

**Fig. 5. The development of the anchovy larvae  
(Rearranged from Charyakul, 1996 Note length of D is obviously wrong)**

### **3. THE BIOLOGY OF ANCHOVY**

#### **3.1 The distribution of eggs and larvae**

Wattanachai (1978) surveyed the distribution of fish eggs and larvae using larval nets. Anchovy eggs and larvae were abundantly distributed in March around Chang and Kuit Islands in Trad Province and Sattahip in Cholburi Province (Fig. 6). Songchitsawat (1989) surveyed the fish larvae around Chang Island on the east coast of the Gulf of Thailand, in Trad Province in the year 1983. The average number of Engraulid larvae at 16 stations showed a high peak of abundance in July. The average number of larvae per 1,000 cubic meters of water gradually increased from August to May of the following year. The highest number was 1,887 in July (recalculated from Songchitsawat, 1989). Engraulid larvae near Chang Island showed spatial distribution; the outer zone of the island was less abundant than the inner zone. The seasonal distribution in northeast, inter-monsoon and southwest monsoons showed a percentage of occurrence of 35.0%, 23.2% and 30.4% respectively (Songchitsawat, 1989).

Chayakul (1980, 1996) also surveyed fish eggs and larvae in Prachuab Kiri Khan and Surat Thani Provinces. The results showed high density of anchovy eggs and larvae in these areas with two peaks in February-April and July-August. Engraulid larvae were found all over the Gulf of Thailand and Andaman Sea (Songchitsawat, 1989; Chayakul, 1996).

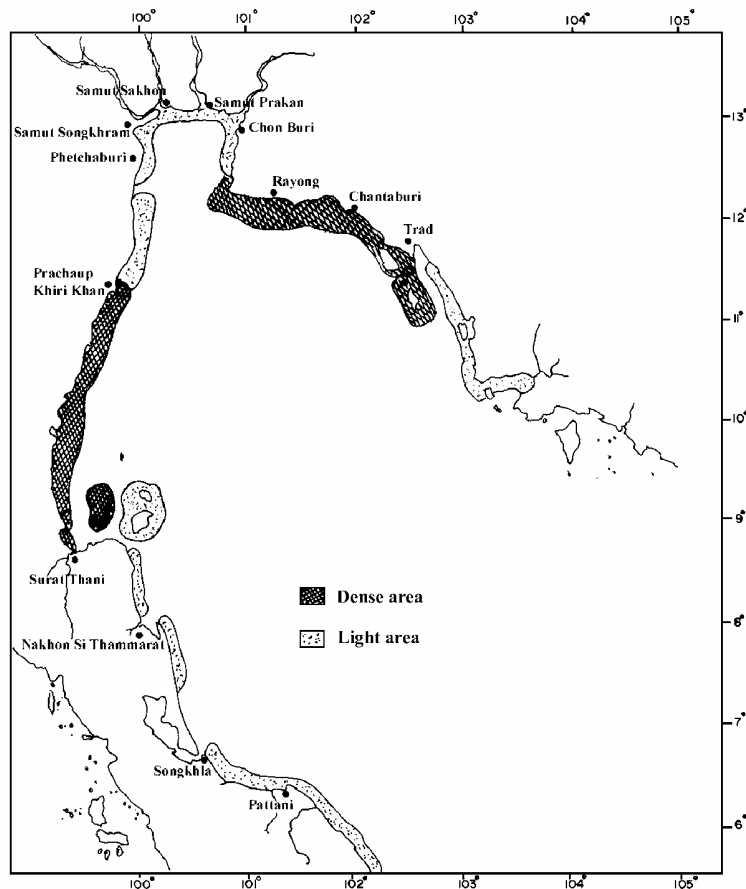


Fig. 6. The distribution of anchovy eggs and larvae in the Gulf of Thailand

### 3.2 The distribution of adult anchovy

Adult anchovies are distributed all over the Gulf of Thailand at a depths ranging from 5 to 60 m. The dense areas are near islands and river mouths.

In the eastern part of the Gulf of Thailand (Trad, Chantaburi and Rayong Provinces), the dense areas are around Chang, Kuit Islands, Ao Makam Pom to Haad Mae Rampeong, Samae San in Rayong up to Chonburi Province of the upper Gulf areas. On the western coast of the Gulf, anchovies are found abundantly in Chumphon, Ao Ban Don and Toa, Samui and Phangan islands of Surat Thani Province and the Songkhla and Pattani Provinces in the south (Fig. 7).

### 3.3 Length-weight relationship

Vadhanakul, 1996 determined the length-weight relationship of mixed sexes of *Encrasicholina heteroloba* as

$$W = 0.002907 * L^{3.415362} \text{ (weight in g, total length in cm)}$$

According to Yoosookswat, 1990 the length-weight relationship of anchovy separated by sex on the eastern coast of the Gulf were:

$$W = 0.000007089 * L^{2.9329} \text{ for females}$$

$$W = 0.000002064 * L^{3.2494} \text{ for males (weight in g, total length in cm)}$$

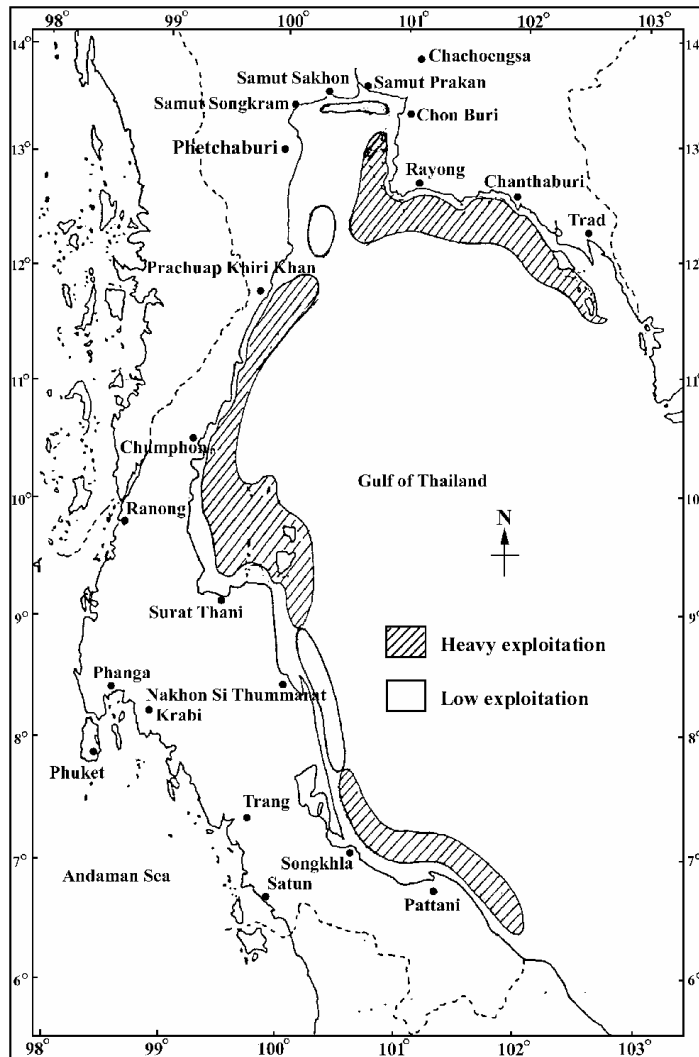


Fig. 7. Distribution and fishing grounds of anchovies in the Gulf of Thailand

### 3.4 Sex ratios

Taweessit and Isara (1972) studied the sex ratios of anchovies in the upper Gulf of Thailand, the result showed that the ratio between males and females was 1:1. Vadhanakul (1996) studied the sex ratios of *Encrasicholina heteroloba* in the areas along the coasts of Prachuab Kiri Khan and Chumphon Provinces. The ratio between males and females was 1.4:1. In Rayong Province the ratio was 1.75:1 (Manprasit, 1996).

### 3.5 Growth parameters

Supongpan and Isara (1984) reported that the juveniles of the anchovy (*Encrasicholina heteroloba*) were very fast growing with an increase in length of 3 cm in 56 days. At ages between 6 and 12 months the increment was 3.8 mm per month. Anchovy has an average life span of only one year. The exploited ages are about 7 to 9 months. The asymptotic length ( $L_{\infty}$ ) was

estimated at 8.9 cm. Yoosookswat (1990) reported an asymptotic length ( $L_{\infty}$ ) of anchovy in the eastern coast of the Gulf of 10.54 cm, while length at first maturity ( $L_m$ ) was 5.64 cm and K was 1.81 per year.

### 3.6 Maturity and fecundity

One female could produce 1,140-3,660 oocytes. The oocytes' diameter ranged from 0.2 to 1.0 mm (Vadhanakul, 1996). In Rayong Province, one female could produce 101–4,606 oocytes. The size range of fully mature females was 7.5-9.0 cm (Manprasit, 1996)

Vadhanakul (1996) studied the reproductive biology of *Encrasicholina heteroloba* on the west coast of the Gulf (Prachuab Kiri Khan and Chumphon Provinces) and found that mature females were abundant throughout the year. Sizes in daytime catches were lower (range 2.5-9.5 cm with a peak at 7.5-8.0 cm) than in nighttime catches (range 4.0-10.0 cm also with a peak at 7.5-8.0 cm). Investigations of the stages of maturity (5) showed that the smallest size of maturity was 5.5 cm.

Table 1 shows the sizes of mature and young fish caught by depth zones (data reading from Figs. 3 & 5 in Vadhanakul, 1996; stages I, II and III regrouped into young fish and stages IV and V regrouped into mature fish). Mature fish, both male and female were abundant at depths 30-40 m. Young fish were found only in the shallow waters, whereas mature fish can be found at any depth.

