Bay of Bengal Programme

Small-Scale Fisherfolk Communities

SMALL-SCALE CULTURE OF THE FLAT OYSTER
(*Ostrea Folium*) IN PULAU LANGKAAWI
KEDAH, MALAYSIA

BOBP/WP/73

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

<<

BAY OF BENGAL PROGRAMME
Brackishwater Culture

BOBP/WP/73

Small-scale culture of the flat oyster *(Ostrea folium)* in Pulau Langkawi, Kedah, Malaysia

By

Devakie Nair

Fisheries Research institute
Penang, Malaysia

Bjorn Lindeblad

Economist (Associate Professional Officer)
Bay of Bengal Programme

BAY OF BENGAL PROGRAMME
Madras,
1991

<<

This paper describes the small-scale culture of the flat oyster *(Ostreafolium)* in Pulau Langkawi, Kedah (between 1979 and 1980), which was part of a programme aimed at developing oyster culture along the west coast of Peninsular Malaysia.

The trials were initially managed by a Bay of Bengal Programme (BOBP) field biologist with help from the fishermen and their families and with support from the Bay of Bengal Programme (BOBP) and the Department of Fisheries, Malaysia.

Acknowledgement is due to the Director General of Fisheries, Malaysia, Dato Shahrom bin Haji Abdul Majid for his kind support and permission to publish this paper, the Director of Research and Charles Angell for encouragement, guidance and constructive criticism of the manuscript, and to Ruslan B Shamsuddin for information furnished on the project.

The Bay of Bengal Programme (BOBP) is a multi-agency regional fisheries programme which covers seven countries around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka, Thailand. The Programme plays a catalytic and consultative role it develops, demonstrates and promotes new techniques, technologies or ideas to help improve the conditions of small-scale fisherfolk communities in member-countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, by member-governments in the Bay of Bengal region, and also by UNFPA (United Nations Population Fund), AGFUND (Arab Gulf Fund for United NatiOns Development Organizations) and UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

This document is a working paper and has not been cleared by the Government concerned or the FAO.

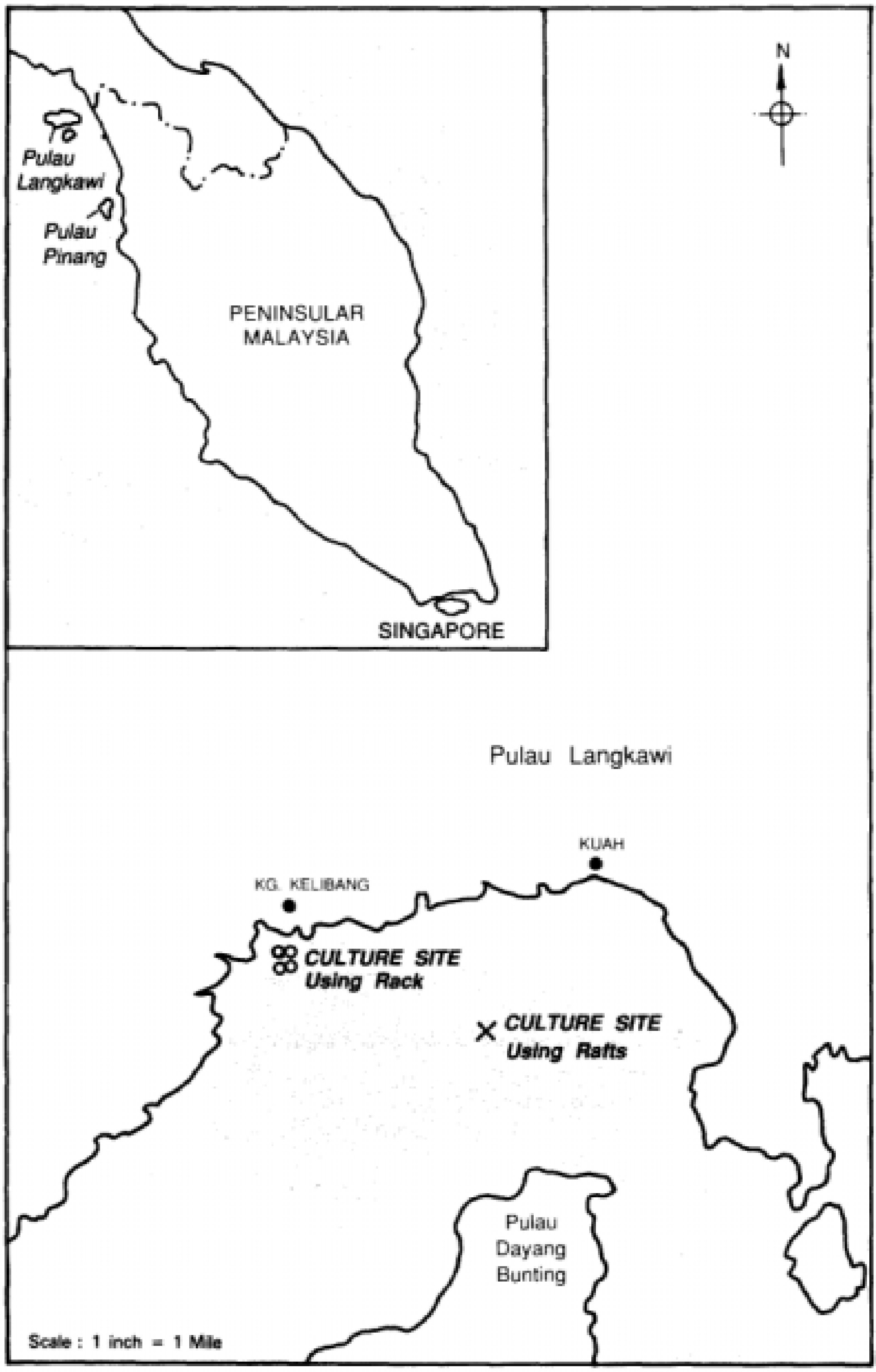
November 1991

Published by the Bay of Bengal Programme, 91 St. Mary's Road, Abhiramapuram, Madras 600 018, India, and printed for the BOBP by Nagaraj & Co., Madras 600 041.

CONTENTS

Page

Fig 1. Oyster culture sites oft Pulau Langkawi



<<

1. *INTRODUCTION*

Experimental culture of oysters in Malaysia was first attempted in the Sixties (Okada, 1963). In the Seventies, culture of *Crassostrea beicheri* was carried out in Sg. Mapang, Tawau, Sabah (Chin and Lim, *1975).* More recently, the Fisheries Research Institute (FRI), Department of Fisheries, Malaysia (DOF), successfully demonstrated the culture of the flat oyster, *Ostreafolium,* in Pulau Langkawi, Kedah (Ng, 1979 and 1980).

In 1988, the Department of Fisheries received technical assistance from the Bay of Bengal Programme for Fisheries Development (BOBP) for the development of oyster culture in Malaysia. The BOBP-assisted programme is aimed at developing oyster culture along the west coast of Peninsular Malaysia where several areas have now been.identified as suitable for the culture of *Crassostrea beicheri, C. iredalei* and the flat oyster, *Ostreafolium.* The areas include: Batu Lintang (Kedah), Kg. Teluk and Telaga Nenas (Perak) and Sg. Muar (Johore) for *C. belcheri;* Kuala Setiu and Sungai Merchang (Trengganu) for *C. iredalei;* and Pulau Langkawi for *Ostreafolium.* This report deals with the culture trials of *0. folium* in P. Langkawi. The culture sites are shown in Figure 1.

0. folium, the Malaysian flat oyster, has been described by Ng (1980). It is a small subtidal species inhabiting the outer coasts of peninsular Malaysia where salinity is normally over 30 ppt and of low turbidity. It is not a significant commercial species, but may be collected in the vicinity of Langkawi Island in small quantities along with *Saccostrea spp.* Like other species of *Ostrea,* it broods eggs and larvae, rather than spawning directly into the sea as *Crassostrea spp* and *Saccostrea spp* do.

The spawning cycle has been described by Ng (1979) for Langkawi waters. Setting occurs throughout the year, with peaks in April and September, although there are variations from year to year. Fish cage culturists in Langkawi often experience heavy fouling by *O.folium.* Based on this observation, a culture system was developed on an experimental basis (Ng 1979).

2. *CULTURE METHOD*

The raft iulture technique was chosen and polyethylene net was selected as cuitch material for the culture. Polyethylene nets were chosen because earlier studies by Ng 1979) had shown that these materials exhibit better spat settlement and face less fouling problems from barnacles.

An intertidal rack (measuring 6.7 m^2 in size) method, using mangrove *(Rhizophora sp)* poles, was also tried about 500 m from the shoreline off Kg. Kelibang. However, due to siltation and heavy fouling of the collectors by barnacles, this culture method was abandoned.

