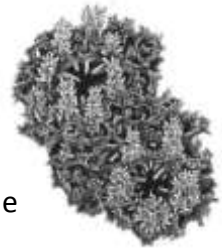


Genus *Montipora*

Montiporas are characterized b the absence of axial corallites, and the presence of very small (<2mm) immersed or exsert radial corallites.

A variety of growth forms and colours exhibited within this genus.

The coenosteum of *Montipora* species is covered with projections:
***tuberculae* (projections that are larger than the diameter of corallites)**
***papillae* (projections that are smaller than the diameter of corallites).**



tuberculae

papillae

laminar with conspicuous ridges

corallites clearly visible in rows between ridges perpendicular to margin – ***M. foliosa***

laminar, may be encrusting or form whorls or tubes

tall thecal papillae, fused into a corallite hood, v. sml corallites – ***M. aequituberculata***

encrusting plates

gentle ridges to margin, uniform immersed corallites .6-.7mm, well developed thecae often tiered - ***M. monasteriata***

surface raised onto irregular mounds, small corallites .4-.7mm – immersed to exsert, tall thecal papillae - ***M. tuberculosa***

fine branches

thick digitate or arborescent, smooth surface – ***M. digitata***

encrusting with columns or branches

small indistinct corallites, tuberculae fused into short ridges – ***M. undata***

vertical ridges on column top, immersed corallites, sml papillae, rootlets – ***M. spumosa***

may have rootlets, widely spaced immersed corallites, surface smooth, verrucae on lower part of colony - ***M. spongodes***

arborescent, verrucae fused at tip or margins – ***M. capitata***

corallites immersed & exsert, tall papillae around corallites – ***M. hispida***

ring of fused papillae around corallites, fine ridges – ***M. australiensis***

massive or thick plates with irregular upgrowths

may be submassive, small immersed corallites, tall papillae - ***M. peltiformis***

colony surface covered in mounds, obvious papillae, may form a ring around corallite openings - ***M. efflorescens***

smooth surface, small immersed corallites .5mm, may form lower lip or tube – ***M. mollis***

mounds, uniform immersed corallites .7-.9mm – ***M. turgescens***

funnel-shaped corallites, slight walls – ***M. venosa***

large rounded verrucae, obvious corallites immersed b/w verrucae – ***M. verrucosa***

large verrucae partly fused into ridges, corallites small,immersed – ***M. danae***

submassive

colony surface undulates, corallites slightly exsert surrounded by thick papillae - ***M. grisea***

plates or encrusting, tall even papillae, even & immersed corallites – ***M. informis***

large tuberculae, corallites small .6-.7mm on and between tuberculae – ***M. floweri***

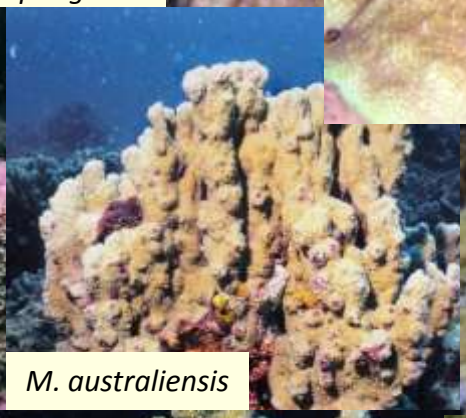
med. traberculae, corallites tiny, immersed .4-.6mm, rarely on tuberculae – ***M. millepora***


M. foliosa


M. spongodes


M. peltiformis


M. aequituberculosa

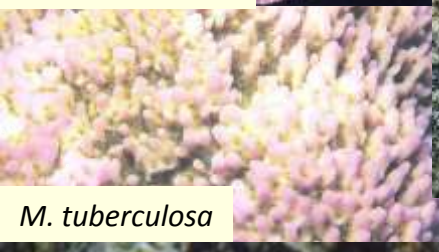

M. australiensis


M. calcarea


M. monasteriata


M. hispida


M. turgescens


M. tuberculosa


M. digitata

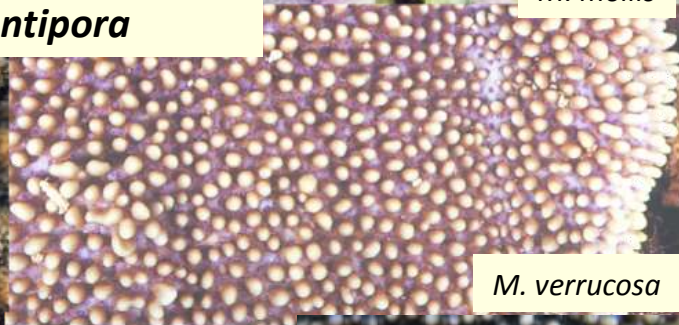

M. peltiformis


M. mollis

Genus *Montipora*


M. undata


M. efflorescens

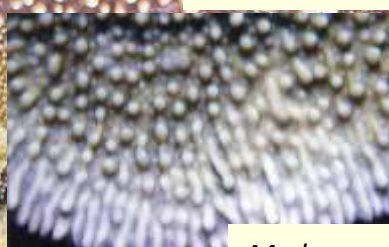

M. verrucosa


M. venosa


M. millepora


M. grisea


M. informis


M. danae

Genus Astreopora

Species within the genera are generally massive, laminar or encrusting mostly cream or brown in colouration. Corallites are immersed or conical with short, numerous, neatly spaced septa. The corallites appear like "jet engines" they are relatively empty of skeletal elements. Corallite openings are very large and conspicuous. Coenosteum is very coarse (granulated).

Massive

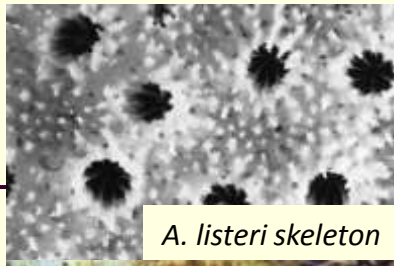
corallites small and immersed, coenosteum smooth - ***Astreopora listeri***

corallites mixed sides, some large and exsert others small and immersed coenosteum very bumpy due to closely compacted spinules - ***Astreopora myriopthalma***

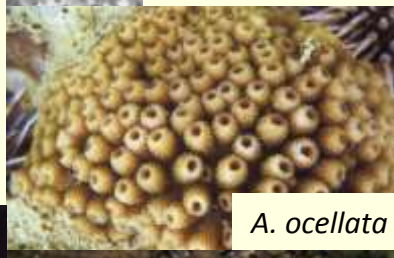
corallites large and exsert, very bumpy coenosteum - ***Astreopora ocellata***

Flat plates

corallites inclined on colony surface, corallites empta with short septa, smooth coenosteum - ***Astreopora expansa***



A. listeri skeleton



A. ocellata

A. listeri

A. myriopthalma

A. expansa

Genus *Anacropora*

Anacroproa forbsei

Slender irregular branching colonies, branches less tan 10mm thick with blunt ends as there is no axial polyp. The lower lip of corallites slightly protrudes. Often a pale brown or white colouration. May form thickets.

Anacropora forbsei

Family Astrocoeniidae

This family is represented by only a single living genus. The diagnostic feature of this family is the presence of fine spinules on the upper margins of corallites and a columellae in the form of a pointed style (rod). Species in this family are often encrusting but may be slightly massive or form small branches or columns.

Stylocoeniella armata

Genus *Stylocoeniella*

small encrusting colonies

coenosteum styles large and prominent - ***S. armata***

encrusting colonies forming knobs and small columns coenosteum styles small - ***S. guntheri***

Stylocoeniella guntheri

Stylocoeniella armata

Family Poritidae

Genus Porites

Species in this genus have small immersed corallites. Most are filled with skeletal structure (septa, pali, columella), and differences in the arrangement of the corallite structure is used to distinguish between species.

Massive

large hemispherical, helmet-shaped colonies or microatolls

triplet fused, corallites are filled with skeletal elements, shallow corallites with acute walls – ***P. lutea***

triplet almost fused, 5 tall pali, large columellae, corallites slightly immersed – ***P. somaliensis***

triplet free

5 obvious tall pali, 3 smaller pali, corallites shallow, walls quite thick, rarely forms microatolls – ***P. australiensis***

8 weakly developed pali, corallites appear open, corallites slightly immersed, colony surface smooth to touch – ***P. lobata***

surface smooth to undulating, large corallites, no pali, triplet free – ***P. solida***

Columns or Plates

triplet free, columellae small or absent, less than 8 pali (usually 6), slightly acute walls between corallites, usually bright yellow – ***P. lichen***

triplet fused, tall columellae, shallow corallites, often encrusting with short branches – ***P. aranetai***

Laminae & Branches

corallites small 1mm

corallites separated by ridges

no columellae, branches contorted – ***P. rus***

small columellae, thick wall between corallites, often thick columns - ***P. monticulosa***

corallites over 1mm

thin laminae with thin upright branches,

shallow corallites with thick walls, septa are short, 6 tall pali – ***P. sillimaniana***

slightly immersed corallites, 4-6 pali, corallites have irregular walls – ***P. latistella***

Branching

very thick straight branches, deeply excavated corallites, acute walls – ***P. profundus***

