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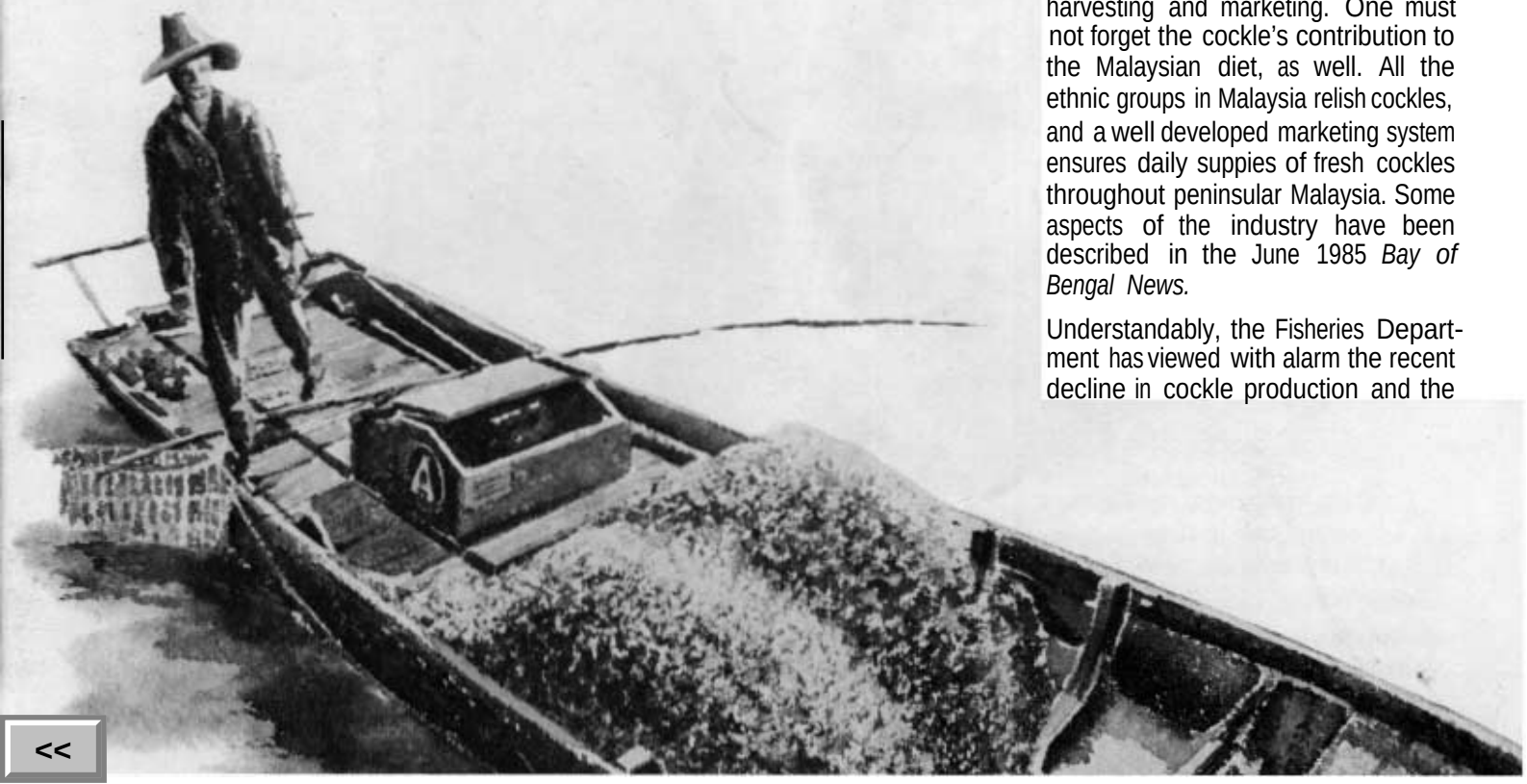
Better management through better knowledge : BOBP cockle activities in Malaysia

Several activities have been initiated in Malaysia to help improve cockle resource management by strengthening and broadening the knowledge base.
BOBP aquaculturist Charles Angell discusses these activities.

The cockle, *Anadara granosa,* is Malaysia's premier aquaculture product in volume and value. Cockle farmers make a good living; and cockle culture generates many other jobs as well — through seed collection, harvesting and marketing. One must not forget the cockle's contribution to the Malaysian diet, as well. All the ethnic groups in Malaysia relish cockles, and a well developed marketing system ensures daily suppies of fresh cockles throughout peninsular Malaysia. Some aspects of the industry have been described in the June 1985 *Bay of Bengal News.*

Understandably, the Fisheries Department has viewed with alarm the recent decline in cockle production and the



apparent instability in seed supply. The strict enforcement of a long-standing regulation on harvest size of cockle seed had whipped up a controversy and hit the economics of the culture industry, or so said the farmers.

In 1984, the Department of Fisheries in Malaysia requested BOBP's assistance in developing biological investigations which would lead to better management of the natural and cultured cockle resources. The objectives of the study were several

- Study existing seed-producing areas and recommend improved management measures to enhance seed production.
- Study, develop, and implement techniques for reseeding potential new areas for cockle seed production and revitalize existing natural beds.
- Evaluate present cockle culture practices and recommend improvements.
- Train fisheries department staff in culture management and techniques.

The project was entitled "Technical assistance in the development and management of cockle culture *(Anadara granosa)* industry in Malaysia"

The International Centre for Living Aquatic Resource Management (ICLARM) was asked to assist with project formulation. They sent an aquaculturist and an economist to work with the Fisheries Research Institute (IPP) in Penang for formulating a plan of action. A variety of activities were undertaken by the IPP staff with BOBP support to meet the objectives of the project:

- Growth and maturation of cockle farms and beds in Perak, Selangor and Penang to verify size at first spawning, spawning periodicity by different size groups and variations in growth rates between- different farms and areas.
- Developing aging or age determination techniques for cockles using direct methods, i.e., daily growth bands.
- Training in hatchery rearing on a laboratory scale to better understand the early life history of the cockle.
- Monitoring spatfall areas to determine growth and mortality of spat, leading to better utilization of this important resource.
- Assessing potential areas for cockle culture through study of environmental conditions (temperature, salinity, soil).
- Training in population dynamics and data analysis to enable rapid computer analysis of growth data.

Staff was assigned, equipment purchased and field work begun in earnest in 1984. BOBP-supported activities terminated in 1985. In January 1986, a workshop was held in Penang to discuss the findings of the of the research and provide a forum for interaction with cockle culturists in Thailand and Indonesia.

