

Annexure 4

MACKEREL FISHERIES IN THE MALACCA STRAITS

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Introduction

The surface area of the Indonesian part of the Malacca Straits is estimated at 100,000 sq km or just around 1.7% of the total marine waters of Indonesia. The fishing area is estimated at 55,000 sq. km or about 0.9%. However, the Malacca Straits is very important, being the shortest route for ships sailing from the West to the Far East. The Malacca Straits is also one of the most important fishing zones, and its resources are exploited by Indonesia, Malaysia and Thailand. The Indonesian coast along the Malacca Straits is a densely populated area, where the number of fishermen is about 85,735, 16.5% of the total number of fishermen in Indonesia. The number of motorized boats is increasing very rapidly, at about 18.0% per annum (from less than 5 to 30 GHT class). The most important gear used in this area is the purse seine, its number increasing annually by 25%.

Since 1984, sampling has been carried out in Banda Aceh, Lhok Sumawe, Langsa, Belawan and Asahan. The sampling activities aim at collecting data on:

- catch by species by boat
- fishing grounds
- number of sets
- number of days per trip
- number of boats landing.

In Lhok Sumawe and Belawan, sampling was discontinued before the end of the project, because of personnel problems.

Species caught

Usually, two species of *Rastrelliger* are caught, i.e. *R. kanagurta* and *R. brachysoma*, and two species of *Decapterus* i.e. *D. macrosoma* and *D. russelli*. Although Malaysia and Thailand refer to one of the *Decapterus* species as *D. maruadsi*, the name *D. russelli* will continue to be used until the taxonomical problem is solved. In order to solve this problem, samples have been sent to Dr. Smith-Vaniz as suggested by Dr. Sivasubramaniam, and his reply is awaited.

Although four species are caught, they are lumped together into two groups: the "kembung" group for *Rastrelliger* spp. and the "layang" group for *Decapterus* spp. No other species of *Rastrelliger* or *Decapterus* have been reported from this area, but *R. faughni* has been reported from Thai waters and *D. kurroides* and *D. macarellus* have been reported from the Eastern Indian Ocean.

Fishing gears and vessels

For catching pelagic fish on the Indonesian side of the Malacca Straits, the main gear types used are purse seine, Danish seine and gillnet. The rapid development of purse seine in this area has led to a decrease in the number of Danish seines, and in Langsa (East Aceh) Danish seines are not operated any more.

The purse seine used in the Indonesian part of the Malacca Straits is of the American type where the bunt is located at one side of the net. Target species of this fishery are small tunas;

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In the absence of small tunas the fishing directs its effort towards other small pelagics like scads, mackerels or sardines.

Gillnets are mainly used near the coast (for instance in Asahan) to catch Indo-Pacific mackerels.

In Banda Aceh, the purse seine is used without any lures or fish aggregating devices (FADs). Fishing trip generally have a duration of one day. The distance to the fishing grounds is about 15-20 miles. In 1985, a small number (2 or 3) of purse seiners operated off the west coast of Sumatra. The size of the vessels operating off Banda Aceh ranges between 7 and 18 m (LOA) and between 5 and 10 GRT, while the (inboard) engine power ranges from 12 to 17 hp.

The fishermen landing their catches at the Langsa Harbour and Iri Fishery Auction Centre use FADs made of bamboo and coconut leaves. Around the new moon period, fishing is carried out with kerosene or battery lamps as lures. The size of vessels at this centre varies between 7 and 25 m (LOA), 5 and 25 GRT and with inboard engine of 33 to 120 hp.

The length of the nets used between 600 and 800 m. In Lhok Surnawe, there are some mini purse seiners of 1.8 to 5.4 GRT, with a crew of 8-12 men and using outboard motors of about 15 hp, while bigger vessels have a size of 16-20 GRT (Anonymous, 1984). In Lhok Sumawe, the size of the big purse seine used is 800 to 1000 m in length, 45 to 75 m in depth and operated by 15 to 25 fishermen.

FADs are used in the Asahan district also to congregate fish for the purse seine fishery. Vessels landing in the Asahan District are of a bigger size than those in the other areas, the biggest vessels steaming a greater distance to reach the fishing grounds. The size of vessels and the engine power range from 13 to 35 GRT and from 33 to 240 hp, respectively. The purse seines used are to 450 to 600 m length. 259 purse seiners are landing their catches in the Asahan area.

In general, it was observed that there is hardly any relationship between the size of the vessel and the size of the gear used. Neither is there any relation between the size of the vessel and the power of the engine. Higher horse power engines are mainly used in order to reduce the steaming time to the fishing grounds.

Monthly catch rates

The monthly catch rates by species, for the purse seine fleet operating in the Indonesian part of the Malacca Straits, are presented in Figures 1 to 4. Peaks in catch rate may be seen for *D. russelli* in May/June in Langsa, for *D. macrosoma* in January/February in Langsa, for *R. brachysoma* from April to June in Banda Aceh, Langsa and Asahan, and for *R. kanagurta* in July/August in Asahan.

Catch rates by vessel size

At the three main harbours, catch rates (kg/boat/day) were obtained for several sizes of vessels, consequent to the attempt to get fishermen to complete fishing log sheets provided by the BOBP project (RAS/81/051).

For Banda Aceh the following information was obtained:

Size of Vessel (GRT)	CPUE (kg/boat/day)
Smaller than 6	725
6-7	828
7-8	736
Larger than 8	528

Vessels of 6-7 GRT appeared to have higher catch rates than larger vessels.

Vessels landing in Langsa range from 5 to 25 GRT. As in Banda Aceh, hardly any relationship exists between the size of the vessel and the catch rate. The available catch and effort data are summarised below.

Size of vessel GRT	No. of days operating	Total catch (kg)	CPUE (kg/day)
5	42	17,200	410
7	448	179,565	401
8	512	208,430	407
9	243	91,795	378
10	127	36,055	284
11	95	16,785	177
12	105	28,745	274
13	138	44,140	320
24	9	4,400	489
25	35	6,900	200

The catch rates of 5-9 and 24 GRT vessels were remarkably high. Though the 24 GRT vessels showed the highest catch rate, the number of samples for this estimate was very small.

The CPUE data (kg/boat/day) collected in Teluk Nibuing (Asahan District) were as follows:

Size of Vessel (GRT)	CPUE (kg/boat/day)
13	400
14	450
15	450
17	618
22	625
25	650
27	700
28	767
30	800
34	1,017
35	1,350

It may be concluded that the larger vessels exhibited higher catch rates. It is assumed that the larger vessels exploit fishing grounds different from those frequented by the smaller vessels and also have a greater endurance.

The monthly catch rates for the three areas are presented in Figure 5.

