PHUKET MARINE BIOLOGICAL CENTER

BY URUPUN BOONPRAKOB*

Phuket Marine Biological Center

HISTORY

Phuket Marine Biological Center (P.M.B.C.), Department of Fisheries, Ministry of Agriculture and Cooperative was established as the result of 5th Thai-Danish expedition operation along the west coast of Thailand from January to March 1966, on board of Royal Thai Research vessel No 2, Department of Fisheries. The Thai group was lead by Commander Sawang Charernpol R.T.N., Dr. Arporn Sribhribadh, Coordinator, and fifteen marine scientists from the Department of Fisheries and Chulalongkorn University. The Danish team was comprised of Dr. Gunnar Seidenfuden, former Danish Ambassador to Thailand, and three Danish Scientists, Prof. Dr. Gunnar A.W. Thorson, Mr. Bent J. Muus, Mr. Kurt W. Ockelmann.

During the expedition, the Thai and Danish scientists agreed that an institute for conducting research in marine biology should be established on the west coast of Thailand. Such establishment would (indirectly) tighten relationships between scientists from both countries. The expedition team submitted the plan to M.R. Chakratong Tongyai, Under Secretary of Agriculture and Cooperatives and Mr. Prida Karnasut, the Director-General of the Department of Fisheries during their field visit to Phuket. They both agreed in principle to the plan.

In April, 1967, the Danish Government arranged informal discussions in Copenhagen. The discussion was attended by Under Secretary of Ministry of Agriculture and Cooperatives, the Director-General of the Department of Fisheries and

Fig. 1. Danish and Thai scientists working together on board the Research Vessel No. 2 in 1966.

* Director of Phuket Marine Biological Center.
a representative of the Danish Government. The technical details were drafted. The drafts of the bilateral agreement were eventually submitted to both Thai and Danish Governments. On October 16, 1968, the Agreement between the Thai Government and the Danish Government was signed at the Ministry of Agriculture and Cooperatives by Pra Prakart Sahakorn, Minister of Agriculture and Cooperatives, and H.E.A. Wulff Konigsfeldt, Ambassador of Denmark to Thailand. The Agreement was to be in effect for a period of 5 years.

After the first Agreement ended in October 16, 1973, a second Agreement was signed for another 4-year period which ended in October 17, 1977. A third Agreement was discussed and finally signed, and the contract was continued for another period of 4 years.

Before the first agreement was signed, the survey of a provincially suitable site for the research center had been carried out. The area along the southeast of Phuket Island at Lam Pan Wa, Mung District, Phuket Province was chosen. The construction plan of the Center was approved by Thai Cabinet on the first of October 1968. A committee headed by Mr. Aoun Surakul, Governor of Phuket Province was set up to purchase the land of approximately 20.8 Acres in September 1969.

For the construction works, the Ministry of Agriculture and Cooperatives set up a working committee headed by the Director General of the Department of Fisheries to manage and deal directly with the Danish Project Leader, Mr. Vagn Hansen. Danish Government also assigned Mr. Knut Black as a project engineer to advise some of the construction works and installation of equipment. Finally, the Center was officially declared operational in April 1971 and Mr. Boonlert Phasuk was assigned to be the Thai Director of the Center and Mr. Vagn Hansen as the Director of the Danish Project until September 26, 1975 which is the second phase of the second Agreement.

Fig. 2. The pier at PMBC.
Since then, all the administration has been under the Thai supervision and Mr. Soren Wiium-Anderson became the Danish Advisor for the second period of the Agreement up to October 1977. From the first of February, 1977 up to the present time, Mr. Urupun Boonparakob has been Director of the center. On December 1, 1979, Mr. Jorgen Hylleberg was assigned to be the Danish advisor for the period of the Third Agreement. In order to supervise the activities of the Center, a Commission Board of Phuket Marine Biological Center was set up on October 22, 1970. The members of the Board were:

1. The Minister of Agriculture and Cooperatives, (M.R.C. Chakratong Tongyai) ... Chairman.
2. Danish Ambassador to Thailand (H.E.A. Wulff Konigsfeldt).
3. Director General of the Department of Fisheries.
4. H.E. Dr. Gunnar Seidenfaden (Former Danish Ambassador to Thailand).
5. Representatives from Kasetsart University, in alternate term with Chulalongkorn University for a period of 2 years.

