# BAY OF BENGAL NEWS

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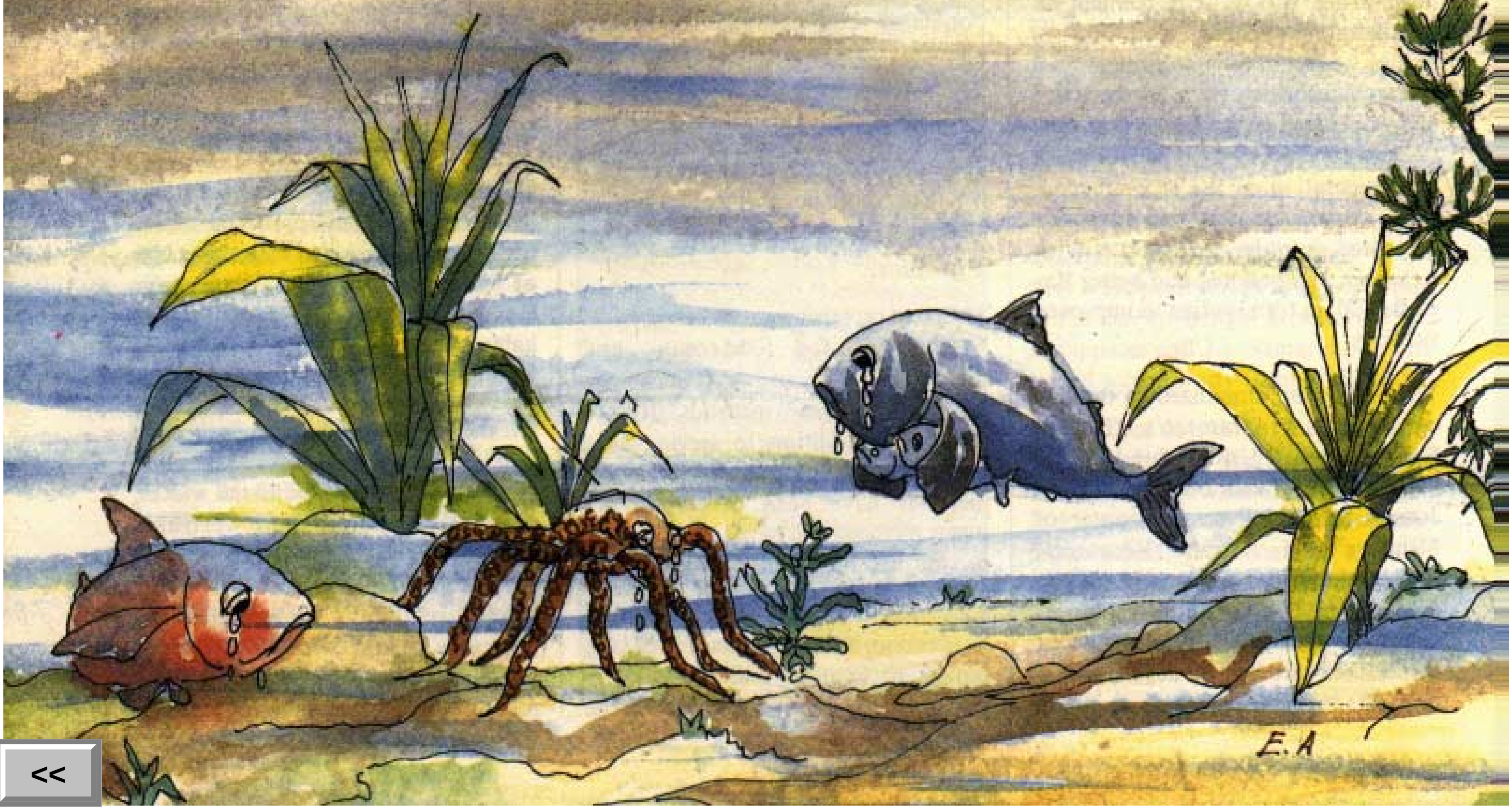
# POLLUTING THE MARINE ENVIRONMENT



# THE ENVIRONMENT'S EFFECT ON THE FISHERIES OF THE BAY

*by Staffan Holmgren*
(Environmental Adviser, SWEDMAR/BOBP)

The waters of the Bay of Bengal are not as polluted as generally thought and the impact of environmental degradation on the fisheries of the Bay is only moderate. This could be concluded from the various presentations, and the discussions that followed, at the Workshop on Environment and Fisheries in the Bay of Bengal, held in Colombo, Shri Lanka, in February 1993. But as speaker after speaker from the region expressed concern over specific instances of pollution of the coastal waters, habitat destruction and over-exploitation of fishery resources, it became obvious that the present environmental condition of the Bay should not be cause for complacency but that problems indicated should be treated as a timely warning and appropriate action taken to improve the Bay.

Waste treatment and disposal, better monitoring, stricter enforcement of legislation, improved education to ensure community involvement and research priorities were all discussed and prioritized at the Workshop. The sessions concluded with a call for quick implementation of the recommendations, based on the status reports presented, in order to help in making a cleaner, less polluted and better Bay of Bengal, in turn leading to improved fisheries.

The Workshop, organized by the Bay of Bengal Programme's (BOBP) Environment Unit, funded by SWEDMAR, was inaugurated by Joseph Michael Perera, Minister of Fisheries and Aquatic Resources, Shri Lanka. The keynote address was delivered by Dr Olof Linden, University of Stockholm, who stressed that tropical seas are heavily dependent on nutrients from the coastal resource, unlike the cold seas of the north. He pointed out that tropical marine production might be reduced by as much as 90 per cent if the coastal areas were denuded and/or the waters polluted. Particularly good care of the coastal region was essential in tropical waters if sustainable fish production was to be ensured, Dr Linden stated.

The Workshop was divided into three sections. Participation was enthusiastic in every session, indicating the genuine concern over the environmental problems of the region. During the first session, country representatives presented the highlights of their studies (see box, page 7). These are summarized below but are given in some detail on pages 4, 5 and 6.

Sewage pollution appeared to be of particular concern in ALL the countries. Wastes are directly discharged into the waterways, without any treatment, in the densely populated coastal regions. Rivers, lakes, lagoons, bays etc are anoxic for shorter or longer periods during the year, causing fishing kills. In addition, there are serious health problems connected with such pollution. About three-quarters of all diseases in India are caused by waterborne micro-organisms.

The most promising remedies suggested were sewage-fed fishfarming and biological treatment in oxygen ponds or ditches. These methods offer a revenue in addition to serving as a waste treatment process. Some farming methods have been developed but newer methods will have to be explored to suit differing local conditions.

Siltation, causing reduced primary production and obstruction of the outlets of lagoons and estuaries, is another major problem. Large amounts of fertile soils are lost due to existing agricultural and forestry practices. Some studies indicate that the sedimentation loads in the large rivers around the Bay of Bengal have increased a hundred times in the last century. This reduces carrying capacity, both in terrestrial and aquatic habitats, and the consequences can be disastrous in view of the continued population growth. It is, therefore, urgent that this problem be at least mitigated, if not solved, as soon as possible.

Destruction of marine habitats has also been causing great concern over the future of fisheries in the region. Coral reefs and mangroves are degraded in all countries bordering the Bay of Bengal and many coastal areas are overexploited. The delicate balance between marine life and coastal habitats, like lagoons, estuaries, mangroves and coastal wetlands, is disturbed almost everywhere. Only small pockets along the west coast of Sumatera and the northern Andaman Sea coast of Thailand are still pristine to some extent.

Overexploitation of the marine living resource and the environmental impact of aquaculture are also major concerns of the region and need new management plans, a closer look at habitat destruction and a review of fishing methods.

On the more positive side is the fact that, in spite of large discharges and lack of treatment of industrial wastes, pesticide residues and fertilizer leakages — all dangerous to the Bay of Bengal environment in many ways — residues of heavy metals and pesticides seldom exceed health limits in fish and other seafood caught in the region. The tropical aquatic food web seems to have more beneficient structures and dynamics than in temperate habitats. But studies have shown that young herbivorous fish here often have higher concentrations of mercury than the top predators, which, in cold climates, always have the highest toxic residues. This phenomenon deserves further scientific research.

Remedies suggested to curb continued environmental degradation include:

- Increasing public awareness;
- Implementing coastal planning;
- Stricter enforcement of existing environmental legislation;
- Making Environmental Impact Assessments prior to permitting any new industrial, or environmentally dangerous, activity; and
- Finding solutions relevant to the problems of the tropical environment.

In the second section of the workshop, the present status of the marine habitats that had important impacts on fish production in the Bay of Bengal region were surveyed. The speakers were: Dr. Alan White, on coral reefs; Dr. Hansa Chansaeng, on seagrass beds; and Dr. Richard Coutts, on mangroves in northern Sumatera; and Dr. R Gouda on the environmental situation in lagoons and estuaries.

The effects of aquaculture on the coastal environment were also pointed out in two papers during this session. Aquaculture in Asia produces 12 mt of fish and shrimp annually, representing a value of US $ *17.5* billion. It is 80 per cent of the global aquaculture industry. Its rapid expansion has, unfortunately, caused growing waterquality problems. Concomitant production losses, disease outbreaks and product contamination have caused substantial economic losses to the industry. In 1990, the losses in the Asia-Pacific region were estimated to amount to at least US $ 1.4 billion.

Dr. Mike Phillips gave a broad overview of the environmental threats to, and by, aquaculture in the Bay of Bengal region. He spoke of the degradation of water quality caused by the effluent from fish and shrimp farming activities. Dr. Patsy Wong, on the other hand, presented a case study on how Hong Kong had met the challenge. Today, aquaculture exists and grows side by side with other coastal activities there. To solve user conflicts, 26 special coastal areas have been designated for aquaculture and licences are required to keep the activities within the carrying capacity of the areas. The problems in the Bay of Bengal area are not yet of the same magnitude as in Hong Kong, but much could be learnt from the solutions presented by her.

How waste could be put to use in ways beneficial to fisheries was described in the third session. The Calcutta example of suburban fish farms was cited, but a pioneer in the field, Dr. D. Ghosh, could not, unfortunately, be present. Dr. Ingemar Näslund gave examples of how sewage has been used to increase fish production in northern Scandinavia. He also spoke of how aquatic environmental probleffis could be solved by manipulation of fish species composition. Dr. Phang Siew-Moi, from Universiti Malaya in Kuala Lumpur, presented some biological methods that have been deployed in Malaysia to reduce organic wastes from oil palm mills, rubber mills etc. She also presented studies on the future commercial use of chemicals extracted from algae and bacteria during treatment in ponds and ditches. Dr. Staffan Holmgren, BOBP, gave a short presentation on the use of bioindicators as a way of monitoring water quality. This method has considerable potential in the tropics, where there is great species diversity. It is also cheap and simple and can be used in remote areas (see article, pp 8 and 9).

Integrated coastal planning is probably the most important way of preserving a good coastal environment and, thus, ensuring sustainable fish production for the future. Two substantial contributions in this area, therefore, concluded this session. Alan White gave a broad çwerview of the activities in the Bay of Bengal area and in the Philippines and J.I. Samarakoon presented a case study from Shri Lanka.

On the final day, three groups — India and Bangladesh; Shri Lanka and the Maldives; and Thailand, Malaysia and Indonesia — met and discussed the issues raised, recommended areas of research and specific remedial actions.

The papers presented will be published in a series of reports by the Bay of Bengal Programme during 1993.

## A timely warning

**The impact on fisheries of environmental degradation in the Bay of Bengal is as yet slight or, at worst, moderate. Only the coastal areas, lagoons and estuaries in some parts of the region have been affected. Algal blooms are rare and there have been few outbreaks of Paralytic and Diarrhoeic Shellfish Poisoning or similar diseases. Even where high concentrations of pesticides and heavy metals have been found in the water or the sediments, the residues in fish and other marine organisms are still below recommended health limits. The environmental situation is much worse in the Gulf of Thailand and in the seas bordering China and the Korean peninsula.**

**This, however, is no reason for complacency; it only means that there is still time for appropriate action to be taken to, at least, preserve the Bay as it is, if not, improve it.**

**Coastal planning must be strictly vetted and rigorously implemented in all countries bordering the Bay of Bengal. Ways must be found to curb not only the loss of valuable fertile soils by the side of rivers inland, but also to prevent these soils making coastal waters turbid and silting estuaries and lagoons. Better management of fisheries — preventing overfishing — is also necessary to ensure that limited resources are sustainable.**

**The growing aquaculture industry is constrained by different types of environmental degradation of the coast, but aquaculture has its own environmental impact and could itself suffer from it. Lessons must be learnt from Taiwan and Thailand, which have had large economic losses due to these reasons, if future problems in the Bay are to be avoided.**

**These were the major conclusions arrived at, at the Workshop on Environment and Fisheries in the Bay of Bengal, held recently in Colombo, Shri Lanka. They are detailed in this and other articles in this issue.**

## BANGLADESH

lo protect the inhabitants from devastating floods and to increase foodgrain production, many water resource projects have recently been developed. With free movement from freshwater to brackishwater being hampered as a result of these projects, changes have been caused in the aquatic ecosystems and fish production affected. The migration of ***Hilsa*** and other anadromous and catadromous species has, for instance, been obstructed.

The Sundarbans forest in the southwestern part of the country is the largest single compact mangrove resource in the world, but a 1985 survey showed that the standing volume of the main species had declined alarmingly since an inventory 20 years earlier. Besides overcutting and overestimation of regeneration times, diversion of river waters has been responsible; by increasing salinity, it has impaired the growth of the mangroves. There is an increasing conflict between mangrove forests, shrimp farms and rice cultivation. The felling of mangrove forests for aquaculture has entailed loss of protection from cyclones and tidal waves, increased salinity because of longer retention times of tidal water and greater evaporation and acidification of surface water.

The extensive use of set bagnets in nearshore fisheries has resulted in overexploitation. In the absence of sufficient hatcheries, collection of wild Tiger Shrimp postlarvae in estuaries and nearshore waters has led to some destruction of other shrimp and finfish species.

Industrial production in the country has grown 50 per cent over the last few years, but since there is no treatment of the waste products before their discharge, local environmental degradation has occurred in the five major industrial zones: Dhaka, Chittagong, Narayanganj, Khulna and Ghorashal. This, together with lack of sewage treatment plants, has resulted in fish kills as well as occurrences of toxic substances in fish and shrimp.

Since the introduction of HYVs by farmers, the annual transport of pesticides into the Bay of Bengal has been estimated at 1800 t. There are few studies on the impact of agrochemical residues on fisheries, but toxic residues have been recorded in both shell and finfish.

Siltation has increased exponentially over the last century at the mouth of the Ganga-Brahmaputra-Meghna river systems and has actively reshaped the coastal and nearshore habitats, with consequent impact on fisheries. Changes in bottom topography, increased turbidity and entrapment of pollutants are some of the detrimental effects.

Enlightened environmental laws exist, but enforcement is inadequate due to institutional, strategic and financial drawbacks.

## INDIA

### Andhra Pradesh

The annual use of pesticides in Andhra Pradesh exceeds 26,000 t — a third of the total used in India. Residues are found in shrimp, bivalves, gastropods, molluscs and fish. But considering the amounts released, the concentrations are surprisingly moderate.

It seems evident that the biomagnification in the tropics is lower than in cold climates. One reason could be that pesticides are volatilized into the atmosphere. A better understanding of the relevant food chains and associated conditions connected with pesticides in a tropical aquatic environment is badly needed. A very appropriate area for such studies would be the Kolleru Lake, located between the deltas of the Godavari and Krishna Rivers.

The marine environment in Andhra Pradesh is still in a good condition and no great threats to fisheries have been identified.

### West Bengal

The Hugh Estuary in West Bengal is probably one of the most polluted estuaries in the world. Ninetysix factories manufacturing almost everything producing hazardous wastes — paper, pesticides, chioroalkalis, alcohol, yeast, rayon, cotton, thermal power, vegetable oils, fertilizers, antibiotics etc. — are nearby and discharge almost half a billion litres of untreated wastes into the estuary a day.

Comprehensive studies of the environmental conditionsin the Ganga River and Hugh Estuary were done in 1960 and 1988 and showed that chloride concentrations and alkalinity had increased in the river during this period, while oxygen had decreased. But the nutrients had increased significantly in the river and, surprisingly, there were no major changes in the chemical parameters in the estuary during the same period. Regular flushing by tidal water had evidently taken all wastes out to sea and the estuary itself had not changed significantly.

A look at the statistics for fish catches is still more intriguing. While the catches in the Ganga had fallen, during the period, and 100 species in it were endangered, the catches in the estuary had increased from 7.5 t in 1960 to 24 tin 1980! Most of the increase was from the outer zone of the estuary and was not due only to increased fishing effort. Evidently the increased loads of nutrients in outer zone had been beneficial to fish production!

Sewage treatment in Calcutta provides another surprise. Almost all municipal waste collected passes through one or two systems of fish ponds before it is released into the Hugh River. One fishermen's cooperative makes industrial waste water pass through an ingenious system of ditches with dense vegetation (water hyacinths and Valesneria) to reduce the toxic compounds and uses the treated water to produce 5 - 7 t of fish without any additions Of feed or fertilizers. By refining this method it will be possible to produce 15-20 t of fish per hectare. Treated waste water is also used for irrigating and fertilizing gardens and orchards. The income from the fish ponds, vegetables and fruit here supports 2,000 - 3,000 people on 65 ha. The area was earlier wasteland, used for waste disposal. Analyses for mercury and pesticide residue in the flesh of fish grown in the ponds, as well as of the bacterial contents, are well below WHO recommendations.

