

**REVIEW OF THE CHUB MACKEREL FISHERY  
(*RASTRELLIGER* SPP.) ON THE WEST COAST OF THAILAND**

**Introduction**

It is well known that small pelagic fish, especially the mackerels, are very important for marine fisheries in Thailand. The exploitation of these resources has developed rapidly during the last two decades. This rapid development may, in the near future, lead to over-exploitation of resources unless regulatory measures are taken. In order to be successful in resource management and fishery development planning, it is necessary to analyze the resources and the current status of the fisheries.

Some research and biological studies on these resources have been carried out by the Phuket Marine Fisheries Station of the Department of Fisheries, but a comprehensive review of the resources and of the research results at this station has not been made. The present paper, therefore, aims at reviewing present information available on the biology of the *Rastrelliger* resource and the status of their fisheries.

**Taxonomy**

There are at least three species of *Rastrelliger* spp. being caught off the west coast of Thailand, namely *R. brachysoma* (locally referred to as Pla-tu), *R. kanagurta* (Pla-lung) and *R. faughni* (Pla-lung-ching-chok).

Results from a study on the identification of mackerels showed that the two later species exhibited a body length slightly more than that of *R. brachysoma*, in the fish caught by trawlers (Sukhavisidh, 1978).

**Distribution**

Mackerels are distributed throughout the coastal area of the west coast of Thailand. Their distribution and fishing grounds are shown in Fig. 1 and Fig. 2.

*R. brachysoma* is found in most of the areas and it is the most abundant among mackerels, accounting for 16% of the total pelagic catch or about 58% of the total mackerel catch. *R. kanagurta*, also found throughout the area, accounted for 13% of the total pelagic catch or about 40% of the total mackerel catch. *R. faughni* is found mainly in the upper west coast and has been of minor importance compared to the two other species.

It is believed that *R. brachysoma* is a coastal form or neritic in nature while *R. kanagurta* and *R. faughni* are open sea or offshore species.

**Spawning**

*R. brachysoma* has a long spawning season, from June to March. However, the information on the seasonal change in the gonadosomatic index (GI) indicates that there are two peaks of spawning, one between January and March and the other from June to August, for the upper west coast and, one from December to March and a second from August to September, for the lower west coast. As for *R. kanagurta*, the spawning may take place from December to April (Pimoljinda, et al., 1977).

Up to the present, there is no temporal/spatial coverage of the spawning survey; the spawning grounds of mackerels in this area cannot, therefore, be determined with any certainty.

### **Maturatinn and fecundity**

*A. brachysoma* is believed to mature at 16.5 and 17.0 cm LX for the fish found along the upper and lower west coast, respectively. Sex of the fish could be distinguished when they reach about 12 cm LX.

The fecundity of *R. brachysoma* was estimated to range from 118,685 to 222,455 with an average of 170,570 for fish ranging from 15.2 to 19.5 cm LX.

The size at first maturity of *R. kanagurta* has been reported as 20.0 cm LX and its fecundity was estimated to be 96,712 to 224,633, or an average of about 160,672 for fish ranging from 15.3 to 22.3 cm LX. Based on the frequency distribution of ova diameters, the maturity stage of *Rastrelliger* spp. has been classified as follows:

Maturity stage	Ova diameter
1	<0.25 mm
2	0.25 – 0.45 mm
3	0.46 – 0.60 mm
4	0.61 – 0.87 mm
5	>0.88 mm

It should be noted that the fecundity figures given for mackerels do not indicate that all the eggs spawn in a single season. It seems that during a spawning season, a female releases eggs in batches of approximately 25,000 to 40,000 for *R. brachysoma* and 15,000 to 30,000 for *A. kanagurta*.

### **Growth**

Growth of *R. brachysoma* is very rapid. The results of tagging experiments indicated that the growth increment of small and medium sized fish averaged about 1.2 cm per month. Since the data obtained from the investigation of seasonal change in the length distribution was far from adequate, the analysis to estimate the parameters of growth function has not been carried out.

### **Food**

Mackerels are well known as plankton feeders. This is indicated by the feature of the gill rakers as well as by their swimming behaviour when they form a big school.

*R. brachysoma* feeds mainly on phytoplankton. The results of an investigation of stomach contents showed that the food items comprised phytoplankton (64%), dinoflagellates (30%), copepods (5%) and other planktonic organisms (1%).

*R. kanagurta* is a species with a marked preference for zooplankton. Its food items comprise zooplankton (52%), dinoflagellates (31%), crustaceans (10%), fish and squid larvae (2%) and other planktonic organisms (5%) (Suthakorn, 1977).

### **Migration**

The results of the tagging experiments which were carried out by the Phuket Marine Fisheries Station during 1981-1983 showed that of 6,383 *R. brachysoma* tagged and released in Ko Langu, Ko Bulon and Ko Terutao of Satul province, 84 fishes (1.3%) were recaptured at various

locations (Fig. 3 and Table 1). Although most of the recaptured fish had moved only short distances from the released areas, a small component showed northward migration to Trang province during March-April and August-October and southward migration to Kedah state in Malaysia during June-July. It is assumed therefore, that the *R. brachysoma* along these areas of Thailand and Malaysia intermingle to some degree, or that this particular stock may be shared by Thailand and Malaysia.

However, the information on migration is scanty due to the poor recapture; further tagging experiments should be carried out both in Thailand and Malaysia to provide more information.

### **Stock identity**

Due to lack of information, it is difficult to identify with any degree of certainty the unit stocks present along the west coast of Thailand. However, the tagging data showed that some tagged fish released on the lower west coast have moved into the area and some others moved into Malaysian waters. It is conjectured that Thailand harvests more than one stock of the *R. brachysoma*—one off the upper west coast and the other off the lower west coast.

Hence, the stock off the lower west coast might be exploited by both Thailand and Malaysia. Similarly, the stock off the upper west coast might be shared with Burma. This hypothesis should be tested through intensive tagging experiments in the future.

A preliminary examination of the length frequency distribution of *R. brachysoma* in the two different areas seems to show signs of a certain modal progression of each brood in each area. This phenomenon, therefore, may support the idea of the occurrence of two stocks.

### **Fishing gears**

The mackerel fisheries on the west coast of Thailand expanded after some fishermen from the Gulf of Thailand had moved into the area and introduced fishing gear like purse seines, and gillnets, to catch inshore pelagic fish. Since 1969, Thai fishermen have modified trawl nets for catching pelagic fish in substantial quantities. With the gradual mechanization of fishing boats and improvement of gears, the mackerel fishing grounds were extended further offshore to waters up to 100-200 m depth.

The most important fishing gears used are the purse seine and its modifications, i.e., Chinese purse seine, Thai purse seine and luring purse seine. The description of these gears follows:

1. *Chinese purse seine*: The Chinese purse seine was introduced to Thailand around 1925, employing a sail boat (which is now motorized) with two small rowing boats for setting the net. The size of boat varies from 14 to 25 m in length. The net is rectangular without a bag but with the purse line. The size of the net is 600-1,200 m in length and 60-80 m in depth. The mesh size of the net is usually between 18 and 25 mm. The operation is carried out so that when a fish school is spotted by the master fishermen, it is surrounded with the net and the purse line is closed so that fish cannot escape toward the bottom; then the net is hauled. The Chinese purse seine is operated in the coastal areas where the depth of water ranges from 10 to 50 m. The favourite time for operation is during moonless nights.

2. *Thai purse seine*: The Thai purse seine is a gear which evolved from the Chinese purse seine and is being widely used in Thailand, particularly after 1957. Instead of using two rowing boats to set the net, the main boat, which is now motorized, sets the net by itself. Other operations are very similar to those of the Chinese purse seine. The gear employed is usually larger than that used for Chinese purse seining which was widely used two decades ago. Thai purse seine fishing is carried out from an engine-powered boat of a size ranging from 12 to 25 m in length. The size of the net is 800-1,500 m in length. The mesh size of the net used varies from 18 to 90 mm.

Recently, large purse seiners have been equipped with power-saving devices such as the purse line winch and power block, thus enabling a boat to reduce its crew nearly by half. In addition, more medium and large size purse seiners are now equipped with echo sounder or sonar for fish school detection, radar, wireless equipment and refrigeration.