The Board's responsibility was to formulate the Center's policy and to solve problems that might arise during the Center's operation. The Board should have a meeting at least once a year. For the meeting both Thai and Danish Leaders prepared an annual report to submit to the Board.

The role of the Commission terminated on October 17, 1975 and was replaced by an Advisory Board. The members of the Advisory Board were:

1. Under Secretary of the Ministry of Agriculture and Cooperatives (Mr. Preda Karnasut) ... Chairman.
2. Prof. M.R. Chakratong Tongyai ... Advisor.
3. Ambassador of Denmark to Thailand (H.E. Mr. Frantz B. Howitz).
4. Director-General of the Department of Fisheries (Mr. Chertchai Amatyakul).
5. Prof. Dr. Bent J. Muss.
6. Representatives from Kasetsart University, in alternate term with Chulalongkorn University for a period of 2 years.

The Advisory Board was authorized to advise on various activities of the Center as follow:

1. Training and education of students and scientists in the field of marine biology.
2. Research and investigation in the field of marine science, especially fishery biology along the west coast of Thailand.
3. Solving any problems that may arise during the previous year and providing useful advise for the function of the Center.

The Chairman of the Advisory Board was changed from Under Secretary to Deputy Minister of Agriculture and Cooperatives during the period of the Third Agreement (September 21, 1979 to October 1983). A Steering Committee was established by Advisory Board in order to administer the joint projects between the two Governments, e.g. requesting short term consultants, approval of scientific equipment needed by the Center, arranging courses for students from various universities, and also providing funds for these students.

OBJECTIVES OF THE FUNCTION OF THE CENTER

1) To promote training and education of students and scientists both Thais and foreigners in the field of Marine Biology.
2) To carry out research and investigation in the field of marine science including fishery biology of the coastal waters of Thailand to such an extent that the knowledge will be useful in the development and conservation of living resources in these waters for the benefit of future generations.

ASSISTANCE FROM THE DANISH GOVERNMENT

ASSISTANCE DURING 1968-1977

First agreement (5 years)  9,000,000 Baht (450,000 US. Dollar)
Second agreement (1974-1977)  5,700,000 Baht (285,000 US. Dollar)

Of the assistance money, 73% were used for salary and allowance for Danish scientists and the rest were for equipments, vehicles, library and student’s allowance. The details of the assistance from the Danish Government were:

1) Sending scientists to work at P.M.B.C.

1.1 Chief advisor. (4-5 years). The responsibility of the chief advisor was to effect coordina-

tion between the Director of the Center and the Danish Government according to the Agreement. He also assisted foreign scientists in conducting research and carried out his own research project.

1.2 Advisors (2-4 years). Most of them were Danish scientists with certain experience in marine research.

1.3 Short term consultants (2-4 months). Scientists experienced in particular subjects in the field of marine science rendered assistance to young Thai scientists in some special projects.

1.4 Volunteers (2 years). Young scientists volunteered to work at P.M.B.C. and carried out their own research project.

The results of foreign scientists research were published in P.M.B.C. Research Bulletin or various international journals.

2) Scholarships

During the past nine years, the Danish Government offered scholarships for Thai scientists of P.M.B.C. to study or train abroad in order to gain more experience and knowledge.

Fig. 3. The R/V Pramong 8 (35.5 ton), the PMBC sea-going vessel.
2.1 Seven M.Sc. scholarships to United Kingdom. Four of them received their M.S. degrees and returned to Thailand, other three continued for Ph.D. degrees from their own support, two of these have already returned to work while the last person is expected to be back in 1982.

2.2 Five one-year training scholarships

2.3 Two three-month short-term scholarships

3) Equipment

The Danish Government assisted the Center in purchasing necessary equipment and accessories for some research projects, including scientific equipment and survey vehicles.

