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Chapter 1

Introduction

Chapter 1. Introduction

1-1. Preface

This Final Report (hereinafter referred to as "the Report") is prepared in accordance with "The Scope of Work (S/W) for the Marine Resources Study in Viet Nam (hereinafter referred to as the Study)" and "Minutes of Meeting on the the Study" agreed upon between the Japan International Cooperation Agency (JICA) and the Ministry of Fisheries of the Government of Viet Nam in September, 1994.

1-2. Background of the Study

The Socialist Republic of Viet Nam is extensively covered by mountainous zones that occupy three quarters of the land, covering 330,541 km^2. Even though the coastal zone covers only some 24,000 km^2, more than 50 % of the total population of 74 millions (1995) live in this area that comprises some half of the provinces and cities of the country. The country is situated between Lat. 8°30'N and Lat. 23°30'N, on the western side of the South China Sea. The S-shaped country has a long coast line extending 3,260 km. There are more than 3,000 islands along the coast. These topographic features give the country its Exclusive Economic Zone (hereinafter referred to as EEZ) of about one million km^2. The east-west width of the country at its narrowest is only 50 km (central Vietnam). Wide delta zones exist along the Mekong River in the south and along the Red River in the north. The continental shelf is wide in the north and south regions. It is narrow in the central region.

The fisheries industry plays the fourth most important role in Viet Nam's international trade based economy, following oil production, rice farming and textile manufacture. Furthermore, it supplies some 40 % of animal protein to the national diet. Advancement of fisheries industry must contribute to the development of the national economy by increasing the supply of high quality nutrients to the peoples and through the acquisition of foreign currency through export. Thus it offers chances for the promotion of related industries and the increase of employment.

The Vietnamese fishery suffers with problems needing to be solved for medium- and long-term development such as over-exploitation of living resources in the

inshore waters, under-exploitation of offshore fishery resources, underdeveloped infrastructure, shortage of finance for modernization, lack of systems for managing the living resources, delay of privatization of national enterprises and lack of organization of fishermen.

According to statistics issued by the Government of Viet Nam, total fishery production attained about one million tons, including 670 thousand tons by the marine-capture fishery, in 1990, and reached to 1.1 million tons in 1992. The number of fishing vessels operated in 1992 totaled 84,000, divided into 54,600 motorized boats and 29,400 non-powered boats. Among the motorized vessels, only 3,700 exceed 10 tons in capacity. Most of them are small in size and deteriorating with age, limited in capability to carry the ice for preservation of catch and fuel for cruising. Subsequently many boats operate in narrow coastal areas shallower than 40 m in sea depth, where these are now showing symptoms of over-exploitation of the resources.

To solve these problems, the Ministry of Fisheries of Viet Nam has attempted to establish plans for balanced development of the coastal and offshore fisheries. It is urgently requested to clarify distribution of, and to evaluate abundance of the living resources in the offshore waters, in order to determine plans for encouraging the offshore fisheries.

Under these circumstances, the Government of Viet Nam requested implementation of a fishery resources survey to the Government of Japan. In response to this request, JICA dispatched a preparatory study team to Viet Nam to confirm contents of the request and to discuss the cooperation in April 1994 and sent the Scope of Work Mission in September 1994 that concluded the Scope of Work (S/W).

Chapter 2

Outline of the Study

Chapter 2. Outline of the Study

2-1. Objectives of the Study

(1) To investigate relative stock abundance of pelagic fishery resources in the Viet Nam Exclusive Economic Zone;

(2) To clarify coastal fishery conditions through landing site survey at selected major fish landing sites;

(3) To prepare guide-lines for a marine resources management plan which would include the proper fishing methods;

(4) To carry out technology transfer and training in the course of the Study to the counterpart personnel of the Government of Viet Nam, and thus to contribute to establishing sustainable utilization of marine resources in Viet Nam.

2-2. Study area

The sea-borne survey area was mainly the central region defined as the offshore area exceeding 40 m in depth within the Viet Nam EEZ, from 8° to 18° North and from the shoreline to 112° East, excepting internationally disputed areas as described in Minutes of Meeting of S/W.

The land site survey was carried out at the five selected provinces in the central region and closely adjacent parts of the northern and southern regions. The selected provinces (and fish landing sites) were Ba Ria - Vung Tau (Vung Tau), Binh Thuan (Phan Thiet), Khanh Hoa (Nha Trang), Quang Nam Da Nang (Da Nang), and Quang Binh (Dong Hoi).

2-3. Study Period and Duration

The research was executed for three years divided into two phases. The sea-borne survey was conducted twice a year considering the changes of the ocean current direction due to seasonal winds.

[The First Phase]

(1) The first field survey (12 March 1995 to 27 May 1995)

(a) Explanation to and consultation with the counter parts on the Inception Report.

(b) Collection of information and data on the resource management (legislation, policy, system), research activities (scientific achievement, research systems), fishing communities (size of population, amount of catch, species composition, method and gear of fishing, social organization) and fishery economics (income of fishermen, distribution of catch, markets).

(c) General survey on natural factors (oceanic conditions, meteorological conditions), and socioeconomic conditions (administration systems, fisheries establishment).

(d) Examination and drafting of contract, and execution of improvement of RV Bien Dong.

(e) Supervision and advice of works to repair the hull, fishing equipment, engines and electric equipment of RV Bien Dong.

(2) The second field survey (2 July 1995 to 3 September 1995)

(a) The second land site survey (2 July 1995 to 3 September 1995)
Consultation with counterparts in regard of methods and details of research items, explanation of survey methods to staffs of fisheries bureaus of local governments, and execution of socioeconomic survey and statistical survey of amount of catch at the selected landing ports.

(3) The third field survey (1 October 1995 to 6 February 1996)

(a) The first sea-borne survey (NE Monsoon season) 31 October 1995 to 21 December 1995: The survey aimed at collection of data required for evaluation of relative abundance. The first survey covered test fishing with drift gillnets together with echo sounding, oceanographic observations and biological collection during the northeast monsoon season.

(b) The third land site survey (19 November 1995 to 6 February 1996): Confirmation of findings by, and extension of the second survey. The

Vietnamese counterparts executed additional surveys in January and April 1996.

(c) Repair of the RV Bien Dong, including installation of survey apparatus.

(d) Confirmation of function of, and training to practice with the survey apparatus, after installation works commenced in 1995.

(4) The fourth field survey (1 May 1996 to 14 October 1996)

(a) The second sea-borne survey (SW monsoon season), 8 May 1996 to 23 June 1996: Execution of survey activities for evaluation of relative abundance.

(b) The fourth land site survey (4 August 1996 to 14 October 1996): Compilation and examination of data and information obtained by preceding surveys, together with complementary survey.

(5) The fifth field survey (2 September 1996 to 31 October 1996)

(a) Consultation with, and confirmation of request from the counterpart in regard of plans inclusive of techniques of fishing method and gear.

(b) The third sea-borne survey (NE monsoon season), 6 September 1996 to 26 October 1996: Execution of survey activities for evaluation of relative abundance.

(6) Preparation of the Interim Report.

[The Second Phase]

(7) The sixth field survey (5 May 1997 to 16 December 1997)

(a) Explanation of the interim report to, and consultation on it with the counterpart.

(b) The fourth sea-borne survey (SW monsoon season), 5 May 1997 to 26 June 1997: Execution of survey activities for evaluation of relative abundance, together with test fishing of the Vietnamese sub-surface gillnets aiming at capture of major fishes for comparison to nets of five different mesh sizes employed in the First Phase.

(8) Field consultation on the reports and other results.

(a) Explanation of the draft final report to, and consultation on it, with the counterpart.

(b) Seminar on technique transfer

(9) Preparation and submission of the final report

Table 2-1 Performance of four sea-borne survey

Phase	Cruise No.	Season	Duration	Days
1	First	NE monsoon	From 31 Oct. to 21 Dec. 95	52
	Second	SW monsoon	From 8 May to 23 June 96	47
	Third	NE monsoon	From 6 Sep. to 26 Oct. 96	51
2	Fourth	SW monsoon	From 11 May to 26 June 97	48

2-4. Research Vessel

The Research Vessel named "BIEN DONG" of Research Institute of Marine Products, was operated for this sea-borne survey. The main items of the "BIEN DONG" are shown in Table2-2.

"BIEN DONG" is a stern trawler-type research vessel built in Norway in 1975. Due to the vessel's age of about 20 years, the hull had deteriorated, and some items of equipment were found to be out of date. The improvement works were executed in advance the survey cruise. The main items are as follows:

Table 2-2 Main items of Research Vessel

Name of ship	BIEN DONG
Year & place of construction	1975, Bergen, Norway
Port of registry	Haiphong, Vietnam
Gross tonnage	495.35 TS
Major dimensions	47.5m × 10.3m × 4.3m
Main engine Auxiliary engine	NORMO DEISEL TYPE LDMCB-9 1500ps 1 unit VOLVO REDUCTION GEAR VOLDA TYPE ACG500 1 unit
Maximum speed	12 knots
Number of personnel	36 persos including 18 crew members
Freezers	Stocked of −25°C 10 volume tons, Stocked of −1°C 8volume tons
Major cruise apparatus	28-inch radar of 25KW 120miles, GPS, Direction finder INMARSAT, Weather Facsimile receiver
Major obs. apparatus	Scanning SONAR, Color Display Fish Finder, Simplified Depth Meter Doppler's Current Meter, RADAR

2-5. Fishing gear

2-5-1. First phase

Surface drift gillnets of five different mesh sizes were employed for the assessment of relative abundance of pelagic fishes in offshore waters. In order to accommodate to anticipated wide range of sizes of fishes, mesh sizes selected for the surveys were 73-mm, 95-mm, 123- mm, 150-mm and 160-mm.

The net fabric is either nylon mono-filament for 73-mm, 95-mm and 123-mm nets or multi-filament for 150-mm and 160-mm nets. Appendix Table 1 shows specifications of the nets of five mesh sizes. Taking 150-mm mesh net as an example, construction and specifications are given in Figure 2-1 and Table 2-3. As a rule, nets of 20 tans of each mesh size were connected, making a set of 100 tans for operation.

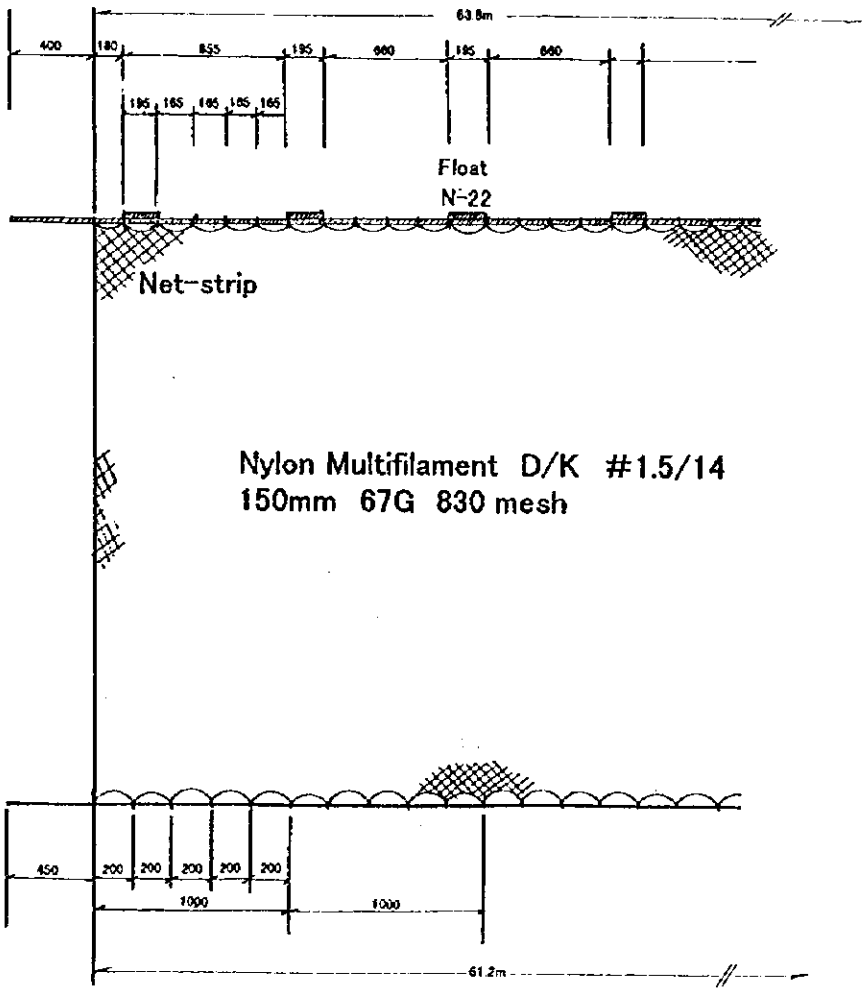


Figure 2-1 Construction of surface gillnet of 150-mm mesh size

Table 2-3 Specifications of surface gillnet of 150-mm mesh

Part	Specifications
Mesh size	150 mm
Float Line	(U-Line) P.P Dan-Line Rope 12.5g 6mm right and left each 1 Length of Float line: 63.8m Total length: 64.6m
Float	N-22 Buoyancy: 220g 75 pieces Total buoyancy: 16,500g
Lead Line	(U-Line) P.P Lead Core Rope100g 6mm right and left each 1 Length of Lead Line: 61.2m Total length: 62.1m
Net-strip	Nylon Multifilament D/K #1.5/14 150mm 67G 830 mesh
Sewing Twine	Float - Float Line: KUREMONA 12#(W) Lead - Lead Line: KUREMONA 12#(GG) Net-Net: KUREMONA 15# 580m/kg
Hanging	Upper: 48.8% Lower: 50.84%

2-5-2 Second phase

Added to nets of the five mesh sizes used during the First Phase was net of 100 mm mesh for better sampling envisaged as such from examination of data collected during the First Phase. Nets of 100 mm mesh were used in mid-layer to compare catch ability at different layers. The same nets of five mesh sizes used during the First Phase were again employed on this occasion. Newly introduced 100-mm nets were made of nylon mono-filament fibers. The sinking nets were converted from the surface nets of 100-mm mesh size. The construction and specifications of the sinking nets are given in Figure 2-2 and Table 2-4. Each type of net consisted of 15 tans, making size of total surface gears as a rule 90 tans. Before casting, nets were tied to each other by rope (Figure 3-2).

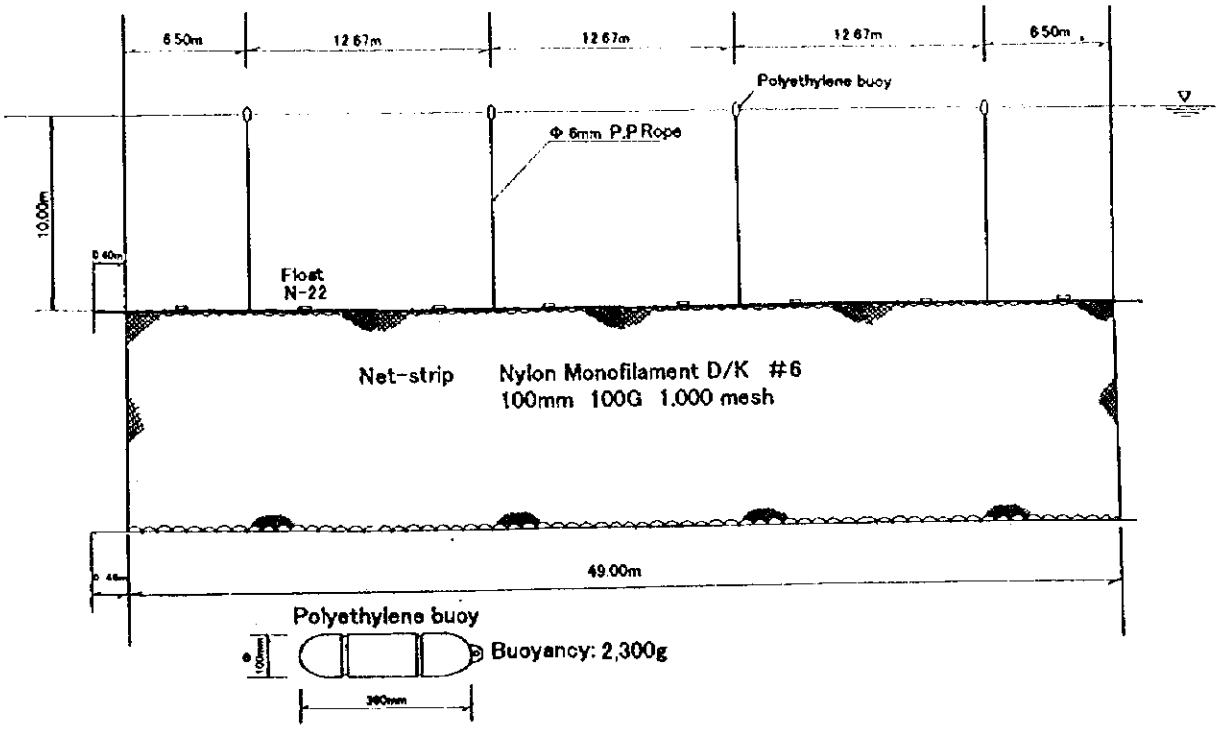


Figure 2-2. Construction of sinking gillnet of 100-mm mesh

Table 2-4 Specifications of sinking gillnet of 100-mm mesh

Part	Specifications
Mesh size	100 mm
Float Line	(U-Line) P.P Dan-Line Rope 12.5g 6mm right and left each 1 Length of Float line: 51.0m Total length: 51.8m
Float	N-22 Buoyancy: 220g 8 pieces Polyethylene buoy 2,300g 4 pieces Total buoyancy: 10,960g
Lead Line	(U-Line) P.P Lead Core Rope100g 6mm right and left each 1 Lenght of Lead Line: 49.0m Total length: 49.9m
Net-strip	Nylon Monofilament D/K #6 100mm 100G 1,000 mesh
Sewing Twine	Float - Float Line: KUREMONA 12#(W) Lead - Lead Line:KUREMONA 12#(GG) Net-Net: KUREMONA 15# 580m/kg
Hanging	Upper: 49.0% Lower: 51.0%

Chapter 3

Methodology of the Study and the Data Obtained

Chapter 3. Methodology of the survey

3-1. The sea-borne survey

The sea-borne survey was conducted in the offshore parts of the Vietnamese EEZ exceeding 40 m in depth, delineated as being between Latitude 8° N and 18° N, and west of Longitude 112° E. The survey area was divided into 35 latitudinal and longitudinal one-degree quadrangles (Figure 3-1). One test fishing and oceanographic station was located in each one-degree quadrangle during each survey cruise.

