Farming the Micronesian Wool Sponge (*Cosinoderma matthewsi*)

Simon Ellis, Eileen Ellis, Walden Lohn, Maria Haws and Quentin Fong

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For more information please contact Dr. Maria Haws, University of Hawaii Hilo, Pacific Aquaculture and Coastal Resources Center, 200 W. Kawili Street, Hilo, HI 96720, USA. Tel. 808-933-0707. Email haws@aol.com

1. Introduction

Natural sponges are harvested from many different locations in the world, primarily the Mediterranean and Caribbean seas. The world demand for sponges, at source, is currently estimated at around USD 35 million per annum. Due to over harvest and disease, wild sponge stocks are in decline worldwide and the current supply of natural sponges cannot keep pace with demand. Farming sponges is a solution to meeting this demand as it is relatively easy, low cost and can supply a uniform product to the market. Sponge farming is a very new field and is being tested on a small scale in the Mediterranean and parts of the Pacific including Micronesia, Australia, New Zealand, Solomon Islands and Fiji. Uses for natural sponges include: bath and beauty; painting; medical; and industrial applications.

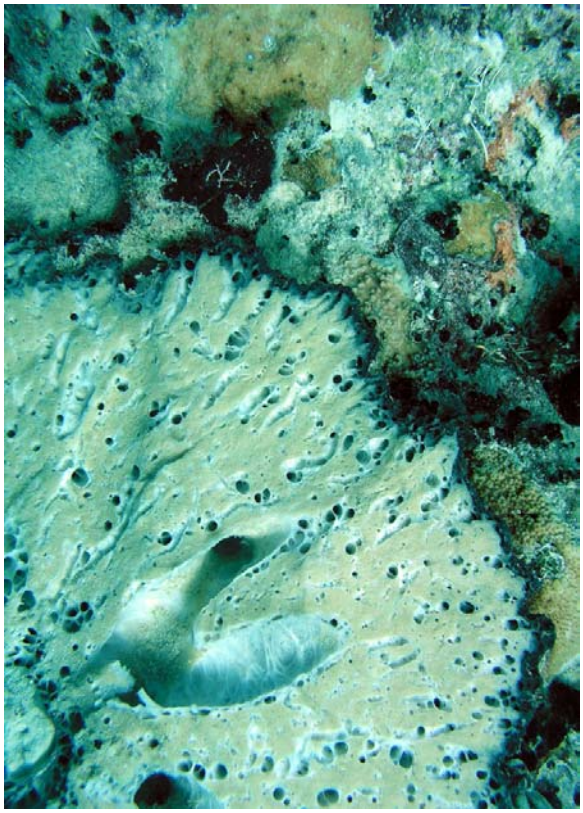

Figure 1. Cross-section of a Micronesian wool sponge showing the channels and chambers used for feeding

The Micronesian wool sponge (*Cosinoderma matthewsi*) is one of the first sponges to be farmed in the world. In the late 1930's and early 1940's Japanese farmers in Micronesia first began experimenting with this sponge. This technology was lost due to the outbreak of WWII but efforts were renewed in the 1980's up to the present. Today, sponge farming methods for the Micronesian wool sponge are well developed and low cost culture technology exists. This manual gives a simple pictorial overview of current farming practices for the Micronesian wool sponge in Pohnpei, Federated States of Micronesia. These methods could easily be transferred to similar species in different parts of the world.

Sponges are very simple animals that feed by drawing water through a series of channels and chambers within their bodies (Figure 1). The sponge is supported by an internal skeleton made up of a soft, elastic material called spongin. It is this material, which is left after the sponge is processed, that makes it valuable. The chambers and channels in the spongin skeleton are what enables the sponge to hold large amounts of water.

2. Collection

The Micronesian wool sponge tends to be found in water from 4-25 m (15-80 feet) in depth, often in channels. It grows up to 60-90 cm (2-3 feet) in size and is recognized by its dark black or brown skin (Figures 2-4). In Micronesia, this sponge is common in the main lagoons of Pohnpei, Chuuk and Palau main island lagoon areas. It has been found only on Ulithi in Yap and is considered rare in the Marshall Islands.