3. *Luring purse seine*: The luring purse seine is very similar to Thai purse seine but the operation is carried out by luring techniques using palm leaves by day and lamp by night in order to attract the fish school. After throwing the lure into the sea for 7-10 days or attracting fish with lamps for 3-6 hours, fishermen will wait until they are sure that fish gathers around the lure in a big school; then the fish is surrounded by the net and the net is hauled. This type of fishing gear was developed from the luring liftnet around 1971 and has been widely used in the Gulf since 1973 due to its high fishing efficiency. It was introduced in the west coast of Thailand and has gained popularity since 1975. The luring purse seine fishing is carried out by using a one-engine powered boat in the size range of 16-25 m in length and one small rowing boat for setting the lures. The rectangular net ranges from 400 to 800 m in length and 50-80 m in depth. The mesh size of the net ranges from 18 to 25 mm. The power of the generator varies from 20 to 50 kilowatt. It can be operated in both shallow and deep waters during day time and at night.

Table 2 gives the total number of fishing vessels and number of major pelagic gears registered with the Department of Fisheries from 1971 to 1981. The fluctuation in the number of units is indicative of the development of the marine fisheries. A significant decreasing trend is clearly observed in the number of Thai purse seines, especially after 1976, while there is an increasing trend in the number of luring purse seines. As for the numbers of Chinese purse seines, it shows a decreasing trend after 1973, but a small fluctuation in numbers was observed from 1975 to 1981.

The majority of the purse seiners operated in the area are of medium size, i.e., between 14 and 25 m in length; there are very few small purse seiners.

## Production

It is seen from Table 3 that the total production of mackerels obtained from major fishing gears from 1971 to 1981 shows large fluctuations. The maximum catch for both *R. brachysoma* (13,005 tonne) and *R. kanagurta* (10,329 tonne) was in 1973. The catch value has declined since then to reach the minimum value in 1981.

Mackerels are caught by a variety of fishing gears, but the major portion of the catch was contributed by Thai purse seines and trawl nets for *R. brachysoma* and by Thai purse seines and Chinese purse seines for *R. kanagurta* (Table 4).

Taking into account the catch by type of fishing method, there is no doubt that luring purse seines have recorded an increase in numbers in recent years, but there is no catch recorded except in 1979. The reason could be sampling errors in the data collection; the multi-purpose fishing nature of the Thai purse seiner might have caused the enumerators some confusion; it might also be due to the fact that luring purse seiners on the west coast return to the middle Gulf during some seasons to catch coastal tuna and hardtail scad, which are available in greater quantity and have higher value, but are still being registered as luring purse seiners on the west coast.

If we look at the monthly landings of the mackerels in various provinces along the west coast (Table 5), it can be seen that the fishing season of mackerels extends throughout the year. The peak season for *R. brachysoma* on the upper and lower west coast are from August to February and May to October, respectively. For *R. kanagurta*, the best fishing season seems to be during January-April and April-June for the upper and lower west coast, respectively.

In 1980, substantial quantities of *R. brachysoma* were obtained from the lower west coast (Satul, Trang and Krabi), while the amount obtained from the upper west coast (Ranong,

Phang Nga and Phuket) was minor. On the contrary, the majority of the *R. kanagurta* was landed in the upper west coast while the amounts in the lower west coast were minor.

### Stock assessment

Many studies have been made to assess the potential of mackerel resources on the west coast of Thailand (Bhatia, et al. 1979, Bhatia and Chullasorn, 1980). In their analysis, the data on the basis of which the assessments are made come from annual catch and effort obtained from the Annual Fisheries Statistics. These data, however, are not in the ideal form required for precise analysis. But in spite of their shortcomings, they provide some useful information enabling a preliminary analysis to be made. In addition, these assessments are based on the assumption that only one stock exists or else that the stocks examined behave as a single entity and without any interaction.

As mentioned earlier, there will be some justification for treating the *A. brachysoma* as two unit stocks, namely, the upper west coast stock (Area I) and the lower west coast stock (Area II). Therefore, the present assessment has been carried out for each local unit area. Based on the figures of catch, effort and catch per unit effort in each area, given in Table 6, the potential yields are estimated as 4,542 and 7,014 tonnes at optimum fishing effort of about 19,848 and 22,256 days fishing by Thai purse seine unit for Area I and Area II, respectively (Fig. 4 and Fig. 5). This result indicates that *A. brachysoma* stocks in the two areas are not in a state of heavy exploitation.

For *A. kanagurta*, the estimate of potential yields in Area I and Area II are 6,237 and 2,281 tonnes at the optimum fishing effort of 20,899 and 40,555 days fishing of Thai purse seine unit, respectively (Fig. 6 and Fig. 7). This indicates that the level of exploitation of *R. kanagurta* in Area I is heavy, a level which was reached between 1973 and 1975. As regards the stock in Area II, it seems to be lightly exploited.

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Table 1

Results of tagging experiments on *Rastrelliger brachysoma*,  
on the west coast of Thailand, 1981-1983.

Year	Tagged fish released (nos.)	Recapture (nos.)	Recapture (%)	Time between release and recapture (days)	Area of release
1981	513	8	1.56	22-131	Ko Terutao, Satul
1/1982	242	4	1.65	14-71	Ko Langu, Satul
2/1982	832	24	2.88	10-179	Ko Langu, Satul
(1982)	1074	28	2.61	10-179	
1/1983	478	7	1.46	1-111	Ko Terutao, Satu
2/1983	694	3	0.43	13-21	Ko Terutao, Satul
3/1983	722	2	0.28	21-?	Ko Bulon, Satul
4/1983	697	2	0.29	14-20	Ko Bulon, Satul
<b>5/1 983</b>	<b>659</b>	<b>26</b>	<b>3.94</b>	<b>1-140</b>	<b>Ko Terutao, Satul</b>
6/1983	546	5	0.91	4-146	Ko Terutao, Satul
7/1 983	544	2	0.37	5-31	Ko Bulon, Satul
8/1 983	459	1	0.217	?	Ko Bulon, Satul
<b>(1983)</b>		<b>48</b>	<b>1.0</b>	<b>1-146</b>	

**Table 2**

**Number of registered fishing vessels and fishing gear units by vessel size operating on the west coast of Thailand**

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	
Type	Length of vessel (m)											
Fishing vessels	434	614	987	901	773	818	1347	1689	2565	2970	2207	
	<14	145	235	440	343	265	388	813	1151	1900	2122	1437
	14-18	176	248	375	352	339	289	365	399	415	544	471
	18-25	109	131	172	206	167	140	166	127	225	283	273
	>25	2	—	—	—	2	1	3	12	25	21	26
Unknown	2	—	—	—	—	—	—	—	—	—	—	
Thai purse seine	61	54	68	112	85	89	22	47	4	12	17	
	<14	7	15	8	10	13	6	12	16	1	7	5
	14-18	37	23	31	60	35	41	10	31	3	4	9
	18-25	17	16	29	42	37	42	—	—	—	1	3
	>25	—	—	—	—	—	—	—	—	—	—	—
Chinese purse seine	27	32	50	37	17	15	22	15	15	12	14	
	<14	—	2	4	2	—	—	—	1	—	—	—
	14-18	10	20	23	19	10	7	9	6	7	9	7
	18-25	17	10	23	16	7	8	13	8	8	3	7
	>25	—	—	—	—	—	—	—	—	—	—	—
Luring purse seine	2	—	—	1	—	—	95	68	69	114	127	
	<14	1	—	—	—	—	—	1	3	9	13	
	14-18	1	—	—	—	—	56	37	38	54	46	
	18-25	—	—	—	1	—	39	30	28	51	68	
	>25	—	—	—	—	—	—	—	—	—	—	
Encircling gillnet	—	—	1	5	—	—	—	1	1	2	1	
	<14	—	—	1	4	—	—	1	1	2	1	
	14-18	—	—	—	1	—	—	—	—	—	—	
	18-25	—	—	—	—	—	—	—	—	—	—	
	>25	—	—	—	—	—	—	—	—	—	—	



**Table 3****Total annual marine catch, pelagic catch and mackerel catches from the west coast of Thailand, 1971-1981**

Year	Total marine catch	Total pelagic		<i>R. brachysoma</i>		<i>R. kanagurta</i>	
	(t)	(t)	% of total marine)	(t)	(% of pelagic)	(t)	(% of pelagic)
1971	237,568	45,632	19	12,313	27	3,856	8
1972	230,097	43,359	19	5,702	13	3,966	19
1973	291,194	56,265	20	13,005	23	10,329	18
1974	244,492	31,108	13	5,120	16	6,050	19
1975	222,188	35,874	16	7,979	22	5,722	16
1976	256,050	24,554	10	3,141	13	5,384	22
1977	218,861	33,593	15	4,623	14	2,545	8
1978	218,014	18,881	9	2,354	12	2,392	13
1979	237,668	34,551	15	4,511	13	2,881	8
1980	186,211	15,157	8	1,794	12	976	6
1981	184,389	13,926	8	1,780	13	577	4