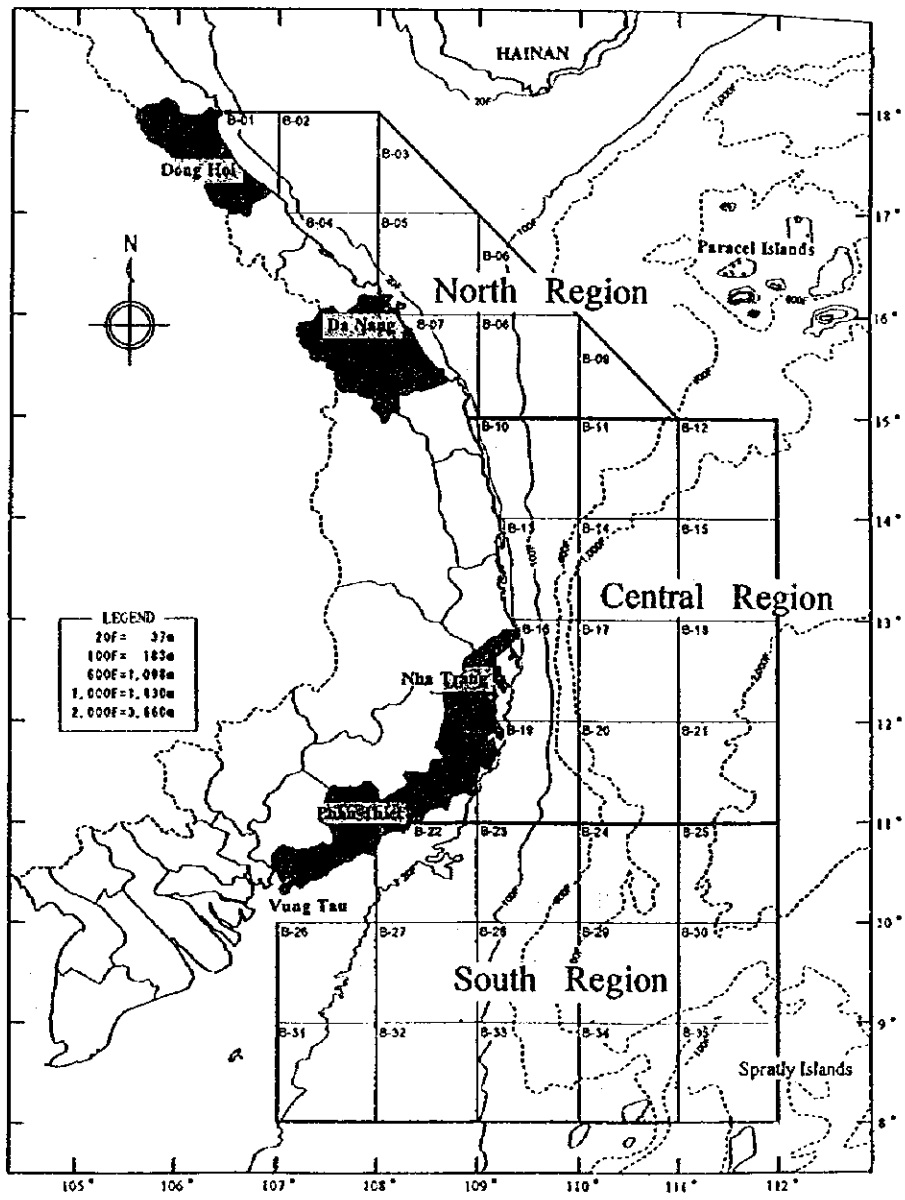


Figure 3-1 The survey area.

3-1-1. Oceanographic Observation

(1) Items and Methods

In order to investigate the environment of fishing grounds off Viet Nam, oceanographic observation was conducted simultaneously with test fishing in the survey area. The items, contents and methods of oceanographic observation in the first Phase and second phase are the same, and are shown in Table 3-1.

Table 3-1 Items and contents of oceanographic observation

Item	Contents	Methods
Water surface temperature	At every hour and station (every gillnet setting): On the voyage from leaving to return	Thermometer installed at the bottom of the ship
Meteorology and oceanographic phenomena	Weather, wind direction & velocity, air temperature, atmospheric pressure wind wave & swell, water colour, and transparency	Visual observation with Class Table of the Meteorological Agency of Japan Water colour: Forel's scale Transparency: transparency board (Secci disk)
Water temperature, salinity	At every survey station : Vertical observation by CTD Water temperature and salinity	CTD secured data every 1m in depth up tp 1000m
Current direction & & velocity	At every hour during the voyage: Measured three layers (2,10,30m)	Measured by current meter installed at the bottom of the ship
Zooplankton	At every station (every gillnet setting): Sampling by NORPAC net	Vertical hauling by NORPAC net from 150m in depth to the surface
Phytoplankton	At every station (every gillnet setting): Sampling by KITAHARA's net	Vertical hauling by KITAHARA's net from 150m in depth to the surface

(2) Analysis of Samples Collected

The collected samples of phyto-and zoo-plankton were fixed in formalin on board and preserved in the vessel during the survey. These fixed samples were analyzed by Vietnamese researchers on land.

3-1-2. Test Fishing

(1) First phase

① Fishing method

Surface drift nets of 5 mesh sizes were operated for evaluating relative abundance of pelagic fishes in the sea area under survey. As a rule, the nets were set before the sunset, and hauled at sunrise of the next day. The Research Vessel stayed near the nets throughout the night for protecting the nets from accidents. It was intended to cast 100 tans of nets, 20 tans for each of 5 mesh sizes. At some stations, damage of some nets made the total less than 100 tans.

Fishes and other animals obtained after operation were classified into mesh size as well as species for biological researches. Construction of nets used during the First and Second Phases are given in Figure 3-2.

② Operation Logbook

Records were kept in the prescribed from as to position and time of fishing , water/sea depth, sea surface temperature, duration of operation, number of fishing gears used, amount of fish caught, current condition, and other findings and matters of interest.

③ Collection of records on the fish shoals

Collection of records on the fish shoals by using echo sounder and scanning sonar was carried out during each cruise.

(2) Second phase

① Fishing method

Attempting to obtain data on promising species identified as such on the basis of examination of data taken during the First Phase, the survey consisted two test fishings: surface drift net operation with increased mesh sizes including 73-mm, 95-mm, 123-mm,150-mm, 160-mm and newly added 100-mm, and comparison between surface and mid-layer nets with mesh size of 100-mm (Figure 3-2).

The fishing gears were operated from the sunset to the following sunrise as in

the First Phase. Number of nets of each mesh size was reduced to 15 tans, making 90 tans in total. Number of nets for mid-layer or sinking type was also 15 tans. These nets were connected to each other by rope (Figure 3-2).

Procedures used during the First Phase were employed for treatment of catch, records of operations, and collection of data on fish schools.

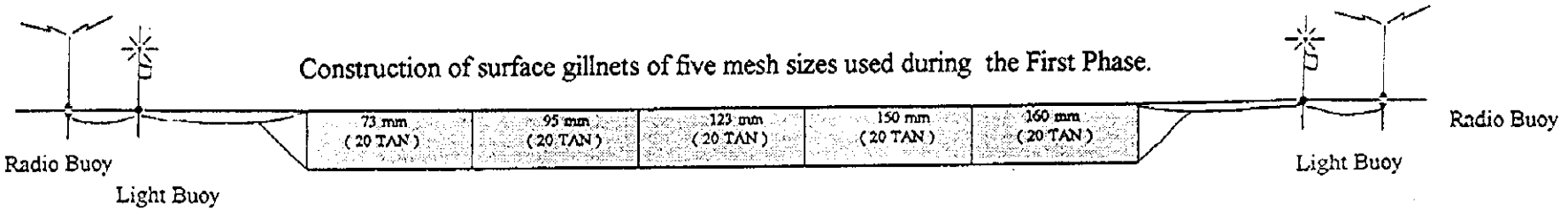
3-1-3. Biological Survey

After finishing hauling gillnets, major species of fishes were determined by sex and measured by body length and body weight. Scales, otoliths, gonads and stomachs were taken out from fish processed on board and maturity of gonad and stomach contents were investigated on board. The Vietnamese scientists, principally, took charge of examination of otoliths, scales, gonads, stomach contents and other materials.
Procedures of treatment of catch for biological survey during the 1st Phase and 2nd survey were the same. The on board works covered the following items:

a. Amount of fishing effort expressed in number of tans of gillnets of each mesh sizes and number of fish caught by species.
b. Measurement of body length and body weight: (maximum 100 individuals for each species).
c. Identification of sex and gonad: (maximum 20 individuals for each of major species).
d. Sampling of otoliths, scales, stomachs: (maximum 20 individuals for each of major species).
e. Preservation of typical specimens.
f. Photograph of typical specimen(all species).

3-2. Technology transfer of survey method

In order to ensure the full transfer of skills to Vietnamese counterparts, the survey activities were re-explained to Vietnamese staff by the Japanese staff. This included re-explanation of the Vietnamese version of manuals for the sea-borne survey and video tapes of operation of drift gillnets as used in Japan.



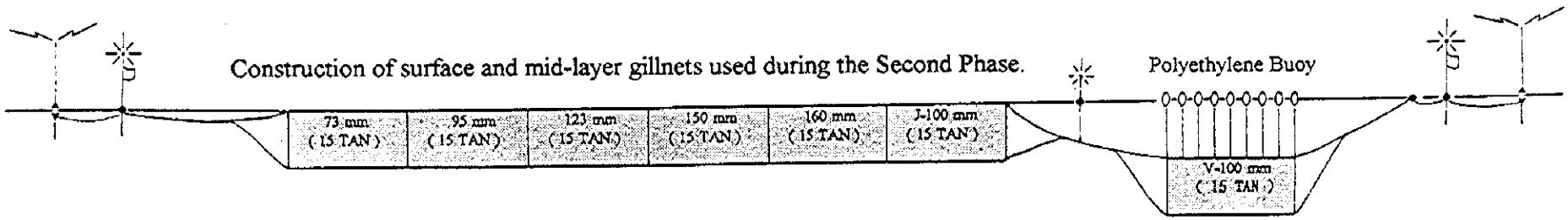


Figure 3-2. Construction of fishing gear employed during the First and Second Phases.

The manuals consisted of two parts: one being the safety manual including items of system connection with instructions on board the research vessel and communication net works. The other being the work manual including processes of drift net operation, illustration of staff and crew arrangement, and types, methods and recording forms for research activities.

3-3. Definition of Relative Abundance (CPUE) and Abundance Index

Since the number of actually used nets in the test fishing often varied between stations, the catch of each operation was converted to that for 100 tans for the sake of even comparison. Likewise, the soaking time of nets in the sea often varied, and so each soaking time, from end of casting nets to start of hauling, were standardized by mean time of all operations. Catch-per-unit effort of each operations were converted to the values of 100 tans standardized by soaking time.

Hereafter in this Report, the **relative abundance** (in terms of number of individuals and of weight) is defined as CPUE standardized according these procedures. The CPUE in number and CPUE in weight are synonyms of the relative abundance defined as such.

Additionally the **abundance index** was calculated by multiplying above-mentioned CPUE and extent of area of latitudinal and longitudinal one degree.

Namely, relative abundance, RA_i, and abundance index, AI_i, in a quadrangle comprising i-th operation are given by

$$RA_i \text{ (number)} = \Sigma \{(C_{ij}/E_{ij}) * 20\} * (TT/T_i)$$

$$RA_i \text{ (weight)} = \Sigma \{(W_{ij}/E_{ij}) * 20\} * (TT/T_i)$$

and $$AI_i = RA_i * (A_i/AA)$$

Here symbols in the equations are defined as follows:

E_{ij} : Number of effective nets of j-th mesh size employed at i-th station.
Effective nets mean those operated adequately, not broken nor entangled.

C_{ij} : Number of specimens of a species caught by effective nets of j-th mesh size employed at i-th station

W_{ij} : Weight of specimens of a species caught by effective nets of j-th mesh size employed at i-th station

T_i : Duration of time for operation of gillnets at i-th station

TT : Average of duration of time for operations of gillnets at all the stations

A_i : Size of a quadrangle comprising i-th station

AA : Size of a quadrangle located between Lat. 8° N and 9° N, without any land

3-4. Amount of effort and obtained data of surveys

The contents of obtained data by four survey cruises are shown in order activity of research vessel, test fishing , oceanographic observation, and biological survey.

3-4-1. Activity of research vessel

Here is outlined the activity of the research vessel. Daily performance of each cruises are shown in Appendix tables 2 to 5. Also, wind direction, wind velocity and wave height of the during each cruises are given in Appendix Tables 6.

(1) The 1st Survey

Daily passages of the research vessel during the 1st survey are shown in Figure 3-3. The survey started with taking refuge from typhoon. The research vessel met with two successive typhoons on leaving from Hai Phong port on 31 October. After the passage of the typhoons, the sea off Viet Nam had already become rough due to the prevailing NE monsoon. Accordingly, the research vessel had no chance but to undertake oceanographic observation in a spell of rough sea and the survey team finally had to finish the survey with only three operations of test fishing and without having chance to get fully proficient in gillnet fishing with this vessel.

(2) The 2nd Survey

Daily passages of the research vessel during the 2nd survey cruise is shown in Figure 3-4. The long spell of good weather enabled the research vessel to perform the

survey smoothly and according to plan. The total days on which a strong wind blew at more than 10 m/sec during this cruise was only 5 days.

During the first half of the 2nd survey cruise, the research vessel went around the southern part of survey area and had completed almost all survey stations in that area without having to stop survey activities due to bad weather.

During the latter half of this cruise, the R/V "BIEN DONG" went around the northern part of survey area while carrying out the oceanographic observations and test fishing at each stations. The operations of the 2nd survey covered each of the 32 points of test fishing and oceanographic observation.

(3) The 3rd Survey

Daily passage of the research vessel during the 3rd cruise is shown in Figure 3-5. Learning a lesson from the 1st survey, the date of the 3rd survey was brought forward by about two months. The amendment of survey period by about two months gave the survey team longer working days during from the beginning of September to mid-October.

During the first half of the 3rd survey, the research vessel managed to perform the survey in the northern region while keeping away from rough sea condition areas and finished the survey in the northern region for supplying of fuel oil at the end of September, leaving 3 survey points.

The research vessel moved to the southern region to supply fuel oil. The survey activities in the southern region progressed smoothly and finished in mid-October. During a week before end of the survey, a typhoon and tropical depression stayed on the northern region and the survey team could not perform the remaining 3 survey points due to rough sea conditions in the northern region. The coverage of the 3rd cruise was 29 survey points of test fishing and 32 points of oceanographic observation.

(4) The 4th survey

Daily passage of the research vessel during the 4th cruise is shown in Figure 3-6. After leaving Hai Phong port on 10 of May, the long spell of good weather enabled the

research vessel to perform the survey in the north part of survey area smoothly .

The research vessel had completed almost all of the survey stations in the North Region by 19th May and entered Nha Trang port for repairs to engine parts during on 20th - 23rd May. After leaving Nha Trang, the research vessel went around the south part of the Central Region and coastal area of the South Region while carrying out surveys, it had completed 14 survey stations by the time of entering Vung Tau port at the beginning of June.

During latter half of this cruise ,the research vessel went around the South Region and the south part of Central Region for two successive weeks, and had completed almost all stations in these area under good condition.

After that, the research vessel went up to the north while carrying out the oceanographic survey and test fishing at each stations, and finished the survey schedule with performance of 31 survey points of test fishing and 30 points of oceanographic observation on 25 of June.

