SEAFDEC Training Department

SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

TD/RES/28 April 1991

Observation Report on Tuna Longline Fishing Operation and Fishing Ground Survey in the Bay of Bengal on board the SHINYO-MARU 9-28 February 1991

By

TD/SEAFDEC

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Mr. Suppachai Ananpongsuk

THE DEPARTMENT OF FISHERIES

Mr. Chitjaroon Tantivala
Mr. Supatr Sriphanpaiboon
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Mr. Thagoon Anugul

Shinyo-Maru Training Vessel
Tokyo University of Fisheries

Training Department
Southeast Asian Fisheries Development Center

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I. Introduction

Tokyo University of Fisheries, has conducted shipboard training, fishing gear experiments and fishing ground surveys from the Shinyo-Maru in the Bay of Bengal since 1987. From these, many technical papers in various fishery disciplines have been published. These reports are very important and of great benefit to those interested in the field of oceanic fisheries.

The Shinyo-Maru, a 649 gross tonnage training vessel of Tokyo University of Fisheries, left Tokyo on 18 January 1991 under the command of Professor Yujiro SAOTOME, the captain of the vessel, with 21 staff and 22 students. The vessel proceeded to the Bay of Bengal for shipboard training, fishing gear experiments and other studies as in previous years.

This year, the President of Tokyo University of Fisheries offered six places on board the Shinyo-Maru to staff of the Southeast Asian Fisheries Development Center, Training Department (TD/SEAFDEC) and The Department of Fisheries, Thailand (D.O.F., Thailand). The six were to study and observe a new type of tuna longline fishing and the operation of modern oceanographic equipment such as CTD, XBT etc. The TD/SEAFDEC provided funds for food on board, travelling and a daily allowance for the six participants.

The six Thai participants embarked the Shinyo-Maru in Singapore on February 8, 1991. The vessel left Singapore on February 9, at 10:00 am. for fishing grounds in the Bay of Bengal. (Fig. 1)

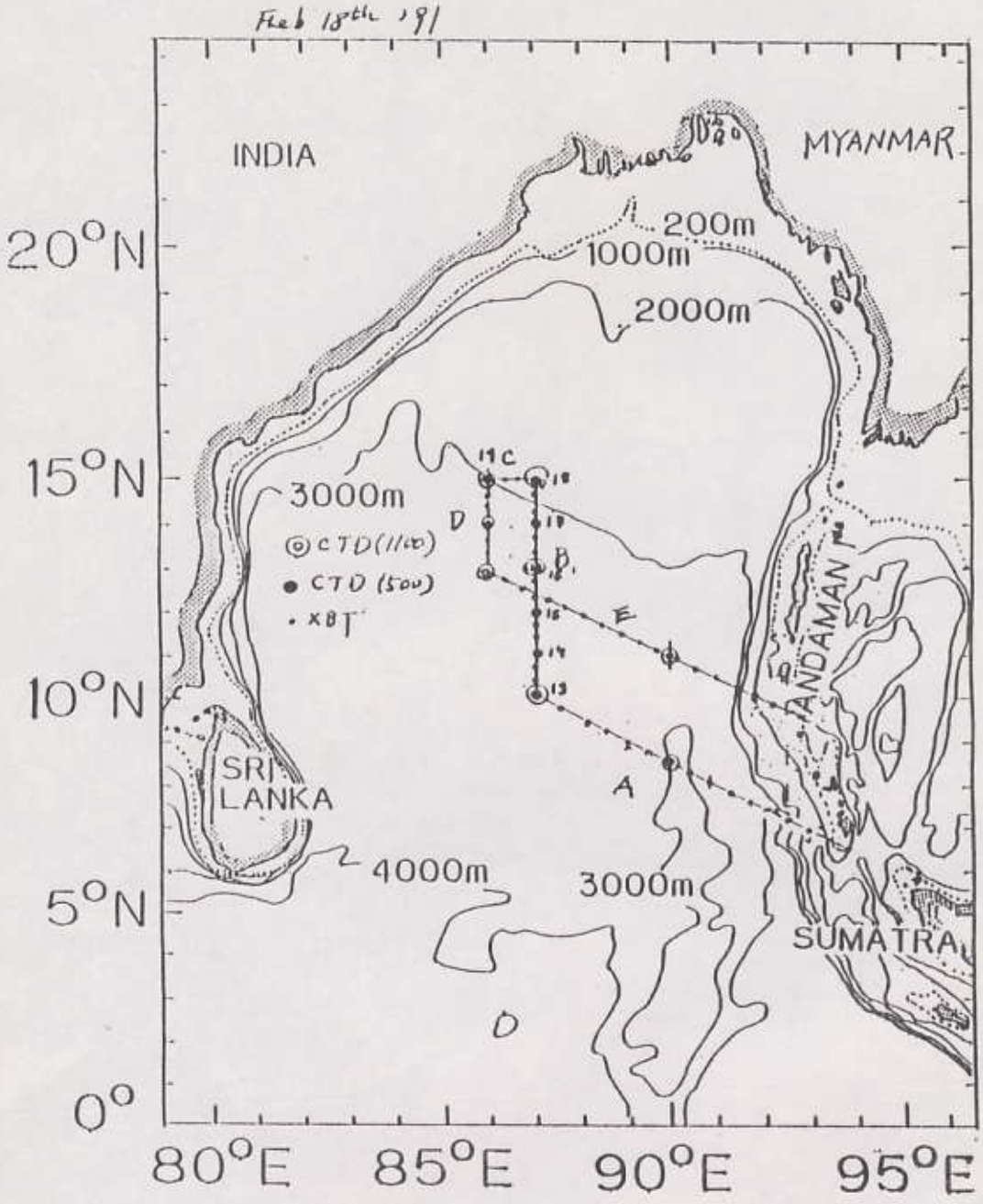


Fig. 1 Route of the Shinyo-Maru, Tuna Longline and Oceanographic Survey Station.

II. Instructors and Participants

Instructors

- Shinyo-Maru staff

Prof. Yujiro SAOTOME	Captain
Asst. Prof. Jiro ASHIDA	Chief Engineer
Asst. Prof. Isao KASUKA	Chief Officer
Mr. Katsuyuki YAMANE	First Engineer
Mr. Yoshihiro KURITA	Second Officer
Mr. Toshifumi HAYASHI	Third Officer

- Tokyo University of Fisheries staff

Prof. Dr. Kaname SATOH	Lab. of Fishing Gear Technology and Engineering.
Dr. Jiro YOSHIDA	Lab. of Marine Environmental Science.
Mr. Seiichi TAKEDA	Lab. of Fishing Gear Technology and Engineering.

