

Appendix

LIST OF PARTICIPANTS

First and Second Working Group Meetings¹ on Tuna in the Andaman Sea

INDONESIA

Gomal H. Tampubolon	Fishery Biologist	Fishing Technology Development Centre, Semarang, Indonesia
I. G. Sedana Merta	Fishery Biologist	Research Institute for Marine Fisheries, Jakarta, Indonesia

MALAYSIA

Abdul Hamid Yasin	Fishery Officer (Research)	Head, Fisheries Research Institute Pulau Kambing, Kuala Terengganu, Terengganu, Malaysia
-------------------	----------------------------	--

THAILAND

Pairoh Suthakorn	Fishery Biologist	Phuket Marine Fisheries Station Phuket, Thailand
Veera Boonragsa ²	Fishery Biologist	Phuket Marine Fisheries Station, Phuket, Thailand
Ravi Saranakomkul ²	Fishery Biologist	Phuket Marine Fisheries Station, Phuket, Thailand
Udom Bhatia	Director, Phuket Marine Fisheries Station	Phuket Marine Fisheries Station, Phuket, Thailand
<i>Observers</i>		
Amara Chuenpan	Fishery Biologist	Marine Fisheries Division, Sapanpla, Yanawa, Bangkok, Thailand
Sakul Supongpan	Fishery Biologist	Marine Fisheries Division, Sapanpla, Yanawa, Bangkok, Thailand
Somsak Chullasorn	Fishery Biologist	Marine Fisheries Division, Sapanpla, Yanawa, Bangkok, Thailand
Chitjaroon Tantivala	Fishery Biologist	Exploratory Fishing Division, Paknam Samuthrakarn, Thailand
Dheerasak Wasuthapitak	Fishery Biologist	Exploratory Fishing Division, Paknam
Hiran Klinmuang	Fishery Biologist	Marine Fisheries Division, Sapanpla, Yanawa, Bangkok, Thailand

BOBP/FAO Representatives (RAS/87/051)

K. Sivasubramaniam	Senior Marine Fishery Biologist	C/o FAO, BOBP PO Box 1505, Colombo, Sri Lanka
T. Nishida	Statistician/APO	C/o FAO, BOBP PO Box 1505, Colombo, Sri Lanka
Martin Van Der Knaap²	Fishery Biologist APO	C/o FAO, BOBP PO Box 1505, Colombo, Sri Lanka

1 First Working Group Meeting
— Colombo, Sri Lanka, October 10-11, 1985

Second Working Group Meeting
— Phuket, Thailand, August 25-26, 1986

2 Attended only the Second Working Group Meeting.

Annexure 1

TUNA RESOURCES IN THE THAI WATERS OF THE ANDAMAN SEA

by Veera Boonragsa

Phuket Marine Fisheries Station, Phuket, Thailand.

This paper was presented at the second meeting of the Working Group on tuna in the Andaman Sea area, 1986.

1. Introduction

Prior to 1970, tuna were caught incidentally by purse seiners and gillnetters that were targeting more lucrative species such as mackerels, sardines and carangids. The development of the pelagic fishery together with the development of a fish canning industry during the 1970s has considerably expanded the market for mackerel, sardine and tuna. The development of this industry in recent years has resulted in a rapid increase in the production and export of canned tuna. The total catch of tuna on this coast increased from 1,721 t in 1980 to 3,321 t in 1984.

The rapid development of the canned tuna industry is making Thailand a significant contributor to world trade in canned tuna. This industry has grown ninefold between 1979 and 1983, and with the rapid increase in production, export rose from 340,000 cases in 1979 to 3,000,000 cases in 1983.

2. Fisheries

There are 10 types of fishing gear engaged in coastal tuna capture on the west coast of Thailand. These include four types of purse seines (Thai, luring, Chinese and anchovy purse seines), three types of gillnets (king mackerel drift gillnet, mackerel encircling gillnets, and other gillnets), beach seine, bamboo stake trap, and king mackerel troll line.

The principal fishing craft used for capturing coastal tunas are purse seiners and gillnetters. Purse seining has developed a unique style of seining appropriate to the conditions in Thai waters. This development was based on the catch of small pelagic species other than tunas, and only recently have tunas been considered as a target species because of the development of the tuna canning industry in Thailand.

The Thai purse seine was considered to be the most important gear, accounting for 65 per cent of the annual tuna landings from 1971 to 1978. The luring purse seine has played an important role in recent years, its catch ranging from 1,296 to 667 t between 1979 and 1983. Gillnets are less important for capturing tunas. Among them the king mackerel drift gillnet is considered the most important type of gillnet and its catch ranged from 20 t to 897 t between 1972 and 1981.

The size classes of purse seiners are divided into three categories : less than 14 m, 14 m-18 m and 19 m-25 m in length (LOA). The dominant type of boat is the one ranging from 14 m to 18 m (Table 1). The purse seine net ranges from 800 m to 1600 m in length and from 60 m to 120 m in depth with the stretched mesh sizes ranging from 2.5 cm to 9.69 cm. However, there was no correlation between size of vessel and size of seine net used along this coast (correlation coefficient $r^2=0.2$). Generally the purse seiners make only one-day cruises, sailing out from port in the afternoon, searching schools or operating purse seines around lures and landing their catches from early morning to noon on the following day. Sophisticated electronic equip-

ment such as depth recorders, sonars, transceivers and satellite navigation instruments are used on board. However, purse seiners still rely on manpower with as many as 40 crew members on a 25 m vessel. The traditional Thai purse seine is operated in coastal waters not deeper than 80 m so that the lead line is allowed to reach the bottom before the net is pursed. A thick braided polyethylene rope is used as purse line and is hauled over the bow by two capstan head winches. The use of this method, however, results in a slow sinking net which allows tunas to escape before the net reaches the bottom. Presently, some purse seiners in the Gulf of Thailand are deviating from the traditional purse seining method to more modern techniques.

Previously, the gillnetters targeted on king mackerel (*Scomberomorus* spp.) by using vessels smaller than 14m, with gillnets ranging from 3,000m to 5,000m in length and 30m to 50m in depth. Incidental big catches of tunas are also obtained but are often of low quality, as graded by the canneries. The trolling lines are also used as minor gear catching tuna at the lower part of the coast in some areas of Trang and Satul provinces.

There are about 10 purse seiners that have recently been modified into tuna purse seiners. Among them, seven seiners between 14 m and 18 m in length are operating purse seine nets of 600 x100 m and 7.6 cm mesh size, about 30 km or further offshore. The rest are 24 m in length and use nets of 1400 x 120 m and 9.4 cm mesh size, to operate around 30 km or further offshore.

The landings of tuna are higher in the southern part, but the tuna landings in the Taimuang port in the north have formed a high percentage of total tuna landings since 1983. Takuapa landing port, located near Taimuang and sharing the fishing ground, had high landings in 1985, as shown in Table 2.

Targeting on tunas is influenced largely by prevailing prices paid by tuna canners. There has been a marked increase in the price of tunas, from approximately baht 3/kg in 1977 to over baht 20/kg in late 1980. In the last few years the prices for tunas were graded by species and they have been about baht 35/kg for yellowfin, baht 28/kg for skipjack, baht 24/kg for longtail and baht 14-18/kg for different sizes of smaller species. The increase in price in recent years has encouraged fishermen to fish actively for tunas.

3. Species composition

Although tuna fishing along the west coast of Thailand is not recognised as a major fishery due to its seasonal character, Thai fishermen have classed tuna caught in Thai waters as "bonito" with no breakdown of species. The sampling survey conducted by the Phuket Marine Fisheries Station showed that tuna resources comprised three main species: eastern little tuna (*Euthynnus affinis*), frigate tuna (*Auxis thazard*), and longtail tuna (*Thunnus tonggol*). Other species which were less occasionally landed are bigeye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwonus pelamis*), dogtooth tuna (*Gymnosarda unicolor*), bullet tuna (*Auxis rochei*), yellowfin tuna (*Thunnus albacares*) and oriental bonito (*Sarda orientalis*). The Fisheries Department has recorded that the proportion of longtail tuna in the landings is the highest, with smaller amounts of eastern little tuna and frigate tuna (see Table 3), but the Phuket Marine Fisheries Station survey shows that few longtail tuna have formed part of the various samples. This might be due to the virtual absence of this species in the commercial catches at the time this sampling programme was conducted.

4. Catch rate

The catch rate of longtail tuna in kg per boat per day in the purse seine fishery along the west coast of Thailand, has shown a fluctuating trend since 1982. The catch rate dropped from 125 kg/day in 1982 to 28.8 kg/day in 1983, increased to 180.4 kg/day in 1984 and decreased to 19.73 kg/day in 1985, as shown in Table 4A. This fluctuation may have been caused by the uncertainty in estimating the fishing effort of the purse seiner fleet. Generally the Thai, Chinese and luring purse seiners make only one-day cruises while the tuna purse seiners carry out cruises lasting 3-14 days. The effort of the non-tuna purse seiners is not specific and may be considered to be equally directed on almost all pelagic species, while the tuna purse seiners operate mainly in areas where tunas are abundant.

The catch rate for coastal tuna, which consists of the eastern little tuna and frigate tuna, has been decreasing since 1982. However, it showed an upward trend in 1985, as shown in Table 4B.

5. Seasonality

Tunas in the Thai waters of the Andaman Sea have been caught incidentally all year round and seasonality is not well defined, probably because effort is not specifically directed on tunas throughout the year. Nevertheless as shown in Table 5, the monthly catches of tunas between 1982 and 1985 were considered to be higher during the north-east monsoon (November to April) than during the south-west monsoon.

