

Final Report

Mariculture Research and Development Project in Indonesia

ATA-192

(August 30, 1978-March 31, 1986)

Written by

Toranosuke Yoshimitsu	Team leader
Hiroki Eda	Fish culture expert
Kazuhito Niramotsu	Fish culture expert

Japan International Cooperation Agency

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国際協力事業団

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FOREWORD

Mariculture Research and Development Project started in 1978 in the Banten Bay of Indonesia as one of technical cooperation programs between Japan and Indonesia, and it ended successfully at the end of March, 1986 through the joint efforts of many experts of both countries as well as of the both governments.

In the course of the Project, a number of results of their researches in the fields of fish culture and seed production have been published, and this report summarizes these researches.

I would like to express my deep appreciation to the people concerned with the Project, and I hope that this report will help to solve immediately some of present technical problems and will contribute to the long-run development of the mariculture industry in Indonesia.

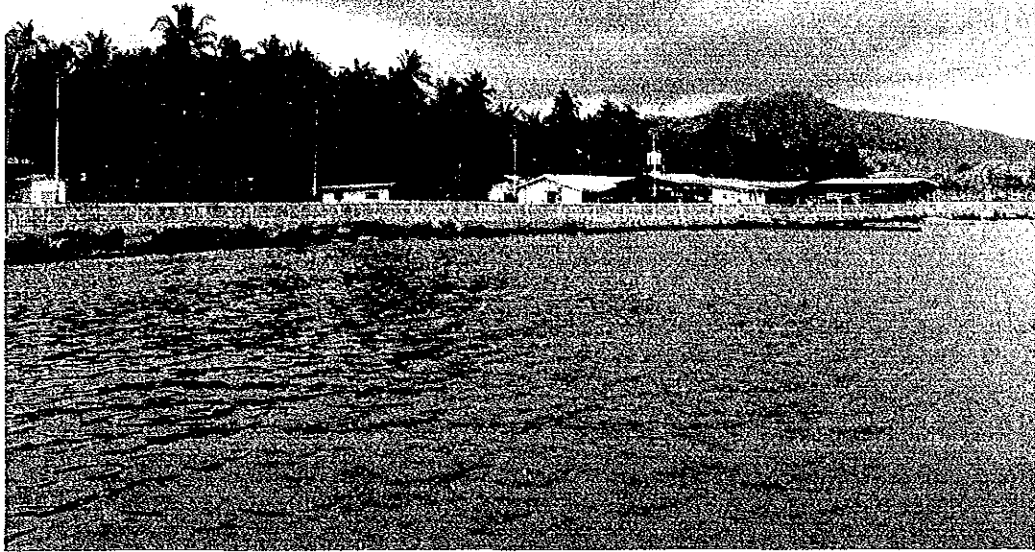
June 30

Toranosuke Yoshimitsu

Team Leader

Mariculture Research and Development Project

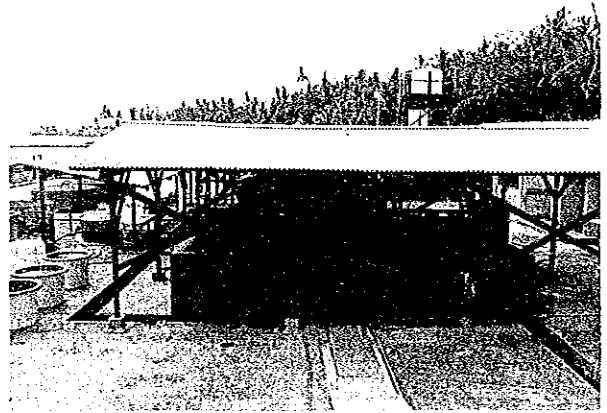
(ATA-192)



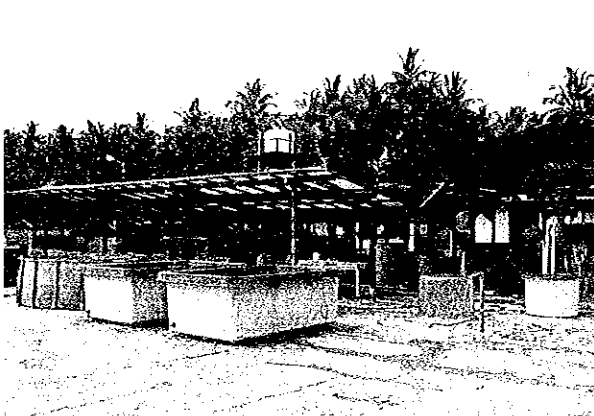
Bojonegara Experimental Station



Culture Tank



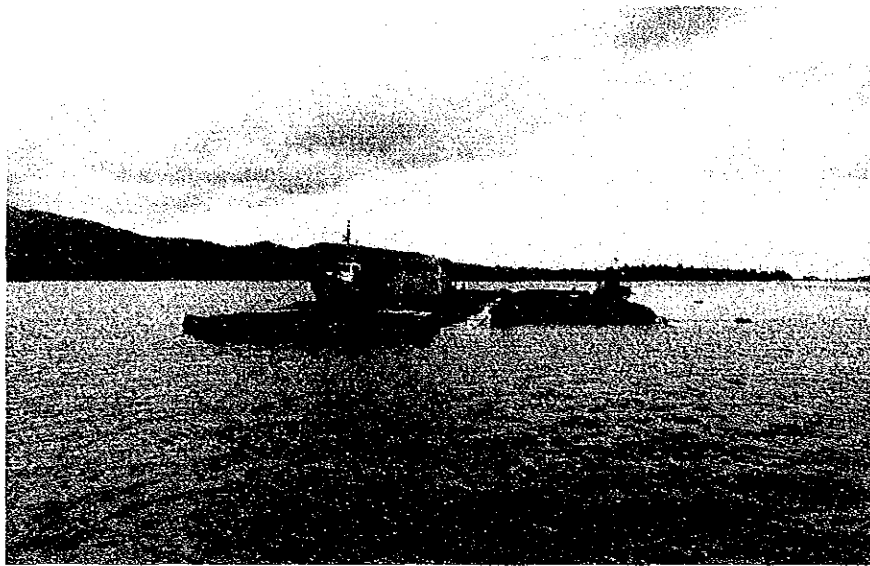
Culture Tank



Phytoplankton Culture Tank



Dry Laboratory and 125 m³ Tank

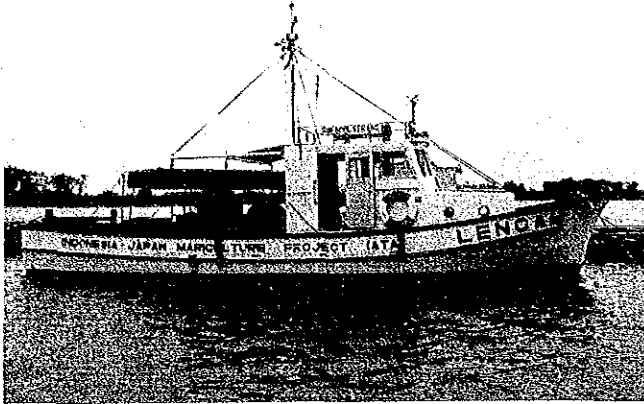


Floating Net Cage of Bojonegara Experimental Station

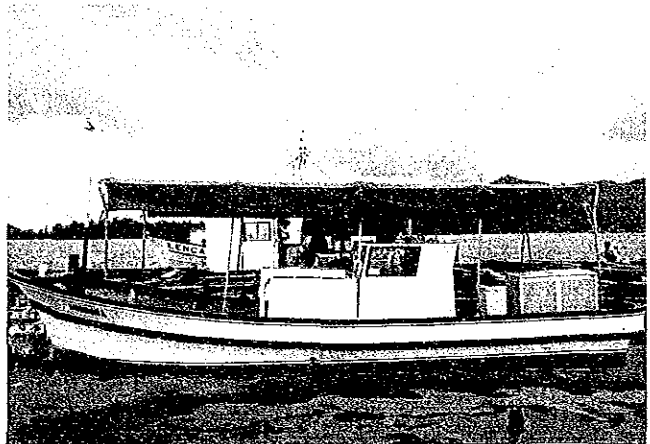


Floating Net Cage of Bojonegara Experimental Station

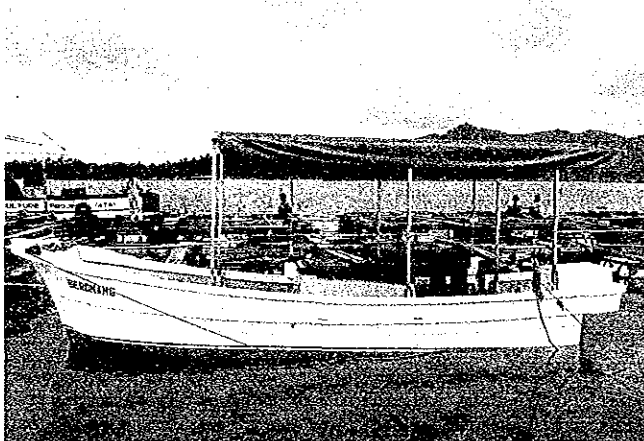
Research Ship "LENCAM" 10 ton (FRP)



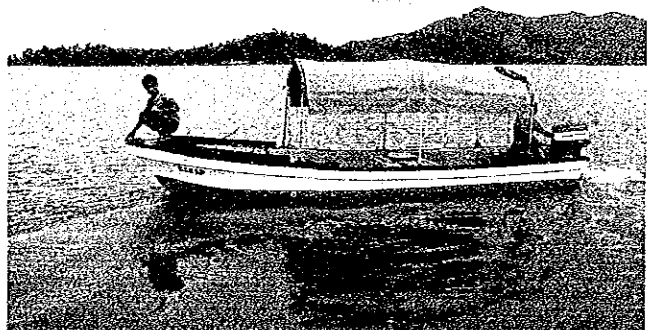
Research Ship "ANADARA" 2 ton (FRP)



Research Ship "BERONANG" 1 ton (FRP)



Research Ship "KAKAR" (FRP)





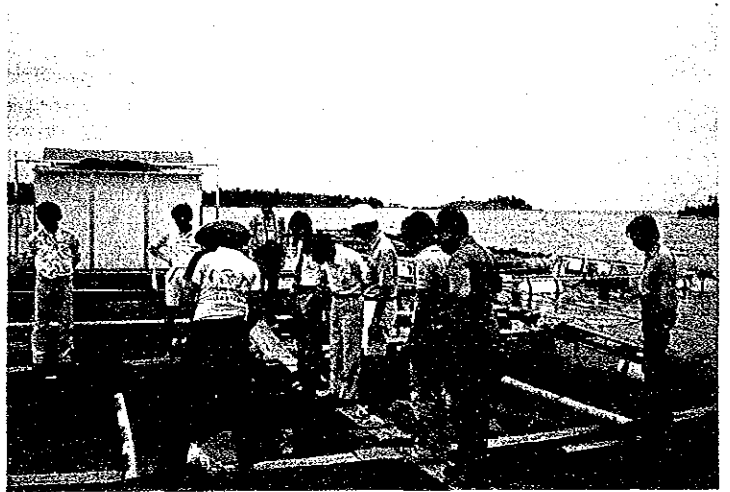
Minister of Agriculture Visit Project Site



Harvest Celemony by Junior Minister of Agriculture
at the Floating Net Cage of Bojonegara Experimental
Station



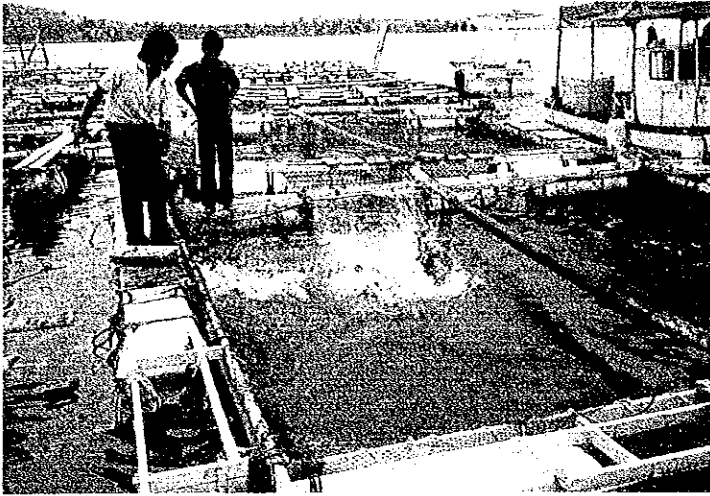
After Joint Evaluation Committee



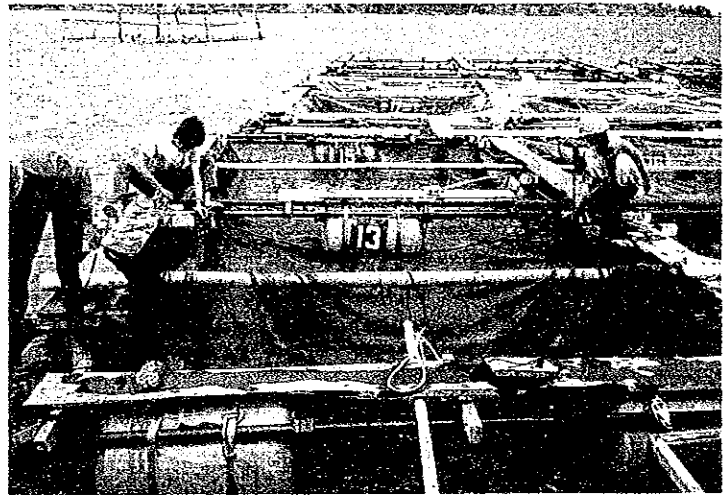
Evaluation Team Visit Bojonegara Experimental Station



Ambassador, Minister, Other members of Japanese Embassy and press visit



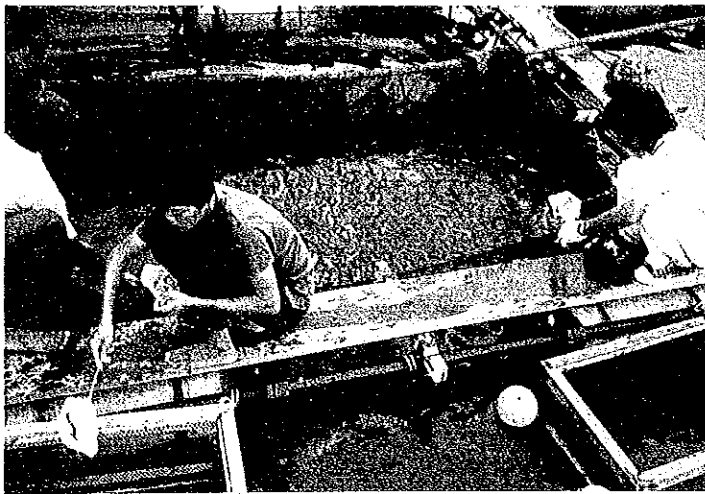
Feeding to Culture Giant Seaperch



Change of Net



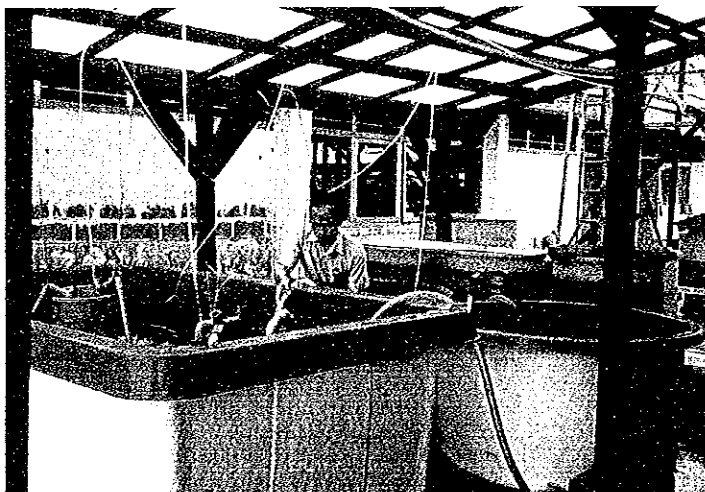
Measurement of Fish



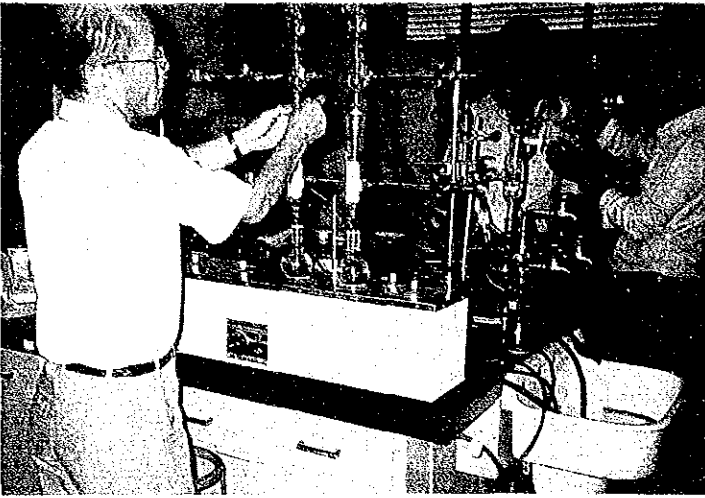
Selection of Rabbit Fish Fries



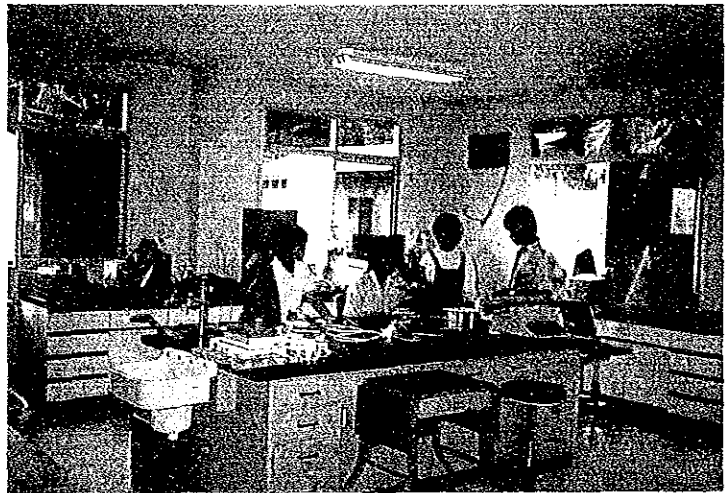
Wet Laboratory



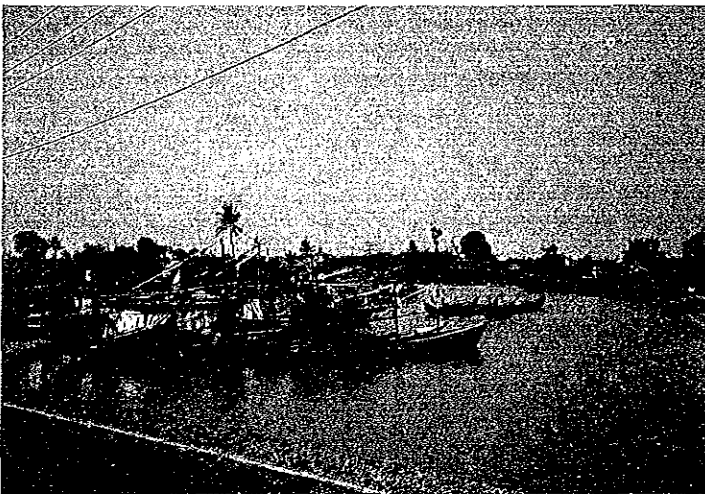
Rotifer Culture Tank



Instruction of Chemical Analysis



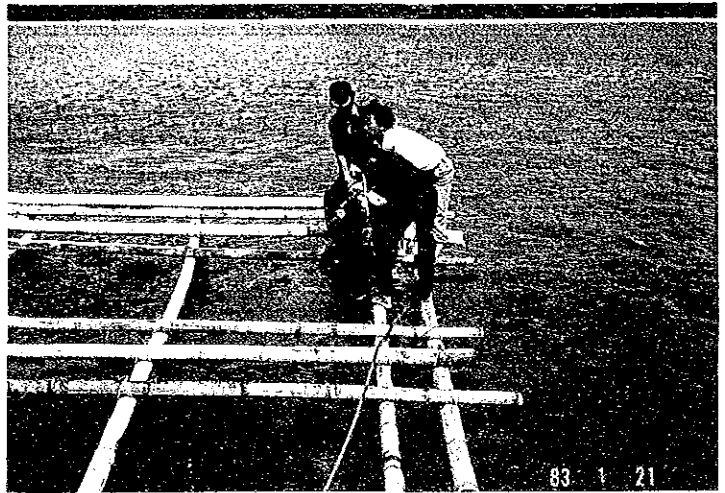
Dry Laboratory



Bojonegara Fishing Port



Bojonegara Fish Market



Culture of Green Mussel



Culture of Oyster

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I. INTRODUCTION

In view of developing mariculture in Indonesia, this Project started seven years and four months ago, based on the "Record of Discussion" signed on August 30, 1978. As a result of the first joint evaluation, an extension of the project for another two years up to March 31, 1984 was recommended and the "Record of Discussion of Extension" was signed on March 31, 1982. Thereafter, the cooperation in the field of shellfish culture was finalized successfully on March 31, 1983, being the cooperation in the field of finfish culture continued.

In October 1983, the second joint evaluation was conducted with resulting recommendation to extend the project for additional two years up to March 31, 1986 in consideration for developing the research works in the field of fish culture and the "Extended R/D" was signed on March 16, 1984.

During these periods, the conducted activities have provided successfully the basic knowledge and technologies necessary for the development of mariculture which was at the initiating stage when the Project was started in Indonesia.

As a part of the activities, the shellfish culture and environmental study had achieved the Project objectives successfully and terminated on March of 1983 and 1984 respectively, as agreed at the Joint Committee Meeting held on October, 1983. For the cooperation in the field of fish culture, the research activities have progressed remarkably due to the improved facilities and equipments especially in the last two years. Several basic knowledges and technologies have already been mastered for establishment of totally organized production system, and also for smooth management of mariculture at the project site.

