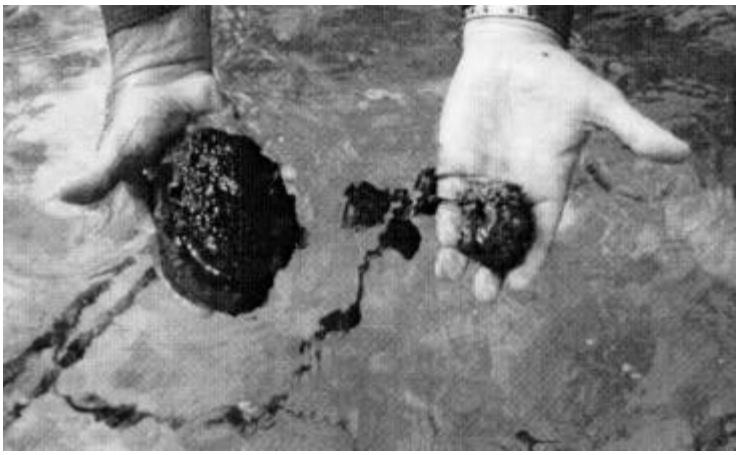
# Starting A Successful Commercial Sponge Aquaculture Farm



Prepared for

Center for Tropical and Subtropical Aquaculture

By

University of Hawaii Sea Grant College Program
Communications Office

School of Ocean and Earth Science and Technology

CTSA Publication No. 120

# How To Use This Manual

The purpose of this manual is to provide the reader with the basic information needed to start a successful commercial sponge aquaculture farm. While this booklet will be useful as a reference tool, we recommend potential sponge farmers directly contact the experts identified at the back of, this manual and any sponge farmers who may already be working in your vicinity before planting your first sponge crop. This manual does not attempt to discuss all of the potential problems that may occur in the process of growing, harvesting, and selling commercial sponges. However, by being creative, using common sense, and consulting experts when necessary, you should be able to successfully overcome most of the challenges that might prevent you from creating a successful and profitable sponge farm.

Highlighted words are found throughout the text, and definitions for these words can be found in the glossary at the end of this manual.

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The views expressed in this publication are those of the author, and do not necessarily reflect the views of the Center for Tropical and Subtropical Aquaculture or the U.S. Department of Agriculture. Financial support for this project was provided by the Center for Tropical and Subtropical Aquaculture through a grant from the U.S. Department of Agriculture (USDA grant number 9438500-0065). This paper is supported in part by a grant from the National Oceanic and Atmospheric Administration, project #M/C-1, which is sponsored by the University of Hawaii Sea Grant College Program (SIESTA), under Institutional Grant No. NA36RG0507. The views expressed herein are those of the author and do not necessarily reflect the views of USDA, CTSA, NOAA or any of its subagencies. UNIHI-SEAGRANT-MB-96-02.

Note to Online Readers: The layout of this manual has been slightly modified for electronic publication, but the content remains the same as the printed version.

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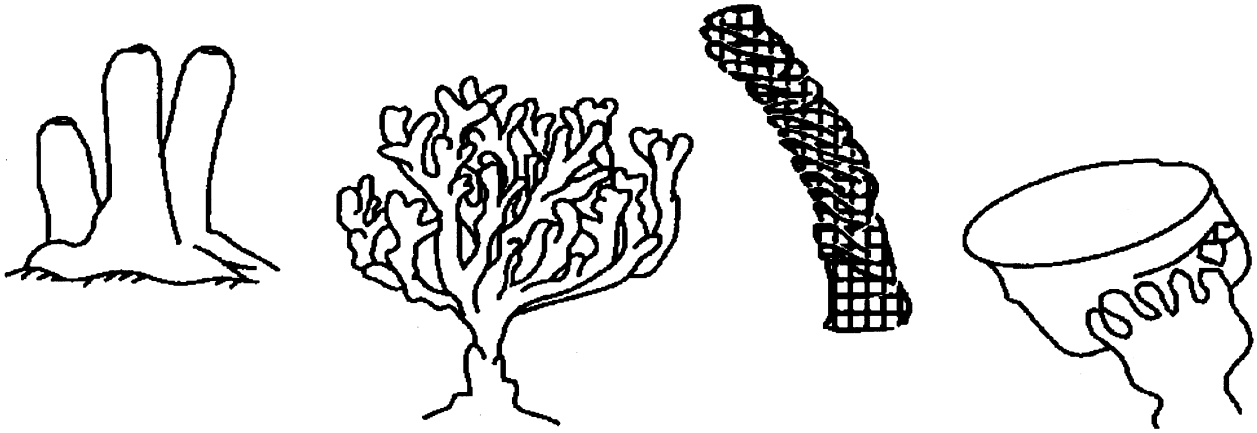
# Part I - Common Questions