While the workshop did not generate any formal recommendations, it showed that additional knowledge had been acquired on the biology of cockle, and that new data had been obtained, which would be useful for formulating resource management strategy and planning future research. From the comments of the workshop participants, the contents of the papers presented and further discussions with IPP staff, recommendations for future work did indeed emerge.

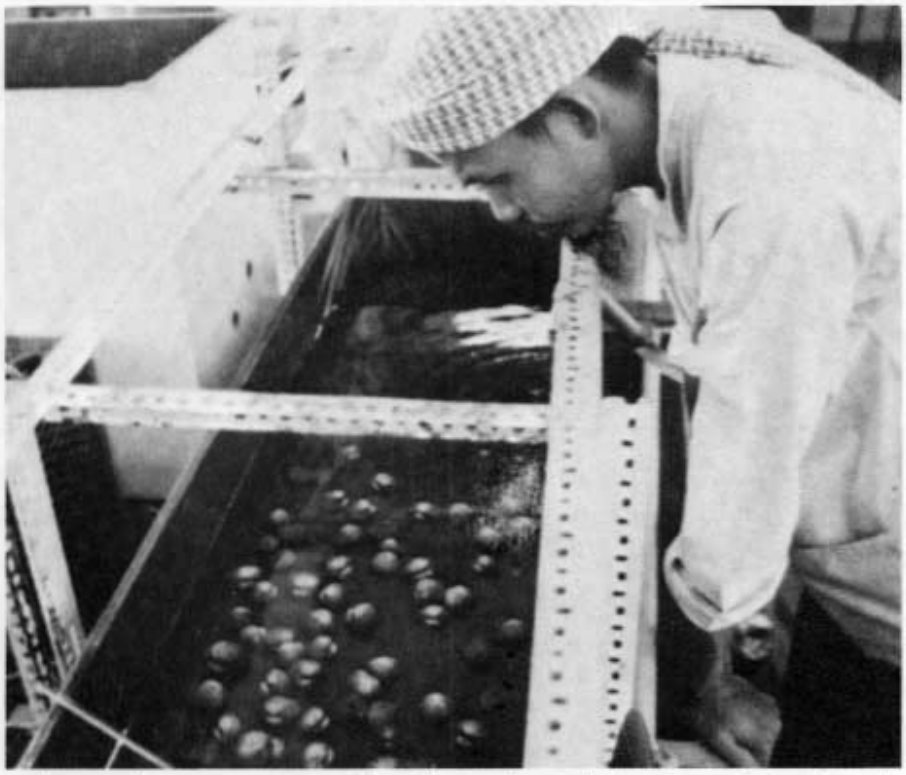
Unloading of cockle harvest.

It was apparent that reliable data relating to seed supply was difficult to obtain. In the first instance, prediction of spatfall at given locations proved impossible. While some sites were consistent producers, others showed great variability in both occurrence and abundance. Changes in bottom configuration, current, wind and tide were recognized as prominent influences on setting. Conversely, it has proven impossible to identify brood stocks for specific setting areas, partly due to very limited knowledge of inshore currents. It was suggested that trying different management measures and regulations and following their impact on seed supply might be more useful than lengthy and expensive ecological studies.

Economic studies of supply and demand for seed and cockles shed some light on fluctuations in seed availability. The additional demand for seed created by the expansion of cockle culture in Malaysia and southern Thailand (where there is ho indigenous seed supply), could not be adequately supplied from Malaysian sources and led to shortages in 1980-83. The resulting high seed prices resulted in lower stocking rates in Malaysia followed by reduced harvests. A strict ban on seed exlxrts by the Malaysian government seems to have reversed this trend.

The results of growth and mortality studies bore directly upon the controversial minimum harvest size regulations that had been put into effect to insure adequate spawning. The maximum yield per recruit, irrespective of location, occurs at 1 year of age, by which time the cockles cannot reach the minimum legal size of 31.8 mm. Growth and mortality studies were based on ELEFAN analyses of length frequencies and it was suggested that these be combined with direct aging methods. However, the techniqut which was tested during the project proved difficult to apply as more information is needed on the causes of marks or checks in the shell structure.

Participants in the 1986 Penang workshop suggested that data obtained from maturation and spawning investigations could be used to predict spatfall in a general sense, since hatchery work indicated that the cockle's planktonic phase lasts about 3 weeks. As mentioned earlier, it would still be impossible to predict spatfall at specific locations.



Inducing of mass spawning of cockle at the Fisheries Research Institute in Glugor, Penang.

Both Malaysia and Thailand evinced considerable interest in artificial broodstock seeding. The Thai fisheries department has tried several experiments in broodstock seeding, but as yet there is no conclusive evidence as to their success. Given the poor knowledge of inshore currents as well as the many uncontrollable environmental factors which influence spatfall, many at the workshop felt it was an expensive long shot.

It was also clear that more detailed studies will be required to ascertain the economic condition of the industry. Not only is more reliable production data needed, but micro-level studies of farming practices are lacking. Factors affecting the marketing of both seed and adult cockles require clarification.

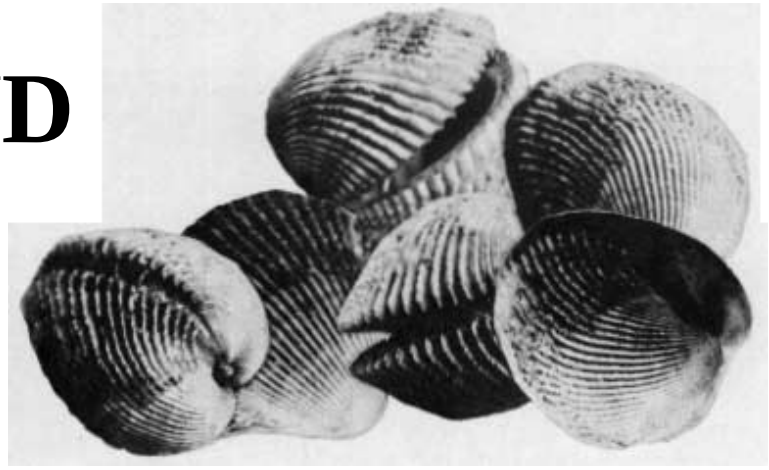
Much remains to be done and indeed, the Malaysian government is proceeding with several projects aimed at improving the productivity of the industry. It has decided to go ahead with broodstock reseeding and programs will be launched in five states. More concentrated effort will be put on monitoring spatfall areas as to occurrence, growth and mortality. Work will be concentrated at three sites. If a CIDA-sponsored coastal oceanography programme materializes, much light will be shed on larval dispersion.

