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MARINE FISHERY RESOURCES
DEVELOPMENT AND MANAGEMENT
DEPARTMENT OF SEAFDEC

KUALA TERENGGANU, MALAYSIA

SEAFDEC MFRDMD RM/4

REPORT OF THIRD REGIONAL WORKSHOP

ON

SHARED STOCKS IN THE SOUTH CHINA SEA AREA

ORGANISED BY:

MARINE FISHERY RESOURCES
DEVELOPMENT AND MANAGEMENT DEPARTMENT
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTER

KUALA TERENGGANU, MALAYSIA

-8 OCTOBER, 1997

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REPORT OF THE
THIRD REGIONAL WORKSHOP ON SHARED STOCKS IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia
6 - 8 October 1997

I. INTRODUCTION

1. At the invitation of the Marine Fishery Resources Development and Management Department of SEAFDEC (SEAFDEC/MFRDMD), the Third Regional Workshop on Shared Stocks in the South China Sea area was held in Kuala Terengganu, Malaysia, from 6 - 8 October 1997.

2. The Workshop was attended by participants from Brunei Darussalam, Indonesia, Malaysia, Philippines, Thailand, and Vietnam, as well as observers from two local universities (UPM and UKM), special guest from the internationally known FAO and staff of the host department. The list of participants and observers appears as **Annex 1**.

OPENING CEREMONY

3. On behalf of the Government of Malaysia and the Southeast Asian Fishery Development Center, Mr. Ismail Taufid Md Yusoff, Chief of SEAFDEC/MFRDMD, welcomed warmly the participants to the workshop. In his opening address, Mr. Ismail Taufid felt happy that the participants had responded positively by accepting the invitation to participate in this third workshop despite the threatening haze that was affecting the whole country and the region, and the present currency crisis.

4. Such a gesture would help foster closer regional cooperation in relevant areas such as fish taxonomy, tagging techniques, stock differentiation and assessment, remote sensing technology, acoustic techniques and others. Subsequently in order to assure the sustainable development of small pelagic fisheries in the region, he expressed the hope that fisheries managers would comprehend and put into practice the Code of Conduct of Responsible Fisheries.

5. Since this workshop would focus on the small pelagic fisheries and their management measures, this meeting has taken the cue from the recently conducted APFIC Working Party On Marine Fisheries held in May 1997 in Bangkok. At this convention, some nine recommendations had been made, and Mr. Ismail Taufid was glad that the technical secretary to this Working Party, Dr. P. Martosubroto, was present at the workshop to guide the discussion regarding the management of the small pelagic fisheries. The Opening Address of Mr. Ismail Taufid Md Yusoff appears as **Annex 2**.

6. Mr. Ismail Taufid Md Yusoff declared the Workshop open.

ADOPTION OF THE AGENDA AND TIME TABLE

7. The Agenda and Time Table, which appears as **Annex 3** was adopted.

ELECTION OF CHAIRMEN AND RAPPORTEURS

8. Messrs. Ismail Taufid Md Yusoff, Keiichiro Mori, Raja Mohammad Noordin Raja Omar and P. Martosubroto were elected Chairmen of the Workshop sessions, while Messrs. Mohd Taupek Mohd Nasir, Idris Haji Abdul Hamid, Hiroyuki Yanagawa Kamaruzaman Haji Salim, Rooney Biusing, Mansor Mat Isa and Ms. Tengku Rozaina were elected Rapporteurs for the sessions. Messrs. Mohd Taupek Mohd Nasir served as the Technical Rapporteur for the Workshop.

II. STATUS OF DATA COLLECTION RELATED TO SHARED STOCKS

9. In order to assess the present status of data collection and management related to shared stocks, each participating country presented their Country Status Reports, which include the updated data and information on the status of their marine fishery resources, catch-effort, biology, and oceanography. The presentation of the status reports was followed by discussions among the participants of the Workshop.

10. The first country report presented at this workshop was entitled "Status of small pelagic fisheries in Brunei Darussalam" by Mr. Idris Hj Abdul Hamid (*see* **Annex 4**). He reported that the main gears catching the small pelagics were the purse seine, ring net, hook and line and drift gill net, with the purse seine providing the highest catch per unit of effort (CPUE) at 0.58 tonnes/operational day. He pointed out that the highest fish production occurred for the year 1991, which declined ever since due probably to a number of suspected factors like overexploitation of the stocks and conflicting use of fishing grounds between different fishing gears such as trawls and other gears, including those that use FADs. Some management measures were being considered to uplift the declining trend in the production.

11. From Indonesia, Mr Gomal H. Tampubolon presented the second paper entitled "The small pelagic fisheries resources and their management measures in the South China Sea area of Indonesia" (*see* **Annex 5**). He felt that small pelagics in the South China Sea area of Indonesia were lightly exploited, with its production in recent years on the increase at about 4.62% annually, due to a parallel increase in the number of fishing efforts like the purse seine, payang (Danish seine) and other gears operating in the area. He informed the meeting that in 1995 an estimated 723 foreign fishing boats operated within this area. Research activities relating to shared stock identification, utilization and management were needed to support the increase in production.

12. The third presentation, by Mr Rooney Biusing from the host country Malaysia, illustrated the pelagic fishery situation in Sabah (*see* **Annex 6**). From the available statistics, annual landings for tunas and mackerels appeared to be declining, unlike those for roundscads and the mixed pelagic group. This might be attributed to the saturation of fishing effort in the inshore waters, where the fishery was mainly concentrated, and perhaps also to the limited sampling coverage that produced the analysed data.

13. Mr. Albert Chuan Gambang outlined the pelagic resource status for Sarawak in this fourth presentation entitled "Status report: Pelagic fish stock in Sarawak, Malaysia" (*see* **Annex 7**). He noted that the small pelagic species were still very much underexploited with an annual production since 1990 at 15,000 - 24,000 tonnes, and increasing yearly. The potential yield estimated for this

group of fish was slightly over 100,000 tonnes. A similar situation existed for the small tunas, with production in recent years at only around 2,000 tonnes, being still very much lower than the estimated potential yield of 45,000 tonnes.

14. For the situation in the peninsula, in his paper entitled "Pelagic fisheries resources in the Peninsular Malaysia" (*see* **Annex 8**), this being the fifth presentation, Mr Mohamad Saupi Ismail noted that in 1995 the primary pelagic species mainly caught by the purse seines, drift nets and hooks and lines were the *Rastrelliger* spp., *Decapterus* spp., trevallies, sardines, anchovies and the hardtail scads. The highest landing for *Rastrelliger* spp. by all gears, estimated at about 113,078 tonnes, also occurred for this year with the west coast supplying the greater share at 101,003 tonnes.

15. The sixth report entitled "Country status report: small pelagic fisheries in the Philippines" was jointly presented by Ms. Luz B Regis and Mr. November A Romena (*see* **Annex 9**). They noted that small pelagic fisheries consisted of commercial and municipal fisheries, with the former having the greater share. In the commercial fishery, the main commercial fishing gear was the purse seine, which had contributed around 59% of the total catch. Roundscads were another group caught, with the annual landings close to 200,000 tonnes. The government had been seriously implementing management programs to address issues on marine resource enhancement, environmental rehabilitation, control of destructive fishing activities, and improving law enforcement through a community based management approach.

16. From Thailand, being the seventh presentation, Mr. Pirochana Saikliang and Mr. Veera Boonragsa presented their paper "Pelagic fisheries and resources in Thai waters" (*see* **Annex 10**). The target species of this fishery had changed according to the current market demand. They felt that almost all of the pelagic fish stocks in the Gulf of Thailand had been heavily exploited, while some, like the roundscads, had shown signs of stock depletion. They anticipated that such a situation would continue in the future unless adequate countermeasures in fisheries management relating to resource conservation can be quickly undertaken.

17. The eighth paper was on the "Small pelagic fisheries of Vietnam" by Dr. Chu Tien Vinh (*see* **Annex 11**). He remarked that small pelagics, being very important to the small-scale fisheries of Vietnam, were heavily exploited in the nearshore waters. Destructive fishing methods (using explosives and poison) were still being practised in some areas, while the overall resource in nearshore waters appeared to be on the decline. He suggested reduction in fishing pressure in the nearshore areas by limiting entrance into the fisheries, prohibiting the destructive methods and conducting research on new fishing grounds and target species in the offshore areas. Stock assessment of the pelagic resources, although difficult, should nevertheless be attempted, while fishery statistics need to be established at all fish landing sites along the coast. The relationships between oceanographic factors and resource distribution need to be studied in detail.

III. MANAGEMENT AND STATUS OF THE SHARED STOCKS IN THE REGION

18. Dr. Purwito Martosubroto from FAO presented the ninth paper entitled "Towards management of shared stocks in South China Sea region" (*see* **Annex 12**). He highlighted the need to fully understand the term "shared stocks" and their delimitation. Various steps of the management requirements for shared stocks were described including stock identification, assessment and data require-

ment, allocation and coordinated regulation, surveillance and enforcement. He felt that SEAFDEC/MFRDMD, being a regional fisheries organization, occupied a strategic position to play a key role in providing information relating to shared stocks in the region to its member countries. To this end, SEAFDEC/MFRDMD could serve as a centre for a regional data base and the focal point of scientists working on shared stocks.

19. The tenth paper was entitled "Status of fisheries and stocks of small pelagic fishes in the South China Sea area" (*see* **Annex 13**) by Dr. Hiroyuki Yanagawa of SEAFDEC/MFRDMD. Based on the stocks identified during the 1985 FAO/SEAFDEC Workshop, he presented the status of nine shared stocks in the region. He also presented the trends of landings of 19 small pelagic species (barracudas, mullets, roundscads, jacks, selar scads, hardtail scads, black pomfrets, white pomfrets sardines, anchovies, wolf herrings, longtail tuna, eastern little tuna, frigate tuna, Spanish mackerels, king mackerels, Indian mackerels, Indo-Pacific mackerels and hairtails) occurring in the region.

20. The eleventh paper, entitled "Biological parameters and population dynamics on shared stocks of the South China Sea" (*see* **Annex 14**) by Dr Mansor Mat Isa of MFRDMD, was intended to provide a base towards a comprehensive comparison between the species/groups of small pelagics among the SEAFDEC member countries. The paper attempted to compile various biological parameters eg. size, age, growth, spawning season, fecundity, recruitment pattern, and length-weight relationships of the small pelagics that comprise, among others, of mackerels, roundscads, Torpedo scads, scads, small tunas, Spanish mackerels, Jacks and Sardines.

IV. OCEANOGRAPHICAL PARAMETERS RELATED TO SHARED STOCKS

21. Mr. Raja Mohammad Noordin of MFRDMD presented the twelfth paper entitled "Availability of environmental data related to the shared stocks in the South China Sea" (*see* **Annex 15**). A number of oceanographic studies had been conducted previously in this area such as the Naga Expedition (1959-1960), the Wyrtki Survey (1961), the 'Cooperative study of Kuroshio and adjacent seas' (1965-1970), the Matahari Expedition (1985-1989) and the recent collaborative MV SEAFDEC Survey (1995-1997), but the currently available data could only draw few preliminary conclusions concerning the effect of variability in oceanographic parameters on the pelagic fish stocks. A lack in the number of fisheries oceanographers for the region was a major constraint, while communication between existing researchers, even within one's own country, needed to be improved.

22. The final presentation, being verbal and reflecting more towards that of a group discussion, was jointly provided by two staff of MFRDMD. Mr. Raja Bidin Raja Hassan discussed on the requirements for a better management of shared stocks in the South China Sea area, while Dr. Mohd Taupek Mohd Nasir presented to the meeting with the regional research programs planned by MFRDMD for the next three years (1998 - 2000).

V. QUESTIONS AND DISCUSSIONS AFTER PRESENTATION OF PAPER

23. Most of the questions and remarks made at the end of the presentation were usually for the purpose of seeking clarification regarding certain ambiguities in the presentation. Nevertheless, where remarks were made in the form of suggestions or recommendations, they were listed out for consideration and adoption by the participants.

VI. RECOMMENDATIONS

The Workshop identified the following recommendations pertaining to the management of the shared stocks in the region.

1. There is still very limited information on the hydrodynamics of the South China Sea in most SEAFDEC member countries. Recognising that a better understanding of this issue is deemed important especially in its relationship to the distribution of small pelagic fish resources, and consequently their overall production, it is recommended that more efforts and studies are needed to map accurately the various natural phenomena occurring in these waters. Moreover, there is a strong need to comprehend the biological and physical processes working in the South China Sea.

2. For the short term, priority should be given to the study on the shared stocks of mackerels, roundscads and small tunas. The study should focus on stock identification through various means (morphometric, meristics, DNA analysis, tagging).

3. Due to the increasing availability of information exchange and communication through the use of e-mail and the internet, researchers in this region are strongly encouraged to make use of such facilities for exchanging fisheries data or contacting one another.

4. As overexploitation of a shared stock by any individual country will have an impact on the fisheries of neighbouring countries, efforts should be focused on establishing a joint management among the countries concerned.

5. SEAFDEC/MFRDMD needs to play a more effective role in the collection and compilation of data/information published elsewhere for the use of researchers in this region.

6. SEAFDEC/MFRDMD needs to establish better working relationships with other external and international agencies/organisations for the implementation of the various regional programs.

VII. CLOSING CEREMONY

25. In his Closing Remarks, the Chief of SEAFDEC/MFRDMD, Mr. Ismail Taufid Md Yusoff, thanked the participants for their active participation during the Workshop. He expressed confidence that the meeting had gathered enough information on the needs of the participants for the management and research inputs of shared stocks. This meeting had also provided everyone with some insights to review and update some of the research programs. He bid the participants a safe journey home.

ANNEXES

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OPENING ADDRESS

BY:
CHIEF OF MFRDMD/SEAFDEC

Ladies and gentlemen,

A very good morning to all present here today.

On behalf of MFRDMD/SEAFDEC I would like to bid a warm welcome to everyone to The Third Regional Workshop on Shared Stocks in the South China Sea Area, beginning today and lasting for three days. We do hope that you have rested well and feeling very refreshed this morning.

Let us hope that the weather throughout the workshop will be good especially at this time of the year on the east coast of Peninsular Malaysia which normally experiences the early signs of the north-east monsoon which is usually scheduled in November.

We are extremely happy that all participants invited turn up. Initially we were quite worried too, especially with the threatening haze that was affecting the whole country and also the region. I am sure that all of you are very aware of the recent situation which caused rescheduling of flights and unwarranted crash and collision. The currency in the region too was affected. The whole situation could be attributed to the "el nino" effect which decided to show up this year.

Coming back to our agenda for today, this third regional workshop on shared stocks will focus on small pelagic fisheries and their management measures. We have taken the cue from the recent APFIC Working Party On Marine Fisheries organized by FAO/RAPA, Bangkok in May 1997.

During the APFIC meeting in Bangkok some nine recommendations were made. We are very fortunate to have with us today Dr. P. Martosubroto, the technical secretary of the APFIC Working Party on Marine Fisheries, to guide us in our discussions on the management of small pelagic fisheries.

We at MFRDMD/SEAFDEC hope to foster closer regional cooperation in relevant areas such as fish taxonomy, tagging techniques, stock differentiation and assessment, remote sensing technology, acoustic techniques, etc. Subsequently in order to assure the sustainable development of small pelagic fisheries in the region we hope that fisheries managers will comprehend and put into practice the Code of Conduct of Responsible Fisheries.

With that I would like to end this short address and wish all of you will have a very lively and fruitful discussion during this workshop.

AGENDA AND TIME TABLE

6 October 1997 (Monday)

09.00 - 09.30	:	Registration
09.30 - 09.45	:	Welcome remarks and Opening address (by Mr. Ismail Taufid Md Yusoff - Chief of MFRDMD)
09.45 - 10.15	:	Coffee break

Morning Session

Chairman	:	Mr. Ismail Taufid Md Yusoff
Rapporteur	:	Ms. Tengku Rozaina Tengku Mohammad @ Jaafar Dr. Kamaruzaman Haji Salim Dr. Mohd Taupek Mohd Nasir
10.15 - 12.45	:	Election of chairperson and rapporteurs - Adoption of agenda - Presentation of country status reports Brunei Darussalam - CR1 Indonesia - CR2 Malaysia - CR3, CR4 and CR5
12.45 - 14.00	:	Welcome Lunch

Afternoon Session

Chairman	:	Dr. P. Martosubroto
Rapporteur	:	Ms. Tengku Rozaina Tengku Mohammad @ Jaafar Mr. Idris Hj. Abdul Hamid Mr. Rooney Edward Buising
14.00 - 15.15	:	Presentation of country reports - Philippines - CR6 - Thailand - CR7
15.15 - 15.30	:	Coffee break
15.30 - 16.30	:	Presentation of country report and discussion - Vietnam - CR8

7 October 1997 (Tuesday)

Morning Session

Chairman	:	Dr. K. Mori
Rapporteur	:	Ms. Tengku Rozaina Tengku Mohammad @ Jaafar Mr. Gomal Tampubolon Mr. Veera Boonragsa

09.15 - 10.15	:	Presentation of the policy measures on management for small pelagic fisheries by FAO - Dr. P. Martosubroto - w/p 01
10.15 - 10.30	:	Coffee break
10.30 - 12.45	:	Presentation of the various information related to small pelagic fisheries and management (SEAFDEC/MFRDMD); 1. Status of fisheries and stocks by Dr. H. Yanagawa - w/p 02 2. Biology and population dynamics by Dr. Mansor Mat Isa - w/p 03 3. Environmental factors including oceanography and remote sensing by Mr. Raja Mohammad Noordin Raja Omar - w/p 04 - Discussion of management measures for small pelagic fisheries
12.45 - 14.00	:	Lunch break

Afternoon Session

Chairman	:	Mr. Raja Mohammad Noordin Raja Omar
Rapporteur	:	Ms. Tengku Rozaina Tengku Mohammad @ Jaafar Dr. H. Yanagawa Mr. Pirochana Saikliang
14.00 - 15.15	:	Collaborative research requirements for better management of small pelagic fisheries by Mr. Raja Bidin Raja Hassan - w/p 01
15.15 - 15.30	:	Tea break
15.30 - 16.30	:	Presentation of research program on shared stock by Dr. Mohd Taupek Mohd Nasir - w/p 02 Continue discussion on collaborative research and other matters.

8 October 1997 (Wednesday)

Morning Session

09.15 - 12.45	:	Excursion (optional) and preparation of the draft report by secretariat
12.45 - 14.00	:	Lunch break

Afternoon Session

Chairman	:	Dr. K. Mori
Rapporteur	:	Ms. Tengku Rozaina Tengku Mohammad @ Jaafar Dr. Mansor Mat Isa
14.00 - 15.15	:	Adoption of the report
15.15 - 15.30	:	Tea break
15.30 - 16.30	:	Closing Address by Mr. Ismail Taufid Md Yusoff
20.00 - 22.00	:	Dinner hosted by The Chief of MFRDMD

ANNEX 4

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 1

COUNTRY STATUS REPORT

BRUNEI DARUSSALAM

STATUS OF SMALL PELAGIC FISHERIES IN BRUNEI DARUSSALAM

By:

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1. INTRODUCTION

Pelagic capture fishery contributes a substantial amount to the total annual landing of fresh fish in Brunei Darussalam. In 1996, a two-phase pelagic survey estimated a total biomass of 15,320 m.t. and a potential yield of 7,660 m.t. from the EEZ. This paper presents the status of exploitation of the small pelagic resources, some biological aspects of the stocks and management measures.

2. STATUS OF FISHERIES

The 1997 rate is anticipated to be lower than the 1996 figure. A number of factors contribute to this prediction. The most prominent one would be the decline in the production of three important gears namely, the purse seine, gill net and traps that contributed an average of about 22% of the total pelagic landings. (see Table 1)

Table 1: Percentage fluctuation in the total pelagic fish production of various fishing gears from 1989 to 1997

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Hook & Line	6 %	22 %	4 %	28 %	29 %	48 %	47 %	44 %	53 %
Gill Net	1 %	4 %	3 %	16 %	15 %	1 %	1 %	2 %	1 %
Trawl	16 %	6 %	7 %	14 %	10 %	20 %	15 %	24 %	31 %
Traps	8 %	17 %	12 %	13 %	14 %	13 %	18 %	3 %	1 %
Ring Net	22 %	24 %	64 %	25 %	26 %	17 %	17 %	25 %	15 %
P. Seine	8 %	6 %	4 %	5 %	6 %	1 %	2 %	2 %	0 %
Drift G. Net	19 %	9 %	2 %	0 %	0 %	0 %	0 %	0 %	0 %
Lampara	19 %	12 %	5 %	0 %	0 %	0 %	0 %	0 %	0 %
	100 %	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**

3. CATCH EFFORT AND FISHING GEAR

Apart from specialised gears such as ring net, hook and line, purse seine and drift gill net, pelagic species are also caught by the demersal trawl, gill net and trap. Figure 1 shows the mean CPUE (in metric tons/operational days) from various fishing gears that catch small pelagic fishes. Purse seine provides the highest mean CPUE at 0.58 mt/operational day. It was followed by ring net and trap with 0.5 mt/operational days, respectively. (see also Table 2).

Figure 1 also provides the annual fluctuation in the CPUE of fishing gears during the period. The catch rate from purse seine, ring net and trawl shows a significant decline from 1991 to 1997 while traps, gill net and hook and line present an increasing trend especially among the traditional fisheries sector.

Figure 1: Annual fluctuation in the CPUE of various fishing gears.

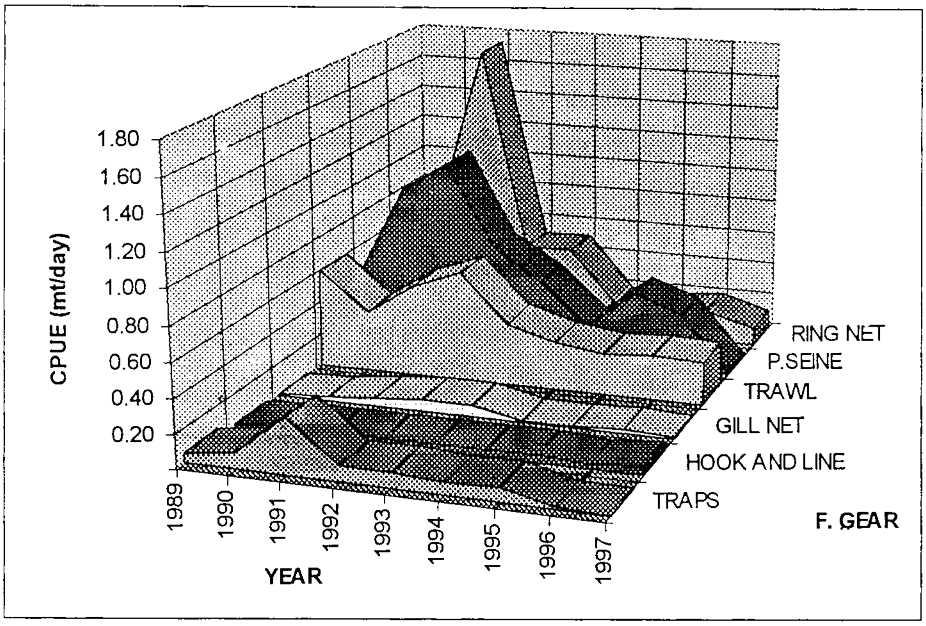


Table 2: Annual fluctuation in the mean CPUE (metric tons per operational day) of important fishing gears in the waters of Brunei Darussalam

	1989	1990	1991	1992	1993	1994	1995	1996	1997	Mean
Traps	0.06	0.10	0.32	0.09	0.09	0.07	0.08	0.01	0.004	0.09
Hook and Line	0.02	0.04	0.04	0.04	0.04	0.04	0.05	0.03	0.05	0.04
Gill Net	0.00	0.01	0.04	0.06	0.06	0.004	0.005	0.020	0.002	0.06
Trawl	0.59	0.36	0.54	0.65	0.37	0.29	0.25	0.26	0.25	0.40
P. Seine	0.41	0.97	1.15	0.64	0.46	0.20	0.44	0.34		0.58
Ring Net	0.44	0.68	1.74	0.50	0.50	0.18	0.17	0.19	0.11	0.50
Drift Gill Net	0.24	0.41	0.80	na	na	na	na	na	na	
Lampara Net	2.00	0.90	1.46	na	na	na	na	na	na	

4. PRODUCTION ESTIMATE

Table 3 presents the annual fluctuation in the total fish production among the major fishing gears from 1989 to 1997. The highest production was recorded in 1991 and from there the production started to decline. Considering the 1996 potential yield estimate of 7,660 metric tons, only about 43% (3,305 mt) have been exploited in 1996. However, during the period from 1990 to 1993 the fishing harvests exceeded the estimated potential yield. It is probable that the MSY might have been reached during that period. But this is yet to be confirmed by the present monitoring survey being conducted by the Department.

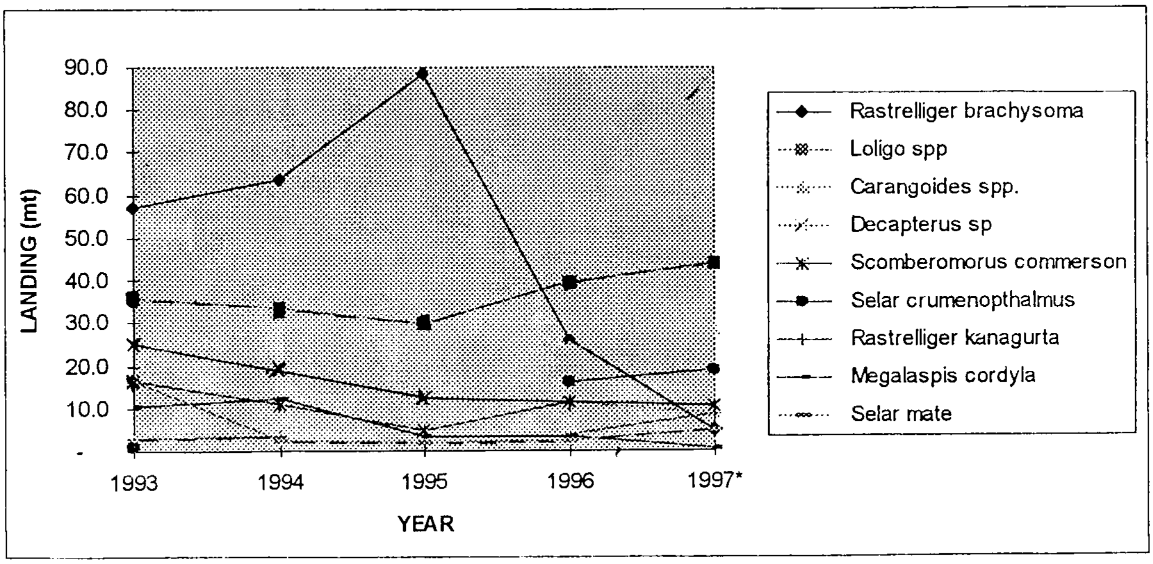
Table 3: Estimated annual fish production from the major fishing gears

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Hook & Line	262	2,120	547	2,213	2,277	2,222	3,036	1,467	1,344
Gill Net	45	421	397	1,294	1,160	35	59	63	37
Trawl	689	542	992	1,082	795	916	979	796	783
Traps	339	1,642	1,720	1,011	1,146	585	1,119	87	15
Ring Net	943	2,394	9,604	2,033	2,098	776	1,090	822	374
P. Seine	317	563	663	371	459	66	111	71	-
Drift Gill Net	790	892	289	-	-	-	-	-	-
Lampara Net	810	1,222	703	-	-	-	-	-	-
	4,195	**9,796**	**14,915**	**8,003**	**7,935**	**4,600**	**6,394**	**3,305**	**2,553**

5. SPECIES COMPOSITION

Figure 2 presents the fluctuation in the landings of selected species from the catch composition of trawlers from 1993 to 1997. The catch during the period was dominated by *Rastrelliger brachysoma* (on average during the period) which contributed about 27% of the total landings. However, it indicated the largest decline from 1995 to 1997. It was followed closely by *Loligo* sp. at 21%. The squid registered the increase during the same period that might indicate symptoms of overexploitation. In some areas like the Philippines, the dominance of squid in the fish landings is marked as one of the indicators of overexploitation.

Figure 2: Estimated annual fluctuation in the species composition from the catch of trawlers from 1993-1997



6. BIOLOGY OF PELAGIC FISHES

Growth parameters

Table 4 shows the growth parameter estimates for three small pelagic species being monitored in the waters of Brunei Darussalam. Similar treatment is being done on the length frequency data collected from the major fishing gears observed in the area.

Table 4: Growth parameters of selected pelagic species in Brunei Darussalam

Species	L_{inf}	k	NRP	Z	M	F
Caranx malabaricus	28.57	1.8	1	5.9	2.8	2.5
Parastromateus niger	28.35	1.3	2	4.7	2.2	2.6
Rastrelliger kanagurata	29.05	0.9	1	5.3	3.4	2.0

Length-weight relationships

The length-weight relationship was established for 20 small pelagic fishes in the waters of Brunei Darussalam. The data were lifted from the hydrobiological survey conducted in 1996. A total of about 2,000 individuals belonging to 8 families were used in the analysis. The mean b-value was estimated at 2.83. The length-weight relation was used in various aspects of stock assessment such as weight frequency distribution, production estimates and biomass estimate using the target strength taken from the hydroacoustic survey. Table 5 presents the length-weight relationship parameters such as a and b.

Table 5: Length-weight relationship of small-pelagic fishes found in Brunei Darussalam

Species	**a**	**b**	**r**	**Min**	**Max**
Ariomma indica	0.24237	2.10454	0.61125	12.5	15.0
Caranx malabaricus	0.01517	3.09487	0.93757	6.8	25.2
Deacpterus macrosoma	0.06708	2.36172	0.85047	10.5	19.1
Dussumieria acuta	0.13847	2.07430	0.64000	12.0	16.5
Dussumieria hasselti	0.08869	2.23870	0.68000	12.0	16.8
Magalaspis cordyla	0.01217	2.99384	0.73784	17.4	21.0
Parastromateus niger	0.07276	2.58875	0.77758	7.5	19.0
Pentaprion longimanus	0.04237	2.64988	0.80664	5.5	13.9
Pterocaesio chrysozona	0.01154	3.03647	0.52716	7.2	12.1
Rastrelliger brachysoma	0.01140	3.15136	0.69235	14.5	16.5
Rastrelliger kanagurta	0.03125	2.73316	0.61873	18.8	20.6
Sardinella albella	0.01236	2.99018	0.92218	11.2	16.8
Selar crumenopthalmus	0.00578	3.36844	0.95477	12.4	21.6
Selaroides leptolepis	0.01000	3.17880	0.96219	9.2	13.5
Seriolina igrofasciata	0.05144	2.69884	0.98179	19.7	31.0
Sphyraena barracuda	0.00410	3.12303	0.83384	28.5	34.0
Sphyraena jello	0.01735	2.68945	0.71517	18.0	22.5
Stolephorus indicus	0.01055	3.00191	0.95674	7.1	14.0
Thrichiurus haumela	0.00024	3.28033	0.97027	31.7	51.7
Uraspis helvola	0.01147	3.30355	0.88103	4.0	12.5

7. OCEANOGRAPHIC, REMOTE SENSING AND ENVIRONMENTAL DATA

A complete and continuously collected oceanographic data are not available. The 1996 pelagic survey collected physical oceanographic data only. In 1992 the Coastal Resources Management Plan team had, under their project, included a study on benthos composition and diversity in the coastal waters of Brunei Darussalam. A study on the water quality of the coastal areas was also carried out. The previous demersal surveys in the 1970s did not include benthic study/sample collection although bottom sediments were obtained but merely for the observation and recording of the sea bed condition.

The Department of Fisheries however is continuously collecting seawater samples from various sampling stations within the bay and offshore areas, for the red tide monitoring. No remote sensing data presently available although these could be obtained from external sources such as NOAA.

8. CONCLUSIONS

‡ The general trend in the pelagic fish production in the waters of Brunei Darussalam is declining since 1991 and it is due to a number of factors such as the suspected overexploitation of the stocks and conflicting interests between the trawlers and other gears such as ring nets in the use of fishing grounds and deployment of FAD's.

‡ The following are some of the measures that are being considered to abate the decline in the fish production:

=> a continous research and monitoring on the biology and assessment of the fish stocks

=> experimentation on the improvement and selectivity of fishing gears

=> deployment of various fish aggregating devices and fish shelter structures

=> preventing the trawl operations near the shoreline

Annex 1:

Catch trend of pelagic fishes by commercial P. Seiners

Species	1993	1994	1995	1996	Total	%
Rastrelliger kanagurta	187,131	29,914	61,873	31,570	310,488	50.51
Selar mate	45,392	13,876	19,931	19,895	99,094	16.12
Alepes melanoptera	71,800	12,017	7,613	3,852	95,282	15.50
Decapterus sp	10,150	3,252	11,307	9,373	34,082	5.54
Rastrelliger brachysoma	26,339	225	137	396	27,097	4.41
Sardinella sp	4,750	1,506	4,345	2,098	12,699	2.07
Parastromateus niger	4,059	4,039	491	1,161	9,750	1.59
Selaroides leptolepis	6,833	-	171	588	7,592	1.24
Selar Crumenopthalmus	2,078	666	2,316	1,920	6,980	1.14
Katsuwonus pelamis	5,422	204	-	-	5,626	0.92
Euthynnus affinis	1,411	383	2,506	209	4,509	0.73
Scomberomorus commerson	1,080	na	na	na	1,080	0.18
Megalaspis cordyla	330	na	na	na	330	0.05
Selar kalla	42	na	na	na	42	0.01
Arioma indica	na	na	na	na	na	na
Auxis thazard	na	na	na	na	na	na
Carangoides malabaricus	na	na	na	na	na	na
Dussumieria acuta	na	na	na	na	na	na
Dussumieria hasselti	na	na	na	na	na	na
Gnathanodon speciosus	na	na	na	na	na	na
Illisha melastoma	na	na	na	na	na	na
Loligo spp	na	na	na	na	na	na
Rachycentron canadus	na	na	na	na	na	na
Scomberomorus guttatus	na	na	na	na	na	na
Sphyraena jello	na	na	na	na	na	na
Sphyraena obtusata	na	na	na	na	na	na
Stolephorus indicus	na	na	na	na	na	na
Thunnus albacares	na	na	na	na	na	na
Thunnus obesus	na	na	na	na	na	na
Thunnus tonggol	na	na	na	na	na	na
Uraspis uraspis	na	na	na	na	na	na
Alectis ciliaris	na	na	na	na	na	na
Alepes djadaba	na	na	na	na	na	na

*Catches in kilograms

Annex 2:

Catch trend of pelagic fishes by commercial Trawlers

Species	1993	1994	1995	1996	1997*	Total	%
Rastrelliger brachysoma	57,161	63,755	88,575	25,895	4,709	240,095	27.47
Loligo spp	35,887	33,650	29,468	39,760	43,812	182,577	20.89
Carangoides spp	35,512	37,630	26,324	23,921	28,304	151,691	17.36
Decapterus sp	24,912	18,636	12,242	11,343	8,660	75,793	8.67
Scomberomorus commerson	16,674	10,974	4,695	11,173	10,369	53,885	6.17
Selar crumenopthalmus	1,037	na	na	16,097	18,632	35,766	4.09
Rastrelliger kanagurta	2,798	3,440	11,125	3,836	8,571	29,770	3.41
Megalaspis cordyla	10,235	12,181	3,304	3,075	449	29,244	3.35
Selar mate	16,674	2,546	1,674	2,196	4,786	27,876	3.19
Pampus argentus	3,048	2,255	2,896	3,200	1,520	12,919	1.48
Selaroides leptolepis	5	na	na	2,979	4,379	7,363	0.84
Parastromateus niger	1,330	1,235	1,199	1,880	876	6,520	0.75
Rachycentron canadus	41	11	72	173	4,655	4,952	0.57
Scomberomorus guttatus	745	615	850	1,019	1,231	4,460	0.51
Sphyraena obtusata	365	151	920	644	1,100	3,180	0.36
Euthynnus affinis	122	131	940	431	886	2,510	0.29
Gnathanodon speciosus	237	1,335	215	467	61	2,315	0.26
Sardinella sp	533	193	364	204	782	2,076	0.24
Alectis indicus	689	103	na	na	na	792	0.09
Sphyraena jello	38	na	48	na	na	86	0.01
Katsuwonus pelamis	25	na	12	na	na	37	0.00
Alectis ciliaris	na	na	na	na	na	na	na
Alepes djadaba	na	na	na	na	na	na	na
Alepes melanoptera	na	na	na	na	na	na	na
Arioma indiaca	na	na	na	na	na	na	na
Auxis thazard	na	na	na	na	na	na	na
Dussumieria acuta	na	na	na	na	na	na	na
Dussumieria hasselti	na	na	na	na	na	na	na
Illisha melastoma	na	na	na	na	na	na	na
Selar kalla	na	na	na	na	na	na	na
Stolephorus indicus	na	na	na	na	na	na	na
Thunnus albacares	na	na	na	na	na	na	na
Thunnus obesus	na	na	na	na	na	na	na
Thunnus tonggol	na	na	na	na	na	na	na
uraspis uraspis	na	na	na	na	na	na	na
	na	na	na	na	na	na	na

*Data from January to August only **Catches in kilograms

ANNEX 5

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 2

COUNTRY STATUS REPORT
INDONESIA

THE SMALL PELAGIC FISHERIES RESOURCES AND THEIR MANAGEMENT MEASURES IN THE SOUTH CHINA SEA AREA OF INDONESIA

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1. INTRODUCTION

Indonesia is an Archipelagic country consisting of more than 18,000 island, and about 5.8 millions km^2 of marine waters. In order to fisheries management the Indonesian waters has grouped into 9 coastal waters which one of those is South China Sea Area (Fig. 1).

South China Sea Area of Indonesia consists of many island bordering to Riau, Jambi. South Sumatera and West Kalimantan Provinces. The marine fisheries resources are mostly utilized by fishermen from provinces bordering to this area, but also from other provinces, mainly from Central Java, Jakarta and chartered boats. The present explotation condition of marine fisheries resources in this area are still under-developed. Since about 1986 the marine fisheries in the IEEZ of South China Sea Area have developed remarkably, starting from 45 boats in 1986 to 8,813 boats in 1995 foreign and national boats or increasing about 67% annually (Fishing Boats Statistics Operated in the IEEZ, 1997).

In this report presented the data were collected from Jambi, South Sumatera and West Kalimantan Provinces.

2. THE EXISTING FISHERIES

2.1. Fishing Gears

There were various gears used by fishermen in the area, such as Payang, Danish seine, Beach seine, Purse seine, Drift gill net, Encircling gill nets, Set gill net, Lift net, Troll line and traps. The most important gears used for small pelagis fisheries are presented in Appendix Table 1. Troll line was increasing very fast, faster than Purse seine and any other gear. Purse seine developed in this area since 1989, increasing about 12% annually (1989-1995). Payang was also increasing but not as fast as Purse seine.

Since 1980's, some Purse seiners from Central Java Province have been operating to this area, mainly in the East Season. The seiners operating in this area are still increasing and mostly large seiners fishing days 30-45 days/trip.

The small scale fisheries used were non power boats and power boats. The number of non powered boats were increasing every year about 1% but powered boats were increasing 7% and 4% respectively for out board and inboard motors.

The size of inboard motors are ranging from under 5 GT to 50 GT. The number of fishing boats operating in IEEZ, the foreign flagged (chartered) and Indonesia flagged boats by type of fishing gears are presented in Table 1.

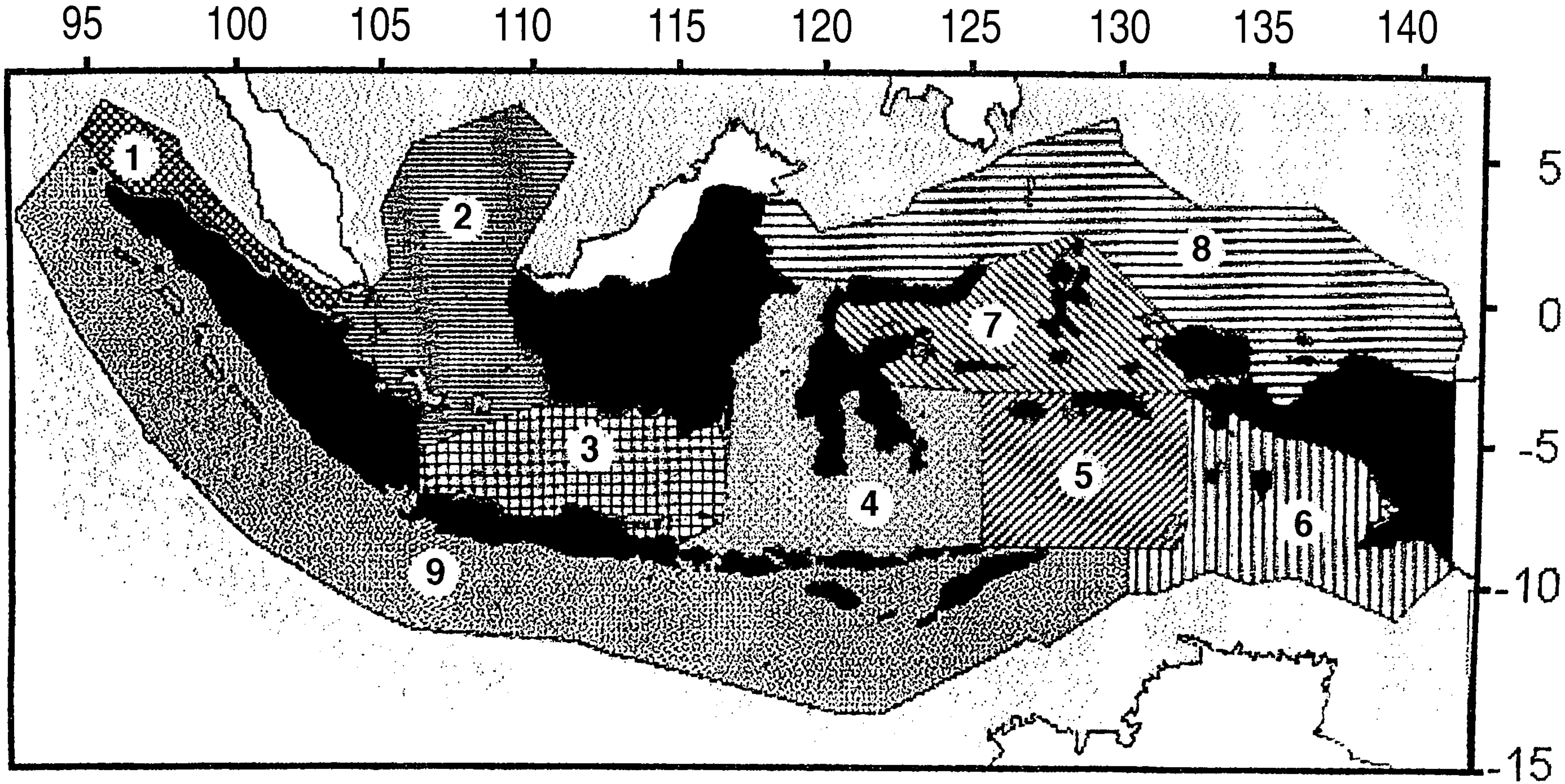
Table 1: Number of Foreign and Indonesia Fishing Boats Operating in IEEZ of South China Sea, by Type of Gear (1986 - 1995)

Gears / Years	Type of Gears						Total
	LL	PS	GN	FN	FC	PU	
1986	-	24	-	-	21	-	45
1987	-	191	-	13	9	-	213
1988	140	238	40	163	9	-	590
1989	30	206	46	219	19	-	510
1990	-	437	82	312	7	-	838
1991	12	501	119	368	3	-	1,003
1992	9	266	143	485	3	-	906
1993	21	426	144	539	6	43	1,183
1994	16	165	99	523	-	-	803
1995	3	125	98	497	-	-	723

Remark:
LL = Long liner
PS = Purse seiner
GN = Gill netter
FC = Fish carrier
PU = Shrimp net
FN = Fish net

Source: Fishing Boats Statistics Operated in IEEZ of South China Sea, 1997

Figure 1: The Management Areas of Marine Fisheries Resources In The Indonesian Waters



1. Malaca Strait
2. South Cina Sea
3. Jaya Sea
4. Makasar Strait and Flores Sea
5. Banda Sea
6. Arafura Sea
7. Tomini Bay; Maluku Sea and Seram Sea
8. Celebes Sea and The Pacific Ocean
9. The Indian Ocean

2.2. Production

Marine Fisheries production are recorded as species groups in fisheries Statistics of Indonesia. There are 18 species groups of small pelagic, 4 large pelagic and 20 demersal fishes were catching from this area. Skipjack, Hardtail scad, Rainbow runner were recorded individually, are not mixed with other species. The production by species groups of small pelagic fishes from 1989 to 1995 is presented in Appendix Table 2. The average dominant species for 1989 - 1995 were Sardinella spp; oil sardine; Rastrelliger spp. In Appendix Table 3 is presented the total production of marine production by species groups in the South China Sea of Indonesia for 7 years periods (1989-1995, 1989-1995).

The production of small pelagic fishes in this area were increasing about 4.62% annually. This due to the increasing number of Purse seiner, Payang and other gears operating in this area.

The production by dominant gears for small pelagic fishes are presented in Table 2. In the table indicated no. of unit; total catch and catch per unit effort (CPUE) for dominant gears.

Table 2: The Production of Dominant Gears for Small Pelagic Fishes in the West Kalimantan, Indonesia, 1989-1995

Gears		Years	1989	1990	1991	1992	1993	1994	1995
1	Payang	F	370	21	146	21	147	153	60
		C	7,332	93	80	89	7,855	535	2,085
		CPUE	19.8	4.42	0.55	4.24	53.90	3.50	34.75
2	P. Seine	F	4	6	12	6	6	21	23
		C	1,780	1,978	1,277	1,930	2,458	5,263	5,807
		CPUE	445	330	106	332	410	251	253
3	Drift GN	F	880	1,375	955	875	883	852	943
		C	16,386	10.922	14,765	16,106	19,332	16,397	15,377
		CPUE	20	8	15	18	22	19	16
4	Encircling GN	F	145	234	144	173	178	185	225
		C	2,537	2,438	2,368	2,677	2,783	4,783	6,507
		CPUE	17	- 11	16	15	16	26	29
5	Lift net	F	560	777	602	607	566	544	538
		C	2,801	3,277	3,522	3,259	1,896	2,486	2,399
		CPUE	5.0	4.2	5.9	5.4	3.3	4.6	4.5
6	Troll line	F	130	106	177	161	187	210	194
		C	558	869	554	604	667	705	695
		CPUE	4.3	8.2	3.1	3.8	4.0	4.6	3.6

The Table 2 indicated that the fluctuations of CPUE of Payang, may be some misrecorded in the number units of gear, but the others gears indicated, a little decreasing.

2.3. Level of Explotation

The small pelagic fishes potentials in South China Sea of Indonesia was assessed in 1991, 1995 and 1997 as Table 3.

Table 3: The Small Pelagic Fishes Potentials in South China Sea of Indonesia

Years	Area (Km^2)	Density (ton/Km^2)	Potential Yield (10^3ton)	Landing Catch (10^3ton)	Exploitation rate (%)
1991 (a)	595	0.56	330	75	22.73
1995 (b)	595	0.60	357	75	21.01
1997 (c)	558	0.92	513	150	29.24

Sources:
(a) The potential assessment of marine fisheries resources in Indonesia Waters Directorate General of Fisheries, Jakarta, 1991
(b) Workshop on Stock Assessment of Marine Fisheries Resources in Indonesia, FAO/ DANIDA, Jakarta 1993.
(c) The Potentials Assessment of Marine Fisheries Resources in Indonesia Waters, DGF, 1997.

The above table, indicated the level of explotation for small pelagic fishes in South China Sea of Indonesia is still under fishing. There is still possibility for expantion.

3. BIOLOGICAL PARAMETERS

Since the Workshop on Shared Stocks in the Southeast Asia were conducted to review the possibility of shared stocks in this area for marine fisheries resources. There is no any research activities carried out yet in South China of Indonesia to support the identification of shared stocks. But in 1996, was began to collect the landing catch of Purse seine in West Kalimantan and length frequentis data for 5 species of small pelagic fishes. Those data, are not yet analyzed to produce the biological parameters.

The Java Sea Pelagic Fishery Assessment Project (the collaboration of ORSTOM, France and Research Institute for Marine Fisheries, Jakarta) which was establish in 1991, has been monitored the catch landing of seiners which were operating in the South China Sea Area. The landing place of the seiners in Central Java Provinces. The data consists of catch by species and length frequentis measurement for small pelagic species. The result of this activities is not yet published.

4. FISHERIES MANAGEMENT MEASURES

The most serious management problems facing Indonesian fisheries policy makers are related to coastal waters where the vast majority of fisheries operate. Many of these fishing grounds are heavily exploited by large numbers of small scale fishermen, who are limited to inshore operations by existing boats and gears. Existing management regulations reflect concern for protecting both vulnerable resources and rights of access to inshore fishing grounds by small scale fishermen.

There were some fisheries management in Indonesia waters, (which are also effected in the South China Sea), as follows:

(a) The Minister of Agriculture, issued Decree 56/1973, calling for the rational exploitation of fisheries resources;

(b) The Minister of Agriculture issued Decree 1 of 1975 established that Ministry's authority to limit fishing effort in marine fisheries by regulating (1) seasons of operations, (2) type, size and number of boats in a particular areas and (3) size of mesh that could be used;

(c) The Ministerial Decree 607, was issued in 1976 establishing a series of coastal zones parallel to the shore in which operations of various types of boats (categorized by both hull size and engine power) were restricted. This Decree is now under discussion for revision. The coastal belts established by this Decree are still in force and are summarized in Table 4.

(d) The Minister Decree No. 15/1990, licencing for fishing vessel < 30 GT/90 HP is issued by Province Fisheries Service and for > 30 GT issued by Directorate General of Fisheries. Where as, there are no fishing license for small boat/canoes of < 5 GT/unmotorized due to the fishing activities only appraised as subsistance activity only. For the last category, the fishermen should reported their activity for statistic data and fisheries resources management measurement.

Table 4: Zones of Operation for Fishing Boats Established by the Minister of Agriculture's Decree 607 in 1976.

Zone	Disitance from Shore	Close to
I	0.3 nautical miles	1. Boats with inboard engines displacing over 5 GT; 2. Boats with inboard engines over 10 hp; 3. All types of trawl gear; 4. All purse seines; 5. Encircling gill nets and drifting gill nets for tuna; 6. Seine nets longer than 120.
II	3-7 nautical miles	1. Boats with inboard engines displacing over 25 GT; 2. Boats with inboard engines over 50 hp; 3. Otter trawls with head ropes longer than 12 m; 4. Midwater trawls and pair trawls; 5. Purse seines longer than 300 m.
III	7-12 nautical miles	1. Boats with inboard engines displacing over 100 GT; 2. Boats with inboard engines over 200 hp; 3. Demersal and midwater trawls using otter boards equipped with headropes over 20 m in length; 4. Pair trawls; 5. Purse seine longer than 600 m.
IV	Over 12 nautical miles	1. Pair trawls, except in the Indian Ocean where they are permitted.

Note: Except for trawlnet fisheries since 1980 by the President's degree no: 39/1980 about the trawl ban in the western part in Indonesia waters.

5. CONCLUSIONS

1. The production of Small Pelagic Fishes is increasing due to the increasing of the gear operating in this area, mainly purse seine, gears;
2. Up to present, data collection an small pelagic fishes, are carried out by the Java Sea Pelagic Fishery Assessment Project from Central Java seiners operating in South China Sea Area;
3. Small pelagic fishes in the South China Sea at Indonesia is still under exploited;
4. Research activities area urgently needed to support shared stock identification, utilization and management in the area;
5. As a whole at government policy in fisheries management, presently has been taken practically regulations in related to small pelagic fishes i.e.: fishing zonation in certain area of bordered with dense population, conservation and protection of certain species, implementing MCS Program.

Appendix Table 1

The Development of Some Main Gears Used in South China Sea Area

Year	Payang	Beach seine	Purse seine	Drift G.N.	Enc. G.N.	Shrimp G.N.	Set G.N.	Trammel net	Troll line
1982	341	269	-	1,678	389	2,648	1,582	-	-
1983	392	435	-	4,206	379	2,560	1,498	-	-
1984	450	443	2	3,708	329	2,456	1,762	703	42
1985	431	753	2	3,076	321	2,300	1,864	747	45
1986	599	656	2	3,754	471	2,199	1,864	1,137	96
1987	649	649	4	3,711	465	2,358	1,452	1,004	90
1988	661	429	4	3,108	411	2,268	1,766	1,023	132
1989	1,064	332	4	3,331	330	2,532	1,839	984	130
1990	842	781	6	6,145	533	2,462	2,908	2,138	431
1991	1,094	407	12	3,363	432	2,423	1,663	936	177
1992	1,113	834	6	5,826	465	2,852	3,113	1,739	889
1993	1,530	866	6	6,039	478	3,120	3,206	1,591	1,210
1994	1,265	1,069	21	6,340	451	2,491	3,194	1,804	1,165
1995	2,429	1,742	23	6,765	434	2,024	4,359	1,463	760

Source: Directorate General of Fisheries (1984 - 1994)

Appendix Table 2:

The Production by Species of Small Pelagic Fishes in South China Sea of Indonesia, 1989 - 1995

Unit: Ton

No	Species	1989	1990	1991	1992	1993	1994	1995	Average	(%)
1	Barracuda *Sphyraena* spp	759.8	852.8	898.0	1,050.0	970.3	183.3	1,437.0	878.7	0.70
2	Roundscads *Decapterus* spp	25.9	27.6	256.0	-	199.0	202.0	1,261.5	281.7	0.20
3	Trevalies *Selar* spp	7,893.9	8,086.1	9,500.6	9,376.0	7,905.9	9,165.8	11,563.6	9,070.3	7.00
4	Hardtail scads *M. cordyla*	683.1	707.1	887.5	875.5	1,063.0	988.9	706.3	844.5	0.60
5	Queen fishes *Chorinemus* spp	1,750.3	2,151.1	2,008.0	2,126.7	2,300.4	1,928.3	3,250.1	2,216.4	1.70
6	Rainbow runner *E bipinnulatus*	97.0	119.0	120.0	122.0	147.0	268.0	287.0	165.7	0.10
7	Mullets *Mugil* spp	2,489.0	2,495.0	3,981.9	3,997.9	4,152.1	4,323.9	2,741.4	3,454.5	2.70
8	Needle fishes *Trichiurus* spp	1,117.0	1,609.7	1,720.0	2,362.2	1,838.6	1,128.6	1,729.6	1,643.7	1.30
9	Anchovies *Engraulidae*	7,591.3	7,463.3	8,489.8	8,211.8	7,977.1	8,438.8	10,902.9	8,439.3	6.50
10	Rainbow sardines *Dussumieria* spp	1,947.0	1,009.0	2,288.0	2,336.0	4,358.0	4,290.0	5,108.0	3,048.0	2.30
11	Fringscale sardinellas *Sardinella* spp	17,696.3	17,340.0	16,518.6	16,707.6	15,185.9	14,478.1	14,538.4	16,066.0	12.40
12	Indian oil sardine *A. sirm*	7,920.0	8,082.0	8,126.0	8,250.0	7,352.0	8,444.0	9,522.0	8,242.3	6.0
13	Wolf herrings *Chirocentrus* spp	7,049.3	6,987.3	6,014.5	6,135.5	6,636.6	7,478.6	10,252.8	7,225.9	5.60
14	Tolishads/chineseherrings *I. tolli*	125	132	-	-	-	-	-	36.7	0.01
15	Indianmacherels *Rastrelligel* spp	9,653.4	9,785.4	9,314.8	9,818.8	10,754.5	16,949.4	8,456.8	12,104.7	9.40
16	Seerfishes *Scomboromorus* spp	10,738.0	11,278.0	9,649.8	10,115.8	9,805.7	10,462.4	14,640.8	10,947.2	8.50
17	Small tunas *Euthynnus* spp *Auxis* spp	12,981.0	9,785.4	8,390.5	14,714.5	14,829.8	16,475.2	18,690.3	13,696.2	10.50
18	White pomprets	1,827.6	1,845.6	3,531.2	3,502.2	3,809.7	2,686.9	4,317.2	3,074.3	3.40
19	Black pomprets	3,897.4	4,059.4	1,959.2	1,991.2	2,037.5	2,258.6	2,650.2	2,693.4	2.10
20	Others	25,018.4	25,368.9	24,982.5	22,782.5	26,741.1	26,425.9	25,623.6	25,277.6	19.50
Total		123,333.1	127,660.2	120,263.2	126,046.9	129,838.3	130,413.3	157,251.6	129,407.1	100

Note: The production is not included the landing catch of purse seine form north coast of Java which are fishing ground in the South China Sea Area

Appendix Table 3:

Production of Marine Fishery in Southern Part of South China Sea Area by Group of Species.

Unit: Ton

Year	Small P	Large P	Demersal	Crustacea molluces	Total
1989	124,812	41	89,016	37,542	251,411
1990	129,248	-	88,810	38,058	256,116
1991	121,725	97	103,704	42,060	267,489
1992	127,892	-	99,691	56,568	284,151
1993	131,752	-	109,042	51,636	284,670
1994	133,344	-	117,288	39,941	290,573
1995	159,789	703	130,179	52,426	343,097
Increase (%)	5.00	-	7.70	6.61	6.08

Appendix Table 4:

Number of Boats, Days at Sea, Catch of Pelagic Fish by Seiners from Central Java Recorded from Pekalongan Landing Place

Years	Number of Boats	Days at Sea	Catch (kgs)	Fishing Ground	CPUE (kg/Day)
Large seiner					
1992	106	2,974	3,074.177	A	1,033.7
	2	69	49,596	C	718.8
1993	123	3,896	5,350.179	A	1,373.2
	132	4,367	5,801.881	B	1,328.6
	1	37	40,235	C	1,087.4
1994	96	3,327	4,637.703	A	1,394.0
	2	46	70,545	C	1,533.6
Average				A	1,267.0
				B	1,328.6
				C	1,113.3
Year	Number of Boats	Days at Sea	Catch (kgs)	Fishing Ground	CPUE (kg/Day)
Medium seiner					
1991	6	112	84,593	A	755.3
	29	296	143,710	C	485.5
1992	6	86	71,193	A	827.8
1993	4	56	84,861	A	1,517.4
	7	149	224,148	B	1,504.3
1994	17	670	722,313	A	1,078.1
	1	180	189,717	B	1,054.0
Average				A	1,044.6
				B	1,279.2
				C	485.5

ANNEX 6

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 3

COUNTRY STATUS REPORT

MALAYSIA

(1) SABAH

STATUS REPORT: SABAH, MALAYSIA

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ABSTRACT

This status report is based on the Malaysian fish landing statistics for the 1991-1995 period. The status of the pelagic fishery in Sabah are given in this report. An attempt is also made to assess the mackerel, round scad and tuna fisheries using the Beverton and Holt Yield per Recruit Model. From available statistics, it seems that the annual landings for tunas and mackerels are on a declining trend, and on the contrary for round scads and mixed pelagic group. These trends maybe attributed to the saturation of fishing effort, where the fishery is concentrated mainly in inshore waters. However, limited sampling coverage can also be a major contributing factor.

1. INTRODUCTION

Fisheries play an important role in the economic development of the country. Besides providing cheap protein (national per caput: 37kg/year or 60-70% of animal protein consumed), it also provides various social economic opportunities (including employment for full-time 82,200 fishermen). In 1995, the total fisheries production (including ornamental fish production) amounted to 1,245,117 metric tons valued at RM3.15 billion constituting about 1.47% of the national GDP or about 19.19% of the agricultural sector. Compared to 1994, there was an increase of 5.36% in terms of quantity of the total production and 5.35% in terms of value of the total production. Table 1 shows the annual fisheries statistics (capture fisheries and aquaculture only) for the 1990-1995 period which are self explanatory.

During the 1991-1995 period, the annual pelagic landings fluctuated between 305,904 - 412,273 metric tons. The main components are mackerels (63,582 - 127,461 metric tons), round scads (44,645 - 64,722 metric tons) and tunas (25,444 - 35,980 metric tons) which contributed about 48.3 - 50.6% of the pelagic landings or about 15.3-18.8% of the marine landings. During the same period, Sabah con-tributed 18.6-22.0% of the annual pelagic landings in the country, i.e. contributing 38.6-47.6% of tuna, 7.7-18.6% of mackerel, 12.6-26.6% of round scad and 18.0-24.0% of other pelagic species landed. This report covers the sectoral performance of the pelagic fisheries sector in Sabah, with emphasis on mackerels, tunas and round scads.

2. OVERVIEW OF THE FISHERIES INDUSTRY IN SABAH

2.1. The Marine Capture Fisheries Sector

2.1.1. Physical Environment

The fishing grounds in Sabah can be devided into three main zones: west coast (South China Sea), Kudat (South China Sea and Sulu Sea) and east coast (Sulu Sea and Sulawesi Sea). Its 1600 km coastline fringed with vast areas of coral reefs, sea grasses, mangroves, estuaries, and its diverse aquatic ecosystems have one of the richest diversity of marine life in the Indo Pacific region. Fishing grounds within the continental shelf are estimated about 30,000 nm^2 (102,000 km^2), i.e. 9,000 square nautical miles on the east coast and 21,000 nautical miles on the west coast (Figure 1).

In general most of the fishing activities are concentrated in the coastal waters within the 30 nautical mile zone which sustains both traditional and commercial fisheries. On the other hand, the offshore waters (beyond the 30 nautical mile zone) are at present still under-exploited. For purse seiners, the main fishing grounds are mainly of Semporna, Lahad Datu and along the west coast, where the target species are coastal tunas and small pelagics (*mackerels, round scads, scads*).

The physical and oceanograhic features of the Palawan Trench located off the west coast makes it a potential fishing ground for oceanic tunas. Data from past fishing operations indicated that both bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacares*) tunas are abundant and widely distributed in the area.

2.1.2. Potential Yield

There is limited information on the potential yield of marine fishery resources in Sabah. Preliminary estimate indicated the potential yield to be around 350,000 metric tons, consisting of 174,000 metric tons of pelagic fish and 176,000 metric tons of assorted demersal species (including crustaceans (biusing, 1995a). This is a rather conservative estimate, where the potential yield of pelagic resources (e.g. tuna and small pelagics) in the EEZ and fishes in coral reefs and shoal areas are unknown and might be underestimated.

2.1.3. Fishing Boats

The commercial fisheries comprised of large-scale fishing operations using various types of modern gears (e.g. trawlnets, purse seiners, gillnets), which is better organized, more capital intensive and accounts for greater income as opposed to traditional fisheries involving various traditional gears (misc. traps, hook & lines, liftnets) which is much smaller, dispersed and often fragmented in organization, high labour intensive and low in capital investment. The operators involved are artisanal fishermen who operated non-motorised or small boats. Coastal fisheries are defined as to all fishing activities confined within 30 nautical miles of the coast, where fishing vessels that operate within this zone are not greater than 70 GRT in size. While deepsea fisheries are defined as fishing operations carried out by large vessels (beyond 70 GRT in size) beyond the 30 nautical mile zone. Deep sea fishing are mainly carried out by purse seiners, trawlers and longliners.