4) Library

A library is one of the most important factors needed for conducting research and investigation. During the beginning of the first period, the Danish Government sent a Danish Librarian to set up a library and provided budget for acquiring text books, reprints, and periodicals. At present the library has established an exchange programme with various international institutes. It can be said that the P.M.B.C. library is one of the most advance libraries in the field of marine science in this region.

5) Short term courses for students from various universities

Since 1972, the Center arranged short term courses (see appendix 3) for university students during summer. The lectures were given by Danish and Thai scientists. Danish Government also provided allowance for the students.

ASSISTANCE BETWEEN 1979-1983

Assistance during October 1979-1983 is scaled down compared to the first and second agreements. Assistance included in this agreement is:-

1. Advisor

As a member of P.M.B.C. Steering Committee, the responsibility of the advisor is to coordinate
and to make decision on projects which will receive assistance from the Danish Government. In addition to providing assistance to Thai scientists on some projects, he has his own research project as well.

2. Funding of equipment

The Danish Government will provide the amount of 420,000 Kroner. (1,583,400 Baht) to obtain necessary equipment by the approval of the Steering Committee.

ORGANIZATION OF P.M.B.C.

During the first period the Center was organized into:-

1. Administration
2. Training and Education
3. Primary productivity
4. Plankton study
5. Benthic study
6. Study of life history of some economic important invertebrates
7. Analyses of sea water properties

In 1977 the Center was reorganized into 7 units which were:-

1. Administration Unit
2. Taxonomy Unit
3. Marine Pollution Unit
4. Marine Environmental Unit
5. Coastal Ecology Unit
6. Off-shore Ecology Unit
7. Life History and Behaviour Unit

Each unit is divided into 3-4 sub-unit (see chart).

In 1979, the Center received budget from the Thai Government to build a public aquarium. The public aquarium is expected to be opened in 1982. The unit of study of life history and behaviour of marine organisms will then be united with the public aquarium unit.

MANPOWER

During the first period of its establishment (1968), the Center had a personnel of only 31 persons, among these only 3 were scientists. The lack of staff made it necessary to request foreign scientists to undertake various research projects. Up to

Fig. 5. Technician in chemistry laboratory.
the present time number of staff has increased to 100 (Appendix 1), among these, 20 are scientists. However, more than half of the scientists are young scientists which have just graduated from universities. This makes it necessary to request for shortterm consultants to train them in various fields.

**BUDGET**

During 1977 to 1981, the Center received budget through the National Thai Budget Bureau and various institutes, ranging from 4 to 12 millions Baht annually (see Appendix 2).

**SCOPE OF THE FUNCTION OF THE CENTER**

The operation of the Center, according to the objectives, also has included the following work

1) **Promote training, education, and seminars**

1.1 Training students from technical colleges, universities and officers from other government sectors.

1.2 Teaching undergraduate students from various universities (see Appendix 3) in:-

1.2.1 Marine Ecology
1.2.2 Marine Biology
1.2.3 Marine Invertebrates
1.2.4 Invertebrate Ecology
1.2.5 Invertebrate Zoology

Due to extension of scope of work, the P.M.B.C. staff have to spend more time on research projects. From 1981 the Center will arrange an undergraduate course only once a year in Marine Ecology eventually repeated during intersemester periods on request. However, the Center will continue to offer facilities to any university to conduct its own course at Phuket. The Center will also provide some scientists presuming that assistance will not interfere with research in progress.

1.3 Providing facilities e.g. laboratory, library, equipment, accommodation and advise to scientists, lecturers, university students, both Thais and foreigners to carry out research project at P.M. B.C.

1.4 Arranging seminar in the field of marine science at P.M.B.C.

**2) Research and Investigations**

The west coast of Thailand (740 Km.) from Ranong to Satun Provinces is under the responsibility of the Center. The area is rich in marine resources and composed of different kinds of habitats e.g. sandy beach, muddy beach, rocky shore, mangroves, and coral reefs, making the Center an ideal site for conducting research and investigation in the field of Marine Science and Fishery. It is also rich in mineral resources (tin) especially along the west coast of Phuket and Pangha Provinces.