2.1. *Description of the rafts*

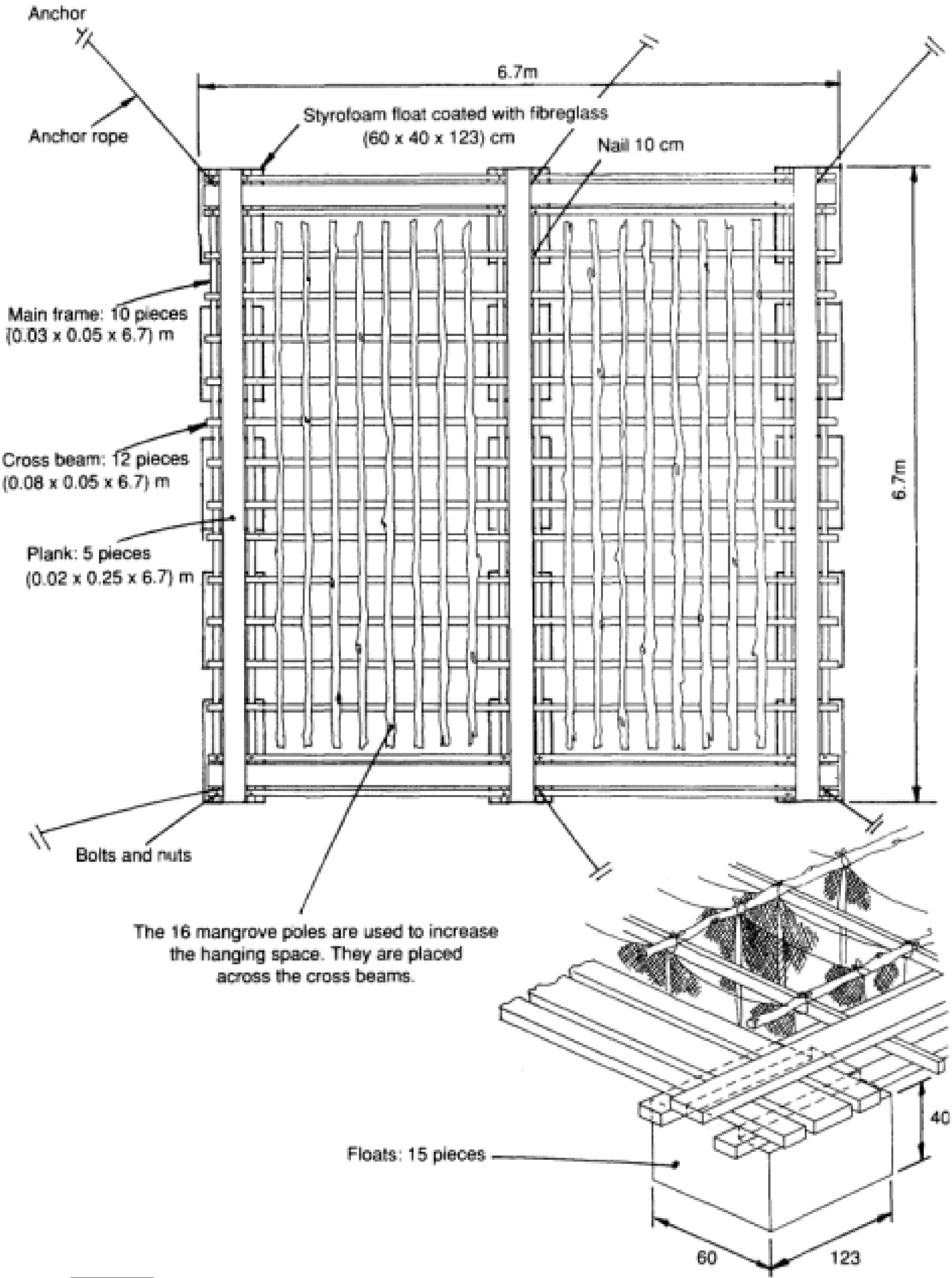
Five rafts (each 6.7 m^2) were constructed from local hard timber *(Balanocw'pus heirnii),* with 15 floats (styrofoam coated with fibreglass) supporting each. The rafts, costing about M$7,650 (Table 1), were constructed by the culturist under the supervision of BOBP's field biologist.

Table I
Breakdown of costs for the construction of culture rafts

Material amount	*Quantity*			
	per raft	*for 5 rafts*	*price per piece(M$)*	*Total (M$)*
70 kg anchor	1 piece	5 pieces	50.00	*250*
Floats	15 pieces	75 pieces	40.00	3,000
Anchor rope (20 mm dia)	20 metres	—	—	1,400
Mainframe	10 pieces	50 pieces	27.00	1,350
Crossbeam	12 pieces	60 pieces	4.00	240
Planks	5 pieces	25 pieces	18.00	450
Bolts & nuts	36 pieces	180 pieces	0.50	90
Nails	—	—	—	20
Mangrove poles	16 pieces	80 pieces	2.00	160
Construction cost (5 rafts)	—	—	—	360
			Total cost (5 rafts)	7,320

<<

Fig 2. Plan of an oyster culture raft



<<

Each raft can easily support a total of 128 net panels, each net measuring 1 m x 1 m. A detailed plan of a raft is shown in Figure 2. The life span of the wood used for the raft is about five years, while the floats are expected to last about the same time. Cuitch materials (net panels) are normally suspended from the rafts (stone weights are added to the bottom of the net panel to hold it vertically in the water column), about 20 cm below the water surface.

2.2 *Site selection*

Net panels collect spat and, simultaneously, serve as the growout substrate. The paramount criteria for selecting a culture site is the setting intensity and duration. Figure 3 illustrates how spat density builds up over several months, eventually reaching an adequate number of oysters for profitable operation.

Secondary considerations include:

- protection from strong winds;
- rafts not interfering with fishing activities or navigation;
- moderate depth, to reduce anchoring costs; and
- proximity to the farmer's village, thus reducing maintenance and operation costs and simplifying watch-and-ward.

The sheltered area east of the town of Kuah, called Kampong Kelibang, was known to be a potential spatfall area, based on previous studies (Ng 1979). It also fulfilled all the above-mentioned criteria (Figure 1).

Little or no spat were collected at other sites, *e.g.* Tanjong Rhu on the north coast of Langkawi Island.

2.3 *Culture management*

The project was initially managed by the BOBP's field biologist who enlisted the help of a fisherman and his family to prepare and hang out collectors for spat collection and to harvest the oysters. The first harvest of shucked meat was sold to FIMA. Bhd., Penang. One cycle of the activities was completed so that the culturist could follow the entire culture operation, which was then handed over to him in December 1989. The field biologist continued to provide technical advice and assist in the marketing of the shucked oyster meat in Penang.

2.4 *Rack culture*

Rafts represent a large investment for fisherfolk and could, therefore, be difficult to finance. An alternative and much less expensive method could be rack culture.

An experimental rack was constructed in the lower intertidal zone in November 1988, inshore of the raft culture site. Two hundred net panels were suspended from the rack, but failed to collect any spat between December and March. No further trials were conducted.

Trials were conducted with *Crassostrea iredalei* transplanted from Merchang and Kuala Setiu, Trengganu. About 18,000 spatted shell were used in the trials. Spat were a mixture of the above species and *Saccostrea spp.* Single spat were placed in Netlon bags suspended from intertidal racks, or strings of spatted shell were hung from the same racks. Initial growth was encouraging, but subsequently there was heavy fouling by barnacles, resulting in unacceptable mortality. Attempts to control barnacle fouling with lime dips were unsuccessful.

Spat collection, using *Saccostrea echinata* and intertidal rack culture, were attempted at Teluk U, on the north shore of Langkawi. Setting was prolonged but light, using old oyster shell as cultch. Growth on racks in the intertidal zone of Teluk U was very slow and heavy barnacle fouling was encountered. *S. echinata* may warrant further trials, but in view of the poor results at the particular location, trials were discontinued.

