Work Plan Implementation
(General Paper)

IPTP/88/GEN/15

REPORT OF THE 2ND SOUTHEAST ASIAN TUNA CONFERENCE AND 3RD MEETING OF TUNA RESEARCH GROUPS IN THE SOUTHEAST ASIAN REGION

Kuala Terengganu, Malaysia.
22 - 25 August, 1988

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INDO-PACIFIC TUNA DEVELOPMENT AND MANAGEMENT PROGRAMME

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REPORT OF THE 2ND SOUTHEAST ASIAN TUNA CONFERENCE AND 3RD MEETING OF TUNA RESEARCH GROUPS IN THE SOUTHEAST ASIAN REGION

1. OPENING OF THE SESSION

1.1. Opening Address

The second Southeast Asian Tuna Conference and the third meeting of the Tuna Research Groups in the Southeast Asian Region was formally opened by the Honourable Deputy Minister of Agriculture, Y.B. Encik Mohd Kassim bin Ahmed at 0900 hrs. on the morning of 22 August 1988. He extended a warm welcome to all participants, observers and officials of Malaysia and expressed his pleasure for the opportunity to address the tuna scientists from the Southeast Asian region and other parts of the world.The full text of the Honourable Deputy Minister's opening address is given in Appendix 1.

1.2. Welcome Address

The Director General of the Fisheries Department, Mr. Shahrom Hj. Abd. Majid in his address welcomed the delegates, observers and IPTP personnel to the Second Southeast Asian Tuna Conference. He noted that it was very appropriate that Kuala Terengganu had been chosen as the venue for the conference as it is the main center for tuna and deep-sea fishing in the Malaysian EEZ of the South China Sea. His welcoming address is given in Appendix 2.

After the opening ceremony, Mr. T. Sakurai, Programme Leader of the Indo-Pacific Tuna Development and Management Programme, on behalf of IPTP expressed his gratitude to the Government of Malaysia for hosting the meeting. He briefly outlined the objectives of this meeting as :

1. to review the status of fisheries, resources, statistics and research on tuna and tuna-like species in the region;

2. to identify future needs for better understanding and assessment of these resources;

3. to provide a forum for scientists to exchange their views and experiences in research on tuna and tuna- like species in the region and adjacent waters.

The Programme Leader also mentioned that the continuation of the IPTP was one of the topics discussed at the Tuna Committee of the Indian Ocean Fisheries Commission meeting held in Mauritius during 28 June through 1 July 1988. It was agreed that a new organization under FAO would be established for the management of tuna resources of the Indian Ocean. Some areas of Southeast Asia including the Philippines, Gulf of Thailand and eastern Indonesia might be excluded from this new organization. He asked the participants to consider this matter and to make recommendations. The Japan Trust Fund Project which is now funding the tuna sampling programmes in the region and also this meeting was scheduled to continue to 1990.

The Programme Leader also said that this was a technical meeting and encouraged participants to engage in frank and friendly discussions. He ended his address by noting the tradition of these meetings to be chaired by a participant from the host country.

1.3. Appointment of Chairman

Mr. Cheah Eng Kean, Senior Fisheries Officer, Fisheries Department, was unanimously elected as Chairman of the meeting.

1.4. Adoption of Agenda

The Chairman called the attention of the participants to the agenda which was presented by the Secretariat. The agenda was adopted without amendments and is given as Appendix 3. A list of participants is given in Appendix 4.

2. STATUS REPORTS

The full text of the country status reports are given in Appendix 5.

2.1. Philippines

The 1987 tuna landings totalled 271,000t, a 1.5% increase over the previous year. The commercial sector contributed 54% and the municipal sector, the remainder. The increase in the landings by the commercial sector could be explained by the increase in the number of vessels and also expansion into international waters. The decrease in the municipal sector landings may be attributed to rampant piracy in some areas and the shift to landing quality fish instead of quantity. The important commercial fishing gears for tuna are purse-seine, ringnet and bagnet, whereas those of the municipal sector are hook and line and ringnet/purse-seine. Fourteen percent of the tuna catch was exported, an increase of 2,000t over the previous year. Canned fish accounted for 70% and frozen fish 30% of the export volume.

Tunas are classified into 4 categories in Philippine statistics; skipjack, yellowfin/bigeye, kawakawa and Auxis species. However, catches are identified to the 6 major species at the tuna sampling programme sites. Seven landing sites are presently being monitored for catch, effort, species and size compositions.

A Malaysian participant pointed out that some tuna caught off the east coast of Semporna (Sabah) was being transported by carrier vessels to the Philippines and asked if this catch would be included in their statistics. He asked what proportion of the catch landed in the Philippines was captured in the waters of other countries. A Filipino participant stated that fishing companies through private arrangements were presently fishing off Papua New Guinea, Marshall Islands and Sabah. It is not certain whether landings from these joint-ventures were included in the national statistics.

2.2. Indonesia

The 1986 tuna landings totalled 282,000t in 1986, a 1% increase over the previous year. Exports of tuna have also been increasing and reached 17,900t in 1985. The export of sashimi-grade tuna is a recent development, with about 1,350t being air-freighted to Japan in 1987. Pole and line fishing is conducted in eastern Indonesia by vessels of state and private fishing companies. Vessels engaged in this fishery range from 10gt to 300gt, but mostly 30gt. However, the 10gt vessels are becoming increasingly popular because of their low operating costs. Purse-seining for tuna with large, modern vessels is conducted out of Biak, Irian Jaya and with small traditional vessels out of Banda Aceh, Sumatra and Prigi, Java. Longlining activity is increasing to cater to the lucrative sashimi market in Japan. There are 54 national and 20 foreign vessels fishing under licence in Indonesian waters. The government is attempting to stimulate further development of this market by improving port facilities and encouraging the national airline carrier to initiate new air routes to Japan from north Suluwesi and increase the number of flights from Jakarta and Bali. Seven landing sites were being monitored during 1987 for catch, effort, species and catch composition. Also, research is being conducted on baitfishes, efficiencies of fishing gears, effectiveness of FADS and vital parameters of small tunas.

The Programme Leader (IPTP) inquired of future plans for further tagging experiments. Funds were not available for tagging during the current year, but have been requested for the next fiscal year. The results of the Philippine tagging experiment would be followed closely as the methods could have application in western Indonesia. A Filipino participant inquired of the nationalities of the joint-venture partners. They included Taiwanese, Honduran, Korean and Thai. There were no plans to put observers on the joint venture vessels.

2.3. Thailand

2.3.1. West Coast of Thailand

The 1987 tuna landing from the west coast almost doubled from the previous year to 13,250 t. Species composition of the catch was kawakawa 48%, frigate 38% and longtail tuna 14%. Ninety-seven percent of the tuna catch was captured by purse-seiners. Three tuna purse-seiners and about 200 other purse-seiners operated off this coast in 1987. Purse-seine fishing grounds are 3 to 45 km. from the coast, in depths ranging from 30 to 100 m. The highest landings are made at 3 sites along the northern half of the coast. The fishing season for tuna is during the northeast monsoon from November to May. There has been an increase in catch rates of tuna from 0.1t/day in 1985 to 0.3t/day in 1987. Longtail tuna captured off the west coast ranged in size from 11 to 50 cm, kawakawa from 9 to 58 cm, and frigate from 9 to 42 cm. Various aspects of the biology of these small tunas studied by the staff of the Phuket Marine Fisheries Station was summarised.

2.3.2. Gulf of Thailand

The tuna catch from the Gulf of Thailand increased from 6,500t in 1973 to 90,400t in 1986. The species captured are longtail, kawakawa and frigate tunas, which represented 37%, 44% and 10%, respectively, of the 1987 catch. Purse-seiners accounted for 69% and drift gillnetters for the remaining 31% of the catch in 1987. There are two fishing seasons for purse-seiners in the Gulf of Thailand; one during January - May and the other during July - September. Gillnet catches are more uniform throughout the year.

A production model was used to derive estimates of maximum sustainable yield for the Gulf of Thailand. Purse-seine effort was taken as the standard unit. The estimated MSY and optimum effort for all species combined was 82,000t and 284,000 days, respectively. The estimated MSY's derived separately for longtail and kawakawa/frigate were 45,000t and 41,000t, respectively.

A participant from Malaysia said that as the size at first capture was less than the size at first maturity for all species captured off the west coast of Thailand, there was the possibility of the fishery collapsing with increasing effort. The participant from the Philippines commented that there is a similar situation with skipjack and yellowfin in the Philippines. Juveniles are captured as the pre-adults migrate out of Philippine waters and generally not available for capture by Filipinos. The Japanese participant observed that there is no documented case of recruitment overfishing for any tuna species. Also, in most tuna fisheries, the length at first capture is less than the length at first maturity. He also questioned the suitability of using purse-seine effort as the standard unit for the Gulf of Thailand. There has been changes in the fishing grounds, target species, fishing gears and ancillary equipment which has greatly changed the efficiency of purse-seiners from the seventies to the eighties.

The SEAFDEC participant asked that a clarification be made of the terminology used for fishing gears in this region specifically purse-seines and ringnets. For the Philippines, standard purse-seines have the bunt at one side of the net, whereas the purse-seines of Thailand and Malaysia have the bunt in the center. Similar nets are referred to as ringnets in the Philippines.

2.4. Malaysia

Trolling boats off the east coast of Peninsular Malaysia make trips of 4 to 5 days duration. They use troll lines with 2 to 25 hooks for tuna and handlines for larger fish such as king mackerel and marlins. Purse-seiners deploy aggregating devices comprised of coconut leaves suspended on bamboo poles. Fish attracted to these devices are generally fished at night with the aid of floating gas lamps. Sixty percent of the tuna catch is comprised of longtail tuna and the rest of kawakawa and frigate, with trace quantities of bullet tuna. The total tuna catch for

Malaysia in 1987 was 29,000 t. Forty purse-seiners have recently been launched on the east coast for off-shore fishing so that further increases in landings are expected. There are prospects for greater exploitation of the bigeye, yellowfin and skipjack resources in the waters off Sarawak and Sabah in the future. Tuna are mostly caught for local consumption with a small proportion exported to Thailand for canning. Malaysia at present is producing fish sausages and smoked tuna.

The Malaysian sampling programme is mainly concentrated on the catch of trollers and gillnetters. The catch rate of trollers for 1987 was 300 kg/trip. Many arrive at the jetty at almost the same time, which makes sampling difficult. Also, boat-owners frequently refuse to permit sampling of the desired numbers of fish. The numbers of registered vessels is available, but it is impossible to determine fishing effort as the numbers of vessels landing along the entire coast are not recorded.

Tuna catches in Sabah ranged from 1,000t to 5,700t during the 1978 to 1986 period. Seventy-one percent of the tuna and 53% of the seerfish are landed on the east coast. Landings are low as the tuna fisheries are not yet fully developed. The fishing gears used in Sabah include purse-seine, gillnet, handline and longline. Some of the tuna caught off the east coast of Sabah (Semporna) are being transported by carrier boats to the Philippines.

3. EXPERIENCE AND RESEARCH PAPERS

The papers presented at this meeting are reproduced either in full or in abstract in Appendix 6. Some key points of discussions of the papers are summarized below.

Several points were raised about the paper presented by Mr. Ishida on the log book system for longliners scheduled to be introduced in Indonesia in January 1989. The first point was the use of codes for areas instead of the actual position, as codes were not necessarily simpler on vessels equipped with modern electronic navigational aids. Codes were useful for small-scale fisheries in which the vessels generally do not have such equipment. The second point was the definition of regular and deep longlines which could vary from captain to captain. It was suggested that this be changed to number of hooks per basket. The third point was to record sailfish and short-bill spearfish separately. Sport fishing was becoming increasingly important and better statistics are required for future studies. Another point was the difficulties of obtaining good information for weight as fish may be frozen, fresh, gutted/gilled and gutted/headed and for value because prices are so variable depending upon the quality and market.

After Dr. Hayase's presentation, there was some discussion on the standardization of effort for hook and line and gillnet fisheries. The hook and line vessels of Terengganu use vertical handlines and troll-lines, depending upon the time and season. Furthermore, the number of hooks used on troll lines ranges from

2 to 25. Gillnets used in Malaysia ranges from less than 1 km to a few kms. Dr. Yamamoto stated that the fishing gear classification in all Southeast Asian countries have basically not been changed since their introduction. Fishing gears are constantly being modified so that their classification must be updated at regular intervals.

Mr. Monintja was asked after his presentation the effective attracting range of FADs. In eastern Indonesia, FADs were deployed 5 to 7 miles apart in areas with steep continental slopes and at the entrance of deep basins. FADs are also deployed as near as possible to a supply of live-bait. Once a FAD has been colonized by tuna, they are generally fished every day by 2 to 3 boats. Tuna are fished by pole and line boats within a 200m radius around the FAD.

There was discussion on Mr.Uktolseja's paper on population parameters of skipjack tuna. The gillnet is a selective fishing gear which could affect the results of length frequency analyses for population parameters. Another comment was the estimate of total mortality (Z) most probably includes emigration and therefore over-estimated. On the other hand, the natural mortality (M) estimate was low compared to estimates for western Pacific skipjack. Subtracting M from Z would give gross over-estimates of fishing mortality (F). Another comment was that the sample used in such studies should be representative of the population, but this was probably not the case in this study as the sampling area was very restricted.

A comment regarding Dr. Aprieto's paper on research and development programmes for tuna in the Philippines was that such a programme should be considered on a regional rather than on a national level. Tunas are highly migratory species so that it is impossible for any one state to assess and manage tuna stocks. Southeast Asian countries should take the example of the European Economic Commission and begin considering a plan for the development and management of shared tuna stocks in the EEZ of the Southeast Asian region.

4. MEETING OF TUNA RESEARCH GROUPS

4.1. 1987 Tuna Statistics

The Programme Leader reminded tuna research groups of the deadlines for submission of the 1987 tuna statistics. IPTP forms should be submitted by the end of June for the interim report and by the end of November for the regular report.

4.2. Tuna Sampling Programme

4.2.1. Sampling Sites

In Thailand, the two sampling sites on the Gulf of Thailand coast (Songkla and Pattani) should be continued. However, it was suggested that continuation of the TRANG site on the west coast of Thailand should be reconsidered as the present sampling programme did not adequately cover the tuna fisheries in the Andaman Sea.

Malaysia should continue its programme at Terengganu. In addition, assistance of IPTP was requested for establishing a sampling programme at Semporna (Sabah).

4.2.2. Types of gear to be sampled

It was suggested that a sampling strategy be established for each type of gear. Tunas are captured incidentally in the operations of luring purse-seiners. Landings by these vessels should be monitored in Thailand and Malaysia.

4.2.3. Items to be collected

The Statistics Division of Thailand has defined the Gulf of Thailand into 7 fishing grounds. The tuna research group should adopt these fishing grounds to facilitate comparative studies. Also, fishing grounds should be defined for the east coast of Peninsular Malaysia.

Sample size of 500 fish per month should be sufficient for longtail tuna caught by trolling off the east coast of Peninsular Malaysia. There was no further need to collect the weights of fish. A key to a successful sampling programme is to get the cooperation of fishermen and middlemen.

4.2.4. Method of Data Processing

Thailand and Philippines agreed to use dBase III to produce monthly summaries. Indonesia is entering data with LOTUS and could possibly switch to dBase III in the future. Malaysia expressed preference for its own system (SPSS) of data processing.

4.2.5. Data Submission to IPTP

It was agreed by the tuna reasearch groups that monthly summaries be submitted to IPTP every two months in diskette. Necessary diskettes will be sent to each tuna research group. Research groups were informed that IPTP staff would periodically visit sampling sites for monitoring sampling programmes and training local scientists and samplers on sampling techniques and computer operations.

4.3. Research Relating to Tuna

The Programme Leader expressed IPTP's support for research activities relating to tunas in the region. Participating countries are invited to submit research proposals to IPTP for consideration and support.

4.4. Tagging Programme

A tagging programme will start in the Philippines in September. IPTP may invite scientists from other countries for training in tagging techniques.

4.5. Training Courses and Study Tours Required

In order to implement project RAS/86/026 - Regional Collaboration in Fisheries of Tuna and Tuna-like Fishes, further consultations will be continued with relevant officials in the countries concerned.

5. RECOMMENDATIONS

The following recommendations were made based on the discussions during the meetings:

1. FAO continue the present activities of IPTP in the Southeast Asian Region after 1989, when the IPTP is scheduled to be terminated.

2. Accurate statistics are essential for a proper assessment of tuna resources. The inadequacies of classifications for both species and fishing gears should be brought to the attention of national statistical offices as well as the FAO/SEAFDEC workshop to be held in 1989.

3. The present tuna sampling programme in each country be continued to obtain accurate information of tuna fisheries. The tuna research groups should closely monitor their respective sampling programmes to ensure quality data. IPTP should continue to assist the tuna research groups in maintaining these programmes.

4. IPTP provide assistance in initiating sampling programmes in areas of developing tuna fisheries and/or in areas where information is lacking for existing tuna fisheries.

5. A standard computer programme for processing data collected by the sampling programmes be introduced by IPTP to facilitate comparative studies in the region.

6. All countries in the region cooperate in the tagging experiments being planned for the Philippines and the South Pacific Commission region to ensure maximum return of tags recovered in their waters.

7. A review and assessment of the tuna stocks in the Gulf of Thailand and the east coast of Peninsular Malaysia be completed as soon as possible by scientists from Thailand, Malaysia and IPTP.

Appendix I

Speech By Mohamed Kassim Bin Ahmed, Deputy Minister of Agriculture, Malaysia

Encik Shahrom Hj. Abd. Majid, Director General of Fisheries, Malaysia

Mr. Toshifumi Sakurai, Programme Leader, Indo-Pacific Tuna Development and Management Programme;

Participants and Observers

Ladies and Gentlemen,

I would like to join the Director General of Fisheries Malaysia, Mr. Shahrom Hj. Abd. Majid in extending a very warm welcome to all participants, observers and officials to Malaysia. For me, personally, it is a pleasant feeling to be given this opportunity to address and meet with such a distinguished group of tuna scientists from all over the world. In this State of Terengganu, there is a particular liking for the tuna fish which we call locally as 'ikan tongkol'. A lot of fishermen fish for tuna off the coast of Terengganu. In fact for your information, this tuna fish is a must for a favourite local breakfast called 'nasi dagang' in which tuna fish is served with rice and curry. It is difficult for me to describe how good the taste is but you can try it yourself while you are here. I am sure you will enjoy it too just like all the people of Terengganu.

Ladies and gentlemen, our National Agriculture Policy has clearly spelt out policy guidelines with regard to fisheries development. One of the strategies is that increase in fish production should come from the development of the deep sea fisheries resources. In compliance with our policy objectives, we have carried out many fisheries resources surveys in our Exclusive Economic Zone which is very extensive, covering a large part of the South China Sea. Based on information about the resources available, the Malaysian Government is now implementing an accelerated deep sea fisheries development programme involving fishing vessel construction and operation by the private sector while the Government is providing training, research and other supporting services. In the next few years there will be large fleets of Malaysian fishing vessels fishing in our Exclusive Economic Zone, including the harvest of tuna and tuna related fishes. Our investment in research, training and protection for fishermen will also be increased.

Malaysia's desire to expand her tuna fisheries is not only due to her expanded jurisdiction resulting in an Exclusive Economic Zone of 160,000 square nautical miles, and the tuna resources found therein, but also due to encouragement in seeing the success of her Asean neighbours in expanding their tuna fisheries so fast.

Thailand, the Philippines and Indonesia are presently very big exporters of tuna to the world markets. Thailand, our neighbour to the north produced about 8,000 tonnes of tuna in 1973 but by 1985 her production has gone up to about 88,000 tonnes which is a very rapid increase. Thailand's increase in tuna fishing is in response to the increasing world demand. Many purse-seiners which normally fish for small pelagic fish such as mackerels and scads for domestic consumption have been converted to tuna purse-seiners to meet the world demand for tuna. As a result of increased production, Thailand has also built up a very large tuna canning industry; which also imports tuna to meet its raw material requirement, including from Malaysia.

Ladies and gentlemen, in 1987, the private sectors of Thailand and Malaysia co-operated in the operation of 40 tuna purse-seiners, based in Malaysia and exporting its tuna catch to Thailand.

As for Philippines, the landings of tuna exceeded a quarter of a million metric tons in 1985, an impressive performance, considering that in 1970, the production was only 25,000 tonnes. The Philippines is now among the six major tuna producing nations of the world.

Indonesia, which has an established tuna fishery also doubled her tuna landings from 127,000 tonnes in 1979 to 215,000 tonnes in 1984.

After looking at all these developments around her, Malaysia also started to increase her tuna fishing effort, to meet export market demand.

Ladies and gentlemen, I have been informed that the Indo-Pacific Tuna Development and Management Programme was set up by the Food and Agriculture Organization to assist participating countries in monitoring and managing tuna fish stocks found within their areas of jurisdiction. Since the tuna species are migratory in habit with wide ranging habitats, especially the oceanic tunas, it is very appropriate that such a body as the Indo-Pacific Tuna Development and Management Programme be set up. This programme has succeeded in collecting a lot of data, with the co-operation of participating countries, to give an overall picture of the tuna fish stocks in the Indo-Pacific region. Much valuable reports and documents have been published by this Programme including manuals for tuna statistics collection and atlases of tuna fisheries. The work of the IPTP will therefore further enhance the co-operation already existing among the countries of this region in managing the tuna resources.

Ladies and gentlemen, your deliberations here over the next few days will be of great significance to the tuna fishery industry. As you are meeting every year, a lot of you will be anxious to know the latest position with regards to research work on tuna as well as the state of resources since your last gathering. I wish you all every success in your conference and hope the outcome will be beneficial to everyone.

However, besides the pre-occupation with tuna, I hope you can continue your stay in Terengganu to enjoy the beautiful sceneries and our culture and traditions. Some of you may venture down south to see our leathery turtle nesting beaches. It will be worth your time I can assure you.

May I now, with the greatest pleasure, declare this Second Southeast Asia Tuna Conference and the Third Meeting of the IPTP Tuna Research Groups in Southeast Asia officially opened.

Thank you.

Appendix 2.

Speech By Shahrom B. Haji Abdul Majid
Director General of Fisheries, Malaysia

Y.B. Encik Mohd Kassim Ahmed, Deputy Minister of Agriculture, Malaysia;

Mr. Toshifumi Sakurai, Programme Leader, Indo-Pacific Tuna Development and Management Programme;

Ladies and Gentlemen,

I am very glad to be able to personally deliver this welcome address to all delegates, observers and IPTP officials attending the Second Southeast Asia Tuna Conference which is being held simultaneously with the Third Meeting of the IPTP Tuna Research Groups in the Southeast Asia.

It is very appropriate, in my opinion, that the state of Terengganu has been chosen as the venue for this conference. It is Malaysia's frontline state not only for tuna fishing but also for deep sea fishing in our Exclusive Economic Zone stretching into the South China Sea. Terengganuu fishermen contribute about half of the country's tuna production.

The tuna fishing industry in Malaysia is a fast developing one. The production trend is a rising one. For example in 1979 Malaysian fishermen landed about 9,000 tonnes of tuna but in 1987 landings have increased to 25,500 tonnes. Compared to neighbouring countries our tuna landings is not very large but we intend to fully develop the tuna resources available in our EEZ. Besides, tuna fishing is part of the deep sea fishing programme being actively promoted by the government. I am confident that the trend in tuna landings will continue to be upwards in the years to come. While traditionally most of our tuna fishing are for neritic or coastal tunas such as the longtail, kawakawa and frigate tunas, we are now also going after the oceanic tunas such as yellowfin and skipjack. Exploratory fishing with purse seines and using payaos in the deeper waters of our Exclusive Economic Zone have been conducted to determine the tuna resources will be maintained and strengthened.

Ladies, and gentlemen, Malaysia has been participating in the activities of IPTP since its inception. Not only that we have consistently attended the meetings of the Tuna Research Groups of Southeast Asia which was set by IPTP to focus research efforts on the tuna resources of this region. Presently, IPTP has a tuna sampling project in Terengganu for studying the growth and recruitment of neritic tunas, mainly the longtail tuna or tongkol as is known locally. Due to the migratory habit of these tuna species, co-operation with neighbouring countries is essential to

get accurate information on them. I would like to take this opportunity to express our appreciation to the Indo-Pacific Tuna Development and Management Programme for its contribution to the development of tuna fisheries in this region. Malaysian fisheries officers have benefitted from participation in IPTP activities.

Ladies and gentlemen, the state of Terengganu is not only well known for its tuna landings but has another unique feature. It has the world famous leathery turtle nesting beaches which is just south of here, about an hour by road. There are few places in the world where giant leathery turtles come ashore to lay their eggs once a year. We are happy that the leathery turtles have chosen Terengganu. Tourists, nature lovers and turtle experts come from all over the world during the turtle nesting season to observe this special event. And I wish to inform all of you that your conference is being held in the midst of this year's turtle nesting season which will last until September. There will be an opportunity for you to witness the giant leathery turtles lay their eggs and also visit our turtle hatchery in Rantau Abang.

Thank you and have a successful meeting.

Appendix 3

A G E N D A

Monday, 22 August 1988

0800 - Registration

0900 - Opening ceremony

0930 - Tea

1030 - Address by IPTP
Election of Chairman
Adoption of agenda and time table

Submission of Status Reports

1100	-	Status Report	- Philippines
1130	-	Status Report	- Thailand
1230	-	Lunch Break	
1400	-	Status Report	- Indonesia
1430	-	Status Report	- Malaysia
1500	-	Tea Break	

Submission of Experience and Research Reports

1530	-	Trend of tuna catches and profiles of tuna fisheries in the southeast asian region.	- T. Sakurai
1600	-	A review of tuna fisheries in the Gulf of Thailand and off the east coast of Peninsular Malaysia.	- N. Yesaki & T. Nishida

Tuesday, 23 August 1988

0900	-	Log book survey of longline fishery in Indonesian waters.	- K. Ishida
0930	-	Current Status on tuna/tuna-like fisheries in Peninsular Malaysia.	- C. Hayase
1000	-	Tea Break	

Submission of Experience & Research Reports (Contd)

1030	-	Analysis on the utilization of the rumpon as fish aggregation device on the skipjack tuna fisheries in Indonesia.	- D.R. Monintja
1100	-	Experiment on drift gillnets for tunas.	- S. Soodhom
1130	-	Parasites of tuna of the South China Sea and their use as biological indicators.	- F. Shahrom
1200	-	Some population parameters of skipjack tuna in the waters adjacent to Pelabuhanratu, West Java.	- J.C.B.Uktolseja
1230	-	Lunch Break	
1400	-	The skipjack tuna (K.pelamis) fisheries of the Philippines: changes in catch volumes and size composition.	- R.A. Ganaden, N.C. Barut & P.N. Arce.
1430	-	Occurrence & distribution of larval tunas in Ragay Gulf, Burias Pass, Ticao Pass and waters north of Samer Sea.	- Z.V. Abuso
1530	-	Tea Break	
1600	-	The Philippine tuna fisheries: Research and development.	- V. Aprieto

Wednesday, 24 August 1988

0900	-	Status of tuna fisheries in the western and Central Pacific Ocean.	- J. Hampton
0930	-	Recent Japanese research activities on tunas and billfish resources in the western equatorial Pacific Ocean.	- Z. Suzuki
1000	-	Tea Break	
1030	-	Impact of new regime of the sea to tuna fisheries of USA and Mexico with a particular reference to Mexican tuna fleet at Ensenada.	- T. Yamamoto
1100	-	Development of Taiwanese tuna fishery.	- Taiwanese Tuna Fisheries Assn
1130	-	Open Discussion	

1230 - Lunch Break

1400 - Meeting of tuna research groups.

Thursday, 25 August 1988.

0615 - 1200 Field Visits

1400 - 1500 Adoption of Report

2000 - 0130 Excursion to Rantau Abang Turtle Sanctuary

Appendix 4

LIST OF PARTICIPANTS AND OBSERVERS

INDONESIA

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Appendix 5

Status Reports:

5.1 Philippines

(1) The Status of Philippine Tuna Fisheries

5.2 Thailand

(1) Studies on the Tuna Resources in The Gulf of Thailand.

(2) Tuna Fisheries and Resources in the West Coast of Thailand, Andaman Sea.

5.3 Indonesia

(1) Country Report.

5.4 Malaysia

(1) Status Report of Malaysia.

(2) Status Report of the Tuna Fisheries in Sabah, Malaysia.

THE STATUS OF THE PHILIPPINE TUNA FISHERIES[1]

by

Noel C. Barut[2]

Introduction

The Philippine tuna fisheries is one of the major fishery of the country in the past few years and is still the most important in terms of production and volume of export of marine fishery products. Production has increased remarkably from more than 184,000 m.t. in 1978 to about 271,000 m.t. in 1987. Export also increased by about 2,000 m.t. in 1987 making it the number one fishery export in 1987 in terms of volume valued at more than 1 billion pesos (47.6 million dollar). An increased production of about 4,000 m.t. in 1987 was recorded from that of the 1986 catch.

General Data

1.1 Fisheries

The Philippine statistics for fisheries differentiate two categories in fishing operation based on the tonnage of vessel used. Catches landed by vessels of 3 gross tonnage or more are termed commercial catches, while those by vessels of less than 3 gross tonnage are termed municipal. Commercial catches therefore are those catches landed by bigger boats and are usually mechanized while the municipal catches are those catches landed by smaller boats which are either powered or non-powered.

[1]Paper presented at the 2nd Southeast Asian Tuna conference and the 3rd meeting of the Tuna Research Groups in the Southeast Asian Region, 22-25 August 1988, at Pantai Primula Hotel, Kuala Terengganu, Malaysia.

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1.2 Trends in tuna catches

Statistics showed that the Philippine tuna production is increasing steadily from 1978 to 1987 except in 1984 when production decreased by more than 16 thousand m.t. (Table 1)

The commercial fishery sector of tuna has also shown a steady increasing trend (Table 3) and contributed 54% to the total tuna production in 1987. The municipal fishery sector has a varied trend (Table 4) and contributed 46% to the 1987 total tuna production.

The commercial fishery sector showed an increased of more than 13,000 m.t. compared to the 1986 production and this, maybe attributed to the increase in the number of fishing vessels and the bigger fishing vessels have shifted to international waters to fish. The decreased of around 9,000 m.t. in the catch of municipal tuna production in 1987, maybe due to the decrease in the number of fishermen who go out fishing because of rampant piracy in some of the fishing area. Another factor was the demand for the sashimi grade tuna in Japan which changed the fishermen's mode of fishing. Previously, they used to catch as many fish as they could without considering the quality of the fish they will land; but now, the fishermen tend to catch smaller volume of tuna and land good quality fish which command a higher price in the market. The target market of the fishermen now is for the sashimi market in Japan. However, fish that will not pass for sashimi grade goes to canning factory or to the public market which command lesser price.

1.3 Species Landed

There are 6 species of tuna exploited commercially, in the Philippines which constitute the main tuna fishery of the country. These are the Yellowfin tuna (*Thunnus albacares*), big eye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwunos pelamis*), frigate tuna (*Auxis thazard*), bullet tuna (*Auxis rochei*) and eastern little tuna (*Euthynnus affinis*).

The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) statistics do not differentiate yellowfin from big eye tuna and frigate tuna from bullet tuna, so that these four species of tuna are recorded as yellowfin/big eye tuna and frigate tuna only in BFAR statistics. But when the tuna sampling project was started in late 1979, these four species of tuna have been identified and listed separately by the project.

1.4 Fishing Gear

The major commercial fishing gear used in catching tunas are purse seine, ringnet, bagnet and troll line. Other gears used are trawl, longline, beach seine, hook and line and round haul seine (Table 4). Hook and line is the most important municipal fishing gear used in catching tunas which accounted for 62% in the 1987 municipal tuna production. Ringnet/purse seine is second followed by gill net and long line. Other gears used are troll line, bagnet, beach seine, fish corral, pole and line, drive-in-net, round haul seine and baby trawl (Table 5).

Table 6 presents the number of commercial fishing boats, type and size of gear from 1978-1987. The number of fishing vessels by type of gear varies from year to year.

Almost all the gears used in capturing tunas are being operated with the aid of an indigenous fish aggregating device (FAD) locally known as payao. The payao is usually made of bamboo but some structures are made of steel for longer life.

1.5 Tuna landing by species and fishing gear

Skipjack was the major catch of purse seine which accounted for 50% followed by frigate /bullet tuna 25%, then yellowfin/big eye tuna 20% and eastern little tuna 5%. The ringnet landing has frigate/bullet tuna as the dominant catch which is 59% of the catch, with eastern little tuna next 22%, then skipjack 14% and yellowfin/big eye tuna 5%. Other gears which operate nearshore are catching mostly frigate/bullet tuna and eastern little tuna while those gears which operate offshore are dominated mostly by skipjack and yellowfin/big eye tuna.

Municipal gears which are being operated nearshore are catching mostly the frigate/bullet tuna and eastern little tuna except hook and line and longline which operate offshore are catching the bigger yellowfin/big eye tuna which average around 35-40 kg per piece.

1.6 Tuna landing by region

The Philippine is divided into 13 political regions from Region I to 12 and the National Capital Region (NCR). Statistical data enumerators are assigned in each region to collect fisheries data, the number of enumerators depend upon the size of the landing sites.

Landings of tuna by political region in 1987 showed that Region IX has contributed 28% followed by Region XI 20% and NCR 18% to the total commercial landings of tuna. The other regions contributed 10% and less to the total tuna production (Table 7). The NCR recorded a high landings of tunas because vessels fishing in the different fishing grounds of the country unload their catch at the Navotas Fishery Port, the premier fishery port of the country located at NCR where auction selling is done.

The number one producer in the municipal landing of tuna in 1987 was Region IX followed by Region IV, VI and XI where more than 10,000 m.t. of tunas were unloaded (Table 8).

1.7 Export of Philippine Tuna

Export of Philippine tuna was only 14% of the total tuna production. Canned tuna contributed 70% to the tuna export while frozen tuna 30%. The total tuna export in 1987 was 37,311 m.t. valued at about 1.4 billion pesos. There was an increased of about 2,000 m.t. from the 1986 tuna export (Table 9).

The major importer of canned tuna was the USA, West Germany and Mozambique (Table 10). Japan top the importer of frozen tuna (Table 11). Export of tuna to Japan increased by more than 3,000 m.t. in 1987. The increased was maybe due to the better handling of handline fishermen of their catch which almost all were accepted as sashimi grade tuna for export to Japan.

Table 12 presents the export of tuna by kind, quantity, value and destination.

Biological Sampling of Tuna

2.1 Background information

Biological sampling of tunas was started in November 1979 when the Bureau of Fisheries and Aquatic Resources (BFAR) in collaboration with the South China Sea Fisheries Development and Coordinating Programme (SCSP) initiated a Tuna Sampling Project in 4 landing sites in Mindanao namely: Sta. Cruz, Davao del Sur; Opol, Misamis Oriental; Labuan, Zamboanga City; and Gen. Santos City, South Cotabato.

In January 1982 two sampling sites were added namely: Navotas, Metro Manila and Recodo, Zamboanga City; and by January 1984, 2 more sampling sites were opened at Initao Misamis Oriental and Malita Davao del Sur

2.2 Results and Discussion

2.2.1 Effort and catch by landing sites

2.2.1.1 Recodo

Recodo is one of the landing site for purse seine in Zamboanga City. Purse seine is the gear being monitored and for 1987 there were 200 boat landing observed and all these boats were sampled. The total catch was 24,526,499 kg and only 13% of this catch was sampled for length and weight measurements (Table 13).

2.2.1.2 Labuan

Labuan is one of the major landing site in Zamboanga City. Ringnet, troll line, handline and multiple handline are the gears used in capturing tuna and all these gears are being monitored. Handline was observed to have the most number of vessel landing followed by ringnet, troll line and multiple handline. The total landed catch of handline was 506,007 kg; for ringnet was 3,094273 kg; troll line, 315,722 kg and multiple handline 153,539 kg (Table 13).

2.2.1.3 General Santos City

Gen. Santos City is probably the major landing site in Region XI. Around 100 metric tons of tunas are being unloaded every day.

Purse seine, ringnet and handline are the gears being monitored and with a total landed catch of 3,633,500 kg, 14,007,328 kg and 4,838925 kg respectively.

Handline has the highest number of boat landing, totaling 17,088 followed by ringnet, 1956 and purse seine 384 boat landing.

2.2.1.4 Sta. Cruz

One of the main landing site in Davao Gulf is Sta. Cruz. Ringnet and handline are the gears being monitored in this area. Catches of tunas by ringnets in Davao Gulf have been declining so that other operators were forced to stop fishing while others who opted to continue with the business have to transfer their fishing operations to Moro Gulf and land their catch in Gen. Santos City. This will explain why no ringnet landings was ,monitored in 1987. Handline vessels monitored were 420 boat landing with a total landed catch of 40,484 kg (Table 13).

2.2.1.5 Opol

Ringnet accounted for almost all the tuna landings in Opol. There were 522 boat landings observed and the total landed catch was 187,247 kg (Table 13).

2.2.1.6 Initao

Initao is one of the major landing site in Misamis Oriental. Handline is the only gear being monitored by the project as other gears are also being monitored by the other project of the Office. There were 1,516 boat landings observed in 1987 and with a total landed catch of 8,576 kg (Table 13).

2.2.1.6 Navotas

The Navotas Fishery Port located at Navotas, Metro Manila is the premier landing site of the Philippines. Almost all fishing boats, which are larger in sizes, fishing in the different fishing grounds of the country are unloading their catch here. Purse seine is the only gear being monitored. There were 543 boat landing observed. The total catch of purse seine was 16,957,672 kg (Table 13).

2.2.2 Catch, species composition and size ranges

A total of 68,269.772 kg of tuna was recorded at the different sampling sites. This total comprised 46% skipjack, 33% yellowfin, 8% frigate, 10% bullet, 2% eastern little tuna and 1% big eye/oriental bonito.

Only 4 species of tuna were found in the catch of purse seine at Recodo. Skipjack dominated the catch with yellowfin tuna next, then bullet tuna and big eye tuna. Catches of skipjack is increasing from 1985 to 1987 and also the catches of big eye tuna. However catches of yellowfin and bullet tuna varies from year to year (Table 14).

Table 15 presents the species composition, size ranges and total catch attained by the different gear used in capturing tuna at Labuan, Zamboanga City from 1985 to 1987. Skipjack is the dominant catch of ringnet and troll line while handline yellowfin tuna and multiple handline, eastern little tuna in 1987.

Catches of the different species by ring net and handline showed an increasing trend from 1985 - 1987, while catches of troll line and multiple handline varies from year to year.

The different gear is also catching a wide size ranges of the different tuna species.

In Opol, Misamis Oriental, Bullet tuna dominated the catch except in 1986 when frigate tuna was more. (Table 16) Other species caught by ringnet are skipjack, and yellowfin tuna. There is also a wide size ranges of the tuna species caught by ringnet at Opol.

At Sta. Cruz, Davao Del Sur, skipjack dominated the catch in 1985 and 1986 followed by yellowfin, frigate and bullet tuna. No ringnet catch was observed in 1987 as they have moved to other fishing grounds and landed their catch in other landing sites (Table 17).

Three species of tuna is being caught by handline at Sta. Cruz namely yellowfin skipjack and big eye tuna with yellowfin tuna dominating the catch.

Table 18 presents the different species caught by the different gear being monitored in Gen. Santos City from 1985 to 1987.

Skipjack is again the dominant catch of ringnet and purse and showed an increasing trend in both gear during the three year period. All the 6 species of tuna exploited commercial are found in the catch of purse seine and ringnet and all these species showed an increasing production trends.

Yellowfin and big eye tuna are the only species caught by handline and likewise showed an increasing catch trend in the past three years.

2.2.3 Catch and catch rate

2.2.3.1 Purse seine

Purse seine catch was highest at Recodo followed by Navotas and at Gen. Santos City.

The catch rate at Recodo was also high reaching 122,632.5 kg/vessel landing followed by the purse seine at Gen. Santos City then at Navotas. (Table 19)

2.2.3.2 Ring net

In the 3 sampling sites in Mindanao using ringnet in capturing tuna, Gen. Santos was observed to be the landing site with the highest landed catch (14,007328 kg) and likewise has a high value of catch rate (7,161.21 kg/vessel landing). Labuan was second having a total landed catch of 3,094.273 kg with a catch rate of 1,609.25 kg/vessel landing. In Opol the total landed catch of ringnet was 187,247 kg with a catch rate of 359.71 kg/vessel landing. (Table 19)

2.2.3.3 Handline

The highest landing of the handline was recorded at Gen. Santos reaching 4,839,925 kg having a catch rate of 283.18 kg/vessel landing. Labuan was second with a total landed catch of 506,007 kg with catch rate of 197.97 kg/vessel landing. Only 40,484 kg was observed in Opol and with a low catch rate of 96.39 kg/vessel landing. (Table 19).

2.2.3.4 Troll line

Troll line is being monitored only in Labuan and has contributed a total landed catch of 315,722 kg to the tuna production in the area. The catch rate for this gear was 175.5 kg/vessel landing. (Table 19)

2.2.3.5 Multiple Handline

Multiple handline is also being monitored only in Labuan. The share of this gear to the total tuna production in Labuan was 153,539 kg, with a catch rate of 147.92 kg/vessel landing. (Table 19).

Table 1. Annual total landings (MT) of tunas in the Philippines from 1978-1987

YEAR / SPECIES	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
FRIGATE TUNA/BULLET TUNA	50899	79909	96874	78248	67363	74219	80305	95118	87225	98032
YELLOWFIN/BIG EYE TUNA	47029	49224	48023	56176	51922	62036	58924	64293	99514	51814
SKIPJACK TUNA	49730	45084	31178	38439	50795	57151	44671	60536	77031	73751
EASTERN LITTLE TUNA	36341	23094	24730	30891	46524	48880	41899	41060	42445	46934
T O T A L	183999	197311	200805	203754	216604	242286	225799	261607	266211	270527

Source: BFAR Statistics

Table 2. Annual commercial landings (MT) of tunas in the Philippines from 1978-1987

YEAR / SPECIES	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
FRIGATE TUNA/BULLET TUNA	20997	29144	33310	47141	39562	34097	47360	33478	44196	57620
YELLOWFIN/BIG EYE TUNA	5519	11402	11446	20073	19787	20502	22254	22115	11758	13329
SKIPJACK TUNA	14816	19534	12456	17704	31183	39613	28871	42433	51778	47191
EASTERN LITTLE TUNA	7468	7269	9958	13071	14442	12459	14832	18675	20348	22613
T O T A L	50700	78204	87250	97991	105274	106676	117317	136749	133080	146503

Source: BFAR Statistics

Table 3. Annual municipal landings (MT) of tunas in the Philippines from 1978-1987

YEAR / SPECIES	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
FRIGATE TUNA/BULLET TUNA	50002	40215	43564	31107	27301	40122	32945	42240	43029	40362
YELLOWFIN/BIG EYE TUNA	41510	37817	36527	36103	32135	41529	36670	42108	43752	33281
SKIPJACK TUNA	14914	25250	18692	20755	19612	17538	15800	18103	25252	26060
EASTERN LITTLE TUNA	26873	15825	14772	17820	32082	36421	25067	22587	22097	24321
T O T A L	133299	119107	113555	105763	111350	135618	104482	124838	133131	124024

Source: BFAR Statistics

Table 4. 1987 commercial fishery production by species and gear

SPECIES	BAGNET	TRAWL	PURSE SEINE	RINGNET	BEACH SEINE	ROUND HAUL SEINE	TROLL LINE	HOOK & LINE	LONGLINE	OTHERS	TOTAL
FRIGATE TUNA/BULLET TUNA	7167	1892	19108	29212	117	28		80	59	7	57670
YELLOWFIN/BIG EYE TUNA	148		15171	2425	36		156	33	360		18579
SKIPJACK TUNA	328		39125	7052	2		890	5	291		47691
EASTERN LITTLE TUNA	2343		3883	11080			5305	2			22613
T O T A L	9986	1892	77287	49769	155	28	6351	98	930	7	146503

Source: BFAR Statistics

Table 5. 1987 municipal fishery production by species and gear

SPECIES	BAGNET	DRIVE IN NET	GILLNET	TROLL LINE	RINGNET/ PURSE SEINE	BEACH SEINE	ROUND HAUL SEINE	BABY TRAWL	HOOK & LINE	LONGLINE	FISH CORRAL	POLE & LINE	OTHERS	TOTAL
FRIGATE TUNA/BULLET TUNA	442	10	7319	2339	5903	1146	67	62	20829	1697	341	2	214	40362
YELLOWFIN/BIG EYE TUNA	276	1	2160	379	491				26394	3195	173	145	67	33291
SKIPJACK TUNA	533		2658	647	4822	54			14624	1727	335	647	13	26660
EASTERN LITTLE TUNA	37	92	2613	586	5068	80	-	94	15708	141	328	74	-	24321
T O T A L	1288	103	14750	3951	16284	1280	67	56	77046	6760	1177	868	294	124634

Source: BFAR Statistics

Table 6 Number of Commercial Fishing Vessels, Horsepower and Gear from 1978 - 1987

TYPE OF GEAR	TYPE AND SIZE OF BOATS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
GILLNET	3.1 - 4.9 P	43	67	58	56	52	45	53		37	26
	3.1 - 4.9 N.P.	1	2	2	1		1	1			
	5 - 9.9 P	201	174	168	171	152	152	144		130	145
	5 - 9.9 N.P.	2	4	2	1		6	1		1	3
	5 - 9.9 N.R.		1	1	1	1	1	1		1	3
	10 - 14.9 P	174	170	182	183	199	183	186		165	183
	10 - 14.9 N.P.	8	5	5	5	5	8	5		1	10
	10 - 14.9 N.R.		1	1	1	1	1	1		1	8
	15 - 19.9 P	80	60	59	69	51	49	56		62	64
	15 - 19.9 N.P.		1	1	1	1	1	4		1	1
	20 - 24.9 P	50	76	77	64	57	67	87		94	95
	20 - 24.9 N.P.		1	1	1	2	1	1		75	1
	25 - 49.9 P	59	55	48	60	46	60	63		1	72
	25 - 49.9 N.P.		1	1	1	2	1	1		1	1
	25 - 49.9 N.R.		1	1	1	1	1	1		1	3
	50 - 99.9 P	11	13	15	6	2	3	2		2	2
	100 - 149.99	10	14	2	4	4	1	1		1	1
	150 - 199.99 P	2	1	1	1	1	1	1		1	1
	200 - 249.99 P	1	1	1	1	1	1	1		1	1
	250 - 299.9	1	1	1	1	1	1	1		1	1
	300 - 349.9	1	1	1	1	1	1	1		1	1
	350 - 399.9	1	1	1	1	1	1	1		1	1
	400 - 449.99	1	1	1	1	1	1	1		1	1
	450 - OVER	1	1	1	1	1	1	1		1	1
	NOT REPORTED	1	1	1	1	1	1	1		1	1
TOTAL		643	641	624	552	663	578	652		563	618
TRAWL	3.1 - 4.9 P	39	50	53	30	41	49	51		21	31
	3.1 - 4.9 N.P.	1	1	1	1	213	1	2		1	1
	3.1 - 4.9 N.R.	1	1	1	1	1	1	1		2	1
	5 - 9.9 P	183	251	259	158	211	297	265		214	3
	5 - 9.9 N.P.	1	1	1	15	1	1	2		1	217
	5 - 9.9 N.R.	1	1	1	1	1	1	1		5	5
	10 - 14.9 P	96	124	172	11	122	222	209		197	220
	10 - 14.9 N.P.	1	1	1	127	1	1	1		1	8
	10 - 14.9 N.R.	1	1	1	1	1	1	1		1	18
	15 - 19.9 P	22	15	17	141	11	16	17		12	29
	15 - 19.9 N.P.	1	1	1	36	1	1	1		1	1
	15 - 19.9 N.R.	1	1	1	1	1	1	1		1	1
	20 - 24.9 P	51	51	51	3	26	24	28		27	1
	20 - 24.9 N.P.	1	1	1	3	1	1	1		1	112
	25 - 49.9 P	147	145	159	3	141	146	134		107	4
	25 - 49.9 N.P.	1	1	1	1	1	1	1		1	1
	25 - 49.9 N.R.	1	1	1	1	1	1	1		1	91
	50 - 99.9 P	169	175	145	1	129	130	125		97	2
	100 - 149.99	29	61	55	1	38	41	43		25	27
	150 - 199.99 P	3	2	1	1	1	2	3		1	1
	200 - 249.99 P	3	3	1	1	1	1	1		1	1
	250 - 299.99 P	1	1	1	1	1	1	1		1	1
	300 - 349.9	1	1	1	1	1	1	1		1	1
	350 - 399.9	1	1	1	1	1	1	1		1	1
	400 - 449.99	1	1	1	1	1	1	1		1	1
	450 - OVER	1	1	1	1	1	1	1		1	1
	NOT REPORTED	1	1	1	1	1	1	1		1	1
TOTAL		769	827	849	735	829	932	884		708	768
PURSE SEINE	3.1 - 4.9 P	29	35	13	17	11	9	1		1	1
	3.1 - 4.9 N.P.	1	1	2	56	1	29	1		1	1
	5 - 9.9 P	54	53	45	44	24	27	7		5	6
	5 - 9.9 N.P.	1	1	1	1	1	26	1		1	1
	5 - 9.9 N.R.	1	1	1	1	1	1	1		1	1
	10 - 14.9 P	33	54	52	22	62	20	10		7	6
	10 - 14.9 N.P.	1	1	1	27	1	64	1		1	1
	10 - 14.9 N.R.	1	1	1	1	1	1	1		1	1
	15 - 19.9 P	18	24	28	66	45	105	7		4	1
	15 - 19.9 N.P.	1	1	1	101	1	1	1		1	1
	20 - 24.9 P	20	26	29	74	32	85	13		7	9
	20 - 24.9 N.P.	1	1	1	12	1	14	1		1	1
	25 - 49.9 P	27	35	67	5	20	9	57		64	50
	25 - 49.9 N.P.	1	1	1	1	1	1	1		1	1
	25 - 49.9 N.R.	1	1	1	1	1	1	1		1	2
	50 - 99.9 P	94	92	94	1	109	4	111		103	109
	50 - 99.9 N.P.	1	1	1	1	1	1	1		1	1
	100 - 149.99	35	39	66	3	79	2	69		68	70
	150 - 199.99 P	6	6	9	57	14	4	12		14	13
	200 - 249.99 P	1	6	2	1	6	4	1		7	7
	250 - 299.9	1	1	3	1	1	4	2		2	1
	300 - 349.9	1	1	2	1	1	2	1		1	1
	350 - 399.9	1	1	2	1	1	3	1		1	1
	400 - 449.99	1	2	1	1	1	5	1		1	1
	450 - OVER	1	1	1	1	1	17	1		1	1
	NOT REPORTED	1	1	1	1	1	1	1		1	1
TOTAL		327	408	409	450	1	404	318		290	289
RINGNET	3.1 - 4.9 P	35	27	26	33	24	23	27		22	25
	3.1 - 4.9 N.P.	1	1	2	1	6	1	1		1	1
	3.1 - 4.9 N.R.	1	1	1	1	1	1	1		1	1
	5 - 9.9 P	46	21	17	55	49	56	89		72	10
	5 - 9.9 N.P.	1	1	1	2	10	11	1		1	29
	5 - 9.9 N.R.	1	1	1	1	1	1	1		11	11
	10 - 14.9 P	25	34	43	16	53	67	89		76	114
	10 - 14.9 N.P.	1	1	1	1	1	1	1		1	6
	10 - 14.9 N.R.	1	1	1	1	1	1	1		1	51
	15 - 19.9 P	6	24	22	26	45	27	33		36	3
	15 - 19.9 N.P.	1	1	1	20	1	1	1		1	1
	20 - 24.9 P	13	11	19	51	23	32	38		42	43
	20 - 24.9 N.P.	1	1	1	6	1	1	1		1	2
	25 - 49.9 P	17	17	29	1	46	85	102		110	138
	25 - 49.9 N.P.	1	1	1	1	1	1	1		1	1
	25 - 49.9 N.R.	1	1	1	1	1	1	1		1	3
	50 - 99.9 P	4	4	1	1	8	7	8		8	12
	50 - 99.9 N.R.	1	1	1	1	1	1	1		1	1
	100 - 149.99	1	1	1	1	1	1	1		1	1
	150 - 199.99 P	1	1	1	1	1	1	1		1	1
	200 - 249.99 P	1	1	1	1	1	1	2		1	1
	300 - 349.9	1	1	1	1	1	1	1		1	1
	350 - 399.9	1	1	1	1	1	1	1		1	1
	400 - 449.99	1	1	1	1	1	1	1		1	1
	450 - OVER	1	1	1	1	1	1	1		1	1
	NOT REPORTED	1	1	1	1	1	1	1		1	1
TOTAL		147	143	156	247	268	330	394		401	524

BEACH SEINE	3.1 - 4.9 P		9	7	16	5	2		14		2			
	3.1 - 4.9 N.P.		1	6	9	15	12	21	5		7			
	3.1 - 4.9 N.R.										8			
	5 - 9.9 P		13	16	18	21	7		24		2			
	5 - 9.9 N.P.		2	6	17	4	23	18	3		9			
	5 - 9.9 N.R.										22			
	10 - 14.9 P		11	8	5	2	2		2					
	10 - 14.9 N.P.		1	2	2	1	5		1					
	10 - 14.9 N.R.										2			
	15 - 19.9 P			3	5	2	1		5					
	15 - 19.9 N.P.		7											
	15 - 19.9 N.R.										1			
	20 - 24.9 P			2	1		3							
	20 - 24.9 N.P.													
	25 - 49.9 P		1	10	4	2	2		1					
	25 - 49.9 N.P.					1			2					
	25 - 49.9 N.R.													
	50 - 99.9 P			3	2		2							
	100 - 149.99													
	150 - 199.99 P													
	200 - 249.99 P													
	300 - 349.9													
	350 - 399.9													
	400 - 449.99													
	450 - OVER													
	NOT REPORTED													
TOTAL			46	63	77	56	59	39	55	0	80			
ROUND HAUL SEINE	3.1 - 4.9 P		10	12	18	24			19		3			
	3.1 - 4.9 N.P.			6	1	3	21		3		1			
	3.1 - 4.9 N.R.										9	12		
	5 - 9.9 P		12	11	14	9			11		5	1		
	5 - 9.9 N.P.			3			13		4		4			
	5 - 9.9 N.R.										5	11		
	10 - 14.9 P			2										
	10 - 14.9 N.P.										1	7		
	10 - 14.9 N.R.										2	2		
	15 - 19.9 P			1										
	15 - 19.9 N.P.													
	20 - 24.9 P													
	20 - 24.9 N.P.													
	25 - 49.9 P			2										
	25 - 49.9 N.P.													
	25 - 49.9 N.R.													
	50 - 99.9 P			1										
	100 - 149.99													
	150 - 199.99 P													
	200 - 249.99 P													
	300 - 349.9													
	350 - 399.9													
	400 - 449.99													
	450 - OVER													
	NOT REPORTED													
TOTAL			23	36	33	36	34	0	37	0	29	28		

HOOK AND LINE	3.1 - 4.9 P		3	1		2	2		5		6	4		
	3.1 - 4.9 N.P.													
	5 - 9.9 P		2	8	36	37	11	1	35		19	16		
	5 - 9.9 N.P.													
	5 - 9.9 N.R.													
	10 - 14.9 P		5		9	21	6		24		18	15		
	10 - 14.9 N.P.													
	10 - 14.9 N.R.											1		
	15 - 19.9 P		2	4	2	5	2		8		2	1		
	15 - 19.9 N.P.					11								
	20 - 24.9 P		10	3	7		3		18		7	7		
	20 - 24.9 N.P.					21								
	25 - 49.9 P		15	24	23		19		37		18	18		
	25 - 49.9 N.P.					15								
	25 - 49.9 N.R.													
	50 - 99.9 P		11	11	16		11		18		16	11		
	50 - 99.9 N.P.					2								
	100 - 149.99		2	1	1	1	5		10		2	2		
	150 - 199.99 P				1	1	1		3		2	1		
	200 - 249.99 P					1					1	1		
	250 - 299.9 P						1							
	300 - 349.9													
	350 - 399.9													
	400 - 449.99													
	450 - OVER													
	NOT REPORTED													
TOTAL			50	57	97	109	61	1	158	0	92	77		
LONG LINE	3.1 - 4.9 P							2				1		
	3.1 - 4.9 N.P.			8		8								
	5 - 9.9 P				7	5		2						
	5 - 9.9 N.P.							3						
	5 - 9.9 N.R.													
	10 - 14.9 P				4	7	2	5	1		3	4		
	10 - 14.9 N.P.					4		32						
	10 - 14.9 N.R.													
	15 - 19.9 P			1	3	36	9	11	2			3		
	15 - 19.9 N.P.					8								
	20 - 24.9 P			2	5	1	5	1	7		1	3		
	20 - 24.9 N.P.							1						
	25 - 49.9 P		2	5	8	2	29	1	58		30	45		
	25 - 49.9 N.P.					2								
	25 - 49.9 N.R.													
	50 - 99.9 P		1	3	1	3	13	7	7		6	3		
	100 - 149.99						1		1		3	1		
	150 - 199.99 P			2		1	3		1					
	200 - 249.99 P			1			1							
	250 - 249.99 P			2	1		2							
	300 - 349.9		2	1					1					
	350 - 399.9			2	2				1					
	400 - 449.99													
	450 - OVER			1			2							
	NOT REPORTED													
TOTAL			5	22	26	70	61	62	62	0	41	62		

Table 8 1987 annual [illegible] (Tonnes) [illegible]

SPECIES \ REGION	I	II	III	NCR	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
EXIGATE TUNA/BULLET TUNA	515	53	193		14851	3661	2311	2228	1983	19883	1001	1987	640	50362
YELLOW FIN/FIN EYE TUNA	190	21	4843		3312	337	391	96	298	9053	439	9036	2021	32291
SKIPJACK TUNA	400	1	2044		3213	1489	3160	254	749	7863	1130	2211	2745	26464
EASTERN LITTLE TUNA	17	-	1		1924	2576	8937	112	63	4189	266	170	384	24326
T O T A L	1920	80	7076		25300	7681	19919	3002	3017	34030	4376	13831	5790	124024

Source: BFAR Statistics

Table 9 Export of tuna by kind (MT) from 1980 - 1987

KIND OF TUNA	1980	1981	1982	1983	1984	1985	1986	1987
FROZEN/CHILLED	47,290	35,830	17,731	10,533	13,307	11,099	9,160	11,230
SMOKED	551	341	193	80				
CANNED	71	18,033	19,411	23,537	22,599	25,312	26,402	26,061
DRIED					44			
T O T A L	47,912	54,204	37,335	42,150	36,030	37,211	35,570	37,311

Table 10. Export of canned tuna (MT) by destination from 1980 - 1987

DESTINATION	1980	1981	1982	1983	1984	1985	1986	1987
Australia		294	14	385	585	137		88
Austria					46	24	61	112
Belgium		95	51	78	69	136	29	73
Canada		1,687	1,268	1,791	2,036	2,526	1,099	1,278
Denmark		145	40	15	56		114	168
Finland		243	67	165	43	46	31	163
France		141	42	143	140	103	135	79
Federal Republic of Germany	71	2,990	2,717	3,312	4,763	5,936	7,998	7,142
Greece							15	63
Israel		88	122	15	28		517	471
Japan				151		17		
Kuwait				29		19	14	
Lebanon			72	14	257	71		43
Maltao-Gozo					173	101	200	89
Mozambique						106	993	3,083
Netherlands		45	79	64	198	192	399	1,045
Puerto Rico				15		43	26	29
Sweden		69	164	463	553	327	456	317
South Africa						27		
Switzerland		140	126	168	214	99	216	197
Saudi Arabia				29				43
United Kingdom		1,327	1,368	3,049	3,050	2,348	1,981	2,146
U. S. A.		10,899	13,252	13,610	10,224	15,046	12,003	9,187
Norway							15	
Italy							34	68
Singapore							18	13
Others		70	29	43	139	4		162
T O T A L	71	18,033	19,411	23,537	22,594	25,312	26,399	26,061

Table 11. Export of frozen tuna (MT) by destination from 1980 - 1987

DESTINATION	1980	1981	1982	1983	1984	1985	1986	1987
Canada							11	1
Denmark		24	63	22		45	26	26
Hawaii	1,113	325	1,018		3	1	3	319
Israel	66	71	85		43	111	219	831
Italy	9,480	5,651	4,545	8,110	6,238	1,669		934
Japan	1,923	3,710	5,128	4,812	6,998	6,191	3,999	7,082
Hongkong							5	3
Korea	2,067						1	
Panama	120							
Puerto Rico	1,280							
Singapore	4,139	1,698		593		29	5	2
Spain		200						
Switzerland	350	533						
Taiwan								
Thailand			360			3,746	2,878	1,284
United Kingdom		45	20					
U.S.A.	26,770	23,616	6,509	4,294	103	58	190	370
Others		2	3			6	2	4
T O T A L	47,290	35,830	17,731	18,533	13,387	11,899	9,168	11,250

Table 12. Export of Tuna by Kind, Quantity, Value and Destination

	Qty. (Kgs.)	Value (Pesos)
1. Tuna, frozen (except fillets)		
Canada	1,411	48,184
USA	510,282	12,720,578
Denmark	20,000	449,812
Italy	853,758	20,091,207
Israel	831,350	17,985,906
Thailand	1,763,848	25,667,175
Singapore	1,546	69,171
Hongkong	3,231	2,915,399
Japan	7,081,512	272,790,159
Okinawa	407	46,483
Guam	1,790	70,867
Hawaii	319,392	214,250,666
Trust Territory of the Pacific Islands	1,000	22,417
TOTAL	11,249,527	571,678,564
2. Tuna, fillets - fresh or chilled		
Singapore	40	8,317
3. Tuna, prepared or preserved in airtight containers		
Canada	1,278,293	62,735,703
USA	9,186,363	236,131,396
Puerto Rico	29,164	1,042,062
Sweden	217,296	12,795,461
Finland	165,419	6,842,406
Denmark	167,886	7,912,890
United Kingdom	2,146,369	92,265,653
Netherlands	1,045,216	43,222,923
Belgium	93,103	3,489,843
France	98,763	3,322,085
West Germany	7,146,504	289,517,622
Austria	112,210	4,868,112
Switzerland	197,005	9,949,558
Malta and Gozo	88,967	3,755,634
Italy	67,868	2,872,110
Greece	62,554	2,504,471
Israel	471,480	21,912,383
Singapore	12,730	584,964
Mozambique	3,083,029	138,329,480
Barbados	13,506	627,596
Ireland	45,757	2,115,530
Cyprus	14,288	612,560
Lebanon	42,864	2,034,577
Saudi Arabia	42,864	1,831,178
Bahrain	765	52,430
Thailand	72,669	1,992,962
Australia	52,912	3,517,755
New Zealand	15,981	658,660
TOTAL	26,061,235	1,055,538,202

Table 13. No. of vessels monitored and total no. of tuna landed and sampled (98)

Sampling Site	Fishing Gear	VESSELS: Total No.	VESSELS: No. monitored	VESSELS: % monitored	LANDINGS (KG): Total wt.	LANDINGS (KG): Wt sampled	LANDINGS (KG): % sampled
RECODO	Purse Seine	200	200	100	24526499	3122710	12.73
LABUAN	Ringnet	1924	684	35.55	3094271	25644	.83
	Handline	2556	550	21.52	506007	45292	8.95
	Troll line	1799	486	27.02	315720	30213	9.57
	Multiple - Handline	1038	150	14.45	153539	13350	8.69
GEN. SANTOS CITY	Purse Seine	384	60	15.61	3633500	6761	0.19
	Ringnet	1956	236	12.07	14007328	13685	0.08
	Handline	17088	4842	28.34	4838925	129205	2.67
STA. CRUZ	Handline	420	420	100	40484	40484	100
OPOL	Ringnet	522	207	39.66	187247	6847	3.66
	Handline						
INITAO	Handline	1516	996	68.70	8576	8056	94
NAVOTAS	Purse seine	543	543	100	16957672	16957672	100

Table 14. [illegible]

Area	Item / Species	1993				1994				1995*			
		No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)	No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)	No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)
[illegible]	[illegible] Type	19	42 - 49	196	9336	76	27 - 45	132	14421	43	32 - 48	360	19421
	[illegible] Type	11	32 - 43	196	1143	17	21 - 44	132	2175	14	32 - 44	360	1954
	[illegible] Type	1	47 - 47	196	156	3	32 - 43	132	334	1	38 - 38	360	254
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	1	29 - 39	196	111	7	27 - 49	132	238	3	43 - 49	360	1873
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-

Table 15. [illegible]

Area	Item / Species	1993				1994				1995			
		No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)	No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)	No. Comp.	Size (mm)	No. Boats (Landed)	Total Catch (t)
[illegible]	[illegible] Type	21	29 - 63	329	629	24	29 - 64	494	845	36	32 - 62	1929	1742
	[illegible] Type	5	34 - 61	329	1	-	-	-	-	-	-	-	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	1	21 - 39	329	34	1	21 - 38	494	39	10	32 - 44	1929	293
	[illegible] Type	10	31 - 39	329	15	4	21 - 34	494	44	-	32 - 36	1929	439
	[illegible] Type	7	31 - 49	329	64	12	29 - 48	494	134	13	31 - 54	1929	312
	[illegible] Type	2	34 - 38	329	17	-	-	-	-	2	32 - 39	1929	47
[illegible]	[illegible] Type	36	38 - 62	264	29	44	37 - 62	316	43	43	37 - 63	2536	317
	[illegible] Type	12	37 - 63	264	44	38	34 - 64	316	34	34	42 - 64	2536	376
	[illegible] Type	2	42 - 132	264	2	2	29 - 64	316	3	3	41 - 133	2536	33
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
[illegible]	[illegible] Type	23	38 - 64	293	27	33	28 - 67	376	21	34	38 - 69	1779	199
	[illegible] Type	26	29 - 176	293	3	11	38 - 161	376	31	34	28 - 163	1779	199
	[illegible] Type	1	129	293	1	1	99 - 34	376	1	1	99 - 129	1779	2
	[illegible] Type	2	29 - 33	293	1	-	-	-	-	-	-	1	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	13	13
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	17	34
[illegible]	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	-	-	-	-	-	-	-	-	-	-	-	-
	[illegible] Type	7	34 - 39	114	1	11	31 - 54	278	1	1	29 - 37	1938	9
	[illegible] Type	41	32 - 43	114	1	36	29 - 45	278	2	29	31 - 38	1938	64
	[illegible] Type	17	31 - 42	114	1	34	29 - 48	278	3	17	32 - 52	1938	79
	[illegible] Type	11	31 - 43	114	1	21	32 - 38	278	2	1	29 - 38	1938	11

Table 16. Species Composition, Size Ranges and Total Catch of Ringnet, Handlines Landing at Opal Hill, Br. from 1985 - 1987.

Year	Species	1985 % Comp.	1985 Size Ranges	1985 No. Boats Lander	1985 Total Catch (K.T.)	1986 % Comp.	1986 Size Ranges	1986 No. Boats Lander	1986 Total Catch (K.T.)	1987 % Comp.	1987 Size Ranges	1987 No. Boats Lander	1987 Total Catch (K.T.)
Ringnet	Skipjack Tuna	2	17 - 34	176	21	18	16 - 61	563	29	12	28 - 78	522	22
	Yellowfin Tuna	2	17 - 50	176	2	14	17 - 68	563	58	11	28 - 68	522	20
	Big Eye Tuna	-		-	-	-	-	-	-	-	-	-	-
	Frigate Tuna	1	14 - 29	176	1	36	28 - 33	563	152	33	24 - 38	522	61
	Bullet Tuna	95	13 - 29	176	94	20	16 - 29	563	54	44	28 - 33	522	13
	Eastern Little Tuna	-	-	-	-	-	-	-	-	-	-	-	-
Handline	Skipjack Tuna	1	26 - 61	39	1								
	Yellowfin Tuna	95	17 - 168	39	1								
	Big Eye Tuna	-	-	-	-								
	Frigate Tuna	-	-		-								
	Bullet Tuna		-	-									
	Eastern Little Tuna	-	-	-	-								

Table 17. Species Composition, Size Ranges and Total Catch of Ringnet, Handlines Landing at Sta. Cruz from 1985 - 1987.

