Field Guide to the Corals of Wake Island

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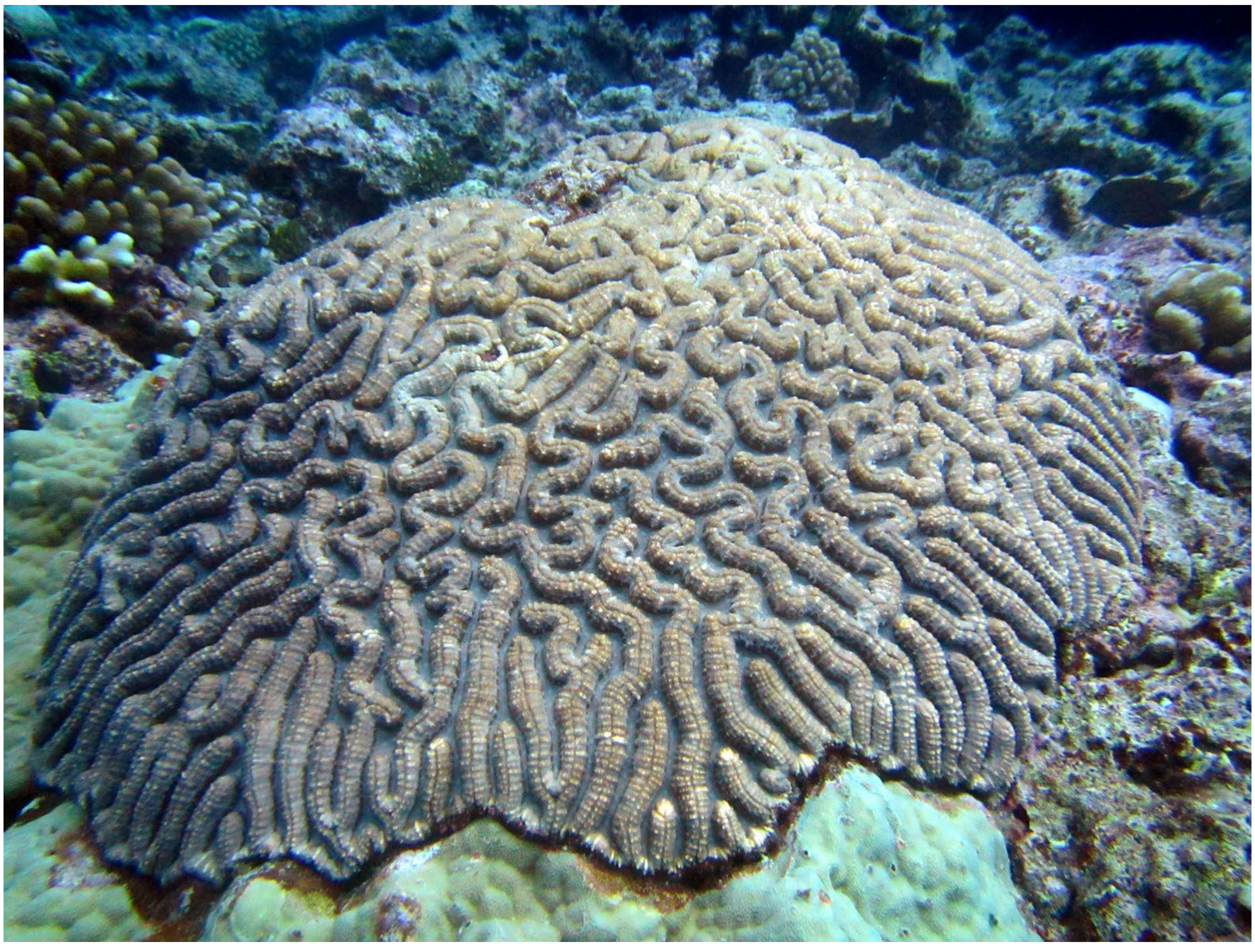
A guide to the underwater identification of 79 species of corals in 27 genera that secrete hard skeletons on Wake Island.



A colony of *Lobophyllia radians*, Wake Island.

All photographs in this guide were taken in Wake by the author unless indicated otherwise. Most species in this guide are in Wake and look the way the corals look here. However, I have also added pictures of other species reported from Kenyon et al (2013), using pictures from American Samoa. This is a first draft ID guide for Wake. In future years I hope to photograph many more corals and add many more species to this guide. Parts of the introductory text are the same as in the other guides.

To Michel Clareboudt, for all you do for corals and reefs.

Other field guides by the same author:

Fenner, D. 2005. Corals of Hawai'i, A Field Guide to the Hard, Black and Soft Corals of Hawai'i and the Northwest Hawaiian Islands, including Midway. Mutual Publishing, Honolulu. 143 pages.

Sheppard, C., Fenner, D., and Sheppard, A. 2017. Corals of Chagos. http://chagosinformationportal.org/corals

Fenner, D. 2022. Field Guide to the Corals of the Marshall Islands. Marshall Islands Marine Resources Authority.

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Fenner, D. 2018. Field Guide to the Corals of the Federated States of Micronesia.
Fenner, D. 2018. Field Guide to the Corals of Saipan.
Fenner, D. 2019. Field Guide to the Corals of Vanuatu
Fenner, D. 2020. Field Guide to the Corals of the Northern Mariana Islands
Fenner, D. 2021. Field Guide to the Corals of the Marianas.
Fenner, D. 2022. Field Guide to the Corals of New Caledonia.

We stand on the shoulders of giants: this guide would not have been possible without the work of many coral taxonomists who went before me: J.E.N. “Charlie” Veron, Carden Wallace, Bert Hoeksema, Richard Randall, Francisco Nemenzo, John Wells, and Austin Lamberts to name but a few. I thank Lance Smith at NOAA Fisheries' Pacific Islands Regional Office for supporting the development of this guide.

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Corals by the New Systematics: DNA-sequencing (PCR) Phylogeny

Here, families are listed alphabetically, genera within each family are listed alphabetically, and species with each genus are listed alphabetically. The species names used are those of the new taxonomy, based on DNA sequencing. There are quite a few changes in which genera species are in and which families genera are in. The old families were based completely on morphology, and morphology had little to base families on. It was impossible to visually identify families. So it is not surprising that DNA sequencing has indicated new groupings of genera into families. What is surprising is that several genera are indicated by the DNA sequencing to be in families that are morphologically very different. So for instance, *Alveopora* which has polyps almost identical to *Goniopora*, is moved from the Poritidae to the Acroporidae to join *Acropora*, *Montipora*, *Astreopora*, *Isopora*, and *Anacropora*, none of which have polyps or skeleton like *Alveopora*. However, under the electron microscope, *Alveopora* is seen to have minute scales on its skeleton like all the other genera in Acroporidae (and a few other species in other genera and families). Plus it has septa unlike Goniopora, they consist of smooth spines, much like the pegs that form septa in *Montipora*. And, that result has now been replicated using a method that uses much more DNA. Also, the Faviidae in the Pacific and Pectinidae are no more, species in those genera have been moved into the Merulinidae. The faviids, pectinids, and merulinids are all quite different morphologically but all are now in the Merulinidae. The former *Favia* in the Pacific have been renamed *Dipsastrea*, except *Favia stelligera*, which was moved into *Goniastrea*. *Diploastrea* and *Plesiastrea* get their own families. *Montastraea* in the Pacific was divided into *Astrea*, *Phymastrea*, and *Paramontastrea*, which is not surprising, Veron has commented that it seemed to be a collection of different things. The families Mussidae and Echinophyllidae are no more, their species have been moved into a new family, the Lobophyllidae. The morphology of the species in Muissidae and Echinophylliidae are quite different. The genus *Symphyllia* is no more, all the species in *Symphyllia* have been moved into *Lobophyllia*. *Psammocora explanata* and *Coscinaraea wellsi* have been placed in *Cycloseris*, which they don't remotely resemble. *Fungia concinna* and *Fungia repanda* are moved out of *Fungia* which they closely resemble, into the genus *Lithophyllon*, which they don't remotely resemble. Several species in *Fungia* have been moved into *Pleuractis*, and several others into *Danafungia*, and one into *Lobactis*. Only one species remains in *Fungia*, *Fungia fungites*.

Learning to identify corals is less difficult when similar species are compared, and the old taxonomy based on morphology tended to group corals together that had more similar morphology. So the order that corals are presented in this guide is more similar to the old taxonomy than the new systematics. The order of families, genera, and species in the new systematics as shown below is derived from Montgomery et al (2019) which was based on WoRMS (World Register of Marine Species, marinespecies.org). It is said that convergent evolution has produced similar appearances in species that are not closely related. but so far there is no independent evidence for that for most cases with coral taxonomy.

Introduction

This field identification guide was written to help identify corals in Wake. All the photos were taken in Wake, so the photos look like the corals in Wake. Corals look different from each other on a wide range of scales from near to each other to different reefs to different archipelagoes close together to archipelagos very far apart. No species are included in this guide that are not present in Wake, so you don't have to pick your way through many species that aren't in Wake. This is a first version of this and so many corals that are in Wake. are not yet in this guide, but with additional visits by the author more species will be added. The order in which genera are presented is one that has been commonly used in the past (e.g., Veron, 2000) because it tends to put species together that look similar, which hopefully aids learning to distinguish them. The order of genera and species has been modified slightly here to try to put similar-looking species close together in the order, to assist identification.

Fringing reefs typically have two major types of habitats for coral reefs and barrier reefs and atolls typically have four. Both have fore reef slopes, which are on the outside of the fringing reef or barrier reef and slopes steeply at about a 45-degree angle down into the abyss. Another that all three types of reef have is the reef flat: a flat, shallow reef area between the reef crest where the waves break and either the lagoon or the island. A habitat that only barrier reefs and atolls have is the inside slope from the island or reef flat down into the lagoon. And the fourth that barrier reefs and atolls have consists of patch reefs some of which are in the shape of pinnacles, in the lagoon. Lagoons are typically sandy bottomed, and are usually between about 30 m and 100 m deep. There are often patch reefs or pinnacles in lagoons. The fore reef slope typically has wave surge that decreases with depth, and may have currents at times. The reef flat has waves coming across it after they break at the crest, and anything extending above the flat may be exposed to air at extreme low tides. The reef flat on the lagoon side of islands is much more protected than the outer reef flat and thus may have different communities. The slope and patch reefs in the lagoon are protected from open ocean waves and typically have no current. The ring of reefs may have passes where the ring of coral is deeper than elsewhere. Such passes usually have strong currents as water levels outside the lagoon rise or fall with the tides. On rising tides, water rushes through passes into the lagoon, and on falling tides water rushes out. Water on the outer fore reef slope is usually very clear, while that in the lagoon may not be as clear. Each of these zones typically hosts different species of coral, and species that live on one often don't live on the others or are less common on the others. In addition, coral communities are affected by how much wave action they are exposed to. If one side of an atoll has continual heavy wave action and the other side is always calm, there may be quite different coral communities on those two sides. Depth also affects corals, probably from both decreasing light with depth, and decreasing wave surge with depth. Many coral species show some depth zonation, being most abundant at one depth and less abundant deeper or shallower than that. Some may even not be present at some depths. A few species have very wide depth ranges.

Wake Atoll is a small atoll north of the Marshall Islands, which may be one of the oldest atolls on earth. Kenyon et al (2013) reported a total of 97 species of hard corals in their study and previous studies. Some of the Wake coral species are also found in Hawaii, the Marshall Islands, and the Marianas, but the Wake assemblage is more similar to the Marianas than the other locations.

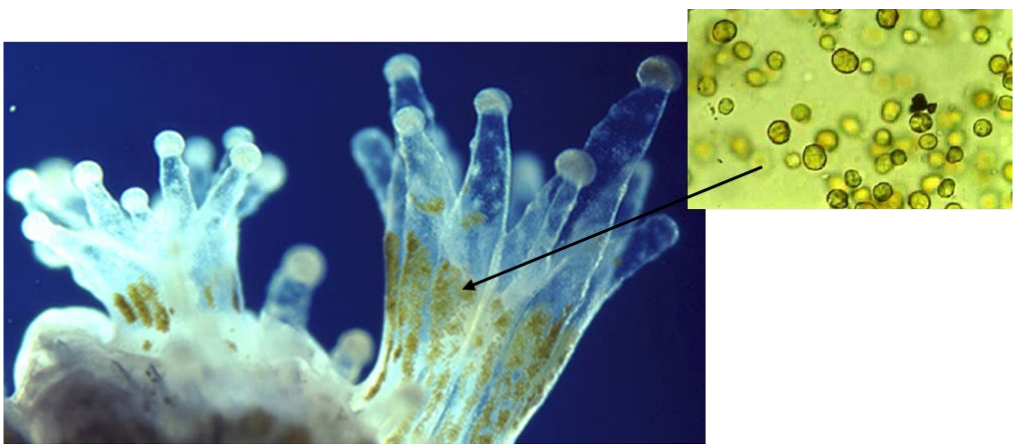
For more background information on marine environments, coral reef ecosystems and habitats in Wake, see Wells, 1978; Miller et al, 2008; Kenyon et al, 2013; and Lobel and Lobel, 2008, 2019. For more information on coral reefs and corals in general, see Veron (1995; 2000), Wallace (1999), Goldberg (2013), Sheppard et al (2018), Sheppard (2021) and Fenner (2022).

Coral Anatomy and Biology: what are corals? Corals 101.

Corals are animals made up of units or modules called “polyps.” A polyp is a bag full of seawater, with a thin wall made of 3 layers, an outer layer of cells called the “epidermis,” a middle layer of connective tissue called the “mesoglea.” and an inner layer of cells called the “gastroderm.” The opening of the bag is the mouth, and it is actually turned inside the opening of the bag. There is a ring of tentacles around the mouth. Each tentacle is a hollow tube much like the finger on a glove, filled with water that is continuous with the water inside of the polyp. The water-filled space inside the polyp is called the “gastrovascular cavity” because it serves the function of both a digestive cavity and a circulatory system. Polyps are very simple and lack organs like a heart, blood vessels, and a brain. The gastrovascular cavity has only one opening, the mouth, unlike the tube digestive systems of higher animals, which have two openings and can digest things in a sequence like an assembly line. Anything that is indigestible has to be spat out the mouth. The inner two layers of the body wall project in a series of curtains called “mesenteries” that extend into the gastrovasuclar cavity. Hard corals have ether six mesenteries or multiples of six, and they have as many tentacles as mesenteries. Usually they have multiples of six. Coral polyps vary in size between species, ranging from less than 1mm diameter up to as much as 30 cm diameter.

Corals and their relatives are carnivores, sit and wait predators. They have a remarkable and unique type of stinger in their tentacles, called a “nematocyst.” Nematocysts are actually sub-cellular structures inside cells, secreted by the cell, and not alive. They are oval capsules, with a coiled thin tube inside them. The opening of the tube connects to the end of the capsule which touches the cell surface that is exposed to the water. When an animal touches the trigger on the surface of the cell, it provides a chemical that is only found in animals, a short polypeptide. In addition, the movement of the animal provides a mechanical stimulus. Both chemical and movement are necessary to trigger the nematocysts off. Corals and their relatives eat animals. When the nematocyst is triggered, water from the cell moves into the capsule, but the capsule is rigid and does not stretch. So the pressure goes up very high, about that of a scuba tank, the highest in any organism. There are 3 spines inside the tube which are attached to the tube and their sharp points are against the capsule where the capsule touches the cell surface that is exposed to the outside water. The pressure pushes the spines through the capsule wall, releasing the pressure, which then pushes the tube inside out, and outside the capsule and pushes the spines into the prey. The tube has many tiny spines attached inside it, initially pointing inward. As the tube turns inside out like a sock, the tiny spines are thrust out the end where the tube is being turned inside out, and stick into the prey. As the tube turns inside out, then they stick into the prey backwards, holding the tube in the prey. The spines poke into the prey and anchor the tube in the prey, and pull the tube into the prey. The tiny tube is very long, vastly longer than the capsule in which it was tightly wound up. Thus it can go well into the prey. The capsule is filled with a wide variety of nasty venoms, which attack nerve cells, blood and body cells. The end of the tube is open, so it serves as a hypodermic needle, invented by evolution probably over 500 million years ago. The prey is then pushed into the mouth and on into the gastrovasucular cavity by the tentacles. The layers of cells in the body wall have muscle cells in it which can cause the tentacles or body wall to contract. Once in the gastrovacular cavity, the food item is surrounded by the edges of the mesentery curtains, which have cells on the edge which secrete enzymes that digest the prey. The digested juice of the prey leaks out from between the mesentery edges into the gastrovascular cavity and diffuses through it, sped by body wall contractions that move the water inside it, so the juice reaches cells throughout the body wall and tentacles and feeds them.

The gastrodermis also has single algae cells in it, living inside the coral animal cells. They are called "zooxanthellae" which simply means "colored algae cells that live in animal cells." The zooxanthellae are in a group of single cells called "dinoflagellates" which when they are in water, have two flagella (hairs) that beat, one on the end of the cell, and one in a groove around the equator of the cell. When they beat, the cell swims and spins. The cells have chloroplasts in them that have chlorophyll, and can do photosynthesis in light. They also have other pigments that are red, orange or yellow, and together with green chlorophyll they always look brown. When they build glucose sugar in photosynthesis, some of it leaks out into the coral cell and feeds it. Thus, corals have two sources of food, animals they eat, and sugar from photosynthesis. The sugar is high in energy and low in nutrients, and supplies much of the coral's energy needs. The animals that corals eat are mostly small, and called "zooplankton." They provide the nutrients like nitrogen and phosphorus the coral animal cells need. The algae living inside the animal cell gets the waste products of the animal which are nutrients, fertilizer for plants. Plus, it gets a very well defended, stable spot in the sun. This is a mutualistic symbiosis, two different organisms living together, both benefitting, and it produces tight recycling of nutrients in low-nutrient water. The polyps are all connected by continuous tissue, and the gastrovascular cavities are all connected. The nervous system consists of nerve cells connected together like a net, with no brain or ganglion to control it. All the polyps behave as one connected individual coral organism. In addition, the polyps are all genetically identical and all the same sex. Thus, the colony is the individual, not the polyp. Polyps are modules within an individual.



Coral polyps on the left have tentacles. The white on the end of the tentacles and white bumps on the sides of tentacles are large cells called "nematocyst batteries" because they have many nematocysts. (Image: ocean.si.edu) The brownish green spots are zooxanthellae, seen in a microscope photo on the right. (Image: www.captivereefs.com).

Sexual maturity comes when the colony reaches a certain size, not when polyps reach full size. Eggs and sperm are produced by groups of cells which form gonads on the sides of the mesenteries. In a majority of species, the eggs and sperm are released into the water in what is called "broadcast spawning", where sperm from other colonies of the same species fertilize the eggs. The eggs and sperm are released together in egg-sperm bundles, which float to the surface and then break apart. Once the eggs are fertilized, they begin to divide and it takes about a week for them to divide enough to form a little larva, about the size of the head of a pin, called a "planula' larva. It is then capable of settling if it can find a suitable surface. If not, it can continue to float in the water. Over time, if they don't find a substrate, more and more die, and the last ones may live up to 100 days or so. In some places like the Great Barrier Reef, most coral species all spawn on the same night every year. The floating eggs are so numerous there they can form slicks on the surface so large they can be seen by aircraft. Most larvae probably don't go very far, with fewer and fewer going farther and farther with the currents. In other coral species the eggs are retained in the parent and sperm released, and sperm enter through the mouth to fertilize the eggs inside the parent. Then the egg divides and develops into a larva inside the parent, before being released. These are called "brooded larvae." Brooded larvae are able to settle immediately after being released, or they can float with the currents like other larvae. Some brooders release a few larvae every night, with more during some moon phases and times of the year. In addition, a majority of coral species are hermaphroditic, producing both eggs and sperm in one colony. A minority of species have separate sexes. Broadcast spawning and brooding are types of sexual reproduction.

When a coral planula larva settles, it then metamorphoses into a coral polyp of the same, tiny, size. The polyp then grows until it reaches a mature size. The mature size of polyps differs between species. Once the founding polyp reaches the mature size, it starts to divide. It can divide equally into two new polyps. It divides by the two polyps slowly growing and pulling away from each other. But they don't finish the job of dividing, they continue to stay attached to each other by a thin connection. So all corals start out as one tiny polyp which then grows to a mature size and divides into two. As those two grow, they reach the mature size and then they divide into 4. Then 4 into 8, 8 into 16, and so on until there may be hundreds, thousands, or millions of polyps.

Corals also can reproduce asexually, mainly by fragmentation. If something breaks a coral colony, the pieces can survive and grow if they are stable on a hard surface which they can attach to. In some relatively fragile branching species, this is the primary way they reproduce. In other, sturdier colonies, asexual reproduction by fragmentation is rare. Colonies can also have partial colony mortality which may leave islands of tissue living. In that case, as the islands of living tissue grow, they may reach each other and fuse. Only genetically identical tissue will fuse, when different colonies grow until they touch, they do not fuse. All fragments broken off of one colony are genetically identical and can be called "clone mates." Some species like staghorns form extensive thickets of these clones and are called "clonal." Branching corals like staghorns grow fast at the tip and slow on the sides. At the tip, only thin walls are secreted between corallites so the skeleton is highly porous and weak. Then with time the tissue keeps adding calcium to thicken the walls, until low on the branch not only is the branch thicker but it is nearly solid and very strong. If you think about it, leverage means that pressure near the end of the branch produces much more breaking force low on the branch than near the tip. The fact that the low part of the branch is thicker and more solid and thus much stronger, guards against breakage at the base. Thus, it appears that evolution has actually selected branching corals to resist breakage. That is probably because many fragments do not get stabilized on hard substrate and do not survive. Asexual reproduction by fragmentation can come at a high price. Mushroom corals have a few additional variations on these asexual fragmentation themes. When the larva of a mushroom coral settles, the polyp it forms, grows larger and then taller, and then the top surface with the corallte and septa starts widening beyond the stem-shaped part of the corallite. Then the tissue dissolves a crack in the skeleton under the wide top of the polyp. Then only the tissue holds the top on, and something like wave surge breaks the tissue and it falls off. That top that falls off is the shape of a mushroom coral, and grows much larger without ever attaching to anything. In the two species of "*Diaseris*" mushroom corals, the mature corallite dissolves a crack in its skeleton across the disc, and then the two halves are held together only by tissue. Something breaks the tissue and now there are two, half-disc mushroom corals which proceed to regenerate the other half and then dissolve another crack to do it all over again. As a result, those species can form large numbers of clone mate mushroom corals.

Coral polyps are very similar to sea anemone polyps, but reef building corals are usually colonial with several to many polyps, while anemones are solitary with single polyps that can, in some species, grow quite large. Reef building corals can grow large and have many polyps, and they almost always have zooxanthellae. Other corals are usually small, often solitary, don't have zooxanthellae, and live often in the dark, often in deeper water, and those that live in deep water are in very cold water and a few species live in cold polar waters. Reef building corals live only in warm, shallow water and usually live in clear water. Thus, coral reefs are all in warm, shallow water. All corals build what we call a skeleton, made of calcium carbonate. Calcium and carbonate are abundant in sea water, and actually have a higher concentration than needed to precipitate (but precipitate slowly). Corals take calcium carbonate out of the water and secrete it beneath themselves in a single structure that is external, underneath the living polyps, and not alive. So it is different from our skeleton, which have many separate pieces which are inside and have cells in them and are alive (and our skeletons are made of a complex phosphate compound, "hydroxyapatite"). Calcium carbonate can exist in at least two solid forms, one called "calcite" which forms thick crystals, and another called "aragonite" which forms long thin fiber-like crystals. Corals only build aragonite skeletons. After the larva settles on a surface, it secretes skeleton that is cemented to the substrate. Most coral species are firmly attached to hard substrate, but a few are not. Because the skeleton is not alive, it doesn't matter if other organisms like sponges burrow in the skeleton. As long as it doesn't break, it makes no difference to the living coral which is only on the surface of the skeleton. Each polyp sits in a cup in the skeleton called a "corallite." The inside surface of the cup has walls of skeleton that project into the cup and are called "sclerosepta" with "sclero" meaning hard and "septa" means walls. The corallite shape fits very closely to the polyp and reflects all the fine details of the polyp size and shape. The skeleton is much more permanent than the polyp and can retain its shape indefinitely out of water in a museum, and so is used for identification and taxonomy. All the taxonomy with only one exception is based on the skeleton shape. The irony is that a species is a group of living organisms, but we define coral species based on their skeletons, which are not alive. Both the shapes of colonies and the fine details of the corallites and other details of the skeleton, usually observed under a microscope, are used to separate species. Identification of living corals is not definitive, it requires confirmation by examining skeleton. Living corals in the water have some advantages for studying species, since you can see the whole colonies instead of pieces in a museum, and you can see large numbers of colonies, and it is non-destructive. Skeletons in a museum have the advantage that living tissues are not in the way of you seeing the skeleton details, and you can use a microscope, and you can see the same skeletons other people see.

There are a few general things about coral morphology that may be of help to you as you go along. The main unit in coral morphology is the polyp, and the corresponding cup in the skeleton which a polyp sits in. The cup in which a polyp sits is called a "corallite" and includes both the inside and the outside surfaces of the cup. The inside of the cup is called a "calice." There are walls that extend from the inside wall of a corallite into the central space of the corallite, which are called "septa." Each corallite has at least six septa. Septa come in sets, the first set having six septa, the second set also having six which are between the first set of six and usually smaller than the first set of six. The third set is 12 and is in between the existing 12 septa, the next set is 24, etc. In the center of the corallite there is a small structure called a "columella" which may be a single solid column or more often many small columns, or curving, twisted columns. The septa commonly extend up over the rim of the corallite and down the outside surface of the corallite, where they are called costae (costa is singular). Septa and costae may have teeth or granules on the edge and granules on their sides. Corallites can come in many different sizes and shapes. They range in size from about 0.5 mm to about 30 cm diameter. Some are circular, others oval, some quite elongated. Each elongated corallite corresponds to an elongated polyp which has several or many mouths but shares a single gastrovascular cavity. The corallite walls in that case are elongated and usually meander, forming a "meandroid" coral, commonly called a "brain coral." There are many other details.

Coral Identification

Coral species are notoriously difficult to identify. Coral identification and taxonomy are not for the faint hearted. You need all the help you can get. We all do. The purpose of this identification guide is to help you to learn to identify coral species you see in Wake. This is a preliminary version of the guide, as the author gets more time underwater and finds and photographs more corals, more species will be added. The goal is to present photographs of the corals taken in the Wake and have clear and helpful text that points out the features of the corals that can help in identification and how each species differs from others. One of the advantages of a pdf is that it can easily be updated as often as desired. Another is that photographs can fill the whole screen. The larger the photographs, the better you can see the corals that you are trying to identify. This guide attempts to show both pictures of the whole colony shape, and of close ups of the corals, and some of the variation between corals. There are valuable identification clues in both the colony shapes and in the features of the corallites and areas in between corallites. You need to be able to see as many of these features as possible to help you identify the corals you see.

At any one reef, only a portion of the world's coral fauna will be present, and an even smaller portion of that fauna will be common enough that you encounter it frequently. The more often you see a coral, the more chance you have to practice your identification skills. The author recommends looking at the guide as often as possible, including before you get in the water. Then it is good to look again after you get out of the water. Going between the guide and looking underwater, back and forth, is one of the best ways to learn coral species. You will see corals in the water that don't fit well with the species in this guide. You will also see things in the guide that you won't initially see in the water, but with more and more time in the water you will see more and more of them. The author is doing the same thing, finding more species with time spent underwater in more places, and using pictures taken to add to the guide. But a local guide has several advantages over a guide that presents all species from all over the world (such as Veron's "Corals of the World"). For one thing, many of the species in a worldwide guide aren't at your location. That means you have to look through many photos of all sorts of things that aren't on your reef. For another, not all coral species look the same everywhere. Some can look quite different in different parts of the world or on different archipelagoes. Some look virtually identical, but others don't. Most or even all of the pictures taken in a worldwide guide weren't taken in Wake, and so many of them may look quite different than corals in Wake. This guide helps you by only showing you coral species that are in Wake, and only showing you photos of corals in Wake, so the photos look as much as possible like the corals you see.

Unfortunately, there are only a few common names that have been applied to coral species consistently, and most of those apply to groups of corals. So some corals are called "staghorns" and others "table corals" and others "brain corals." But there are several staghorn species and several table coral species. In this guide, similar looking species are presented together as far as possible. Genera are presented in a traditional order, which tends to put corals that look similar together. In addition, within genera corals that appear similar are put together, so all the "staghorn corals" are together, and all the "table corals" are together, and so on. But the species are all labelled with the scientific (Latinized) names, because only those names correspond (as far as possible) to the actual biological species. Common names in widespread use are also given, but usually there are several species that have the same common name. So there is no easy way around using the scientific names.

There are two major reasons that corals are difficult to identify. The first is a naming problem, and the second is a problem of figuring out what group of organisms is the species you are studying. Names are arbitrary human inventions, while the group of organisms is something that exists in nature whether we give it a name or not. We need species names in order to be able to communicate to each other what we are talking about, but the name itself is arbitrary, any name would do, and everybody has a different idea of what name they would like to call it. The solution is a set of rules invented by Carl Linnaeus. You probably know some of the rules. One of the most important is that the first name correctly applied to a species is the one that is correct. This is called "priority." A second rule is that species names must have two words, the first is the genus and is capitalized, the second is the species and is not capitalized, and both are in italics. Any words can be used, from any language, but the words must be Latinized, making them look like Latin. So the word in English, "bushy", taken from a reef in the Great Barrier Reef where a coral was first discovered, was converted to Latin and became "bushyensis" and the species was named "*Acropora bushyensis*". Another rule is that the name and a description of the species must be published. The rule book does not specify where the name must be published. There are other rules, which are contained in a rulebook, "The International Code of Zoological Nomenclature" (which is available online open-access). This is in effect the rulebook for a game played by taxonomists, that is, naming species. There are a variety of problems with this, but one of the worst come from the publications that commonly are used for new species. Very few people are interested in the original descriptions of new species, mostly just other taxonomists that work on the same group of animals, and usually there are only a few of those in the whole world. No widely read journal that publishes papers that many people think are important will publish original descriptions of new species, because almost no one will be interested and read it. So almost all descriptions of new species are published in obscure little journals that almost no one reads, and almost no libraries subscribe to them, since almost no one uses them. One result is that most coral taxonomists have not read most original descriptions, primarily because they can't find copies of them. So many taxonomists have described as new species, species that were described before, sometimes many times. These are called "synonyms", when two names refer to the same species. Taxonomists occasionally write "revisions" of groups of organisms, in which they give new descriptions, and they list all the names that have been previously applied to what is now all considered one species. This requires considerable taxonomic knowledge and skill, because you have to look at lots of old descriptions to figure out which are all the same species. Yet a single species varies between individuals and locations, so original descriptions from different places are often a little different even though it is the same species, and everyone uses different words and sentences, making this a difficult task.

In addition, the rules do not specify which language must be used in original descriptions. At first, most were written in Latin, because that was the scholarly language of the time in Europe where taxonomy originated. Then they were written mostly in a variety of European modern languages, and now most are written in English. Even in English, the language has changed over time, particularly in coral taxonomy. Older publications in English use terms that they didn't define, and which we don't use now. That makes it harder even in English. I have seen an original description of a coral species that consisted of two sentences in Latin. Your Latin better be very good, the whole definition could hang on the meaning of one word in Latin.

Originally there were no samples of the new species, or photographs (photography had not been invented!) or even drawings of the new species. Then people started including drawings in their new species descriptions. The drawings were often made from a particular piece of the species, and slowly those pieces, in a museum, were taken to be "type specimens" that helped define new species. In time, photographs were added. In 2000, the rules were revised to require the description of a new species to include designating a type specimen (usually in a museum). Type specimens are extremely helpful, because if an original description leaves out something that you now think is important, you can look at the type specimen and find out what that is. Further, it is often difficult to imagine what a species looks like from a description. The saying goes that "a picture is worth a thousand words." Of course, we are handicapped by the fact that for the species that were named long ago, there are no type specimens. Another problem is that some old type specimens are in terrible shape. One that Veron has a picture of on his website (Corals of the World) looks like it was dragged behind a car on beach for a couple miles, all the surface is worn off. You can't even tell what genus it is in. This may not be quite as bad a problem as that, most type specimens are not in bad condition. Another problem is that the type specimen doesn't have to be typical of the species, and the original description doesn't either. That's in part because a wide range of samples of a species are almost never available when a new species is being described, and a large collection of samples is needed to determine the variation within the species and what is typical. At this time, for most coral species, we still don't know the range of variation over the geographical range of the species. No one can go to everywhere there are corals and sample many colonies from every site of every species. But we know they vary from site to site. So some or many type specimens may not be typical, and for most species we don't even know whether they are typical or not.

It has been said that the main job of 20th Century taxonomists was to try to clean up the mess left to them by earlier taxonomists. Much of that comes from the arbitrary naming rules, but some comes from the variability in the organisms themselves.

The second great hurdle for recognizing coral species and doing taxonomy on them, is the question of what group of individual organisms comprise a species. This is an empirical question. With some species, it is easy. For *Homo sapiens*, we have the advantage that no other human species is alive today. Our nearest living relatives, chimpanzees and bonobos, are so different from us no one would ever confuse one with a human, and many people don't believe we're related at all. If Neanderthals were alive, it would be much more difficult.

Almost all species ever named and described were named and described based on their morphology and anatomy alone. Originally, only morphology was known and could be included. Plus, morphology until recently has been the quickest and easiest thing to use to describe species. And it makes it possible to identify species in the field. About 1-2 million species of all types of life on earth have been described, but it is estimated that there are 10-30 million species on earth (and other estimates that run from 3 million to a billion; nobody really knows). After about 250 years, we may have only named and described about 10% of the organisms on earth, and we have little prospect of speeding that up substantially. It is not immediately obvious how large the anatomical differences need to be between individuals for them to be different species. There is lots of variation within some species, so something that is different might be a new species or just a variation within a species. How do you tell? Not easy. One thing is that it is helpful to have at least two different features that are different between two species, and that the two go together. So species 1 has features A and B, and species 2 has features a and b. and individuals that have A and b or a and B are rare or can't be found. Another rule of thumb is that in a single feature that has variation between individuals within a species as well as between species, the distribution of that feature (such as length or body weight) has two modes (one for each species) and at least a small gap in between with no individuals. Of course these things require a lot of knowledge about many individuals within a species. That sort of information is very rarely available when describing a new species, but sometimes is available later on when much more is known about the species. Describing new species remains a fairly intuitive thing.

For corals, the morphology that is used in coral taxonomy is the morphology of the skeleton. Originally, the only thing available to taxonomists was the skeleton. Long sailing voyages of creaky old wooden European sailboats went long distances, sometimes around the world. Along the way the crew would pick up all kinds of curiosities, sometimes including corals. Months or even years later, the ship would return to Europe, and by then the coral had long had all the tissue rot off, and only the skeleton was left. If the taxonomist was lucky, the skeleton had not been broken into many pieces or ground against other pieces as the ship rocked. In time, deliberate collecting voyages were organized, financed, and crewed with people whose purpose was to collect. Corals were usually collected by dredging, pulling a dredge behind a boat which broke many corals and gathered many broken pieces of coral. But only within the lifetime of older people living now, has it become possible to dive into the water with scuba gear and view living corals in their natural state. Pieces of coral in museums are exactly that, they are almost always just pieces, and the overall colony shapes usually can't be seen. Further, it is possible now to see large numbers of living, whole colonies underwater, many more than can be seen in museums. Plus viewing corals is non-destructive. I know one coral taxonomist who has collected over 30,000 coral specimens in his lifetime. That is still tiny compared to the hundreds of millions of colonies destroyed by a single, natural, hurricane. But still it is significant. The colony shape of corals is one of the more useful cues that can be used to identify species, but it is usually only available when they are viewed alive on a reef. So viewing corals alive on a reef has its advantages for identifying coral. One disadvantage is that viewing a living coral is ephemeral and in and of itself you usually can't show it to a variety of colleagues. Now, underwater photography fills that gap, and it is possible to show pictures of whole living colonies and close-ups of smaller features to as many people as you wish. Another disadvantage with living corals is that the skeleton on which the taxonomy and secure identification rests, cannot be seen directly, usually, because it is covered with living tissue. The living tissue obscures many of the features you need to use in identification, such as skeletal septa, spines, etc. Further, underwater you can't use a dissecting microscope, your mask fogs up, waves or currents throw you around, you have to do a lot of other things to stay safe like watch your buddy and check your dive computer and air gauge, all the while you are trying not to break coral and to handle the camera and perhaps collecting tools. So there are advantages to working on a piece of skeleton in a lab or museum as well. But it is good to remember that an identification of a coral in the water is a hypothesis, and firm identification requires examination of skeletal samples under a microscope. The present guide is not yet backed up with examination of skeleton under a microscope by the author, but that is planned for the future. Identification of living corals is guesswork, hopefully well educated guesses, which can be checked against skeleton.

Discovering or studying species requires some idea of what a species is. Darwin wrote that many scientists differ in how they define what a species is, they have an intuitive feel for what it is. By now, about 30 different definitions of species have been offered. What I was describing in the previous paragraph is something like a definition of a species based on morphology, which has been called a "morphospecies." Another famous definition is what is called the "biological species". That defines a species as a group of organisms that interbreed within the group, but not with other groups. Reproductive isolation from other species is the hallmark of a "biological species." Reproductive isolation makes sense of some major problem cases for the morphological definition of species. For instance, dogs have enormous morphological variation. The differences between many dog breeds is far greater than that between many wild species. Yet we are sure all dogs are one species. Why? Because they can interbreed freely. Humans also have lots of variation, yet all modern humans are the same species, we can all interbreed. Another problem with morphospecies is illustrated by parrotfish. There are parrotfish that were described as different species because they are different sizes and have different color patterns. But subsequently, they were seen to be interbreeding, they were different sexes of the same species. Many (but not all) species are dimorphic to some degree, with different morphology in males and females. Sexual dimorphism is an example of polymorphism. There are some species, such as some butterflies, that have multiple morphs that look different, but interbreed freely, they are the same species. So the reproductive isolation definition of species handles these problems well. Intuitively we know that reproductive isolation is a better definition of species than morphology alone. However, one problem with reproductive isolation is that it takes a LOT more time and effort to gather the information needed to define species this way than by morphology alone, and we have millions of species left to describe so we don't have the luxury of testing reproductive isolation with each new species (or most of the old species).

There are at least two other major problems with the reproductive isolation definition of species. One is that a majority of all species are extinct and we know them only through fossils. Yet we can't record in fossils which organisms interbreed with each other and which don't. All we have is morphology. Second, there are some species that don't interbreed at all. Rotifers are entirely unisexual and do not interbreed, and have not been interbreeding for about 200 million years, it is thought. Some microorganisms don't interbreed. Bacteria exchange genetic material, but that's not interbreeding in the sense we mean, and bacteria can easily exchange DNA between different species. So interbreeding isn't much help there. In zooxanthellae, interbreeding has never been observed except in the original description of *Symbiodinium*. So it is in some cases not possible to use the reproductive isolation, and in most or almost all cases it is impractical. There is one study with about 20 species of *Acropora* which spawn all on the same night on the Great Barrier Reef, where reproductive isolation was studied. All possible crosses of these species were made, and whether the crosses would produce fertilized eggs. Several were able to cross, including at least one pair of species that had nearly as high frequency of fertilization success and within species. But most did not cross, and most that did cross had fairly low fertilization success.

The newest challenger is of course genetics. It is possible now to quickly get DNA sequencing data from large numbers of samples. One problem is simply handling the enormous volume of information when more than just single genes or small stretches of DNA are sequenced. Interpretation of the results in some cases is not always clear. For many types of animals, there is a relatively small stretch of DNA that is highly variable between species. The DNA sequence in that locus is unique for each species. This is the technique called "DNA finger printing" or "bar coding." If you define a species by morphology and then sequence this locus in the DNA, then you can sequence that locus in many individuals blindly and the results are "fingerprints" or "bar codes" that can identify the species for you. Thus, for the first time, large volumes of samples and species can be separated into species groups without the laborious task of identifying based on morphology. It is easy to sequence large numbers of individuals and use the fingerprints to divide the samples into species. Then matching to databases of known species sequences, you can identify species. You can only get a species name if a taxonomist has identified a species and it has had its DNA sequence fingerprint taken. Further, you have to sample each individual you want to identify, which would be impractical for some types of ecological surveys or monitoring. For most corals, the problem is that there is not enough variation in these markers to separate species (though it may work for genera), and no one has yet found a new stretch of DNA that works. Markers that do work for species have been found for *Pocillopora* and the Agariciids. So genetic fingerprinting doesn't work with all corals at this time, but it does for some. Note that if you compare a DNA sequence for an individual coral with a database, you have to assume that the specimen for which the sequence appears in the database was correctly identified. That assumption may not be warranted for corals, people without significant training in coral ID may get ID's wrong.

The main problem with morphology for corals, is that corals are so highly variable in morphology within species. There is variation at every possible level. Variation between spines in a single corallite. Variation between neighboring corallites on a single colony. Variation between regions (like top and side) of a single colony. Variations between adjacent colonies (in the same environment). Variation between colonies in different zones of the same reef. Variations between reefs, between islands within the same archipelago, between adjacent archipelagoes and between distant archipelagoes. When you're trying to tell two species apart, they both have variations at all these levels, with all the different morphological features they have, all at the same time and perhaps independently. The variation within species is large, and often the variation between species is small. Some studies have quantitatively measured many features in the same individual coral, on the order of 30 or more features, on several corallites or locations of each coral. Do that on more than a few colonies and the work quickly becomes enormous, do it on all the archipelagoes within a species range and it has never been done and may never be done because the work is way out of proportion to the value of the end product, it is too inefficient.

For more on the results of DNA sequencing of corals, see the section after "Contents" on "Corals by the New Systematics: DNA-sequencing (PCR) Phylogeny' and Kitahara et al (2016). For more on the conflict between DNA sequencing and morphology, see Losos et al (2012). For more on the problems of morphological taxonomy with corals, see Veron (1995; 2000) and Veron et al (2022).

Yet we still very much need to be able to identify corals to species, for studies of ecology, monitoring, and conservation. So we struggle along, doing the best we can. My suggestion is to concentrate on enjoying the feeling of accomplishment each time you learn to identify one more species. Don't dwell on the fact that there are many to go, enjoy learning to identify coral species as you progress.

There are a few general things about coral morphology that may be of help to you as you go along. The main unit in coral morphology is the polyp, and the corresponding cup in the skeleton which a polyp sits in. The cup in which a polyp sits is called a "corallite" and includes both the inside and the outside surfaces of the cup. The inside of the cup is called a "calice." There are walls that extend from the inside wall of a corallite into the central space of the corallite, which are called "septa." Each corallite has at least six septa. Septa come in sets, the first set having six septa, the second set also having six which are between the first set of six and usually smaller than the first set of six. The third set is 12 and is in between the existing 12 septa, the next set is 24, etc. In the center of the corallite there is a small structure called a "columella" which may be a single solid column or more often many small columns, or curving, twisted columns. The septa commonly extend up over the rim of the corallite and down the outside surface of the corallite, where they are called costae (costa is singular). Septa and costae may have teeth or granules on the edge and granules on their sides. Corallites can come in many different sizes and shapes. Some are circular, others oval, some quite elongated. Each elongated corallite corresponds to an elongated polyp which has several or many mouths but shares a single gastrovascular cavity. The corallite walls in that case are elongated and usually meander, forming a “meandroid” coral, commonly called a “brain coral.” There are many other details.

Useful Terms

The descriptions often refer to “corallites.” These are the skeleton cups that the polyps sit in. The word “corallite” refers to both the inside of the cup and the outside.

The descriptions also commonly refer to several different colony shapes. Here are some of the shapes:

Massive = dome shaped or hemispherical colonies without deep cracks.

Branching = having branches that have side branches and can go in any direction.

Columnar = having near vertical columns that don’t branch much.

Encrusting = forming a thin crust over the substrate and attached to it, with no space under the coral. Much like paint though not usually as thin as paint.

Foliose = plate = a relatively thin, nearly flat structure that is thin and has two sides like a plate. Plates are commonly near horizontal but can be at any angle including vertical.

Mushroom coral = resembles the overturned cap of a mushroom.

Staghorn = branching, with branches that look like staghorn (always in genus *Acropora*)

Table = a flat top surface held up by a pedestal which is usually under the center of the table (always in genus *Acropora*)

Digitate = branches look like fingers, without any side branches, not very long, and usually parallel, extending upward from an encrusting base (always in genus *Acropora*).

Corymbose = similar to digitate, but thinner branches, which are often growing up from larger horizontal branches (always in genus *Acropora*).

Caespitose = bushy, branches going in all directions.

Hispidose = in the shape of a bottlebrush, with short thin branchlets radiating from a central larger branch (always in genus *Acropora*).

The identifications in this guide are primarily based on Veron (2000), Veron et al (2020), Wallace (1999), Wallace et al (2012), Hoeksema (1989), Randall and Cheng (1984) and references therein.

The Corals

Phylum Cnidaria

This phylum contains animals that have a very simple sack-body with three layers of cells and not organs. It has a mouth that leads to a water-filled gastrovascular cavity, but the mouth is the only opening to the cavity. It has a ring of hollow tentacles around the mouth, which are extensions of the body wall. The body shape can be a polyp which has an upward facing mouth and the downward end of the body is attached to a surface, or a medusa, which is a jellyfish which is free swimming. In some classes, polyps and jellyfish (medusa) alternate, in one (Anthozoa), only polyps are present.

Class Anthozoa

This class contains animals that have only a polyp stage (no jellyfish = medusa stage). It has two main groups in it, those with exactly 8 tentacles (Octocorals: soft corals, gorgonians, and sea pens), and those with multiples of six tentacles (Hexacorals).

Subclass Zoantharia or Hexacorals

This subclass contains animals that have six tentacles or multiples thereof: sea anemones, Scleractinia (hard corals), black corals, ceranthid anemones, zoanthids, and corallimorphs.

Order Scleractinia

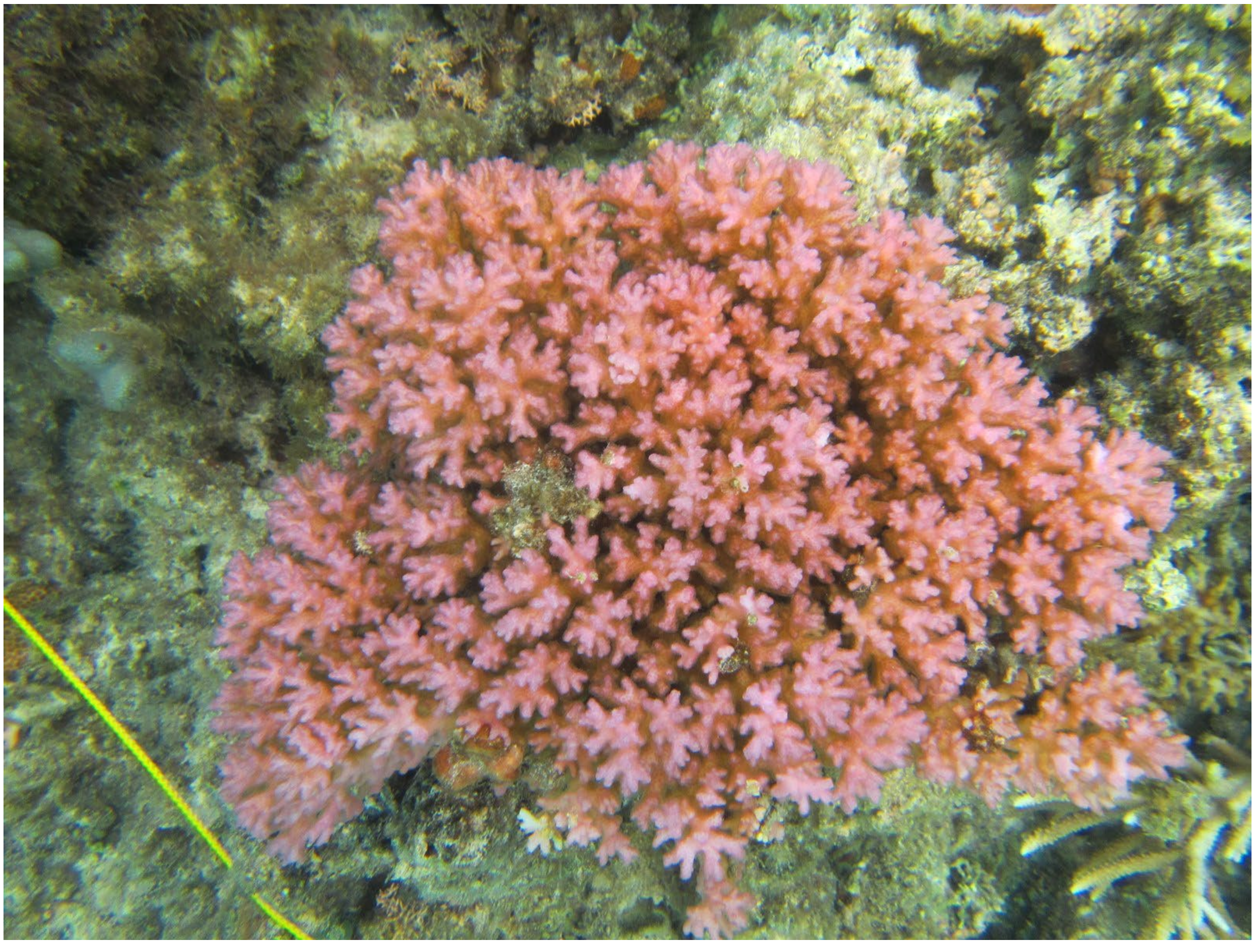
This order contains animals that build skeletons underneath themselves, and in the corallites ("polyp cups") that polyps sit in, there are "sclerosepta" there are thin walls made of skeleton that project into the calice (the inside of the corallite). This includes almost all of the reef-building hard or stony corals. The reef-building corals have zooxanthellae (single-celled algae inside the coral cells), though there are almost as many scleractinian corals that don't have zooxanthellae and live in deep, dark, cold water or a few that live in shady locations on reefs. Those that have zooxanthellae are called "zooxanthellate" and those that don't are called "azooxanthellate." Most azooxanthellate species are small, many have only one polyp, but a couple of species that live on reefs are large enough to be reef builders. Most Scleractinia are attached to a hard surface, but a few like most of the mushroom corals are not attached. Most reef-building Scleractinia have multiple to many polyps and corallites, but a few are solitary, with only one polyp. For those that have many polyps, the colony is the individual, and polyps are modules not individuals. In a sense a polyp could be considered an individual, but the polyps in a colony are all connected together with continuous tissue. Further, all polyps are the same sex in a colony, all are genetically identical, and their digestive systems and nervous systems are connected. They reach sexual maturity when the colony reaches a minimum size, not when polyps reach a minimum size. They function and behave as a single individual with modular units, from which a piece can break off and regrow. Polyps vary greatly in size between species from less than 1 mm diameter to as large as 30 cm diameter, and they vary greatly in shape and other details. Colonies also vary greatly in shape, which is helpful in identification

Pocillopora

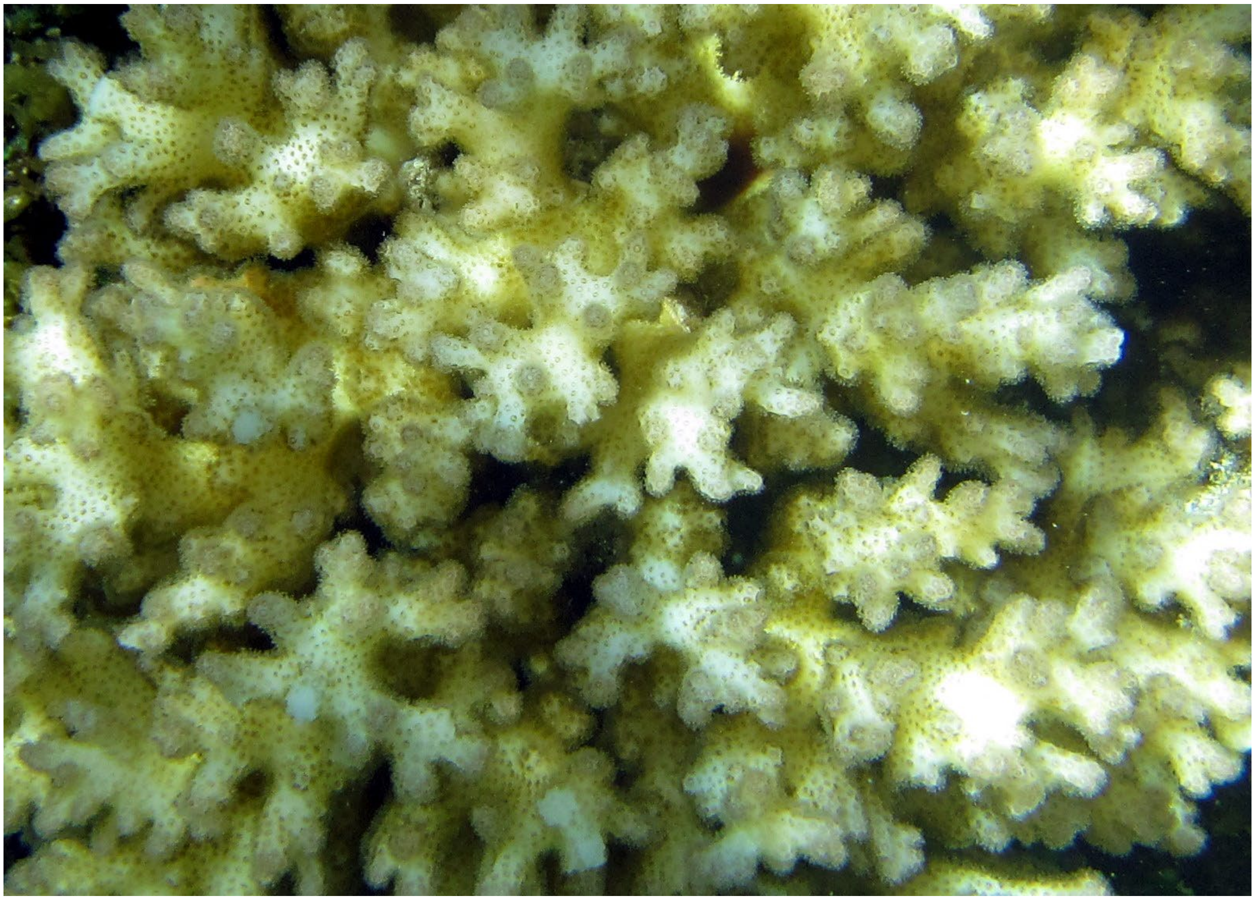
Colonies are always branching, with branches covered with small bumps called "verrucae" (Latin for "blister". The corallites and polyps on them are tiny, about 1 mm diameter, and are randomly all over the bumps and on the branches between bumps. Some *Montipora* have "verrucae" also, but the species that have them are not branching, and they are smooth and rounded and have no corallites on them. *Stylophora* can have branches similar in shape and size, but has no verrucae, just little spine/hoods over the corallites.

Pocillopora damicornis (Linnaeus, 1758)

Colonies branch finely until the tips of branches are the same size as the bumps (verrucae). The branches on other species of *Pocillopora* are larger. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



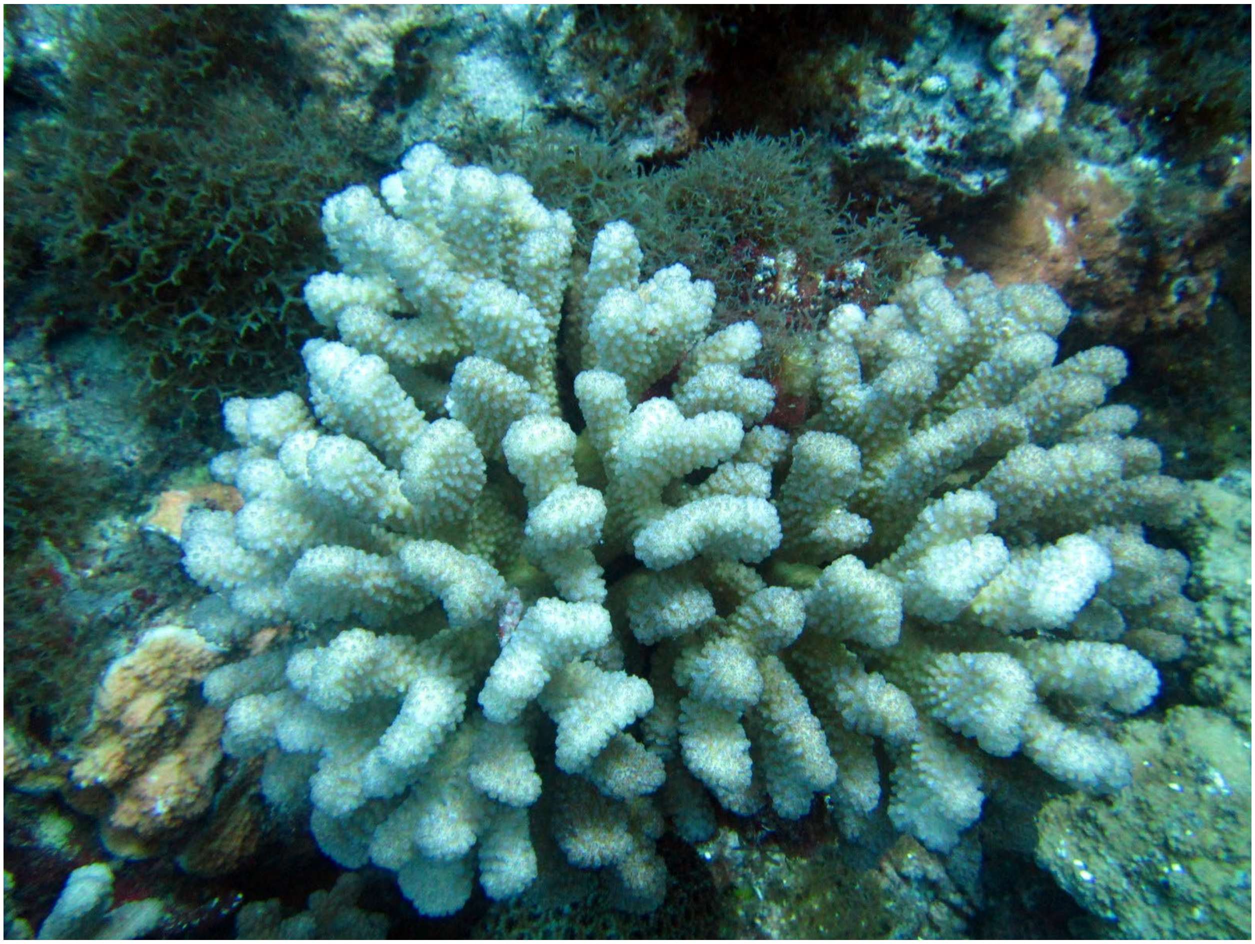
A large colony of *Pocillopora damicornis*. Most colonies are yellow or brown. This photo is from the Marianas.



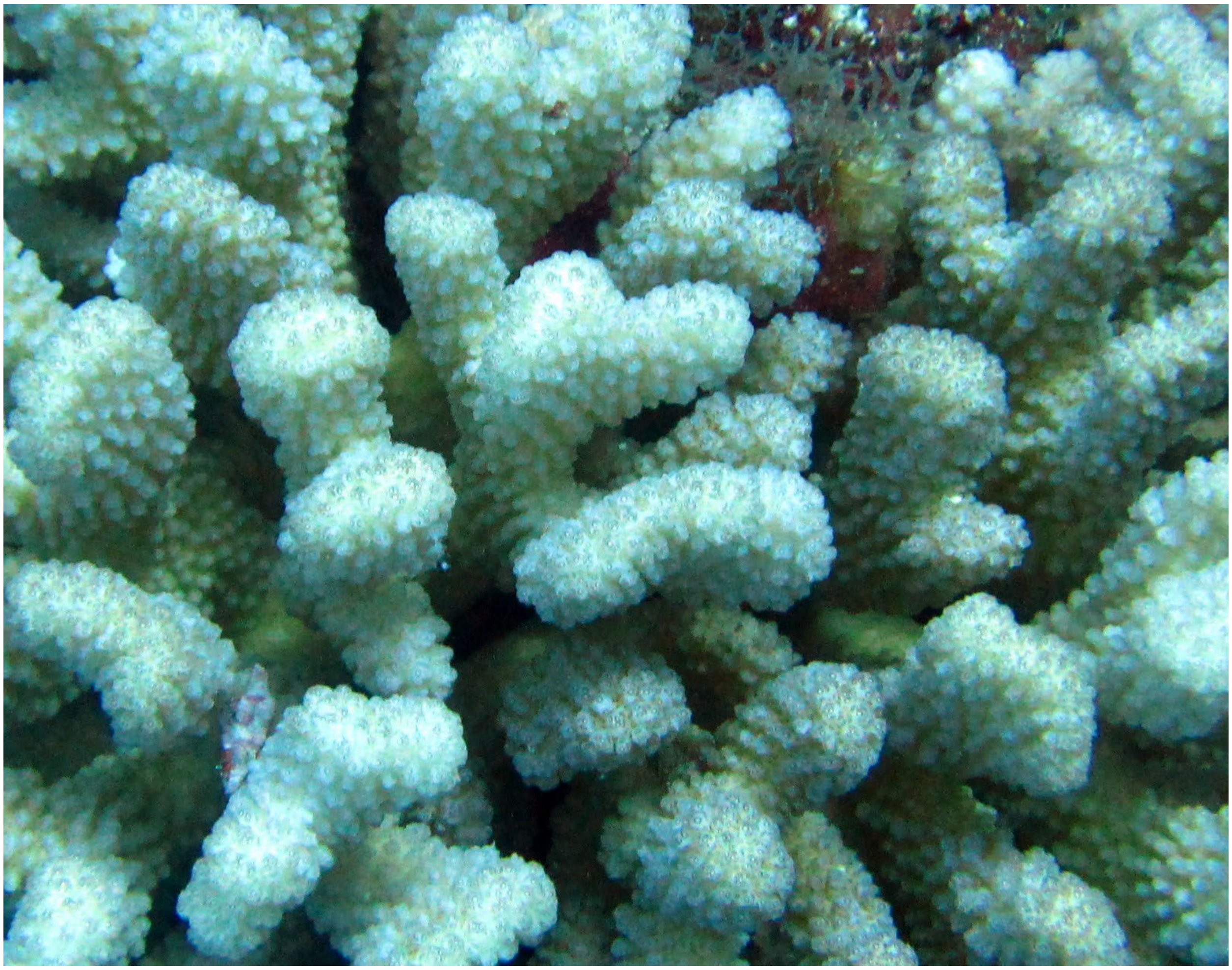
A close-up photo of *Pocillopora damicornis*. The little dots on the branches are the corallites. This is a typical color. This photo is from the Marianas.

Pocillopora verrucosa (Ellis & Solander, 1786)

Colonies have radiating branches that are cylindrical or nearly cylindrical. Colonies reach about 1 foot diameter. *Pocillopora meandrina* has flattened branches, *Pocillopora setchelli* has branches close together, and *Pocillipora grandis* (=*eydouxi*) has larger flattened branches.



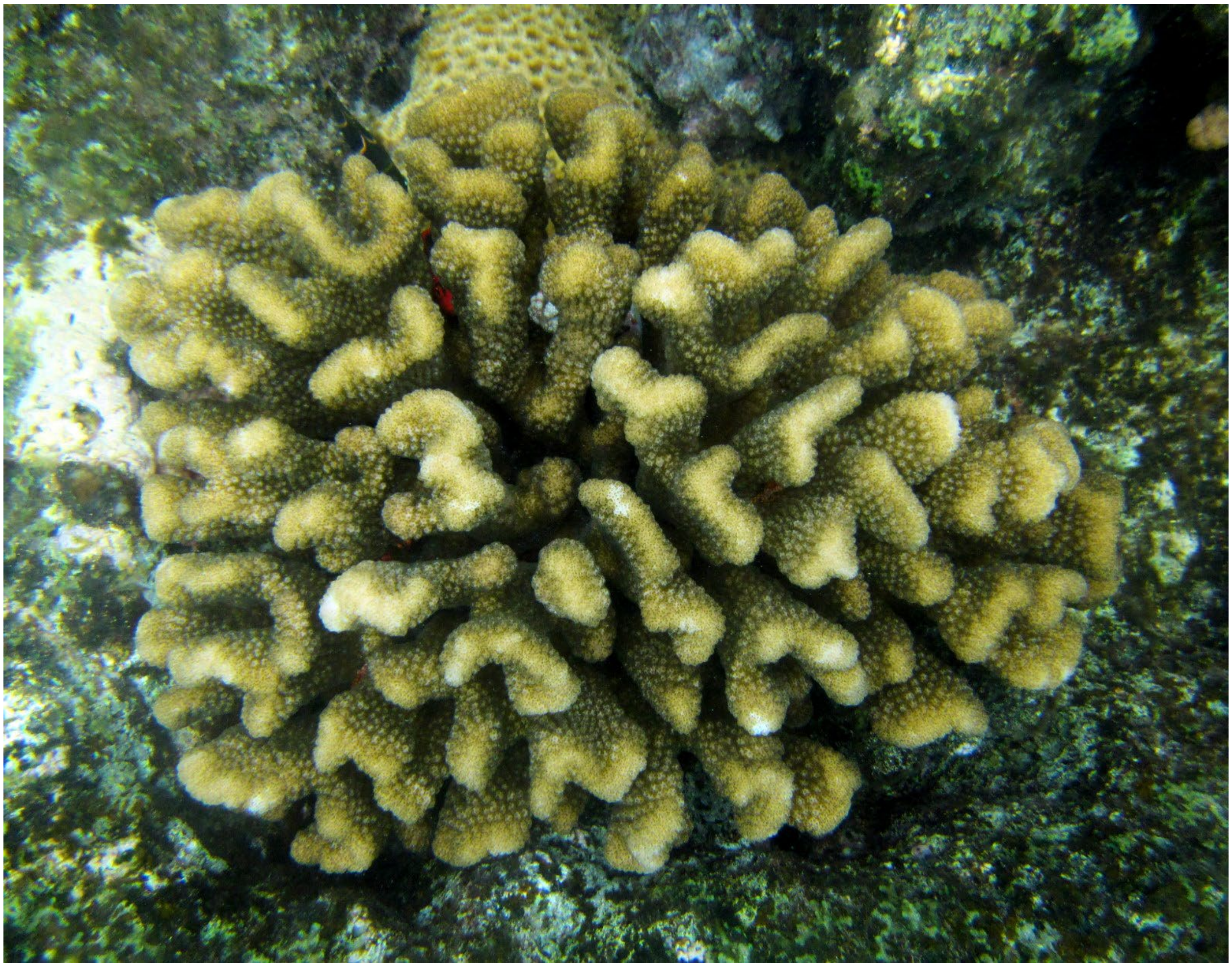
A photo of *Pocillopora verrucosa*.