Apart from the work mentioned in the organization chart of the Center. The Center serves the need of the Department of Fisheries and also recognizes local problems as part of its research projects. Up to the present time research projects have been concentrated in the areas around Phuket Island. Some projects are also conducted along the entire west coast of Thailand e.g. the survey of tarballs, taxonomy of marine animals (fish, molluscs, spiny lobsters and corals). However, much more research and investigations on various topics including some useful informations related to marine fisheries are still waiting to be done.

**3) Public Aquarium**

The Department of Fisheries recognized the lack of an institution to transfer knowledge on marine organisms, fishery, conservation of marine resources and environment to the public. Hence the establishment of the Public Aquarium at P.M.B.C. has the aims of:-

3.1 Display life in the sea, research and investigation into the best method in keeping such animals for the longest period possible in aquaria and also curing such animals from parasites and diseases.
3.2 Submit knowledge on conservation, marine environment, fisheries, and life history of marine organisms to the public.

3.3 Invariably the aquarium will also be an attraction for promoting Phuket as a tourist center.

4) Cooperation with other sectors and international institutes.

The policy of the Center is also to increase cooperation with other sectors and international institutes by carrying out research and give advice on marine biology and environment or any subject related to the field of interest of the Department of Fisheries.

SUMMARIES OF THE FUNCTIONS OF P.M.B.C.

1) Promote training, education and seminars

1.1 Supplementary training.

Since 1978 the Center has offered training courses to 6 students a time from Prince of Songkla University, Srinakarindara Viroj University, (Bangsane), Silpakorn University and Chumporn Agriculture Technical College in taxonomy, rearing some special marine organisms, and impact of environment upon marine organisms. It is also the policy of the universities to encourage students to take interest in the existing problems.

1.2 Lectures.

Since 1969 the Center has arranged courses for undergraduate students and also the course for teaching colleges. From the beginning up to 1980, the Center has arranged study courses 13 times (Appendix 3), 1-2 times a year during the end of the semester.

1.3 Supported 187 researchers and investigators both Thais and foreigners.

1.4 Seminars

1.4.1 Cooperating with FAO and DANIDA in arranging a workshop on “Fish Taxono-
my in South East Asia", November 6-December 8, 1972.

1.4.2 Cooperating with AIT in arranging a seminar on "Marine Pollution" October 1974.

1.4.3 Cooperating with National Research Council of Thailand in arranging a workshop on "Mangrove and Ecology" 10-15 January 1976.

2) The results of research and investigations

During the first period, the Center lacked personnel and many of them were on leave to study abroad. This is the reason why most research was conducted by foreign scientists. Forty-three publications were published in the P.M.B.C. Research Bulletin and various international periodicals (Appendix 4), 27 of these were published in P.M.B.C. Research Bulletin. The Center exchanged publications with 177 internal and international institutes.

3) Phuket Aquarium Project

Most of the main construction works has already been finished, but much more still need to be done such as installation of glass windows of the main tank (150 m³), pumps, ozonizer, and construction of parking area and break-water. All the works are expected to finish in 1982 if there is no problem about the budget.

At present, about 20,000 visitors visit the Center annually to see marine life in the laboratory aquarium. The number of the visitors is expected to increase in future.

4) Cooperation with other sectors and international institutes.

The Center receives some funds from various institutes to conduct research projects. These institutions are:-

1. Thai National Research Council supports research project on distribution of tarballs along the west coast of Thailand.

2. National Environmental Board supports studies on inventory of living resources along the west coast of Phuket, and on the possible effects of offshore tin mining on such resources.

Fig. 7. Diving equipment, indispensable tool in underwater study.
3. UNESCO supports the study on effects of dissolved organic matter derived from decomposition of mangrove leaves.

PROBLEMS

1. Scientists

Some scientists have been assigned to conduct research in the fields where they have not much experience. In Thailand, governmental scientists must pass an examination from the central government which specifies only broad qualification. Some young scientist do not graduate in marine science or fisheries. However, if such scientists are interested in the subject, they can always learn and acquire expertise. In case where a senior scientist changes work to a new field, the efficiency of the work will be temporarily reduced or it will take longer time to finish the project.