Sabah has the largest traditional fishing fleet, i.e. 86% for non-powered boats and 41% for outboard engine boats. The main gears are liftnets *(selambau)*, hook and lines and other static gears (e.g. traps). However, for inboard engine boats, the percentage is rather low (14% of the national commercial fishing fleet size). The fishing fleet breakdown are given in Tables 2-3.

2.1.4. Fishermen Population

It is estimated that there are about 19,819 people involved in fulltime fishing in Sabah with the breakdown by gear group is given in Figure 2. The number of fishermen without licensed gears are not taken into account.

2.1.5. Marine Fish Landings

The estimation of fish landings is carried out in major landing sites in each of the 15 major fishing districts in Sabah (Figure 1). Catch statistics for each fish group are estimated by gear and GRT under the national SMPP (or *Fisheries Management Information System*) program. An overview of the capture fishery in Sabah is given in previous papers (Biusing, 1994a, 1994b, 1995a, 1995b, 1997).

In general, about 200-300 species of marine fishes (including trash fish) are landed in the major local fish markets, with an average of 50-100 species displayed for sale daily in the market stalls. Additional species may appear from time to time depending on the time of the year. Some species are found to predominate the market landings during the monsoons, while others which permanently inhabits estuaries, bays or coral reefs are usually landed throughout the year. The magnitude of fish landings are closely linked to the monsoons. Generally, during the northeast monsoon between the months of January - March, the supply is low due to rough sea conditions which lead to minimum fishing activities carried out. In some areas, fish landings might increase during this time of the year, where pelagic fishes migrate to inshore waters to avoid the strong winds and currents prevailing in the open seas.

The annual marine landings in Malaysia during the 1991-95 period are given in Figure 3. In 1995, about 1,108,436 metric tons was landed, with an increase of 4.02% over the previous year. During the 5 year period, the average marine landing is about 1,031,364 metric tons, with 44.8% landed on the west coast of Peninsular Malaysia, followed by the east coast (30.3%), Sabah (14.3%), Sarawak (8.8%) and FT Labuan (1.8%).

The breakdown of the pelagic landings during the 1991-95 period are given in Table 4 and Figure 4. In 1995, pelagic landings accounted about 412,273 metric tons or about 37% of the total marine landings, with an increase of 8.9% over 1994. During the 1991-95 period, pelagic landings fluctuated around 305,904 to 412,273 metric tons (mean 363,921 metric tons) or about 34-37% (mean 35%) of the total annual marine landings. The west coast of Peninsular Malaysia contributed the highest pelagic landings (31-45%, mean 38% or 137,494 metric tons), followed by the east coast (26-40%, mean 34% or 122,854 metric tons), Sabah (19-22%, mean 21% or 75,068 metric tons), Sarawak (5-6%, mean 6% or 20,084) metric tons) and FT Labuan (1-3%, mean 2% or 8,421 metric tons). In Sabah annual pelagic landings fluctuated between 56,877-84,136 metric tons (mean 75,068 metric tons), which represented about 48-53% (mean 51%) of the annual marine landings in the state.

Table 4 and Figures 5-6 shows the species breakdown by fishing region of pelagic landings in the country. Mackerels formed the most important pelagic group (5-year mean 85,983 metric tons), which represented about 23.6% of the pelagic landings or 8.3% of the marine landings (Figure 7). Round scads formed the second largest group (mean 55,966 metric tons), contributing respectively about 15.4% and 5.4% of the pelagic and marine landing (Figure 8). Tunas formed the third largest group (mean 30,161 metric tons), contributing respectively about 8.3% and 2.9% of the pelagic and marine landings (Figure 9). Other species (mainly selar scads, hardtail scads, anchovies, spanish mackerels, sardines) contributed the bulk of the pelagic landings (mean 191,911 metric tons), i.e. 52.7% and 18.6% of the pelagic and marine landings in the country (Figure 10).

The estimated marine landing breakdown by gear type and resource group in Sabah (incl. FT Labuan) during the 1991-1995 period are given respectively in Figures 11-12 and Table 5. Trawlnets contributed the bulk of the landings (29.1%), followed by drift nets (21.4%), purse seiners (19.0%), hook and line (12.6%), liftnets (12.3%) and misc. traditional gears (5.6%). About 34.1% of the pelagic landings are contributed by purse seiners, followed by gillnets (23.3%), liftnets (22.1%), hook and line (11.1%), trawlnets (8.5%) and less than 1% by misc. traditional gears. Purse seines and liftnets are the principal pelagic gears, with > 90% of the catch consisting of pelagic species. About 55.4% of the gillnet landings consisted of pelagic species. While pelagic species represented about 44.9% of the hook and line landings. Only 14.8% of the trawl landings consisted of pelagic species, where the target species are shrimps.

From the 1991-1995 annual statistics, pelagic fishes contributed between 48-52% (mean 50.9% or 75,068 metric tons) of the marine landings in Sabah. Demersal fishes contributed between 19-22% (mean 20.6% or 30.363 metric tons), followed by crustaceans between 10-14% (mean 11.4% or 16,807 metric tons). While the mixed portion (various species including invertebrated) contributed between 13-22% (mean 17.2% or 25,347 metric tons).

During the 1991-1995 period, tunas, mackerels (Rastrelliger) and round scads (Decapterus) contributed about 46.7% of the pelagic landings in Sabah (excluding FT Labuan). This group of fishes contributed respectively about 42-51% of the total pelagic landings or 21-26% of the total marine landings in Sabah each year. The annual gear landing breakdown of mackerels, round scads, tunas and mixed pelagic species for the 1991-1995 period are given in Figures 13-16. The Yield per Recruit (Y/R) isopleth for mackerels (Rastrelliger), round scads (Decapterus) and kawakawa (Euthynnus affinis) are given respectively in Figures 17-19. The analysis are based on biological data reported for these species (Biusing, 1991, 1994a, 1994b, 1995a).

Tunas (mainly neretic species) contributed the highest pelagic landings (17% pelagic landings). The landing in 1995 was about 10,704 metric tons (decreased by 7.4% from 1994). The principle gears are purse seiners (61.3% of tuna landings) and gillnets (28.5%). Hook and line gears only contributed about 6.9% of the landings (except in 1993, where it contributed about 12.8%). It was noted that liftnets contributed 9.0% and 4.8% of the landings in 1993 and 1994, and in other years (1991-92 and 1995) less than 0.02% (2-3 metric tons). It is believed that these landings consisted of juveniles caught in near inshore waters. During the 5-year period, the mean landing is about 13,045 metric tons. There is a declining trend in the landings, which reached its peak in 1993 (17,136 metric tons) and then decreased gradually to only 10,704 metric tons in 1995.

Mackerels formed the second largest group (14.8% pelagic landings). The landing in 1995 was about 9,830 metric tons (increased by 5.7% from 1994). Purse seine is the principle gear used in the fisher. During the 1991-95 period, purse seines contributed between 51-55% (mean 52.4%) of the mackerel landings. Other important gears in the fishery are lift nets (14.4% landings), trawlnets (14.1%) and gillnets (11.3%). During the 5-year period, the mean landing is about 11,089 metric tons. Like tunas, there is also a declining trend in the landings, reaching its peak in 1992 (13,337 metric tons) and then decreased to only between 9,300-9,830 metric tons in 1994-95.

Round scads formed the third largest group (14.6% pelagic landings). The landing in 1995 was about 14,784 metric tons (increased by 12.4% from 1994). The principle gears used in the fishery are liftnets, purse seiners an trawlnets. Lift nets contributed about 33-58% (mean 46.2%) of the annual round scad landings. While purse seiners contributed about 32-49% (mean 40.8%) of the landings. Trawlnets as part of the by-catch contributed about 5-17% (mean 11.6%) each year. During the 5-year period, the mean landing is about 10,935 metric tons. Unlike tunas and mackerels, it seems that round scads landings are on an increasing trend, from only 6,701 metric tons in 1991 to its peak in 1995 (14,784 metric tons).

The mixed pelagic catch represented by various species (sardines, hardtail scads, king mackerels, selar scads, anchovies, etc.) represented about 49-58% of the annual pelagic landings. In 1995 the total landings was about 48,818 metric tons (increased by 14.6% from 1994). The main gears used to land these species in order of importance are gill nets (22.1-36.4% annual landings, mean 31.0%), liftnets (22.8-24.5%, mean 23.8%), purse seines (12.2-26.7%, mean 18.3%), hook and line (11.5-18.8%, mean 16.5%) and trawlnet (8.4-9.4%, mean 8.8%). During the 5-year period, the mean landing is about 39,998 metric tons. Likewise for round scads, this group of fish is only on an increasing trend, from only 29,006 metric tons in 1991 increased to its peak in 1995 (48,818 metric tons).

3. CONCLUSION AND RECOMMENDATIONS

3.1. Conclusion

There is an indication that the tuna and mackerel fisheries in Sabah are declining. However, more studies are needed to confirm this finding. Sampling error in the collection of landing data might have been a possible contributing factor. As such, there is an urgent need to carry out more rigorous assessment on the pelagic fishery sector, including catch and effort monitoring and biological studies. At present, the paucity of required information on the status of pelagic fisheries resources in the state make it very difficult for DOF managers to implement rational management measures to manage the fishery within sustainable levels.

3.2. Recommendation

A comprehensive study on the pelagic fisheries resources in Sabah is urgently needed. This study should cover extensive acoustic surveys both on a temporal basis (between monsoons) in both inshore and offshore waters, catch and effort monitoring and related biological studies.

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Table 1: Fish production statistics, Malaysia (1990-95) (metric tons)

		1991	1992	1993	1994	1995
Marine Landings	Sabah	108,464	136,300	155,115	160,328	166,462
	Sarawak	86,610	88,240	81,920	95,624	99,255
	FT Labuan	7,275	19,743	19,141	24,554	23,255
	Semenanjung	709,590	767,530	791,620	785,079	819,464
Total		**911,939**	**1,011,813**	**1,047,796**	**1,065,585**	**1,108,436**
Marine Aquaculture	Sabah*	900	900	2,143	2,869	3,226
	Sarawak	49	144	50	82	104
	FT Labuan	0	0	0	0	0
	Semenanjung	48,290	62,662	86,054	92,564	110,618
Total		**49,239**	**63,706**	**88,247**	**95,515**	**113,949**
Freshwater Aquaculture	Sabah	6,223	7,086	5,800	6,015	6,123
	Sarawak	165	1,634	811	1,342	1,210
	FT Labuan	0	0	0	0	0
	Semenanjung	4,701	7,271	8,857	11,238	11,160
Total		**11,089**	**15,991**	**15,467**	**18,598**	**18,493**
Grand Total		**972,267**	**1,091,510**	**1,151,510**	**1,179,698**	**1,240,878**

Note: 1991-92 statistics only for shrimp, 1993-1995 including shrimp, mollusc and fish.
Source: Annual Fisheries Statistics of Malaysia (1991-1995)

Table 2: Licensed fishing fleet by GRT (gross tonnage), Sabah 1995

				Inboard engine boats GRT category						
	Grand Total	Non Powered	Outboard Engined	Inboard Engined	<10	10-20	20-25	25-40	40-70	>70
Sabah	9,144	2,597	3,939	2,608	1,498	635	163	250	53	9
FT Labuan	89	3	75	11	0	0	0	0	5	6
Sub Total	9,233	2,600	4,014	2,619	1,498	635	163	250	58	15
Malaysia	34,906	3,097	13,829	17,980	9,798	4,262	790	1,394	1,164	572
% Malaysia	26.45	83.95	29.03	14.57	15.29	14.90	20.63	17.93	4.98	2.62

Source: Annual Fisheries Statistics of Malaysia (1991-1995)

Table 3: Licensed fishing fleet by gear type, Sabah 1995

gear group	Sabah	FT Labuan	Sub Total	Malaysia Total	% Malaysia
Gillnet	915	31	946	16,551	5.72
Trawlnet	1,058	5	1,063	5,632	18.87
Hook & line	424	27	451	2,470	18.26
Seine net	158	8	166	1,838	9.03
Liftnet	146	8	154	265	58.11
Others	367	10	377	2,396	15.73
Total	3,068	89	3,157	29,152	10.83

Source: Annual Fisheries Statistics of Malaysia (1995)

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Table 4: Marine fish landings (metric tons) in Malaysia (1991-95)

Region	species	1991	1992	1993	1994	1995	mean
Sabah	Tunas	10,821	15,000	17,136	11,564	10,704	13,045
AREA I	*Rastrelliger*	10,349	13,337	12,631	9,300	9,830	11,089
	Decapterus	6,701	9,143	11,094	12,954	14,784	10,935
	Other pelagics	29,006	40,177	39,403	42,587	48,818	39,998
	PELAGIC	56,877	77,657	80,264	76,405	84,136	75,068
	DEMERSAL	23,040	30,788	29,153	32,341	36,492	30,363
	CRUSTACEAN	14,834	19,983	16,817	16,306	16,093	16,807
	OTHERS	13,713	19,572	28,433	35,276	29,741	25,347
	SUB TOTAL	**108,464**	**148,000**	**154,667**	**160,328**	**166,462**	**147,584**
FT Labuan	Tunas	302	1,698	1,381	1,465	2,281	1,425
AREA II	*Rastrelliger*	452	1,736	2,528	2,536	1,907	1,832
	Decapterus	116	204	321	711	688	408
	Other pelagics	1,776	5,329	4,492	6,429	5,755	4,756
	PELAGIC	2,646	8,967	8,722	11,141	10,631	8,421
	DEMERSAL	3,224	6,191	5,708	6,008	5,902	5,407
	CRUSTACEAN	975	2,634	1,672	1,638	939	1,572
	OTHERS	430	1,951	3,039	5,767	5,783	3,394
	SUB TOTAL	**7,275**	**19,743**	**19,141**	**24,554**	**23,255**	**18,794**
Sarawak	Tunas	1,992	2,109	1,511	1,519	1,835	1,793
AREA III	*Rastrelliger*	3,003	3,610	3,090	3,270	2,646	3,124
	Decapterus	119	118	190	114	361	180
	Other pelagics	14,058	13,703	16,367	13,308	17,496	14,986
	PELAGIC	19,172	19,540	21,158	18,211	22,338	20,084
	DEMERSAL	13,943	14,594	13,486	13,911	19,089	15,005
	CRUSTACEAN	15,152	14,724	10,918	16,724	10,755	13,655
	OTHERS	38,340	39,383	36,362	46,778	47,073	41,587
	SUB TOTAL	**86,607**	**88,241**	**81,924**	**95,624**	**99,255**	**90,330**
Peninsular East Coast AREA IV	Tunas	9,890	8,002	10,492	8,334	6,897	8,723
	Rastrelliger	14,398	12,501	13,622	14,769	12,075	13,473
	Decapterus	39,622	28,211	42,610	37,883	29,398	35,545
	Other pelagics	57,322	64,863	75,748	67,820	59,813	65,113
	PELAGIC	121,232	113,577	142,472	128,806	108,183	122,854
	DEMERSAL	37,537	43,542	45,430	39,869	38,058	40,887
	CRUSTACEAN	8,007	8,805	9,968	8,898	9,449	9,025
	OTHERS	140,911	127,613	147,233	147,204	134,956	139,583
	SUB TOTAL	**307,687**	**293,537**	**345,103**	**324,777**	**290,646**	**312,350**
Peninsular West Coast AREA V	Tunas	5,051	8,194	5,460	2,939	3,727	5,074
	Rastrelliger	35,380	46,066	36,104	63,771	101,003	56,465
	Decapterus	6,641	6,969	10,507	9,979	10,392	8,898
	Other pelagics	58,905	77,486	59,639	67,393	71,863	67,057
	PELAGIC	105,977	138,715	111,710	144,082	186,985	137,494
	DEMERSAL	44,230	46,611	51,374	50,498	53,515	49,246
	CRUSTACEAN	69,856	89,558	76,631	67,764	66,449	74,052
	OTHERS	181,837	199,111	206,800	197,958	221,869	201,515
	SUB TOTAL	**401,900**	**473,995**	**446,515**	**460,302**	**528,818**	**462,306**
Grand Total	Tunas	28,056	35,003	35,980	25,821	25,444	30,061
	Rastrelliger	63,582	77,250	67,975	93,646	127,461	85,983
	Decapterus	53,199	44,645	64,722	61,641	55,623	55,966
	Other pelagics	161,067	201,558	195,649	197,537	203,745	191,911
	PELAGIC	305,904	358,456	364,326	378,645	412,273	363,921
	DEMERSAL	121,974	141,726	145,151	142,627	153,056	140,907
	CRUSTACEAN	108,824	135,704	116,006	111,330	103,685	115,110
	OTHERS'	375,231	387,630	421,867	432,983	439,422	411,427
	GRAND TOTAL	**911,933**	**1,023,516**	**1,047,350**	**1,065,585**	**1,108,436**	**1,031,364**

Source: Annual Fisheries Statistics of Malaysia (1991-1995)

Table 5: Pelagic fish landings (metric tons) by gear type, Sabah (1991-95)

	Year	LANDING BY GEAR TYPE (in metric ton)						GRAND	%
Rastrelliger		TN	PS	GN	LN	HL	OT	TOTAL	Pelagic
	1991	1,120	5,334	1,791	1,411	584	109	10,349	**18.2**
	1992	1,343	6,838	2,437	1,792	797	130	13,337	**17.2**
	1993	1,609	6,892	1,240	2,312	542	36	12,631	**15.7**
	1994	2,500	4,782	288	1,244	419	67	9,300	**12.2**
	1995	1,244	5,215	522	1,224	1,555	70	9,830	**11.7**
	Mean	1,563	5,812	1,256	1,597	779	82	11,089	**14.8**
Decapterus		TN	PS	GN	LN	HL	OT	TOTAL	
	1991	365	2,293	113	3,862	68	0	6,701	11.8
	1992	500	3,128	153	5,269	93	0	9,143	11.8
	1993	817	3,505	321	6,451	0	0	11,094	13.8
	1994	2,223	6,411	0	4,320	0	0	12,954	17.0
	1995	2,443	6,990	0	5,338	13	0	14,784	17.6
	Mean	1,270	4,465	117	5,048	35	0	10,935	14.6
Tunas		TN	PS	GN	LN	HL	OT	TOTAL	
	1991	22	7,479	2,719	2	599	0	10,821	19.0
	1992	28	10,210	3,928	3	831	0	15,000	19.3
	1993	5	7,683	5,724	1,538	2,186	0	17,136	21.3
	1994	1	6,808	3,362	557	836	0	11,564	15.1
	1995	0	7,784	2,874	3	40	3	10,704	12.7
	Mean	11	7,993	3,721	421	898	1	13,045	17.4
Other pelagics		TN	PS	GN	LN	HL	OT	TOTAL	
	1991	2,568	3,525	9,918	7,115	5,457	423	29,006	51.0
	1992	3,781	5,269	13,187	9,838	7,501	601	40,177	51.7
	1993	3,346	5,302	14,359	8,969	6,849	578	39,403	49.1
	1994	3,831	9,533	13,717	9,921	4,882	703	42,587	55.7
	1995	4,088	13,022	10,769	11,796	8,360	783	48,818	58.0
	Mean	3,523	7,330	12,390	9,528	6,610	618	39,998	53.3
Combined		TN	PS	GN	LN	HL	OT	TOTAL	
Pelagic	1991	4,075	18,631	14,541	12,390	6,708	532	56,877	
Landings	1992	5,652	25,445	19,705	16,902	9,222	731	77,657	
	1993	5,777	23,382	21,644	19,270	9,577	614	80,264	
	1994	8,555	27,534	17,367	16,042	6,137	770	76,405	
	1995	7,775	33,011	14,165	18,361	9,968	856	84,136	
	Mean	6,367	25,601	17,484	16,593	8,322	701	75,068	

TN = trawlnet PS = purse seine GN = gillnet LN = liftnet HL = hand line OT = others

Source: Annual Fisheries Statistics of Malaysia (1991-1995)

Figure1: Fishing grounds of Sabah, Malaysia.

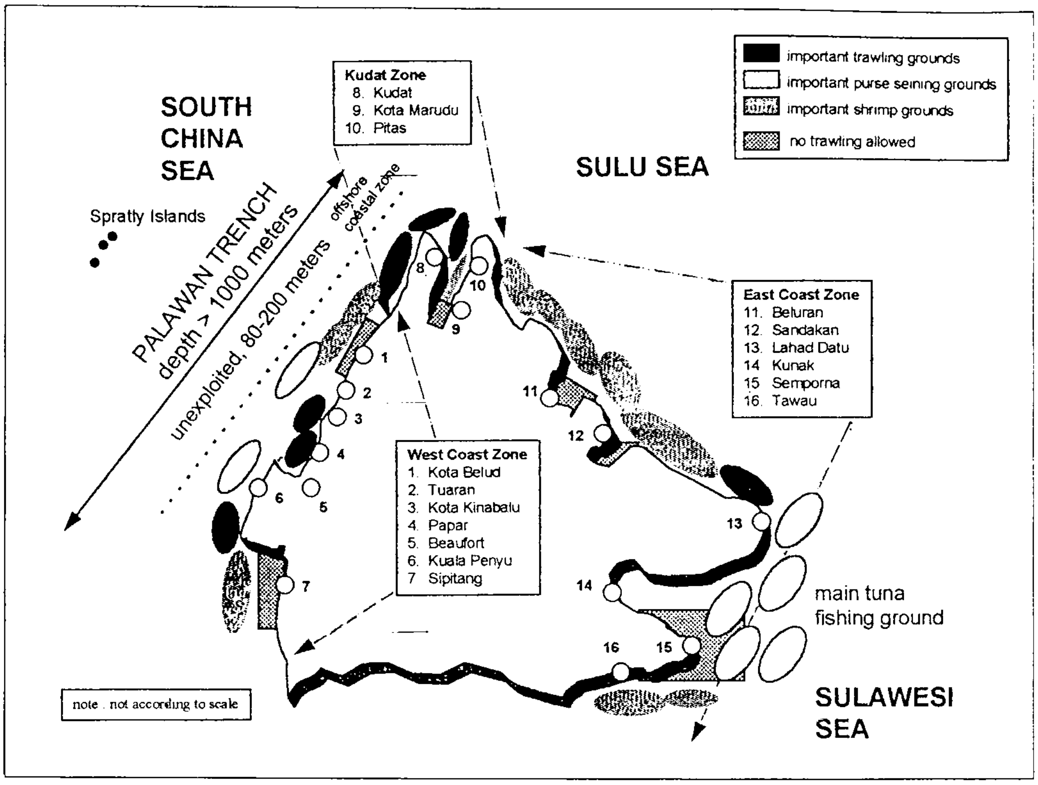


Figure 2: Breakdown of fishermen population by gear group, Sabah 1995.

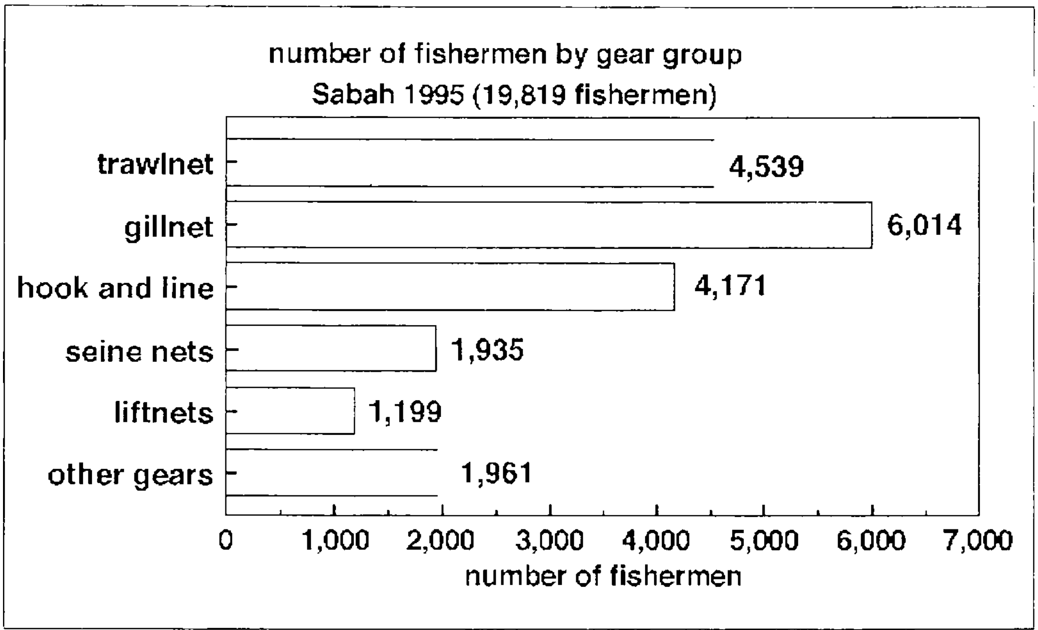


Figure 3: Landing breakdown of marine landings, Malaysia (1991-95).

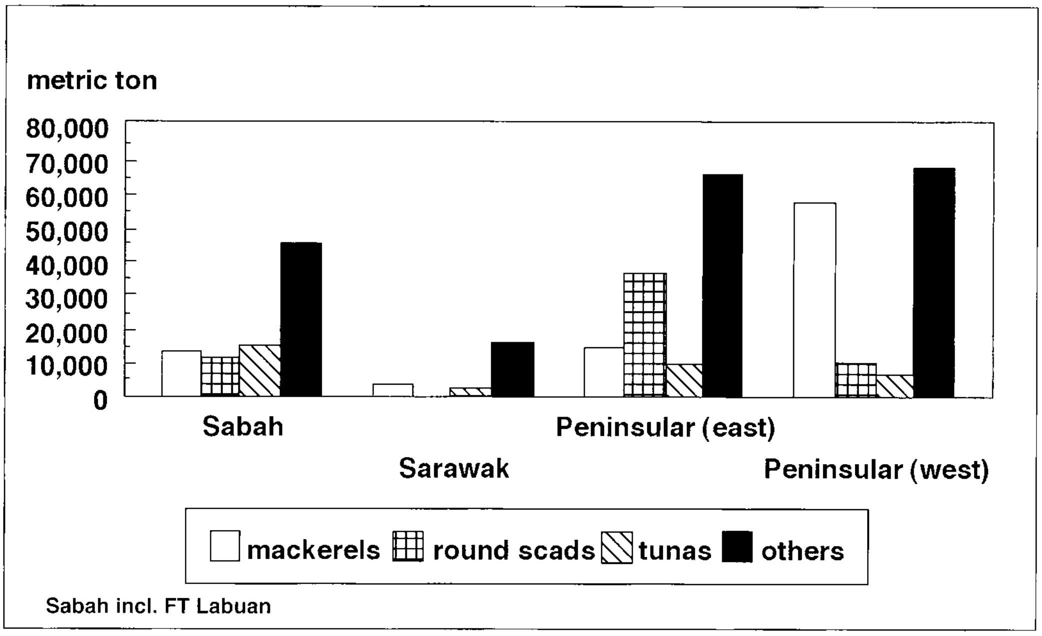


Figure 4: Landing breakdown of pelagic landings, Malaysia (1991-95).

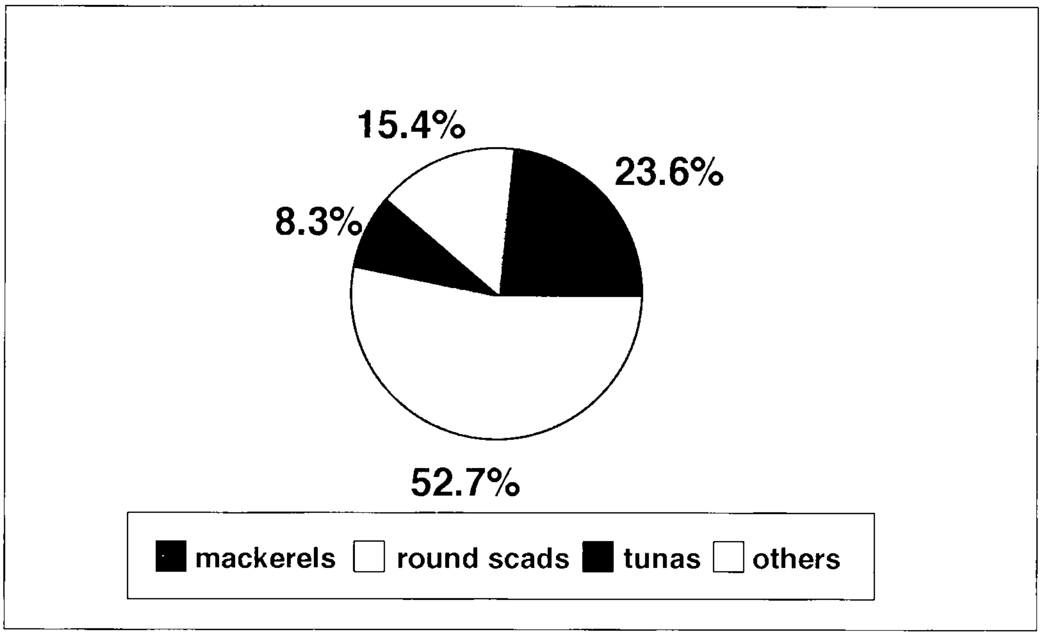


Figure 5: Species breakdown of pelagic landings, Malaysia (1991-95).

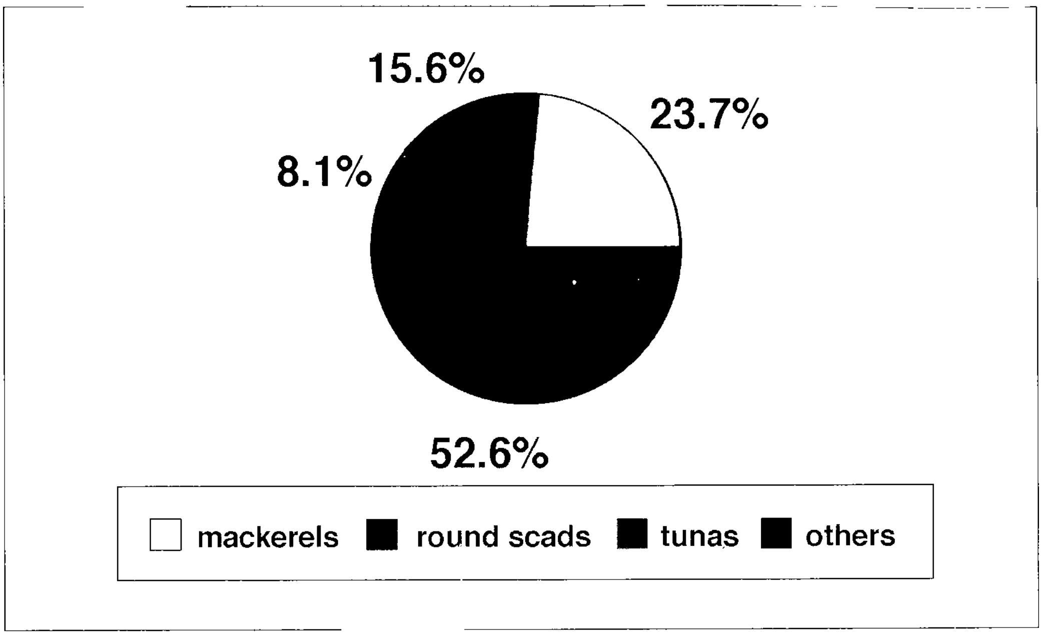


Figure 6: Species breakdown of pelagic landings, Malaysia (1991-95).

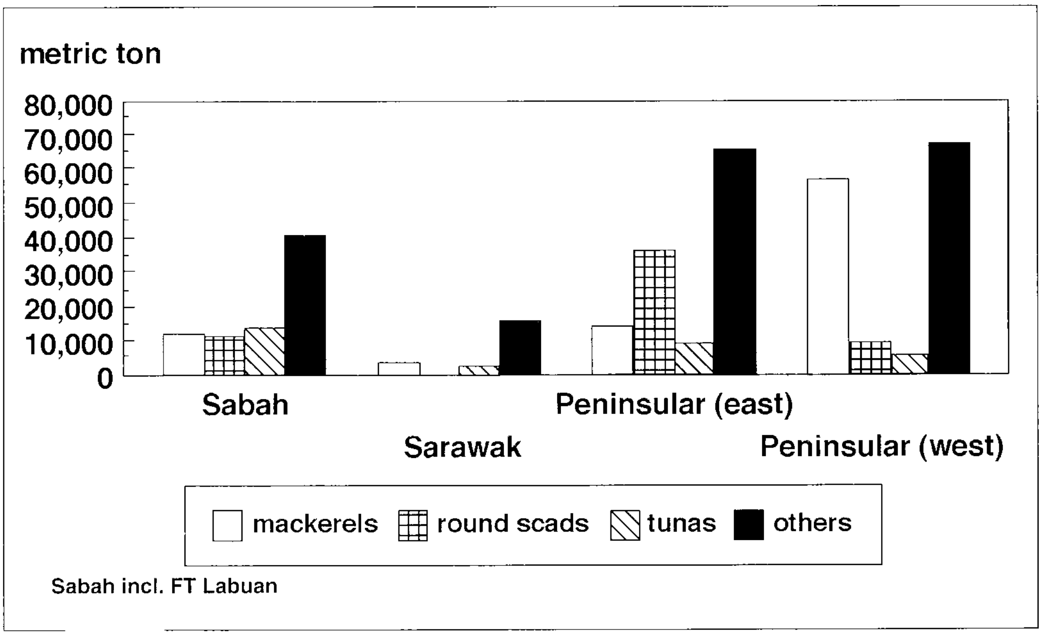


Figure 7: Landing breakdown of mackerel, Malaysia (1991-95)

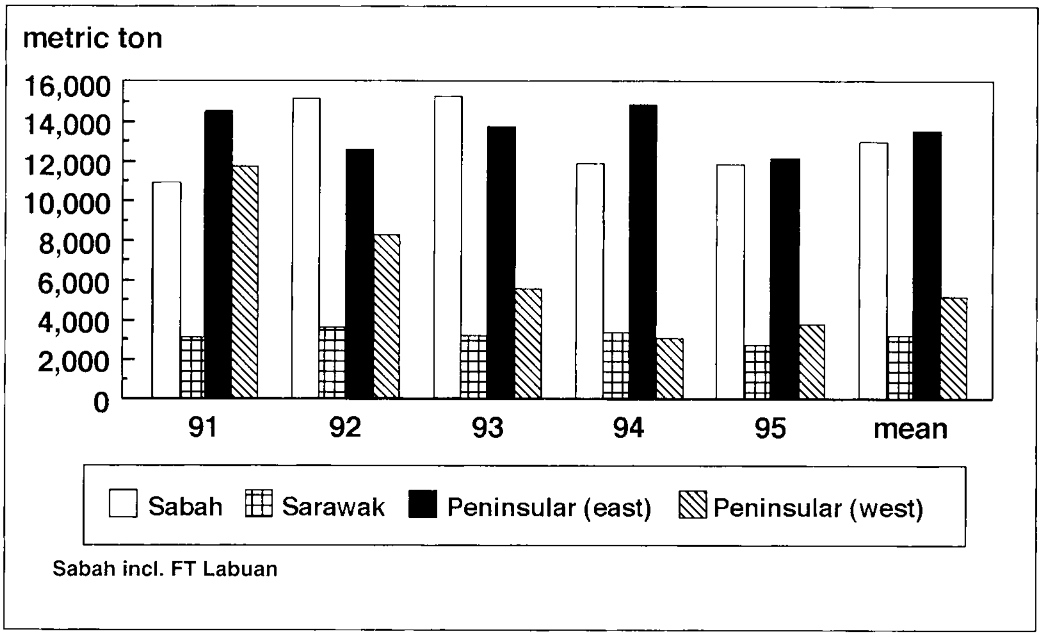


Figure 8: Landing breakdown of round scad, Malaysia (1991-95)

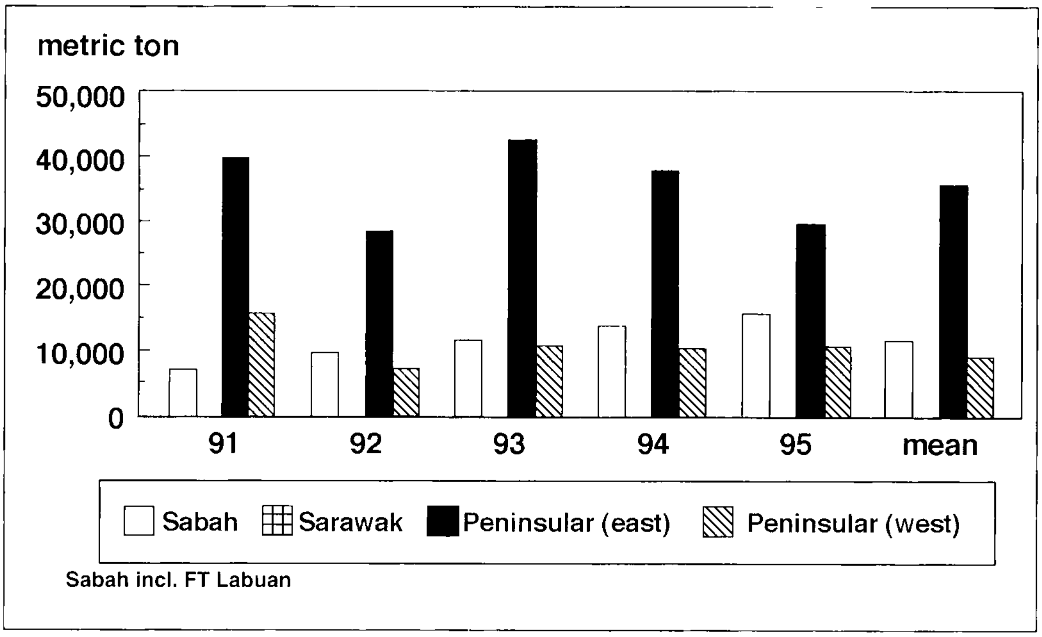


Figure 9: Fish landing breakdown of tuna, Malaysia (1991-95).

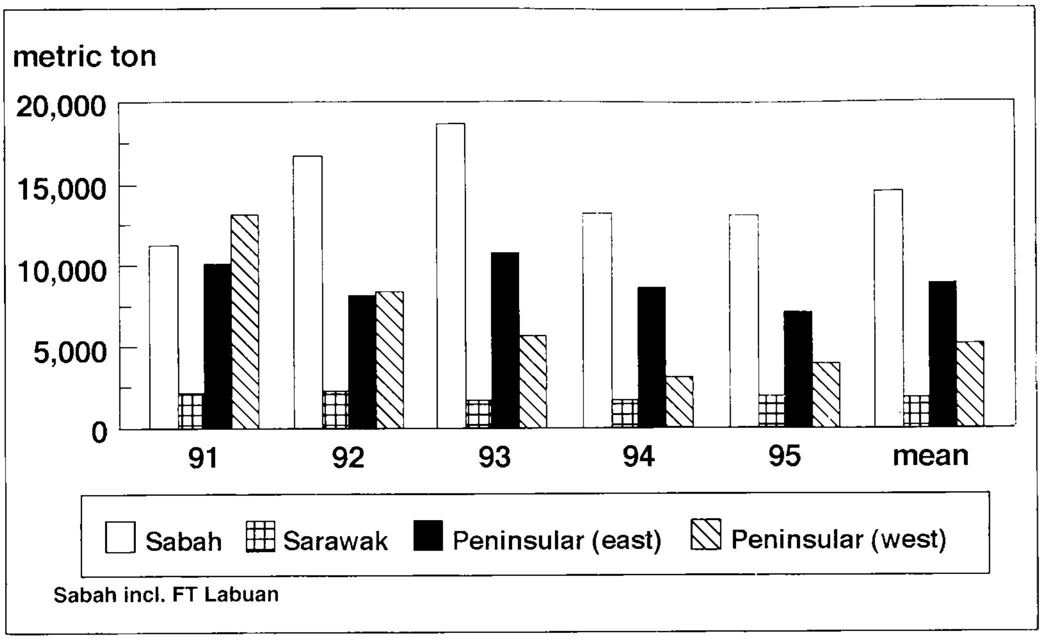


Figure 10: Fish landing breakdown of misc. pelagics, Malaysia (1991-95).

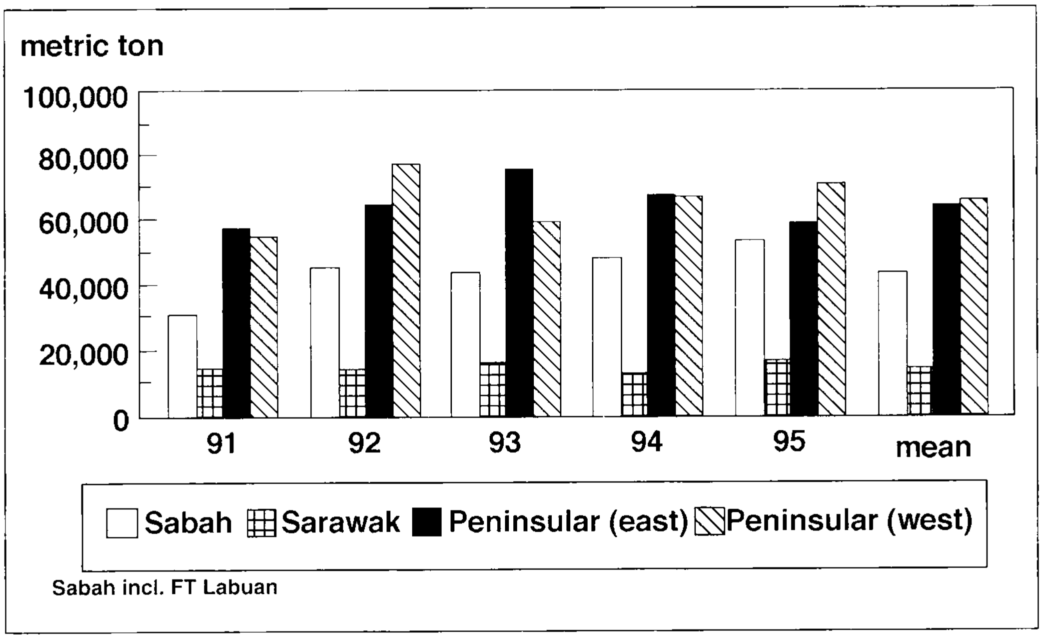


Figure 11: Marine Fish landing breakdown by gear group, Sabah (1991-95).

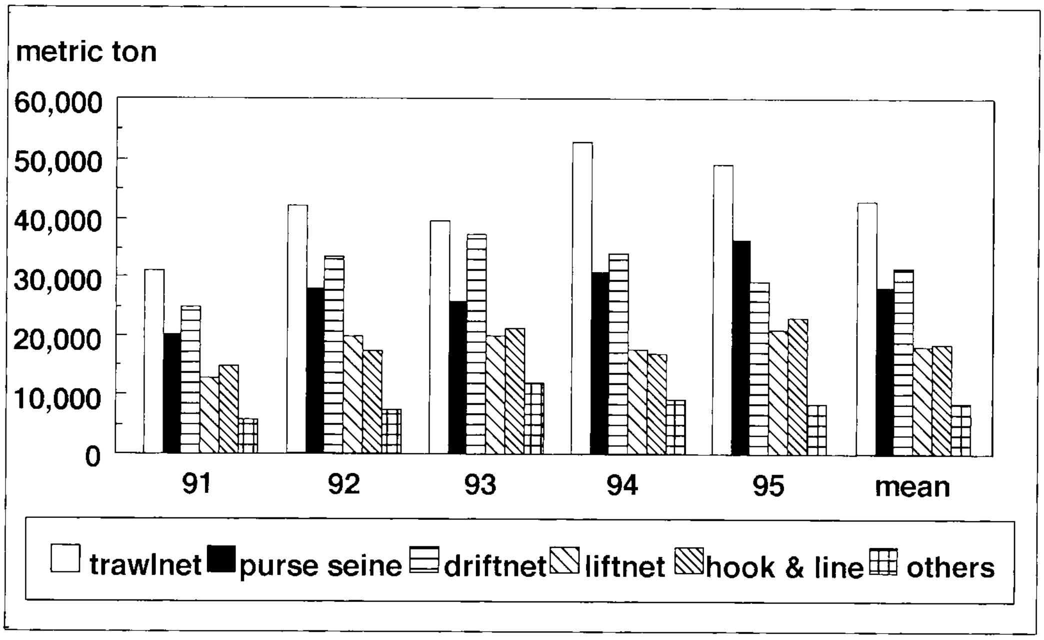


Figure 12: Fish landing breakdown by resource group, Sabah (1991-95).

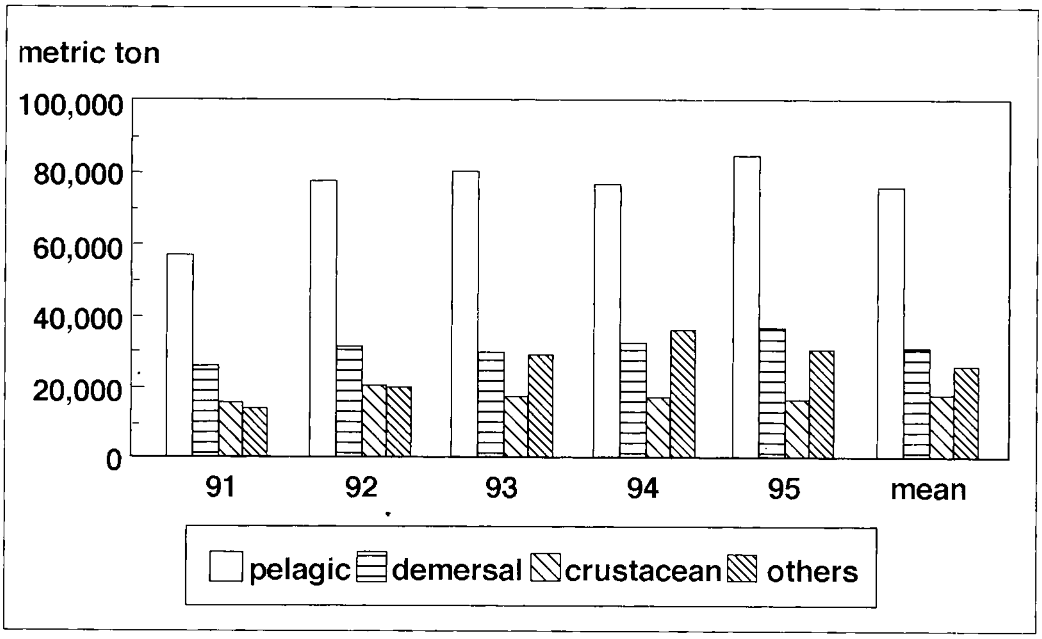


Figure 13: Gear landing breakdown of mackerel (*Rastrelliger*), Sabah (1991-95).

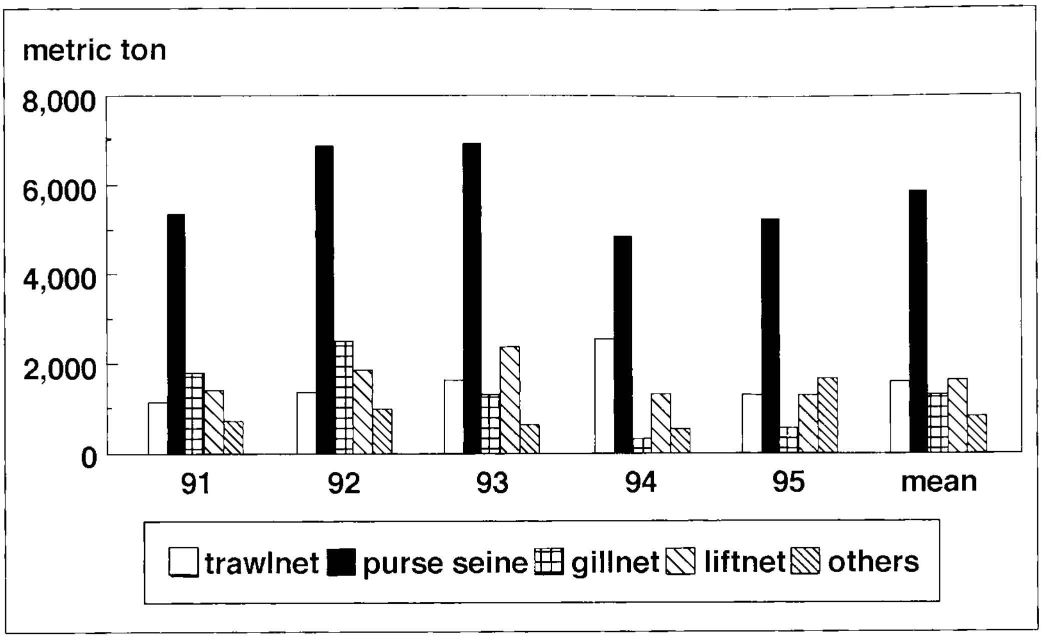


Figure 14: Gear landing breakdown of round scad (*Decapterus*), Sabah (1991-95).

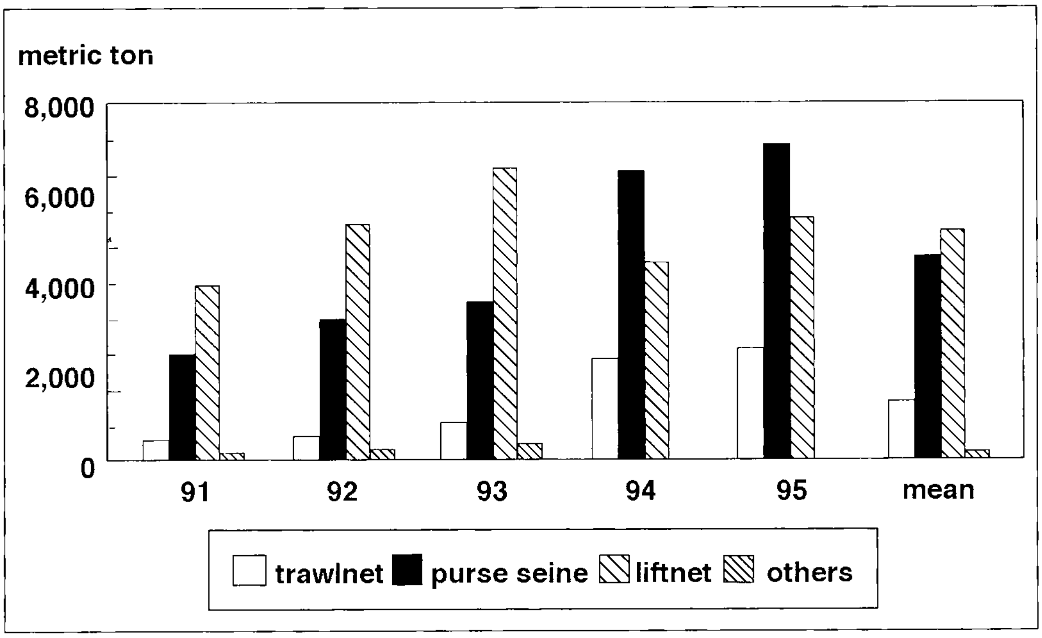


Figure 15: Gear landing breakdown of tuna (mixed species), Sabah (1991-95).

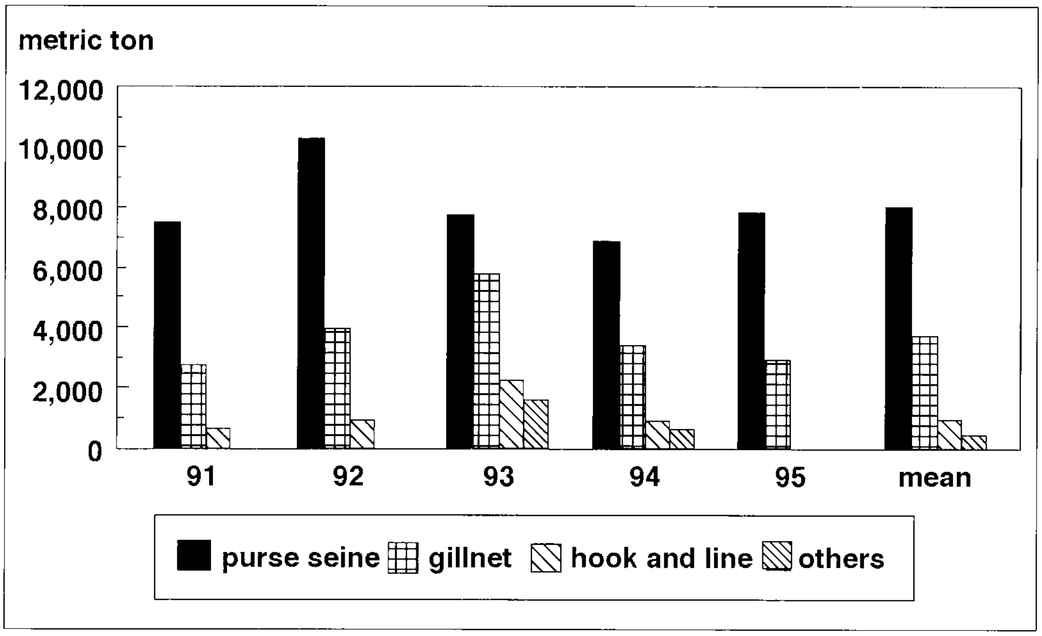


Figure 16: Gear landing breakdown of other pelagic species, Sabah (1991-95).

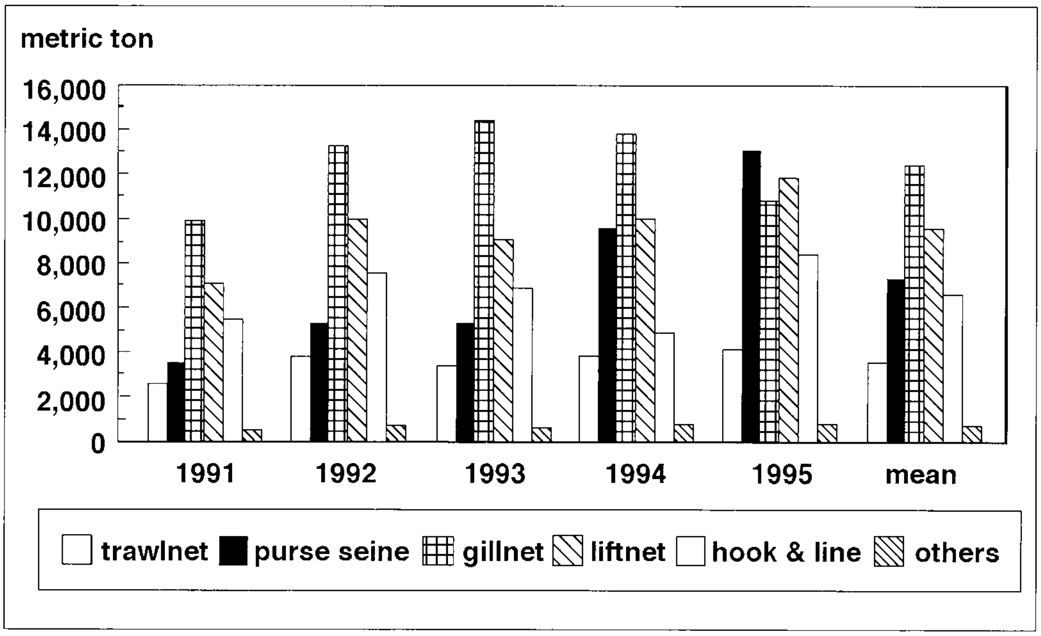


Figure 17: Yield per Recruit (Y/R) isopleth model of *Rastrelliger kanagurta* stock (South China Sea) (Loo = 35.7cm TL, K = 0.73/yr, Woo = 613 gram, M = 1.41/yr, Tr = 0.45 yr = 10cm TL)

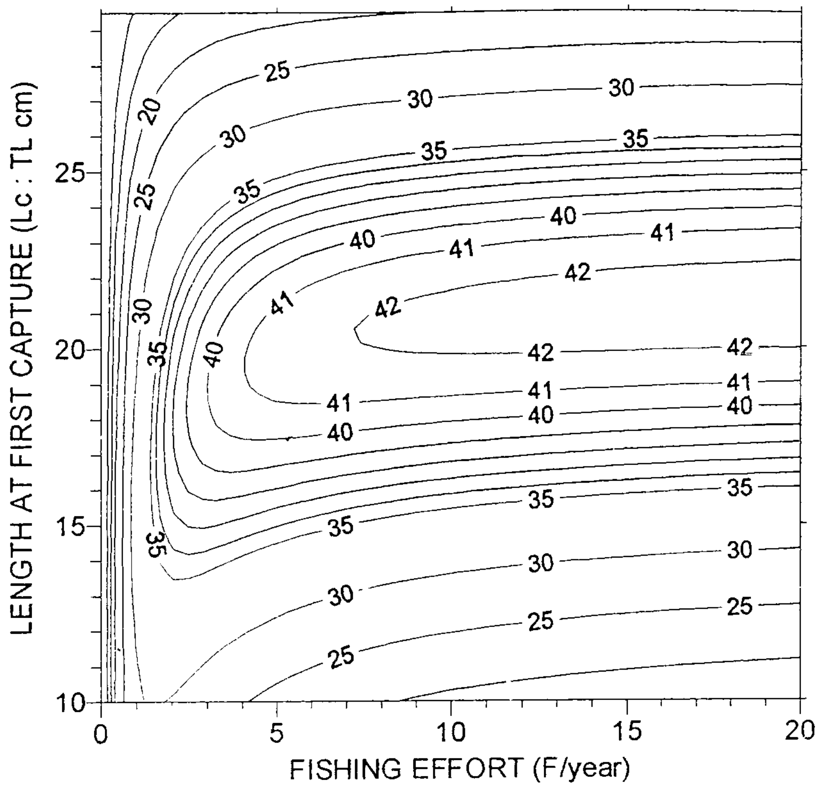


Figure 18: Yield per Recruit (Y/R) isopleth model of *Rastrelliger kanagurta* stock (South China Sea) (Loo = 33.8cm TL, K = 0.54/yr, Woo = 500 gram, M = 1.31/yr, Tr = 0.55 yr = 10cm TL)

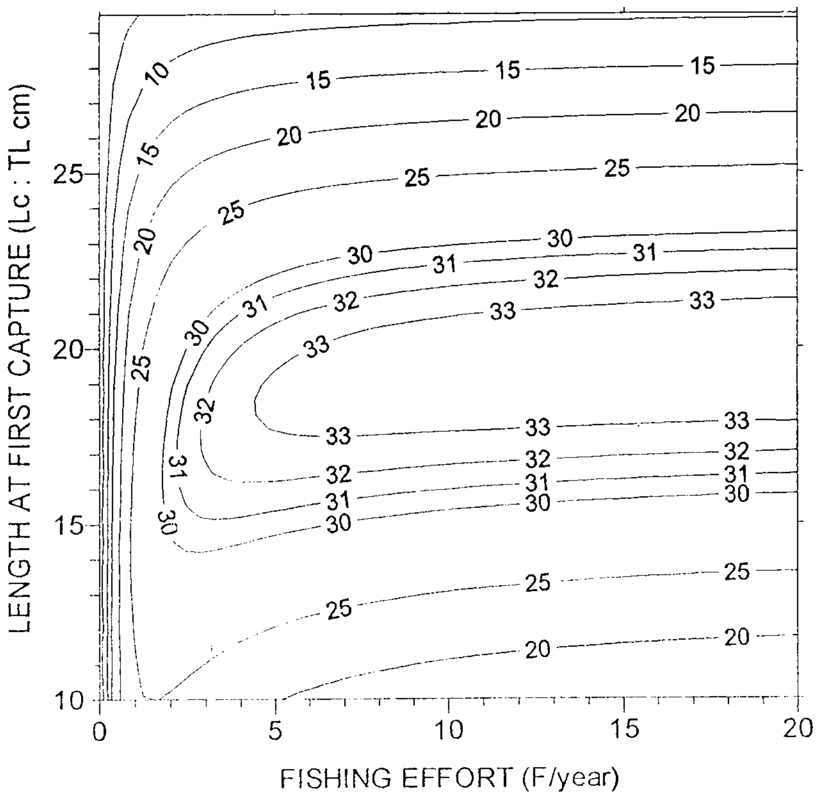


Figure 19: Yield per Recruit (Y/R) isopleth model of *Decapterus ,russelli* stock (South China Sea) (Loo = 27.3cm TL, K = 0.56/yr, Woo = 155 gram, M = 1.28/yr, Tr = 0.36 yr = 5cm TL)

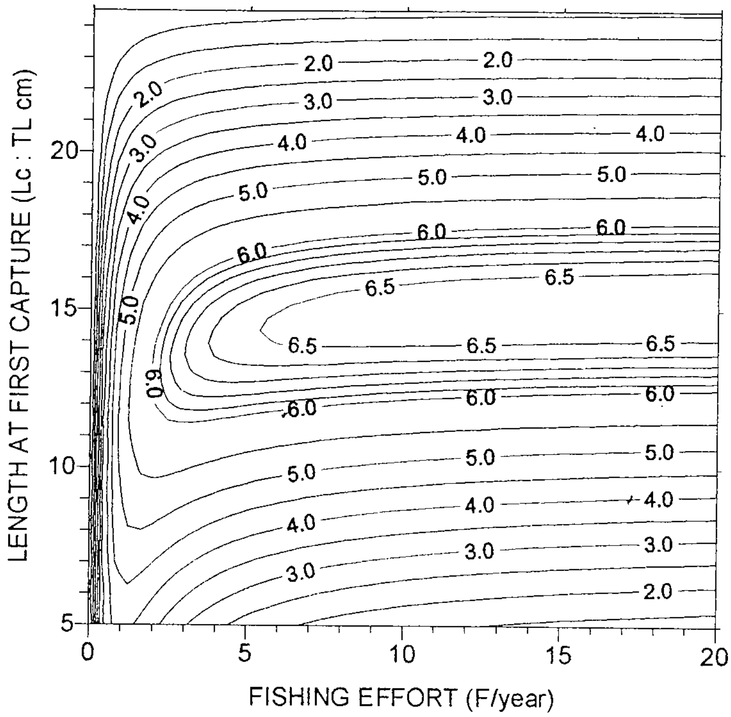


Figure 20: Yield per Recruit (Y/R) isopleth model of *Decapterus macrosoma* stock (South China Sea) (Loo = 30.0cm TL, K = 0.56/yr, Woo = 281 gram, M = 1.24/yr, Tr = 0.33 yr = 5cm TL)

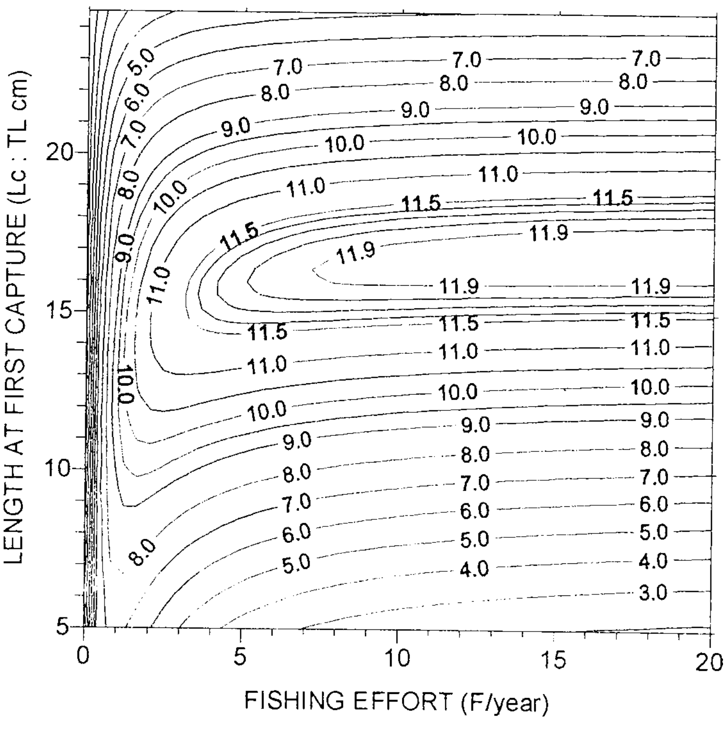
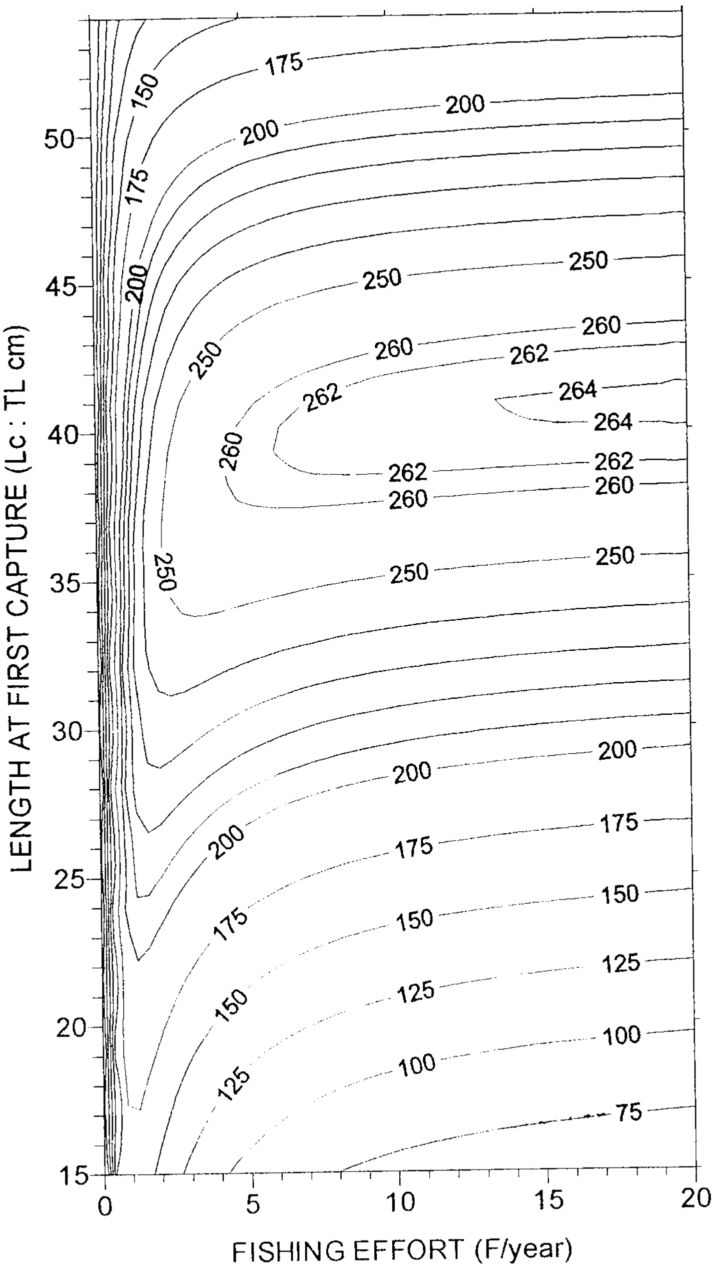


Figure 21: Yield per Recruit (Y/R) isopleth model of *Euthynnus affinis* stock (South China Sea) (Loo = 66.8cm TL, K = 0.52/yr, Woo = 4087 gram, M = 0.95/yr, Tr = 0.50 yr = 15cm TL)



ANNEX 7

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 4

COUNTRY STATUS REPORT

MALAYSIA

(2) SARAWAK

STATUS REPORT: PELAGIC FISH STOCK IN SARAWAK, MALAYSIA

By:

ALBERT CHUAN GAMBANG

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1. INTRODUCTION

- Southern part of the South China Sea
- Current pattern affected by Northeast Monsoon (October to May) and Southwest Monsoon (June - September)
- EEZ area of 160,000km^2; continental shelf area of 125,000km^2
- Water depth: Continental shelf up to 200 metres depth, and reach up to 2500 metres in the northern trend
- 1995, total number of fishermen; 11,659
    * Total number of boats: 4,950
    * No. of boats by Gear Groups;
      Pelagic gear: 1979
      (Purse seine - 25; Drift nets 1,757)
      Bottom trawlers: 778
      (Fish and prawn)
      Others: 648
      (Handline, bottom longline, traps, traditional gear)
- Landing (1980 to 1995) - 85,000 - 100,000 mt
    * Pelagic fish 23%
    * Demersal 60%
    * Others 17%

2. SMALL PELAGIC SPECIES

- Characterised by maximum length of 20-30 cm
- Estimated biomass 216,300 mt, potential yield of 108,150 mt
- Landings (Fig. 2) since 1990, 15,000 - 24,000 mt, increasing yearly
- Pelagic species categorised into the following groups (Table 5)
- Main groups categorised as shared stocks
    * Bigeye Scad, *Selar crumenophthalmus*
    * Round Scad, *Decapterus macrosoma*
    * Hardtail Scad, *Megalaspis cordyla*
    * Sardine, *Sardinella spp*
    * Round Herring, *Dussumiera acuta*
    * Indian Mackerel, *Rastrelliger spp*
    * Arriommatids, *Arriomma sp*
    * Spanish Mackerel, *Scomberomorus guttatus, s. commersonii*
- Landings of main shared stock species as shown in Fig. 2
- These main species occupied 42% of the pelagic catch.