Year	Species	1985 % Comp.	1985 Size Ranges	1985 No. Boats Lander	1985 Total Catch (K.T.)	1986 % Comp.	1986 Size Ranges	1986 No. Boats Lander	1986 Total Catch (K.T.)	1987 % Comp.	1987 Size Ranges	1987 No. Boats Lander	1987 Total Catch (K.T.)
Ringnet	Skipjack Tuna	67	21 - 31	72	14	78	16 - 68	294	21	-	-	-	-
	Yellowfin Tuna	14	18 - 138	72	1	17	21 - 78	294	1	-	-	-	-
	Big Eye Tuna	-	-	-			-	-	-			-	-
	Frigate Tuna	7	28 - 43	72	1	4	13 - 28	294	1	-		-	-
	Bullet Tuna	7	17 - 29	72	1	1	14 - 29	294	1	-			-
	Eastern Little Tuna	-	-				-	-	-		-	-	-
Handline	Skipjack Tuna	4	33 - 66	131	1	1	31 - 67	630	1	1	33 - 68	429	1
	Yellowfin Tuna	96	22 - 166	131	18	98	31 - 167	630	56	99	51 - 111	429	66
	Big Eye Tuna	-	-		-	1	129 - 14	630	1	-	-	-	-
	Frigate Tuna	-		-				-		-		-	-
	Bullet Tuna	-		-		-	-	-	-	-	-	-	-
	Eastern Little Tuna	-	-	-			-	-	-	-	-	-	-

Table 18. Species Composition, Size Ranges and Total Catch of Ringed handline Purse seiner landing at General Santos from 1985 - 199

GEAR	YEAR	1985					1986					1987				
	SPECIES	% COMP	SIZE RANGES	(NO.BOATS) LANDED	TOTAL CATCH (MT)	% COMP	SIZE RANGES	(NO.BOATS) LANDED	TOTAL CATCH (MT)	% COMP	SIZE RANGES	(NO.BOATS) LANDED	TOTAL CATCH (MT)
PURSE	SKIPJACK TUNA	68	37 - 77	508	1486	53	34 - 69	577	4459	6	39 - 57	195a	5648
	YELLOWFIN TUNA	24	35 - 47	508	674	29	32 - 63	577	757	5	41 - 54	195a	4338
	BIG EYE TUNA	3	20 - 47	508	54	1	19 - 49	577	131	1	22 - 54	195a	84a
	FRIGATE TUNA	6	14 - 27	508	186	13	13 - 33	577	1572	3	17 - 27	195a	1291
	BULLET TUNA	1	27 - 34	508	22	1	23 - 34	577	174	1	25 - 33	195a	243a
	EASTERN LITTLE TUNA	2	26 - 34	508	54	2	21 - 33	577	226	1	28 - 34	195a	176
HANDLINE	SKIPJACK TUNA	-	-	-	-	-	-	-	-	-	-	-	-
	YELLOWFIN TUNA	95	21 - 153	1677	772	97	19 - 152	1677	7747	98	16 - 149	58	4934
	BIG EYE TUNA	2	29 - 175	1677	14	1	23 - 87	1677	44	-	-	49	16
	FRIGATE TUNA	-	-	-	-	-	-	-	-	-	-	-	-
	BULLET TUNA	-	-	-	-	-	-	-	-	-	-	-	-
	EASTERN LITTLE TUNA	-	-	-	-	-	-	-	-	-	-	-	-
PURSE SEINE	SKIPJACK TUNA	60	19 - 49	467	1377	49	18 - 51	384	1633
	YELLOWFIN TUNA	33	24 - 48	467	971	32	24 - 104	384	845
	BIG EYE TUNA	1	39 - 79	467	27	1	37 - 58	384	25
	FRIGATE TUNA	6	16 - 37	467	348	14	25 - 34	384	684
	BULLET TUNA	1	30 - 34	467	44	1	30 - 37	384	41a
	EASTERN LITTLE TUNA	1	27 - 34	467	28	1	26 - 37	384	19

Table 19. Catch and catch rate of Tunas caught by different gear per area (.MT

Sampling Site	Fishing Gear	Total No. of Vessels	Total Catch MT	Catch Rate MT/vessel
REGION	Purse Seine	394	2402644**	1224/2.5
	Ringnet	1431	2243277	1.5 - 1.57
	Handline	2224	744000	1.4 - 3
[illegible]	Troll Line	1743	213722	.75.2
	Multiple Handline	1376	157773	197.4,
SEA SURFACE CITY	Purse seine	387	2612506	1962.24
	Ringnet	1431	1444 7525	1a1.21
	Hand line	12083	4520922	251.16
CITY ZONE	Handline	47.	64464	9[illegible].59
[illegible]	Ringnet	32.	18774	76*.2,
	Handline	1201	857*	1 **
[illegible]	Purse seine	387	1[illegible]72	[illegible].25

STUDIES ON THE TUNA RESOURCES IN

THE GULF OF THAILAND

by

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Introduction

Catches of coastal tuna supporting major fisheries in parts of the Gulf of Thailand, have increased year by year, but little is known concerning the details of coastal tuna distribution and life history as well as the situation of stocks. It is stated that they are generally found throughout the Gulf of Thailand and adjacent waters, but the relationship among them is still unknown. However, it seems that the situation of tuna fishery in the Gulf of Thailand has reached the overf fishing stage. Thus, it is important to examine the dynamicsof the fisheries to determine man's effect on the abundance of the stocks, and to manage the tuna fisheries efficiently.

Before an assesment of the potential yield and some activities can be made or the abundance at any particular time be predicted. It will be necessary to collect all existing data concerning the tuna fisheries in this area which might lead to estimate of population dynamics mentioned above. It is the purpose of the author to examine critically the information received from the sampling program and the statistical section of the Department of Fisheries. Unfortunately, since insufficient of time the little information can be sorted. However, having more than ten year data, the Schaefer's model was then used to estimate the maximum sustainable yield.

The tuna fishery

The tuna fishery in the Gulf of Thailand Fig 1 was supposed to begin when the coastal tuna were first captured incidentally by drift gill netters in 1925. But the main target species that time was not tuna until a rapidly expanding market of tuna species for cannings led to the change in tuna fishery by means of target species from 1978.

At present, most tuna species captured in the Gulf of Thailand are taken by gill netting and purse seining.

Number of the drift gill net has been varied rather steady until 1979, the number had risen to 301 boats in 1981 (Table 1) and droped down a little in later period, since the target of species was change to squid purpose. However, it is indicated that the number of this gear tend to increase from 1984.

Regarding the purse seine fishery, schools of tuna are located visually and encircled with a large net, then the bottom of the net form as a big purse and the volume of the purse decreases when the net is pulled aboard the vessel. By the method described, the luring purse seine which required the use of coconut leaves to attract and capture some pelagic fishes.are commonly operated in forms of purse seine searching for fish school during the sailing to the destination of luring places.Therefore it is inseparable between luring purse seine and thai purse seine, then the number of these two gears are combined as the purse seine from 1984. This remarkable change in gear can be appreciated by examination of Fig. 2

As the demand for tuna of canning industries has increased every year and being aroused by the good price, the fishermen have tried to catch as much quantity as possible by the improvement of gear used and method. By the way, the important development of gear efficiancy by installation of electronics equipments were introduced and among those equipments sonar is the most popular for purse seiner from 1982.

The production

The coastal tuna is a pelagic species as widely distributed throughout the tropical waters, there are three species occur in the Gulf of Thailand, namely, longtail tuna (Thunnus tonggol) kawa kawa (Euthynus affinis) and frigate tuna (Auxis thazard). To illustrate the magaitude of the fisheries for coastal tuna in this area, the three species were grouped. The total landings for all species fluctuated from 6,519 ton to 90,384 ton (Fig.3). It should be pointed out, however, that the production of tuna in 1987 as indicated by the statistics was probably overestimated. It may happen that because some of the vessels which were operated out of the Gulf were combined.

The total landings of tuna are probably made by mackerel drift gill nets and some small fishing gears. It is noted in Table 2. what the proportion they made up of the total landings.

Monthly changes in catches from the purse seine fishery and drift gill net fishery from 1985-87 are observed. Fig 4 catches from drift gill net fishery showed almost identical fluctuations. While, from purse seine fishery the two peaks of good catches were identified.

Species composition

When catches of tuna are investigated , it is often constitute of the three species, particularly the mixed schools of kawa kawa and frigate tuna are so common. To examine the combinations of tuna, the past three year data from 1985 were used. But, due to the catch statistics have been recorded as LOT for longtail tuna and TUN for kawa kawa combine with frigate tuna, Fig. 5, the monthly percentage compositions were plotted. The plot of combine gear seems to be the widely difference between the percentage of catch of the two groups for five month after that the combinations are about equal for three to four month, then showing the difference alternatively. Moreover, the combination by each gear indicated that the dissimilarily of the two groups appeared in the purse seine fishery.

Owing to the assistence from IPTP to conduct the sampling program in 1987. The tuna landings were classified as it occur in the catch which comprised of 36.85 % of longtail tuna, 44.31 % of kawa kawa and 18.84 % of frigate tuna. The monthly species composition data are available from purse seine and drift gill net vessels. Fig 6, the percentages of longtail tuna caught by gill net were not so good as kawa kawa and frigate tuna.

Trend in CPUE from fisheries

In this paper, the description of stock density from purse seine fishery and drift gill net fishery were examined. The available statistics for this study had been collected by the statistial section of the Department of fisheries from 1979 - 1986. The last year data, 1987 were obtained by the sampling program. Though tuna caught by some other gears as mackerel encircling gill net and some small fishing gear occur in municipal fisheries, the CPUE values from these vessels were not representative of the abundance of tuna. Since the main target species of these vessels are indian mackerel,indo-pacific mackerel and some small demersal fishes. Therefore, the purse seine and drift gill net fishing were investigated (Table 3). It would be ideal to compare the monthly CPUE of these two gears, unfortunately the data are not readily available.

Annual trends in CPUE from purse seine and drift gill net fisheries were illustrated in Fig. 7 . It indicated that the abundance of tuna species tend to increase from 1981, except for the CUPE of LOT from drift gill net in 1987.

Fig. 8 showed the monthly average values of CPUE from both fisheries. There was much less variations in abundance of the two species form gill net fishery than the purse seine fishery.

Furthermore, the abundance for purse seine fishery was very low from the begining of the year, then rised rapidly to a peak in September and December for TUN and LOT respectively.

Again, the 1987 data alone were examined in Fig 9 with the details of three species break down, LOT for longtail tuna,

KAW for kawa kawa and FRI for frigate tuna. It appeared in the abundance from gill net fishery that the values for May to October were nearly identical.

Yields from the fisheries

In view of the information available on the coastal tuna exploited in the Gulf of Thailand, It is apparently that the typical fishery for tuna is a multispecies fishery. By this reason, all the amounts of tuna captured in the Gulf of Thailand combined on the yearly basis from 1973-87. The sources of data mainly used were from the statistical section. The last year data used of 1987 were from the sampling program.

Assumming that the tuna population throughout the Gulf of Thailand were considered as a single stock, the maximum sustainable yield (MSY) was estimated by the Schaefer s model. Table 4 showed the converted effort in terms of purse seine units. Fig 10 the relationship between abundance and estimated effort was shown for 1973 to 1987. There was not apparent relationship between the two values during the period 1973-1978. It may be concluded that for the time mentioned, tuna species were by catch. The relationship from 1978 seemed to vary greatly, as effort was decreased the abundance then increased. The estimations of MSY and optimum effort were as follows :

C/F = 576.7114 - 0.001016 F (r = 0.67)

MSY = 31,340 ton

Optimum effort = 283,315 days.

where C/F = catch per unit of effort (kg./day)

F = standard fishing effort (day)

In addition, when considered deeply into the details of tuna statistics during 1979 - 1987, the Schaefer's model was then tried to evaluate the MSY for longtail tuna (LOT) as well as the combination of kawa kawa and frigate tuna (TUN). It was also using the assumption of single stock in this area to achieve the estimation of yield for each species. Table 5 and Fig. 11 the result for LOT were as follow:

C/F = 517.7794 - .001486 F (r = .88)

MSY = 45119 ton

Optimum effort = 174,278 days

In table 6 and Fig 12 combined data of kawa kawa and frigate tuna were available. The calculation gave the result as follow:

C/F = 506.51196 - .001551 F (r = .88)

MSY = 41349 ton

Optimum effort = 163,268 days

where C/F = catch/day

F = standard fishing effort (kg./day)

It is important to note that of the two vales of MSY for LOT and TUN. If the investigation make by adding together, which is about 86,468 MT, then compare with the MSY of all tuna obtained from data in Table 4. It is about 5000 MT over than the all tuna MSY. The reason for the difference may be that the all tuna MSY is based on the long period data which include effort direct to other species in the previous year, when tuna was not the main target species. Anyhow, it may conclude that the catch has exceeded the maximum level.

Table 1 Number of fishing vessels registered by types of gear and sizes of boat in the Gulf of Thailand 1979 - 1986

Size of boat (m)	1979	1980	1981	1982	1983	1984	1985	1986
Drift gill net	203	272	301	250	234	243	256	297
- 14	62	86	53	47	40	50	45	37
14 - 18	112	142	166	148	134	116	135	148
18 - 25	29	44	82	55	60	76	75	106
25 -	-	-	-	-	-	-	-	6
Thai purse seine	64	103	40	42	40	363	448	414
- 14	36	40	9	21	20	26	27	18
14 - 18	28	51	28	19	17	116	144	98
18 - 25	-	12	3	2	3	218	270	285
25 -	-	-	-	-	-	3	7	13
Luring purse seine	480	506	603	589	556	265	218	258
- 14	67	59	75	59	42	25	18	27
14 - 18	138	150	189	154	124	34	33	42
18 - 25	275	294	331	369	377	200	162	187
25 -	-	3	8	7	13	6	5	2
Mackerel encircling gill net	355	305	257	227	141	167	210	191
- 14	217	174	125	103	36	87	113	106
14 - 18	101	73	76	70	57	40	48	41
18 - 25	37	58	56	54	48	40	49	44
25 -	-	-	-	-	-	-	-	-

Source : Fisheries record of Thailand, 1979 - 1986, Department of Fisheries.

Table 2 Percentage of Tuna catch by major fishing gear in the Gulf of Thailand, 1973 - 1987.

Year	Total catch		Drift gill net	Thai purse seine	Luring purse seine	Mackerel encircling gill net	others
	MT	%					
1973	6,519	100	44.2	33.6	7.8	3.7	10.7
1974	8,715	100	20.4	44.9	4.6	7.2	22.9
1975	11,172	100	23.6	36.9	8.8	2.0	28.7
1976	8,890	100	26.8	37.4	10.9	7.9	17.0
1977	11,296	100	41.5	21.4	31.2	4.9	1.0
1978	8,258	100	34.8	28.5	17.5	5.1	14.1
1979	14,713	100	29.4	4.2	47.1	9.8	9.5
1980	12,895	100	44.4	16.7	31.6	4.4	2.9
1981	20,198	100	55.5	5.1	37.9	0.1	1.4
1982	39,661	100	48.9	3.1	42.6	4.7	0.7
1983	82,001	100	16.0	0.3	81.8	1.7	0.2
1984	69,213	100	26.4	70.3[a]		3.1	0.2
1985	81,234	100	23.0	74.8		2.1	0.1
1986	90,384	100	18.8	78.5		2.5	0.2
1987	41,550[b]	100	31.3	68.7		-	-

a. Combined percentage of catch by LPS and TPS.

b. Raised to total from data available for the eight month of May - Dec.

Table 3 Catch in MT, days in fishing and CPUE in kg/day of tuna by purse-seine net and drift gill net 1979 - 1987

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987*
Purse seine net									
LOT	5,189	2,901	3,639	4,174	43,766	30,455	37,973	38,819	9,402
TUN	1,701	1,174	4,020	12,739	23,269	18,203	22,785	31,915	9,566
Days	99,101	93,985	119,133	105,211	113,335	143,239	122,040	164,146	16,071
CPUE LOT	52.4	30.9	30.5	39.7	386.2	212.6	311.2	236.5	585.0
CPUE TUN	17.2	12.5	33.7	121.1	205.3	127.1	186.7	194.4	595.2
Drift gill net									
LOT	2,336	3,108	5,640	10,008	5,711	6,965	7,329	7,122	896
TUN	1,988	2,615	5,578	9,202	7,394	11,300	11,369	9,832	7,327
Days	32,926	35,515	41,244	39,669	45,251	47,457	43,974	58,609	36,422
CPUE LOT	71.0	87.5	136.8	252.3	126.2	146.8	167.0	126.7	24.6
CPUE TUN	60.4	73.6	136.2	232.0	163.4	238.1	259.1	173.7	216.3

* data not available from Jan - Apr

Table 4 Catches, fishing effort and estimates of CPUE for tuna in the Gulf of Thailand, (purse seine units) : 1973 - 87

Year	Catch (Ton)	Effort (day)	CPUE (kg./day)	Total C (Ton)	estimated effort (day)
1973	509	23,073	22.1	6,519	295,507
1974	403	30,871	13.1	8,715	667,595
1975	984	38,302	25.7	11,172	434,868
1976	966	70,096	13.8	8,890	645,086
1977	3,520	126,582	27.8	11,296	406,213
1978	1,444	141,747	10.2	8,258	810,628
1979	6,890	99,101	69.5	14,713	211,622
1980	4,075	93,985	43.4	12,895	297,408
1981	7,659	119,133	64.3	20,198	314,173
1982	16,913	105,211	160.8	39,661	246,720
1983	67,033	113,335	591.5	82,001	138,642
1984	43,658	143,239	339.7	69,213	203,749
1985	60,758	122,040	497.9	81,234	163,169
1986	70,734	164,146	430.9	90,384	229,746
1987	18,967	16,071	1,180.2	41,550	35,206

Table 5 Catches, fishing effort and estimates of CPUE for LOT* in the Gulf of Thailand, (purse seine units): 1979 - 87

Year	Catch (Ton)	Effort (day)	CPUE (kg./day)	Total LOT	estimated effort day
1979	5,189	99,101	52.4	100,583	202,117
1980	2,861	93,985	30.9	7,962	257,949
1981	3,699	119,133	30.5	9,956	326,863
1982	4,174	105,211	39.7	16,306	411,014
1983	43,769	113,335	386.2	58,451	130,540
1984	30,455	143,239	212.6	38,470	180,935
1985	37,973	122,040	311.2	45,340	145,717
1986	38,819	164,146	236.5	43,403	196,238
1987	9,402	16,071	585.0	10,299	17,450

Note * Longtail tuna

Table 6 Catches, fishing effort and estimates of CPUE for TUN* in the Gulf of Thailand, (purse seine units): 1979 - 87

Year	Catch (Ton)	Effort (day)	CPUE (kg/day)	Total LOT	estimated effort day
1979	1,701	99,101	17.7	4,130	210,616
1980	1,174	93,985	12.5	4,933	394,913
1981	4,020	119,133	33.7	10,240	303,463
1982	12,739	105,211	121.1	23,355	192,888
1983	23,267	113,335	205.3	31,550	153,682
1984	18,203	143,239	127.1	30,999	243,930
1985	22,785	122,040	186.7	35,626	190,818
1986	31,915	164,146	194.4	43,976	226,178
1987	9,566	16,071	595.2	17,493	29,389

Note * Kawa kawa and frigate tuna combined

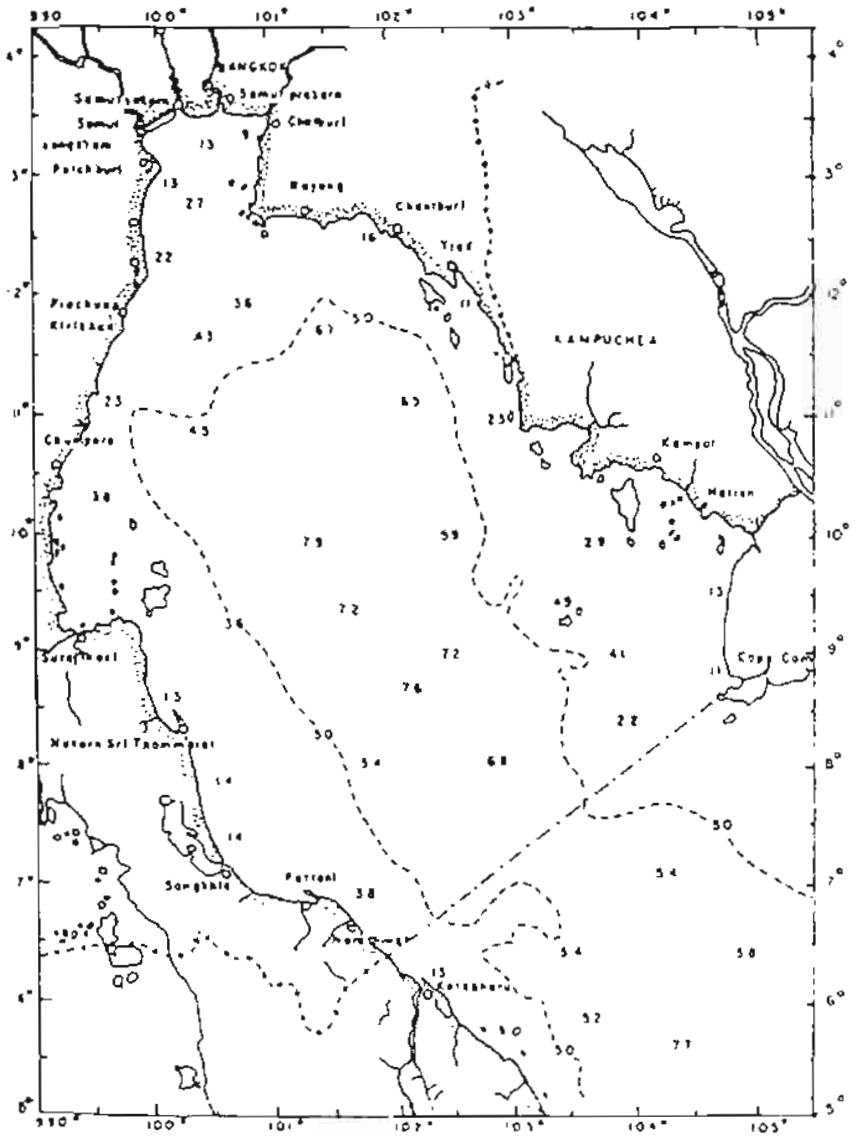

Fig 1 The Gulf of Thailand

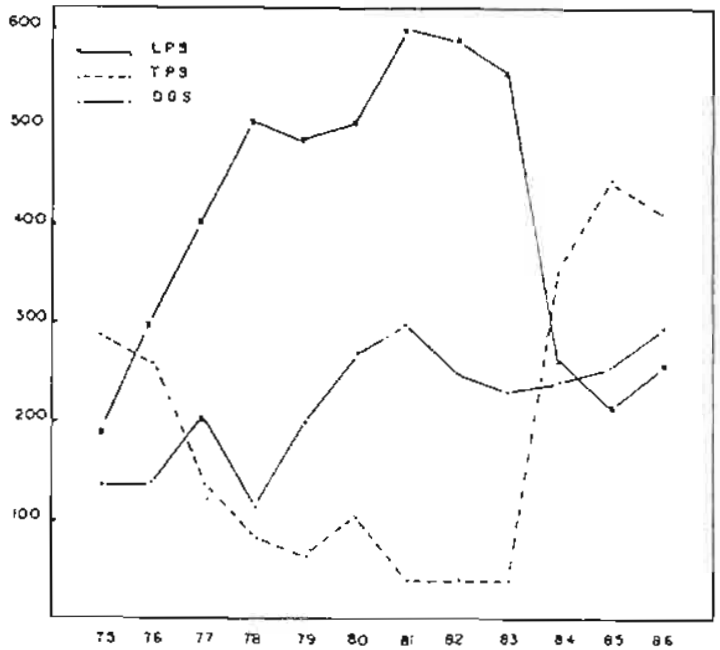

Fig 2 Variations of fishing boats registered in the Gulf of Thailand, 1975 - 1986

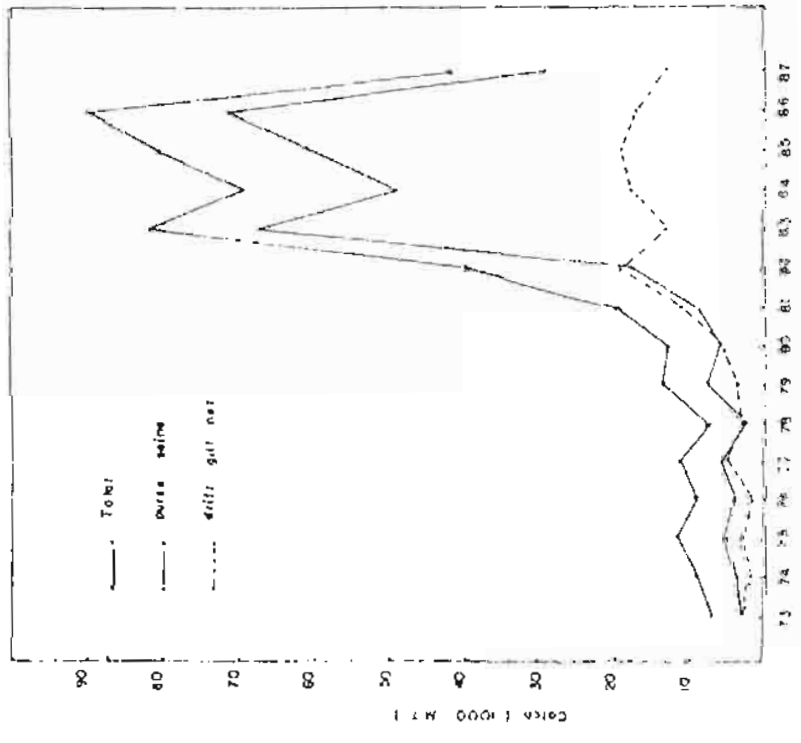

Fig 3 Annual catch of types by major types of fishing gears in the Gulf of Thailand 1973 - 1987

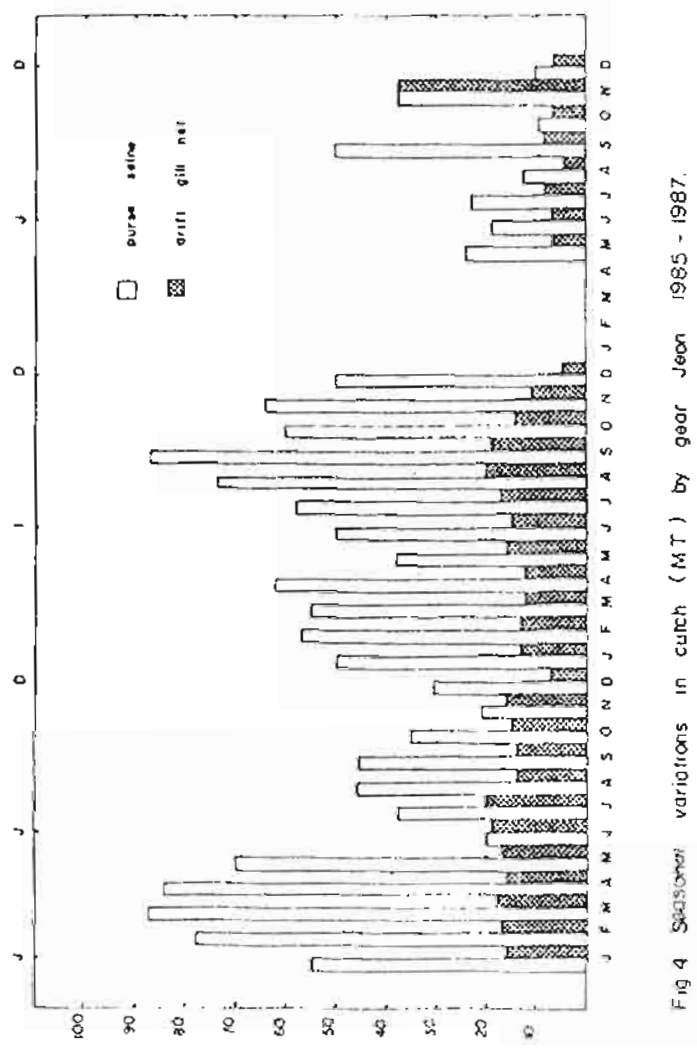

Fig 4 Seasonal variations in catch (M T) by gear Jean 1985 - 1987.

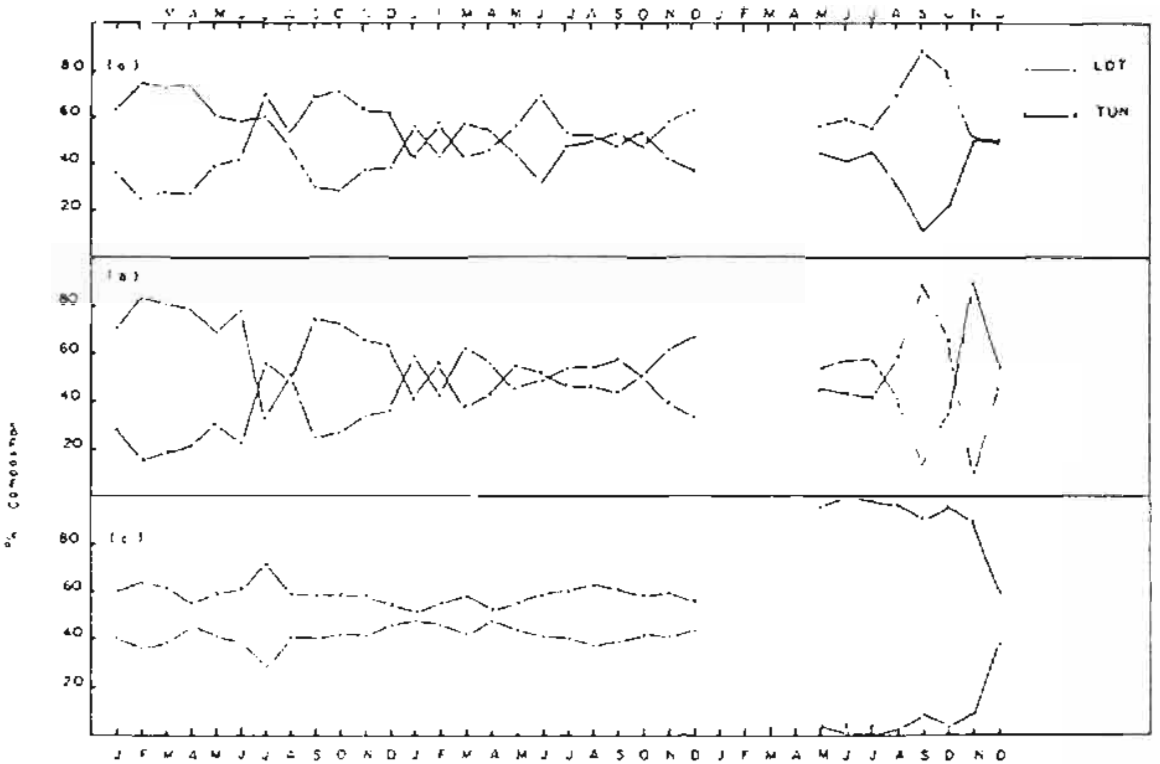

Fig 5 Change in species compositions of tuna in the Gulf of Thailand 1985 – 1987

panel a : showing the composition by all fishing gears

panel b : showing the composition by purse seiners

panel c : showing the composition by gill netters

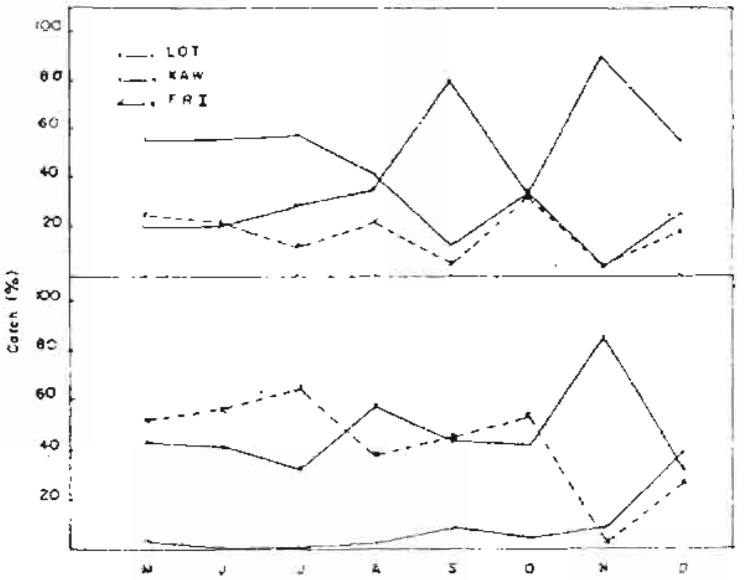

Fig 6 Monthly changes in compositions of tuna species from the Gulf of Thailand in 1987 (upper panel from purse seine fishery, lower panel from drift gill net fishery)

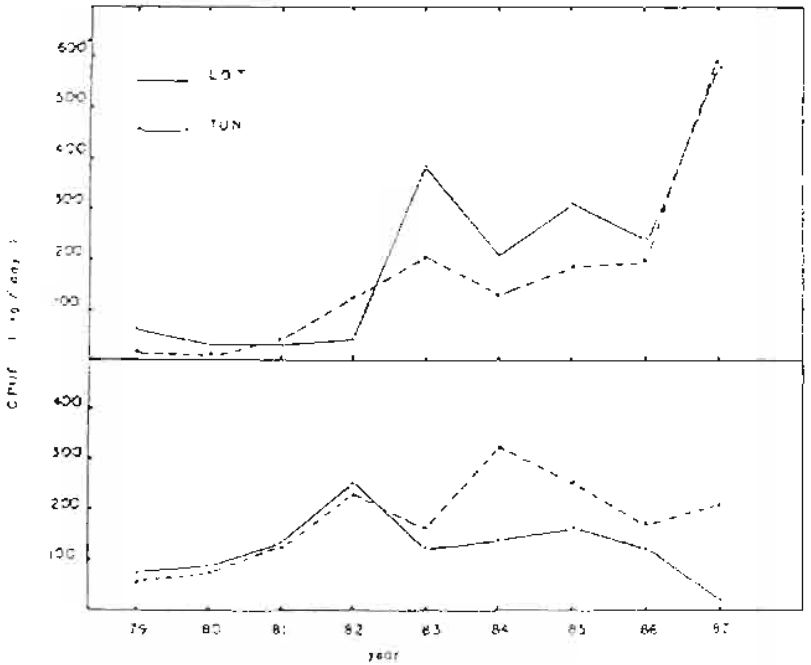

Fig 7 Annual changes in CPUE of longtail tuna (LOT) and Eastern tuna (TUN) from purse seine fishery (upper panel) and drift gill net fishery (lower panel) in the Gulf of Thailand

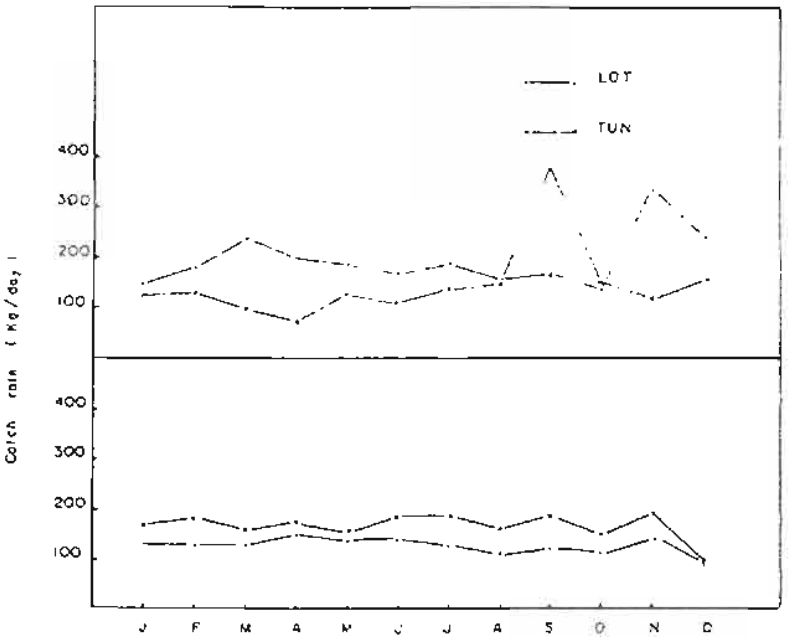

Fig 8 Average monthly catch rate (kg / day) of tuna in the Gulf of Thailand from purse seine fishery (upper panel) and drift gill net fishery (lower panel) 1979 - 1987

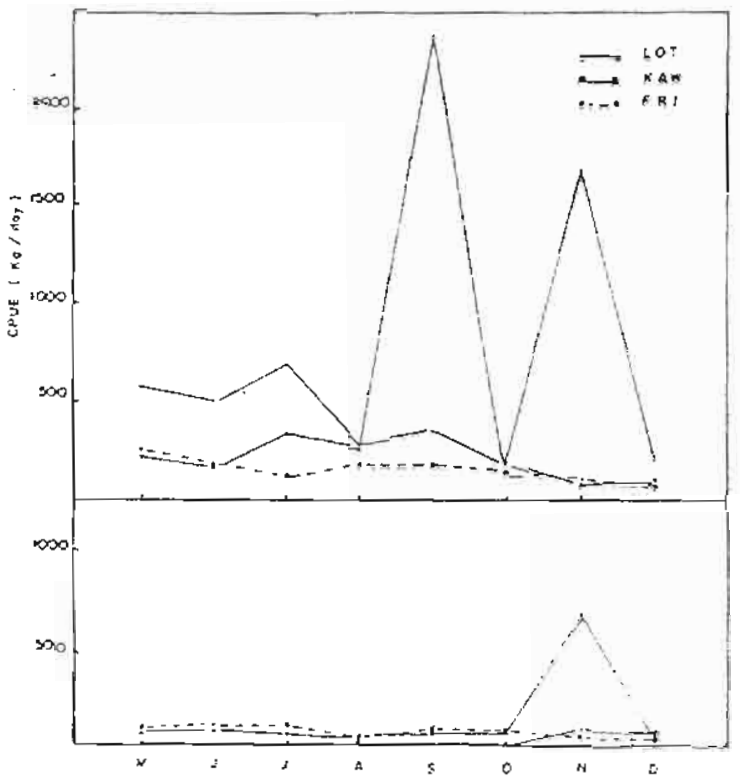

Fig 9 Trends in CPUE of Tunc species from the Gulf of Thailand in 1987 by purse seiner (upper panel) and drift gill netter (Lower panel)

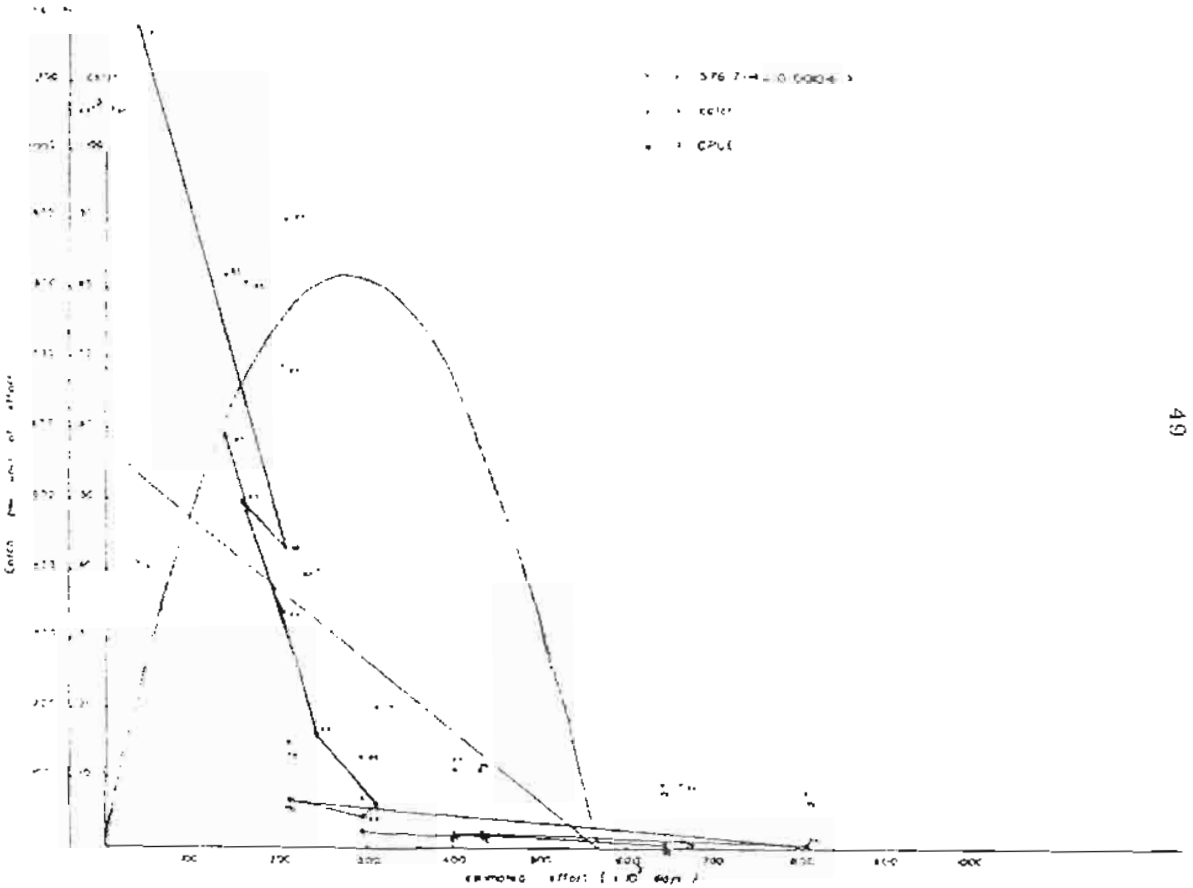

Fig 10 Relationship between fishing effort (purse seine units) and CPUE for tuna in the Gulf of Thailand and estimated equilibrium yields, 1978 - 87.

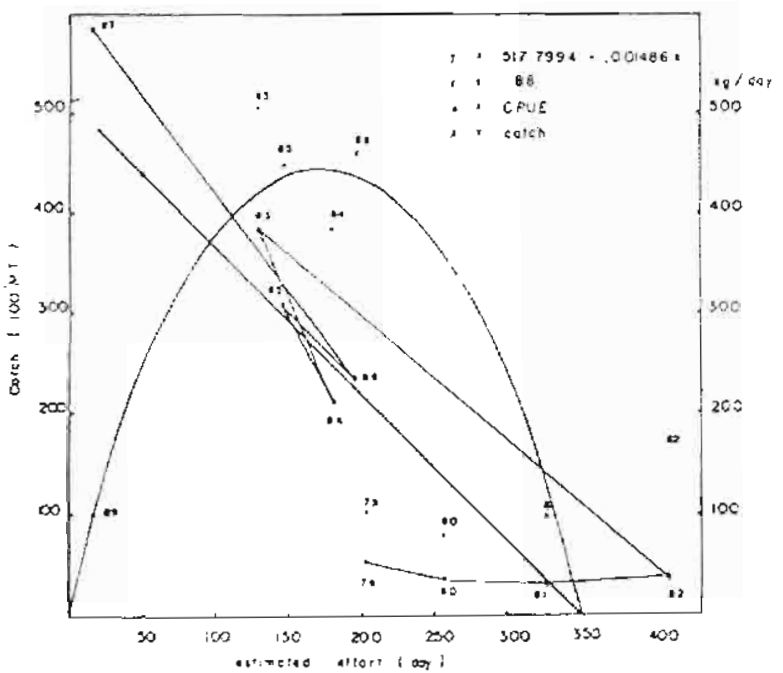

Fig. 11 Catches and CPUE plotted against estimated fishing effort for longtail tuna (LOT), 1979 - 1987

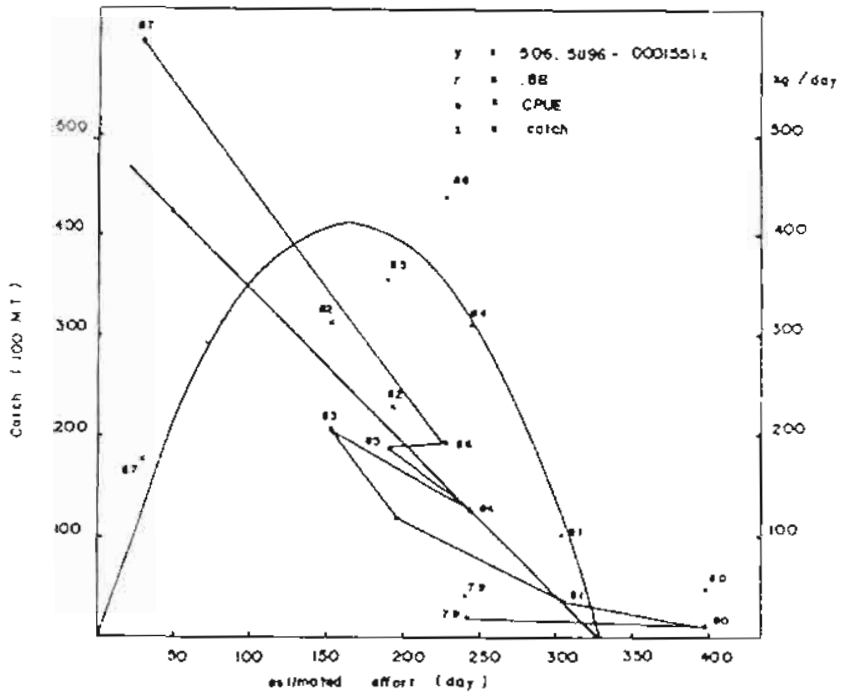

Fig. 12 Catches and CPUE plotted against estimated fishing effort for kawa kawa and frigate tuna combined (TUN), 1987

Country report

On

Tuna fisheries and resources in the west coast of Thailand,

Andaman Sea.

By

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Phuket Marine Fisheries Station

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Paper presented in the 2nd Southeast Asian tuna conference and the 3rd meeting of tuna research groups in the Southeast Asian region. Penang, Malaysia

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ABSTRACT

Small tuna in the west coast of Thailand has played the important role since 5 - 6 years ago, because of the corresponding growth in demand of tuna canneries. As demand has grown the price of small tunas has also risen. Small tunas are mainly exploited by purse seines (Thai, Chinese, light luring and tuna purse seines). This fishery contributed approximately 97 % in the total landing of small tunas from all gear types during 1985-1987. The rapid growth in small tunas catch has continued to this day, it increased from 2,880 tons in 1983 to 13,240 tons in 1987 and were accounted for 4.4 % and 12.1 % in the total pelagic landings in the mentioned year respectively. The catch rate of small tunas were observed to be increased during 1985-1987

Small tuna caught in this area during 1985-1987 comprised of 46.7 % frigate tuna (Auxis thazard), 38,4 % eastern little tuna (Euthynnus affinis) and 14.0 % longtail tuna (Thunnus tonggol). Only few production of skipjack tuna (Katsuwonus pelamis)was incidentally caught by tuna purse seine and light luring purse. The biological parameters were also studied and have been summarized.

Tuna fisheries and resources in the west coast of Thailand

Andaman Sea

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Introduction

Small tunas in the west coast Thailand, Andaman Sea became the significant species in the pelagic fisheries in recent years due to the demand for tuna canneries was steadily growing. As demand has grown the price of small tunas has also risen. Small tunas landed on the west coast of Thailand contributed only 2,380 tons or was accounted to be 4.4 % in the total pelagic fish landed in 1983, but it increased to 13,250 tons or was accounted to be 12.1 % in the total pelagic fish landed in 1987 as shown in Table 1, and Fig. 1.

The purpose of this paper is to review and discuss on the available information of tuna fisheries and resources on the west coast of Thailand. Especially, the data have been collected by the staff Phuket Marine Fisheries Station during the years 1985-1987.

The development of tuna fisheries

A distinct development of pelagic fisheries in the west coast of Thailand have been observed since 1973 when luring techniques were modified by using FADs (Fish Aggregating Devices) and kerosene lamp by day and night. Until 1982, the luring technique at night has been well developed by equipped generator on board and became the popular fish gear for mixed species such as chub mackerels, scads, hardtails, king mackerels and small tunas. Purse seining for tuna was introduced during 1985-1986. Some mackerel purse seiners operate with tuna as the target species, some larger vessels operate larger purse seine nets with a larger mesh size than in the mackerel nets.

Generally, there are about 200-220 purse seiners operate along the West coast of Thailand. This amount consisted of regular purse seines (Thai purse seine, Chinese purse seine and tuna purse seine) and ligth luring purse seines. The principle for light luring purse seine is set the net after using light attraction, in addition, it can operate as Thai purse seine method by searching the fish school and operate while sailing to the destination of luring place. As a result, estimation of realistic effort values has become problematic. Over all view, purse seine fishery contributed catches of small tunas approximately 96.7 % in the total landing of small tunas caught by all gears through out the period 1985-1987. In such that high percentage 66.2 % provided by light luring purse seine and 30.5 % by the regular purse seine. (Table 2)

Generally, purse seine at size class 18-22 meter in boat length was the most poppular during 1985-1987. The common mesh size used in Thai and light luring purse seine is approximately 2.5 cm while the length and depth of the seine within range of 300-1100 m and 50-130 m respectively. The other size of purse seine only used for Thai purse seine are 450-1200 m in length, 60-140 m in depth and 3.8 cm mesh size.

Regarding to tuna purse seine, there are about 10 seiners have been modified as tuna purse seine during 1965-1966. Among them 7 seiners at size class 14-18 m. in boat length with the net of 100/600 m. and 7.6 cm mesh size. The rest are more than 24 m. in boat length with the net of 170/1400 m. and 9.4 cm. mesh size. However, these 7 smaller seiners have been modified as light luring purse seine again in 1987, due to the limitation of small tunas occurence only 5-6 months a year while the light luring fishery can operate all year round. The rests of 3 tuna seiners are still operate as tuna purse seine, operated mostly in Northeast Monsoon (from November to May) in the further offshore.

The number of purse seiners operated along the West coast of Thailand by excluding to light luring and regular purse seines are shown in Table 3.

Tuna species available

Observation made by the staff of Phuket Marine Fisheries Station as shown in Table 4 and Fig 2, small tunas in the west coast of Thailand, comprised of three species namely, eastern little tuna (Euthynnus affinis), frigate tuna (Auxis thazard) and longtail tuna (Thunnus tonggol), its share about 36.4 %, 47.6 % and 14.0 % respectively from the total production of small tunas in the period 1985-1987. Besides these three species, skipjack tuna (Katsuwonus pelamis) is sometime found in landing sites in a few production from tuna purse seine and light luring purse seine.

Fishing ground

The fishing ground of small tunas spread along the coast. The important fishing areas where effective gears, purse seines are commonly operated normally within the range 3-45 km. from shore, the depth range from 30-100 m. as shown in Fig. 3. Fishing grounds for frigate and eastern little tuna are located off Surin Island and Similan Islands in the upper part, pee-pee Islands and the area between Trang-Satul province in the lower part. For longtail tuna, it was not clear for specific the fishing ground. This information was obtained from the interviewing of master fisherman during the sampling survey along the coast in the period 1986-1987. However, the evidence of these 3 species have been observed to be shifted year by year.

Landing sites

There are seven major landing from the north to the south along the west coast of Thailand, four landing sites (Ranong, Kuraburi, Taimuang and Phuket) in the upper part and three landing sites in the lower part (Krabi, Trang and Satul). Small tunas landing are substantial in the lower part of the coast during 1979-1982 but since 1983, the abundance has been shifted to the upper part of the coast as shown in Table 4.

Seasonality

Small tunas the west coast of Thailand are caught incidentally all year round as shown in Table 5. The monthly catch during 1985-1987,

for coastal tunas showed higher catch between December-May but for longtail tuna does not well defind, probably due to longtail tuna distributed more abundantly out of the intensive fishing ground for purse seines. Nevertheless, it is indicated that the catch of small tunas were attributed to higher during the Northeast Monsoon (November to April) than the Southwest Monsoon

Size Composition

In the period 1985-1987, the recruitment of frigate and eastern little tuna are occure at minimum length 9.0 cm. (round March to April) and June while modes in the size of frigate and eastern little tuna are 28.5-32.5 cm (range 9.0-48.0 cm.) and 25.5-34.5 cm. (range 9.0-58.0 cm.) respectively. Hence for longtail tuna, it's recruitment appear to enter the fishery at minimum length of 11.0 cm. in first and modes in the size are 34.5-38.5 cm. 33.5-49.5 cm. (range 11.0-49.5 cm.) as a result, it should be noted that recruitment for three species of small tuna are occure to enter the fishery in the same period around March to April.

Regarding to the size, mean fork length in cm. for three species of small tunas caught by light luring purse seine and regular purse seine (Thai, Chinese and tuna purse seines) during 1984-1987, its has been observed that the mean size of three species of small tunas caught by light luring purse seine appeared to be smaller than caught by regular purse seine in almost years as shown in Fig 4. For the mean length of each tuna species by year and type of purse seines during 1984-1987 showed fluctuate year by year, except the mean length of eastern little tuna from regular purse seine showed increasing trend. The mean length of longtail tuna and eastern little tuna caught by regular purse seine are increased abruptly in 1985 and 1987, in this case may be dued to the new fishing ground for regular purse seine where located westward of Adang Islands of Satul Province in the lower part of the coast which almost of longtail tuna and eastern little tuna caught were in medium and big size, it effected to increasing mean length abruptly in 1985. In the case of 1987, due to the large size of regular purse seine begin to operate more concentrate in the further offshore where longtail and eastern little tuna more abundance and occurred in bigger size than in continental shelf area, it effected to increasing the mean length abruptly in 1987 too.

Catch, catch rate and effort

As mentioned earlier that small tunas for three species (kawakawa, frigate and longtail tuna) on the west coast of Thailand are mainly exploited by purse seines, the items of catch, catch rate and effort of small tunas caught by purse seines during the period 1985 - 1987 are thus categorised into coastal tunas (kawakawa and frigate tuna combined) and longtail tuna as given in Table 6 (A, B and C).

Catch and catch rate by purse seines (regular and light luring purse seines combined) for coastal tunas increased from 3240.5 tons and 0.76 tons per day in 1985 to 11427.4 tons and 0.270 tons per day in 1987. For longtail tuna, catch and catch rate were observed to be fluctuated. However, when considering the three tuna species combined, the catch and catch rate showed an increasing trend during 1985 - 1987 with and abruptly high peak occurred in 1987.

Regarding to different types of purse seines, it was observed that the catch and catch rate of longtail tuna by regular purse seines were higher than by light luring purse seine in almost years. As for the coastal tunas, the catch and catch rate in 1987 increased abruptly by light luring purse seine and were higher than by regular purse seines. For the three tuna species combined, the catch and catch rate by light luring purse seine showed an increasing trend year by year in comparison to a fluctuation in almost years by regular purse seines.

The trend of seasonal variation in catch and catch rate of the three tuna species combined during 1985 - 1987 are demonstrated in Figs 5 and 6. Mostly high catch and high catch rate occur in the same pattern by almost years in December to May, and show the highest trend in April.

Seasonal variation in catch and catch rate of coastal tunas by purse seines (regular and light luring purse seines combined) are shown in Figs 7 and 8. The results show high catch and catch rate occur in the same pattern by almost years in December to May and show the highest trend in April. But no clear cut evidence was observed for seasonal variation in both catch and catch rate of longtail tuna as shown in Figs 9 and 10 respectively.

In the case of fishing effort, regular purse seines and light luring purse seine seemed to be in the reversed direction. The effort for regular purse seines showed a decreasing trend whilst the light luring purse seine show an increasing trend during the same period.

Seasonal variation in fishing effort by purse seines (regular and light luring purse seines combined) during 1985 - 1987 are shown in Fig 11. Mostly high effort were observed during the same period in almost years, i.e, during the Northeast Monsoon (November to April or May)

For the above evidences, it can be concluded that mostly of high catch and high catch rate of tuna species by purse seines on the west coast of Thailand were observed during the Northeast Monsoon (November to April or May).

Stock assessment

The stock size of tuna can not be estimated from limitted area such as only Thai waters because tuna species are widely migratory species and tend to have their distribution extending beyond Thai waters, probably to the entire Malacca strait or throughout the Andaman Sea. To assess the total stock size of tuna, an appropriate production analysis should be based on data from the whole area.

However, when considering the status of tuna stock entering the fishing ground on the west coast of Thailand, taking into a account of the fishing effort which does not specifically direct on tunas only and not specific in areas where only tunas are abundant, it is believed that the tuna stocks are unlikely to be effected by the present fishing efforts in this area.

Biological aspected

Preliminary studies on biological aspects of small tunas on the west coast of Thailand such as spawning ground and season, length at first maturity, and also some parameters about growth, length at first capture, etc. have been carried out by fisheries biologists of Phuket Marine Fisheries Station. The results of these studies are summarized in Table 1.

Fisheries statistics collection

Data collection was made by the staff of Phuket Marine Fisheries Station on monthly basis at 9 major landing ports along the coast from pelagic fishing gears, concentrated on purse seine fishery. The number of samples taken varied with the season of the fishery. The information obtained at each landing port included the types of purse seine, with the details on catch, species composition, effort, fishing ground, length frequency distribution, number of boat landing etc.

During the past 2-3 years, the fisherman and owners of most landing ports were more cooperative with the interviews and the staff of Phuket Marine Fisheries Station could easily made a copy of fishery record books belonging to them. The record books provide data of the previous month on catch by species, trips and others, from different gear types.

However, there seems to be some problems in connection with data collections; these include (1) difficulties in obtaining the length-frequency data for some months due to time limitation at the fishing ports, (2) possible errors in identifying the tuna species due to many different local names being recorded in the fishery record books, and (3) most tunas caught were immature, and hence the data on spawning season could not be achieved.

Table 1 Total catch and species composition of pelagic fish in the west coast of Thailand, 1979 - 1987.

Year	Total catch (tons)	Species composition (%)										
		1	2	3	4	5	6	7	8	9	10	11
1979	30696	28.1	13.2	5.9	4.6	7.9	29.6	0.1	3.8	2.6	2.0	2.2
1980	33996	38.5	9.1	5.1	5.2	5.0	25.3	-	4.6	2.4	2.6	2.2
1981	44423	34.2	7.1	9.3	5.4	4.2	31.3	-	3.9	1.8	1.7	1.1
1982	36837	26.4	5.1	9.8	6.0	3.4	41.5	0.2	2.3	2.4	1.9	1.0
1983	65374	17.4	6.1	4.4	21.3	8.9	24.2	4.6	10.0	1.5	0.9	0.7
1984	59187	27.3	6.0	5.6	19.8	6.1	25.3	3.9	3.5	1.0	0.9	0.6
1985	59215	39.1	9.8	7.3	12.9	1.2	12.6	1.7	5.0	←	10.4	→
1986	65611	30.4	5.6	7.7	17.6	0.8	19.1	1.3	5.4	←	12.1	→
1987	109366	13.8	6.8	12.1	24.3	0.5	15.7	2.6	6.9	←	17.3	→

Source : 1979 - 1984 The landing place survey, Department of Fisheries, Thailand.
1985 - 1987 From the sampling survey conducted by Phuket Marine Fisheries Station.

Note :
1. Indo-Pacific mackerel
2. Indian mackerel
3. Small tunas
4. Round scads
5. Hardtail scad
6. Sardines
7. Jack,cavalla
8. Crevalle, scad
9. Spanish mackerel
10. Wolf herring
11. Others

Table 2 Catch (tons) of each tuna species and gear types in the west coast of Thailand, 1985 - 1987.

Gear types	1985 Catch, (%)				1986 Catch, (%)				1987 Catch, (%)			
	LOT	KAW	FRI	Total	LOT	KAW	FRI	Total	LOT	KAW	FRI	Total
Thai purse seine # 2.5cm.	481 (48.6)	555 (47.8)	242 (11.2)	1278 (25.4)	120 (15.7)	442 (13.9)	161 (14.1)	723 (14.2)	64 (4.5)	122 (2.8)	67 (0.9)	253 (1.9)
Thai purse seine # 3.8cm.	429 (43.3)	186 (15.7)	531 (24.5)	1146 (26.4)	296 (38.8)	583 (18.4)	66 (5.8)	945 (18.6)	342 (23.9)	633 (14.5)	538 (7.2)	1513 (11.4)
Chinese purse seine	18 (1.8)	97 (8.2)	35 (1.6)	150 (3.5)	4 (0.4)	89 (2.8)	55 (4.8)	147 (2.9)	3 (0.2)	154 (3.5)	117 (1.6)	274 (2.1)
Light luring purse seine	40 (4.1)	296 (25.2)	1298 (59.7)	1634 (37.6)	327 (42.9)	1934 (61.0)	828 (72.3)	3089 (60.8)	540 (37.8)	3264 (74.9)	6488 (86.9)	10292 (77.7)
Tuna purse seine	-	-	-	-	-	-	-	-	448 (31.4)	16 (0.4)	25 (0.3)	489 (3.7)
Others	22 (2.2)	46 (3.9)	4 (0.2)	134 (3.1)	17 (2.2)	123 (3.9)	35 (3.0)	175 (3.5)	32 (2.2)	169 (3.9)	228 (3.1)	429 (3.2)
All gear	990	1182	2170	4342	763	3171	1145	5079	1429	4358	7463	13250
%	(22.8)	(27.2)	(50.0)		(15.0)	(64.4)	(22.6)		(10.8)	(32.9)	56.3	

Source : From the sampling survey conducted by Phuket Marine Fisheries Station.

Notes : LOT = longtail
KAW = Kawakawa (eastern little tuna)
FRI = Frigate

Table 3 Number of boats and fishing effort of purse seine, operated in the west coast of Thailand, 1985 - 1987

type of purse seine		year 1985	1986	1987
Regular purse seine	No of boats	193	87	69
	effort (day)	27569	15061	14467
Light luring purse seine	No of boats	81	123	134
	effort (day)	14578	21143	27857
Total	No of boats	254	210	203
	effort (day)	42147	36204	42324

Source : From the sampling survey conducted by Phuket Marine Fisheries Station.

Table 4 Landing of small tunas by major fishing port (in mt. and %) in the west coast of Thailand, 1979 - 1987

Year / Landing port	1979		1980		1981		1982		1983		1984		1985		1986		1987	
	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%
Ranong	12	0.7	22	1.3	309	5.1	6	0.2	235	6.2	74	2.5	186	4.3	491	9.7	247	1.9
Takuapa (1)	154	7.6	86	4.9	394	6.4	113	3.1	85	2.8	142	3.4	866	20.0	1073	21.1	3580	25.1
Kuraburi (2)	34	1.9	69	4.0	475	15.5	339	9.6	144	12.9	635	13.9	778	17.9	1393	27.4	2303	17.4
Phuket	8	0.4	6	0.3	30	0.7	17	0.5	524	18.2	666	20.2	791	18.2	1122	22.1	4855	36.6
Krabi	324	16.0	1149	72.1	555	13.5	460	11.9	14	0.7	1501	45.5	327	7.5	221	4.3	159	1.2
Trang	1.7	83.5	461	26.9	909	19.3	478	13.3	548	19.0	279	8.3	19	0.9	451	8.9	1769	13.3
Satul	718	35.8	964	60.1	1977	48.5	2251	62.4	525	18.2	-	-	1355	31.2	331	6.5	598	4.5
Total	2043		1721		4119		3604		2880		3297		4342		5079		13249	

Sources : 1979 - 1984 The landing place survey, Department of Fisheries, Thailand.

1985 - 1987 From the sampling survey conducted by Phuket Marine Fisheries Station

Notes : (1), 1985 - 1987 Takuapa and Tairuang

(2), 1979 - 1984 Tairuang

Table 5 Monthly catch of small tunas (tons) in the west coast of Thailand, 1985 - 1987

Year / Month	Longtail tuna			Coastal tunas		
	[illegible]	1986	1987	[illegible]	1986	1987
January	-	3	39	36	113	512
February	6	249	294	622	156	1021
March	15	146	429	310	698	1492
April	121	205	31	792	1270	4484
May	-	19	135	578	511	1697
June	-	78	22	17	339	745
July	[illegible]	-	3	245	[illegible]	[illegible]
August	1	-	-	367	61	62
September	8	-	65	37	-	346
October	287	5	57	125	77	272
November	279	57	61	137	142	385
December	-	1	293	86	827	737
Total	990	763	1429	3352	4316	11821

Source : From the sampling survey conducted by Phuket Marine Fisheries Station.

Table 6. Catch (tons), effort (day) and catch per unit of effort (tons per day of trawl fishing) by gear in the

in the west coast of Thailand, 1985 - 1987

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Gear	Catch, effort CPUE	Month												Total
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
OTS	Catch TUN	33.8	341.4	115.0	117.6	62.4	11.9	126.5	353.9	32.1	112.8	308.7	30.4	1646.5
	Catch LOT	-	5.6	12.1	118.2	-	-	266.4	1.1	8.0	270.2	246.3	-	926.1
	Catch total	33.8	347.0	127.1	235.8	62.4	11.9	392.9	355.0	40.1	383.0	555.2	30.4	2574.6
	Effort	2419	4305	2376	2976	3068	1019	2020	2370	1756	3824	3872	1344	27569
	CPUE TUN	0.014	0.126	0.048	0.040	0.019	0.012	0.063	0.149	0.018	0.062	0.058	0.023	0.060
	CPUE LOT	-	0.001	0.005	0.040	-	-	0.132	0.000	0.005	0.148	0.432	-	0.034
	CPUE total	0.014	0.127	0.053	0.079	0.019	0.012	0.195	0.150	0.023	0.210	0.190	0.023	0.093
[illegible]	Catch TUN	1.3	57.4	184.2	648.9	497.9	4.2	110.3	2.0	3.4	8.0	23.4	51.0	1592.0
	Catch LOT	-	-	2.8	-	0.4	-	-	-	-	9.9	28.8	-	41.1
	Catch total	1.3	57.4	187.0	648.9	498.3	4.	110.3	2.0	3.4	17.8	52.2	51.0	1633.0
[illegible]	Effort	392	648	1118	2860	1300	181	790	504	1145	1456	1600	2184	14278
	CPUE TUN	0.003	0.089	0.165	0.227	0.383	0.0 1	0.140	0.003	0.003	0.005	0.014	0.023	0.109
	CPUE LOT	-	-	0.003	-	0.000	-	-	-	-	0.007	0.016	-	0.003
	CPUE total	0.003	0.089	0.167	0.227	0.383	0.011	0.140	0.003	0.003	0.012	0.030	0.024	0.112
[illegible] OTS	Catch TUN	35.1	398.8	299.2	766.5	560.3	16.1	236.8	355.9	35.5	120.8	332.1	83.4	3240.5
	Catch LOT	-	5.6	14.9	118.2	0.4	-	266.4	1.1	8.0	280.1	273.3	-	968.0
	Catch total	35.1	604.4	314.1	884.7	560.7	16.1	503.2	357.0	43.5	400.9	605.4	83.4	4208.5
	Effort	2811	4953	3494	5836	4568	1405	2810	2976	2904	5280	5562	3528	42147
	CPUE TUN	0.012	0.121	0.086	0.131	0.122	0.011	0.084	0.120	0.012	0.037	0.037	0.024	0.077
	CPUE LOT	-	0.001	0.004	0.020	0.000	-	0.095	0.000	0.003	0.083	0.077	-	0.023
	CPUE total	0.012	0.122	0.090	0.152	0.122	0.011	0.179	0.120	0.015	0.122	0.114	0.024	0.100

Table 6 (Cont...

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Gear	etc. effort ...ch	Month												Total
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
[illegible]	Catch TUN	25.9	35.0	313.4	1164.2	51.1	208.2	59.6	29.8	-	1.0	4.2	548.4	2460.8
	Catch LOT	1.1	254.9	101.0	0.6	1.2	74.4	0.3	0.1	-	5.0	55.8	-	474.4
	Catc. total	27.0	289.9	414.4	1164.8	52.3	282.6	59.9	29.9	-	6.0	60.0	548.4	2935.2
[illegible]	Effort	1213	1364	1105	1708	1164	1404	1120	1036	1134	1116	1360	1152	15061
	CPUE TUN	0.021	0.041	0.284	0.682	0.044	0.148	0.053	0.029	-	0.001	0.003	0.476	0.163
	CPUE LOT	0.001	0.179	0.091	0.000	0.001	0.053	0.000	0.000	-	0.004	0.036	-	0.031
	..PUE total	0.022	0.216	0.375	0.682	0.045	0.201	0.053	0.029	-	0.005	0.038	0.476	0.195
[illegible]	Catch TUN	81.0	91.0	356.6	58.5	442.3	118.9	37.7	28.9	-	73.1	133.0	248.7	1697.7
	Catch LOT	3.6	8.6	42.1	200.1	16.9	1.4	-	-	-	-	-	0.8	271.5
	Total tota.	84.6	103.6	400.7	258.6	459.2	120.3	37.7	28.9	-	73.1	133.0	249.5	1969.2
	Effort	3100	2592	2755	2088	1587	878	544	635	544	1780	2470	2520	21143
	CPUE TUN	0.027	0.040	0.130	0.028	0.279	0.135	0.106	0.046	-	0.041	0.054	0.099	0.080
	CPUE LOT	0.001	0.004	0.015	0.096	0.012	0.002	-	-	-	-	-	0.000	0.013
	CPUE total	0.027	0.043	0.145	0.124	0.331	0.137	0.106	0.046	-	0.041	0.054	0.099	0.093
[illegible]	Catch TUN	108.9	150.0	672.0	1222.7	493.4	327.1	117.3	58.7	-	74.1	137.2	797.1	4158.5
	Catch LOT	2.7	263.5	143.1	200.7	18.1	75.8	0.3	0.1	-	5.0	55.9	0.8	746.0
[illegible]	Catch total	111.6	393.5	815.1	1423.4	511.5	402.9	117.6	58.8	-	79.1	193.1	797.9	4904.5
[illegible]	Effort	4318	3736	3860	3796	2551	2282	1664	1671	1678	2896	4030	3722	35204
	CPUE TUN	0.025	0.040	0.174	0.322	0.193	0.143	0.070	0.035	-	0.026	0.034	0.214	0.118
	CPUE LOT	0.001	0.065	0.037	0.053	0.007	0.033	0.000	0.000	-	0.002	0.014	0.000	0.021
	CPUE total	0.026	0.105	0.211	0.375	0.201	0.177	0.071	0.035	-	0.027	0.048	0.214	0.139

Table 6 (Cont...)