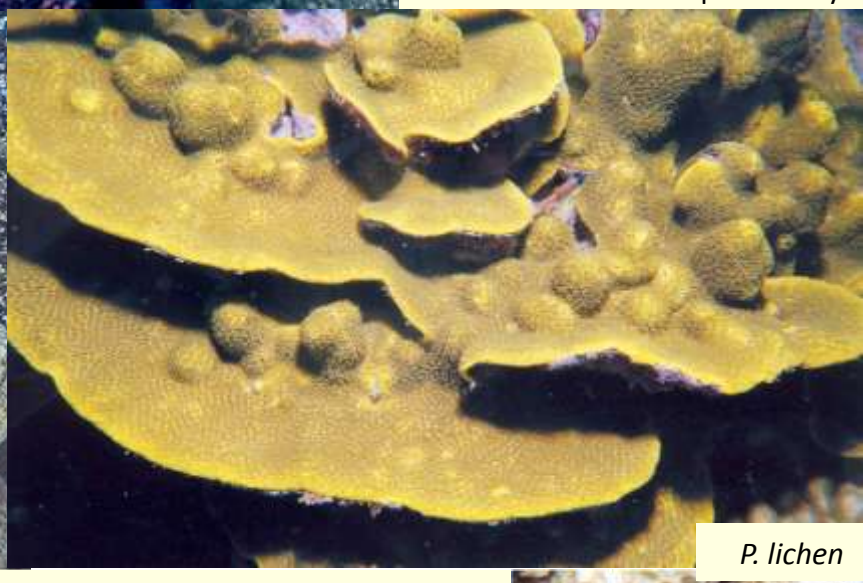
thick branches, corallites shallow, branch tips rounded – ***P. cylindrica***

thin branches, corallites immersed, branch tips angular – ***P. nigrescens***

P. lutea - microatoll

P. lobata - helmet-shaped colony

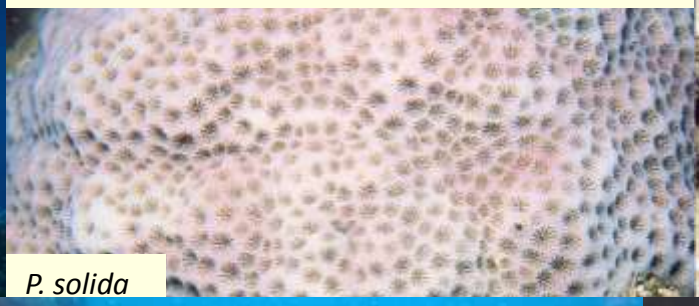
P. australiensis



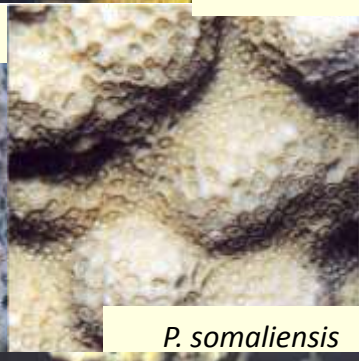
P. lichen

Genus Porites

P. rus

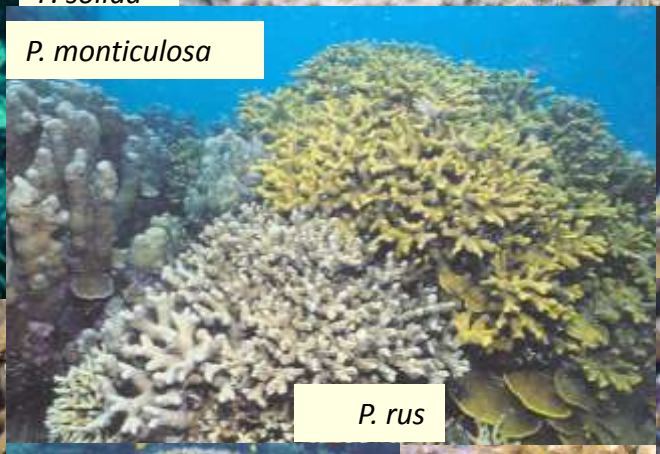


P. solida



P. somaliensis

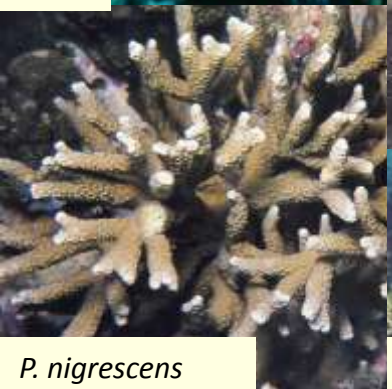
P. monticulosa



P. rus

P. latistella

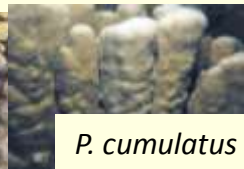
P. sillimaniana



P. nigrescens

P. cylindrica

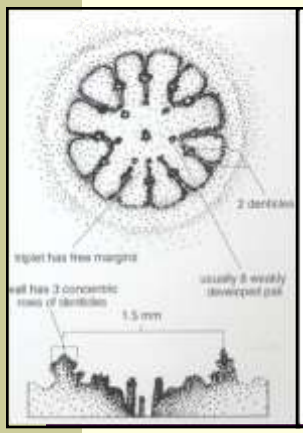
P. profundus



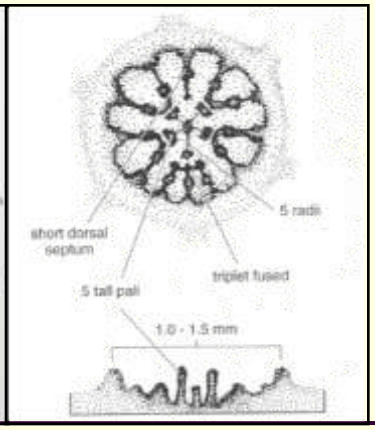
P. cumulatus

Genus Porites

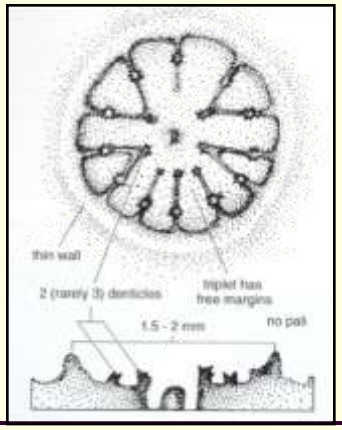
Plan view and cross section of corallite skeletal structures