- Pelagic fish as a group are scattered and distributed over a wide area and difficult to harvest unless using FADs.
- No comprehensive study has been carried out on the small pelagic species relating to seasonal patterns, migrations, behaviour, unit stock identification and other biological information useful in the development and management of the stock.
- Some biological studies and information:

Decapterus russelli	-	size range 15.1 - 19.1cm, mean 16.9 cm size at first maturity 16.6 cm
Decapterus macrosoma	-	offshore mean size 31.7 cm coastal mean size 17.1 cm Length-Weight relationship $W = 0.01118L^{2.9532}$
Scomberomorus commersonii	-	size range 19 - 103 cm found at coastal area
Scomberomorus guttatus	-	size range 12 - 17 cm at coastal area size range 58.5 - 86.0 cm offshore area

3. SMALL TUNA

- Usually below 20 kg in weight, mostly at juvenile stage
- Estimated biomass at 90,000 mt and potential yield of 45,000 mt
- Recent years landing has been around 2,000 mt only (Fig. 1)
- Very small compared to potential yield
- Under exploited
- Distribution as shown in Fig. 3. Generally neretic tunas along western part of coastline, oceanic tunas along the eastern coastline where continental shelf are close to shore and towards deeper waters
- Can only be harvested using FADs which attract and segregate tunas
- Larger species, yellowfins, found between northern coastline and Layang-Layang Island
- Average catch rate per FADs per operation range from 10 - 18 mt
- Average size (length 37 - 83 cm, average weight of 0.9 - 10 kg.
- Six main species:

Neretic species:	Kawa-Kawa, *Euthynnus affinis* Longtail, *Thunnus tonggol* Frigate, *Auxis thazard*
Oceanic species:	Skipjack, *Katsuwonis pelamis* Yellowfin, *Thunnus albacares* Bigeye, *Thunnus obesus*

- Seasonal occurrence

- Present around FAD's from March - June, much reduced present from August to February
- Biology:

  Kawa-Kawa - Length at first maturity 39.0 cm

  Growth at 0.16 cm/day
- Studies:

  Tagging experiment was not successful due to poor return of tags
- Present studies carried out on tuna are to assess the effectiveness of FADs in attracting and segregating tuna and their general biology under the IRPA programme

4. LARGE TUNA

- Those tunas more than 20 kg in weight
- Distribution between Luconia shoals to Pulau Layang-Layang and western coast of Sabah
- Assessment by tuna longline shows that average catch rate is 0.41 tails per 100 hooks per operation
- Average site range 10.7 cm-15.5 cm
- Estimated population for the area at 1,500 - 4,000 tails per season
- 2 main species:

  Yellowfin, *Thunnus albacares*

  Bigeye, *Thiunnus obesus*
- Seasonal and shared nutrition behavior
- No biological study yet on large tuna in area

5. SHARKS

- Landing has been around 2,000 mt annually (see fig. 1)
- Caught mostly by driftnets, bottom trawl, barrier net and hook and lines
- Distribution (Fig. 3)
- Species:
- Biology:

6. CEPHALOPODS

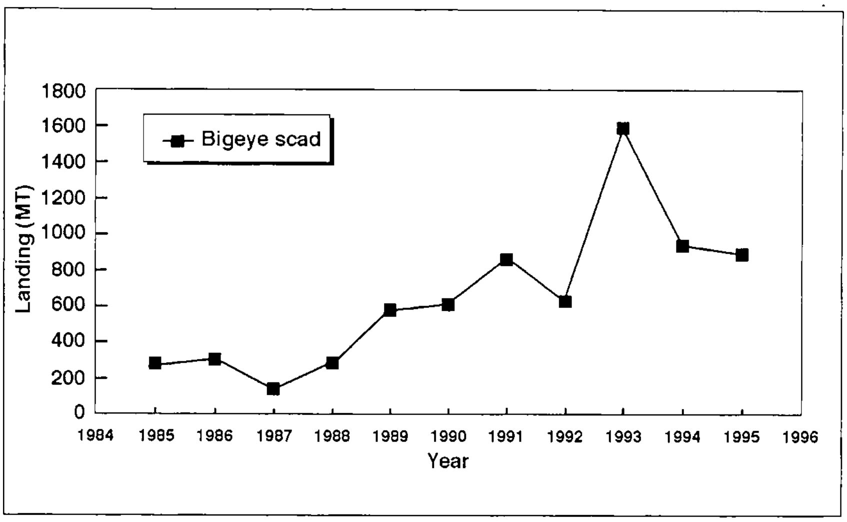
- Landing more than 1,500 mt annually since 1989 (Fig. 1)
- Mostly caught as by-catch of bottom trawl
- Distribution mainly along coastal area of Sarawak
- Seasonal fluctuation, high catch in April/May
- Species:

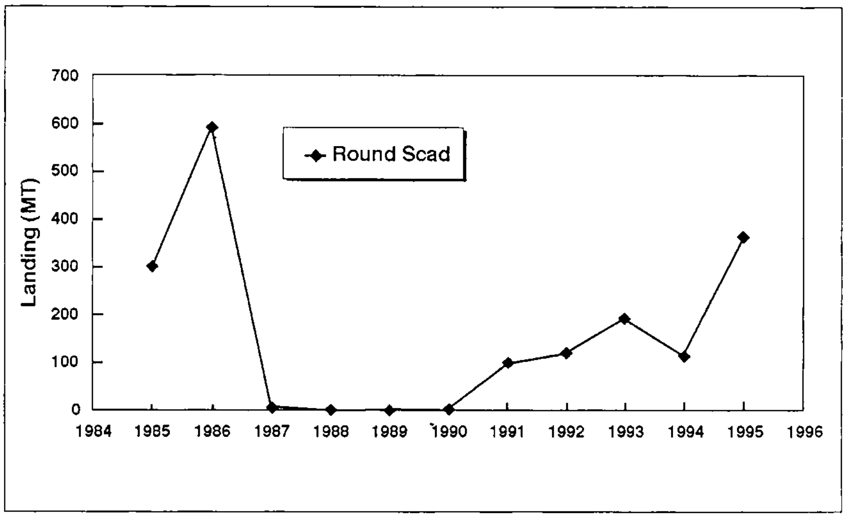
  Squid, *Loligo edulis*

  Cuttlefish, *Sepia esculenta, s. pharoanis*

  Octopus

Figure 2: Trend of Landings for Pelagic Fish Species





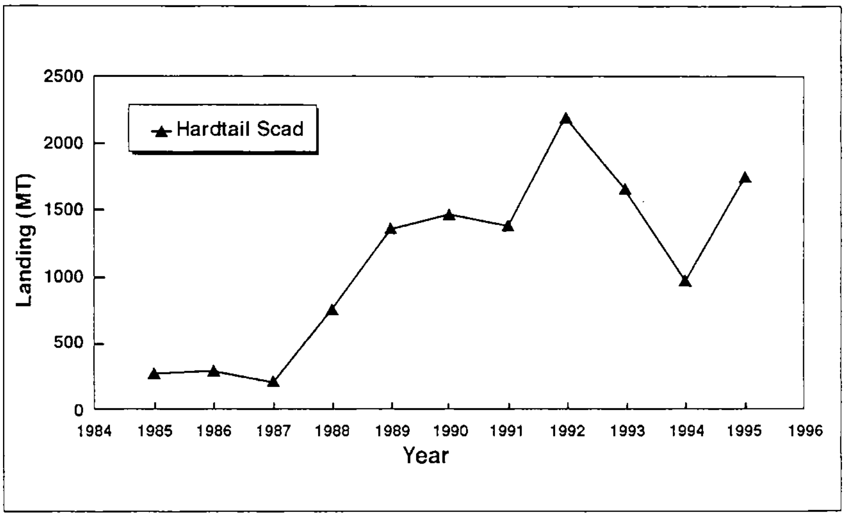
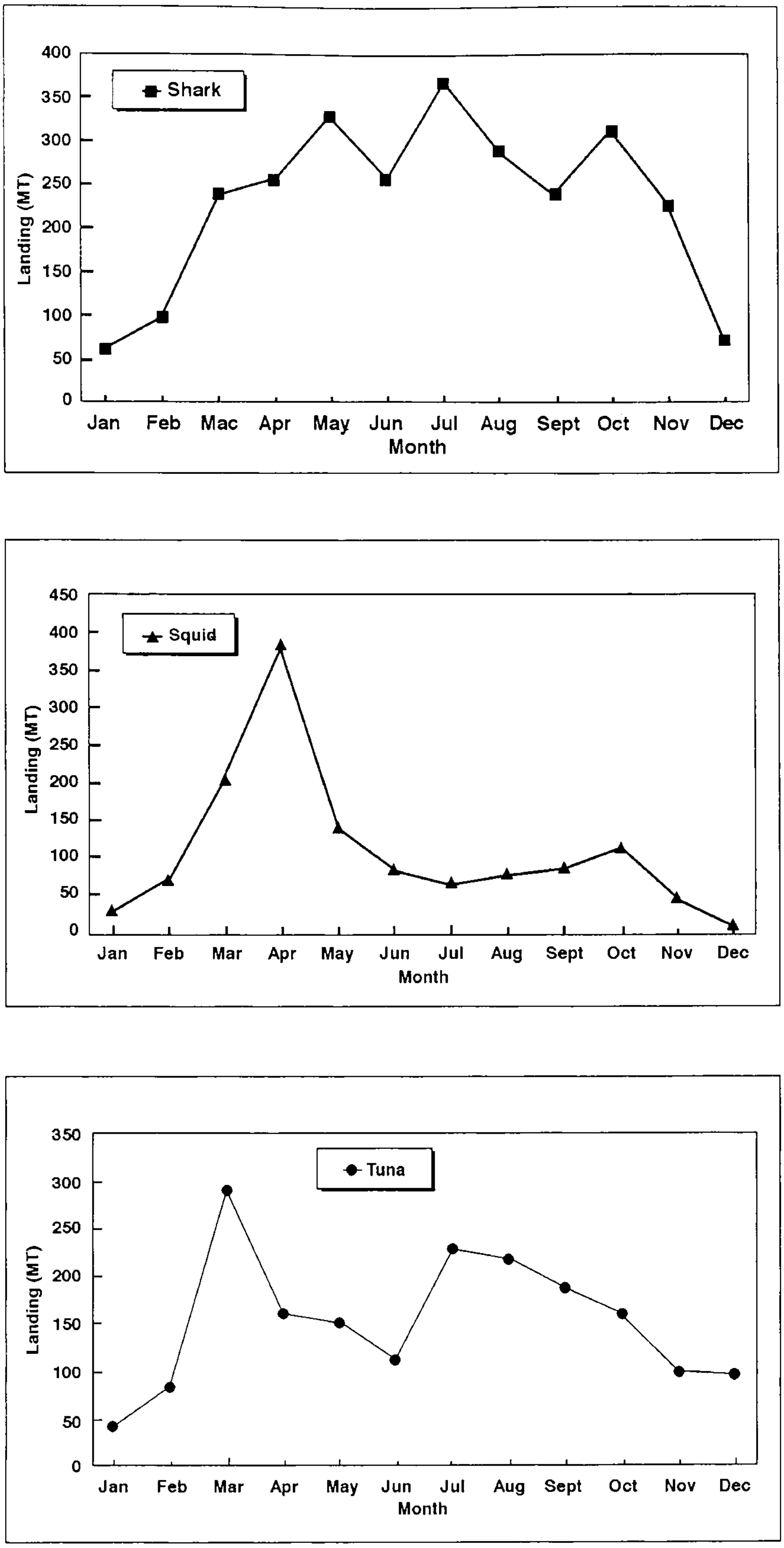


Figure 3: Landing of Species by Months, 1995



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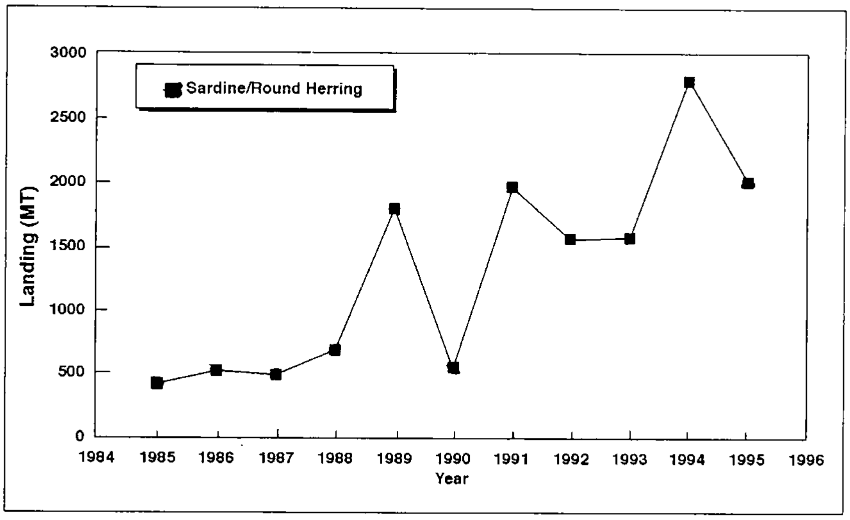

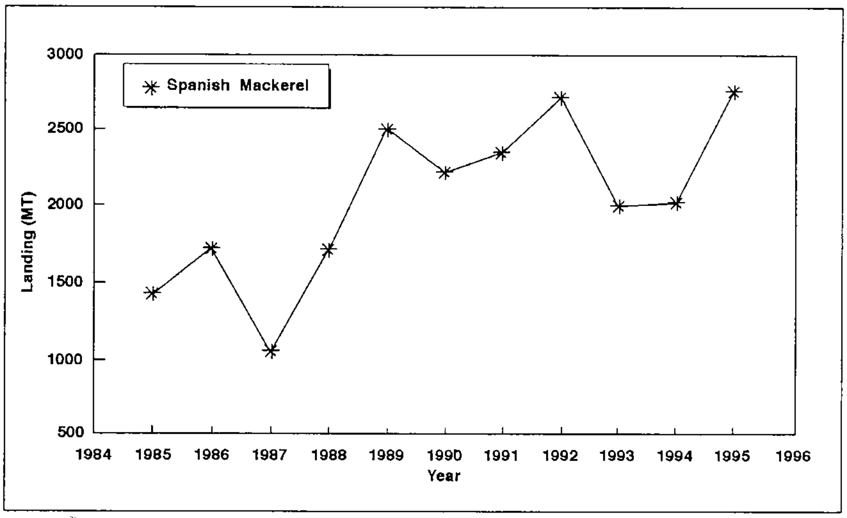

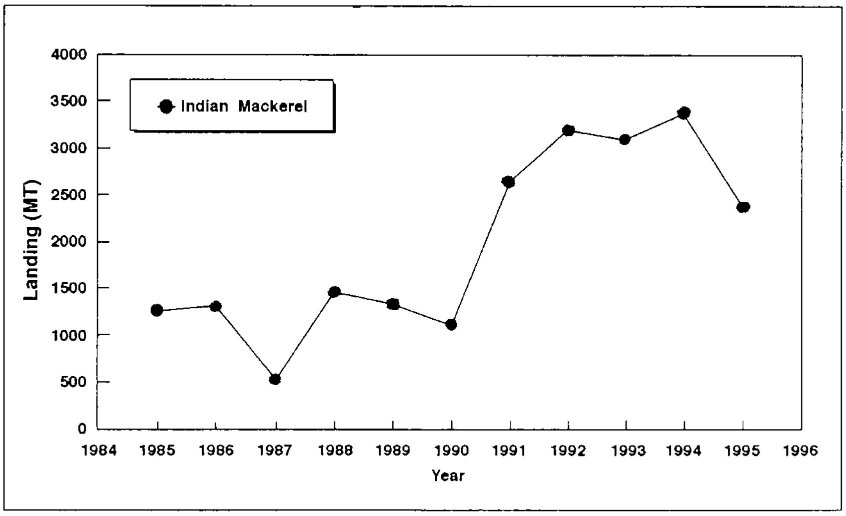

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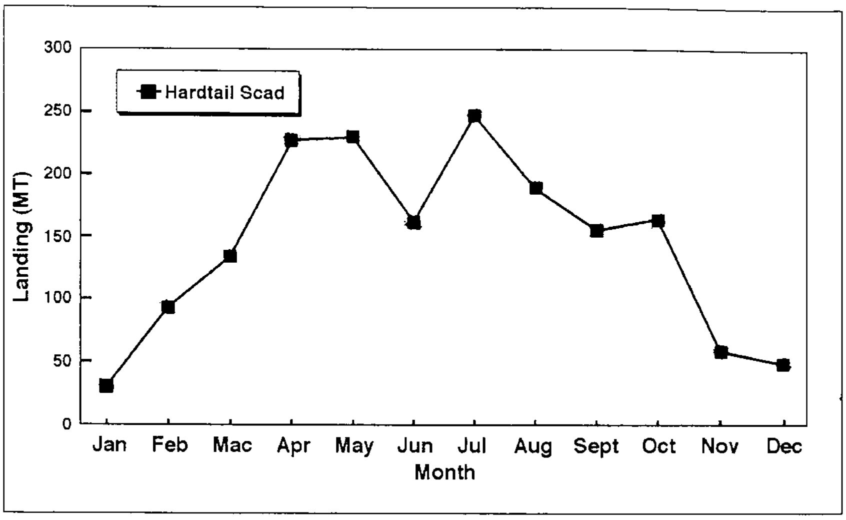

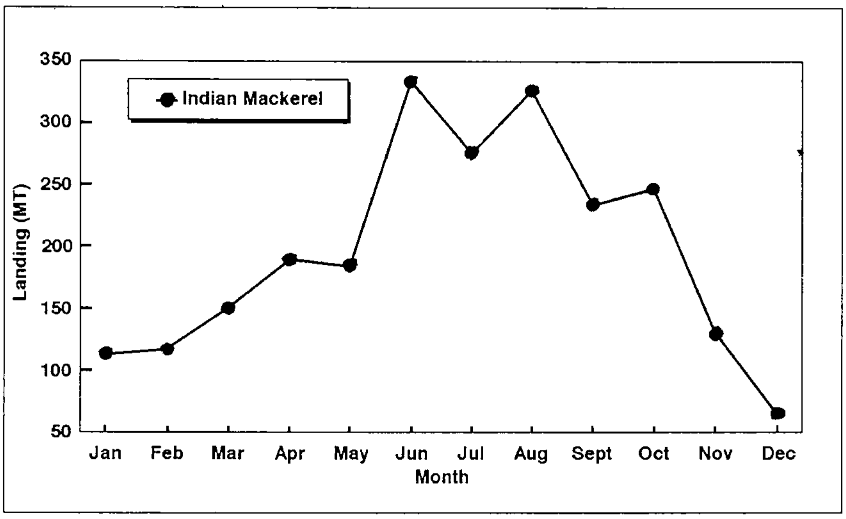

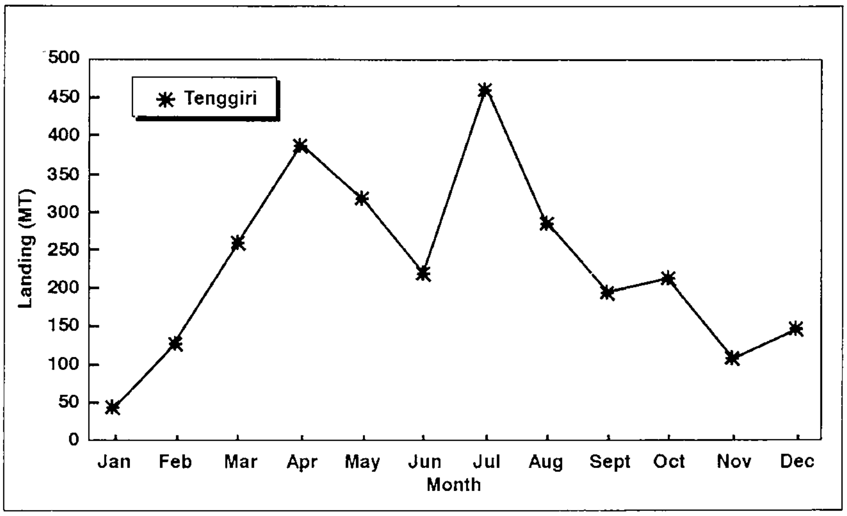

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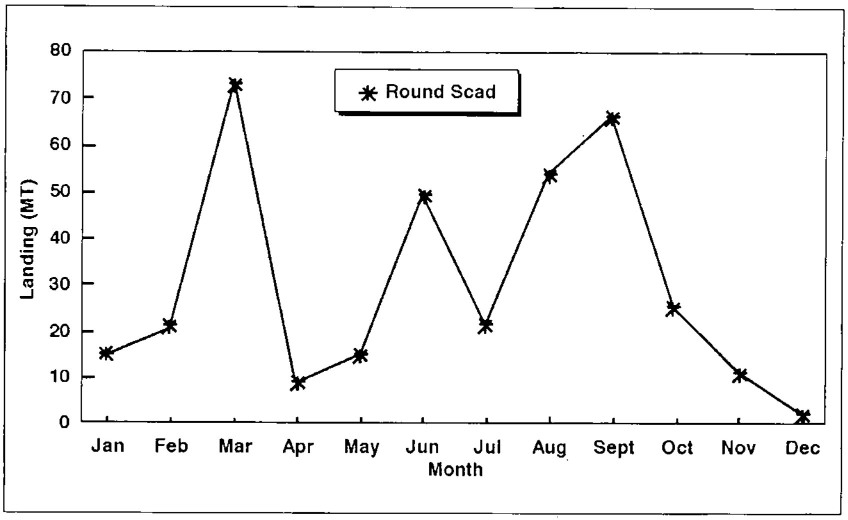
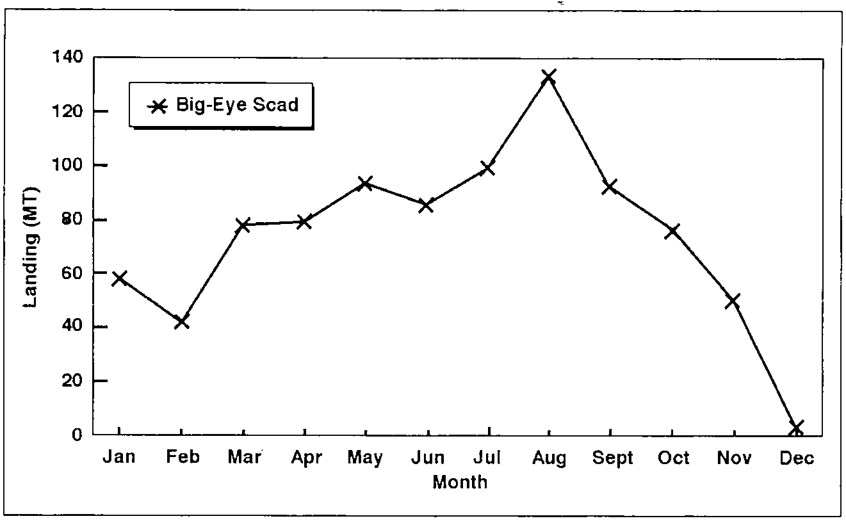




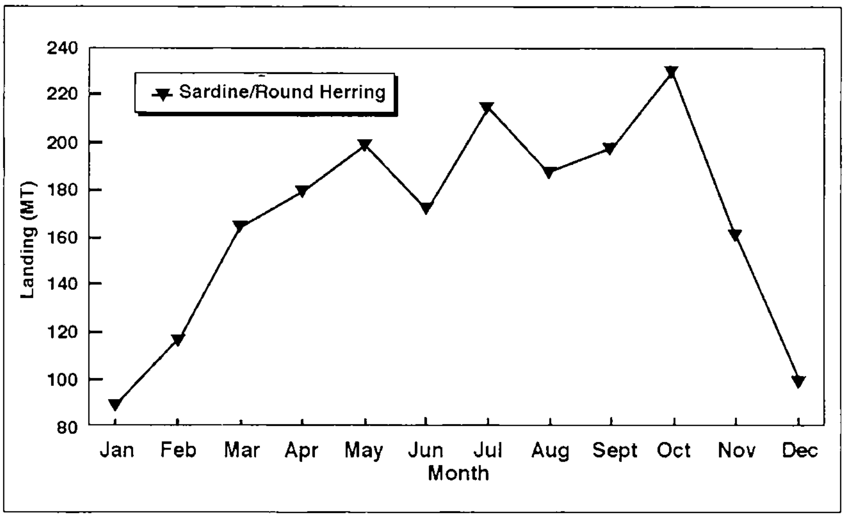
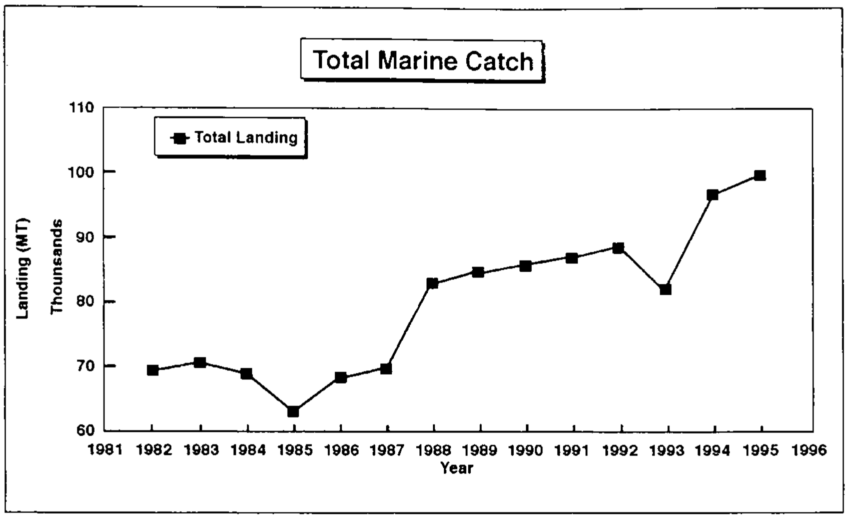
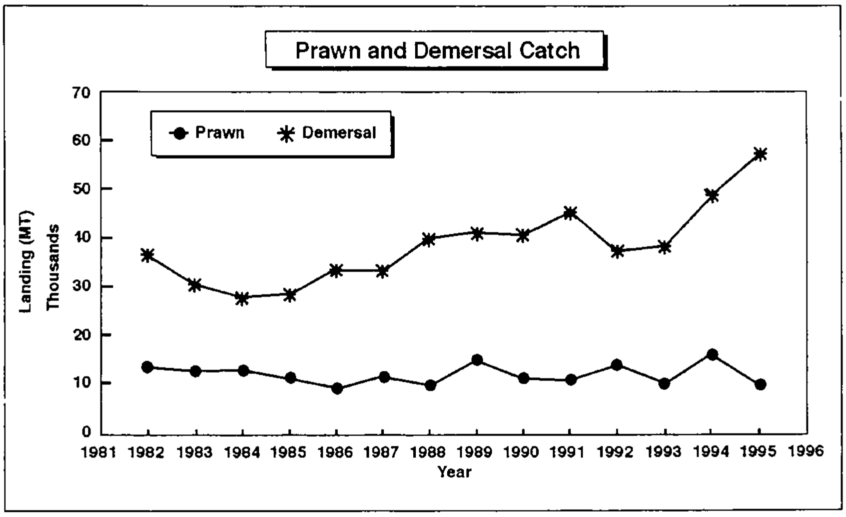


Figure 1: Trends of fish landings for Sarawak





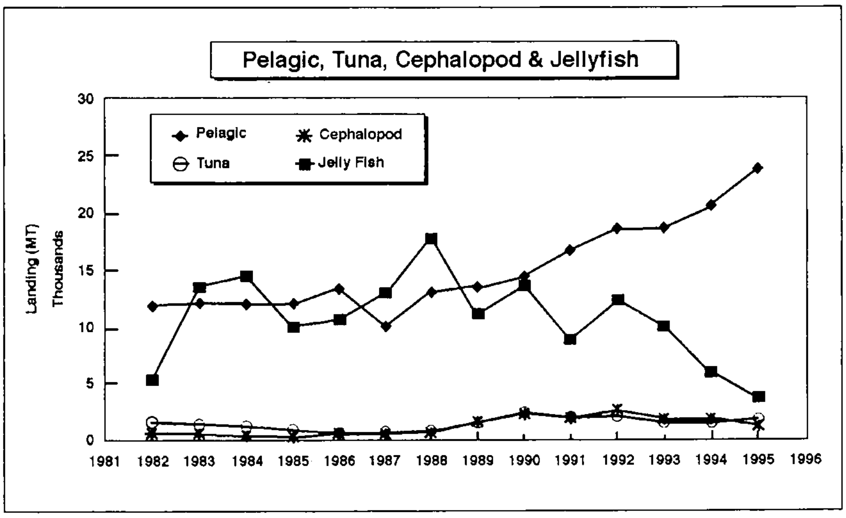
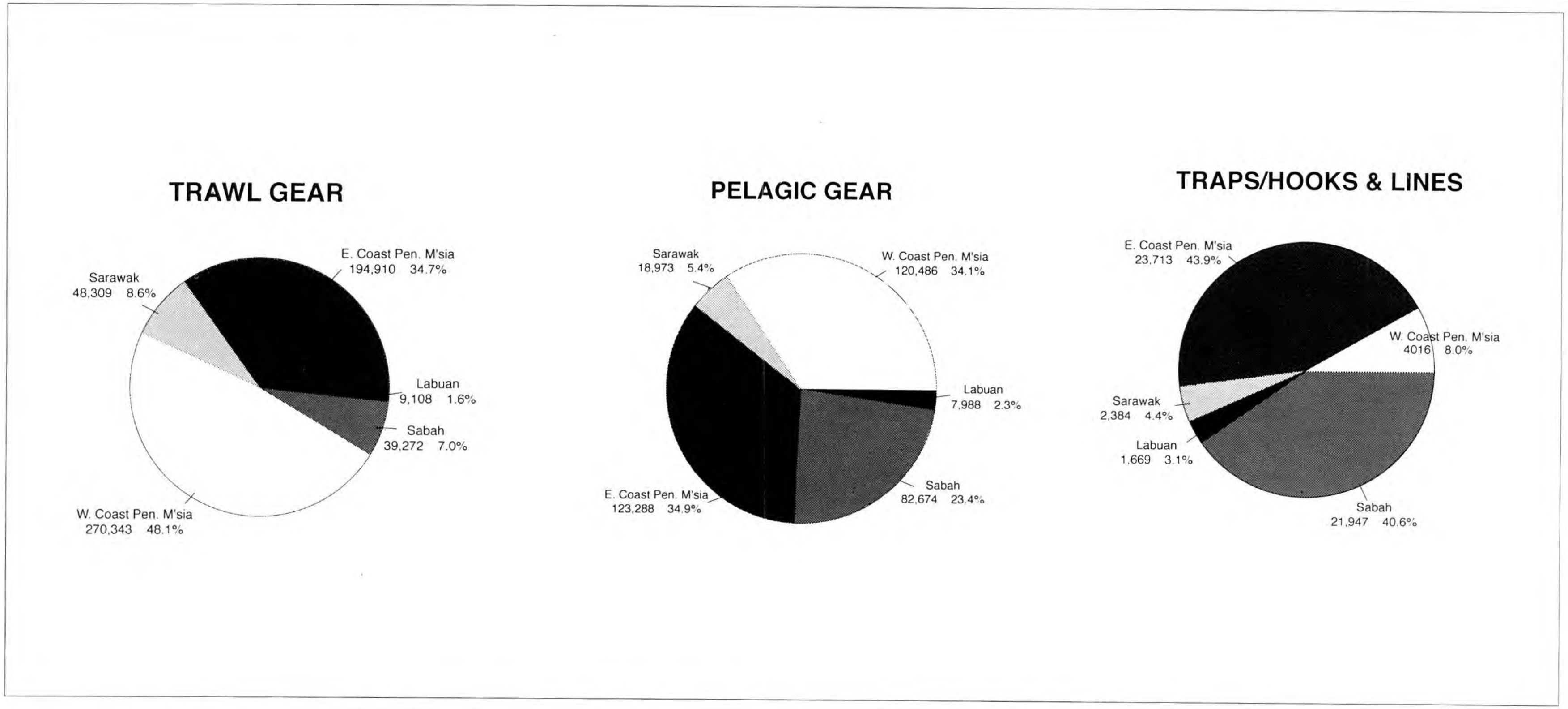


Figure d: Landings (mt) of Marine Fish by Region and Gear Groups (1992).



ANNEX 8

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 5

COUNTRY STATUS REPORT

MALAYSIA

(3) PENINSULAR MALAYSIA

PELAGIC FISHERIES RESOURCES IN THE PENINSULAR MALAYSIA

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1. INTRODUCTION

The fisheries sector in Malaysia plays a significant role with regards to the provision of employment, especially in rural areas, and in the support it provides to economic growth and perhaps most importantly, however, is its role in the provision of fish as food. In 1995, the marine fisheries contributed 1,108,436 tonnes or 89.02% of the total fish production, valued at RM2.711 billion. The rate of demand for fish as the main source of protein is expected to increase from an annual consumption of 630,000 metric tons to over 1,579,800 metric tons by the year 2010 (DOF, 1995). Hashim (1993) reported that in 1991, a total of 175,216 tonnes of fishery commodities were exported, which valued at RM739.7 million. The exports of fishery commodities showed an increase for the last three years from RM577 million in 1989 to RM739.7 million.

Total landing in the Peninsular Malaysia in 1995 had increased by 4.2% from the previous year to 819,464 tonnes. The overall total marine landing for the West Coast of Peninsular Malaysia increased by 14.89% (from 460,302 tonnes to 528,818 tonnes). However, the East Coast of Peninsular Malaysia showed a decrease in its total marine landing by 10.51% (from 324,772 tonnes to 290,646 tonnes).

The deep sea fisheries include vessels of 70 GRT and above operating trawlnet, fish purse seine nets (except anchovy purse seine nets), hooks and lines, have been issued for the vessels of more than 70 GRT in the Peninsular Malaysia out driftnets and operate a distance of above 30 nautical miles from the coast. Presently, 427 licenses of which 135 of them are purse seines. In 1995, the deep sea fisheries contributed a total of 91,997 tonnes of fish landing in the Peninsular Malaysia, which was about 8.3% of the total marine fish landing of Malaysia.

2. TOTAL ANNUAL PRODUCTION AND CATCH RATES

The annual production of *Rastrelliger* spp shows a significant increased from 1994 to 1995 (Fig. 1). The total landings of the *Rastrelliger* spp by all gears had increased by 61.8% from 69,877 tonnes in 1984 to 113,078 tonnes in 1995. The west coast recorded bigger increase of the total landings of the *Rastrelliger* spp by 68.3. In contrast, the total landings of the *Rastrelliger* spp in the east coast shows a decrease by 26% from 16,220 tonnes in 1984 to 12,075 tonnes in 1995. The total landings of the *Decapterus* spp in Peninsular Malaysia in 1995 had increased by 65% compared to year 1984 (Fig. 2). However, the annual production shows the decrease by 17% compared to year 1994.

With the expansion of the maritime jurisdiction, tuna fishery is seen as among the important fishery resources to be exploited. The total landings of the tuna by all gears in the Peninsular Malaysia show a slightly decreased from 1984 to 1995 (Fig. 3) with exceptance of the total landings in 1987 where it showed a slight increase. The total landings in 1984 was 17,723 tonnes and dropped to 10,624 tonnes in 1995. The annual landings of the tuna in the east coast are 2 time higher than the west coast.

Apart from tuna landings by local boats in the west coast, there are the Taiwanese tuna longliners continuing to discharge and export their catches of deep sea tuna at Penang Harbour. Their catches from Indian Ocean fishing areas comprised mostly of yellowfin tuna *(Thunnus albacares)* followed by small quantities of bigeye *(Thunnus obesus)* and other species of sharks, swordfish and small tuna (Chee, in press). Total montly landings ranged from 136 - 2,040 tonnes over the period of 1990 - 1994 (Chee, In Press). From January to July 1995, the average catch per boat per trip ranged from

5.8 tonnes to 8.8 tonnes. The fishing season was similar to that observed for previous years. i.e. peak fishing activity was observed from September/October till March/April the following year.

The maximum sustainable yield for the *Rastrelliger* spp. and *Decapterus* spp. in the west coast calculated through surplus production model estimated to be 45,629 tonnes and 8,419 tonnes respectively and their fMSY in term of horse power are 88,631 and 1,108,126. This brings out the idea that the *Rastrelliger* spp stock in the west coast waters is slightly under-exploited while the catch of the *Decapterus* spp shows the other way round. The estimated potential yield of small tuna solely in the east coast waters with regard to MSY is between 14,000 to 16,000 tonnes.

3. LANDINGS PATTERN AND FISHING SEASON

Generally, the total monthly landings of tuna in the west coast in 1995 appeared to be constant ranging between 100 - 600 tonnes (Fig. 4). The annual production in 1995 had increased by 26.8% for the west coast, however the east coast recorded a decrease of 17.2% (Fig. 5). In the east coast, the fishing activities on the small tunas actively occurred immediately after the end of the north east monsoon March till October.

For the *Rastrelliger* spp, the fishing season in the east coast seems to start from May till October just immediately before the north-east monsoon where the landings range from 1,100 - 2,300 tonnes. While in the west coast the total monthly landings fluctuated between 4,500 tonnes to 13,400 tonnes and decreasing toward the end of the year.

The fishing season of the *Decapterus* spp. in the east coast occurs almost at the same period as of the *Rastrelliger* spp. However, in the west coast there is no clear fishing seasons were observed and total monthly landings ranged from 600 to 1,100 tonnes.

4. FISHING GEARS AND FISHING AREAS

Figure 6 and 7 show the different in catch rates by two major fishing gears; purse seines (Fig. 6) and drift nets (Fig. 7) in the west and east coast of Peninsular Malaysia.

In 1991, there was a sudden drop of the catch rates from these two gears to the range of 13.07 - 4.78 tonnes and 0.42 - 0.73 tonnes for purse seines and drift nets respectively. This phenomenon occurred probably due to a drastic increase of effort level (total no of boats) in 1991.

Purse seine, drift net and trawler are the major fishing gears that catch *Rastrelliger* spp in the west coast waters. Annual total landings in 1995 of the Rastrelliger spp by trawlers, purse seines and drift net had increased in catches by 66.6%, 85.8% and 40.8% respectively. For the tuna and round scads, purse seines contributed more that 90.7% and 58.4% respectively of the total annual production in the west coast. There are two operation methods of the purse seine where they use FAD and spotlight to lure the fish, but the later method is more common and widely used by the fishermen. The trawlers of more than 70 GRT frequently operating using high opening trawl nets and *Rastrelliger brachysoma* form a dominant species caught by this gear.

In the east coast, purse seines from the major fishing gear to catch tuna, *Rastrelliger* spp and *Decapterus* spp. The landings of *Rastrelliger* spp by this gear had dropped from 9,831 tonnes in 1994 to 6,725 tonnes in 1995. Also, the landing of *Decapterus* spp and tuna record the decrease by 23.5%

and 2.6% respectively. Other fishing gears that contribute to the tuna landings in the east coast are longlines and drift nets with the former form the second important gear after purse seines.

Study on the fishing area in the northern part of west coast of Peninsular Malaysia, shows that the majority of the drift netters preferred to operate their vessels in coastal waters. The popular fishing grounds for drift netters in Penang, were located of Pulau Kendi and the coastal areas extending from Teluk Kumbar to Teluk Bahang. Also, areas around Pulau Song-Song, Pulau Bidan and Pulau Langkawi were marked to be the most common fishing grounds for Kedah drift netters (Figure 8). The fishing areas for fish purse seiners were quite dispersed, extended from 10 nm from the coast toward Pulau Perak (Figure 9). Most of them operated away from each other. However, their fishing grounds were easily located by the presence of fish lures.

5. MAJOR PELAGIC SPECIES

In 1995, pelagic fish species primarily *Rastrelliger* spp., *Decapterus* spp., Trevallies group, Sardines, Anchovies and Hardtail scad were mainly caught by purse seines, drift nets, and hooks and lines (Figure 10). The highest landing of *Rastrelliger* spp was recorded in 1995 on the west coast of Peninsular Malaysia at 101,003 tonnes. Tuna catches were dominated by the small neritic species such as Kawakawa (*Euthynnus affinis*), Longtail (*Thunnus tonggol*), Frigate (*Auxis thazard*) and Skipjack (*Katsuwonus pelamis*). The other species caught were the oceanic species; Yellowfin (*Thunnus albacores*) and Bigeye (*Thunnus obesus*)

The catch composition of the tuna group in the west coast is dominated by *Thunnus tonggol* while *Euthynnus affinis* make up only small percentage. In the mackerel group, *Rastrelliger brachysoma* form the most abundance species. There are three species in Genus *Rastrelliger* occur in the west coast; *R. brachysoma, R. kanagurta* and *R. fughni.* Small pelagic caught by the purse seine nets in the west coast waters, mainly from species *Euthynnus affinis, Thunnus tonggol, Decapterus* spp, *Rastrelliger kanagurta. Rastrelliger brachysoma*, and *Rastrelliger faughni.* For the *Rastrelliger* spp., *Rastrelliger kanagurta* normally caught by using FAD while the *R. brachysoma* form the main *Rastrelliger* spp caught by high opening trawlers. Other common pelagic species are *Atule mate, Sardinella fimbriata, Selaroides leptolepis* and *Scomberomours* spp that are also caught by purse seine nets.

The main neretic tuna species in the east coast water comprise of *Euthynnus affinis, Thunnus tonggol* and *Auxis thazard*, where the first two species form the main spp caught by purse seine nets, lift nets and hook and lines. Generally, *Rastrelliger kanagurta* is the dominant species and may be the only *Rastrelliger* spp caught in the east coast waters. For the *Decapterus* spp, it consists of *Decapterus ruselli, D. maruadsi and D. macrosoma* (ANON, 1978). However, in the west coast waters the *Decapterus maruadsi* appeared to be the main and most common spp caught by purse seine nets whereas in the east coast, *Decapterus ruselli* is the major species.

6. FISHERIES BIOLOGY

Biological information of all the small pelagic and tuna species still do not cover various aspects comprehensively. The total length and weight of the *R. kanagurta* ranging from 94 - 277 mm and 71.1 - 257.2 g respectively. The combine length-weight relationship of both juvenile, male and female is W = 3.04 x 10 - 6 L3.245 (Mansor and Abdullah, 1995). For the *Decapterus ruselli*, the size of length and weight ranging from 97 - 168 mm and 9.1 - 167.7g respectively. While the combined length-weight relationship is W = 7.53 x 10 - 6 L3.052.

The growth and mortality parameter recorded by Mansor and Abdullah (1995) for species *R. kanagurta* and *D. ruselli* from the east coast sample are shown in table 1. In the west coast, the average size of *Rastrelliger kanagurta* and *Rastrelliger brachysoma* are ranged from 168 - 228.3 mm and 160 - 197 mm respectively.

Table 1: Growth and mortality parameters of *R. kanagurta* and *D. ruselli*
(*average values from west coast samples)

	L^{∞}	K	M	F
R. kanagurta	252 - 322 29.2*	0.42 - 1.33 0.65*	101 - 214	1.56 - 1.56
Decapterus ruselli	235 - 322	0.56 - 1.10	1.01 - 2.07	0.13 - 3.23
Euthynus affinis	65*	0.5*		

Irregular availability of sample for certain species were the limiting factor on biological sampling. This restricted the ability to provide comprehensive information of the biological aspect particularly on species maturity. Table 1 also shows gonadosomatic indices for small pelagic and tuna species. For *Rastrelliger kanagurta*, highest values of GSI were recorded in March, April and August while for *Rastrelliger brachysoma*, the values seem to be high in all the year round except in August giving suggestion that *R. kanagurta* spawned twice a year while *R. brachysoma* spawned throughout the year.

Study on food habit of small tuna species in the east coast, shows the primary food items of the species consist of squid, anchovies, Indian mackerels and filefishes (Zainuddin and Noordin, unpublished). Landing pattern of the tuna species seems to exhibit similar trend of these prey particularly the squid and Indian mackerels that prove the close prey-predator relationship between tuna and these respective preys.

Study on *Rastrelliger brachysoma*, at one of the major landing centre in the west coast showed that in 1994 the monthly mean length of *R. brachysoma* ranged from 15.5 cm to 19.4 cm total length, and from January to May 1995 the monthly mean size of fish fluctuated between 18.0 cm and 19.6 cm.

Larger fish were sampled in the last quarter of the year, while the smallest average size of fish were sampled in February and June. In December 1994, the GSI of 7.7% calculated for male fish and 6.2% for female fish were highest value recorded. This coincided with the time when the largest size fish were recorded suggesting that *R. brachysoma* could spawn just after the last quarter of the year and the young fish could then recruit into the fishery in the first half of the following year.

However other possible smaller spawning peaks could accur as suggested by the fluctuating GSI. Thus it is concluded that mature fish could be found throughout the year but the spawning intensity may vary monthly to result in one major and other minor spawning peaks.

7. OCEANOGRAPHIC INFORMATION

Very few data regarding oceanography information on the coastal and offshore fishing areas are availabled. However, since 1992, study on fisheries oceanography have been carry out in the west coast particularly in the coastal areas off the northwest Peninsular Malaysia. Monthly data collection for certain parameters are still being carried out and it will be part of future fisheries research activities. On the deep-sea fishing areas, the oceanographic data collection were carried out along with the regular monthly monitoring to locate the main offshore fishing areas by using Resource Management Vessel.

Certain water quality parameters like dissolved oxygen, sea surface temperature, salinity, pH and conductivity were collected to study the relationship between certain water quality parameters with the distribution and seasonal movement of fish. In 1995, the average values for sea surface temperature, dissolved oxygen, conductivity and salinity in the northern part of west coast of Peninsular Malaysia were 30°C, 6.1 mg/1, 49.5 umhos/cm and 32 ppt, respectively. The relationship between the parameters with the distribution and seasonal movement of the fish will be studied when more data are collected.

Generally, the sea surface temperature in Malaysia waters is relatively constant throughout the year, ranging between 26.1°C to 32.2°C (Fisheries Research Institute, 1987). During the north-east monsoon period, the temperature range between 26.1 to 28.8°C but during the off monsoon period, the range is 28°C to 30°C. The average surface water temperature during the south-west monsoon period in the east coast of Peninsular Malaysia is 30.5°C and it range between 28.8°C to 32°C (Hamid, 1989).

The surface salinity in the west coast of Peninsular Malaysia during the north-east monsoon period ranged between 27 to 33.3 ppt, and at the depth between 13 to 21 m, the salinity ranged between 25.4 to 33.4 ppt (Samsuddin, 1995).

In term of bottom topography, the depth of water off the west coast of Peninsular Malaysia seldom exceeds 120 m within the Malaysian EEZ, where the deepest part is at the northern tip of the Straits of Malacca or the eastern part of Bay of Bengal, where the two water bodies meet. It has a distinctly large area of mud-flats, running north-west from the central part of the coast. The east coast of Peninsular Malaysia has a relatively flat sea bottom. Again the depth of the water is seldom deeper than 100 m (Abu Talib and Alias, 1997)

8. RECOMMENDATIONS FOR REGIONAL COLLABORATIVE EFFORTS

Regional collaboration effort of the topic of sustainable exploitation of shared stocks should be viewed on:

(i) Formulation a research framework approach that can be adopted by each participating countries for shared stocks assessment purposes.

(ii) Discuss ways and means how these data can be utilized in the assessment on the status of the stocks and in providing measures for the management purposes.

(iii) Discuss ways and means how these data can be shared by all participating countries in the form of database using available information technology facilities.

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ANNEX 9

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 6

COUNTRY STATUS REPORT
PHILIPPINES

SMALL PELAGIC FISHES IN THE PHILIPPINES

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1. INTRODUCTION

The Philippines is a major fishing country. Considering the geographical characteristic and open access to its fishery resources, an estimated 12% of the population or roughly seven million Filipinos are dependent in some way on the fishing sector (Librero, 1985). The country's fishing industry itself provides employment to about a million Filipinos or 5% of the country's labor force (BFAR, 1996). Fish, a staple food for the Filipinos, provides 50-70% of the animal protein requirements (Ronquillo, 1975; Gonzales, 1985) and its production supports various sectors in the country's economy.

Production of marine fisheries for 1996 (Table 1) was estimated to reach 1.6 million metric tons (mt) or about 58% of the total fisheries production of 2.7 million mt (BFAR. 1996). Small pelagic fisheries contributed more than half of the marine fisheries production and about one-quarter of all fish landed in the Philippines. From 1984 to 1995, average annual catch of small pelagic fishes ranged from 652,532 mt to 976,333 mt or about 54.48% of the total marine production (Fig. 1).

Major small pelagic fishes landed, based on the average annual catch from 1984 to 1995 were Carangidae (36.4%), Scombridae (28.1%), Clupidae (18.6%) and Engraulidae (11.7%) (Fig. 2).

Based on the total commercial landings covering the period of 1991-95, the major fishing grounds for small pelagic fishes were South Sulu Sea (17.4%), West Palawan Waters (16.8%), Visayan Sea (14.9%) and Moro Gulf (7.2%) (Fig. 3).

This paper is a synthesis of all available data and information on small pelagic species selected for the third regional workshop on shared stocks in the South China Sea area. However, omission of some small pelagic species recognized in the recently APFIC meeting resulted to a minimal variations in some of the statistical figures.

2. STATUS OF SMALL PELAGIC FISHERIES

The Philippine small pelagic fisheries, as described by Dalzell *et al.* (1990), share four characteristics with that of the other fisheries in the South-East Asian region namely:

1. They are open access fisheries with little regulation,
2. They are both multispecies and multigear fisheries,
3. They are composed of relatively few commercial fishermen and large number of municipal fishermen, and
4. They are grossly overfished.

Several studies have also concluded that the small pelagic fisheries in the Philippines are biologically and economically overfished (Dalzell *et al.*, 1991, 1988a, 1988b, 1987a, 1987b). This is in fact, the significant finding of the Small Pelagic Management Project conducted by the Philippine Bureau of Fisheries and Aquatic Resources in collaboration with ICLARM last 1987 to 1988 which resulted to several publications describing the status of small pelagic fisheries in the Philippines.

A countrywide estimate of annual maximum sustainable yield (MSY_{ii}) for small pelagic fishes was about half a million tons which could be taken with about half of the present levels of fishing effort (Dalzell *et al.*, 1987b) (Fig. 4). Correlation in the time series data of total small pelagic catch, fishing effort and catch per effort from 1948 to 1986 indicated overfishing (Fig. 5). The data showed that rapid increase in fishing effort began in mid 60's. Catches also increased rapidly from late 60's until early 70's and became erratically decreasing until mid 80's. The overall trend for catch per effort was continuously declining. Based on these findings, the author recommended to reduce fishing effort on both municipal and commercial fisheries and further suggasted the following steps to be implemented:

1. Selective bans or total closure of fishing grounds that are overfished and effective enforcement.
2. Reduction of both municipal and commercial fleet sizes and numbers of fishermen. A regulatory step would be to put a moratorium on the issuance of licenses or increase in license fees.
3. Increase other livelihood opportunities other than fishing for municipal fishermen.
4. Regional strengthening of fisheries management.
5. And continuous monitoring of Philippine small pelagic fishes to provide greater information on the status of fish stocks.

The above management measures which could be implemented to revive the dwindling small pelagic resources of the country was extensively discussed by Dalzell *et al.* (1991; 1988). Finally, management options for Philippine small pelagic fisheries was also presented by the same author (Dalzell *et al.*, 1991) (Fig. 6).

3. PRESENT MANAGEMENT ISSUES AND STRATEGIES

The Philippine government through the Bureau of Fisheries and Aquatic Resources (BFAR), the agency responsible for fisheries monitoring and management, focused management programs not only for small pelagic fisheries but for the whole fisheries resources in the Philippines. The following are its highlighted efforts:

1. The ADB-funded fisheries Sector Program (FSP) implemented in 1991 to 1997 was an initial program of the government to address marine resource enhancement, environmental rehabilitation, control of destructive fishing activities and improve law enforcement through a community based management approach in the 12 priority bays of the country.
2. Monitoring, Control and Surveillance (MCS) System for the Philippines coastal areas and Exclusive Economic Zone is in its way for implementation. By its definition from Food and Agriculture Organization (FAO), monitoring involves data collection and analysis; control involves in legislation and formulation of administrative ordinances; and surveillance involves in law enforcement. The main thrust of the program is to provide a credible deterrent to the violation of fishery laws and regulations and prevent unlawful foreign and domestic fishing in the Philippine waters. In the conduct, it will include the collection of information on fishing effort/catches, vessel traffic and ocean sector activities, and such other data that are needed in formulating national policies or laws and making strategic and tactical decisions regarding ocean planning and management including enforcement (BFAR Primer).
3. The National Fishery Resources Assessment Program started its implementation last year in the fourteen regions in the country. The program is geared toward strengthening regional capability and establishment of continuous monitoring and analysis of landed catch and effort of fishery resources. This will also answer to the need of localization of fishery management and the improvement of the quality of stock assessment data needed to support future formulation of fisheries management options in each region of the country. The impact of the above FSP program in the coastal resources may also be deduced from the assessment results.

program in the coastal resources may also be deduced from the assessment results.

In addition, the following steps were recommended and are being implemented by the government:

1. Moratorium in the inssuance of commercial fishing boat license (CFBL) for new fishing vessels except for large fleet that will operate in the EEZ and international waters is formulated for the approval of the Secretary of the Department of Agriculture.
2. Regulation on the use of fine mesh nets in fishing under fisheries Administrative Order No. 155 and 188;
3. Encouragement of the larger commercial fishing fleets to fish offshore or enter into joint-venture agreement with other countries with room for expansion of their fisheries.

Presently, there is a pending Bill, known as the "Fisheries code" being deliberated in the congress of the Philippines. The Bill entails the provisions for the development, management and conservation of the fisheries and aquatic resources. It has also provisions to revert BFAR into a line bureau from being a staff bureau. Consequently re-establishment of BFAR's regional offices will strengthen further fisheries administration at the regional level.

The obvious need for small pelagic fisheries is to reduce fishing effort and reallocate the excess to lightly fished areas. There are indications that this expansion has occurred since the work of Dalzell *et al.* (1987), (Barut *et al.*, 1997).

4. CATCH-EFFORT AND FISHING GEAR

Small pelagic fisheries in the Philippines consist of commercial and municipal landings, whereby the former involves fishing vessels of more than 3 gross tons and operates within water areas beyon 15 km away from and parallel to the coastline unto the limits of EEZ. While municipal landings on the other hand involves fishing vessels of less than 3 gross tons and operates within water areas from the shore unto the perimeter 15km away and parallel to the coastline.

Commercial landings constitute greater share in the small pelagis fisheries. It was estimated to have an average annual catch of 477, 486 metric tons or 57% of the annual small pelagic landings. Commercial catch showed an increasing trend from 323,680 mt in 1984 to 639,256 mt in 1995 (fig. 7) Prior to 1986, the quantities of commercial landings were inferior to the municipal landings. However from 1986 to 1995, the former surpassed the latter and increased continuously. The increase in catch most especially during the 90's was attributed to the expansion of fishing activities towards the high seas. While municipal landings, on the other hand, produced an average annual production of 356,080 mt or 47% of the total small pelagic catch. Annual municipal catch had miimal varioation with catch ranging from 318,377 to 392,266 mt. The trend had a slight increase from 332,509 mt in 1985 to 392,266 mt in 1990. After 1990, the catch declined gradually to 318,377 mt in 1995. The decrease in municipal catch during the 90'2 was not clearly defined. However, it was assumed that municipal fishing folks shifted from catching small pelagic to large pelagic species due to higher economic value.

Roundscads (*Decapterus* spp.) dominated the commercial catch with an average annual catch of 189,993 mt comprising 40% of the total annual small pelagic catch followed by sardines (*sardinella* spp.), 92,115 mt; frigate & bullet tunas (*Auxis* spp.), 55,214 mt; mackerels (*rastrelliger* spp.0, 40, 251 mt; achovies (*stolephours* spp.), 33,102; and others (Fig. 8).

The bulk of commercial landings of small pelagic species were caught by purse seines contributing 59% of the total catch from 1991 to 1995 followed by ringets, 20%; bagnets, 9%; trawls, 6% and others (Table 2).

Unlike commercial catch, no single species distinctively dominated the municipal small pelagic landings (Fig. 9). Anchovies (*Stolephorus* spp.) ranked first with an average annual landings of 64,983 mt followed immediately by sardines (*Sardinella* spp.), 63,630 mt; frigate & bullet tunas (*Auxis* spp.), 44,838 mt; mackerel (*Rastrelliger* spp.) 37,459 mt; and other. Roundscads ranked fifth due to its oceanic dwelling behavior (*Dalzwell,* 1987).

Though inventory was conducted in selected priority bays of the FSP in 1993, data on municipal fishing gears directed to small pelagic fisheries were incomplete.

5. BIOLOGICAL PARAMETERS

Roundscads

Most biological studies were concentrated on the two dominant species of genus *Decapterus* (roundscads) namely *D. macrosoma* and *D. russelli.* Spawning period for these species was from November to March in Palawan waters and extends up to April and May in manila Bay (Tiews *et al.*, 1970). Recruitment into the fishery accurs from January to April (Dalzell *et al.*, 1987) with lengths between 10 to 12 cm towards the end of their first year of life (Tiews, *et al.*, 1970); Ingles and Pauly, 1984). For Camotes Sea ringnet fishery in Central Visayas, the two recruitment peaks that were observed in a year may be associated with the two major monsoon periods in the Philippines. In the same area, the mean length at firs capture for D. macrosoma wa 12.9 cm and for *D. russelli* was 4.5. cm (Jabat and Dalzell, 1988).