A report of the exploratory fishing conducted by the "Pole and Line Tuna fishing in Southern Thailand" project, from May 1979 through September 1980, determined the relative abundance of large pelagic fish by school sightings, and concluded that fish schools were sighted much more frequently during the north-east monsoon (1.33 schools/h) than during the south-west monsoon (0.87 schools/h). The lower rate for the south-west monsoon was generally due to bad sea conditions which decreased the effectiveness of visual search. However, another approximation of the seasonal species composition of fish schools off the west coast was made by visual identification, trolling and pole and line operations. It was found that longtail tuna was the dominant species, accounting for 60-70% of the fish schools in the outer neritic zone throughout the year. The eastern little tuna was the second most abundant species, representing 17-19% of all fish schools, and the catches obtained from pole and line showed its abundance in the south-west monsoon. Skipjack tuna is a common species, representing 4-5% of fish schools in the outer neritic zone during the north-east monsoon. Frigate tuna is a common species during the same season.

6. Fishing grounds

Since the beginning of the development of the pelagic fishery on the west coast of Thailand in 1963, pelagic species have been caught mainly by Chinese and Thai purse seiners in the coastal area at a depth of 30 m, which is about 10-15 km offshore. The luring purse seine was introduced to this coast in 1973 and, as a result, the main fishing grounds have been expanded further offshore. Presently, the purse seine fisheries are conducted mainly in waters of the depth range 30-80 m, which is about 45 km wide in the north and 30 km opposite Phuket island, and widens to about 80 km in the south. Geographically, the major fishing grounds for tunas are off Surin Islands due south of Similan Islands and off Raja Islands. The new fishing grounds for tunas in the lower part of the coast are located about 40 km west of

Adang Islands of the Satul Province. The king mackerel drift gillnets are mainly operated in the depth range of 20-50 m not more than 20 km from the shore. The map of fishing grounds for tunas in the west coast of Thailand is shown in Figure 1. This information was obtained from interviews with master fishermen during the sampling survey along the coast.

There have been some surveys for large pelagic fish along the west coast of Thailand. A survey by the modern purse seiner *Southward Ho*, chartered by the South China Sea Programme, was conducted from late November 1975 to mid-January 1976. The survey was coordinated with an aerial fish spotting survey in both the neritic and oceanic areas. Eight flights were conducted during an eight day period, but the large pelagic fish schools were not detected during these flights and some surface swimming tuna schools were observed during the surveys by the vessel.

Resurvey of the surface and sub-surface waters and searches for fish schools during day and night were conducted by the purse seiner *Royal Venture*, which was chartered by the South China Sea Programme, during the first week of August 1976. Few fish schools were observed in the oceanic area and many coastal tuna schools were found in the neritic regime.

Exploratory and simulated commercial fishing operations were carried out by *R. V. Pramong 10*, of the Phuket Marine Fisheries Station, in cooperation with the FAO/UNDP "Pole and Line Tuna Fishing in Southern Thailand" project from October 1978 through September 1981. The results of this project have shown that tuna resources exist in this area with potential total catches estimated to lie in the range 9,400 to 15,200 t annually. Concerning the species composition of the tuna resources it was reported that longtail tuna was the first dominant species, while eastern little tuna frigate tuna and skipjack tuna were the seriate dominant species respectively.

7. Size composition

The mean size of eastern little tuna and frigate tuna have declined over the years since 1976 as shown in Figures 2 and 3, except in 1982 for eastern little tuna. This may be due to shifting to the new fishing grounds west of Satul Province as evident from the area-wise production presented in Table 2.

The entry of small eastern little tuna (9-16 cm) occurs from January to April and in June, while fish of maximum size (45-47 cm) are caught in December. From February to June small frigate tuna (9-18 cm) enter the fishery and fish of a larger size range (39-41 cm) are caught in February, August and December. Small sized longtail tuna (11-18 cm) appeared to enter the fishery from January to July and the maximum sizes (47-49 cm) appeared in the catches in February, April and September. The size compositions for these three species are shown in Figures 4, 5 and 6.

The FAO/UNDP project concluded that eastern little tuna of the 20-40 cm size range from the inner neritic zone had moved out to the outer neritic zone after attaining a length of 40 cm, remained in this regime until they touched 53 cm, and then probably migrated out from this coast. Frigate tuna of the 20-35 cm size range were distributed in the inner neritic area and moved offshore at about 30 cm. Longtail tuna with a mean length 37.6 cm were caught in the inner neritic area south-west of Phuket Island during the south-west monsoon and distributed principally in the outer neritic zone after entering the 40-49 cm length range. Larger fish of more than 50 cm are believed to migrate out from the coast. On the basis of these findings, it is postulated that the inner neritic zone south-east of Phuket island is the nursery ground of longtail tuna.

8. Spawning season

The gonad index study based on data collected from commercial tuna catches in this coast shows that eastern little tuna has a major spawning during February and March and a minor spawning from August to October. The monthly changes in mean gonad index of frigate tuna show that there are two spawning periods for this species, which extend from February to April and from September to November, as shown in Figures 7a and 7b.

The spawning seasons of each species had been separately studied by the FAO/UNDP project. It was reported that longtail tuna had a major spawning peak during the north-east monsoon from January through April, the principal spawners being about two years old. A minor peak of spawning during the south-west monsoon seemed to occur in August and September.

The monthly distribution of maturity stages of eastern little tuna indicated that the principal spawning period extended from February to April and that the second occurred in September. As for frigate tuna, it was similar to longtail and eastern little tuna in having its spawning period during the north-east monsoon.

However, length frequency data of longtail tuna, eastern little tuna and frigate tuna obtained from a sampling survey were analyzed using the ELEFAN programs, and only one annual peak of recruitment was obtained for both species as shown in Figures 4, 5 and 6.

9. Spawning grounds

On the basis of a study of maturity stages and the proportions of mature females of eastern little tuna and frigate tuna occurring in different areas, it is expected that their spawning grounds may be in the areas of Surin Island, Similan Island and south of Pipi Island. Additionally, an egg and larval survey conducted by the M.S. *Fishery Research Vessel No. 2* between February and April 1986 showed that Thunnidae (*T. tonggol*) larvae are abundant south-west of Phuket Island. More larvae were collected during February than in March and April. Small quantities of larvae were found west of Similan Island. The occurrence of the Thunnidae larvae per 1,000 cubic metres, from horizontal hauls at the surface during the oceanographic survey along this coast in February, is shown in Figures 8a-8e.

10. Growth parameters

The results of the estimation of growth parameters of eastern little tuna, frigate tuna and longtail tuna obtained through the ELEFAN program, are as follows:

	K	L _∞
Eastern little tuna	0.6	48.0 cm
Frigate tuna	0.63	44.0 cm
Longtail tuna	0.75	51.5 cm

The modal progressions in eastern little tuna and frigate tuna length frequencies are very clear, and hence good growth curves were realized for both species. This was not the case for longtail tuna data, probably because of insufficient length frequency data. The growth curves for these three species are shown in Figures 4, 5 and 6.

11. Status of stocks

The ELEFAN II program analyses yield, mortality rates and the selection patterns as follows:

	Z	M	F	E	L _c
Eastern little tuna	2.24	1.12	1.12	0.50	27.9
Frigate tuna	2.42	1.19	1.23	0.51	26.06
Longtail tuna	1.47	1.27	0.20	0.14	32.3

Z: Total mortality. M: Natural mortality. F: Fishing mortality E: Exploitation rate.
L_c: Mean length at first capture.

The exploitation rate for longtail tuna is rather low, perhaps because its distribution is mostly in peripheral areas where only large seiners are able to operate.

The maximum sustainable yields for longtail tuna, eastern little tuna and frigate tuna were estimated from yield curves established using available catch and fishing effort data. The data obtained from the landing place survey of the Fisheries Statistics Subdivision, Department of Fisheries, were used for these estimates (see Tables 4 A and 4 B). Though the results obtained from this survey probably differ from statistics presented in earlier reports (data used from the sampling survey), the correlation coefficient (r^2) derived was much higher with the present set of data. As mentioned earlier, tunas are mainly caught by purse seiners; therefore, the purse seine was considered as the standard gear for the assessment.

The estimated maximum sustainable yield is 2,550 t for longtail tuna and 1,994 t for eastern little tuna and frigate tuna, as shown in Figures 9 and 10 respectively. The maximum sustainable yield for longtail tuna was exceeded in 1981 and that for coastal tunas in 1985. The fishing effort for longtail tuna has exceeded the optimum effort level for the past several years and that for coastal tunas was exceeded from 1983 to 1985. This impression may have been created by the fact that the fishing effort estimated was not specifically on tunas only and not specifically in areas where only tunas are abundant, as discussed earlier. Hence, the results must be regarded with great caution.

12. References

- Anonymous, 1976 Report of the workshop on the fishery resources of the Malacca Strait-Part 2. South China Sea Fisheries Development and Coordinating Programme.
- Asian Development Bank, 1985 Thailand Fisheries Sector Study; 232 pp.
- Bhatia, U. and S. Chullasorn, 1980 Coastal fisheries on the west coast of Thailand. A paper presented at the Consultation on Stock Assessment in Small-Scale Fisheries. Chittagong ; 46 pp.
- Bhatia, U. Boonsiri Wongchitsue and Twatchai Chantawong, 1980 The status of marine fishery resources along the west coast of Thailand. Phuket Marine Fisheries Station, Department of Fisheries, Thailand; 23 pp.
- Chullasorn, S. and S. Shindo, 1980 A preliminary study on the present status of fish stocks based on catch effort data with special reference to Thai pelagic fisheries. A paper presented to the technical workshop on fisheries statistics and stock assessment held by SEAFDEC, Bangkok, Thailand. 8-1 2 September, 1980 ; 24 pp.

- Marine Fisheries Division, 1981 The present status of pelagic fisheries of Thailand. A paper presented to the seminar on stock assessment of pelagic resources with emphasis on shared stocks organised by SEAFDEC in collaboration with FAO/UNDP/SCSP, Bangkok, Thailand. 10-14 August.
- 1985 Tuna resources and fisheries in Thailand. Department of Fisheries, Bangkok, Thailand ; 18 pp.
- Sivasubramaniam, K., 1985 Marine Fishery Resources of the Bay of Bengal. BOBP/WP/36; 84 pp.
- Yesaki, M., 1982 Thailand biological and environmental observation. A report prepared for the Pole and Line Tuna Fishing in Southern Thailand Project, FAO, Rome.

