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Wooden kattumaram or...?

With the price of timber increasing and making the traditional kattumaram more expensive, alternative materials for kattumaram have been explored. But everything still points to timber being the most economical material for this traditional craft of the South Indian coasts.

Wooden kattumaram or..?

by M.R. Anderson

The traditional materials used br the construction of *kattumaram* in India, solid logs *of Albyzzia stipulata,* have become scarce during the last few years due to the depletion of natural resources. The price of wood has increased considerably and fishermen have been forced to build their craft out of timber like *Bombax Malabaricum* and other species that are not so suitable but cheaper. This has resulted in various programmes which have tested *kattumaram* built to new designs and with such untraditioiial materials as Marine Plywood,. Glass Reinforced Plastic (GRP), Polyethylene Pipe and Ferrocement. Trials have also been conducted to assess the suitability of pressure treatment of the logs used for *kattumaram* construction and this has proved the most attractive proposition, promising an increase in service life at relatively low cost.

Work on developing different types of *kattumaram-like* craft, built with a multitude of materials, has been going on in India for the last 20 years, but the commercial results have been limited. The Bay of Bengal Programme (BOBP) in November 1991 investigated the results of these tests to establish the merits or otherwise of the different types of building materials used.

BOBP had carried out tests with two different craft in Madras in 1980, the IND-il and IND-13. The former was a single hulled craft using the principle of buoyancy blocks, a floating material encapsulated in a non-watertight shell 4of cheap wood. The IND-13 was a further development of IND-11, but built in marine plywood. Both craft were motorized, each with a 4.8 hp air-cooled diesel engine mounted inboard. The size of each craft ruled it out as a direct replacement of the traditional *kattumaram;* both craft were seen more as an upgrading of the traditional boats.

Additional work on developing a *kattumaram* built with marine plywood was undertaken by the South Indian Federation of Fishermen's Societies (SIFFS), Thiruvananthapuram, Kerala. SIFFS has, over the. years, developed three craft, starting with the *Kottarkat* in 1981. This craft is a 7m flat-bottomed decked plywood canoe propelled by a traditional lateen sail. At about the time this craft was introduced, the outboard motors were first seen in Kerala. This led to the majority of the craft, originally intended to bepure sailing craft, being equipped with engines. The fishermen of Kerala use this craft extensively and, till date, approximately 2000 plywood craft have been built, half *Kottarkats*

Traditional wooden kattumaram *on the beach*

and half the larger version, the ply *va/lam.*

The *Kottarkat* does not specifically meet the needs of fishermen using traditional *kattumaram* at present, as its cost is several times that of the traditional *kattumaram.* To meet the special requests for a replacement of the traditional *kattumaram,* SIFFS developed a 3.6m *kattumaram* built with plywood. But this craft has not been operated extensively. A conclusion cannot therefore be made of its suitability for fishing operations along the coasts of India. SIFFS is, however, conducting further trials with these and is propagating their use.

The use of marine plywood for the construction of fishing craft does not seem as unusual to the fishermen as the use of GRP, but the traditional *teppa* fishermen of Orissa have been pleased with a newly developed 9m GRP *teppa* built in Pun. Around 150 craft of this type are operating along the coast Orissa. These additions to the traditional wooden *teppa* fleet have proved seaworthy, but their long-term durability is still to be judged, as the first craft were built only 18 months ago. Pricewise, these craft cannot compete with the wooden *teppas,* but considering their lighter weight and the status which comes with owning a GRP *teppa,* the fishermen of Orissa feel that these craft are an improvement on their traditional craft and several have replaced the wooden *teppa* with GRP *teppa.*

Orissa is not the only place along the Indian coast where *kattumaram-like* craft built of plastic materials are being tried out. In Tamil Nadu, tests are being made with *kattumaram* built out of High Density Polyethylene pipes, a material normally used for sewage pipes etc., but also used for boat-building in, for example, Taiwan. The craft, five so far, have been built and tested by the Murugappa Chettiar Research Centre in Madras. In these craft the HDPE pipes have been welded together to form a raft *kattumaram.* The pipes are closed at the end by a simple heating/pressing process and welded together by heating the material with a blow-torch, under compression. The stem is thereafter bent upwards to resemble the stem of the traditional wooden raft *kattumaram* used in Tamil Nadu.

The technology has proved to be good, but the finished product is not able to compete on price with a wooden *kattumaram* of the same size. The cost of a HDPE pipe *kattumaram* is 3-4 times more than a wooden one, even when selling the former without a profit. The HDPE *kattumarams* have also been reported as being too slippery and too light, thereby affecting surf-crossing and crew comfort during fishing operations.

As an aside, it may also be mentioned that tests have been done in Tamil Nadu with ferrocement *kattumaram.* These were not very successful due to the inherent limitations of the material. The minimum thickness of the material means that it is not suitable for craft below lO.5m in length. For small craft the weight is much too high, putting severe limitations on carrying capacity.

It is clear that none of the tests mentioned have provided a clear solution to the problem of finding a suitable replacement for the traditional wooden *kattumaram.*

The craft with the brightest future have been built by the Forest Research Laboratory, Bangalore, during experiments carried out between 1968 and 1982. The laboratory fabricated two *kattumaram* which were subjected to pressure treatment in a test plant erected by FRL. The test *kattumaram* were treated with a copper-chrome-arsenic (CCA) composition, and put into operation in Vishakhapatnam in 1968. FRL assessed the two treated *kattumaram,* as well as two untreated

An experimental kattumaram *made of ferro-cement in India.*

ones, to ascertain the results of the pressure treatment in respect of extended service life and necessary repairs.

The tests showed a considerable increase in the service life of the treated *kattumaram.* The better durability of the treated *kattumaram* was seen from the fact that the craft operated without replacement of major timber parts, whereas the untreated *kattumaram* had to have 90-95 per cent of its timber replaced by the time they were taken out of operation. The two treated craft were surveyed in 1982 after 14 years of operation and FRL found that they were in a condition which would allow further operation.

From the tests conducted by FRL, it appeared that pressure treatment of *kattumaram* logs woqid be a feasible way of preserving the logs, but, unfortunately, the tests did not result in a programme for large-scale treatment of *kattumaram,* even though it costs only Rs 2000 at present to treat a 6m *kattumaram.*

From the results of the tests described above it will be seen that three materials stand out as suitable construction materials for *kattumaram* – like craft. They are timber, pressure treated timber and GRP.

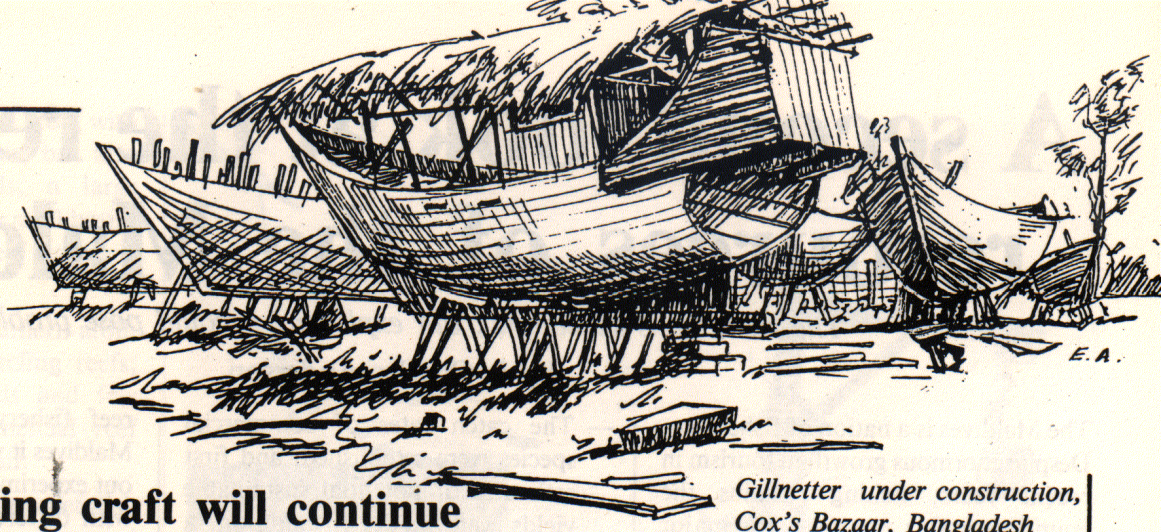
Timber is the traditionally used material, and it is still the cheapest material available for fabrication of a low cost beachlanding craft.

Pressure treated timber offers the familiar characteristics of untreated timber. But the treatment increases the lifetime of the logs considerably, at a relatively low increase in cost. But at present, there is no commercial. treatment of *kattumaram,* mostly due to the fact that the logs have to be transported to treatment plants located in urban centres like Madras.

GRP makes it possible to fabricate a lightweight craft which can be shaped so as to give the best seagoing capabilities. At the same time, it offers a craft with a good load-carrying capacity.

Evaluating the three materials on the basis of suitability, and cost, it would appear that pressure treated timber offers the best value for money. A wider use of it, though, is doubtful because of the limited availability of treatment plants. The GRP has been introduced and will make further inroads, but for a long time to come the majority of fishermen will continue to use the traditional log craft they have been using for centuries.

High Density Polyethylene tubes were used for this experimental kattumaram *developed by the Murugappa Chettiar Research Centre, Madras, India.*



Gillnetter under construction, Cox's Bazaar, Bangladesh

Wooden fishing craft will continue to dominate in Bangladesh

The traditional material for boat-building in Bangladesh is wood. But with the price of wood increasing, boat-building costs have been causing concern in Bangladesh. To offer a viable option, the Bay of Bengal Programme, in late 1991, made a study of whether boats could be built in Bangladesh with unconventional materials and, if so, whether they would prove economical.

O Gulbrandsen, a naval architect, who was commissioned to do the study found that the price of timber in Bangladesh was increasing not because of any shortage of it, but because there was increasing demand for timber for other uses, particularly for fuel. But he also found that while Glass Reinforced Plastic (GRP) boats could be built in the country, building boats with traditional materials was much more economical, even if the price of wood rose considerably.

The study found that though there are thousands of fishing craft, mainly made of timber, operating in Bangladesh, they fall into three major types — *kosha,* the *chandi* and the gillnetters.

The *kosha* is a non-motorized, flat-bottomed craft of 4-6 m LOA. It is built using cross planking, or longitudinal planking, for the skin. To offset the increased prices of timber, the wooden planking is occasionally being substituted with galvanized metal sheets fastened to the wooden frames. This technique is only seen in inland waters where the corrosive effect of the water is limited.

The *chandi* boat is a round bilge planked boat with a high sheer aft. This type of craft is normally of 5-12 m LOA. The larger *chandis* are motorized and have engines of 8-12 hp. The construction of the *chandi* boat utilizes a unique Bangladeshi method of construction. The planks are shaped and stapled together with steel strips before the frames are inserted.

The gillnetters mainly operate from harbours in Barisal, Chittagong and Cox's Bazaar. They measure 10-15 m LOA and are equipped with marine diesel engines of 22-60 hp.

All three types of craft are built with local species of wood, such as *Jarul, Chambal, Garjan, Jamgoda* and *Telser.*

The boat-builders of Bangladesh need, for repairs as well as replacement of craft, about 45,000 cu.m. of timber a year, assuming average service life of four years. Bangladesh's annual production of wood, as stated by FAO, is 59,417,000 cu.m. The timber needed for the boat-building industry is, therefore, a negligible amount.

Nevertheless, do increasing prices of timber justify the introduction of GRP craft?

The building price of a GRP boat in Bangladesh is approximately **five times** more than the price of a similar sized wooden boat built of *Jarul.* The high price of a GRP craft in Bangladesh is due to the high import duty on the materials. Polyester resin carries a 40 per cent duty, while chopped strand mat carries a 60 per cent duty. And even if there was no import duty on the materials, it would not be feasible to utilize GRP as building material on a large scale, as the GRP craft would still be approximately four times more expensive than a wooden craft of the same size. This great price difference cannot be justified either by the promise of a longer service life or a lower cost of maintenance.

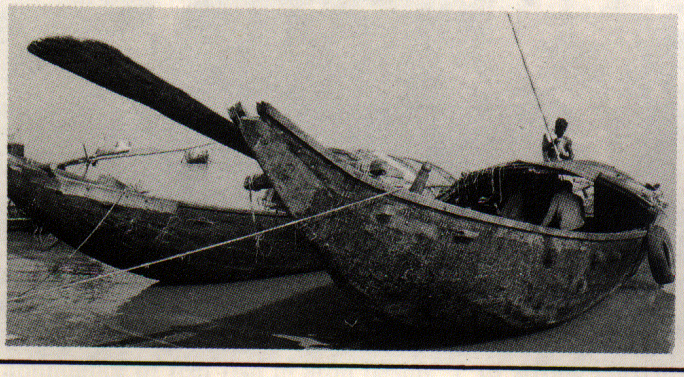
At present, there is only one builder of GRP boats in Bangladesh, exclusively building special purpose craft for Government departments. Would it be feasible to start up other units to produce GRP boats for export? The possibilities seem limited.

To establish a GRP boat-building industry in Bangladesh, the best solution for obtaining the technical know-how and craft designs would be to found a joint-venture company with a foreign partner. This is being done extensively in Taiwan, Singapore, and Thailand, where boats are built for foreign markets. Bangladesh has got a large amount of cheap labour, but, unfortunately, it is not the only place in the region where this is the case. It is, in these circumstances, difficult to envisage any particular advantages that would make Bangladesh the preferred choice of country for a foreign investor.

