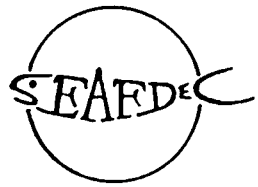

THE SECOND REGIONAL WORKSHOP ON SHARED STOCK IN THE SOUTH CHINA SEA AREA

Kuala Terengganu, Malaysia, 18 — 20 July 1995

SEAFDEC / MFRDMD / WS / 95 / CR. 2

COUNTRY STATUS REPORT
MALAYSIA

(2) SABAH

STATUS REPORT: ON THE CURRENT STUDY OF SHARED FISH STOCKS IN SABAH, MALAYSIA[1]

By

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STATUS REPORT ON THE CURRENT STUDY OF SHARED FISH STOCKS IN SABAH, MALAYSIA[1]

EXECUTIVE SUMMARY

The marine fish landings in Malaysia had increased from 951,000 mt to 1,047,350 mt over the 1989-1993 period. In 1993, pelagic fishes contributed at least 34% of the estimated total marine landings. Carangids and scombrids formed the backbone of the marine capture fishery sector, where the important components were mackerels, round scads and tunas, whose combined landings were estimated to contribute at least 46% of the total pelagic landings. Purse seines contributed 48% of the pelagic landings followed by gillnets (19%) trawlnets (19%), liftnets (8%) and other type of gears (1-6%). During the same period, the pelagic landings in Sabah estimated about 89,130 mt (51% of the state's total marine landings) contributed about 24% of the country's pelagic fish production.

Mackerels (*Rastrelliger* spp.) which contributed about 19% (67,975 mt) of the total pelagic production were mainly landed by purse seiners (43% landings) and gillnets (24%). Sabah contributed about 22% (15,160 mt) of the total mackerel production, which were landed by purse seines (56%), liftnets (16%) and gillnets (12%).

Round scads (*Decapterus* spp.) which contributed about 18% (64,722 mt) of the total pelagic production were mainly landed by purse seiners (81%) and lifnets (12%). Sabah contributed about 18% (11,420 mt) of the total round scad production, which were landed by liftnets (58%) and purse seines (32%).

Tunas (mainly *Thunnus tonggol, T. allalunga, Euthynnus affinis, Auxis thazard*) which contributed about 10% (35,980 mt) of the total pelagic production in Malaysia were mainly landed by purse seiners (50%) and hook & line (18%). Sabah contributed about 52% (18,520 mt) of the total tuna production, which were landed by purse seines (40%), gillnet (33%) and hook & line (12%).

The studies on the biology and stock assessment of marine fishes are concentrated on west coast stocks, where 39 species (11 families) of commercial importance were covered including mackerels (3 species), round scads (3 species), tunas (4 species), selar scads (3 species) and hardtail scad *(Megalaspis cordyla)*. The present database available on these species consist of length frequency and biological data (2-6 years duration). These studies are currently funded under the national IRPA Program *(Intensification of Research in Priority Areas)*. This paper describes the status of some of the current studies on shared fish stocks in Sabah.

1. INTRODUCTION

The pelagic fisheries play an important role in the development of the marine capture fisheries sector in Malaysia. The marine fish landings in Malaysia in 1993 was estimated around 1,047,350 mt **(appendix 1)**, with pelagic fishes contributing about 34% of the landings **(appendix 2).** Carangids and scombrids formed the backbone of the pelagic sector, with mackerels (*Rastrelliger* spp.), round scads (*Decapterus* spp.) and tunas as the principal species. During the 1993 period, the combined landings of these species in Sabah was estimated about 45,000 mt (27% of the national landings).

These species are presently also being exploited by other countries in the South East Asian region, forming the backbone of their respective coastal capture fishery sectors. Considering the importance of these species in the development of the pelagic fishery sector within the SEA region, various management measures are urgently needed. To ensure the sustainable exploitation of these resources, joint collaborative studies on the biology and capture fishery aspects of these stocks need to be carried out. The information obtained can be used as the basis for the improvement of existing management measures and policies pertaining to the sustainable exploitation and management of these resources within the region.

During the 1st SEAFDEC *workshop on shared stocks* held in 1994, among the common fish stocks which were identified as priority species for the proposed joint collaborative studies are mackerels, round scads and neritic tunas. This report deals with the fishery status and current studies carried out on these species in Sabah waters.

2. STATUS OF FISHERIES

2.1. Fishing Fleet

The pelagic sector in Malaysia involves both traditional and commercial gears, where among the important ones are: longline, purse seines, gillnets, bagnets and liftnets (including the traditional *selambau* and *bagang* gears in Sabah). In some areas, a significant volume of pelagic fishes were also landed by trawlers. Traditional gears are operated in the inshore coastal waters using non-powered or outboard engined boats, while commercial gears are operated using bigger boats (inboard and outboard engines) much further from the coastline. The gear breakdown of the 31,575 licensed fishing boats in Malaysia (1993 period) by GRT and HP (Horse power) categories are given in **appendices 4-5.**

Compared to 1992, the overall fishing fleet had decreased by 3%, caused by a marked reduction in the number of fishing boats in most categories in Peninsular Malaysia, mainly for non powered and outboard powered boats except for some increase in the number of inboard engined boats (>40 GRT class category). For Sabah, the fishing fleet size had increased by 8%, although there was some decrease in the trawler fleet (-1%) and other misc. gears (-10%).

The estimated breakdown of fishermen involved in the marine capture fisheries sector by fishing region, gear type and race (*bumiputeras* — indigenous locals, others— including legal/illegal foreign fishermen) for the 1992—1993 period are given in **appendix 6.**

Overall, the decrease in the fishermen population (80,278 fishermen) in 1993 by 5.6% over the 1992 period was caused by the marked reduction of fishermen in Peninsula Malaysia. The reduction of the fisherman population is in line with the government present fisheries management policy to reduce the number of fishermen so that each one will have a bigger share of the resources and only fishermen who are genuinely interested in fishing will stay in the industry. However, the fishermen population in East Malaysia (Sabah and Sarawak) in 1993 had increased respectively by 7% and 8% over the 1992 period, mainly due to the marked increase in the number of licensed fishing vessels. For Sabah, besides due to the expansion of the fishing fleet (mainly purse seiners and gillnets), it was also caused by the influx of illegal transient fishermen from neighboring countries, which was estimated to make up at least 20% of the present fishermen population in the state.

2.2. Overview of the present marine Landings

The marine fish landing in 1993 was estimated about 1,047,350 mt (retail value of RM3,269 million), which shows an increase of 2.33% over the 1992 period **(appendix 3).** Sabah contributed about 173,800 mt or about 17% of the marine landings. Pelagic landing was estimated around 366,000 mt or about 35% of the marine landings **(appendix 7).** During the same period, the pelagic landings in Sabah estimated around 89,130 mt or about 51% of the total marine landings in the state, contributed around 24% of the country's total pelagic landings.

The summaries of the pelagic landing breakdown in Malaysia by fishing region and gear group type are given in **appendix 8-9.** The breakdown figures given are only for dominant pelagic species.

In 1993, mackerels (*Rastrelliger* spp.), round scads (*Decapterus* spp.) and tunas were the dominant pelagic species landed (combined landings about 168,700 mt), contributing about 16% to the total fish landings. Mackerels were the most dominant species (67,975 mt), followed by round scads (64,722%) and tunas (35,980 mt). The combined total landings of these species had increased by almost 8% over the 1992 period, attributed by the increase in both round scad and tuna landings. However, the landings of mackerels had decreased by 12% over the 1992 period.

Most of the mackerel landings come from the west coast of Peninsular Malaysia (Straits of Malacca: 53%), followed by Sabah (22%) and east coast of Peninsular Malaysia (20%). The east coast of Peninsular Malaysia contributed about 66% of the round scad landings, followed by Sabah (18%) and Straits of Malacca (16%). For tunas, about 51.5% were landed in Sabah, followed by the east coast of Peninsular Malaysia (29%, mainly in Terengganu). The significant increase in the tuna landings from Sabah during the last 2-3 years was mainly due to the increase in the fishing fleet (purse seine and longline). The improvement of the present catch statistics sampling program in Sabah under the national *Fisheries Management Information System* (FMIS) might be another factor.

During the 1993 period (**appendix 8**), about 87% of the pelagic fishes were landed by purse seiners (41%), followed by gillnets (19%), trawlers (19%) and liftnets (8%). The combined landings of these gears had contributed about 83% of the total marine landings. Trawlers contributed about 54% of the total marine landings, followed by fish purse seiners (15%), gillnets (11%) and misc. traditional gears (8.4%). Other gears (hook and line, liftnet, other seine nets, anchovy purse seine: in order of importance) each contributed only between 2-4% of the total marine landings.

For purse seiners, the dominant pelagic species landed (in order of landing importance) were round scads, mackerels, tunas, sardines (mixed species), yellow trevally *(Selaroides leptolepis)* and selar scads (*Selar* spp.), which make up about a total of 87% of the present fish purse seine landings, which is about 13% of the total marine fish landings.

About 93% (63,355 mt) of the mackerel landings were contributed by fish purse seiners (42%), gillnets (29%) and trawlers (22%). For round scads, about 91% (59,032 mt) were landed by fish purse seiners (79%) and liftnets (12%). On the other hand, about 91% (32,700 mt) of the present tuna landings were landed by fish purse seiners (50%), gillnets (24%) and longline (17.5%).

2.3. Pelagic landings in Sabah

In Sabah, the seven important pelagic species in 1993 by order of landing volume were tuna (18,517 mt), mackerel (15,159 mt), round scad (11,415 mt), spanish mackerel (*Scomberomorus* spp.) (10,074 mt), sardines (6,235 mt), selar scad (*Selar* spp.) (4,277 mt) and hardtail scad *(Megalaspis cordyla)* (4,242 mt), which contributed about 78% of the estimated total pelagic landings (89,130 mt). Anchovies *(Engraulis, Stolephorus)* are important components of the *bagang* fishery. The present annual anchovy landings (500-2,000 mt) was believed to be grossly underestimated considering that more than 1,000 bagang units in active operation each year along the east coast (mainly unlicensed). The volume of dried anchovies from the east coast was believed to be substantial, estimated at least 2,000-4,000 mt/year.

2.3.1. *Tuna fisheries*

The annual tuna landings were estimated around 11,000-18,500 mt during the 1991-1993 period, with neritic species making up the backbone of the fishery. The main gears used in the fishery are purse seine, hook & line and drift gillnet, which contributed about 84% of the present tuna landings, with fish purse seine as the most dominant gear (39% tuna landings).

Neritic tuna landings were mainly represented by at least five species: *Euthynnus affinis, Sarda orientalis, Thunnus tonggol, Thunnus allalunga* and *Katsuwonus pelamis.* These species were mainly caught by purse seine, gillnet, liftnet and trawlnet. Oceanic species were caught mainly by gillnet and longline; where the important fishing grounds are in the Sulu Sea and Celebes Sea (between Lahad Datu and Semporna waters) and off the west coast (Palawan Trench). Data from past commercial longline operations and DOF Malaysia surveys had shown the presence of abundant oceanic tuna resources along the Palawan Trench (including the Spratly Islands), where the dominant species were bigeye *(Thunnus obesus)* and yellowfin *(Thunnus albacares).* The biological aspects of two neritic tuna stocks *(Euthynnus affinis, Thunnus allalunga)* on the west coast of Sabah sampled during the 1992-1994 period are given in **appendix 11.**

2.3.2. *Mackerel fisheries*

The annual mackerel (*Rastrelliger* spp.) landings were estimated in the region of 10,000-15,000 mt during the 1991-1993 period, with two species *(R. kanagurta, R. brachysoma)* making up the bulk of the landings. *R. faughni* is also landed but in much smaller quantities (landings very seasonal with significant annual variations).

Mackerels are mainly caught by purse seines besides other type of gears e.g. liftnet *(selambau* and *bagang),* drift gillnet and trawlnet. The important fishing ground are along the west coast and southern portion of the east coast (between Lahad Datu and Semporna). The Japanese mackerel *(Scomber australasicus)* is also a component of the mackerel fishery (annual landings : < 2,000 mt), where the main gears used are purse seine and liftnet.

R. kanagurta is more widely distributed and caught throughout the year compared to other species. *R. brachysoma* is also caught throughout the year but mainly in the inshore waters, while *R. faughni* which is very seasonal is mainly caught in deeper waters. Both *R. brachysoma* and *R. faughni* caught in Sabah waters consisted mainly of juveniles and immature sub adults (maximum size caught: 22-24 cm TL). For *R. brachysoma,* available data had shown that most of the landings

were represented by 1—2 year classes. On the other hand, *R. kanagurta* is caught from young juveniles to mature adults (size range: 10-31 cm TL). Two specimens *R. kanagurta:* 36 cm TL, 650-750 gram & *R. brachysoma:* 37-38 cm TL, 750-850 gram) observed in Semporna (1984) indicated that both species can grow to large sizes. The biological aspects of three mackerel stocks *(Rastrelliger kanagurta, R. brachysoma, R. faughni)* on the west coast of Sabah sampled during the 1992-1994 period are given in **appendix 12.**

2.3.3. *Round scad fisheries*

The annual round scad *(Decapterus* spp.) landings were estimated around 7,000-12,000 mt during the 1991-1993 period, with three species *(D. macrosoma, D. maruadsi, D. russelli)* making up the bulk of the landings. *D. tabl* (identification still unconfirmed, mainly caught on the east coast) is also landed but in much smaller quantities. All four species were caught throughout the year but has different peak seasons with significant annual variations. The main gears used in the fishery are liftnet *(selambau)* and purse seine. About 50-70% of the present annual round scads landings comes from the west coast (4,000-6,000 mt), where more than 60% are landed by lifthets. The biological aspects of three round scad stock *(Decapterus macrosoma, D. russelli, D. russelli, D. maruadsi)* on the west coast of Sabah sampled during the 1992-1994 period are given in **appendix 13.**

2.3.4. *Spanish mackerel fisheries*

The annual spanish mackerel (*Scomberomorus* spp.) landings were estimated around 8,000-10,000 mt during the 1991-1993 period. The main gears used in the fishery are drift gillnet and hook & line. There are four species presently exploited by the fishery: i.e. *S. commerson, S. guttatus, S. lineolatus* and *S. queenlandicus* (identification still unconfirmed, characteristics similar to *S. sexfasciatus?).* The former three species formed the bulk of the fishery, while landings of the later were rather low in volume and very seasonal in nature. Not much information is available on the biology of these species except for some length-frequency data of west coast stocks sampled during the 1994 period.

2.3.5. *Sardine fisheries*

The annual sardine landings for the 1991-1993 period were estimated in the region of 4,000-6,500 mt. The main gears used in the fishery are liftnet and purse seine. The bulk of the sardine landings are mainly represented by *Dussumieria (D. sirm, D. hasseltii, D. fimbriata, D. acuta)* and *Herklosichthys quadrimaculatus* (species identification yet to be verified).