Table 1

The pelagic fishing fleet registered by type of gear and by size of boats along the west coast of Thailand, 1975-1983.

Fishing gears	Size of boat (metres)	Year								
		1975	1976	1977	1978	1979	1980	1981	1982	1983
Thai purse seine	< 14	13	6	12	16	1	7	5	1	—
	14-18	35	41	10	31	3	4	9	-	-
	> 18	37	42	—	—	—	1	3	-	-
	Total	85	89	22	47	4	12	17	1	—
Chinese purse seine	<14	—	—	—	1	—	—	—	—	—
	14-18	10	7	9	6	7	9	7	9	10
	> 18	7	8	13	8	8	3	7	4	8
	Total	17	15	22	15	15	12	14	13	18
Luring purse seine	<14	—	—	—	1	3	9	13	16	7
	14-18	—	—	56	37	38	54	46	42	41
	> 18	—	—	39	30	28	51	68	81	87
	Total	—	—	95	68	69	114	127	139	135
King mackerel gillnet	<14	23	7	17	14	9	7	7	14	19
	14-18	15	15	21	22	15	17	19	17	11
	> 18	5	—	—	—	—	—	—	—	-
	Total	43	22	38	36	24	24	26	31	30

Source: Thai fisheries vessels statistics, Department of Fisheries, Thailand.

Table 2
Landings of small tunas by major fishing port on the west coast of Thailand, 1979-1985

Landing port	1979		1980		1981		1982		1983		1984		1985	
	Catch t	%	Catch t	%	Catch t	%	Catch t	%	Catch t	%	Catch t	%	Catch t	%
Ranong	12	0.7	22	1.3	209	5.1	6	0.2	235	8.2	84	2.5	194	4.7
Takuopa	138	7.6	84	4.9	264	6.4	113	3.1	80	2.8	112	3.4	858	20.8
Taimuang	34	1.9	69	4.0	475	15.5	309	8.6	949	32.9	655	19.7	780	18.9
Phuket	8	0.4	6	0.3	30	0.7	17	0.5	524	18.2	666	20.1	825	20.0
Krabi	324	18.0	129	7.5	555	13.5	480	11.9	19	0.7	1,525	45.9	317	7.7
Trang	569	31.5	463	26.9	589	14.3	478	13.3	548	19.0	279	8.4	33	0.8
Satul	718	39.8	948	55.1	1,997	48.5	2,251	62.4	525	18.2	—	—	1,118	27.1
Total catch	1,803		1,721		4,119		3,604		2,880		3,321		4,125	

Sources: For 1979-1984, the Landing Place Survey, Department of Fisheries, Thailand. For 1985, the sampling survey conducted by Phuket Marine Fisheries Station.

Table 3
Annual catch and catch by types of gear of tuna species
in the west coast of Thailand, 1979-1985

Year	Total t	Species	Sub- total t	RPS		LPS		Others	
				Catch t	%	Catch t	%	Catch t	%
1979	1,803	LOT	1,624	527	29.2	990	54.9	107	5.9
		TUN	179	37	2.1	106	5.9	36	2.0
1980	1,721	LOT	1,548	—	—	—	—	—	—
		TUN	173	—	—	—	—	—	—
1981	4,119	LOT	3,188	—	—	—	—	—	—
		TUN	931	—	—	—	—	—	—
1982	3,604	LOT	2,007	918	25.5	1,006	27.9	83	2.3
		TUN	1,597	31	0.9	1,499	41.9	67.	1.8
1983	2,880	LOT	1,397	1,303	45.2	88	3.1	6	0.2
		TUN	1,488	22	0.8	1,430	49.6	31	1.1
1984	3,321	LOT	2,014	—	—	—	—	—	—
		TUN	1,307	—	—	—	—	—	—
1985	4,125	LOT	848	785	19.0	43	1.0	20	0.5
		TUN	3,277	1,604	38.9	1,597	38.7	76	1.8

LOT Longtail tuna TUN — Other tunas

Sources: For 1979-1984, Marine Fisheries Statistics based on Landing Place Survey, Department of Fisheries, Thailand. For 1985, the sampling survey conducted by Phuket Marine Fisheries Station.

Table 4
Catch, effort and catch per unit of effort data (purse seine
as standard gear) of tuna in the west coast of Thailand, 1979-1985.

A. Longtail tuna

Year	1979	1980	1981	1982	1983	1984	1985
Total catch (tons)	1,624	1,548	3,188	2,007	1,397	2,014	745
Total effort (days)	27,377	42,692	37,916	16,056	48,507	11,165	37,760
CPUE (kg/day)	59.32	36.26	84.08	125	28.8	180.38	19.73

B. Coastal tuna

Year	1979	1980	1981	1982	1983	1984	1985
Total catch (tons)	179	173	931	1,597	1,483	1,307	3,380
Total effort (days)	9,521	12,098	2,804	10,541	26,964	29,298	44,200
CPUE (kg/day)	18.8	14.3	332.0	151.5	55.0	44.61	76.47

Sources: For 1979-1984, total catch from the Landing Place Survey, Department of Fisheries, Thailand. For 1985, total catch from the sampling survey conducted by Phuket Marine Fisheries Station. For 1979-1985, CPUE from the sampling survey conducted by Phuket Marine Fisheries Station.

Table 5
Monthly catch of small tuna by various types of
gear in the west coast of Thailand, 1982-1985

(tonne)

Month/Year	Longtail tuna				Coastal tuna			
	1982	1983	1984	1985	1982	1983	1984	1985
January	293	199	25	—	259	207	50	36
February	162	280	43	6	102	138	91	613
March	416	189	260	15	232	272	100	306
April	217	391	219	121	135	189	118	785
May	109	249	9	—	168	233	235	574
June	45	35	54	—	105	70	289	17
July	76	7	287	273	54	78	44	242
August	186	13	233	1	294	37	34	362
September	184	20	216	8	78	84	59	36
October	60	—	287	144	88	1	60	86
November	144	8	242	280	22	6	95	135
December	115	6	139	—	60	168	132	85
Total	2,007	1,397	2,014	848	1,597	1,483	1,307	3,277

Sources: For 1979-1984, the Landing Place Survey, Department of Fisheries, Thailand.
For 1985, the sampling survey conducted by Phuket Marine Fisheries Station.

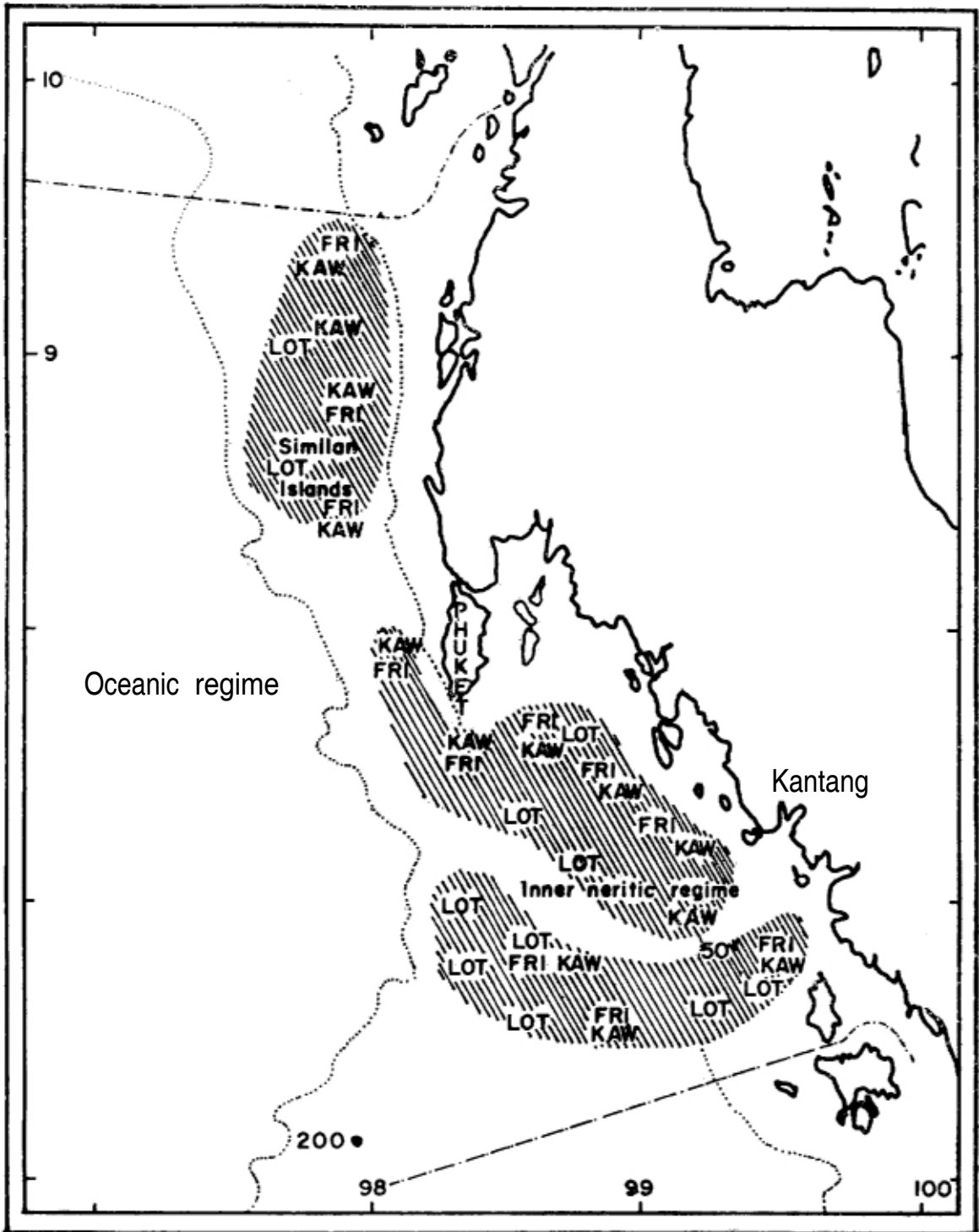


Fig. 1 Major fishing grounds for tuna on the west coast of Thailand.
 FRI-Frigate Tuna, KAW-Kawakawa, LOT-Longtail Tuna.