GRP boat-building, therefore, appears to have little future in Bangladesh. The traditional way of boat-building, on the other hand, will continue to thrive and prove economical for decades to come as it has for centuries past, considering that timber is abundant even if it is becoming pricey.

M.R.A.

A chandi *boat*



A kosha *boat being built*

A second look at the reef fish resources of the Maldives

The resource is substantial, but exploiting it could pose problems.

by R Charles Anderson

The Maldives is a nation of fishermen. Despite enormous growth in tourism' recent years, fishing remains t country's major employer, the major source of export earnings, and the major source of protein for the population. This has undoubtedly been the case since the country was first populated, perhaps as long as 4000 years ago, because the Maldives has few natural resources other than those which the sea provides.

The country is made up entirely of coral reefs and has enormous reef fish resources. It is, therefore, surprising that reef fish are barely exploited in the Maldives, especially as there have never been any cases of reef fish poisoning *(ciguatera)* reported there. The fact is, however, that tuna (especially skipjack tuna) has formed the staple of the Maldivian fishery for years. Tuna is the favourite food of Maldivians, and the mainstay of the export industry.

Conscious of the considerable untapped stocks of reef fish available, the Ministry of Fisheries and Agriculture (MOFA) of the Maldives was interested in finding out the following:

- How much reef fish is available,
- Which gear are most suitable for exploiting these fish, and
- Which species and sizes of commercial reef fish are available.

Therefore, with funding from UNDP and assistance from FAO, through the Bay of Bengal Programme, MOFA initiated a Reef Fish Resources Survey in 1986. Under that project, a 14-month fishing survey of the reef fish resources of North Male Atoll in central Maldives was carried out (see *BOB News,* Issue No. 33). During that survey the following results were obtained

- Different types of fishing gear were tried; it was found that handlines and longlines were efficient at catching commercially valuable reef fish, while traps were unsuitable for reef fishing in the Maldives.
- The catch rates of commercial species were established, and first estimates of potential sustainable yields were made. In addition, a considerable quantity of biological information of value for longer-term stock assessment was collected.
- A preliminary examination of the economic feasibility of expanding the reef fishery was undertaken.

That survey was confined to North Male Atoll for reasons of logistics. However, it was recognized that extrapolation of results from a survey of a single atoll to the country as a whole could lead to erroneous conclusions. In particular, it was realized that in order to make an assessment of the reef fishery potential of the entire Maldives it would be necessary to carry out experimental fishing in other atolls with different ecological characteristics. Therefore, a second phase of the Reef Fish Resources Survey was undertaken, again with funding from UNDP and assistance from FAO-BOBP. During this second phase of the survey, reef fishing was carried out in three other atolls which were chosen because they are characteristic of the following conditions

SHAVIYANI ATOLL : A northern atoll, with atoll rim reefs poorly developed; numerous wide channels to the open sea; a moderate number of reefs inside the atoll basin. And a little reef fishing is carried out.

Baiting the longline aboard the R.V. *Farumas.*

ALIFU ATOLL : A central atoll, with a well-developed atoll rim, but also with numerous channels; a large number of reefs inside the atoll basin. A moderate amount of reef fishing is carried out.

LAAMU ATOLL : A southern atoll, with well-developed encircling reefs; there are a few channels and few internal reefs. No commercial reef fishing is carried out at all.

In the second phase of the reef fish survey, most of the work was carried out between August 1990 and July 1991. Several trips were made to each of the three target atolls to carry out longlining and handliing. In each atoll, fishing was done in each of three major habitats, namely the atoll basins, the shallow reef areas, and the deep reef slope,outside the atolls.

Results of the fishing survey

Catch rates by longline, day handline and night handline were established for each Of the three major habitats 11n each of the three atolls surveyed. Generally, handline catches were rather variable, but somewhat lower than commercial handline catches. This can be explained as being due to both lack of local knowledge and the tight fishing schedule, which resulted in handline fishing sometimes being carried out in less than ideal locations in between other activities.

Longline catches inside the atoll basins varied significantly and consistently between atolls. Highest catch rates were achieved in Alifu and N. Male Atolls in the central Maldives, while Laamu Atoll in the south gave the lowest catch rates. Catch rates in Shaviyani Atoll in the north were intermediate. It is difficult to explain this finding, because many ecological factors in the Maldives vary in a north-south direction along the atoll chain. For example, the strength of the monsoonal reversal, the number of openings from the atolls to the ocean, and the frequency of ring reefs, or *faros,* are all greatest in the north. In contrast, the depths of atoll basins and the lengths of reefs in atoll rims increase to the south.

Reef fish abundance in atoll basins might have been assumed to vary similarly along a north-south gradient. It clearly does not. Nor can the abundance of reef fish in atoll basins be related to reef fishing activity. Most reef fishing occurs in N. Male Atoll and Alifu Atoll. Some occurs in Shaviyani Atoll, and virtually none in Laamu Atoll. It is unlikely that reef fishing increases reef fish abundance; it is more likely that reef fishing is preferentially carried out in those atolls with large reef fish resources; If this is the case, it can be considered a fortunate coincidence that Male and the tourist resorts (which are the major markets for reef fish in the Maldives) are in atolls rich in reef fish.

In addition to longlining inside the atoll basins, it was also carried out on the reef slopes' outside the atolls. These reefs are often very steep and subject to strong currents, so longlines were often entangled, broken and even completely lost while fishing. Nevertheless, some interesting results were obtained. In relatively shallow areas *(Le.* less than 70 m) catch rates were achieved, probably because the many small fish living ón the reefs at these depths nibbled at the bait, leaving the hooks bare. Also, at great depths *(i.e.* below 170 m) catch rates were low, in this case probably because of relatively low fish abundance. However, at intermediate depths *(i.e.* 80-160 m), high catch rates (about 24 kg per 100 hooks) were achieved. Catches at these depths included significant proportions of deepwater snapper, such as *Aphareus rutlians,* and deepwater grouper, such as *Epinephelus morrhua.*

Ready to set the longline

Hauling in the longline

Stock assessment

A major aim of the survey was to make a stock assessment of the reef fish resources of the Maldives. While models for estimating stock size from trawl and echo-sounder surveys are well developed, this is not the case for longline or handline surveys. However, some recent work in New Caledonia in the South Pacific has demonstrated that there is a direct relationship between longline catch rates and reef fish abundance as determined by diving surveys. Using these findings and other information on reef fish abundance from the Pacific, it was possible to make a first, rough assessment of the size of Maldivian reef fish stocks. From these estimates, it was then possible to make rough estimates of the potential annual yields of reef fish, as follows

Atoll basins	24,000 ± 11,500t
Reef areas	*5,500* ± 1,500t
Deep reef slopes	500 ± lOOt
Total	30,000 ±13,000t

To put these figures into some perspective, it should be noted that the current annual catch of the Maldives is of the order of 70,000t, most of which is tuna. This estimate of potential reef fish yield is crude and imprecise, but is clearly much greater than current catches of demersal reef fish (unknown, but less than 5000t per year). The reef fish resources of the Maldives are underfished. The presence of many large and old fish in both survey and commercial catches reinforces this interpretation. While an increase in reef fishing activity is therefore, possible, and may be seen as desirable (particularly if a high value export market can be developed), the following points should be borne in mind:

- The estimate of potential annual yield applies to the country as a whole. The logistical difficulties of operating a high-value export-oriented fishery in the outer atolls would be considerable. Therefore, any such fishery is most likely to develop within reach of Male International Airport. The central area of Maldives already supports the highest level of reef fishing in the country, to supply Male market and the tourist resorts. This area may therefore suffer overfishing of the most valuable species and/or conflicts between users, while in other areas the reef fish resources remain relatively untouched.
- A particular source of conflict may be between resorts and fishermen. Tourism is now the most important industry in the Maldives, and many tourists visit Maldives specifically to dive or snorkel and observe the abundant fish life. In many other countries, spearfishing (which is banned in Maldives) in particular and overfishing in general have reduced the fish life, especially the larger species. An expanding reef fishery might not help tourism (although, paradoxically, the tourist resorts themselves are a major market for reef fish!).
- The deepwater snapper, which do have export potential and can be caught in commercially interesting quantities, in fact have a rather small stock size. This is because the zone of reef that they inhabit is no more than a narrow band around the perimeter of the atolls. These deepwater resources, being small

and thinly spread around the country, would probably be very easy to overfish locally.

– In contrast, the reef fish resources of the atoll basins appear to be considerable. They are also at present little utilized, so may offer considerable scope for development. The atoll basins have the advantage of being 'out of sight' as far as diving tourists are concerned. However, many of the fish species caught in the atoll basins are also present on the reefs, so any development of such a fishery should be carefully monitored.

Regional differences

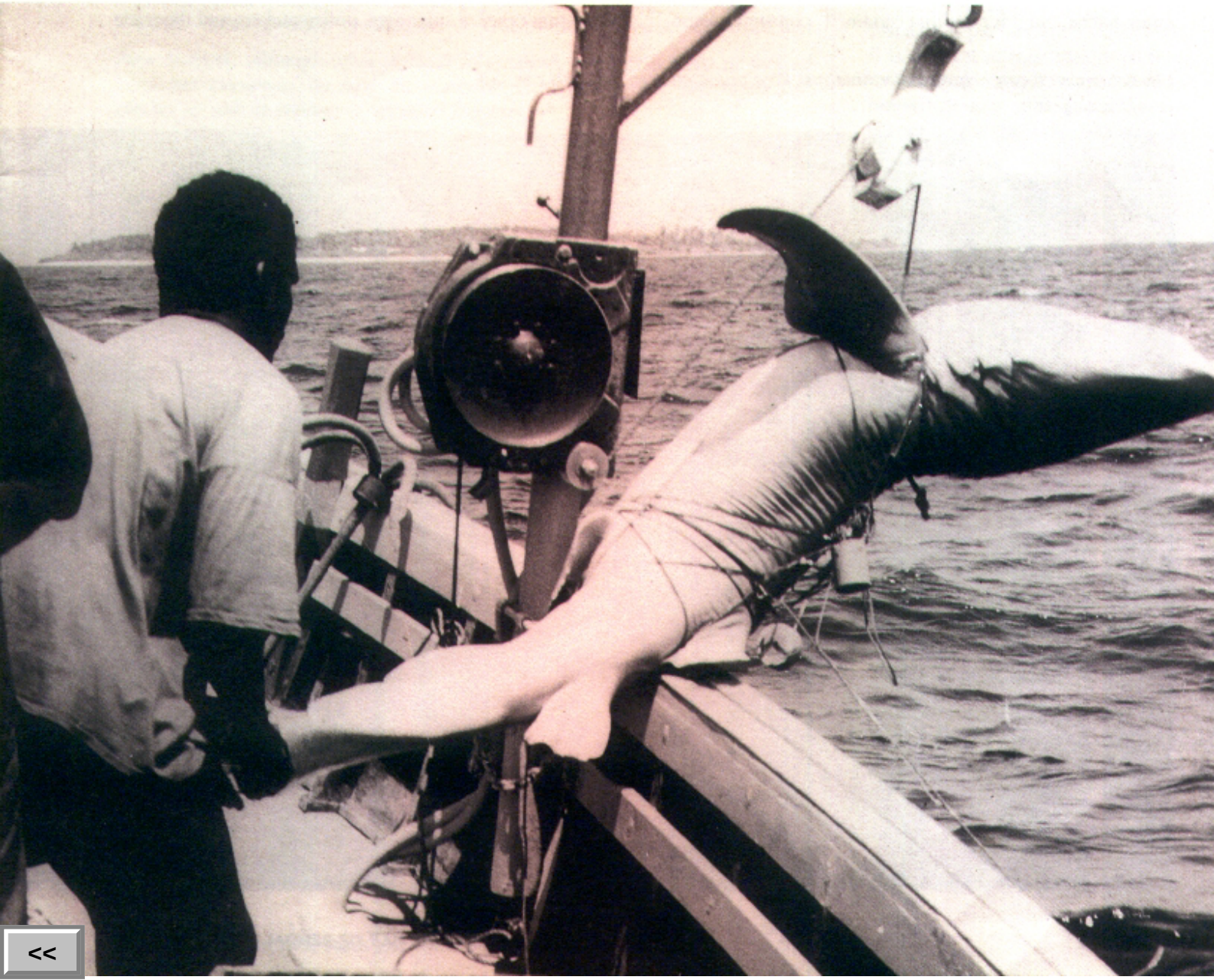
In addition to the estimation of potential yields of reef fish, another major result of the second phase of the Reef Fish Resources Survey was the finding that the fish fauna of Laamu Atoll in the south of Maldives is distinctly different from that of the three atolls surveyed in the centre and north of the country. In fact, the first day's fishing in Laamu Atoll in August 1990 produced five species that were previously unrecorded from the Maldives. These included two species of snapper that are' of potential commercial interest. Species of snapper that were common further north were rare in Laamu. Similar differences were noted in grouper, jack and shark catches.

As mentioned above, many ecological factors vary in a north-south direction along the Maldivian atoll chain, it is perhaps not surprising that the composition of the fish fauna also shows some north-south variation. What remains unclear is the extent to which the fish fauna of Laamu Atoll is representative of that of the southern Maldives as a whole, and, if it is, the position of the boundary, or the extent of the overlap, between the 'southern' and 'northern' fish faunas.

Conclusions

The Reef Fish Resources Survey in the Maldives answered the questions it was intended to. The Ministry of Fisheries and Agriculture now has a clearer picture of reef fish 'catch rates, species compositions and size compositions in the habitats and atolls sampled. It also has a first estimate of the size and potential yield of the country's reef fish resources. But, as with most, if not all, such surveys, many interesting new questions have now arisen which will have to be answered before a full understanding of the fishery resources is achieved.