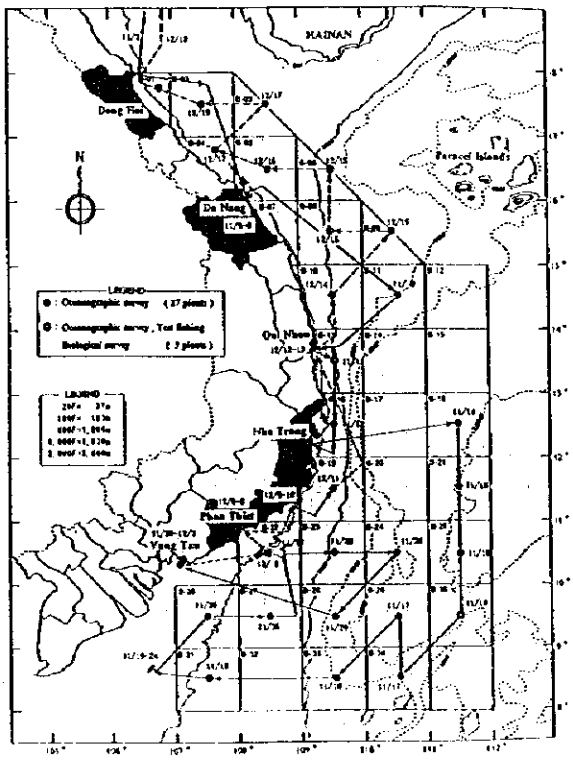


Figure 3-3 The passage of the research vessel during 1st cruise (Oct.- Dec.1995)

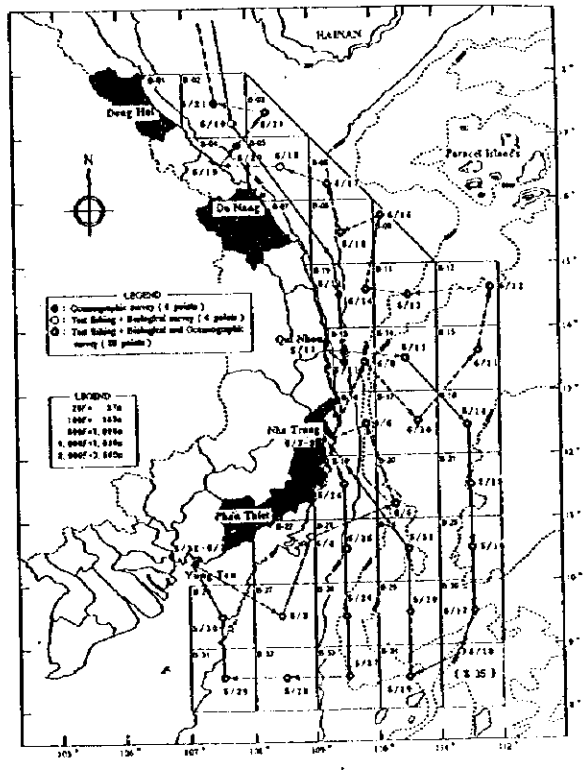


Figure 3-4 The passage of the research vessel during 2nd cruise (May - June 1996)

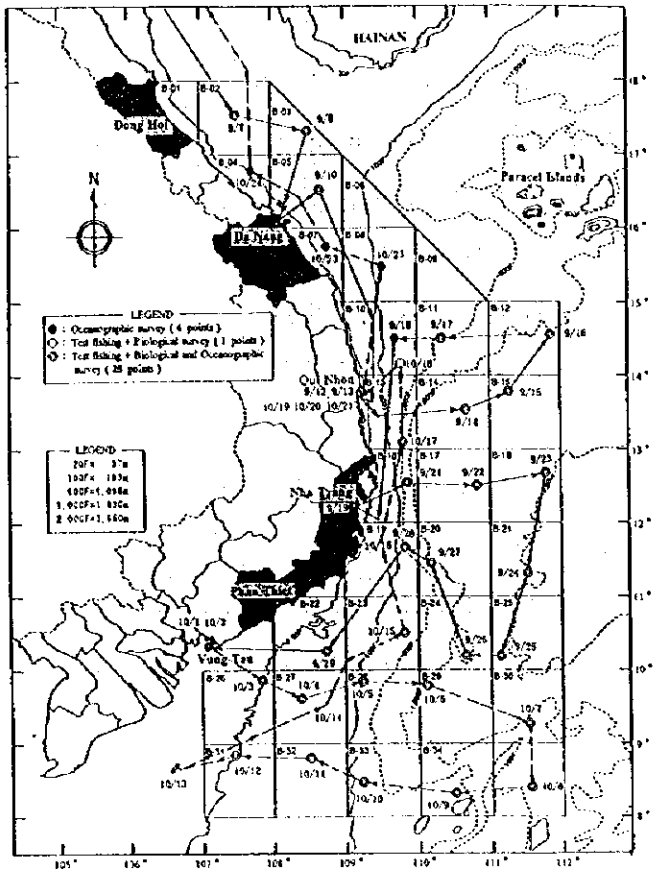


Figure 3-5 The passage of the research vessel during 3rd cruise (Sep.- Oct. 1996).

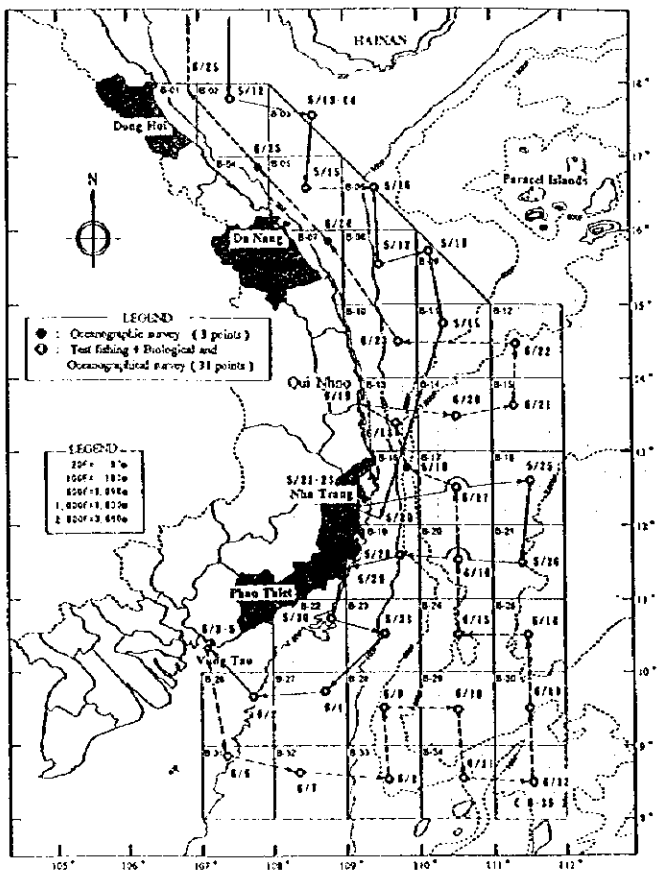


Figure3-6 The passage of the research vessel during 4th cruise (May - June 1997)

3-4-2 Oceanographic observation

The obtained data of oceanographic observation during four survey cruises are as follows.

Table 3-2 Obtained data by oceanographic observation

Station	The 1st survey cruise Oct. ~ Dec. 1995			The 2nd survey cruise May ~ Jun. 1996		
	Water temperature, and salinity	Zooplankton Phytoplankton	Meteorology and oceanographic phenomena	Water temperature, and salinity	Zooplankton Phytoplankton	Meteorology and oceanographic phenomena
B-01	O	O	O			
B-02	O	O	O	O	O	O
B-03	O	O	O	O	O	O
B-04	O	O	O	O	O	O
B-05	O	O	O	O	O	O
B-06	O	O	O	O	O	O
B-07						
B-08	O	O	O	O	O	O
B-09	O	O	O	O	O	O
B-10	O	O	O	O	O	O
B-11	O	O	O	O	O	O
B-12				O	O	O
B-13	O	O	O	O	O	O
B-14				O	O	O
B-15				O	O	O
B-16	O	O	O	O	O	O
B-17				O	O	O
B-18	O	O	O	O	O	O
B-19	O	O	O	O	O	O
B-20				O	O	O
B-21	O	O	O	O	O	O
B-22	O	O	O	O	O	O
B-23	O	O	O	O	O	O
B-24	O	O	O	O	O	O
B-25	O	O	O	O	O	O
B-26	O	O	O	O	O	O
B-27	O	O	O	O	O	O
B-28	O	O	O	O	O	O
B-29	O	O	O	O	O	O
B-30	O	O	O	O	O	O
B-31	O	O	O	O	O	O
B-32				O	O	O
B-33		O	O	O	O	O
B-34	O	O	O	O	O	O

Station	The 3rd survey cruise Sept ~ Oct. 1996			The 4th survey cruise May ~ Jun. 1997		
	Water temperature, and salinity	Zooplankton Phytoplankton	Meteorology and oceanographic phenomena	Water temperature, and salinity	Zooplankton Phytoplankton	Meteorology and oceanographic phenomena
B-02	O	O	O	O	O	O
B-03	O	O	O	O	O	O
B-04	O	O	O	O	O	O
B-05	O	O	O	O	O	O
B-06				O	O	O
B-07		O		O	O	O
B-08	O	O	O	O	O	O
B-09				O	O	O
B-10	O	O	O	O	O	O
B-11	O	O	O	O	O	O
B-12	O	O	O	O	O	O
B-13	O	O	O	O	O	O
B-14	O	O	O	O	O	O
B-15	O	O	O	O	O	O
B-16	O	O	O	O	O	O
B-17	O	O	O	O	O	O
B-18	O	O	O	O	O	O
B-19	O	O	O	O	O	O
B-20	O	O	O	O	O	O
B-21	O	O	O	O	O	O
B-22	O	O	O	O	O	O
B-23	O	O	O	O	O	O
B-24	O	O	O	O	O	O
B-25	O	O	O	O	O	O
B-26	O	O	O	O	O	O
B-27	O	O	O	O	O	O
B-28	O	O	O	O	O	O
B-29	O	O	O	O	O	O
B-30	O	O	O	O	O	O
B-31	O	O	O	O	O	O
B-32	O	O	O	O	O	O
B-33	O	O	O	O	O	O
B-34	O	O	O	O	O	O
B-35	O	O	O	O	O	O

3-4-3. Amount of effort and resultant catch in test fishing.

Table 3-3 to 3-6 show amount of effort expended and resultant catch at each station of test fishing made during four cruises in a period from 31 October 1995 to 26 June 1997.The tables give day and time, position and duration required for setting, and day and time and duration required for hauling nets, number of nets of each mesh size in tans, duration of the nets in the sea, and amount of catch in number of individuals and in weight by species

Table 3-3 Amount of effort and resultant catch in test fishing during the 1st survey (Northeastern monsoon season)

	Settig nets		Hauling nets	Number of nets					Total	Soaking	Catch	
				Mesh size (mm)								
St.	Start time	Position	Start time	73	95	123	150	160	Tan	time(mini.)	Species/ Indiv	Total weight
B-13	11/11 17:10	13-17.01N	11/12 05:15	15	0	15	0	0	30	725	6	14.40
		109-49.36E									19	
B-30	11/15 20:10	09-28.04N	11/16 06:10	4	0	0	0	0	4	600	4	6.50
		111-29.40E				*12					10	
B-6	12/15 19:02	16-28.18N	12/16 06:08	0	14	0	17	0	31	666	2	5.30
		109-29.45E									3	

* The number of lost gillnet's tan

Total amount of wei 26.2

Total number of spe 9

Table 3-4 Amount of effort and resultant catch in test fishing during the 2nd survey (SW monsoon season)

St.	Settig nets		Setting	Hauling	Number of net by mesh size (mm					Total	Soaking time	Catch		
	Start time	Position	time (min)	time (min)	73	95	123	150	160	Tan	of nets (min)	Species	Indiv.	Total weight (kg)
B-03	5/10 02 16	17-13.48N	25	120	14	13	11	11	12	61	**324	2	6	*** 6.50
		107-49.02E	*41	*197									18	**** 20.4
B-14	5/12 17 30	13-31.23N	60	140	14	21	11	26	12	84	700	3	7	23.28
		110-50.80E	71	167									7	17
B-18	5/13 19 22	12-31.23N	43	217	14	30	11	26	19	100	625	7	14	9.50
		111-29.12E	43	217									18	15
B-21	5/14 23 26	11-32.73N	57	163	8	30	11	29	19	97	404	6	17	97.70
		111-33.01E	59	168									66	138
B-25	5/15 19 25	10-30.85N	33	85	8	15	11	18	0	52	647	6	12	20.30
		111-31.01E	63	163									21	26
B-30	5/16 19 09	09-30.48N	30	90	5	15	11	18	0	49	651	7	17	22.25
		111-33.01E	61	184									31	33
B-35	6/17 17:15	08-51.06N	39	60	5	15	9	18	0	47	816	8	26	15.42
		111-16.82E	83	128									53	26
B-34	5/18 21 52	08-31.26N	47	140	5	29	9	29	18	90	501	5	28	62.50
		110-31.44E	52	156									39	78
B-29	6/19 19 35	09-30.22N	20	50	5	5	9	18	0	37	615	6	14	28.60
		110-30.68E	54	135									26	39
B-24	5/20 17 27	10-41.18N	45	112	9	24	9	29	20	91	643	5	18	24.10
		110-30.68E	49	123									26	24
B-19	5/23 19 34	11-29.60N	63	153	7	24	9	29	20	89	563	10	32	63.00
		109-29.57E	71	172									45	69
B-23	5/24 17:30	10-29.83N	60	125	7	24	8	29	20	88	685	11	47	117.50
		109-31.98E	66	142									46	35
B-28	5/25 16:40	09-30.06N	72	92	4	24	9	29	20	86	763	10	50	289.40
		109-31.02E	84	107									95	200
B-33	5/26 18 20	08-30.29N	80	90	4	24	9	29	20	86	630	10	51	105.50
		109-26.11E	93	105									61	90
B-32	5/27 18 40	08-35.69N	70	80	4	24	9	29	20	86	625	8	14	70.70
		108-23.43E	81	93									27	64
B-31	5/28 16 50	08-31.12N	60	80	0	24	6	20	16	66	740	7	49	25.90
		107-32.68E	91	121									56	27
B-26	5/29 17:05	09-31.87N	40	55	2	24	6	17	16	65	750	8	17	12.4
		107-33.40E	62	85									20	14
B-27	6/2 22:48	09-38.36N	62	103	6	23	9	26	30	94	360	2	6	2.04
		108-11.72E	66	110									21	10
B-22	6/3 19:27	10-45.83N	58	85	6	23	9	26	30	94	565	8	45	106.80
		109-02.66E	62	90									85	161
B-20	6/4 18:20	11-15.99N	65	70	6	23	9	24	29	91	600	4	7	17.50
		110-21.11E	60	77									8	17
B-16	6/5 18:54	12-30.01N	43	85	6	22	9	24	29	90	618	10	43	225.60
		109-50.25E	48	94									89	64
B-13	6/8 19:45	13-29.74N	55	88	5	21	9	24	29	88	545	8	34	278.50
		109-49.34E	63	100									49	93
B-17	6/9 19:36	12-29.50N	44	85	4	21	9	24	29	87	565	7	25	56.30
		110-38.63E	51	98									39	51
B-15	6/10 17:15	13-35.03N	40	95	4	21	9	24	29	87	700	8	17	134.30
		111-15.25E	46	109									16	90
B-12	6/11 18.32	14-31.81N	36	95	4	21	9	24	29	87	782	7	24	224.40
		111-48.88E	41	109									55	38
B-11	6/12 18 35	14-29.53N	35	71	4	21	9	24	29	87	657	4	16	30.00
		110-29.77E	40	82									35	39
B-10	6/13 17:00	14-38.05N	30	80	4	21	9	24	29	87	750	12	92	75.10
		109-55.79E	34	92									173	86
B-09	6/14 17:47	15-49.41N	33	100	4	21	9	24	29	87	700	13	107	51.70
		110-04.09E	38	115									162	68
B-08	6/15 17.40	15-30.12N	38	95	4	21	9	24	29	87	707	7	72	212.90
		109-29.72E	44	109									231	277
B-06	6/16 17:20	16-18.40N	37	77	4	21	9	24	29	87	723	14	131	218.50
		109-18.58E	43	89									156	198
B-05	6/17 16:66	16-35.38N	29	75	4	21	9	24	29	87	725	5	15	27.81
		108-26.81E	33	86									11	20
B-03	6/20 17:27	17-23.12N	30	57	2	20	9	24	29	84	726	13	35	154.20
		108-17.37E	36	68									101	129

Total number of species	71

Total amount of weight	2,809.70
Total amount of relative abundance weight	2,256
Total number of indiv.	1,087
Total number of relative abundance indiv.	1,887

* Lower figure in the colum of setting and hauling time shows the time converted into per 100 tan.
** Soaking time is duration from end of setting nets to bebinning of hauling nets.
*** catch in total weight excludes amount of incidentaliy caught species.
**** Lower figure in the colum of catch in total weight and individuals shows amount of relative abundance[individual and weight(kg)] converted into the value per 100 tan.

Table 3-5 Amount of effort and resultant catch in test fishing during the 3rd survey (NE monsoon season)

St.	Settig nets		Setting	Hauling	Number of net by mesh size (mm)					Total	Soaking time		Catch	
	Start time	Position	time (min)	time (min)	73	95	123	150	160	Tan	of nets (min)	Species	Indiv.	Total weight (kg)
B-02	9/7 18:48	17-29.50N	46	100	20	20	18	20	20	98	682	9	55	*** 91.2
		107-30.15E	*47	*102									58	**** 77
B-03	9/8 18:05	17-17.88N	35	90	20	20	20	20	20	100	725	13	74	72.50
		108-31.77E											74	72
B-05	9/10 17:55	16-27.84N	45	125	20	20	20	20	20	100	755	5	27	27.20
		108-39.48E											27	26
B-14	9/14 18:20	13-30.94N	50	90	20	20	20	20	20	100	700	13	49	188.90
		110-39.97E											50	73
B-15	9/15 17:35	13-46.89N	27	85	19	19	20	20	18	96	750	11	77	118.10
		111-17.06E	28	89									77	121
B-12	9/16 16:55	14-31.30N	45	60	17	20	20	19	18	94	740	8	71	41.50
		111-50.00E	48	64									76	44
B-11	9/17 17:08	14-30.21N	35	90	19	21	21	18	18	97	732	9	65	80.10
		111-15.03E	36	93									67	84
B-16	9/20 18:40	12-30.20N	42	115	18	21	20	19	18	96	665	12	64	145.80
		109-52.94E	44	120									73	173
B-17	9/21 16:55	12-29.10N	37	70	16	20	19	19	18	92	755	8	27	19.90
		110-48.22E	40	76									30	22
B-18	9/22 17:00	12-36.09N	38	105	18	18	20	19	17	92	760	18	186	696.90
		111-49.88E	41	114									191	111
B-21	9/23 19:30	11-20.37N	47	70	17	20	18	18	14	87	615	7	49	38.30
		111-30.24E	54	80									64	53
B-25	9/24 17:08	10-10.80N	37	62	16	21	18	16	13	84	777	8	27	17.60
		111-07.29E	44	74									28	21
B-24	9/25 17:10	10-10.40N	35	60	16	20	20	18	14	88	740	6	24	47.55
		110-40.50E	40	68									27	59
B-20	9/26 17:05	10-25.21N	33	75	18	20	19	22	20	99	780	8	27	37.80
		110-10.20E	33	76									26	34
B-19	9/27 18:00	11-40.66N	38	84	19	20	19	20	20	98	700	9	31	107.50
		109-50.77E	39	86									31	19
B-22	9/28 17:43	10-14.46N	37	87	19	20	20	20	20	99	680	8	39	151.90
		108-45.47E	37	88									42	163
B-26	10/03 17:03	09-17.91N	34	78	19	20	20	20	20	99	777	20	232	266.60
		107-54.93E	34	79									216	248
B-27	10/04 17:11	09-35.37N	38	112	19	20	20	20	20	99	767	16	86	309.40
		108-19.87E	38	113									84	295
B-28	10/05 17:22	09-49.50N	38	75	8	20	20	17	20	85	763	16	54	82.68
		109-10.46E	45	88									79	85
B-29	10/06 16:55	09-51.27N	45	65	16	20	20	20	20	96	785	12	30	14.13
		110-05.13E	47	68									29	14
B-30	10/07 17:10	09-16.45N	33	70	20	20	20	20	20	100	770	7	78	23.60
		111-28.55E											74	22
B-35	10/08 17:13	08-32.95N	35	85	20	20	20	20	20	100	762	13	147	67.90
		111-28.55E											141	55
B-34	10/09 18:12	08-15.84N	38	80	20	20	20	20	20	100	713	11	46	53.00
		110-35.62E											46	54
B-33	10/10 16:56	08-28.71N	36	69	20	20	20	20	20	100	781	8	61	125.40
		109-08.57E											57	116
B-32	10/11 17:02	08-50.12N	45	78	19	20	20	20	20	99	778	6	9	3.30
		108-30.32E	45	79									9	3
B-31	10/12 17:00	08-45.27N	39	75	20	20	20	20	20	100	780	5	19	76.59
		107-28.73E											19	71
B-23	10/15 19:32	10-25.50N	47	80	20	20	20	20	20	100	660	11	79	83.33
		109-52.29E											92	98
B-13	10/17 20:15	13-13.05N	38	70	20	20	20	20	20	100	590	11	47	56.63
		109-49.93E											56	71
B-10	10/18 19:00	14-13.62N	43	65	20	20	20	20	20	100	665	9	57	18.77
		109-40.03E											61	21

Total number of specie	63

Total amount of weight	3,053.84
Total amount of relative abundance weight	2304
Total number of indiv.	1,837
Total number of relative abundance indiv.	1,906

* Lower figure in the colum of setting and hauling time shows the time converted into per 100 tan.

