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DEVELOPMENT AND MANAGEMENT OF COCKLE (ANADARA GRANOSA) CULTURE IN MALAYSIA

Project Description and Work Plan prepared for the Bay of Bengal Programme (BOBP) and the Malaysian Department of Fisheries (DOF)

by

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ACRONYMS

BOBP : Bay of Bengal Programme of Fisheries Development

DOF : Department of Fisheries, Malaysia

ICLARM: International Center for Living Aquatic Resources Management

IPP : Institut Penyelidikan Pesikanan (Fisheries Research Institute)

LKIM : Lembaga Kemajuan Ikan Malaysia (Fisheries Development Authority of Malaysia)

PN : Persatuan Nalayan (Fishermen's Association)

TOL : Temporary Occupation License

PROJECT SUMMARY

Title	:	Development and Management of Cockle (*Anadara granosa*) in Malaysia
Cooperating Agencies:		Ibu Pejabat Perikanan (DOF), Kuala Lumpur, Malaysia.
	:	Bay of Bengal Programme (BOBP) for Fisheries Development, Madras, India.
Project Duration	:	18 months beginning September 1984.
General Objectives	:	To provide guidelines for the effective management and development of natural cockle seed resources and their future conservation to supply an expanding cockle industry. To assess the potential for expansion of the cockle culture industry by improving production from existing culture beds and by establishing culture beds in new areas.
Funding Requirements:		US$100,000 from BOBP
Liaison Officers	:	Mr. Cheah Eng Kean, Department of Fisheries, Kuala Lumpur, Malaysia.
		Mr. Lars Engvall, Bay of Bengal Programme, Madras, India.
Project location (Base for field and laboratory work)	:	Institut Penyelidikan Perikanan (IPP), Glugor, Pulau Pinang.
Senior Project Staff	:	(to be determined)

I. Background and Justification

A. Status of the Industry: The blood cockle (Anadara granosa) is of considerable importance to Malaysia, the world's largest producer of this cockle species. Cockle production by volume of 69,000 tons in 1981 represented over 80% of the country's total aquaculture production that year. Production has varied from year to year, however, (Table 1). From only 6,000 tons in 1957, production reached a peak of 121,000 tons in 1980 but has declined since then. At currently prevailing prices, (Ringgit 0.35/kg), the landed value of cockles (in-shell) exceeds 15 million Ringgit (approximately US$6.5 million) annually.

Production areas are concentrated on the extensive mud flats of West Coast of Peninsular Malaysia in the States of Perak, Penang, and Selangor. Official estimates of production area are approximately 3,000 hectares but it is generally acknowledged that the actual area may be 3 - 5 times as large due to significant culture areas being unregistered. Culture of cockles is carried out by individual farmers, fishing community associations, (PN) or the Fisheries Development Authority Malaysia, Lembaga Kemajuan Ikan Malaysia (LKIM). All culturists, including LKIM, are required by federal law to obtain a Temporary Occupation License (TOL) which is usually valid for one year. The annual TOL fee ranges from 30 Ringgit per acre (US$28/ha) in Penang to 100 Ringgit per acre (US$95/ha) in Perak. License fees are set by state governments which also retain the license income. There is currently no legal limit to the size of farm which can licensed.

This substantial aquaculture industry is dependent for its seed stock upon natural spatfalls that occur along the Western coastline of Peninsular Malaysia usually during the months of November to February. Spatfall is extremely variable

Table 1. Annual production of cockle in Malaysia, 1957 to 1983.

	Annual production (tons)
1957	6,666
1972	29,348
1975	29,000
1978	55,598
1979	63,412
1980	121,000
1981	69,000
1982	49,500
1983	38,500

Source: Ibu Pejabat Perikanan (Department of Fisheries Kuala Lumpur)

Table 2. Annual seed cockle collection, in thousands of tins, 1979-1982 (one tin equals 15-18 kg).

State	1979	1980	1981	1982
Perak	49	15	55	53
Selangor	19	184	167	46
Pulau Pinang	none	84	none	none
	68	283	222	97

Source: Ibu Pejabat Perikanan (Department of Fisheries) Kuala Lumpur

from year to year (Table 2) and there is a high degree of unpredictability as to where spat will settle in large quantities. While some coastal areas, especially in Selangor, experience spatfall every year, other areas in Perak and Penang receive spatfalls only intermittently.

After spatfall has been recorded in a particular locale, the Department of Fisheries (DOF) is notified and a short collecting period of approximately one week is authorized to take place a few months later when the seed cockles are presumed to have reached an approximate length of 6.4 mm. Fishermen from nearby fishing communities collect seed cockles in large quantities (and earn considerable windfall income in the process) and sell them to buyers who transport them to the culture areas. Here, they are spread over the nursery areas of cockle farms at varying densities depending upon seed size. A few months later they are thinned and transplanted at reduced densities to the rest of the farm. Harvest can begin as soon as 6-7 months after initial stocking, but somewhat longer (10-18 mos.) is required in most locations for cockles to reach the minimum allowable size for marketing of 31.8 mm.

Markets for the final product in fresh form include domestic markets and export markets in Thailand and Singapore. In addition, some very small quantities of fresh cockles have been sent by cockle wholesalers to Sabah, Sarawak, Australia and Hongkong for trial marketing. A small quantity is processed (canned) and sold locally or exported to Europe and elsewhere. The exact breakdown of market outlets is not known, however, nor has the potential for expanded domestic and export markets been determined.

B. Government Policy and Programs: Current government activities and regulations that effect the cockle industry include those related to natural areas, seed collection, cockle production and marketing.

In general these activities and regulations are designed to ensure continued supply of seed for culture purposes and to encourage the participation of coastal fishermen in the cockle industry. The major specific activities and regulations are as follows:

1. With respect to natural cockle beds and seed collection:
   - closed season for seed collection (location specific)
   - licenses required for seed collectors
   - minimum size for seed collection of 6.4 mm
   - no culture of cockle in natural spatfall areas.
2. With respect to cockle production:
   - licenses (TOL) required for the area under culture
   - culture limited to members of fishermen associations (PN)
   - no culture in natural cockle bed areas
3. With respect to seed and cockle marketing:
   - export of seed is controlled by issue of permits
   - minimum market size for cockle of 31.8mm.

The guiding legislation for the cockle industry is the Fisheries (Cockle Conservation and Culture) Regulations 1964 as ammended in 1982. Although enforcement of these regulations was not strong initially, the DOF has taken more effective steps recently in the interest of conservation. Enforcement of the minimum size regulation, for example, has resulted in arrests and confiscation of lorries transporting undersized cockles. Nevertheless, a large portion of the culture areas remain unlicensed and cockle seed are alleged to be smuggled to Thailand. Due to recent declines in cockle production, the DOF views the need for cockle conservation and management with considerable urgency and is determined to strengthen the scientific base necessary for more informed decision-making.

LKIM (The Malaysian Fisheries Development Authority) is also involved in the cockle industry. In 1976, LKIM began culturing cockles on a pilot scale basis with the intention of introducing cockle culture to fishing community associations (PN) when such associations were able to manage the farms in question. PNs are under the guidance and direction of LKIM. The LKIM production area began to expand rapidly by 1980, which explains in part the very high production that year (121,000 tons) as private entrepreneurs, who expected to be displaced, harvested all their cockles. In 1981, LKIM was awarded a monopoly for the purchase and distribution of cockle seed but this was removed in 1983. LKIM currently farms in excess of 1000 ha; limited progress has been made in turning over LKIM farms to PNs, though in several areas (especially Penang) PNs now culture cockle areas formerly cultured by individual entrepreneurs. While privatization of government enterprises has become national policy, the rate at which such privatization may proceed with respect to the LKIM cockle farms is unclear.

While LKIM is primarily concerned with uplifting the income levels of coastal fishermen (through cockle farming in this case) the primary interest of the DOF is management of the cockle resources, especially the seed supply. Both agencies also have an interest in the possibilities for encouraging expansion of cultured area and production, but for the DOF, management to assure continued adequate seed supply for the industry is currently of paramount concern. To develop a cockle resource management plan, a "Committee on the Management of Cockles" has been established within the DOF.