Estimation using growth parameter revealed that roundscads have a maximum lifespan of 3-5 years (Dalzell and Ganaden, 1987a). Ingles and Pauly (1984) computed the life span of *D. macrosoma* and *D. russelli*, at 3.2 and 2.3 years respectively. Corpuz *et al.* (1985) also computed the life span of *D. maruadsi* to be 4.2 years. Results of estimated growth and mortality parameters of Philippine roundscads from different authors are given in Table 3.

Sardines

FAO (1985) suggested that stocks of sardines in Southern Visayan Sea/Bohol Sea are contiguous with those of Sulu Sea and Celebes Sea. The lifespan of sardines in general appears to be 2-3 years and probably up to 4 years (Calvelo, 1997). *Sardinella longiceps* is the prevalent species in Camotes Sea with lengths ranging from 11.5 cm to 19.5 cm (Bognot, 1996). Some estimates of growth and mortality parameters of *Sardinella fimbriata, S. albella, S. longiceps and Amblygaster sirm* are presented in Table 4.

Anchovies

Substantial studies have been undertaken on the biology of *Stolephorus* anchovies. Aside from biological studies by Tiews (1962) and Tiews *et al.* (1970) estimates of the growth and mortality of several anchovy species were made from length-frequency data by Ingles and Pauly (1984), Corpuz *et al.* (1985) and just recently by Gonzales *et al.* (1997). Tiews *et al.* (1970) indicated that *S. heterolobus, S. devisi and S. punctifer spawn* through out the year but the peak of the activity is associated with northeast monsoon season (October to March). The average life span of stolephorids are 1-2 years, however with *S. indicus*, the largest in the genus, it could reach up to 2 years (Calvelo, 1997). Pauly (1982) has performed yield-per-recruit analyses of *S. heterelobus, S. indicus,* and *S. commersonii* in San Miguel Bay and showed that the mesh size being used are far too small for efficient exploitation of said species.

Indo-pacific mackerels

There is little biological information on the various stocks of mackerels in the Philippines. Some estimates of growth and mortality parameters of *Rastrelliger kanagurta, R. faughnii and R. brachysoma* in Philippine waters have been made by the use of length-frequency data (Table 5). The spawning grounds were presumably in deeper water and recruitment patterns are generally either unimodal or bimodat (Dalzell and Ganaden, 1987). Growth parameters estimates for *R. kanagurta* and *R. brachysoma* suggest that life span of these mackerels are between 1.5 and 2 years (Ingles and Pauly, 1984).

Small tunas

The species of small tunas referred here are *Auxis thazard, A. rochei* (frigate and bullet tunas) and *Euthynus affinis* (kawakawa or eastern little tuna). The spawning season of *A. rochei* occurs in March, May to July and November to December in Batangas Bay (Arce, 1987). While for kawakawa, the spawning is all year round (Wade, 1950b). Data of size ranges of small tunas caught from Southern Philippines suggests that the exploited stocks are juveniles. Moreover, it appeared that there was a continuous recruitment into the fishery since size composition did not very through the years (Arce, 1995). In Camotes sea, the modal size of *A. rochei* caught by ringnet around payao was 21 cm implying that the fishery is composed of fish of 1 to 2 years of age based on report that *A. rochei* reach 17, 29, 35 and 42 cm (FL) at ages of 1 and 4 years, respectively (Calvelo, 1997). Estimations of growth and mortality parameters are presented in Table 5.

6. OCEANOGRAPHIC, REMOTE SENSING AND ENVIRONMENTAL DATA

Oceanographic studies in the Philippines have been very limited due primarily to the absence of a research vessel for its conduct. Current researches are focused on coastal oceanography particularly on the study of some hydorlogical and climatological parameters and its effect on the distribution and abundance of toxic dinoflagellates in selected areas (Bajarias, 1993, unpublished). Hence, present oceanographic data cannot be correlated with the small pelagic catch. Available oceanographic information presented in the 2nd workshop has no updates.

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Figure 1: Percentage share of small pelagic to the total marine landings

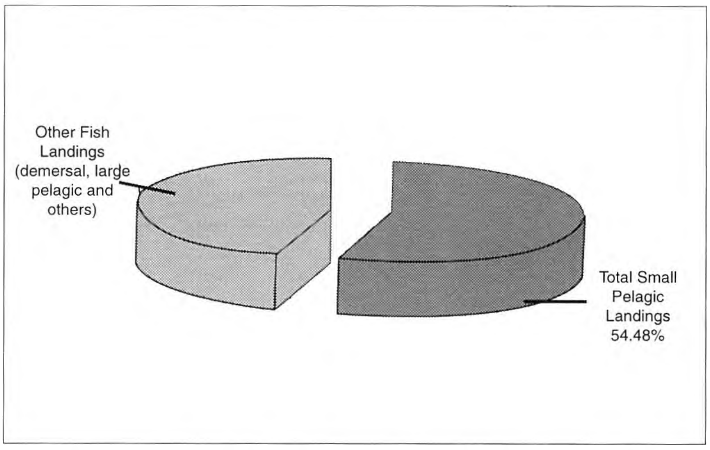


Figure 2: Catch distribution by abundance (mean annual landings, 1984-95)

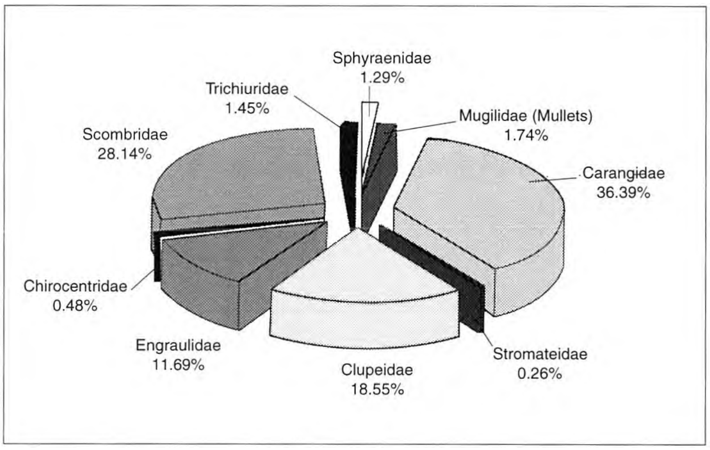


Figure 3: Catch distribution by fishing grounds (mean annual catch, 1991-95)

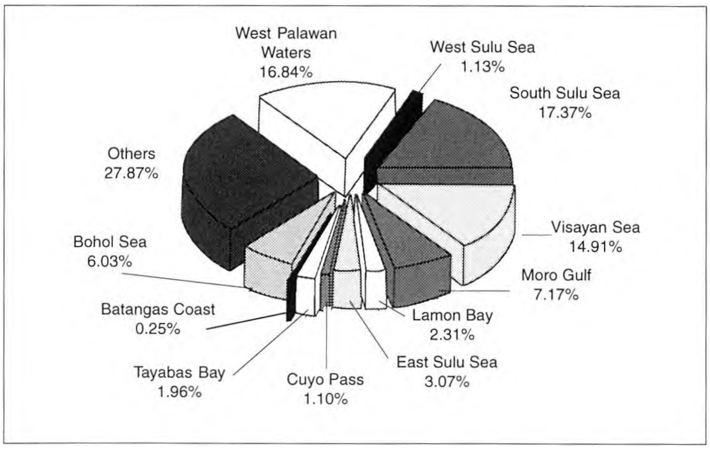


Figure 4: Surplus production model of small pelagic fisheries in the Philippines providing estimates of MSY and economic rent for exploitated areas/resources (Source; Dalzell et al., 1987)

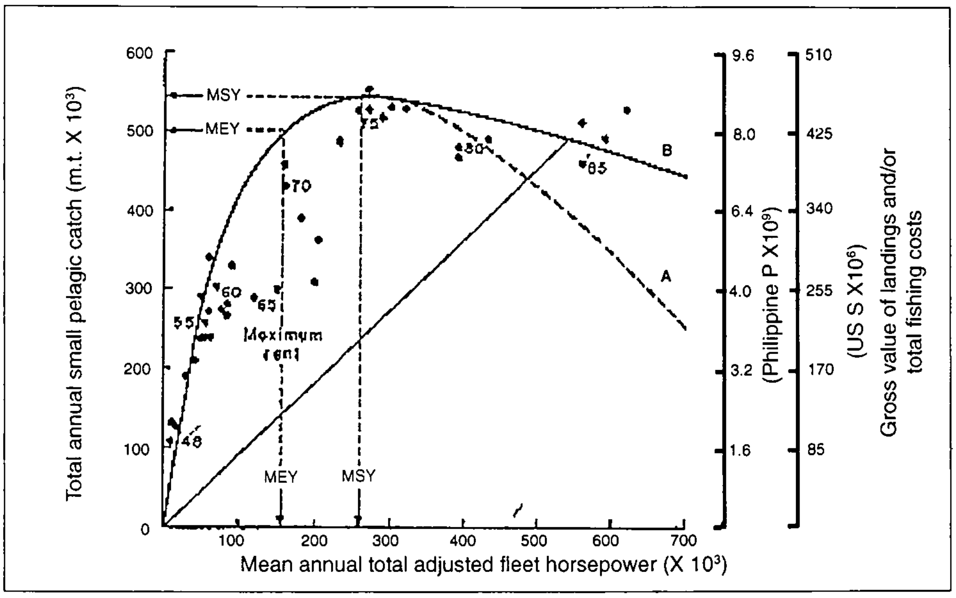
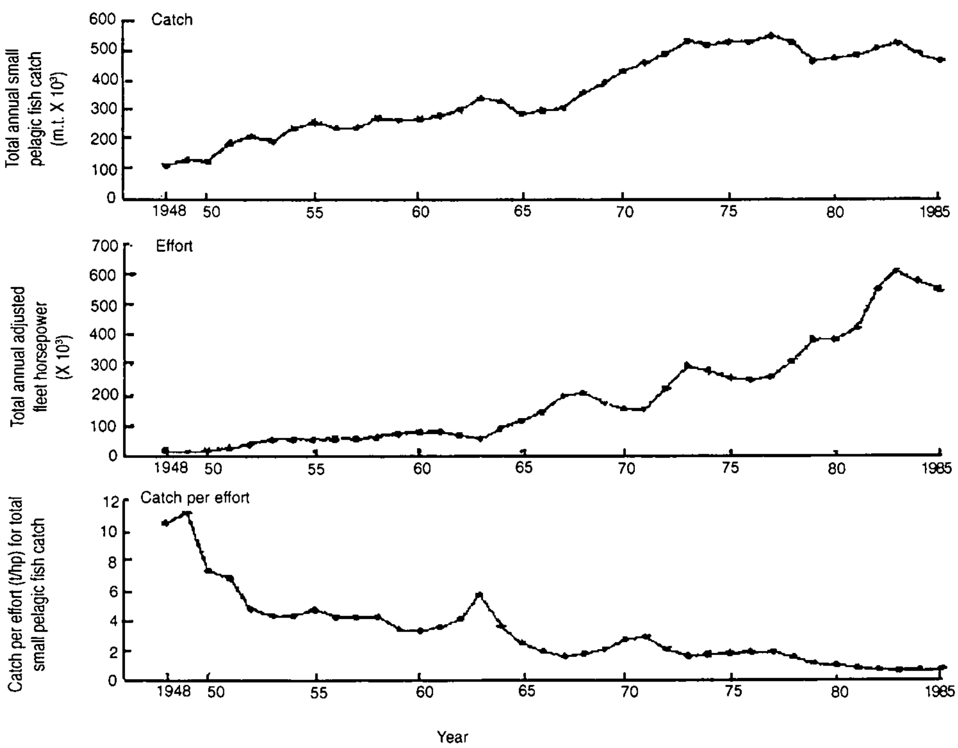
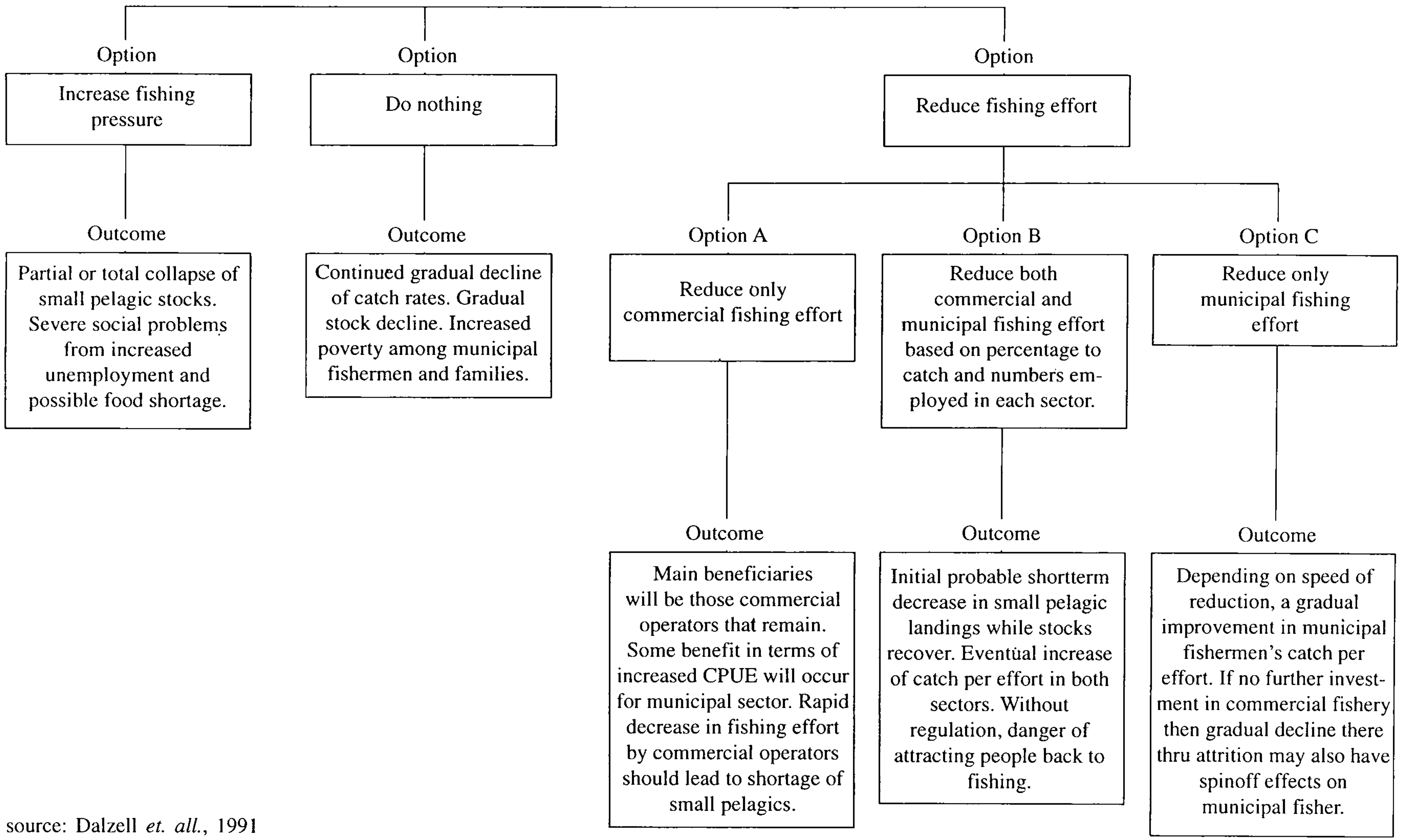


Figure 5: Time series of total small pelagic catch, fishing effort and catch per effort, 1948-1985.



Source: Dalzell *et. all.*, 1987

Figure 6: Management options for Philippine small pelagic fisheries.



source: Dalzell *et. all.*, 1991

Figure 7: Small pelagic fisheries annual production, 1984-95.

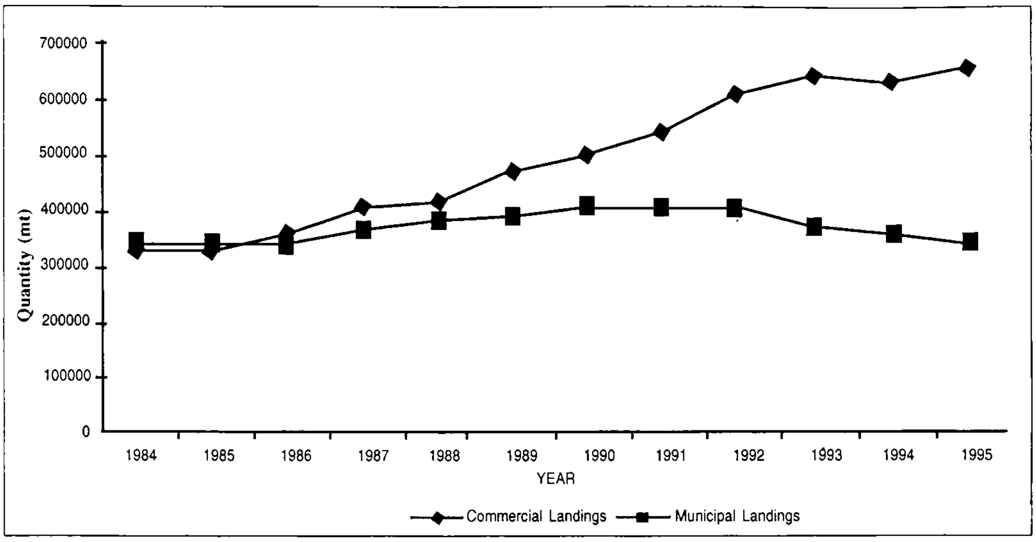


Figure 8: Commercial landings of small pelagic fishes (average annual catch, 1984-95)

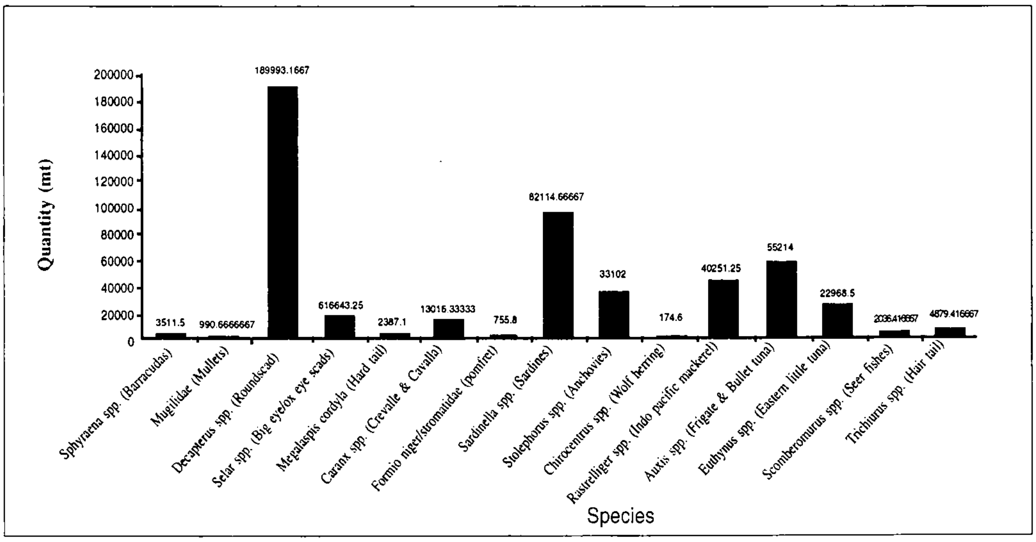


Figure 9: Municipal landings of small pelagic fishes (average annual catch, 1984-95)

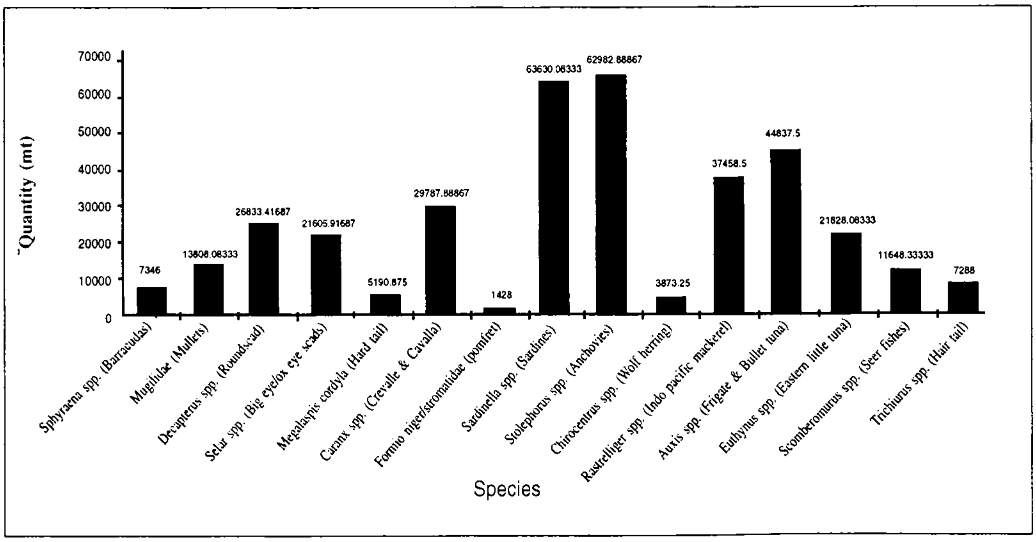
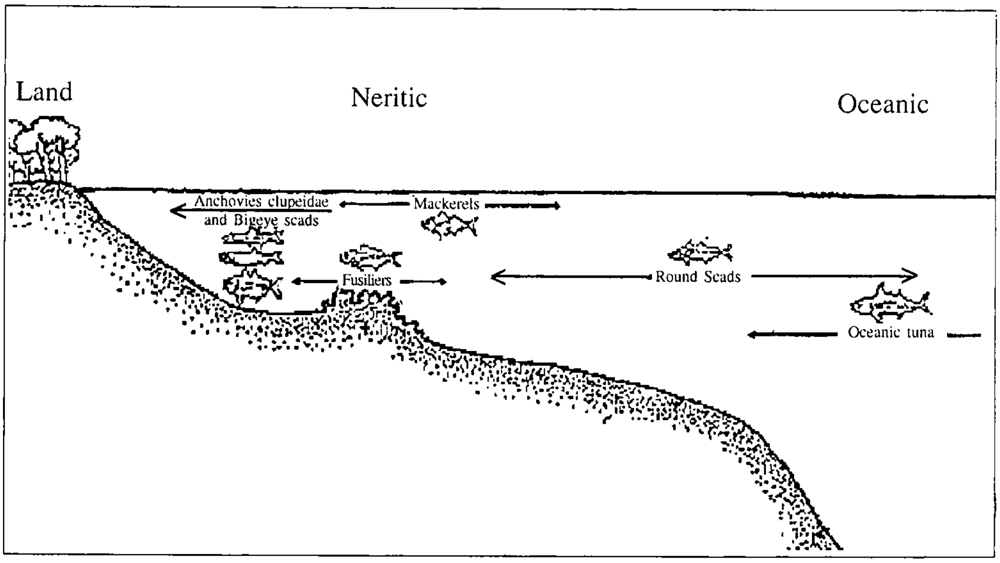


Figure 10: Schematic representation of the distribution of the seven principal small pelagic species groups with respect to inshore, neritic and oceanic zones.



source: Dalzell *et. all.*, 1987

Table 1: Annual marine fisheries production for 1984 to 1996.

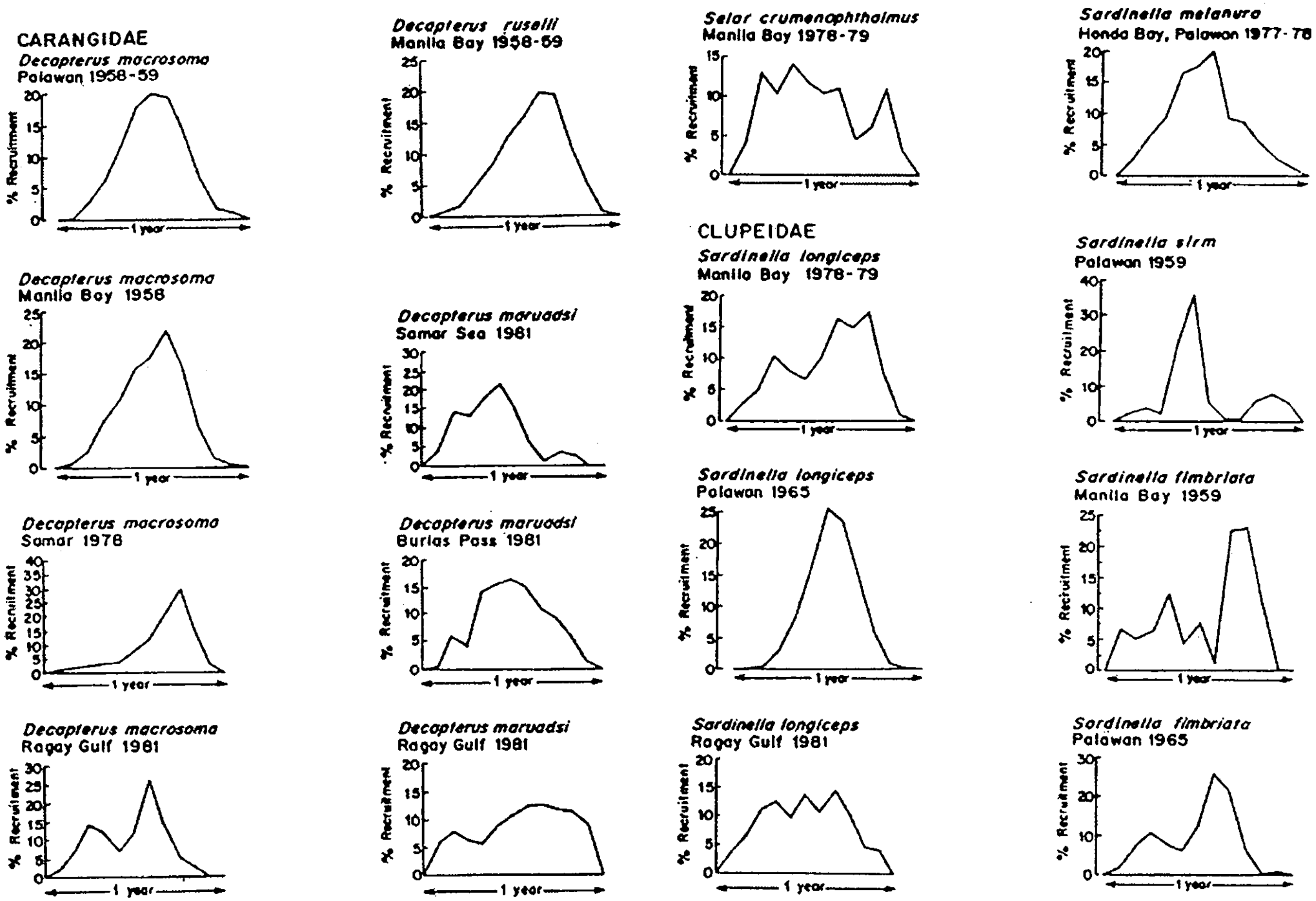
Year	Total commercial production	Total municipal production	Total marine production
1984	513,335	789,975	1,303,310
1985	511,987	785,132	1,297,119
1986	546,230	807,275	1,353,505
1987	591,192	816,247	1,407,439
1988	599,995	838,366	1,438,361
1989	637,138	882,369	1,519,507
1990	700,564	895,040	1,595,604
1991	759,815	913,524	1,673,339
1992	804,866	854,687	1,659,553
1993	845,431	803,194	1,648,625
1994	885,446	786,847	1,672,293
1995	926,887	785,369	1,712,256
1996	879,043	731,308	1,610,351

Table 2: Total small pelagic fisheries production per commercial fishing gears, 1991-95

Family/Species	Trawl	Purse Seine	Ringnet	Bagnet	Gillnet	Round Haul Seine	Denish Şeine	Others
Sphyraenidae								
Sphyraena spp. (Barracudas)	7,479	3,585	918	470	134	25	6,946	658
Mugilidae (Mullets)	1,304	1,047	10	434	246		23	1,598
Carangidae								
Decapterus spp. (Roundscad)	35,072	878,391	161,543	110.007		1,429	22,254	5,055
Selar spp. (Big-eye/ox-eye scad)	5,301	43,995	24,656	2.568		137	4.275	4.633
Megalaspis cordyla (Hardtail)	3,192	5,140	1,290	639	121		4,492	383
Caranx spp. (Crevalle & Cavalla)	14,479	14,822	4,219	2,474	700		25,344	5,213
Stromateidae								
spp. (pomfrets)	736	988	320	77	268		2,657	375
Clupeidae								
Sardinella spp. (Sardines)	52,611	506,676	137,718	63,134		1,267	7,658	6,509
Engraulidae								
Stolephorus spp. (Anchovies)	19,191	12,188	24,423	59,939		5,366	1,571	8,877
Chirocentridae								
Chirocentrus spp. (Wolf herring)	175	164	5	5	1		372	197
Scombridae								
Rastrelliger spp. (mackerel)	25,183	133,793	28,006	7,421		618	19,832	5,646
Auxis spp. (Frigate & Bullet tunas)	1,953	106,063	126,264	20,763	5,457		844	10,065
Euthynus spp. (Eastern little tuna)	459	41,769	93,533	1,590	3		732	1,190
Scomberomorus spp. (seerfishes)	797	2,793	1,057	75	87		771	2,506
Trichiuridae								
Trichiurus spp. (Hairtail)	13,303	7,948	259	991	41		2,770	4,951
TOTAL	181,235	1,759,362	604,221	270,587	7,058	8,842	100,541	57,856

source: Bureau of agricultural Statistic (1991-1995)

Figure 11: Recruitment patterns generated from length frequency data by ELEFAN II for various species of small pelagic fish from different locations in the Philippines *(source: Dalzell et al., 1988)*



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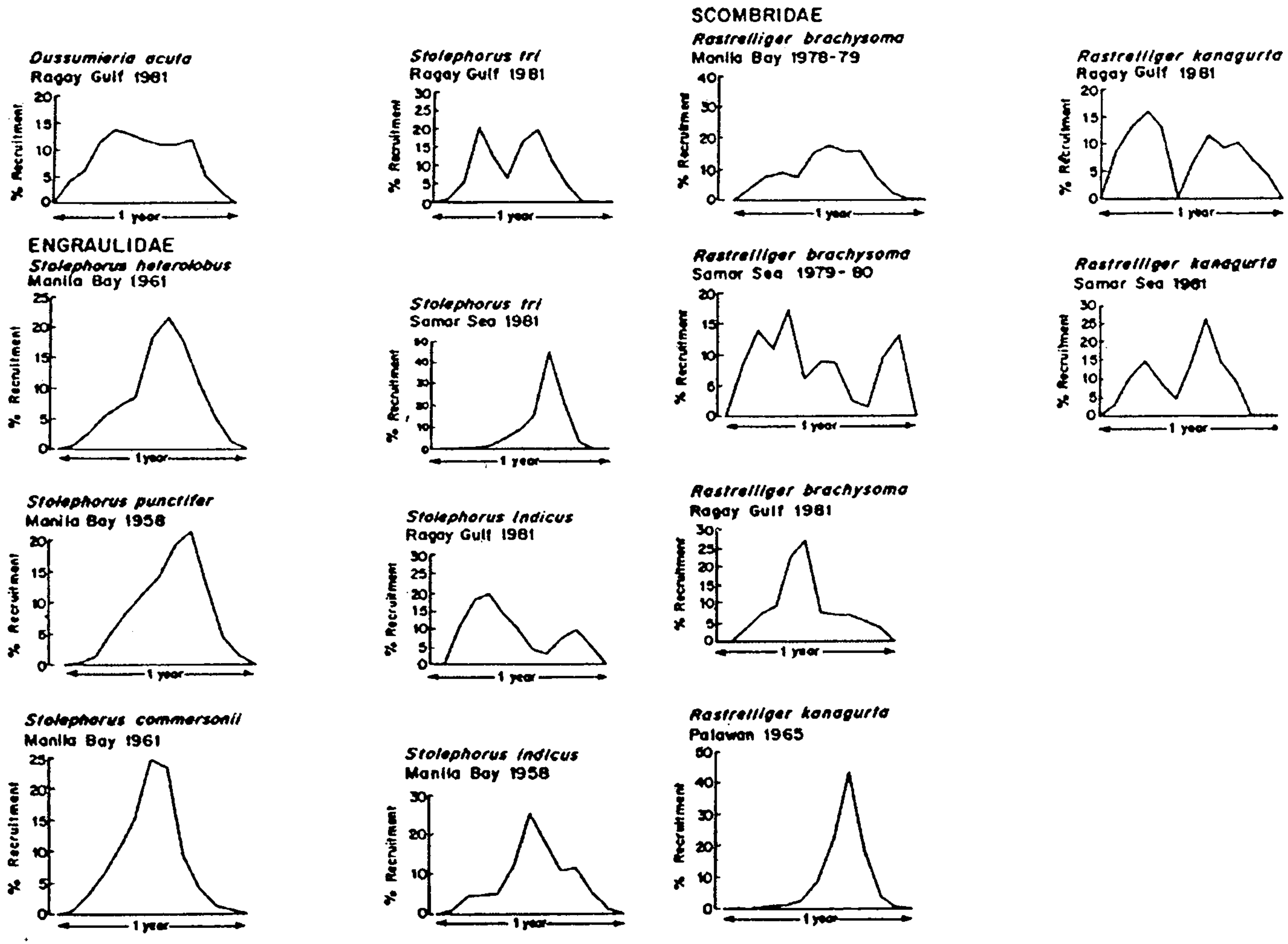
SCOMBRIDAE
Dussumieria acuta
Ragay Gulf 1981
Stolephorus tri
Ragay Gulf 1981
Rastrelliger brachysoma
Manila Bay 1978-79
Rastrelliger kanagurta
Ragay Gulf 1981
ENGRAULIDAE
Stolephorus heterolobus
Manila Bay 1961
Stolephorus tri
Samar Sea 1981
Rastrelliger brachysoma
Samar Sea 1979-80
Rastrelliger kanagurta
Samar Sea 1981
Stolephorus punctifer
Manila Bay 1958
Stolephorus indicus
Ragay Gulf 1981
Rastrelliger brachysoma
Ragay Gulf 1981
Stolephorus commersonii
Manila Bay 1961
Stolephorus indicus
Manila Bay 1958
Rastrelliger kanagurta
Palawan 1965
% Recruitment
1 year

Table 3: Growth and mortality parameters for roundscad species in the Philippines

Family/Species	Area	L (cm)	Lmax (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
CARANGIDAE								
Decapterus macrosoma	Camotes Sea	25.00		0.88	1.73			Jabat and Dalzell (1988)
Decapterus macrosoma	Manila Bay	31.50	28.00	0.65	1.33			Ingles and Pauly (1984)
Decapterus macrosoma	Manila Bay	31.50	28.00	0.71	1.41			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	27.00	25.00	0.90	1.72			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	26.80	25.00	0.71	1.47			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	26.50	25.00	1.00	1.85			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	27.80	25.00	0.83	1.61			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	33.00	31.00	0.50	1.10			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	27.50	21.00	1.25	2.12			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	25.00	20.00	1.20	2.12			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	25.50	22.00	0.85	1.68			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	25.50	22.00	0.80	1.62			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	33.00	30.00	0.65	1.31			Ingles and Pauly (1984)
Decapterus macrosoma	Palawan	30.00	27.00	0.74	1.47			Ingles and Pauly (1984)
Decapterus macrosoma	Samar Sea	23.00	22.00	1.25	2.19			Corpuz *et al.* (1985)
Decapterus macrosoma	Ragay Gulf	25.50	23.00	1.26	2.12			Corpuz *et al.* (1985)
Decapterus macrosoma	Leyte Gulf	27.30	27.62	1.40	2.28	4.67	1983-1988	Gonzales *et al.* (1997)
Decapterus macrosoma	Visayan Sea	31.30	29.57				1984-1988	Gonzales *et al.* (1997)
Decapterus macrosoma	Guimaras Strait	31.70	30.23				1984-1986	Gonzales *et al.* (1997)
Decapterus macrosoma	Samar Sea	27.00	27.11				1985-1987	Gonzales *et al.* (1997)
Decapterus macrosoma	Camotes Sea	28.00	30.02	1.60	2.47	5.13	1985-1987	Gonzales *et al.* (1997)
Decapterus macrosoma	Davao Gulf	29.90	31.21				1983-1986	Gonzales *et al.* (1997)
Decapterus macrosoma	South Sulu Sea	27.80	26.80	1.20	2.05	7.25	1983-1988	Gonzales *et al.* (1997)
Decapterus macrosoma	Moro Gulf/Illna Bay	21.40	24.48	2.30	3.38	4.25	1983-1988	Gonzales *et al.* (1997)
Decapterus kurroides	Davao Gulf	25.00		0.80	1.62			Gonzales (1991)
Decapterus kurroides	Visayan Sea	29.80	30.74				1983-1988	Gonzales *et al.* (1997)
Decapterus kurroides	Samar Sea	31.40	30.29				1983-1988	Gonzales *et al.* (1997)
Decapterus kurroides	Davao Gulf	24.80	25.97				1983-1988	Gonzales *et al.* (1997)
Decapterus russelli	Manila Bay	27.00	23.00	0.80	1.59			Ingles and Pauly (1984)
Decapterus russelli	Manila Bay	30.00	26.00	0.54	1.19			Ingles and Pauly (1984)
Decapterus russelli	Manila Bay	26.90	24.00	0.69	1.44			Ingles and Pauly (1984)
Decapterus russelli	Manila Bay	26.00	24.00	0.73	1.51			Ingles and Pauly (1984)
Decapterus russelli	Manila Bay	33.00	28.00	0.45	1.03			Ingles and Pauly (1984)
Decapterus russelli	Camotes Sea	33.70		0.36	0.89			Jabat and Dalzell (1988)
Decapterus russelli	Visayan Sea	36.50	38.64				1984-1987	Gonzales *et al.* (1997)
Decapterus russelli	Camotes Sea	35.10	34.50	1.40	2.13	6.71	1985-1988	Gonzales *et al.* (1997)
Decapterus macarellus	Pujada Bay	24.30	24.36	1.80	2.78	3.66	1986	Gonzales *et al.* (1997)
Decapterus macarellus	Davao Gulf	33.60	33.59				1986	Gonzales *et al.* (1997)
Decapterus maruadsi	Burias Pass	27.70	22.00	0.82				Corpuz *et al.* (1985)
Decapterus maruadsi	Samar Sea	23.55	23.00	0.81				Corpuz *et al.* (1985)
Decapterus maruadsi	Ragay Gulf	23.50	22.00	0.52				Corpuz *et al.* (1985)
Decapterus maruadsi	Tayabas Bay	27.30	26.69	1.10	1.95	5.39	1987	Gonzales *et al.* (1997)
Decapterus maruadsi	South Sulu Sea	25.00	24.03	1.20	2.11	3.51	1984-1986	Gonzales *et al.* (1997)
Decapterus maruadsi	Camotes Sea	31.17	29.56	1.30	2.10	6.86	1987-1988	Gonzales *et al.* (1997)
Selar crumenopthalmus	Manila Bay	36.50	34.00	0.89	1.57			Ingles and Pauly (1984)
Selar crumenopthalmus	Illana Bay	18.10	18.90	0.72	1.66	2.01	1988	Gonzales *et al.* (1997)
Selar crumenopthalmus	Pujada Bay	23.30	23.43	1.20	2.16	2.37	1986	Gonzales *et al.* (1997)
Selar crumenopthalmus	Davao Gulf	28.60	28.80	1.90	2.75	8.34	1983-1987	Gonzales *et al.* (1997)
Selar crumenopthalmus	South Sulu Sea	24.60	26.52	1.49	2.45	4.14	1987	Gonzales *et al.* (1997)
Selar crumenopthalmus	Leyte Gulf	26.40	27.31	1.50	2.41	3.86	1985-1987	Gonzales *et al.* (1997)
Selar crumenopthalmus	Camotes Sea	28.50	28.88	2.00	2.85	7.41	1983-1987	Gonzales *et al.* (1997)
Atule mate	Leyte Gulf	30.50	31.11	0.92	1.68	2.19	1987	Gonzales *et al.* (1997)

Table 4: Growth and mortality parameters for mackerel species in the Philippines

Family/Species	Area	L (cm)	L'max (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
Rastrelliger brachysoma	Samar Sea	24.50	22.00	1.28	2.17			Corpuz *et al.* (1985)
Rastrelliger brachysoma	Samar Sea	25.00	23.00	1.30	2.32			Corpuz *et al.* (1985)
Rastrelliger brachysoma	Samar Sea	25.50	23.00	1.45	2.19			Corpuz *et al.* (1985)
Rastrelliger brachysoma	Manila Bay	34.00	30.00	1.10	1.84			Ingles and Pauly (1984)
Rastrelliger brachysoma	Samar Sea	25.00	22.00	1.60	2.56			Ingles and Pauly (1984)
Rastrelliger brachysoma	Manila Bay	34.00		0.98			1958-1960	BFAR files (unpublished)
Rastrelliger brachysoma	Visayan Sea	34.00		0.98			1983	BFAR files (unpublished)
Rastrelliger brachysoma	Visayan Sea	32.50		1.20			1984	BFAR files (unpublished)
Rastrelliger brachysoma	Samar Sea	29.75		1.30			1984	BFAR files (unpublished)
Rastrelliger brachysoma	Leyte Gulf	34.00		0.98			1984	BFAR files (unpublished)
Rastrelliger faughni	Camotes Sea	25.90		1.45	2.44			Jabal and Dalzell (1988)
Rastrellige kanagurta	Illana Bay	39.00		0.72			1984	BFAR files (unpublished)
Rastrelliger kanagurta	Guimaras Strait	27.80		1.65			1985	BFAR files (unpublished)
Rastrelliger kanagurta	Samar Sea	26.50		1.60			1984	BFAR files (unpublished)
Rastrelliger kanagurta	Visayan Sea	37.00		0.70			1984	BFAR files (unpublished)
Rastrelliger kanagurta	Visayan Sea	29.50		1.50			1983	BFAR files (unpublished)
Rastrelliger kanagurta	Visayan Sea	38.00		0.80			1983-1987	Guanco (1991)
Rastrelliger kanagurta	Samar Sea	27.50	25.00	1.30	2.11			Corpuz *et al.* (1985)
Rastrelliger kanagurta	Samar Sea	28.00	26.00	1.31	2.13			Corpuz *et al.* (1985)
Rastrelliger kanagurta	Palawan Water	28.00	25.00	1.55	2.43			Ingles and Pauly (1984)
Rastrelliger kanagurta	Camotes Sea	25.50		1.50	2.45			Jabal and Dalzell (1988)
Rastrelliger kanagurta	Guimaras Strait	33.90	34.11	1.00	1.72	2.83	1984-1986	Gonzales *et al.* (1997)
Rastrelliger kanagurta	Visayan Sea	33.10	33.90				1983-1986	Gonzales *et al.* (1997)
Rastrelliger kanagurta	Camotes Sea	30.30	30.48				1987	Gonzales *et al.* (1997)
Rastrelliger faughni	Visayan Sea	28.10	28.21	1.50	2.37	3.60	1983-1987	Gonzales *et al.* (1997)
Rastrelliger faughni	Camotes Sea	27.03	27.45	2.20	3.08	5.22	1987	Gonzales *et al.* (1997)
Rastrelliger faughni	Leyte Gulf	30.10	30.91	2.00	2.80	3.79	1986-1987	Gonzales *et al.* (1997)
Rastrelliger faughni	Tayabas Bay	28.10	29.21				1987	Gonzales *et al.* (1997)
Rastrelliger brachysoma	Guimaras Strait	28.50	29.89	1.40	2.25	4.33	1984-1986	Gonzales *et al.* (1997)
Rastrelliger brachysoma	Visayan Sea	31.80	31.81				1983-1988	Gonzales *et al.* (1997)
Rastrelliger brachysoma	Leyte Gulf	27.30	27.08				1983-1987	Gonzales *et al.* (1997)
Auxis thazard	Camotes Sea	36.60	38.23	1.20	1.90	4.78	1983-1987	Gonzales *et al.* (1997)
Auxis rochei	Camotes Sea		36.69				1983-1987	Gonzales *et al.* (1997)

Table 5: Growth and mortality parameters for Sardines, Anchovy and Mullet species in the Philippines

Family/Species	Area	L (cm)	L'max (cm)	K (yr-1)	M (yr-1)	Z (yr-1)	Year (s)	References
SARDINELLA								
Sardinella fimbriata	South Sulu Sea	20.10	21.41				1983-1988	Gonzales *et al.* (1997)
Amblygaster sirm	South Sulu Sea	25.20	26.74	2.10	3.04	6.99	1983-1988	Gonzales *et al.* (1997)
Amblygaster sirm	Camotes Sea	31.00	24.28	1.35	2.15	6.88	1987	Gonzales *et al.* (997)
Sardinella albella	Visayan Sea	26.40	25.40				1983-1986	Gonzales *et al.* (1997)
Sardinella albella	Guimaras Strait/ Samar Sea	23.00	23.93				1983-1986	Gonzales *et al.* (1997)
Sardinella longiceps	South Sulu Sea	19.40	20.82	1.00	2.01	2.54	1987	Gonzales *et al.* (1997)
Sardinella longiceps	Visayan Sea	30.40	27.14	0.98			1983-1987	Gonzales *et al.* (1997)
ENGRAULIDAE								Gonzales *et al.* (1997)
Stolephorus commersonii	Manila Bay	11.30	10.00	0.96	2.28			Ingles and Pauly (1984)
Stolephorus commersonii	Illana Bay	13.30	11.54				1983	Gonzales *et al.* (1997)
Stolephorus punctifer	Manila Bay	10.10	9.00	1.10	2.55			Ingles and Pauly (1984)
Stolephorus punctifer	Manila Bay	10.60	9.20	1.85	3.53			Ingles and Pauly (1984)
Stolephorus punctifer	Manila Bay	9.20	8.00	1.15	2.69			Ingles and Pauly (1984)
Stolephorus punctifer	Tayabas Bay	11.60	12.10				1987	Gonzales *et al.* (1997)
Stolephorus punctifer	South Sulu Sea	12.40	12.60	1.20	2.57	3.51	1987	Gonzales *et al.* (1997)
Stolephorus indicus	Manila Bay	16.30	15.00	1.42	2.67			Ingles and Pauly (1984)
Stolephorus indicus	Manila Bay	15.70	15.00	1.08	2.23			Ingles and Pauly (1984)
Stolephorus indicus	Ragay Gulf	14.50		1.30	2.55			Corpuz *et al.* (1985)
Stolephorus tri	Ragay Gulf	14.50		1.30	2.55			Corpuz *et al.* (1985)
Stolephorus tri	Samar Sea	14.50		1.30	2.55			Corpuz *et al.* (1985)
Stolephorus heterolobus	Tayabas Bay	11.60	12.00	2.30	4.01	5.78	1987	Gonzales *et al.* (1997)
Stolephorus heterolobus	South Sulu Sea	12.30	12.70	1.50	2.98	5.34	1987	Gonzales *et al.* (1997)
Engraulis japonicus	Tayabas Bay	12.90	13.50				1987	Gonzales *et al.* (1997)
Engraulis japonicus	South Sulu Sea	13.40	14.20				1987	Gonzales *et al.* (1997)
MUGILIDAE								
Liza subviridis	Manila Bay	36.50	3.19	0.63			1978-1979	Ingles and Pauly (1984)

Table 6: Annual landings of small pelagic fishes from 1984-1995

Family/Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	mean
Sphyraenidae													
Sphyraena spp. (Barracudas)	8,888	8,454	11,191	10,234	11,133	10,746	11,507	12,307	12,200	11,937	11,039	10,654	10,858
Mugilidae (Mullets)	13,077	11,865	12,901	14,895	14,300	14,306	14,648	15,363	18,719	13,726	17,272	14,113	14,599
Carangidae													
Decapterus spp. (Roundscad)	131,673	131,708	175,855	184,411	178,687	209,821	249,300	277,330	296,979	272,049	233,160	260,946	216,827
Selar spp. (Big-eye/ox-eye scad)	37,513	33,481	34,407	35,461	36,530	38,614	41,255	36,264	37,766	33,498	50,288	43,913	38,249
Megalaspis cordyla (Hardtail)	5,106	5,943	6,586	6,790			8,453	9,297	10,316	8,345	3,032	1,530	6,540
Caranx spp. (Crevalle & Cavalla)	45,614	42,350	42,150	44,189	45,710	37,284	37,502	39,939	47,066	44,631	47,531	39,682	42,804
Stromateidae													
Formio niger/Stromateus spp. (pomfrets)	1,964	1,175	2,332	1,753			626	697	1,331	1,354	1,112	927	1,327
Clupeidae													
Sardinella spp. (Sardines)	109,027	81,927	73,303	98,694	96,405	122,465	156,748	158,622	195,879	256,744	248,834	270,289	155,745
Engraulidae													
Stolephorus spp. (Anchovies)	99,545	109,885	99,687	108,373	126,373	122,250	107,036	100,882	84,652	81,437	65,380	71,516	98,085
Chirocentridae													
Chirocentrus spp. (Wolf herring)	2,659	2,482	4,004	7,125			52	127	361	259	131	39	1,724
Scombridae													
Rastrelliger spp. (mackerel)	60,842	66,374	65,476	68,053	80,091	74,962	89,309	91,526	87,664	84,241	85,971	78,008	77,710
Auxis spp. (Frigate & Bullet tunas)	80,305	95,718	87,225	98,032	105,436	117,545	88,801	93,236	125,655	110,357	109,887	88,421	100,052
Euthynus spp. (Eastern little tuna)	41,899	41,060	42,445	46,934	56,266	57,899	43,762	47,850	31,943	26,670	46,321	54,486	44,795
Scomberomorus spp. (seerfishes)	13,725	12,746	15,150	17,852	13,796	17,908	14,995	16,187	9,072	12,959	9,234	10,593	13,685
Trichiuridae													
Trichiurus spp. (Hairtail)	8,664	7,364	9,658	9,795	10,387	11,235	14,320	13,845	16,730	15,320	16,175	12,516	12,167
TOTAL	660,501	652,532	682,370	752,591	775,114	835,035	878,314	913,472	976,333	973,527	945,367	957,633	833,566

Source: BFAR Fisheries Statistics (1984-1987)
Bureau of Agricultural Statistics (1988-1995)

Table 7: Commercial landings of small pelagic fishes per fishing grounds from 191 to 1995

Family/Species	West Palawan Waters	West Sulu Sea	South Sulu Sea	Visayan Sea	Moro Gulf	Lamon Bay	East Sulu Sea	Cuyo Pass	Tayabas Bay	Batangas Coast	Bohol Sea	Others
Sphyraenidae												
Sphyraena spp. (Barracudas)	1,959	914	397	6,227	1,459	744	37	266	1,564	3	797	5,848
Mugilidae (Mullets	39	56	30	20	13	75	129	3	142		5	4,150
Carangidae												
Decapterus spp. (Roundscad)	421,682	11,632	303,874	109,882	137,832	44,122	27,092	10,360	24,083	2,541	21,924	98,727
Selar spp. (Big-eye/ox-eye scad)	8,986	2,131	19,829	12,203	11,253	2,605	1,307	842	617	91	3,659	22,042
Megalaspis cordyla (Hardtail)	1,315	429	171	3,991	401	49	278	645	907	3	78	6,716
Caranx spp. (Crevalle & Cavalla)	8,671	2,682	6,734	21,498	4,262	2,088	622	950	2,258	24	1,606	15,856
Stromateidae												
Formio niger/Stromateus spp. (pomfrets)	538	32	10	1,530	481	143	64	27	23		9	2,564
Clupeidae												
Sardinella spp. (Sardines)	75,437	10,971	214,870	248,171	43,515	6,584	36,861	2,754	6,061	897	48,270	81,182
Engraulidae												
Stolephorus spp. (Anchovies)	6,212	5,309	9,991	4,613	13,475	17,246	3,893	4,999	16,564	920	2,699	45,634
Chirocentridae												
Chirocentrus spp. (Wolf herring)	1		203	184	34	6	15	43		23		408
Scombridae												
Rastrelliger spp. (mackerel)	31,845	2,610	39,677	66,578	11,505	6,787	6,939	1,769	5,136	181	4,471	43,729
Auxis spp. (Frigate & Bullet tunas)	43,450	2,861	19,777	26,887	21,550	1,697	29,321	14,983	12,488	4,115	53,434	40,846
Euthynus spp. (Eastern little tuna)	2,265	40	7,882	23,406	10,574	388	3,581	1,769	20	5	79.346	10,000
Scomberomorus spp. (seerfishes)	744	433	925	986	1,161	355	92	149	8	3	218	3,012
Trichiuridae												
Trichiurus spp. (Hairtail)	2,398	380	66	10,109	327	238	52	92	578	10	160	15,853
TOTAL	605,542	40,480	624,436	536,285	257,842	83,127	110,283	39,651	70,449	8,816	216,676	396,567

Source: Bureau of Agricultural Statistics (1991-1995)

ANNEX 10

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 7

COUNTRY STATUS REPORT

THAILAND

PELAGIC FISHERIES AND RESOURCES IN THAI WATERS

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ABSTRACT

The study on fisheries status, the resources of important economical pelagic species in the Thai Waters and their management, are the consequence of the regional workshop on shared stocks in the South China Sea Area. The objectives of this paper are to analyses and review technical reports pertaining to pelagic fisheries and resources both in the Gulf of Thailand and Andaman Sea. In the Gulf of Thailand, the average catches during the last ten years (1984-1994) of Indo-Pacific mackerel; Indian mackerel; round scads; small tunas; anchovies; sardines; king mackerel; hardtail scad; bigeye scad and total pelagic are 83,022; 30,223; 28,258; 114,630; 93,570; 101,346; 9,154; 15,258; 19,988 and 543,549 metric tons, respectively. The Maximum Sustainable Yields of Indo-Pacific mackerel; Indian mackerel; round scads; small tunas; anchovies; sardines; king mackerel; hardtail scad and bigeye scad estimated using Schaefer's model are 94,791; 34,282; 29,280; 86,000; 106,118; 110,457; 14,599; 18,433 and 18,500 metric tons, respectively. In the Andaman Sea, the average catches of Indo-Pacific mackerel; round scads; small tunas; sardines and total pelagic are 29,021; 12,470; 16,507; 29,651 and 108,346 metric tons, respectively and the Maximum Sustainable Yields of Indo-pacific mackerel; small tunas; sardines and total pelagic are 24,453; 8,383; 36,228 and 144,848 metric tons, respectively. The further objective is also to establish the pelagic fisheries resources and management which the resources are shared with neighbouring countries.

It express that many stocks of important economical pelagic species in Thai's Waters have been fully exploited and there is a sign of stock depletion of the round scad resources in the Gulf of Thailand. Therefore, the fishermen have change their fisheries to fish the fishery industrial target species. Some pelagic stocks, as a result, have been neglected for a while and could be rehabilited within a short time.

1. INTRODUCTION

Marine capture fisheries, both demersal and pelagic fisheries, play an important role on the Economic Development of Thailand. It is also a major source of animal protein for Thai people. Prior to 1950's, Thai marine fisheries was coastal fisheries, using traditional types of fishing gear. Those marine resources were consumed largely by people inhabiting coastal areas. Since early 1960's, the marine fisheries has been rapidly developed, resulted from the introduction of new fishing gears and technologies, venture of fishing fleets into new fishing grounds, improvement of fishing and restructuring of both supporting facilities and infrastructure. These development, resulted in a spectacular increase in total marine capture. It exceeds 1 and 2 million metric tons in 1968 and 1977 respectively (DOF, 1982a). In 1994, the total marine fisheries production reach 3.15 million metric tons, of which consist of 73% from the Gulf of Thailand and 27% from the Andaman Sea (DOF, 1996a). Due to rapid development without appropriate management measures, especially trawl fisheries, have resulted in the decline of stock abundances. In the Gulf of Thailand, the significant increase in number of otter board trawlers from 99 units in 1960 to some 13,000 units in 1990 including small trawl nets, has resulted in drastic decrease in the catch rate as express by the information obtain through the research trawler of the Department of Fisheries. The rates tend to decrease from 256kg/hr trawling in 1963 to 170kg/hr in 1980 and 20kg/hr in 1989. More than 65 percent of the trawl catches are trash fish comprising small non-edible species, edible species of low commercial value and juveniles of commercially important species. Among them, the juvenile species are estimated about 40 percent of the total trash fish (DOF, 1994a). According to the drastic reduction of catch rates, the occurrence of over fishing of demersal and invertebrate resources have been clearly observed.

As the trawl fisheries weaken, the pelagic fisheries is lighted up. There has been developed in terms of fishing gear and technique. The main particularity is purse seine. From early seventies, the ordinary purse seine fisheries for capturing small and medium size of pelagic fish such as sardines, mackerels and scads, have been added up with new modern and larger purse seiner together with gill netters. In addition, the extension of fisheries into offshore waters from the early eighties to the deeper part of the Gulf of Thailand and distant-water fishing grounds are the relative important development of pelagic fisheries. It boosts the marine fishery production of Thailand, resulting the increase of pelagic fish production shared in the total marine production from 13% (197,235 tons) in 1973 to 30% (953,907 metric tons) in 1994, which lead pelagic fisheries to play more important role of marine fisheries in Thailand (DOF, 1977 and 1996a). Therefore, the perspective feature of pelagic fisheries in the Gulf of Thailand and the Andaman Sea are decribed using the marine fisheries statistics base on the sapling survey during 1980 to 1994.

2. DEVELOPMENT OF PELAGIC FISHERIES

Pelagic resources are mainly exploited by purse seines, which account for approximately 83% of total pelagic catches in 1994. The rest, 10%, 2% and 5% of total production are caught by trawlers, king mackerel drift gill netter and other gears respectively (Table 1). Pelagic fisheries had started when Chinese purse seines (CPS) targeting on school fish such as Indo-Pacific mackerel was introduced in 1925.

Table 1: Total pelagic fishes caught by type of fishing gears in Thailand, 1994

Unit: Metric tons

Area	Purse seine	Trawlnets	Gillnets	Other	Total pelagic
Gulf of Thailand	82%	9%	2%	7%	644,073
Andaman Sea	85%	14%	1%	0%	309,834
Total	83%	10%	2%	5%	953,907

Source: DOF, 1996a

Remark: Purse seine = Other purse seine (PS) + Anchovy purse seine (APS) + CPS
Trawlnets = Otter board trawl (OBT) + Pair trawl (PT) + Beam trawl (BET)
Gillnets = King mackerel drift gill net (KMN)
Other = Other gears

The remarkable development are recognized after the end of the second World war, CPS have been modified into Thai purse seine (TPS) in 1930, which operates by setting the net using one main boat instead of setting the net by 2 row boats as being used in CPS (Phasuk, 1978). In 1973 several kind of luring techniques such as payao with coconut leaves and kerosene lamp are introduced. Until 1982 the luring techniques has been well developed by equipped electric generator on board which are called luring purse seine (LPS) become the popular fishing gear for mixed species. At the same time, tuna purse seine (TUNP) are developed by increasing the size of purse seine net and mesh size to catch small tunas in deeper waters together with and expansion to the offshore areas. Anchovies purse seine (APS) commonly used to catch anchovies in coastal areas have been developed as well, to operated with light luring for attracting the fish school at night time and move further offshore to fish.

3. FISHING GEAR

The purse seine net is the major fishing gear used to exploit the pelagic fish resources. It shows the increase in number year by year. The number of registered purse seine which classifies into Chinese purse seine (CPS), anchovy purse seine (APS) and other purse seines (TPS, LPS and TUNP) are shown in Figure 1. In the Gulf of Thailand, the registered number of purse seines increase from 585 unit in 1979 to 1,175 unit in 1994 which shows the great peak of 1,260 unit in 1991. In the Andaman Sea, the registered number of purse seines increase from 86 unit in 1979 to 273 unit in 1994 which shows the peak of 280 unit in 1989. Anyhow, it is obvious that the whole trend of purse seiners tend to increase in both fishing areas.

Normally, the mesh size of 2.5 centimeter is used for CPS, TPS and LPS, 1.0 centimeter for APS and the mesh size range from 7.5 to 9.4 centimeter are used for TUNP. However TPS may use the net with 3.8 centimeter mesh size when the Indo-Pacific mackerel of marketable size enter into the fishing ground. Most of the net are range from 300-1,600 meters in length and 50-150 meters in depth which depend on type of purse seines, size of boat and depth of fishing ground.

The production of Indo-Pacific mackerel, Indian mackerel, round scads, small tunas, anchovies and sardines caught by purse seine in the Gulf of Thailand are about 59%; 83%; 100%; 91%; 90% and 97% of the yield by all gears respectively. While the catch of those species in the Andaman sea are about 76%; 88%; 100%; 98%; 100% and 98% respectively (Table 2 and 3).

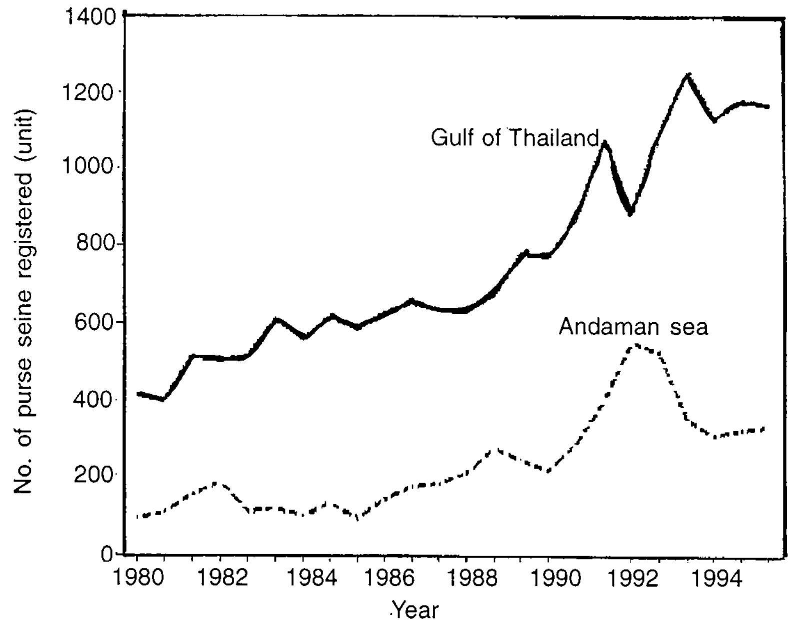


Fig. 1: Trend of number of purse seines registered in the Gulf of Thailand and Andaman Sea Coast of Thailand, 1971-1994.