**Table 4**

**The mackerel catch on the west coast of Thailand, by major fishing gears, 1971-1981**

(tonne)

(a) *R. brachysoma*:

Gear	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
OTT	927	753	1,149	622	335	544	2,101	1,239	2,220	770	1,081
TPS	11,375	4,053	10,874	4,318	5,371	2,437	2,162	1,036	346	986	1,095
cPS	0	838	605	967	950	145	352	12	17	39	44
LPS	0	0	0	0	0	0	0	0	0	0	0
DGN	0	0	9	1	12	2	6	0	25	0	0
BST	11	58	0	6	0	13	0	0	0	0	0
SSF	0	0	368	106	951	0	2	67	18	—	—
Total	12,313	5,702	13,005	5,120	7,979	3,141	4,623	2,354	2,626	1,795	2,220

(b) *R. kanagurta*

OTT	0	173	288	492	0	9	71	131	60	27	69
TPS	3,856	853	2,416	745	872	3,573	1,192	1,731	300	516	241
cpS	—	2,940	7,531	4,511	4,848	1,744	1,251	526	729	433	526
DGN	0	0	0	217	2	3	0	3	27	0	0
BST	0	0	0	—	1	0	0	0	0	0	0
SSF	0	0	94	4	0	55	31	1	0	—	—
Total	3,856	3,966	10,329	6,050	5,722	5,384	2,545	2,392	2,881	976	836

OTT = Otter board trawl  
 SSF = Small-scale fisheries  
 BST = Bamboo stake trap  
 TPS = Thai purse seine  
 CPS = Chinese purse seine  
 LPS = Luring purse seine  
 DGN = Drift/gilinet

**Table 5**

**Monthly landings of mackerels by province along  
the west coast of Thailand, 1980**

(tonne)

(a) *R. brachysome*

Province	Total	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Ranong	1344	208	139	60	8	30	23	33	152	164	109	243	175
PhangNga	—	—	—	—	—	—	—	—	—	—	—	—	—
Phuket	1	—	—	—	—	—	—	—	1	—	—	—	—
Krabi	507	—	—	1	10	33	—	5	151	133	59	39	76
Trang	4598	282	209	395	386	839	730	228	439	155	361	137	437
Satul	6642	251	642	923	263	306	439	800	720	958	645	531	164
Total	13092	741	990	1379	667	1200	1192	1066	1463	1410	1174	950	852

(b) *R. kanagurta*

Ranong	443	90	17	49	62	50	23	66	61	10	10	—	5
Phang Nga	866	55	123	196	125	17	51	35	118	45	33	45	23
Phuket	706	52	44	63	55	52	74	65	78	46	53	59	65
Krabi	350	10	27	29	115	39	70	54	3	—	—	3	—
Trang	206	5	1	20	31	114	30	5	—	—	—	—	—
Satul	465	—	—	—	—	465	—	—	—	—	—	—	—
Total	3036	212	212	357	388	737	248	225	260	101	96	107	93

**Table 6**

**Total catch (A), fishing effort (B) and catch per day (C) of mackerel in area I (upper) and II (lower) on the west coast of Thailand, 1972-1981**

**A. Total catch (ton)**

Species	1972		1973		1974		1975		1976		1977		1978		1979		1980		1981	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<i>R. brachysoma</i>	1331	4371	4776	7861	2351	2448	1953	5042	936	1769	2271	491	621	819	1800	342	1177	183	64	1716
<i>R. kanagurta</i>	816	3150	9385	850	3673	1313	5180	542	3359	160	2151	11	1688	196	2410	166	708	8	232	575

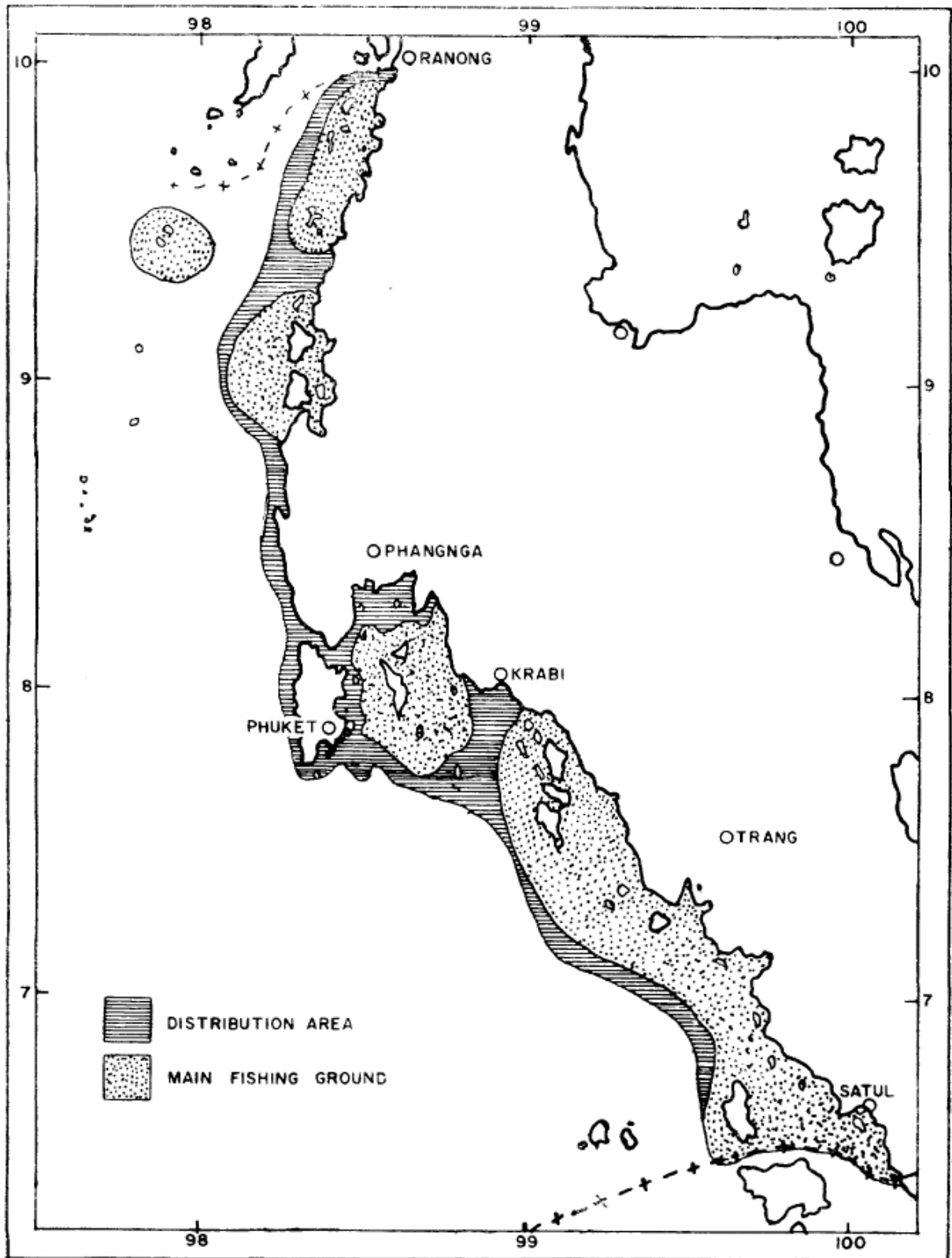
**B. Fishing effort<sup>1</sup> (days)**

Species	1972		1973		1974		1975		1976		1977		1978		1979		1980		1981	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<i>R. brachysoma</i>	3578	15177	6489	11510	6477	6857	4846	6599	4313	3922	1394	1269	989	2536	5751	523	2200	235	145	1902
<i>R. kanagurta</i>	6182	75000	28526	14655	33697	22254	36738	6302	7193	3137	2815	80	1408	879	22523	1092	3955	92	407	25000