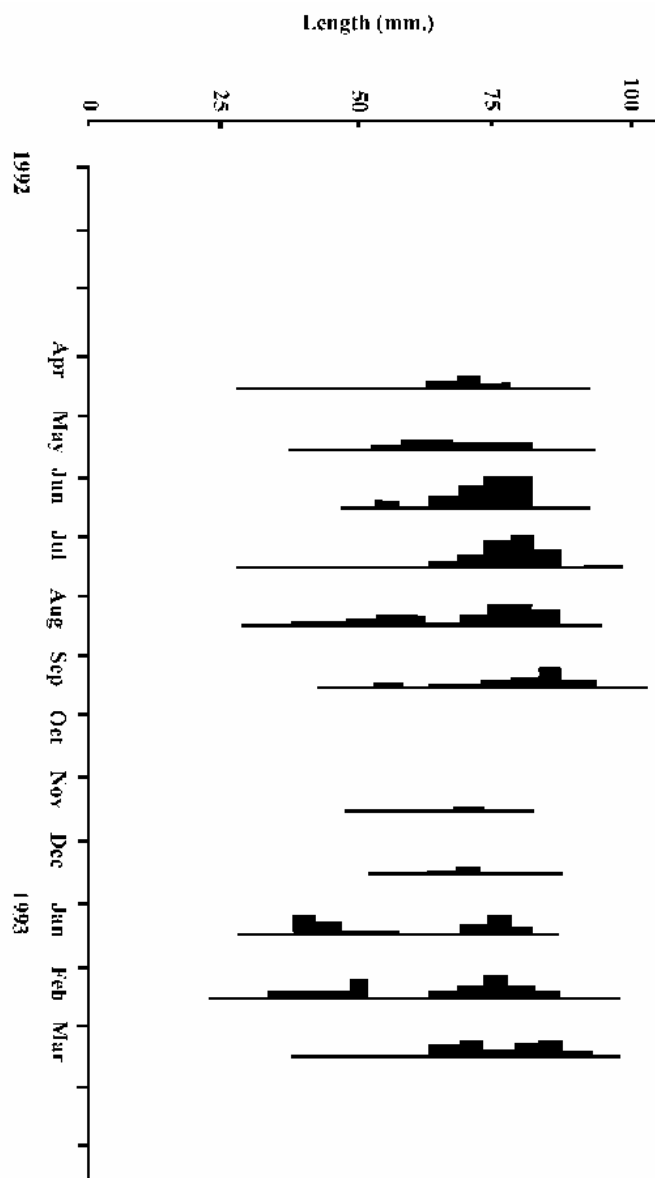
**Table 1. Female and male maturation stages by size and depth zone**

Depth zone (m)	Female		Male	
	Young fish (cm)	Mature fish (cm)	Young fish (cm)	Mature fish (cm)
10-20	5.0-9.5	5.5-9.5	5.5-9.5	6.3-10.0
20-30	5.0-9.5 (stage I, few)	6.2-9.5	5.0-9.5 (stage I, few)	6.2-9.5
30-40	5.0-10.0 (stage I, absent)	6.7-10.0	5.0-9.0 (stage I, absent)	6.2-9.5
40-50	7.0-10.0 (stage I, absent)	7.5-10.0	5.5-8.5 (stage I, absent)	7.2-9.0

### 3.7 Spawning grounds and spawning season

Anchovy is a schooling pelagic fish, oocytes and spermatozoa are under multiple synchronized development and continuously released for external fertilization (Manprasit, 1996). The largest-sized oocytes were to be found in January-February-March up to August with a diameter range of 0.5-1.0 mm (Vadhanakul, 1996). The size range of released eggs collected by larval net was 0.8-3.0 mm (Chayakul, 1999, pers. comm.). Fertilized eggs were hatching within 24 hrs. Small-sized anchovy occurred all year round and it was evident that spawning took place the whole year (Vadhanakul, 1996). Young fish are first and not yet fully recruited into the fisheries in January, May and August (Vadhanakul, 1996), at a size range of 1.5-3.0 cm, the so-called Saimai (Fig. 2), which can be caught by fine meshed gear. Fully recruited sizes ranged from 3.0 to 5.0 cm, depending on the type of fishing gear (Figs. 8A and 8B).

Sitichokapan (1970) studied the spawning grounds and spawning seasons on the west coast of the Gulf of Thailand from fish eggs and larvae samples. The results showed that there were two prominent spawning peaks. The first during March-April and the second during July-September. Chayakul (1990) also surveyed fish eggs and larvae and found that the first high peak was in April and the second in May.



**Fig. 8 A. The recruitment of young anchovy (redrawn from Vadhanakul, 1996). Length frequency of anchovy caught at night-time (APSL)**

Manprasit (1996) studied the reproductive biology of short-head anchovy on the east coast of the Gulf of Thailand, in Rayong Province and found that this anchovy spawned all year round. The percentage of maturity and the mean gonadosomatic index (GSI) of both sexes showed two peaks of spawning. The high peak was from October to May and the low peak from June to September (Figs. 8C&D). The relationship between fecundity and total length (Vadhanakul, 1996) was expressed as  $F = 151.7545L^{1.3045}$  where  $L$  = total length in cm and  $F$  is number of eggs.

It can be concluded from the investigations of oocyte development that the short-head anchovy (*E. heteroloba*) has the typical ovary of a multiple spawner. Rainfall seems to create unfavourable conditions for gonad development, as was observed by Manprasit (1996).

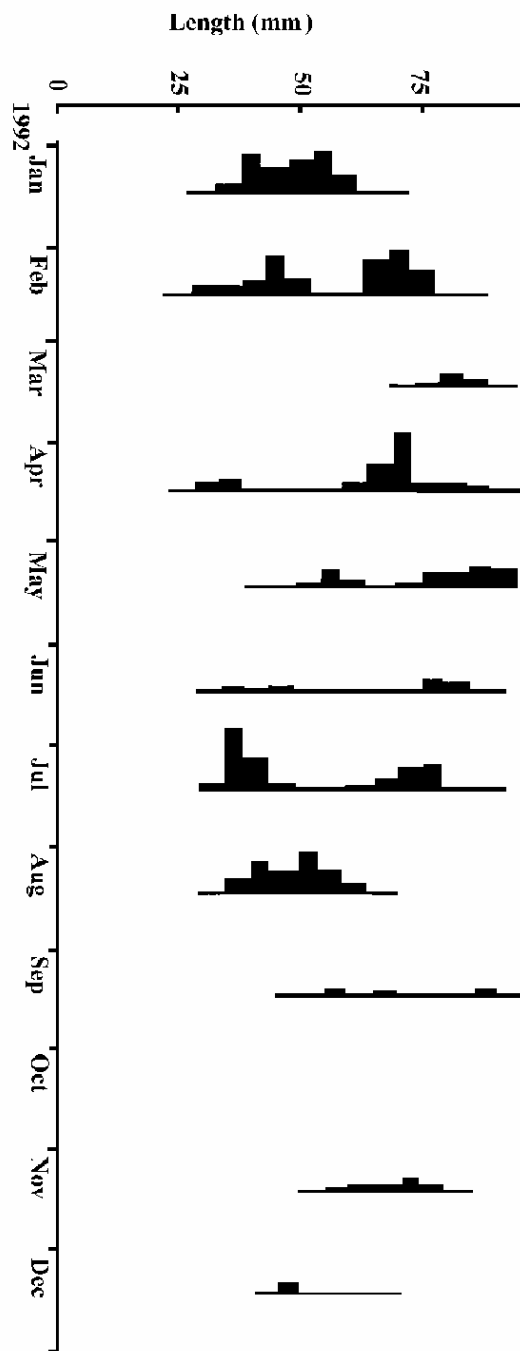


Fig. 8B. The recruitment of young anchovy (redrawn from Vadhanakul, 1996). Length frequency of anchovy caught at daytime (APS)

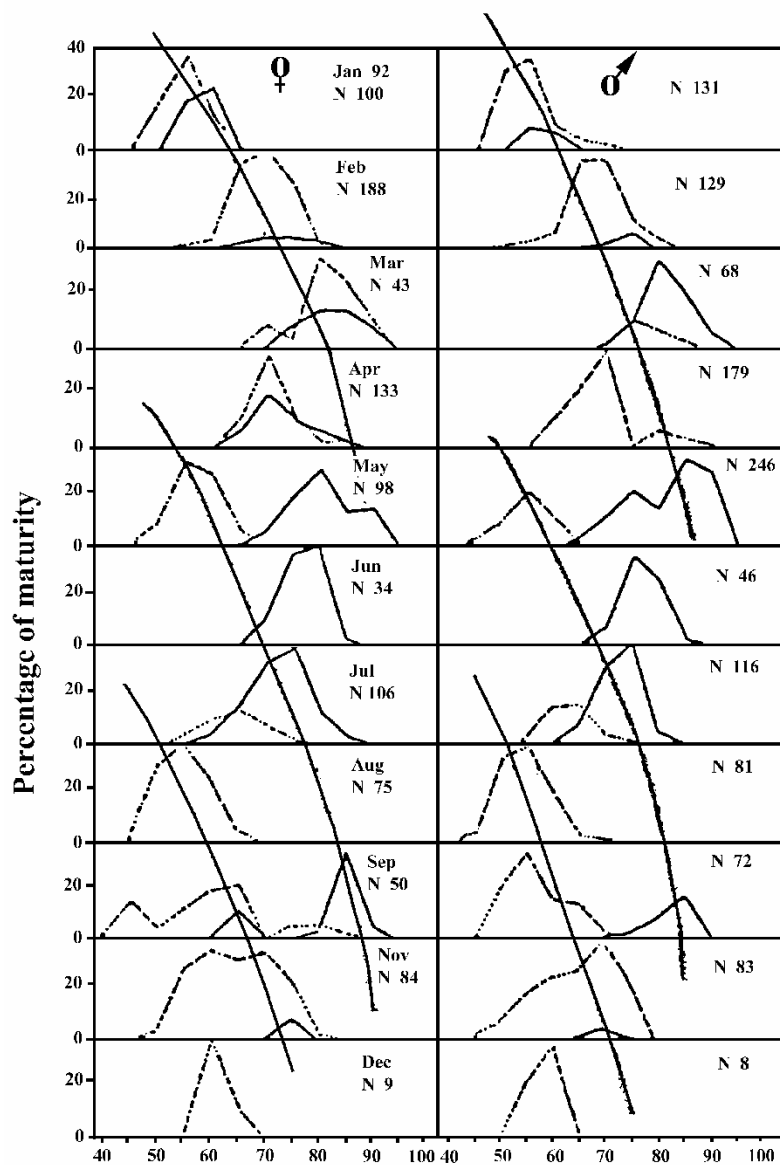


Fig. 8C. The percentage of maturity of *E. heteroloba*, female and male, daytime fishing at upper Gulf of Thailand in January-December 1992. (Dotted line indicates stages 1-3, dark line indicates stages 4-5, figures redrawn from Vadhanakul, 1996)

