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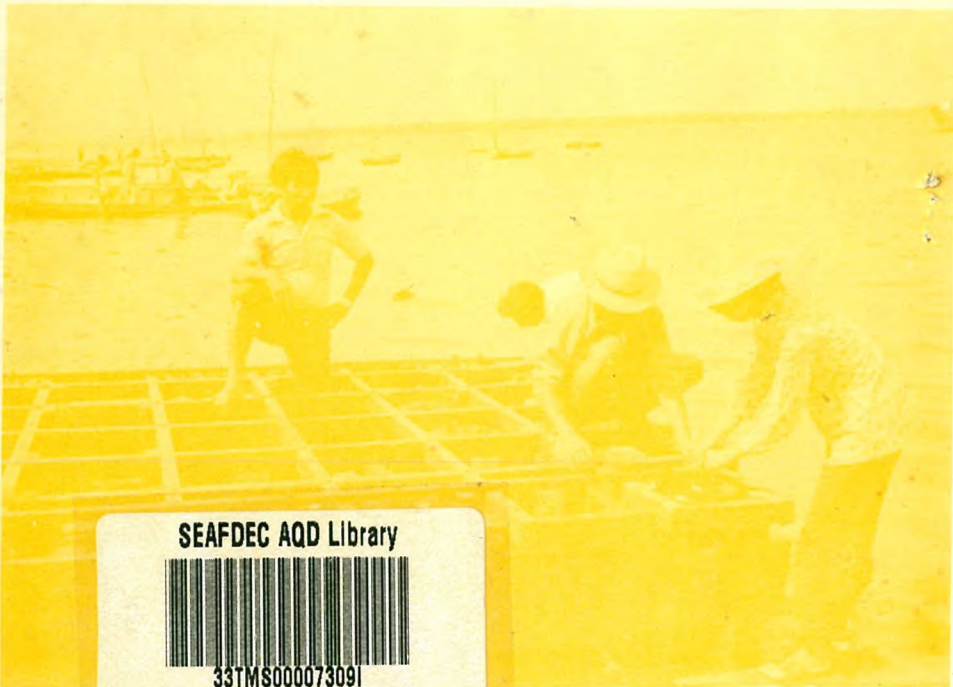



Southeast Asian Fisheries Development Center
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SAFIS Extension Manual Series No. 3, 1983

MUSSEL CULTURE



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by
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SAFIS Manual No.3

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The Secretariat

Southeast Asian Fisheries Development Center

June 1983

The present text is a translation of the Malay text entitled, "Menternak Siput Sudu/ Kupang" by P.S. Choo, published by the Department of Fisheries, Ministry of Agriculture, Malaysia (Bahagian Perikanan, Risalah Perikanan Bil. 13, 1979).

Cover: A raft used for the suspension of rope collectors for the culture of mussels.

MUSSEL CULTURE

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INTRODUCTION

Compared to the culture of other molluscs such as oysters, the culture of mussels has a more recent history. It is believed to have started in 1235 when a sailor was shipwrecked near the port of Esnodes in France. In his search for food, he constructed a large net suspended from two poles driven into the substratum of the sea in an attempt to catch sea birds, but instead discovered that mussels got encrusted on the poles. With this discovery, the beginning of mussel culture came into being.

Mussels are found throughout the world. The species found in Southeast Asia is *Perna viridis* Linnaeus (syn. *P. smaragdinus*).

The sexes in mussels are separate. In Malaysia, spawning takes place the whole year round with one or more peak periods in a year. For example in the Straits of Johore, spatfalls have been found to occur throughout the year with peaks from February to May and October to November in the east, and from June to August in the west of the Straits.

In Southeast Asia mussels are cultured extensively in the Philippines and Thailand. In Singapore and Malaysia trials have been carried out only on a small scale. These trials have, however, shown promising results, and it is hoped that these results will generate interest in the possible development of large-scale mussel culture in the country.

CULTURE OPERATIONS

The culture of mussels involves the following two major operational phases:-

1. Collection of seed
2. Growing for market

1) Collection of seed

Before seed mussels can be collected, a suitable site for collection must be selected. A good site will be one where natural mussels are found in abundance, for example in the Straits of Johore.

Seed mussels can be collected for cultivation by using various kinds of collectors (materials used for catching spat). Collection of spat can be done by driving wooden or bamboo poles of 10 to 20 cm in diameter into the substratum of the sea, and mussel spat will settle on the poles (Photo 1). Collection can also be done by suspending collectors from some fixed horizontal frames (Photo 2) or from rafts (Photo 3).