** Soaking time is duration from end of setting nets to bebinning of hauling nets.

*** catch in total weight excludes amount of incidentaly caught species.

**** Lower figure in the colum of catch in total weight and individuals shows amount of relative abundance[indivdual and weight(kg)] converted into the value per 100 tan.

Table 3-6 Amount of effort and resultant catch in test fishing during the 4th survey (SW monsoon season)

St.	Setting nets		Setting	Hauling	Number of net by mesh size (mm)					Total	Soaking time	Catch		
	Start time	Position	time (min)	time (min)	73	95	123	150	160	Tan	of nets (min)	Species	Indiv.	Total weight (kg)
B-02	5/11 19:20	17-52.07N	55	106	20	20	20	20	20	100	**547	8	55	*** 50.55
		107-24.69E	*39	*76									69	**** 64
B-03	5/12 17:20	17-53.00N	52	135	18	18	19	20	15	90	683	6	41	34.00
		108-28.11E	58	150									61	39
B-05	5/14 17:33	16-56.85N	35	78	15	15	9	15	15	69	689	6	30	19.65
		108-27.83E	51	113									40	26
B-06	5/15 17:36	16-31.17N	48	58	15	15	15	15	15	75	672	10	52	83.83
		109-29.09E	64	77									70	114
B-08	5/16 17:35	16-37.64N	40	73	15	15	15	15	15	75	682	9	202	218.40
		109-25.90E	53	97									269	91
B-09	5/17 17.00	15-29.62N	40	70	15	15	15	15	15	75	715	10	34	64.15
		110-18.45E	53	93									42	82
B-11	5/18 17.00	14-39.51N	40	85	15	15	15	15	15	75	715	9	74	86.54
		110-24.41E	53	113									94	111
B-18	6/24 17.00	12-27.38N	40	78	15	15	15	15	15	75	722	10	78	52.95
		111-30.33E	53	104									98	67
B-21	6/25 17.00	11-32.76N	58	70	15	15	15	15	15	75	702	10	29	63.17
		111-36.09E	77	93									37	85
B-19	6/27 17.03	11-34.38N	47	95	15	15	15	15	15	75	705	9	68	95.10
		109-43.73E	63	127									76	124
B-22	5/30 18.00	10-48.49N	48	130	15	15	15	15	15	75	657	8	45	37.80
		108-43.29E	64	173									61	53
B-23	5/31 17.53	10-31.90N	30	60	5	3	12	15	5	40	677	11	50	70.04
		109-31.79E	75	150									138	106
B-27	6/1 17.25	9-49.96N	40	67	12	5	7	17	14	55	685	7	37	31.50
		108-43.29E	73	122									82	68
B-26	6/2 17:15	9-39.73N	42	99	12	5	7	17	13	54	700	11	176	111.10
		107-44.69E	78	183									387	229
B-31	6/6 21:08	8-51.95N	52	65	17	15	12	17	12	73	475	11	140	80.65
		107-27.55E	71	89									269	155
B-32	6/7 17.00	8-31.11N	45	73	17	15	12	17	12	73	707	7	28	27.25
		108-25.48E	62	100									33	32
B-33	6/8 17.00	08-31.50N	43	88	17	15	12	17	12	73	709	11	21	23.42
		109-29.93E	59	121									24	34
B-28	6/9 17.05	09-32.71N	50	77	17	15	13	17	13	75	703	8	78	160.90
		109-34.18E	67	103									99	213
B-29	6/10 17.00	09-31.88N	50	82	17	15	11	17	12	72	705	9	33	53.10
		110-32.75E	69	114									40	69
B-34	6/11 17.02	08-29.54N	43	79	17	15	15	17	12	76	713	7	8	34.35
		110-31.05E	57	104									10	54
B-35	6/12 17.00	08-29.89N	45	75	17	15	15	17	12	76	712	5	5	4.70
		111-29.63E	59	99									6	7
B-30	6/13 17.00	09-29.63N	43	80	16	15	15	15	12	73	717	5	43	100.70
		111-29.76E	59	110									57	135
B-25	6/14 17.04	10-30.14N	44	75	16	15	15	17	12	75	712	8	71	31.20
		111-33.37E	59	100									87	38
B-24	6/15 17.00	10-39.18N	40	67	15	15	15	17	12	74	723	6	25	15.40
		110-39.24E	54	91									31	19
B-20	6/16 16.57	11-25.80N	43	108	15	15	15	17	12	74	630	7	40	49.65
		110-26.45E	58	146									51	63
B-17	6/17 17.20	12-32.00N	40	80	15	15	15	17	12	74	675	10	116	135.50
		110-32.10E	54	108									158	86
B-13	6/18 17.35	13-21.47N	35	90	15	15	15	17	12	74	685	9	42	44.99
		109-46.00E	47	122									54	59
B-14	6/20 17.34	13-31.39N	38	67	14	15	15	17	12	73	686	5	27	12.90
		110-30.36E	52	92									37	17
B-15	6/21 16.58	13-39.78N	39	63	13	14	15	17	12	71	718	7	40	39.10
		111-12.97E	55	89									55	59
B-12	6/22 17.00	14-34.96	38	62	12	14	15	17	12	70	682	8	21	179.80
		111-20.09E	54	89									33	251
B-10	6/23 17.00	14-30.45N	34	57	11	12	14	17	12	66	726	10	133	44.18
		109-39.58E	52	86									225	72

Total number of species	55

Total amount of weight	2,056.1
Total amount of relative abundance weigh	2,622
Total number of indiv.	1,833
Total number of relative abundance indiv.	2,761

* Lower figure in the colum of setting and hauling time shows the time converted into per 100 tan.

** Soaking time is duration from end of setting nets to bebinning of hauling nets.

*** catch in total weight excludes amount of incidenntaliy caught species.

**** Lower figure in the colum of catch in total weight and individuals shows amount of relative abundance[indivdual and weight(kg)] converted into the value per 100 tan.

3-4-4 Biological survey

The number of specimens obtained by biological survey in each test fishings are as follows.

Table 3-7 The number of each species used for acquisition of biological data (1).

	species	May - June, 1996	Sept. - Oct., 1996	May - June, 1997	Total
1	*Stegostoma fasciatum*	0	0	1	1
2	*Pseudocarcharias kamoharai*	0	4	0	4
3	*Galeocerdo cuvier*	1	0	0	1
4	*Prionace glauca*	2	0	0	2
5	*Carcharhinus sorrah*	1	1	0	2
6	*Carcharhinus brevipinna*	1	1	0	2
7	*Carcharhinus falciformis*	4	7	4	15
8	*Sphyrna lewini*	0	0	1	1
9	*Isistius brasiliensis*	1	2	2	5
10	*Manta birostris*	1	1	0	2
11	*Mobula japonica*	7	5	2	14
12	*Chirocentrus dorab*	2	4	0	6
13	*Saurida sp.*	1	2	0	3
14	*Diaphus gigas*	0	1	0	1
15	*Diaphus watasei*	0	1	0	1
16	*Exoccetus volitans Linnaeus*	1	0	0	1
17	*Cypselurus sp.*	2	1	6	9
18	*Cypselurus atrisignis*	0	3	2	5
19	*Cypselurus poecilopterus*	1	2	2	5
20	*Cypselurus cyanopterus*	5	1	2	8
21	*Cypselurus spilonotopterus*	1	6	3	10
22	*Cypselurus unicolor*	1	0	1	2
23	*Cypselurus longibarbus*	1	0	0	1
24	*Cypselurus naresii*	0	0	2	2
25	*Ablennes hians*	3	6	5	14
26	*Tylosurus acus melanotus*	1	0	0	1
27	*Paraexocoetus sp.*	0	0	1	1
28	*Therapon jarbua*	0	0	1	1
29	*Priacanthus macracanthus*	12	5	29	46
30	*Rachycentron canadum*	1	0	3	4
31	*Parastromateus niger*	1	0	2	3
32	*Elagatis bipinnulata*	0	2	0	2
33	*Naucrates ductor*	3	5	6	14
34	*Seriolina nigrofasciata*	0	9	6	15
35	*Scomberoides commersonnianus*	2	0	13	15
36	*Seriola rivoliana*	13	4	6	23
37	*Scomberoides lysan*	2	0	2	4
38	*Scomberoides tol*	9	0	3	12
39	*Trachinotus baillonii*	0	0	2	2
40	*Megalaspis cordyla*	4	0	1	5
41	*Decapterus russelli*	0	0	4	4
42	*Decapterus macrosoma*	0	7	3	10
43	*Decapterus maruadsi*	1	0	4	5
44	*Decapterus akaadsi*	0	1	7	8
45	*Selar crumenophthalmus*	5	11	10	26
46	*Atule mate*	0	7	0	7
47	*Alectis ciliaris*	1	0	0	1
48	*Uraspis helvola*	1	2	1	4
49	*Carangoides ferdau*	1	0	0	1
50	*Carangoides orthogrammus*	4	13	24	41

Table 3-8 The number of each species used for acquisition of biological data (2).

	species	May - June, 1996	Sept. - Oct., 1996	May - June, 1997	Total
51	*Coryphaena hippurus*	179	235	218	632
52	*Coryphaena equiselis*	13	33	63	109
53	*Mene maculata*	0	9	0	9
54	*Brama orcini*	122	397	157	676
55	*Lobotes surinamensis*	48	56	28	132
56	*Kyphosus vaigiensis*	0	3	0	3
57	*Pseudocaliiurichthys sp.*	0	0	1	1
58	*Naso brevirostris*	1	0	0	1
59	*Lepidocybium flavobrunneum*	1	0	2	3
60	*Ruvettus pretiosus*	2	6	0	8
61	*Gempilus serpens*	1	9	6	16
62	*Promethichthys prometheus*	1	0	0	1
63	*Rastrelliger kanagurta*	0	8	3	11
64	*Scomber australasicus*	3	0	23	26
65	*Auxis thazard*	127	242	289	658
66	*Auxis rochei*	189	58	591	838
67	*Sarda orientalis*	4	0	0	4
68	*Euthynnus affinis*	6	30	26	62
69	*Katsuwonus pelamis*	144	197	301	642
70	*Thunnus tonggol*	0	40	71	111
71	*Thunnus albacares*	1	11	7	19
72	*Thunnus obesus*	15	4	59	78
73	*Acanthocybium solandri*	1	1	0	2
74	*Scomberomorus commerson*	0	1	0	1
75	*Istiophorus platypterus*	10	26	8	44
76	*Makaira indica*	4	8	0	12
77	*Makaira mazara*	6	10	0	16
78	*Tetrapterus audax*	0	0	3	3
79	*Xiphias gladius*	0	0	1	1
80	*Psenes arafurensis*	5	0	0	5
81	*Psenes maculatus*	3	0	0	3
82	*Psenes cyanophrys*	8	4	8	20
83	*Cubiceps squamiceps*	0	34	0	34
84	*Cubiceps pauciradiatus*	3	0	22	25
85	*Cubiceps baxteri*	1	0	0	1
86	*Nomeus gronovii*	0	0	1	1
87	*Ariomma indica*	0	0	5	5
88	*Remorina albescens*	0	1	0	1
89	*Echeneis naucrates*	1	3	8	12
90	*Remora remora*	0	1	0	1
91	*Melichthys vidua*	0	1	0	1
92	*Canthidermis maculata*	2	10	5	17
93	*Aluterus monoceros*	4	131	2	137
94	*Aluterus scriptus*	2	1	1	4
95	*Lagocephalus sp.*	0	1	0	1
96	*Lagocephalus lagocephalus oceanicus*	0	1	0	1
97	*Diodon holocanthus*	2	0	0	2
98	*Diodon eydouxii*	3	7	7	17
99	*Diodon hystrix*	1	0	18	19
100	*Thysanoteuthis rhombus*	0	0	1	1
101	*Sthenoteuthis oualaniensis*	76	144	163	383
102	*Tremoctopus violaceus*	1	0	0	1

3-5. Land Site Survey

3-1. Fields of the Survey

Given the broad Terms of Reference and the limited time allotted for this field survey, as well as the absence of comprehensive and reliable data on the marine fisheries of Viet Nam, the survey is divided to two broad fields, namely fisheries production and fisheries socio-economics. The fisheries production survey covered the modalities of marine fisheries operations and associated topics such as target species, fishing grounds, and developmental perspectives of fishers. The socio-economics survey , on the other hand, handled subjects such as population, labor, technology, capital, management, fish distribution and information, among others.

Such a method of field survey does not necessarily imply the use of sophisticated techniques. This is important in the case of most developing nations, where the existing data base is scanty at best and the logistical support required to generate data is still rudimentary. In fact, the survey has been aimed at understanding basic production structure and socio-economic conditions in and related to the fishery sector, even though precision of detail might be sacrificed.

3-2. Manuals and "Mini-workshops" for Technology Transfer

Based on findings during the first familiarisation visit to the five provinces in March 1995, a field survey handbook was prepared together with survey questionnaires for each of the two fields (Appendix 4). The questionnaires were supplemented by checklists to organize semi-structured interviews with stakeholders whom it would not be suitable to interview using a questionnaire. After that, the survey handbooks and questionnaires were translated into Vietnamese and pre-tested and revised, where necessary, in collaboration with the staff of RIMP before actually being used for field survey. Further three visits were made to each of the provinces (June-August 1995, December 1995-January 1996, and August-October 1996), for a total of about 10 weeks to undertake both fisheries production and socio-economic surveys.

"Mini-workshops" were conducted at the beginning of the first and second visits to each provincial fisheries department, with the objective of familiarizing collaborating

fisheries officers with the purposes of the survey and the methodology for collecting and organizing data. A total of 13 provincial fisheries officers were trained through mini-workshops and the succeeding field surveys.

Evaluation meetings were held with collaborators at the end of each visit to each landing site, to assess progress and elicit suggestions regarding the collection and interpretation of primary data. In three provinces of Khanh Hoa, Quang Nam Da Nanag and Quang Binh, collaborating fisheries officers continued interviewing during the 3-month period between the conclusion of the second socio-economic field survey and the beginning of the third. A further 150 samples were obtained in this manner.

3-5-3. Fisheries Production Survey

The survey was conducted using a series of questionnaire-based interviews with local fishers and their families, and by making observations in fish landing places and villages. To ensure representativeness of the principal fishing port(s) within each province together with outlying fishing villages were selected for survey. However, since interviewees were selected based on the suggestions of local fishery officers and officials of the local People's Committee, the sample might be biased toward fishers of "good performance." The sample sizes were as follows:

Ba Ria Vung Tau	:26
Binh Tuan	:33
Khanh Hoa	:26
Quan Nam Danang	:48
Quang Binh	:20

To structure the interviews, a calendar year was divided into three seasons, "good", "intermediate" and "poor", and fishers were queried on their production per fishing trip in each of these three seasons. The annual total volume and value of production for a particular fishery are often calculated from based on such figures per trip. But it is unrealistic to assume that per trip production remains constant for each of the three seasons. Therefore, the data derived from the interviews were carefully cross-checked and adjusted, where necessary, based on other information and factors.

Specifically, the actual estimation of fishery production was done using the following procedures:

(1) Fishing boats were classified into four categories, less than 20 h.p., 20-45 h.p., 45-75 h.p., and larger than 75 h.p.;
(2) As the statistical classification in terms of types of fisheries differs little among the five provinces, we used their classification system;
(3) Where data were missing on the numbers of fishing boats by engine h.p. operating in a fishery, the number of units was estimated by multiplying percentages of h.p. categories to the total number of fishing boats operating that fishery type;
(4) Where possible, catch data obtained through interview are classified the four categories -- finfish, cephalopods (squid and cuttlefish), shrimp, and by-catch fish, and arranged as monthly data;
(5) The annual per boat average catch for a fishery was estimated by summing the monthly data for the 12 months given in (4) above;
(6) The annual total catch of a fishery was calculated by multiplying the annual per boat average given in (5) above by the number of fishing boats given in (3) above.
(7) Missing information in questionnaires was estimated from the other samples.
(8) Months in lunar calendar with which fishers describe their fishing operation were converted to corresponding solar calendar months as much as practical.