During peak seasons, the bulk of sardines caught by purse seiners along the west coast are sent direct to nearby fish meal plants because of marketing problems. It is generally believed that the present landings from purse seiners might have been underestimated. The volume of sardines landed by purse seiners to fish meal plants is not known and at present not monitored closely by the FMIS program. Not much information is available on the biology of sardines in Sabah waters except for legth-frequency and biological data of *Herklosichthys quadrimaculatus* and *Dussumieria acuta* (west coast stocks) sampled during the 1994 period.

2.3.6. *Selar scad fisheries*

The annual selar scad (*Selar* spp.) landings were estimated in the region of 1,500-4,500 mt during the 1991-1993 period. The main gears used in the fishery are liftnet, drift gillnet, purse seine, hook & line and trawlnet. Three species are exploited: *S. crumenopthalmus, S. boops* and *S. mate.* Among these, *S. crumenopthalmus* is the most important component in terms of landing contribution and market price, followed by *S. boops* and *S. mate.* It is believed that the present landings might have been underestimated. The biological aspects of two selar scad stocks *(S. crumenopthalmus, S. boops)* on the west coast of Sabah sampled during the 1992-1994 period are given in **appendix 14.**

2.3.7. *Hardtail scad fisheries*

The annual hardtail scad *(Megalaspis cordyla)* landing was estimated around 3,500-4,500 mt during the 1991-1993 period. This species is caught mainly by purse seine, drift gillnet and liftnet. The biological aspects of the hardtail scads stock on the west coast of Sabah sampled during the 1992-1994 period are given in **appendix 15.**

3. RESEARCH STATUS

Present studies on the marine fishes in Sabah (title: *Population dynamics, biological-reproduction and morphometrics of commercially important marine fish stocks along the west coast of Sabah, Malaysia)* are concentrated on west coast stocks using funds from the national IRPA *(Intensification of Research in Priority Areas)* program of the Ministry of Science, Technology and Environment.

The information from this study consisted of length frequency and biological data of about 39 species (11 families). The species covered in the present study are given in **appendix 10**. Due to lack of experienced manpower, most of the data are still unprocessed or semi-processed.

At present, due to manpower constraints, the data collection is concentrated on only one sampling site based in Kota Kinabalu. Previous field studies had indicated that a significant volume of these species that were landed at the various landing sites along the west coast were brought over to Kota Kinabalu for market disposal. In the incoming 7th Malaysian Plan (1996-2000), the present study will be more extensive covering more sampling sites throughout the coastline of Sabah.

Sample treatment:

a. **biological data:** Besides biological data (length, weight, gonad maturity stage), morphometric characters were also measured (note: from September 1994 onwards, the morphometric characters recommended during the 1st workshop on shared stocks in the SEA region were used in the study);

b. **determination of the maturity stages:** visual observation using the following maturity keys: stage I (immature), stage II (maturing), stage III (mature/ripe), stage IV (spent);

c. **otoliths samples:** samples representing each length class were taken for "ageing study" purposes in the near future.

Data treatment:

a. analysia of length frequency data: FISAT, Compleat ELEFAN, LFSA;

b. analysis of biological data: data input using MICROSTAT. Subsequent data analysis and presention of results were made using electronic spreadsheets (e.g. Lotus 123) and other relevant statistical analysis software (MICROSTAT, STATGRAPHICS, SYSTAT).

4. RECOMMENDATIONS

a. the use of standard statistical procedures (including software applications) pertaining to the preliminary treatment and subsequent analysis of biological and morphometric data among participating scientists;

b. future workshops should also emphasize on joint in-situ data analysis cum training as part of the human resources development of fisheries scientists in the region;

c. creation of fish Technical Working Groups (TWG) among participating fisheries scientists (e.g. round scad TWG, tuna TWG, mackerel TWG);

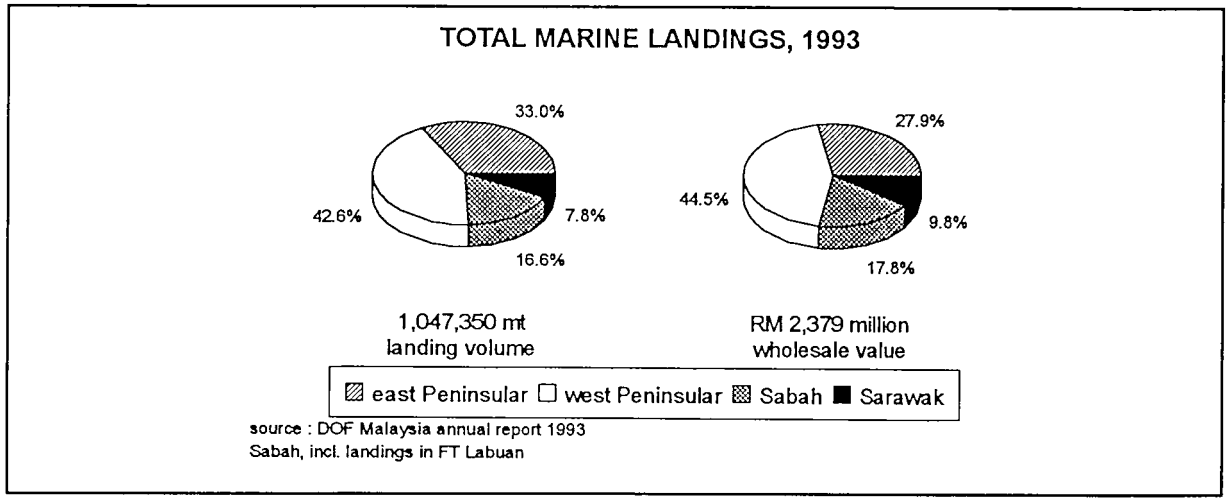
d. the usage of other methods (e.g. parasites, electrophoresis, DNA mitochondria) for fish stock differentiation purposes besides morphometric data;

e. a MFRDMD-SEAFDEC fishery biology database on shared stocks within the SEA region to be incorporated in a GIS (Geographical Information System) setup is proposed.

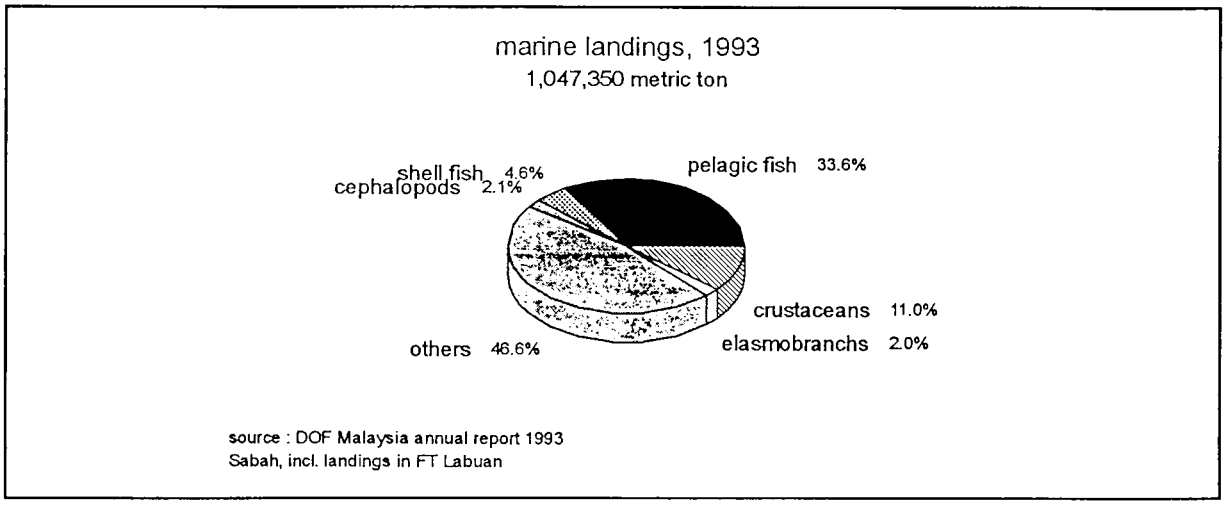
5. ACKNOWLEDGEMENTS

The author is grateful to Tuan Dato' Haji Sharom bin Haji Abdul Majid, Director General of Fisheries Malaysia, for giving me this opportunity to represent the country in this workshop. Many thanks are also given to my colleagues and staff in MFRDMD-SEAFDEC, DOF Malaysia and DOF Sabah for their kind assistance in the preparation of this report.

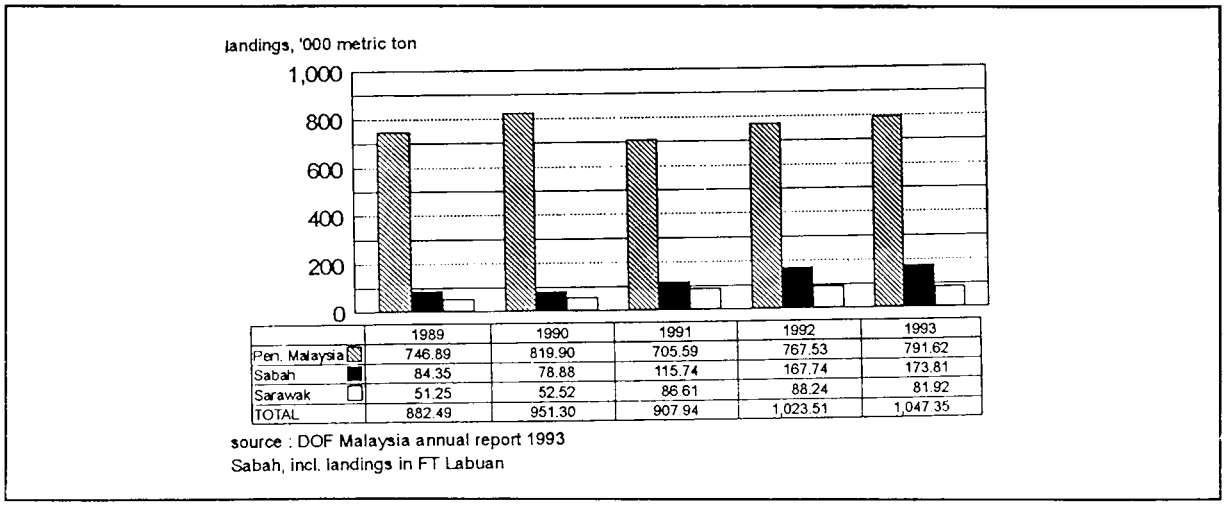
Appendix 1: Regional breakdown of marine landings in Malaysia



Appendix 2: Species breakdown of marine landings in Malaysia



Appendix 3: Annual marine fish landings, Malaysia 1989-1993



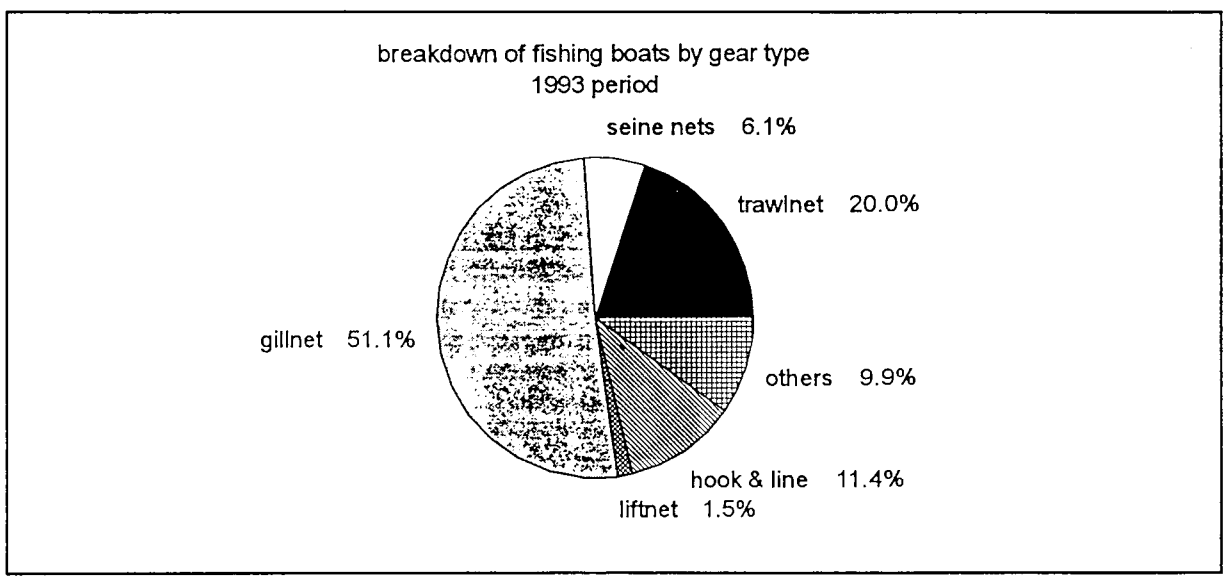
	1989	1990	1991	1992	1993
Pen. Malaysia	746.89	819.90	705.59	767.53	791.62
Sabah	84.35	78.88	115.74	167.74	173.81
Sarawak	51.25	52.52	86.61	88.24	81.92
TOTAL	882.49	951.30	907.94	1,023.51	1,047.35

Appendix 4: Fishing fleet breakdown by GRT (gross tonnage) and gear type, Malaysia 1993

				inboard engine powered/GRT category								
MALAYSIA, 1993 period	*grand total*	*non power*	*outboard powered*	*sub total*	*< 5*	*5-10*	*10-15*	*15-20*	*20-25*	*25-40*	*40-70*	*> 70*
Pen. Malaysia	20,020	463	5,206	14,351	2,496	5,539	1,761	1,514	503	1,064	1,018	456
Sarawak	2,941	9	748	2,184	473	660	417	128	126	112	132	136
Sabah	8,485	1,756	4,336	2,393	443	767	470	250	193	213	47	10
FT Labuan	129	1	111	17	0	1	0	0	0	1	5	10
TOTAL 1993 period	31,575	2,229	10,401	18,945	3,412	6,967	2,648	1,892	822	1,390	1,202	612
TOTAL 1992 period	32,550	2,267	10,879	19,404	3,627	7,009	2,787	1,968	815	1,439	1,156	603
% change	-3.0	-1.7	-4.4	-2.4	-5.9	-0.6	-5.0	-3.9	+0.9	-3.4	+4.0	+1.5

