Sponges on Chumbe Island

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Abstract

The sponge population of Chumbe Island, off the western coast of Unguja Island was studied. Opportunistic observation, underwater photography, and sponge collection on the eastern side of the island was conducted. The sponge samples collected where then taxonomically analyzed in the lab. This is study will contribute to the limited amount of information known about sponge taxonomy and prevalence in the Western Indian Ocean region. It will increase the knowledge about the diversity of sponges in this region. The information collected from this experiment was compiled into a booklet that will be available to the tourists as well as the educational department at Chumbe Island.

Introduction

Background Biology of Sponges (Ecology and Anatomy)

Sponges, Phlyum Porifera, are abundant invertebrates frequently found on the coral reef, as well as in sea grass beds and deep waters. Sponges are one of the most unfamiliar group of all marine animals. Although they may resemble plants, sponges are animals and contribute significantly to the biodiversity of marine life, especially on the coral reef. A sponge is an exclusively aquatic organism and they are the most primitive of multicellular animals (Hooper, 1998).

Adult sponges are sedentary suspension feeders or filter feeders. They filter water throughout their body through unique channels. The outer layer, or pinacoderm, of a sponge is made up by a single layer of cells called pinacocytes. The pinacoderm is a very leaky layer as there are no inter-cellular connections. Water comes through the sponge through a small hole called an ostium (ostia plural). Tubular shaped cells, called porocytes, surrounding the ostia, create a pore for which water can flow freely into the sponge.(Kroening, 2000). The inner layer is made up of a single layer of tiny flagellated cells, called choanocytes (or collar cells), that pump the water in one direction throughout the canals and chambers in the body of the sponge (Samaai, 2005). The choanocytes draw water and move food particles into the interstitial body cells, called the mesophyl matrix (Richmond, 2002). The mesophyl, or middle layer, makes up most of the mass of a sponge. The mesophyl in most sponges is a combination of spicules and spongin.

Amoebocytes are mobile cells that can be located moving through the middle layer of the sponge transporting food and waster, producing sponging and spicules, and replacing other cells. (Kroening, 2000). The spongocoel is the large open chamber or main channel in the middle of the sponge. Water flows through the spongocoel before exiting the sponge through oscula. (Kroening, 2000) (See appendix for figure of sponge body). Sponges can have anywhere between 7,000 to 18,000 chambers in the water vascular system. Water and waste exit the sponges through an osculum (oscule plural). .

Sponges catch, eat, digest, and excrete waste all within the cells of their body and do not have specialized organs (Hooper, 1998). They do not have distinct circulatory, respiratory, digestive, or excretory systems, nor do they have any tissues or sensory organs either. They are actually made up of totipotent cells, cells that can change their function to carry out different processes throughout the body. It has been found that in certain species a sponge can be pushed through a strainer and put itself back together again due to the totipotent cells, as well as the lack of intercellular connections. Sponges filter oxygen, bacteria, and food from the water. They also filter sea water that contains toxic chemicals that have been released into the water by other plants (Hooper 1998). They modify these plant toxins and reuse them within their body for other purposes. They can filter up to ten times their body volume each hour and are commonly known as the "vacuum cleaners" of the sea. To put it into perspective, a sponge the size of your fist can filter 5,000 liters (1,100 gallons) on one day (Coleman, 1991). Sponges are also natural biological eroders. They bore into dead coral and help initiate nutrient recycling (Richmond, 2002).

Sponges come in many shapes and colors. A single species may appear in an encrusting form in open sea areas or may grow upright and branched in sheltered areas. A single species may also be a different color then in the light (Coleman 1991). Due to the large variety in appearance sponges can be hard to identify in the water and can be easily confused with some soft coral, sea squirts, sea grasses and other marine invertebrates.

Although sponges are the most primitive of multicellular organisms, they have a very complex anatomy. Adults have asymmetrical (irregular) or radial symmetry. External and internal characteristics are both used to describe complexity of sponge anatomy. During field observations there are several criteria that can be used to identify a sponge when it comes to external characteristics. The morphology of a sponge can range from encrusting forms, to branching tubular forms, to cup-like and fan-shaped forms. In addition there are several surface features that make some species unique. The surface may be rigid, corrugated, hispid, spiny, verrucose and more. Arrangement and location of oscules and ostia (how far apart they are from one another as well as the how large they are in diameter) is also a characteristic used to differentiate species. Sponge consistency can be soft, hard, resilient, elastic, fragile, compressible, soft, rubbery, tough, and smooth. Finally, the colors of sponges are extremely variable and they can be seen in many different colors.