Participants

- TD/SEAFDEC

Mr. Aussanee MUNPRASIT	Researcher in Fishing Gear Technology.
Mr. Suppachai ANANPONGSUK	Asst. Researcher in Stock Evaluation Section.

- The Department of Fisheries, Thailand

Mr. Chitjaroon TANTIVALA	Fisheries Biologist, Oceanic Fisheries Division.
Mr. Supatr SRIPHANPAIBOON	Fisheries Biologist, Marine Fisheries Division.
Mr. Pairaj THAOCHALEE	Fisheries Biologist, Marine Fisheries Division.
Mr. Thagoon ANUGUL	Fisheries Biologist, Marine Fisheries Division.

III. Schedule

7-2-1991	:	Left Bangkok for Singapore by plane.
8-2-1991	:	Embarked the Shinyo-Maru at Clifford Pier, Singapore.
9-2-1991	:	10:00 am. left Singapore for fishing grounds in the Bay of Bengal, and prepared CTD equipment.
10-2-1991	:	Briefing on oceanographic survey using modern equipment by Dr. Jiro YOSHIDA, and briefing on tuna longline fishing gear and operation by Chief Officer (Asst. Prof. Isao KASUGA).
11-2-1991	:	Briefing on electronic navigational equipment, and fishing operations by Mr. Seiichi TAKEDA. Afternoon lecture on new design equipment for tuna longline fishing by Prof. Dr. Kaname SATOH.
12-2-1991	:	The first CTD operation was carried out and tuna longline fishing gear preparation was done in the afternoon.
13-2-1991 to	:	Seven experimental tuna longline fishing operations and an oceanographic survey by CTD were carried out each a day.
19-2-1991	:	An XBT operation was conducted every 20 nautical-miles along the route at layers of 0-500 meters depth.
	:	A study on catch efficiency in relation to the oceanographic conditions of the fishing ground, was made.
20-2-1991	:	Two CTD operations were conducted at 500 and 1,100 meters depth.
	:	XBT operations were also continued by the same method.
21-2-1991	:	One CTD operation was conducted at layers 0-1,100 meters depth; XBT continued.
	:	Washing, cleaning and storage of the CTD was carried out after the last operation (equipment maintenance).

22-2-1991 : Evaluation of this programme was carried out with the help of Prof. Dr. Kaname SATOH, Dr. Jiro YOSHIDA and Mr. Seiichi TEKEDA.

23-2-1991 to 26-2-1991 : The report was written while the vessel returned to Singapore.

27-2-1991 : Proof reading of the report was done by Prof. Dr. Kaname SATOH and his staff.

28-2-1991 : Disembarked at Singapore.

: Left Singapore for Bangkok by plane.

IV. Observation and practice activities

1. Briefing and lectures by instructors on board

In order to orientate the participants, Prof. Dr. K. Satoh had arranged the first two days for briefing and lectures on all equipment systems in the vessel, fishing gear and its operation, and fishing gear experiments for this cruise. A summary of each briefing and lecture follows.

Oceanographic equipment and surveys.

The heart of oceanographic equipment on the Shinyo-Maru is the CTD system (Conductivity, Temperature and Depth). It consists of a sensor head (temperature, salinity, oxygen and pressure) with rosette water sampler set; CTD winch with conducting wire; and a central control unit with computer and laser printer. This CTD system is linked to the Central Processing Unit (CPU) of the vessel, and can conduct surveys from sea level down to over 1,100 meters depth. This CTD system is made by NEIL BROWN COMPANY, USA. The second important piece of equipment is the XBT-system (Expendable Bathy-Termograph). It consists of an XBT launcher, XBT-converter, computer, printer and XBT-probes, which are each used only once. The XBT-system is also linked to the CPU. Other laboratory equipment on the Shinyo-Maru is computerized wave measuring equipment, a particle counter set, and a surface water conductivity measuring system. All equipment is linked to the CPU, so that computerized data from any system is available at any time. All equipment is controlled by computer, so that just 2-3 men are required to run the oceanographic laboratory on the Shinyo-Maru.

Modern navigational equipment, has been installed on the Shinyo-Maru; a Satellite Navigation System (NNSS), a Global Position System (GPS), an environmental satellite display receiver with a four colour printer (NOAA), radar, scanning sonar, scientific echo-sounder, a Doppler sonar current indicater, plotter, auto pilot and others. All equipment on the bridge is linked to the main system (CPU), even the information from the engine console in the engine control room. All equipment can run at the same time; all data is recorded and saved by the main computer and easily recalled for analysis.

There are three types of fishing gear on this vessel, otter trawl, automatic squid angling machine and tuna-longline. Tuna longline was used on the cruise, and five different designs of branchline were prepared for the experiment. It was the first time fluro-carbon material was used for the branchline of tuna longline. The original design was cremona rope -ø6-7mm- a unit of this gear is called a basket. It is composed of seven pieces of 40 m. mainline or trunkline joined together with a 20 cm. double end eye spliced wire -ø3mm- six branch lines or hooklines connected to a mainline by snaps at the joints, and one piece of 10 m. cremona -ø6mm- for the buoy-line. The gear is shot out from the stern and hauled-up at the starboard bow of the vessel by line hauler.

The catch efficiency of the five branchline designs, made of different materials, was compared. The study on tuna longline fishing in the Bay of Bengal started in 1987 and has continued every year in February with Shinyo-Maru and Tokyo University of Fisheries staff. The study has been concerned not only with the fishing gear itself but also with the oceanographic conditions of fishing grounds. This study may continue next year with a different perspective to cover gaps in experiments to date.

After the briefing and lectures were over, participants held a discussion and set up a study proposal (as shown in Annex 1) to be followed during the trip.