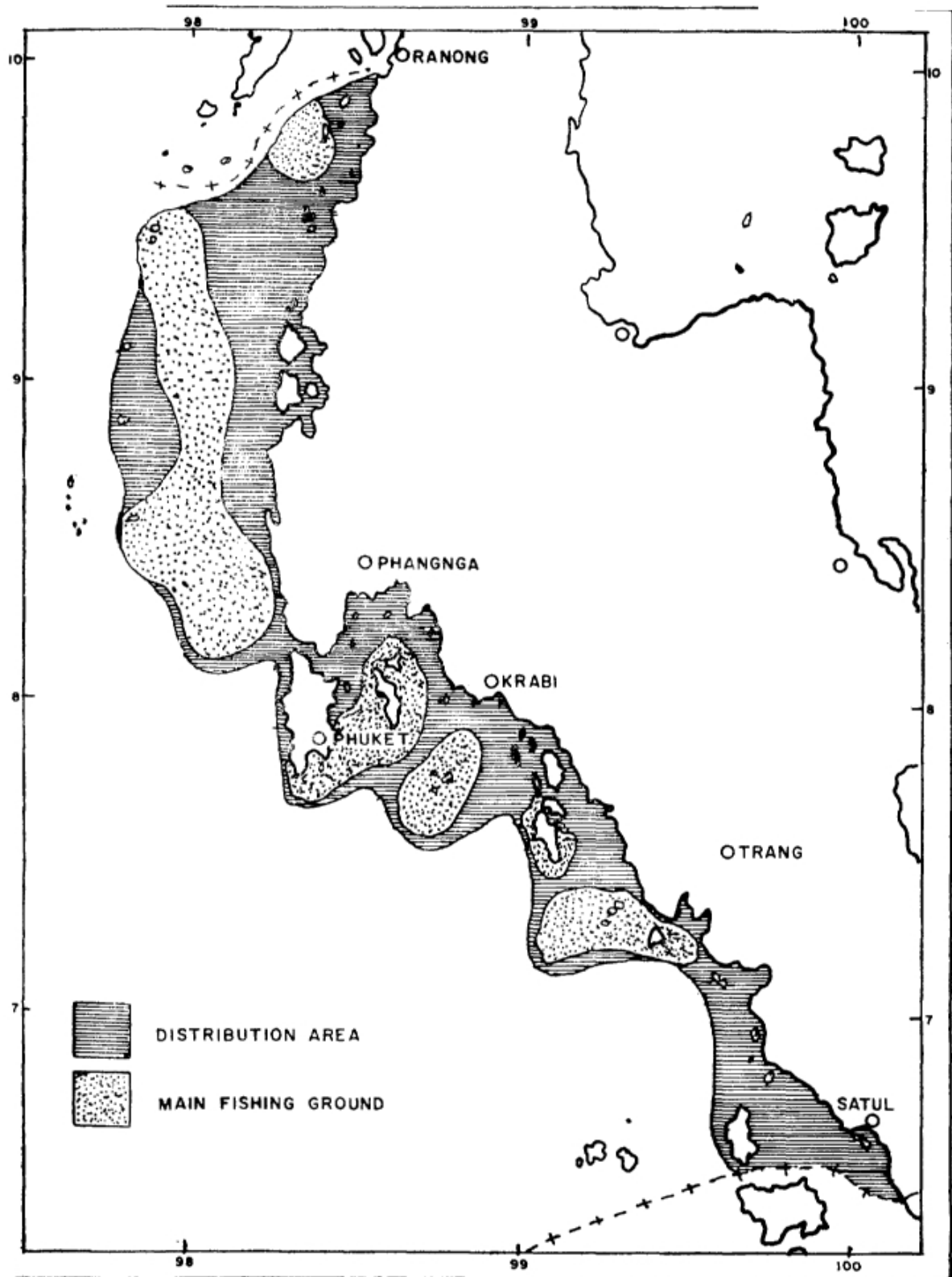
**C. Catch per day (kg/day)**

Species	1972		1973		1974		1975		1976		1977		1978		1979		1980		1981	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
<i>R. brachysoma</i>	372	288	736	683	363	357	403	764	217	451	1629	387	628	323	313	654	535	778	441	900
<i>R. kanagurta</i>	132	42	329	58	109	59	141	84	467	51	746	137	1199	223	107	152	179	87	570	23

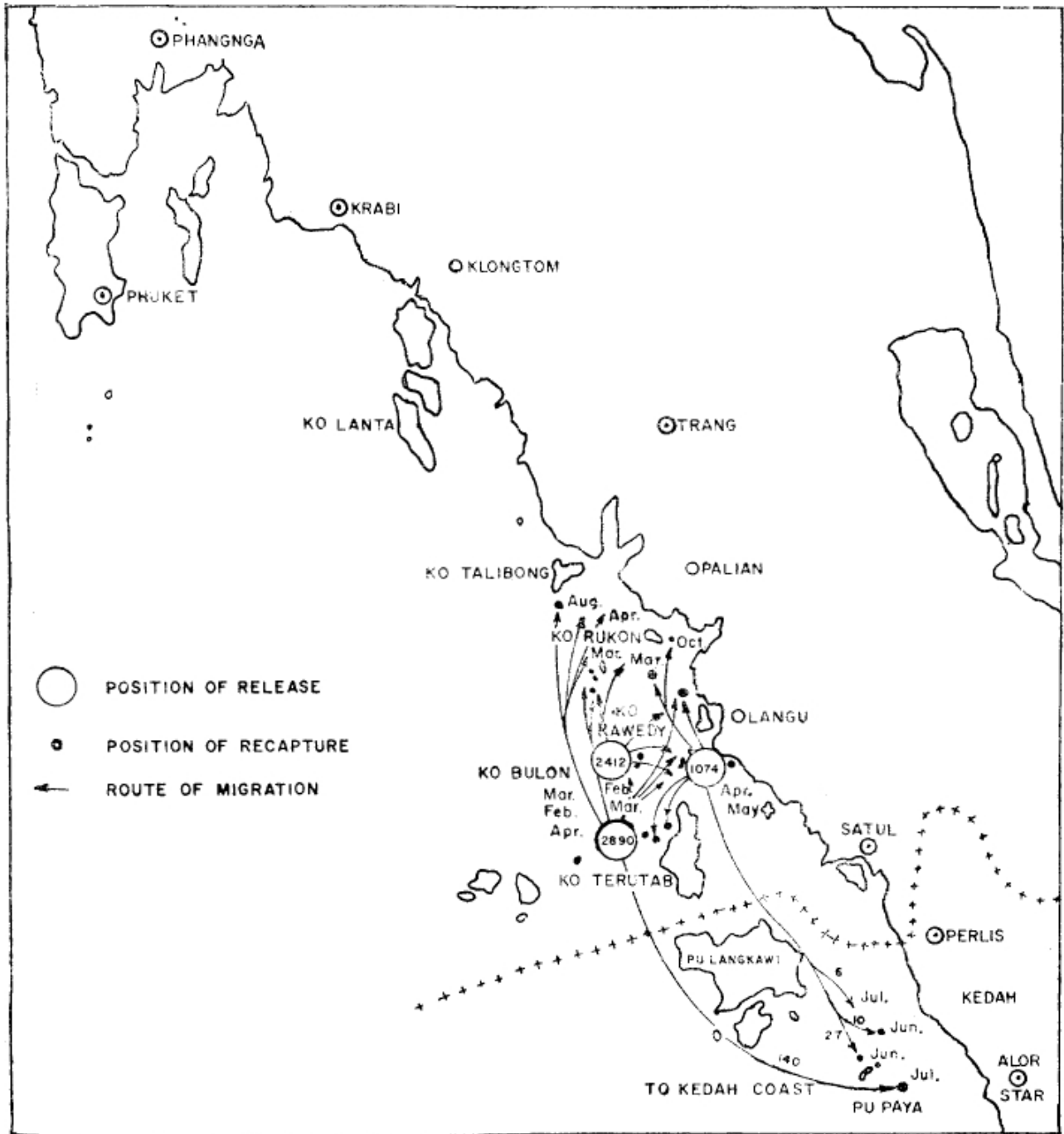
<sup>1</sup>Estimated numbers of days fishing standardized to Thai purse seine.