3-5-4. Fisheries Socio-Economic Survey

A grand total of 403 interviews using questionnaires was conducted in five fishing ports representative in each of five provinces. Of these 255 were designed for "fisheries stakeholders" and 148 for the "Standards of Living" survey. The 255 stakeholder interviews used questionnaires designed specifically for each stakeholder group involved in the existing coastal and distant water fisheries. The 148 questionnaires for the "Standard of Living" survey were administered to marine fisheries households and to non-fisheries households for comparative purposes although the emphasis was on the former. The sample sizes were as follows:

Ba Ria Vung Tau	:T = 30, [8 F and 22 NF]
Binh Tuan	:T = 34, [21 F and 13 NF]
Khanh Hoa	:T = 20, [7 F and 13 NF]
Quan Nam Danang	:T = 40, [33 F and 7 NF]
Quang Binh	:T = 24, [21 F and 3 NF]

Chapter 4

Improvement Work of the Research Vessel

Chapter 4. Improvement Work of the Research Vessel

4-1. Outline of the Research Vessel " Bien Dong"

It was agreed in the S/W meeting held between the Government of Japan and the Government of Vietnam that the research vessel " Bien Dong" which belonged to the Research Institute of Marine Products of the Ministry of Fisheries of Vietnam would be used for the sea borne survey of this Study upon installation of appropriate new survey equipment and the rehabilitation of the vessel.

The vessel was built at the MJELLEM & KARLSEN Shipyards, Norway,1976 as a research vessel equipped for stern-trawling and purse-seine methods. It was subsequently granted to the Government of Vietnam from the Government of Norway. Main particulars of the vessel are shown in Table 2-2.

4-1-1. Operational circumstances of the vessel

(1) Operation records

There are records of the research voyages starting from the 1st voyage of Mar.22 - Apr.1,1977, followed by twenty voyages from the 2nd voyage from May 4,1977 to the 21st voyage up to Nov. 21,1979. However it was assumed that several voyages were made other than those noted in the records.

Operational records in recent years are as follows:

1993: 2 - 3 months period, 2 voyages made as support vessel for oil exploration.

1994: 3 weeks in May, 1 voyage made as above 2 weeks in June, operated as cargo carrier to southern China.

In this period, the vessel was moved out of harbor of Hai Phong, 4 - 5 times a month, depending on harbor congestion conditions.

(2) Dry docking records

in 1984: May 14 - June 21 Dry docking in Kobe Dockyards Co., Japan.

in 1989: Dry docking in Bason Shipyard in Ho Chi Minh City.

in 1991: Dry docking in Pha Rung Shipyard in Hai Phong. Main engine, generators, controlable pitch propeller etc. overhauled.

4-1-2. Evaluation for application of the vessel to the Study

(1) The condition of the main parts of the vessel were found to be in reasonable condition, such as main engine, generators, refrigerators, side thruster etc., however some parts were deteriorated or damaged, such as; hull plating, hydraulic pipe line on deck, observation equipment and air conditioning for accommodation.

(2) Some inconvenience was anticipated on deck work during the Study due to construction arrangement of the vessel and lack of equipment for gillnet system and observation. It was considered that the vessel had to be thoroughly repaired in dry dock and appropriately modified for gillnet fishing.

(3) Main repair works for the vessel were mentioned in the Preliminary Report of the Marine Resources Survey in Vietnam(JICA, 1994.12).

(4) Marine resources study in high sea area was needed to be undertaken repeatedly and over a long period of time in order to obtain proper resource data. The survey work shall be taken over by the Vietnamese counterpart after the study period there by utilizing the vessel and the equipment arranged by this Study. This will help effect of the transfer of appropriate technology.

4-2. Selection of the ship repair yard

Attention was paid to selection of the ship repair yard as it was assumed performance of the rehabilitation work would considerably affect the smooth operation of the study work which followed. There was a lack of information about ship repair yards in Northern Vietnam prior to preparation of the study, therefore effort was made to gather suitable information about them.

Outline of six shipyards:

(1) NAMTRIEU SHIPYARD: This company has three factories in interior Hai Phong but two of them are still plain land. Approximately 300 workers are engaged in mainly floating ship repair work.

(2) PHA RUNG SHIPYARD COMPANY: Started in 1984 under technical assistance from Finland. One dry-dock and repair quay are operating with basic facilities and optimum layout. Number of workers is approximately 750. This is the only Vietnamese repair yard listed in Lloyds Maritime Directory.

(3) BACH DANG SHIPYARD: Since 1960 it has been in operation working in ship building, ship repair, fabrication and machining under Chinese aid. Facilities are modern but these appears to be less maintenance which may bring problems in the future. There are 2,000 workers. Engineers and technicians total 165. Design work is subcontracted to an affiliated company.

(4) HAIPHONG SHIP SERVICE AND DEMOLITION CORP.: Demolition of steel vessel and the export of steel scrap are the major business of this company. 120 workers are employed.

(5) HAIPHONG SHIPYARD: Started in 1962, undertaking ship building and repair. Number of employees is 300 including 25 engineers. This is a smaller operation than BACH DANG but has the appearance of being more aggressive in operation.

(6) BEN KIEN SHIP BUILDING FACTORY: Since 1972,undertaking ship building, ship repair and machining. Employees total 400 including 55 engineers. There is no experience in foreign ship repair.

As an illustration of capability, rust removal from hull/shell was only observed as using sandblasting at PHA RUNG, compared with manual chipping in other shipyards. Shipyards other than PHA RUNG and BACH DANG seemed not to have efficient organizations for effective ship repair. It was judged that PHA RUNG should be the contractor for this rehabilitation work, due to experience in handling such repairs. It was the only yard available to meet schedule of this Study among the noted shipyards.

General view of PHA RUNG SHIPYARD:

Dry-dock	Length 156m x Width 25m with	1 set	15 tons x 28 m tower crane
Quay		1 set	do.

Machine shop	one
Fabrication shop	one
No. of workers	750 persons
Working hours	Monday - Saturday 8 hours per day

4-3. Items for rehabilitation and survey equipment installation work

4-3-1. Modification work for gillnet system

As this ship had been equipped with stern-trawling and purse seine fishing systems, modification for gillnet system working was planned. This ship has a long forecastle but many pieces of equipment, such as winches, windlass, mooring facilities etc. occupying the deck. As it appeared not possible to handle gillnet on the forecastle deck, a location just behind the forecastle deck house on the starboard side, 1st deck was chosen for a gillnet lifting and handling location.

Several modifications were made as follows:

(1) Bulwark on 1st deck starboard between Fr.42 and 51 cropped and removable hand-railing fitted in way.

(2) Part of bridge deck above gillnet lifting space was cropped and reinforced for deck crane support. Deck ladder, rest of boat work in the way, relocated.

(3) Winches, line hauler for trawling or purse seine together with oil piping on 1st deck in way were removed and stored.

(4) One net hauler and high pressure oil pump provided by JICA was installed on 1st deck at net lifting location, complete with control stand and associated piping etc. Net hauler: Lifting capacity 400 kg 136 rpm at hydraulic oil flow 120 l/min

(5) Slip way on the stern was made flat by installing false deck. Guides for net shooting were fitted.

(6) Gutter way for net handling fabricated and fitted.

(7) Gillnet stock pile bulkheads installed.

4-3-2. Installation and operation of survey equipment

The vessel was equipped with a scanning sonar and a fish finder initially, but these were not in a workable condition. These were replaced with new instruments and a new Doppler current meter was also installed. Display units of these systems were located in the wheel house. Transmitter/receivers were replaced in the sonar domes under the ship's bottom. New instruments and systems were provided by JICA.

Specifications of instrumentation as follows:

Scanning sonar: Range 75m - 2,000 m, Frequency 55 kHz	1 set
Fish finder: Color display type	1 set
Doppler current meter: Water depth 2 - 100 m, 3 layers	1 set
Electrical water temperature meter : Sensitivity 0.01	1 set

4-3-3. Modernization of nautical instruments

For the purpose of increasing voyage safety and for the rapid determination location during survey on the Study, the radar was replaced and a GPS navigation system and INMARSAT communication system were newly installed. These were also provided by JICA.

Specification:

Ships radar : Range 120 mile, 25 kw, 28 inches display	1 set
GPS navigation system: Accuracy of location 15 m, velocity 0.1 kn	1 set
INMARSAT: Telephone and facsimile	1 set

Installation of INMARSAT was delayed due to procedural problems with Vietnamese authorities. It's operation started from the 3rd year of survey however could not work smoothly due to some problems with the land station.

4-3-4. Hull and deck maintenance

(1) Hull repair and painting

Prior to the repair docking, the vessel was docked for inspection in March 1995 and bottom inspection was made by VIRES (Vietnam Register of Shipping) inspector. Damages on port side bottom at middle were found, hull plates PA-4, PB-3, PB-4,

PB-5,PC-6, PC-7 and PC-8 (10 mm thick. each) which were sub-segments were renewed and some internals were also repaired on recommendation of the surveyor.

Deterioration was noted on other hull plating and the following plates were renewed or partly renewed.

Starboard side middle: SF-3 and SF-5 (8 mm thick. each)

Port and starboard forward: PF-8, PF-9, SF-8 and SF-9 (8 mm thick. each),
PE-8, PE-9, SE-8 and SE-9 (10 mm thick, each)

In addition to the above, it was found that there was a little heavy deterioration at the port side shell close area for discharge from the galley. However, this was cropped and partly renewed in PD-4 and PE-5 (600 mm dia.10 mm thick.)

The out side of the hull was entirely sand-blasted, cleaned and applied each 2 layer coats of A/C paint, followed with 1 layer coat of A/F paint to the bottom, 2 layer coats of B/T paint to the boottop and 2 layer coats of colored paint to the topside were applied respectively. Letters and marks such as ship's name, port of registry, draft marks etc. were repainted.

All sea-chest gratings were displaced, the interior cleaned, repainted and refitted.

All zinc anodes were renewed around the propeller and the side thruster.

All tanks were drained, plugs refitted and hydrostatic tests for survey undertaken after the hull repairs were carried out.

(2) Reconditioning of accommodation space

Four Japanese study team members were onboard during the survey, therefore 4 cabins ex. C/E, 2/O, C/S and C/IE were reconditioned. In addition the library was converted into a meeting room.

One refrigerator and one hot water generator were installed.

All accommodation spaces were cleaned and refurbished.

(3) Reconditioning of piping systems

As sanitary and scupper piping were very deteriorated, most of this piping was

renewed.

Pumps and valves were opened and reconditioned.

(4) Reconditioning of refrigerating system

Compressors, fans, control box, safety device, valves, filters, piping, tanks and other fittings for refrigerators to the store and freezer were opened, checked and refitted.

Compressor, fans, filters and sea water pumps were opened , checked and refitted.

(5) Reconditioning of life saving and fire fighting equipment

Life boat, life rafts and other life saving equipment were inspected by VIRES inspector.

Two additional life rafts were installed.

All openings and watertight doors on the 1st deck were inspected, 40 sections of door coamings were partly renewed and checked for water-tightness.

The top plate of the fish hatch cover on the stern ramp was renewed due to deterioration.

(6) Reconditioning of rudder and steering system

Rudder plate, rudder stock and tiller were disassembled, steering engine and rudder carrier were opened, inspected by VIRES inspector and reassembled.

The deteriorated part of the leading edge of the rudder plate was partly renewed and zinc anodes were renewed on the rudder.

Auto pilot system was examined.

(7) Reconditioning of anchoring and mooring system

Anchors and anchor chains were ranged out on the dock bottom, cleaned and inspected by VIRES inspector.

Chain locker was cleaned and inspected by VIRES inspector.

Windlass was dismantled and overhauled, windlass seat renewed, hydraulic piping examined then remounted and tested.

(8) Reconditioning of oceanographic observation winch

Hydraulic oceanographic observation winch and davit on 1st deck port side were dismantled, overhauled and remounted, hydraulic piping on deck was renewed, then tested.

4-3-5. Machinery maintenance

(1) Main engine

NORMO 7292 PUP9 1500 PS was overhauled, then inspected by VIRES inspector.

Deteriorated parts were replaced with new parts and reassembled.

Fuel injection pump was overhauled and needle valves were ground and lapped.

Governor was overhauled and corn drive gear wheel replaced.

The air compressor driven by the main engine was overhauled, clutch adjusted and brake band replaced.

Main air vessel opened, cleaned and inspected. Valves were ground and lapped, reassembled and tested.

Fresh water pump on main engine was overhauled.

Main engine exhaust silencer cover was renewed.

(2) Auxiliary engines maintenance

Two sets of VOLVO PENTA MODEL TMD 120 AK225 cv were overhauled and inspected by VIRES inspector. Worn parts were replaced.

Crank shafts of No. 1 and No. 2 engines were scratched and so replaced with new parts.

Fuel injection pumps, engine driven lubricating oil pumps, fuel oil pumps and cooling water pumps were dismantled, overhauled and reassembled.

Turbo chargers were dismantled, overhauled and reassembled.

(3) Propulsion system maintenance

Controllable pitch propeller and shafting were removed from ship, overhauled,

inspected by VIRES inspector, reassembled and reinstalled.

Propeller blades were disassembled, polished and reassembled. Oil seals on propeller boss were renewed.

Stern tube bearing was removed, inspected by VIRES inspector, re-metal, machine-finished and reinstalled. Simplex oil seals were replaced with new parts.

Propeller shaft bearings were opened and inspected by VIRES inspector and reassembled.

Reduction gear box was opened, cleaned, inspected by VIRES inspector and reassembled.

Thrust bearing was opened, cleaned, inspected by VIRES inspector and reassembled.

(4) Bow and stern side thrusters maintenance

Bow and stern side thrusters were examined. Deteriorated hydraulic piping was cropped and renewed. Cooler for hydraulic oil was dismantled, cleaned, inspected and reassembled. Automatic control system was examined and adjusted.

(5) Auxiliary machinery maintenance

Air compressor was dismantled, overhauled, safety valve refitted and adjusted.

Pressure gauge was reassembled and calibrated.

Air vessel for main engine was opened, cleaned, safety valve checked, applied pressure tested and resettled.

Sea and fresh water pumps for main engine cooling, fire pump, refrigerator cooling pump, LO pump, FO pump and associated cooling devices were dismantled, overhauled, inspected and reassembled upon repair or replacement of worn parts.

Bilge pump was dismantled, cleaned, DEVCON was applied to worn casing, machined, finished, reassembled and tested.

Daily fresh water pump and accumulation tank were opened, cleaned, after inspected and reassembled.

Oil and water separator was dismantled, opened, cleaned and inspected by VIRES

inspector and reassembled.

(6) All sea valves were opened, cleaned, lapped, tested and refitted

4-3-6. Electrical maintenance

(1) The two main generators were dismantled, including pulling out of rotors, cleaned by steam, dried, varnished and reassembled.

Shaft bearings of No. 1 generator were replaced with new parts.

Generator controller was examined.

(2) All motors were dismantled, opened, steam cleaned, dried, re-varnished and reassembled. Five motors with failed insulation were rewound.

(3) All cables and wiring, distribution boards, terminals were tested for insulation and examined.

(4) Remote controls, signals and alarms

Main engine remote control and signal systems were examined, indication and alarm lamps were replaced and the whistle was renewed.

Remote steering stand on bridge deck starboard was relocated for gillnet fishing and tested.

Brackets for signal lights on aft mast were renewed.

(5) Reconditioning of lighting equipment

One 250w projecting light was installed on bridge deck aft.

Fluorescent lamps in accommodation were examined and 200 unit lamps were replaced.

High pressure mercury lamps were examined and 20 unit lamps were replaced.

Stern 2,000w flood light was renewed.

Emergency battery 140 h (8 sets) and battery for generators (4 sets) were renewed.

4-3-7. Dry docking, inclination test and sea trial

Dry docking was undertaken at the inspection dock from Mar.15 to Mar.19, with the first docking from Apr. 3 to May 11 and the second docking from Sept.

15 to Oct. 7. This vessel has initial trim as designed, then, draught at dry-docking was 2.4 m at the bow. 4.35 m at stern and trim was 1.95 m astern. Trim adjustment prior to dry docking was necessary by applying some adjusting weight on the bow.

An inclination test for determining the center of gravity and light weight of the ship was conducted just after leaving the second dry-docking period.

A sea trial was satisfactorily carried out on Oct. 16 under the supervision of VIRES inspectors.

4-3-8. Spare parts preparation

For this maintenance work, parts to be used for replacement and spares for main engine, generators, auxiliary machinery, propulsion system and electrical equipment were prepared from their makers in foreign countries, mostly Northern Europe, through agents in Singapore. As a result it took approximately one month to receive parts after placing purchase orders. Problems arose in some cases due to differences in detail dimensions.

4-4. Planning of the work

It was estimated that the term of the work would be two or three weeks if it was carried out in Japan but there was little information on or experience of North Vietnamese shipyards capabilities and conditions for preparing machinery parts. Therefore the work was allocated a two months period. A problem occurred with the delivery of equipment provided by JICA, therefore, the repair dry-docking period was divided into two periods. During the first dry-docking, it was planned to concentrate on a periodical survey of the vessel, including structural conversion for the sea borne survey and maintenance works. During the second dry-docking, the work would be concentrated so as to install or replace survey equipment.

4-5. Implementation of the work

The substantial contents of the work had been specified between the Study team and the counterpart upon inspection by VIRES inspectors in the inspection

docking in March 1995. A contract for the work implementation was signed between the Study team and the shipyard at end of March,1995 then the work started. Upon completion of the second dry-docking, a sea trial was carried out and the vessel was subsequently delivered to RIMP (Table 1).

