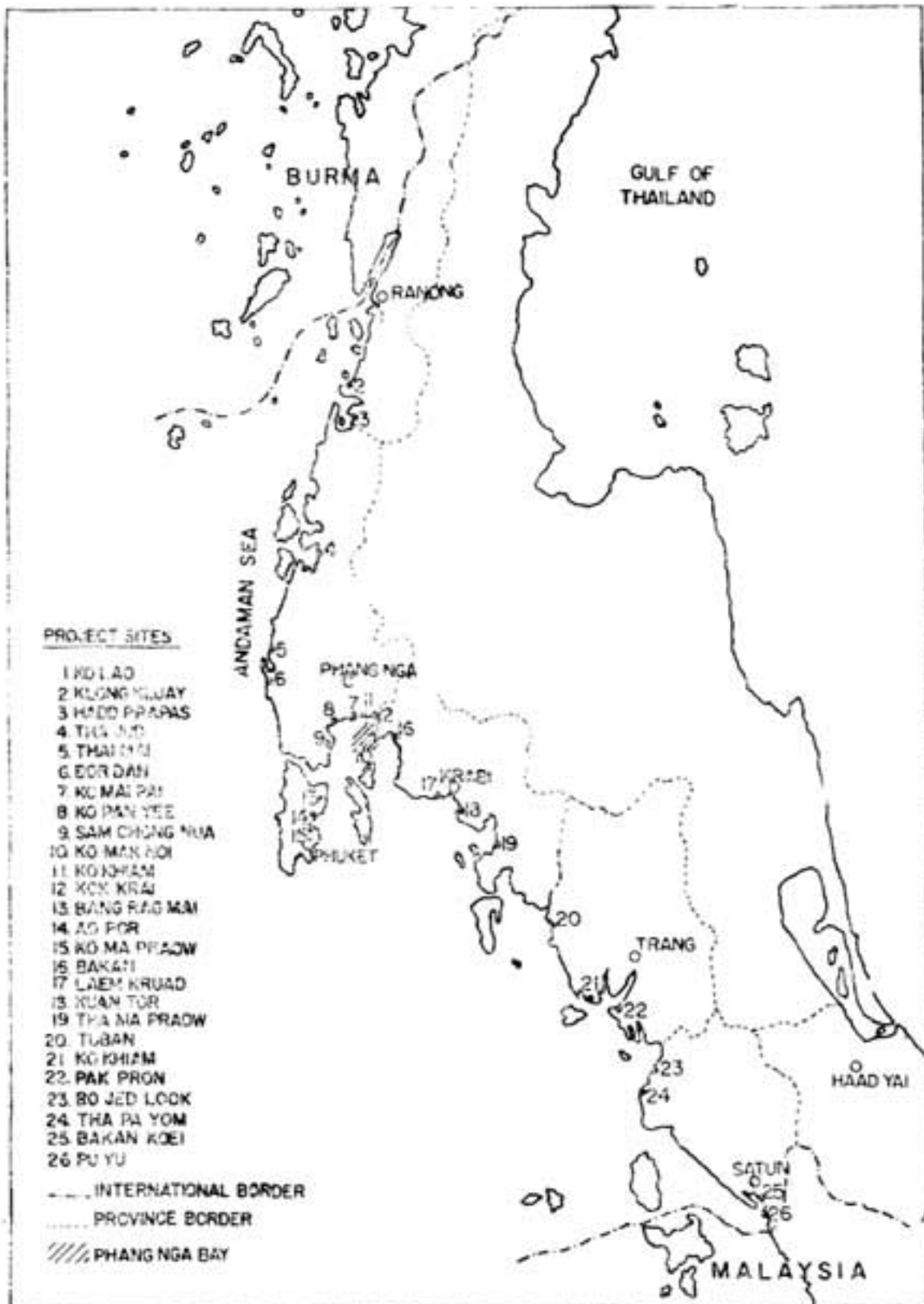


Appendix 1

LOCATION OF PROJECT SITES



Appendix 2

ORGANIZATIONAL STRUCTURE OF THE PROJECT

During the first phase of the project, technical support was provided by the South China Sea Programme which also undertook responsibility for the disbursement of external funds provided by BOBP. During the next three phases, these arrangements were discontinued and local expenditure of externally provided funds for the project were handled directly by BOBP through a FAO sub-imprest maintained in Phuket. In addition to intermittent visits by BOBP headquarters staff to assist in planning and monitoring, BOBP also provided the services of a full-time Project Officer whose function was to assist the Project Director and the Team Leaders in the administrative aspects of the implementation of the project.