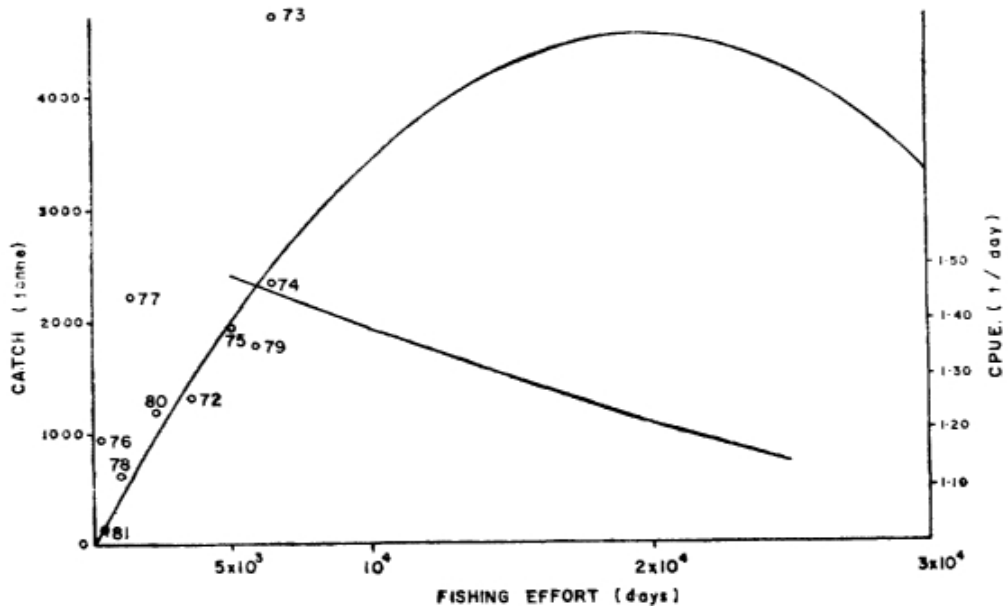
App. 1, Fig. 1. Distribution area and fishing grounds of *Rastrelliger brachysoma* on the west coast of Thailand.



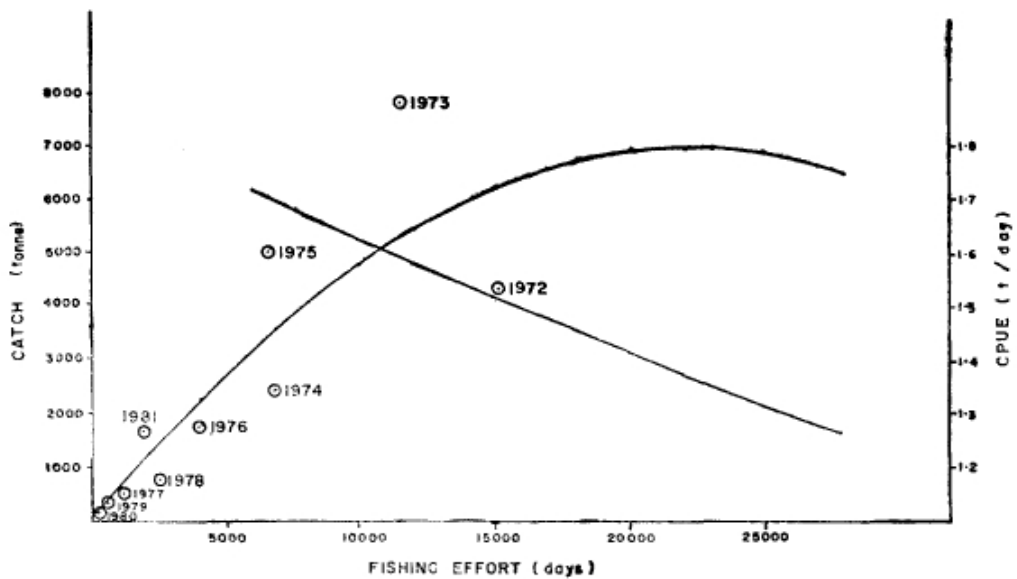
App. 1, Fig. 2. Distribution area and fishing grounds of *Rastrelliger kanagurta* on the west coast of Thailand.



App. 1, Fig. 3. Results of the tagging experiment on *Rastrelliger brachysoma* on the west coast of Thailand during 1981—83.

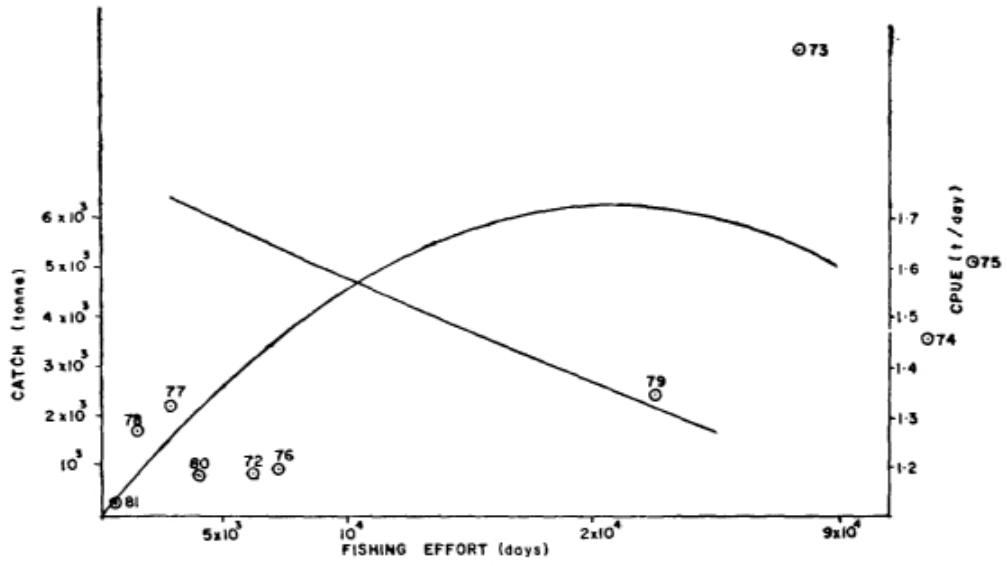


App. 1. Fig. 4. catch and catch per unit effort related to effort in the Thai purse seine fishery for *Rastrel/iger brachysoma* on the upper west coast of Thailand (Area I), 1972-81.

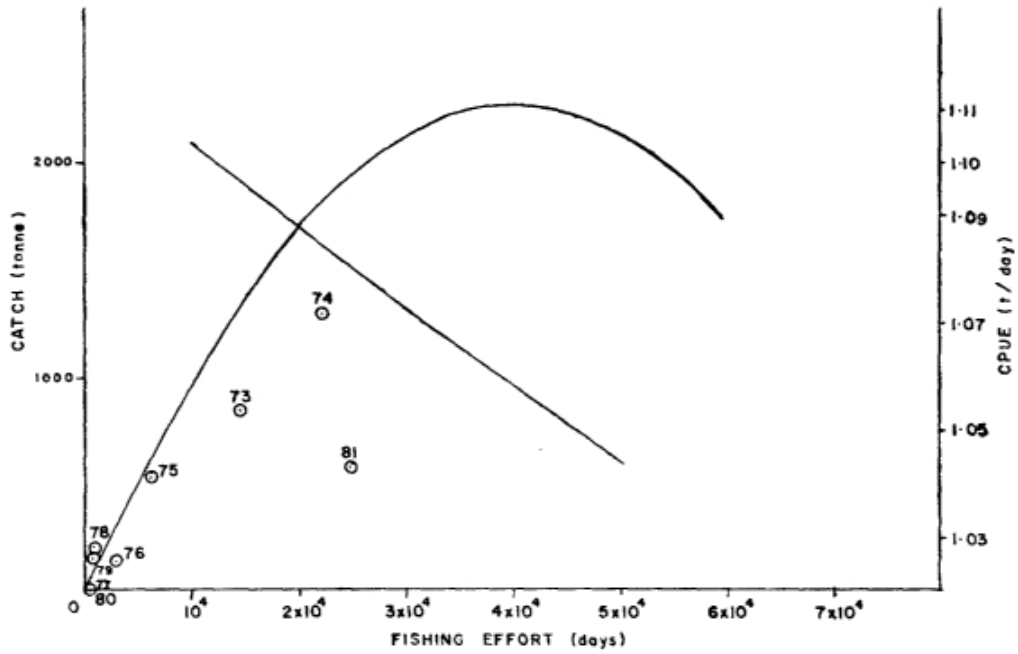


App. 1. Fig. 5. Catch and catch per unit effort related to effort in the Thai purse seine fishery for *Rastrel/iger brachysoma* on the lower west coast of Thailand (Area II), 1972-81.





App. 1, Fig. 6. Catch and catch per unit effort related to effort in the Thai purse seine fishery for *Rastrel/iger /ranagurta* on the upper west coast of Thailand (Area I), 1972—81.



App. 1, Fig. 7. catch and catch per unit effort related to effort in the Thai purse seine fishery for *Rastre/iger kana,gurta* on the lower west coast of Thailand (Area II). 1972—81.