C. Problem Identification: The cockle industry is beset by uncertainty and incomplete information which makes development of a rational management plan extremely difficult. While the issues of immediate concern are those related to cockle resources management (i.e. seed supply and broodstock conservation) and are thus primarily biological/technical in nature, broader issues regarding industry

management and development also contain economic and institutional dimensions. For thorough planning of government activities and regulations, a multidisciplinary perspective is required. The major constraints to planning and implementation of management measures include inadequate scientific information on the biology of the cockle and incomplete information on the current status of the industry.

Of the above, the shortage of reliable scientific information on cockle biology is the most critical in order to evaluate the seed and broodstock management measures (minimum size of 6.4 mm for seed collection and 31.8 mm for cockle harvesting) that are currently the source of much debate. However, scientific information alone is insufficient to manage the cockle industry as a whole and particularly to address the question of potential for further expansion. For these, both technical and socio-economic information is required.

1. Biological Constraints and Proposed Solutions

Published information on Malaysian cockle biology and culture is inadequate for effective management and development of the industry. Useful studies have been made on growth, reproductive biology and ecology (e.g. Pathansali 1966; Broom 1983) but many important questions remain unanswered. Broom (1981) has reviewed biological information relevant to Malaysian cockle resource management and is currently reviewing aspects of the biology and culture of all Anadara species for ICLARM.

The most serious information gaps concern seed resources. Spatfall is seasonal and recurs fairly regularly every year in some areas, but is sporadic or very rare in others. Some areas with massive culture beds are said to have never experienced any spatfall. Any area which has experienced spatfall is designated a natural bed and is excluded from culture operations under current regulations. In no case, however, has it been possible to determine the location of the spawning population (broodstock) responsible for a given spatfall, since cockle larvae are

planktonic and are distributed by water movements for an unknown period. We do not know which broodstocks among natural and transplanted (cultured) populations are the important sources of spatfall.

To remedy this, the history and location of spatfalls will be documented as fully as possible and considered in relation to the location and size of contemporary culture areas and prevailing water movements. Mature cockle populations on natural and culture beds will be examined to determine the proportions of spawners. In addition, cockles will be induced to spawn in the laboratory and the larvae reared through to settlement under different environmental conditions, to determine the duration of the planktonic phase.

The work will facilitate in-depth studies on the early growth and survival of seed cockles which will give useful information on how to regulate natural seed collection. Under present regulations, seed cockles less than 6.4 mm total shell length cannot be collected, but culturists seem to prefer to purchase much smaller seed and to sow them very densely. Seed production on a laboratory scale will enable researchers to investigate this issue and should lead to recommendations for optimizing utilization of the natural resource. Researchers at present find it difficult to gain early access to natural spatfalls remote from their laboratory.

This work cannot be expected to answer all the outstanding questions on cockle spawning and spatfall but it will provide vital information for development and management planning, including an appraisal of the likelihood of success of so-called 'reseeding' operations. Reseeding is the transplantation of mature and/or seed cockles to conservation areas to form broodstocks which are left unharvested in the hope that they will produce local spatfalls. Reseeding is a high cost, high risk activity with little history of success. ICLARM is involved in reseeding operations in Thailand, where there is a chronic shortage of cockle seed. These

operations are confined to semi-enclosed sea areas: bays with little water exchange. Any results from Thailand will be reported in 1985.

In addition, the proposed studies will indicate scope for recovery of natural beds which were previously used for seed collection but which have since become unavailable, through culture or other activities, or unproductive for other reasons.

The proposed field and laboratory studies on cockle spawning and cockle seed will be interactive with age and growth studies. Cockle growth rates and the sizes at which full sexual maturity is attained and first spawning occurs are a matter of controversy at present. Recent enforcement of a ban on harvesting cockles less than 31.8 mm total shell length (see Appendix) has drawn protests from farmers that their cockles cannot be grown to this minimum size in a reasonable culture period. The ban is supposed to ensure that most cockles on the culture beds get a chance to spawn before being harvested. This is a complex issue. In most aquacultural operations fish and shellfish are harvested while immature or with fully developed gonads but not as 'spent' individuals, in which condition index is at a minimum. The relevance of the field studies discussed above is obvious. Moreover cockle growth appears to be density-dependent and location-specific which makes it difficult to apply general case length-weight and maturation/spawning relationships in management.

To clarify such issues, work will be done on the size frequency structure of natural and cultured populations and a method for ageing bivalve molluscs, by counting daily/tidal growth rings in the shell, will be tested on cockles for the first time. If such rings can be readily identified and reliably interpreted it will enable workers to check the claims of farmers that they are now having to delay their harvests in comparison with traditional practices.

This work on age and growth will be linked with detailed observations of culture practices, especially cockle densities after seeding, relaying and growout

since density affects growth and may not be well managed at present. Moreover mortality from seeding through harvesting appears to be around 60-70% and ways to reduce this will be investigated.

The results of all this biological work - information gathering, field and laboratory studies - will help to resolve the following development - and management - related questions: Has there ever been? Is there now? Or could there be a seed shortage? What conservation measures are necessary for natural cockle beds? What regulations are appropriate for culture beds? It is vital that these questions be resolved quickly.

It should be emphasized that none of the proposed biological work will lead to the development of cockle seed production hatcheries. The seed requirements of the industry are so vast that it is absurd to contemplate shore-based hatcheries. This point is emphasized here since the history of aquaculture has many instances of laboratory scale successes in larval rearing having seduced developers into wasting large sums on hatchery development projects only to find that production could not be scaled up for technical reasons or that the seed produced was much too expensive. There are no examples of successful Anadara hatcheries anywhere in the world. Indeed the vast majority of bivalve culture industries rely on natural spatfall, particularly in the tropics. For Malaysian cockles therefore, management options are limited to seedstock, broodstock and habitat conservation, improvements to culture techniques to increase survival and growth from seeding through harvesting, recovery of previously productive natural seed production beds and (possibly) reseeding operations to produce additional spatfall.

2. Economic Constraints and Proposed Solutions:

To address the question of the potential for renewed growth in the industry it is crucial to know the current economic viability of the industry, the

availability and costs of the added inputs (mudflat area, seeds, labor, and capital) necessary to either intensify production on existing areas or expand to new areas, and the potential of domestic and/or export markets to absorb the additional quantities of cockles that might be produced. Information from the industry will help in evaluating the impact on culture practices and economics of the seasonality and annual fluctuations of seed supply and prices. Most importantly, industry information would help in determining why annual cockle production has been falling for the past three years and what economic and/or institutional constraints must be overcome for production increases to resume.

While there have been a few university (faculty and student) papers recently on economic and institutional aspects of the current industry, these are insufficient for management and planning purposes because they are out of date. An in-depth industry study is needed to supplement the production and partial price data collected by the DOF.

The following information would be required to assess the industry's economic viability, potential for expansion and possible need for management:

- spatfall locations and annual seed production;
- seed prices by year and location;
- incomes derived from seed collection and factors that influence the intensity and duration of seed collection;
- current area under culture and potential for expansion;
- costs of production and profits earned by the various private entrepreneur, LKIM and PN cockle culturists and factors that influence these costs and profits;
- wholesale and retail prices of market size cockles by year and location;
- potential for increased efficiencies in cockle production and marketing; and

- total production, domestic and export market volumes, extent of processing and potential of markets to absorb additional cockle production.

Some of the above information requirements (i.e. spatfall, culture area and potential areas for expansion) will be provided by the project biologists. Also, the project biologists will evaluate the technical efficiencies of various culture practices; complementary economic analysis would indicate whether the proposed technical improvements can be justified on economic grounds.

The DOF believes that it is important to make progress on the biological issues identified earlier before embarking on any major economic studies. Their belief is more than simple setting of priorities within a limited budget; rather the DOF wishes to be on a stronger scientific footing before addressing economic issues, some of which are quite sensitive. Therefore, the economic studies proposed for this projct will consist in their early stages primarily of information acquisition regarding selected aspects of the cockle industry (i.e. seed production and prices; harvested cockle production and prices). Upon the request of the DOF, a re-assessment of the possibility of conducting more in-depth economic analysis of the industry will be made in mid-1985. The basis for this re-assessment will include an evaluation of the biological work to that date, progress made towards resolving the cockle resource management issues (i.e. seed supply and broodstock conservation) and availability of project funding. The initial acquisition of production and price data will be conducted by the DOF Management and Licensing Unit.