Figures 2, 3 & 4. Micronesian wool sponge in the wild

Sponge collection is best done using SCUBA gear but if sponges are found in shallow water, they can be collected using snorkel gear only. The collector carries: a knife; sharpening stone; mesh bag; and/or a piece of rope for carrying the collected sponges (Figures 5 and 6).

Figure 5. Diver equipped for collecting broodstock sponges

Figure 6. Knife and sharpening stone used for collecting sponges

Only the top two thirds of the sponge is removed, leaving the bottom part to re-grow (Figures 7-12). It is very important to keep the knife very sharp by re-sharpening every few cuts. Smaller sponges are put in the bag and larger ones are threaded onto the

Figure 7. Collecting broodstock sponges

Figure 8. Collecting broodstock sponges

Figure 9. Collecting broodstock sponges

Figure10. Collecting broodstock sponges

Figure 11. Collecting broodstock sponges

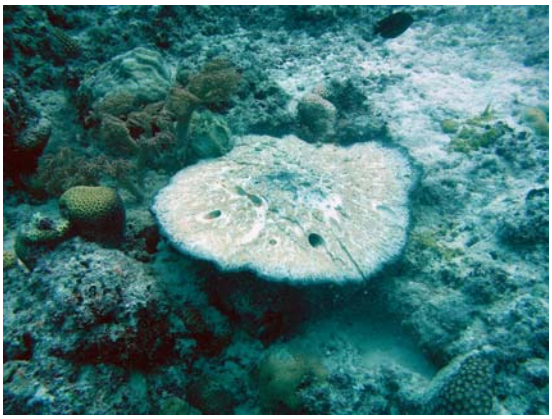

Figure 12. Portion of the sponge left after cutting

rope (Figure 13-16). In this way the collectors can carry enough sponges for up to 1000 seedlings per dive.

Figure 13. A sponge collector threading a large sponge onto a stringer

Figure 14. A sponge collector threading a large sponge onto a stringer

Figure 15. A sponge collector threading a large sponge onto a stringer

Figure 16. A sponge collector carrying a large number of broodstock sponges.

3. Transport

Sponges must be kept in the waer during all stages of transportation or they will die. When the divers returns to the boat they pass the sponges up one by one to an assistant who places them very quickly into an ice chest filled with clean seawater (Figures 17-19). Sponges are very simple animals and cannot stop pumping water through their bodies when they are collected. For this reason, it is important that the entire sponge is covered with water or else it will take in air and die (Figure 20). They are also sensitive to large changes in water temperature and should be moved as quickly as possible between the collection and farm site. For trips greater than 30 minutes clean water should be added to the ice chest to provide a water exchange. Once the sponges reach the farm site, they should be placed in 3-5 m (10-15 feet) of water in readiness for planting. It is better to wait one week between collecting the sponges and planting them so they can recover from the stress of collection and transport.

Figure 20. An ice chest filled with collected sponges

Figure 17. Moving sponges from the ocean to an ice chest

Figure 18. Moving sponges from the ocean to an ice chest

Figure 19. Moving sponges from the ocean to an ice chest

4. Choosing a Farm Site

The best farm sites are close to the farmer's house, allowing the farm to be visited regularly at minimum cost. Sponges grow fastest and have the least fouling in areas where the water is clean and has good circulation.

In Pohnpei, the best farms are on the shoreline that is exposed to the prevailing wind and in areas of the lagoon that are closer to the barrier reef. Farms are strung between coral outcroppings (Figure 21). Sponges are very sensitive to fresh water so farms should not be set-up close to large river mouths.