## 1. What are sponges?

**Sponges** are living animals whose cells are loosely arranged about a soft fibrous and glass skeleton. Sponges provide homes for many other animals, plants, and microorganisms. In many cases, they all work together in a mutual symbiotic relationship. Well over 10,000 different sponges have been identified by scientists throughout the world, but at present only a few of them are harvested commercially. Most sponges are **sedentary,** and live attached to stationary underwater objects such as coral heads, rocks, logs, or shells. They are incapable of moving around on their own. Like birds, fish, and other animals, sponge species can vary widely from each other in overall size, shape, and color. Some sponges are as small as a grain of rice, while others are more than four feet long.

However, despite these external differences, all of these animals are placed in the scientific group, or **Phylum** Porifera (meaning "pore-bearer") because of the many pores or holes in the body and skin of the sponge.



## 2. Where are commercial sponge farms located?

While several species of sponge are still being harvested from wild stocks off the coast of Florida, most of the current interest and activity in sponge aquaculture is occurring in the Federated States of Micronesia and other US-affiliated Pacific countries.

Sponges grow quickly in the nutrient-rich lagoonal waters of the tropical Pacific Ocean, making many Pacific islands ideal for sponge aquaculture enterprises. In the late 1930s and early 1940s, Japanese farmers in Micronesia experimented with different sponge growing techniques, only to have their efforts halted by the outbreak of World War II. Today, sponge aquaculture is being rediscovered by many individuals in the Pacific region, and new growing techniques are being used to produce higher yields with less effort. In fact, most of the information presented in this manual is based on the experiences of Richard Croft, a sponge farmer and researcher living in Pohnpei, FSM. Through years of hard work, often learning by trial and error, Croft has become one of the world's leading experts on sponge aquaculture, and the insights and growing techniques developed at his farm on Pohnpei (which are detailed at length in this manual), are invaluable to those wishing to start a sponge farm of their own.

# 3. What are the benefits of growing sponges commercially?

- **It's easy.**

Growing sponges requires very little special knowledge, and anyone in the family, from grandparents to young children, can participate in planting, maintenance, and harvesting of the sponge crop. This can make even the most tedious tasks on the farm more enjoyable, and extra hands working on a crop means more sponges being planted, increasing a family's potential income. Also, by placing the sponge farm near their home, a family can work on the sponge crop at its leisure and attend to other activities easily.

- **It's profitable.**

Although it is unlikely that anyone will get rich growing sponges, the activity can provide a farmer with a continuous income year-round, and improve his overall standard of living. Sponge farming can be a part-time enterprise, allowing time for pursuing other sources of income if needed. A sponge farmer and an assistant working three days per week can reasonably expect to plant 30,000 sponge cuttings in a year, and earn approximately $10,000 to $12,000 (US).

- **It's environmentally friendly.**

Sponge farming is a relatively new business opportunity that does not harm the marine environment. Growing sponges commercially actually reduces harvesting pressures on local wild sponge stocks, making it less likely that any sponge species will become extinct. Sponge aquaculture also benefits the lagoon in which the farm is located. Cultured sponges release eggs into the water, as do their wild counterparts; new sponges will start growing in the immediate vicinity of the sponge farm. As the ropes and lines become crowded with various small "fouling" organisms, several species of fish will be attracted to the farm-site. For more information on fouling, see **Part IV- Line Fouling.**

## 4. How much can I expect to earn from my farm?

Growing sponges commercially will provide a farmer with an income just like growing other crops for sale. However, like any other activity, the more work the farmer puts in, the more income he can expect in return. Experience at an existing commercial farm located on Pohnpei, FSM, demonstrates that two farmers can plant at least 200 cuttings per day (approximately 4-b hours of work). If these two farmers work three days each week planting sponges, they will be able to plant approximately 30,000 sponges in one year's time. At the end of the second year, they will be able to harvest and sell at least 10,000-12,000 of these sponges, at an average price of $1.00 (US) per sponge. In other words, they could earn $10,000 to $12,000 (US) a year for their work. If they were to work more than three days per week, these farmers could earn even more. To maintain this $10,000 to $12,000 (US) yearly income level, a farmer must plant at least 30,000 new cuttings each year.