Published research reports and extension manuals concerning individual technologies generated by the Project are considered to be of great use by both sides for further development of mariculture in Indonesia.

This final report mentions the general history and the activities of the project, and the summary of research works by Japanese long term and short term experts and Indonesian counterparts during the period of the project, especially, the last four years activities concerning fish culture which have been remarkably progressed and have produced successful results.

The project is terminated on March 31, 1986, giving considerable impacts for the future development of Indonesian mariculture. After the termination of the Project, the Indonesian counterparts is suggested to be able to lead research works on other parts of the country and will contribute to the future development of mariculture in Indonesia. In this connection, further efforts should be made to have a better arrangement on the equipments and facilities and maintenance of research activity at the Bojonegara Experimental Station.

II Table of the Progress of Mariculture Research
and Development Project (ATA-192)

Item	1975 March	April		1976 February	March
Mission	Survey Mission Dr. Arakawa and Dr. Okada			Survey Mission Dr. Kafuku, Dr. Fukusho, Mr. Ogawa and Mr. Tokutake	
Long-term Expert					
Short-term Expert					
Training of Indonesian Personnel					
Providing Equipments					
Infrastruction and Emergency Budget					
Budget and Construction from Indone- sian side					
Others	Place of Survey:	Ketapan coast Jepara Muncar Pari Is.		Place of Survey:	Lampung Bay Kenjeran Surabaya Benoa Bay Bali Madura Kalianget

Item	1977				1978	
	August Sept.	October	November	December	January	February
Mission	← Long-term Investigation of Fish: Dr. Yusa → ← Long-term Investigation of Shellfish: Mr. Yamagata →					
Long-term Expert						
Short-term Expert						
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget						
Budget and Construction from Indonesian side						
Others	Dr. Ysa's survey: Ujungpandang, Probolinggo, Pasuruan, Lekok, Jepara and Pari Is. Mr. Yamagata's survey: Banten Bay, Bintan Is., Ketapang, Gagara Menyan, Kenjaran and Pasuruan					

Item	1978 August	September	October	November	December
Mission	←→ Project Formulation Team R/D agreed on August 30, 1978				
Long-term Expert					
Short-term Expert					
Training of Indonesian Personnel					
Providing Equipments					
Infrastruction and Emergency Budget					
Budget and Construction from Indone- sian side					
Others	R/D agreement signed by Mr. Unar and Dr. Kafuku				

Item	1979 January	February	March	April	May	June
Mission						
Long-term Expert		<p>←————→</p> <p>Mr. M. Yamashita (Team leader)</p> <p>←————→</p> <p>Mr. K. Imanishi (Fish culture)</p>		<p>Until March, 1982</p> <p>Until March, 1982</p>		
Short-term Expert						
Training of Indonesian Personnel						
Providing Equipments			The equip- ments of the 1978 fiscal year arrived			
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side				Budget of 1979 fiscal year: Karngautu: 300 m ³ office and laboratory 100 m ³ store house 24 m ³ Generator house		Staff house (Serang) 70 m ² x 5 unit
Others			Remarks Value of provided equipments was about 3,300,000 yen			

Item	1979 July	August	September	October	November	December
Mission					← Guidance Team Dr. Kafuku and other two persons →	
Long-term Expert	← Mr. H. Tanaka (fish culture) →		Until March, 1984		← Mr. M. Hosoya (Shell- fish) →	← Until Nov., 1981 →
Short-term Expert						Mr. T. Ogasawara (Engineer- ing)
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget						Model Infra- structure: improvement of culture pond and tank
Budget and Construction from Indone- sian side	Linduk Station Pond con- struction (20,000m ²) 120m ² labora- tory	Panjang Is. sta- tion Pond Construc- tion 10,000m ² 120m ³ labora- tory				
Others						Remarks: Value of Model In- frastruc- ture was 16,154,000 yen

Item	1980 January	February	March	April	May	June
Mission		←→ Guidance of model infra- structure Team Dr Matoba and other two persons				
Long-term Expert				←→ Mr. T. Asazu (Coordi- nator)		→ Until July, 1987
Short-term Expert	Mr. T. Ogasawara (Engineering)			←→ Dr. H. Ida (Taxo- nomy)		
Training of Indonesian Personnel			←→ Mr. M. Unar (Observation)			
Providing Equipments			The equip- ments of the 1979 fiscal year arrived			
Infrastruction and Emergency Budget						Research ship (YAMAHA 2 ton)
Budget and Construction from Indone- sian side					Budget of 1980 fiscal year: Guest house (Serang)=150m ²	
Others			Remarks: Value of provided equip- ments was about 56,500,000 yen (including 10 ton research ship)			Remarks: Value of research ship (complete set) was about 4,200,000 yen

Item	1980 July	August	September	October	November	December
Mission						
Long-term Expert						
Short-term Expert			Dr. K. Fukusho (Fish culture)	Dr. M. Horikoshi (Taxonomy)		
Training of Indonesian Personnel			Mr. Danakusumah (Fish culture) Mr. Basyarie (Fish culture) Mr. Muhari (Shell fish culture)			
Providing Equipments	The equipments of the 1980 fiscal year arrived (first shipment)					The equipments of the 1980 fiscal year arrived (second shipment)
Infrastruction and Emergency Budget						
Budget and Construction from Indonesian side	Bojonegara station 120m ² office and Laboratory					
Others	Remarks: Value of equipments was about 10,000,000 yen as first shipment					Remarks: Value of equipments was about 37,000,000 yen as second shipment

Item	1981 January	February	March	April	May	June
Mission	←→ Project consultation Team Dr. T. Nose and other two persons					
Long-term Expert						
Short-term Expert						
Training of Indonesian Personnel						
Providing Equipments	Land cruiser (TOYOTA)					
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side				Budget of 1981 fiscal year: Bojonegara Station Wel laboratory: 150 m ² Culture Tanks: 30 m ³ x 2		
Others						

Item	1981 July	August	September	October	November	December
Mission					←→ Evaluation Team Dr. H. Sasaoka, Mr. Saeki, Dr. Fukusho and Mr. Ishiwata	
Long-term Expert						
Short-term Expert		←→ Dr. H. Kanno (Taxonomy)			←→ Dr. K. Fukusho (Fish culture)	
Training of Indonesian Personnel		←→ Mr. Fatuchri (Shellfish culture) Mr. Sugama (Fish culture)			←→ Mr. Wardana (Observation)	
Providing Equipments						The equip- ments of the 1981 fiscal year arrived
Infrastruction and Emergency Budget			Emergency budget of the 1981 fiscal year			
Budget and Construction from Indone- sian side						
Others			Remarks: Improve- ment of pier and construc- tion of culture tank roof value was 3,300,000 yen			Remarks: Value of equipments was about 36,800,000 yen

Item	1982 January	February	March	April	May	June
Mission						
Long-term Expert				Mr. T. Yoshimitsu (Team Leader)	Mr. H. Eda (Fish culture)	Until April, 1986 Until March, 1986
Short-term Expert		Dr. H. Ida (Taxonomy)				
Training of Indonesian Personnel				Miss. Hariati (Plankton culture)		
Providing Equipments			Pellet Making Machine			
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side				Budget of 1982 fiscal year:		Bojonegara Station 100 m ² store house
Others			Remarks: Value was about 4,500,000 yen			

Item	1982 July	August	September	October	November	December
Mission		←→ Project consultation Team Dr. T. Nose, Dr. Fukusho, Dr. Funakoshi and Mr. Nakauchi				
Long-term Expert						
Short-term Expert	←		Mr. M. Hosoya (Shellfish culture)			
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget						Emergency budget: Improvement of sea water Intake pipe
Budget and Construction from Indone- sian side						
Others						Remarks: Value of emergency budget was about 1,660,000 yen

Item	1983 January	February	March	April	May	June
Mission						
Long-term Expert			Mr. T. Kurihara (Coordinator)	Until March, 1984		
Short-term Expert		Mr. G. Ito (Facilities)	Mr. R. Okamoto (fish culture) Mr. F. Hirata (Chemical analysis)			Mr. M. Hosoya (Food organising culture)
Training of Indonesian Personnel			Mr. Wasada (Fish culture) Miss Nuraini (Fish culture)			
Providing Equipments			The equip- ments of the 1982 fiscal year arrived			
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side				Budget of 1983 fiscal year:		
Others			Remarks: Value of equipments was about 14,000,000 yen			

Item	1983 July	August	September	October	November	December
Mission			←→ Evaluated Team Dr. T. Nose, Mr. Hamada, and Mr. Kusama			
Long-term Expert						
Short-term Expert	Mr. M. Hosoya →					Dr. M. Takeda (Nutrient analysis)
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side						
Others						

Item	1984 January	February	March	April	May	June
Mission						
Long-term Expert						Mr. K. Hiramatsu (Fish culture)
Short-term Expert	→ Dr. M. Takeda ← Mr. R. Okamoto (Seed protect- tion)		←→ Dr. T. Matsuzato (Fish pathology) Mr. H. Shoji (Chemical analysis)			
Training of Indonesian Personnel		←→ Mr. Mangundjojo (observation)		← Mr. Purwanto (Shellfish culture) Mrs. Wahyuni (Fish culture)		
Providing Equipments			The equip- ments of the 1983 fiscal year arrived			
Infrastruction and Emergency Budget						
Budget and Construction from Indone- sian side				Budget of 1984 fiscal year: 123,600,000 RP		
Others			Remarks: Value of equip- ments was about 41,400,000 yen			

Item	1984 July	August	September	October	November	December
Mission	←→ Project Consulta- tion Team Dr. T. Nose, Dr. Fukusho and Mr. Kageyama					
Long-term Expert	Mr. → Hiramatsu	Until March, 1986				
Short-term Expert					←→ Mr. T. Kindaichi (Food organisms culture) Mr. T. Kanemitsu (Pellet making)	
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget				Emergency budget: Construct- tion of security fence and floring		
Budget and Construction from Indone- sian side						
Others				Remarks: Value was 3,830,000 yen		

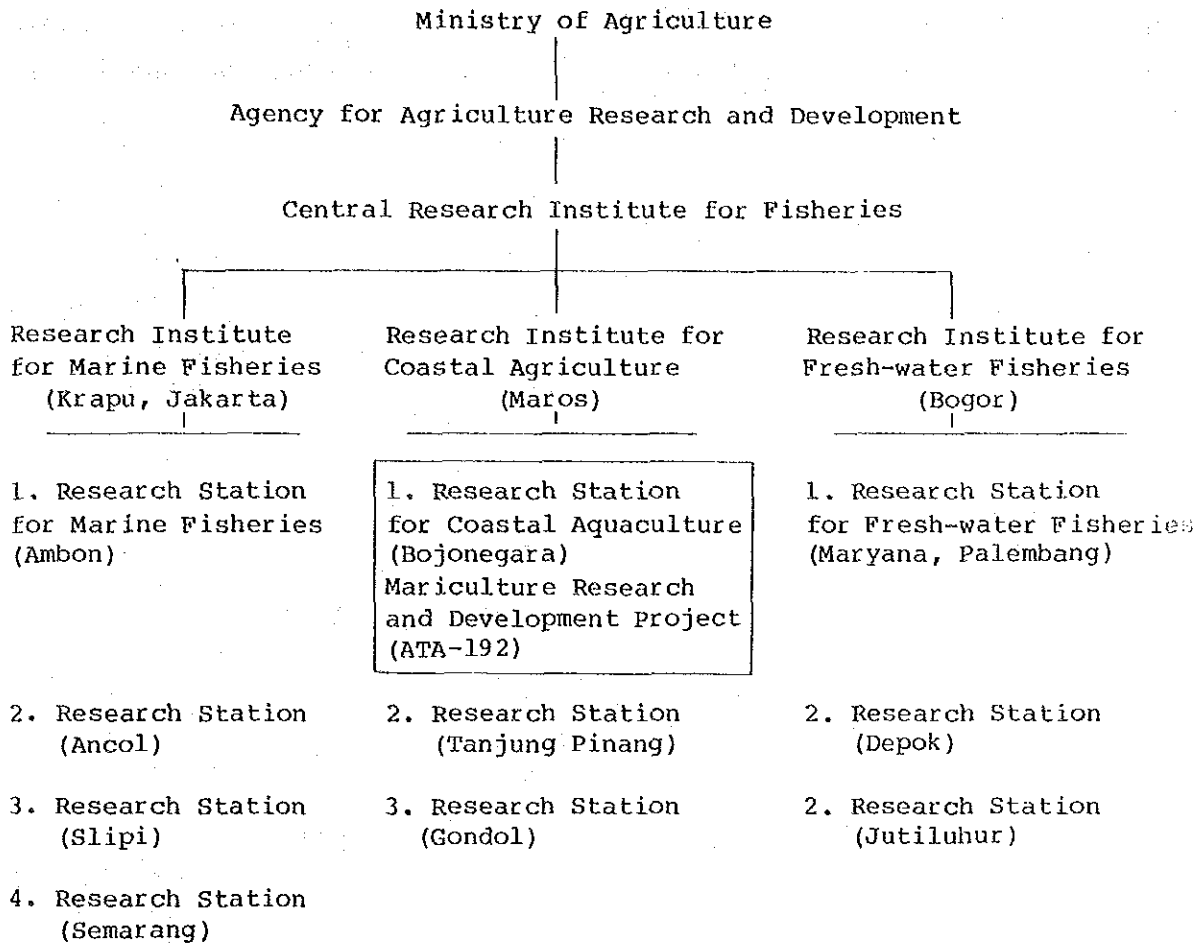
Item	1985 January	February	March	April	May	June
Mission						
Long-term Expert						
Short-term Expert	Mr. Kanemitsu					
Training of Indonesian Personnel						
Providing Equipments			The equipments of the 1984 fiscal years arrived			
Infrastruction and Emergency Budget			Construction of 125 m ³ tank and Dry Laboratory (120 m ²)			
Budget and Construction from Indonesian side				Budget of 1985 fiscal year: 125,000,000 PR		
Others			Remarks: Value of equipments was about 23,000,000 yen Mr. Danakasumah and Mr. Waspada made technical exchange trip to Thailand and Singapore			

Item	1985 July	August	September	October	November	December
Mission						
Long-term Expert						
Short-term Expert		<p style="text-align: center;">←————→</p> Dr. T. Honjo (Plankton culture)	<p style="text-align: center;">←————→</p> Dr. T. Matsuzato (Fish pathology)			
			<p style="text-align: center;">←————→</p> Mr. A. Tsujiyado (Seed production)			
Training of Indonesian Personnel			<p style="text-align: center;">←————→</p> Miss Partasasmita (Fish pathology)	<p style="text-align: center;">←————→</p> Mr. Mustahal (Plankton culture)		<p style="text-align: center;">←————→</p> Mr. Imanto (Fish culture)
Providing Equipments			The equipments of the 1985 fiscal year arrived (first shipment)		The equipments of the 1985 fiscal year arrived (second shipment)	
Infrastruction and Emergency Budget						
Budget and Construction from Indonesian side						
Others			Remarks: Value of equipment was about 19,000,000 yen		Remarks: Value of equipment was about 4,800,000 yen	
			Mr. Danakasumah and	Mr. Waspada made	technical exchange	trip to Thiland on Singapore.

Item	1986 January	February	March			
Mission	←→ Evaluation Team Dr. T. Nose, Dr. Fukusho, Mr. Tsunematsu and Mr. Kageyama					
Long-term Expert						
Short-term Expert						
Training of Indonesian Personnel						
Providing Equipments						
Infrastruction and Emergency Budget			Construction of fresh water deep well			
Budget and Construction from Indone- sian side						
Others						

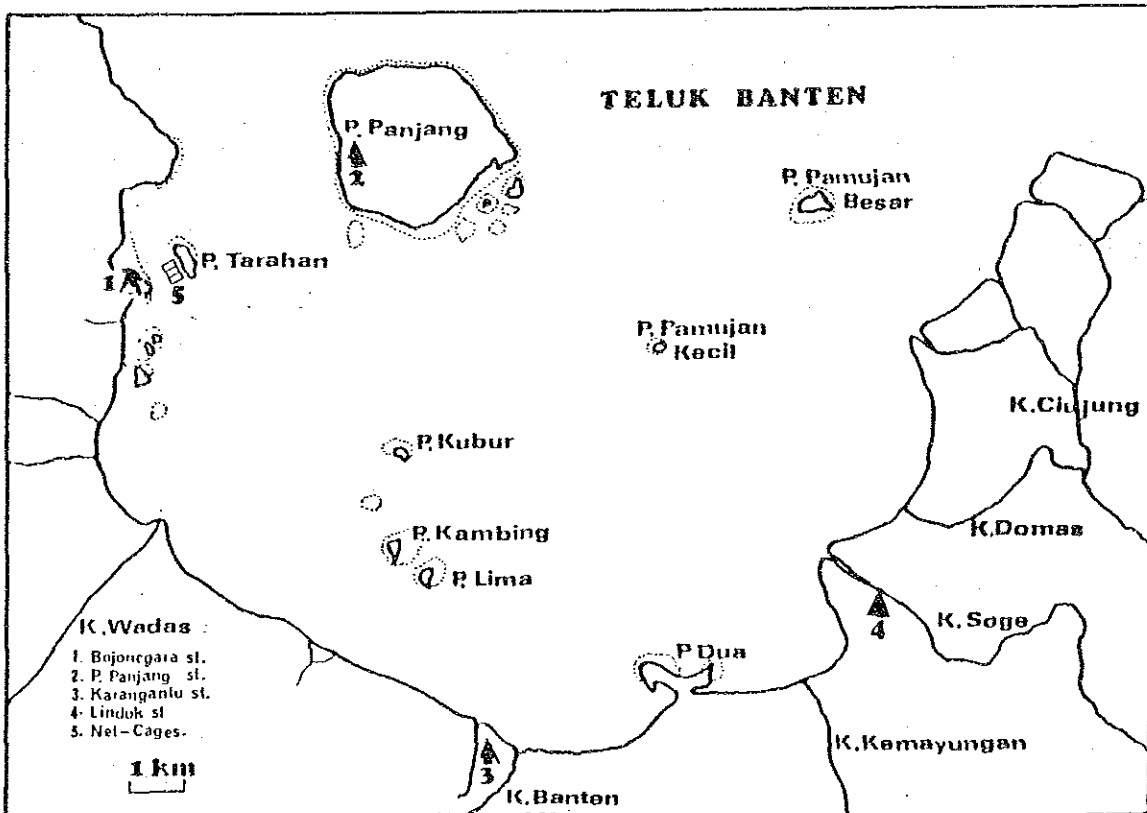
III ORGANIZATION CHART

in 1986



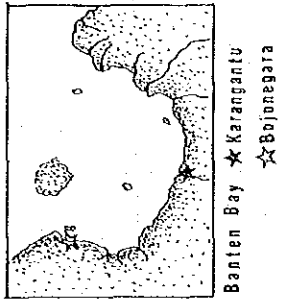
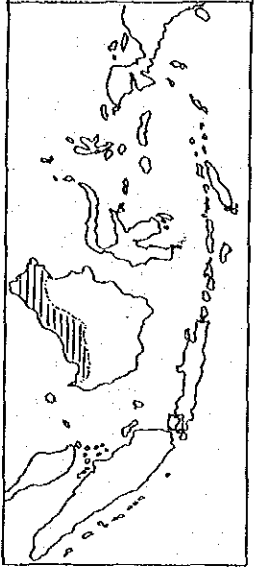
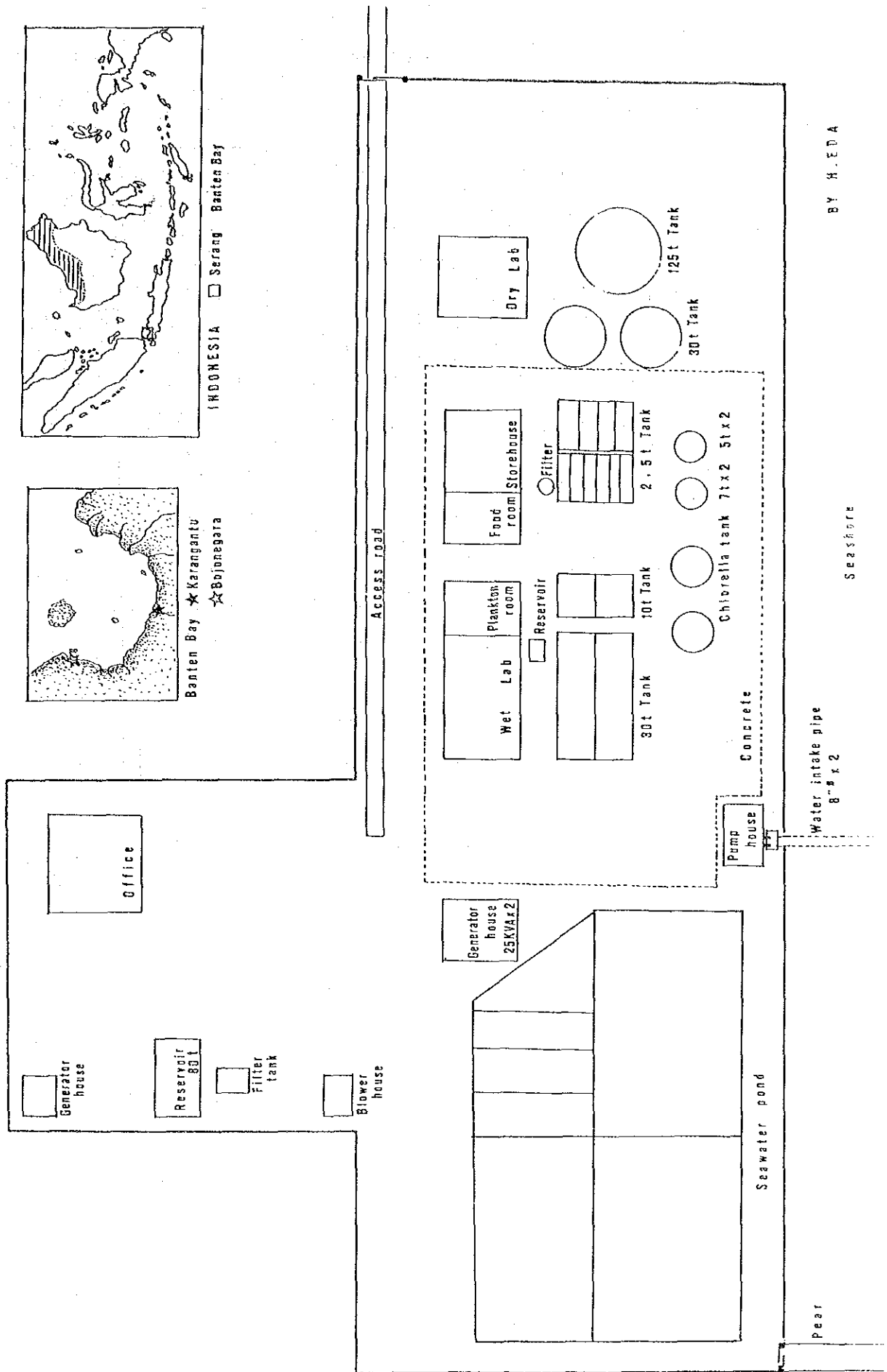
IV Project Site

The activities of Mariculture Research and Development Project (ATA-192) have been conducted at Bojonegara Experimental Station as a main research center, and Karagantu Station, Panjang Is. Station and Linduk Station as the sub research center.



