



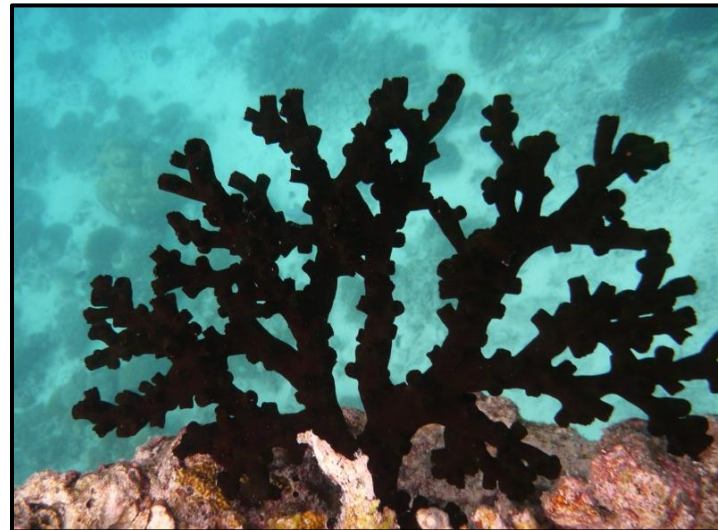
Substrate

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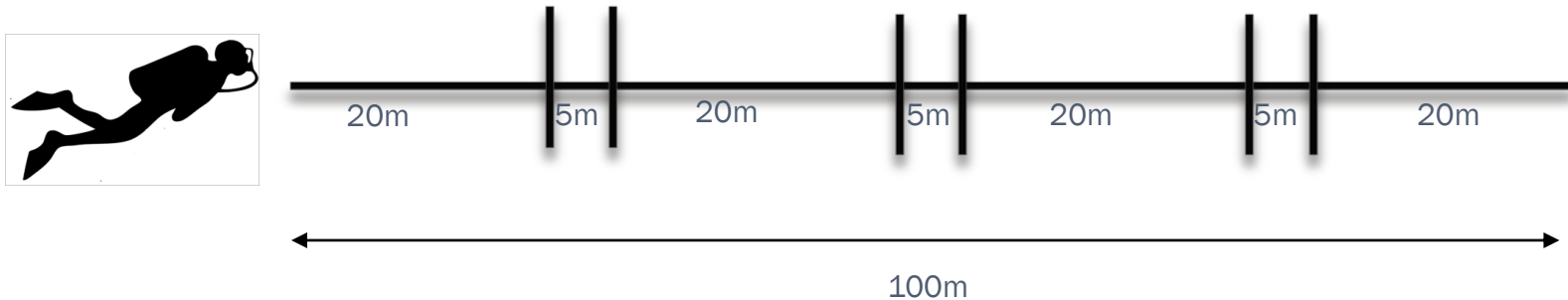


INTRODUCTION

- ✖ The aim of the substrate survey is to collect information on the percentage cover of the major benthic organisms and substrate types on the reef in order to assess the percentage of living and dead components of the seabed.
- ✖ This booklet will help to identify the 10 categories of substrate that must be recorded during the survey. These categories have been chosen due to their function in the tropical reef ecosystems, not for taxonomic reasons; These functions will be covered as we go through each category.



THE TRANSECT



- ✓ The basic idea of the Reef Check protocol is to swim along a 100 meter measuring tape (called a transect) and write down every 50cm the type of substrate found under the transect line.
- ✓ Because of the complex topography of a reef, there may be some distance between the transect line and the substrata below. To ensure that bias is removed and the exact point below the tape is surveyed, a plumb line must be used. A less time-consuming solution is to push the line with the finger until it touches the substrate underneath.
- ✓ It is very important to respect the 5 meters gap between each 20 meter segment.