Figure 21. Aerial view of a good farm site showing where lines would be attached to outcroppings

5. Setting up the farm

The structure of the farm is formed using 6 mm (¼") nylon braided line (Figure 22), called the main line, which is strung between selected coral heads. The main line is tied around rocks or coral heads (Figures 23-25) in about 2-4 m (8-12 feet) of water. Length of each main line varies depending on the site but about 30 m (100 feet) is average for each line (Figure 26). A minimum of two of these lines, spaced

Figure 22. Farmer holding a roll of 6 mm nylon main line

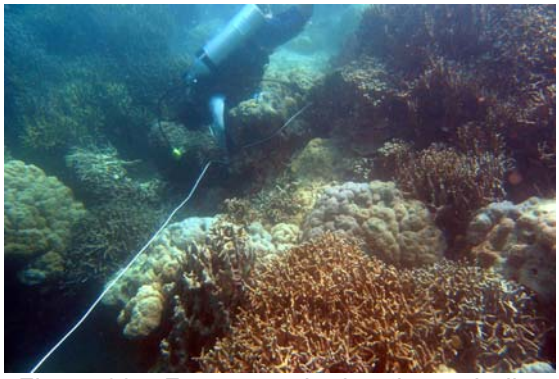

Figure 23. Farmer anchoring the main line around a coral head

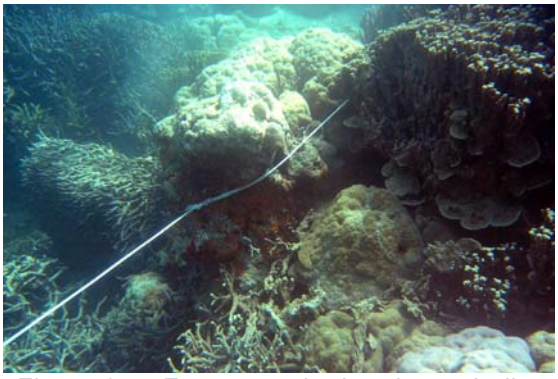

Figure 24. Farmer anchoring the main line around a coral head

Figure 25. Farmer anchoring the main line around a coral head

Figure 26. Farmer swimming with main line to another anchor point across the reef

about 6-9 m (20-30 feet) apart are used to create the farm (Figure 27). The farm site should be at least 9 m (30 feet) deep. While it is not necessary to use SCUBA for this work, it is easier to do so.

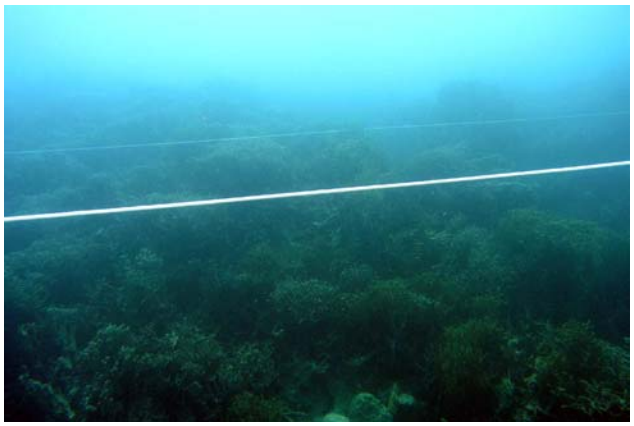

Figure 27. The correct distance between main lines

Once the main lines are installed they can be raised to the surface using floats and all work can then be done using only snorkel gear. To do this the farmer uses 2-4 large floats each attached to 20 m (60 ft) of 6 mm braided line. The farmer swims down and places the line under the main line of the farm and then surfaces (Figures 28 and 29). The farm is then raised by pulling up the line attached to the float (Figure 30) until the main line is only a few feet below the surface (Figure 31). The float is then tied off to the main line (Figure 32). Multiple floats can be used to raise the farm so all work can be done using snorkel gear only (Figure 33).