Location of Each Research Station

Bojonegara Experimental Station



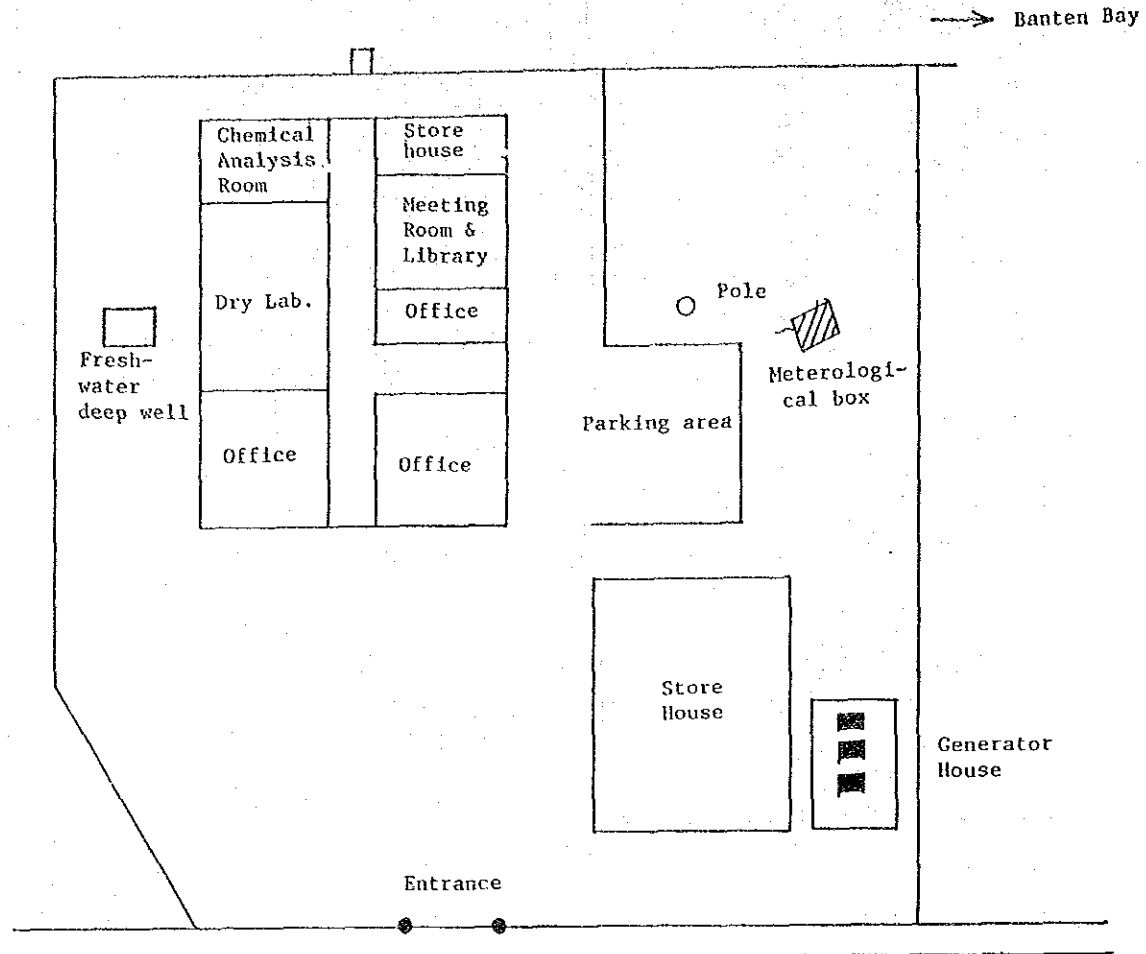
BY H.EDA

Seashore

Water intake pipe
8" x 2

Pear

Karangantu Station



Panjang Is. Station: Culture pond (sea water) with 10,000 m²
Office

Linduk Station: Culture pond (brackish water) with 20,000 m²
Office

V JICA Mission

Investigation	Period	Member
Survey mission	1975.3.28-4.17	Dr. Arakawa and Dr. Okada
Survey mission	1976.2.26-3.20	Dr. Kafuku, Dr. Fukusho, Mr. Ogawa and Mr. Tokutake
Long-term investigation	1977.8.11- 1978.2.10	Dr. Yusa, Fish Biologist
Long-term investigation	1977.9.23- 1978.2.10	Mr. Yamagata, Shellfish Biologist
Project formulation R/D	1978.8.15-9.2	Dr. Kafuku, Mr. Yamashita Mr. Nakajima, Mr. Mori and Mr. Sakamoto
Guidance	1979.11.25-12.24	Dr. Kafuku and other two members
Guidance of model infrastructure	1980.2.13-2.26	Dr. Matoba and other two members
Project formulation	1981.1.26-2.6	Dr. Nose and other two members
Evaluation	1981.11.4-11.18	Dr. Sasaoka, Mr. Saeki, Dr. Fukusho and Mr. Ishiwata
Project formulation	1982.8.26-9.10	Dr. Nose, Dr. Fukusho, Dr. Funakoshi and Mr. Nakauchi
Guidance (Evaluation)	1983.9.25-10.7	Dr. Nose, Mr. Hamada and Mr. Kusama
Project formulation	1984.7.2-7.16	Dr. Nose, Dr. Fukusho and Mr. Kageyama
Guidance (Evaluation)	1986. 1.8-1.22	Dr. Nose, Dr. Fukusho, Mr. Tsunematsu and Mr. Kageyama

VI Japanese Expert

Name		Field	Working Period
I. Long-term Expert			
Masao Yamashita	Team Leader	1979.2 - 1982.3	(3 years)
Masuo Imanishi	Fish Culture	1979.2 - 1982.3	(3 years)
Hideyuki Tanaka	Fish Culture	1979.7 - 1984.3	(3 years) (8 months)
Masahiro Hosoya	Shell fish Culture	1979.11- 1981.11	(2 years)
Tokio Asazu	Coordinator	1980.4 - 1982.7	(2 years) (3 months)
Toranosuke Yoshimitsu	Team Leader	1982.4 - 1986.4	(4 years)
Hiroki Eda	Fish Culture, Coordinator	1982.5 - 1986.3	(4 years)
Tsutomu Kurihara	Coordinator	1983.2 - 1984.3	(1 year)
Kazuhito Hiramatsu	Fish Culture	1984.6 - 1986.3	(1 year) (9 months)
II. Short-term Expert			
Toshiya OGASAWARA	Engineering	1979.12- 1980.4	(4 months)
Dr. Hitoshi IDA	Taxonomy (Larvae)	1980.4 - 1980.4	(2 weeks)
Dr. Kunihiko FUKUSHO	Fish Culture	1980.9 - 1980.9	(2 weeks)
Dr. Masuomi HORIKOSHI	Taxonomy (Shellfish)	1980.10- 1980.11	(2 weeks)
Dr. Hitoshi KANNO	Taxonomy (Shellfish)	1981.8 - 1981.9	(1 month)
Dr. Kunihiko FUKUSHO	Fish Culture	1981.11- 1982.12	(1 month)
Dr. Hitoshi IDA	Taxonomy (Larvae)	1982.1 - 1982.2	(1 month)
Masahiro HOSOYA	Shellfish	1982.7 - 1983.3	(8 months)
Goichi ITO	Electric work	1983.1 - 1983.3	(2 months)
Dr. Ryo OKAMOTO	Fish Culture	1983.3 - 1983.4	(1 month)
Fumio HIRATA	Chemical analysis	1983.3 - 1983.4	(1 month)
Masahiro HOSOYA	Food Organisms Culture	1983.6 - 1983.9	(3 months)
Dr. Masahiko TAKEDA	Nutrient analysis	1983.12- 1984.1	(1 month)
Dr. Ryo OKAMOTO	Seed Production	1984.1 - 1984.1	(2 weeks)
Dr. Toshihiko MATSUSATO	Fish Disease	1984.2 - 1984.3	(1 month)
Hajime SHOJI	Chemical Analysis	1984.2 - 1984.3	(1 month)
Takushi KINDAICHI	Food Organisms Culture	1984.11- 1984.12	(1 month)
Tsunetoshi KANEMITSU	Combination Feed (Pellet Making)	1984.12- 1985.2	(2 months)
Dr. Tsuneo HONJO	Plankton Culture	1985.8 - 1985.9	(3 weeks)
Dr. Toshihiko MATSUSATO	Fish Disease	1985.9	(3 weeks)
Akira TSUJIGADO	Fish Fry Production	1985.9 - 1985.10	(1 month)

VII Training Indonesian Personnel in Japan

List of Trainees of Indonesian Personnel

No.	Name	Subject	Dispatch	Duration
1.	Mohamad UNAR	Observation	31 Marc. 1980	- 2 weeks
2.	Edward DANAKUSUMAH	Fish Culture	10 Sept. 1980	- 3 months
3.	Achmad BASYARIE	Fish Culture	10 Sept. 1980	- 3 months
4.	MUHARI	Shellfish Culture	10 Sept. 1980	- 3 months
5.	Mochamad FATUCHRI	Shellfish Culture	6 Aug. 1981	- 3 months
6.	Ketut SUGAMA	Fish Culture	21 Aug. 1981	- 3 months
7.	Wardana ISMAIL	Observation	22 Nov. 1981	- 3 weeks
8.	Tuti HARIATI	Plankton Culture	Marc. 1982	- 3 months
9.	WASPADA	Fish Culture	16 Marc. 1983	- 3 months
10.	Siti NURAINI	Fish Culture	16 Marc. 1983	- 3 months
11.	Sukusnu MANGUNDOJO	Observation	Feb. 1984	- 2 weeks
12.	Markos Juli PURWANTO	Shellfish Culture	4 Apr. 1984	- 4 months
13.	Indar Sri WAHYUNI	Fish Culture	4 Apr. 1984	- 4 months
14.	Suwidah PARTASASMITA	Fish diseases	17 July. 1985	- 4 months
15.	MUSTAHAL	Plankton Culture	12 Sept. 1985	- 2 months
16.	Philip Taguh IMANTO	Fish Culture	26 Oct. 1985	- 2 months
17.	E. DANAKUSUMAH*	Observation trip	28 Marc. 1985	- 2 weeks
18.	WASPADA*	Observation trip	28 Marc. 1985	- 2 weeks

* As members of Technical Exchange trip in Thailand and Singapore

Study in Japan

	Name	Degree	University	Period
1	Edward Danakusumah	Master	Kagoshima	1982.1 - 1984.3
2	Achmad Basyarie	Master	Kagoshima	1983.1 - 1985.3
3	Muchari	Master	Kagoshima	1984.9 - 1987.3
4	Ketut Sugama	Master	Kochi	1985.10- 1988.3

VIII Indonesian Project Staff

i) Indonesian Counterpart

Ir. E. Danakusumah, MSC (Official)
Achmad Basyarie, MSC (")
Drs. Waspada (")
Ir. Markus JP (")
Drs. Mustahal (")
Ir. M. Isra
Drs. Pramu Sunyoto
Muchari Maan (Official)
Ir. Sugama Ketut (")

ii Assistant

M. Muslikh (Official)
Toni Fatoni (")
Safrudin (")
Sofyan Sulaedy (")
Moh Rodif (")
Tana Rukmana
Sugandi
Rustanto
Sutirman
Suherman
Ogan Armajaya
Ropi

iii) Engineer

Suharjo
Edy Djuhaedi
Suhendi

iv) Crew of Investigation Ship

KM LENCAM

Apip Muapik (Official)

Ateng Supriatna

Mulyo Wagimin

Maman Hakim

Bambang Junaedi

KM. ANADARA

Dadang Ismunandar

Arjaya

KM. BERONANG

Mulyadi

Muchtadi

KM KAKAP

Burhan

Tarsiman

v) Office Worker

Nurhaman Sadig (Official)

Udjang Sudirman (")

Aam Jamil (")

M. Ali (")

M. Mukhtar (")

Parman (")

Ema Hermawati (")

M. Saleh

Agus Buldani

Hasanah

Elis Sulistiawati

Arkian

Udju Djunaedi

Lukman

Tb. Rachmat

Bay Sulaeman

Supono

Aspuri

vi) Driver

Iyon Sation

Enim

Sobri

vii) Guard

M. Munir

Nasrudin

Hariri

Gojali

Madmukti

Robani

Kifni

IX Equipment Supply

Fiscal year	Value (yen) *
1978	3,300,000-
1979	62,000,000-
1980	50,000,000-
1981	41,000,000-
1982	16,000,000-
1983	45,400,000-
1984	25,600,000-
1985	25,300,000-
Total	268,600,000-

* Approximation

X Infrastructure and Emergency Budget

Fiscal year	Item	Construction or improvement	Value (yen) *
1979	Model infrastructure	Construction of culture pond, concrete tank, sea water intake pipe, pier and others	16,150,000-
1981	Emergency budget	Improvement of pier and construction of roof of culture tank	3,300,000-
1982	Emergency budget	Improvement of seawater intake pipe	1,660,000-
1983	Emergency budget with	Construction of security fence and flooring	3,830,000-
1984	Emergency budget with equipment supply	Construction of 125 m ³ concrete tank and dry laboratory (120m)	9,800,000-
1985	Emergency budget with equipment supply	Construction of fresh water deep well	5,400,000-
Total			40,140,000-

* Approximation

XI Land and Construction taken by Indonesian side

Bojonegara Experimental Station

Area:	20,020 m ²	(including coastal area and access road)
Office:	120 m ²	
Wet laboratory:	150 m ²	
Store house:	100 m ² x 2 = 200 m ²	

Karangantu Station

Area:	3,500 m ²	(including access road)
Laboratory with office:	300 m ²	
Store house:	100 m ²	
Generator house:	24 m ²	
Fresh water well:	1 unit	(140 m depth)

Linduk Station

Area:	20,500 m ²	(including culture pond)
Fish(culture)pond:	20,000 m ²	
Laboratory	120 m ²	

Panjang Island Station

Area:	10,500 m ²	(including culture pond)
Fish(culture)pond:	10,000 m ²	(4,000 m ara improved by model infrastructure)
Laboratory:	120 m ²	

Dormitory(location at Serang)

Area:	4,000 m ²	
House:	70 m ² x 7 unit	

Guest House(location at Serang)

Area:	500 m ²	
House:	150 m ²	

XII Project Budget (Indonesian budget)

x 1,000- Rp

Fiscal year	Project budget	Administration budget and others	Total
1979	168,925	17,500	186,425
1980	183,580	20,000	203,580
1981	199,843	22,000	221,843
1982	200,112	24,000	224,112
1983	156,699	24,000	180,699
1984	125,000	24,000	149,000
1985	123,600	30,000	153,600
Total	1,157,858	161,500	1,319,358

XIII Result of research works of project

1. Preface

Our project is named "Mariculture Research and Development Project ATA-192." The managing agency is Research Institute for Coastal Aquaculture, Central Research Institute for Fisheries and Agency for Agriculture Research and Development (AARD).

Although the original period of the agreement (R/D period) was from August 30, 1978 to March 31, 1982, the period is currently prolonged until March 31, 1986 since the period was extended twice.

The sea area subjected to the research and development of the project is Banten Bay, which is situated near the western most part of Java Island facing Java Sea.

The project was started for the purpose to conduct the fundamental biological study on useful marine fishes and shell fishes in the bay, as well as to transfer the relating technique for developing the mariculture of the country.

In the field of shell fish culture, the study was mainly conducted aiming at green-mussels, oysters and arkshells, and the relating technical transfer was completed as of March 31, 1983.

In the field of fish culture, several useful fishes in a tropical sea area were selected since the commencement of the project, and various experiments and researches have been continued till present day.

Owing to the persisting endeavour of the concerned personnel in the project, several precious knowledges have been acquired during the last seven years.

This paper reports the results of the basic study, the current problems as well as points for future development, concerning the culture through experiments on rabbit fish, giant seaperch, snappers, groupers, etc. which are main fishes currently taken up by the project.

2. Circumstance and Location of Banten Bay

Banten Bay is a vast semicircular with the east to west diameter of about 16.5 kilometers and the north to south distance of about 9 kilometers.

The bay is shallow, with the depth of 5-7 meters averagely. As for the meteorological conditions in Western Java, the dry season is from April

to September, while the wet season from October to March, resulting the annual precipitation of approximately 1500 millimeters. A north-eastern wind mostly blows in the dry season, while a north-western one in the wet season. Several rivers flow into Banten Bay, behind which a plain expands. (Fig. 1).

From the results of environmental survey by this project, from February 1979 to February 1983, the changes of temperature, monthly rainfall, water conditions and current direction are shown in fig. 2 - 16.

Further, in August 1985, the survey was conducted on the distribution of phytoplanktons. From the result of this survey, Banten Bay is divided into 3 type areas, that is, oceanic type, estuarine type and low production type area (Fig. 17).

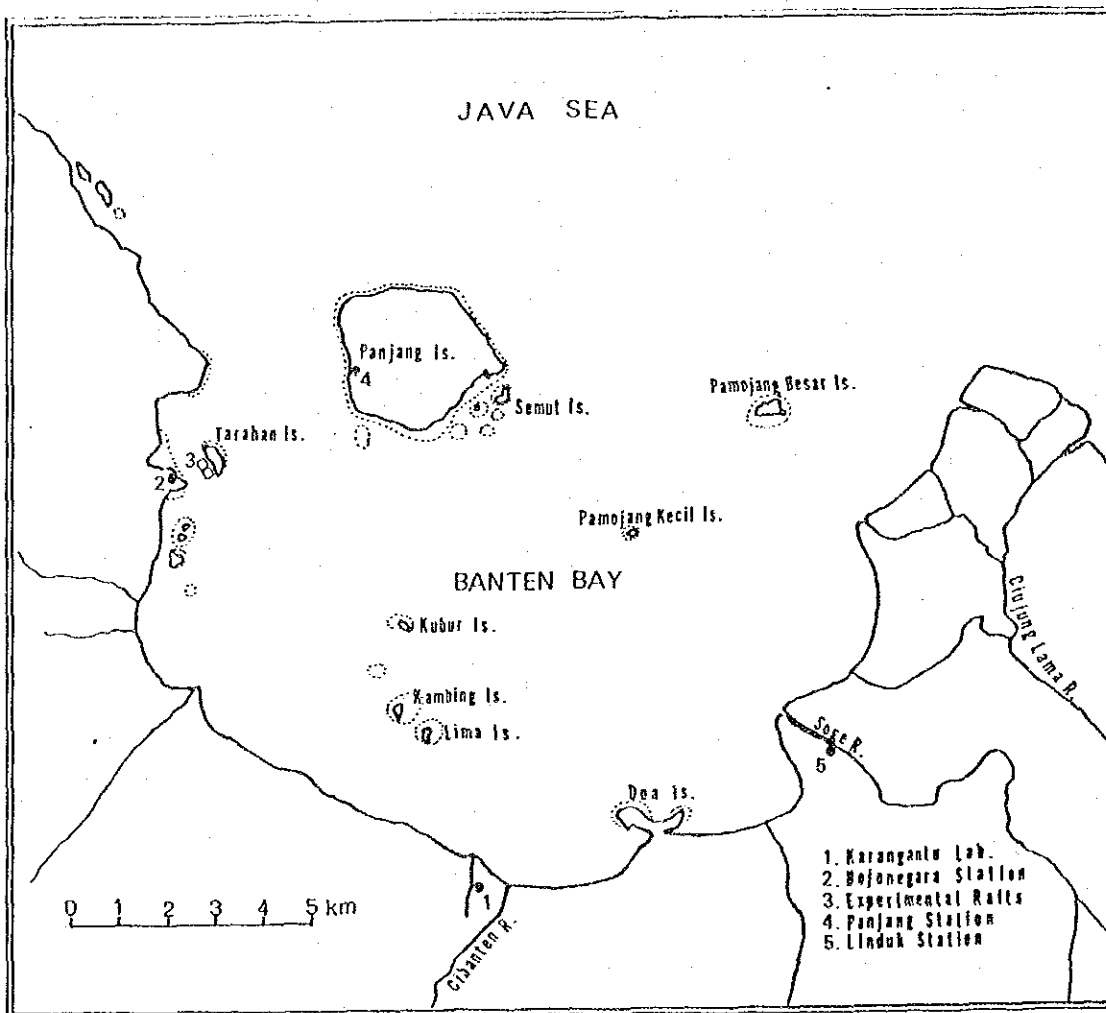
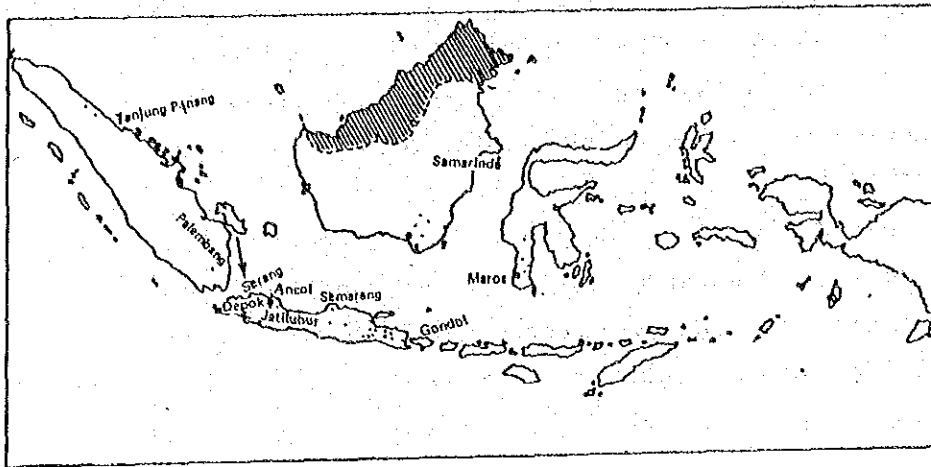