A close-up photo of *Pocillopora verrucosa*.

Pocillopora meandrina Dana, 1846

Colonies are branching, with flattened branches that often curve. Colonies reach about 1 foot diameter. *Pocillopora verrucosa* has cylindrical branches, *Pocillopora setchelli* has branches close together, and *Pocillopora eydouxi* has larger colonies and flattened branches.

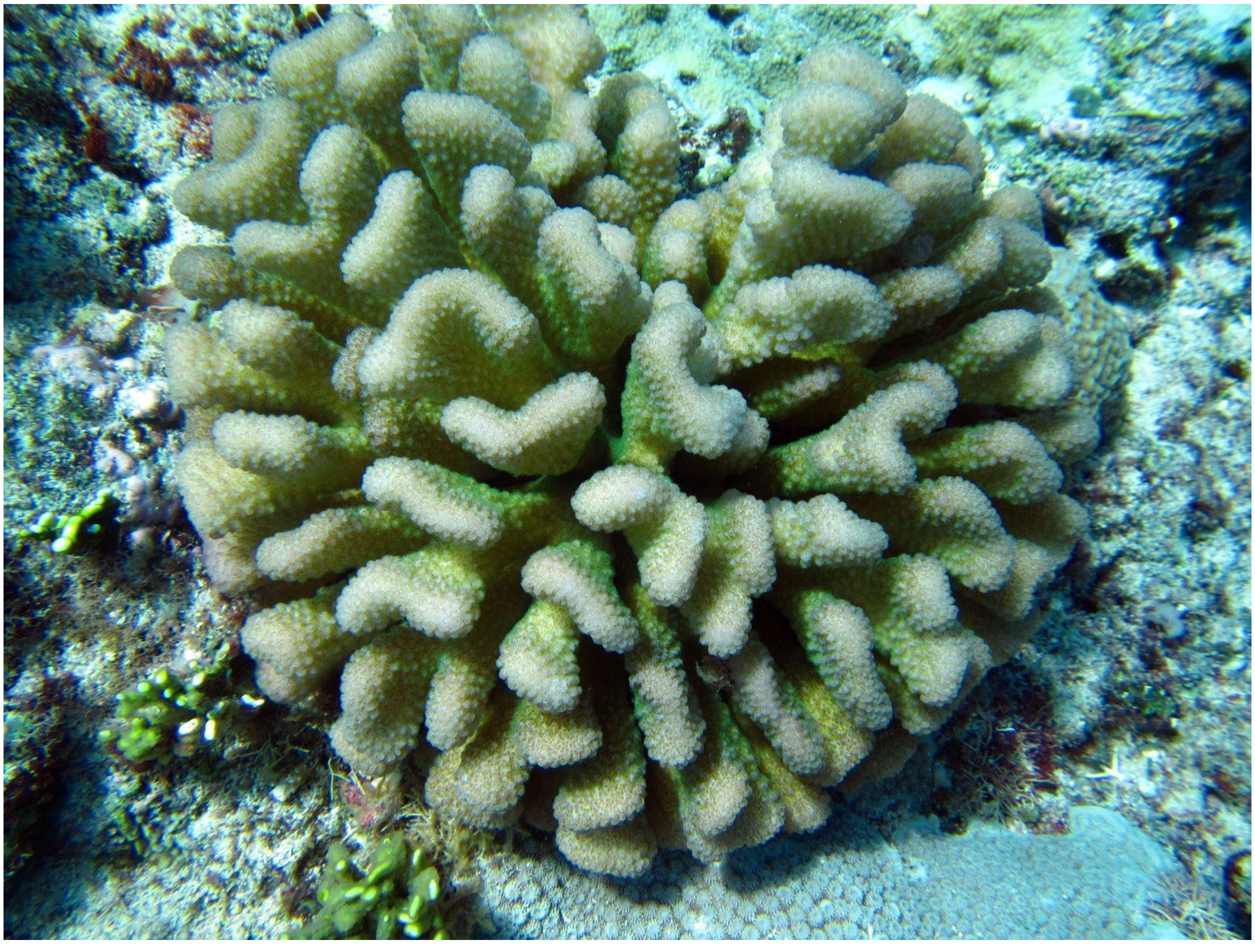


A colony of *Pocillopora meandrina*.

A close-up photo of *Pocillopora meandrina*, showing the flattened, curved branches.

Pocillopora elegans Dana, 1846

Colonies have flattened branches that are often curved. It is identical to *Pocillopora meandrina* except the verrucae are smaller. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Pocillopora elegans* showing the small verrucae. This photo is from the Marianas.

A close-up photo of *Pocillopora elegans*, showing the small verrucae. This photo is from the Marianas.

Pocillopora setchelli Hoffmeister, 1929

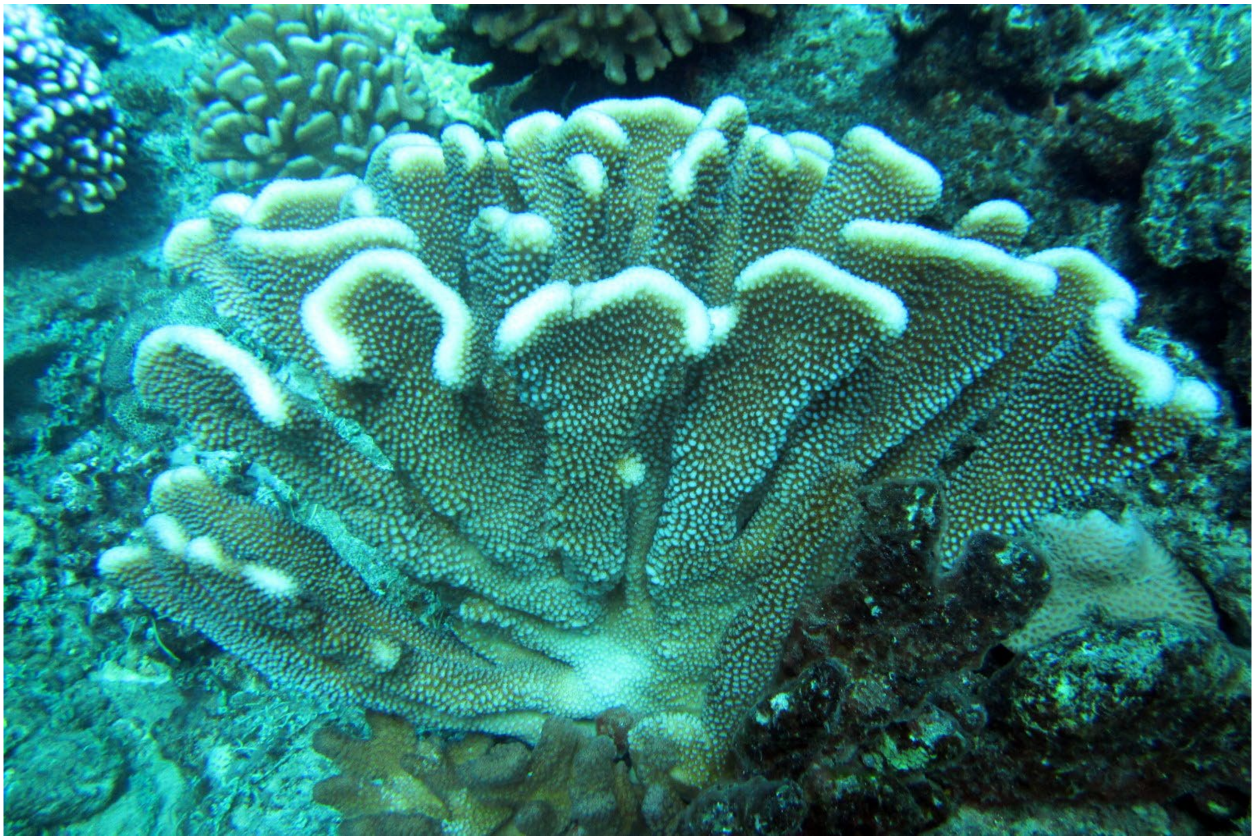
Colonies have branches that are very close together. Colonies reach about 10 inches in diameter, and are usually found in shallow areas near the reef crest. Branches are closer together than other species of *Pocillopora*.

A colony of *Pocillopora setchelli*.

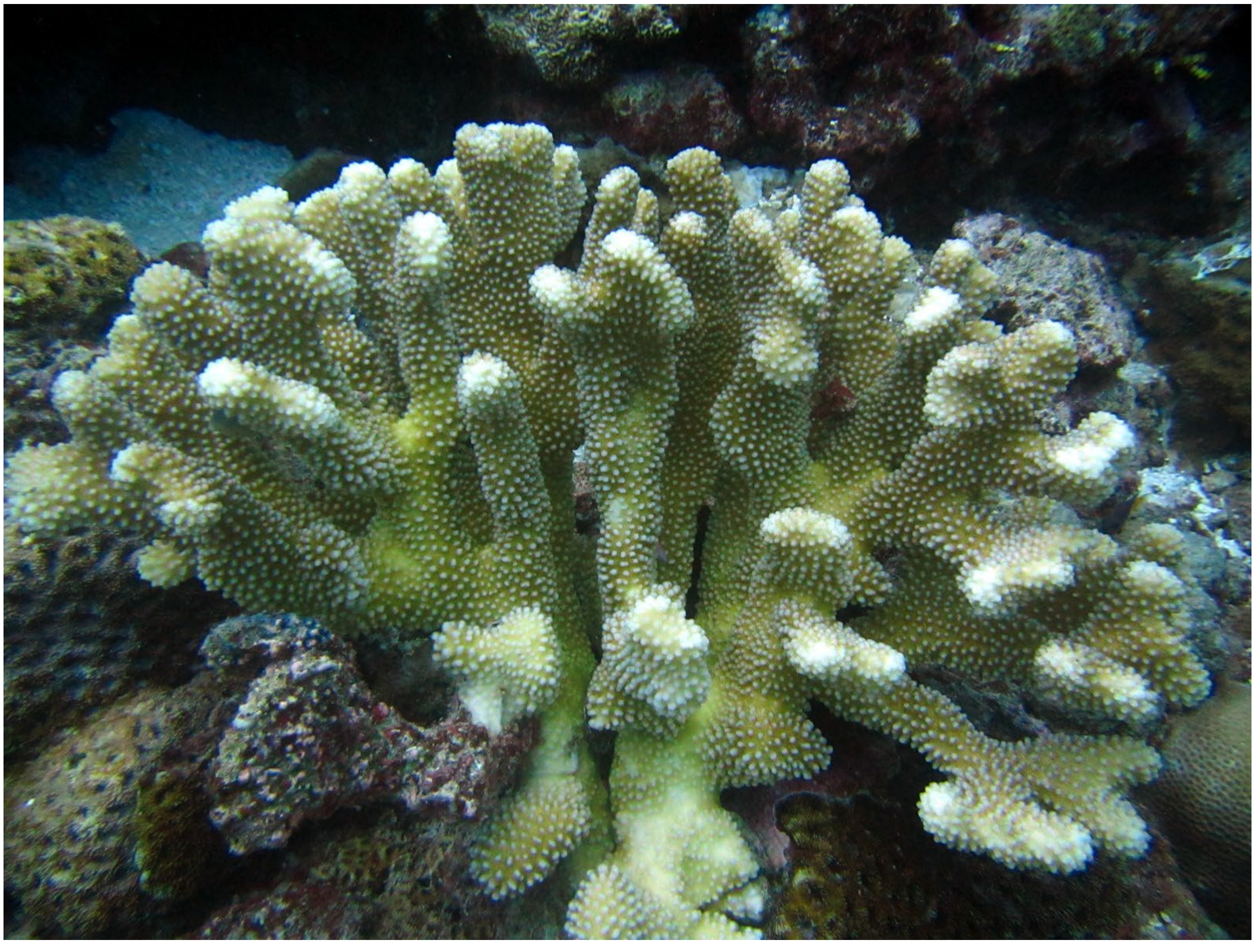
A colony of *Pocillopora setchelli*.

Pocillopora grandis Dana, 1846 This used to be called Pocillopora eydouxi.

Colonies have large branches which are usually flattened and may be curved. Colonies can be up to 3 or 4 feet high. The shape is similar to that on *Pocillopora meandrina*, but the branches and the colony are larger and branches are farther apart.



A colony of *Pocillopora grandis*.



A photo of a colony of *Pocillpora grandis* with less flattened branches.

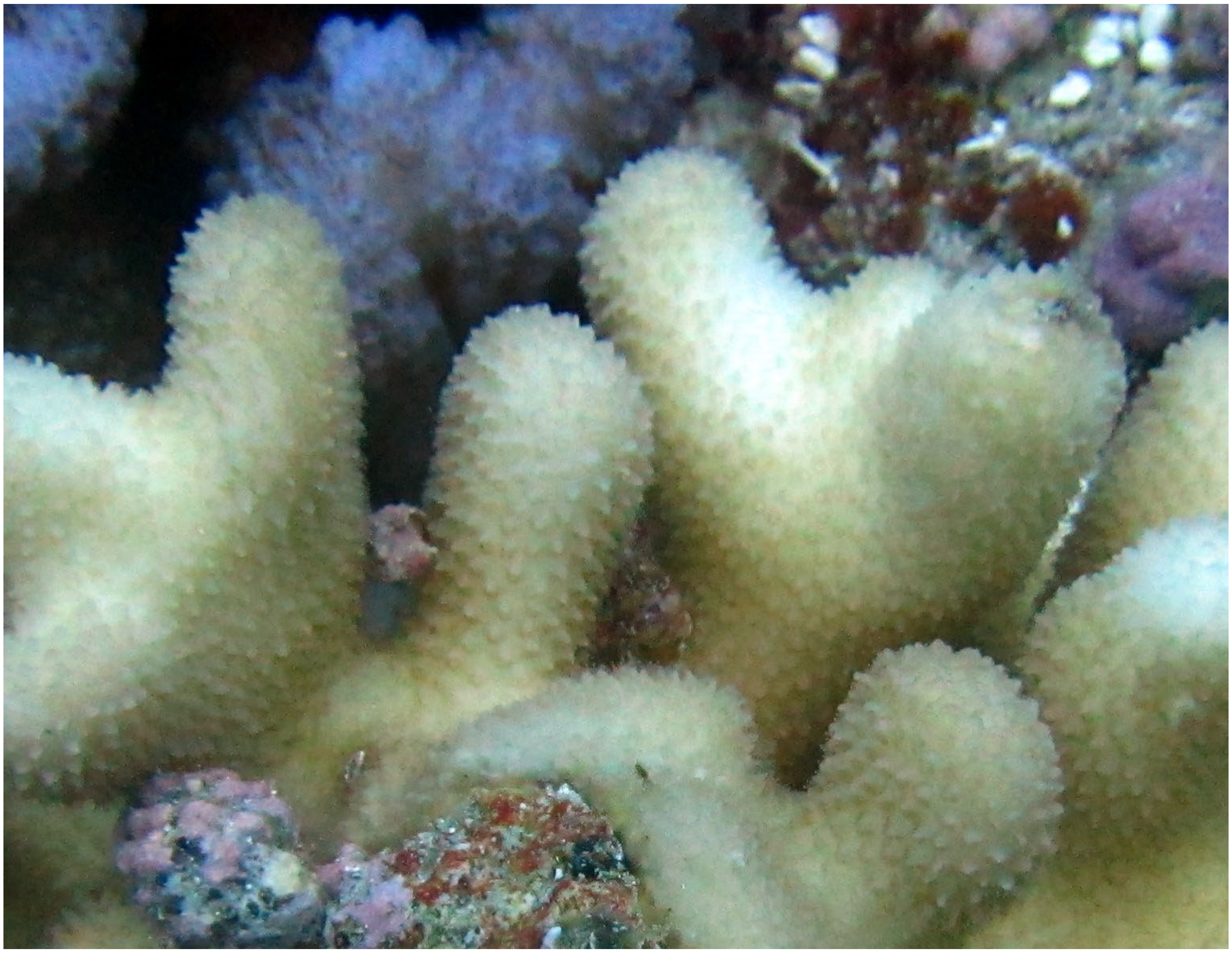
Stylophora

Colonies are branching and have tiny corallites about 1 mm diameter. Each corallite has a tiny pointed hood over it, which is essentially a spine. The spines are small enough they can be hard to see, but can be easily felt. There are only a few species. *Pocillopora* can appear similar but has bumps all over the branches instead of hood/spines.

Stylophora pistillata Esper, 1797

Colonies are branching, with thick rounded branches the diameter about that of a thumb. Branch tips can be flattened or not. This species has the largest branches in the genus. It can look like *Pocillopora* but has spines instead of bumps.

A colony of *Stylophora pistillata*.



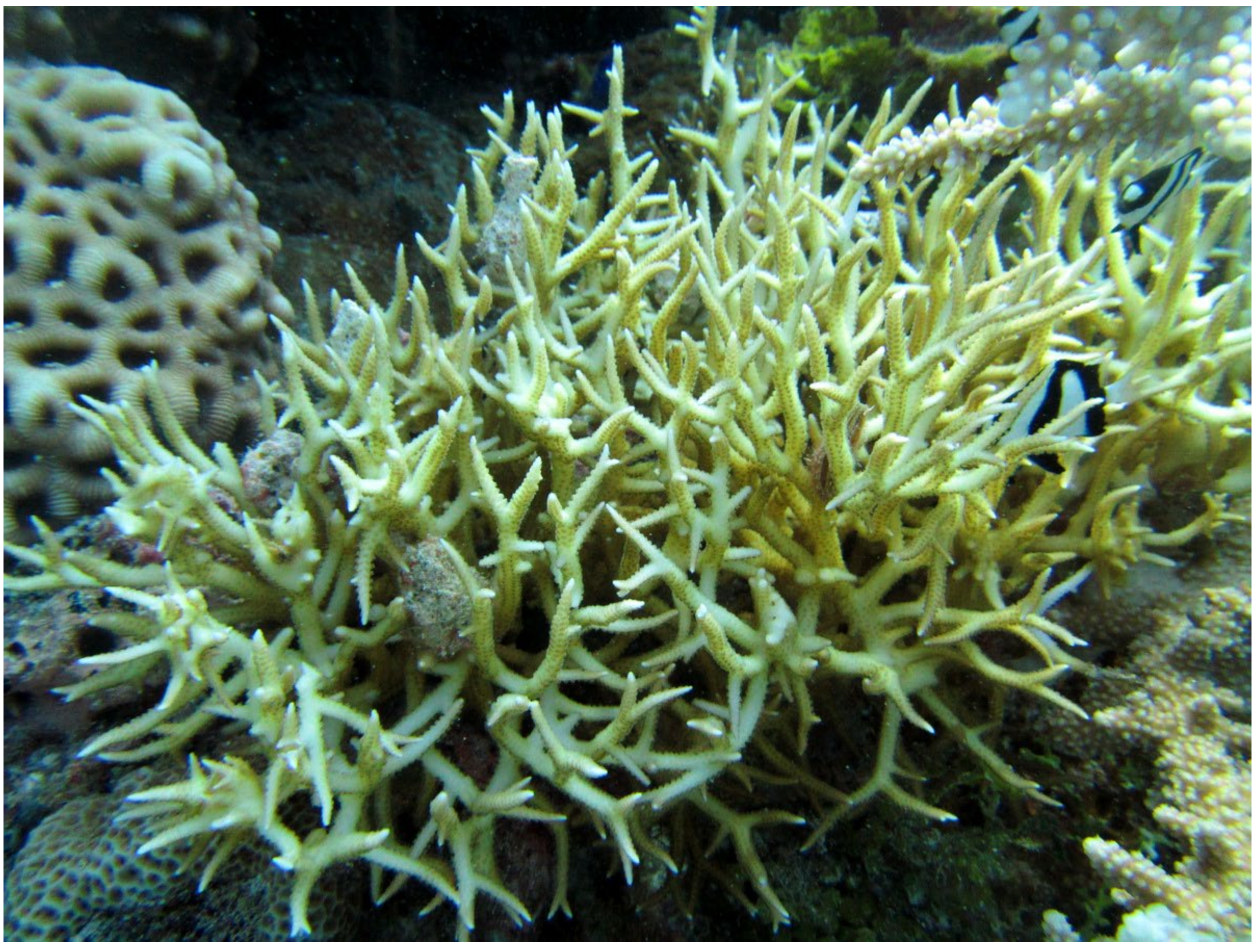
A close-up photo of *Stylophora pistillata*, showing the tiny hoods.

Genus Seriatopora

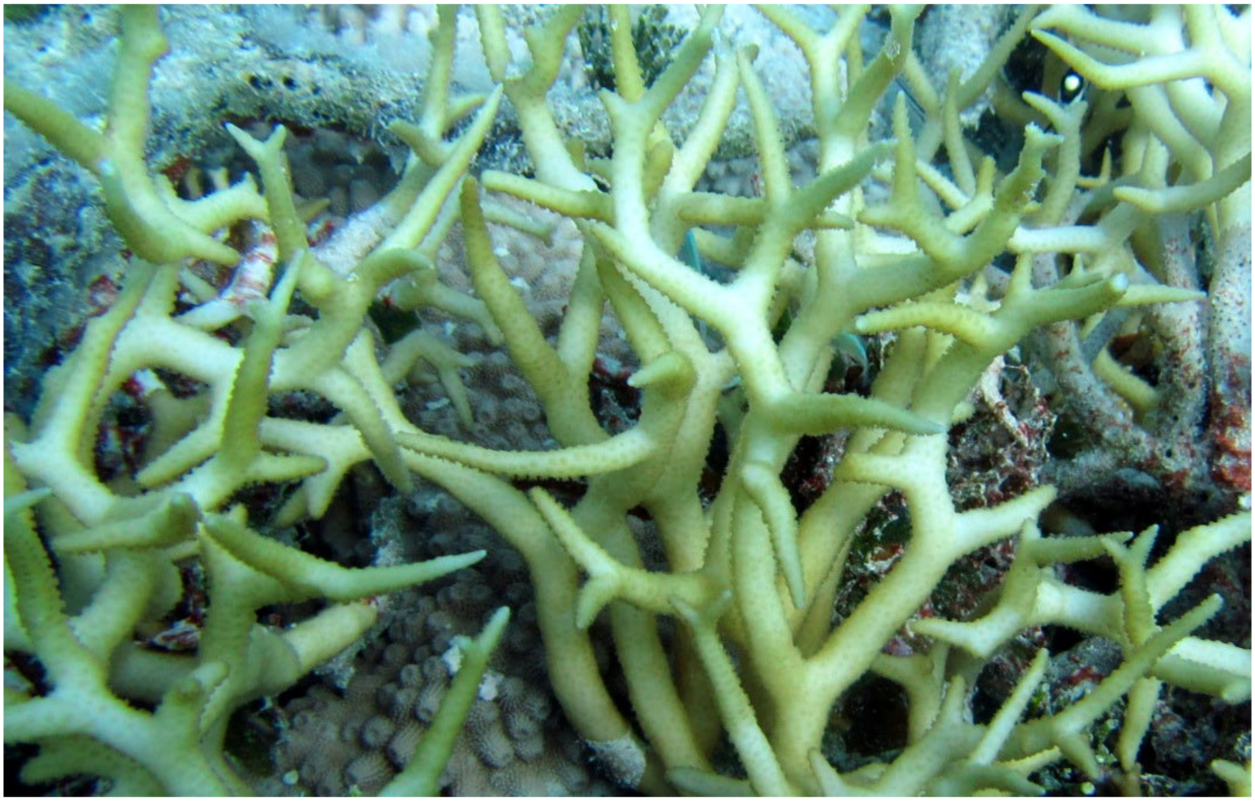
This genus forms branching colonies with branches about the diameter of a pencil. In most species, the branches taper to fairly sharp points. Branches are thinner than in most other genera. Thin branched *Acropora* have a polyp cup at the end of every branch.

Seriatopora hystrix Dana, 1846

This species forms pencil-thin, smooth, long branches that gradually taper to a sharp point. Colonies are usually cream or light yellow, but rarely can be purple. Common in lagoons, the most common *Seriatopora* species. *Seriatopora aculeata* often has very short branches, and branches taper strongly over a short distance to a relatively sharp point. *Seriatopora stellata* can have longer branches but also tapers strongly at branch ends, however it has corallites in raised rows along the branch sides. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A typical colony of *Seriatopora hystrix*. This photo is from the Marshall Islands.



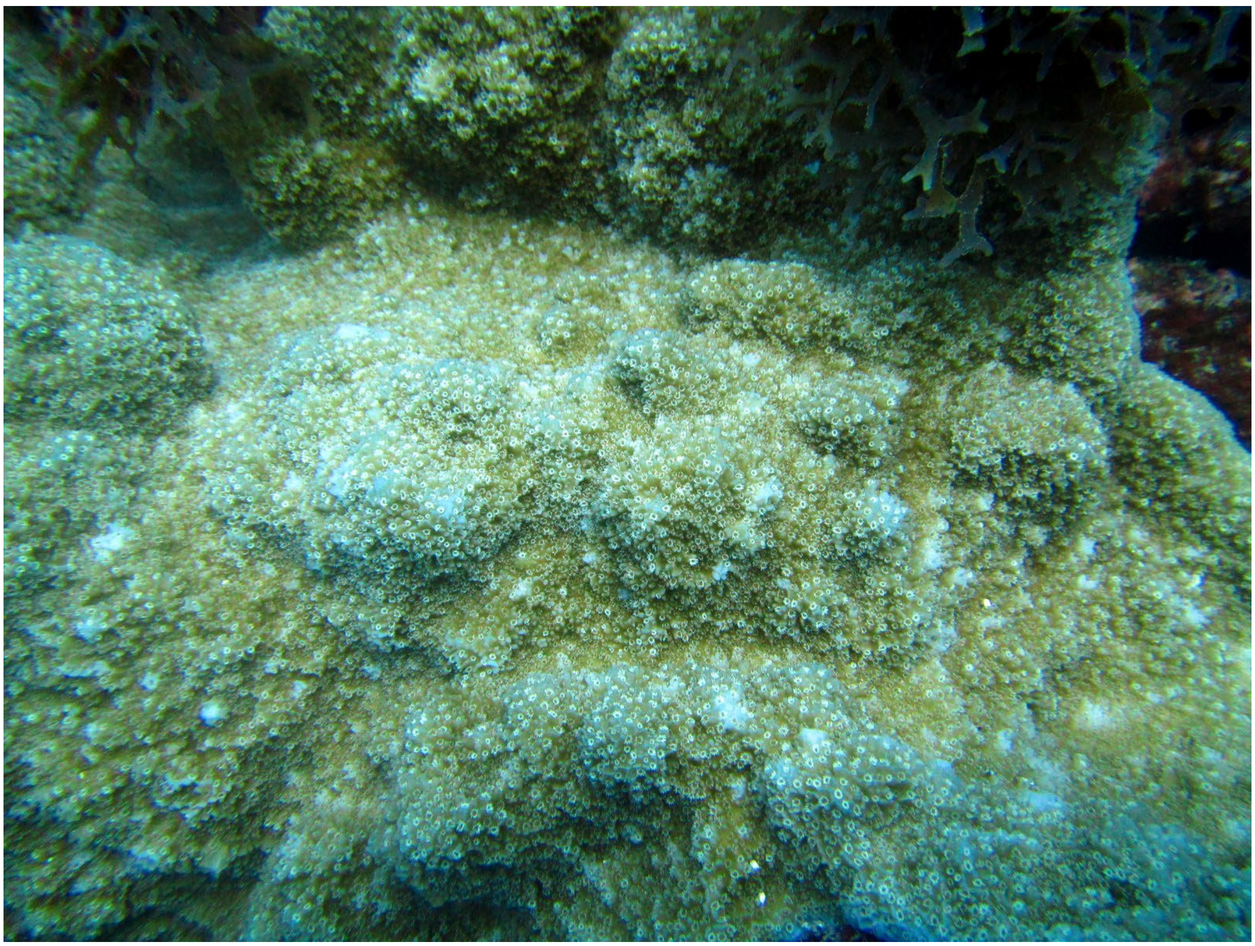
The corallites on the sides of branches are usually very hard to see on *Seriatopora hystrix*. This photo is from the Marshall Islands.

Montipora

Colonies can be encrusting, plates, massive, branching, or columnar. Corallites are tiny, about one millimeter diameter. Some species have tiny spines on their surface, smaller than the corallites. The spines are called “papillae”. Others have rounded, smooth, uniform bumps larger than corallites, that look like blisters and are called “verrucae.” Others have larger irregular lumps. Some have little thin ridges that are between corallites. There is no one thing that is visible underwater that defines this genus, so it is necessary to memorize each species to know the genus. *Montipora* is the second largest genus of corals, with about 75 species known currently. *Pocillopora* has bumps that are also called “verrucae” but they have corallites all over the verrucae while *Montipora* has no corallites on verrucae, and often is not branching while *Pocillopora* always is.

Montipora grisea Bernard, 1897

Colonies are encrusting and have many tiny papillae (spines) on the surface so it looks and feels like sandpaper. Often the colony surface appears to have little cylindrical bumps, which are rings of papillae surrounding and raising a corallite. *Montipora aequituberculata* forms plates and has papillae fused into short ridges near the edge of the colony.

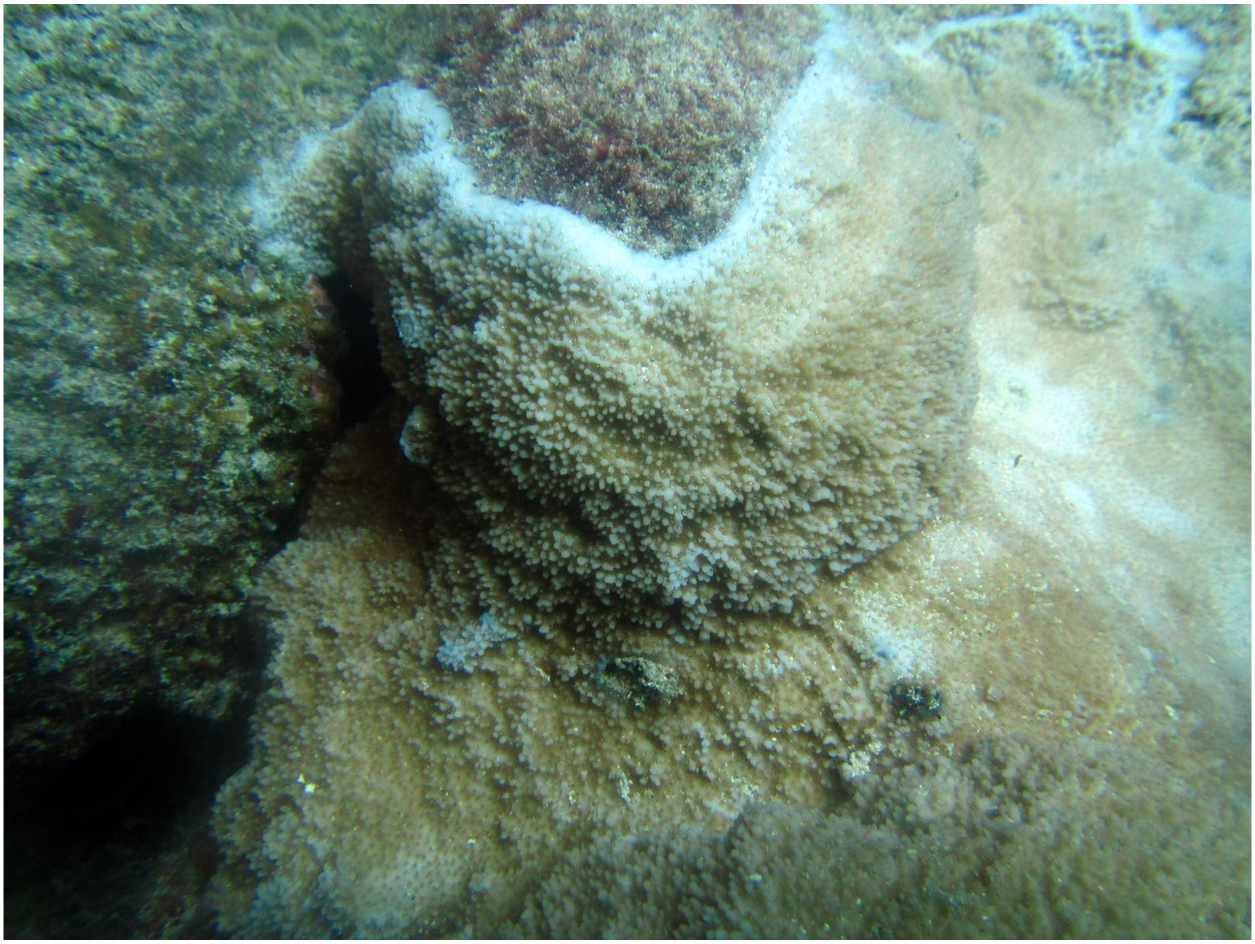


A photo of a colony of *Montipora grisea*.

A close photo of *Montipora grisea*, showing raised corallites. The blue spots are the polyps, and the tiny projecting spines are the papillae.

Montipora informis Bernard, 1897

Colonies are usually encrusting, and are covered with a uniform covering of papillae which are just large enough to see. In some places the papillae are white. Corallites are usually not visible. The papillae are a little larger and appear to be smooth cylinders unlike on *Montipora grisea*. Also, corallites do not have rings of papillae around them and are not raised.

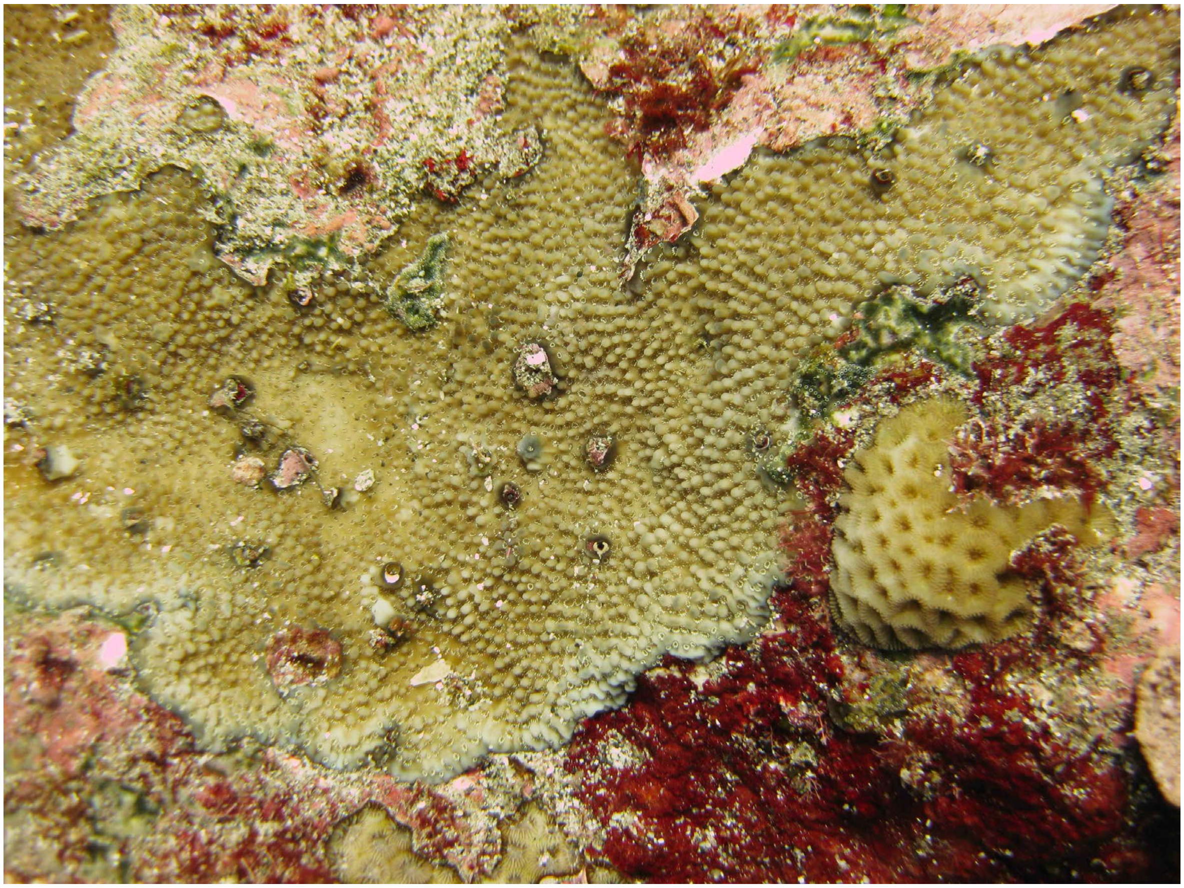


A colony of *Montipora informis*.

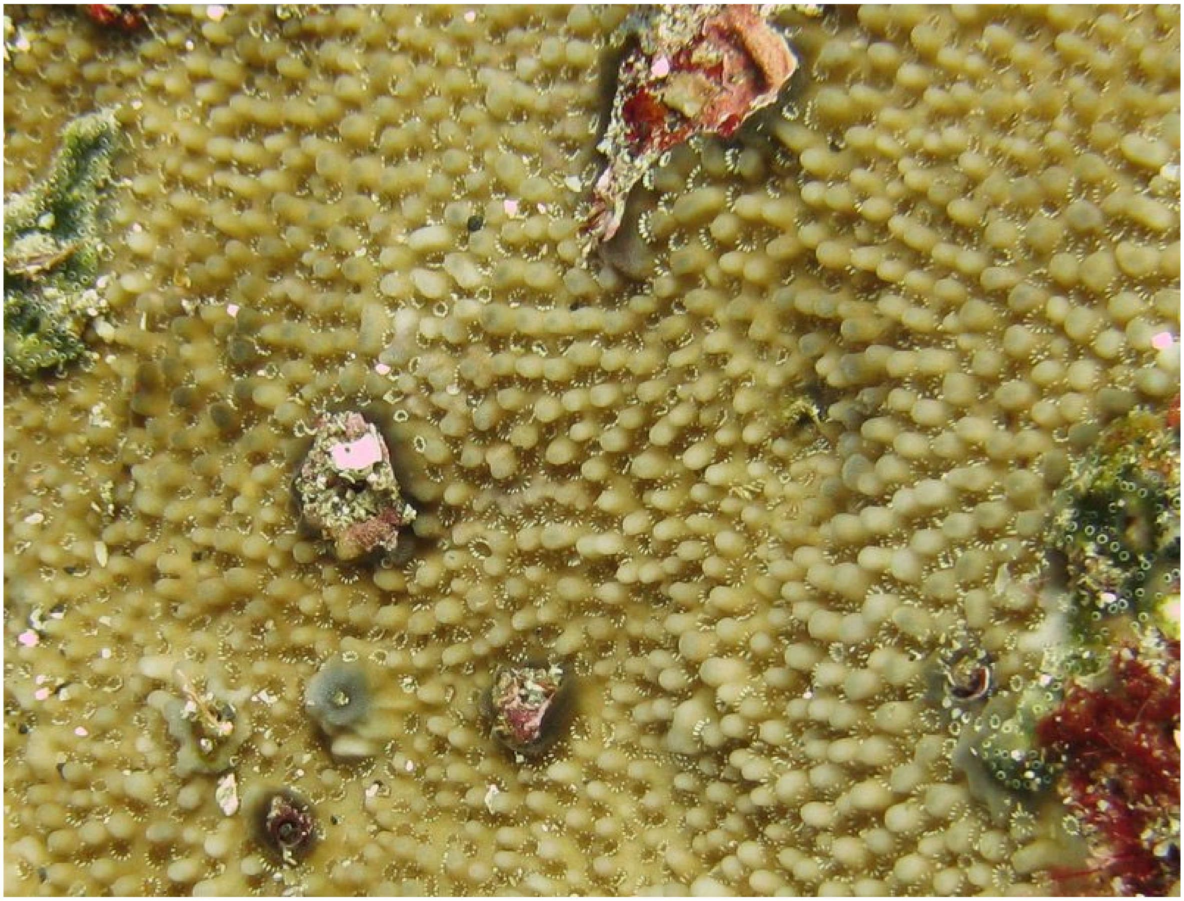
A close-up photo of *Montipora informis* showing the uniform tiny papillae.

Montipora tuberculosa (Lamarck, 1816)

Colonies surfaces have tuberculae, which are larger than papillae but smaller than verrucae, and are about the size of corallites (1 mm diameter). The tuberculae do not fuse into ridges as on *Montipora caliculata*. The tuberculae are larger than the papillae on *Montipora grisea* and *Montipora informis*, but smaller than the verrucae on *Montipora capitata* or *Montipora verrucosa*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



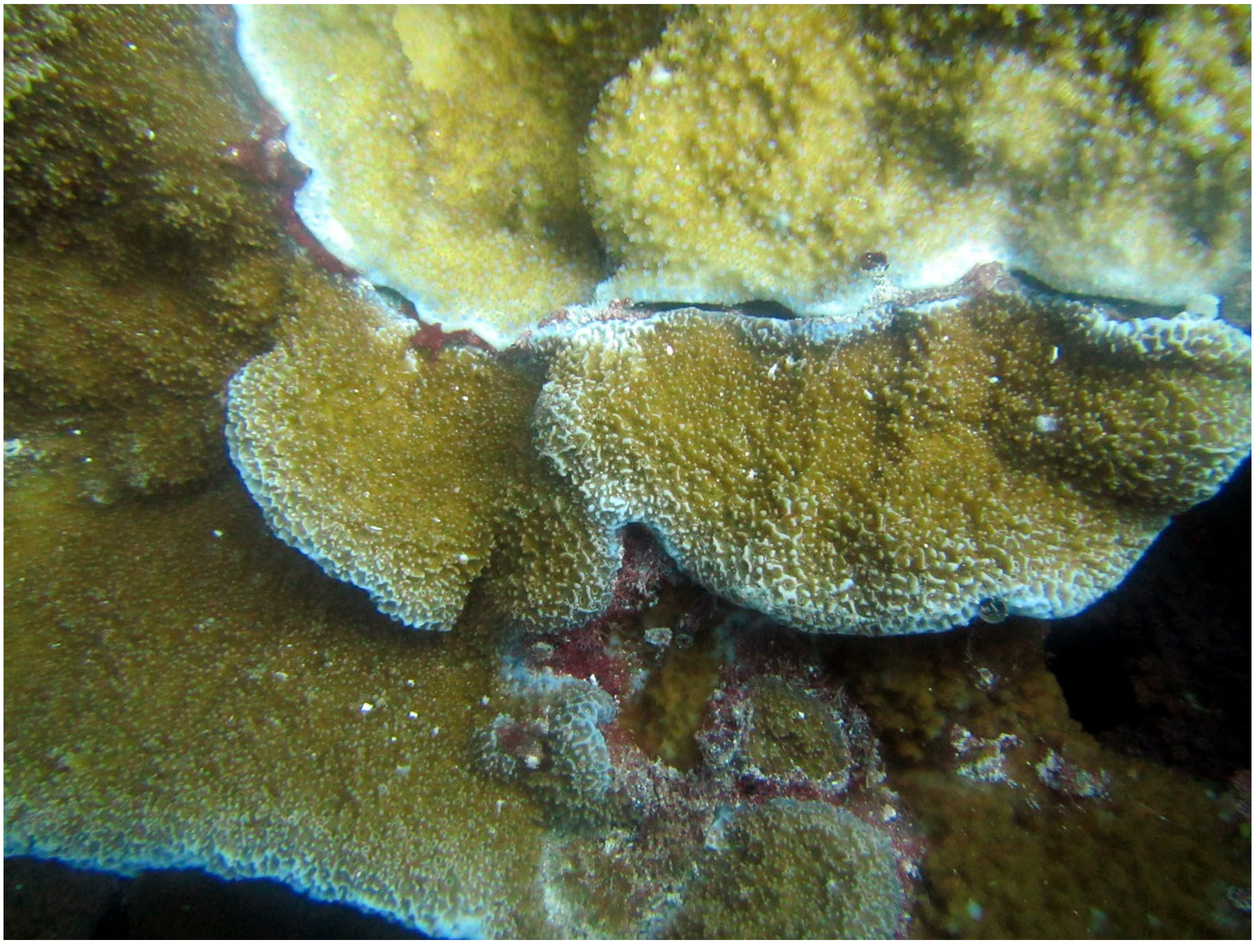
A photo of a colony of *Montipora tuberculosa*. This photo is from American Samoa.



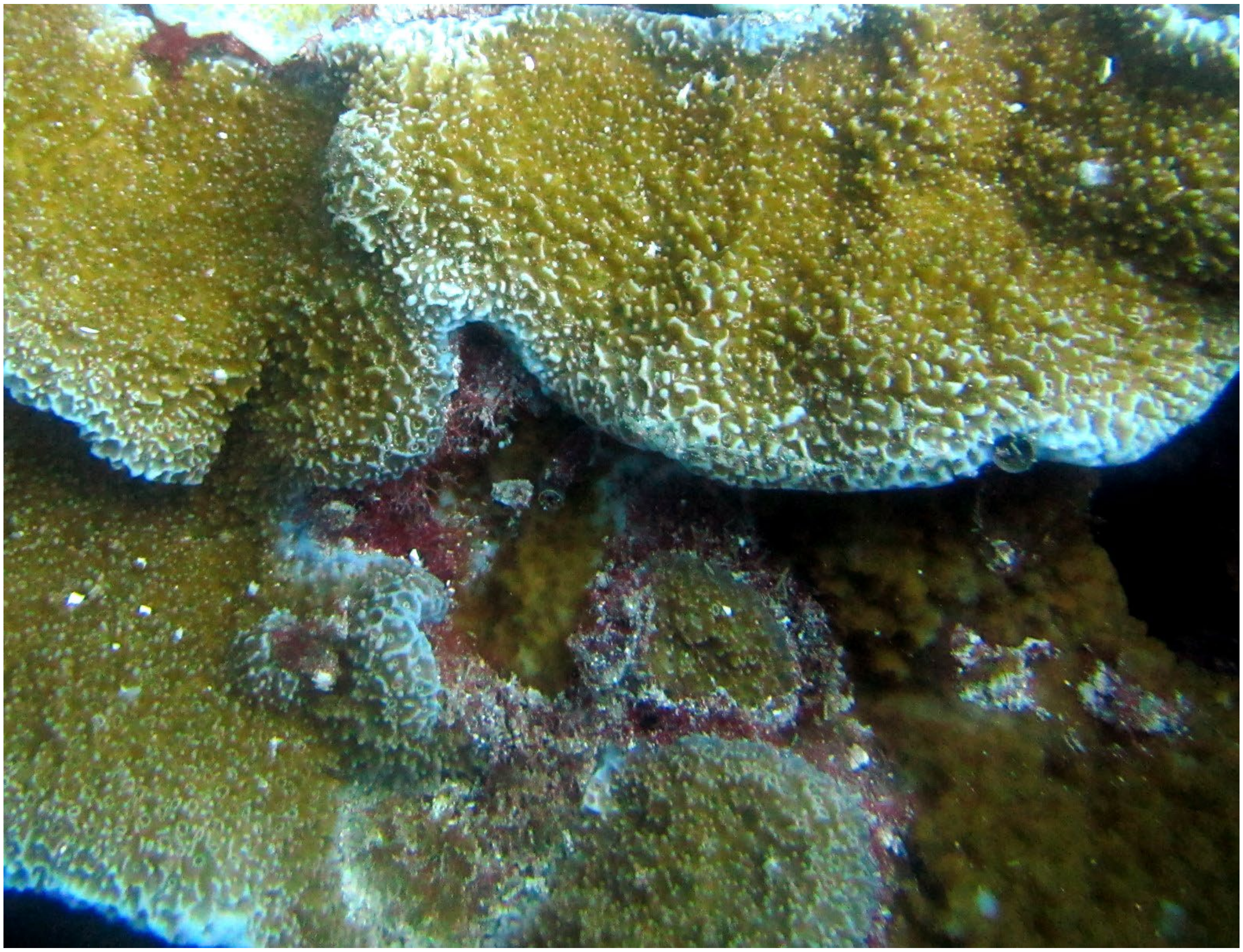
A close-up photo of *Montipora tuberculosa*. This photo is from American Samoa.

Montipora aequituberculata Bernard, 1897

Colonies form plates. The upper surface has papillae (tiny spines) that fuse into short radiating ridges at the edge of the plates. *Montipora grisea* and *Montipora Informis* are encrusting with papillae and do not have short radiating ridges. Most other species of *Montipora* at Wake have larger structures on their surfaces.



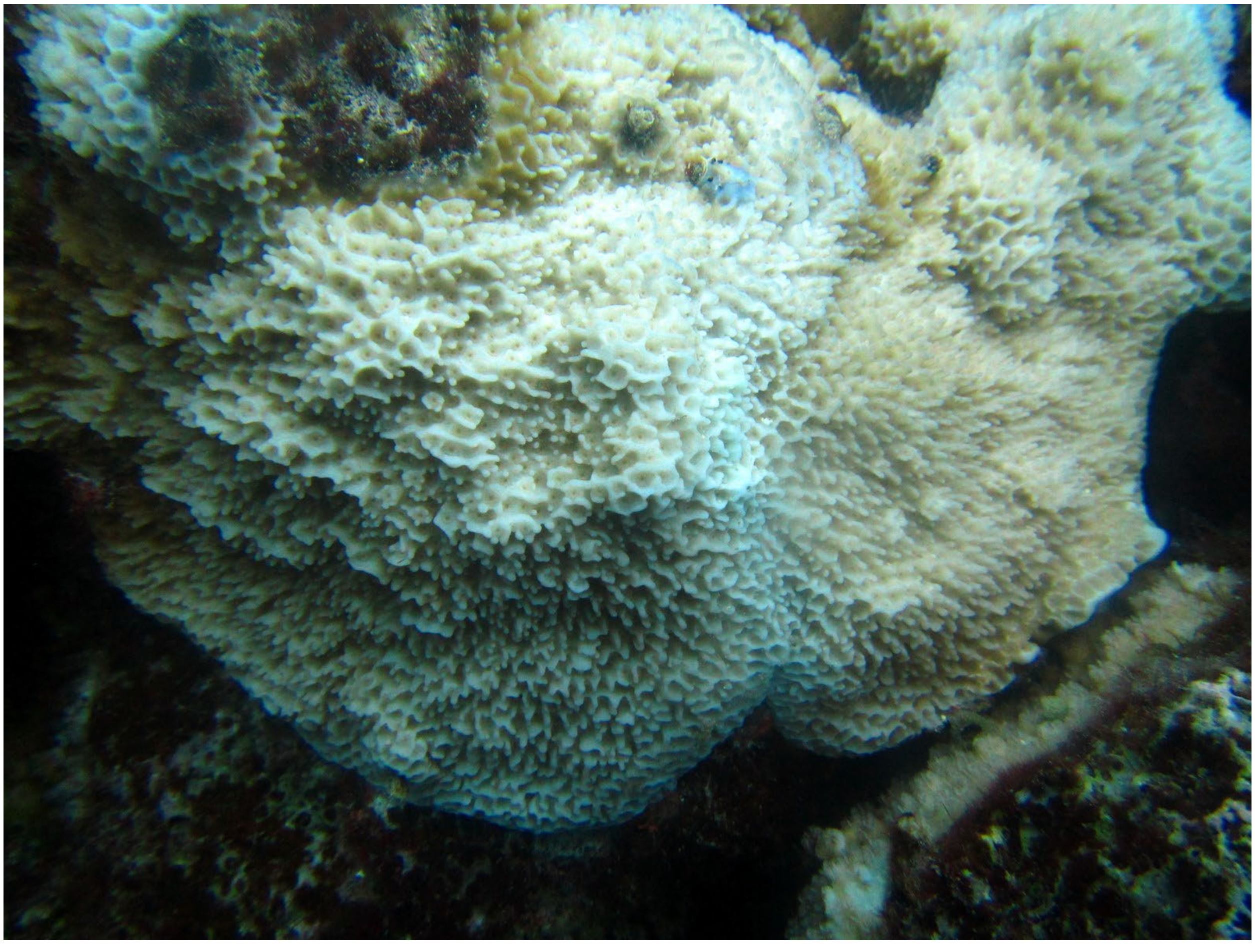
A photo of *Montipora aequituberculata*. The only the lower, darker colony is *Montipora aequituberculata*.



A close-up photo of *Montipora aequituberculata*.

Montipora caliculata (Dana, 1846) Vulnerable

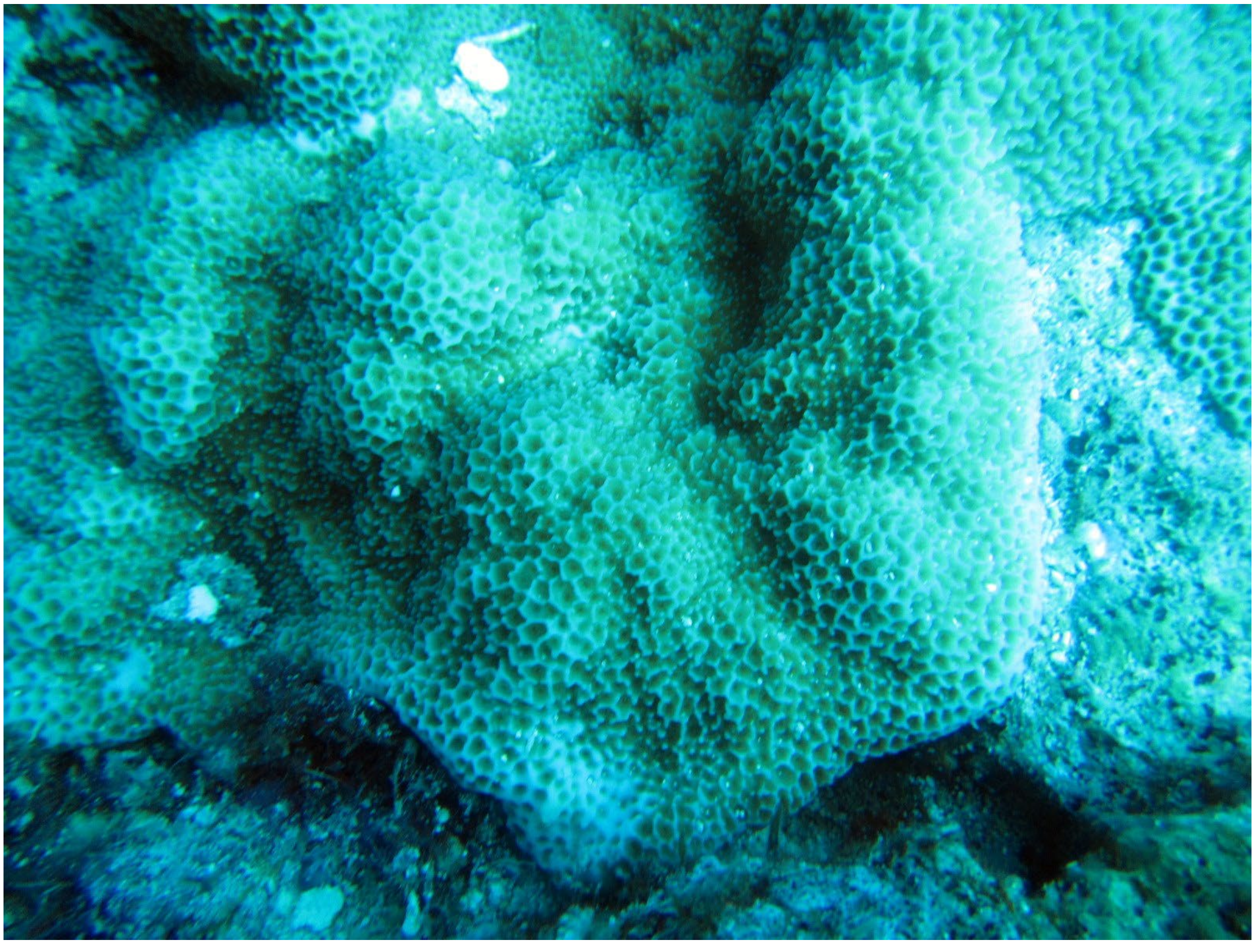
Colonies are encrusting. Parts of the surface have individual papillae on them, and in other parts the papillae are fused into little ridges that partially or completely surround corallites. *Montipora grisea* does not have papillae that fuse into ridges. *Montipora foveolata* has the little ridges surround the corallites completely. *Montipora tuberculosa* has tuberculae that are larger than papillae and about the diameter of a corallite.



A photo of *Montipora caliculata*, with papillae and ridges made of fused papillae.

Montipora foveolata (Dana, 1846)

Corals are massive or encrusting. Corallites are completely surrounded by a ridge, or they can be considered to be recessed into the coral. *Montipora caliculata* only has ridges partly surrounding most corallites. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

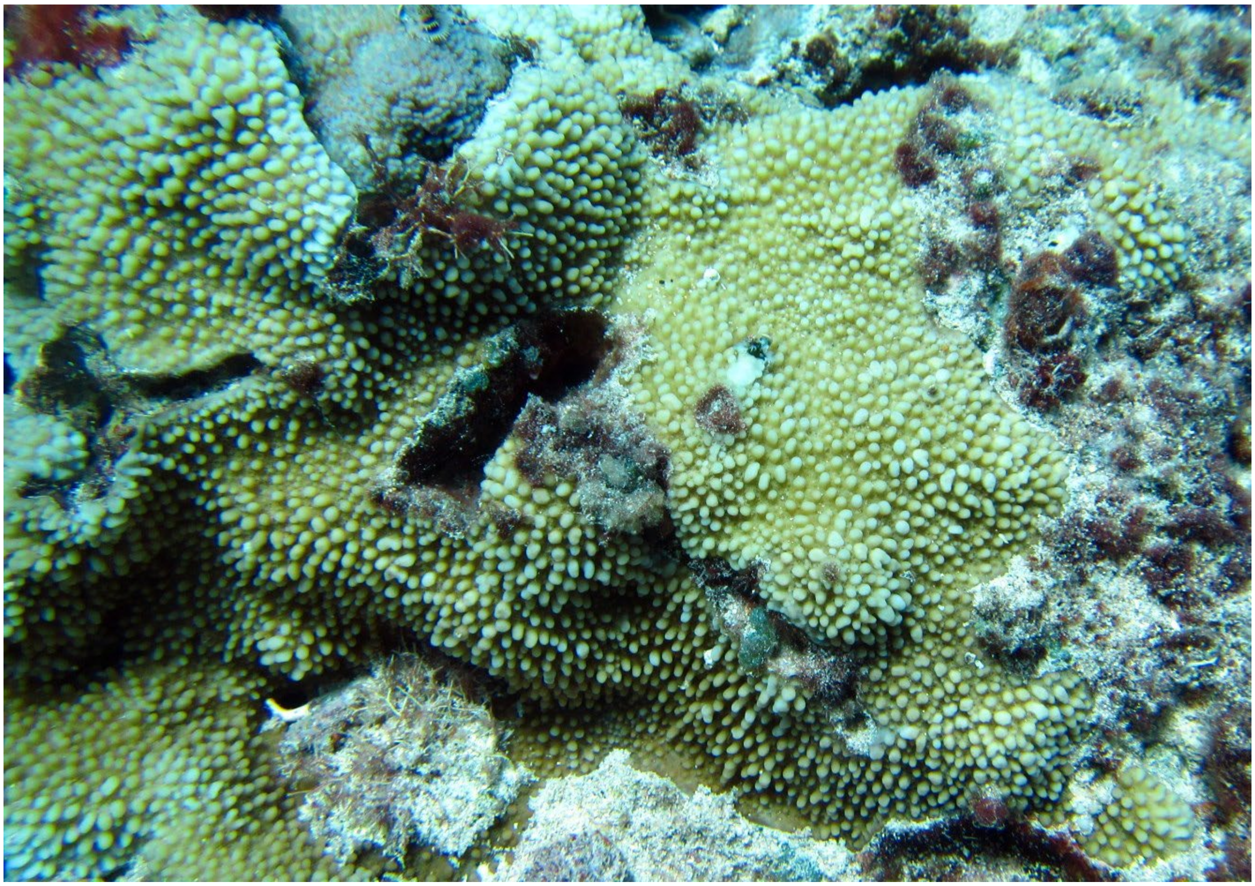


A colony of *Montipora foveolata*. This photo is from the Marianas.

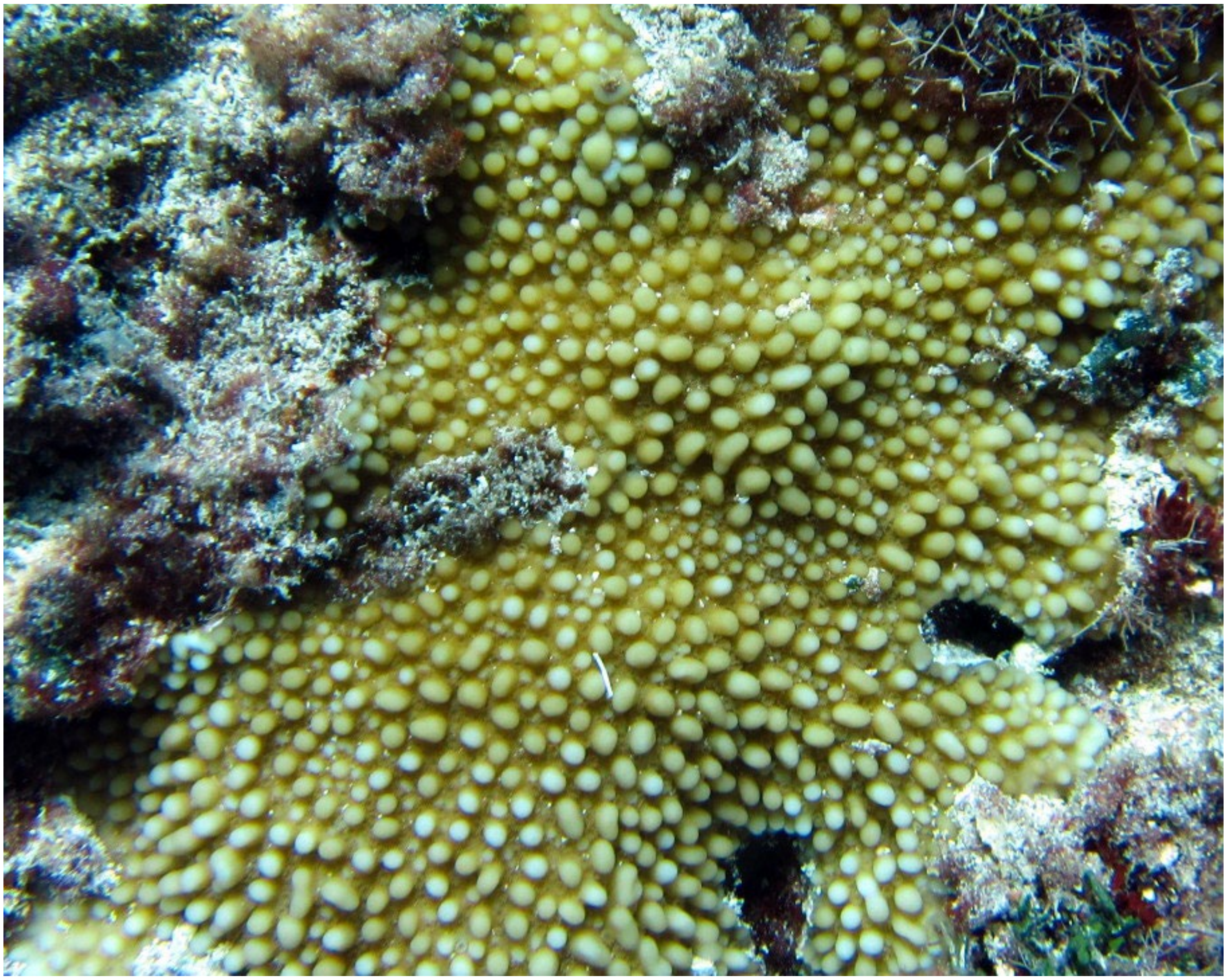
A close photo of *Montipora foveolata*. This photo is from the Marianas.

Montipora capitata (Dana, 1846)

Colonies are usually encrusting but can be branching or both. The surface has verrucae between the corallites. The verrucae are about 2 mm wide and tall. The verrucae are larger than the papillae on *Montipora informis* and *Montipora tuberculosa*. This species has long been confused with *M. verrucosa*, which has wider verrucae. *Montipora verrucosa* was reported from Wake by Kenyon et al (2013) but neither it nor *Montipora capitata* have been found on Wake by Fenner yet. The latter seems to be more common in the Pacific, so the choice was made to present it here instead of the former until there is a picture to examine.