Production and level of exploitation

From 1976 to 1985, the production of *Rastrelliger* fluctuated between 10,396 (1981) and 22,809 tonnes (1985). The *Decapterus* landings increased from 758 tonnes in 1976 to 16,168 tonnes in 1985 (Table 1). The data collected from sampling sites are presented in Tables 2, 3 and 4. From Lhok Sumawe and Banda Aceh, only small quantities of mackerels were reported during the sampling period. This is probably because the target species of the purse seiners in this area are tuna and tuna-like fish rather than mackerel.

For the calculation of the MSY for *Rastrelliger* and *Decapterus*, the data used were those for the period 1979 to 1985.

Application of Schaeffer's production model to the catch and catch rate data resulted in MSY values of 6,750 tonnes for *R. brachysoma*, 12,306 tonnes for *R. kanagurta* and 10,767 tonnes for both *Decapterus* species, but the production of these species in 1985 was of the order of 7,379, 15,430 and 16,168 tonnes respectively.

For each species, the production models were initially applied to catch and catch rate data separately for the northern and southern parts of the Malacca Straits. Since no evidence was available to justify separating these into two stocks, it was considered more reasonable to calculate the MSY for the total Indonesian production (by species) in the Malacca Straits but

to use the catch rates obtained from the southern part because of greater reliability of the estimates from this area (Table 1).

The production models for both *Rastrelliger* species are presented in Figures 6 and 7. It must be noted that no production models for the *Decapterus* species are presented because of very low correlation coefficients for the available data.

Biology

For biological purposes, length, weight and morphometric measurements were collected. The length frequencies for the various species and landing sites obtained from the purse seine fishery in 1985 are presented in Figures 8 to 11. The modal progressions were not clearly evident and the sampling was insufficient because the biologists had practical difficulties in making regular visits from their distant base stations. During trawl surveys by research vessel BAWAL PUTIH II on the east coast of Sumatra in March 1985 and October 1986, 160 specimens of *R. kanagurta* and *R. brachysoma* were obtained. Their lengths varied between 11 and 24 cm and 17 and 23 cm in fork length, respectively. The modal groups for *R. kanagurta* were 20-22 cm in March and 15-16 cm in October. That for *R. brachysoma* was 22-23 cm in March and there was no catch in October. The modal sizes of both species during March were higher than those observed in the purse seine catches made during the same period but most of the *R. kanagurta* samples from October were smaller than the modal size of the purse seine samples for that month. Length frequency data collected were analyzed at the Research Institute for Marine Fisheries using ELEFAN programmes provided by BOBP (Post Sicily version), to estimate growth parameters. The results obtained are presented in Table 5. The L values for *D. macrosoma*, *D. russelli*, *R. kanagurta* and *R. brachysoma* were 280, 260, 285 and 265 mm respectively. The K values were 1.22, 0.9, 0.9 and 1.05 respectively for the four species (Table 5).

Maturity

Studies were carried out on the maturity of scads and mackerel species. Samples were collected from commercial vessels at the landing places and during surveys of the research vessel BAWAL PUTIH II. The total number of fish (by species) examined and their size ranges are summarised in Table 6. The length at first maturity (50%) for *R. kanagurta* was 195 mm for males and 208 mm for females.

In the case of *R. brachysoma* the length at first maturity could not be properly determined, because of the small size of the sample. The lengths at 50% maturity for *D. macrosoma* and *D. russelli* were observed at 166 and 148 mm respectively for males and at 177 and 158 mm respectively for females.

Discussion

The MSYs for *Rastrelliger kanagurta*, *R. brachysoma*, *Decapterus macrosoma* and *D. russelli* obtained using Schaeffer's model appear to have been surpassed by the respective production estimates only recently (1985).

Growth parameters were estimated independently with the length frequency samples from each sampling centre for each species, and these exhibited a wide range of values. Only those considered to be reasonable in terms of modal progression in the frequency distribution and fitness of the growth curve are presented in Table 5.

References

- Anonymous, 1984. Country report from Indonesian mackerels of the Malacca Straits. In Mackerels in the Malacca Straits, BOBP/WP/30, RAS/81/051 p. 50-59.
- Directorate General of Fisheries, 1981-1984. Fisheries Statistics of Indonesia 1981-1984. Dir. Gen. Fish. Min Agri. Jakarta.

Table 1
Production of scads and mackerels and catch rates in the Indonesian part of the Malacca Straits

Year	<i>R. kanagurta</i>		<i>R. brachysoma</i>		Total <i>Rastrelliger</i> (t)
	Catch (t)	CPUE (kg/trip)	Catch (t)	CPUE (kg/trip)	
1976	5,648	—	6,021	—	11,669
1977	6,944	—	6,849	—	13,793
1978	5,253	—	5,979	—	11,232
1979	7,335	215	4,392	22.9	11,942
1980	8,074	75	4,838	7.9	12,987
1981	9,879	114	3,490	12.2	10,510
1982	9,879	154	5,215	16.5	15,248
1983	8,344	174	4,300	18.5	12,818
1984	9,804	444	4,589	47.4	14,837
1985	15,430	449	7,379	47.4	23,258

Year	<i>D. macrosoma</i>		<i>D. russelli</i>		Total Decapterus (t)
	Catch (t)	CPUE (kg/trip)	Catch (t)	CPUE (kg/trip)	
1976	—	—	—	—	758
1977	—	—	—	—	1,365
1978	—	—	—	—	2,536
1979	1,677	92.6	719	89.4	2,489
1980	1,941	32.0	872	31.0	2,813
1981	2,542	49.0	1,855	47.6	4,397
1982	2,989	66.1	2,064	64.1	5,119
1983	4,623	74.5	3,103	72.2	7,800
1984	5,881	190.8	2,843	185.1	8,915
1985	8,529	77.9	7,612	75.5	16,219

Table 2
Catch and effort data collected in Banda Aceh in 1985

Month	No of Trios	No. of Sets	<i>D. macrosoma</i> (kg)	<i>D. russelli</i> (kg)	<i>R. brachysoma</i> (kg)	<i>R. kanagurta</i> (kg)	Others (kg)	Total (kg)
January	429	1,339	1,010	—	1,100	—	107,047	109,157
February	384	1,336	590	275	1,040	—	112,465	114,370
March	297	1,112	—	12,950	14,275	600	32,205	60,030
April	269	1,056	—	13,262	18,025	—	36,945	68,232
May	136	556	—	2,540	3,590	—	59,305	65,435
June	51	136	—	375	400	450	6,630	7,855
July	193	—	—	055	—	2,645	32,045	35,545
August	—	—	—	—	—	—	—	0
September	297	—	—	1,785	—	—	70,645	72,430
October	408	—	—	—	—	4,080	144,335	148,415
November	374	—	—	2,405	—	5,145	83,325	90,875
December	330	—	—	—	—	2,675	74,820	77,495
Total	3,168	5,535	1,600	34,447	38,430	15,595	759,767	849,839