Landing a nurse shark



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CONSUMER POWER
Market research Into fish consumption

by Tim Bostock

Active promotibn of non-traditional fish varieties backed by dynamic market research could be one solution to the problem of how to augment supplies of fish to an ever-burgeoning population in the face of dwindling coastal stocks. Can the power of the consumer be harnessed to stimulate new and more efficient directions in fisheries effort and, if so, who would spearhead these activities? An initial study of fish consumption in Madras is described and from this several issues are raised which may help to answer some of these questions.

Most of us are aware that the consumer is the main determinant of the quantity and diversity of fish supplied to the market. Because the Bengalis favour fresh water fish their markets are full of it, as the Tamils have a penchant for *sankara,* their markets supply them with it, and soon.

Indian consumers may be fairly conservative by nature in their fish eating habits, but it is clear that certain influences can lead to drifts in their traditional consumption patterns. Significant changes may arise either as a result of *internal* factors, such as changes in income levels and social status, or due to *external* factors, such as a sustained reduction in the supply of favoured traditional varieties to markets. The latter, often attributable to poor fisheries management, may lead to price increases to which the consumer responds by selecting other species which she perceives as satisfying similar needs.

Whereas unplanned external influences like those described often lead to vague drifts in consumption patterns, planned external forces, such as active **market promotion, can play a** significant role in inducing and controlling consumption patterns. The extent to which this can be achieved is of great interest to development planners, policy makers and the trade

Market research can help us determine just how much markets like this can put us off eating fish.

in general, because significant social, political and economic benefits can accrue to those who achieve success. The potential outcomes of controlled drif;s in both production and mai,keting sectors is also of particular interest to fisheries strategists anxious to identify ways of improving fish supplies in more sustainable and cost-effective ways.

Why is there a need to induce changes at present? The overriding consideration is that, with an ever-increasing population, the demand for fish is rapidly growing. Productivity is, however, declining, particularly in the inshore waters due to both a stark absence of coastal fisheries management and considerable post-harvest losses. This scenario raises several questions :

* To what extent is current demand being satisfied?
* What prospects are there of satisfying an increasing demand, either from existing production through more efficient marketing, or from new areas?
* Who is actually eating fish and how important is it in their diet?
* **How** are consumer attitudes towards fish consumption modified by parameters such as quality, price, availability, hygiene at point of sale? Just how flexible or intransigent is the consumer?

Without answers to these questions we are floundering.

In order to address as many of these questions as possible, the BOBP, through its ODA-funded Post-Harvest Project, undertook, in coordination with the Marketing and Research Group (MARO), a piece of exploratory consumer market research. This was implemented in two distinct phases: a quantitative listing of over 2500 households in Madras (approx. 0.25 per cent of the. population) followed by qualitative research to probe issues arising from the listing. One of the main variables studied was the differences in consumption between families of different income levels. The sample was suitably stratified to cover this. The intention is that, given useful results, similar studies could be commissioned in other consumer centres in the BOB region.

Some of the most significant results of the research, which is now nearing completion, are:

* 91 per cent of all Madras households are non-vegetarian (non-veg) fish consumers (98 per cent in the poorest sectors and 72 per cent in the most well-Off). Although there appears to be an increase in vegetarianism (veg) with increasing income, there also appears to be an underlying trend towards non-veg and, therefore, growing demand for fish. This is clearly shown by the increasing incidence of non-veg households with the decreasing age of the housewife.
* Of the fish eaters, all consume sea fish, 79 per cent consume shrimp, 64 per cent crab, 75 per cent dried fish and 20 per cent fresh water fish. It is of great interest that dried fish is consumed by all income levels. Nevertheless, it is mainly the poor (83 per cent of the <Rs 500/month) who eat it.
* Overall, the expenditure on all fish products (including crustacea and molluscs) is second only to milk among the animal proteins, but, significantly is the most important in the lower income groups (<Rs 1000/month).
* The average quantity of fish products consumed on a *per capita* basis is 7.2 kg. The amount of protein supplied by this is roughly equivalent to that supplied by milk, is twice that of eggs and several times that of either chicken or mutton. Overall consumption, however, is **low compared to other** locations (Sri Lanka 14.6 kg, West Bengal upto 25 kg) atid is particularly low among low income groups, a high proportion of whom consume less than 2kg/month.
* Fish is considered economical and better value for money (especially by the poor), more easily available (by all), tastier (especially by the poor) and easier to cook than any other animal protein food. Furthermore, the' perception of fish as "healthy" and "nutritious" is fairly high across

New markets, although often difficult to establish, perhaps because of lack of consumer awareness, do have the potential for improving and promoting fish quality as well as enhancing vendors' incomes.

Peripatetic traders such as these are responsible for the vast bulk of fish sales to the lower socio-economic groups.

all income groups. Amongst the negative factors highlighted were resistance by children due to smell and bones; skin allergy associations; heat producing tendency; status disbenefits; and difficulty in cleaning and preparation.

* Awareness of marine fish varieties is very high, *sankara* and seer standing out above all others in all income groups. Preference, however, is restricted to only a few types clearly demarcated by income. Whereas some fish groups appear to be acceptable at all levels *(e.g. sankara* and *sudumbo),* the majority are consumed to a lesser or greater extent according to income, *e.g.* seer, shark, pomfret consumption increases with income, whereas whitefish, anchovy, silverbelly consumption decreases. These differences are not motivated by price alone; most consumers also consider taste and availability as major criteria in first selection. Economy plays a major role mainly in the lower income group.
* Research indicated quite clearly that the market is not yet ready to accept processed or packaged food in its strictest sense. However, fillets and products which are near-to-basic in form could be offered on a trial basis. Only upper income consumers would pay premium prices for this type of presentation.
* Initial data on hygiene, sanitation and fish quality at the point of sale, puts freshness fairly high amongst the factors influencing a purchasing decision. As the current state of cleanliness of markets in Madras leaves something to be desired, this could well be identified as a key constraint in the qualitative study.
* Availability is more of a problem in the upper income groups, who tend to travel further to favoured points of sale. In lower income groups, fish is largely purchased at the doorsteps from itinerant traders.

Fish, it would seem from this, is very highly regarded by the vast majority of the population and across all income groups. It is a very important source of protein, especially amongst the poorer sectors. Even so, overall consumption is low, but this corresponds to the typical dietary habits of South India where consumption of animal protein is low anyway.

That there is an underlying trend towards greater meat and fish consumption is of great significance. With population growth, this will place an even heavier demand on the fish trade, which is already groaning under the effort and suffering through lack of investment.

Can the findings of such research help in achieving a change in consumer demand which would better accommodate to impoverished production, yet go some way towards meeting future demand? Some potential solutions are

– Address the existing marketing constraints through the development of improved wholesale and retail facilities as well as other essential infrastructure designed to increase the efficiency of the marketing operation, reduce loss and simply make the most of what is already there. It should be noted that promotional campaigns to improve awareness of quality and cleanliness at the point of sale are likely to be effective only if the cost of the technical interventions required can be passed on to the consumer. Considering the important role fish plays in the diet of the poor, this may not be possible at all levels.
– Promote the positive health aspects of fish consumption amongst the poorest socio-economic groups; dispel some of the myths and taboos about fish consumption.
– Take a closer look at new varieties of fish which are currently wasted or underexploited. Perhaps in the not too distant future, and with a strong promotional effort, skipjack, tuna or bonito could become as important in the diet of the Tamils as they are in Sri Lanka and as they are becoming in Kerala.

Who should spearhead these improvements and promotional strategies based on ongoing market research? Chicken, eggs, milk and other protein foods, not only have more centralized and organized production and distribution systems, but also have their own promotional organizations – such as the Egg Producers' Association of India, the Poultry Producers' Association, the Milk Marketing Board etc. Fish, is however, produced and marketed by large numbers of small-scale operators who can ill afford such activities.

It is unfortunate that in many BOB countries no such centralized body exists to support the domestic fish marketing sector. The development of an organization similar to the White Fish Authority (now Sea Fish Industry Authority), which has actively promoted domestic fish marketing and consumption in Britain for several decades, would be a vital step in the right direction.

Multiday offshore fishing shows promise

by J. Gallene

Exploratory efforts near Land's End in India have shown that traditional fishermen can be trained to make a success of fishing for large offshore pelagic species.

The traditional small-scale fishermen of the Bay of Bengal region have, for hundreds of years, fished inshore, using primitive but effective gear and craft. Most of their fishing has been done for short hours early in the morning or a few hours late in the evening. But the increasing number of small-scale fishermen and the decreasing inshore resources have been putting greater pressure on the poorer fisherfolk.

Five years ago, the Bay of Bengal Programme had helped out with a similar challenge in Sri Lanka and some impressive results were reported about the performance of new craft and fishing techniques BOBP had introduced in the island *(BOB News,* Issue No. 30, June 1988). The Tamil Nadu state government, India, concerned over the plight of its fisherfolk who use traditional *kattumaram* (log rafts), coastal gilinetters and small trawlers that do not go out more than 25 nautical miles, requested the BOBP to look into whether the Sri Lanka experience could be replicated in the state.

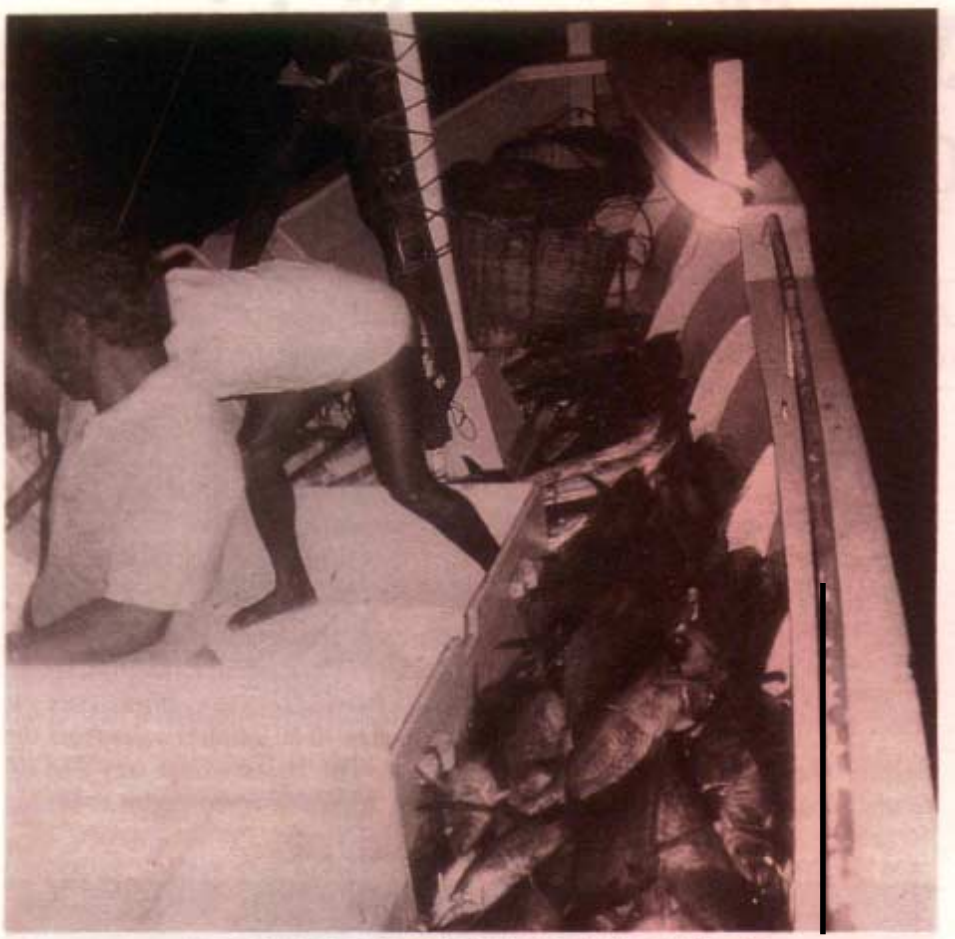
The preliminary reports of the BOBP effort from July 1990 to December 1991, from a base near Land's End (Kanniyakumari), indicate that small-scale offshore fisheries is a viable alternative to a fishery needing larger and more costly fishing vessels. While it is still too early to draw conclusions from a 16-month trial, the trends have been promising enough to indicatethe need for a further twelve months of trials before a final recommendation can be made on the advisability of a switch-over from traditional fishing practices to those tried out during the 1990-1991 operation.

The BOBP's exploratory exercise commenced with a SRL 15 craft, that the BOBP team had used in Sn Lanka, being moved to the new fishing harbour of Chinnamuttam, not far from the major fishing centre of Kanniyakumari, the southernmost tip of India. Six months later, a new SRL 15 was added, so, for most of 1991, two craft were available. But for much of that time only one craft was in use for one reason or another, each of which pin-pointed the factors that could affect for the worse such a fishery.

Despite these negative factors, the fishing, which ranged from Mannapad in Tamil Nadu, in the east, to off Kollam (Quilon) in Kerala, in the west, showed a modest Internal Rate of Return (IRR) of 19 per cent on a catch of 35,982 kg of fish that fetched a price of Rs 388,111 (appx. US $ 15,500).

To make this catch, the boats went out as far as 100 nautical miles from shore, but fished for the most part at distances 30-60 nautical miles from the coast. The boats would stay Out on most trips for three nights, running

Hauling in the driftnets and catch



A good catch of seerfish on the deck of SRL 15

Shark caught on a drift longline being loaded for market

during the day and drifting during the night.