REEF CHECK SUBSTRATE CATEGORIES

- × HC : Hard Coral (includes Blue Coral, Fire Coral and Organ Pipe Coral)
- × SC : Soft Coral (includes Zooanthids)
- × NIA : Nutrient Indicator Algae (includes seaweed that proliferates with high nutrient input)
- × OT : Other (other living and non-living substrata such as hydroids, anemones, gorgonians and ascidians)
- × SP : Sponge
- × RC : Rock (includes any surface that coral could settle onto including rock covered with turf algae, bivalves, coralline algae and dead coral)
- × RKC : Recently Killed Coral (coral that has died in the last year. Such corals still have a white/partially white skeleton & are slightly overgrown with algae)
- × RB : Rubble (dead coral of 0.5 to 15 cm in diameter)
- × SI : Silt
- × SD : Sand (pieces less than 0.5 cm in diameter)

HARD CORALS : *The reef builders*

- ✖ Hard corals are the main builders of the reef. They provide both food and shelter to numerous marine organisms. Blue, fire and organ pipe corals are included as they also are reef builders and occupy space.
- ✖ If an exceptional event occurs, such as unusual warm sea temperature, outbreak of crown-of-thorns starfish or pollution, leading to the degradation of the reef then the organisms reliant upon the hard coral structures for hiding from predators will likely decrease in abundance as their habitat is lost.
- ✖ The number of their tentacles is a factor of 6 (if visible !) and the colony does not move if you waft it with your hand.
- ✖ If it is an encrusting structure, with a sandpapery and knobby surface then it is a hard coral but if you can see holes at its surface and is smooth it might be another type of organism.

Branching Hard Coral

- ✖ Branching corals are characterized by having branches with secondary branches which can be thick & strong or thin & fragile. They are fast growing species that are one of the first to recolonize.
- ✖ They are often broken during storms as they grow in shallow water.
- ✖ They are regularly eaten by *Drupella* snails.
- ✖ They are very important because they create a complex topography on a reef, providing an efficient shelter for numerous species.

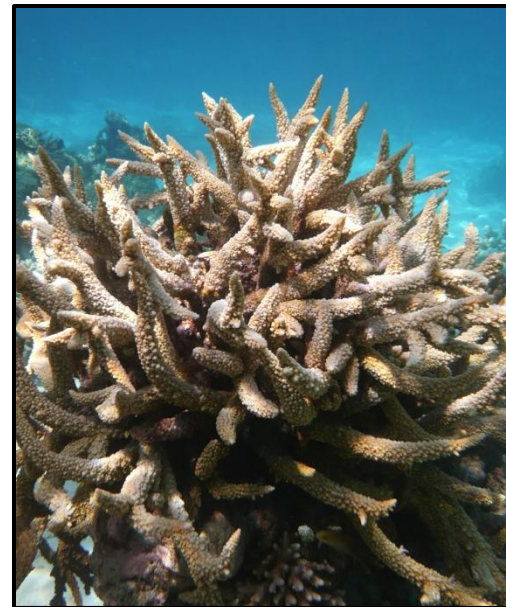
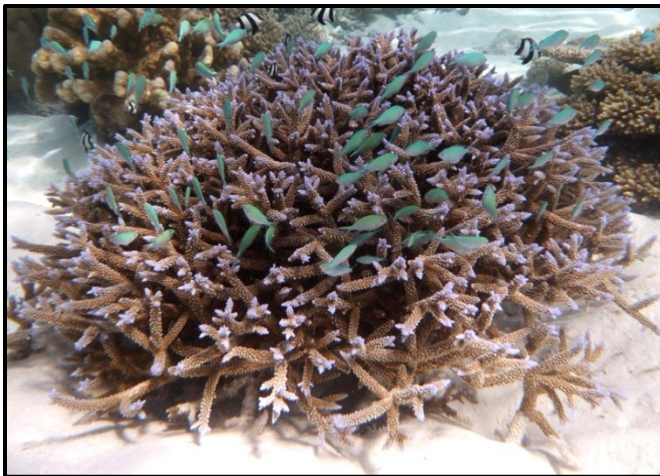
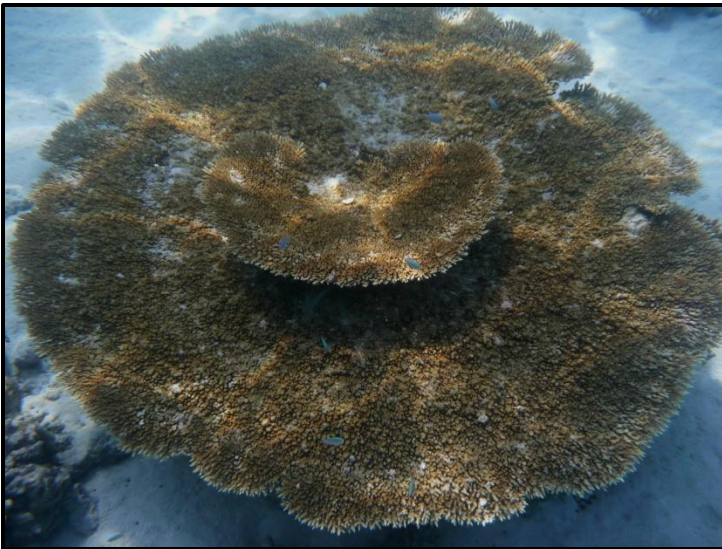