Tamil Nadu

This state is quite heavily industrialized, 80 per cent of its 12,000 units located close to the coast. There are also 2,200 tanneries in the state, accounting for more than 80 per cent of India's leather production. The industrial pollution is worst in the heavily industrialized Madras area in the north, with high concentrations of heavy metals found in water and sediments. Surprisingly, the concentrations of metals in seafood are still well below health limits. Biomagnification of toxins evidently has other pathways and patterns than in cold climates.

Bacterial contamination of seawater is most prominent in the coastal areas around Madras. For tourism development and to prevent health hazards to the coastal population, a study should be made of how to improve the water quality.

Thermal generation of electricity (70 per cent of the state's requirements) results in discharge of fly ash slurry and causes damage to fisheries. The environmental effects of nuclear plants (contributing 10 per cent of the state's electricity) are little known and requlre more study.

Orissa

The marine environment of Orissa is still inra good condition. Algal blooms occur occasionally, but are not toxic to marine organisms. A marine monitoring programme was started in 1990 and bottom samples are collected in the main river mouths twice a year. Rather large amounts of Hg and Pb have been found far from possible industrial sources. Complicated current patterns evidently transport these pollutants long distances. Analysis of mercury in fish downstream a chloro-alkahi industiy in the Rushikulya Estuary showed values well above the limit of 0.5 mg/kg w w. recommended by WHO.

In Chilika Lake in southern Orissa, significant environmental degradation has taken place. The main problems are the proliferation of weeds in the lake and heavy siltation causing decreased water exchange with the sea. No significant change in fish catches has yet been demonstrated, but an increase in freshwater species has been observed.

INDONESI

The west coast of Sumatera, adjacent to the Bay of Bengal, is still rather unpolluted. However, some parts of its east coast, facing the Straits of Malacca, show a deteriorated water quality due to industrial and municipal wastes. Organic compounds, heavy metals and coliform bacteria often exceed national standards for bathing and swimming as well as for the health of marine organisms and mariculture. The concentrations of lead and cadmium in the tissue of molluscs have sometimes exceeded environmental standards.

The concentrations of hydrocarbons in the Straits also sometimes exceed the limit for marine organisms. The heavy use of the straits by oil tankers evidently has a negative impact on the water quality. There have recently been several large oil spills in the Straits of Malacca as a result of oil tanker accidents.

MALAYSIA

Municipal sewage discharges and wastes from piggeries accounted for considerable bacterial contamination of the coastal waters of the west coast of peninsular Malaysia. The bulk of the analyzed samples are above the limits for recreational purposes.

lbrbid water and sedimentation consequent to bad land management is another coastal problem and this probably causes more damage to fisheries than bacterial contamination. The diminished light penetration reduces primary production. recent study of the rivers in peninsular Malaysia showed that about 50 per cent of the rivers were heavily polluted and 10 per cent moderately polluted.

Oil and grease in the marine environment, particularly in the southern states, also exceed the standard for marine aquatic resources. High concentrations of heavy metals are found in most rivers and coastal waters. Fortunately the biomagnification is insignificant and all samples of residues in fish and molluscs are well under health limits. The same is true for pesticide residues.

Red tide is often reported from the Malaysian coasts but only innocuous genera like Noctiluca have bloomed on the west coast. *Horneiia marina,* however, has caused fish and shrimp kills in Johore in the south and PSP has been reported from Sabah. The situation needs to be watched.

## MALDIVES

Fisheries-related environmental threats in the Maldives are of two types:

- those caused by landbased activities, and
- those caused by resource exploitation.

Sewage disposal is perhaps the greatest landbased threat in the densely populated islands. Septic tank leaks destroy the groundwater, the only source of freshwater, and lack of space makes it impossible to construct sewage treatment plants. The only practical solution is to discharge the sewage into the sea, but this endangers the coral reefs and marine water quality. Water currents, wave action and other water movements however, may act as mitigating factors.

Reclamation of reef flats leads to the renewable fish resource being lost forever and an end to the production of coral, aquarium fish, giant clam, bait fish and any other commercially valuable resource.

Dredging and habour constructions cause sedimentation and turbid water that can kill coral and change fish species composition.

However, while coral- and sand-mining, land reclamation and sewage discharges cause local environmental degradation in the Maldives, they have negligible effects on the deep reef habitats and open sea — the grounds for commercial fishing. There are also no other obvious threats to the open water fisheries. Reef associated organisms alone are susceptible to overexploitation.

## SHRI LANKA

Insufficient information is available for the marine environmental situation to be properly assessed, but it would seem that the open sea is still not affected very much by pollution. However, the Colombo municipality discharges sewage into the sea, and signs of oil pollution are also seen along the southern beaches in the increased occurrence of tar balls. Some lagoons and estuaries have been damaged by overfishing, sedimentation and other types of environmental degradation. The main marine problem is coral mining that has degraded many coral reefs along the coasts and caused severe local erosion.

Industrial discharges have been detrimental to fisheries in the Lunawa Lagoon, south of Colombo, where there are regular fish kifis and the fish has a tainted taste. Fish kills have also been reported from the Kelani River due to ammonia discharges from the Embilipitiya pulp and paper mill. Irrigation schemes have diverted freshwater to some lagoons in the south, such as Kalametiya and Rekewa, significantly reducing the production of shrimp and fish.

Most industries in Shri Lanka are situated in the Greater Colombo area and few of them have in-house waste treatment facilities. The industrial zones established under the Greater Colombo Economic Commission, however, have been provided with central waste treatment facilities that are regularly monitored. New industrial activities are being licensed only if they meet the terms of the National Environmental Act, which requires installation of treatment facilities.

Unplanned utilization of coastal resources, in municipal, agricultural and tourism development, have caused local pollution and sedimentation problems. The use of pesticides is high in Shri Lanka but the environmental impacts have not been studied.

Shri Lanka is fairly well equipped with legal provisions to protect the marine environment, but these have hitherto been inadequately enforced. NGOs play a vital role in the island, mobilizing people's participation in improving the environment. This growing awareness among the general public is probably the best way of monitoring the environment and ensuring the enforcement of laws which protect it.

## THAILAND

Tin mining used to be done on a very large scale along the west coast of Thailand. Phuket accounted for 10 per cent of the world production. But low international prices have now reduced these activities considerably. Any new increase in tin mining activities along the Andaman coast in Thailand could have serious impacts on fish production.

Urban development and the tourist industry have caused increased loads of organic compounds and bacterial contamination of coastal waters, especially along the southern coasts and around Phuket. The northern coasts are still rather clean. The Andaman Sea is still rather unpolluted and clean, compared to conditions in the Gulf of Thailand.

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### Pollution problems in the Bay — and some remedies for them

| *Country* | *Problem (as prioritized)* | *Remedy* |
|---|---|---|
| **Bangladesh** | Dumping of untreated sewage into rivers, estuaries and neritic waters.<br>Destruction of mangrove and other forests.<br>Siltation causing turbid water and leading to formation of sandbars and closure of estuary mouths.<br>Discharge of industrial effluents of various origins.<br>Overfishing — capture fisheries and shrimp seed collection.<br>Release of agrochemicals — fertilizers and pesticides.<br>Solid waste disposal in aquatic ecosystems. | Promote quality research relating to environmental issues.<br>Creation of data bases.<br>EIAs should be made before implementation of activities which might effect the environment.<br>Need for the creation of chartered environmental auditors who are authorized.<br>Common standards for different aquatic environments should be introduced.<br>Regular monitoring of aquatic ecosystems should be introduced and all data must be published.<br>Exchange of personnel information should be encouraged, particularly amongst the countries of the BOB region. |
| **India** | Dumping of untreated sewage into rivers, estuaries and neritic waters.<br>Discharge of industrial effluents of various origins.<br>Siltation causing turbid water and leading to formation of sandbars and closure of estuary mouths.<br>Release of agrochemicals — fertilizers and pesticides.<br>Aquaculture practices causing environmental degradation.<br>Pollution, generated by power plants.<br>Solid waste disposal in aquatic ecosystems.<br>Overfishing — capture fisheries and shrimp seed collection.<br>Destruction of marine habitats, such as coral reefs, mangroves and seagrass beds. | |
| **Indonesia** | Oil, sewage and pesticide pollution.<br>Mangrove, coral reef and sea grass destruction.<br>Overexploitation. | Better data collection analysis.<br>Sea water standards.<br>Waste recycling.<br>Waste disposal guidelines.<br>EIA implementation.<br>Resource use planning base on sustainable use.<br>Education and community involvement.<br>Legislation and enforcement. |
| **Malaysia** | Sewage, oil and siltation pollution and agro-industrial waste.<br>Mangroves, coral reef and sea grass destruction.<br>Overexploitation. | |
| **Thailand** | Sewage pollution.<br>Mangrove, coral reef and sea grass destruction..<br>Siltation and agro-industrial waste.<br>Over-exploitation. | |
| **Maldives** | Coral mining.<br>Sewage/industrial/aquaculture and agriculture discharges.<br>Solid waste disposal.<br>Overexploitation of marine living resources.<br>Land reclamation/siltation.<br>Sand mining.<br>Dredging.<br>Construction of unplanned structures on the coast.<br>Mangrove destruction.<br>Oil pollution. | Education and awareness.<br>Strict enforcement of laws.<br>Feasibility studies on locations available for sand mining.<br>Support to sewage treatment disposal plan proposal in critical areas.<br>Improving existing sewage farms and better management.<br>Improve collection/handling systems of solid waste.<br>Establish suitable land fill sites.<br>Control land filling.<br>EIA before dredging.<br>Develop management plans for M.S.Y.<br>Remove subsidies on boats and gear.<br>Control over destructive fishing methods.<br>Strict enforcement of forest ordinance.<br>Rehabilitation of mangroves.<br>Water quality monitoring in chronic areas of oil pollution.<br>Implementation of coastal zone management plan.<br>Guidelines for resort development. |
| **Shri Lanka** | Coral mining.<br>Sewage/industrial/aquaculture and agriculture discharges.<br>Solid waste disposal.<br>Construction of unplanned structures on the coast.<br>Sand mining.<br>Mangrove destruction.<br>Over exploitation of marine living resources.<br>Land reclamation/siltation.<br>Oil pollution.<br>Dredging. | |

# BIOINDICATORS.

*A simple inexpensive way of monitoring water quality*

Bioindicators are a great help in monitoring the environment, having as they do many advantages over chemical analysis.

For instance, if a chemical plant has been cleaning containers and vessels before the summer vacation and discharging the waste into a river at four in the morning, there is no chance of revealing such a crime with chemical analysis, as the toxic discharge would be far downstream or diluted by the time any tests are made. A biological sample, upstream and downstream the discharge, would provide a fair indication of what had happened. But if you put out a little basket with water moss, *Fontinalis* ***antipyretica,*** upstream and downstream the industry, it will provide the best chance of prosecuting the owner of the industry for endangering fish and thirsty cattle with toxic water, because the water moss would take up significant amounts of the toxic compound even if the compound had been diluted by then. By comparing the extent of the poison in the ***Fontinalis*** upstream and downstream there would be scientific proof acceptable in a courtroom!

Another advantage with biomomtoring is that it provides information about the biological significance of the damage. Chemical analyses only indirectly measure biological dangers. What worries humans is whether they will get sick from eating, drinking or breathing a particular substance, and not whether concentrations of dangerous compounds are above or below certain recommended values. Sometimes chemical values can be very high, but the toxic substances may not be biologically available and would thus be innocuous. In other cases, the concentrations could be below the detection limit of sophisticated analytical instruments, yet the water could be dangerous to organisms and humans. A striking example of this is mercury.

The highest measured values of mercury in water and sediments were found in small rivers in a mining area of central Sweden, Bergslagen, but the fish living there had very low values or no mercury at all in their flesh. The reason was that the mercury was blocked by the selenium found in the water and was, thus, not biologically available. After Sweden banned the use of mercury and its discharge into air or water, concentrations were often found to be under detection limits in water and sediments in most parts of the country. But, to the great surprise of the authorities, the concentrations in freshwater fish have increased substantially in the last few years and many mothers who've included fish in their diet during pregnancy have unexpectedly borne retarded children. It turned out that it was not the amounts of mercury that had changed but its bioavailability. The acid fallout in Scandinavia from industries in central and eastern Europe has changed the chemical and biological processes in the soil and water in such a way that mercury is now much more available to organisms that it was before. The position is now so bad that women in the fertile age group in Sweden are told not to eat freshwater fish at all. This is very unfortunate, as fish is otherwise a very healthy and appropriate food during pregnancy.

Two other problems with chemical analysis are the enormous number of different substances that have already been discharged into water and air, and the high cost of analysis. About 2.5 million new chemical substances have been produced this century and every year 200,000 new chemicals are synthesized in laboratories, of which about 500 are introduced into the market. Most of them are beneficial to society, but many constitute potential threats to human health and to the environment. But when a single chemical analysis of some of the substances could cost up to US $ 2,000 and, in some cases, could be made only in fewer than ten laboratories in the world, then the only option is biomomtonng and the use of bioassay techniques.

A good example of the bioassay technique is the use of the harpactocoid crustacean ***Nitocra spinosa*** that has been developed by Sweden's Bengt-Erik Bengtsson. This method is now being tested for tropical conditions at the AlT in Bangkok. *Nitocra*, which can live in freshwater, brackishwater and seawater, is very easy to cultivate. But it is a little bit too hardy and resistant to be useful to test natural conditions in temperate waters. It seems to be more sensitive in tropical climates and has turned out to be very useful for testing effluents from industries. By simply adding suspected water to a container with *Nitocra* and seeing if the crustaceans survive, you can quickly tell if the water is biologically dangerous or not. You do not need to know anything about the chemical composition or structural formulas of the compounds and you do not need to pay for expensive analyses.

***Hydropsyche angustipennis*** is another good natural bioindicator and of a type more likely to be prevalent in the tropical environment. The caddis fly family, *Hydropsychidae*, have larval stages that spin webs to catch their feed. Most species live in streams and rivers and can be found all over the world. When the water is polluted, the larvae lose their ability to coordinate properly and the meshes of their webs become irregular. A fascinating

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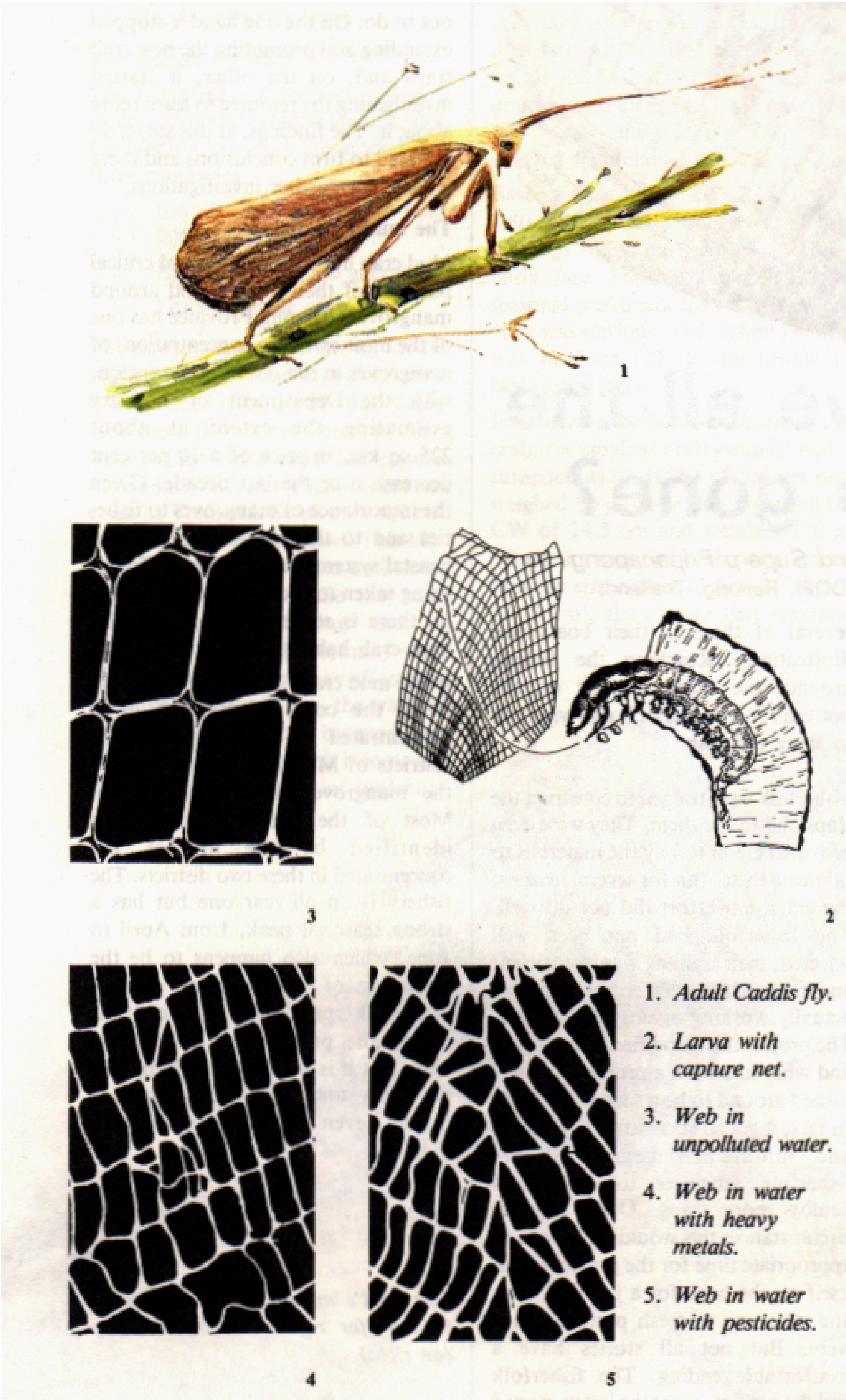
discovery was that heavy metals gave one type of deviation and chlorinated organic compounds and pesticides another.