At sunset, the gear, comprising a combination of large mesh gilinets **and** longlines, would be set and the boats allowed to drift. After about 7-8 hours of soaking time, the gillnets would be hauled in. The catch was mainly tuna species, such as yellowfin and skipjack, some billfish species, the occasional shark and other large pelagic species. The longline was hauled in around 5 a.m. Its catch was mainly shark and billfish species. Once the catch was stored with the ice carried on board, the boats would start engines and run for 3-6 hours to reach a new fishing ground. And preparations would then begin for the next night's fishing.

Several problems during the trials over 16 months not only affected the economy, but should also be considered before any long-term project on similar lines is initiated. These include

1. The training of traditional fishermen in the handling of new craft and the use of new fishing techniques.
2. The lack of shore facilities to cope with mechanical failures of craft.
3. The low price pelagic fish, such as tuna and shark, fetch in India.

While the traditional fishermen are amenable to training, multi-day fishing does not appeal to many. The defections of crew during training **were** substantial in the early months of the operation. In time, however, more stable and willing crews were assembled and they responded well to multiday offshore fishing.

During the training, four crew for each craft had to be not only trained in most aspects of offshore fishing operations, but endurance at sea was at first limited to only 24 hours. This had to be gradually increased up to 4 days — and this took time.

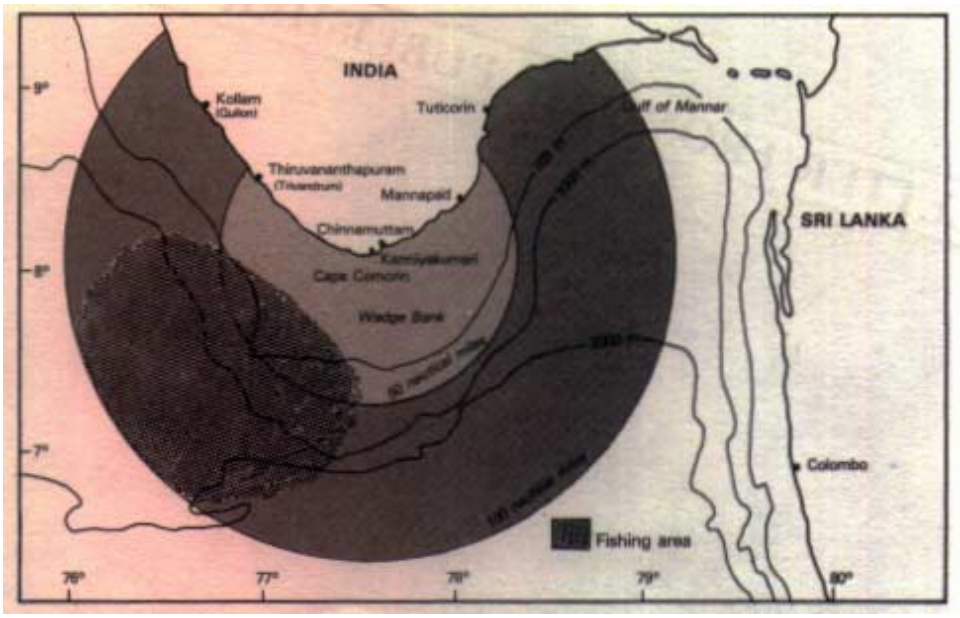
The non-availability of spares laid up the first SRL 15 for a long time. The sea trips also indicated the need for training of at least some of the crew in coping with mechanical failures. And, during the trial period, a shortage of fuel, caused by the Gulf Crisis, severely limited the boats going out.

The catch from these trials posed the third problem. Indian consumers do not relish tuna and shark and are

suspicious of iced fish. Hardly any coastal driftnetter on a night's fishing uses ice. In time, however, the local buyers were weaned from the belief that fish iced for long periods gets spoilt. But getting the Indian consumer to eat tuna or shark by choice is likely to be a lon&er struggle and would require major marketing inputs. Meanwhile, such fish do not fetch an attractive enough price to make the fishermen want to go out to sea for four days at a stretch.

One particularly positive aspect of the training was the ease with which the fishermen became familiar with a simple method of establishing their position at sea. This was done with a medium waveband PHILIP'S transistor radio receiver made in India. This was used as a direction finder by tuning in to two broadcasting stations in India (Thiruvananthapuram (Thvandrum) and Tirunelveli), as well as one in Sri Lanka (Colombo). To cross the appropriate bearing lines, a **copy of the Marine Chart,** on which bearing lines were traced, was used, giving a position of about 15 nautical miles triangular precision nearly 80 nautical miles from shore. This portable radio, which costs about Rs 600 (approximately US $ 23), can be afforded by any of these fishermen. It took three months to train four fishermen with little or no reading **background to** become confident with **this navigational system and it** has been **well appreciated by several other** fishermen since.

It is against the background of these problems that it is felt that a further 12-month trial should be conducted to assess the real economic feasibility of such fishing. The ideal number of 4-day trips, about 50 a year, should be attempted during this period. Simultaneously, **some of the problems** mentioned, such as better marketing of pelagic fish, should be addressed. It will then be possible to discover **whether a** small-scale offshore fisheiy is a viable alternative for fishermen wedded to inshore fishing using traditional craft.



CRAFF **DATA**

The SRL 15 is a FRP boat whose present price is about Rs 400,000 (US $ 15,500) **It** accommodates four crew members and has a galley equipped with a gas stove allowing the crew to have hot meals at any time. Its other features include an emergency dipping lug sail, compass and manual longline drum. Its specifications are:

LOA	9.65 m
BEAM	2.70m
DRAFF DWL	0.90 m
TONNAGE	3.5 tonnes
ENGINE POWER	25 hp Yanmar diesel (watercooled)
SPEED	7.5 knots
FRESHWATER	2001
DIESEL FUEL	285 l
FISHHOLD	1.4 tonnes

Six hundred kilos of ice is carried on each voyage, enough for a fishing trip of three nights. Its fishing gear comprises of a fleet of 20 multifilament drift gillnets, 125 mm and 130 mm mesh size (1.5 km), longlines (maximum 100 hooks or 3 km) and three trolling lines. The complementary trolling lines are used to and from the fishing grounds to capture small tuna and similar species.

OPERATIONAL DATA (for **16 months)**

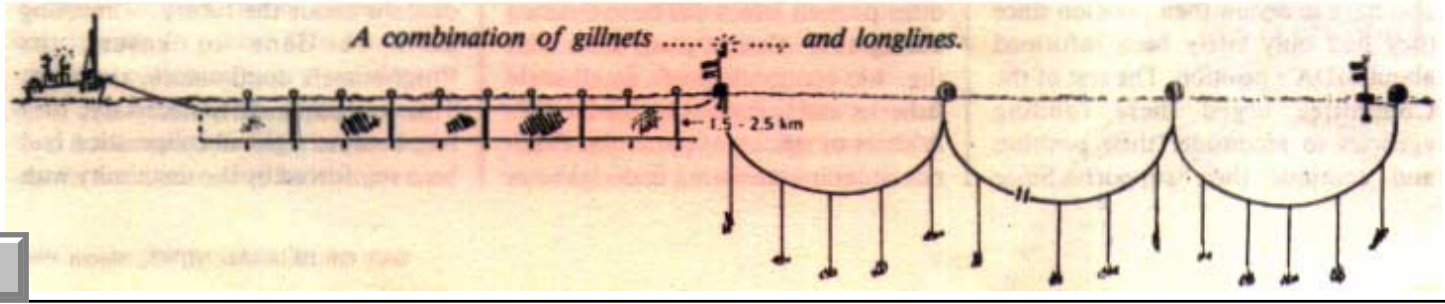
Trips (no)	:96
Time at sea (h)	5204
Fishing days (no)	215
Sailing engine time (h)	2730.25
Total catch (kg)	35,982
Gross earnings (Rs)	388,111
Total variable cost (Rs)	91,558
Ice value as per cent of variable cost (/o)	11
Gross cashflow to boat-owner (Rs) (60 per cent)	166,470
Net cashflow to boat-owner (Rs)	154,329
Cash flow to crew members (Rs) (40 per cent)	111,147
Earning per month by crew (Rs)	1744

FUEL DATA

Fuel consumption (1)	9,100
Fuel consumption (Rs.)	49,182
Fuel expenses (per cent of gross earnings)	13

- including cost of diesel fuel, ice, food etc.

After maintenance expenses



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LETTER FROM THE PUBLISHER

Phase I : Development of small-scale fisheries

Phase II : Small-sca

Over the years, the Bay of Bengal Programme (BOBP) has had fairly smooth sailing with regard to funding support. Rough weather, which rocked the boat considerably, was encountered for the first time at the 16th Advisory Committee meeting held in Thailand in January this year. The only consolation was the splendid hospitality of the hosts.

The most important item on the agenda was the discussion on the proposal for a third phase of the "mother project" of the Programme, for which endorsement by the funding agencies was anticipated. Fisheries Management had been proposed as the main theme of the third phase. The two earlier phases had been mainly oriented towards technology development and extension, respectively.

While the content of the third phase proposal was endorsed, the Committee was shocked to hear that SIDA, the major funding agency since the inception of BOBP, had no plans to continue their support. In view of this, DANIDA, the co-sponsors of the second phase, stated that they would also have to review their position since they had only lately been informed about SIDA's position. The rest of the Committee urged these funding agencies to reconsider their position and continue their support. Since DANIDA had explicitly stated that they were very satisfied with the performance of the project, there is still hope that they will come forward with at least a substantial portion of the funding.

As a consequence of this uncertain funding position, the Committee decided to advise the Project to economize its operation by phasing out those subprojects that could be completed before the end of the second phase in late 1992 and to cut down on all non-priority activities. It was also suggested that efforts should be made to seek supplementary bilateral funding support for specific activities.

A silver lining was that the ODA may continue the Post-Harvest Fisheries Project, irrespective of the decision on the third phase of the proposed DANIDA/SIDA sponsored project. This was much appreciated by the Committee, since Post-Harvest matters ,are becoming increasingly important in view of the scarcity of the fishery resources. It is now more than ever necessary to make more of less.

The Programme has at present two other projects which will be terminated during 1993. One of them deals with the bio-economics of small-scale fisheries and is funded by the UNDP. A series of studies of particular fisheries situations are being undertaken in five of the countries in the region, with emphasis on integrating economic, social and biological aspects as a preparatory measure for fisheries management. The other project attempts to assess the pollution hazards in fisheries in the Bay of Bengal area of the participating countries. This is sponsored by **SIDA** through the **SWEDMAR division of the National** Swedish Board of Fisheries. This project will culminate in the first quarter of 1993, with a regional workshop to discuss the findings. A minor project supplementary to the latter deals with promotion of cleaner fishery harbours and is sponsored by SIDA through IMO.

The situation at present is, therefore, that the Programme will continue to exist as a multidisciplinary organization till the end of 1993 but may, thereafter, only consist of the Post-Harvest Fisheries project.

The country representatives were greatly disappointed by the news given by the funding agencies at the Advisory Meeting and both in and outside the meeting they expressed their deep concern about the future. Something must be done to ensure the Programme's continuance, they felt. This was particularly necessary, they felt, because regional cooperation had been reinforced by the unanimity with

sherfolk communities

The Future of BOBP

Phase III : Management of small-scale fisheries??

which the Committee had now assigned the highest priority to fisheries resources management in particular and environment protection in general. In the past, the views of the Committee had been more diverse, with different countries assigning different priorities to subjects such as Fishing technology, Brackishwater culture or Extension.

It was felt that the Programme as it exists now provides a very valuable forum for cooperation in solving problems and meeting challenges of common concern. The fact that the countries are increasingly making use of it demonstrates its usefulness and the sustainability of its efforts. In the long run, the countries will have to cooperate in their exploitation of their fishery resources and then BOBP may form a suitable base or vehicle for such cooperation.

During the preparation of the third phase proposal, a lot of aspiratiojis and hopes had been raised and in some countries (Sri Lanka, for instance) requests for assistance had not been made to other donors, such as UNDP, because support from BOBP was anticipated. In others (Thailand, for instance) national funds have already been allocated for third phase activities. And in all the countries, arrangements are under way for the government's cash contributions. A participant at the meeting compared the Programme's situation to an aircraft being forced to reverse its engines at the end of the runway just before take-off.

BOBP has, over the years, been a leading regional programme, not only in the Bay of Bengal area, but also in a global perspective. It has been a path-breaker and trend-setter in many areas *e.g.* multidisciplinary approach, the role of women, non-formal education, people's participation, stimulation of private sector participation in development and extension, bio-socio-economic approaches and environmental studies. Much of this has come about on suggestions from the donor agencies through the Advisory Committee.

In the proposed third phase, there is no doubt that BOBP would also take a lead in small-scale fisheries management, which would generate an impact in the participating countries and have an influence in other parts of the world. The impact of the work is, thus, much more far reaching than might be apparent from a clinical analysis of particular activities. For instance, the debate in the Advisory Committee Meetings on development and management issues is an ongoing process and since the countries are represented by very high-level fisheries administrators, the ideas and views expressed in the meetings are having an impact on the policies for fisheries development in the respective countries.

It is to be hoped that the funding agencies will consider in depth the above mentioned aspects and favourably reconsider the position taken in the Advisory Committee Meeting. It is also to be hoped that, in addition to the mother-project, other agencies will join the Programme with supplementary projects as in the past, so as to facilitate consolidated and coordinated support to small-scale fisheries in the region.