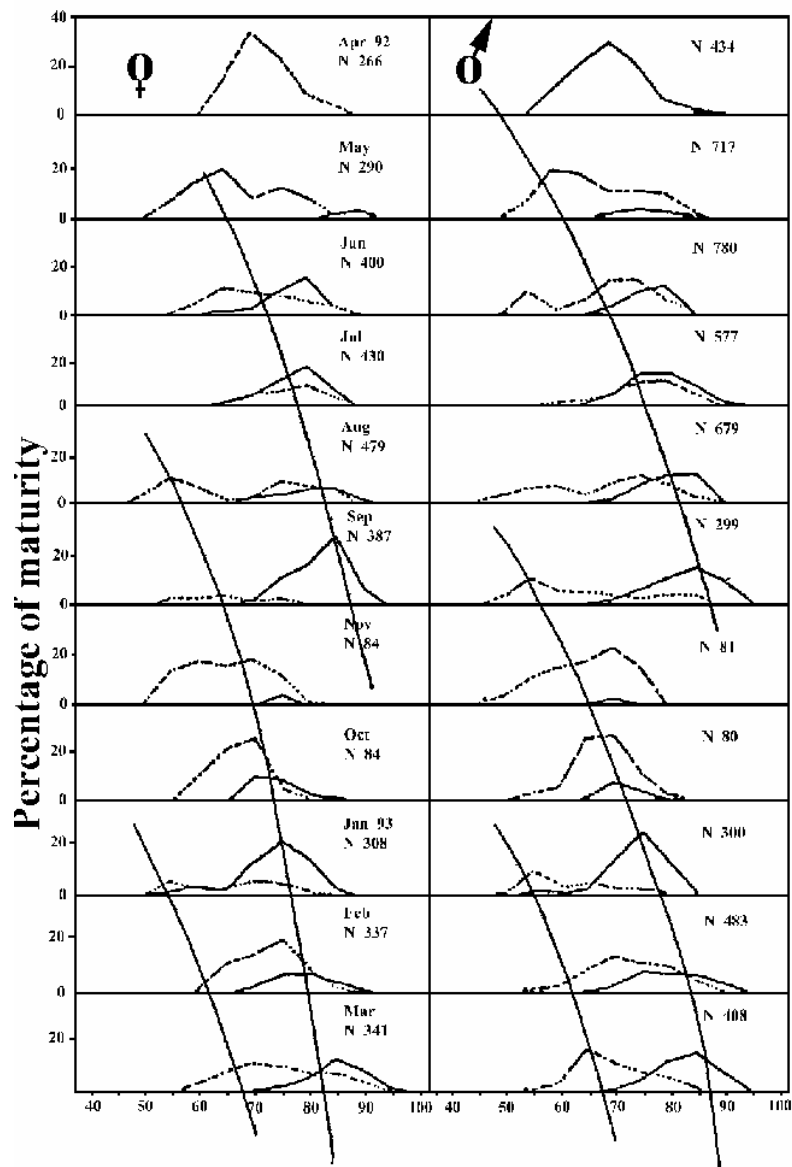


Fig. 8D. The percentage of maturity of *E. heteroloba*, female and male, nighttime fishing at upper Gulf of Thailand in April 1992-March 1993. (Dotted line indicates stages 1-3, dark line indicates stages 4-5, figures redrawn from Vadhanakul, 1996)

### 3.8 Food, feeding and predators

Anchovy is a phytoplankton and zooplankton feeder. Sribyatta, (1996) investigated the stomach contents of *Encrassicholina* caught by anchovy purse seine (APS) and anchovy purse seine with light luring (APSL) in Prachaub Kiri Khan, Chumphon and Surat Thani Provinces during February to December 1992. The 170 specimens investigated, with a size range of 3.8-8.9 cm (TL) showed that the species composition of the diet of anchovies of different sizes caught in different places, months, water depths, day or night was the same, but that the quantities differed by species. It was found that anchovies feed on copepods, diatoms, crab larvae, dinoflagellates, nauplii, bivalve larvae, cirripedia, cladocera, fish eggs and unidentified crustaceans. The highest rate of occurrence of species groups in



the anchovy stomach contents were crustacean fragments 66%, *Cosinodiscus* (diatom) 13.1%, dinoflagellates 13.2% and others 7.6%.

Major predators of the anchovy are pelagic fish, demersal fish and some invertebrates, including Indo-Pacific mackerel, tunas, wolf herring, trevallies, barracudas, threadfin breams, hairtails and cephalopods (Marine Fisheries Division, 1993).

### 3.9 Parasites

A high rate of occurrence of undigested nematodes was found in the stomach contents of anchovies in the size range of 6.0-9.0 cm. It might be concluded that nematodes live in the anchovy stomach in the same way as those found in the digestive tract of fish, *Sillago sihama* and *S. maculata*, reported in Swadpeera and Mutuwan (1991).

Premkit (1991) examined the parasites of anchovy caught in the upper Gulf and western coast of the Gulf of Thailand, during January to December 1989. A total of 2,511 specimens of six species were investigated and it was found that anchovies were infected by ecto- and endoparasites. Ectoparasites comprised three species of copepods (*Nothobomolochus* sp., *Clavellisa dorosomatis*, *Lernaeinicus longiventris*), one species of nematode (*Contracaecum* larva type A) and three species of trematodes (*Clupeocotyle* sp., *Neoclupeocotyle* sp., *Hemiurus* sp.). Endoparasites comprised two species of nematodes (*Camallanus* sp., *Contracaecum* larva type A) and four species of digenetic trematode (*Hemiurus* sp., *Lecithochirium* sp., *Bacciger* sp. and unspecified species). The dominant species with the highest rate of occurrence was the digenetic trematode, *Hemiurus* sp. This parasite can be found abundantly in March-June. Ectoparasites were usually found on gills and the body, whereas endoparasites were found in the stomach, digestive tract, intestine, pancreas, appendix, testes and ovary.

## 4. BACKGROUND AND DEVELOPMENT OF ANCHOVY FISHERIES

Before 1982, the anchovy fisheries were subsistent fisheries. Fishermen caught anchovies in the shallow waters along the coasts of the Gulf of Thailand and Andaman Sea as well as in river mouths. The fishing gears commonly used were Anchovy Purse Seine (APS), Push Net (PN), Beach Seine (BS) and Bamboo Stake Trap (BST).

Previously, the Anchovy Purse Seine could be divided into two types, namely Anchovy Purse Seine without purse line or Surrounding Net (SN) and Anchovy Purse Seine with purse line (APS). Small-sized boats (LOA 8-14 m) with 16-18 hp and 6-10 crew, used Surrounding Nets, length 200-400 m, depth 5-30 m, no knots, mesh sizes 6.3 and 8.5 mm to catch anchovy near shore (Okawara and Mathawee, 1986). The surrounding net had no purse line but used C-shaped steel hooks to close the bottom part of the net. The C-shaped steel hooks were 7.0-8.0 cm in size. The gear was operated in daytime from early morning until late evening. The fishing boat searched for schools of fish by naked eye. The net was released to surround the schooling fish, two fishermen dived to close the bottom part of the net using the C-shaped steel hooks. When finished, the fishermen lifted up the net. This was a very special type of fishing that could be found only in Rayong Province, at Ao Makam Pom Village. As of recently, this type of fishing is no longer practised due to the lack of skilled divers.

APS is still used to catch anchovy. The small-sized boats are usually found in Rayong, Choburi and Prachuab Kiri Khan Provinces and the big-sized boats are in Chumphon and Surat Thani Provinces.

The SN and APS were selective gears in catching anchovy as target species while the other gears caught anchovy as bycatch. During 1973-1981 anchovy production was quite stable at around 10,000-30,000 tonnes. Anchovies were used for domestic consumption as fresh fish, dried fish or processing into good quality fish sauce, budu and fishmeal.

The process of simply drying anchovy has been gradually developed to one where they are boiled on board before drying in the sun. This process was first introduced in Chumphon and Surat Thani Provinces, transferred from Satul Province in the Andaman Sea. Boiled-dried anchovy was of a better quality than ordinary dried anchovy. The process of boiled-dried could almost always be finished in

one day and if it was not dry enough it could be dried in an extra half day. This process was widely used. The fishermen of the bigger boats boiled and dried fresh anchovies on board. After 1982, the boiled-dried anchovy became well known and the foreign market became interested. Therefore, the fisheries for anchovy significantly expanded and boiled-dried and dried anchovies were exported at a high price to Malaysia, Taiwan (Province of China), Japan, Sri Lanka and countries in the middle east.

Fishermen tried to catch more anchovies to meet the export demand. During these times, anchovy fishing was developed by converting from squid fishing using light at night. While night fishing was developed, daytime fishing remained also in operation. Fish lured by light were caught by purse seine net, lift net and falling net. This led to an increased production of anchovy from 14,000 tonnes in 1981 to around 100,000 tonnes in 1985 then production decreased to around 50,000-60,000 tonnes during 1986 to 1988. The next increase started in 1989 with a production of around 110,000 tonnes (Chullasorn, 1993), reaching 167,987 tonnes in 1995.

Nowadays, some of the squid light luring fishing boats have an anchovy net on board in order to be able to switch over to anchovy when it is abundant.

Presently, the common and the most effective fishing gears for catching anchovy are, anchovy purse seine (APS, daytime fishing), anchovy purse seine with light luring (APSL), lift net with light luring (LNL) and falling net with light luring (FNL). The APSL is actually illegal, but it can be found anywhere in the Gulf of Thailand and Andaman Sea.

The fishing season on the western coast of the Gulf of Thailand is from February to October. From November to January the boats are not operated due to the strong southwest Monsoon. Some boats move to the eastern part of the Gulf to catch anchovy in the Provinces Rayong, Chanta Buri and Trad.