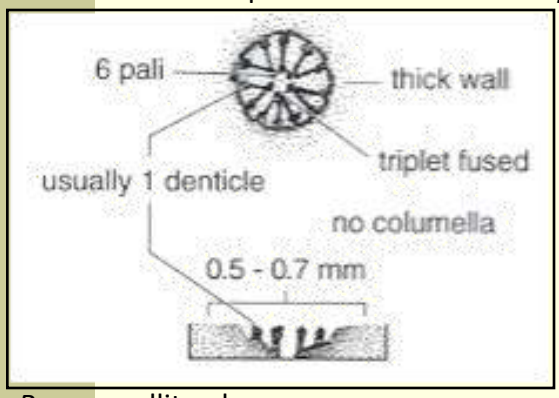
P. lobata corallite plan



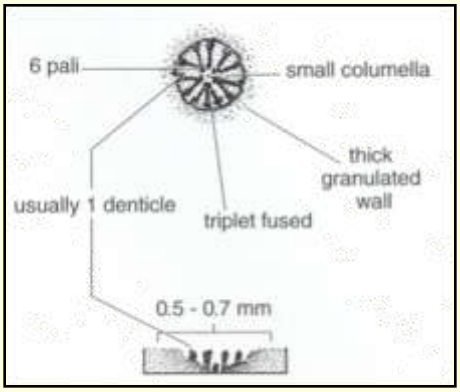
P. lutea corallite plan



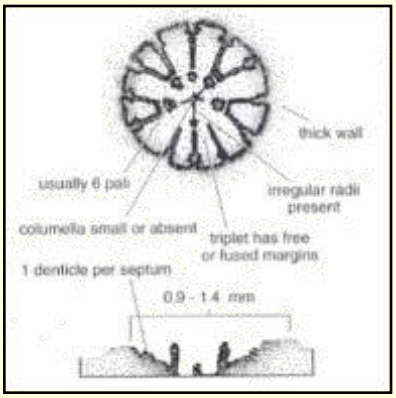
P. solida corallite plan



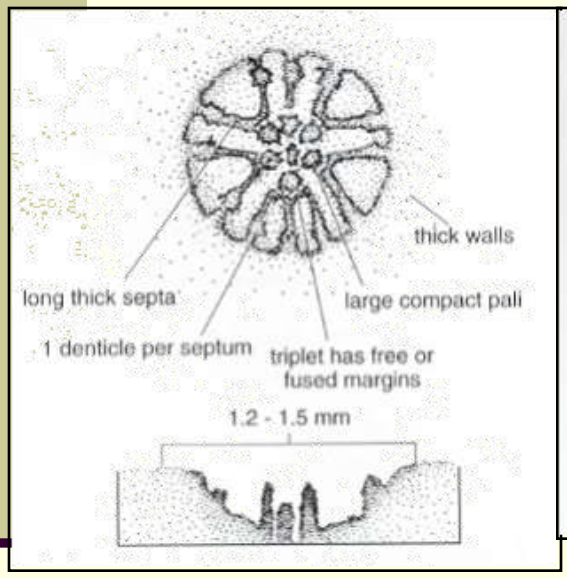
P. rus corallite plan



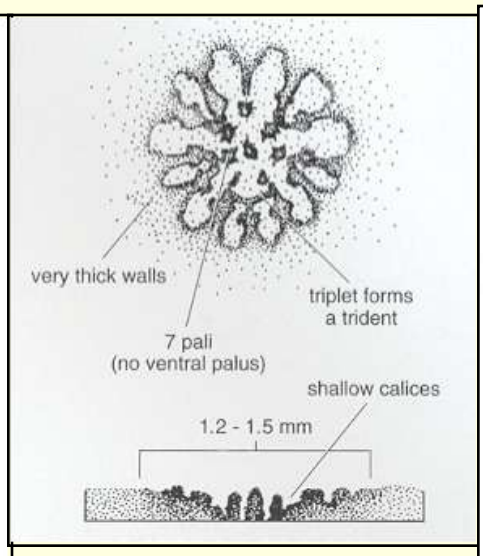
P. monticulosa corallite plan



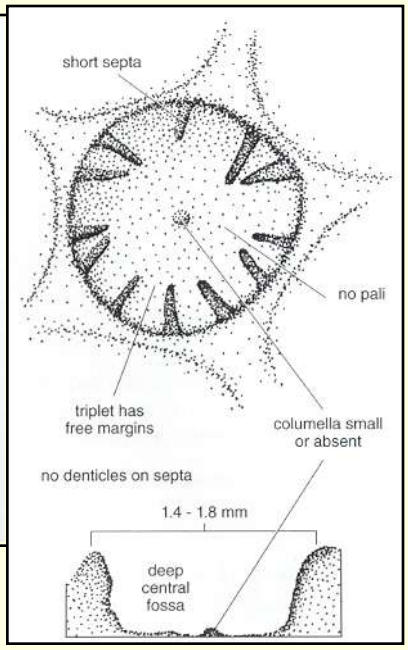
P. lichen corallite plan



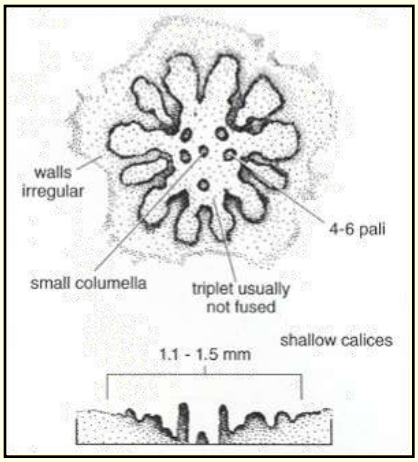
P. nigrescens corallite plan



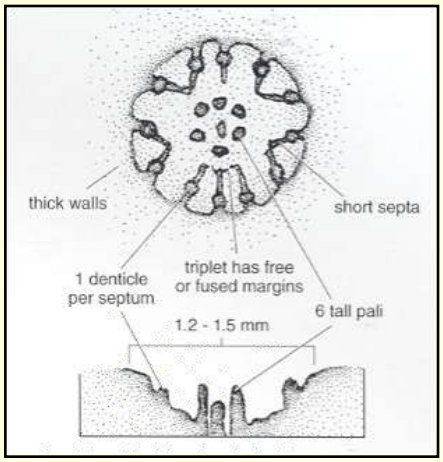
P. cylindricata corallite plan



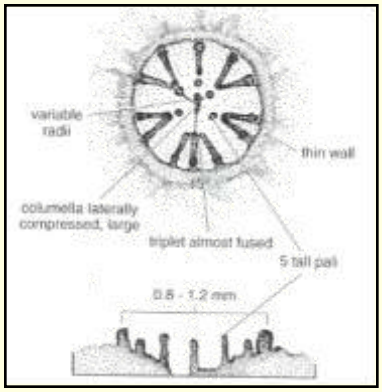
P. profundus corallite plan



P. latistella corallite plan



P. sillimaniana corallite plan



P. somaliensis corallite plan

Genus Goniopora “24 tentacles”

G. somaliensis skeleton

massive

large corallites over 5mm

corallites have ragged walls, small hemispherical colonies, may be freeliving, reproduces asexually via budding off daughter colonies – ***G. stokesi***

large oral disc, corallites have even walls, may be columnar, may form monospecific stands – ***G. djiboutiensis***

medium corallites 3 – 5mm

corallite rounded, thin walls, large paliform lobes, polyp tentacles are blunt and a uniform length – ***G. tenuidens***

corallites rounded, thick walls, thick fused paliform crown, septa heavily granulated, may be encrusting – ***G. minor***

columnar

large corallites over 5mm

large oral disc, large columellae, may form mono-specific stands – ***G. columna***

small oral disc, small columellae – ***G. lobata***

medium corallites 3-5mm

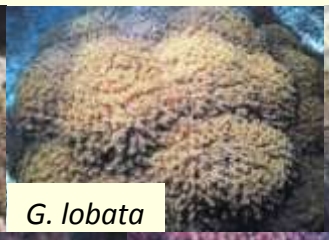
submassive to stunted columnar colonies, small oral disc – ***G. planulata***

encrusting

thick or thin plates, may be very large, smooth surface, shallow corallites 3-5mm – ***G. somaliensis***

G. columna

G. djboutensis



G. lobata

G. planulata

G. somaliensis

G. stokesi

G. tenuidens

A. fenestrata skeleton

Genus Alveopora “12 tentacles”

encrusting, columns or plates

large thick plates, septal spines are short, do not alternate and rarely connect – ***A. spongiosa***

large columns, septa alternate, tentacle tips are stunted – ***A. daedalea***

encrusting or columnar, corallites are full of structure – septal spines mix in with columellae – ***A. allingi***

small colonies, evenly tapered septal spines, knobs on tentacle tips – ***A. tizardi***

massive

elaborate corallite walls, septa connect deep within the corallite – ***A. fenestrata***

A. allingi

A. fenestrata

A. spongiosa

A. tizardi

Family Siderastreidae

Massive, columnar, encrusting or leafy colonies. Corallites are small and immersed with poorly defined walls. Inner edge of septa are fused forming a fan or petaloid pattern.

6 Genera in RMI: Psammocora, Coscinarea, Pseudosiderastrea, Siderastrea, Anomastrea, Horastrea.

P. contigua

Genus Psammocora "petaloid, indistinct walls"

Massive, encrusting or columnar colonies. Corallites are small and shallow, sometimes forming valleys. Walls are indistinct. Petaloid pattern of septa is distinctive.

flattened branches

large branches, colony surface smooth – ***P. contigua***

small irregular branches, corallites indistinct, columellae obvious – ***P. obtusangula***

plates or encrusting

large corallites, obvious petaloid formation, long septo-costae – ***P. explanulata***

columnar

obvious petaloid formation of septa – ***P. digitata***

encrusting to submassive

colony irregular shape, corallites small and shallow, walls rounded – ***P. superficialis***

corallites shallow and in short valleys, distinct corallite centres, walls generally rounded but may have an acute top, septa not exsert – ***P. profundacella***

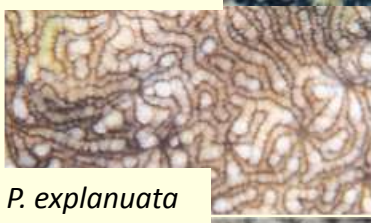
corallites immersed in short meandering valleys, walls have obvious acute tops, septa not exsert – ***P. haimeana***

meandering valleys, steep walls. Colony has rough surface due to exsert septo-costae – ***P. nierstraszi***

P. digitata

P. haimeana

P. nierstrazi



P. explanuata

Genus *Coscinarea "large characters"*

Massive, encrusting or plate-like colonies with well-developed corallite walls. Septo-costae are fused into a pinnacle on top of the corallite wall.

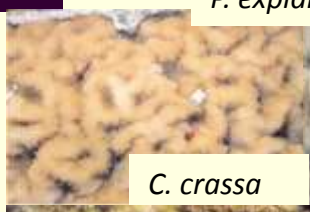
encrusting or massive with plate-like margins

corallites immersed in short valleys, septo-costae do not alternate – ***C. columna***

large corallites, septo-costae alternate – ***C. crassa***

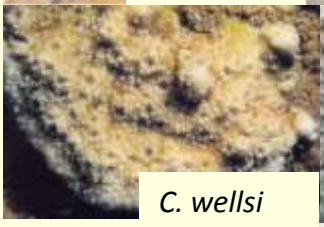
may form tiered plates, corallites irregularly distributed, some corallites raised above colony surface, septo-costae thick and granuated – ***C. wellsi***

columnar, may form big colonies, obvious granule near colony wall – ***C. exesa***

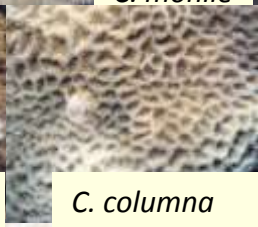


C. crassa

C. monile



C. wellsi



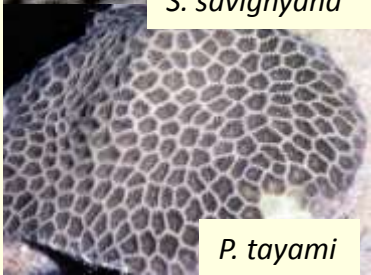
C. columna

Genus *Siderastrea, Pseudosiderastrea*

Siderastrea savignyana – encrusting or low mounds. Corallites angluar 2-4mm. Septa fuse into neat fans at columellae. Fine ridge along the top of walls.

Pseudosiderastrea tayami – small encrusting to massive colonies. angular ceroid corallites. Corallites 3-6mm, fine dentations on septa. Septa may fuse to each other. Walls distinctively white.

S. savignyana



P. tayami

Family Agariciidae

Members of this family may have massive, laminar or leafy colonies. Corallites are immersed with poorly defined walls. Ridges form between corallites in some species. Septa are continuous over the wall (i.e. septo-costae) and seldom fuse.

5 Genera in RMI: Pavona, Pachyseris, Leptoseris, Gardineroseris, Coeloseris

Genus Pavona

P. maldivensis skeleton

Thin contorted upright fronds

corallites very small, aligned in irregular rows - ***P. cactus***

laminar base with radiating ridges that intergrade with the fronds, corallites arranged parallel to margin - ***P. frondifera***

corallites deeply set, may be aligned parallel to margin or ridges - ***P. dessucata***

Laminar or encrusting colonies

large corallites, well spaced and round, smooth alternating septo-costae, columellae present - ***P. explanulata***

small corallite aligned between ridges perpendicular to the margin - ***P. varians***

P. frondifera

Submassive or encrusting colonies

corallites in short deep valleys with acute walls, no columellae - ***P. venosa***

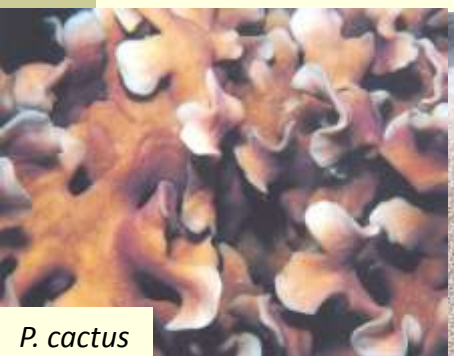
ridges slightly developed - ***P. bipartita***

Columnar

corallites circular, some exsert - ***P. maldiviensis***

large cylindrical columns, may form large stands, corallites have thick walls - ***P. clavus***

large elongate columns, small superficial corallites - ***P. duerdeni***

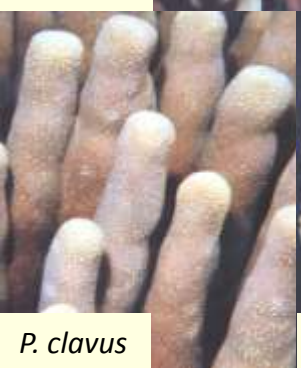


P. cactus

P. explanulata

P. venosa

P. maldivensis



P. clavus

P. dessucata

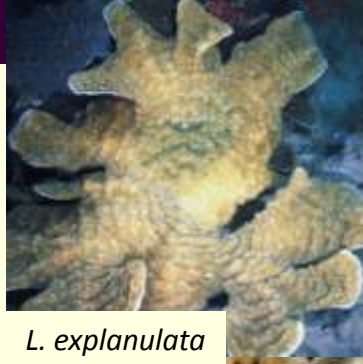
P. varians

P. bipartia

P. duerdeni

Genus Leptoseris

Unifacial plates and encrusting
- widely spaced corallites inclined towards the margin
  - corallites exsert - ***Leptoseris explanulata***
  - corallites deep and rounded, coensteum smooth,
    - may have central corallite - ***Leptoseris hawaiiensis***
- forming columns or tubes, may have a central corallite
  - corallites superficial - ***Leptoseris scabra***
- forms tubes, no central corallite
  - mounds between corallites - ***Leptoseris solida***
  - well developed radiating ridges - ***Leptoseris myceteroides***



