

Annexure 3

ON THE STATUS OF THE *RASTRELLIGER* AND *DECAPTERUS* FISHERIES OF THE WEST COAST OF PENINSULAR MALAYSIA IN 1984.1985.

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1. Introduction

It is well known that the mackerel is the most important fishery resource on the west coast of Peninsular Malaysia in Malaysia. In the first meeting of the working group on mackerels in Penang (1983) organised by the BOBP, the maximum sustainable yields (MSY) of *Rastrelliger* spp. and *Decapterus* spp. were estimated at 21,000 and 5,800 tonnes respectively (Chee 1984).

Following the recommendations made by the working group at its first meeting, biological studies were carried out with special emphasis on catch rates, production, MSY, length frequency analysis, maturity, gonadosomatic and morphometric studies. This working paper includes information collected during the Second and Third meetings of the working group on mackerels and scads in the Malacca Straits.

2. Sampling sites and gear

The study was conducted on the west coast of Peninsular Malaysia and five landing sites were chosen. These centres were Kuala Perlis (State of Perlis), Kuala Kedah (Kedah), Teluk Bahang (Penang), Pulau Pangkor (Perak), and Sungai Besar (Selangor). The fishing areas for these landing centers are shown in Figure 1. Sampling for catch rates of each species was carried out at all five centres.

The length frequency samples were taken from purse seines and highopening bottom trawls. Sampling of luring purse seine catches **was** done in Perlis, Penang, Perak and Selangor while that from highopening trawl catches were taken at Kedah, Perak and Selangor. Monthly sampling for gonad maturity studies of *R. brachysoma* were conducted at Kedah, Perak and Selangor and those for *R. kanagurta* and *D. maruadsi/russelli* were conducted at Perlis and Penang.

3. Catch rates

R. brachysoma

Trawlers: In Perlis, high catch rates by 25 GRT trawlers were recorded in March (see Figure 2a). In Kedah, catch rates between January and March were much higher than those between April and December, for both 25 and 40 GRT trawlers (Figure 2b). In Penang, a sharp increase in catch rate was observed from March to June in 25 GRT trawlers (Figure 2b). In Perak, the catch rate of the 25 GRT trawlers increased from February to May, whereas that of the 40 GRT class fluctuated throughout the year with peaks in May and in December (Figure 2d). In Selangor, catch rate by the 25 GRT trawlers fluctuated from January to July and September to December with peaks in June and October. On the other hand, the 40 GRT vessels produced the highest catch rates (26.1 kg/day/boat) in November (Figure 2e). Kedah and Penang showed higher catch rates than the other three centres. The peak catch rate was the lowest in Selangor.

Purse seiners: In Perlis, two high peaks for catch rates were recorded in April (40 kg/h/boat for 25 GRT and 500 kg/h/boat for 40 GRT) and in September (280 kg/h/boat for 40 GRT and 350 kg/h/boat for 25 GRT (Figure 3a). In Kedah, January and February showed high catch rates (60-70 kg/h/boat for 25 and 40 GRT) with much lower rates for other months (less than 20 kg/h/boat) (Figure 3b). In Penang, the peak catch rate by 25 GRT purse seiners was in February (620 kg/h/boat), with other months showing less than 300 kg/h/boat (Figure 3c). In Perak, February to May was a period for higher catch rates (700-2100 kg/h/boat) and other months yielded less than 400 kg/h/boat (Figure 3d). In Selangor, 40 GRT provided significantly high catch rates in April (2600 kg/h/boat) and May (2400 kg/h/boat) and during other months it was less than 1400 kg/h/boat for both classes of vessels (Figure 3e). The highest peak catch rate was observed in the southern centre at Selangor and lowest peak catch rate was in Kedah, in contrast to the patterns by the trawl fishery.

R. kanagurta

Trawlers: In Perak, catch rates of 40 GRT were higher than those of 25 GRT. The peak month for 40 GRT was in July (12 kg/h/boat) (Figure 4).

Purse seiners: In Perak a significant peak by 40 GRT was observed in July (1400 kg/h/boat) (Figure 5a). In Perlis, March was the significant month for 40 GRT (1300 kg/h/boat), whereas other months were less than 500 kg/h/boat (Figure 5b). In Penang, the catch rates of the vessels declined from February (475 kg/h/boat) to December (50 kg/h/boat) (Figure 5c).

D. maruadsilrusselli

Purse seiners. In Perlis, the monthly catch rates by 25 GRT vessels fluctuated throughout the year with high CPUE in March (564.13 kg/day), whereas for the 40 GRT boats a high CPUE was achieved in April (1452.7 kg/day) (Figure 6a). In Penang, significantly high catch rates by 40 GRT purse seiners were observed in February (180.38 kg/day) and in October (246.23 kg/day) (Figure 6b).

4. Production

The total mackerel production by type of gear for the period 1972-1985 is presented in Table 1a. Since the first working group meeting the production of mackerels increased considerably up to a level of 68,966 tonnes in 1984 which, however, declined to 54,982 tonnes in 1985. The composition of the fishing fleet is shown in Table 1 b.

The estimated monthly landings of mackerels at various landing centres, in 1984 and 1985, are shown in Table 2. There were no *R. kanagurta* landings recorded in Kedah and Selangor. This was probably because of the operation of mainly the high opening trawls and night time purse seiners which contribute mainly to the production of *R. brachysoma*, in contrast to luring purse seines (daytime luring purse seine with coconut leaves) which generally catch *R. kanagurta* and *Decapterus* spp.

The estimated monthly landings of scads in 1984 are shown in Table 3. The table shows that 89.2% of the total landings of scads were in Perlis, followed by Penang with 9.8%, Perak, 0.91 % and Selangor, 0.19%.

The major portion of the mackerel landed in all the states on the west coast of Peninsular Malaysia was caught by purse seiners except in Kedah where mackerels were mainly caught by trawlers. In Selangor, purse seines and gillnets are the major gear used in mackerel production.

As shown in Table 2, in 1984, there was no significant variation in the monthly landing of mackerel in Perlis, except in May, when only 343 t were landed compared to over 500 t in other months. On the other hand, in 1985, a large production (3095 tonnes) was recorded in March and those of other months varied between 200 and 900 t.

In Kedah, the landings of *Rastrelliger* spp. in 1984 oscillated between 4,788 t (in April) and 500 t (in August), while it varied between 2,710 t (February) and 376 t (June) in 1985. There are no data available for mackerel production in Penang during 1984, but in 1985 available data showed variation between 4 t (November) and 410 t (February).

In Perak, the landings fluctuated widely between about 4 to 5 tonnes in November and December to 2,500 t in August in 1984, but in 1985 higher ranges were observed from 121 (August) to 5,373 t (February).

5. MSY and optimum effort

MSY and optimum effort were estimated using Schaeffer and Fox production models, with the help of FAO stock assessment computer programs for Apple IIe. Results are shown in Table 4a and 4b for *Rastrelliger* spp. with two types of standardized units of effort (Number of purse seine boat days and number of purse seine boats), in Table 4 for *R. brachysoma* (effort in purse seine boat days), in Table 4d for *R. kanagurta* (Effort in boat days) and Table 4e for *Decapterus* spp. (effort in number of purse seine boats).

The annual catch rates of *Rastrelliger* spp. (*R. brachysoma* and *R. kanagurta* combined) exhibited satisfactory correlation with fishing effort expressed as number of purse seine boats in operation,

But showed relatively very poor correlation when effort was expressed in terms of number of purse seine boat-days. The purse seine fishery being a mixed target species fishery, the entire effort by any one purse seiner cannot be considered to have been applied to catch only *Rastrelliger* species. This factor contributed to the poor correlation observed.

In spite of the differences in the correlation coefficients (as a result of expressing effort values in two different ways), and irrespective of whether the maximum sustainable yield values are estimated for the two species together or separately, the overall MSY for chub mackerels on the west coast of Peninsular Malaysia works out to 60,000 – 70,000 t per annum, with an optimum effort value of some 2,000 purse seine boats.

6. Length frequency distribution

Length frequency sampling (total length) for *R. brachysoma* and *R. kanagurta* were carried out monthly in 1984-85. Random samples were taken at various landing places. The length frequency distribution exhibits a polymodal appearance. The fishery exploited *R. brachysoma* off Kuala Kedah (Figure 7a) and Pulau Pangkor (Figure 7b) in sizes ranging from 13 to 22.5 cm and *R. kanagurta* in Kuala Perlis from 10.5 to 22.5 cm (Figure 7c). The size range of *R. brachysoma* caught by trawlers was similar to that for the purse seiners and the modal sizes failed to show significant difference (Figures 8a-8e). *D. maruadsi* caught off Perlis and Penang ranged between 8 and 20 cm (Figures 8h-8i).

7. Estimated growth, mortality and related parameters

The growth, mortality and related parameters (L_{∞} , K , Z , L_c , L) for the five landing centres obtained from the detailed analysis of the length frequency data of 1985 using the ELEFAN program (I – Post Sicily version and II) are tabulated in Table 5. Figures for length frequency distribution, growth curves, recruitment patterns (%), catch curves and selection patterns are depicted for *R. brachysoma* (Figures 8a-8e), *R. kanagurta* (Figures 8f-8g) and *D. maruadsi* (Figures 8h-8i) by area and by gear.

8. Maturity study and mean length at maturity

Monthly random sampling for gonad maturity studies was done at Perak, Kedah and Selangor for *R. brachysoma*, and in Perlis and Penang for *R. kanagurta* and *Decapterus* spp. (July 1985-June 1986).

The percentage composition of maturity stages (I to V) for *R. brachysoma* and *R. kanagurta* are as shown in Table 6a and 6b respectively (January 1984-July 1985).

Previous studies on *R. brachysoma* by Chong (1974) showed that the spawning period of *R. brachysoma* extends from August to December. Chong observed that about 40% or more of the fish had ripe or spent gonads.

According to Pathansali (1962), mature *R. kanagurta* were found from October to April with the maximum occurrence from January to March.