	Malaysia	*Peninsular Malaysia*		*inboard engine/GRT category (Pen. Malaysia)*						*Sabah/1*	*Sarawak*
Gear group	*grand total*	*non power*	*outboard powered*	*sub total*	*< 10*	*10-20*	*20-40*	*40-70*	*> 70*	*sub total*	*sub total*
Trawlnet	6,304	0	1	4,151	190	1,715	1,273	726	247	1,565	587
Purse seine	844	0	0	625	6	63	145	269	142	193	56
Anchovy purse seine	146	0	0	141	9	53	8	16	55	5	0
Other seine net	940	22	154	698	684	11	3	0	0	66	0
Gillnet	16,132	251	4,375	6,075	5,354	667	51	1	2	3,634	1,797
Liftnet	481	0	26	98	57	40	1	0	0	357	0
Hook and line	3,588	29	286	1,618	0	541	40	1	1	1,587	68
Bagnet	758	13	72	335	0	1	0	0	1	0	388
Others	2,382	148	292	610	0	184	46	5	8	1,207	45
TOTAL 1993 period	31,575	463	5,206	14,351	8,035	3,275	1,567	1,018	456	8,614	2,941
TOTAL 1992 period	32,550	632	6,223	14,999	8,505	3,476	1,590	973	455	7,959	2,737
% change	-3.0	-26.7	-16.3	-4.3	-5.5	-5.8	-1.4	+4.6	+0.2	+8.2	+7.5

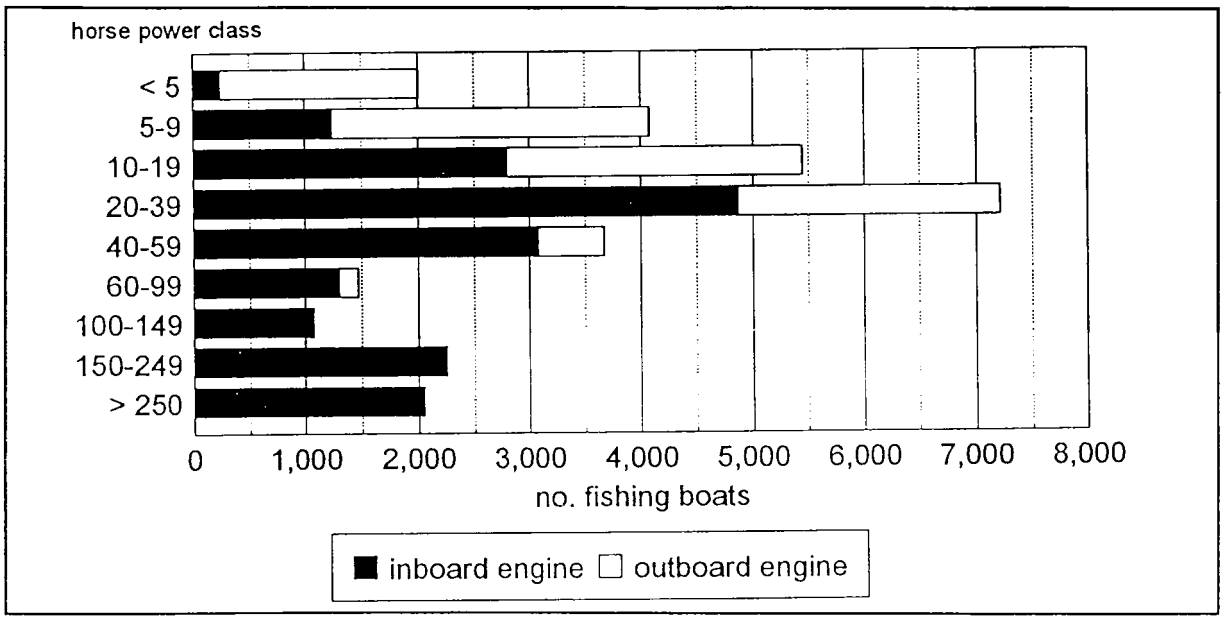
Source: DOF Malaysia annual report 1993,
1/including FT Labuan



Appendix 5: Fishing fleet breakdown by HP (horse power category)

a. **Inboard engined fishing vessels**				
HP horse power	*Peninsular Malaysia*	*Sabah 1/*	*Sarawak*	*Sub Total*
< 5	154	53	33	240
5-9	705	150	389	1,244
10-19	2,011	167	620	2,798
20-39	4,097	164	610	4,871
40-59	2,360	606	118	3,084
60-99	903	260	147	1,310
100-149	735	294	54	1,083
150-249	1,583	556	118	2,257
> 250	1,803	160	95	2,058
sub total	14,351	2,410	2,184	18,945
b. **Outboard engined fishing vessels**				
HP horse power	*Peninsular Malaysia*	*Sabah 1/*	*Sarawak*	*Sub Total*
< 5	1,485	235	52	1,772
5-9	2,178	465	201	2,844
10-19	927	1,675	57	2,659
20-39	555	1,629	168	2,352
40-59	61	327	209	597
60-99	0	114	61	172
100-149	0	2	0	2
150-249	0	0	0	0
> 250	0	0	0	0
Sub total	5,206	4,447	748	10,401
GRAND TOTAL	18,557	6,857	2,932	29,346

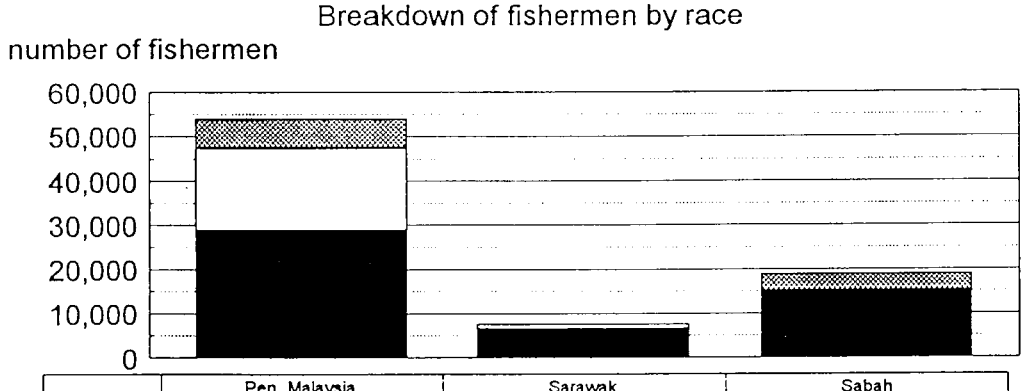
Source: DOF Malaysia annual report 1993,
1/including FT Labuan



Appendix 6: Fishermen population breakdown by gear group, Malaysia

Fishing region/ fishing gear	*Period*	*Peninsular Malaysia*	*Sabah 1/*	*Sarawak*	*Sub Total*	*% change*
Trawlnet	1992	14,061	4,625	2,560	21,246	-3.4
	1993	13,346	4,573	2,595	20,514	
Fish purse seine	1992	11,779	1,453	298	13,530	+2.1
	1993	11,781	1,717	318	13,816	
Anchovy purse seine	1992	2,591	88	0	2,679	-10.7
	1993	2,304	88	0	2,392	
Other seine nets	1992	2,124	201	0	2,325	-11.9
	1993	1,850	199	0	2,049	
Gillnets	1992	21,425	5,408	3,070	29,903	-10.4
	1993	17,620	5,707	3,474	26,801	
Liftnets	1992	413	882	0	1,295	-6.6
	1993	332	877	0	1,209	
Hook and lines	1992	4,706	3,074	192	7,972	-5.7
	1993	3,919	3,368	231	7,518	
Other gears	1992	3,311	1,959	865	6,135	+23.0
	1993	2,058	2,317	372	7,545	
Sub total	1992	60,410	17,690	6,985	85,085	-5.6
	1993	53,887	18,846	7,545	80,278	
% Change 1992-1993		- 10.8	+6.5	+8.0	-5.6	

Source: DOF Malaysia annual report 1993,
1/including FT Labuan



	Pen. Malaysia	Sarawak	Sabah
Bumiputera	28,766	6,513	14,929
Chinese	18,466	1,031	130
Indians	245	0	0
others	6,410	1	3,777
TOTAL	53,887	7,545	18,836

source : DOF Malaysia annual report 1993
Sabah, incl. landings in FT Labuan

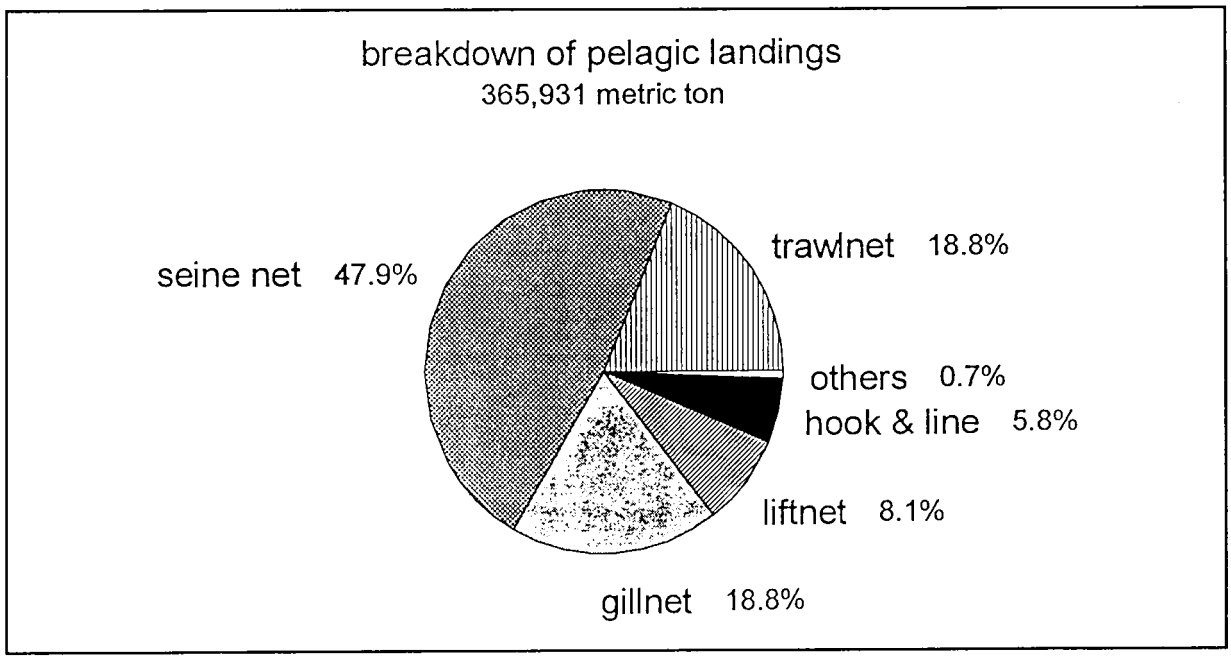
Appendix 7: Summary of regional marine landings, Malaysia 1993

			EAST MALAYSIA		*WEST MALAYSIA*			
Local Name	*English Name*	*Scientific Name*	*Sabah*	*Sarawak*	*East coast*	*West coast*	*sub total (metric ton)*	*% total landing*
***a.* Pelagic Landings**								
Kembong	Mackerel	*Rastrelliger* spp.	15,159	3,090	13,622	36,104	67,975	6.5
Selayang	Round Scad	*Decapterus* spp.	11,415	190	42,610	10,507	64,722	6.2
Kayu	Tuna	Mixed species	18,517	1,511	10,492	5,460	35,980	3.4
Selar Kuning	Yellow Trevally	*Selaroides leptolepis*	1,136	246	25,128	2,946	29,456	2.8
Tamban	Sardine	Mixed Species	6,235	1,567	14,111	5,023	26,936	2.6
Bilis	Anchovies	Mixed Species	1,837	1,916	8,230	12,802	24,785	2.4
Tenggiri	Spanish Mackerel	*Scomberomorus* spp.	10,074	2,003	4,347	4,411	20,835	2.0
Selar	Selar Scad	*Selar* spp.	4,277	1,595	10,807	3,844	20,523	2.0
Cincaru	Hardtail Scad	*Megalaspis Cordyla*	4,242	1,644	4,699	4,724	15,309	1.5
Bawal	Pomfrets	Mixed Species	2,432	2,195	871	4,631	10,129	1.0
Puput	Shad	*Pellona* spp.	681	1,206	300	6,225	8,412	0.8
Timah	Hairtails	*Trichiurus* spp.	767	1,079	1,467	4,123	7,436	0.7
Ikan Yu	Sharks	Mixed Species	2,436	1,679	1,485	694	6,294	0.6
Demudok	Horse Mackerel	*Caranx* spp.	3,705	137	1,009	771	5,622	0.5
Parang-2	Wolf Herring	*Chirocentrus dorab*	186	537	1,326	2,449	4,498	0.4
Alu-2	Barracuda	*Sphyraena* spp.	1,654	265	937	1,036	3,892	0.4
Belanak	Mullet	*Valamugil* spp.	1,536	27	54	1,481	3,098	0.3
Cermin	Trevally	*Caranx, Alectes*	658	638	1,521	244	3,061	0.3
Kebasi	Gizzard Shad	*Anodonstoma* spp.	219	166	27	2,633	3,045	0.3
Talang	Queenfish	*Scomberoides* spp.	1,295	312	123	579	2,309	0.2
Pisang	Rainbow Runner	*Elagastis Bipinnulatus*	242	0	127	262	631	0.1
Layar	Marlin/Sailfish	Mixed Species	388	0	81	0	469	0.0
Terubuk	Longtail Shad	*Hilsa* spp.	0	370	0	45	415	0.0
Bulan-2	Indo Pacific Tarpon	*Megalops* spp.	40	38	14	7	99	0.0
TOTAL PELAGIC LANDINGS (metric ton)			89,131	22,411	143,388	111,001	365,931	34.9
Percent (%) total pelagic landings			24.4%	6.1%	39.2%	30.3%	100%	
Percent (%) pelagic to total marine fish landings			51.3%	27.4%	41.6%	24.9%		
***b.* Other marine landings**								
Ikan Baja	Trash Fishes	Mixed Species	9,896	16,562	113,080	156,840	296,378	28.30
Udang	Shrimps	Mainly Penaeids	18,617	10,397	8,766	72,928	110,708	10.57
Lain-lain	Other Fishes	Mixed Species	56,164	32,554	79,869	105,746	274,333	26.19
TOTAL MARINE FISH LANDINGS (metric ton)			173,808	81,924	345,103	446,515	1,047,350	
Percent (%) total marine fish landings			16.6%	7.8%	33.0%	42.6%		100%
PELAGIC LANDING COMPOSITION BY FAMILY CATEGORY								
			East Malaysia		*West Malaysia*			
			Sabah	*Sarawak*	*East coast*	*West coast*	*Sub total (metric ton)*	*% total landings*
Scombridae (tuna, spanish mackerel. mackerel, etc.)			44,138	6,604	28,542	45,975	125,259	12.0
Carangidae (scads, trevallies, horse mackerels, etc.)			26,728	4,762	85,897	23,615	141,002	13.5%
Others (sardine, anchovys, clupeid, barracuda, etc.)			18,265	11,045	28,949	41,411	99,670	9.5%

Source: DOF Malaysia annual report 1993,
1/ Sabah including landings for FT Labuan

Appendix 8: Summary of marine pelagic landings by gear type, Malaysia 1993 (metric ton)