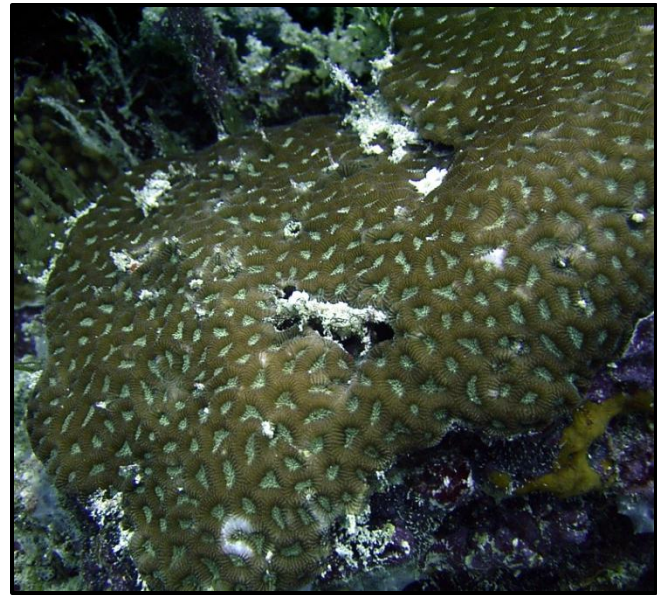
Plate Hard Coral

- ✖ Plate corals are made of fused branches.
- ✖ They are very delicate and can be found up-side-down after episodes of strong storms.
- ✖ They are regularly eaten by COTs starfish.
- ✖ They create hideouts for many fish and invertebrates.



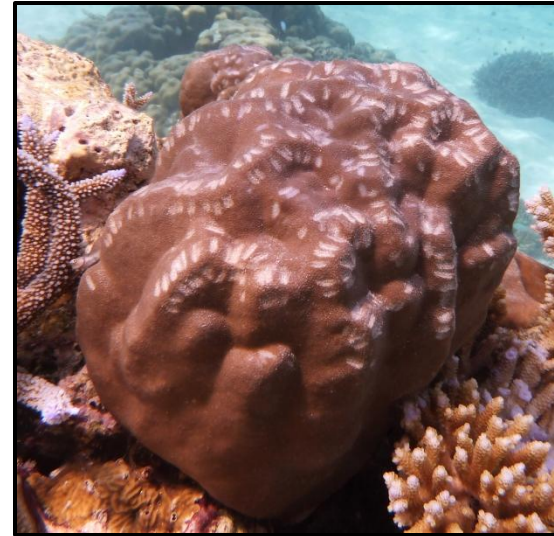
Encrusting Hard Coral

- ✖ They grow over the existing surface and are consequently very robust. The layer is about few mm thick and they have a knobby, sandpapery surface.
- ✖ They help to cement the reef structure together.



Massive Hard Coral

- ✖ They are boulder shaped.
- ✖ These corals can grow to 10 metres diameter and live up to 1000 years.
- ✖ They are extremely robust and withstand better physical disturbance such as storms than more delicate shapes (branching corals).
- ✖ They are one of the slowest growing organisms on the reef and are important ecologically due to their impressive size and lifespan.