Table 3
Catch and effort data collected at Iidi, East Aceh district (1984-1986)

Month	No. of Days	No of Sets	<i>D. macrosoma</i> (kg)	<i>D. russelli</i> (kg)	<i>R. brachysoma</i> (kg)	<i>R. kanagurta</i> (kg)	Total (kg)
November 1984	66	80	56,400	1,650	—	—	58,050
December	129	198	70,950	1,500	—	—	72,450
Total	195	278	127,350	3,150	0	0	130,500
January 1985	84	109	65,300	—	—	—	65,800
February	179	239	114,175	—	—	—	114,175
March	216	286	68,650	29,850	1,575	75	100,150
April	128	171	48,325	13,675	1,225	3,525	66,750
May	143	201	45,445	8,150	7,725	6,915	68,235
June	44	69	8,285	8,150	925	825	18,185
July	74	104	8,495	5,750	350	2,225	16,820
August	143	198	16,390	10,435	1,425	1,325	29,575
September	249	323	29,125	20,075	3,950	3,125	56,275
October	163	204	8,890	6,905	1,450	1,225	18,470
November	210	291	30,627	21,013	2,470	4,130	58,240
December	224	296	15,190	11,285	1,185	1,767	29,427
Total	1,857	2,491	459,397	135,288	22,280	25,137	642,102
January 1986	179	232	22,450	24,980	1,520	2,440	51,390
February	299	388	89,245	88,495	4,910	10,170	172,820
March	261	342	44,215	56,515	4,785	7,045	112,560
April	273	359	60,640	43,955	1,625	2,690	108,910
May	156	188	47,080	29,850	1,605	1,360	79,895
June	132	146	39,915	23,345	2,705	1,095	67,060
Total	1,300	1,655	283,545	287,140	17,150	24,800	592,633

Table 4
Catch and effort data collected in Asahan (1984-1985)

Month	No. of Trips	<i>R. kanagurta</i> (kg)	<i>R. brachysoma</i> (kg)	<i>Decapterus spp.</i> (kg)	Total (kg)
January 1984	614	75,529	23,515	300,622	399,666
February	329	53,620	7,853	185,024	246,497
March	609	114,465	9,749	423,924	548,138
April	952	172,259	20,543	857,770	1,050,572
May	1,105	436,886	22,556	760,491	1,219,933
June	2,636	913,453	3,884	673,749	1,591,086
July	1,636	558,260	16,462	938,913	1,513,635
August	1,614	1,068,353	1,635	394,243	1,464,231
September	1,418	965,235	4,067	322,529	1,291,831
October	1,344	802,711	10,035	250,419	1,063,165
November	1,144	388,235	368,076	262,700	1,019,011
December	788	249,497	159,080	234,910	643,487
Total	14,189	5,798,503	647,455	5,605,294	12,051,252

Month	No. of Trips	<i>R. kanagurta</i> (kg)	<i>R. brachysoma</i> (kg)	<i>D. macrosoma</i> (kg)	<i>D. russelli</i> (kg)	Total (kg)
January 1985	825	263,561	115,739	133,130	98,890	611,320
February	698	271,490	177,385	97,824	41,926	488,625
March	678	196,061	204,064	56,889	52,661	509,675
April	1,023	391,867	320,608	67,024	32,126	811,625
May	828	31,500	348,200	87,223	84,577	551,500
June	991	26,850	514,080	93,087	90,236	724,253
July	1,334	937,651	27,650	53,375	118,525	1,137,201
August	1,367	1,005,162	1,538	13,972	135,480	1,156,152
September	—	—	—	—	—	0
October	—	—	—	—	—	0
November	1,011	274,334	151,915	353,333	342,616	1,122,198
December	763	177,380	98,170	253,444	245,756	774,750
Total	9,518	3,575,856	1,959,349	1,209,301	1,242,793	7,987,299

Table 5
Growth parameters, mortality and exploitation rates obtained by means of the ELEFAN programs

Species	Location	L_{∞}	K	Z	F	M	E	L_c	L	L'
<i>R. kanagurta</i>	B Aceh	86,285	0.9	3.07	1.39	1.69	0.45	161.02	196.4	170
<i>R. brachysoma</i>	Asahan	84,265	1.05	8.84	7.03	1.91	0.79	178.98	—	180
<i>D. macrosoma</i>	B Aceh	84,280	1.22	5.4	3.37	2.11	0.62	165.08	195.64	170
<i>D. russelli</i>	Idi	84,260	0.90	5.5	3.80	1.73	0.69	166.68	185.41	170

Table 6
Summary of the numbers of scads and mackerels and their size ranges (in mm) examined during Gonad maturity studies

Males	<i>R. kanagurta</i>	<i>R. brachysoma</i>	<i>D. macrosoma</i>	<i>D. russelli</i>
0	10	0	0	3
I	34	3	19	10
II	27	0	26	40'
III	20	42	2	60
IV	20	11	0	27
Total	111	56	47	140
	Range 135-235		125-235	

Females	<i>R. kanagurta</i>	<i>R. brachysoma</i>	<i>D. macrosoma</i>	<i>D. russelli</i>
0	1	0	0	0
I	13	0	17	4
II	28	4	30	25
III	16	18	8	31
IV	4	5	0	21
Total	62	27	55 ¹	81
	Range 135-295		165-245	

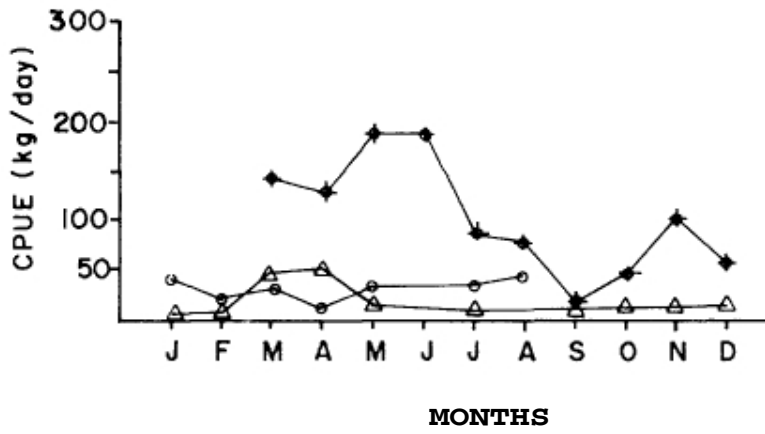


Figure 1. Monthly catch rates of *D. russelli* collected at several landing sites along Sumatra.