2. Budget

Although the numbers of P.M.B.C. scientists have been increased up to 70%, the budget for the Center is still more or less the same. The difficulty in expanding any research projects is pronounced, considering the rate of inflation.

3. Equipments

Due to the assistance from the Danish Government, the Center has quite good equipment but the problems still occur for various reasons.

3.1 Damage occurs faster than under normal circumstances due to high humidity and corrosive effect of salt spray.

3.2 High cost of repairing and maintenance and difficulty in obtaining spare parts. Equipment purchased in beginning was made in Denmark or other European countries and not sold in Thailand. This created problems in repairing and maintenance of the equipment.

4. Accommodation

At the moment, there is not enough accommodation for staff of the Center due to the increasing number of staff. The Center has only one guest
house, enough to accommodate only 2 visiting scientists.

5. Freshwater supply

The Center is situated 11 Km. from Phuket town outside municipality area. The only way to get water supply is through its own reservoir, containing rain water which is inadequate for the whole year supply. There is lack of underground water around the Center so we have spent considerable amount of money for freshwater and sometimes we can not obtain it in time.

CHALLENGES TO BE MET IN THE FUTURE

P.M.B.C. is a fairly new institution situated on the west coast of Thailand. This area is rich in marine resources, 174,425 ton/year of fish landing worth 33 million U.S. dollars were recorded (Fisheries statistic 1977). This figure also includes fish caught in international waters. When neighboring countries extend their economic zones to 200 miles limit, Thai fishing grounds will eventually be reduced. This makes it urgent to promote coastal fisheries and aquaculture. The important information related to these fields are needed for wise utilisation, proper management and conservation of our coastal resources. The results of research and investigation by P.M.B.C. personnel will benefit Thailand in gaining more knowledge in these fields.

APPENDIX 1

MANPOWER OF THE PHUKET MARINE BIOLOGICAL CENTER (P.M.B.C.)

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>1. Civil servant</td>
<td></td>
</tr>
<tr>
<td>Scientist</td>
<td>3</td>
</tr>
<tr>
<td>Librarian</td>
<td>-</td>
</tr>
<tr>
<td>Assistance librarian</td>
<td>-</td>
</tr>
<tr>
<td>Technician</td>
<td>1</td>
</tr>
<tr>
<td>Secretariat</td>
<td>1</td>
</tr>
<tr>
<td>Accountant</td>
<td>-</td>
</tr>
<tr>
<td>Artist</td>
<td>-</td>
</tr>
<tr>
<td>Mechanic</td>
<td>-</td>
</tr>
<tr>
<td>Electrician</td>
<td>-</td>
</tr>
<tr>
<td>Total number of civil servants</td>
<td>4</td>
</tr>
<tr>
<td>2. Permanent employee</td>
<td>23</td>
</tr>
<tr>
<td>3. Temporary employee</td>
<td>4</td>
</tr>
<tr>
<td>Total number of staff</td>
<td>31</td>
</tr>
</tbody>
</table>

N.B.1. Number (+) = number of new staff which was approved by Civil Service Board, but still waiting for the budget approval from the National Thai Budget Bureau

2. Number in ( ) = Total number of the staff which also includes the new staff that waiting for the new budget.
APPENDIX 2

BUDGET OF THE PHUKET MARINE BIOLOGICAL CENTER FROM 1977-1981, INCLUDING THE FUNDS RECEIVED FROM OTHER INSTITUTES.