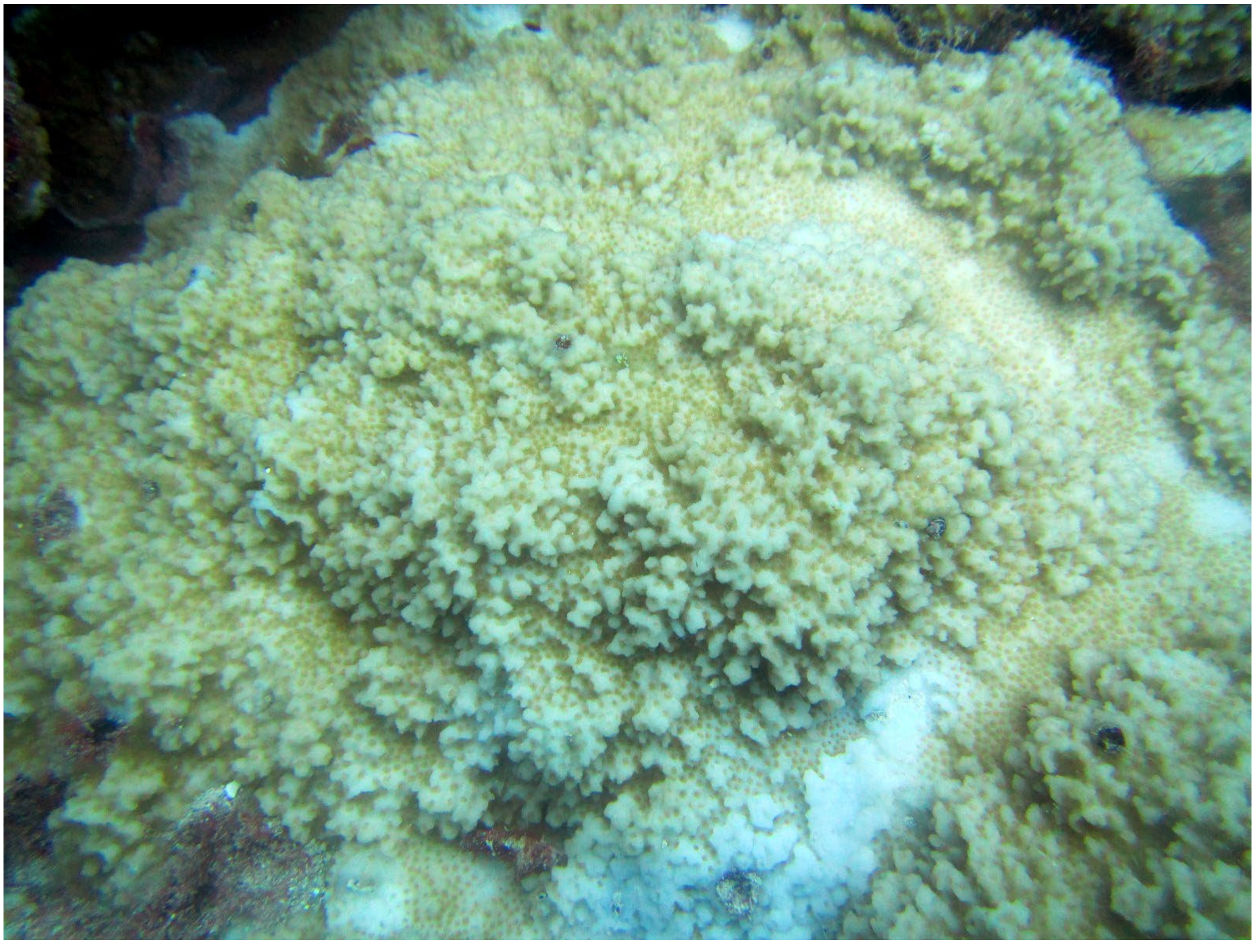
A colony of *Montipora capitata*. This photo is from the Marianas.



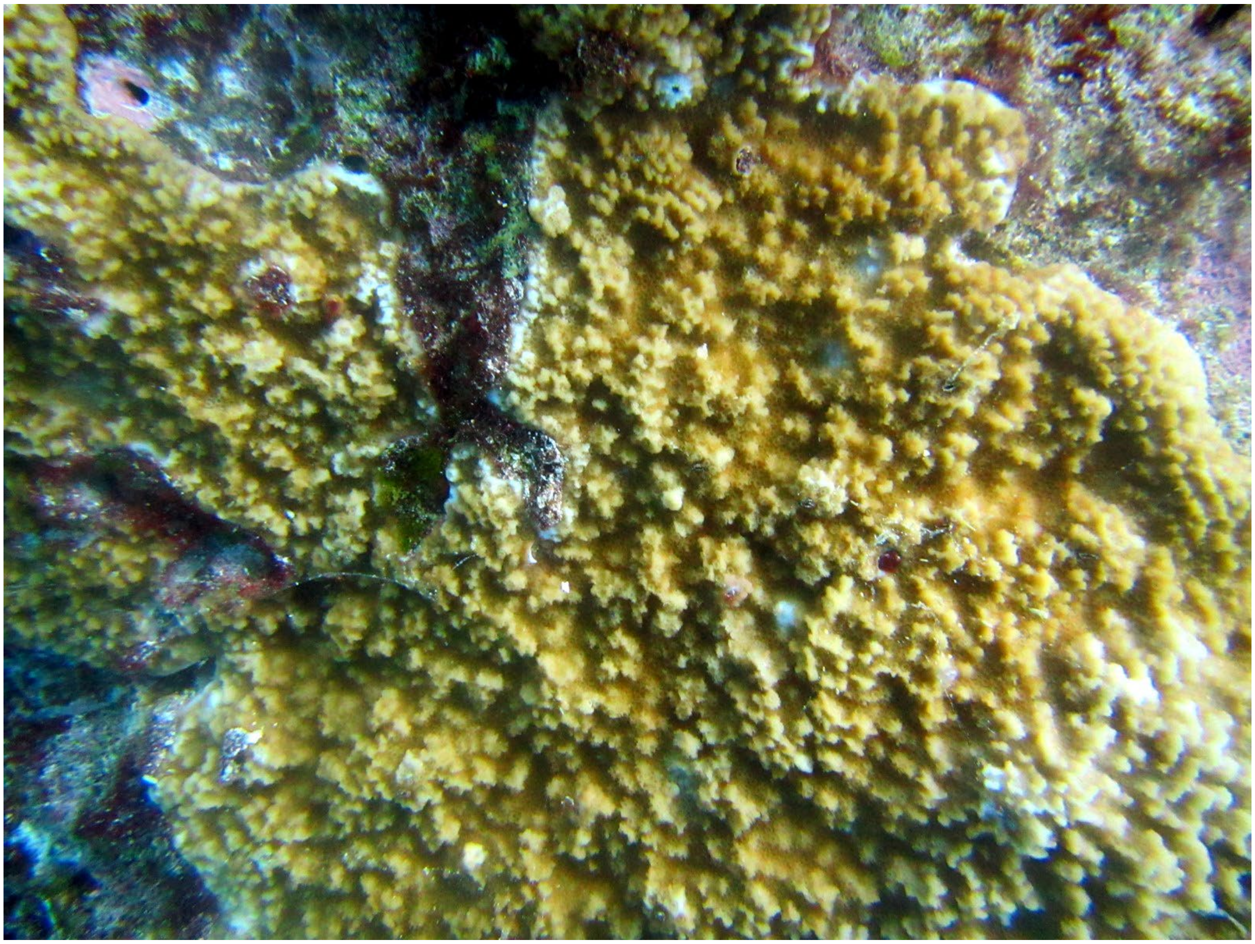
A close-up photo of *Montipora capitata*. There is often significant variation in the width of the verrucae within a single colony. This photo is from the Marianas.

Montipora hoffmeisteri or Montipora floweri or Montipora turgescens.

Colonies have small irregular lumps on them. The lumps are larger than papillae and tuberculae and most verrucae. The lumps are also irregular in size and shape, unlike papillae, tuberculae and verrucae and not smooth. There are a few corallites on the lumps as well. *Montipora hoffmeisteri* and *M. floweri* are difficult to distinguish in the field. *Montipora turgescens* has larger lumps.



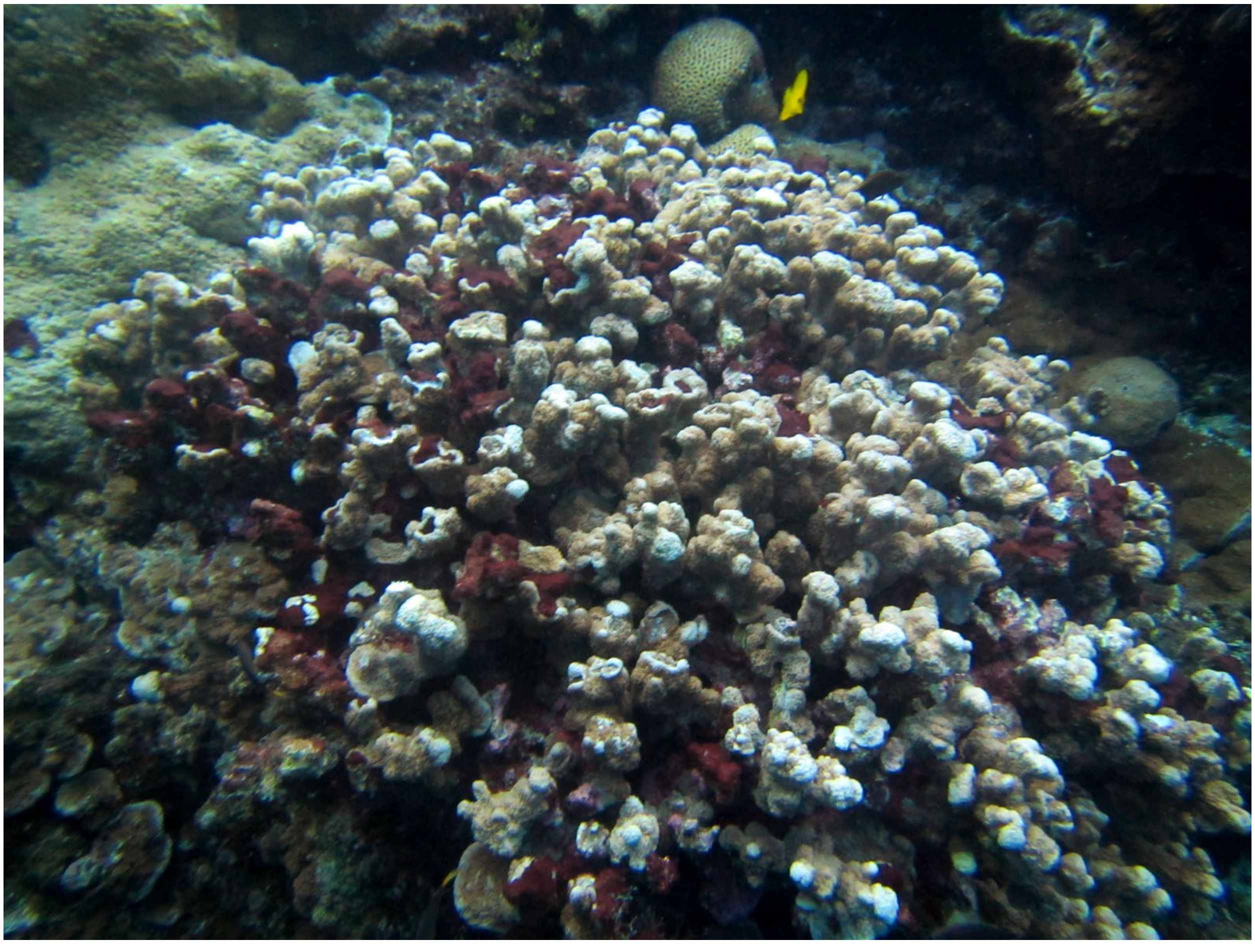
A colony of *Montipora hoffmeisteri* or *M. floweri or M. turgescens*.



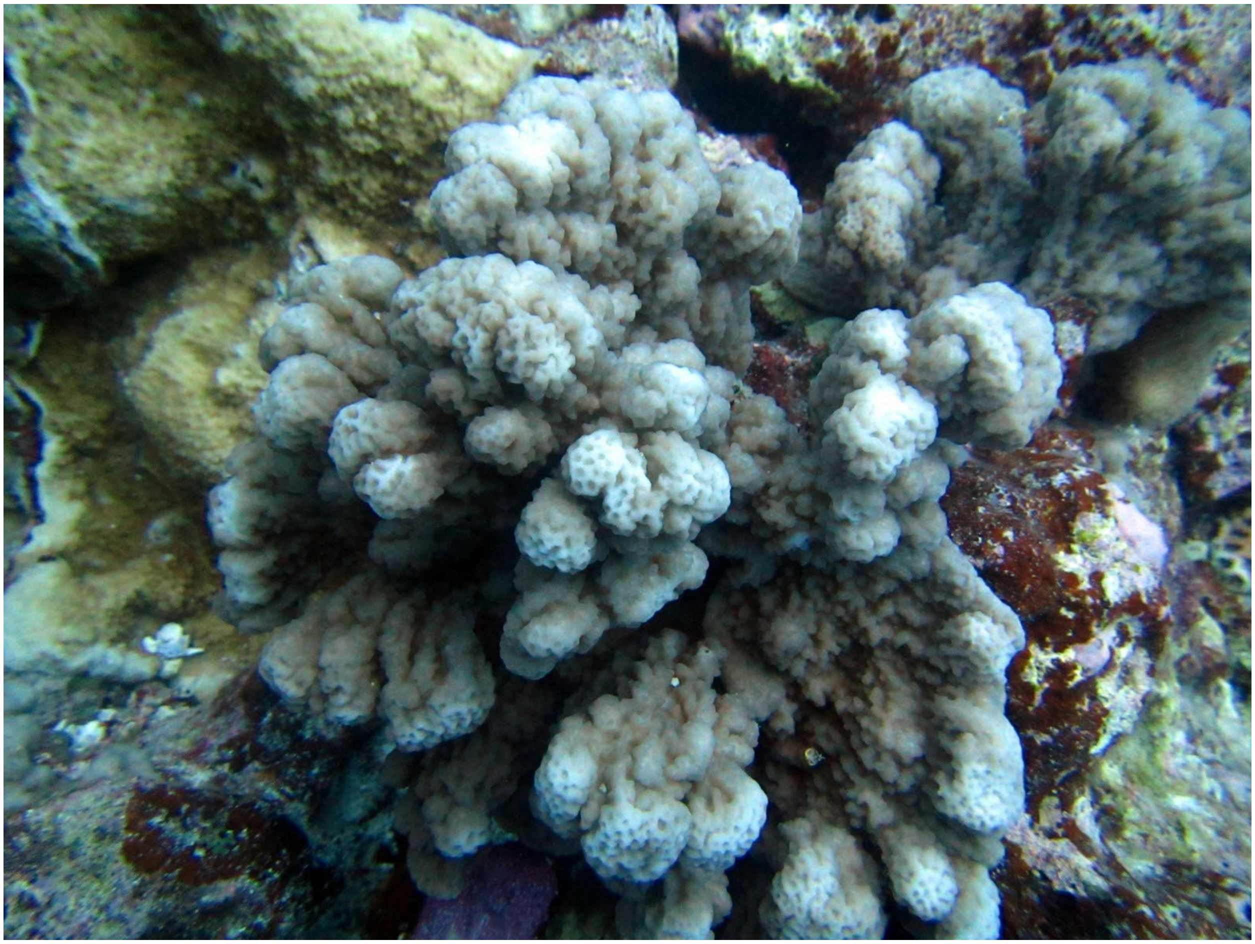
A photo of a colony of *Montipora hoffmeisteri*, *M. floweri,* or *M. turgescens*.

Montipora incrassata (Dana, 1846)

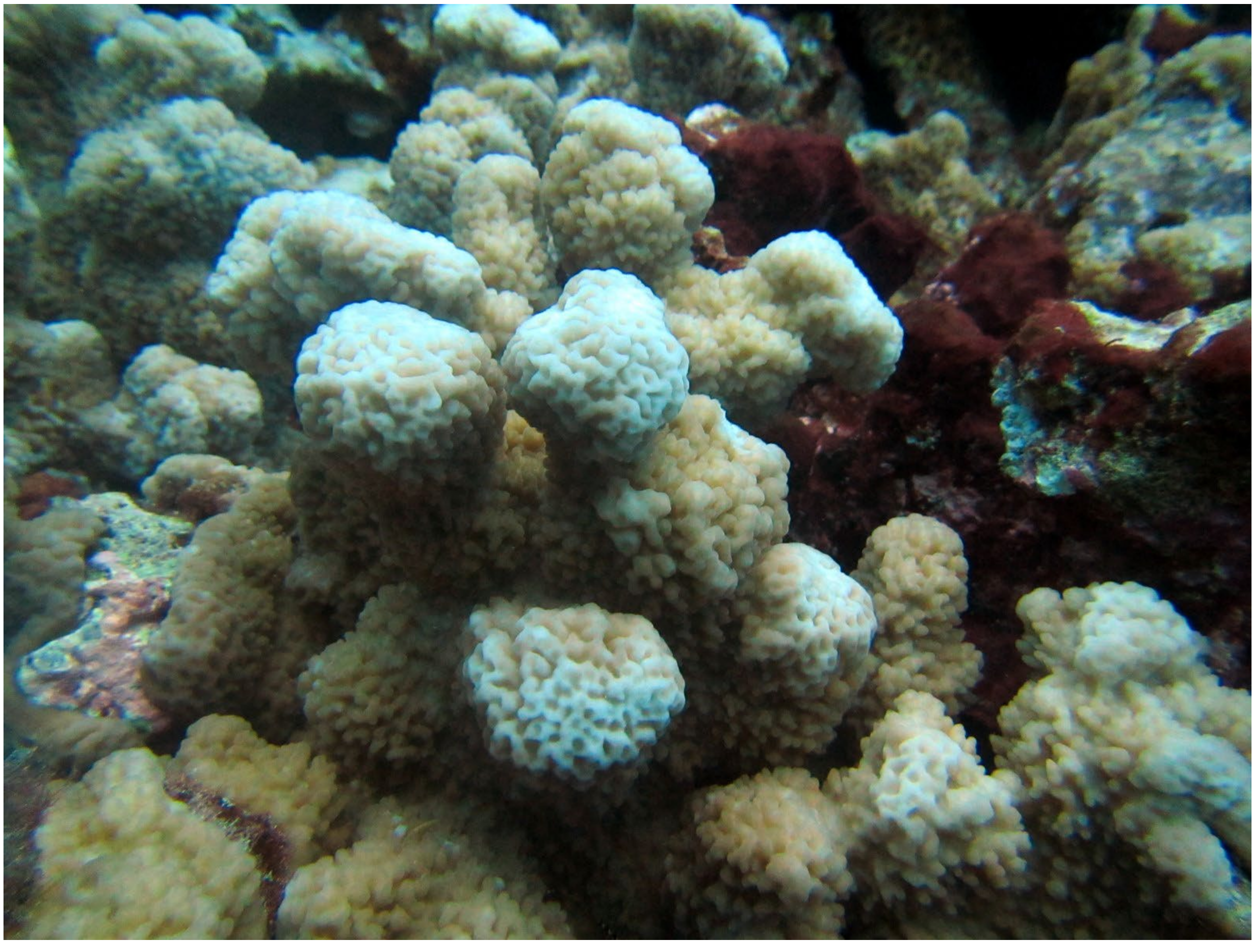
Colonies are columnar, with irregular, lumpy, rounded columns that are about 1-1.5 inches in diameter. The columns commonly all reach about the same height. Columns fuse irregularly. Colonies may have encrusting bases, but often those are hard to find or see. Surfaces are covered with small, rounded bumps. The tops of columns are white with corallites embedded down into them like tiny holes. Other *Montipora* do not form columns this size that are the same shape.



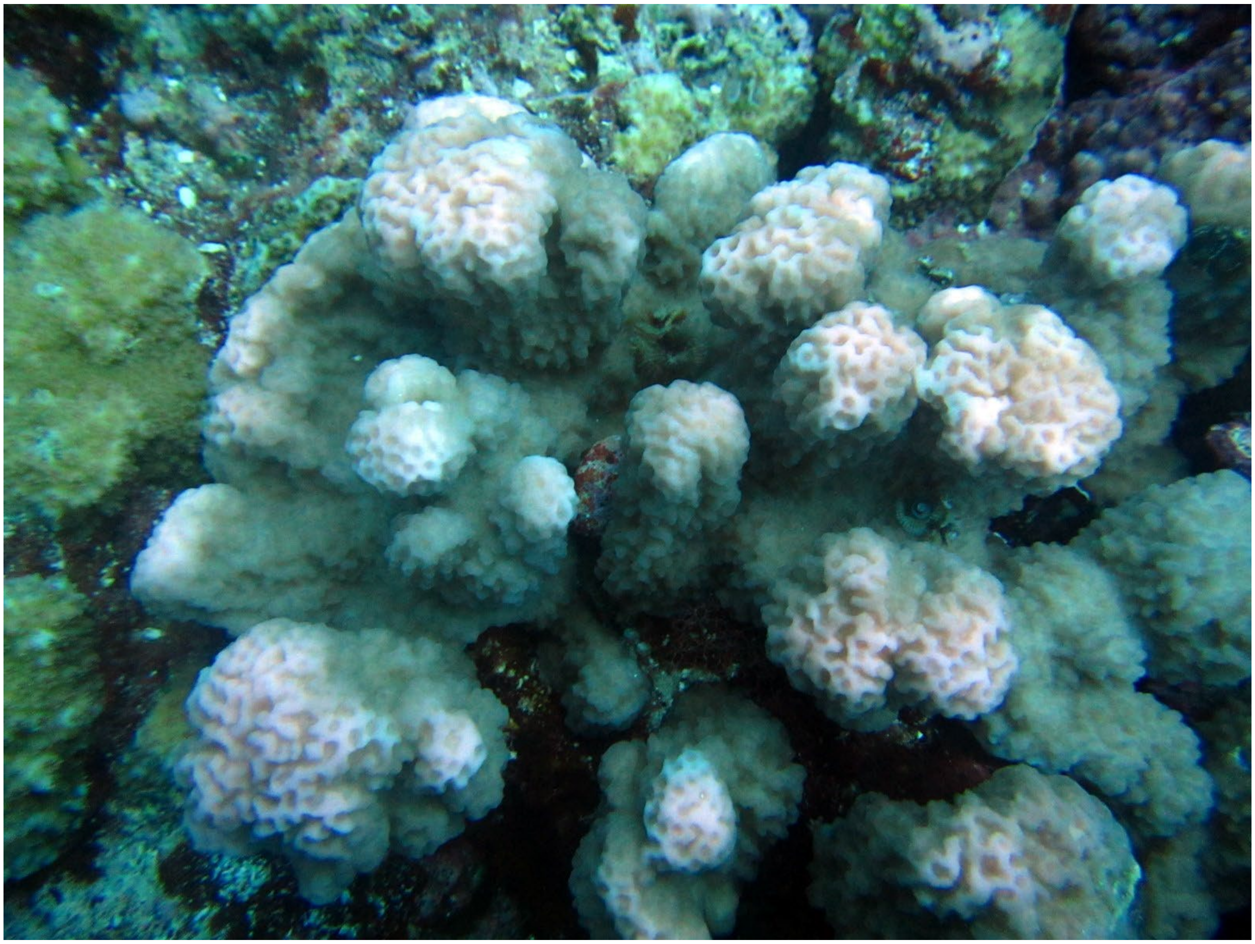
A photo of a large colony of *Montipora incrassata*.



A colony of Montipora incrassata.

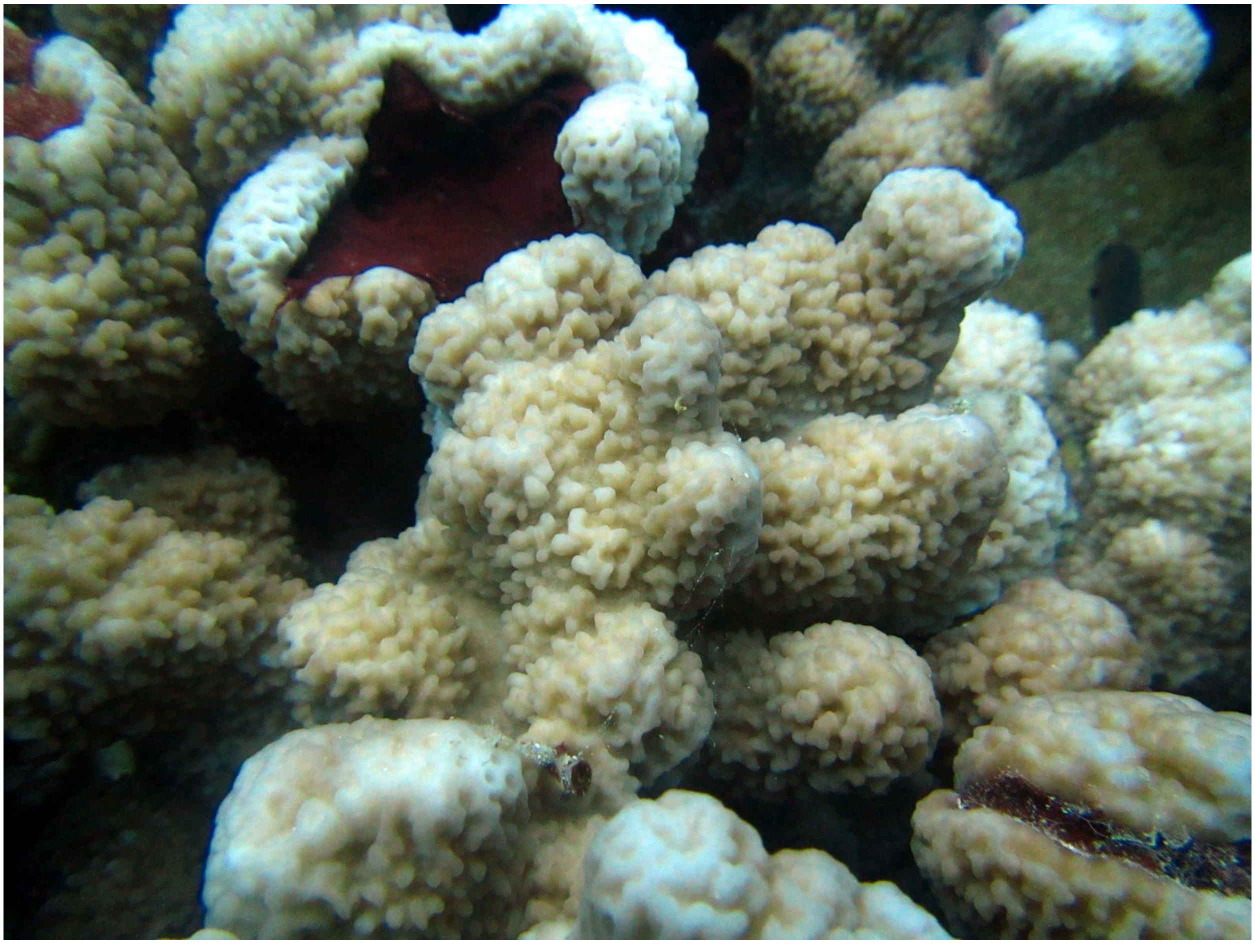


A photo of *Montipora incrassata*, showing the irregular columns, whit column tops, and indented corallites on the tops of columns.



A photo of *Montipora incrassata* columns showing the recessed corallites on the tops of columns.

A photo of the base of a colony of *Montipora incrassata* showing a low plate edge.



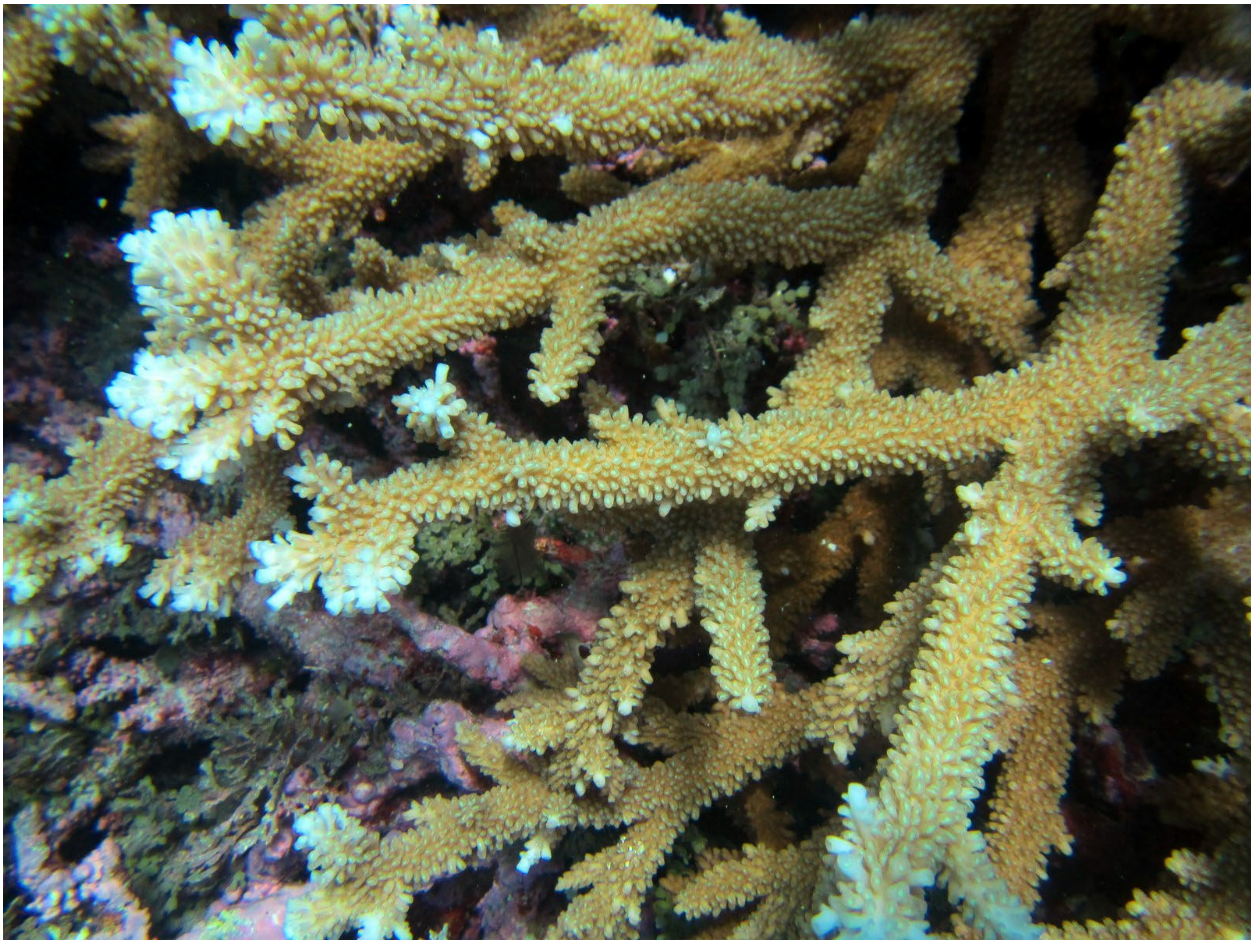
A close-up photo of columns of *Montipora incrassata*, showing the surface covered with rounded lumps and ridges. The corallites are between the ridges.

Acropora

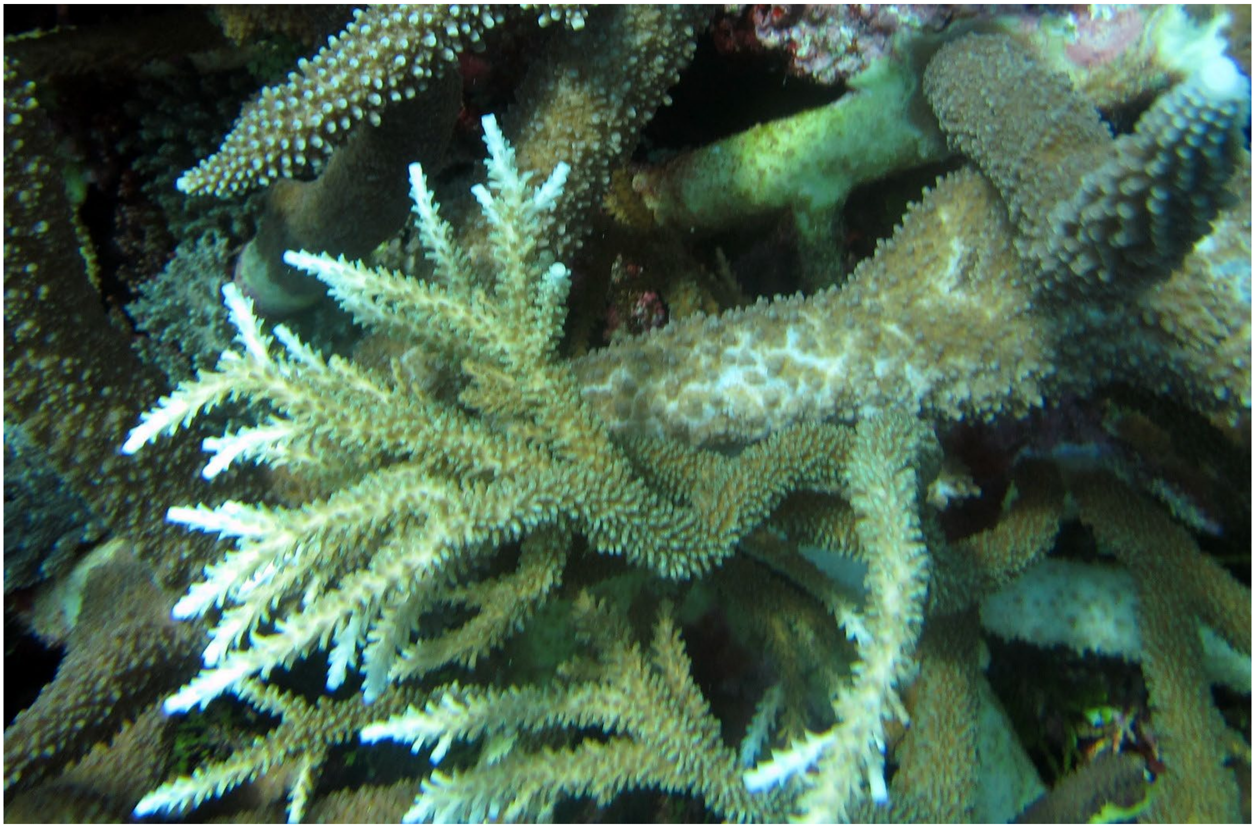
Colonies are always branching. Each branch tip has one and only one corallite on it, and the sides of branches have many corallites. The corallite on the tip of the branch is called an "axial" corallite, and the corallites on the sides of branches are called "radial" coralltíes. Axial corallites are usually larger than radial corallites. Radial corallites come in a variety of shapes. Colony shapes and radial corallite shapes are the two most useful characters for species identification. Some colonies are shaped like deer antlers, with cylindrical branches that taper to a sharp point. They are called "staghorn" coral. Other colonies have short, vertical branches that are the size and shape of fingers, and are called "digitate". Other colonies have smaller branches that all grow upward in parallel, and are called "corymbose." Still others grow a column and then start spreading out in a thin layer, and are called "table corals." Still others have branches surrounded by little thin branchlets that make it look like a bottlebrush, which is what they are called. *Acropora* is the largest genus of corals, with 165 species known and more yet to be named.

Acropora muricata (Linnaeus, 1758) "staghorn coral"

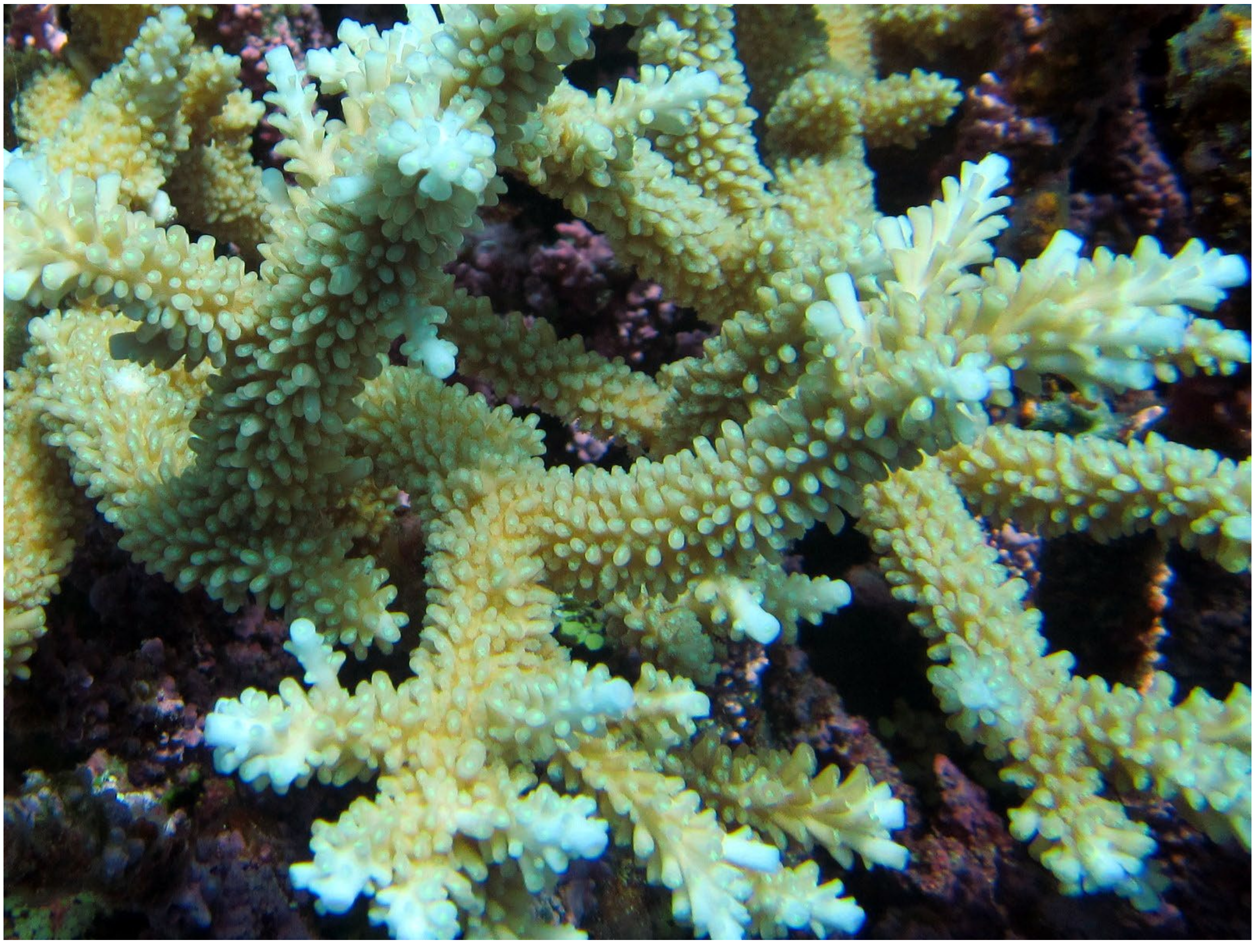
This species forms staghorn branches which can form large thickets. The branches are smaller than on *Acropora intermedia*. The axial corallite is a small tube. Radial corallites are thinner than the axial corallite and form tubes projecting from the branch. They project farther from the branch than on *Acropora intermedia*. This species prefers protected locations such as lagoons. The branches and radial corallites are thinner than on *Acropora intermedia*, and the radial corallites are tubular not flat lips like on *Acropora pulchra*. This species used to be called "*Acropora formosa*." This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



Here, the branches of *Acropora muricata* are long as in other staghorn corals. This photo is from the Marshall Islands.



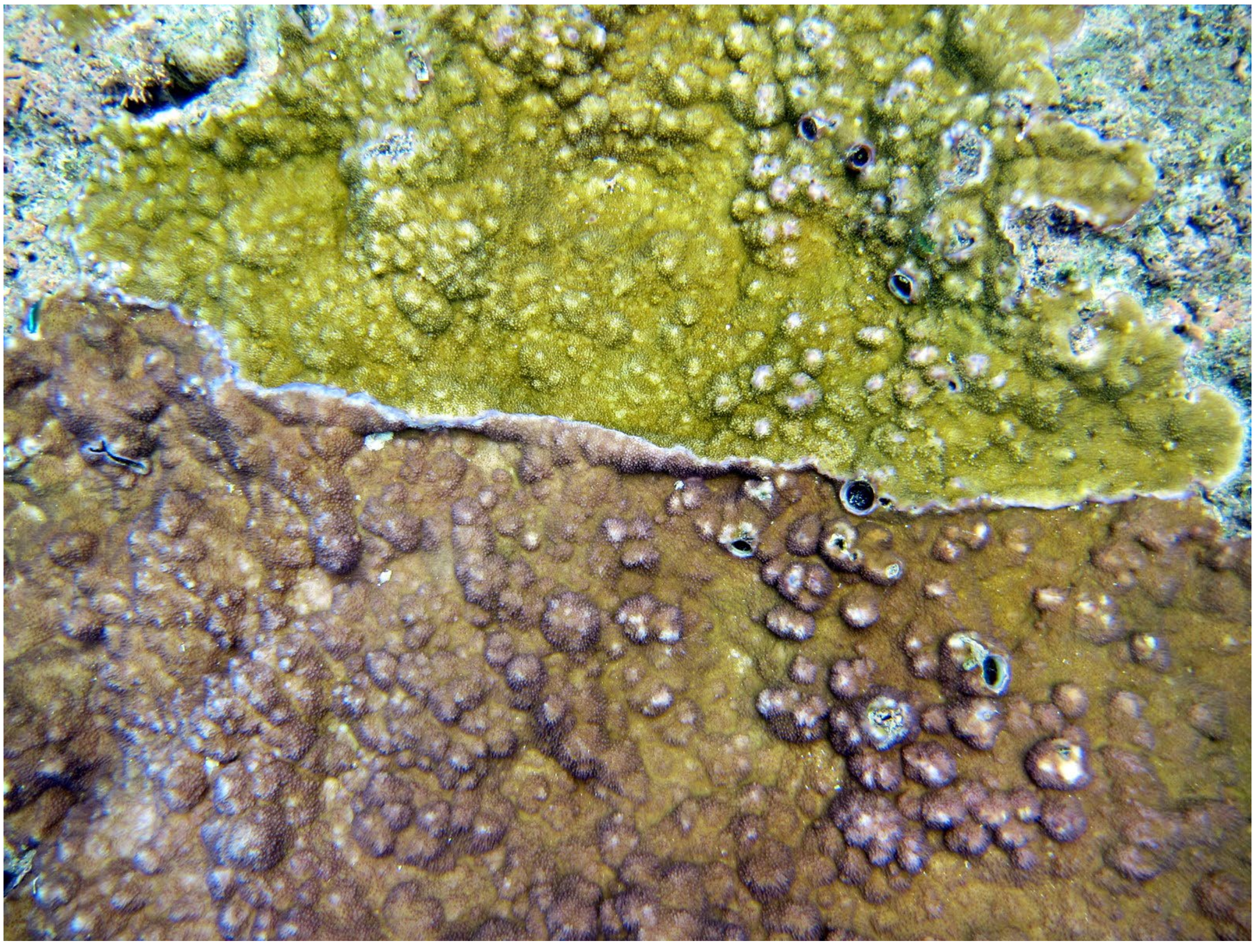
A small colony of *Acropora muricata*, showing the thinner branches and corallites than on the surrounding branches of *Acropora intermedia*. This photo is from the Marshall Islands.



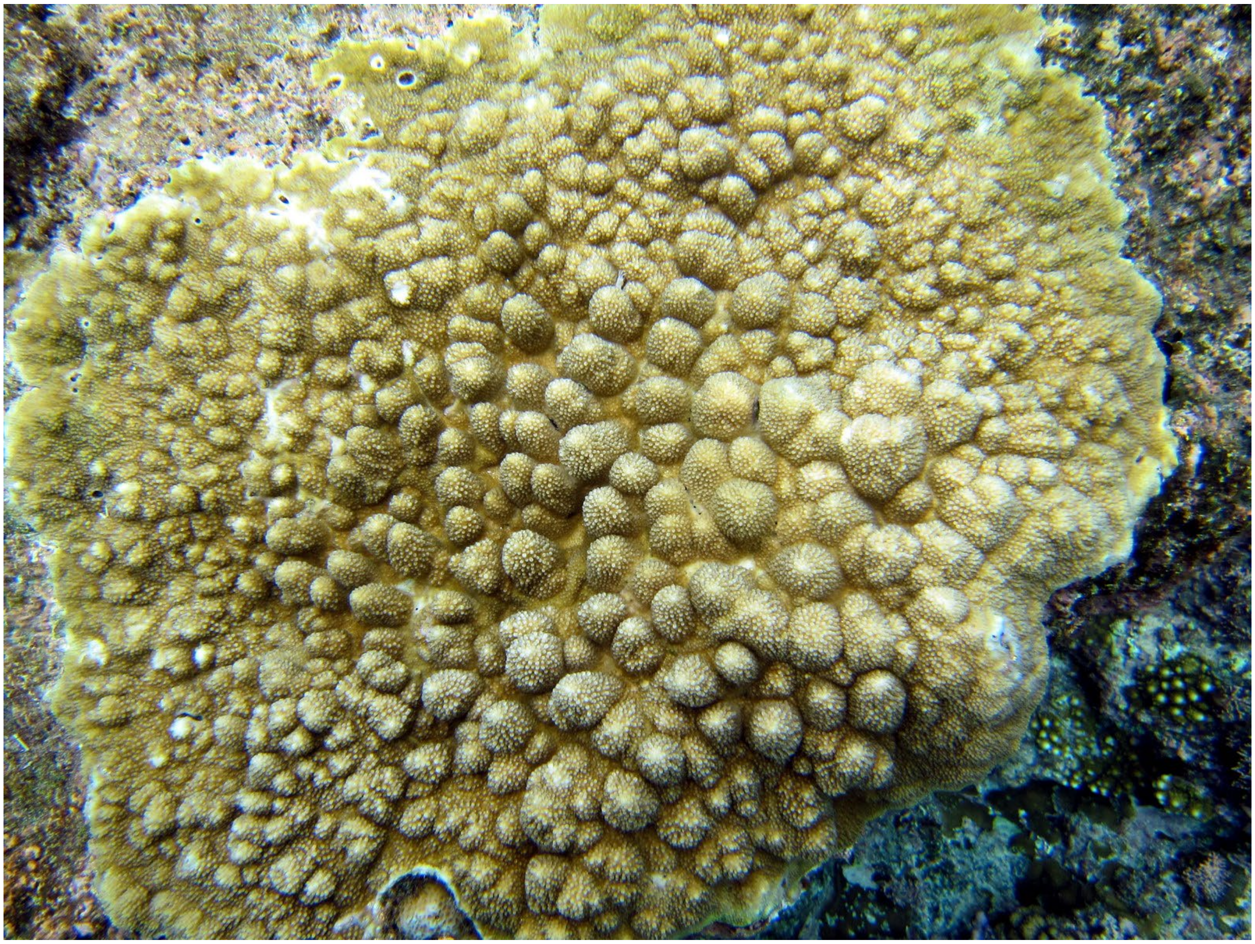
In this close-up photo of *Acropora muricata*, the radial corallites can be seen to be tubular with openings cut at a slant. Near branch tips the radials commonly are inclined towards the branch tip. This photo is from the Marshall Islands.

Acropora palmerae Wells, 1954

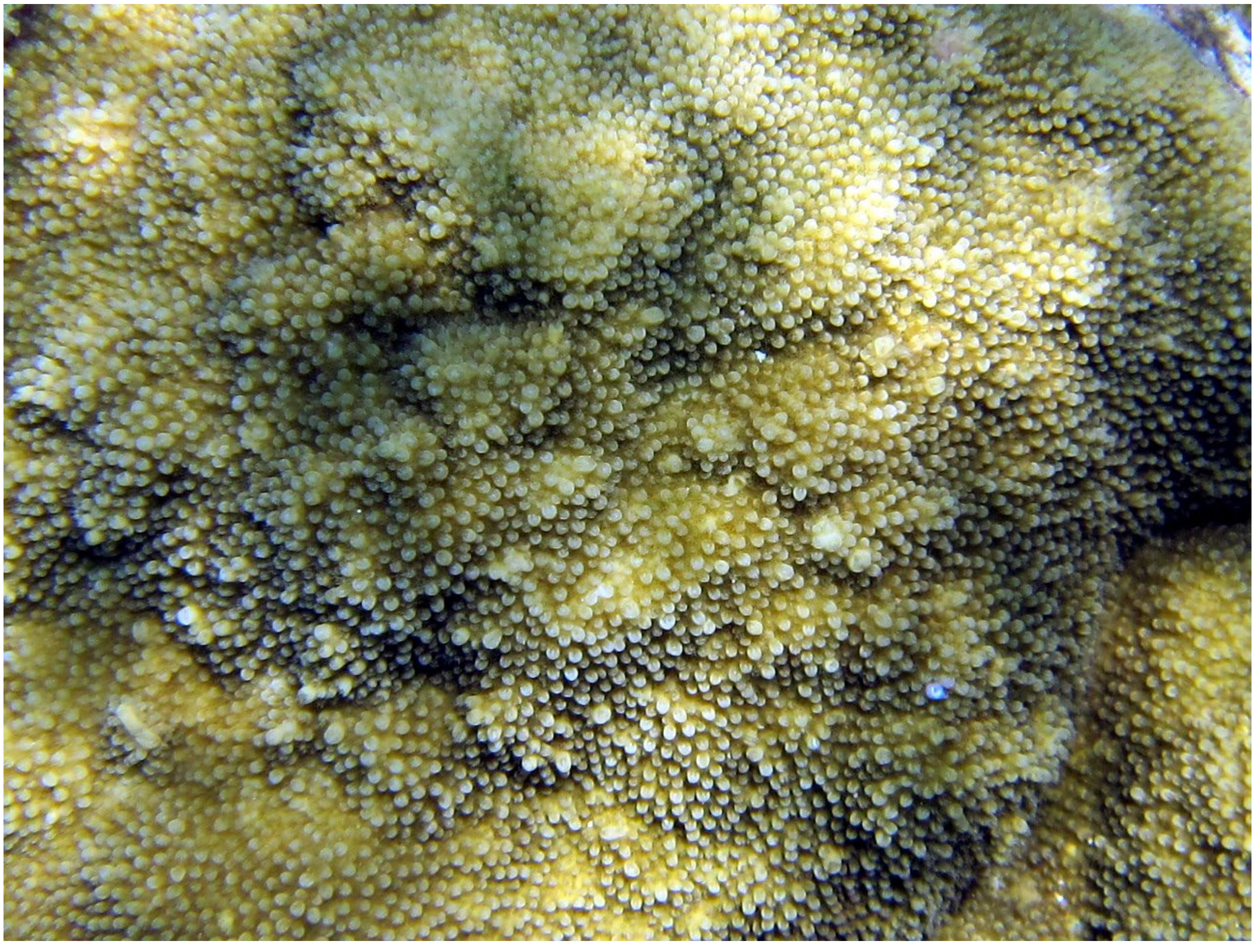
Colonies are encrusting, but some have a few small branches which are staghorn-shaped and identical to the branches of *Acropora robusta*. Short branches grade into small knobs. Branches are cylindrical with uniform radial corallites which are cut at an angle so the opening points toward the branch tip. The encrusting base is covered with similar radial corallites. *Acroproa robusta* is almost all branches with a small encrusting base (that usually can't be seen under the branches) but otherwise is near identical. *Acropora palmerae* can easily be mistaken at a distance for encrusting species of other genera, but the corallites are typical *Acropora* radial corallites. Rare colonies with many short branches could be mistaken for *Acropora monticulosa*, but colony edges are encrusting. Tan, yellow, purple. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A photo of two *Acropora palmerae* colonies of different colors. Photo from the Marianas.



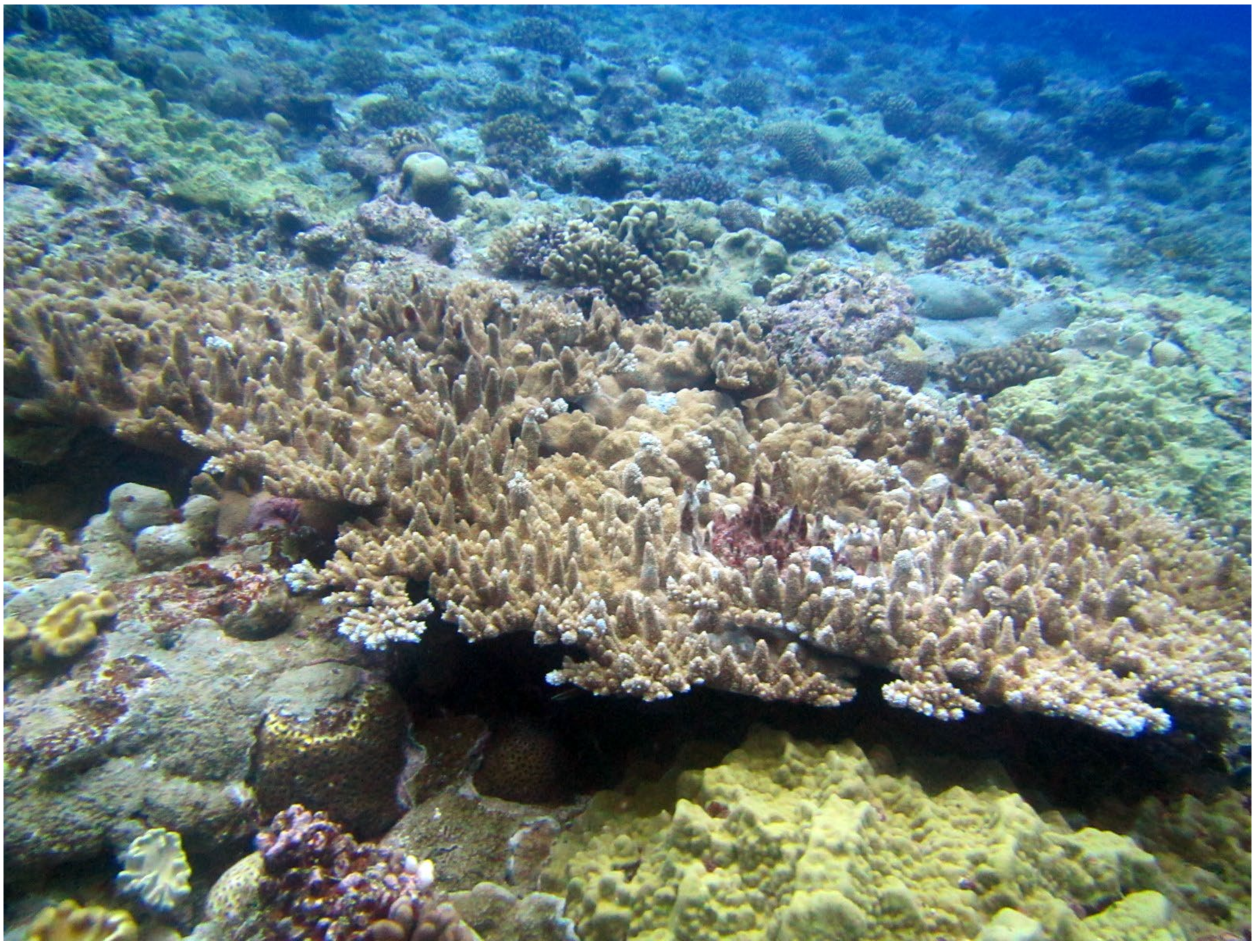
A colony of *Acropora palmerae* with many very short branches. Notice that colony edges are mostly encrusting. Photo from the Marianas.



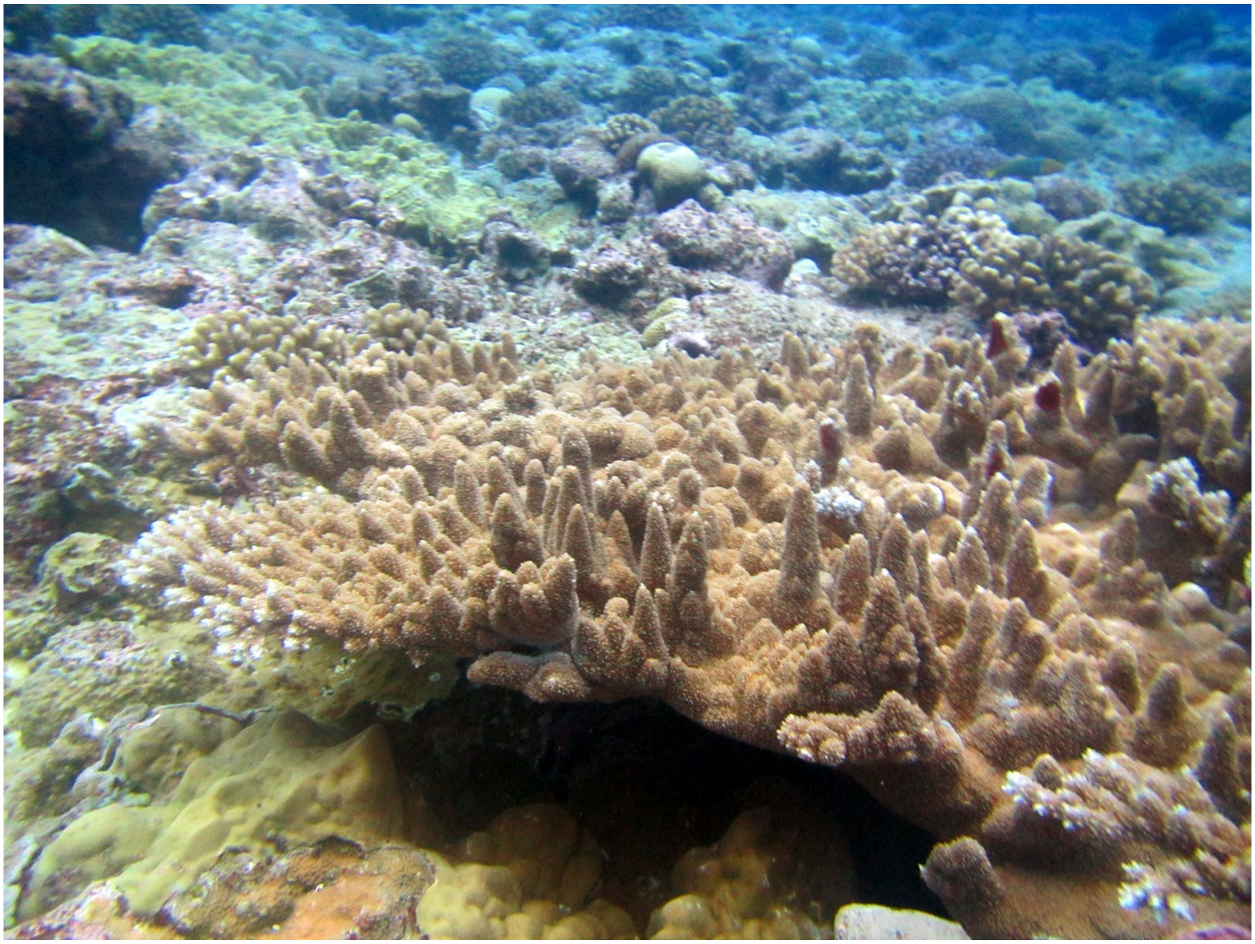
A close-up photo of the surface of an encrusting *Acropora palmerae* colony. The corallite are thin tubes with openings cut at a slant. Photo from the Marianas.

Acropora abrotanoides (Lamarck, 1816)

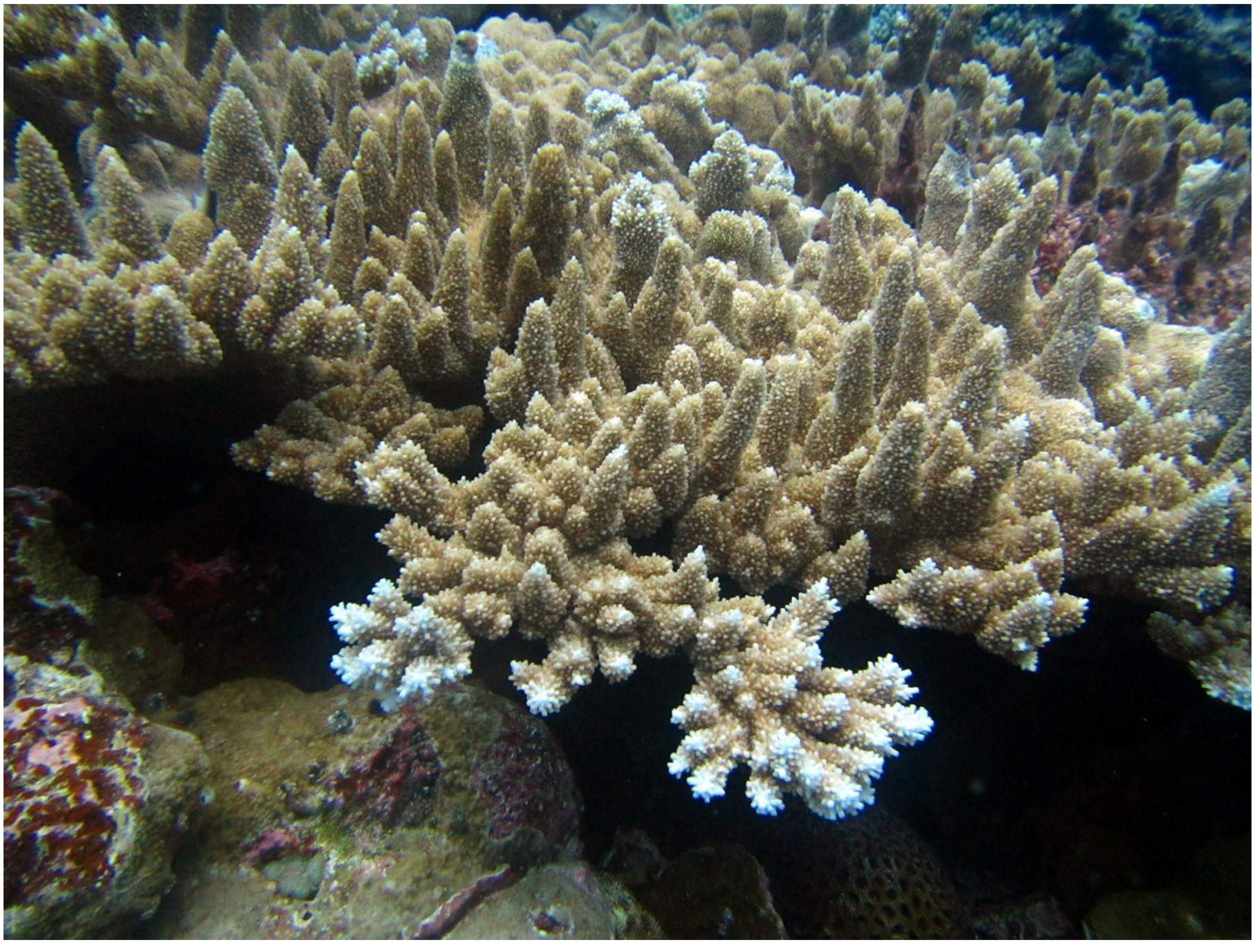
Colonies are discrete but can reach large sizes of a few yards diameter. In the center of the colony, branches grow vertically and are similar to staghorn corals: cylindrical and tapering to a sharp point. At the edges of colonies, and sometimes growing from the sides of vertical branches, are small, horizontal fans of branches. Colonies vary in what proportion of branches are vertical and horizontal. Branches have short, uniform radial corallites except near the tips of branches, particularly horizontal branches, where the radial corallites grow long and tubular.



A photo of a large, low colony of *Acropora abrotanoides*. Colonies often grow higher than this.