The overall skeleton of a sponge is highly diagnostic. There are three canal systems; asconoid, syconoid, and leuconid. The asconoid condition is the simplest form. Canals run straight through the body of the sponge and choanocytes line the central large chamber. Most asconoids have cylindrical hollow bodies. Asconoids are only found in the Calcareous class. Syconoid are also only found in the calcarea class. They have thicker body walls then Asconoids, but have branched canals, and only their canals are lined with choanocytes. Leuconids are found in all of the sponge classes and tend to make up a majority of sponges. They have the most complicated canal system, consisting of many branching long canals that lead to separate chambers that are lined with choanocytes. Leuconid sponges tend to live in large groups made up of individual sponges that have their own osculum but act more like a large communal organism. (Ramal, 2008) (See appendix for figure of the three body types).

Since field identification for classifying sponges taxonomically (scientific name) is virtually impossible due to the wide variety of sponge morphology, sponges are identified based on their spicule type and shape. A spicule is a silica or calcite crystal made by sponge cells for structural support (Richmond, 2002). The internal skeleton of a sponge may also include inorganic spicules which are responsible for its general shape, the collagen, and the spongin fibers. Spongin is a keratin-like material that is very resistant to decomposition; as a result, sponge skeletons may take years to decompose and can be seen on washed up beaches.

Sponges live in many different habitats and sites within the water. All sponges are attached to substrate, with the exception of sponge larvae that float and swim around before settling on substrate (Coleman 1991). A majority of sponges are found in saltwater, but a few hundred freshwater species have been discovered. They can be found on coral reefs, the underside of rocks in intertidal zones, buried in the mud or sand, in seagrass beds. Throughout the ocean floor, sponges thrive in ecosystems ranging from the intertidal zones, sub-tidal zones, and deep water.

Sponges are unique animals in that they can reproduce several ways depending on their species. Most sponges are hermaphrodites (possessing both male and female sex cells). An example is when a species of sponges releases sperm through the oscules, which enters through the inhalant ostia where they fertilize eggs. The larvae then exit through the exhalent pore (oscule). (Coleman, 1991).

Sponges can take process in viviparous, oviparous, and asexual reproduction depending on the species. Viviparous reproduction is when eggs are fertilized internally and then undergo development within the interstitial part of the sponge body. The planktonic-like larvae are then released through the oscules. Oviparous reproduction takes place when eggs and sperm are simultaneously released into the water column by several sponges and undergo fertilization in the water. Asexual reproduction refers to the process when parts of an adult sponge break off and settle on substrate, also known as budding or fragmentation (Samaai, 2005).

As of 2009 they are currently 8,246 species of sponges recorded world wide. In the Western Indian Ocean there have been approximately 3,000 species identified. Sponges fall under the kingdom animalia, and phylum porifera (literally translated in latin to mean pore bearers). There are three classes of sponges based on their skeleton composition. Calcarea, or calcareous sponges, are characterized by tripod shaped calcium carbonate spicules. Demospongia, or demosponges, consist of a combination of silica spicules, collagen, and sometimes spongin. Hexacitinellid, or glass sponges, are composed of six rayed free of fused silicia spicules (Richmond, 2002,Samaai, 2005). Under these three classes there are seven subclasses, 24 orders, 127 families, and 682 genera of existing sponges. There are currently over 1600 generic names as well as approximatly 500 names that are currently invalid (Hooper, 2002).

Importance of Sponges

Sponges have great ecological importance. They are home to a variety of marine organisms including bacteria, fungi, crustaceans, polychaetes, echinoderms, small fish and even other sponges (Richmond, 2002). Sponges also have a symbiotic relationship with zoonzanthellae. The zoozanthellae provide the sponge with a source of nutrients through photosynthesis and the sponge provides the zoozanthellae with protection. Sponges are natural bio-eroders. They help keep the reef clean by boring into dead coral and other substrate. Additionally, sponges filter toxic chemicals out of the water.