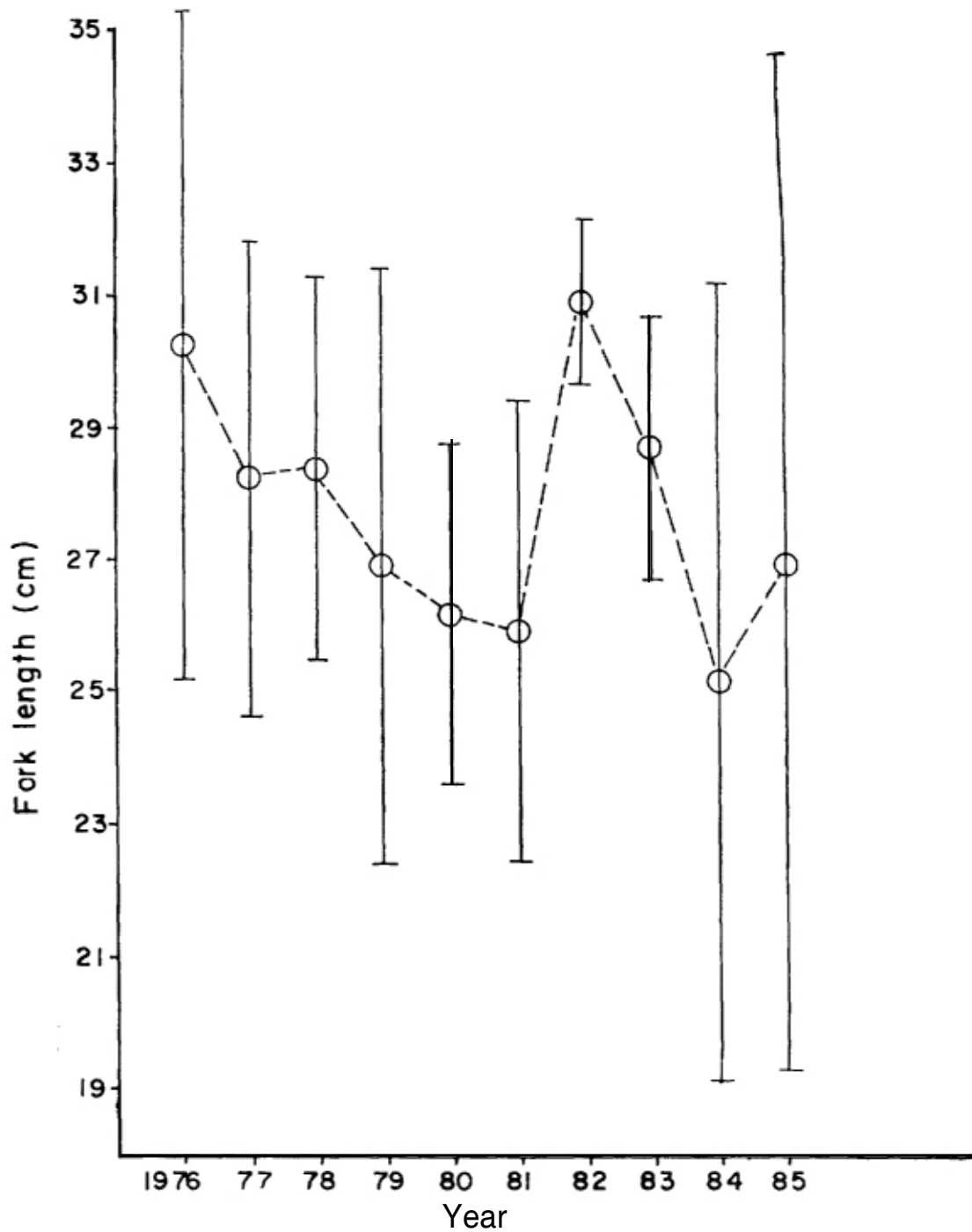


Fig. 2 Annual mean length and size ranges of *E. affinis* on the west coast of Thailand, 1976—1985.

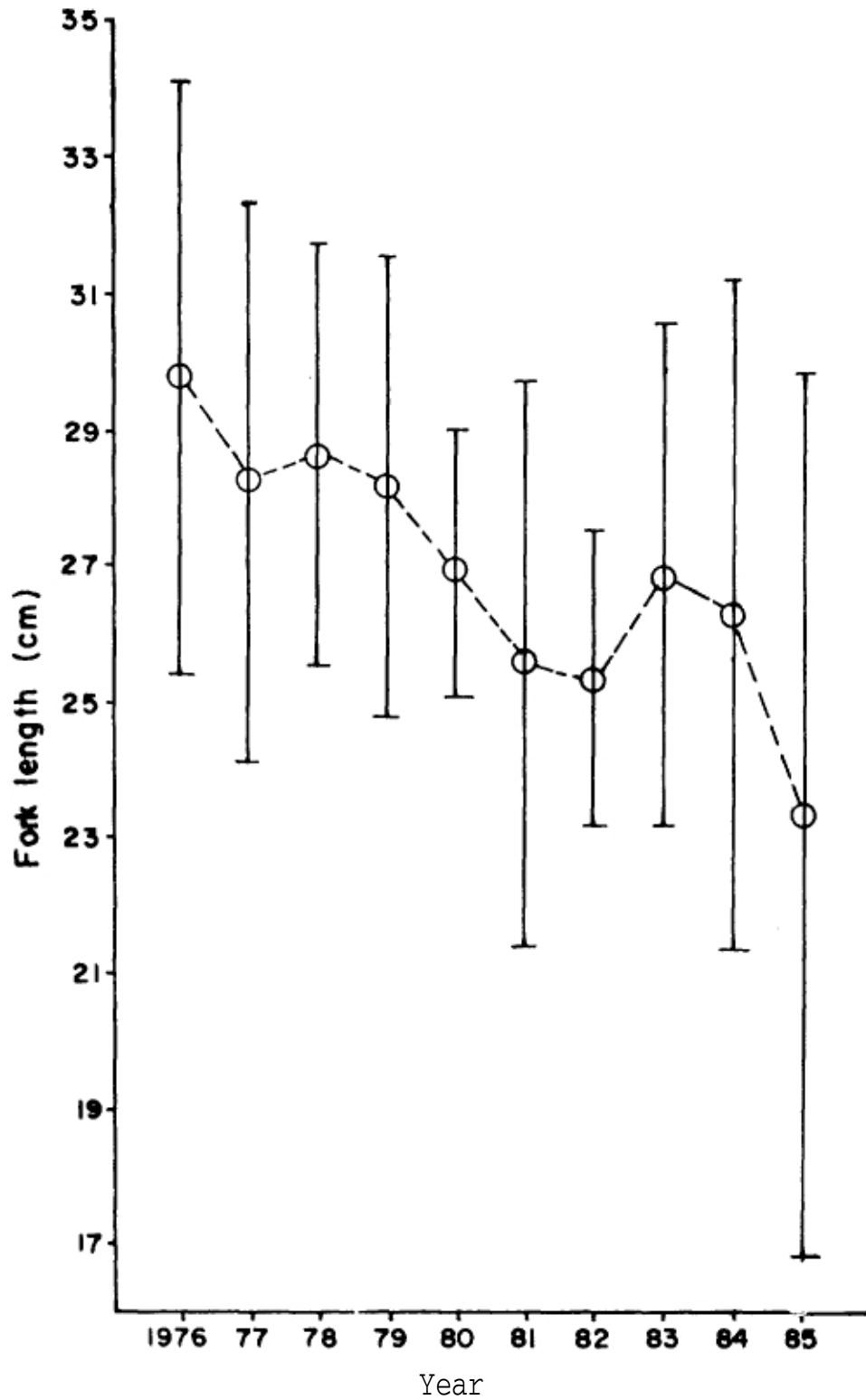


Fig. 3 Annual mean length and size range of *A. thazard* on the west coast of Thailand, 1976-1985.