3. An Appraisal of the Problems: The complexity of the problems facing the cockle industry and those government institutions tasked with its development and management are apparent from the above discussion.

Consequently, it is important to maintain a realistic perspective regarding the potential for a set of research activities to answers these management and

development issues. Within the budget (approximately US$100,000) and time frame (18 months) available for the proposed project, definitive answers are probably not possible. Nevertheless, considerably more will be known at the end of the 18-month period than is currently. The project objectives and work plans outlined in the next sections reflect this realistic perspective and give first priority to improving the base of scientific information on the cockle resource and second priority to collecting up-to-date information on the economic aspects of the cockle industry.

II. Objectives and Expected Results

A. General

To provide guidelines for the effective management and development of natural cockle seed resources and their future conservation to supply an expanding cockle culture industry.

To assess the potential for expansion of the cockle culture industry by improving production efficiency on existing culture beds and by establishing culture beds in new areas.

B. Specific

The proposed biological studies will be designed to answer the following development and management-related questions:

Question	Expected Project Results
1. Has there ever been? Is there now? or should we plan to expect a cockle seed supply shortage?	Detailed documentation will be made of all spatfall records and their exploitation, with recommendations for future management. This will answer the question.
2. Which cockle populations, natural and/or cultured are important	Detailed comparisons will be made of past spatfalls with contemporary culture

sources of spatfall?	activities and hydrographic data and the length of the planktonic larval phase will be determined. This will not answer the questions completely but will help to plan future conservation of resources.
3. Should culture operations be allowed in natural spatfall areas?	See 1, 2 above; these studies will answer the question, at least for areas which emerge as being of major or minor importance.
4. Should a 6.4 mm size limit and/or regulations be continued/imposed on seed collection?	Both the field and laboratory studies proposed will yield important new information on seed biology which can help in desiging new management plans for this resource.
5. Should culture regulations be designed to ensure that most cultured cockles spawn before harvesting is allowed?	See 1, 2 above; also the proposed field studies will include appraisals of current spawning successes under the 31.8 mm minimum size regulation. This will help to answer the question, especially if comparisons are made with past harvesting practices and production.
6. Is the current 31.8 mm size limit a reasonable measure to ensure spawning before harvest?	see 5, above.
7. Is there significant variation in growth rates (culture periods) between different culture areas	The proposed field studies on culture practices and the proposed analyses of age, growth and length frequency will do

and if so how can regulations be designed to meet both conservation and production objectives on a national basis?	much to answer these questions. Accurate age determination for cultured cockles would be a particularly useful check on farmers' claimed culture periods.
8. Can previously productive natural seed beds be recovered and conserved to increase seed supply?	The proposed field studies will indicate the possibility of success and the nature of necessary conservation measures.
9. Are reseeding programs a realistic approach to increasing seed supply?	The proposed field and laboratory studies will give an indication of this, but reseeding is always a high risk venture.
10. Are there suitable unexploited areas for expansion of the cockle culture industry?	The proposed field studies will answer this question.
11. Can production efficiency be improved from existing culture areas?	The proposed field studies will enable the researchers and consultants to make recommendations for improving survival and growth by better farm management.

The economics component of this project is designed to answer the following question:

Question	Expected Project Results
1. Is there a shortage of cockle seed?	Historical data on seed prices and prices of harvested cockles over the past 10 years (collected from a sample of culturists) and information on past seed collecting and distribution methods/

buyers will allow some preliminary conclusions as to whether alleged seed shortage is (was) real or artificial.

If a decision is reached in mid-1985 to expand the economics work, the following questions could be addressed:

2. Do prevailing economic conditions in the cockle industry warrant further expansion, either in terms of increased production from existing area or from new culture areas?	Historical and current data on input costs (seed and lease), production costs and profits, wholesale and retail prices of harvested cockles will provide indications of the extent to which profits to seed collectors, producers and middlemen and resource rents to the licensing authorities are being earned. The presence of significant profits and rents earned implies that the industry can expand production even if lower prices of harvested cockles result. Sensitivity analysis will determine "break-even" prices. Socio-economic and institutional feasibility studies will be conducted in selected locations where (and if) cockle expansion is recommended.
3. What is the market potential for expanded cockle production?	Data on retail prices, consumer preferences, alternative product forms and the extent of the export market will help establish market potential.

4. Are recommended improvements in culture practices warranted on economic grounds?	Costs and benefits of the changes recommended by project biologists will be evaluated.
5. Which institutional arrangements in the industry best enable it to meet national goals of increased cockle production and increased income for the former fishermen who are now (or could in future be) involved in seed procurement, cockle culture and marketing?	Analysis of the efficiency of various groups currently involved in cockle farming, the level of income earned by participating fishermen and the degree of government support required will help answer this question.

Question No.1 above would be addressed within the budget and first 9 months of this project. Questions 2-5 would require additional personnel (perhaps subcontracted with Universiti Pertanian Malaysia, for example) and budget if the DOF decides to proceed with further economic analysis.

III. Work Plan

A. General Considerations

Major emphasis for the biological work will be placed on field studies, backed up by laboratory work on field samples and additional activities. The main thrust of the work is to enable the IPP biologists to get a close appraisal of the industry in the field and thereby make recommendations for its further development and management based on their field and laboratory research results.

The economic analysis will consist of an initial 9-month information gathering phase which will focus on production and price data (for both seed and harvested cockles), possibly to be followed by an in-depth industry study.

The work plan is given here under separate headings - information acquisition, field studies, laboratory studies, consultancies, economic analysis and training - but all these are highly interactive.

B. Information Acquisition

The IPP staff responsible for the project will start by making thorough literature searches for all published and unpublished information relevant to the project and will purchase or copy this wherever appropriate. This information will include books, reprints from scientific journals, university theses, reports, feasibility studies, surveys, hydrographic data, maps and coastal charts. A complete set of coastal charts for Malaysia should be acquired. This material should be maintained as a project reference library at IPP in Penang. Copies of this material should also go to the DOF Management and Licensing Unit in Kuala Lumpur.

In addition, the IPP librarian and project staff will visit other university and technical libraries in West Malaysia to determine their holdings for future reference. They will also determine how best to ensure that adequate information is acquired on a continuing basis by consulting with other libraries or agencies which have access to machine searchable data bases, abstracts and current awareness publications, such as "Current Contents".

C. Biological Studies

1. Field Studies

Field visits will be a continuous feature of the project from its inception and throughout the visits by consultants (see below). The proposed work will require about two field trips per month each of 4-5 days duration (in addition to the ongoing IPP project in which 6 field project sites are visited once a month; although there is obviously scope for combined visits on occasions).

Field visits will utilize the project vehicle and to some extent DOF boats. However for much of the work at sea, local boats will be hired since this is cheaper than using the speedboats which are available and will also lessen the extent to which the researchers are identified by farmers as working with the enforcement agency.

The initial thrust will be to study the areas of natural spatfall. Spatfall records will be collated and further interviews made to get as much information as possible on their timing and location. A major task here will be an analysis of how spatfalls and their extent are discovered and how this knowledge is spread. These studies will also address the question of recovery of natural beds which previously experienced spatfalls but which are now unproductive because of culture activities or other environmental causes. All this information will be analysed relative to the structure of the cockle culture industry at the time (areas under culture and their location) and hydrographic data.

The ensuing field studies, where not specific to the needs of consultants, will be concerned with (1) assessments of areas for expansion; and (2) evaluation of current culture practices and will be complementary to an IPP farm study by questionnaire which is already underway. Visits will be made to known culture beds and potential new areas to make a general assessment of how much area exists for new culture trials. Visits will be planned by considering TOL's (of which complete records will be obtained from all west coast States with cockle culture activities), from local knowledge of the extent of culture beyond TOL - leased areas and by examining relevant coastal survey information. At promising new sites, samples of mud and benthos will be collected and a rough assessment of likely salinity fluctuations will be made.