There is anecdotal evidence that cockle consumption is dropping due to health concerns. Cholera vibrios have been found in cockles during outbreaks of the disease. To address this concern, depuration technology is being investigated at IPP with ASEAN support. An experimental UV system is being used to evaluate operating parameters and it is hoped a scale-up will be possible soon. The microbiology section is also undertaking water quality monitoring in major production areas. These steps are crucial if consumer confidence in the industry's product is to be restored.

Any aquaculture industry will confront disease problems sooner or later. In view of occassional mass mortalities of cultured cockles not always explained by physical environmental changes, it is imperative that IPP staff receive training in shellfish disease diagnosis.

Consumer-oriented market research would also be useful in identifying steps that need to be taken by the industry to increase domestic consumption. In view of the area available for expansion, about 12,500 ha, if the fa,mer can be assured an adequate seed supply at a reasonable price and consumer interest maintained, the cockle industry should have a bright future in Malaysia.

GROWTH AND AGING OF MALAYSIAN COCKLES



How can patterns in cockle shells help determine the age of the animals? What clues do they offer to the environmental conditions under which the cock/es grew? Dr. C.A. Richardson, who spent six weeks in Malaysia as BOBP consultant to assist the Fisheries Research Institute in Penang, provides some answers.

A sample of *Anadara Granosa* cockle shells sent in October 1984 to the University College of North Wales (UCNW) from the Fisheries Research Institute in Penang gave me an opportunity to examine the structure of the cockle shell and speculate about the animal's Life prior to its death. The technique developed at UCNW involves embedding a shell valve in resin and cutting the shell in half in a plane from the hinge to the rim of the shell. The cut surface is finely polished and etched with dilute acid to differentiate the crystal structure. An acetate peel replica of the etched surface is then prepared and examined under the optical light microscope. A pattern of bandsis revealed (Figure 1). The Penang cockle shells provided an initial interpretation of the conditions under which the cockles had been growing, and set the scene for practical experiments conducted some 10 months later in the cockle culture areas of west Malaysia.

A problem sometimes encountered in studies of shell fish (bivalve) populations is obtaining an accurate estimate of the ages of individual shellfish. A number of possible methods are open to the fisheries biologist for establishing the age structure of shellfish populations. One method is to collect samples of animals from the study area at regular intervals, measure the dimensions of the shells and construct size frequency distributions. After several years of work, it is possible to build up a picture of the patterns of growth and of the age of individuals in the population. Another method is to count the rings on the shell surface. In temperate waters such as the British Isles, seasonal fluctuations in water temperature result in rapid growth during the summer and slow growth in winter. The seasonality of growth leads to ring formation on the shell surface. These rings can be counted to age the animal, and the distance between them can be used to estimate the annual rate of growth. In tropical regions, there is little seasonal change in water temperature and almost continuous growth, so that annual rings are frequently absent from the shell surface. Thus, there is no way of estimating the age of the shell from its external appearance.

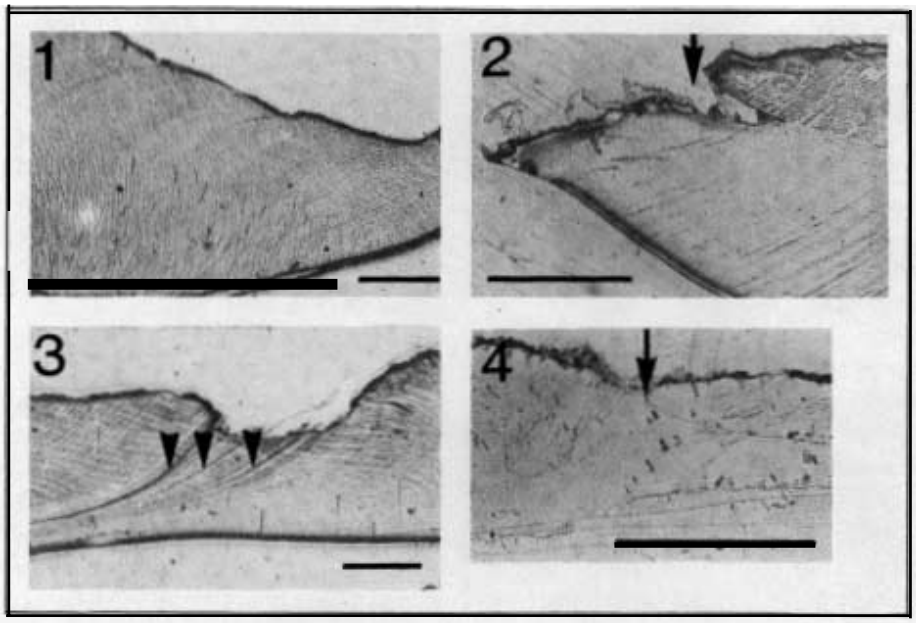
Reproduced below are replicas of shell sections, polished and etched, of Anadara granosa.

1. *Thin dark lines show microgrowth bands*

2. *Arrow shows cleft induced by cold shock marking.*

3. *Salinity stress lines formed during the monsoon; the most conspicuous are indicated by arrows.*

4. *Disturbance of banding pattern during first month of growth following transfer of cockle from the spat settlement area to the culture site.*



Scientists at the Fisheries Research Institute set out to develop a technique for aging cockles and measuring shell growth using microgrowth banding patterns in the shell structure. Before the patterns could be used to measure growth rates, it was first necessary to establish what the patterns meant. Small plastic mesh cages were sunk into and filled with the surrounding substratum in a cockle culture area close to the institute. Some cockles were marked by cold shock, 1 hour in a refrigerator at 8°C, while in others the growing edge of the shell valve was carefully abraded with a steel file. This provided a datemark to which all subsequent growth could be related. The cockles were placed into the cages for periods of 2 to 4 weeks, then they were recovered and killed. The shell valves were embedded in resin and sectioned, and acetate peels were prepared. The number of bands between the datemark and the shell margin showed that the bands had a tidal periodicity, i.e., 2 bands were formed per day (Figure 2). The number of bands along the shell would provide an estimate of the number of tides or days the cockles were growing. Furthermore, from the number of bands in a given distance, e.g. 1 mm, counted at several locations along the shell section, an estimate of the total number of bands laid down during the life of the cockle could be made. Using the shell band techniques, estimates were made of the ages of cockles around a main culture site at Port Weld, near Taiping, in the state of Perak. Generally, the calculated ages of the cockles tallied with the ages given by the cockle culturist who farms the particular site.