## Appendix 2

### REVIEW OF THE SCAD MACKEREL FISHERY (*DECAPTERUS* SPP.) ON THE WEST COAST OF THAILAND

#### General information

The round scad or scad mackerel (*Decapterus* spp.) is one of the economically important pelagic fishes in the Malacca Strait. In Thailand it has been observed to inhabit waters of 30-80 m depth and it has been caught mainly by the Chinese and Thai purse seines since the beginning of the pelagic fisheries development in 1963. Since 1977, the luring purse seines have played an important role in the fishery. In the period 1972 to 1981, the annual landings of the scad mackerels on the west coast of Thailand ranged from 1,475 to 2,370 tonne or 1.525 tonne on an average.

Before the research survey of *Decapterus* spp. on the west coast of Thailand, carried out by the Phuket Marine Fisheries Station since 1978, little was known about the biology of the fish in this area. An attempt had been made to point out some biological aspects from the available data.

#### Species exploited

Two species of *Decapterus* dominate the landings, namely *D. maruadsi* and *O. macrosoma*, of which the former is more important, comprising about 60% of the scad mackerel catch.

#### Distribution

*Decapterus* spp. appear throughout the coastal area of the west coast of Thailand. The fishing grounds are located in the waters of 30-80 m depth (Fig. 1).

#### Maturity and spawning

The size at majority of mature *O. maruadsi* and *O. macrosoma* range from 15.5-21.5 cm and 17.3-22.2 cm in total length, respectively.

The spawning season, as determined from the gonad index of data collected from November 1978 to September 1981, shows that *D. maruadsi* has a long spawning season from December to April. The peak of spawning for *O. macrosoma* lies between February and April but in 1980 the peak of its spawning season occurred from January to June (Fig. 2).

#### Length frequency distribution

The length data of *Decapterus* spp. have been sampled from the commercial catch at various landing places by measuring the body length. The data are collected from all types of purse seines, categorized by area (the upper west coast as Area I and the lower west coast as Area II) and month.

The length frequency distribution (Figs. 3, 4) exhibits a multimodal appearance and it was applied to determine the general pattern of recruitment. The fishery has exploited small *D. maruadsi* ranging in size from 11.5 to 25 cm (in Area I) and 12.0 to 24cm (in Area II). *D. macrosoma* was caught in sizes ranging from 14.0 to 18.5cm (in Area I) and 13.5 to 19.0cm (in Area II).

The major marketable size of *Decapterus* spp. in both areas was in the range between 14.0 cm and 18.0 cm.

Taking into account the monthly variation of length distribution, from the data obtained, it is concluded that the possibility of utilizing a length-structured approach to determine growth and mortality parameters is very low unless there is a more effective sampling programme.

### **Production**

*Decapterus* spp. are not the target species of purse seiners on the west coast of Thailand and the catch obtained is incidental among many other species.

On the west coast of Thailand, the production of *Decapterus* spp. decreased from 1,780 tonne in 1971 to 811 tonne in 1973. Since then the production has fluctuated around a level of about 1,000 tonne (Table 1).

According to monthly landing statistics collected by Fisheries Statistics Section in a survey in 1980 (Fig. 5), *Decapterus* spp. were exploited all year round. The best fishing season was August to November which is the inter-monsoon period.

### **Stock assessment**

Table 2 shows the annual catch and effort data for *Decapterus* spp. from 1972 to 1980. The data were collected from commercial fisheries by the Fisheries Statistics Section, Dept. of Fisheries, through the sampling survey system. Estimates of the total standardized fishing effort for use in the yield calculation were derived by dividing the total catch obtained from the major fishing gears by the CPUE of the standard gear, i.e., Chinese purse seine.

The annual catch (tonne) and catch per unit of effort (tonne/day) are plotted against the fishing effort in number 31 days fishing of Chinese purse seine units (Fig. 6). The result shows that the maximum sustainable yield for the *Decapterus* spp. on the west coast of Thailand is about 1,500 tonne at the optimum fishing effort of about 9,000 days fishing.

It is obvious that the fishing effort exceeded the optimum level in 1973 and 1975 and that the production exceeded the MSY in 1975. It is concluded, therefore, that the *Decapterus* spp. were fully exploited in the period from 1972 to 1975. Thereafter, the fishing effort has been lower than the optimum level and the production is also lower than the MSY.

**Table 1**

**Annual catch of *Decapterus* spp. in the west coast of Thailand by type of major fishing gear, 1971-1981**

(tonne)

Gear \ Year	Year										
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
OTT	0	0	0	0	29	3	1	0	0	0	0
TPS	1780	0	72	12	97	224	134*	14	19	112	47
CPS	0	1475	739	1403	1409	820	1315*	869	941	783	1137
LPS	0	0	0	0	0	0	0	0	83	0	0
EGN	0	0	0	1	0	0	0	3	0	0	0
Total	1780	1475	811	1416	1535	1047	1450	886	1044	895	1184

\* estimated figure

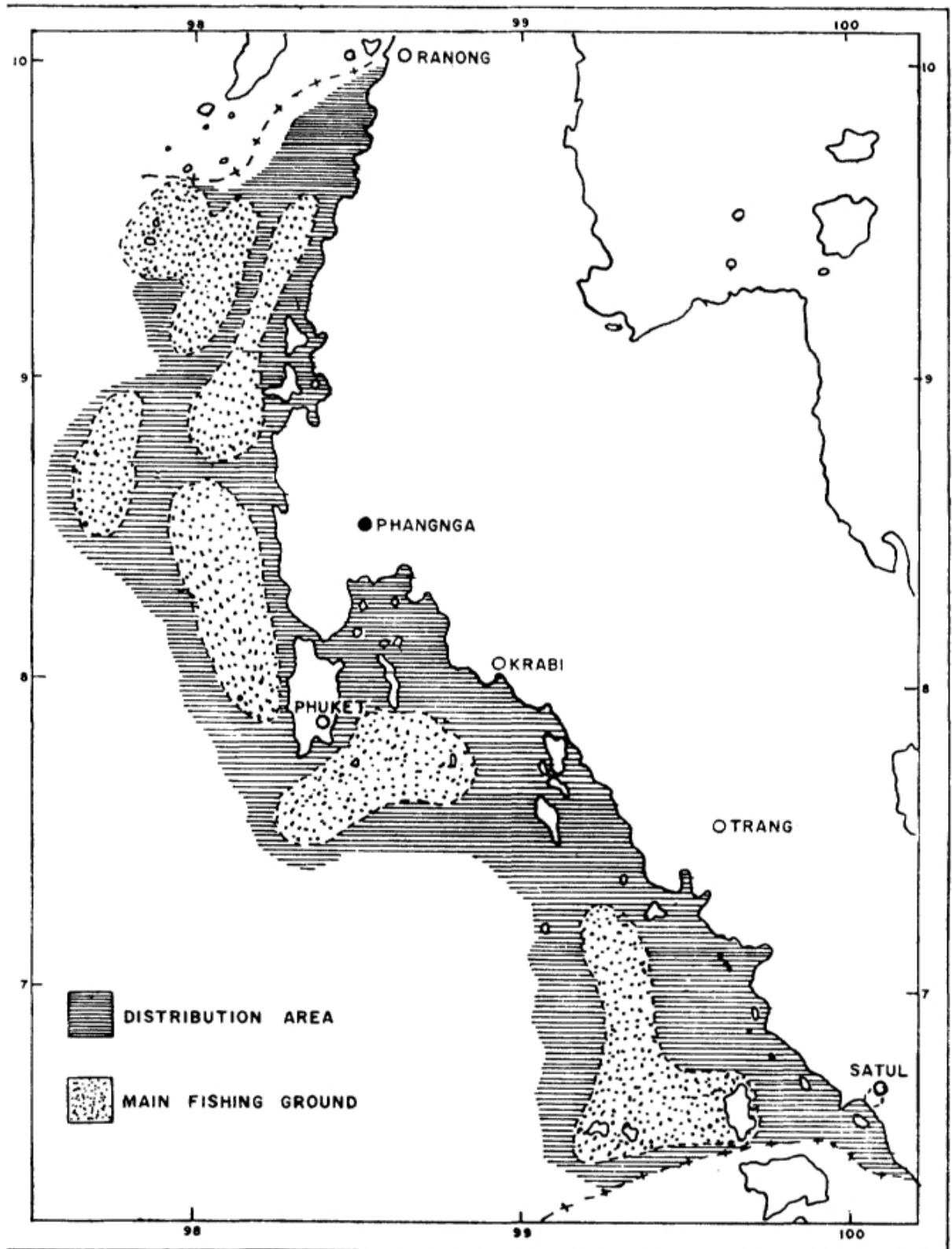
OTT—Otter board trawl  
 TPS—Thai purse seine  
 CPS—Chinese purse seine  
 LPS—Luring purse seine  
 EGN—Encircling gillnet