2. Tuna longline fishing operation

a) Fishing gear design and construction

Generally, tuna longline is used in oceanic waters to catch pelagic fish such as tuna, marlin, shark, etc. After setting, the gear drifts in the sea upon the current. The bait attracts pelagic fish like tuna which bite on the hook. The target fish are rather large and very active and powerful. The design and construction of the gear must take this into consideration especially where materials are concerned. The design of tuna longline on the

Shinyo-Maru consists of one basket of seven pieces of 40m. cremona -Ø7mm- joined together with 20cm. double eye spliced stainless steel wire -Ø3mm- six branch-lines 28m. in length and one piece of 10m. cremona -Ø6mm- as buoyline. (Fig. 2)

On this cruise it was proposed to test new material, fluro-carbon monofilament in comparison with nylon monofilament, and cremona with wire. Five different designs of branchline were constructed for the experiment; specifications and details are shown in Table I. Fifty baskets of each design were arranged into the total line of 150 baskets for one operation in one day.

In addition, 50 baskets of nylon monofilament No. 150 were used as mainline (trunkline) in comparison with cremona -7mm- mainline on the last two days of operations (the 5th and 6th). It was coiled into five drums (stainless steel Fig. 3).

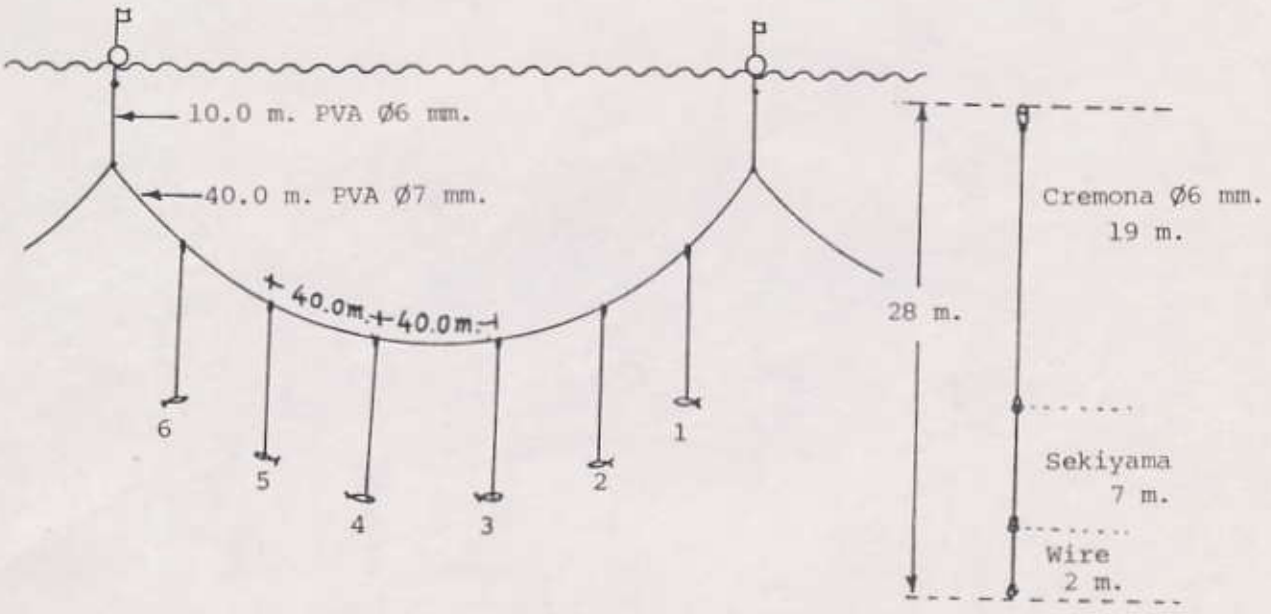


Fig. 2 General design of Tuna Longline (Shinyo-Maru)

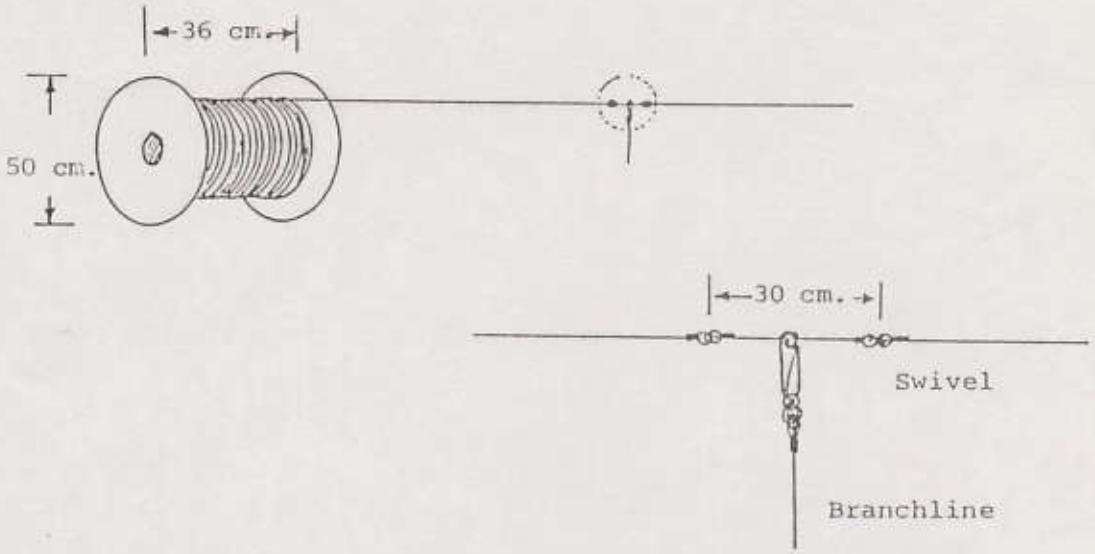


Fig. 3 Nylon monofilament mainline (PA mono No. 150)

Table 1. Specification of five designed branchlines

Type material	A1(m.)	A2(m.)	B(m.)	D(m.)	E(m.)
Snap	*	*	*	*	*
Cremona ϕ6 mm. Multifilament	19	19	15		
Sekiyama wire # 28+cotton	7	7	10		
Wire # 28	2		3		
Nylon Monofilament No. 150				28	
Flurocarbon Monofilament No. 150		2			28
Hook	*	*	*	*	*

b) Fishing operation and fishing techniques

Most of the tuna longline fishing was conducted in daytime, shooting begining early in the morning (4:00 am.) and hauling from midday (12:00 am.). In tuna longline fishing, bait is one of the most important factors to directly effect catch efficiency and is therefore handled carefully. It should be selected considering kind, size, and quality and then frozen in cases of long operational periods. Bait is removed from the freezer about 6-8 hours before shooting then left to defrost at air temperature. Most of the bait on this cruise was pike mackerel (saury) and about 300 pieces of pacific mackerel, used in the third operation.