Collectors commonly suspended are various kinds of ropes, such as coconut coir, polypropylene and polyethylene ropes, which are 20 to 40 mm in diameter.

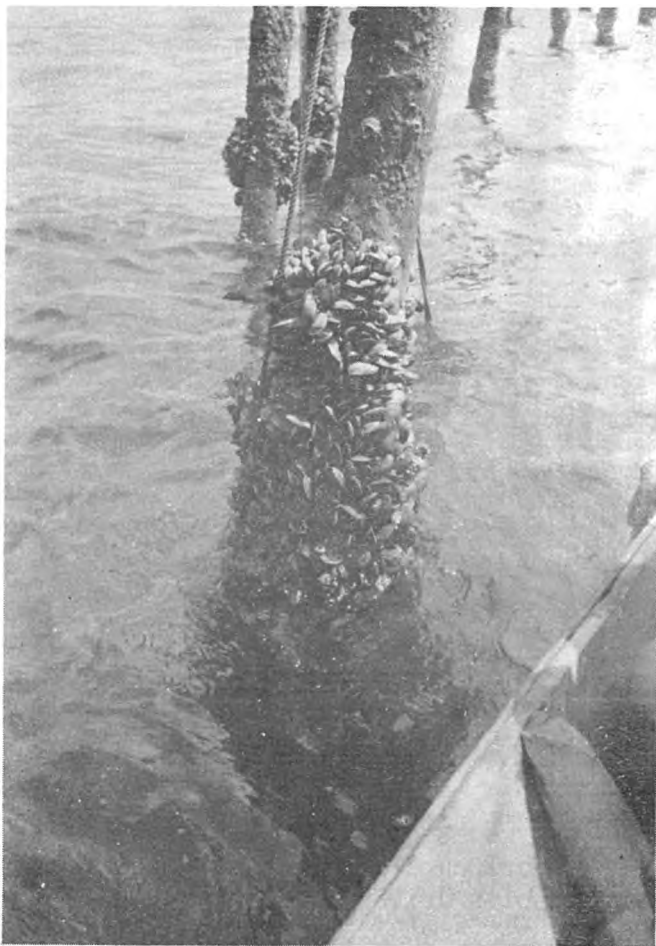


Photo 1. Mussels attached to poles driven into the seabed.

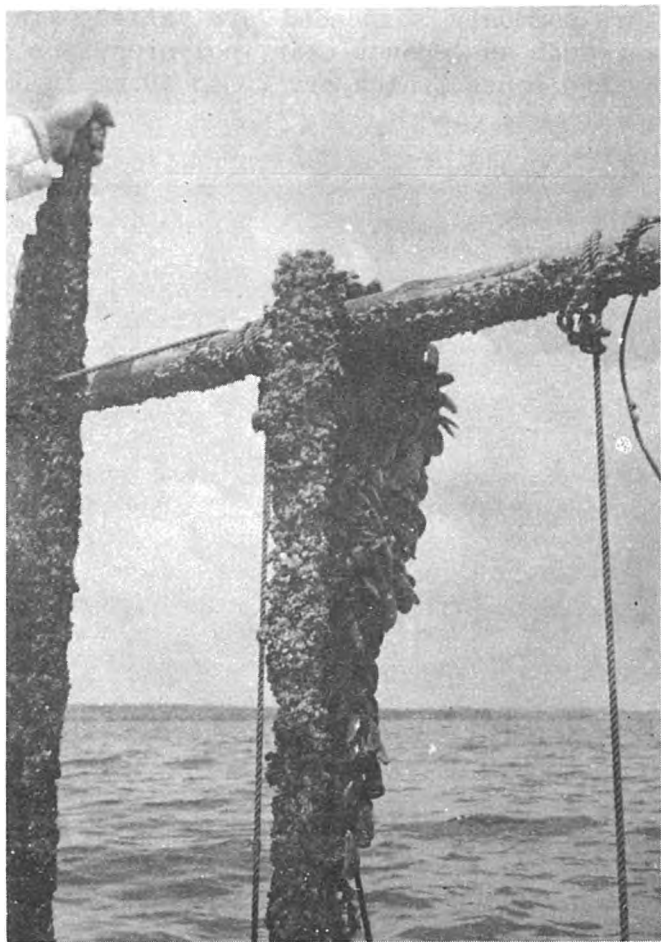
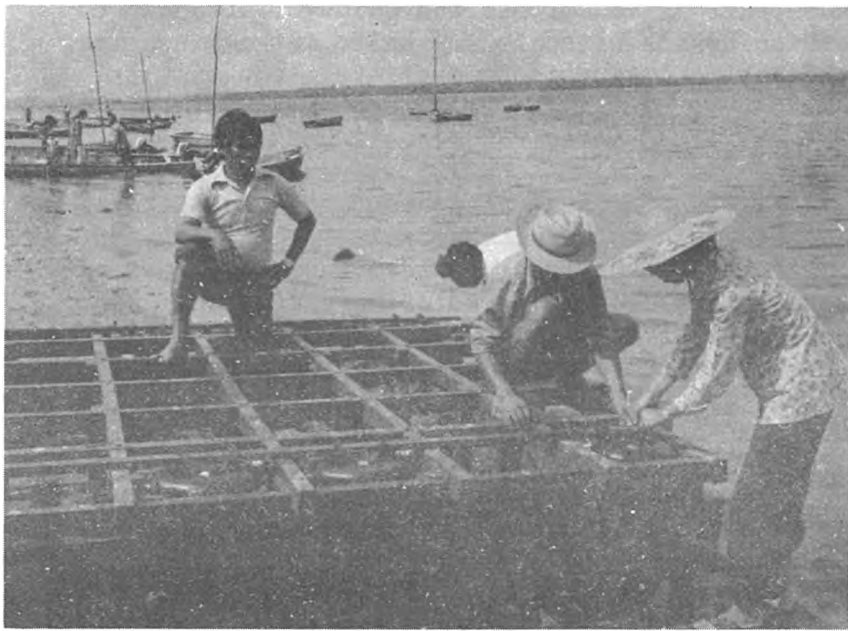