**Table 2**

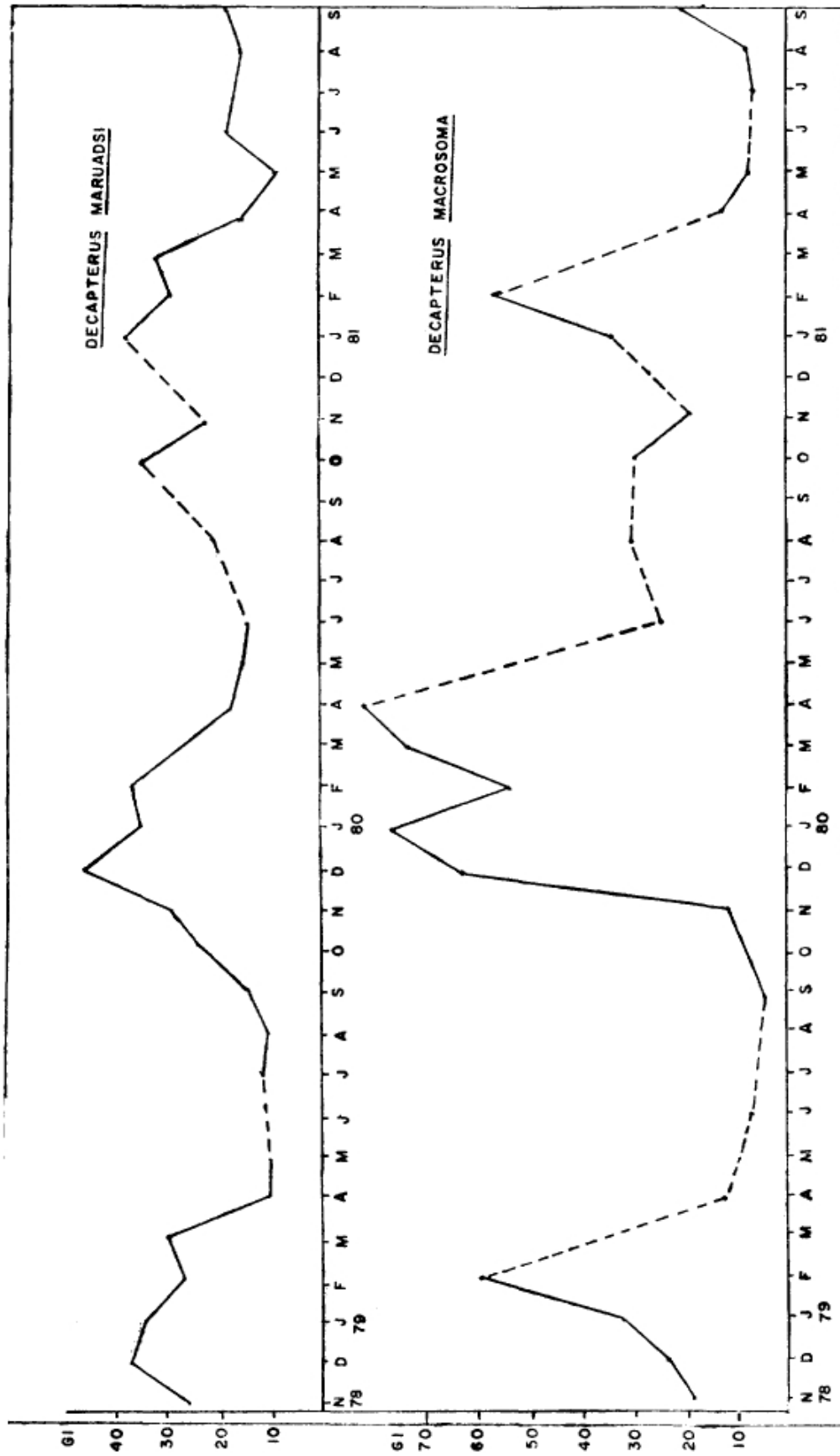
**Total catch, fishing effort and catch per unit of effort' of *Decapterus* spp. on the west coast of Thailand**

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Total catch (t)	1475	811	1416	1535	1074	1450	886	1044	895	1184
Fishing effort (days)	7749	11322	8080	10360	4900	5179	4105	4247	3214	3496
CPUE (kg/day)	190	72	175	148	219	280	216	246	278	339

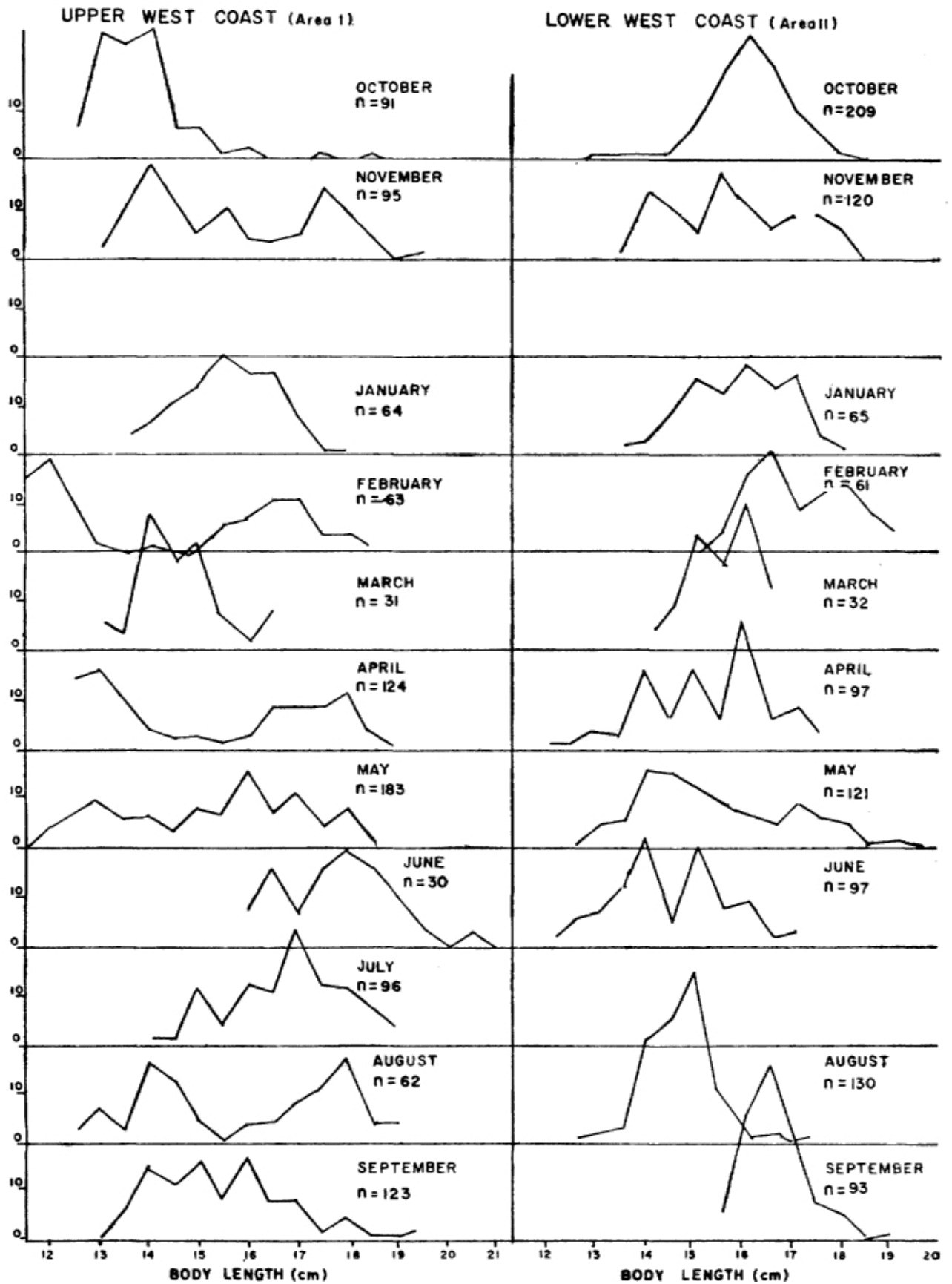
'Estimated numbers of fishing days of chinese purse seine.