Source: DOF, 1973, 1975; 1978; 1988a; 1993a and 1996b. (Data compiled)

Table 2: Percentage of important pelagic species caught by types of fishing gear in the Gulf of Thailand, 1994

Species	Purse seine	Trawlnets	Gillnets	Other	Total (tons)
Indo-Pacific mackerel	59	13	-	28	82,021
Indian mackerel	83	12	0	5	50,898
Round scads	100	-	-	-	38,394
Small tunas	91	-	9	0	99,833
Anchovies	90	3	-	7	102,729
Sardines	97	-	-	3	125,179
King mackerel	7	45	33	15	9,904
Hardtail scad	76	22	0	2	20,809
Bigeye scad	94	6	-	-	37,080

Source: DOF, 1996a

Remark:
Purse seine = PS + APS + CPS
Trawl nets = OBT + PT + BET
Gill nets = KMN
Other = Other gears
0 = non-significant catches
- = nil

Table 3: Percentage of important pelagic species caught by types of fishing gear in the Andaman Sea Coast of Thailand, 1994

Species	Purse seine	Trawlnets	Gillnets	Other	Total (tons)
Indo-Pacific mackerel	76	24	-	0	65,499
Indian mackerel	88	12	0	-	13,695
Round scads	100	-	-	-	35,994
Small tunas	98	-	2	-	31,182
Anchovies	100	0	-	-	66,630
Sardines	98	-	-	2	29,455
King mackerel	25	52	15	8	6,473
Hardtail scad	61	39	0	-	14,143
Bigeye scad	97	3	-	-	2,487

Source: DOF, 1996a

Remark: Purse seine = PS + APS + CPS; Other = Other gears
Trawlnets = OBT + PT + BET; 0 = non-significant catches
Gillnets = KMN; - = nil

4. SPECIES COMPOSITION

The main pelagic species caught during 1980-1994 consists of Indo-Pacific mackerel, Indian mackerel, round scads, small tunas, anchovies and sardines, which share about 78-87% and 65-89% in the Gulf of Thailand and the Andaman Sea respectively (Table 4 and 5). Other pelagic fish species are bigeye scad, hardtail scad, and king mackerel which contribute about 13-22% and 11-35% in the Gulf of Thailand and Andaman Sea respectively.

Table 4: Percentage of pelagic fishes caught by commercial fishing gears* in the Gulf of Thailand, 1980-1994

Year	Species (%)											Total catch (metric tons)
	1	2	3	4	5	6	**1-6**	7	8	9	10	
1980	17	9	11	4	34	6	**81**	3	4	5	8	286,109
1981	19	5	10	6	38	4	**82**	3	1	8	6	339,076
1982	23	6	10	13	28	7	**82**	2	1	5	5	313,253
1983	14	12	6	19	23	9	**83**	2	4	5	6	424,795
1984	22	7	6	15	18	19	**87**	2	1	5	5	457,806
1985	20	7	5	16	14	21	**83**	2	1	3	11	495,051
1986	18	8	5	19	19	12	**81**	2	4	4	9	484,857
1987	18	7	8	19	17	11	**80**	2	3	5	8	499,968
1988	17	4	3	27	17	13	**81**	2	4	2	10	515,478
1989	17	5	3	22	20	17	**84**	2	3	2	9	559,445
1990	12	4	2	28	16	21	**83**	2	2	4	9	557,220
1991	10	3	4	26	21	21	**85**	1	2	3	8	534,599
1992	13	4	6	23	21	18	**85**	1	3	3	7	675,904
1993	12	6	8	18	19	20	**83**	2	3	3	9	583,895
1994	12	8	6	16	20	16	**78**	1	3	6	11	614,814

Source: DOF, 1983a, 1983b, 1984, 1985, 1986, 1987, 1988b, 1989, 1990, 1991, 1992, 1993b, 1994b, 1995, 1996a and 1996c

Remark: 1 = Indo-Pacific mackerel; 2 = Indian mackerel; 3 = Round scads;
4 = Coastal tuna; 5 = Anchovies; 6 = Sardines;
7 = King mackerel; 8 = Hardtail scad; 9 = Bigeye scad
10 = Other trevallies, Silver pomfrets, Black pomfrets, Wolf herring, Blackbande trevally, Threadfins & Mullets
* = PS + APS + CPS + OBT + PAT + BET + KMN

Table 5: Percentage of pelagic fishes caught by commercial fishing gears* in the Andaman Sea Coast of Thailand, 1980-1994

Year	Species (%)											Total catch (metric tons)
	1	2	3	4	5	6	**1-6**	7	8	9	10	
1980	17	9	8	7	6	22	**69**	7	5	2	17	10,800
1981	16	6	9	15	3	15	**65**	8	5	3	19	13,527
1982	17	2	6	16	0	46	**89**	2	3	2	4	58,362
1983	21	3	15	6	1	39	**85**	1	5	4	5	62,920
1984	21	3	19	8	0	35	**87**	1	6	3	3	86,993
1985	21	2	12	8	1	41	**85**	2	5	2	6	66,378
1986	24	2	4	6	0	47	**84**	3	3	2	9	56,474
1987	15	2	14	6	1	41	**80**	2	4	3	11	101,400
1988	13	6	19	5	0	35	**79**	2	5	8	6	92,269
1989	16	6	19	4	0	25	**71**	2	7	8	12	114,822
1990	19	8	17	5	1	21	**70**	2	7	9	13	133,344
1991	24	9	15	9	7	15	**79**	2	7	4	9	162,611
1992	24	6	6	9	27	14	**86**	3	3	3	6	137,532
1993	28	6	4	17	17	16	**87**	1	2	1	8	239.980
1994	23	4	13	11	23	10	**84**	2	5	1	8	286,509

Source: DOF, 1983a, 1983b, 1984, 1985, 1986, 1987, 1988b, 1989, 1990, 1991, 1992, 1993b, 1994b, 1995, 1996a and 1996c

Remark: 1 = Indo-Pacific mackerel; 2 = Indian mackerel; 3 = Round scads;
4 = Coastal tuna; 5 = Anchovies; 6 = Sardines;
7 = King mackerel; 8 = Hardtail scad; 9 = Bigeye scad
10 = Other trevallies, Silver pomfrets, Black pomfrets, Wolf herring, Blackbande trevally, Threadfins & Mullets
* = PS + APS + CPS + OBT + PAT + BET + KMN

The group of pelagic species commonly found both in the Gulf of Thailand and the Andaman Sea are the followings; mackerels consist of Indo-Pacific mackerel (*Rastrelliger brachysoma*) and Indian mackerel (*R. kanagurta*); round scads consist of white tip round scad (*Decapterus maruadsi*) and slender round scad (*Decapterus macrosoma*); small tunas consist of longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*), sardinellas consist of goldstriped sardine (*Sardinella gibbosa*) and spotted sardine (*Amblygaster sirm*); Anchovies consists of shorthea anchovy (*Encrasicholina heteroloba*) and Indian anchovy (*Stolephorus indicus*) and group of bigeye scad (*Selar crumenopthalmus*). The restrictive species merely found in the Andaman Sea are skipjack tuna (*Katsuwonus pelamis*) and round scad (*D. macarellrus*).

5. FISHING GROUND

There are two main fishing grounds, the Gulf of Thailand and the Andaman Sea Coast of Thailand.

The fishing area in the Gulf of Thailand cover the whole Gulf which the depth ranges from 20 to 80 meters. The different fishing ground of specific species in this area are shown in Fig. 2. The fishing ground for Indo-Pacific mackerel is along the west coast and the upper part of the Gulf (Fig. 2a). Indian mackerel scatter in the Gulf where the depth range from 30-70 meters (Fig. 2b) while round scads are found in offshore area with the depth over 50 meters (Fig. 2c). Small tunas are found in the whole Gulf with the most abundance in the central part of the Gulf (Fig. 2d). Anchovies are mainly caught in coastal water along the western coast and eastern part of the Gulf (Fig. 2e). Sardines are also scatter in coastal and offshore area likely to Indian mackerel (Fig. 2f).

The fishing area in the Andaman Sea is the area within 3-45 kilometers from shore which the depth ranges from 20-100 meters. Figure 3 shows the fishing ground for specific species.

In Andaman Sea, the main fishing ground of Indo-Pacific mackerel are located in the lower part along the coast (Fig. 3a), while the Indian mackerel are found scattering (Fig. 3b). The fishing ground for round scads are scatting along the coast in the upper part and the area around Raja Island in the lower part (Fig. 3c). The fishing ground for small tunas are also scatteringe along the coast in the upper part (Fig. 3d). Sardines are widely distributed throughout the coast with high concentration in the coastal areas (Fig. 3e). Anchovies are commonly distributed in the inshore waters along the coast.

6. FISHING SEASON

Fishing of pelagic species in the Gulf of Thailand and Andaman Sea occur to be all year rounds. The peak of catch considers to be high during the southwest monsoon (June-October) and northeast monsoon (November-May) in the Gulf of Thailand and the Andaman Sea.

7. PRODUCTION AND CATCH RATE

Gulf of Thailand

The annual catches of small pelagic fishes caught by commercial fishing gears during the period 1980-1994 show the increasing trend from 286,109 metric tons in 1980 to 534,599 metric tons in 1991. It rises up to show the peak of 675,904 metric tons in 1992 then drop to the ordinary increasing trend from 1993 (Fig. 4). The annual catches and catches rates of commercially important pelagic fish are shown in Table 6.

The annual catches of Indo-Pacific mackerel fluctuate and slightly decrease from the peak of 99,638 metric tons in 1984 to 73,727 metric tons in 1994. The trend of catch rates are shown to be identical to the trend of catches.

The catches of Indian mackerel increase from 29,827 metric tons in 1984 to 38,803 metric tons in 1986 then decrease to the lawest catch of 16,256 metric tons in 1991, after that it increase to the peak of 49,231 metric tons in 1994. Catch rates show the decreasing trend from 240 kgs/day in 1985 to the lowest catch rates of 61 kgs/day in 1988, after that it increase to the lighest peak of 278 kgs/day in 1994.

Figure 2: The main fishing grounds of some economic pelagic species in the Gulf Thailand

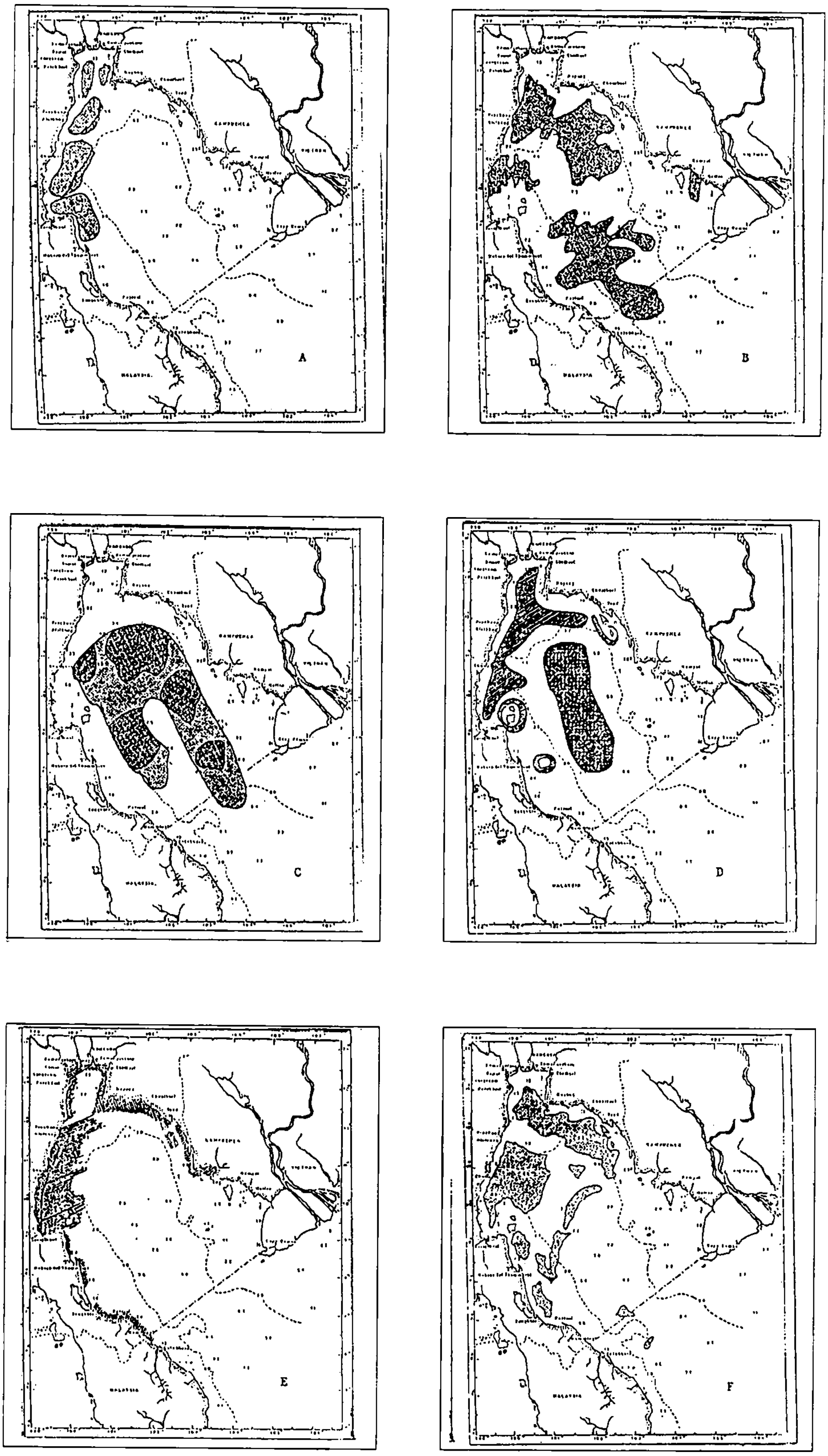
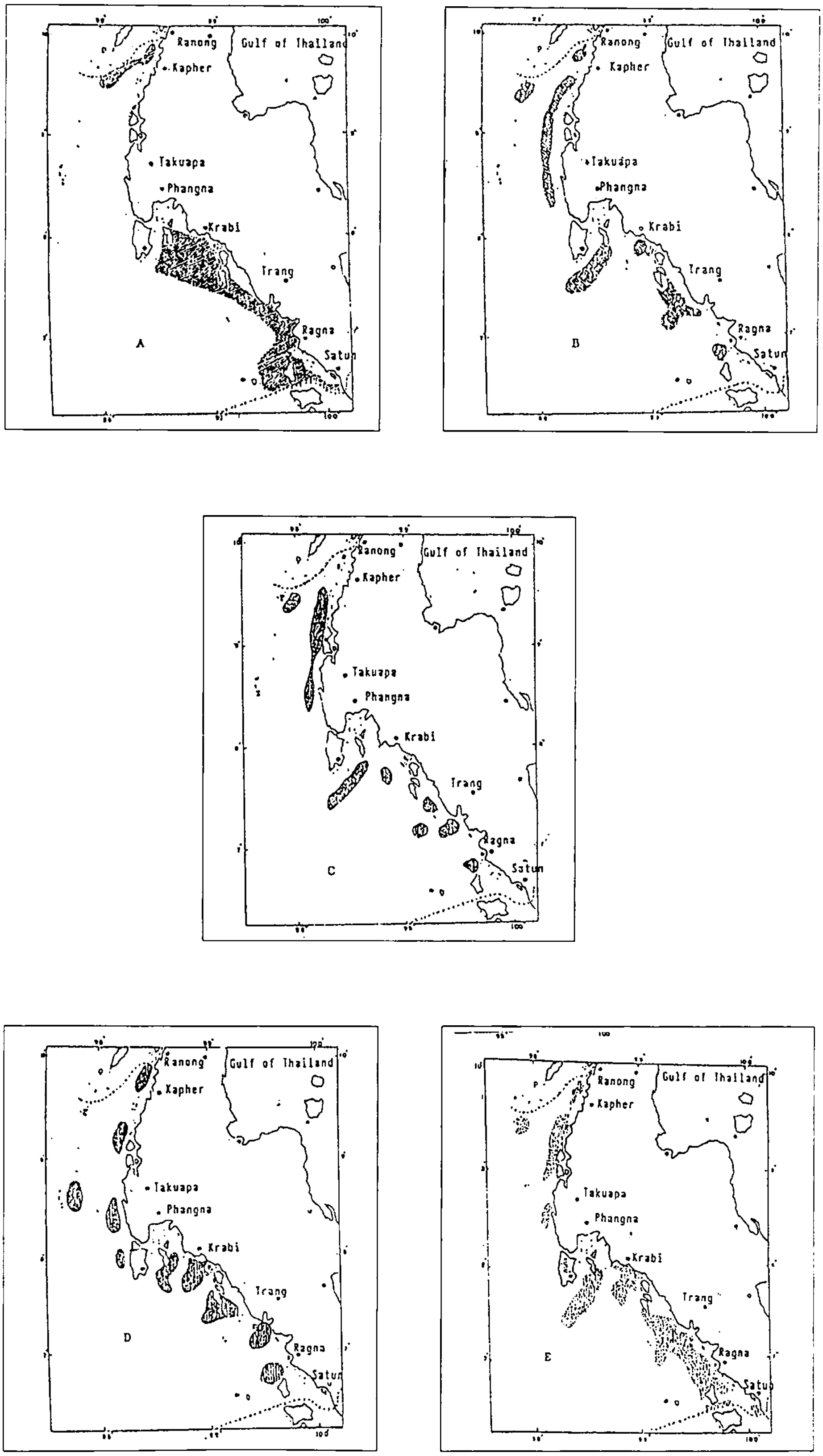
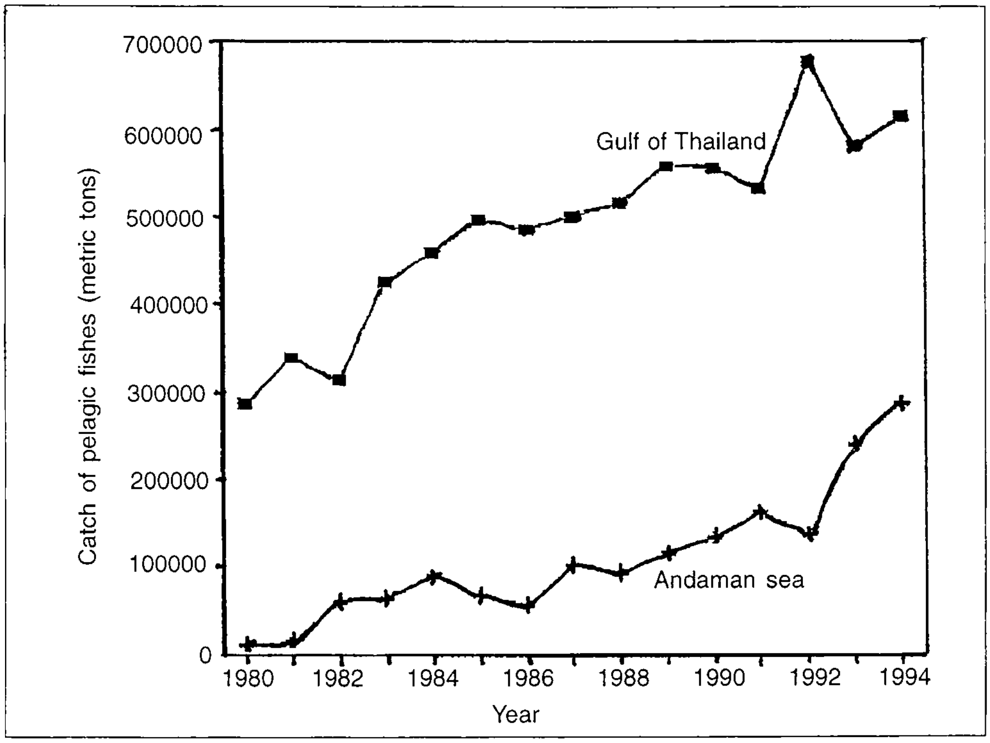


Figure 3: The main fishing grounds of some economic pelagic species in the Andaman Sea



The trend of annual catches of round scads is slightly decrease from 27,475 metric tons in 1984 to 23,947 metric tons in 1986 then increase abruptly to 41,838 metric tons in 1987, after that it expresses sharply decreased to the lowest point of 10,676 metric tons in 1990. It increase again up to the peak of 46,186 metric tons in 1993. Catch rates of round scads fluctuate with decreasing trend from 1984 to 1990, after that it increase from the lowest point of 46 kgs/day in 1990 upto 254 kgs/day in 1994.

Figure 4: Total catch of pelagic fishes caught by main fishing gears in the Gulf of Thailand and Andaman Sea Coast of Thailand, 1980-1994.



The catches of small tunas increase from 69,355 metric tons in 1984 to 141,274 metric tons in 1988 then it fluctuates between 141,274 - 156,208 metric tons during 1988 to 1990. It fluctuates which shows the hightest peak of 157,163 metric tons in 1992, after that it shows the decreasing trend from 1993. The catch rates has shows the similar trend of catches. The lowest and the highest of catch rates are 330 kgs/day and 846 kgs/day in 1984 and 1991 respectively.

The catches of anchovies have been remarkably increased after 1981 to 1985, from 12,095 metric tons to 103,101 metric tons then declines to the lowest catches of 55, 466 metric tons in 1987. After 1988 the catches increase up to reach the peak again. Total landing of anchovies during 1990-1994 still maintain the level of 110,000 - 120,000 metric tons. Catch rates of this species fluctuate during the period of 1984 to 1994, with the lowest rate of 1,569 kgs/day and the peak of 6,282 kgs/day in 1987 and 1992 respectively.

The catches of sardines tend to be slightly increased from 83,814 metric tons in 1984 to 123,700 metric tons in 1994, with peak of 141,422 metric tons in 1992. The trend of catch rates is similar to the trend of catch which shows the peak in 1994.

Table 6: Total catches and catch rates of commercially important pelagic fish in the Gulf of Thailand, 1984-1994

Species name/Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Standard gear
Indo-pacific mackerel												
Total catch (Tons)	99,638	97,852	88,768	92,155	88,822	92,688	68,160	55,186	88,308	68,025	73,727	
Catch rate (kgs/day)	731	1,067	275	1,076	1,019	1,142	612	1,450	1,244	400	1,338	MEN
Indian mackerel												
Total catch (Tons)	29,827	32,862	38,803	36,259	18,653	26,498	20,844	16,256	29,337	33,882	49,231	
Catch rate (kgs/day)	187	240	213	185	61	122	68	86	108	140	278	SEINE
Round scads												
Total catch (Tons)	27,475	25,667	23,947	41,838	14,015	17,267	10,676	22,747	42,525	46,286	38,394	
Catch rate (kgs/day)	186	206	144	259	73	102	46	149	181	237	254	SEINE
Small tunas												
Total catch (Tons)	69,355	81,200	90,225	96,131	141,274	124,899	156,208	137,869	157,163	106,797	99,811	
Catch rate (kgs/day)	330	489	426	495	651	681	626	846	617	491	600	SEINE
Anchovies												
Total catch (Tons)	88,804	103,101	57,959	55,466	66,675	94,315	118,727	110,020	120,211	116,648	97,343	
Catch rate (kgs/day)	2,722	2,100	1,808	1,569	1,895	1,814	1,754	2,119	6,282	4,677	2,680	APS
Sardines												
Total catch (Tons)	83,814	68,447	92,527	83,633	89,077	114,310	90,789	114,465	141,422	112,620	123,700	
Catch rate (kgs/day)	494	520	523	430	410	624	360	730	583	575	795	SEINE
King mackerel												
Total catch (Tons)	8,099	8,380	10,978	11,924	12,050	9,181	9,153	6;110	6,711	9,568	8,537	
Catch rate (kgs/day)	89	93	99	92	82	78	63	87	83	94	98	SEINE
Hardtail scad												
Total catch (Tons)	5,928	5,608	17,299	17,468	19,765	19,533	13,648	11,937	17,775	18,345	20,532	
Catch rate (kgs/day)	102	106	291	281	241	393	212	315	431	313	463	SEINE
Bigeye scad												
Total catch (Tons)	23,061	17,174	18,728	22,978	11,931	12,063	19,972	15,451	21,851	19,581	37,080	
Catch rate (kgs/day)	152	136	112	135	52	60	74	90	87	95	230	SEINE

Source: DOF, 1986, 1987, 1988b, 1989, 1990, 1991, 1993b, 1994b, 1995, 1996a and 1996c.

The annual catches of king mackerel shows the increasing trend from 8,099 metric tons in 1984 to the peak of 12,050 metric tons in 1988. After that it declines to the lowest point of 6,110 metric tons in 1991, then increases again. The catch rates shows the decreasing trend from the peak of 99 kgs/day in 1986 to the lowest rates of 63 kgs/day in 1990 and turn upward to 98 kgs/day in 1994.

The landings of hardtail scad tend to increase from the lowest catch of 5,608 metric tons in 1985 to 19,765 metric tons in 1988. After that it increases to 11,937 metric tons in 1991 then increases again up to the peak of 20,532 metric tons in 1994. The trend of catch rates show the same pattern of the catching trend.

The annual catches of bigeye scads fluctuate from 1984 to 1994, the lowest catch of 11,931 metric tons and the peak of 37,080 metric tons are found in 1988 and 1994 respectively. The trend of catch rates appears to be similar to the trend of total catch with the lowest catch rates about 52 kgs/day and the peak of 230 kgs/day in 1988 and 1994 respectively.

Andaman Sea

In the Andaman Sea, small pelagic catches in 1980 and 1981 are about 10,800 and 13,527 metric tons respectively. The annual catches range from 60,121 metric tons in 1982 to 309,834 metric tons in 1994 (Fig. 4). It shows the fluctuation every 2-3 year during 1982-1988, after that it increases to reach the peak in 1994. The catch rates show the decreasing trend from the peak of 4,280 kgs/day in 1983 to the lowest catch rate of 1,790 kgs/day in 1988 then aburtly increase to 2,397 in 1989 after that it drops until 1991 then increases to reach the peak 2,916 metric tons in 1994. The amount of catches and catch rates of commercially important pelagic fish are shown in Table 7.

The total catches of Indo-Pacific mackerel increase from 10,056 metric tons in 1982 to 65,499 metric tons in 1994 with the peak of 66,985 metric tons in 1993. Catch rates fluctuate from 474 kgs/day in 1982 to the lowest catch rate of 237 kgs/day in 1988. After that it increase up to the peak of 994 kgs/day in 1993.

The total catches of round scads in overall view increase from 3,758 metric tons in 1982 to rise the peak at 23,982 metric tons in 1991 and sharply decrease to 8,434 and 8,984 metric tons in 1992 and 1993 respectively. The catches increase abruptly with the peak of 35,994 metric tons in the year after. The trend of catch rates show declining trend from 213 kgs/day in 1983 to the lowest 102 kgs/day in 1986 then increase to 484 the rate of kgs/day in 1989, after that it decrease again to 143 kgs/day in 1993.

The total catches of small fluctuate year by year from 1982 to 1989 with the peak of catch about 40,784 metric tons in 1993. Catch rates decrease from 465kgs/day in 1982 to the lowest catch rate of 89kgs/day in 1988, then it increase up to the peak of 634kgs/day in 1993.

The total catches of sardines in overall view show slightly decrease from 27,030 metric tons in 1982 to 20,893 metric tons in 1992, then increase abruptly to the peak of 38,440 metric tons in 1993. The trend of catch rates during 1982 to 1994 is identical to the trend of the total catches.

The other economically important pelagic fishes that contribute to the fishery of the West Coast of Thailand or Andaman Sea are Indian mackerel, king mackerel, hardtail scad, bigeye scad and anchovies. There seems to be non-significant trend of catches of these species except anchovies which shows the jumping increase from 1991. This group contribute about 101,138 metric tons of catches of anchovies increase abruptly from 782 metric tons in 1990 due to the development of fishing technique by using the light for attracting the fish school and further moving offshore.

Table 7: Total catches and catch rates of commercially important pelagic fish in the Andaman Sea, 1984-1994

Species name/Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Standard gear
Indo-pacific mackerel												
Total catch (Tons)	18,675	13,757	13,766	15,029	12,044	17,487	25,127	38,616	32,863	66,833	65,499	
Catch rate (kgs/day)	507	593	548	362	237	366	378	461	667	994	715	SEINE
Round scads												
Total catch (Tons)	16,777	8,025	2,464	14,276	17,747	22,330	22,559	23,982	8,434	8,984	35,994	
Catch rate (kgs/day)	646	373	102	336	359	494	352	335	194	143	520	SEINE
Small tunas												
Total catch (Tons)	7,369	5,594	3,392	6,261	4,845	4,695	6,883	14,256	11,908	40,784	31,182	
Catch rate (kgs/day)	269	251	124	146	89	94	99	187	247	634	440	SEINE
Sardines												
Total catch (Tons)	30,563	27,545	26,604	41,641	32,619	29,186	27,375	24,167	20,893	38,440	29,455	
Catch rate (kgs/day)	995	1,162	1,098	905	660	632	427	337	450	596	418	SEINE
Total Pelagic												
Total catch (Tons)	90,846	67,852	59,960	120,563	98,912	121,646	146,281	176,794	140,969	243,176	309,834	
Catch rate (kgs/day)	2,812	2,754	2,316	2,263	1,790	2,397	2,192	1,888	2,029	2,836	2,916	SEINE

Source: DOF, 1986, 1987, 1988b, 1989, 1990, 1991, 1993b, 1994b, 1995, 1996a and 1996c.

8. THE STATUS OF PELAGIC RESOURCES AND THIER FISHERIES

The pelagic resources in Thailand have likewise been intensely fished during the past two decades, especially, Indo-Pacific mackerel which is one of the most economically important species caught both in the Gulf of Thailand and the Andaman Sea. However, the most effective gear used is purse seine which is the multipurpose of catching pelagic fishes. Therefore, it cause the different effect on each of species and fishing ground as follow described. In the Gulf of Thailand, it is considered that the stocks of small pelagic resources in the Gulf of Thailand have been fully exploited. Morever there is a noticeable sign of stock depletion of round scad (DOF, 1993c). The assessment on the state of stock taken from previous reports and present study based on the sampling data through statistical section during 1984-1994 using Scheaffer's model are shown in Table 8. The MSY estimation of Indo-Pacific mackerel in the Gulf of Thailand is about 94,791 metric tons at an exerted fishing effort of about 106,550 days fished by mackerel encircling gill nets which indicates that there has been fully exploited since 1984. The Indian mackerel has no definite sign of overfishing with the estimated maximum sustainable yield about 34,282 metric tons and optimum fishing effort about 185, 411 days fished by purse seine. Other estimation of the maximum sustainable yield for small tunas, anchovies; sardines, king mackerel, hardtail scad and bigeye scad are also shown in Table 8.

Table 8: Catches and maximum sustainable yield of important pelagic species in Gulf of Thailand

Species	1984-1994 (tons)	Average (tons)	MSY (tons)	References
Indo-Pacific mackerel	55,186 - 99,638	83,022	94,791	
Indian mackerel	16,256 - 49,231	30,223	34,282	
Round scads	10,676 - 46,286	28,258	29,280	
Small tunas	69,355 - 156,208	114,630	86,000	Cheunpan, 1996
Anchovies	55,466 - 120,211	93,570	106,118	
Sardines	68,447 - 123,700	101,346	110,457	
King mackerel	6,110 - 12,050	9,154	14,599	
Hardtail scad	5,608 - 20,532	15,258	18,433	
Bigeye scads	11,931 - 37,080	19,988	18,500	Isara, 1993
All pelagic species	286,109 - 614,814	543,549	?	

In the Andaman Sea, the consideration of all parameters combining with other information on fishery are as follow:

- The signs of overfishing have been observed for Indo-Pacific mackerel and sardines, but further the recovery of these stock seem to be gradually improved.
- No definite sign of overfishing has been observed for other important economic species. Forever the less, some species such as Indo-Pacific mackerel, the production and fishing effort are close to MSY (Table 9).

Table 9: Catches and maximum sustainable yield of important pelagic species along the Andaman Sea

Species	1984-1994 (tons)	Average (tons)	MSY (tons)
Indo-Pacific mackerel	12,044 - 66,833	29,021	24,453
Round scads	2,464 - 35,994	16,507	-
Small tunas	4,695 - 40,784	12,470	8,383
Sardines	19,874 - 41,641	29,651	36,228
All pelagic species	56,474 - 286,509	108,346	144,848

Taking into account, the review of status of small pelagic fisheries resources in Thailand mention earlier, it is recognized that the development of pelagic fisheries has been clearly observed since 1973 up to the present. It shows the remarkable increase in pelagic fish production almost four folds of the previous production to 901,323 metric tons in 1994. It is certainly that almost all species of pelagic fishes are subjected to fully exploitation and some stock such as round scads has been depleted without the recovery compared with the Indo-Pacific mackerel, since the lack of strong enforcement under the inhabiting regulation and the rapid development of fishing efficiencies especially light luring technique together with the increasing in number of fishing vessels. The deteriaration of pelagic stocks in Thailand is effected to further progress in fisheries. Large scale purse seines have been modernized; equiped with colour echo-sounder or sonar for fish school detection; installed power saving devices (e.g. purse line winch, power block) that enabling a boat to reduce its man power; facilitating radar, wireless communication equipment, satellite navigation and refrigerator unit as well; therefore it makes them extended their fishing ground to the longer distance and period. Especially, small tunas fishery has been rapidly developed since 1982. Being supported by the strong demand for canning industries, small tuna fisheries has been dramatically expanded due to the improvement of fishing gear and fishing method of purse seines. The catches has been increased from 39,368 metric tons in 1982 to 157,163 metric tons in 1992, which was the outcome of promoting fisheries outside the Thai waters through joint ventures or fisheries agreements with neighbouring countries, and the exploration for new fishing grounds. These may lead to make the resources faster depleted. Nevertheless, the pelagic fish resources in the Gulf of Thailand are multispecies in nature, it is easy for the fishermen to change the target species from heavily exploited species to another without much difficulties. Therefore, the problem of resource depletion for pelagic resources are not so serious as it should be.

9. THE BIOLOGICAL AND ENVIRONMENTAL PARAMETERS

Thai seas are located in the tropical zone, which environment in this area is generally less variable than the temperate zone. The Gulf of Thailand can be considered as one of the large marine ecosystem owing to its unique topography and general oceanographic characteristics govern by prevailing climatic conditions, it is one of the richest areas in the world, because the coastal areas have high level of nutrients. Therefore, it is abundant in living aquatic resources. Recently, environmental condition of the Gulf has markedly changed. The Gulf of Thailand is now facing with great ecological loss caused by economic and social growth. The most severe problems are the biological over-

overexploitation using excessive fishing effort and destructive fishing gears, uncontrolled urban and industrial waste discharge, waste water discharge from shrimp farms, habitat destruction and run-off. It is known fact that marine biological communities are fragile and susceptible to accept foreign substances. It may result in the change of their population and distribution.

There has been a study on the environmental impacts of mariculture in the inner Gulf of Thailand and Andaman Sea suggest a possibility that a portion of nitrate in the inshore waters might derive from nitrate discharged from shrimp farm and it could boost primary production and lead to eutrophication. This is implicated by the periodic formation of Noctiuluca blooms and subsequent anoxic bottom condition in inshore area that impose a high risk to fishery resources (Suvapepun, 1995). The influence of waste water from shrimp farms in the southern part of the Gulf has also affected on water quality which further controlled the abundance of pelagic and benthic communities in the adjacent area. Anyhow there has been no relative informations on environmental factors to discussed herewith.

The important biological features of small pelagic fish in the Gulf of Thailand and along the Andaman Sea coast of Thailand compiled from research works conducted by many scientists of the Department of Fisheries are given in Table 10. They comprise 9 species of economical important pelagic fish, i.e. Indo-Pacific mackerel, Indian mackerel, round scad, small tunas, anchovies, sardines, king mackerel, hardtail scad and bigeye scad. It is noted that the results of studies given in the table very greatly according to the period and area surveyed as well as methodologies applied. Therefore those parameters given in the table are based on available, update and average values for further consideration.

On the account of research undertaken, pelagic resources in Thailand have become very important for commercial fisheries since the begining of marine fishery development up to the present. The Marine Fisheries Division of the Department of Fisheries have initiated intensive studies on many small pelagic species during the past 30 years. But those activities have not covered all numbers of important species since each group comprises many species. An important shortcomings is the availability of specimens and data to be collected continuously for a certain long-term period. More intensified research and study for their relevant species of each group are awaited for comparative study.

10. MANAGEMENT OF THE PELAGIC FISHERIES

The rapid development and expansion of pelagic fisheries in the Gulf of Thailand during the last two decades resulted in intensive exploitation of both nearshore and offshore pelagic resources. Many groups of small pelagic fish have been subjected to fully exploitation and may be overfished. It seems that the room for further fishery development is very scarce. Many scientists have reported their status and proposed to set up an appropriate measure to conserve, manage and control fishing operation with a view to harmonize fishing activities for the available potential resources. It is a known fact that without systematic management, monitoring, control, survillance and rehabilitation, it will lead to greater conflict in their use.

In order to conserve the marine fishery resources, the Department of Fisheries of Thailand has set up various management measures through the Fisheries Act of 1901 which was consequently revised in 1947 and 1982 (Annex 1). The regulations that have been issued, with the objective of conserving marine fishery resources, include: determination of the size and kinds of fishing implements that are permitted in fisheries; prohibiting the use of certain types of fishing methodology in certain areas; establishing spawning and nursing seasons and areas of marine resources and prohibiting the use of certain types of fishing gear during the said season and areas; mesh size regulation for purse seining, gill netting and lift netting; limiting the new entry of trawl fisheries and ceasing to grant new trawl licenses.

Under the 1947 Fisheries Act, a series of Ministerial rules and regulations concerning the conservation of pelagic resources and its relevant have been issued. The actives regulation concern to the management metod are as follows:

Closed area

To served the purpose of maintaining the productivity in coastal area or near-shore waters, Department of Fisheries established the regulation of 20^{th} July 1972 to prohibit fishing by trawlers and push netters within a distance of 3,000 m from the shoreline and within a perimeter of 400 m of any stationary fishing gear in Thailand.

Closed season in an area

A conservation area in the Gulf of Thailand about 26,400km^2 was declared to protect several commercially exploited species of demersal and pelagic fish during their spawning and breeding seasons from 15^{th} February to 15^{th} May each year. This regulation of 28^{th} November 1984 is to prohibit all types and sizes of trawlers except beam trawlers, all types of purse seiners and encircling gillnetters with less than 4.7cm mesh size, to operate in the area along the coastline of Prachuap Khirikhan, Chumphon and Surat Thani provinces, as well as Khanom District in Nakhon Sri Thammarat province in the Gulf of Thailand. According to the description of purse seine, the anchovy purse seine operating in day time during 15^{th} February to 31^{th} March, are excluded. Recently, the anchovy purse seine are also prohibitate under the regulation of 12^{th} February 1994.

The conservation measures for protecting the breeding species in their spawning and nursery grounds were extended to the Andaman Sea by the declaration of 1,800km^2 about to Phangnga and Krabi as a zone of conservation through selectively controlled fishing by closed seasons and/or prohibition of selected fishing gear during 15^{th} April to 15^{th} June. The same rules regarding the types of prohibited fishing gear as applied in the Gulf of Thailand and laid out in the afore-mentioned Ministry regulation of 11^{th} April 1985, where also extended to the conservation zone in the Andaman Sea.

Prohabited fishing gears

The night-time operation of small mesh size of purse seine nets (less than 2.5cm) are banned in both fishing ground in Thailand under the regulation of 14^{th} November 1991.

However, such regulations particularly the restriction on fishing gear and provision of closed areas and seasons have not been fully enforce and some fishermen still operate illegal fishing gear evading the regulation. In particular, complete enforcement of regulations to small-scale fishermen is difficult. Taking this problem into account, it is proposed that improvement in fishery management will be necessary, e.g. license limitation, mesh size regulation, light luring devices regulation and zoning system for a certain size of fishing vessel and fishing methods. Recently, the Department of Fisheries has established a project on artificial reef installation which form physical obstacles to fishing operation and provide habitats for juveniles allowing more fish to reach marketable and reproductive size.

Table 10: Important biological features and parameters of small pelagic fish in Thailand

(Body size refers to total length unless specified as FL: fork length or SL: standard length; sexes are combined unless specified as M: male or F: female)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
FAMILY SCOMBRIDAE *Rostrelliger brachysoma*	Gulf of Thailand[1]	20-40	15.0	20.95 21.5	10-14 mi off Prachuab Surattani	2-4, 6-8	egg = $9 \times 10^{-8} L^{4.8356}$ 20 000-30 000/ batch	10.25	1-3, 7-9	17.5	1:1	0.33	z = 1.06	2-3	Phyto-planktons, zoo-planktons	$W = 0.006138L^{3.215}$ M:$W = 0.000005732L^{3.1235}$ F:$W = 0.000006578L^{3.1235}$
R. brachysoma	Andaman Sea[2]	-	17.5	21.0	Koh Yao Krabi	12-3, 8-10	30 000/ batch 97 250-241 832	9.5-12.5	4, 8-10	17.8	1:1.3	2.1	-	-	Phyto-planktons, zoo-planktons, diatoms, copepods	Log W = 1.8874 + 3.2104* Log L
R. kanagurta	Gulf of Thailand[3]	30-60	16.0	22.9	-	2-4 7-8	200 000	7.5	5-6	18.6	1:1	k = 2.76	M = 3.75 F = 4.973 Z = 8.73 3	2-3	Phyto-zoo-planktons, diatoms, copepods	M:$W = 0.000001958L^{3.7653}$ F:$W = 0.000009454L^{3.0375}$
R. kanagurta	Andaman Sea[4]	-	-	19.2	-	12.2	25 000/ batch 94 495 263 178	13.0-14.0	5-12	18.67	1:0.9 3	-	-	-	Phyto-planktons, diatoms, zoo-plankton crustaceans dinofla-gellates	

Source: FAO, 1986

[1] Boonprakob (1965, 1967, 1972); Tabtimtai 91968) Succhondhamam et al. (1970); Somjaiwong et al. (1970); Suvapepun and Suwanrumpha (1970).

[2] Boonragsa et al. (1984); Bussarawitch (1984, 1984a, 1984b)

[3] Vanichkul and Hongskul (1965); Boonprakob (1967); Tantiswetratana (1979)

[4] Boonragsa et al. (1984); Bussarawitch (1984)

Table 10: (continue)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
Auxis thazard	Gulf of Thailand[5]	20	35.0	-	-	4-6 8-9	-	19.0 27.0	8-11 2, 4-5	34.1	1:1	-	-	3-4	-	$W = 0.00002L^{2.99}$
A. thazard	Andaman Sea[6]					.			2-4,9	34.0						$W= 0.00002316L^{2.9617}$
Euthynnus affinis	Gulf of Thailand[7]	20	37.0	-	-	1-3, 6-7	1 730 000	21.0 26.0	2-4, 6.12	37.5	1:1	-	-	-	-	$W = 0.000015L^{2.979}$
E. affinis	Andaman Sea[8]					1-3, 6-7				37.0						$W= 0.00001731L^{2.9992}$
Thunnus tonggol	Gulf of Thailand[9]	20	38.5	-	-	3-5 7-12	1 400 000	22.0- 26.0	1-2, 4-6	39.6	1:1	1.5cm/ month	-	-	-	$W = 0.000021L^{2.979}$
T. tonggol	Andaman Sea[10]					3-5, 8-12				40.0						$W= 0.00002493L^{2.9471}$
Scomberomorus commerson	Gulf of Thailand[11]	20-60	50.0	92.0	-	2-3, 6-9	500 000 3 800 000	11.0- 21.0	3-5, 7-10	58.6	1:1.6	0.12 3.4cm/ month	-	4-5	Fish, molluses, cristaceans	$W = 0.01302L^{2.8843}$
FAMILY ENGRAULIDAE																
Stolephorus heterolobus	Gulf of Thailand[12]	5-50	4.5	8.89	30 mi off Prachuab	3-4, 7-9	2000- 4000	2.8- 4.0	All around 4-12	5.5- 6.0	1:1	k=0.198 k=1.8/ year	Z=13.50 M=3.54	1-1.5	Phyto-planktons	M:W= $2.064 \times 10^{-6}L^{3.2494}$ F:W= $7.089 \times 10^{-6}L^{2.9329}$
FAMILY CLUPEIDAE																
Sardinella gibbosa	Gulf of Thailand[13]	15-40	10.0	18.4	entire coastal zone	All around 3-4, 7-8	-	12.9	-	-	-	0.33	-	1-2	Phyto-plankton	$W = 9.28*10^{-6} *L^{3.0047}$

[5] Klingmuang (1978, 1981); Cheunan (1984)
[6] Yesaki (1982); Boonragsa (1993)
[7] Klinmuang (1978, 1981); Cheunpan (1984)
[8] Yesaki (1982); Boonragsa (1993)
[9] Klingmuang (1978, 1981); Cheunan (1984)
[10] Boonragsa (1993)
[11] Chullasorn, Chotiyaputtad Chayakul (1973); Supong and Chayakul (1979)
[12] Sdtichokpun (1970); Taweesith (1979); Isara (1972); Supongpan et al. (1984)
[13] Chullasrn, (1979)

Table 10: (continue)

Species	Area (country) surveyed	Vertical distribution range (m)	Body size captured		Spawning		Fecundity	Recruitment		Size at first maturity (cm)	Sex ratio (M:F)	Growth (rate or coefficient)	Mortality (coefficient)	Life span (year)	Food organisms	Length-weight relationship
			Mean (cm)	Maximum (cm)	Area	Season (month)		Size (cm)	Season (month)							
FAMILY CARANGIDAE																
Decapterus maruadsi	Gulf of Thailand[14]	30-40	13.2	23.1	Central Gulf	2-3, 7-8	38 000-515 000	5.5-6.5	1-2, 6-8	16.1	1:1.2	0.11 1-2cm/month	-	2-3	crustaceans copepods	$W = 0.00005L^{2.811}$
D. macrosoma	Gulf of Thailand[15]	30-60	-	-	-	12-5	-	-	-	16.5	1:0.9	-	-	-	-	-
Atule mate	Gulf of Thailand[16]	15-45	16.0	25.8	30 mi off Chumporn-Nakorn	3-4	-	5.5-6.5	1-3, 6-9	--		0.8cm/ k=0.107	-	2-3	-	-
Selar crumenophthalmus	Gulf of Thailand[17]	30-60	20-25	28.4	-	-	-	10.0	-	19.4	1:1.3	k=2.4	Z=9.7 M=3.3 F=6.5	-	-	-
Megalaspis cordyla	Gulf of Thailand[18]	20-50	22.0	28.8	-	12-5, 8-11	-	10.5-11.5	5, 9	-	1:0.8	1-2cm/month 0.2	-	-	Fish, crustacean	$W=0.144L^{2.9785}$
M. cordyla	Andaman Sea[19]	-	-	34.2	-	3-4	-	15.2	9-12	28.0	1:1.24	-	-	-	-	-

[14] Chullasorn and Yusuksawad (1977); Chantarasri (1980); Cheunnan (1981)

[15] Chullasorn and Yusuksawad (1977)

[16] Piyathirativorakul (1983)

[17] Department of Fisheries, Thailand (1984)

[18] Nupech et al. (1983); Supongpan et al. (1982)

[19] Bhatia et al. (1979)

11. CONCLUSION AND RECOMMENDATION

Resulting from the rapid development and expansion of pelagic fisheries, it has effected a great pressure on the available resources in Thailand. It is clear that almost all of pelagic fish stock have been fully exploited and some stocks are subjected to overfishing. The catch composition is changing toward smaller size of fishes and less in values as clearly observed in sardine stock that over 40% have been used for fish meal production due to too small size and unacceptable for canning factories. It is anticipated that this situation will be continued in the future if adequate countermeasure for fishery management, resource conservation and utilization have not. been undertaken.

It is recommended that urgent management measure, including limitation of fishing effort through licensing system, mesh size regulation, fishing efficiency reduction regulation (such as light intensity limitation for luring purse seine), closed area and seasons during spawning and nursing season, quota system (such as limitation on quantity and size of fish that can be allowed to land) and etc. have to be issued and implemented. In order to receive a good success, monitoring, control and survillance of those management has to be strictly practised.

It is recognized that oppropriate research used for generating management advises to the decision maker is very necessary. There are gap in knowledge on biological information still remained in many subjects of many species. It is noted that information on spawning areas, season, size at first maturity, life span, food and feeding, growth and mortalities of many species are still lacking. Besides, information on migration of other pelagic species that are migratory fish are also very sparse.

It is well known that the most important basic requirement in stock assessment is the statistics especially time series of catch and effort and size composition by species. Although the statistics particularly catch by species/group of species and its associated effort are available, its reliability is still the question. In using of such information, careful examination and cross check should be taken into consideration.

Another constraint is a confusion and lack of firm basis for the species identification. At present, the concensus on species identification of scientific name of many small pelagic fish such as *Decapterus, Encrasicholina (Stolephorus)*, *Sardinella* and etc. has not yet been established. It is recommended that this problem has to be solved as soon as possible in order to have proper research plan in the right way.

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Annex 1:

The notification of the Ministry of Agriculture and Cooperatives concerning the prohibition of fishing some aquatic species*

Subject	Date	Content
The prohibition of using any trawl and any push net with a motor boat for fishing	July 20, 1972	No person shall fish with any baged trawl and any push net or all kinds and size of baged trawl with motorboat for fishing by all means within 3,000 metres from a coastline and within 400 meters from the locating area of all fixed fishing gears or any gulfs in all coastal provinces except any activities done by the government authorities for scientific purposes with any written permission issued by the Director-General, Department of Fisheries.
The prohibition of using some fishing gears for fishing within the spawning season and nursery season in some areas in specific period	November 28, 1984	1. The spawning season shall be started from 15th February to 31st March of each year. 2. Subject to timming in 1, no person shall fish with any pair trawl net using with a motorboat, otter board trawls using with a motorboat or any purse seines (except bamboo stake trap) in some parts of prachuab Khirikhan-Chumporn-Surathani seas except any fishing activities during the night time by using beam trawl with a motor or using otter board trawls with a motorboat. 3. The nursery season shall be started from 1st April to 15th May of each year. 4. Subject to the season in 3, no person shall use pair trawl net with a motorboat, otter board trawl with a motorboat, purse seine (except bamboo stake trap) for fishing in the marine area designated in 2. However, this shall not be applied to any beam trawl with a motor boat or otter board trawl with a motorboat. 5. This notification shall not be applied to any activities the authorities for scientific research after having the written permission by the Director-General of Department of Fisheries.

* The Important Notifications of the Ministry of Agriculture and Cooperatives Regarding Thailand's Fisheries, Division of Law and Treaties, Department of Fisheries.

Subject	Date	Content
The prohibition of using some fishing gears to fish within spawning season and nursery period in some areas within a computed period of time.	April 11, 1985	1. The spawning season and nursery period will be designated from 15th April to 15th June of each year. 2. Refering to 1., no person shall use all types, of sizes trawl net with a motorboat, use purse seine and any net which has mesh size smaller than 4.7cm. For fishing in the sea within the area of Krabi province. Exception: This notification shall not apply to any fishing by anchovy purse seine during the day time, not apply to any fishing by beam trawl, otter board trawl with beam, with a motorboat which will fish during the night time only and fishing by towing line and bamboo stake trap. 3. This notification shall not be applied to the authorities activities involving in scientific experiment after getting Director-General of Department of Fisheries.
The designation of prohibited purse seine which has its mesh size smaller than 2.5cm to fish during the night time.	November 14, 1991	No person shall use any purse seine which has its mesh size smaller the 2.5cm to fish during the night time in the sea or the gulfs located in all coastal provinces except any fishing activities for scientific purposes after receiving the written permission issued by the Director-General, Department of Fisheries.

ANNEX 11

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/CR. 8

COUNTRY STATUS REPORT

VIETNAM

SMALL PELAGIC FISHERIES OF VIETNAM

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1. INTRODUCTION

Recognizing the prominent role of the Fisheries in supplying the needed animal protein food and creating employments for the Vietnamese peoples, the Government of Vietnam has given high priority to the sustainable development of the Fisheries Sector and decided that the Fisheries Sector should be the first to function under a full market economy.

Due to the new policy and sufficient supports of the Government, over the last decades the Vietnamese Fisheries Sector, especially the Marine Fisheries has had a growth in total production volume of 4-6% per year, providing approximately 40% of the total intake of animal protein (About 17.6 kg per capita). The total marine fish landings of Vietnam in 1995 reached about 929,000 MT with the export value of fisheries productions estimated at about US$551.2 million.

There are 54 provinces in Vietnam, of which 28 are coastal ones and conventionally are divided into four Regions, namely: The Tonkin Gulf, Central, South-Eastern and South-Western waters. The differences in the bottom topography, oceanographic conditions and natural fisheries resources between regions are reflected in the structure of the operating Fishing fleet as well as the fishing gears and methods being used.

The Marine Fisheries of Vietnam is classified as a Small-Scale Fisheries which is characterized by muti-species, multi-gears and multi-vessels including both motorized and artisanal fishing boats. In general, fishing activities are strongly dependent on the monsoon system which caused seasonal and special distributions of demersal and pelagic fisheries resources.

The fisheries resources in the coastal areas of Vietnam (within 50m water depth stratum) are generaly believed and reported be heavily exploited. There are indications that the waters beyond 50 m depth still contain relatively rich fisheries resources, especially of pelagic fishes.

The Government and Ministry of Fisheries of Vietnam are commited to ensuring that the Marine Fisheries should be developed in accordance with the capacity and characteristics of the living resources and their habitats to sustain exploitation. This means that the process of reduction of fishing efforts in the coastal and increase in offshore areas must be based on knowledges of the carrying capacities of the fisheries resources and a parallel monitoring and evaluation of the fisheries resources utilizations.

During the first and second SEAFDEC/MFRDMD Workshops on shared stocks in the South China Sea area held in 1994 and 1995 in Malaysia, status of the data collection and some biological parameters and fisheries status of shared stocks of *Decapterus, Rastrelliger* and Tunas in coastal seawaters of Vietnam have been presented (Chung B.D; Vinh C.T & Duc N.H; 1995). This paper deals with the small pelagic fisheries and their management measures of Vietnam.

2. STATUS OF FISHERIES

Natural Resources

Up to now, 2038 species of fishes belonging to 320 Orders, 198 families, 717 Genera have been identified in seawaters of Vietnam, of which about more than 100 species are of economic importance (Thi N.N. 1991). According to the ecological features, they can be divided into 4 Groups, namely: Pelagic, Semi-Pelagic, Demersal and Coral Reef.

The Pelagic Group consists of about 260 species accounting for 13% of the total number of species and they are commonly inhabiting in supper layers of the water columns. Among the pelagic fishes, species belonging to the oceanic sub-group account for 32.2% while neritic ones 67.8%.

The following small pelagic species are of economic importance in terms of catches: *Decapterus maruadsi, D. lajang, D. kurroides; Sardinella aurita, S. jussieu; Rastrelliger kanagurta, R. brachsoma; Scomberomorus guttatus, S. commerson; Selar crumenopthamus, S. mate; Stolephorus commersonii, S. indica; Selaroides leptolepis; Megalaspis cordyla; Sphyraena jello, S. obtusata; Trichiurus lepturus; Mugill* spp.; *Thunnus tonggol; Auxis thazard, A. rochei; Euthynnus affinis, Katsuwonus pelamis, Formio niger; Pampus argenteus.* In terms of value *Pampus argenteus, Formio niger, Decapterus* spp. *and Rastrelliger* spp. are most important.

The Marine fish standing stock of Vietnam is estimated at about 4-4.2 million MT with the Potential Yield of about 1,700,000 MT and of which the pelagic fish resources accounted for 41.6% (1,740,000 and 694,000 MT respectivelly). Estimations of standing stock and potential yield of small pelagic fishes in seawaters of Vietnam are given in Table 1.

Table 1: Standing stock and Potential Yield of small pelagic fishes in Seawaters of Vietnam

Regions	Standing stock (MT)	Potential Yield (MT)	%
Gulf of Tonkin	390,000	156,000	22.4
Central	500,000	200,000	28.7
South-Eastern	524,000	209,600	30.1
South-Western	316,000	126,000	18.2
Offshore Seamounts	10,000	2,500	0.6
Grand total	1,740,000	693,500	100.0

Catch - Efforts

No statistical data on catch and efforts for each pelagic species available, of total fisheries production, small pelagic fishes catches accounted approximatelly for 40%. Results of bottom trawl catch of research vessels (2350 Hp) carried out in seawaters of the South Vietnam during 1979-1985 are shown in Table 2.

Table 2: Catch per Unit of Effort (CPUE) for some pelagic species

ord	Species	Catch (Kg)	Number of Hauls	Catch per Haul (Kg)	Catch per Hour (Kg/h)
1	*Decapterus maruadsi*	55,062.9	423	130.2	87.6
2	*D. lajang*	4,057.8	114	35.6	32.4
3	*D. kurroides*	23,859.0	151	158.0	182.1
4	*Sardinella aurita*	1,773.5	77	23.0	17.4
5	*S. jussieu*	2,237.5	106	21.1	17.3
6	*Megalaspis cordyla*	5,169.6	182	28.4	17.8
7	*Rastrelliger kanagurta*	9,235.7	323	28.6	20.2
8	*Scomber japonicus*	11,135.8	31	359.2	269.1
9	*Scomberomorus guttatus*	1,479.2	171	8.7	6.1
10	*S. commersoni*	4,501.8	345	13.1	8.8
11	*Formio niger*	2,175.3	208	10.5	7.0
12	*Pampus argenteus*	327.2	38	8.6	6.0
13	*Selaroides leptolepis*	30,954.2	462	67.0	42.3
14	*Selar crumenopthamus*	5,135.9	213	24.1	16.9
15	*Caranx mate*	8.96	7	2.0	1.3
16	*C. malam*	1,462.8	107	13.7	9.4
17	*C. chrysophrys*	315.2	39	8.1	6.0
18	*C. malabaricus*	2,904.9	283	10.3	8.7
19	*Trichiurus lepturus*	790.0	45	17.6	17.3
20	*Sphyraena jello*	1,886.8	109	17.3	10.1

Fishing Fleet and Gears

In 1994 the total number of motorized fishing vessels was estimated at about 65,000 units with a total engine capacity of approximately over 1,400,000 Hp of which fishing vessels with engines smaller than 10 Hp accounted for approximetaly 50%, with engines of 11-33 hp - 34% and with engines more than 33 Hp - only 15%. Besides, about 15,000 artisanal fishing boats are operating.

The distribution of motorized fishing vessels in terms of units and engines capacity along the coastal regions is shown in Fig. 1 & 2. It is clear that approximately half of the fishing fleet operating off the coast of central region, where pelagic fisheries resources are relatively abundant.

A variety of fishing methods are being used in Vietnam. The number of fishing gears and their distribution are given in Table 3.

Table 3: Number and distribution of fishing gears in seawaters of Vietnam

Fishing gears Groups	Tonkin Gulf	Central	South-Eastern & South-Western	Total
Trawling	586	19,221	1,850	21,657
Purse Seines	57	3,489	394	3,940
Lifting net	85	4,861	14	4,940
Gill net	3,982	24,333	3,312	31,627
Lines	1,613	17,452	975	20.040
Set net	1,825	911	8,659	11,395
Grand total	8,148	70,267	15,204	93,619

Purse seines, Drift Gillnets, Lifting nets and Trawling are the major fishing gears for catching small pelagic fishes. As seen in Table 3, fishing gears that used for catching pelagic fishes were almost concenrated in Central region of Vietnam. Due to scattered distributions of small pelagic fishes, artificial devices such as electric, kerocine light as well as fish aggregating devices (FAD) are being used.

3. FISHERIES BIOLOGY

Fish schools behavior and migration

Number of pelagic fish schools varies by seasons of the year, small-sized schools are dominant and accounted for 82.4% of total number of schools, medium-sized schools - 15.0%, big-sized schools - 0.7% and very big-sized - only 0.1%. About 56.4% of fish schools appear within depth stratum of 20-50m, 25.7% within depth of 50-100m, 2.8% within depth of 100-200m and only 0.6% within depth beyond 200m.

In the Northeast monsoon period, number of fish schools were estimated at two times more than in Southwest monsoon period.

Many pelagic fishes eventually have day-night migration pattern. At the day time they are distributed near the bottom and at night time they are scatterelly distributed in waster columns and in surface layers. It has seen very clearly for fishes belonging to *Decapterus, Rastrelliger* and *Sardinella* Genera.

Biological characteristics and population parameters of some small pelagic species

Biological characteristics and population parameters of some small pelagic species available in seawaters of Vietnam are summerized and given in Table 4.

Table 4: Main biological characteristics and population parameters of small pelagic species available in seawaters of Vietnam

Species	Captured Body Length (mm)	Coefficents a & b in Length-weight Relationship Equation	L∞ (mm)	K	to	Z	M	F
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Decapterus maruadsi	60-239	Central Tonkin Gulf: a = 0.00001340 b = 2.5330 Southern part a = 0.0001005 b = 2.6020	243 262	0.32 0.52	0.89 0.79		0.98 1.19	0.75 0.80
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Decapterus kurroides	200-390	For Male: a = 0.00219 b = 3.4577 For Female: a = 0.00343 b = 3.3309	Male: 443 F.m.: 411	 0.18 0.22	 0.697 0.40			
S. jussieu	120-149							
S. aurita	175-230	a = 0.0112 b = 2.9071						
Rastrelliger kanagurta	67-295	a = 0.084 b = 2.330						
Selaroides leptolepis	60-190	a = 0.00006 b = 3.1432	218.6	0.58	0.52	1.63	0.7	0.47
Auxis thazard	240-290	a = 0.00164	605.8	0.98	0.11	1.94	1.56	0.38
Euthynnus affinis	200-640	a = 0.00058 b = 2.698	510.0	0.50		1.00	0.48	0.52
Thunnus tonggol	260-680	a = 0.000731	722.2	0.899	0.128	1.30	1.03	0.27
Katsuwonus pelamis	410-650	a = 0.000114 b = 2.710	720.8	1.10	0.08	0.54	0.26	0.28
Stolephorus commersonii	30-100							
Sphyraena obtusata	220-310							

In general, most of small pelagic species in seawaters of Vietnam have relatively short life-span (4-5 years old), the under exploitation stock consists mainly of fishes of 2-4 years old. The growth rate was estimated very high during the first year of life and age at first maturity is commonly recorded at the end of the first year. The spawning migrations of almost species of pelagic fishes have been from March to September.

Distributions of abundance of neritic Tunas

Distributions of relative abundance (in terms of weight) of neritic tunas caught by driff gillnets in off shore Vietnam in the Southwest and Northeast monsoons 1996 are shown in Figures 3-6.

4. OCEANOGRAPHIC PARAMETERS RELATED TO MARINE FISHERIES

Rich oceanographic data are available in seawaters of Vietnam. All data were collected throught the research activities conducted by Research Institutions of Vietnam alone or in coolaboration with oversea research organizations. Based on these data the Physical, Hydrological and Dynamical Atlas of the South China Sea have been completed. The Atlas contained the seasonal and spatial distributions of temperature, salinity, conditional density, dissolved oxygen, current, wave by standard stratums.

The dynamics of fisheries resources in seawaters of Vietnam are found deeply influenced by oceanographic conditions, especially by Upwelling phenomenon which was observed along the coast of Ninh Thuan-Binh Thuan Provinces (South of Central Vietnam) in Winter and Summer seasons (Figures 7-8). During the Southwest monsoon (SW) the upwelling is stronger than in Northeast monsoon (NE).

During SW monsoon, the surface water is flown affshore, cool water originaling from depth of 80-100m upwells close to shore, the thermohaline layer (or pyanakline-sized) was observed closer to the surface water and shore. The fish schools (mostly small-sized) usually migrated and dispersed in nearshore water (particularly near the thermohaline layer) for spawning and and feeding.

During NE monsoon, the upwelling was observed in offshore water and the downwelling may occur in shore water. The thermohaline layer was observed near the bottom, in this period relatively bigger fish shools were recorded.

Generally, the forming and migrations of fish schools in upwelling area are closely related to fluctuations of the thermohaline layer near the sea bottom. Fishes are found rather more abundant in peripheries of an upwelling than in center.