The Advisory Committee meeting was held January 22-23, 1992 at the Metropole Hotel in Phuket, Thailand, and was chaired by Dr. Veravat Hongskul, Assistant Director General, Department of Fisheries, Thailand. The meeting was attended by all BOBP countries as well as Myanmar which attended as an observer. All the major funding agencies – DANIDA, SIDA and ODA – were also present and this time the EEC was also there as an observer.

L O ENGVALL

Cleaner Fishery Harbours in the Bay of Bengal

by R. Ravikumar

Garbage, sewage, fish offal, oily bilge and faeces are not words that should go together with shrimp, mackerel and tuna. But they do in most of the fishery harbours and landing centres in the region. This pollution was the topic of discussion at a regional consultation held in Penang, Malaysia, December 9-11, 1991.

The consultation followed an IMO-sponsored project under which country surveys, to obtain baseline information on pollution in selected fishery harbours, were conducted in India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand (See Table 1). In each case, the surveys were conducted by a team of national experts in marine pollution and post-harvest technology. The findings of the surveys were discussed at the consultation.

Some of the conclusions of the discussions were

- Harbour water pollution is mostly organic in nature.
- Garbage collection and disposal facilities must be improved.
- Clean water must be provided for washing fish.
- Toilet facilities must be improved.
- Harbour managers need to be trained.

Lack of awareness among the users on the importance of keeping the environment clean was seen as a major problem. Standards for water quality and sewage disposal were also required if rules and regulations were to be adopted and enforced.

To remedy the situation, the consultation recommended follow-up action that addresses these problems. In addition, it was emphasized that integrated planning was required to enable all those responsible for environment, urban planning, industrial development, health and fisheries to collectively act and prevent further environmental degradation, not only in fishery harbours but beyond its confines.

The whole exercise was a result of the interest expressed by member countries of the Bay of Bengal Programme in having another IMO-sponsored, BOBP-executed pilot project similar to the one in 1988-89 aimed at improving the port environment at Vishakhapatnam. That project had brought out the fact that fishery harbours could be polluted in many ways and, more importantly, fish quality could be seriously affected, especially if washed using polluted harbour waters.

Table I

Fishery harbours surveyed under the project

Country	*Fishery harbours*
INDONESIA	Belawan, Lampulo, Bungus
INDIA	Kakinada, Madras, Tuticorin
MALDIVES	Male, Felivaaru
MALAYSIA	Batu Maung, Kuala Kedah
SRI LANKA	Beruwela, Galle, Tangalle
THAILAND	Ranong, Phuket, Satun province

The fmdings of the more recent surveys confirmed that most of the fishery harbours suffered from pollution of one kind or another. Though some had specific problems, the majority had several in common. And one of the common problems is that in almost all the places, polluted harbour water is used to clean the fish at some stage after landing.

Fishery harbours are busy places. Landing of fish, marketing, boat supplies, fuel and water supplies, boat repairs and fish processing are some of their activities. Nearly all generate pollutants and, if the infrastructure to handle them is inadequate – which is the case in most places – the port environment and the harbour water quality suffer. The problem can be exacerbated by untreated sewage and other effluents flowing into the harbour.

Many such cases of pollution were presented on video at the consultation. Several of these visuals were quite shocking and generated concern among the participants, who felt there was urgent need to initiate clean-up operations, so as to avoid giving the fishing industry a bad name. (BOBP will shortly publish a report on the consultation and release a video highlighting the various problems.)

How relevant such a project is can be debated. After all, the bulk of marine landings in the region are on open beaches and at small landing centres. And there are not many reported instances of public health problems due to polluted fishery harbours. However, the fact remains that most of these fishery harbours have been created at an enormous cost to provide better and cleaner landing and other facilities for the motorized fishing fleet which is growing all the time. This investment needs to be protected, if not salvaged.

From top right, dockwise:

- *AnimaLs have free access to the fish-handling areas of the harbours*
- *Decomposed fish offal lies strewn around in these harbours with maggots and worms pro!jferating*
- *Rubbish is abundant in the harbours and BOD values high*
- *Bilge water is regularly discharged into the harbours*
- *Fish are gutted on the piers and waste washed into the harbour waters.*

External resources play major role in fisheries development in the Bay

by Claude Fernando

A clearly discernible feature of the development of fisheries in the Bay of Bengal region is the reliance on external resources by countries in the region. In most of the member countries of the Bay of Bengal Programme (BOBP), the financial resources allocated in the national budget for fisheries development are meagre compared to the actual needs. This is largely due to the low priority assigned to fisheries in almost every member country with the possible exception of the Maldives. The relatively high financial costs involved in fisheries research and fish resource studies and surveys, and in the building of fisheries infrastructure such as harbours, jetties etc. is another reason for the heavy reliance on external resources.

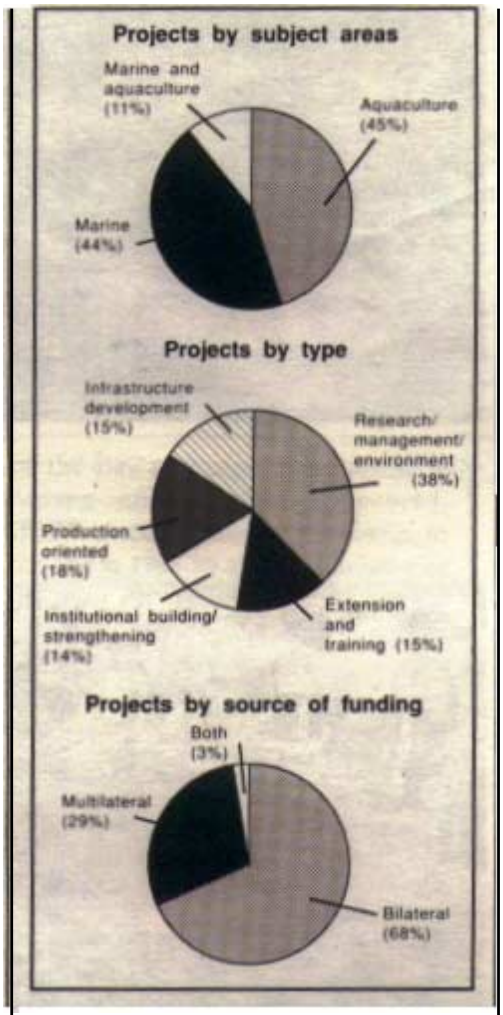
External assistance for fisheries development in the region, as in most of the other underdeveloped regions of the world, has come from multilateral aid agencies such as the United Nations, the World Bank and the Regional Banks (such as the Asian Development Bank) and countries such as the United States, Japan and the European nations.

The following analysis of the situation is based on information provided by the member countries of the BOBP. and covers those projects which were being implemented or were in an advanced stage of preparation in 1991. For convenience of presentation, aquaculture and inland fisheries have been grouped together. In the multilateral funding categories are included all the projects supported by the United Nations system, the World Bank and the Asian Development Bank.

Externally **Funded Regional** Projects

The countries in the Bay of Bengal region area benefit from three categories of externally funded regional projects. They are:

i) Projects implemented exclusively within the ASEAN group and covering Malaysia, Thailand and Indonesia. In this category there are three projects, two of which are funded by the European Economic Community (EEC) and the third by Canada (CIDA). The project funded by Canada is concerned with post-harvest fisheries technologies, to improve Government facilities for inspection and quality control, and the exchange and transfer of technology within ASEAN. The other two projects are concerned with aquaculture development and fisheries resources evaluation. The total cost of these projects is US $ 1lm.



ii) Three major projects and four smaller projects have been implemented under the umbrella of the BOBP. The major projects are the Project for Small-Scale Fisherfolk Communities in the Bay of Bengal (funded by SIDA and DANIDA), the Project for Post-Harvest Fisheries (funded by ODA) and the Project for Bio-Economics of Small-Scale Fisheries (funded by the UNDP). Three smaller projects are the Project for Assessment of Pollution Hazards in Fisheries (funded by SIDA), the Project for Training of Small-Scale Fisherfolk Communities (funded by AGFUND), and the Cleaner Fishery Harbours Project (funded by IMO). In addition, there is the BOBP's Information Service, which is truly a regional co-operative effort, being co-funded by all seven member countries.

iii) Two regional projects, covering a much wider geographical area than the Bay of Bengal, are the Tuna Development and Management Programme in the Indian Ocean and South East Asian Region, and the INFOFISH Project. The former is a project aimed at building a self-sustained data base on Tuna fisheries, while the latter aims at facilitating the transfer of appropriate fish handling and processing technology, dissemination of technical information and the support of training activities in order to improve the quality of fish products in the region.

Externally Funded National Projects

Sixtysix national fisheries development projects have been completed or are in different stages of implementation in the BOBP countries within the 1985-94 timeframe. These projects can be broadly categorized under Technical Assistance Projects and Investment Projects.

There are 49 projects that fall into the category of Technical Assistance Projects, while 17 are Investment Projects. The total cost of these projects is US $63 m and US $424 m respectively.

Twentynine of the projects have been in the Marine Fisheries Sector, while 30 support aquaculture and inland fisheries projects. Seven projects have been of a general nature, covering both subsectors. This reflects the trend seen in the past two decades of more and more emphasis being placed on inland fisheries and aquaculture. This emphasis is primarily due to the potential of aquaculture to bring in increased foreign exchange earnings through exports and to absorb the coastal fishermen likely to be displaced from fishing as a result of dwindling resources.

Source of Funding

The largest number of projects have been funded by bilateral donor agencies in the developed countries. These agencies supported 45 of the 66 projects. However, in terms of the amount of funding, these accounted for only 24 per cent of the total funding. The multilateral agencies, including banks and the United Nations agencies, funded 19 projects. Though this number is relatively smaller, it is noteworthy that these projects accounted for 57 per cent (US $ 280 m) of the total funding. In addition, there were two other large projects, in Bangladesh and the Maldives, funded through a combination of multilateral and bilateral assistance. These projects accounted for 19 per cent of the total funding.

Types **of Projects**

The largest number of projects *(25)* have been in the category of research management or environment-oriented. The other subjects dealt with are, in order of importance: Extension and Training (10), Institution Building and Strengthening (9), Production-oriented (12) and Infrastructure Development (10).

Most of the research and environment projects are very small, as far as cost is concerned, and limited in.ierms of scope and objectives. The large number of institutional building projects are designed to support the newly created organizations primarily concerned with research and training, for which assistance has come primarily from the UNDP. The infrastructure projects, though few in number, are by far the most expensive in terms of cost (about 35 per cent of the total external assistance). Such projects include the building of fishing ports and harbours as well as cold room/freezers, ice plants etc.

One noteworthy feature about the types of projects is that very little attention has been paid to post-harvest aspects. There are only three projects primarily concerned with post-harvest aspects and even those projects are to be implemented in countries which are already well developed and advanced in post-harvest aspects (Thailand and Malaysia). Another significant feature of the project types is the virtual absence of any projects concerned with the introduction of technologies in marine fisheries.

Extension and training, as well as institution building and strengthening, continue to be subjects preferentially supported by multilateral donor agencies. Another interesting feature is that fisheries management, which is now accorded higher priority than in the past, is yet to be supported by external agencies on any major scale. Perhaps this is due to seemingly negative aspects which make management projects unattractive to most donor agencies, particularly the bilateral agencies.

The countrywise situation with regard to externally funded national projects is as follows

Bangladesh

The 15 projects cost US $ 162.7 m of which US $ 8.7 m is for Technical Assistance Projects while the rest is for six investment projects. Of the *15,* six are funded by bilateral sources, seven by multilateral sources and two by a combination of bilateral and multilateral sources. Inland fisheries and aquaculture projects are predominant, and out of 15 there are nine such projects, indicating the high priority accorded to such activity in the overall fisheries development programme of the country. It is also worthy of mention that as many as six projects are extension projects — also in aquaculture and inland fisheries.

India

India has only five externally funded projects, all of which are supported by bilateral funding agencies. Considering the area and the population of the country, the total cost (US $ *33.5)* is relatively small. Three of the five projects are in marine fisheries and **two** are in fisheries research.

Indonesia

Indonesia's eight projects cost the most — US $ 192.4 m. Six of these (all technical assistance) are **funded by** bilateral sources, while all the investment projects are funded by multilateral sources. By subsector, there is a balance: Three are inland, two are marine and three are common to both subsectors.

Malaysia

As in the case of India, Malaysia's external assistance projects are not very many in number or much in cost. There are only five Technical Assistance Projects in all, of which three are funded by bilateral agencies.

Maldives

There are eleven projects, of which nine are technical assistance projects and two investment projects. The investment projects account for as much as 90 per cent of the total project cost.

Sri **Lanka**

Sri Lanka is implementing eight projects, of which four are technical **assistance projects and the others** investment projects. But the investment projects account for almost ***95*** per cent of the total cost. Two of the four investment projects relate to the development of infrastructure — **a** labour and a cold room complex. Unlike in most of the other countries (with the exception of the Maldives), there is a large marine fisheries bias in Sri Lankan projects — sil out of the eight being exclusively concerned with marine fisheries.

Thailand

Thailand has the second largest number of projects, 14 in all, but all these projects are small and cost a mere US $ 18.2 m. All are funded through bilateral sources. Half the projects are concerned with very narrow and specific research activities. It is noteworthy that not even a single investment project is supported **by** external sources. This is quite different from the situation in the other countries and may reflect the affluence of the economy in general and the dominant role of the organized private sector in Thai fisheries.

Why did seaweed farming fail?