The hooking of bait is a specialized technique in tuna longline fishing. On this occasion bait was hooked on the head in the case of pike mackerel and on the back (first dorsal fin) in the case of pacific makerel. (Fig. 5)

Shooting operations started in the early morning (4:00 am.) at the stern of the vessel, following the wind direction. The 150 baskets of cremona mainline took 15-20 crew and students about 2 hours and 20 minutes to shoot. The shooting station for crew and students is shown in Fig. 4. The best time for fish to take bait was estimated around sunrise, so the shooting would be finished before or around sunrise or not more one hour later.

Hauling usually started at noon from the foredeck. The foredeck mainline was hauled by linehauler and the branchline by branchline hauler at the starboard bow of the ship. If there was a catch, it was taken up on board at the starboard sterndeck. The hauling station of the crew and students is shown in Fig. 4. The total time required by 15-20 crew and students for hauling 150 baskets was about 5-6 hours depending on the catch and type of mainline. Nylon monofilament mainline took about four hours for 50 baskets.

c) Catch and preservation.

The result of seven days experiments on the tuna longline operation varied depending on the location of the fishing ground and type of fishing gear. However, overall many kinds of fish were caught, as follows:-

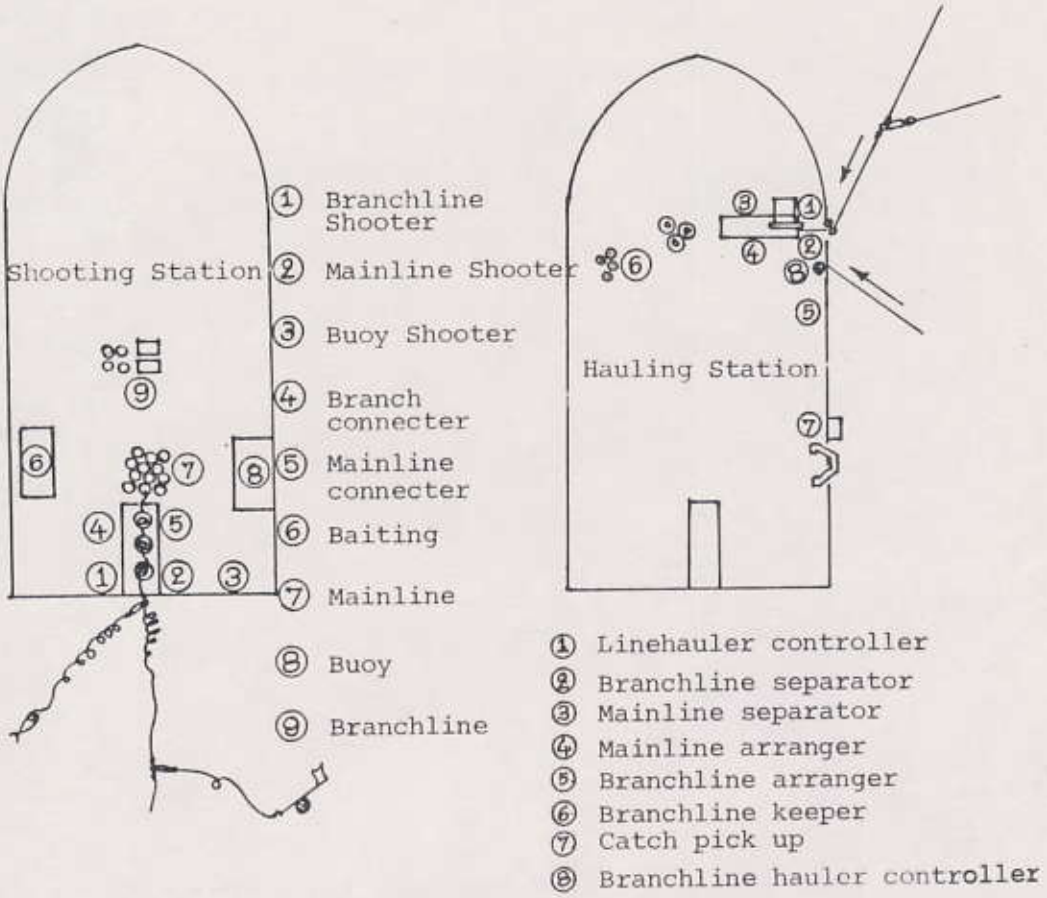


Fig. 4 Diagram of Tuna Longline Fishing Operation.

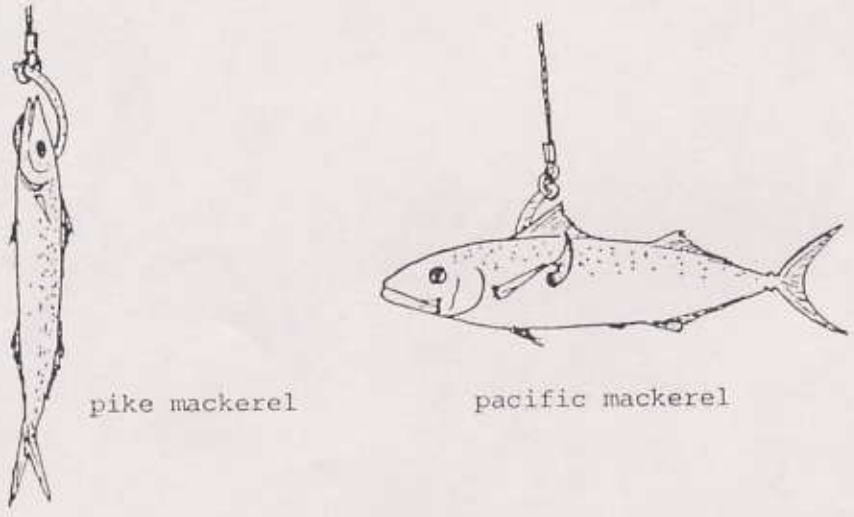


Fig. 5 Baiting Technique

- 44 yellowfin tuna (length 93-173 cm., weight 29-93 kgs.)
- 10 marlin (length 135-245 cm., weight 51-95.5 kgs.)
- 8 sail fish (length 150-238 cm., weight 14-54 kgs.)
- 1 sword fish (length 196 cm., weight 104 kgs.)
- 8 wahoo
- 18 shark
- plus sting ray, baracuda, longnose lancet fish and turtle which were thrown back into the sea.