Figure 28. Farmer putting a rope attached to a float under the main line

Figure 29. Farmer surfacing with the rope

Figure 30. Farmer using the float to pull the farm line to the surface

Figure 31. Farmer tying off the main line to the float

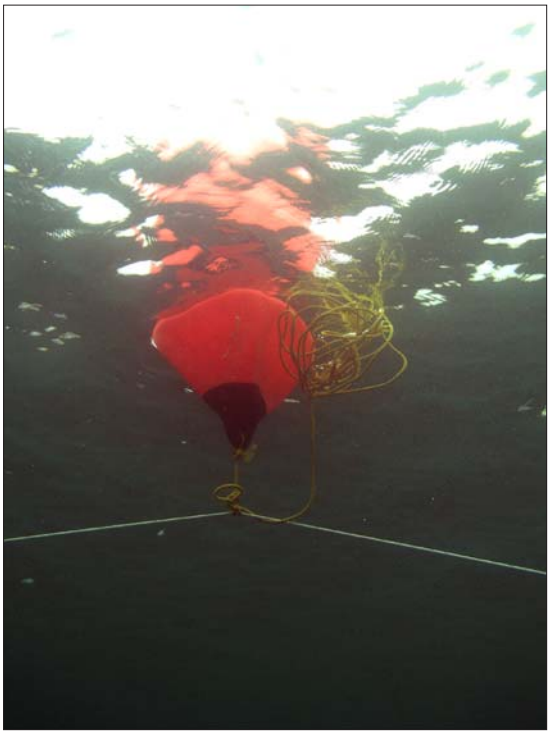

Figure 32. The float holding the main line at the surface

Figure 33. View from the surface when the farm has been raised up to the surface.

Lighter grow out lines of 70 kg (150 lb) test are then tied between the main lines of the farm (Figure 34). These are placed 0.5-1 m (2-3 feet) apart across the width of the farm. The farm is now ready for planting sponges (Figures 35-38).