The shell banding patterns yielded information about seasonal growth of cockles from the estuarine areas where fresh water would have inundated them during the inter-monsoon period. In shells from these areas, the tine semi-diurnal bands were replaced with strongly pronounced lines (Figure 3). From examination of the tidal bands, it was possible to determine when the lines were produced, and it was ascertained that they were laid down in the shell during the inter-monsoon period between September and November. These stress lines were not seen in shells collected from areas towards the open sea away from the estuary. Salinity data collected by Mr. Ng Fong Oon of the Fisheries Research Institute shows that the salinity of the seawater was at its lowest between September and November. The deposition of the salinity-related lines probably occurred under abnormal conditions when the shell valves remained closed during the freshwater spates and hence lost feeding and growing time. This may explain why the shells from the estuarine areas were smaller than those collected from the open sea.

Cockle harvesting gear.

In some of the shells examined, a notch, cleft or strong band had been produced in the outer layer of the shell during the early years of the cockle's life (Figure 4). The cleft was probably produced when the cockles were transferred from the spat settlement areas to the main ongrowing culture plots. Here within the shell is evidence of the size of the cockle when it was collected and transplanted; and the banding patterns offer a detailed history about the effects of environmental conditions on growth throughout the animal's life.

During its short duration, the project achieved a number of objectives. The periodicity of the banding patterns was established through examination of the experimentally marked cockles; the patterns in shells collected from the culture areas were used to measure shell growth rates and estimate the age of the animals; and band patterns in the shells reflected conditions of lowered salinity at the culture sites.

The interpretation of the banding patterns in cockle shells forms the basis from which further studies can be carried out on seasonal fluctuations in shell growth. Shell band examination is a new concept in understanding the growth of molluscs. Shell patterns reflect the behaviour and physiology of molluscs, and reveal the history of their growth that until now lay locked within the shell structure.

People's participation in BOBP extension activities

by Gita Narayanan, Tirfe Mammo and S.R. Madhu

The December 1986 Bay of Bengal News discussed "people's participation" in fisheries projects and the one-year S!DA-funded BOBP study on the subject. This article discusses whether, how and with what effect BOBP's target audience of small-scale fisherfolk has taken active part in BOBP's extension activities.

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BOBP's concept of extension is wider than the traditional meaning of the term — which is to extend technology that has been developed and tested to the target groups. BOBP sees extension as including areas like women's activities, credit and education — which are not related to fisheries technology but are essential for development.

BOBP extension work has covered a wide span: women-related development activities in Tamil Nadu (India), Bangladesh, Sri Lanka and Thailand; credit for fisherfolk in Orissa, India; non-formal education for adult fisherfolk in Tamil Nadu and fisherfolk children in Orissa.

People's participation (PEP) has not been an across-the-board articulated objective in -BOBP extension work. In some activities participation was intended but did not occur; in others, participation occurred without the intention; in some others, there was both intention and occurrence; and in others there was neither. The one-year S!DA-funded BOBP study on PEP will help institutionalize PEP in all project activities.

Link Workers Adivate Fisherwomen in Tamil Nadu.

In 1981, BOBP conducted a socio-economic field study of three fishing villages near Madras. The survey assessed the conditions of fisherwomen, their activities, Sand their views on how they could raise their incomes. Following the survey, various possibilities to improve the incomes of fisherwomen were considered. None of these were found to be economically viable without subsidies.

The concept of link worker training was then taken up. Selected fisherwomen could be trained to function as links between the villages and the government. They could catalyze development by trying to ensure that their villages fully utilized various welfare and development schemes and subsidies for which they were eligible. In furtherance of the link worker concept, BOBP organized a 10-week residential course in 1982 for 21 link workers from seven villages near Madras.' The course was geared to promoting organizational and communications skills and knowledge of development and welfare schemes available to fisherwomen. A second 2-week course was later held to help the link workers to improve their skills.

With guidelines from the Fisherwomen's Extension Service of Tamil Nadu, the trained link workers helped fisherwomen set up cooperative societies in their villages. Through the societies, a number of schemes for fisherwomen were introduced : low-interest credit, subsidies for motorized tricycles for fish transport, medical centres, child daycare centres, a primary schoQi. In cooperation with the Natesan Cooperative Training College in Madras and the FWES, a training course was later organized for link workers on the management of cooperatives.

BOBP's direct role in the project ended 1984, but its assistance has now been sought by the government for statewide expansion of the link worker scheme. A project proposal to this effect has been formulated for funding by an international donor agency.

"People's participation" (PEP) was evident in the Tamil Nadu link worker scheme in various ways.

- During the 1981 socio-economic survey, the fisherwomen were consulted on how their incomes could be raised; the trials with possible income-generating activities were carried out with their active cooperation.
- The selection of "link workers" for BOBP training was done by the headmen and village leaders.
- The link workers regularly met and discussed with the fisherwomen to initiate and catalyze various activities. These helped increase the awareness of fisherwomen and their ability to understand and think through their problems and organize their own lives.

Thus PEP formed the basis of group action among Tamil Nadu fisherwomen aimed at self-reliance. Extension of the link worker scheme will make possible PEP and group action on a larger scale.

and in Bangladesh

In Bangladesh too, the link worker approach was the basis of a PEP project with fisherwomen, 1981-1985. (BOBP/REP/24 reports on the activity). After a socio-economic survey, several activities to help fisherwomen were initiated : net-making, fish culture, poultry farming, tree planting, savings, credit, preventive health care, nutritional training. Two social workers engaged by BOBP liaised with two fisheries officials and with nine link workers who &)ordinated 13 groups of 178 fisherwomen. While the project was on it led to definite benefits; higher incomes, better awareness, enthusiastic group action. When the project terminated, it was handed over to a voluntary agency. However, the latter failed to sustain the project's energy and enthusiasm.

Would the project have survived had it been transferred to the government? For various reasons it was not suitable for government take-over. The project called for an inter-disciplinary, multi-sector mode of operation, for active participation by field workers, link wørkers and supervisors, for coordinatictn of effort among a number of authorities and institutions, for special training of field workers and link workers and for flexible use of project funds; all these requirements pose problems with a government structure.

A lesson from the Bangladesh fisherwomen's project is that the participatory approach needs a long time to take root and flourish. Premature withdrawal of technical support may stunt growth and breed cynicism and despondency.

Another lesson is perhaps that while PEP is essential for a project's success, it is not the only requirement. Strong government or institutional backing is important as well. BOBP's other extension activities seem to bear out this theory.

Orissa fisherfolk get loans

This successful project has figured frequently in *Bay of* Bengal News (articles in March 1984 and June 1985). It has also been discussed in detail in BOBP/REP/32. Under the project, nine banks provided loans worth Rs. 7.4 million in the form of fishing craft, fishing gear and bicycles for marketing to 2,500 fisherfolk households over a period of two years. NABARD refinanced the bank loans.