In the case of *R. brachysoma*, spent gonads were observed in January/February and from August to October (1984), which was only partly observed by Chong (1974).

Concerning *R. kanagurta*, the high percentage of spent gonads in March 1984 corroborates Pathansali's conclusions (Pathansali, 1962) although in March 1985 no spent gonads were observed.

Table 7 shows numbers of matured fish (maturity stage IV and V) in the samples examined, by sex, by species and by area over a period of 10-12 months. For *R. brachysoma* a higher percentage of matured fish was observed among females than among males in all areas. Percentages of mature fish were greater in Kedah and Perak than in Selangor (Table 7).

R. kanagurta showed a slightly higher percentage of mature fish among males than among females. A higher percentage of mature fish was observed in Perlis than in Penang (Table 7).

For *Decapterus* spp. the percentages of mature females and males were not significantly different.

In Perlis a higher percentage of mature fish was recorded than in Penang (Table 7)

Overall, there was a higher percentage of mature *R. brachysoma* than of *R. kanagurta* or *Decapterus* spp. in the samples taken over the periods indicated.

The mean lengths at first maturity of *R. brachysoma* in Kedah, Perak and Selangor were estimated as 17.85 cm, 18.15 cm and 18.1 cm respectively. Those for *R. kanagurta* in Perlis and Penang were found to be 19.6 cm and 20.6 cm respectively, whereas for *D. maruadsilrusselli* it was 17 cm in Perlis and 16 cm in Penang.

9. Sex ratio (January 1984 – July 1985)

From the examination of fish throughout the year, there appears to be no segregation of sexes. Of the total 553 *R. brachysoma* specimens from random samples examined between January 1984 and July 1985, 337 were females and 216 were males, giving a percentage of 60.9% and 39.1 % respectively. Of the 599 sample of *R. kanagurta* examined, 47.2% were females and 52.8% were males. Monthly and size-wise differences in sex ratios were not examined.

10. Gonadosomatic index study (July 1985 – June 1986)

The gonadosomatic index (GSI) was estimated by taking the ratio of gonad weight to body weight for samples of *R. brachysoma* caught in Kedah, Perak and Selangor and *R. kanagurta* and *Decapterus* samples caught in Perlis and Penang.

R. brachysoma: In Perak peak GSI values were seen in July 1985, in Kedah in March 1986 and in Selangor during December 1985/March 1986. Perak shows higher peak values of GSI throughout the year than Kedah and Selangor (Figure 9a).

R. kanagurta: The seasonal sampling was incomplete. Peak values of GSI appeared to be in August/September 1985 (Perlis) and in August 1985 (Penang). A declining though fluctuating trend was observed from October to May in both locations (Figure 9b).

D. maruadsilrusselli: Data are rather incomplete for many months and the available data indicate that peaks were in August 1985 and February – March 1986 (Penang) and in February 1986 (Perlis) (Figure 9c).

11. Conclusions

As may be seen in this paper, there are some data which could not be analysed and some which could not be collected due to unforeseen circumstances. Some of the findings are not conclusive.

- 1) Catch and effort data should be improved for more reliable estimation of CPUE, production and MSY.
- 2) Length frequency data were re-appraised as easy and useful information to grasp basic parameters for the population dynamics of mackerels. Data collection should be continued.
- 3) Maturity studies should also be continued to elucidate the life history and migration patterns of mackerels in the Malacca Straits.

References

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2. Chee Phaik Ean (1984) : The Rastrelliger and Decapterus fisheries of the west coast of Peninsular Malaysia Appendix 3 No. BOBP/WP/30: 42-49.
3. FAO (1959) : Report of the International Training Center on the methodology and technique of research on mackerel (Rastrelliger). FAO report No. 1095.
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Table Ia
Trends in mackerel production on the west coast of Peninsular Malaysia,
by gear group, during 1972/1985

(tonnes)					
Year	Purse seines	Trawls	Gillnets	Other gears	Total catch
1972	9,334	329	24	13	9,763
1973	21,021	553	78	21	21,675
1974	11,299	721	279	13	12,313
1975	8,175	1,520	277	14	9,987
1976	7,042	4,989	365	18	1,244
1977	8,592	10,450	384	143	19,570
1978	11,936	10,962	728	122	23,803
1979	28,300	5,395	352	105	34,153
1980	41,635	6,683	2,884	529	51,799
1981	27,235	1,401	3,375	403	45,027
1982	27,921	20,470	5,928	301	54,719
1983	37,510	19,545	5,252	277	62,594
1984	50316	14,474	3,080	224	68,966
1985	?	?	?	?	54,982

Table Ib
Estimated number of purse seiners, trawlers, gillnetters and vessels with other
gears in operation in 1972-1984 on the west coast of Peninsular Malaysia

Year	Purse seiners	Trawlers	Gillnetters	Other gear
1972	1,488	4,068	3,698	1,385
1973	1,446	3,267	3,530	1,185
1974	1,353	3,909	4,091	1,160
1975	1,687	3,873	4,359	1,200
1976	1,425	4,008	5,092	1,151
1977	1,204	4,195	5,951	1,066
1978	1,294	4,463	6,656	1,017
1979	1,450	5,112	7,878	1,458
1980	1,854	5,265	8,453	1,698
1981	1,985	5,266	8,525	2,235
1982	2,032	5,257	8,689	2,175
1983	874	3,289	10,825	2,706
1984	7,146	2,906	9,761	2,285

Table 2
Monthly production of *Rastrelliger* spp. by area for 1984 and 1985 (by all gears)

Area/ Month	Perlis		Kedah		Penang		Perak		Selangor	
	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
January	522	172	1,162	2,768		133	219	180	198	1,691
February	541	183	2,141	2,010		410	61	5,373	92	766
March	545	3,095	2,561	1,489		314	509	3,006	76	514
April	546	858	4,788	1,357		330	958	3,790	143	1,033
May	343	891	2,931	559		231	253	2,929	104	972
June	543	726	1,417	376		139	619	238	258	222
July	544	617	2,433	581		84	353	199	319	232
August	539	191	500	544		41	2,514	121	2,092	—
September	547	536	1,971	689		5	362	157	2,766	180
October	553	548	1,589	694		36	29	741	2,821	172
November	550	499	1,412	599		4	5	1,850	2,115	54
December	565	344	1,806	698		31	4	447	2,067	375

Table 3
Landing of *Decapterus* spp. in the west coast of Peninsular Malaysia by state and month in 1984

Month	(P.S.)						(tonne)
		Perlis	Kedah	Penang	Perak	Selangor	Total
January		396.25		142.8	2.48		541.53
February		534.21		112.56	1.09	0.96	648.82
March		666.84		16.8	21.43	0.5	705.57
April		1,812.91		5.46	2.42	0.03	1,820.82
May		157.11		3.36	0.55	1.15	162.17
June		202.22		38.01	0.88		241.11
July		422.16		14.49	5.53	0.09	442.27
August		236.88		45.99			282.87
September		443.03		44.31			487.34
October		376.15		136.68			512.83
November		348.97		56.28	24.43	2.91	432.59
December		144.8		14.28			159.08
Total		5,741.53		631.02	58.81	5.64	6,437.00
%				(89.2)	(0.9)	(9.8)(0.09)	(100)

Table 4
Summary of the various production model analysis applied to data from the west coast of Peninsular Malaysia

	Schaefer model			Fox model		
	MSY (tonnes)	Optimum effort	r^2	MSY (tonnes)	Optimum effort	r^2
<i>Rastrelliger</i> spp	69,229	2321 boats	0.8613	62,301	1983 boats	0.9132
<i>Rastrelliger</i> spp	66,161	123,928 boat days	0.4685	72,502	174,089 boat days	0.4630
<i>R. brachysoma</i>	54,394	123,766 boat days	0.4653	59,532	173,771 boat days	0.4686
<i>R. kanagurta</i>	11,530	124,732 boat days	0.4651	12,664	175,881 boat days	0.4593
<i>Decapterus</i> spp	7,350	12,276 boats	0.3125	6,131	1670 boats	0.1481

Table 5
List of parameters estimated by ELEFAN method, for mackerels and scads
in the west coast of Peninsular Malaysia

Area	Species	L_{∞}	K	M	F	Z	E	L'	L_C	ESP/ASP
Perlis	<i>R. kanagurta</i> (PS)*	29.7	1.19	1.97	4.93	6.90	0.71	20	19.5	0.260352
	<i>D. maruadsilrusselli</i> (PS)	27	1.01	1.82	7.74	9.56	0.81	16	15.6	0.353693
Kedah	<i>R. brachysoma</i> (Tr)**	24	1.04	1.92	8.29	10.21	0.81	19	18.8	0.299018
Penang	<i>R. kanagurta</i> (PS)	29	1.21	2.01	6.13	8.14	0.75	19	18.7	0.316294
	<i>D. maruadsilrusselli</i> (PS)	24	0.81	1.63	1.94	3.67	0.54	17	15.9	0.60564
Perak	<i>R. brachysoma</i> (PS)	26	0.6	1.31	5.59	7.9	0.81	19	18.9	0.562807
	<i>R. brachysoma</i> (Tr)	25	0.82	1.62	5.17	6.79	0.76	19	18.8	0.236961
Selangor	<i>R. brachysoma</i> (PS)	24.2	0.52	1.22	3.21	3.43	0.73	19	18.9	0.405238
	<i>R. brachysoma</i> (Tr)	24	1.02	1.89	5.26	7.15	0.74	19	18.8	0.223843

* PS - Purse Seines

** Tr - Trawls

Table 6a
Percentages of maturity stages of *R. brachysoma* off Kedah
(January 1984-July 1985)