5. CONCLUSIONS AND RECOMMENDATIONS

Small-pelagic fisheries are considered to be very important for small-scale fisheries of Vietnam, however due to heavy exploitation in nearshore waters and somewhere destructive methods of fishing (with explosives, poisons) are being still taken place, the resources seemed to be decreased. Therefore we should have to reduce fishing presures on nearshore fishing grounds by limiting entry into fisheries, prohibiting destructive methods of fishing, enlarging mesh size of fishingnets being used and to conduct research activities on new fishing grounds as well as new target species in offshore. In addition, proper and effective methods of fishing should be used.

Stock assessment of small pelagic resources remained an important and difficult issues. Acoustic method and Virtual Population Analysis (VPA) in FISAT (FAO-ICLARM STOCK ASSESSMENT TOOLS) are considered usefull and suitable in tropical waters.

Fisheries statistical systems are urgently needed to be eshtablished at all fish landing sites along the coast, and fisheries biologists should be involved into this activities.

The relationship between ocenanographic factors and distributions, behaviour as well as biological features of fishes should be further studied in detail. In addition, remote sensing method in fisheries research need to be developed.

Collaborative research on studies of shared stock in general and fisheries resources and marine environmental related should be conducted the sooner the better.

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ANNEX 12

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/WP. 1

TOWARD MANAGEMENT OF SHARED STOCKS IN THE SOUTH CHINA SEA REGION

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ABSTRACT

Fisheries in the South China Sea region have shown rapid development in the last two decades. Landings of the eight countries of Southeast Asia bordering the South China Sea have grown from 4.1 million tonnes in 1975 to 7.2 million tonnes in 1995, or an increase of 75% in the last two decades. Increased fishing pressure in coastal areas had brought about stagnant catches of shrimp in some individual countries, while allocations of tuna fishing effort by Indonesia o neighbouring countries indicated that high fishing pressure for tuna occurred in some countries. This trend of development and the momentum arises from the current progress in the negotiation and establishment of an organization that deals with tuna resources in the Indian Ocean and the western and central Pacific, should eventually lead to the initiative of management of shared stock in the region. General requirements and steps in the management of shared stocks are described as an attempt to promote understanding among potential participating countries in this venture.

1. INTRODUCTION

The term "shared stocks" has been commonly used to refer to those transboundary stocks exploited by two or more countries. However, in large countries, e.g. China and Indonesia, two different types of fisheries may also exploit a shared stock in national jurisdiction, e.g. trammel net fishermen may exploit a shared stock in national jurisdiction, e.g. trammel net fishermen may exploit the shrimp stocks exploited by the trawl fishermen. This paper shall deal only with the former, i.e., the stocks that are being shared by two or more countries, with a brief account of the potential activities for the management of such stocks.

Despite the frequent use of the term "fish stock", precise definition such as those to denote "species" or "population" is not available. A "unit stock" is a technical term to denote an empirical grouping of fish that is sufficiently large that, when analysing the data concerning it, or taking decisions about its exploitation and management, events on "adjacent stock" can be ignored, or at least treated in a different way to events within the stock (Gulland, 1980). It should be borne in mind that what is considered a "stock" is not an absolute, but can be adapted, depending on the purpose, for convenience of analysis or policy making.

The concept of shared stocks relates to the reality that fishing deals with migratory resources and the disregard of such resources for man-made boundaries. Demersal species which are less mobile than the pelagic species, during their lives also perform movements, namely during larval stage and spawning phase. If such movement only takes place within the jurisdiction of a coastal state then such resources form a shared stock within a jurisdictional country. A good example is coastal shrimp fishery where stocks are exploited during the larval stage and the juvenile/adult stage. The management of the fishery should consider the two fisheries exploiting a single shared stock.

In line with the movement of resources and in relation to the exclusive economic zone, Caddy (1982) has made a systematic description on shared stocks of which four are considered important as in the following:

1 Stocks that lie almost entirely within a single national jurisdiction;

2 Non-migratory resources lying across the boundary between adjacent zones, and which are continuously available in each zone;

3 Migratory species moving across boundary areas which are only available in each zone on a seasonal basis; and

4 Highseas stocks that are only occasionally or partially available inside national zones.

In the context of the South China Sea region, some of the resources fall within the first three groups above and a more limited number belong to the fourth group, e.g. some of the tuna species.

2. HOW MUCH DO WE KNOW ABOUT SHARED STOCK?

The FAO/SEAFDEC Workshop on Shared Stocks in Southeast Asia (Bangkok, 18-22 February 1995) identified potential shared stocks in the South China Sea to which by this time additional information has become available and could be added to the list of shared stock identified in 1985. Reports of two past SEAFDEC Workshops also updated the status of potential shared stocks in the region.

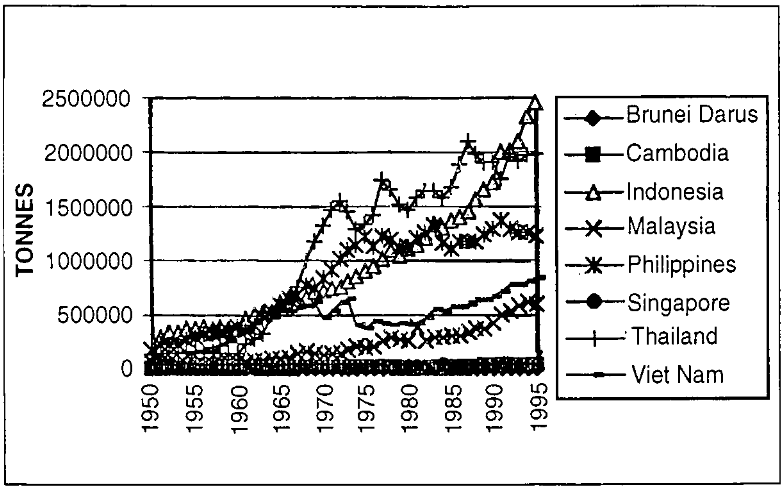
In a tropical environment like the South China Sea where multispecies resources are found, the shared stock concept also applies for species groups rather than a single species. This is particularly relevant for the demersal species that in many cases perform transboundary movement across neighbouring coastal states, e.g. shrimp in the Malacca Straits (between Malaysia and Thailand) and the Gulf of Thailand (between Malaysia and Thailand) and (between Thailand and Cambodia and Cambodia and Vietnam). Such categorisation also applies to a certain extent to some pelagic species where detailed information is still meagre.

Despite less variation of oceanographic conditions in the tropics than in temperate waters, much of the aquatic life especially during their larval stages are sensitive to environmental conditions. Impact of monsoonal changes on larval production and recruitment of many fish species is still not well understood, and remains a challenge for scientists in the region. The relatively short lives of many tropical fish and continuous spawning demonstrated by some pelagic species may complicate boundaries of stocks. Some of these form a research agenda for future research work in the region.

3. TRENDS OF CATCHES IN THE REGION

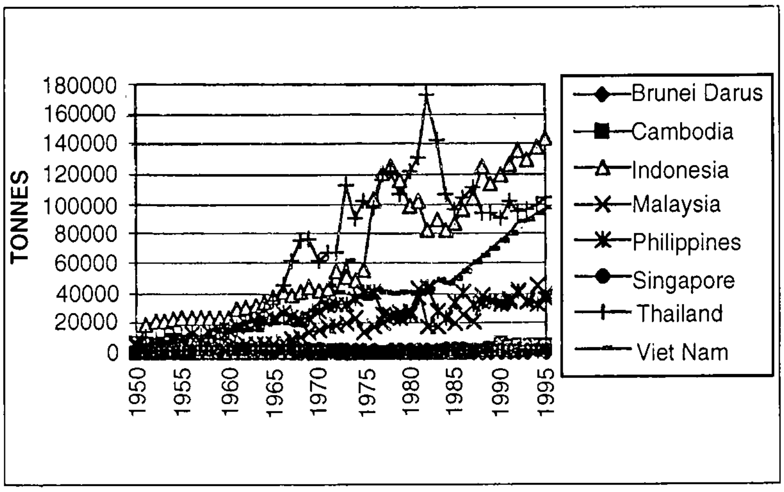
The development of fisheries in the region has resulted in total marine landing of the eight countries bordering the South China Sea (Brunei Darussalam, Cambodia, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam) amounting to 7.2 million tonnes in 1995 (excluding seaweeds), of which 99% contributed by the six countries as the other two, Brunei and Singapore, are small coastal States. The annual aggregate rate of increase in the last three decades was about 5%, an indication of a relatively fast growth (figure 1). Of the total amount of marine landing, 6% were shrimp, 12.8% demersal, 37.4% pelagic, 13% tuna and 27.9% miscellaneous fish. Current catches of cephalopods and other invertebrates were still less than 5% of the total catch. Please note that in the absence of breakdown of catches in the national fishery statistics, the reported catch is treated as miscellaneous fish in the FAO Statistics, such as in the case of Vietnam and Cambodia. This contributed to the high percentage of miscellaneous fishes as shown in the analysis above.

Figure 1. Trends of landings of major states in the South China Sea region



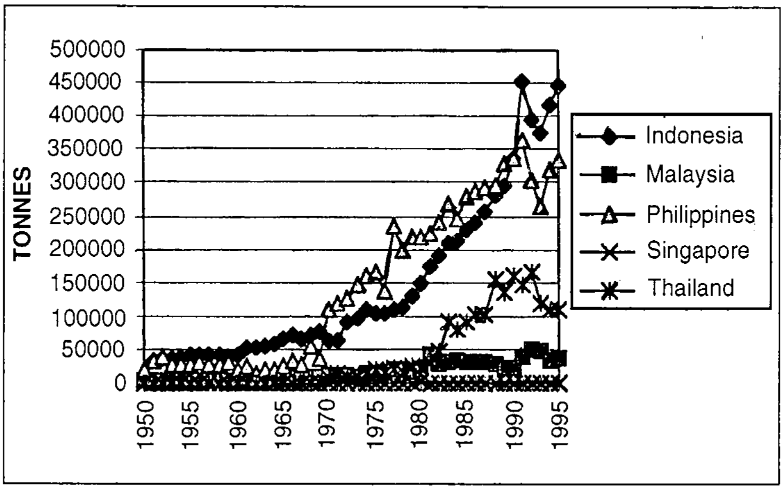
Individual trends of shrimp landings in Malaysia, Philippines and Thailand showed flat curves since the mid-1980's, indicating that the shrimp stocks in their waters have probably been overexploited since that time (Figure 2). It is unlikely that further increase can be expected in shrimp capture fisheries in the future. Shrimp culture production in those countries, however, has compensated for the stagnant production of the capture fisheries. To prevent further decline of shrimp production from the wild stocks, the management of shrimp fisheries is needed not only nationally but also to a certain extent regionally as some of the stocks are transboundary between countries, such as those in the border between Thailand and Cambodia in the northern Gulf of Thailand and between Thailand and Malaysia in the northern part of the Malacca Strait (FAO, 1985).

Figure 2. Trends of shrimp landings of major states in the South China Sea region



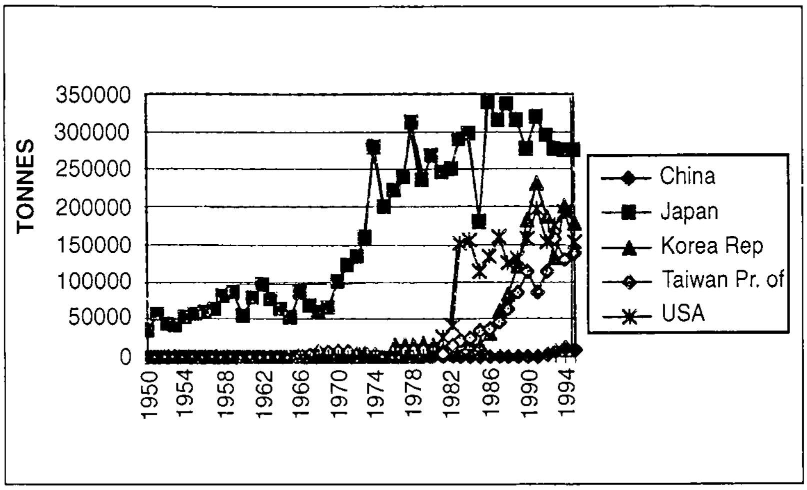
Development of tuna fishing in the region is worth nothing. Indonesia and the Philippines are the two countries with a high landing of tuna, their catch statistics indicated 448,000 tonnes and 334,000 tonnes respectively in 1995 with some fluctuation in early 1990s (Figure 3). Some of the Philippino purse seiners obtained fishing access in the adjacent Indonesian EEZ through the licensing scheme of the Indonesian Government, while some other licensed foreign purse seiners have been fishing in the Indonesian part of the South China Sea as well (Gillet, 1996). This development obviously demands more information on updated resources availability on the Indonesian side and it should encourage collaborative efforts between the two countries in obtaining catch and effort data on tuna fishing as a first step in developing the data base needed in the management of tuna fisheries.

Figure 3. Trends of tuna landings of major states in the South China Sea region



Tuna catch of the distant-water fishing nations in the high seas of the Western Central Pacific (obviously outside the South China Sea) has increased in the last decade and the catch amounted to 754,000 tonnes in 1995 (Figure 4). Despite the decline of the Japanese catch in the nineties, their catch was still higher on the average than those of other distant-water fishing states (around 250,000 to 300,000 tonnes). China joined the others in late 1980's with the small longline fleets which landed around 5,000 - 10,000 tonnes in 1994-1995. Total tuna catch the countries bordering the South China Sea was still higher (931,000 tonnes) than that of the distant water fishing states as the catch included the coastal tunas.

Figure 4: Trends of tuna landings of distant-water fishing states in the Western Central Pacific (fishing area-71)



4. WHY MANAGEMENT OF SHARED STOCKS?

The contribution of the region to the global fisheries production is on significant importance as described in the preceeding section. Despite the increasing sign of overexploitation of resources in the coastal waters, it is still common to find increase of production as being one of the objectives of fisheries development plan in countries in the region. In addition, the absence of a fisheries management plan in many countries also reflects the low priority that has been given to fisheries management in the region. With this background, there is not doubt that fisheries management institutions in many countries are still in a developing stage.

Overlaping claim of EEZs among countries in the region has become an important topic in the current news media. The cause of overlapping claim was, however, more related to the suspected potential of oil reserves in some of the islands than to fisheries. An encouraging development in the region in dealing with this problem is the new practice to make use of the conflicting area to become a production sharing area where the conflicting countries could obtain mutual interim benefit (Matics, 1997).

It appears that in the fisheries sector, the initiative towards management of shared resources has been pioneered by the recent development in the establishment of the Indian Ocean Tuna Commission (IOTC), to which the management of tuna fisheries will be the main part of its mandate. Members of IOTC are not limited only to the coastal states surrounding the Indian Ocean but also includes the distant-water fishing states. In the Pacific side, a similar type of development has also been taking place where coastal nations and the distant-water fishing states hve actively participated in several diplomatic meetings which hopefully will lead to the establishment of an organization to which management of tuna fisheries in the Western and Central Pacific will rest on. Small island developing states in this region have been very active in the negotiation under its regional organization FFA (Forum Fisheries Agency), while from countries bordering the South China Sea, Indonesia and the Philippines have participated. The participation of China in this meeting is a mere reflection of China being a member of the distant-water states fishing in the Pacific Ocean. The next diplomatic meeting has been scheduled for June 1998 (Doulmann, pers.comm.).

Concern of the world community on the current exploitation of fishery resources has grown and this is reflected by the outcome of global initiatives, e.g. the 1992 Rio Declaration and the Agenda 21 of UNCED, 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, the 1995 UN Agreement for the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and the 1995 FAO Code of Conduct For Responsible Fisheries. At the request of its member states, FAO is presently engaged in developing a series of guidelines of the Code of Conduct for Responsible Fisheries. FAO is also charged with monitoring the implementation of the Code. Some developed countries have agreed to fund the global activities in promoting the Code of Conduct and its implementation through FAO. Globalization of trade has also opened doors for countries to impose trade barries to block markets for certain fishery products which are caught from irresponsible fisheries. It is likely that such types of global pressures will increase in the future and will, no doubt, become a burden for countries where irresponsible fisheries still flourish.

The Code of Conduct for Reponsible Fisheries with its respective guidelines serves as important direction for the countries towards building sustainable fisheries. The current momentum in the establishment of regional organization dealing with shared tuna resources should serve as an incentive for the member countries in strengthening the management institutions in each individual country. Hopefully this process will lead to initiatives in the direction of promoting the management of any stocks shared among countries in the region. How fast the process will progress is very much dependent on the perception and response of the countries concerned, the regional bodies such as SEAFDEC and APFIC could only act as a catalyst. Once the countries sharing the resources are ready to negotiate, the countries concerned could make use of the regional organization in providing technical information relating to the concerned resources. The information below provides a brief note on general requirements and the steps normally taken, but some variation may also exist depending on the status of resources, level of exploitation, socio-economics of the fisheries and the management objectives of the individual countries.

5. REQUIREMENTS FOR THE MANAGEMENT OF SHARED STOCK

In general, the requirements and the process of management of fisheries in the individual EEZs apply to the management of shared stocks. The difference is in the number of parties involved being more than one, which undoubtedly requires cooperative agreement. If the countries exploiting the stocks have a different level of economic development, the management arrangement would be different from those applied to the situation where the parties are of equal level. Nevertheless the process of management of shared stock should, in principle, be similar. Mahon (1987) presented four major sequential activities in the management of shared stocks as follow: (a) definition of stocks; (b) stock assessment; (c) allocation and co-operative regulation, and (d) survellance and enforcement. These activities are dealt with in the following sections.

The definition of stocks

All parties in the management of shared stocks should agree on the definition of stocks which will be used as the basic unit for management. An important aspect of stock that should be taken into account, where its delimitation should be agreed by the parties concerned, is the boundary of stock. The boundary may be revised based on a better understanding of the dynamics of the stock concerned. In a simple situation, stock be may confined to a certain habitat although such a situation may not be so obvious in the tropics, except for certain habitats such as coral reefs, mangroves, etc.

Approaches in distinguishing stocks may be taken through inferences or direct observation. Three types of inferences and direct observation were put forward by Mahon (1987). The first inference is through genetic discrimination. Morphometric (measurements of body parts, e.g., length or width of the body, fins, etc.) and meristic analysis (the counts of spines, scales, fin rays, gill rackers, etc.) are commonly employed. More recently, biochemical techniques are becoming frequently used (electrophoresis).

The second approach is through inference from population dynamics parameters. Similar pattern of variation of certain population parameter of different stocks such as variation of abundance of the different groups may indicate that the groups are of the same stock. Another inference is through analysis of growth and migratory patterns. If the individuals of a species migrate through a number of fisheries, the timing of their migration, coupled with information on growth, may indicate which fisheries share a common stock. This method, however, is likely to end in ambiguous interpretation.

The third approach is the direct observation which has been commonly executed through tagging and recapture of individuals. While another is to follow patches of eggs and larvae as they disperse. The direct methods are subject to different interpretation and therefore application of various methods are desirable to obtain convincing results.

Stock Assessment

Assessment of shared stock bears the same characteristic as assessment of stock under single national jurisdiction. As aquatic resources live in a fluid environment their assessment faces many uncertainties, therefore, varied stock assessment approaches need to be employed. In the case of shared stock, the degree of complexity of the stock assessment methods also depends on the management approach agreed by the participating countries.

In principle there are two main approaches to managing shared stocks (Mahon, 1987). First, aloocation of catch or effort and second, co-ordinated conservation oriented regulation. The allocation of catch is derived from the estimate of total allowable catch (TAC), while allocation of effort from total allowable effort)TAE). Two methods ore commonly employed to derive the basis for allocation, one through yield per recruit analysis and the other through surplus production estimation. Detailed descriptions of the methods is not presented here as they are generally available including that of Ricker (1975) and Gulland (1969).

In practice, allocation of effort is easier to monitor and control than allocation of catch. Nonetheless, both still require regular monitoring activities. Present practice by some countries in the region in providing licenses to foreign boats is basically based on allocation of effort, although such allocation may not have been supported by a scientifically based calculation of TAE. As fishing gear used by participating countries is generally not the same, calibration of effort is always required. Assessment of the stock may run into difficulty when the number of nominal effort keeps constant but effective effort is increasing due to technological innovation, then the impact of fishing will be difficult to see. In such cases, regular resource surveys are needed to enable one to get an independent estimate of the stock.

Co-ordinated regulation

Along with the allocation of catch or effort that participating countries may have agreed on the management of shared stocks, they may also agree to introduce compatible regulations to maintain the sustainability of the catch. Closed area or closed season may be employed to protect the spawning stocks and mesh size limitation for reducing catch of the undersized fish.

Negotiation among countries for fishing on shared stocks requires knowledge of the stocks on both sides, thus exchange of information and collaborative research need to be developed accordingly. In the context of South China Sea, as no regional mechanism for management of shared stocks is available, SEAFDEC could play an important role in facilitating such co-operative research to support the management of shared stocks in this region.

Surveillance and enforcement

Fisheries management is not an easy task and it will not bear fruit unless the rules and regulation associated with it are followed by the participants. Surveillance and enforcement are coastly, yet important. Such an effort should be under the joint responsibility of the parties concerned to which joint enforcement could be finally established by the participating countries.

6. CONCLUSION

Development of fisheries in the last four decades has brought a spectacular increase in marine fishery production in the region. However, occurences of overexploitation of resources, especially the coastal ones, has also increased. Fisheries development in the region has also resulted in the expansion of fishing by some countries in their neighbouring EEZs. Allocation of fishing access by individual countries to the neighbouring countries and other distant-water fishing states have subsequently emerged. The Philippines and Thailand are the two countries that seek fishing access to neighbouring countries apart from the other distant-water fishing fleets such as the Republic of Korea and Taiwan, Province of China. Such development will open doors for further management arrangements in the future once the parties recognise that the shared resources are under heavy fishing pressure.

The SEAFDEC/MFRDMD has a strategic position in the region to play a role in the collation of information on shared stocks, establishment of regional database and networks for scientists working on shared stocks in the region. Such an effort is essential towards building management oriented information for the shared stocks. FAO, through the APFIC Committee and its Working Party on Marine Fisheries, will join hand in hand with SEAFDEC in helping the Member States to facilitate such activities.

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ANNEX 13

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/WP. 2

STATUS OF FISHERIES AND STOCKS OF SMALL PELAGIC FISHES IN THE SOUTH CHINA SEA AREA

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1. INTRODUCTION

The South China Sea Area is one of the most important Areas for marine capture fisheries in the world, and the marine catches of the Area accounted for around 10% of the world grand total. Among the fisheries resources, the small pelagic fish resources are considered as important in the Area from the economical viewpoint. The purpose of this paper is to provide the baseline information on the small pelagic fish resources management. This paper, therefore, describes the catch trends and major fishing gear of 19 small pelagic fish species (groups) and stock status of 9 species (groups) among them.

On the small pelagics, 19 species (groups) were selected for this Area in this paper from the tentative list of small pelagics agreed at the First Session of Working Party on Marine Fisheries organized by APFIC (Asia-Pacific Fishery Commission) held in Bangkok, May 1997. On the catch trends, data were obtained from SEAFDEC Fishery Statistical Bulletins for the South China Sea Area from 1976 to 1994, and catch tends of the Area (data were consisted of catch quantity at countries concerned) by species (group) were shown. On the fishing gear, major fishing gears used in Malaysia, the Philippines and Thailand (Gulf of Thailand and Indian Ocean) in 1994 for each species (group) were described.

On the stock status, possible stocks in this paper followed the identification of stocks described in the report of the FAO/SEAFDEC Workshop on shared stocks in Southeast Asia 1985. As the stock limits described in the above mentioned report and available area for statistics in this paper were not exactly the same, this paper showed the differences between the limits of stocks and the available data area were shown in text and Annex-Figures, and described the catch trend and relationships of catch quantity in stocks by species.

2. MATERIALS AND METHODS

Data were obtained from the SEAFDEC Fishery Statistical Bulletin for the South China Sea Area for 1976 to 1994 published by SEAFDEC. The Bulletins cover the South China Sea, Fishing Area 71, as designated by the FAO, and the territorial waters of the Andaman Sea belonging to Malaysia and Thailand. Therefore, catch data described in this paper were obtained from Brunei, Taiwan, Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand. Selected species (groups) in this paper are shown in Table 1.

Table 1: Species (group) list and codes of ISSCAAP (FAO) and SEAFDEC examined in this paper

ISSCAAP (FAO)		SEAFDEC		
Group	Code	Name	Code No.	Family/Scientific name
34. Jacks, mullets, sauries, etc.	BAR	1. Barracudas	3402	Sphyraenidae - *Sphyraena* spp
	MUL	2. Mullets	3403	Mugilidae
	SDX	3. Round scads	3405	Carangidae - *Decapterus* spp.
	TRE GLT	4. Jacks, cavalla and trevallies	3406	Carangidae - *Caranx* spp *Gnathanodon speciosus (including Alectis* spp., *Atropus atropus, Caranx chrysophrys, C. malabaricus, C. ignobilis)*
	BIS TRY	5. Selar scads	3407	Carangidae - *Selar crumenophthalmus, Selaroides leptolepis* (including *Alepes* spp., *Selar* spp.)
	HAS	6. Hardtail scad	3408	Carangidae - *Megalaspis cordyla*
	POB	7. Black pomfret	3410	Formionidae - *Formio niger*
	SIP	8. White pomfrets	3411	Stromateidae - *Pampus argenteus* (including *Pampus chinensis*)
35. Herrings, sardines, anchovies, *etc.*	SIX	9. Sardines	3501	Clupeidae - *Sardinella* spp.
	STO	10. Anchovies	3503	Engraulidae - *Stolephorus* spp
	DOB	11. Wolf Herring	3505	Chirocentridae - *Chirocentrus dorab*
36. Tunas	LOT	12. Longtail tuna	3604	Scombridae - *Thunnus tonggol*
	KAW	13. Eastern little tuna	3606	Scombridae - *Euthynnus affinis*
	FRZ	14. Frigate tuna and bullet tuna	3607	Scombridae - *Auxis thazard Auxis rochei*
	COM	15. Narrow-barred king mackerels	3609	Scombridae - *Scomberomorus commerson*
	GUT STS	16. King mackerels	3610	Scombridae - *Scomberomorus guttatus, Scomberomorus lineolatus*
37. Mackerels	RAG	17. Indian mackerels	3701	Scombridae - *Rastrelliger kanagurta* (including *Rastrelliger faughni*)
	RAB	18. Indo-Pacific mackerel	3702	Scombridae - *Rastrelliger brachysoma*
	CUT	19. Hairtails	3703	Trichiuridae

Information on stocks of each species (group) was obtained from FAO Fisheries Report No. 337, 1985 (Report of the FAO/SEAFDEC Workshop on shared stocks in Southeast Asia). Comparative table of the possible stocks described in the FAO report and their applied catch data sources (areas) are shown in Table 2. The names (areas) of stock described at above mentioned report were applied for this paper.

On catch trends of 19 species (groups), the data of 1979 were revised from the original data because of lack of Indonesian data in 1979. The 1978 catch quantities of Indonesia were applied to those of 1979 data. On status of stocks, some data also revised from the original data by applying the ratios of previous years stock catch. Regarding Malaysian data by area by species, Malaysian Annual Fisheries Statistics for from 1991 to 1994 also cited.

Table 2: Comparative table of the possible stocks described in the FAO/SEAFDEC Workshop (1985) report and their applied catch data sources (areas).

Shared stocks from the FAO Report (FAO/SEAFDEC Workshop, 1985)	Applied areas in this paper (Area name from SEAFDEC Bull)
Gulf of Thailand to Sunda Shelf	Gulf of Thailand and East Coast of Peninsular Malaysia
Malacca Strait .... Malacca Strait and Andaman Sea	Indian Ocean (Thailand), west coast of Peninsular Malaysia, Singapore and Malacca Straits (Indonesia)
Eastern South China Sea	Sabah, Sarawak (Malaysia), Brunei and the Philippines
North and West Borneo	Sabah, Sarawak (Malaysia) and Brunei
Gulf of Thailand	Gulf of Thailand
Sunda Shelf-Northwest of Borneo .... West and Northwest of Borneo	Sarawak, Labuan (Malaysia) and Brunei
Northwestern Celebes Sea	Sabah (Malaysia) and Mindanao (Philippines)
Malacca Strait (east)	Indian Ocean (Thailand), West Coast of Peninsular Malaysia and Singapore
Northeastern South China Sea	Sabah (Malaysia) and the Philippines
Western Gulf of Thailand to Singapore	Gulf of Thailand and East Coast of Peninsular Malaysia and Singapore
Palawan-Celebes Sea	Sabah (Malaysia) and the Mindanao (Philippines)

*The limits of distribution of possible shared stocks and their applied areas for catch data cited in this paper are not exactly the same.

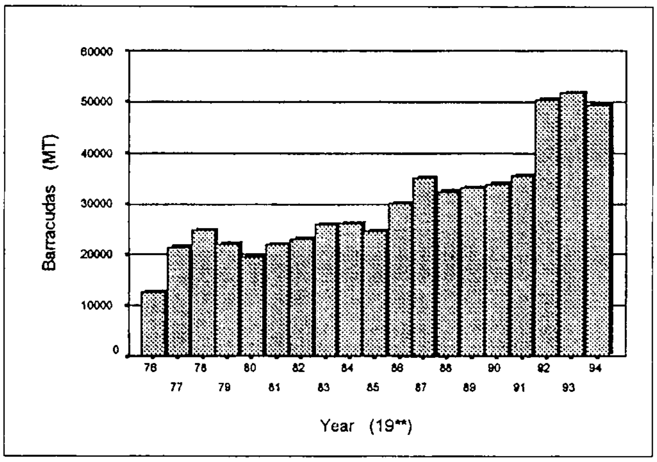
The names of the fishing gear were followed from the original ones in each country. In case of appearance of same fishing gear names, the categories of large and small-scale fishery also followed from the original identification by country.

Barracudas

Catch Trend

Barracudas catch (Fig. 1) in the Area recorded at 12,700 MT (accounted for 0.22% of the grand total) in 1976 and it showed a big increase to 21,400 MT (0.32% in 1977 and 24,700 MT (0.37%) in 1978. The catch remained constant until 1985 with slight variations, and then it increased and reached at 30,100 MT (0.41%) in 1986 and 35,000 MT (0.44%) in 1987. In 1988 the catch decreased slightly and it remained constant until 1991. Then, the catch showed a big increase to 50,400 MT (0.53%) in 1992 and remained constant around 50,000 MT until 1994.

Figure 1: Catch trend of barracudas in the Area from 1976 to 1994



Fishing Gear

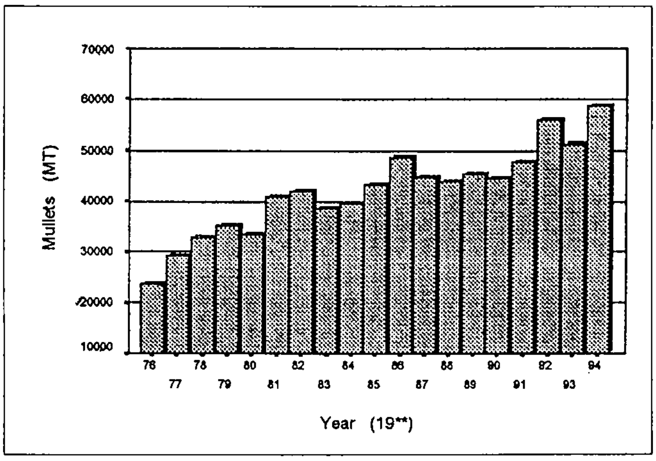
Major fishing gears for barracudas in 1994 by country and area were as followed. In Malaysia, trawl (accounted for 52.7%) was the most dominant, followed by hook-and-line (23.8%) and drift gill net (13.6%). In the Philippines, hook-and-line (35.7%) was the most dominant, followed by small-scale gill net (15.3%), otter board trawl (11.6%), one boat purse seine (10.6%) and boat seine (9.6%). In the Gulf of Thailand, otter trawl (79.8%) was the most dominant, followed by pair trawl (13.1%) and purse seine (4.8%). In the Indian Ocean (Thailand), otter trawl (56.9%) was the most dominant, followed by purse seine (23.3%) and pair trawl (18.9%).

Mullets

Catch Trend

Mullets catch (Fig. 2) in the Area recorded at 23,700 MT (accounted for 0.41% of the grand total) in 1976 and it increased steadily to 42,000 MT (0.63%) in 1982 with a slight decreasing in 1980. In 1983 the catch decreased slightly to 38,600 MT (0.54%), but it again increased to 48,700 MT (0.67%) in 1986. Then, the catch decreased to 43,400 MT (0.56%) in 1987 and it remained constant until 1991. After 1991 the catch recorded over 50,000 MT and it reached a peak of 58,700 MT (0.59%) in 1994.

Figure 2: Catch trend of mullets in the Area from 1976 to 1994



Fishing Gear

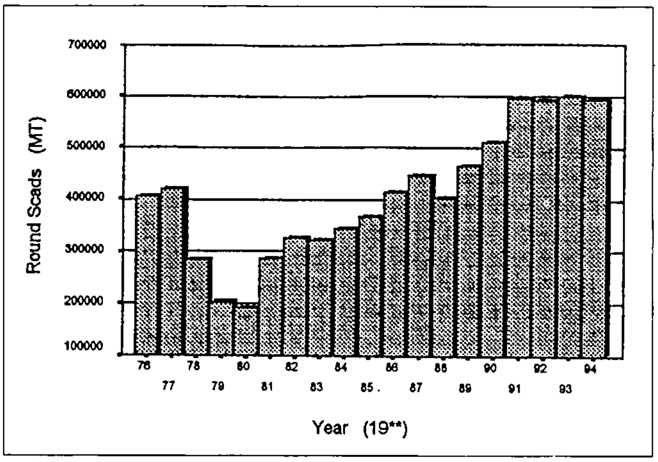
Major fishing gears for mullets in 1994 by country and area were as followed. In Malaysia, drift gill net (accounted for 85.1%) was the most dominant, followed by trawl (5.4%) and purse seine (4.1%). In the Philippines, small-scale gill net (63.5%) was the most dominant, followed by trap (11.7%) and hook-and-line (6.5%). In the Gulf of Thailand, small-scale gill net (75.6%) was the most dominant, followed by shrimp gill net (18.5%) and stationary gears (4.0%). In the Indian Ocean (Thailand), small-scale gill net accounted for 99.7% in mullets catch.

Round Scads

Catch Trend

Round scads catch (Fig. 3) in the Area recorded at 405,000 MT (accounted for 7.03% of the grand total) in 1976 and remained constant in 1977. The catch decreased drastically from 1978 and recorded at 193,000 MT in 1980 (3.15%), but it started to increase at 286,000 MT (4.48%) in 1981 and it increased steadily and reached to 446,000 MT (5.56%) in 1987. In 1988 the catch decreased slightly, but it increased again to 596,000 MT (6.78%) in 1991 and remained constant until 1994.

Figure 3: Catch trend of round scads in the Area from 1976 to 1994

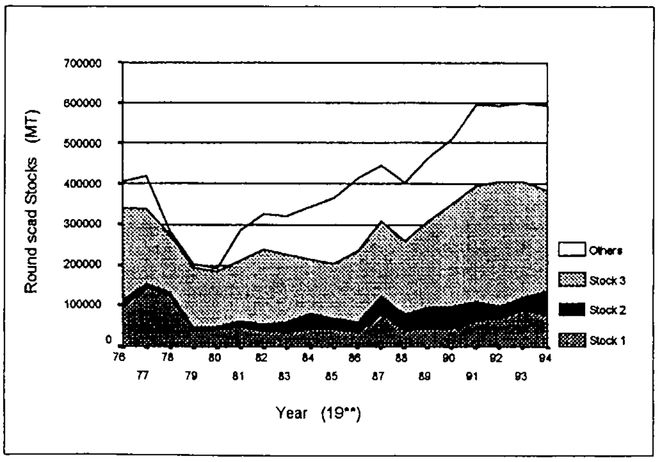


Stock Status

Four possible **round scads, *Decapterus* spp.**, stocks were identified by the Workshop 1985, but the catch trends of three of them and others were shown in this paper (Fig. 4, also refer to Annex-Fig. 1).

Stock 1	:	**Gulf of Thailand to Sunda Shelf**; Gulf of Thailand and East Coast of Peninsular Malaysia.
Stock 2	:	**Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.
Stock 3	:	**Eastern South China Sea**; Sabah, Sarawak, Brunei and the Philippines
Others	:	Data were obtained from Taiwan (1988, 89), Hong Kong and Indonesia (excluding Malacca Strait).

Figure 4: Round scads catch by possible stock in the Area from 1976 to 1994



The catch of Stock 3 was the most dominant in the round scads catch (accounted for 49.4% of mean in the total round scads catch) followed by Stock 1 and Stock 2 in the Area. The catch from Others accounted for 27.2% of mean. The relationships between total round scads catch and catch of each stock were as followed; the catch of each stock as Stock 2 and Stock 3 with (versus) total round scads catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; the catches between Stock 2 and Stock 3 showed a significant correlation.

Therefore, the stock of "Eastern South China Sea" is recognized as the most dominant in round scads in the Area and catch of its ranged from 133,000 to 306,000 MT with a mean of 196,000 MT. The catch trends of stocks of "Malacca Strait" and "Eastern South China Sea" were highly correlated, but "Gulf of Thailand to Sunda Shelf" can be considered as different trend.

Fishing Gear

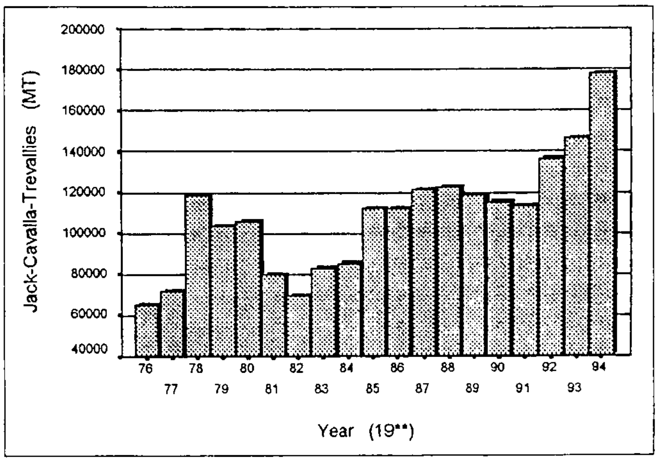
Major fishing gears for round scads in 1994 by country and area were as followed. In Malaysia, purse seine (accounted for 80.6%) was the most dominant, followed by trawl (10.2%) and lift net (8.1%). In the Philippines, one boat purse seine (75.1%), followed by lift net (10.8%) and small-scale one boat purse seine (4.2%). In the Gulf of Thailand and the Indian Ocean (Thailand), purse seine accounted for 100% in round scads catch.

Jacks, Cavalla and Trevallies

Catch Trend

Jack, cavalla and trevallies catch (Fig. 5) in the Area recorded at 65,000 MT (accounted for 1.13% of the grand total) in 1976 and slightly increased in 1977 then it increased dramatically to 118,000 MT (1.76%) in 1978. The catch showed decrease trend to 83,000 MT (1.05%) in 1982, but it increased again to 123,000 MT (1.53%) in 1988. After 1988, the catches decreased slightly and recorded at 113,000 MT (1.29%) in 1991, then increased to 147,000 MT (1.51%) in 1993, and it showed a big increase to 178,000 MT (1.77%) in 1994.

Figure 5: Catch trend of jacks-cavalla-trevallies in the Area from 1976 to 1994

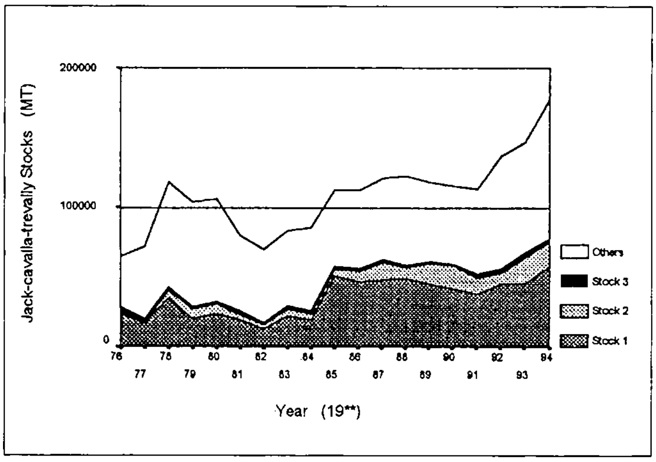


Stock Status

Four possible **trevallies (jacks-cavalla-trevallies)** stocks were identified by the Workshop 1985, but the catch trends of three of them and others were shown in this paper (Fig. 6, also refer to Annex-Fig. 2).

Stock 1	:	**Gulf of Thailand to Sunda Shelf**; Gulf of Thailand and East Coast of Peninsular Malaysia.
Stock 2	:	**Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.
Stock 3	:	**North and West Borneo**; Sabah, Sarawak and Brunei
Others	:	Data were obtained from Taiwan (1992-94), Indonesia (excluding Malacca Strait) and the Philippines.

Figure 6: Jack-cavalla-trevallies catch by possible stock in the Area from 1976 to 1994



The catch of Stock 1 was the most dominant in the jack-cavalla-trevallies catch (accounted for 31.1% of mean in the total jack-cavalla-trevallies catch) followed by Stock 2 and Stock 3 in the Area. The catch from Others accounted for 63.2% of mean. The relationships between total jack-cavalla-trevallies catch and catch of each stock were as followed; the catch of each stock as Stock 1 and Stock 2 with (versus) total jack-cavalla-trevallies catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; the catches between Stock 1 and Stock 2 showed a significant correlation.

Therefore, the stock of "Gulf of Thailand to Sunda Shelf" is recognized as the most dominant in jack-cavalla-trevallies in the Area and catch of its ranged from 12,500 to 57,800 MT with a mean of 34,600 MT. The catch trends of stocks of "Gulf of Thailand to Sunda Shelf" and "Malacca strait" were highly correlated, but "North and West Borneo" can be considered as a different trend.

Fishing Gear

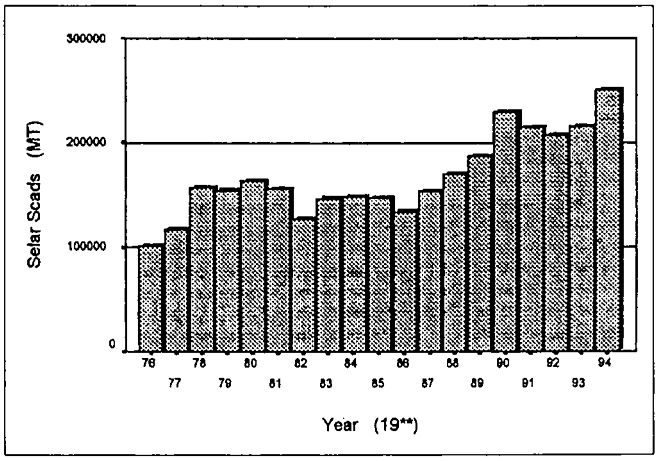
Major fishing gears for jack-cavalla-trevallies in 1994 by country and area were as followed. In Malaysia, trawl (accounted for 41.7%) was the most dominant, followed by hook and line (29.5%) and drift gill net (12.6%). In the Philippines, small scale gill net (26.3%) was the most dominant, followed by hook and line (19.6%), boat seine (12.8%) and one boat purse seine (9.3%). In the Gulf of Thailand, purse seine (78.0%) was the most dominant, followed by otter trawl (15.7%) and pair trawl (4.3%). In the Indian Ocean (Thailand), purse seine (51.6%) and otter trawl (46.8%) were dominant fishing gears for jack-cavalla-trevallies catch.

Selar Scads

Catch Trend

Selar scads catch (Fig. 7) in the Area recorded at 101,000 MT (accounted for 1.75% of the grand total) in 1976 and it increased to 157,000 MT (2.34%) in 1978. The catch remained constant until 1981 and it decreased to 127,000 MT (1.91%) in 1982 but it recovered to 147,000 MT (2.05%) in 1983 and remained constant until 1985. In 1986 the catch slightly decreased to 134,000 MT (1.84%) in 1986, but it started to increase and reached at 229,000 MT (2.69%) in 1990, then slightly decreased to 207,000 MT (2.17%) in 1992 and remained constant in 1993, then increased to 251,000 MT (2.51%) in 1994.

Figure 7: Catch trend of selar scads in the Area from 1976 to 1994

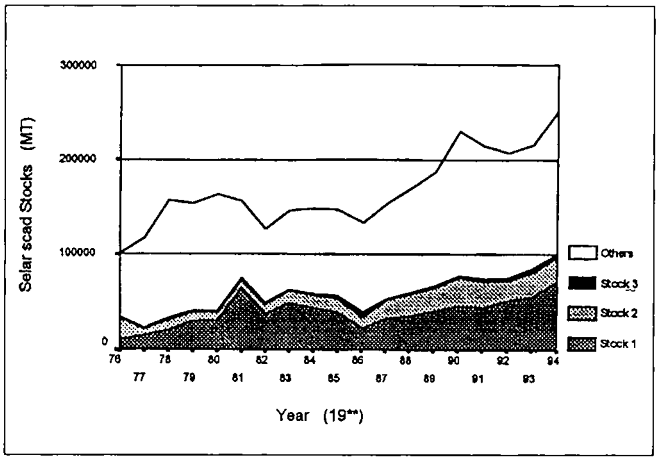


Stock Status

Four possible **trevallies (selar scads)** stocks were identified by the Workshop 1985, but the catch trends of three of them and others were shown in this paper (Fig. 8, also refer to Annex-Fig. 3).

Stock 1	:	**Gulf of Thailand to Sunda Shelf**; Gulf of Thailand and East coast of Peninsular Malaysia.
Stock 2	:	**Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.
Stock 3	:	**North and West Borneo**; Sabah, Sarawak and Brunei
Others	:	Data were obtained from Taiwan (1990-93), Indonesia (excluding Malacca Strait) and the Philippines.

Figure 8: Selar scads catch by possible stock in the Area from 1976 to 1994



The catch of Stock 1 was the most dominant in the selar scads catch (accounted for 22.9% of mean in the total selar scads catch) followed by Stock 2 and Stock 3 in the Area. The catch from others accounted for 65.6% of mean. The relationships between total selar scads catch and catch of each stock were as followed; the catch of each stock as Stock 1 and Stock 2 with (versus) total selar scads catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; there were no significant correlations among the stocks.

Therefore, the stock of "Gulf of Thailand to Sunda Shelf" is recognized as the most dominant in selar scads in the Area and catch of its ranged from 10,200 to 71,200 MT with a mean of 38,900 MT. The catch trend of stock of "North and West Borneo" can be considered as a different trend from total selar scads catch.

Fishing Gear

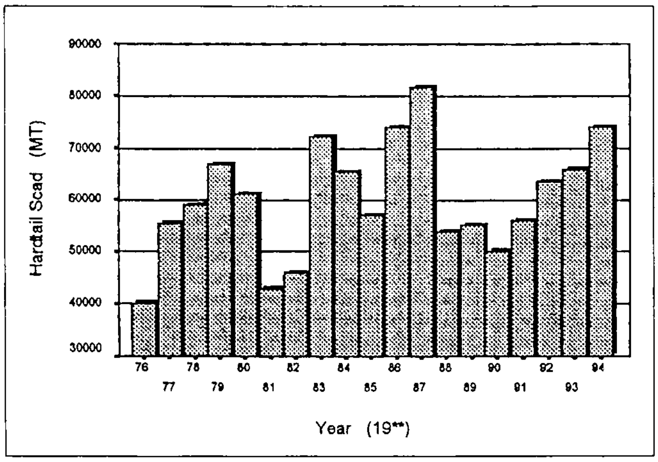
Major fishing gears for selar scads in 1994 by country and area were as followed. In Malaysia, purse seine (accounted for 55.6%) was the most dominant, followed by trawl (23.1%) and lift net (12.2%). In the Philippines, hook and line (35.7%) was the most dominant, followed by one boat purse seine (33.8%) and small scale gill net (10.3%). In the Gulf of Thailand, purse seine (93.7%) was the most dominant, followed by otter trawl (5.1%) and pair trawl (1.2%). In the Indian Ocean (Thailand), purse seine accounted for 97.0% and the other was 3.0% of otter trawl.

Hardtail Scad

Catch Trend

Hardtail scad catch (Fig. 9) in the Area showed big fluctuations, and it recorded at 40,000 MT (accounted for 0.70% of the grand total) in 1976 and increased to 67,000 MT (1.08%) in 1979, but it decreased drastically to 43,000 MT (0.67%) in 1981. The catch slightly increased in 1982 and it increased dramatically to 72,000 MT (1.01%) in 1983. Then the catch decreased to 57,000 MT (0.84%) in 1985, and it increased again and reached at 82,000 MT (1.02%) in 1987. The catch, however, decreased drastically again to 54,000 MT (0.67%) in 1988 and recorded at 50,000 MT (0.59%) in 1990. The catch showed steady increase trend again and reached to 74,000 MT (0.74%) in 1994.

Figure 9: Catch trend of hardtail scad in the Area from 1976 to 1994



Stock Status

Three possible **hardtail scad,** *Megalaspis cordyla*, stocks were identified by the Workshop 1985, but the catch trends of two of them and others were shown in this paper (Fig. 10, also refer to Annex-Fig. 4).

Stock 1 : **Gulf of Thailand**; Gulf of Thailand.

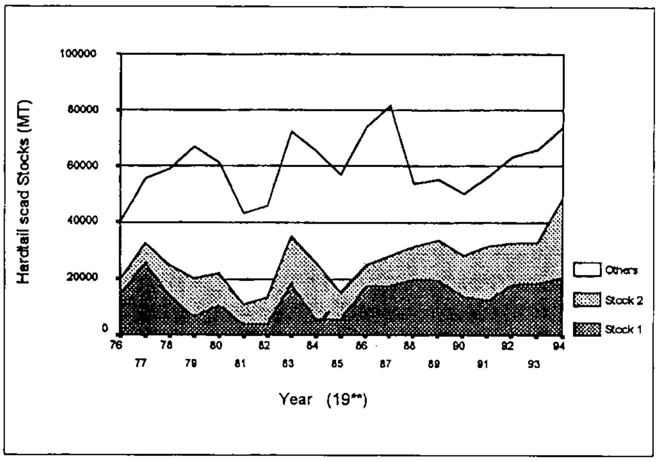
Stock 2 : **Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

Others : Data were obtained from Taiwan (1976-87, 92, 93), Indonesia (excluding Malacca Strait), Malaysia (excluding West and East Coasts of Peninsular Malaysia) and the Philippines.

The catch of Stock 1 was a bit abundant than that of Stock 2 in the hardtail scad catch (accounted for 23.6% of mean in the total hardtail scad catch) in the Area. The catch from others accounted for 55.0% of mean. The relationships between total hardtail scad catch and catch of each stock, and among the catches of stocks showed no significant correlations.

Therefore, the stock of "Gulf of Thailand" is recognized as the most dominant (but "Malacca Strait" also similar catch quantities) in the Area and catch of its ranged from 3,800 to 25,600 MT with a mean of 14,100 MT. The catch trends of both two stocks can be considered as different trends from total hardtail scad catch.

Figure 10: Hardtail scad catch by possible stock in the Area from 1976 to 1994



Fishing Gear

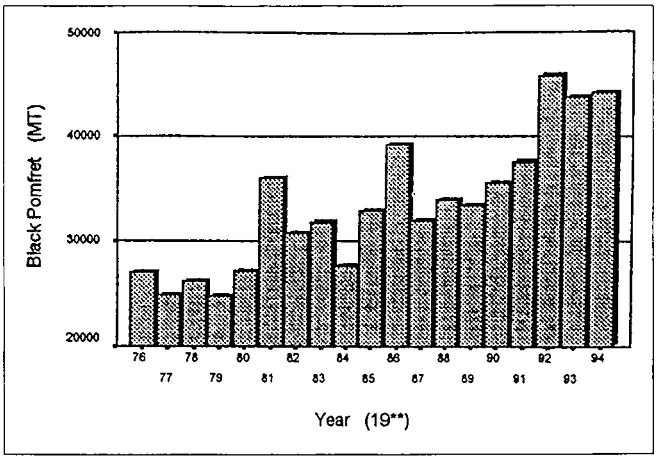
Major fishing gears for hardtail scad in 1994 by country and area were as followed. In Malaysia, trawl (accounted for 49.9%) was the most dominant, followed by purse seine (34.6%) and drift gill net (6.9%). In the Philippines, hook and line (21.7%) was the most dominant, followed by boat seine (16.9%), small scale gill net (16.3%) and one boat purse seine (7.2%). In the Gulf of Thailand, purse seine (75.1%) was the most dominant, followed by otter trawl (16.9%) and pair trawl (5.4%). In the Indian Ocean (Thailand), purse seine (61.2%) and otter trawl (38.7%) were occupied nearly 100% for hardtail scad catch.

Black Pomfret

Catch Trend

Black pomfret catch (Fig. 11) in the Area recorded at 27,000 MT (accounted for 0.47% of the grand total) in 1976 and it remained constant until 1980. In 1981, the catch showed a big increase to 36,000 MT (0.56%), but it decreased to 27,700 MT (0.42%) in 1984. The catch showed increases again and reached to 39,200 MT (0.54%) in 1986, but it fell to 31,900 MT (0.40%) in 1987. After 1987 the catch increased slightly to 37,600 MT (0.43%) in 1991, then it showed a big increase to 45,800 MT (0.48%) in 1992 and remained constant until 1994.

Figure 11: Catch trend of black pompret in the Area from 1976 to 1994



Fishing Gear

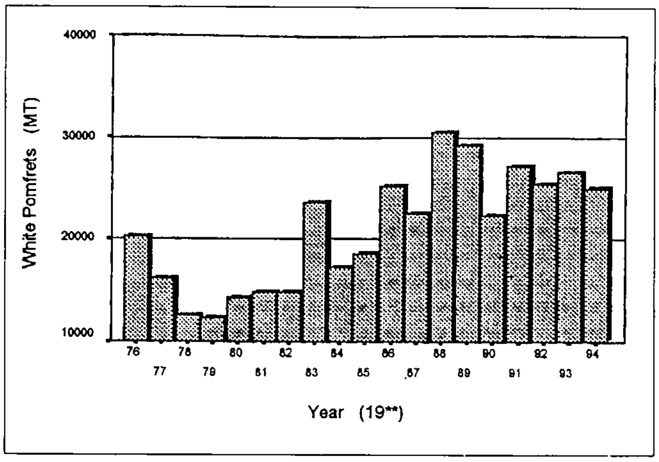
Major fishing gears for black pomfret in 1994 by country and area were as followed. In Malaysia, trawl (accounted for 42.9%) was the most dominant, followed by drift gill net (37.1%) and purse seine (11.7%). In the Philippines, boat seine (27.8%) was the most dominant, followed by hook-and line (22.4%), small-scale gill net (12.9%) and otter board trawl (10.6%). In the Gulf of Thailand, purse seine (39.7%) was the most dominant, followed by otter trawl (32.6%) and pair trawl (14.9%). in the indian Ovean (Thailand), otter trawl (70.0%) was the most dominant, followed by purse seine (21.1%) and pair trawl (4.1%).

White Pomfrets

Catch Trend

White pomfrets catch (Fig. 12) in the Area recorded at 20,300 MT (accounted for 0.35% of the grand total) in 1976, and it decreased to 12,300 MT (0.20%) in 1979. Then the catch increased slightly to 14,300 MT (0.23%) in 1980 and it remained constant until 1982, but it showed a big increase to 23,600 MT (0.33%) in 1983. In 1984 the catch fell to 17,300 MT (0.26%) but it showed an increase trend and reached a peak of 30,500 MT (0.38%) in 1988. Then the catch showed a slight decrease trend to 25,000 MT (0.25%) in 1994.

Figure 12: Catch trend of white pomprets in the Area from 1976 to 1994



Fishing Gear

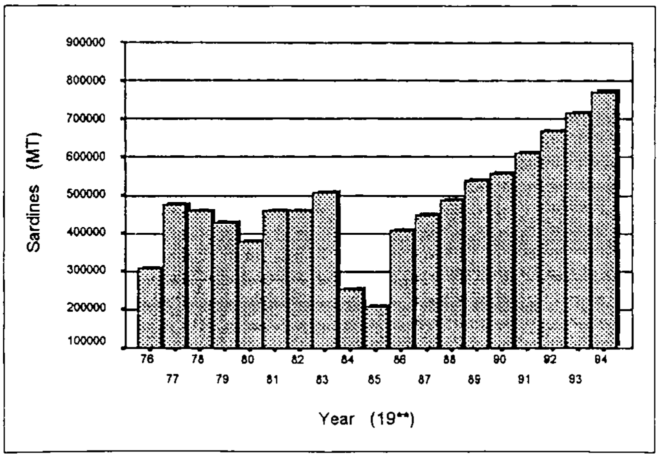
Major fishing gears for white pomfrets in 1994 in Thailand were as followed. In the Gulf of Thailand, otter trawl accounted for 90.9% and pair trawl was 8.8% for white pomfrets catch. In the Indian Ocean (Thailand), otter trawl (88.6%) was the most dominant, followed by small scale gill net (6.1%) and pair trawl (5.1%).

Sardines

Catch Trend

Sardine catch (Fig. 13) in the Area recorded at 309,000 MT (accounted for 5.35% of the grand total) in 1976 and increased to 475,000 MT (7.19%) in 1977, then it decreased slightly to 380,000 MT (6.21%) in 1981. The catch increased again to 508,000 MT (7.09%) in 1983, but it decreased drastically to 253,000 MT (3.80%) in 1984 and 208,000 MT (3.04%) in 1985. After 1985, the catch increased dramatically to 406,000 MT (5.57%) in 1986, then it increased steadily for eight years and reached to 770,000 MT (7.68%) in 1994.

Figure 13: Catch trend of sardines in the Area from 1976 to 1994

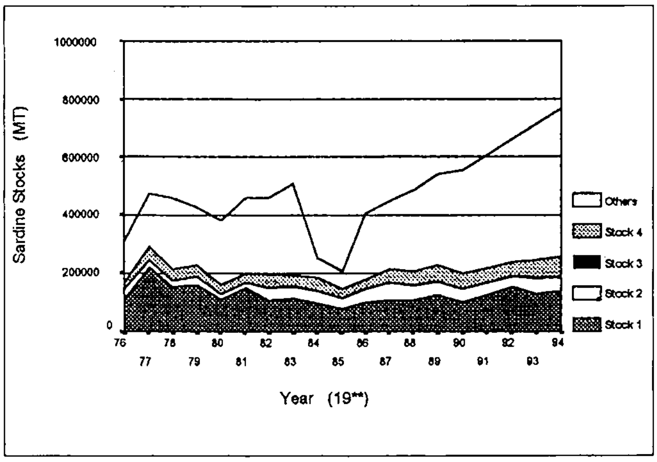


Stock Status

Five possible sardines, Sardinella spp., stocks were identified by the Workshop 1985, but the catch trends of four of them and others were shown in this paper (Fig. 14, also refer to Annex Fig. 5).

Stock 1	:	**Gulf of Thailand to Sunda Shelf**; Gulf of Thailand and East Coast of Peninsular Malaysia.
Stock 2	:	**Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.
Stock 3	:	**Sunda Shelf Northwest of Borneo**; Sarawak, Labuan and Brunei
Stock 4	:	**Northwestern Celebes Sea**; Sabah and Mindanao.
Others	:	Data were obtained from Taiwan, Hong Kong, Indonesia (excluding Malacca Strait) and the Philippines (excluding Mindanao).

Figure 14: Sardine catch by possible stock in the Area from 1976 to 1994



The catch of Stock 1 was the most dominant in the sardine catch (accounted for 27.7% of mean in the total sardine catch) followed by stock 4, Stock 2 and Stock 3 in the Area. The catch from Others accounted for 53.8% of mean. The relationships between total sardine catch and catch of each stock were as followed; the catch of each stock as Stock 3 and Stock 4 with (versus) total sardine catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; the catches among Stock 2, Stock 3 and Stock 4 showed a significant correlation each other, and catches between Stock 1 and Stock 2 showed a significant correlation negatively.

Therefore, the stock of "Gulf of Thailand to Sunda Shelf" is recognized as the most dominant in sardine catch in the Area and catch of its ranged from 77,000 to 220,000 MT with a mean of 125,000 MT. The catch trends of stocks of "Malacca Strait", "Sunda Shelf Northwest of Borneo" and "Northwestern Celebes Sea" were highly correlated, but "Gulf of Thailand to Sunda Shelf" can be considered as a different trend, especially from "Malacca Strait".

Fishing Gear

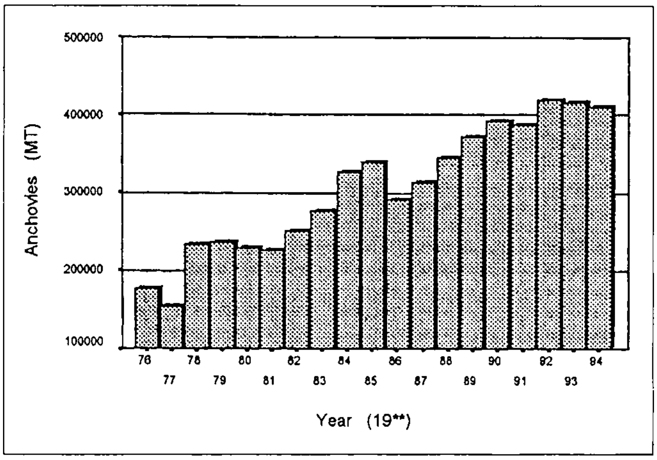
Major fishing gears for sardines in 1994 by country and area were as followed. In Malaysia, purse seine (accounted for 65.1%) was the most dominant, followed by lift net (18.8%) and drift gill net (7.9%). In the Philippines, one boat purse seine (60.4%) was the most dominant, followed by small scale gill net (15.0%) and lift net (9.2%). In the Gulf of Thailand, purse seine (95.8%) was the most dominant and few others were mackerel encircling gill net (1.6%) and small scale gill net (1.1%). In the Indian Ocean, purse seine occupied nearly 100% for sardines catch.

Anchovies

Catch Trend

Anchovies catch (Fig. 15) in the Area recorded at 177,000 MT (accounted for 3.07% of the grand total) in 1976 and decreased slightly to 154,000 MT (2.33%) in 1977 then increased to 234,000 MT (3.49%) in 1978. The catches after 1978 it remained constant until 1981 at around 230,000 MT, and it showed increase trend to 339,000 MT (4.97%) in 1985. In 1986 the catch decreased to 291,000 MT (3.98%) in 1986, but it increased steadily to 419,000 MT (4.40%) in 1992, and it remained constant at over 410,000 MT until 1994.

Figure 15: Catch trend of anchovies in the Area from 1976 to 1994



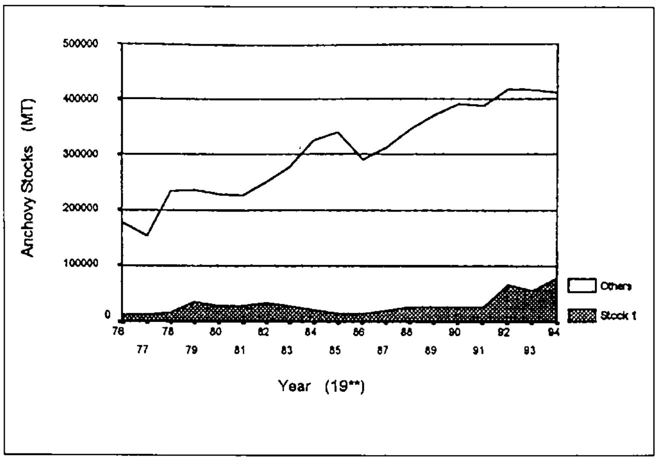
Stock Status

One possible anchovies, Stolephorus spp., stocks were identified by the Workshop 1985, so the catch trends of it and others were shown in this paper (Fig. 16, also refer to Annex Fig. 6).