The credit project was an off-shoot of an in-service training scheme for 15 Orissa marine fisheries extension officers. Much hard work preceded the project. Surveys and field studies generated valuable data on Orissa artisanal fisheries and on the incomes,

(Continued on page 11)

Assessing a fishery res Bay of what BOB and what

by K. Siva

What's the state of the art concerni of Be,5gal? What is happening to th the areas where they abound? How of fish stocks through computers, so concluded BOBP project tackled t answers, summarized in this article.

The BOBP's four-year UNDP-funded project for development and management of marine fisheries resources in the Bay of Bengal commenced in January 1983 and terminated in December 1986. The member-countries were Maldives, Sri Lanka, Bangladesh, Thailand (west coast), Malaysia (west coast of the Peninsula) and Indonesia (Sumatra).

The project aimed at improving the practice of fisheries resources assessment; and at stimulating and assisting joint assessment and management activities among countries with shared fish stocks.

Reviews were undertaken of fishery resources and assessment and management practices in the Bay of Bengal region. Four "working groups" investigated tuna resources in Sri Lanka and the Maldives; hilsa resources in Bangladesh; scads and mackerel resources of Thailand, Malaysia and Indonesia in the Malacca Strait; and tuna resources of Thailand and Indonesia in the Andaman Sea. The project also undertook computerization of data processing and stock assessment in the region. In the area of training, national biologists were encouraged to develop the ability to improve sampling techniques, identify and collect the required data, and analyse and interpret the results.

The project conducted a total of 19 training courses, working group meetings, workshops and seminars. Some 15 publications (containing about 30 technical papers by national biologists and half a dozen reports by project staff) were prepared, besides 15 *Bay of Bengal News* articles by project staff. The findings and recommendations of the project are summarized in this article.

STATE OF EXPLOITATION

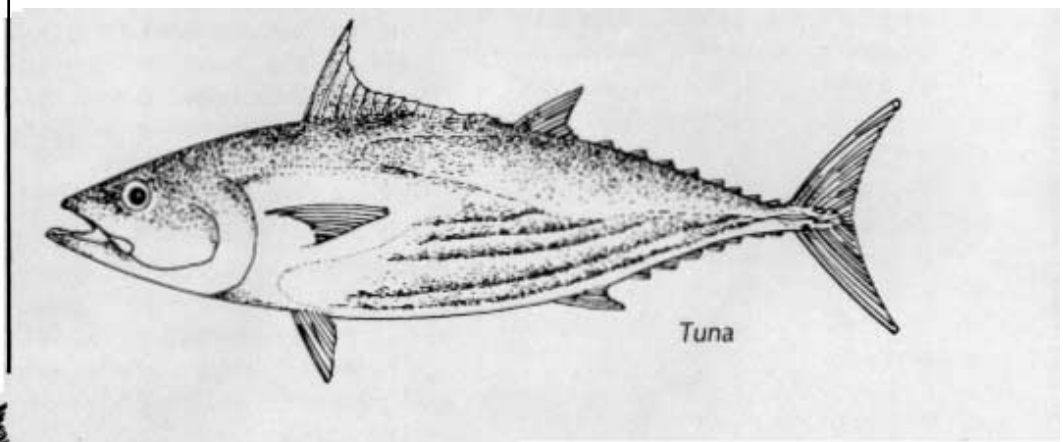
(a) Exploited resources

The project reviewed the state of marine fisheries in the Bay of Bengal in general, and of the shrimp fisheries, deep sea demersal resources and mackerel fisheries in particular. It also reviewed fishery resource research facilities in countries around the Bay of Bengal and the fisheries statistical systems in operation.

Annual marine fish production from the Bay of Bengal region is estimated at 2.2 million tonnes. About 60% of it is shared almost equally by Malaysia, Burma and India, about 15% by Indonesia, close to 9% each by Sri Lanka and Thailand, nearly 7% by Bangladesh and about 1% by Maldives. Estimates of catch composition are reasonably good in some countries, incomplete in a few and totally lacking in others. Reliable catch and effort estimates are lacking in almost all the participating count.ries. Biological information is rather qualitative and insufficient for the purpose of stock assessment and management. Correct identification of species also poses a problem in some areas.

Production of pelagics exceeds that of demersals in Maldives, Sri Lanka and the west coast of Sumatra; but the reverse is true for other countries. Further increase in the production of large pelagics (such as tunas and sharks) is possible around Maldives, Sri Lanka, India, Thailand and the west coast of Sumatra. The production of small pelagics (mackerels and hilsa) can increase significantly off Burma and to a lesser extent around Sumatra.

In Sri Lanka, a marginal increase in the production of valuable demersals and a significant increase of small and less valuable demersals is possible. There is significant development potential for reef fishery in the Maldives. There is potential for a 40% increase in demersal fish production on the west coast of Sumatra and a 35% increase off Burma.



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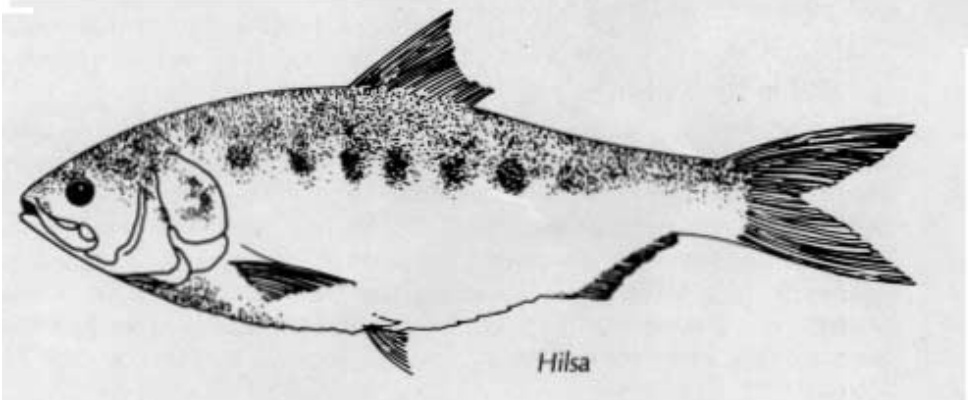

Hilsa

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subramaniam

ing marine fishery resources in the Bay e hilsa, tuna and mackerel resources in v can scientists standardize data analysis that knowledge can be shared? A just- rhese questions and brought up some

Shrimp resources are fished intensively around the Bay of Bengal, and from available information no significant rise in production appears possible for any particular area.