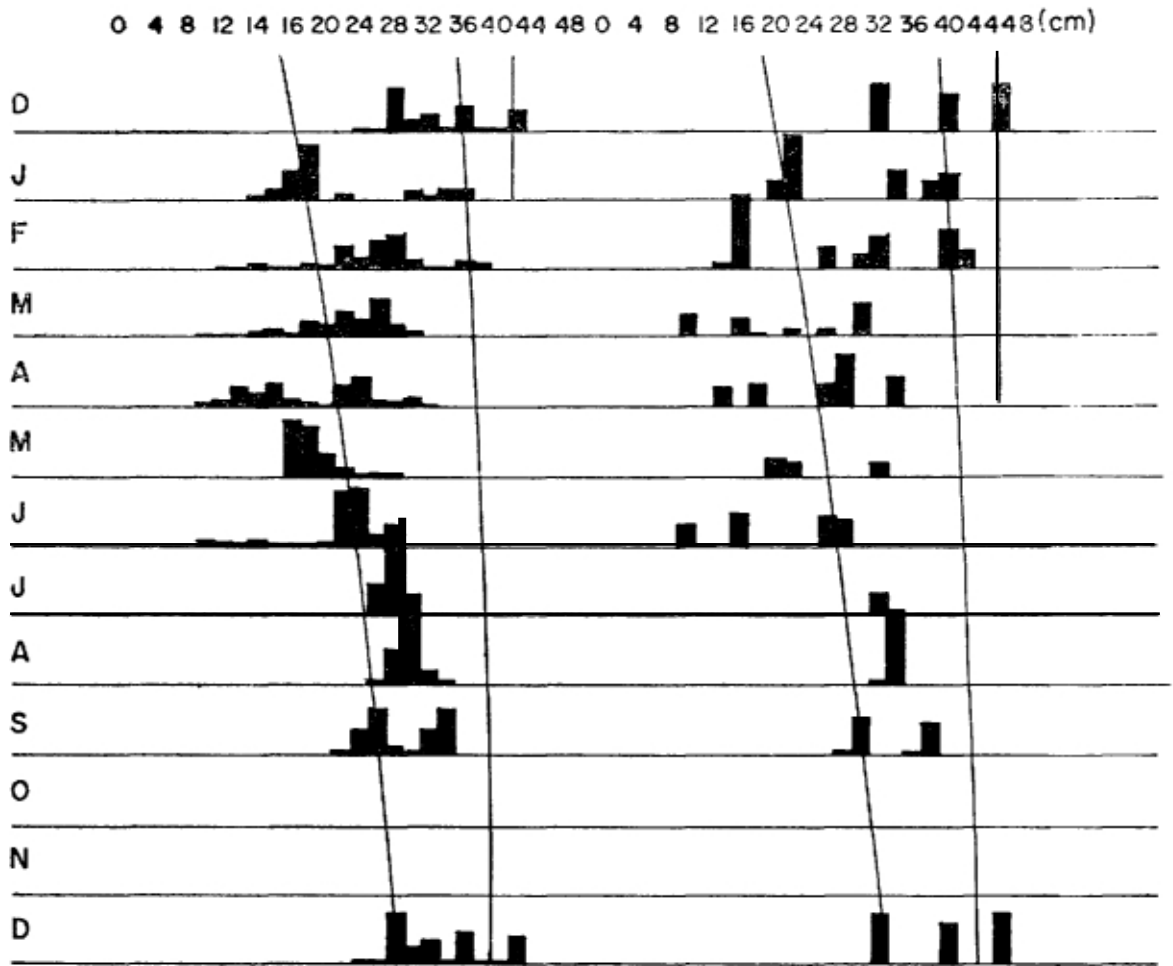


Fig. 4 Monthly length frequency distributions, restructured frequencies and growth curve of *E. affinis* from the west coast of Thailand (1985).

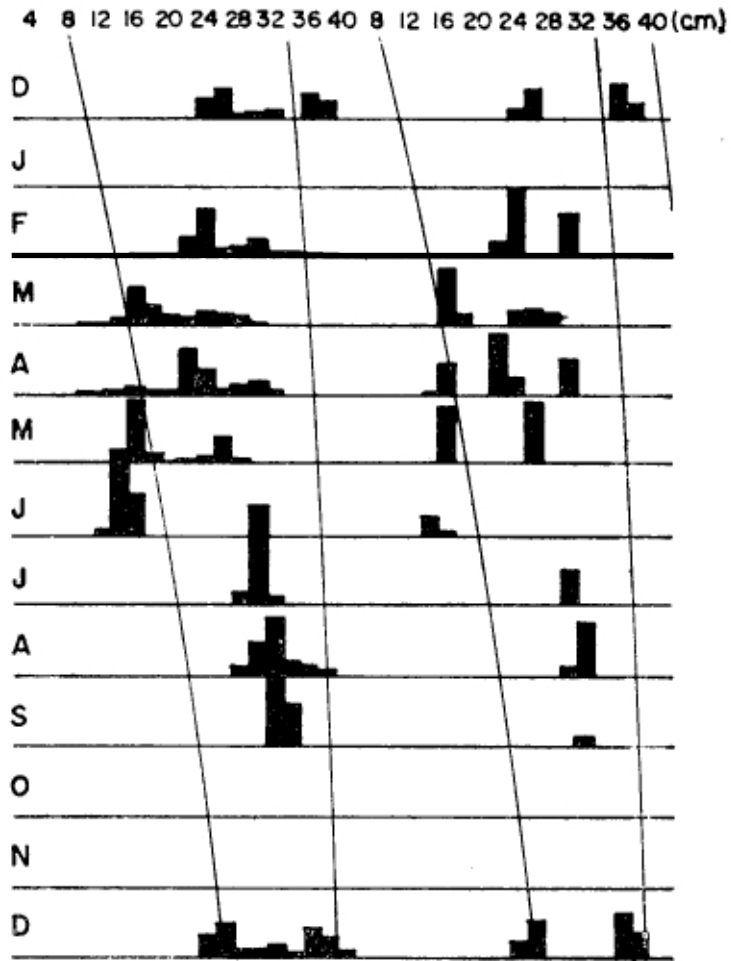


Fig. 5 Monthly length frequency distributions, restructured frequencies and growth curve of *A. thazard* from the west coast of Thailand (1985).

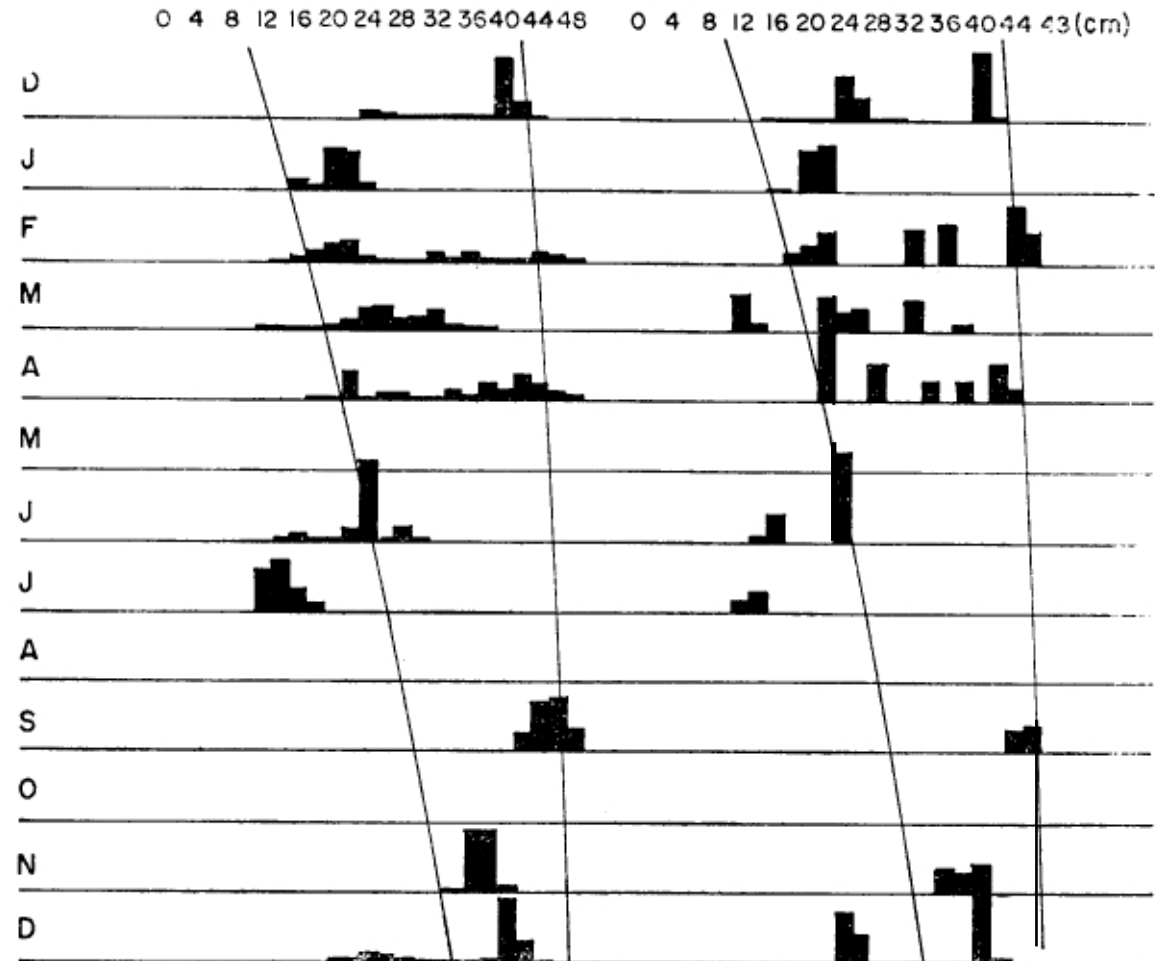


Fig. 6 Monthly length frequency distributions, restructured frequencies and growth curve of *T. tonggol* from the west coast of Thailand (1985).