<<

Fig. 3 **Monthly changes in percentage of oysters** in **spawning condition**

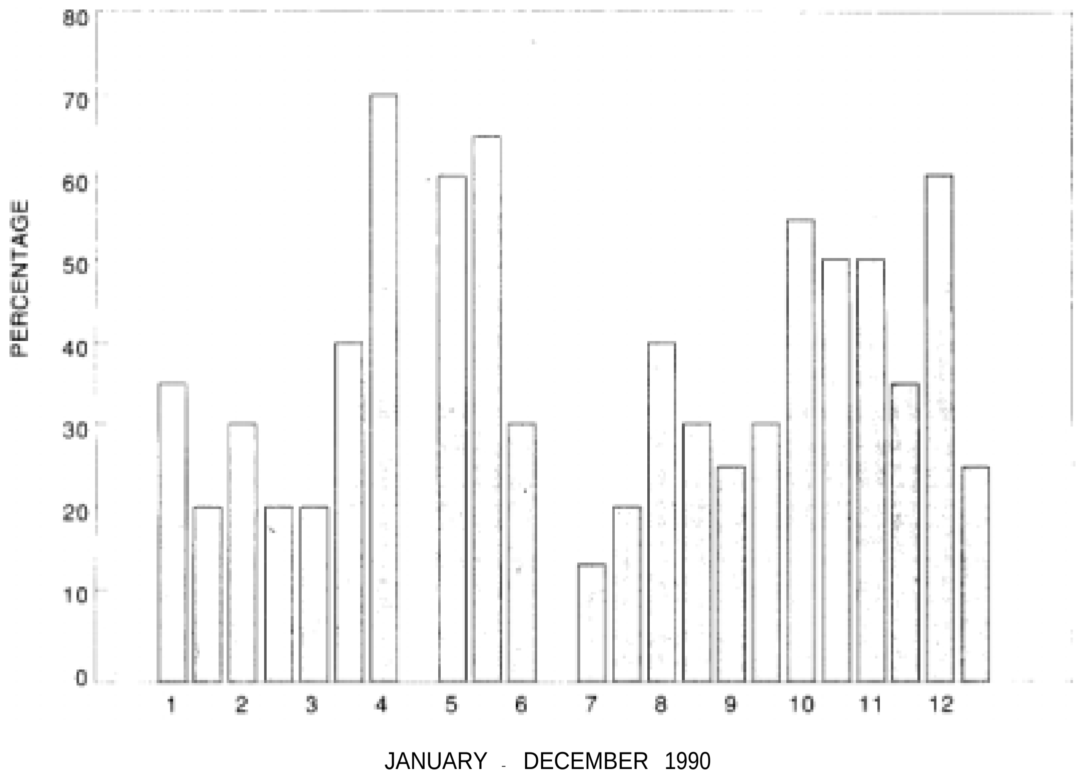
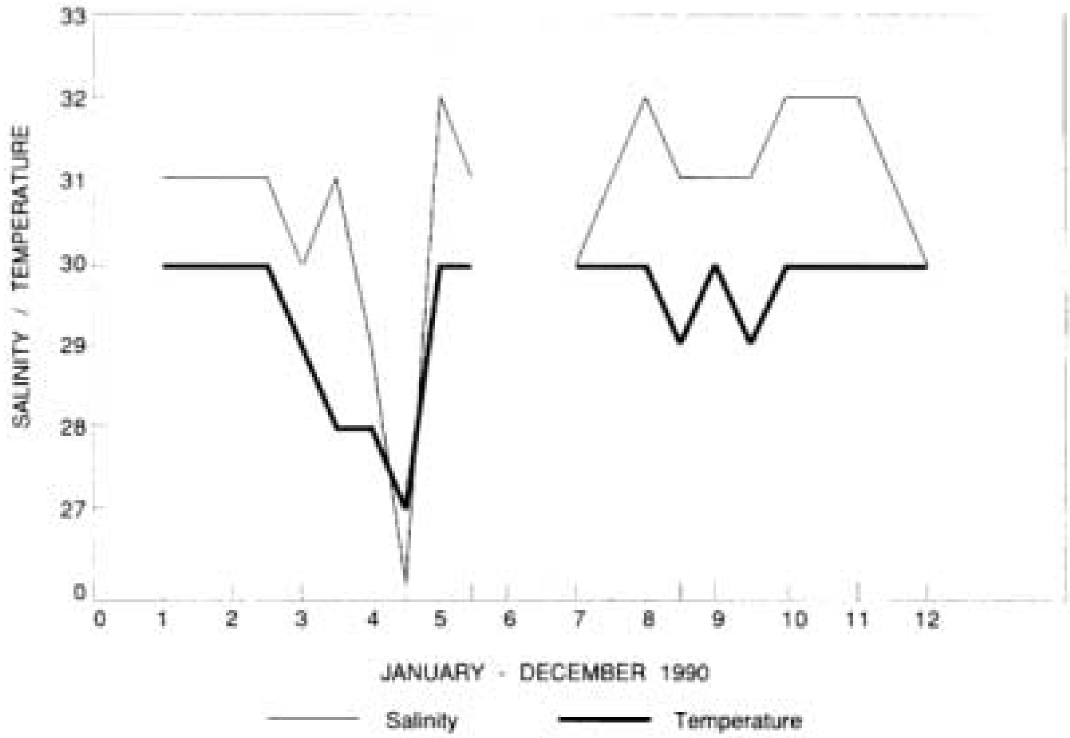


Fig. 4 Salinity and **temperature at Kampong Kelibang, P; Langkawi during 1990**



<<

3. *CULTURE CYCLES*

3.1 *Environmental parameters*

Langkawi Island lies a few kilometres off the west coast of peninsular Malaysia. The waters around the island are not influenced much by freshwater runoff. There is some coral growth, but the surrounding sea is very shallow and the muddy bottom results in turbidity. Figure 4 illustrates the very narrow ranges of temperature and salinity found at the culture site. Most of the year, surface salinity varies between 30 and 32 ppt. Only occasional heavy rains cause temporary depressions in both salinity and temperature.

3.2 *Spat collection and seasons*

Seasonal cycles in spatfall were monitored with ten test panels placed in the water from the culture rafts at approximately monthly intervals. These test panels were examined regularly and spat were counted as soon as they became visible. There was a considerable time lag between actual setting on the net panels and the appearance of spat.

Criteria had to be developed to indicate when actual setting began. Observations were made of the state of maturation of adult oysters, and plankton samples were examined for the presence of eyed larvae of *O. folium*. Adult oysters were staged according to the grossly visible state of gonad development, *viz*, running ripe, mature and spent. Running ripe oysters exuded gametes upon light scratching of the surface of the gonad. Mature specimens exhibited full gonad development, but no exudation of eggs or sperm. Spawned oysters had a flaccid appearance, with little or no gonad development. Samples were staged at hi-monthly intervals.

As can be seen from Figure 3, spawning is continuous, with peaks in the per cent frequency of ripe and running oysters. Oysters in spawning condition are most numerous during April and May, which corresponds to one of the peak setting periods. The second peak in spatfall, between August and October, is not clearly associated with an increasing frequency of spawning oysters, although the general trend is upward.

Collectors were hung out as soon as the presence of eyed larvae was detected from monthly water sampling. The ten test panels were also hung out.

<<

Raft culture of Ostrea folium

Oysters on net panels

<<

Shucking oysters on the shore

Results have shown that spat can be obtained throughout the year, but with two notable peaks. The first peak is between April and May, while the second peak falls between August and October. Spat are accumulated over a period of several months and a net panel can easily collect about 200 oyster spat/cycle. Table 2 shows records of the average number of oyster spat collected over a period of ten months (Jan - Oct 1989).

Table 2

Average number of oyster spat collected on test panels

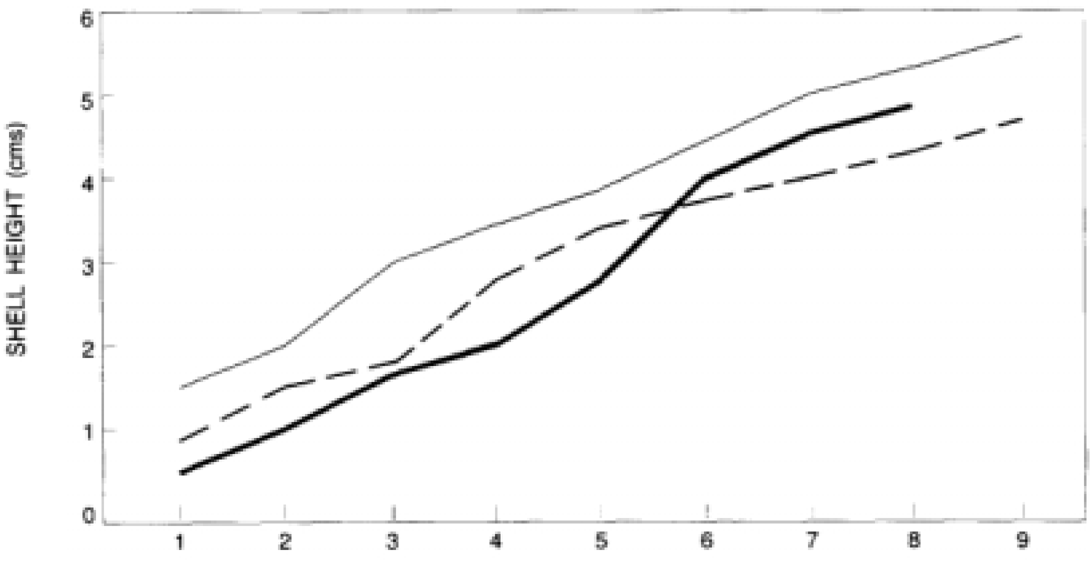
Date panels were hung	Date of Monitoring 16.2.89	16.3.89	16.4.89	15.5.89	15.6.89	15.7.89	15.8.89	15.9.89	15.10.89
15.1.89	12								
16.2.89		NIL	20						
16.3.89			NIL	95					
16.4.89				NIL	57				
15.5.89					NIL	23			
15.6.89						8			
15.7.89							17		
15.8.89								38	
15.9.89									21

N.B Ten panels were suspended each month and the average number of spat collected was counted during the monitoring in the subsequent month.