Stage Month	I	II	III	IV	V
January 1984	2.27	—	56.82	29.54	11.36
February	20.00	33.33	33.33	6.67	6.67
March	—	—	—	—	—
April	—	—	—	—	—
May	29.33	9.33	32.00	29.33	—
June	2.94	91.18	5.88	—	—
July	—	—	—	—	—
August	24.13	41.38	27.59	3.45	3.45
September	40.00	13.33	23.33	16.67	6.67
October	63.27	8.16	12.24	4.08	12.24
November	20.00	40.00	28.00	12.00	—
December	—	—	—	—	—
January 1985	—	—	—	—	—
February	4.35	8.70	65.22	21.74	—
March	—	—	—	—	—
April	3.28	32.79	47.54	14.75	1.64
May	11.11	13.89	72.22	2.78	—
June	2.94	91.18	5.88	—	—
July	—	6.67	43.33	50.00	—

Table 6b
Percentages of maturity stages of *R. kanagurta* off Perlis
(January 1984-July 1985)

Stage Month	I	II	III	IV	V
January 1984					
February	94.74		5.26		
March	34.60	11.54	7.69	15.38	30.77
April	96.3	—	3.70	-	
May					
June					
July	32.00	16.00	44.00	8.00	
August	4.00	40.00	48.00	8.00	
September					
October					
November					
December					
January 1985		-			
February	—				
March	50.00	8.33	36.67	5.00	
April					
May	77.50	10.00	10.00	2.50	
June	91.49	2.13	6.38	—	
July	87.50	12.50	—	—	

Table 7
Observation on the percentages of mature (Stage IV & V)
males and females of each species in different areas

Area	Observation periods	Year	No of female			No. of Males			Combined average (%)
			Observed	Matured	%	Observed	Matured	%	
<i>R. brachysoma</i>									
Kedah	July 1985-June 1986	1986	239	87	36.4	468	87	18.6	24.6
Perak	July 1985-May 1986	1986	551	174	31.6	615	94	15.3	23.0
Selangor	July 1985-April 1986	1986	487	77	15.8	614	89	14.5	15.1
					Average			15.9	20.4
<i>R. kanagurta</i>									
Perlis	July 1985-May 1986	1986	300	59	19.7	348	47	13.5	16.4
Penang	June 1985-May 1986	1986	497	23	4.6	318	5	1.6	3.4
					Average			7.8	9.2
<i>Decapterus</i>									
Perlis	August 1985-May 1986	1986	163	12	7.4	189	20	10.6	9.1
Penang	July 1985-April 1986	1986	275	12	4.3	276	12	4.3	4.4
					Average			6.9	7.6

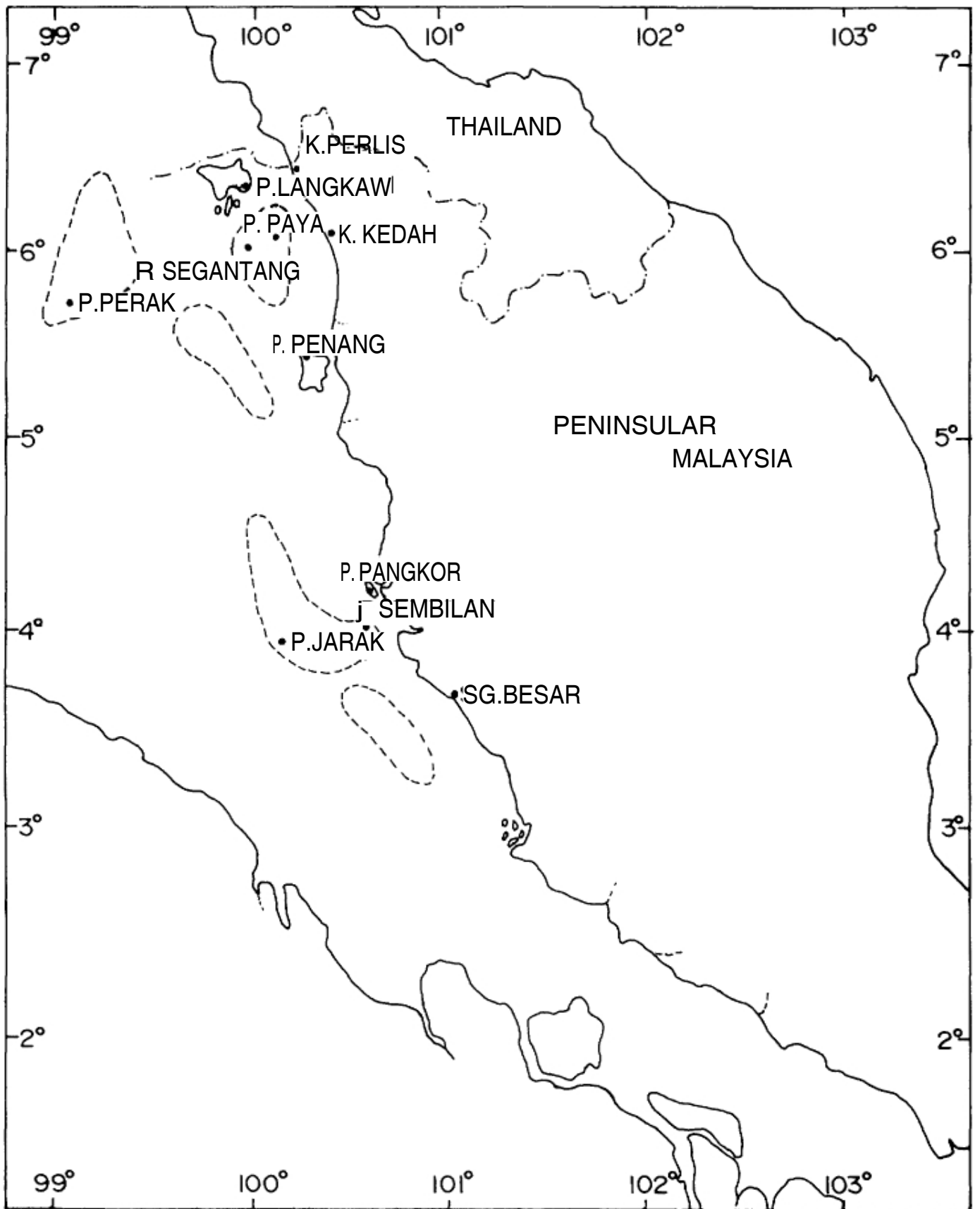


Figure 1. Fishing areas of mackerels and scads on the west coast of Peninsular Malaysia.

Figure 2a-2e.

Monthly catch areas of *R. brachysoma* caught by trawlers at each centre.

25 GRT —————
 40 GRT - - - - -

Fig2c - PENANG

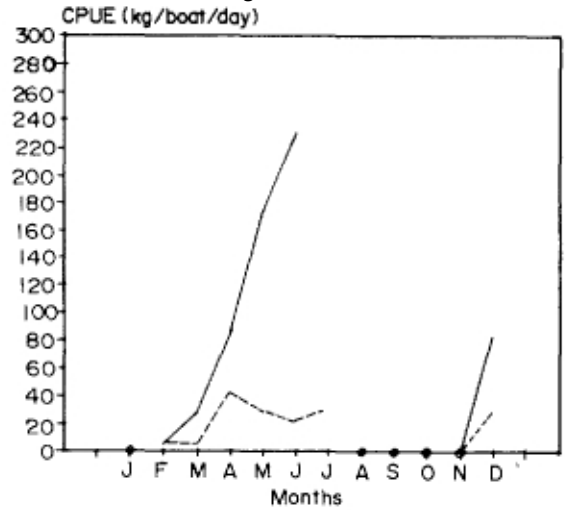


Fig 2a - PERLIS

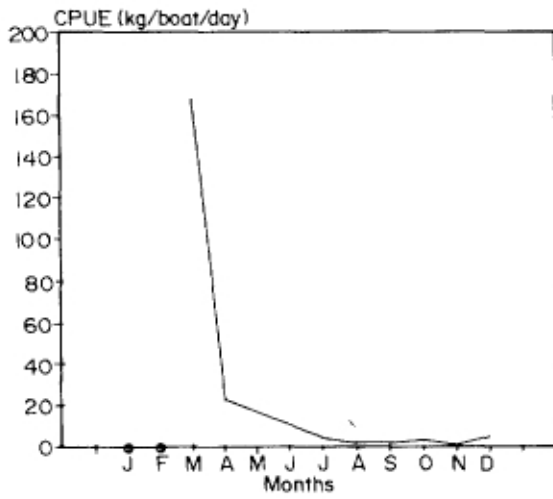


Fig 2d- PERAK

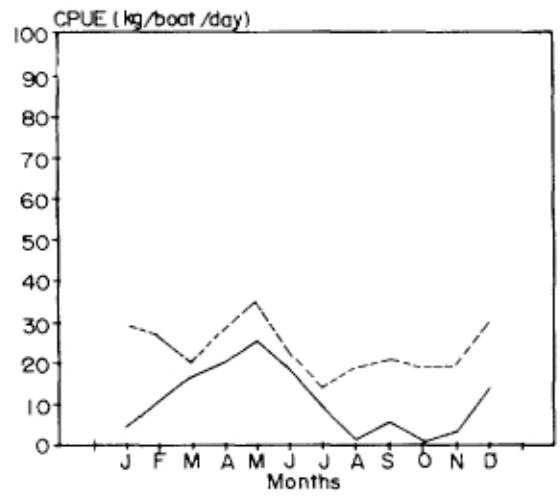


Fig 2b - KEDAH

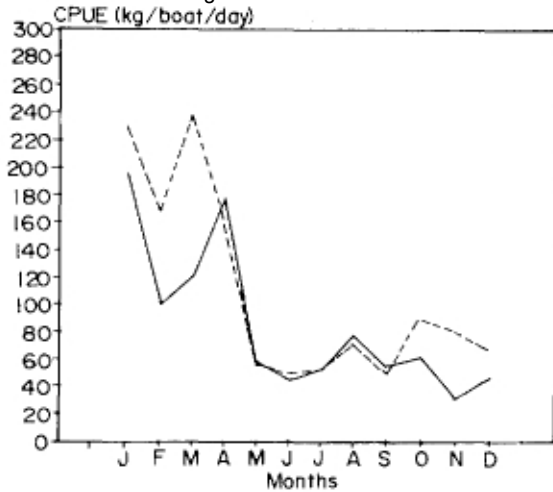


Fig 2e-SELANGOR

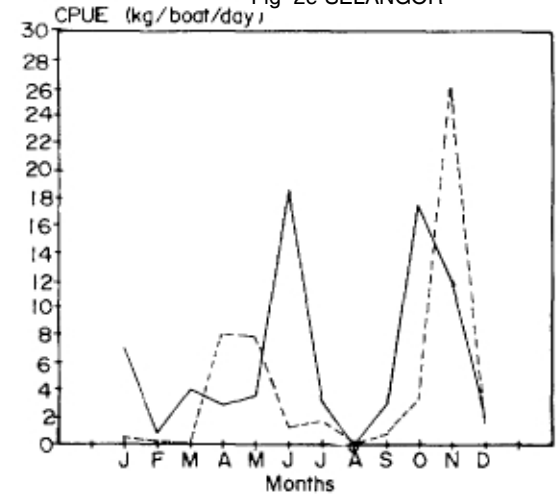


Figure 3a-3e.