Table 4-1 Survey equipment installation and rehabilitation work procedure

MONTH / ITEMS	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Inspection Dock									
1st term Work Implementation			———						
JICA Equipment Preparation			·····	·····	·····	·····	·····		
2nd term Work Implementation								———	
Sea Trial								◎	
Training									
1st Sea-borne Survey									———

4-5-1. First term work implementation

One machinery engineer of the Study team attended the shipyard from Mar. 12 to May 27, 1995 and one electrical engineer attended from Apr. 23 to May 27 to supervise the work and to facilitate technological transfer. Drawings necessary for installation of survey equipment or structural conversion were made by the support team in Japan and delivered to the shipyard (Figure 4-1).

Maintenance work was generally managed and implemented by the shipyard. The vessel had been accommodated in dry-dock with another vessel. The schedule was disturbed several times due to necessary dock flooding. The work implementation procedure is shown in Table 4-2

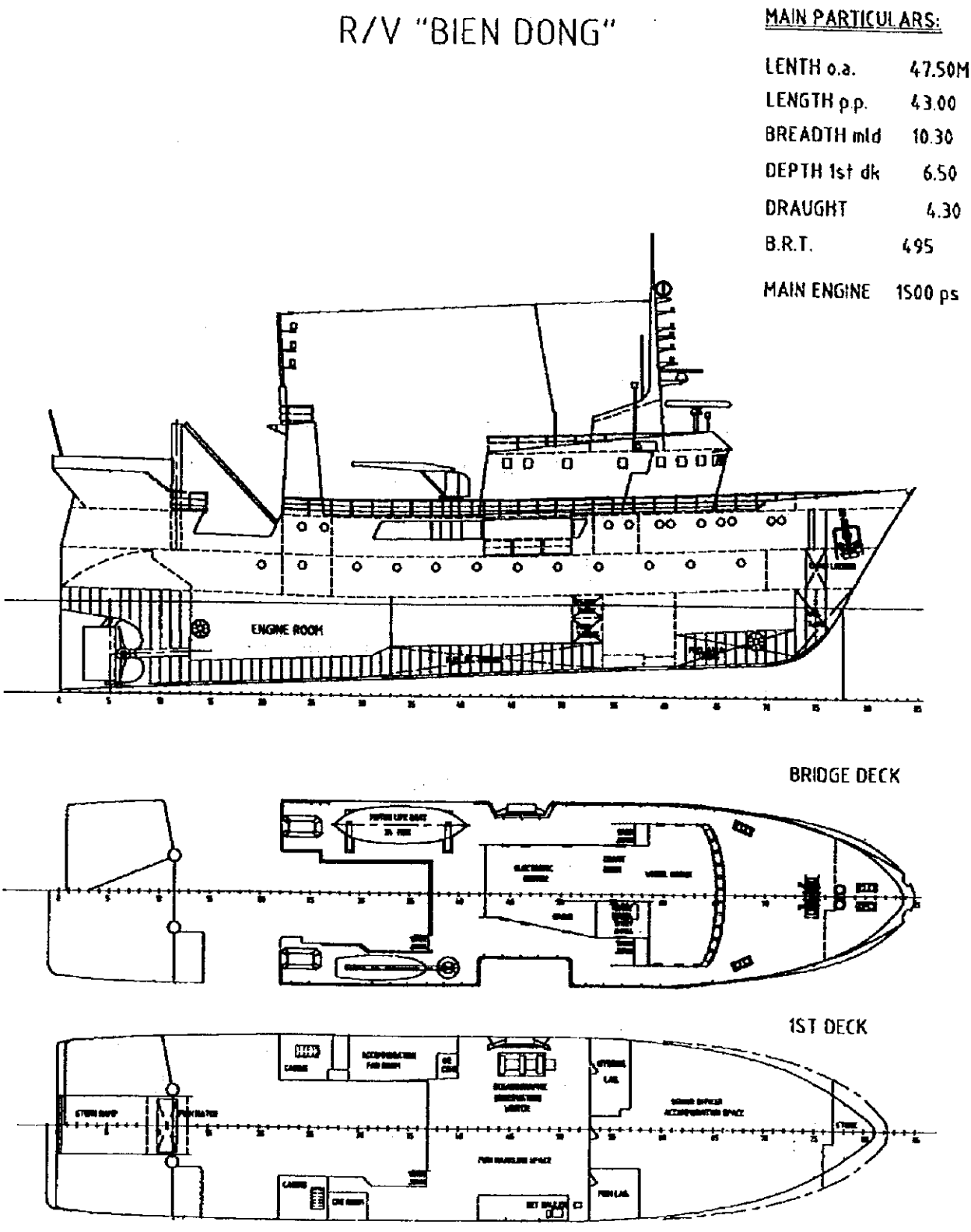


Figure 4-1. General arrengement of BIEN DONG

4-5-2. Second term work implementation

One electrical engineer attended the shipyard from Oct. 1 to Oct. 16. Support engineers from the manufacturers of the survey equipment and the navigation instruments also attended to provide technical support and adjustment services. The work implementation procedure is shown in Table 4-3.

4-6. Estimation of the ship's stability for the sea-borne survey

As the vessel was designed for trawling and purse-seine methods, the vessel originally had a sufficiently high stability. Referring to the load condition documents as had been obtained, 20 tons of fishing gear was as estimated as the load on the bridge deck level as the design base but this was not to exceed 2.5 tons of fishing gear together with fish caught in the survey. It was therefore estimated that the vessel would be safe in operation during the survey.

Furthermore, assumptions were made about the vessel's stability in each period of the voyages considering fuel oil, fresh water, other provisions consumption and the loading of fish caught. The result of the assumptions showed no cause for concern and secured at least 44 cm of GM (height of meta-center above center of gravity).

Upon completion of the modification and maintenance work, an inclination test for the vessel was conducted to determine the change of center of gravity and ship's displacement caused by alterations for gillnet handling and the new instrumentation. The result of these tests showed that the assumptions were correct and confirmed the safety of the vessel at sea.

A study of the stability of the vessel was carried out based on the following materials issued by the ship builder, MJELLEM & KARLSEN and prepared by the Research Institute of Marine Products: STABILITY CONTROL USING A KG LIMITING CURVE, HYDROSTATIC PROPERTIES

For instance, calculation output at departure, each 1/5, 1/2, 3/4 way through a voyage and arrival condition are as follows:

Case	Draft at mid-ship	Max..allowable C.G.height		Calculated C.G.height
Departure	4.03 m	4.745 m	>	4.44 m
1/5 way	3.95	4.753	>	4.50
1/2	3.88	4.734	>	4.64
3/4	3.95	4.725	>	4.44
Arrival	3.87	4.727	>	4.51

Another figure for the range of safe work on deck was assumed as 6 degrees roll and the restoring moment at the roll state would be 21.6 ton-meter in the worst case which showed that the vessel was capable of a hanging load of 4.2 tons at ship's side, or 6 tons in other conditions.

4-7. Periodical Survey and Issue of Certificates

Through inspection docking in March and the sea trial in October, VIRES inspectors had implemented the inspection and examination of the vessel and issued a recommendation to fulfill the periodical survey of the vessel. The following certificates were issued.

Type of certificate	Date of Issue
CERTIFICATE OF REGISTRY	27 OCT,1995
SEAWORTHINESS CERTIFICATE	24 OCT,1995
CERTIFICATE OF MINIMUM SAFE MANNING	28 OCT,1995
GIAY PHEP DI BIEN	26 OCT,1995
SHIP STATION LICENCE	12 OCT,1995
INTERNATIONAL OIL POLLUTION PREVENTION CERTIFICATE	24 OCT,1995
SHIP SAFETY EQUIPMENT CERTIFICATE	24 OCT,1995
CARGO SHIP SAFETY RADIO CERTIFICATE (SOLAS1974)	24 OCT,1995
REPORT OF PERIODICAL SURVEY (MARPOL73/78)	24 OCT,1995
STATUTORY SURVEY REPORT	24 OCT,1995
FREEBOARD REPORT	24 OCT,1995
INSPECTION RESULT OF CO2 EXTINGUISHING SYSTEM	2 JUL,1995

Table.4-2 First Term Modification and Maintenance Work Procedure

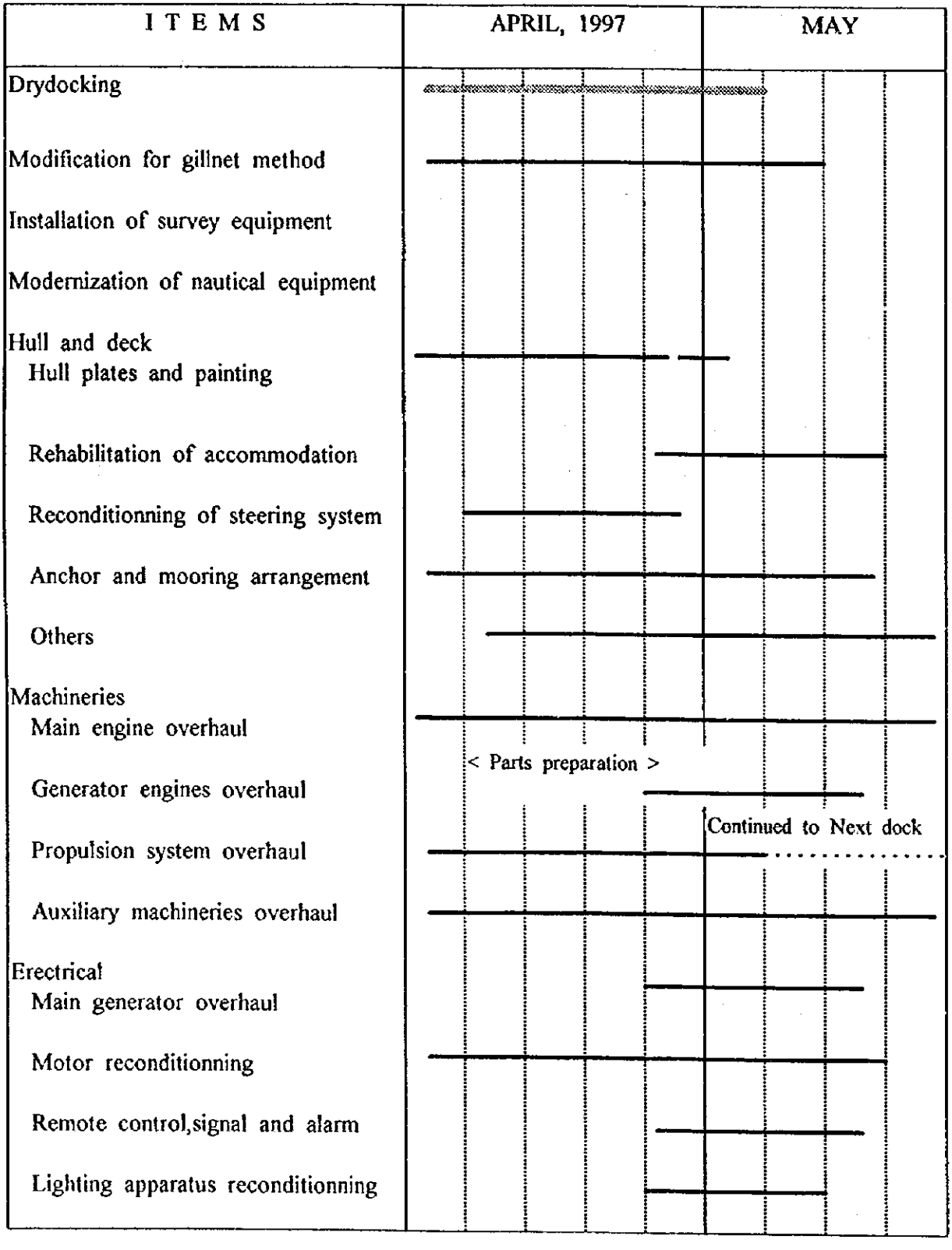


Table.4-3 Second Term Modification and Maintenance Procedure

DATE / ITEMS	OCT.,1995
	5 10 15 20 25
Drydocking	
Modification for gillnet method	
Installation of net hauler	
Installation of survey equipment	
Scanning sonar	
Fish finder	
Doppler current meter	
Modernization of nautical equipment	
Radar	
GPS navigation system	
IMMARSAT	
Machineries	
Propulsion system	
Inclination test	
Sea trial	

Chapter 5

Results of the Sea-borne Survey

Chapter 5. Results of the Sea-borne Survey

5-1 Oceanographic characteristics

Oceanographic characteristics observations of items given in Table 3-1 were conducted to clarify the oceanographic features off Vietnam. The works were undertaken, as a rule, prior to net cast at each test fishing. Temperature and salinity from sea surface to 500 m depth were measured with the use of a conductivity temperature depth meter (herein after referred as CTD).

① Water temperature and salinity

The present examination is based on analysis of data of water temperature and salinity, and vertical distribution of sea water density σ t estimated from these data. The vertical profiles of temperature and salinity were prepared along each of Line-1 to 3 for the north-south direction and along each of Line-A to G for the east-west direction (Figure 5-1). Horizontal distribution of temperature and salinity are based on the measurements at the 10-m depth layer, not the values at the sea surface in order to avoid meteorological disturbance. Average horizontal patterns of temperature and salinity were calculated with the data taken from the four surveys, together with deviation of values, or anomalies, from the averages for the four cruises. It is necessary to calculate the anomaly by extensive oceanic surveys in future so as to obtain average figures based on data taken throughout a period of years. Tentative values shown in the present report may still provide some idea on the oceanography in this area. Some of the vertical and horizontal profiles in the 1st cruise were not included in this report, due to shortage of data, even though these are given in the separate data book.

② Direction and velocity of current

Doppler's current meter as installed on the R/V BIEN DONG recorded direction and velocity of current at three depth layers of 2 m, 10 m and 30 m from the bottom of the ship on the hour. The deepest layer was set at 50 m during the second survey. However, the current meter is able to measure only relative velocity against the sea bottom of 250 m or less. Therefore, the measures do not always represent the

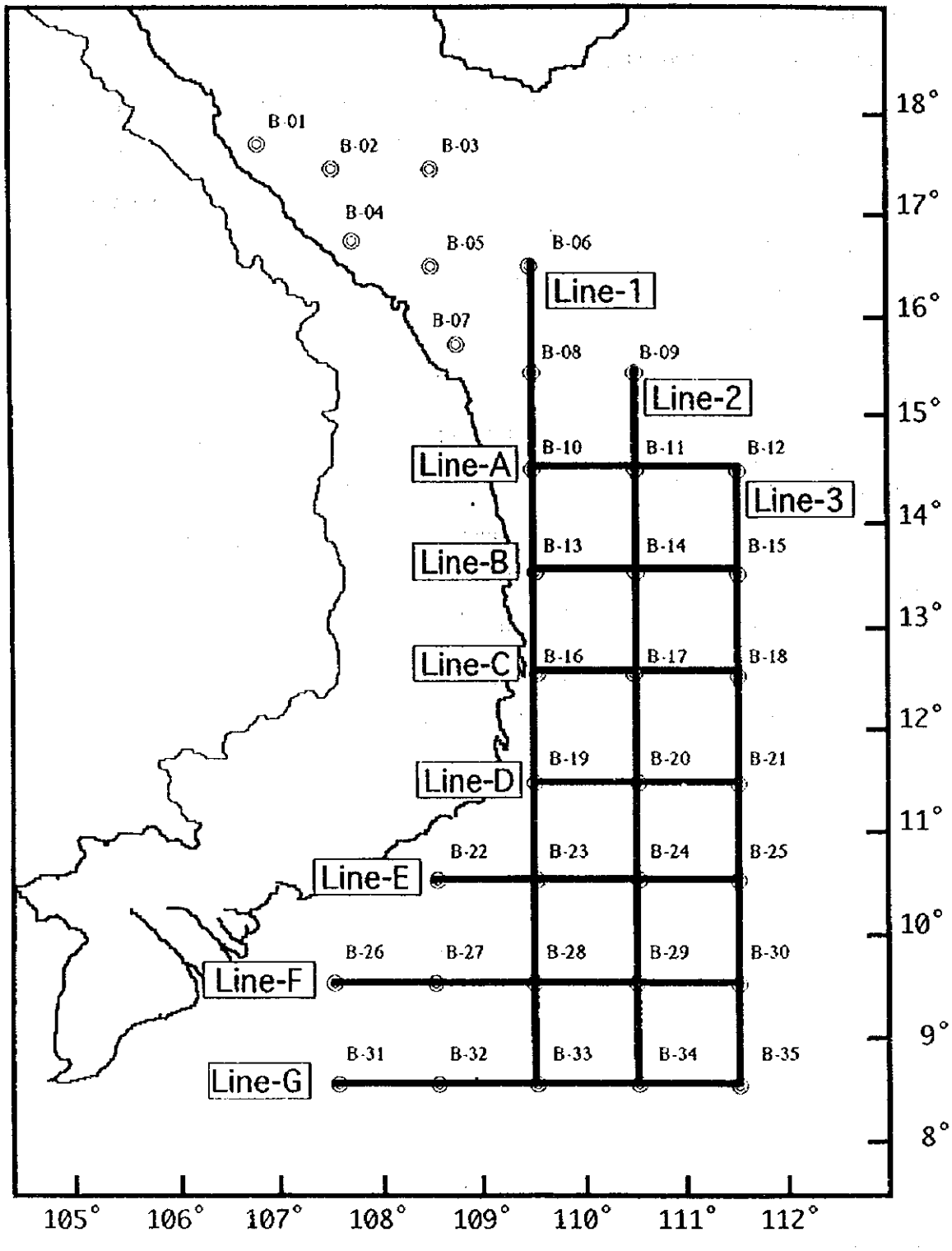


Figure 5-1 Line of cross section

absolute value of velocity of the currents in the waters deeper than 250 m. Some data was taken at stations with a sea bottom deeper than 250 m, but this was not corrected due to technical difficulties. In this report, these measurements were shown without correction.