Photo 2, A rope collector suspended from a horizontal frame tied to vertical poles driven into the seabed.

Photo 3. A raft used for the suspension of rope collectors.



Mussel spat will usually settle on the collectors two or three months after they are put into the sea. The collectors need a period of seasoning, and mussel spat are attracted to the collectors after these have been covered with barnacles and hydroids.

If the collectors catch a great number of mussel spat, the spat (about 20 to 30 mm in size) are transferred to other ropes in order to prevent overcrowding, which may lead to poor growth rates and the detachment of whole clusters of mussels from the collectors. Inspection of collectors must therefore be carried out frequently to decide whether the spat need to be thinned. Detachment

of mussels from the collectors must be done carefully. The best way of detaching mussels from a substrate is to cut off the point of attachment of the byssus with a sharp knife without causing the entire byssus to come off from the mussels.

2) Growing for market

The spat attached to the collectors can be grown to marketable size (5-6 cm) on the collectors themselves provided the collectors are not overcrowded with spat. The excess spat can be removed from overcrowded collectors and made to reattach to other ropes. They can be transferred to nylon or cotton netting, into which a rope has been inserted. The spat in the netting are then again suspended in the sea. After two or three weeks the spat will grow out of the netting and will already be attached to the new rope collector.

The mussel spat caught on rope collectors can then be grown to marketable size in the following ways:-

- (a) by suspending collectors from rafts
- (b) by suspending collectors from fixed horizontal frames
- (c) by wrapping rope collectors around poles driven into the substratum of the sea
- (d) by scattering seed mussels on the sea bottom.

(a) From rafts

Rafts are normally used in sheltered waters not less than 3 to 4 metres deep at low-water spring tides. Oil drums coated with tar or jerry cans can be used as floats for the rafts. About 3 to 5 ropes of mussel spat can be hung from every square metre of raft. The ropes should be about one metre above the sea bottom to prevent silting and to prevent bottom predators from climbing up the ropes. The main advantage of floating cultures is that the mussels are submerged all the time and are able to filter-feed the whole day long. Mussels from floating cultures are also free of bottom predators such as starfish.

(b) From fixed horizontal frames

Fixed suspended cultures are normally practised in shallow waters with a small tidal range. Fixed frames can be made by driving wooden supports into the substratum of the sea and fixing poles, horizontally between the supports, for hanging the ropes.

(c) Poles driven into the substratum of the sea

The spat transferred to new ropes can be wrapped around bamboo or wooden poles driven into the substratum of the sea, on which the mussels will attach themselves and are allowed to grow.

(d) On the sea bottom

One other method by which mussels can be grown is by scattering seed mussels

(which need not be attached to ropes) on the sea bottom, which must not be too soft and silty, and where strong currents are absent. If the seed mussels are about 10 to 20 mm in size, about 300 tons of seed can be planted per one acre of ground.