Throughout the life of the project, the Director of the Brackishwater Fisheries Division, Department of Fisheries, functioned as the Project Director.

A staff member of the Phuket Brackishwater Fisheries Station functioned as the Team Leader of the project during the first phase. The Phang Nga activities of the project were also under his charge during the second phase. The project activities in Satun during the second phase were placed under the part-time charge of the Chief of the Satun Brackishwater Fisheries Station.

During the third phase of the project, activities in Phang Nga and Krabi provinces were placed under the part-time charge of the Chief of the Phuket Brackishwater Fisheries Station and those in Satun and Trang provinces under the part-time charge of the Chief of the Satun Brackishwater Fisheries Station.

During the fourth phase of the project, activities in Satun, Trang and Krabi provinces were placed under the charge of the Chief, Satun Brackishwater Fisheries Station and the activities in Phang Nga, Phuket and Ranong provinces under the charge of the Chief, Phuket Brackishwater Fisheries Station.

The team leaders were assisted by biologists, technicians and administrative and support personnel assigned to the project on a full-time basis by the Department of Fisheries. In addition, the Department provided the services of professional specialists, when required, on a short-term basis. Liaison between the Department and BOBP, mainly in matters pertaining to policy, was provided by the Fishery Economics Section of the Department.

During the first and second phases, there was collaboration between the team leader of the Phang Nga unit and the Phang Nga provincial government through the Provincial Fisheries Officer, Phang Nga. In the third and fourth phases, the Provincial Fisheries Officers and District Fisheries Officers were actively involved in the implementation of project activities in their respective provinces.

Appendix 3

MAJOR FEATURES OF DEMONSTRATED AQUACULTURE TECHNIQUES

1 Cage culture of finfish

A *floating cage* is one of many types of enclosures which can be used to contain fish. Several features make it attractive. The initial investment for small flexible cages is relatively limited. They make productive use of existing water bodies, in this case the rivers along which the villages are built. The cages are therefore readily accessible, and guarding against predators is not much of a problem. The fishing community can provide many of the inputs needed (labour, boats, feed and to a certain extent the seed) without disturbing its normal activities.

The *raft* from which the synthetic netting is suspended is usually made of locally cut mangrove poles or wooden planks, or in more exposed sites, of galvanized pipes. Polystyrene blocks or sometimes plastic containers ensure the buoyancy. The principal lay out of a raft is given in Fig. 1.

The poles or planks are usually nested in rows parallel to the shore. Collapsing of the netting material, which would result in crowding the fish, is prevented by weighting the corners with stones. A typical grow-out cage is 3 x 3 x 2.5 m (Fig. 2) with PE webbing of 40 mm mesh size. The largest cages used were 5 x 5 x 2 m. For nursing of fry the cages were 1 x 2 x 1 m with a mesh size of 4 mm. An intermediate cage of 1 x 2 x 1.5 m was used for nursing and rearing of fingerlings.

The fish species selected for culture were seabass (*Lates calcarifer*) and grouper (*Epinephelus tauvina*), both fetching high prices on the market. Grouper is the more valuable but seabass seed is more readily obtained because it is hatchery-produced at the Phuket and Satul Brackish-water Fisheries Stations and also at private hatcheries. Nursing of the seabass fry is done in cages by the fish culturist.

In general, the marketability during the nursing period was very high and efforts were made to train the farmers and to establish specialized nursery farmers. Grouper fingerlings are mostly caught from the wild in traps (60 x 30 x 30 cm) made of wood and chicken wire. The fish trapped weigh 100 to 300 g. They are caught all around the year but March-April is the peak season. At that time 150 fishes can be caught per trap and month. Because of their size no nursing is required. They are immediately stocked in grow-out cages and the survival rate is very high (80 - 100%).

The stocking density for both seabass and grouper is about 300 fishes in a standard cage of 3 x 3 x 2 m.

The production can be expected to amount to about 150 kg per cage. Groupers of 100 - 300 g grow in 5 to 8 months to 500 - 800 g. Seabass requires about 12 months to grow from a 3 g fry to a marketable size of 600 - 800 g.

The table below summarizes the stocking and harvest ranges for grouper and seabass.

Species	Initial stocking		Rearing period (months)	Harvest (kg/m ³)	Size of fish	
	fish/m ³	kg/m ³			Initial (g)	Harvest (g)
Seabass	1.5-25.6	0.01-0.1	± 12	1.5-10.8	4 - 6	490-1670
Grouper	2.2-13.1	0.4 -3.6	5-8	2.1- 8.1	160-210	350-950

Please note the following corrections:

Page 32: Appendix 3, para 3 line 1 -- Please read 'cages' for 'poles or planks'... The first line should read: The cages are usually nested in rows parallel to the shore.