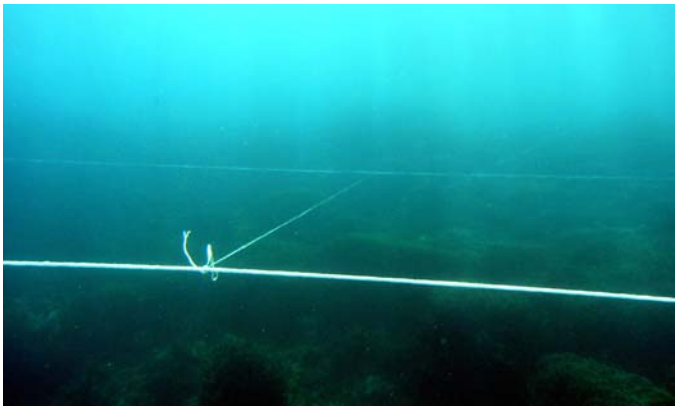

Figure 34. Grow out lines strung between the main lines

Figure 35. Farmers attaching grow out lines between the main lines

Figure 36. Farmers attaching grow out lines between the main lines

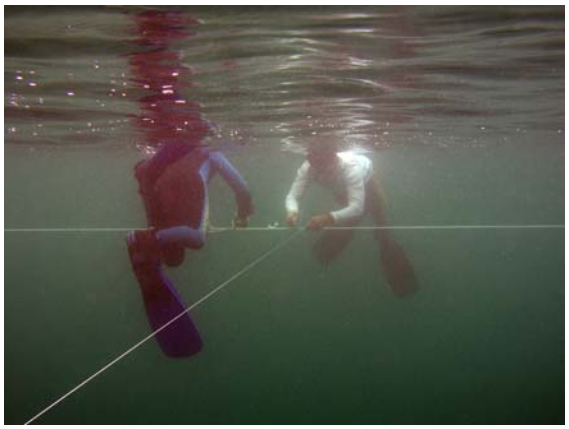

Figure 37 Farmers attaching grow out lines between the main lines

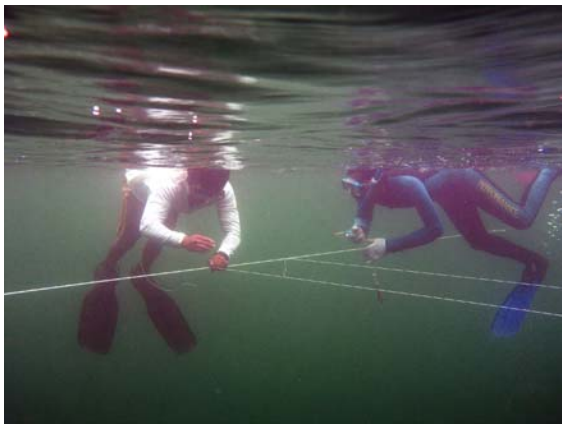

Figure 38. Farmers attaching grow out lines between the main lines

6. Cutting, Stringing and Planting

This process is best done in a group of three farmers: one to cut the sponges; one to string them; and one to tie the string. All work takes place on the reef flat using snorkel gear only. The person cutting the sponges uses a sharp knife to cut pieces of the broodstock sponge into pieces about 8 cm (3 inches) in size (Figures 39-42). The knife must remain very sharp and should be sharpened every 5-6 cuts. In addition care should be taken not to squeeze the sponges as this will kill them. Cut sponges are piled up for stringing.

Figure 39. Farmer sharpening the knife underwater

Figure 40. Farmer cutting large broodstock sponge into strips

Figure 41. Farmer cutting large broodstock sponge into strips

Figure 42. Sponge strips being cut into planting size pieces

Figure 43. Farmer preparing stringing line by coiling it around his arm

Sponges are strung using a 40 kg (90 lb) test tarred twine. Batches of 100 pieces of twine are prepared on the boat prior to entering the water. The farmer coils the twine between elbow and hand 100 times (Figures 43 and 44). The twine is then cut and tied to form a bunch (Figures 45 and 46).

Figure 44. Farmer preparing stringing line by coiling it around his arm

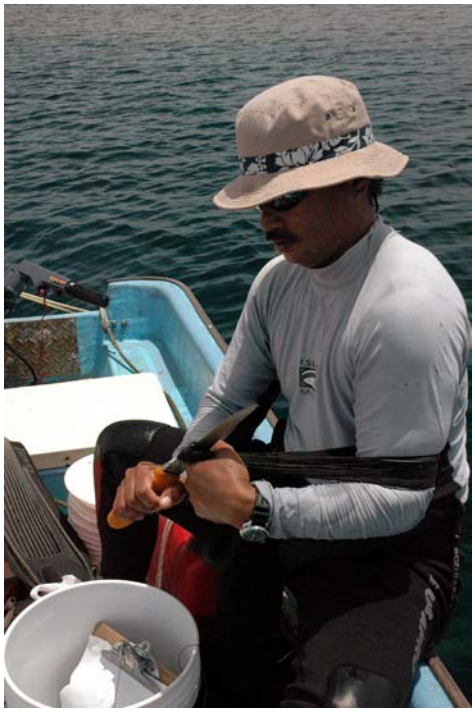

Figure 45. Farmer cutting the coiled stringing line

Figure 46. Farmer holding prepared stringing line

To string the sponge, a sharpened crochet hook or hook shaped wire is used. The hook is pushed through the sponge (Figure 47) and used to catch a piece of the tarred twine (Figure 48).

The twine is then pulled back through the sponge cutting (Figures 49-51). Care must be taken not to squeeze the sponge or hold it too tightly.

Figure 47. Sponge cutting with hook pushed through it

Figure 48. Sponge cutting with hook catching the tarred string

Figure 49. Sponge cutting with hook drawing the string through the cutting

Figure 50. Sponge cutting with string drawn through it

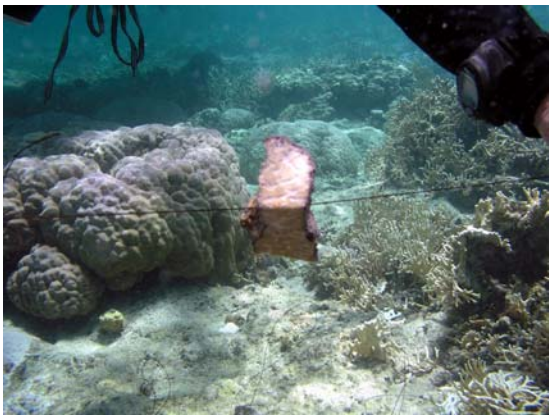

Figure 51. Sponge cutting with string drawn through it

Figure 52. Tying the ends of the tarred twine

Figure 53. Strung sponge cuttings ready for planting

The final step in the stringing process is to tie the two ends of the twine together (Figures 52 and 53). The knot in the twine is moved around until it fits snugly to the sponge cutting.