Gear	Catch, effort, CPUE	Month												Total
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
BP1	Catch TNP	1.5	1.2	379.4	252.2	459.1	234.2	0.3	-	-	379.8	57.5	203.0	1,717.6
	Catch LOT	-	223.7	239.5	0.8	4.0	12.7	0.4	-	-	31.4	27.6	233.8	775.1
	Catch total	1.5	224.9	618.9	253.0	463.1	246.9	0.5	-	-	411.2	85.1	436.8	2492.7
	Efforts	744	1320	1212	1092	1079	1312	1008	522	744	1416	1248	1464	14463
	CPUE TNP	0.002	0.001	0.313	0.169	0.307	0.163	0.000	-	-	0.092	0.027	0.139	0.116
	CPUE LOT	-	0.169	0.149	0.001	0.003	0.010	0.000	-	-	0.026	0.020	0.160	0.055
	CPUE total	0.002	0.170	0.462	0.170	0.310	0.173	0.000	-	-	0.128	0.046	0.298	0.172
LP1	Catch TNP	999.3	966.0	1056.2	4086.9	1484.6	506.6	65.8	60.3	333.1	131.7	333.6	308.3	9751.6
	Catch LOT	57.9	53.7	179.8	29.1	128.2	8.9	1.2	-	63.9	4.7	31.6	52.8	601.8
	Catch total	1057.2	1019.7	1236.0	4116.0	1612.8	515.5	67.0	60.3	399.0	136.4	365.2	361.1	10353.4
	Efforts	2028	2736	2964	2990	1350	936	836	522	2028	3540	3636	3744	27837
	CPUE TNP	0.361	0.358	0.416	1.367	0.893	0.545	0.0079	0.116	0.165	0.038	0.092	0.136	0.350
	CPUE LOT	0.031	0.023	0.071	0.010	0.096	0.010	0.001	-	0.032	0.001	0.009	0.014	0.022
	CPUE total	0.493	0.381	0.486	1.377	0.989	0.553	0.081	0.116	0.197	0.039	0.101	0.150	0.372
BP1 & LP1	Catch TNP	1000.8	967.2	1435.6	4339.1	1943.7	740.8	65.9	60.3	333.1	261.5	390.9	711.3	11550.4
	Catch LOT	57.9	277.4	419.3	29.9	132.2	21.6	1.6	-	63.9	36.1	59.2	286.6	1385.6
	Catch total	1058.7	1244.6	1854.9	4369.0	1779.9	762.4	67.5	60.3	399.0	337.6	450.1	998.1	12936.0
	Efforts	2772	4056	4260	4446	2809	2248	1844	834	2838	4956	5052	5208	42324
	CPUE TNP	0.360	0.238	0.338	0.969	0.692	0.329	0.036	0.072	0.141	0.053	0.077	0.137	0.273
	CPUE LOT	0.020	0.068	0.098	0.007	0.047	0.010	0.001	-	0.023	0.011	0.012	0.055	0.033
	CPUE total	0.380	0.306	0.436	0.976	0.630	0.339	0.037	0.072	0.164	0.064	0.088	0.192	0.306

Note : BP1 = Thai, Chinese and three purse seines

LP1 = Light luring purse seine

TNP : Anchovy and fingers have combined

LOT : Longtail tuna

Table 7 Summary of biological information of small tunas in the west coast of Thailand.

Species	Distribution	Size composition (cm)	Length at first capture (cm)	Size at first maturity (cm)	Spawning season	$L_t = V_t$ relationship	Sex ratio	Recruitment	Growth and Other parameter
Dogtooth tuna (*Gymnosarda unicolor*)	Adult Juvenile (Fishing and Total Mortality) Larvae In the lower part, Mu Koh, Phuket Is. Koh Re, Ko Rok	LF : 11.0-49.5 Modes in catch 20.5-38.5 and 42.5-49.5		42-50.0	Feb.-May, Aug.-Sept.	$V = 0.00002 M^{2.993} L$	1 : 0.25	March, LF = 11.0	K = 0.11/month, L2 = 50.0 (Bhattacharya method, Ford-walford plot) K = 0.73/year, L2 = 49.0 (ELEFAN PROGRAM)
Indo-Pacific king mackerel (*Scomberomorus guttatus*)	Adult Inner shelf waters Juvenile Surface, deeper and Koh Re Larvae Deeper Is.	LF : 9.0-47.0 Modes in catch 17.5-30.5	LF 53.5 (1985) 53.5 (1986)	42-53.0	Aug-Nov.	$V = 0.0000 M^{2.962} L$	1 : 0.89	March-April and June, LF = 9.0	K = 0.15/month, L2 = 50.5 (Bhattacharya method, Ford-walford plot) K = 0.63/year, L2 = 44.0 E = 0.48 (1985) E = 0.58 (1986) (ELEFAN PROGRAM, bevertonand holt)
Narrow-barred Spanish mackerel (*Scomberomorus commerson*)	Adult Inner shelf waters Juvenile Surface and Deeper Is. All Ko Phuket, Ko Ra Larvae Deeper Is.	LF : 9.0-80.0 Most in catch 24.5-44.5	LF 52.5 (1985) 54.5 (1986)	42-53.0	Aug-Nov.	$V = 0.0000 M^{2.977} L$	1 : 1.15	March-April and June, LF = 9.0	K = 0.15/month, L2 = 62.2 (Bhattacharya method, Ford-walford plot) K = 0.40/year, L2 = 49.0 E = 0.37 (1985) E = 0.55 (1986)

Sources: Somboonsuke (1984, 1985)
Sathianpong (1985, 1986)
Nithisoros (1986)

Note: For estimates K and L2 used length frequency data from 1984 - 1985.

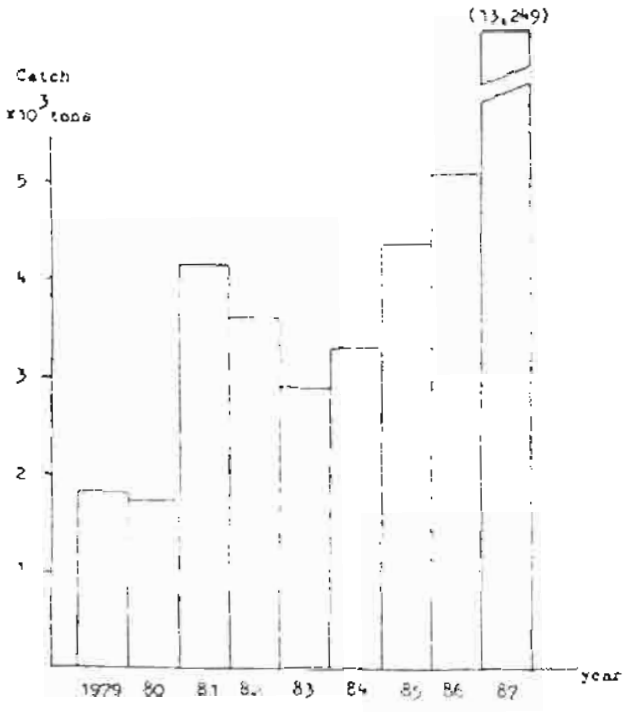

Fig. 1 Trend of small tunas landing in the west coast of Thailand, 1979 - 1987

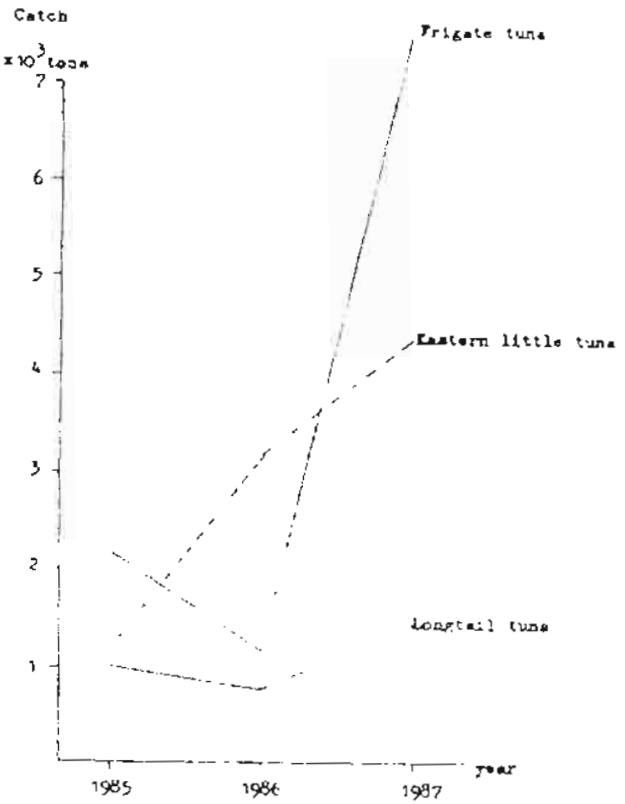

Fig. 2 Trend of tunas catch by species in the west coast of Thailand, 1985 - 1987.

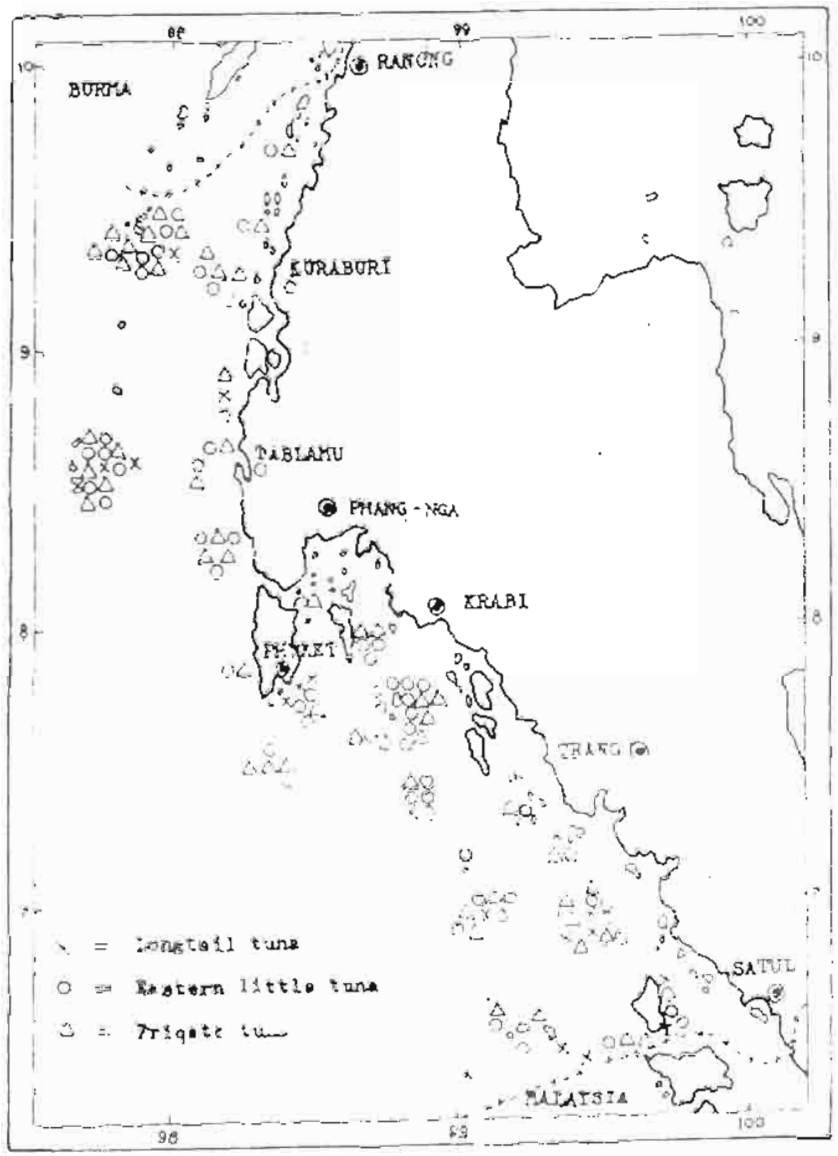

Fig. 3 The fishing ground of small tunas in the west coast of Thailand, 1986 - 1987

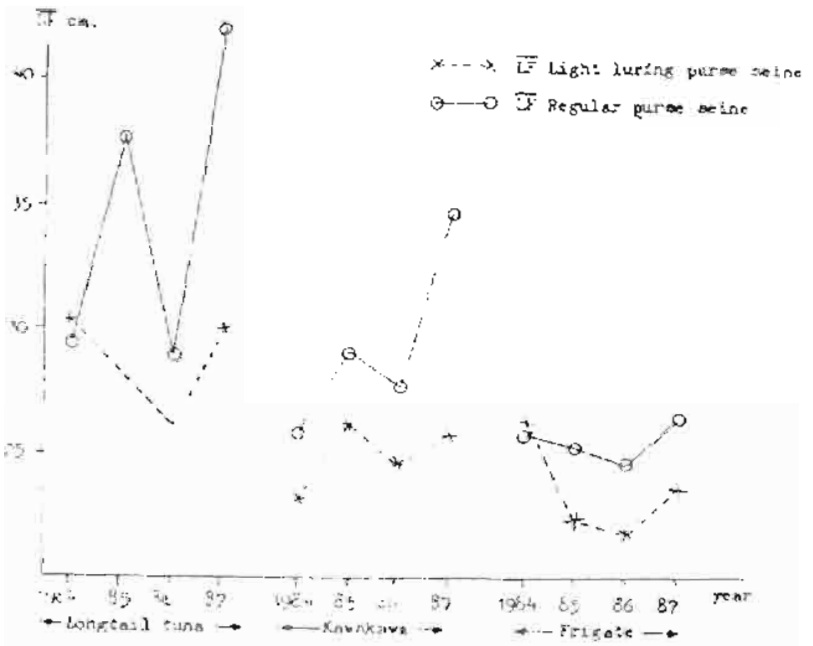

Fig. 4 Mean lenght of small tunas caught by regular and light luring purse seine in the west coast of Thailand, 1984 - 1987.

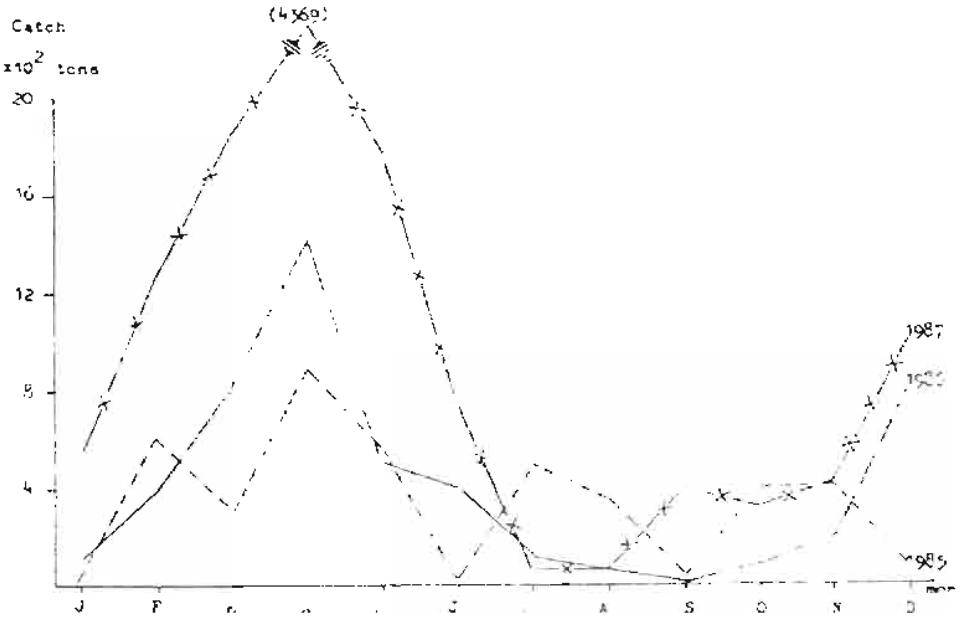

Fig. 5 Monthly catch of Small tunas (Frigate, Kawakawa and longtail tuna) by purse seine in the west coast of Thailand, 1985 - 1987

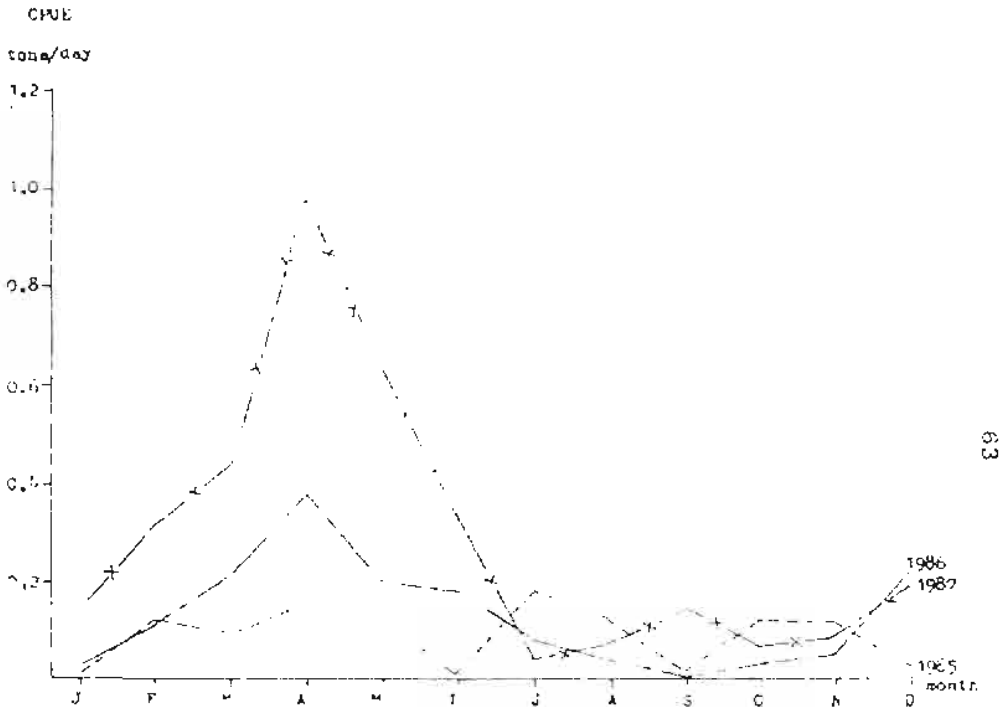

Fig. 6 Monthly catch rate of Small tuna (Frigate, Kawakawa and longtail tuna) by purse seine in the west coast of Thailand, 1985 - 1987

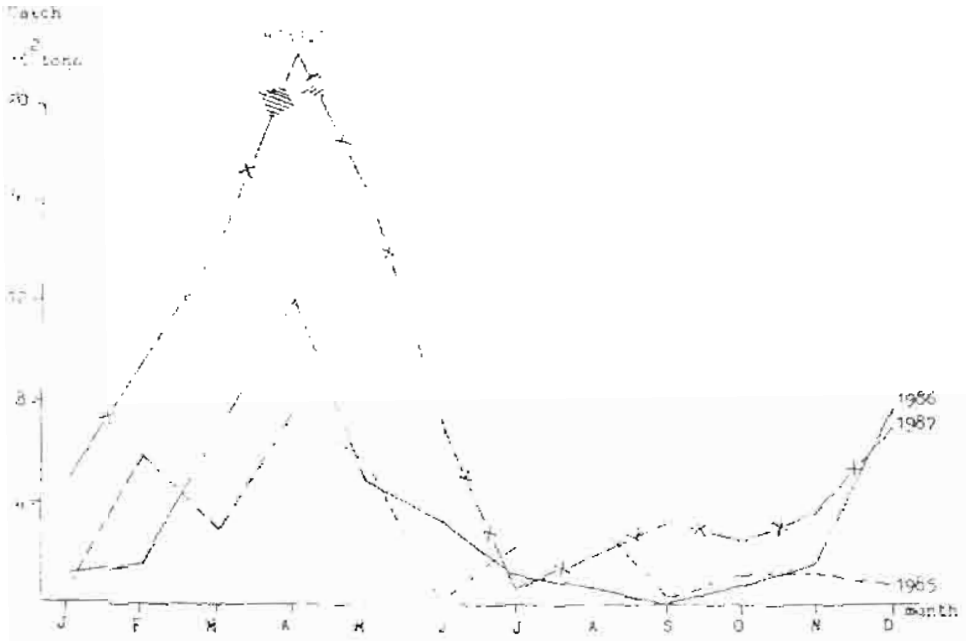

Fig. 7 Monthly catch of Coastal tunas (Frigate and Kawakawa) by purse seine in the west coast of Thailand, 1985 - 1987

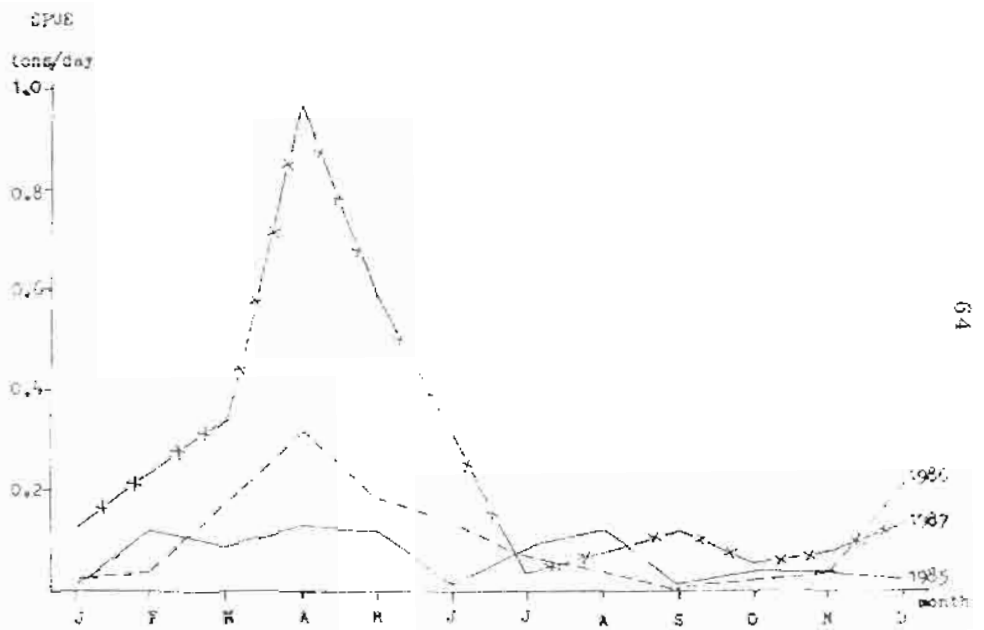

Fig. 8 Monthly catch rate of coastal tuna (Frigate and Kawakawa) by purse seine in the west coast of Thailand, 1985 - 1987.

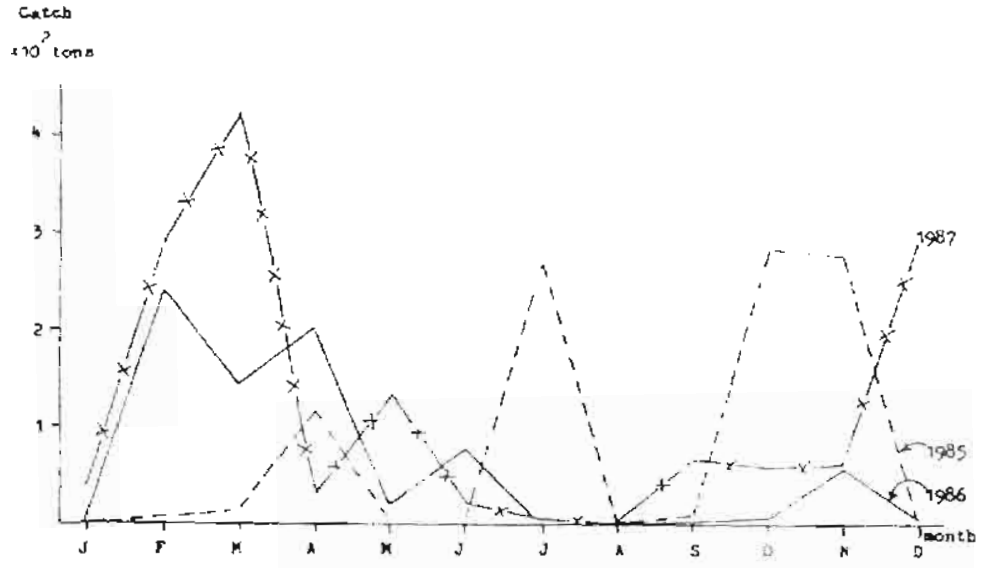

Fig. 9 Monthly catch of longtail tuna by purse seine in the west coast of Thailand, 1985 - 1987

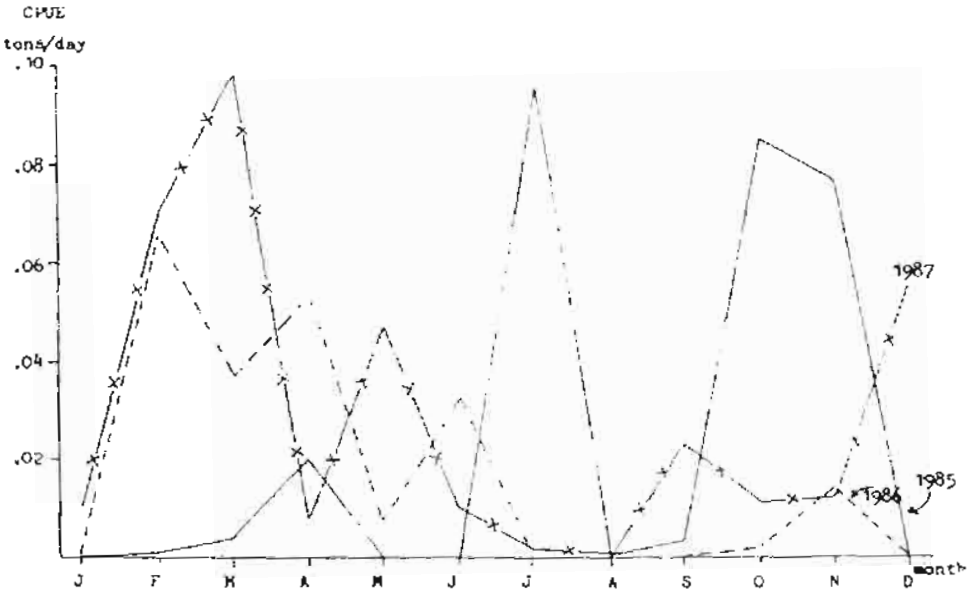

Fig. 10 Monthly catch rate of longtail tuna by purse seine in the west coast of Thailand, 1985 - 1987.

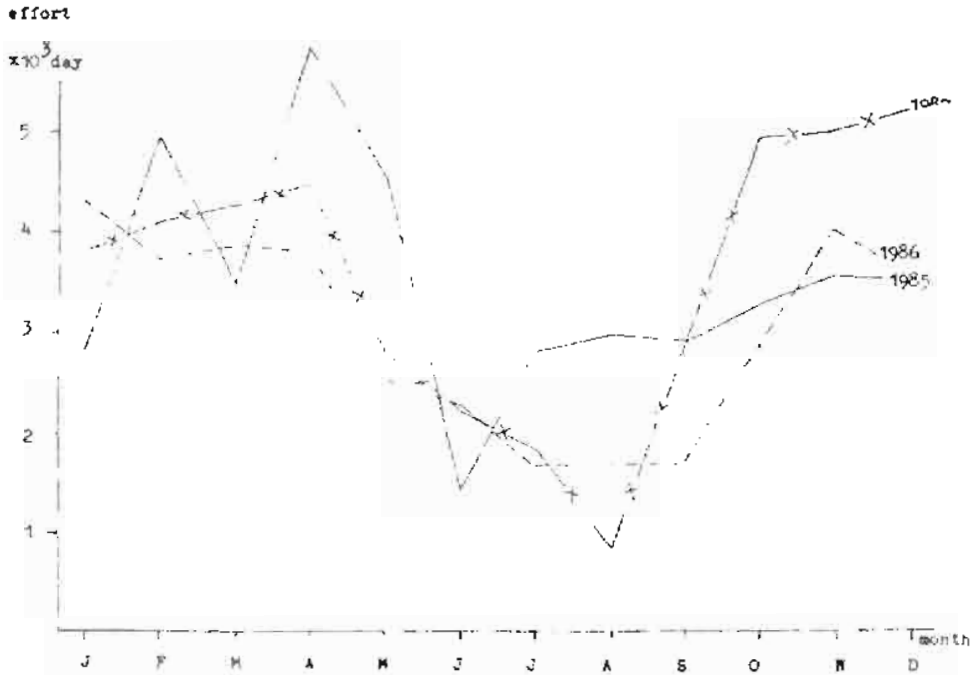

Fig. 11 Seasonal variation in purse seines effort in the west coast of Thailand, 1985 - 1987

RECENT DEVELOPMENT OF TUNA FISHERIES IN INDONESIA [1)]

COUNTRY REPORT

RESEARCH INSTITUTE FOR MARINE FISHERIES
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1) Paper presented on the 2nd Southeast Asian Tuna Conference and 3rd Meeting of Tuna Research Groups in the Southeast Asian Region, 22 - 25 August 1988, Kuala Trengganu, Malaysia.

INTRODUCTION

The production of tuna and skipjack in the period of 1978 to 1986 is increasing remarkably, with the total production of 102,171 MT in 1978 to 222,146 MT in 1986 and the average of about 214,887 MT annually (DJP., 1987). It means that tuna and skipjack production contributes about 13.9% to the total marine fisheries production in 1986. It is 1.1% higher than the production in 1985. The tuna and skipjack exports are also increasing rapidly from 9,426 MT or US$ 6,139,000 in 1978 to 17,925 MT or US$ 12,770,000 in 1985 (DJP., 1987). These place the tuna and skipjack exports as number two in the exports of non oil and gas commodity.

Lately, the demand of fresh tuna particularly from Japan for sashimi is also increasing, and the export is about 200 MT daily. In 1987 the export of fresh tuna was about 819 MT with the value of about US$ 3,824,730. The price of fresh tuna in Japan varies from US$ 400 to US$ 600 per MT and it depends also on the species of the tuna.

The by catch of long line fishery is shark which is about 15-20% of the catch. Shark by catch has a good prospect in the future. Their fins have high price, their meat can be used as "abon", a seasoning of meat reduced to fibres, and their skin used as raw materials for leather craft.

Skipjack pole and line fishery, tuna long line fishery as well as tuna hand line fishery are developing rapidly in east Indonesian waters, and their are concentrated in Sorong, Ambon, Ternate, Bitung, Kendari and Maumere.

Besides, tuna and skipjack resources in the Indonesian Economic Exclusive Zones are almost still untouched by the Indonesian fleets, which in the other waters are still under exploited.

FISHING METHODS

1. Pole and Line

Skipjack pole and line fishery is only developing in eastern Indonesian waters by state compnaies, private companies, joint venture and small scale sectors. State companies for skipjack pole and line are located in Sorong, Ambon and Bitung, while joint venture copmany in Biak, and private companies in Sorong, Bitung and Kendari. Small scale sectors are in Sorong, Ambon, Ternate, Labuha, Bitung, and Kendari. In 1981 skipjack pole and line fishery started to operate in Maumere from one boat at the beginning to 37 in 1987.

The boat size used in pole and line fishery varies, i.e. 30 GT, 100 GT and 300 GT used by state companies, but since 1985 boats of 100 GT and 300 GT are only used for collecting tuna and skipjack catches from small scale sectors. The joint venture which is located in Biak using 300 GT boats and the private companies using 15 GT, 30 GT

and 40 GT. The size of the boat used by private companies are as follows :

- Sorong : 25 and 30 GT
- Ambon : 30 GT
- Ternate and Labuha : 5, 10 and 30 GT
- Bitung : 30 and 40 GT
- Maumere : 15 GT
- Kendari : 15 GT

2. Purse Seine

Large purse seines are only used by join venture company in Biak, while small purse seines develop in Bnda Aceh and Prigi. The size of the boats used for purse seine in Biak are ranging from 632 to 765 GT, in Banda Aceh from 23 to 105 GT with their nets ranging from 700 to 1,200 meters length and 20 to 40 meters depth. Small purse seine which is operated in Prigi not only for tuna and skipjack, but also for small pelagic fishes. They are using two boats, one boat with 4 to 5 GT and 40 to 50 HP and the other one with 11 to 21 HP. The size of the net used ranging from 400 to 500 meters length and 40 to 50 maters depth.

3. Gill Net

Gill net for tuna develops in Pelabuhan Ratu and Prigi. The size of the boats used are ranging from 2.5 to 4 GT with 40 HP engine, and the number of fishermen per boat are 3 to 4. The length of the nets are about 60 to 65 meters length and 20 meters depth with their mesh size are ranging from 3.5 to 4.5 inch.

4. Seine Net (Payang)

Seine nets are only operated in Pelabuhan Ratu, with boats ranging from 4 to 5 GT and with 40 HP engine. he number of fishermen per boat are about 14 to 20. Their operation is one day fishing.

5. Troll Line

Troll lines are only developed in west Sumatra, using boats ranging from 4 to 29 GT with 16 to 55 HP. About 80% of the boats using 33 HP engine. The number of lines in one boat are about 8 to 12 with 3 to 4 fishermen. They are operating about 3 to 7 days in one trip with the average is 6 days.

6. Long Line

Tuna long line fishery has developed rapidly since about two years ago, following the high demand for fresh tuna particularly from Japan, and also due to the nucleus and plasm systems developed by the goverment. Besides, the government of Indonesia invites foreign investors to develop tuna fisheries in the IEEZ. The number of boats including the foreign boats licenced operating in Indonesian waters is presented in Table 1.

PRODUCTION

1. Pole and Line

The production of tuna and skipjack in Indonesia in 1985 decreased about 1.42% compared to that in 1986. The production of tuna, skipjack and tuna-like in the eastern and western Indonesian waters in the period of 1978 to 1987 is presented in Table 2. The catch of 30 GT pole and line boats which are operated by state companies in Sorong, Ambon and Bitung are shown in Table 3, 4 and 5, while for 40 GT boats operated by state company in Bitung in Table 6. The catch of small scale sector in Maumere is presented in Table 7.

2. Purse Seine

The catch of small purse seine in Banda Aceh is in Table 8. No data from Prigi because it was stopped in 1987

3. Gill Net

The development of catch and effort data for gill net only available from Pelabuhan Ratu which is presented in Table 9.

4. Seine Net

Monthly catch of seine net in Pelabuhan Ratu is shown in Table 10. Small pelagic fishes which are usually caught by seine net are mackerels, roundscads and sardines.

5. Troll Line

Catch and effort data are only available from April 1987, the beginning of the sampling activities in west Sumatra, and this is in Table 11. The catch is for local consumption only.

6. Long Line

Catch by species of state tuna long line company in Bali is presented in Table 12, while catch by companies which are located in Bali and Jakarta is in Table 13.

SAMPLING ACTIVITIES

Sampling is carried out mainly to collect catch, effort, length and weight data from some designated sampling sites. In east Indonesian waters sampling is done in state companies. Sampling activities for 1987/1988 fiscal year have been conducted in Sorong, Ambon, Bitung, Pelabuhan Ratu and Padang. Due to lack of samplers, the sampling activities in Kendari are not started yet, while sampling in Banda Aceh done only during April to September 1987, because the data collected by the samplers were very bad. The frequency distribution collected from sampling sites are presented in Figure 1 to Figure 10.

Besides, other informations are also collected at sampling sites, such as :

- catch by species by boat

- GT and HP of the boats
- number of fishermen per boat
- fishing grounds
- number of days per trip

The data which have been collected from sampling sites are 66 months data for catch and effort and 66 months also data for length and weight. Some data have been stored into floppy disks, i.e. months data for catch and effort and months data for length and weight.

FISHING SEASON

The data collected have been analyzed to define pole and line fishing seasons in Sorong, Ambon, Bitung and Ternate, and also for gill net fishing in Pelabuhan Ratu. Fishing season for pole and line fisheries in Sorong, Ambon, Bitung and Ternate are shown in Figure 11, while for gill net fishery in Pelabuhan Ratu in Figure 12.

Table 1: List of tuna tuna line Boats (Indonesia) in April 1988

Name of Company	No of Boats	Name of Boats	Size of Boats (GT)	Fish Hold Capacity (M3)	Engine (HP)	Base	Year of Operation Started
1. P.T. [illegible]	5	Sari Segara No.1	50	35	280	Benoa, Jakarta	1986
		Sari Segara No.2	50	35	280		1986
		Sari Segara No.3	50	35	280		1986
		Sari Segara No.4	33.73		280		1988
		Sari Segara No.5	33.73		280		1988
2. P.T. BALI RAYA	5	Bali Raya No.1	33.22		220	Benoa, Jakarta	1987
		Bali Raya No.2	33.22		220		1987
		Bali Raya No.3	33.22		220		1987
		Bali Raya No.4	33.97		280		1987
		Bali Raya No.5	33.97		280		1987
3. P.T. INTI NUSA	1	Inti Nusantara 1	313.61		1100	Kupang, Jakarta,	1987
4. P.T. SAPTA [illegible] SEJATI	1	Polaris	34.85		170	Tarakan, Kendari.	1988
5. P.T. [illegible]	1	Anugrah No.1	224.88		850	Ambon, Benoa Jakarta	1988
6. P.T. [illegible]	4	Lucia 5	319.16	312.48	1100	Ambon/Jakarta	1986
		Lucia 6	304.68	353.20	1100		1986
		Lucia 7	394.68	338.23	1300		1987
		Nila No.1	314.05	372.48	1300		1987
7. P.T. [illegible]	4	Dayanita No.1	253.24	311.00	675	Ambon/Jakarta	1986
		Dayanita No.2	95.27	81.65	700		1986
		Dayanita No.3	174.57	220.39	675		1986
		Dayanita No.5	271.03	239.25	900		1987
		Dayanita No.6	314.98	352.90	1000		1987
		Dayanita No.	294.97	320.10	1000		1987
8. P.T. [illegible]	3	Swadaya No.1	470		650	Ambon, Jakarta.	
		Swadaya No.5	470		650		
		Swadaya No.6	470		650		
Sub total	24						

Name of Company	No of Boats	Name of Boats	Size of Boats (GT)	Fish Hold Capacity (Ltrs)	Engine (HP)	Base	Year of Operation Started
9. P.T. PERIKANAN SAMUDRA BESAR	17	Samudra 02	111	40	370	Benoa/Sabang	1974
		Samudra 03	111	40	370	Jakarta	1974
		Samudra 04	111	40	370		1974
		Samudra 05	111	40	370		1974
		Samudra 06	111	40	370		1974
		Samudra 07	111	40	370		1974
		Samudra 08	111	40	370		1974
		Samudra 09	111	40	370		1974
		Samudra 10	111	40	370		1974
		Samudra 11	114	44	400		1975
		Samudra 12	114	44	400		1975
		Samudra 14	114	44	400		1975
		Samudra 15	114	44	400		1975
		Samudra 16	114	44	400		1975
		Samudra 17	114	44	400		1975
		Samudra 18	114	44	400		1975
		Samudra 19	114	44	400		1975
10. PERUM PERTAMINA (PERSERO)	1	Pertamina 03	[illegible]	[illegible]	[illegible]	Cilacap, Bontang	1983
11. P.N. PERIKANAN SULAWESI UTARA-TENGAH	1	Pertamina II	[illegible]	[illegible]	[illegible]	Pertamina Bitung	1982
12. P.T. KOPAL FISHERY DEV. PROJ.	1	Tuffide No.1	204.80		1000	Jakarta/Cilacap	1984
13. P.T. SURYA MAS LESTARI	6	Maslindo I	204.03		1000	Cilacap, Jakarta	1993
		Maslindo II	253.67	280.32	1000		1993
		Maslindo III	298.76	452.80	1000		1995
		Maslindo No.5	298.63	461.60	1000		1995
		Maslindo No.6	299.25	405.50	1000		1995
		Maslindo 80	204.24	464.89	1000		1995
14. D.G.F./Research Vessel	1	Tenggiri	300			Jakarta, Benoa	1978
15. A.U.P./Training vessel	1	Nadidharey	400			Jakarta	1988
Total	54						

Companies not registered yet:

Source : D.G.F.
Statistik (1992)

P.T. Eksalna Karya Perkasa (Base at Jakarta) 10 boats - Tenggiri (1 ea)
P.T. Putra Pinggawa Samudra (Base at Bali) - 4 boats, operation late 1992
P.T. Nina Sapta Samudra - 1 boat Jakarta (HP 320, 1993)
- 1 boat Jakarta II (HP 240, 1993)

Foreign Vessels:

Flag Country	Name of Company (Agency)	Name of Boats	Size of Boats (GT)	Size of Fish Hold (MT)	Operation	Remarks
Taiwan	P.T. Yala Mina Thana Karya Perpanjangan	CHU FA	153.97	130.49	Pacific	
		No. 201 YANG DAR	356.63	276.35	Pacific	
		SHEH YUNG NO.3	358.66	315.476	Pacific	
		TAWA LONG NO.66	161.68	115	Pacific	
		SIN TA	355.57	442	Pacific	
		SE YANG NO.1	175.82	115	Pacific	
		GOWIG DAR	328.96	346	Pacific	
		SHONG CHIANG NO.1	254.98	180	Pacific	
Honduras	P.T. Nina Sapta Samudera	TUNA KING NO.1	49.07	80	Indian Ocean	Based at Jakarta
		TUNA KING NO.2	57.21	100	Indian Ocean	Based at Jakarta
		TUNA KING NO.3 +				
		KINGFOOD NO.2	73.41	67	Indian Ocean	
		KINGFOOD VII	73.41	67	Indian Ocean	
S.Korea	P.T. Eraska Nova	NO.52 DONG	431.61	554.18	Indian Ocean	35 Crews
Thailand	P.T. Sari Bahna Indah	VICHAI MARLE	24.84	12.67	South China Sea	
		THAI PANDIT 96	31.92	21.24	South China Sea	
		THAI PANDIT 101	30.9	18.43	South China Sea	
		THAI PANDIT 102	30.9	18.92	South China Sea	
		THAI PANDIT 103	37.20	18.46	South China Sea	
		THAI PANDIT	27.19	10.22	South China Sea	
	P.T. Bintan Tiga Segati	BINTAN SEJATI NO.1				

Source: D.G.F. and Personal Communication (*)

Table 2. Catch statistics for tuna and tuna-like fishes, 1980 - 1986 [MT].

A R E A	1980	1981	1982	1983	1984	1985	1986
Eastern Indian Ocean [Area 57]							
- T u n a	3,348	3,350	3,740	5,888	4,242	4,473	3,270
- Skipjack	7,573	6,575	11,832	12,458	10,447	9,602	10,954
- Tuna-like	15,206	12,46[illegible]	22,860	23,444	24,195	31,897	21,600
Seerfishes				-	-	5,321	7,382
Total :	26,127	27,396	38,432	41,790	38,889	51,293	43,206
Western Pacific Ocean [Area 71]							
T u n a	17,550	21,889	24,340	20,200	26,450	29,587	34,238
Skipjack	44,745	50,851	49,745	64,332	70,211	72,318	68,843
Tuna-like	61,591	70,264	83,152	80,434	78,984	85,653	90,727
Seerfishes					-	46,860	44,614
Total :	123,386	143,004	157,237	164,966	175,645	234,418	238,422
T o t a l	149,513	170,400	195,669	206,756	214,534	285,711	281,628

Table 3. Monthly Catch [C], Effort [E], and Catch Per Unit of Effort [CPUE] for Skipjack tuna of P.T. Usaha Mina [Persero] 30 GT Pole and Line vessels in Sorong, 1987.

Month	Total Catch [MT]	Operation day	CPUE [KG/OD]	Bait available by day [buckets]	kg tuna per bucket	Purchased [buckets]	Catch [buckets]	Total bait [buckets]
January	169.0	224	754.5	33.7	22.4	3,560	4,000	7,560
February	158.4	258	613.9	31.7	19.4	3,650	4,532	8,182
March	210.3	322	653.1	31.8	20.6	3,450	6,782	10,232
April	165.3	280	590.4	29.0	20.4	2,635	5,473	8,108
M a y	332.8	373	892.2	24.4	36.6	4,315	4,774	9,089
J u n e	120.1	221	543.4	29.5	18.4	2,655	3,861	6,516
J u l y	159.4	254	627.6	29.4	21.3	3,877	3,595	7,472
August	179.8	220	817.3	30.7	26.6	3,752	3,009	6,761
September	259.5	229	1,133.2	36.9	30.2	5,353	3,104	8,457
October	276.7	328	843.6	29.4	28.9	5,885	3,675	[illegible]
November	280.1	315	889.2	36.6	25.0	4,798	6,420	11,218
December	276.9	294	941.8	36.9	25.5	5,712	5,144	10,856
T o t a l	2,588.3	3,318				49,642	54,369	104,009

Table 4. Monthly Catch, Effort, and CPUE for Stripjack tuna of Perum Perikani Nalulu 30 GT Pole and Line vessels in Ambon, 1987

Month	Total Catch (MT)	Operation Day	CPUE (kg/OD)	Bait available (buckets)	kg tuna per bucket	Total bait (buckets)
January	87.8	122	791.8	9.9	39.5	1,209
February	25.6	147	174.1	6.1	28.4	200
March	166.8	180	926.0	6.0	153.6	1,086
April	106.5	158	674.1	6.0	112.1	950
May	184.1	184	1,000.7	9.3	107.9	1,706
June	45.5	141	322.7	6.6	48.6	935
July	19.1	125	152.8	7.1	20.8	919
August	33.3	110	302.7	6.1	48.7	699
September	91.7	129	542.6	8.0	65.5	1,400
October	229.6	194	1,183.5	12.9	91.7	2,509
November	175.4	188	933.0	9.4	99.3	1,770
December	92.1	153	595.5	7.1	63.8	1,160
Total	1,319.5	1,877				15,551

Table 5. Monthly Catch, Effort, and CPUE for Stripjack tuna and baitfish of PN Perikani Sulawesi Utara-Tengah 30 GT Pole and Line vessels in Bitung, 1987.

Month	Total Catch (MT)	Operation Day	C P U E (kg/day)	Bait Available Or day (kg)	Kg Tuna Per Kg	Total Bait (kg)
January	5.7	31	183.4	7.9	15.2	244.0
February	19.7	20	985.0	155.9	6.3	3,117.0
March	27.8	31	896.8	197.6	4.5	6,126.0
April	24.4	24	1,016.7	120.7	7.8	3,138.0
May	59.4	67	886.6	44.4	20.0	2,976.0
June	17.6	75	502.9	95.2	5.9	3,340.0
July	16.7	29	575.9	68.1	10.0	1,974.0
August	69.8	34	1,836.8	124.9	14.2	1,746.0
September	68.5	37	1,851.4	112.6	16.5	4,144.0
October	135.1	47	1,872.6	134.5	13.9	8,340.0
November	137.1	67	747.8	154.3	11.3	10,340.0
December	30.6	38	805.3	65.4	12.3	2,484.0
Total	571.4	479				50,969.0

Table 6. Monthly Catch, Effort, and CPUE for Skipjack tuna and Baitfish of PN Perikanan Sulawesi Utara-Tengah 30 GT Pole and Line vessels in Bitung, 1987.

Month	Total Catch (MT)	Operation Day	C P U E kg/OD	Bait Available by day (kg)	kg Tuna Per kg	Total Bait (kg)
January	10.7	51	200.0	26.5	7.6	1,350.0
February	32.6	79	412.8	49.1	8.4	3,876.0
March	221.4	131	1,690.1	88.4	19.1	11,578.0
April	56.1	54	1,038.9	49.4	21.0	2,669.0
May	68.2	86	793.0	90.1	8.8	7,750.0
June	90.5	119	760.5	72.3	10.5	8,602.0
July	57.4	98	585.7	75.5	7.8	7,400.0
August	75.2	67	1,092.5	104.5	10.3	7,133.0
September	108.2	83	1,303.6	90.2	83.3	8,150.0
October	218.0	189	1,159.1	94.6	82.1	18,042.0
November	182.7	159	1,211.3	103.3	11.7	16,424.0
December	68.5	91	752.7	72.0	10.4	6,553.0
T o t a l	1,197.0	1,208				99,530.0

Table 7. Monthly Catch for Skipjack tuna of Pole and Line vessels (8 - 20 GT) in Manokwari, 1982 - 1987.

Year	1982		1983		1984		1985		1986		1987	
Month	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number
January	-		5,894	1,593	112,961	30,540	189,007	51,108	46,214	14,445	37,467	24,489
February	-	-	57,457	15,529	45,262	12,233	238,668	64,505	32,138	10,137	14,870	4,890
March	25,200	6,810	37,592	8,930	151,700	41,000	134,784	361,784	63,635	19,886	231,163	77,054
April	17,870	4,830	41,984	10,337	195,845	52,931	270,281	73,049	94,733	29,601	39,339	13,113
May	8,450	2,282	48,155	13,015	90,691	24,511	88,127	23,818	191,228	59,759	45,747	15,249
June	3,000	807	119,961	31,417	6,299	1,142	27,902	7,541	25,030	7,822	87,380	29,127
July	11,562	3,125	54,937	12,828			37,688	10,186	20,492	6,404	113,319	37,783
August	10,841	2,930	26,629	2,915	12,114	3,274	21,998	5,944	67,174	20,992	42,351	14,117
September	8,902	2,406	25,312	5,831	32,922	8,898	101,243	28,194	121,761	32,836	56,476	18,825
October	36,737	9,939	20,481	2,497	35,603	7,628	207,984	64,995	154,058	48,143	146,243	48,748
November	28,895	5,807	89,899	20,323	113,105	30,569	173,421	54,194	195,722	62,163	329,223	109,758
December	39,371	7,939	166,115	42,835	57,022	14,070	74,767	23,207	199,136	63,230	122,187	40,702
Total	190,828	48,865	694,426	168,110	846,544	230,796	1,568,365	771,525	1,211,621	374,215	1,245,565	433,855

Table 8. Monthly Catch, Effort, and CPUE for Skipjack and Small Tuna of Small Purse Seiners (19 - 20 GT) in Banda Aceh, 1985 - 1987

Month	1985			1986			1987		
	Effort[1]	Total Catches[2]	Catch rate (kg/day)	Effort	Total Catch	Catch rate (kg/day)	Effort	Total Catch	Catch rate (kg/day)
January	445	111.0	247.2	171	290.9	1660.3	117	359.1	812.4
February	388	112.5	292.9	113	149.6	1322.9	255	138.8	544.3
March	297	30.1	108.4	110	282.2	1755.9	282	93.2	325.8
April	269	36.9	137.2	108	264.0	2444.4	252	269.9	1071.0
May	136	59.3	436.0	87	235.8	2710	337	842.7	2500.4
June	51	6.6	129.4	90	120.0	1333.3	284	255.4	899.3
July	493	32.1	166.3	147	260.2	1770.1	214	47.3	221.0
August				111	220.0	1981.9	170	66.4	390.6
September	297	70.7	238.0	138	193.9	1401.4	273	165.2	606.5
October	402	144.3	353.7	187	497.5	2660.4			
November	324	83.2	222.5	151	210.5	1394.1			
December	330	34.8	256.7	137	268.8	2203.3			
Total	3,184	763.5		1,491	3,016.4		2,510	2,037.5	

[1] No of fishing day
[2] in Tons

Table 9. Monthly Catch, Effort, and CPUE of Gill Net (2.5 - 4 GT) in Pelabuhan Ratu, West Java, 1985 -1987.

Month	1985 (Tons)					1986 (Tons)					1987 (Tons)				
	Effort[1]	SKJ	YFT	KAW	CPUE Kg./day	Effort[1]	SKJ	YFT	KAW	CPUE Kg./day	Effort[1]	SKJ	YFT	KAW	CPUE Kg./day
January	195	10.6	1.0	0.2	60.2	112	7.3	0.7	0.1	72.3	78	5.3	1.2	0.8	93.6
February	74	5.9	0.5	0.2	89.2	103	13.1	0.9	0.4	94.1	68	5.9	0.9	0.1	105.9
March	266	37.0	5.1	0.1	158.6	125	15.9	1.6	0.8	93.8	188	16.2	2.1	4.4	121.8
April	249	31.1	1.7	0.1	122.7	208	15.9	1.4	0.2	84.1	85	4.6	0.7	0.2	64.7
May	321	31.8	1.7	0.2	105.6	487	56.4	3.8	0.3	123.7	123	7.5	1.3	2.7	93.5
June	231	13.1	1.6	0.2	66.7	381	29.2	2.0	0.5	104.3	219	22.5	4.9	3.8	162.5
July	241	27.8	2.0	0.6	126.1	426	55.4	1.8	4.8	144.1	241	25.5	3.7	8.4	197.5
August	334	33.9	2.6	15.5	156.0	254	29.8	1.7	1.8	130.3	475	152.7	10.3	15.1	374.9
September	351	45.2	5.2	3.6	153.9	307	40.6	2.0	10.1	171.7	635	183.4	25.9	40.6	393.5
October	256	16.6	2.0	0.7	73.8	101	12.7	2.6	0.6	66.8	340	64.8	10.4	7.3	247.4
November	184	11.8	0.4	0.5	67.0	102	4.0	0.2	0.1	48.0	200	18.2	0.1	1.9	100.5
December	186	21.1	1.0	0.2	123.9	89	3.6	1.1	0.2	57.5	175	20.4	0.7	4.6	166.9
Total	2,901	340.0	24.2	22.4		2,738	283.3	21.1	19.0		2,827	537.0	62.5	90.4	

Source: Fisheries sector Pelabuhan Ratu
[1] Trip

SKJ : Skipjack
YFT : Yellowfin tuna
KAW : Kawa-kawa.

Table 10. Monthly Catch, Effort, and CPUE of Dannish Seiners "Payang" [4 - 5.61] in Pelabuhan Ratu, West Java, 1985 -1987

Month	1985 [Tons]					1986 [Tons]					1987 [Tons]				
	Effort[*]	SKJ	YFT	KAW	CPUE Kg./day	Effort[*]	SKJ	YFT	KAW	CPUE Kg./day	Effort[*]	SKJ	YFT	KAW	CPUE Kg./day
January	353	[illegible]	0.6	3.0	[illegible]	44	[illegible]	0.1	0.1	104.5	58	4.7	3.4	5.3	213.0
February	135	[illegible]	[illegible]	0.8	[illegible]	[illegible]	[illegible]	0.6	6.2	234.3	89	10.9	1.2	11.0	293.3
March	[illegible]	[illegible]	0.2	6.0	[illegible]	[illegible]	2.6	0.6	[illegible]	35.7	124	30.3	2.4	17.0	400.8
April	572	150.9	0.4	14.9	[illegible]	97	3.3		1.4	48.5	90	5.5	2.5	6.9	165.6
May	499	14.1	0.5	[illegible]	[illegible]	[illegible]	45.1	0.3	13.7	269.9	115	7.2	0.5	10.1	154.8
June	325	4.9		16.9	67.4	208	26.7	0.2	13.9	196.2	44	6.4	0.5	3.2	229.5
July	95	3.3		[illegible]	152.6	328	14.2		30.0	134.8	63	7.2	2.5	5.1	234.9
August	1072	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.3	18.6	278.2	126	23.0	5.2	11.7	316.7
September	1313	[illegible]		[illegible]	260.5	600	[illegible]	0.3	75.0	141.0	209	32.4	15.7	38.7	377.0
October	1044	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.7	0.7	43.4	205.5	578	55.1	18.2	226.3	518.3
November	[illegible]	[illegible]	0.1	[illegible]	[illegible]	[illegible]	[illegible]		3.4	42.9	262	18.5	4.1	57.2	303.8
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.9		2.4	47.8	58	7.1	1.1	2.6	186.2
Total	5,752	[illegible]	[illegible]	[illegible]		[illegible]	254.1	[illegible]	215.4		1,816	208.3	57.3	390.1	

Source : Fisheries sector Pelabuhan Ratu
*) Fishery day.
SKJ Skipjack
YFT Yellowfin tuna
KAW Kawa-kawa

Table 11. Monthly Catch, Effort, and CPUE of Trollers [5 - 10 GT] in Padang, West Sumatera, 1987.

Month	No. of Operation Day	Skipjack		Yellowfin		Kawa Kawa		Total Catch [kg]
		Catch [kg]	Kg/O.Day	Catch [kg]	Kg/O.Day	Catch [kg]	Kg/O.Day	
January								
February								
March								
April	2,073.0	47,835.0	23.1	22,615.0	10.9	44,460.0	21.4	114,910.0
May	1,989.0	352,912.0	177.4	52,597.0	26.4	20,029.0	10.1	425,538.0
June	1,365.0	229,235.0	167.9	20,810.0	15.2	3,799.0	2.8	253,844.0
July	1,669.0	312,920.0	187.5	32,357.0	19.4	10,813.0	6.5	356,090.0
August	1,170.0	195,675.0	167.2	20,407.0	17.4	7,975.0	6.8	224,077.0
September	1,214.0	175,022.0	144.2	47,865.0	39.4	1,821.0	1.5	224,708.0
October	1,459.0	284,815.0	192.2	98,205.0	67.3	9,577.0	6.6	391,497.0
November	1,373.0	254,517.0	185.4	135,322.0	98.6	6,513.0	4.6	396,352.0
December	1,286.0	170,892.0	132.9	79,097.0	61.5	3,201.0	2.5	253,190.0
Total	13,598.0	2,023,823.0	1,377.8	509,275.0	356.1	108,188.0	62.8	2,640,206.0

Source : Research Institut for Marine Fisheries M.Day Operation day
Sampling activitas started on April 1987.

Table 1. Monthly Production by species of P.T. Samodra Besar 100 GT longliners, 1987.

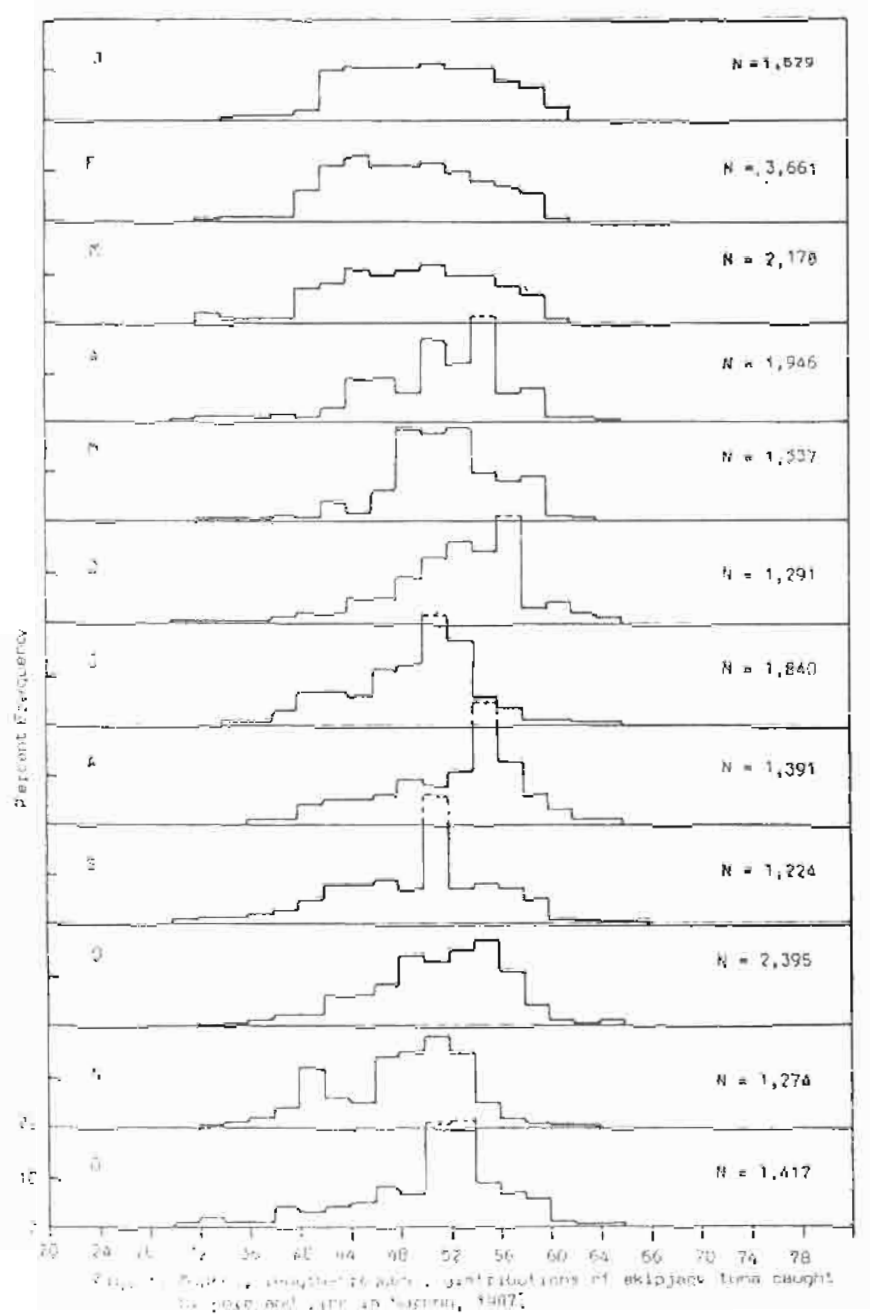
Month/Ton	YFT	BFT	SBF	ALB	BUM	SWO	SAI	WSA	Total
January	15.90	3.40		0.07	0.80	0.50	0.40	1.00	42.07
February	19.60	3.40		0.05	0.80	0.60	0.10	0.90	25.45
March	14.70	41.10	[illegible]	4.70	0.50	0.50	0.20	0.70	33.00
April	[illegible]	34.20	0.60	10.10	2.10	1.70	0.40	1.70	130.70
May	47.70	42.10		19.30	3.50	0.60	0.40	2.00	144.10
June	[illegible]	[illegible]		51.30	4.30	1.20	0.10	2.30	219.30
July	[illegible]	85.40		93.70	4.10	2.40	0.30	2.40	307.80
August	79.20	61.50		70.70	3.60	3.00	0.10	2.90	221.20
September	[illegible]	[illegible]	0.60	16.70	3.90	2.70	0.20	2.90	156.70
October	[illegible]	[illegible]	0.90	[illegible]	4.90	3.30	0.70	3.90	157.00
November	177.00	24.20		0.[illegible]	2.80	2.50	0.40	3.70	171.10
December	113.40	12.40	0.10	0.10	3.20	2.40	0.50	1.60	133.70
Total	905.00	455.30	2.80	773.12	34.70	21.40	3.80	26.00	1,742.12

Remarks : YFT - Yellowfin tuna
BFT - Bigeye tuna
SBF - Southern Bluefin tuna
ALB - Albacore
BUM - Blue marlin
SWO - Swordfish
SAI - Sailfish
WSA - White shark

Table 12. The total catch of tuna by the Indonesian Longline fishery in the Indian ocean and the East Indonesian waters, 1987.

No.	Name of company	Production/ton Frozen	Production/ton Fresh	Total
1.	Pt. Perilanan Samodra Besar	867.5	874.6	1742.10
2.	Pt. Sari Segara Utama	-	340.0	340.02
3.	Pt. Bali Raya	149.4	67.2	216.60
4.	Pt. Putra Penggama Samudra	-	19.6	19.60
5.	Pt. Mina Sapta Samudra	-	34.8	34.80
6.	Pt. Sumber Masilindo	4379.4	-	4379.40
7.	Pt. Utam Sari Bachtera	768.4	-	768.40
8.	Pt. Pertuni	1919.9	-	1919.90
9.	Pt. Lotide	185.0	-	185.00
10.	Pt. Duyot Mita Utama	135.0	-	135.00
	Total	8404.6	1336.22	9740.82

Source : Research Institut for Marine Fisheries
Sampling activitas started on April 1987.



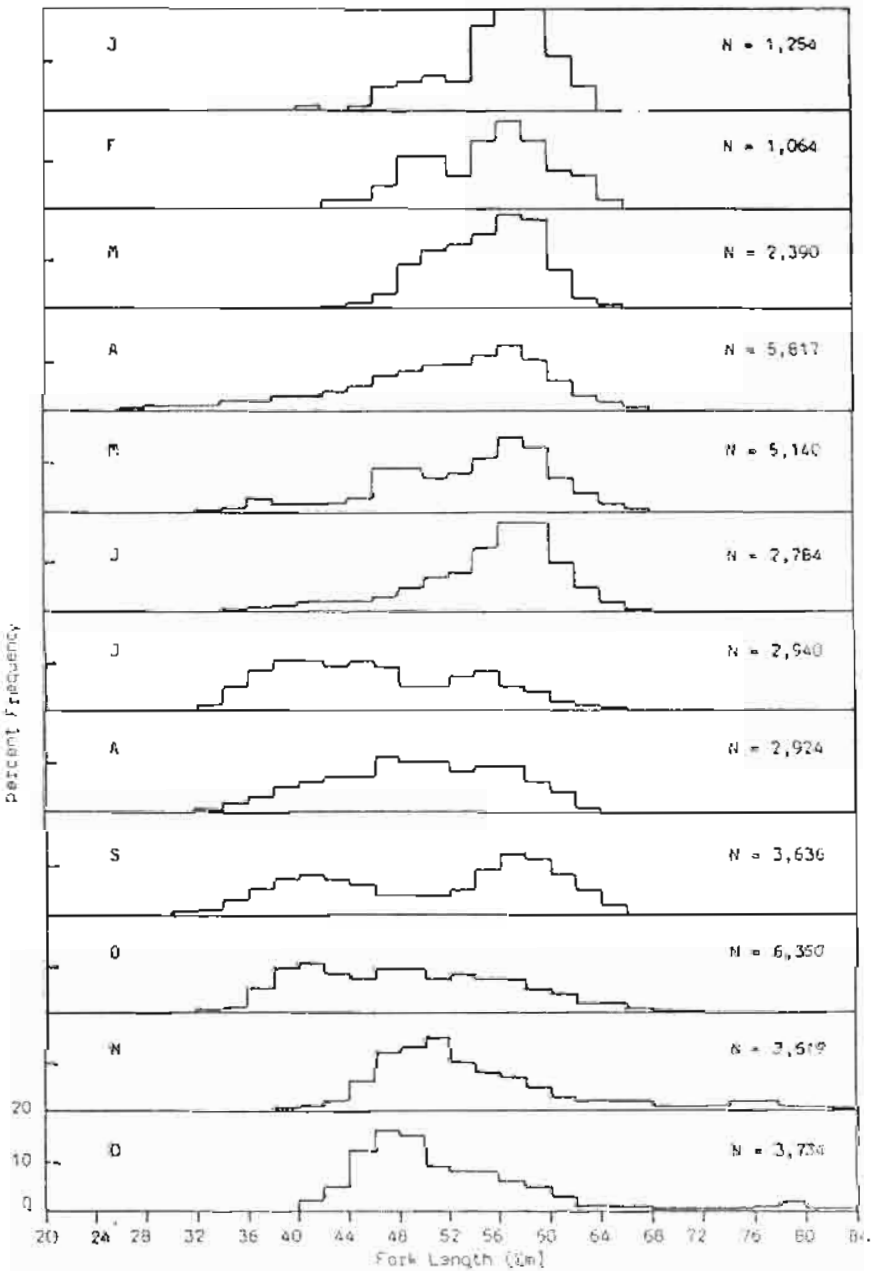


Fig. 2. Monthly length-frequency distributions of skipjack tuna caught by pole and line in Ambon, 1987.

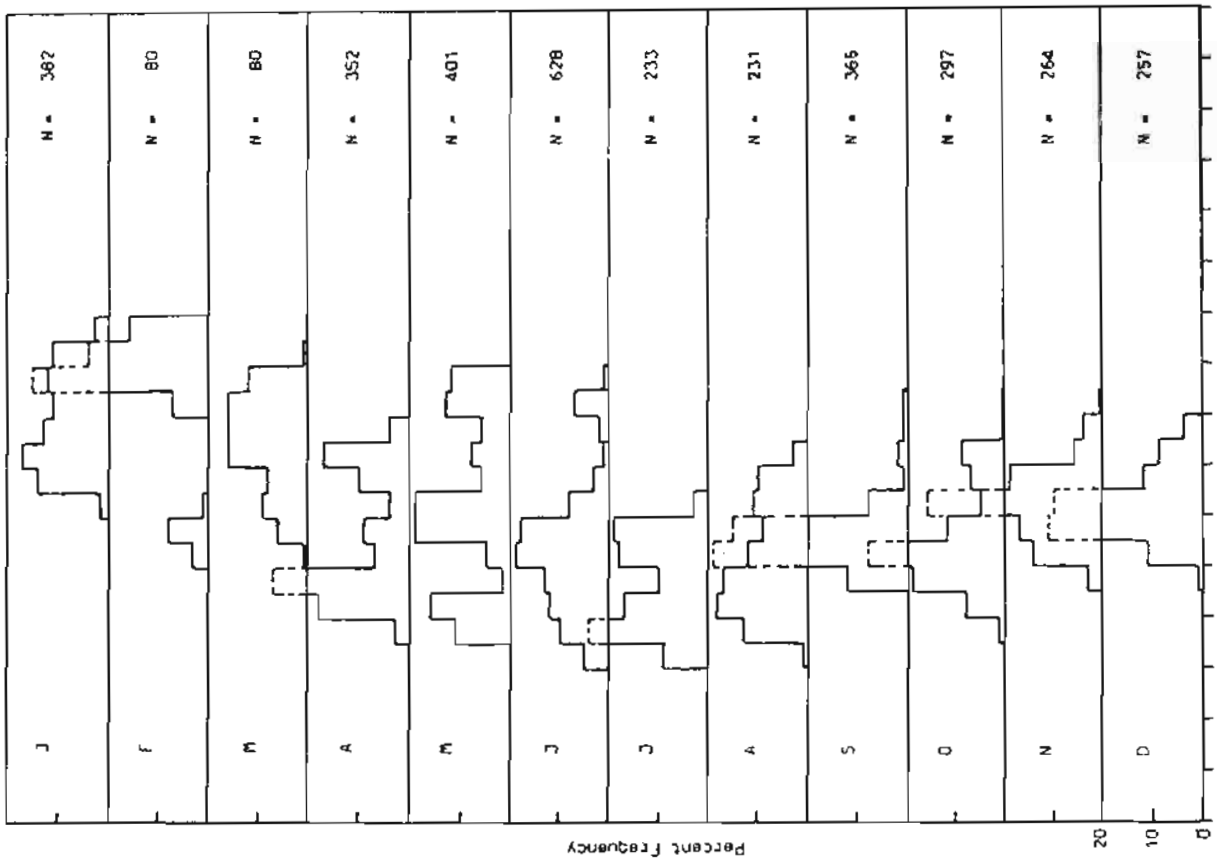


Fig. 4. Monthly length-frequency distributions of skipjack tuna caught by Gillnet in Pelabuhan Ratu, 1987.