Stock 1 : **Malacca Strait (east)**: Indian Ocean, West Coast of Peninsular Malaysia and Singapore.

Others : Data were obtained from Taiwan, Hong Kong, Indonesia, Malaysia (excluding West Coast of Peninsular Malaysia). the Philippines and Thailand (excluding Indian Ocean).

Figure 16: Anchovies catch by possible stock in the Area from 1976 to 1994.



On anchovies, one possible stock was identified and catch of Stock 1, "Malacca Strait (east)", accounted for 8.7% of mean in the total anchovies catch in the Area. The catch of "Malacca Strait (east)" ranged from 11,700 to 78,800 MT with a mean of 30,000 MT. Catch from Others accounted for 86.3% of mean.

Fishing Gear

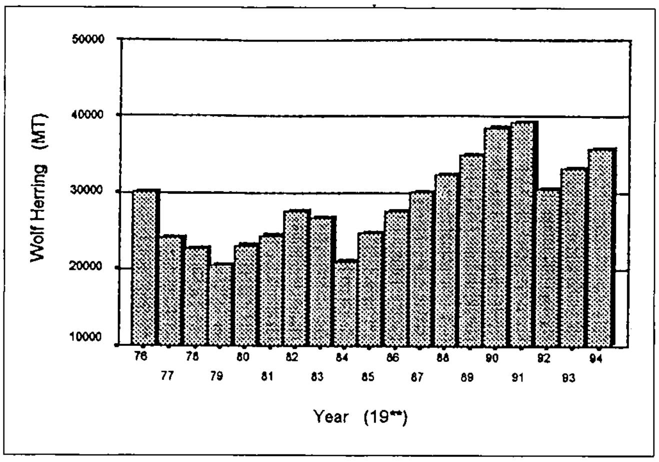
Major fishing gears for anchovies in 1994 by country and area were as followed. In Malaysia, anchovy purse seine (accounted for 81.0%) was the most dominant, followed by lift net (15.9%) and trawl (1.7%). In the Philippines, beach seine (23.5%) was the most dominant, followed by lift net (16.1%), one boat purse seine (15.6%) and small scale gill net (13.4%). In the Gulf of Thailand, anchovy purse seine (89.9%) was the most dominant, followed by squid light luring (3.4%) and otter trawl (3.1%). In the Indian Ocean (Thailand), anchovy purse seine accounted for 90.4% and purse seine was 9.6% in anchovies catch.

Wolf Herring

Catch Trend

The wolf herring catch (Fig. 17) in the Area recorded at 30,000 MT (accounted for 0.52% of the grand total) in 1976 and it showed a decrease trend to 20,500 MT (0.33%) in 1979. In 1980 the catch increased slightly to 23,000 MT (0.38%), and it increased continuously to 27,400 MT (0.41%) in 1982. The catch decreased to 21,000 MT (0.32%) in 1984, but after 1984 it showed a steady increase trend and reached to 39,200 MT (0.45%) in 1991. In 1992 the catch fell to 30,500 (0.32%), but it again increased to 35,700 MT (0.36%) in 1994.

Figure 17: Catch trend of wolf herring in the Area from 1976 to 1994



Fishing Gear

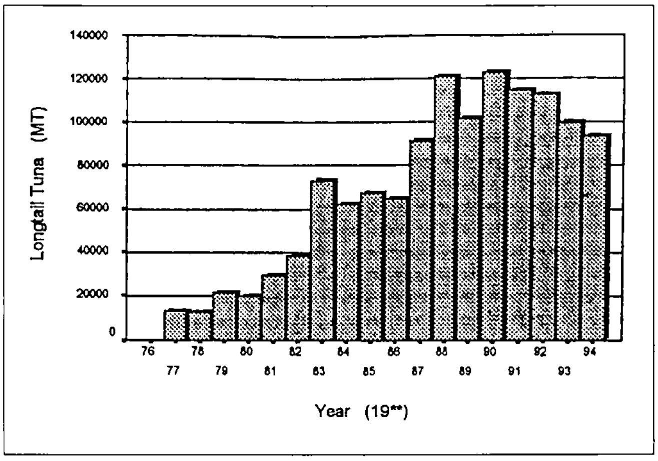
Major fishing gears for wolf herring in 1994 by country and area were as followed. In Malaysia, drift gill net (accounted for 50.9%) and trawl (45.4%) were dominant fishing gears for wolf herring catch. In the Philippines (1993), one boat purse seine (53.2%) was the most dominant, followed by small-scale gill net (18.7%) and boat seine (11.6%). In the Gulf of Thailand, otter trawl (80.6%) was the most dominant, followed by pair trawl (6.1%) and small-scale gill net (5.7%). In the Indian Ocean (Thailand), otter trawl (68.8%) was the most dominant, followed by purse seine (17.1%) and pair trawl (13.4%).

Longtail Tuna

Catch Trend

Longtail tuna catch (Fig. 18) in the Area recorded 74 MT only in 1976, then it recorded at 13,000 MT (accounted for 0.19% of the grand total) in 1977 and it increased steadily to 73,000 MT (1.02%) in 1983. The catch remained constant until 1986 and it increased dramatically to 121,000 MT (1.51%) in 1988, then it decreased in 1989, but it reached again to 123,000 MT (1.44%) in 1990. After 1990 the catch showed a decrease trend to 94,000 MT (0.93%) in 1994.

Figure 18: Catch trend of longtail tuna in the Area from 1976 to 1994



Fishing Gear

Major fishing gears for longtail tuna in 1994 by country and area were as followed. In Malaysia, purse seine (accounted for 35.0%) was the most dominant, followed by drift gill net (24.0%) and hook and line (18.2%). In the Gulf of Thailand, purse seine accounted for 91.1% and king mackerel drift gill net was 8.8%. In the Indian Ocean (Thailand), purse seine accounted for 97.7% and king mackerel drift gill net was only 2.3% in longtail tuna catch.

Eastern Little Tuna (Kawakawa)

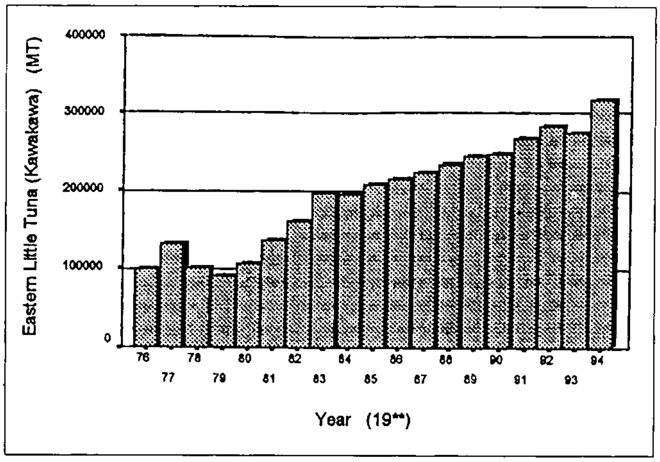
Catch Trend

Eastern little tuna catch (Fig. 19) in the Area recorded at 99,000 MT (accounted for 1.72% of the grand total) in 1976 and increased to 132,000 MT (2.01%) in 1977, but it decreased to 91,000 MT (1.47%) in 1979. After 1979 the catch showed a steady increase trend to 197,000 MT (2.75%) in 1983, and then it showed continuous slight increase to 283,000 MT (2.97%) in 1992, it remained constant in 1993, and increased to 317,000 MT (3.17%) in 1994.

Fishing Gear

Major fishing gears for eastern little tuna in 1994 by country and area were as followed. In the Philippines, one boat purse seine (accounted for 76.4%) was the most dominant, followed by small scale gill net (10.7%) and hook and line (6.9%). In the Gulf of Thailand, purse seine accounted for 91.1% and king mackerel drift gill net was 8.8%. In the Indian Ocean (Thailand), purse seine occupied nearly 100% and king mackerel drift gill net was only 0.1% in eastern little tuna catch.

Figure 19: Catch trend of eastern little tuna (kawakawa) in the Area from 1976 to 1994



Frigate and Bullet Tunas

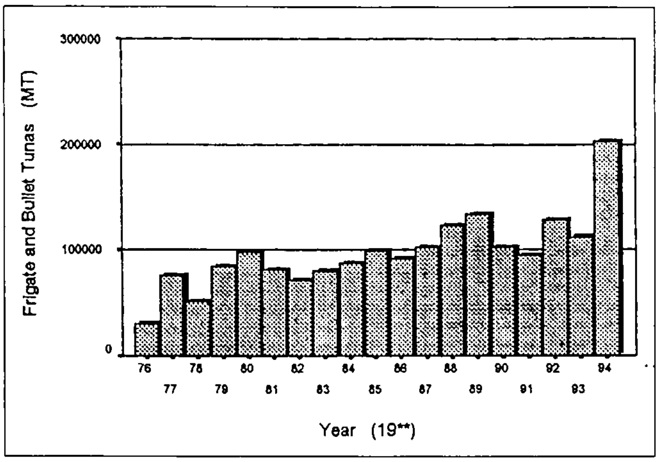
Catch Trend

Frigate and bullet tunas catch (Fig. 20) in the Area recorded at 30,000 MT (accounted for 0.53% of the grand total) in 1976 and increased dramatically to 76,000 MT (1.15%) in 1977 and then decreased to 51,000 MT (0.76%) in 1978. The catch increased again to 98,000 MT (1.61%) in 1980, but decreased to 72,000 MT (1.08%) in 1982. After 1982 the catch increased steadily to 134,000 MT (1.61%) in 1989 with a slight decrease in 1986, and then it decreased both in 1990 and 1991 at around 100,000 MT, it reached again to 128,000 MT (1.34%) in 1992. The catch decreased to 113,000 MT (1.16%) in 1993, but it showed a dramatic increase and reached to 203,000 MT (2.02%) in 1994.

Fishing Gear

Major fihsing gears for eastern little tuna in 1994 by country and area were as followed. In the Philippines, one boat purse seine (accounted for 76.4%) was the most dominant, followed by small-scale gill net (10.7%) and hook and-line (6.9%). In the Gulf of Thailand, purse seine accounted for 91.1% and king mackerel drift gill net was 8.8%. In the indian Ocean (Thailand), purse seine occupied nearly 100% and king mackerel drift gill net was only 0.1% in estern little tuna catch.

Figure 20: Catch trend of frigate and bullet tunas in the Area from 1976 to 1994



Fishing Gear

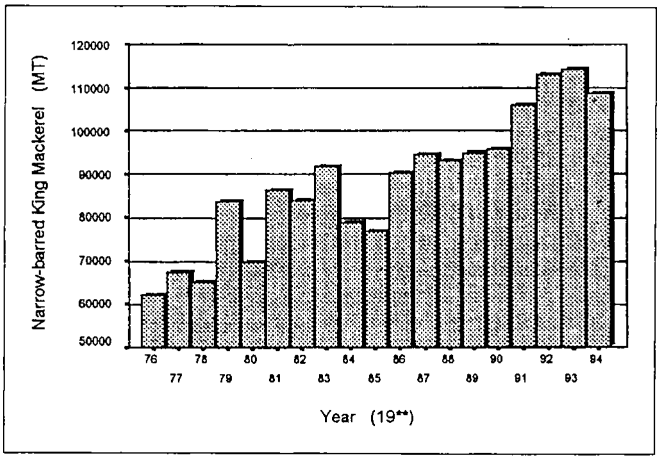
Major fishing gears for frigate and bullet tunas in 1994 in the Philippines were as followed. One boat purse seine (accounted for 46.1%) was the most dominant, followed by hook and line (28.7%) and small-scale gill net (8.4%).

Narrow-barred King Mackerel (Spanish Mackerel)

Catch Trend

Narrow-barred king mackerel catch (Fig. 21) in the Area recorded at 62,000 MT (accounted for 1.08% of the grand total) in 1976 and increased slightly to 67,000 MT (1.02%) in 1977. The catch decreased slightly in 1978 and then it increased to 84,000 MT (1.35%) in 1979, in 1980 the catch decreased again to 70,000 MT (1.14%) in 1980. After 1980 the catch increased to 86,000 MT (1.35%) in 1981, but it showed decrease trend to 77,000 MT (1.13%) in 1985 with an exception of 1983. In 1986 the catch showed increase trend to 90,000 MT (1.24%) and then it remained constant during from 1987 to 1990. The catch started to increase again from 1991 and reached at 114,000 MT (1.18%) in 1993, then decreased slightly to 109,000 MT (1.09%) in 1994.

Figure 21: Catch trend of narrow barred king mackerel in the Area from 1976 to 1994.

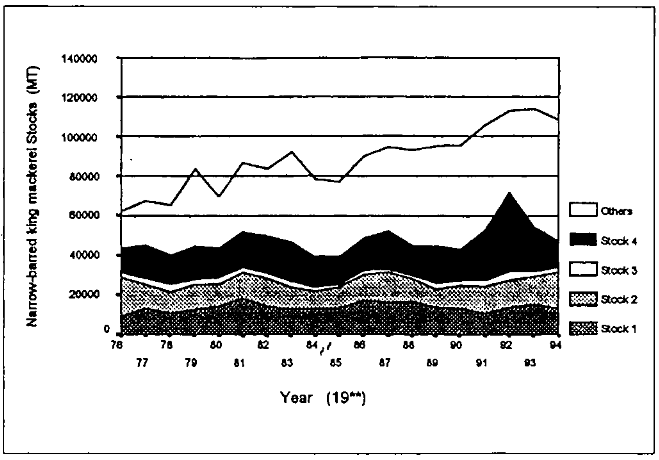


Stock Status

Five possible **Spanish mackerels, *Scomberomorus* spp., (narrow-barred king mackerel, *Scomberomorus commerson*)** stock identified by the workshop 1985, but the catch trends of four of them and others were shown in this paper (Fig. 22, also refer to Annex Fig. 7).

Stock 1	:	**Gulf of Thailand to Sunda Shelf**; Gulf of Thailand and East Coast of Peninsular Malaysia.
Stock 2	:	**Malacca Strait to Andaman Sea**: Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.
Stock 3	:	**Sunda Shelf-Northwest of Borneo**: Sarawak, Labuan and Brunei.
Stock 4	:	**Northeastern South China Sea:** Sabah and the Philippines
Others	:	Data were obtained from Taiwan (1976, 88-94), Hong Kong and Indonesia (excluding Malacca Strait).

Figure 22: Narrow-barred king mackerel catch by possible stock in the Area from 1976 to 1994.



The catch of Stock 4 was the most dominant in narrow barred king mackerel catch (accounted for 20.9% of mean in the total narrow barred king mackerel catch) followed by Stock 1, Stock 2 and Stock 3 in the Area. The catch from others accounted for 45.2% of mean. The relationship between total narrow barred king mackerel catch and catch of stock was as followed; the catch of stock as Stock 4 with (versus) total narrow-barred king mackerel catch showed a significant correlation. Also the relationships among the catches of stocks were as followed; the catches between Stock 3 and Stock 4 showed a significant correlation, and the catches between Stock 1 and Stock 3 showed a significant correlation negatively.

Therefore, the stock of "Northeastern South China Sea" is recognized as the most dominant in narrow barred king mackerel in the Area and catch of its ranged from 12,100 to 40,100 MT with a mean of 18,400 MT. The catch trends of stocks of "Sunda Shelf-Northwest of Borneo" and "Northeastern South China Sea" were highly correlated, but "Gulf of Thailand to Sunda Shelf" can be considered as different trend, especially from "Sunda Shelf-Northwest of Borneo".

Fishing Gear

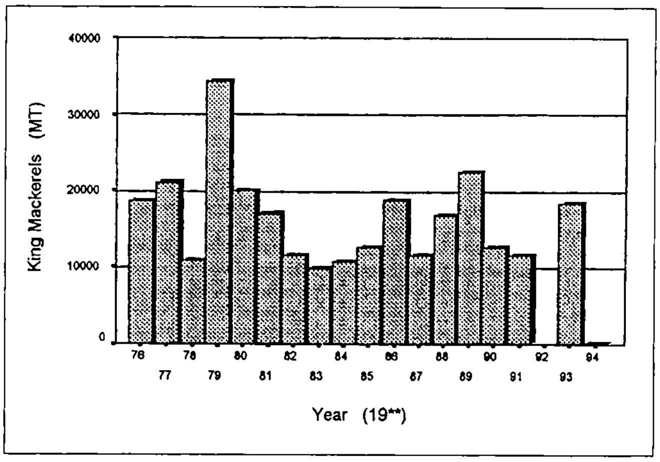
Major fishing gears for narrow-barred king mackerel in 1994 by country and area were as followed. In Malaysia, drift gill net (accounted for 53.2%) was the most dominant, followed by hook and line (21.9%) and trawl (21.4%). In the Philippines, hook and line (42.9%) was the most dominant, followed by small-scale gill net (33.0%) and one boat purse seine (9.3%). In the Gulf of Thailand, otter trawl (38.2%) was the most dominant, followed by king mackerel drift gill net (33.5%), purse seine (7.0%) and pair trawl (6.4%). In the Indian Ocean (Thailand), otter trawl (49.0%) was the most dominant, followed by purse seine (25.0%) and king mackerel drift gill net (14.9%).

King Mackerels

Catch Trend

King mackerels catch (Fig. 23) in the Area recorded at 18,700 MT (accounted for 0.32% of the grand total) in 1976 and it remained constant in 1977, but it decreased to 10,900 MT (0.16%) in 1978. In 1979 the catch showed a dramatic increase to 34,300 MT (0.55%), but it showed a decrease trend to 9,900 MT (0.14%) in 1983. After 1983 the catch showed an increase trend to 22,500 MT (0.27%) in 1989 with an exception of 1987. Then the catches of 1990, 1991 and 1993 recorded 12,700, 11,700 and 18,300 MT respectively, but those of 1992 and 1994 were 47 and 90 MT respectively.

Figure 23: catch trend of king mackerels in the Area from 1976 to 1994.



Fishing Gear

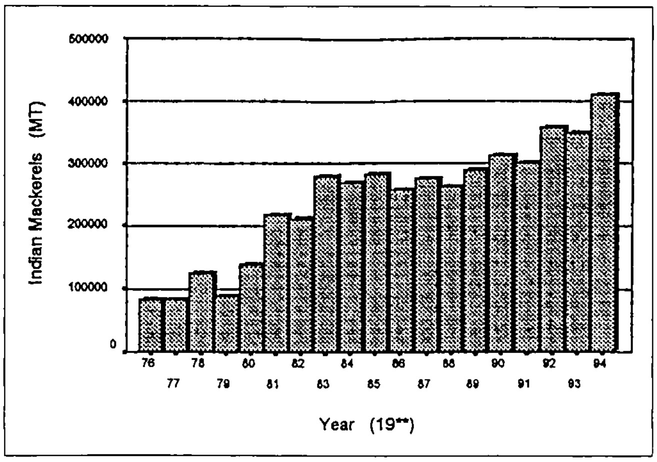
Fishing gears used for king mackerels can be considered as the similar with those for narrow-barred king mackerel.

Indian Mackerels

Catch Trend

Indian mackerels catch (Fig. 24) in the Area recorded at 84,000 MT (accounted for 1.45% of the grand total) in 1976 and it increased to 279,000 MT (3.89%) in 1983 with slight decreases in 1979 and 1982. The catches remained constant during from 1983 to 1988, then it increased to 357,000 MT (3.75%) in 1992 with a slight decrease in 1991, it remained constant in 1993, and increased to 411,000 MT (4.10%) in 1994.

Figure 24: Catch trend of Indian mackerels in the Area from 1976 to 1994.

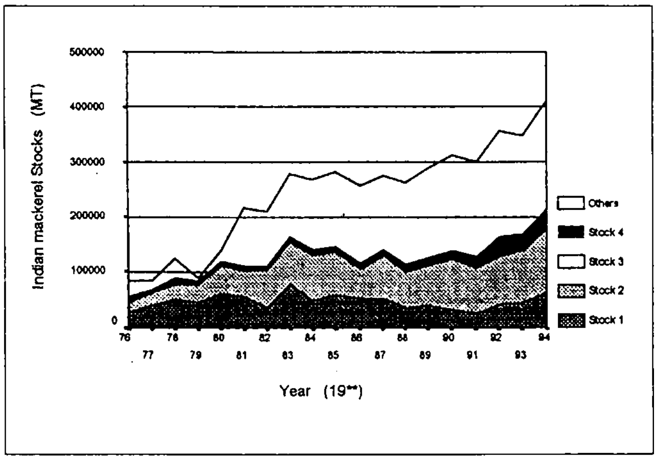


Stock Status

Seven possible **mackerels, *Rastrelliger* spp., (Indian mackerels)** stocks were identified by the Workshop 1985, but the catch trends of four of them and others were shown in this paper (Fig. 25, also refer to Annex Fig. 8).

Stock 1	:	**Western Gulf of Thailand to Singapore**; Gulf of Thailand, East Coast of Peninsular Malaysia and Singapore.
Stock 2	:	**Malacca Strait**: Indian Ocean, West Coast of Peninsular Malaysia and Malacca Straits.
Stock 3	:	**West and Northwest of Borneo**: Sarawak and Brunei.
Stock 4	:	**Palawan-Celebes Sea:** Sabah and Mindanao.
Others	:	Data were obtained from Indonesia (excluding Malacca Strait) and the Philippines (excluding Mindanao).

Figure 25: Indian mackerel catch by possible stock in the Area from 1976 to 1994.



The catch of Stock 2 was the most dominant in the Indian mackerels catch (accounted for 27.1% of mean in the total Indian mackerels catch) followed by Stock 1, Stock 4 and Stock 3 in the Area. The catch from others accounted for 43.2% of mean. The relationships between total Indian mackerels catch and catch of each stock were as followed; the catch of each stock as Stock 2, Stock 3 and stock 4 with (versus) total Indian mackerels catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; the catches among Stock 2, Stock 3 and Stock 4 showed a significant correlation each other.

Therefore, the stock of "Malacca Strait" is recognized as the most dominant in Indian mackerels in the Area and catch of its ranged from 17,800 to 115,000 MT with a mean of 65,000 MT. The catch trends of stocks of "Malacca Strait", "West and Northwest of Borneo" and "Palawan-Celebes Sea" were highly correlated, but "Western Gulf of Thailand to Singapore" can be considered as a different trend.

Fishing Gear

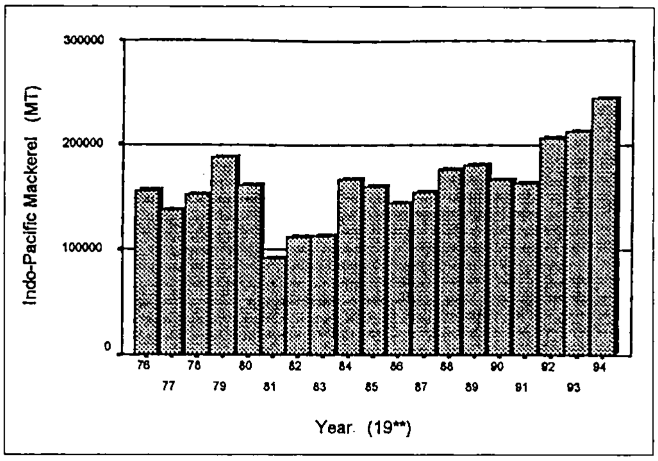
Major fishing gears for Indian mackerels in 1994 by country and area were as followed. In Malaysia, drift gill net (accounted for 39.3%) was the most dominant, followed by purse seine (32.6%) and trawl (24.5%). In the Philippines, one boat purse seine (39.5%) was the most dominant, followed by small-scale gill net (38.0%) and hook and line (7.7%). In the Gulf of Thailand, purse seine (82.5%) was the most dominant, followed by otter trawl (7.3%) and pair trawl (4.7%). In the Indian Ocean (Thailand), purse seine accounted for 87.6% and otter trawl was 12.3% for Indian mackerels catch.

Indo-Pacific Mackerel

Catch Trend

Indo-Pacific mackerel catch (Fig. 26) in the Area recorded at 156,000 MT (accounted for 2.71% of the grand total) in 1976, then it reached at 188,000 MT (3.03%) in 1979 with a slight decrease in 1977. The catch decreased drastically to 92,000 MT (1.43%) in 1981, but it increased again to 167,000 MT (2.50%) in 1984. The catch decreased slightly to 144,000 MT (1.97%) in 1986 and it increased slightly to 180,000 MT (2.17%) in 1989. The catch showed a slight decrease to 164,000 MT (1.86%) in 1991, then increasing and reached to 244,000 MT (2.44%) in 1994.

Figure 26: Catch trend of Indo-Pacific mackerel in the Area from 1976 to 1994.



Stock Status

Seven possible **mackerels, *Rastrelliger* spp., (Indo-Pacific mackerel)** stocks were identified by the Workshop 1985, but the catch trends of four of them and others were shown in this paper (Fig. 27, also refer to Annex Fig. 9)

Stock 1 : **Western Gulf of Thailand to Singapore**; Gulf of Thailand, East Coast of Peninsular Malaysia and Singapore.

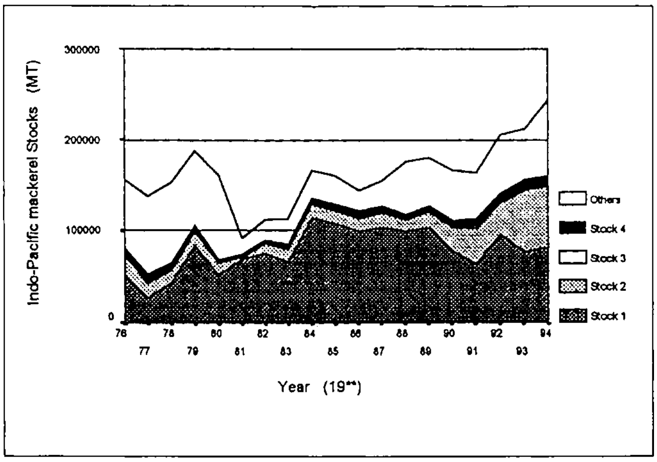
Stock 2 : **Malacca Strait**; Indian Ocean, West Coast of Peninsular Malaysia and Malacca Straits.

Stock 3 : **West and Northwest of Borneo:** Sarawak and Brunei.

Stock 4 : **Palawan-Celebes Sea:** Sabah and Mindanao.

Others : Data were obtained from Taiwan (1976, 77, 88-94), Indonesia (excluding Malacca Strait) and the Philippines (excluding Mindanao).

Figure 27: Indo-Pacific mackerel catch by possible stock in the Area from 1976 to 1994.



The catch of Stock 1 was the most dominant in the Indo-Pacific mackerel catch (accounted for 49.9% of mean in the total Indo-Pacific mackerel catch) followed by Stock 2, Stock 4 and Stock 3 in the Area. The catch from Others accounted for 32.7% of mean. The relationships between total Indo-Pacific mackerel catch and catch of each stock were as followed; the catch of each stock as Stock 2 and Stock 4 with (versus) total Indo-Pacific mackerel catch showed a significant correlation respectively. Also the relationships among the catches of stocks were as followed; the catches between Stock 2 and Stock 4 showed a significant correlation.

Therefore, the stock of "Western Gulf of Thailand to Singapore" is recognized as the most dominant in Indo-Pacific mackerel in the Area and catch of its ranged from 26,600 to 115,000 MT with a mean of 78,700 MT. The catch trends of stocks of "Malacca Strait" and "Palawan-Celebes Sea" were highly correlated, but "Western Gulf of Thailand to Singapore" and "West and Northwest of Borneo" can be considered as different trends.

Fishing Gear

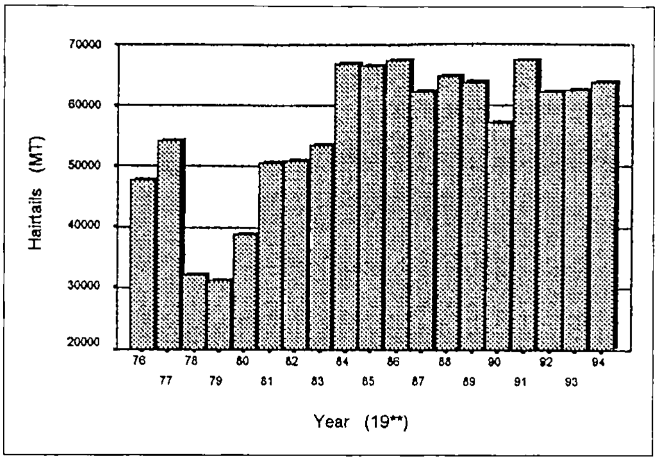
Major fishing gears for Indo-Pacific mackerel in 1994 by country and area were as followed. In the Philippines, one boat purse seine (accounted for 43.9%) was the most dominant, followed by boat seine (18.9%), small scale gill net (12.6%) and otter board trawl (9.6%). In the Gulf of Thailand, purse seine (58.4%) was the most dominant, followed by mackerel encircling gill net (17.8%) and small-scale gill net (9.7%). In the Indian Ocean (Thailand), purse seine accounted for 75.5% and otter trawl was 24.0% in Indo-Pacific mackerel catch.

Hairtails

Catch Trend

Hairtails catch (Fig. 28) in the Area recorded at 48,000 MT (accounted for 0.83% of the grand total) in 1976 and it increased to 54,000 MT (0.82%) in 1977. But the catch showed a drastic decrease to 32,000 MT (0.48%) in 1978, and it remained constant in 1979. After 1979 the catch increasing and recovered to 51,000 MT (0.79%) in 1981 and it remained constant until 1983. After 1983 the catches increased and remained at high level until 1994 from 62,000 MT (1987, 92 and 93) to 67,000 MT (1986) and 91) with an exception of 57,000 MT (0.67%) in 1990.

Figure 28: Catch trend of hairtails in the Area from 1976 to 1994.



Fishing Gear

Major fishing gears for hairtails in 1994 by country and area were as followed. In Malaysia, trawl (accounted for 78.4%) was the most dominant, followed by drift gill net (15.8%) and purse seine (4.2%). In the Philippines, hook and line (36.4%) was the most dominant, followed by otter board trawl (20.4%) and small scale gill net (20.3%). In the Gulf of Thailand, otter trawl (82.1%) was the most dominant, followed by pair trawl (10.9%) and purse seine (4.3%). In the Indian Ocean (Thailand), otter trawl (77.4%) was the most dominant, followed by purse seine (14.0%) and pair trawl (8.6%).

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FAO/SEAFDEC. (1985). Report of the FAO/SEAFDEC Workshop on shared stocks in Southeast Asia. Bangkok, 18-22 February 1985. FAO Fisheries Report No. 337. (FIRM/R337).

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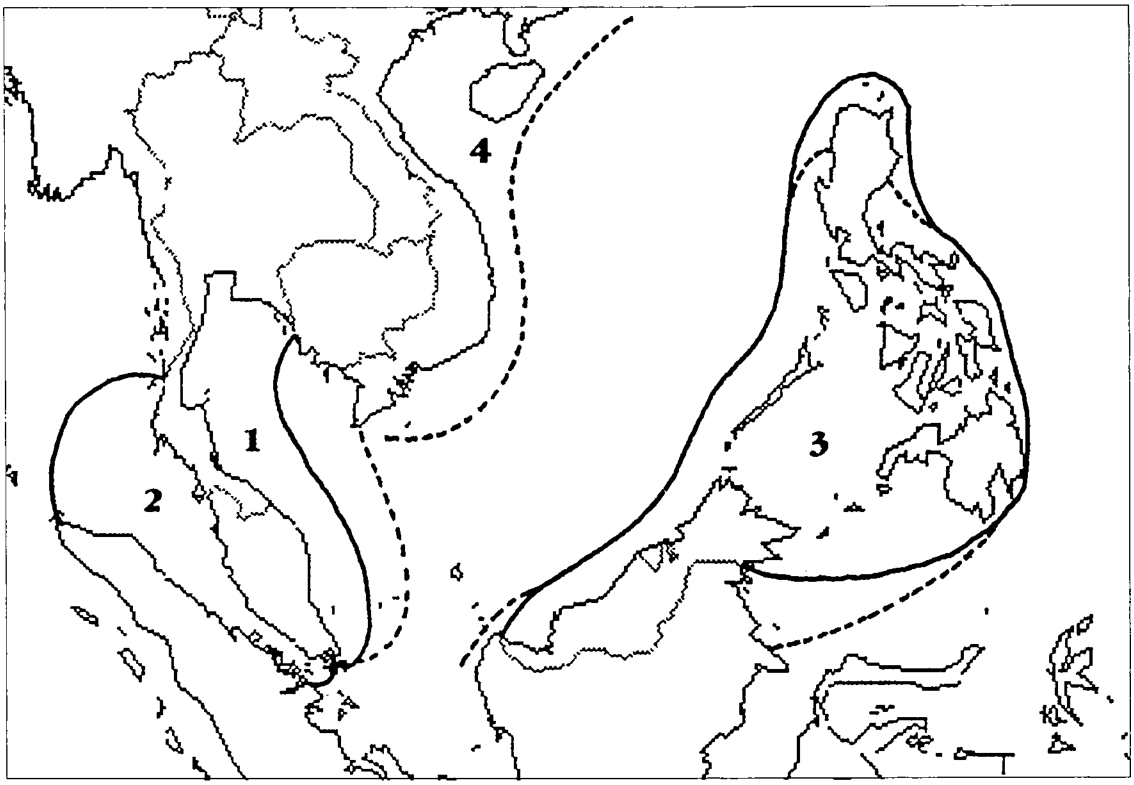


Annex-Figure 1: Stocks of round scads, *Decapterus* spp., in the Area. The original identification of stocks was obtained from the report* of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

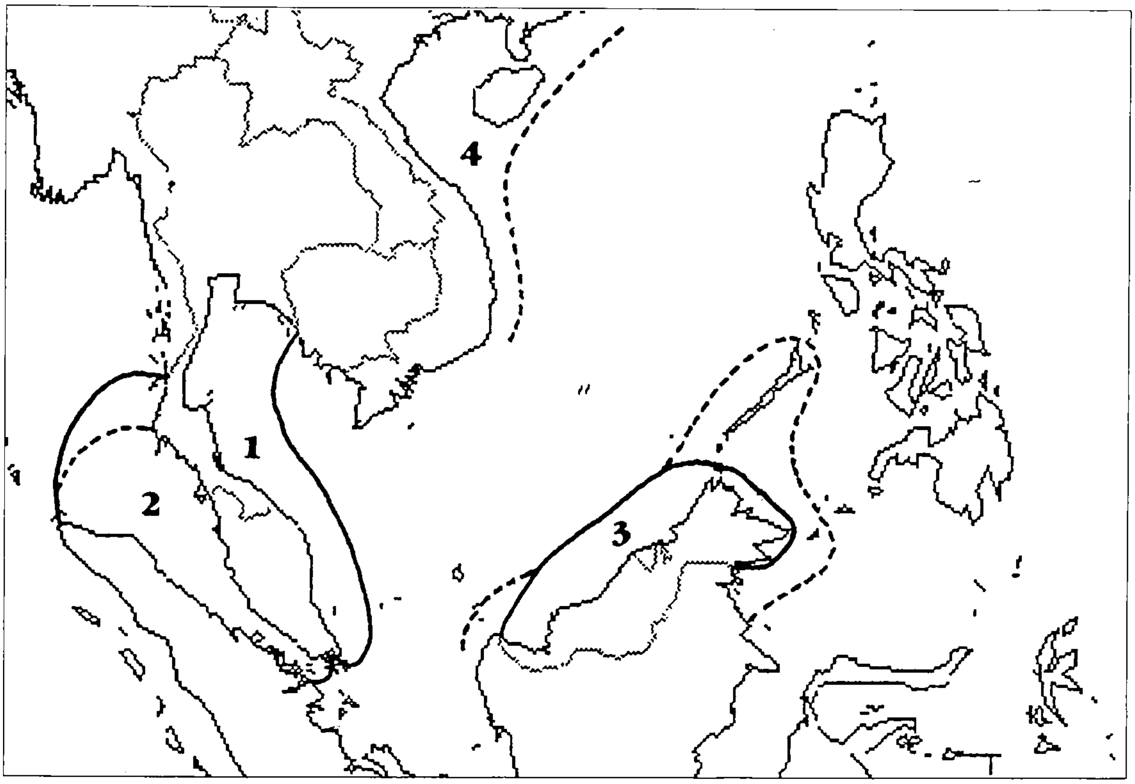
Stock 1 : **Gulf of Thailand to Sunda Shelf;** Gulf of Thailand and East Coast of Peninsular Malaysia.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

Stock 3 : **Eastern South China Sea;** Sabah, Sarawak, Brunei and the Philippines.

Stock 4 : **Gulf of Tonkin**

* There is probably one or more stocks that are not shared in Indonesian waters.



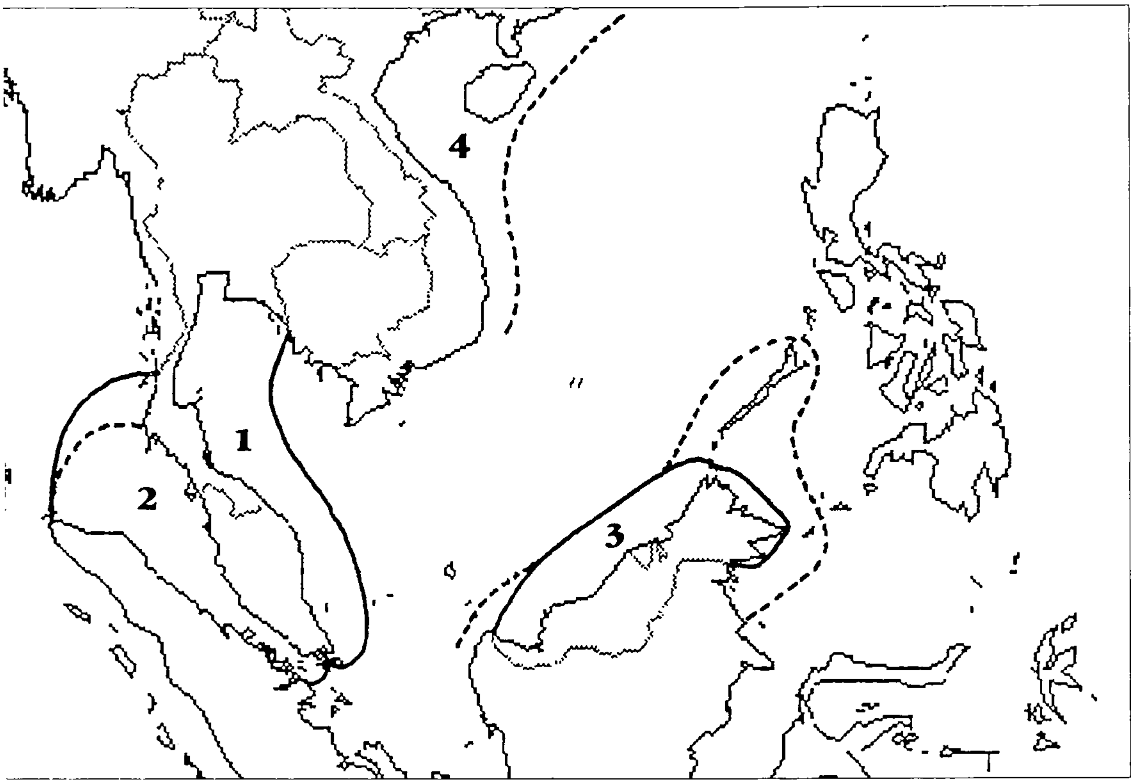
Annex-Figure 2: Stocks of trevallies (jacks-cavalla-trevallies), in the Area. The original identification of stocks was obtained from the report of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Gulf of Thailand to Sunda Shelf;** Gulf of Thailand and East Coast of Peninsular Malaysia.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

Stock 3 : **North and West of Borneo;** Sabah, Sarawak and Brunei.

Stock 4 : **Gulf of Tonkin**



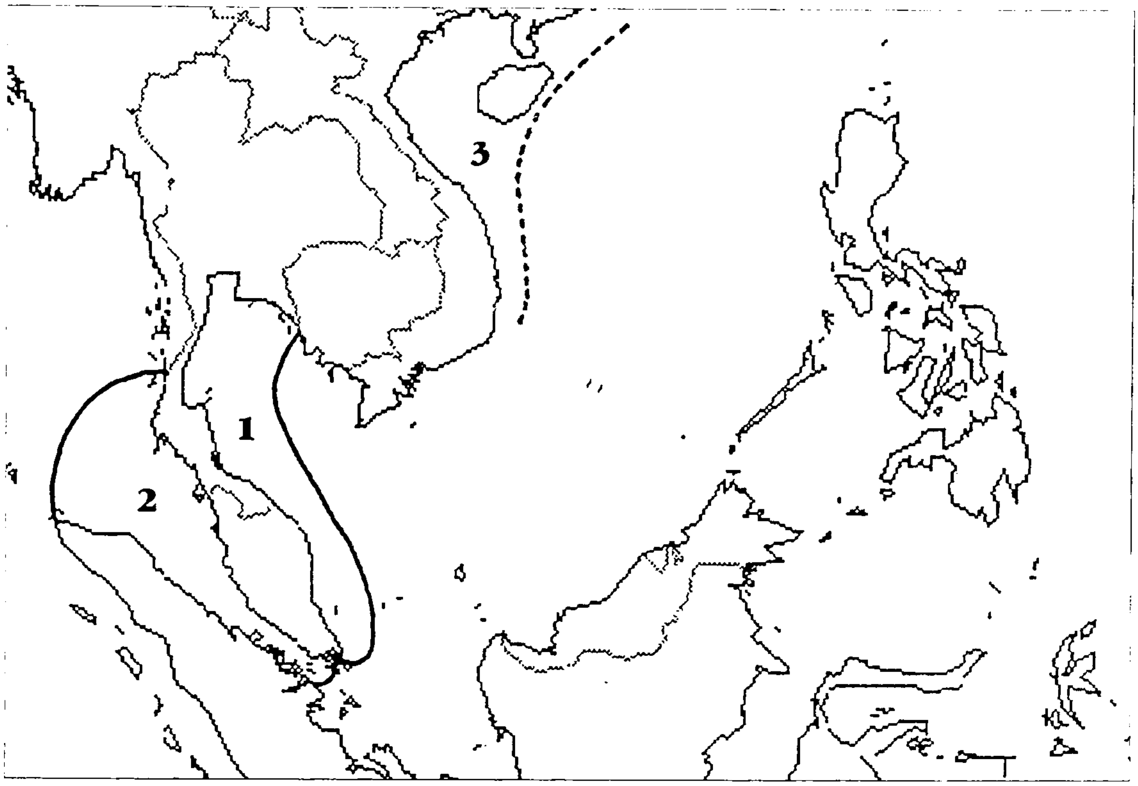
Annex-Figure 3: Stocks of trevallies (selar scads), in the Area. The original identification of stocks was obtained from the report of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Gulf of Thailand to Sunda Shelf;** Gulf of Thailand and East Coast of Peninsular Malaysia.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

Stock 3 : **North and West of Borneo;** Sabah, Sarawak and Brunei.

Stock 4 : **Gulf of Tonkin**

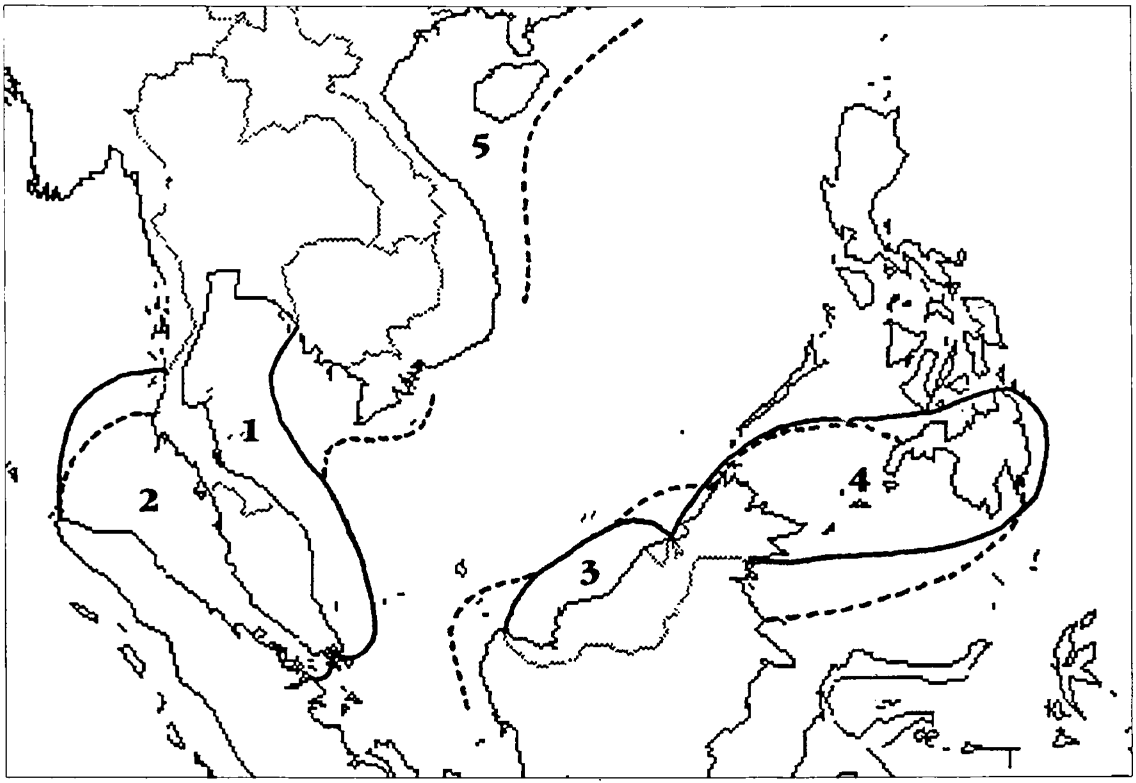


Annex-Figure 4: Stocks of hardtail scad, *Megalaspis cordyla*, in the Area. The original identification of stocks was obtained from the report of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Gulf of Thailand;** Gulf of Thailand.

Stock 2 : **Malacca Strait;** Indian Ocean, West coast of Peninsular Malaysia, Singapore and Malacca Straits.

Stock 3 : **Gulf of Tonkin**



Annex-Figure 5: Stocks of sardines, *Sardinella* spp., in the Area. The original identification of stocks was obtained from the report* of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Gulf of Thailand to Sunda Shelf;** Gulf of Thailand and East Coast of Peninsular Malaysia.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

* Possibly separate stocks on each side of the strait.

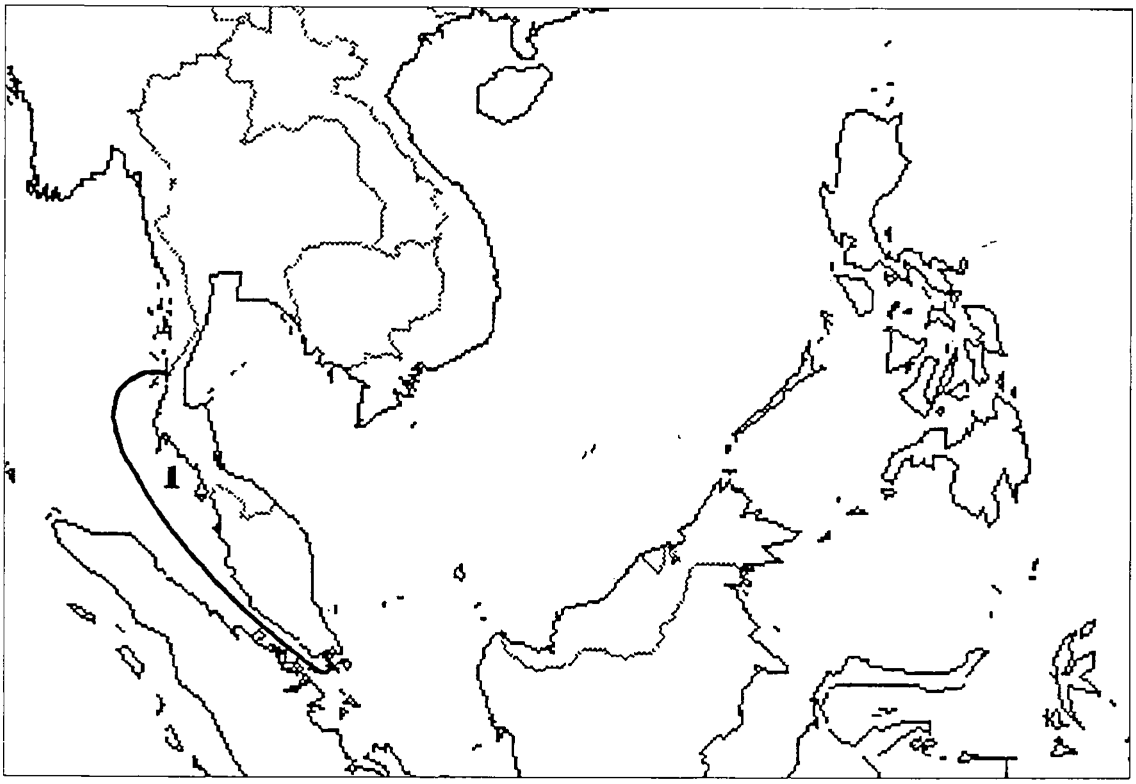
Stock 3 : **Sunda Shelf-Northwest of Borneo;** Sarawak, Labuan and Brunei.

* There was considerable uncertainty about the limits of this stock.

Stock 4 : **Northwestern Celebes Sea;** Sabah and Mindanao.

Stock 5 : **Gulf of Tonkin**

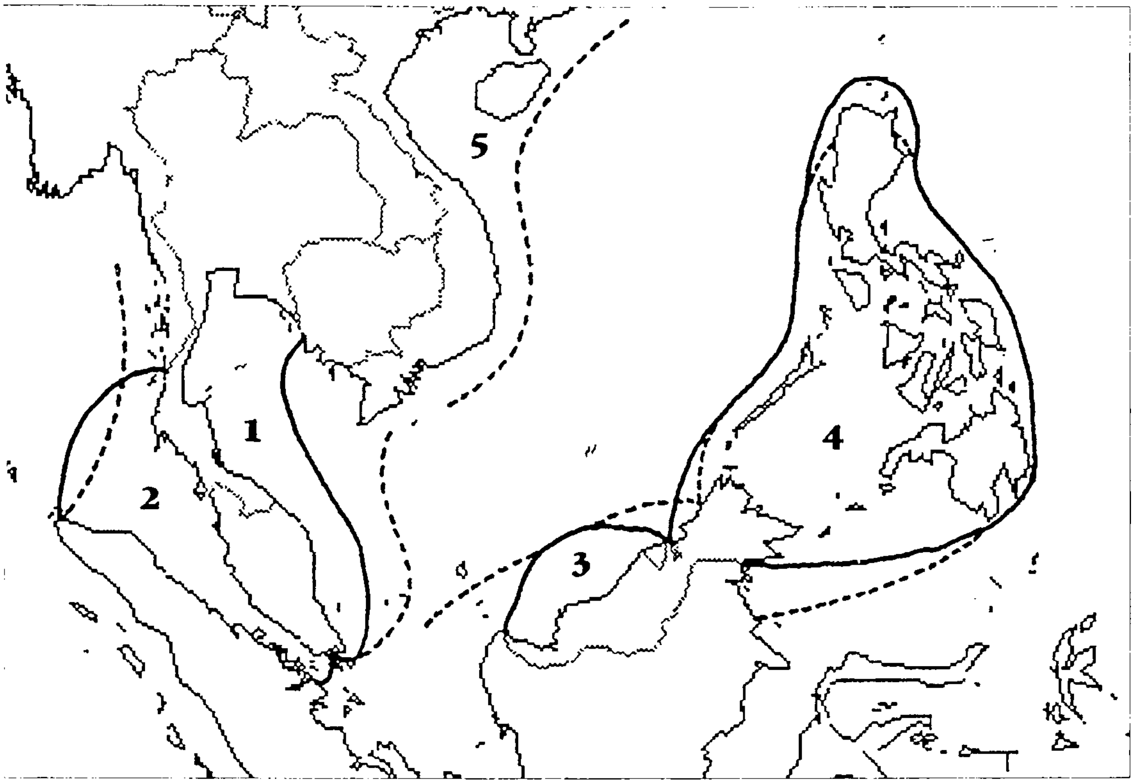
* Other stocks which are not shared are known to exist in Indonesian waters, and probably also in northern and central Philippine waters.



Annex-Figure 6: Stocks of anchovies, *Stolephorus* spp., in the Area. The original identification of stocks was obtained from the report* of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Malacca Strait (east)**; Indian Ocean, West Coast of Peninsular Malaysia and Singapore.

* There may be several other stocks being shared in the region; however, little information is available to confirm those.



Annex-Figure 7: Stocks of Spanish mackerels, *Scomberomorus* spp., (narrow-barred king mackerel), *Scomberomorus commerson*, in the Area. The original identification of stocks was obtained from the report of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Gulf of Thailand to Sunda Shelf;** Gulf of Thailand and East Coast of Peninsular Malaysia.

Stock 2 : **Malacca Strait to Andaman Sea;** Indian Ocean, West Coast of Peninsular Malaysia, Singapore and Malacca Straits.

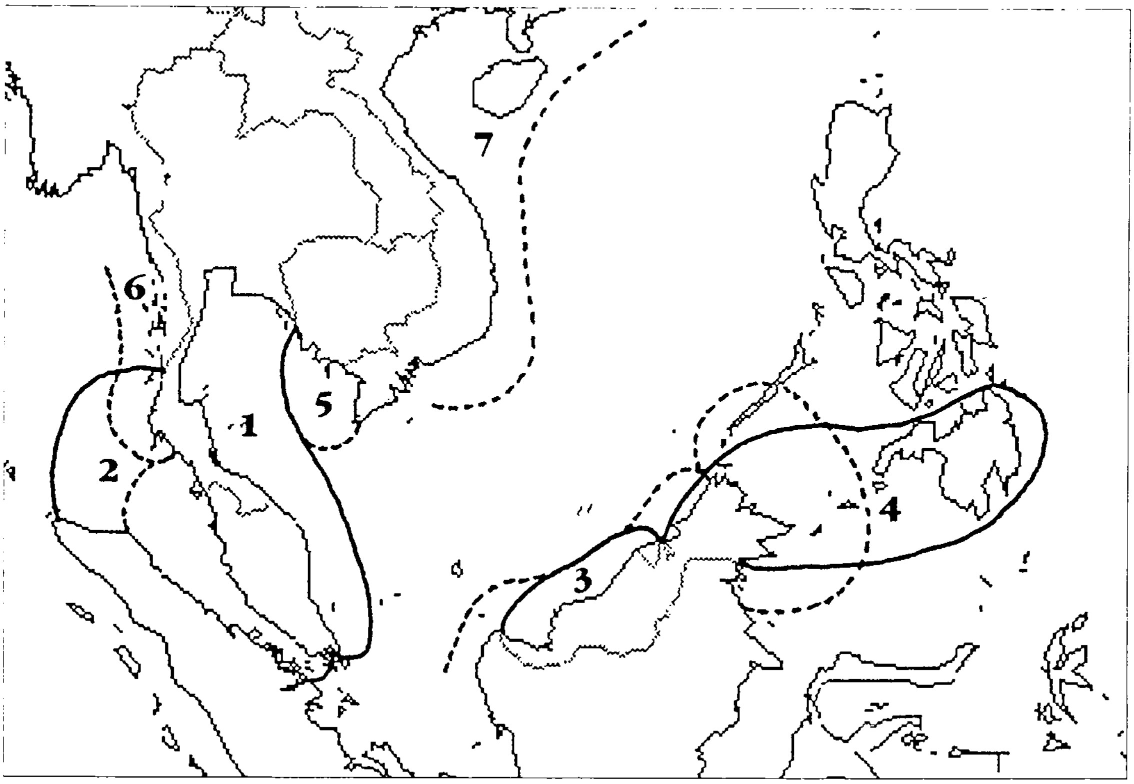
* Possibily separate stocks on each side of the strait.

Stock 3 : **Sunda Shelf-Northwest of Borneo;** Sarawak, Labuan and Brunei.

* There was considerable uncertainty about the limits of this stock.

Stock 4 : **Northeastern South China Sea;** Sabah and the Philippines.

Stock 5 : **Western South China Sea**



Annex-Figure 8: Stocks of mackerels, *Rastrelliger* spp., (Indian mackerels), in the Area. The original identification of stocks was obtained from the report* of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Western Gulf of Thailand to Singapore;** Gulf of Thailand, East Coast of Peninsular Malaysia and Singapore.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia and Malacca Straits.

* The view was expressed that these may be two stocks in the Malacca Strait, one on the north side and the other on the south, but the degree of mixing was unknown.

Stock 3 : **West and Northwest of Borneo;** Sarawak and Brunei.

Stock 4 : **Palawan-Celebes Sea;** Sabah and Mindanao.

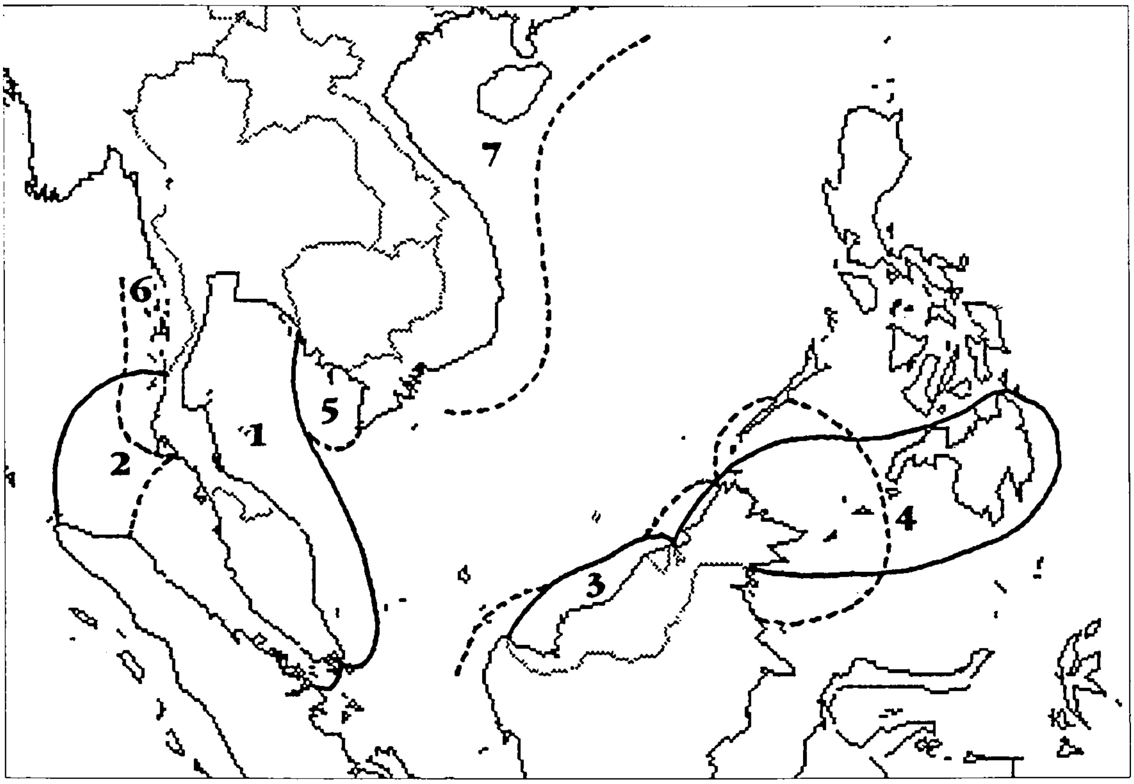
* The limits of this stock are far from clear.

Stock 5 : **Eastern Gulf of Thailand**

Stock 6 : **Andaman Sea**

Stock 7 : **Gulf of Tonkin**

* In addition, there will be stocks that are not shared in northern Philippines and in Indonesian waters.



Annex-Figure 9: Stocks of mackerels, *Rastrelliger* spp., (Indo-Pacific mackerel), in the Area. The original identification of stocks was obtained from the report* of the FAO/SEAFDEC Workshop in 1985 in Bangkok. Straight line shows data availability of possible stock in this paper and dotted line shows limit of stock obtained from above mentioned workshop report.

Stock 1 : **Western Gulf of Thailand to Singapore;** Gulf of Thailand, East Coast of Peninsular Malaysia and Singapore.

Stock 2 : **Malacca Strait;** Indian Ocean, West Coast of Peninsular Malaysia and Malacca Straits.

* The view was expressed that these may be two stocks in the Malacca Strait, one on the north side and the other on the south, but the degree of mixing was unknown.

Stock 3 : **West and Northwest of Borneo;** Sarawak and Brunei.

Stock 4 : **Palawan-Celebes Sea;** Sabah and Mindanao.

* The limits of this stock are far from clear.

Stock 5 : **Eastern Gulf of Thailand**

Stock 6 : **Andaman Sea**

Stock 7 : **Gulf of Tonkin**

* In addition, there will be stocks that are not shared in northern Philippines and in Indonesian waters.

ANNEX 14

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/WP. 3

BIOLOGICAL PARAMETERS AND POPULATION DYNAMICS ON SHARED STOCKS OF THE SOUTH CHINA SEA

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SMALL PELAGIC RESOURCES OF THE SOUTH CHINA SEA
(potential transboundry shared stocks)

Mackerels (*Rastrelliger* spp.)

Round scads (*Decapterus* spp.)

Scads (*Selar* spp., *Atule mate*)

Torpedo scad (*Megalaspis cordyla*)

Sardines (*Sardinella* spp., *Dussumieria* spp.)

Small tunas (*Auxis thazard, Euthynnus* spp., *Thunnus tonggol, Sarda* spp.)

Spanish mackerels (*Scomberomorus* spp.)

Jacks, trevallies (*Caranx* spp., *Carangoides* spp.)

Anchovies (*Stolephorus* spp.)

Queenfish, leatherskin (*Scomberoides* spp.)

Barracudas (*Sphyraena* spp.)

Pomfrets (*Parastromateus niger, Stromateus* spp.)

Wolf-herrings (*Chirocentrus* spp.)

Hairtails (*Trichiurus* spp.)