The farmer then plants the sponge cuttings by attaching them to the growing lines at intervals of 0.5-0.7 m (1.5-2 feet) apart. To do this the sponge is looped through the tarred twine and pulled tight against the growing line (Figures 54-57).

Figure 54. Farmer planting sponge cuttings

Figure 55. Farmer planting sponge cuttings

Figure 56. Farmer planting sponge cuttings

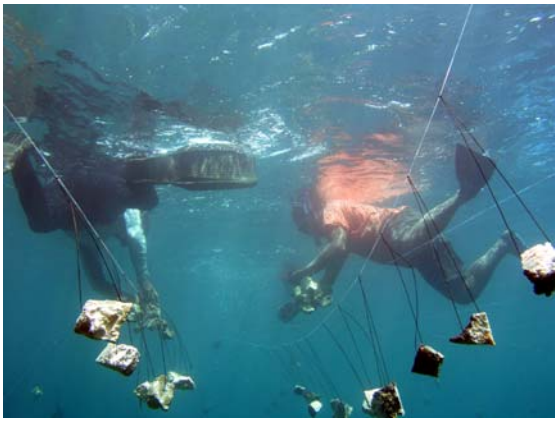

Figure 57. Farmers planting sponge cuttings

7. Grow-out and Maintenance

Freshly cut sponges will have parts of the inside of the broodstock sponge exposed. These areas are white or cream in color (Figure 58). After 1-2 weeks the sponge cuttings will take on a wooly appearance and may even appear to be dead (Figure 59). After this time the new black skin will start to form on the sponge until it is entirely covered with a new skin (Figures 60-62).

Figure 58. Farm with freshly planted cuttings

Figure 59. Sponge cuttings in the healing phase when the new black skin begins to grow

Figure 60. Sponge cutting with new skin forming

Figure 61. Sponge cutting almost completely healed with new skin

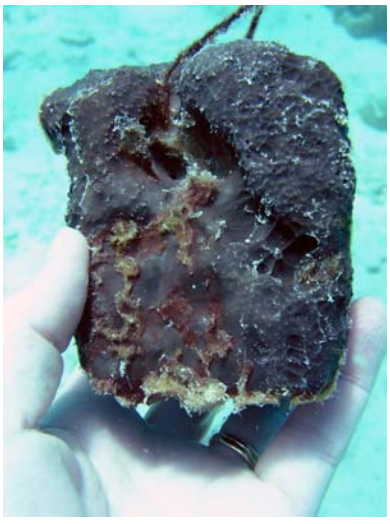

Figure 62. Healed sponge showing square shape that needs to "round out"

Once the new skin is formed the sponge will start growing and will slowly "round out" as it loses its square corners (Figures 63-65). Growth to harvest size of 10-15 cm takes 1.5-3 years depending on the farm site.

Figure 63. Sponge which has taken on a desirable rounded shape

Figure 64. Sponge which has taken on a desirable rounded shape

Figure 65. Sponge which has taken on a desirable rounded shape

At some farm sites, other plants and animals (called biofouling) will grow on the sponges and lines (Figures 66-68). If biofouling is heavy, the sponges will not grow well or will be deformed and must be cleaned by rubbing the sponge by hand. In some cases it is easier to move the farm to a new location than constantly cleaning the sponges at a bad site.

Figure 66. Sponge fouled with hydroids

Figure 67. Sponge fouled with colonial ascidians, half of which have been peeled away.

Figure 68. Farm lines and sponges fouled with colonial ascidians

8. Harvesting

After one and a half years of grow-out, the farmer can begin looking for faster growing sponges to harvest. The farmer swims down the growing lines looking for sponges that have rounded out well and are large enough to be harvested. These are removed from the growing line by cutting the tarred twine (Figures 69 and 70). Sponges are collected in a bag for removal to the processing site (Figure 71). About 25% of sponges harvested should be set aside on growing lines for use as future broodstock for the farm.