It has been found that when these small primitive creatures are unable to coordinate their movements properly, it has been due to some substances in the water that have caused them brain damage. You do not need much imagination to realize what could happen to humans who drink this water or use it to prepare food. This little creature tells you better than a long list from chemical analysis whether a particular water is fit for human consumption or not. Even politicians and industrialists would be convinced by pictures of the consequences to *Hydropsychidae.*

Another valuable tool in making a quick assessment of water quality is its phytoplankton composition. For scientific research the biomass should be analyzed, but for a quick appraisal a net sample is adequate. By identifying the species composition and judging from the dominant species as well as the presence/absence of other species, it is possible to arrive at reasonable conclusions about the quality of the water. *Melosfra helvetica* in a pristine lake becomes substituted by *M. islandica* when nutrients increase and by *M. granulata* when the lake is eutrophic. In hypereutrophic/saprobic conditions, monocultures of chlorococcal green algae often develop. And the dominance of the different algal groups also provide information – *Dinophyceae*, for instance, is found in lakes only if they have a low carbon and high acid content.

Finally, fishing with survey nets gives a good picture of what has happened during the last few years in the lake. Is the species composition normal? Is the size distribution normal or do yon find too many small/too many big fish? Have all species been able to spawn in the last few years?

The otohites in the organs of equilibrium are of special interest. They can be compared to tachographs in cars or the black boxes in aeroplanes. By studying them, the age as well as the whole life history of the fish can be revealed. A case of temporary damage to a lake in Germany years previously, following an industrial discharge, was proved and dated by the help of otolites in its fish.




1. *Adult Caddis fly.*
2. *Larva with capture net.*
3. *Web in unpolluted water.*
4. *Web in water with heavy metals.*
5. *Web in water with pesticides.*

S.H.

# Where have all the BIG crab gone?


*by Pradit Chonchuenchob and Suparp Pripanapong*
(Coastal Aquaculture Station (DOF), Ranong, Thailand)


The fisherfolk in Ranong, a coastal province of southern Thailand on the Andaman Sea, have fished for mud crab *(Scylla serrata)* for generations using crab liftnets (a long bamboo pole with a circular net containing bait at the bottom – see illustration). These nets are efficient and inexpensive, but they do have a few disadvantages. In 1987, a Bay of Bengal Programme (BOBP)-assisted extension project in Ranong had discussions with the fisherfolk and identified the disadvantages as:

- Only one crab being caught at a time;
- The crab liftnets needing to be watched continuously; and
- The fishermen needing to be alert all the time, lest the crab escape.

The project therefore decided to introduce a trap (new to Ranong) which had shown success elsewhere in Thailand. These traps, made of metal frames and covered with netting have, unlike the liftnets, the potential to catch several crab at a time. They are collapsible and fisherfolk can carry several of them in their boats (see illustration). Reaching the fishing ground, the traps are left on the bottom for a couple of hours with bait to snare the crab.

Fisherfolk were trained to construct the traps and to use them. They were even provided credit to buy the materials to fabricate them. But for several reasons, the extension effort did not do well. The fisherfolk had not been well selected, their training was insufficient and it was felt that the cheap credit was actually working against the success. The project then modified its approach and what had been a problem in 1987 turned around to be a success by 1989. In fact, it got so successful that traders and middlemen began to give fisherfolk advances to make and deploy, more traps. Under normal circumstances this would have been an appropriate time for the project to pat itself on the back for a job well done and move on to fresh pastures, as it were. But not all stories have a comfortable ending. The fisherfolk and the project, more the latter, started to notice that a very large number of very small size crab were being caught and sold. And, this was worrying.

When only small crab are caught it either means that the fisherfolk for some reason want them small and are targeting them, or that only the small ones are around. In either case, it is necessary to make sure that there is a healthy crab resource around to fish. And that is exactly what theproject set out to do. On the one hand it stopped extending and promoting the new crab traps and, on the other, it started investigating the resource to learn more about it. The fmdings, at this stage, do not lead to firm conclusions and there is need for further investigations.

## The mud crab fishery

Mud crab live considerable and critical portions of their lives in and around mangroves. Ranong Province has one of the most extensive concentrations of mangroves in the Asia-Pacific region, with the Department of Forestry estimating the extent at about 225 sq km, in spite of a 10 per cent decrease over the last decade. Given the importance of mangroves to fisheries and to the physical integrity of coastal systems, considerable effort is being taken to protect the mangroves. So there is some assurance that the mud crab habitat is being preserved.

While mud crab fishing is prevalent all along the coast of Ranong, it is concentrated in the two southern districts of Muang and Kapur where the mangroves flourish (see map). Most of the twenty landing sites identified by the project are concentrated in these two districts. The fishery is an all-year one but has a strong seasonal peak, from April to June, which also happens to be the beginning of the monsoon season. Fisherfolk spend most of their time during the peak season fishing for crab. But it is not the only thing they do. They undertake other kinds of fishing, even some agriculture and

*Our artist's impression : A crab liftnet in use (far right) and a crab trap (on right).*

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horticulture, and these other activities become more important in the off-season.

The common gear are the crab hiftnet and now the metal trap. Fisherfolk concentrate on fishing for crab during a few days before and after each spring tide, which adds up to about 10-12 days a month. Each fisherman sets out in his boat and usually deploys 15- 20 units of either gear.

The market for crab

The fisherfolk sell their crab live to dealers and traders at the landing sites. On landing, the crab are graded into three categories

- Small crab (less than 200 g/crab)
- Big crab (over 200 g/crab)
- Gravid female crab

The market demand is strong for the big crab and for the gravid females, which are considered delicacies. However, there does seem to be a demand for small crab for culture, particularly in Surat Thani on the east coast of Thailand. Small crab are also sold for local consumption. This kind of a market demand poses a dilemma for the fisherfolk. While they may realize that Overfishing and, in particular, removing too many small crab from the resource may affect their resource, and its future, the tradeoff is a difficult choice, because they would have to forego their income and seek alternative sources of income..

Understanding the resource

The extension project, late in 1990, decided to sample the data of crab landings. From December 1990 to December 1991, the landings of crab were recorded at 15 landing sites (selected out of the 20, for their importance and contribution) on a daily basis. This was done after the traders had sorted the crab by size, and generated only gross figures. Further, three landing sites, one each in Muang, Kapur and Laun Districts, were visited one day each month and, after sorting, 100 'small' and 50 'big' crab were selected for detailed investigation.

Based on the data, the total landing in 1991 was estimated' to be 165 t. When landings were charted on a monthly basis (see Figure 1 overleat) the seasonal peaking of the catch in April-June was obvious. The highest landing was in June (20 t), the lowest in November (5 t).

In analyzing the data on the size of the crab, the smallest crab sampled had a carapace width (CW) of 5.4 cm and weighed 30 g, while the largest had a CW of 14.5 cm and weighed 770 g. When the sampled crab were sorted into ten size classes (5-6, 6-7, 7-8, 14-15 cm), the picture that emerged

**Map of sampling location in Ranong Province.**

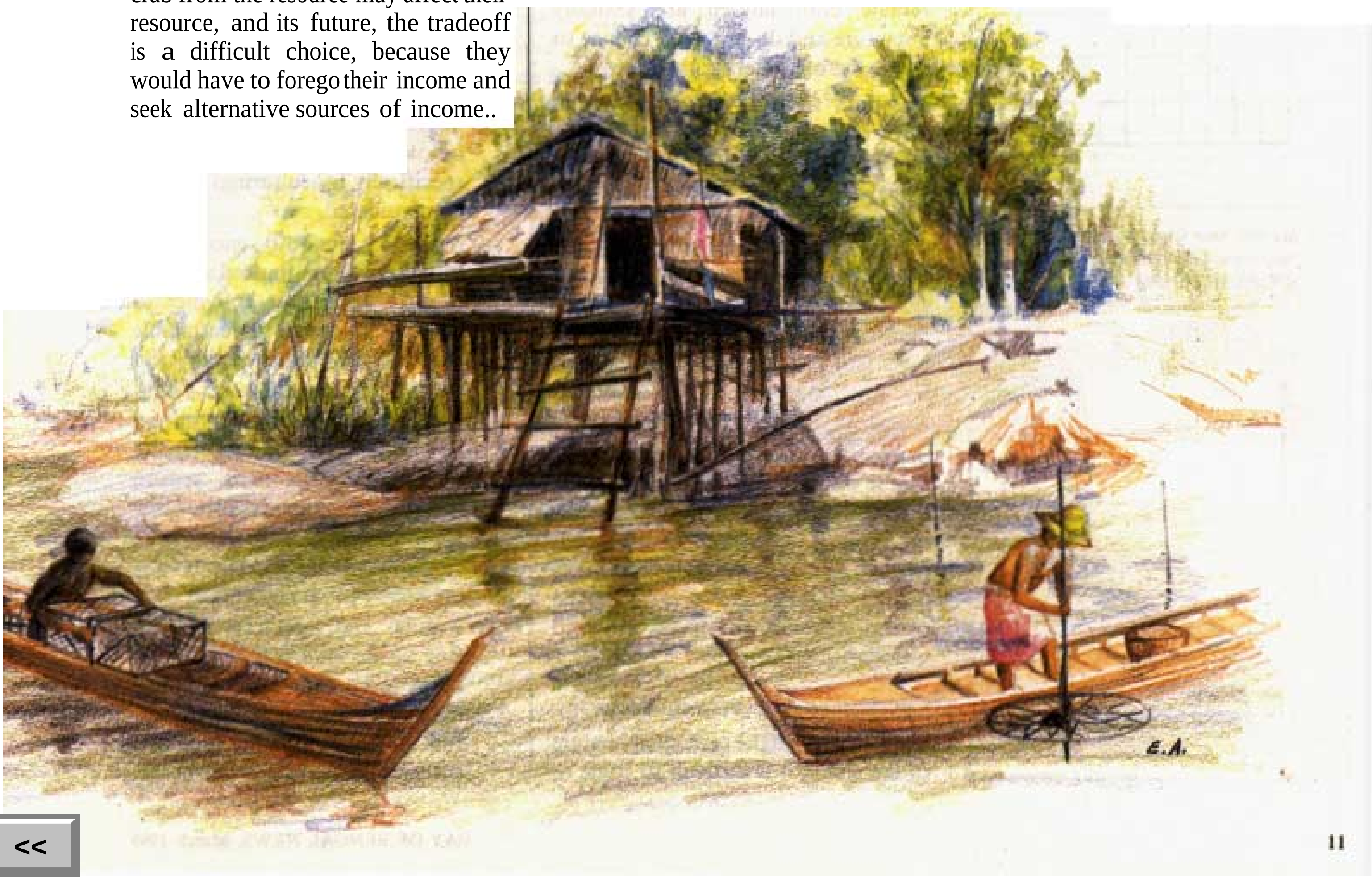



**Fig. 1 Monthly landing data of mud crab in Ranong, Thailand. Bar represents total monthly landing, while – represents landing data of large crab (weigh > 200gm) and – represents landing data of small crab (weigh < 200 gm).**

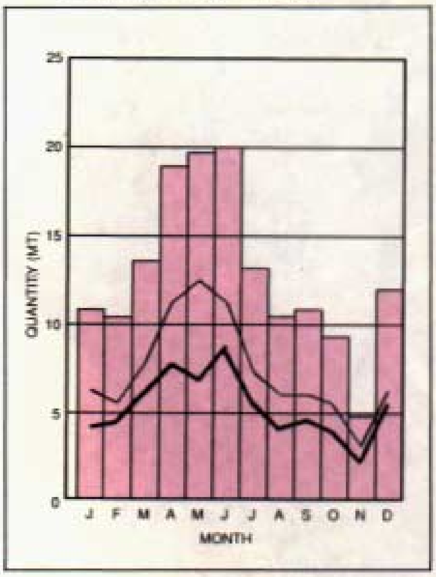



**Fig. 2 Size distribution in sample of mud crab.**

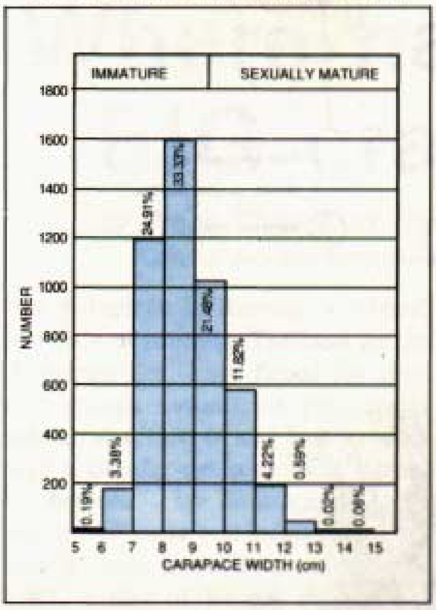
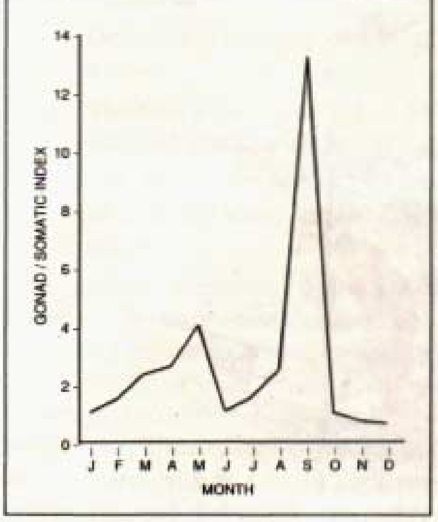



**Fig. 3 Monthly mean Gonad/Somatic Index (GSI) of female mud crab in Ranong Province, Thailand. (UNDP/UNESCO, 1986)**




(see Figure 2) suggested that over 90 per cent of the crab landed fell into the 7-11 cm CW category. For the Ranong area, the estimated maximum size for mud crab is about 17 cm CW (Cheewasedtham, 1990), but our present study shows that sizes beyond 12 cm are very rare or negligible (0.6 per cent). Only 16 per cent are mature ones, and they are primarily of the 11-12 cm size or just matured ones; there are hardly any older and bigger crab. Where are they? Have they declined because of overfishing? Is the existing fishery targeting for the smaller sizes only? Or, are the large mud crab living in some other area? More studies are needed to answer these questions.

## Sexual maturity

Looking at the sexual maturity of the crab landed adds to the information gathered on the sizes landed. The smallest ovigerous mud crab found in the sample had a CW of 8.2 cm and weighed 95 g. However, analysis suggested that, in the Ranong region, mud crab become sexually mature when they reach a CW of 10-11 cm, on the average. Given this, Figure 2 shows that nearly 84 per cent of the catch landed consists of sexually immature crab. Further, the data suggests that 41.3 per cent of the female crab landed are sexually immature and do not get a chance to spawn before entering the fishery.

The data from a UNDP/UNESCO study (1986) suggests that the highest mean Gonad/Somatic Index (GSI) value for female crab occurred in September (see Figure 3). If' the (iS! values are read along with the catch data by sex, some interesting conclusions can be reached. The number of female crab caught gradually decreased from August to January. The ratio of female to male crab in the catch was lowest in October and Noyember.

Supporting this fmding was the fact that it was during this period that the numbers of berried females caught in the offshore trawl fishery increased, suggesting that the female crab move out of the mangrove area to the offshore region, to spawn, between October and December.,

## Conclusions & recommendations

Keeping in mind the preliminary nature of the study, it is difficult to come to firm conclusions. However, some trends and tendencies seem clear. There does seem to be a tendency to fish for smaller and immature crab in Ranong. The fact that a large proportion of the females caught are immature and also the fact that gravid females are preferred by the market is a concern.

Can we say that the crab resource is at risk of being overfished? The data and our understanding at the end of the study cannot lead us to such a conclusion, but the concerns are there and there is no doubt that the resource needs to be studied in detail. And the Department of Fisheries, through the Coastal Aquaculture Station in Ranong, is committed to continuing the study in order to give guidance to the fishery in the future.

Based on the trends noticed, even without the more detailed study to follow, some recommendations can be made, and these are:

- There is a need to strengthen the protection and conservation of mangroves not only to sustain forestry production but also fishery production.
- Extension, training and motivation programmes for fisherfolk are neccessary to limit and reduce destructive fishery methods and to ensure that undersized and immature crab are not caught. Regulations to ban the catching of and, even more importantly, trading of crab below 10 cm CW (except specifically for culturing) need to be considered.
- Fisherfolk should be encouraged to either release undersized crab or take up culture activities to growout the crab to reasonable size, which would also earn them more.
- Regulations to prohibit capture and holding of gravid females during the spawning season should be considered, while simultaneously educating the consumers of the dangers of their preference for gravid female crab.
- Regular and long-term monitoring of the mud crab population needs to be undertaken to guide the fishery and to enable fisherfolk to manage the resource in a sustainable manner.