Charles Angel4 BOBP Senior Aquaculturist, examines some of the factors that led to the failure of seaweed culture projects supported by BOBP and some of the lessons learned from the experience.

This is the story of an aquaculture project that did not succeed despite the enthusiastic participation of the fisherfolk of several villages in South India and Sri Lanka. But if seaweed farming failed as a pilot project, it nevertheless did demonstrate that, with its technology so readily acceptable to fisherfolk, there exists the potential, in the right circumstances, to nurture an income-generating activity that is, at the same time,easy on the marine environment.

The Bay of Bengal Programme's (BOBP) seaweed farming experiment provides a classic study of the whys and wherefores of aquaculture and of what can go wrong with such projects despite the most careful planning. As such a study, it warrants a closer look.

The increasing contribution aquaculture makes to fisheries production worldwide is what has aroused the interests of governments and development planners. They see it as a potential export earner on the one hand and an income generator for rural folk on the other. The BOBP's focus has been the latter. BOBP has, since its inception, worked with its regional partners to develop suitable aquaculture technologies that could be handled by coastal fisherfolk, and which would help them to generate additional income.

That successes have been few attests to the complexity of the technology transfer process in the context of the coastal fisher folk communities. "Appropriate technology" is, therefore necessary in alt such cases and this means not only low cost inputs of minimal complexity, but also technology that fits into the economic and social milieu of the community. BOBP's seaweed farming project took note of this and adapted appropriate new technologies that were accepted by local fisherfolk. Thereafter, it showed much promise, but in the end, the pilot projects had to be described as failures. Not because of lack of technology acceptance by the fisherfolk or the non-availability of markets but because of several other reasons, explained and unexplained. This, then, is the story of an experiment that promised much but ended disappointingly.

Seaweed farming

Most of the region's coastal aquaculture development had for years stressed shrimp for its foreign exchange-generating potential. But the experience of transferring shrimp culture technology to local fisherfolk had not been very successful. Seaweed farming appeared an attractive alternative. *Gracilaria* is in considerable demand in India and Sri Lanka, especially for use as a gel in the food industry.

Some of the poorest fisherfolk in the region are to be found in such areas as southern Tamil Nadu, in India, and the Puttalam District of western Sri

A good crop of seaweed at a farm in Vedalai, Tamil Nadu

After the grazers have been at work

Lanka, but, physically, these areas are not suitable for shrimp culture using available, proven technologies. However, both areas have been traditional producers of natural *Gracilaria* and seemed to be ideal sites for farming trials. The fisherfolk here were familiar with seaweed, and established marketing chains existed in southern Tamil Nadu.

The offshore islands in this part of Tamil Nadu are known as the 'seaweed belt', but overharvesting had severely depleted natural stocks. Harvesting of natural seaweed in the Puttalam area was, on the other hand, inconsistent due to natural growth factors and local marketing practices. It was against this background that BOBP selected these two areas for its trials.

Although almost all commercial farming of *Gradilaria* world-wide is in ponds, the BOBP aquaculturists chose open sea culture because both 'the Puttalam District of western Sri Lanka and the Ramnad District in southern Tamil Nadu have sandy coasts where freshwater is scarce. Pond culture would not have been possible in such areas.

Open water culture trials in Penang, Malaysia, by BOBP in 1983-84, had demonstrated a technology that was technically feasible.

The Projects

In Tamil Nadu, the Department of Fisheries was the lead agency through its Kurusadai Island Marine Biology station in Mandapam, Ramnad District. The participant selection process involved extensive interviews and meetings BOBP field workers had with fisherfolk in several villages in the district. Eventually, two villages, Vedalai and Chinnapalam, were selected. These villages formed their own management committees, each headed by a chairman. The committees were responsible for organizing the seaweed farming activities. An article in the *Bay of Bengal News,* December 1989 (Issue No.36), describes the village selection process in detail.

The village activity in Sri Lanka was implemented by the Sarvodaya Shramadana Sangamaya, Sarvodaya for short, with technical and financial support from BOBP. Sarvodaya is a very well established NCR) with a remarkable record of promoting village self-help schemes. BOBP felt that Sarvodaya was particularly appropriate because it had a variety of programmes underway and was trying to expand its work in the Puttalam District. The National Aquatic Resource Agency, NARA, undertook a research component closely tied to the vifiage activity.

A biologist was assigned to the seaweed culture project and BOBP constructed a lab on the coast near Puttalam where spore-setting would be undertaken.

NARA's biologist consulted closely with the Sarvodaya field coordinator, exchanging experiences and passing on research results. It took some months to encourage good communication between the two parties, but towards the end of the project, communication was satisfactory and demonstrated the potential for collaboration between research and village workers.

The approach taken by Sarvodaya in Puttalam was much better when compared to that in the two villages in Tamil Nadu. In Puttalam, the seaweed culture trials were only a part of a wider range of activities organized on a voluntary basis. Although fewer participants were involved, the level of motivation was high. Most were young people with lots of energy and the willingness to take risks.

Despite such comparisons it must be stressed that people's participation was very good in both Sri Lanka and in India. Activities were carried out more or less on schedule, weather permitting. Vandalism and theft were almost nonexistent (the one minor case that did arise in Vedalai was resolved by the

participants themselves). The villagers proved fully capable of handling *Gradilaria* farming technology from spore-setting to vegetative propagation. The Chinnapalam participants even designed a spore-setting shed which was a considerable improvement on the one installed by BOBP's staff in Vedalai!

Failure: The reasons why

RAMNAD DISTRICT: The project's failure can **be** attributed to biological factors, known and unknown. And of these, site selection appeared to be the dominant one. This only illustrates what can go wrong when the environmental requirements of the target species are over-ridden by other considerations.

The offshore islands of Ramnad District, the 'seaweed belt', is where the pilot project should have been implemented; stocks of *Gracilaria* occur naturally there. Indeed, experiments done some years back had shown promise. Unfortunately, the islands were declared a national park in 1989 and placed under control of the Forestry Department. The park is intended to protect the dugong, an endangered species, and development activities are prohibited. Traditional seaweed harvesters could be excluded should regulations be strictly enforced.

The declaration of the park as a sanctuary had been anticipated at the onset of the seaweed project. It was seen that the livelihood of the fisherfolk would be threatened as much by possible exclusion from the islands with their natural stocks of *Gradilaria* as by over-harvesting. There was, therefore, ample justification to select sites along the mainland, near villages dependent on harvesting the seaweed of the islands. Scientific research institutes had also conducted trials in the area which seemed to indicate potential for *Gracilaria* farming. However, these experiments were very small-scale and of short duration.

Banking on BOBP's Penang experience, a pilot project including *45* culture units and two spore-setting sheds was set up in the two villages. It was felt that the pilot project should be large enough to give results which could be extrapolated to a production system. But after several months of spore-setting trials at Vedalai, no germination occurred on about 90km of lines. Spore release and setting had been observed. Nevertheless, no young plants were ever observed on outplanted lines. The reason remains unknown to this day, even after consultations with experts.

As an alternative to spore-setting technology, the BOBP team decided to undertake large-scale vegetative propagation using cuttings inserted in HDPE rope. The fatal scourge of the project immediately manifested itself - rabbitfish! The pilot farms had been established in seagrass beds which were the grazing grounds for juvenile *siganids* (rabbitfish). Repeated outplantings were quickly chewed down to stubs! There were a few months during the last and first quarter of the year when most of the juveniles migrated beyond near-shore environment. Some culture was possible at those times, but not enough to support an enterprise.

Scarelines, traps and fencing were tested for their effect on the grazers. The first two options proved ineffective, while fencing was too expensive to sustain even by the theoretical productivity of farm units. Nevertheless, early in 1989, some good growth occurred inside one of the fenced units at Vedalai. A partial harvest was made by pruning. Much to the horror of everyone, most of the pruned plants degenerated and died shortly after the harvest! It would seem that the seedlings had been under stress and could not tolerate the pruning shock. The reasons are, again, unknown.

In sum, the plants were unable **to** adapt to the near-shore environment.

If the microhabitat of natural stock around the offshore islands is compared with that at the culture site, there is little difference in temperature and salinity. But there are other observable differences. The natural habitat is open sandy bottom, where *Gracilaria* is often found in association with other species of both red and green algae. The water has flowed over and around an offshore fringing reef, most likely altering its chemical composition. The near-shore region, in contrast, is carpeted with *En/ia/us,* a seagrass. During windy periods, the water is more turbid than around the offshore islands.

These observable environmental differences may or may not have been prejudicial to the transplanted *Gradlana,* but it is believed that biotic rather **than** technological **factors have** been

Traps were tried out in Tamil Nadu to catch the predator rabbitfish

responsible for the poor results in **Tamil Nadu.**

SRI LANKA: The same *Gradilaria* species in Sri Lanka is found in close association with seagrass! Spores appear to set on exposed rhizomes (underground stems of the seagrass) from which new plants germinate. The life cycle of *Gracilaria* in Puttalain also proved to be markedly different from that of the offshore islands of Tamil Nadu.

The events in the cycle became clearer during the latter half of 1989 and early 1990. Spore-producing female plants appeared in August. Spore release peaked in October and by February the female phase degenerated. Little is known of the fate of *Gracilania* during the following months. Thalli are not visible, although it is presumed the seaweed is in its asexual, or tetrasporic, phase, perhaps outside Puttalam Lagoon.

During the last quarter of 1989, NARA scientists were able to demonstrate the feasibility of spore-setting, albeit on a small scale. Once set, spores entered a dormant period of two months, quite contrary to the experience in Penang, where germination occurred within a few days of spore-setting. But following the appearance of young thalli of about 1 cm, signalling the end of the dormant phase, growth was astonishingly rapid. Plants could be harvested in 60-90 days.

Preparations were made for further spore-setting trialsin 1990. The reappearance of spore-bearing plants was anticipated in August, repeating the cycle of the previous year. This failed to materialize and, in fact, by December there was no appreciable regrowth of *Gnacilania* in Puttalam Lagoon.

The environmental triggers bringing on changes in the life cycle of tropical *Gradilania* species are, in general, unknown, so it cannot even be speculated what suppressed or altered the cycle. Continued research will be required **to uncover the causes** and to describe the seasonality of life cycle changes. If it is unpredictable, then seaweed farming in Puttalam Lagoon would be impossible.

Meanwhile, in the village of Kunjimatotam, where Sarvodaya was implementing village trials, the all too familiar problem of grazing by juvenile *siganids* threatened the viability of the project. Fencing had to be resorted to, but at a much lower cost than in Tamil Nadu. By the time fencing had been installed, the growing season was over and, with the failure of *Grad/aria* to reappear in 1990, nothing more could be done.

Why did rabbitfish graze the village plot and not the natural beds, which are also associated with seagrass? Probably because the farm sites were very much inshore, unlike the natural beds.

Because of this, another problem very common to aquaculture was also confronted – user conflict. Hand pushnetting is practised in all shallow areas of Puttalam Lagoon, including over the *Gradilaria* beds. Fishermen have prior rights, precluding use of the further offshore banks for any other purpose. In fact, a promising site had to be abandoned as a result of opposition by local fishermen.

Despite these failures, Sri Lanka presents further opportunities for seaweed culture development. Trincomalee was the traditional primary source of 'Ceylon moss'. Dutch Harbour, which is just north of the mouth of Puttalam Lagoon, may also harbour stocks of *Grad/aria.*

Conclusion

If the reasons for failure are to be categorized, the following causes may be listed

- Grazing.
- Differences between the native habitat of the target species and the farm site.
- Unpredictable life cycle changes.
- Lack of access to alternative sites.

The appropriate way to overcome the problems that plagued the BOBP-supported seaweed farming trials would be to conduct intensified testing of alternative sites, focusing where *Gracilania* occurs naturally. Spore-setting and vegetative propagation, but particularly spore-setting, wilt succeed in the right environment.

Research should also concentrate on understanding the life cycle of the target species. These studies should relate to specific sites, since there seems to be wide variation inlife cycles from place to place. The environmental triggers which bring on shifts in these cycles need to be found to enable prediction and the evolution of culture protocols.

BOBP had to give up the pilot testing of *Gracilaria* farming because:

- long-term research was necessary if success was to be achieved; and
- the unlikelihood of fisherfolk participating in projects which required a lengthy gestation period.

However, it is clear that the technology is sujtable for and readily accepted by small-scale fisberfolk, and, therefore, seaweed farming, which is easy on the environment, has the potential to develop into an income-generating activity for them if the problems could be ironed out and the fisherfolk's interest in the activities could be sustained.

Nets helped some, but their cost was excessive

MUD CRAB CULTURE AND TRADE AROUND THE BAY OF BENGAL

Fiftyfour from BOBP member countries, the Philippines and Australia met at a BOBP seminar in Surat Thani, Thailand, November 5-8, to review the present situation and discuss the future of mud crab culture and trade in the region.

INTRODUCTION

The mud crab, *Scylla* sp. is found throughout the Indo-Pacific region and has become increasingly popular by virtue of its large size and meat quality. While regional trade in the species has been growing, very little attention has been given to the fishery and culture in the Bay of Bengal region.

The fishery, culture and trade in *Scylla* sp. is small scale and involves artisanal fisherfolk, and it is this which attracted the interest of the Bay of Bengal Programme (BOBP). It was felt that a regional seminar might be an appropriate medium for an exchange of information among BOBP's member countries, since so little was known of the state of the industry.