<table>
<thead>
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<tbody>
<tr>
<td>1. Department of Fisheries</td>
<td>4,153,000</td>
<td>12,228,400</td>
<td>7,856,800</td>
<td>8,009,000</td>
<td>8,954,400</td>
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<tr>
<td>2. National Thai Research Council</td>
<td>-</td>
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<td>113,900</td>
<td>109,100</td>
<td>173,100</td>
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<td>3. National Environmental Board</td>
<td>-</td>
<td>-</td>
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<td>216,170</td>
<td>144,650</td>
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<td>4. Department of Technical and Economical Coopera-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>68,000</td>
<td>81,600</td>
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<tr>
<td>5. Danish International Development Agency</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>388,500</td>
<td>388,500</td>
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</tbody>
</table>

Total (Baht)                                    | 4,153,000 | 12,228,400 | 7,790,700 | 8,791,670 | 9,742,250 |

APPENDIX 3

STUDY COURSES AND TRAINING AT P.M.B.C.

<table>
<thead>
<tr>
<th>Period</th>
<th>Subject</th>
<th>Institute</th>
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<tr>
<td>4 April-15 May 1972</td>
<td>Marine Ecology</td>
<td>Chulalongkorn University</td>
</tr>
<tr>
<td>9 April-19 May 1973</td>
<td>Marine Biology</td>
<td>Chulalongkorn University</td>
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<td>1 April-10 May 1974</td>
<td>Marine Invertebrates</td>
<td>Chulalongkorn University</td>
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<td>20 Oct. - 7 Sep. 1975</td>
<td>Invertebrate Zoology</td>
<td>Mahidol University</td>
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<td>17 - 27 March 1976</td>
<td>Invertebrate Ecology</td>
<td>Chiangmai University</td>
</tr>
<tr>
<td>13 - 30 October 1976</td>
<td>Invertebrate Zoology</td>
<td>Mahidol University</td>
</tr>
<tr>
<td>21 March - 8 April 1977</td>
<td>Invertebrate Zoology</td>
<td>Chulalongkorn University</td>
</tr>
<tr>
<td>27 June - 1 July 1977</td>
<td>Marine Pollution</td>
<td>Asian Institute of Technology</td>
</tr>
<tr>
<td>14 - 28 October 1977</td>
<td>Invertebrate Zoology</td>
<td>Mahidol University</td>
</tr>
<tr>
<td>27 Nov. - 1 Dec. 1978</td>
<td>Marine Environment and Marine Biology</td>
<td>Teacher College</td>
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<tr>
<td>7 - 16 Jan. 1980</td>
<td>SCUBA Diving</td>
<td>Scientists from Department of Fisheries</td>
</tr>
<tr>
<td>21 April-10 May 1980</td>
<td>Marine Invertebrates</td>
<td>Chulalongkorn and Songkla Universities</td>
</tr>
<tr>
<td>20 Oct.-4 Nov. 1980</td>
<td>Marine Biology</td>
<td>Chiangmai University</td>
</tr>
</tbody>
</table>
APPENDIX 4 (I)

P.M.B.C. RESEARCH BULLETIN


1 Phasuk, B. and Rongmuangsart, S.

2 Rongmuangsart, S. and Luvisa, O.
   1973 Studies on the biology and population dynamics of the spiny lobster, Panulirus polyphagus (Herbst), of the west coast of Thailand, with notes on experimental rearing of P. versicolor (Latrielle) in the laboratory. 22 pp.

3 Serene, R and Lundoe, S.
   1974 Observations on the male pleopod of the species of Hyophas Stimpson with a key to the identification of the species. 10 pp.

4 Lundoe, S.

5 Bhatia, U.
   1974 Distribution of spiny lobsters along the west coast of Thailand with observations on their fishing grounds. 20 pp.

6 Wongratana, T.

7 Wongratana, T.
   1975 A record of a flatheadfish, Thysanophrys papillolabium Schultz, in the Andaman Sea, with a key to fourteen species of the platycephalid family from Thai waters (Pisces : Platyccephalidae). 9 pp.

8 Boonruang, P. and Phasuk, B.
   1975 Species composition and abundance distribution of anomuran sand crabs and population biometrics of Emerita emeritus (L.) along the Idian Ocean Coast of Thailand (Decapoda : Hippidae). 19 pp.

9 Nielsen, C.
   1976 An illustrated checklist of bivalves from PMBC beach with a reef-flat at Phuket, Thailand. 7 pp. + 17 plates.