General knowledge about sponges is important to know about for proper reef management and conservation. Some species of sponges have even been known to bore into and chemically eat away coral at a rate faster then coral can grow, consequently killing the coral. Poor visibility may also be an indicator of a lack of sponges on the reef.

Sponges also have economic potential. While not practiced in Zanzibar, sustainable bath-sponge harvesting plays a role in other coastal community economics around the world. Sustainable farming techniques can be used they may provide another source of income for developing communities.

Sponges are a potential genetic and chemical resource. They have been said to have the most active biochemical potential. The modified chemicals found in sponges may have potent toxicity against human pathogens and ailments (Hooper, 1998). Current research suggests that chemicals in sponges may be used as antibiotics, to treat tumors, as anti-AIDS and anti-malarial medication. Sponges are still an unknown biological resource. As sponges are they most poorly known group of marine organism significant research needs to be continued to further reveal the various potentials that sponges may have.

Study Area

Chumbe Island Coral Park is located 12 km southwest of Stone town (Latitude/Longitude: 6 16' S; 39 10' E). Chumbe is only one out of four existing Marine Protected Areas (MPA) in Zanzibar. The island is on the UN list of protected areas. CHICOP (Chumbe Island Coral Park) is a non-profit organization that was established in 1992 for the sole purpose of conserving and managing the island. The lease to Chumbe and the surrounding reefs were purchased by a private investor, Sibylle Riedmiller. Formerly the island was controlled by the Zanzibari military until 1988 as a shipping channel so fishermen and the tourist industry did not have access to the island. An eco-tourism lodge was established on the island and was opened for guests in 1998. The eco-lodge was designed with the intent of having the least amount of impact on the island on the possible. This is carried out through solar powered electricity, compost toilets, gray water filtration and collection of rain water.

The island itself is 1.1 km long and 300m wide making up a total of 22 ha. The main substrate consists of coral rag. They are many large overhangs around the circumference of the island due to many years of chemical, physical, and biological erosion. These overhangs can be exposed up to 3.5m at low tide. Because of Chumbe's history and conservation management plans, the island is a perfect place to conduct marine research as the reef was left relatively undamaged when controlled by the government and thus preserved. The current MPA management plan for 2006-2016 includes the establishment of a no-take zone. Nothing is allowed to be taken from the reef on the west side of the island, not even shells. This prohibits fishermen from taking fish from the reef and allows the fish to reach large sizes. The east side of the island is still open for fishermen to compensate for the west side. In addition CHICOP educates local fishermen about proper fishing techniques that do not harm the reef as well as educating them about conservation and why it's important.

CHICOP also involves the local community within part of their program. rangers on Chumbe are all former local fishermen. They have a formal education program that brings in local students from Unguja. The students go on a forest walk, snorkel, and learn about the fauna and flora of the island. The program also teaches the students what can be done to improve the future of the reef and what they can do to help. Chumbe Island is a pristine example of how tourism, education, and conservation can all work together.

Methodology

Field Identification

Transects were originally going to be used to examine and determine the sponge distribution and population. After setting one transect and swimming the reef it was concluded that transects would not be the most beneficial, nor feasible method for this project. The sponges on Chumbe are in all different parts of the intertidal and subtidal zones. Many of the different sponges were also very far apart and scattered on the reef. In addition many of the sponges seen were un-identifiable with field identification.

Opportunistic observation was performed on the reef through snorkeling and walking the intertidal zone at low tide. The sponge consistency, morphology, color, surface texture, location, and the substrate were recorded when a sponge was encountered. In addition pictures were taken of the sponges observed.

Sponge Collection

Materials Needed:

1 liter 70% ethanol

Small plastic bags

Knife

Alcohol swabs

Gloves

Parafilm

Plastic containers with lids

Permanent marker

Underwater camera

Underwater slate

Procedure:

All samples were accompanied by in-situ photograph as well as a description of sponge morphology recorded for each sample (shape, surface texture, size, oscule and ostia arrangement, location, surface consistency). A small piece of sponge was cut off with a knife that had been sterilized with an alcohol swab to avoid cross contamination. The sample was then placed in a plastic bag with saltwater for transport to land. The sponge that was collected was then placed in plastic container with 70% ethanol for preservation.