Due to the high demand of anchovy products, the fishing grounds have been expanded into deeper zones, up to 60 m. Some fishing gears were modified to fish anchovy as target species, e.g. to use light luring, squid fishing boats modified their net and light bulbs; some fishing boats also move to fish in places where anchovy is abundant rather than staying in their local areas. Likewise some anchovy fishermen from Rayong Province moved to settle permanently in Songkhla Province and some moved from Songkhla to fish in the Andaman Sea, in Satul, Phanga Provinces during the off season in Songkhla. These movements caused some violent conflicts between the local fishermen (operating small trawlers and gill netters) and the “invaders” and also among operators of various fishing gears. The conflicts became more and more violent, leading to socio-economic and political problems.

## **5. FISHING GEARS AND METHODS**

The following eight types of fishing gear are presently used for capturing anchovy:

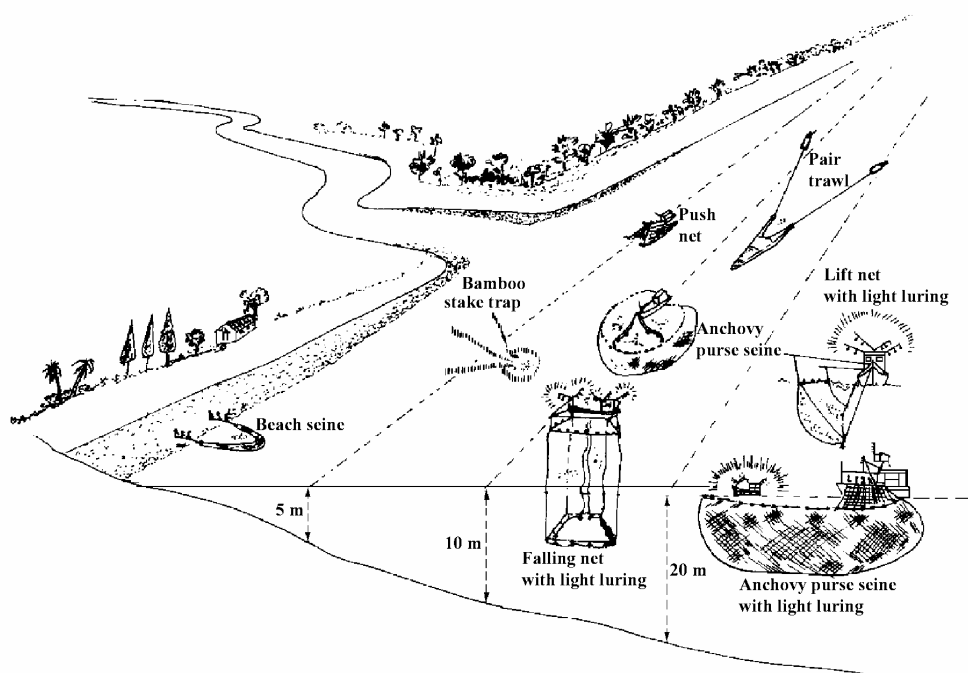
1. Anchovy Purse Seine without light, daytime fishing (**APS**)
2. Anchovy Purse Seine with Light luring (**APSL**)
3. Lift Net with Light luring (**LNL**)
4. Falling Net with Light luring (**FNL**)
5. Pair Trawl (**PT**)
6. Push Net (**PN**)
7. Bamboo Stake Trap (**BST**)
8. Beach Seine (**BS**)

The major selective fishing gears for capturing anchovy are APS, APSL, LNL and FNL. The other gears, push net, pair trawl, bamboo stake trap and beach seine, are non selective gears, the catch of anchovy by these gears is considered as bycatch (Department of Fisheries, 1993). These eight types of gear are used to fish in different depth zones, e.g. LNL and APSL in waters more than 20 m deep,

APS, FNL and PT fish at depths of 10-20 m; PN and BST fish at 5-10 m; BS fish at depths less than 5 m (Fig. 9). Details of each type of fishing gear and fishing methods are given below.

### 5.1 Anchovy Purse Seine without light (APS, daytime fishing)

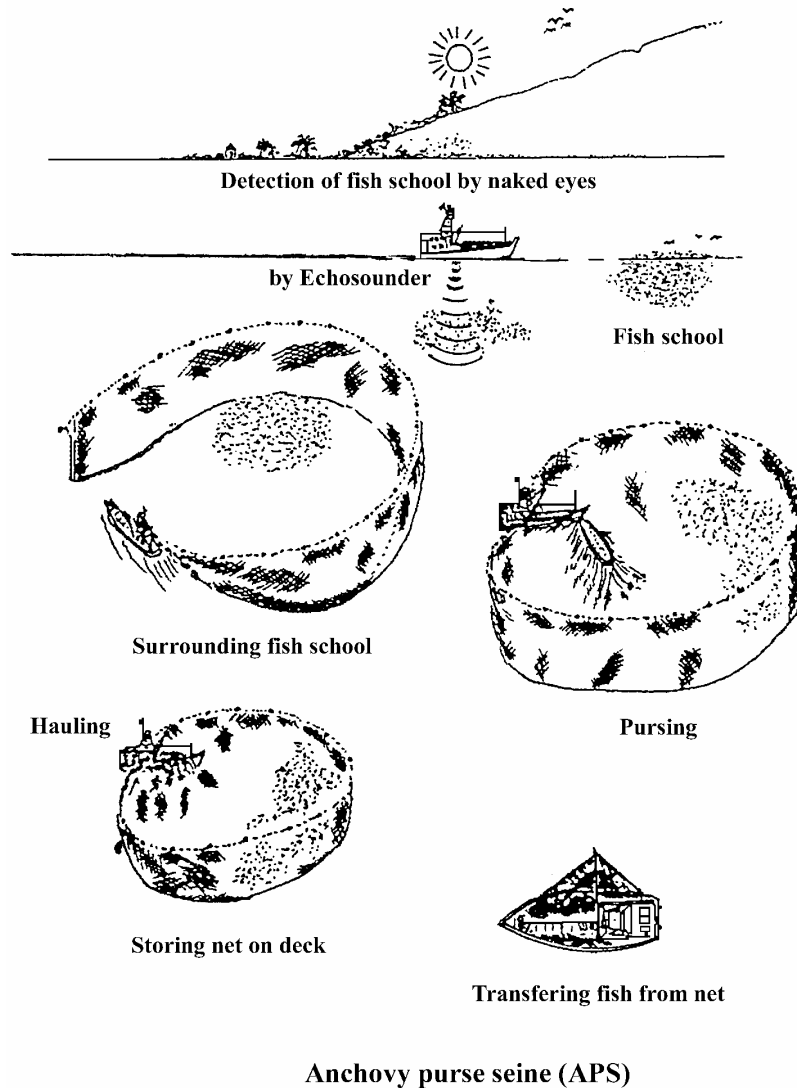
Anchovy Purse Seine is the most popular fishing gear in capturing anchovy effectively. The most important method is to release the net, surrounding the school and closing the bottom of the net by pulling the purse line, then to lift the net to get the fish in the boat. Anchovy Purse Seines can be operated with or without luring lights.



**Fig. 9 Anchovy fisheries by type of fishing and depth zones**

The boats are of various sizes. The small-sized boats (LOA 8-10 m) usually use long-tailed outboard engines). The medium-sized boats (LOA 14-18m), mostly found in the southern part of the Gulf of Thailand (Nakorn Sri Thammarat, Songkhla and Pattani Provinces) are popular and can be found everywhere, including the Andaman Sea. The large-sized boats (LOA 20-22 m) can be found only in the Provinces Chumphon, Surat Thani and Satul. The shape of the large-sized boat and method of fishing are somewhat peculiar for Thailand, because fishermen from certain places have bought the boats in Malaysia and then registered them as Thai boats. The captain and crew are Muslims from Satul Province (on the Andaman Sea), who moved to fish in the Gulf of Thailand. At first, they used two medium-sized boats (14-18 m LOA), 150-175 hp (Supongpan and Saikliang, 1985), of which one boat was used to catch anchovy and the other to boil and dry the anchovy at sea. Later, the fishermen used only one big boat with LOA 20-22 m, 250 hp (Fig. 10). Boiled-dried anchovy caught the previous day is brought on land to dry the next day. If it is raining, it will be dried in closed houses with charcoal stoves and electric fans.

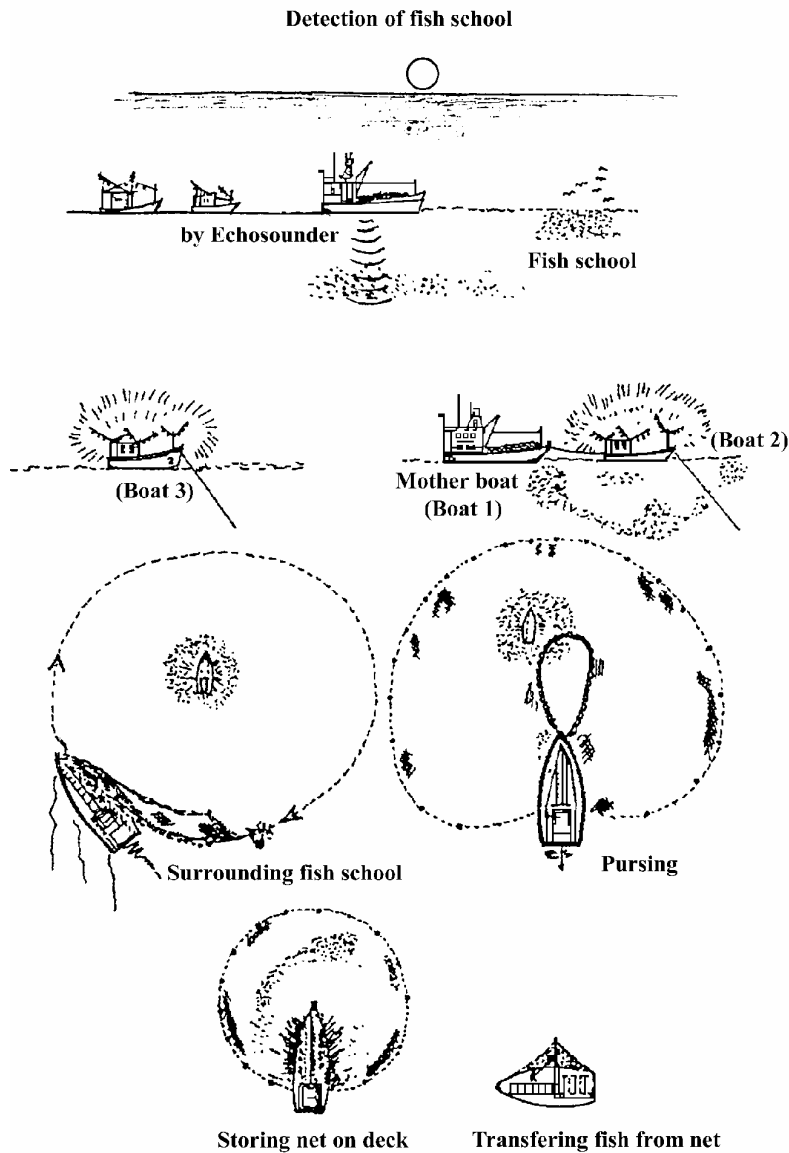
The APS is used in daytime on daily trips with 2-5 sets per day. Echosounders are used to find fish schools, while some find schools by sight. The net will be released to entrap the fish school, wherever the fish are found in dense concentrations. The mesh sizes used are 0.6 cm for the smaller boats and 0.8 cm for the bigger ones.