## 5. How long will it take for my first sponge crop to mature, and where are sponges sold?

In the warm waters off Pohnpei, FSM, sponge cuttings can grow to commercial size (800 grams) in just two years. Once a sponge farmer is ready to harvest his first crop, he can reserve those sponges that are the largest in size (and with the highest growth-rates), and use these as broodstock to replant his farm. This will reduce the overall growout time for subsequent sponge crops. Sponges will continue growing after the third year, but their increased size no longer brings a corresponding

increase in value. Sponges in Florida generally take much longer to reach commercial size (up to seven years), due to the cooler water temperatures found in the Atlantic Ocean. It's a good idea for a new sponge farmer to attempt to contact potential sponge buyers before planting his first crop, in order to get a sense of the sizes in demand and the price at which they can be sold. A sponge farmer should then try to harvest as many sponges as possible at the size commanding the highest price.

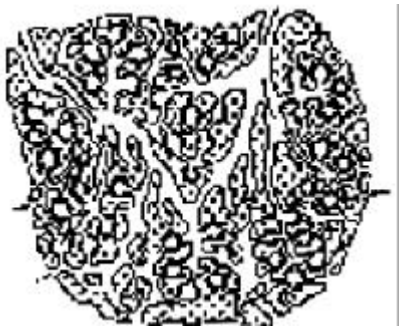
Natural sponges are currently in considerable demand worldwide for their numerous medical, industrial, and household uses. Hospitals purchase natural sponges because of their unique ability to withstand high sterilization temperatures. Natural sponges are also commonly used for bathing and cosmetic purposes, window washing, and the application of industrial lubricants. Sponges are also being marketed to tourists in Micronesia as part of attractive gift baskets featuring local goods. For more information on this topic, see **Part VI – Local and Worldwide Markets.**

# Part II – Sponge Biology

## 1. Introduction

It is important for a potential sponge farmer to have a basic understanding of what these animals are made of, as well as what they eat, and how they reproduce. A farmer with a good working knowledge of sponges is more likely to possess a healthy and bountiful sponge crop. The following section will provide the reader with the necessary fundamentals of sponge biology. Remember, when it comes to producing a healthy sponge crop, there is no such thing as having too much information. The experts identified at the back of this book will be happy to assist you in finding additional material on sponge biology, or at the very least, they can direct you to additional resource materials.

A sponge is a living animal made up of loosely arranged cells surrounding a framework of fiber and glass. The cells that make up a sponge are specialized, and each variety of cell has a unique shape based on its function in the sponge. Water is drawn into the sponge by cells with tails ( **flagellated cells)** that whip back and forth. These cells sit in thousands of little chambers inside the sponge, and are connected to holes **(ostia** or pores) on the outside of the sponge via narrow channels. Once water enters a chamber, food is removed by the flagellated cells. The water then flows into several large channels running throughout the sponge, before finally being pushed out of the large holes on the top of the animal **(osculum** -singular; **oscules** -plural). The only sponge species that is currently being cultivated in Micronesia, *Coscinoderma mathewsi,* has several large oscules on the surface of the sponge, surrounded by thin, rubbery tissue. These oscules are approximately 1 cm in diameter, but they can be smaller and can close if the sponge is handled. The shape and structure of C. *mathewsi is* similar to that of the sponge in the diagram below.



## 2. How do sponges eat?

Sponges eat by filtering dissolved nutrients and tiny plants and animals floating in the ocean water that is moving through their bodies. Most of these food particles are so small they cannot be viewed even with a standard microscope. In general, the more food particles in the water surrounding a sponge, the faster it will grow. Sponges, such as C. *mathewsi,* grow well in Pohnpei because the lagoon is rich with nutrients due to the high rainfall and run-off into the lagoon.