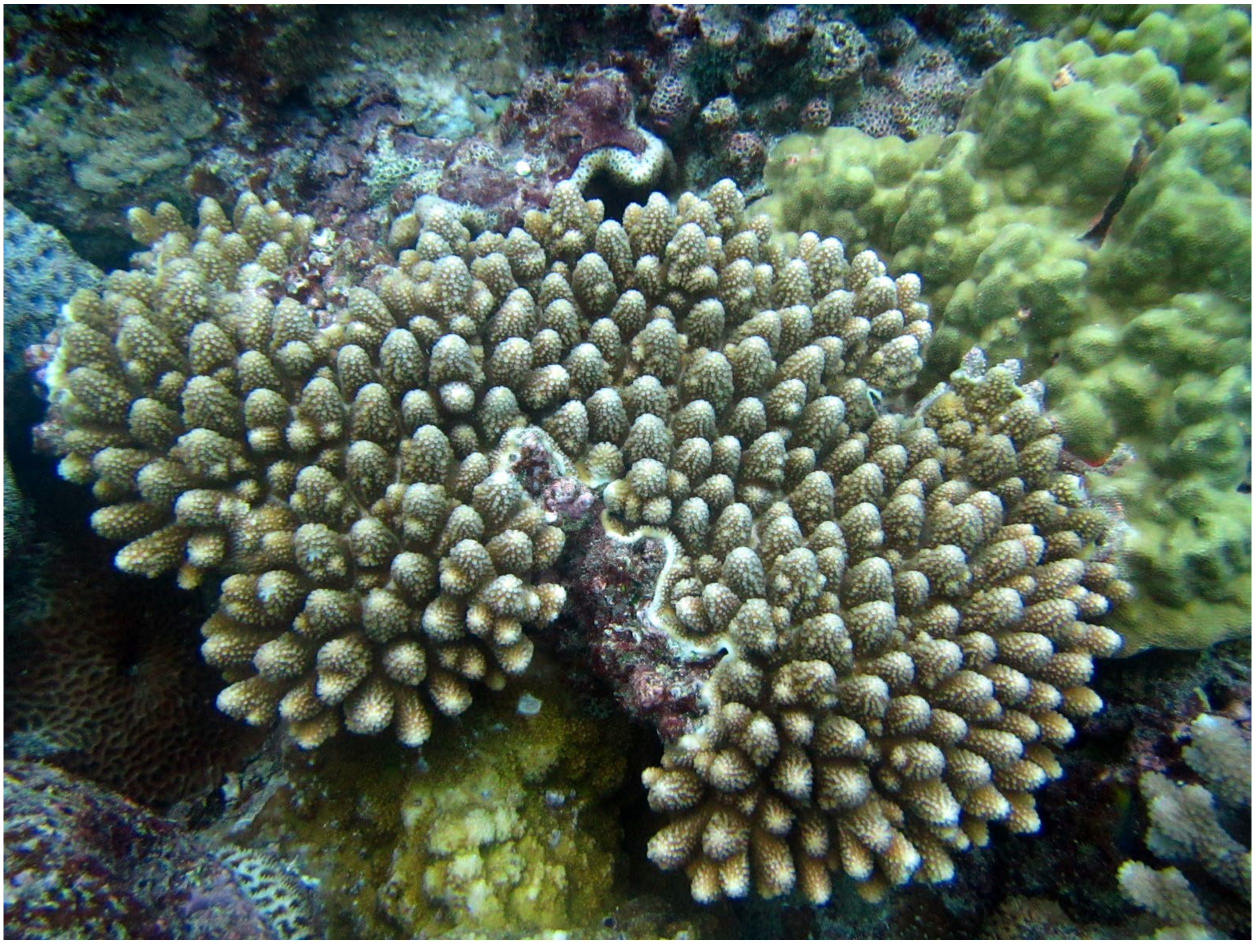
A closer photo of a colony of *Acropora abrotanoides*, showing the vertical branches and horizontal branches on the left. This colony has an unusually solid horizontal plate. Most colonies have separate branches growing horizontally.



A photo of the same colony of *Acropora abrotanoides*, showing both the vertical branches and horizontal fans of branches at the edge of the colony.

Acropora globiceps (Dana, 1846) Vulnerable Threatened

Colonies are digitate, with finger-shaped and size vertical branches growing upward, close together, parallel, uniform length, with few side branches and narrow spaces between them. The axial corallites are short tubes, and the radial corallites are smaller and sometimes are in rows. Colonies are usually less than a foot and a half in diameter but one colony in Wake is 3 feet diameter. The radial corallites are shorter and more uniform in length, and have thinner walls than on *Acropora retusa*.



A photo of a colony of *Acropora globiceps*.

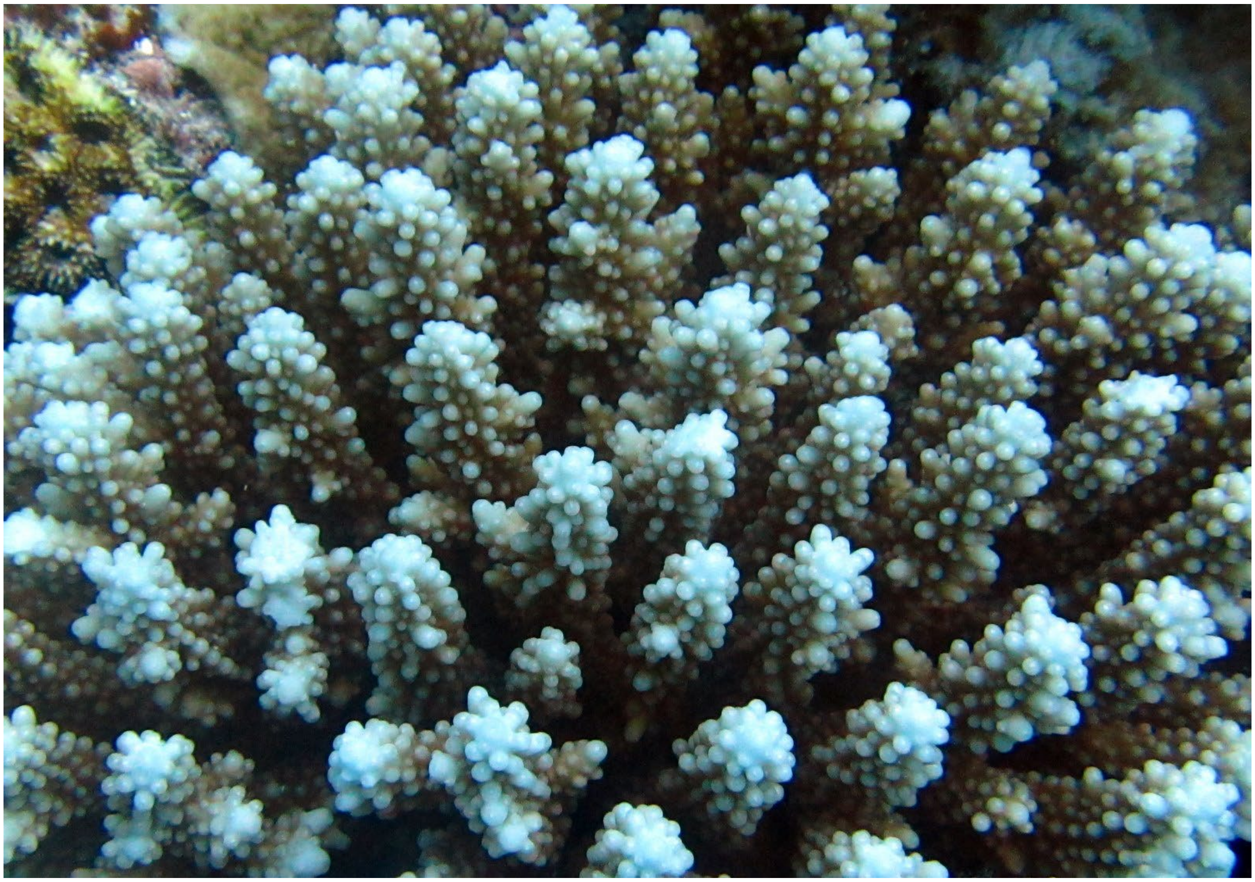
A close photo of *Acropora globiceps*. The axial corallites can be seen clearly.

Acropora retusa (Dana, 1946) Vulnerable Threatened

Colonies are digitate, with branches that are finger size and shape, branch little if any, grow vertically, are uniform in size, with little space between them. The corallites have thick walls and radial corallites extend to a variable degree, making the branches look prickly. The radial corallites are longer and more irregular in length, and have thicker walls than on *Acropora globiceps*.

A photo of a large colony of *Acropora retusa*.

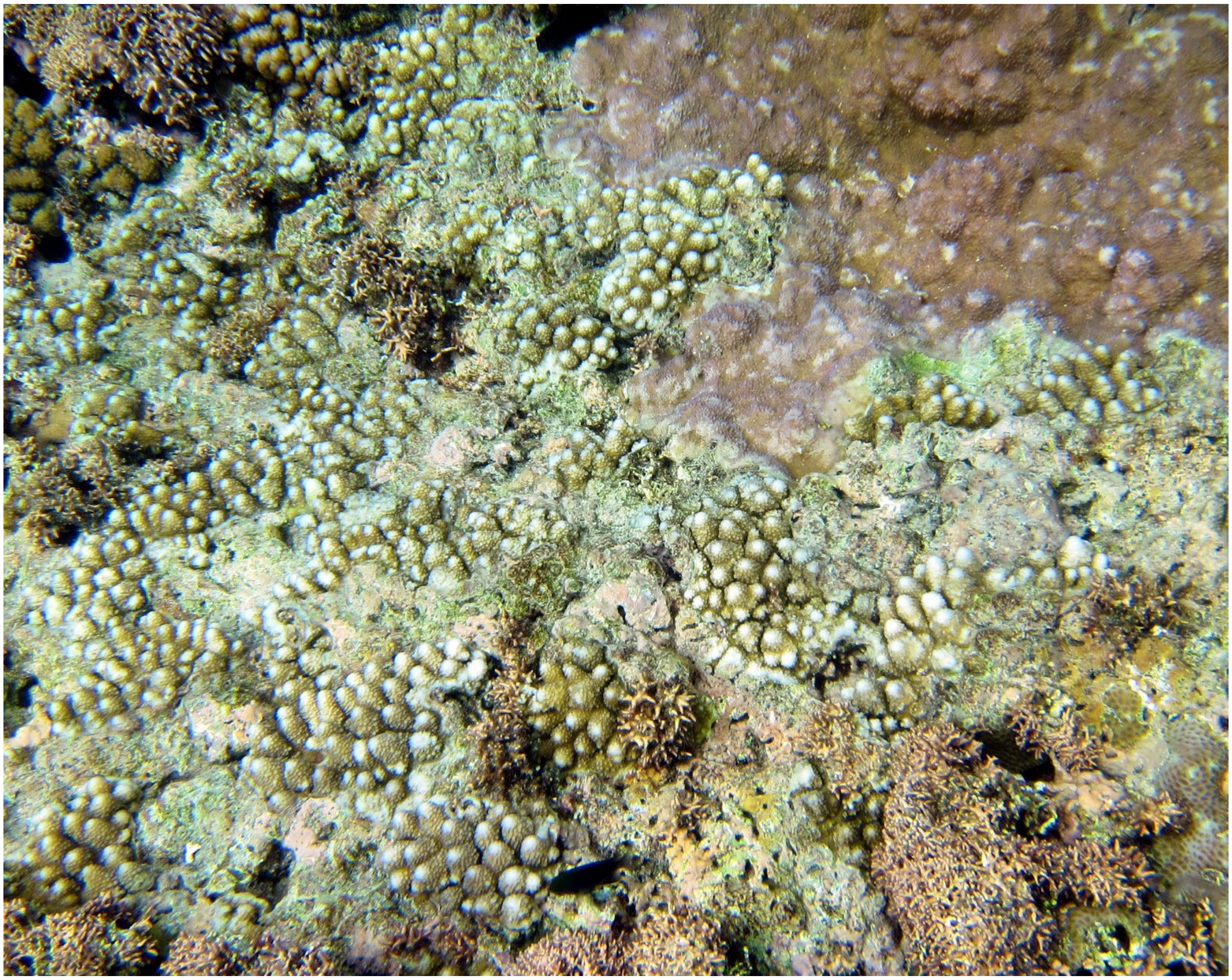
A closer photo of *Acropora retusa*.



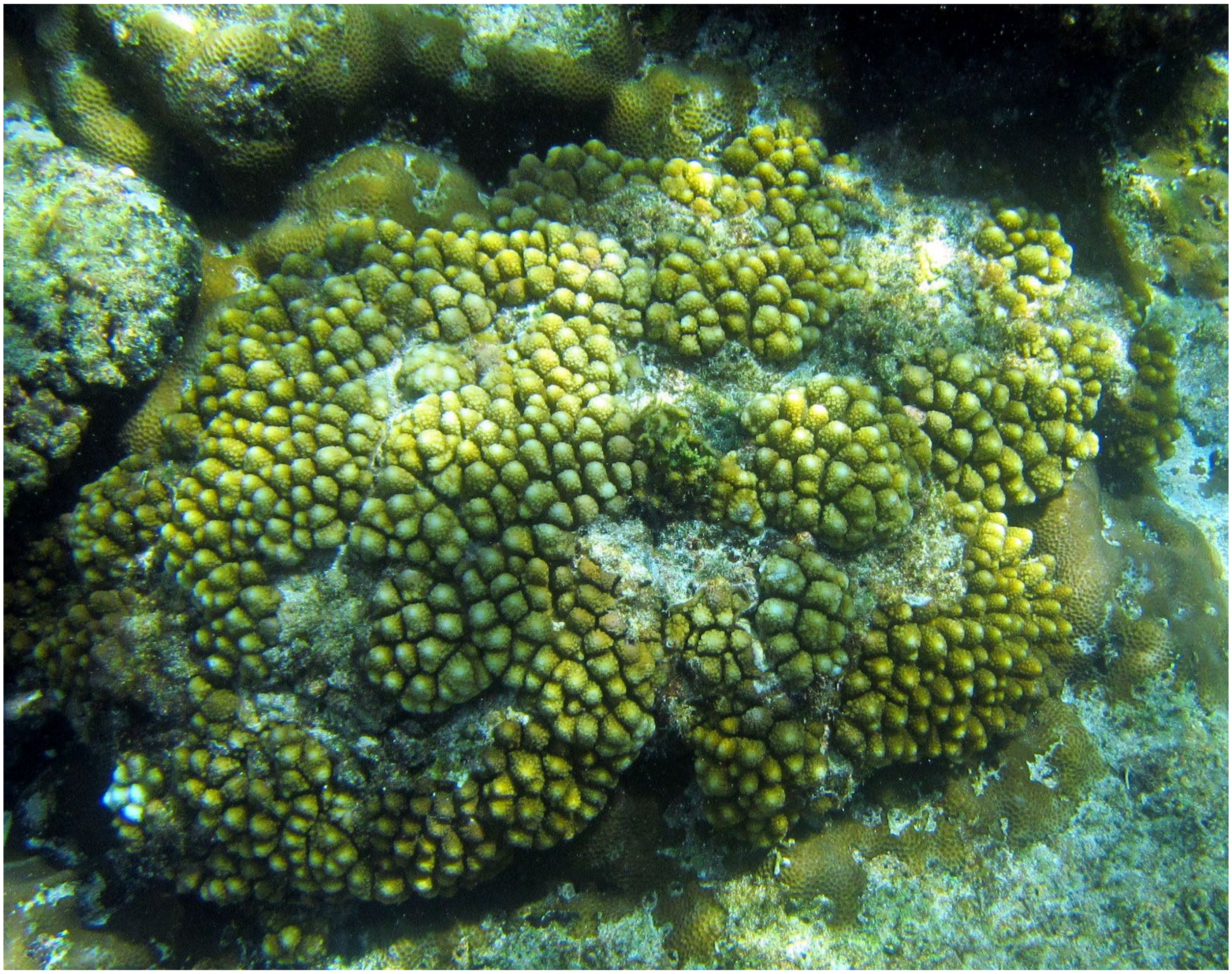
A close photo of *Acropora retusa*.

Acropora ocellata sensu Randall and Myers, 1983

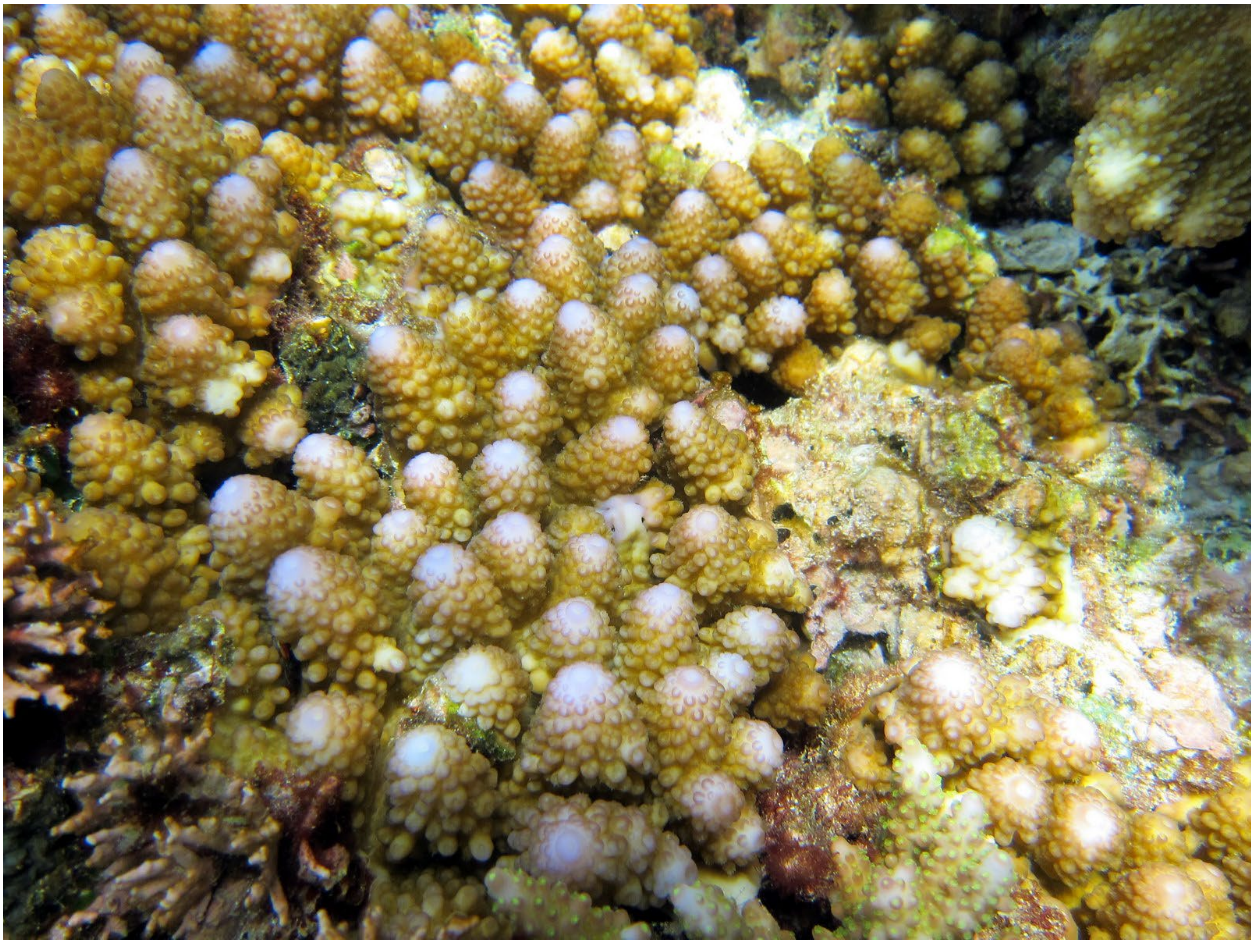
Colonies are digitate, with very short branches. Colonies often consist of a group of separate colonies. Most colonies are flat but a few may be dome-shaped. The branches taper smoothly. Branches often have cracks between them. Some colonies have large, dome-shaped axial corallites. The branches are shorter than on other digitate *Acropora*, and other species do not have groups of colonies like this. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A flat group of *Acropora ocellata sensu* Randall and Myers, 1983 colonies. Photo from the Marianas.



A colony of *Acropora ocellata sensu* Randall and Myers, 1983 that is somewhate dome-shaped. Photo from the Marianas.

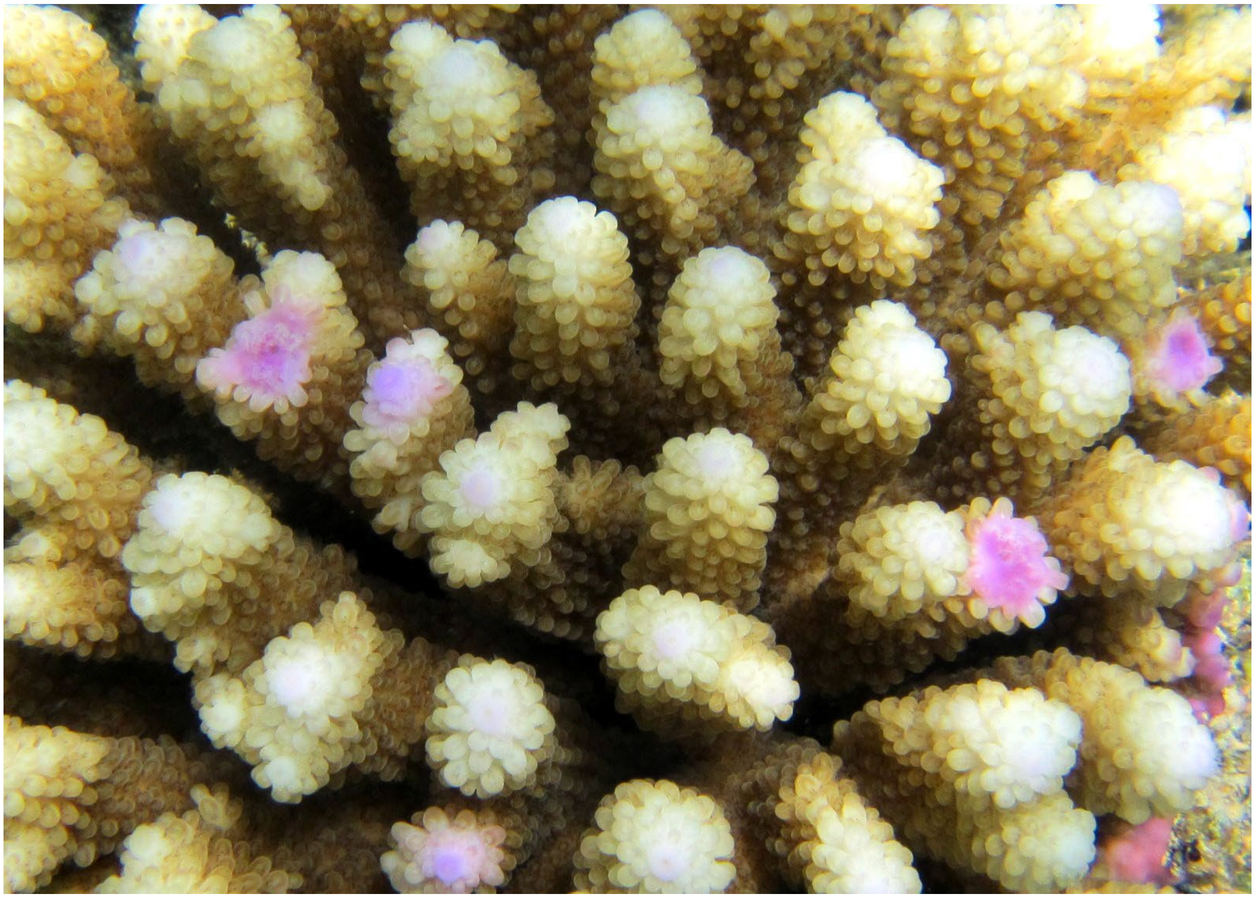


A close photo of a colony of *Acropora ocellata sensu* Randall and Myers, 1983. Photo from the Marianas.

Acropora cf. *nasuta* (Dana, 1846)

Colonies are digitate or corymbose, with parallel vertical branches. Radial corallites are uniform and open upward. The "cf." indicates some uncertainty about the identification. *Acropora digitfera* has larger colonies in shallower water, with blue branch tips. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

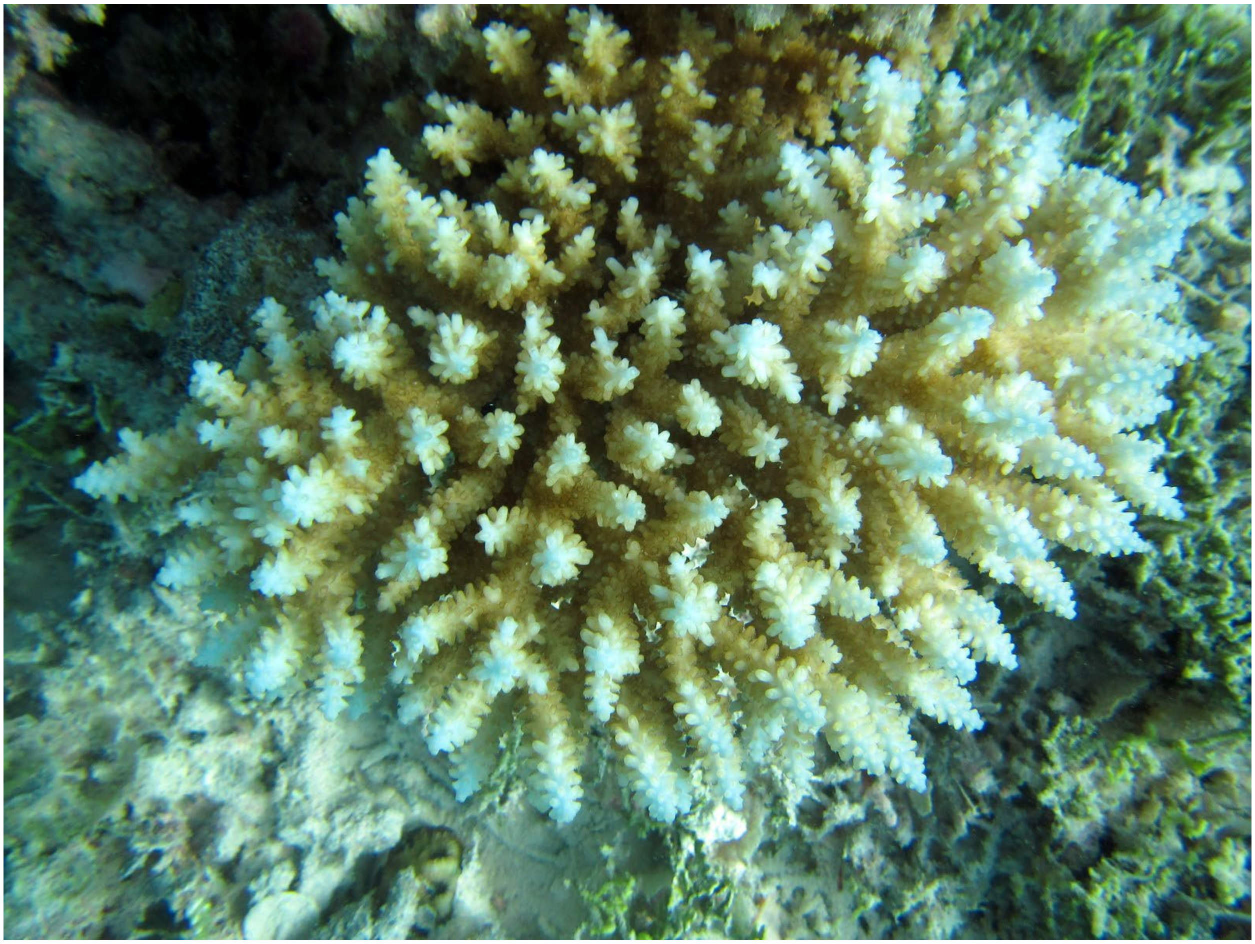
A colony of *Acropora* cf. *nasuta*. The purple areas are injuries, perhaps a fish bite. Photo from the Marianas.



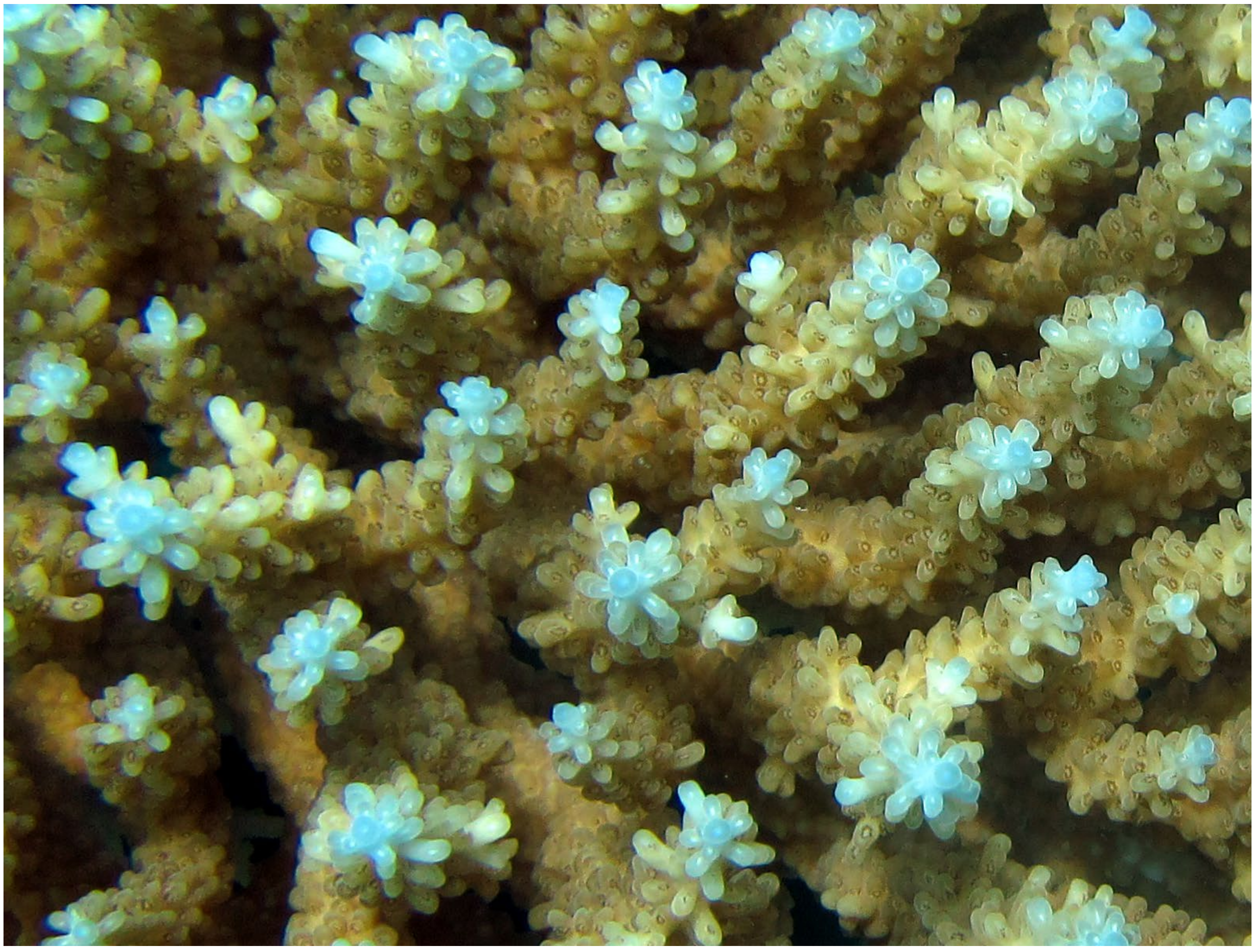
A close-up photo of *Acropora* cf. *nasuta*. This photo is from the Marianas.

Acropora cerealis (Dana, 1846) "corymbose"

This species forms colonies with vertical or radiating branches which are thin but have long tubular radial corallites. The axial corallites are also small tubes. The radial corallite openings are angled towards the branch tip. This species has smaller branches than *Acropora nasuta* or *Acropora polystoma*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Acropora cerealis*. This photo is from the Marshall Islands.

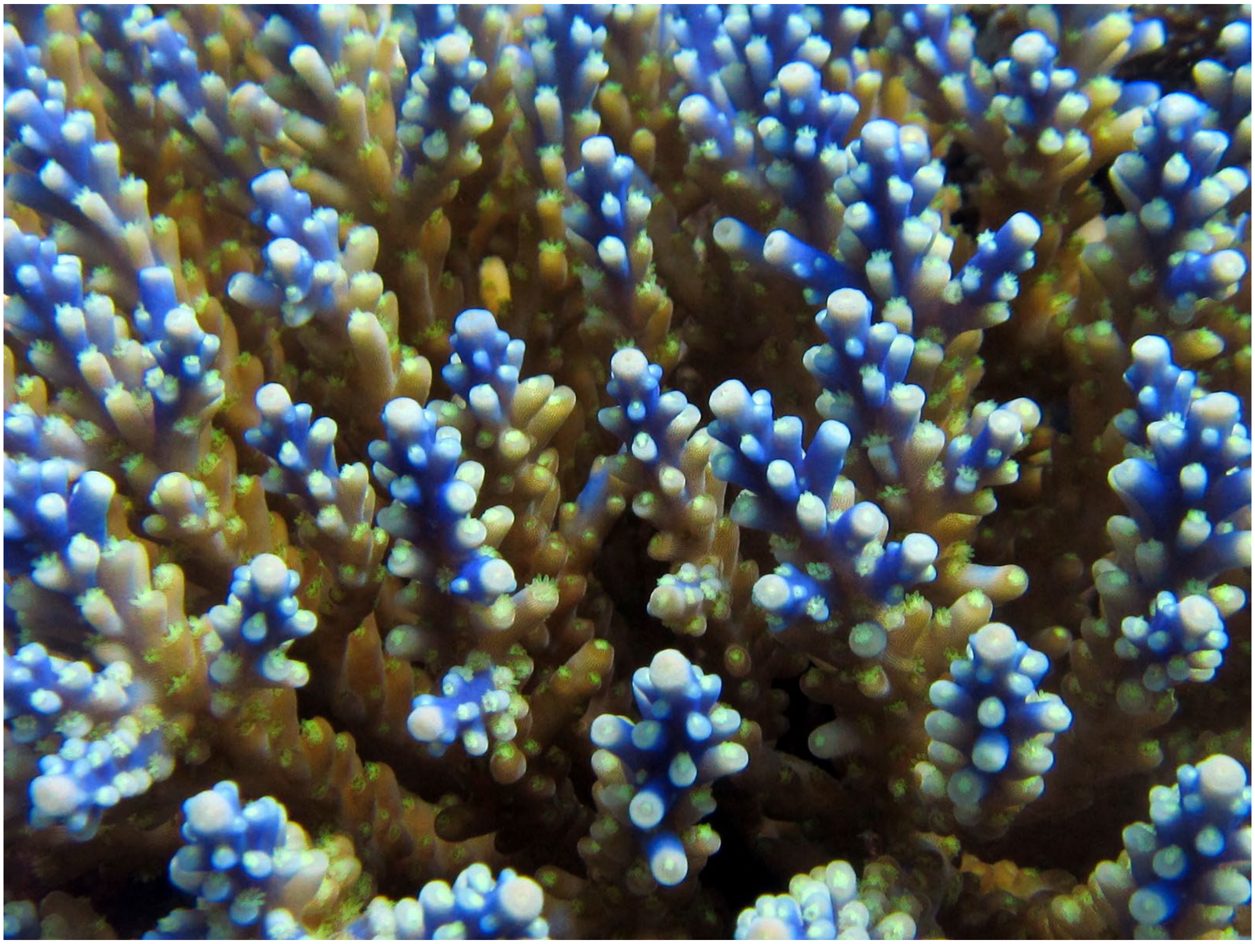


A close-up picture of *Acropora cerealis*, showing the axial and radial corallites. This photo is from the Marshall Islands.

Acropora cf. *valida* (Dana, 1846)

Colonies are corymbose, with pencil thick branches that are vertical or radiate. Axial and radial corallites are tubular. Radial corallites are short and rounded. Colonies are blue or purple between corallites. *Acropora nana* is not purple, and radial corallites project farther. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

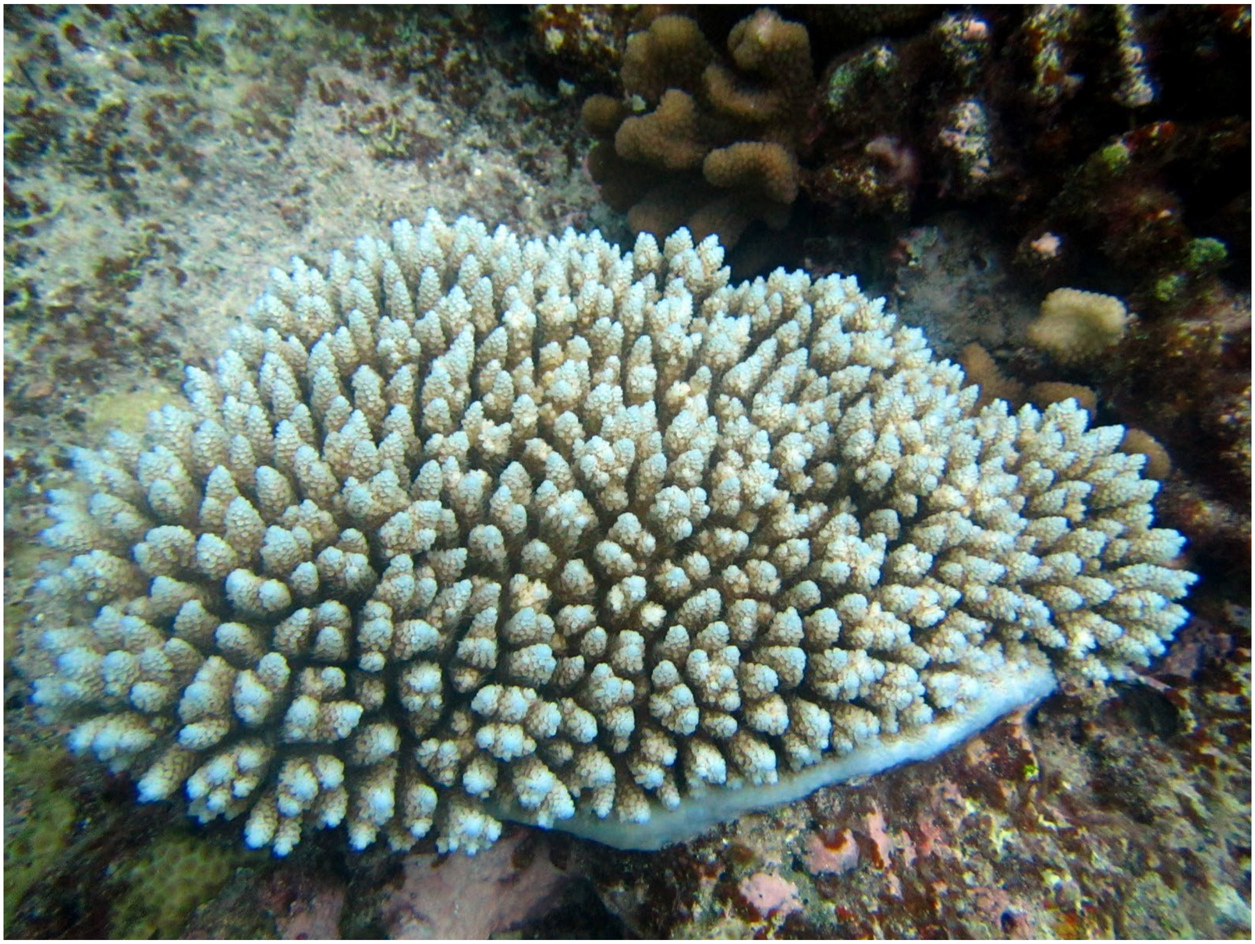
A colony of *Acropora valida*. This photo is from the Marianas.



A close-up photo of *Acropora valida*. This photo is from the Marianas.

Acropora surculosa (Dana, 1846)

Colonies are corymobose, with pencil-thin or thinner branches growing vertically and close together. There are few side branches, but a few branches appear to be in pairs or multiples that are fused together. Radial corallites are cup-like. Often long tentacles can be seen in the cracks between branches. The branches are thinner than *Acropora globiceps* and *Acropora retusa*.



A photo of a colony of *Acropora surculosa*.

A closer photo of a colony of *Acropora surculosa*. Some of the branches are fused together.

A close-up photo of a colony of *Acropora surculosa*. Some long white tentacles can be seen between branches.

Acropora aculeus (Dana, 1846)

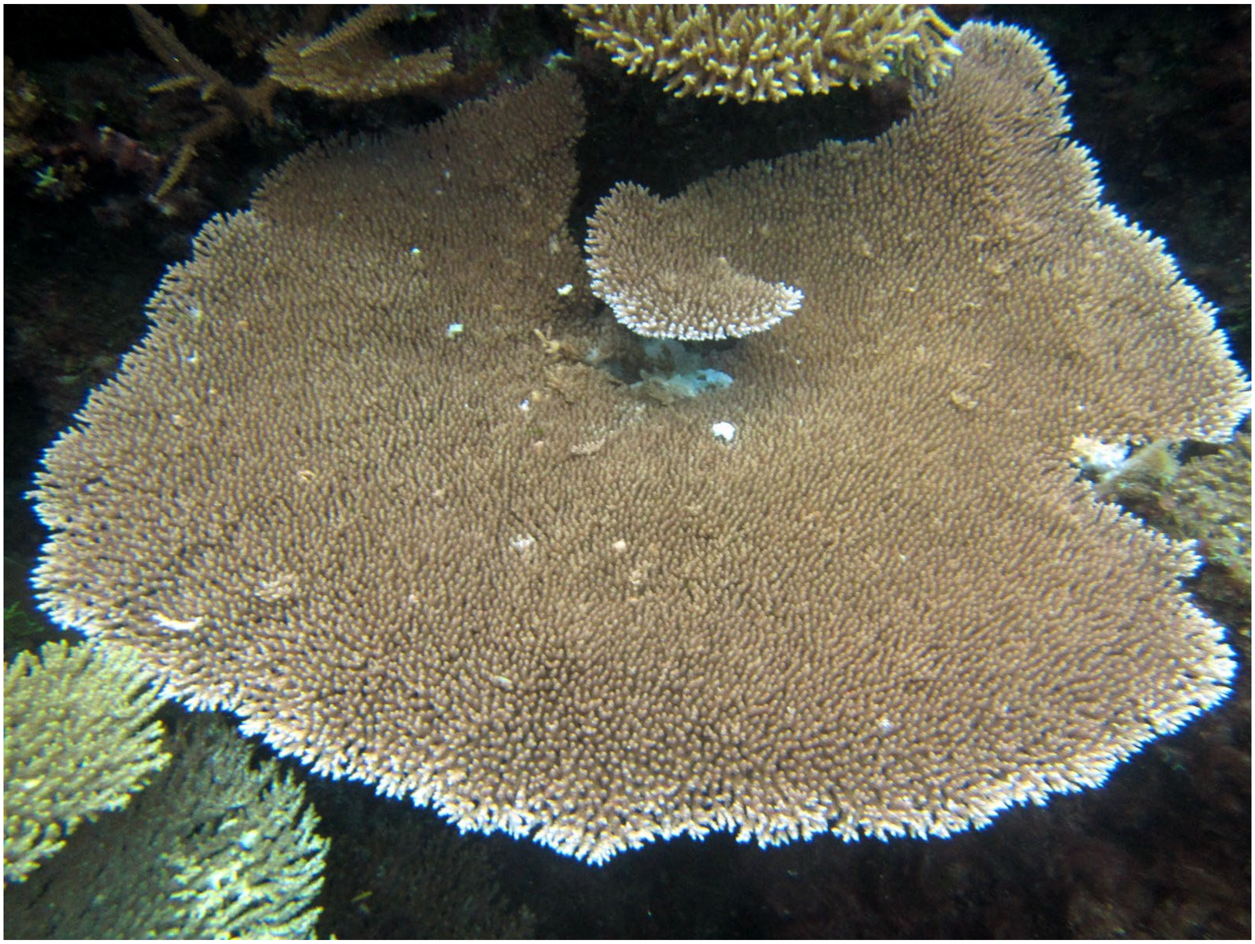
Colonies are corymbose, but with significant numbers of small side branches and extended radial corallites. Colonies are bushier than *Acropora diversa* and *Acropora delicatula*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

A colony of *Acropora aculeus*. This photo is from the Marianas.

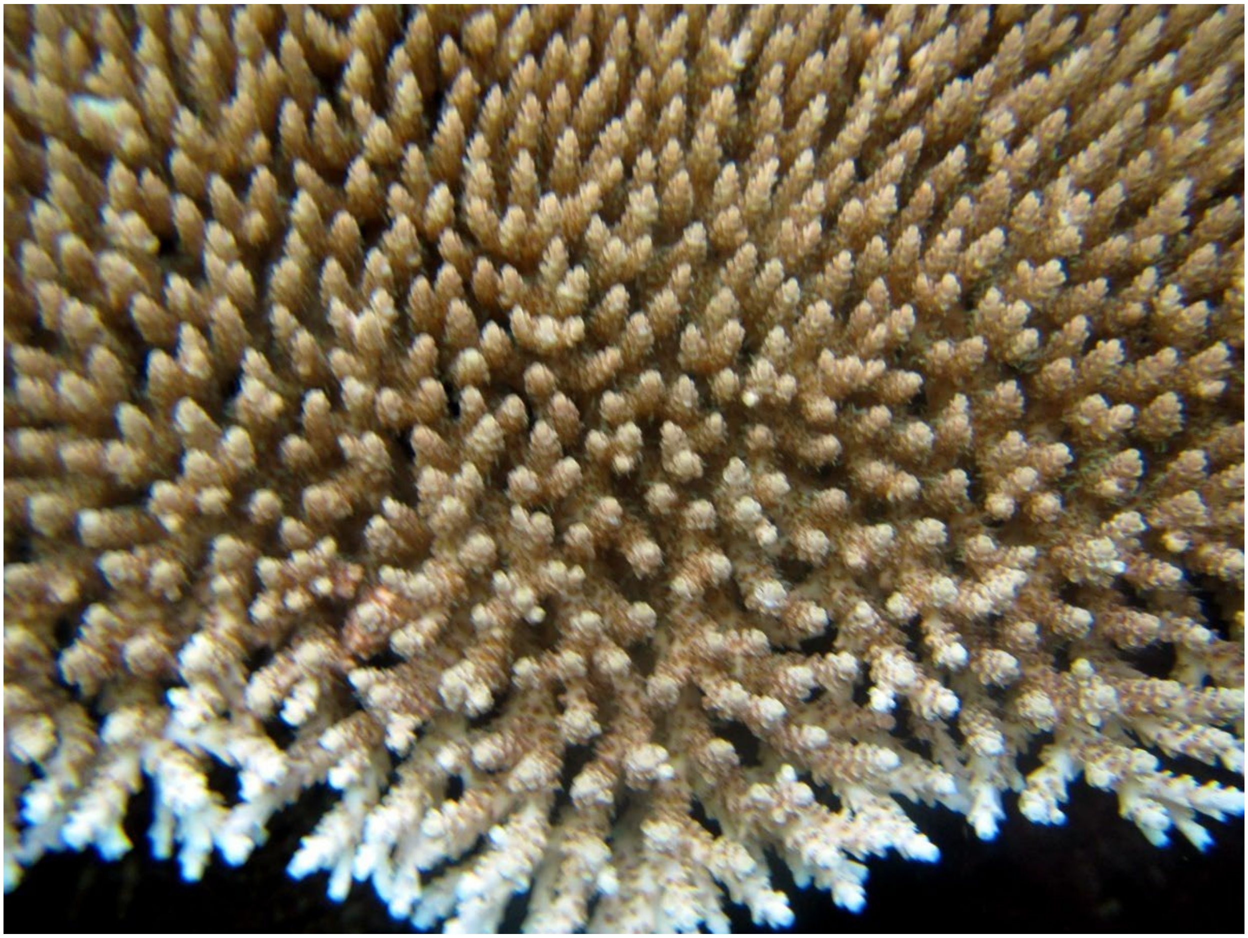
A closeup photo of *Acropora aculeus*. This photo is from the Marianas.

Acropora hyacinthus (Dana, 1846) "table coral"

This species forms a "table coral." A table coral has a central cylindrical stem that holds up a wide flat top. The top is covered with small or tiny vertical branchlets. *Acropora hyacinthus* can form large tables. The branchlets are small but fairly thick with leafy corallites projecting from the branchlets like petals on a flower. The branchlets are thicker than on *Acropora cytherea*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A large *Acropora hyacinthus* table. This photo is from the Marshall Islands.



A closer photo of the branchlets on the upper surface of an *Acropora hyacinthus* table. This photo is from the Marshall Islands.

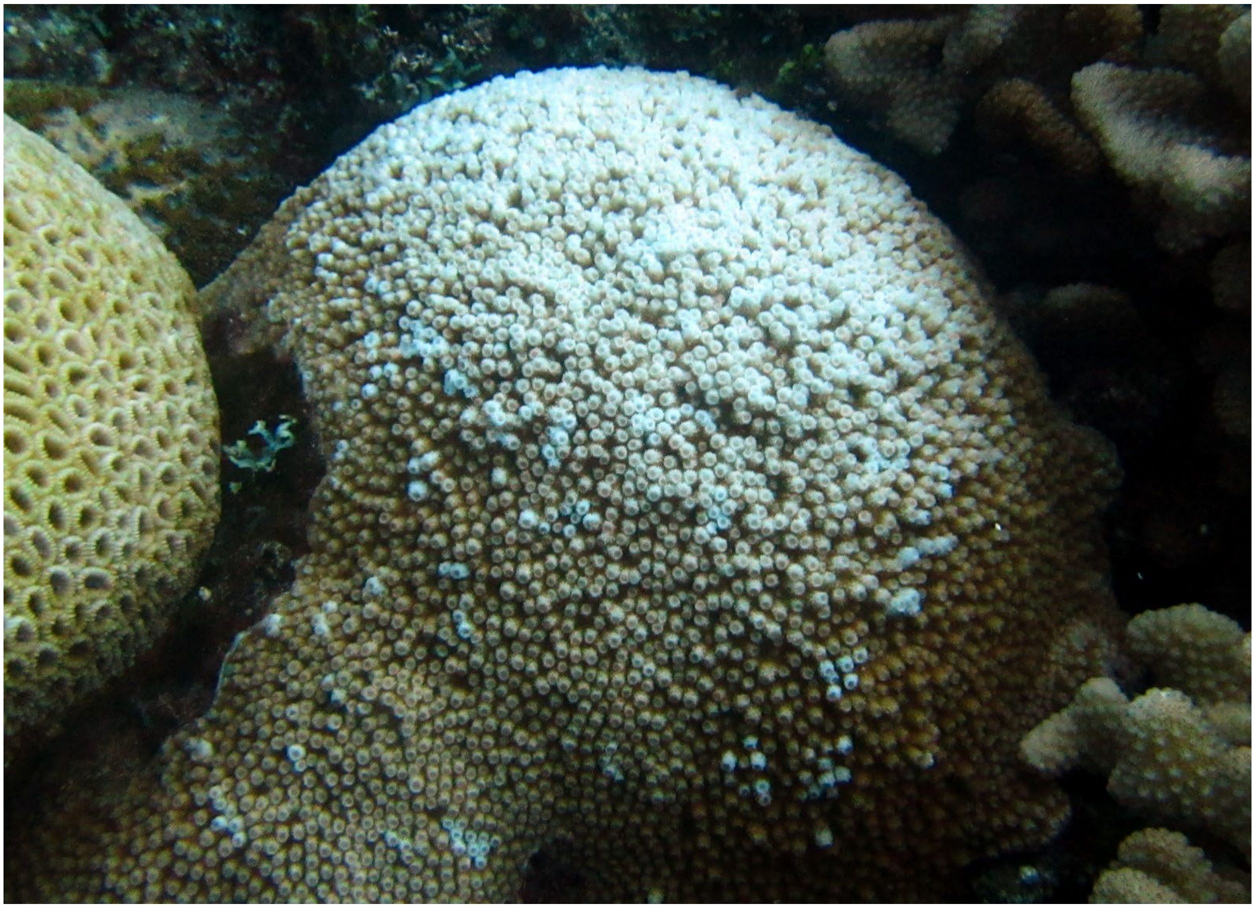
A close-up photo of an *Acropora hyacinthus* table. The axial corallites and leafy radial corallites can be seen. This photo is from the Marshall Islands.

Astreopora

Colonies are usually massive, but can be encrusting or plates. Corallites cover the surface and are small and shaped like volcanoes. The hole where the polyp lives is the size of a pencil or pen point (1 mm diameter) and the outside base is about 3-4 times as large.

Astreopora myriophthalma (Lamarck, 1816)

Colonies are massive, with uniform little volcano-shaped corallites covering the surfaces.

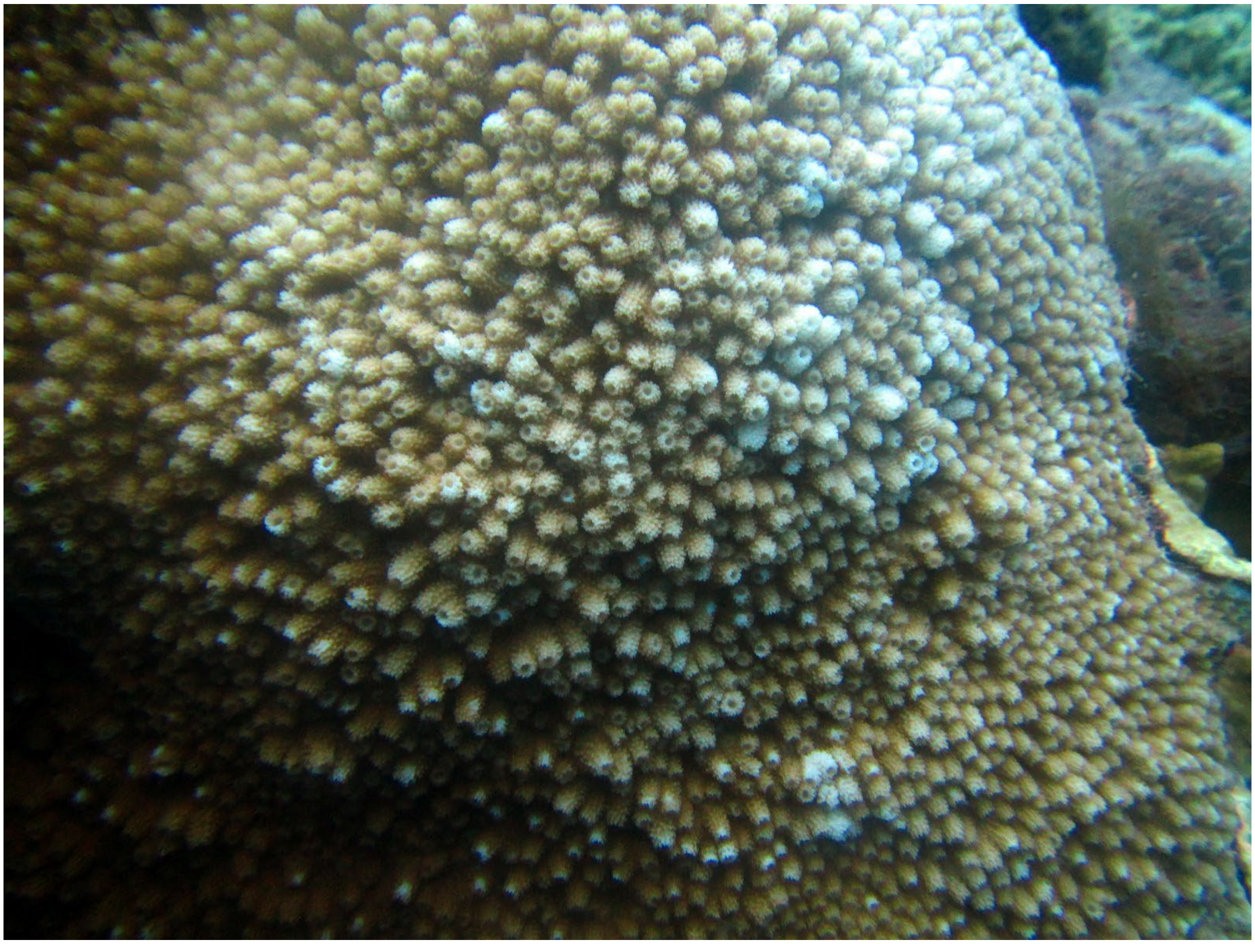


A photo of an *Astreopora myriophthalma* colony. The white may be bleaching.

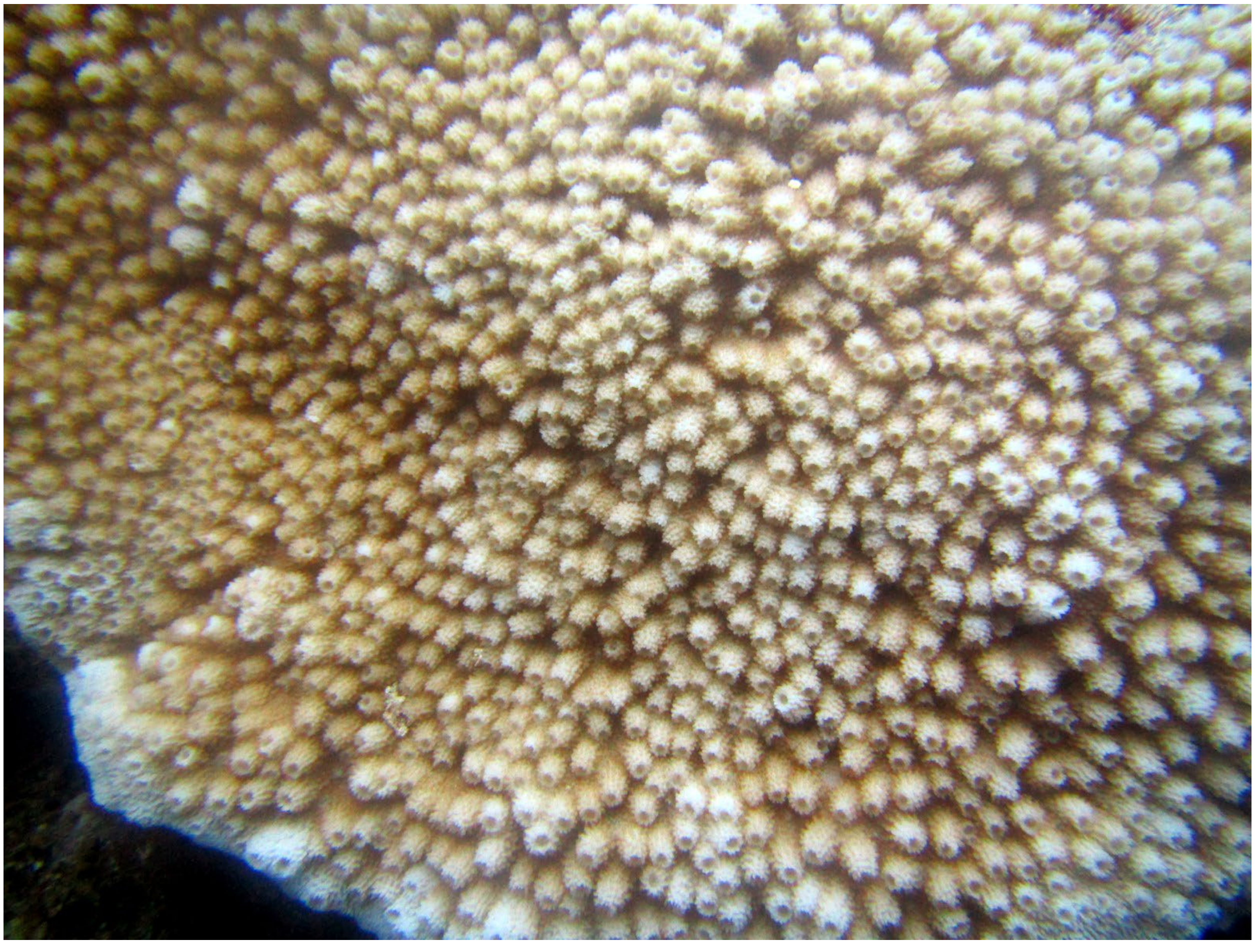
A close-up photo of *Astreopora myriophthalma*.

Astreopora cucullata Lamberts, 1980

Colonies are massive. Corallties are uniform and project at right angles from the surface on the top of the colony, but are inclined downward on the sides. All corallites on *Astreopora myriophthalma* project at right angles from all surfaces.



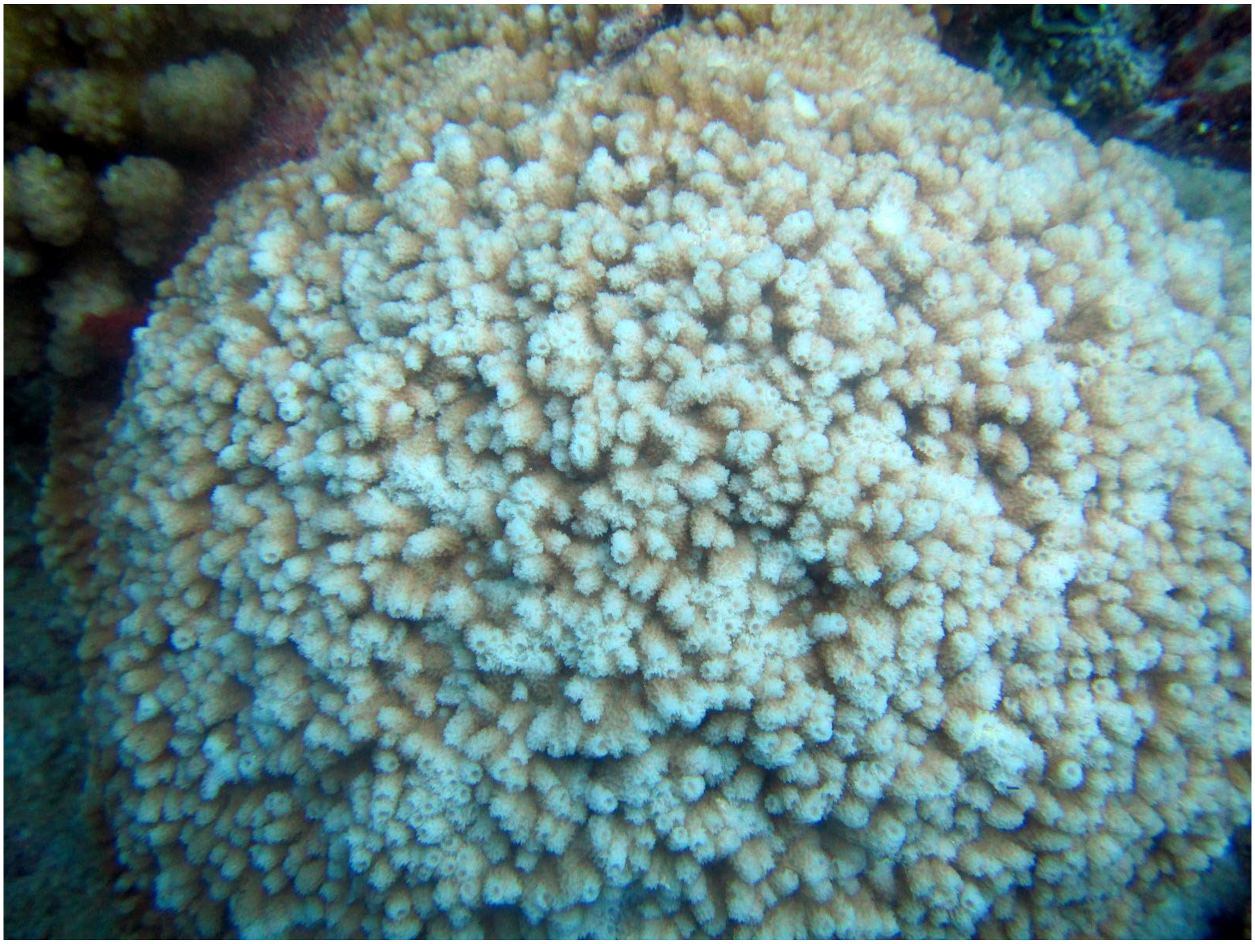
A photo of a colony of *Astreopora cucullata*.



A photo of the side of a colony of *Astreopora cucullata*, showing the downwardly inclined corallites.

Astreopora gracilis Bernard, 1896

Colonies have corallites that are variable in size, length, and orientation. Corallites in other species of *Astreopora* are not variable in size, length and orientation.

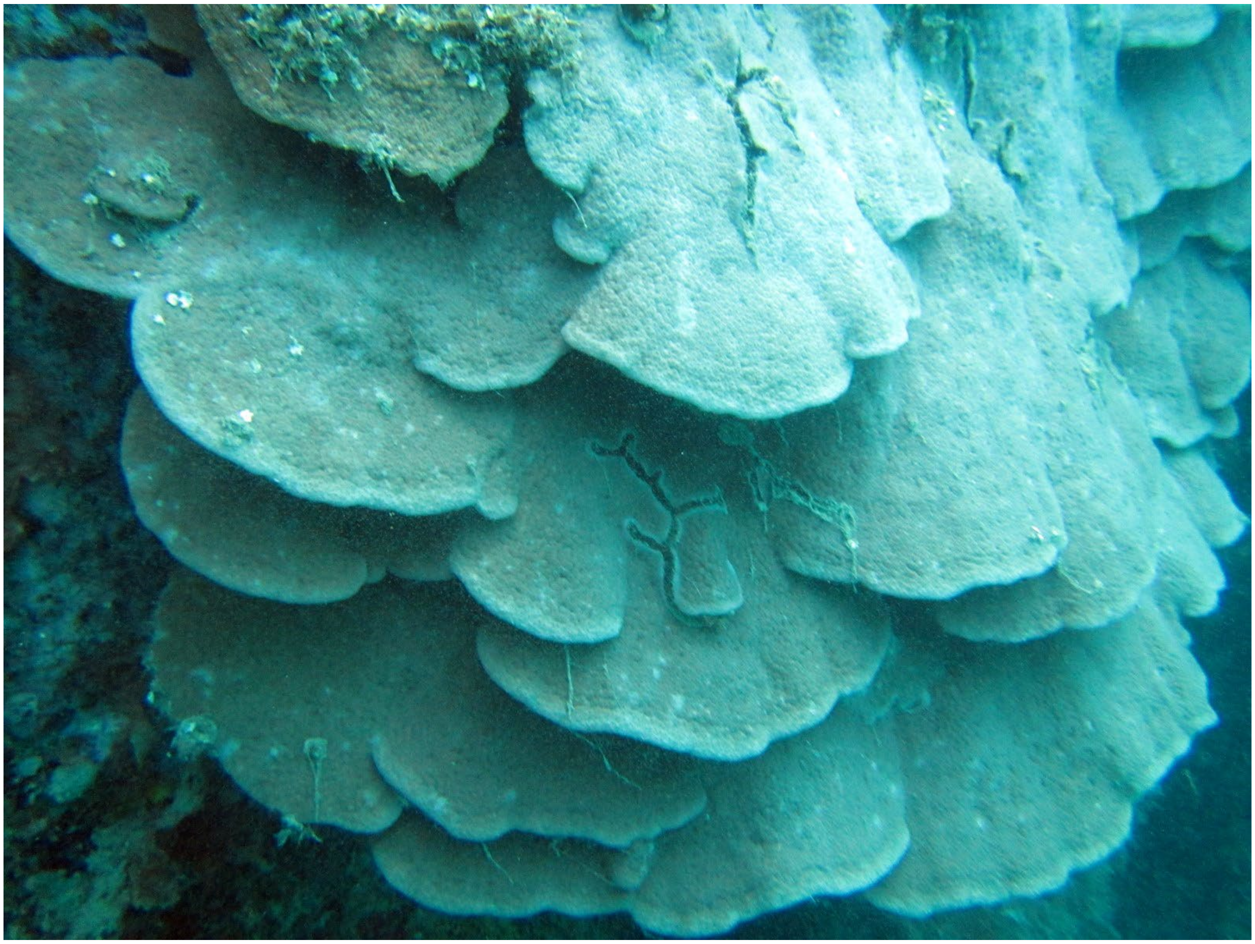


A photo of a colony of *Astreopora gracilis*.