Para 5, first line and second line: Please read 'mortality for marketability' and nursery 'farms' for farmers. The lines should read : In general, the mortality during the nursing period was very high and efforts were made to train the farmers and to establish specialized nursery farm.

Page 36: Para 3, 2nd line. Please read 'sown' for 'grown'. The line should read: Cockle seed, 1000 - 3000 cockles/kg is sown at a rate of about 1 t/rai (6t/ha)

1.8.1986

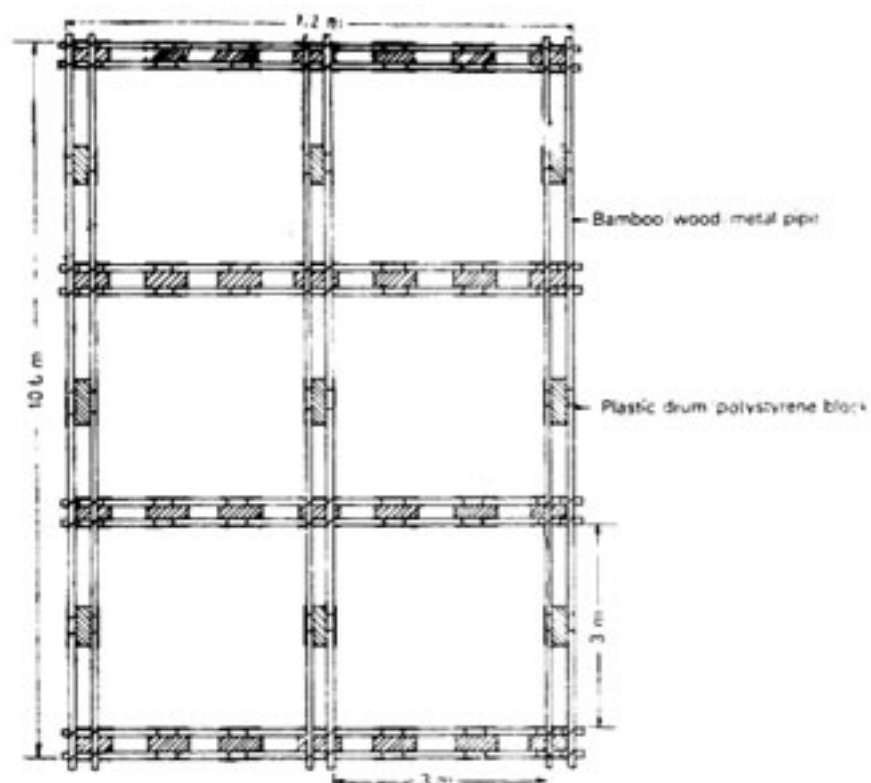


Fig. 1 GENERAL LAYOUT OF A RAFT FOR SIX CAGES

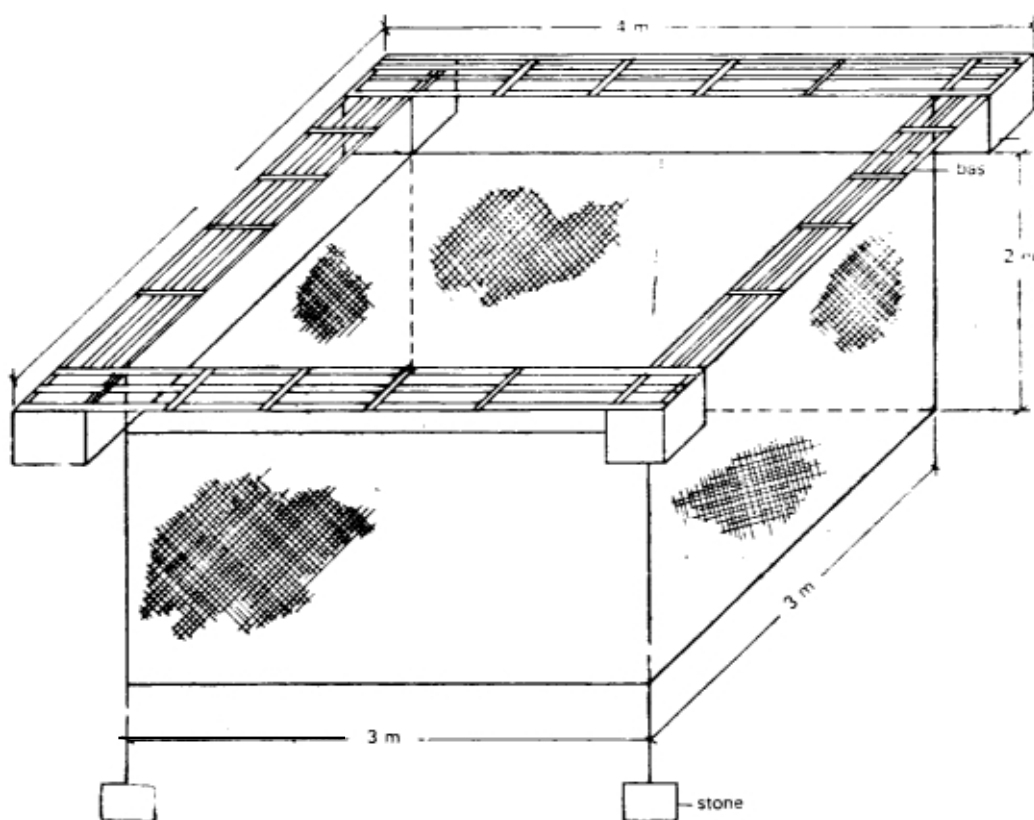


Fig. 2. CAGE OUTLAY (3 x 3 x 2 m) INSIDE RAFT OF 4 x 4 m

Appendix 3 (contd.)

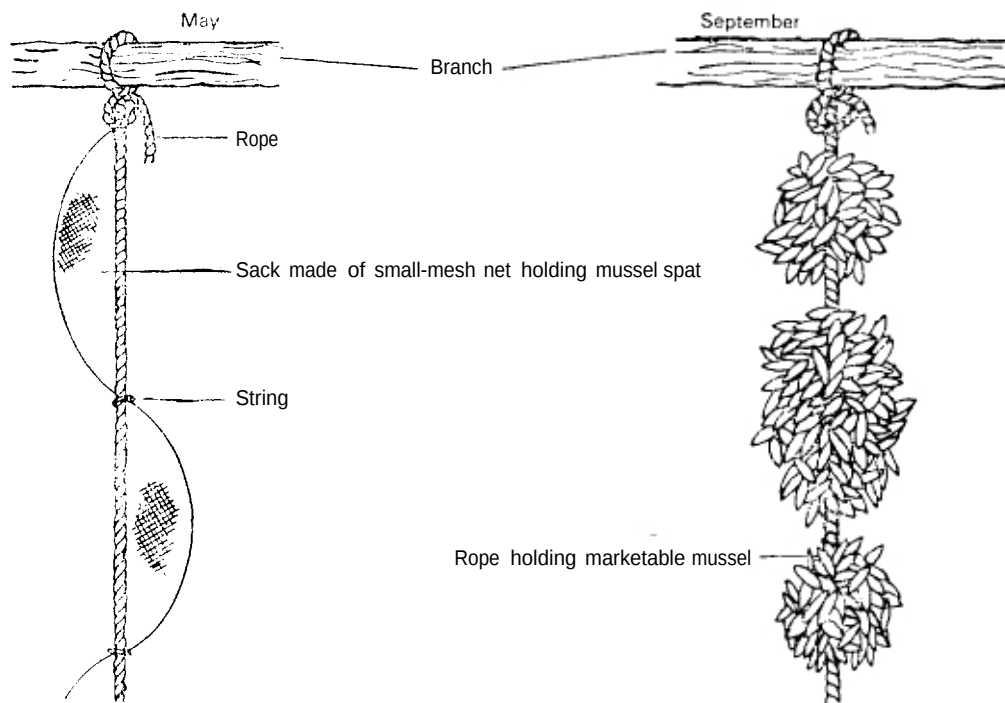
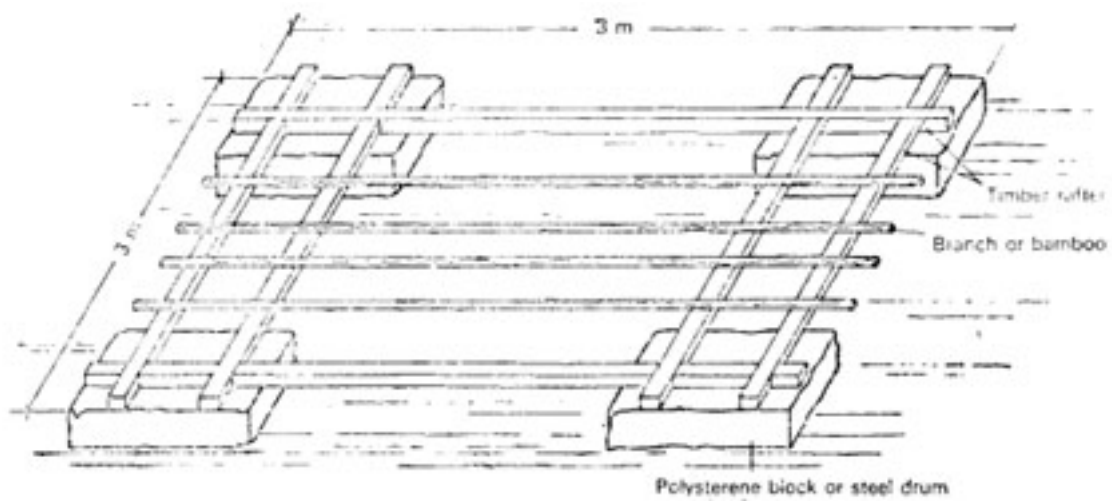