Monthly catch areas of *R. brachysoma* caught by purse seiners at each centre.

25 GRT —————
 40 GRT - - - - -

Fig 3a- PERLIS

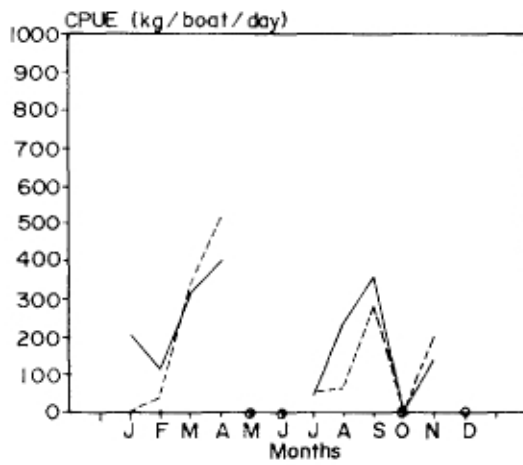


Fig 3c - PENANG

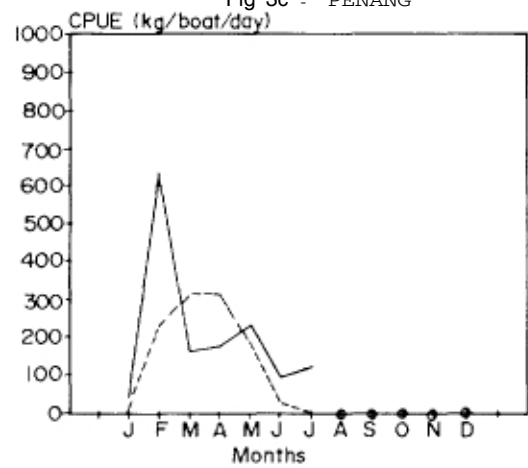


Fig 3d- PERAK

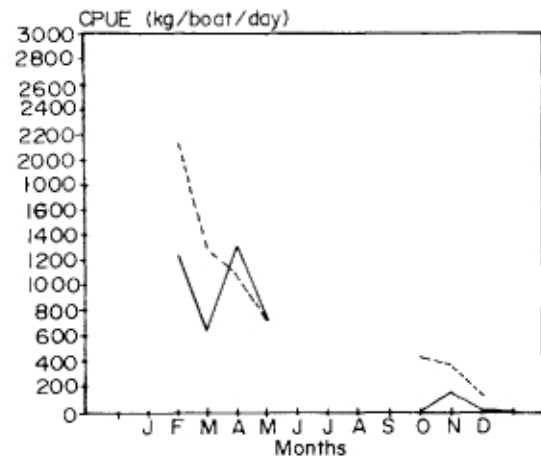


Fig 3b - KEDAH

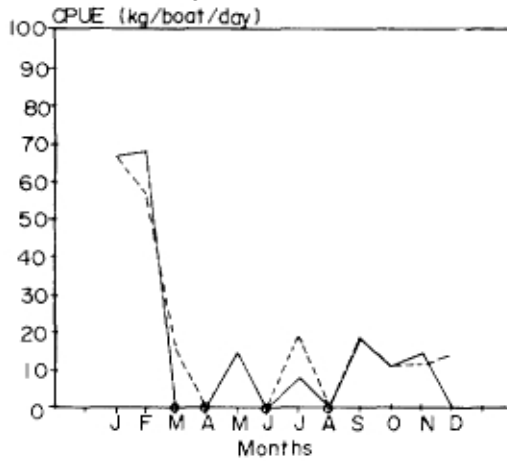


Fig 3e-SELANGOR

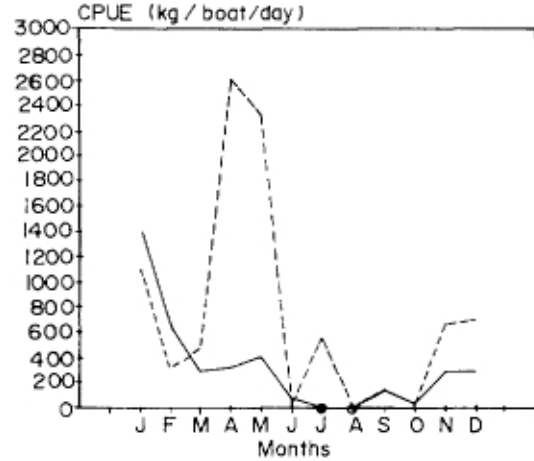


Figure 4, 5a-5c. Monthly catch areas of *R. kanagurta* caught by trawlers and purse seiners at each centre.

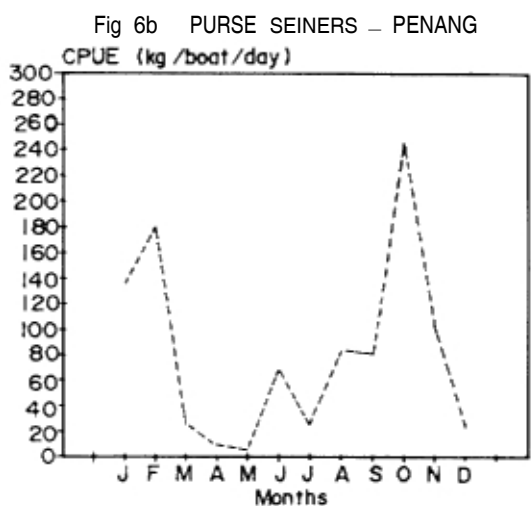
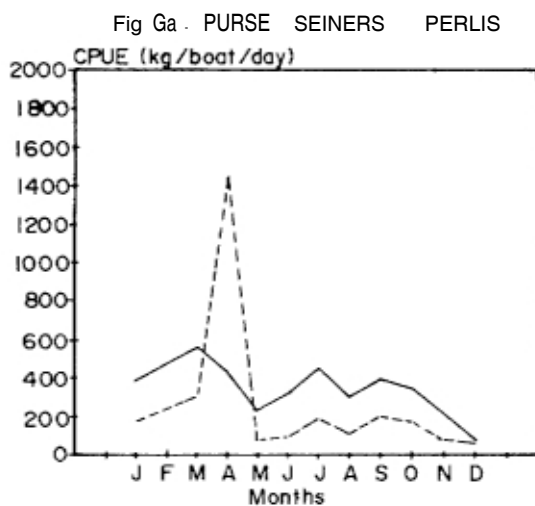
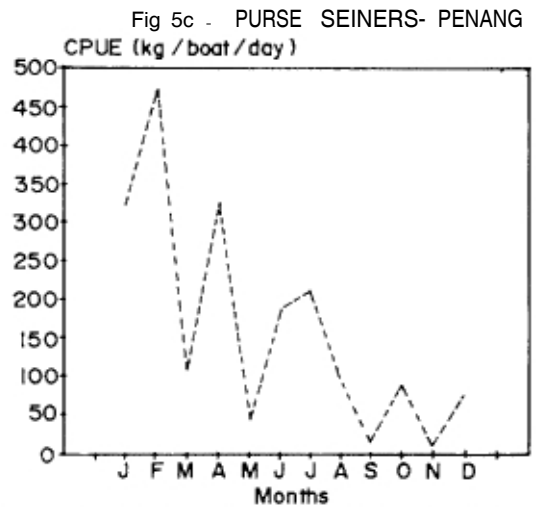
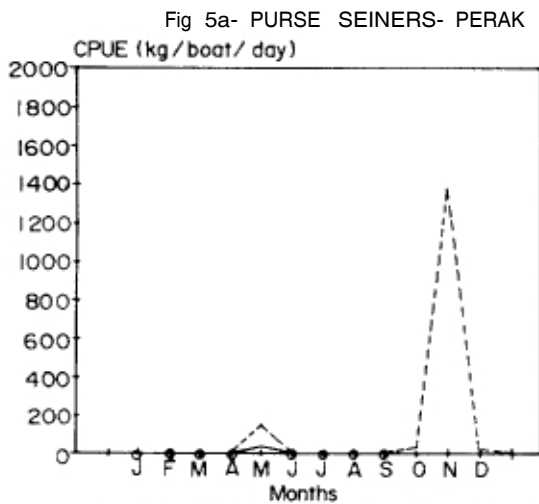
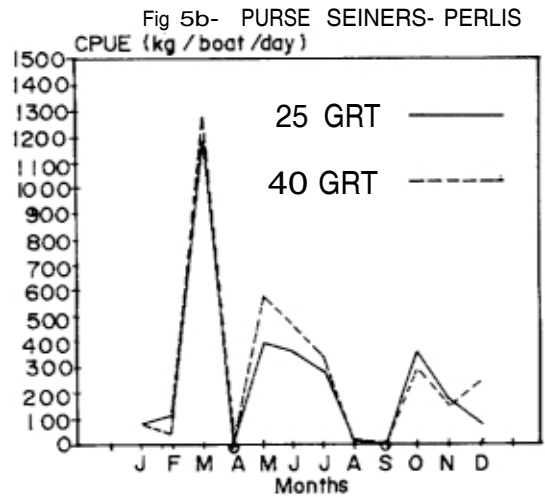
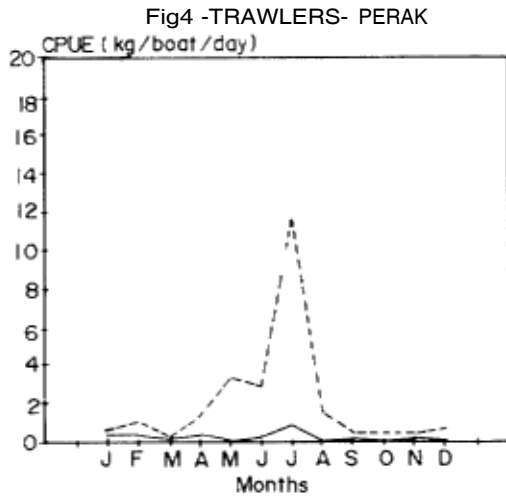


Figure 6a-6b, Monthly catch areas of *D. russelli* caught by purse seiners at Perlis and Penang.