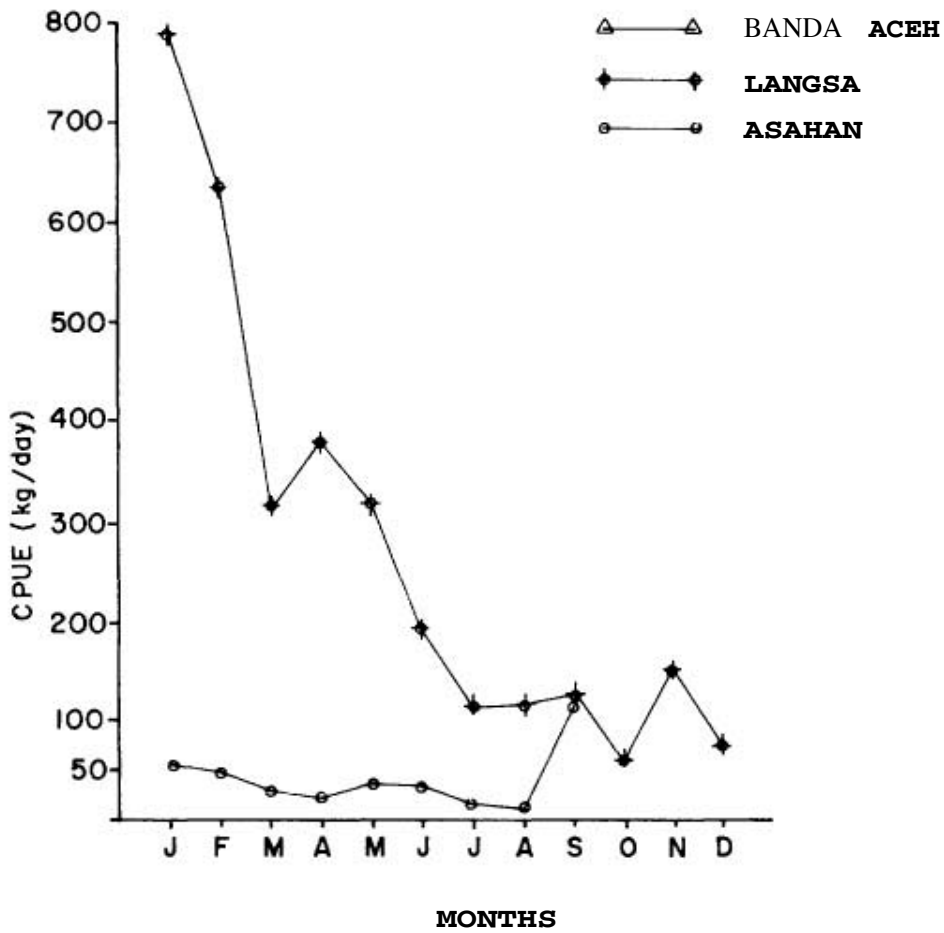


Figure 2. Monthly catch rates of *D. macrosoma* collected from the purse seine fishery operating in the Indonesian part of the Malacca Straits.

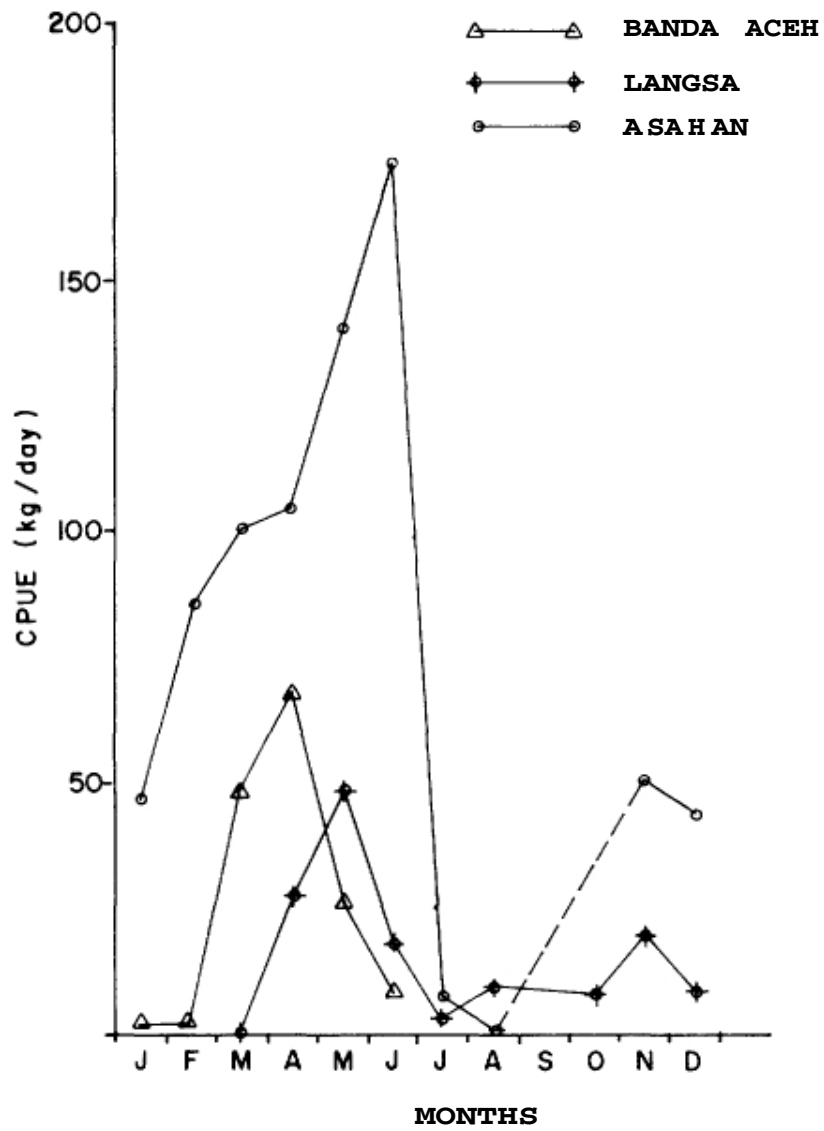


Figure 3. Monthly catch rates of *R. brachysoma* collected from the purse seine fishery operating in the Indonesian part of the Malacca Straits.