A close-up photo of *Astreopora gracilis*.

Astreopora randalli Lamberts, 1980

Colonies are encrusting and if on a steep slope have a plate lower edge. On a slope plate lower edges can overlap. Corallites have radiating rows of spines on their sices. Colonies form plates on lower edges on steep slopes, while *Astreopora expansa* forms stacks of plates when it is not on a slope. Corallites on *Astreopora randalli* have radiating rows of spines unlike on *Astreopora expansa*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A large colony of *Astreopora randalli*. This photo is from the Marianas.

A close-up photo of *Astreopora randalli*. This photo is from the Marianas.

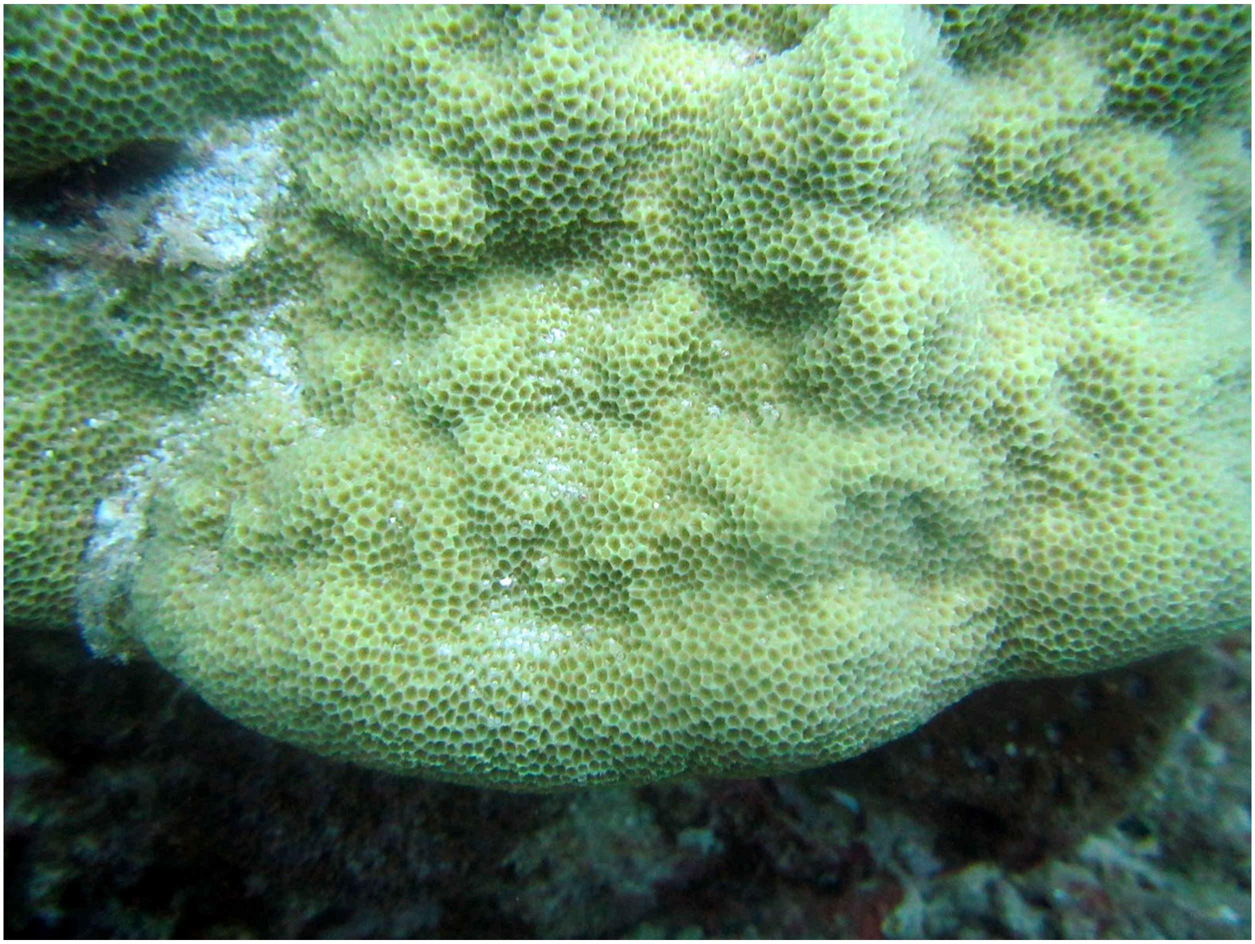
Porites

Colonies can be massive, encrusting, plates, or branching. Massive colonies can reach very large sizes (roughly house size) but all corals start out tiny. The corallites are tiny, about pencil or pen point (1 mm diameter), and are usually close together.

Massive Porites

Colonies are usually hemisphere or helmet-shaped and range from tiny to gigantic. The surface of colonies is often lumpy. A close look at the surface reveals the tiny corallites. There are at least a half dozen species that can get very large, and several others that do not get large. These are the most difficult of all coral species to identify, either in the water or under the microscope. Large colonies can reach at least 700 years old and very likely 1000. Xrays reveal annual bands in the skeletons like in trees. Large colonies can be drilled for cores that hold records of temperatures and what was in the water over their lifespan.

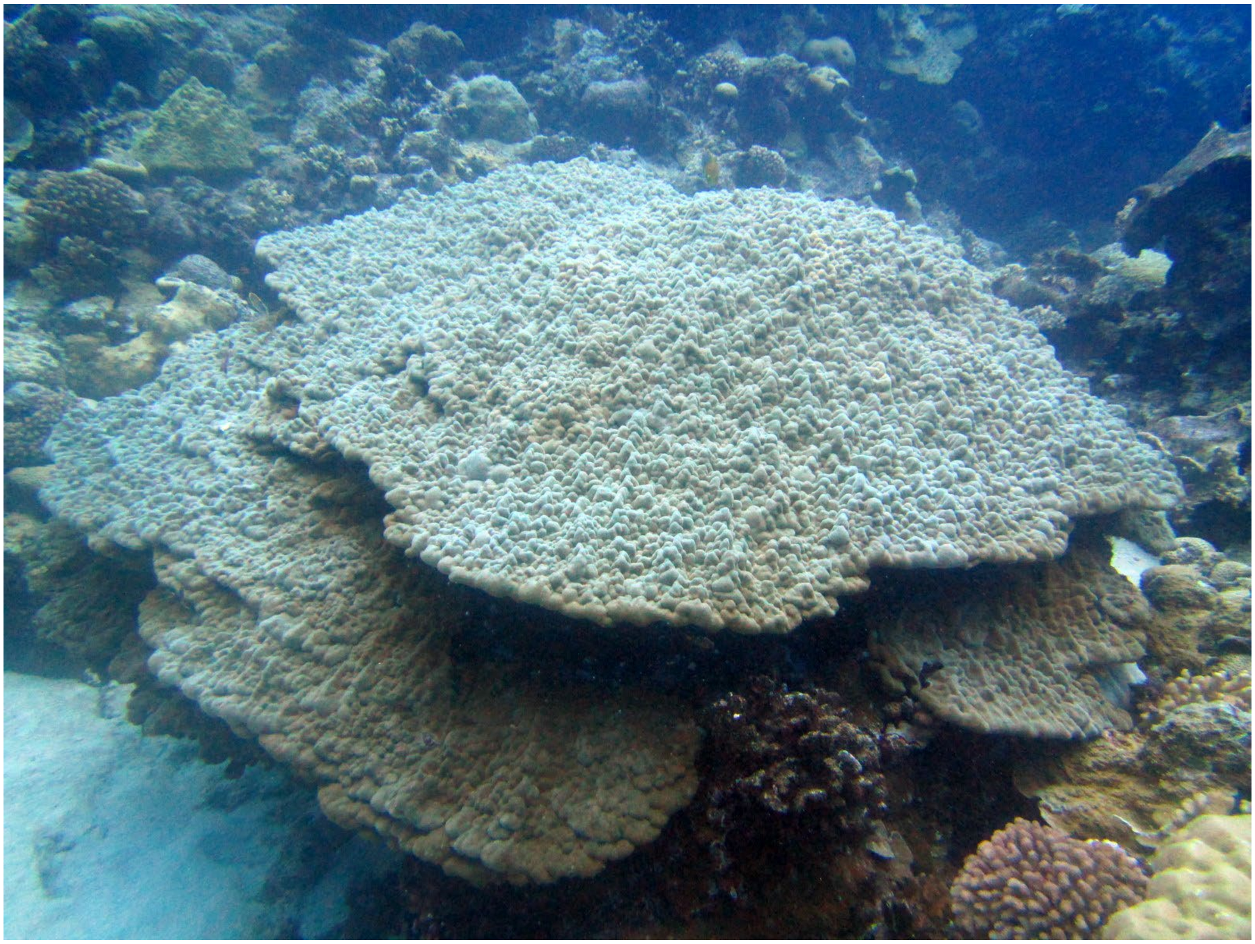
A large colony of massive *Porites*.



A close-up photo of the surface of a massive colony of *Porites*, showing the tiny corallites.

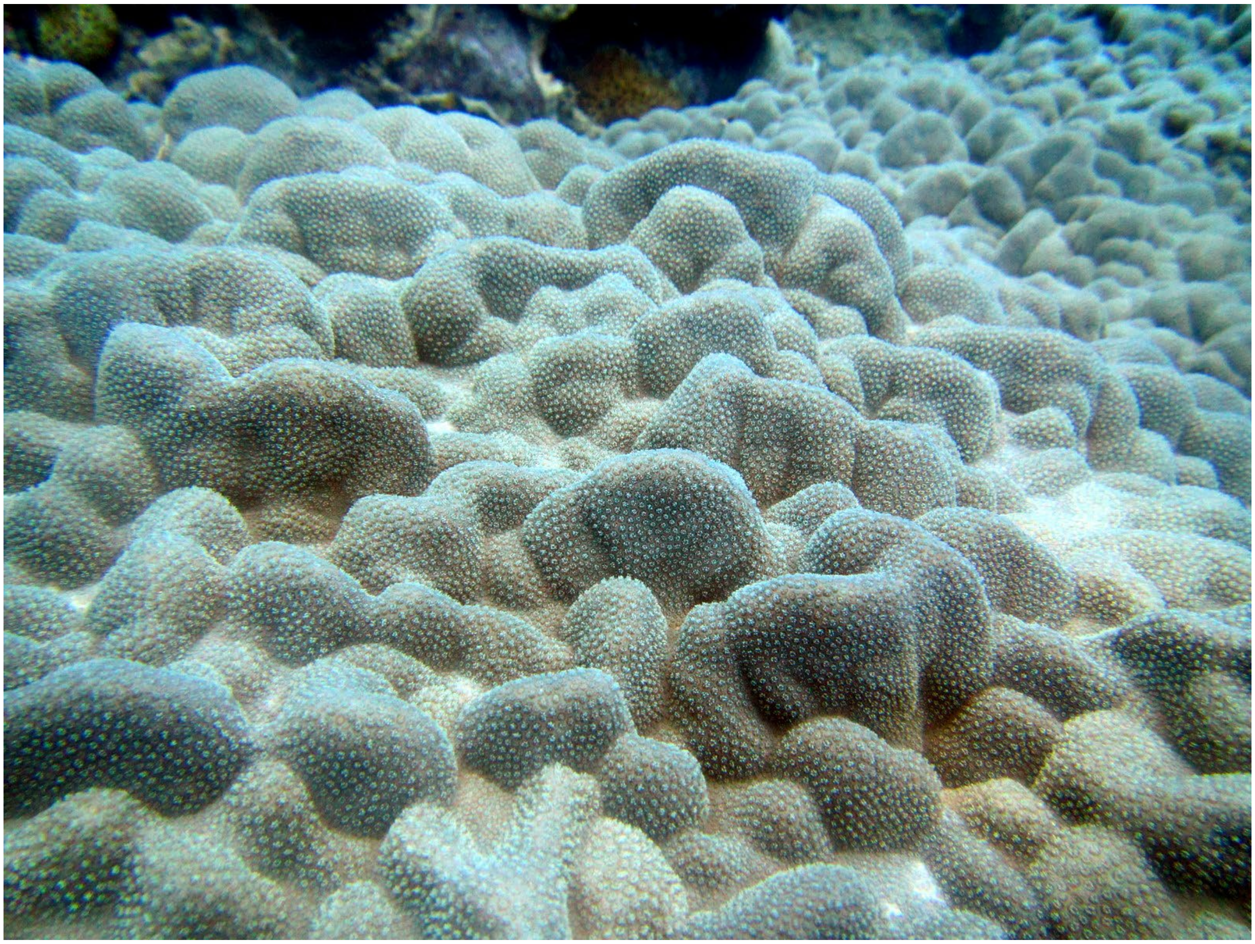
Porites evermanni Vaughan, 1907

Colonies can get large and may be hemispherical to low dome-shaped. The surface is covered with rounded knobs that are fairly uniform in size and shape. The tentacles are almost always partly extended as a tuft of tentacles in the center of the corallites. Colonies are usually brown. This is one of only a couple of massive *Porites* species that get large and can be identified in the water.



A photo of a large colony of *Porites evermanni*, which is unusual in having two layers.

A photo of the lumps on *Porites evermanni*.

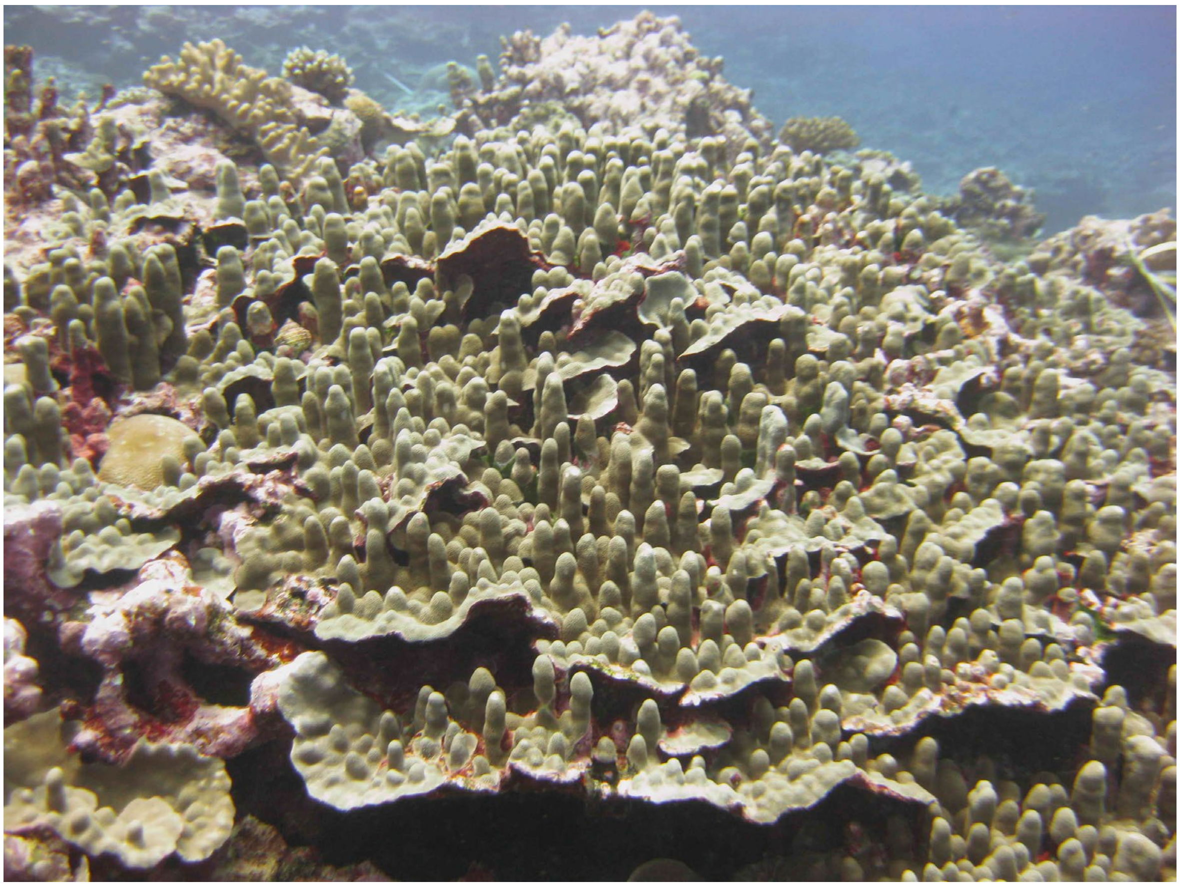


A closer photo of *Porites evermanni* showing the lumps with the polyp tentacles extended.

A close-up photo of *Porites evermanni* showing the polyp tentacles extended.

Porites lichen Dana, 1846

This coral on reef slopes forms thin plates with rounded knobs that can grow into finger-like columns, which usually are not fused and typically are different heights. The surface is fuzzy with tufts of tentacles. In backreef pools, the knobs and columns are close together or fused together with just a small plate at the lower edge. Some corallites are in rows, especially on plates. Colonies do not grow as large as *Porites cylindrica* and are not as common. Colonies have thin plate bases and tentcles extend as tufts unlike on *Porites cylindrica*. The tops of columns are not white like on *Porites annae* and colonies are not dark brown. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

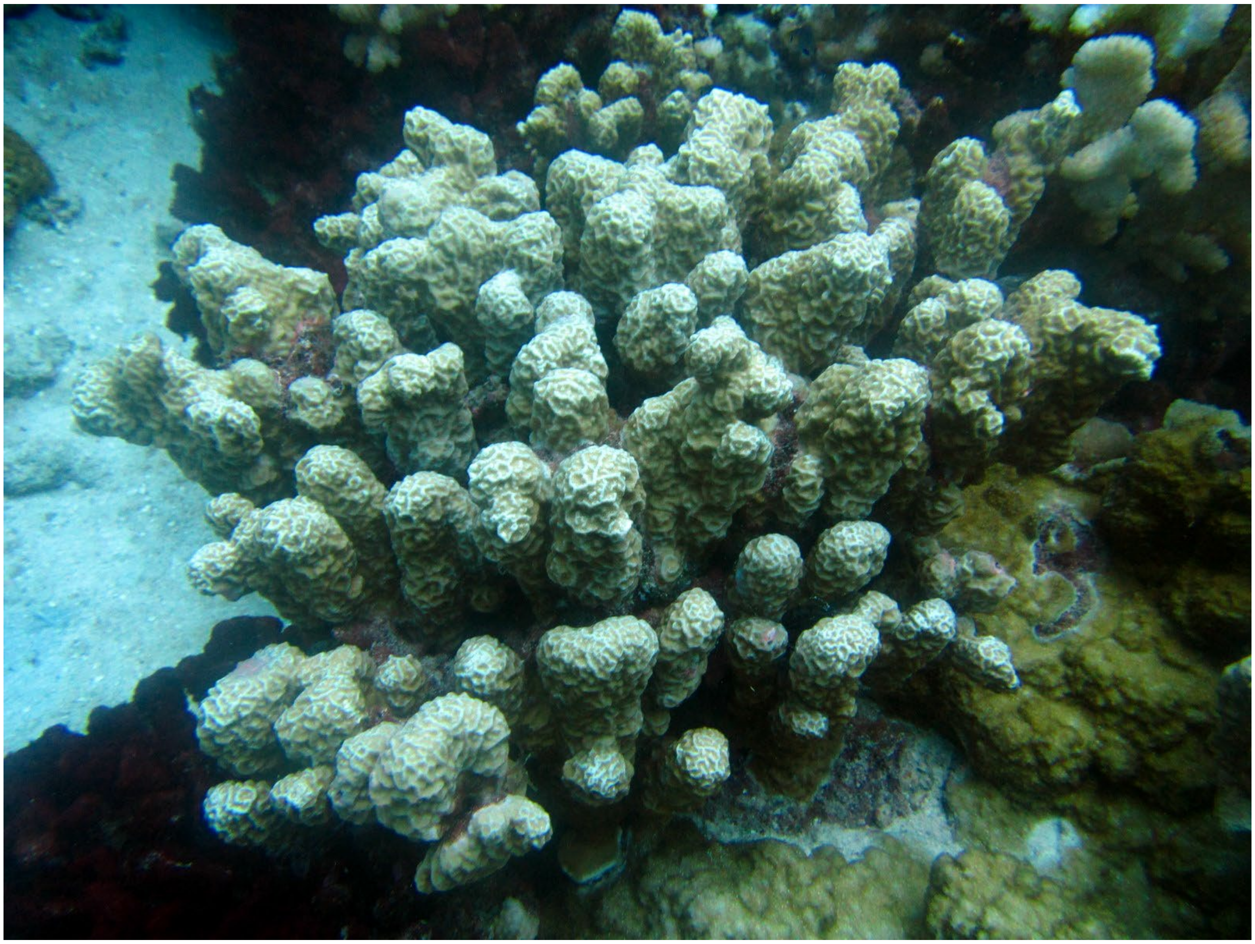


A large colony of *Porites lichen.* This photo is from American Samoa.

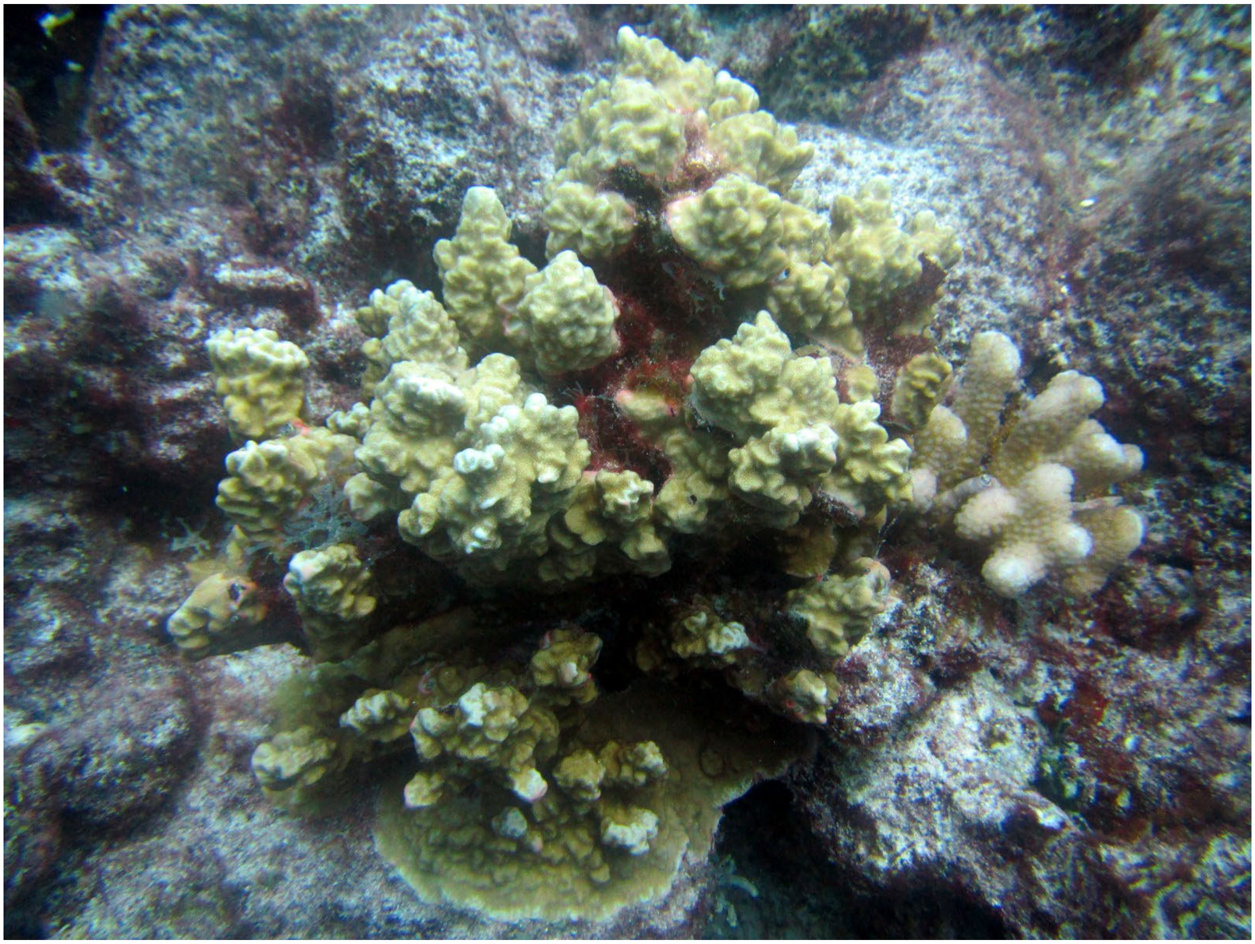
A close-up of a colony of *Porites lichen* on the reef slope, showing the tufts of tentacles. This photo is from American Samoa.

Porites rus (Forskål, 1775)

Colonies are usually composed of a combination of thin plates at the base of the colony and irregular columns growing up from the top of the colony. Surfaces have tiny winding ridges on them. The corallites can be seen only as dots.



A colony of *Porites rus* that consists only of columns.



A photo of an irregular colony of *Porites rus*.

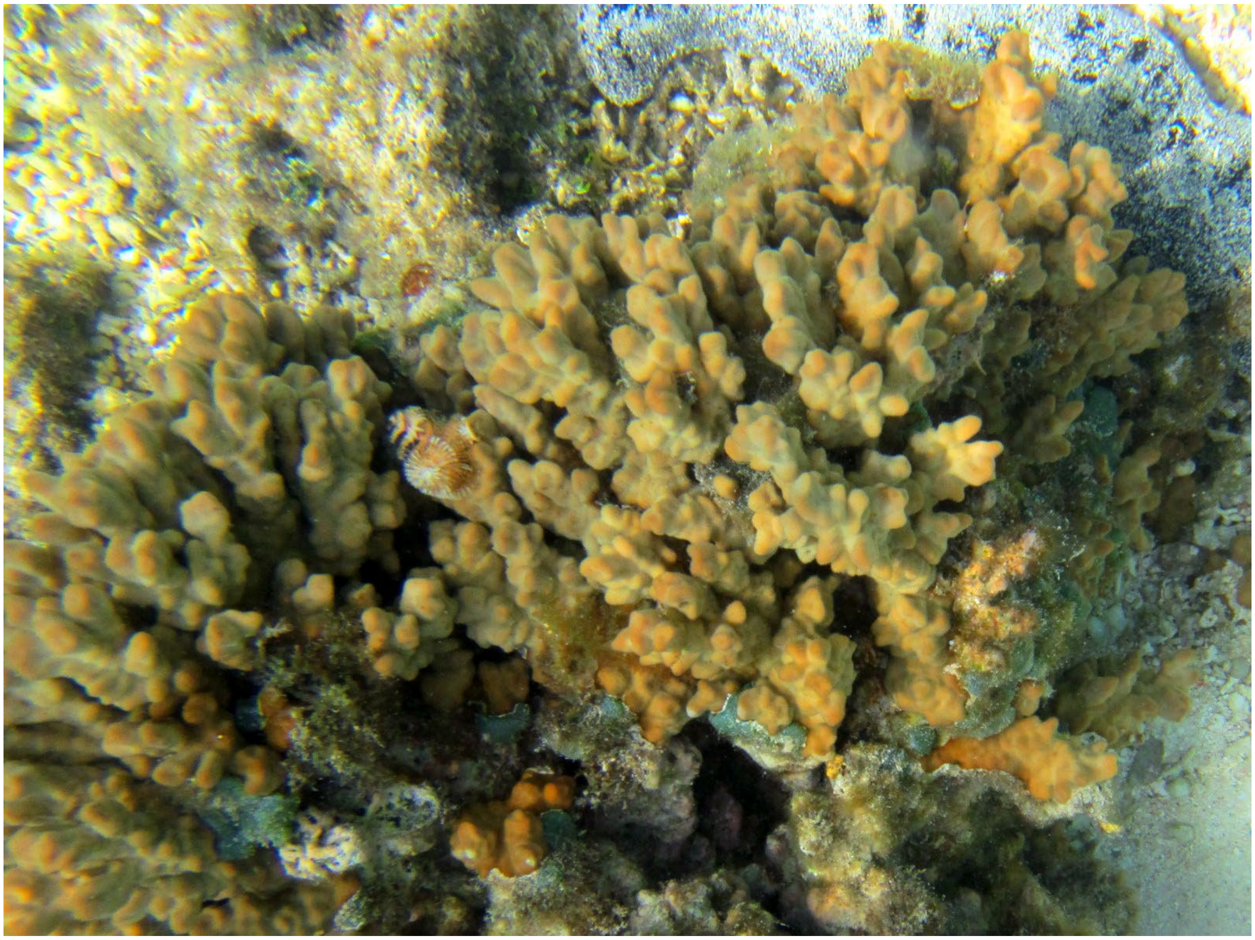
A close photo of *Porites rus*. The tiny dots are corallite centers.

Psammocora

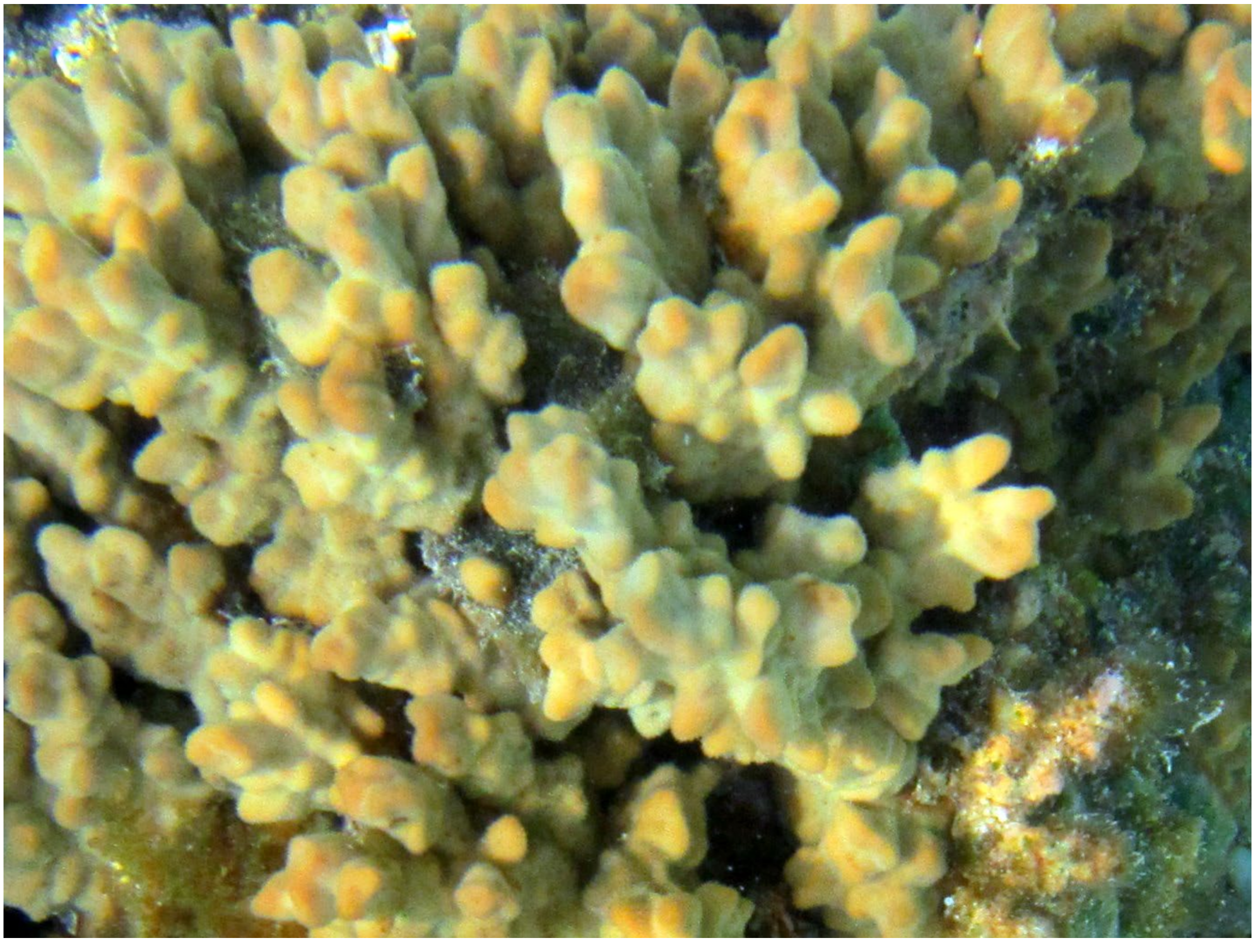
This genus has corallites that are small and usually can't be made out in the living coral. Colonies can be encrusting, columnar, branching or massive. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

Psammocora contigua (Esper, 1797)

Colonies are not large and branches are around finger size. They are irregularly lumpy and sometimes have flattened branch tips. They are usually a shade of brown. There are no visible corallites unlike most corals. *Psammocora stellata* has more cylindrical branches that are smaller and most other *Psammocora* are very different colony shapes. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Psammocora contigua*. This photo is from the Marianas.



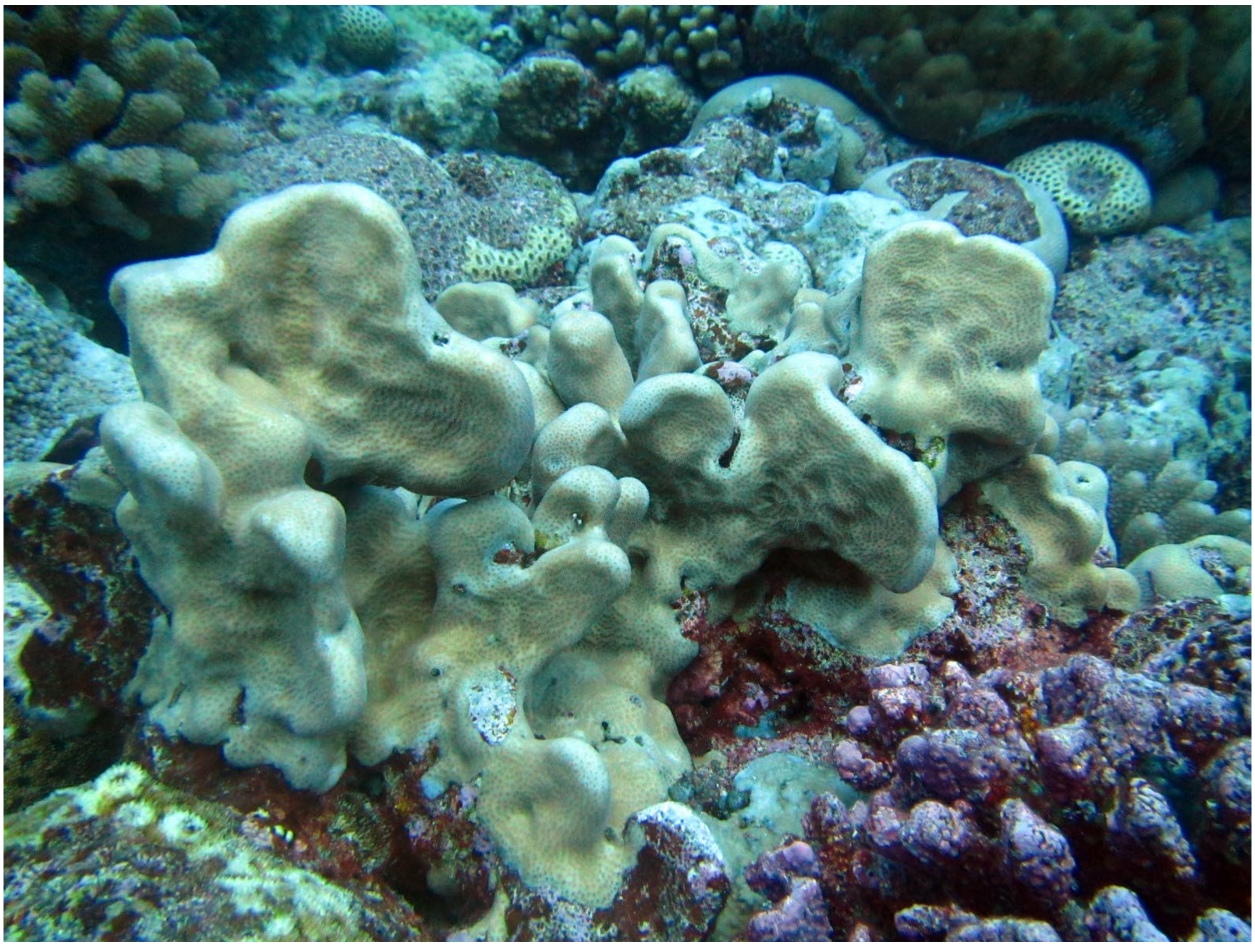
A close-up photo of *Psammocora contigua*. Often the branch tips are ligher than the rest of the colony. This photo is from the Marianas.

Pavona

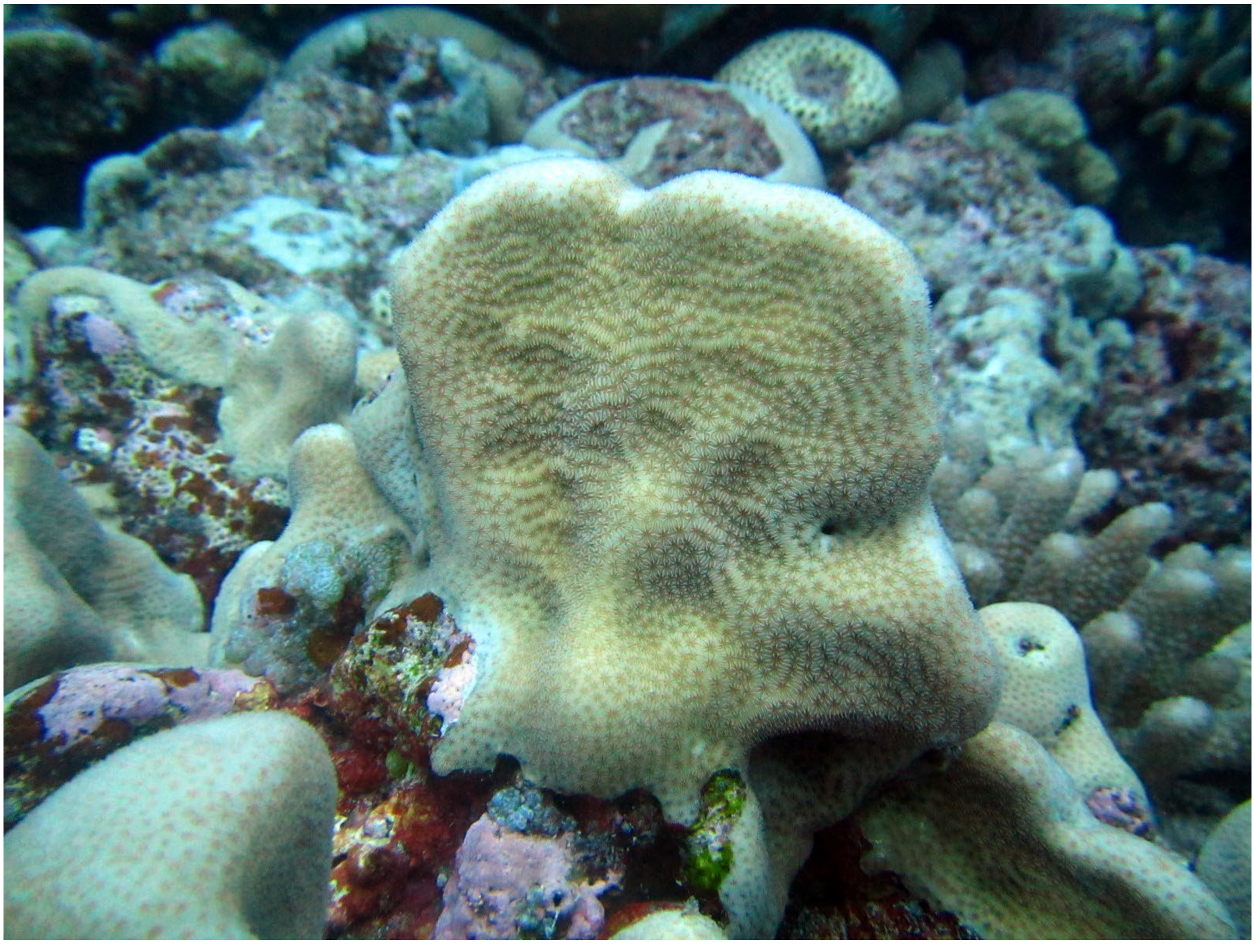
Colonies can be massive, encrusting, plates or branching. Corallites are small. There are no distinctive features of this genus which can be seen underwater to distinguish it from other genera, so it is necessary to learn to identify species and the species tell you what genera they are in.

Pavona duerdeni Vaughan, 1907

Colonies may have encrusting bases but usually produce upgrowths that are most often thick vertical plates that slightly resemble pork chops. Colonies often also include more cylindrical knobs. The corallites are quite small, about 2-3 mm diameter and can at times be hard to see.



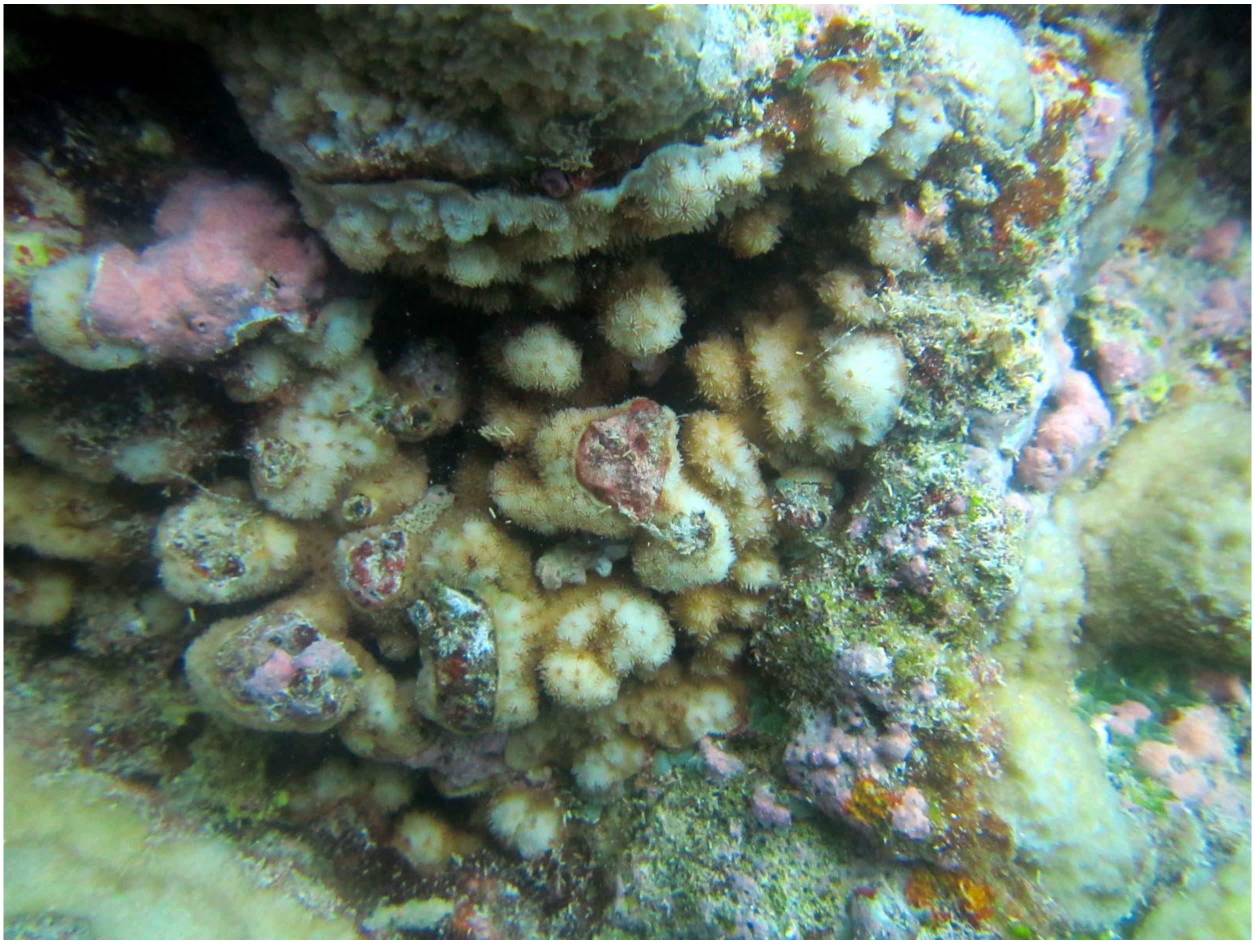
A photo of a colony of *Pavona duerdeni*.



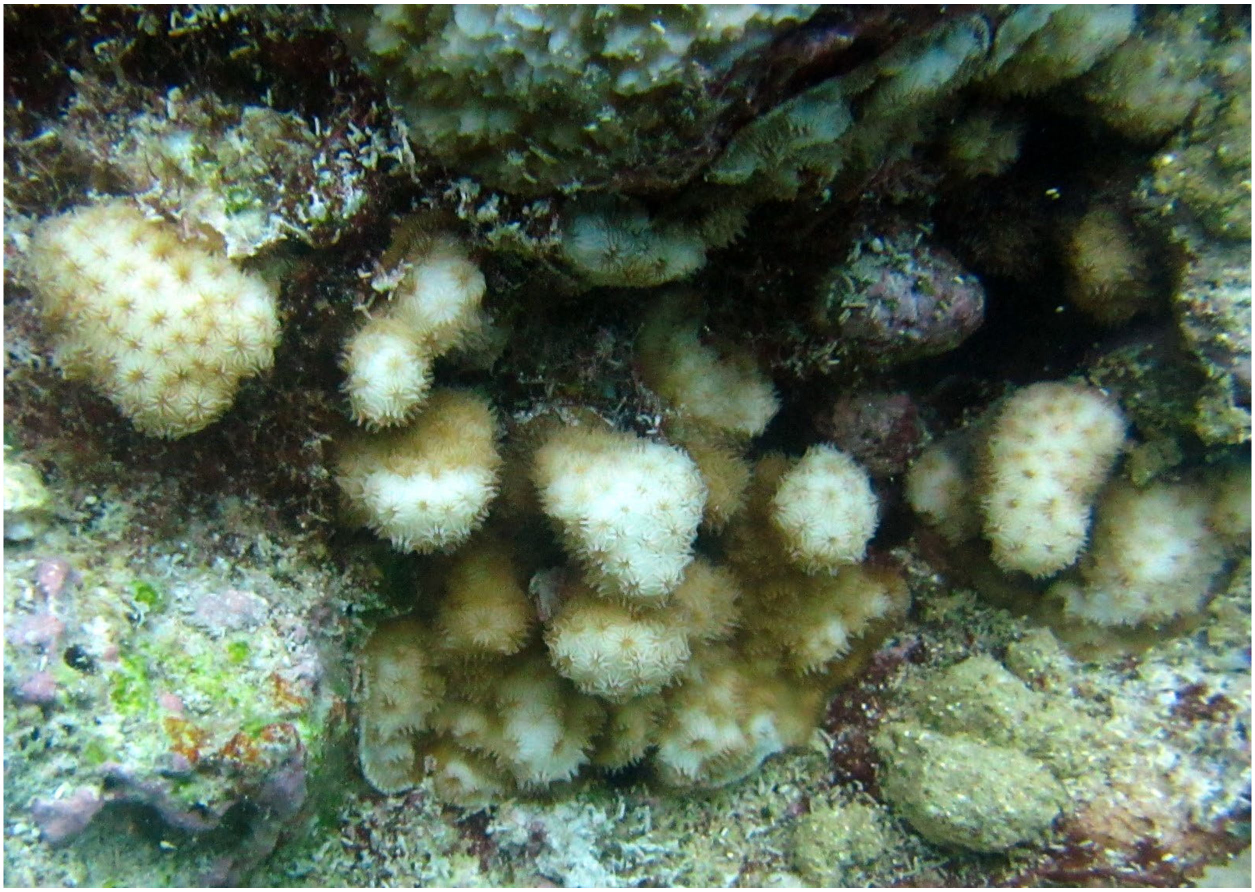
A close-up photo of *Pavona duerdeni*.

Pavona maldivensis (Gardiner, 1905)

Colonies have encrusting bases and small knobs. Corallites on the knobs project and are small, about 3 mm diameter. Colonies hide in cracks and can easily be overlooked. In Hawaii, colonies are similar but the knobs even smaller, pea sized. Elsewhere, this species forms branches that are about thumb size or slightly larger, and colonies are out in the light and can be up to at least a foot in diameter.



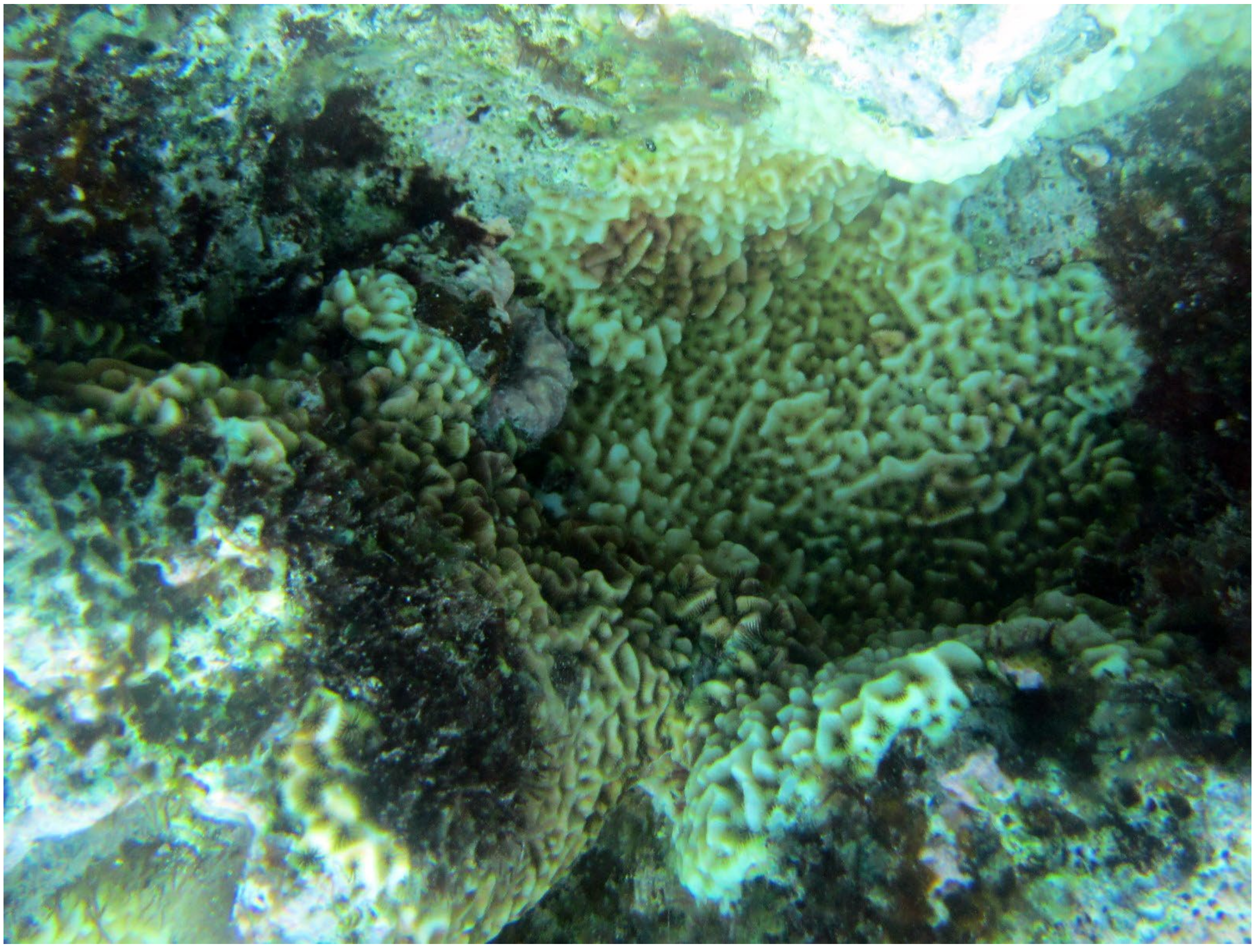
A colony of *Pavona maldivensis*.



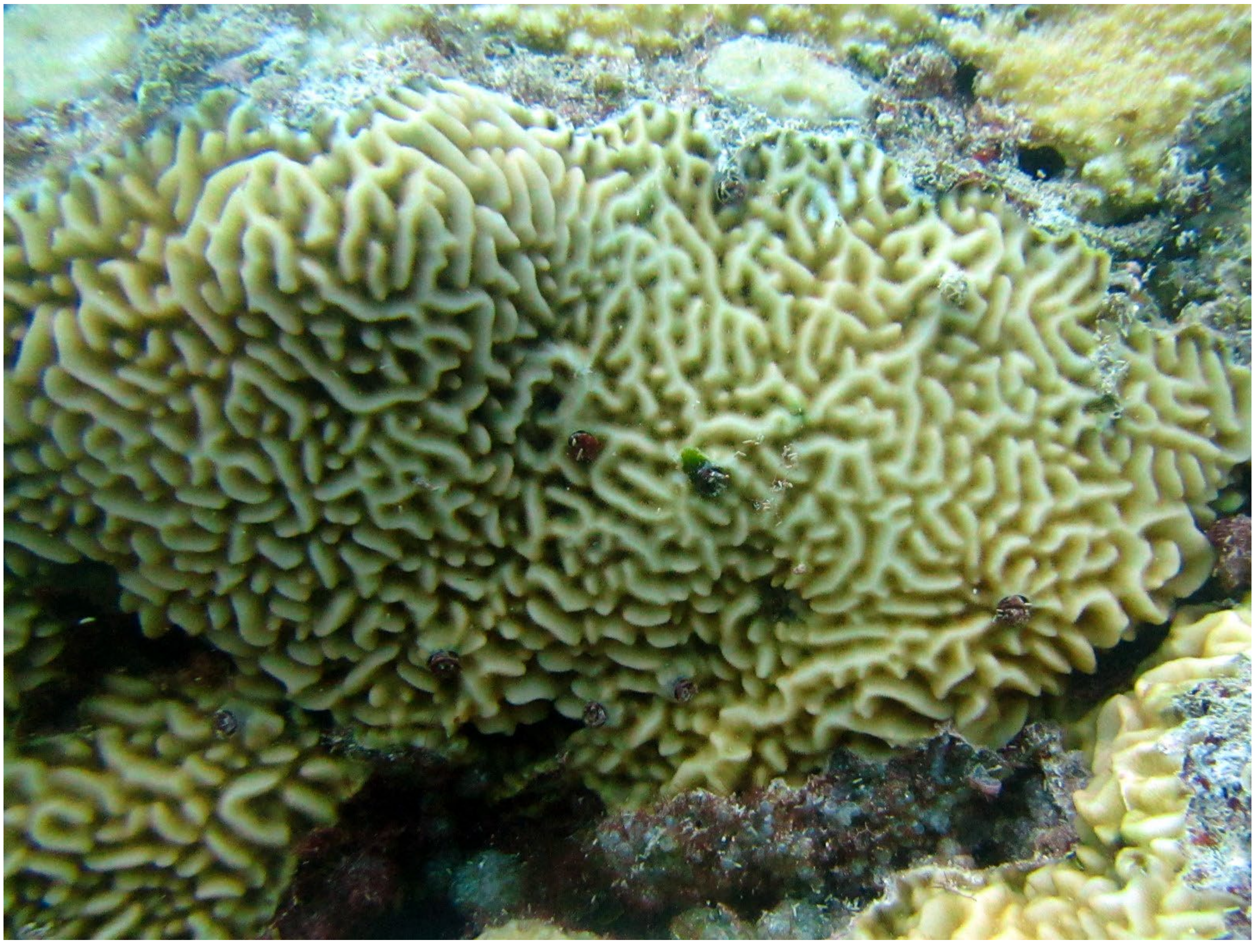
A close-up photo of a colony of *Pavona maldivensis*.

Pavona varians Verrill, 1864

Colonies are encrusting and sometimes have raised plate edges. Colonies are covered with curving small ridges of a variety of lengths. The corallite centers are between the ridges and tiny septa run up the ridges but usually can't be seen underwater. Colonies are almost always brown. Ridges are shorter on *Pavona chiriquiensis*.



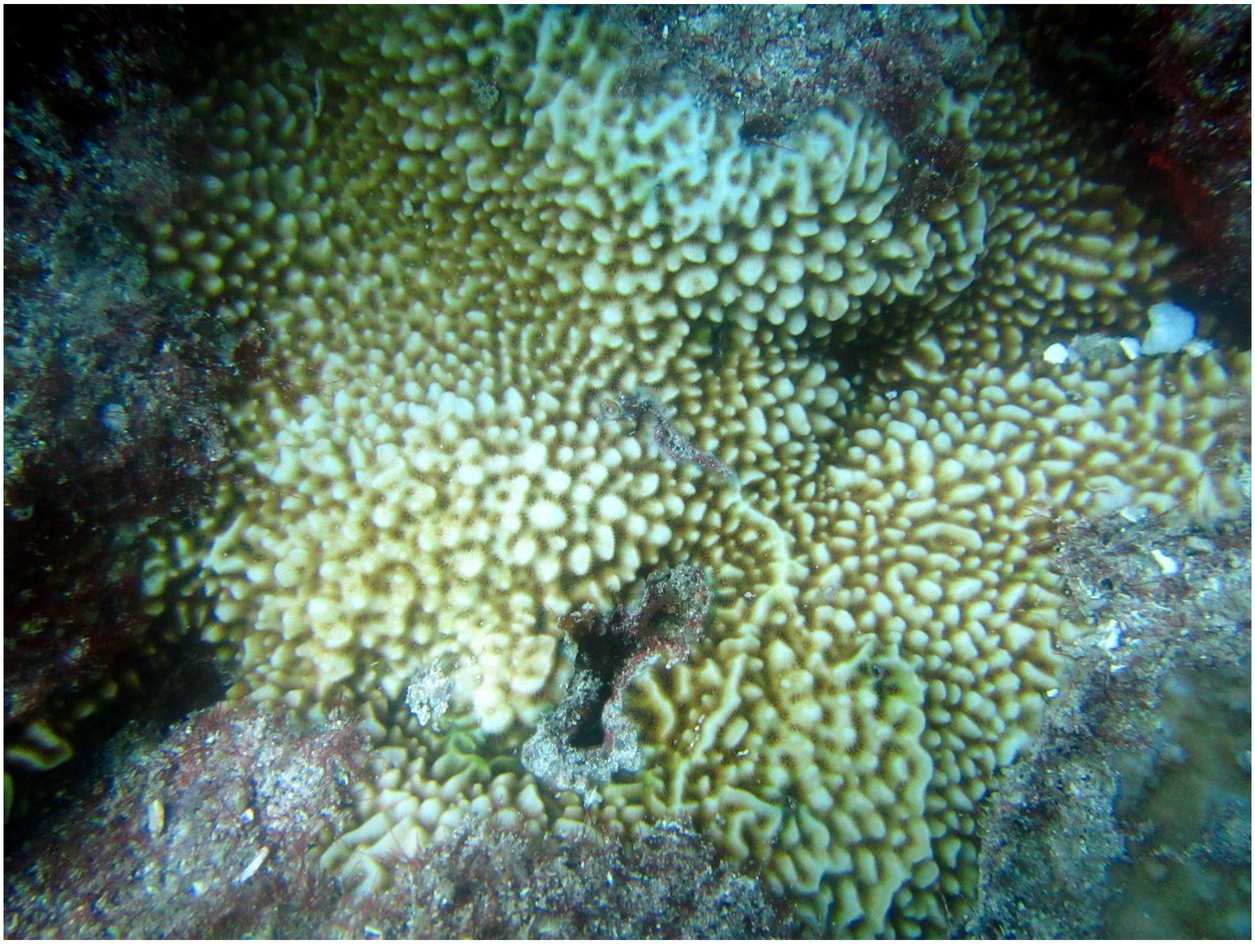
A colony of *Pavona varians*. The dark spots are corallite centers.



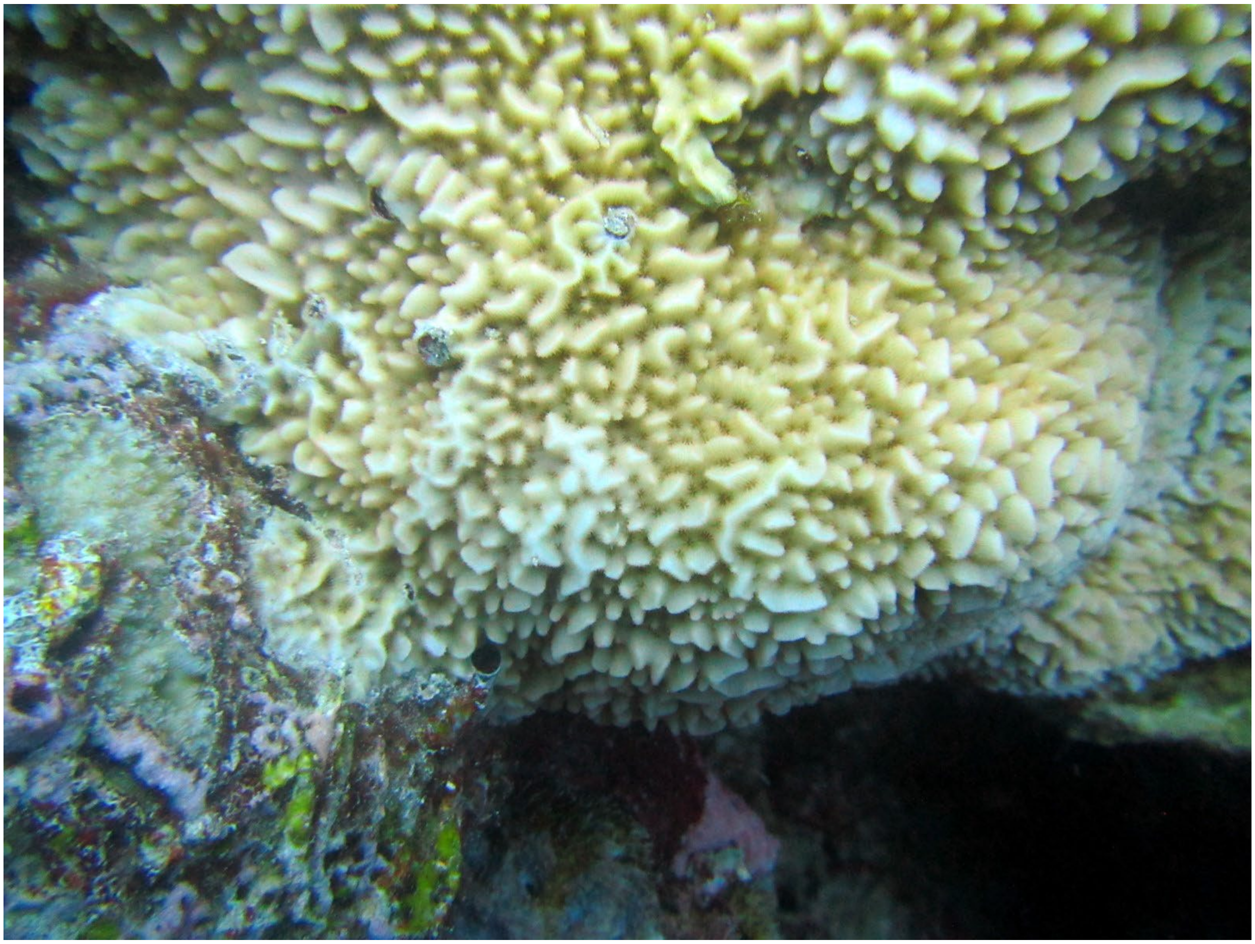
A close photo of *Pavona varians*.

Pavona chiriquiensis Glynn, Mate & Stemann, 2001

Colonies are encrusting. The surface is covered with bumps that can range from short and circular to short ridges. Colonies are near identical to *Pavona varians*, but it has longer ridges.



A colony of *Pavona chiriquiensis*.