3.3 *Growth rates and grow-out period*

Figure 5 shows growth curves for three groups of spatted cultch placed out as test collectors. Growth rates,derived by linear regression of shell height on monthly increments,ranged from 0.5 to 0.7 cms/

Fig. 5. Growth curves for three different sets of *O. folium* during 1990



MONTHS OF GROWOUT FROM INITIAL SPAT MEASUREMENT

April - Dec — — April - Dec May - Dec

<<

month from an initial spat size of 0.5 to *1.5* cms. It should be noted that spat require at least one month to reach *0.5* cms after setting, from which time they can be measured. It is difficult to age spat precisely, as they cannot be accurately measured and counted until they have reached 0.5 cm. However, it is desirable to harvest the oysters when they are about six months old, because natural mortality is high from then onwards.

3.4 *Maintenance procedures*

During the culture, the main problem encountered was fouling of nets by silt. However, silt can be easily removed by rinsing the nets vigorously in water. Plastic drum floats were rotated occasionally to ensure that they were not damaged by the strong sunlight. Additional plastic floats were added, whenever necessary, to support the rafts, especially when the oysters approached marketable size. The net panels were inspected about twice a month and any fouling by silt or other sedentary organisms, such as bryozoans and algae, was minimized by washing the panels as soon as any trace of fouling became visible. Thinning of oysters from the net panel was not carried out because spat density was not high and no evidence of crowding effects was observed.

Net panels could be reused after shucking the attached oysters. Panels were sun-dried until any remaining shell became brittle and easily removed by crushing. Care was taken to avoid damaging the net panel threads during cleaning.

3.5 *Manpower requirements*

A week was required for three persons to construct five rafts. On an average, it took the culturists and the field biologist two days to prepare 128 net panels for a raft. The culturist could handle the entire culture operation himself, as there was not much work involved after hanging the net panels for spat collection. During the harvesting period, three or four women were employed to shuck the oysters.

3.6 *Harvesting methods*

As mentioned above, harvesting had to be done after 5 to 6 months' growth. All the panels on a raft were harvested simultaneously, as labour availability allowed. Net panels were brought to the beach, where village women were engaged as shuckers.

0. folium has a peculiar habit whereby the right valve forms digitations which encircle the net threads like a clamp. When shucking the oysters, only the left valve is removed, leaving the other firmly attached to the net panel.

Immediately after shucking, the meat was kept on ice, before freezing. An experienced worker, using a sharp knife, could shuck about a kilogram of meat in four hours. Each worker was paid 2.00 M$/kg of shucked meat. The shucked meat was stored in a freezer, in 1 kg packs, before being sold.

3.7 *Yield*

Average production was 64 kg/raft/cycle, with two cycles a year yielding a total production of 640 kg/year for the five-raft model. Each raft carried 128 net panels. It has been possible to increase this to 160 panels/raft by installing additional floats. This would increase productivity to 400 kg/cycle (for five rafts).

4. *MARKETING*

A preliminary survey of the market for oyster in Malaysia was first undertaken by INFOFISH, under a BOBP contract, in 1988. Following this survey, a more in-depth study was conducted by BOBP (Angell, 1988), which emphasized market chains, hawker businesses and consumer preferences. One of the locations selected for this study was P. Langkawi.

4.1 *Oyster marketing chains in P. Langkawi*

The above mentioned study found that P. Langkawi is a buyer's market, characterized as monopolistic. The producers (collectors) have no power to influence prices and they are forced to sell at a price fixed by the buyer. Apparently, there is only one buyer on P. Langkawi who caters to demand off the island. Demand for oyster meat in P. Langkawi is low (5M$/kg) compared to external demand (12M$/kg in Penang). Despite the high demand off-island, prices remain low due to the monopoly situation. The collectors themselves are unable to handle the marketing because they are not organized and lack the skill and the connections to obtain better prices elsewhere.

4.2 *Oyster marketing strategy for P. Langkawi*

Collectors sell their oyster meat to the local buyer at prices ranging from *4-5M$/kg*, which is below the break-even price of M$5.50 for raft-cultured oysters. With a shucking cost of 2 M$/kg, the culturist would be left with only 2-3 M$/kg of meat. Such a margin would not enable the culturist to offset other operational expenses, such as preparation of cuitch and the construction and maintenance of the rafts. Thus, it was suggested that the culturist resort to off-island sources, like Penang, where higher prices are offered.

As the daily harvest was only a few kilograms, freezing the shucked meat was the only way to accumulate enough product for marketing off-island. Air shipment was preferable to surface transport due to the time factor, but this route incurred additional costs other than freight. Pulau Langkawi is a duty free port, requiring air exports to go through an agent whose minimum fee is M$ 50, which meant that a sufficient quantity had to be shipped to cover the agent's fee. Two consignments of 60 - 80 kg of oyster meat were sent to the buyer in Penang.

Although it is generally assumed that oyster meat requires no special treatment prior to, or during freezing, the Penang buyer reported off-flavours, or a "bitter" taste, and toughness of the meat after cooking. Several factors could influence the quality of thawed oyster meat, such as

- Freezing with a home model freezer being too slow. Blast freezing at - 40°C is required, but would be quite impractical for village culture operations.
- Time of harvesting. It was noted that fresh oysters may have a bitter taste if they are immature. As it is impossible to ascertain an oyster's state of maturity from its external appearance, selective harvesting is not an option,

Local outlets were taken advantage of for some marketing, but the selling price range of M$ *5-6* was only a break-even price. The culturist attempted on one occasion to market frozen oysters at the farmer's market in Alor Setar, on the mainland, the apparent advantage being the availability of a ferry service and elimination of the shipping agent's fee. But because of slow sales and a lack of cold storage facilities, a large consignment was lost. Nearby Setul, Thailand, is readily accessible by ferry, but shucked oyster meat prices are too low there to offer an alternative market.

5. *ECONOMIC ANALYSIS*

The following economic analysis, developed with end 1989 data, is based on the experience of more than a year of culture, harvesting trials and pilot marketing in Penang.

It is assumed in the economic model that a farming unit would consist of five rafts, with 128 net panels suspended from each raft. After harvest, the oysters are shucked, deep frozen and air freighted to Penang, where they are sold.

It is further assumed that the venture can operate as a secondary source of income; the labour demand in terms of daily maintenance is low. Since the primary target group consists of fisherfolk, it is also assumed that a potential oyster cultivator already owns a boat.

5.1 *Production and revenue*

It is forecast that each raft can produce 64 kg net weight of shucked oysters per culture cycle. This is based on actual production during the trials. With two cycles or crops per year, the annual production of a farming unit is 640 kg. Only one crop can be harvested during the first year of operation. At a price of 12 MS/kg, as obtained in Penang during marketing trials, the annual revenue amounts to M$ 7,680.

5.2 *Investment and depreciation*

The total investment in rafts, net panels and a freezer amounts to M$ 12,522. The corresponding yearly depreciation is M$ 3017. A breakdown is given in Table 3 below.

Table 3

Investments summary for a production unit of five rafts

Item	*Number of Units*	*Unit Price*	*Investment*	*Economic Life Span*	*Annual Depreciation*
RAFI'S					
Raft frame	5	500	2310	5	462
Floats	75	40	3000	5	600
Anchors	5	50	250	5	50
Anchor ropes			1400	5	280
Labour, man-days	18	20	360	5	72
Total **for all** rafts			7320		1464
COLLECTORS					
Net panels	640	4.3	2752	3	917
Cement weights	1280	0.06	75	3	25
Ropes	30	35	1050	3	350
Labour	32	10	320	2	160
Total **for** all **collectors**			4197		1452
OTHERS					
Freezer	1	1005	1005	10	101
Total for others			1005		101
GRAND TOTAL			12,522		3017

The estimates are based on actual costs incurred during the construction of the rafts for the trials, but are considered to be on the conservative side. Past experience shows that when new technology is assimilated by fisherfolk, they normally find various means to significantly reduce costs. The hard wood used in the rafts, brought from the main land, may, for example, be substituted with a less costly, locally available type of wood.

5.3 *Operating costs*

The total operating costs amounts to M$ 2,480 (Table 4). About half this amount (M$ 1,280) goes towards the shucking of oysters at a rate of MS 2/Kg. Another heavy cost item is the airfreight, namely MS 640 (1 MS/kg.) Fees and cost of transport came to 26 MS/shipment. This amounts to MS 332, assuming average shipments of 50 kg. Finally, the harvesting costs amount to MS 128, determined by an opportunity cost of family members at 5 MS/day.