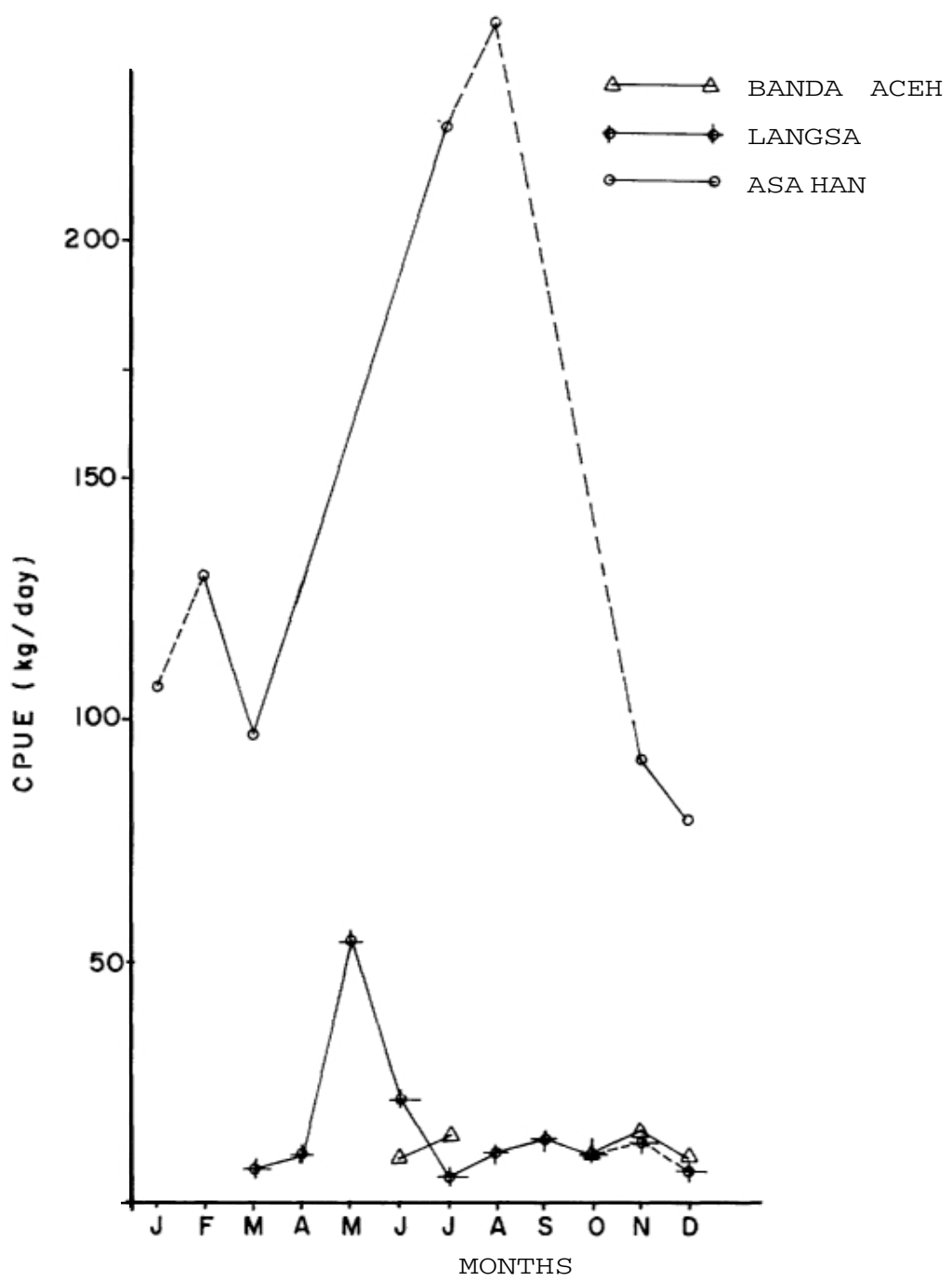
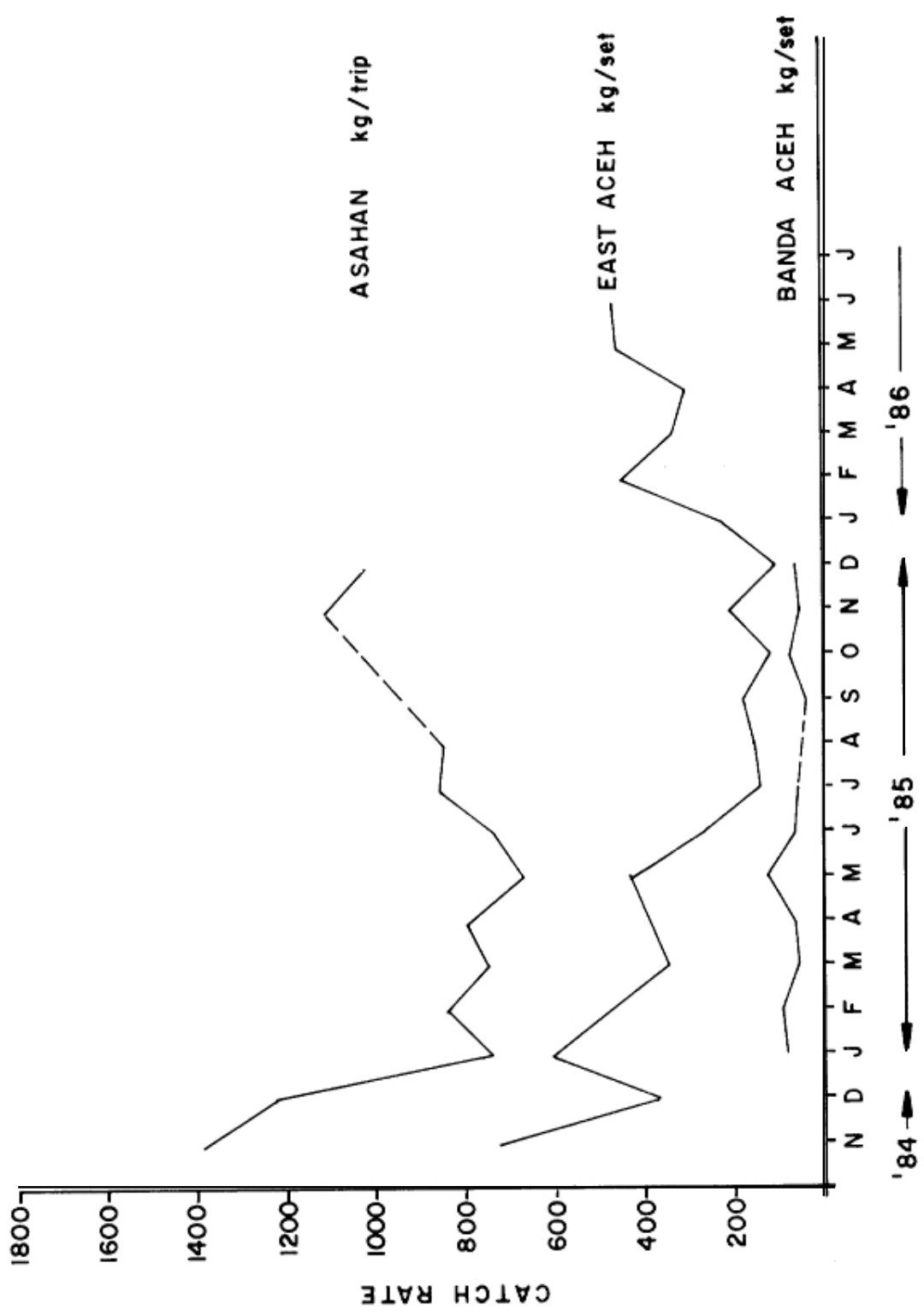


Figure 4. Monthly catch rates of *R. kanagurta* collected from the purse seine fishery operating in the Indonesian part of the Malacca Straits.