L. explanulata

L. hawaiiensis

L. explanulata skeleton

L. myceteroides

L. solida

L. scabra

Genus *Pachyseris*

P. speciosa

Pachyseris speciosa

Tiered, horizontal or upright laminae with obvious radiating ridges

Pachyseris rugosa

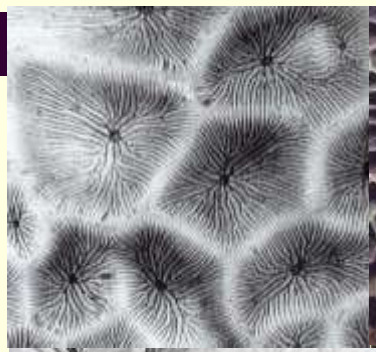
upright contorted anastomosing bifacial plates with irregular ridges.

P. rugosa

Genus *Gardineroseris*

Gardinoseris planulata

Massive, laminar or encrusting, corallites have poorly defined walls but acute ridges.



G. planulata skeleton

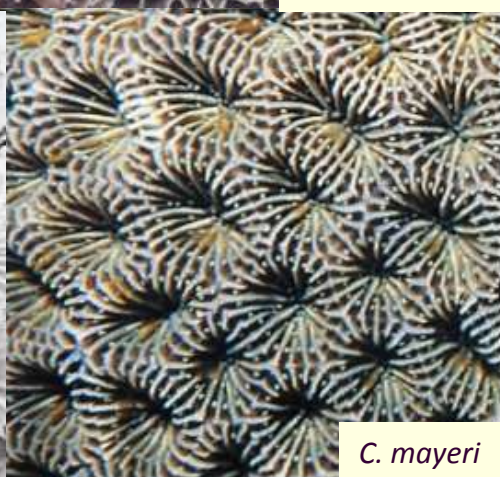
G. planulata

Genus *Coeloseris*

Coeloseris mayeri

Massive colonies, corallites are ceroid with shared walls, a granule is present above the wall where the septa and costae join.

C. mayeri skeleton



C. mayeri

Family Fungiidae

Most members of this family are free-living. Most individuals are single polyps. The arrangement of septal teeth and costal spines are a diagnostic feature of this family.

9 Genera in RMI: Fungia, Cycloseris, Herpolitha, Halomitra, Ctenactis, Polyphyllia, Cantharelus, Diaseris, Podabacia

Genus Fungia

Polyp circular

Teeth large and pointed

flat, thick & heavy polyps Septa densely packed and wavy. Costae unequal with simple spines, perforations between costae - ***F. scruposa***

central arch distinctive

lightly calcified, septa straight, pits b/w costae – ***F. danai***

thick, septa straight, long spines on costae – ***F. horrida***

irregular high arch

septa different sizes – ***F. corona***

septa equal sizes – ***F. klunzingeri***

Teeth triangular with a central rib – ***F. fungites***

Teeth middle-sized and rounded

septa thick

flat or arched, thick wavy septa, pits b/w fine costae – ***F. granulosa***

septa thin

flat, smooth appearance, densely packed septa – ***F. concinna***

thick and flat or arched, pits b/w costae, costal teeth granular – ***F. repanda***

septal teeth have fine serrations – ***F. scabra***

Polyp oval

Tentacular lobe obvious, septa thick and exsert, polyp weakly arched – ***F. scutaria***

Tentacular lobe immersed, small polyps (>150mm long), fine septa - ***F. seychellenis***

Tentacular lobe absent, strong central arch – ***F. paumotensis***

Polyp irregular shape

Mouths at edge of colonies – ***F. moluccensis***

Septal dentations

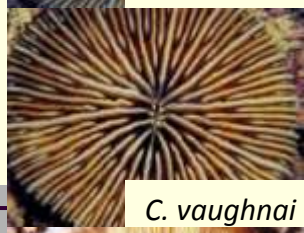
Fungid species with a central arch

tentacles

Genus Cycloseris

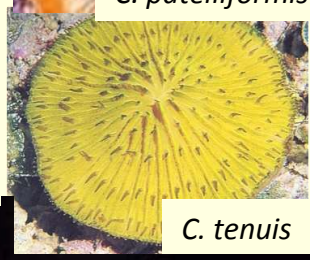
C. somervillei

C. costulata



C. vaughnai

C. patelliformis



C. tenuis

Polyp circular and arched

polyp >40mm diameter, septa straight, primary septa thick and exsert around mouth – ***C. cyclolites***

polyp >80mm diameter, septa straight, thick and exsert – ***C. costulata***

polyp >90mm diameter, septa wavy, thick and exsert – ***C. curvata***

Polyp circular and flat

dome-shaped, costae alternate at polyp margin – ***C. vaughani***

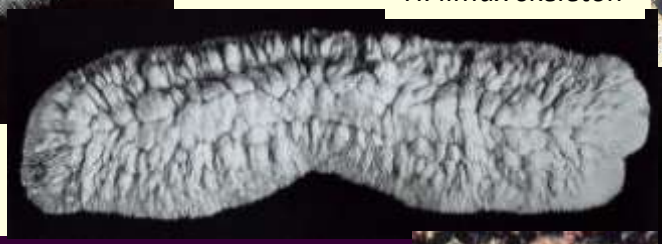
slightly oval, central dome, flat undersurface costae do not alternate at margin – ***C. patelliformis***

circular, thin, septa in markedly different orders, costae thick – ***C. tenuis***

Polyp oval and flat

obvious central dome, flat undersurface, primary septa exsert – ***C. somervillei***

H. weberi skeleton



H. limax skeleton

Genus Ctenactis, Herpolitha, Polyphyllia, Halomitra, Diaseris and Podobacia

D. fragilis

C. crassa skeleton

Ctenactis crassa - elongate polyps with long axial furrow several mouths.

Herpolitha weberi - flat, narrow, elongate, pointed ends, axial furrow along entire colony, many mouths (SW Madagasgar).

Herpolitha limax - elongate or rounded, rounded ends, x, y, or t shaped, may have mouths outside furrow.

Polyphyllia talpina - elongate or x, y, t-shaped, high arch underneath, septa petaloid

Halomitra pileus – large, dome-shaped colonies, no axial furrow, may have sections of septo-costate running in different directions.

Diaseris distorta – septa thin and uniform

Diaseris fragilis – septa thick and wavy

Podobacia crustacea – attached, encrusting or laminae, may be tiered. Large corallites exsert and inclined towards the colony margin.

Podobacia motuporensis – attached, encrusting or laminae, may be tiered. Small peripheral corallites not inclined towards colony margin.

D. distorta

Halomitra pileus

P. talpina and skeleton

P. motuporensis

P. crustacea

P. crustacea

Family Oculinidae

Genus *Galaxea*

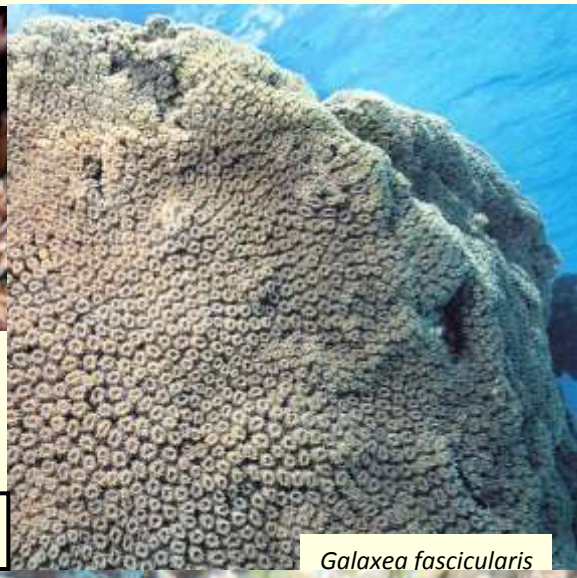
Colonies massive, columnar or encrusting. Corallites form cylindrical tubes with thin walls. Septa are exsert and coenosteum is blistery.

Corallites large (over 5mm diameter), massive cushion-shaped coionies- ***G. fascicularis***

Corallites small (< 5mm diameter), submassive, encrusting or columnar - ***G. astreata***

Galaxea astreata skeleton

***Galaxea astreata* with elongate corallites**



Galaxea fascicularis

Family Pectiniidae

Genus *Pectinia*

Submassive or thick plates

large elongate valleys - ***P. lactuca***

Massive

monocentric, tending towards

meandroid - ***P. africanus***

P. *lactuca*

P. *africanus*

Genus *Echinophyllia*

Thick laminae or submassive

large corallites protrude in different directions,

costae thick and beaded, tall paliform crown – ***E. orpheensis***

Thin laminae

central corallite obvious

few corallites, flat or vase-shaped colony – ***E. echinata***

central corallite not obvious

many exsert corallites, costae toothed, no paliform lobes, colonies may form tiers or whorls – ***E. aspera***

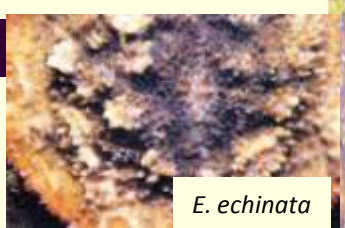
E. orpheensis

E. aspera

Genus Oxypora

Oxypora lacera

thin encrusting or laminae colonies, slight costal ridge, toothed costae, slits



E. echinata

Oxypora lacera

Family Mussidae

This family contains solitary and colonial species characterized by large corallites with large septa with large dentations. Polyps are thick walled and fleshy.