Fig. 3 RAFT METHOD OF CULTURING GREEN MUSSEL
Mytilus smaragdinus

Appendix 3 (contd.)

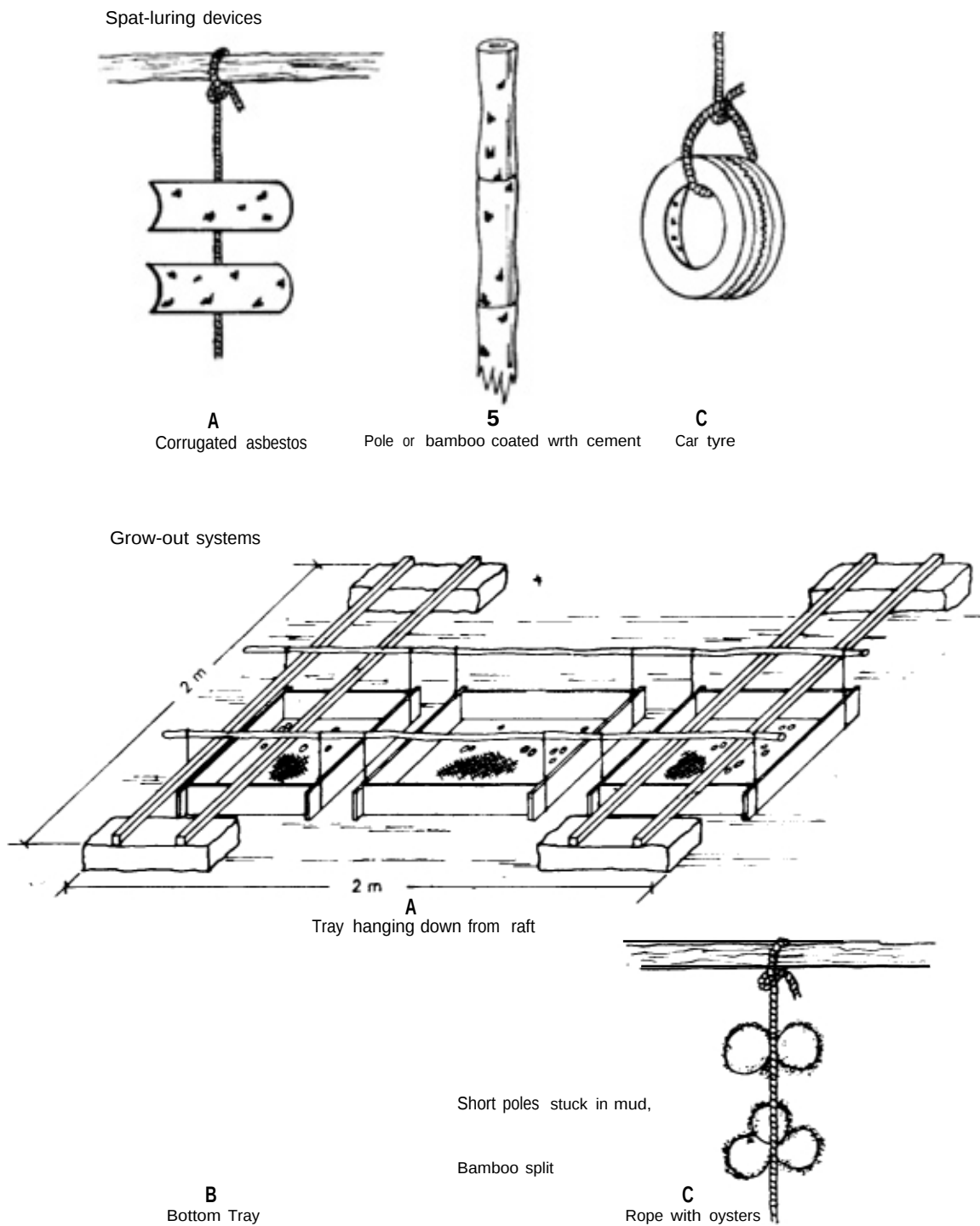


Fig. 4 SPAT-LURING DEVICES & GROW OUT SYSTEMS FOR OYSTERS

The fish are given supplementary feed daily during the entire culture period. It consists of chopped trash fish which at each time is given until satiation. The feed conversion ratio is in the range of 6-10 i.e., to produce 1 kg of fish, 6-10 kg of trash fish is required. The groupers are at the *lower* end of the range and the seabass at the upper end.

2 Shellfish culture

The culture of shellfish differs from fish culture mainly in one aspect, i.e. feeding. There's no feed administered by the aquaculturist. Mussel, oyster and cockles feed on algae filtered from the water. These algae are converted into high quality animal protein.

Cockle culture

Culture of cockles (mainly *Anadara granosa*) is carried out on leased mud flats. Cockle seed, 1000-3000 cockles/kg, is grown at a rate of about 1 t/rai (6t/ha). Harvest starts 12 months later. Production is up from 3-t/rai (18-t/ha) depending on the site, management and extent of poaching. Cockles are filter-feeders and therefore do not need to be fed during culture. Management is limited to predator control and thinning if too high densities are recorded.

A major limitation on the expansion of cockle culture is the seed supply. *Anadara granosa* is not native to Thailand. Seed had to be imported from Malaysia. The export of cockle spats from Malaysia has however recently been banned.

Raft culture of mussel and oysters

Rafts are floating structures from which ropes or collectors on which the shellfish grow, are hung (See Fig 3 and Fig. 4). Species cultured are the green mussel (*Perna viridis*) and oysters (mainly *Crassostrea Lugubris*). Green mussel culture depends on spat supply from the east coast. A variety of collectors (old tyres, corrugated asbestos) are used to lure oyster spat.

Mussels are cultured to market size (8 - 10 cm) in 5 - 8 months. Oysters take a longer time (12 - 14 months) to reach 10 - 12 cm. Rafts are not the only method to culture these shellfish. Mussels can be reared on poles. Oysters can be cultured on the sea bottom, on platforms or in trays. A problem with these methods is that predators which crawl on the bottom, such as starfish, have access to the shellfish. This is avoided by the use of rafts.

Appendix 4