Certain species, such as dolphinfish and rainbow runners, are not significantly tapped by existing fishing techniques, and FADs may help increase production. Similarly, trawl gear could increase exploitation of the mackerel and scad resources which exist at 80-120 m depth off the east coasts of India and Bangladesh and on the west coast of Peninsular Malaysia.

(b) Unexploited resources

Unexploited demersal finfish, deep sea shrimp and lobster resources are available in the 100-600m depth around the Bay of Bengal, with a higher concentration in the 100-300m depth. Commercially oriented fishing and marketing trials have to be conducted to determine the viability of tapping these resources.

Tuna, sharks and billfish constitute the pelagic resource in the unexploited range of the EEZs. Surface and subsurface fisheries can be developed fore these resources around Maldives, SrL. Lanka, India, Thailand and Sumatra7

STUDIES ON SPECIFIC RESOURCES

Four working groups were established to review existing data and information on specific resources and prepare work programmes for improved data collection and analysis. The groups met subsequently to monitor progress in sampling and analysis and to discuss the results. Necessary training was provided between working group meetings. Computers were used, information was exchanged and a •standardized approach evolved for collective analysis and intrepretation of results.

(a) Tunas in Sri **Lanka and the Maidives**

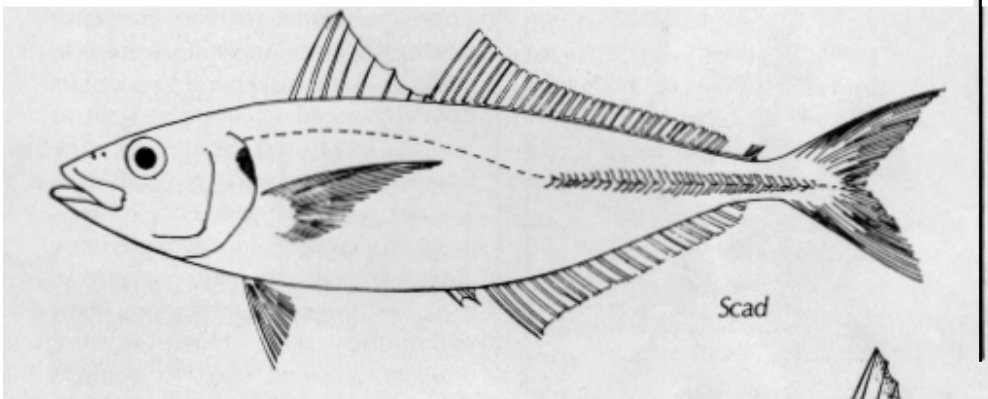
Analysis of catch and effort data to assess the state of tuna fisheries in the Maldives was standardized for the first time, and much better understanding of the tuna fisheries resulted. Both in the Maidives and Sri Lanka, biological information was obtained on growth, maturity and spawning of tunas. Expansion into unexploited ranges was considered necessary for development of the tuna fisheries. For this purpose, two FAOITCP projects for exploratory tuna fishing — one in each country — have just started.

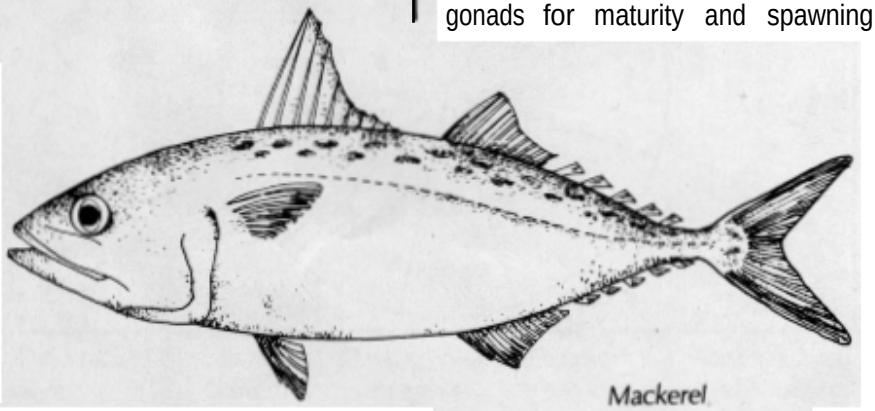
(b) Hilsa in **Bangladesh**

A comprehensive review was undertaken of the fishery and biology of hilsa in the upper Bay of Bengal. Sampling surveys and experimental fishing were conducted and detailed information obtained on the hilsa fishery in the riverine, estuarine and marine sectors of Bangladesh. The biologists were trained in sampling, conducting surveys, analysis and interpretation of results. The working group made growth estimations and conducted preliminary analysis of marketing, spawning, size composition, distribution, mesh selectivity and production trends of hilsa. The theory that many races of hiisa exist was not borne out. Though hilsa is not presently being overfished, it seems necessary to protect juveniles as a management measure. All the results being preliminary, further all-round investigation must be continued, and the fishery should not be expanded until such investigation is completed. Parallel activities in India and Burma are also necessary for better understanding of the hilsa resource in the upper Bay of Bengal.

(c) Scads and mackerels in **the Malacca Straits**

The sampling of catch effort, species composition, length frequencies and gonads for maturity and spawning