Table 4

Operating costs for *folium* culture (5-raft enterprise)

Cost Item	*M$*
LABOUR	
Harvesting	128
Shucking	1280
Total Labour	1408
TRANSPORT	
Airfreight	640
Agent fee	166
Airport tax	38
Transport to and from airport	128
Total transport	972
UTILITIES	
Electricity	100
TOTAL OPERATING COSTS	2480

5.4 *Results*

The above assumptions lead to an estimate of an internal rate of return (IRR) of *25* per cent over a ten-year culture period. This is the minimum level laid down by the Department of Fisheries, Malaysia, for a fisheries sector activity to be encouraged.

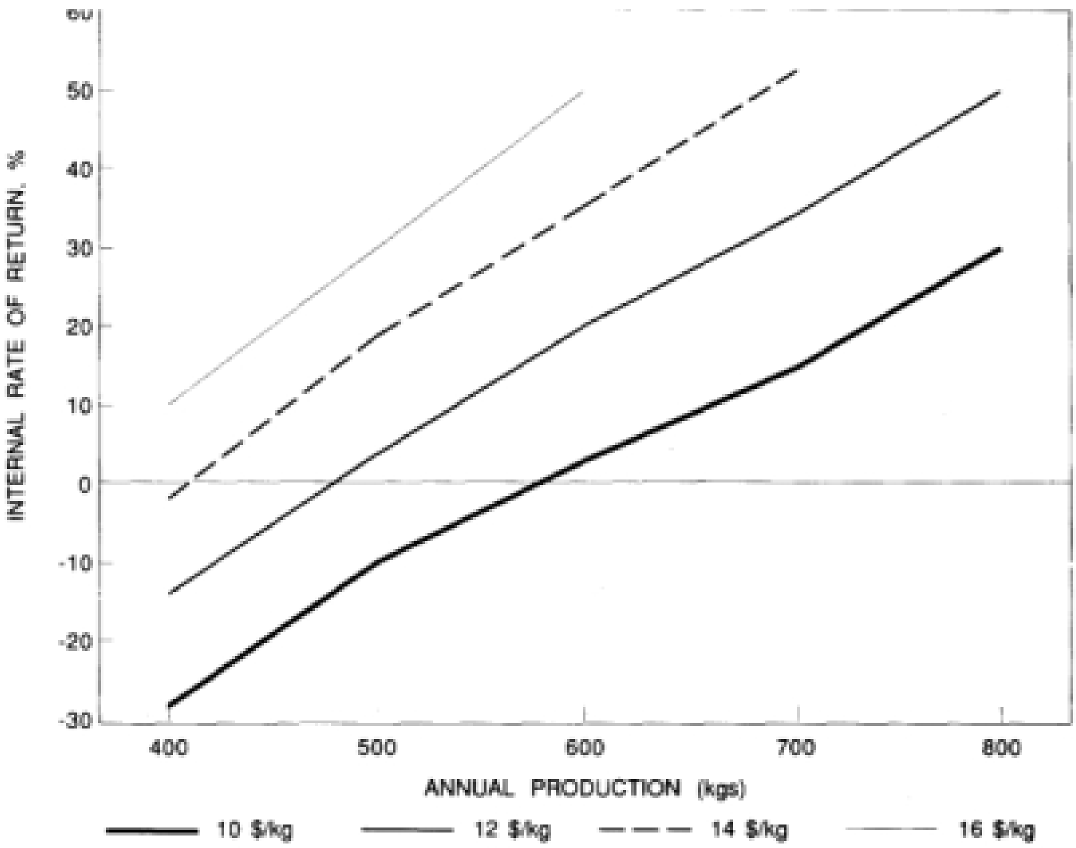
The yearly financial margin (revenue less operating costs) is M$ *5,199,* which indicates a pay-back period of 2.6 years,depending on the interest on borrowed capital. Loans are granted to the small-scale sector at rates of as low as 4 per cent.

While the calculations are made for a production unit of a particular size (five rafts), it should be noted that the scale of operation may be modified according to the preferences of a potential culturist. Except for the freezer and a small part of the raft support, all investment costs will decrease proportionally if the venture is scaled down to one or two rafts. The annual operating costs are also all variable with the production level.

The two most sensitive variables in this analysis are the price of oysters and the production level. The flat oyster will have to compete with other oysters, but during the trials it was evident that the former is not that competitive. The production is entirely dependent on the natural spat falls and these may vary from year to year. How will irregularities in these two variables effect the economic viability? An indication is given in Figure 6.

At the price of 12 M$/kg, as assumed in the calculations, the production must be at, or above, 640 kg/year to stay within the investment criteria of the Department of Fisheries. If the price is reduced to 10 M$/kg, the production would have to be over 160 kg/raft to maintain the same return on investment. Such production is not likely to be achieved with the present technology. If, on the other hand, a better price (16 M$/kg) can be obtained, the venture would be viable at about 100 kg/raft.

Fig. 6. Effect of price and production on economic viability



<<

6. *PEOPLE'S PARTICIPATION*

A meeting with fisherfolk was convened in July 1989 at Desa Permai on Langkawi Island. Its objectives were to explain the results of the oyster culture trade and to obtain feedback from fisherfolk on the problems and possibilities associated with oyster culture, as they saw them.

The meeting was attended by 36 fish erfolk, from six villages of Langkawi identified by IPP staff as having potential for oyster culture development Officials from the Fisheries Office, Aquaculture Extension, Department of Fisheries, Kuala Lumpur, and the BOBP field biologist stationed on Langkawi were moderators and presenters at the meeting. Other participants were IPP Research Officers, staff of the Kedah State Fisheries Services and other BOBP field biologists.

The principal problems identified by fisherfolk were, in order of priority

1. Assets for investment, to cover the relatively high initial investment on the raft culture method.
2. Lack of knowledge in dealing with such technical aspects as raft construction and site selection.
3. Marketing, particularly the need for alternative channels, given the low price paid for oysters on Langkawi.

Lack of assets available for investment in oyster culture could be addressed in two ways:

- Continuing trials placing emphasis on reducing the costs of oyster culture rafts or, in suitable locations, using alternative, cheaper methods; and

  Once economic and technical feasibility has been conclusively established, developing a financing scheme, either through formal banking institutions or fisherfolk savings, by which assets for investment can be developed.

Lack of knowledge in technical matters could be addressed by encouraging fisherfolk to visit the existing culture site in Kampong Kelibang, Langkawi, and by organizing training for fisherfolk.

The marketing problem could be addressed by:

- Continued experimentation with alternative channels, using the production of the trial oyster culture unit; and
- Once the technology is ready for extension, providing training for fisherfolk in organizing marketing activities in markets away from Langkawi Island.

Attempts could also be made to keep fisherfolk in the six villages informed of the progress of trials, by the BOBP field biologist and IPP staff monitoring the oyster culture trials at Langkawi.

Subsequent efforts by the Department of Fisheries to encourage fishermen to culture oysters in other localities, such as Tg. Rhu, were not successful, primarily because of lack of sufficient spat to start a culture operation. It was also observed that the cage culturists selected for the trial project were more interested in mussel culture. The Department initiated the culture of *Ostreafolium* at P. Langkawi, Singa Island, in 1990. Siltation and inadequate spatfall were encountered.

7. *CONCLUSIONS*

Four facets of the pilot project should be considered, namely, technical, social, marketing and economic. The latter is taken to include marketing as well as measures of profitability.

7.1 *Technical*

Ostreafolium is found in abundance only around Langkawi Island. Technology developed for the culture of this species is, by its very nature, extremely site-specific — it will have no applicability anywhere else along the west coast of Peninsular Malaysia.

The pilot study indicated that the net panel and raft system can be profitable, but only if a site can be found where spatfall is predictable and sufficiently abundant. The system design, plus the prolonged build up of oyster density on the net panels, preclude transplanting spat to locations remote from the collection site. Experience to date indicates there are very few sites with adequate spatfall for culture operation.

Limited tests with racks showed that *O. folium* cannot be cultured intertidally, which would have reduced investment costs significantly. Intertidal culture trials with *C. iredalei,* an exotic estuarine species, were unsuccessful. High salinity and heavy barnacle fouling were probably responsible for the lack of success.

7.2 *Social*

The technology was not easy for the participating fisherman to adopt. He found it very difficult to integrate culture operations with his usual fishing activities. Maintenance proved an overly burdensome task. Many oysters were lost because of delayed harvesting. The technology is relatively costly and would be difficult for fisherfolk to finance. With a sufficiently large operation, and entrepreneurial skills, *0. folium* culture could be profitable, but these pre-requisites would be difficult to develop on Langkawi Island.