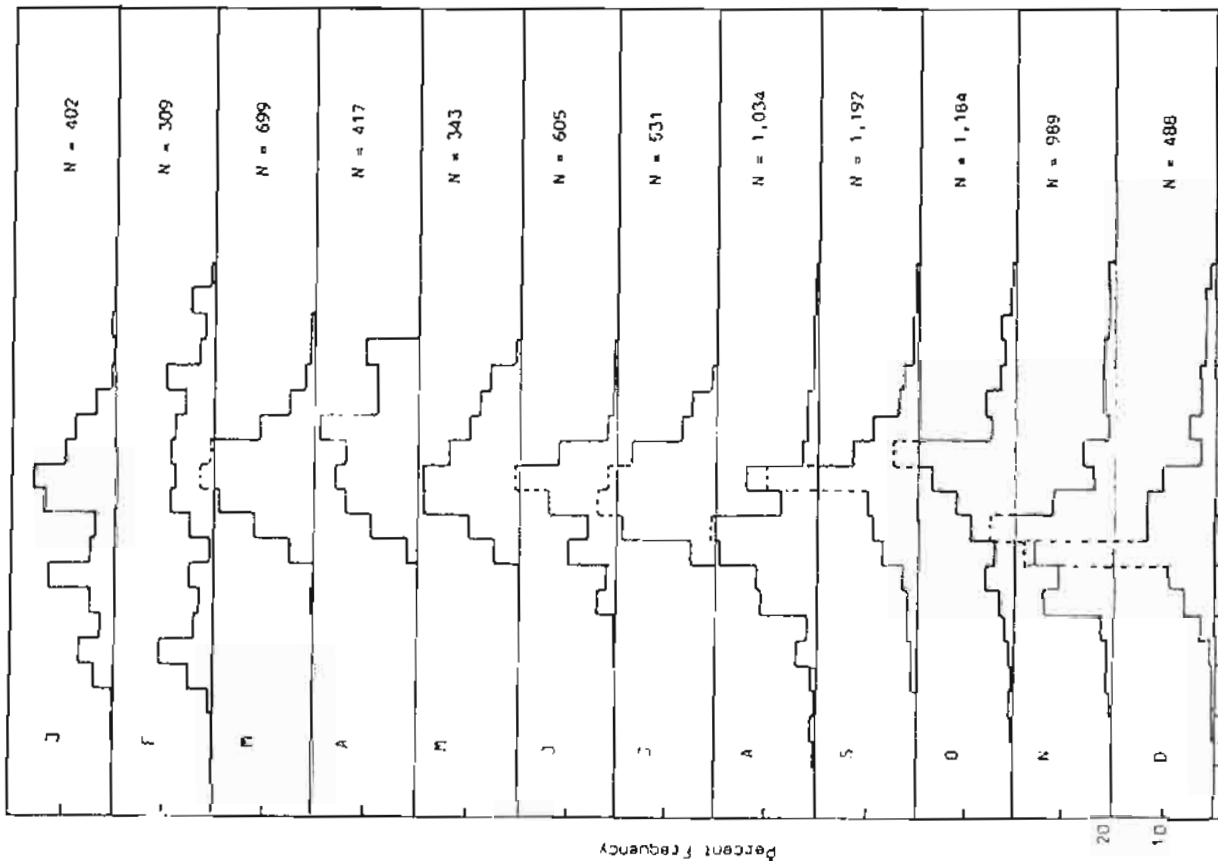


Fig. 3. Monthly length-frequency distributions of skipjack tuna caught by pole and line in Bitung, 1987.

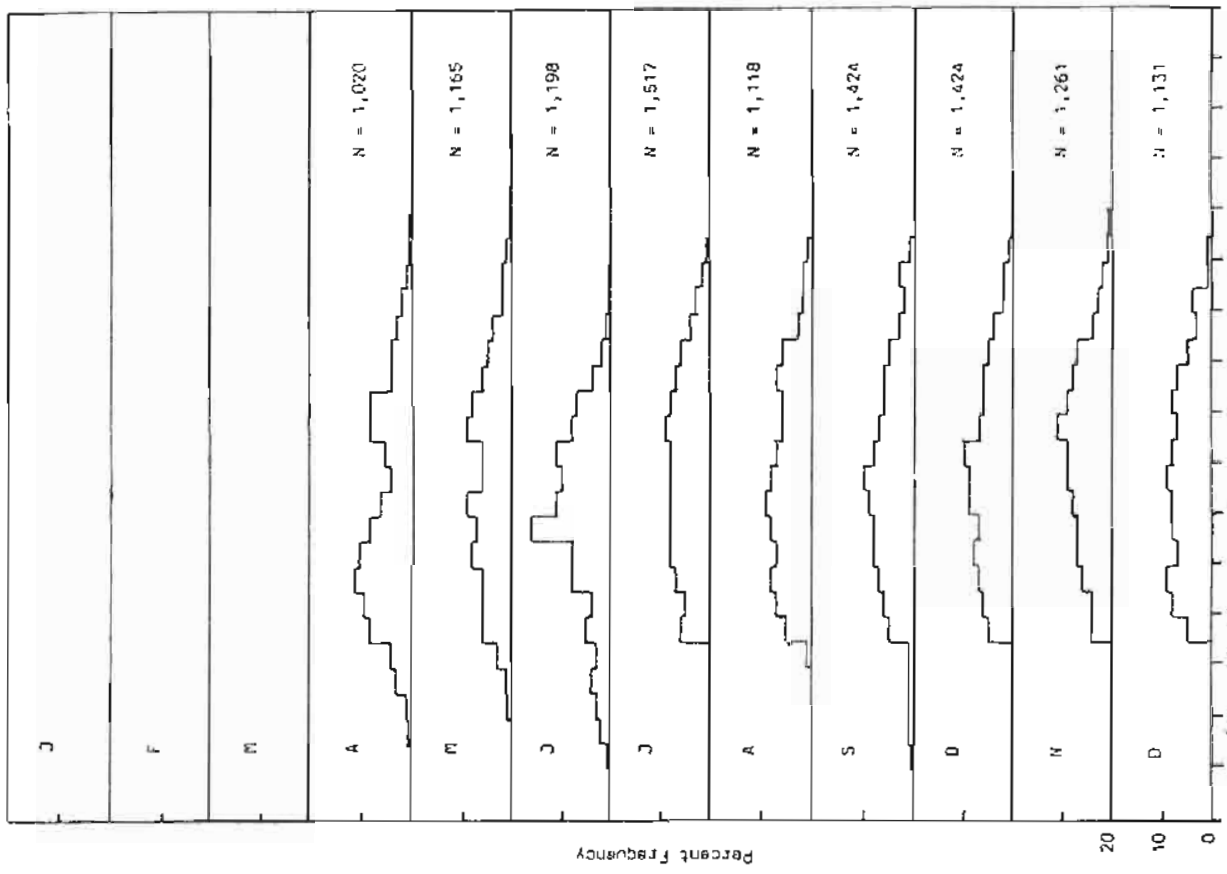


Fig. 6. Monthly length-frequency distributions of skipjack tuna caught by trolling in Padang, 1967.

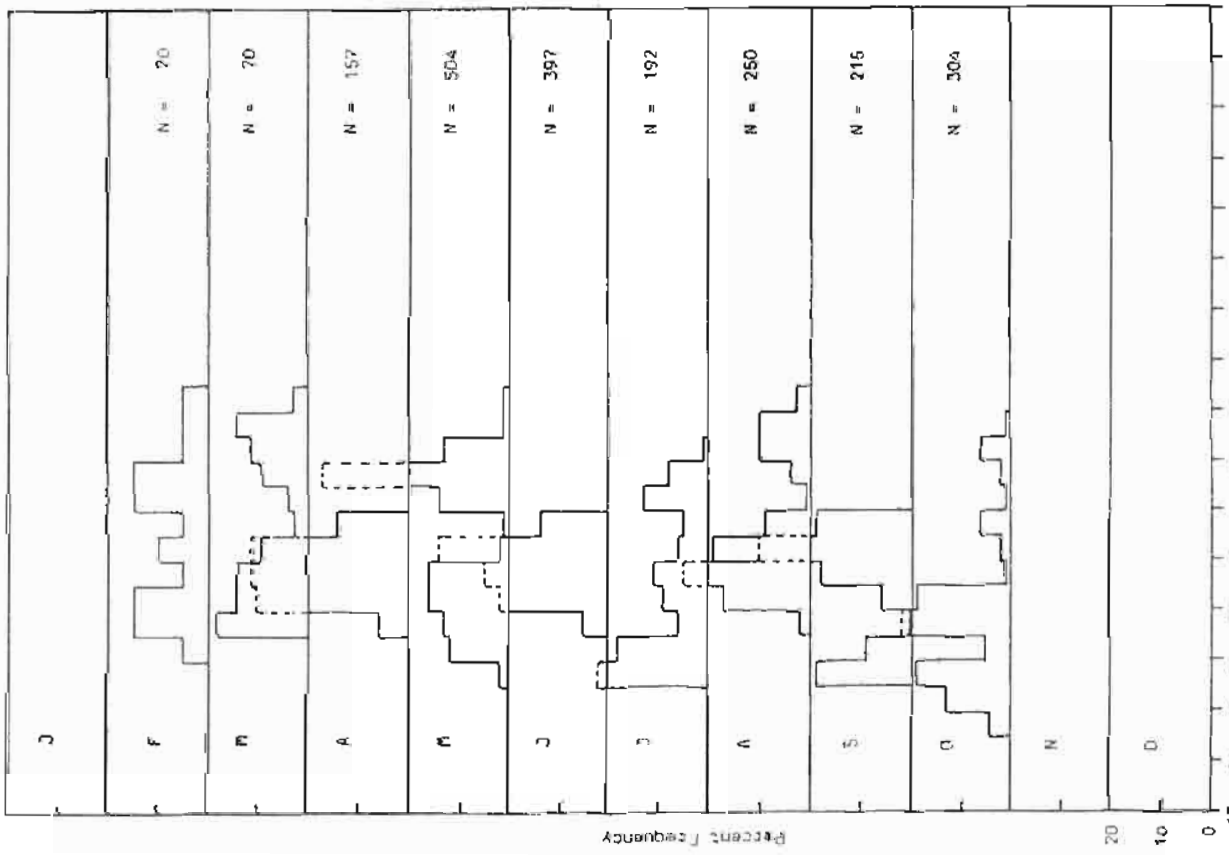


Fig.5. Monthly length-frequency distributions of Kawakawa caught by Gill net in Pelabuhan Ratu, 1967.

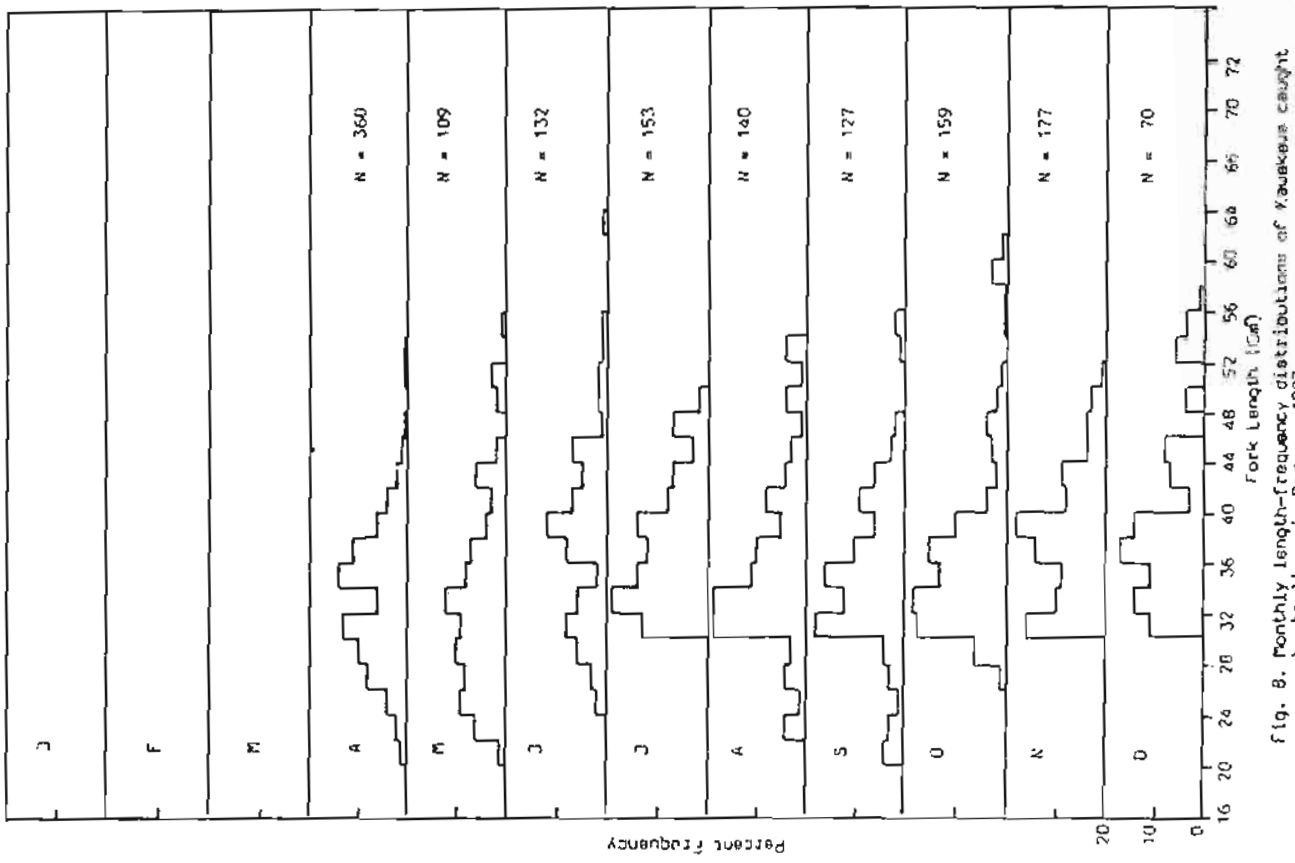


Fig. 8. Monthly length-frequency distributions of kawakawa caught by trolling in Pagang, 1987.

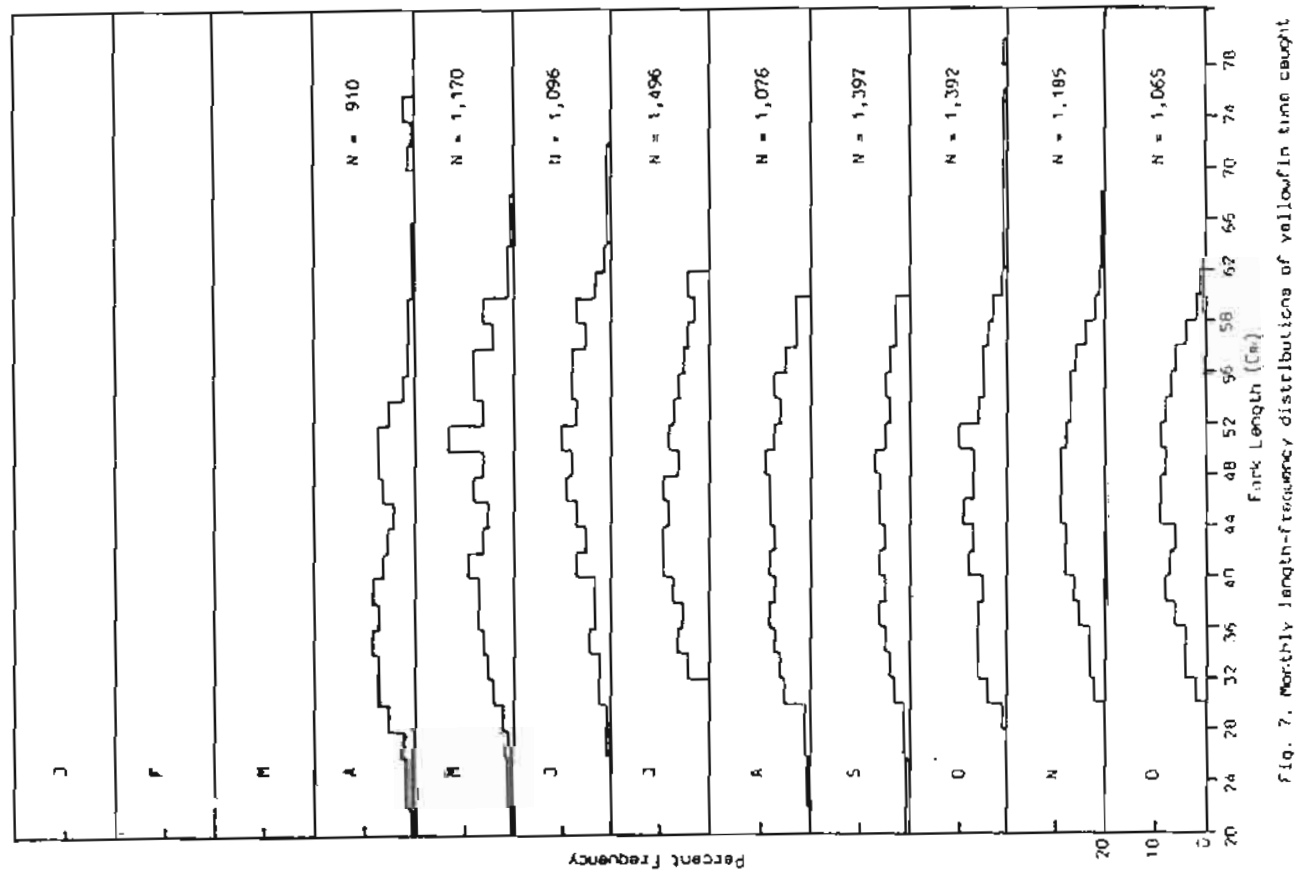


Fig. 7. Monthly length-frequency distributions of yellowfin tuna caught by trolling in Pagang, 1987.

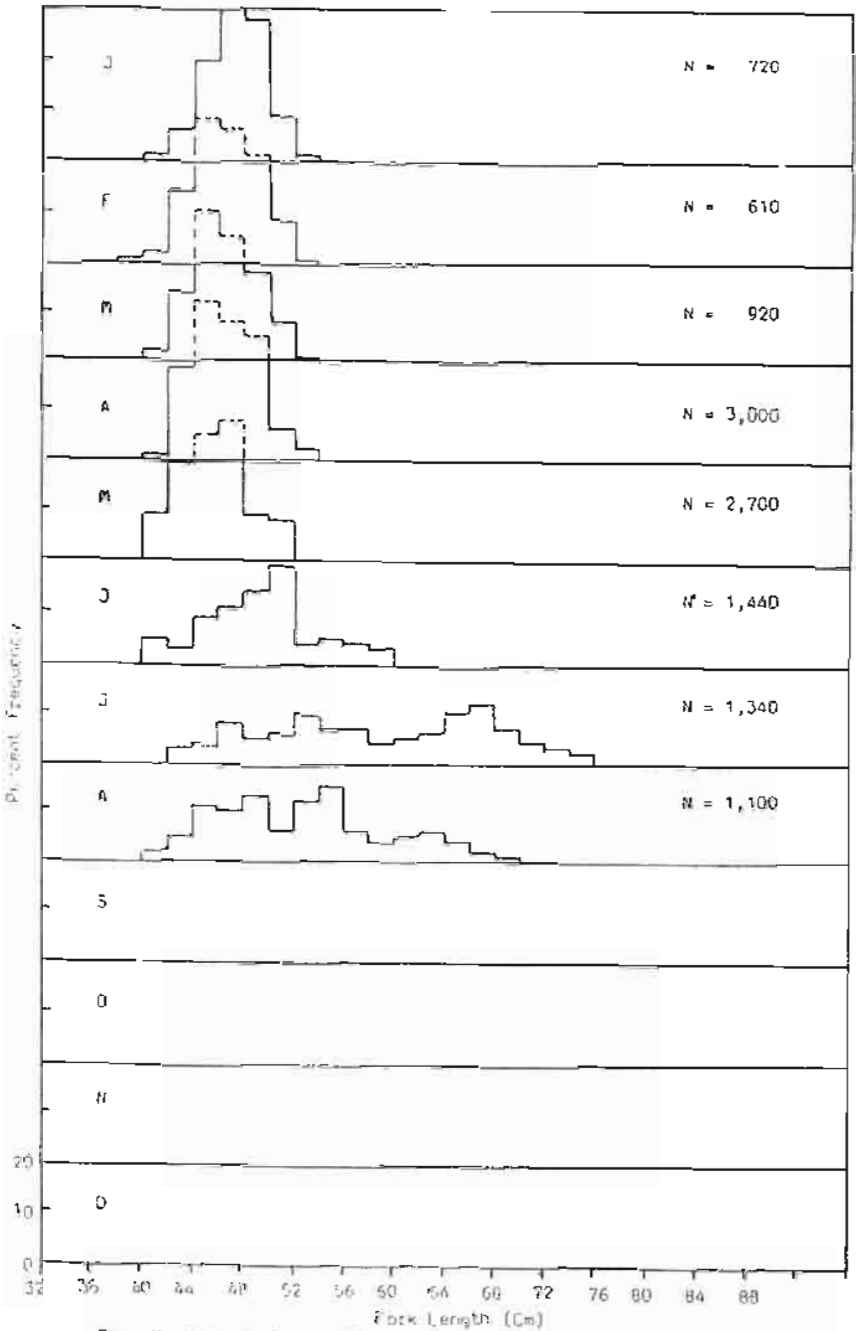


Fig. 9. Monthly length-frequency distributions of skipjack tuna caught by small purse-seine in Banda Aceh, 1987.

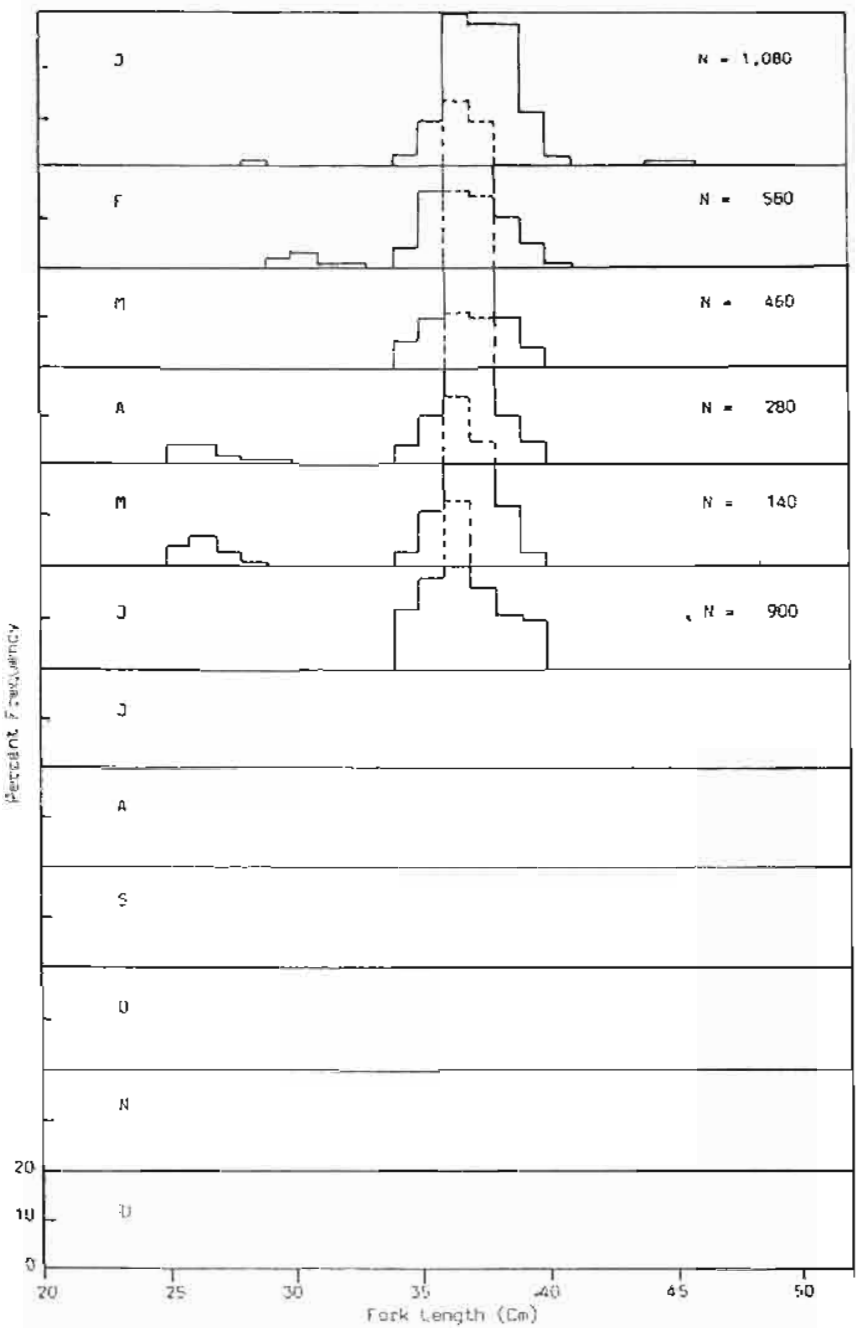


Fig. 10. Monthly length-frequency distributions of Kawakawa caught by small purse-seine in Banda Aceh, 1987.

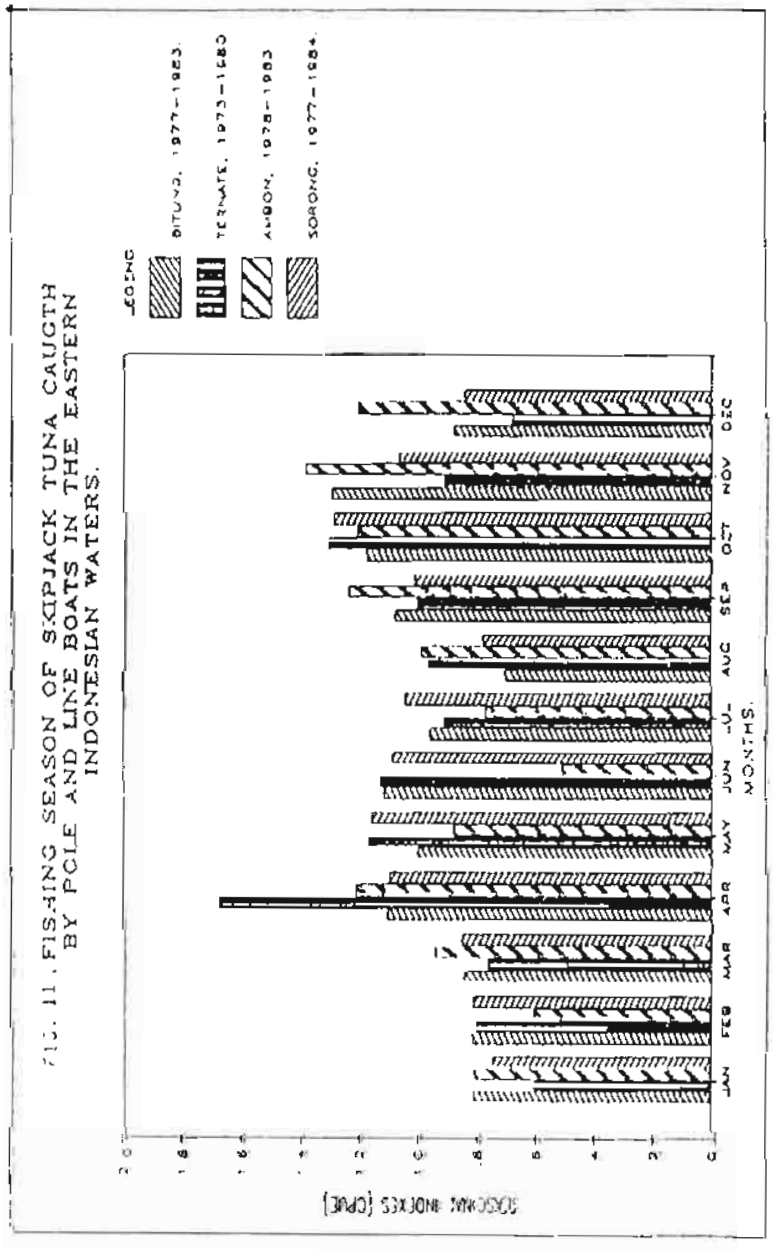


FIG. 11. FISHING SEASON OF SKIPJACK TUNA CAUGTH BY POLE AND LINE BOATS IN THE EASTERN INDONESIAN WATERS.
LEGEND
BITUNG, 1977-1983.
TERNATE, 1975-1980
AMBON, 1978-1983
SORONG, 1977-1984.
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTHS.
CATCH/DAY INDEXES (CPUE)

STATUS REPORT OF MALAYSIA

INDO-PACIFIC TUNA DEVELOPMENT AND MANAGEMENT PROGRAMME (IPTP)

THIRD MEETING OF TUNA RESEARCH GROUPS

IN

THE SOUTHEAST ASIAN REGION

by

CHEE PHAIK EAN and ABDUL HAMID YASIN

22nd. - 25th. August, 1988

Kuala Terengganu, Malaysia.

STATUS REPORT - MALAYSIA

1. Review of significant fisheries development during the past year.

With the completion of the deep sea fisheries resources survey in the waters of the Malaysian Exclusive Economic Zone (EEZ) (Anon. 1987), there has been considerable interest generated within the fishing industry for exploiting the available fisheries resources in this area. The results obtained from this survey coupled with information collected from economic viability studies carried out in the deep sea areas not commonly exploited by local fishermen, showed that there is potential for further developing the deep sea fisheries resources in Malaysia particularly in the South China Sea area.

The most significant development in the tuna fishery in 1987 is the launching of a commercial fishing fleet and the exploration of new fishing grounds.

2. Progress and/or difficulties in the collection of statistics during the past year.

2.1 Progress

2.1.1 The number of boats sampled were about the same number as in the last year. Landings from troll lines, gill nets and purse seines were sampled in order to obtain a good representation of the size frequency of the tuna species caught. The estimation of the landings of tuna by gear was done by direct observation. The majority of the boats however still fished for tuna using trolling lines.

2.1.2 The number of tails of fish measured per species was restricted wherever possible.

2.1.3 The actual fishing effort exerted could not be estimated although the data on the number of gears and fishing boats licensed were available.

2.1.4 All raw data collected under this project were entered into computer using specified software provided by IPTP and the floppy disks were sent to IPTP regularly.

2.2 Difficulties

2.2.1 A large number of fishing boats come back to the landing site at the same time. Sampling of the fish has to be done very fast as the fish has to be sold immediately. At the landing site, direct observation to estimate the total catch of a large number of boats cannot be made because the boats will leave as soon as the fish has been landed to allow other boats to land their catch.

2.2.2 The speed at which the fish is being sold does not allow for a large number of fish to be sampled and measured. Weighing a sufficient number of fish has the same problem. Since the fish is handled so quickly, only a few fish can be handled. Additional samplers are needed to adequately sample the required number of fish and boats.

2.2.3 It is difficult to ascertain the actual fishing grounds where the boats operate. Most of the boats sampled do not have proper navigational equipment. Thus it is difficult to tell where the fish were actually caught.

2.2.4 Very little data on the actual fishing effort is available. The difficulties of collecting good effort data are well known.

2.2.5 The statistics on the landings of tuna for Malaysia are not categorised by species. Since the species distribution for Peninsular Malaysia is different from Sabah and Sarawak, it would be useful for the statistics collected to be categorised by species.

3. Catch and effort trends

3.1 Catch

Figure 1 shows the landings of tuna in Malaysia from 1970. A general increase in the landings could be observed from 1970. In 1987, the landings of tuna reached approximately 29,000 tonnes; the main increase came from the East Coast of Peninsular Malaysia (Annual Fisheries Statistics 1970 - 1986, Annual Fisheries Statistics 1987, in press).

The increase in tuna landings could be attributed to the increased exploitation of areas in the South China Sea that were previously not commonly frequented by our local

fishing boats. With the encouragement by the government, local fishermen have now started to venture further out to sea to fish using improved fishing gears. The mainstay of the tuna fishery off the East Coast of Peninsular Malaysia is still the longtail tuna, *Thunnus tonggol*.

A fishery for oceanic tuna looks promising in the EEZ off Sabah and Sarawak.

For the year 1987, the landings of tuna at Pulau Kambing, Kuala Terengganu by gear type and month as monitored under this project, are shown in Table 1. It can be seen here that there were two peaks observed i.e. one in June and the other in October 1987.

Table 2 gives the species composition of the landings of tuna at Kuala Terengganu in 1987. The dominant species was the longtail tuna. This was followed by the kawakawa and then by frigate tuna.

3.2 Effort

Table 3 gives the number of fishing gears licensed in 1987. It is not possible to allocate the actual fishing effort to the tuna fishery because generally these gears are not species selective and the multi-species nature of the fish stocks makes it difficult to partition the fishing effort.

4. Current research

As has been previously mentioned, more emphasis has been placed on exploratory fishing to map out new potential fishing grounds in the Malaysian EEZ. This is important since the Malaysian EEZ can be rationally exploited for fisheries resources to meet the increasing demand for fish proteins as food and to cut down on the imports of fish by the country.

Since the potential for development of the deep sea fisheries lies in the South China Sea area, current research is being focussed in this area.

Among the important studies undertaken were the experimental fishing trials using the Malaysian research vessel K/K MANCHONG in the waters off Sabah and Sarawak (Gambang and Chong 1988). One of the activities covered was to map out the distribution of tuna species in this area.

Besides these, experiments using payaos as aggregating devices were also undertaken. Preliminary results show that the payaos are efficient for aggregating fish and further work is being done presently to compare these payaos with traditional fish aggregating devices.

Biological information on the major tuna species e.g. *Thunnus tonggol* is being collected. Analysis of length frequency data is also being attempted to gather relevant information for the proper assessment, exploitation and management of the tuna fishery in Malaysia.

5. References

Annual Fisheries Statistics 1970 - 1986. Kementerian Pertanian Malaysia. Kuala Lumpur, Malaysia.

Annual Fisheries Statistics 1987 (in press). . Kementerian Pertanian. Kuala Lumpur, Malaysia.

Anonymous 1987. Deep sea fisheries resources survey within the Malaysian Exclusive Economic Zone. Jabatan Perikanan. Kementerian Pertanian Malaysia. Kuala Lumpur, Malaysia.

Gambang A. C. and G. C. M. Chong 1986. K/K MANCHONG activities off-shore. Paper presented at the Seminar Penyelidikan Perikanan. Penang. 28 - 29 June 1986

Figure 1: Landings of tuna in Malaysia

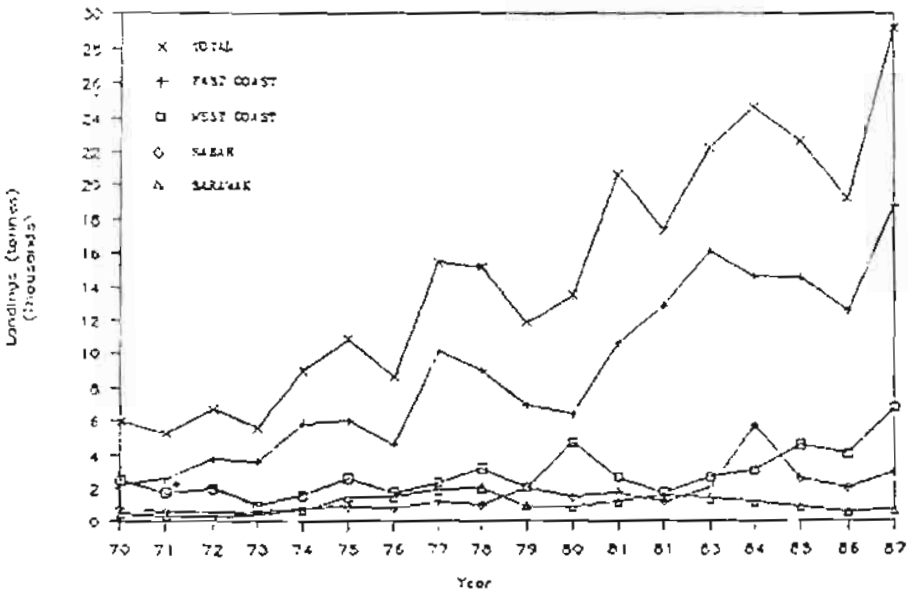


Table 1: Monthly landings of tuna (kg) by gear type and month at Pulau Kambing, Kuala Terengganu in 1987.

Month	Gear type				
	Gill net	Hook & line	Purse seine	Trawl	Total
January	328	4491.5	53	0	4872.5
February	1458	8671.0	0	0	10129.0
March	714.0	13276.0	100	0	14090.0
April	884.5	24696.1	1350	0	27129.6
May	3411	20571.5	15000	0	38982.5
June	1771	28591.3	0	0	30362.3
July	0	19020.5	650	0	19676.5
August	1045	11562	1050	0	13657
September	0	35892	625	0	36517
October	1498	45826.5	1375	0	48699.5
November	0	31268	310	740	32318
December	0	4132.2	0	0	4132.2
Total	12538.5	247505.4	20513	740	281296.9

Table 2: Species composition of tuna landed at Kuala Terengganu in 1987

Month	Species		
	Longtail	Frigate tuna	Kawakawa
January	57.5	1.7	40.8
February	80.6	0.9	18.6
March	44.5	2.1	53.3
April	30.8	3.0	66.2
May	42.2	12.2	45.5
June	45.5	7.7	46.8
July	63.1	8.8	28.1
August	66.0	6.9	27.1
September	61.4	0.9	37.7
October	57.6	0.1	42.3
November	71.9	28.1	0
December	2.8	97.0	0.1

Table 3: Number of fishing gears licensed at Kuala Terengganu in 1987.

Month	Purse seine	Trawl	Gill net	Hook & line
January	5	30	3	17
February	4	58	3	17
March	10	9	9	32
April	9	10	13	73
May	1	9	1	5
June	2	3	3	8
July	5	0	2	9
August	2	1	1	2
September	0	0	1	1
October	1	0	2	0
November	1	0	0	5
December	0	0	0	6

STATUS REPORT OF THE TUNA FISHERIES IN SABAH, MALAYSIA

By Edward Rooney Biusing, Joseph Wong Tung Sang
and Rayner Stuel Galid

ABSTRACT

Catch statistics breakdown of tuna and seerfishes based on fishing regions in Sabah for the 1978 - 1986 period are presented in this paper. Annual tuna landings fluctuated between 1000 - 4700 metric ton (1978-1986 period). As for seerfishes, annual landings fluctuated between 4000 - 11 000 metric ton (1978-1986 period).

The bulk of the tuna and seerfishes catches in this region comes from the East Coast, contributing respectively about 71% and 52% of the total landings. The major tuna fishing ground in Sabah is in Semporna (52% of total landings). As for seerfishes, most of the catch are landed in the Kota Kinabalu (1477 metric ton : 23%), Sandakan (1285 metric ton : 20%), Semporna (1079 metric ton : 17%) and Kudat (917 metric ton : 14%) districts.

Oceanic tuna species landed are represented mainly by Bigeye tuna (Thunnus obesus), Yellowfin tuna (T. albacares), Albacore (T. alalunga) and Skipjack (Katsuwonus pelamis). And for coastal tuna species, the main bulk of the catch consist of longtail tuna (T. tonggol) and kawakawa (Euthynnus affinis).

For seerfishes (spanish mackerels), common species that are landed are represented mainly by 3 species, i.e. Scomberomorus guttatus, S. lineolatus and S. commersoni.

The principal fishing methods used to catch tunas are purse seines and hook & line. The purse seiners are usually operated by using FAD's and light boats. As for seerfishes, floating gillnets and trolling are the two main fishing methods used.

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3/ Senior Fisheries Officer (Marine),
Department of Fisheries, Kota Kinabalu

I. INTRODUCTION

The tuna and mackerel (seerfishes) fisheries in Sabah play an important role in the development of the local marine fishing industry. In 1986, landings of tuna related and seerfishes was reported about 13% (7200 metric ton) of the total fish production in the state valued approximately about $MR 14,100,000 (Fisheries Department of Sabah Annual Report, 1988). The existence of large tuna related species caught around Sabah waters indicated that the local tuna fisheries in this region has a good potential for future development.

II. FISHING GROUNDS

The tuna and seerfishes fishing grounds of Sabah are treated here as three unit stocks, i.e. the West Coast, East Coast and Kudat Regions. The fishing grounds off the West Coast faces the South China Sea, the East Coast facing the Sulu and Celebes seas, and the Kudat Region bounded by the South China and Sulu seas. In the west and north (Kudat) of Sabah, a deep water trench comes in from the north east and runs parallel along the coast. The trench has steep sides and the depth of the water exceeds 2000 m. This kind of bathymetric feature usually has tuna associated with it. Off the east coast of Sabah, the depth of the water exceeds 1000 m within 13 nautical miles of Semporna. This area is a rich tuna fishing ground

III. ANNUAL CATCH STATISTICS

Catch statistics breakdown of tuna and seerfishes for this 3 regions during the 1978 - 1986 period are presented in Appendix B (Table 1 and 2). The average (1978-1986 period) catch breakdown (in percent) of tuna-like and seerfishes based on fishing grounds are presented in Appendix C (Figure 1 - 3).

The average landings of tuna-related species for this period was estimated about 2265 metric ton. Most of the tuna landings (71% : 1570 metric ton) comes from the East Coast. The chief tuna fishing ground in Sabah is in the Semporna District (average landings : 1165 metric ton), which contributed about 68% of the total tuna landings on the East Coast or about 52% of the total tuna landings in Sabah. On the other hand, the West Coast region only contributed about 20% (447 metric ton) of the total tuna landings in the state, landed mainly in Kota Kinabalu (45%) and in Kuala Penyu (27%).

The average landings of seerfishes (spanish mackerels) for this period was estimated about 6755 metric ton. The bulk of the landings comes from the East Coast (3599 metric ton : 53%). The landings of seerfishes on the West Coast was estimated about 2325 metric ton (35%). On the East Coast, the main fishing ground are in Sandakan (1285 metric ton), Semporna (1079 metric ton) and in Tawau (917 metric ton). On the West Coast, most of the seerfishes are landed in Kota Kinabalu (1479 metric ton).

IV. SPECIES COMPOSITION

The main tuna landings in Sabah consists of oceanic species, among others, are the Bigeye Tuna (Thunnus obesus), Yellowfin Tuna (Thunnus albacares), Albacore (Thunnus alalunga) and Skipjack (Katsuwonus pelamis). As for coastal species, the main bulk of the landings consist of longtail tuna (Thunnus tonggol), Kawakawa (Euthynnus affinis) and Frigate tuna (Auxis thazard).

As for seerfishes (spanish mackerels), the main bulk of the landings are being represented by 3 species, i.e. Scomberomorus lineolatus, Scomberomorus guttatus and Scomberomorus commersoni. In Semporna, S. commersoni represented more than 50% of the seerfishes caught. On the West Coast, the bulk of the catch of seerfishes are represented by S. lineolatus and S. guttatus.

V. PRINCIPAL FISHING METHODS USED

The principal fishing methods used to catch tuna in Sabah are purse seining and using hook and line. The purse seiners are usually operated by using FAD's and lightboats. As for seerfishes, the main fishing gear used by fishermen are the floating gillnet and trolling. In 1986, breakdown of fisheries licenses issued by the Sabah Fisheries Department for fishing gears that are associated with tuna and seerfishes fishing are : gillnets (693 units), purse seiner (83 units), hook and line (228 units) and long line (33 units). Breakdown of these licensed fishing gears related to tuna and seerfishes fishery based on fishing grounds are presented in Appendix 6 (Table 3).

VI. MARKETING

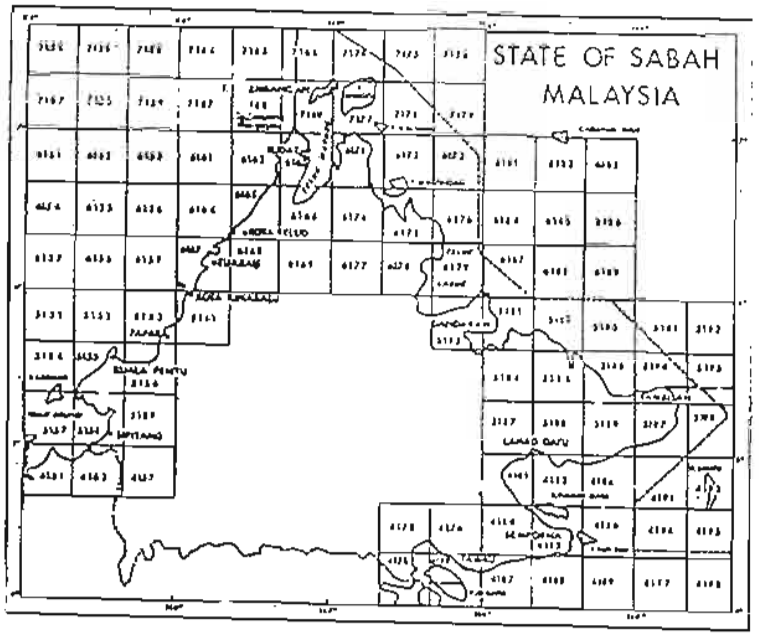
In Sabah, only a small proportion of the smaller type of tuna species (kawakawa and longtail tuna) are consumed locally. Most of the large species are being exported to other countries. Most of the tuna exports in Sabah are being handled by SAFMA (Sabah Fish Marketing Sdn. Bhd.) a private company owned by the state government since it was first formed in 1983. This company has at present two (2) fisheries complex in Kota Kinabalu and in Semporna equipped with cold storage facilities to handle the large volume of tuna landed daily. Prior to this, most of the tuna catches (yellowfin, skipjack and bigeye) on the East Coast (Semporna Region), are being shipped directly to the Philippines by carrier vessels for canning. As for seerfishes, most of the catch are being utilized for local consumption.

VII. FUTURE DEVELOPMENT

The availability of large tuna related species off Sabah waters indicates the possibility of developing the local tuna fishing industry for exports for the sashimi and katsuboshi markets. With the existence of SAFMA Sdn. Bhd. with its modern post handling facilities, and proper handling techniques being introduced and taught to local fishermen, indicates that a bright future lies ahead for the tuna fishery in Sabah.

VIII. RECOMMENDATIONS

The need to conduct proper biological research on tunas and close monitoring of the CPUE trend of the fishery in Sabah should be emphasized. The state Fisheries Department will be conducting an intensive research on this fishery in the near future.



Appendix 5

Table 1. Estimated Production of Tuna in Sabah during the 1978-1986 Period (units : metric ton)

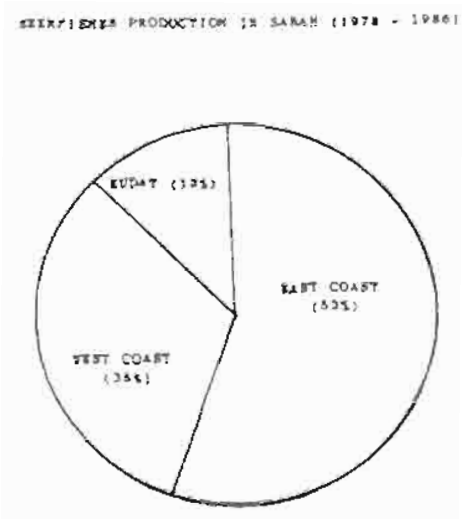
District	1978	1979	1980	1981	1982	1983	1984	1985	1986
East Coast	857	1607	1085	768	605	1023	4696	1951	1561
West Coast	122	253	220	575	404	716	664	452	594
Kudat	41	140	195	337	191	261	340	197	145
Total	1000	2000	1500	1700	1200	2000	5700	2600	2300

Table 2. Estimated Production of Seerfishes in Sabah during the 1978 - 1986 Period (units : metric ton)

District	1978	1979	1980	1981	1982	1983	1984	1985	1986
East Coast	7118	3729	3269	4532	3764	3820	1538	2206	2418
West Coast	3220	1766	1704	1576	3006	3953	2206	1363	2138
Kudat	662	1005	1027	892	1730	1227	456	341	354
Total	11000	6500	6000	7000	8500	9000	4200	4000	4900

Table 3. Breakdown of Licensed Fishing Gears Related to Seer fishes and Tuna Fishery in Sabah based on Fishing Grounds in 1986

Fishing Gear	East Coast	West Coast	Kudat	Total
Purse Seine	71	11	1	83
Gillnet	198	457	38	693
Handlines	113	68	47	228
Long Line	28	5	-	33
Total	410	541	86	1037



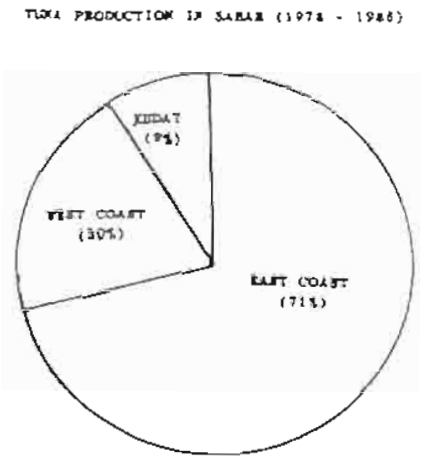
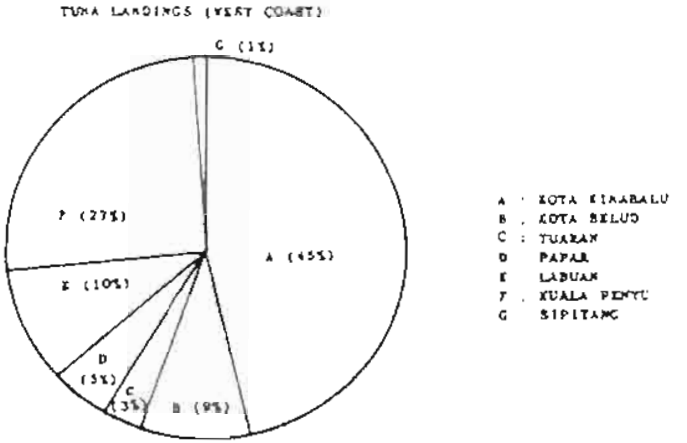


Fig. 1. Breakdown of Tuna and Seerfishes Landings based on Fishing Regions (1978 - 1986 Average)



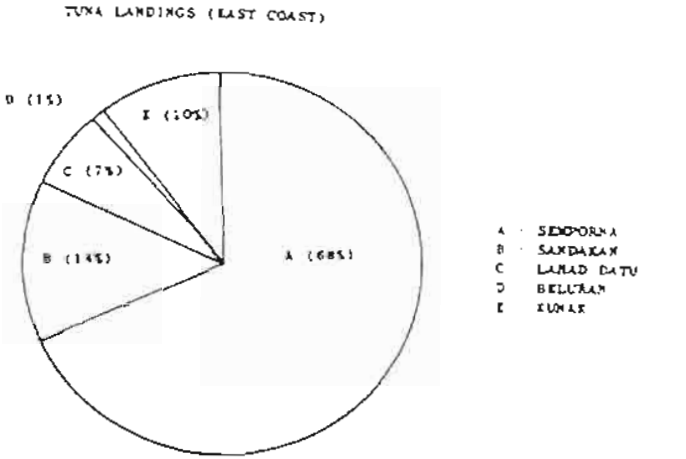
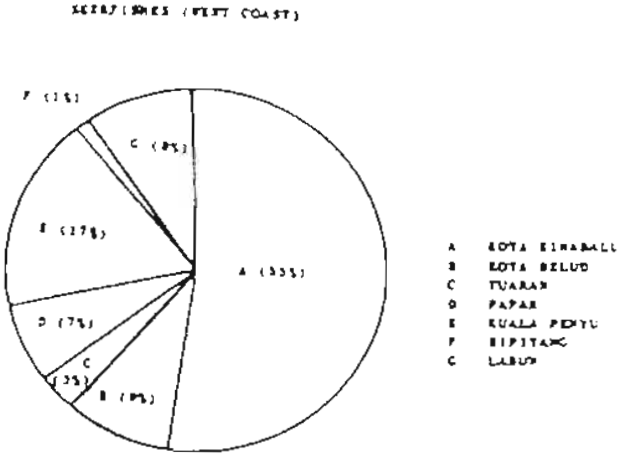


Fig. 2. Breakdown of Tuna Catches (1978 - 1986 Average) based on Fishing Districts and Regions



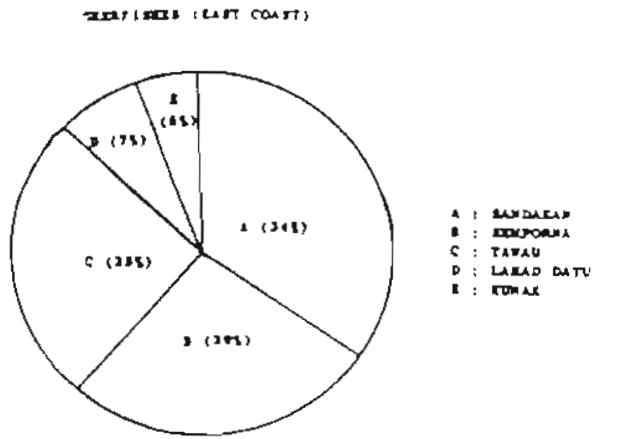


Fig.3. Breakdown of Seerfishes Catches (1978 - 1986 Average) based on Fishing Districts and Regions

Appendix 6

Experience & Research Papers Presented:

6.1 Trend of tuna catches and profiles of tuna fisheries in the Southeast Asian region.

by T. Sakurai

6.2 A review of the tuna fisheries in the Gulf of Thailand and off the east coast of Peninsular Malaysia.

by M. Yesaki &
T. Nishida.

6.3 Log book survey of tuna longline fishery in Indonesian waters.

by K. Ishida &
T. Yamamoto.

6.4 Current status of tuna/tuna-like fisheries in Peninsular Malaysia.

by S. Hayase.

6.5 Analysis on the utilization of the rumpon as fish aggregating device on the skipjack tuna fisheries in Indonesia.

by D.R. Monintja.

6.6 Experiment on drift gillnets for tunas.

by Y. Matsunaga &
S. Soodhom.

6.7 Parasites of tuna of the South China Sea and their use as biological indicators.

by F. Shahrom,
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H. Yasin

6.8 The skipjack tuna (K.pelamis) fisheries of the Philippines: changes in catch volumes and size composition.

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6.9 Occurrence and distribution of larval tunas in Ragay Gulf, Burias Pass, Ticao Pass and waters north of Samar Sea.

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6.15 Observations on skipjack (Katsuwonus pelamis) and yellowfin tuna (Thunnus albacares) in the Andaman Sea of Thailand.

by W. Pokapunt &
P. Sawasdiworn.

TREND OF TUNA CATCHES AND PROFILES OF TUNA FISHERIES IN THE SOUTHEAST ASIAN REGION

by

T. Sakurai

ABSTRACT

The Southeast Asian region consisting of the Philippines, Indonesia, Thailand and Malaysia is one of the rich areas in the world in tuna and tuna-like species resources. IPTP/FAO statistics shows that the total catch of the region was 695 thousand MT for 1985 which was more than that of Atlantic Ocean and Indian Ocean being 604 thousand MT and 495 MT respectively. The total catch of tuna and tuna-like species in the region has increased from 300 thousand MT in 1976 to 706 thousand MT in 1986. It became more than twice for the past ten years and this increasing tendency is still continuing at present.

In the region, there are 10 major species of tuna and tuna-like species including 6 species of tuna, 2 species of seerfish and 2 species of billfish, of which dominant tuna species are skipjack tuna, yellowfin tuna, frigate tuna, bullet tuna, longtail tuna and kawakawa. There are many types of fishing gear engaged in capturing tunas in the region. The major types of gear used in the region are purse-seine, pole and line and gillnet.

The trend of the catch by species and by gear are discussed on regional and country basis on their features.

In order to obtain a better understanding of their importance and diversity, country profiles showing total catch by species and gear, number and size of fishing boat, fishing grounds, etc., are described on maps which are excerpts from the 'Atlas of the Tuna Fisheries in the Indian Ocean and Southeast Asian Regions', published by IPTP in May 1988.

A review of the Tuna Fisheries in the Gulf of Thailand and off the east coast of Peninsular Malaysia

by

M. Yesaki & T. Nishida

ABSTRACT

Tuna are captured by gillnet and purse-seine fisheries in the Gulf of Thailand and by troll, gillnet and purse-seine fisheries off the east coast of Peninsular Malaysia. Available information of effort, catch, species and size compositions of tuna landings by Thai gillnet and purse-seine fisheries and Malaysian troll fishery were reviewed. Tuna landings in the Gulf of Thailand increased markedly in 1983 to 82,000t and has remained at this level. There has been a general shift in gillnet and purse-seine effort from inside the Gulf of Thailand during the seventies to the entrance and middle of the Gulf during the first half of the eighties. Available catch rate information does not conclusively show changes in the relative abundance of tunas. However, evidence indicates a change in species composition with decrease in the percentage of longtail in gillnet catches and a slight increase in the percentage of frigate tuna in purse-seine catches. The mean size of longtail and kawakawa has decreased from 1977 to 1987, especially in the purse-seine catches.

Tuna landings from the east coast of Peninsular Malaysia has ranged between 12,000t and 19,000t since 1981. Available information does not indicate changes in catch rates and species composition. Mean size of troll caught longtail and kawakawa at Kuala Trengganu, on the other hand, has increased from 1983 to 1987.

LOG BOOK SURVEY ON TUNA LONG LINE FISHERY IN INDONESIAN WATERS [1)2)]

By

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and

Tadashi Yamamoto
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Contents:

1. Introduction
2. Objectives
3. Organization responsible for the survey
4. Survey objectives
5. Survey items and classifications
6. Survey forms and principles
7. Tabulation programme
8. Estimate to catch and fishing effort not reported
9. For implementation of the programme
References
Tables,figures and appendix lists

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1. Paper presented on the second Southeast Asian tuna conference and the third meeting of tuna research groups in the Southeast Asian region, 22 - 25 August 1988, Kuala Terengganu, Malaysia

2. Paper prepared by in close collaboration with Indonesian fisheries officials

1. Introduction

Indonesia began tuna long line fishing in 1972 (Marcille et al., 1984). Total catch by tuna long line reached to more than 9000 MT in 1987. Seventy national and twenty one foreign tuna long line boats are operating in Indonesian water in early 1988 (Table 1.*). However, catch and effort data collection for this fishery is not implemented satisfactorily by any of authority.

IPTP introduces a catch report (log book) system for tuna long line fishing to Indonesia as a part of work " Improvement of tuna fishery statistic in Indonesia".

Preparation work started in March 1988. The survey will commence in January 1989 (Table 2.). The present paper deals with a new tuna long line fishing survey programme in Indonesia.

2. Objectives of survey

- To provide data necessary for the management of tuna long line fishery as well as the stock assessment of tuna resources in Indonesian waters.
- Make data comparable between Indonesia, Taiwan and Japan.
- This survey will be designed so as to act as a data source for the current Indonesian national fishery statistical system.

3. Organizations responsible for the survey and statistics

Both the Directorate General of Fisheries (DGF) and the Research Institute for Marine Fisheries (RIMF) is responsible for the implementation of the survey by sharing the works in the following manners:

3.1. The DGF is responsible for the implementation of the survey as a part of its National Statistical System for current fishery statistics through its administrative channel.

3.2. The RIMF is responsible for data processing and analyses on those which were reported by tuna long line operators through the survey.

4. Survey objectives

All fishing boats engaged in tuna long line fishery in Indonesian waters, regardless of the nationality of boats are

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* : Appendix list 1

covered by survey. Indonesian water refers to both her territorial water and exclusive economic zone (EEZ)

Thus the following are to be covered:

(a) All national tuna long line boats flying Indonesian flag regardless of whether a fishing license was issued by the DGF or the Dinas Perikanan Province (DPP. Fisheries office in provincial level.) A tuna long line boat operated by a joint venture company is also included herein, if such a case become available.

(b) All foreign tuna long line boats which were allowed to fish in Indonesian water with a fishing permit granted by the Government of Indonesia. (The survey covers such foreign boats only when they fished in Indonesian water. Therefore, foreign vessels operated entirely outside of Indonesian water are excluded from the survey.)

5. Survey items and classifications

5.1. Survey items

The survey covers the following items.

i. No of fishing establishment
ii. No of fishing boats
iii. No of trips
iv. No of days absent and days fished
v. No of long line sets used
vi. No of hooks used
vii. Type of bait used
viii. Depth of long line set from the surface of the sea
ix. Catch by species in numbers, quantity and value
x. Port of landing

5.2. Classification

The survey uses the following classifications:

i. Classification of fishing boat by sizes (Table 3)
This definitions are exactly same as those which were established for national statistical system.
ii. Species classification (Table 4)
iii. Fishing area classification (Fig. 1)

The following two types of fishing area are used:

(a) Unit area : One degree square is used as a unit fishing area to study the distribution of catch, fishing effort and possibly the migration route of tunas.

(b) Block area : By grouping neighboring unit fishing areas, block fishing areas are established to do macro-study of tuna fishery resources.

A code number is established for each unit fishing area by referring to a latitude and a longitude at the left and bottom corner of respective unit fishing area. However, for the Northern hemisphere 1 is added before the latitude, whereas for the Southern hemisphere 2 is added before the latitude.

6. Survey forms and their principles

Beside survey forms developed for the on-going National Fishery Statistical System, another two new forms, "Catch Report for Tuna Long line Fishery" and "Catch Report Recovery Check Form" will be used in the present survey.

6.1 Catch report for tuna long line fishery (Fig. 2)

The operator of tuna long line boat is responsible for completing "Catch Report" and forwarding it to the Dinas Perikanan Regency (DPR. Fisheries office in regency level.) by the end of a month subsequent to a month when a trip was completed. Thus, e.g. the catch report for a trip which was completed on any day of May has to be forwarded to the DPR by the end of June.

When a tuna long line operator has two offices at two different ports and his tuna boat changes its landing port from time to time due to the seasonal change of tuna fishing grounds, his main office which is fully in charge of the fishing operation and keeps the records of all fishing operation is responsible for reporting the catch report regardless of whether catch was landed at her home port or other port. Thus, e.g. when a tuna boat is primarily based at Benoa of Denpasar but operates occasionally based at Jakarta, her main office located in Denpasar is always responsible for the reporting of the catch report to DPR Denpasar regardless of whether catch was landed at Benoa or Jakarta.

The catch report is prepared for each trip separately. When a trip is made over two consecutive months, e.g. from May 21 to June 5, the catch report for this trip is prepared in June covering fishing effort and catch of both May and June. When a boat made two trips in a same month e.g. from 5 to 10 and from 15 to 23 in June the catch report for these trips has to be prepared for each trip separately.

6.2. Catch report recovery check form (Table 5)

Dinas Perikanan of any regency (DPR) which governs any main office of tuna long line operator within its jurisdiction is responsible for the recovery of all catch reports regardless of whether their catch was landed to that regency or other regency. To ensure the complete recovery of all the catch reports, the DPR uses Recovery Check Form.

6.3. Forwarding catch report to DGF via Dinas Perikanan Province

The catch reports together with a photo copy of the related recovery check form are forwarded to the DGF via Dinas Perikanan Province (DPP) by the end of a month which is two months after the month when a trip was completed. Thus, e.g. the catch report of a trip which was completed in May should be forwarded to the DGF by the end of July.

6.4. Relationship between catch report and on-going national fishery statistical system

According to the on-going national fishery statistical system the tuna long line fishery is supposed to have been covered under marine fishery survey with the use of the survey form SL-3 (Table 7.) (abbreviated as SL-3). This survey system will still continue in parallel with the present new tuna long line vessels will have to complete both the SL-3 and the catch report as newly created in the present survey and is responsible for forwarding them to respective DPR.

In the on-going national fishery statistical system and corresponding trip are to be counted at a landing place where the catch was landed regardless of the port where the boat has been registered. This principle should be strictly followed even for tuna long line fishery.

So as to cope with this principle the main office of tuna longline boats should prepare a separate SL-3 and submit it to the respective DPR. when his tuna boat landed the catch to port other than home port. For an example, when a tuna boat officially based at Benoa under the management of its main office at Denpasar landed the catch at Jakarta, the main office at Denpasar is responsible to submit that SL-3 directly to the DPR which takes care of Jakarta harbour.

7. Tabulation Programme (Appendix List 2)

The aims of the tabulation programme is to provide a set of tables for the use of economic and biological analysis.

8. Estimation to Catch and Fishing Effort Not Reported

This estimation works will be made on calendar month basis by applying raising factors to the catch and fishing effort tabulated in terms of size of boat, type of bait, unit area.

So Estimated fishing efforts and catch statistic is obtained:

Catch and effort data collected

by

[Size of boat]
[Type of bait fish] X Raising factor
[Unit area (1 square]
[Month]

The raising factor will be obtained by dividing the total number of trips including the number of trips not submitted the catch report by the number of trips for which the catch reports were submitted. This factor will be prepared separately, by size of boats and by major fishing area, for three sea areas, Pacific Ocean (Northern outside of Indonesian Archipelago), Banda Sea (Indonesia Archipelago water) and Indian Ocean (Southern out side of Indonesian Archipelago). These original data will be obtainable from the Catch Report Recovery Form.

$$\text{Raising factor} = \frac{\text{Number of trips submitted to the official}}{\text{Number of trip actually taken}}$$

9. For implementation of the programme

All the work follow time schedule shown in Table 2. The result will be published by the authority possibly on yearly basis.

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Table 1. Number of tuna long line boats operating in Indonesia water as of April 1988

Size of boat (GT)	Total	Nationalities				
		Indonesia	Taiwan	Honduras	Thailand	S. Korea
Total	31	20	8	5	7	1
20 - 30	2				2	
30 - 50	13	8		1	4	
50 - 100	9	6		3		
100 - 200	21	18	3			
> 200	30	24	5			1
Not known	16	14		1	1	

Data Source : DGF and personal communication

Table 2. An overall work schedule for tuna longline survey in Indonesia

Activity	'88										'89	
	3	4	5	6	7	8	9	10	11	12	1	2
1. First preparatory period (2 months)	———											
2. First short term consultant service (2 weeks)			—									
3. Second preparatory period (3 months)				———		———						
4. Second short term consultant service (2 weeks)							—					
5. Third preparatory period (3 months)								———		———		
6. Commencement of survey											———	

1. Preparation of general status of tuna longline fishery, including list of tuna longline boats, fishing permit for foreign vessels, making of draft catch report.
2. Establish frame work for implementation
3. Prepare forms and related instructions
4. Finalize all drafts
5. Print and deliver forms and instructions

Table 3. Classification of fishing boat by sizes for the use of tuna longline survey in Indonesian wate:

Size class of boat Unit : GT
10 - 20
20 - 30
30 - 50
50 - 100
100 - 200
> = 200

Table 4. Species classification for use of tuna longline survey in Indonesian water

Indonesian Name	English Name	Scientific Name
Madidihang/Sisik	Yellowfin tuna	*Thunnus albacares*
Matabesar	Bigeye tuna	*T. obesus*
Albakora	Albacore	*T. alalunga*
Tuna sirip biru	Southern bluefin tuna	*T. maccoyii*
Setuhuk hitam	Black marlin	*Makaira indica*
Setuhuk putih	Indo-pacific blue marlin	*Makaira mazara*
Setuhuk loreng	Striped marlin	*Tetrapturus audax*
Ikan tumbuk	Shortbill spearfish	*T. angustirostris*
Ikan layaran	Indo-pacific sailfish	*Istiophorus platypterus*
Ikan pedang (todak)	Swordfish	*Xiphias gladius*
Cakalang	Skipjack tuna	*Katsuwonus pelamis*
Cucut moro	Shortfin Mako	*Isrus oxyrinchus*
Cucut/hiu	Sharks NEI	--

English names are quoted from FAO species catalogue (1983, 1985)

Table 5. Monthly tuna catch report recovery check list

	Name of company	Name of boat	GT	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov	Dec
(e.g.)	P.T. Samudra	Samudra No.1	100	10____	__5 23__	__5		3____20							

Name of fisheries office:

Table 6. Reporting form by fishing company or fish auction market (after Yamamoto, 1980)

Type of Gear ..... Month ..... Year .....

Name of Organization .....

Province ..... District .....

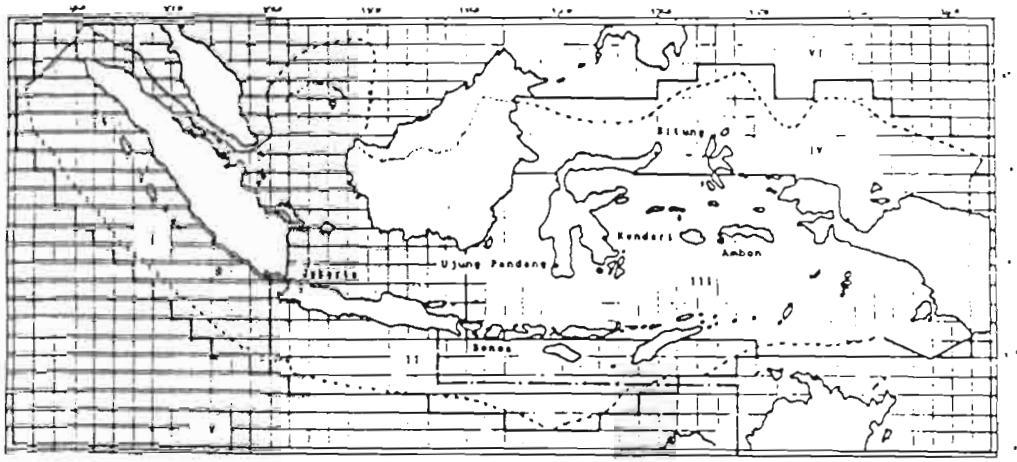
1. No. of Trips 2. Catch by Species

Size of Boat			Species	Quantity (kg)	Value (Rp)	£	Price (Rp)
(1)			(2)	(3)	(4)	(5)	(4)/(3)
Non-Powered Boat	Small		Total	(7)		(8)	
	Medium						
	Large						
Out-board Powered Boat							
In-board Powered Boat	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						
	[illegible]						

Note

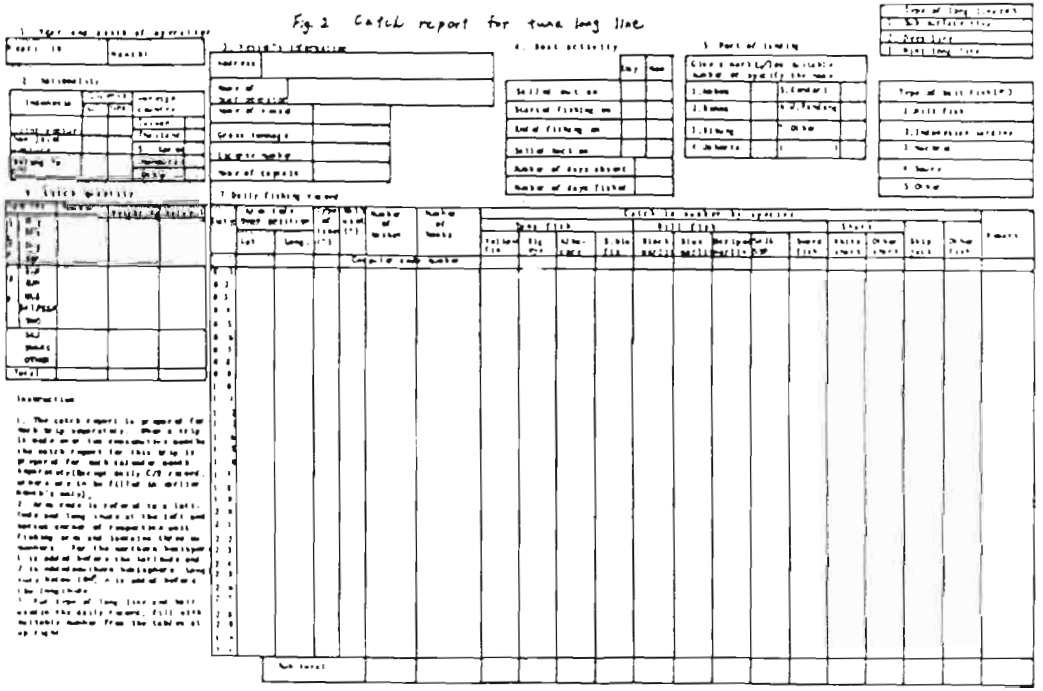
1. This form is used for fishing companies for which L-I survey is applied and all fish auction market regardless of whether L-II or L-III survey is applied.
2. This form is prepared on monthly basis for each type of fishing gear separately.
3. Catch in quantity reported by fish auction market for which L-II survey is applied is used as base of ratio estimation.
4. Catch in quantity and the number of trips which are reported by other fish auction markets are used to estimate average catch per trip for L-III Survey.