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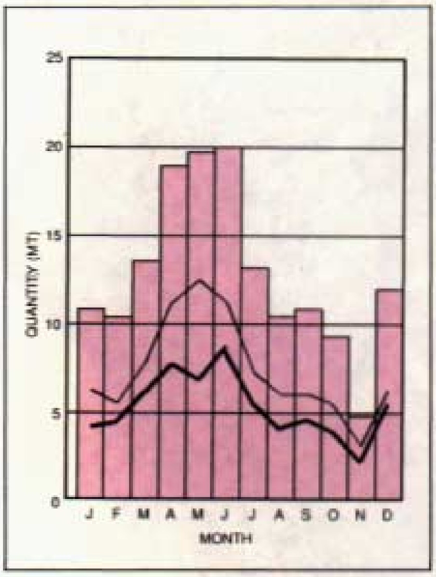


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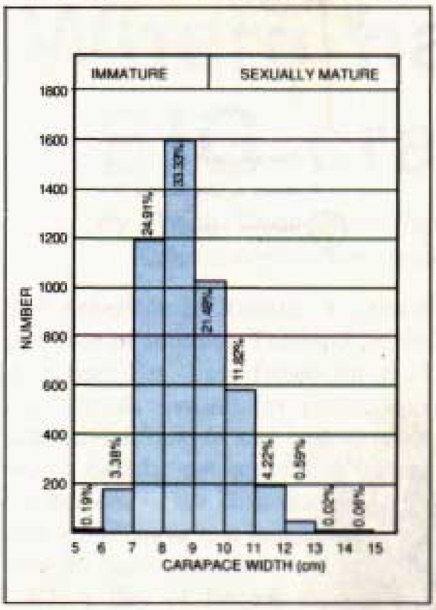


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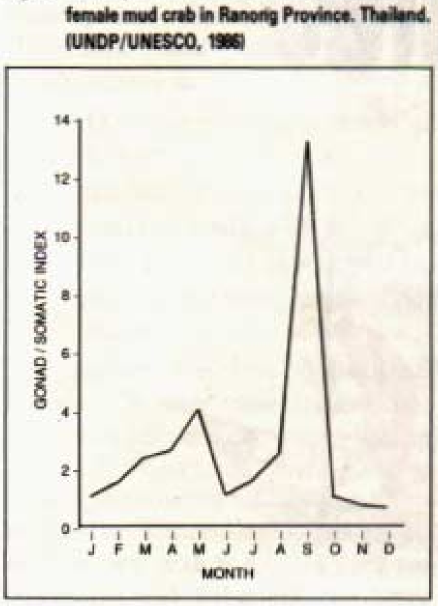


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Supporting this finding was the fact that it was during this period that the numbers of berried females caught in the offshore trawl fishery increased, suggesting that the female crab move out of the mangrove area to the offshore region, to spawn, between October and December.,

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# THE DOLPHIN ISSUE ‘IN SHRI LANKA

## New study puts it. in a better perspective

by Leslie Joseph* and Pauline Dayaratne**

Shri Lanka, labelled a dolphin-killing nation and accused of catching nearly 60,000 dolphin a year, may, in fact, be catching no more than 5200 dolphin a year. This estimate, the lowest ever, is revealed in the most comprehensive study undertaken of what has become a major environmental issue in Shri Lanka in recent years. That the incidental catches of dolphins and small whales in Shri Lanka’s marine fisheries has become a serious, environmental issue is not surprising, considering the recent international concern over incidental catches of cetaceans, other marine mammals and other nontarget species in many different fishing operations around the world.

Incidental catching of dolphin during commercial fishing operations in Shri Lanka has a long history, with available literature dating back to the late 19th Century. A targeted fishery, by harpooning, has also been reported in certain areas.

A number of studies during the last decade, by local as well as foreign researchers in Shri Lanka, have provided estimates ranging from 8000 to 60,000 dolphin caught a year. Almost all these studies were confined to sampling of dolphin catches at a few fish landing centres for short periods of time., The catch rates thus obtained were simply multiplied by the total number of motorized craft in the island to yield annual estimates. There was no allowance made for seasonality of fishing (fishing effort), regional differences,, in relative abundance of dolphin, categories of craft-gear combination associated with dolphin catching or landing etc. Despite these limitations, the highest estimates have received much international exposure, resulting in Shri Lanka being identified as one of the main dolphin-killing nations. Local journalists and environmentalists have been quick to sensationalize this.

### Objectives of study

Shri Lanka has a very large component of pelagic drift-netting in her small-scale fisheries, both in the inshore and offshore ranges of her EEZ. The country has also launched an ambitious development programme to expand her offshore/deep sea fisheries with an emphasis on driftnetting and longlining. The Ministry of Fisheries was, therefore, much concerned over the dolphin issue and requested the Bay of Bengal Programme’s (BOBP) assistance for a comprehensive study of the dolphin catch. BOBP funded, and provided technical support to, a one-year study carried out by the National Aquatic Resources Agency (NARA), which focussed on these objectives

- Estimation of the total number of dolphin caught around Shri Lanka.
- Assessment of the economic importance of dolphin catches to fisherfolk and consumers.
- Assessment of attitudes and perceptions of fisherfolk, traders, consumers and nonconsumers, to capture and utilization of dolphin.

### Methodology

The bioeconomic component of the study was conducted by NARA with the assistance of seven trained data collectors deployed around the island, except in the strife-torn North. Some were even provided with motor cycles to facilitate travel to remote areas. Based on a frame survey, the detailed information on the number and type of craft associated with dolphin catching or landing, their fish catch, income and operational expenditure, dolphin catch by species etc. were collected, according to a designed sampling programme which was executed at 14 selected stations around the country. The work of the data collectors was closely supervised by NARA and BOBP staff.

The socioeconomic component of the study was conducted by the Lanka Market Research Bureau (LMRB) with close supervision and coordination by NARA/BOBP. Considering the need for in-depth and quantified information, both quantitative and qualitative surveys were

*Spinner Dolphin*

*Bottlenose Dolphin*

* BOBP Consultant

** Director, National Aquatic Resources Agency undertaken, *face-to-face* interviews conducted and structured questionnaires answered. Fishermen, traders/retailers, consumers/nonconsumers and agency officials, Government officials, environmentalists and journalists were interviewed.

## Dolphin catch data

The seven data collectors spent 1547 mandays in the field, each averaging over 18 sampling-days a month. There were eight species of dolphin and six species of small whale amongst the 2791 animals encountered during the study (see Table 1). These were either found entangled in the driftnet

Table 1. Overall species composition of dolphin landed around Shn Lanka.

| *Species* | *Male* | *Female* | *MIF* | *Total* | *Percentage* |
|---|---|---|---|---|---|
| Spinner Dolphin *Stenefla longirostris* | 824 | 683 | 114 | 1621 | 58.1. |
| Striped Dolphin *S. coeruleoalba* | 106 | 89 | 05 | 200 | 7.2 |
| Bottlenose Dolphin Tursiopsspp. | 118 | 98 | 19 | 235 | 8.4 |
| Risso's Dolphin *Grampusgriseus* | 67 | 51 | 05 | 123 | 4.4 |
| Spotted Dolphin *S. attenuata* | 110 | 62 | 21 | 193 | 6.9 |
| Roughtoothed Dolphin *Steno bredanensis* | 21 | 14 | – | 35 | 1.3 |
| Fraser's Dolphin *Lagenodelphis hosei* | 09 | 06 | – | 15 | 0.5 |
| Common Dolphin *Delphinus delphis* | 03 | – | — | 03 | 0.1 |
| Melon-headed Whale *Peponoceph,ala electra* | 41 | 30 | 02 | 73 | 2.6 |
| Dwarf Sperm Whale *Kogia simus* | 09 | 07 | — | 16 | 0.5 |
| Pygmy Killer Whale *Feresaattenuata* | 29 | 21 | – | 50 | 1.8 |
| False Killer Whale *Psendocra crassidens* | 19 | 09 | 05 | 33 | 1.2 |
| Pygmy Sperm Whale *Kogia breviceps* | 11 | 04 | 01 | 16 | 0.5 |
| Southern Bottlenose Whale *Hyperoodon planifrons* | 02 | 01 | – | 03 | 0.1 |
| Unidentified | — | — | 175 | 175 | 6.3 |
| TOTAL | 1369 | 1075 | 347 | 2791 | 100 |

operated for tuna and shark or harpooned. Five species of dolphin — the Spinner, Striped, Bottlenose, Risso's and Spotted Dolphin — made up over 85 per cent of the catch, with the Spinner Dolphin more than half of it. The overall sex ratio showed a preponderance of males over females in almost all the species.

Dolphin accidentally entangled in the large-mesh driftnet were observed at practically all the sampling stations, but harpooned dolphin were found only in four sampling sites — Negombo (west), Beruwala (southwest), Mirissa and Dondra (south). The harpooned dolphin comprised 31 per cent of the total number of dolphin recorded as caught, with 85 per cent of them from Mirissa. The species composition of harpooned and entangled dolphin from Mirissa and Beruwala showed some interesting differences. For instance

- Spinner and Spotted Dolphin were better represented amongst the harpooned dolphin compared to entangled ones.
- Striped and Risso's Dolphin were better represented amongst entangled dolphin compared to harpooned ones.
- Small whale species were predominant amongst the entangled.
- Bottlenose Dolphin was equally represented amongst both groups.

Harpooning dolphin for longline bait has been a tradition among fishermen in the Mirissa and Dondra areas, long before the driftnet fishery for tuna came into existence. Fishermen generally resort to harpooning during poor tuna fishing trips and it often occurs on their return trips, closer to the coast. Therefore, the differences mentioned above could well reflect spatial differences in relative abundance of various species.

## Which craft land dolphin?

In 1992, in Shri Lanka, 25,589 fishing craft have reportedly engaged in fishing activities. These were grouped into

| | | |
|---|---|---|
| Clifi with inboard eoajaes. | | |
| Multiday craft of over 11 m | | 118 |
| Multiday craft of 10-11 m | | 1,083 |
| Day boats of 9 m | | 1,258 |
| | Subtotal: | 2,459 |
| Craft with outboard motors | | |
| 5-6 m FRP craft | | 7,004 |
| Traditional craft | | 1,749 |
| | Subtotal: | 8,753 |
| No.motorized traditional craft | | 14,371 |
| | Total: | 25,589 |

The nonmotorized traditional craft and craft with outboard motors generally fish inshore, up to 8-10 n miles of the coast. Using a variety of fishing methods they target small to medium size pelagic and demersal resources. All the inboard engine craft of 10 m and above conduct large mesh driftnet fishing, drift-longlining and trolling for tuna, shark and billfish. These multiday craft may spend 5-10 days at sea during fishing operations, venturing over 100 n miles offshore. Day-boats of 9m are largely engaged in large mesh driftnet-cum-drift-longlining, but some engage seasonally in other fishing methods. Exact numbers in each fishery, during different seasons, are not known.

All the dolphin encountered during the study were landed by inboard engine craft; 27 per cent by the 3.5 GT day-boats, 67 per cent by the medium-sized (10-il m) multiday craft and 6 per cent by the larger (over 11 m) multiday craft. The species composition of dolphin obtained by coastal day-boats and the offshore boats showed differences, with the Spinner Dolphin represented more in the day-boat catches, whereas the Bottlenose, Striped, Risso's and Spotted Dolphins and the small whale were better represented in the catches of offshore boats. As in the case of the differences between harpooned and entangled dolphin, these differences could also reflect differences in relative abundance of dolphin between different fishing ranges.

## Dolphin catch rates

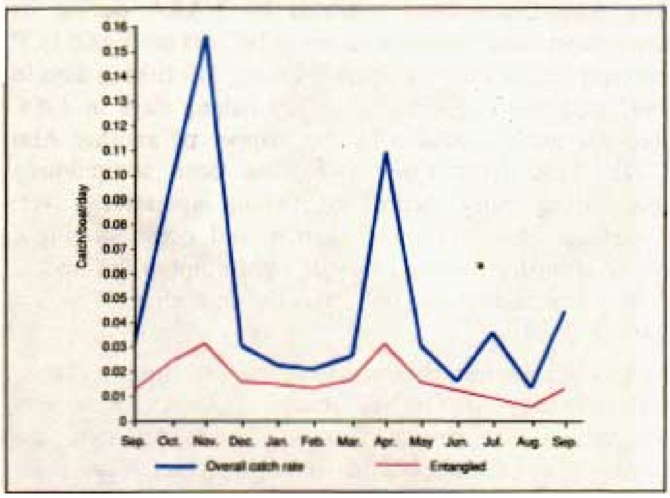
The monthly mean catch rate (catch per boat per day) determined for the different subareas showed a remarkable similarity: a peak catch rate in the Nov.-Jan. period followed by a decline, and a secondary peak (March-April) in some areas. This is shown in Figure 1, which also clearly emphasizes the importance of harpooned dolphin to the overall catch rate in the South. The peak catch rate periods for dolphin are lean seasons for tuna in the driftnet fishery. This seasonal variation in catch rate was similar in different craft types as well as between entangled and harpooned dolphin.

## Estimation of all-island catch

Over 40 per cent of the inboard engine craft operating during 1992 were located at the 14 landing sites sampled by the data collectors. For purposes of estimating an all-island catch, the coastal area of the island was divided into eight subareas (Figure 2). Dolphin catches were estimated on a monthly basis for different subareas. In each month, the dolphin catch rate and the fishing effort (number of boats landing) established for each craft category (day-boat, 10-11 m multiday boat and lim multiday boat) were utilized to estimate monthly dolphin catch for each subarea. The multiday fishing craft averaged about 20 sea days and 13 fishing days per month, while the day-boats averaged 20 fishing days. Differences in the number of days were small between subareas; so were the monthly variations within subareas. Harpooning for dolphin took place even on nonfishing sea days. The number of fishing/sea days, multiday - and day-craft were estimated by interviewing fishermen in each subarea every month, and the estimate of the total fishery effort was increased by 10 per cent, to avoid any underestimation. This method of calculation

**Fig. 2. Sampling sites of the dolphin study**


**Fig 1. Seasonal variation in dolphin catch rates (south coast)**




greatly reduces the bias (positive or negative) inherent in applying a single annual dolphin catch rate to the whole island and the fishing effort without allowing for seasonal variations.

The estimated dolphin catch in Shri Lanka * for 1992 is 5181 (about 3000 of one species and approximately 170 of each of the other 13 species — see Table 2). How does this estimate compare with the previous ones? For one thing, it is the lowest estimate made so far. But the study leading to it is also the most comprehensive undertaken so far. A summary of information on studies leading to all previous estimates is presented in Table 3. It has also been reported that preliminary estimates by NARA of dolphin catches by the 1im Abu Dhabi gillnetters were in the region of 1000 animals a month. In the absence of a well-coordinated sampling programme aimed at this class of boat, and in the absence of technical documents substantiating this information, the reliability of this estimate is questionable. However, environmentalists have had no hesitation in adding 12,000 (annual estimate) to the highest estimate provided by Leatherwood and Reeves *(1985)* to come up with the figure of 60,000!

Table 2: Estimated numbers of dolphin caught in Shri Lanka by subarea and craft type

| *Subarea* | *CRAFT TYPE* | | | |
|---|---|---|---|---|
| | *3.5GT,9m Day-boats* | *9-JOm Multiday boats* | *Over Jim Multiday boats* | *TOTAL* |
| Northwest | 380 | 14 | — | 394 |
| West | 255 | 661 | 258 | 1174 |
| Southwest | 167 | 1112 | — | 1279 |
| South | 214 | 1355 | 8 | 1577 |
| East | 373 | — | — | 373 |
| Northeast | 384 | — | — | 384 |
| TOTAL | 1773 | 3142 | 266 | 5181 |
| PERCENTAGE | 34.2 | 60.6 | 5.1 | — |
| Inboard craft at sampling sites | 620 | 458 | 62 | 1140 |
| Inboard craft (whole island total) | 2158 | 1083 | 118 | 3359 |

* It must be noted that no work was done in the North, there were also no inboard engine craft operating there in 1992.

The only reliable data available on dolphin catches by the Abu Dhabi driftnetters gives a somewhat different picture. The Abu Dhabi boat operated by NARA during its exploratory tuna resources survey in 1987/88 (an FAO/TCP project) caught only six dolphin during 119 fishing days in 1987 and five dolphin during 129 fishing days in 1988. Records made available by the skipper of another Abu Dhabi boat from Galle (who has been scrupulously maintaining daily records of fishing operations data, including information on weather and oceanographical observations) showed a catch of eight dolphin during 183 fishing days in 1988 and only two dolphin during 156 fishing days in 1989.

In another interesting turn of events, the estimates made following the NARA/UNEP study have been reassessed by the same authors (admitting to an error in earlier calculations) and the dolphin caught per year reduced to 8042-11,821 animals. Unfortunately for Shri Lanka, this revised estimate may not get the same prominence as the estimate of 60,000, hidden as it is in an annex to a large report.

The size compositions of the dolphin caught indicate that large proportions of the dolphin were smaller than the size at maturity. However, in view of the small numbers caught, this may not have a significant impact on the population.

## Economic importance of dolphin catch

The 2791 dolphin observed during the study were estimated to have a landed value of SLRs. 1.6 million*. The average beach price was 13.09 SLRs/kg and the consumer paid 40-50 SLRs/kg. The fish catch and income as well as operational expenses data collected of various categories of craft during the study were utilized to calculate the monthly net earnings per fisherman. Very often, the boatowners do not claim any share from the sale of dolphin. The annual income obtained by a fisherman in different areas, for different craft types, is shown below, together with the annual income obtained from the sale of dolphin catch.

* US $ 1 = SLRs. 46/-

| *Area/Sampling site* | *Craft type* | *Annual income from fishing (SLRs.)* | *Annual income from dolphin catches (SLR5.)* |
|---|---|---|---|
| Trincomalee (east) | 3.5 Os day-boats | 41,002 | 1551 |
| Negombo (west) | 9-lOm multiday | 61,812 | 2109 |
| Negombo (west) | ii m multiday | 103,303 | 2920 |
| Mirissa (south) | 9-10 m multiday | 69,275 | 16103 |

In Mirissa, the income from dolphin is almost a quarter of that from fishing. Harpooned dolphin in Mirissa gave each fisherman an annual income of SLRs. 14,298. Not taking into account harpooning, the income from the dolphin caught entangled in nets would be around three per cent of the income from fishing and, thus, negligible, as in most other areas. The annual income levels also show Mirissa fishermen earn almost the same as large-mesh driftnet fishermen in most areas, with perhaps bait for shark as justification for harpooning dolphin.