Figure 69. Farmers collecting sponges for harvest

Figure 70. Farmers collecting sponges for harvest

Figure 71. Harvested sponges collected in a bag for transport to the processing site

9. Processing and Packaging

After harvest the sponge must be rotted to remove the skin and any other living material from the skeleton. The sponges are left out of the water for at least 2 hours to die (Figure 72). After this, they are placed in a plastic mesh basket which is suspended in between the high and the low tide for 7-14 days (Figures 73 and 74). This allows for agitation of the sponges. The plastic basket should only be one half to two thirds full. After 7 days the sponges are checked every 2 days for readiness (Figure 75). The sponge is ready when it can be squeezed and the skeleton comes back to its original shape immediately (Figure 76). This is an indicator that all the living material in the sponge has been rotted out. Also the sponge should not smell rotten. Each sponge is then rinsed by vigorous squeezing in the water.

Figure 72. Sponges left out of the water to die

Figure 73. Sponges rotting in plastic baskets in the intertidal area

Figure 75. Basket with sponges that have finished rotting

Figure 74. Sponges rotting in plastic baskets in the intertidal area

Figure 76. Cleaned sponges that have finished the rotting process

Figure 77. Domestic washing machine used for washing sponges

Figure 78. Sponges during the washing process

The final step in the cleaning process for the sponges is to put the sponges through a household washing machine for 2-3 wash cycles (Figures 77 and 78). During the first cycle, household laundry detergent is used to wash the sponges. In subsequent cycles, no laundry detergent is used. The sponges are then laid out on a flat, well ventilated surface to dry (Figures 79 and 80). Properly rotted and washed sponges should be light in weight and resume their original shape immediately after squeezing. Sponges that do not do this may have residual organic matter inside the skeleton.

Sponges that are sold with some kind of packaging are worth more than those sold without. Packaging should allow the sponge to be seen and have some kind of descriptive tag or label (Figures 81-83).

Sponges are graded into three categories: Grade A; Grade B; and Rejects. Grade A sponges have a good round shape, no dirt or stain on them and no large holes. Grade B sponges have small stains and/or a slightly irregular shape. Reject sponges have large stains, very irregular shape with large holes in them.

Figure 79. Sponges being dried in a well ventilated area

Figure 80. Sponge packaged in a mesh bag with descriptive tag

Figure 81. Sponge packaged in a mesh bag with descriptive tag

Figure 82. Sponge packaged in an organza bag with descriptive tag

10. Economics of Sponge Farming in Pohnpei

In this section a simple model for producing 5000 saleable, grade A sponges is presented. Data used for calculating costs is based on actual production costs in Pohnpei with growth, survival and production rates from existing farms.

Farming assumptions are as follows:

A. Farm and Production Scenario

1. Target production is 5000 Grade A sponges per year
2. The farm is located close to the farmers house and the farmer tends the farm using a canoe
3. The farmer pays another group to collect sponges for planting
4. The farmer buys enough broodstock sponge material to plant 800-900 cuttings per delivery of broodstock
5. Cutting size is 5-6 cm and target harvest size is minimum 12 cm
6. Planting and grow-out mortality is 15%
7. Time from planting to harvest is an average of 30 months with first harvest taking place at 24 months
8. 25% of planted sponges are set aside as future broodstock
9. 40% of harvested sponges are grade B or rejects, leaving only 60% of harvest as saleable grade A sponges
10. Taking into account the above percentages for mortality, broodstock set aside and harvest loss, 12576 sponges must be planted each year to harvest 5000 grade A sponges.
11. Farmer passes raw, live sponges onto another party for processing.

B. Labor

1. Labor cost is $1.35 per hour, the minimum wage in Pohnpei
2. Cutting and planting time is 1.5 hours per 100 sponges
3. Farm maintenance and cleaning rate is 200 sponges per hour
4. Harvest rate is 50 sponges per hour
5. Farm set up cost is a one time charge of 32 hours
6. Replanting of broodstock sponges rate is 1.5 hours per 100 sponges

The needed equipment and supplies, along with costs, for the farm is listed in Table 1. Taking into account depreciation on equipment and supplies, the total cost per year is $519.45.