Fig. 1 Location of Serang and Map of Banten Bay

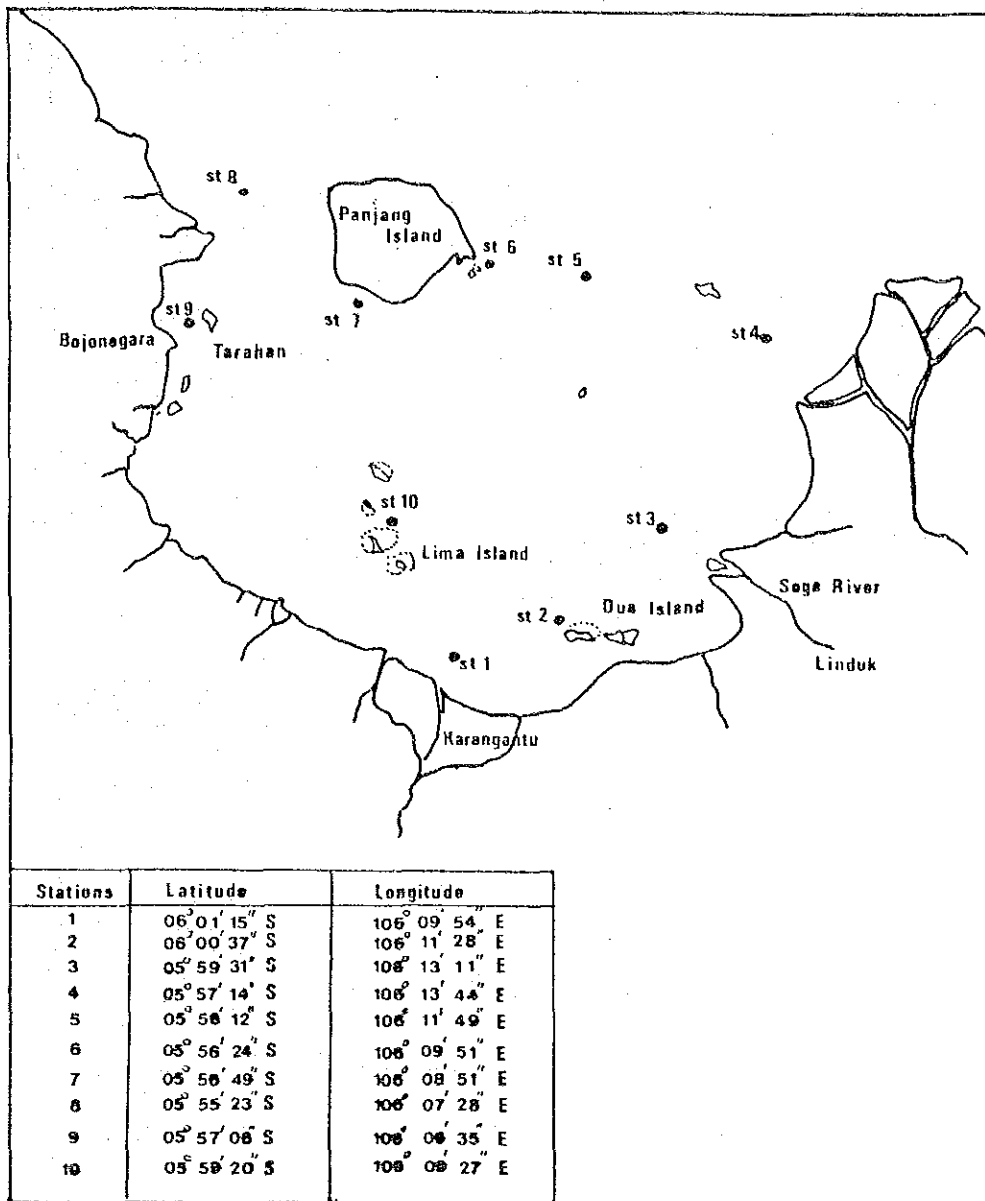


Fig. 2 Banten Bay and the Location of Observed Stations

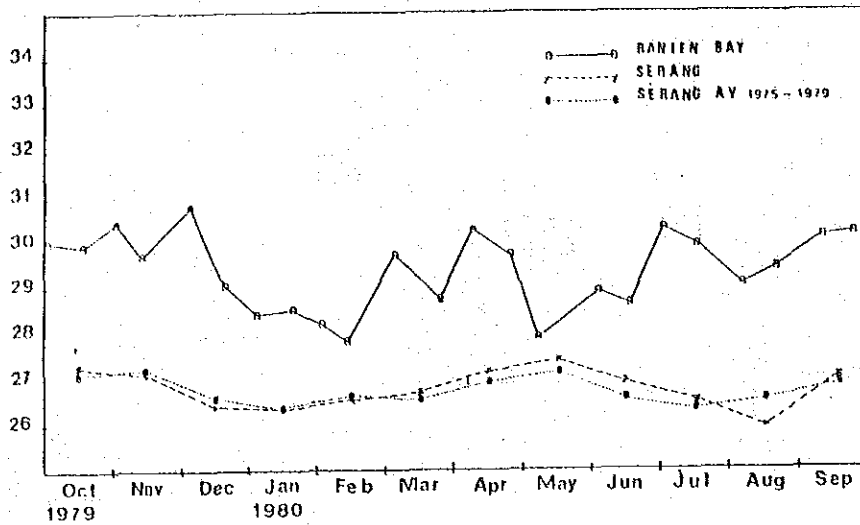


Fig. 3 Seasonal Change of Atmospheric Temperature ($^{\circ}\text{C}$) in Banten Bay and Serang, Oct. 1979–Sep. 1980

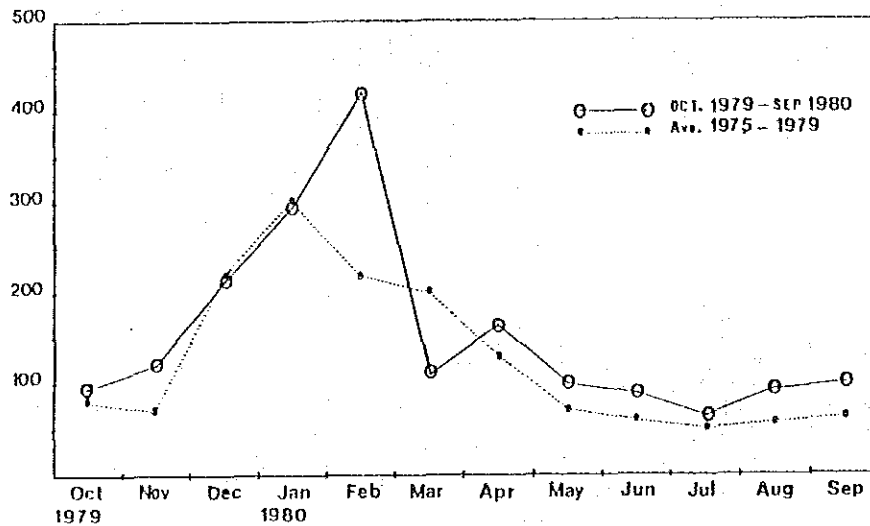


Fig. 4 Seasonal Change of Monthly Rainfall (mm) in Serang, Oct. 1979–Sep. 1980

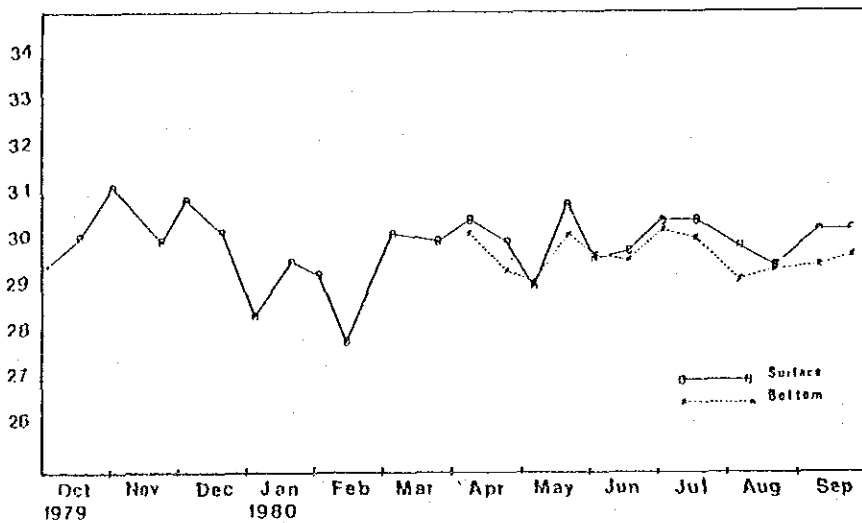


Fig. 5 Seasonal Change of Water temperature ($^{\circ}\text{C}$) in Banten Bay, Oct. 1979–Sept. 1980

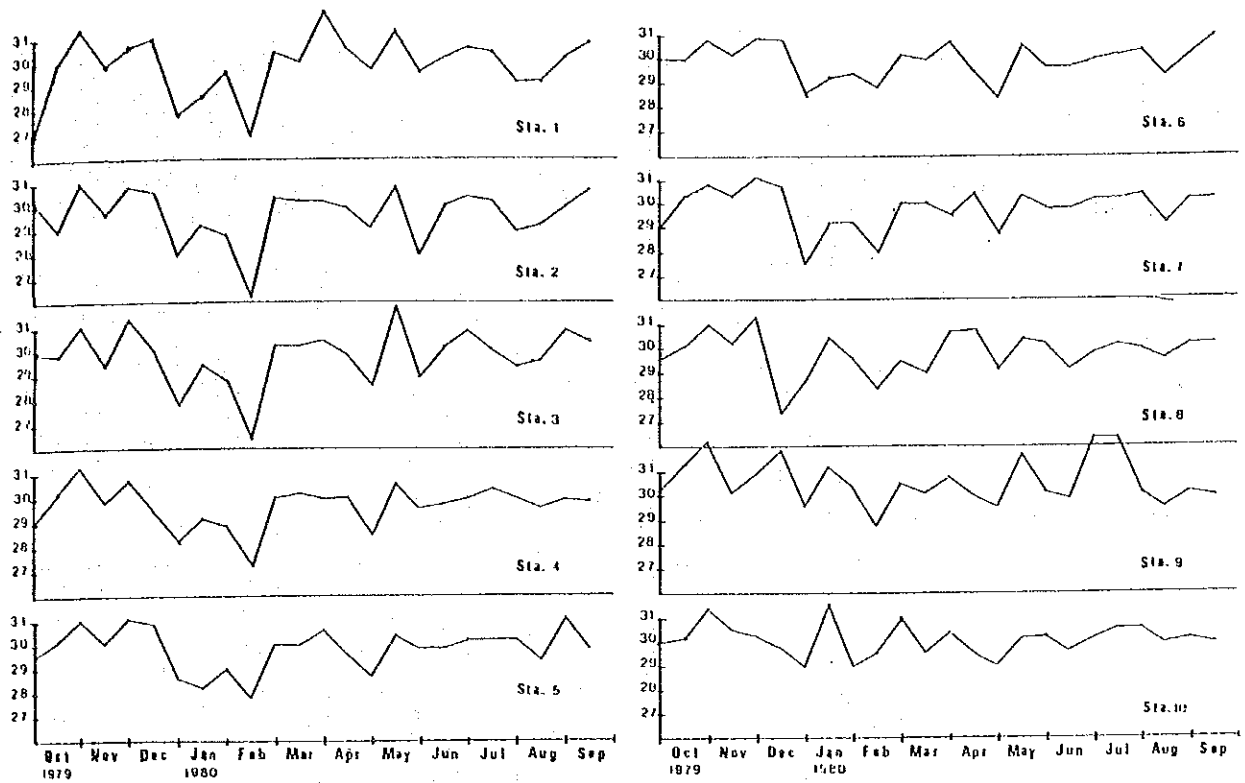


Fig. 6 Seasonal Change of Water Temperature (°C) in Each Station in Banten Bay, Oct. 1979–Sep. 1980

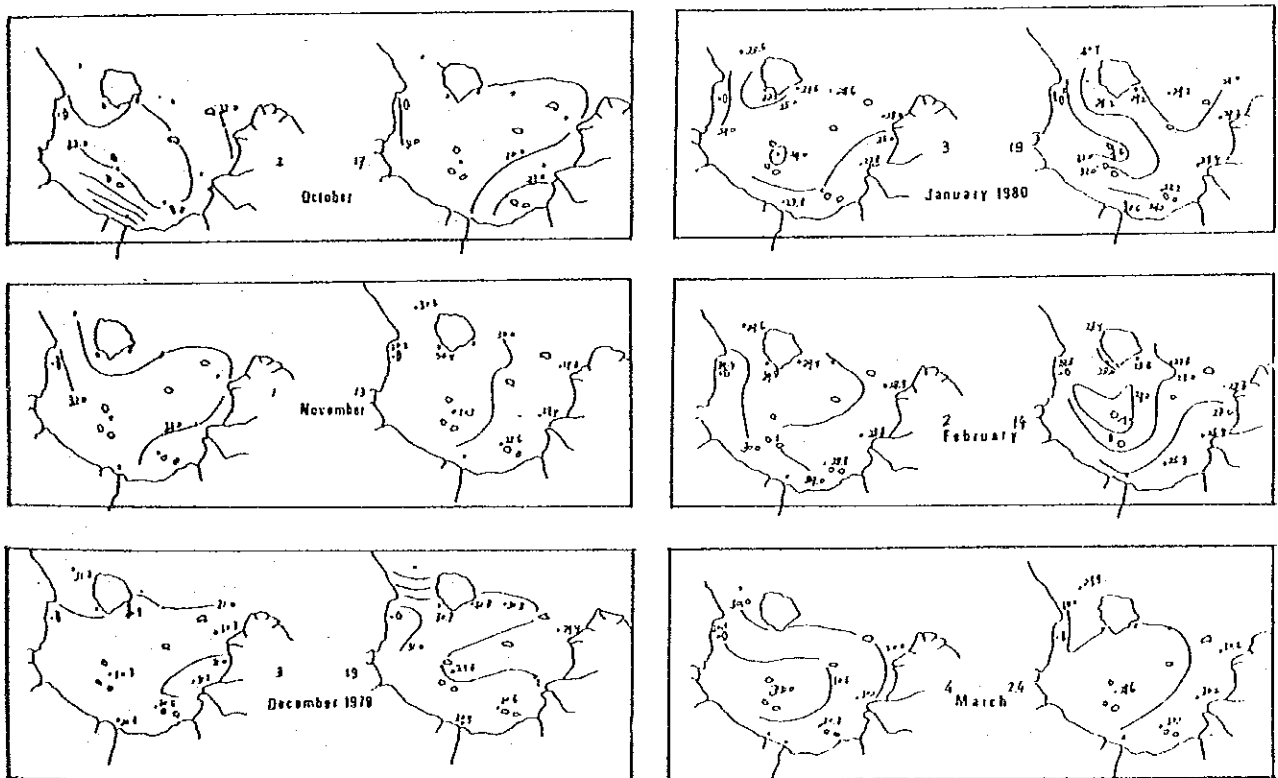


Fig. 7 Horizontal Distribution of Water Temperature (°C) in the Surface Layer in Banten Bay, October 1979–March 1980.

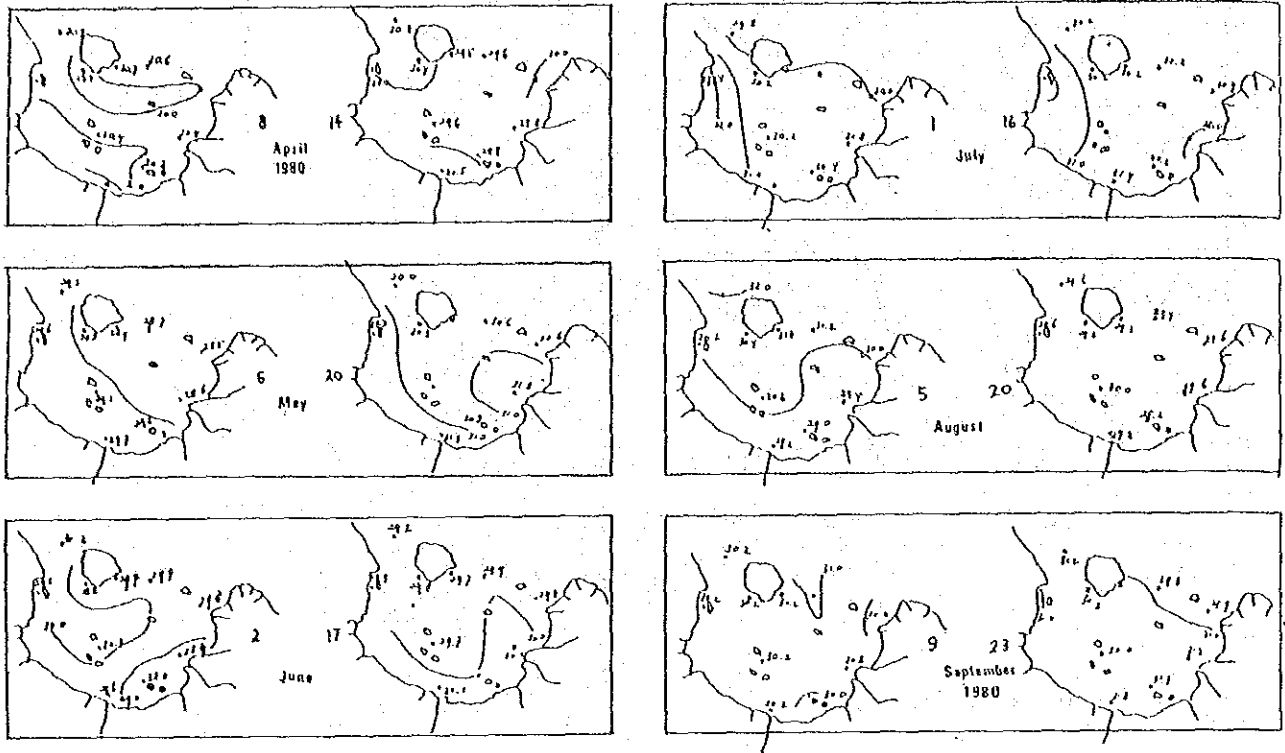


Fig. 7 Continued

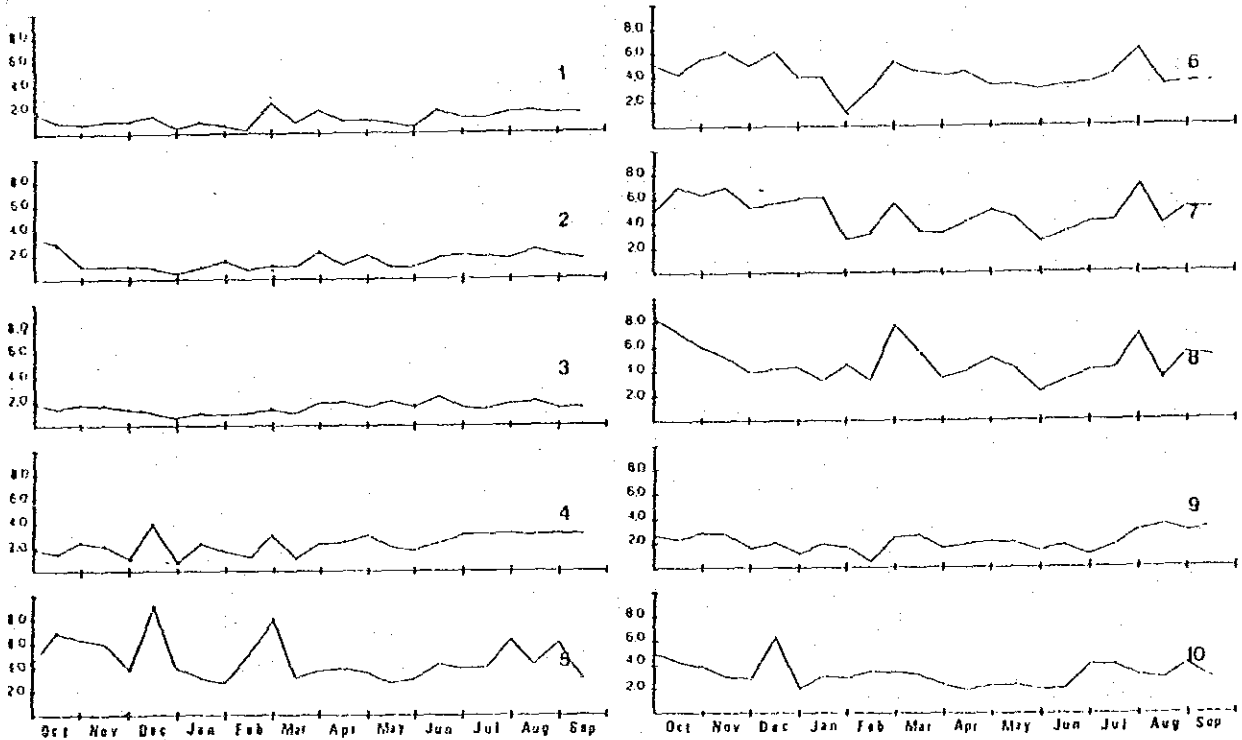


Fig. 8 Seasonal Change of Transparency [m] in Each Station in Banten Bay, October 1979-September 1980