10 Frith, D.W., Tantanarsiwong, R. and O. Bhatia,

11 Nielsen, C.
   1976 Notes on Littorina and Murex from the mangrove at Ao Nam Bor, Thailand. 4 pp.

12 Serene, R. and Soh, C.L.

13 Ditlev, H.
   1976 Stony corals (Coelenterata : Scleractinia) from the west coast of Thailand. 14 pp.

14 Cristensen, B. and Wiium-Andersen, S.
   1977 Mangrove plants, sea grasses and benthic algae at Surin Island, west coast of Thailand. 5 pp.

15 Wiium-Andersen, G.

16 Wiium-Andersen, S.
   1977 Primary production in waters around Surin Island off the west coast of Thailand, 4 pp.

17 Frith, D.W.
   1977 A preliminary list of macrofauna from a mangrove forest and adjacent biotopes at Surin Island, Western Peninsular Thailand. 14 pp.

18 Frith, D.W. and Frith, O.B.
   1977 Observations on fiddler crabs (Ocypodidae : Genus Uca) on Surin Island, Western Peninsular Thailand, with particular reference to Uca tetragonon (Herbst) 14 pp.
19 Frith, D.W.
1977 A bibliography of selected mangrove literature. 142 pp.

20 Dingle, H., Caldwell, R.L., and B.B. Manning

21 Tantanarithwong, R.
1978 An illustrated checklist of marine shell gastropods from Phuket Island, adjacent mainland and offshore island, Western peninsular, Thailand. 22 pp. + 41 plates.

22 Limpsaichol, P.
1978 The physico-chemical and nutrient conditions in the sea around Surin Island, Western peninsular, Thailand. 8 pp.

23 Limpsaichol, P.

24 Frith, D.W. and Alexander, H.G.L.
1978 A preliminary list of land crabs (crustacea: Decapoda) from Koh Similan, Andaman Sea, including eight species new to Thailand. 6 pp.

25 Frith, D.W. and Frith, C.B.
1978 Note on the ecology of fiddler crab populations (Ocypodidae: Genus Uca) on Koh Surin Nua and Yao Yai Island, Western Peninsular, Thailand. 13 pp.

26 Boonruang, P.
1978 The degradation rates of mangrove leaves of, Rhizophora apiculata (Bl) and Avicennia marina (Forsk) Vierh, at Phuket Island, Thailand. 7 pp.

27 Tantanarithwong, R.
1979 A checklist of marine bivalves from Phuket Island, adjacent mainland and offshore island, Western Peninsular, Thailand. 15 pp.

APPENDIX 4 (2)

RESULT OF INVESTIGATION BY P.M.B.C. SCIENTISTS SUBMITTED AT ASIAN SYMPOSIUM ON MANGROVE ENVIRONMENT : RESEARCH AND MANAGEMENT, KUALA LUMPUR, MALAYSIA, 1980

1. Nateewathana, A. & Tantichodok, P.
1980 Species composition, density and biomass of Macrofauna of a mangrove forest at Ko Yao Yai, Southern Thailand.

2. Limpsaichol, P.
1980 An investigation of some ecological parameters at Ao Nam Bor Mangrove, Phuket Island, Thailand.

1980 Heterotrophy of benthic diatom isolated from mangrove forests.

4. Chansang, H.
1980 Structure of a mangrove forest at Ko Yao Yai.

5. Chansang, H.
APPENDIX 4 (3)
RESEARCH AND INVESTIGATIONS CONDUCTED BY FOREIGN SCIENTISTS.
PUBLISHED IN VARIOUS INTERNATIONAL PERIODICALS.

No. 1 LOIS EGEROD.

No. 2 LOIS EGEROD.
1975 Marine Andaman Sea Coast of Thailand : Chlorophyceae.
*Botanica Marina* vol. XVIII, 41-66.

No. 3 R.L. CALDWELL and H. DINGLE.

No. 4 C. BERTElsen
1975 Ecology of reef flats. Published in Danish, *Naturens Verden*.

No. 5 C. NIELSEN.

No. 6 B. CHRISTENSEN and S. WIUM-ANDERSEN.
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