7.3 *Marketing*

Langkawi presents serious marketing constraints. Local demand is too low to sustain development. Off-island marketing can be done, particularly by air shipment, but is costly and too complex for fisherfolk. Frozen shucked meat proved unacceptable to Penang consumers, but with the limited production from the pilot project, marketing fresh shucked oysters off-island is not viable. *0. folium* meat could be combined with product collected from natural beds to get enough quantity to ship. However, farmers would also have to act as brokers, buying from collectors. The target group is not likely to want to play such a role, if for no other reason than the lack of financial means. Island hotels do not appear interested in purchasing local oysters, and even if they were, payment would be on 90-day terms, normally unacceptable to fisherfolk.

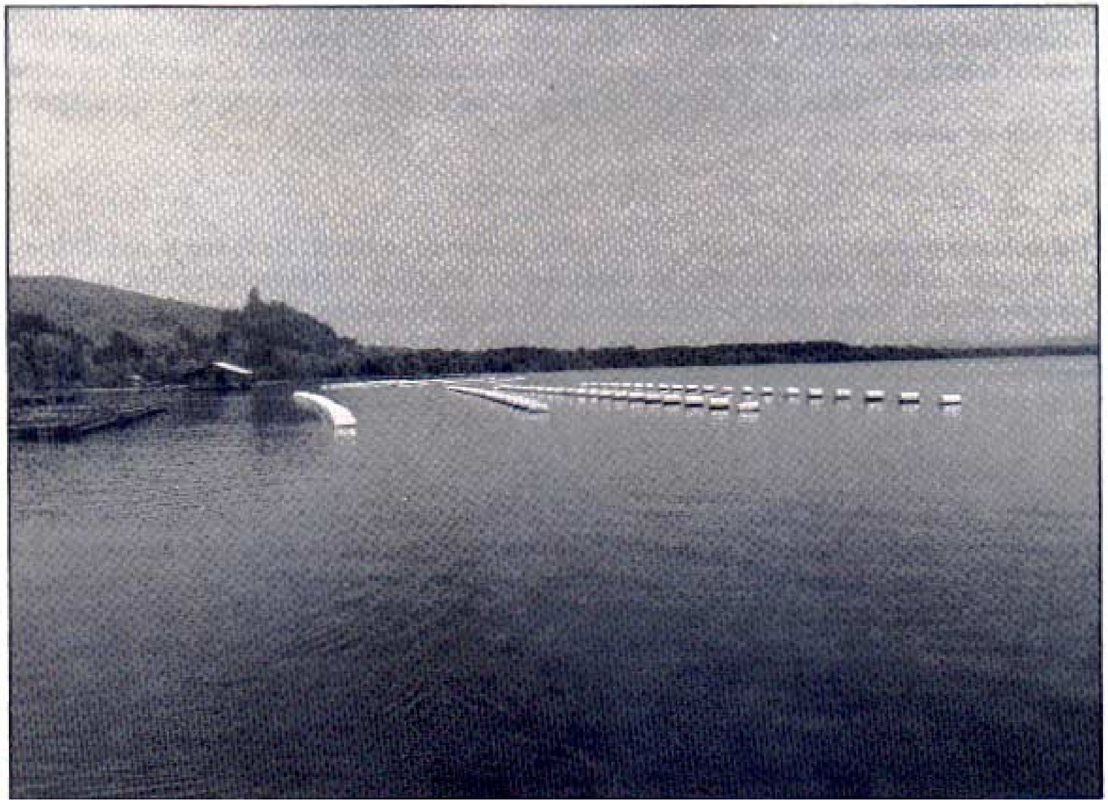
7.4 *Economic*

Marketing has been emphasized as the critical constraint facing *0. folium* culture. If enough fresh shucked produce is available, surface transport to Penang would be feasible, but the pilot project could not produce the required quantity. It might also be difficult to find enough women to shuck sufficient quantities of oysters within the limited time that marketing a fresh product would demand. Should the above constraints prove surmountable, it would be possible to market fresh shucked *0. folium* on the mainland. After shucking, the flat oyster is just another small oyster, competing with the wild, harvested product. Oyster collectors have very little overheads and could effectively compete with cultured flat oysters. On the other hand, wild oyster stocks appear to be over-exploited.

7.5 Alternatives

Other bivalve molluscs may provide opportunities to develop local culture industries. Although our initial trials with S. *echinata* were not encouraging, further work may be justified, as it is an indigenous species, well adapted to the high salinity waters surrounding the island. S. *echinata* will grow to a large size, albeit slowly, and has been experimentally cultured in some of the Pacific islands.

Research may be directed to various species of the *Pteridae,* such as the winged oyster, *Pteria penguin.* Several species of *Pinctada* are abundant around the island and were frequently encountered as “fouling” organisms. They grow fast and have a high meat yield. The shells of some species of *Pteridae* are highly nacreous and are used in the cottage shellcraft industry. Half, or blister, pearls are relatively easy to produce in *Pteria penguin.* Shells are already exported from Langkawi to Thailand. The adductor muscles of the *Pteridae* are similar to scallop meat and even the entire animal may be consumed.

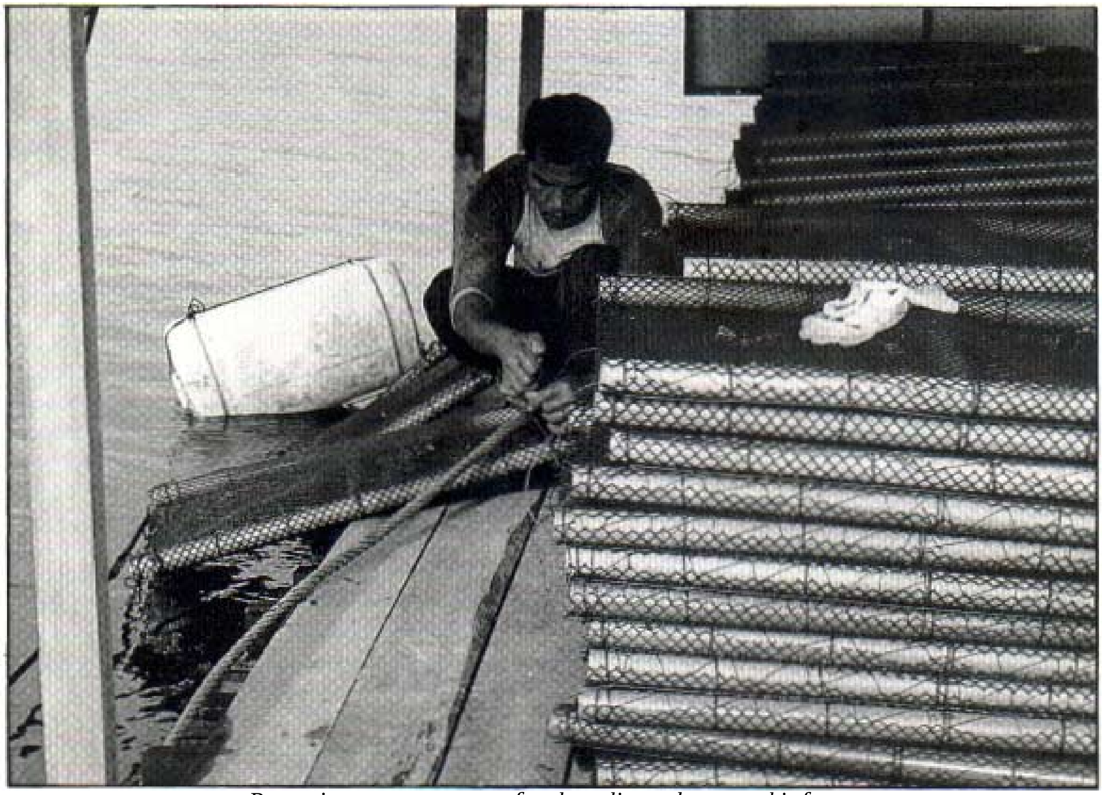


The pictures on the following pages are of similar culture experiments in other paris of Malaysia. This picture (above) is of an oyster farm in Perak.