Mullets

Population dynamics parameters on shared stock species of the South China Sea

Fish group: Round scads
Family names: Carangidae
Species names: *Decapterus maruadsi*
Common names:

Area examined	Brunei	Malaysia E. coast, P. Malaysia	Malaysia E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition						
minimum length					70 mm	
maximum length		32.1 cm		23.1 cm	202 mm	
mean length in catch		20 cm		13.2 cm		
Age and growth						
growth rate (K)		0.8-0.85		0.11	0.52-0.82	0.32 (N), 0.21 (SE), 0.22 (S)
length infinity (Linf)					23.5-27.7	243 (N), 286 (SE), 258 (S)
mortality (M)						
exploitation rate (E)					1.22-1.67	
total mortality (Z)		2.85-3.59				
Spawning						
season area						
length at 1st maturity				1:1.2		
sex ratio (M:F)						
Fecundity						
Nursery ground						
Nursery periods						
Recruitment						
season mean length				5.5-6.5 cm		
Length-weight rel.		W=0.0062 L^ 3.17		W=5.0x10^ -5 L^ 2.8¡11		W=0.0000134 L^2.533 (N) W=0.00006839 L^2.6507 (SE) W=0.0001005 L^2.6020 (S)
Food and feeding habit						
Predators						

Note: Mansor and Hamid, 1990; Chung & Dinh, 1996; Corpuz et al., 1985

Population dynamics parameters on shared stock species of the South China Sea

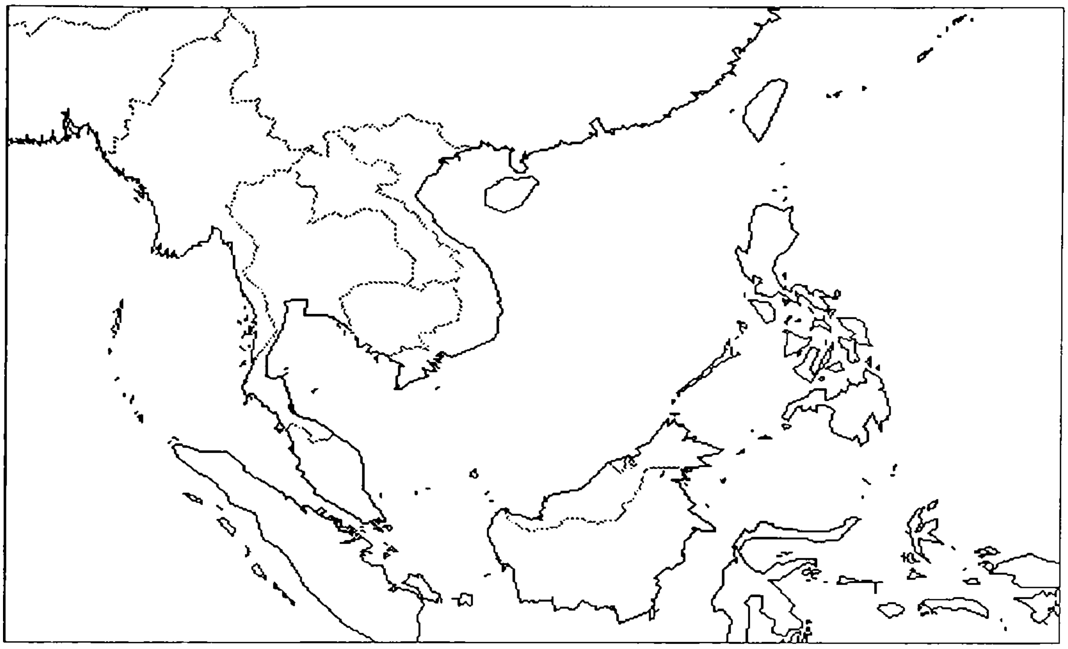
Fish group: Round scads
Family names: Carangidae
Species names: *Decapterus russelli*
Common names: Slender scad

Area examined	Brunei	Malaysia E. coast, P. Malaysia	 E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition minimum length maximum length mean length in catch		 97 mm 260 mm 113-135 mm			 30 cm	
Age and growth growth rate (K) length infinity (Linf) mortality (M) exploitation rate (E) total mortality (Z)		 0.56-1.30 235-322 1.52-2.21 0.39-0.61 2.5-4.88			 0.54-0.80 2.06-6.89 42-77%	
Spawning season area length at 1st maturity sex ratio (M:F)		 July-Aug, April-May 21.9 mm (M), 21.1 mm (F)				
Fecundity						
Nursery ground						
Nursery periods						
Recruitment season mean length		 May-June				
Length-weight rel.		W=7.528x10^-6 L^ 3.052				
Food and feeding habit						
Predators						

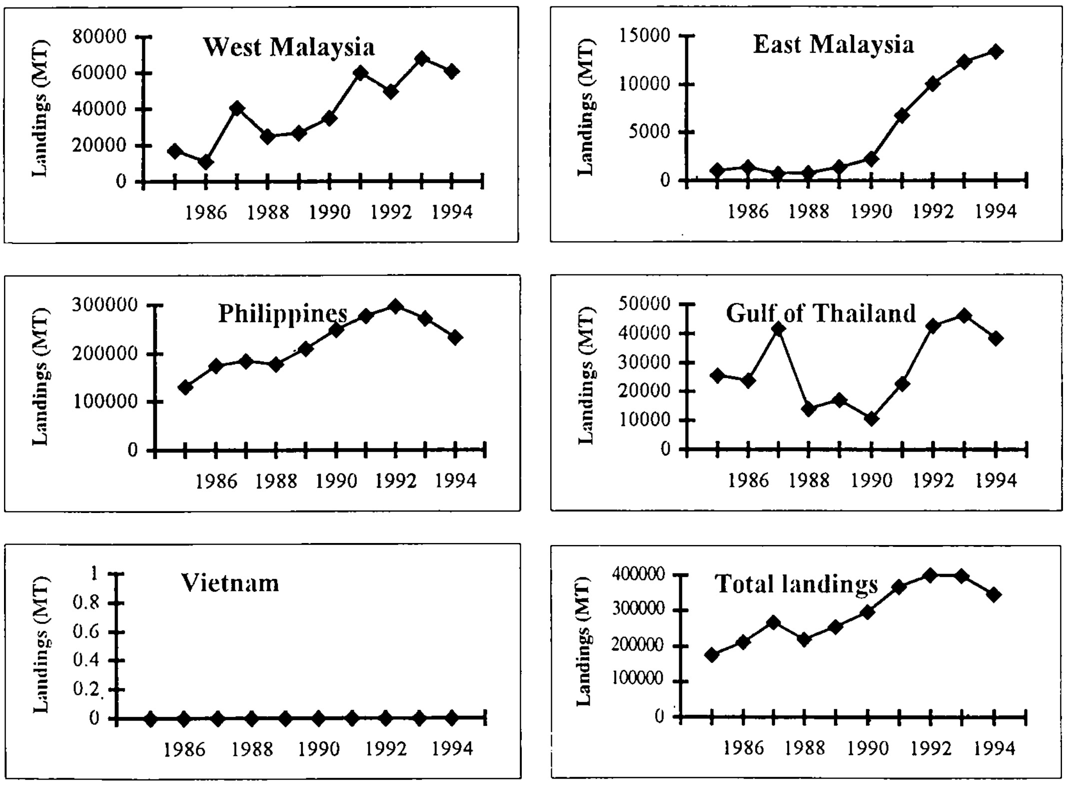
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: ***Decapterus* spp.**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Decapterus* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

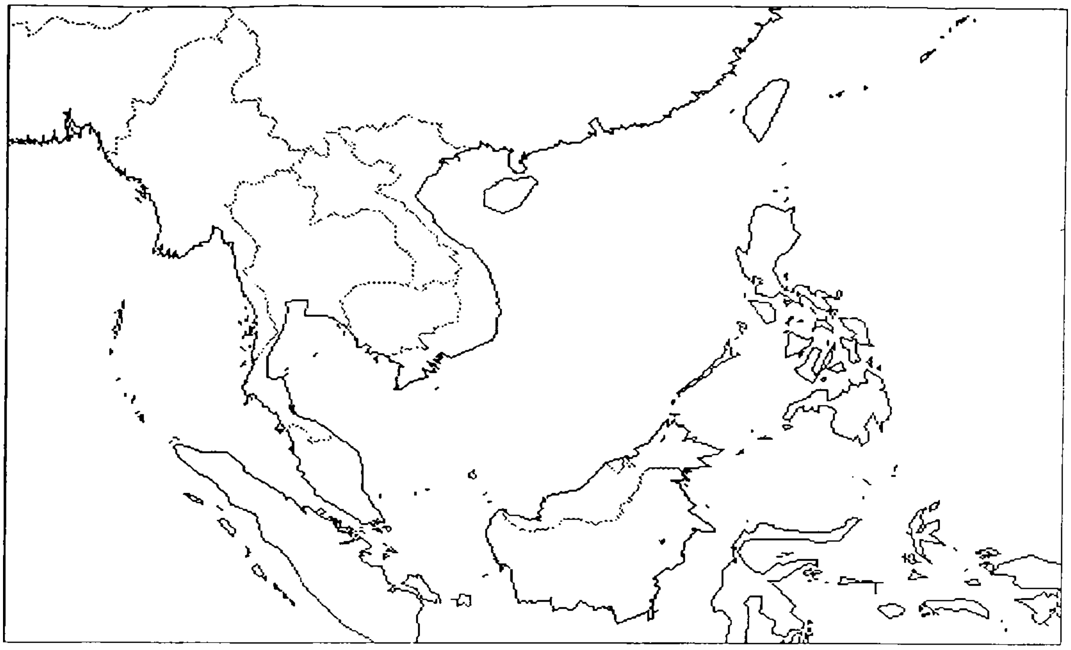
Fish group: Jacks and Trevallies
Family names: Carangidae
Species names:
Common names:

Area examined	Brunei	Malaysia E. coast, P. Malaysia	Malaysia E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition minimum length maximum length mean length in catch						
Age and growth growth rate (K) length infinity (Linf) mortality (M) exploitation rate (E) total mortality (Z)						
Spawning season area length at 1st maturity sex ratio (M:F)						
Fecundity						
Nursery ground						
Nursery periods						
Recruitment season mean length						
Length-weight rel.						
Food and feeding habit						
Predators						

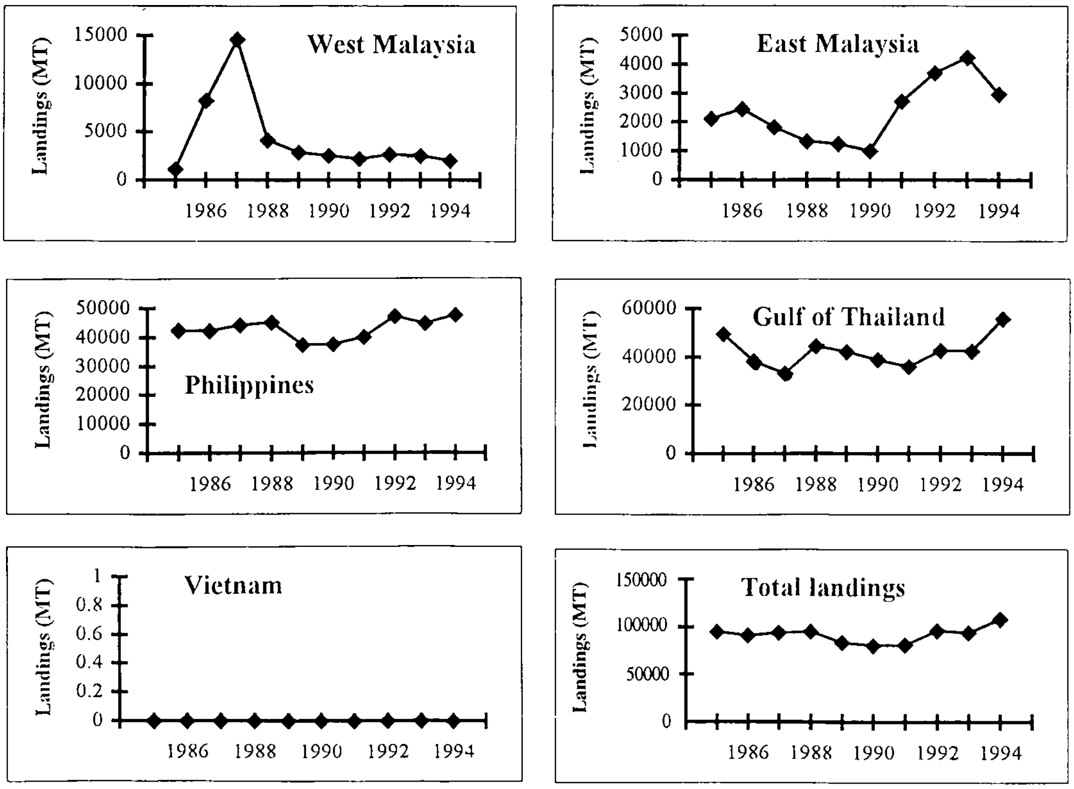
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: **Jacks, trevallies**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Caranx* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

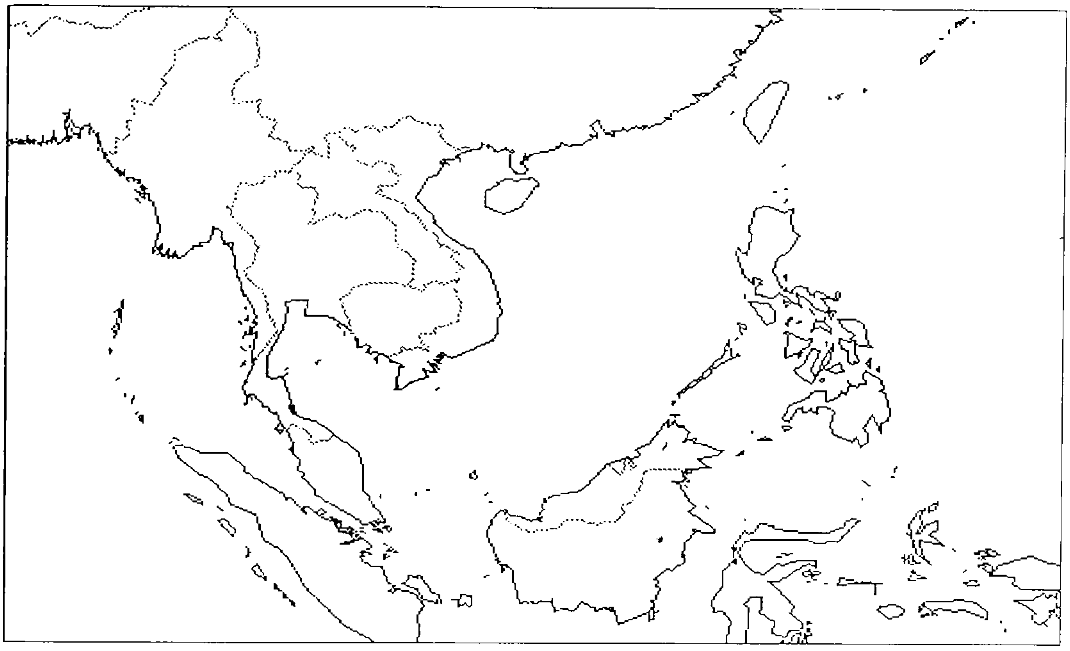
Fish group: King mackerels
Family names: Scombridae
Species names: *Scomberomorus commerson*
Common names: Narrow-barred Spanish mackerels

Area examined	Brunei	Malaysia: E. coast, P. Malaysia	Malaysia: E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition						
minimum length		50 cm		20 cm		
maximum length		220 cm		92 cm		
mean length in catch		50-55 cm		50 cm		
Age and growth						
growth rate (K)		1.15		0.12	0.7	
length infinity (Linf)						
mortality (M)		1.37			1.23	
exploitation rate (E)		0.48			1.49	
total mortality (Z)		3.13				
Spawning						
season area				Feb.-March, Jun-Sept.		
length at 1st maturity		65 (M), 70 (F)		58.6 cm		
sex ratio (M:F)				1:1.6		
Fecundity				5-3.8 million		
Nursery ground						
Nursery periods						
Recruitment						
season mean length				March-May, July-Oct. 11-21		
Length-weight rel.		W=0.00 L^ 3.55		L 2.8843		
Food and feeding habit		Stolephorus, sardinella, small carangids, squids, penaeid shrimps				
Predators						

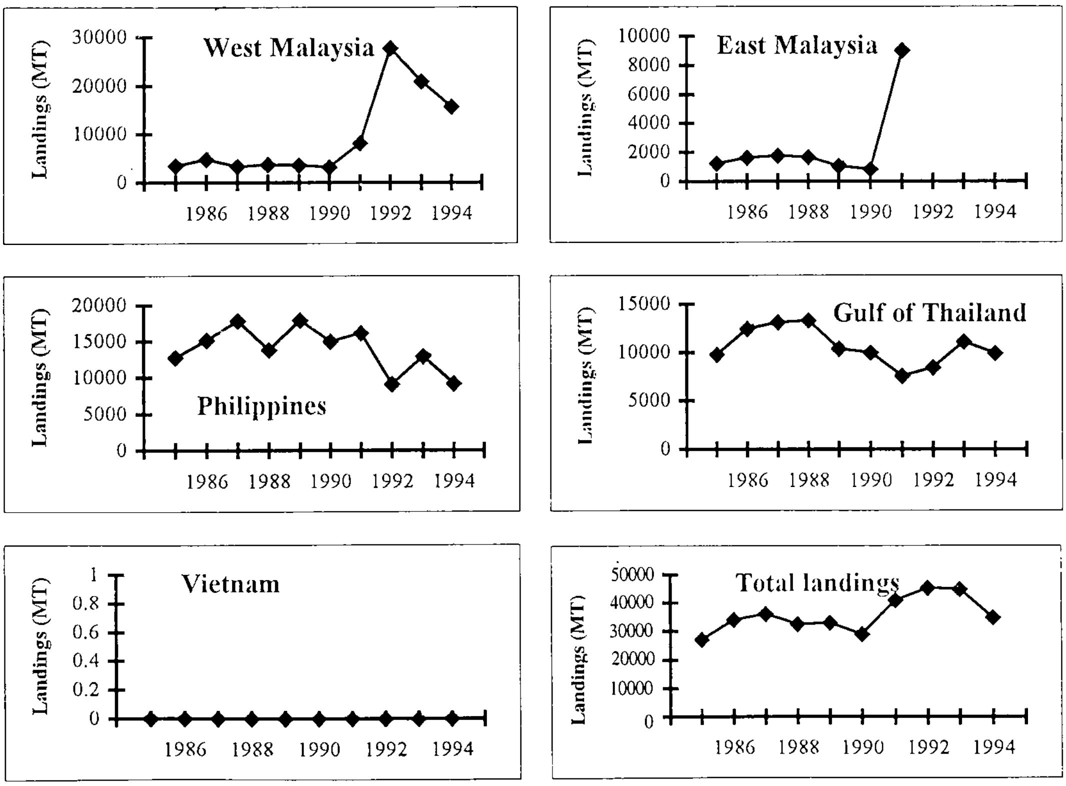
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: ***Scomberomorus* spp.**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Scomberomorus* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

POPDYSCS - XLS

Population dynamics parameters on shared stock species of the South China Sea

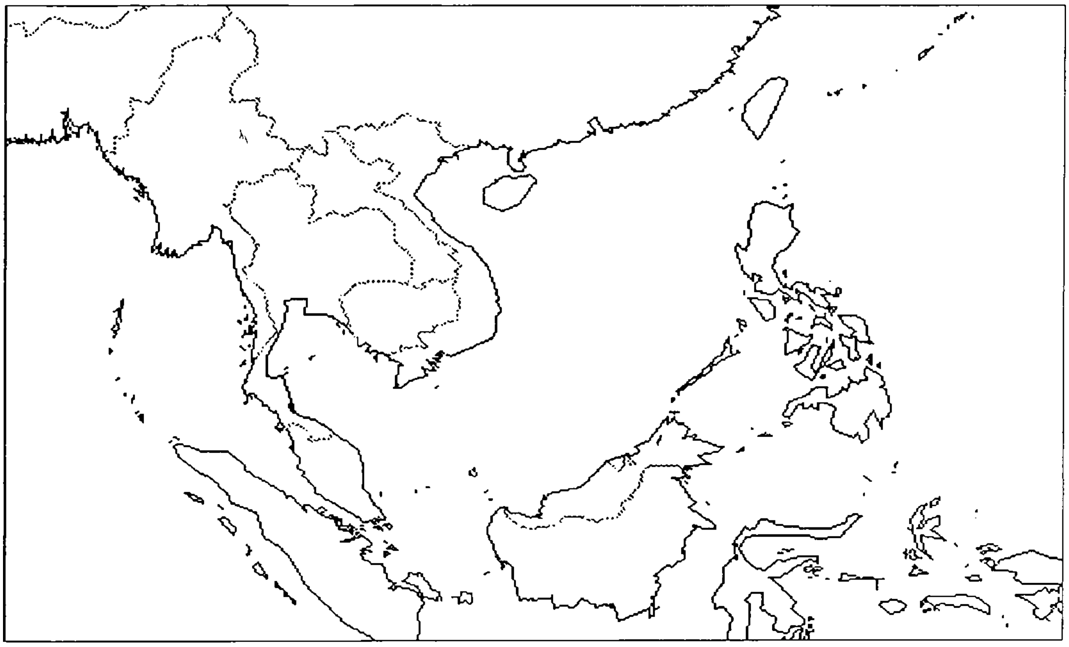
Fish group: Tunas
Family names: Scombridae
Species names: *Thunnus tonggol*
Common names: Longtail tuna

Area examined	Brunei	Malaysia		Thailand (Sabah & Sarawak)	Philippines	Vietnam
		E. coast, P. Malaysia	E. Mal			
Size composition						
minimum length		80 cm				
maximum length		35 cm		38.5 cm		
mean length in catch						
Age and growth						
growth rate (K)		0.6			0.7	
length infinity (Linf)						
mortality (M)					1.23	
exploitation rate (E)					1.49	
total mortality (Z)		2.45				
Spawning						
season area				Mar-May, July-Dec.		
length at 1st maturity				39 cm		
sex ratio (M:F)				1:1		
Fecundity				1.4 million		
Nursery ground						
Nursery periods						
Recruitment						
season mean length				Jan.-Feb., Apr.-Jun. 22-26 cm		
Length-weight rel.		W=0.0075 L^3.19		W=2.1x10.5 L^2.979		
Food and feeding habit						
Predators						

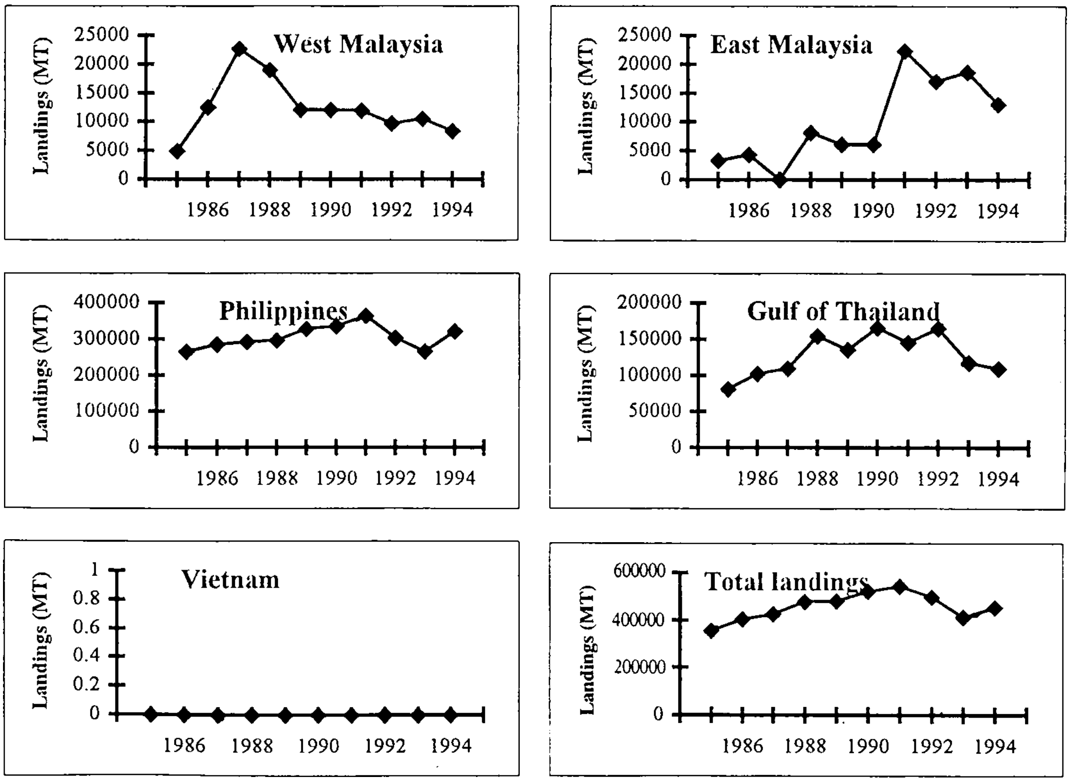
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: **Naritic tunas**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Auxis thazard* by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

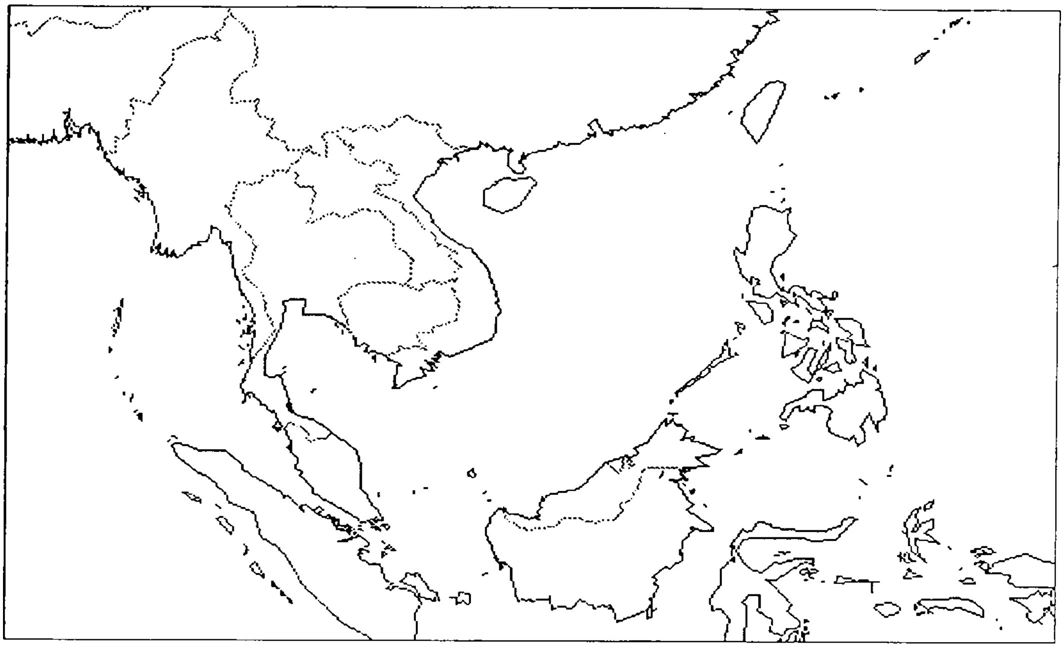
Fish group: Sardines
Family names: Clupeidae
Species names:
Common names:

Area examined	Brunei	Malaysia		Thailand (Sabah & Sarawak)	Philippines	Vietnam
		E. coast, P. Malaysia	E. Mal			
Size composition minimum length maximum length mean length in catch						
Age and growth growth rate (K) length infinity (Linf) mortality (M) exploitation rate (E) total mortality (Z)						
Spawning season area length at 1st maturity sex ratio (M:F)						
Fecundity						
Nursery ground						
Nursery periods						
Recruitment season mean length						
Length-weight rel.						
Food and feeding habit						
Predators						

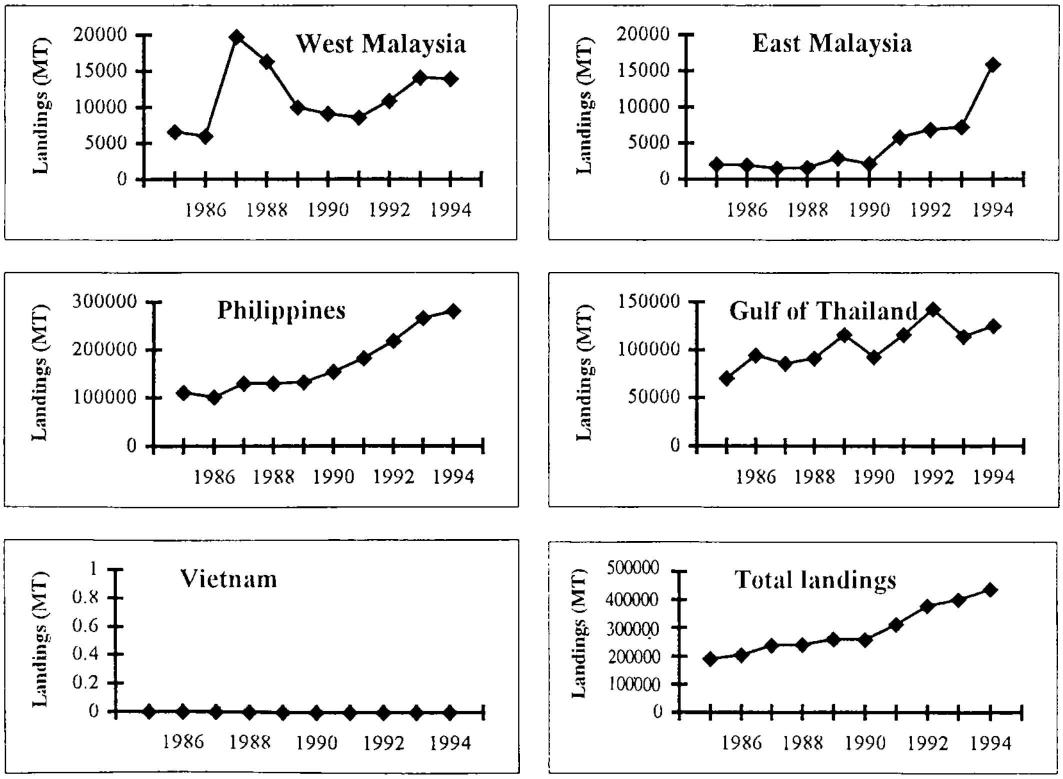
Note: Mansor and Hamid, 1990; Mansor and Abdullah, 1995; Mohsin and Ambak, 1996

Geographical distributions of shared stocks in the South China Sea

Species names: ***Sardinella* spp.**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Sardinella* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

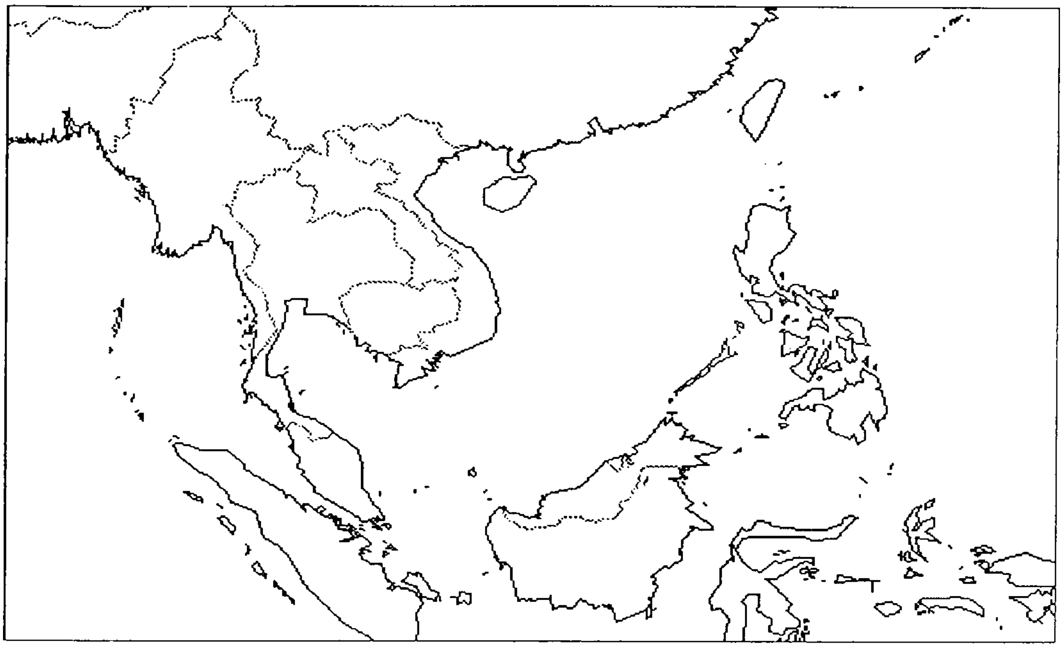
Fish group: Torpedo trevally
Family names: Carangidae
Species names: *Megalaspis cordyla*
Common names: Hardtail scad

Area examined	Brunei	Malaysia		Thailand (Sabah & Sarawak)	Philippines	Vietnam
		E. coast, P. Malaysia	E. Mal			
Size composition minimum length maximum length mean length in catch		 20 cm 39.7 cm 23 cm		 22 cm 28.8 cm		
Age and growth growth rate (K) length infinity (Linf) mortality (M) exploitation rate (E) total mortality (Z)		 0.9 3.13		 0.2		
Spawning season area length at 1st maturity sex ratio (M:F)				 Dec.-May, Aug.-Nov.. 1:0.8		
Fecundity						
Nursery ground						
Nursery periods						
Recruitment season mean length				 May-Sept. 10.5-11.5 cm		
Length-weight rel.		W=0.0017 L^2.84		W=2.1x10-5 L^ 2.9785		
Food and feeding habit						
Predators						

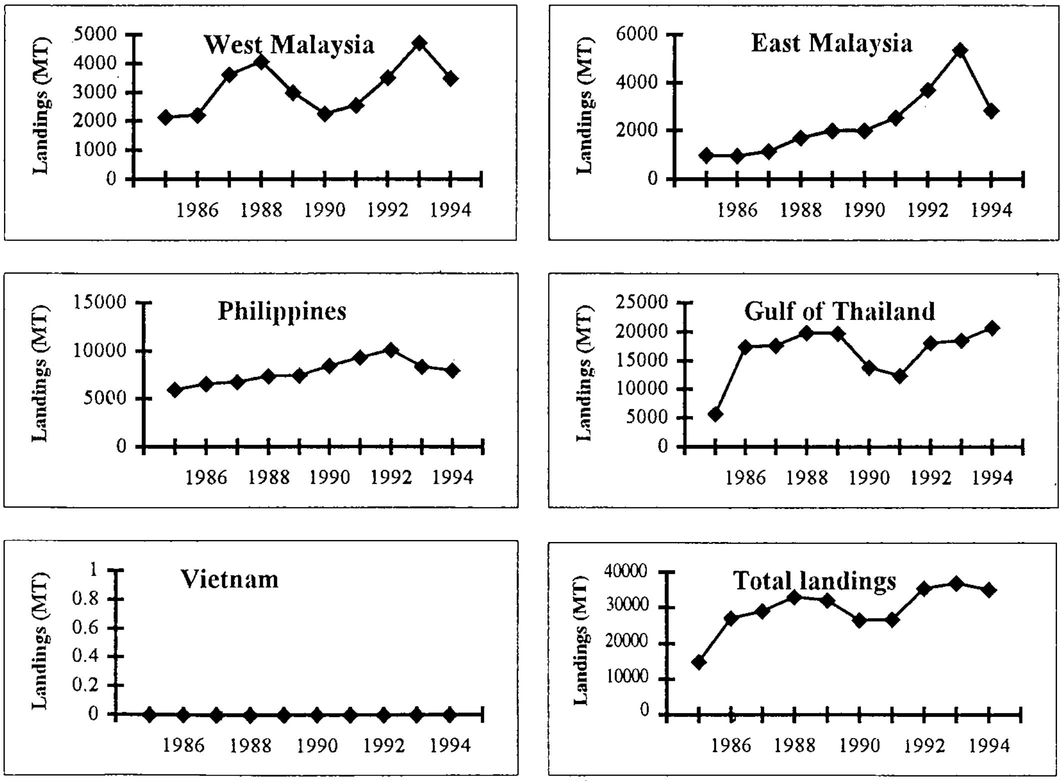
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: ***Megalaspis cordyla.***



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Megalaspis cordyla* by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

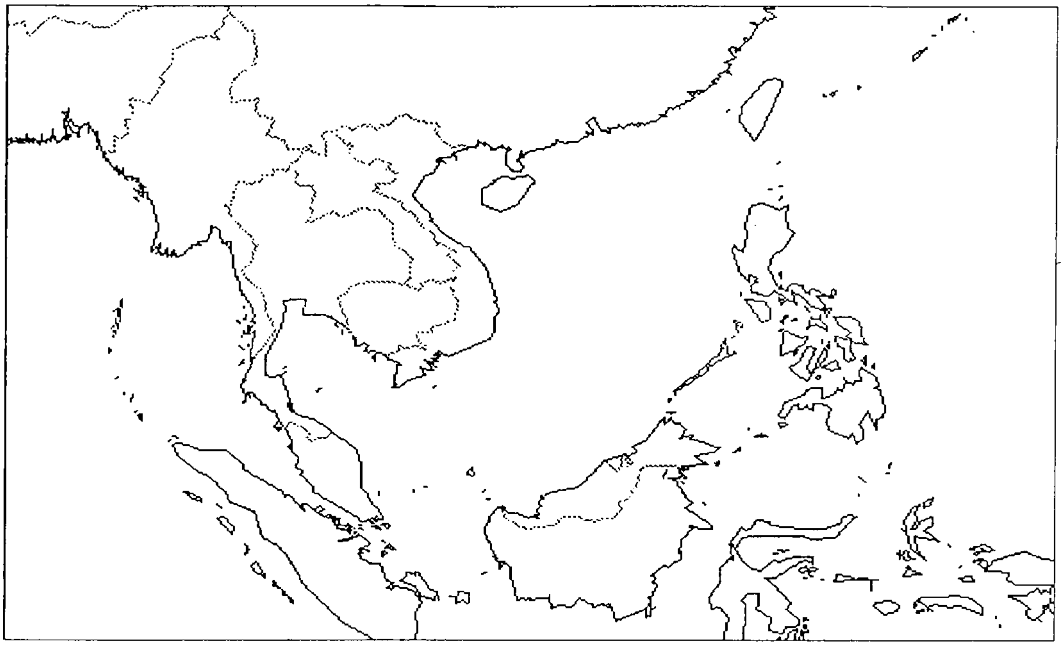
Fish group: Scads
Family names: Carangidae
Species names: *Atule mate*
Common names: Yellowtail scad

Area examined	Brunei	Malaysia		Thailand (Sabah & Sarawak)	Philippines	Vietnam
		E. coast, P. Malaysia	E. Mal			
Size composition						
minimum length						
maximum length		28 cm				
mean length in catch		16 cm				
Age and growth						
growth rate (K)		0.6-1.2			0.17	
length infinity (Linf)		28-30.3				
mortality (M)		1.74-2.05			1.23	
exploitation rate (E)					1.49	
total mortality (Z)		3.64				
Spawning						
season area		Mar-May,				
length at 1st maturity		23.9 cm (M), 23.8 (F)				
sex ratio (M:F)						
Fecundity						
Nursery ground						
Nursery periods						
Recruitment						
season mean length				Jan.-Mar, July-Sept. 5.5-6.5 cm		
Length-weight rel.		W=0.0025 L^3.5				
Food and feeding habit						
Predators						

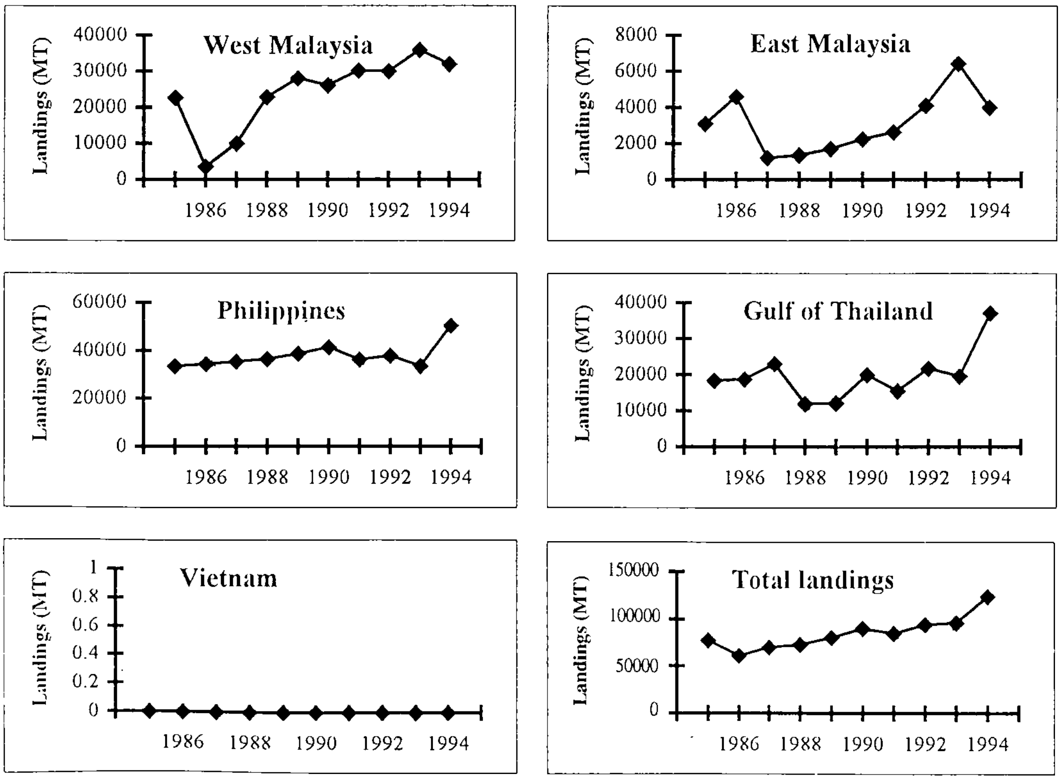
Note:

Geographical distributions of shared stocks in the South China Sea

Species names: ***Selar* spp.**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Selar* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

Population dynamics parameters on shared stock species of the South China Sea

Fish group: Mackerels
Family names: Scombridae
Species names: *Rastrelliger brachysoma*
Common names: Indo-Pacific mackerel

Area examined	Brunei	Malaysia E. coast, P. Malaysia	Malaysia E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition						
minimum length						
maximum length		20.1 cm			34 cm	
mean length in catch						
Age and growth						
growth rate (K)		0.36-0.44			1.1	
length infinity (Linf)						
mortality (M)		0.38				
exploitation rate (E)						
total mortality (Z)		0.82			4.27	
Spawning						
season area		Oct.-Mar, Straits of Malacca		Jan.-Mar, June-Aug.		
length at 1st maturity		18.5 cm		16.5-17 cm		
sex ratio (M:F)						
Fecundity				118,685-222,455 (mean 170,570)		
Nursery ground						
Nursery periods						
Recruitment						
season mean length						
Length-weight rel.		W=0.006138 L^3.215				
Food and feeding habit						
Predators						

Population dynamics parameters on shared stock species of the South China Sea

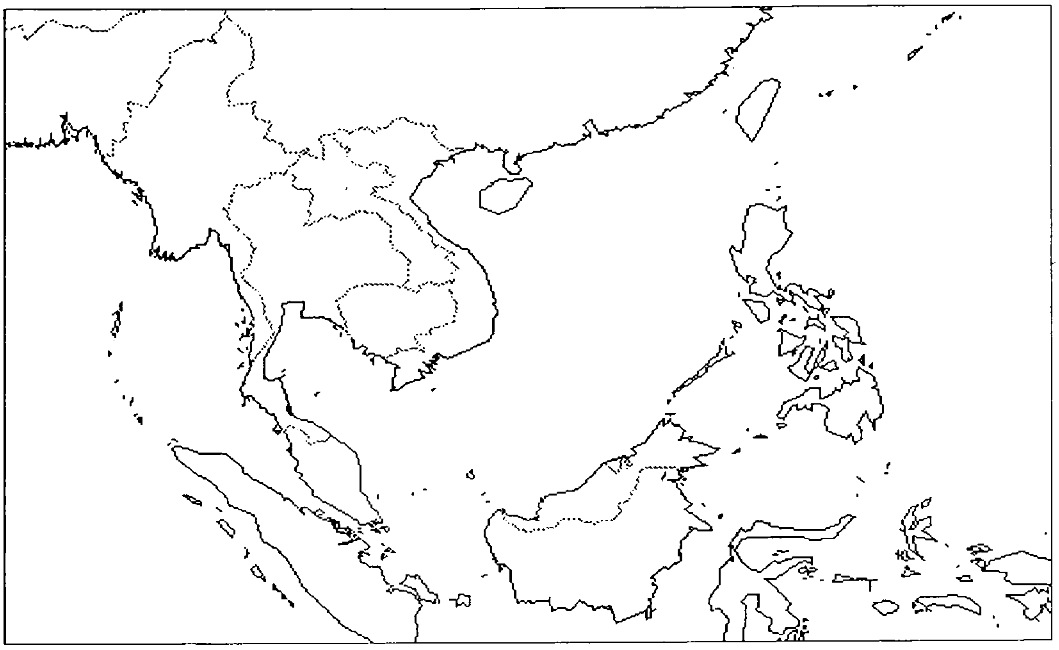
Fish group: Mackerels
Family names: Scombridae
Species names: *Rastrelliger kanagurta*
Common names: Indian mackerel

Area examined	Brunei	Malaysia E. coast, P. Malaysia	Malaysia E. Mal	Thailand (Sabah & Sarawak)	Philippines	Vietnam
Size composition minimum length maximum length mean length in catch		 94 mm 372 mm 180-200 mm			 35 cm 21-29 cm	
Age and growth growth rate (K) length infinity (Linf) mortality (M) exploitation rate (E) total mortality (Z)		 0.42-1.33 277-326 1.01-2.14 0.49-0.83 3.33-5.92			 0.7-1.65 25.5-39 4.27	
Spawning season area length at 1st maturity sex ratio (M:F)		 May-June, Sept.-Oct. 242 mm (M), 238 mm (F)			 23 cm	
Fecundity		96,712-224,633				
Nursery ground						
Nursery periods						
Recruitment season mean length		 April-June, Sept.-Oct.				
Length-weight rel.		W=3.035x10^-6 L^3.245	Log W=-5.591+3.282 Log T	W=0.1985x10^-7 L^3.7653		
Food and feeding habit		diatoms, peridinians, copepods mysids, pteropods, larval bivalves, fish eggs				
Predators		shark, marlin, ribbon fish, tunas, dolphin fish				

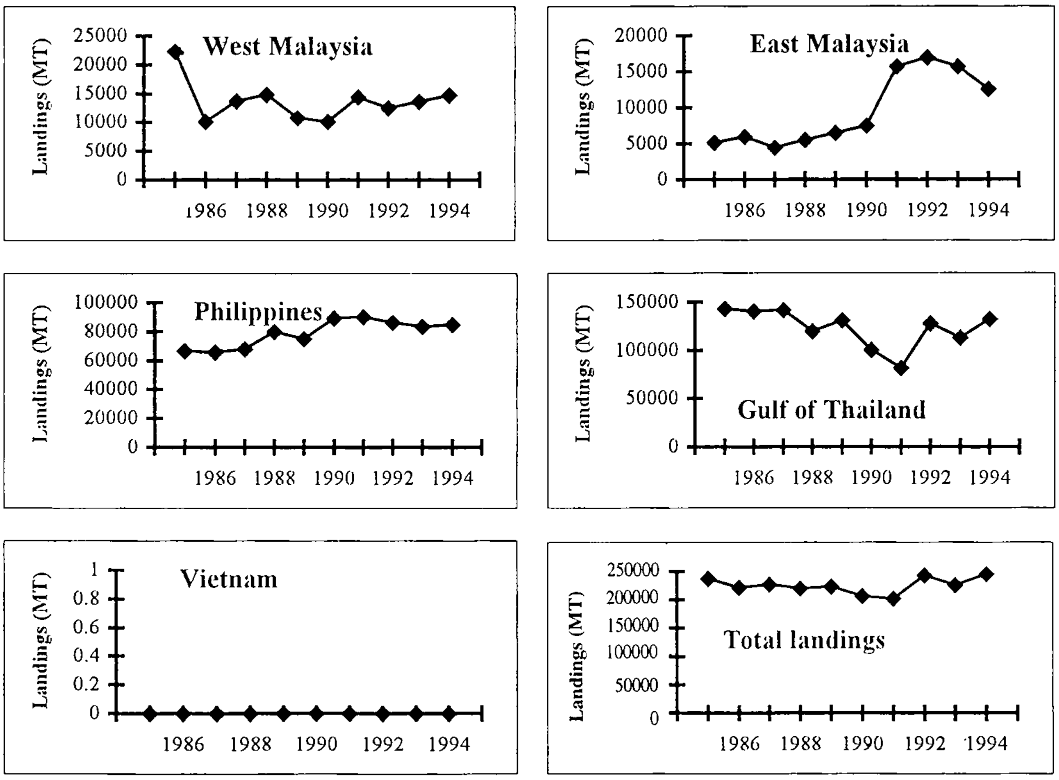
Note: Mansor and Hamid, 1990; Mansor and Abdullah, 1995; Mohsin and Ambak, 1996

Geographical distributions of shared stocks in the South China Sea

Species names: ***Rastrelliger* spp.**



Map showing geographical distribution of fishing and spawning ground and migration patterns



Trend landings of *Rastrelliger* spp. by gear group in the East Coast of Peninsular Malaysia.

Fisheries and stock status: biomass
underexploited/overexploited

ANNEX 15

THE THIRD REGIONAL WORKSHOP ON SHARED STOCKS
IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia 6 - 8 October, 1997

SEAFDEC/MFRDMD/WS/97/WP. 4

AVAILABILITY OF ENVIRONMENTAL DATA RELATED TO THE SHARED STOCKS IN THE SOUTH CHINA SEA

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ABSTRACT

The availability and of type environmental data in the South China Sea are discussed. Information from the papers presented in the last two shared stocks workshops were examined with regards to the availability of oceanographic data. Results of the recent collaborative survey conducted by SEAFDEC on MV SEAFDEC were presented particularly those obtained in the Eastern Peninsular Malaysia. It was found that the data currently acailable would be able to draw only few preliminary conclusions on the effects of the variability of oceanographic parameters on the pelagic fish stocks in the South China Sea area. However more data is required to fill the gaps and to ascertain accurate relationships between the pelagic fish and the environment in these tropical waters.

1. INTRODUCTION

Following the papers tabled in the two previous workshops of this series in March 1994 (Yanagawa, 1994) and July 1995 (Hamid, 1995) the proposed environmental studies and resources survey were implemented. A collaborative research program was formulated and conducted jointly by the Training Department (TD) and the Marine Fishery Resources Development and Management Department (MFRDMD) of SEAFDEC through four separate cruises using the MV SEAFDEC (Yanagawa, 1997). The studies were conducted in two areas namely Area 1, in the western Gulf of Thailand and Eastern Peninsular Malaysia and Area 2, the waters of Sarawak, Sabah and Brunei Darussalam. In both areas the sampling work and data collection were made before and after the North East Monsoons of the 1995/1996 and 1996/1997. Annually the South China Sea is exposed to the monsoons, that are comprised of the northeast winds blowing generally from November to February and the southwest winds from May to August. from another perspective the surveys were carried out during the transitional periods of the occurrence of the two monsoon periods. Area 1 has 81 stations whilst Area 2 has 79 stations. This paper aims to highlight some of the results of the survey in Area 1 in relation to the scope of this workshop.

2. STATUS OF OCEANOGRAPHIC RESEARCH

The first major collaborative oceanograpic survey and research program in the South China Sea area was probably the Intergovernmental Oceanographic Commission sponsored (IOC) program named the 'Cooperative Study of Kuroshio and Adjacent Seas (CSK). This program was conducted in the East and Southeast Asian Seas in 1965-1970 (Hirano, 1992). This program involved researchers from Indonesia, Japan, Malaysia, Philippines, Thailand and other countries participating.

Liong (1974) conducted the first documented study on oceanography in Malaysia in August 1972 in the Eastern Peninsular Malaysia. The study suggested the occurrence of a cold bottom current flowing westwards from the Natuna Islands and proceeding in parellel to the coast and surfacing into warmer waters in the north. The next well documented survey is a series of expeditions called the Matahari Expedition. The survey was jointly carried out by the Japanese scientists and the researchers of the Universiti Putra Malaysia (formerly, the Universiti Pertanian Malaysia) on board the vessel *RV Kagoshima Maru*. The survey intending to expose students in the field of fisheries science comprised of the Ekspedisi Matahari '85, Ekspedisi Matahari '86, Ekspedisi Matahari '87 and Ekspedisi Matahari '89.

Other surveys by Southeast Asian countries consisted of mainly sampling data in coastal waters and most data would be the oceanographic parameters pertaining to the red tide occurrence. Reports of data collection status made in the previous workshops did not elaborate or show clearly their relationship to the fish species.

Other notable documents include the survey by Wyrtki in 1961, the Naga Expedition in the 1959 - 1960 and the surveys conducted by the Marine Fishery Resources Department in 1970s.

In the Gulf of Thailand, many oceanographic investigations have been under-taken as early as in 1920s namely the oceanographical Expadition of the Carlberg Foundation Round the would of 1928-1930 by a Dadish RV Dana (Suvapepun, 1992). The Naga Expedition conducted sampling in the Gulf using the RV Stranger belonging to the Scripps Institution of Oceanography. A joint Thai-Japanese -SEAFDEC research program was conducted on board *RV Nagasaki Maru* and *MV Paknam.*

3. RESULTS OF THE MV SEAFDEC IN AREA 1

A Technical Seminar was held in Bangkok in February 1997 for the researchers of the collaborative project to present and highlight their research findings in Area 1. This area entailed cruises made from 4 September 1995 to 4 October 1995 and 23 April 1996 to 23 May 1996. This paper deals only with the results of the studies on plankton and nutrients that were presented in the seminar.

Hamid (1997) found that microphytoplankton were more abundant than microzooplankton in the Gulf of Thailand and Eastern Peninsular Malaysia. The majority of the microphytoplankton at the genus level found were *Coscinodiscus, Chaetoceros* and *Rhizosolenia*. These general were high in density in the Eastern Peninsular Malaysia. Majority of the microzooplankton genus found comprised of *Ceratium* and *Peridinium*. Apparently the plankton density was higher in September 1995 than in April 1996. In other words, the plankton density was higher during teh pre-monsoon period. The diversity and eveness indices were high in coastal areas.

Nutrients are the source of plankton growth and below the euphotic zone photosynthesis could not occur. Thus the nutrients vital for the plankton growth would need to be taken upwards to be within the euphotic zone. The normal process of bringing the nutrients up is through upwellings where water at the bottom that consists higher levels of nutrient flows up and disperses. It is often observed that the nutrients at the surface are much less than at the bottom, this being due to the uptake by pytoplankton.

The existence of high-density phytoplankton is crucial to the zooplankton and larval fish. It was shown that zooplankton and larval fish need a certain critical density to survive and this level of density usually occurs within the phytoplankton patches but not outside them.

4. REMOTE SENSING STUDIES IN THE SOUTH CHINA SEA

Literature on the remote sensing studies in the waters of the Southeast Asian countries is even much scarcer. Apart from the few studies in coral reets, remote seasing applications have been founed on land and the sea has been minimal. Realizing this in 1994 MFRDMD installed a High-Resolution

Picture Transmission (HRPT) system to receive NOAA AVHRR (National Oceanic and Atmospheric Administration Advance Very High Resolution Radiometer) data. Prior to this, attempts had been made to start fish forecasting studies as early as in 1993 using other satellite images. NOAA AVHRR data is free and this is one of the reasons why the HRPT system is purchased. However the dicipline itself requires skilled and knowledgeable staff to conduct studies in the area. Nevertheless, Malaysian researchers are currently conducting a study on the remote sensing of fishing zones in cooperation with some purse-seiners in the waters of Eastern Peninsular Malaysia.

Noordin and Ku Kassim (1997) attempted to use NOAA AVHRR images to determine the extent of the estuarine plume flow of the Mekong River into the South China Sea. They hypothesized that the shrimp resources found in the Eastern Peninsular Malaysia during the North East Monsoon originated from the mangrave coasts of Southern Vietnam. This they reckoned was attributed to the northeast winds that blew continously during the North East Mansoon to carry the shrimps along with the currents to the eastern shores of Terengganu.

5. SOME ENVIRONMENTAL INFLUENCES ON FISH RESOURCES

The physical effects of the environment would derive from the motion of the winds, which affects the sea. As described earlier, in the South China Sea the monsoon winds have a large effect on the processes occurring in the sea.

Drinkwater (1986) described the profound effects of the river input that can extend to over a thousand kilometers. For example in the South China Sea, the effect of the Coriolis force would have some effects on flow of the Mekong River plume. During the South West monsoon season, the plume would therefore be exerted by two forces, the southwest winds and the Coriolis force. The plume flows in the northeast direction and the extent of the plume flow is estimated to be about 100 - 200km (Noordin and Ku Kassim, 1997). Conversely during the North East monsoon, the north east winds are stronger than the influence of the Coriolis force. Such an image is yet to be analyzed and which would show the direction of the plume flowing in the southwesterly direction and perhaps extending as far down to about 300 km. In addition, the tidal flow in the area will affect the flow and consequently the timely image that would be required in this study is when the plume is flowing during the ebb tide. This is when the river runoff is high and the plume is more distinct. This kind of image is still being sorted for further analysis.

The effects of the freshwater runoff of the Mekong River that effected by the Northeast winds could bring large abundance of shrimps into the coastal waters of the Eastern Peninsular Malaysia. This corredsponds to the seasonally of shrimps in the Terengganu waters of the area. The shrimps are abundant during the Nort East monsoon season (Ibrahim Johari and Syed Abdullah, pers. comm.) and they seem to disappear after the monsoons. The distance between the Mekong estuary and the Terengganu coast is about 300 nautical miles (560 km).

In order to understand the extent of the plume flow in a wide area such as the South China Sea one approach is to use daily NOAA cloud-free images. A similar study has been conducted succesfully in temperature waters of the West Coast of Ireland by Huang et al., 1993). The NOAA AVHRR has been shown by Spitzer and Roozekrans (1990) to be useful in the synoptic assessment of the sea surface temperature and the total suspended matter in the North Sea.

Changes in the terrestrial environment obviously affect the sea where the rivers flow into it. Therefore such study of the plumes in this semi-enclosed ecosystem will enable scientists to understand better the fate of the nutrients and the living resources particularly fish larvae that are present in the plumes (Govoni et al, 1989). In the context of the South China Sea, the 'terubok' fish (*Tenualosa toli*) of Sarawak is one anadromous species that spawn in the river and spend their adult tage in the coastal waters. According to Yong (1994) the eggs, larvae and juveniles of 'terubok' fish are found in the Sarawak rivers all the year round.

The plume has also some effects on the population of the squids. In a tagging study of squids (Raja Bidin, 1993), there were apparently two populations of squids found in the waters of Terengganu. Squids tagged in the north part of the Terengganu river mouth would migrate northwards and conversely those tagged in the southern part moved south along the coastline. He suggested that the river outflow of the Terengganu River caused the segregation of the squids into possibly two stocks.

6. PROBLEMS AND CONSTRAINTS

The biggest constraint is the lack or total absence of fisheries oceanographers in the region. There are specialists in the field of fish biology, stock assessment and oceanography but there are yet to be found experts.in fisheries oceanography. The combination between the fields of fisheries and oceanography requires long term study and commitment.

The other problem faced in this area is not so much of the lack of adequate data but the lack of communication between researches even in one's own country. This is evidenced in the papers presented in country reports in the previous two workshops. Attempts were made to indicate positively the status of oceanographic research but the data were not detailed as that shown for the status of pelagic fisheries.

7. CONCLUSIONS

The proposal to have a standard survey manual as suggested by Yanagawa (1994) in the first workshop should be accepted and implemented. Results obtained using such a manual could be compared and conclusions drawn.

Most of the data available were obtained mostly when the weather permitted. Data during the North East monsoon constitute the gap and this requires immediate survey through national surveys or using latest techniques involving the deployment of moored buoys installed with telecommunications gadgets for relays to the shore based receivers. Thus these buoys will provide data during the adverse weather conditions and such data will complete the scenario of the processes working in the South China Sea.

The study of river run-offs should also be considered. This is important in the study of larval transport of anadromous fish species. From remote sensing, the future abundance of the species could be predicted by the pattern of the plume which bears the fish species. Thus future research should also look at the presence of fish larvae of the pelagic species or even the demersal to obtain an indication of the stocks in the future. Shared stock of the demersal species which straddle along the common boundary of two countries should also be considered.

It has been recognized that tropical seas have low variations in the sea surface temperature (SST). Due to this, it is much more difficult to develop algorithms most suited to the fisheries. The next alternative for future consideration would be to use the density of plankton to detect the concentration of fish. Thus this line of argument would suggest more in-depth study of the feeding habits of the pelagic fish and the process of the plankton blooms and its dynamics.

A concerted effort should be made to combine the oceanographic study of plankton and the application of remote sensing. As the insidences of the fish are also directly related to the plankton, locating the occurrences of plankton blooms and type would reveal the species of fish in the temporal and spatial scales. Although the bloom would occur in short periods of time, this information could nevertheless be used in combination with the physical parameters to indicate the migratory patterns of the small pelagics. Future studies should therefore focus on the remote sensing of the plankton and food habits of pelagic fish.

With complete data, expected output could be developed in accordance to the sketch by Mann and Lazier (1991) as depicted in Figure 1. The sketches would show clearly the flows of all the shared stocks thus enabling the managers to decide on the proper measures which are supported by strong scientific data.

Acknowledgements

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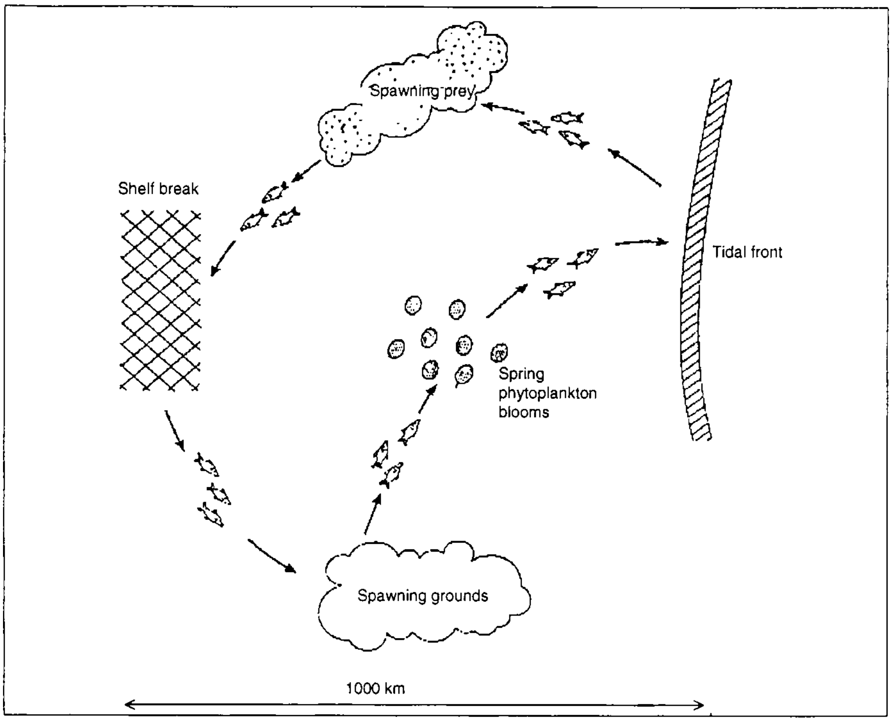
Figure 1: A schematic diagram showing the flow of stock which could cut across many coastal states bordering the South China Sea. (From Mann and Lazier, 1991)



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