Figure 1. Fishing area classification for the use of tuna long line in Indonesia



I - VI : Block area
- - - - - : Exclusive ecomic zone of Indonesia
- - - - - : FAO statistic area

Fig. 2 Catch report for tuna long line



APPENDIX LIST I - A

LIST OF TUNA LONGLINE FISHING BOATS OPERATED IN INDONESIA IN APRIL 1988

Foreign Vessels:

Flag Country	Name of Company (Agency)	Name of Boats	Size of Boats (GT)	Size of Fish Hall (M3)	Operation	Remarks
Taiwan	P.T. Tala Mina Thana Karya Perpanjangan	CHAU FA	153.57	130.49	Pacific	
		No. 201 TANG DAR	356.63	276.35	Pacific	
		SHEN YING NO.3	350.66	315.476	Pacific	
		THAN LONG NO.66	161.60	115	Pacific	
		SIN TA	355.57	442	Pacific	
		TE TANG NO.1	175.82	115	Pacific	
		GOANG DAR	328.96	346	Pacific	
		SHONG CHIANG NO.1	254.98	180	Pacific	
Honduras	P.T. Mina Sapta Samudera	TUNA KING NO.1	49.07	80	Indian Ocean	Based at Jakarta
		TUNA KING NO.2	57.21	100	Indian Ocean	Based at Jakarta
		TUNA KING NO.3 *				
		KINGFORD NO.2	73.41	67	Indian Ocean	
		KINGFORD VII	73.41	67	Indian Ocean	
S.Korea	P.T. Eraska Nova	NO.52 OTANG	433.61	554.18	Indian Ocean	25 Crews
Thailand	P.T. Sari Darma Indah	VICHAI VAREE	24.64	12.67	South China Sea	
		THAI PRABIT 96	34.95	21.24	South China Sea	
		THAI PRABIT 101	30.9	18.43	South China Sea	
		THAI PRABIT 102	30.9	18.92	South China Sea	
		THAI PRABIT 103	37.29	18.46	South China Sea	
		THAI PRABIT	27.39	10.22	South China Sea	
	P.T. Bintan Tiga Sejati	BINTAN SEJATI NO.1 *				

Source: D.C.F. and Personal Communication (*)

APPENDIX LIST 1 - B

LIST OF TUNA LONG LINE BOATS (NATIONAL) IN APRIL 1988

Name of Company	No of Boats	Name of Boats	Size of Boats (GT)	Fish Hold Capacity (M3)	Engine (HP)	Base	Year of Operation Started
1. P.T. SARI SEGARA UTAMA	5	Sari Segara No.1	50	35	280	Benoa, Jakarta	1986
		Sari Segara No.2	50	35	280		1986
		Sari Segara No.3	50	35	280		1986
		Sari Segara No.4	33.73		280		1988
		Sari Segara No.5	33.73		280		1988
2. P.T. BALI RAYA	5	Bali Raya No.1	33.22		220	Benoa, Jakarta	1987
		Bali Raya No.2	33.22		220		1987
		Bali Raya No.3	33.22		220		1987
		Bali Raya No.4	33.97		280		1987
		Bali Raya No.5	33.97		280		1987
3. P.T. INTI AGRO	1	Inti Nusantara 1	313.61		1100	Kupang, Jakarta.	1987
4. P.T. SAPTA MEKAR SEJATI	1	Polaris	34.85		170	Tarakan, Kendari.	1988
5. P.T. ANUGERAH TIMUR SEJATI	1	Anumurti No.1	224.88		850	Ambon, Benoa Jakarta	1988
6. P.T. DIAN SARI BAHTERA	4	Lucia 5	319.16	312.48	1100	Ambon/Jakarta	1986
		Lucia 6	284.68	353.20	1100		1986
		Lucia 7	284.68	338.23	1300		1987
		Nila No.1	314.85	372.48	1300		1987
7. P.T. DOYOT MINA UTAMA	6	Doyomita No.1	253.26	311.00	675	Ambon/Jakarta	1986
		Doyomita No.2	95.27	81.65	700		1986
		Doyomita No.3	194.57	235.39	675		1986
		Doyomita No.5	224.03	239.25	900		1987
		Doyomita No.6	314.90	352.80	1000		1987
		Doyomita No.7	284.89	320.10	1000		1987
8. P.T. SWADAYA NELAYAN	3	Swadaya No.3	650		650	Ambon, Jakarta.	
		Swadaya No.5	650		650		
		Swadaya No.6	650		650		
Sub Total	26						
9. P.T. PERIKANAN SAMODRA BESAR	17	Samodra 02	111	40	370	Benoa/Sabang Jakarta.	1974
		Samodra 03	111	40	370		1974
		Samodra 04	111	40	370		1974
		Samodra 05	111	40	370		1974
		Samodra 06	111	40	370		1974
		Samodra 07	111	40	370		1974
		Samodra 08	111	40	370		1974
		Samodra 09	111	40	370		1974
		Samodra 10	114	44	400		1974
		Samodra 11	114	44	400		1975
		Samodra 12	114	44	400		1975
		Samodra 14	114	44	400		1975
		Samodra 15	114	44	400		1975
		Samodra 16	114	44	400		1975
		Samodra 17	114	44	400		1975
		Samodra 18	114	44	400		1975
		Samodra 19	114	44	400		1975
10. PERUM PERIKANAN MALUKU	1	Perikani 03	59.30	33	400	Ambon, Benoa	1982
11. P.N. PERIKANI SULAWESI UTARA-TENGAH	1	Aertembaga II	99.80	96	470	Aertembaga/ Bitung.	1982
12. P.T. KORAL FISHERY DEV. PMDN	1	Kofide No.1	284.80		1000	Jakarta/Ambon	1986
13. P.T. SUMBER HASLINDO	6	Haslindo I	284.03		1000	Ambon, Jakarta	1983
		Haslindo II	253.65	280.32	1000		1983
		Haslindo III	288.76	462.80	1000		1985
		Haslindo No.5	284.61	464.88	1000		1985
		Haslindo No.6	299.25	405.50	1100		1985
		Haslindo 38	284.26	464.88	1000		1986
14. D.G.F./Research Vessel	1	Tenggiri	300			Jakarta, Benoa	1986
15. A.U.P./Training Vessel	1	Madidihang	300			Jakarta	1988
Total	54						

Companies not registered yet:

P.T. Binamina Karya Perkasa (Base at (Jakarta) - 10 boats (minayasa 01-10)
P.T. Putra Punggawa Samudra (Base at Bali) - 4 boats, operation start 1987
P.T. Mina Sapta Samudra - 1 boat Janata I HP 320 50 GT
1 boat Janata II HP 340 50 GT (expect in May)

Source : D.G.F.
Simorangkir (1982)

APPENDIX LIST 2

List of tabulation programme in Tuna longline survey

I. For the use of economic analysis

1. Number of fishery establishments engaged in T.L.F.

   1.1. By fishing ports based at and by nationalities
   1.2. By type of fishery management and by nationalities

2. Number of fishing boats engaged in tuna longline fishery

   2.1. By fishing ports based at and by nationalities
   2.2. By sizes of boats and by nationalities

3. Number of trips made

   3.1. By fishing ports based at and by nationalities
   3.2. By sizes of boat and by nationalities

4. Number of days absent by port of landing (ports and by size of boat where catch was landed)

5. Number of days fished by port of landing and by sizes of boat

6. Catch landed by species and by ports of landing

   6.1. Catch in number
      a. Yellowfin tuna
      b. Bigeye tuna
      c. Albacore
      d. Southern bluefin tuna
      e. Black marlin
      f. Blue marlin
      g. Stripped marlin
      h. Shortbill spearfish & Indo-Pacific sailfish
      i. Swordfish
   6.2. Catch in M/T
   6.3. Catch in Value

7. Average weight per fish by port of landing and by months (with annual average)

   7.1. By species
   7.2 By month
   7.3. By port of landing

8. Number of trips made and catch landed by month

II. For the use of biological analysis

1. Yearly total number of sets, hooks and catch in number by block area

   1.1. Yearly total number of sets, hooks and catch in number by block area, by size of boat and by type of baitfish
      a. Block area I
      b. Block area II
      c. Block area III
      d. Block area IV
      e. Block area V
      f. Block area VI

2. Yearly total number of sets, hooks and catch in number by size of boat
   2.1 Yearly total number of sets, hooks and catch in number by size of boat, by type of baitfish and by block area
      a. 10 - 20 GT
      b. 20 - 30 GT
      c. 30 - 50 GT
      d. 50 - 100 GT
      e. 100 - 200 GT
      f. > = 200 GT

3. Yearly total number of sets, hooks and catch in number by type of baitfish

   3.1. Yearly total number of sets and catch in number by type of baitfish, by size of boat and by block area
      a. Milkfish
      b. Indonesian sardine
      c. Mackerel
      d. Saury
      e. Others

4. Number of hook used

   4.1. By block area and by Nationality
   4.2. By block area and by type of longline
   4.3. By block area and by size of boat

5. Catch in number of fish

   5.1. By block area and by species
   5.2. By type of baitfish and by species
   5.3. By type of longline and by species

6. Hook ratio by species

   6.1. By block area
   6.2. By type of baitfish
   6.3. By type of longline
   6.4. By block area and by type of baitfish
   6.5. By block area and by size of boat

7. Number of hook used, catch in number of fish, average hook rate by area of capture

   7.1. Estimates of number of hooks by unit area by nationalities
        a. By month
        b. By year

   7.2. Estimates of number of sets, hooks, catch number and hookrate by species, by 1 square, by size of boat, by type of baitfish
        a. By month
        b. By year

Current Status of Tuna/Tuna-like Fisheries in Peninsular Malaysia

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Abstract

Landings data of coastal tunas and spanish mackerels by different gear based was analysed. The catch from the waters off Peninsular Malaysia comprised three groups of coastal tunas, i.e; Long-tail tuna (LOT), Kawakawa (KAW) and Frigate tuna (FRI), three species of spanish mackerels i.e; Barred Spanish mackerel (COM), Spotted Spanish mackerel (GUT) and Streaked Spanish mackerel (STS).

The laudings of coastal tunas fluctuated from 11,000 tons in 1980 to 19,000 tons in 1985 (Spanish mackerels: 7,400 tons in 1984-85, 13,000 tons in 1981-82). The main fishing gears were Hooks and Lines for coastal tunas and Drift/Gill nets for Spanish mackerels.

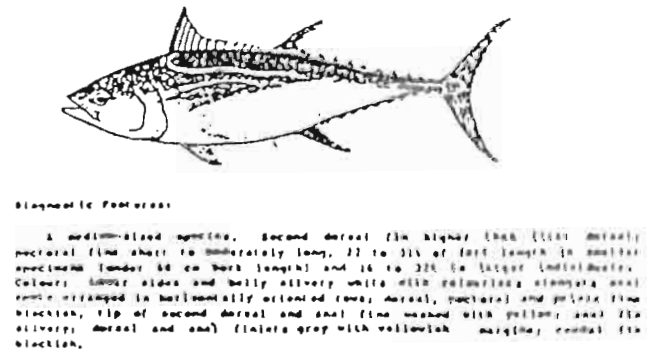
Majority of them (about 80% of coastal tunas and 51% of Spanish mackerels) were landed in the east coast of Peninsular Malaysia, particularly from the water off Terengganu coast (Area VI).

Estimated CPUE (Catch (ton)/ Fishing Unit) suggested that the most productive areas both for coastal tunas and Spanish mackerels were central to southern (Areas II & III) in West Coast, Areas VI & VII in East Coast) waters of Peninsular Malaysia.

The uses of Hooks and Lines, Drift/Gill nets and Purse Seines in those areas are recommended.

Introduction

The demand from fish canning industry in Malaysia is not so high as Thailand that the tuna or tuna-like resources being classed as Grade II or III quality in wholesale market. Therefore the catch statistics classed coastal tunas collectively as "Aya, Kayu and Tongkol" in local name with no breakdown into specific tuna species as shown in below.



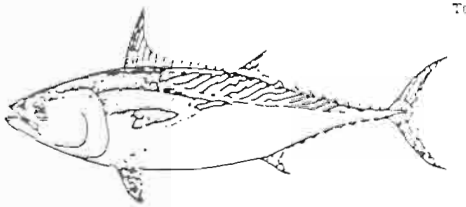
Diagnostic Features:

A medium-sized species. Second dorsal fin higher than first dorsal; pectoral fins short to moderately long, 22 to 31% of fork length in smaller specimens (under 60 cm fork length) and 16 to 22% in larger individuals. Colour: Lower sides and belly silvery white with relatively elongate oval spots arranged in horizontally oriented rows; dorsal, pectoral and pelvic fins blackish, tip of second dorsal and anal fins washed with yellow; anal fin silvery; dorsal and anal finlets grey with yellowish margins; caudal fin blackish.

Alpha Code: FAO
FAO English Name: Kawakawa
Scientific Name: Euthynnus affinis

Local English
Mackerel tuna
Bonito

Local name
Aya kurik,
Kayu
Tongkol



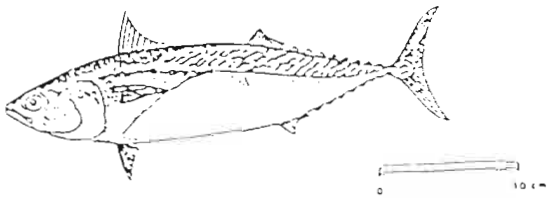
Diagnostic Features:

A medium-sized fish with a robust, elongate and fusiform body. Teeth small and conical, in a single series; about 25 to 35 on each side of lower jaw; palatine teeth present. Two dorsal fins, the first with 10 to 15 spines; both fins separated by only a narrow interspace (not wider than eye), anterior spines of first much higher than those, mid-way, giving the fin a strongly concave outline; second dorsal fin much lower than first and followed by 8 to 10 finlets; pectoral fins short: 25 to 29 rays; never reaching the interspace between the dorsal fins; anal fin with 11 to 15 rays, followed by 4 to 6 finlets. Body naked except for corselet and lateral line. Colour: back dark blue or irridescent green with a complicated striped pattern which does not extend forward beyond middle of first dorsal fin; lower sides and belly silvery white without dark longitudinal stripes; several characteristic dark spots between pelvic and pectoral fins.

Alpha Code: FRI
FAO English Name: Frigate tuna
Scientific Name: Auxis thazard

Local English
Frigate mackerel
Tuna

Local name
Tongkol
Aya, Kayu



Diagnostic Features

Pectoral fins short, but reaching past vertical line from anterior margin of scaleless area above corselet; corselet well developed and narrow in its posterior part (no more than 5 scales wide under second dorsal fin origin). Colour: a pattern of 15 or more narrow, oblique to nearly horizontal, dark wavy lines in the scaleless area above lateral line.

According to "Description of Species" published by Indo-Pacific Tuna Development and Management Programme (IPTP), three species of king mackerels, Scomberomorus commerson, S. guttatus and S. lineolatus are found in Malaysian waters, but they were all called as "Tenggiri" and no breakdown into specific species.

Alpha Code: COM
FAO English Name: Narrow-barred king mackerel
Scientific Name: Scomberomorus commerson

Local English
Barred spanish
mackerel

Local name
Tenggiri batang
Tenggiri bunga

Diagnostic Features:

First dorsal fin with 15 to 18 spines, usually 16 or 17; second dorsal with 15 to 20 rays, usually 17 or 18, followed by 8 to 10 finlets; anal fin with 16 to 21 rays, usually 18 or 19 followed by 7 to 12 finlets, usually 9 or 10; pectoral fin rays 21 to 24. Lateral line abruptly bent downward below end of second dorsal fin. Colour: sides silvery grey marked with transverse vertical bars of a darker grey; bars narrow and slightly wavy, sometimes breaking up into spots ventrally; bars number 48 to 50 in adults but are usually fewer than 28 in juveniles up to 45 cm fork length; cheeks and lower jaw silvery white; first dorsal fin bright blue rapidly fading to blackish blue; pectoral fin light grey turning to blackish blue; caudal fin lobes, second dorsal, anal, and dorsal and anal finlets pale greyish white turning to dark grey.

Alpha Code: GUT
FAO English Name: Indo-Pacific king mackerel
Scientific Name: Scomberomorus guttatus

Local English
Spotted spanish
mackerel

Local name
Tenggiri papan

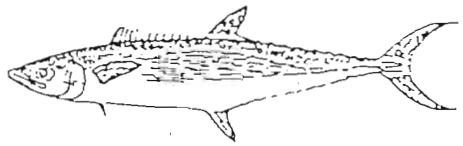
Diagnostic Features:

First dorsal fin with 15 to 18 spines, usually 16 or more; second dorsal with 18 to 24 rays, usually 20 to 22, followed by 7 to 10 finlets; anal fin with 19 to 23 rays; followed by 7 to 10 finlets, usually 8; pectoral fin rays few, 20 to 22, modally 21. Lateral line with many fine auxiliary branches extending dorsally and ventrally in anterior third, gradually curving down toward caudal peduncle. Colour: sides silvery white with several longitudinal rows of round dark brownish spots (smaller than eye diameter) scattered in about 3 irregular rows along lateral line. First dorsal fin membrane black up to the 8th spine white posteriorly, with the distal margin black; pectoral, second dorsal and caudal fins dark brown; pelvic and anal fins silvery white.

Alpha Code: STS
FAO English Name: Streaked seerfish
Scientific Name: Scomberomorus lineolatus

Local English
Streaked spanish
mackerel

Local name
Tenggiri musang
Tenggiri kikus



Diagnostic Features:

First dorsal fin with 15 to 18 spines, usually 16 to 17; second dorsal with 15 to 19 rays, rarely 21 or 22, usually 17 or 18, followed by 7 to 10 finlets, usually 9; anal fin with 17 to 22 rays, usually 20, followed by 7 to 10 finlets; pectoral fins covered with scales; pectoral fin rays 20 to 24, modally 23. Lateral line without auxiliary branches anteriorly, running almost straight below second dorsal finlet, then slightly bent downward toward keel of caudal peduncle (which is very wide). Colour: sides silvery marked with series of irregular, horizontal, narrow black lines and few if any spots; first dorsal fin black anteriorly, white posteriorly.

Table 1 Landings of coastal tunas and Spanish mackerels by gear group in Peninsular Malaysia, 1980-1986

(metric tons)

Species	Year	Trawl	Purse Seine	Anchovy Purse seine	Drift/gill net	Hook and line	Others	Total
	80	1.5	4,868.4	0	3,066.1	2,833.2	317.8	11,087.0
	81	11.8	2,956.6	114.8	6,264.3	8,335.0	42.7	17,725.2
LOT	82	2.2	1,881.2	12.7	4,346.8	8,359.2	1.0	14,603.1
KAW	83	4.9	3,799.0	158.2	6,033.3	8,832.2	9.9	18,837.5
FRI	84	37.9	4,278.9	609.0	6,287.0	6,477.7	32.1	17,722.6
	85	0.7	7,354.5	314.2	5,232.7	6,242.5	6.2	19,150.8
	86	0	5,073.0	8.0	3,125.0	8,348.0	36.0	16,590.0
	80	854.0	180.5	0	5,760.4	3,239.4	140.7	10,175.0
	81	823.4	296.1	0	7,630.1	3,608.6	207.5	12,565.7
COM	82	949.8	553.3	0	8,184.4	3,161.6	123.9	12,973.0
GUT	83	708.5	216.8	0	6,665.8	2,108.5	50.3	9,749.9
STS	84	506.1	16.8	0.2	4,661.1	2,237.4	3.8	7,425.4
	85	608.8	54.0	0	4,975.6	1,787.6	6.5	7,432.5
	86	1,214.0	433.0	3.0	5,526.0	3,408.0	7.0	10,591.0

LOT : Longtail tuna (Thunnus tonggol)
KAW : Kawakawa (Euthynnus affinis)
FRI : Frigate tuna (Auxis thazard)

COM : Narrow-barred king mackerel (Scomberomorus commerson)
GUT : Indo-Pacific king mackerel (S. guttatus)
STS : Streaked seerfish (S. lineolatus)

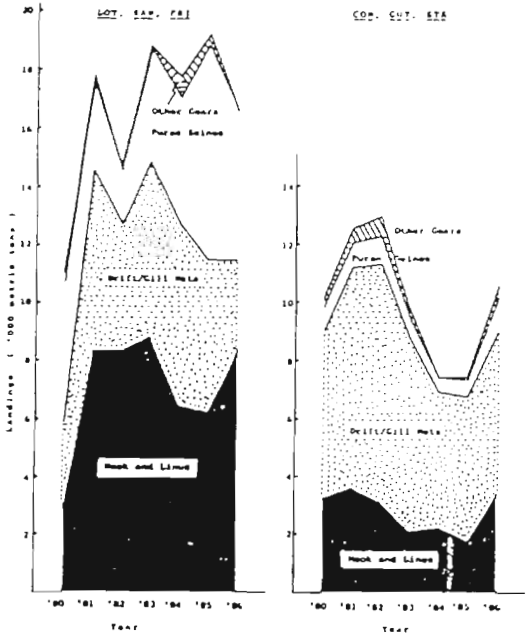


Fig. 1 Landings of coastal tunas and king mackerels by gear group in Peninsular Malaysia, 1980-1986.

The landings of coastal tunas in Peninsular Malaysia fluctuated from 11,000 metric tons in 1980 to 19,000 tons in 1985. While for king mackerels; 7,400 metric tons in 1984-1985, 13,000 metric tons in 1981-1982 (Table 1, Fig. 1).

Generally coastal tunas and king mackerels in Peninsular Malaysia are caught by three types of fishing gears i.e., purse seines, drift/gill nets and hooks and lines. Among those fishing gears, hooks and lines for coastal tunas and drift/gill nets for king mackerels predominated respectively, and the proportion of landings of each group by each type of gear averaged 43% and 61% respectively (Table 2).

Table 2 Proportion of landings of tuna/tuna-like fish by gear group in Peninsular Malaysia, 1980 - 1986

(%)

Species	Year	Trawl	Purse seine	Anchovy purse seine	Drift/gill net	Hook and line	Others (Lift net Traps)
	80	0	43.9	0	27.7	25.5	2.9
	81	0.1	16.7	0.6	35.3	47.0	0.3
LOT	82	0	12.9	0.1	29.8	57.2	0
KAW	83	0	20.2	0.8	32.0	46.9	0.1
FRI	84	0.2	24.1	3.4	35.5	36.6	0.2
	85	0	38.4	1.6	27.3	32.6	0.1
	86	0	30.6	0.1	18.8	50.3	0.2
	Average (80 - 86)	0.1	26.1	1.0	29.7	42.7	0.4
	80	8.4	1.8	0	56.6	31.8	1.4
	81	6.6	2.4	0	60.7	28.7	1.6
COM	82	7.3	4.3	0	63.1	24.4	0.9
GUT	83	7.3	2.2	0	68.4	21.6	0.5
STS	84	6.8	0.2	0	62.8	30.1	0.1
	85	8.2	0.7	0	66.9	24.1	0.1
	86	11.4	4.1	0	52.2	32.2	0.1
	Average (80 - 86)	8.0	2.5	0	61.2	27.6	0.7

Majority of them, about 80% of coastal tunas and 51% of king mackerels in seven year average, were landed in the east coast of Peninsular Malaysia, particularly Area VI (the water off Terengganu) was the most productive area where 55% of coastal tunas and 33% of king mackerels were landed (Table 3).

Whereas the second productive areas werelocated in Area VIII for coastal tunas (15%) and Area III for king mackerels (17%0 respectively (Fig. 2).

Table . Proportion of landings of tuna/tuna-like fish by fishing area of Peninsular Malaysia, 1980-1986

(%)

Species	Year / Area	West Coast I	II	III	IV	Sub total	East Coast V	VI	VII	VIII	Sub total	TOTAL LANDINGS (metric tons)
	80	7.4	34.2	0.8	0	42.4	1.4	40.6	6.0	9.6	57.6	11087.2
	81	9.3	4.2	1.3	0	14.8	1.2	62.8	2.6	18.6	85.2	17725.2
LOT	82	8.8	2.8	0.1	0	11.7	1.3	52.6	13.4	21.0	88.3	14603.1
KAW	83	4.5	9.2	0.5	0	14.2	0.5	66.3	9.0	10.0	85.8	18837.5
FRI	84	12.3	4.9	0.1	0	17.3	0.1	53.2	7.4	22.0	82.7	17722.6
	85	5.0	18.1	0.7	0	23.8	3.0	57.1	6.4	9.7	76.2	19150.8
	86	7.9	11.9	4.5	0	24.3	2.4	44.7	17.6	11.0	75.7	16590.0
Average (80 - 86)		7.8	11.2	1.2	0	20.2	1.4	55.0	8.8	14.6	79.8	115716.4
	80	13.4	13.1	10.1	11.2	47.9	1.4	29.0	8.0	13.7	52.1	10175.1
	81	10.5	10.0	9.7	10.8	41.0	1.1	31.3	14.5	12.1	59.0	12565.7
COM	82	10.9	16.9	13.8	10.0	51.6	0.5	31.2	8.6	8.1	48.4	12973.0
GUT	83	13.4	10.2	17.5	11.9	53.0	0.7	33.0	3.4	9.9	47.0	9749.9
STS	84	5.8	8.6	15.6	12.2	42.2	0.5	44.1	4.8	8.4	57.8	7425.4
	85	5.0	14.2	23.6	10.6	53.4	0.8	35.7	4.3	5.8	46.6	7432.5
	86	5.0	10.4	30.2	8.3	53.9	1.4	31.6	6.8	6.3	46.1	10591.0
Average (80 - 86)		9.5	12.1	16.7	10.6	48.9	0.9	33.1	7.7	9.4	51.1	70912.6

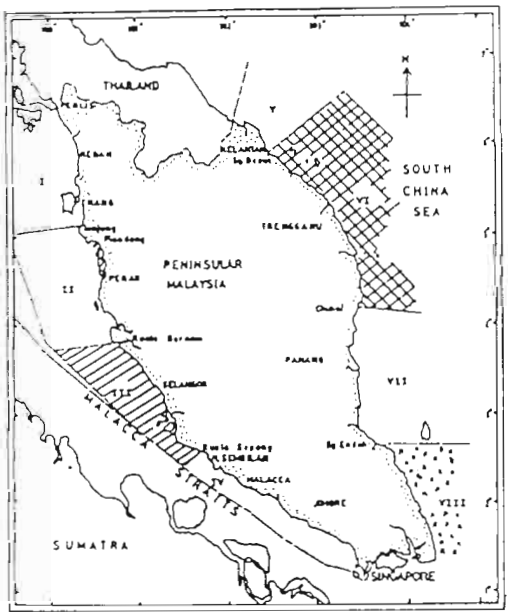


Fig. . Distribution of coastal tunas and Spanish mackerels in the waters off Peninsular Malaysia, average in 1980-1986.

Main (first) fishing ground both for coastal tunas and Spanish mackerels

Second fishing ground for coastal tunas

Second fishing ground for Spanish mackerels

Fishing Season

Both tunas and king mackerels were generally caught plentifully during the latter half of year, particularly from August to December (before the northwest monsoon season) in West Coast and from July to November (southeast monsoon season) in East Coast (Fig. 3).

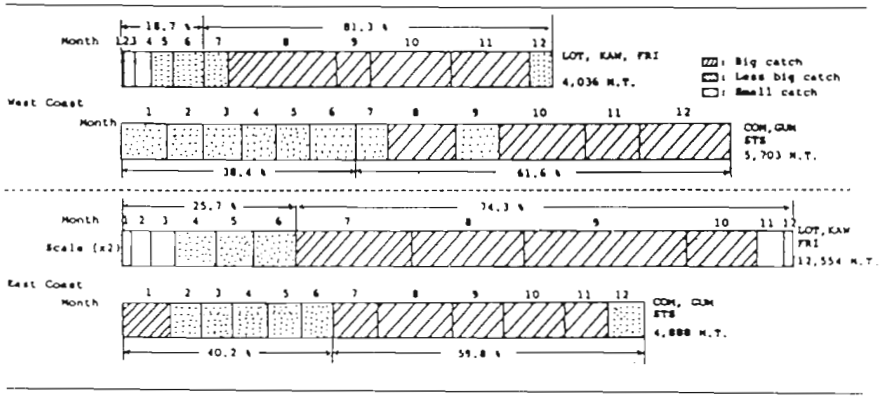


Fig. 3 Monthly catch of coastal tunas and king mackerels in Peninsular Malaysia, 1986.

Fishing Effort : Number of Fishing Gears in Operation

A much larger number of commercial and artisanal fishing gears being operated in the waters both from west and east coasts of Peninsular Malaysia in 1986 (Fig. 4). Among them, drift/gill nets were operated predominantly in the whole areas off the West Coast, while purse seine and other seines were operated mostly in the northern waters off the West Coast of Peninsular Malaysia. Hook and lines were not so popular but they were operated in the waters off Perak or Terengganu States, and those commercial/artisanal traditional gears seemed to be effective for catching tuna/tuna-like species. Unlike other traditional gear, drift/gillnets are more efficient and "aggressive" in terms of its catching techniques and this may be the main reason for a big proportion of landings of king mackerels by drift/gill nets (see Table 2).

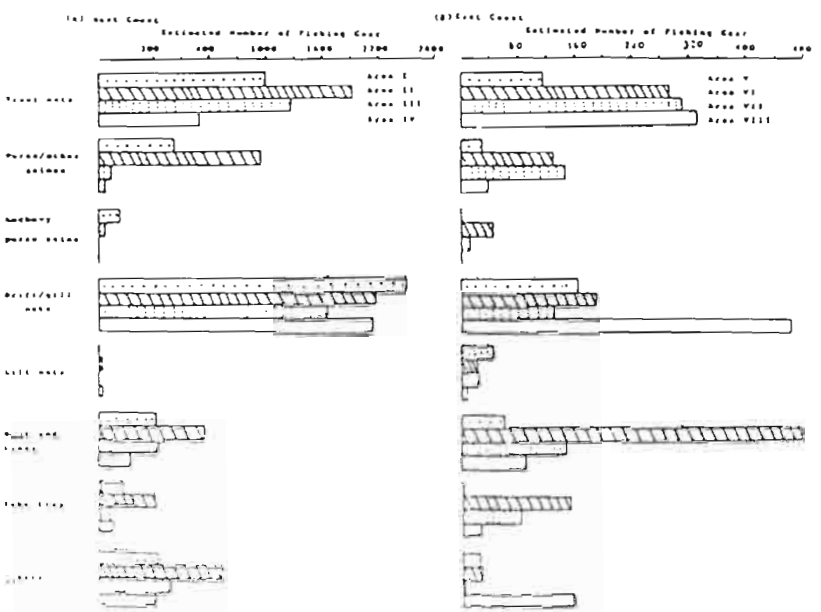


Fig. 4 Estimated number of fishing gears in operation in Peninsuair Malaysia, 1986 (Source: Annual Fisheries Statistics, Malaysia-1986).

CPUE (Catch Per Fishing Unit)

The estimates of CPUEs (ton/fishing unit) for coastal tunas and king mackerels in each fishing area by different fishing gear were done on the bases of Table 3 and Fig. 4 data, and resulted that higher CPUEs for coastal tunas and king mackerels distributed from central to southern waters (Areas II & III in West Coast; Areas VI & VII in East Coast) of Peninsular Malaysia (Table 4).

Table 4 CPUE (ton/fishing unit) by different types of gear, 1986

KDT, KAN, PEN

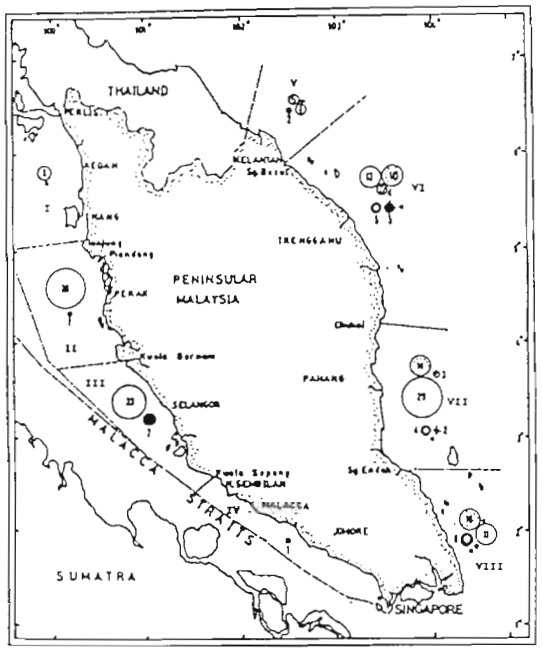
Gear \ Area	West Coast I	II	III	IV	Average I - IV	East Coast V	VI	VII	VIII	Average V - VIII	All Peninsular
H/L	-	-	-	0	-	4.67	10.34	13.91	16.00	11.12	5.00
D.G	0.04	0.06	0.03	0	0.03	0.25	4.12	2.40	0.42	1.40	0.33
P.S	8.06	26.14	23.33	0	14.92	4.33	13.25	28.83	10.89	13.60	11.03

CCM, COT, ETE

Gear \ Area	I	II	III	IV	I - IV	V	VI	VII	VIII	V - VIII	All Peninsular
H/L	0.03	0.03	0.18	0.08	0.07	1.78	4.80	3.52	6.06	4.45	3.84
D.G	0.16	0.37	1.41	0.30	0.49	0.24	4.87	1.55	0.40	1.43	0.59
P.S	0.21	0.94	6.40	1.29	1.37	0.14	0.48	0.57	0.32	0.43	0.94
T.W	0.11	0.11	0.51	0.48	0.25	0.03	0.21	0.04	0.04	0.09	0.22

H/L : Hooks and Lines, D.G : Drift/gill nets, P.S : Purse seines, T.W : Trawl nets

In those areas, the highest CPUEs were about 29 metric tons per purse seine for coastal tunas in Area VII, and about 7 metric tons per purse seine for king mackerels in Area III, respectively (Fig. 5).



○ : Coastal tunas by hooks & lines ○ : Spanish mackerels by hooks & lines
◐ : Coastal tunas by drift/gill ◆ : Spanish mackerels by drift/gill nets
○ : Coastal tunas by purse seines ● : Spanish mackerels by purse seines

Fig. 5 Estimated CPUE (catch (ton)/fishing unit) of coastal tunas and Spanish mackerels by different types of gear, 1986. The size of the circle is proportional to each CPUE.

Recommendation

Tuna/tuna-like fish production by purse seine fisheries

As regards purse seine fisheries in Terengganu area, total landings themselves fluctuated every year with a peak of about 56,000 metric tons in 1981 (Fig. 6). The landings comprised pelagic fishes from 8 major species of round scad (Decapterus sp.), ox-eye scad (Selar boops), hardtail scad (Megalaspis cordyla), coastal tunas (Thunnus tonggol, etc.), Indian mackerels (Rastelliger spp.), Spanish mackerels (Scomberomorus spp.), rainbow sardine (Dussumieria sp.), black pomfret (Parastromateus niger) and other fishes.

Among these fishes caught by purse seines, round scad predominated in landings followed by Indian mackerels, ox-eye scad and rainbow sardine. While Spanish mackerels and black pomfret were the highest in wholesale value. As a result, two outstanding features of the landings are the large proportion of production for round scads ($C_1V_1/\Sigma C_iV_i$) and Indian mackerels ($C_5V_5/\Sigma C_iV_i$), both regarded as Grade III fish (average price M$ 1.53 per kg). Therefore, the net revenues from the landings of coastal tunas and king mackerels by purse seines are not so high than expected and no more higher production of tuna/tuna-like fish could be expected from purse seine fisheries.

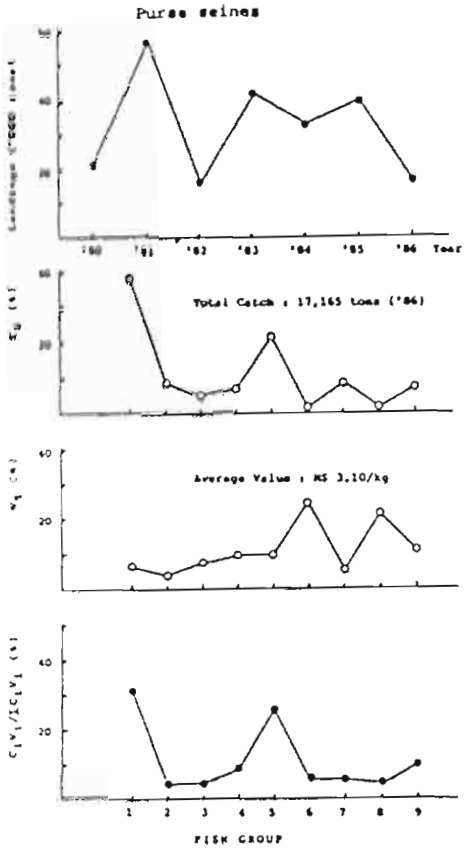


Fig. . Annual landings by purse seines and each proportion by fish group caught in waters off Terengganu, 1986.

1: Round scads (Decapterus spp.), 2: Oxeye scad (Selar boops)
3: Coastal tunas (Thunnus tonggol, Euthynnus affinis, Auxis thazard)
4: Hardtail scad (Megalaspis cordyla)
5: Indian mackerels (Rastrelliger spp.)
6: Spanish mackerels (Scomberomorus spp.)
7: Rainbow sardine (Dussumieria sp.)
8: Black pomfret (Parastromateus niger), 9: Other fishes

Drift/gill net fisheries , Hook and line fisheries

Among artisanal fisheries in Terengganu area, the landings by drift/gill nets showed a similar trend to those by purse seiners, that is, total landings by drift/gill nets fluctuated every year with a peak of about 24,000 metric tons in 1981 (Fig. 7).

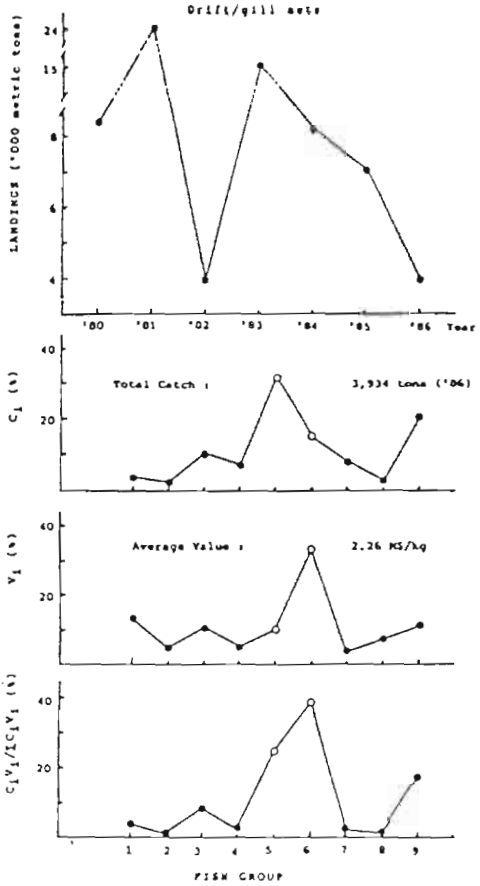


Fig. : Annual landings by drift/gill nets and each proportion by fish group caught in the waters off Trengganu(Area VI), 1986.

1: Hardtail scad (Megalaspis cordyla), 2: Marine catfish (Tachysurus sp.)
3: Croakers (Johnius spp.), 4: Wolf herring (Chirocentrus dorab)
5: Coastal tunas (Tunnus tonggol, Euthynnus affinus, Auxis thazard)
6: Spanish mackerels (Scomberomorus spp.), 7: Sharks (Scoliodon spp.)
8: Tigger-fish (Abalistes spp.), 9: Other fishes

The major fishes caught by drift/gill nets comprised both pelagic and demersal species from hardtail scad, marine catfish (Tachysurus sp.), croakers (Johnius spp.), wolf herring (Chirocentrus dorab), coastal tunas, Spanish mackerels, sharks (Scoliodon spp.) and tiggerfish (Abalistes spp.). A minor difference of fish composition between purse seines and drift/gill nets is due to the following reason; purse seines usually operated in surface zone, whereas drift/gill nets operated both in surface and mid-water zones.

Among these fishes caught by drift/gill nets, coastal tunas predominated in landings followed by Spanish mackerels, croakers and sharks. And Spanish mackerels (V_6) was the most valuable (Grade I fish) followed by hardtail scad (V_1), croakers (V_3) and coastal tunas (V_5). Therefore two outstanding features of the landings are the large proportion of production for Spanish mackerels ($C_6V_6/\Sigma C_iV_i$) and coastal tunas ($C_5V_5/\Sigma C_iV_i$) representing 19% and 25% of total revenue produced by drift/gill net fisheries, respectively (Fig. 8)

The hook and line, another traditional gear operated in Terengganu area, showed a different type of landings. The total landings produced by hooks and lines fluctuated biennially with two peaks of about 13,000 metric tons both in 1983 and 1986, and the pattern of fluctuation was very different (contrary) from that of drift/gill nets. The major fishes caught by hooks and lines also comprised both pelagic and demersal species from marine catfish, groupers (Epinephelus spp., Plectropoma spp.), treadfin breams, black kingfish, hardtail scad, Selar scads (Selar spp.), coastal tunas, Spanish mackerels and snappers (Lutjanus spp.). Among these fishes caught by hooks and lines, coastal tunas (C_7) super-predominated in landings followed by Spanish mackerels (C_8) and snappers (C_9). Spanish mackerels (V_8) was also the most valuable in wholesale price followed by threadfin breams (V_3) and snappers (V_9). As a result, two outstanding features of landings were observed from the large proportion of production for Spanish mackerels ($C_8V_8/\Sigma C_iV_i$) and coastal tunas (C_7V_7/ C_iV_i) representing 34% and 31% of total revenue produced by hook and line fisheries, respectively (Fig. 9).

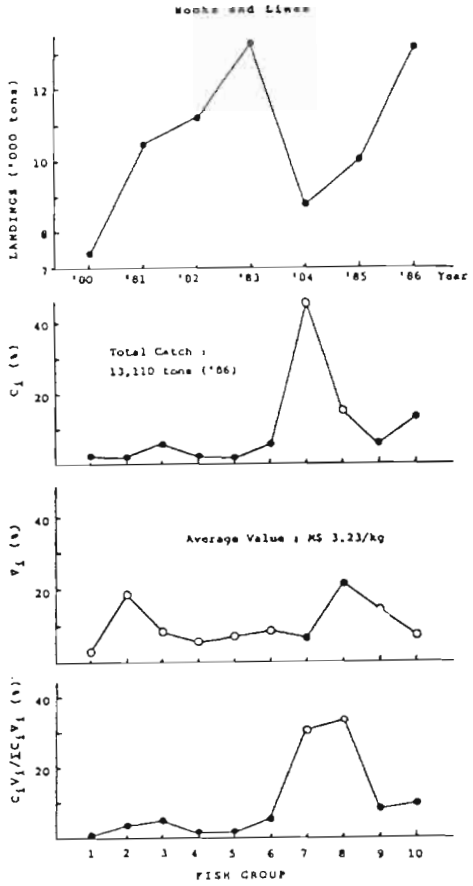


Fig. 8 Annual landings by hooks and lines and each proportion by fish group caught in the waters off Terengganu (Area VI), 1986.

1: Marine catfish (Tachysurus sp.), 2:Groupers (Epinephelus spp.) (Plectropoma spp.)
3: Threadfin breams (Nemipterus spp.)
4: Black kingfish (Rachycentron canadus)
5: Hardtail scad (Megalaspis cordyla), 6: Selar scads (Selar spp.)
7: Coastal tunas (Thunnus tonggol, Euthynnus affinis, Auxis thazard)
8: Spanish mackerels (Scomberomorus spp.)
9: Snappers (Lutjanus spp.), 10: Other fishes

ANALYSIS ON THE UTILIZATION OF THE RUMPON AS FISH AGGREGATION DEVICE ON THE SKIPJACK TUNA FISHERIES IN INDONESIA

BY

DANIEL R. MONINTJA

THE 2ND SOUTHEAST ASIAN TUNA CONFERENCE
AND
THE 3RD MEETING OF TUNA RESEARCH GROUPS IN THE SOUTHEAST ASIAN REGION
22 - 25 AUGUST 1988
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ANALYSIS ON THE UTILIZATION OF THE RUMPON AS FISH AGGREGATION DEVICE ON THE SKIPJACK TUNA FISHERIES IN INDONESIA *

by : Daniel R. Monintja **

ABSTRACT

A survey on the utilization of "rumpon" (Fish aggregation device) on the skipjack pole and line fisheries has been conducted in October 1987 to December 1987, covering the skipjack tuna fisheries in Irian Jaya and North Molucca Sea, Indonesia. The objectives of the study, were to analyze the performance of the existing rumpons and to reveal the impact of the rumpon implementation to the skipjack tuna fisheries in the studied areas.

The rumpon were commercially installed by the USAHA MINA LTD.CORP. since 1985, in order to increase the skipjack production of the Pole and Line fisheries in the eastern Indonesia waters. Together with the installation of the rumpon, a Nucleus Estate for Small holders (NES) system has been developed by the USAHA MINA LTD. CORP., which act as the Nucleus, while the artisanal fisheries of pole and liners were considered as the plasm.

Analysis on the performance of the rumpon deployed shows that in the average the newly installed rumpon were visited by the skipjack on the first 25 days, with a modus on the first 10 days after the rumpon deployment. The rumpon installed in the waterdepth less that 1000 meters, in the average last about 10.2 months, while those installed above the 1000 meters waterdepth last only about 9.2 months. The most productive rumpons in the studied areas were the rumpon deployed in the 1000 meters waterdepth.

Analysis on the impact of the rumpon implementation to the skipjack tuna fisheries, shows the trends of : decrease in fishing effort, increase in total catch, increase in catch per unit effort, decrease in live-bait consumption and decrease in fuel consumptions.

The rumpon utilization combined with the NES system developed by the USAHA MINA LTD.CORP., has significantly increased the contribution of the artisanal fisheries to the skipjack tuna production and export volume. The system has also increase the venture efficiency and the income of the small scale pole and line fishermen, as well as the live-bait fishermen. As a whole, the rumpon implementation has been a technological breakthrough in the skipjack tuna fisheries development in Indonesia, specifically in the studied areas.

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1. INTRODUCTION

1.1 Background of the Study

The skipjack tuna (Katsuwonus pelamis) is among the most important export commodities of Indonesian fisheries. The species is distributed in the areas covering the Eastern part of Indonesian waters, mainly in Irian Jaya, Maluku, North Sulawesi, Central Sulawesi, South Sulawesi and Southeast Sulawesi waters, as well as the waters adjacent to the Indian Ocean. The waters around Ternate, Tidore and Bacan Islands were reported to be yearly round visited by the species.

In tropical waters, the skipjack tuna tends to form relatively small schoolings and scattered (Uchida, R.N., 1975). Together with their local movement and the uncertainty of their positions, cause a lot of difficulties and inefficiencies in exploiting the resource, especially in time and energy consumption. Fortunately these problems to a certain extent can be overcome by setting the rumpon as fish aggregating device in the right location, in order to increase the efficiency and effectivity of the fishing units.

Preston G. (1982) stated that the Fish Aggregating Device are man-made substitutes for naturally occuring floating objects that can improve the economics of a

given fishing operation, by :

(1) Reducing time and fuel spent in fish searcling

(2) Improving catch per unit of effort due to increased vulnerability or availability of the target species

(3) Improving the value of catch, in terms of species or size composition.

Furthermore, Boy, R.L and B.R. Smith (1984) stated that such devices have demonstrated their effectivences in augmenting catches from both commercial and artisanal fisheries, and their use is rapidly changing the pattern of fishing activities throughout the South Pacific, and indeed worldwide.

The implementation of the deep sea rumpon for skipjack tuna fishing in Indonesia has just starting in this past two years (1985) on commercial bases. Should it will be further developed and spread out to the vast skipjack fishing areas in Indonesia, needs a set of careful analyses on the existing activities. A rumpon development model should be established by taking into account the factors that will or potentially will affect the fisheries. This study would be one of the important steps to be taken prior to the further development of rumpon in Indonesia, speciafically in eastern waters skipjack fishing ground.

1.2 Objectives

Basically, the objectives of this study is aimed to :

(1) Evaluating the performance of the existing deep sea rumpons for skipjack tuna in Indonesia

(2) Revealing the impact of the rumpon on the existing skipjack fisheries in the studied area

(3) Based on the above findings, providing recommendations for further steps of skipjack tuna fisheries development in the country.

1.3 Methodology

1.3.1 Data Collection

As a whole the research activities is a case study, where the rumpon a d the skipjack tuna fisheries in the studied area were treated as the case unit. Literature observations and collection of secondary data were carried out to reveal the rumpon performance and the impact to the fisheries. Direct observations at the rumpon sites and the rumpon construction were conducted to reveal the rumpon design implemented.

Survey method was used to get the primary data for economic and social aspects. A set of questionnaires was prepared for interviewing purposes. Respondents were randomly sampled from the skipjack pole and line fishermen

were divided into three groups, namely :

(1) The "non rumpon/non NES fishermen", which are the skipjack fishermen who are not utilizing the rumpon and not joinning the Nucleus Estate for Small Scale industries system. Samples were taken from Tomalou Village, at Tidore sub-district, Central Halmahera Regency.

(2) The "rumpon/non NES fishermen", those skipjack fishermen who are utilizing rumpon, but not involved in the NES system. Samples were taken from Dufa-dufa Village, Kota Ternate Utara sub-district, North Molucca Regency.

(3) The "rumpon/NES fishermen", those fishermen who are utilizing the rumpon and involved in the NES system. Samples were taken from Bajo Village, Bacan subdistrict, North Molucca Regency.

1.3.2 Data Analyses

(1) Descriptive and simple tabulation methods were used in revealing the present status of the rumpon utilization.

(2) The B-C Ratio, Net Present Value and Internal Rate of Return analyses were used as the measuring tools for financial efficiency of the three types of skipjack fisheries.

(3) Production model equations were provided for the skipjack fishing enterprises before and after utilizing the rumpon. The Cobb Douglas production model equation was used :

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}X_7^{b_7} \quad \text{or}$$

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7$$

where,

Y = The net income/year (thousand rupiah/year)

X_1 = Vessel's size (ton)

X_2 = Power (HP)

X_3 = Energy consumed (ton/year)

X_4 = Live-bait consumed (1000 bucket/year)

X_5 = Fishing days (day/year)

X_6 = Man power (man)

X_7 = Operational cost (thousand rupiah/year)

a = Intercept

b_{1-7} = Production factors elasticity.

(4) Comparative analyses were made to show the rumpon productivity, rumpon effectivity, rumpon endurance, financial efficiency, and production models.

2. RUMPON DEVELOPMENT IN INDONESIA

The Indonesia fishermen have been traditionally using rumpon as fish aggregating device, mainly in the North coast of Java. The rumpon were made of natural material and were poorly designed to catch the small pelagic fishes in the shallow waters. A traditional type of deepsea rumpon has long been used by the tuna fishermen in South Sulawesi waters. The mooring line of this type used to be made of ratan material. In most cases, this traditional rumpon last in relatively short period of time and had to be replaced frequently. Realizing this condition, the government had put a lot of effort to improve this traditional rumpon.

Starting in early 1980's the modern deepsea type of rumpon for skipjack and tuna has been considered to have a good prospect in the skipjack tuna and skipjack fisheries development. A number of fishing experiments activities including trial fishing has been conducted by the research Institute of Marine Fisheries (BPPL) as weel as by the industries sectors such as PN. PERIKANI SULAWESI UTARA TENGAH, PT. USAHA MINA and PERUM PERIKANI MALUKU.

A total number of 171 units of deep sea rumpon have been experimentally or commercially installed in Indonesian waters. Table 2.1 shows the location where the rumpons were deployed.

Table 2.1. Rumpon deployment areas

Water areas	Number of rumpon deployed
West Sumatra	8
South Celebes	40
Molucca	23
Irian Jaya	100

Those rumpons were installed as aggregating device for skipjack and tuna fishes which are distributed abundantly in those waters.

3. TECHNICAL PERFORMANCE

3.1 Rumpon Endurance

Study on deep sea rumpon endurance has been done on 30 pieces rumpons installed by the PT. USAHA MINA during 1984 - 1986 in northern Irian Jaya waters and North Molucca waters. Those rumpons were monitored, and 27 pieces among them were lost or damaged where 10 rumpons installed at water depth of 600 - 1000 m (middle value of 800 m) and 17 rumpons at 1100 - 1500 m (middle value of 1300 m).

Based on Table 3.1, it is indicated that the average endurance of rumpons installed at middle value of 800 m is 10.17 months, while the rumpons at middle value of 1300 m is 9.22 months. The endurance distribution for those 2 groups, is biased from normal. The sifnificant difference of endurance is not tested because data were not distributed in normal pattern. However, the data distribution modes from that 2 groups indicate that 60 % of 1st group rumpons installed at 800 m depth have the endurance of 8.85 months, while the endurance of 53 % of rumpons installed at 1300 m depth are 4.95 months. Therefore, the rumpons installed in shallower water depth tend to have higher endurance.

Table 3.1. Rumpon endurance based on waterdepth

Rumpon Installment / Endurance (Month)	Waterdepth			
	600-1000 M		1100-1500 M	
	Number	Percentage	Number	Percentage
4.95	2	20	10	52.84
8.85	6	60	2	11.76
12.15	0	-	1	5.88
15.75	0	-	1	5.88
19.35	2	20	2	11.76
22.95	0	-	1	5.88
Total	10	100	17	100
Endurance average (Month)	10.17		9.22	

Row Data Source : PT. Usaha Mina (1987).

3.2 Rumpon Effectiveness

Based on collected information either from fishermen or field observation in North Molucca, the small size skipjack is found in the upper layer of sea water around rumpon. They fastly approach the chummed bait, but soon they move back to the rumpon. In succesfull fishing operation those fish were firstly caught and when their number decreased the bigger size of the species will be easily caught.

Together with those bigger size the yellow-fin tuna are also caught.

Those condition prove the theoritical deduction that the bigger the specimen of tuna the deeper the swimming layer.

Waiting time for first colonization of fish around rumpon installed by PT. USAHA MINA is shown in Table 3.4. At the most (47 %) the waiting time were 10.5 days with an average of 24.6 days.

Table 3.5 shows the rumpon waiting time in Halmahera Basin. The highest percentage is 8 days, with an average of 14 days.

Table 3.4. Waiting time for the first colonization of skipjack around rumpon.

Waiting time (days)	Middle value (days)	Number of Rumpon	Relative Percentage (%)
5 - 16	10.2	8	47
17 - 28	22.5	4	24
29 - 40	34.5	2	12
41 - 52	46.5	0	0
53 - 64	58.5	3	18
Average	24.62	17	100

Raw Data Source : PT. Usaha Mina (1987).

Table 3.5. Waiting time for the first colonization of skipjack around rumpon in Halmahera Basin.

Waiting time (days)	Middle values (days)	Number of Rumpon	Relative Percentage (%)
5.5 - 10.9	8.2	7	64
11.0 - 16.4	13.7	1	9
16.5 - 21.9	19.2	0	0
22.0 - 27.4	24.7	1	9
27.5 - 32.9	30.2	2	18
Average	14.2	11	100

3.3 Rumpon Productivity

The rumpon has significantly reduced the uncertainty of the fishing ground of the skipjack tuna. Tuasamu, A.R. (Waluyo Subani, 1986) reported that from 16 experimental fishing held in Sorong waters, a total catch of 22,096 kg of skipjack and tuna were caught around rumpon, while the catch at non-rumpon fishing ground yield only 15,231 kg. Table 3.6 shows the detailed data of the experiment.

Table 3.6. Catch composition records during experimental fishing with rumpon and without rumpon in Sorong waters.

Species	With Rumpon		Without Rumpon	
	Kg	%	Kg	%
- Skipjack	20,129	91.1	13,662	89.7
- Yellowfin	1,531	6.9	1,508	9.9
- Little tuna	436	2.0	61	0.4
Total	22,096	100,0	15,231	100,0

Source : Waluyo Subani (1986).

Based on two years data recorded by the PT. USAHA MINA on 30 rumpons which were installed since 1984, the average productivity in 1985 was 1720 kgs fish/day for the rumpon deployed at 1000 M, waterdepth. In 1986, the productivity of rumpon (1000 M depth) was 1307 kgs/day, as indicated in Table 3.7. It seems that from 2 years data, the 1000 M waterdepth is more productive and suitable position for rumpon installment.

Table 3.7. Rumpon productivity in difference depth at East Indonesia waters 1985 - 1986.

Depth (M)	1985		1986	
	Number of Rumpon	Kg/days/ Rumpon	Number of Rumpon	Kg/days/ Rumpon
700	1	804	3 (2)	1,528
800	2	912	4 (3)	1,144
1000	3	2,982	2	2,140
1200	3	846	3	588
1300	7	2,073	8	1,375
2600	1	-	-	-
Total Average	17	1,720	20 (18)	1,307

Row Data Source : Zainal Abidin (1987).

4. IMPACT ON THE SKIPJACK FISHERIES

4.1 Impact on Catch and Effort

Skipjack production in North Molucca from 1984 to 1987 is shown in Table 4.1 the increase of this skipjack production caused by the development of artisanal fisheries. From the total skipjack production handled PT. USAHA MINA in 1986, 20.1 % was obtained from artisanal fisheries. In 1987 the skipjack production by artisanal fisheries increased to 57.1 % from the total production in North Molucca, where the PT. USAHA MINA contributes the other 42.9 %. This condition shows that artisanal fisheries unit is developing, because the chance for fishing operation was given more to the artisanal fisheries which joint the rumpon operation, within the NES framework. NES is a joint operation between the large scale fishing enterprise of the PT. USAHA MINA and the artisanal fisheries.

Skipjack production in North Molucca has increased the skipjack export value from US $ 2,871,000 in 1986 to US $ 3,700,000 in 1987, or increase of 28.88 % (Table 4.1). The number of traditional fishermen involved with PT. USAHA MINA is shown in Table 4.2.

Before and after the implementation of the rumpon, the annual production of PT. USAHA MINA was fluctuated. However, there is tendency that the annual production was

Table 4.1. Skipjack Production by PT. USAHA MINA and the Artisanal Fisheries in North Molucca, 1984 - 1987

Year	Production (ton)		Total	Production increment (%)	Export (US $ 1000)	Export increment (%)
	Usaha Mina	Artisanal Fisheries				
1984	2,368 (100%)	-	2,368	143.62	1,451	73.01
1985	5,238 (90.8%)	530 (9.2%)	5,769	4.56	2,516	14.02
1986	4,400 (79.9%)	1,106 (20.1%)	5,506	27.13	2,871	28.88
1987*)	3,000 (42.9%)	4,000 (52.1%)	7,000	-	3,700	-

*) Production up to September 1987
Source : Fleet Division, PT. USAHA MINA, Sorong.

Table 4.2. Number of Artisanal fishermen involved in NES/ PT. USAHA MINA, in North Molucca.

Fishing Gear	Species Caught	Number of Fisherman	Percentage (%)
Lift net	Bait	60	12.5
Pole and line	Skipjack/Tuna	400	83.3
Tuna Vertical line	Tuna	20	4.2
Total	-	480	100.0

Source : Fleet Division, PT. USAHA MINA, Sorong.

greater during two-year period of rumpon utilization. The annual average production of 6-year period of non-rumponized fishing ground was only 3,294.2 tons, where as the two-year period of rumponized fishing ground gave a value of 3,681.2 tons (Table 4.3).

The monthly-annual average of CPUE before and after the implementation of rumpon by PT. USAHA MINA showed more remarkable difference, especially in December (Fig. 4.1). The value of December annual mean of CPUE after rumpon implementation was nearly three times of the value before implementation (Table 4.4).

Number of fishing vessels in the period of 1979-1984, tend to decrease, but after implementing rumpon in 1985-1986 the number of vessels increase, with fishing days relatively shorter than the condition before rumpon implementation (Table 4.5). Certainty of fishing ground is a major factor to enhance the fishing activities.

Table 4.3. PT. USAHA MINA annual production of skipjack/tuna before and after rumpon implementation.

Year	Total catch (ton)	Average Catch (ton)	Percentage (%)	Average percentage (%)
1979	4,131.64		10.5	
1980	3,696.32		3.3	
1981	3,573.84	3,294.17	31.2	37.85
1982	2,461.95		35.9	
1983	3,843.56		46.7	
1984	2,057.69			
1985	4,105.19	3,681.16	99.5	60.10
1986	3,257.14		20.7	

Remarks : 1979 - 1984, period before rumpon implementation
1985 - 1986, period after rumpon implementation

Source : Fleet Division, Usaha Mina, Sorong

Table 4.4. Percentage of Monthly CPUE increase before (1979-1984) and after (1985-1986) rumpon implementation

Month	Before Rumpon (A)	After Rumpon (B)	Relative Difference (B-A)/A x 100 %
January	20	38	90
February	22	51	132
March	23	45	96
April	31	52	68
May	35	43	23
June	31	45	45
July	26	44	69
August	31	39	26
September	31	53	71
October	36	46	28
November	30	53	77
December	26	76	200
Total	342	587	71.6

Percentage of increase after rumpon : 71.6 %

Table 4.5. Number of vessel and fishing days of 30 GT pole and line, 1979 - 1986.

Year	Total of Vessel **	Total Fishing days/vessel
1979	26	488
1980	26	440
1981	25	432
1982	23	349
1983	24	347
1984	23	288
1985	22	304
1986	21	276

Percentage of decrease effort after rumpon 35.3 %

Remarks :

1979 - 1984 period before rumpon implementation

1985 - 1986 period after rumpon implementation.

** Number of vessel owned by NES/PT. USAHA MINA.

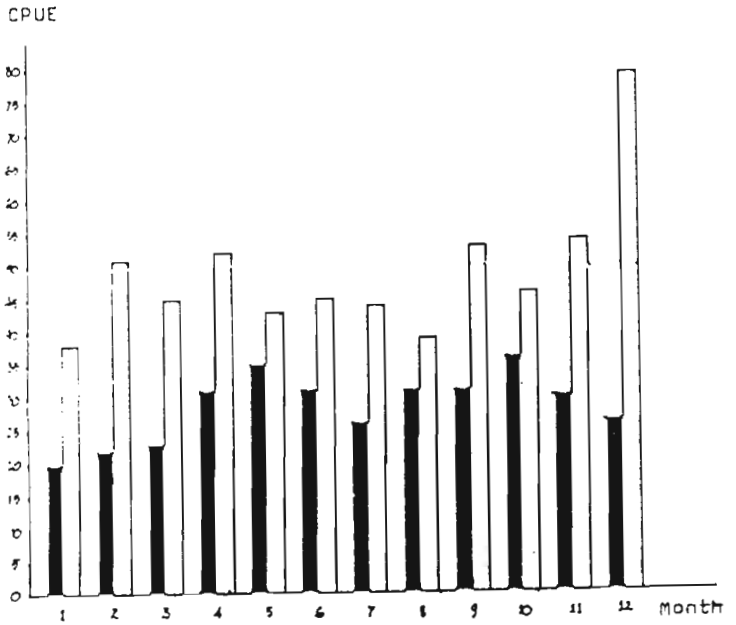

Figure 4.1. Monthly fluctuation of CPUE before and after rumpon implementation

■ : Before rumpon implementation (1979-1984)
□ : After rumpon implementation (1985-1986)

4.2 Impact on the Fuel and Live Bait Consumption

The fuel and live bait expenses are the most operational cost significantly influencing the income of the pole and line fisheries. Annual average of fuel consumption in the period of that of non rumpon was greater than in period of rumpon (Table 4.6). It is also seen that unnecessary chumed bait was reduced in rumpon period.

The eficiency of fuel consumption in the rumpon period is show in Table 4.6.

The monthly average of those two period for fuel and bait consumption were more remarkable reduced, as could be seen in Figs 4.2 - 4.3, respectively, as well as in Table 4.7 and Table 4.8.

Table 4.6. Total annual pole and line baitfish and oil consumption from 1979 until Sept.1986.

Year	Total Oil (ton)	Average (ton)	Oil/ boat	Total baitfish (bucket)	Average (bucket)	Baitfish/ Boat
1979	3134		121	120728		4643
1980	3148.7		121	128614		4947
1981	3004.5	2796.0	120	121744	118734	4870
1982	2577		112	92663		4029
1983	2708.2		113	152745		6364
1984	2203.7		96	95910		4170
1985	2363.4	2227.9	107	114151	111759.5	5189
1986	2092.4		100	109368		5208

Remarks : 1979-1984 period before rumpon implementation
1985-1986 period after rumpon implementation.

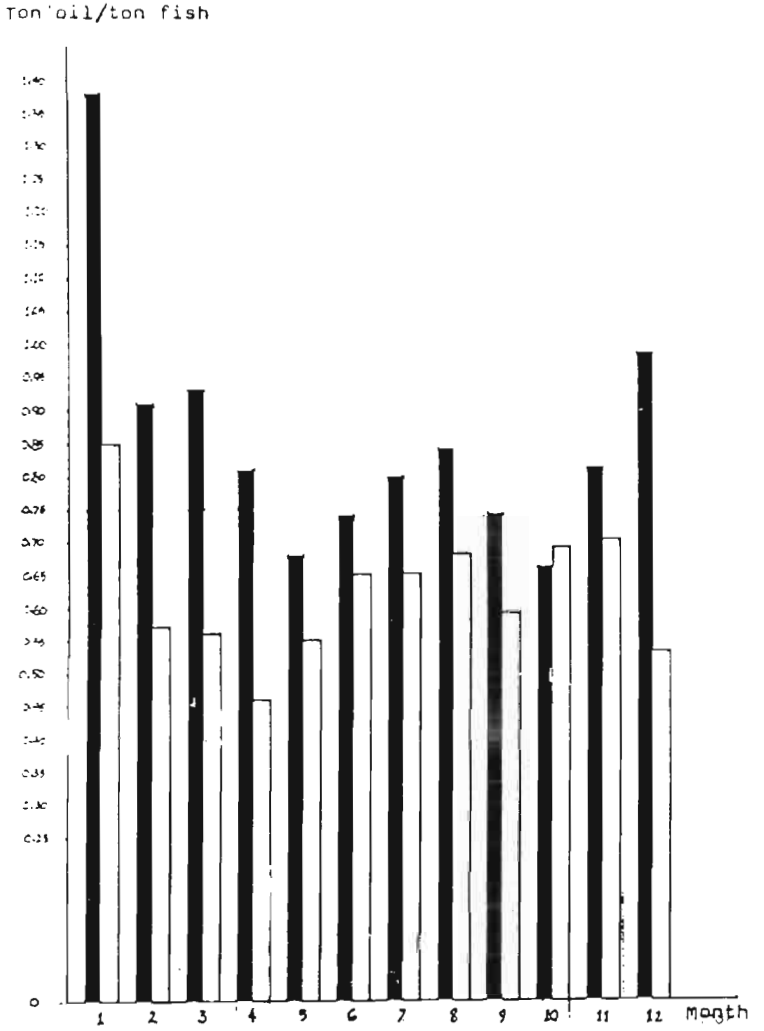

Figure 4.2.: Monthly fluctuation of oil consumption per ton fish before and after rumpon introduced

■ : Before rumpon implementation (1979-1984)
□ : After rumpon implementation (1985-1986)

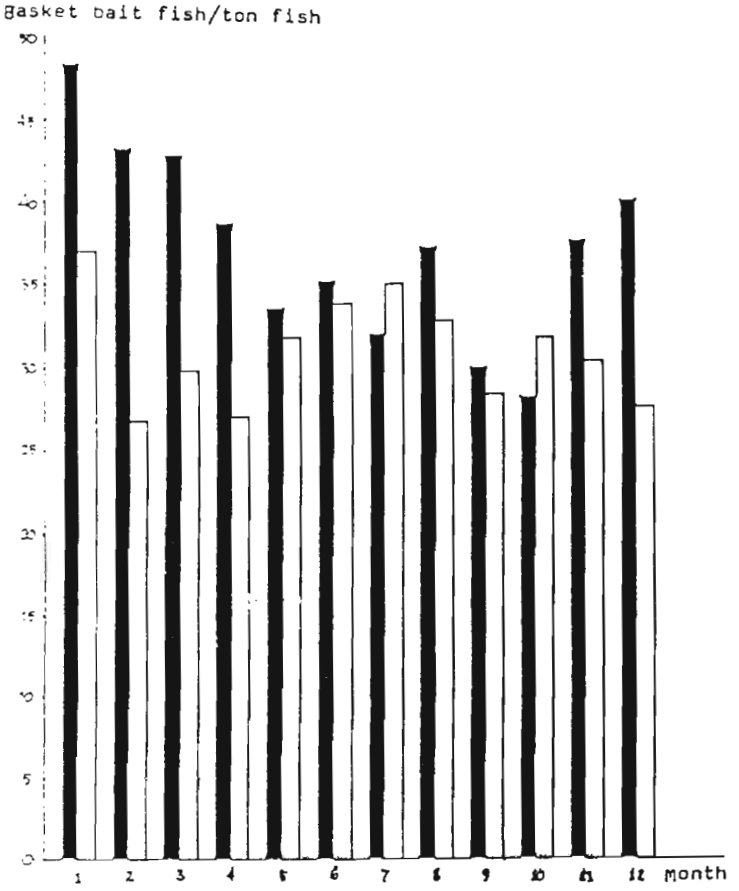

Figure 4.3 : Monthly fluctuation of baitfish consumption before and after rumpon implementation

■ : Before rumpon implementation (1979-1984)
□ : After rumpon implementation (1985-1986)

Table 4.7. Fuel consumption (ton/ton fish) per month before and after the rumpon implementation.