Southern Thailand, particularly the province of Surat Thani, has long been a centre for the capture and culture of the mud crab. With the proximity of the provincial brackishwater station and the opportunity to observe the industry first hand, the town of Surat Thani promised to be an ideal venue for the seminar. And so, BOBP, in collaboration with the Department of Fisheries of the Government of Thailand, convened the seminar from November 5 to 8, 1991.

Representatives from all the BOBP member countries, as well as the Philippines, Australia and the U.S.A. attended. Aquaculturists, scientists, traders, socio-economists, feed manufacturers and development strategists were among the *54* participants.

There were five sessions: biology and natural resources; seed supply; culture; trade; and a combined session on extension, credit.and economics. Twentyfive papers were presented in the course of the proceedings, in addition to the six background papers commissioned by BOBP. To our knowledge, this was the first seminar in the region and, perhaps, in the world, devoted exclusively to the mud crab.

Dr. Udom Bhatia, Director of the Phuket Marine Biological Centre, chaired the seminar. Dr. Bhatia also presented the keynote address, in which he pointed to the growth of trade in the mud crab, and outlined some of the outstanding problems which will have to be overcome if culture and trade are to expand.

PROCEEDINGS

What is the state of wild stocks in the region?

Seven papers addressed issues related to the fishery and the status of the stocks on which it depends. In most member countries, the level of exploitation is not well-known. Very little biological data is available upon which stock assessments can be made.

Sombat Poovachiranon of the Phuket Marine Biological Centre presented his studies on the Andaman Sea coast of Thailand. His work showed that there is an offshore spawning migration during the first and last quarters of the year. Consequently, the sex ratio in catches will vary, with more male crabs being caught during the season of offsh6re migration of the females. Size restrictions were proposed as a possible management measure.

According to M. Kathirvel of the Central Institute of Brackishwater Aquaculture (CIBA), India, the size range of crabs in the fishery in India is *75* to 205 mm, but the bulk of the catch measures around *105* mm. The sex ratio varies according to depth. The breeding season shows peaks, but occurs throughout the year in most areas of the Indian coast that have been studied.

Kador Ahmed, Fish Inspection and Quality Control Division, and Giasuddin Khan from the Marine Fisheries Resource Survey Management and Development Project, both of Bangladesh, reported that in their country about 30per cent of the catch consists of berried females. The peak fishing season there is from June to August. Fishermen believe that periods of less abundance are due to offshore migration of crabs. A high percentage of the catch consists of small, immature specimens. These are not accepted by exporters and are disposed of in local markets at very low prices.

Ms. S.C. Jayamanne, in her background paper, informed the participants that landings in Sri Lanka have been declining since 1984, according to export data collected from the Customs Department. Exclusion of areas involved in the present civil strife may be the cause, rather than

overfishing. However, most of the mud crab catch from Negombo Lagoon, which is one of the major fishing centres, consists of undersized crabs. The heavy exploitation of immature crabs poses a threat to the long-term stability of the fishery. Catch per unit effort measured as catch per trap hou'r has also declined.

Several authors described the gear used for catching mud crabs. It is simple, and ranges from a hooked iron rod to various kinds of traps, gillnets and baited lines. Traps and small liftnets are common. Even bare hands may be used, which takes a bit of courage! It was apparent that mud crab gear is similar throughout the Bay of Bengal region.

In hisS second paper, Kathirvel shed some light on the sometimes confusing taxonomic picture of the mud crab. It has been popularly assumed that there is only one species of *Scyila,* whereas, in fact, there are at least two, S. *serrata* and *S. tranquebanica;* the latter may be synonymous with *S. oceanica. S. tranquebanica (oceanica)* grows to a large size and does not burrow, while ***S.*** *serrata* is smaller and exhibits the opposite behaviour. It lives predominantly in estuaries. Papers from Thailand and Malaysia referred to two 'varieties' being recognized by the trade. The brown variety is caught in the mangroves, while the green is found outside the mangroves, in coastal waters. They may represent these two species.

None of the countries around the Bay have instituted management measures. Outside the region, Australian fisheries officials have recognized the value of the mud crab fishery and have taken several conservation measures. Chris Lee of the Bribie Island Research Station, Queensland, described some of these. Among the steps taken are a ban on the capture of females of any size and a minimum size for male crabs. The number of traps per fishermen is also restricted. The mangrove habitat of The mud crab is protected through the creation of numerous national parks and fisheries reserves.

If the papers represent the state of knowledge of wild stocks of the mud crab, it is evident that a great deal more data is required. Proper management of mud crab stocks will be impossible without it.

How** has **mud crab culture developed in the region?

Thirteen papers covered hatchery and culture technology. Hatchery work has been confined to only two of the BOBP member countries, Malaysia and India. Outside the region, pioneering work in larval rearing has been done in Australia.

R. Marichamy of the Central Marine Fisheries Research Institute, India, has been able to produce small numbers of first crab stage in an experimental system. Zainoddin Jamari from the National Prawn Fry Production and Research Centre (NAPFRE), Malaysia, used production scale tanks of 2 and 10 MT for the Centre's experiments, achieving survival of up to 20 per cent.

Both Marichamy and Jamari used rotifers and *Artemia* as feed for zoea stage larvae. Rotifers were given to early zoea, followed by *Artemia.* Megalopa were fed with *Artemia* as well, but supplemental foods were also given. Early crab stage larvae were fed various artificial feeds. Nevertheless, cannibalism during the megalopa and' early crab stages plagued hatchery trials in both India and Malaysia.

According to Chris Lee, early hatchery experiments in Australia led to commercial development, which ultimately failed. **Work is** continuing at the Bribie Island Centre. Mortality remains high among early zoea and crab stages. Nutritional deficiencies and water quality are suspected as contributors to poor survival.

These experiments are continuing, but it seems there is still some way to go before hatchery production can contribute to the expansion of crab culture. Much of the advances made in penaeid larval rearing could probably be applied to crab larvae. Micro-encapsulated diets hold promise in overcoming nutritional deficiencies in existing live food diets. Beyond the hatchery, nursery technology will have to be developed, and there were no reports of work in this area.

Culture, particularly 'fattening', is widely practised in Thailand, Malaysia and Indonesia. In contrast, it has not developed in the South Asian member countries of BOBP. These countries export their fishery production to ASEAN markets, Hong Kong and Japan. A bit of experimental work has been done in India, according to information provided by S. Srinivasagam of CIBA, Madras.

As explained by **Dr. Fuad** Cholik from Indonesia, Leong Pit Chong of Malaysia and Ms Rachada of Thailand, culture methods are comparable throughout the BOB region. Details may, of course, vary.

'Fattening' describes the process of holding newly moulted market size crabs and feeding them for a short period of time. During the fattening period, which may be as short as two weeks, the exoskeleton grows in thickness, and flesh weight rapidly increases. floating cages, as well as ponds, are used for fattening. Highly prized gravid females can be produced in about 30 days. Trash fish is used as the primary food in both fattening and culture operations. Principal constraints to expansion are a shortage of seed stock and inconsistent supplies of tr.ash fish.

A session is inaugurated at the BOBP-sponsored mud crab seminar in Surat Thani, Thailand.

Both fattening and culture are small scale, often done by fisherfolk. Anuwat **Rattanachote and Ms Rachada** Dangwatanakul reported in their paper **that** large enterprises had been started **in Surat** Thani a few years ago, but **have** all gone out of business or changed to shrimp fanning. Seed stock shortages were given as one of the contributing factors to the failure of these businesses.

Experimental crab fattening and culture have been undertaken by the private sector in Sri Lanka. **Bede de** Silva of A E Aquatic Enterprises presented the results of his company's trials. Small cement tanks were used for some of the work. Modified shrimp ponds were also eva'uated. Slaughter house offal was used as feed, but led **to** occasional pond pollution. A **thorough economic analysis would have** been premature, but the results were considered positive.

R P Samarasinghe of Andriesz Mariculture Ltd, one of the pioneer shrimp farms in Sri Lanka, tried crab culture in one of his shrimp ponds. Small crabs from 25 to 100 g were stocked and fed minced silverbellies (a locally available 'trash' species). Samarasinghe felt that crab culture could be profitable on a small scale.

BOBP invited Ms Daisy Ladra of the Bureau of Fisheries and Aquatic Resources of the Philippines to give a picture of mud crab culture in her country. Crab fattening is the preferred practice as opposed to growout from small seed stock. Almost anything is fed **to the crabs,** including kitchen waste, trash fish, animal entrails and manure! Pens and ponds are used, but pens are very adaptable to small businesses and may be found under fishermen's houses in some regions. Milkfish ponds may be converted to mud crab fattening during the rainy season, as it is difficult **to** grow lablab (an algal mat upon which the milkfish feed). The fattening period ranges from 15 to 30 days. Most of the production is meant for **export.**

Depending on trash fish will constrain the expansion of crab culture and fattening. Shrimp culturists, aquaculture **feed manufacturers and the** poultry industry all compete for diminishing supplies.

An interesting study was presented by **Dr Chin How Cheong, of Ceylon** Grain Elevators, Colombo, dealing with the development of an artificial food for mud crab culture. Experimental results showed that a prepared diet with a protein level of 35 per cent can be used. Unfortunately, high mortality among experimental animals was a significant problem. However, this is the first reported attempt to develop a prepared feed for the mud crab, so improvements can be expected as more is learned of the nutritional requirements of *Scylla* sp.

Leong Pit Chong explained that crab fattening in Malaysia is done in either floating cages or small ponds. Most of the seed stock is imported from Thailand, Indonesia and Sri Lanka. Trash fish and fish offal are given, but supply and storage pose problems. The production of early crab stages at NAPFRE has led to nursery and grow-out experiments. Crab culture, as opposed to fattening, is practised in small, less than one ha, ponds, either owned by the culturist or leased.

Fuad Cholik reported that crab fattening in Indonesia is done in floating cages or pens set up in shallow water. The crabs are held for two to three weeks, depending upon the initial weight of the crabs. As is the practice in other countries, trash fish are fed on a daily basis. Small ponds, usually about 200 m^2, are used in West Java. Growing crabs to market size is done in ponds similar in design to the milkfish ponds of Java. Bamboo fences are put up to prevent the escape of crabs.

What is the extent of trade around the Bay of Bengal?

Mahesh Raj, BOBP consultant, surveyed the mud crab trade in South India, particularly Kerala and Tamil Nadu. Mud crabs are landed in all the east coast states. Kerala, on the west coast, is a major supplier. Although there is a good local market for mud crabs, interest is centred on their export. Madras is the principal centre for air shipment to Singapore and Malaysia.

Exporters buy from middlemen who, in turn, have purchased from fishermen. This is the usual pattern throughout the region. After packing in bamboo baskets, the crabs are containerised. Customs procedures at both ends increase costs. Exporters in Madras also complained about high air freight rates.

Chris Lee presented a paper by his colleagues at Bribie Island which dealt with packing and transport problems. As might be expected, packing in Australia employs modern packaging materials. Crabs are carefully packed in waxed cardboard cartons after their claws have been carefully trussed. Heavy duty plastic liners prevent leakage. Mud crabs'are air freighted **to** consumption centres throughout the country. High temperature and dehydration are the main causes of mortality. The authors recommended the use of polystyrene containers, but their use has been restricted on the basis of cost.

Ms Chinnamma George described experiments at the Central Institute of Fisheries Technology, India, which dealt with processing and storage of frozen and tinned crab meat. Chitin is also a valuable by-product of crab processing and can be converted to chitosan, a compound with wide industrial applications.

Ms. Ladra looked at current marketing trends in the Philippines. About half of the country's production originates from brackishwater fish ponds, of which there are several hundred thousand hectares. Exportable crabs are over 200 g, while smaller animals are sold locally. Exporters themselves **may undertake fattening. Market** channels are well developed as a result of the strong export market. Middlemen operate buying stations and often secure their supplies through cash advances to the fishermen. Operators of large fishponds tend to sell directly to traders and exporters, bypassing the intermediaries to whom fishermen sell.

Bamboo or rattan baskets and plastic-lined cardboard cartons are used for internal transport. Crabs destined **for** export are repacked in styrofoam boxes. Major markets are Taiwan, Hong Kong, Guam, Japan and **the** USA. Most exports are purchased by buyers in Taiwan.

Well developed air **traffic in the BOBP** region has facilitated the development of an international trade in mud crabs. The 'centre of gravity' is Singapore and Malaysia. Supplies of live crabs come in from all the other BOBP countries, either as seed stock for fattening operations or ready for direct marketing to restaurants and sea food

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Participants in the BOBP mud crab seminar visit a typical mud crab fattening farm in Surat Thani, Thailand.

markets. However, given the high value of live mud crabs, it is unlikely that much attention will be dedicated to processing. On the other hand, swimming crabs of the genus *Portunus* may have some potential as processed meat.

What are the economies of crab culture? And is there extension experience?

Ms Giselle Samonte of SEAFDEC presented the only rigorous study of the economics of crab culture. Her work concerned crab culture in small ponds in the Philippines. The range of stocking densities varied from 5,000 to 20,000 crabs per ha. The return on investment was highest at lower stocking densities.

The Thai Department of Fisheries, with support from BOBP, implemented a fisheries extension project in the Ranong District of southern Thailand from 1986 through 1991. A wide variety of activities, including the introduction of new crab traps, was included. Ms Hanne Kristensen of BOBP recounted the problems encountered in the process of extending a new fishing technology to fisherfolk of the district. Ranong is one of the wettest places in the region the eight-month rainy season made crab fattening difficult.

CONCLUSION

The seminar ended with the formulation of a number of recommendations or directions that could be taken to promote the development of mud crab culture and trade, particularly for the benefit of small-scale fisherfolk. Here they are, by session

Biology and Natural Resources

1. To overcome difficulties of sampling the varied commercial gear to obtain data for population studies, sampling can be confined to one or two of the most important gear.