For evaluating current culture practices, in addition to seeking the assistance of consultants, the project staff will observe and document seeding and

relaying (thinning) and harvesting operations in detail. Standard ecological techniques will be used to determine actual densities achieved after seeding, relaying and during growout. The most effective way to approach this work is probably to enlist the help of a few farmers ('cooperator farmers') who have an interest in improving their production efficiency and who therefore welcome frequent visits by researchers. Cockle densities on their beds can then be studied in detail and compared with a wider survey ('spot checks') on other farms.

In addition to seeding and relaying, the project staff will investigate and make recommendations for improvements on the following (which are all somewhat interrelated): 1. security measures - are they effective? 2. are there any ways to delineate culture beds (such as buoys) and to facilitate position finding on large beds without posing navigational hazards? are there any serious conflicts of use on existing or potential new culture areas and if so, what can be done? can harvesting methods be made more efficient without prejudicing any conservation or management objectives? The last of these questions could be extended to a subproject on gear development.

Cockle samples will be taken from a few farms representative of the major culture areas visited (say, from one cooperator farmer per area) to study maturation and spawning under culture conditions. The recommended sample size is 150 individuals per farm. The sampling protocol i.e. the number and distribution of sampling stations from which subsamples are pooled to make up the 150 total will depend on the size and shape of the farm. The main requirements are that the subsamples be taken from a small number of dredgings which are representative of the area as a whole and that cockles are taken at random from the dredge. Laboratory studies on the samples are considered below.

2. Laboratory studies

a) Induced spawning, larval rearing and settlement studies

Mature cockles, brought from culture beds and kept in tanks and aquarium at IPP, will be induced to spawn using thermal shock techniques established at IPP and Universiti Sains Malaysia (USM) by Mr. Ng Fong Oon and Dr. Wong Tatt Meng. Attempts to rear larvae through settlement have been unsuccessful so far and total mortality has occurred within a few days. The problems of larval survival will be investigated. The most likely causes of mortality are:

(1) Inadequate nutrition - which will be addressed by trying alternative or additional algal food species such as Pseudoisochrysis.

(2) Unsuitable environmental conditions including water quality, stocking density, culture vessel type, turbulence and presence of harmful organisms (such as ciliate protozoa), all of which will be investigated. Once larval rearing through settlement has been accomplished, a model system (assay) will be set up to investigate settlement behaviour on different soft substrates under different conditions, particularly varying salinity.

b) Studies on cockles, other benthos and mud sampled during field visits

A shipment of cockle shell samples will be sent to the Marine Science Laboratories, Menai Bridge, North Wales, U.K. for preliminary tests on ageing cockes by daily/tidal growth rings. Once a reliable technique has been established, the IPP researchers will apply it to their field samples.

Routines for cockle length and weight measurement, identification of other benthos and particle size frequency analysis of mud samples are all well-established at IPP. Condition (the amount of flesh relative to the shell size) can be used to follow cycles of reproduction in bivalves. Several condition indices (C.I.) have been used by previous workers.

For C.I. measurements in Anadara granosa the following procedure is recommended:

1. Take a random sample of 50 cockles from the site under study.

2. Measure their individual length (to 0.1 mm) and total live weight to 0.1g (or more accurately if an accurate top pan balance is available)

3. Open the cockles one at a time and for each determine the shell cavity volume (S) and the meat volume (M), using small measuring cylinders.

4. Calculate the mean condition index.

$$C.I. = \frac{M}{S}$$ (Baird, 1958)

5. Now determine the meat weight (blotted dry) for 30 individuals and then dry them in an oven at 80°C for 48 hours and reweigh to determine the dry weight of the meat.

6. From this data, two other indices should be calculated.

a) $$C.I. \text{ Commercial} = \frac{\text{Wet meat weight}}{\text{Total live weight}} \times 100$$

b) $$\% \text{ solids} = \frac{\text{Dry meat weight}}{\text{Wet meat weight}} \times 100$$

If there is sufficient time to embark on histological examination of gonad samples, the work should follow the techniques of Broom (1983) and the developmental stages defined by Ting et al (1972).

3. Consultancies

a) Cockle seed consultancy

a) Cockle seed consultancy

A consultant will be hired for about 2 months during the natural spawning/spatfall season. He will assist IPP researchers in developing an induced spawning/larval rearing system for studying the aspects of the early life history of occkles important to seed resource management. He will also make field visits

to natural cockle beds and culture areas and will assess the prospects for recovery of natural areas which used to receive spatfall but are now unproductive. He will also assess the prospects and possible sites for reseeding programs. He will prepare a detailed report containing recommendations on seed resource consrvation and management and on research methods for studying the early life history of cockles and other Malaysian bivalves.

b) Cockle age and growth consultancy

A consultant from the Marine Science Laboratories, Menai Bridge, North Wales will be hired for about 6 weeks to demonstrate bivalve ageing techniques, using shell polishing and etching to reveal daily/tidal growth rings, to IPP researchers. He will make field visits to natural beds and culture areas and will work with the IPP team on project activities related to cockle growth rates. He will prepare a detailed report on cockle age and growth (including method sheets) and an appraisal of the use of size limits as regulations in the cockle industry, with recommendations on these and other options. This consultancy should not take place until all the required equipment for cockle ageing has been purchased for IPP. Otherwise, it can take place at any time of the year.

D. Economics Studies

While there are no economists on the staff of the IPP in Penang, the DOF Management and Licensing Unit has several among its small headquarters staff, including Ch'ng Kim Looi and Edwin Savariraj. Their is unit/supported by two (2) field workers in each State whose primary responsibilities include collection of statistics.

The project's Economics Studies will be conducted by the Management and Licensing Unit. The unit currently collects cockle production data; the additional work planned under this project will expand the cockle data base to include seed production and prices and harvested cockle prices. Production and prices will be

monitored on a continuous basis over a 9-month period beginning September, 1984. In addition, historical prices (covering at least 1979-1984) for seed and havested cockle will be obtained through interviews of cockle farmers using standard recall techniques. This data collection will be closely coordinated with the IPP researchers who will supplement (and provide a useful crosscheck for) this data during their regular visits to their field projct sites. At the end of this 9 month period it should be possible to clarify allegations of seed shortage and also to shed light on why cockle production has been declining since 1980.

In mid-1985, the DOF will consider a possible expansion of this economic analysis to address the broader production economics and industry management and development questions listed in Section II (Objectives). This industry study would require extensive field work and in-depth interviews with a sample of all categories of participants in the industry, including seed collectors, buyers, culturists and labourers, middlemen, (wholesalers, retailers, processors) and exporters. Local, stateand federal officials enforcing cockle regulations would also need to be interviewed. The expanded cockle production and price data base initiated at the beginning of the project would also continue. DOF staff, in collaboration with IPP researchers could also conduct feasibility studies at potential cockle sites, if such sites are identified. The feasibility studies would need to be conducted after the economic data from the industry survey became available.

This expanded scope of work would require additional personnel beyond those DOF staff involved initially. For this reason and due to the sensitive income and earnings data that will be collected during the field work, it is suggested that this industry study be conducted in cooperation with the Faculty of Resource Economics and Agribusiness, University Pertanian Malaysia (UPM). If DOF decides to proceed with the industry study and funds are available to support it, UPM

could be invited to prepare a detailed work plan and budget to meet the objectives of the industry study outlined earlier.

An expanded economic analysis of the industry will require a budgetary allocation from BOBP over the above that included in the project budget (see Section VI). Also, the industry study would likely continue beyond the initial 18 months allocated to the overall project, though of course the early work of the bioogists may warrant continuation beyond 18 months of their work also.

The small costs of the initial DOF production and price data collection by DOF, however, are included in the project budget proposed at this time.