Figure 7a. Seasonal changes in length composition of *R. brachysoma* in Kuala Kedah, 1984/1985.

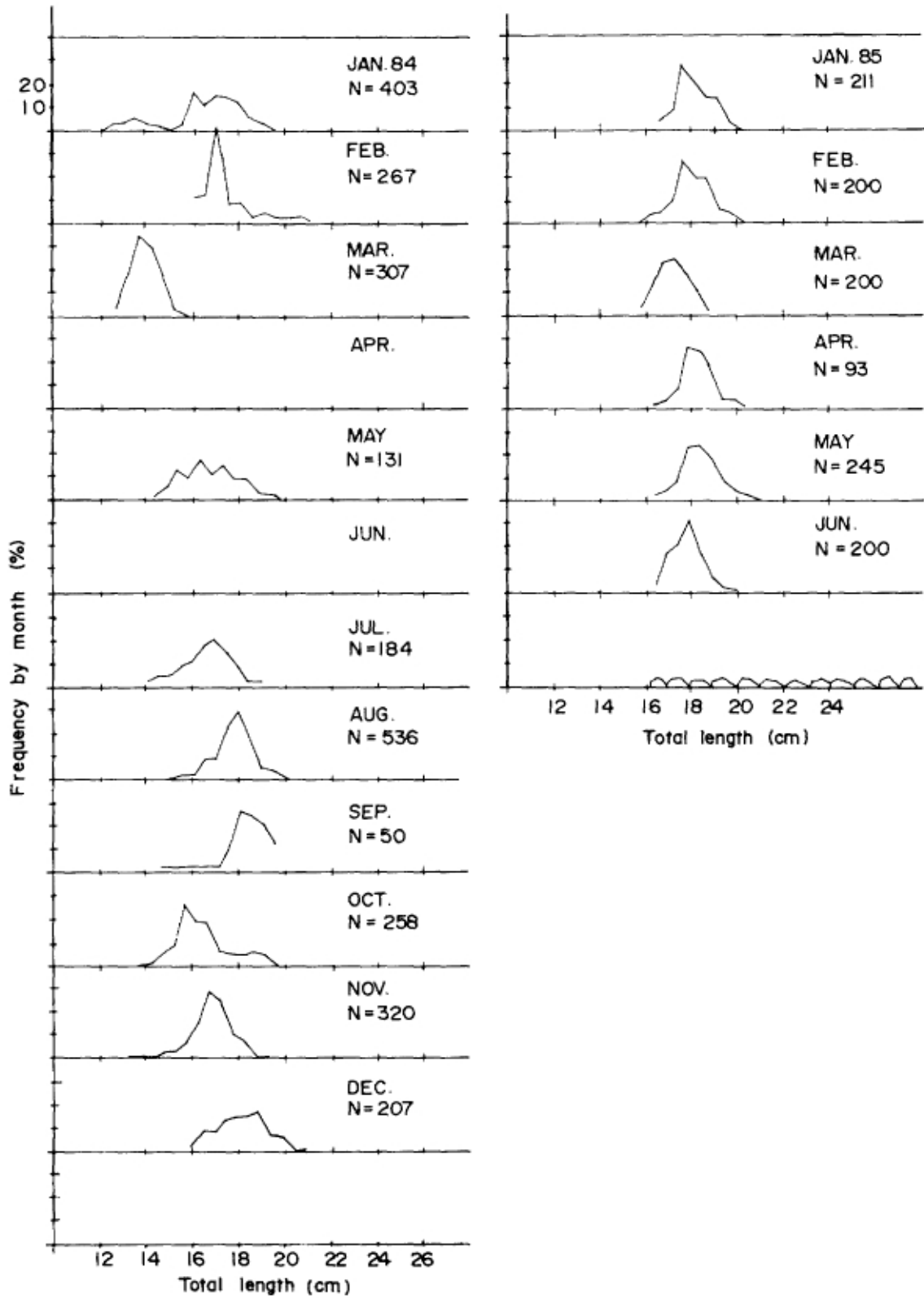
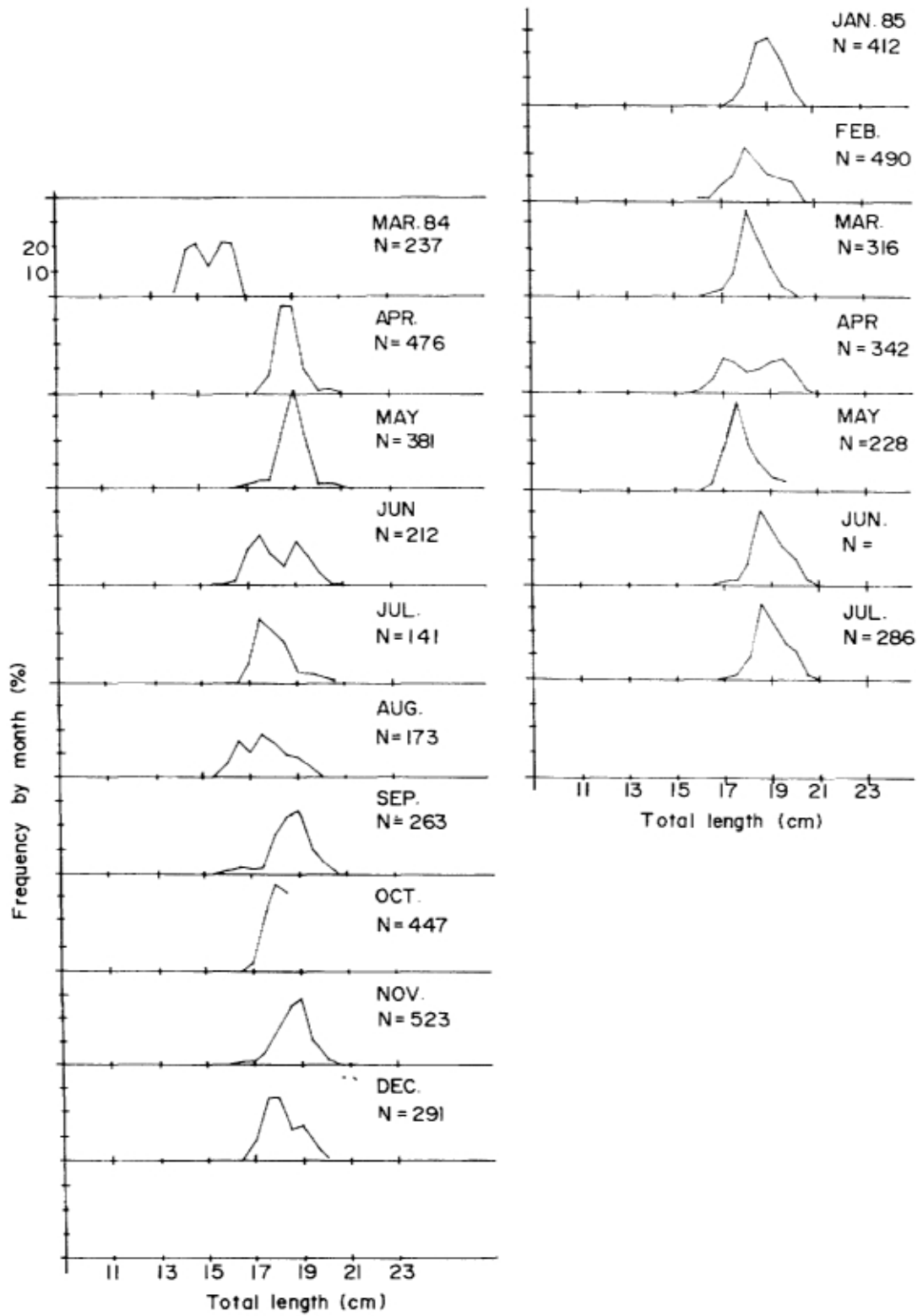


Figure 7b. Seasonal changes in length composition of *R. brachysoma* in Pulau Pangkor, 1984-1985.