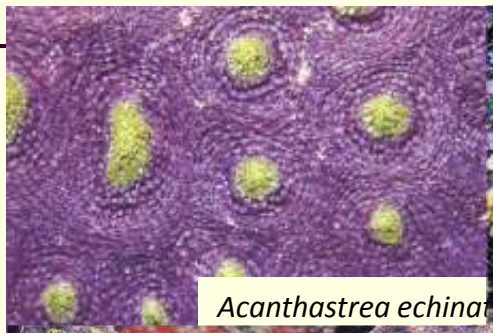
6 Genera in RMI: ***Acanthastrea, Lobophyllia, Sympyllia, Scolymia, Blastomussa, Cynarina***

Genus *Acanthastrea*

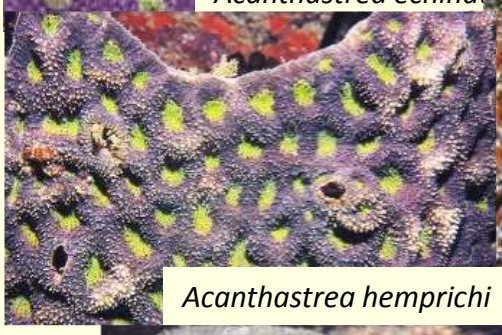
Massive colonies with large monocentric corallites and very prominent septal dentations. There are no paliform lobes.
Thick tissue covers the skeleton in some species. Species with large polyps resemble Lobophyllia. Occur in most shallow reef environments.

Corallites small - less than 15mm
septal spines protrude through mantle - ***A. brevis***
septal spines do not protrude
very thick fleshy walls
plocoid corallites - ***A. echinata***
ceroid corallites
exsert teeth - ***A. hemprichi***
fine teeth, acute walls - ***A. lordhowensis***

Corallites large - more than 15mm
less than 4 prominent teeth - ***A. ishigkiensis***


Acanthastrea echinat


Acanthastrea brevis


Acanthastrea hemprichi


Acanthastrea lordhowenis


Acanthastrea ishigakiensis *Lobophyllia hemprichi*


Scolymia vitensis

Genus *Scolymia*

Solitary and attached colonies. With numerous septa in 5 or 6 cycles. Septa are highly dentate. Columella large.

Scolymia vitiensis

Usually solitary and small (<10 cm) colonies, however sometimes they are larger with multiple mouths. Colonies are very flat and grow from a central attachment. An indistinct wall is developed at the colony margin where septa meet costae. Colonies are fleshy and often green and brown. Present in most reef environments esp. slopes.

Genus *Symphyllia* "no gaps between valleys"

Massive colonies, corallites meandroid with wide valleys.

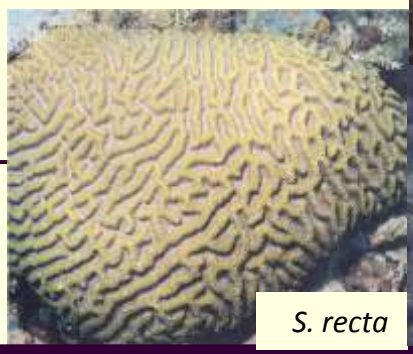
Central and outer parts of colony different - ***S. valencinessi***

Central and outer parts of colony the same fully meandroid, long valleys

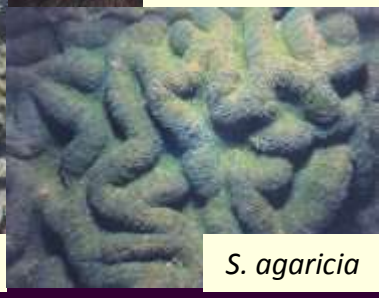
valleys less than 12mm, sharp teeth - ***S. recta***

valleys greater than 12mm, 2 rows of centres - ***S. agaricia***

S. valencinessi



S. recta



S. agaricia

Genus *Lobophyllia* "gaps between valleys"

Colonies phaceloid tending towards flabello-meandroid. Colonies can be very large, individual corallites can be up to 1m long. Septa can be highly dentate.

Phaceloid, pointed teeth

corallites more than 20mm, well spaced - ***L. corymbosa***

corallites over 40mm - ***L. robusta***

Flabello-meandroid - ***L. hemprichii***

L. hemprichii

L. robusta

L. corymbosa

Genus *Cynaria*

Cynarnia lacrymalis

monocentric**,** paliform lobes, septa have very large rounded teeth (visible through mantle). Mantle inflates with water and are translucent.

C. lacrymalis skeleton

C. lacrymalis with mantle inflated.

Genus *Blastomussa*

Blastomussa merleti

phaceloid colonies, corallites very small (less than 7mm). 2 cycles of septa, second cycle reaches a poorly developed columellae. Mantles extend during the day.

B. merleti and skeleton

Family Faviidae

Favids are the second most abundant family with the greatest number of genera. Members exhibit most growth forms and corallite types and small, medium and large polyps often occur within most genera. Colonies are formed by extra or intratentacular budding and this characteristic is used to distinguish between genera. Paliform lobes are commonly developed and form a distinct crown in genus Goniastrea. Columella are often present in trabecular or plate-like form. Most favid genera are well preserved in the fossil record due to their solid construction and wide distribution. Faviidae was the dominant hermatypic family in the Mesozoic and Cenozoic eras. Today faviids are widely distributed across the globe throughout a wide latitudinal range and occur in most coral reef habitats.

13 Genera have been recorded in RMI: Favia, Favites, Goniastrea, Caulastrea, Echinopora, Platygyra, Montastrea, Leptastrea, Cyphastrea, Plesiastrea, Oulophyllia, Leptoria, Diploastrea.

Key to Genera within the Family Faviidae

(please remember that exceptions to the groupings listed below occur within some genera e.g. some Goniastrea species are meandroid)

Colonies phaceloid – **Genus Caulastrea**

Colonies massive
- Budding intratentacular or meandroid
  - Colonies plocoid
    - Corallites not exsert **– Genus Favia**
  - Colonies ceroid
    - Paliform crown not obvious **– Genus Favites**
    - Paliform crown obvious – **Genus Goniastrea**
  - Colonies tending towards meandroid
    - Valleys wide and deep – **Genus Oulophyllia**
  - Colonies meandroid
    - Columellae absent or mesh-like **– Genus Platygyra**
    - Columellae plate-like – **Genus Leptoria**
- Budding extratentacular
  - Colonies plocoid
    - Corallites small (<4mm diameter)
      - Corallites crowded – **Genus Cyphastrea**
      - Corallites well spaced – **Genus Plesiastrea**
    - Corallites medium
      - Septa do not alternate – **Genus Montastrea**
    - Corallites large - **Genus Diploastrea**
  - Colonies ceroid
    - Corallites small (<4mm) **– Genus Leptastrea**

Colonies plates or branching, monocentric corallites – **Genus Echinopora**

Genus Favia

Colonies are generally massive or forming columns. Corallites are plocoid (separate with their own walls). Although some species are ceroid (share walls). Septa usually have fine dentations and paliform lobes may be present. The columella is generally trabecular and budding is usually intratentacular.

Separate into species using the size, shape and spacing of corallites, the septal characteristics, and the amount of dentation on septa and costae.

Favia

corallites small, less than 8mm
- columnar – ***F. stelligera***
- hemispherical, regular conical corallites – ***F. laxa***

corallites middle sized, 8-12mm
- paliform crown
  - septa irregular in height, corallites inclined - ***F. truncatus***
  - septa even, corallites conical - ***F. helianthoides***
- paliform lobes not well developed
  - corallites circular
    - septa irregularly exsert – ***F. matthai***
    - septa not exsert – ***F. speciosa***
  - corallites angular, well spaced or irregular - ***F. pallida***

corallites large, over 12mm
- corallites irregularly shaped and exsert
  - septa exsert – ***F. rotumana***
  - septa not exsert – ***F. rosaria***
- corallites evenly shaped and exsert
  - corallites conical
    - costae strongly beaded – ***F. danae***
    - costae not strongly beaded – ***F. favus***
  - corallites not conical
    - tightly packed – ***F. rotundata***
    - well spaced, paliform lobes not obvious – ***F. maritima***
- corallites angular, corallite walls touching - ***F. veroni***
- corallites round, corallites tending towards plocoid - ***F. lizardensis***

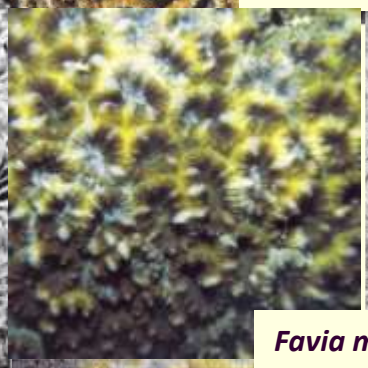
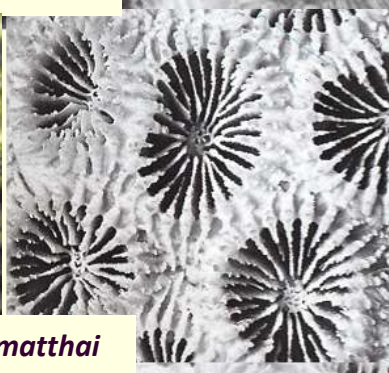


Favia stelligera


Favia lizardensis

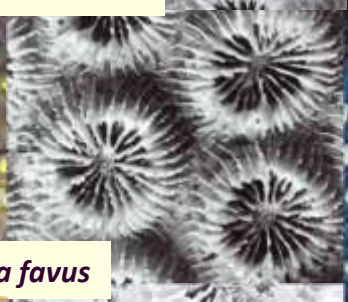

Favia laxa

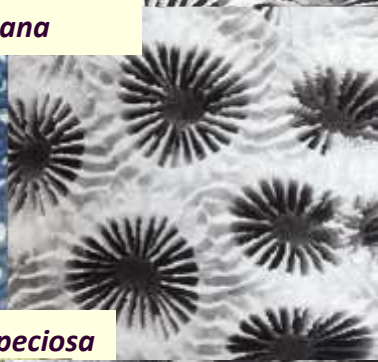
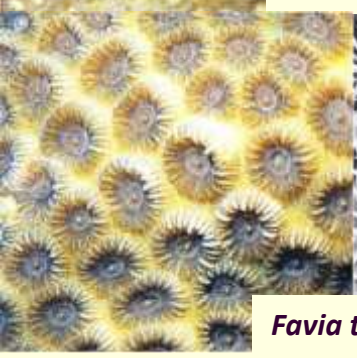
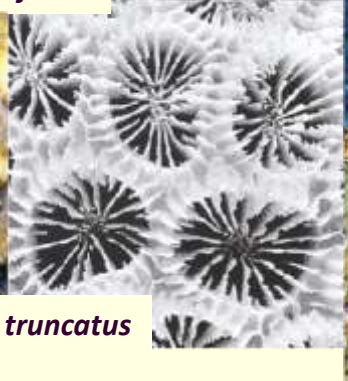

Favia maritima


Favia pallida


Favia matthai


Favia helianthoides


Favia rotumana


Favia favus


Favia speciosa


Favia truncatus


Favia veroni

Genus Favia

Colonies are generally massive or encrusting. Corallites are ceroid (share walls), but some Species have subplocoid growth. Paliform lobes may be completely absent or grow as an obvious crown. Septal dentations may be large. Budding is Intratentacular but usually occurs towards the colony margin.