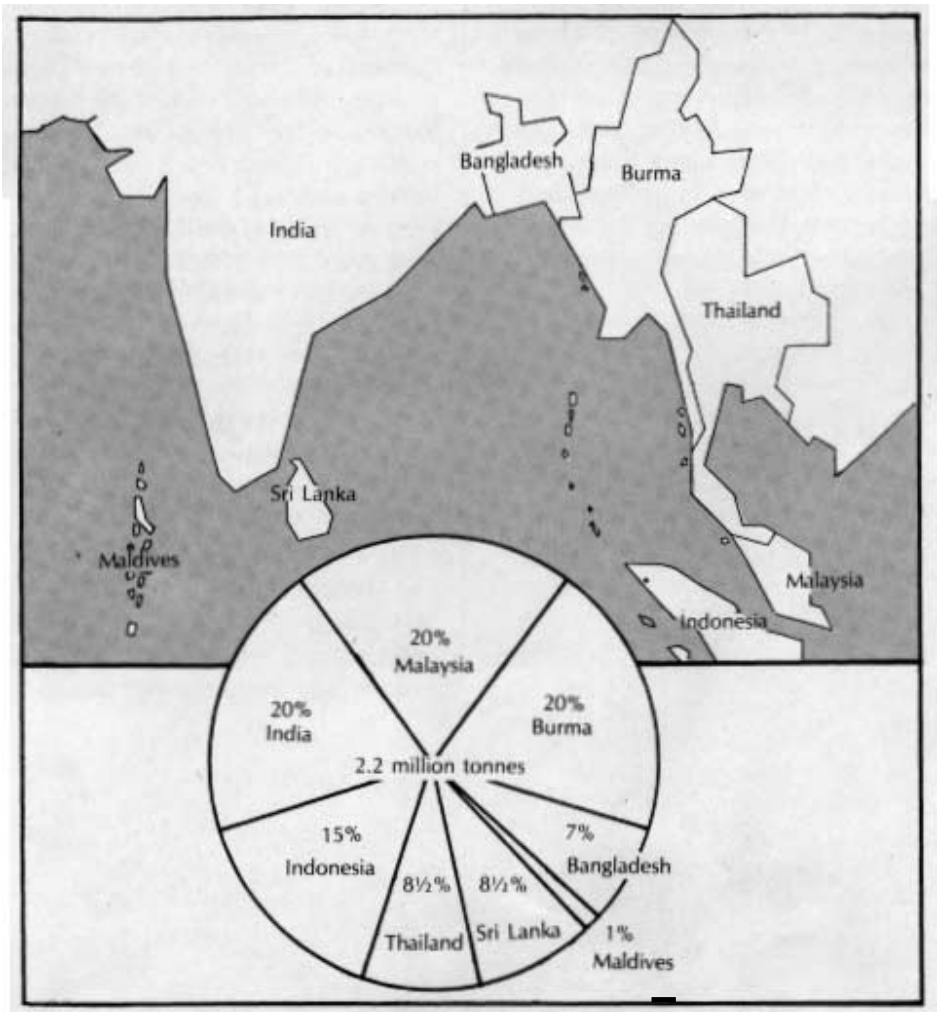




studies have been substantially improved for the mackerel resources in the Malacca Strait. As a result, it is now possible to estimate catch by species, growth parameters, maturity conditions, spawning seasons, density distribution, migratory patterns and improved sustainable yield values for each species. The new information obtained confirmed that closed seasons should be established for the mackerel fishery on the west coast of Thailand to reduce the exploitation of juveniles. Intermingling of scads and mackerel resources among the three EEZs in the Malacca strait has become evident, and the need for controlling expansion of the mackerel fishery has been pointed out. The working group has recommended that member Governments should consider establishing a joint committee to examine the information now available and suggest suitable mechanisms for managing the mackerel resource in the Malacca Strait.

(d) Tunas **in the Andaman** Sea **area**

The work programme for tunas in the Andaman sea area was not as intensive as that for mackerels, owing to lack of personnel and funds. Hence it was conducted as a supplementary programme of the mackerel working group. The group reviewed the state of the tuna fishery on the west coast of Thailand and Sumatra (North & East coasts); sampled catch effort, species composition and length frequencies; and made preliminary estimates of tuna species growth. There is no evidence at present of interaction between the tuna fisheries of the two countries, but interaction is likely to occur when the two fisheries expand offshore and exploit common stocks of skipjack, yellowfin tuna and perhaps longtail. Malaysia, which has a relatively shallow EEZ in this area, has a small tuna production that possibly will not expand significantly. However, information from Malaysian waters and also from the Indian waters around the Andaman Islands will enhance understanding of the tuna resources in this area. Follow-up activities were identified and proposals drafted for exploratory offshore gillnet fishery for tunas on the west coasts of Thailand and Sumatra.



This figure shows the project area *(Ma/dives, Sri Lanka, Bangladesh, Thailand, Malaysia, Indonesia) and a chart of the* marine *fish production in the Bay of Bengal region.*

COMPUTERIZATION OF DATA PROCESSING AND STOCK ASSESSMENT

When the project began, most of the fishery biologists concerned were unfamiliar with computers. The project introduced computerization so that member countries could (a) standardise fisheries data compilation and analysis (b) get opportunities to use stock assessment methods involving complex mathematical formulae (c) exchange data of common interest (d) undertake joint analysis by combining data from different EEZs for common resources.

Apple lie micro computers, with 128 expansion RAM and floppy disk and hard disk drives, were provided to all participating countries. Statistical and stock assessment packages available for other hardware makes were translated for the benefit of Apple lie users. The project also developed a comprehensive package for fisheries statistics (BOBFINS) and a new package of some stock assessment methods tailored for this region.

Two training courses were conducted, about 1½ years apart. Biologists of member countries excluding Bangladesh followed up the first training course by actually using the hardware and software to compile and analyse data, using various stock assessment programs provided in their own institutes and at the project's working group meetings. Between these two courses, the project helped the users overcome difficulties they faced. Copies of some of the programs developed from Apple lie were also made available on request to scientists from non-member countries such as Burma, India and Seychelles. The fisheries statistical package (BOBFINS) was not as popular as the stock assessment programs, mainly because there are not enough data entry operators in most of these countries to enter voluminous data. However, the program is being used to compile research sampling data on specific fisheries. BOBFINS was also meant to stimulate improvements to data collection, in order to obtain more and reliable information through various analytical options in the package. Thanks to the project, fishery biologists of member-countries have begun using computers, exchanging data and comparing results.

(Continued on page *13)*

People's participation in. BOBP extension activities

(Continued from page 7)

assets, and socio-economic environment of the loan applicants. A series of workshops brought together bank officials and extension officers. The former acquired fisheries knowledge, the latter learnt about bank procedures. Armed with all the data they needed, the banks found it easy to advance loans to fisherfolk on the basis of sound banking principles. Repayment of the loans by fisherfolk was excellent; about 95%.

PEP was a crucial project element. The active cooperation of fisherfolk made possible the surveys and field studies that yielded the data the banks needed. The credit plan was so formulated that it took into account the needs of fisherfolk: simple procedures, direct bank-fisherfolk contact, multi-purpose character of credit, quick and timely disbursement, flexible repayment schedules. No wonder the fisherfolk responded splendidly with an unprecedented 95% repayment rate.

The energetic cooperation of fisheries and other government officials and of bank officers at several levels was another feature of the project. A second round of NABARD-sponsored bank credit is on after BOBP's withdrawal — indicating that the foundation for a permanent bank-fisherfolk relationship has been laid.

Onssa fisherfolk children

— **a brighter future**

The December 1984 and December 1985 issues of *Bay of Bengal News* have described BOBP's work in devising a special non-formal education package for Orissa marine fisherfolk children between the ages of 6 and 14.

Project facts:

- Some 120 pictorial bookets have been developed by BOBP in cooperation with numerous agencies: NCERT, SCERT, UNICEF, Directorate of Fisheries. The booklets cover three main subject areas: literacy-numeracy, socio-economics, oceanography.
- Children who complete the curriculum satisfactorily will be eligible to join Class VI of regular (formal) school.
- Four non-formal centres operate in Orissa's four coastal districts, where children use the new curriculum.