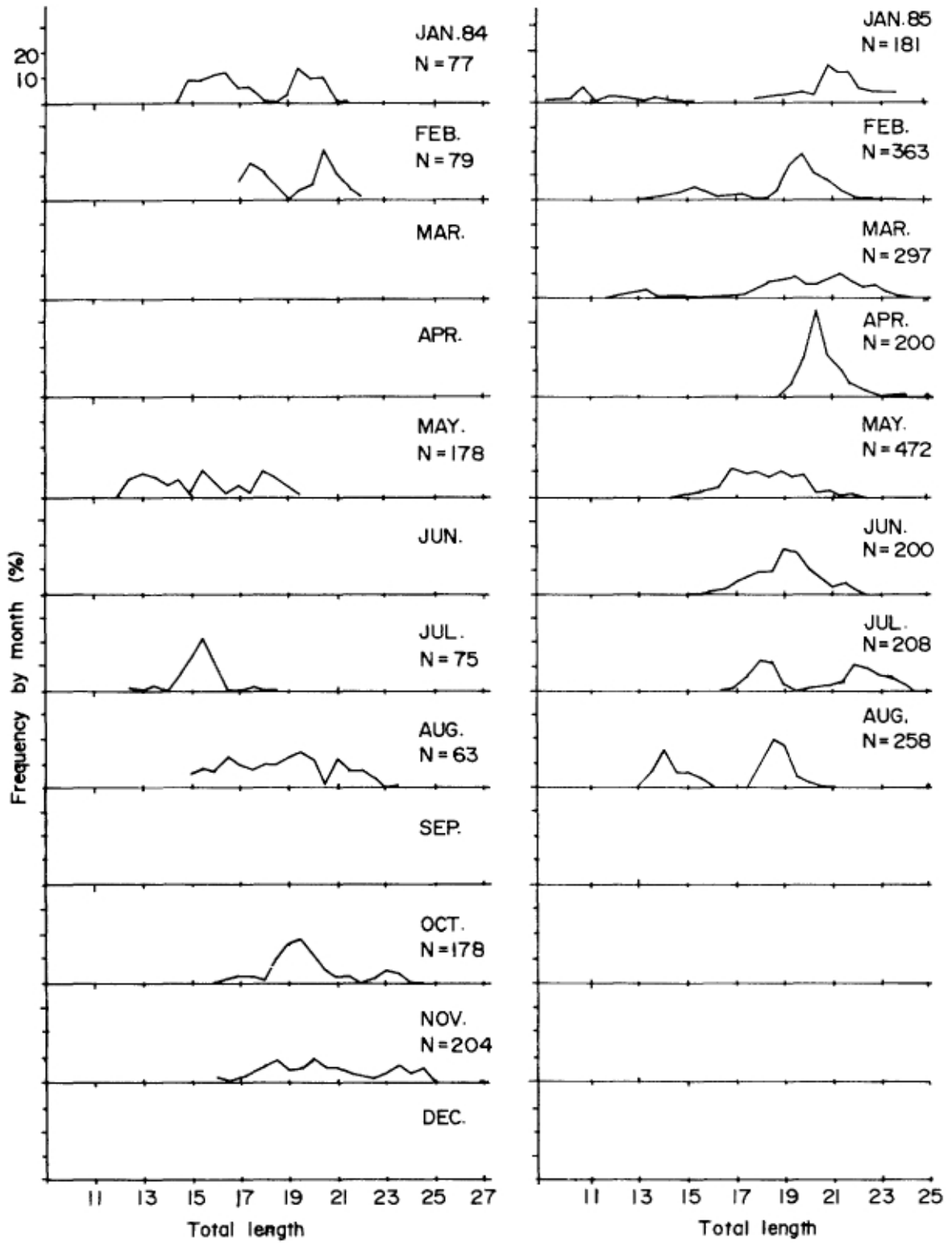


Figure 7c. Seasonal changes in length composition of *R. kanagurta* in Kuala Perlis, 1984/1985.

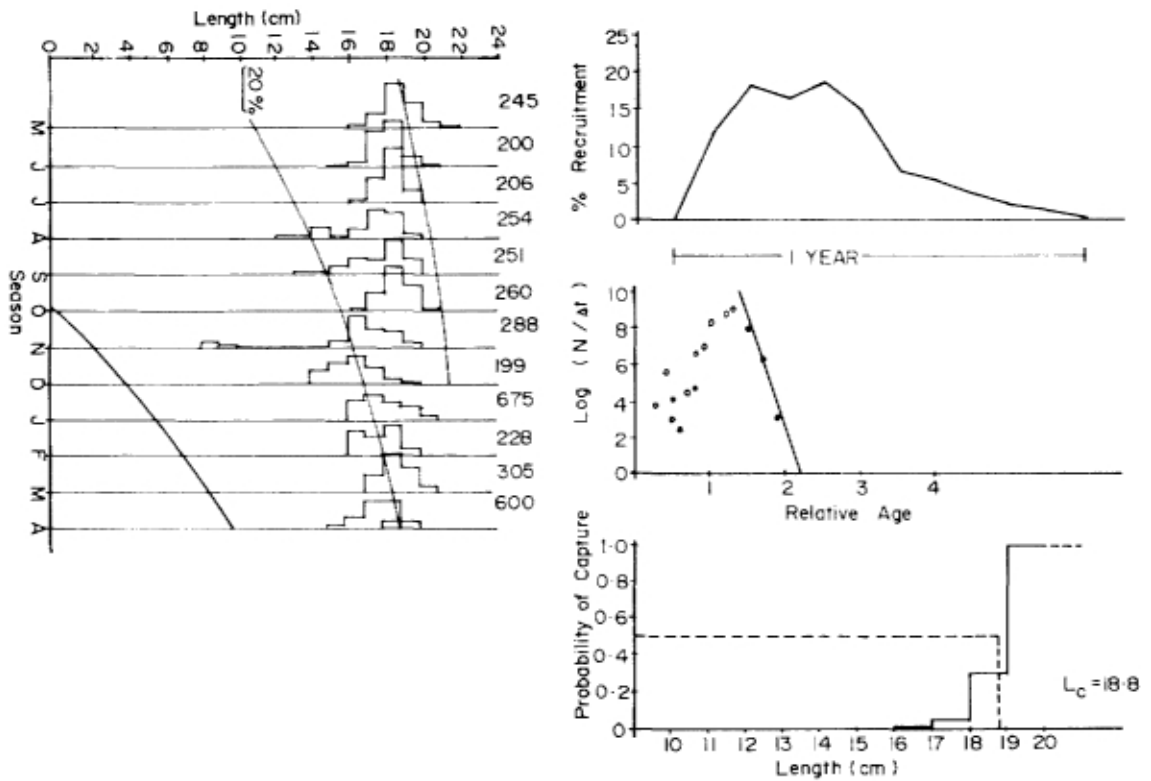


Figure 8a. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Kedah, trawlers,

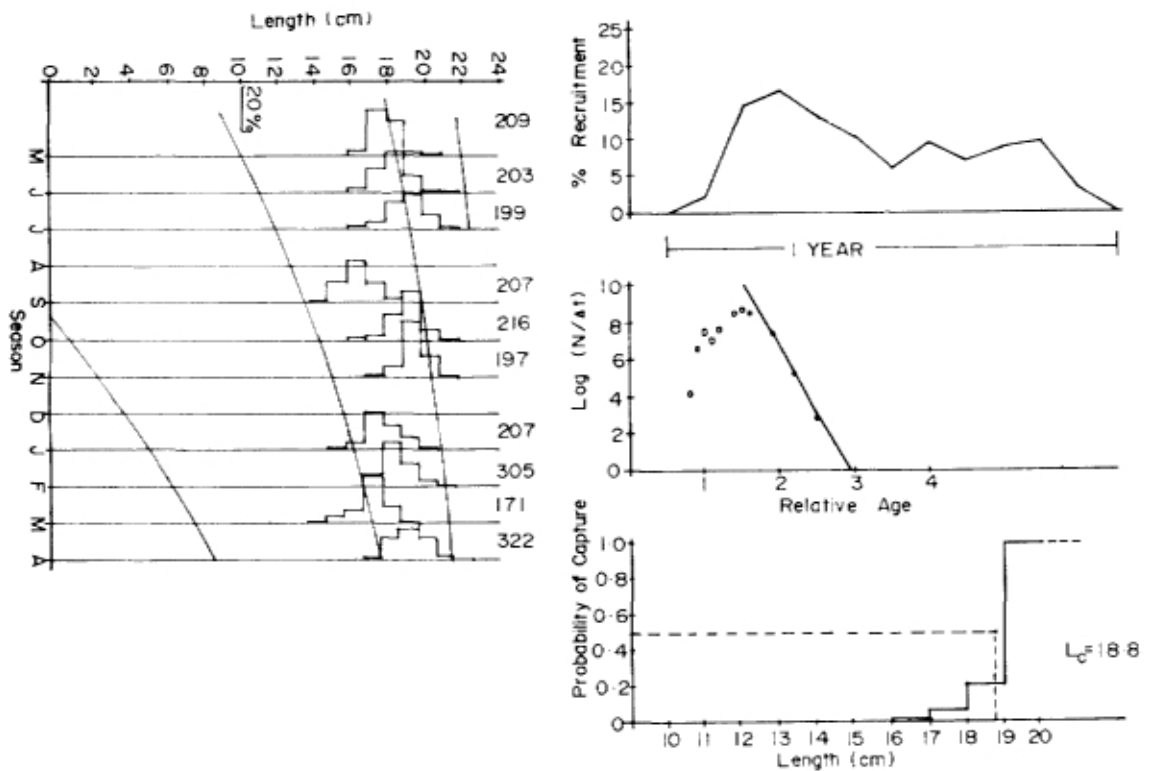


Figure 8b. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Perak, trawlers.