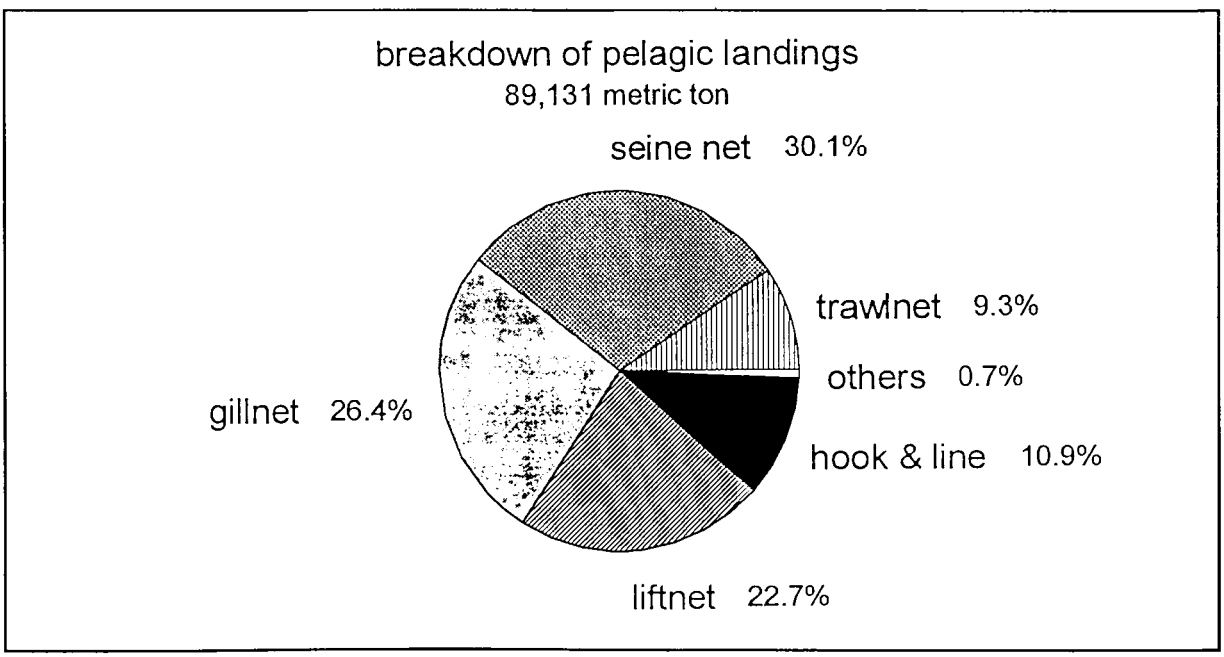
		Fishing Gear Category								
			Seine Nets							
English Name	*Scientific name*	*Trawl*	*Fish Purse Seine*	*Anchovy Purse Seine*	*Other Seine Nets*	*Gillnet*	*Liftnet*	*Hook and Line*	*Others*	*Total*
Mackerel	*Rastrelliger* spp.	15,191	28,598	840	26	19,566	2,479	1,219	56	67,975
Round Scad	*Decapterus* spp.	3,863	51,344	1,115	0	434	7,688	270	8	64,722
Tuna	Mixed Species	86	17,888	254	1,320	8,500	1,621	6,308	3	35,980
Yellow Trevally	*Selaroides leptolepis*	8,574	14,075	147	0	549	5,833	102	176	29,456
Sardine	Mixed Species	1,761	17,568	1,186	100	1,637	4,481	129	74	26,936
Anchovies	Mixed Species	634	55	19,900	21	1,345	2,311	0	519	24,785
Spanish Mackerel	*Scomberomorus* spp.	3,584	553	0	0	9,575	1,575	5,545	3	20,835
Selar Scad	*Selar* spp.	3,926	10,446	208	0	1,818	1,644	2,315	166	20,523
Hardtail Scad	*Megalaspis Cordyla*	4,762	6,720	24	2	1,731	939	1,116	15	15,309
Pomfrets	Mixed Species	3,992	1,310	0	1	3,566	797	0	463	10,129
Shad	*Pellona* spp.	3,354	75	0	0	4,951	0	3	29	8,412
Hairtails	*Trichiurus* spp.	5,928	120	41	0	1,290	18	33	6	7,436
Sharks	Mixed Species	3,216	4	0	7	2,466	0	582	19	6,294
Horse Mackerel	*Caranx* spp.	1,997	358	0	17	1,017	60	1,886	287	5,622
Wolf Herring	*Chirocentrus Dorab*	2,028	39	31	0	2,386	1	12	1	4,498
Barracuda	*Sphyraena* spp.	2,326	192	0	11	506	24	703	130	3,892
Mullet	*Valamugil* spp.	294	20	0	34	2,550	8	3	189	3,098
Trevally	*Caranx, Alectes*	1,742	208	0	0	472	1	425	213	3,061
Gizzard Shad	*Anodonstoma* spp.	911	12	0	13	2,045	2	0	62	3,045
Queenfish	*Scomberoides* spp.	519	34	0	9	1,553	18	129	47	2,309
Rainbow Runner	*Elagastis Bipinnulatus*	32	233	0	0	160	0	198	8	631
Marlin/Sailfish	Mixed Species	41	0	0	0	257	0	171	0	469
Longtail Shad	*Hilsa* spp.	4	0	0	0	396	0	15	0	415
Indo Pacific Tarpon	*Megalops* spp.	15	9	0	0	48	0	0	27	99
Sub Total		68,780	149,861	23,746	1,561	68,818	29,500	21,164	2,501	365,931
% Over total pelagic landings		18.8	41.0	6.5	0.4	18.8	8.1	5.8	0.7	100%
Total marine landings		561,942	160,269	24,003	20,360	117,515	31,262	44,153	87,846	4,047,350
% pelagic over total marine fish landings		12.2%	93.5%	98.9%	7.7%	58.6%	94.4%	47.9%	2.9%	34.9%
Source: DOF Malaysia annual report 1993										



Appendix 9: Summary of marine pelagic landings by gear type, Sabah (metric ton)

		Fishing Gear Category								
			Seine nets							
English Name	*Scientific Name*	*Trawl*	*Fish Purse Seine*	*Anchov Y Purse Seine*	*Other Seine Nets*	*Gillnet*	*Liftnets*	*Hook and Line*	*Others*	*Sub Total*
Mackerel	*Rastrelliger* spp.	1,731	7,614	828	26	1,823	2,471	630	36	15,159
Round Scad	*Decapterus* spp.	827	2,522	1,115	0	322	6,629	0	0	11,415
Tuna	Mixed Species	5	7,228	175	1,320	6,065	1,538	2,186	0	18,517
Yellow Trevally	*Selaroides leptolepis*	406	16	147	0	358	130	79	0	1,136
Sardine	Mixed Species	0	2,588	33	100	2	3,431	50	31	6,235
Anchovies	Mixed Species	1	0	335	21	7	1,424	0	49	1,837
Spanish Mackerel	*Scomberomorus* spp.	523	150	0	0	5,177	1,575	2,649	0	10,074
Selar Scad	*Selar* spp.	422	806	125	0	957	1,192	747	28	4,277
Hardtail Scad	*Megalaspis Cordyla*	564	1,309	24	2	1,012	938	388	5	4,242
Pomfrets	Mixed Species	155	31	0	0	1,448	748	0	50	2,432
Shad	*Pellona* spp.	554	1	0	0	122	0	3	1	681
Hairtails	*Trichiurus* spp.	163	45	0	0	515	17	25	2	767
Sharks	Mixed Species	830	3	0	7	1,234	0	360	2	2,436
Horse Mackerel	*Caranx* spp.	1,101	11	0	15	946	51	1,453	128	3,705
Wolf Herring	*Chirocentrus Dorab*	7	0	0	0	179	0	0	0	186
Barracuda	*Sphyraena* spp.	593	136	0	2	281	22	565	55	1,654
Mullet	*Valamugil* spp.	8	0	0	28	1,402	8	3	87	1,536
Trevally	*Caranx, Alectes*	210	0	0	0	231	0	186	31	658
Gizzard Shad	*Anodonstoma* spp.	119	0	0	10	34	2	0	54	219
Queenfish	*Scomberoides* spp.	78	5	0	7	1,036	18	108	43	1,295
Rainbow Runner	*Elagastis Bipinnulatus*	4	0	0	0	125	0	111	2	242
Marlin/Sailfish	Mixed Species	0	0	0	0	255	0	133	0	388
Indo Pacific Tarpon	*Megalops* spp.	3	0	0	0	10	0	0	27	40
Sub Total		8,304	22,465	2,782	1,538	23,541	20,194	9,676	631	89,131
% Over total pelagic landings		9.3	25.2	3.1	1.7	26.4	22.7	10.9	0.7	100%
Total marine landings		48,380	23,983	2,782	2,204	40,772	20,921	22,620	12,146	173,808
% pelagic over total marine fish landings		17.2	93.7	100	69.8	57.7	96.5	42.8	5.2	51.3

Source: DOF Malaysia annual report 1993
1/ estimates for Sabah include FT Labuan



Appendix 10: List of species currently covered by DOF Sabah fish stock assessment program

Scientific Name	*Length Frequency Data Collection*	*Biological-reproduction Data Collection* [1]	*Morphometric Studies* [2]		
			1994 period	*1995 period (april 1995)*	*Total*
SCOMBRIDAE (14 species)					
01. Euthynnus affinis	Y	Y	0	75	75
02. Katsuwonus pe'amis	Y	Y	30	0	30
03. Rastrelliger kanagurta	Y	Y	0	75	75
04. Rastrelliger brachysoma	Y	Y	0	51	51
05. Rastrelliger faughni	Y	Y	0	0	0
06. Sarda orientalis	Y		0	0	0
07. Scomber australasicus	Y	Y	0	0	0
08. Scomberomorus commerson	Y		0	0	0
09. Scomberomorus guttatus	Y		0	0	0
10. Scomberomorus lineolatus	Y		0	0	0
11. Scomberomorus queenslandicus	Y		0	0	0
12. Auxis thazard	Y	Y	0	0	0
13. Auxis rochei	Y	Y	0	0	0
14. Thunnus alalunga	Y	Y	0	0	0
CARANGIDAE (10 species)					
01. Decapterus macrosoma	Y	Y	0	25	25
02. Decapterus maruadsi	Y	Y	0	94	94
03. Decapterus russelli	Y	Y	0	0	0
04. Megalaspis cordyla	Y	Y	0	150	150
05. Selar boops	Y	Y	0	25	25
06. Selar crumenophthalmus	Y	Y	0	75	75
07. Selar (Atule) mate	Y	Y	150	125	275
08. Selaroides leptolepis	Y	Y	0	0	0
09. Seriolina nigrofasciata	Y	Y	0	75	75
10. Alepes djeddaba	Y		0	0	0

Scientific name	*Length Frequency Data Collection*	*Biological-reproduction Data Collection* [1]	*Morphometric Studies* [2]		
			1994 period	*1995 period (april 1995)*	*Total*
OTHER FAMILIES (15 species)					
01. Abalistes stellaris	Y	Y	0	20	20
02. Dussumeria acuta	Y	Y	30	0	30
03. Herklosichthys quadrimaculatus	Y	Y	60	0	60
04. Gerres filamentosus	Y	Y	46	30	76
05. Lactarius lactarius	Y	Y	0	50	50
06. Nibea semifasciata	Y	Y	0	0	0
07. Nemipterus japonicus		Y	0	0	0
08. Nemipterus nemurus		Y	0	0	0
09. Nemipterus peronii	Y	Y	30	100	130
10. Priacanthus macracanthus	Y	Y	0	0	0
11. Priacanthus tayenus	Y	Y	0	150	150
12. Sphyraena forsteri	Y		0	0	0
13. Sphyraena jello	Y		0	0	0
14. Sphyraena obtusata	Y	Y	60	0	60
15. Siganus javus	Y	Y	80	0	80
Total: 39 species (11 families)	**sub total**		486	1,120	1,606

Note:

Y : Yes, covered in the study.

1/ : Inclusive of morphometric characters measured: TL (total length), FL (fork length), SL (standard length), BD (maximum body depth), HL (head length), PL (pectoral fin length), ED (eye diameter), SD1 (distance from head tip to 1st dorsal fin) and SD2 (distance from head tip to 2nd dorsal fin).

2/ : Morphometric characters recommended during the MFRDMD-SEAFDEC 1st Workshop on shared stocks in the SEA region.

Appendix 11: Biological aspects of tuna stocks along the west coast of Sabah, Malaysia

a. ***Auxis thazard*** (n-365) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	381.67	48.71	12.76	254-511
FL (fork length)	356.79	45.55	12.77	238-469
SL (standard length)	333.82	42.50	12.73	227-455
BD (body depth)	85.97	12.03	14.00	57-115
BW (body weight)	856.52	307.95	35.95	225-2000
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	4.16	0.15	3.61	3.82-4.53
FL/HL	3.73	0.08	2.16	3.55-3.96
FL/SD 1	3.31	0.08	2.53	2.10-3.55
FL/SD 2	1.60	0.03	1.68	1.53-1.69
TL/SL	1.14	0.02	1.40	1.11-1.18

Morphometric relationships	*correlation (r)*
FL = 1.5739 + 0.9307 TL	0.9954
SL = 2.9955 + 0.8668 TL	0.9936
SL = 2.3102 + 0.9201 FL	0.9959
Log_{10} FL = 0.0110 + 0.9929 Log_{10} TL	0.9961
Log_{10} SL = 0.0179 + 0.9844 Log_{10} TL	0.9946
Log_{10} SL = 0.0020 + 0.9494 Log_{10} FL	0.9966
Length-weight relationships	
Log_{10} BW = -5.2020 + 3.142 Log_{10} TL	0.9927
Log_{10} BW = -5.1202 + 3.1461 Log_{10} FL	0.9908
Log_{10} BW = -5.0672 + 3.1610 Log_{10} SL	0.9884
Log_{10} BW = -2.4715 + 2.7824 Log_{10} BD	0.9664