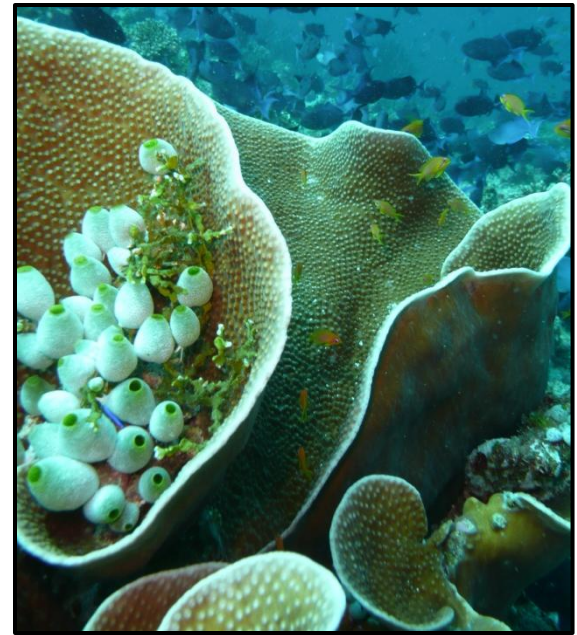
Submassive Hard Coral

- ✖ Submassive corals have an irregular shape, midway between branching and massive corals.
- ✖ They are relatively slow growing and not as delicate as branching corals.
- ✖ *Euphyllia ancora* colony has long tentacles and looks branching, but the branches are very thick (like your wrist) as well as having a thick base.
- ✖ *Goniopora* species has a 24 tentacles polyp (6X4); if you waft it, the polyps will retract and you will see the hard skeleton beneath.



Foliose Hard Coral

- ✖ Foliose or lettuce-like corals are delicate corals. They can also have an encrusting form but the important difference is that they come up at the edges, e.g. *Turbinaria* species.



Digitate Hard Coral

- ✖ Digitate or columnar corals have thick, finger-like branches.
- ✖ They are often found on the reef flats because they can withstand strong waves action.



Mushroom Hard Coral

- ✖ Unlike other corals, mushroom corals are attached to the reef as young colonies that look like mushrooms; later the “hats” break free and they reside on sand or rocks.
- ✖ Each mushroom coral is just one single polyp.
- ✖ The *Heliofungia actiniformis* has long tentacles that remain extended during the day and consequently, this species can be confused with a sea anemone.



Blue Coral : *Heliopora*

- ✖ It is not a true hard coral as it has a blue argagonite skeleton instead of calcium carbonate (limestone). However, its skeleton is hard and therefore considered as a reef builder, filling the same function as a hard coral.
- ✖ Blue Coral come in many shapes, usually branching but the branches can be fused together.
- ✖ It appears brown or grey in the water but the inner skeleton is bright blue and can be seen on broken part.



Fire Coral : *Millepora*

- ✖ It looks like a hard coral but is actually a hydroid.
- ✖ It has a hard skeleton, a distinctive tan color with white tips.
- ✖ It comes in a wide variety of shapes from wavy plates to thin branches.
- ✖ They have tiny hair-like tentacles.



Organ Pipe Coral : *Tubipora musica*

- ✖ The Organ Pipe Coral is an octocoral (8 tentacles) but has the same function on the reef as a hard coral.
- ✖ If you see one during your survey, waft it vigorously so that the polyps retract themselves, revealing the typical organ pipe shape of the skeleton.



Bleached Hard Coral : *Global warming indicators*

- ✖ Bleaching occurs when the zooxanthellae (a brown micro algae) living in the coral's tissue are expelled allowing us to see the calcium carbonate skeleton through their thin tissue.
- ✖ Some may appear pink, purple or green. Corals also contain fluorescent pigments that remain in the tissue even if the zooxanthellae left.
- ✖ Despite the fact that the coral is bleached, it still belongs to the category HC on the substrate survey until it dies. Once dead it will be recorded as RKC.