FURTHER DETAILS OF FISH PROCESSING TECHNIQUES DEMONSTRATED BY THE PROJECT

1. Shrimp paste production

Shrimp paste production has been undertaken by fisher-folk in the project area for ages. Long ago, the paste used to be produced mainly for household consumption. The demand for shrimp paste in towns and cities has changed this situation. Shrimp paste production is controlled by fisherwomen. Some are professional shrimp paste makers, others make it only for use at home. The professional producers buy the raw material — Ascetes -from fishermen in their villages. As the Ascetes catch is seasonal and peaks during the rainy season, the producers often face problems in drying Ascetes.

The Ascetes is mixed in a jar with salt (for preservation) and sugar (for fermentation) and then sun-dried for one to two days. It is then pounded into a fine paste and dried for another five to 10 days depending on the weather. On rainy days the paste is kept to ferment overnight in bamboo baskets lined with plastic sheets. During sunny days the mixture is spread out on bamboo mats on the jetties or on the verandah floors (see photograph on page 9). It is finally packed into 50 kg bags and sold to merchants who get it repacked into one kg bags and labelled for sale in nearby towns.

The investment costs (for stone grinders/pounders, bamboo baskets, earthen jars, plastic bags) are negligible when compared to the gross profit.

The raw material cost for 1 kg of shrimp paste is about Baht 8.20 and the product is sold for Baht 25 per kg.

Some professional producers make about 500 kg of shrimp paste per month. The labour requirements for this can be met with female labour (two persons).

The project tried to introduce the following new production techniques:¹

- the use of honey in addition to or instead of sugar
- better cleaning of the Ascetes
- replacement of stone grinders by manual hand grinders
- extended fermentation period from 12 days to four months

These techniques increased the production costs which could not be compensated by higher market prices. As a result, the new production techniques were not adopted by professional shrimp paste producers. However the trainees sold some paste in an annual local fair. The limited impact of the training course on new techniques of production may have also been due to the fact that only young girls and not professional paste makers were trained.