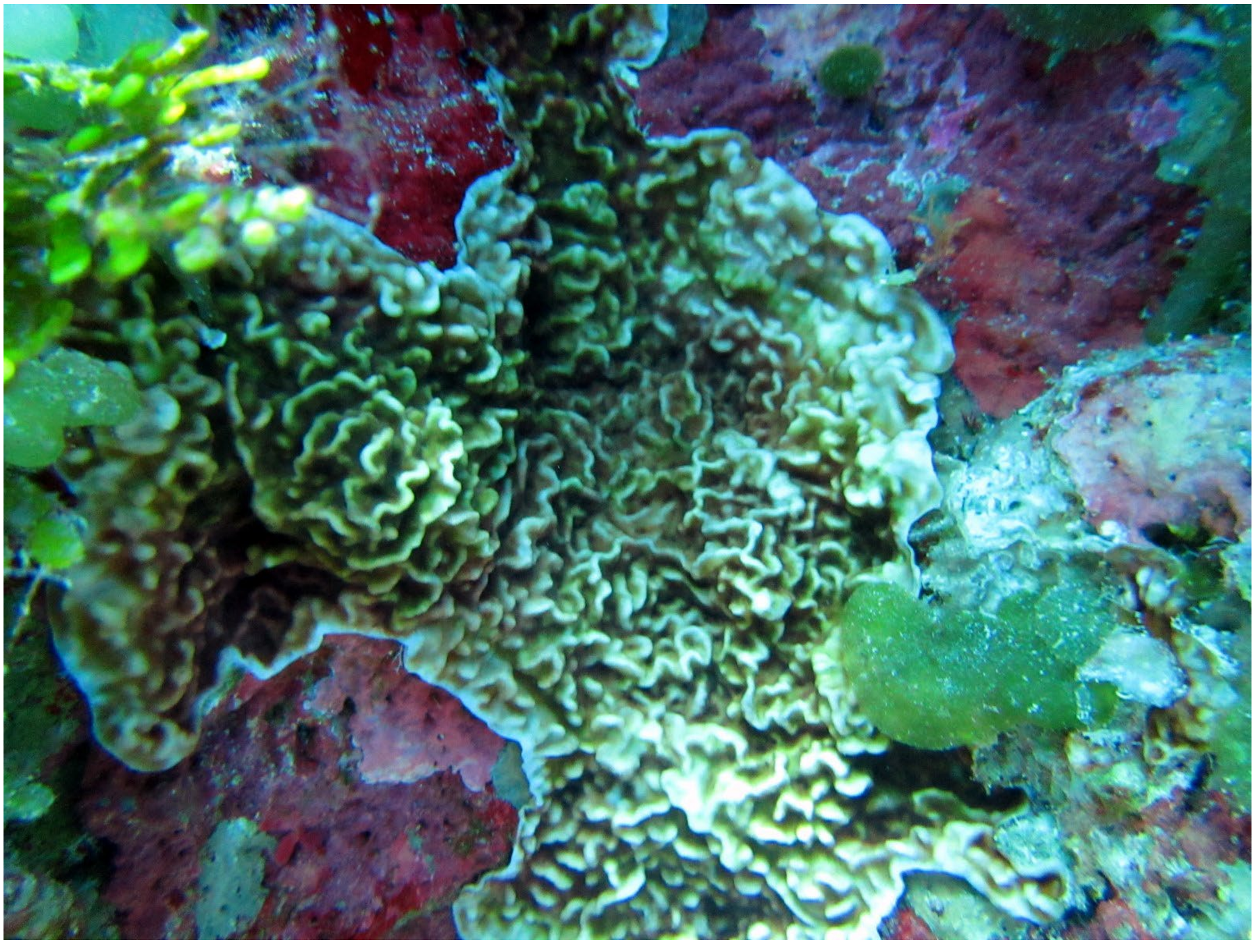
A close-up photo of *Pavona chiriquiensis*.

Genus Leptoseris

This genus produces colonies that are usually thin plates close to the substrate, but sometimes the plates are higher up, or they are encrusting, or they are small curving, twisted fronds. Sometimes the edges of corallites are raised as a ring around corallites, in other cases the corallites are recessed between ridges, and in others the corallites are so small and flush with the surface that they can't be seen underwater. In some species with raised rings around corallites, the corallites are tilted towards the edge of the plate. *Leptoseris* tends to be in shaded locations or deeper water. *Pavona* is similar but often forms more massive colonies and corallites do not have raised rings around them. *Pavona* is almost always out in the sun.

Leptoseris mycetoseroides Wells, 1954

This species forms encrusting colonies with thin, high, interconnecting ridges that run in random directions over the colony, and enclose deep spaces where the corallites are located. They are extended ridges not short bumps like on *Leptoseris incrustans*. The ridges are higher and valleys wider than on *Pavona varians* and *Psammocora nierstraszi*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Leptoseris mycetoseroides*. This photo is from the Marshall Islands.

Lobactis *"mushroom corals"* *This used to be in Fungia.*

Corals are disc-shaped, with thin ridges radiating from a central crack. The central crack is the mouth and the radiating ridges are septa, which are hard walls of skeleton that the thin tissue covers. These corals are commonly called "mushroom corals" because the resemble an overturned mushroom cap. Each coral is a single polyp, and they are not attached. The underside has radiating rows of spines. Species in other genera are circular discs, but in this genus they are oval. Most are usually found with the mouth side up, but some may have the mouth down. Having the mouth side down does not seem to hurt them.

Lobactis scutaria Lamarck, 1816 "mushroom coral" This used to be in *Fungia*.

Corals are oval discs, with thin ridges radiating from a central crack. The radiating septa have small extensions shaped like part of a disc. These are called "tentacle lobes" because there is a tentacle attached to each lobe, though it is usually contracted during the daytime. The spines on the underside are small enough they are granules like sandpaper. This species has the largest and most obvious tentacles lobes of any mushroom coral.

A photo of a *Lobactis scutaria*. The tentacle lopes are white on this coral.

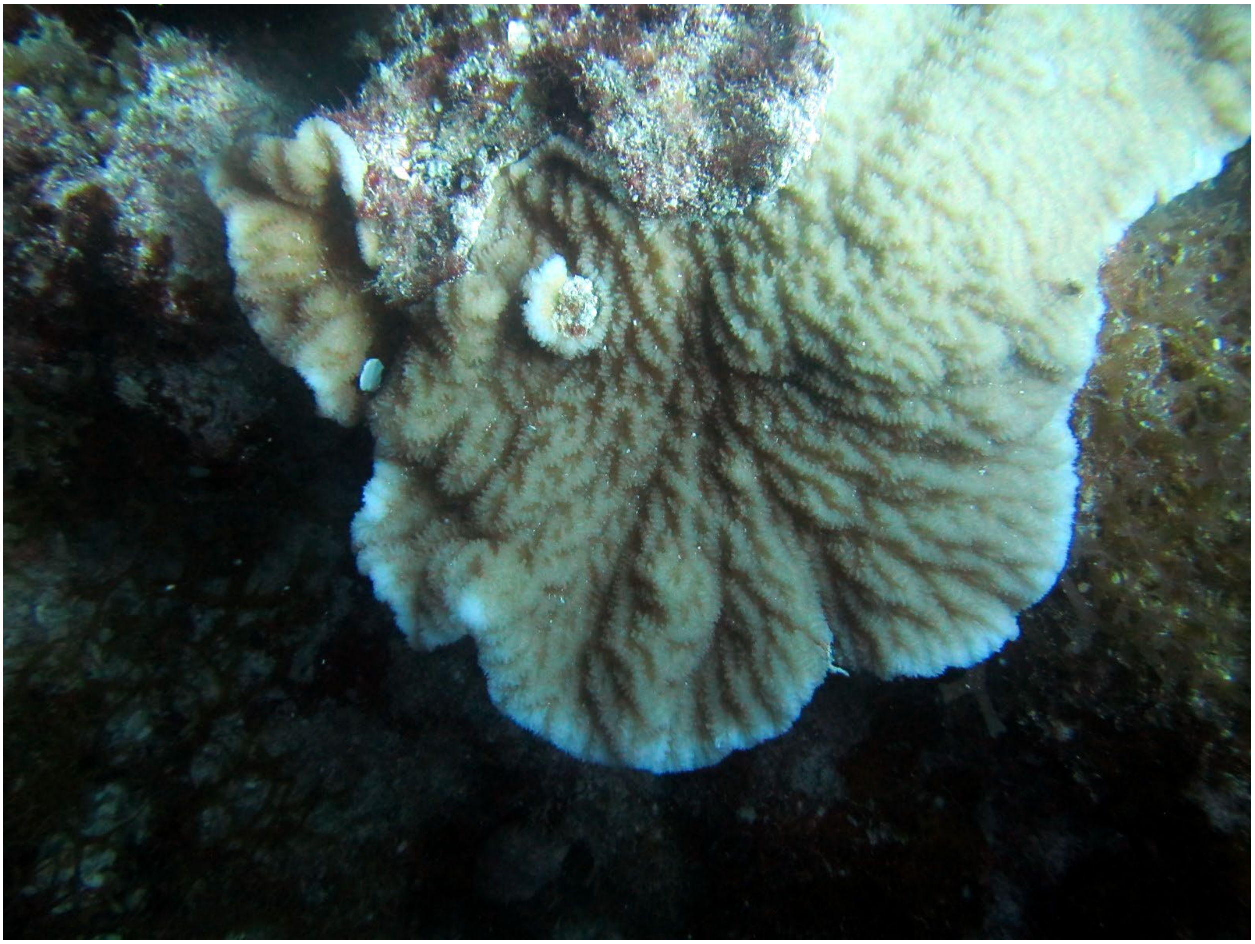
Merulina

Colonies form plates that can be anything from close to the substrate to at an angle or nearly vertical, or they can be encrusting. The upper surface has radiating ridges that divide and anastamose. The ridges have tiny cross-ridges that are septa. The corallite centers are between the ridges.

Merulina ampliata (Ellis & Solander, 1786)

Colonies have radiating rounded ridges, which are larger than on the other species of *Merulina*.

A colony of *Merulina ampliata*.



A photo of *Merulina ampliata*.

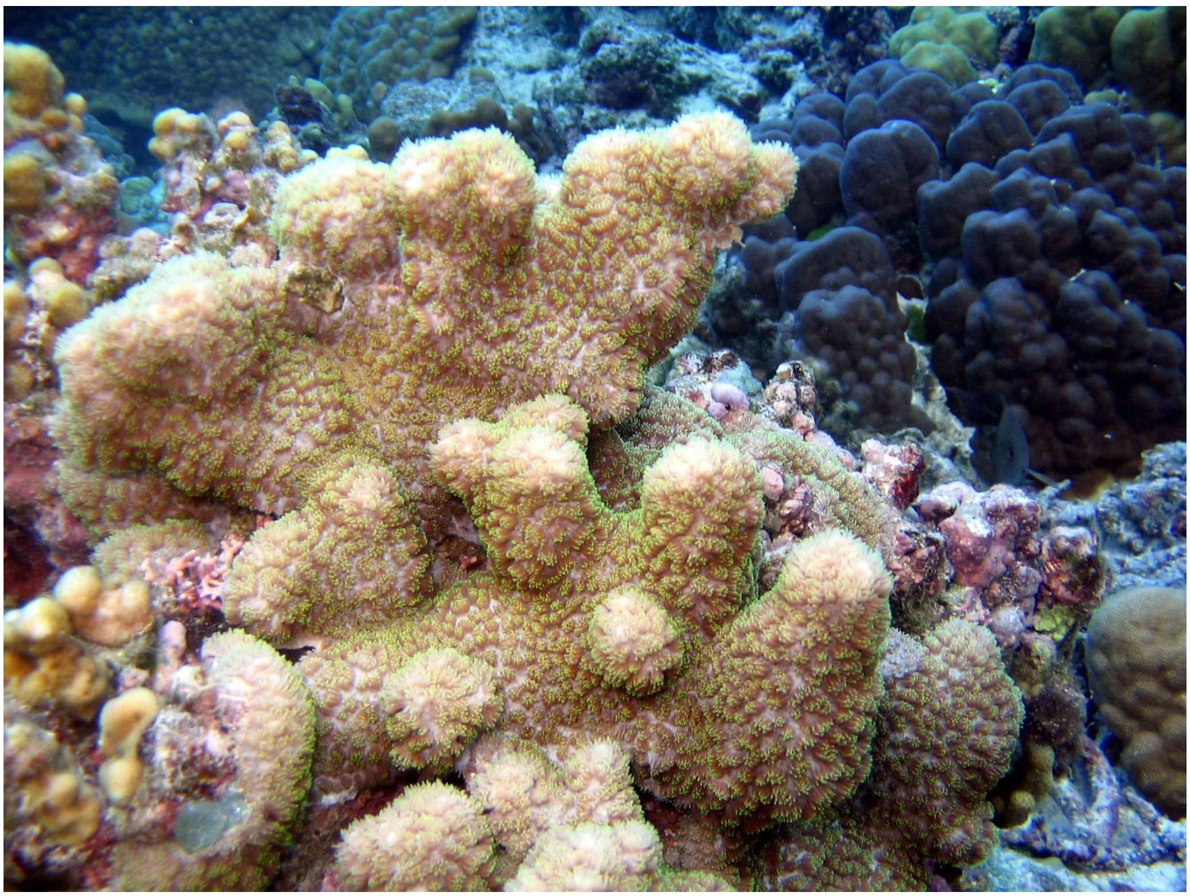
A close-up photo of *Merulina ampliata* showing the septa on the ridges.

Hydnophora

Hydnophora can be massive, or have an encrusting base with branches, or be all branches. In all cases the surface is covered with fairly sharp bumps. If the bumps are tiny they are nearly round, larger bumps are usually oval or elongated into short ridges. The bumps are between corallites and have tiny ridges on their sides that are septa. The bumps are called "hydnophores" hence the name. In encrusting and branching colonies, tentacles are often extended, obscuring the bumps. The bumps are usually larger and are not rounded with corallites on them like on *Pocillopora*, and the bumps are not smooth like on *Montipora* and the tentacles if present are larger.

Hydnophora exesa (Pallas, 1766)

This coral forms encrusting sheets which usually have irregular upward growths on them. The surface is covered with small oval bumps which are surrounded by small tentacles. The tentacles may extend far enough to obscure the bumps. Grey or green, uncommon, reef slopes. *Hydnophora microconos* is massive and has smaller bumps. *Hydnophora rigida* is exclusively branching with thin branches. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Hydnophora exesa*. This photo is from American Samoa.

A close-up of *Hydnophora exesa*. This photo is from American Samoa.

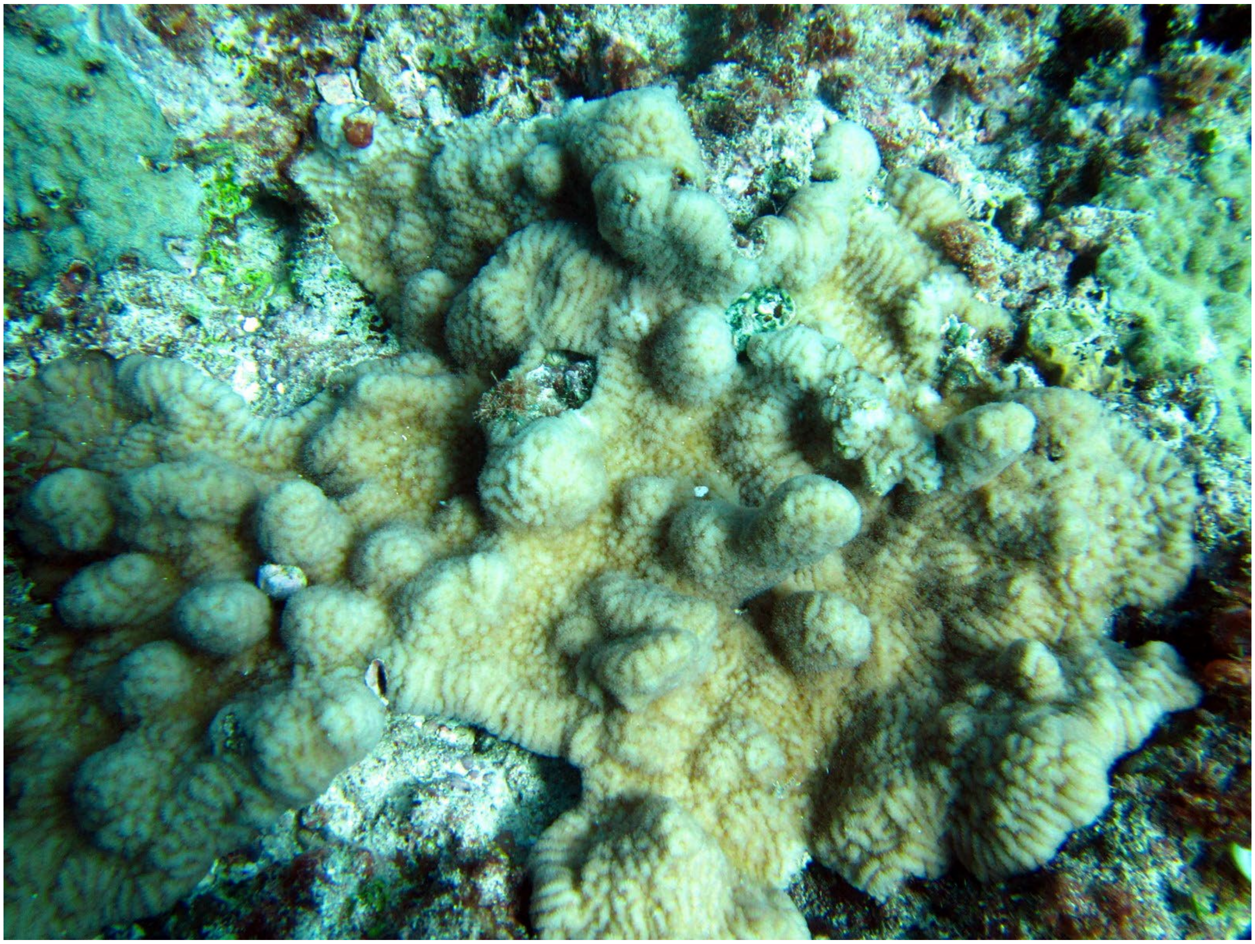
Scapophyllia

This genus forms columnar colonies with winding ridges on it, and so could be considered "meandroid" or a "brain coral." There is only one species.

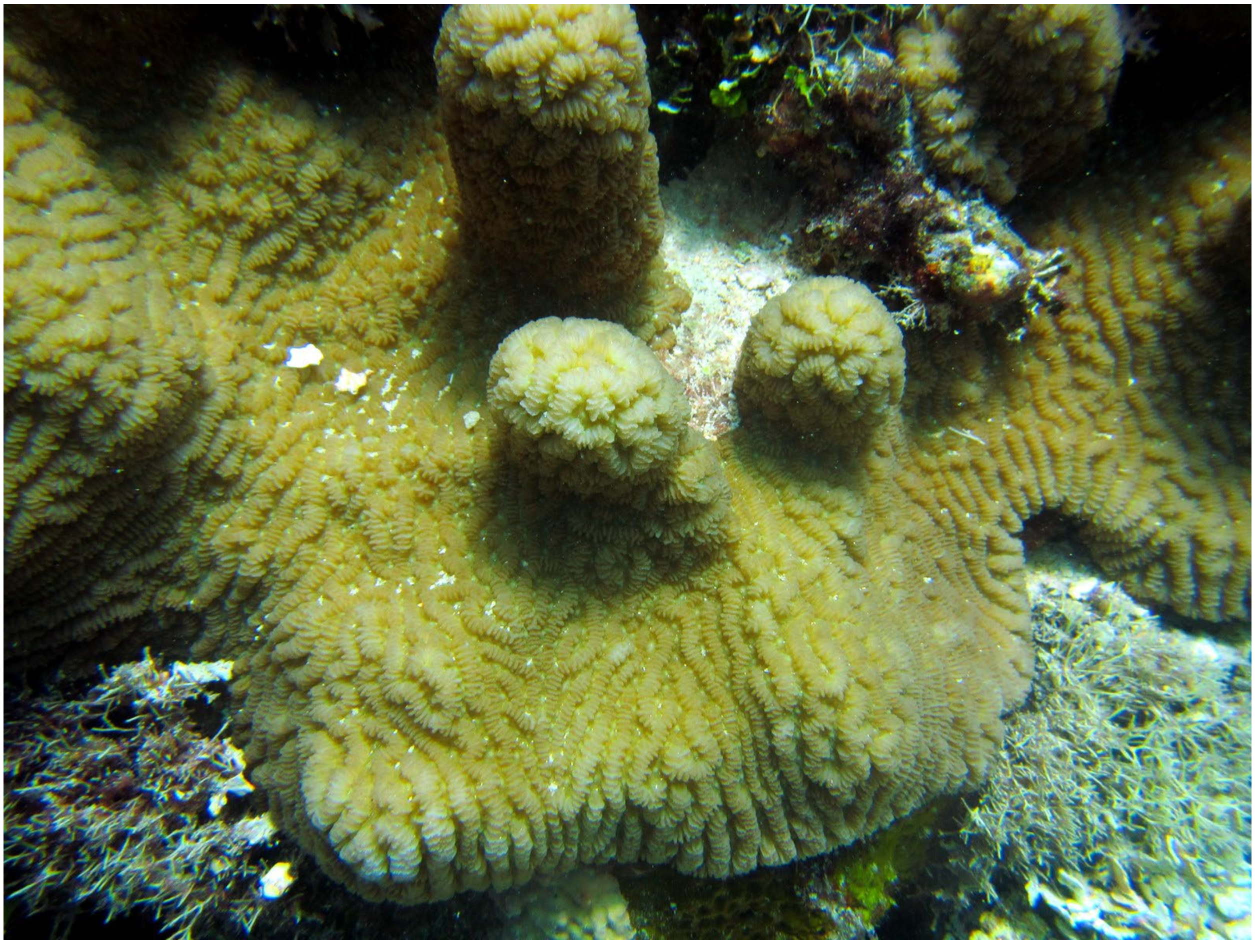
Scapophyllia cylindrica Milne Edwards & Haime, 1848

This species forms columns that vary between cylindrical and oval in cross section. Colonies generally start from an encrusting base, and some colonies only have nodules on them instead of columns. The surfaces are covered with winding ridges which have tiny septa on their sides. Colonies have thick bumps or columns unlike *Merulina*, which can have thinner branches. The columns of *Psammocora haimeana* do not have meandering ridges. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

A colony of *Scapophyllia cylindrica* with tall columns. This photo is from the Marshall Islands.



A large encrusting colony of *Scapophyllia cylindrica* with many nodules or short columns on it. This photo is from the Marianas.



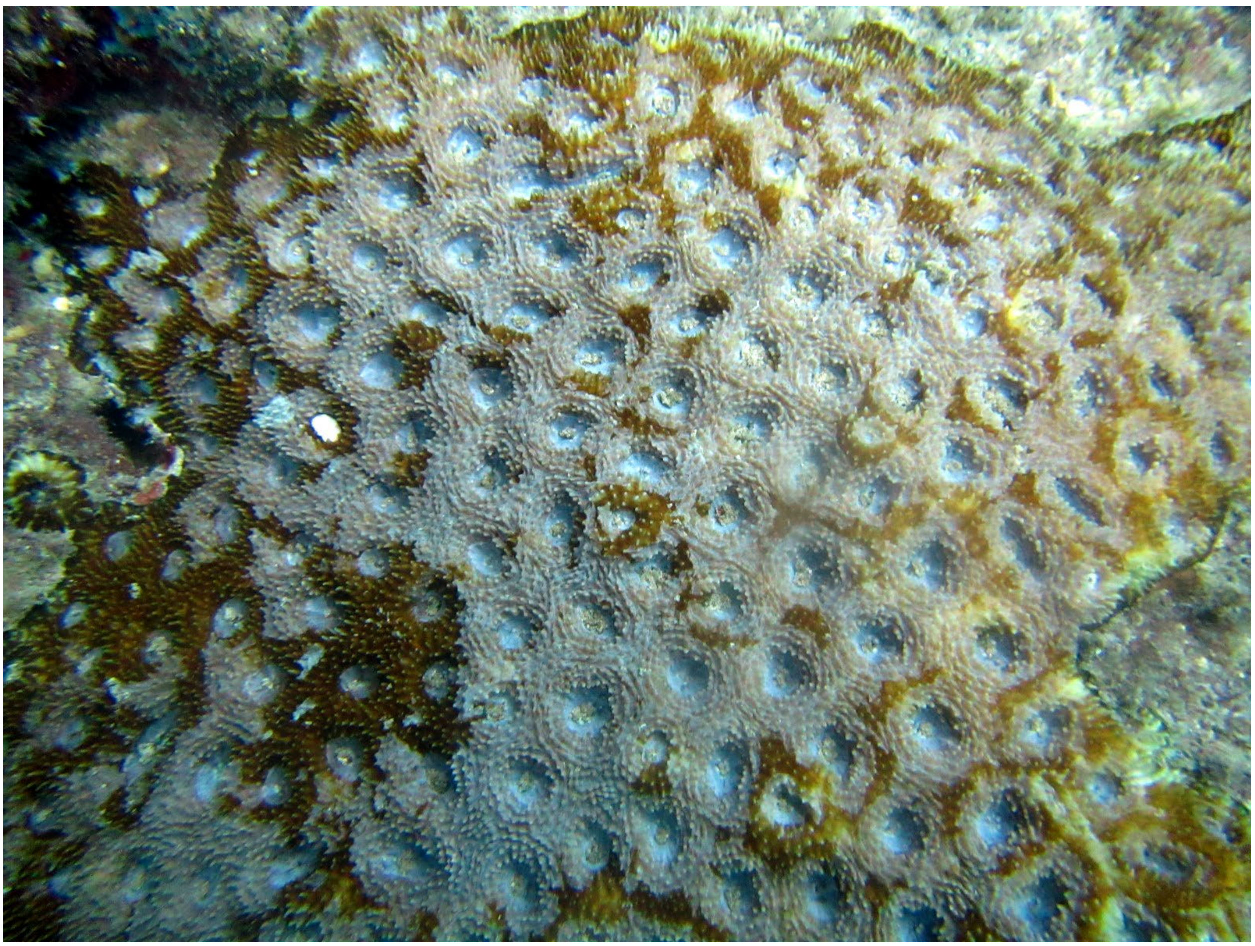
A closer photo of *Scapophyllia cylindrica* knobs or short columns on an encrusting base. This photo is from the Marianas.

Acanthastrea

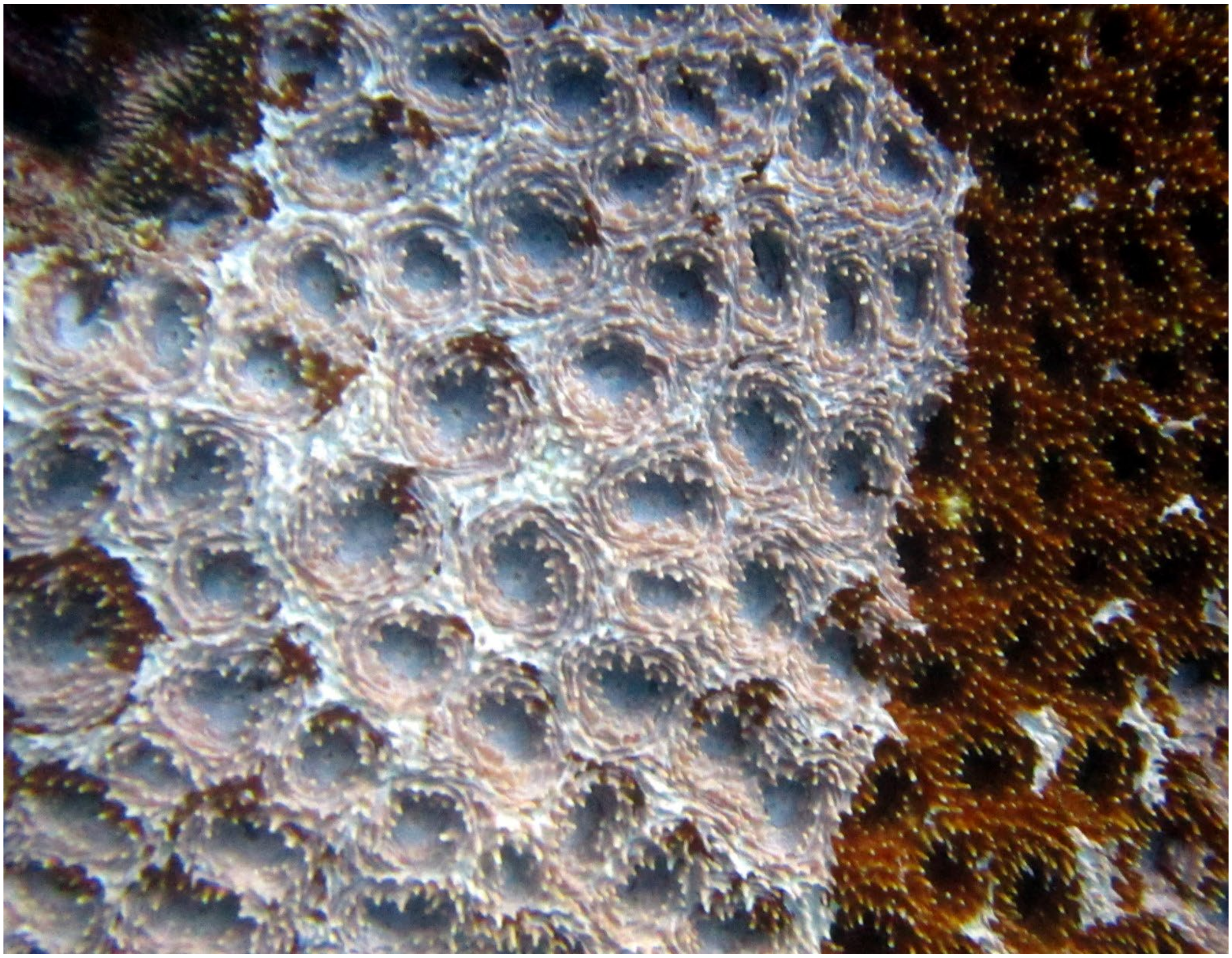
Colonies are usually encrusting though a few species are massive. Corallites are medium size, about finger diameter, and are recessed, with a single wall between corallites. Corallites are usually roughly circular, but some are oval to narrow. Corallites are much spinier than *Favites*.

Acanthastrea echinata (Dana, 1846)

Colonies are encrusting, corallites are circular, and colonies are moderately spiny. Colonies are slightly fleshy, with enough flesh for wrinkles caught on the spines make concentric circles around the corallites. *Acanthastrea* brevis is spinier, *Acanthastrea hemprichii* has thinner walls between corallites, and *Acanthastrea hillae* makes massive colonies that can be larger, and corallites are larger.



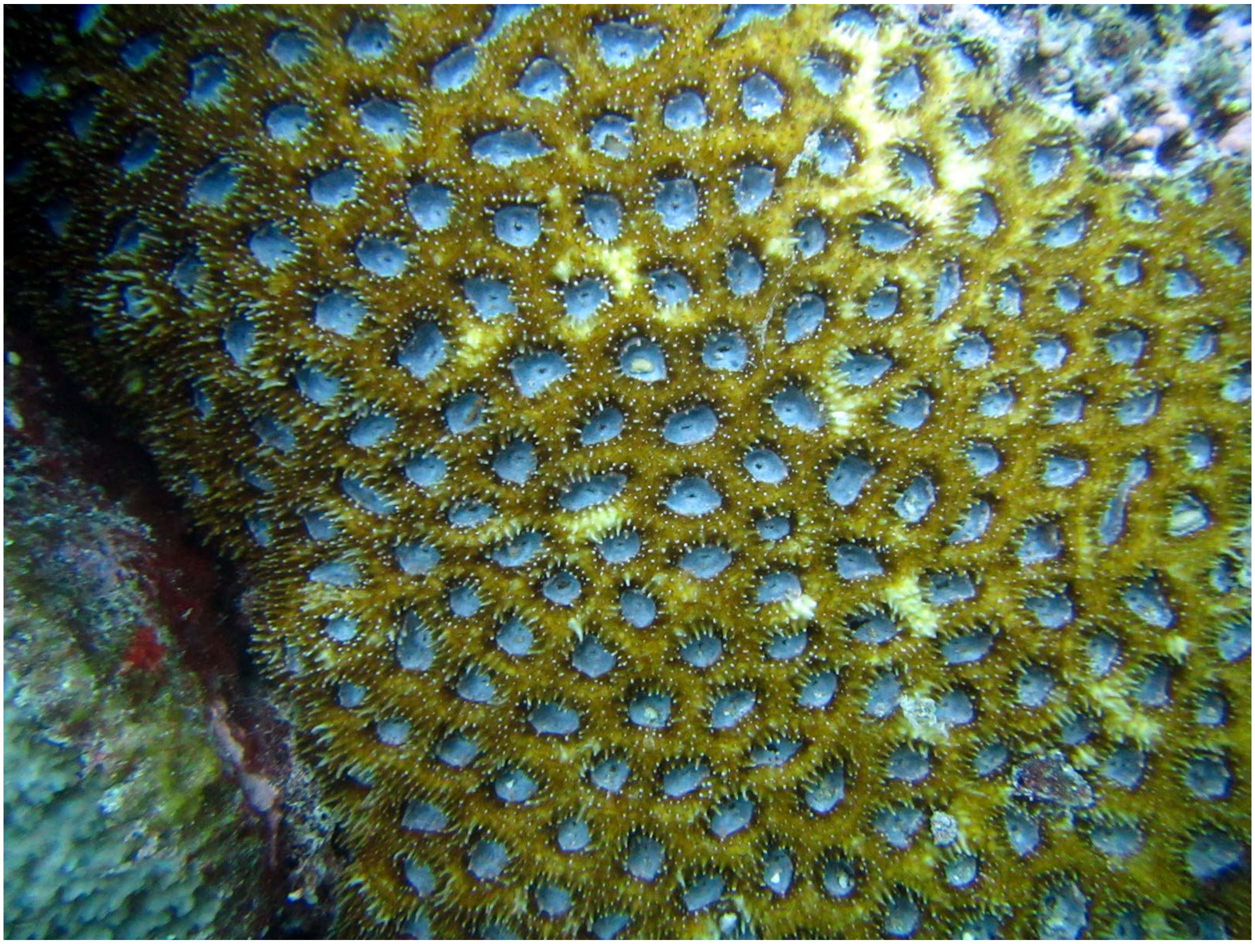
A photo of a colony of *Acanthastrea echinata*.



A close photo of a colony of *Acanthastrea echinata*.

Acanthastea hemprichii (Ehrenberg, 1834) Vulnerable

Colonies are encrusting, moderately spiny, and the walls between corallites are thin. There are no concentric tissue folds. *Acanthastrea echinata* has wider walls between corallites and concentric tissue folds. *Acanthastrea brevis* is spinier. *Acanthastrea hillae* is massive, larger, with larger corallites.

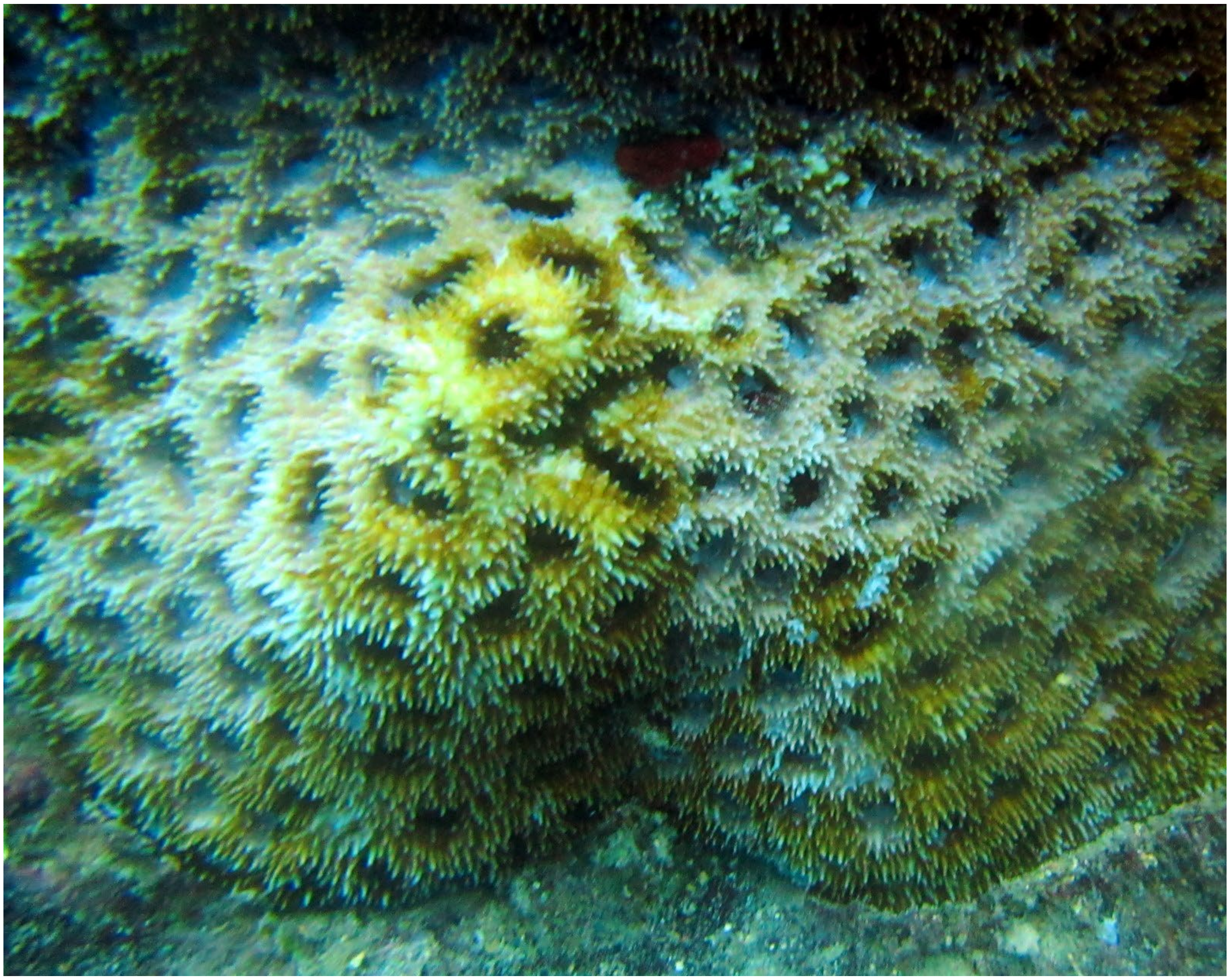


A colony of *Acanthastrea hemprichii*.

A closer photo of *Acanthastrea hemprichii*.

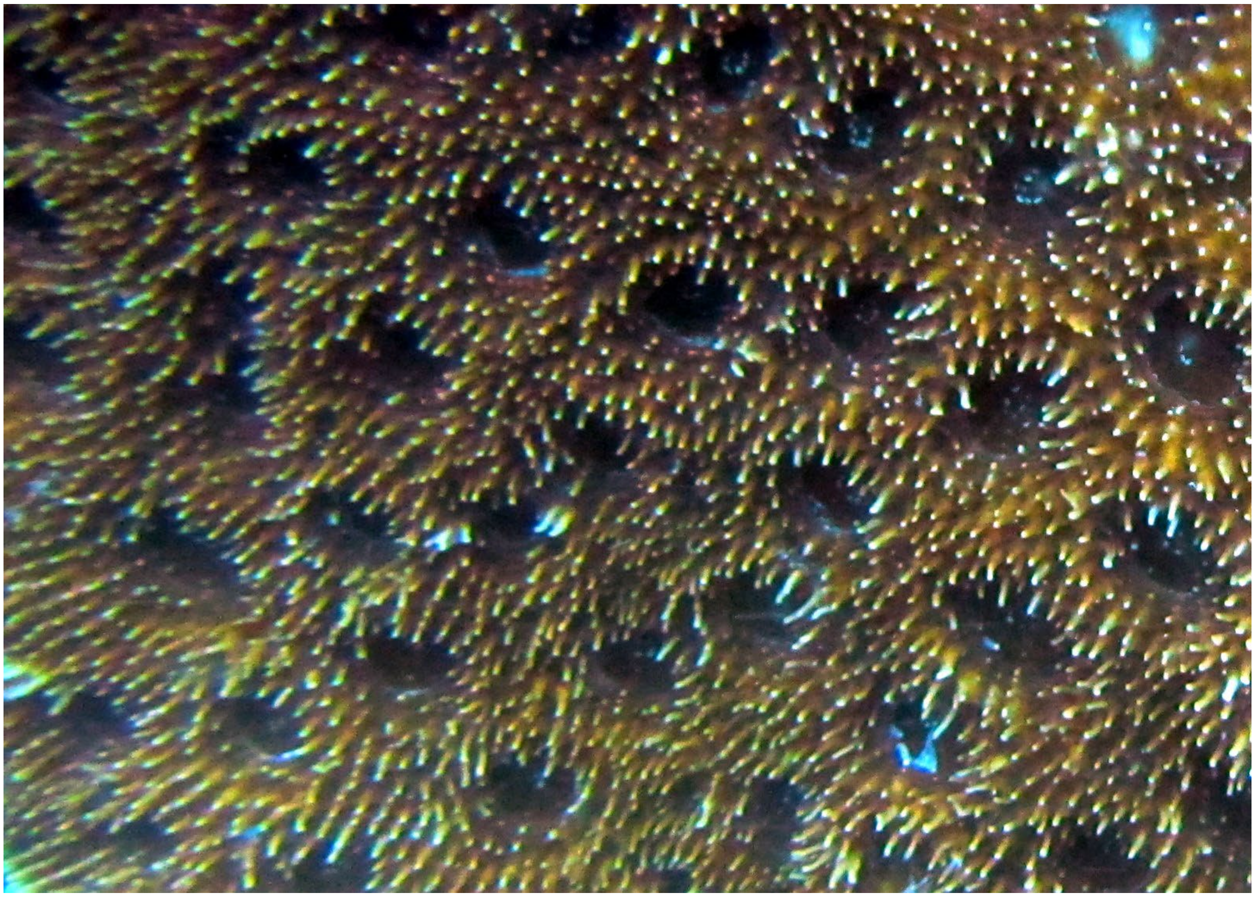
Acanthastrea brevis Milne Edwards & Haime, 1849

Colonies are encrusting to massive, often small, spiny, without concentric tissue folds. *Acanthastrea echinata* has tissue folds and is less spiny, *Acanthastrea hemprichii* has thinner walls between corallites and is less spiny, and *Acanthastrea hillae* is massive, has larger colonies, larger corallites, and is less spiny.



A colony of *Acanthastrea brevis*.

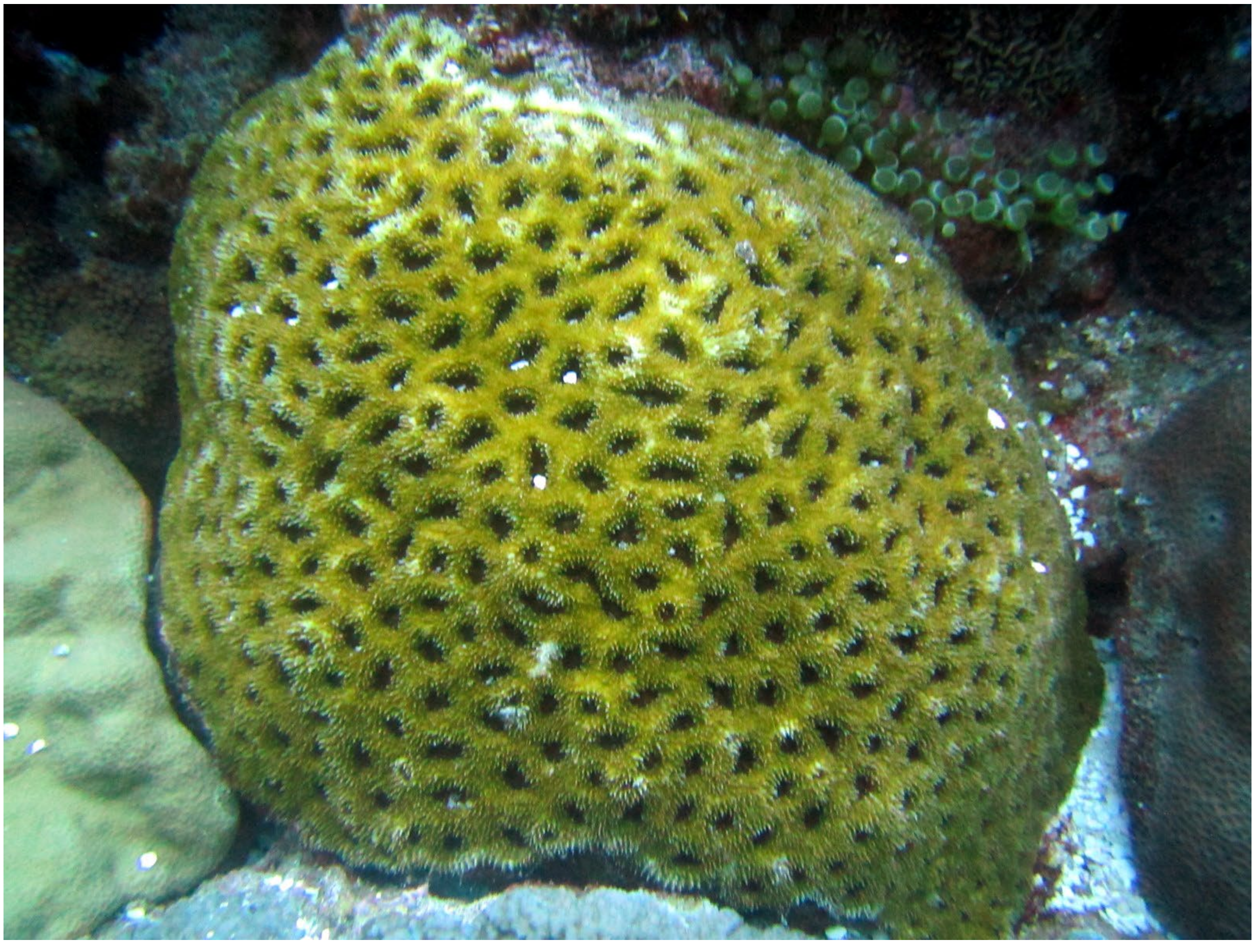
A close photo of *Acanthastrea brevis*.



A close-up photo of *Acanthastrea brevis*.

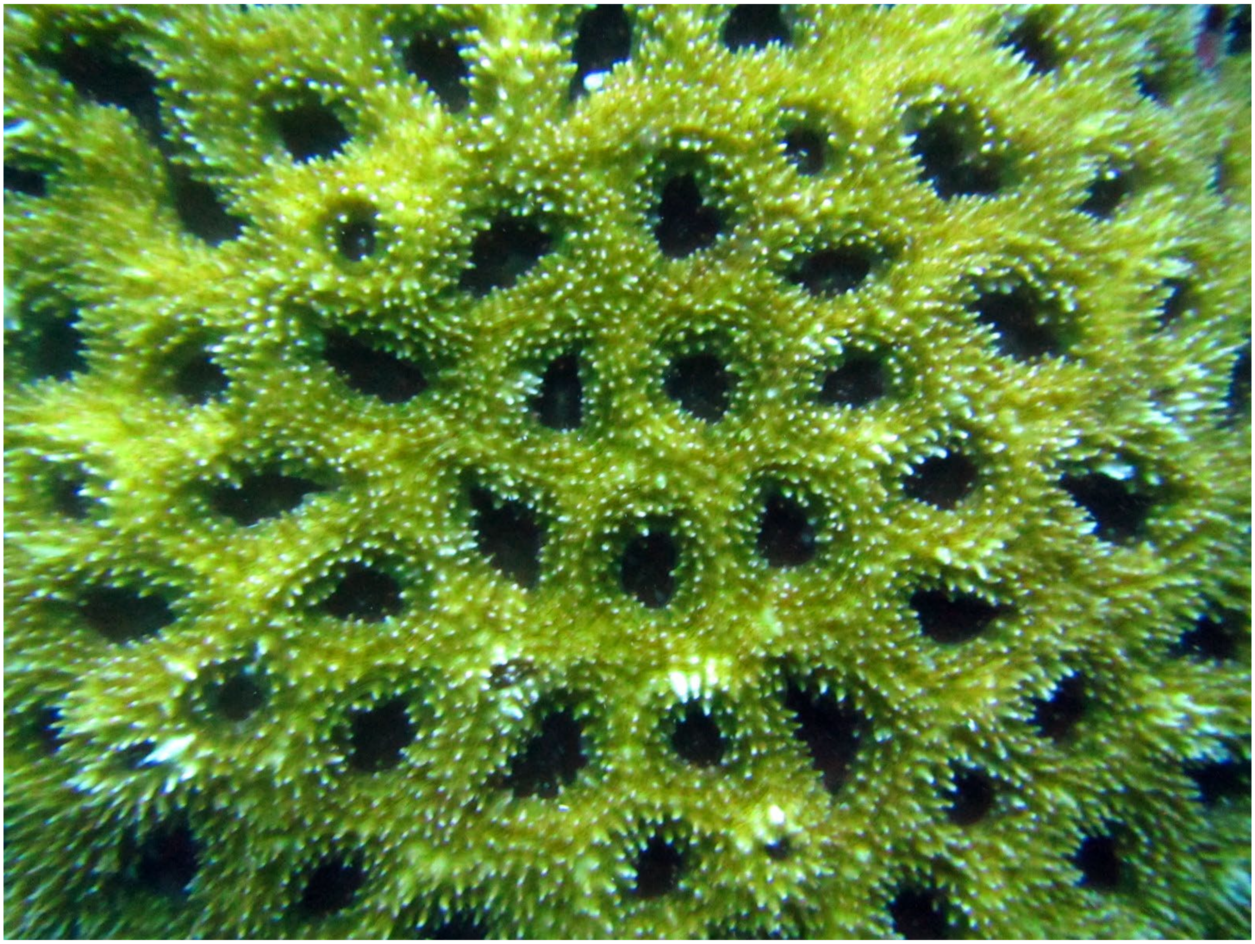
Acanthastrea hillae Wells, 1955

Colonies are massive and can be large, and are moderately spiny without concentric tissue folds. *Acanthastrea echinata* is encrusting and has concentric tissue folds, *Acanthastrea hemprichii* is encrusting and has thin walls between corallites, and *Acanthastrea brevis* is spiny and often small.



A photo of a colony of *Acanthastrea hillae*.

A colony of *Acanthastrea hillae*.



A close photo of *Acanthastrea hillae*.

Lobophyllia

Colonies are submassive or massive to encrusting, and have large polyps or are meandroid (brain coral). Submassive species appear to be massive, but actually are branching with branches very close together. In meandroid species the ridges are the larger than any other meandroid genus. This genus now incorporates both submassive species that were previously in *Lobophyllia*, and meandroid species that were in *Symphyllia*. A few species are intermediate, being meandroid in the center and nearly submassive near the edges.

Lobophyllia hemprichii (Ehrenberg, 1834) "submassive"

Colonies can become quite large and when large may be low domed. Corallites are large, up to at least 6 inches diameter. Corallites has raised rounded edges, which can always be traced in loops. Some corallites are circular but many are a variety of other shapes, as they begin the process of dividing. Cracks between polyps are very narrow but very deep as the polyps are on the ends of branches. There is variation between colonies in how smooth or spiny the polyps appear, and colonies can have a wide variety of colors, though brown is most common. A few colonies have greatly elongated corallites. This is the most common species of *Lobophyllia*. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

A moderate size colony of *Lobophyllia hemprichii*. This photo is from the Marianas.

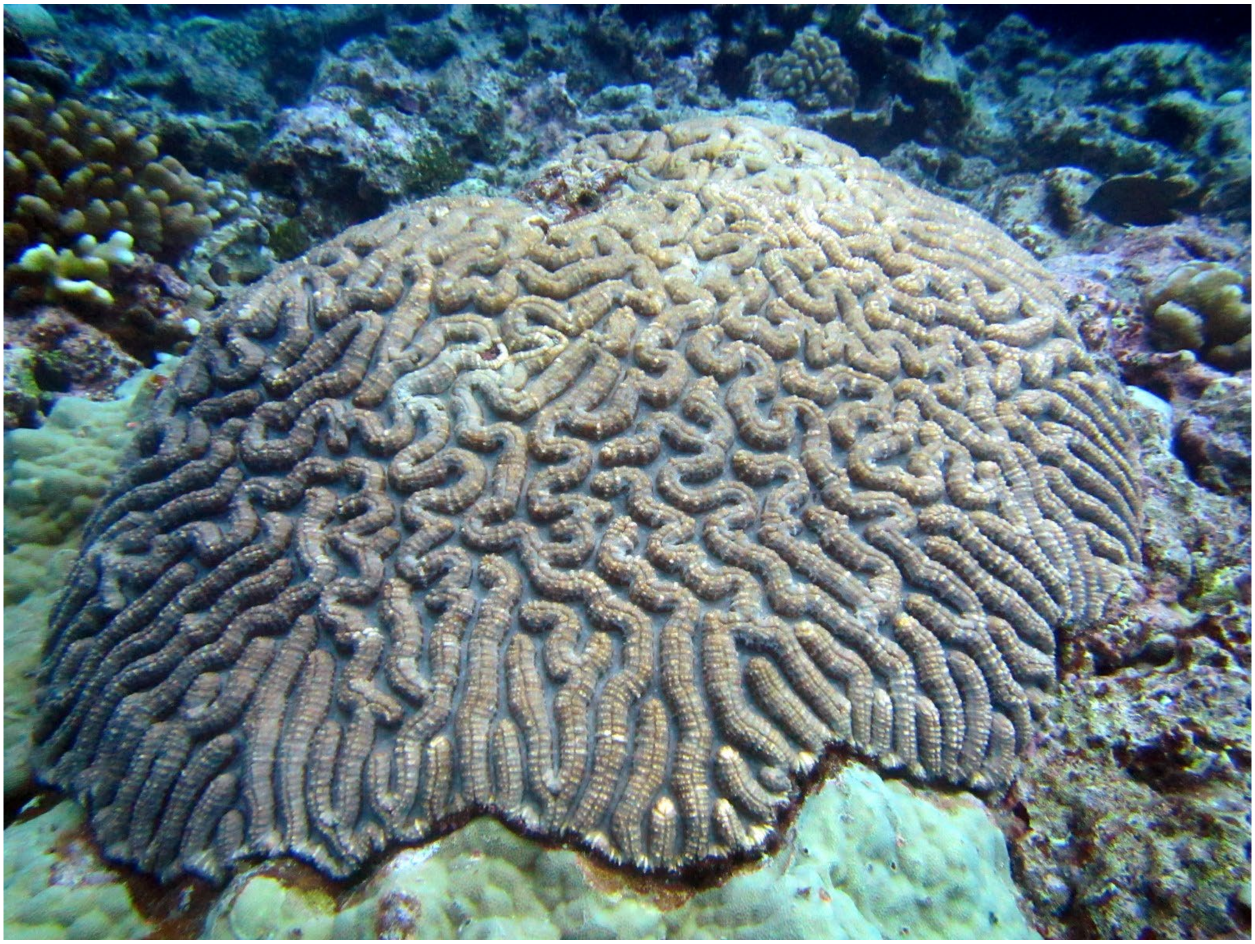
A photo of *Lobophyllia hemprichii*. This photo is from the Marianas.

Another colony of *Lobophyllia hemprichii*. Most colonies are brown but a few can be brilliant orange or red. This photo is from the Marianas.

Lobophyllia radians Milne Edwards and Haime, 1849 meandroid or "brain coral"

This used to be in *Symphyllia*, which no longer exists.

Colonies have moderately large meandering ridges, about finger width. The ridges often radiate towards the edges of the colony on large colonies. The ridges are bumpy. The ridges are smaller than on *Lobophyllia agaricia* but larger than on *Lobophyllia recta*, neither of which have ridges radiating near the edge of colonies.



A colony of *Lobophyllia radians*.

A close-up photo of the edge of a colon of *Lobophyllia radians*.

Lobophyllia recta (Dana, 1846) meandroid, "brain coral"

Colonies have meandering ridges that are as thin or thinner than a small finger. The ridge surfaces can be fairly smooth.

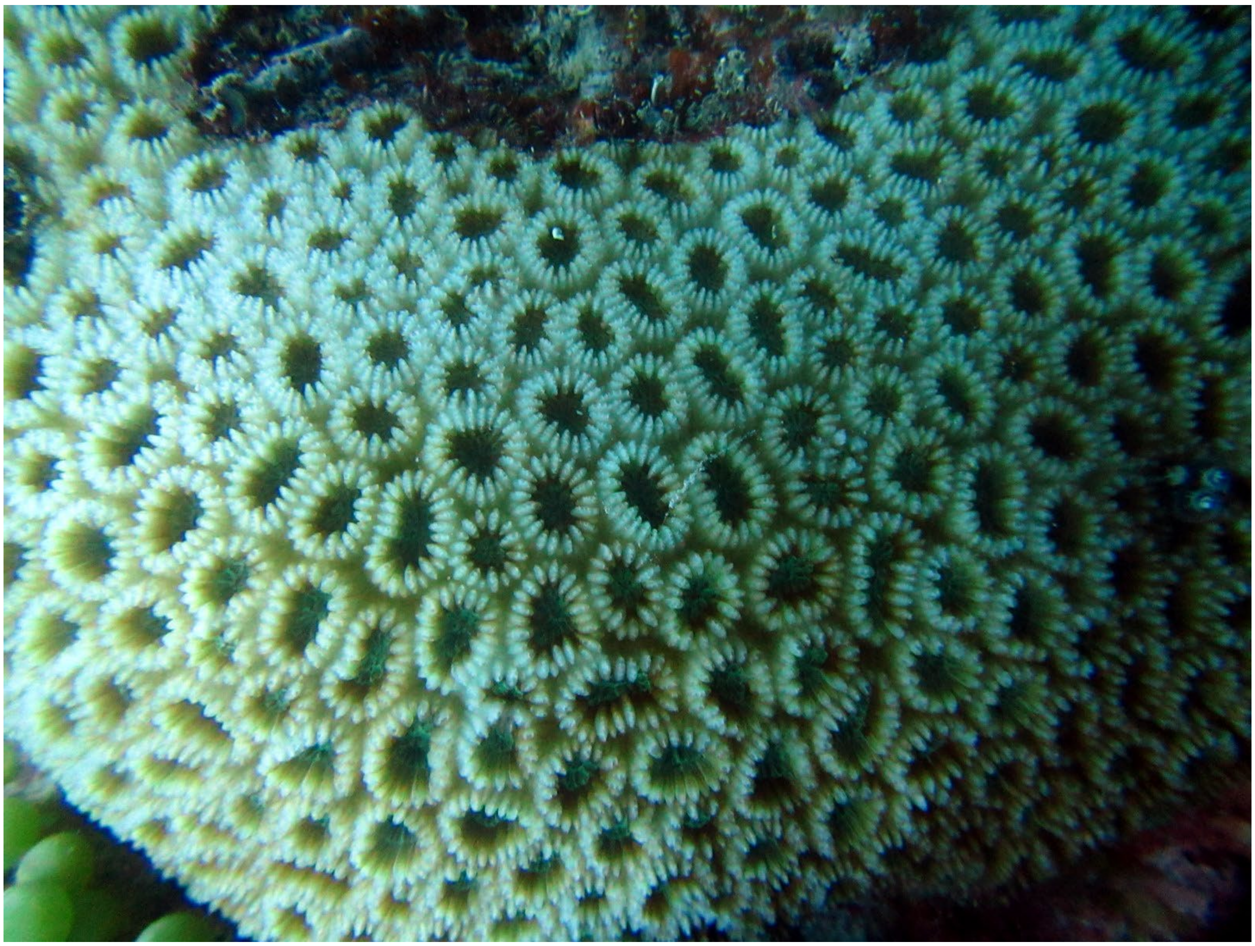
A close photo of *Symphyllia recta*.

Dipsastrea   *This used to be in Favia.*

Colonies are usually massive but can be encrusting or columnar. Corallites are medium to small size. Corallites are separate, projecting, with a groove between them. *Astrea* is very similar without easy ways to distinguish it as a genus. *Echinopora* has smaller corallites and is usually plating or foliose. *Favites* has fused corallites with just one single wall between corallites, no groove, and the same for *Goniastrea* and *Leptastrea*. Species within *Favia* are difficult to reliably identify.

Dipsastrea matthai (Vaughan, 1918)   This used to be in *Favia*.

Colonies are massive, corallites have thin rims with uniform short septa projecting upwards slightly. *Dipsastrea pallida* has dark corallite centers. Goniastrea *stelligera* has much smaller corallites.

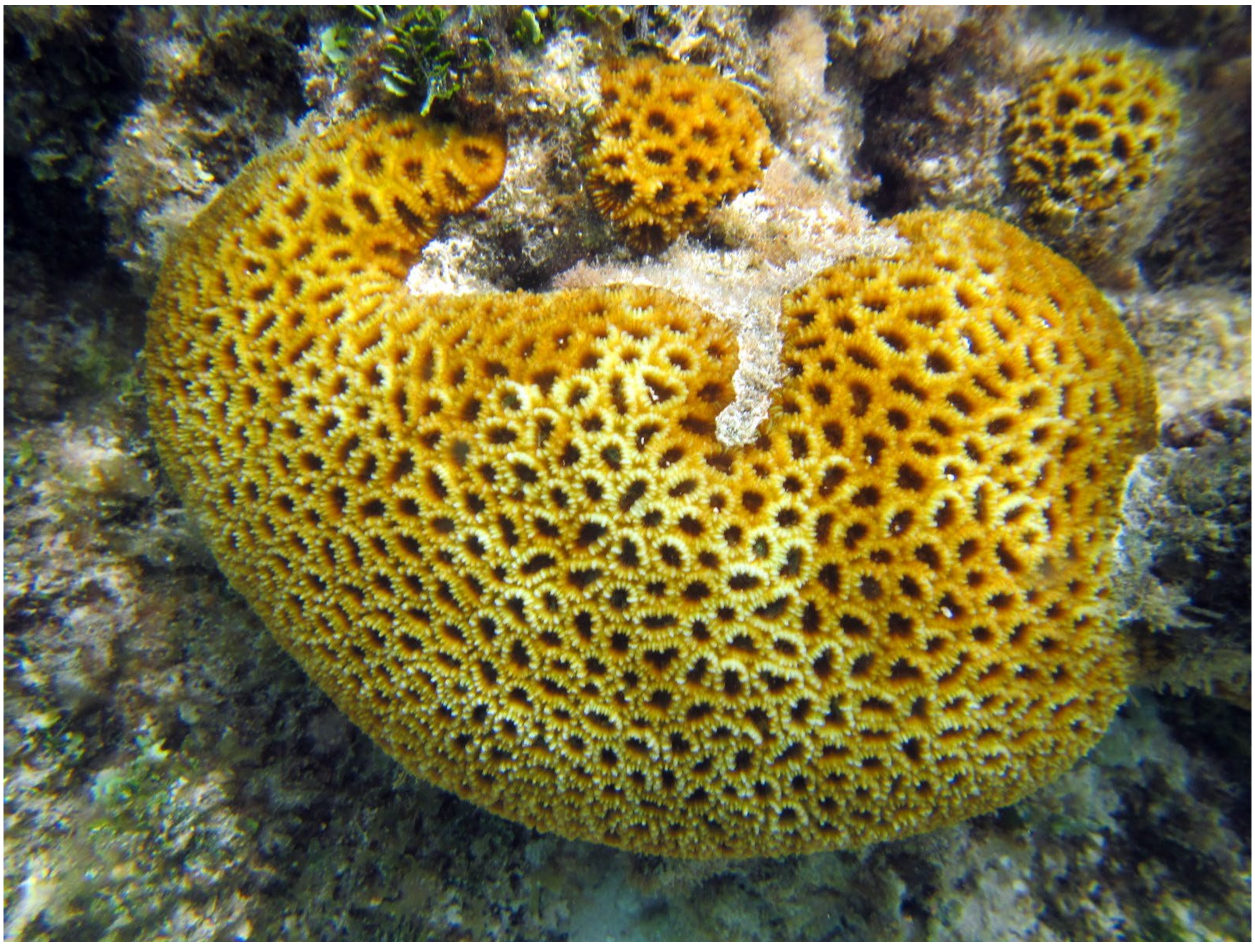


A colony of *Dipsastrea matthai*.