Separate into groups using the size and shape of corallites, the degree of paliform lobe development and the septal characteristics including amount of dentation.

Favites

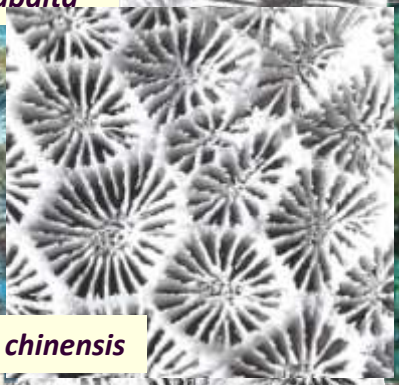
corallites small: 6-10mm
- angular
  - paliform crown – ***F. pentagona***
  - paliform lobes weakly deveoped, septa very exsert - ***F. spinosa***
- round
  - paliform crown – ***F. bestae***
  - no paliform lobes – ***F. chinensis***

corallites middle sized: 10 – 14 mm
- hillocky – ***F. halicora***
- colony not hillocky
  - septa irregularly exsert – ***F. russelli***
  - septa even
    - angular – ***F. abdita***
    - round – ***F. complanata***

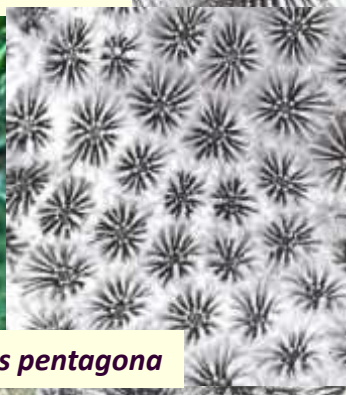
corallites large: over 14mm
- corallites angular
  - septal teeth obvious – ***F. flexuosa***
  - septal teeth not obvious - ***F. paraflexuosa***
- corallites round - ***F. vasta***

Favites abdita

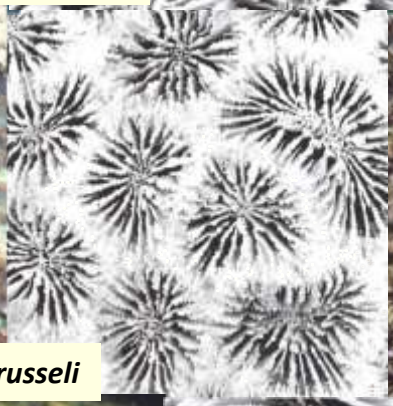
Favites halicora



Favites chinensis

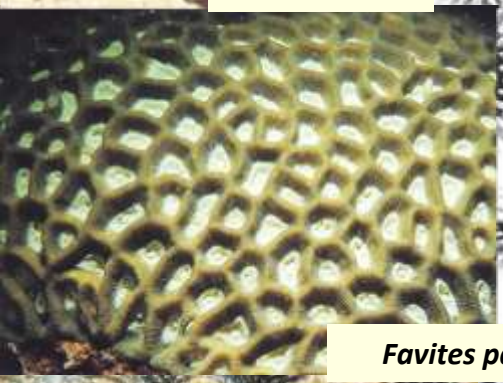


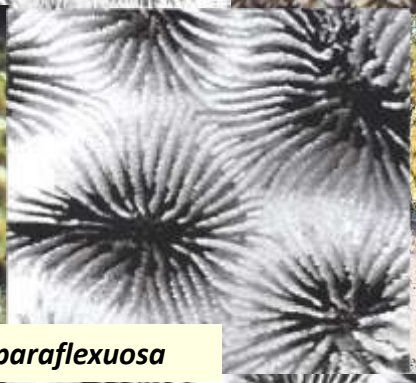
Favites pentagona



Favites russeli

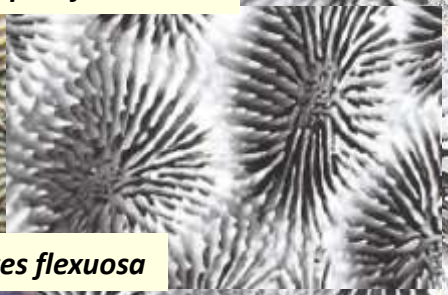
Favites spinosa



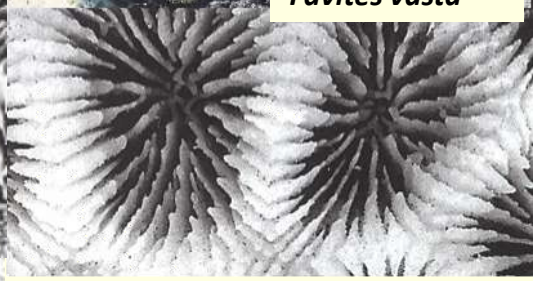


Favites paraflexuosa

Favites vasta



Favites flexuosa



Favia complanata

Genus *Favites*

Genus *Goniastrea*

Colonies are massive or encrusting. Corallites have a neat appearance and are ceriod tending toward meandroid. Septa have fine regular dentations and the paliform lobes are very distinct and may form obvious paliform crowns. Columellae are small and budding is intratentacular

Separate into species using colony formation and corallite size.

ceroid, massive
- corallites very small (<2mm) - ***G. minuta***
- corallites small (2 - 5mm)
  - walls thick and rounded, corallites arranged irregularly – ***G. edwardsi***
  - walls thin and acute, corallites neatly arranged – ***G. retiformis***
- corallites medium up to 15mm
  - paliform lobes obvious, angular, thick walled corallites – ***G. aspera***
- corallites large, over 15mm
  - paliform lobes obvious – ***G. palauensis***
  - paliform lobes not obviois, corallites aligned in valleys at the colony margin - ***G. peresi***

irregularly meandroid
- tending towards ceroid, paliform lobes obvious, submassive to encrusting with branchlets – ***G. pectinata***

fully meandroid – ***G. australiensis***

G. minuta

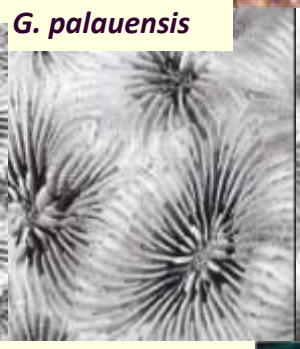
G. retiformis

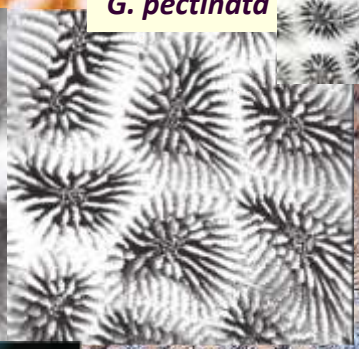
G. aspera

G. palauensis

G. peresi

G. pectinata

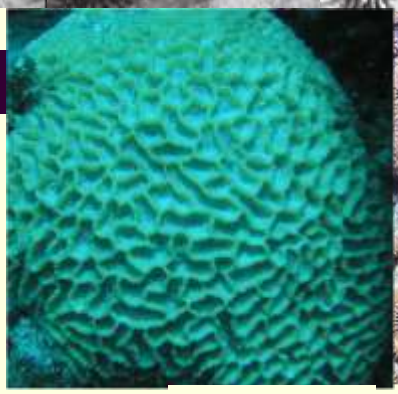




Genus *Oulophyllia*

Oulophyllia crispa

Massive colonies with monocentric corallites tending towards meadroid. Short deep valleys with acute walls and elaborate spines on top of the walls.



O. crispa

G. australiensis

Genus *Platygyra*

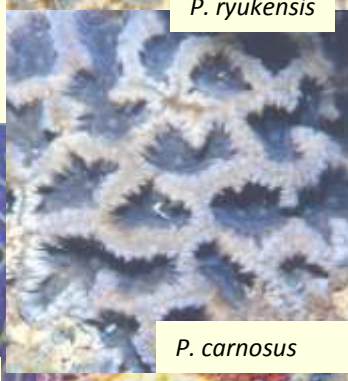
Massive "brain" colonies with meandroid corallites however some species have ceroid corallites. Paliform lobes are not developed and columella is usually absent or mesh-like.

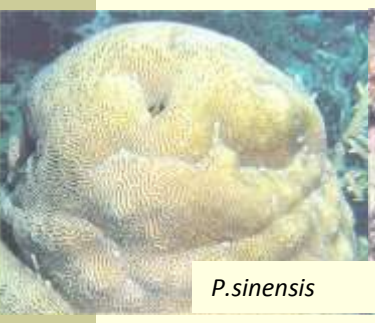
Colonies monocentric tending towards valleys
- Walls thick
  - Columellae well developed – ***P. crosslandi***
  - Columellae not well developed – ***P. pini***
- Walls thin
  - Valleys have multiple mouths – ***P. ryukensis***
  - Monocentric, columellae well developed – ***P. carnosus***

Colonies meandroid
- Walls thick – ***P. lamellina***
- Walls thin
  - Septa irregularly exsert – ***P. daedelea***
  - Septa even – ***P. sinensis***

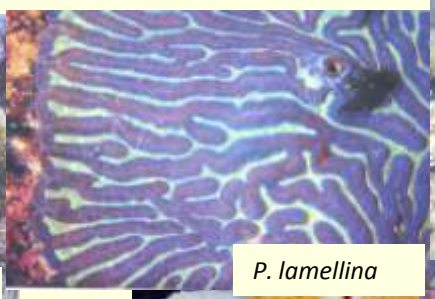

P. crosslandi


P. ryukensis


P. carnosus


P.sinensis


P.daedelea


P. lamellina

Genus *Montastrea*

Massive colonies with monocentric plocoid corallites. Budding is predominately extratentacular. Openings formed by minute polychaete worms may be present between corallites. Septa are often neatly arranged.