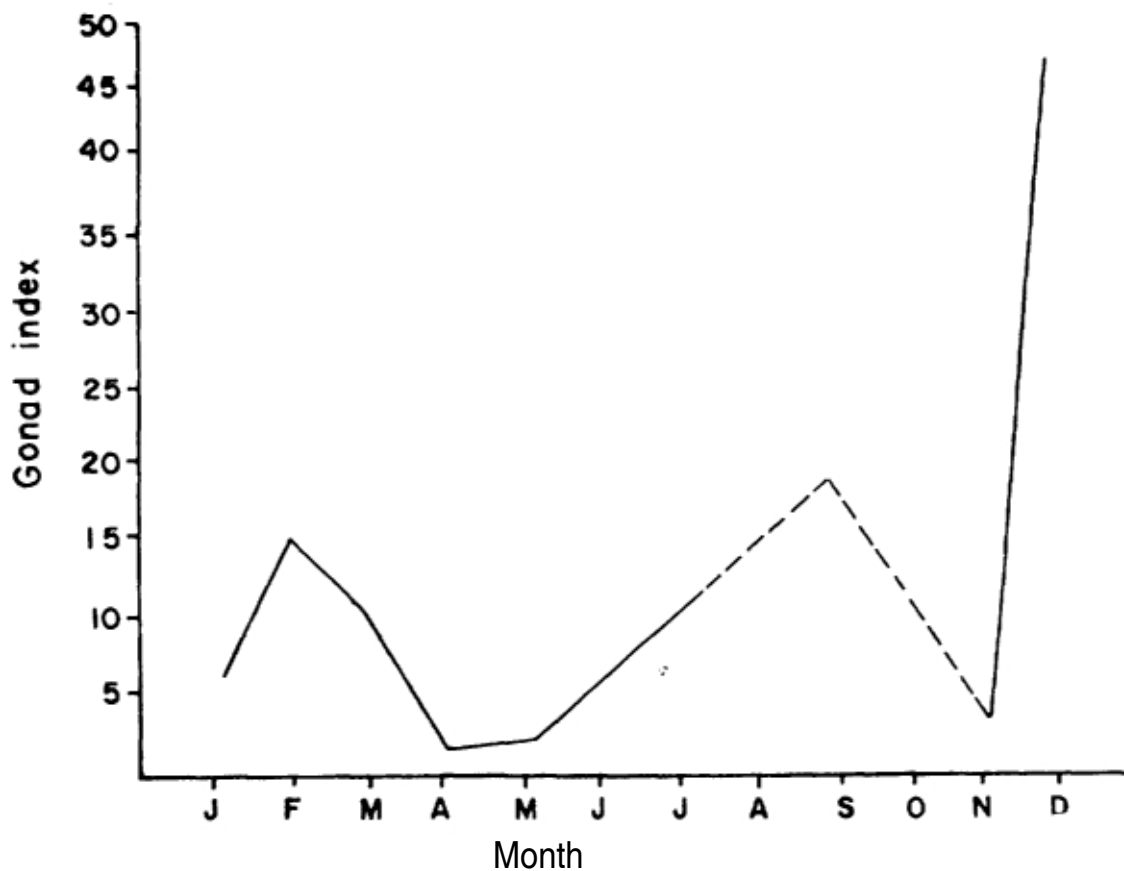


Fig. 7a Monthly changes in mean gonad index of *A. thazard* from west coast of Thailand (1979—1981)

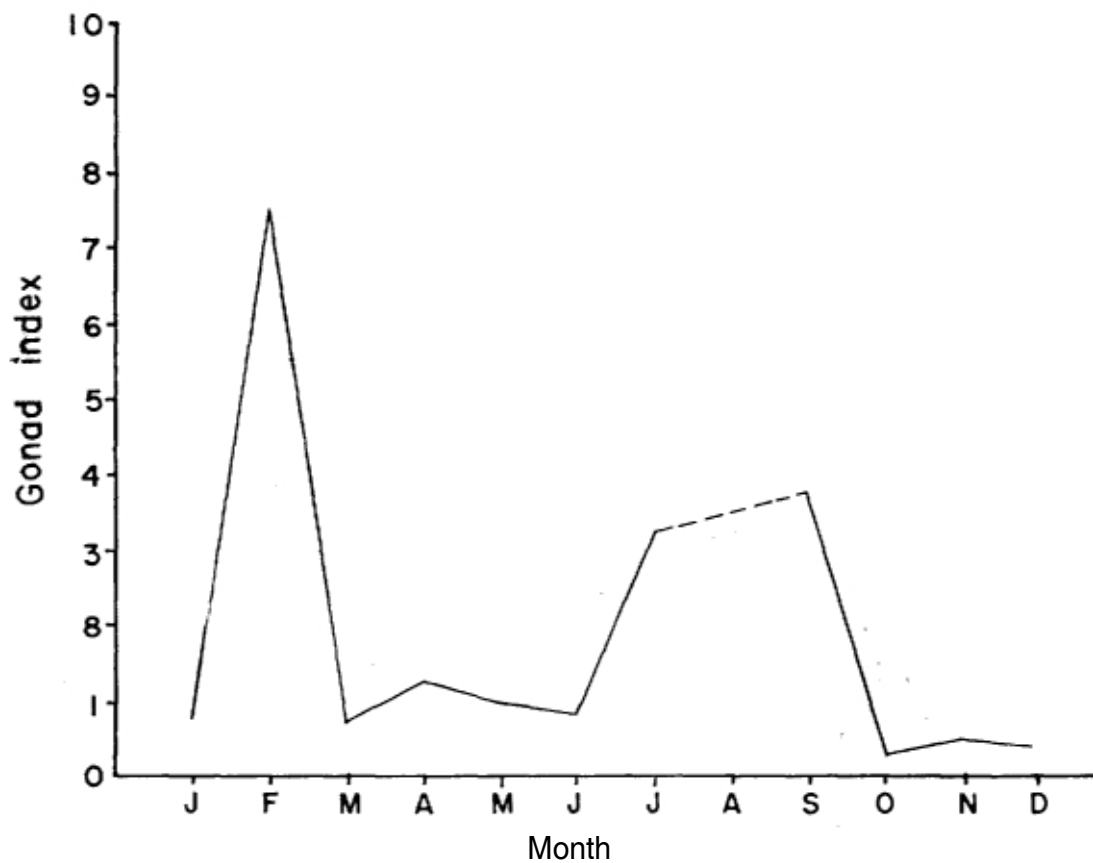


Fig. 1b Monthly changes in mean gonad index of *E. affinis* from west coast of Thailand (1979—1981)

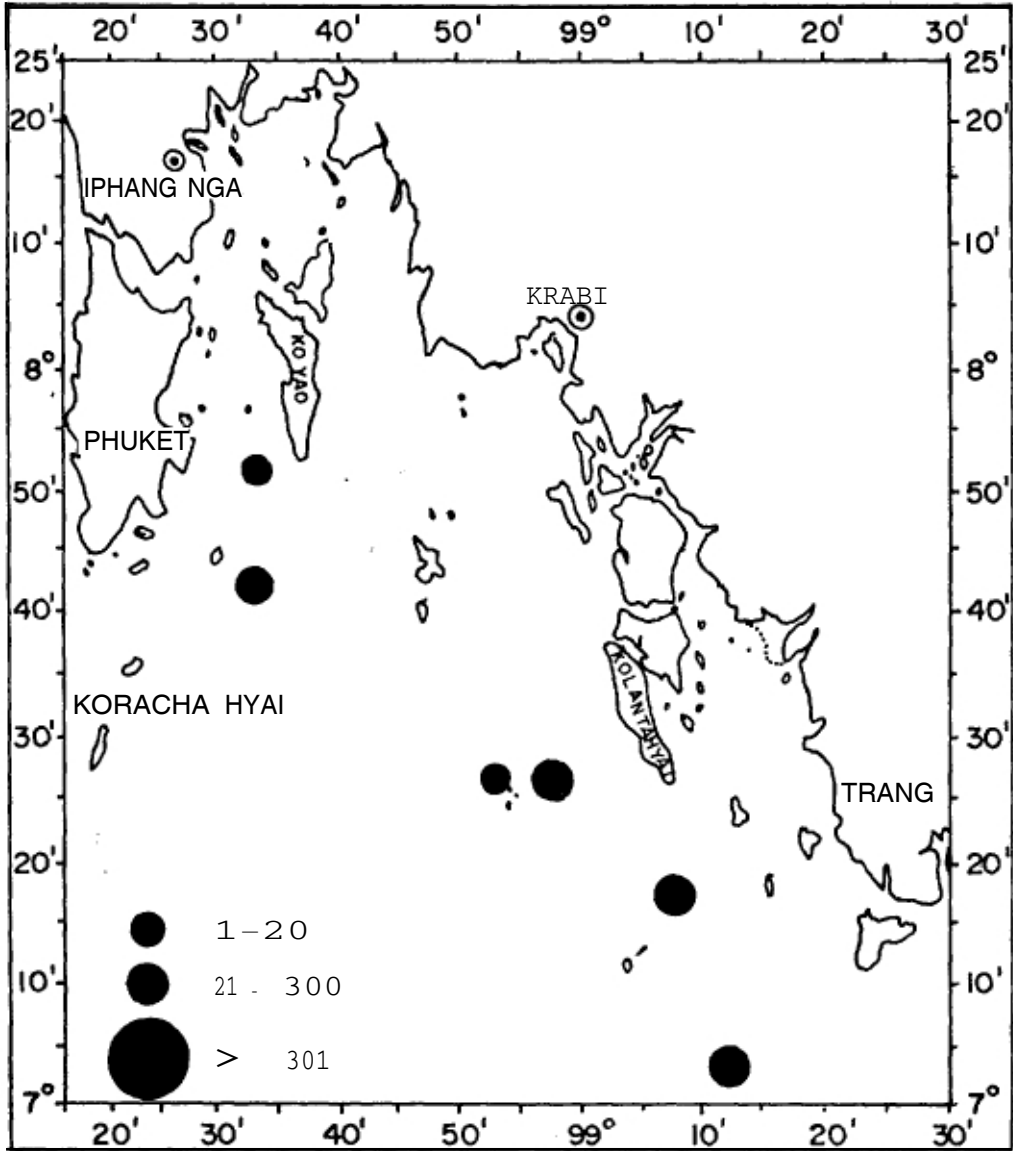


Fig. 8a Occurrence of *T. tonggollarvae* per 1000 m³ as estimated from oblique hauls on the west coast of Thailand during February, 1986.