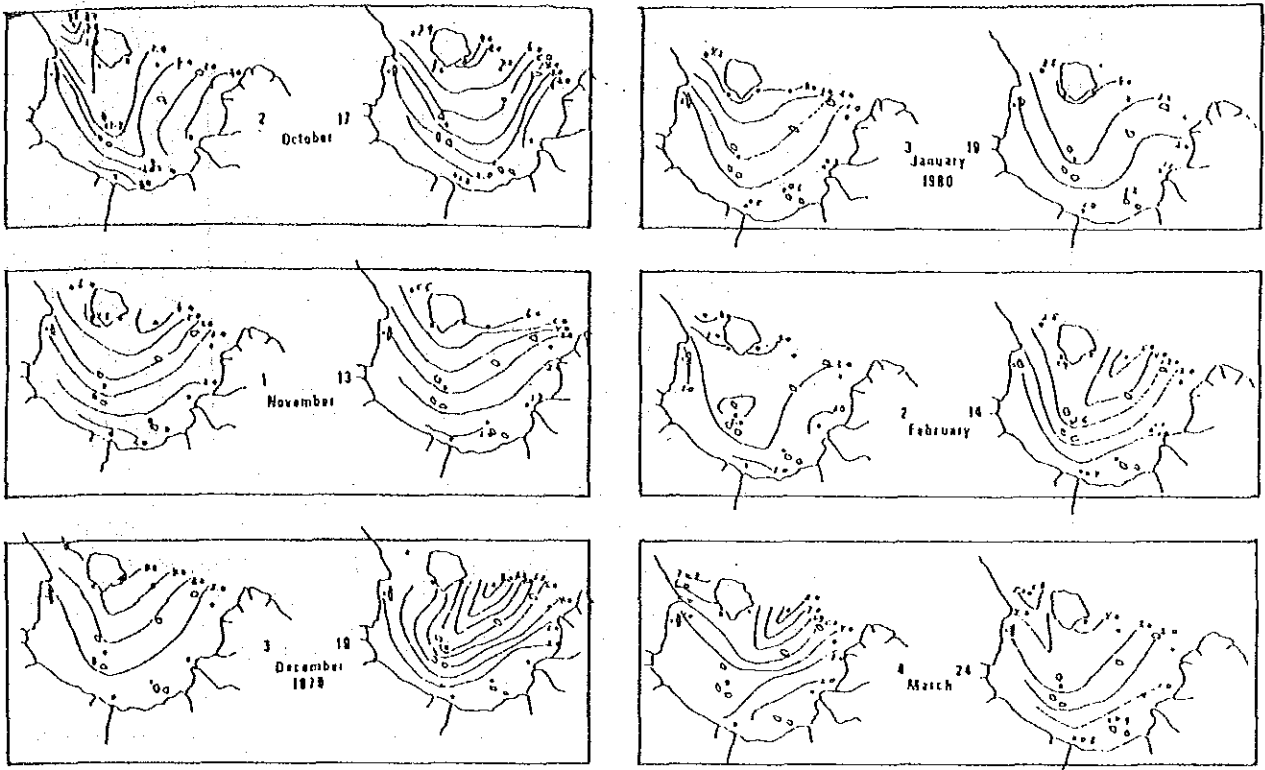


Fig. 9 Horizontal Distribution of Transparency [m] in Banten Bay, Oct. 1979-Mar 1980

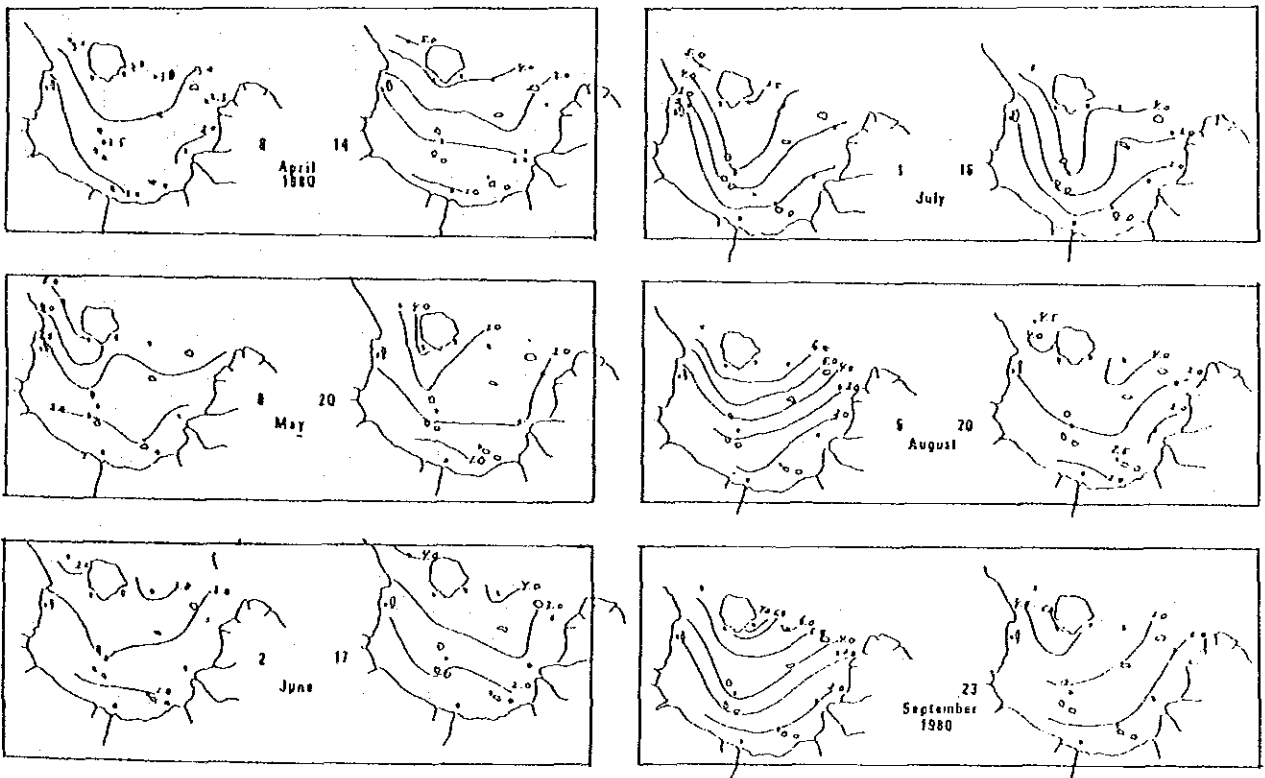


Fig. 9 Continued

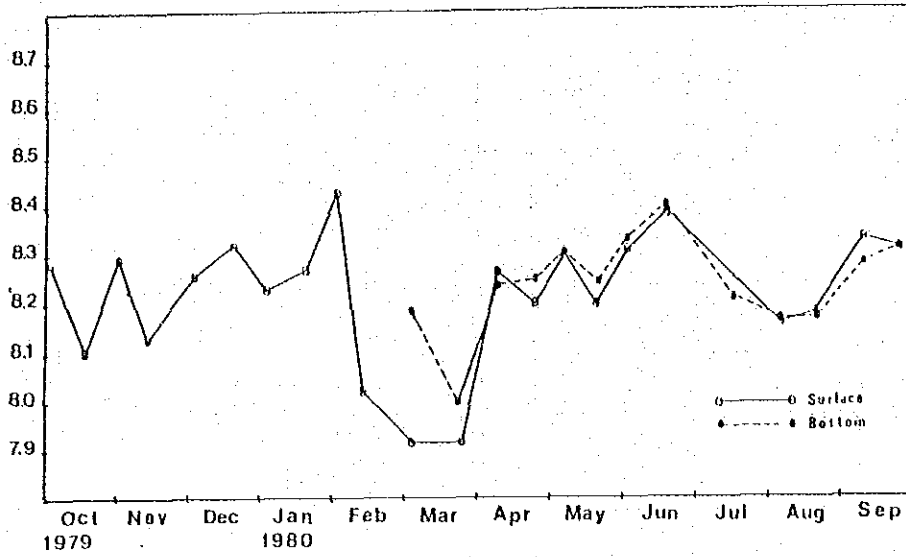


Fig. 10 Seasonal change of pM in Banten Bay, October 1979 - September 1980

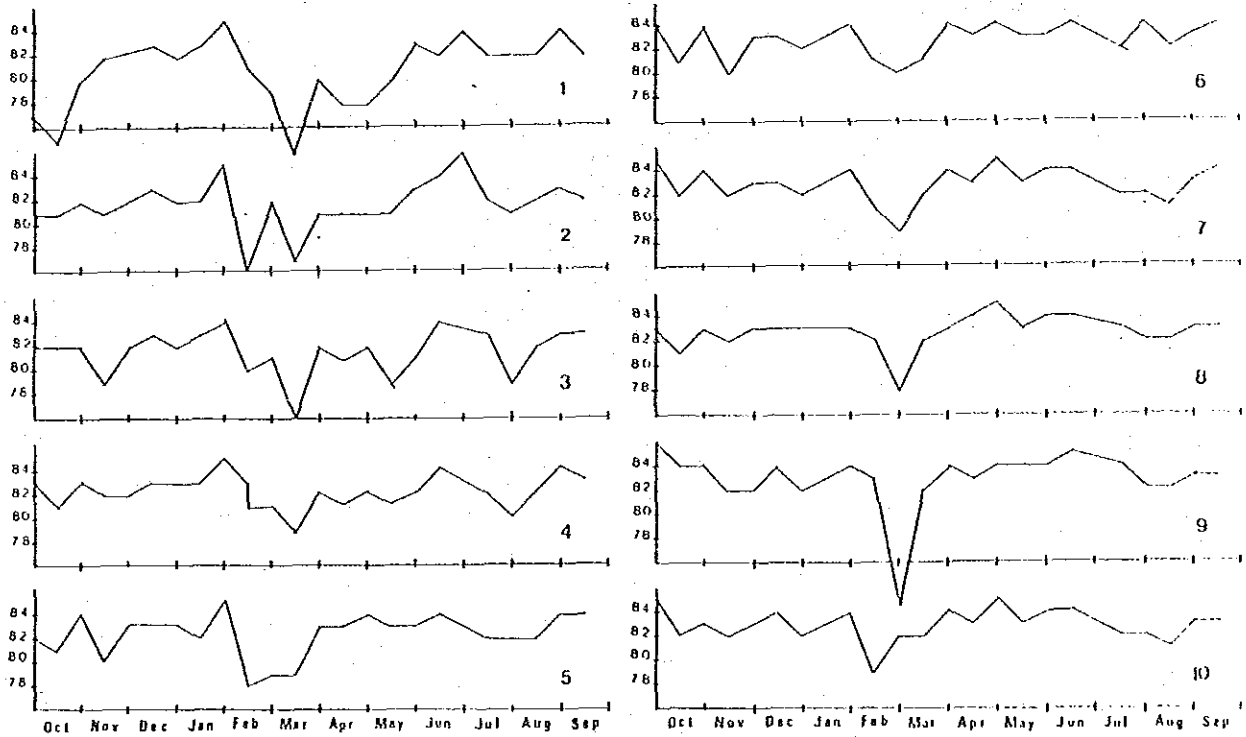


Fig. 11 Seasonal change of pM in each stations in Banten Bay, October 1979 - September 1980

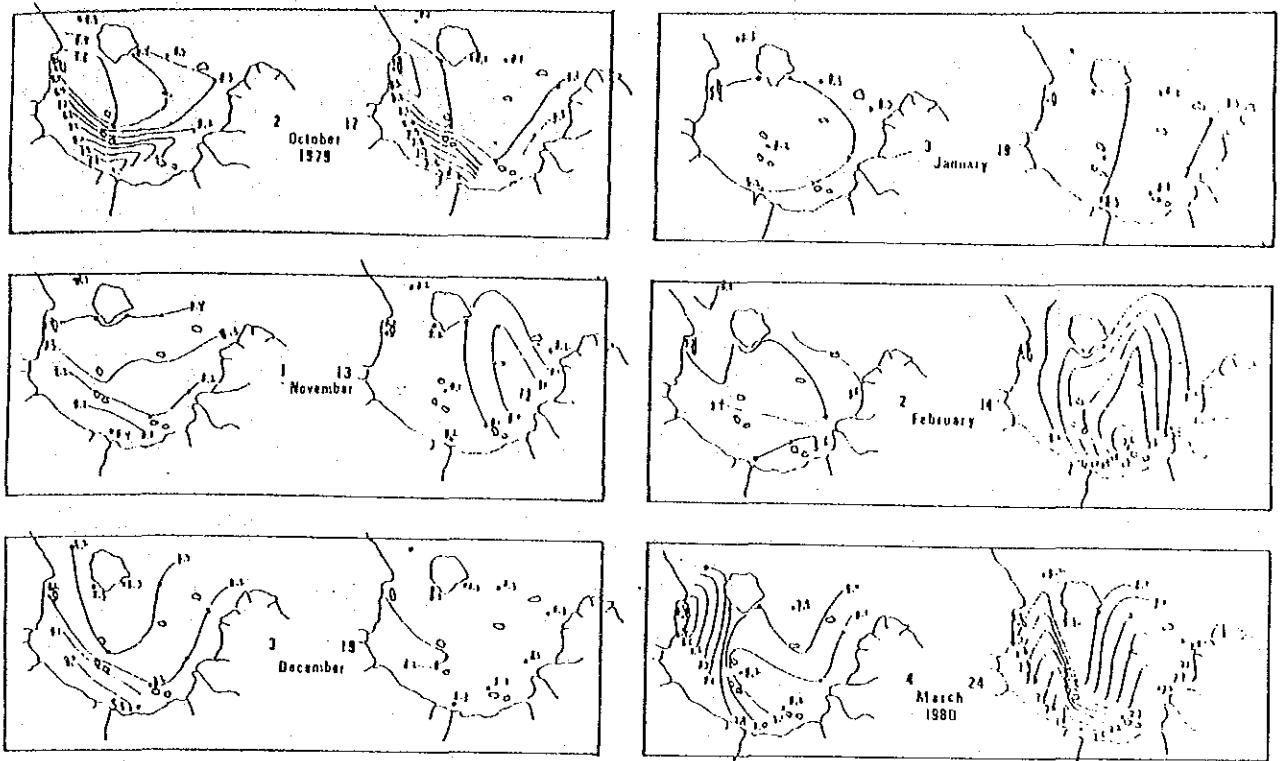


Fig. 12 Horizontal distribution of PM in the surfate layer in Banten Bay, October 1979 - March 1980

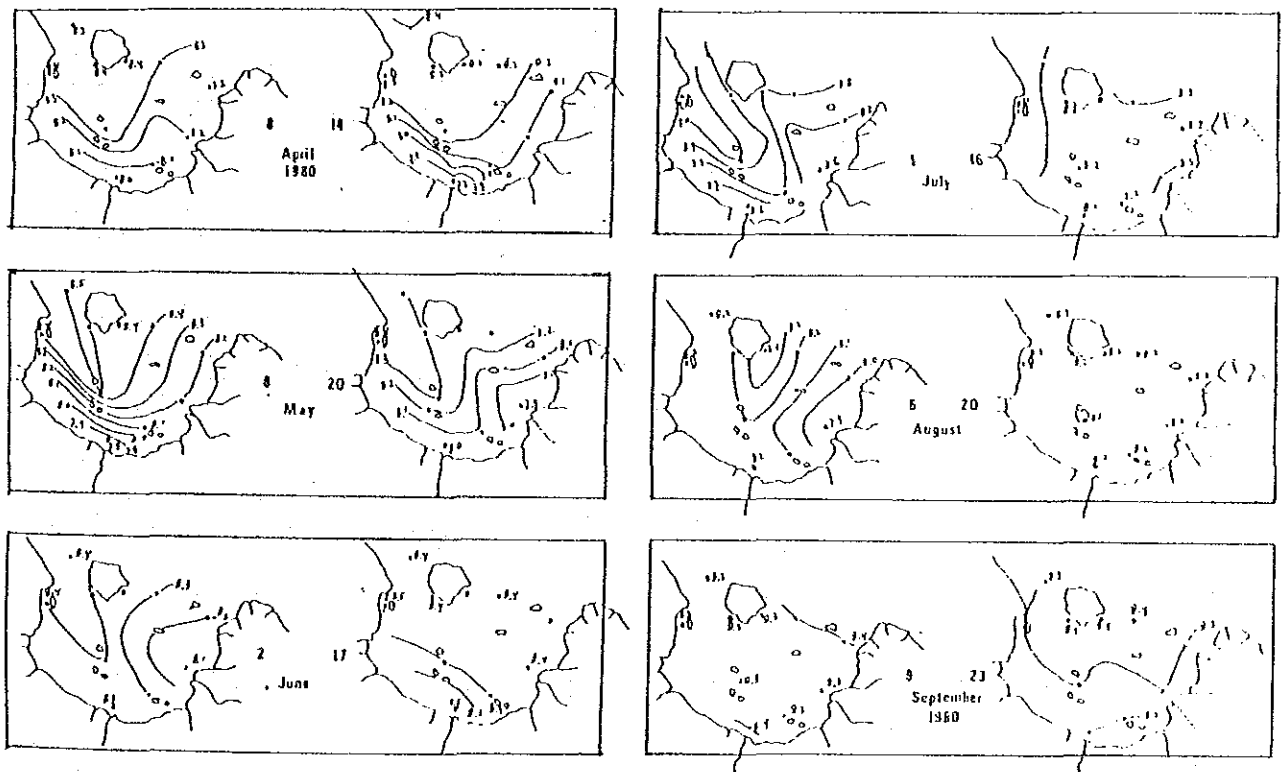


Fig. 12 Continued

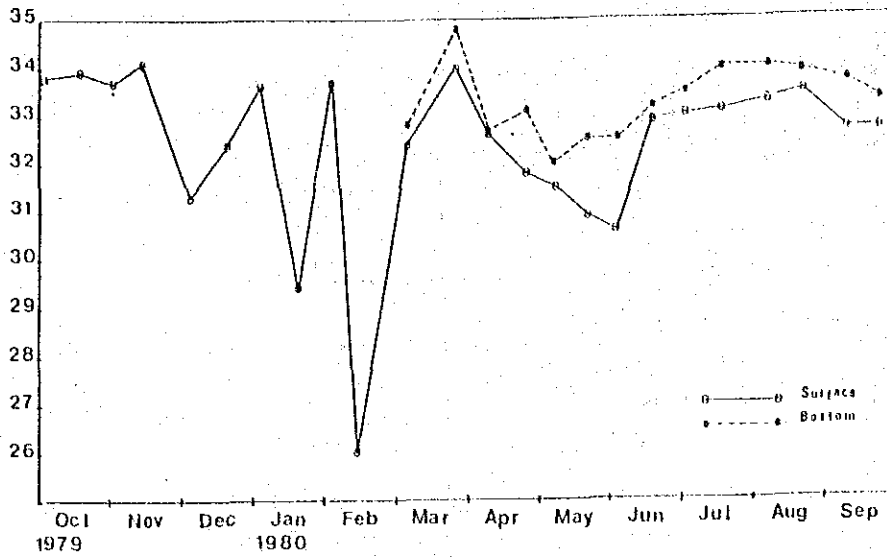


Fig. 13 Seasonal change of salinity (‰) in Banten Bay, October 1979 - September 1980

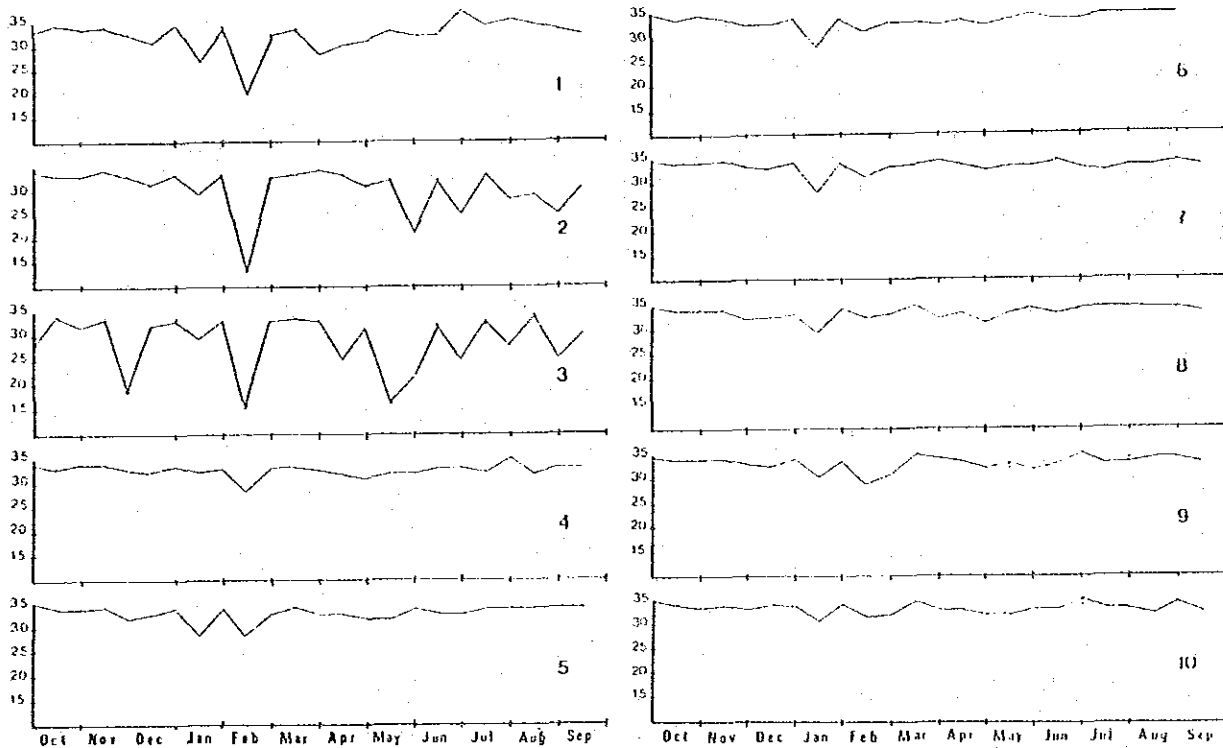


Fig. 14 Seasonal change of salinity (‰) in each stations in Banten Bay, October 1979 - September 1980