③ Plankton

Collection of samples were made vertically using by the North Pacific standard net (herein after referred as NORPAC net) for zooplankton, and by the KITAHARA's net for phytoplankton. Results of examination of these two categories of plankton are given separately. Among zooplankton, the four most abundant groups were selected. They are Copepoda, Ostracoda, Chaetognatha and Tunicata. Adding another group, zooplankton were classified into five groups. Similarly phytoplankton were sorted to two groups of Bacillariacea and Dinoflagellata. Number of individuals of each category are shown on circle graphs for each station. Tables 5-1 and 5-2 give names of all the taxonomic groups of zooplankton and names of genera of phytoplankton taken during the present surveys.

Table 5-1 Major species list of zooplankton (Analyzed by RIMP)

1	Copepoda	16	Ophiuroidea(Echinodermata)
2	Cladocera	17	Limacina(Pteropoda)
3	Ostracoda	18	Heteropoda
4	Amphipoda	19	Decapoda
5	Lucifer	20	Asteroidea
6	Euphausiacea	21	shrimp larva
7	Chaetognatha	22	fish larva
8	Polycheata	23	fish egg
9	Pteropoda	24	crustacea egg
10	Tunicata	25	squid egg
11	Echinodermata	26	squid larva
12	Bivalvia	27	Sepia
13	Mollusca	28	Loligo
14	Gastropoda	29	Cavelina
15	Brachyura		

Table 5-2 Major species of phytoplankton (Analyzed by RIMP)

Bacillariacea				Dinoflagellata	
1	Actinoptycus	19	Hemidiscus	37	Amphisolenia
2	Bacteriastrum	20	Lauderia	38	Ceratium
3	Biddulphia	21	Leptocylindrus	39	Ceratocorys
4	Campylodiscus	22	Navicula	40	Cladopyxis
5	Cerataulina	23	Nitzschia	41	Dinophysis
6	Chaetoceros	24	Planktoniella	42	Orinthocercus
7	Climacodium	25	Pleurosima	43	Peridinium
8	Climacosphenia	26	Rhizosolenia	44	Phrophacus
9	Corethron	27	Schroderella	45	Pyrocystis
10	Coscinodiscus	28	Skeletonema	46	Triposolenia
11	Cyclotella	29	Stephanopyxis		
12	Dactyliosolen	30	Stigmophora		
13	Diatoma	31	Streptotheca		
14	Ditylum	32	Thalassionema		
15	Eucampia	33	Thalassiothrix		
16	Grossleriella	33	Thalassiosira		
17	Guinardia	34	Thalassiothrix		
18	Hemiaulus	35	Trachycis		
		36	Triceratium		

(1) Review of previous information

Features of the oceanographic structures are summarized from Wyrtki's description (1961, NAGA Report, vol. 2). The most significant climatic feature is presence of strong monsoon.

① The homogeneous layer here is only at 30 to 40 m during the southwest monsoon, but 70 to 90 m during the strong northeast monsoon.

② The surface layer of the tropical ocean is warm and the annual variation of temperature is normally small. Off the southwest coast of Vietnam the temperature range is 4 degrees, increasing to 10 degrees near Hong Kong.

③ The Mekong discharge is in the south of Vietnam, but its water is rapidly carried away by the strong currents off the coast.

④ In August the south monsoon is fully developed and brings the rainy season for the area north of the equator. The salinity in the southern China Sea is considerably reduced, and a tongue with low salinity penetrates to the northeast along the coast of Vietnam.

⑤ With the northeast monsoon, water of high salinity is transported along the coast of Vietnam to the south, In the central parts there is a counter current flowing in the opposite direction and carrying less saline water to the northeast.

⑥ During the southwest monsoon the situation is reversed, water of about 32.5 is

transported along the coast of Vietnam to the north, and in the central parts a counter current carries water of above 33.2 to the southwest.

⑦ In the CHINA SEA a wind drift is formed with the beginning of the southwest monsoon in May and June. Off the coast of Vietnam a westward intensification of this current is clearly visible.

⑧ In August, from the coast of Vietnam, at about 11° N, the main current flows almost east, later it dissolved and flows again northwards.

⑨ In September these movements decrease and in October the northeast monsoon starts blowing with considerable strength.

⑩ In December, the northeast monsoon is fully developed over the China Sea and the currents are strong and off the shore of Vietnam these often exceed 100 cm/sec.

* In the report by the Wyrtki, the South China Sea is called simply CHINA SEA or China Sea.

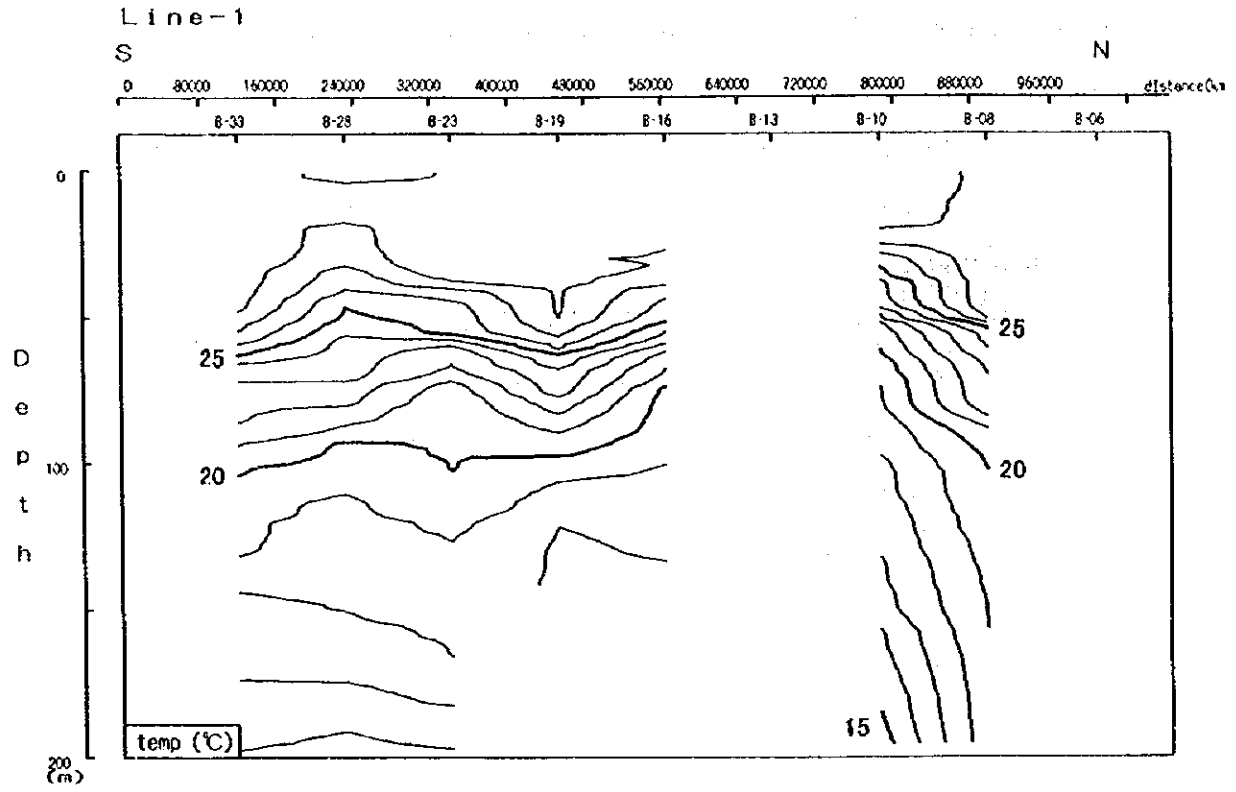
(2) Temperature and salinity profiles

(a) Northeast monsoon season

The first and third surveys were executed at different seasons from each other. Data was analyzed separately; those from the 3rd survey, September and October 1996, for the early phase, and those from the 1st survey, November and December 1995 for the later phase of the northeast monsoon season.

① Early phase

During the early phase, thermoclines were distributed densely in the vertical direction between B-11 and B-17 along the Line-2, but spread between B-17 and B-24 (Figures 5-3 and 5-4). The thermocline represented by 25℃ is located at a depth of about 30 m in the north Stations B-17 and B-24, while at depth of about 75 m, deeper by 45 m, in south. A similar north-south change of depth of thermocline was found along the Line-3 between B-18 and B-25. The vertical profiles indicate that the mixing layer was thin, about 20 m, at Stations B-11 and B-12 located at the northern end of the survey area, while thick, about 60 m, at Stations B-34 and B-35 at the southern end.



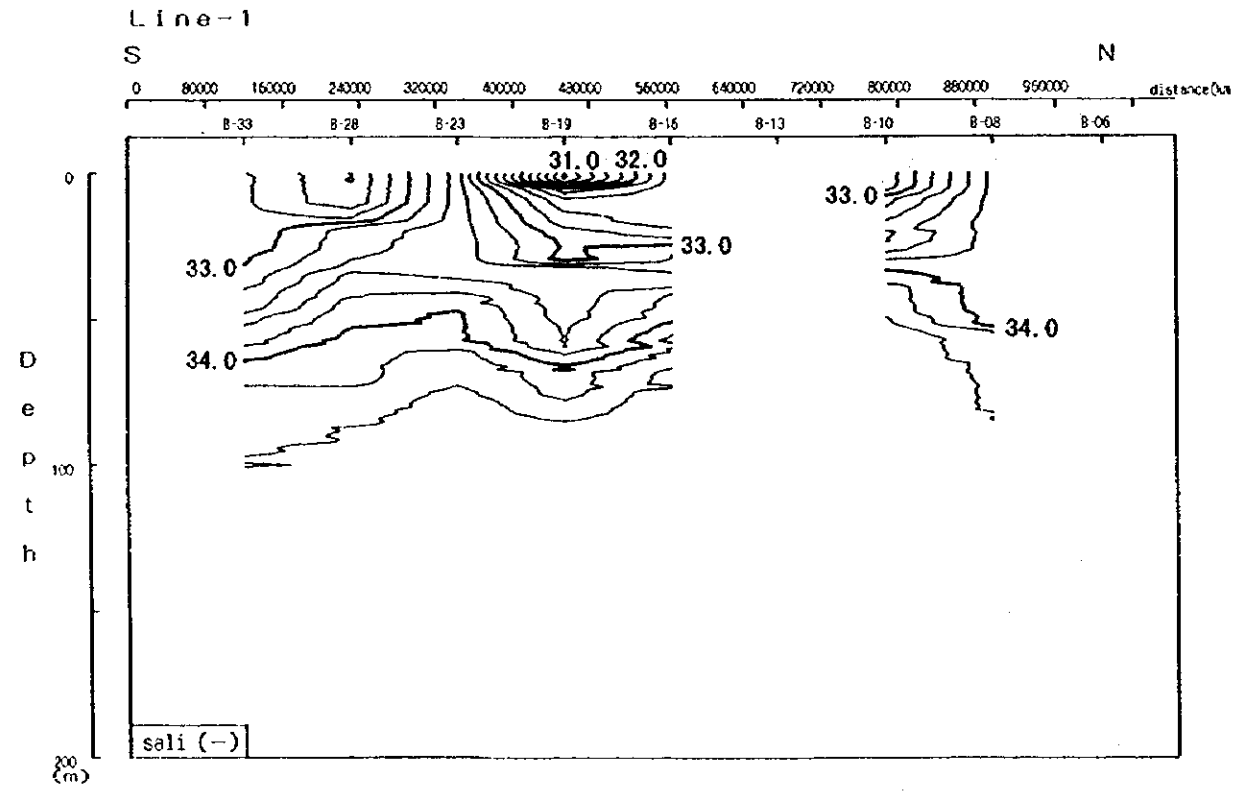


Figure 5-2. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-1. (From Sept. to Oct. 1996, 3rd cruise)

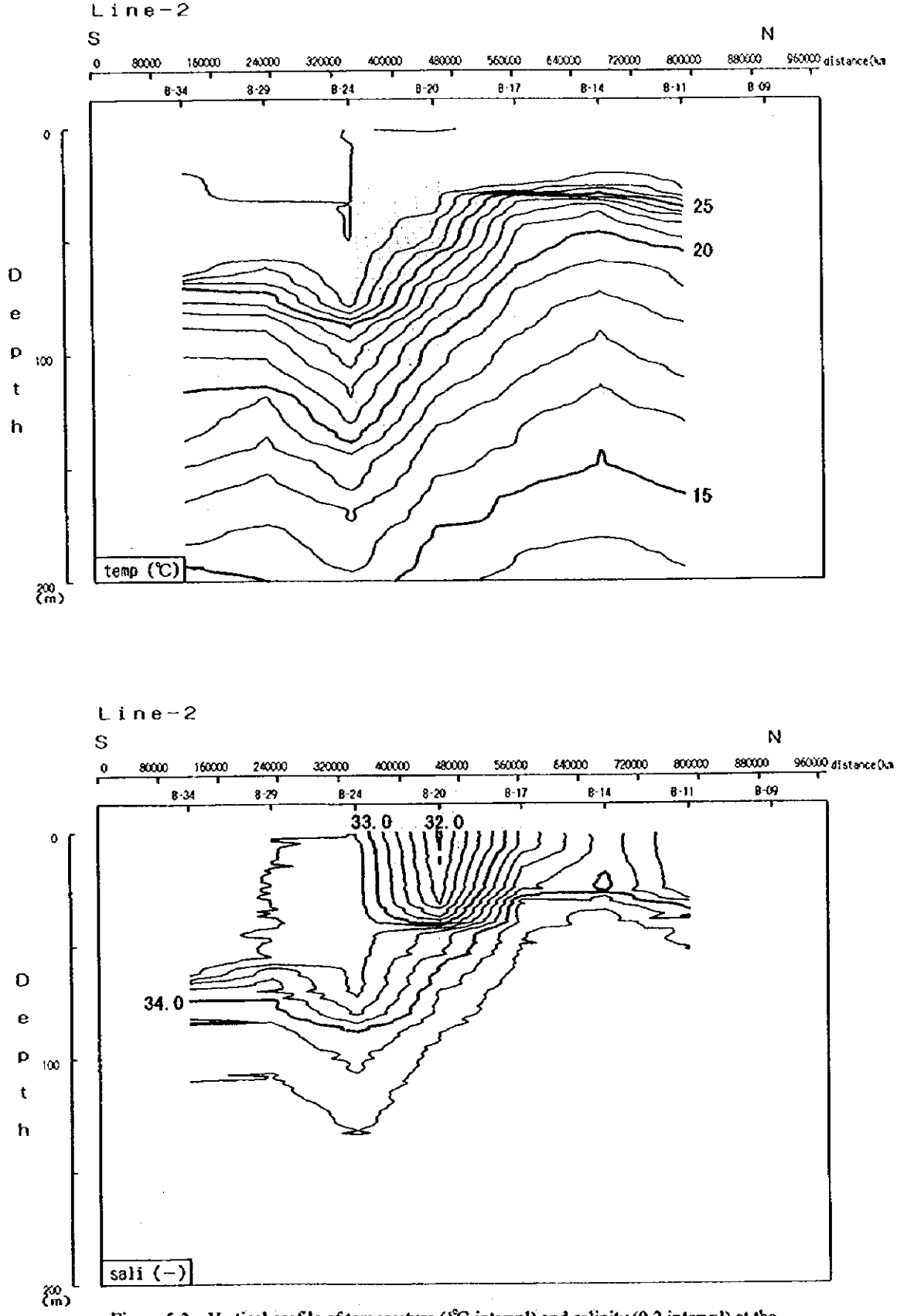
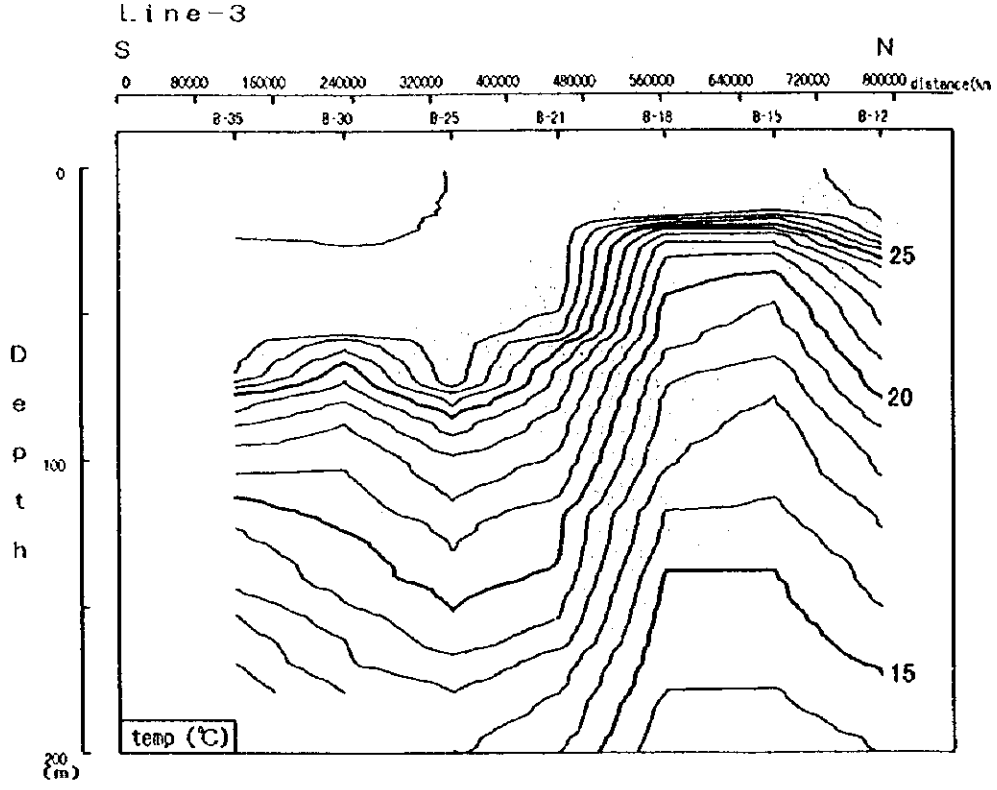


Figure 5-3. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-2. (From Sept. to Oct. 1996, 3rd cruise)