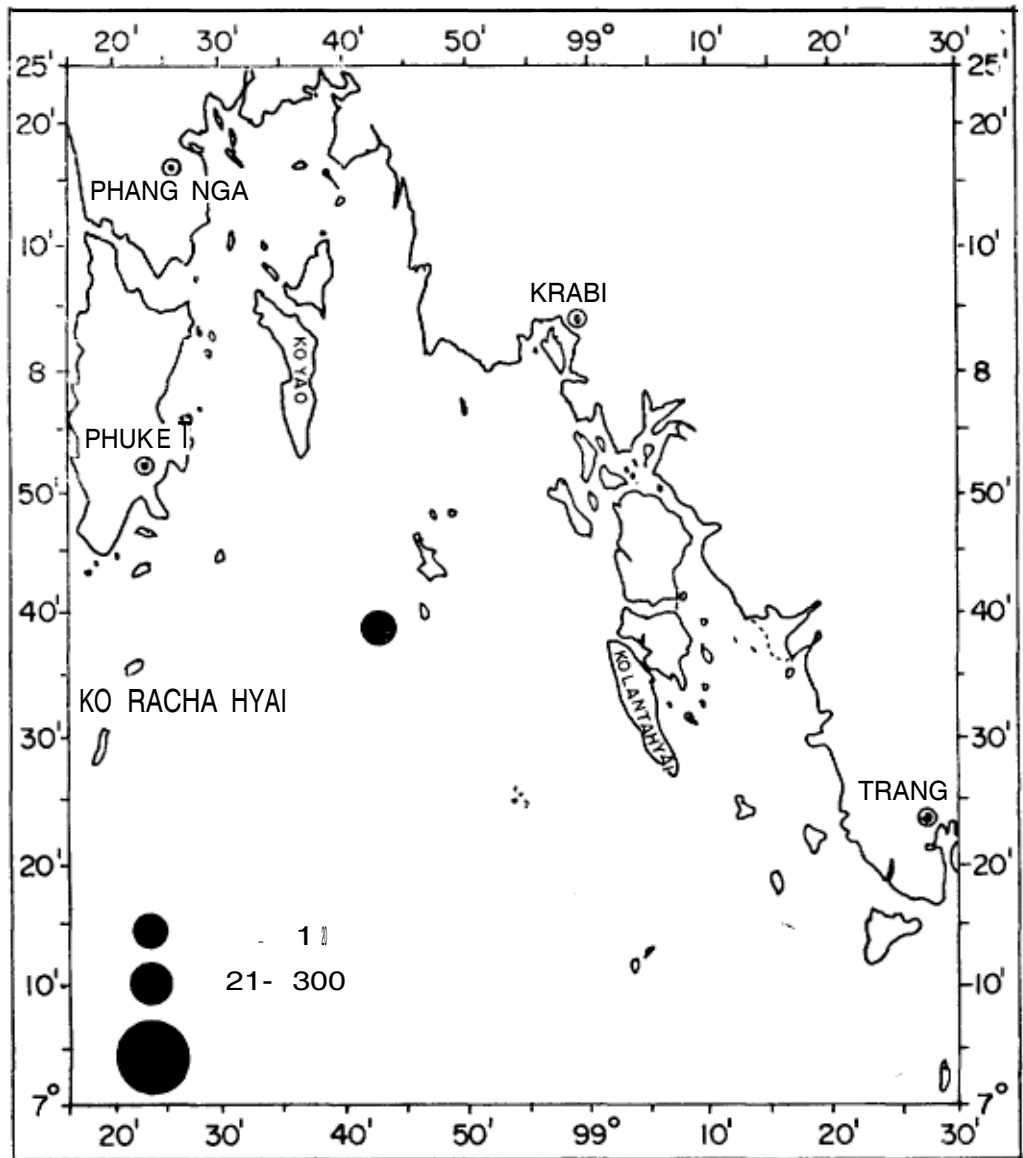


Fig. 8b Occurrence of *T. tonggol* larvae per 1000m³ as estimated from oblique hauls on the west coast of Thailand during March, 1986.

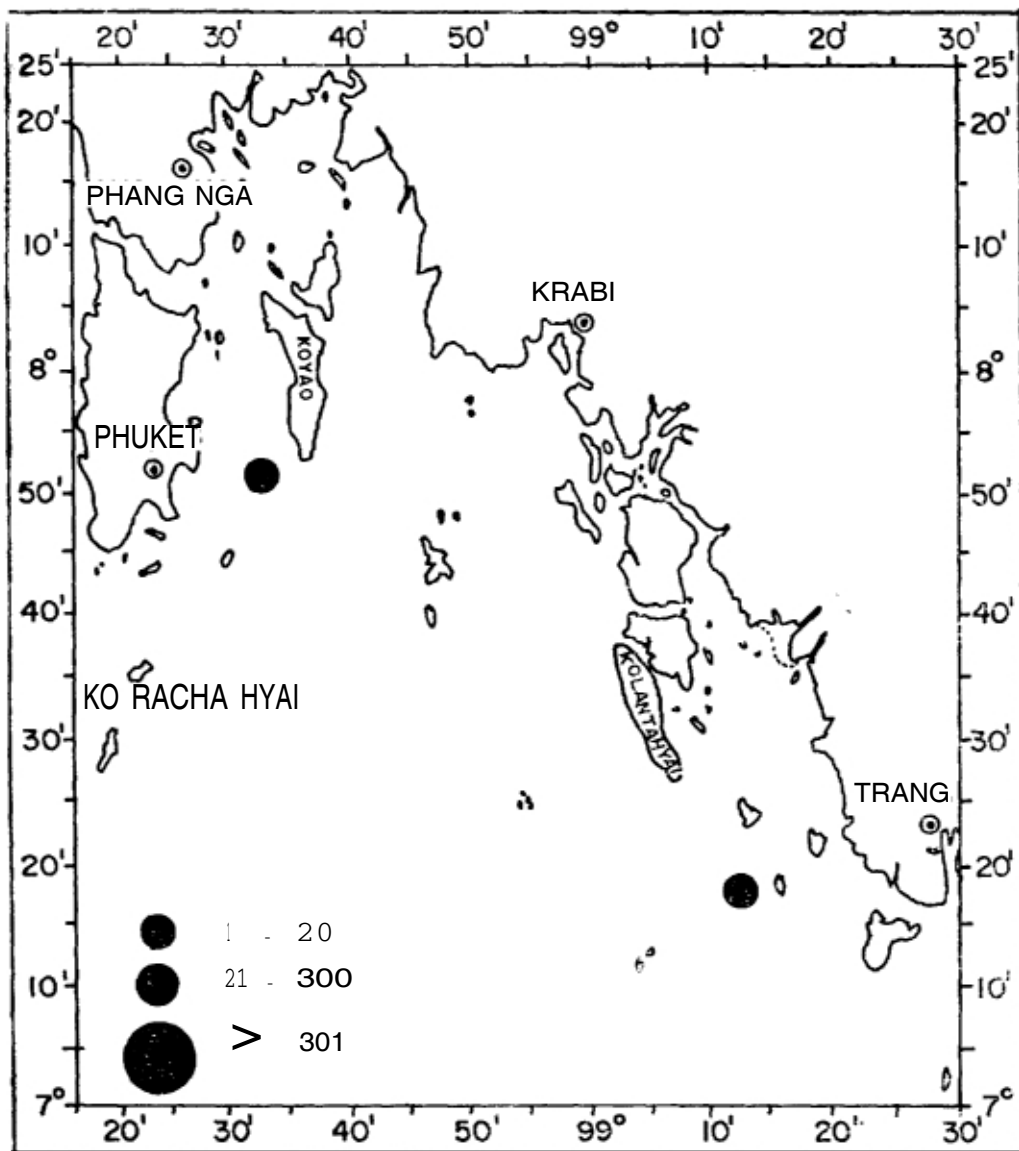


Fig. 8c Occurrence of *T. tonggol* larvae per 1000m³ as estimated from oblique hauls on the west coast of Thailand during April 1986.

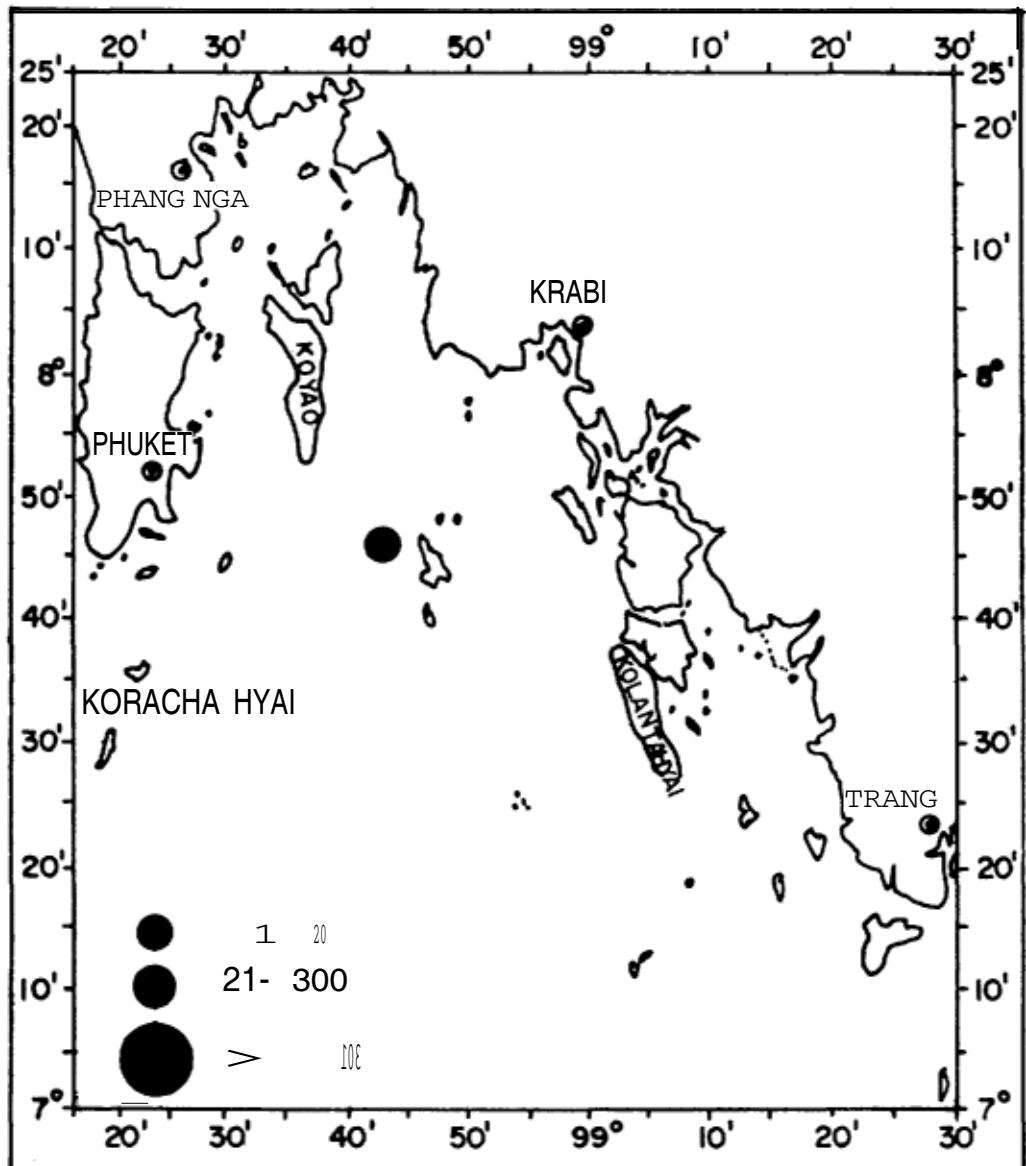


Fig. 8d Occurrence of *E. affinis* larvae per 1000 m³ from oblique hauls on the west coast of Thailand, February 1986 (larva-net)