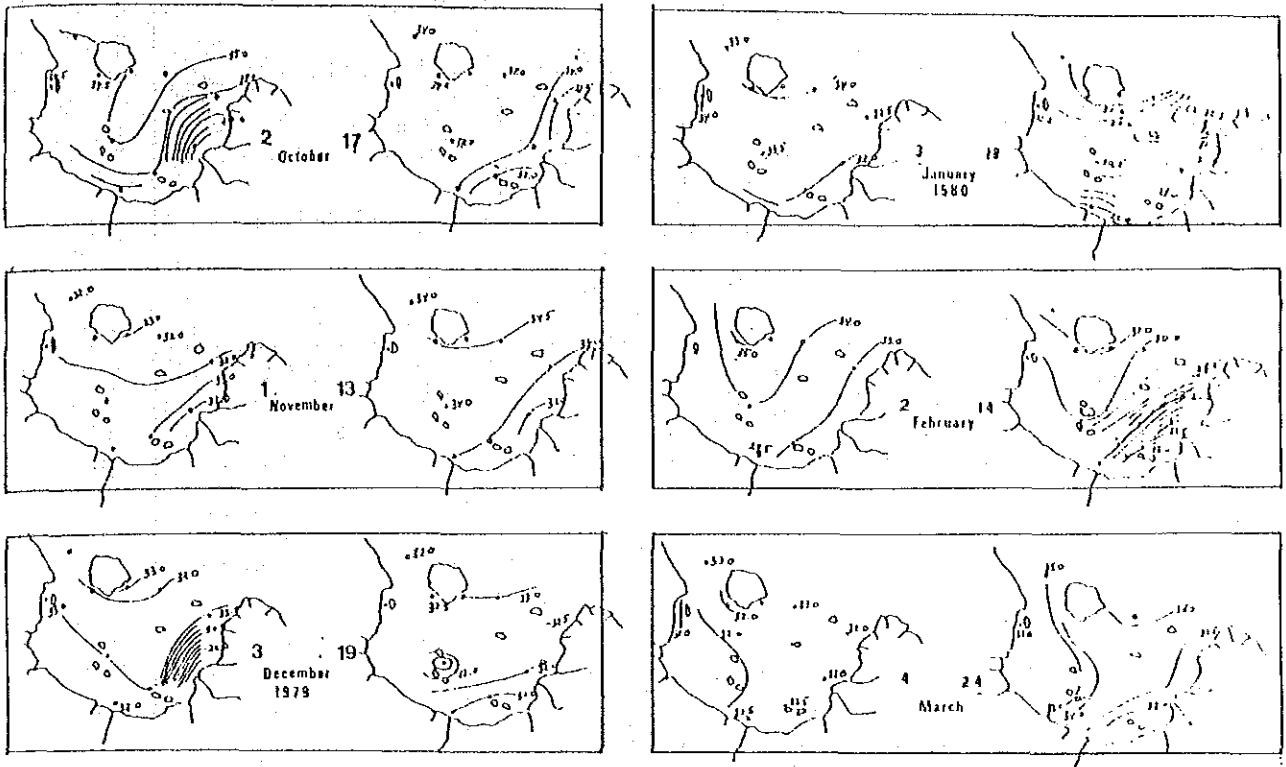


Fig. 15 Horizontal distribution of salinity (‰) in surface layer in Bintan Bay, October 1979 - September 1980

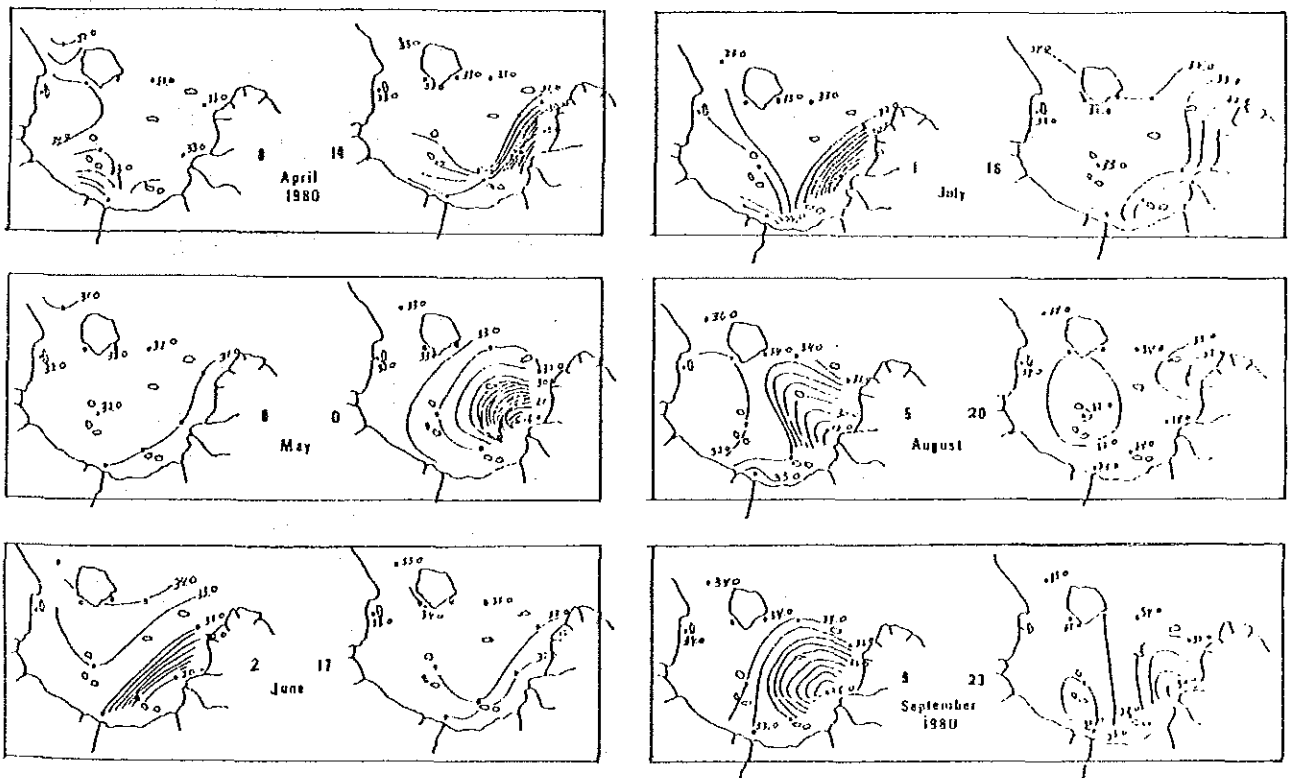


Fig. 15 Continued

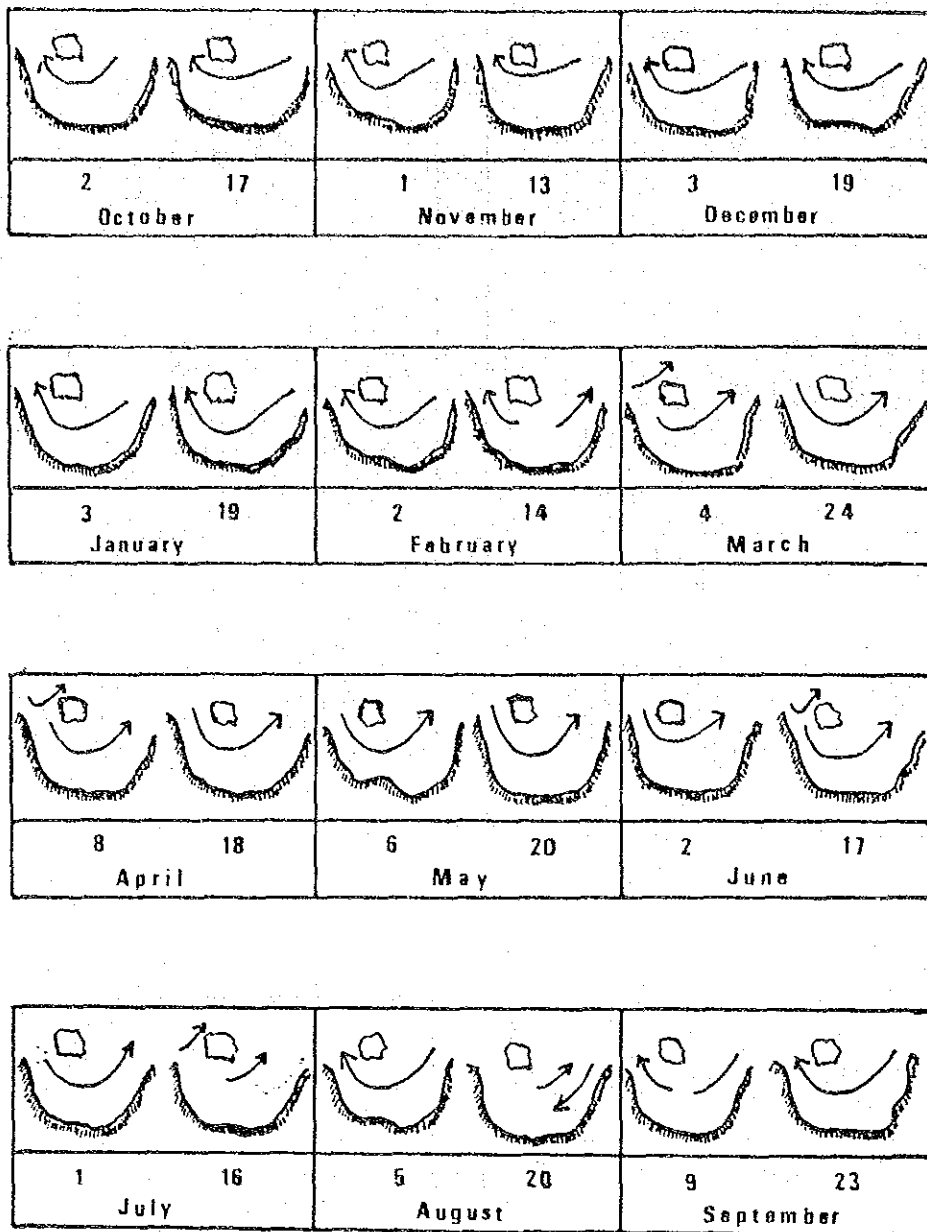


Fig. 16 Current direction in Banten Bay, Oct. 1979 - Sept. 1980

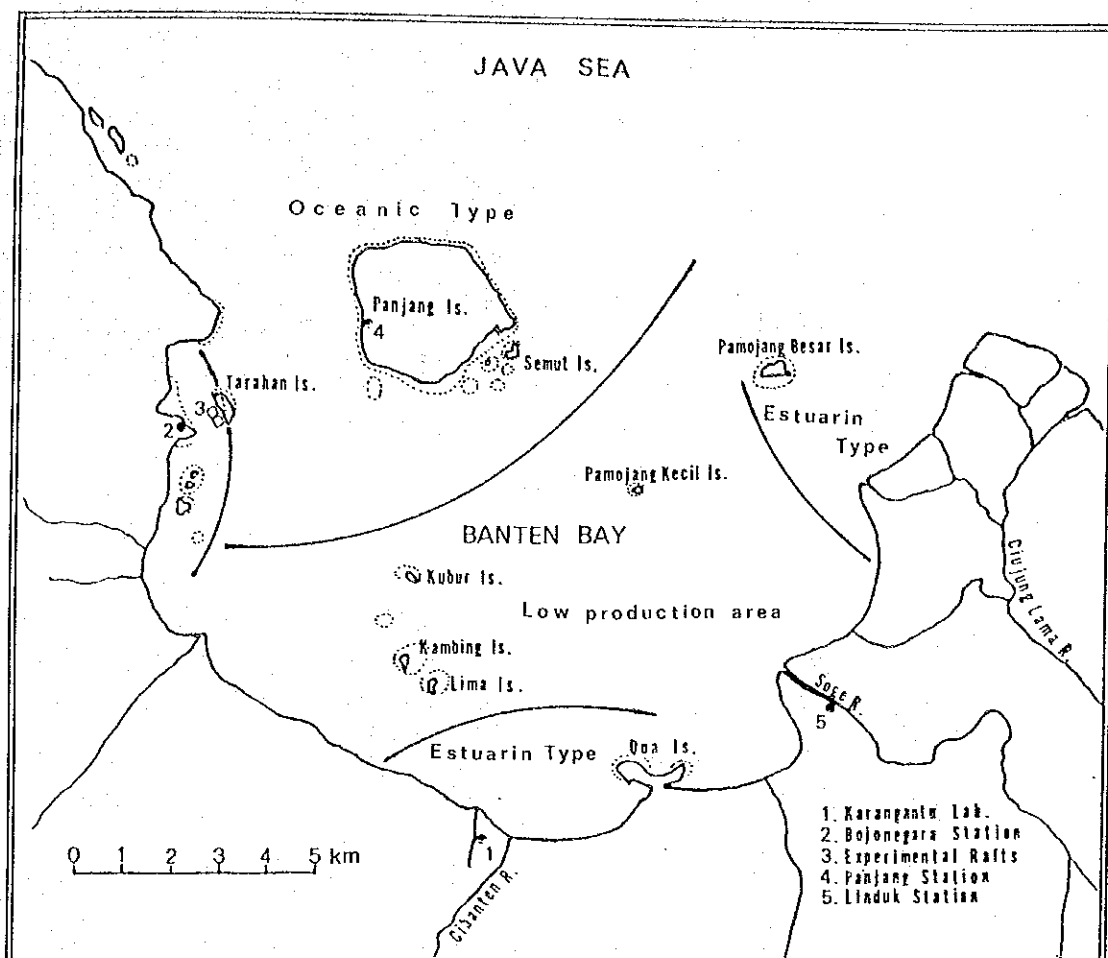


Fig. 17 Three types of area divided by the phytoplankton distribution in Banten Bay.

The phytoplanktons which were observed in this survey are shown in table 1 and photo 1 - 12.

Table 1 Suitable diatoms for mariculture collected by the survey, in August, 1985.

Species of Diatoms
<u>Skeletonema costatum</u>
<u>Chaetoceros spp.</u>
<u>Rhizosolenia spp.</u>
<u>Nitzschia spp.</u>
<u>Navicula spp.</u>
<u>Bacteriastrum spp.</u>

Almost species are useful for mariculture but some species (Chattonella spp., etc.) are representative red tide organisms. According to the progress of industrialization, those species seem to form red tides in even Banten Bay. The mechanism of flagellate red tide in Japan is