The target fish such as tuna, marlin, sail fish, sword fish and shark, were processed immediately to preserve the quality of the fish. The steps of processing for preservation are as follows. (Fig. 6)

1. Cut tail from body at the position of finlet number four.
2. Cut lateral blood vessels on both sides.
3. Break heart at auricle.
4. Sluice pipe water through the broken heart and vessels to drain blood from the body.
5. Take out gut and visceral mass. (Cut off half of gill operculum)
6. Break central nervous system.
7. Cut all fins off and clean the whole body.
8. Wash the body with fresh water and blow out the retained water with pressurized air.
9. Put in the quick freezing refrigerator, 50°C -70°C.

d) Other equipment required for tuna longline fishing operations:

There are many methods used to find the hook layer depth of tuna longline. The one used on board the Shinyo-Maru was a chain module with depth recording equipment. The depth recorder and depth meter, measure the depth of the deepest hook. Temperature recording equipment is also attached to ascertain the water temperature at the hook layer. (Fig. 7)

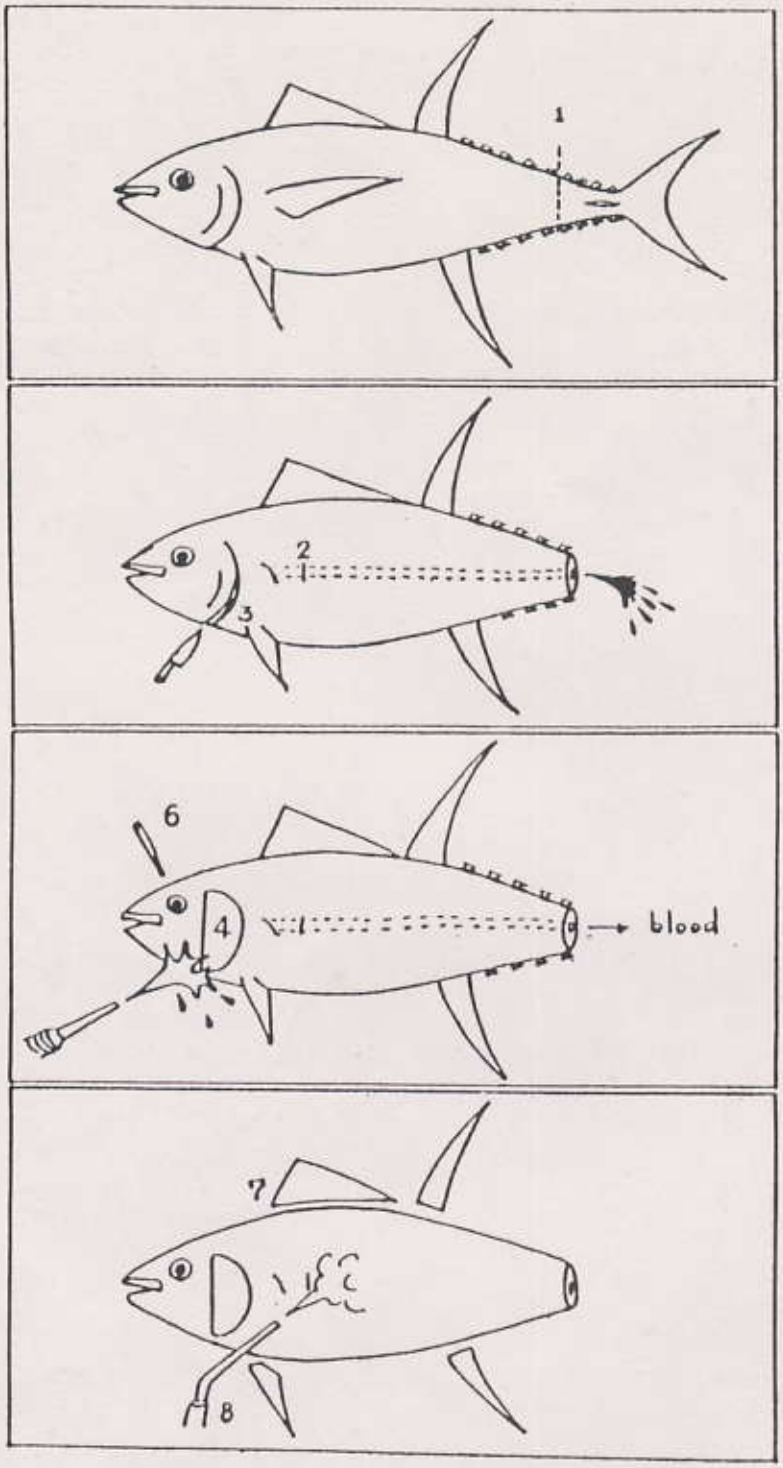
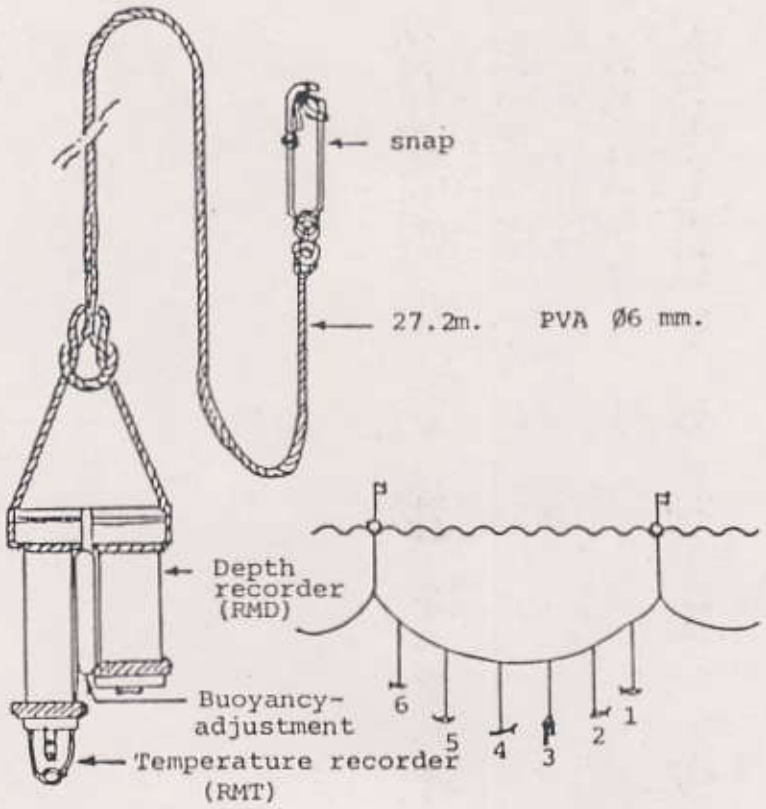
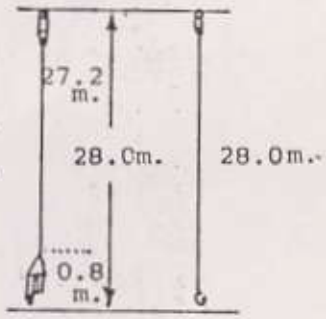