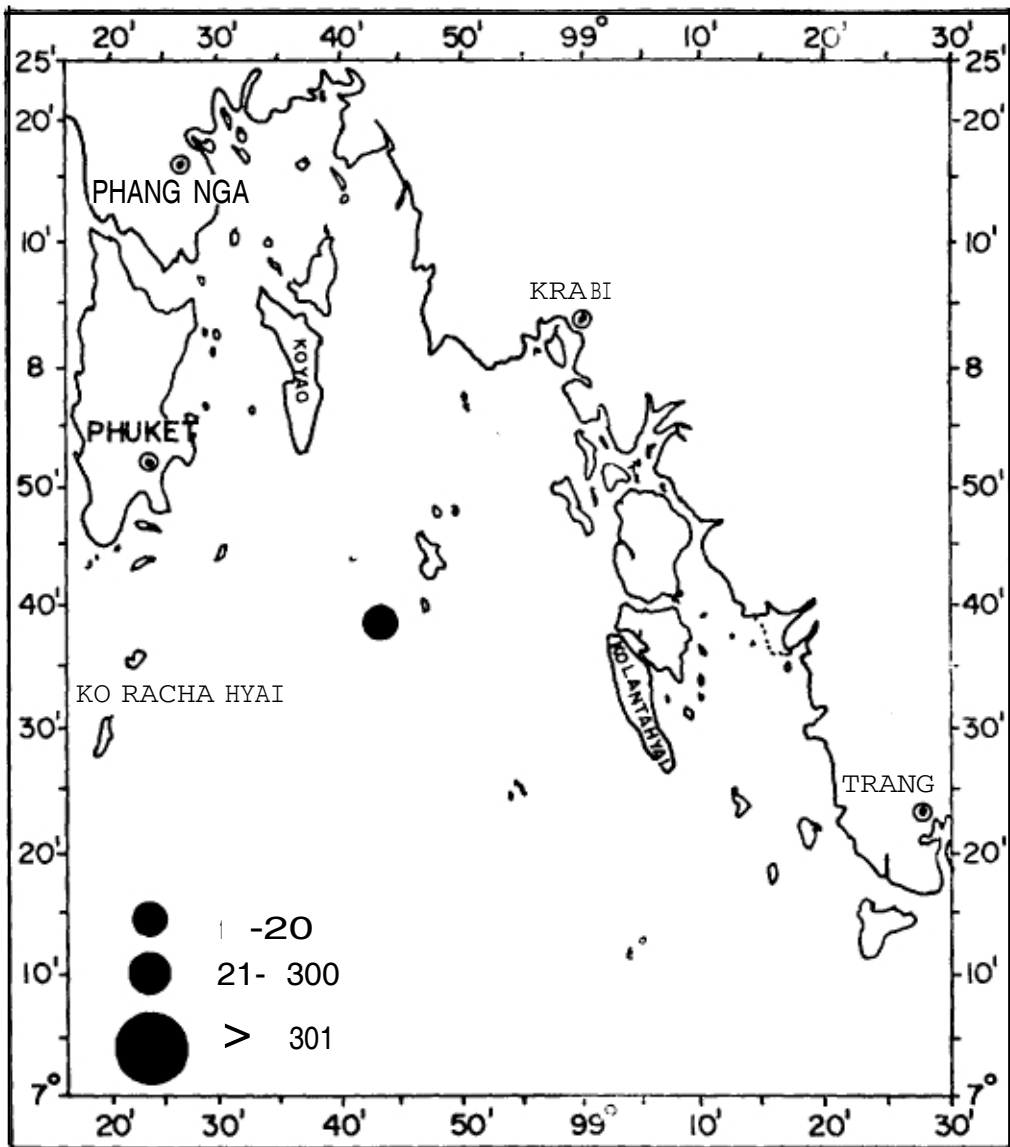


Fig. 8e Occurrence of *A. thazard* larvae per 1000 m³ from oblique hauls on the west coast of Thailand, March 1986 (larva-net)

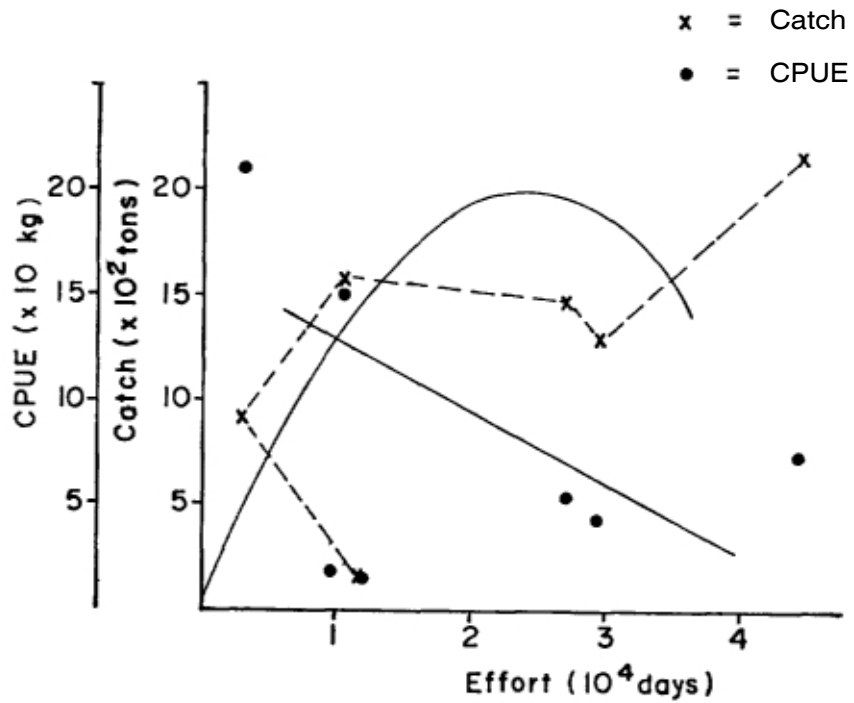


Fig. 9 Catch and catch per cent of effort related to total standardised effort (purse seine units), for *T. tonggol* on the west coast of Thailand (1979—1985).

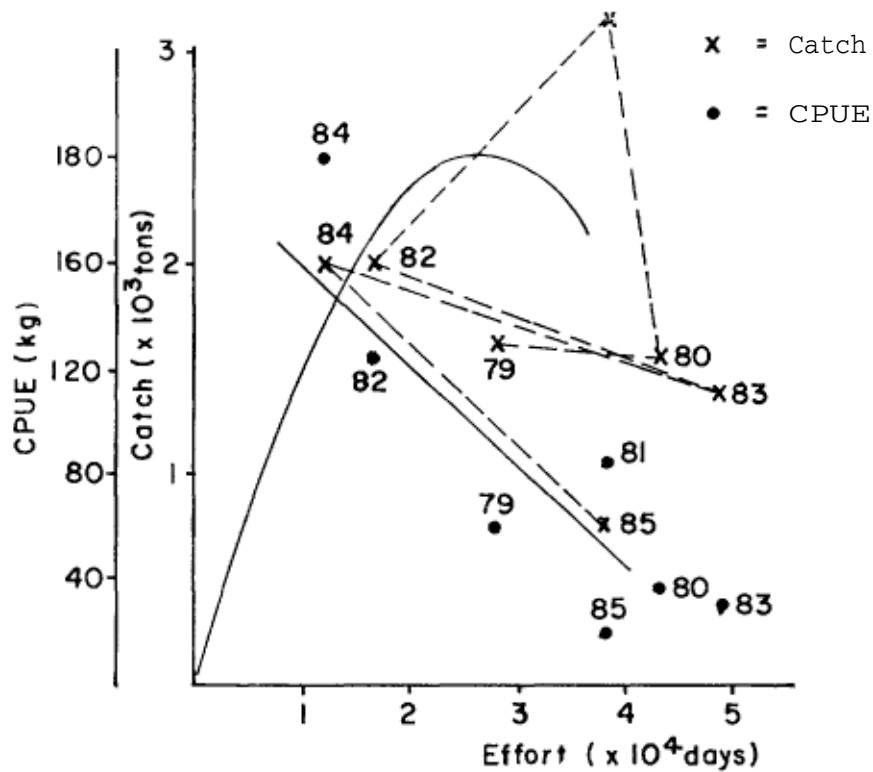


Fig. 10 Catch and catch per cent of effort related to total standardised effort (purse seine units), for coastal tuna on the west coast of Thailand (1979—1985).