The container was parafilmed around the seal of the container and the lid to avoid leaking and labeled with a number. Any color changes in the sponge samples were recorded once placed in ethanol.

Taxonomic Lab Examination

Bleach preps for rapid examination

Materials Needed:

Microscope

Slides

1 liter of commercial bleach

Small container to place the bleach in (to avoid contamination of the bleach)

Razor blades

Pipette

Permanent marker

Procedure:

A very small portion of the ectosome and choanosome (inner and outer layer) from the sponge was sliced with a razor blade on a cutting board. The sponge sample was then placed on a labeled slide and a few drops of commercial bleach were applied with a pipette. Samples were left to sit in the bleach for 20 minutes to allow the tissue to be digested and the bubbling to stop. Once the tissue was digested by the bleach, only spicules remained on the slide. The slides were then examined under the microscope and the spicule shape and measurement was recorded.

Nitric Acid Spicule Preparation

Materials needed:

Nitric acid

Forceps

Razor blades

Pipette

Slides

*Gloves Recommended

[Nitric Acid is highly corrosive and must be handled with care. It is advised that one should use a fume hood when working with nitric acid, especially during the heating process]

Procedure 1:

A very small portion of the ectosome and choanosome (inner and outer layer) from the sponge was sliced with a razor blade on a cutting board. The sponge sample was then placed on a labeled slide and a few drops of nitric acid were applied with a pipette. Samples were left to sit in the nitric acid for 60 minutes to allow the tissue to be digested and the bubbling to stop. A heat lamp was put directly above the samples to speed the process up. Once the tissue was digested by the bleach, only spicules remained on the slide. The slides were then examined under the microscope and the spicule shape and measurement was recorded.

Procedure 2:

A very small portion of the ectosome and choanosome (inner and outer layer) from the sponge was sliced with a razor blade on a cutting board. The sponge sample was then placed on a labeled slide and a few drops of nitric acid were applied with a pipette. The sample was then placed on a hot plate (set at 150 degrees Celsius) to allow the nitric acid to evaporate and to help speed the tissue digestion process. A few drops of nitric acid where added again and the sample was again placed on the hot plate. This was repeated until the nitric acid stopped bubbling and until it appeared that the tissue had been fully digested. The slide was then looked at under a high powered optical microscope under 10X and 20X magnification.

Results

Field Identification

After opportunistic observation it was found that there are approximately 19 different sponge varieties in the surrounding areas off of Chumbe Island (See Table 1 in appendix). Pictures of only 17 varieties were taken. It was noted that the sponges on the east side of the reef were different then the sponges on the west side of the reef. The sponges were obviously more abundant on west side since it is protected, however a few sponges found on the east side were not found on the west side at all. Even though the reef on the east side is considerable less healthy and the abundance of dead coral is significantly higher due to the reef being unprotected and accessible to fishermen, there were still several different sponges inhabiting different zones.

Sponge Collection

Eight different types of sponges were collected, preserved in 70% ethanol and taken to the lab for identification (See table 2 in appendix).

Taxonomic Lab Identification

Bleach slides were prepared for identification of spicules. The bleach did not fully digest the tissue and bleach crystals began to form on the slides, making them unusable. Nitric acid was then used and the even though the slides sat overnight for the acid to digest the tissue, these slides also proved to be unusable. Finally nitric acid was applied to the slides and the slides were then placed on a hot plate (See table 2 for spicule results).

Discussion

The surveyed areas of Chumbe Island were found to have several different sponge varieties. Identification was not possible to do in the field; however, sponge morphology was recorded. Nineteen different sponge varieties were seen. Of these nineteen, eight samples were collected. The results of this experiment are by no means a comprehensive list of all of the sponges that exist on the reef at Chumbe. Nevertheless, the information gathered from this experiment was placed into a booklet about sponges for Chumbe. This booklet answers basic questions and provides general information about sponge biology and ecology, as well as providing pictures of the sponges seen (the booklet can be found in the appendix). This booklet will present an additional resource for the education department at Chumbe as well as an educational resource for guest to look at.