Month	Before rumpon (1979-1984) (A)	After rumpon (1985-1986) (B)	Relative Different (%) (A - B)/A
January	1.38	0.85	- 38
February	0.91	0.57	- 37
March	0.93	0.56	- 40
April	0.81	0.46	- 43
May	0.68	0.55	- 19
June	0.74	0.65	- 12
July	0.80	0.65	- 19
August	0.84	0.68	- 19
September	0.74	0.59	- 20
October	0.66	0.69	+ 5
November	0.81	0.70	- 14
December	0.98	0.53	- 45

Table 4.8. Bait-fish consumption (Bucket/ton) before and after the rumpon implementation.

Month	Before rumpon (1979-1984)	After rumpon (1985-1986)	Relative difference (%)
January	48.46	37.16	- 23
February	43.33	26.85	- 38
March	42.96	28.97	- 33
April	38.68	26.96	- 30
May	33.68	31.83	- 6
June	35.15	33.85	- 40
July	32.02	34.95	+ 9
August	37.32	32.77	- 12
September	29.99	28.46	- 5
October	28.32	31.84	+ 12
November	37.58	30.47	- 19
December	40.11	27.66	- 31

(2)The income is tending to increase, by diversification demand.

(3) The possibility to be owner of the fishing unit become higher for the labour-fishermen.

On the other hand, there are still disadvantage in present pricing system of bait-fish price. Complained by bait fishermen, they propose a more apropriate price, i.e. Rp. 1500/bucket instead of Rp. 1000/bucket.

Table 4.13 indicates the skipjack fishermen income in Sorong during 1985 - 1987. It is appeared that the average monthly income is not different much for every year.

Table 4.13. Monthly income of skipjack fishermen in Sorong during 1985 - 1987

Year	Income/Month	
	Owner Rp/vessel	Fishermen Rp/person
1985	2,600,000	85,000
1986	2,200,000	80,000
1987*	2,300,000	80,000

Source : PT. Usaha Mina, (1987)
*) Until November 1987

Based on analysis of primary data, the monthly income for skipjack fishermen in Bacan, Ternate, and Tidore are provided in Table 4.14.

Table 4.14. Monthly income of owner and fishermen of skipjack fishing unit in Bacan, Ternate and Tidore.

Fishing unit	Monthly income	
	Owner Rp/vessel	Fishermen Rp/person
Skipjack fishing Rumpon NES in Bacan	1,160,525	98,000
Skipjack fishing rumpon non-NES in Ternate	1,001,583	83,465
Skipjack fishing non-rumpon in Tidore	708,333	70,833
Average	956,813	84,099

It is clear that monthly income for the owners of fishing unit (rumpon NES, rumpon non-NES and non-rumpon) are different each other, but for labor-fishermen did not have significant difference.

Income for skipjack NES plasm fishermen in Bacan is better than rumpon non-NES fishermen in Ternate or non rumpon in Tidore. Furthermore, fishermen in Ternate had the higher income than fishermen in Tidore.

Concerning the standard of minimum supporting life expenditure for Maluku society as shown in Table 4.15 the fishermen income in all regions were greater value of poverty level, although they still categorized into low level of prosperous society.

Ternate Fishing Port should be developed, so the function of port to support fisheries activities would be in reality.

Fishermen community at Tumalou does not use rumpon, because most of them operated far away from Tidore waters. Although 13.3 % of the respondents said that rumpon do not affect their catch, the implementation of this technology should be considered. Several respondents admitted that bait-fish supply is not enough, and rumpon is regarded as a way out to overcome this problem. Also, the respondents in this community express their desire to use rumpon, once it is installed. Nowadays, Tumalou fishermen sell their catch to state owned enterprise the PN PERIKANI SULUTTENG from North Celebes

Respondents in Bacan Island said that they have utilized rumpon and they join a community called "Tunas Jaya" this community has relation with USAHA MINA and use the facilities provided by the company, i.e. rumpon, fuel, ice, bait- fish, maintenance and repair of vessels, insurance, premi, and license of fishing. In return, the Tunas Jaya members have to sell their catch to PT. USAHA MINA.

PT. USAHA MINA provides 400 litres fuel and 30 buckets bait-fish for every ton of catch. In this case, fish price is Rp. 250/kg for exportable quality (> 1.5 kgs), and Rp. 175/kg for non-export quality. Fish price for fishermen who do not use such a facilities Rp. 375 higher and USAHA MINA facilitated fishermen i.e. Rp. 325 for every kg and Rp. 250/kg for export and non-export quality respectively.

There are many fishermen who claimed the disadvantage of frame-work with USAHA MINA. Consequently, many fishermen thought better not to use the provided facilities. Most (93.3%) of the respondents are not satisfied with the level of present price, especially for Yellowfin tuna. However, as much as 80% of the respondents agree with NES system, and 73.3 % express their willingness to join the system.

Considering those facts, it is stressed that the development of NES system firstly is to create a better management. Legal aspect of "Tunas Jaya" as a NES plasm. Should be provided, so that the outsider fishermen will be undoubtful to join the system.

So far, there is no disturbance on the rumpon installment and utilization, however 6.7%of the respondents say that presence of white shark in rumponized ground, made the fishing operation become unsuccesful.

USAHA MINA also established a relationship with light lift net fishermen to maintenance the supply of bait-fish which will be used by member of "Tunas Jaya" fishermen community. For every bucket bait USAHA MINA paid Rp. 1000. The advantages of the rumpon existence for the lift net labor-fishermen are as follows :

(1) Saving time, effort and cost to dry the catch, because now it is sold as live-bait to skipjack fishermen.

direction. In fact, the additional operating cost will decrease the net income.

Total correlation coefficient as much as 0.80573 indicates that all production factors are influential significantly to the net income or skipjack production.

Total regression coefficient of 0.137106, shows that skipjack production and net income are in Decreasing stage. Test on the hypothesis indicates that vessel size (X_1), propulsive engine power (X_2), fuel (X_3), baitfish (X_4), and operating cost (X_7) are influential significantly on 95 % confidence interval (Table 4.10). The other production factors, i.e. fishing days and number of manpower are not significant.

Production model for skipjack fishing unit with rumpon non NES in Ternate (Table 4.10) indicates that all production factors are influential significantly to the net income on confidence interval of 95 %.

Production model for skipjack fishing unit non rumpon in Tidore (Table 4.10) shows that all production faktors are significant to the net income. However, the hypothesis test indicates that only fuel consumption (X_3) as production factor which influential significantly on 95 % confidence interval. The other production factors are not significant.

Table 4.10 production analysis of skipjack fishing unit (rumpon/NES, rumpon/non NES, and non rumpon), 1987

Items	Fishing unit rumpon NES in Bacan	Fishing unit rumpon/non NES in Ternate	Fishing unit non rumpon in Tidore
Production model	Y=5.07617-2.29668X1 +2.87964X2+1.72803 X3-1.45651X4+0.591 858X5+0.121338X6- 1.43042X7	Y=-1.25781+0.105713X1 +2.38379X2+0.543457 X3-0.0811768X4-0.67 1875X5+0.708008X6+ 0.631836X7	Y=5.62451-3.13159X1 -1.12003X2+0.9811 55X3+0.267303X4+ 0.237701X5+0.3810 27X6+0.173248X7
t-table (0.05/2.12)	± 2.179	± 4.303	± 2.447
Testing 95 %	X1, X2, X3, X4, X7 significant difference	-	X3 significant difference
F-table (0.05)	2.91	19.35	4.21
Testing 95 %	All production factors are significant differences	All production factors are significant differences	All production factor are significant differences

4.5. Social Aspect

The perception and aspiration of fishermen on rumpon have been analized from data obtained in several fishermen communities, i.e. Dufa-dufa and Bajo villages in North Molucca and Tumalou village in Central Halmahera. Those fishermen in Dufa-dufa and Bajo villages have utilized rumpon for their fishing activities. However, fishermen in Tumalou village do not use rumpon technology for fishing. A number of 53.3 % of the respondents claim that they use rumpon and tie up with Usaha Mina Corp.Ltd, while another 46.7 % of the respondents have not tied yet with Usaha Mina (Table 4.11).

Table4.12 indicates the aspiration of fishermen on rumpon utilization. All respondents claim that they have knowledge about rumpon, and 86.7 % among them agree to use rumpon while another 13.3 % the fishermen in Tumalou say that rumpon does not affect their fishing results.

Fishermen from Dufa-dufa village sell their catch at fish market in Ternate because Usaha Mina does not provide facilities for marketing at Dufa-dufa. Moreover, fish price at fish market is relatively better. Fishermen should sell fish to Usaha Mina, considering their catch originally taken from 3 rumpon installed by Usaha Mina. However, the fishermen are reluctant to do so. Therfore, catch from Ternate area is used for local consumption. Facilities of

Table 4.11. Perception of Fishermen on Rumpon

No.	Perception	positive Response (%)
1.	Knows about rumpon	100
2.	Agree with rumpon	86.7
3.	Relation with Usaha Mina	53.3
4.	Satisfied with fish price	6.7
5.	Agree with PIR system	80
6.	Existence of social friction	93.3

Table 4.12. Aspiration of Fishermen on Rumpon

No.	Aspiration	positive Response (%)
1.	Fishermen will utilize rumpon (specially for Tumalou fishermen)	86.7
2.	Fishermen will join NES system	73.3
3.	Rumpon will be utilized cooperatively	100
4.	Rumpon managed by the government	100
5.	The presence of rumpon will disturb navigation	100

Ternate Fishing Port should be developed, so the function of port to support fisheries activities would be in reality.

Fishermen community at Tumalou does not use rumpon, because most of them operated far away from Tidore waters. Although 13.3 % of the respondents said that rumpon do not affect their catch, the implementation of this technology should be considered. Several respondents admitted that bait-fish supply is not enough, and rumpon is regarded as a way out to overcome this problem. Also, the respondents in this community express their desire to use rumpon, once it is installed. Nowadays, Tumalou fishermen sell their catch to state owned enterprise the PN PERIKANI SULUTTENG from North Celebes

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Concerning the standard of minimum supporting life expenditure for Maluku society as shown in Table 4.15 the fishermen income in all regions were greater value of poverty level, although they still categorized into low level of prosperous society.

Table 4.15. Average of minimum supporting life expenditure in Molucca Province, fiscal year 1979/1980 to 1985/1986.

Fiscal year	Minimum supporting life expenditure		
	PL (Rp)	K^2 (Rp)	K^3 (Rp)
1982/1983	60,057.11	135,947.78	162,598.34
1983/1984	64,594.00	140,535.00	175,313.00
1984/1985	69,915.00	145,166.00	173,656.00
1985/1986	70,046.00	146,844.00	176,028.00

Remarks : PL = poverty level

The advantage of rumpon is to increase the prosperity level of fishermen. Prosperity level can be judged by observing the consumption pattern population. In an area is called prosperous if percentage of expenditure for food is always less than that for non food.

Table 4.16 illustrates the prosperity level of fishermen in Tidore, Ternate and Bacan. The highest percentage of expenditure for non food is in Bacan (71.3%), followed by fishermen in Ternate (60.8%), and Tidore (58.0%). Therefore the fishermen in those areas can be categorized as prosperous.

Also, the people in those areas showed the motivation to save their money in the bank or cooperetive investment, however, their percentage were small, i.e. 17.5 % for Bacan, 14.9 % Tidore and 2.7% Ternate. The other motivation have been shown is to build worship place such as mosque, and moslem pilgrimage.

Table 4.16. Indicators of prosperity level for fishermen in Tidore, Ternate and Bacan, observed from consumption expenditure.

No.	Allocation for consumption expenditure	Location		
		Tidore (%)	Ternate (%)	Bacan (%)
1.	Expenditure for non food :			
	a. Non food materials	43.1	58.1	53.7
	b. Saving	14.9	2.7	17.5
	Total	58.0	60.8	71.3
2.	Expenditure for food	42.0	39.2	28.8
	Total	100.0	100.0	100.0

5. DISCUSSIONS

Around 170 units of rumpon have been experimentally deployed in Indonesian waters by several projects and skipjack tuna enterprises. After about 5 years trials, at last the technology proved to be success for commercial operation. Analyses on the technical and socio economic aspects have shown a set of positive reasoning for further development of the rumpon in the research area.

The result of the technical aspect analyses has proved that the existing design and construction of rumpon is sufficient to be implemented in commercial bases. This means that the technology is already available. In the further rumpon development.

The trends of catch and effort also shows a significant possibility for expanding the skipjack tuna fisheries scale.

Analyses on the economic aspects also shows a very promising future for the skipjack fishing units and live-bait fisheries in respect to their productivity and venture efficiency. The Nucleus Estate for Small scale Industry system developed by the PT. USAHA MINA, combined with the utilization of the rumpon technology turned out to be a good management system for developing the skipjack fishery in the area.

Most of the expected output to certain extent have been achieved, and most likely the future development will render a similar output. At present, the unexpected output, such as over fishing and decrease in price have not veen occured yet. A monitoring and evaluation program should be done for early identification of the potential problems, so that a set of controll mechanism can be employed.

The above results will positively compose a good foundation and reasoning for further development of the rumpon utilization for the skipjack tuna fisheries in the Moulucca Sea. While there are still a lot of factors and considerations should be taken into account, the above facts could be used as a starting point for a decision on future development of the rumpon implementation in the research area.

(5) The rumpon utilization combined with the NFS pattern developed by PT. USAHA MINA, has increase the contribution of skipjack production by the artisanal fisheries to the total volume of skipjack handled by PT. USAHA MINA from 20.1 % before 1986 to 57.1 % after 1986. Mean while, the total skipjack tuna export values of PT. USAHA MINA also increased with 28.8 %.

(6) Analysis on the impact of the rumpon to the skipjack fisheries based on the available data, shows the trends of :

(i) Decrease in fishing effort (35.3 %)

(ii) Increase in total production of skipjack tuna (99.5 %)

(iii) Increase in catch per unit effort (71.6 %)

(iv) Decrease in live-bait consumption (6 %)

(v) Decrease in fuel consumption (20 %).

(7) Financial analysis on the skipjack fishing ventures operating in the water of Ternate, Tidore and Bacan Islands shows that the operations at present are in the profitable business. The "Rumpon/NFS" fishing units in Bacan Island having the highest B/C value and IRR value, compare to the "non rumpon/non NFS" units in Tidore and the "rumpon non NFS" units in Ternate. This can be used as indicators that the utilization of rumpon and the NFS pattern developed

6. SUMMARY AND CONCLUSIONS

(1) The deep sea rumpon or payaos as fish aggregating device for the skipjack and tuna fishing, has been successfully operated by the PT. USAHA MINA in commercial scale.

(2) In the average the endurance of the rumpon installed by the PT. USAHA MINA reached about 10.2 months for the less than 1000 m-water depth rumpon group, while the above 1000 m-water depth rumpon group only reach about 9.2 months. Those two average values are above the minimum economic life expectancy for a rumpon

(3) An analysis on the behaviour of the skipjack around the existing rumpon, shows that in the average, the skipjack schools visited the newly deployed rumpon on the first 25 days, with a modus on the first 10 days after the rumpon deployment. The skipjack tend to form size groups, according to time and depth of the waters.

(4) Fishing around rumpon yield a higher catch compared for fishing without rumpon. The most productive rumpons in the studied areas, were the rumpon deployed in the 1000 meters water depth.

(11) Analysis on the social aspect of the fisherman shows that :

(i) Most of the fisherman agreed upon the rumpon development in the waters of North Moluccs

(ii) In principle the local fishermen are willing to participate in the NES developed by PT. USAHA MINA, provided that there will be an improvement on the skipjack and tuna buying price by the enterprise

(iii) The fishermen are willing to utilize the rumpon cooperatively and managed by the government

(iv) The management system of the existing "Tunas Jaya" group as the plasms of the PT. USAHA MINA/NES needs to be improved.

(12) The existance of the rumpon installed by the PT. USAHA MINA combined with its NES pattern render several benefit for the live-bait fishermen.

(i) Increase in venture efficiency

(ii) Increase in income

(iii) Decreasing the role of usurers.

(13) The income of the fishermen in Bacan, Ternate and Tidore Islands, has barely above the standard of minimum living requirement. The Bacan Island fishermen's income in the average is higher than those fishermen in Ternate and Tidore Islands.

(14) The level of prosperity of the rumpon skipjack fishermen in Bacan Island in the average is above the non-rumpon skipjack fishermen in Ternate and Tidore Islands.

(15) Basically, the rumpon has a good prospect to be developed nationwide. Rumpon can be considered as a technological breakthrough in the skipjack fishing process in Indonesia and will be as an accelerating factor in skipjack and tuna fisheries development.

(16) The rumpon development followed by the NES pattern developed by the PT. USAHA MINA, is considered to be a combination positive action in development stage to increase the production, productivity, and the income of the artisanal fishermen.

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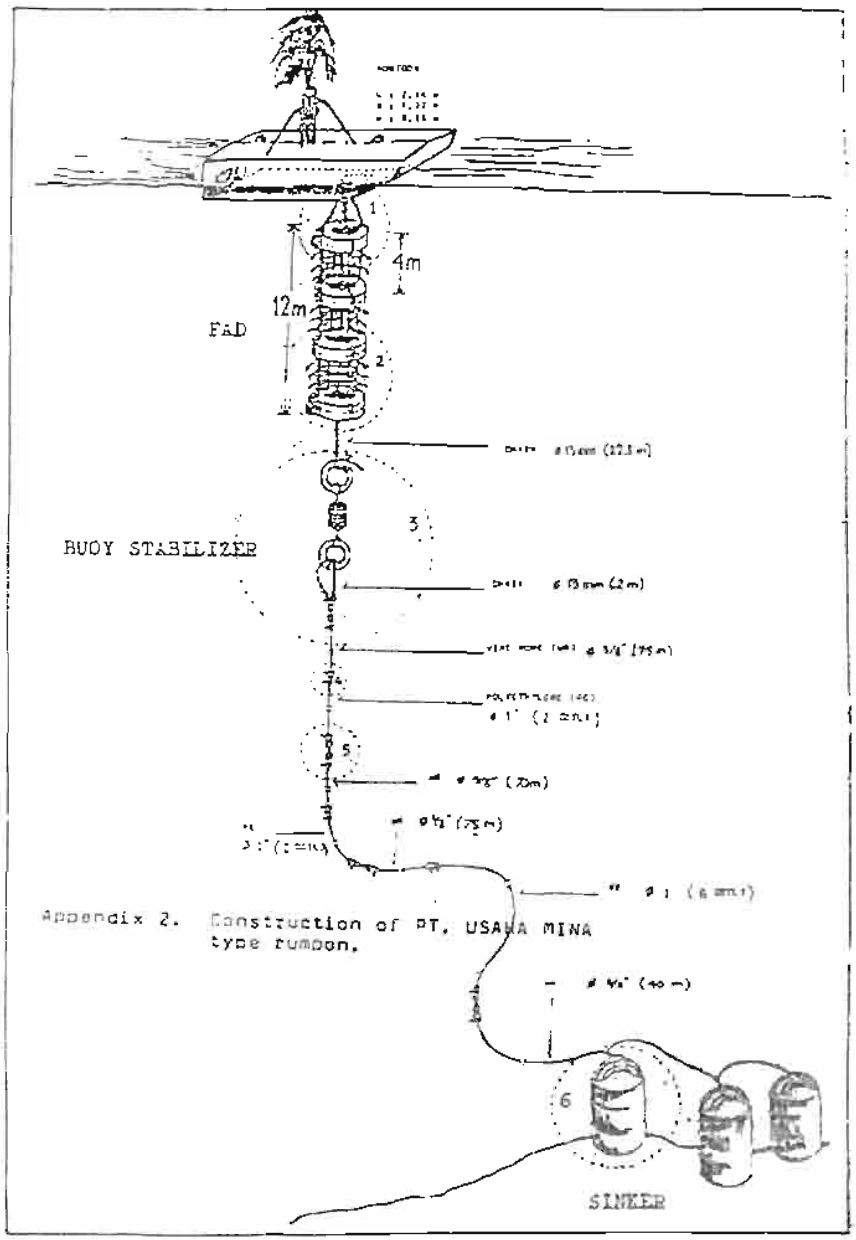
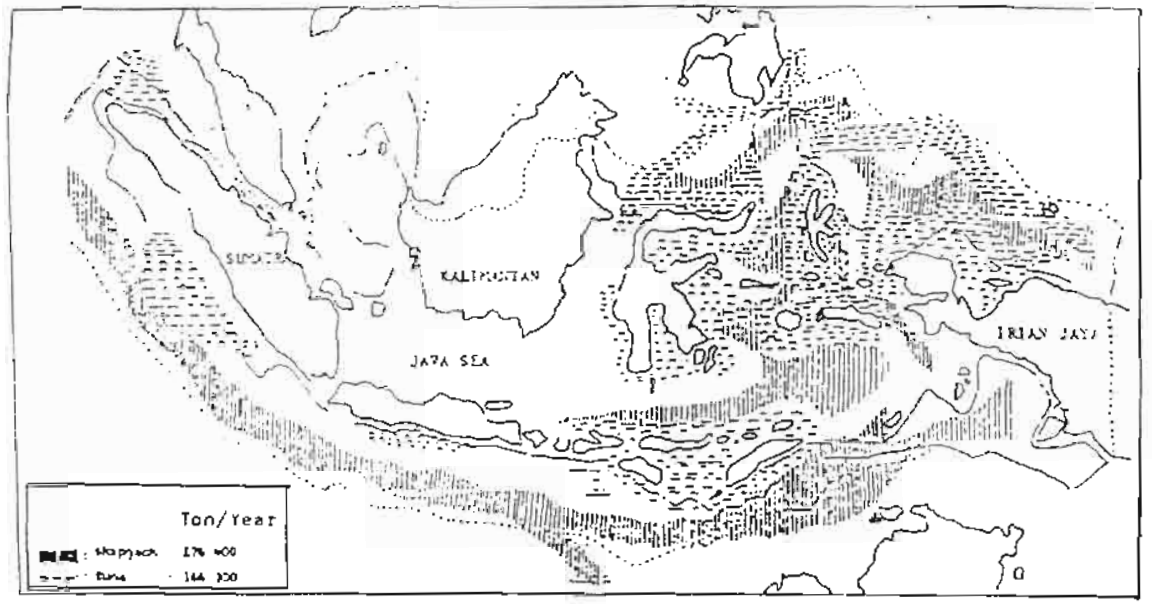
Appendix 1. Types, sizes, number and material of rumpon on each construction component in PT. USAHA MINA Sorong, Irian Jaya.

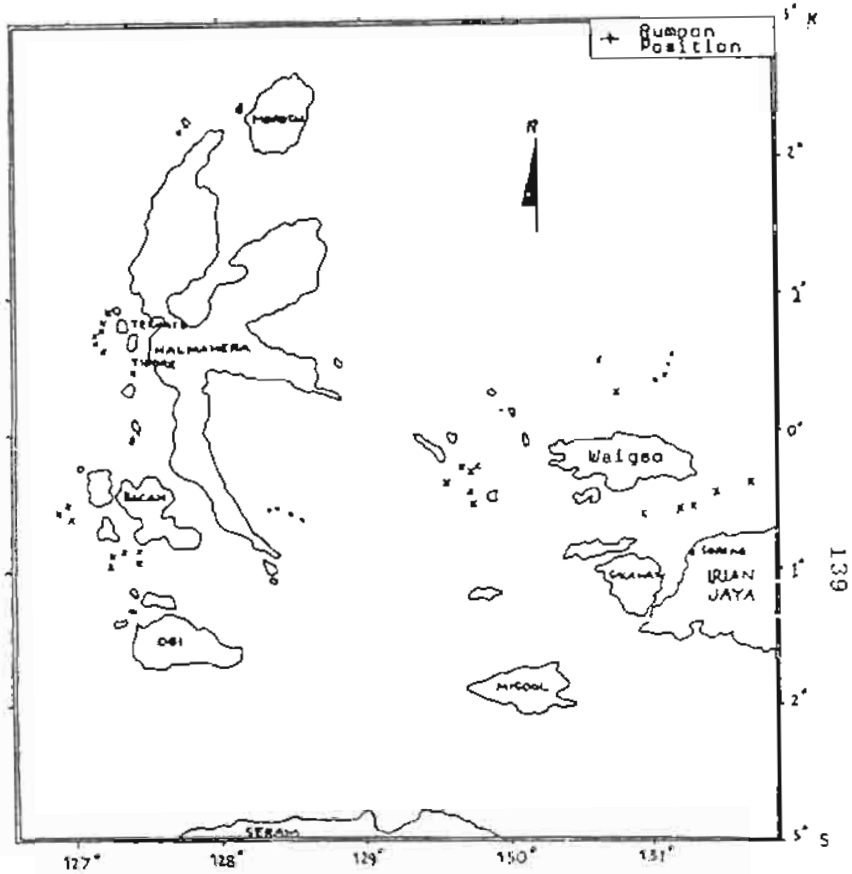
No.	Component	Material	Size	Unit
1.	Buoy			
	- pontoon	steel plate	L=3.66 cm B=2.2 m D=0.61 m	1 unit
	- hanging ring	iron	Ø=5/8 m	3 unit
	- swivel	iron	Ø=7/8 m	1 unit
2.	vertical line attractor			
	- chain line attractor			
	- chain/wire rope	iron/stainless steel	Ø=5/8 in L=100 in	-
	- shackle	iron	Ø=5/8 in	-
	- frame attractor			
	- ring of iron	iron	Ø=5/8 in L=100 m	2 unit
	- ring diameter	lorry tire rope	-	4 unit
	- attractor			
	- wire rope	polyethylene	Ø=3/8 in	-
	- appendages	coconut leaves		40-60 sheet
3.	buoy stabilizer			
	- sinker	concrete cement	Ø=30 cm	1 unit
	- ring of lorry tire	used lorry tire		2 unit
	- hanging ring	iron	Ø=5/8 in	2 unit
4.	connecting of line			
	- first line	polyethylene	Ø=5/8 in L=0.5 sea water	-
	- swivel	iron	Ø=0.5 in	2 unit
	- counterweight	wire rope	Ø=5/8 in	-
	- second line	polyethylene	L=0 sea water	
5.	bottom sinker			
	- sinker	concrete cement, angular bar	200 lt of drum oil	3 unit
	- sinker's line			
	- first line	wire rope	Ø=5/8 in L=5 m	-
	- second line	wire rope	Ø=5/8 in L=5 m	-
	- third line	wire rope	Ø=5/8 in L=40 m	-



Appendix 2. Construction of PT. USAHA MINA type rumpon.



Appendix 3 Tuna and Skipjack Distribution in Indonesia



Appendix 4. Distribution of rumpon in North Maluccs and Irian Jaya.

Experiment on Drift Gillnets for Tunas

(Y. Matsunaga & S. Sondhom)

Introduction

Drift gillnets fishing is operated widely throughout the Gulf of Thailand aiming to catch pelagic species i.e. mackerels, bonito, caranx etc. It has the following advantages.

1. Structure of gear is simple and handling of gear is easy
2. Operation is possible in very deep as well as in shallow waters
3. Gear selectivity for species is high.

However, drift gillnets for skipjack is newly designed to catch skipjack and tunas species which commonly formed schools in the Andaman Sea from January till June every year.

Objective

The aim of this survey was to investigate the feasibility of skipjack drift gillnetting in Andaman Sea.

Method of Experiment

a. Date and place of experiment

Information on the date and place of experiment, schedule of operations, depth of water where the experiment was carried out are given in Table 1. A rough map indicating the location of the experiment is shown in fig. 1.

b. Gear used for experiment

Two types of gillnets were prepared, the detail is shown in fig. 2 and fig. 3. Netting for skipjack gillnet was made of Nylon 210 D/18, mesh size 16.5 cm and 7000 m in total length, whereas for Spanish mackerel gillnet was made of Nylon 210 D/18, mesh size 10.0 cm, 400 m in total length. The two types of netting were numbered by float intervals and joined together.

c. Research Boat

M.V. PLATOO, a 65 gross tons fiberglass purse seiner equipped with hydraulic hauling devices necessary for gillnets fishing.

Results

Species and amounts caught by drift gillnets are shown in Table 2. Most of the catch were little tuna and skipjack. On the other hand it is not possible to make a comparison result of catch between skipjack and spanish mackerel drift gillnets due to less number of operations and amount of catch. Further experimental fishing is being considered for 1989 program in the same area in Andaman Sea.

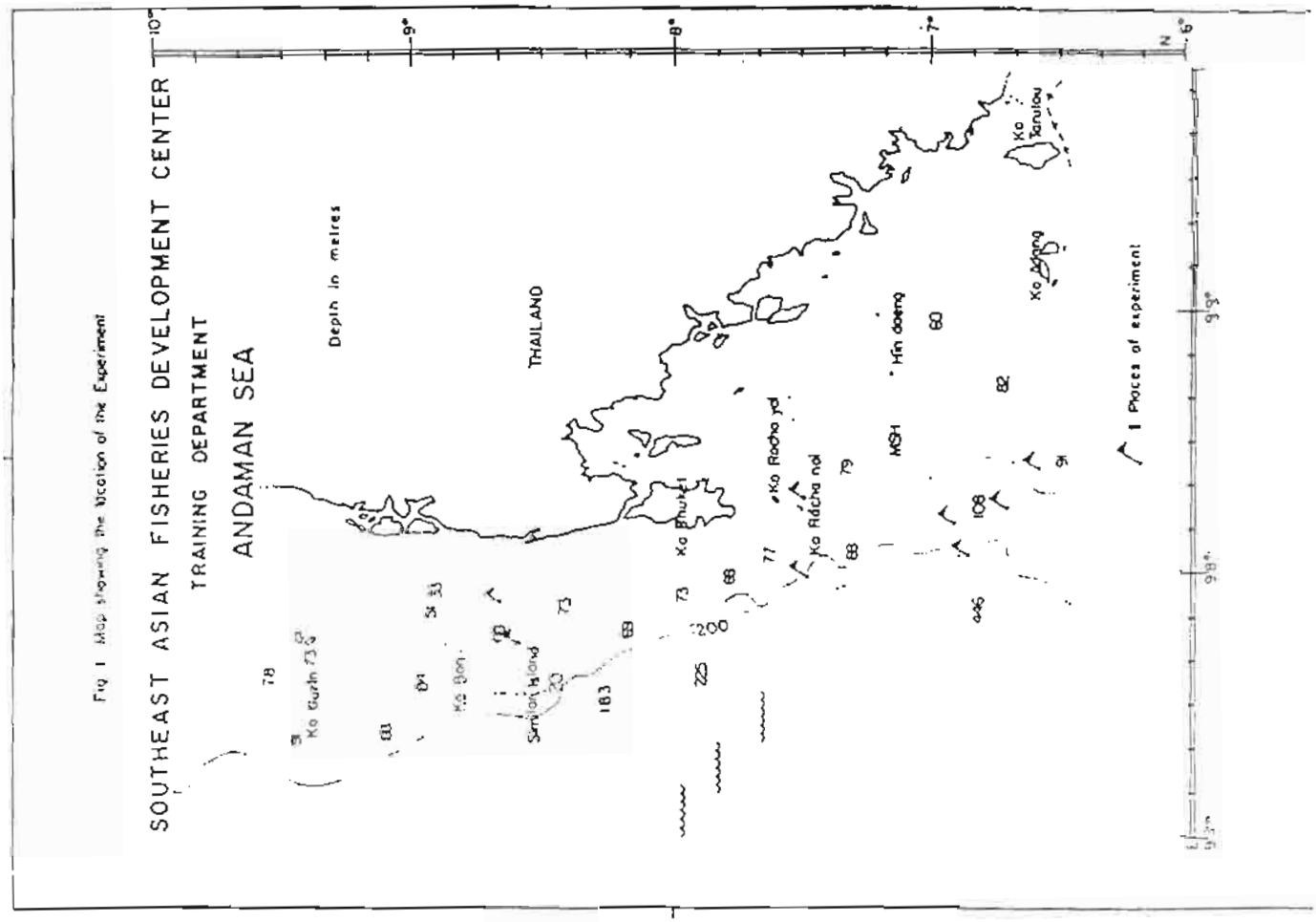


Fig 1 Map showing the location of the Experiment

Table 1. Detail of fishing operations gillnets for Tunas

Station No.	1	2	3	4	5	6	7	8
Date	6/2/88	7/2/88	8/2/88	9/2/88	11/2/88	12/2/88	13/2/88	14/2/88
Latitude Longitude	07° 29.75'N 098°17.5'E	07°28.7'N 098°01.0'E	08°38.2'N 097°54.4'E	08°34.8'N 097°46.8'E	06°43.8'N 098°14.6' E	06°52.3'N 098°04.8' E	06°56.2'N 098°11.6' E	06°35.0'N 098°23.4' E
Shooting time Hauling time	17.32 20.46	17.40 02.14	17.59 05.21	17.36 01.20	23.58 12.30	00.55 07.03	17.44 02.17	16.10 00.09
Sea depth (metre)	54	130	63	77	128	294	260	104
Water Temperature (-°C)	29.6	29.0	32.8	30.6	28.8	29.4	29.8	31.0
Total catch (kg)	1.5	2.5	13.5	10 00	222.4	247 5	113.9	12.3
No. of Tunas (pieces)	1	—	73	9	16	11	5	6

Fig. 2 TUNAS GILL NET

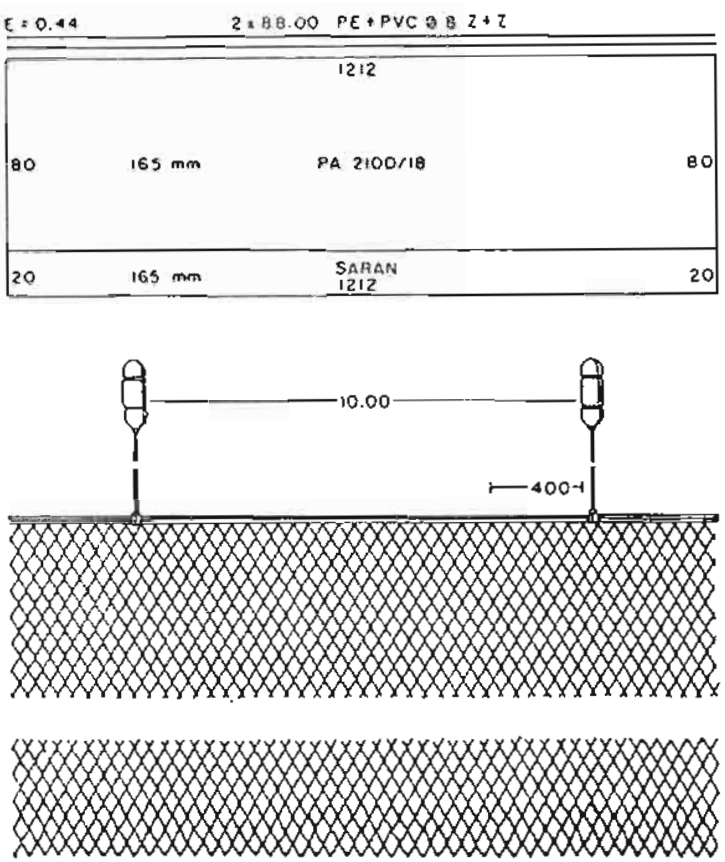


Fig. 3 SPANISH MACKEREL GILL NET

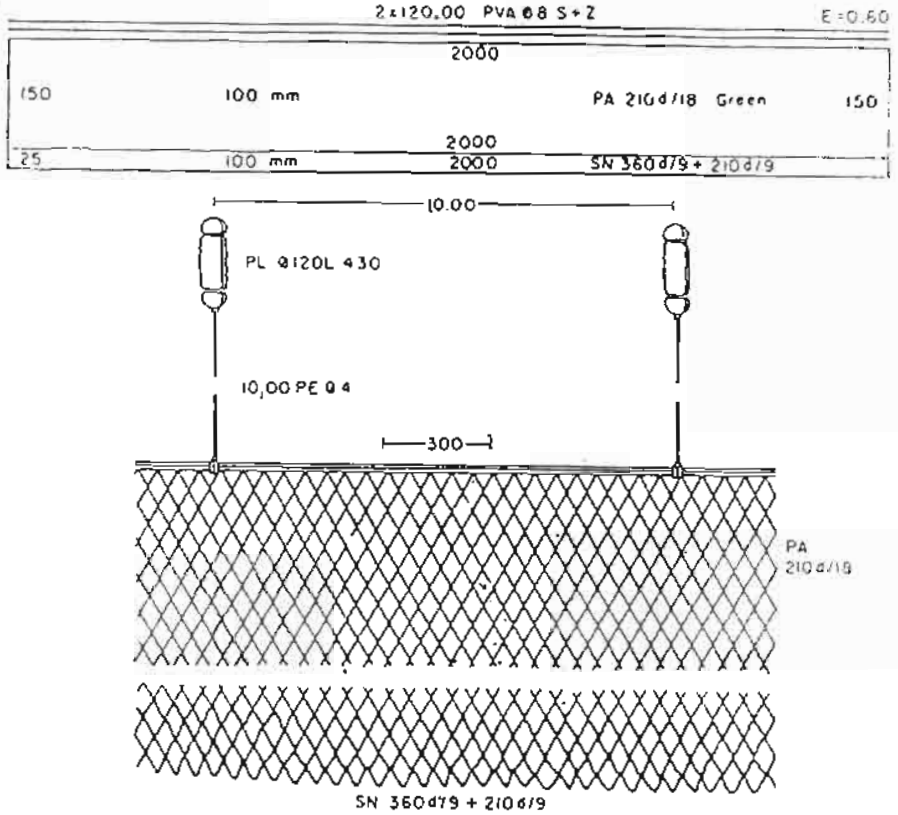


Table 2 Species and amount caught

a Tunas

Little tuna	85	pcs	21.3	kg
Skipjack	23	pcs	35.7	kg
Yellow fin tuna	4	pcs	30.6	kg
Frigate mackerel	8	pcs	-	kg
Longtail tuna	1	pcs	1.6	kg
TOTAL	121	pcs	94.2	kg

b Others

Sharks	24	pcs	440.7	kg
Rays	2	pcs	190.0	kg
Barracuda	5	pcs	12.7	kg
Others	33	pcs	8.0	kg
TOTAL	64	pcs	651.4	kg
GRAND TOTAL	185	pcs	745.6	kg

THE AVERAGE LENGTH AND WEIGHT OF TUNA SPECIES

Tuna species	Station No								Average (cm)	Average (kg)
	1	2	3	4	5	6	7	8		
Little Tuna	40.0 (1)	—	20.8 (73)	31.4 (9)	20.0 (1)	—	63.0 (1)	—	22.0 (85)	0.25 (85)
Skip Jack	—	—	—	—	50.1 (10)	39.3 (3)	—	48.0 (6)	47.2 (19)	1.79 (19)
Yellow fin	—	—	—	—	—	73.5 (4)	—	—	73.5 (4)	7.65 (4)
Frigate mackerel	—	—	—	—	—	23.6 (4)	41.1 (4)	—	32.3 (8)	0.65 (8)
Long tail	—	—	—	—	53.0 (1)	—	—	—	53.0 (1)	1.60 (1)

( ) = Number of individual

Parasites of tuna of the South China Sea and their use as biological indicators

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Abstract:

Three species of tuna from the South China Sea, Auxis thazard, Euthynnus affinis and Thunnus tonggol, were examined. Of these, only Euthynnus affinis was found to be heavily infected with parasites. It harboured the digenean Brachyphallus sp., cestode larvae Scolex polymorphous and the nematode larvae Anisakis sp.. The morphology and prevalence of parasitic infection is described. The stomach of Thunnus tonggol was heavily infected with the yellowish cysts of the Didymozoid Didymocystis sp.. The advantages of Anisakis as a biological indicator are also highlighted.

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Introduction

There is very little work done on the parasites of tuna from the South-East Asian region. The only work done so far is by Premkit (1986). He examined fifty-five specimens of Thunnus tonggol from the Gulf of Thailand and found thirteen species of parasite: Copepoda (2), Nematoda (3), Acanthocephala (1), Monogenea (3) and Digenea (2). Very little is known of the parasites of tuna from the South China Sea. This work has been done primarily to rectify this situation but was also undertaken to ascertain if it was possible to use any of the parasites of tuna as biological indicators. Biological tags are better indicators than metallic tags since they do not cause inflammation or irritation. Metal tags have been known to cause these histopathological changes as reported by Wolfgang and Overstreet (1987).

Materials and Methods

The tuna fish were bought from local fishermen and examined by taking smears from the gills and also by dissecting the abdomen and examining the viscera. The worms obtained were fixed in 70 % alcohol, stained with paracarmine, dehydrated through an alcohol series, and mounted in Canada Balsam.

Resu

Euthynnus affinis was heavily infected with the following parasites: Brachyphallus sp., Scolex polymorphous and Anisakis sp.. Thunnus tonggol was infected with the Didymozoid Didymocystis sp.. The morphology of the worms are described below. Measurements are in millimeters, except where stated. The range is given in parenthesis.

Brachyphallus sp.

Class : Trematoda

Family : Hemiuridae Luhe, 1901

Genus : Brachyphallus Odhner, 1905

No. of specimens examined : 4

Host : Euthynnus affinis

Total length 1.70 ± 1.08 (1.55 - 1.80).

Maximum width 0.37 ± 0.04 (0.34 - 0.42).

Anterior sucker, length 0.11 ± 0.04 (0.07 - 0.16); width 0.11 ± 0.03 (0.08 - 0.14). Situated near anterior end, it is smaller than the ventral sucker. Pharyngeal length 0.05 ± 0.02 (0.04 - 0.06); width 0.05 ± 0.01 (0.05 - 0.06). Genital pore, anterior end distance from oral sucker 0.04 ± 0.01 (0.03 - 0.05). Preacetabular pit present, 70 ± 3 (66 - 72) um. Ventral sucker, diameter 0.32 ± 0.05 (0.27 - 0.38). Two testes situated laterally, size 0.17 ± 0.06 (0.13 - 0.26); distance from ventral sucker 0.06 ± 0.018 (0.05 - 0.07). Left testes, size 0.16 ± 0.06 (0.12 - 0.24); distance from ventral sucker 0.09 ± 0.01 (0.04 - 0.06). Ovary situated near posterior end, close to vitelline glands. Ovary size 0.19 ± 0.01 (0.17 - 0.20); distance from acetabulum 0.51 ± 0.02 (0.50 - 0.53). Egg non-filamentous, size 11.6 ± 0.1 (11.5 - 11.7) um. Long intestinal caecum reaching almost to posterior end. Vitellaria in the form of tightly packed two-lobed masses.

Anisakis sp. larvae

Order : Ascarida Skryabin and Shultz, 1940

Family : Anisakidae Skryabin and Karokhin, 1945

Genus : Anisakis Dujardin, 1845

No. of specimens examined : 10

Host : Euthynnus affinis

Length 14.60 ± 2.49 (19.00 - 23.00).

Width 0.35 ± 0.03 (0.28 - 0.40).

Body cylindrical with thin cuticle; anterior end larger with pointed posterior. Three labia at anterior with a small, short boring tooth. Oesophagus straight and rounded, anterior muscular portion 1.71 ± 0.06 (1.60 - 1.79), width 0.13 ± 0.01 (0.12 - 0.14). Ventricle length 0.54 ± 0.04 (0.51 - 0.60); width 0.17 ± 0.03 (0.14 - 0.20). Oesophageal apendix and intestinal caecum absent.

Scolex polymorphous

Plerocercoids of cestodes were found in the intestine of Euthynnus affinis. These were not identifiable and are given the name Scolex polymorphous. These are elongated plerocercoids with a uniformly narrowed posterior end. Maximum length 0.63 ± 0.04 (0.62 - 0.63). Four bothridial flaps surround the anterior sucker of the scolex.

The prevalence of these parasites is shown in Table I.

Didymocystis sp.

Class : Trematoda

Family : Didymozoidae

Genus : Didymocystis

No. of specimens examined : 20

Host : Thunnus tonggol

Cysts yellow in colour, length 1.52 (0.52 - 3.12); breadth 1.23 (0.47 - 2.21). The cysts were full of ovoid eggs, length 15 um; breadth 10 um. Ten eggs were measured.

Discussion

Out of the three species of tuna examined - Auxis thazard, Euthynnus affinis and Thunnus tonggol - the second harboured the most parasites. The prevalence of 40 % Brachyphallus sp. in Euthynnus affinis is quite high compared to the findings of other researchers. Hicks and Threlfall (1973) found Brachyphallus crenatus in four species of salmon in Labrador with prevalences as follows ; in Salmo salar (3 %), Salvelinus fontinalis (12 %), Salvelinus alpinis (31 %) and in Salvelinus namaycush (52 %). The prevalence of Scolex polymorphous was 60 % in Euthynnus affinis. These plerocercoids could be the larva of tetraphyllydean cestodes from the appearance of the bothidial flaps but it is difficult to identify them with certainty.

The low prevalence of Anisakis sp. larvae (40 %) in the intestine of Euthynnus affinis, when compared to the prevalence in other fish hosts, indicated that this is not an important intermediate host of this nematode. Layat (1985) obtained 78 % prevalence of Anisakis sp. larva in the pyloric caecum of Rastrelliger kanagurta and 70 % in the intestine and stomach of Atule mate. Abol and Shaharom (1986) found this parasite in fish belonging to the family Lutjanidae, Serranidae, Nemipteridae, Carangidae and Priacanthidae.

The larvae of the anisakid group of nematodes are amongst the most common parasites of marine fish (Smith and Wootten, 1978; Mackenzie, 1983; Bourgeois and Ni, 1984; Scott, 1985) and have constantly been used as tags.

In this study Anisakis larvae are only found in Euthynnus

affinis, none being found in Auxis thazard or Thunnus tonggol. Euthynnus affinis is also infected with Brachyphallus sp. and Scolex polymorphous. Only Thunnus tonggol is infected with the Didymozoid. Hence here it is evident that three different stocks of tuna can be distinguished mainly by their parasites.

In this study only the endoparasites were examined as the fish caught were not fresh and therefore were not suitable for ectoparasitic examination. Premkit (1986) found the copepod Caligus and Pseudocycnus sp. and the Monogenea Discocotyle sp., Axine sp. and Nitzchia sp. on the gills of the longtail tuna Thunnus tonggol.

This study only looks at the main parasites found without carrying out the mean intensity, prevalence or abundance of the parasites at different trawling sites. Similar parasitic abundance indicate similar migration periods of similar stocks of fish.

In the Baltic Sea there are stocks of herrings and garfish, Belone belone (L), which spawn in areas of low salinity and migrate seasonally to feeding grounds further west in areas of higher salinity. These migratory stocks can be identified in the spawning grounds by their infections of the characteristic(all) marine anisakid nematode larvae, adult hemiurid digeneans and trypanorhynch metacestodes (Gaevskaya and Shapiro, 1981; Galda, 1981).

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The Skipjack Tuna (*E. pelamis*) Fisheries of the Philippines: Changes in Catch Volumes and Size Composition

by

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Abstract

This paper presents the state of the skipjack tuna (*E. pelamis*) fisheries in the Philippines with emphasis on the changes in the catch landings and size composition during 1980-1987 in Southern Philippines where regular monitoring activities are carried out.

The skipjack accounted for about 25 percent of the total tuna landings throughout the Philippines and about 47 percent in Southern Philippines (mean for 10 years).

The catch per purse seine vessel at Gen. Santos City remained steady through the years while that of Recodo increased gradually from 1982 to 1985 and dropped slightly in 1987. The trend in catch per ringnet vessel vary at all sites and that of handline boats increased gradually until 1984, abruptly in 1985 with a sudden drop from 1986 to 1987.

The sizes of skipjack exploited by the various gears in the Southern Philippines did not vary much from year to year.

1. Introduction

The Philippine tuna fisheries is supported by six species of tunas, one of which is the skipjack tuna (*Katsuwonus pelamis*). The total skipjack tuna landings from 1978 to 1987 ranged from 31,178 m.t. to 77,031 m.t., with a mean value of 52,837 m.t. which is about 25% of the total tuna landings. It contributed from 14 to 26 percent (x = 18.3%) and from 14 to 38.9 percent (x = 27.98%) to the total municipal and commercial tuna landings in the Philippines, respectively.

The major fishing areas for skipjack are Moro Gulf, East, West and South Sulu Seas, Tayabas Bay, Davao Gulf, Lingayen Gulf, Batangas Coast, Cuyo Pass and Manila Bay.

The skipjack are mainly caught by purse seine, ringnets and handlines (White and Ingles 1982).

Prior to the Tuna Sampling Program initiated by the South China Sea Fisheries Development Program, very few studies, particularly on skipjack, have been done. Studies on the biology and population dynamics of skipjack have been reported by Ronquillo (1953, 1964), Bunag (1956), White (1982), Yesaki (1983) and Tandog-Edralin *et al.* (1987).

This paper will attempt to document the changes in the skipjack fisheries in the Philippines particularly in Southern Philippines where there is continuous monitoring activities being carried out.

2. Sources of data

2.1 Catch Data

The National Catch Data are extracted from the BFAR Fisheries Statistics of the Philippines from 1978 to 1987 and are separated by municipal and commercial fisheries sector, by gear and by statistical fishing areas.

For the Southern Philippines (Regions IX, X and XI), data was also extracted from the BFAR Fisheries Statistics of the Philippines from 1978 to 1987 and from the Tuna Sampling Programme established by BFAR at five sampling sites in Mindanao, namely: Sta. Cruz, Labuan, Recodo, Opol and Gen. Santos City.

2.2 Length frequency

The length data were obtained from the length measurements done by the Tuna Sampling Programme at the same sites.

3. Changes in Catch Volumes

3.1 National Level

Through the years from 1978-1987, the annual landings of skipjack by the municipal fisheries sector (vessels of *less than* 3 gross tons) *fluctuated* greatly from about 35,000 m.t. *in* 1978 to about 18,000 m.t. in 1983 or from 26% and 12.9% of the total tuna landings, respectively. The contribution of skipjack to the commercial fisheries (over 3 gross tons vessels) sector landings of tuna fluctuated yearly from 14% to 38%, the highest percentage contribution observed in 1986 with a value of 51,778 m.t. (Tables 1A and 1B, Fig. 1).

The skipjack landings of major municipal and commercial fishing gears from 1978-1987 is presented in Table 2 and Fig. 2. The landings from handline boats, the main municipal gear for skipjack, indicated an increasing trend from 1978 to 1981, decreased by almost one-half in 1982 and 1983 and finally increased to the same level in 1987. The total municipal landings by all gears also indicate a declining trend until 1984 and gradually picked up by 1986 and 1987.

The total skipjack landings by purse seine vessels have largely influenced the total commercial landings for the ten-year period. Slight fluctuations are indicated from 1978 to 1981, increased to more than double in 1983, dropped slightly in 1984 and increased again by about 10,000 m.t. in 1987. The ringnet landings fluctuated irregularly (Table 2, Fig. 2.).

The skipjack are caught in all fishing areas of the country. The geographical location of the ten main fishing areas for both the municipal and commercial fisheries sectors are presented in Fig. 3. The first five municipal fishing areas, based on their mean annual landings, are Moro Gulf, Cuyo Pass, South Sulu Sea, Tayabas Bay and Davao Gulf. The first five commercial fishing areas, based on their mean annual landings, are Moro Gulf, South Sulu Sea, West Sulu Sea, Lingayen Gulf and East Sulu Sea. The annual landings from all these fishing areas fluctuated yearly (Tables 3 and 4).

The municipal fisheries landings from Moro Gulf fluctuated from a low value of 3,379 m.t. in 1980 to a high of 10,963 m.t. in 1986. The commercial fisheries landings from the same area indicated a low value of 1,394 m.t. in 1980 to a high value of 21,802 m.t. in 1986.

3.2 Southern Philippines

3.2.1 The skipjack landings in Regions IX, X and XI are presented in Table 5 and Fig. 4.

The annual landings in Region IX from the commercial sector showed a steadily increasing trend from 1980 to 1987, from values of 3,178 m.t. to 25,381 m.t., respectively, with a slight decrease in 1986. The municipal landings decreased from 1978 to 1980, steadily increased until 1982 and continuously declined until 1984 and again rose up to 1987. The number of purse seine and ringnet vessels show a similar trend, indicating that the increase in effort is still generating increased catches.

The annual municipal landings from 1978 to 1987 in Region X fluctuated year by year, the highest was in 1979 and in 1983. There is a decline in 1987. The commercial fisheries landings increased steadily from 1978 to 1981, declined in 1982 and remained steadily increasing until 1986 and decreased slightly in 1987.

The annual municipal landings from 1978 to 1987 in Region XI also showed a decreasing trend up to 1979, then rose in 1980 and declined abruptly in 1981, gradually decreasing until 1984 and picked up slightly until 1986 and went down again in 1987. The commercial landings likewise indicate a similar pattern but decrease in catches in 1984 and 1987 were abrupt while that of the frigate /bullet tuna increased. This phenomenon was attributed to the enumerators' difficulty to differentiate the skipjack from the bullet/frigate tuna in these areas.

For Region IX, the skipjack contributed from 19.7% to 79.3% to the total tuna commercial landings and from 9.3% to 21.3% to the total tuna municipal landings from 1978-1987. For Region X, the contribution of skipjack ranged from 2.3% to 27.1% and from 5.3% to 32.5% to the total tuna commercial and municipal landings, respectively. For Region XI, the values ranged 16.9% to 49.7% of the total tuna commercial landings and from 5.2% to 22.0% of the total tuna municipal landings. The annual contribution of skipjack to both the municipal and commercial landings of tuna vary from year to year (Table 6.)

3.2.2. Based on the regular monitoring data at various landing sites, wherein the catch data from each gear type were converted into catch per vessel, there is a very apparent fluctuation in the monthly as well as in the annual catches of skipjack from all sites and from all gear.

The monthly changes in the catch per ringnet boat at Gen. Santos City and Labuan from 1980 - 1987 is presented in Fig. 5. At Gen. Santos City and Labuan, the catch per ringnet boat fluctuated monthly through the years 1980 - 1987. However, certain months of the year indicated better catches.

The monthly changes in the catch per ringnet boat at Opol and Sta. Cruz are presented in Fig. 6.

The monthly changes in the catch per purse seine vessel at Gen. Santos City and Recodo are presented in Figs. 7 and 8, respectively.

The annual changes in the catch per vessel at the various sampling sites are presented in Fig. 9. For Gen. Santos purse seiners, the yearly catch per vessel remained almost steady from 1980 to 1985 with slight increases from 1986 to 1987. The Recodo purse seiners demonstrated a steadily increasing catch per boat from 1983 to 1986 with values from 50,072 kg/boat to 82,763 kg/boat and declined slightly in 1987.

The catch per ring net boat at Opol declined from 1980 to 1982 and increased steadily until 1984 then declined again until 1987. The Gen. Santos ringnet catch per boat showed an increasing trend from 1981 to 1984 then decrease slightly until 1986. The catch per ringnet boat at Sta. Cruz show a variable trend until 1984 but declined gradually until 1987.

4. Changes in size composition

4.1 The annual changes in the size composition of skipjack caught by purse seine at Recodo and Gen. Santos are presented in Figs. 10 and 11, respectively. Those of ringnets from Gen. Santos City, Opol and Labuan are presented in Figs. 11 to 13, respectively; and those of handline at Labuan in Fig. 14.

The comparative size composition of the three major gears, all sites combined, are presented in Fig. 15.

4.2 The combined monthly size composition from 1980 to 1987 for the purse seine catches at Gen. Santos City and Recodo are presented in Figs. 16 and 17, respectively.

For the ringnet catches at Gen. Santos City, Opol, Sta. Cruz and Labuan, the monthly size composition are presented in Figs. 18-21, respectively.

The monthly size composition of the handline catches from all sampling sites are presented in Fig. 22.

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Table 11. Annual landings (m.t.) of skipjack (*K. pelamis*) and that of all tunas in the Philippines from 1978-1987.

	1978		1979		1980		1981		1982		1983		1984		1985		1986		1987		$\bar{x}$	
	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT	SJ	AT
Municipal	34914	133299	25250	119107	10682	113555	20733	105763	19612	111330	17550	135610	15900	109482	18103	124838	25253	133131	26000	124024	19925.5	120913.9
Commercial	14816	50700	19834	78204	12486	87250	17706	97991	31183	105274	39613	106676	29171	117317	42631	136769	51770	133080	47601	146503	30641.6	105976.9
TOTAL	49733	183998	45084	197311	31178	200805	38439	203754	50796	216604	57151	242286	44671	226799	60536	261607	77021	266211	73751	270527	52036.6	226890.3

Note: SJ - Skipjack tuna
AT - All tunas

Table 18. Percentage contribution of skipjack (*K. pelamis*) to the the total tuna landings

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	$\bar{x}$
Municipal	26.19	21.20	16.46	19.60	17.62	12.93	14.56	14.50	18.97	21.91	18.30
Commercial	28.22	25.36	14.31	18.07	29.62	37.13	24.61	31.02	38.91	32.55	27.98
TOTAL	27.03	22.85	15.53	18.86	23.45	23.59	19.78	23.14	28.94	27.26	23.04

Table 2. Annual landings (m.t.) of skipjack (*Katsuwonus pelamis*) by major commercial and municipal fishing gears in the Philippines, 1978-1987.

Fishing Gear	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	$\bar{x}$
Commercial											
Purse seine	6279	10955	9135	12607	26414	28026	23440	28054	38929	39125	22296.3
Ring net	7052	1414	2786	4683	4082	11068	5256	14303	12105	7052	6980.3
Bagnet	1302	213	157	243	364	192	35	11	681	320	352.6
Municipal											
Handline	6753	8194	9911	14264	7639	7828	11403	10244	13523	14624	10448.3
Gill net	7321	4073	4908	2995	2437	1980	1221	2183	2851	2657	3262.6
P.seine/R.net	574	5444	3085	1441	26	877	1280	423	6288	4822	2426.0
Longline	1366	344	358	440	475	1301	624	735	590	1727	796.0
Troll line	-	-	41	663	360	382	504	699	540	640	385.7

Source of basic data: BFAR Fisheries Statistics of the Philippines, 1978-1987

Table 5. Catch trends (m.t.) of skipjack (*E. pelamis*) from the municipal fisheries sector in major tuna fishing grounds of the Philippines

Statistical Fishing Area	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	X
Zamboanga Bay	4449	1638	3815	2127	1331	197	177	2432	521	259	1493.5[3]
Moro Gulf	4252	3323	2375	4565	1935	5215	1611	5791	10563	6571	5033.7[1]
South Sulu Sea	2522	1135	259	1745	5823	3507	625	1307	1476	928	1978.6[2]
Davao Gulf	2429	2422	1057	456	436	2707	1215	1353	2529	1457	1515.4[4]
East Sulu Sea	435	127	311	4735	1221	414	334	266	693	2474	1433.1[5]
Bohol Sea	415		1284	991	261	1219	1569	505	572	593	598.8[10]
Bataan-Cavite Coast	321	983	1819	1364	255	735	279	570	1671	1254	853.4[6]
Cuyo Pass		2595	2954	1009	1123	391	2312	802	2708	3151	1313.6[7]
Leyte Gulf	215	1572	565	495	329	1423	1117	986	1496	1597	1011.4[8]
Lingayen Gulf	151	1410	1057	825	501	442	342	331	571	430	457.0
Manila Bay	19			36	1515	1661	1179	1119	983	271	774.2[9]
Sibuyan Sea		331	145	37	148	323	564	775	203	569	319.1
Visayan Sea	194	5	1990	552	324	62	69	65	23	85	565.5

Source: BFAR Fisheries Statistics of the Philippines

Note: 1-10 represents ranking

Table 6. Catch trends (m.t.) of skipjack (*E. pelamis*) from the commercial fisheries sector in the major tuna fishing grounds of the Philippines, 1978-1987

Statistical Fishing Area	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	X
Moro Gulf	7554	7170	1364	5200	9253	18359	7046	21802	13459	9429	10067.3[1]
South Sulu Sea	5875	9409	733	449	3258	5209	11439	7395	17232	15116	7354.6[2]
Bohol Sea	1948	260	160	915	794	2777	1352	3180	2356	429	1401.1[5]
East Sulu Sea	743	670	179	752	2156	1600	980	1119	1350	5537	1585.6[3]
West Sulu Sea	301		2035	4305	6061	2061	758	989	12537	12124	4519.1[3]
Davao Gulf	251	1200	1355	513	502	307	323	463	58	210	569.2[9]
Cuyo Pass		190	251	918	1436	2861	1990	2260	1169	865	1194.0[7]
Lingayen Gulf		60	723	3635	6490	3296	2923	2954	1083	961	2052.9[4]
Manila Bay	9		14	385	2061	1137	1072	1239	1329	1507	675.3[8]
Zamboanga Bay	16	42	17	21	2	137	107	670	955	935	279.6[10]
Visayan Sea	113	194	145	124	442	354	107	79	1	8	154.3

Source: BFAR Fisheries Statistics of the Philippines

Note: 1-10 represents ranking

Table 5. Percentage share of skipjack (K. pelamis) to the total tuna landings in Southern Philippines (Regions IX, X and XI), from 1978-1987.

Year	Region IX		Region X		Region XI		$\bar{X}$	
	Mun.	Comm.	Mun.	Comm.	Mun.	Comm.	Mun.	Comm.
1978	16.7	79.3	5.3	11.9	21.9	44.7	16.0	45.3
1979	17.9	41.4	18.6	22.0	17.5	20.3	18.0	27.9
1980	9.3	19.7	8.2	15.8	5.2	19.2	7.6	18.2
1981	19.6	34.8	20.1	27.1	7.6	27.9	15.8	29.9
1982	20.5	58.6	15.5	4.6	6.8	26.1	14.3	29.8
1983	15.9	54.0	15.4	2.6	16.2	49.7	15.8	35.4
1984	10.1	54.3	29.5	2.3	10.8	16.9	16.8	24.5
1985	9.6	54.2	28.3	2.6	13.0	38.4	17.0	31.0
1985	12.2	56.2	29.7	4.4	22.0	47.8	21.3	36.1
1987	21.3	61.3	32.5	4.6	19.6	30.2	24.5	28.7

Source of basic data: BFAR Fisheries Statistics of the Philippines, 1978-1987.

Table 6. Annual landings (m.t.) of skipjack (K. pelamis) in Southern Philippines from 1978 - 1987.

Year	Region IX			Region X			Region XI			Grand Total		
	Comm.	Mun.	Total	Comm.	Mun.	Total	Comm.	Mun.	Total	Comm.	Mun.	Total
1978	3178	3495	6673	101	376	477	6814	8366	15180	10093	12237	22330
1979	4383	2800	7183	256	1993	2249	3405	3669	7074	8044	8462	16506
1980	543	1353	1896	339	1143	1482	2874	1527	4401	3756	4023	7779
1981	1305	4699	6004	622	1293	1915	5091	1311	6402	7018	7303	14321
1982	9705	8533	18238	139	796	935	5122	796	5918	14966	10125	25091
1983	14200	6559	20759	106	1954	2060	11437	3297	14734	25743	11810	37553
1984	15738	2302	18040	108	1830	1938	4584	4707	6292	20431	5839	26270
1985	20600	3865	24465	136	1115	1251	12754	1747	14501	33490	6727	40217
1986	18999	5057	24056	233	1514	1747	14350	3162	17512	33582	9733	43315
1987	25381	7864	33245	249	1429	1678	6056	2718	8774	31686	12011	43697
TOT	114032	46527	160559	2289	13443	15732	72488	28355	100788	186809	88270	275079

Source : BFAR Fisheries Statistics of the Philippines, 1978-1987.

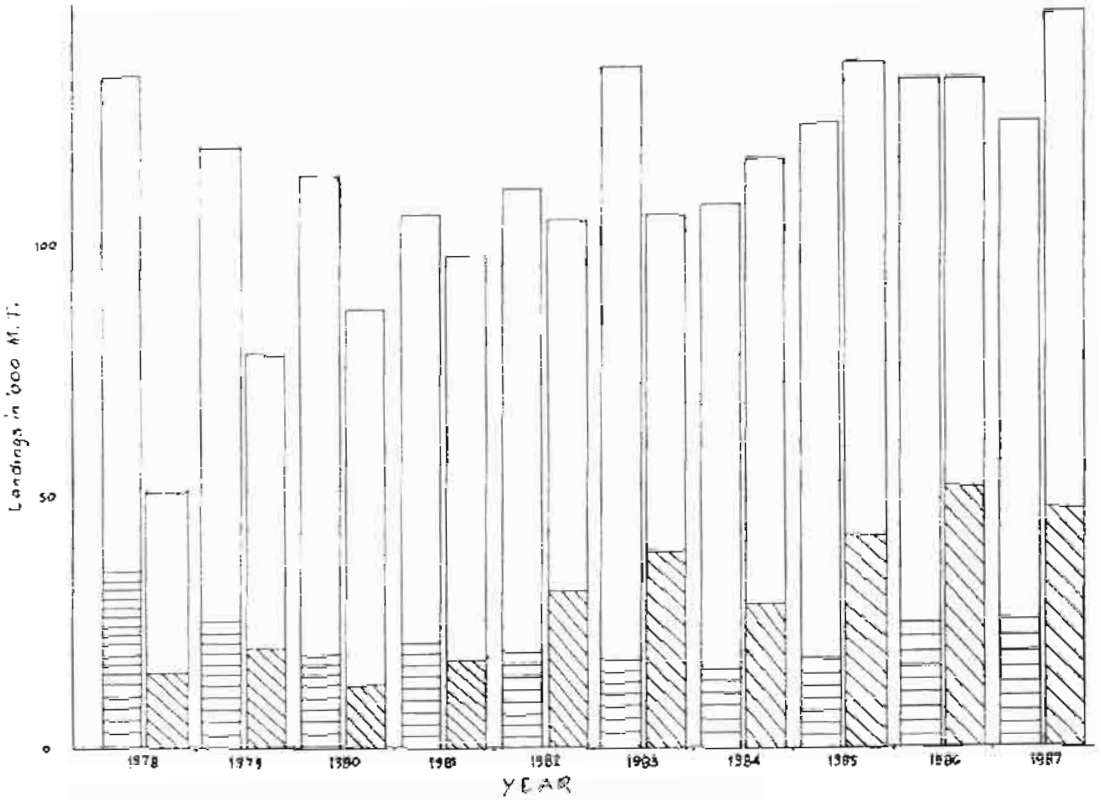
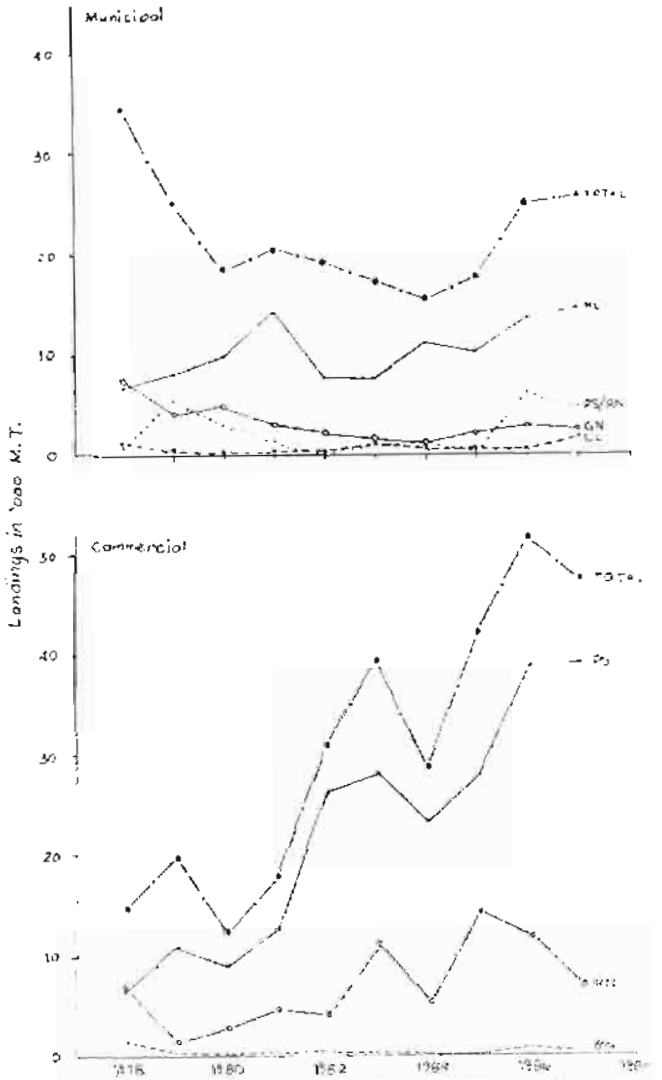


Fig. 1 Trends in annual landings (M.T.) of Skipjack (K. pelamis) in relation to the municipal ▤ and commercial ▥ landings of tunas in the Philippines from 1978–1987.



Landings in '000 M.T.

Fig. 2 Trends in annual landings (M.T.) of skipjack (K. pelamis) by municipal and commercial fishing gears in relation to its total municipal and commercial landings respectively.