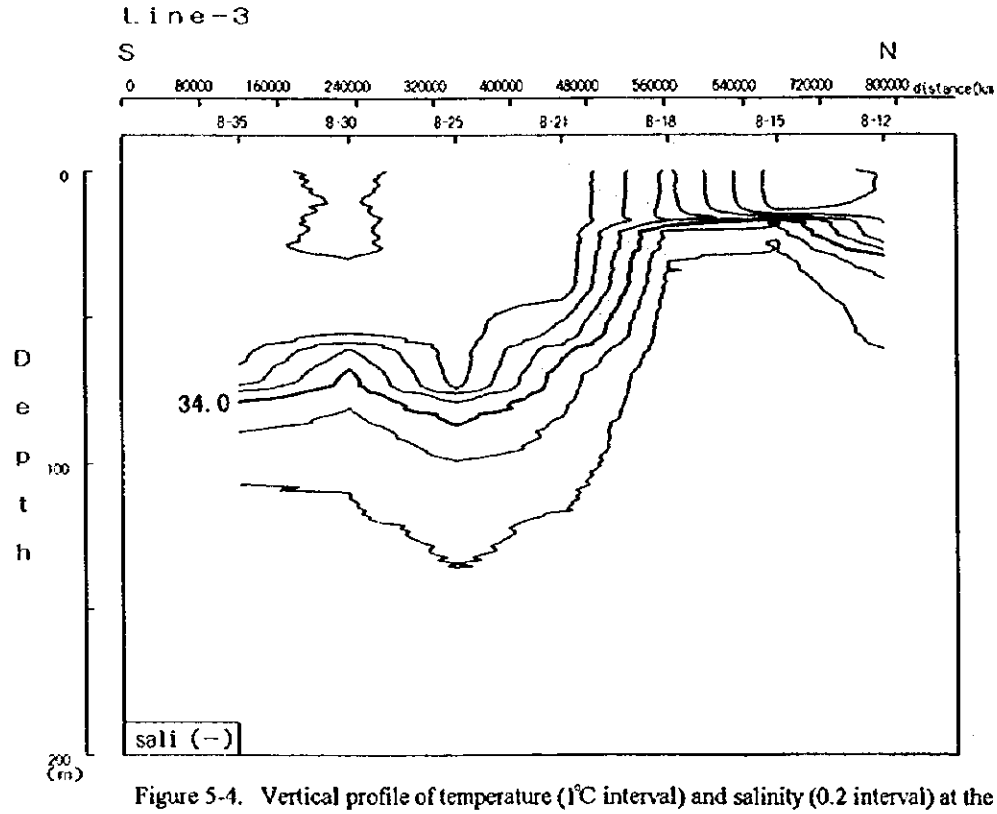


Figure 5-4. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-3. (From Sept. to Oct. 1996, 3rd cruise)

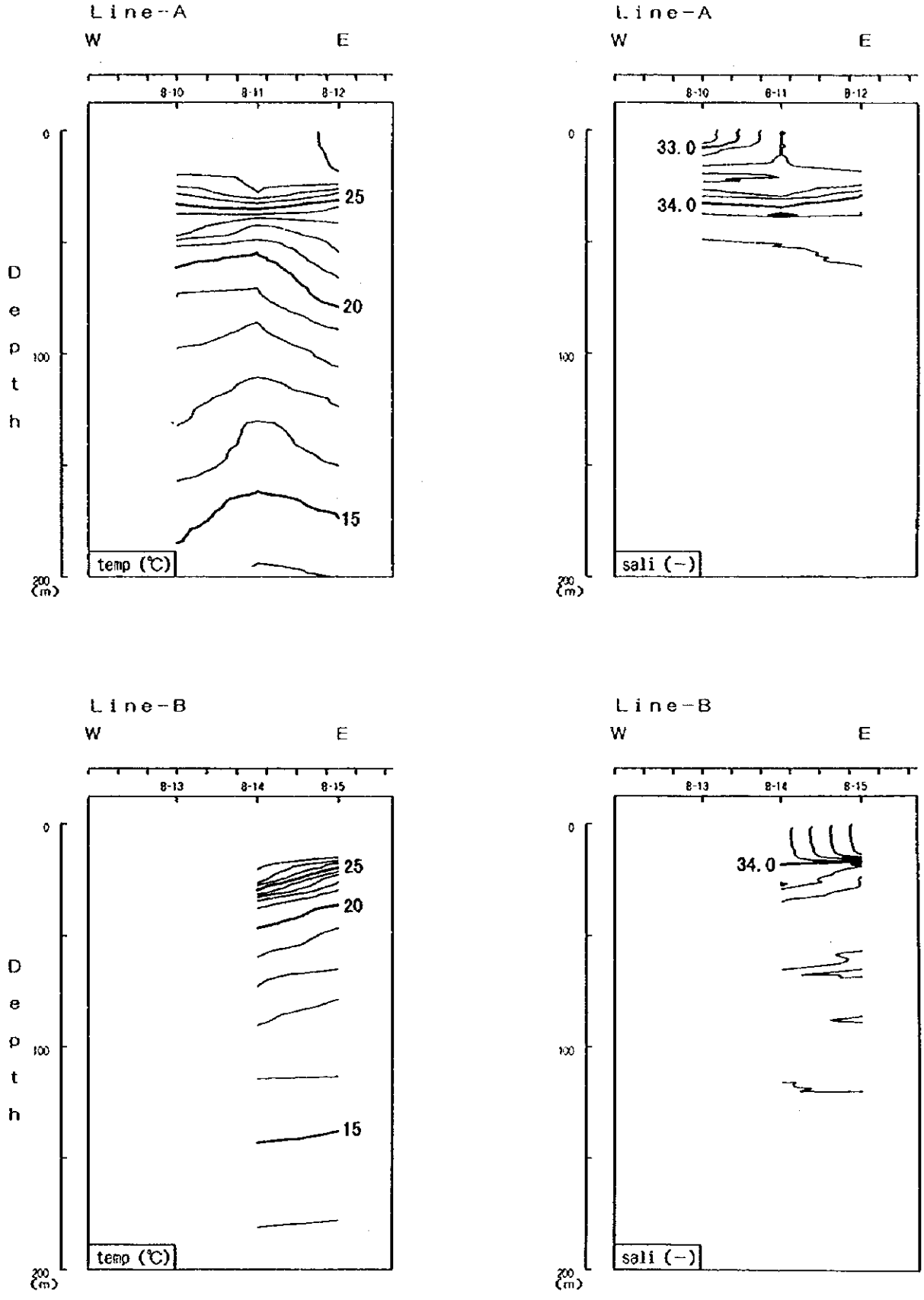


Figure 5-5. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-A and B. (From Sept. to Oct. 1996, 3rd cruise)

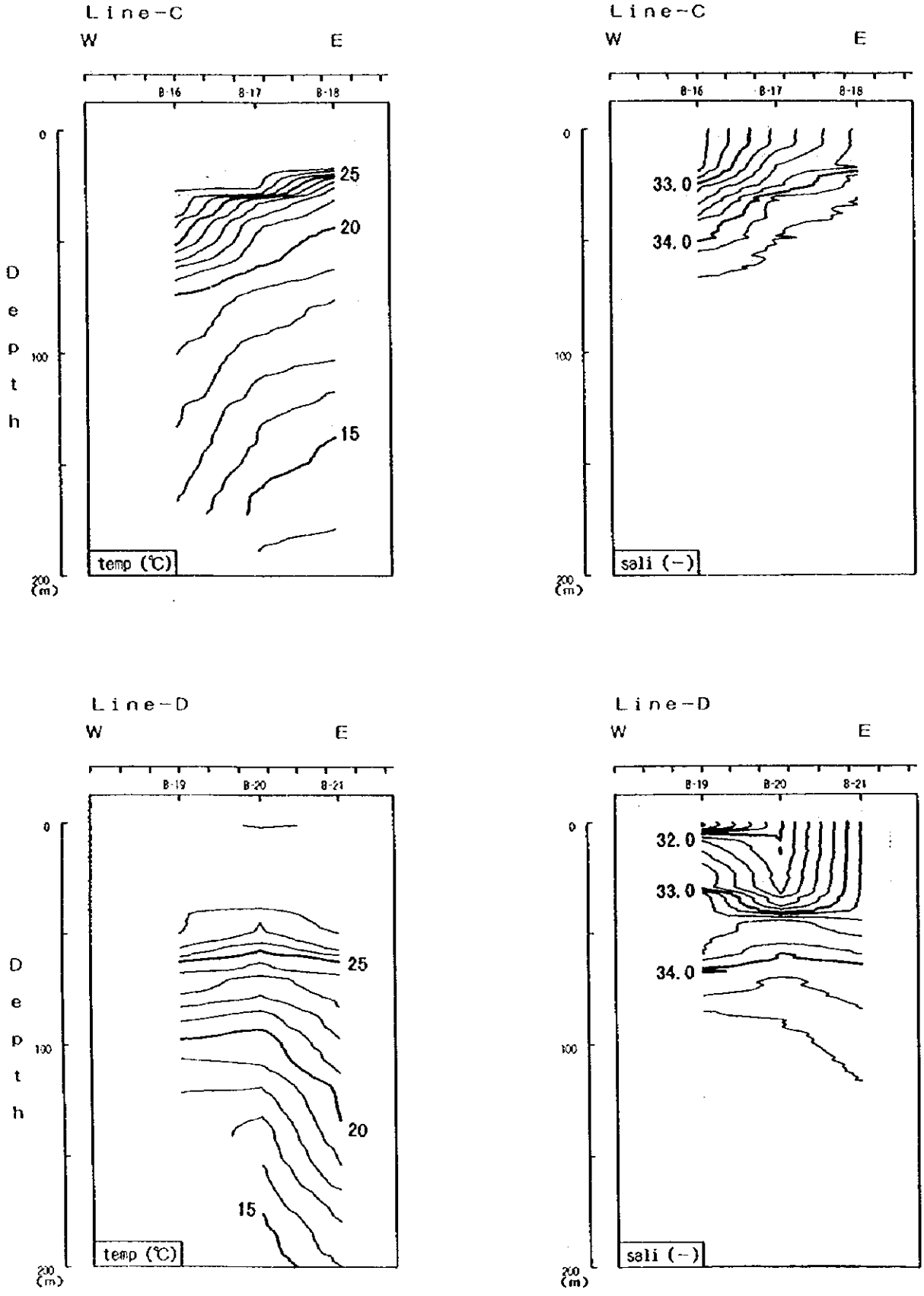
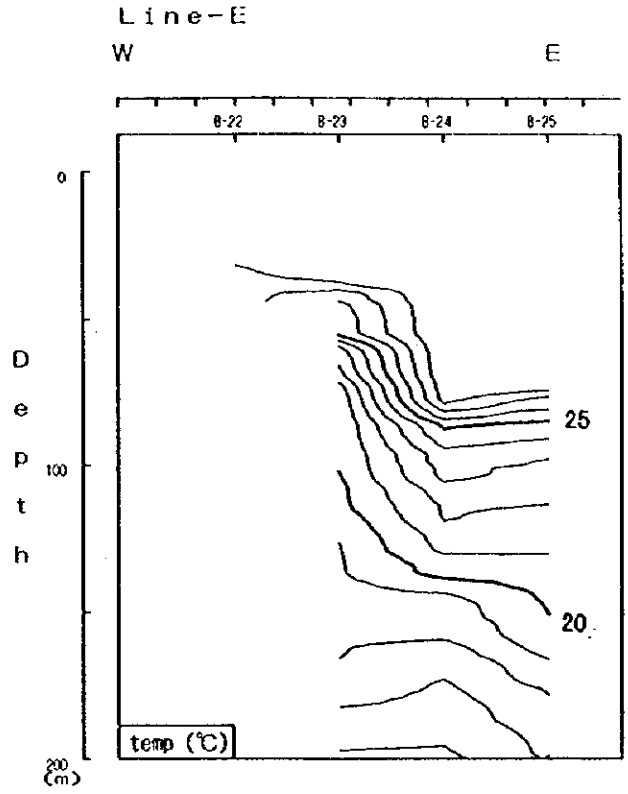


Figure 5-6. Vertical profile of temperature (1°C interval) and salinity (0.2 interval) at the cross section of LINE-1. (From Nov. to Dec. 1995, 1st cruise)



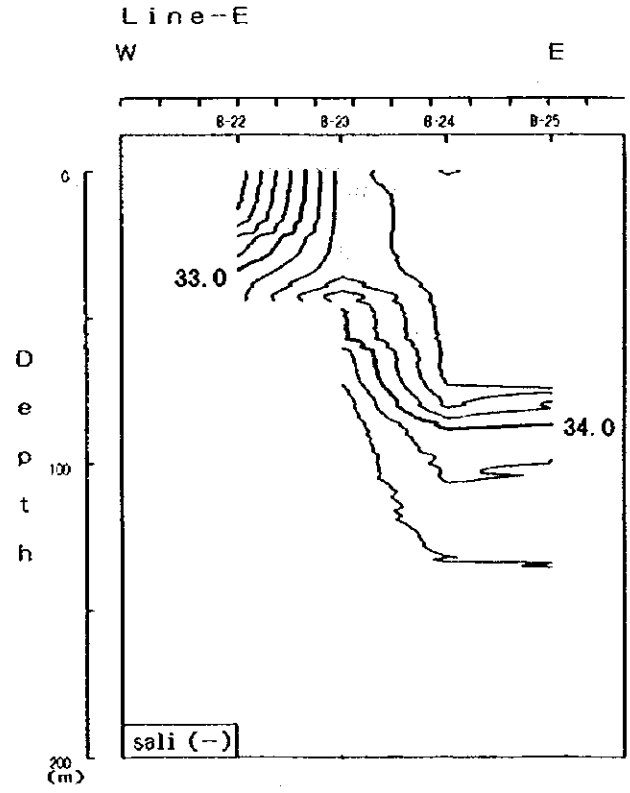
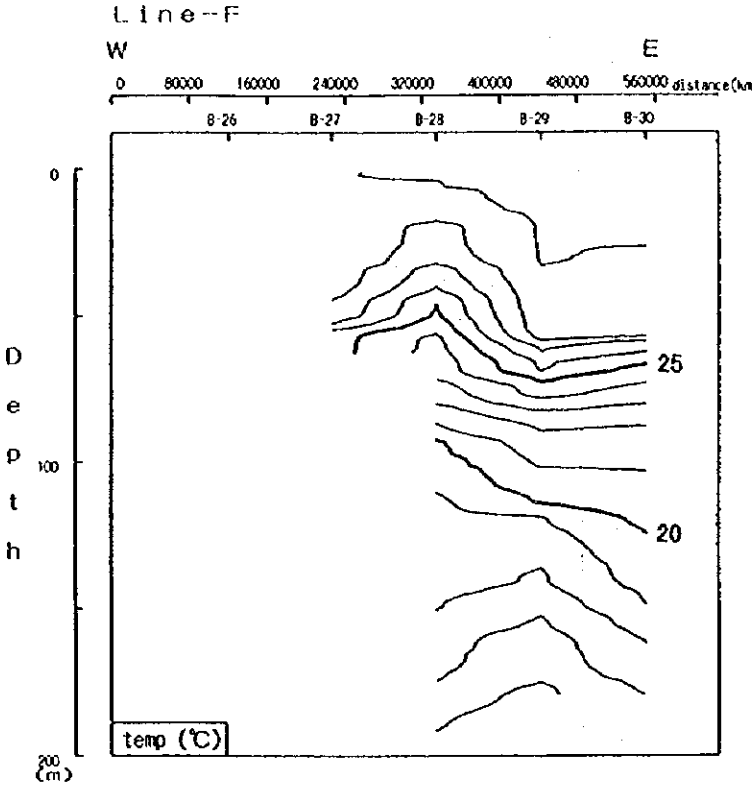


Figure 5-7. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-E. (From Sept. to Oct. 1996, 3rd cruise)



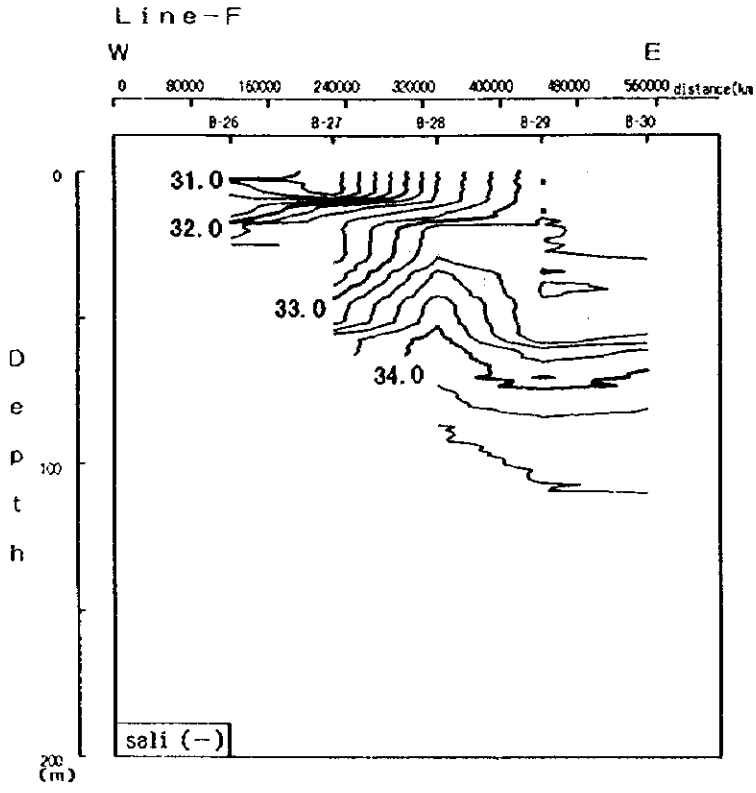


Figure 5-8. Vertical profile of temperature (1℃ interval) and salinity (0.2 interval) at the cross section of LINE-F. (From Sept. to Oct. 1996, 3rd cruise)