Like other animals, sponges need to take in oxygen and remove wastes from their system in order to stay alive. Both food and oxygen are moved into the sponge by special cells set in chambers within the body of the sponge. These flagellated cells create the water current moving through the sponge's canals by whipping their tails. Special **ameboid** cells in the body of the sponge assist in the removal of cell wastes, the uptake of oxygen, and the transport of food from the flagellated cells.

## 3. What gives a sponge its shape?

Sponges have a skeleton, just as we do, that gives the animal its shape and holds the chambers and canals open so that the sponge can exchange water and stay inflated. Sponge skeletons come in two varieties- **spongin** (similar to human nose-cartilage) or **spicules** (small glass crystals that come in a fascinating number of shapes) Spicules are often embedded in the spongin to strengthen it, but can be distributed throughout the body of the animal in intricate networks. The more spicules in a sponge, the harder it is to the touch. The more spongin in a sponge, the more soft and elastic it is when handled. Some sponges use sand to help strengthen their fibers. Bath sponges are mostly soft, elastic spongin, with a few bits of sand buried in their surface skin and main fibers.

## 4. How do sponges reproduce?

Sponges reproduce in a variety of ways. Most sponges are **hermaphrodites,** meaning that they have both sperm and eggs necessary to form a new sponge. Some sponges can also release a small packet of cells that settle to the bottom and create a new sponge. Still other sponges form from a small "bud" that breaks off from the outer skin and begins growing on its own. Lastly, when a sponge is damaged or cut into small pieces, as may happen in a storm, each piece can grow into a new sponge. It is this ability to reproduce from small cuttings that makes commercial sponge farming such an easy and practical way to make money.

# Part III – Planning A Sponge Farm

## STEP 1 – Finding a suitable location

The best location for a sponge farm in Micronesia is in the lagoon just offshore from the farmer's home. This situation allows the farmer to work on the sponge crop at his own discretion, and shortens the amount of time spent traveling back and forth to the farm. The following factors must also be considered when selecting a farm site:

- **Keep the sponges away from fresh water**

The farm cannot be near an area where a river or stream flows into the lagoon. ***Fresh or brackish (a combination of fresh and salt) water will kill your sponges.***

- **Depth of the water**

The water must be at least five feet deep at low tide, to keep the sponges from becoming overheated by the sun (which can kill them), and to prevent motorboats from snapping the lines if they happen to pass over the farm.

- **Tidal changes**

The area selected as a farm site should have some water flow during tide changes. While it will not hurt the sponges, strong currents from large tidal changes make it difficult to work at the farm site.

## STEP 2 - Choosing a sponge farm support growout method

There are many different growing techniques that can be used to produce a large and healthy sponge crop. As a result, the selection of a method is usually based on the cost of the materials, the ease with which a farmer can work on the sponges, and the adaptability of the technique to different reef conditions. One method that has been used in the past involves attaching sponges to concrete discs along the bottom of the ocean. Japanese sponge farmers in Micronesia have also hung sponges on vertical lines extending from bamboo rafts, and along lines attached to beer bottle floats. However, the horizontal line method, which is currently being used by most sponge farmers in Micronesia, is probably the cheapest, easiest, and most versatile way to culture sponges developed to date. That is why it is the only sponge aquaculture technique discussed at length in this booklet.

Basically, the horizontal line method consists of attaching heavy support lines to coral anchors that are roughly parallel to each other. Lighter "growing" lines are strung between these support lines, and the sponges themselves are hung from these growing lines. If the horizontal line method is not suitable for your site, contact one of the experts identified at the back of this manual to design alternative methods.

## STEP 3 - Purchasing the materials

Sponge farms using the horizontal line method are low-cost operations, and in most areas of the world, the materials required to set it up can be obtained for less than $1,000 (US). The following is a list of the items that you will need to plant approximately 30,000 sponges, and their general cost:

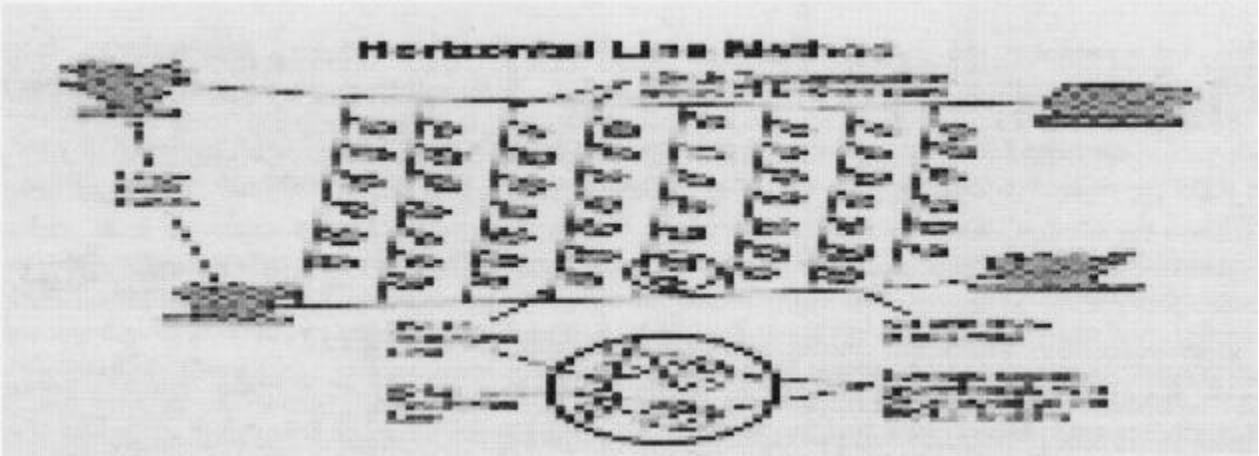
| | |
|---|---|
| 1 /4 inch polypropylene rope- 2,400 feet | $160 |
| 150 lb. multifilament nylon test line- 60 spools | $380 |
| 50-60 lb. multifilament nylon test line- 55 spools | $400 |
| Knives | $ 20 |
| Sharpening stone | $ 10 |
| Diving mask | $ 25 |
| **Total** | **$995** |

Source: *1995 Memphis Net and Twine Company*

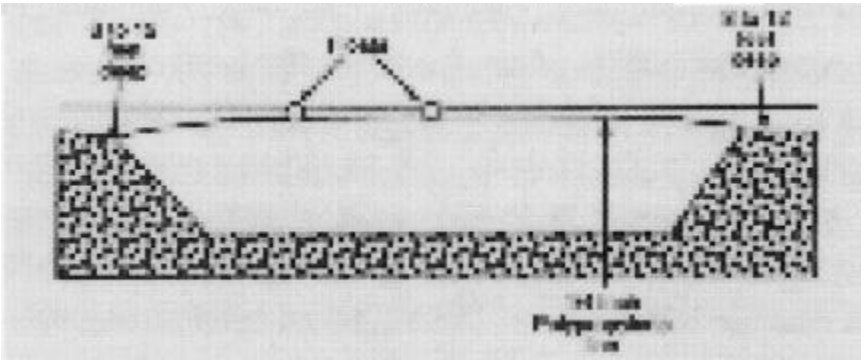
If your farm site is far from your home, you will probably need to use a boat. And of course, if that boat has a motor, you will have to purchase fuel. The 1/4-inch rope and the 150 pound test-lines will last many years in the water, and your costs will be a little less in each of the following years if you continue to use them.

## STEP 4 - Setting up the farm

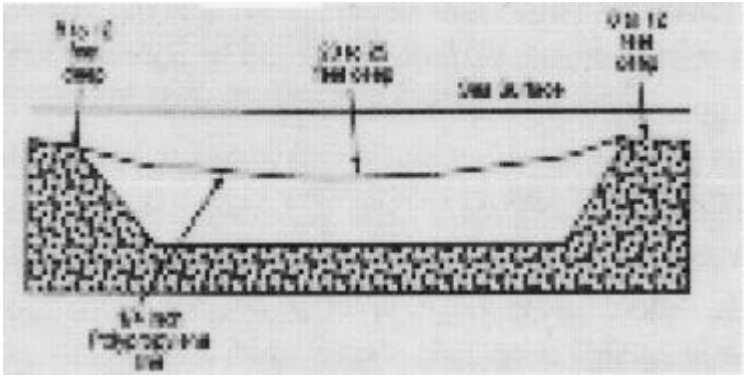
The horizontal line method sponge farm (shown on page 11) is set up by attaching "heavy" support lines (polypropylene rope) to coral anchors that are roughly parallel to each other. Lighter "growing lines" (150 lb. test) are strung between support lines, and the sponges themselves are hung from the growing lines on 50-60 lb. test line.