PEP has been quite conspicuous in this project. The non-formal centres or schools were started in response to the fisherfolk's stated need. The fisherfolk selected the sites themselves and built schools with local labour and material; further, they encourage their children to attend classes, maintain the schools and decide on the timings. Even food and accommodation are sometimes provided for teachers by the fishertolk.

- The education package is based on materials that relate to the marine environment. The curriculae is need-based, problem-oriented, locally-specific.
- Inter-institutional cooperation is again very strong in this activity. NCERT, SCERT, UNICEF and the fisheries andeducation departments or Orissa have been equal partners with BOBP in initiating the project.

Tamil Nadu fisherfolk — **a new educational** opportunity

The participatory approach is nowhere more evident in BOBP work than in two publications that have set off ripples of excitement in educational circles: the Trainers' Manual and the Animators' Guide. These are part of a package of about 50 non-formal education booklets developed by BOBP for Tamil Nadu marine fisherfolk, their animators and the trainers of these animators.

The two books, requests for which have come in from all parts of the world, contain detailed "model training programmes" that are in fact a model of PEP: they enable fisherfolk to become more critically aware of themselves, their environment, their problems. The package dramatizes the concept that education has to be internalized from within, not injected from without.

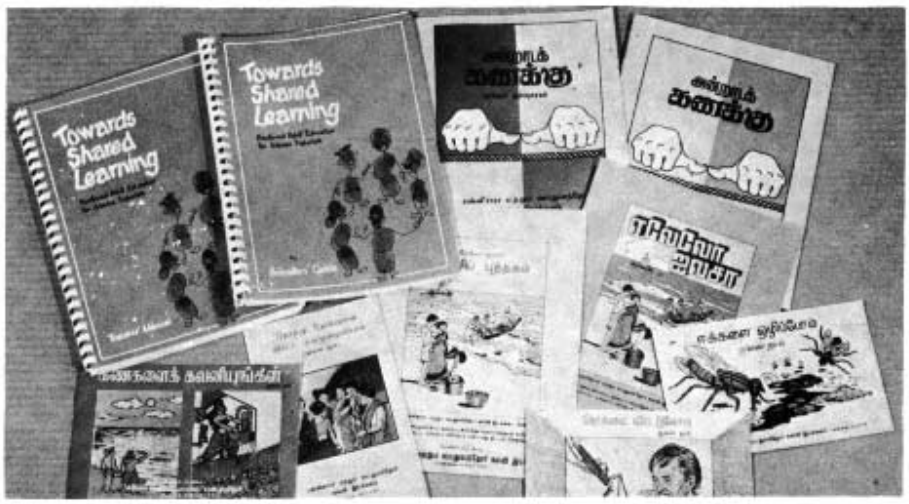
Literacy primers, numeracy primers and supplementary readers (all in Tamil) are other components of the NFE package.

While these booklets have become popular as NFE material, NFE centres for their use by fisherfolk have yet to come up. These centres have been suggested in a proposal formulated by BOBP for international donor funding. If and when the proposal materializes, it will mark a triumph of PEP — with thousands of Tamil Nadu fisherfolk taking up an educational opportunity that they missed early in life.

Vigorous inter-institutional cooperation was a feature of this activity too — several government, academic and voluntary bodies and numerous individuals assisted in developing the package.

Thus "people's participation" has indeed been a feature of BOBP work in the past. But the 'one-year SIDA-funded study has enabled the BOBP to analyze and ruminate on its PEP experience. The BOBP is richer for this study, in knowledge and practical wisdom, a fact that will doubtless be reflected in future activities — particularly those relating to extension.

BOBP publications on non-formal education for Tamil Nadu tisherfolk are an excellent example of the participatory approach in action.



Fishery Resources Research in the Bay of Bengal : a Factsheet on Peninsular Malaysia (West)

Unlike demersal resources — which have been the subject of both planned and routine monitoring surveys in the past — pelagic resources have not been systematically investigated in peninsular Malaysia. In recent years, however, even the routine monitoring surveys for demersals have been less regular than before because of constraints in replacing demersal sampling trawl gear used in the surveys.

The Directorate of Fisheries in Kuala Lumpur and the Research Institute in Penang have established a joint committee for management of marine resources and for matters concerning statistics. Detailed catch statistics are being published annually. However statistics of effort, particularly for pelagic fisheries, are limited to the number of registered crafts or gear. An attempt is being made to estimate purse seine effort in terms of fishing days and number of sets. With this progressive step by the Fisheries Research Institute, production estimates are being attempted independently for certain species with the help of microcomputers by the Research Institute. Biological research has also been intensified in recent years. Universities take active part in research relating to mariculture and coral reefs.

Table 1 — Resources Surveys and Exploratory Fishing

Period	Vessel	Type of Survey	Limitations	Remarks
1965	M.V. Selayang	Bottom Trawl		
Dec. 1970-Jan. 1971	K.K. Jenahak	Bottom Trawl (fish)	10-60 m depth	Original name was PENYLIDIK 1
Sept.-Oct. 1971	K.K. Jenahak	Bottom Trawl (fish)	60-120 m depth	
Dec. 1971-Jan. 1972	K.K. Merah	Bottom Trawl (fish)	10-60 m depth	Original name was PENYELIDIK II
June-July 1972	K.K. Jenahak	Shrimp trawl	5-50 m depth	
April 1973	K.K. Jenahak	Fish trawl	20-90 m depth	
Nov.-Dec. 1974	K.K. Jenahak	Fish trawl	10-60 m depth	
Oct.-Nov. 1978	K.K. Jeriahak	Bottom trawl	10-60 m depth	
June-July 1980	Dr. Fridjof Nansen	Acoustic, bottom, trawl, pelagic trawl	> 100 m depth	Limited seas and coverage
Nov.-Dec. 1980	K.K. Jenahak	Bottom trawl (fish)	10-60 m depth	
April-July 1981	K.K. Pelaling	Bottom trawl (shrimp)	5-50 m depth	
Oct.-Nov. 1981	K.K. Jenahak	Bottom trawl (fish)	10-60 m depth	
April-Aug. 1982	K.I. Pelaling	Bottom trawl (shrimp)	<40 m depth	
September 1984	K.K. Mersuji	Bottom trawl (fish)	10-60 m depth	
March-April 1986	K.K. Mersuji	Vertical long-line	30-100 m depth	
Oct.-Nov. 1986	K.K. Mersuji	Bottom trawl (fish)	Under analysis	