One advantage of bottom culture is that a high degree of mechanization (e.g., using a dredge for harvesting) is possible. One disadvantage is that the mussels growing on the bottom are exposed to bottom-living predators, for example starfish.

HARVESTING

Seed mussels of about 2 cm require five to six months to grow to a marketable size of 5 to 7 cm. There is no fixed period of the year for harvesting, and mussels can be marketed the whole year round.

COST AND PRODUCTION ESTIMATES

In Malaysia there is no commercial venture in mussel culture at the moment. To provide some idea of the amount of profit which could be expected from such a venture, the expenditure and gross return of a mussel farm in the Philippines, as reported by Tortell and Yap (1976), are given below.

Cost and production estimates of a one-hectare mussel farm
(bamboo stake method) in Bacoor Bay, Philippines

<u>CAPITAL INVESTMENT</u>	<u>Pesos</u>	<u>M\$ (1 peso = 34¢)</u>
Boat	3650	1241
Underwater breathing apparatus	2190	744.60
Municipal lease fee	<u>510</u>	<u>173.40</u>
Total	6350	2159.00
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OPERATING EXPENSES

(five-month season)

	<u>Short Stakes</u>		<u>Long Stakes</u>	
	<u>Pesos</u>	<u>M\$</u>	<u>Pesos</u>	<u>M\$</u>
Bamboo plus installation	10,585	3,598.90	25,550	8,687.00
Boat maintenance and expenses	2,920	992.80	2,920	992.80
Labourers	2,920	992.80	2,920	992.80
Interest on loan (10%)	<u>2,260</u>	<u>768.40</u>	<u>3,870</u>	<u>1,315.80</u>
	18,685	6,352.90	35,260	11,988.40
Total expenses for first season	<u>25,035</u>	<u>8,511.90</u>	<u>41,610</u>	<u>14,147.40</u>

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PRODUCTION

	<u>Short Stakes</u>	<u>Long Stakes</u>
Yield (total weight in kg)	150,000	400,000
Gross return	<u>219,000 pesos</u>	<u>584,000 pesos</u>
	<u>M\$ 74,460</u>	<u>M\$ 198,560</u>

ENEMIES OF MUSSELS

The enemies of mussels include predators like starfish and crabs. Starfish predation can be controlled by destroying them or avoiding them, e.g., by raft culture. Starfish can be removed during low tide with a rod which has a barb attached to one end. On deeper grounds, they can be removed by mopping with starfish mops, which are made of the same material as floor mops.

Mussels are most vulnerable to attack by crabs when small (about 20-30 mm in size). Ways and means of controlling crab predation are still being developed, and methods such as poisoning and building barriers are being tried.

Barnacles, tube-worms and sponges compete with mussels for space and food. They also settle on the shells of mussels, making handling more difficult, and their appearance less attractive to the buyer. Barnacles, however, also serve a useful purpose. A settlement of barnacles on collectors normally attracts a settlement of mussel spat, which grow between the crevices formed by the barnacles.

One of the most serious parasites of the mussels in the European cultures is the copepod, *Mytilicola intestinalis*. Heavy infestation with copepod causes poor flesh condition and also mortality. This disease can wipe out the culture from an area unless all the infected mussels are removed from the stricken area.

PUBLIC HEALTH

Two of the possible health hazards of mussels are bacteria contamination and phytoplankton toxicity tied up with the phenomenon known as "red tides". Bacteria contamination is common in molluscs, which may pick up the pathogenic bacteria from sewage polluted waters. The bacteria in the mussels can be killed by boiling the mussels for two or three minutes. If polluted mussels are to be marketed live, the bacteria can be removed by keeping the mussels in bacteriologically clean seawater for two to four days. The bacteria in polluted mussels can also be removed by keeping the mussels in sterilized water for two days. Sterilized water can be produced by means of an ultraviolet sterilizer unit, an ozonator or by chlorination.

The phenomenon of "red tides" caused mainly by dinoflagellate blooms has been reported in temperate countries and, in 1976, for the first time in Southeast Asia, off the coast of Brunei. However, no known incidence of harmful effects from eating mussels has been reported from Malaysia, Singapore, the Philippines and Thailand. It can be concluded that eating mussels is as safe as eating cockles and other shellfish.

UTILIZATION OF MUSSELS

Mussels can be prepared in a number of ways. They can be cooked in curry or mixed with noodles (fried or cooked in soup), and fresh or dried mussels can also be used to give added flavour to soup. They are also used as an animal feed. In Singapore they are used as a pig feed and in Thailand as a duck feed.