Figure 5. Monthly catch rates in the Indonesian part of the Malacca Straits. Purse seine total catches (kg) per trip or set.



SEASONS

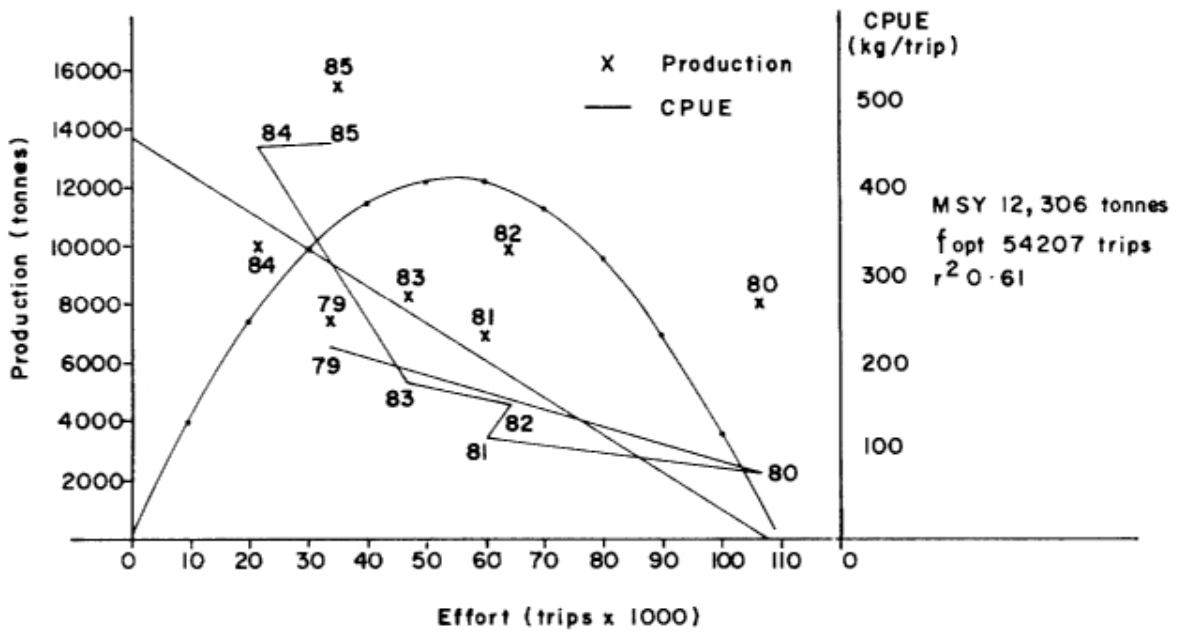


Figure 6. Shaeffer's production model applied to Indonesian catch and effort statistics for *R. kanagurta*.

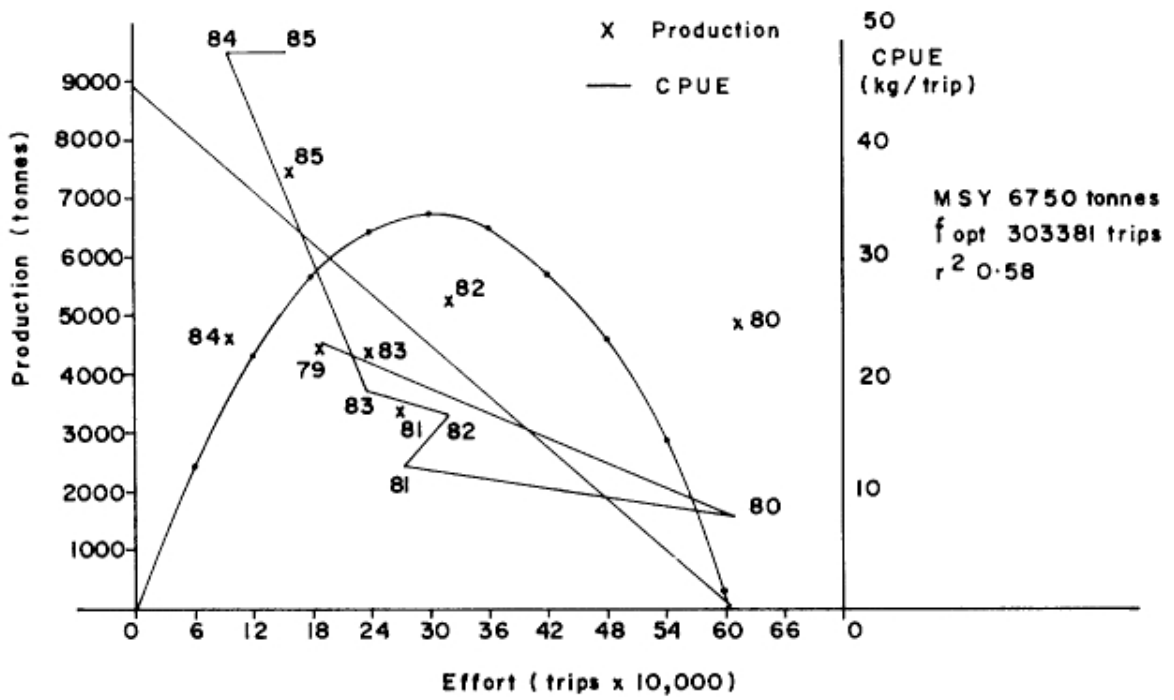


Figure 7. Shaeffer's production model applied to Indonesian catch and effort statistics for *R. brachysoma*.