Corallites small (<5mm diameter) – ***M. curta***
Corallites medium (5-8mm diameter), septa irregular sizes – ***M. annuligera***
Corallites large (>8mm diameter), corallites have wide openings, septo-costae even – ***M. magnistellata***

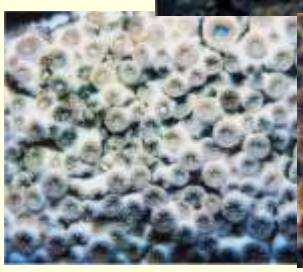

M. curta

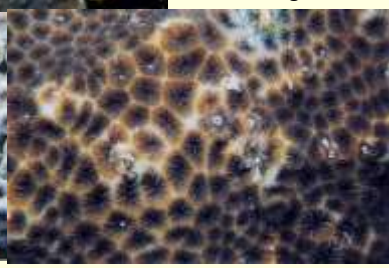

M. magnistelata


M. annuligera

Genus Leptastrea

Colonies submassive or encrusting.
Corallites are usually ceroid.
Costae are poorly developed or absent.
Columellae is usually poorly developed.


L.bottae


L. purpurea

Corallites circular, uneven septa (not in distinct cycles) – ***L. bottae***
Corallites angular, septa even, not granulated – ***L. purpurea***

Genus *Caulastrea*

Phaceloid colonies with small corallites and fine septa.

Corallites over 10mm diameter, septa plunge steeply into corallite - ***Caulastea connata***
Corallites less than 10mm, septa exsert and irregular , may form monospecific stands- ***Caulastrea furcata***


C. connata


C. furcata

Genus *Cyphastrea*

Massive or encrusting colonies. Corallites are plocoid and small. Coenosteum is granulated.

Massive colonies
12 primary septa
Septa even – ***C. serailia***
Costae alternate – ***C. chalcidicum***
10 primary septa – ***C. micropthalma***


C. serailia


C. chalcidicum


C. micropthalma

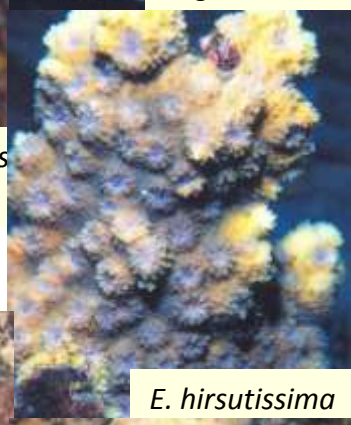
Genus *Echinopora*

Colonies are usually laminar, sometimes with irregular branches, one species is branching. Corallites are plocoid and usually widely spaced.
The coenosteum is granulated.

Flat plates with contorted branches
Coenosteum smooth – ***E. mammiformis***
Plates or encrusting to submassive
Corallites small (>5mm diameter), paliform lobes indistinct, thin septa – ***E. gemmacea***
Corallites medium (4-7mm diameter), coenosteum heavily granulated, very thick septa - ***E. hirsutissima***
Plates forming tiers
Corallites small (>4mm diameter), sometimes forms upright tubes, paliform lobes obvious – ***E. lamellosa***


E. gemmacea


E. mammiformis


E. hirsutissima


E. lamellosa

Genus *Diploastrea, Plesiastrea and Leptoria*

Plesiastrea versipora

Massive colonies, extratentacular budding, corralites well spaced, obvious paliform lobes.


P. versipora

Diploastrea heliopora

Massive colonies, large dome-shaped corallites, dense skeleton. Thick equal septa, primary septa join between adjacent coraliites.

Leptoria phygia - Massive neat meandroid colonies, solid plate-like columellae.


Leptoria phygia

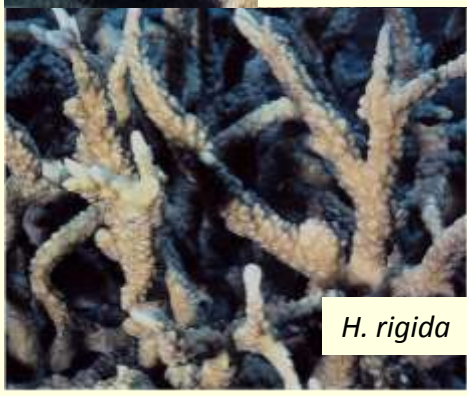

Diploastrea helipora

Family Merulinidae

3 Genera in RMI: ***Hydnophora, Merulina***Members of this family are characterized by highly fused skeletal structures forming pyramid-like mounds (monticules) in Genus *Hydnophora* or ridges (fusion of corallite walls) in Genus *Merulina*.

Monticules formed by the Fusion of skeletal structures.

H. microconos



H. rigida

H. exesa

Genus *Hydnopora*

Branching

branches less than 10mm, monticules fused into ridges on branch sides - ***H. rigida***

Subarborescent, tall monticules -***H. exesa***

Submassive or encrusting with even small monticules - ***H. microconos***

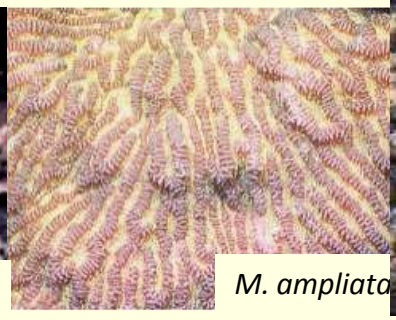
Genus *Merulina*

Laminar with upright branches, valleys spread like a fan

skeletal structures thick and blunt - ***M. ampliata***

skeletal structures thin and sharp - ***M. scabricula***

M. scabricula



M. ampliata

Gyrosmilia interrupta

Family Trachyphylliidae

Genus *Trachyphyllia*

This genus has a single species with a large fleshy polyp. Colonies are flabello-meandroid and may be free-living. It has large paliform lobes and dentate septa.

Trachyphyllia geoffroyi - generally rare, but may be patches on inshore reefs.

Family Euphylliidae

Euphyllia glabrescens

This family of "bubble corals" is characterized by vesicles or tentacle. Species within the family have large corallites and widely spaced smooth septa that may be very exsert.

4 Genera in RMI: ***Euphyllia, Plerogyra, Physogyra, Catalaphyllia***

Separate this family into genera using colony form and presence of tentacles or vesicles.

Euphyllia - phaceloid - tentacles
Physogyra - meandroid - vesicles all over
Plerogyra - flabello-meandroid - vesicles all over
Catalaphyllia - flabello-meandroid - oral disc with tentacles and wide valleys.

Euphyllia glabrescens

Phaceloid, septa not very exsert, tentacles elongate with round white tips and obscure the underlying skeleton. Resembles the mushroom coral *Heliofungia actiniformis* when tentacles are extended.

Euphyllia ancora

Flabello-meandroid, may form mono-specific stands. Tentacles have T-shaped tips. Very exsert septa.

Plerogyra sinuosa

Flabello-meandroid, septa large, widely spaced and exsert. Vesicles extended during the day. Colonies can look very different depending on the degree of vesicle inflation.

Physogyra lichtensteini

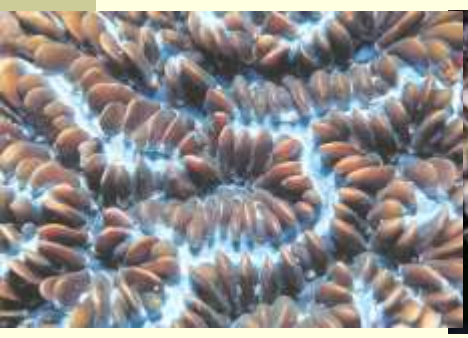
Massive or plates, meandroid with short widely separated valleys. Coenosteum blistered, large exsert septa, no columellae.

Catalaphyllia jardinei

Flabello-meandroid with wide valleys. Valleys have acute walls. Septa are smooth. Fat tentacles extend from the margin of a fleshy oral disc. Tentacles have a pink tip and oral disc is striped. Occurs in shallow protected habitats.

E. glabrescens skeleton

P. sinuosa with vesicles fully extended



Physogyra lichtensteini

P. lichtensteini with vesicles contracted revealing very exsert septa.

Pleorgyra sinuosa with bubble-like vessicles

Cataphyllia jardinei

E. glabrescens with phaceloid colony form

Family Dendrophylliidae

This family exhibits zooxanthellate and azooxanthellate species. Free-living or attached growth forms are also exhibited. Polyps are plocoid, and medium to large.

Genus *Turbinaria*

This genus includes species with encrusting, massive, laminar or foliaceous growth forms.