**Fig. 10. Operation of anchovy purse seine, day time fishing (APS)**  
(Adapted from Department of Fisheries, 1993)

## **5.2 Anchovy Purse Seine with Light luring (nighttime fishing, APSL)**

This type of fishing can be found almost everywhere, e.g. Trad, Rayong, Prachaub Kiri Khan and Chumphon Provinces. The boats: LOA 14-24m, 90-250 hp, crew of 16-25. A mother boat and two smaller ones for light attraction are used together. The mother boat is used for fishing and has some equipment, e.g. radio, GPS, echosounder and/or sonar. The length (300-450 m) and the depth (60-80m) of the net depend on the size of the boat. The net is green, knotless, made of nylon with a mesh size of 0.83 cm. The other two boats (9-14 m LOA, crew 1 or 2) are used for light luring in different places. Each luring boat has a generator of 10-20 kW. The luring boats also have radios and echosounders. The skipper on the mother boat uses sighting or echosounder or sonar to find fish schools and then points out the position to a luring boat to move there and turn on the lights. After fishing the mother boat will move to fish in another dense area where fish are lured by the boat. This process can be repeated 2-3 times before sunrise (Fig. 11).



**Fig. 11. Operation of anchovy purse seine with light luring (APSL)  
(Adapted from Department of Fisheries, 1993)**

In Prachuab Kiri Khan Province, one set of APSL comprises one mother boat (LOA 14-20 m) and two light luring boats with light intensity of 10-20 kW, 20-22 total crew. The instruments used are echosounder, GPS, radio and mobile telephone. The knotless net has a purse line and mesh size of 0.8-0.9 cm. The dimensions of the net depend on the size of the boat: LOA 14-16m length 250-350m, depth 50-78 m; LOA 16-18m length 300-360m, depth 60-78m; LOA 18-20m length 350-400m, depth 64-86m. Most of the APSL boats originate from Trad Province, the rest are from Rayong Province. The fishing season is from February to October. The boats in Prachuab Kiri Khan Province fish from Prachuab Kiri Khan to Chumphon in this fishing season and then move to fish in the eastern coast of the Gulf and the Andaman Sea. The fishing boats from Trad Province on the eastern side of the Gulf move to fish in Prachuab Kiri Khan Province during June-October. Thereafter, they move back to fish

on the eastern side during the strong Northeast monsoon. The fishing grounds for this type of fishing are deeper than those for APS, usually at depth 30-40m, maximum 45 m. The best fishing grounds are the northernmost part of Prachuab Kiri Khan Province and southward to Bang Sapan Noi. Fishing is concentrated at 10-25 nautical miles from shore or about 1.5-3.5 hours steaming. Normally, fishing activities last one night, sometimes two nights, with 2-3 sets per night, the first set at 23.00 hr, the second at 02.00 hr and the third at 05.00 or 05.30 hr. Fishing is conducted about 23 nights per month.

### **5.3 Anchovy Lift Net with Light luring (LNL)**

The boats are usually medium-sized LOA 14-18 m. The larger ones use echosounders to locate fish schools. This type of fishing can be found in the Provinces Chonburi and Prachuab Kiri Khan (Pranburi). The luring method and light bulb arrangements are almost the same as for the squid light luring lift net. In total 10-50 light bulbs are used, together about 5-25 kW. The gear was adapted from the squid light luring lift net, but with 5-10 spotlight bulbs, whereas for squid fishing only two spotlight bulbs are used. The technique of switching lights off and on is also different, due to the behaviour of fish that responds to different light intensities. For catching anchovy, after having switched on the light to lure fish gathering in a dense area, the light will suddenly be switched off and then switched on again, the fishermen repeat this about 1-10 times. This technique is useful to bring the fish from the sea bottom to the surface, where it is caught by the net. The net material is green, knotless with mesh sizes from 0.83-0.93 cm. The upper part of the net is longer than the lower part; the length of the net is 3-4m longer than the length of the boat and the depth of the net is 1m more than the length of the boat (Fig. 12).

### **5.4 Anchovy Falling Net with Light luring (FNL)**

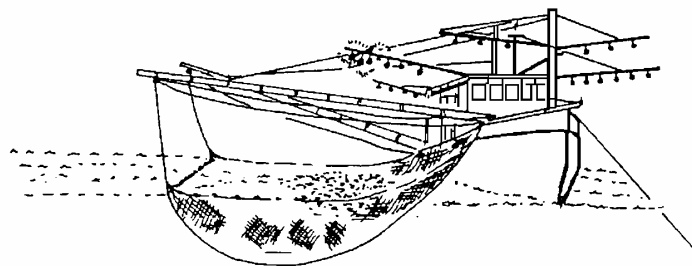
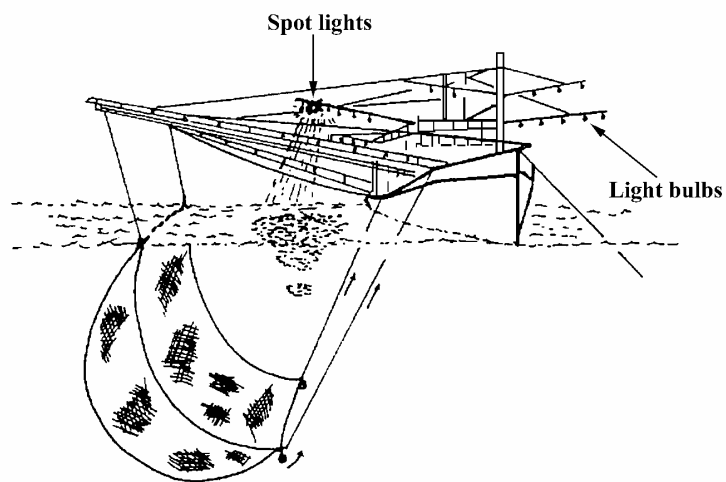
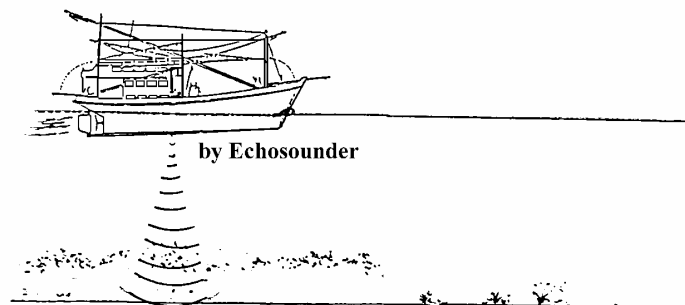
This type of fishing is also adapted from squid fishing by using a finer mesh of 0.6 cm, the net has a semi-rectangular shape. The width of the net is equal to the length of the boat, while its depth is about 18 to 23 m. The total number of light bulbs is 20-40, of which 5-6 are spotlight bulbs of 5-40 kW. The fishing boats are in three size-classes: small (LOA<14m), medium (LOA 14-18m) and large (LOA 18-25 m). This type of fishing is also widely used and it can be found all over the Gulf. The fishing boats in the southern part of the Gulf are somewhat larger than in other parts. In the Provinces Songkhla and Pattani (southern part) all three size classes are found, whereas in Trad, Rayong, Chantaburi, Prachuab Kiri Khan and Chumphon only small and medium boats are used. The luring and catching methods are the same as in the lift net fishery (Fig.13).

In Prachuab Kiri Khan Province, the fishing boats are small and medium-sized, mostly 10-12 m LOA, 4-6 crew. The engine power is 150 hp, light intensity 5-20 kW from 20 light bulbs of 500 W each and 5 spotlights. The important instrument is the echosounder. The semi-rectangular net is stretched out by bamboo poles having a mouth opening of 48 m (10+10+12+16), the depth of the net is 18-23 m with mesh sizes of 0.6-0.7 cm. The bottom part of the net is weighted by lead at 2m intervals with metal hooks of 10 cm diameter with 100 m length rope inside.

The fishing season is from February to October. During July to August, fishing boats from Trad Province move to fish at Prachuab Kiri Khan Province. There are no fishing activities from November to January due to the strong northeast monsoon. The fishing grounds of the FNL off Prachuab Kiri Khan are around Tab Sakae, Ao Bang Sapan, Ko Talu to Pratew at depths of 5-20 m. The distance from the coast to the fishing grounds is about 0.5 to 1.5 hours steaming. Fishing takes place about 22-23 days per month, starting from 4 days after full moon (waning phase of the moon) until 3 days before full moon. The fishing boats leave the fishing pier in the evening and come back in the early morning after 1-15 hauls, mostly 5-10 hauls per night.

Fishing is aimed at small-sized anchovy called Saimai (young anchovy). Boiled-dried young fish is costly, about 160-180 Baht per kg, while the boiled-dried adult fish is only 30-40 Baht per kg. Some of the FNL have been changed to APS to fish in daytime due to this targeting of small-sized fish (Boonger, 1997).

In Songkhla Province, the fishing boats can be classified into two types: local fishing boats and mobile fishing boats from other places. The local fishing boats are from Jana and Taepa in the southern parts of Songkhla Province.