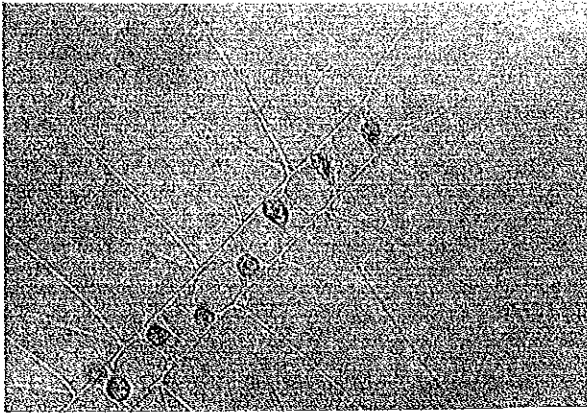


Photo 1 Chaetoceros sp

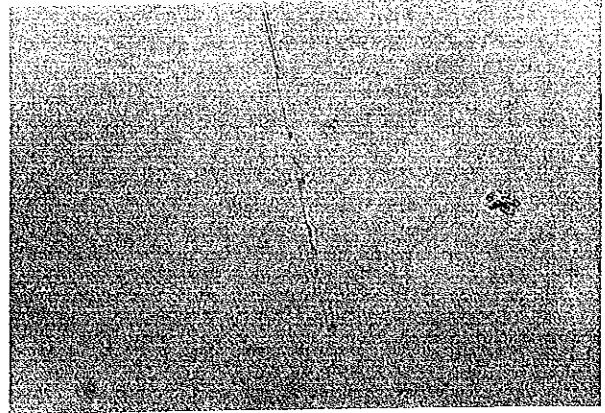


Photo 4 Nitzschia sp

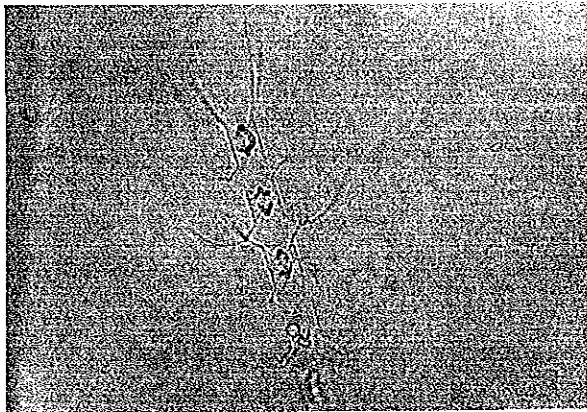


Photo 2 Chaetoceros sp

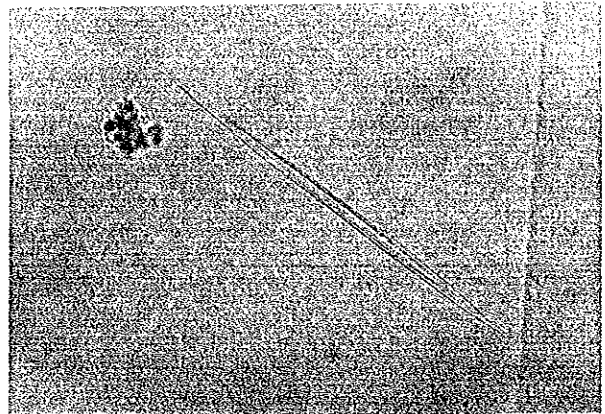


Photo 5 Nitzschia sp

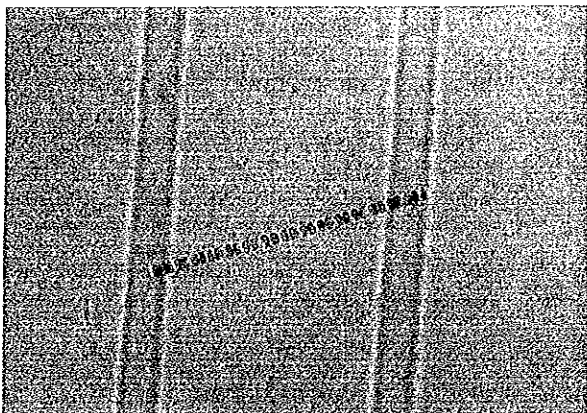


Photo 3 Chaetoceros sp

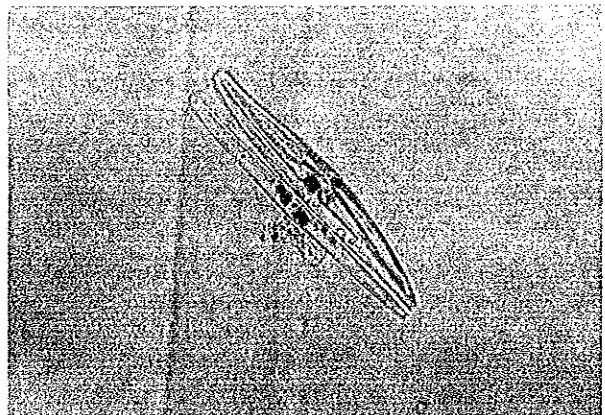


Photo 6 Nitzschia sp

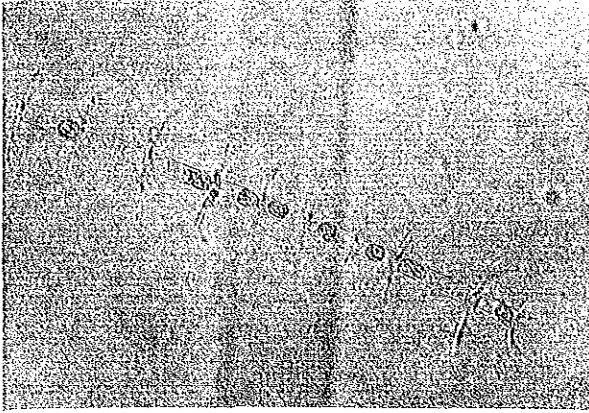


Photo 7 Bacteriastrum sp

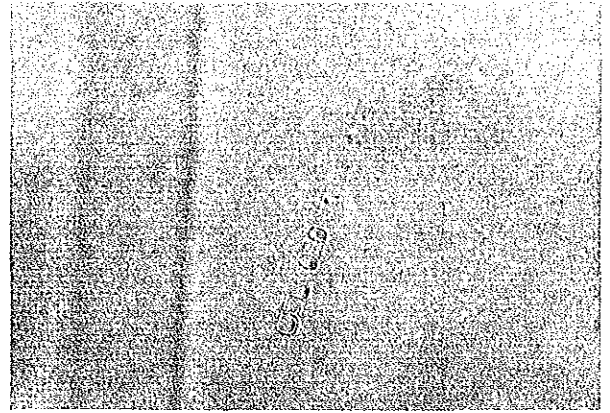


Photo 10 Skeletonema costatum

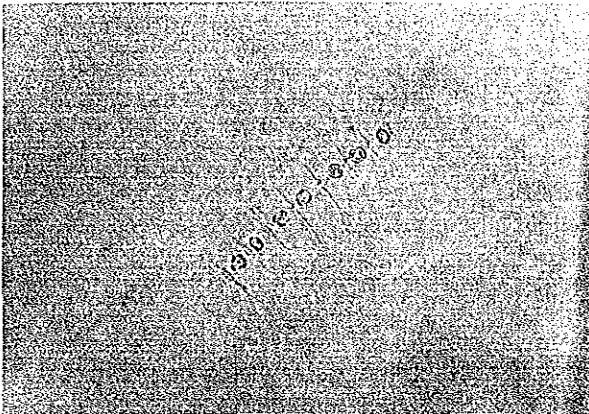


Photo 8 Bacteriastrum sp

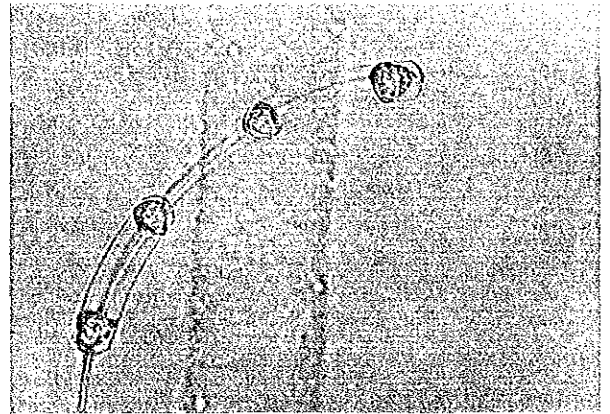


Photo 11 Rizosolenia sp

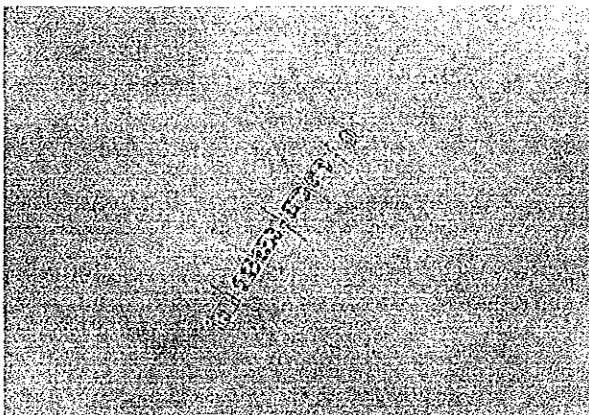


Photo 9 Bacteriastrum sp

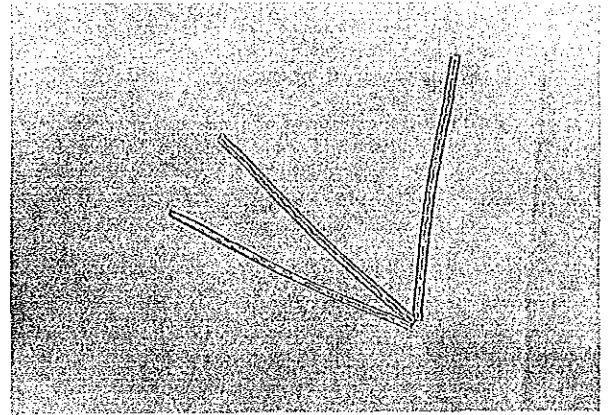
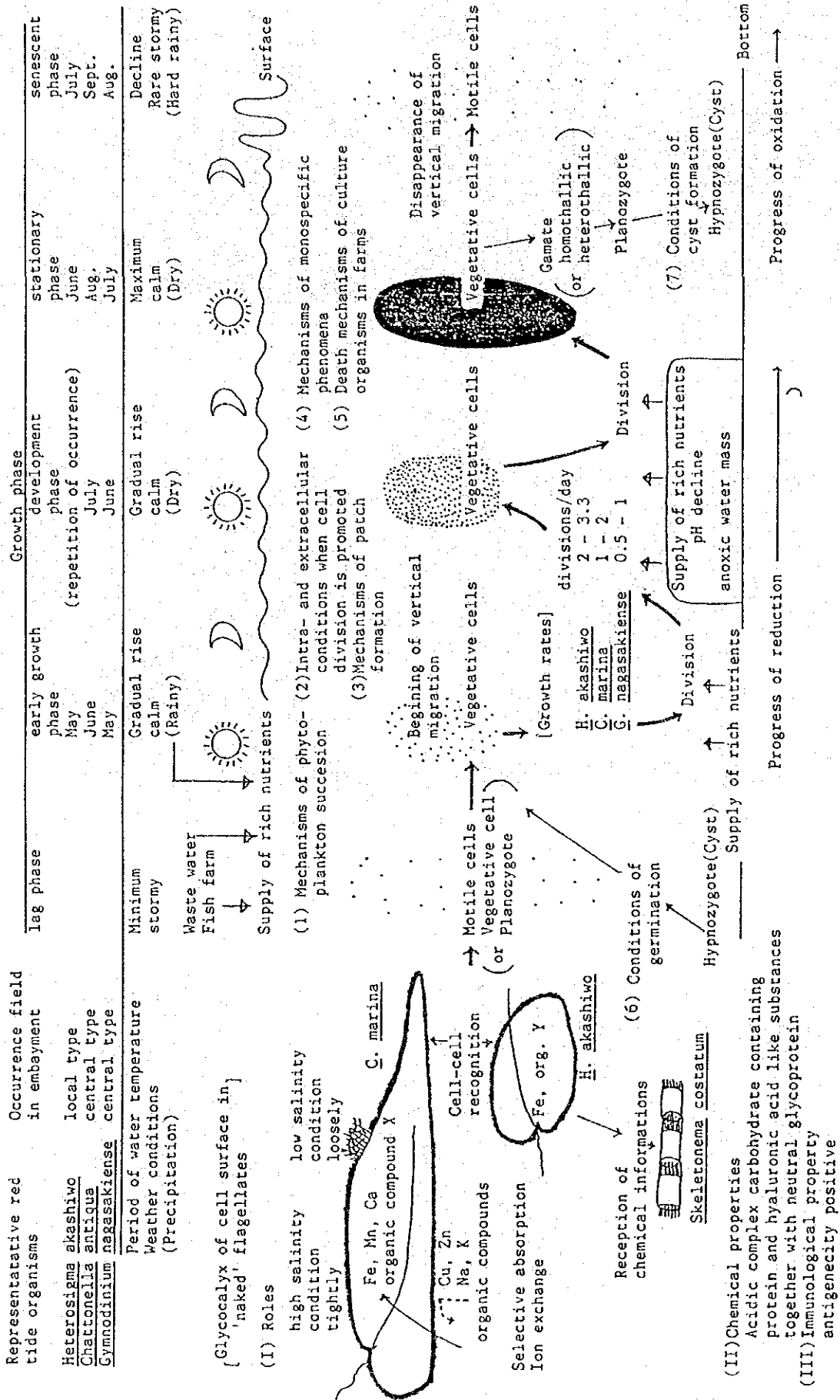


Photo 12 Thalassiothrix sp

Fig. 18 The occurrence mechanism of flagellate red tide



(From lecture of HONTO, 1985)

3. Fish Culture in Banten Bay

3-1 Suitable species for mariculture more than 19 species had been raised experimentally (1979 - 1984) to select suitable species for mariculture in Indonesia (Table 2). Eight of the 19 species were selected as target fishes for mariculture. Eight species of fishes were rabbit fish (Siganus guttatus, S. javus and S. canaliculatus), giant seaperch (Lates calcarifer), snappers (Lutjanus johni, L. altifrontalis and L. argentimaculatus) and grouper (Epinephelus tauvina) (Photo. 13 - 20).

Table 2 English and Local Name of Main Fishes Concerned in the Project

English name	Local name	Scientific name
1. Rabbitfishes		
1) Streaky Rabbitfish	Beronang	<u>Siganus javus</u>
2) Pearl-spotted Rabbitfish	Lingkis	<u>S. canaliculatus</u>
3) Golden Rabbitfish	Beronang Lada	<u>S. guttatus</u>
4) Cold-spotted Rabbitfish	Manggilala	<u>S. chrysospilos</u>
5) Rabbitfish	Kea-Kea	<u>S. virgatus</u>
2. Giant sea-perch		
	Kakap	<u>Lates calcarifer</u>
3. Groupers		
1) Estuary Grouper	Kerapu Lumpur	<u>Epinephelus tauvina</u>
2) Carpet Grouper	Kerapu Macan	<u>E. fuscoguttatus</u>
3) Black Grouper	Kerapu Balong	<u>E. merra</u>
4) Speckled-finned Grouper	Kerapu Pasir	<u>E. summana</u>
5) Grouper	Kerapu	<u>E. sp</u>
4. Snappers		
1) Red snapper	Kakap Merah	<u>Lutjanus sanguineus</u> , <u>L. altifrontalis</u>
2) John's snapper	Jenah	<u>L. johni</u>
3) One-spot snapper	Jenah	<u>L. monostigma</u>
4) Red snapper	Kakap Merah	<u>Pinjalo sp</u>
5) Mangrove Jack	Kakap Merah	<u>L. argentimaculatus</u>
5. Others		
1) Naked Head Snapper	Lencam	<u>Lethrinus lentjan</u>
2) Banded Grunter	Kerong-Kerong	<u>Therapon sp</u>
3) Herring-Trevally	Selar Batang	<u>Alepes kalla</u>
4) Marine Catfish	Sembilang	<u>Plotosus canius</u>

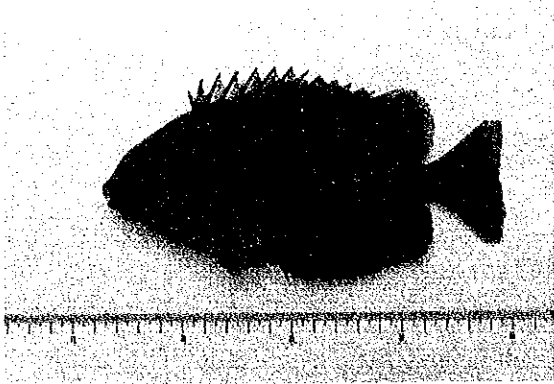


Photo 13 Siganus guttatus

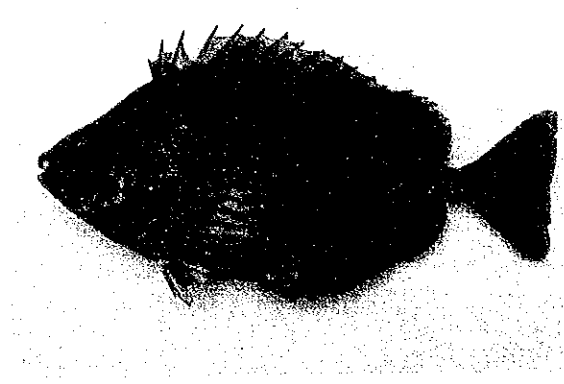


Photo 14 Siganus javus

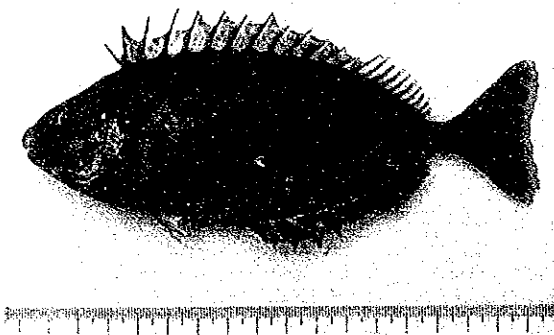


Photo 15 Siganus canaliculatus

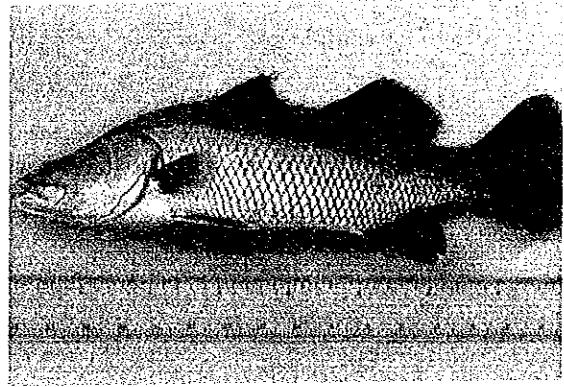
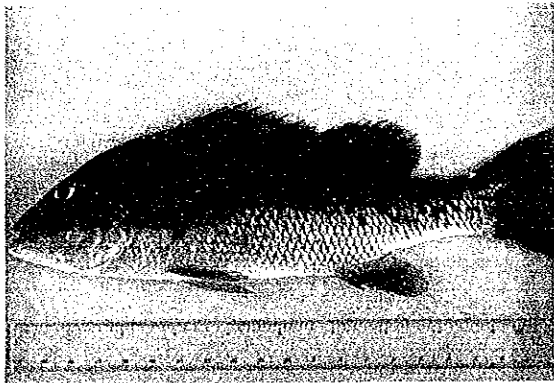


Photo 16 Lates calcarifer



Phot 17 Lutjanus johni

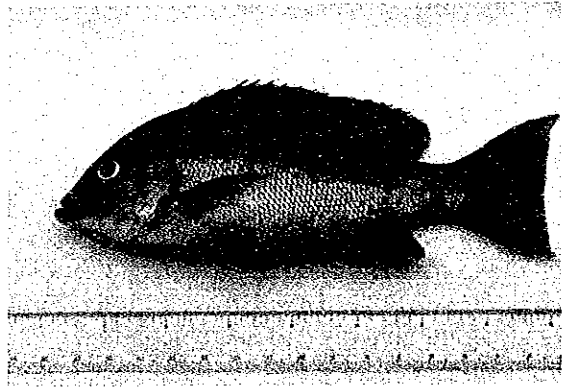


Photo 18 Lutjanus altifrontalis

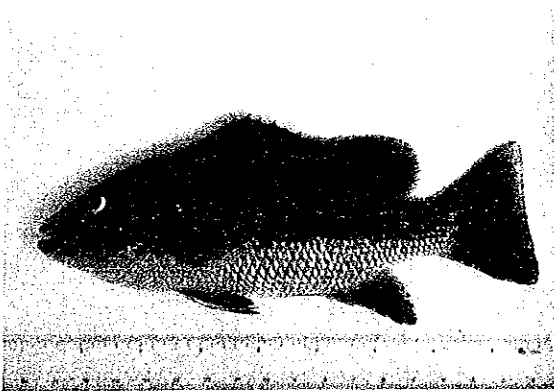


Photo 19 Lutjanus argentimaculatus

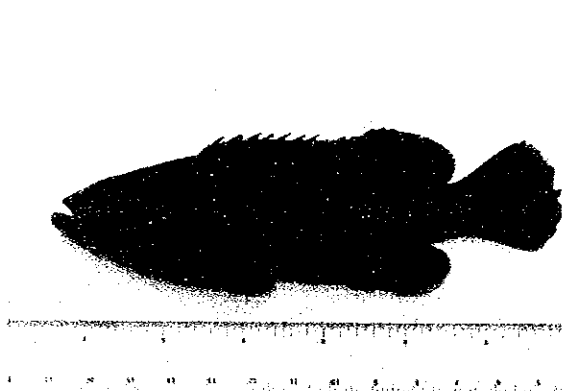


Photo 20 Epinephelus tauvina

3-2 Culture Method

3-2-1 Dike Type Method (Fig. 19)

Dike is made as enclosing some water area, for example, innerbay, inlet, channel, etc. Water change is done by the change of tidal level through the gate.

3-2-2 Wall Net Method

1) Net fence with poles type (Fig. 20)

This is a type stretching a rope at poles of reinforced concrete of about 40 cm diameter or of steel pile or about 20-30 cm diameter, and spreading a separating net with the rope.

2) Hanging net with rope type (Fig. 21)

This is a type to stretch a rope from one place at the coast to another place at the coast, and hung a separating net at the rope.

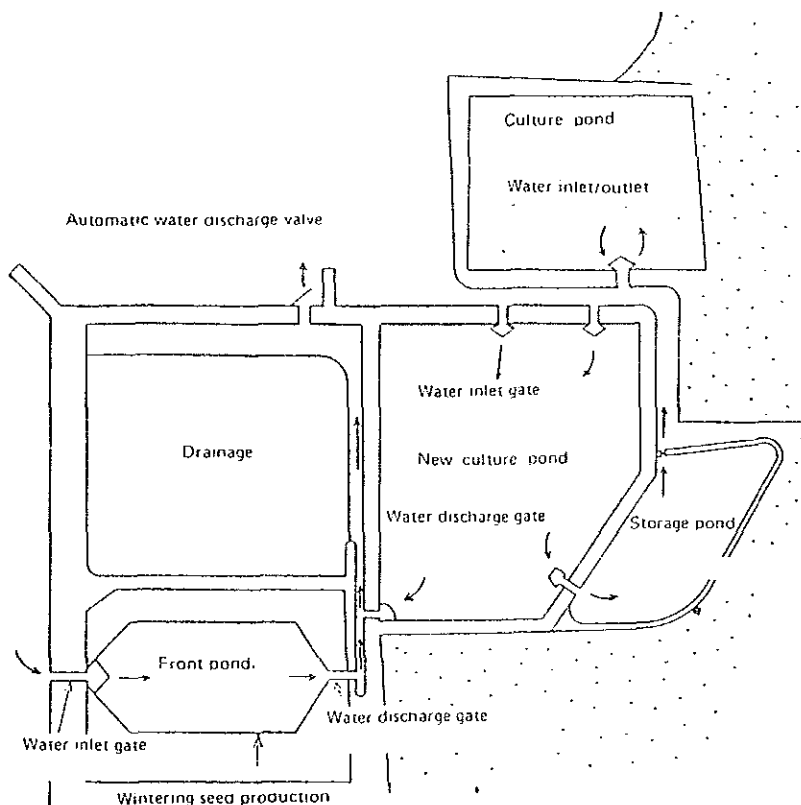


Fig. 19 Dike type culture pond.

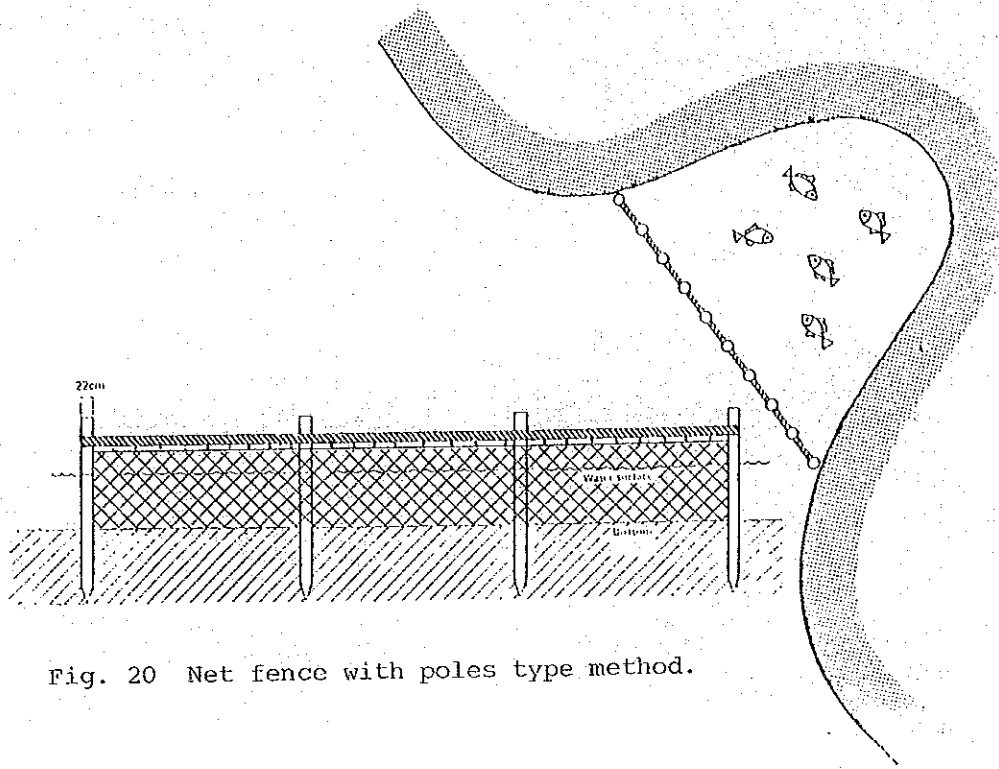


Fig. 20 Net fence with poles type method.

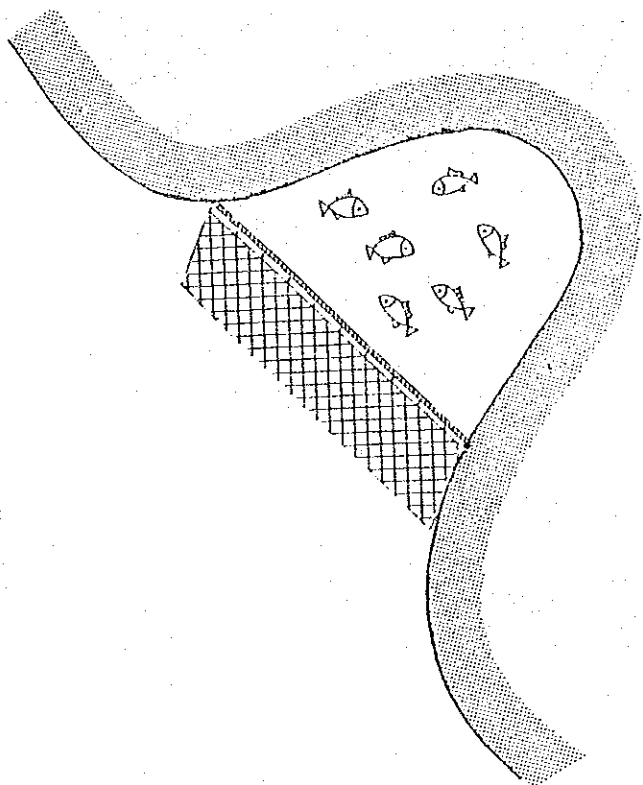


Fig. 21 Hanging net with ropes type method.

3-2-3 Net Cage Method

1) Floating net cage type (Fig. 22)

Floating net cage was conducted in Bojonegara experimental station. The construction of a raft by the modern Japanese technique were practiced, and the manuals for them were prepared. The kinds of rafts and their constructing methods.