Table 1. Capital Costs for Sponge Farm

Equipment	Cost	Depreciation (Years)	Cost per Year
Floats	$30.00	10	$3.00
Knives and Sharpening Stones	$30.00	1	$30.00
White String (per 13000 sponges)	$146.64	3	$48.88
Black String (per 13000 sponges)	$240.32	1	$240.32
1/4 inch line (per 13000 sponges)	$119.60	5	$23.92
Mask, Fin Snorkel (3 sets)	$350.00	3	$116.67
Stringing Needles	$20.00	3	$6.67
Gloves	$20.00	1	$20.00
Canoe	$300.00	10	$30.00
Total	**$1,256.56**		**$519.45**

Table 2. shows the cost of one collecting trip for broodstock amounting to 800-900 cuttings. This is estimated at $148 per trip for an annual cost of $3146. Because cuttings are set aside for future broodstock, this cost only extends until the end of year 2 of production. At this time the farm should be self sustaining.

Table 2. Per Trip Broodstock Collection Cost

A. Boat

Item	Unit	Amount	$/Unit	Cost
Fuel	Gallons	8	$7.00	$56.00
Boat				$20.00
			Total	$76.00

B. Dive Operation

Item	Unit	Amount	$/Unit	Cost
Diver	Man Hours	10	$4.00	$40.00
Scuba Tank Rental	4		$8.00	$32.00
			Total	$72.00
			Grand Total	**$148.00**
			Annual Cost	**$3,146.00**

The farm schedule and production model is shown in Table 3. Over a 5 year time frame, the cost of production per sponge is $0.96 per grade A sponge. If the time frame is reduced to only 3 years, the cost rises to $2.16 per grade A sponge. This is because harvest of sponges does not begin until the 25th month of operation and also because there are substantial broodstock collection costs in the first two years that end by year 3. Once the farm is in full production, the cost drops even further to $0.37 per grade A sponge.

Table 3. Farm Annual Production Schedule and Costs

Year	Duties	Month												Total	Total on Farm
		1	2	3	4	5	6	7	8	9	10	11	12		
One	Planting	838	838	838	838	838	838	838	838	838	838	838	838	10056	
	Harvesting	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Broodstock	210	210	210	210	210	210	210	210	210	210	210	210	2520	12576
Two	Planting	838	838	838	838	838	838	838	838	838	838	838	838	10056	
	Harvesting	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Broodstock	210	210	210	210	210	210	210	210	210	210	210	210	2520	25152
Three	Planting	838	838	838	838	838	838	838	838	838	838	838	838	10056	
	Harvesting	1389	0	1389	0	1389	0	1389	0	1389	0	1389	0	8334	
	Broodstock	210	210	210	210	210	210	210	210	210	210	210	210	2520	29394
Four	Planting	838	838	838	838	838	838	838	838	838	838	838	838	10056	
	Harvesting	1389	0	1389	0	1389	0	1389	0	1389	0	1389	0	8334	
	Broodstock	210	210	210	210	210	210	210	210	210	210	210	210	2520	29394
Five	Planting	838	838	838	838	838	838	838	838	838	838	838	838	10056	
	Harvesting	1389	0	1389	0	1389	0	1389	0	1389	0	1389	0	8334	
	Broodstock	210	210	210	210	210	210	210	210	210	210	210	210	2520	29394

	Labor (Hours)					Total Hours	Wages per hr.	Total Labor	Annual Equip.	Brood Stock	Total Cost
Year	Set Up	Plant	Brood stock	Harvest	Maint.						
One	32.0	150.8	37.8	0.0	251.5	472.2	$1.35	$637	$519	$3,146	$4,303
Two	32.0	150.8	37.8	0.0	503.0	723.7	$1.35	$977	$519	$3,146	$4,642
Three	32.0	150.8	37.8	167.0	587.9	975.5	$1.35	$1,317	$519	$0	$1,836
Four	32.0	150.8	37.8	167.0	587.9	975.5	$1.35	$1,317	$519	$0	$1,836
Five	32.0	150.8	37.8	167.0	587.9	975.5	$1.35	$1,317	$519	$0	$1,836