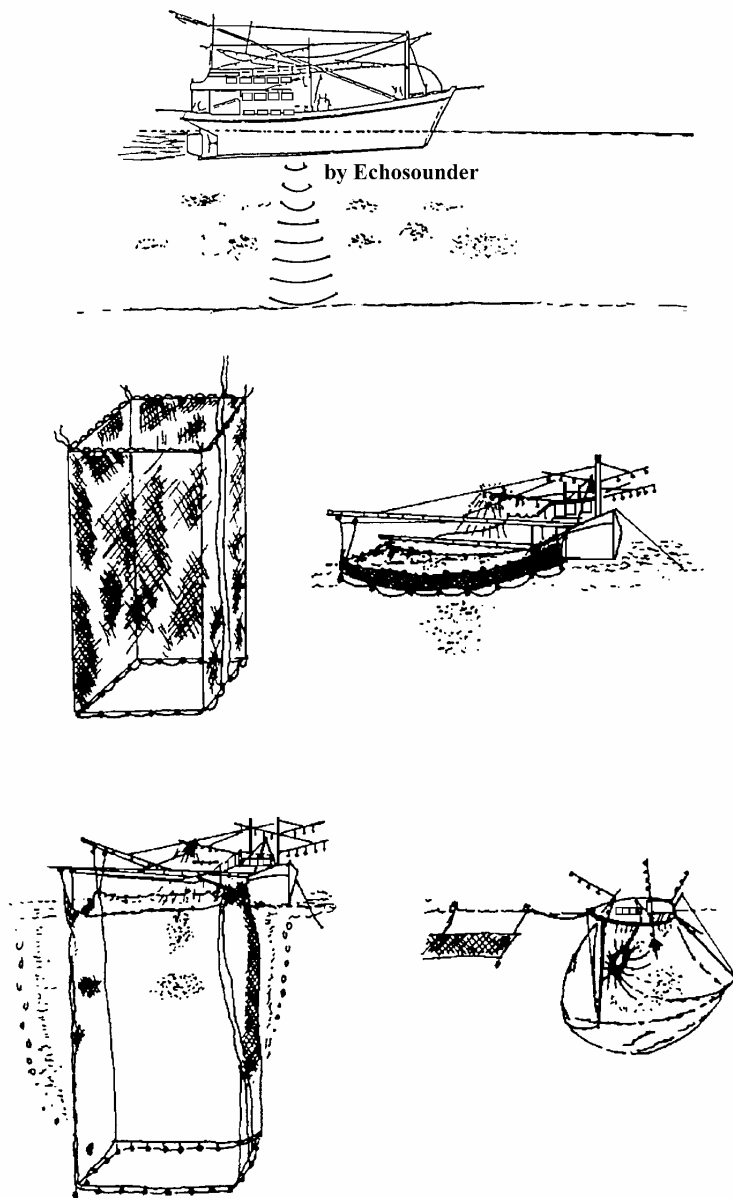


**Lift net with light luring (LNL)**

**Fig. 12. Operation of anchovy lift net with light luring (LNL)  
(Adapted from Department of Fisheries, 1993)**

There are about 60 fishing boats in Jana, LOA 6.0-11.5 m, width 1.5-2.5 m, crew 3-4. (Office of Provincial Fisheries, 1998). Most of those are converted to trawlers outside the anchovy season. The

skippers are the owners. Engines from 16-45 hp, one generator as an energy source, 20-25 light bulbs, 2-4 spotlights. Net material is knotless, mesh size 0.55 cm, length of net 6-12 m and depth 8-10 m. The fishing grounds are at 10-18 m depth, 3-15 nm away from shore. Fishing is conducted during the southwest monsoon for about 5 months, June to October, about 23 nights per month, one night fishing with 3-4 hauls, 2.0-3.0 hr per haul.



Falling net with light luring (FNL)

Fig. 13. Operation of anchovy falling net with light luring (FNL)  
(Adapted from Department of Fisheries, 1993)



There are 19 local fishing boats in Taepa (Office of Provincial Fisheries, 1998), mostly used for crab gill net fishing outside the anchovy season. The boats LOA are 11.4-15.0 m, engines 130-135 hp, two dynamos, 18-23 light bulbs, 4-9 spotlights. The net material is knotless with mesh size 0.55 cm. The net is semi-rectangular shaped, the outer part of the net is 24 m long and the inner part near the boat side is 14-16 m. The other two sides are 12-16 m long and stretched out by two bamboo poles. The fishing grounds are at depth 15-20 m, at 5-25 nautical miles from shore. The fishing season is during the southwest monsoon, starting in May or June to October. No fishing can be done during the northeast monsoon due to strong winds. Only nighttime fishing is done, fishing can be carried out about 18 nights in a month, 1-3 hauls per night, 3.0 hr per haul and crews number are 10 (Pramokchutima, 1998).

The mobile fishing boats from other places are small and medium-sized LOA 13-18 m, mostly modified from squid light luring fishing and some from trawlers, with echosounders. The light intensity is 10-20 kW with two dynamos as a light source. There are 20-42 light bulbs with 4-11 spotlights, knotless net material with mesh size 0.55 cm. Two bamboo poles, length 13-18m, equal to the boat length, are used to stretch out the net. The depth of the net is 13-34 m. The fishing grounds are between 16 and 33 m deep, about 10 to 25 nm from shore. Fishing activities take place during the whole year, always at night, for one night only. During the northeast monsoon, these boats fish on the east side of the Gulf, in Rayong and Chantaburi Provinces. During the southwest monsoon from May until October, they move to fish in Songkhla Province. Fishing starts 4 days after full moon to a few days before full moon. Fishing can be done about 26 nights per month, 3-10 hauls per night, 0.5-4.0 hr in each haul. Some boats from Rayong Province have moved to stay permanently in Singha Nakorn in Songkhla Province. They sell fish at Singha Nakorn and Ta Sa-Arn piers in the northern part of Songkhla Province (Pramokchutima, 1998). The total number of mobile fishing boats is 84 (Office of Provincial Fisheries, 1998).

The other types of fishing such as trawl, push net, beach seine will not be mentioned in this context, since these gears do not fish anchovy as a target species and anchovy is only caught in small quantities.

## **5.5 Number of fishing boats**

The registration of APS during the years 1971 to 1995 increased gradually and reached its maximum at 323 in 1995 (Table 1). The size categories of the APS are shown in Table 2. Most of the APS are small and medium sized, some large sized. Since 1988 squid cast nets were gradually modified to catch both squid and anchovy. The real number of fishing gears used to catch anchovy is uncertain, when comparing the registered number to the census surveys in the years 1985 and 1995 (Tables 3 & 4) and to the surveys by the Anchovy Working Group in the years 1996 to 1998- 1999 (Table 5).

Pramokechutima (1998) reported the total number of anchovy fishing boats in Songkhla Province as 248 of which local boats 164 and mobile boats coming from other places 84.

From the surveys of the Working Group, numbers of each type of fishing boat by size category are shown in Tables 6 to 9. These surveys were undertaken during February-March 1999. The total of 1,430 of anchovy fishing boats comprised 176 APS, 325 APSL, 242 LNL and 687 FNL.

**Table 1. Registered number of anchovy fishing boats and squid cast net boats in the Gulf of Thailand, 1971 – 1995 (Department of Fisheries, 1971-1995)**

Year	APS	Squid cast nets	Total	Year	APS	Squid cast nets	Total
1971	42	--	42	1984	53	521	574
1972	48	--	48	1985	118	662	780
1973	66	--	66	1986	92	652	744
1974	46	--	46	1987	47	794	841
1975	30	--	30	1988	69	1,102	1,171
1976	45	--	45	1989	76	915	991
1977	14	--	14	1990	105	1,027	1,132
1978	28	34	62	1991	234	1,257	1,491
1979	43	6	49	1992	228	1,460	1,688
1980	28	115	143	1993	255	1,745	2,000
1981	13	235	248	1994	285	1,881	2,166
1982	22	637	659	1995	323	1,734	2,057
1983	37	514	551				

Note: Some cast nets caught squid and anchovy simultaneously due to the occurrence of both.

**Table 2. Number of anchovy purse seine fishing boats registered by size categories in the Gulf of Thailand, 1971 - 1995**

Year	Total	< 14 m	14 - 18 m	18 - 25 m	> 25 m	Year	Total	< 14 m	14 - 18 m	18 - 25 m
1971	42	15	27	0	0	1984	53	24	15	14
1972	48	29	19	0	0	1985	118	51	23	40
1973	66	41	25	0	0	1986	92	28	25	39
1974	46	23	23	0	0	1987	47	21	13	15
1975	30	17	13	0	0	1988	69	31	18	20
1976	45	32	13	0	0	1989	76	35	25	16
1977	14	6	6	2	0	1990	105	43	36	25
1978	28	13	10	5	0	1991	234	93	90	51
1979	43	25	11	7	0	1992	228	92	85	50
1980	28	14	9	5	0	1993	225	90	84	81
1981	13	6	4	3	0	1994	285	112	89	84
1982	22	10	6	6	0	1995	323	193	74	54
1983	37	21	11	5	0					

Sources: Department of Fisheries of Thailand, 1971 - 1995.