## Conclusions drawn

- Resources studies on dolphin have been poor around the world. Nevertheless, the eastern tropical waters of the Pacific Ocean, covered by the Inter-American Tropical Tuna Commission and where dolphin abundance studies have been relatively intensive in recent years, dO not show evidence of any significant changes in the abundance of dolphin species, despite annual catches ranging from 125,000 to 53,000 during the 1986-90 period. Considering the relatively smaller numbers of dolphin entangled in the tuna driftnets as

Table 3: Comparison of studies leading to estimates of dolphin mortality in Shri Lanka

| *Author* | *Area covered* | *Thuodon of study* | *Orrfl type sampled* | *All-island eslb,wle* | *Method of estimation* |
|---|---|---|---|---|---|
| 1. Alling, A (1983) | Beruwala (Southwest) | 7 months (1983) | 3.501 dayboats | 13,500 (15,200- revised) | A single mean catch rate estimated for Beruwala applied to all 3.5 01 class boats in Shri Lanka. |
| 2. iospeh, L and Siddeek, M.S.M. (1985) | Beruwala (Southwest) Negombo (West) | 1 year (1985) (56 sampling days) | 3.501 dayboats | 9129 | A single mean catch rate from study area applied to all 3.501 boats in Shri Lanka excluding those engaged in shrimp trawling in Chilaw, Gulf of Mannar and the North. |
| 3. Ailing, A (1985) | BeTuwala (Southwest) Trincomalee (East) Valachchenai (East) | May 1982-Oct. 1984 (68 sampling days) | | 42,480 | A single mean catch rate from the three areas applied to all 3.501 and 6.7m FRP (OBM) crafts in Shri Lanka. |
| 4. Leatherwood, S. and Reeves. R.R. (1989) (report on NARA/UNEP study) | West Southwest South Northeast | 1985-1986 | | 26,332.49,863 | Service of total mortalities is estimated for two areas, using two mean catch rates for 3.501 craft. |



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# Questions and answers on the new outrigger canoes introduced in Nias

*by G Pajot*

**(Sr. Fishing Technologist, BOBP)**

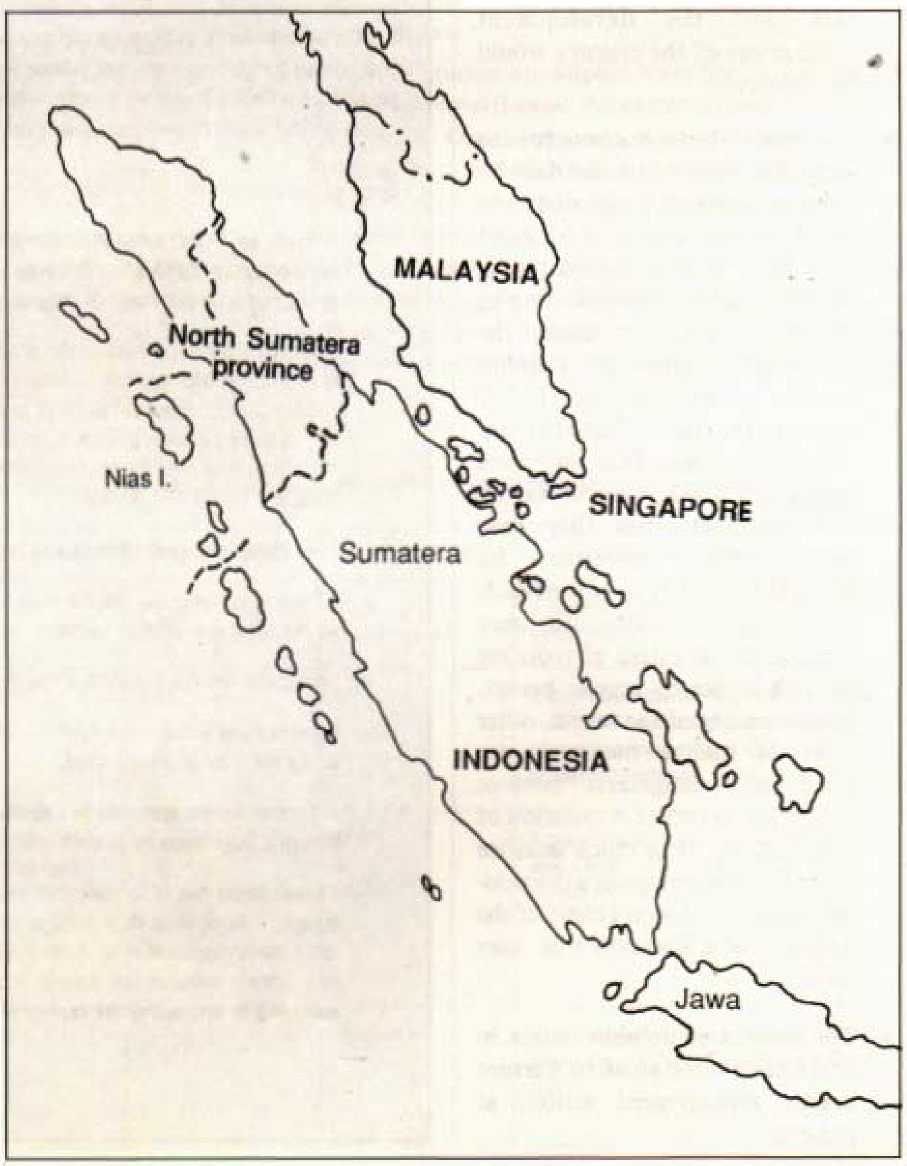
Four years after the Bay of Bengal Programme (BOBP) initiated a subproject in Nias island, North Sumatera Province, Indonesia, to increase the production of fish and the earnings of the fisherfolk through the introduction of a new fishing craft, an assessment of the subproject indicated that the fishery using outrigger canoes with inboard diesel engines was "likely to expand further... without much external assistance".

The background to this development was the introduction of the new fishing craft in Nias after Indonesia joined the Bay of Bengal Programme in 1987 and identified North Sumatera Province as the area where new capture-oriented activities should be introduced. When field surveys indicated that there were too few fish for too many fishermen off the east and west coast, the offshore island of Nias, about 65 n miles west of North Sumatera, was surveyed in 1989. This survey revealed good fishery resources, but a low level of productivity due to the limited range of operation of the fishermen (BOBP/WP/78: *The Fisheries and Fisherfolk of Nias Island, Indonesia).* The small size of the bulk of their outrigger canoes and the lack of motorization were identified as problems standing in the way of Nias fishermen increasing production and their earnings. Considering their familiarity with outrigger canoes, the development of a larger, motorized outrigger canoe was seen as a step in the right direction and, in late 1989, the work started. (BOBP/WP/77: *Development of Canoe Fisheries in Sumatera, Indonesia,* describes the development, technical trials and fishing trials of those plank-built outrigger canoes.)

In March 1993, when the subproject came to an end, the assessment of it prepared for presentation to the Advisory Committee of the BOBP at a meeting in Dhaka, Bangladesh, stated:

> "The objectives of the subproject ... have been achieved in selected fishing centres on the east and west coasts of Nias Island. Given the interest of the private sector in demersal fish for shipment to distant urban markets, the outrigger canoes with inboard engines will likely expand further to most important fishing centres of Nias without much external assistance.
>
> However, unless an easy financing scheme is implemented, further introduction will primarily be thmugh small-scale entrepreneurs and not directly through the small-scale fishermen."

It is in this context that the questions below have been posed. The answers



to them may help to better understand the results of this project and in the execution of similar projects.

Was the selection of the outrigger canoe concept for further development of fisheries a step in the right direction?

Looking back on the project, the end result — the INS-5 outrigger canoe — appears to have been the right choice, because:

- It is a craft that can be operated from beaches and is ideal for an area where most of the fishing villages do not have protected anchorages;
- It achieves greater speeds than monohull craft of the same horsepower;
- It is fuel efficient;
- It provides crew comfort, thanks to the stabilizing effect of the outrigger;
- It can be built by local carpenters in the fishing villages themselves with locally available timber and accessories; and
- It can carry an insulated icebox to preserve the catch in ice during long voyages.

However, while the INS-S type has been found suitable for the hook-and-line coastal fishery, it has not proved to be an alternative to larger, inboard motorized monohull fishing craft for fishing further offshore. For various reasons, the large mesh driftnet fishery with the 9.5 m canoe failed.

Was motorization of the new canoes with inboard diesel engines the right. idea?

The fishermen of Nias certainly think so, on account of its reliabifity, its purchase price, running and maintenance costs, and the easy availability of engine and spare parts. The boat operators of Nias feel that imported outboard motors are too expensive to buy, run and maintain. Unlike with fishermen in Shri Lanka, ownership of a slick-looking outboard motor, even at a higher cost, is not a status symbol here. Cost-effectiveness is what concerns most of the fishermen of Nias.

The recent introduction of low-cost, Chinese-made diesel engines, at half the cost of Japanese ones, has reinforced this idea and will ensure sustained use of diesel engines for outrigger canoes.

Were too many prototypes built for outrigger canoe development?

Three prototypes of different sizes and design built during the development of this outrigger canoe was justified, as they demonstrated to the fishermen and developers the pros and cons of each craft and engine for specific fisheries. Most important, they provided the fishermen with a choice of technology instead of one technology being forced on them.

Was the new construction method appropriate?

Considering the low cost of timber, compared to other materials (FRP and plywood) suitable for outrigger canoe construction, and the prevailing standards of local timber boat construction, it was believed that timber should be used but with improved methods of construction to suit new designs. The enthusiastic response by fishermen and carpenters indicates the idea was correct. And a manual on how to build such canoes is now being published in Indonesian by BOBP, for dissemination elsewhere in Indonesia.

How successful was the training of local carpenters?

The INS-5 was designed for construction at village level in a makeshift shed using basic tools. The training of carpenters was, thus, an important component of the subproject. Several carpenters selected by local fisheries officers, as well as some fishermen, were trained as builders by an international master boatbuilder. Carpenters with previous boatbuilding experiences were found to be better trainees. After building two canoes under supervision, they proved to be capable of building canoes to very high standards on their own. Some of them even proved to be good on-the-job trainers later.

*Traditional outrigger canoe*

*INS-5 outrigger canoe*

*Carpenters during training to construct new canoes.*

Subsequently, some entrepreneurs got untrained carpenters to build their canoes, The Provincial Fisheries Services (PFS) of North Sumatera also contracted a large boatyard to construct 13 new canoes, introduced under a revolving fund scheme in the Sibolga area on the west coast of Sumatera. This boatyard was also contracted by the PFS to build canoes for Nias. The quality of construction of all these canoes was poor. Over-confidence coupled with a commercial outlook were the cause.

The opportunity to promote small-scale economic activities in fishing villages by training local carpenters was, thus, not well used, the PFS itself contracting out the construction of new canoes instead of making use of the well-trained carpenters of Nias.

How was the catch marketed?

Having no marketing component in this subproject was initially of some concern. But the experience proved that this was to underestimate the capability of the small-scale private fish traders of Nias.

Having seen the potential of these new canoes that used insulated ice boxes on long fishing trips to distant grounds, some private traders saw new business opportunities and organized small-scale icemaking facilities. Other traders offered fishermen/canoe operators free insulated ice boxes and ice to ensure better quality and higher prices of fish. These private traders and the fishermen they work with have now established a new demersal fishery on the east and west coast of Nias, which can compete with the Sibolga and Padang fisheries which use larger craft.

Where and for what are the new outrigger canoes feasible?

The new canoes have been tried out and proven feasible in the east, north and west coasts of Nias for hook-and-line fisheries. However, considering the limited shelf area where hook-and-line fishing can be carried out and the concentration of fisherfolk population on the east coast, expansion of the fishery should not be encouraged on this coast. Instead, it should be promoted on the north, west and south coasts where the continental shelf areas extend 10-30 n miles and where demersal species are more abundant. The feasibility of this canoe for offshore large-mesh driftnetting has, so far, not been proved; its limited carrying capacity is an obstacle.

How effective was the participation of the local fisherfolk?

The fishing communities where the activities took place were kept regularly informed by a field worker and other staff on the progress of the subproject. However, participation of community members was selectiye.

Except for the design of the canoe, the initial training of the carpenters and the development of extension and information material (a video film and a manual), which require particular expertise, the fisherfolk were deeply involved in the work. Carpenters built new canoes and trained other carpenters. Fishermen carried out fishing trials and trained others. Workshop owners made and supplied engines and boatbuilding accessories. Some fish traders organized

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icemaking, storage and supplies to the fishermen as well as to other fish traders. And fish traders organized the marketing of the catch in and outside Nias Island, etc.

After the first year of development, PFS and BOBP staff played the role of coordinators and facilitators more than executors of the subproject.

What have been the means used for extension of the canoe technology?

A video film on the development of these outrigger canoes and a manual on how to build them have been developed. Field visits were arranged to expose fishermen and carpenters from other areas to the activities of the project.

The video film was mainly used by the field staff to introduce the concept of the new canoes in other fishing villages. The manual on how to build outrigger canoes was later developed and it was felt it would help untrained carpenters improve the construction quality. In fact, it has been suggested that if only such a manual had been available at the initial stages of the introduction of the canoe, it would have facilitated better quality canoe-building by untrained carpenters.

The field visits by selected fishermen to the fishing villages, where the new canoes were being built by local carpenters or demonstrated by local fishermen, appeared to be the best extension effort. The fishermen want to see to believe. Also, the carpenters and fishermen turned out to be good extension workers.

Who are the potential beneficiaries of the new canoes?

So far, the small-scale fishing entrepreneurs with financial and managerial capability have been the main and direct beneficiaries in Nias Island and not the small-scale fishermen without assets. Local banks do not provide credit for purchase of any fishing craft. Traditional fisherfolk receive the lowest priority in loan sanctions, because of a poor record of loan repayments. The irregular repayment of the loans given for the first two commercially built INS-5 canoes, both guaranteed by BOBP, reinforced this view. The fishermen have, however, benefited through catch-share earnings.

A revolving fund, well monitored, as in Sirombu, may help skilled fishermen without immovable assets. But will it work in Sibolga?

How replicable is this canoe technology?

In the case of this subproject, the replicability within the island of Nias and, to some extent, North Sumatera has already been demonstrated. It is also being demonstrated by fishermen of Nias going to the southern area of Aceh Province. Considering the similarity of the fishing conditions and the importance of outrigger canoe fisheries in the various provinces of Sumatera and elsewhere in Indonesia, it is obvious that such canoe technology could be used elsewhere. To facilitate replicability of this technology, the Directorate General of Fisheries should distribute the Indonesian manual, *How to Build New Timber Outrigger Canoes,* widely.

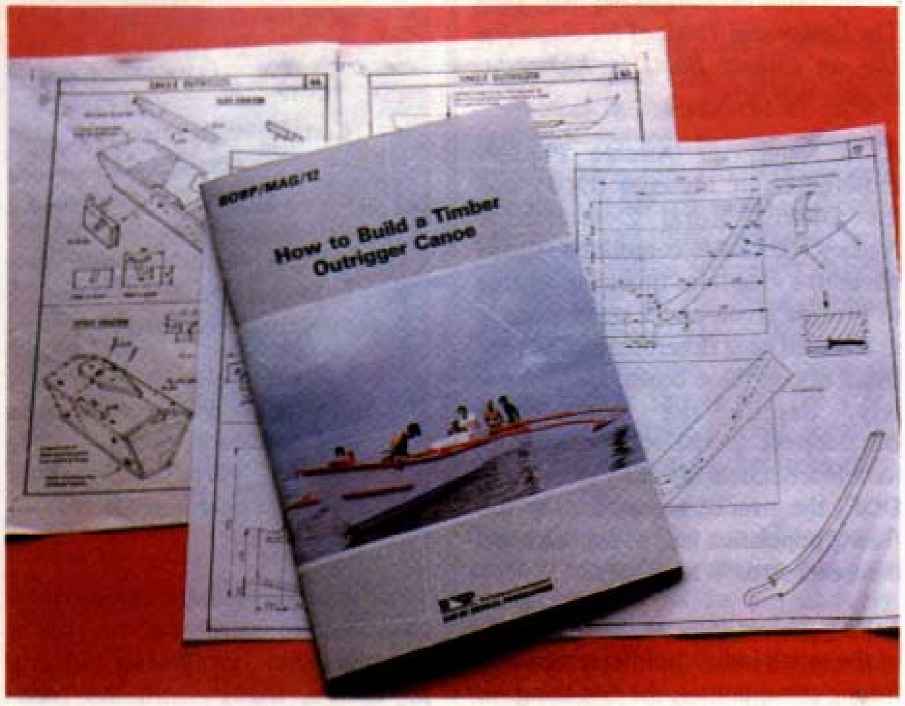
How sustainable is this development?

Continuing construction of new outrigger canoes by small-scale entrepreneurs in the Gunung Sitoli and Sirombu areas during the last year is evidence of the sustainability of this development in Nias. Recently-organized supplies of ice and marketing of high quality demersal fish by small-scale entrepreneurs in the fishing areas where the outrigger canoes were introduced reinforce the positive signs.

However, it is to be hoped that this type of canoe will not be the privilege of the fishermen of only a few fishing centres in Nias Island but will be introduced elsewhere ih Indonesia.

*Construction of timber outrigger canoe.*

*Manual on 'How to build timber outrigger canoes.*



# ICE BOXES

## Greater flexibility in design and price brings benefit to small-scale fishermen

by Tim Bostock,
*(Post-Harvest Fisheries Adviser, ODA)*

The use of ice for preserving fish is, of course, not a new technology. However, its potential for use at sea by the small-scale fishing sector in India has yet to be realized. By resolving specific fish-handling problems within communities and linking these with improved marketing strategies, considerable impact can be made through reducing losses and increasing incomes, thus greatly benefitting the less well-off members of the fishing community.