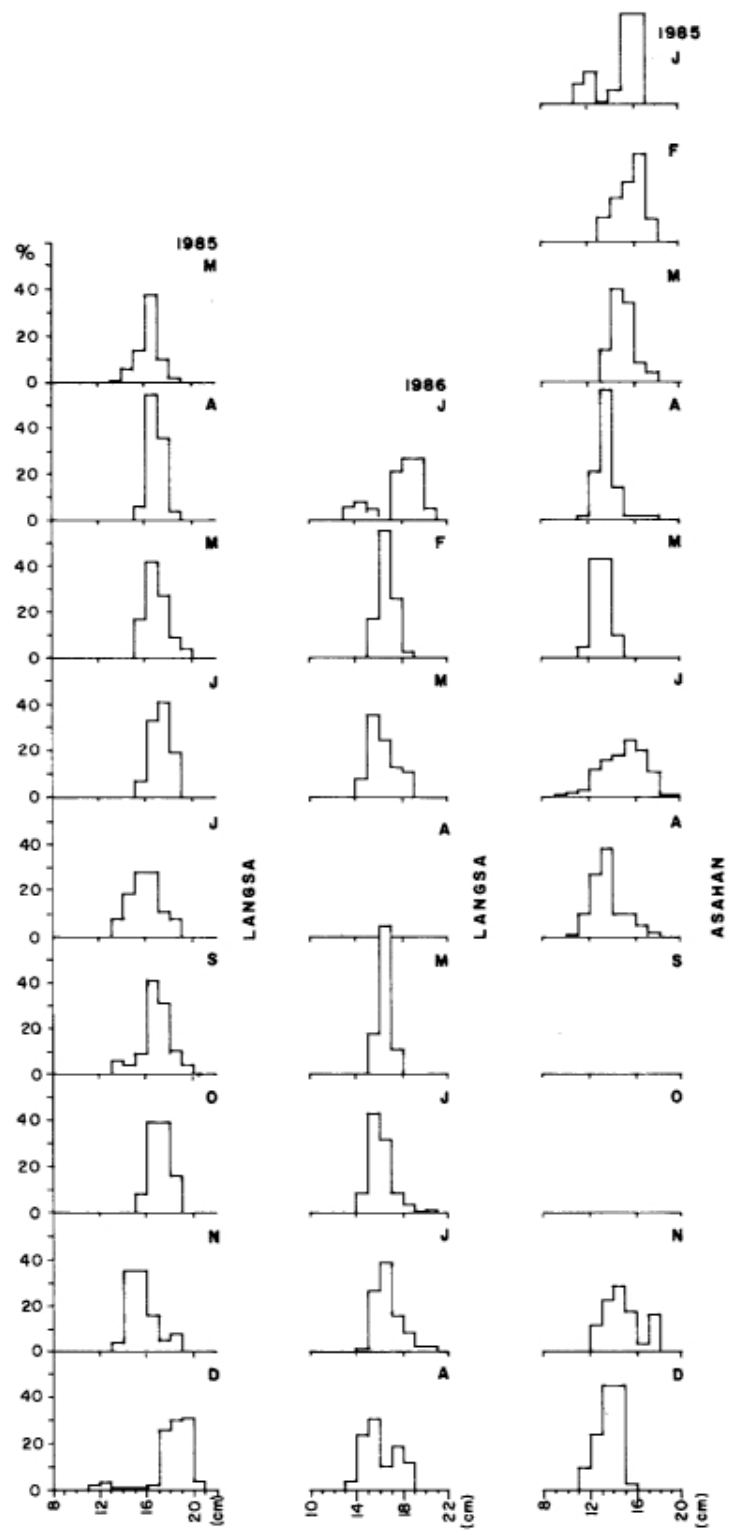


Figure 8. Length frequencies of *D. russelli* caught by purse seine in Langsa (1985-1986) and in Asahan (1985) Indonesia.

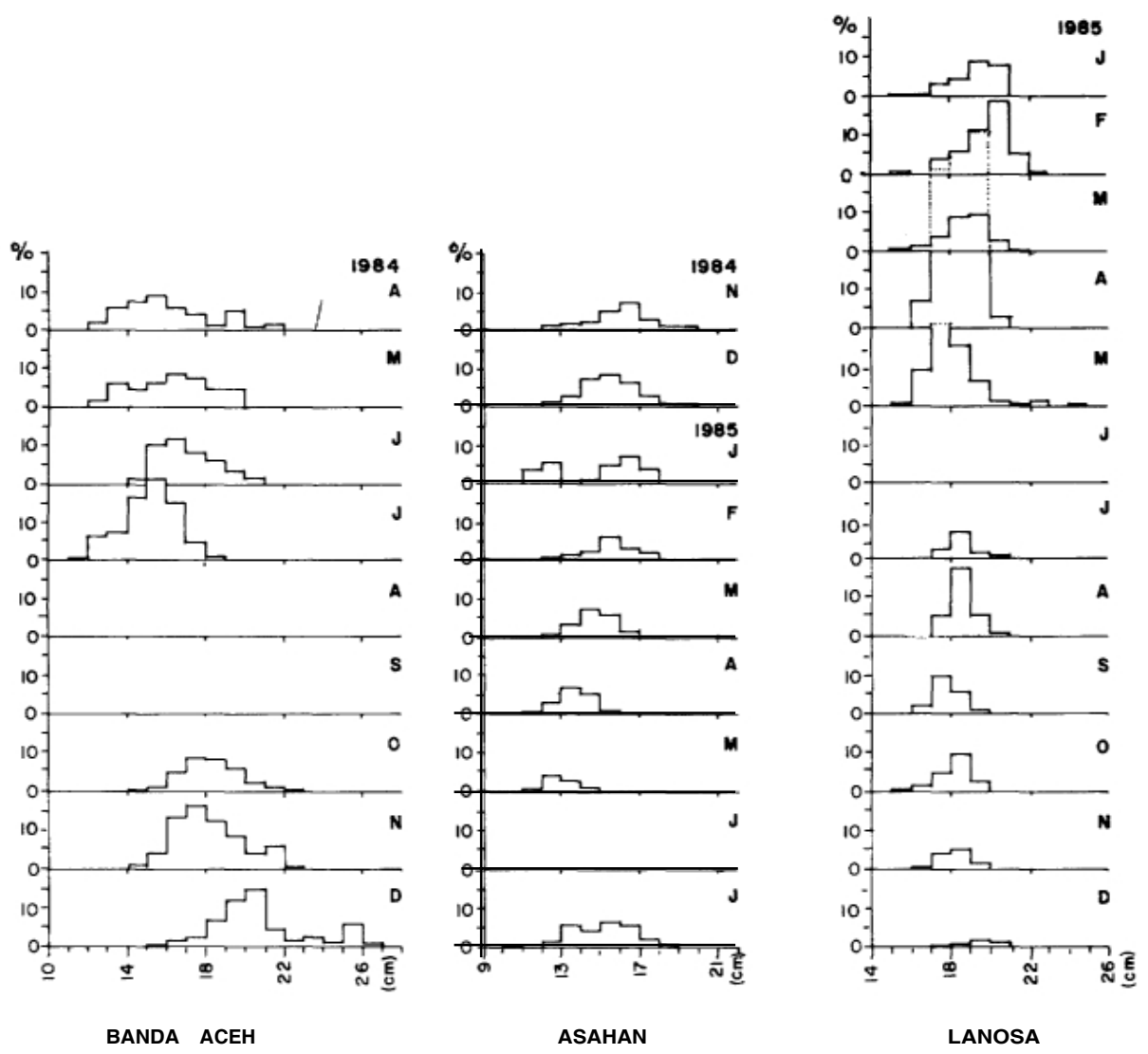


Figure 9. Length frequencies of *D. macrosoma* caught by purse seine in Banda Aceh (1984), Asahan (1984-1985) and Langsa (1985).