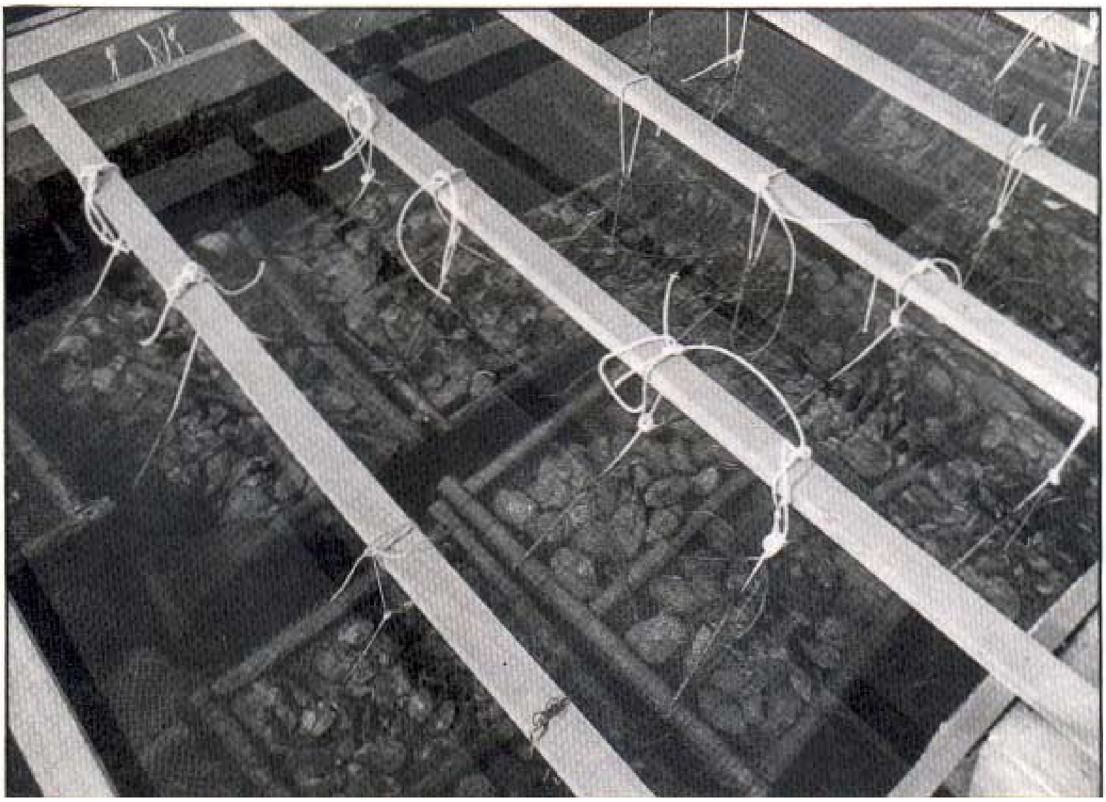
(The *Ostreafolium* project discussed in the main report is one part of BOBP's oyster project in Malaysia. The pictures on these pages are from another, but rather similar, part of the oyster project. The latter part, however, deals with different species and will be the subject of another report.)

in Perak.

A close-up of culture rcifts at a Perak farm site. Note the floats.



Preparing grow-out trays for long-line culture at this farm.



,*A close-up of oyster grow-out trays suspended from the rafts.*

C. iredalai *(upper) and* C. beicheri *(lower). Fine half shell oysters ready for the table.*

LITERATURE CITED

Angell, C. L. *Oyster marketing in Peninsular Malaysia: Prospects and problems.* Bay of Bengal News 32 pp 19-23 (1988)

Chin, P.K.; Lim AL. *Some aspects of oyster culture in Sabah, Malaysia.* Fisheries Bulletin, No. *5,* Ministry of Agriculture and Rural Development, Malaysia. (1975)

Ng. F.O. *Experimental culture of aflat oyster* (Ostrea folium L.) *in Malaysian waters.* Malaysian Agriculture Journal 52 (2) (1979).

Ng. F.O. *Occurrence of a flat oyster,* Ostrea folium, *in Malaysian waters.* Malaysian Agriculture Journal 52 (2) (1980).

Okada, H. *Report on oyster culture experiment in Malaysia.* Ministry of Agriculture and Land, Fisheries Division, Kuala Lumpur. (1963)

PUBLICATIONS OF THE BAY OF BENGAL PROGRAMME (BOBP)

The BOBP brings out the following types of publications

Reports (BOBP/REP/...) which describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and subprojects in member-countries for which **BOBP** inputs have ended.

Working Papers (BOBP/WP/...) which are progress reports that discuss the findings of ongoing BOBP work.

Manuals and Guides (BOBP/MAG/...) which are instructional documents for specific audiences.

Information Documents (BOBP/INF/...) which are bibliographies and descriptive documents on the fisheries of member-**countries in the region.**

Newsletters *(Bay of Bengal News)* which are issued quarterly and which contain illustrated articles and features in non-technical **style on BOBP work and related** subjects.

Other publications which include books and other miscellaneous reports.

A list of publications in print follows. A complete list of publications is available on request.

Reports (BOBP/REP/...)

21. *Income-Earning Activities for Women from Fishing Communities in Sri Lanka.* **E.** Drewes. (Madras, **September** 1985.)
22. *Report of the Ninth Meeting of the Advisory Committee.* **Bangkok,** Thailand, February 25-26, 1985. **(Madras, May 1985.)**
23. *Summary Report of BOBP Fishing Trials and Demersal Resources Studies in Sri Lanka.* **(Madras,** March 1986.)
24. *Fisherwomen's Activities in Bangladesh : A Participatory Approach to Development.* **P.** Natpracha. (Madras, **May 1986.)**
25. *Attempts to Stimulate Development Activities in Fishing Communities in Adirampattinam, India.* **P.** Natpracha, V. **L. C. Pietersz. (Madras, May 1986.)**
26. ***Report of the Tenth Meeting** of the Advisory Committee.* Male, Maldives. 17-18 February 1986. (Madras, April 1986.)
27. ***Activating** Fisherwomen for Development through Trained Link Workers in Tamil Nadu, India.* E. Drewes. (Madras, **May 1986.)**
28. ***Small-scale Aquaculture Development Project in South Thailand: Results and** Impact.* **E. Drewes. (Madras, May** 1986.)
29. ***Towards Shared Learning: An Approach to Non-formal Adult Education for Marine Fisherfolk of Tamil Nadu, India.*** **1. S. Saraswathi and P. Natpracha. (Madras, July 1986.)**
30. ***Summary Report of Fishing Trials with Large-mesh Dr,ftnets in Bangladesh.*** (Madras, May 1986.)
31. ***In-service Training Programme for Marine Fisheries Extension Officers in Orissa, India.*** U. Tietze. **(Madras,** August **1986.)**
32. ***Bank Credit for Artisanal Marine Fisherfolk of Orissa, India.*** U. Tietze. (Madras, May 1987.)
33. ***Non-formal Primary Education for Children of Marine Fisherfolk in Orissa, India.*** U. Tietze, Namita **Ray.** (Madras, **December 1987.)**
34. ***The Coastal Set Bagnet Fishery of Bangladesh — Fishing Trials and Investigations.*** **S. E. Akerman.** (Madras, **November 1986.)**
35. ***Brackish water Shrimp Culture Demonstration in Bangladesh.*** **M.** Karim. (Madras, December 1986.)
36. ***Hilsa Investigations in Bangladesh.*** **(Colombo, June** 1987.)
37. ***High-Opening Bottom Trawling in TamilNadu, Gujarat and** Orissa, **India .· A Summary of Effort and Impact.*** (Madras, **February 1987.)**
38. ***Report of the Eleventh Meeting of the Advisory Committee.*** Bangkok, Thailand, March 26-28, 1987. (Madras, June **1987.)**
39. ***Investigations on the Mackerel and Scad Resources of the Malacca Straits.*** (Colombo, December 1987.)
40. ***Tuna in the Andaman Sea.*** (Colombo, December 1987.)
41. ***Studies of the Tuna Resource in the EEZs of Sri Lanka and Ma/dives.*** **(Colombo, May 1988.)**
42. ***Report of the Twelfth Meeting of the Advisory Committee.*** **Bhubaneswar,** India, 12-15 January **1988. (Madras, April 1988.)**
43. ***Report of the Thirteenth Meeting of the Advisory Committee.*** **Penang,** Malaysia, 26-28 January, 1989. (Madras, **March 1989.)**
44. ***Report of the Fourteenth Meeting of** the Advisory Committee.* Medan, Indonesia, 22-25 **January, 1990. (Madras, April** 1990.)
45. ***Report of the Seminar on Gracilaria Production and Utilization in the Bay of** Bengal **Region.*** (Madras, November 1990.)
46. *Exploratory **Fishing** for **Large Pelagic** Species **in the Maldives.*** **R.C. Anderson and A.** Waheed. **(Madras, December 1990.)**

47. *Exploratory Fishing for Large Pelagic Species in Sri Lanka.* **R.** Maldeniya & S.L. Suraweera. (Madras, April 1991.)

48. *Report of the Fifteenth Meeting of the Advisory Committee.* Colombo, Sri Lanka, 28-30 January, 1991. (Madras, April 1991.)

Working Papers (BOBP/WP/...)

24. *Traditional Marine Fishing Craft and Gear of Orissa.* P. Mohapatra. (Madras, April 1986.)

27. *Reducing the Fuel Costs of Small Fishing Boats.* **0.** Gulbrandsen. (Madras, July 1986.)

30. *Mackerels in the Malacca Straits.* (Colombo, February 1985.)

31. *Tuna Fishery in the EEZs of India, Maldives and Sri Lanka.* (Colombo, February 1985.)