2. Processing of other new fish products

The demonstration/training course on “some simple methods of making fish sausages, smoked fish, shrimp biscuits and crackers and fish sauce”² was intended to provide the basis for diversified and improved income earning opportunities.

¹ R. Pruthiarenun, Report of three workshops held to improve quality of locally produced shrimp paste. FAO/SCSP Working Paper 7, Manila, 1980.

² S. Ithipongs, Report of a village level post harvest fisheries technology training/ demonstration course, FAO/SCSP Working Paper 5, Manila, 1980.

The training course was conducted by a group of officers from the Technology Development Division of the Department of Fisheries. Training equipment provided by the project, such as food grinders, mixers, slicers, smoke ovens etc., were left with the trainees for later use.

The trainees (young girls from several pilot villages) were expected to take up production and marketing of the products by themselves after the three-day training course. However this did not prove to be feasible. Although the trainees were able to sell certain products at annual fairs, they could not do so on a regular basis.

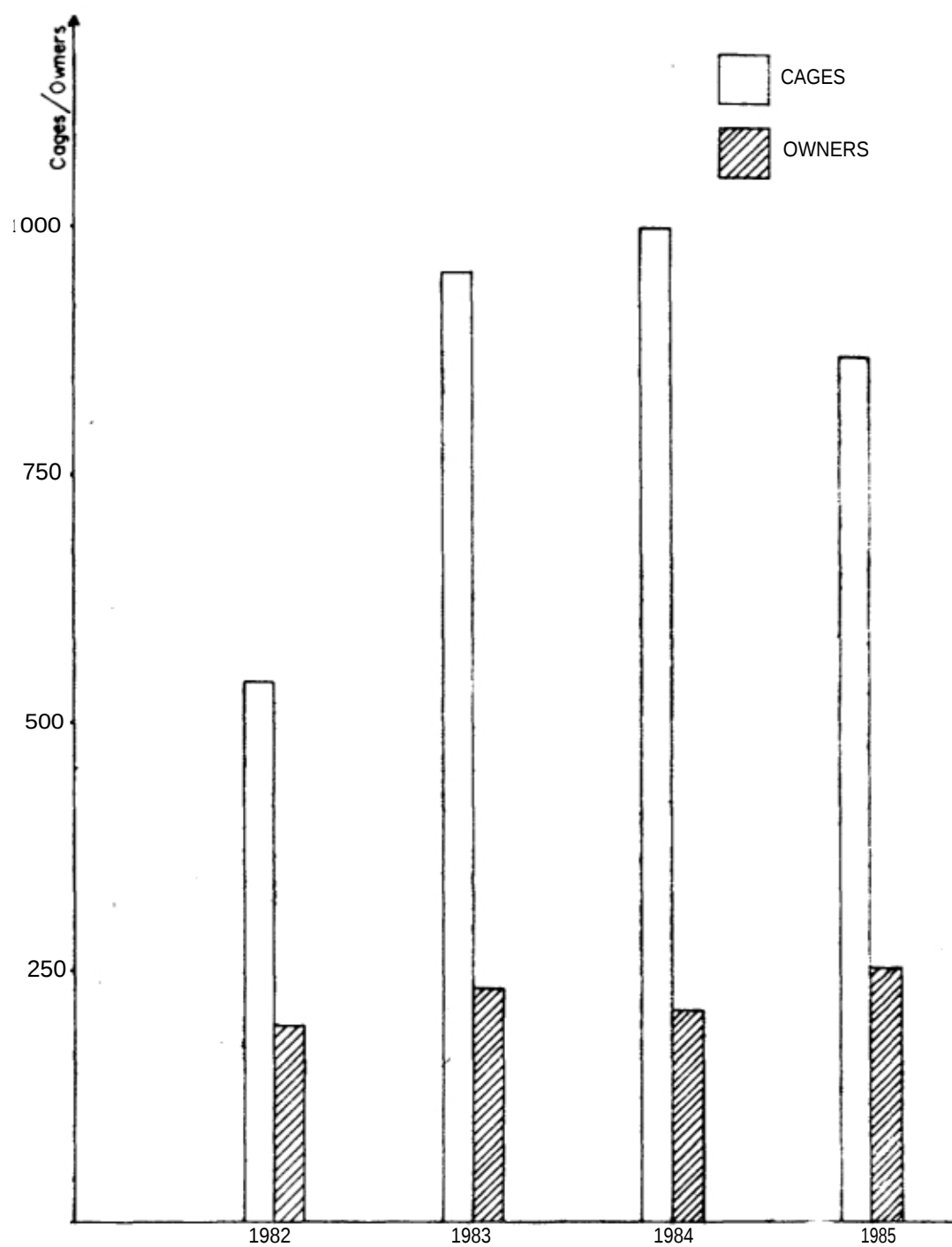
Appendix 5

COSTS AND EARNINGS OF ONE FISH CAGE

I. Investment costs	<i>Baht</i>
8 kg netting materials	700
3 polystyrene floats -second hand	450
6 wooden poles	120
Ropes	250
Labour	160
Sub-total	<u>1680</u>
II. Operating costs	
(a) 200 fingerlings (groupers) at the rate of B 15 per seed	3000
(b) 1200 kg of feed at the rate of B 2.50/kg	3000
Sub-total	<u>6000</u>
III. Fixed costs	
(3-year lifespan of investment materials)	
(a) Depreciation	560
(b) Interest (equalized over 3 years) of 14% on investment capital	156
Sub-total	<u>716</u>
IV. Total annual costs (II+III)	6716
V. Total annual gross earnings : 160 fish x 0.6 kg x 85 Baht	8160
VI. Annual earnings of operator per cage	1444

Appendix 6

NUMBER OF FISH CAGES AND OWNERS



Appendix 7

OWNERSHIP DISTRIBUTION AND DEVELOPMENT TRENDS OF MUSSEL FARMS IN PHANG NGA PROVINCE

Village					Number of farms							Seeds under culture in tons						