E. Training

During the proposed consultancies, IPP researchers will learn new techniques for induced spawning, larval rearing and cockle ageing and will also benefit greatly from the consultants' suggestions on ecological, laboratory and data interpretation techniques. In addition, the project will provide the following training opportunities:

1. An IPP fisheries officer will visit ICLARM, Manila for three weeks at the conclusion of the current 12-month IPP program studying cockle growth on 6 experimental sites in Penang, Perak and Selangor States. ICLARM will instruct the trainee in data analysis using microcomputer software developed for length frequency analysis of fish populations (ELEFAN) and other methods appropriate to bivalve shellfish. Data from the proposed project will also be examined and suggestions made for improving sampling and data handling at IPP. This training should be timed to coincide with Dr. Daniel Pauly's presence in Manila during 1985. This means August or September 1985 at the earliest.

2. An IPP fisheries officer will visit a research laboratory outside Malaysia for about three weeks to observe work on bivalve induced spawning and larval

rearing. The most likely location is the Prachuap Khirikhan Brackishwater Station of the Department of Fisheries, Thailand.

3. An IPP fisheries officer will attend the one month course, "Economics for Aquaculturists" that is offered each year (May) by the Faculty of Resource Economics and Agribusiness, Universiti Pertanian Malaysia. This course is particularly useful training for aquaculture researchers when they need to conduct project feasibility studies, a strong possibility if cockle industry expansion is to be promoted.

Some flexibility with respect to training opportunities and exact duration will be necessary, but the total training cost is not expected to exceed the US$6,000 allocated in the budget.

F. Reporting

The IPP senior staff member in charge of the project will prepare quarterly reports to BOBP on a prompt and regular basis. Such reports will contain a written summary of progress achieved over the preceeding quarter and annexes containing the data gathered, presented in tables, graphs and histograms as appropriate.

G. Possible Future Work Related to Population Biology

From field and laboratory examination of cockles, the project staff will also consider how best to investigate cockle population genetics in the future. While beyond the scope of the present project, this could have considerable implications for management and development. It is well-recognised that there is some polymorphism with respect to shell type in Malaysian cockles: 'long' as opposed to 'round' cockles. The implications for regulations based on shell length are obvious. The basis for such polymorphisms is not known, nor is it known whether subspecies or races of Anadara granosa exist in the region. Moreover it is clear that aquacultural operations which involve massive stocking or transplantation often

change the genetic characteristics of much of the population, sometimes for the worse. Could it be, for example, that the partial harvesting of the largest and fastest growing cockles and the consequent greater opportunities for the 'runts' which are left on the grounds to spawn may be having such an effect? This is highly speculative but clearly the population genetics of Malaysian and other Southeast Asian stocks are well worth investigation. This would require considerable work on shell characteristics and other comparative anatomy, statistical analysis and electrophoretic studies.

IV. Inputs Required for Project Implementation

A. Personnel

IPP will provide the services of:

- 3 Fisheries Officers (biologists)
- 3 Laboratory Assistants
- 2 Laboratory Attendants
- 1 driver (part-time)

In addition, IPP senior staff will oversee the project. The DOF Management and Licensing Unit will provide the services of:

- 1 economist/statistician (part-time)
- Fisheries Assistants (data collectors)

BOBP project funds will be used to provide:

- 1 Consultant on cockle age, growth and ecology, for about 6 weeks (Professor D.J. Crisp, Marine Science Laboratories, Menai Bridge, Gwynedd, North Wales, U.K. or a senior colleague)
- 1 Consultant on induced spawning, larval rearing, seed supply and culture management (Mr. Charles Angell, Seattle, Washington or alternative)

B. Equipment

IPP will provide extensive aquarium, tank and laboratory facilities; computing facilities for data processing; research vessel services (excluding fuel costs) and most of the basic equipment required for field sampling and measurement.

BOBP project funds will be used to provide:

- One project vehicle (Isuzu 'Trooper' -type)
- One research photomicroscope with phase contrast
- Equipment for grinding and cutting cockle shells for age determination
- Three refractometric field salinometers
- Two refrigeration units for induced spawning cold shock treatment
- A drying oven
- An autoclave

C. Materials

IPP will cover the normal running costs with respect to consumable materials for the laboratories concerned. BOBP project funds will be used to purchase additional glassware, reagents and other consumable items required by the project staff for field and laboratory work. Special provision will be made to cover the costs of field study visits, such as boat rentals and fuel costs and the consumable items and field study expenses incurred by the consultants.

D. Training

BOBP project funds will be used to make use of the following training opportunities:

- One IPP project biologist to spend three weeks at ICLARM headquarters, Manila, Philippines to be trained in cockle length frequency and growth analysis.

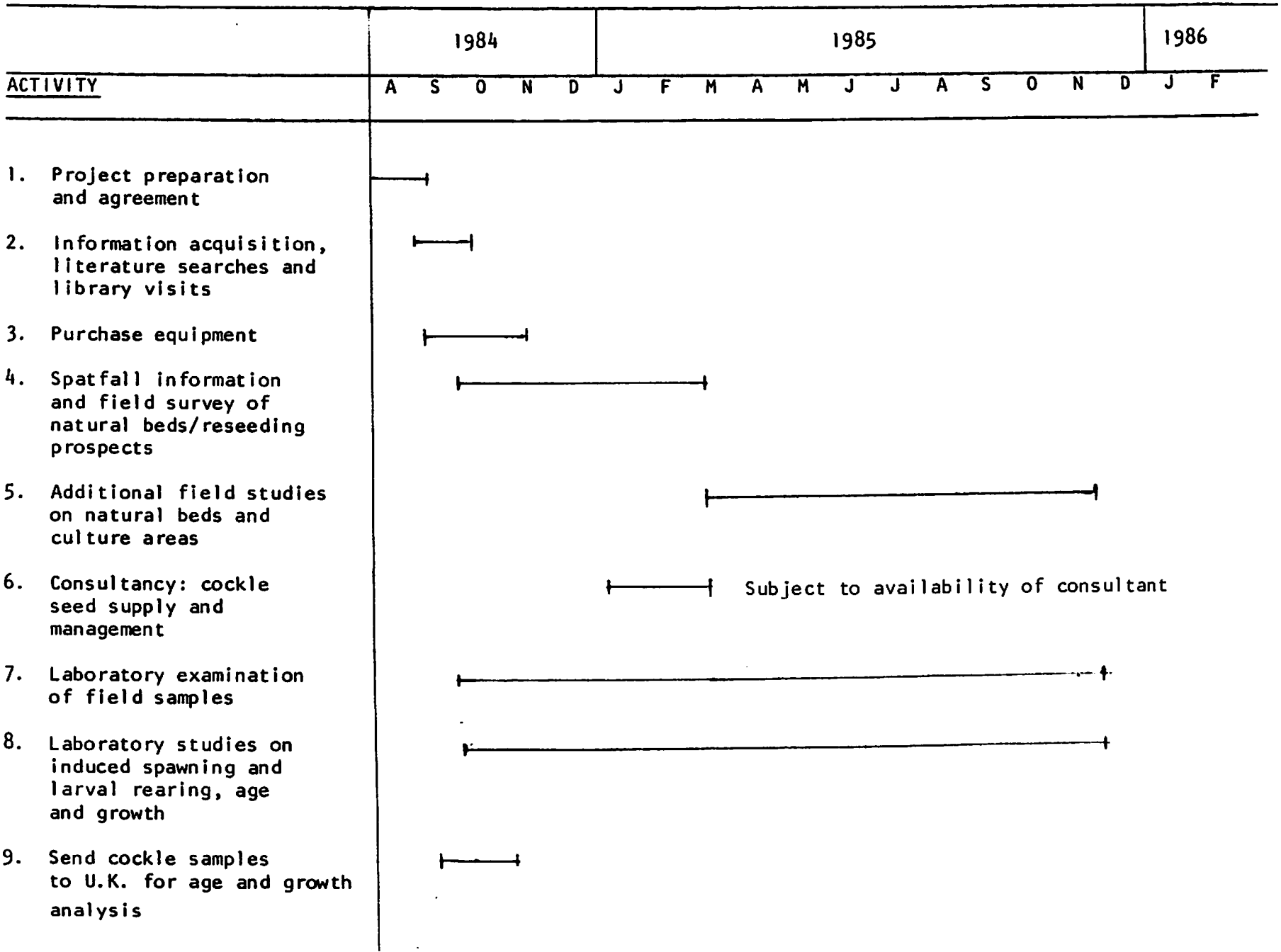
- One IPP project biologist to spend one month at Universiti Pertanian Malaysia, Serdang, Selangor to take a formal course in Economics for Aquaculturists.
- One IPP project biologist to make a study visit to Thailand or an alternative country engaged in research on cockle spawning and larval rearing.