STATUS OF MUSSEL CULTURE IN MALAYSIA

Mussel culture in Malaysia has been carried out on an experimental scale in several areas in Penang, Lumut, Perak and in the Straits of Johore. Spatfall in Penang and Lumut appears to be scarce.

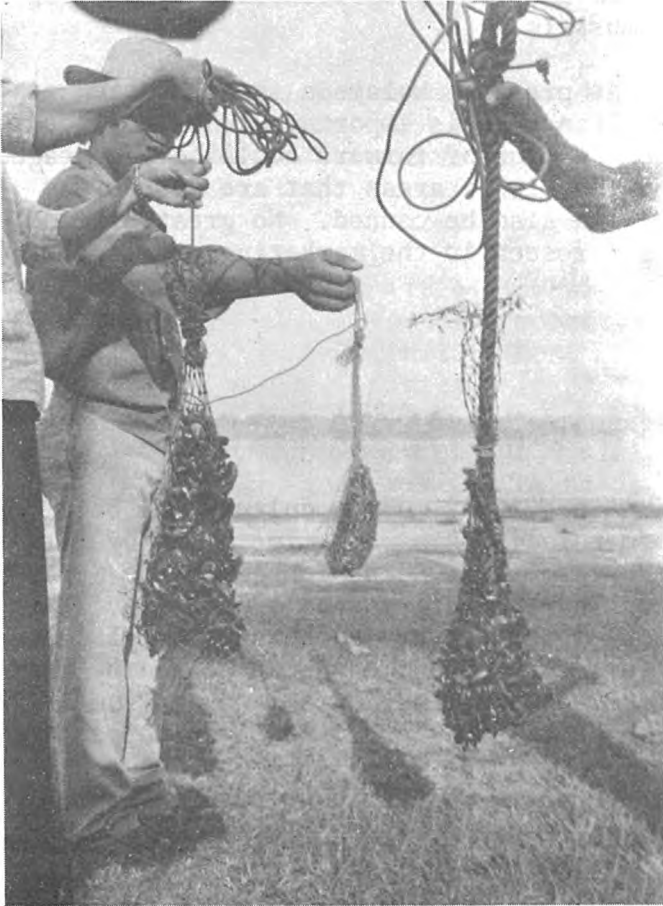
In Selat Tebrau, Johore, various culture methods were used. The rope collectors were mainly suspended from rafts (Photo 3), and from horizontal frames tied to vertical poles driven into the seabed (Photo 2). Poles were also driven into the seabed for collecting and growing mussels (Photo 1). Collection of spat was done all the year round in Selat Tebrau using ropes made of sisal, coconut coir, polyethylene and polypropylene. Collectors such as corrugated asbestos (Photo 4) and coconut husks strung to ropes were also used. Transfer-ring of spat was carried out only when the spat density exceeded 800 - 1000 spat per metre of rope collector. The excess spat were transferred into net bags to be reattached to new ropes (Photo 5). The mussel spat grow very fast.

Within a period of four to six months they can grow to a marketable size of 5 to 6 cm.



Photo 4. Mussels collected on corrugated asbestos strung on ropes.

Photo 5. Transfer of excess spat into net bags to be reattached to new ropes.



Some Malaysians believe that mussels can "weaken" a person if they are consumed in large quantities. It has, however, been reported that mussels are among the most nutritious shellfish, and analysis has shown that Spanish mussels contain 13% protein whereas oysters normally contain 1 to 5% protein (Bardach et al. 1972).

The food value of mussels should therefore be publicised and more people should be encouraged to eat mussels.

At present, Malaysia imports dried mussels from Thailand. This import could be replaced by local production of farmers could be encouraged to culture mussels in areas that are suitable. Mussels can also be canned. No great difficulty is thus foreseen in the marketing of mussels grown locally.

ANNEX

Since 1980, mussel culture has been carried out commercially on a part-time basis by fishermen and fish farmers at Selat Tebrau in the Straits of Johore using the raft method of culture. This was a follow-up to the very successful trial culture of mussels carried out at Selat Tebrau by the Fisheries Research Institute, Penang from 1977-1979 (Choo, 1979), where it was estimated that production from the trial site was about 315 tonnes/hectare/annum of unshelled mussels.

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SAFIS is the Southeast Asian Fisheries Information Service. It is a project of the SEAFDEC Secretariat set up to provide extension materials for small - scale fishermen and fish farmers in the region. For additional information, contact the Project Leader of SAFIS at the SEAFDEC Liaison Office

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