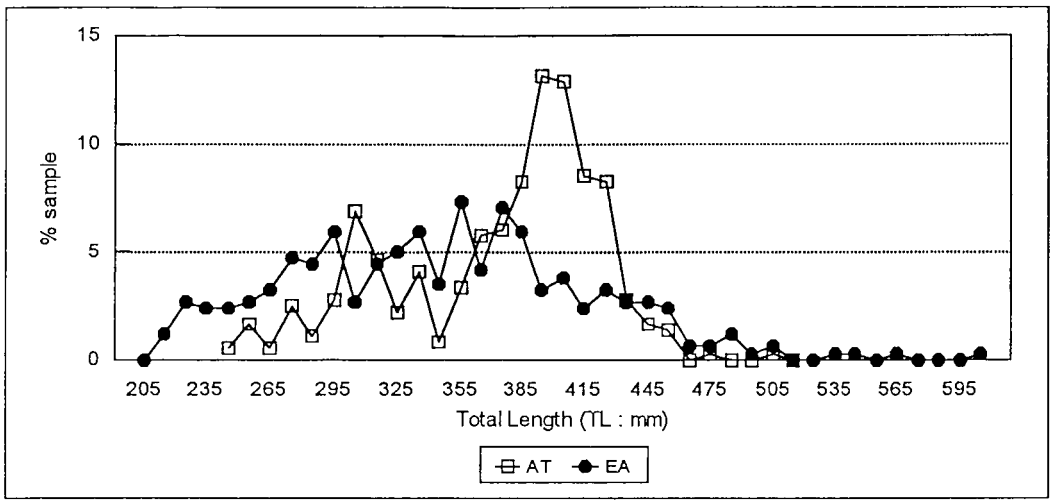
b. ***Euthynnus affinis*** (n-341) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	346.46	73.54	21.23	214-780
FL (fork length)	318.88	66.98	21.00	198-713
SL (standard length)	299.11	62.92	21.04	185-668
BD (body depth)	77.84	18.53	23.81	42-185
BW (body weight)	650.67	514.29	79.04	126-6550
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	4.13	0.22	5.41	3.57-4.79
FL/HL	3.71	0.09	2.68	3.46-3.94
FL/SD 1	3.40	0.09	2.68	3.15-3.64
FL/SD 2	1.71	0.04	0.02	1.60-1.81
TL/SL	1.16	0.02	1.76	1.12-1.22

Morphometric relationships	*correlation (r)*
FL = 4.0029+ 0.9088 TL	0.9790
SL = 3.6533 + 0.8528 TL	0.9967
SL = 0.0274 + 0.9379 FL	0.9984
Log_{10} FL = 0.0047 + 0.9840 Log_{10} TL	0.9857
Log_{10} SL = 0.0187 + 0.9822 Log_{10} TL	0.9875
Log_{10} SL = 0.0223 + 0.9978 Log_{10} FL	0.9982
Length-weight relationships	
Log_{10} BW = -4.8855 + 3.0080 Log_{10} TL	0.9938
Log_{10} BW = -4.8861 + 3.0514 Log_{10} FL	0.9942
Log_{10} BW = -4.7927 + 3.0479 Log_{10} SL	0.9926
Log_{10} BW = -2.2535 + 2.6492 Log_{10} BD	0.9857

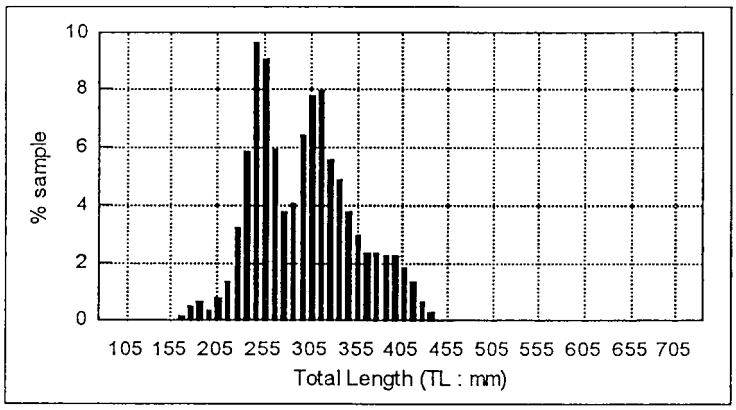
NOTE: Length (in mm units), BW (in gram), HL (head length), SD 1 (distance from head tip to 1st dorsal fin), SD 2 (distance from head tip to 2nd dorsal fin)

continue : appendix 11
LENGTH FREQUENCY DISTRIBUTION OF FISH SAMPLES (BIOLOGICAL STUDIES)
(AT = *Auxis thazard*, EA = *Euthynnus affinis*)

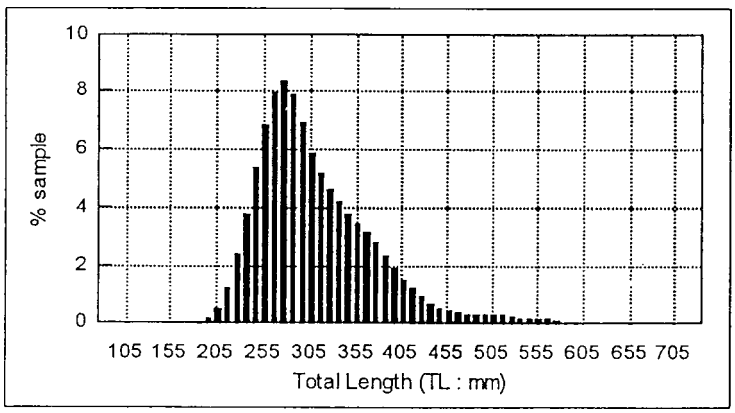


Pooled length frequency data of tunas (1992-1994 period) for stock assessment studies

a. *Auxis thazard* (n = 19,329 measurements)



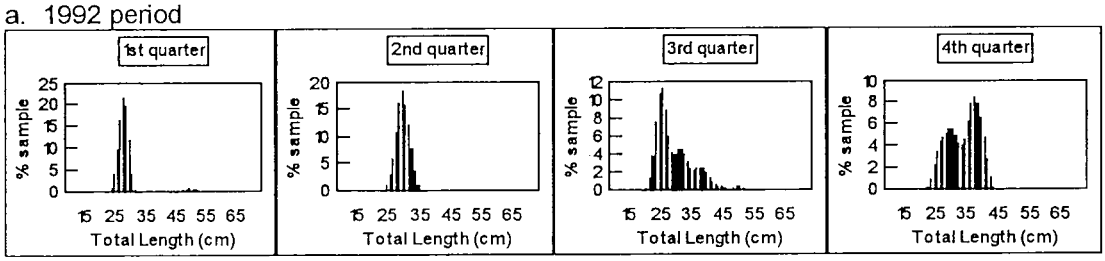
b. *Euthynnus affinis* (n = 16,353 measurements)



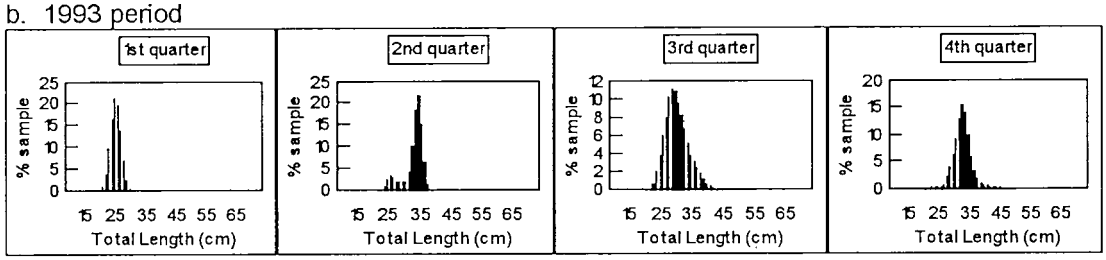
continue : appendix 11

QUARTERLY LENGTH FREQUENCY DISTRIBUTION OF *Euthynnus affinis*

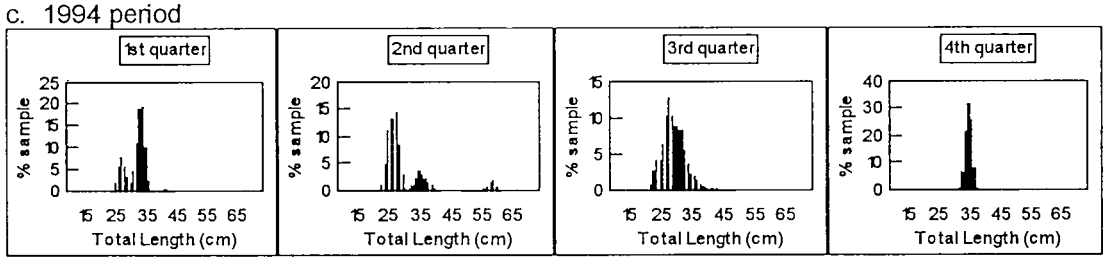
a. 1992 period



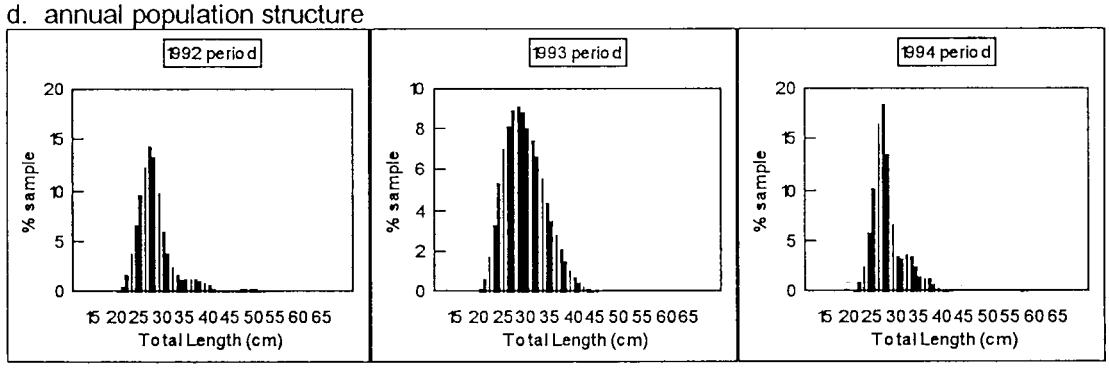
b. 1993 period



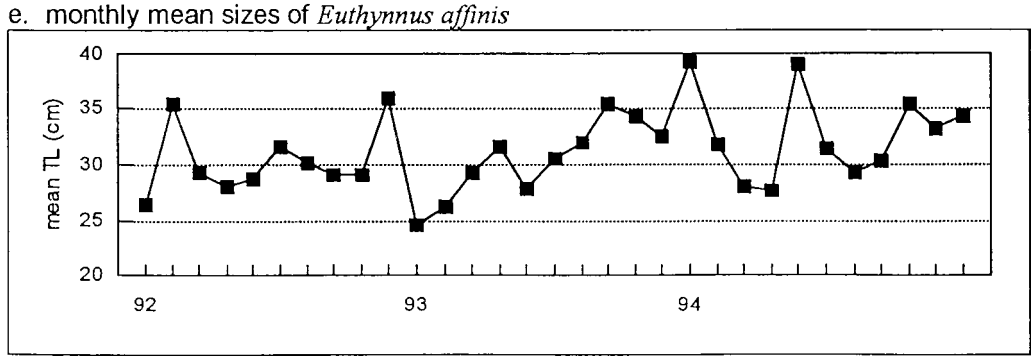
c. 1994 period



d. annual population structure



e. monthly mean sizes of *Euthynnus affinis*



Appendix 12: Biological aspects of mackerel (*Rastrelliger* spp.) stocks along the west coast of Sabah

a. ***Rastrelliger faughni*** (n-75) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	196.43	11.11	5.65	160-220
FL (fork length)	178.36	9.02	5.06	149-198
SL (standard length)	164.59	9.08	5.52	135-183
BD (body depth)	39.39	2.28	5.80	32-44
BW (body weight)	86.31	16.92	19.60	45-25
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	4.53	0.07	1.47	4.35-4.71
FL/HL	3.89	0.07	1.76	3.74-4.03
FL/SD 1	3.06	0.07	2.27	2.92-3.19
FL/SD 2	1.73	0.02	1.44	1.69-1.81
TL/SL	1.19	0.01	0.59	1.18-1.21

Morphometric relationships	*correlation (r)*
FL = 21.1454 + 0.8004 TL	0.9854
SL = 4.7948 + 0.8135 TL	0.9947
SL = -11.9332 + 0.9897 FL	0.9829
Log_{10} FL = 0.2306 + 0.8812 Log_{10} TL	0.9855
Log_{10} SL = 0.0139 +0.9726 Log_{10} TL	0.9948
Log_{10} SL = 0.2041 + 1.0751 Log_{10} FL	0.9833
Length-weight relationships	
Log_{10} BW = -5.8156 + 3.3777 Log_{10} TL	0.9687
Log_{10} BW = -6.5492 + 3.3663 Log_{10} FL	0.9658
Log_{10} BW = -5.6973 + 3.4413 Log_{10} SL	0.9649
Log_{10} BW = -3.2489 + 2.2489 Log_{10} BD	0.9553

b. ***Rastrelliger brachysoma*** (n-522) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	181.14	16.52	9.12	141-217
FL (fork length)	161.37	14.40	8.92	125-194
SL (standard length)	146.67	12.66	8.63	110-175
BD (body depth)	45.28	4.52	9.98	32-55
BW (body weight)	77.90	20.69	26.56	35-130
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	3.57	0.11	3.01	3.28-3.95
FL/HL	3.58	0.10	2.78	3.33-3.89
FL/SD 1	3.04	0.07	2.23	2.90-3.24
FL/SD 2	1.77	0.03	1.70	1.69-1.86
TL/SL	1.23	0.02	1.75	1.20-2.30

Morphometric relationships	*correlation (r)*
FL = 4.6003 + 0.8653 TL	0.9882
SL =7.0622 + 0.7694 TL	0.9794
SL = 4.7601 + 0.8783 FL	0.9790
Log_{10} FL = 0.0154 + 0.9709 Log_{10} TL	0.9890
Log_{10} SL = 0.0147 + 0.9526 Log_{10} TL	0.9802
Log_{10} SL = 0.0245 + 0.9699 Log_{10} FL	0.9797
Length-weight relationships	
Log_{10} BW = -4.9469 + 3.0235 Log_{10} TL	0.9837
Log_{10} BW = -4.8819 + 3.0630 Log_{10} FL	0.9784
Log_{10} BW = -4.7739 + 3.0727 Log_{10} SL	0.9716
Log_{10} BW = -2.4065+ 2.5905 Log_{10} BD	0.9546