E. Additional items

In addition to the above, BOBP project funds will be used to cover the cost of:

- Acquisition by IPP and the DOF Management and Licensing Unit of information from libraries and other agencies relevant to cockle culture.
- Shipment of cockle samples to the United Kingdom for preliminary work on age analysis (and the cost of technical services).
- Expenses for field studies (travel costs, fuel etc.) to supplement the field studies budget of IPP.

V. TIME FRAME


1984
1985
1986
ACTIVITY
A S O N D J F M A M J J A S O N D J F
1. Project preparation and agreement
2. Information acquisition, literature searches and library visits
3. Purchase equipment
4. Spatfall information and field survey of natural beds/reseeding prospects
5. Additional field studies on natural beds and culture areas
6. Consultancy: cockle seed supply and management
Subject to availability of consultant
7. Laboratory examination of field samples
8. Laboratory studies on induced spawning and larval rearing, age and growth
9. Send cockle samples to U.K. for age and growth analysis

Activity	1984 A	S	O	N	D	1985 J	F	M	A	M	J	J	A	S	O	N	D	1986 J	F
10. Consultancy: cockle age and growth	[To be scheduled with Prof. D.J. Crisp]																		
11. Training																			
. Length frequency Data analysis (ICLARM)						[To be scheduled with Dr. D. Pauly of ICLARM, after July 1985]													
. Economics for aquaculturists (UPM)										⊢—	—⊣								
. Field and Lab visit to Prachuap Khirikhan, Thailand	[To be scheduled with Mr. Songchai Sahawatcharint]																		
12. Final Data Analysis and Report preparation (Biology)															⊢—	—	—	—	—⊣
13. Economics information collection (Phase I)	⊢—	—	—	—	—	—	—	—	—	—	—	—⊣							
14. Project Data assessment workshop												⊢—	—⊣						
15. Industry study (economics) and feasibility studies													⊢—	—	—	—	—	—	→ - - -
16. Quarterly reports to BOBP			⊢—	—⊣			⊢—	—⊣			⊢—	—⊣		⊢—	—⊣			⊢—	—⊣

VI. Proposed Budget (for BOBP Funds)

	U.S.$
A. Field Studies - expenses for visits to natural beds and culture areas, fuel costs, travel costs, boat hire, expendable materials	25,000
Subtotal	25,000
B. Equipment	
Project vehicle (Isuzu 'Trooper' type)	8,000
Phase contrast microscope and photomicropgraphic equipment	12,000
Equipment for polishing/cutting shells for age determination	3,000
Autoclave	2,500
3 refractometric field salinometers (American Optical)	1,700
2 refrigeration units for induced spawning	1,500
Drying oven	1,300
Subtotal	30,000
C. Laboratory Studies	
Working budget for induced spawning, seed cockle rearing and cockle ageing, including the cost of initial cockle shipments to the U.K. for ageing and associated technical services	6,500
Subtotal	6,500

D. Consultancies	
Cockle seed consultancy (Charles Angell or alternative)	17,000
Cockle age and growth consultancy (Prof. D.J. Crisp or alternative)	10,000
Local travel and working budgets for both consultancies	2,000
Subtotal	29,000
E. Economics Studies	
Data collection field expenses	2,000
Subtotal	2,000
F. Training	
Analysis of field data and training in microcomputer techniques for age, growth and population dynamics (One individual for 3 weeks; ICLARM, Manila)	4,000
Study visit, probably to Prachuap, Khirikhan, Thailand to learn induced spawning/larval rearing techniques (one individual)	1,000
Short course training (Economics for Aquaculturists); one month at Universiti Pertanian Malaysia (one individual)	1,000
Subtotal	6,000

G. Information

Acquisition of all relevant published scientific information and visits to other technical libraries	1,500
Subtotal	1,500
GRAND TOTAL	100,000

Footnote

The above budget does not include provision for: (1) In-depth economic studies of the cockle industry; or (2) Reseeding projects, for which further applications for support from BOBP or other donors will be necessary as and when appropriate.

VII. References

Baird, R.H. (1958) - Measurement of condition in mussels and oysters. J. cons. 23: 249-257.

Broom, M.J., 1983. Gonad development and spawning in Anadara granosa (L.) (Bivalvia: Arcidae). Aquaculture, 30: 211-219.

Pathansali, D., 1966. Notes on the biology of the cockle, Anadara granosa L. Proceedings of the Indo-Pacific Fisheries Council 11 (II): 84-98.

Ting, M., Kasahara, S. and N. Nakamura 1972. An ecological study of the so-called Mogai (Anadara subcrenata) (Lischke) cultured in Kasaoka Bay. J. Fish. Anim. Husb. Hiroshima Univ., 11: 91-110 (in Japanese). - Main points are in Broom (1983), see above.

VIII. Acknowledgements

The authors wish to thank the staff of IPP, Penang for their kindness in making this assignment so interesting and enjoyable. In particular we wish to thank the IPP Aquaculture Section Head, Mr. Ong Kah Sin for his help and hospitality and Mr. Ng Fong Oon for accompanying us on field trips and coping with the tremendous task of translating our many questions to cockle culturists and for providing us with all the information we requested.

IX. Appendices

1. Fisheries (Cockles Conservation and Culture) Regulations, 1964: L.N. 428 of 1964 and Amendment of 1982.

2. Peraturan Mengenai Kerang, Cockle Anadara granosa L.

FISHERIES (COCKLES CONSERVATION AND CULTURE) REGULATIONS, 1964

(L.N. 428 of 1964)

IN exercise of the powers conferred by section 2 of the Fisheries Act, 1963, the Yang di-Pertuan Agong hereby makes the following regulations: 8/63.

1. These regulations may be cited as the Fisheries (Cockles Conservation and Culture) Regulations, 1964, and shall have application only with respect to maritime or estuarine waters. Citation and application

2. In these Regulations unless the context otherwise requires -

"cockles" means edible bi-valves of the type known as Kerang, Anadara granosa;

"cultured cockle bed" means an area where cockles have been transplanted and allowed to grow under culture;

"fishery officer" means a Maritime Fishery Officer and includes any Deputy Maritime Fishery Officer authorized in writing by the Director of Fisheries to issue licences under these Regulations;

"natural cockle bed" means an area where cockle spatfalls occur;

"registered buyer" means a person registered under these Regulations as a buyer of cockles.

PART I

LICENCE TO TAKE COCKLES

3. (1) No person shall take any cockles from a natural or cultured cockle bed except in accordance with a licence granted under this regulation. Licence for taking of cockles.

(2) Any person wishing to take cockles from a natural or cultured cockle bed may make a written application for a licence to a fishery officer who may in his discretion grant subject to such conditions as he may impose, such licence, or reject the application; and every application shall contain such particulars as the fishery officer may require.

(3) A licence granted under this regulation shall -

(a) in respect of the taking of cockles from a natural bed be valid only for the period or periods provided in regulation 5; and

(b) in respect of the taking of cockles from a cultured bed be valid until the 31st day of December of the year in which it is issued.

(4) A fee of one dollar shall be payable in respect of a licence aforesaid.

4. A person licenced under regulation 3 to take cockles from a natural cockle bed shall not sell any cockles so taken to any person other than a registered buyer. — Sale of cockles taken from a natural bed.

5. (1) No person shall take (whether for the purpose of transplanting to a cultured cockle bed or for consumption) any cockles from any natural cockle bed except during the periods and for the purpose prescribed by a fishery officer by notice to be displayed at public places or at such places as he deems fit. — Taking of cockles from natural cockle beds.