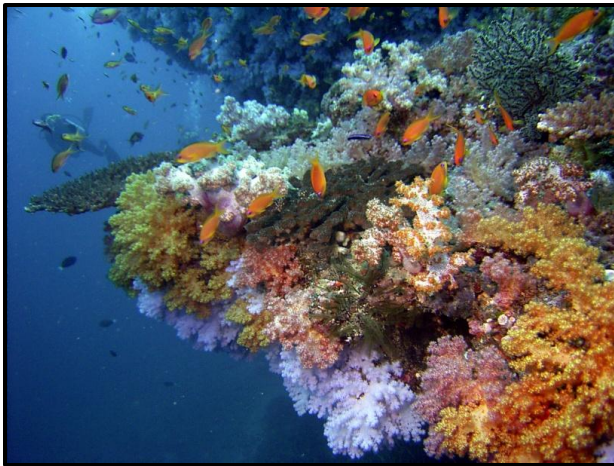


Not all white coral is bleached, any recently killed coral will look white. Coral death can be caused by COT starfish, drupella snails or disease. It is important to look at the whole reef to understand the process taking place.



SOFT CORALS : *Non-reef builders*

- ✖ Soft corals support 8 tentacles on each polyp and are similar to the flowers of a tree.
- ✖ Soft corals are usually feeding at day time thus, the polyps are extended, giving the possibility to count the number of tentacles.
- ✖ You can also easily identify them by wafting the water; if it moves, it can be a soft coral (or a sponge !). When they retract their polyps, no hard structure is visible underneath.



Soft Corals : Zoanthids

- ✖ Zoanthids are not soft corals, in fact they are hexacorals. However, they can cover huge mats of reef and are soft thus, we record them under SC for Reef Check
- ✖ Zoanthid polyp are about 1cm diameter and have a mouth in the middle surrounded by little teeth-like tentacles. They can live separately or in colonies, connected to each other, like a coral structure. They tend to have brown, green or red centre.
- ✖ They can be confused with massive and encrusting corals. To avoid confusion, you can gently touch the surface to determine if it is soft or hard. You can also waft it with your hand : zoanthids will close up whereas the corals won't budge.
- ✖ They may also be confused with sea anemones. The picture shows a colonial anemone that should be placed under OT category.



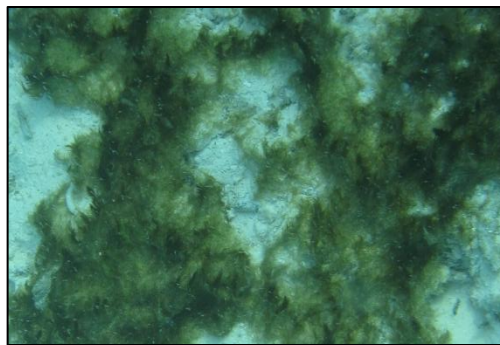
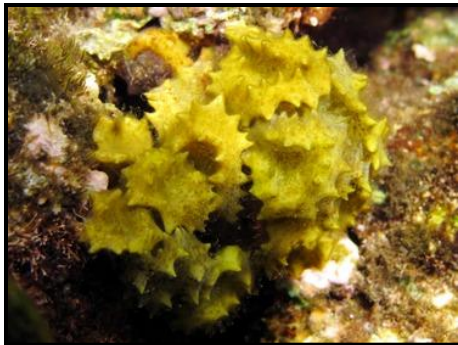
Bleached Soft Coral : *Global Warming Indicators*

- ✖ Soft corals can also bleach as a result of stress. Even though bleached, these corals fall under the category SC.



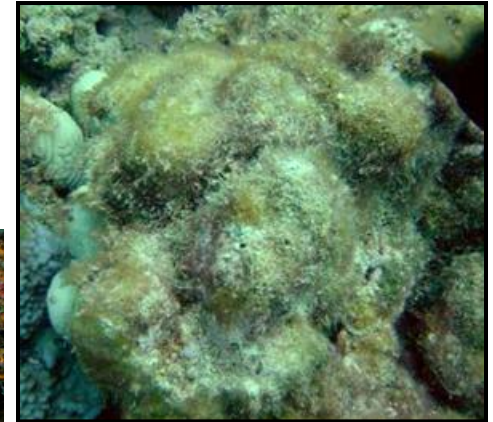
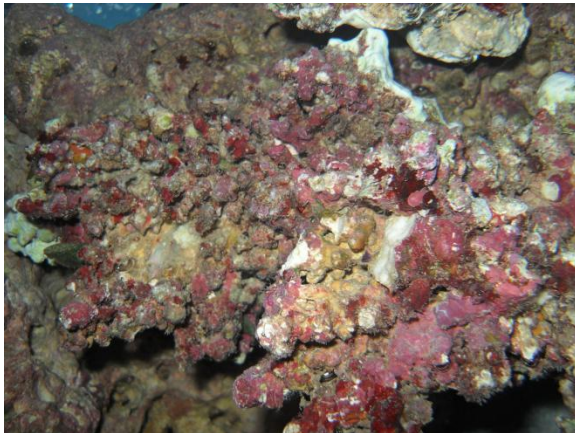
NUTRIENT INDICATOR ALGAE : *Pollution Indicator*