As mentioned before, intial transects were going to measure the abundance and population of sponges on the reef at Chumbe. After observing the reef and examining the sponges it was found that most of the sponges were not only considerable far apart from one another but that there were also a considerable number of sponges within different zones, such as the sea grass beds and the intertidal zones. As the purpose of the project, to find out what different types of sponges existed on Chumbe, it was determined that transects would not be the best way to gather this information. If transects were conducted then they would have had to be over 150 m long to include the intertidal and sea grass bed areas, and even then it would not be guaranteed that you would see a sponge on that transect. Also, as sponges have never been studied before there is no baseline data that could have been used for identification, so transects would have been hard to carry out when identification would have been necessary. In addition some sponges only habitat places that are hard to see unless one is SCUBA diving. It was decided that determining sponge population and distribution would not be possible as inaccurate identification and missing species would most likely happen, as SCUBA diving was not an option. As a solution, the project was shifted to include a general survey of sponges and the results were then compiled into a booklet for the educational department, as well as for the guests at Chumbe.

There were several problems encountered that hindered the results of this project. Samples of sponges on the main reef at Chumbe were unable to be collected because of the no-take zone under the management plan (since Chumbe is a marine protected area).

Sponges were sampled on the east side of the reef, which is open for public use (fishermen) but the sponge population on the east side is significantly different then the population on the west side. A few types were found on both sides of the island but in general, the sponge population of the eastern side was less diverse then that of the western side. They were a few sponges that were found on the east side that were not found on the west side as well. This could be due to substrate difference and the variation in conditions. It would be interesting to look at which sponge species only exist or associate with other organisms in certain environments or substrates. There may be a correlation between physical parameters and sponge variety and species diversity.

Bleach examination of spicules did not work because the bleach did no digest all of the tissue and the spicules were too clumped together and still embedded in tissue, making it impossible to distinguish the shape. Time was given to allow the bleach to keep working so the slides were left overnight, but bleach crystals formed which also made the spicule shaped to be undistinguishable. Nitric acid was then used to work as a reagent to digest the bleach and it was found that it worked best if heated while being applied to the sample.

The sponge samples collected were unable to be identified because of the difficulties associated with distinguishing between species. However, a general lack of knowledge and resources about sponges still exists today in the Western Indian Ocean Region. Although they could not be identified with the time remaining or the available resources, these results may still be able to contribute to the start of a taxonomic guide for this region.

Conclusions

The sponge population and diversity appears to be healthy and thriving on Chumbe island as they inhabit not only the protected and unprotected sides of the island, but also within the marine zones (intertidal, sub-tidal, etc..). Chumbe is a prime place to study sponges as the reef is protected and thus thriving with an abundance of marine life. It should be noted that sponge collection can only take place on the east side of Chumbe, or the unprotected side, as the western side is under the management plan as a no-take zone. While it is important to sample sponges in order for correct and valid identification of species, a lot of research opportunities still exist on that could be very beneficial to Chumbe, as well as the sponge scientist community in the Western Indian Ocean Region.

This project was the first study to take place involving the sponges on Chumbe; virtually any further research would be of great help. Specifically, the distribution and population density of sponges on Chumbe in the intertidal zone, the coastal shallows, the sub-tidal zones, or the coral reef are potential projects that would be useful to Chumbe.

The creation of a species diversity would assist conservation purposes. The comparison of the sponge population of Chumbe's protected reef to an unprotected reef would also be beneficial. Even within Chumbe's waters, between the unprotected and protected sides, there was a notable difference in not just the amount of sponges but also of the species of sponges that were present.

In general, sponge research in the Western Indian Ocean Region is also something that is necessary. A project on the species diversity of an unprotected reef, or at least a reef where sponge collection is easily accessible and allowed, would help to reveal information that is currently unavailable. A taxonomic guide for sponges on Zanzibar and of this region in general is desperately needed. Classification and lab identification may be time consuming and access the necessary equipment on Zanzibar may be difficult, but it is possible and essential. Outdated sponge research is still being relied on today. Occasionally, references were published over 100 years ago.

A significant amount of information about sponges still remains unknown or disorganized. The taxonomic organization and classification for the information that is known about this region, most likely needs to be revised, as scientific names and classification have been changed. Although taxonomy is usually done by experienced field biologists and lab specialists, with the correct classification guides and equipment it can be done.

Another research opportunity exists for studying the potential for sustainable sponge farming and harvesting on Zanzibar. Sponge harvesting, if done properly, could provide supplemental income for many people in need without harming the sponge population.