Laminae - tiers

small widely spaced corallites with thick walls. Corallites may be immersed to slightly conical,colony has a smooth surface - ***T. retiformis***

various sized corallites up to 4mm diameter, corallites may form exsert tubes, colonies may be highly contorted - ***T. frondens***

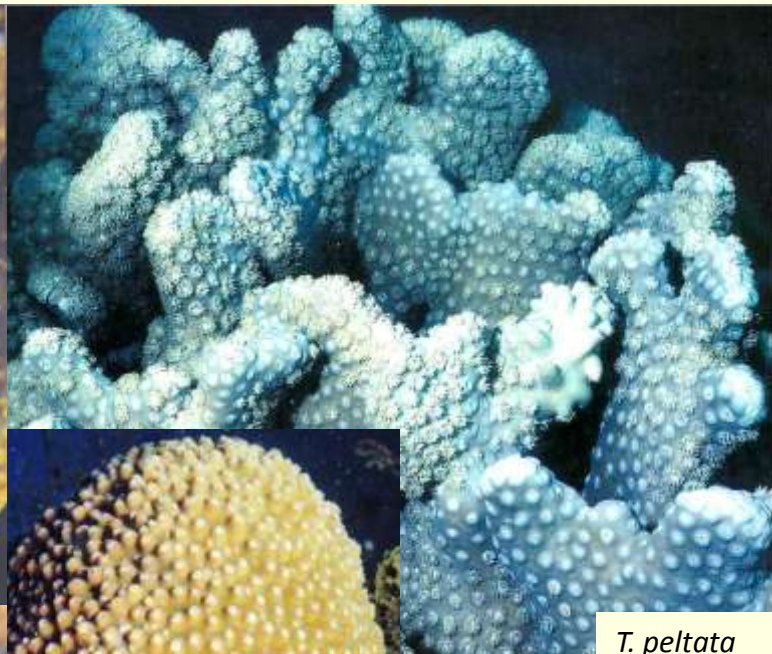
large immersed corallites up to 6mm diameter - ***T. peltata***

Laminae - encrusting

medium corallites with thick walls, coenosteum between corallites is dark - ***T. stellulata***

small irregular exsert corallites, colony may have free margins **-** ***T. irregularis***

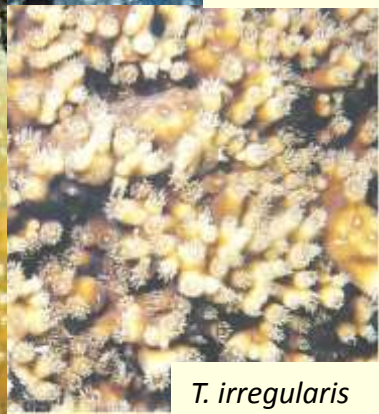
T. retiformis



T. peltata

T. frondens

T. stellulata



T. irregularis

Coral Health

Coral colonies with signs of white syndrome (WS) have been recorded from reef fringing the exposed outer reefs in Majuro since late 2003, following a period of warming and coral bleaching.

New cases of WS have been consistently observed since that time. WS predominately affects, but is not limited to, tabulate acroporid species (*A. cytherea* and *A. hyacinthus)* and mortality of affected colonies has resulted in a detectable decline in coral cover at some Majuro sites.

WS appears similar to Caribbean white diseases and white syndrome recorded in other Indo-Pacific regions, including the Great Barrier Reef and the north-western Hawaiian Islands. Diseases affecting Pacific corals are not yet well characterized and WS may represent more than one distinct disease.

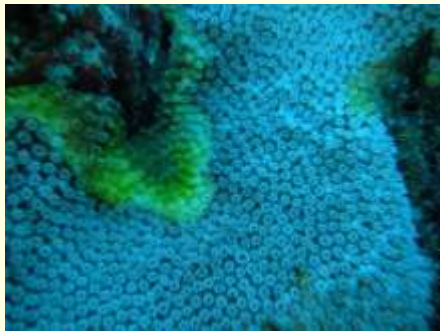
Other potential disease states have been observed affecting colonies of the genera *Platygyra, Goniastrea* and *Turbinaria* on reefs fringing the southern exposed shore of Majuro. Losses of coral tissues associated with these disease signs appear to be relatively slow (millimeters per week).

Frequent cases of coralline lethal orange disease (CLOD) have also been observed affecting crustose coralline algae along this same stretch of reef. CLOD is otherwise infrequently observed elsewhere in the RMI.

Crown of Thorns starfish are common at Majuro so are predatory molluscs (Drupella spp.). Sightings of coral predators should always be noted during coral belt transects.

White Syndrome on *Galaxea astreata*

Acanthaster plancii feeding scar



Invertebrates are counted on 3x250m belt transects of 5m width.

Target invertebrates:

- Holothurians (sea cucumbers)
- Trochus (**Remember to measure basal shell size)
- Large molluscs (such as conch, baler, cone, kauri).
- Clams

The macroinvertebrate diver must swim slowly, checking for invertebrates under caves and overhangs.

The macroinvertebrate surveyor buddies up with the large reef fish surveyor.

Holothurian species

H. leucospilota - small pointy papillae & elongate oral tentacles. Mostly lagoons & reef flat. Beware *H. Atra* and *H. fuscorubra*

H. nobilis – thicker body wall cf. atra
All habs but esp. shallow reef bottoms
Prominent lateral & anal papillae

S. chloronotus – dark green. Smaller morphs in shallow; larger morphs deeper.

T. anax – cream w/orange/pink blotches & warty. Crest & deep water. Can get to <1m long

B. graeffei – mottled w/ dark spots & white-tipped pap. Oft w/ long black tents Mostly crest & deep water.

H. atra **-** Thinner body wall cf. nobilis
Shoter than *leucospilota*, sandy with bare patches. All habs.

T. ananas - All habitats but esp. deep water.

S. hermannii (both photos) - brown/orange w/ darker low tubercules. All habitats, but esp. reef flat & lagoon.

Holothurian species

H. edulis – mostly reef crest & deep water.

A. mauritiana – red with dimpling, sometimes white blotches. Hard substrata in waves & currents <10m depth.

H. fuscopunctata – transverse folds. Pale undersurface. All habitats but mostly deep water.

B. argus – leopard spot mottling (can be variable). All reef habs but not much on crest

A. lecanora – short bulbous red or red/brown mottled. Mostly hard substrata on crest/deep H^20.

H. fuscogilva – whitish w/ dark brown or black dorsal mottling. Mostly crest & deep water.

A. aff. miliaris – Short, fat, black, smooth with small scattered soft papillae.

BENTHIC POINT INTERCEPT TRANSECTS

50m (100 points)

Date:	Site:	Rep:	Depth:		Summary	% cover
1	26	51	76		Turf	
2	27	52	77		Coralline	
3	28	53	78		Macroalgae	
4	29	54	79		Red Algae	
5	30	55	80		Filamentous Algae	
6	31	56	81		Hard Coral	
7	32	57	82		Soft Coral	
8	33	58	83		Sponge	
9	34	59	84		Anemone	
10	35	60	85		Clam	
11	36	61	86			
12	37	62	87			
13	38	63	88			
14	39	64	89			
15	40	65	90		Abiotic	
16	41	66	91		Rubbish	
17	42	67	92			
18	43	68	93			
19	44	69	94			
20	45	70	95			
21	46	71	96			
22	47	72	97			
23	48	73	98			
24	49	74	99			
25	50	75	100			

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1	26	51	76		Turf	
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11	36	61	86			
12	37	62	87			
13	38	63	88			
14	39	64	89			
15	40	65	90			
16	41	66	91		Abiotic	
17	42	67	92		Rubbish	
18	43	68	93			
19	44	69	94			
20	45	70	95			
21	46	71	96			
22	47	72	97			
23	48	73	98			
24	49	74	99			
25	50	75	100			

Reef fish biodiversity datasheet

Site	Date		Habitat type				
GPS							
C auriga		C striatus		An caeleop		Al vai	
C benetti				An		An aureus	
C citri				Bo axillaris		An curacao	
C ephip		C cyanochei		Bo diana		An leuco	
C kleinii				OC arenatus		An chryso	
C lunulat				OC bimacu		Ca acares	
C melanot		A achilles				Ca alpha	
C meyeri		A blochii		Ch chlor		Ca amboi	
C ornatis		A guttatus		OC digram		Ca atripect	
C punctfa		A lineatus		Ch fascia		Ca atripes	
C quadri		A nigricans		OC orient		Ca lepidole	
C rafflesi		A nigricau		Ch oxyce		Ca margari	
C reticul		A nigrofus		Ch trilo		Ca ternat	
C semeion		A nigroris		Ch unifas		Ca viridis	
C tri-lis		A oliva				Ca xanth	
C uliet		A pyro				Ca leucpo	
C unima		A thomp		Ch inermis		Ca traceyi	
C vaga		C binota		Ci balteatus		Du aruanus	
F flavis		C hawai		Ci exquisit		Du reticul	
F longi		C margin		Ci luteovit		Du trimacu	
H polylep		N annul		Co gaimard		Pl dickii	
H accu		N brevir				Pl johnst	
H chrysosto		N caesius		Ep insidia		Pl lacry	
H mono		N hexa		Go varius		Pl leucozo	
H varius		N lit		Ha biocel		Po amboi	
		N unico		Ha chrysus		Po brachia	
		N vlam		Ha hortulanu		Po coeles	
C bicolor		Z flav		Ha margarit		Po pavo	
C japani		Z scopas		Ha marginat		Po vaiuli	
H longi		Z vel		Ha melanurus		Sc fascio	
S altipin		Z corn		Ha melasmap		Sc nigric	
S bleekeri				Ha richmo			
S frenatus		M flavoli		Ha trimac			
S sord		M vanico		He fasciatus			
Sc		P bar-oid		He melap			
Sc		P bar-us		Ho annula		Ce bicolor	
Sc		P bifas		La unilinea		Ce bispin	
Sc		P cyclo		La bicolor		Ce flav	
Sc		P multifa		La dimid		Ce heraldi	
Sc		P pleuro		La pect		Ce vroliki	
Sc				La alleni			
Sc		C caerul		La micro			
		C teres		La xantho			
		P marri		Ma melea		Po imp	
		P tile		Ma negro		Py diacan	
				No taen			
		B undul		Ps evanides		Pa arcatus	
		B conspic		Ps hexatae		Pa forsteri	
A leuco		B viri		Ps tetratae			
C argus		M vidua		Ps octotae		Ap furca	
C leopa		M niger		Ps yama		Ap vires	
C miniata		P flavim		Ps mulucc		Lu bohar	
C spilo		R aculea		Pt cryptus		Lu fulvus	
C urodeta		S bursa		St band		Lu gibbus	
E cyanopo		S chrys		St strgi		Lu kasmir	
E fasciatus				Th ambly		Lu monost	
E fuscogu				Th hardw		M mac	
E hexa				Th lunare		M niger	
E macul		My		Th lutes			
E merra		M adusta		Th purpur		Gl aurolin	
E polyphek		M kuntee		Th quinq		Le ery-can	
E spiloto		M murdjan		Th trilob		Le ery-rus	
G albim		N argent				Le oliva	
P aerolat		N operc				Le obsol	
P laevis		N sam				M grandoc	
P oligac		S caudimac		Si argent			
V louti		S spini		Si puellus			
P dispar		Sar		Si punctat		Ch melam	
P pascalus				Si vulp		El bispin	