(2) The public notice aforesaid may prescribe different periods and different purposes for which cockles may be taken.

6. (1) No cockle which is less than ¾ inch, measured in a straight line across the widest part of the shell, shall be taken for the purpose of transplanting to a cultured cickled bed. — Sizes of cockles to be taken.

(2) No cockle which is less than 1½ inches, measured in a straight line across the widest part of the shell, shall be taken for consumption.

7. The period of the day during which cockles may be taken from a natural cockle bed shall be between six o'clock in the morning and six o'clock in the evening. — Period during the day for taking cockles.

8. Save with the permission of a fishery officer, no person shall use any mechanical apparatus to take cockles from any cockle bed (whether natural or cultured). — Prohibition of the use of mechanical apparatus.

PART II

LICENCES FOR BUYING COCKLES

9. No person other than a registered buyer shall buy any cockles directly from any person taking such cockles from any natural cockle bed. — No person other than a register buyer may buy cockles.

10. (1) Any person may apply in writing to the Director General of Fisheries to be registered as a buyer of cockles and the Director may subject to such conditions as he may impose so register such person and issue him with a licence in that behalf, or reject the application; and every application shall contain such particulars as the Director may require. — Registration as a buyer.

(2) A registration and licence under this regulation shall unless sooner cancelled be valid for a year (ending on the 31st day of December) and may be renewed on an application in writing in that behalf being made to the Director General.

(3) A fee of two dollars shall be payable in respect of a registration and licence aforesaid.

(4) Nothing in this regulation provided shall be taken to authorize a registered buyer to buy cockles which he has reason to believe have been taken from a natural cockle bed in contravention of the provisions of these Regulations.

PART III

GENERAL

11. A licence issued or a registration made under these Regulations shall be liable to cancellation upon there being committed in respect of such licence or registration a breach of any of the conditions imposed thereon or upon the person licensed or registered contravening any of the provisions of these Regulations. Breach of condition and of the provisions of these Regulations.

12. So much of the written laws (as amended from time to time) specified in the Schedule hereto as shall relate to cockles are revoked. Revocation.

SCHEDULE

Reference	Title
F.M.S. Government Gazette Notification No. 5616 of 1938	Fisheries Rules, 1938
F.M.S Government Gazette Notification No. 300 of 1939	Fisheries Rules, 1938
S.S. Government Gazette Notification	The Fisheries Ordinance, 1924 Rules
Federation of Malaysia Government Gazette, Legislative Supplement (Subsidiary Legislation), Johore, L.N. 51 of 1952	Fishing Rules, 1952
Malayan Union Gazette Notification No. 8381 of 1947	Fisheries (Trengganu) Rules
Kedah Government Gazette Notification No. 711 of 1931	Enactment No. 40 (Fisheries) Rules for Fishing under Section 6

Made this 24th day of November, 1964.

[M.A. 1318/47; A.G.250/54-208.]

By Command,

MOHD. KHIR JOHARI,
Minister of Agriculture
and Co-operatives

Pindaan bagi peraturan 11.

6. Peraturan 11 Peraturan-Peraturan ibu adalah dipinda dengan memotong perkataan-perkataan –

(*a*) "or a registration made" dalam baris pertama;

(*b*) "or registration" dalam baris ketiga; dan

(*c*) "or registered" dalam baris keempat.

Diperbuat pada 24hb November 1982.
[KP. Sulit O. 899; PN. (PU²) 160 Pt. III.]

DATO' ABDUL MANAN BIN OTHMAN,
Menteri Pertanian

FISHERIES ACT 1963

FISHERIES (COCKLES CONSERVATION AND CULTURE) (AMENDMENT) REGULATIONS 1982

Act 210.

IN exercise of the powers conferred by section 21 of the Fisheries Act 1963, the Minister makes the following regulations:

Citation.

1. These regulations may be cited as the **Fisheries (Cockles Conservation and Culture) (Amendment) Regulations 1982.**

Deletion of regulation 4 *L.N. 438/64.*

2. The Fisheries (Cockles Conservation and Culture) Regulations 1964, which in these Regulations are referred to as the "principal Regulations", are amended by deleting regulation 4.

Amendment of regulation 6.

3. Regulation 6 of the principal Regulations is amended—

(*a*) by substituting for the words "¼ inches" in paragraph (1) the words "6.4 millimetres";

(*b*) by substituting for the words "1¼ inches" and "consumption." in paragraph (2) the words "31.8 millimetres" and "consumption or sale." respectively; and

(*c*) by adding after paragraph (2) the following new paragraph:

"(3) Any person found in possession of cockles which are less than 31.8 millimetres, measured in a straight line across the widest part of the shell shall, unless he proves otherwise, be deemed to have taken them for a purpose prohibited by this regulation.".

Amendment of regulation 8.

4. Regulation 8 of the principal Regulations is amended by substituting for the words "save with the permission of the Fishery Officer, no" with the word "No".

Deletion of Part II

5. The principal Regulations are amended by deleting Part II.

Amendment of regulation 11.

6. Regulation 11 of the principal Regulations is amended by deleting the words–

(*a*) "or a registration made" in the first line;

(*b*) "or registration" in the third line; and

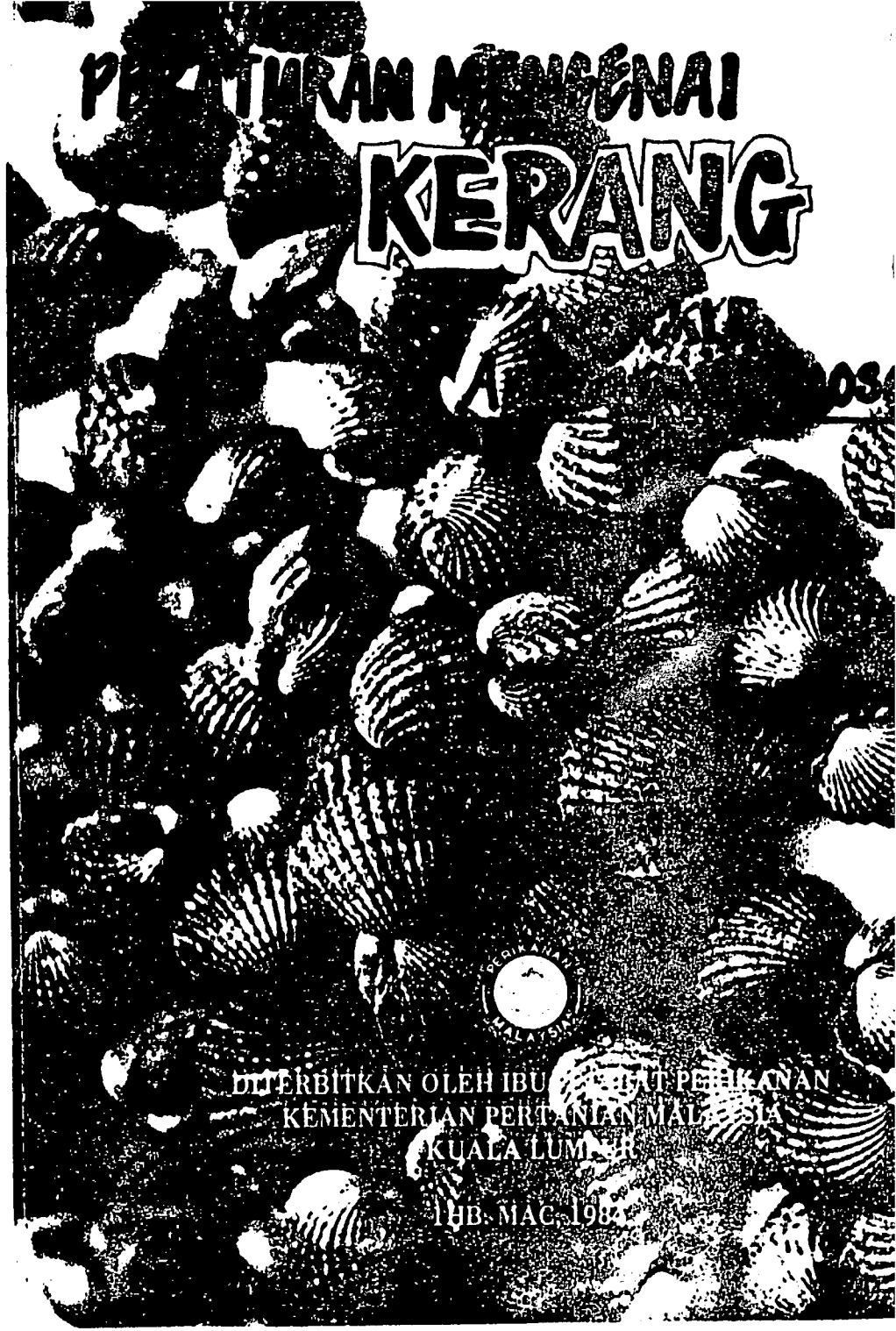
(*c*) "or registered" in the fourth line.