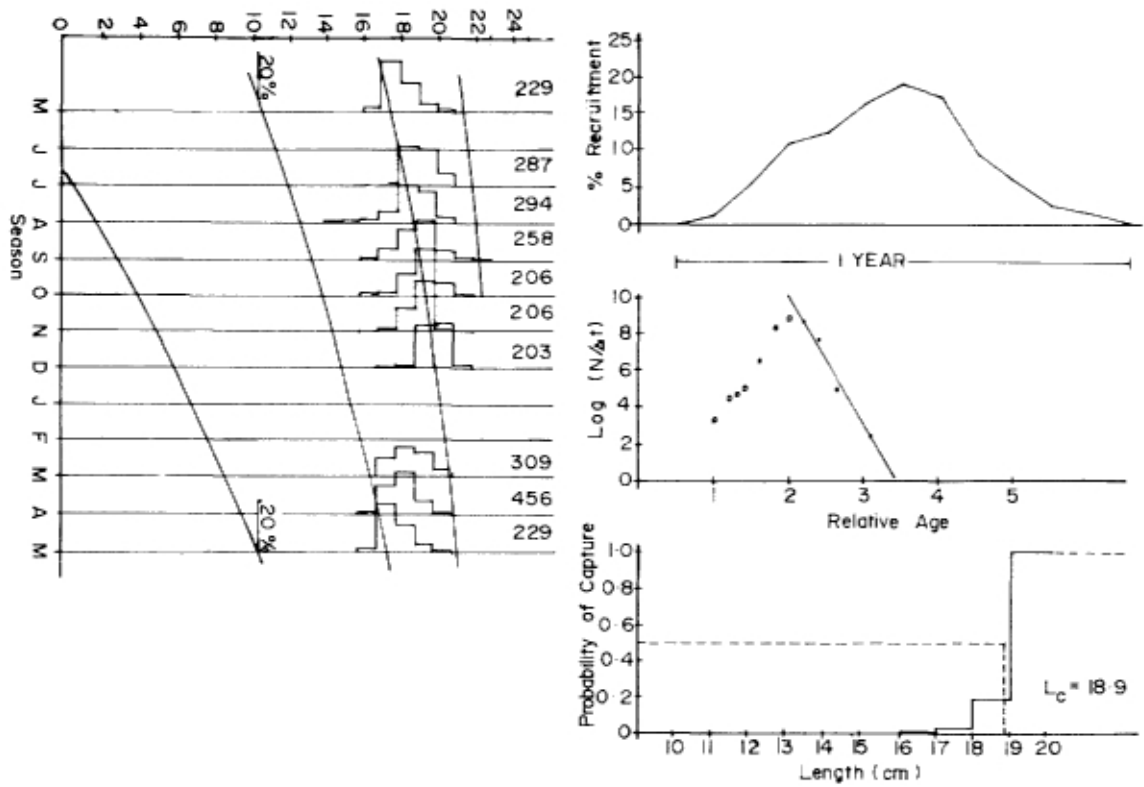


Figure 8c. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Perak, purse seiners.

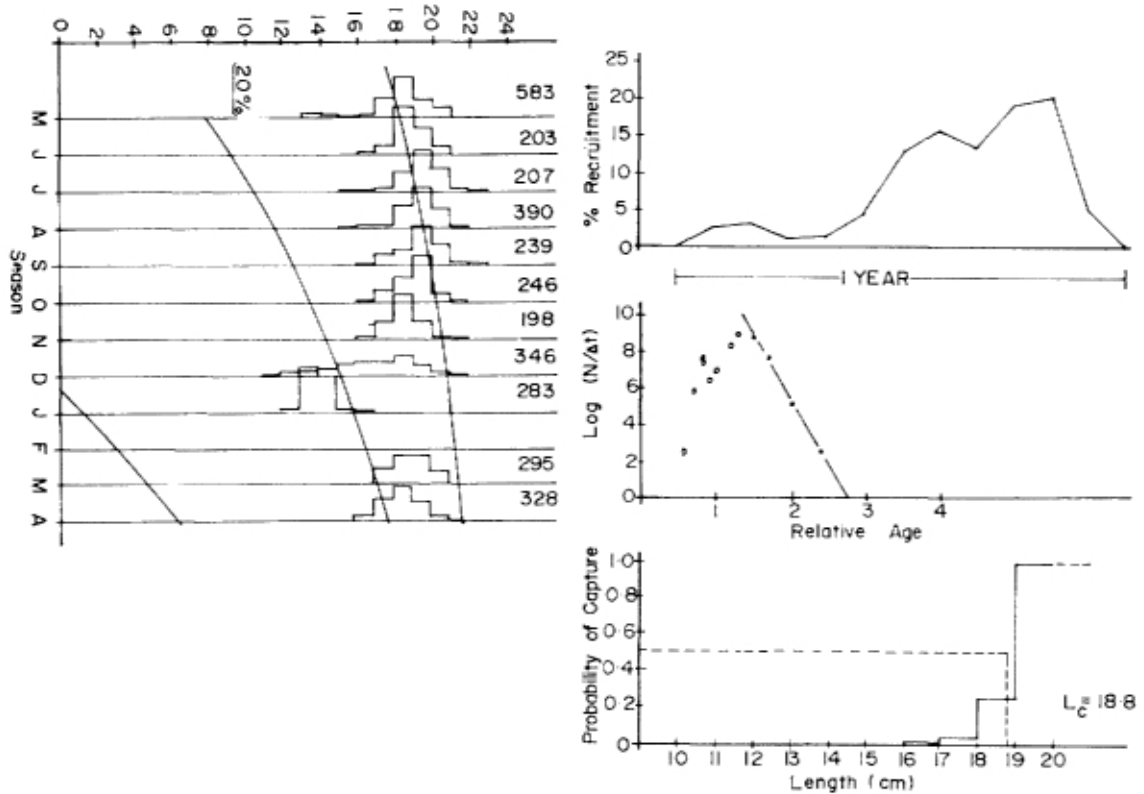


Figure 8d. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Selangot, trawlers.

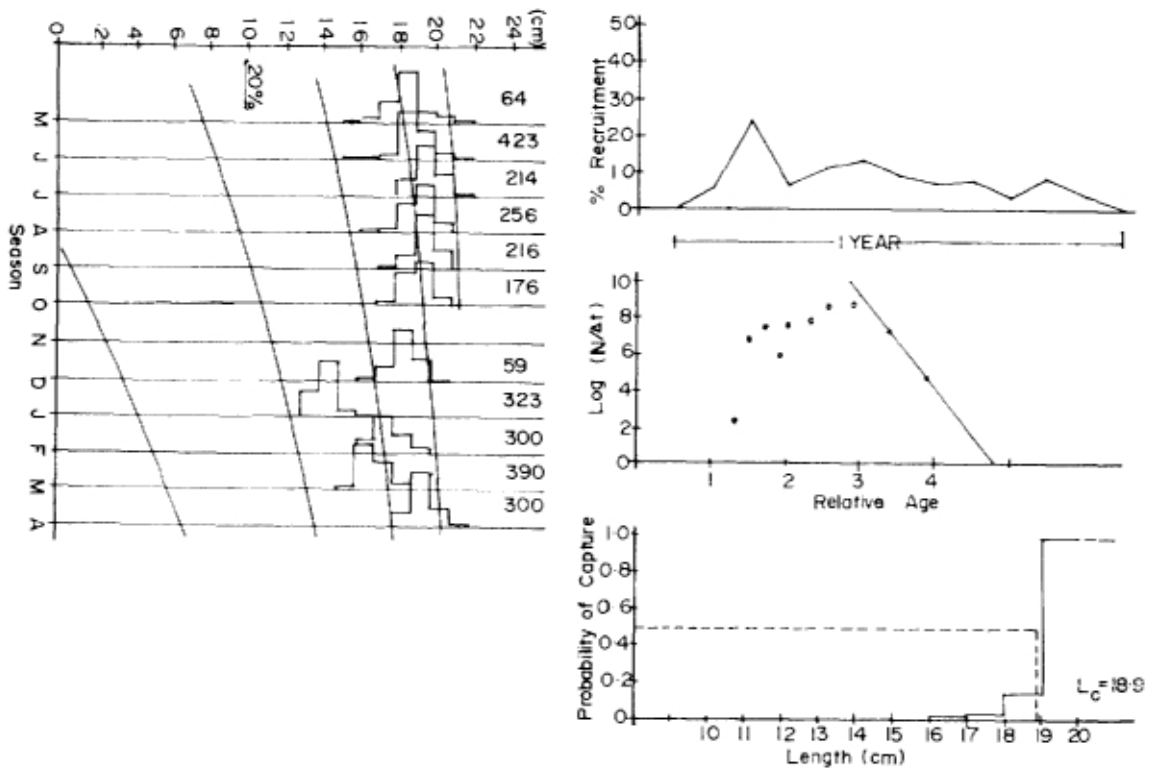


Figure 8e. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Selangor, purse seiners.

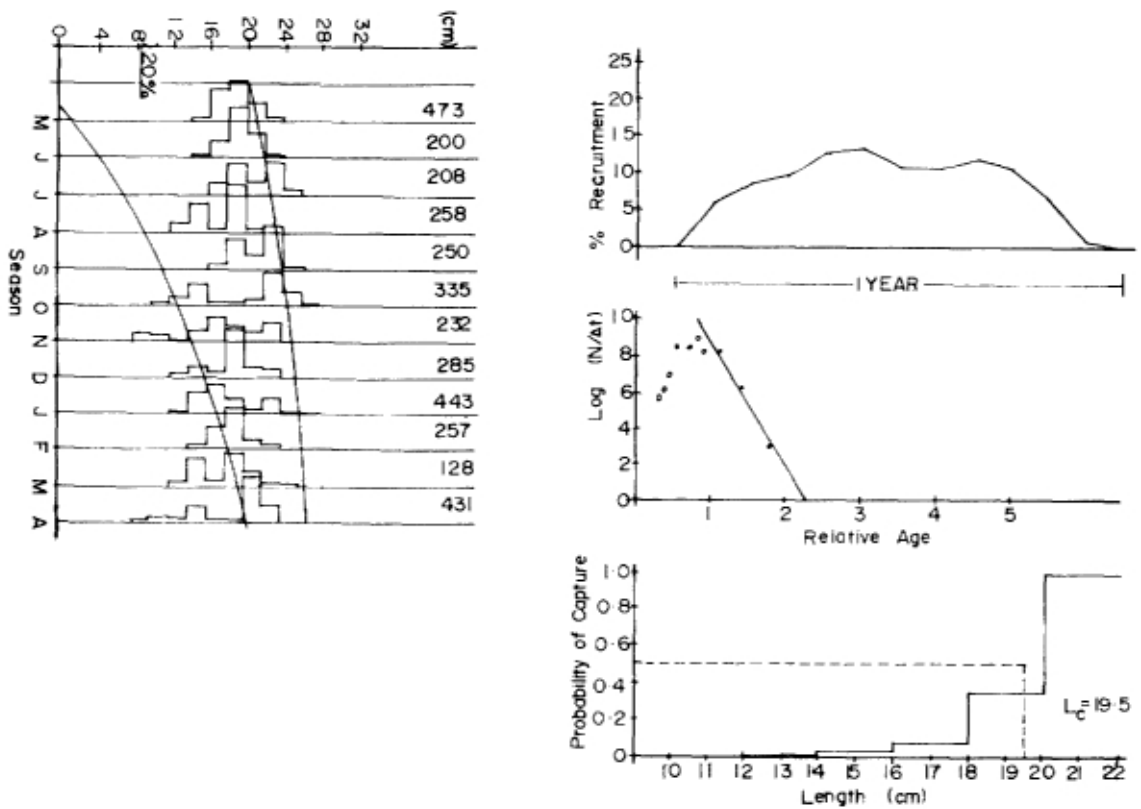


Figure 8f. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. brachysoma* from Perlis, purse seiners.