Fig. 6 High quality fish preservation process



Height of the recorder set with bridle = 0.8m.
Height of the cremona line with snap = 27.2m.
Total height of recorder set line = 28.0m.



1.	Weight in air of the recorder set	=	2.56 kg.
2.	Weight in water of the recorder set	=	30.00 gm.
3.	Weight in air of hook	=	19.00 gm.
4.	Weight in water of hook	=	16.00 gm.
5.	Weight in air of bait	=	100.00 gm.
6.	Weight in water of bait	=	8.00 gm.

$4 + 6 < 2 = (16+8) - 30 = 6$ gram.

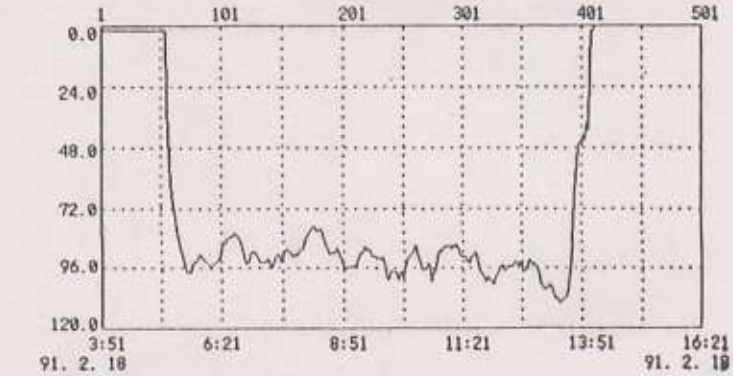
Fig. 7 Setting the position of the Depth and Temperature recorder.

Sample of depth and water temperature profile

(FILE NAME) h3no6.md1 Depth recorder (RMD)

(COMENT) 1991 2/18 Bengal Bay Tuna Fishing No.6 RMD1

(DATE)	91.02.18/03:50
(SAMPLING INTERVAL)	1.5
(START NO. OF DATA)	1
(INTERVAL OF DATA PLOT)	1
(NO. OF DATA IN 1 SCREEN)	500
(NO. OF TOTAL DATA)	411



(FILE NAME) h3no6.mt1 Temperature recorder (RMT)

(COMENT) 1991 2/18 Bengal Bay Tuna Fishing No.6 RMT1

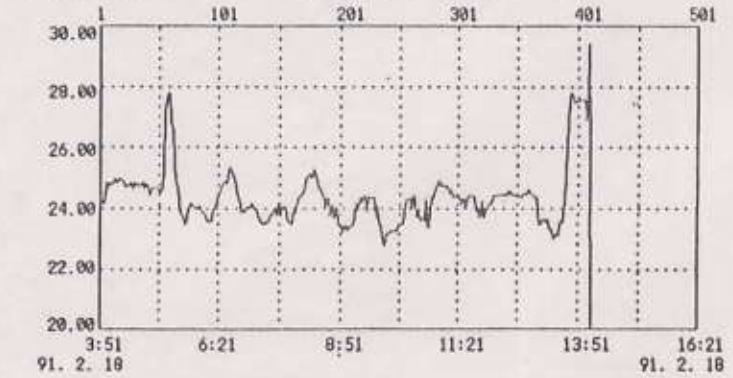


Fig. 8 Temperature and Depth profile.

3. Observations on the conditions of the tuna fishing grounds

a) Important oceanographic parameters.

Measurements made on oceanographic conditions, using CTD, were temperature (^{o}C), salinity (PSU), dissolved oxygen (D.O., ml/L) and sigma-T, as these are the main factors considered in tuna longline fishing.

The temperature results from CTD showed us the changes with each depth layer. Just below the temperature turning point is thought to be a good capture area (from the report of Relations between Tuna Catches and Oceanic Conditions in the Bay of Bengal in 1990 by Mr. Yoshihiro KURITA and ets). In addition to the RMT, attached to branch line number 3 of the 1st, 50th, 100th, and 150th basket respectively to measure temperature distribution at the hooks, was the RMD for measuring the depth. We could then use both results to predict which layer the tuna would be caught in, depth versus temperature.

The temperature levels that we got from XBT surveys both in the track and tuna long line fishing operations were compared to get the nearest exact value.

CTD measurement during the tuna long line fishing (13 to to 19 Feb. '91) has shown that the temperature's rough turning point is a minimum of 27.0 C and a maximum of 28.0 C. The temperature curves changed at the minimum depth pressure of 50 DB and maximum depth pressure of 90 DB.

In the seven days of tuna line fishing operations, the CTD measurements were as follows (approximate value):

DATE	TURNING POINT OF TEMP. (^{o}C)	TURNING POINT OF DEPTH (DB)
13-2-91	28.0	90
14-2-91	27.5	85
15-2-91	27.0	90
16-2-91	27.2	80
17-2-91	27.3	65
18-2-91	27.0	50
19-2-91	27.2	90

As for dissolved oxygen, the graph print out showed the same style as the temperature curve.

Increasing the pressure decreases the D.O. The D.O. in the Bay of Bengal is very low in the surface water, approximately 3.5 ml/l, decreasing to 1.00 ml/l at a pressure depth of about 150 DB by CTD measurement at the first tuna line fishing on 13 Feb. '91. This shows that there is still enough oxygen for marine resources.