It is important to note that the horizontal line method does not require the use of SCUBA diving equipment; all work can be done in shallow water. The cutting of the sponges is done on the adjacent reef flat. Planting is also done in shallow water because the sponge lines, which normally sink to a depth of 20-30 feet, can be brought to the surface using two to four floats (see diagram below).



*Floats are used to pull the sponge lines close to the surface of the water. This way all work can be done using only fins, mask, and snorkel. It is not necessary to use SCUBA diving equipment while farming sponges. Once the work is finished, the sponge lines are freed from the floats, and the lines drop back from the surface.*



*All of the sponge lines will sag due to the weight of the sponges and other organisms growing on the lines.*

Once all work is finished for the day, the sponge lines are then freed from these floats and the lines will sink 20-30 feet below the surface.

If the horizontal line method is not suitable for your site, contact one of the experts identified at the back of this manual to design alternative methods.

In the process of setting up a sponge farm, there are two important rules to remember:

- **The sponges must not touch the bottom.**

The 1 /4 inch support ropes should be tied to the coral heads in such a way as to prevent the sponges from touching the sea bottom. Touching the bottom will not harm the sponges, but they will pick up pieces of sand and coral and require more work to clean prior to sale. The water depth under the hanging sponges makes no difference - it can range in depth from just a few feet to more than 100 feet. It is important to remember the ropes and lines will sag as the sponges grow and as fouling organisms begin to take up residence on the line. Careful planning can avoid unforeseen future problems.

- **The ropes should be placed across the current.**

If there is a current running through a site, the 1/4-inch support ropes should be placed across or perpendicular to the current. By placing the ropes across the current, the sponges tied to the 150-pound test lines end up pointing in the same direction as the current. This reduces the chances of a sponge breaking off during large tidal changes, when currents are strong.

The farm site will probably not be a nice square, and the lengths and distances between the 1/4 -inch support ropes will depend on the spacing between the large coral heads selected. If the distance between the support ropes exceeds 60 feet, floats can be added to keep the 150-pound test growing lines from touching bottom.

## STEP 5 - Finding the broodstock

A sponge farmer must find a supply of parent sponges, **or broodstock,** before he can begin planting his first crop. As stated earlier, when a parent sponge is cut into pieces, each cutting will grow into a new, full-sized sponge, provided the environment is suitable. Broodstock can be obtained from wild stocks, donated by government nurseries, or purchased from other sponge farmers in the region. It is highly recommended that farmers puchase cultured, rather than wild sponges as broodstock because they are already the right variety of sponge, it is easier to obtain a consistent supply of these cultured sponges, and the broodstock is coming from proven good growing stock. Hours can be wasted searching for wild sponges that are commercially valuable. Moreover, the use of cultured sponge broodstock minimizes harvesting pressure currently being placed on depleted wild sponge stocks. After the second year of growth, a sponge farmer should save some of the larger sponges from that year's crop to make the next year's cuttings. Using larger sponges as broodstock will minimize the size differences in later generations, and produce sponges of a more marketable size, in less time.

## STEP 6-Making the sponge cuttings

The parent sponge should be cut into small pieces, usually square, oval, or triangular in shape, with an approximate wet-weight of 150-300 grams. The sponges should be cut in shallow water on the reef flat. At least one side of each cutting must be covered by the sponge's outer black skin. When making cuttings, the more black skin covering the surface of a cutting, the smaller that sponge piece can be. The opposite of this statement also holds true, and thus the less black skin on the outside of a cutting, the larger that cutting needs to be in order for it to grow successfully.

## Things to remember

From experience, we know there are several important considerations in handling and planting sponges:

- **Don't remove sponge cuttings from the water.**

Once they are cut, sponges should not be removed from the water until they are completely covered by their black skin. Even after their black skin is present, sponges will die if they are kept out of the ocean for more than a minute at a time.

- **Don't squeeze the sponges.**

When handling sponges it is very important not to squeeze them, or they will die. As long as you remember the sponges are living animals and handle them carefully, nearly all of your crop will survive until it is harvested.