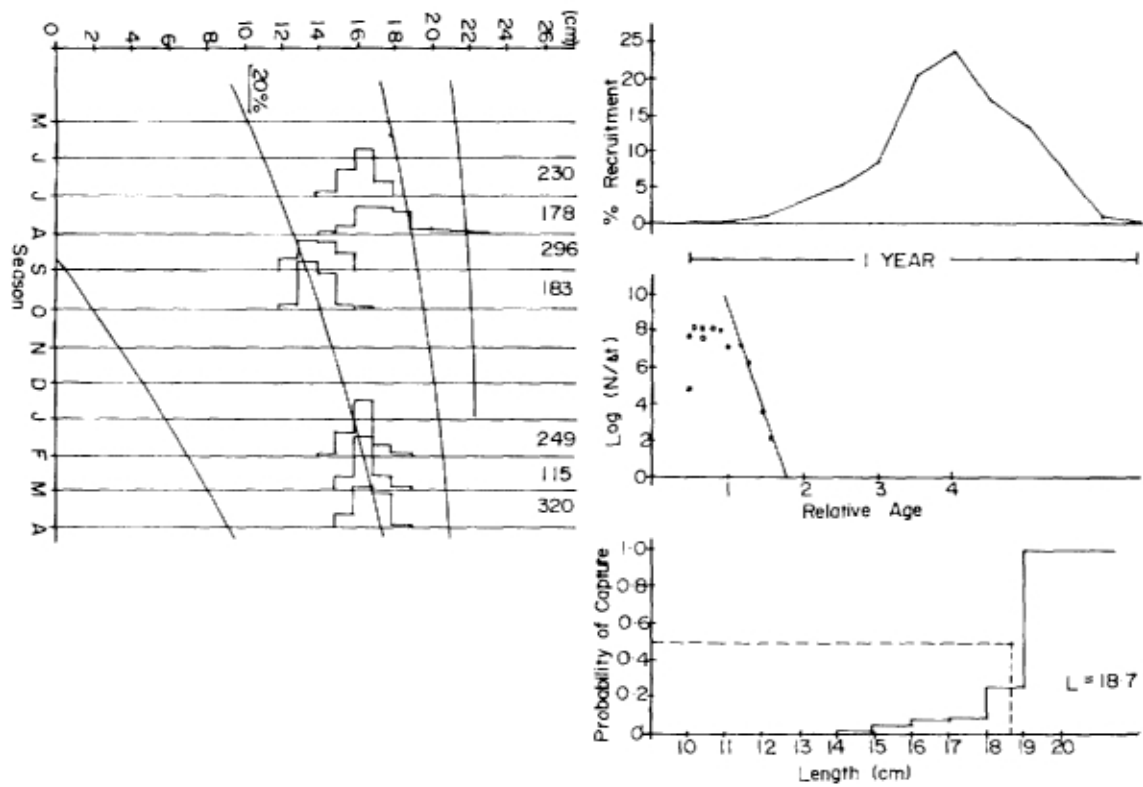


Figure 8g. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *R. kanagurta* from Penang, purse seiners.

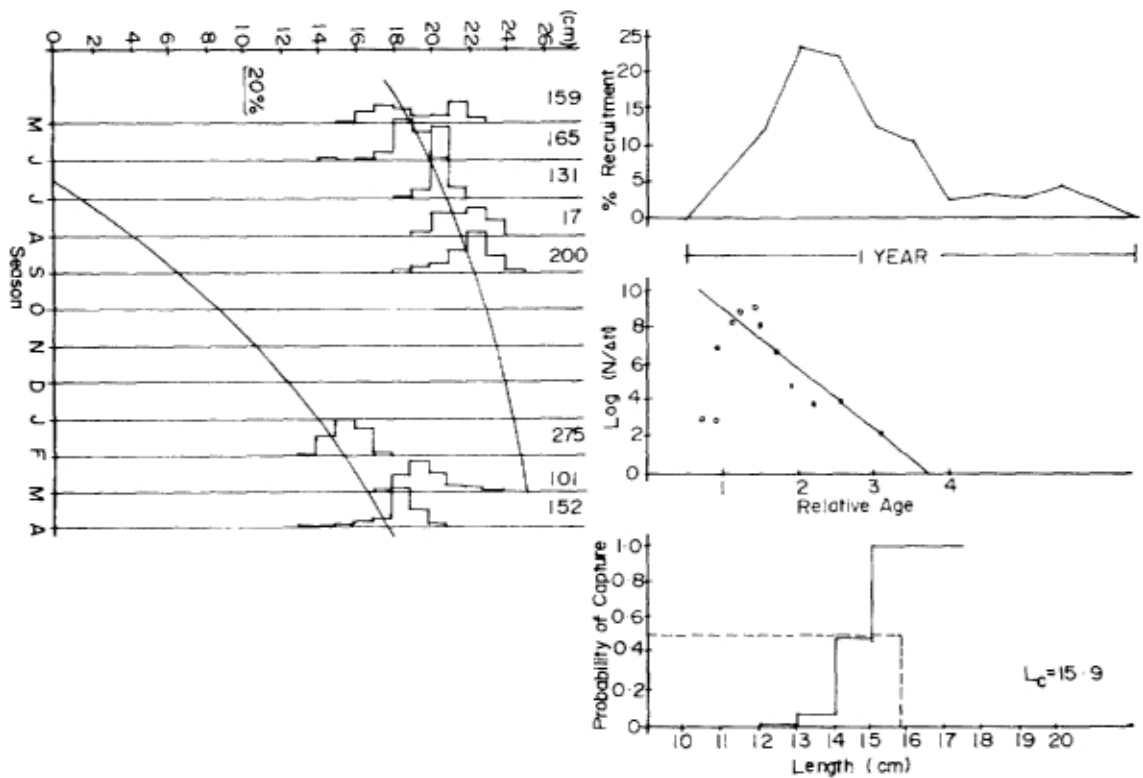


Figure 8h. Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *D. russefii* from Penang, purse seiners.

Figure 8i Length frequency distribution, growth curve, recruitment, catch curve and selection pattern of *D. russelli* from Perlis, purse seiners.

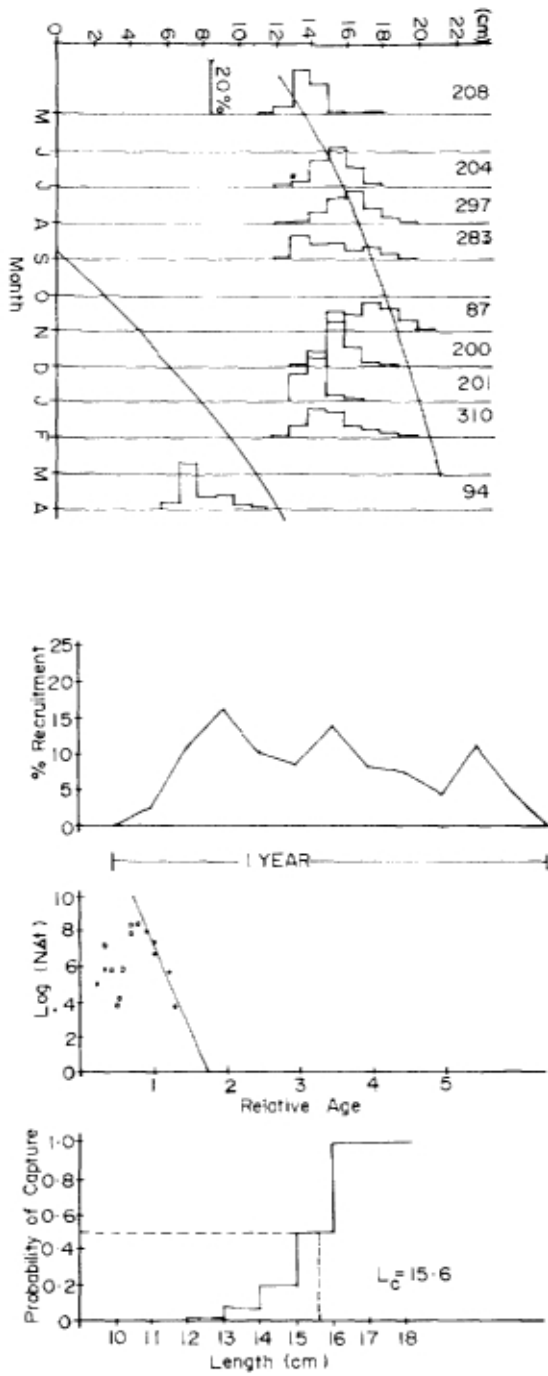


Figure 9a-9c, Mean gonadosomatic index of *R. brachysoma*, *R. kanagurta* and *D. russelli*,