Made the 24th November 1982.
[KP. Sulit O. 899; PN. (PU²) 160 Pt. III.]

DATO' ABDUL MANAN BIN OTHMAN,
Minister of Agriculture

Jika ada apa-apa pertanyaan atau aduan, sila hubungi dengan mana-mana Pejabat Perikanan Negeri/Daerah berhampiran atau Ibu Pejabat Perikanan, Kuala Lumpur.

Nama Pejabat	Nombor Telefon
Pejabat Perikanan Negeri, Kedah/Perlis	04-725573
Pejabat Perikanan Negeri Pulau Pinang	04-371957
Pejabat Perikanan Negeri Perak	05-550944/542148
Pejabat Perikanan Negeri Selangor	03-387412
Pejabat Perikanan Negeri Sembilan/Melaka	06-223885
Pejabat Perikanan Negeri Johor	07-244079
Pejabat Perikanan Negeri Pahang	095-521308
Pejabat Perikanan Negeri Terengganu	096-623246/623497
Pejabat Perikanan Negeri Kelantan	097-782851
Ibu Pejabat Perikanan, Kuala Lumpur	03-982011 atau 982920



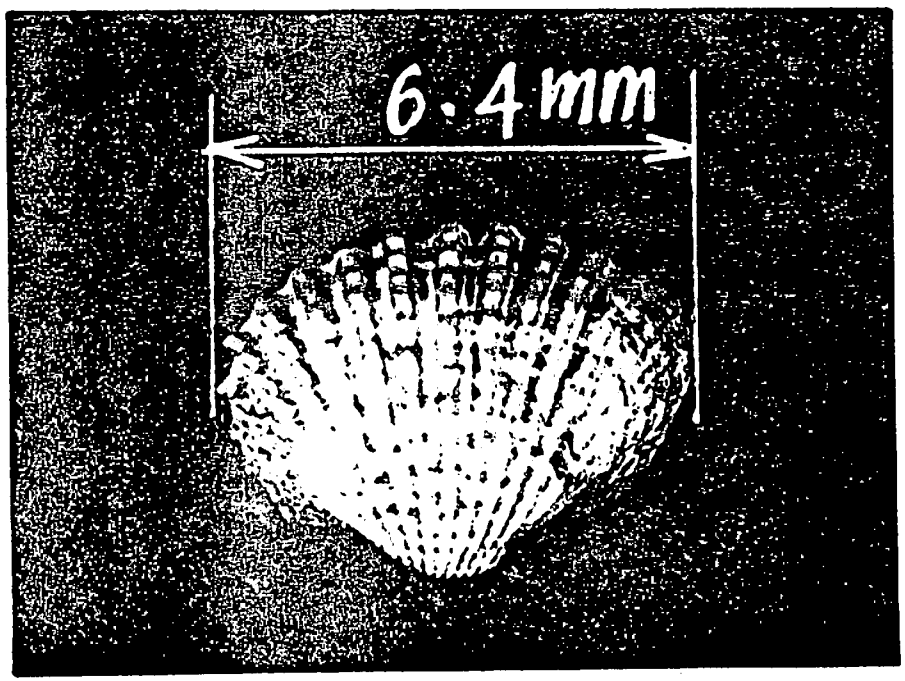
LARANGAN MEMILIKI BENIH KERANG KURANG DARIPADA 6.4 MM (1/4 INCI)

Orang ramai adalah diberitahu bahawa sesiapa yang memiliki benih kerang kurang daripada 6.4 mm (1/4 inci) adalah salah dari segi undang-undang di bawah Akta Perikanan 1963.

Denda tidak lebih dari $1,000 atau dipenjara tidak lebih dari setahun atau kedua-duanya sekali boleh dikenakan kepada sesiapa yang melanggar peraturan ini.

Peraturan ini dibuat kerana benih kerang yang kurang dari 6.4 mm (1/4 inci) jika dipungut dan dipindahkan untuk ternakan akan menyebabkan kadar kematian yang tinggi.

Oleh itu orang ramai diminta supaya jangan memiliki benih kerang kurang dari 6.4 mm (1/4 inci). Jabatan Perikanan akan mengambil tindakan terhadap sesiapa yang melanggar peraturan ini.



Cara mengukur benih kerang
Cockle (*Anadara granosa* L)

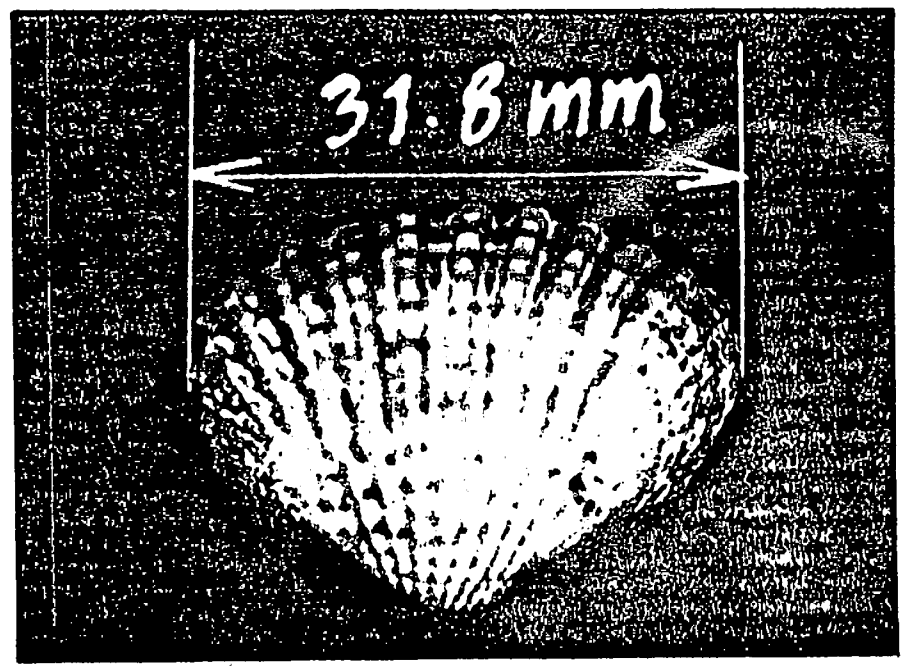
LARANGAN MEMILIKI KERANG DEWASA KURANG DARIPADA 31.8 MM (1¼ INCI)

Orang ramai adalah diberitahu bahawa sesiapa yang memiliki kerang dewasa kurang dari 31.8 mm (1¼ inci) dan tidak dapat membuktikan dengan memuaskannya untuk tujuan ternakan adalah salah dari segi undang-undang di bawah Akta Perikanan 1963.

Denda tidak lebih dari $1,000 atau dipenjara tidak lebih dari setahun atau kedua-duanya sekali boleh dikenakan kepada sesiapa yang melanggar peraturan ini.

Peraturan ini dibuat kerana kerang kurang dari 31.8 mm (1¼ inci) belum mencapai peringkat kematangan untuk membiak.

Oleh itu orang ramai diminta supaya jangan memiliki kerang-kerang tersebut. Jabatan Perikanan akan mengambil tindakan terhadap sesiapa yang melanggar peraturan ini.



Cara mengukur kerang dewasa
Cockle (*Anadara granosa* L)