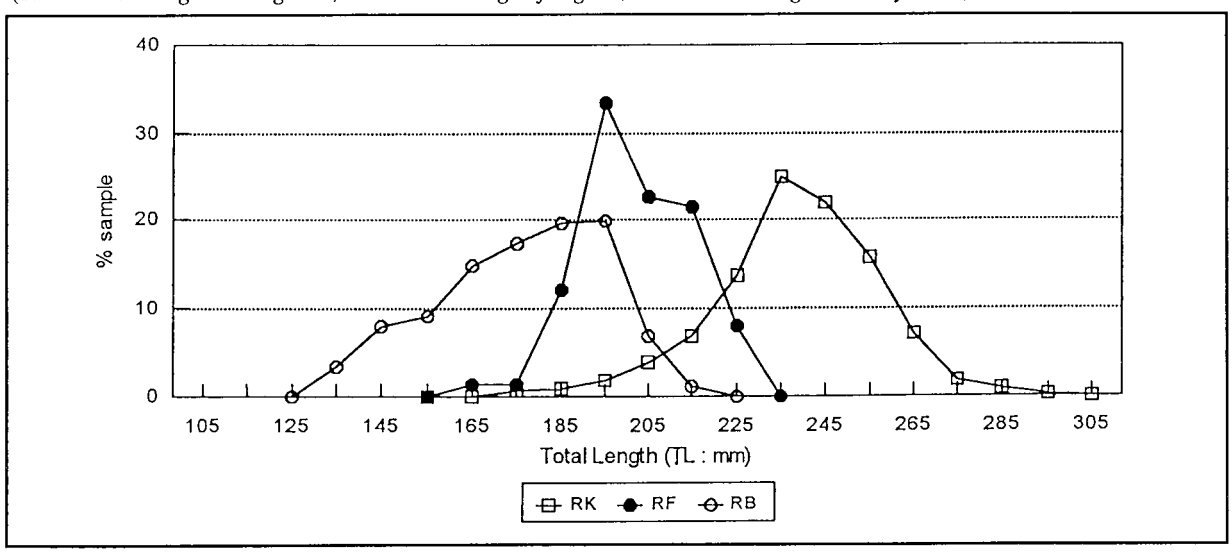
c. ***Rastrelliger kanagurta*** (n-1998) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	236.58	18.47	7.81	162-298
FL (fork length)	212.06	16.18	7.63	147-270
SL (standard length)	195.17	15.32	7.85	135-255
BD (body depth)	51.08	4.61	9.03	37-68
BW (body weight)	162.65	41.44	25.48	40-360
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	4.16	0.16	3.83	3.85-4.59
FL/HL	3.65	0.10	2.81	3.36-3.90
FL/SD 1	2.90	0.09	3.15	2.67-3.08
FL/SD 2	1.69	0.03	1.82	1.60-1.77
TL/SL	1.21	0.02	1.82	1.16-1.27

Morphometric relationships	*correlation (r)*
FL = 7.9555 + 0.8627 TL	0.9846
SL = 4.2976 + 0. 8068 TL	0.9726
SL = -0.7369 + 0.9238 FL	0.9759
Log_{10} FL = 0.0462 + 0.9605 Log_{10} TL	0.9854
Log_{10} SL = 0.0243 + 0.9750 Log_{10} TL	0.9743
Log_{10} SL =0.0432 + 1.0030 Log_{10} FL	0.9770
Length-weight relationships	
Log_{10} BW = -5.5909+ 3.2821 Log_{10} TL	0.9669
Log_{10} BW = -5.6179 + 3.3607 Log_{10} FL	0.9651
Log_{10} BW = -5.1821 + 3.2233 Log_{10} SL	0.9502
Log_{10} BW = -2.3974+ 2.6919 Log_{10} BD	0.9553

NOTE: Length (in mm units), BW (in gram), HL (head length), SD 1 (distance from head tip to 1st dorsal fin), SD 2 (distance from head tip to 2nd dorsal fin)

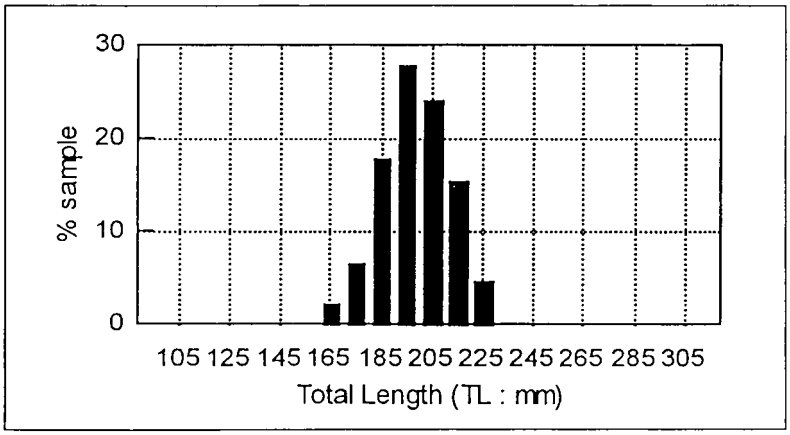
LENGTH FREQUENCY DISTRIBUTION OF FISH SAMPLES (BIOLOGICAL STUDIES)
(RK = *Rastrelliger kanagurta*, RF = *Rastrelliger faughni*, RB = *Rastrelliger brachysoma)*



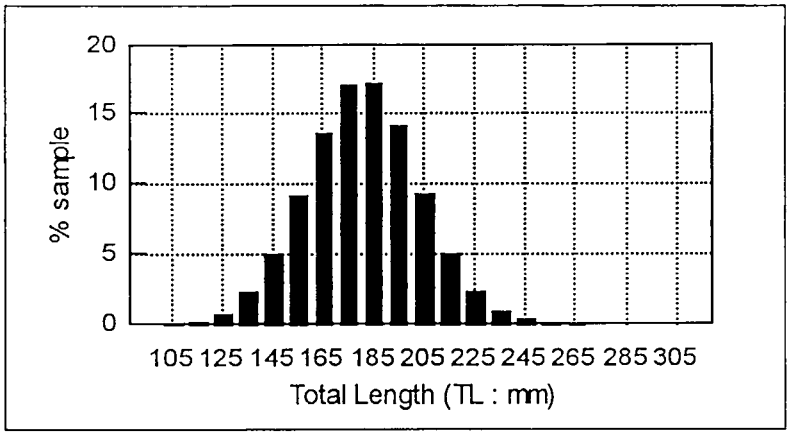
continue: appendix 12

Pooled length frequency data of *Rastrelliger* spp. (1992 – 1994 period) for stock assessment studies

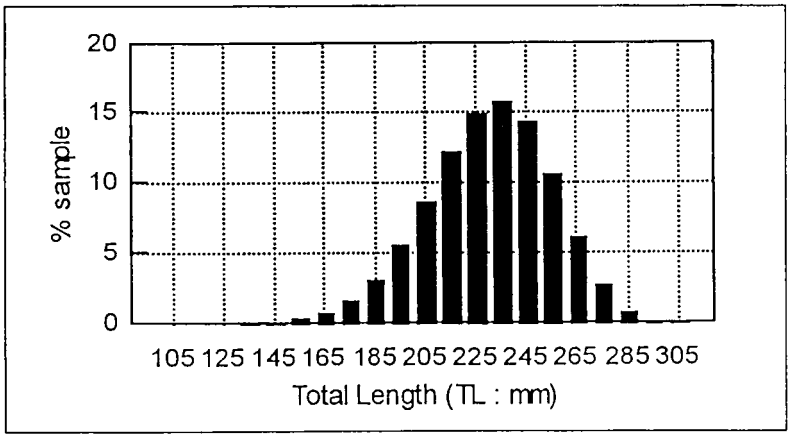
a. *Rastrelliger faughni* (n = 391 measurements)



b. *Rastrelliger brachysoma* (n = 32,709 measurements)



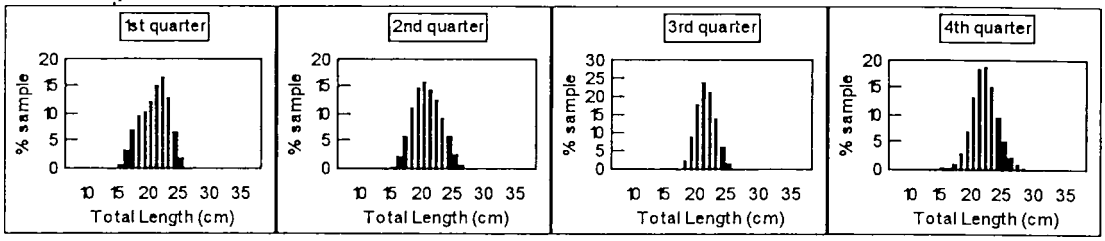
c. *Rastrelliger kanagurta* (n = 45,485 measurements)



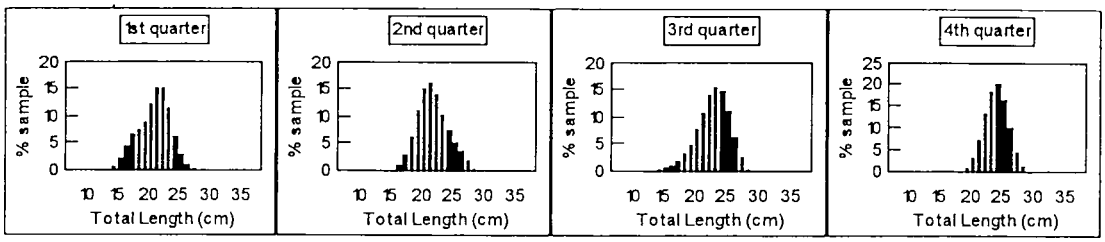
continue: appendix 12

QUARTERLY LENGTH FREQUENCY DISTRIBUTION OF *Rastrelliger kanagurta*

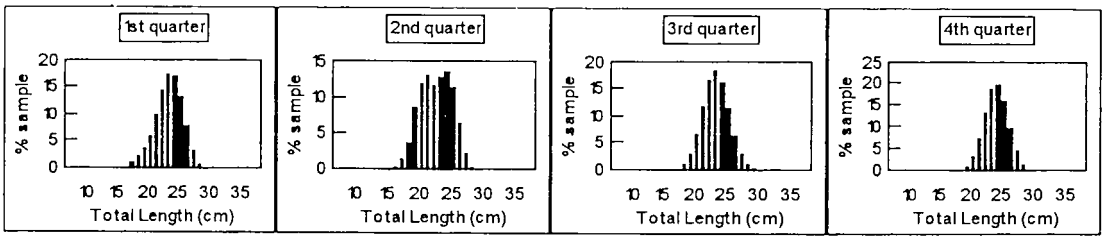
a. 1992 period



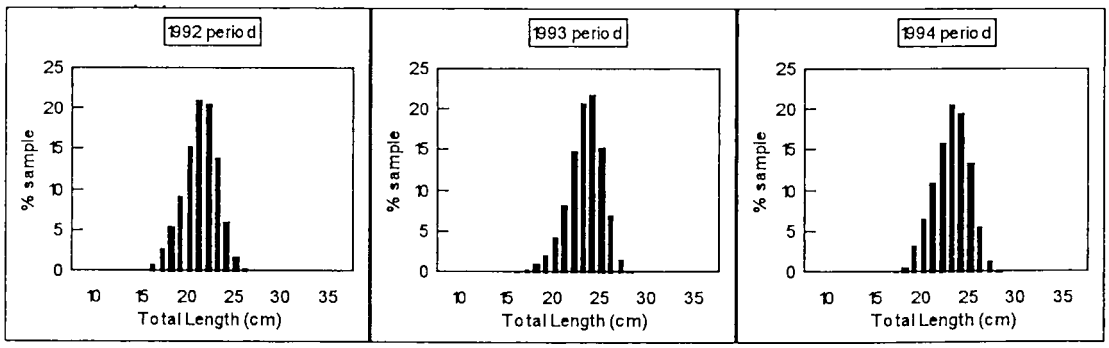
b. 1993 period



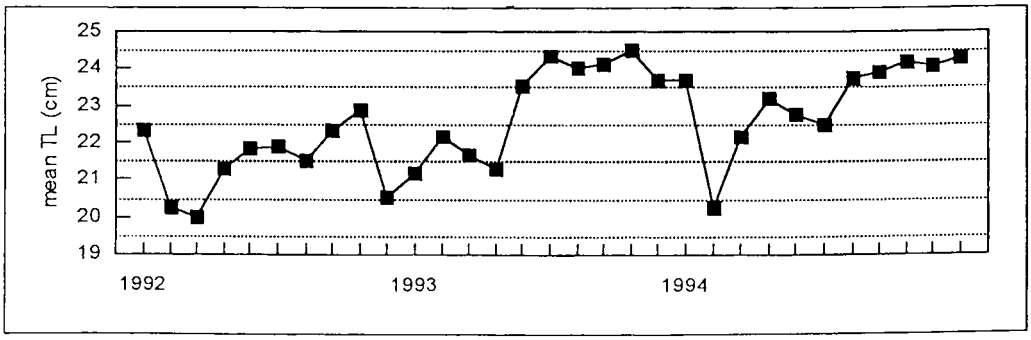
c. 1994 period



d. Annual population structure



e. Monthly mean sizes of *Rastrelliger kanagurta*

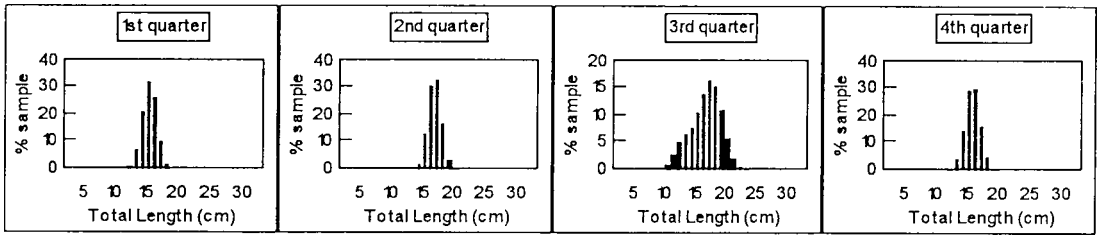


2nd. regional workshop on shared stocks in the South China Sea area. 18–20 July 1995. SEAFDEC, Kuala Terengganu, Malaysia.