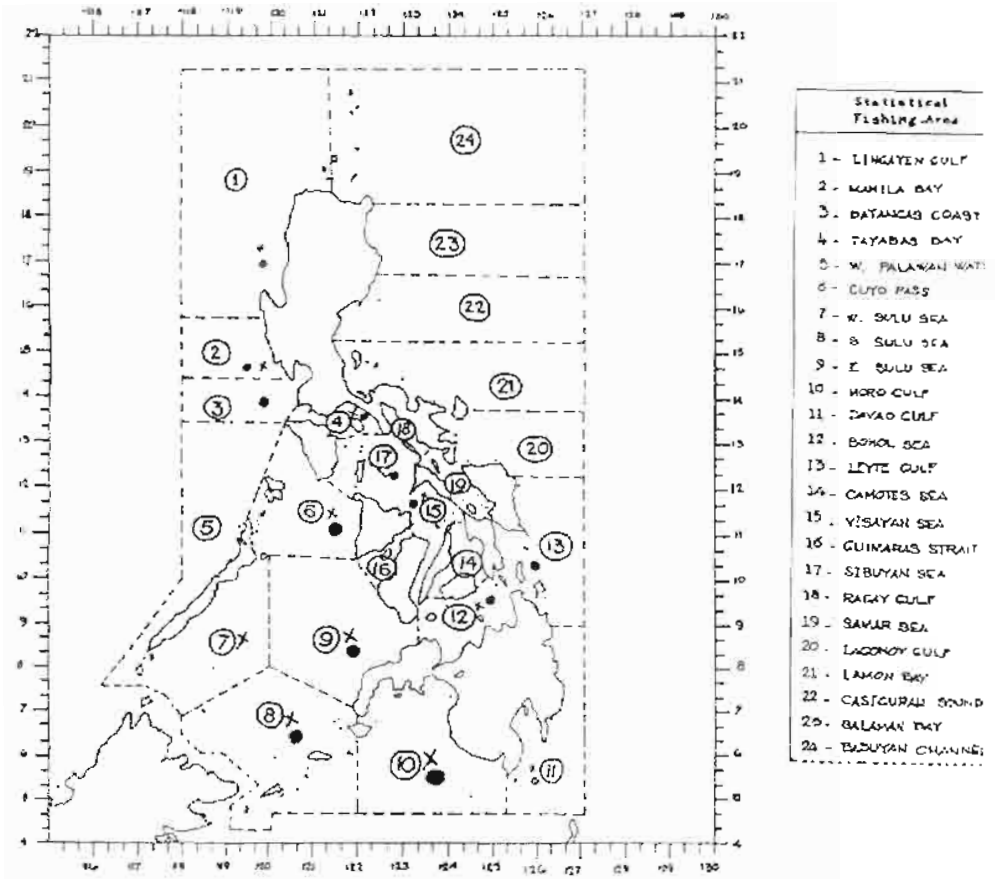


Figure 3 . The major statistical fishing areas for skipjack (K. pelamis) in the Philippines, 1978-1987. ● municipal × commercial

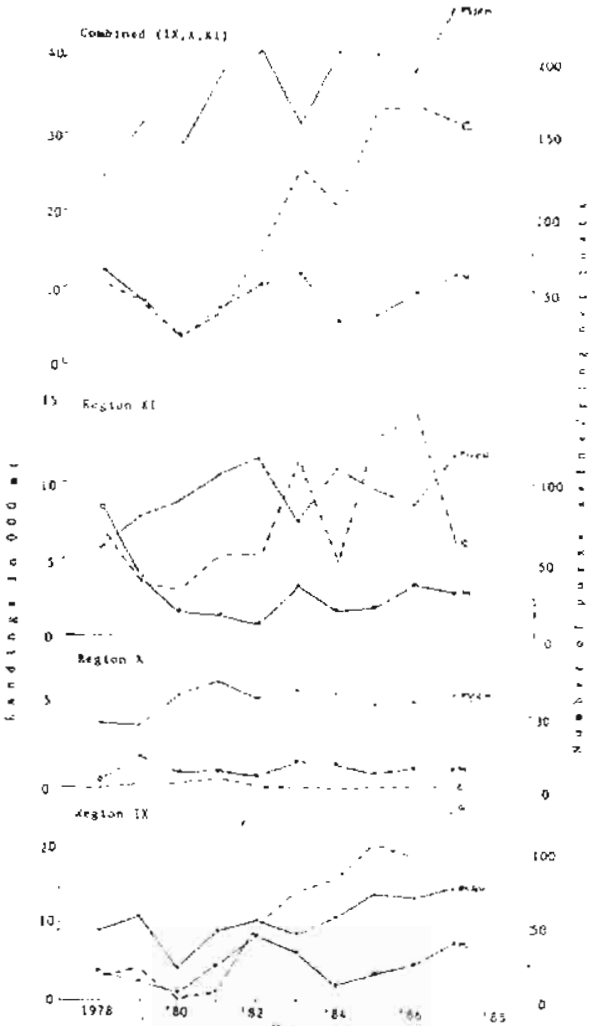
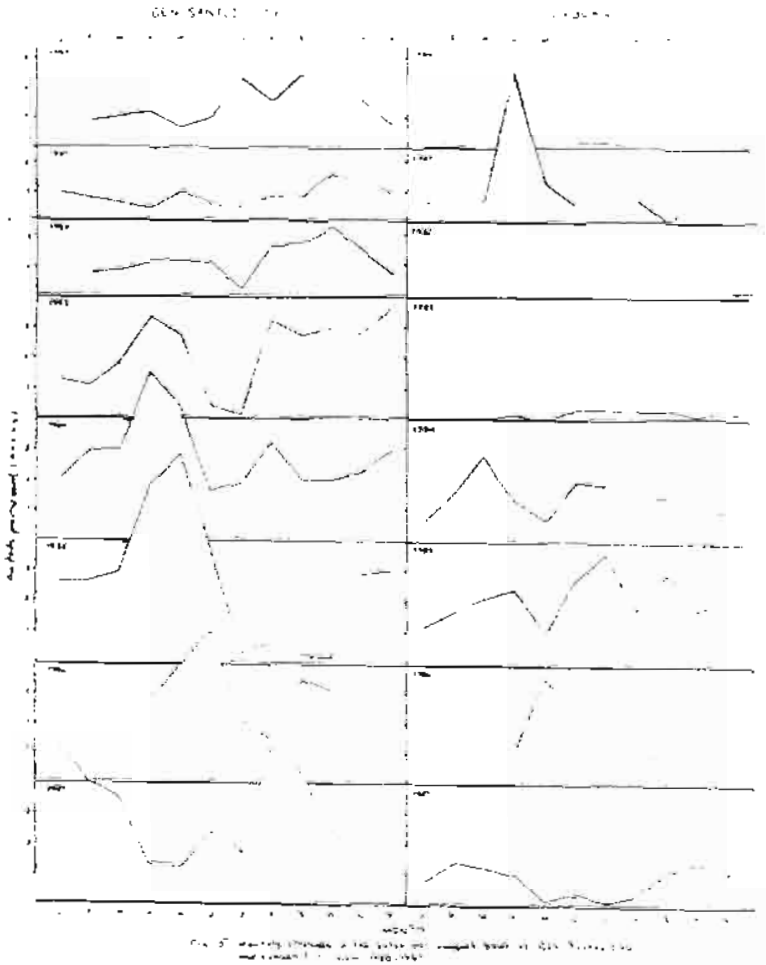


Fig. 4 . Changes in the landings (mt) of skipjack (K. pelamis) and in the number of vessels (PS/BN) in Southern Philippines, 1978-1987 (Source of basic data: BFAR Fisheries Statistics)



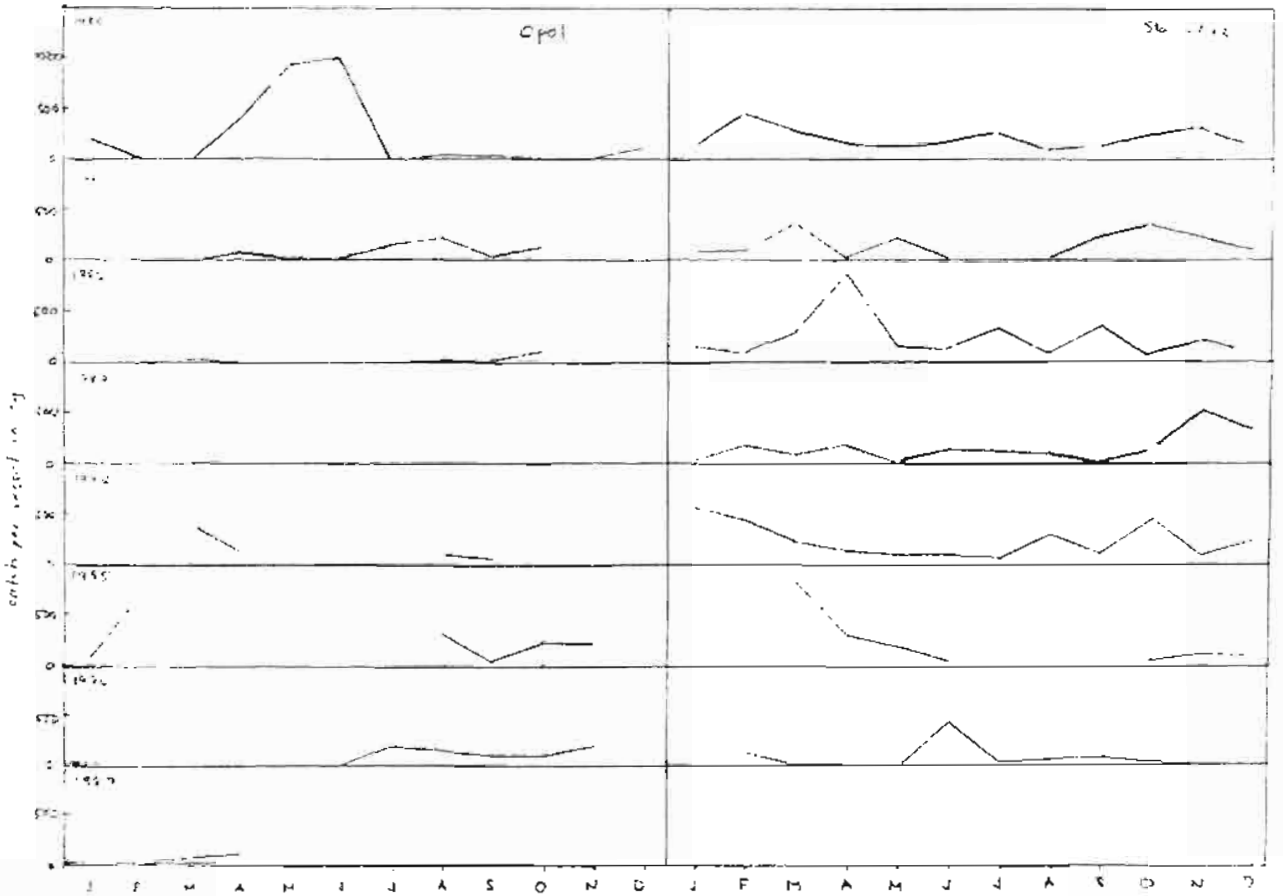


Fig 6 Monthly changes in the catch per ring net vessel at Opol and Sta Cruz from 1980-1987

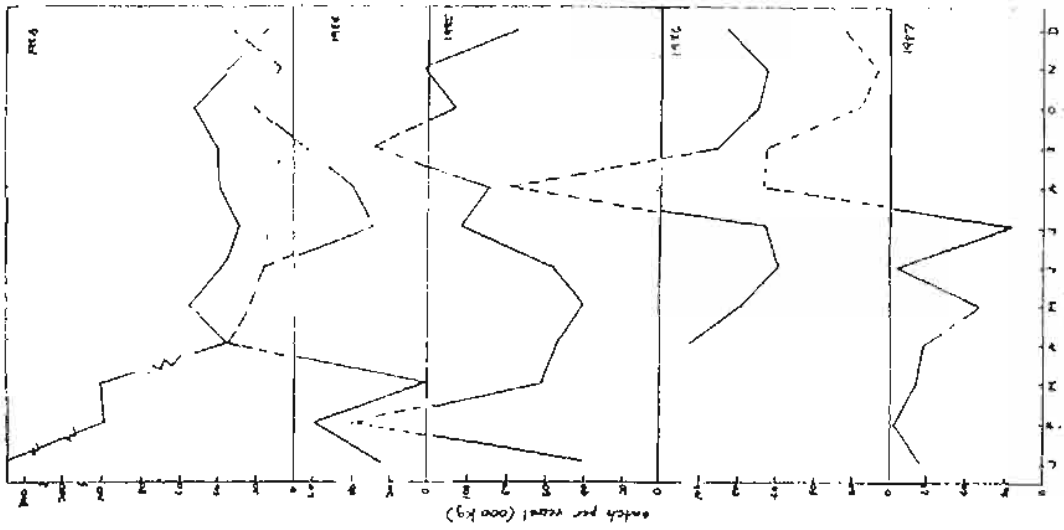


Fig. 8. Monthly changes in the catch per purse seine vessel of Ecuador from 1983-1987.

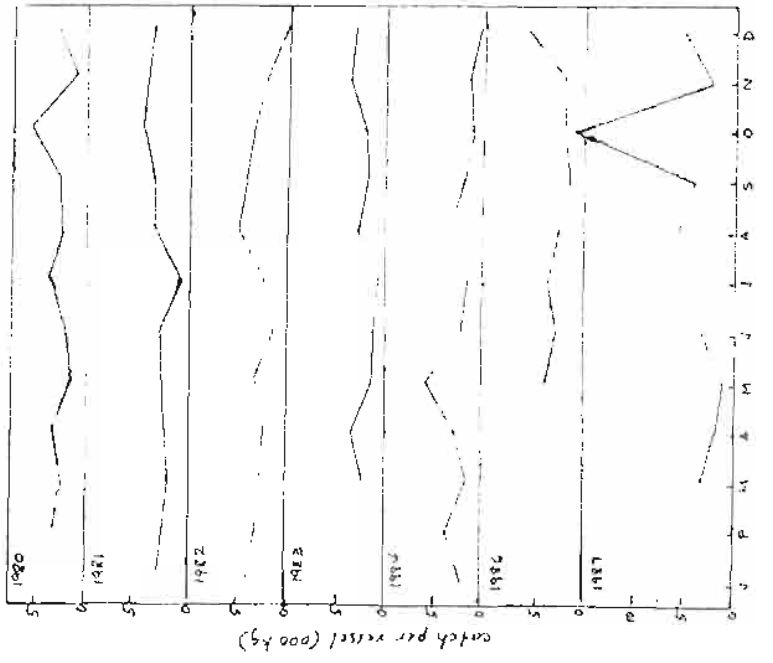


Fig 7. Monthly changes in the catch per purse seine vessel ■ General Santos City from 1981 - 1987

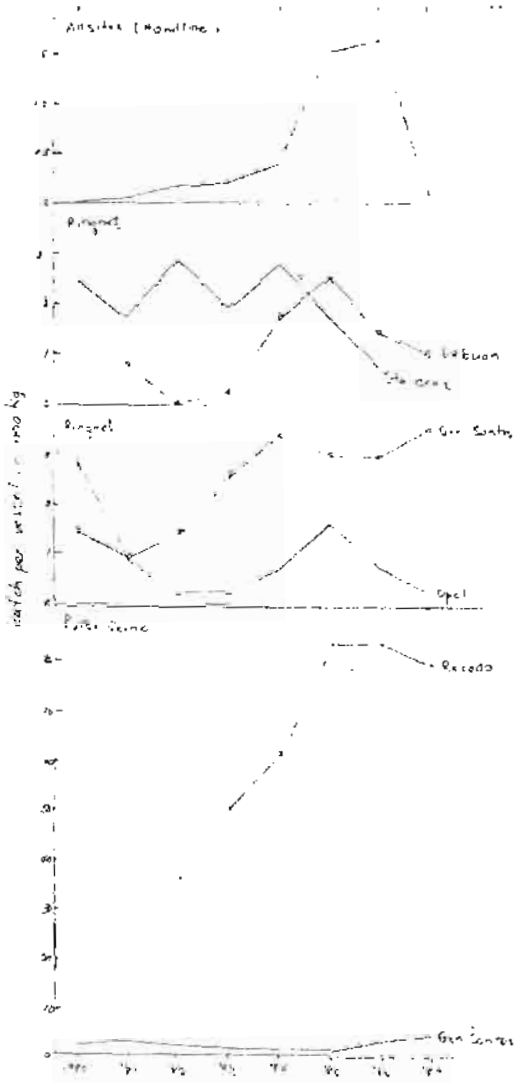


Fig. 9 Annual changes in the catch per vessel of various gears at the [illegible] 1980-1987

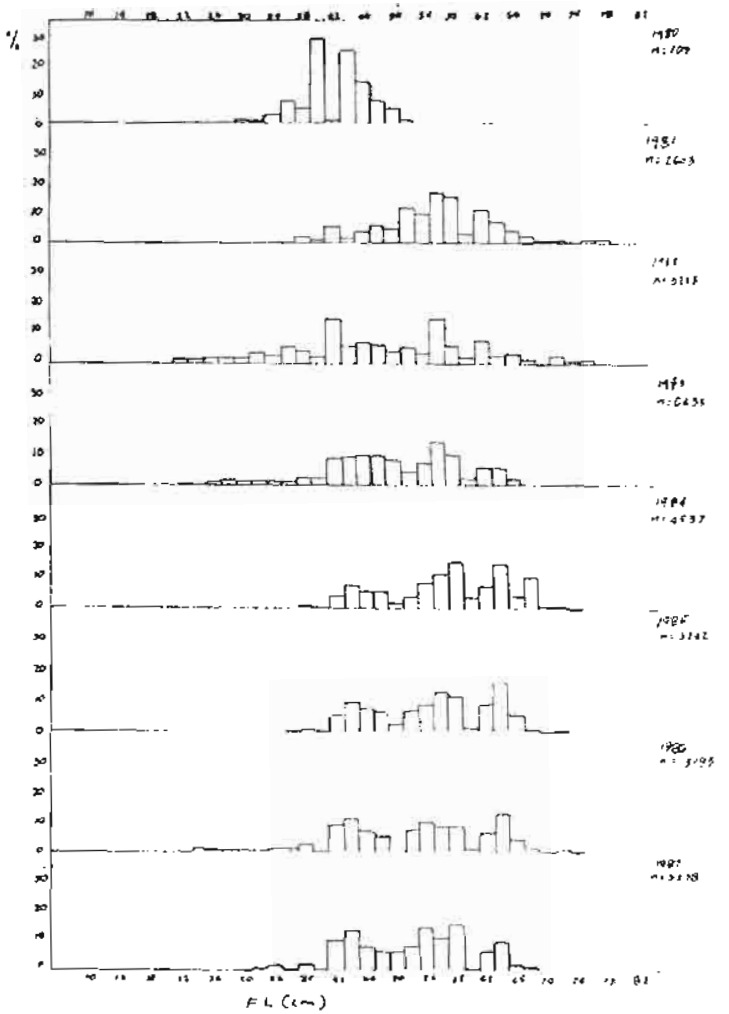


Fig. 10. Annual changes in the size composition of skipjack (K. pelamis) caught by purse seine, Recodo, 1978-1987

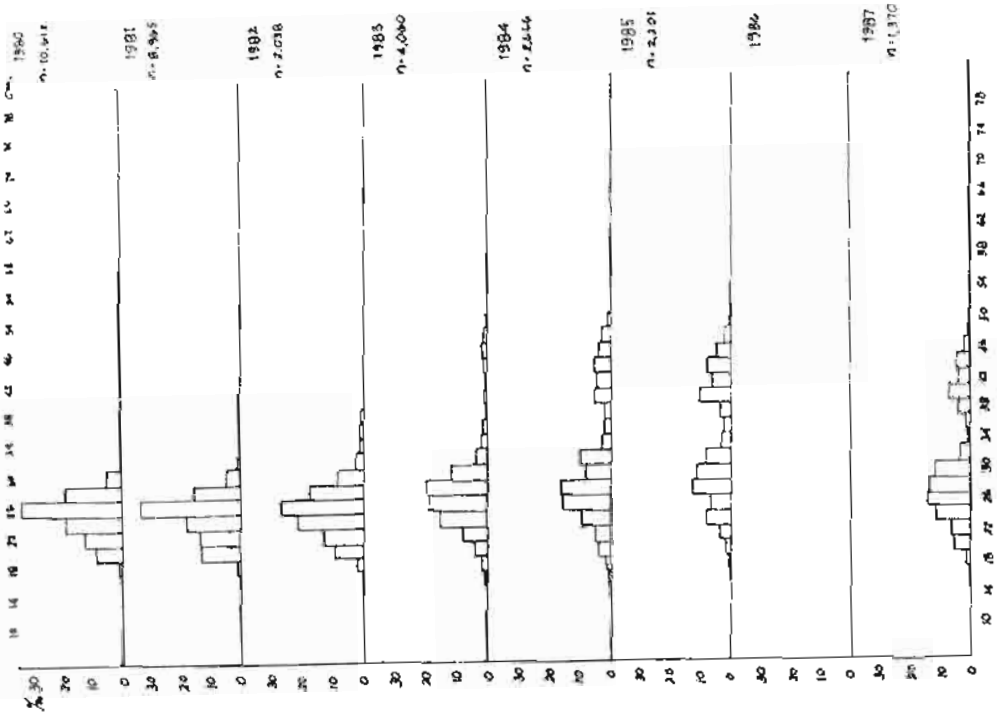


Fig. 12. Annual changes in the size composition of Skipjack (K. pelamis) caught by Ringnet in Gen. Santos City

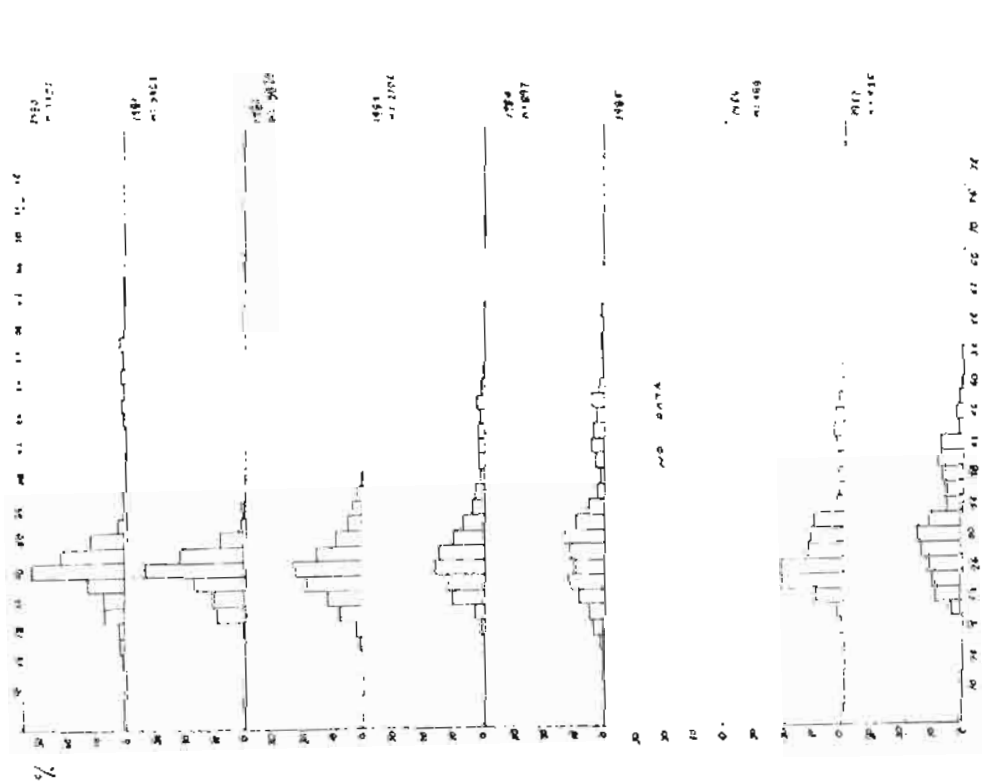


Fig. 11. Annual changes in the size composition of skipjack (K. pelamis) caught by purse seine, Gen. Santos City, 1980-1988

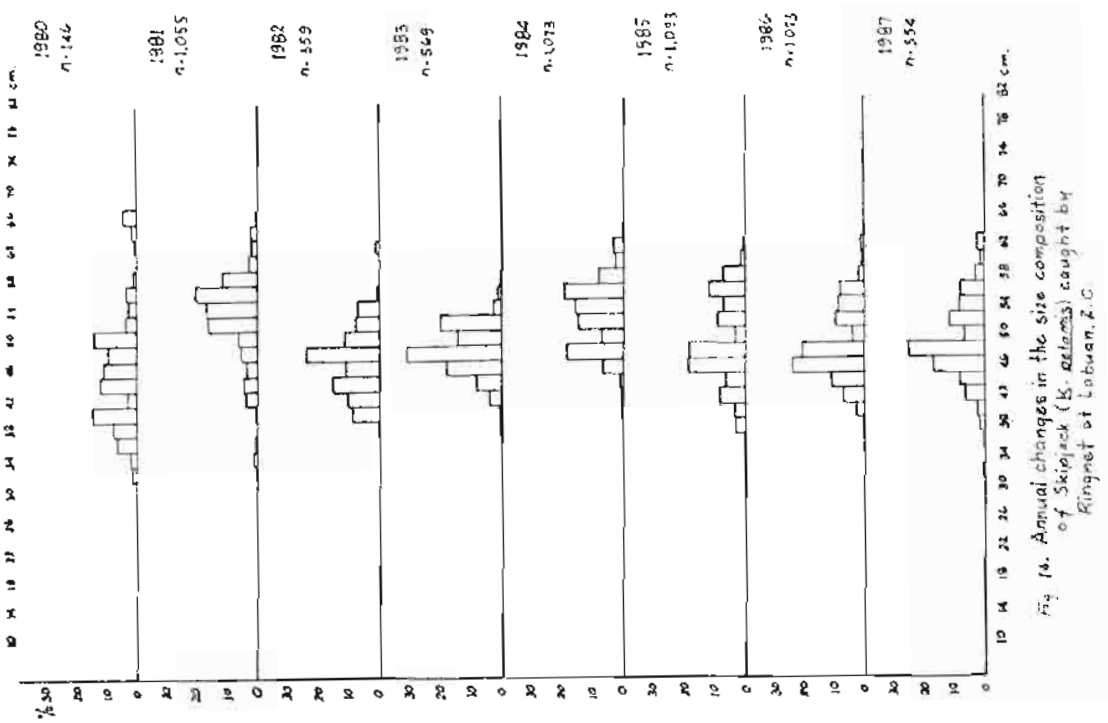


Fig. 14. Annual changes in the size composition of Skipjack (*K. pelamis*) caught by Ringnet at Lohuan, P.C.

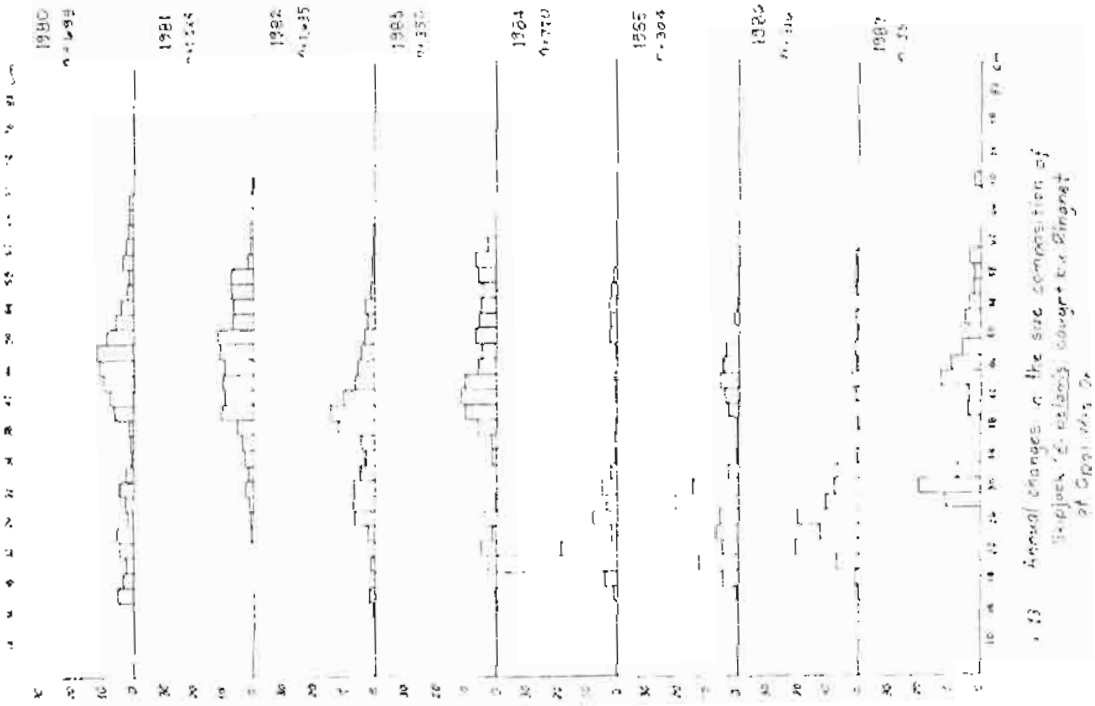


Fig. 13 Annual changes in the size composition of Skipjack (*K. pelamis*) caught by Ringnet at Cagayan, P.C.

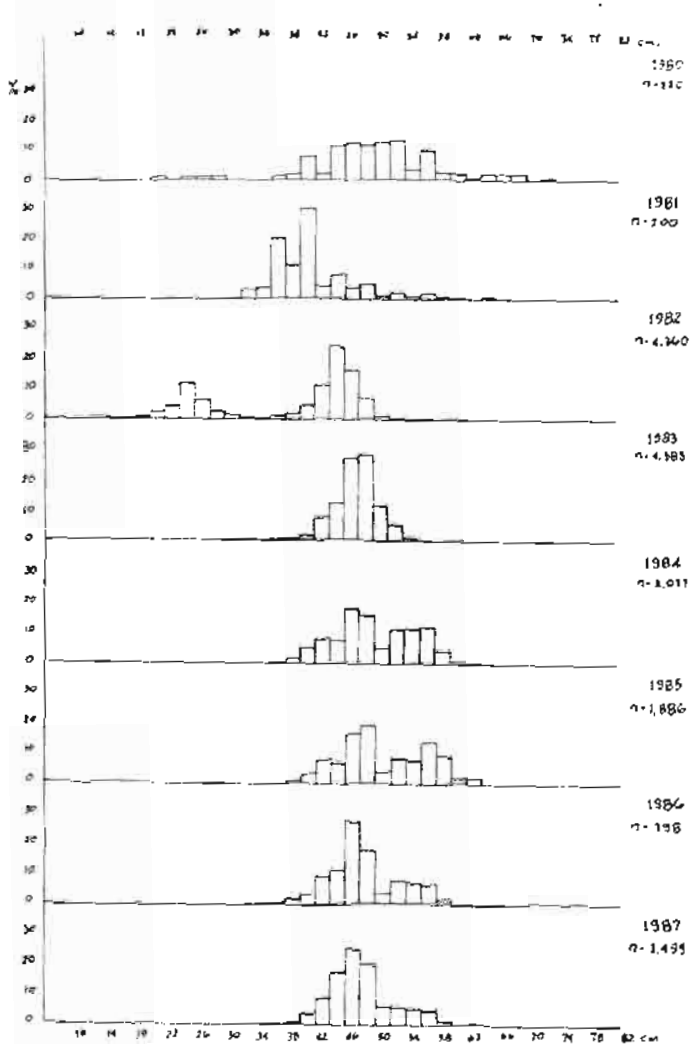


Fig 15. Annual changes in the size composition of Skipjack (*K. pelamis*) caught by Handline at Labuan, Z. C.

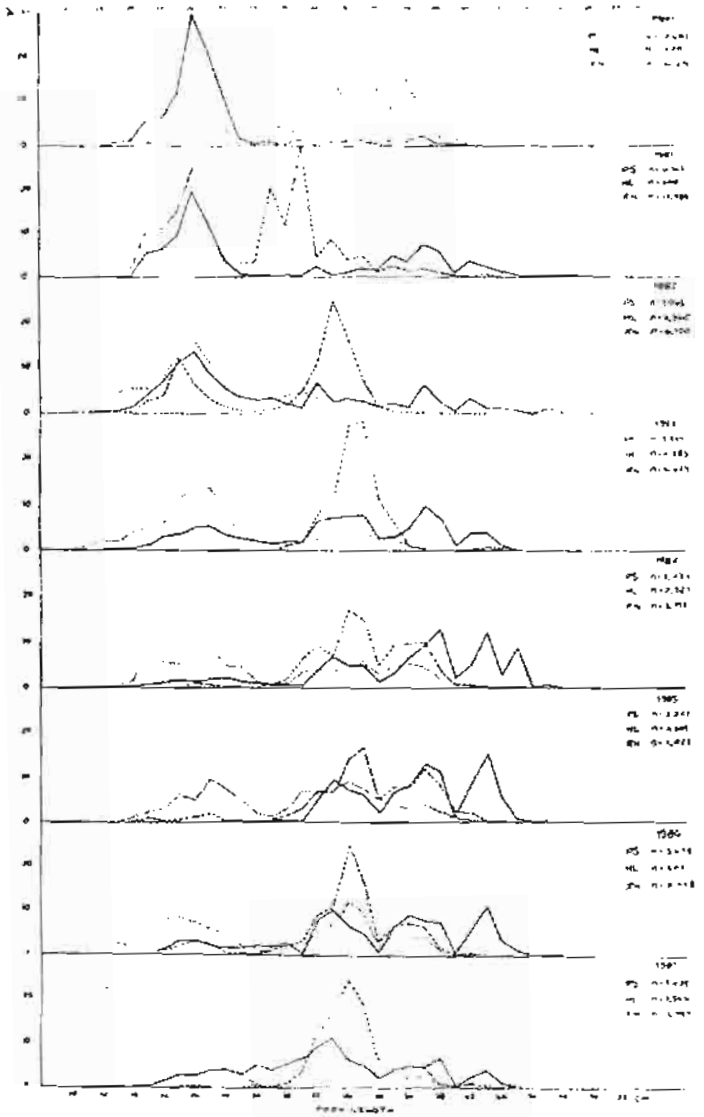


Fig.16. Annual changes in the size composition of Skipjack (*K. pelamis*) caught by purse seine, ringnet and handline in the northern Philippines, 1981-1987

OCCURRENCE AND DISTRIBUTION OF LARVAL TUNAS IN RAGAY GULF, BURIAS PASS, TICAO PASS AND WATERS NORTH OF SAMAR SEA.

By

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ABSTRACT

One hundred forty-six (146) tuna larvae representing a 0.004 % share in the total fish larvae catch was collected from Ragay Gulf, Burias Pass, Ticao Pass, and waters north of Samar Sea from November 1981 - December 1982.

The composition and relative abundance of the species identified are: *Euthynnus affinis* and *Thunnus obesus*, 24 %; *Auxis thazard*, 16.0 %; *Auxis rochei*, 14.0 %; *Thunnus albacares*, 5.0%; *Thunnus alalunga*, 4.0%; and *Katsuwonus pelamis*, 2.0%.

Highest abundance of the larvae were observed mainly in Ragay Gulf in May where warmer temperature of 26.56°C - 28.91°C and salinity values from 33.97°/oo to 34.42°/oo prevailed.

Status of Tuna Fisheries in the Western and Central Pacific Ocean

by

John Hampton

Tuna and Billfish Assessment Programme
South Pacific Commission
B. P. D5, Noumea, New Caledonia

Abstract

Tuna are harvested in the western and central Pacific Ocean by a number of distant-water fishing nations (DWFNs) using pole-and-line, purse seine and longline techniques. The principal DWFNs are Japan (pole-and-line, purse seine and longline fleets), United States (purse seine fleet), Republic of Korea and Republic of China (purse seine and longline fleets). The major species taken are skipjack, *Katsuwonus pelamis* (by pole-and-line and purse seine), yellowfin, *Thunnus albacares* (by purse seine and longline) and bigeye, *T. obesus* (by longline). In 1987, the total DWFN catch of all species in the Western and Central Pacific Ocean was estimated to be about 610,000 tonnes. Over the past ten years, the most spectacular fishery development has been the increase in large-scale purse seining. Catches have increased from only a small amount in 1978 to approximately 380,000 tonnes in 1987.

Several Pacific Island countries have developing national tuna fisheries, the most notable of which is Solomon Islands, whose catch by pole-and-line and purse seine gears exceeded 30,000 tonnes in 1987. There are smaller pole-and-line fisheries in Kiribati and Fiji and a local longline operation in Tonga. In addition, most Pacific Island countries engage to some extent in artisanal tuna fishing.

On a regional basis, catch rates of pole-and-line skipjack appear to have been increasing, while purse seine catch rates for both skipjack and yellowfin have been stable despite large increases in the catch of both species in the past ten years. This would imply that fishing is not yet having a significant effect on the stocks, at least insofar as they may be reflected as changes in catch rates. It is possible, however, that high pole-and-line and purse seine catch rates have been maintained in part by increases in vessel efficacy. Declining longline catch rates indicate that some reduction in adult yellowfin abundance may have occurred, however more data are required to substantiate this conclusion.

In 1989, the SPC will begin a large-scale tagging programme aimed at estimating, in particular, movement and mortality parameters of yellowfin and skipjack in areas of most intense exploitation. This information will be used to evaluate stock condition and answer several important questions regarding interaction of the various fisheries.

Introduction

The area served by the South Pacific Commission (SPC) is large and diverse - it extends from Palau in the west through Micronesia, Melanesia and Polynesia to its eastern extreme of Pitcairn Islands (Figure 1). The area has a population of over five and a half million people and covers a total area of about 30 million square kilometers, only about two per cent of which is land.

It is not surprising, therefore, that fishing has traditionally played an important role in the lives of many Pacific islanders; subsistence and artisanal fishermen for many decades have relied heavily on tuna and other small pelagics for food, income and employment. Since the widespread acceptance of 200-mile EEZs, local control of marine resources has become more certain and tuna fisheries have taken on a new importance for Pacific Island countries. Licensing of distant-water fishing fleets to fish for tuna in the EEZs of a number of countries has created a new, important source of foreign exchange revenue which, for some, is the largest single such source. Several countries have also invested in commercial tuna fishing vessels and associated shore-based facilities, such as markets and canneries, in order to create employment, generate foreign exchange and facilitate training and transfer of fishing and related technologies. The most notable of these ventures is that in the Solomon Islands, whose pole-and-line and purse seine operations have produced in excess of 30,000 tonnes of tuna annually since 1983.

This combination of traditional tuna fishing, developing commercial fleets of island countries and large-scale fishing by distant-water fishing nations (DWFNs) has given the resource owners an awareness of the need for conservation and coordinated management of the tuna resources of the region. The SPC's Tuna and Billfish Assessment Programme undertakes the collection of fisheries statistics and carries out scientific research on behalf of its member countries in support of these goals.

Tuna Fisheries of the Western and Central Pacific Ocean

The tuna fisheries of the western and central Pacific Ocean are usually categorised into (i) locally-based activities, both artisanal and industrial ; and (ii) those operated by foreign-based DWFNs.

1. Locally-Based Fisheries

Artisanal Fisheries

In many Pacific Island countries, tuna are exploited by artisanal fishermen for consumption and, where markets are accessible, for sale. Skipjack (*Katsuwonus pelamis*) and, to a lesser extent, juvenile yellowfin (*Thunnus albacares*) and possibly bigeye (*T. obesus*) are the main species taken. Tuna are caught mostly from small boats by trolling and pole-and-lining using lures made from mother-of-pearl shell.

Artisanal tuna fisheries are of most significance to the smaller island countries, where shortage of land limits both agricultural production and exploitation of inshore marine resources. In these countries, fishing for oceanic tuna species has required the development, over many generations, of fine navigational and sailing skills. In recent years, the deployment of fish aggregation devices has become popular as a means of

reducing searching time and distances travelled.

Despite their social importance, artisanal fisheries are relatively minor in terms of total catch. Although reliable statistics are not available, total catches by artisanal fishermen in the region are estimated to be less than 10,000 tonnes annually (Doulman and Kearney 1987).

Industrial Fisheries

Most of the domestic tuna fishery development in the Pacific Islands region has taken place with the assistance of foreign countries, most frequently Japan, either in the form of joint venture arrangements or as aid packages. A domestic pole-and-line fishery in Papua New Guinea began in 1970 in joint venture with Japan and averaged nearly 30,000 tonnes annually between 1971 and 1981 (Tuna Programme 1983). Operations were suspended in early 1982 because of unfavourable economic conditions. Despite an attempt to revive the fishery in 1984-1985 and continuing interest in tuna fishery development, the large tuna resource in Papua New Guinea waters is currently fished only by DWFNs.

The other major domestic tuna fishery in the region is based in the Solomon Islands. The fishery began in the early 1970s, and is currently comprised of 34 pole-and-line vessels, a group seining operation (under charter from Japan) and two recently acquired 500 grt class single purse seiners. Two locally-based longliners also operate. The total tuna catch in 1987 was approximately 32,000 tonnes (Table 1) and is expected to exceed 40,000 tonnes in 1988.

Smaller operations are currently based in Kiribati, Fiji and Tuvalu (pole-and-line) and in Tonga and New Caledonia (longline).

2. DWFN Fisheries

Foreign involvement in commercial fishing in the Pacific Islands dates back to the early 1920s, when Japanese pole-and-line fleets began to establish themselves in *Micronesia* (Doulman 1987). By the early 1950s, Japan had re-established its distant-water fishing capability, which had been severely depleted during World War II, with pole-and-line fishing in Micronesia and longlining throughout the Pacific Islands region. Longline fleets from Republic of Korea and Republic of China soon entered the area, initially fishing primarily for albacore for canning.

Rising fuel prices and other problems in the pole-and-line fishery led to the introduction of purse seining by the Japanese in the mid-1970s. This method proved very successful, which encouraged other countries, such as Republic of Korea and Philippines, to follow suit. In the early 1980s, the purse seine catch began to expand with the influx of US seiners into the western Pacific, encouraged in part by the reported high catch rates, but also because of declining yellowfin abundance and problems associated with porpoise-kill restrictions in the eastern Pacific purse seine fishery.

Current status, geographic and seasonal distribution, and trends in catch-per-unit-effort (CPUE) of the major DWFN fisheries in the SPC area are discussed below. The information presented is based primarily on log-sheet data submitted to SPC member countries under access agreements with DWFNs, and made available to the Commission for inclusion in its Regional Oceanic Fisheries Data Base. In general, log sheets are submitted only under access agreements, therefore the substantial activity in international waters is largely unreported. Also, for certain DWFNs, not all vessels supply log sheets, even though in principal they must do so under the conditions of their access agreements. In 1987, the estimates of data coverage (percentage of estimated total days fished covered by the log-sheet data) were 28% for pole-and-line, 48% for purse seine and 12% for longline (Tuna Programme 1988). It must be remembered, therefore, that the SPC data base represents only a sample, hopefully unbiased, of the total DWFN fishing activity in the western and central south Pacific region.

The Pole-and-Line Fishery

Current Status-.The DWFN pole-and-line fishery is totally a Japanese activity, the estimated 1987 catch of which was 78,800 tonnes (Table 1) at a catch rate of 7.7 tonnes per day. The catch is comprised almost entirely of skipjack, with a very small amount (2% in 1987) of yellowfin. It is estimated that about 100 vessels were active in the Pacific Islands region during 1987. Catch and effort data from 77 of these vessels were received by SPC.

Geographic Distribution-. The geographic distribution of Japanese pole-and-line effort for the period 1984-1987 by quarter is shown in Figure 2. Effort is concentrated in the Micronesia area during the first quarter, with most activity in the EEZ of Federated States of Micronesia. During the rest of the year, activity in the region is reduced, however there still appears to be substantial fishing in the Marshall Islands EEZ during the second quarter.

Seasonality-. As suggested by Figure 2, the fishery is highly seasonal. February, March and April are the months with highest effort (Figure 3), with activity in the region much lower during other months of the year as most vessels move to fishing grounds closer to Japan or to international waters southwest of Hawaii. CPUE appears to be considerably higher in months of low effort (June - August), possibly indicating that the few vessels remaining during these months are the larger and more efficient vessels in the fleet.

Trends in CPUE-. The trend in CPUE for the Japanese pole-and-line fleet for the period 1978-1987 is shown in Figure 4. CPUE appears to have increased from about 3 tonnes per day in 1978 to a high of over 8 tonnes per day in 1986. The reason for this increase is likely to be due to the better quality of vessels remaining in the fishery. Since the advent of large-scale purse seining in the mid-1970s, the distant-water pole-and-line fleet has declined from over 500 vessels in 1973, to its present status of about 100 vessels, with the older, smaller, less efficient vessels being retired.

The Purse Seine Fishery

Current Status-. Approximately 120 purse seine vessels from 10 countries fished in the SPC region in 1987. The majority of vessels were registered in Japan (about 36), the US (34), Republic of Korea (about 18) and Republic of China (about 13), with other active foreign vessels registered in Cayman Islands, Indonesia, Philippines and USSR. Locally registered purse seiners from Solomon Islands and Vanuatu also fished in the region. The total 1987 catch by the distant-water purse seine fleet is estimated to have been 375,000 tonnes (Table 1) with an overall CPUE of 18.3 tonnes per day. Both skipjack and yellowfin are taken by purse seiners, with yellowfin making up 35% of the catch in 1987. Both the CPUE and the percentage of yellowfin in the catch vary greatly amongst the different nationalities. CPUE ranged from a low of 5.7 tonnes per day with 14% yellowfin for purse seiners from Republic of China to 25.9 tonnes per day with 50% yellowfin for US purse seiners in 1987.

Two distinct methods of purse seine fishing are evident in the SPC region. The more traditional method involves setting, usually in the early morning, around floating logs (tuna are frequently found aggregating beneath flotsam in the western Pacific). Log schools tend to be mixed skipjack and yellowfin of quite variable size, however most yellowfin tend to be small (less than 10 kg - see Figure 5). The second method, which is becoming increasingly popular with technological advances, involves the capture of free-swimming schools, principally of yellowfin. Individual schools tend to be more uniform in size than log schools, with schools of large yellowfin (greater than 30 kg) commonly caught (Figure 5).

In the Japanese purse seine fishery, school fish sets were rare prior to 1982, generally making up less than 10% of total sets. Since 1983, however, school fish sets have made up 25-40% of total Japanese sets. Information on the US purse seine fleet is less reliable, however the high percentage of yellowfin in their catch would indicate a preference for school sets.

Geographic Distribution-. The geographic distribution of purse seine effort by quarter for the period 1984-1987 is shown in Figure 6. Most purse seine activity reported to SPC is carried out in the area between 10°N and 5°S and between 135°E and 160°E (the southern EEZ of Federated States of Micronesia, the northern EEZ of Papua New Guinea and the strip of international waters between the two). This distribution could be somewhat biased by the lack of US data, as some US purse seiners are thought to fish more to the east than vessels from Japan, Republic of Korea and Republic of China.

2nd Southeast Asian Tuna Conference
3rd Meeting of Tuna Research Groups
Kuala Terengganu, Malaysia
22-25 August 1988

Seasonality-. The purse seine fishery operates year round in the SPC area (Figure 7), however as suggested by Figure 6, there is a seasonal shift in the distribution of effort, with vessels tending to fish in Papua New Guinea waters during January and February, moving north into Federated States of Micronesia waters during March - June and then moving back to Papua New Guinea waters for the remainder of the year.

There does not appear to be any seasonal trend in total CPUE for skipjack or yellowfin (Figure 8), however the CPUE for free-swimming yellowfin schools appears to be highly seasonal, with highest catch rates being recorded during August - February (Figure 9). This could be due to a greater abundance of free-swimming yellowfin schools in Papua New Guinea waters, or a greater propensity for yellowfin to surface school during this period, or a combination of both. As observed by Hisada (1973), schooling could be related to spawning behaviour , as gonadosomatic indices suggest increased spawning activity during the period of higher apparent abundance of free-swimming schools.

Trends in CPUE-. The overall trend in CPUE for both skipjack and yellowfin is unremarkable (Figure 10), however interpretation of this figure is confounded by the differences among fleets and methods of fishing described above. Further work is required on the estimation of indices of abundance from purse seine catch and effort data.

The Longline Fishery

Current Status-. The principal longline DWFNs in the SPC area are Japan, Republic of Korea and Republic of China; it is estimated that about 600 longliners were active in the area during 1987. Coverage of the longline fishery in the SPC data base is relatively poor, particularly south of the equator.

The principal species taken by the longline fishery are yellowfin and bigeye, however significant amounts of albacore (*Thunnus alalunga*) and blue marlin (*Makaira nigricans*) are also caught. The total longline catch in the SPC area in 1987 is estimated to have been 156,000 tonnes, with 72,000 tonnes being yellowfin and 62,000 tonnes being bigeye (Table 1). The total longline CPUE for the Japanese fishery (for which coverage is best) was 54 kg per 100 hooks.

Two methods of longlining are generally recognised - conventional and deep longlining. *Setting* six or less hooks between mainline floats (referred to as a basket) is usually

considered conventional longlining, while setting ten or more hooks per basket is referred to as deep longlining (Miyabe and Bayliff 1987). It has been estimated that conventional longlines fish in a depth range of 50-120 m, whereas deep longlines cover a range of 50-250 m (Suzuki *et al.* 1978). Conventional longlines therefore fish mainly in the mixed layer above the thermocline targeting on yellowfin, whereas deep longlines are able to fish in the thermocline, which is the preferred habitat of the more valuable bigeye.

Almost all longlining was originally of the conventional variety, however significant numbers of Japanese longliners began to use the deep longlining technique in the western and central equatorial Pacific towards the end of 1974 (Suzuki *et al.* 1978). Distributions of the number of hooks per basket for Japanese longline sets in the SPC area for the years 1978-1987 are shown in Figure 11. It is evident that both fishing strategies were employed at least until 1983. In 1984, the proportion of conventional longline sets was much smaller than in previous years; this trend continued through 1985-1987, with very few conventional longline sets being recorded in the SPC data base for those years.

Geographic Distribution-. The geographic distribution of longline effort by quarter for the period 1984-1987 is shown in Figure 12. Longline effort is more widely distributed throughout the SPC area than effort by the surface fisheries, however the EEZs of Federated States of Micronesia, Marshall Islands and Papua New Guinea have been the major areas of operation.

Figure 12 highlights a major problem with data collection from the longline fishery and can also be seen to a lesser extent with the pole-and-line fishery (Figure 2). The problem is that data supplied to SPC are generally only those that are first supplied to Pacific Island countries under access agreements with DWFNs. This is of most concern with longlining, where a significant portion of total fishing activity is known to be undertaken in international waters.

Seasonality-. Based on SPC data, there is a noticeable reduction in longline effort during August - December (Figure 13). There is no clear seasonal trend in yellowfin CPUE, however bigeye CPUE appears to be slightly higher during October - March (Figure 14).

Trends in CPUE-. Time series of yellowfin CPUE, categorised as described above into conventional and deep longlining, are shown in Figure 15. CPUE for conventional longlining is generally greater than that for deep longlining, at least prior to 1985 when both methods were in operation to some extent. On the basis of these data, it would appear that CPUE since 1978 has fallen for both methods, particularly conventional longlining. Also, the average weight of yellowfin caught by the two methods, appears to have been increasing since 1981 (Figure 16). Both declining CPUE and increasing average weight could be an effect of declining recruitment to the longline fishery brought about by the large increases in catch by the purse seine fishery.

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In contrast, CPUE for bigeye by both conventional and deep longlining has been increasing since 1981 (Figure 17), and has been accompanied by increases in average weight of fish (Figure 18).

Any conclusions based on longline catch and effort data held by SPC must be tentative at this stage. This is because coverage rates for longliners are low, therefore there is a possibility that the sample of total longline activity represented by the SPC data holdings is biased to some extent. In fact, analyses of the much more complete data held by the Japan Far Seas Fisheries Research Laboratory indicate that recent yellowfin CPUE in the western Pacific has been stable (Dr S. Hayasi, pers. comm.), which is somewhat at variance with the results presented here.

Conclusions

Despite the recent large increases in effort and catch, there is no evidence from DWFN pole-and-line and purse seine CPUE data for skipjack and yellowfin that the stocks available to these fisheries have been significantly affected by fishing activity. This advice must be tempered by the possibility that high CPUEs have been maintained by increases in vessel efficacy. This is certainly the case for the Japanese pole-and-line fishery, where skipjack CPUE has been increasing over the past ten years.

For the purse seine fishery, it is unwise to interpret total CPUE as being an indicator of relative abundance; this is because the purse seine fleet is comprised of a diverse array of vessels that has changed markedly over recent years. Additional complicating factors are the recently increased emphasis on fishing free-swimming tuna schools (as opposed to log schools) and the effect of environmental perturbations such as *El Nino*. As data coverage and quality improves, it is hoped that the application of linear modelling techniques (e.g. Allen and Punsly 1984; Punsly 1987) will enable a much better interpretation of purse seine catch and effort data.

Based on the data available to SPC, there is some indication that longline yellowfin CPUE has declined in recent years. In addition, it would seem that this decline cannot be ascribed to the change in fishing practice from conventional (shallow) to deep set longlines. On face value, the data would suggest that the abundance of large yellowfin has declined in recent years, possibly as a result of increased purse seine activity. However, as mentioned above, analyses of more comprehensive data by Japanese scientists indicate declining yellowfin CPUE during the 1960s, but essentially constant levels since that time. It is therefore possible that the pattern shown in Figure 15 is the result of the small sample size represented by the SPC data base, or that the time series is too short to reveal any long-term trend.

Future Research

Future research needs of the SPC region are dictated by the gaps in our existing knowledge of tuna stocks, both at regional and national levels. The questions of most importance can be summarised as follows:

(i) What are the current levels of exploitation of skipjack and yellowfin in areas of most intensive fishing?

(ii) What are the effects of large-scale purse seining for skipjack and yellowfin upon other fisheries in the region, e.g. the DWFN longline fishery for yellowfin and various locally-based industrial and artisanal fisheries?

(iii) What are the sizes of the tuna resources available to various island countries, e.g. Solomon Islands, and what are reasonable levels of exploitation of those resources?

In order to address these questions, several types of information are required. First and foremost, it is essential that complete and accurate information on catch and effort by all major fisheries in the region be available. As mentioned earlier, there are presently major gaps in data coverage that must be remedied before progress can be made.

Secondly, information on the size composition of catches by the major fleets would provide a number of analytical alternatives for stock assessment and interaction research. Such data are presently only available in a reasonable time series for the Solomon Islands locally-based industrial fishery, however sampling of US purse seiners under the terms of the Multilateral Treaty on Fisheries has recently begun and the first receipts of these data are expected soon.

Thirdly, data from tagging experiments, in conjunction with the above fishery data, are required to provide critical information on tuna population dynamics, particularly regarding mortality, movement and growth. The SPC undertook a major tagging programme during 1978-1981, targeting on skipjack, which has provided a large body of information. Unfortunately, the complete catch and effort data from the recapture fisheries required for proper analysis of the tag returns are as yet unavailable. The SPC hopes to address this question in the near future through a collaborative study with the Japan Far Seas Fisheries Research Laboratory.

Since the SPC's skipjack tagging programme was conducted, major changes in the fisheries have occurred, the most notable of which has been the development of large-scale purse seining. One result of these changes is that yellowfin catches have greatly

increased, thus raising questions not considered by the previous tagging programme.

The SPC is currently planning a Regional Tuna Tagging Project, to begin in early 1989, with funding provided by the European Community. The specific objectives of the project are:

(i) to estimate various population parameters for yellowfin, including mortality, movement and growth, so as to determine the degree of exploitation and the level of interaction between purse seine and longline gears;

(ii) to estimate these population parameters for skipjack, so as to provide a re-assessment of that resource in an area of relatively intense exploitation and to estimate the level of interaction between the DWFN purse seine fishery and various industrial fisheries in island countries;

(iii) to assess the tuna fishery in the Solomon Islands, and specifically estimate the level of interaction between pole-and-line and purse seine gears;

(iv) to assess, where possible, the interaction between industrial fisheries (both DWFN and locally-based fleets) and artisanal fisheries in selected island countries.

To be successful, the Regional Tuna Tagging Project, and in fact SPC's tuna research programme in general, will rely heavily on the cooperation of countries outside the SPC region, in particular DWFNs such as Japan, Republic of China, Republic of Korea and the USA. DWFN fleets will be the major catchers of tuna tagged during the Project, therefore the cooperation of (i) fishermen in returning tags and (ii) national fisheries agencies in providing the necessary catch and effort statistics, publicising the Project and possibly acting as focal points for the collection of tags from their fleets, will be essential to the success of the Project.

It is highly unlikely that the SPC area, as shown in Figure 1, represents a reasonable biological definition of skipjack and yellowfin stocks in the western Pacific. In particular, it is very probable that there is considerable mixing of both species between the SPC area and bordering southeast Asian countries such as Indonesia and Philippines (several skipjack tagged by SPC have been recovered in these countries). This will necessitate a cooperative approach to research, in particular catch and effort data sharing, adoption of uniform tag release techniques, payment of equivalent rewards for tags, etc. Such cooperation is necessary and inevitable, and will result in a more effective research effort on the tuna resources of the western Pacific.

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Table 1. Estimates of total catch and effort in the western and central Pacific Ocean during 1987. Source: Tuna Program (1988). (Units: tonnes; species codes: SKJ skipjack, YFT yellowfin, BET bigeye, ALB albacore, BFT bluefin, BUM blue marlin, MLS striped marlin, BLM black marlin, SAI sailfish, SWO swordfish, SHK shark, OTH other; gear codes: PS purse seine, LL longline, PL pole-and-line)

Vessel Nationality	Days Fished	SKJ	YFT	BET	ALB	BUM	MLS	BLM	SWO	SHK	OTH	TOTAL
Cayman Is												
PS	260	2080	3272								58	5410
Indonesia												
PS	210	2841	531									3372
Fiji												
PL	1400	4682	462									5144
Japan												
PS	5724	86678	34969	610							1	122258
LL	81550		55706	40695	454	5114	220	245	994	147	405	103980
PL	10000	76889	1596								315	78800
Total		163567	92271	41305	454	5114	220	245	994	147	721	305038
Kiribati												
PL	715	242	120								11	373
Panama												
LL	4660	8	1778	2656	262	196	191	2	83	48	16	5240
Philippines												
PS	750	6056	2382	66							166	8670
Solomon Is.												
PS	275	4406	3441								636	8483
PL	7663	23590	239								96	23925
Total		27996	3680								732	32408
ROK												
PS	3600	34196	19287	27							27	53537
LL	29125	12	13018	15112	1568	1807	212	264	368	162	600	33123
Total		34208	32308	15169	1568	1807	212	264	368	162	627	86660
ROC												
PS	2990	14609	2337									16946
LL	23300		1240	3178	3420	2091	264		633	1879	384	13089
Total		14609	3577	3178	3420	2091	264		633	1879	384	30035
Tonga												
LL	196	1	28	14	227				1	11	37	319
Tuvalu												
PL	200	400	40									440
USA												
PS	5945	90084	69616	64	56						10	159830
USSR												
PS	1050	5250	105									5355
Vanuatu												
PS	600	645	60									705
All Nations												
PS	21404	246845	136000	767							898	384510
LL	138831	21	71770	61655	5931	9208	887	511	2079	2247	1442	155751
PL	19978	105803	2457								422	108682
Total		352669	210227	62422	5931	9208	887	511	2079	2247	2762	648943

Figure 1. Area served by the South Pacific Commission.

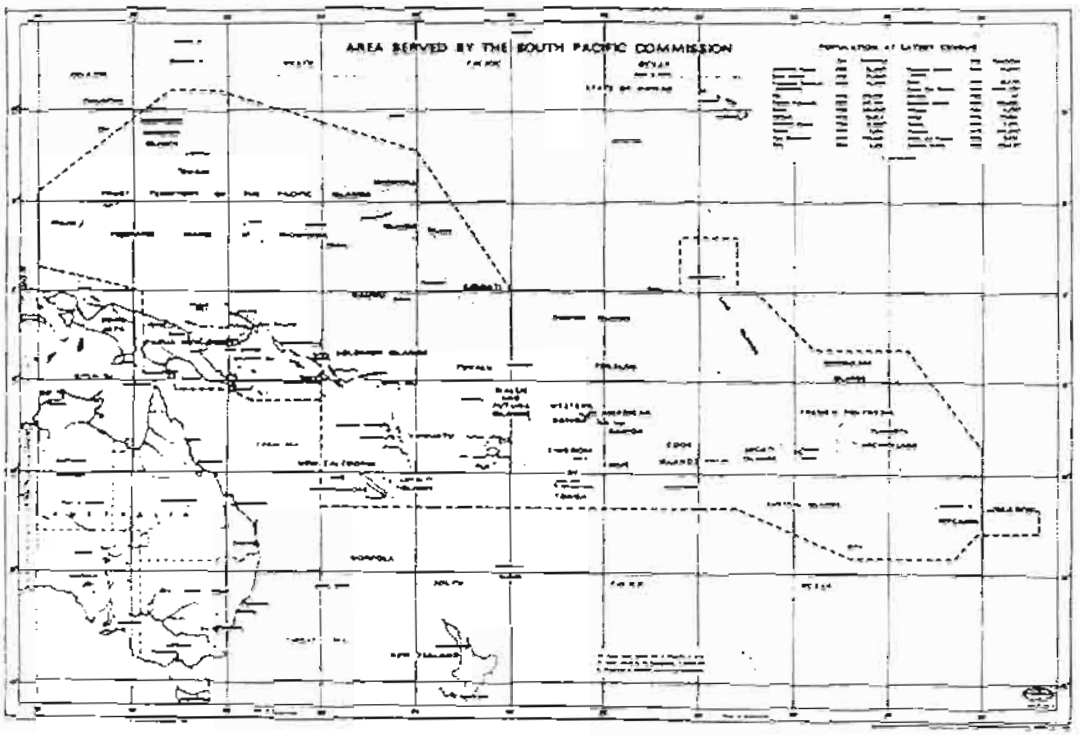


Figure 2. Geographic distribution of Japanese pole-and-line effort for the period 1984-1987, by quarter.

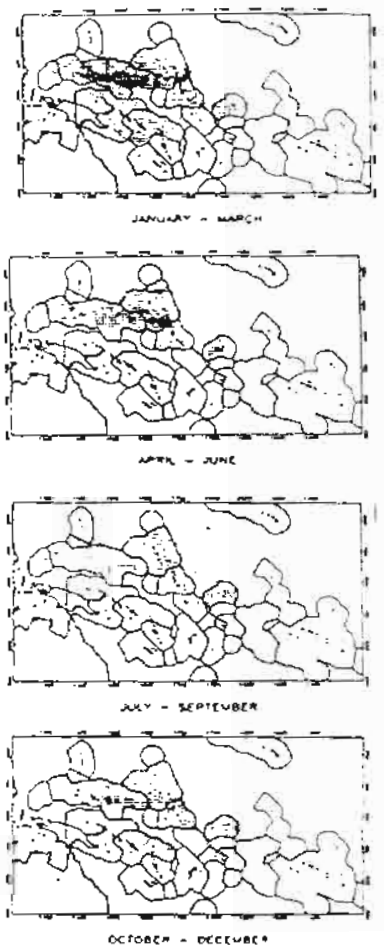


Figure 3. Average monthly effort and skipjack CPUE for the Japanese pole-and-line fishery in the SPC area for the period 1984-1987.

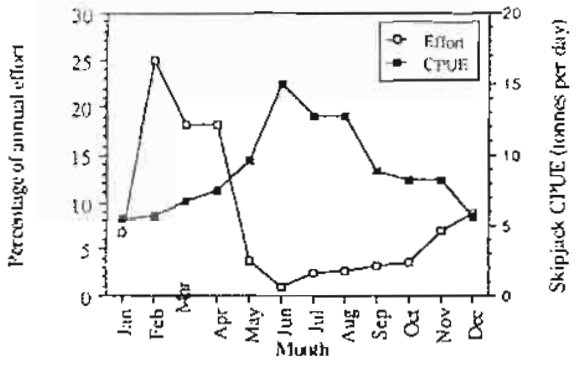


Figure 4. Skipjack CPUE for the Japanese pole-and-line fishery in the SPC area.

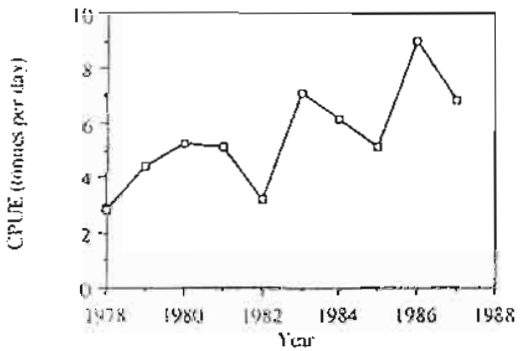


Figure 5. Distribution of average size of yellowfin caught in purse seine school sets and log sets for the period 1978-87, based on fishermen's estimates of the average size of fish in each set. The upper limit of each 5 kg interval is indicated.

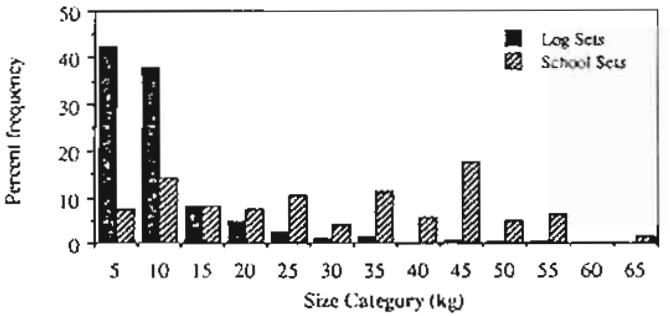


Figure 6. Geographic distribution of purse seine effort for the period 1984-1987, by quarter.

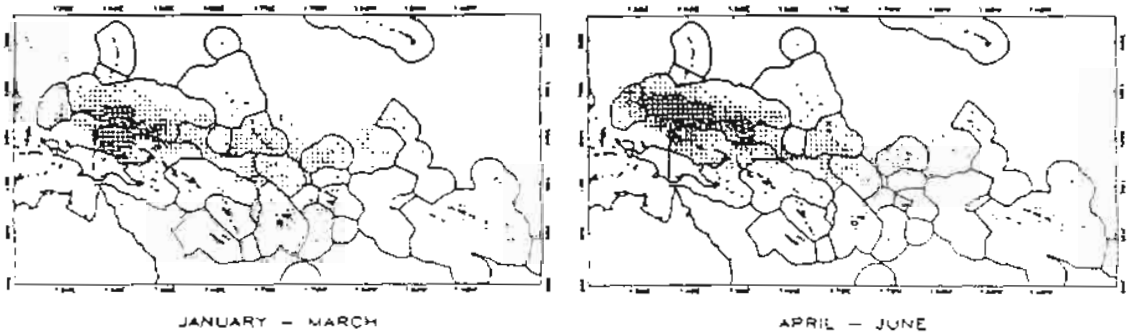


Figure 7. Average monthly purse seine effort (as a percentage of the total) in the SPC area for the period 1984-87.

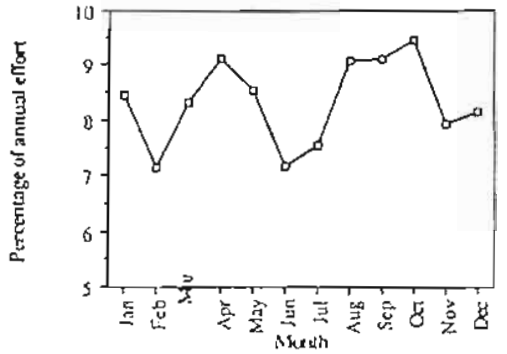
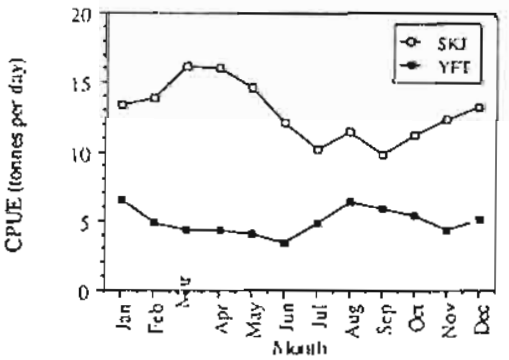


Figure 8. Average monthly skipjack (SKJ) and yellowfin (YFT) CPUE for the purse seine fishery in the SPC area for the period 1984-87.