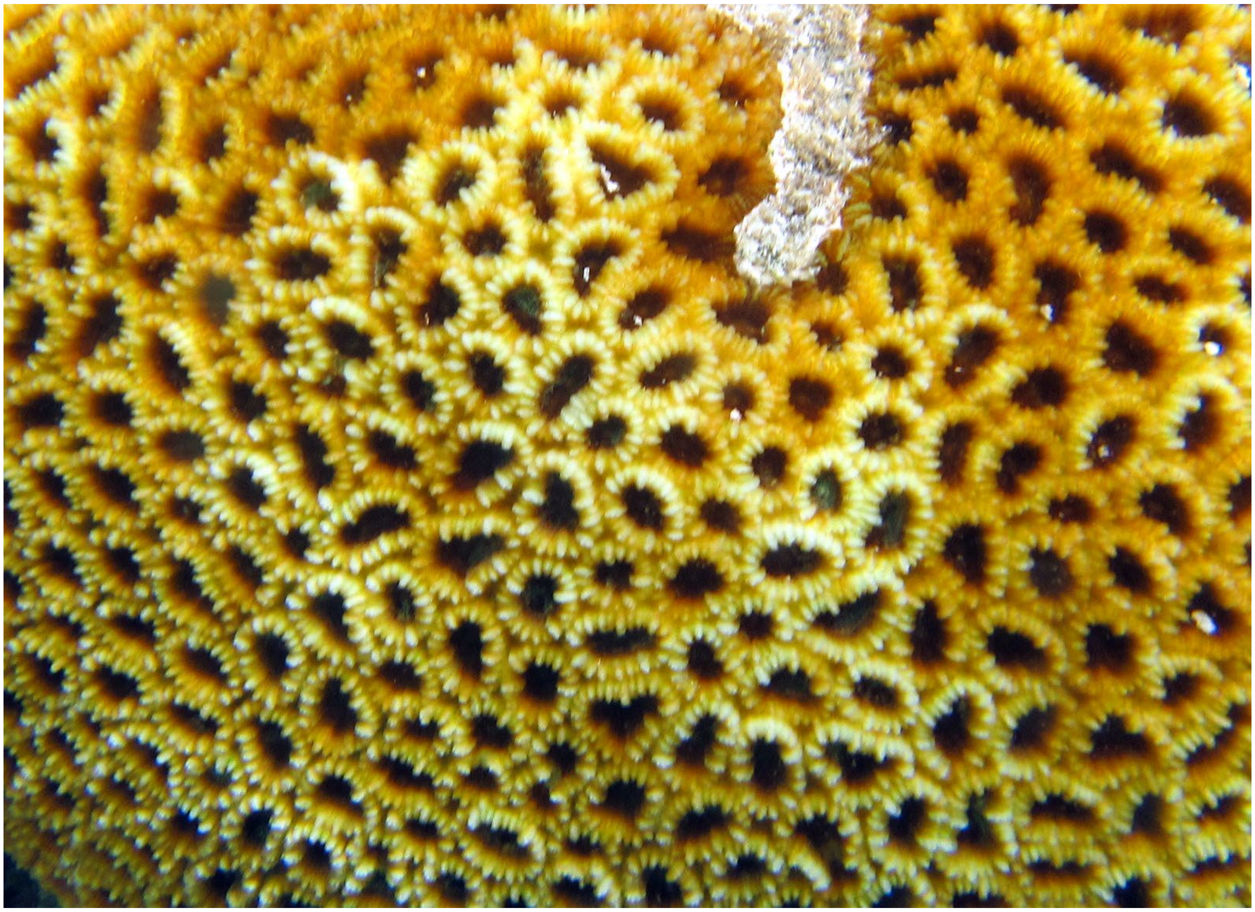
A close photo of a colony of *Dipsastrea matthai*.

Dipsastrea pallida Dana, 1846 This used to be called *Favia pallida*.

Colonies have finger-wide corallites which have a small but obvious groove between them. The rim of the corallites is relatively thin and septa project a little giving the edge of the corallite a slight grainy look. Corallites have dark centers, and colonies are usually yellow. *Favia truncata* has corallites on the sides that are tilted downwards. *Favia matthai* has larger septa and can be different colors. *Favia stelligera* has smaller corallites and *Favia rotunda* has a smooth band around the inner edge of the corallite walls. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Dipsastrea pallida*. This photo is from the Marianas.

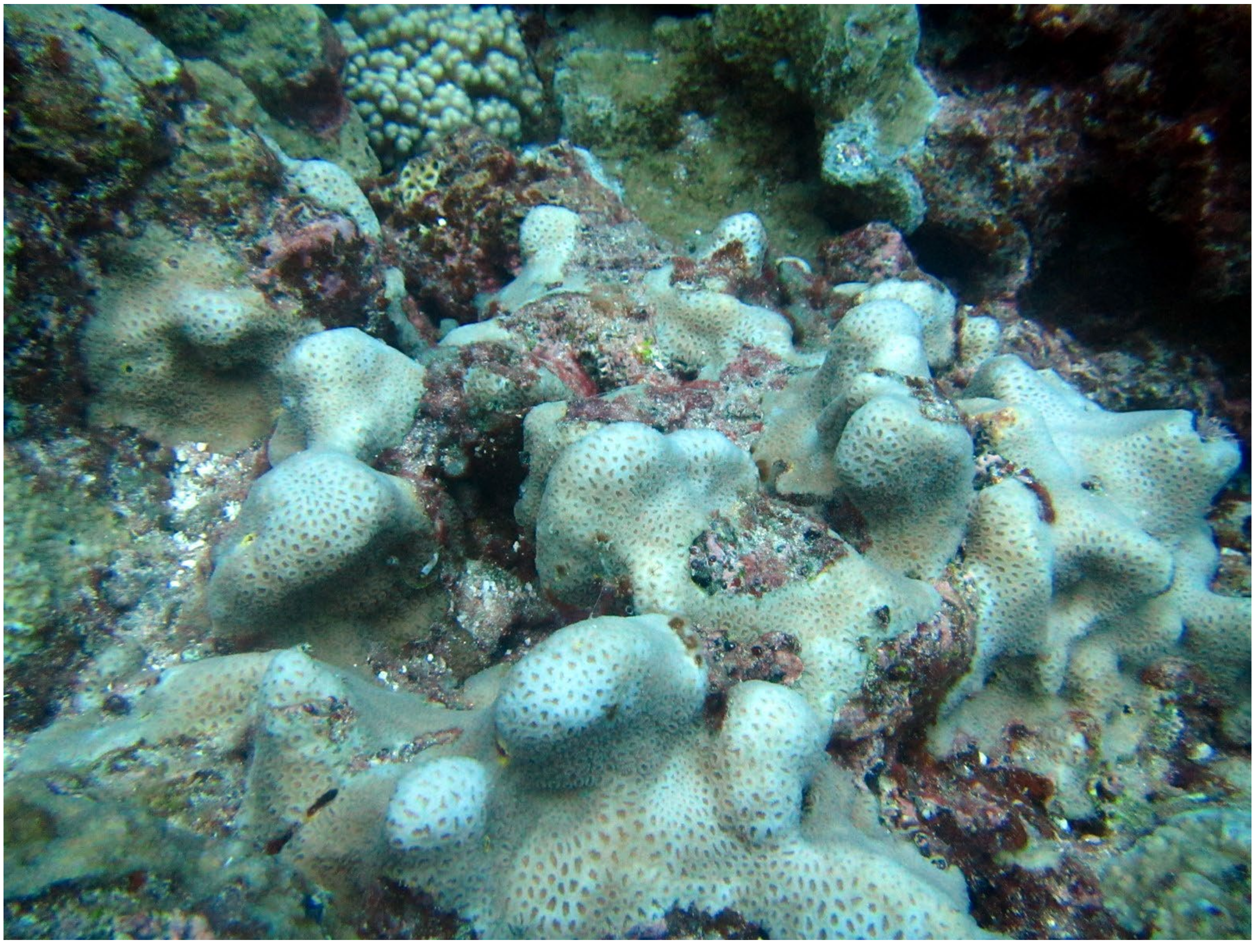


A close-up photo of *Dipsastrea pallida*. This photo is from the Marianas.

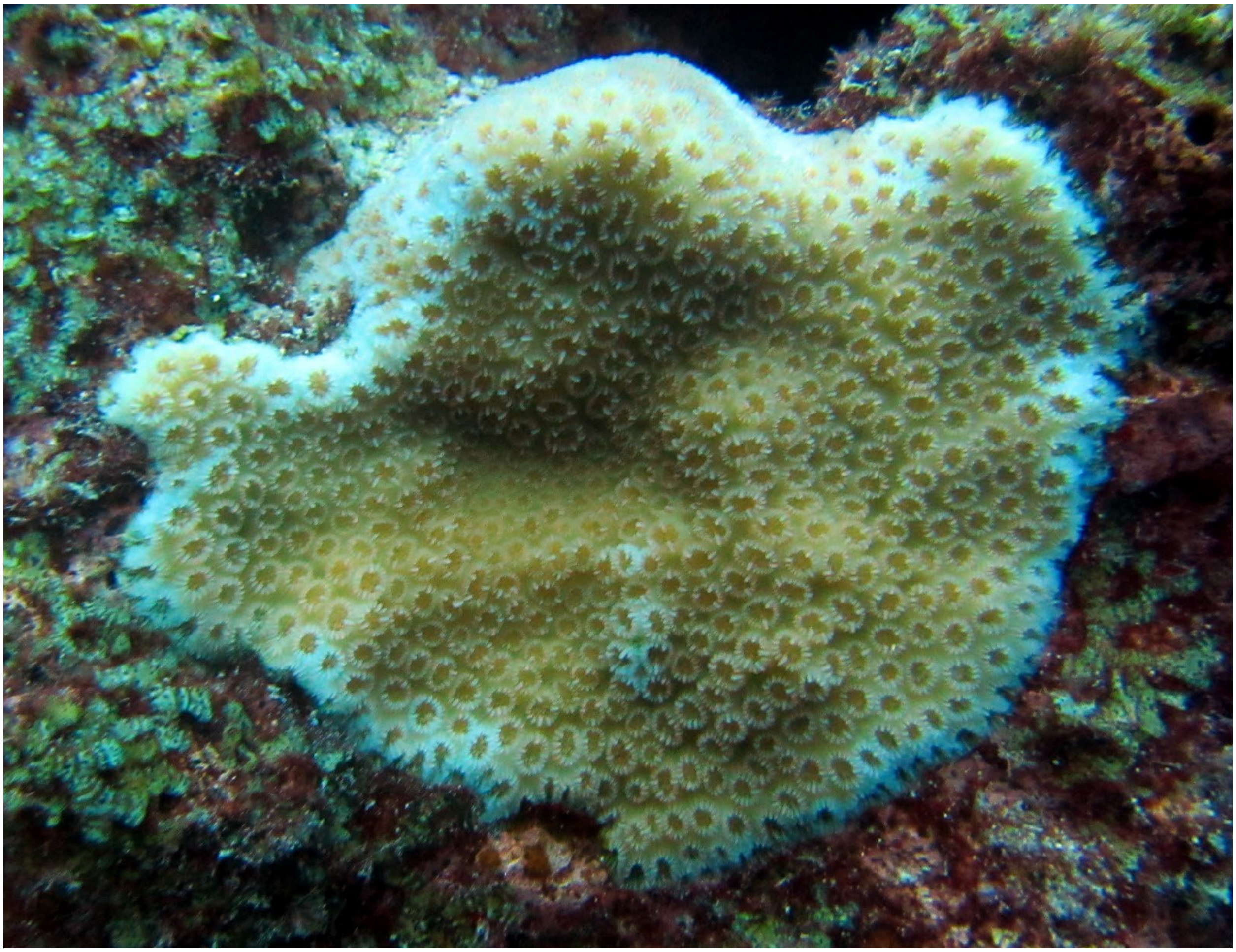
Goniastrea stelligera (Dana, 1846) This used to be in *Favia*.

Colonies vary from encrusting with lumps, to columnar. Corallites are raised with a crack between, and are small, about 4 mm diameter. All *Dipsastrea* have larger corallites. This species was placed here because it looks more like *Dipsastrea* than *Goniastrea*.

A photo of a columnar colony of *Goniastrea stelligera*.



A photo of an encrusting colony with lumps of *Goniastrea stelligera*.



A close photo of a small encrusting colony of *Goniastrea stelligera*.

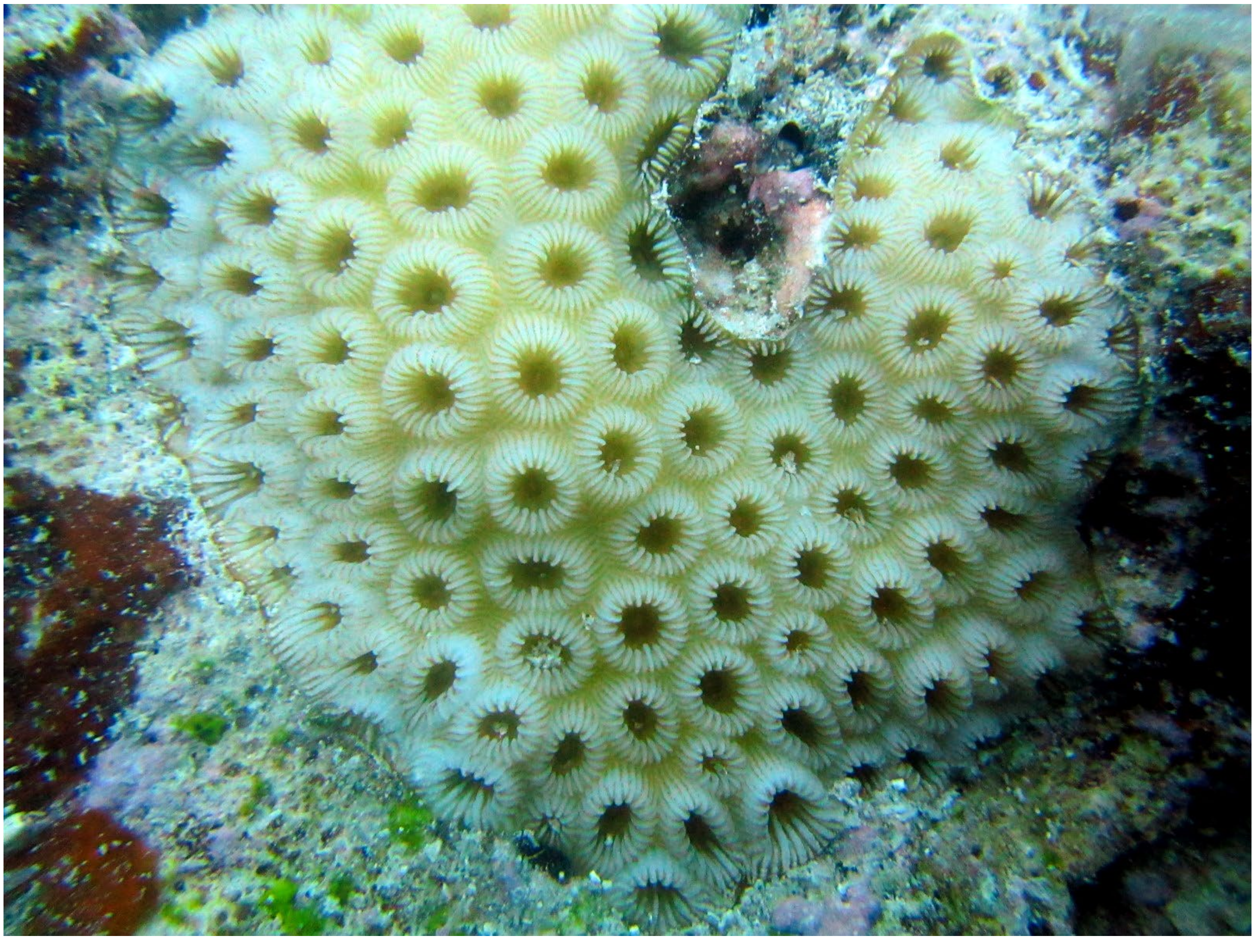
Astrea

Colonies are massive or encrusting. Corallites project, with a crack between them so they have separate walls. Corallites are a bit smaller than a small finger. *Astrea* doesn't have any easily seen differences with *Favia*, the best way to tell them apart is by learning the species which then tells you the genus.

Astrea curta Dana, 1846

Colonies are usually massive. Corallite walls are fairly thick, with uniform septa that are close together. Colonies are often light colored. *Astrea annuligera* is usually encrusting, has some septa longer than others, and is often dark colored.

A photo of a colony of *Astrea curta*.



A close photo of *Astrea curta.*

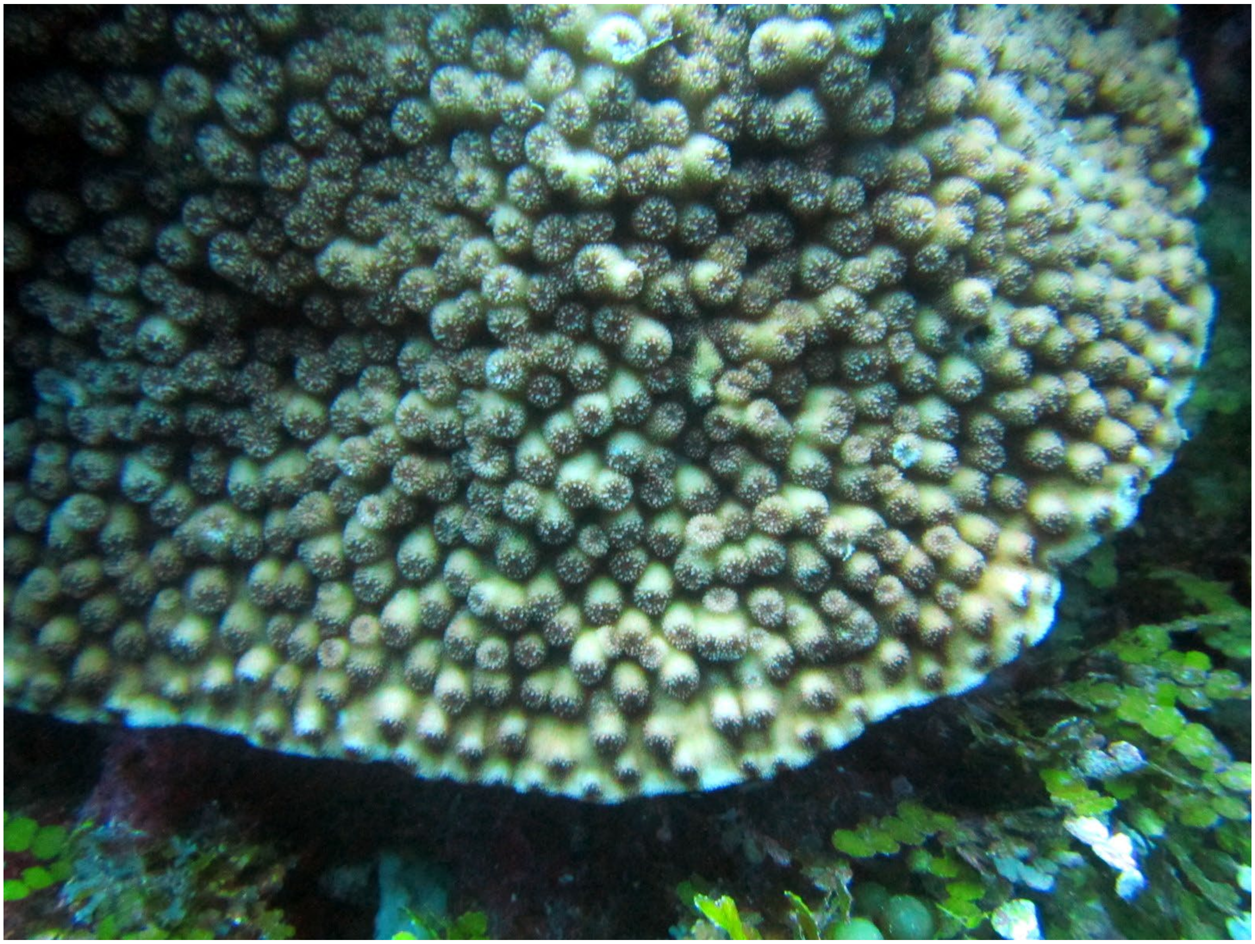
Echinopora

Colonies are plates or encrusting. Corallites project and have separate walls. Corallites are small to nearly tiny. Colonies are massive for *Favia* and *Astrea*, and corallites are larger.

Echinopora pacificus Veron, 1990

Colonies are usually encrusting but may have plate edges. Corallites are slightly larger than on other *Echinopora*, but still small. The surfaces have spines so small that the surfaces look smooth, unlike other *Echinopora*.

An encrusting colony of *Echinopora pacificus*.



A photo of a plate colony of *Echinopora pacificus*.

A close-up photo of an encrusting colony of *Echinopora pacificus*.

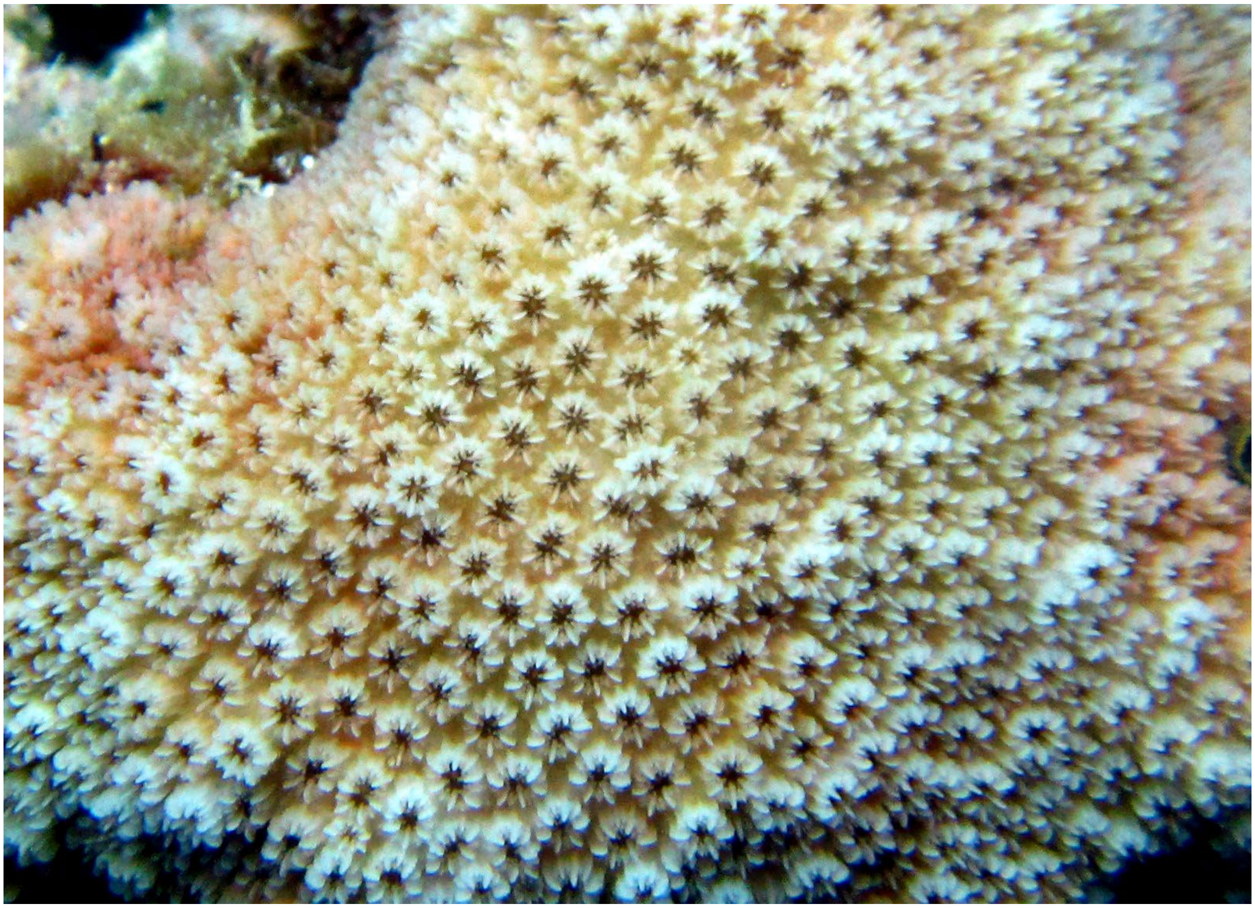
Cyphastrea

Most species have encrusting or massiive colonies, but at least one is branching. The corallites are small, about 2 mm diiameter or a bit larger. The corallites are smaller than on *Plesiastrea* and *Echinopora*. For most species the only features that can be used in identification are the septa and costae, which are so small they are hard to see. Septa can be hard to count reliably even in photographs. This genus was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

Cyphastrea sp. 1

Colonies are encrusting and corallites projet and have 6 septa which project farther upward than the next 6 septa. *Cyphastrea agassizi* has corallites that can be close together in one part of a colony and far apart in another. Also, the number of septa that project upwards more than others varies from 4 to 6, and corallites are a darker color than the spaces between corallites. Other species have different numbers of septa.

A colony of *Cyphastrea* sp. 1. The actual corallites are smaller than in this picture. This photo is from the Marianas.



A close-up picture of *Cyphastrea* sp. 1, highly magnified. This photo is from the Marianas.

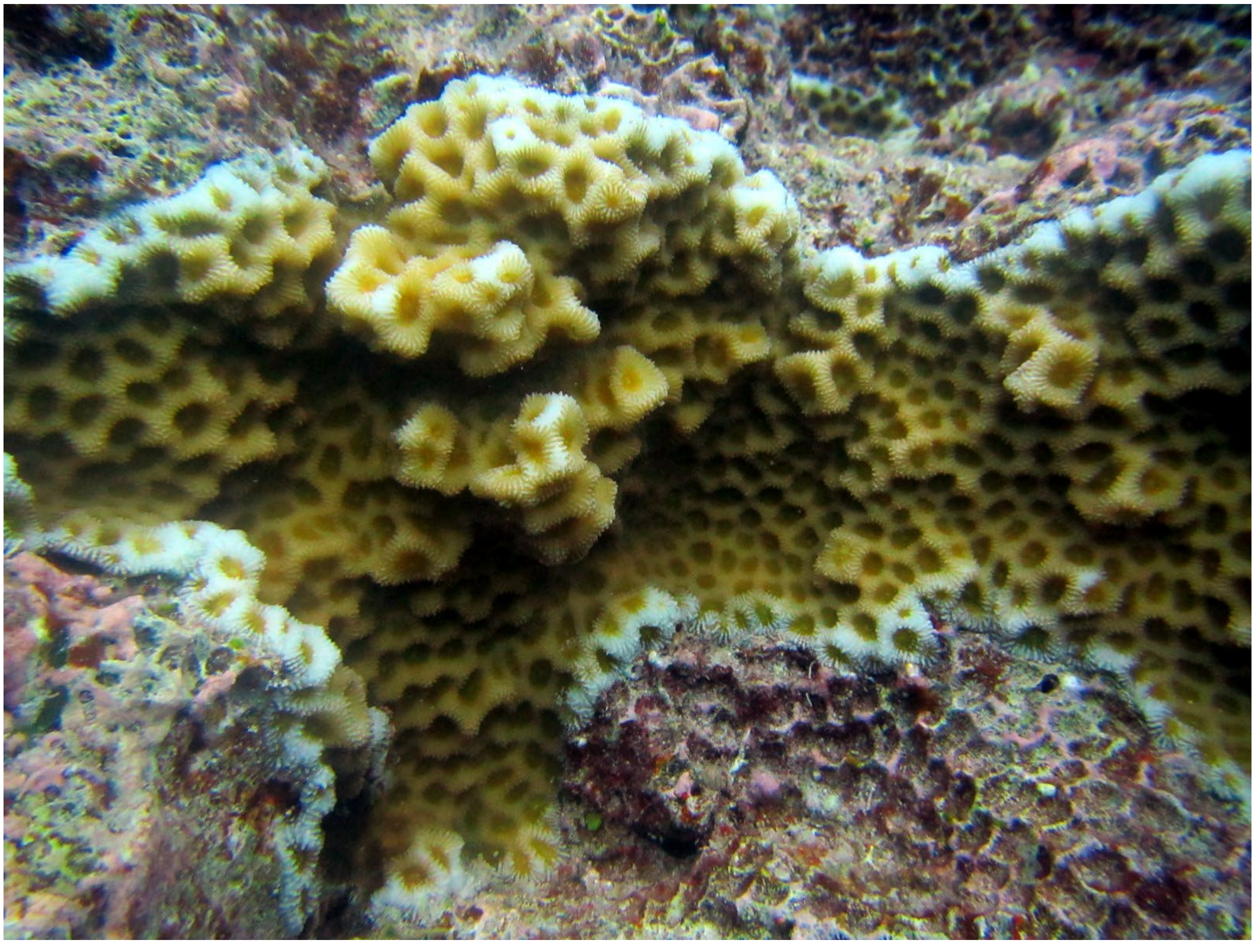
Favites

Colonies are usually encrusting but may be massive. Corallites are recessed, with a single wall between corallites, no groove. *Dipsastrea*, *Favia*, *Astrea* and *Echinopora* have separate walls with a groove between them. *Goniastrea* often has a thin wall between corallites and polygonal corallites. *Goniastrea* and *Leptastrea* usually have smaller corallites.

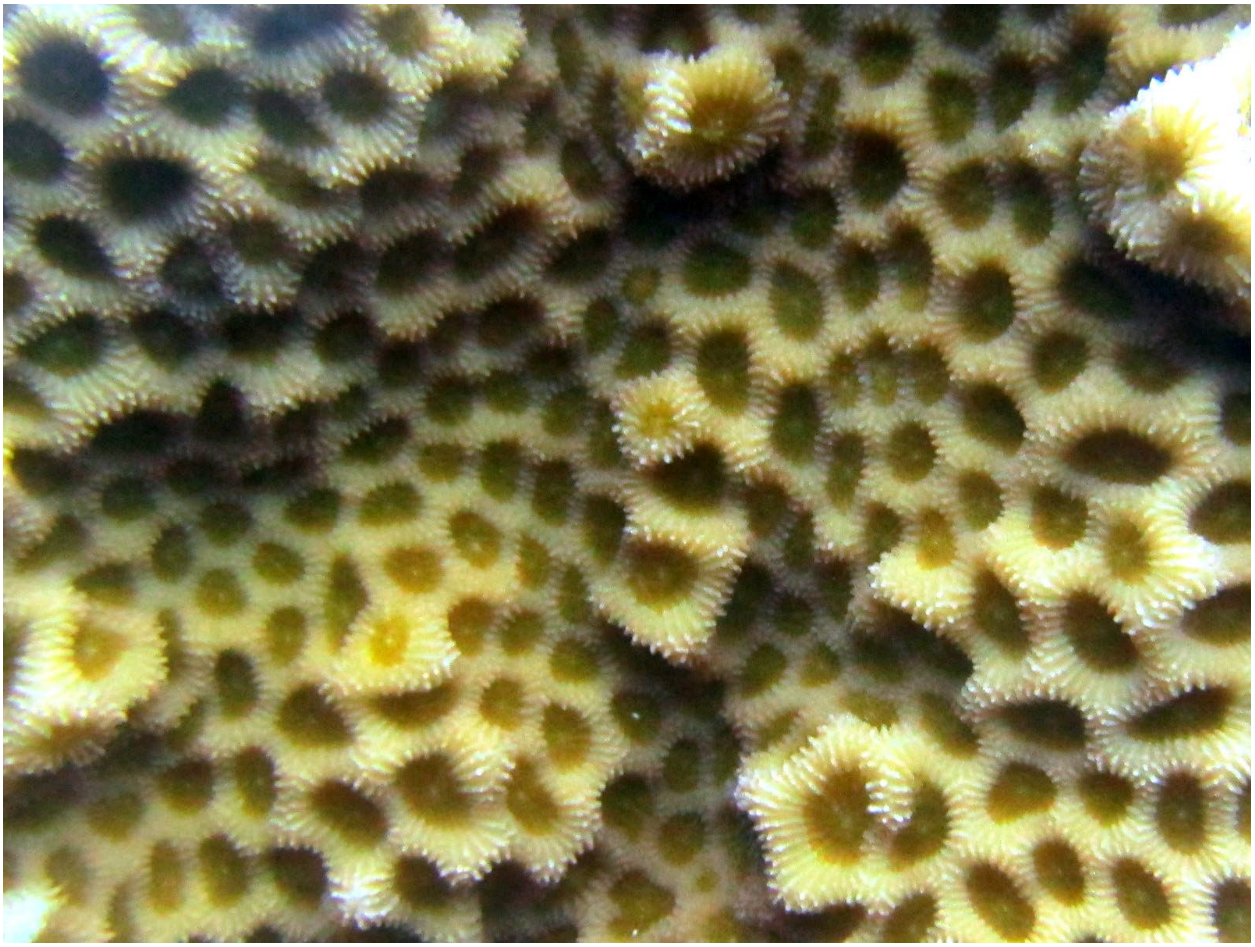
Favites abdita (Ellis & Solander, 1786)

Colonies are usually encrusting but may have irregular lumps. The walls are fairly sharp, and the deep center of the corallites is nearly round. Corallites are about the diameter of a finger or a small finger. *Favites pentagona* and *Favites spicifera* have smaller corallites and/or thinner walls.

A colony of *Favites abdita*.



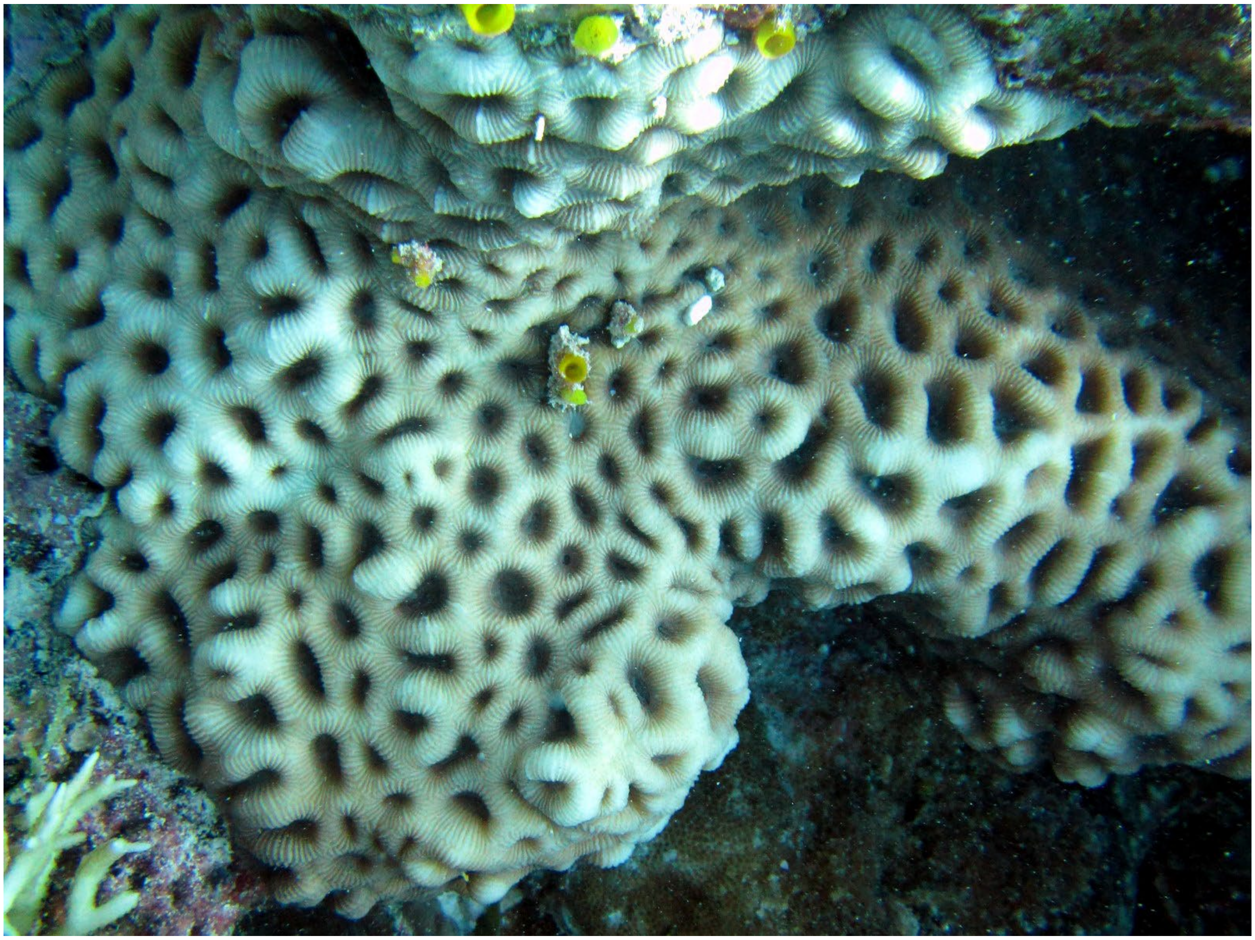
A photo of a colony of *Favites abdita* that has lumps.



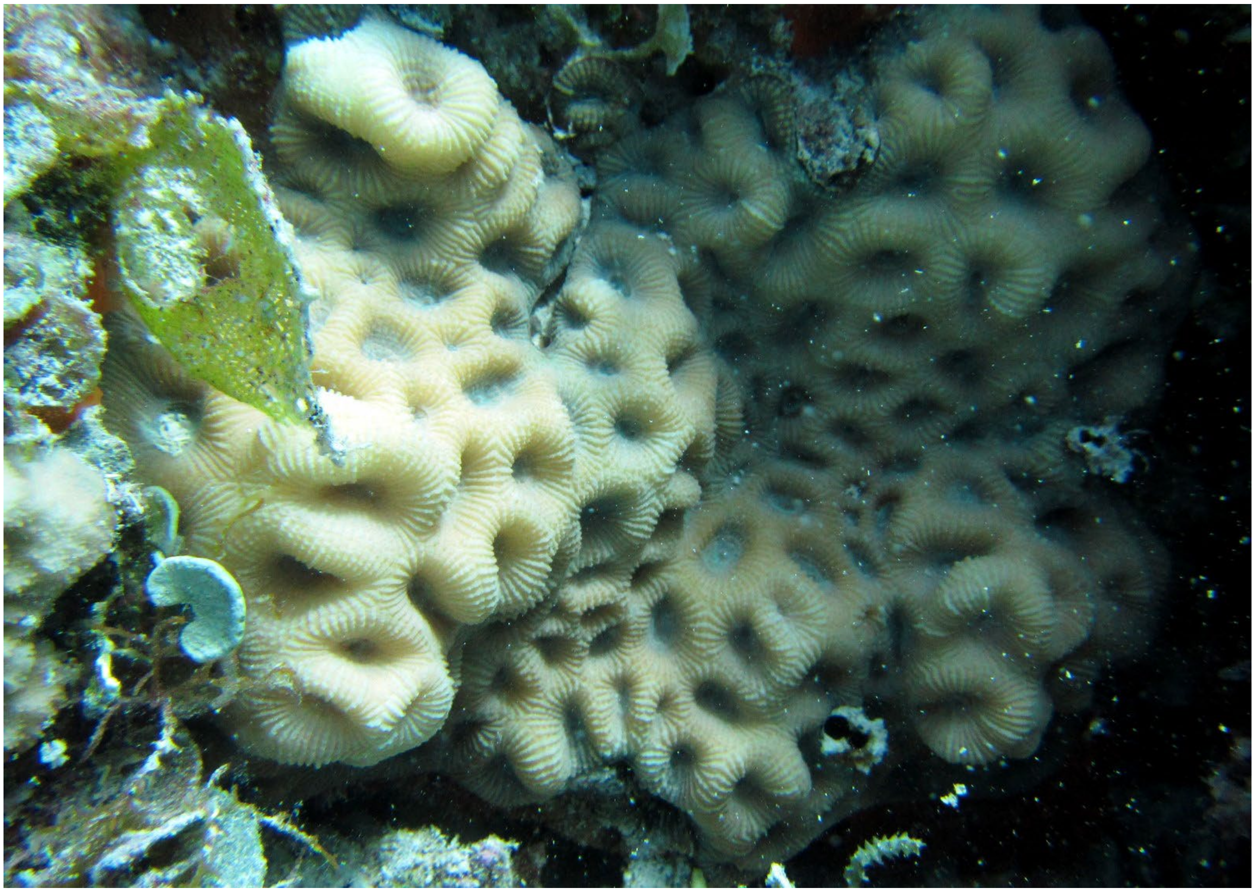
A close-up photo of *Favites abdita*.

Favites halicora (Ehrenberg, 1834)

This species forms colonies with thicker, more rounded ridges between the corallites than *Favia abdita*. Corallites are smaller than on *Favites vasta* and septa easier to see. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



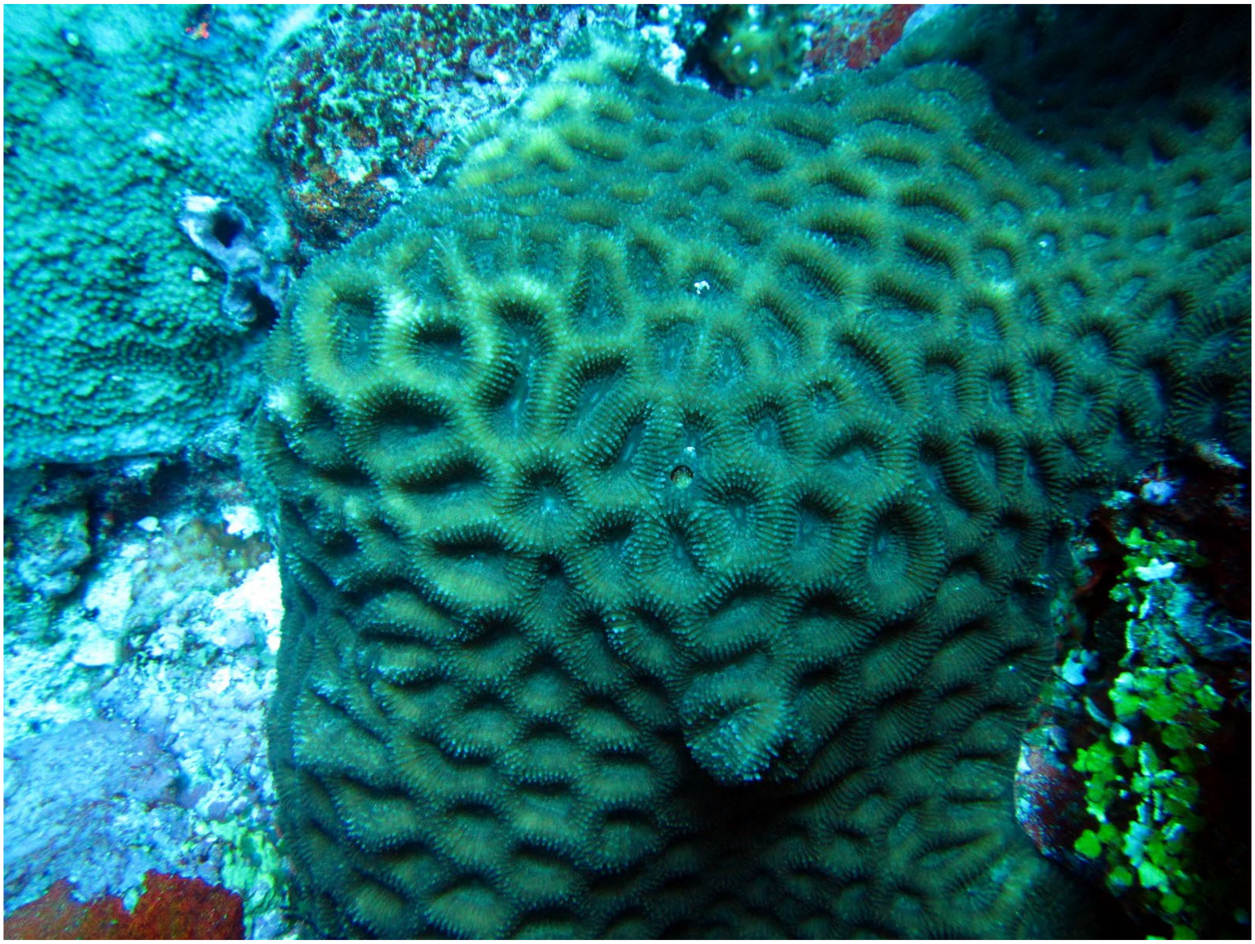
A colony of *Favites halicora.* This photo is from the Marshall Islands.



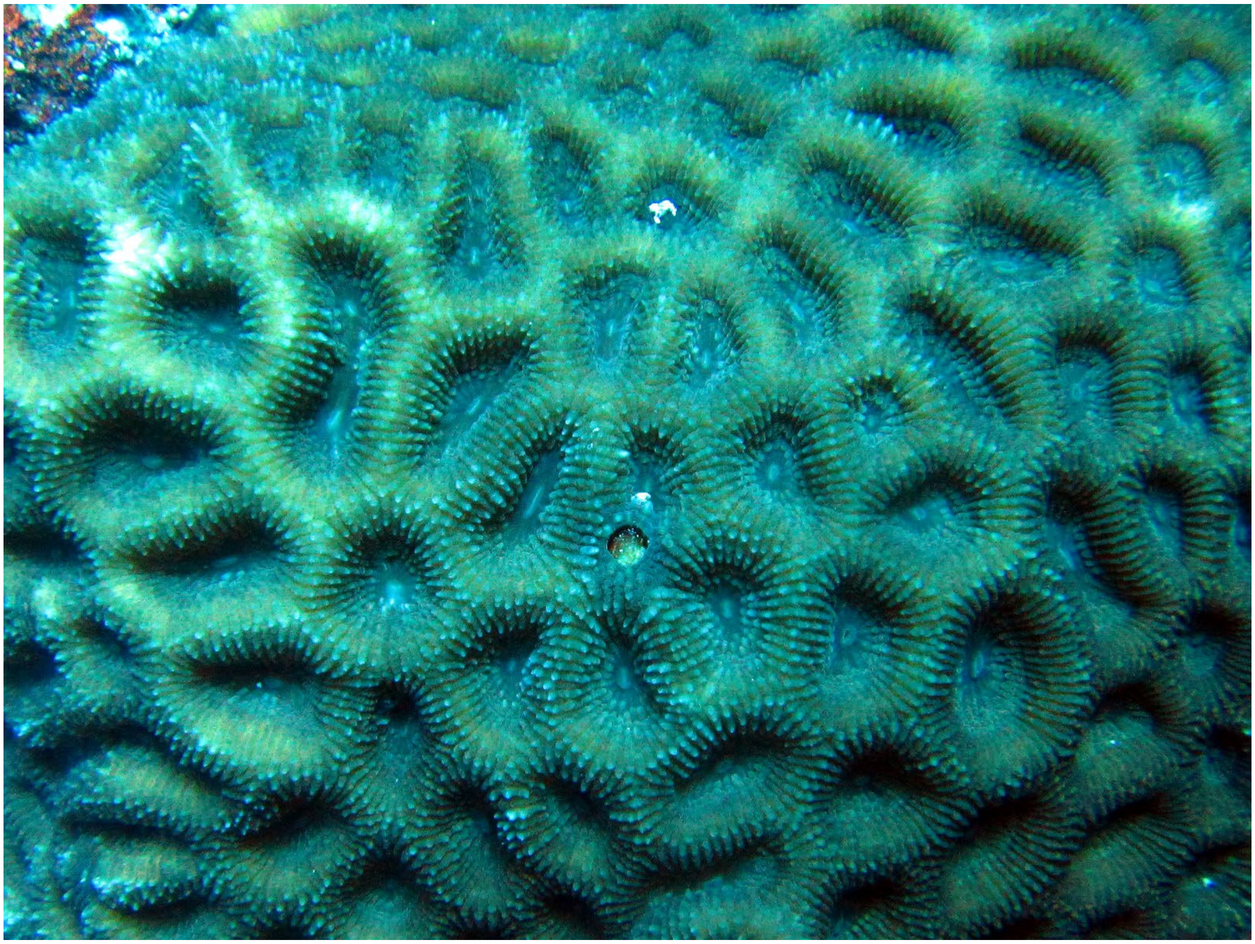
Another photo of *Favites halicora*. This photo is from the Marshall Islands.

Favites flexuosa (Dana, 1846)

Colonies are encrusting or massive. The corallites are a bit larger than on some other *Favites*, and are about thumb diameter. Corallites are spiny. *Favites paraflexuosa* is similar but not as spiny.



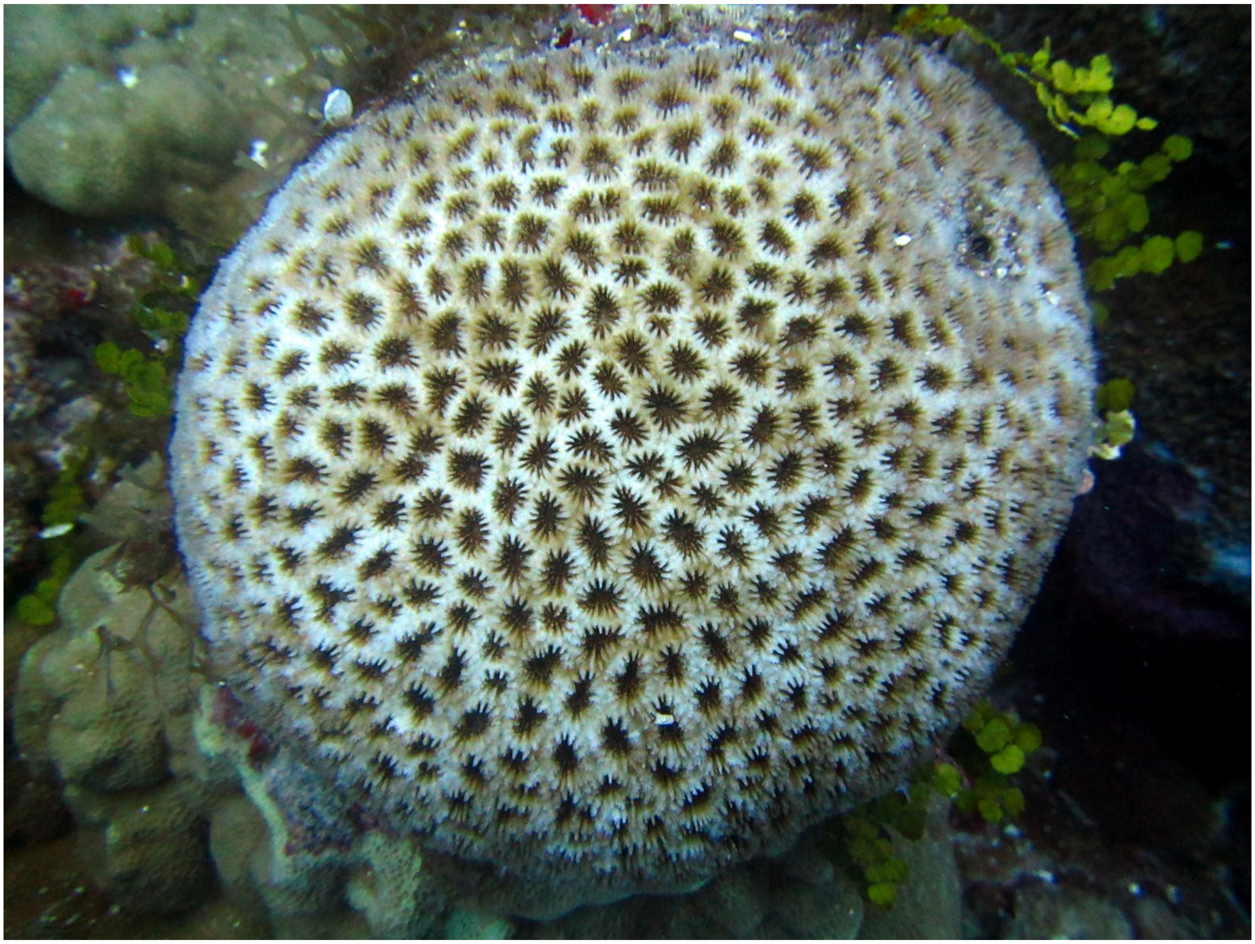
A colony of *Favites flexuosa*. This photo is from Wallis Island (Uvea), Wallis and Futuna.



A closer photo of *Favites flexuosa*. In some colonies the spines are larger than on this one. This photo is from Wallis Island (Uvea), Wallis and Futuna.

Favites spinosa (Klunzinger, 1879)

Colonies are massive. Corallites are small, with a single thin ridge separating them. Septa point a short way into the center of the corallite. Corallites are smaller, walls are thinner, and septa project more obviously into the corallites than on *Favites abdita*.



A photo of a colony of *Favites spinosa*.

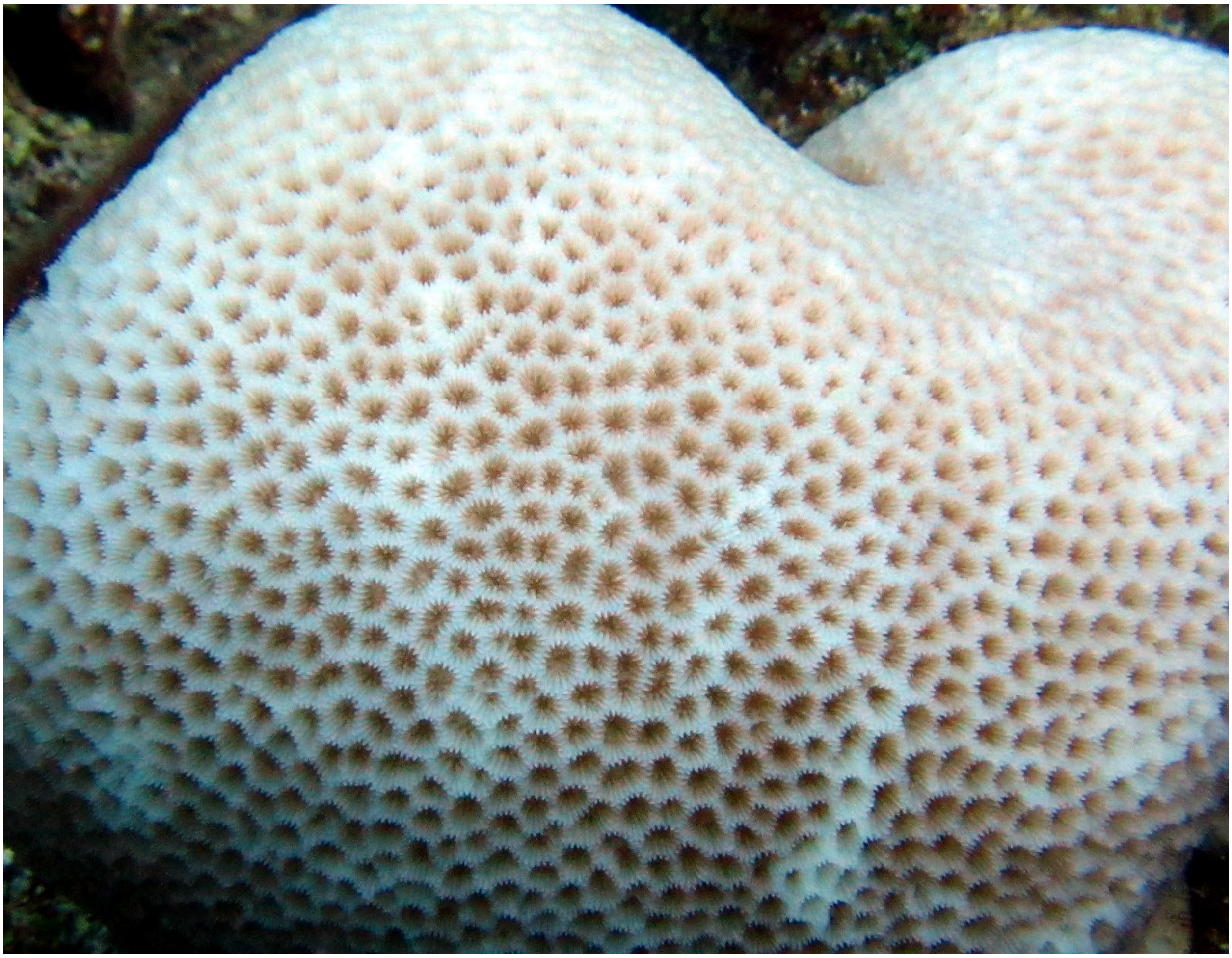
Goniastrea

Colonies are usually massive but can be encrusting. Corallites usually have thin walls between them, but may have this walls. Most species have polygonal corallites with one polyp mouth per corallite, but at least one can have two or three mouths in an elongated corallite, and one is fully meandroid with fairly thick ridges. Sometimes it is possible to see tiny bumps on the outer edges of the floor of corallites, which are due to little points called "pali" in the skeleton, which most other genera don't have. Walls are usually thinner than on *Favites* and in a few species corallites are smaller. Light orange to light purple are common colors. *Leptastrea* has smaller corallites than some *Goniastrea*, but not others, and is encrusting.

Goniastrea retiformis (Lamarck, 1816)

Colonies range from small to quite large, up to 1-2 m diameter. Corallites are quite small, about 3-4 mm diameter, thin walled, and polygonal. They are also deep for their size. Most other *Goniastrea* have larger corallites.

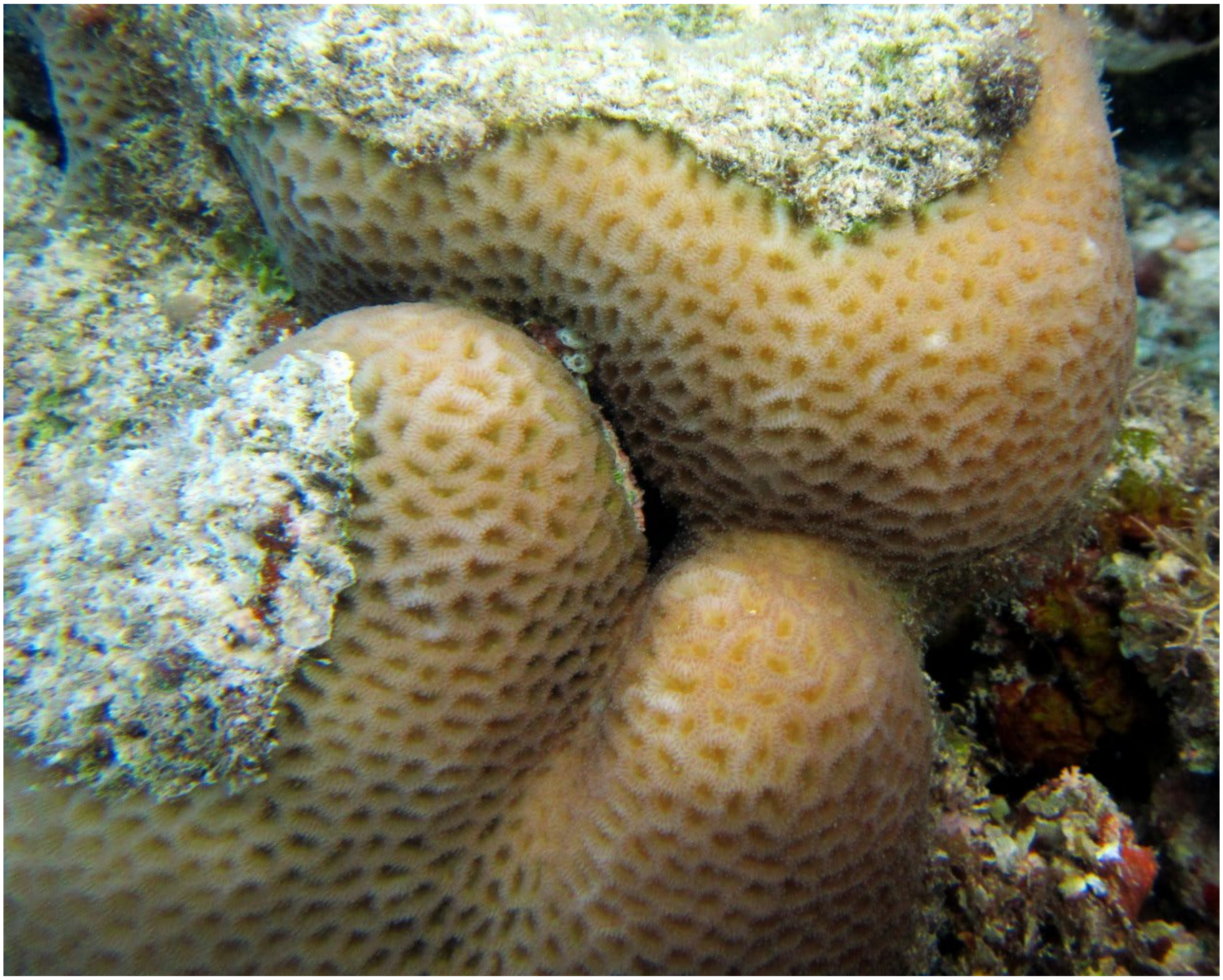
A close photo of a colony of *Goniastrea retiformis*.



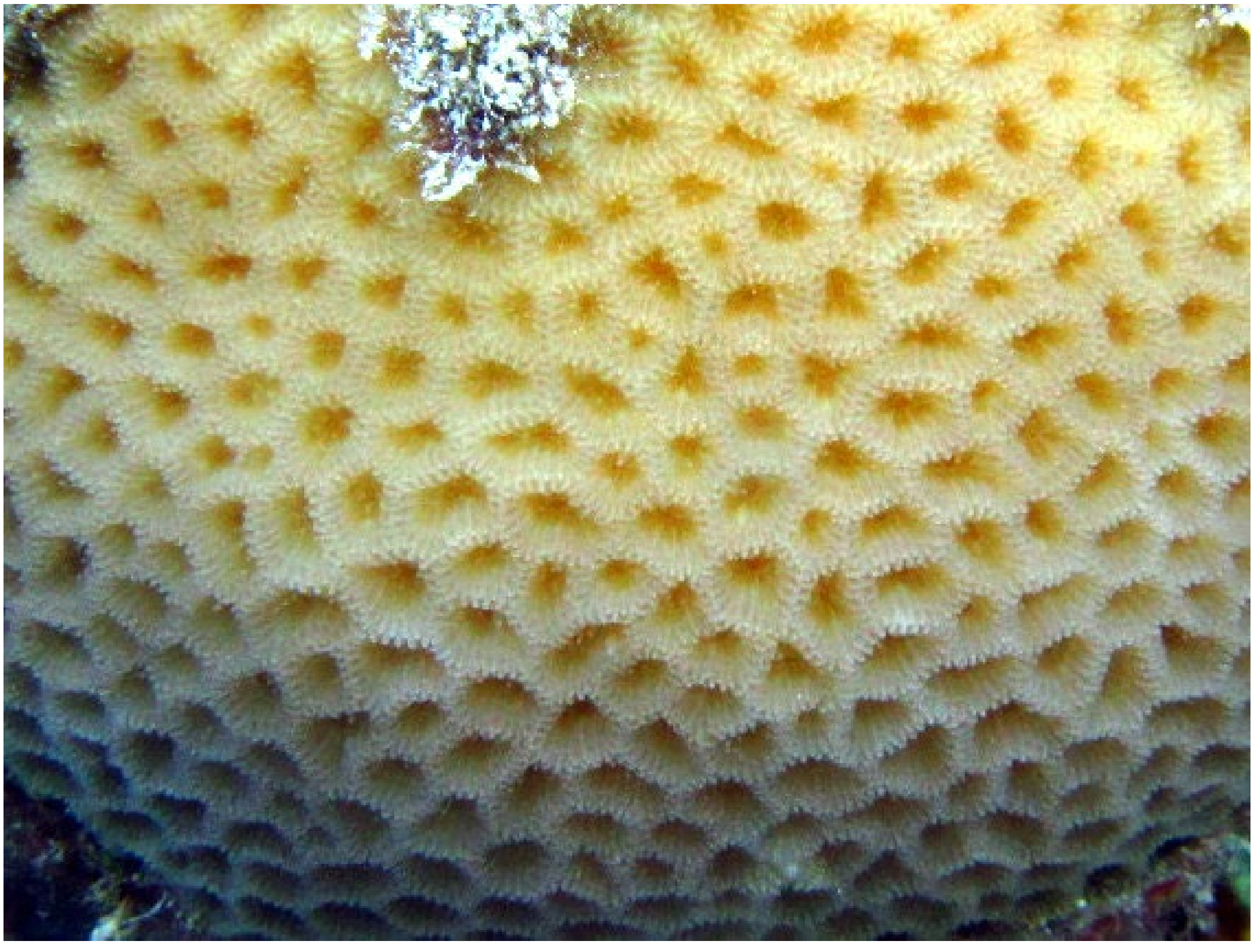
A close-up photo of *Goniastrea retiformis*.

Goniastrea edwardsi Chevalier, 1971

Colonies are massive or encrusting. Corallites are small, about 4 mm diameter. Walls separating corallites are thick. Corallites are polygonal but not elongated. Corallites are smaller than on *Goniastrea pectinata* and *Gonastrea favulus*, and not elongated. larger than on *Goniastrea retiformis* and *Goniastrea minuta*, and the corallite walls are thicker.



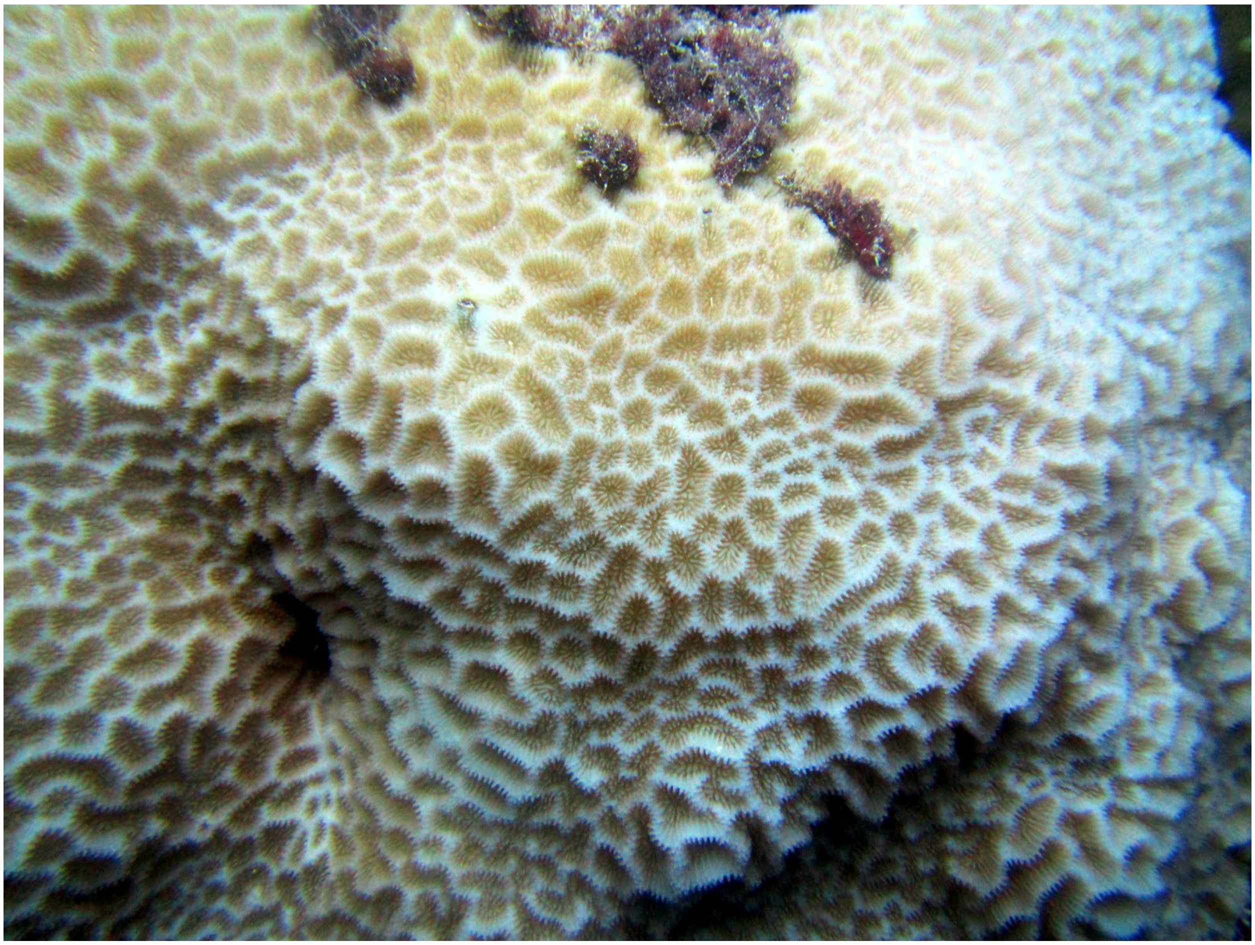
A colony of *Goniastrea edwardsi*. This is a photo from the Marianas.