Salinity which was measured on the same day showed similar values at all levels, about 34 PSU.

b) Oceanographic survey using CTD and XBT

There are many important oceanographic parameters as mentioned before, which effect fish in an area. In order to study fishing ground conditions in the ocean, special equipment is required, the old model oceanographic equipment is not easy to operate, it takes a long time and it is more complicated to analyse the results. Nowadays, a lot of oceanographic equipment has been developed including XBT and CTD.

XBT is used for studying water temperature in the deeper layers of the sea while sailing. XBT consists of an XBT probe (sensor with conducting wire), XBT terminal, XBT converter, computer and printer. Operation is very easy, by first setting the programme on the computer, connecting the XBT probe to the XBT terminal, then pulling out the lock clip to drop the sensor into the sea at the survey site. The sensor is let down until it passes through the expected layer, then the wire is cut. The temperature profile is shown on the computer. (See Fig. 9)

CTD is used to study salinity, temperature, dissolved oxygen and sigma-T in connection with water depth. The composition of the CTD system has already been mentioned in the briefing and lecture section. Operation of CTD is also very easy but care needs to be taken with the sensor. The sensor head with rosette water sampler is dropped into the sea until it reaches the required depth, then the computer shows a profile of the water temperature, dissolved oxygen, salinity and sigma-T. (See Fig. 10) Calibration is also necessary for the CTD operation.

V. Conclusion

On February 23, 1991 the Shinyo-Maru's operations ended; it left the Bay of Bengal and proceeded to Singapore. The participants had completed their observations and practice. Evaluation of the activities was held on board. The results were satisfactory.

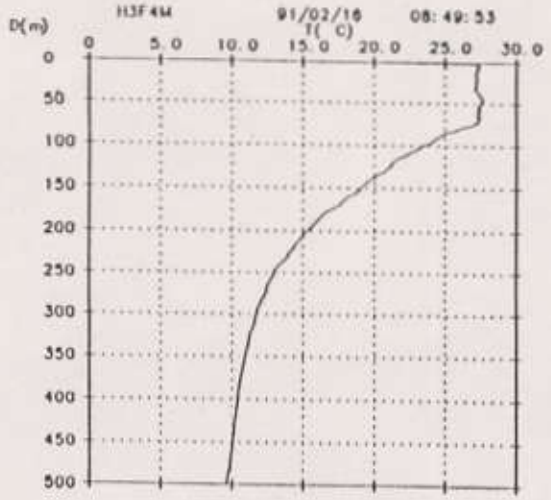


Fig. 9 Temperature profile from XBT

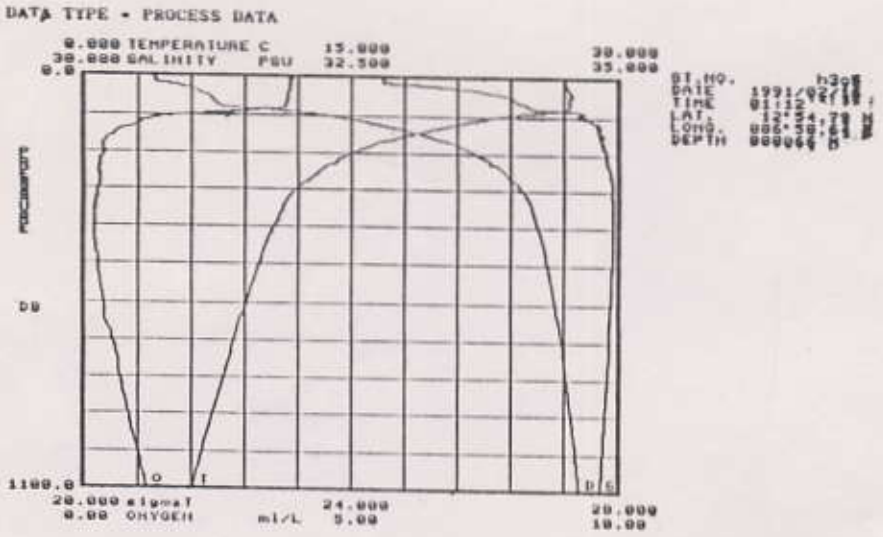


Fig. 10 Profile of water temperature, dissolved oxygen, salinity and Sigma-T from CTD.

This was the first experience of tuna longline fishing operations for some of us. There were also new techniques for all participants to learn including the construction of newly designed gear with new materials such as nylon and flurocarbon monofilament. The results of experiments showed that its catch efficiency was better than the original design. In addition, we had to learn the fish handling process in order to maintain the high quality of the catch. We also learnt how to find the depth of the hook layer.

In the study of tuna longline fishing grounds, we observed and learnt how to operate CTD and XBT for checking fishing ground conditions. We also learnt how to find the thermocline layer, and the optimum dissolved oxygen layer which is the living layer of tuna. CTD and XBT are very effective pieces of oceanographic survey equipment.

In conclusion, we expect to be able to apply these experiences and new knowledge to the development of our work in the future. We hope that this great opportunity will be given to our Thai researchers and scientists again next year or in the near future.

VI. Acknowledgements

This program was totally successful with no problems. Participants gained a lot of knowledge and experience which can be applied to their future work. It was a very useful program which will support future fisheries development in Thailand and Southeast Asian countries.

We would like to express our great thanks to the President of Tokyo University of Fisheries for offering us this great opportunity to be on board the Shinyo-Maru. Thanks also to Dr. Thiraphan Bhukaswan, the Secretary-General of SEAFDEC for kindly providing us with funds for food, travelling, and a daily allowance.

Thanks to Professor Yujiro Saotome, captain of Shinyo-Maru and his staff and all the crew who were very hospitable to us while on board. Thanks to Professor Dr. Kaname Satoh, Dr. Jiro Yoshida and Mr. Seiichi Takeda who taught us a lot and kindly arranged observation and practice schedules too.

Special thanks to Mr. Kazuo Inoue, the deputy secretary general of SEAFDEC who organised this program with Tokyo University of Fisheries and requested funds from SEAFDEC. He also took care of the participants until the program was completed.