- **Use only razor-sharp knives when making cuttings.**

All instruments that are used to cut and string sponges must be razor sharp, and the knife must be resharpened after making three to five cuttings. Sponges will dull a knife very quickly, and unless the knife is razor-sharp, you will have to hold the sponge tightly in order to slice through the sponge, which can kill it. **This point cannot be overemphasized.**

## STEP 7 - Attaching the sponge cuttings

A 50-60 pound, tarred, nylon test line, approximately 20-24 inches long, is threaded through the cutting with a razor-sharp knitting needle, knife, or other tool and the ends of the line are tied, making a loop. This loop is then placed over the growing line (nylon, 150-pound test) and the cutting is pulled back through the loop (see diagram on page 14). While a non-tarred line can be used to attach the sponge cuttings, knots tied with tarred lines seem to hold together better in various ocean conditions (see diagram on page 11.)

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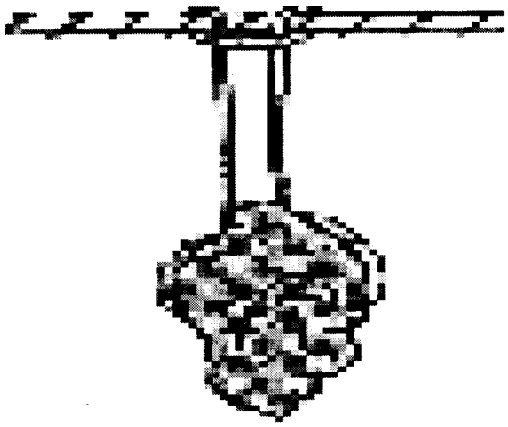

*Nylon test line is strung through the sponge cutting.*

# Part IV Managing Your Sponge Farm

## 1. What are some common problems I might have?

Once they are hung on the line, sponges are surprisingly strong creatures, with few natural enemies. Using the techniques described here, sponge farmers in Micronesia have been able to keep sponge mortalities to a minimum; it is not unusual for 95% or more of the sponge cuttings to survive until they reach commercial size. In general, the less you handle your sponges, the greater their chance for survival.

Although sponge crops in some parts of the world have been wiped out by periodic blights (a kind of sickness), no major sponge disease epidemics have ever been recorded in the tropical Pacific. In fact, broken lines have been the most significant problem for sponge farmers in Micronesia. Placing the farm at least five feet below the surface keeps motorboat propellers from cutting the lines. And, as stated in a previous section, the sponges need to be submerged at least five feet anyway, to avoid getting overheated in the hot surface waters of a lagoon. Ropes can also break by the constant rubbing against the coral head anchors, by fishermen whose hooks snag the sponge lines, and by fish biting through the lines while grazing on fouling organisms.

## 2. Line Fouling

Over time, the ropes and lines used in a sponge farm become covered with fouling organisms. This is normal and should not be a concern, unless the sponges themselves are being covered by the fouling organisms. Fouling problems generally can be avoided by periodically checking the crop, cleaning or changing the lines, or by putting the lines close to the reef front, so the fish can clean the lines. Fouling organisms on sponges can easily be removed by hand; however, care must be taken not to over-handle the sponge.

## 3. What kinds of records should I keep?

Growing sponges requires little record keeping. You will probably want to keep all of your receipts and sales records. You may also wish to mark the growing lines with the date the sponges were planted. However, it is the size of a sponge that determines when a sponge is ready to be harvested, not its age. Knowing the ages of the sponges could help in determining new broodstock. Faster growing sponges may produce faster growing cuttings.

# Part V Harvesting, Cleaning, and Marketing Commercial Sponges

## Harvesting the Sponge Crop

## 1. When do I harvest my sponge crop?

Your sponges should be harvested when they reach commercial size (800 grams). Only medium- and large-sized sponges are currently being marketed in Micronesia. In the warm waters of Micronesia, sponges can reach commercial **size** in just two to three years.

## 2. How do I harvest my sponges?

Harvesting the sponges is a very simple task. You simply cut the 50-60 pound test line linking a sponge to the 150-pound test line. The gap that is left behind on the growing line can be used to plant new sponge cuttings.

## Preparing the Crop for Market

Several steps are required in order to turn your black-skinned sponge crop into a commercially valuable product. The cleaning process should be taken very seriously, or all the time, effort, and money invested in your sponge crop could be lost.