The Bay of Bengal Programme (BOBP) through its Post-Harvest Project has, for some time now, been involved in a programme of activities aimed at improving the handling of fish at sea in traditional craft fishing off the east coast of India. During the earlier phase of these activities, it was demonstrated that the use of large (200 kg) glass reinforced plastic (FRP) insulated boxes in motorized *nava* fishing boats in Andhra Pradesh could increase the value of the catch by as much as 20 per cent, offering considerable benefits to the user. (See *The Design and Trials of Ice Boxes for Use on Fishing Boats in Kakinada,* BOBP/WP/67).

As a result, the Andhra Pradesh Department of Fisheries (DOF) and the District Rural Development Agency (DRDA) committed themselves to a long-term financing scheme to provide credit and a small subsidy to artisanal *nava* fishermen so that they could obtain these boxes. Unfortunately, despite the institutional commitment to the scheme and the joint promotional effort by BOBP and DOF, the overall acceptance by the fishing population has, so far, been less than expected. Why is this?

Taking a close look at the real needs of the many individual fishermen and fishing communities, the first thing we find is that the high unit cost of the original FRP box (about Rs 7000) has tended to reduce its attractiveness. Even with fmance on reasonable tenns, the repayment period can become a matter of years rather than months, unless the target fishery is extremely productive. A second point is that the 200 kg box was specifically designed for the larger, motorized *navas* (of about 10-12m length) operating in the high-value Seer fishery. Although several of these boxes have indeed proven their worth in this sector, in a country where there are as many fisheries, craft designs and sizes as there are types of fish, the prospects of such a one-design box having significant impact on the wider, multifarious artisanal sector are now recognized as being fairly limited.

### *Findings and alternatives*

There have, however, been significant findings from this activity, including the following:

- Small trawlers *(e.g. sona* boats) have found the 200 kg box ideal for on-deck storage of shrimp and high-value by-catch in ice;
- Certain 'niche' fisheries, such as in Nagayalanka (see box), have adopted the large box as it has allowed a significant increase in fishing time and improved the effectiveness of voyage fishing; and
- Certain high-value fisheries, such as for Seer, are transient and, to some extent, opportunistic in nature, making longer capital payback periods unattractive.

To better accord with the varying needs and financial constraints of such a heterogeneous small-scale fishing population, BOBP, with the participation of three fishing communities in Andhra, began to look at alternative systems for using ice to chill fish, including lower cost, smaller and variable size insulated box options. Some of these could be easily manufactured locally while others have fairly recently become available on the market (see *Insulated Fish Boxes: Types specifications and usage* — BOBP/ODA extension guide series).

Besides the all-important shape, size and cost factors, the following hypotheses were made in considering the potential of impact alternative systems

- All catches kept on ice would be in prime condition and therefore command optimum prices.
- Boats could stay at the fishing grounds longer and, therefore, catch more fish.
- Boats could land their catch at any time of day, yet fish would be supplied to the market at the most opportune moment.
- Fish traditionally salted on multiday voyages due to advancing spoilage would be released for fresh sales and, therefore, achieve better prices.

Although the earlier trials conducted by BOBP on large, motorized *nava* had clearly confirmed most of these points, the small-scale sector, comprising non-motorized and low-powered *(i.e* 8hp diesel inboard engines) 7-lOm *nava*, was yet to be convinced. This resulted in another series of trials, with the collaboration of the DOF and local fishermen, in three distinct communities near Kakinada — Uppalanka, Suradapetta and Jaggarajupeta.

*Nava* of 7-lOm are the predominant fishing craft in these villages, contributing about 40 per cent of the total landings in the traditional sector. However, despite their apparent similarity, there are major differences among them in terms of their areas of operation, gear deployment, target fisheries etc. Jaggarajupeta and Surádapetta operate lOm mechanized *nava,* whereas in Uppalanka only 8m non-mechanized *nava* are used. Gillnets are used by all three communities, with Suradapeta also using trammelnets. In Uppalanka, fishing and crab catching is mainly in the Bay of Kakinada, whereas in the other two communities it is in the open sea.

Ice had previously been used at sea only in Uppalanka. In the other two villages, ice was used on land only to preserve high-value species.

Two groups were identified in each village, insulated ice boxes of two types (FRP and high density polyethylene — HDPE) were provided to four fishermen in each village and a control group (nonusers of ice boxes) was also selected. The boxes used were of similar size: FRP (90 l) and HDPE (100 l), manufactured by Andhra


Pradesh Fisheries Corporation boatyard and Sintex Ltd respectively (see photo). Both had been selected by the fishermen, through needs assessment group meetings, as apparently meeting their assumed requirements for shape, size and price.

### *Results of trials*

Over a period of 2-3 weeks, both quantitative and qualitative information related to the fishing and subsequent marketing of the catch of each was recorded. Overall, 219 fishing trips lasting 2,911 hours were observed. The production from this effort was *15,315* kg of fresh fish valued at Rs. 134,397. Some of the more significant findings of the trials are presented overleaf.

From Figures 1 and 2 (see p.24) we can begin to see clear inter-village differences in the patterns of fishing and fish-derived income. Despite species value groups I to III comprising only some 15 per cent of the total catch volume in all three villages, their combined values represent about 47 per cent of the total revenue accrued. These proportions vary considerably between villages but catch groups change throughout the year. Anecdotal evidence showed seasonal differences between catches to be quite considerable.

The aggregate value per kilogram of catch (Figure 2) for the ice box user group appears to be considerably higher than for the non-users. This figure is, however, derived from the total revenue divided by the total

## ICE — a fact of a fisherman's life

*"It's a fact of life now. We can't think of export without ice and ice without a good ice box,"* acknowledges one of the Nagayalanka fishermen during a recent study of the use of insulated ice boxes in small-scale fisherfolk communities in Andhra Pradesh, India.

The *nava* of Nagayalanka are mainly of the 8m variety. They are non-mechanized, engaged in fishing in the river Krishna, its branches and tributaries, and in the inshore waters of the Bay of Bengal. Seven FRP insulated ice boxes of around 200 l capacity had been purchased in 1991 by these fishermen.

Four of the boxes are now used in the *nava* during fishing while the other three have been transferred to the sheds of export traders. Despite some construction faults, like ill-fitting lids, all are being used satisfactorily and profitably, by their owners.

The introduction of ice in this village occurred over a decade ago with the increase in demand for fresh fish from Calcutta and Madras. At that time, simple means of preservation, such as baskets with hay insulation, were used. However, fishing times (and, therefore, access to richer fishing grounds further afield) were restricted due to the high ice meltage rates. A clear advantage of the FRP boxes is that they have allowed a significant and cost-effective increase in voyage times : *"Exploring fresh fishing grounds has become possible,"* says Satyam. *"Earlier we were restricted by time... today, time is of no concern at all — we can go on and on!"*

Indeed, at times, the *nava* now stay out for 7-10 days at a stretch in the rivers and the Bay until the box is filled. Ice need only be replenished every two or three days, whereas, previously, this had to be done laboriously every day, resulting in high transport costs. *"It is not the increased profits from sales, but the savings on expenses that are most attractive with the use of this box,"* stresses Narayana.

Several local codes of practice have developed with regard to the FRP box. *"Never use the same ice twice,"* instructs Satyam... *"... make sure that the top layers of ice remain undisturbed,"* advises Bhaskar Rao. All have been won over by the great utility value of ice and are keen to take advantage of its facility to increase revenues through maintaining fish quality and reducing operational costs.

What are the reactions of some of the non-owners in the village? *"They are good. If smaller boxes can be made, it would be a boon to us,"* says Chinna Satyam. Dinghy owners like him, from across the river, require boxes of about 65 kg capacity due to space restrictions on board. *"The big boxes are for big people,"* interjects Adinarayana, another dinghy fisherman, who fishes the creeks with his wife.

What about the overall 'socioeconomic impact' of the ice boxes? Bhaskar Rao reflects : *"For a small-scale fisherman operating his own craft, the box does make a difference, of course. But all I have is one box; you can't expect it to change my life. I intend to take a few more when the season improves. So the next time you come around with this question, I may have an answer ready!"*

Overall, incomes are low anyway in this fishery and three or four of the group were seriously thinking of switching to the more lucrative aquaculture sector : *"It's all very fine, with the increased earnings, but when the earnings themselves are in a bad shape, with the deckies living at the subsistence level, what can a box do?"* asks Satyam.

T V Narayana, the village patriarch and a pioneer of fishing here, is somewhat patronizing. He claims that it is a 'no-loss, no gain' proposition. *"Still, it has become an essential and integral part of business. 'No box — no business', that is the situation."*

**T.B./V.S.**

**Fig. 1. Catch volumes by villages and fish grouping (%)**

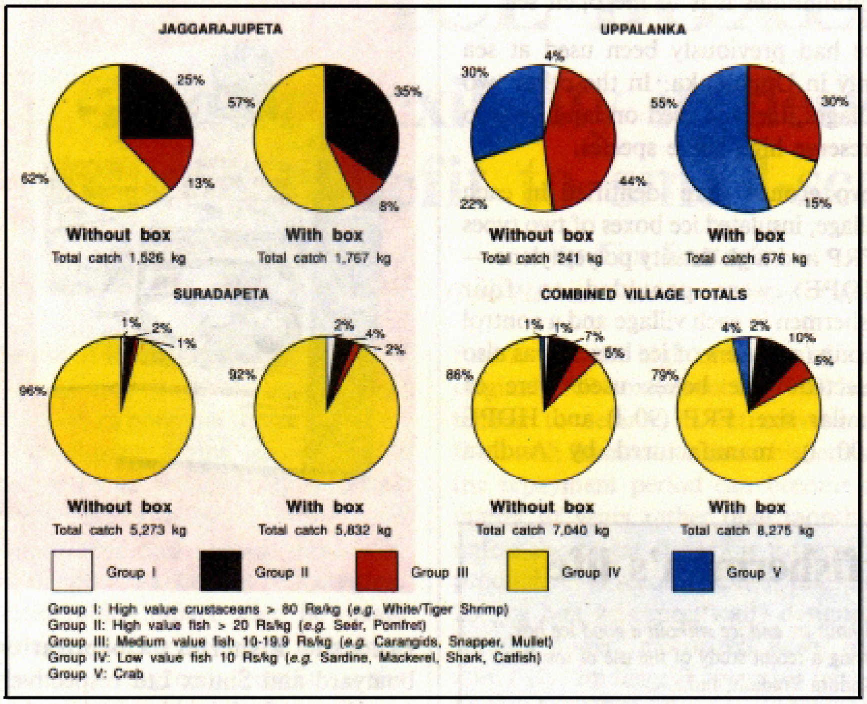



**Fig. 2 Catch revenue by village and fish grouping (%)**

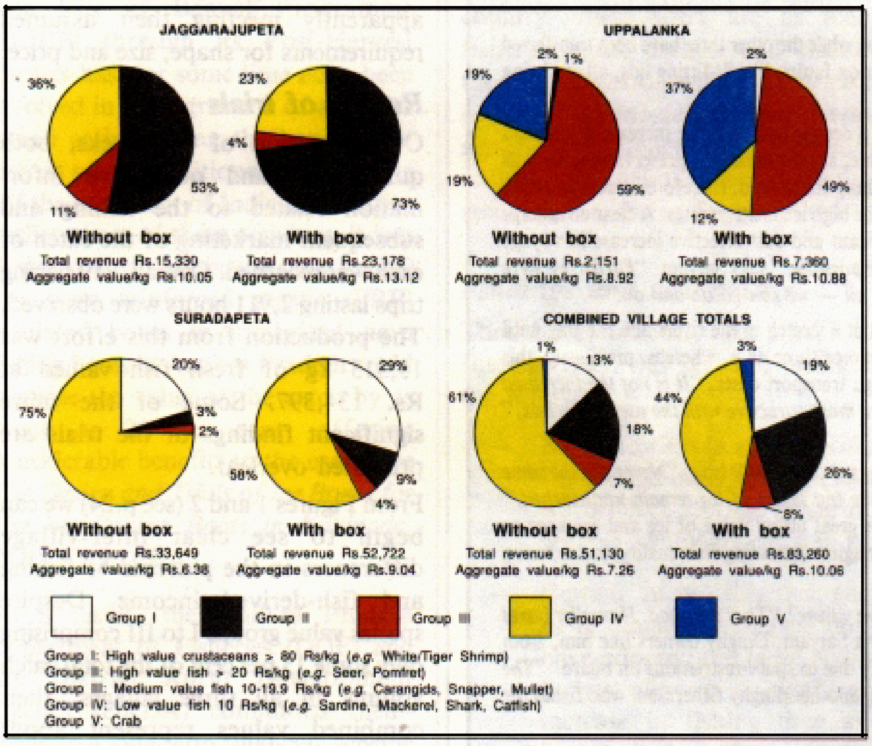



**Table 1: Difference in value of fish by quality and value groupings**

Values in IRupees per kilogram
Quality in category ratings: Prime or Good

| | *Jaggarajupeza* | | *Uppalanka* | | *Suradapeza* | | *Combined villages* | |
|---|---|---|---|---|---|---|---|---|
| | *Prime* | *Good* | *Prime* | *Good* | *Prime* | *Good* | *Prime* | *Good* |
| Group I | — | — | 100 | (8) | 142 | 105 | 142 | 102 |
| Group 11 | 28 | 21 | 22 | 25 | 24 | 14 | 27 | 19 |
| Group 111 | 2 | 8 | 18 | 14 | 19 | 12 | 18 | 10 |

Note: Quantity of Grade I - HI fish categorized as 'poor' quality was negligible and, therefore, not included.

weight and does not, therefore, take account of the much larger differences in value within the higher value groups (I to III). Moreover, it was shown during the execution of the trials that 83.9 per cent of groups I, II and III were iced by the box user group, whereas the remainder would rarely be iced, even when ice was available. In order to quantify any pconomic advantage attributable to the use of ice and the insulated box, we therefore concentrated only upon these three groups.

## *Calculation of quality premium*

Fish quality as judged at the time of landing and sale, whether with or without ice, was categorized as 'prime' (top quality, commanding the highest prices), "good" (acceptable for local marketing in fresh form, but spoilage evident), and 'poor' (suitable only for salting or fishmeal).

By comparing actual values obtained for fish within the same value grouping (*i.e.* I, II or III) but of differing quality (*i.e.* 'prime', 'good' or 'poor'), an idea of the quality premium available was obtained (see Table 1).

In this table, statistically significant differences can be discerned between the value of 'prime' and **'good'** fish quality categories. The average quality premia available (*i.e* the difference between combined 'prime' and 'good' quality categories) are about 40 Rs/kg for group I and 8 Rs/kg for groups II and III.

From figure 3 it can be clearly seen that 'prime' quality fish of any value group was landed only by the ice box users. This reflects the continued spoilage of the catch at high ambient temperatures which begins some 6-8 hours prior to landing. **The** downgradation **of** fish **from Groups I and II, from 'prime' to 'good', can be considered the main cause of loss in value of overall** earnings amongst the nonuser group.

## *Potential to increase income*

Having shown that (a) high quality fish commands a significant premium in the top three value groups (Table 1) and that (b) boats using ice boxes are more likely to land high quality fish than nonusers (Figure 3), the approximate cost benefit to the user group achievable through the

***An 8m non-motorized* nava *near Kakinada, typical of those used in many local fishing communities.***

deployment of these types of ice boxes has been calculated (see Table 2).

From the table the actual increment in income achieved during the trials by the ice box users has been calculated from the difference between the aggregate value (per kg.) of the box users' catch, less that of the non-users' (Figure 2). After deducting the cost of ice (other expenses being equal), this figure is multiplied by the average catch per trip (rows 5 x 3 in Table 2) to give the increment per trip accruing to each fishing boat.

The payback period has then been estimated crudely by assuming that the boat owner (who normally receives about 50 per cent of the income) would pay for the box, the value of which is assumed, pessimistically, to be Rs. 3000.

It is interesting to note that although cost benefit is clear in Jaggarajupeta and Suradapeta, this is not the case in Uppalanka. Inter-village and seasonal differences which affect the catch value groupings will have an important bearing on the overall cost benefit of using an ice box. These differences once again underline the need to make a careful socio-economic appraisal prior to judging the potential effectiveness of introducing such technologies into small communities such as these.

However, the trials clearly showed that the benefits were tangible and that they were sufficiently high to stimulate interest among potential users. As a result of this demonstration alone, orders for 35 boxes have already been placed with fmance organized through the Andhra Bank, and private, self-financing orders for upto fifty boxes have been recorded by the manufacturer.