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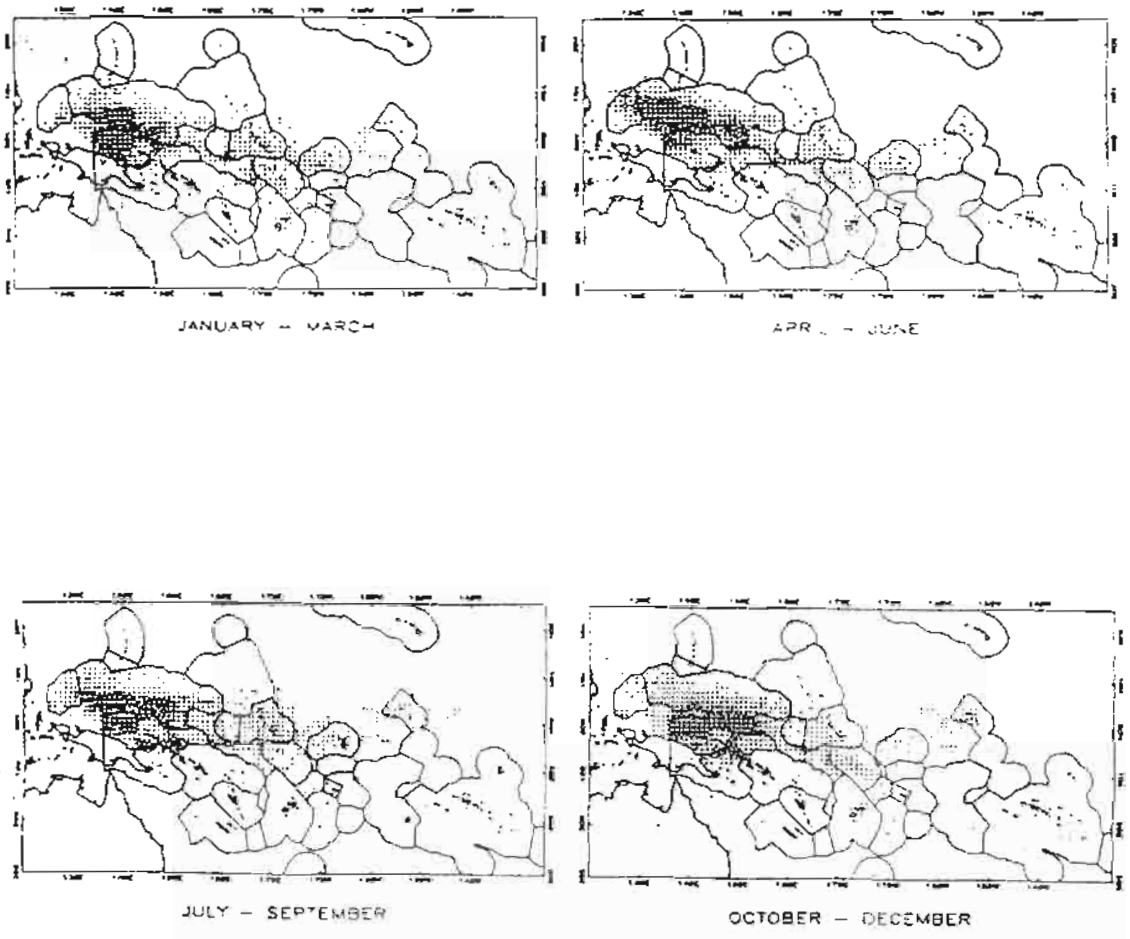

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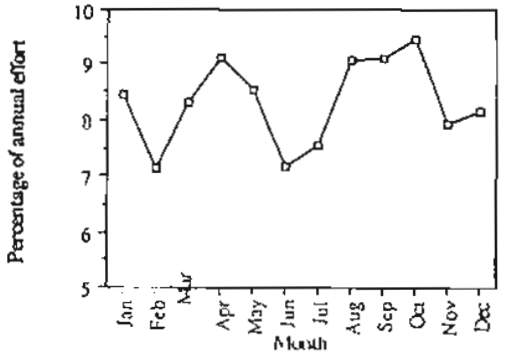

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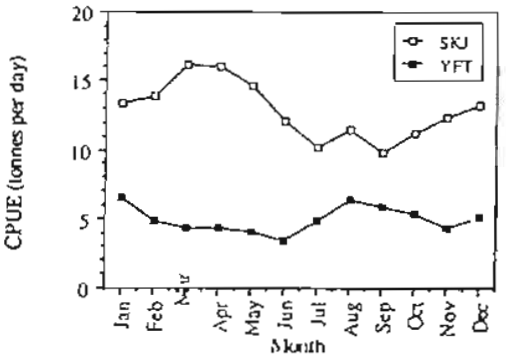


Figure 9. Average monthly yellowfin CPUE for purse seine school sets in the SPC area for the period 1978-87.

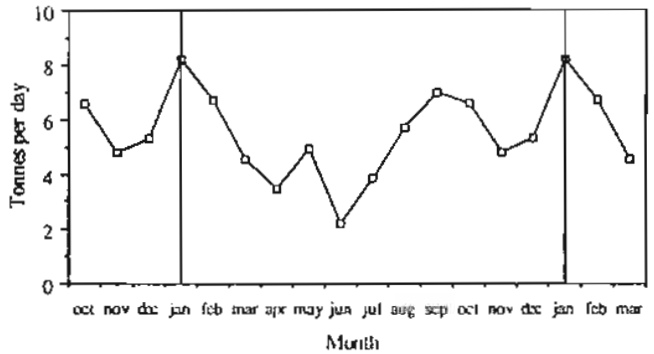


Figure 10. Skipjack and yellowfin catch-per-unit-effort for the distant-water purse seine fishery in the SPC area.

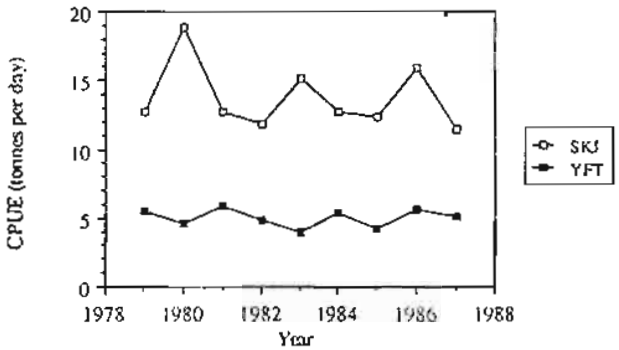


Figure 11. Distributions of the number of hooks per basket for Japanese longline sets in the SPC area, 1978-1987.

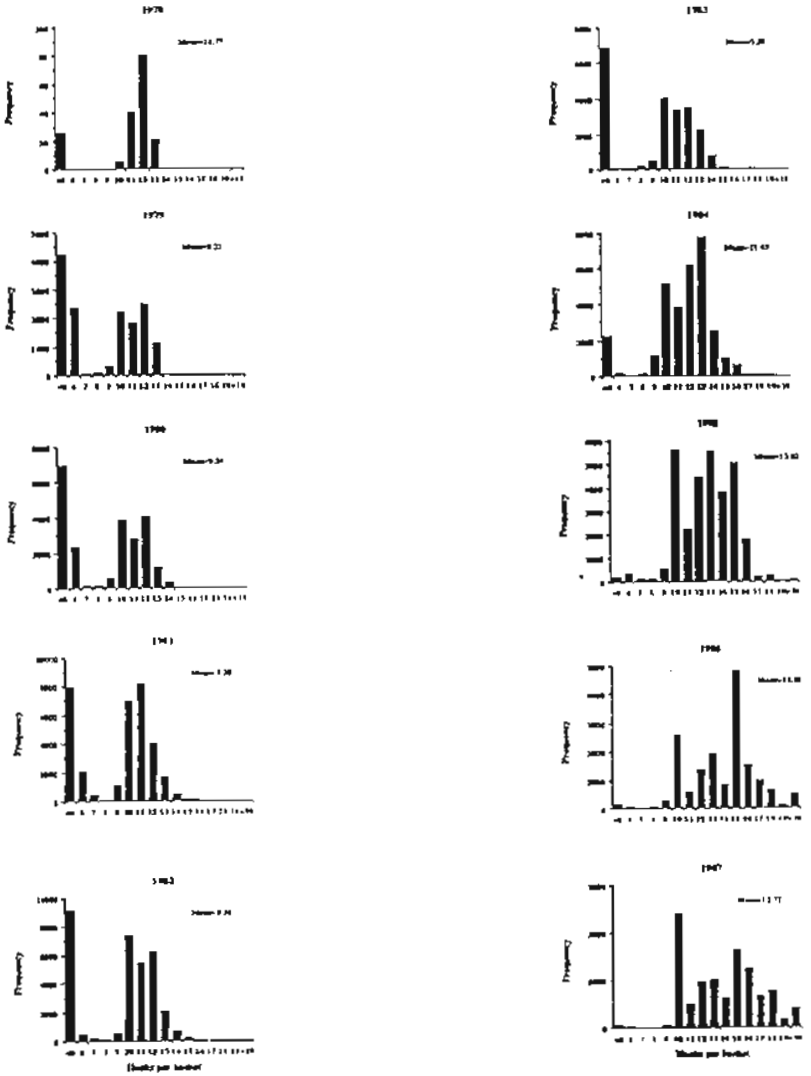


Figure 12. Geographic distribution of longline effort for the period 1984-1987, by quarter.

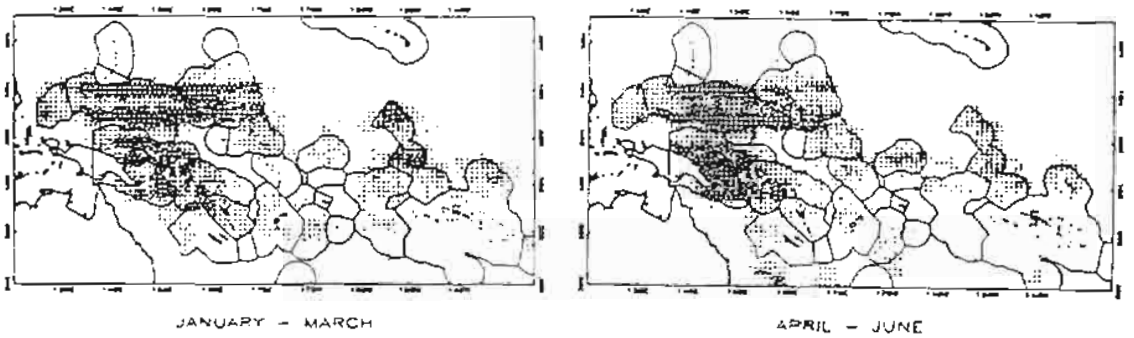


Figure 13. Average monthly longline effort (as a percentage of the total) in the SPC area for the period 1984-1987.

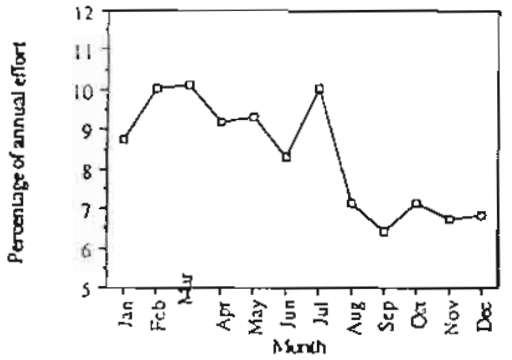
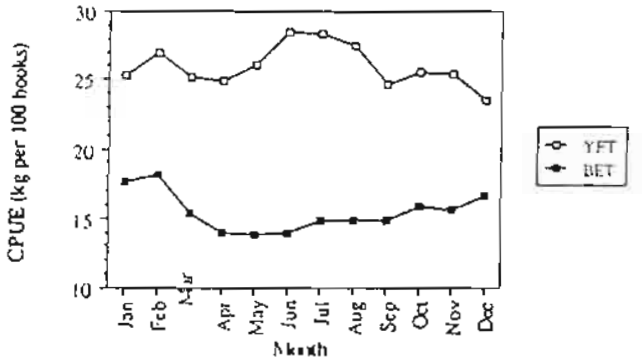


Figure 14. Average monthly yellowfin (YFT) and bigeye (BET) CPUE for the longline fishery in the SPC area for the period 1984-1987.



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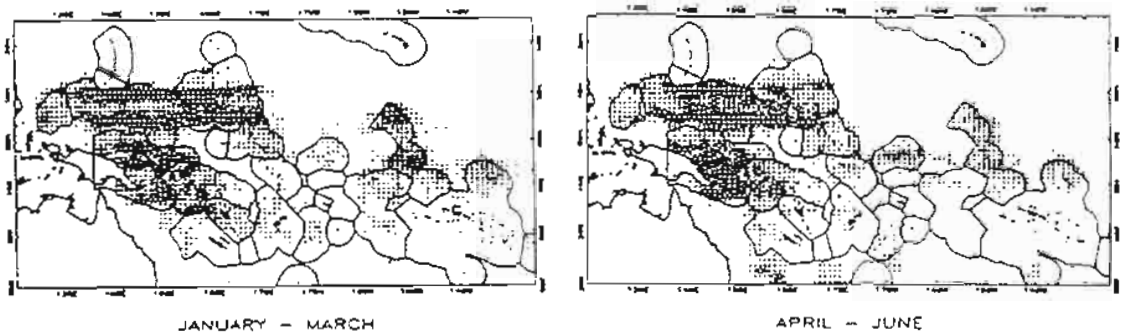

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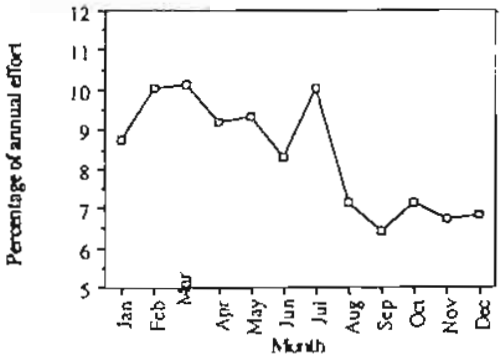

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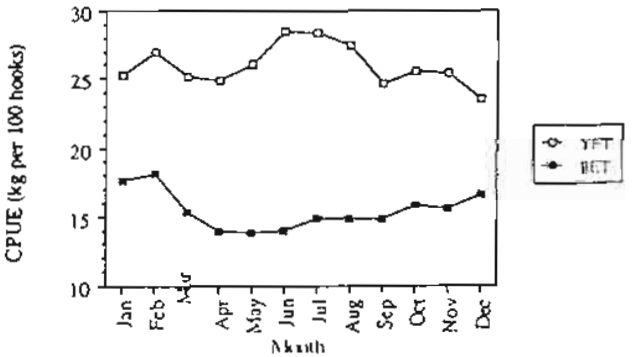


Figure 15. Yellowfin CPUE by deep and conventional longlining in the SPC area.

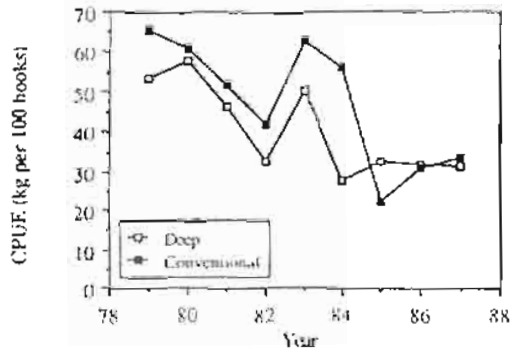


Figure 16. Average weight of yellowfin caught by deep and conventional longlining in the SPC area.

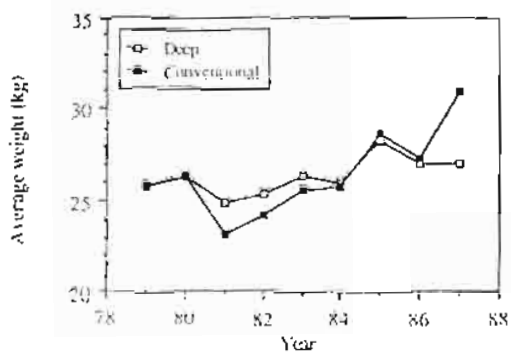


Figure 17. Bigeye CPUE by deep and conventional longlining in the SPC area.

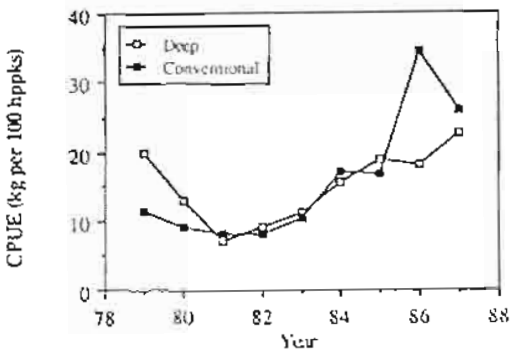
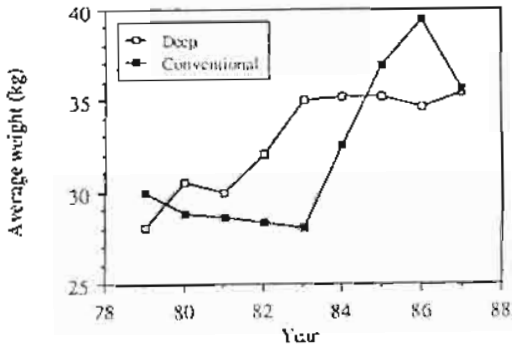


Figure 18. Average weight of bigeye caught by deep and conventional longlining in the SPC area.



Recent Japanese research activities on tunas and billfishes resources in the western equatorial Pacific

Ziro Suzuki
(Far Seas Fisheries Research Laboratory)

Abstract

This paper describes briefly major recent studies on tuna and billfish resources in the western equatorial Pacific conducted by the Far Seas Fisheries Research Laboratory (FSFRL).

As for yellowfin tuna, three topics were reported, 1) comparison of maturity between longline and purse seine caught specimens, 2) preliminary result of sonic tagging experiments around payaos, 3) monitoring of status of stock through Japanese longline and purse seine fisheries. There appears to be no appreciable interaction in global level yet as of 1985 between longline and purse seine fisheries.

Bigeye stock status was assessed by preliminary cohort analysis and a stable population change was observed after 1965.

Billfish stock status was studies for blue and black marlins. It is noted that the catches from the stocks have been sustained over a wide range of fishing effort. However a consistent declining trend of longline CPUE was observed although the decline of the CPUE appeared to have stopped in the recent 10 years.

Effect of El Niño events on yellowfin and bigeye tunas was analyzed with respect to fishing efficiency and recruitment strength. The results suggest a significant influence of El Niño on some of those factors.

1) Comparison of maturity between longline and purse seine caught yellowfin tuna

Presence of yellowfin tuna with more matured gonad in the purse seine catch than in the longline catch has been indicated in the eastern Atlantic, eastern Pacific and in the western Pacific (Suzuki 1988). This phenomenon was further investigated for the western Pacific yellowfin tuna in the area 5° S - 10° N, 130° E - 170° E. The purse seine caught specimens consist of yellowfin tuna taken by the Japanese boats from 1985 to 1987 while those caught by the Japanese longline boats in the period of 1968-1969. Gonad index (GI = GW x 10^4 /FL, GW : gonad weight in gram, FL : fork length in cm) was calculated for the fish larger than 100 cm. Figure 1 confirmed a significantly higher maturity for the purse seine caught specimens than the longline caught fishes. However, the seasonal pattern in maturity of yellowfin caught by the two fishing gears does not necessarily appear to be comparable.

2) Preliminary result of sonic tagging experiments around Payaos

The FSFRL has conducted sonic tagging experiments on yellowfin and bigeye tunas primarily aiming at obtaining information on their vertical swimming behavior. Through the experiments, it was realized that improvement of tracking equipment should be made, especially power-up of transmitter. Meanwhile, usage of payaos in tuna fisheries along the coastal areas of southern Japan has become popular. With using a better equipment commercially available, behavior of tunas around the payaos was investigated for the purpose of estimating aggregating efficiency of the payaos. The trackings were made in the late April 1988 around the payaos set in southern part of Okinawa, Japan (Fig. 2). Five experiments with juvenile tunas, two bigeye and three yellowfin ranged from 6 to 45 hours with an average swimming speed of 1-2 knots. They showed usual pattern of daily swimming with respect to depth, shallower at night and deeper in the daytime (Fig. 3). All of the tagged tunas except one bigeye did not remain or return to its original payao from where they were tagged. This appears to contrast with the results obtained from similar experiments done in Hawaii (Holland MS) which showed some tendency of homing behavior with respect to payaos.

3) Fishing performance on yellowfin tuna by the Japanese longline and purse seine boats

Only Japanese data were analysed due to lack of reliable detailed catch and effort statistics for other fisheries. Figure 4 shows trend of the CPUE for the western stock (west of long. 180°, north of 40° S and south of 40° N) calculated by Honma method. The longline CPUE decreased moderately from 1952 to the middle of the 1970s. During the recent 10 years up to 1985, the CPUE remained rather stable but in a lowest level of the longline fishing history except for the peaks in 1978 and 1983. Catch and effort relationship of yellowfin tuna caught by the Japanese longline fishery seems to have been behaving in response to the changing fishing effort of the longline fishery (Fig 5). Therefore, expected adverse effect of developing purse seine fishery on the longline fishery is not demonstrated at least for global level over the entire western Pacific as of 1985. Purse seine fishery has been experiencing good operations reflected by its stable CPUE.

4) Preliminary cohort analysis on Pacific bigeye tuna

Data on Japanese longline fishery, which takes account of about 70% total Pacific bigeye catch, were used to conduct cohort analysis for the period 1965 to 1985. It was hypothesized that a whole Pacific bigeye consists of single stock. Catch by age table was constructed using age-length relationship estimated by Suda and Kume (1967). The cohort calculation was tuned by the Japanese longline CPUE. Figure 6 shows trend of stock size by age in case of natural mortality coefficient, M=0.4. All segments of age showed a stable change in population size. Although absolute stock number changes significantly with different input parameters such as M and partial recrutment values, general trend of the population size remained unchanged.

5) Brief stock assessment of blue and black marlins in the Pacific

Total catch and effective fishing effort were estimated for Pacific blue and black marlins. The Japanese longline statistics formed a base of the estimation. The effective effort was obtained with the adjustment of fishing efficiency of deep longline with the regular one, followed by further standardization by Honma method. The effective effort of the Japanese longline fishery was raised to total effective effort using a ratio of total catch shown in FAO Yearbooks to the Japanese longline catch. For both species, Pacific wide single stock was assumed. Blue and black marlins showed a similar trends in catch and effort relationships (Figs. 7 and 8). Except early period of the exploitation, catch has been sustained over a wide range of the fishing effort. The CPUE has been rapidly decreasing with stable but low values in recent years. It was not possible to estimate MSY and corresponding optimum fishing effort at present due to inaccuracy of catch statistics and species separation problem between the two species. The stocks should be monitored more closely since low level of CPUE continues.

6) Possible effect of El Niño events on tunas

In the wake of 1982-1983 strong El Niño, several studies of possible effects of El Niño on tuna fisheries as well as on tuna populations have been attempted. Suzuki (1988) suggested for Pacific yellowfin tuna throught the longline data that recruitment strength might be positively related with El Niño but no appreciable link between the longline fishing efficiency and El Niño in the eastern Pacific stock. For the western Pacific stock, no appreciable link of fishing efficiency and recruitment with El Niño was pointed out. However, more detailed study (Fig. 9) on the western stock suggests that in the equatorial Pacific, the longline CPUE often inversely correlated with the depth of surface mixed layer (deeper in El Niño period than in non-El Niño period). For bigeye tuna, distinctive change occurs in longline fishing ground of eastern equatorial Pacific, i.e., formation of good fishing ground in El Niño years along the equator where no fishing ground is formed in non-El Niño years. This appears closely related with oceanographic changes in thermal structure and current systems. Another aspects of interest on bigeye is that stronger cohort originates in the year of El Niño or one year before the El Niño year (Fig. 8). There is some tendency that the fishing efficiency of the longline gear increases in El Niño period. Further follow-up study on these subjects continues.

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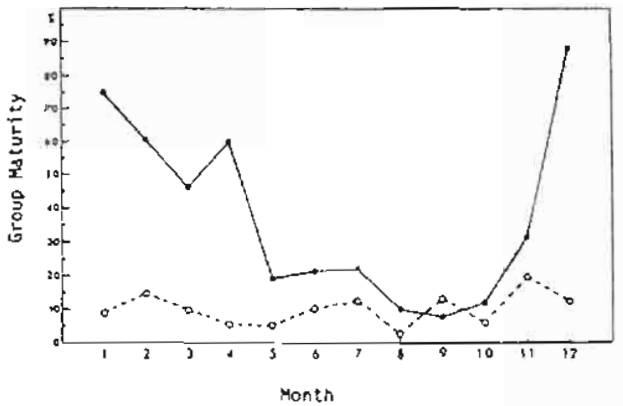


Fig. 1. Seasonal change of group maturity (% of individuals with GI 2.0 and over to the total) for female yellowfin caught by purse seine (solid line) and longline boats (dotted line) in the western equatorial Pacific.

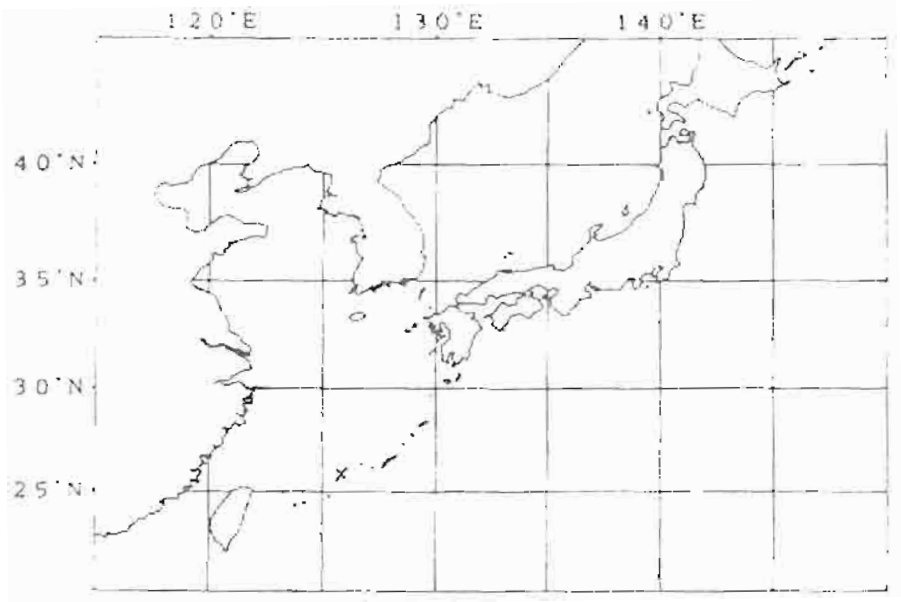


Fig. 2. Location of sonic tagging experiments on juvenile yellowfin and bigeye tunas off Okinawa area (1) Japan

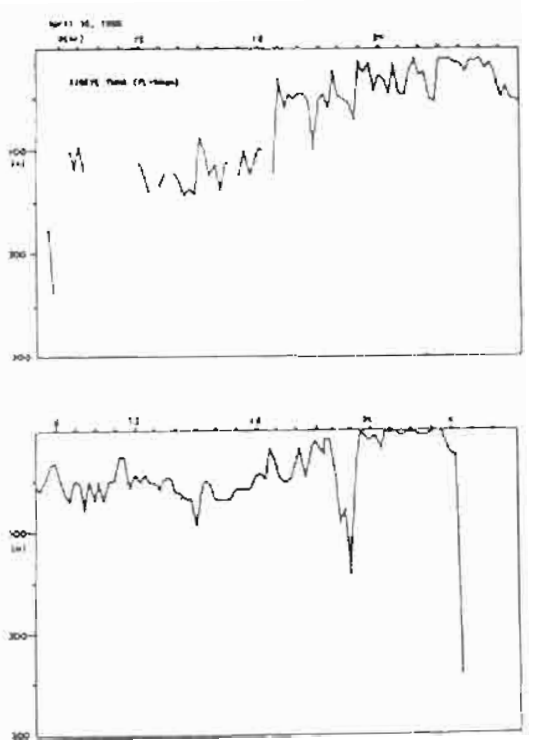


Fig. 3. Vertical movement of bigeye tuna captured around payao off Okinawa area and tracked by sonic tag.

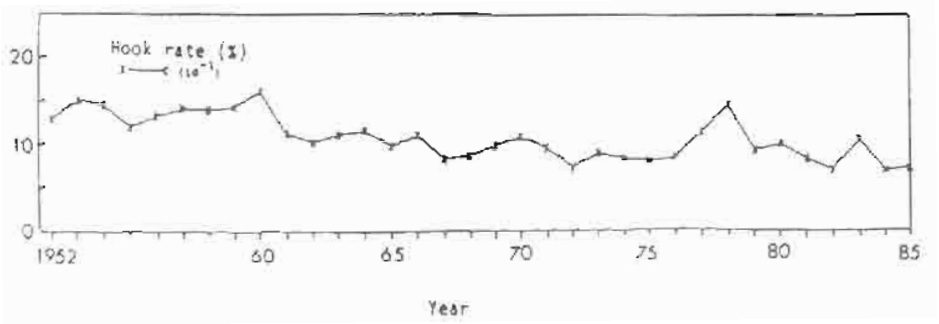


Fig. 4. Trend of CPUE for yellowfin tuna caught by the Japanese longline boats operated in the western Pacific.

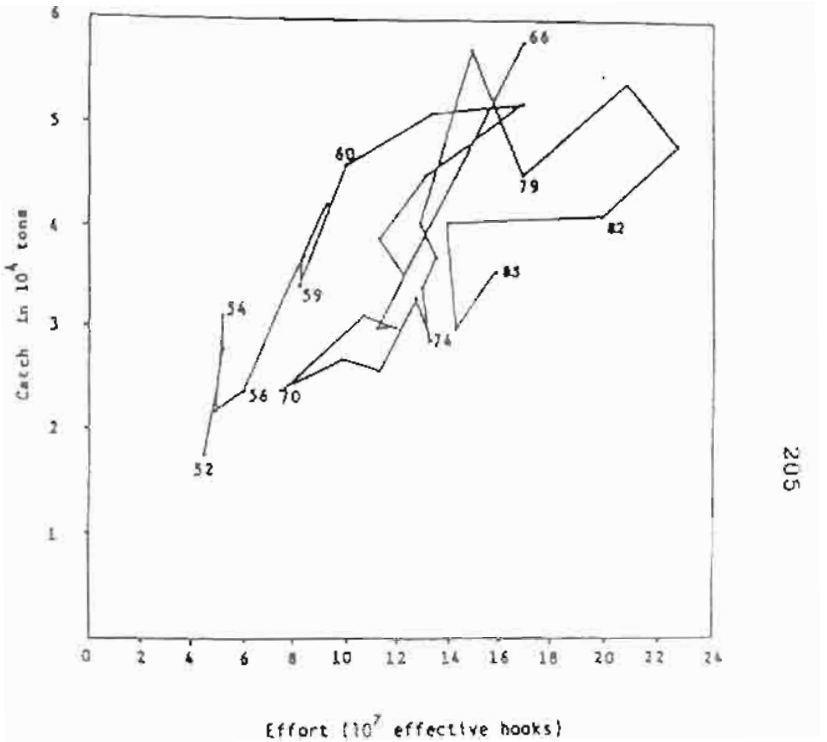


Fig. 5. Catch and fishing effort relationship for yellowfin tuna caught by the Japanese longline boats in the western Pacific.

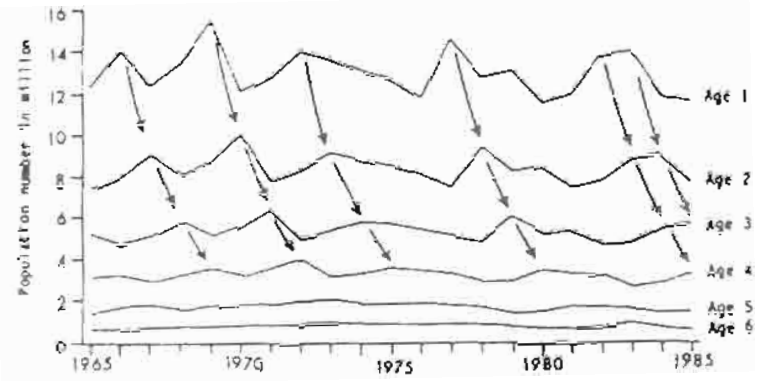


Fig. 6. Trend of population size by age for Pacific bigeye tuna estimated by cohort analysis (M=0.4).

Arrows show a progression of strong year class.

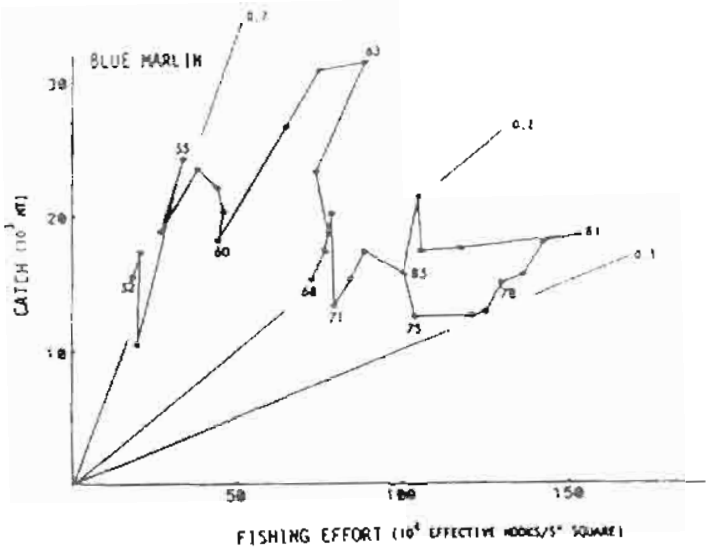


Fig. 7. Catch and fishing effort relationship for Pacific blue marlin, from 1952 to 1985.

Straight line passing through origin represents CPUE.

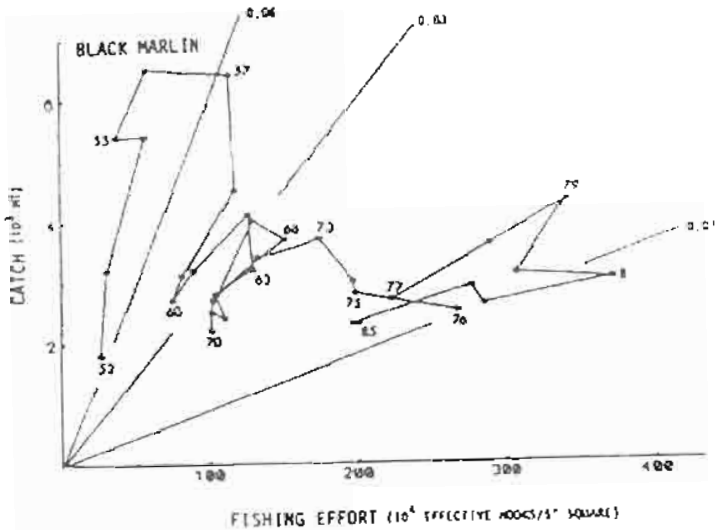
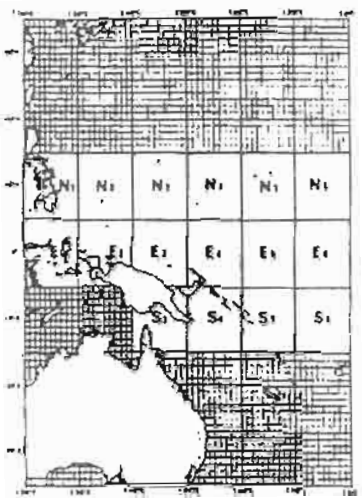


Fig. 8. Catch and fishing effort relationship for Pacific black marlin.



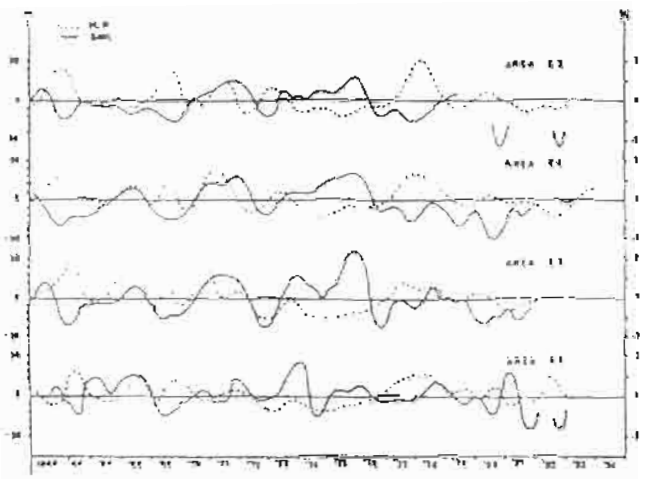


Fig. 9. Comparison of hook rates for yellowfin tuna caught by the Japanese longline boats (H.R.) and depth of surface mixed layer (S.M.L.) in the equatorial Pacific (upper panel).

H.R. and S.M.L. are expressed as deviation from respective mean.

Impacts of New Regime of Sea to Tuna Fisheries of USA and Mexico
-With A Particular Reference to Mexican Tuna Fleet at Ensenada-

Tadashi Yamamoto (Ex-FAO Fishery Officer)

1. International Coorporation on the Exploitation of Tuna Resources off the west coast of USA and Middle America (Eastern Pacific) through Inter-American Tropical Tuna Commission (IATTC)

   Member Countries : Canada, USA, France, Mexico, Nicaraga, Panama and Japan
   Major Fishing ground : Pacific Ocean off Mexico

2. USA Tuna Fishery before 1977

   Based at Los Angels and San Diego for Tuna Canning Industy.

3. Consensus on 200 Miles Economic Zone (EEZ) at UN Conference on Law of Sea, 1977

4. EEZs declared by USA and Mexico and Difference in the Meanings

   i. USA EEZ (Fishery Conservation Zone)
      All fishery resources excluding tuna resources are under the jurisdiction of USA, assuming that US tuna fleet will be allowed to operate in the EEZ of other countries by persuading these countries to follow the principle

   ii. Mexican EEZ
      All fishery resources including tunas resources are under the jurisdiction of Mexico, assuming that she can develop her tuna fishery by phasing out the operation of all foreign fishing vessels from her EEZ.

5. Impacts of EEZs to USA and Mexican Tuna Fishery
   i. Impact to USA : Her tuna fleet was forced to move the fishing ground from off Mexico to south Pacific.
   ii. Impact to Mexico : A new tuna fleet was built, and a new tuna fishing port was constructed at Ensenada. But, US declared the embargo of importing tuna from Mexico.

Development of Taiwanese Tuna Fishery

by P.S.C. Ho

Asian countries have played a very important role in the world tuna production. Among the world 8 major tuna fishing countries, 5 of them are in Asia, with Japan on the lead, producing some 860,000 M/T of tuna in 1986, followed by Indonesia, the Philippines, Taiwan (the Republic of China) and Korea. The production of tuna by Taiwan (Republic of China) reached 209,767 M/T in 1986 and 202,619 M/T in 1987.

Looking back to the development of tuna fishery in Taiwan, the Republic of China one can see that before the mid 1970s base-port operating long liners played the major role, with catches comprised mainly of albacore, yellowfin, bigeye and billfish, majority of which were exported to the USA. Japan and Europe (Italy) for canning. In the mid 1970s, in order to diversify the tuna market, ultra low temperature longliners were introduced, their catches consisted mainly of yellowfin, bigeye and billfish for supply to Japanese sashimi market. In the early 1980s, due to the expansion of world market on light meat tuna and the government's encouragement of development in purse seine fishery, tuna purse seiners were introduced, and at present there are 12 single purse seiners and 3 group purse seiners, whose catches comprise of 70% skipjack and 30% yellowfin, mainly for supply to USA, Thailand and Japan as raw material for canning. In 1984, drift net fishery was developed, and presently there are about 92 drift net vessels, whose major catches consist of albacore, billfish, sharks and squid.

Presently the Republic of China has about 514 deep sea tuna boats in operation, of which 271 are longliners based in the three oceans - 125 in the Atlantic, 37 in the Indian Ocean, 58 in the Pacific and 53 using Kaohsiung as base port while fishing in the Indian Ocean and the Pacific Ocean: 111 ultra low temperature longliners, 15 group and single Purse seiners, and 92 drift net vessels.

The vessels based in the Pacific are mostly 150 - 250 GRT in tonnage, in the Indian Ocean 180 - 250 GRT, and in the Atlantic Ocean 300 - 400 GRT.

In 1987, the total production of tuna was 202,619 M/T of which deep sea longliners produced 145,414 M/T, purse seiners 24,043 M/T and drift netters 32,162 M/T. In addition, the in-shore longliners produced 34,110 M/T.

The major fishing ground and base ports of our vessels are as follows:

Tuna longliners:

The Pacific Ocean - the main fishing grounds are in the areas between $5^{\circ}S$ - $20^{\circ}S$ and 170° - $160^{\circ}E$ with major base ports of American Samoa and Fiji.

The Indian Ocean - areas of fishing are between 15° - $40^{\circ}S$ and 40° - $100^{\circ}E$, using Singapore, Port Louis, Reunion and Seychelles as base ports for transhipment and replenishment.

The Atlantic Ocean can be quite distinctly separated into the North and South Atlantic:

In the North Atlantic, for the period between October and February, vessels mostly operate in areas between 30° - $40^{\circ}N$ and 20° - $30^{\circ}W$ and between April and August, in areas between 15° - $25^{\circ}N$ and 20° - $60^{\circ}W$. The main base ports are: Las Palmas, St. Maarten, Port of Spain and St. Lucia.

In the South Atlantic, between February and August the areas of fishing extend from 20° to $40^{\circ}S$ and $30^{\circ}E$ to $10^{\circ}W$ and between October and January $10^{\circ}S$ to $30^{\circ}S$ and $10^{\circ}W$ to $35^{\circ}W$. The main base ports used are Cape Town and Montevideo.

For ultra low temperature longliners, the fishing areas are mainly around the tropical waters in the Indian Ocean. Occasionally vessels will reach around $30^{\circ}S$ for catching of temperate water bigeye. Most of the vessels use Singapore as base port for transhipment of catches to the Japanese market; sometimes Seychelles is also used as port of transhipment. Small number of ultra low temperature longliners have reached as far as the eastern Pacific for fishing using Panamian port and Tahiti as transhipping ports.

Fishing grounds for purse seiners have been concentrated at the western Pacific, mainly Papua New Guinea and Federated States of Micronesian waters, using Tinian and Guam as transhipping ports.

For drift net vessels, between November and March, operation areas are in the Indian Ocean, target fish are albacore, billfish and sharks, and between May and October, vessels normally operate in the North Pacific for squid and albacore. All catches are landed at Kaohsiung, whether for export or for domestic consumption.

Besides the deep sea tuna fishery as described above, there are some 1,330 inshore tuna longliners of less than 50 GRT. In 1987, tuna produced by the small inshore longliners reached 34,110M/T, majority of which were for supply to Japanese sashimi market by aircargo, and the remaining portion are for domestic consumption in the form of sashimi or fresh fish.

During 1987, the catch rate in the Atlantic Ocean has substantially reduced, resulting an overall cut-down of 3.4% on the total catch, and at the same time the number of vessels operating in the Atlantic has reduced from 178 in the previous year to 125 at present.

In addition to low catching rate experienced, continuous increase in labour cost and devaluation of the US dollar against the NT dollar have also discouraged boatowners to place more fishing effort on longline caught albacore, and those boats which are inefficient because of old age or low carrying capacity, were forced to shift to a fishery which involves lower cost of fishing using ice building permit to build new ultra low temperature longliners for catching of tuna for the Japanese sashimi market, where they are able to obtain higher price. Nevertheless, Japanese tuna boat operators have been complaining that the Republic of China has been trying to expand its sashimi tuna production which will in turn suffocate the already weak sashimi market in Japan, but on the other hand, Japanese consumers are delighted that they can enjoy less expensive sashimi.

People in the industry are aware of the less efficiency of the longline fishing method. At the same time foreign consumers are rather price-conscious on tuna, considering that concentration on catching of albacore for supply to US packers may result over-reliance on US white meat tuna market which has not been very stable in the past years, boatowners have been making more investment on purse seine fishery. The development of this fishery has been quite rapid, and apart from the 15 purse seiners now already in operation, shipyards are fully occupied with new orders.

With the expansion of purse seiner fleet, there is an immediate need of acquiring more fishing grounds, either through foreign fishing agreement or foreign fishery joint venture. We have always been interested in and showing our eagerness in cooperation with coastal states with tuna resources, and with the help of our fishing technique jointly exploit the resources for the mutual benefit of both sides.

As there are plenty of employment opportunities ashore, fewer people prefer to work on board fishing boats, and subsequently there is a shortage of labour force in the fishing industry. To solve this problem, boatowners are urging government to allow employing more foreign fishermen to work on board our vessels. The present regulation only allows 25% of foreign fishermen to work on board our fishing vessels. The fishermen presently employed mostly are from the Philippines and Thailand, and occasionally South African fishermen are also employed by those boats based at Cape Town.

OBSERVATIONS ON SKIPJACK (Katsuwonus pelamis) AND YELLOWFIN TUNA (Thunnus albacares) IN THE ANDAMAN SEA OF THAILAND[1]

BY

Weera Pokapunt[2] and Pattira Sawasdiworn[2]

ABSTRACT

A total of 1,860 samples of skipjack and 2,060 samples of yellowfin tuna were sampling from 25 operation of tuna purse seining in the Andaman Sea of Thailand, by R/V Chulabhorn, during February to May, 1988. Measurement of fork length, body weight and sex were recorded for determine the size distribution, length-weight relationship and sex ratio. The mean length at maturity of skipjack was observed to be 348 mm. for male and 346 mm. for female, while yellowfin tuna was observed to be 417 mm. for male and 429 mm. for female.

Sex ratio of skipjack for immature group to male and female are 1.8:1.4:1 and of yellowfin tuna are 11.6:1.6:1.

1) Paper presented on THE 2 ND SOUTHEAST ASIAN TUNA CONFERENCE & THE 3 RD MEETING OF TUNA RESEARCH GROUPS IN THE SOUTHEAST ASIAN REGION 22-25 August 1988, Malaysia.

2) Exploratory Fishing Division, Department of Fisheries, Bangkok, Thailand.

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Introduction

In April 1987, the oceanic purse seining for tuna was first experimental carried out by R/V Fishery Research "CHULABHORN" in the Andaman Sea, EEZ of Thailand. The R/V CHULABHORN is a newly-built purse seiner of 1,424 gross-tons and diesel engine of 2,800 Hp. with modern facilities for a new multisystem of fishing gear. The purse seine net used is a 1,050 m. long, 240 m. depth and 10 cm. mesh size.

Subsequently, the first fishing ground survey for skipjack and yellowfin tuna was really operated in the Andaman Sea, EEZ of Thailand during February to May, 1988. The survey areas were concentrated along the continental slope of 270-650 m. depth from Latitude 06°-30.0' N to 09°-30.0' N (as shown in Fig.1). Using method of encircling catch tuna shoals which associated with the employment of anchored FAD (Fish Aggregating Devices) or "Payao". However, due to very strong current in the early stage of the survey and the fishing ground is on the continental slope. 10 payaos were set up in the survey but 4 of them were destroyed, the operations could not be carried out satisfactorily. A total of 93 days were spent at the fishing ground, only 10.5 tons (consist of 5.1 tons of skipjack, 3.8 tons of yellowfin tuna and 1.6 tons others) were caught in 25 operations which 6 of them produced no results. Each payaos was set up in the sea for 3-15 days long.

One of the major objectives of this survey is to collect some biological data of skipjack and yellowfin tuna. But very little information of oceanic tuna in Thailand from the commercial fisheries is available. However, the present study attempts to determine the size distribution, length-weight relationship and sex ratio based on data collected only by R/V Fishery Research "CHULABHORN" in 1988. All fish samples were measured and weighed in fresh condition. Fork length was measured in millimetres and body weight was weighed in grams. Sex also was recorded.

Length Frequency Distribution

Although skipjack tuna was the most dominant species caught in this survey consisted of 48.57 %, but the maximum catch per set showed poor results only 7 kg., 1,156 kg., 1,420 kg. and 4,748 kg. in February, March, April and May, respectively.

Figure 2 shows the length frequency distribution of skipjack tuna in the Andaman Sea of Thailand during February to May, 1988. A total of 1,860 fish samples were measured for this study. Size range was observed from 209 mm. to 594 mm. fork length.

During February to March, only a small size of skipjack tuna were caught in the survey, with a size range of 255 mm. to 418 mm, modes at 31 and 38 cm. size class. A medium size of 440 mm. to 600 mm. could be caught in April as well as small size of 220 mm. to 430 mm. The modes were 35 and 54 cm. size-class. In May, the proportion of small skipjack increased rapidly while medium size was nearly disappeared. However, the average size of small fish become smaller than that two months. It can be seen that there are many modes occured in the catch during the survey. The same fish group are not being sampled month after month. It is possible that there are

many recruitments of small skipjack tuna enter into this fishing ground during N.E. monsoon.

Yellowfin tuna was the second most dominant species caught by oceanic purse seine in the Andaman Sea, consisted of 36.19 %. During this period mostly small size of yellowfin tuna range 240 mm.-500 mm. and some median size range 500-640 mm. were caught. A total of 2,060 fish samples were measured. The minimum size was observed at 230 mm. while the maximum size was 145 cm. The length frequency distribution of yellowfin tuna during this three months were summarized in Figure 3. It can be seen that the occurrence of the modes of small yellowfin tuna in March and May are in the same size class at 30 cm. that there is a steady migration of the same age fish through this fishing ground during N.E. monsoon.

Length Weight Relationship

The length weight relationship of each tunas is described by the formula :

$$W = aL^b$$

where W = body weight in kilograms.

L = fork length in centimetres.

a and b = constants

Logarithmic transformation of this formula gives a straight line relationship of the form.

$$\ln W = \ln a + b \ln L$$

In the present study a total of 516 skipjack tuna, of which 222 were immature fishes, 171 males and 123 females were analysed. Immature fishes ranged in fork length from 209 mm. to 412 mm, while males ranged from 348 mm to 594 mm. and females ranged from 346 mm. to 592 mm. Based on these data the following relationship for immatures, males and females separately were obtained :

Immatures	$\ln W = -11.20681713 + 3.03755289 \ln L$
Males	$\ln W = -12.18483635 + 3.314367887 \ln L$
Females	$\ln W = -12.2537919 + 3.33331648 \ln L$

Which is equivalent to :

Immatures	$W = 0.000013581\ L^{3.03755289}$
Males	$W = 0.000005107\ L^{3.314367887}$
Females	$W = 0.000004767\ L^{3.33331648}$

The value of "r" (Correlation coefficient) which is a measure of the degree of association between the length and weight for immature was 0.952332908, males was 0.92979218 and for females was 0.981761698. The regression lines are shown in Fig.4.

Mohan and Kunhikoya (1985) measured 440 skipjack with length range of 360 to 670 mm. from Minicoy Waters of India and calculated the length weight relationship as following equations :-

Males	$W = 0.00000198\ L^{3.35566}$
Females	$W = 0.000001\ L^{3.46279}$
Pooled together	$W = 0.00000155\ L^{3.39301}$

For yellowfin tuna, a total of 615 fish of which 500 immatures, 72 males and 43 females were analysed for this study. Immature fishes rangeu in fork length from 254 mm. to 504 mm. while males ranged between 417 mm. to 636 mm. and females ranged from 429 mm. to 635 mm. Based on these data the following equations for immatures, males and females separately were obtained:-

Immatures	$\ln W = -11.11322303 + 3.036186403 \ln L$
Males	$\ln W = -10.15721149 + 2.792539946 \ln L$
Females	$\ln W = -11.09310572 + 3.029259082 \ln L$

Which is equivalent to :-

Immatures	$W = 0.0000149\ L^{3.0361864}$
Males	$W = 0.0000388\ L^{2.7925399}$
Females	$W = 0.0000152\ L^{3.0292590}$

The value of "r" (Correlation coefficient) between the length and weight for the immatures, males and females were 0.9579676, 0.9589232 and 0.9737161 respectively. The regression lines are shown in Fig.5.

Poreeyanond (1987) measured 117 yellowfin tuna which size range between 450-700 mm.from the first oceanic purse seining experimental by R/V "CHULABHORN" in the Andaman Sea and calculated the length weight relationship as :-

$$W = 0.00011067\ L^{2.57056}$$

Silas and Pillai (1985) summarized the length weight relationship for yellowfin tuna from Minicoy as :-

$$W = 0.000001655\ L^{2.21150}$$

Details of length weight relationship for skipjack and yellowfin tuna are summarized in table 1.

Sex ratio

It is difficult to distinguish sex in small sample of Skipjack and yellowfin tuna. However, in this study attempts to determine the sex of both tunas into immature group, male group and female group as possible. Details of sex ratio are summarized in table 2-3.

A total of 516 skipjack tuna were observed during March to May 1988. The size distribution indicate that the fish of less than 300 mm. in fork length were found to be immatures, more females among the small fish up to 450 mm.and more males among the larger fish. Maturation of skipjack started in fish of about 346 mm. Only one immature fish in March and seven fishes in April were found greater than 450 mm. The overall ratio of female group to male and immature are 1:1.4:1.8

Sex ratio of small yellowfin tuna were also observed during this survey. A total of 615 fish comprised of 81.3 % immatures, 11.7 % males and 7.0 % females. The size distribution indicate that the small yellowfin tuna of less than 400 mm.in fork length were found to be immature and only one immature fish was found greater than 500 mm. The maturity of male and female yellowfin tuna started in fish of about 417 and 429 mm, respectively.

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Table 1 SUMMARY OF LENGTH-WEIGHT RELATIONSHIPS FOR SKIPJACK AND YELLOWFIN TUNA FROM ANDAMAN SEA, EEZ OF THAILAND

Species	Size range (mm.FL)	n	a	b	r
Katsuwonus pelamis					
Immature	209-412	222	0.000013581	3.037552894	0.952332908
Male	348-594	171	0.000005107	3.314367887	0.929794218
Female	346-592	123	0.000004767	3.33331648	0.981761698
Thunnus albacares					
Immature	254-504	500	0.000014914	3.036186403	0.9579676
Male	417-636	72	0.0000388	2.792539946	0.958923226
Female	429-635	43	0.000015217	3.029259082	0.973716182

Table 2 SEX RATIO OF SKIPJACK (Katsuwonus pelamis) IN THE ANDAMAN SEA, YEAR 1988.

Size class (F.L.)		March	April	May
< 300 mm.	% Immatures	100	100	100
	Total number	3	7	16
300-349 mm.	% Males	-	-	3.53
	% Females	-	-	4.71
	% Immatures	100	100	91.76
	Total number	70	74	85
350-399 mm.	% Males	21.11	1.32	6.67
	% Females	23.33	15.79	53.33
	% Immatures	55.56	82.89	40.00
	Total number	90	76	15
400-449 mm.	% Males	66.67	6.25	46.15
	% Females	29.63	50.00	53.85
	% Immatures	3.70	43.75	-
	Total number	27	16	13
450-499 mm.	% Males	-	47.06	51.35
	% Females	-	52.94	48.65
	% Immatures	-	-	-
	Total number	-	34	37
500-549 mm.	% Males	-	48.89	61.82
	% Females	-	51.11	38.18
	% Immatures	-	-	-
	Total number	-	90	55
550-599 mm.	% Males	-	57.14	77.36
	% Females	-	42.86	22.64
	% Immatures	-	-	-
	Total number	-	28	53
> 600 mm.	% Males	-	-	-
	% Females	-	100	-
	% Immatures	-	-	-
	Total number	-	2	-

Table 3 SEX RATIO OF YELLOWFIN TUNA (Thunnus albacares) IN THE ANDAMAN SEA, YEAR 1988.

Size class (F.L)		March	April	May
< 300 mm.	% Immatures	100	100	100
	Total number	7	3	20
300-349 mm.	% Males	-	-	-
	% Females	-	-	-
	% Immatures	100	100	100
	Total number	30	164	115
350-399 mm.	% Males	-	-	
	% Females	-	-	-
	% Immatures	100	100	100
	Total number	49	47	40
400-449 mm.	% Males	10.89	18.52	26.67
	% Females	2.97	7.41	-
	% Immatures	86.14	74.07	73.33
	Total number	101	27	15
450-499 mm.	% Males	18.18	23.26	29.41
	% Females	9.09	9.30	41.18
	% Immatures	72.73	67.44	29.41
	Total number	11	43	34
500-549 mm.	% Males	80.00	42.86	100
	% Females	20.00	50.00	-
	% Immatures	-	7.14	-
	Total number	10	14	6
550-599 mm.	% Males	20.00	66.67	66.67
	% Females	80.00	33.33	33.33
	% Immatures	-	-	-
	Total number	5	9	3
> 600 mm.	% Males	100	55.56	-
	% Females	-	44.44	-
	% Immatures	-	-	-
	Total number	2	9	-

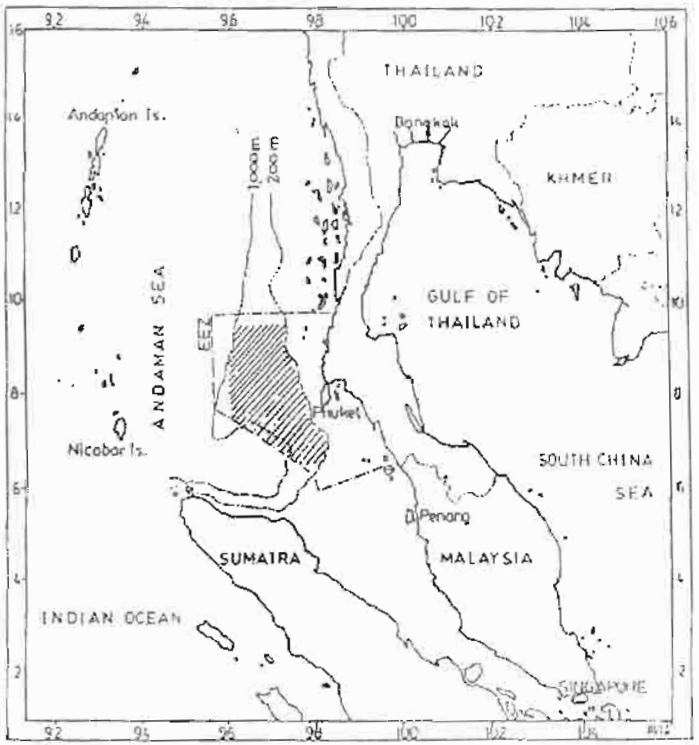

FIGURE 1 THE SURVEY AREA IN THE ANDAMAN SEA, BY R/V CHULABHORN, 1988.

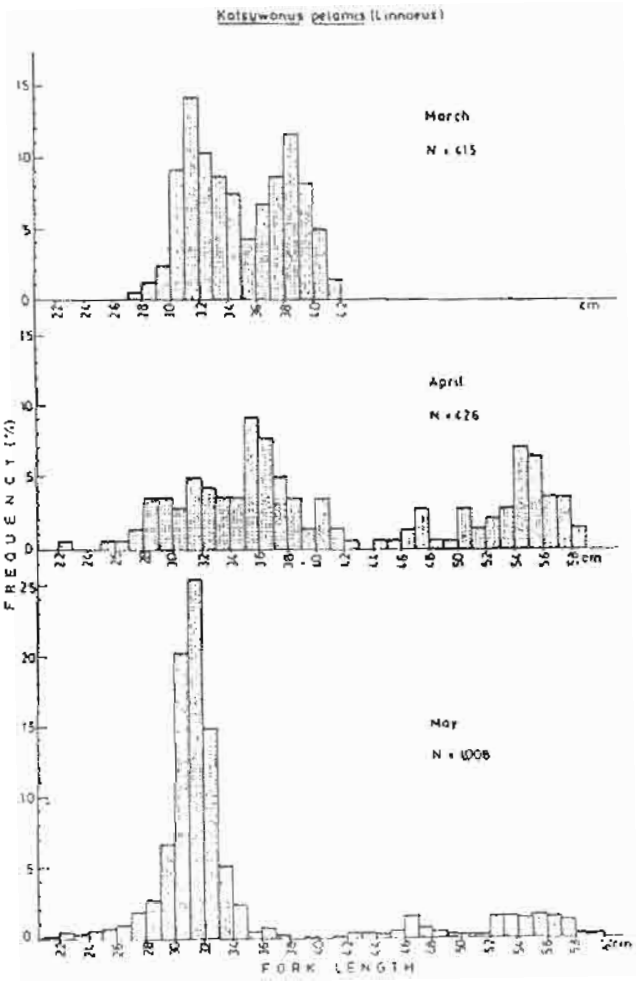

FIGURE 2 LENGTH FREQUENCY DISTRIBUTION OF SKIPJACK TUNA IN THE ANDAMAN SEA, YEAR 1988

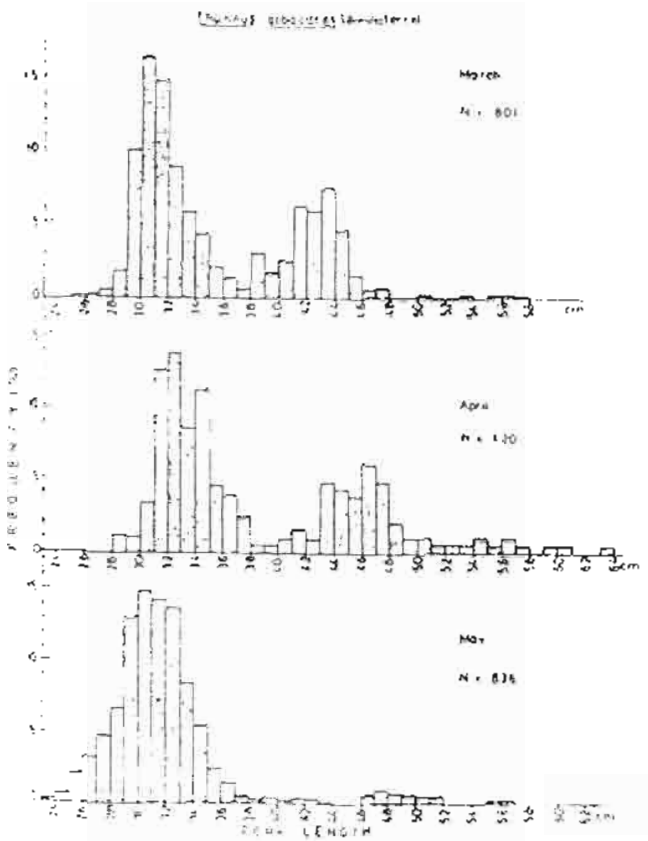

FIGURE 3 LENGTH FREQUENCY DISTRIBUTION OF YELLOWFIN TUNA IN THE ANDAMAN SEA, YEAR 1988.

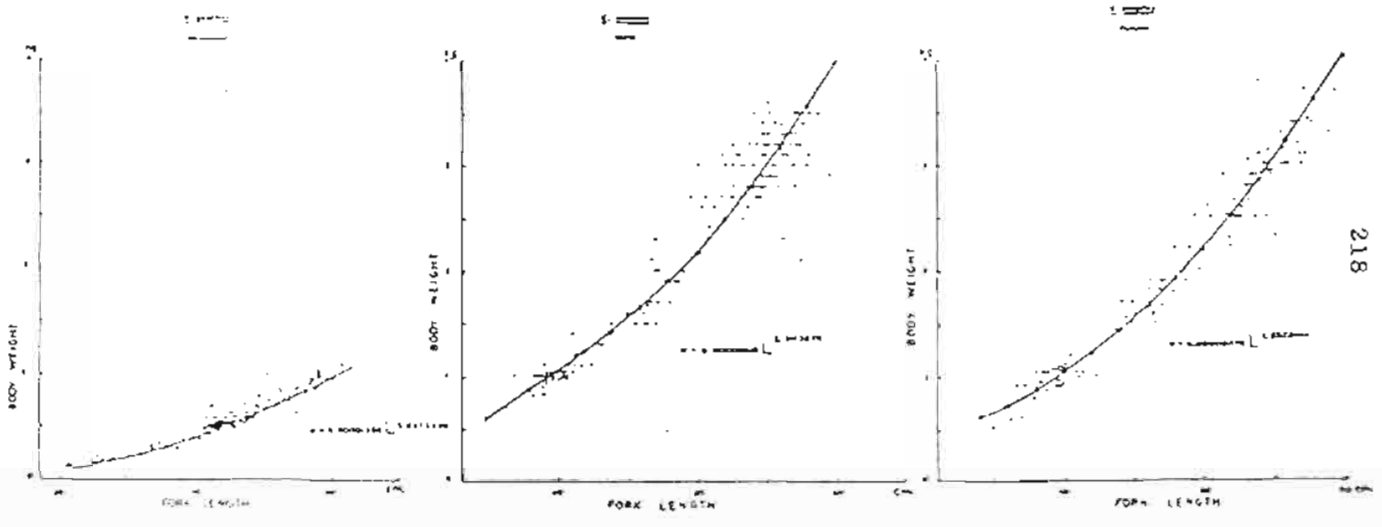

FIGURE 4 LENGTH - WEIGHT RELATIONSHIP OF IMMATURES, MALES AND FEMALES OF SKIPJACK TUNA (Katsuwonus pelamis) AT THE ANDAMAN SEA OF THAILAND, 1988.

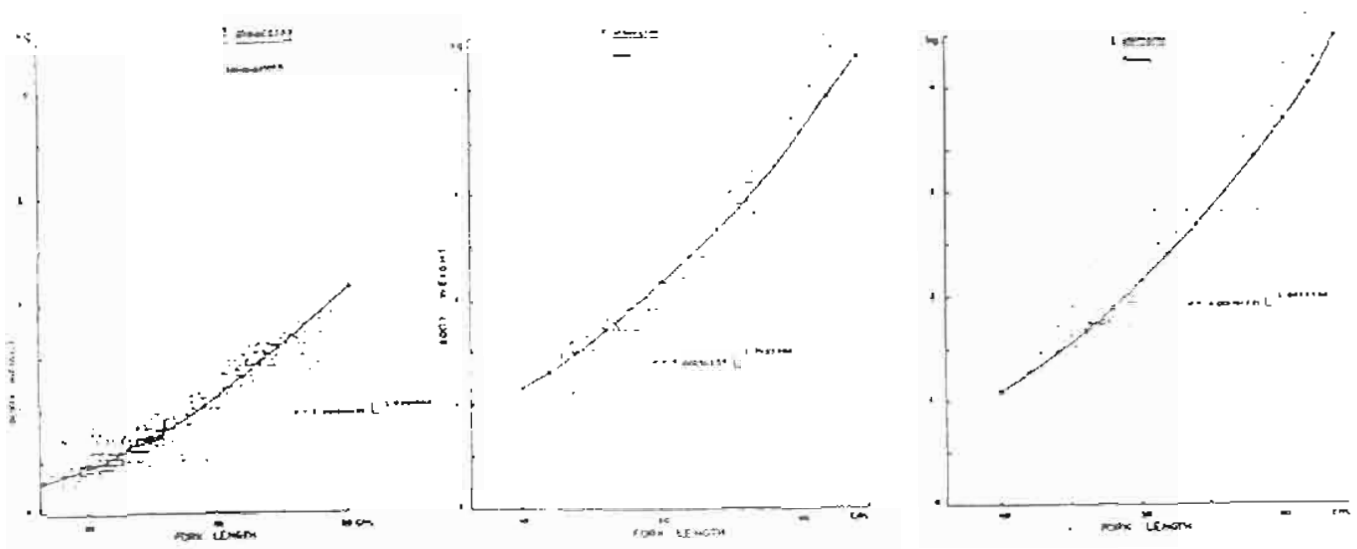

FIGURE 5 LENGTH - WEIGHT RELATIONSHIP OF IMMATURES, MALES AND FEMALES OF YELLOWFIN TUNA (Thunnus albacares) AT THE ANDAMAN SEA OF THAILAND, 1988.

Impacts of New Regime of Sea to Tuna Fisheries of USA and Mexico With A Particular Reference to Mexican Tuna Fleet at Ensenada

Tadashi Yamamoto (Ex-FAO Fishery Officer)

1. International Coorporation on the Exploitation of Tuna Resources off the west coast of USA and Middle America (Eastern Pacific) through Inter-American Tropical Tuna Commission (IATTC)

   Member Countries : Canada, USA, France, Mexico, Nicaragua, Panama and Japan
   Major Fishing ground : Pacific Ocean off Mexico

2. USA Tuna Fishery before 1977

   Based at Los Angels and San Diego for Tuna Canning Industy.

3. Consensus on 200 Miles Economic Zone (EEZ) at UN Conference on Law of Sea 1977

4. EEZs declared by USA and Mexico and Difference in the Meanings

   i. USA EEZ (Fishery Conservation Zone)
   All fishery resources excluding tuna resources are under the jurisdiction of USA, assuming that US tuna fleet will be allowed to operate in the EEZ of other countries by persuading these countries to follow the principle

   ii. Mexican EEZ
   All fishery resources including tunas resources are under the jurisdiction of Mexico, assuming that she can develop her tuna fishery by phasing out the operation of all foreign fishing vessels from her EEZ.

5. Impacts of EEZs to USA and Mexican Tuna Fishery

   i. Impact to USA : Her tuna fleet was forced to move the fishing ground from off Mexico to south Pacific

   ii. Impact to Mexico : A new tuna fleet was built, and a new tuna fishing port was constructed at Ensenada. But, US declared the embargo of importing tuna from Mexico.

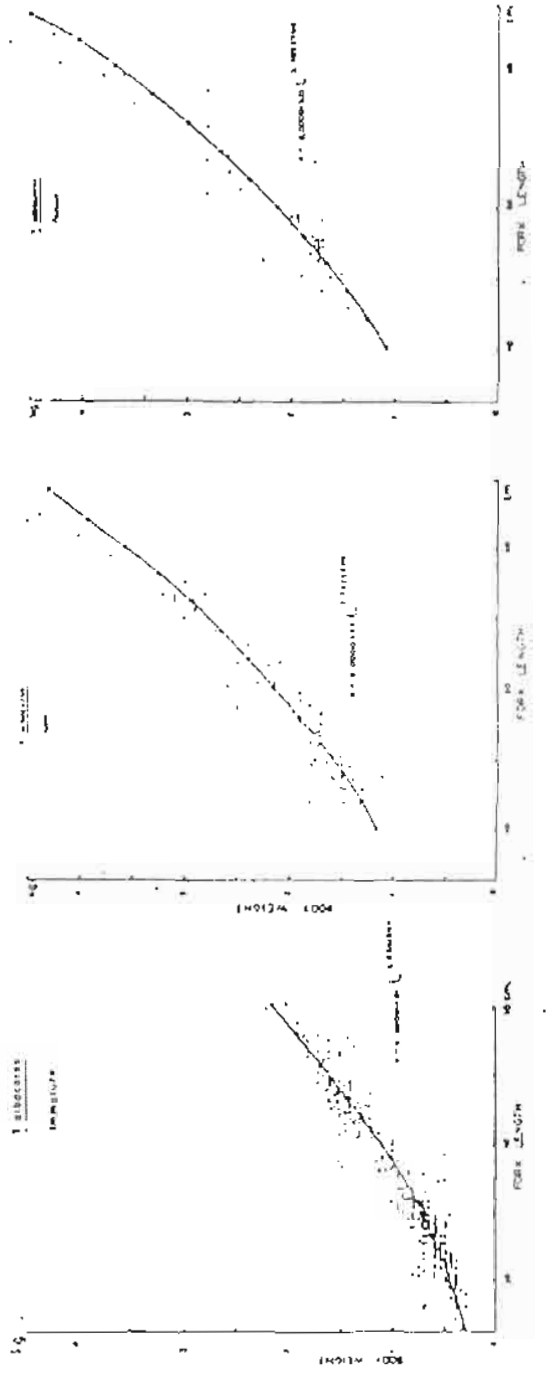

FIGURE 5. LENGTH - WEIGHT RELATIONSHIP OF IMMATURES, MALES AND FEMALES OF YELLOWFIN TUNA (Thunnus albacares) AT THE ANDAMAN SEA OF THAILAND, 1985.

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