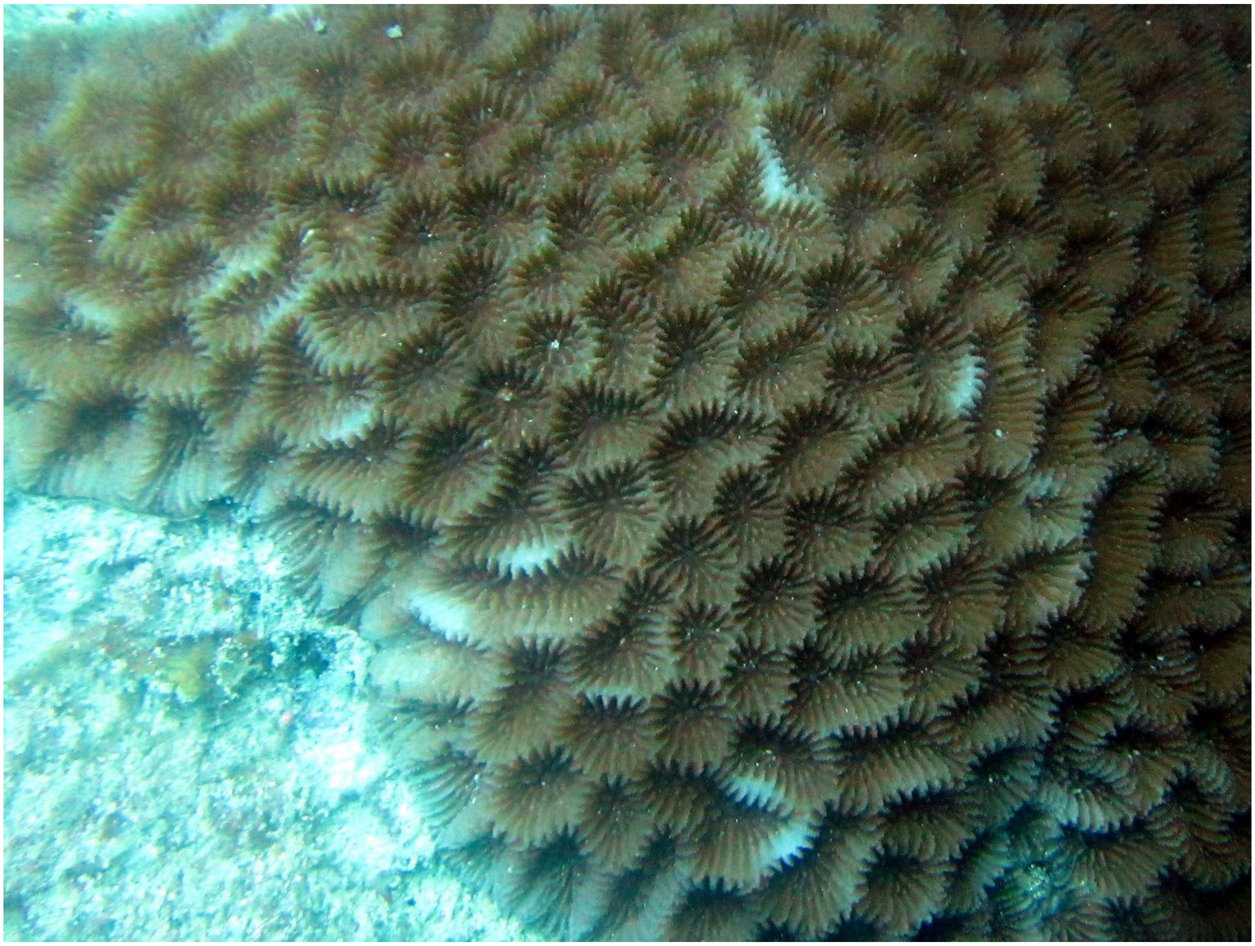
A close-up photo of *Goniastrea edwardsi*. This is a photo from the Marianas.

Goniastrea pectinata (Ehrenberg, 1834)

Colonies are encrusting to massive and often lumpy. Corallites are moderately large, and at least a few corallites are elongated enough to have two or three mouths on the polyp (the mouths are not usually visible). Corallites are not elongated on most other *Goniastrea species*, corallites are larger than on *Goniastrea retiformis* and *Goniastrea minuta*, and colonies are lumpier than on most other *Goniastrea*. The valleys are not fully elongated as in meandroid (brain coral) species.



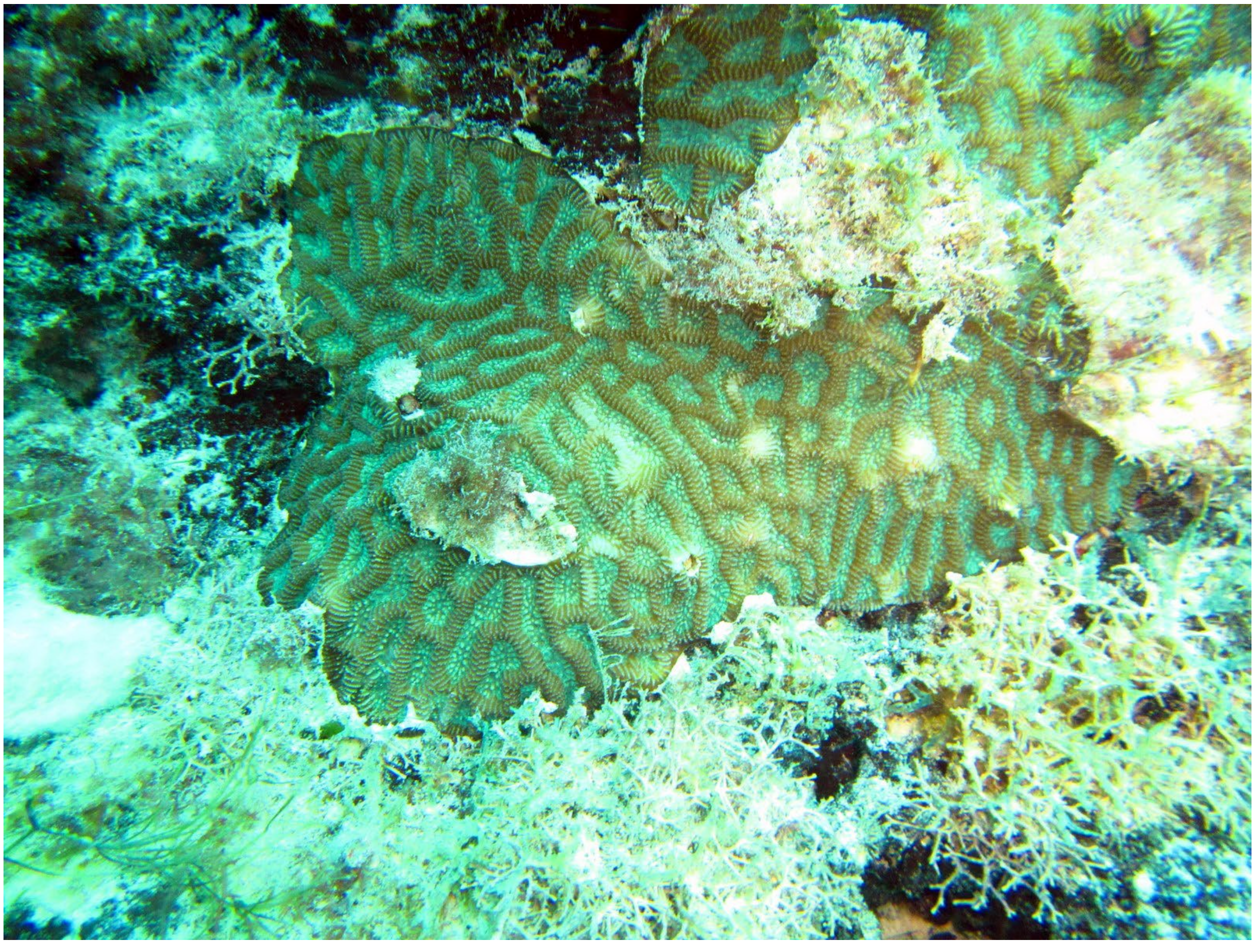
A photo of a colony of *Goniastrea pectinata*.



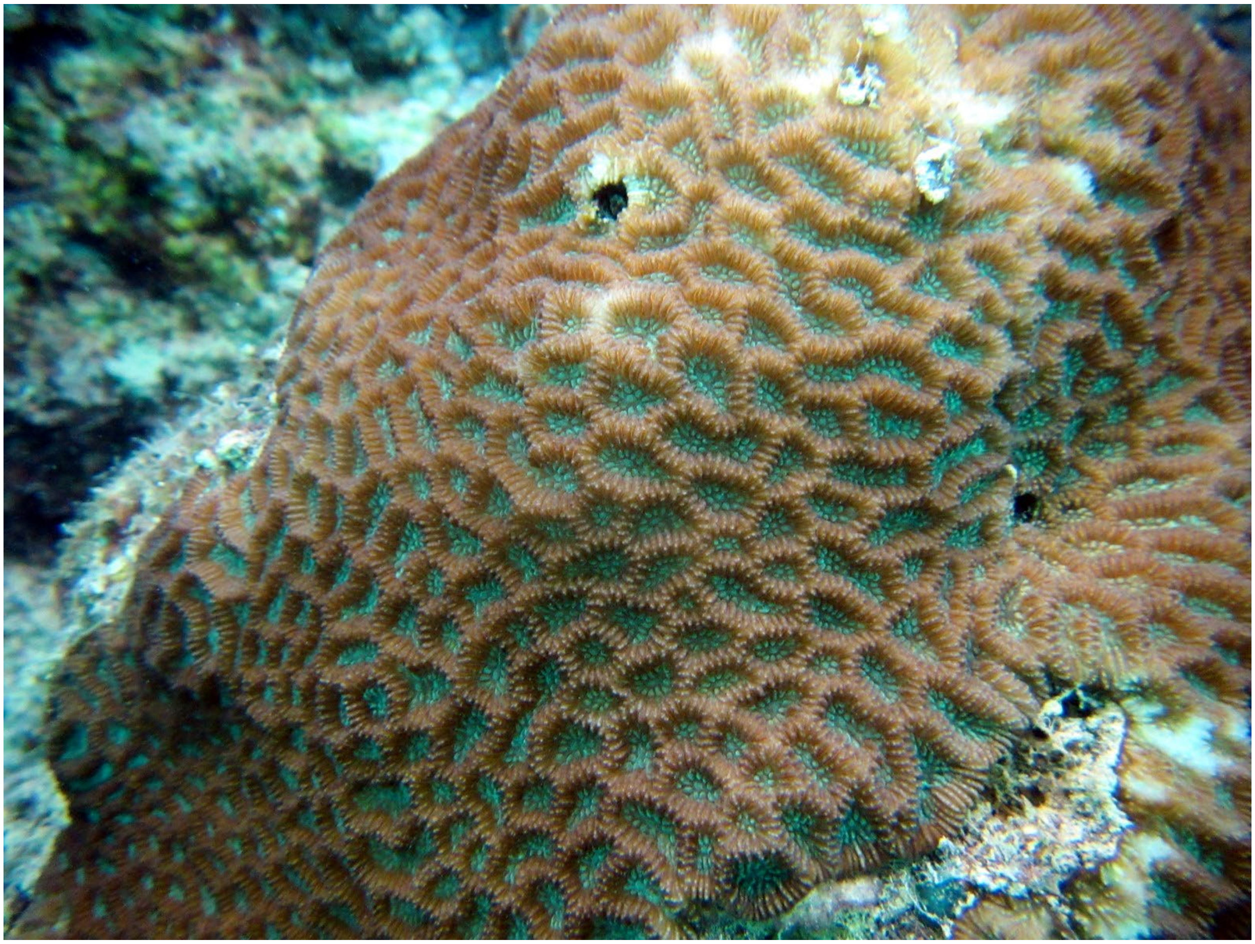
A close photo of *Goniastrea pectinata*.

Goniastrea favulus (Dana, 1846)

Colonies are usually encrusting. Corallites are shallow and may be circular or elongated. Corallites are shallower than on *Goniastrea pectinata* which is usually lumpy, and some corallites may be much longer. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Goniastrea favulus*. This photo is from the Marianas.



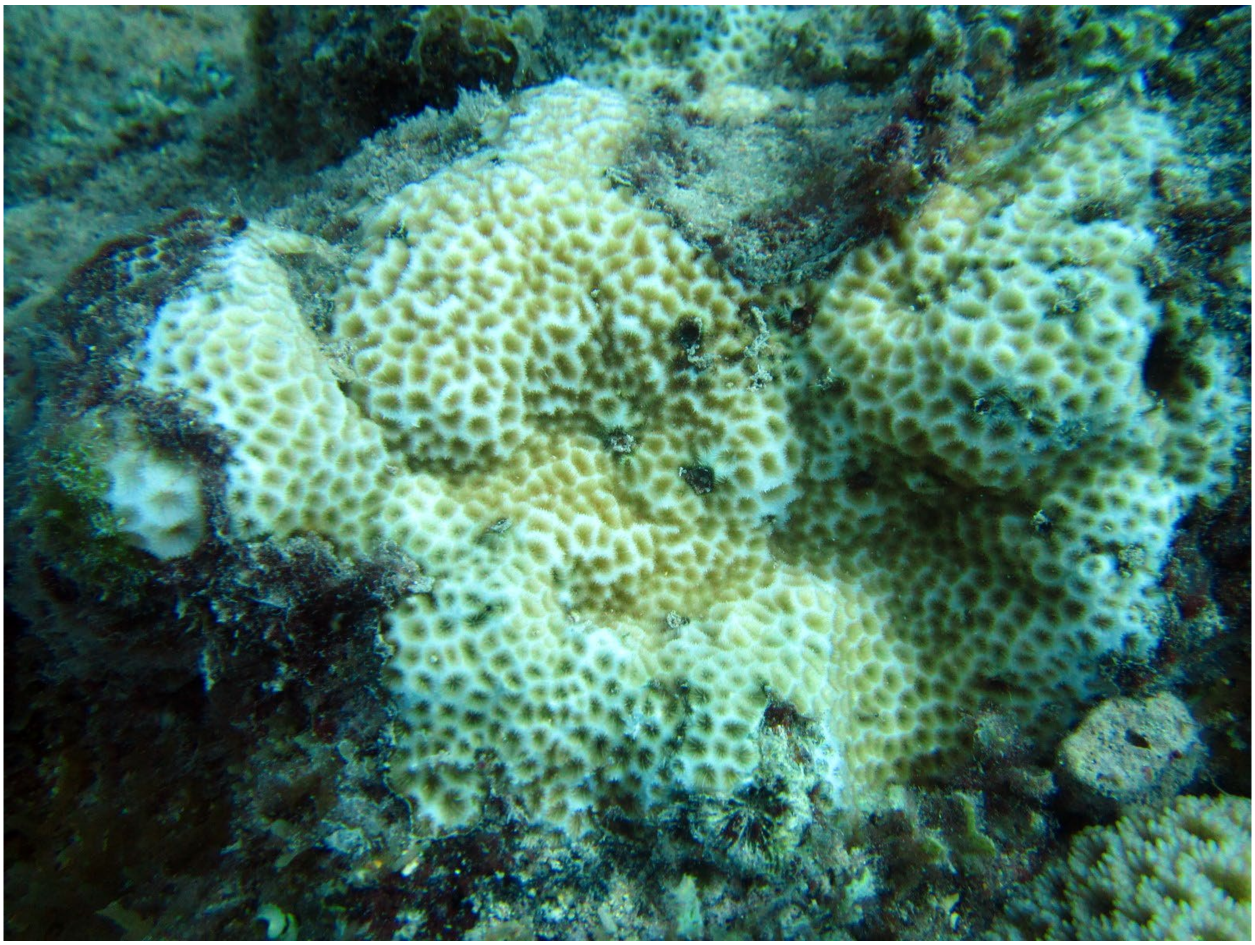
A close-up photo of *Goniastrea favulus*. This photo is from the Marianas.

Leptastrea

Colonies are encrusting, and corallites small. Septa are often hard to see. Corallites are circular or polygonal. *Favites* usually has larger corallites, bumps representing pali may be seen on the floor of some *Goniastrea*, some *Goniastrea* have elongated or meandroid corallites, and *Platygyra* is meandroid or has larger, irregular shaped corallites with septa that are easily visible.

Leptastrea purpurea (Dana, 1846)

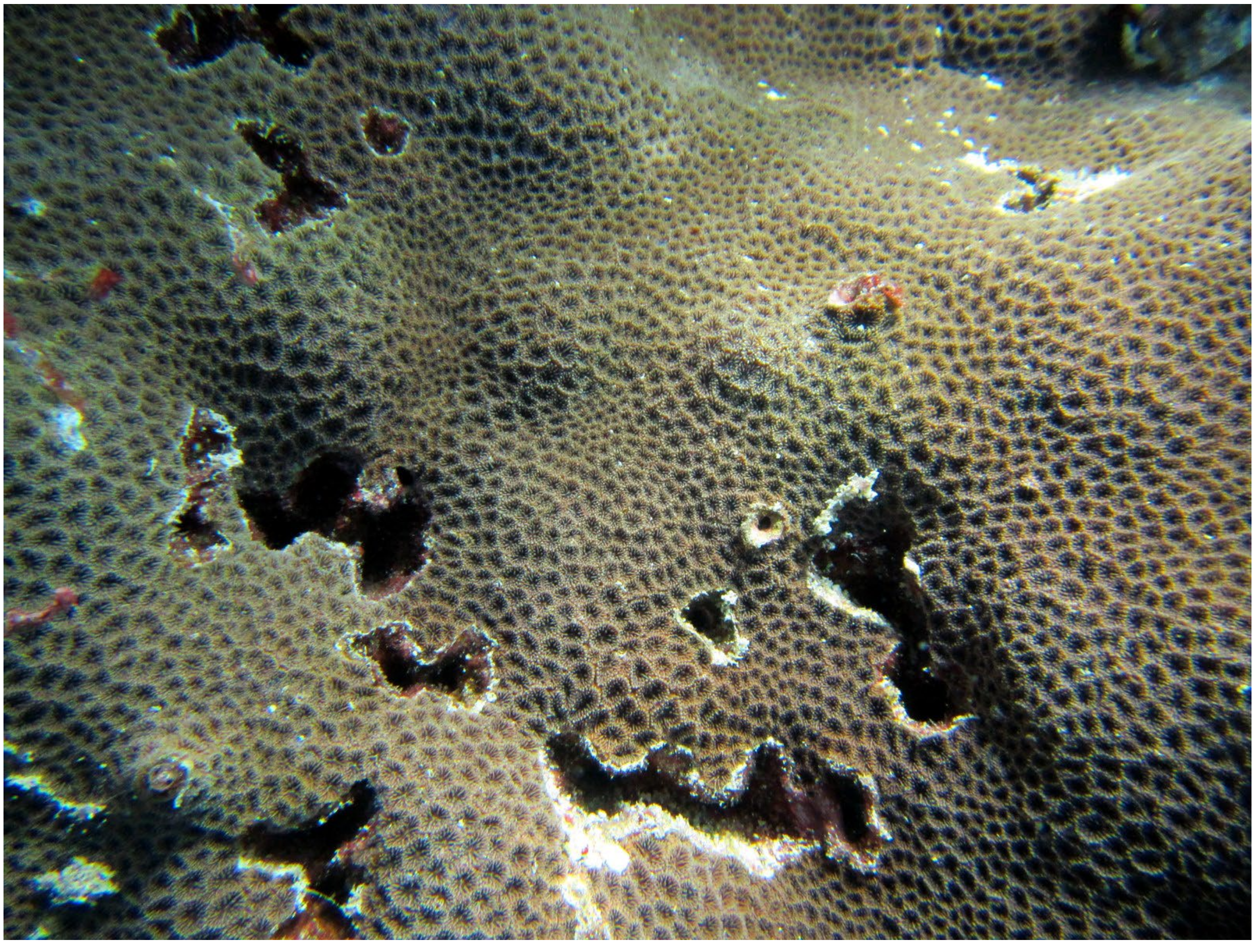
Colonies are encrusting but may be lumpy, corallites are small and close together and polygonal, and corallites can vary greatly in size within a single colony, smaller in depressions and larger in lumps. Colonies are often light colors. Other *Leptastrea* species do not have as great a range of corallite sizes within colonies.



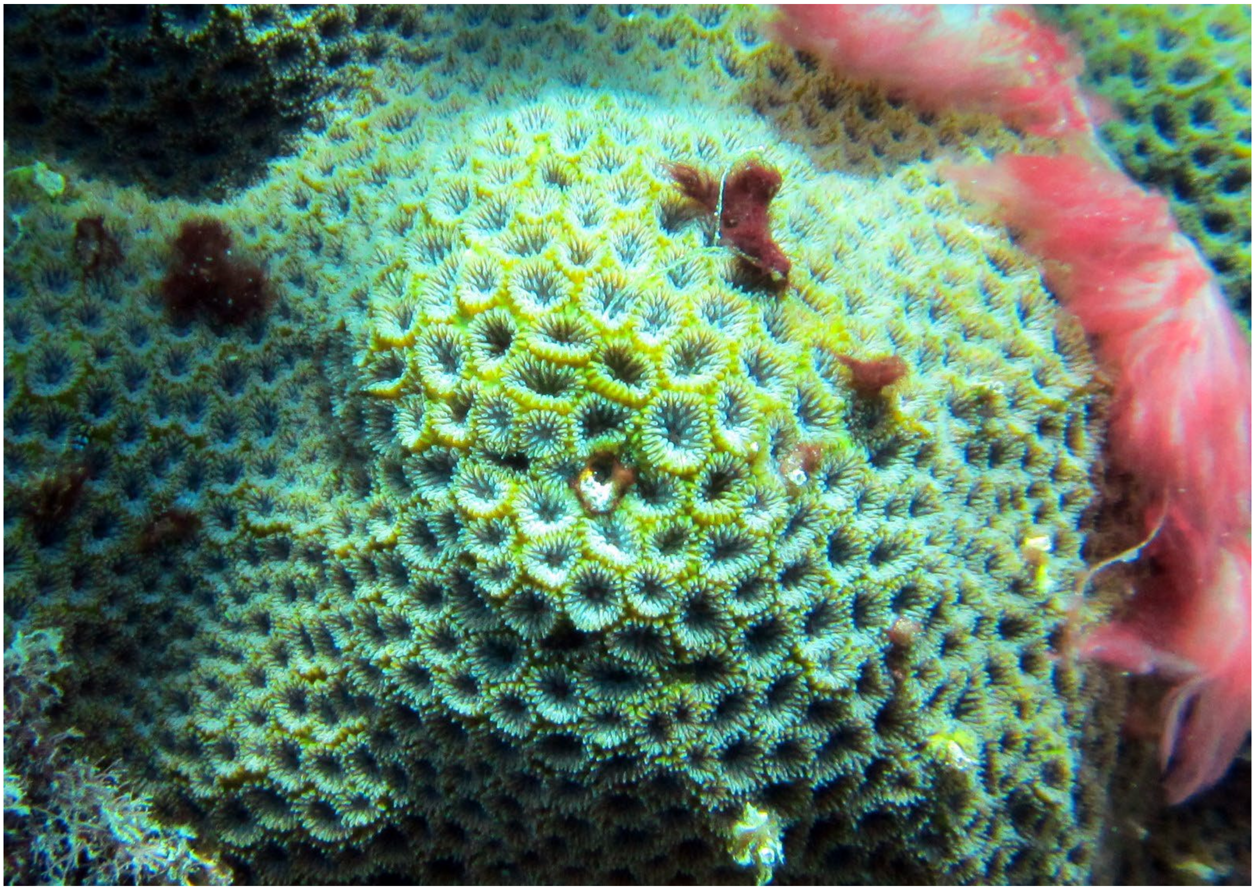
A photo of a colony of *Leptastrea purpurea*.

Leptastrea transversa Klunzinger, 1879

Colonies are encrusting. The corallites are fairly uniform in size. Corallites are close together but have a tiny groove between the corallites. Other species of *Leptastrea* do not have a tiny groove between corallites. *Leptastrea purpurea* has more corallite size variation within colonies than *Leptastrea transversa*. *Leptastrea pruinosa* has contrasting colors between the center of the corallite and the walls. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Leptastrea transversa*. This photo is from the Marianas.



A close-up photo of *Leptastrea transversa*, showing the groove between corallites. This photo is from the Marianas.

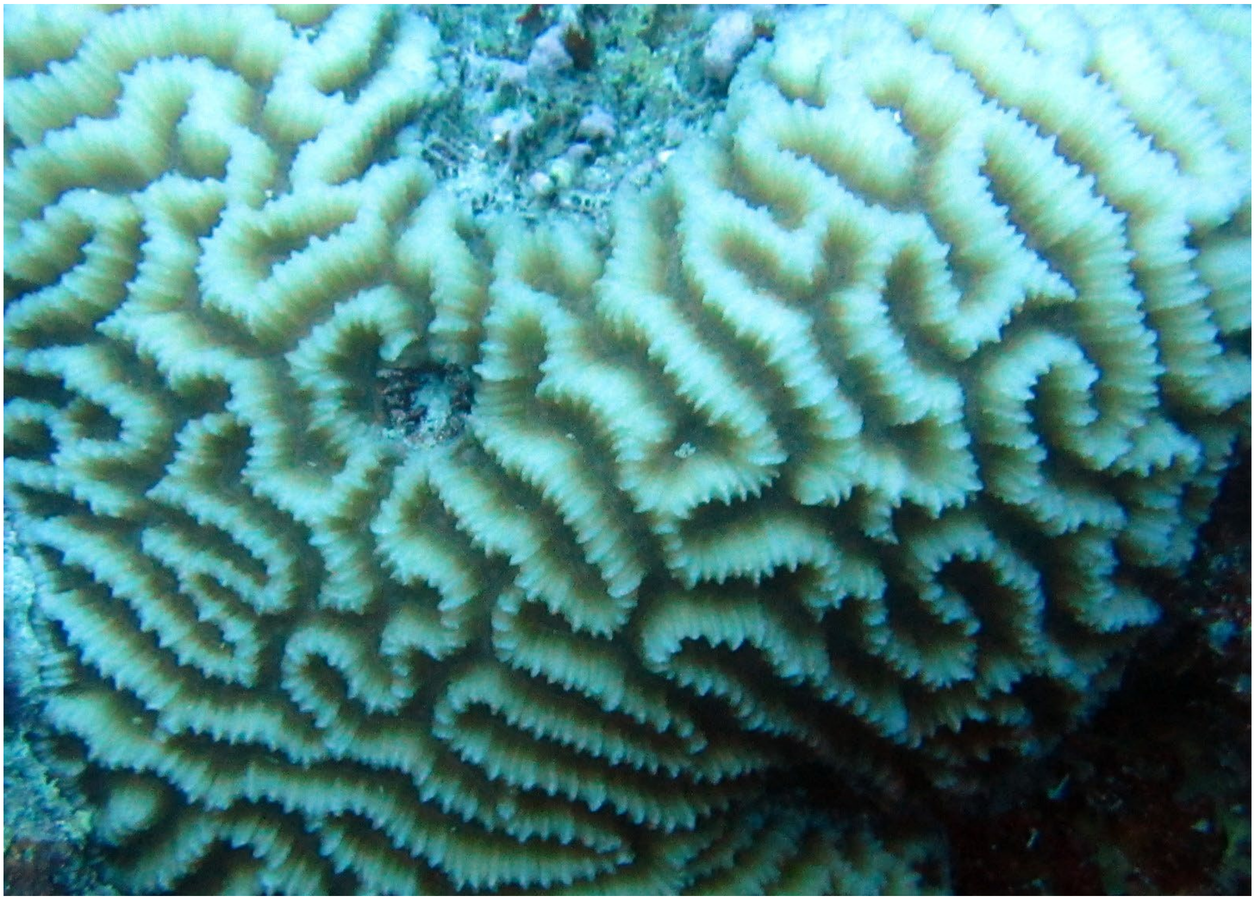
Platygyra

Colonies are usually massive but may be encrusting. Some species are meandroid, with ridges meandering over the surface with valleys between them. Other species have similar ridges which intersect often, enclosing corallites. Septa often project irregularly from the sides of the ridges. *Symphyllia* has larger ridges, *Goniastrea* has larger ridges than all *Platygyra* other than *Platygyra lamellina*, and *Leptoria* has smaller ridges. The valley floors are usually rather narrow, and do not have tiny bumps over pali as *Goniastrea* often has.

Platygyra daedalea (Ellis & Solander, 1786) meandroid or "brain coral"

Colonies are massive and meandroid. Ridges are thicker than on *Platygyra sinensis* and not as uniform. Ridges are thinner than on *Platygyra lamellina* and have less sharp ridge tops than *Platygyra acuta*.

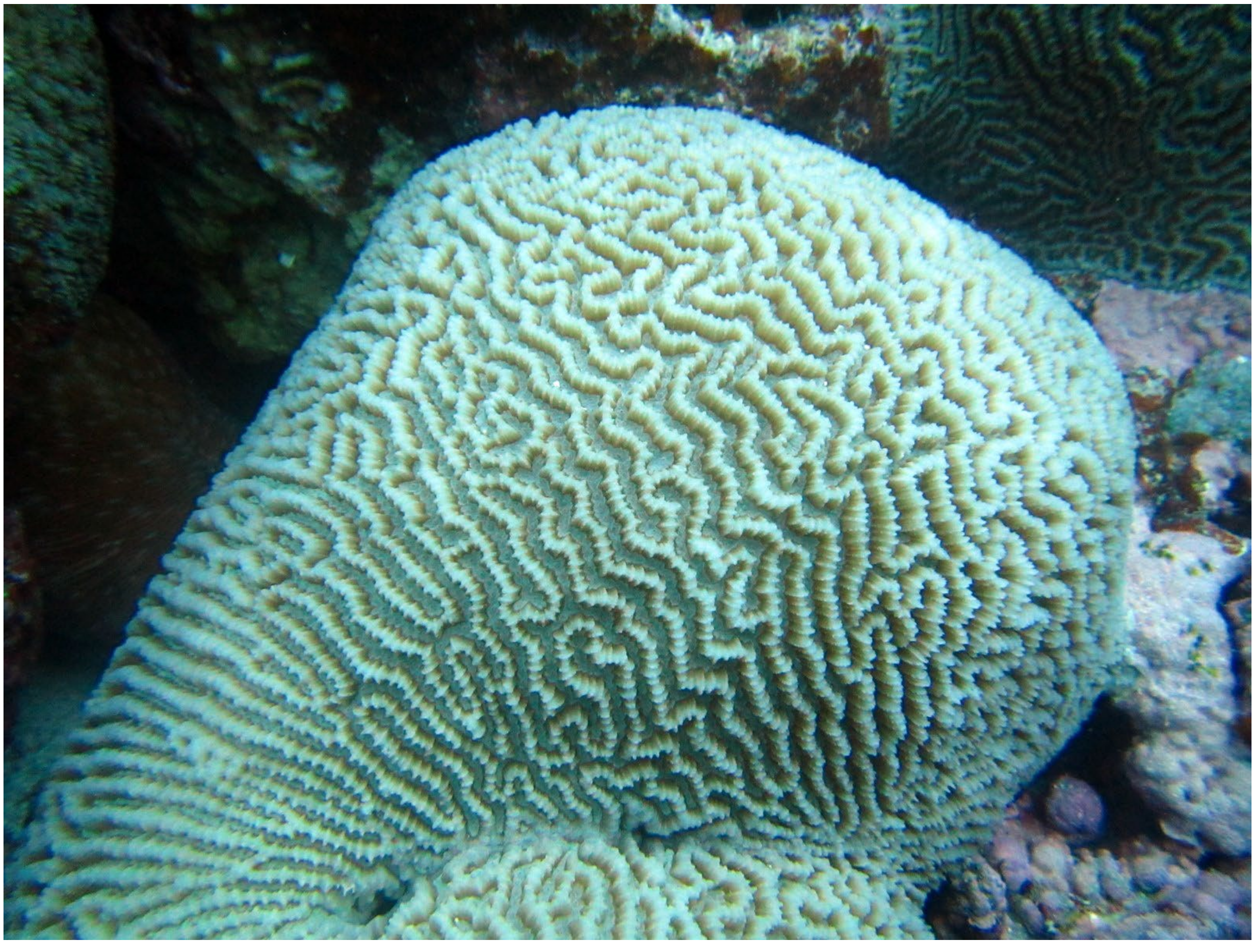
A photo of a colony of *Platygyra daedalea*.



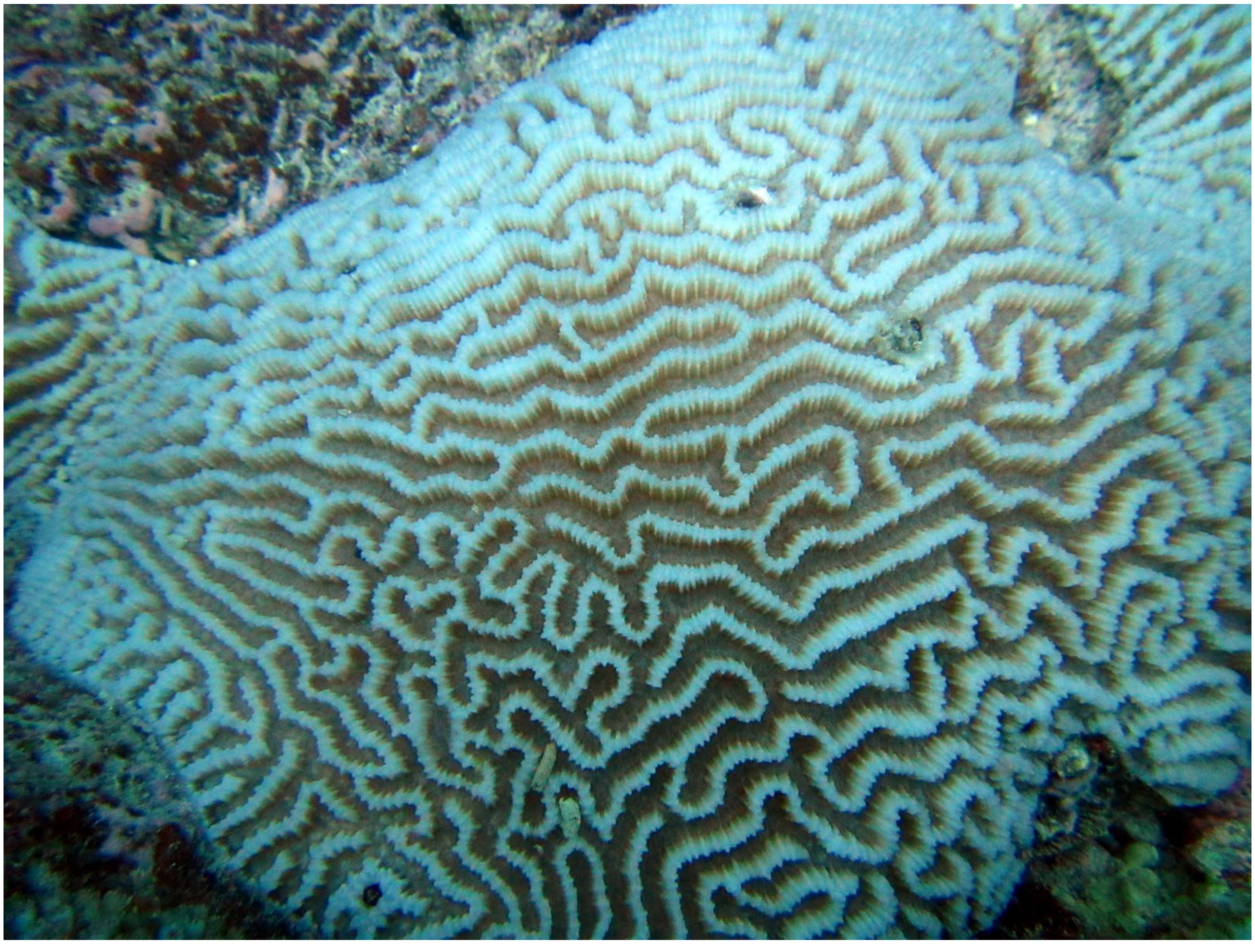
A close-up photo of *Platygyra daedalea*.

Platygyra sinensis (Milne Edwards and Haime, 1849) Meandroid or "brain coral"

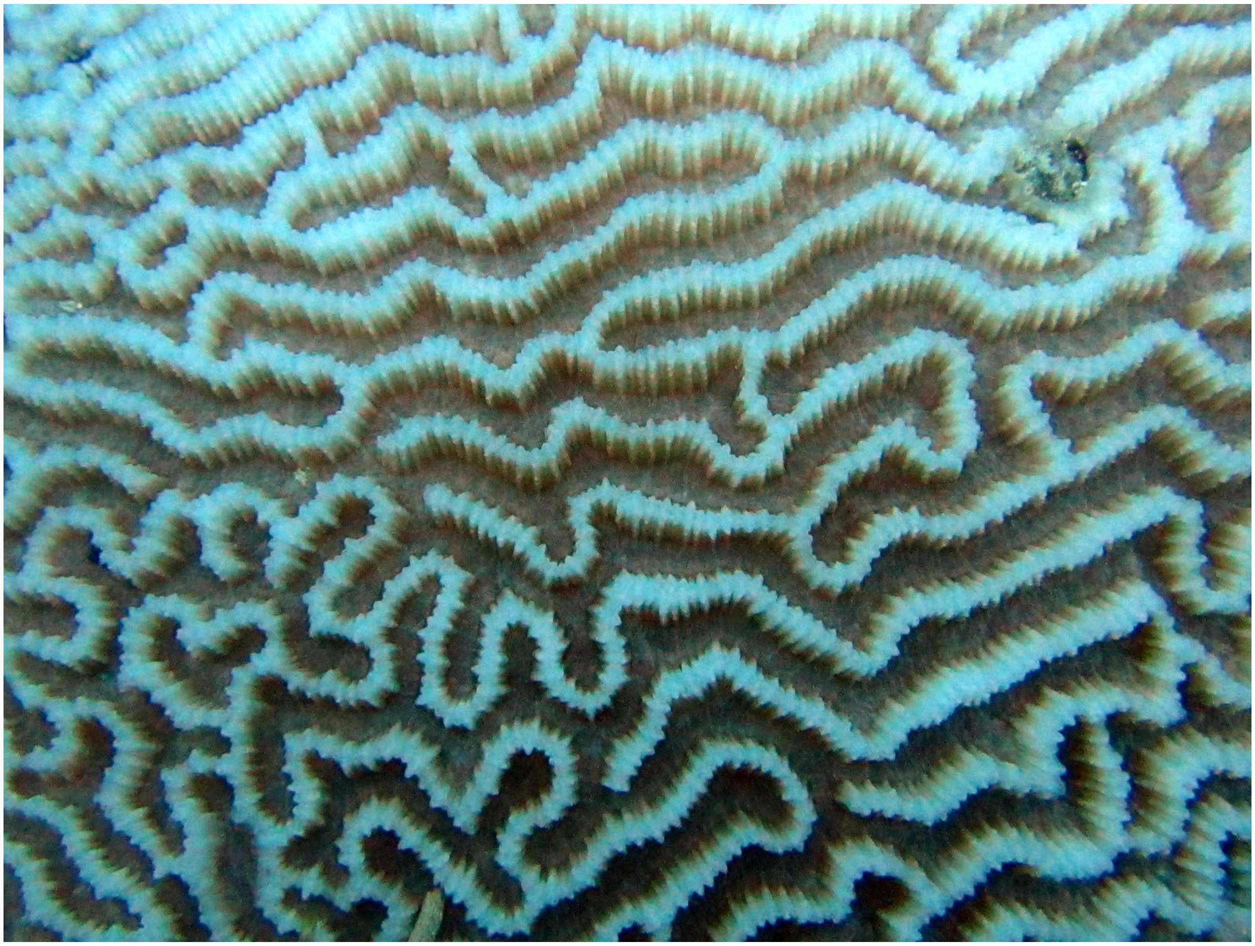
Colonies are massive and meandroid. The meandering ridges are thin and uniform. Ridges are thinner and more uniform than on *Platygyra daedalea*.



A photo of a colony of *Platygyra sinensis*.



A photo of a colony of *Platygyra sinensis*.



A close-up photo of a colony of *Platygyra sinensis*.

Platygyra lamellina (Ehrenberg, 1834) meandroid or "brain coral"

Colonies are massive and meandroid. Ridges are thicker than on *Platygyra daedalea* and *Platygyra sinensis*. *Platygyra pini* is not meandroid. *Symphylla recta* has a rougher surface and may have thicker ridges. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

A photo of *Platygyra lamellina*. This photo is from American Samoa.

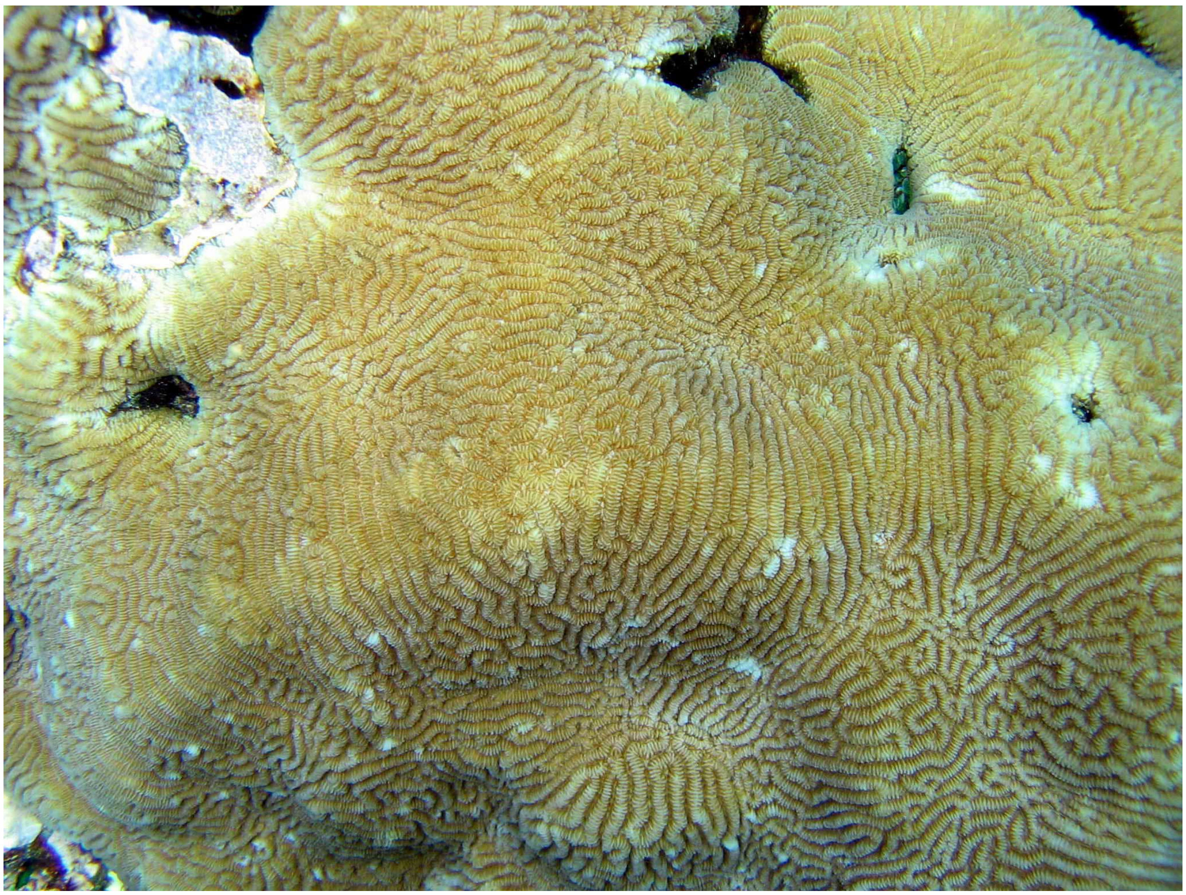
A close-up photo of *Platygyra lamellina*. This photo is from American Samoa.

Leptoria

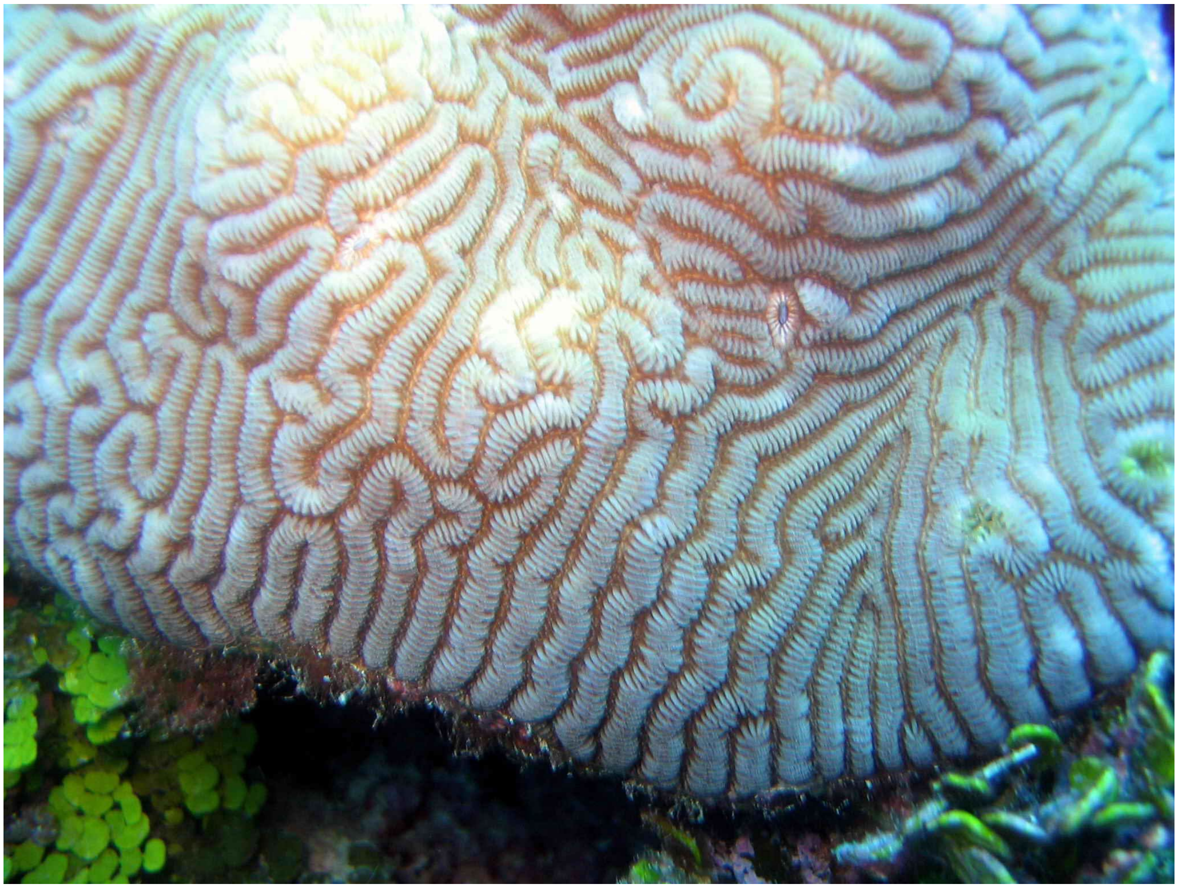
Leptoria forms massive colonies although small colonies may be encrusting. The surface is covered with tiny ridges that wind around, separated by a very thin valley where the corallites are. The ridges are uniform in shape and low, giving the colony as a whole a nearly smooth surface. It has the smallest ridges of any brain coral. Common to uncommon. There is only one species of *Leptoria* in the Samoan archipelago.

Leptoria phrygia (Ellis & Solander) "brain coral"

This coral forms massive encrusting or lumpy colonies with small meandering ridges. The ridges are very short, rounded, and can vary in size across the coral, but are very smooth and uniform. Ridges are smaller than on *Platygyra*. Brown, cream, sometimes fluorescent green between the ridges, common on reef slopes and uncommon on reef flats. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.



A colony of *Leptoria phyrgia*.



A close-up of *Leptoria phrygia*. This photo is from American Samoa.

Tubastraea

Colonies are massive or branching. Corallites are tubular, about the size of a small finger. Colonies are azooxanthellate, and may be brightly colored such as orange, yellow or dark green. In spite of the lack of zooxanthellae, at least two species get large enough to contribute to building reefs. The largest species, *Tubastraea micranthus*, can be a two-meter tall tree with a base about 30 cm diameter. Colonies of most species other than *T. micranthus* are found on overhangs in the shade.

Tubastraea sp.

This light colored colony appears to be branching, but a mature colony might be massive. This species was reported from Wake by Kenyon et al (2013) but has not been found on Wake by Fenner yet.

Tubastraea sp. This photo is from the Marianas.

Class Hydrozoa

Class Hydrozoa contains hydroids, some small jellyfish, and several genera that produce hard skeletons, including the last genus. All hydrozoans alternate generations between small polyps which asexually produce medusa (jellyfish), which in turn produce eggs and sperm which when fertilized grow into polyps. In some hydrozoa the polyp stage is obvious and the medusa stage less so and in others it is the other way around. The stage that produces the skeletons we see in the next genus is a colonial polyp stage and produces tiny medusa (about 1 mm diameter or less) that then release eggs and sperm.

Order Hydrocorallina "Hydrocorals"

This order contains the forms that produce calcium carbonate (aragonite) skeletons, suborders Milleporina and Stylasterina. One genus (*Millepora*) is zooxanthellate and a common contributor to coral reefs, and several genera are azooxanthellate, only two of which are on coral reefs (*Distichopora* and *Stylaster*).

Suborder Milleporina

This suborder has only one family:

Family Milleporidae

This family has only one genus:

Genus Millepora

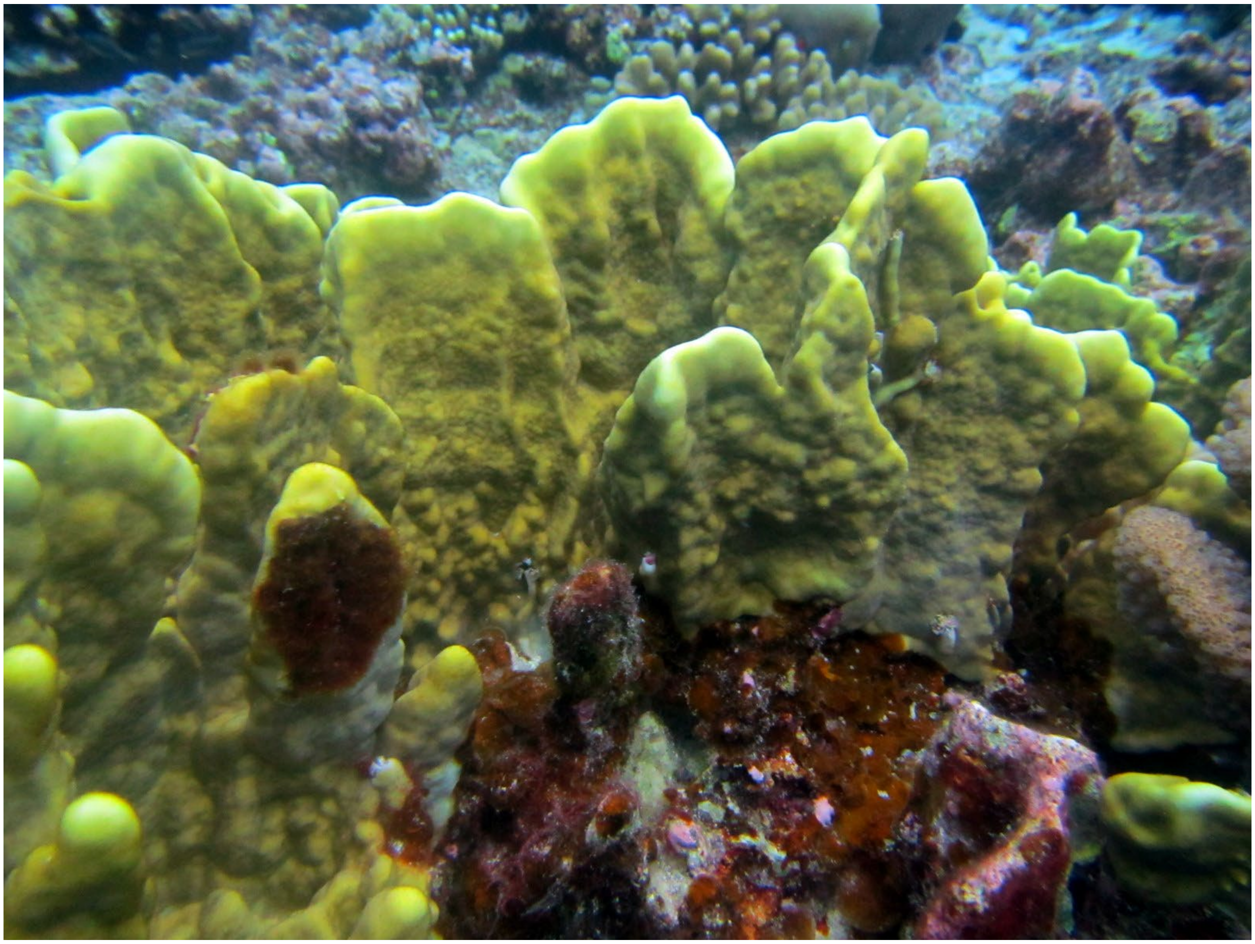
Colonies are encrusting, branching, or form upright walls or paddles, or a combination of these. Surfaces appear smooth because the corallites are too small to see underwater. Corallites are about 1/5th to ½ mm diameter. Polyps are thread-shaped but so small that back lighting is necessary to see or photograph them. There are two types of polyps, short, thicker polyps that have mouths and are called "gastrozoids" and longer, thinner polyps that have no mouths but plenty of stingers, called "dactylozoids." Gastrozoids have larger corallites than dactylozoids. There are no septa. Fire corals have zooxanthellae and build aragonite (calcium carbonate) skeletons like the common Scleractinian corals. They reproduce by growing tiny pouches in the surface of their skeleton which encloses a tiny jellyfish (medusa) that breaks out of the pouch, swims away, and releases eggs and sperm within an hour. A fertilized egg develops into a larva that settles and starts growing the coral, which is the polyp stage.

Millepora platyphylla Hemprich & Ehrenberg, 1834

Colonies can grow fairly large and range from encrusting to lumpy encrusting to growing upward paddles to growing upward intersecting plates. Colonies have smooth surfaces that can have smooth rounded bumps. Colonies have a yellow-green-brown color. Other species have other colony shapes like branching.

A photo of colonies of *Millepora platyphylla* in among *Pocillopora* colonies.

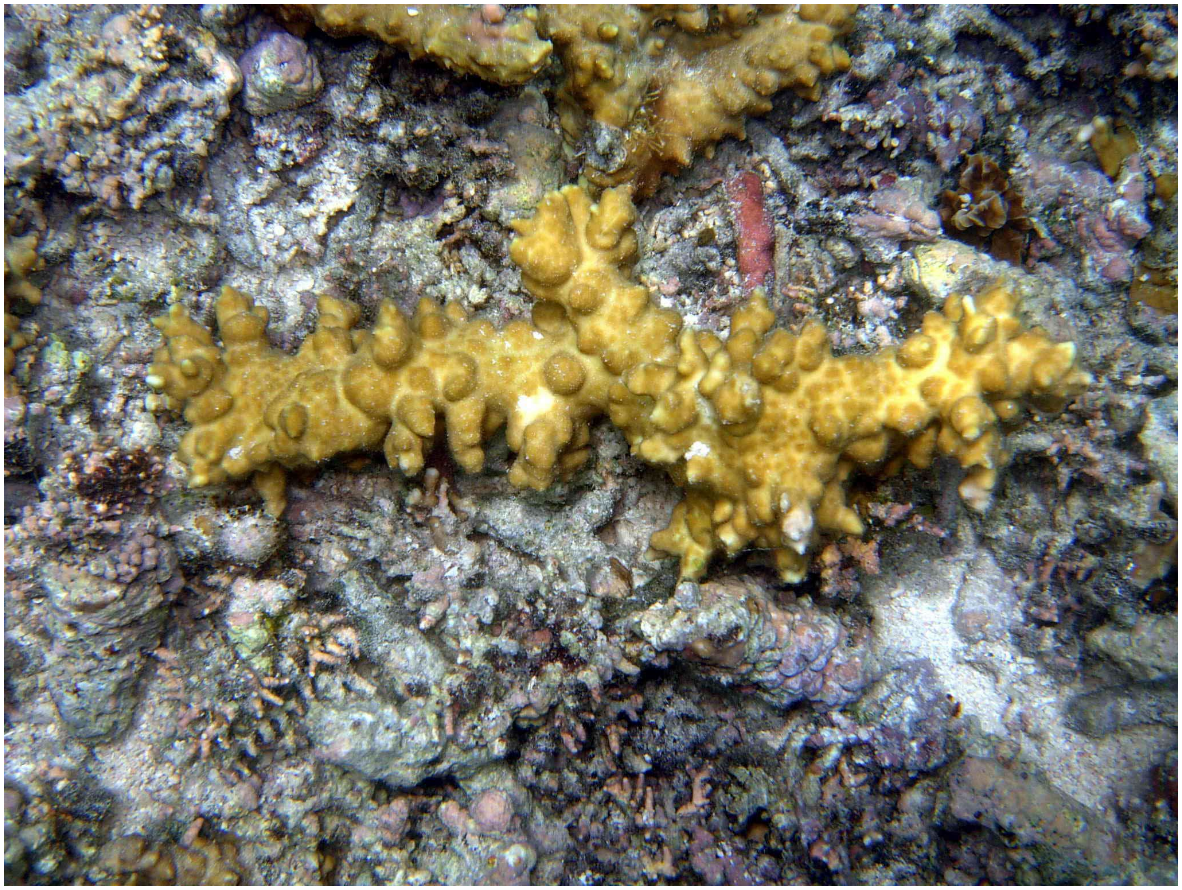
A photo of a colony of *Millepora platyphylla* with an encrusting base and upward growing plates or paddles.



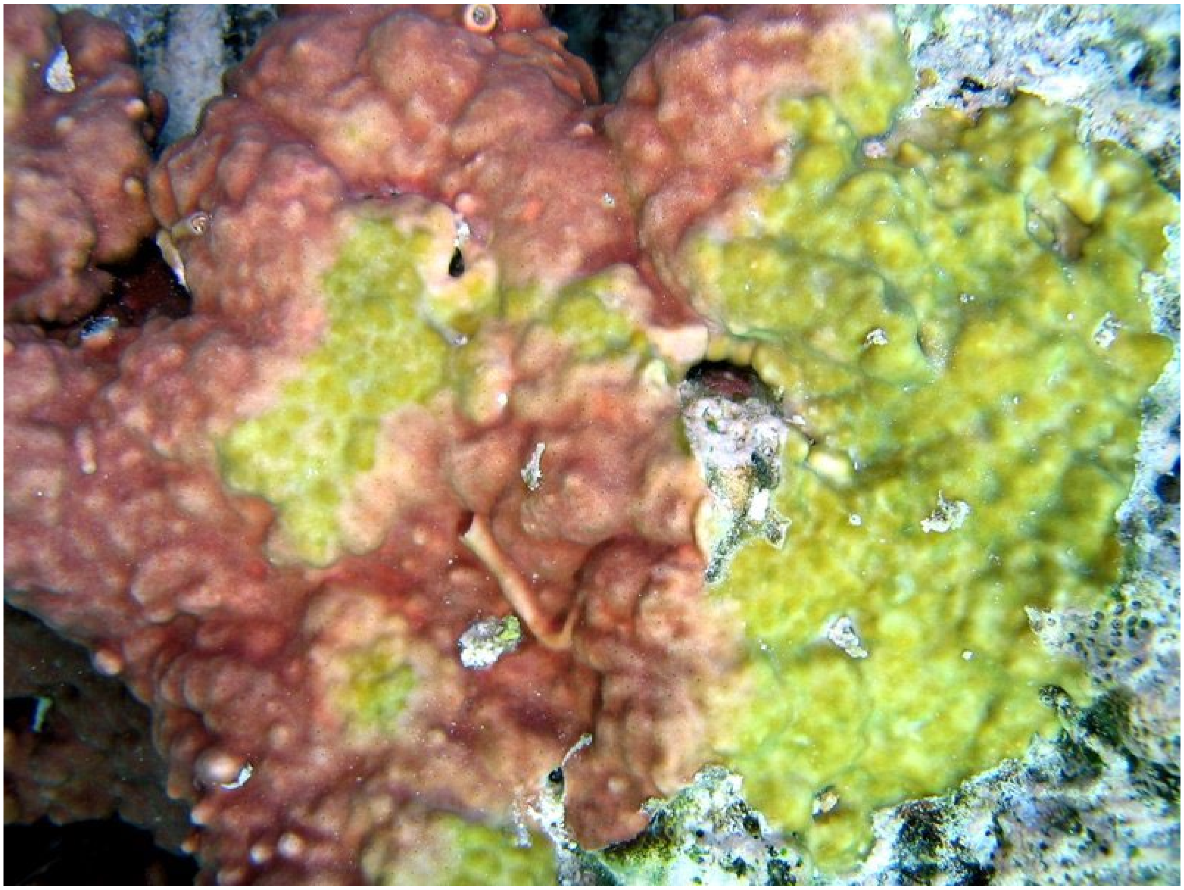
A photo showing a plate or wall-shaped colony of *Millepora platyphylla*.

Millepora exaesa Forskål, 1775

This coral forms bumpy colonies that encrust rubble. Most colonies are a greenish yellow color with some small spotting, but some colonies are pink-purple, and some colonies have some of both. Does not bleach easily. Found in backreef pools. Stings mildly. *Millepora tuberosa* forms large purple encrusting colonies on reef slopes with smaller bumps.



A colony of *Millepora exaesa* encrusting rubble.



A colony of *Millepora exaesa* that is partly green and partly red.

A colony of *Millepora exaesa* that shows a common spotting pattern.

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The Author

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Born in Michigan, USA, the author has lived in a variety of places in the states, including Florida during his high school years, which stimulated an interest in tropical marine life. During his years at Reed College in Portland, Oregon, he was introduced to biology, including invertebrate biology, studied sea urchin tube feet and respiration for his thesis and spent two summers in Hawaii studying fish behavior with his professors. Once graduated he attended the summer invertebrate zoology course at the Marine Biological Laboratory at Woods Hole, Massachusetts and then another summer was a course assistant for that course. Snorkeling trips to the Caribbean (including to Jamaica just before Hurricane Allen) during graduate school at the University of Pennsylvania were followed by scuba trips to the Caribbean. His coral reef research and publications began with surveys and description of reefs in the Caribbean, including Cozumel, Roatan, Cayman Brac, Little Cayman, and St. Lucia. It became clear that to do transects you need to know your corals, and existing guides were inadequate, so Caribbean coral identification and taxonomy were next to be studied. By this time the author lived in Seattle, Washington. Then the author began to study corals in Hawaii, which led to his identification book for Hawaiian corals. Following that, he worked in the Philippines for two years, learning many coral species in that area of high diversity. This was followed by six years of working with Dr. “Charlie” J.E.N. Veron at the Australian Institute of Marine Science on the “Coral ID” electronic key to corals of the world. At that time, the author began to be invited to study and record corals during Rapid Assessment Programs to a variety of places around the Indo-Pacific. In November, 2003, the author began work at the Dept. Marine & Wildlife Resources, in American Samoa. He began working on coral reef monitoring there a year later and continued with that, and continued to make trips to study corals around the Indo-Pacific. Currently, the author has studied coral at 14 islands in the Caribbean and 14 archipelagos and islands of the Indo-Pacific, plus southern Italy in the Mediterranean. He is an author of 17 book chapters and 46 peer-reviewed articles in scientific journals. He has worked as a contractor for NOAA NMFS Protected Species on the threatened coral species since 2013. That work has taken him around the Pacific each year to study corals and teach people how to identify corals. That effort includes photographing corals, writing field guides and building “practice modules” for teaching coral ID and people to practice with. He also works on describing new corals species and diseases and a variety of other coral reef topics. He continues to be based in American Samoa.