**Ag. 3.** Quantity of fish by quality category **and preservation system used**

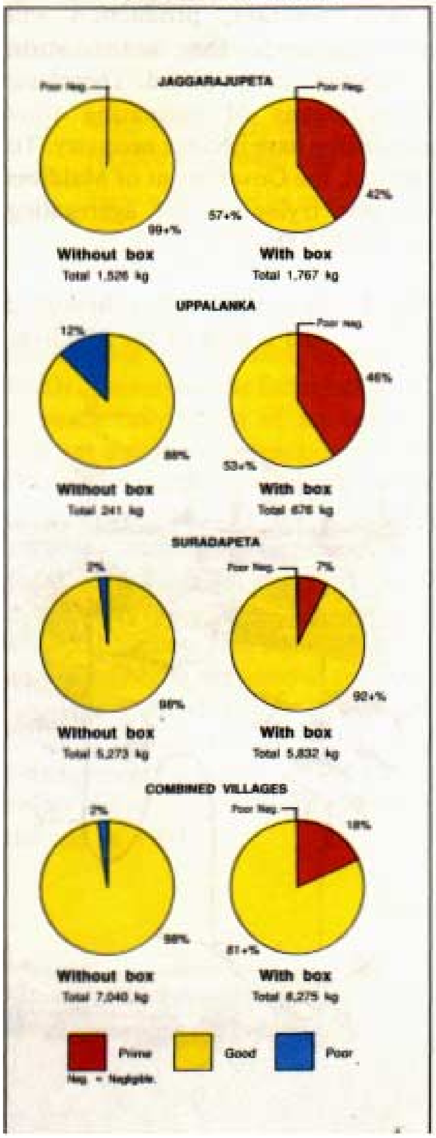



**Table 2 : Calculation of increment in income for ice box users**

| | *Jaggarajupeta* | *Uppalanka* | *Suradapeta* | *Combined* |
|---|---|---|---|---|
| 1. Total trips | 42 | 64 | 113 | 219 |
| 2. Total catch (kg) | 3,293 | 918 | 11,105 | 15,316 |
| 3. Catch per trip (kg) | 78 | 14 | 98 | 70 |
| 4. Ice cost (Rs/kg of fish) | 0.15 | 0.83 | 0.09 | 0.17 |
| 5. Increment (Rs/kg) | 3.07 | 1.97 | 2.66 | 2.80 |
| 6. Increment (Rs/trip) | 229 | 16 | 252 | 196 |
| 7. Increment to owner (50 %) | 114 | 8 | 126 | 98 |
| 8. Crude payback period (fishing days) | 26 | 369 | 24 | 31 |

***Both types of trial boxes being adjusted in the* nava.**

# FADs show promise in the Maldives

*According to the biosocioeconomic assessment of the impact of these devices for tuna fishing*

*FAD-1*

*FAD-2*

The Maldives has one of the least diversified fisheries in the world — over 90 per cent of it is tuna fishing, primarily with pole-and-line, the rest mainly reef fishing. The traditional *dhoni* is the main fishing craft, but the limited population in the islands has kept its numbers more or less constant over the last few decades. However, tuna production has doubled during this period, through increasing motorization of the traditional pole-and-line craft, the *masdhoni.*

With fleet type and size remaining almost constant, production will stagnate once the motorization programme is completed. Therefore, other means of increasing tuna production have become necessary. To this end, the Government of Maldives has been trying out fish aggregating devices (FADs).

Trials with **FADs**

In 1982, under an FAO Technical Cooperation Programme, ten FADs of five different types — fuel drum, woodbox, vessel-hull, spar-buoy and rubber tyres — were fabricated, all with the same kind of mooring, at a unit cost of US $ 700-1100. These FADs were moored with nylon and polypropylene ropes (15 mm), wire cables (7nun), galvanized chain (9mm) or shackles, with steel drums filled with concrete or scrapped anchor chains being used as anchors (700kg). Thals with these FADs were generally promising, showing enhanced catches, but their life varied from only one day to 206 days. Five of the ten units disappeared within about sixty days, for various reasons.

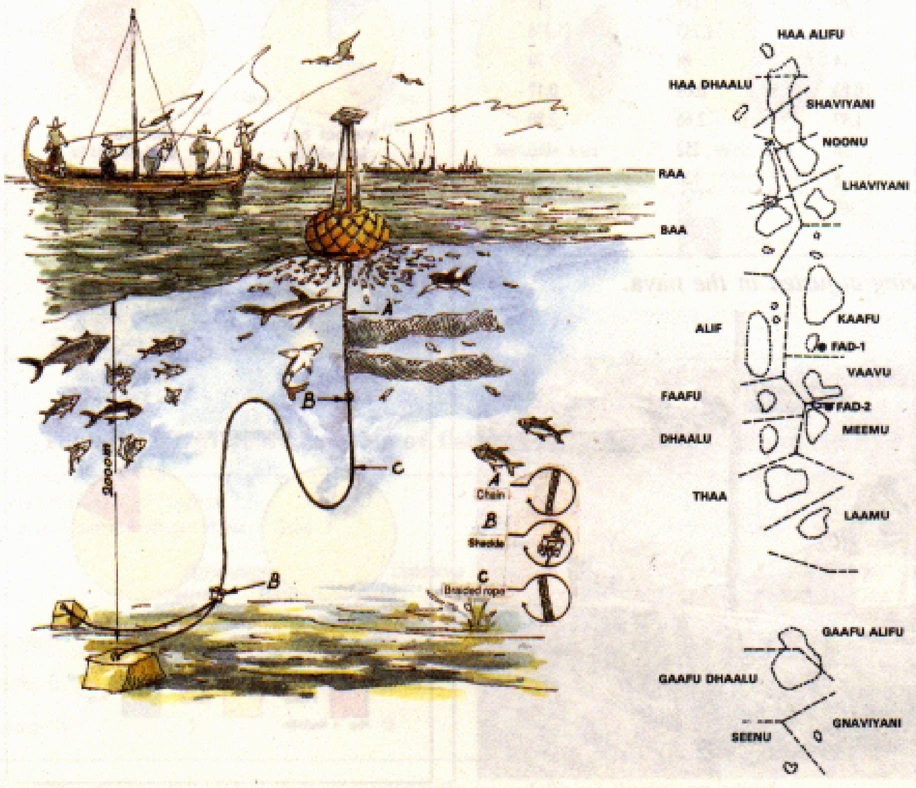
The study concluded that tyre-type FADs should be encouraged and additional such FADs were deployed under a follow-up programme of the Government. These improved FADs, made of readily available materials, are low in cost and are easy to deploy, so that their deployment could be undertaken by the fishennen themselves. During these trials, the FADs demonstrated a much longer life (11-459 days).

With the success of the second series of trials, fishermen all around the country began to demand more FADs and the then Ministry of Fisheries took a policy decision to deploy them in a big way. It now became necessary to assess the biological, economic and sociological impact of such deployment and the management aspects associated with such a major programme. The Ministry of Fisheries and Agriculture (MOFA), therefore, requested a UNDP-funded project on 'Bio-economics of Small-Scale Fisheries' (RAS/91/006) under the umbrella of the Bay of Bengal Programme, to assist in this assessment.

Locations were first identified for deployment of two FADs — one about 15 miles southeast of Guraidhoo island in the South Male Atoll and the other in the Wattaru Channel between Meemu and Vavu Atolls (Figure 1). Five islands close to the latter and three close to the former location were identified for study of the fisherfolk engaged in fishing, at these FADs. A predeployment survey of the bioeconomics of tuna fishing and the socioeconomics of the fisherfolk in the two areas was undertaken. Its objective was to determine

- the catch rates, seasonality, monthly operational costs and earnings in the tuna fishery, and
- the living standards and seasonal changes in other income sources (other fishing, fishery-related and nonfishery activities) of the households, without FADs.

**Fig. 1. A vertical section through the sea to illustrate the complete FAD unit and a map of the Maldives**



The FAD and the mooring system used (similar to practices in the South Pacific Commission area) is illustrated in Figure 1. The first one was deployed off Guraidhoo island in May 1992 and the other in the Wattaru channel in October 1992. These FADs cost around US $ 4000 each.

A postdeployment survey of the same items assessed in the predeployment survey was then carried out and the results for similar seasons are now being studied to assess the quantitative and qualitative differences arising from the use of FADs. Bioeconomic and socioeconomic work is being undertaken by the national staff in the Technology and Economics sections, while the biological and behavioural aspects are being handled by the Marine Research Section, of MOFA. Data collection in the field has been by fishermen selected from the islands identified for the surveys and trained for this work.

Direct observations indicate that small fish or bait fish, such as juveniles of Bluefin Trevally *(Caranx melampygus),* Rainbow Runner *(Elagatis bipinnulatas),* Triggerfish (Balistidae species) aggregate very close to the FAD two or three days after deployment. The rate of aggregation of tuna appears to vary according to season and sea conditions. Fishermen think that the presence or absence of shark at the FAD may accelerate or retard the aggregation, respectively. Since the first FAD was deployed in May, the beginning of the lean season (according to the average fishing condition, established with the catch rates for the past six years) the aggregation was, as expected, poor until about August. Fishermen consider that the shark that were initially around the FAD left and returned only around August. Since August 1992, the fishing around **FAD-i has** been very good.

### The fishery

About ten *dhonzs* concentrate around the FAD in the early hours of the morning. When an additional *dhoni* arrives, one of the early arrivals will usually leave. The *dhonis* generally operate 50-200 m away from the FAD, indicating that tuna aggregation is away from the FAD and on one side of it, not all around it. The direction appears to be dependent on the direction of the current, which, perhaps, also influences the direction of the concentration of the bait fish.

Fishing is more active in the early hours of the morning, but there are some indications that catches can be made late in the evening as well, if the craft happen to be out that time. In December '92 and January **'93,** there was a drop in catch around the FAD and only some juveniles of Skipjack were found.

Around FAD-2, the catch has not yet reached the level of that of the FAD deployed earlier, but large Yellowfin (100 cm) have been abundant at the surface, exhibiting 'frenzy' to chumming (throwing live bait into the water and sprinkling the sea surface water at the same time). One was even found entangled in the netting attached to the mooring line. Fishermen have complained about the occurrence of large Yellowfm, because they think these fish disturb the Skipjack. The large Yellowfm cannot be boiled or sun-dried and the only market for them is the salt processing plant in Meemu Mulee. Only one school of tuna was sighted en route to the FAD, off Guraidhoo, but none between Guraidhoo and Meemu. Response to chumming at the FADs does not appear to be significantly different from the response of schools not associated with FADs.

### Some problems

A few problems have already surfaced. Though there is a prohibition on trolling and handlining for tuna at FADs, when pole-and-line fishing is being conducted — because these disperse the school — some fishermen were seen breaking this rule and lines with jigs were found entangled on the FAD. Secondly, fishermen from South Male Atoll are finding it more and more difficult to land their catches at the Male market. Because the landing of larger catches by them brings down prices, fishermen of Male, therefore, object to these landings by the South Male fishermen. Consequently, the South Male fishermen are increasingly drying their catches on their own island. Another issue is that fishermen from Guhili island claim that, as their motorized craft have lesser horsepower (22 hp) engines, they are unable to sail southwards to fish at the FAD and then sail north to reach the Male market before it is too late to sell the catch.

Sqch problems and issues focus attention on the need to improve the systems for collection of tuna catches from fishermen operating out of islands which do not have markets and processing plants. There is also need to fmd new export markets, to encourage increased production.

More serious questions at the root level are:

- **Who will deploy new FADs or** replace lost ones; and
- How will FADs be managed by the community for the benefit of the community?

These issues will arise when the State stops paying for and taking care of the FADs. Therefore, the fisherfolk must be made fully aware of the benefits they get and the consequences of not sharing the costs and responsibility for deploying, maintaining, protecting and replacing the FADs. Awareness building is necessary and the first extension material to this end — dealing with FAD fabrication and deployment — has already been prepared in the local language (Dbivehi) and distributed among fishermen. Material on management aspects will follow, before the subproject is completed by the end of 1993.

**K.S.**

*Pole-and-line fishing operations around FAD-2*

# WHAT NEXT?

**(after the successful motorization of *chandi* boats in Bangladesh)**

Too much of a good thing often spells trouble. In one sentence, that was what the participants of a two-day workshop on *chandi* boat motorization in Bangladesh concluded. But we are jumping the gun, so let us start from the beginning.

In 1979, the Bay of Bengal Programme (BOBP) undertook a survey of country craft in Bangladesh and identified in Bhola the potential for motorization of the *chandi* boats there. At that time, there were almost no motorized country craft in Bangladesh fishing for *Hilsa* except for a few Chittagong-based gillnetters. A two-year effort with a couple of craft motorized showed rather spectacular results in Bhola island, then a part of Barisal District: the catches doubled, so did the earnings, and the fisherfolk were saved the drudgery of rowing. The doubling of the catch was primarily due to the craft being able to reach fishing areas that had not been accessible with sail due to distance, winds and currents. Motorization, thus, appeared a good way to help fisherfolk increase their earnings, and. the participating fisherfolk were enthusiastic about the idea.

**BOBP** decided to make a beginning on its own, while looking around for donors who might be interested in supporting credit for a larger motorization scheme. In 1988, twenty *chandi* boats were motorized by **BOBP. Fisherfolk were provided** credit to acquire engines and gear, were trained in the use and maintenance of the engines, and their effort was closely monitored and compared with the non-motorized *chandi* boats. An added incentive was regular bi-yearly servicing of the engines. Later, it was found that repayment of credit was very high, at well over 90 per cent, the catches were as good as the trials and the fisherfolk were happy. A beginning had been made.

In 1990, with funding from DANIDA, a second phase of motorization was enabled through credit support for a further fifty craft. Additionally, a smaller BOBP scheme also made available cash credit for working capital, boat and net repair, and consumption.

Meanwhile, several fisherfolk decided not to wait around for agencies to improve their lot. The BOBP effort had convinced them of the benefits of motorization and an agriculture-oriented policy of the Government of Bangladesh made available to them Chinese diesel engines at low cost. The private sector took off oil its own, fuelling the move through savings and informal credit. By the time the Department of Fisheries (DOF) and **BOBP convened a workshop in** January 1993 to reflect on the effort, a staggering 4000-plus fishing craft in Bhola (now a district in its own right) had been motorized.

As the last repayments started trickling in and the motorization project began coming to an end, the fisherfolk and the DOF appeared concerned at the rapid growth of motorization and what it would do to the *Hilsa* fishery, the single most important fishery in Bangladesh. And, so, BOBP and DOF felt the time was right to look back and reflect. The workshop arranged for the purpose was held in Bhola town and brought together 65 participants: the directors of the DOF and Fisheries Research Institute were there, so were senior officers from Bangladesh Agricultural Research Council, the Planning Commission and DOF, bankers, district and *thana* level

*Fishermen beneficiaries participate in discussion at Daulatkhan Thana meeting hall.*

fisheries and administrative staff, fisherfolk, a few NGOs and BOBP staff.

A few papers were presented at the two-day meeting, but particularly. helpful were the field trip to Daulatkhan, which gave the boats participants an opportunity to see the *chandi* boats on their home 'ground' and chat informally with fisherfolk, and the time provided for free discussions. One message came through loud and clear — everyone felt the project had been a success. Of course, BOBP, DANIDA and DOF could not take the entire credit for the rapid and dramatic increase in motorization in Bhola. They could, however, definitely take' the credit for having shown the way by demonstrating the viability and benefits of motorization. The fisherfolk did the rest.

There was concern, lots of it, about fish resources. Over the last decade, fisherfolk have noticed the seasonality of their fishing change; they have also had to go further and further away to get fish, with most of the fishing now taking place at the confluence of the Meghna River and the Bay of Bengal. While there is no indication as yet of a drop in catch rates, everyone is worried about how long motorization could go on without the fisherfolk suffering the consequences of overfishing. This, it turns out, is a very real concern, for, as the fisherfolk disclosed, there were at least 10,000 more *chandi* boats whose owners, given a chance and the funds, would motorize!

It stands to reason, then, that the first and most important recommendation of the workshop was to initiate regular and continuous monitoring of catches **in order assess the stock situation.** It was recommended that there was need for fisheries management to guide and regulate further development. While not denying the need for management, it is important to remember that the problem is much larger than a mere intensification of fisheries. The various efforts at regulating and controlling floods in the past (and those proposed in the numerous Flood Action Plans) have changed, and will change further, the very morphology of the rivers. The consequent impacts on fisheries are not too clearly known. There is, therefore, a need to look at fisheries resource management in the larger context of developments in other sectors too.

*Workshop participants discussing motorization issues with fisherfolk near Daulatkhan.*

Fears of fish availability notwithstanding, fisherfolk want motorization or, more precisely, credit availability for motorization to go on. And this poses a dilemma. There is no question about the fact that even with the high cost of money in informal credit systems, fisherfolk have been finding it economically feasible to motorize. And there is no doubt that given institutional credit they would save considerably, simply because of the almost five-fold difference in the cost of money. The question at the workshop, of course, was whether there really is a need for credit to fuel a process that seems to have taken off, albeit under punitive interest rate conditions. The participants were unanimous in their recommendation that there was a need for well-designed, economically viable credit schemes which fmancial institutions would fmd it worth their while to offer. More than loans for the capitalization effort, a cash credit scheme to make available working capital, money to repair craft, engines and gear and to meet consumption needs, as demonstrated by the project, would, it was felt, be necessary to fisherfolk. The banks kept strangely quiet through all this, emphasizing once again the crisis in small-scale fisheries credit, not just in Bangladesh but in the whole region.

Another recommendation actually evolved out of the discussion on credit. Given the obvious viability of the activity, why don't some people repay? The project made a convincing case of how repayment can be improved through proper selection of bçneficiaries, wherein, through close aiid regular contact, not just the creditworthiness of the candidate but his character could be gauged. Credit schemes designed keeping in mind the characteristics of the fishery, such as seasonality, have a much better repayment rate. Finally, repayment depends considerably on the perceptions of the fisherfolk of how serious the lenders are in getting their money back: perceptions that governments are providing gifts or that they can be politically influenced to write off loans or even the feeling that no strict action will be taken against defaulters have a tendency to affect repayments adversely. Fisherfolk are, by and large, honest folk, but they are not stupid: if they feel they. can get away with not having to repay, they will not repay! But to get back to the original question, why did some not repay? The answer is, in part, piracy. It is not uncommon in the estuarine and coastal waters of Bangladesh to be robbed at sea of your engines and gear. A strong request from the fisherfolk was for the DOF to work with the police and the navy and make the waters more secure.

With BOBP stepping out at the end of the year, the workshop has provided food for thought. The DOF has a challenge ahead. The need for management is obvious, but managing and regulating a private sector effort which has taken off on its own is not very easy to do. The answer perhaps is to blend development with fishery resource management, with the former providing an entry into the latter.