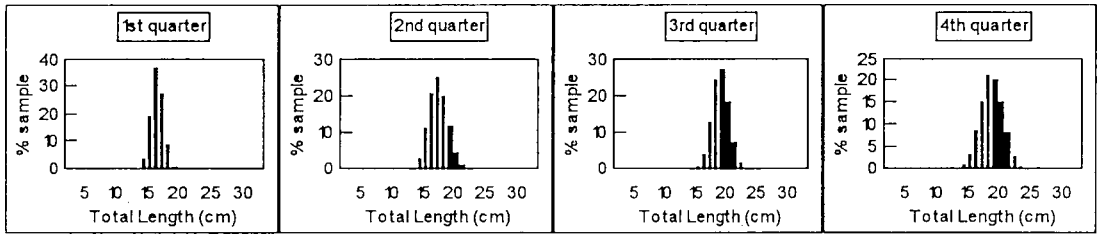
continue: appendix 12

QUARTERLY LENGTH FREQUENCY DISTRIBUTION OF *Rastrelliger brachysoma*

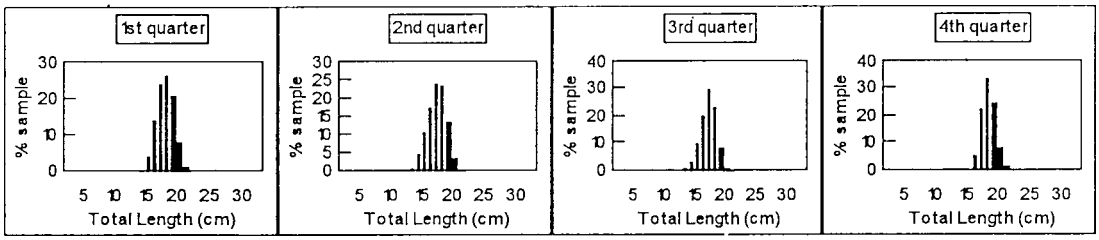
a. 1992 period



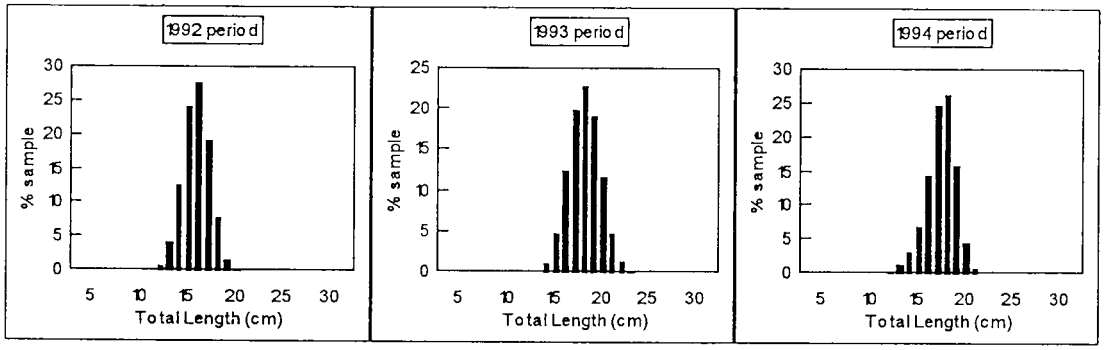
b. 1993 period



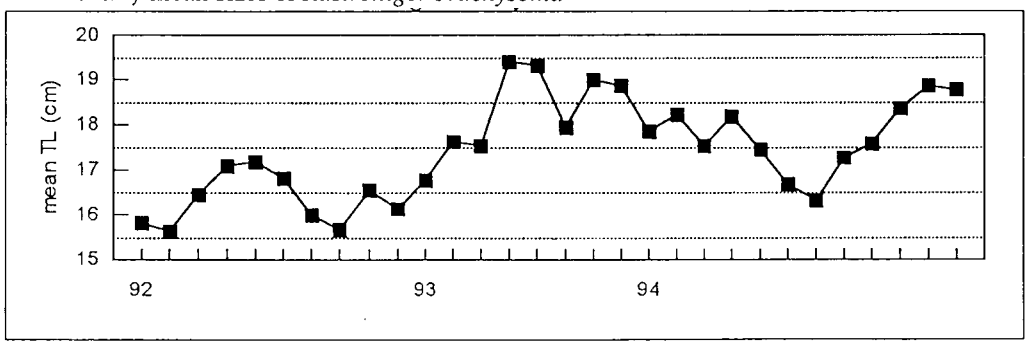
c. 1994 period



d. Annual population structure



e. Monthly mean sizes of *Rastrelliger brachysoma*



Appendix 13: Biological aspects of round scad *(Decapterus)* stocks along the west coast of Sabah

a. ***Decapterus macrosoma*** (n-283) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	179.66	21.51	11.97	129-240
FL (fork length)	165.07	19.75	11.96	115-220
SL (standard length)	154.17	18.27	11.85	108-202
BW (body weight)	64.06	23.95	37.38	22-155

Morphometric relationships	*correlation (r)*
FL = 1.1121 + 0.9126 TL	0.9940
SL = 3.3065 + 0.8387 TL	0.9888
SL = 3.0887 + 0.9152 FL	0.9895
Log_{10} FL = -0.0302 + 0.9971 Log_{10} TL	0.9931
Log_{10} SL = -0.0342 + 0.9857 Log_{10} TL	0.9882
Log_{10} SL = -0.0085 + 0.9828 Log_{10} FL	0.9892
Length-weight relationships	
Log_{10} BW = -4.8717 + 2.9541 Log_{10} TL	0.9904
Log_{10} BW = -4.6892 + 2.9208 Log_{10} FL	0.9831
Log_{10} BW = -4.6223 + 2.9297 Log_{10} SL	0.9797

b. ***Decapterus maruadsi*** (n-263) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	184.17	15.79	8.57	155-263
FL (fork length)	167.81	14.24	8.48	140-234
SL (standard length)	155.25	14.32	9.22	124-220
BW (body weight)	66.49	19.21	28.90	40-170

Morphometric relationships	*correlation (r)*
FL = 4.9895 + 0.8841 TL	0.9807
SL = -6.2324 + 0.8768 TL	0.9672
SL = -9.8262 + 0.9837 FL	0.9782
Log_{10} FL = 0.0289 + 0. 9694 Log_{10} TL	0.9783
Log_{10} SL = -0.1794 + 1.0463 Log_{10} TL	0.9628
Log_{10} SL = -0.1888 + 1.0696 Log_{10} FL	0.9752
Length-weight relationships	
Log_{10} BW = -5.0089 + 3.0109 Log_{10} TL	0.9413
Log_{10} BW = -4.8123 + 2.9772 Log_{10} FL	0.9222
Log_{10} BW = -4.1823 + 2.7358 Log_{10} SL	0.9295

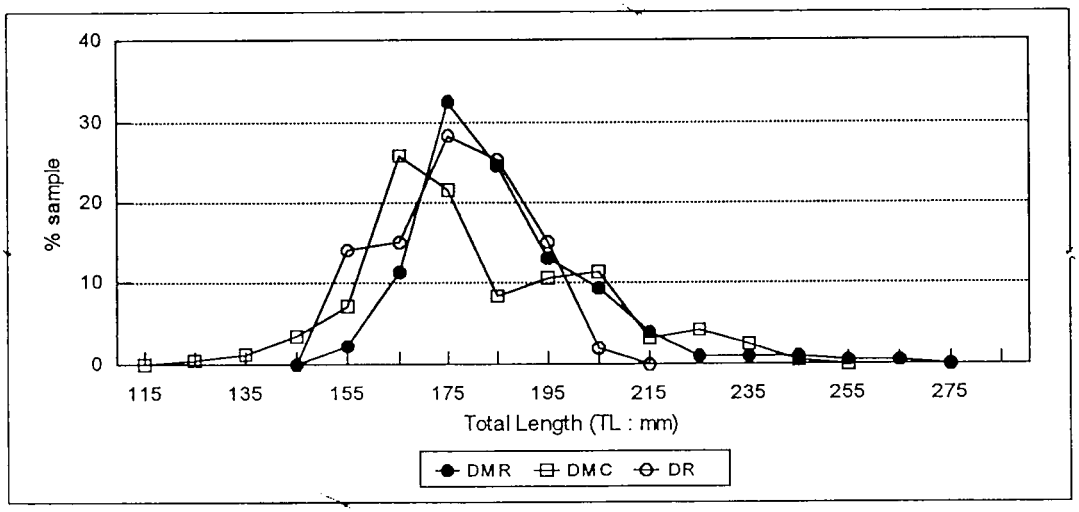
b. ***Decapterus russelli*** (n-100) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	175.47	12.34	7.03	152-202
FL (fork length)	162.46	11.14	6.86	141-186
SL (standard length)	147.85	12.18	8.24	125-175
BW (body weight)	49.18	9.44	19.19	33-70

Morphometric relationships	*correlation (r)*
FL = 7.2256 + 0.8842 TL	0.9790
SL = -19.0959 + 0.9509 TL	0.9633
SL = -26.5306 + 1.0733 FL	0.9821
Log_{10} FL = 0.0665 + 0.9554 Log_{10} TL	0.9794
Log_{10} SL = -0.3768 + 1.1345 Log_{10} TL	0.9650
Log_{10} SL = -0.4503 + 1.1850 Log_{10} FL	0.9833
Length-weight relationships	
Log_{10} BW = -4.2008 + 2.6230 Log_{10} TL	0.9485
Log_{10} BW = -4.2839 + 2.7006 Log_{10} FL	0.9526
Log_{10} BW = -3.0395 + 2.1783 Log_{10} SL	0.9260

NOTE: Length (in mm units), BW (in gram), HL (head length), SD 1 (distance from head tip to 1st dorsal fin), SD 2 (distance from head tip to 2nd dorsal fin)

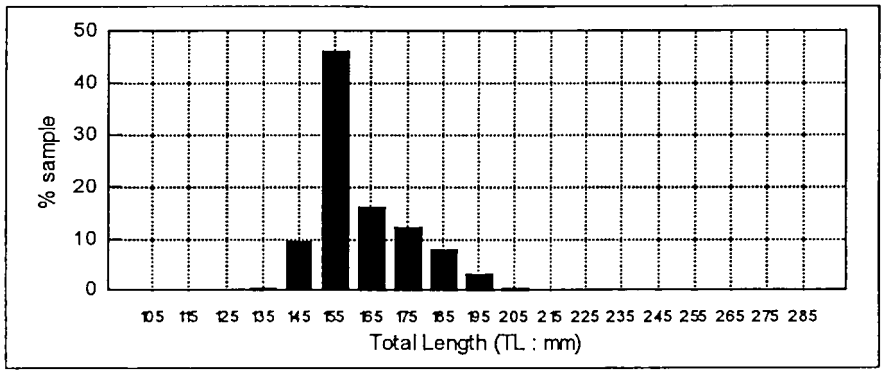
LENGTH FREQUENCY DISTRIBUTION OF FISH SAMPLES (BIOLOGICAL STUDIES)
(DR = *Decapterus russelli*, DMC = *Decapterus macrosoma*, DMR = *Decapterus maruadsi)*



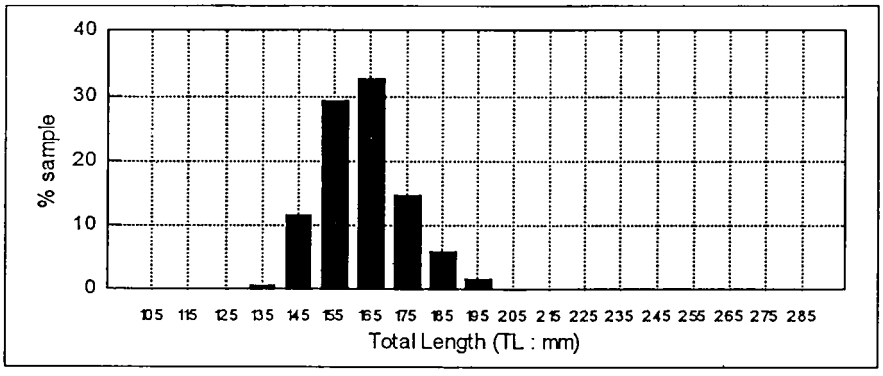
continue: appendix 13

Pooled length frequency data of *Decapterus* spp. (1992 – 1994 period) for stock assessment studies

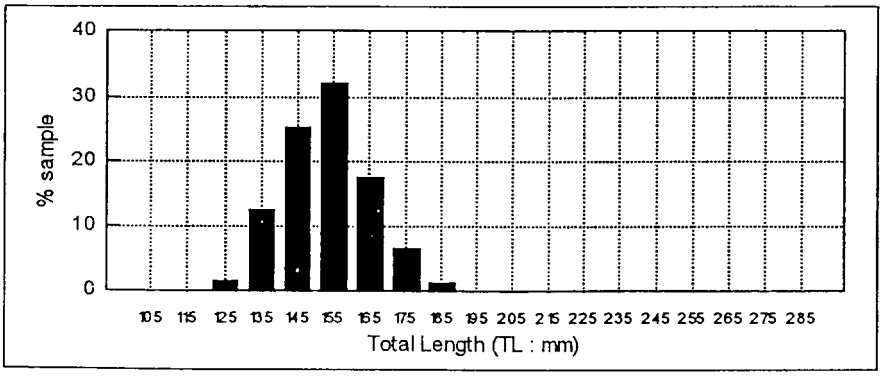
a. *Decapterus macrosoma* (n = 52,267 measurements)



b. *Decapterus maruadsi* (n = 57,009 measurements)



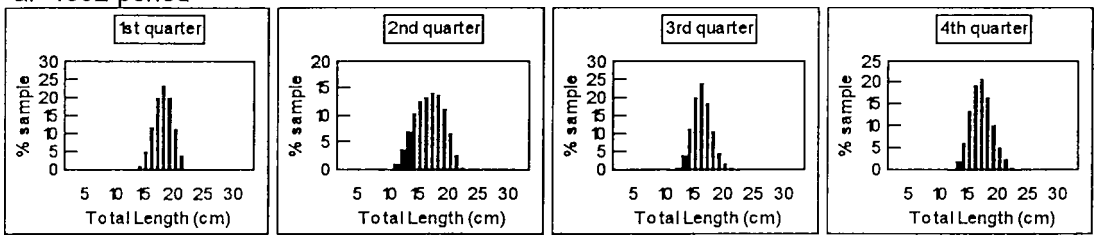
c. *Decapterus russelli* (n = 10,313 measurements)