					1979	1980	1981	1982	1983	1984	1985	1979	1980	1981	1982	1983	1984	1985
1. Koke Krai	..	..	..	—	—	—	—	—	12	—	1	—	—	—	—	6.3	—	3.0
2. Pan Yee	..	..	..	—	—	—	—	—	50	—	—	—	—	—	—	32.0	—	3
3. Sam Chong Tai	..	..	..	—	—	—	—	—	25	—	—	—	—	—	—	22.8	—	—
4. Koh Mak Noi	..	..	..	1	—	7	—	—	—	—	—	2	—	—	—	—	—	—
5. Bang Chan	..	..	..	—	—	—	—	—	—	—	16	—	—	—	—	—	—	12

Appendix 8

SUPPLY OF SEEDS TO FISH CAGE FARMERS FROM THE GOVERNMENT HATCHERY AT PHUKET

Year of Supply	Seabass (no.)	Size (cm)	Grouper (no.)	Size (cm)	No. of operators supplied	Mode of seed supply		
						Free of cost (no.)	Against cash payment (no.)	On credit (no.)
1979	37,142	2-4	—	—	8	1,142	36,000	—
1980	60,450	2-4	—	—	25	45,450	15,000	—
1981	249,500	2-4	—	—	34	62,200	187,300	—
1982	161,130	2-4	—	—	19	13,000	148,130	—
1983	115,160	2-4	—	—	38	22,800	92,360	—
1984	154,600	2-4	—	—	55	64,600	90,000	—
1985	228,100	2-4	127,940	3.0-7.0	184	285,040	71,000	—
TOTAL	1,006,082		127,940		363	494,232	639,790	—

Note:-No details available on the provinces/villages to which seeds were supplied.
No data available from the Satun hatchery.

Appendix 9

BANK LOANS ISSUED FOR FISH CAGE CULTURE IN PHANG NGA PROVINCE, 1984 AND 1985

Village		Number of borrowers				Total loan amount				Remarks
		(a) for cage investment costs		(b) for operating costs (seed, feed)		for cage investment costs (in Baht)		for operating costs (in Baht)		
		1984	1985	1984	1985	1984	1985	1984	1985	
1.	Koke Krai	5	12	76	16	41,000	88,000	803,000	218,000	Max. loan per individual: (a) for investment cost Baht 7,000 as medium-term loans for 3 years, repayment in 2 annual instalments (Sep.-Dec.)
2.	Pan Yee	4	10	12	7	38,000	125,000	104,000	62,500	(b) for operating costs Baht 15,000 as short-term loan for 1 year, repayment in 3 instalments (June, Sept., Dec.)
3.	Samchong Nua	2	1	84	43	17,000	8,000	1,031,000	463,000	-The interest rate was 14% for short-term loans and 16% for medium-term loans. -Various persons who applied for loans, did not however invest in cage culture themselves. They either handed over the loan amount to other cage operators or spent it for other purposes.
Total		11	23	172	66	96,000	221,000	1,938,550	743,500	