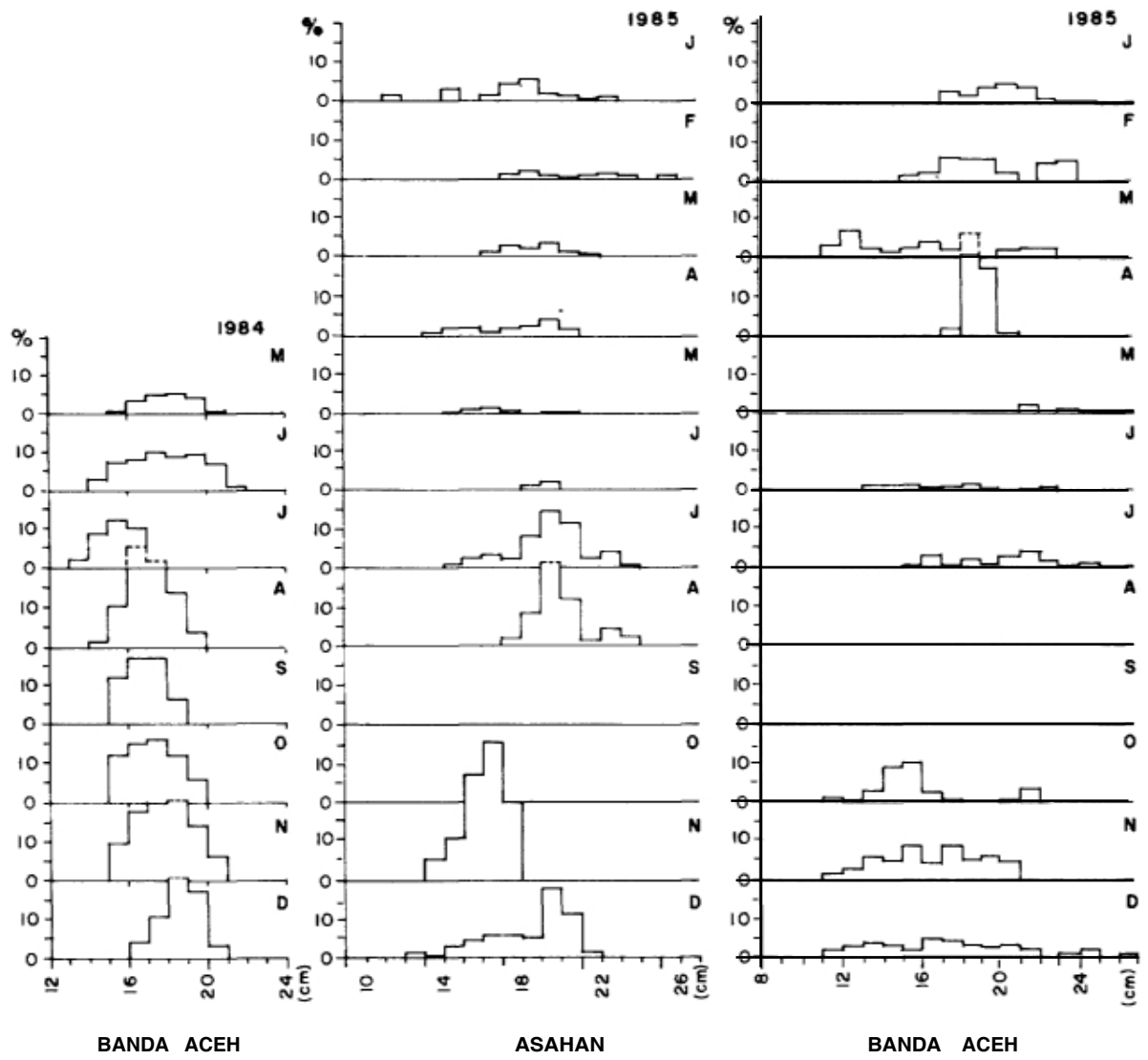


Figure 10. Length frequencies of *R. kanagurta* caught by purse seine in Banda Aceh (1984-1985) and Asahan (1985).

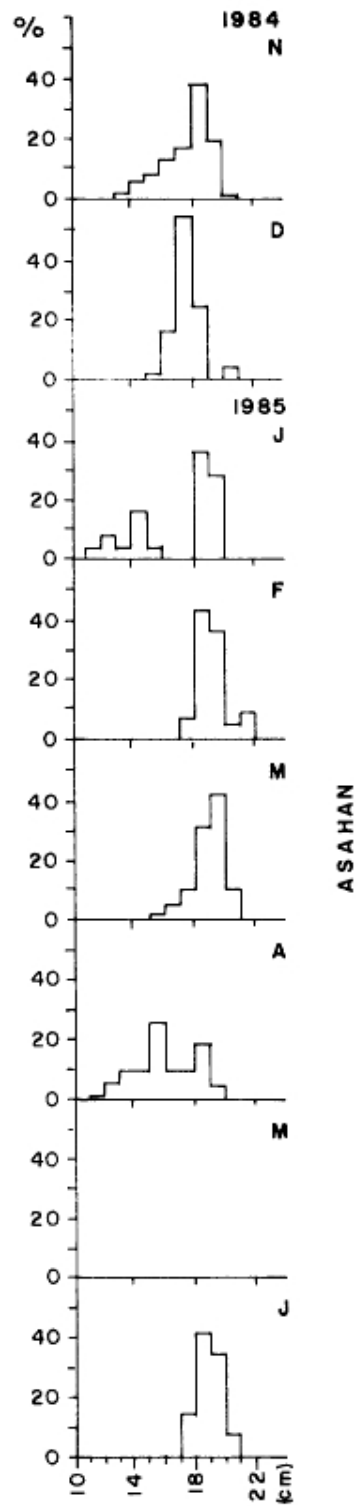


Figure 11. Length frequencies of *R. brachysoma* caught by purse seine in Asahan (1984-1985), Indonesia.