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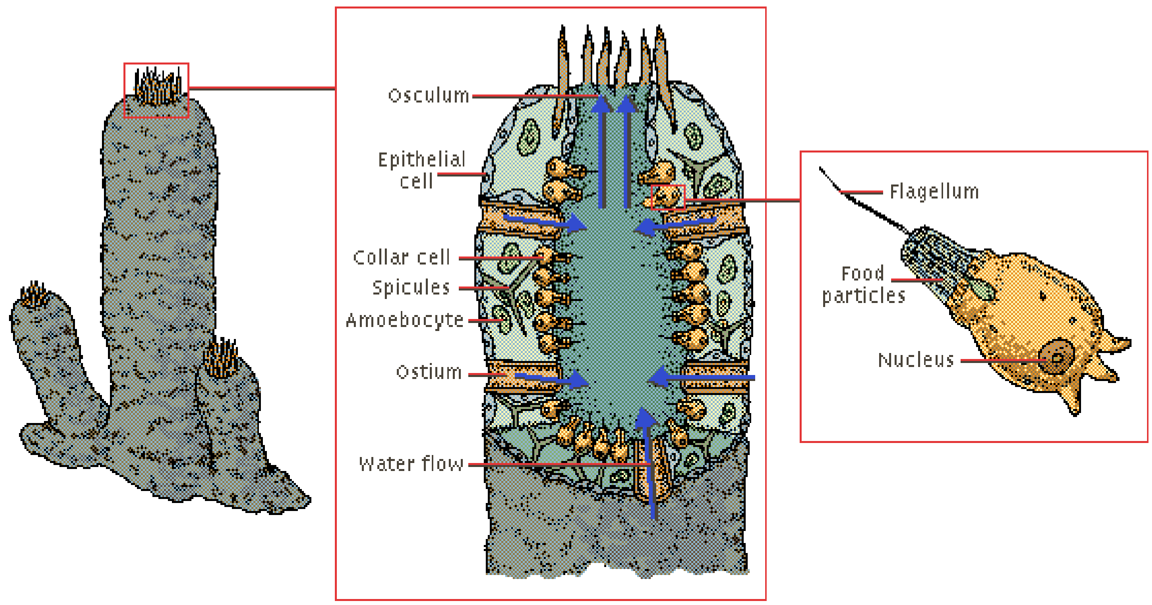
17. *All pictures used for booklet taken by Emily Marshall*