## STEP 1-Bring the sponges to shore, and return them to the ocean.

When it is time to harvest your sponge crop, the sponges should be brought to shore and left out in the sun for several hours. The dead sponges should then be returned to the ocean, and allowed to rot for four to five weeks. The sponges must be kept wet during the entire rotting period, or some of the decaying material will dry and stick to the spongin fibers. Once this has happened, a sponge has very little commercial value. Rotting sponges also smell very bad, and by placing them under water you can minimize the unpleasant odor.

After the fourth week, the sponges should be checked every three to four days, by squeezing the water out of them. If they squeeze easily, have no strong or bad odor, and quickly return to their initial shape, they are probably ready.

## STEP 2 - Rinse with fresh water.

A little more work is necessary before the sponges can be sold. The sponges should be rinsed with fresh water to remove any sand or silt.

## STEP 3 - Wash the sponges in a washing machine.

The sponges should be washed twice in a washing machine, using a high-quality biodegradable laundry detergent during the first wash. An additional rinse (without soap), between these two washings is also recommended. Do *not use any kind of chlorine bleach when washing the sponges, as they will be damaged and you will be unable to sell them.*

## STEP 4 - Store the sponges properly.

Cleaned sponges are easy to store until you are ready to ship them to market. They do not require any special refrigeration or other type of storage. The only requirement is that they be kept dry.

# Part VI Local and Worldwide Markets

Your sponge crop can be sold in a number of places. Most developed nations buy sponges on the world market for industrial, medical, and cosmetic uses. To minimize shipping costs, it is best to sell your sponges to a buyer in the developed nation closest to your farm. Tourists will generally pay higher retail prices for sponges; however, this market is limited by small tourist traffic in many areas.

New sponge farmers may wish to form cooperative marketing arrangements with other sponge farmers in the area. Farmers involved in a cooperative pool expenses (such as shipping costs) with each other, and share profits. By providing a buyer with a larger and more consistent supply of sponges, a cooperative can often negotiate better prices than a farmer can obtain individually.

# Part VII What If I Have Questions?

If you have any questions, contact one of the following:

- **Local Department of Natural Resources**
- **Local Cooperative Extension Service**
- **Richard Croft**
  Pohnpei Natural Products
  P.O. Box 428 Pohnpei, FSM 96941
  fax: (691) 320-2726
- **Universities/Sea Grant Extension Service in your area**
- **University of Hawaii Sea Grant Extension Service**
  1000 Pope Road, MSB 226
  Honolulu, Hawaii 96822
  phone: (808) 956-2858
  fax: (808) 956-2858
- **Center for Tropical and Subtropical Aquaculture**
  The Oceanic Institute
  41-202 Kalanianaole Highway
  Waimanalo, Hawaii 96795
  phone: (808) 259-7951
  fax: (808) 259-8395

# Glossary

**Ameboid cells:** cells in the body of the sponge that assist in the removal of cell wastes, the uptake of oxygen, and the transport of food from the flagellated cells to the rest of the sponge.

**Broodstock:** the parent animals needed to start an aquaculture farm.

**Flagellated cells:** special cells lining the chambers in the sponge, characterized by their whip-like tails. Food and oxygen are brought into a sponge, and wastes are removed from a sponge, via the water current created by the movement of these tails. Flagellated cells are also involved in food intake.

**Hermaphrodites:** animals that have both male and female sex characteristics, such as both sperm and eggs for reproduction.

**Oscules:** one or more holes through which water and wastes are released from the interior of the sponge into the ocean. (singular: **osculum)**

**Phylum:** a scientific classification used to group animals on the basis of similar genetic and/or physical traits.

**Ostia (pores):** thousands of small holes covering the outside skin of a sponge leading to the canals, which feed into the flagellated chambers.

**Sedentary:** lacking movement, such as an animal that remains attached to a fixed object

**Spicules:** small needle-, star-, and rod-shaped crystals of glass found within the spongin that add support to the sponge's fiber skeleton.

**Sponges:** living animals whose cells are loosely arranged about a soft fibrous and glass skeleton.

**Spongin:** the organic skeletal material in a sponge, made from a weave of fibers similar to the cartilage found in human noses and ears.