**Table 3. Comparison of numbers of boats obtained through the census of 1985 and the number of registered boats in the same year.  
(Department of Fisheries, 1985; National Statistics Office, 1985).**

Coastal Zones and Provinces	1.1.1.1.1.1.1 Marine Fishery Census 1985			Registered Department of Fisheries 1985		
	Squid cast net	APS	Total	APS	FN <sup>1</sup>	Total
<b>COASTAL ZONE 1</b>	<b>232</b>	<b>46</b>	<b>278</b>	<b>74</b>	<b>103</b>	<b>177</b>
Trad	24	31	55	27	9	36
Chanthaburi	39	-	39	-	3	3
Rayong	169	15	184	47	91	138
<b>COASTAL ZONE 2</b>	<b>365</b>	<b>6</b>	<b>371</b>	<b>24</b>	<b>88</b>	<b>112</b>
Chol Buri	279	2	281	19	69	88
Chachoengsao	1	-	1	-	2	2
Samut Prakan	9	-	9	-	10	10
Bangkok	-	-	0	2	1	3
Samut Sakhon	3	3	6	-	-	0
Samut Songkhram	4	-	4	3	1	4
Phetchaburi	69	1	70	-	5	5
<b>COASTAL ZONE 3</b>	<b>570</b>	<b>8</b>	<b>578</b>	<b>19</b>	<b>347</b>	<b>366</b>
Prachuab Khiri Khan	332	8	340	-	-	0
Chumphon	115	7	115	19	323	342
Surat Thani	123	-	123	-	24	24
<b>COASTAL ZONE 4</b>	<b>21</b>	<b>2</b>	<b>23</b>	<b>1</b>	<b>101</b>	<b>102</b>
Nakhon Sri Thammarat	2	-	2	-	1	1
Songkhla	6	-	6	1	13	14
Pattani	12	2	14	-	9	9
Narathiwat	1	-	1	-	1	1
<b>GULF OF THAILAND</b>	<b>1,188</b>	<b>62</b>	<b>1,250</b>	<b>118</b>	<b>639</b>	<b>757</b>
<b>COASTAL ZONE 5</b>	<b>48</b>	<b>102</b>	<b>150</b>	<b>79</b>	<b>1</b>	<b>80</b>
Ranong	10	-	10	1	1	1
Phangna	11	88	99	57	-	57
Phuket	13	5	18	8	-	8
Krabi	13	4	17	-	-	0
Trang	-	-	0	-	1	1
Satul	1	5	6	13	-	13
<b>ANDAMAN SEA</b>	<b>48</b>	<b>102</b>	<b>150</b>	<b>79</b>	<b>1</b>	<b>80</b>
Other provinces	--	--	--	--	--	0
<b>GRAND TOTAL</b>	<b>1,236</b>	<b>164</b>	<b>1,400</b>	<b>197</b>	<b>640</b>	<b>537</b>

Notes: <sup>1</sup>In some seasons this gear was changed to anchovy fishing gear.

**Table 4. Comparison of numbers of boats obtained through the census of 1995 and the number of registered boats in the same year.  
(Department of Fisheries, 1995; National Statistic Office, 1995).**

Coastal Zones and Provinces	Marine Fishery Census 1995						Registered(DOF, 1995)		
	Scoop net	Falling net	Squid cast net	Beach seine	APS	Total	APS	FN <sup>1</sup>	Total
<b>COASTAL ZONE 1</b>	<b>27</b>	<b>50</b>	<b>148</b>	<b>13</b>	<b>169</b>	<b>407</b>	<b>209</b>	<b>434</b>	<b>643</b>
Trad	8	11	8	-	58	85	87	66	153
Chanthaburi	4	16	15	8	29	72	3	41	44
Rayong	15	23	125	5	82	250	119	327	446
<b>COASTAL ZONE 2</b>	<b>22</b>	<b>4</b>	<b>397</b>	<b>4</b>	<b>12</b>	<b>439</b>	<b>80</b>	<b>649</b>	<b>729</b>
Chol Buri	3	1	211	-	3	218	73	217	290
Chachoengsao	-	-	-	1	3	4	-	4	4
Samut Prakan	1	-	6	-	2	9	-	22	22
Bangkok	-	-	-	-	-	0	7	8	15
Samut Sakhon	-	-	7	1	-	8	-	31	31
Samut Songkhram	17	3	16	2	3	41	-	55	55
Phetchaburi	1	-	157	-	1	159	-	312	312
<b>COASTAL ZONE 3</b>	<b>3</b>	<b>61</b>	<b>974</b>	<b>24</b>	<b>74</b>	<b>1,136</b>	<b>27</b>	<b>494</b>	<b>521</b>
Prachuab Khiri Khan	3	61	385	5	66	520	18	453	471
Chumphon	-	-	434	10	7	451	2	3	5
Surat Thani	-	-	155	9	1	165	7	38	45
<b>COASTAL ZONE 4</b>	<b>20</b>	<b>3</b>	<b>70</b>	<b>57</b>	<b>101</b>	<b>251</b>	<b>6</b>	<b>157</b>	<b>168</b>
Nakhon Sri Thammarat	9	-	1	2	-	12	-	1	1
Pattalung	-	-	-	3	-	3	-	-	0
Songkhla	2	1	12	15	66	96	4	48	52
Pattani	3	2	35	10	15	65	2	78	80
Narathiwat	6	-	22	27	20	75	-	25	25
<b>GULF OF THAILAND</b>	<b>72</b>	<b>118</b>	<b>1,589</b>	<b>98</b>	<b>356</b>	<b>2,233</b>	<b>322</b>	<b>1,729</b>	<b>2,051</b>
<b>COASTAL ZONE 5</b>	<b>29</b>	<b>5</b>	<b>141</b>	<b>56</b>	<b>58</b>	<b>289</b>	<b>52</b>	<b>160</b>	<b>212</b>
Ranong	-	-	38	10	4	52	1	22	23
Phangnga	21	5	44	20	38	128	1	34	35
Phuket	2	-	10	1	14	27	14	36	50
Krabi	6	-	31	15	1	53	1	30	31
Trang	-	-	3	5	1	9	4	21	25
Satul	-	-	15	5	-	20	31	17	48
<b>ANDAMAN SEA</b>	<b>29</b>	<b>5</b>	<b>141</b>	<b>56</b>	<b>58</b>	<b>289</b>	<b>52</b>	<b>160</b>	<b>212</b>
Other provinces	--	--	--	--	--	--	1	5	6
<b>GRAND TOTAL</b>	<b>101</b>	<b>123</b>	<b>1,730</b>	<b>154</b>	<b>414</b>	<b>2,522</b>	<b>375</b>	<b>1,894</b>	<b>2,269</b>

Notes:<sup>1</sup> In some seasons this gear was changed to anchovy fishing gear.

**Table 5. Number of boats surveyed by the Working Group during November 1998 to June 1999 and the number registered in the year 1996.**

Coastal Zones and Provinces	Working Group Surveyed, 1998 to 1999					Registered (DOF, 1996)		
	Scoop net	FN	APS Day time	APS Nighttime	Total	APS	FN <sup>1/</sup>	Total
<b>COASTAL ZONE 1</b>	-	<b>457</b>	<b>26</b>	<b>155</b>	<b>638</b>	<b>199</b>	<b>431</b>	<b>630</b>
<b>Trad</b>	-	121	-	101	222	79	75	154
<b>Chanthaburi</b>	-	68	-	-	68	1	29	30
<b>Rayong</b>	-	268	26	54	348	119	327	446
<b>COASTAL ZONE 2</b>	<b>237</b>	<b>9</b>	<b>20</b>	<b>5</b>	<b>271</b>	<b>78</b>	<b>590</b>	<b>668</b>
<b>Chol Buri</b>	237	-	20	5	262	73	217	290
<b>Chachoengsao</b>	-	-	-	-	-	-	2	2
<b>Samut Prakan</b>	-	-	-	-	-	-	12	12
<b>Bangkok</b>	-	-	-	-	-	5	4	9
<b>Samut Sakhon</b>	-	-	-	-	-	-	31	31
<b>Samut Songkhram</b>	-	-	-	-	-	-	13	13
<b>Phetchaburi</b>	-	9	-	-	9	-	311	311
<b>COASTAL ZONE 3</b>	<b>5</b>	<b>151</b>	<b>30</b>	<b>24</b>	<b>210</b>	<b>87</b>	<b>370</b>	<b>457</b>
<b>Prachuab Khiri Khan</b>	5	94	20	10	129	58	329	387
<b>Chumphon</b>	-	57	10	14	81	22	3	25
<b>Surat Thani</b>	-	-	-	-	-	7	38	45
<b>COASTAL ZONE 4</b>	-	<b>342</b>	-	-	<b>342</b>	<b>4</b>	<b>157</b>	<b>161</b>
<b>Nakhon Sri Thammarat</b>	-	90	-	-	90	-	3	3
<b>Songkhla</b>	-	164	-	-	164	4	48	52
<b>Pattani</b>	-	88	-	-	88	-	75	75
<b>Narathiwat</b>	-	-	-	-	-	-	31	31
<b>GULF OF THAILAND</b>	<b>242</b>	<b>959</b>	<b>76</b>	<b>184</b>	<b>1,461</b>	<b>368</b>	<b>1,548</b>	<b>1,916</b>
<b>COASTAL ZONE 5</b>	-	<b>269</b>	<b>46</b>	<b>32</b>	<b>347</b>	<b>52</b>	<b>163</b>	<b>215</b>
<b>Ranong</b>	-	-	-	26	26	-	22	22
<b>Phangna</b>	-	6	44	4	54	1	34	35
<b>Phuket</b>	-	80	-	-	80	15	40	55
<b>Krabi</b>	-	13	-	-	13	1	30	31
<b>Trang</b>	-	100	-	-	100	4	21	25
<b>Satun</b>	-	70	2	2	74	31	16	47
<b>ANDAMAN SEA</b>	-	<b>269</b>	<b>46</b>	<b>32</b>	<b>347</b>	<b>52</b>	<b>163</b>	<b>215</b>
<b>Other provinces</b>	--	--	--	--	--	--	3	3
<b>GRAND TOTAL</b>	<b>242</b>	<b>1,228</b>	<b>122</b>	<b>216</b>	<b>1,808</b>	<b>420</b>	<b>1,714</b>	<b>2,134</b>

Notes: <sup>1</sup> In some seasons this gear was changed to anchovy fishing gear.

**Table 6. Number of fishing boats (APS) by size category surveyed by the Anchovy Working Group during February-March 1999**

Provinces	<14m	14-18m	All sizes
Rayong	26		26
Cholburi	17	3	20
Prachuab Kiri Khan	20		20
Chumphon	9	1	10
<b>Total</b>	72	4	176

**Table 7. Number of fishing boats (APSL) by size category surveyed by the Anchovy Working Group during February-March 1999.**

Provinces	<14m	14-18m	18-28m	All sizes
Trad (luring boats)	158	16	16	190
Rayong	10	80		90
Cholburi	17	3		20
Prachuab Kiri Khan		3	7	10
Chumphon		7	8	15
<b>Total</b>	185	109	31	325

**Table 8. Number of fishing boats (LNL) by size category surveyed by the Anchovy Working Group during February-March 1999.**

Provinces	<14m	14-18m	18-28m	All sizes
Cholburi	215	22		237
Prachuab Kiri Khan		3	2	5
<b>Total</b>	215	25	2	242

**Table 9. Number of fishing boats (FNL) by size category surveyed by the Anchovy Working Group in February - March 1999.**

Provinces	<14m	14-18m	Remarks	All sizes
Trad	112			112
Rayong	155			155
Prachuab Kiri Khan	67			67
Chumphon	11	6		17
Songkhla	136	28	Mobile 84	164+84
Pattani	25		Mobile 63	25+63
<b>Total</b>	506	34	147	687

## 5.6 Light intensity

The light intensity used by the anchovy fishing boats varied, but the most popular intensity was 11-20 kW as shown in Tables 10 to 12 (Surveyed by the Anchovy Working Group in 1999).