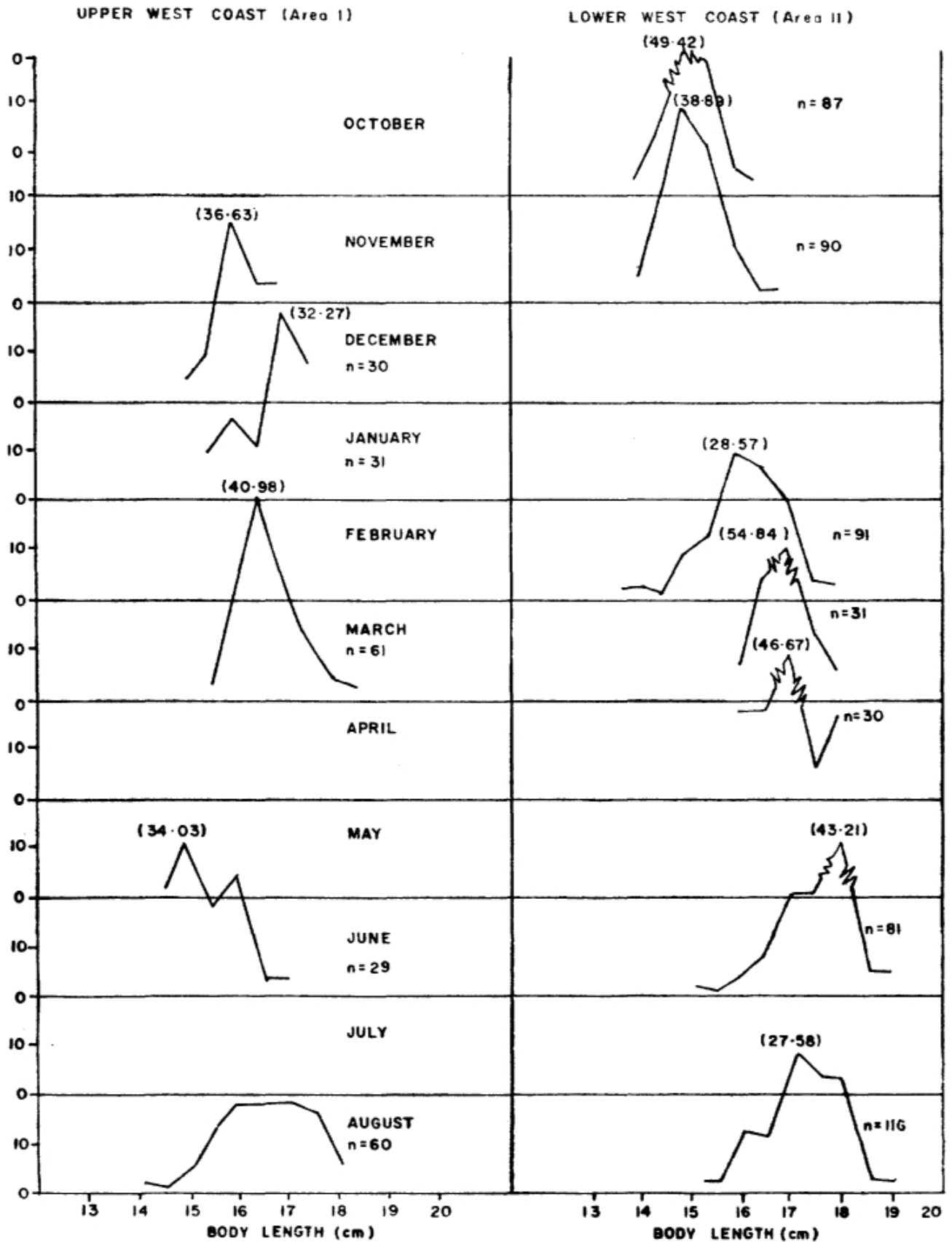
App. 2, Fig. 1. Distribution area and fishing grounds of round scads (*Decapterus* spp.) on the west coast of Thailand.



App. , 2 Fig. 2. Monthly change in the mean gonad index of *Decapterus maruadsi* and *Decapterus macrosoma* in the west coast of Thailand, November 1978–September 1981.

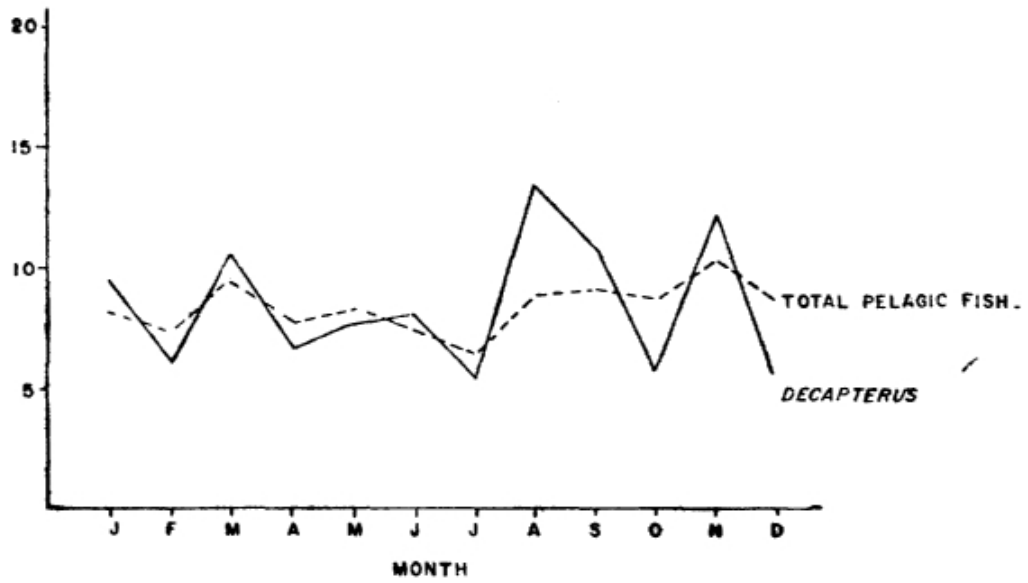


App. 2, Fig. 3. Length frequency distribution of *O. maruadsii* in the upper and lower west coast of Thailand, October 1979—September 1980.

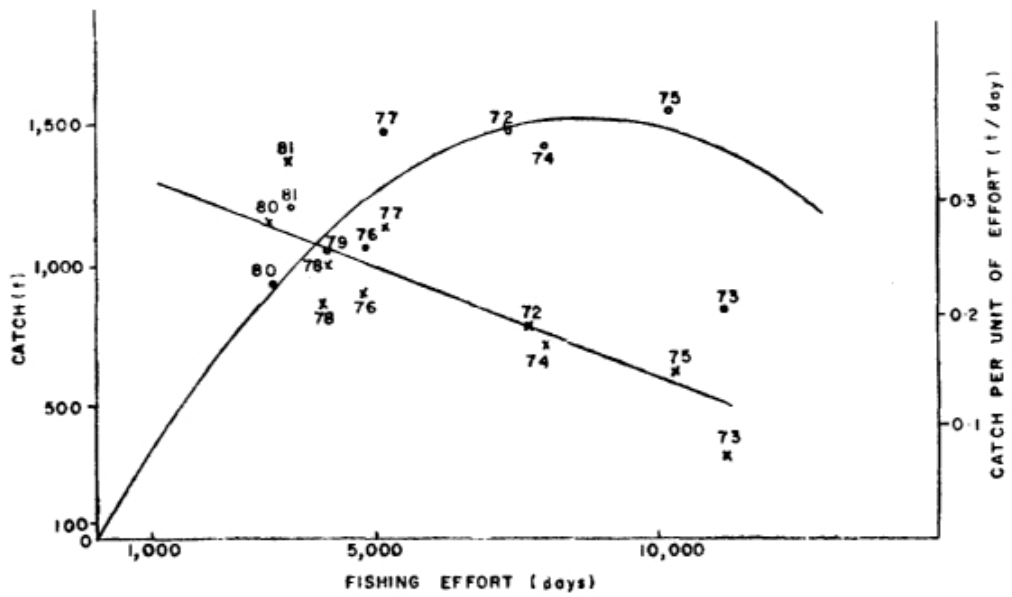


App. 2, Fig. 4. Length frequency distribution of *O. macrosoma* in the upper and lower west coast of Thailand, October 1979—September 1980.





App. 2, Fig. 5. Monthly landing of *Decapterus* spp. and total pelagic fishes (in per cent) on the west coast of Thailand, 1980.



App. 2, Fig. 6. Catch and catch per unit effort in the fishery for *Decaptews* spp. on the west coast of Thailand, 1972-81.