2. Concerted effort should be given to clarification of the taxonomy of the genus *Scylla* on a regional basis. The work should be done by specialists in the region.

3. Stocks of mud crab in the various countries of the Bay of Bengal region should be identified. Data for the estimation of biological parameters need to be collected on these stocks to facilitate the development of management policies.

4. A. thorough sutvey of mud crab seed collection should be conducted, from which seed calendars could be prepared for each country.

5. The most efficient gear should be selected in each country for sampling indices of changes in fishing effort.

6. Feeding studies of natural stocks of mud crab should be done, particularly if food items are also being exploited.

7. Assessment of the impact of pollution and habitat destruction on mud crab stocks.

8. Community management can be undertaken if based on knowledge of local stocks of mud crab.

Seed **Supply**

1. Investigate the environmental and nutritional requirements of planktonic larval stages of mud crab in order to provide basic information for laboratory rearing techniques and to throw light on the reason for low survival in the laboratory.

2. Define the morphological, behavioral and growth rate differences of various types of mud crab for aquaculture as well as basic information for future management of the industry.

3. Investigate the water quality and nutritional requirements of larvae in the laboratory.

4. Apply advances in penaeid larval feeding to mud crab larval rearing.

5. Investigate and compare the viability and effectiveness of recirculating and flow-through 'clean' water techniques and 'green' water rearing methods.

6. Investigate methods to improve maturation of brood stock by environmental manipulation and nutritional enhancement.

7. Determine the cost of production of the various larval culture systems under investigation.

8. Encourage regional collaborative research on seed production technology to stimulate, focus and set realistic achievable targets within a given time limit.

9. Investigate the natural spawning of mud crab and study the dispersal of the planktonic larvae in order to provide basic information for the long-term management of the mud crab fishery.

10. Ensure sustainable natural larval recruitment by providing protection against total exploitation by seed collectors to some nursery grounds.

Culture

1. The major causes of mortality need to be identified, *i.e.* nutrition, cannibalism, water quality and pond management, lack of shelters, or disease.

2. Prepared feed can be developed as a replacement or supplement to trash fish. This will require the following: identification of nutritional requirements, development of least cost formulations using locally available ingredients and adaptation of feed application to crab behaviour.

3. Investment costs should be reduced for the small-scale fisherfolk, concentrating on pens or cages made of inexpensive materials and by improving credit delivery systems.

4. Polyculture systems with finfish or seaweed could be evaluated.

5. Pond management can be improved with regard to the selection of uniformly sized seed stock and the control of environmental conditions so as to synchronize moulting.

Trade

1. Long-term measures, such as the development of economic culture methods and value added products, can be taken.

2. In the near term, the following activities can be undertaken: promote crab fattening through the small-scale sector; reduce transport mortality by the use of improved packaging; develop market intelligence and technical support and dissemination systems for the same; monitor the effect of export trade on domestic crab production and marketing; finally, estimate, the size of the national and export markets for mud crab and develop models to predict the effects of supply fluctuations on price.

Extension **and** Economics

1. Appropriate financing through institutions for the small-scale sector.

2. Reduce investment costs and develop indigenous methods of culture according to local conditions.

3. Evaluate physical environmental conditions as to their suitability for mud crab culture.

4. Synchronize culture with water conditions.

5. Develop an effective marketing system to the benefit of the small-scale sector.

6. Explore the possibility of contract farming with low-income groups.

7. Develop extension and training programmes to popularize culture and fattening.

C.A.

EDITOR'S NOTE: It has not been possible, even briefly, to summarize within the confines of the limited space available here, all the papers presented at the seminar. But the highlights of the seminar have been featured. The full proceedings will be available from BOBP, Madras, in the near future for those wishing a more in-depth discussion of mud crab culture and trade in the Bay of Bengal region.

WORKSHOP SCHEDULED ON THE MARINE ENVIRONMENT

The present and the future of the marine environment of the Bay of Bengal and the northern Indian Ocean, and the impact its pollution has on fisheries, will be discussed during a four-day workshop in Penang, Malaysia, late in January 1993. At this workshop sponsored by the Bay of Bengal Programme's Environment unit, representatives from the member countries will present the results of the surveys of the marine environment made in their respective countries. There will also be invited specialists making presentations on the marine environmental situation, mangrove forests, coral reefs and sea grass beds.

The tentative agenda for the workshop is

1. An introduction by an invited specialist which will highlight the general global situation of marine environment and fisheries.
2. Country presentations of the present marine situation in their cOastal areas and seas of the Bay of Bengal and the northern Indian Ocean. A report from each country will be prepared in advance and will be available at the workshop.
3. Presentations on the environmental status of mangroves, coral reefs and sea grass beds in the Bay of Bengal by invited specialists. Other specialists will discuss the scientific findings on the importance of these for fisheries.
4. A discussion on "The Environment and Fisheries in the Bay of Bengal". This will attempt to arrive at a consensus on the present and future status of both in the Bay.
5. Drawing up recommendations for action to be taken to improve conditions in the Bay. These will be arranged in order of priority and will also identify areas where more studies of present environmental situations are necessary.

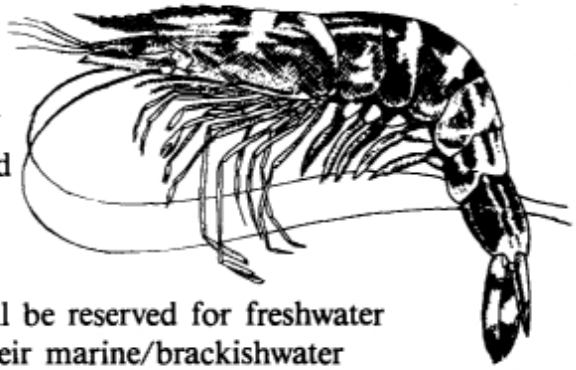
It is hoped that the result of this workshop will be to improve the environment in the Bay of Bengal and the northern Indian Ocean through

- national actions by member countries,
- further support from agencies for large-scale projects, and
- cooperation and exchanges of ideas between the member countries on how to tackle environmental problems.

S.H.

IS IT A PRAWN OR A SHRIMP?

At the 1967 World Conference on the biology and culture of shrimp and prawn held in Mexico City, it was agreed that :



The term **PRAWN** will be reserved for freshwater creatures only. And their marine/brackishwater relatives will be called **SHRIMP.**

Making sure shellfish are safe

An oyster culture project in Malaysia develops an inexpensive portable depuration system.

by Hazbullah Zakariah
(Fidd Biologist, FRI/BOBP)

Oysters, mussels, clams and cockles are prized by seafood fanciers the world over. Aquaculture industries for these species were established long ago, in some cases centuries ago! Those were the times of pristine coastal waters, before the age industrialization and urbanization.

As human settlements grew, they tended to cluster around natural harbours and, in general, along the sea coasts of the world. The level of pollution of the sea by human waste rose. Of course, people went on consuming shellfish, but, now, more often with uncomfortable and even fatal consequences.

Studying the problem, biologists discovered that bivalves like oysters and mussels, are very efficient accumulators of pathogenic organisms. As filter feeders, they can pass amazing quantities of water over their gills, which remove very fine particulate matter from their surrounding aquatic environment. Contaminants, as well as food particles, eventually fmd their way into the digestive system of the animal, where they may be present when it is consumed.

Luckily for the seafood consumer, the biologists also found that bacteria and toxins which cause human illness could be removed by the bivalve's own feeding and digestive activity if the animal was put in clean water. Most pathogenic bacteria are removed within 24 hours, although viruses and some toxins may take much longer to be purged. Most health problems associated with eating fresh shellfish are bacterial in origin and can, thus, be easily eliminated.

Malaysian waters, as indeed is the case with all industrializing countries, are subjected to an ever increasing bacterial load being dumped into them by rapidly growing cities and industries. The Malaysian population is well educated and increasingly aware of nutrition and food safety. It has, therefore, become incumbent upon the Malaysian seafood industry in particular to assure the consumer that its products are wholesome and safe. To do this in the case of shellfish, the Malaysian Fisheries is encouraging the use of depuration.

Depuration, a technical term for the process of cleansing bivalves, simply means placing the shellfish in clean water for a sufficient length of time to allow any harmful materials to be purged. In the simplest instances, oysters (or other bivalves) may be transplanted to waters of known quality. This process usually proves too costly; besides, it is not always-possible to guarantee the quality **of** the receiving waters. On the other hand, water where chlorination, ozone or ultraviolet (UV) radiation is present has proven effective, because all three are aquatic cleansing agents. If shellfish are placed in tanks whose water is recirculated through an apparatus subjecting the water to one of the above cleansing agents, harmful bacteria will be purged within a reasonable time.

The BOBP-supported oyster culture project in Malaysia, implemented by the Fisheries Research Institute at Glugor, Penang, has for some time been working on the best culture methods. As oyster stocks become available, the FRI undertook a promotional campaign to familiarize the public with cultured oysters and to, thus, help the participants develop a market. Depuration was an integral part of the promotion effort and the exhibitions that were held in different parts of the peninsular. Depuration units were demonstrated and the crowds which attended the exhibitions sampled the oysters with confidence in their cleanliness and quality.

The depuration unit built in Batu Lintang, Kedah.

The FRI choose UV for its depuration unit because of its low cost, simplicity and safety compared to the alternatives. The unit was designed with the assistance of Ismail Ishak, FRI's bacteriologist, and the field work and testing was done by the authors, Hazbullah Zakariah, and Ahmad All, both oyster biologists working with the Institute. The main components of the unit are the following:

- one UV box equipped with two 30 watt UV tubes,
- a rack to support the oyster trays,
- fifteen plastic trays to contain the oysters during depuration,
- a seawater reservoir holding about one cubic metre of seawater of 15 to 30 ppt, and
- a 300 W centrifugal corrosion resistant pump to circulate the seawater from the reservoir up to the UV box from whence it flows by gravity through the oyster trays.

This unit can depurate 750 oysters in 24 hours. Two prototypes have been installed at oyster farmers' homes in Kedah and Perak and are functioning well. The system costs MS 3200 (USS 1185) at current prices. With them, the farmers' customers are assured of clean, fresh quality oysters ready for the table.

The latest BOBP video films

The Bay of Bengal Programme (BOBP) has produced on its own, or with local producers, several video films on small-scale fisheries activities. These films are not only informative but are, in most cases, also instructional and provide lessons that can be adopted in any developing country. The latest in thtr series are the six films described below. Copies of the films can be obtained from the Information Service, The Bay of Bengal Programme, 91 St. Mary's Road, Abhiramapuram, Madras 6(X) 018, at nominal cart covering copying and courier charges.

THE **CANOES OF** NIAS, INDONESIA
(1930 min) 1991

The Bay of Bengal Programme undertook to develop a new type of outrigger canoe in Nias island, **Indonesia,** west of Sumatera island, and assess its **technical** and economic feasibility. This **film describes the project** and **features the canoe, whose** feasibility **for the** small-scale fisherfolk of Nias has been established after **two** years of trials. Now, local carpenters, trained duringthe project, have begun building improved outrigger canoes for the **fisherfolk.**

EXTENSION SERVICES IN RANONG
(18.30 mm) 1991

As fishing grows as an industry in Thailand, the **lot of the** small-scale fisherfolk worsens in **communities** like this onein Ranong, **on the picturesque coast by** the Andaman Sea. BOBP teamed with Thai Department **of Fisheries Extension Services to** alleviatc the problems of selected communities in Ranong Province. Aquaculture was encouraged, post-harvest training provided and income- and knowledge-generating activities for womenfolk introduced.

GOOD FISH, GOOD QUALITY
(23 mm) 1991

In India's deep south, the catch is good, but partly due to ignorance, partly due to a lack of capital, incomes arelow in many of the fishing communities. **The BOBP's** Post-Harvest Fisheries Project's introduction **ofice** boxes, drying racks and newlydesigned **fish containers have gone a long way towards adding to the** income **of fisherfolk in** several villages **in South India.**

MOGNAMAPARA — A CASE OF APPROPRIATE TECHNOLOGY
(14 mlii) 1991

In Mognamapara, southern Bangladesh. a **BOBP-sponsored NGO** has helped an **impoveri**shed group **of** landless **fisherfolk to organize** themselves and enhance **their income through the** use **of nursery cages for the shrimp** fry **they catch. The** involvement of the whole family has been emphasized **and the** womenfolk have been involved in this and other income-generating activities.

BETTER FEEDS FOR BETTER SHRIMP
(18 asia) 1991

The Indian Government has been encouraging the pond-rearing of shrimp near **the backwaters of** coastal states. The BOBP's Post-Harvest Project has studied the **feed the** shrimp farmers **of Andhra Pradesh** use **and** has helped develop better quality, water-stable shrimp feed that has led **to high shrimp survival in the** pond-farms.

PRAWN SEED PRODUCTION IN BANGLADESH
(16.30 minI 1991

The BOBP has developed **a shrimp hatchery in** Patiya, southern Bangladesh, **to** increase the supply **of shrimp** seed in the area and **to** serve **as a model for** other parts of the country. **A** NGO **working with BOBP has encouraged** local **fisherfolk to take the** next natural step : go into nursery cage culture.

(NOTE: All in** English FORMAT: **PAL** System — **U-matic or VHS)

BAY OF BENGAL NEWS

Bay of Bengal News is a quarterly publication of the Bay of Bengal Programme (BOBP),a 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 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).

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