RR.

# THE PROFITABLE MALAYSIAN OYSTER

Back in the 17th Century, James I of England cautiously observed, "He was a bold man who first swallowed an Oyster". In Malaysia today, bravery doesn't enter into it; aggressive promotion and media interest have been spurring both production and sales, so that this bivalve mollusc has been gaining in table popularity.

In June 1992, the Malaysian daily, the *New Straits Times* announced that oyster exports had exceeded the 500 t mark, bringing in some M$ 600,000 * in foreign earnings. Yet imports of oysters — mainly from New Zealand — stood at 150 t. Besides this, there is the Bay of Bengal Programme's recent estimate of 155 t/year production on the west coast and 200 t/yr on the east coast. This estimated production not only shows that the export figures are questionable but that if production figures are compared to Malaysia's total fish (marine and inland) catch in 1990, of 600,000 t, oysters still play a minor role in the national fisheries production scenario. But whatever the real production and import and export rates, the truth is that oysters are high on the Malaysian seafood agenda.

"We are attempting to diversify our aquaculture activities," explains one Malaysian fisheries official, "so that we neither strain resources, nor lose out on the technical improvements being made in the field, the world over." Developments in off-bottom culture, which include such materials as stones, pipes or concrete slabs; 'cultching', with spat setting on such diverse objects as bamboo or old tyres; exploring remote setting techniques and growout technology — all these would appear to have made the days of wild oyster collection seem long gone.

But this is not entirely true. A two-phased study carried out by BOBP in 1988 identified a stable market for 'shucked' oysters, originating mostly from intertidal stocks in northwestern Malaysia, or harvested by divers in Muar, for instance. However, government and entrepreneurial interest is focussed on the cultured half-shell Slipper Oyster, *Crassostrea iredelei*, introduced to the west coast by the Fisheries Research Institute, FRI, with BOBP technical assistance provided as part of a project started in the same year to culture this species for the Malaysian market.

Twentyeight-year-old Yusuf is one of the more enterprising of 17 participants involved in the FRP/BOBP oyster culture project. A traditional small-scale fisherman living in Kampong Teluk Air, a hamlet on the Sungai Merbok banks, he is at present working on the same river and meeting with chequered success with Seabass cage culture, shrimp culture and recently added oyster culture. His nine longlines alone are capable of supporting upto 90,000 oysters and are fully utilized, bringing in a steady harvest of 400-600 pieces per week, at, at least, 70 sen an oyster. "At the moment I must stick to this target per week. Spat supply is sometimes irregular, so increased production is difficult," Yusuf claims. Demand, however, is gaining momentum. If he could supply 50,000 oysters a week, for instance, buyers happy to avail of this tasty, UV-light depurated product could be easily found. Even though his is an essentially family setup, he regularly employs four women on a part-time basis at 10 RM/day to undertake the oyster cleaning which is carried out before depuration.

What happens to the oysters once they leave Yusuf's small holding? They are either purchased by small-time agents at approximately 70 sen an oyster and then distributed locally to the up-market retail outlets in the area; or, more commonly, sold to outlets such as 'Eden Seafoods' or 'Shangrila Hotel' in Georgetown, Penang, for about RM 1 each. There is also a considerable amount of direct marketing, principally on the west coast, by collectors to hawkers, open air restaurants, retail fish markets and to the occasional household. The oysters retail at RM *2.50-3.50* apiece, depending on where they are sold and how they are prepared.

The 'shucked' oysters is more gastronomically established in Malaysia — especially with the Chinese population. The more sophisticated half-shell Slipper variety, of the type cultured by Yusuf, is, however, now j,eing marketed on newer, more dynamic lines, and is beginning to gain a foothold in the country.

Considering that oyster culture in Malaysia is a nascent industry, with barely 30 active producers nationwide, the aggressive promotion on the part of the government and media, while commendable, may be slightly over-enthusiastic at this stage. Government-sponsored market promotion at supermarkets, newspaper advertising and articles extoffing the virtues — real or supposed — of oysters, have certainly helped to whet the appetite of an increasingly affluent middle class and rouse the interest of entrepreneurs excited at the prospect of dealing in this profitable mollusc that is far costlier than either clams or that Malaysian favourite, cockles.

Eddie Teo, a Chinese-Malaysian from Kota Bharu on the east coast, is a case in point. He was probably the first businessman in the country to organize an effective network, ten years ago, of regular local spat collection — purchased at equitable rates from about twenty women in 14 outlying villages — then cultured in his own family-run farm or sold to the likes of Yusuf to oversee the bivalve's growout. Teo claims to have "daily increase in the amount of enquiries on the part of fellow businessmen eager to get on the oyster culture bandwagon and learn more about culturing in general". He invariably helps them, "since the demand for oysters is so vast nowadays that I could never be threatened by competition". In addition, he owns a nursery which supplies spat to the west coast, and has

* US $ 1 = **RM 2.50 appx.**
**RM** 1 = 100 sen.

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ambitious plans to start, together with four other partners, an oyster hatchery which, he hopes, will one day supply the "entire east coast" with spat for culture.

Promotional efforts, both in culture and in marketing, must also be directed to coastal communities' through effective extension services, accessible credit and technical knowhow if the alleged oyster culture boom is ever really to take place in Malaysia, and the inherent, yet understandable, wariness of fish farmers is to be countered. Fisherfolk are traditionally accustomed to daily cash sales and, if natural setting is opted for, months go by before oysters reach market size. This drawback is clearly avoided by the development of tropical bivalve hatcheries which permit almost non-stop planting of hatchery-reared spat, thus allowing frequent harvests throughout the year. In effect, what has 'to be worked out, claims one aquaculture expert, is "the mechanics of integrating a relatively high technology system, such as oyster hatcheries, into a low-tech village production system".

This is easier said than done. This is also precisely where the Government must step in. "Extension inputs can be stepped up," claims one fisheries official. "Malaysia is blessed with relatively more funds and technical knowhow than many other countries in the region," he explains, "and so we have the possibility to ensure that fisherfolk are not left out in the cold."

Also, if the grandiose claims made by the *New Straits Times* - 533 tonnes exported last year - can ever be taken seriously, legislation and independent depuration mechanisms (possibly under the Food Safety Act, or controlled by the Agriculture Ministry, respectively), to ensure that oysters reach international health standards, must go hand in hand with a strategy that integrates technology with community development as well as market promotion.

**Lisa C Durante**

# WHITE SLIPPERS ON ICE

Oyster consumers in Malaysia are willing to pay up to 30 Malaysian Ringits (RM) for a half dozen raw oysters on ice in Kuala Lumpur's posh seafood restaurants. With a market like that, oyster farming should be an investment opportunity worth considering.

Yusuf, one of the participants in a Bay of Bengal Programme (BOBP) project (see article), has seen the attractions of oyster culture. Unlike finfish culture, which he had previously worked at, oysters demand little input, yet reap handsome market prices. He has now reinvested in his oyster culture farm and expanded his capacity.

Yusuf has both longlines and rafts, a mixture he likes. Longlines offer rapid initial growth for the young spat; placed in midstream, they allow for maximum water exchange and optimum feeding. Rafts, which must be anchored in calmer waters, offer a more stable and comfortable working environment. While he uses trays of PVC pipe and netlon on his longline, he has opted for smaller and cheaper tyre trays and netlon for his rafts.

Recently, he has further developed the raft design, basically just doubling its size from 7 x 7 metres to 7 x 14 metres. This innovation was made possible by new, cheaper floats made of bales of discarded styrofoam sheets neatly wrapped and stitched in used fishing net. This new, larger raft has further reduced the farmer's cost of oyster suspension for off-bottom culture.

Using Yusuf's experience in developing a functional and economical farm infrastructure, the actual cost of the two most important suspension systems can be seen below (Tables 1 and 2).

**Table 1 : Cost of standard double longline**

| *Materials* | *No. of units* | *RM/ unit* | *Total RM* | *Avg. life* | *Ann. deprec.* |
|---|---|---|---|---|---|
| Floats, 60l. plastic | 20 | 17.00 | 340.00 | 3 | 113.33 |
| Mainline, PE 14 mm | 10.8 kg | 7.50 | 81.00 | 6 | 13.50 |
| Line, PP twist 8 mm | 5 kg | 8.00 | 40.00 | 6 | 6.67 |
| Anchor poles, 7 m each | 4 | 5.00 | 20.00 | 1 | 20.00 |
| Anchorline, PE 14 mm | 2.2 kg | 7.50 | 16.50 | 6 | 2.75 |
| Construction labour | 4 days | 20.00 | 80.00 | 1 | 80.00 |
| Initial investment cost | — | — | 577.50 | — | 236.25 |

**Table 2 : Cost of large raft (7m x 14m)**

| *Materials* | *No. of units* | *RM/ unit* | *Total RM* | *Avg. life* | *Ann. deprec.* |
|---|---|---|---|---|---|
| Floats, 60l, styrobales | 15 | 13.00 | 195.00 | 4 | 48.75 |
| Planks, 7m, 50 x 75 mm | 6 | 10.00 | 60.00 | 6 | 10.00 |
| Planks, 7m, 50* 100mm | 13 | 12.20 | 158.60 | 6 | 26.43 |
| Bolts/nuts, 1/2" * 10 | 36 | 1.50 | 54.00 | 3 | 18.00 |
| Tree trunk poles, 7m each | 14 | 0.00 | 0.00 | 1 | 0.00 |
| Nails, 100 mm galvan. | 4 kg | 3.00 | 12.00 | 6 | 2.00 |
| Nuts/bolts, 3/8" * 4 | 24 | 1.00 | 24.00 | 3 | 8.00 |
| Anchor poles | 4 | 20.00 | 80.00 | 1 | 80.00 |
| Ropes | 24 kg | 10.00 | 240.00 | 6 | 40.00 |
| Construction labour | 1 day | 200.00 | 200.00 | 6 | 33.33 |
| Initial investment cost | — | — | 1023.60 | — | 266.52 |

The culturist can, however, decide the composition and combination of the suspension systems which fit his or her particular needs as well as the local conditions. Oyster farming is basically modular, lacking economies of scale. A culture can range from one to a whole fleet of rafts and longlines.

Table 3 below presents an estimate of what a moderate-size, family-run farm might cost.

**Table 3 : Schedule of initial capital costs**

| *Materials* | *No. of units* | *RM/ unit* | *Total RM* | *Avg. life* | *Ann. deprec.* |
|---|---|---|---|---|---|
| Longline | 9 | 578 | 5198 | 2 | 2126 |
| Large raft | 5 | 1024 | 5118 | 4 | 1333 |
| PVC trays | 630 | 15 | 9167 | 3 | 3056 |
| Tyre trays | 2000 | 5 | 10340 | 6 | 1723 |
| Depuration unit | 1 | 2490 | 2490 | 5 | 522 |
| Working capital | 1 | 29016 | 29016 | — | — |
| Total | — | — | 61328 | — | 8759 |

In the farm described above — which has an annual capacity of 180,000 White Slipper Oysters *(C.iredelei)* — the simple infrastructure for a good size culture need not cost more than RM 30,000. It is the working capital (as income is generated first only one year after start-up), that doubles the initial investment requirements.

Operating costs are quite low, as the oysters do not need artificial feeding or antibiotics, as in other fish culture. The initial purchase of the young oyster spat at around 10 sen each is the main operating cost.

As already mentioned, the market appears good, but it is not easy for a small oyster farmer to market his or her produce in this exclusive market. Until recently, all 'half shell' or live oysters sold in Malaysian restaurants were imported from industrialized countries in North America, Europe and Oceania or were trucked in from neighbouring Thailand. These imported animals cost around RM 1.20 - 1.50 each and are retailed for at least double that. So far, domestic oysters have only been able to command about RM 0.80 - 0.90.

If a farmer is able to get hold of enough oyster spat to fill a family-size floating farm, a handsome income one year later appears assured. Just 30 months after start-up, all the initial investment, including working capital, would be paid back. In other words — the farm described in Table 3, would show a healthy Internal Rate of Return (IRR) of 48 per cent. This moderately high rate of return assumes that it takes a whole year to grow an oyster which sells at a mere 70-90 sen. If these conservative assumptions are proven too pessimistic, oyster farming could well prove to be much more profitable than currently thought.

**R.H.**

# NEW **BOBP PUBLICATIONS**

**BOBP/REP/51** — ***The*** *Mud Crab. A Report* ***on the Seminar*** *Convened* ***in Surat Thani,*** *Thailand,* ***November 54, 1991***

The mud crab, ***Scylla*** sp., found throughout the Indo-Pacific region, has become increasingly popular by virtue of its meat quality and large size. As little is known of the state of the fishery, culture and trade, in the Bay of Bengal region, it was felt that a regional seminar might be an appropriate medium **for an** exchange of information among the Bay of Bengal Programme's member countries and to update knowledge of the industry.

Representatives from all the BOBP member countries, as well as the Philippines, Australia and **U.S.A.,** aquaculturists, scientists, businessmen, socioeconomists, feed manufacturers and development strategists presented 28 papers during five sessions in November 1991. These papers, on biology, natural resources, seed supply, culture, trade, extension, credit and economics, comprise this report.

BOBP/INF/13 — *Bibliography* ***on*** *the Mud* ***Crab. Culture*** *and Trade in* ***the*** *Bay* ***of*** *Bengal* ***region***

This bibliography was prepared by the BOBP for the seminar on Mud Crab Culture and Trade in the Bay of Bengal region held in November 1991. The bibliography deals with the biology, culture, resources, exploitation and management, disease and parasites, marketing, preservation, processing, handling and effects of pollution on mud crab *Scylla* sp.

BOBP/REP/52 — *Feeds* ***for*** *Artisanal Shrimp Culture in India — Their* ***Development and Evaluation***

This report presents the findings of a collaborative programme **conducted** during 1989-91 on the formulation, manufacture and feeding trials of feeds for the artisanal culture of shrimp in India. It describes the Indian shrimp culture industry, the principles and practices used within the project for the formulation of shrimp feeds, the principles and practices of pond environment assessment, feed manufacture and feed evaluation by feeding trial, a financial appraisal of the feeding trials and recommendations for further studies.

**BOBP/REP/53** — ***A Radio Programme*** *for Fisherfolk* ***in SM*** *Lanka*

This report describes the process, achievements **and** learnings of a subproject which set out to introduce a radio programme as a communication and extension tool to help Sri Lankan fisherfolk in their **development. The radio** programme went on the air with daily and weekly programmes in January 1989 and has continued since without a break.

**BOBP/WP/71** — *Manual Boat Hauling Devices* ***in the*** *Maldives*

**The** traditional fishing craft of the Maldives, most of them 8-l5m long, are built with local and imported timber. As they are **not coated** with antifouling paints or sheathed to protect the timber, they are hauled **on to the** beach **at** least once a month for scraping of the hull and application of protective oil. Traditionally, the boats are manually hauled on to the beach by 50-80 men and women. This paper documents the development of simple low-cost manual hauling devices which helped to reduce the hauling crew.

**BOBP/WP/75** — ***Fishing Trials with Beachianding Craft in*** *Tamil* ***Nadu, India***

To diversify and develop small-scale fisheries in the offshore areas off the Coromandel Coast of Tamil Nadu, a subproject to encourage the commercial fishing of pelagic species was executed by the Fisheries Department of Tamil Nadu and the Bay of Bengal Programme from February 1989 to January 1991. This paper reports on the demonstration of the technical and economic feasibility of small-scale offshore fishing by using beachlanding craft and employing diversified fishing gear.

BOBP/WP/81 —*Ercploratory fishing* ***for Large*** *Pelagic Species* ***in*** *South Indian* ***Waters***

Despite the substantial increase in the traditional small craft fishing fleet **of** Tamil Nadu, India, fish production has remained more or less constant in the last few years, indicating **that** fisheries resources within the range **of this** fleet have been fully exploited. In order to introduce fishing for large pelagic species in Tamil Nadu by demonstrating the experience of Shri Lanka, a subproject for fishing demonstrations in Tamil Nadu was established in 1989 with a lOm **FRP boat (SRL** *15)* tested in Shri Lanka's commercial offshore fisheries. The results and the conclusions of these fishing trials are reported in this paper.

**BOBP/WP/83** — *Survey* ***of*** *Fish* ***Consumption in*** *Madras*

Fish occupies an important position in the diet of much of the population of Madras. It is the most favoured and least expensive form of animal protein available. But poor post-harvest techniques cause substantial material and nutritional losses of fish. It was against this backdrop that the ODA-funded Post-Harvest Fisheries Project of the BOBP engaged MARG, a leading marketing and research group, to conduct exploratory research in Madras and study the consumption, and 'attitudes to consumption, of marine produce in households in the city. This document not only reports on the findings by MARG, but it also presents a Foreword indicating possible future interventions in the important area of fish marketing.

BOBP/WP/85 — *Processing* ***and*** *Marketing* ***of Anchovy In South India: Scope for Development***

**The Bay of Bengal Programme's ODA-funded** Post-Harvest Project has been working, in the Kanniyakumari District of Tamil Nadu, India, **to resolve several problems** associated with the traditional practice **of** drying Anchovy directly on the beach sand and marketing a poor quality product. An analysis of the market, both domestic and export, provided several important insights in the potential for developing value added and higher quality products based on the existing, traditional *kattumaram* fishery. Simple and low-cost drying racks made from casuarina poles and second.hand netting were developed and demonstrated as being both a technically and socioeconomically desirable means of achieving improvements in product quality and providing a simple method of enhancing producers' incomes. This paper describes not only the development of the technical systems which have helped to achieve these results, but also discusses the methodologies and socio-economic considerations behind the project.


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