Annex I

STUDY PROPOSAL

1. Title : Study on a new design tuna longline fishing gear operation and the fishing ground conditions.

2. Participants : Mr. Aussanee Munprasit
Mr. Suppachai Ananpongsuk
Mr. Chitjaroon Tantivala
Mr. Supatr Sriphanpaiboon
Mr. Pairaj Thaochalee
Mr. Thagoon Anugul

3. Rationale : Tuna longline is a type of oceanic fishing which is not well known among Thai fishermen and fishery officers. Tokyo University of Fisheries has offered SEAFDEC (Southeast Asian Fisheries Development Center) and the Department of Fisheries, Thailand, the chance to study this method of fishing. On board the Shinyo-Maru, we will have the opportunity to study not only how to catch tuna by longline but also how to find its fishing ground by using various oceanographic instruments. Hopefully, we will gain a lot of knowledge and experience from this cruise on the "Shinyo Maru" that will be very useful for our future work.

4. Objectives : 1) To study the design and construction of fishing gear.

2) To study tuna longline fishing operations.

3) To study tuna fishing ground conditions.

4) To study the operation of oceanographic equipment such as XBT, CTD, .. etc.

5. Duration : 9-23 February 1991.

6. Methods : The study will be divided into two main areas.

1) Tuna longline fishing operations

- fishing gear design & construction
- fishing operation and its techniques
- catch and preservation
- electronic equipment necessary for fishing operations

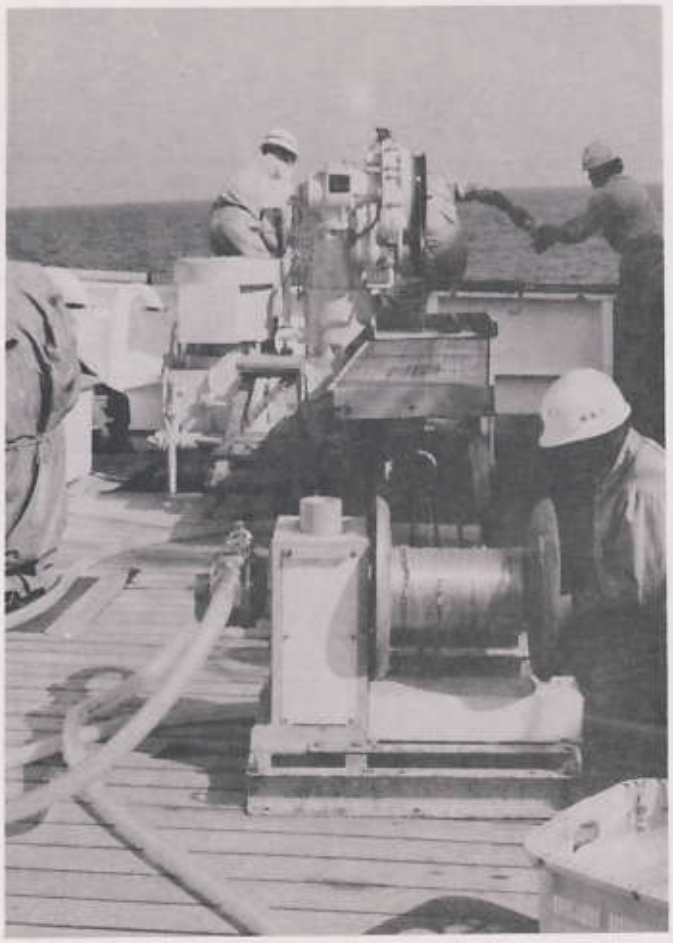
2) Tuna fishing ground observations

- important oceanographic parameters
- oceanographic survey using XBT, CTD and other equipment.

7. Evaluation : After finishing all fishing operations we will evaluate and discuss the results of the study.

8. Report : Reports of this study will be made and completed before leaving the vessel "Shinyo-Maru"

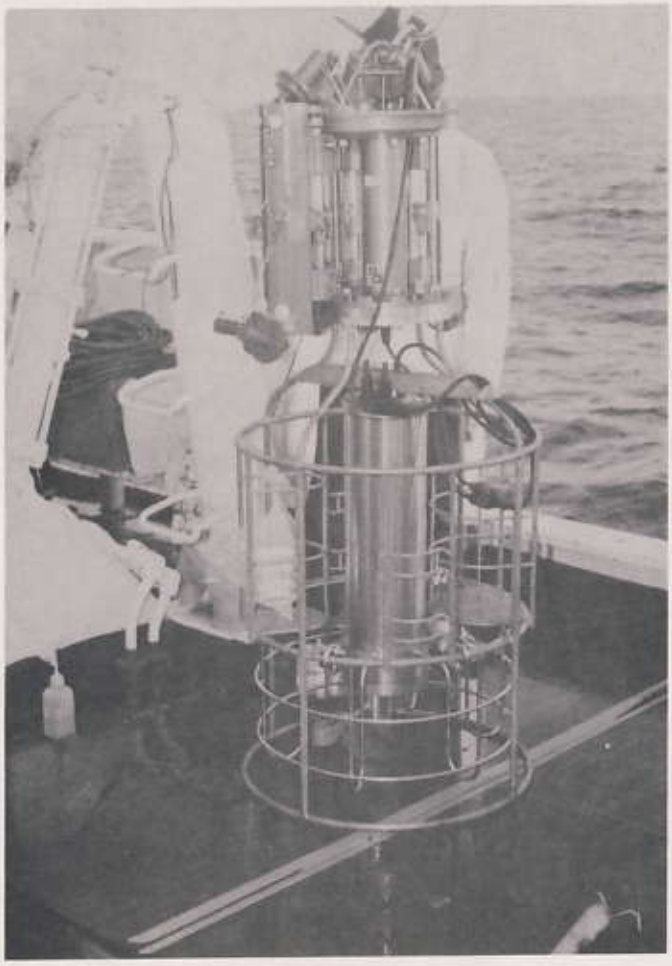
Professors and Instructors of Tokyo University of Fisheries, six Thai participants, and the Captain and his officers on board the Shinyo-Maru.



Hauling operation of new design tuna longline on board Shinyo-Maru 13-18 February 1991.

A yellow fin tuna's tail is removed immediately it is hauled on board - a step in the fish handling process.

One of the participants practising an XBT operation.



The CTD sensor with rosette-sampler is the most popular of modern Oceanographic equipment (CTP-system).

Four participants practising water sample collection from the rosette water sampler for calibration of the CTD.