(1) Bamboo raft

For a raft of the dimension of 5 m x 5 m:

Material	a. Bamboo	12 trunks
	b. Empty drum cans	13 drums (for a buoy)
	c. Wire and auxiliary material	
	d. Workers	5-10 workers

Estimated cost: 200,000 - 300,000 Rp/raft (in Indonesia)

Life: 2 - 3 years

The procedure of construction is shown in photo 21 - 26.

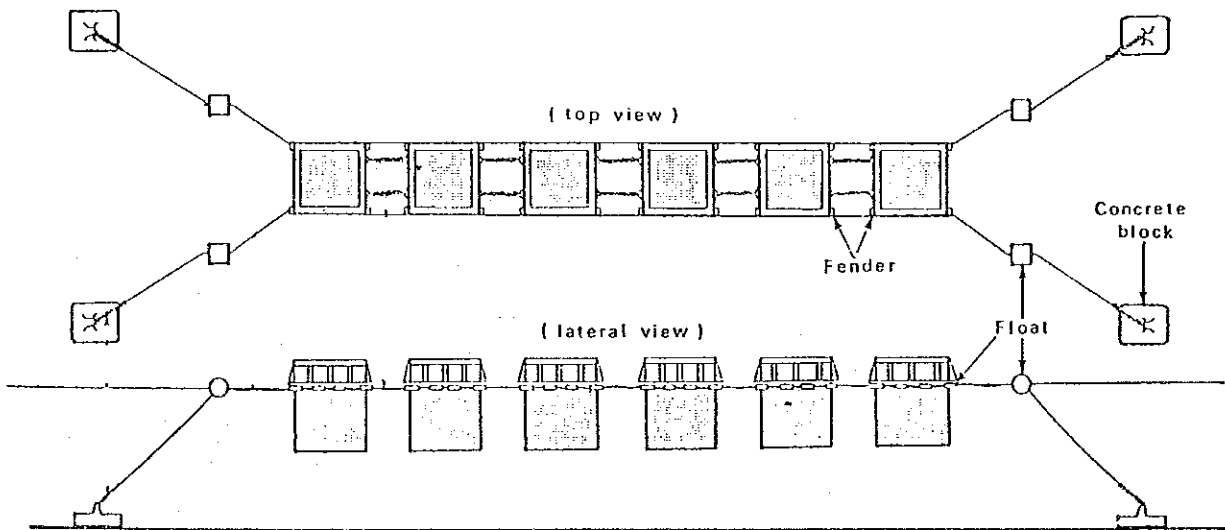


Fig. 22 An example of floating net-cages

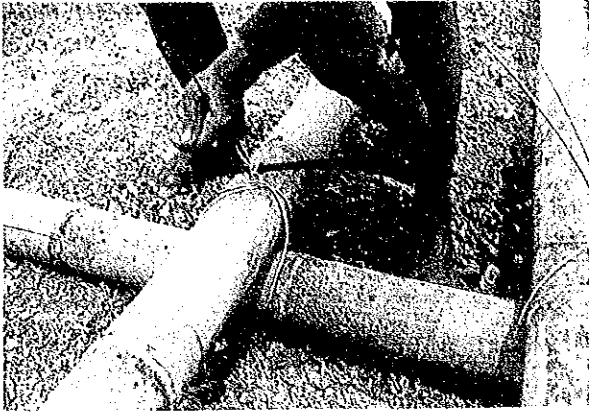


Photo 21 Binding by wire

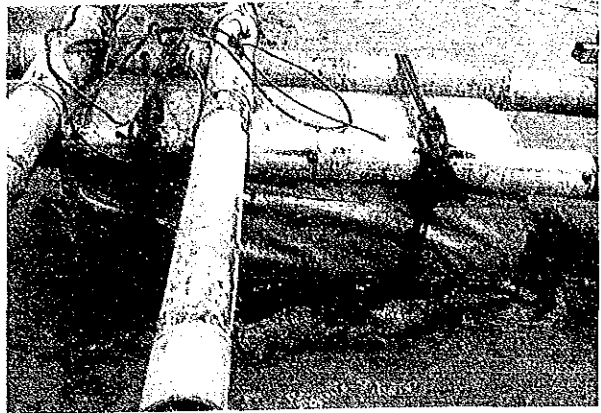


Photo 24 Float set with raft



Photo 22 Float completed

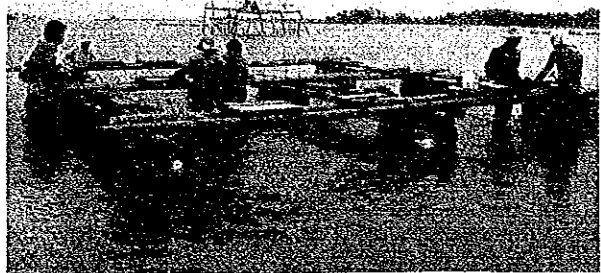


Photo 25 Setting foothold

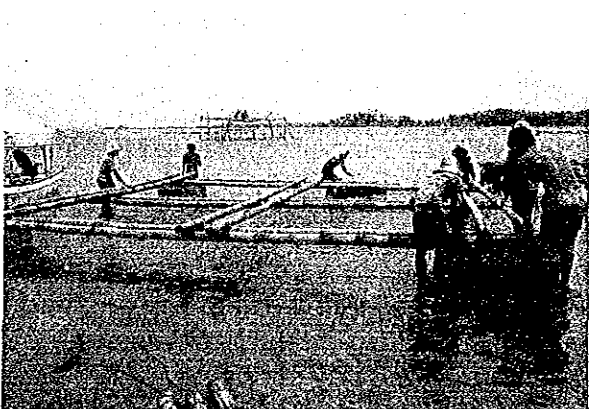


Photo 23 Setting float



Photo 26 Raft completed

(2) Steel raft

Material:	steel
Way of assembly:	by means of nuts (very easy)
Estimated cost:	300,000 yen/ 5 m x 5 m raft
Life:	5 - 10 years

(3) P.V.C.raft

Material:	P.V.C.
Way of assembly:	very easy
Estimated cost:	400,000 yen/ 5 m raft
Life:	5 - 10 years

2) Net Pen Type (Fig. 23)

This method is commonly used for milkfish culture in Philippines. Poles of palm tree on bamboo are driven into muddy bottom area and net or bamboo is enclosed around poles (Fig. 4).

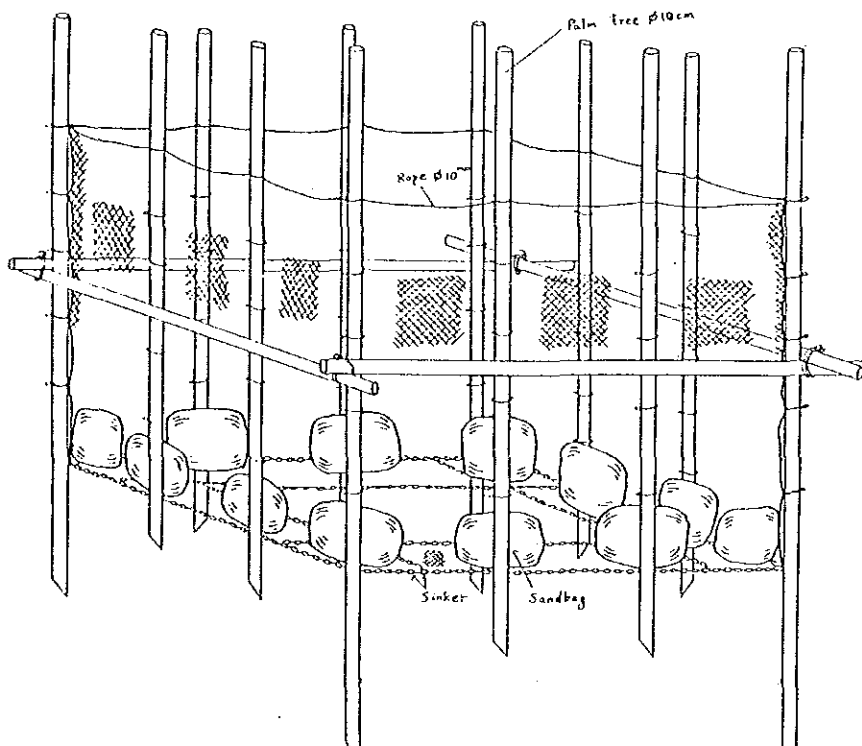


Fig. 23 Net pen type method.

3-2-4 Pond Culture Method (Fig. 24)

This method is commonly used for freshwater or brackish water culture. The pond is usually a flat bottom with some grooves for draining. The pond culture is widely used for shrimp culture in Indonesia and other tropical countries.

The material of net is nylon, polyethylene, Cremona and wire net. Wire net have been already used in farms at various places in Japan. Especially in tropical sea, they display the effect of preventing natural enemies.

However, it is necessary to become skillful in the assembly work and the techniques of setting net in the sea. A similar caution to the case of other net materials is required for the handling after the installation.

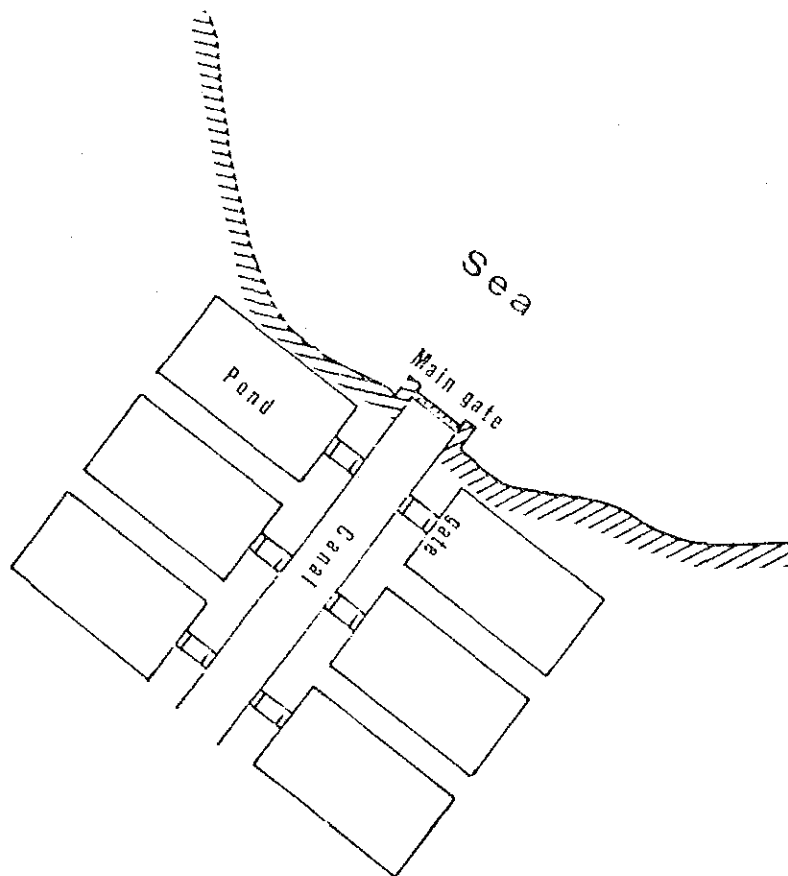


Fig. 24 Pond type method.

3-3 Culture Experiment on Suitable Fishes for Mariculture

Tarahan Island is at about 1,000 m from the coast of Bojonegara Experiment Station. Rafts were installed at the place near the island. The facility is constituted of a raft of 5 m x 5 m, 6 rafts of 7 m x 7 m, a circular raft of 5 m diameter and a working raft (photo. 22 and 28). As of September 1985, various experiments have been conducted in floating net cages, and the total number and total body weight of fish are about 12,000 fish and about 1.2 tons respectively (Fig. 25).

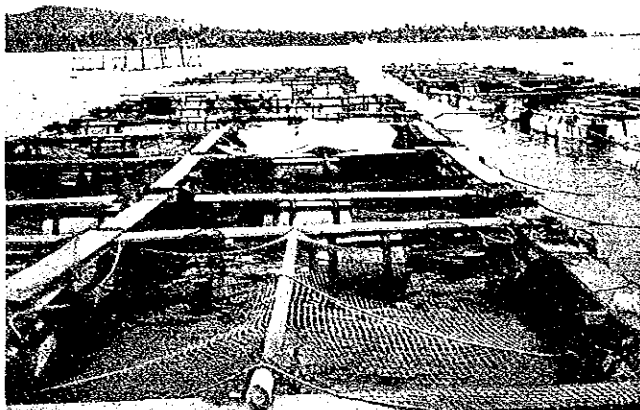


Photo 27 7m x 7m square steel raft

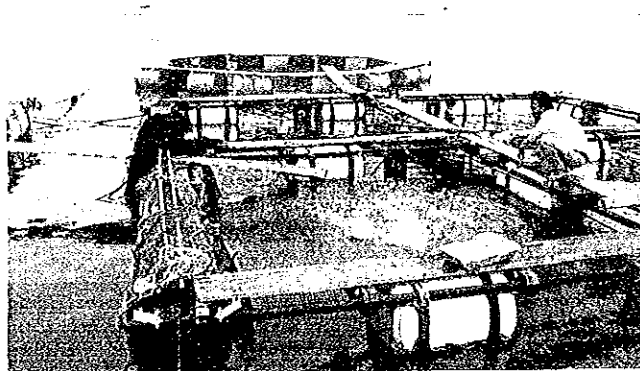
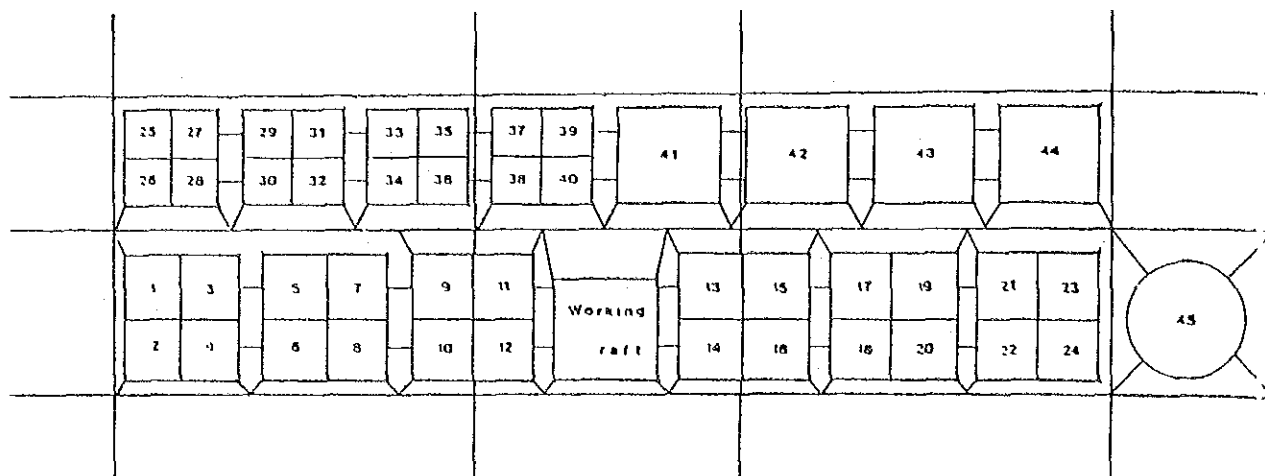


Photo 28 5m circular raft



Rearing floating net-cages, Bojonegara

The number of rearing fish

Species	Num.	ABW	Species	Num.	ABW
No.1.* <u>E. tauvina</u>	100	0.25	No.25.	-	-
2. -	-	-	26.	-	-
3** <u>S. guttatus</u>	153	0.071	27. <u>E. tauvina</u>	317	0.335
4. <u>S. canaliculatus</u>	440	0.048	28. <u>E. tauvina</u>	251	0.223
5. <u>S. canaliculatus</u>	1000	0.060	29. <u>E. tauvina</u>	144	0.157
6. <u>S. canaliculatus</u>	1000	0.064	30.	-	-
7. <u>S. canaliculatus</u>	1000	0.058	31. <u>E. tauvina</u>	114	0.072
8. <u>S. canaliculatus</u>	1000	0.062	32.	-	-
9. <u>S. javus</u>	2460	0.045	33. <u>E. morhua</u>	189	0.086
10. <u>S. javus</u>	1035	0.045	34.	-	-
11. <u>S. javus</u>	925	0.043	35.	-	-
12. <u>S. canaliculatus</u>	182	0.085	36.	-	-
13. <u>E. fuscoguttatus</u>	15	5.4	37. <u>E. tauvina</u>	149	0.216
14. <u>E. fuscoguttatus</u>	22	5.4	38. Lates	7	0.308
15. <u>E. tauvina</u>	93	0.912	39.***	-	-
16. <u>E. tauvina</u>	545	0.185	40. Lates	43	0.905
17. <u>L. altifrontalis</u>	42	1.5	41.	-	-
18. <u>L. johni</u>	31	3.1	42. <u>E. tauvina</u>	49	5.4
19. <u>L. altifrontalis</u>	52	0.15	43. Lates	10	8.5
20. <u>L. altifroncalis</u>	52	0.15	44. Lates(Thai.)	27	2.8
21. <u>L. johni</u>	110	2.2	45. Lates	33	5.0
22.***	-	-			
23. <u>L. argentimaculatus</u>	13	1.9			
24.	-	-			

* E. = Ephinephelus **S. = Siganus ***L. = Lutjanus

****Lates = Lates calcarifer

Fig. 25 Figure of floating net cages of Bojonegara Experimental Station and number of rearing fish (in 1986).

3-3-1 Rabbit Fish

Rabbit fish is an omnivorous fish and highly evaluated in some markets, so this species has a high possibility for mariculture in Indonesia. Especially, two species of rabbit fish, S. guttatus and S. javus were highly evaluated for mariculture because of the high growth and survival rates.

Since the start of the project, various experiments were conducted on rabbit fish, and valuable results were obtained. Particularly, since April 1982, persistent efforts were exerted both on rearing management and seed production technique development. The experiments concerning the seed production technique of rabbit fish had been repeatedly conducted on 4 species, S. virgatus, S. guttatus, S. javus and S. canaliculatus. In a successful result, about 350 fries in total of S. guttatus (period of 30 days after hatching out) were obtained in the larval rearing experiment since April 1985.

The resources of rabbit fish, distributed in Banten Bay, is deemed very large. Since rabbit fish is collected throughout the year in the neighbourhood of Bojonegara Experimental Station, natural seeds are easily provided.

1) Collection of natural seed

Light fishing (Fig. 26) and seine net, "Bondet" (Fig. 27), are used as the methods of fry collection is from February to June every year. During this season, thousands of fries can be collected in a day. Dominated species are S. canaliculatus, S. guttatus and S. javus and the size of fries are 2.0 to 2.5 cm in average total length and 0.5g in average body weight.

Rabbit fish fries are widely distributed in Banten Bay, particularly in the area of Zostrea Zone (Photo. 29). In the peak season, fries can be collected by light fishing in the wide area of Banten Bay and fries can be always collected by seine net through the season. (Photo 30 0 35).

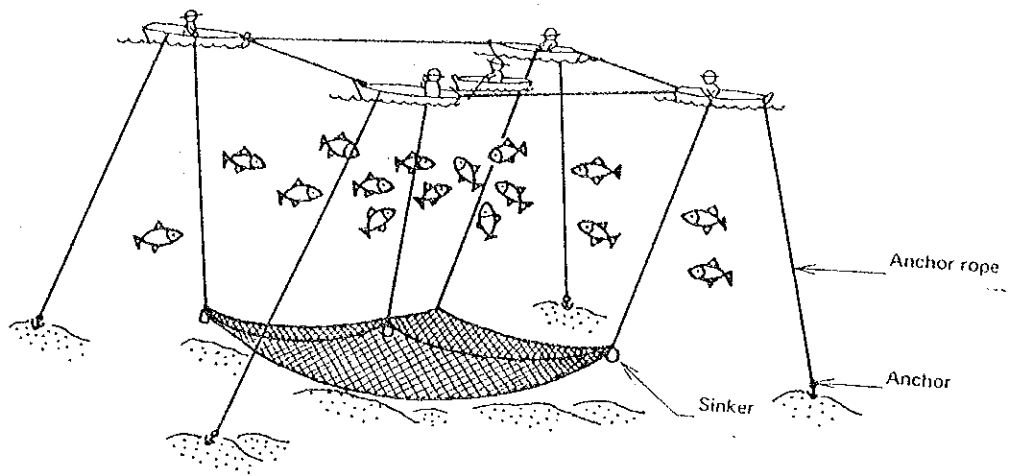


Fig. 26 An example of light fishing.

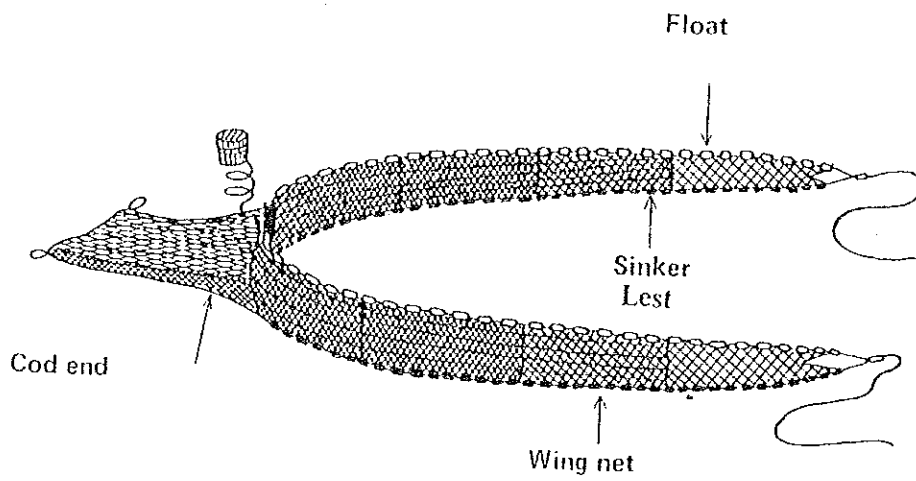


Fig. 27 Seine net.