- ✖ Coral reef are naturally nutrient-poor environments. A high concentration of nitrates and phosphates may induces a proliferation of algae that out compete the corals, smothering them and blocking access to sunlight's but also prevent juvenile corals from settling down.
- ✖ However, algae on reef is both natural and an important source of food for herbivores thus, it does not necessarily mean the reef is unhealthy.



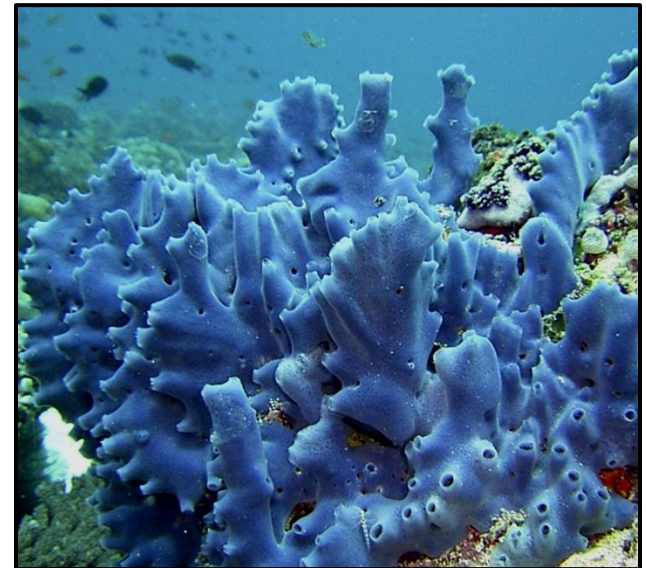
NUTRIENT INDICATOR ALGAE : *Pollution Indicator*

- ✖ Algae not recorded as NIA are :
 - + Crustose and coralline algae. We record the substrate underneath (SD or RC)
 - + Halimeda which comes under OT
 - + Turf algae not longer than 3 cm (size of a thumb). Record the substrate turf algae is growing on.



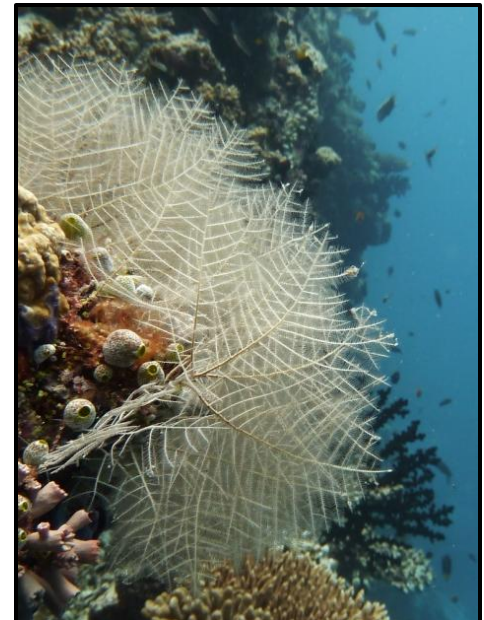
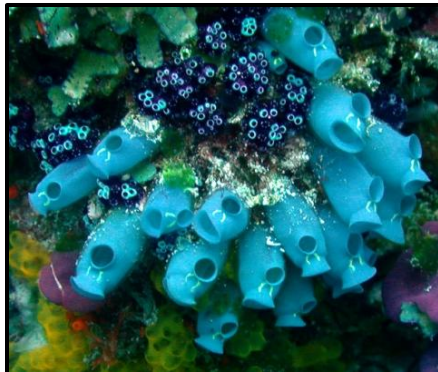
SPONGE : Sewage Pollution Indicator