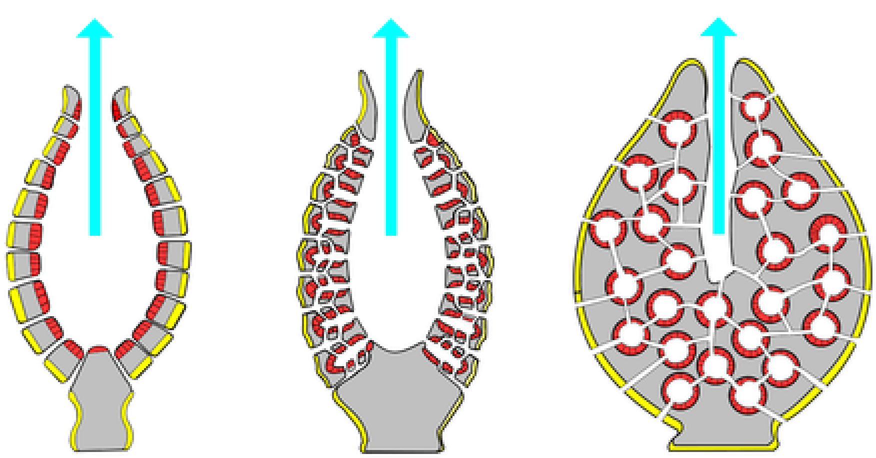
Appendices

Figure 1: Basic sponge anatomy



Picture taken from Microsoft Encarta Generalized anatomy of a sponge

Figure 2: Sponge body complexities



Asconoid **Syconoid** **Leuconoid**

Pinacocytes Choanocytes Mesohyl Water flow

Picture from : zipcodezoo.com/Key/Animalia/Porifera_Phylum.asp

Table 1: Sponge Sample's collected

#	locality	morphology	Spicule shape	Spicule size (um) @ 20 X 1 unit = 3.15 @10 X 1 unit =6.35
1	East/North, intertidal zone	Soft, encrusting underside of coral rag, patches, red/orange, very thin	strongyle	@10 X .3 unit
2	East/South Sub-tidal	Red/orange, growing with sea grass	Tylostyle, very clumped	@10 X .5
3	East/South, Sub-tidal	Orange, encrusting, very thin, growing with coralline algae	Fusiform and tylostlye	@10 X .4
5	East/South, Sub-tidal	Blue, branching, velvety/rubbery, oscules/ostia very visible and evenly distributed	Hastate oxea	@ 20 X .3
6	East/North, intertidal	Slender, black, tubular, soft and easy to cut, "spongy"	Fusiform oxea	@ 20 X .2
8	East/North intertidal	Blue, encrusting underside of exposed coral rag, raised oscules, only a few mm thick		
9	East/North, intertidal	Bright red, digitate, oscules/ostia evenly distributed and very visible	Fusiform and strongyle	@ 20 X .4
10	East/North	Hard, spiky, dark brown, fiberous, tubular	Fusiform oxea	@ 20 X .3

Table 2: Sponge Descriptions (pictures of most can be found in sponge booklet for Chumbe)

	Predicted Scientific Name	Common name	morphology	locality	Other observations
1	:*Cinachyrella Voeltzkowii* or *paratilla* species; order *spirophorida*, family *tetillidae*	Tennis ball sponge	Spherical, brown/orange sunken pits, fuzzy, hispid, often silty which dulls color	Intertidal zone, sea grass beds, subtidal zones (on coral and sandy areas)	
2	*Liosina paradoxa*		Beige/brown, digitate, verrucuse	Subtidal, growing vertically and horizontally on coral	Sea squirt and other small organisms seen living on sponge

3	*Kerasemna humlis*		Orange, encrusting, compressible	Sub-tidal, only found growing with coralline algae	Small fish and plankton-like animals seen feeding on it
4			Beige, digitate, tubular, verrucose/spiky, oscules not visible but sponge wall resilient, flimsy, covered in silt (yellow underneath)	Sub-tidal,	May be the same as number 2
5	*Kallypilidion fascigera*	Blue tube sponge	Tubular, blue, upright, smooth, fiberouse, easily torn	Sub-tidal, seen growing on coral as well as sandy areas	
6			Orange, soft, compressible, no definite shape (globular?), raised oscules	Intertidal, sea grass beds	
7			Oscules only visible/exposed part of the sponge, red/brown, endopsammic, compressible, brittle, and soft	Intertidal, buried in the sand	
8	*Geodia crustos* or *pseudosuberties andrewsi*		Soft, encrusting underside of coral rag, red/orange, patches	Interidal zone, exposed rock 1m high	Sample # 1, living with green and black algae
9			Black/brown, soft/resilent/rubbery, irregular branching, patches, digitate in some parts	Sub-tidal, sandy areas, seen growin intertwined with dead coral (blue-tip acopora)	Living very closeto see urchins
10			White/beige, fan shaped, rubbery	Intertidal, sea grass beds	Looks like carteriospongia foliascens but smaller

11	*Callyspongia conforderata*		Brown/beige, spiky, digitate	Sub-tidal, in between coral head	
12			Brown/tan, large ostia evenly distributed throughout the body, branching	Sub-tidal, in beterrn live coral head	
13			Blue, very thin (a few mm think), raised oscules, encrusting	Intertidal, underside of exposed coral rag rock	Sample #8
14			Blue, large ostai evenly distributed thoughout the body, digitate	Sub-tidal, living on live coral	Sample # 5
15			Red, tubular, digitate, ostia evenly distributed and very visible	Intertidal zone, living in the sand	Sample # 9
16			Black, slender tubes, digitate	Intertidal area, sea grass bed, sandy areas	Sample # 6
17			Brown/beige, branching, very hard, spiky, visible oscules and ostia	Sub-tidal	Sample # 10
18			Red, irregular shape, digitate?, soft	Sub-tidal	Sample # 2, growing with sea grass
19	*Callyspongia conforderata*		Blue, spiky surface, tubular, branching	Sub-tidal, living on coral	

Sponge Booklet created for Chumbe Island