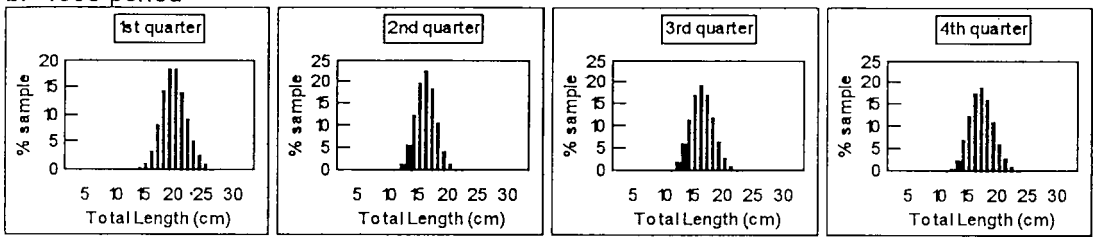
continue: appendix 13

QUARTERLY LENGTH FREQUENCY DISTRIBUTION OF *Decapterus macrosoma*

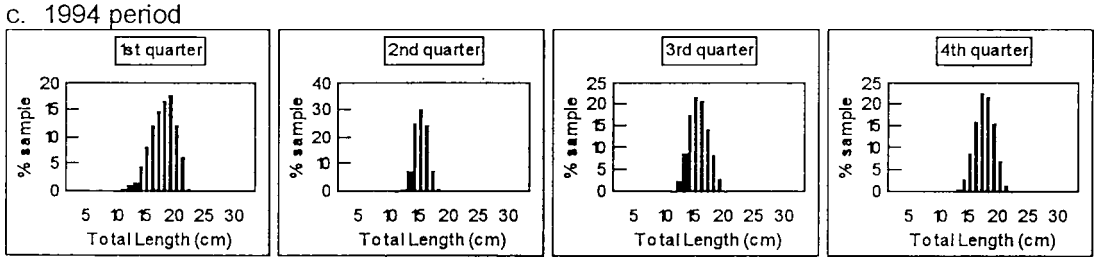
a. 1992 period



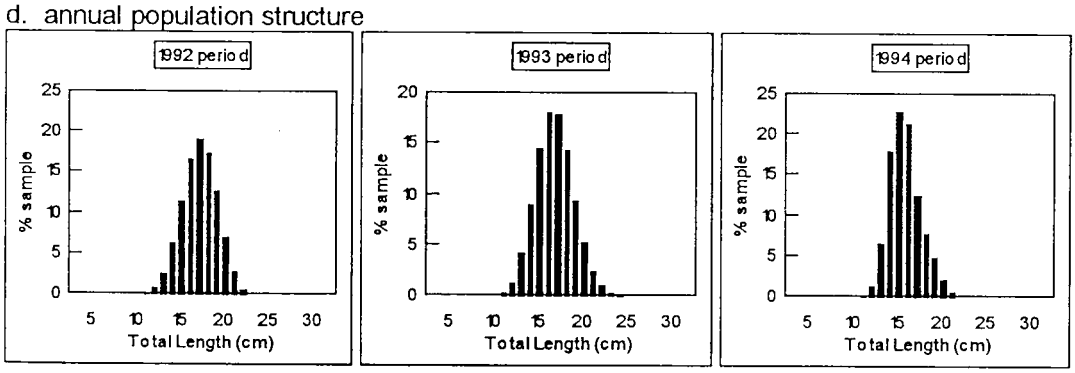
b. 1993 period



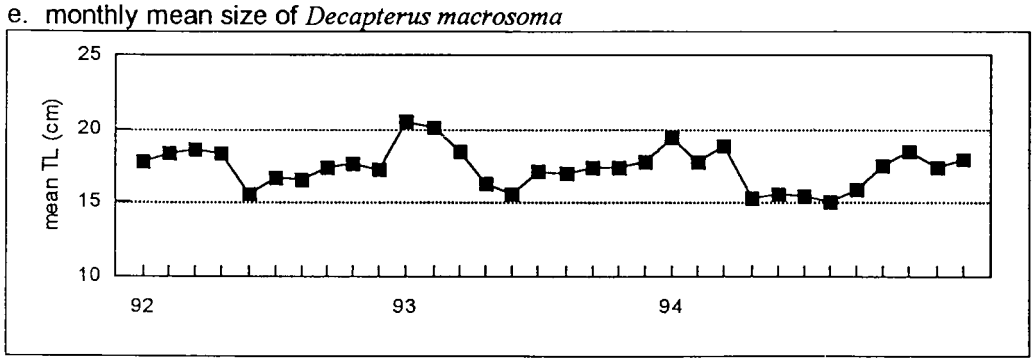
c. 1994 period



d. annual population structure



e. monthly mean size of *Decapterus macrosoma*



Appendix 14: Biological aspects of Selar scad *(Selar)* stocks along the west coast of Sabah

a. ***Selar crumenopthalmus*** (n-497) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	241.73	14.25	5.90	204-276
FL (fork length)	213.45	12.50	5.85	176-244
SL (standard length)	194.74	10.95	5.62	161-220
BD (body depth)	56.40	4.16	7.38	46-71
BW (body weight)	183.33	31.76	17.33	110-282
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	3.79	0.17	4.48	3.36-4.31
FL/HL	3.31	0.08	2.49	3.08-3.58
FL/SD 1	2.75	0.06	2.31	2.61-2.90
FL/SD 2	1.90	0.03	1.62	1.82-1.98
TL/SL	1.24	0.02	1.85	1.16-1.33

Morphometric relationships	*correlation (r)*
FL = 7.4050 + 0.8524 TL	0.9721
SL = 18.4643 + 0.7292 TL	0.9488
SL = 13.9158 + 0.8472 FL	0.9665
Log_{10} FL = 0.0251 + 0.9668 Log_{10} TL	0.9725
Log_{10} SL = 0.1213 + 0.9097 Log_{10} TL	0.9508
Log_{10} SL = 0.1207 + 0.9311 Log_{10} FL	0.9675
Length-weight relationships	
Log_{10} BW = -4.4194 + 2.8020 Log_{10} TL	0.9395
Log_{10} BW =-4.3088 + 2.8195 Log_{10} FL	0.9398
Log_{10} BW = -4.3276 + 2.8767 Log_{10} SL	0.9228
Log_{10} BW = -1.1364 + 2.0644 Log_{10} BD	0.8624

b. ***Selar boops*** (n-50) (weight = gram, length = mm)

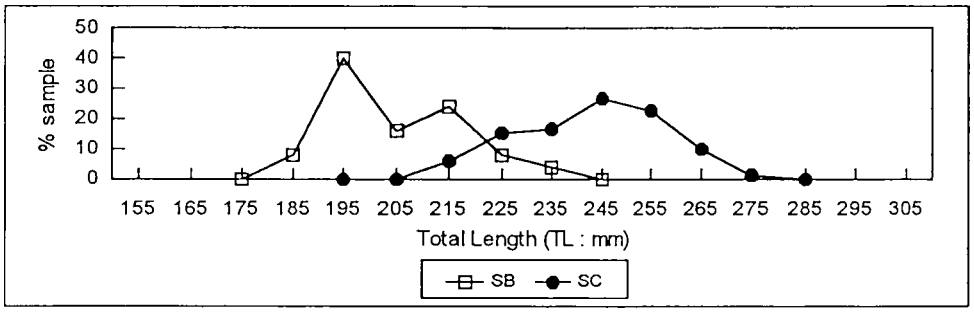
Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	202.96	11.73	5.78	187-230
FL (fork length)	179.58	11.23	6.25	164-204
SL (standard length)	166.54	9.75	5.85	151-188
BD (body depth)	51.30	2.84	5.53	47-58
BW (body weight)	109.26	19.13	17.51	82-163
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	3.50	0.09	2.59	3.33-3.77
FL/HL	3.49	0.06	1.83	3.33-3.67
FL/SD 1	2.93	0.07	2.22	2.80-3.13
FL/SD 2	1.98	0.04	1.89	2.05
TL/SL	1.22	0.02	1.36	1.16-1.26

Morphometric relationships	*correlation (r)*
FL =-10.2556 + 0.9352 TL	0.9768
SL = 2.5861 + 0.8078 TL	0.9722
SL =14.2362 + 0.8481 FL	0.9774
Log_{10} FL = -0.1871 + 1.0541 Log_{10} TL	0.9770
Log_{10} SL = -0.0584 + 0.9881 Log_{10} TL	0.9718
Log_{10} SL = 0.1483 + 0.9197 Log_{10} FL	0.9759
Length-weight relationships	
Log_{10} BW = -4.5784 + 2.8658 Log_{10} TL	0.9735
Log_{10} BW = -3.7449 + 2.5637 Log_{10} FL	0.9396
Log_{10} BW = -4.0885 + 2.7561 Log_{10} SL	0.9519
Log_{10} BW = -2.8452 + 2.8532 Log_{10} BD	0.9305

NOTE: Length (in mm units), BW (in gram), HL (head length), SD 1 (distance from head tip to 1st dorsal fin), SD 2 (distance from head tip to 2nd dorsal fin)

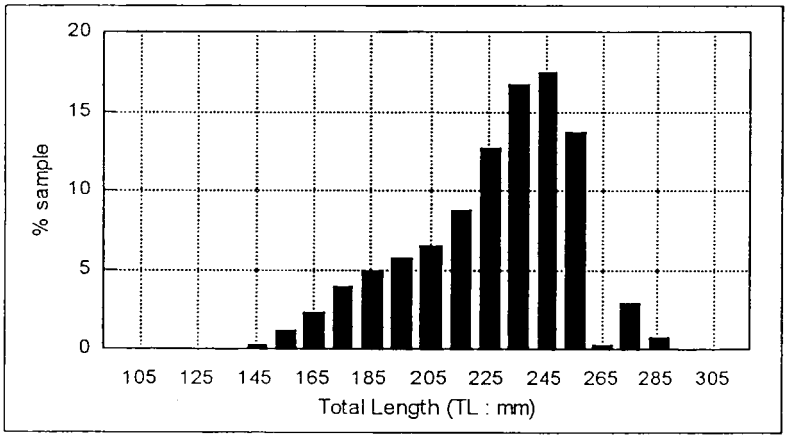
continue: appendix 14

LENGTH FREQUENCY DISTRIBUTION OF FISH SAMPLES (BIOLOGICAL STUDIES)
(SC = *Selar crumenopthalmus,* SB = *Selar boops*)

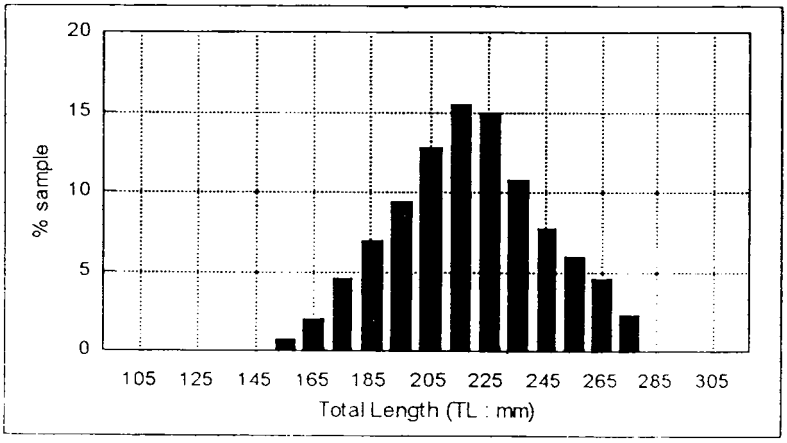


Pooled length frequency data of Selar spp. (1992 – 1994 period) for stock assessment studies

a. *Selar crumenopthalmus* (n = 21,750 measurements)



b. *Selar boops* (n = 1,248 measurements)



Appendix 15 : Biological aspects of hardtail scad *(Megalaspis cordyla)* stock along the west coast of Sabah

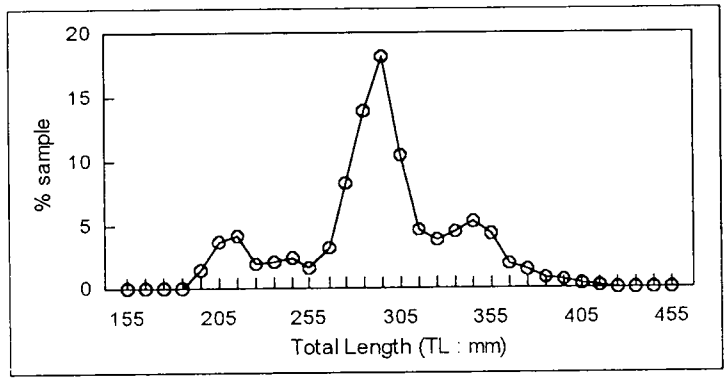
Megalapsis cordyla (n-850) (weight = gram, length = mm)

Variable	*mean*	*sd*	*CV (%)*	*range of values*
TL (total length)	292.08	43.52	14.90	190-420
FL (fork length)	266.57	39.99	15.00	173-380
SL (standard length)	250.38	37.83	15.11	163-361
BD (body depth)	59.36	8.27	13.93	38-84
BW (body weight)	261.66	106.36	40.65	60-680
Morphometric ratio	*mean*	*sd*	*CV (%)*	*range of values*
FL/BD	4.49	0.26	5.76	3.84-4.78
FL/HL	3.12	0.20	6.47	2.67-3.67
FL/SD 1	3.29	0.10	3.07	2.99-2.86
FL/SD 2	2.22	0.05	2.38	2.00-2.46
TL/SL	1.17	0.02	1.55	1.09-1.27

Morphometric relationships	*correlation (r)*
FL = -1.2538 + 0.9160 TL	0.9976
SL = -2.2350 + 0.8650 TL	0.9959
SL =-0.9331 + 0.9434 FL	0.9973
Log_{10} FL = -0.0519 + 1.0048 Log_{10} TL	0.9978
Log_{10} SL = -0.0917 + 1.0099 Log_{10} TL	0.9962
Log_{10} SL = -0.0373 + 1.0043 Log_{10} FL	0.9975
Length-weight relationships	
Log_{10} BW = -4.7340 + 2.8921 Log_{10} TL	0.9893
Log_{10} BW = -4.5699 + 2.8723 Log_{10} FL	0.9894
Log_{10} BW = -4.4280 + 2.8454 Log_{10} SL	0.9867
Log_{10} BW = -2.8947 + 2.9674 Log_{10} BD	0.9795

NOTE: Length (in mm units), BW (in gram), HL (head length), SD 1 (distance from head tip to 1st dorsal fin), SD 2 (distance from head tip to 2nd dorsal fin)

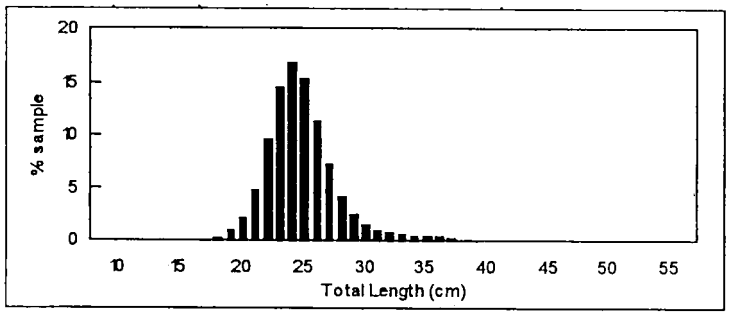
LENGTH FREQUENCY DISTRIBUTION OF FISH SAMPLES (BIOLOGICAL STUDIES)



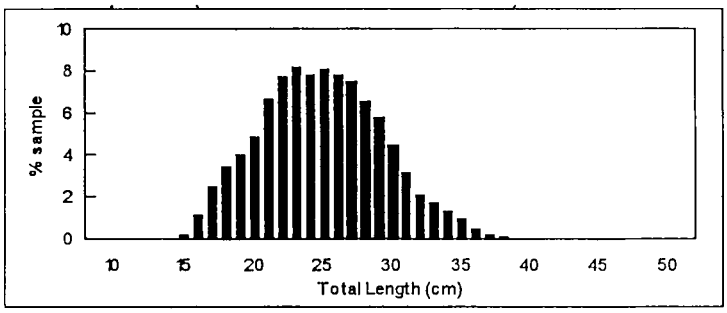
continue: appendix 15

Annual population structure of *Megalaspis cordyla* stock

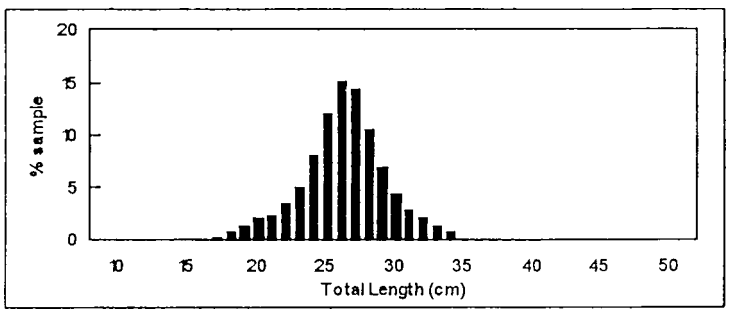
a. 1992 period (n = 8,277 measurements)



b. 1993 period (n = 26,712 measurements)



c. 1994 period (n = 20,900 measurements)



d. Pooled 1992–1994 period (n = 55,889 measurements)