- ✖ Extensive coverage of sponge (mostly encrusting ones) may indicate sewage pollution as there is more food available for these filter feeders; important sponge growth takes up space from Hard Corals.
- ✖ Sponges come in all sizes, shapes and colors and can be easily confused with ascidians but ascidians have complex chambers inside large openings..
- ✖ Sponges are soft, irregular, encrusting structures with irregular holes and if you waft the holes there is no reaction whereas the ascidians ' will close up.



OTHER : *Not Indicator Of Impacts*

- ✖ Ascidians : They can be easily confused with encrusting sponges. If you waft the holes, they will close up. They are colonials or solitary animals.
- ✖ Hydroids : They look like feathers of ferns. Do not touch them , they sting !
- ✖ Anemones : They frequently, but not always, have clownfish living in them. Do not confuse them with mushroom coral.



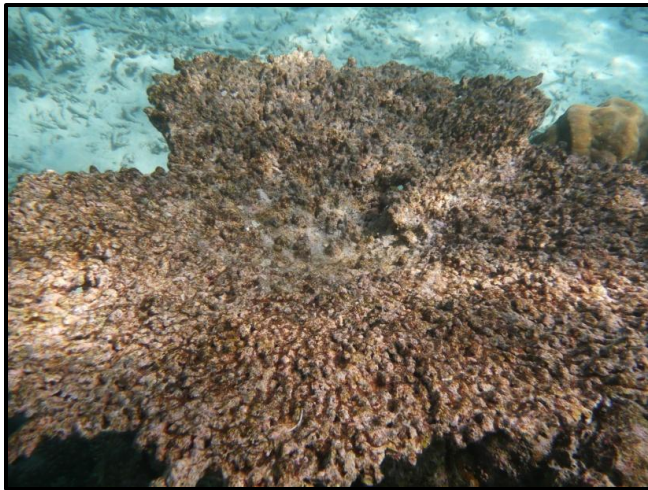
OTHER : *Not Indicator Of Impacts*

- ✖ Tube worms
- ✖ Coralliomorphs : They look like sea anemones which also go under OT thus, the confusion does not matter.
- ✖ Gorgonians : They position themselves against the current and filter out the water.
- ✖ Clams (but the shell goes under RC)



Rock : *Hard Substratum*

- ✖ It is an important category as it provides essential space for recruiting corals.
- ✖ Dead corals, eroded down or/ and covered with coralline / turf algae are recorded as RC.
- ✖ The shell of the clams go under RC while the clam would be counted during the invertebrate survey.
- ✖ Rubbles cemented together by coralline algae are also recorded as RC.



RECENTLY KILLED CORALS : *Indicator Of Recent Disturbance*

- ✕ Corals recorded under these category :
 - + Have corallites which are not much eroded
 - + Still show some white skeleton
 - + Are partially grown over with encrusting algae



A white skeleton does not mean necessarily bleaching but could also mean that the corals has recently died from other causes such as Drupella snails, COTs starfish, diseases...



Drupella snails

RUBBLE : *Unconsolidated Material*

- ✖ Rubble comprises unconsolidated pieces (0.5 to 15 cm diameter) of dead coral, rocks, etc.
- ✖ They move around in wave action and therefore are not suitable for new coral recruits and may also knock off new corals that have settled.
- ✖ Dynamite fishing, anchor damage, cyclones or storms are the main causes.



SILT : *Indicator Of Soil Erosion Or Dredging*

- ✖ Silt is sediment that remains in suspension if disturbed.
- ✖ Silt is recorded if the layer is more than 1 mm thick or covers the underlying substratum such that you cannot observe the color.
- ✖ If you can see the substrate underneath then record it, do not record it as silt.



SAND : *Non Reef Area*

- ✖ This category comprises grain of sand not larger than 0.5 cm diameter.
- ✖ When disturbed, these grains immediately fall to the ground after being lifted.