32. *Pen Culture of Shrimp in the Backwaters of Killai, TamilNadu : A Study of Techno-economic and Social Feasibility.* **R. N.** Roy. (Madras, January 1985.)

33. *Factors that Influence the Role and Status of Fisherwomen.* K. Anbarasan. (Madras, April 1985.)

34. *Pilot Survey of Set Bagnet Fisheries of Bangladesh.* A Kashem. (Madras, August *1985.)*

35. *Pen Culture of Shrimp in the Backwaters of Kitlai, Tamil Nadu.* **M.** Karim and *S.* Victor Chandra Bose. (Madras, May 1985.)

36. *Marine Fishery Resources of the Bay of Bengal.* **K.** Sivasubramaniam. (Colombo, October 1985.)

37. *A Review of the Biology and Fisheries of Hilsa ilisha in the Upper Bay of Bengal.* **B.** T. **A.** Raja. (Colombo, October 1985.)

38. *Credit for Fisherfolk: The Experience in Adirampattinani, Tamil Nadu, india.* **R.** S. Anbarasan and **0.** Fernandez. (Madras, March 1986.)

39. *The Organization of Fish Marketing in Madras Fishing Harbour.* M. **H.** Kalavathy. Madras, September 1985.

40. *Promotion of Botto,n Set Longlining in Sri Lanka.* **K.** T. Weerasooriya, S. S. **C.** Pieris, M. Fonseka. (Madras, August 1985.)

41. *The Demersal Fisheries of Sri Lanka.* **K.** Sivasubramaniam and **R.** Maldeniya. (Madras, December 1985.)

42. *Fish Trap Trials in Sri Lanka.* (Based on a report by T. Hammerman). (Madras, January 1986.)

43. *Demonstration of Simple Hatchery Technology for Prawns in Sri Lanka.* (Madras, June 1986.)

44. *Pivoting Engine installation for Beachlanding Boats.* A. Overa, **R.** Ravikumar. (Madras, June 1986.)

45. *Further Development of Beachianding Craft in india and Sri Lanka.* **A.** Overa, **R.** Ravikumar, **0.** Gulbrandsen, **G.** Gowing. (Madras, July 1986.)

46. *Experimental Shrimp Farming in Ponds in Polekurru, Andhra Pradesh, india.* **J. A. J.** Janssen, **T.** Radhakrishna Murthy, B. V. Raghavulu, V. Sreekrishna. (Madras, July 1986.)

47. *Growth and Mortality of the Malaysian Cockle (Anadara granosa) under Commercial Culture : Analysis through Length-frequency Data.* Ng Fong Oon. (Madras, July 1986.)

48. *Fishing Trials with High-Opening Bottom Trawls from Chandipur, Orissa, India. G.* Pajot and B. **B.** Mohapatra. (Madras, October 1986.)

49. *Pen Culture of Shrimp by Fisherfolk: The BOBP Experience in Killai, Ta,nilNadu, India.* **F.** Drewes, **G.** Rajappan. (Madras, April 1987.)

50. *Experiences with a Manually Operated Net-Braiding Machine in Bangladesh.* **B.** C. Gillgren, A. Kashem. (Madras, November 1986.)

SI. *Hauling Devices for Beachlanding Craft.* A. Overa, **P.** A. Hemminghyth. (Madras, August 1986.)

52. *Experimental Culture of Seaweeds (Gracilaria Sp.) in Penang, Malaysia.* (Based on a report by M Doty and **J** Fisher). (Madras, August 1987.)

53. *Atlas of Deep Water Demersal Fishery Resources in the Bay of Bengal.* **T.** Nishida and **K.** Sivasubramaniani. (Colombo, September 1986.)

54. *Experiences with Fish Aggregating Devices in Sri Lanka.* K.T. Weerasooriya. (Madras, January 1987.)

55. *Study of Income, Indebtedness and Savings among Fisherfolk of Orissa, India.* **T.** Mammo, (Madras, December 1987.)

56. *Fishing Trials with Beachlanding Craft at (Jppada, Andhra Pradesh, India.* **L.** Nyberg. (Madras, June 1987.)

57. *Identifying Extension A ctivities for Fisherwomen in Visakhapatna,n District, A ndhra Pradesh, India.* **D.** Tempelman. (Madras, August 1987.)

58. *Shrimp Fisheries in the Bay of Bengal.* **M.** Van der Knaap. (Madras, August 1989.)

59. *Fishery Statistic-s in the Bat of Bengal.* **T.** Nishida. (Colombo, August 1988.)

60. *Pen Culture of Shrimp in Chilaw, Sri Lanka.* D. Reyntjens. (Madras, April 1989.)

61. *Development of Outrigger Canoes in Sri Lanka.* O. Gulbrandsen, (Madras, November 1990.)

62. *Silvi-Pisciculture Project in Sunderhans, West Bengal: A Summary Report of BOBP's assistance.* **C.** L. Angell, J. Muir, (Madras, September 1990.)

63. *Shrimp Seed Collectors of Bangladesh.* (Based on a study by UBINIG.) (Madras, October 1990.)

64. *ReefFish Resources Surrey in the Maldives* NI. Van Der Knaap, *Z.* Waheed, H. Shareef, M. Rasheed (Madras, April 1991.)

65. *Seaweed (Gracilaria Edulis) Farming in Vedalai amid Chinnapalam, India.* Ineke Kalkman, Isaac Rajendran, Charles L AngelI. (Madras, June 1991).

66. *Improving Marketing Conditions for Women Fish Vendor,s in Besant Nagar, Madras.* **K.** Nienezes. (Madras, April 1991.)

67. *Design amid Trial of ice Boxes for Use on Fishing Boats in Kakinada, India.* **Ii.** Clucas. (Madras, April 1991.)

68. *The By-catch from Indian Shrimp Trawlers in the Bay of Bengal : The potential for its improved utilization.* Ann Gordon. (Madras, August 1991).

69. *.-lgar and rllginale Production from Seaweed in India.* J .J .W. Coppen, P. Nambiar, (Madras, June 1991.)

73. *Small-scale cutture of the flat oyster* (Ostrea tolium) *in Puiau Langkawi, Kedah, Malaysia,* Devakie Nair and Bjorn Lindeblad. (Madras, November 1991).

76-1 *View from the Beach — Understanding the statu,s and needs offisherfolk in the Meemu, Vaavu and Faafu Atolls of the Republic of Ma/dives.* The Extension and Projects Section of the Ministry of Fisheries and Agriculture, The Republic of Maldives. (Madras, June 1991).

Manuals and Guides *(BOBP/MAG/...)*

Towards Shared i.earning . Non-formal Adult Education for Marine Fisherfolk. Trainers' Manual. (Madras, June 1985.)

2. *Towards Shared learning: Non-formal Adult Education for Marine Fisherfolk.* Animators' Guide. (Madras, June 1985.)
3. *Fishery Statistics on the Microcomputer: A BASIC Version of Ha.sselhlad's NORMSEP Program.* D. Pauly, N. David, J. Hertel-Wulff. (Colombo, June 1986.)
4. *Separating Mixtures of Normal Distributions : Basic programs for Bhattacharya's Method and Their Application for Fish Population Analysis.* **H.** Goonetilleke, K. Sivasubramaniam. (Madras, November 1987.)
5. *Bar of Bengal Fisheries Information System (BOBFINS) : User's Manual.* (Colombo, September 1987.)

Information i)ocuments *(BOBP/ INE...)*

8. *Marine Smna/l.Scale Fisheries of Bangladesh : .1 General Description.* (Madras, September 1985.)
9. *food and Nutrition Status of Small-Scale Fisherfolk in India's East Coast States : .4 Desk Review and Resource Investigation.* V. Bhavani. (Madras, April 1986.)
10. *Bibliography on Gracilaria — Production and Utilization in the Bay of Bengal.* (Madras, August 1990.)

LI. *Marine Small-Scale Fisheries of West Bengal : An Introduction.* (Madras, November 1990.)

Newsletters *(Bar of Bengal News)*

Quarterly

Other Publications

Artisanal Marine Fisherfolk of Orissa : Study of their Technologv, Economic Status, Social Organization and Cognitive Patterns. U Tietze. (December 1985.)

Studies on Mesh Selectivity and Performance : The New Fish-cum-Prawn Trawl at Pesalai, Sri Lanka. BOBP/MIS/3. M.S.M. Siddeek. (Madras, September 1986.)

Motorization of Dinghy Boal.s in Kasafal, Orissa. BOBP/MIS/4. S. Johansen and 0. Gulbrandsen. (Madras, November 1986.)

lie/ping Fisherfolk to lie/p Themse/ye.s : A Study in People's Participation. (Madras, 1990.)

For further information contact

The Bay of Bengal Programme, Post Bag No. 1054, Madras 600 018, India.

Cable BAYFISH Telex 41-8311 BOBP Fax 044-836102,

Telephone 836294, 836096, 836188.

<<