**Table 10. The light intensity used in each type of fishing boat (APSL)**

Provinces	5-10 kW	11-20 kW	21-30 kW
Trad (luring boats)	5.3%	94.7%	
Rayong		100%	
Cholburi		100%	
Prachuab Kiri Khan		93%	7%
Chumphon		92%	8%

**Table 11. The light intensity used in each type of fishing boat (LNL)**

Provinces	5-10 kW	11-20 kW	21-30 kW
Cholburi	30.2%	64.1%	5.7%
Prachuab Kiri Khan		93%	7%

**Table 12. The light intensity used in each type of fishing boat (FNL)**

Provinces	5-10 kW	11-20 kW	21-30 kW	31-40 kW
Trad		100%		
Chantaburi	31.6%	68.4%		
Rayong	33.6%	66.4%		
Prachuab Kiri Khan	40.3%	53.7%	6%	
Chumphon	13.3%	73.4%	13.3%	
Songkhla	50.3%	30.3%	15.4%	3.9%

## 5.7 The fishing grounds and fishing season

The anchovy fishing grounds in the Gulf of Thailand can be divided into 4 geographical areas: eastern coast of the Gulf (Trad, Chantaburi and Rayong), inner Gulf (Cholburi), upper south coast (Prachuab Kiri Khan, Chumphon and Surat Thani) and lower southern coast (Songkhla, Pattani and Narathiwat).

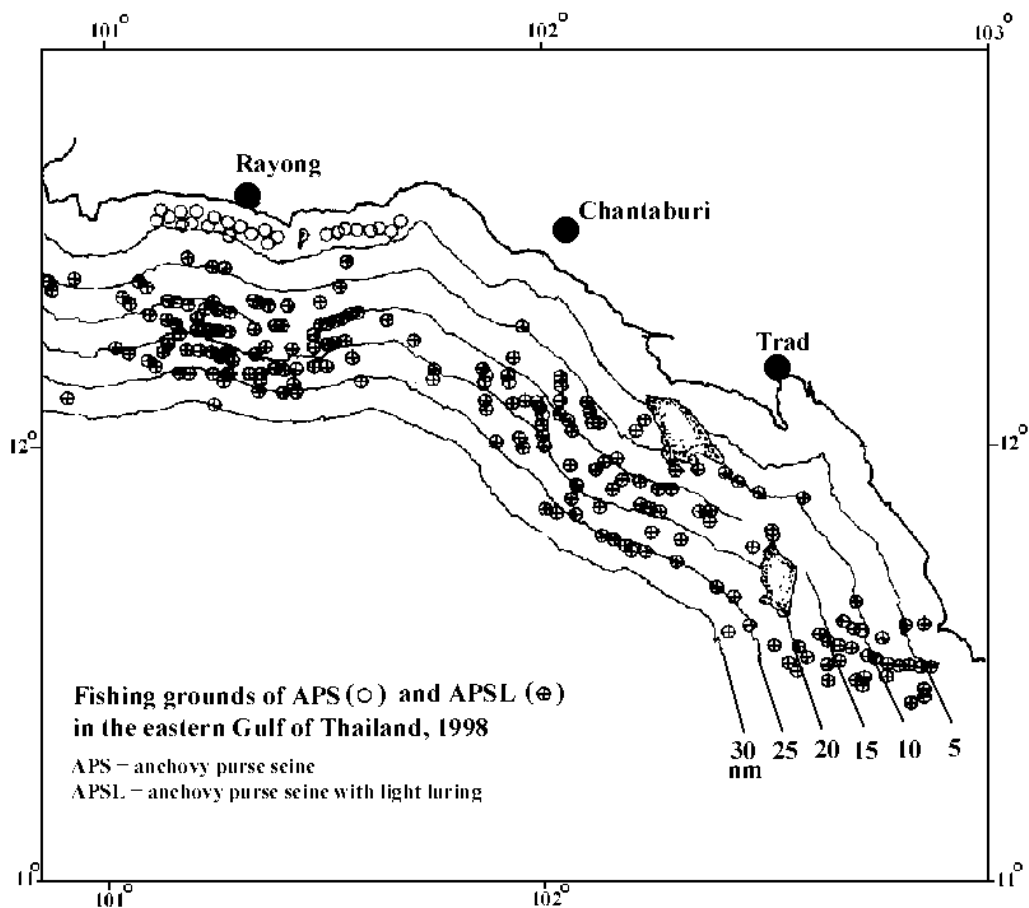
On the east coast of the Gulf, three types of fishing gears are presently used namely APS, APSL and FNL. The most effective and predominant gear is APSL (Yoosuksawat, 1999). The fishing grounds of daytime APS are in the shallow areas (water depth 5-20 m) within 5 nautical miles from the shore, while the nighttime APSL are fished in a deeper zone (water depth 20-40 m), between 5 and 30 nautical miles offshore (Fig. 14). Fig. 15 shows the fishing zones of FNL on the east coast. The high fishing season is during November to February. In the other months during the low fishing season the fishing boats are moved to fish off the southern coast and in the Andaman Sea .

In the inner Gulf, the lift net with light luring (LNL) fishing gear is concentrated in the shallow areas around islands and the area with the distance of 5-10 nautical miles from the shore.

The fishing operation is usually at a distance of not more than 20 nm (Fig. 16). The high fishing season is the same as on the east coast, but boats do not move to other places during the low fishing season.

In the upper south, three types of fishing gear are operated. The major fishing grounds of APS and LNL are within 5-10 nm from shoreline; some are extended to the zone 15-20 nm (Fig. 17). The fishing ground of APSL is concentrated at 10-20 nm and extended to 30 nm. The high fishing season is during June to October. Some fishing boats from the eastern coast are moved to fish in this area during high season. The fishing ground of APSL of Surat Thani is in the zone between 20 and 40 nm (Fig. 18).

In Songkhla, Pattani and Narathiwat (Fig. 18), the fishing grounds of FNL are in the zones between 5 to 40 nm. There is only one type of fishing in this area. Each year the high fishing season is during June to October. Some fishermen in Rayong have settled here permanently to fish anchovy. Some of them moved to fish in the Andaman Sea during this area's low season.



**Fig. 14. The fishing grounds of anchovy purse seine (APS) and anchovy purse seine with light luring (APSL) in the eastern coast of the Gulf of Thailand**



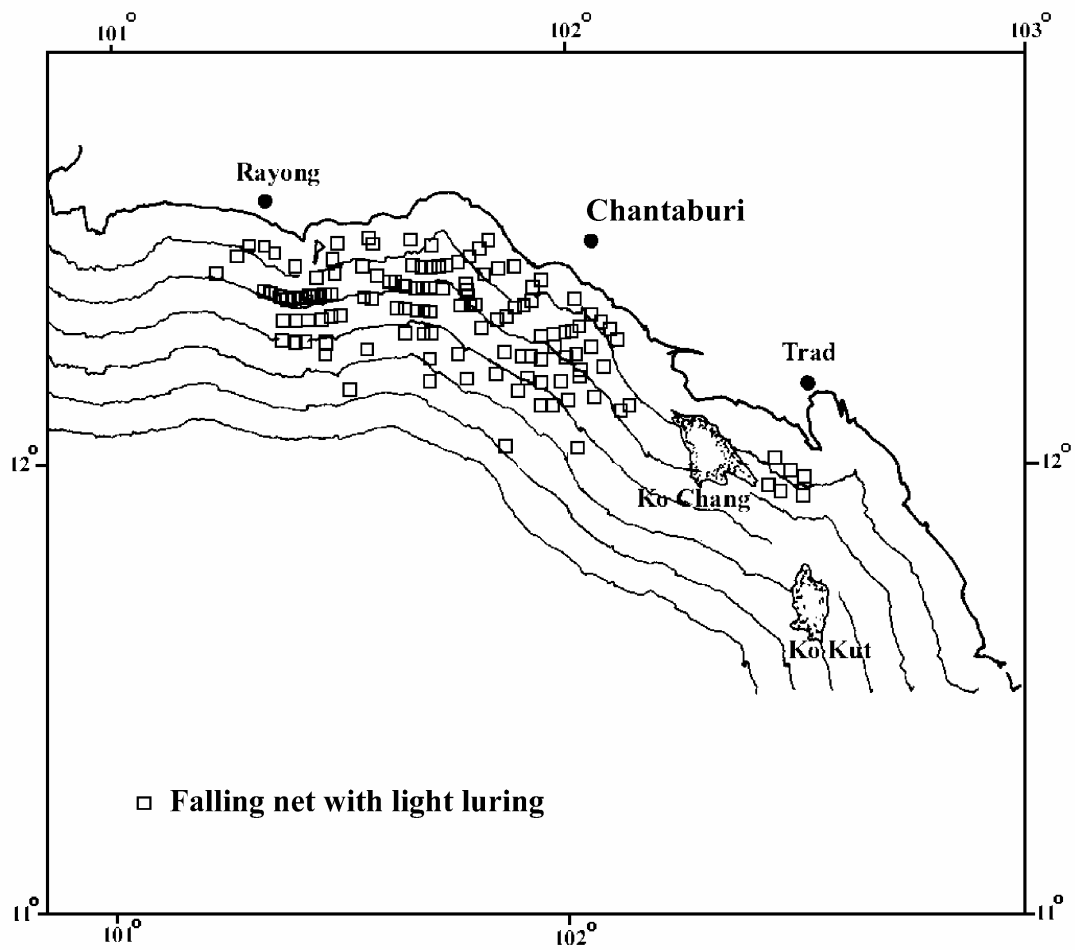


Fig. 15. Fishing ground of falling net with light luring (FNL) in the eastern Gulf of Thailand (the lines indicating the distance from shoreline are the same as Fig. 14)

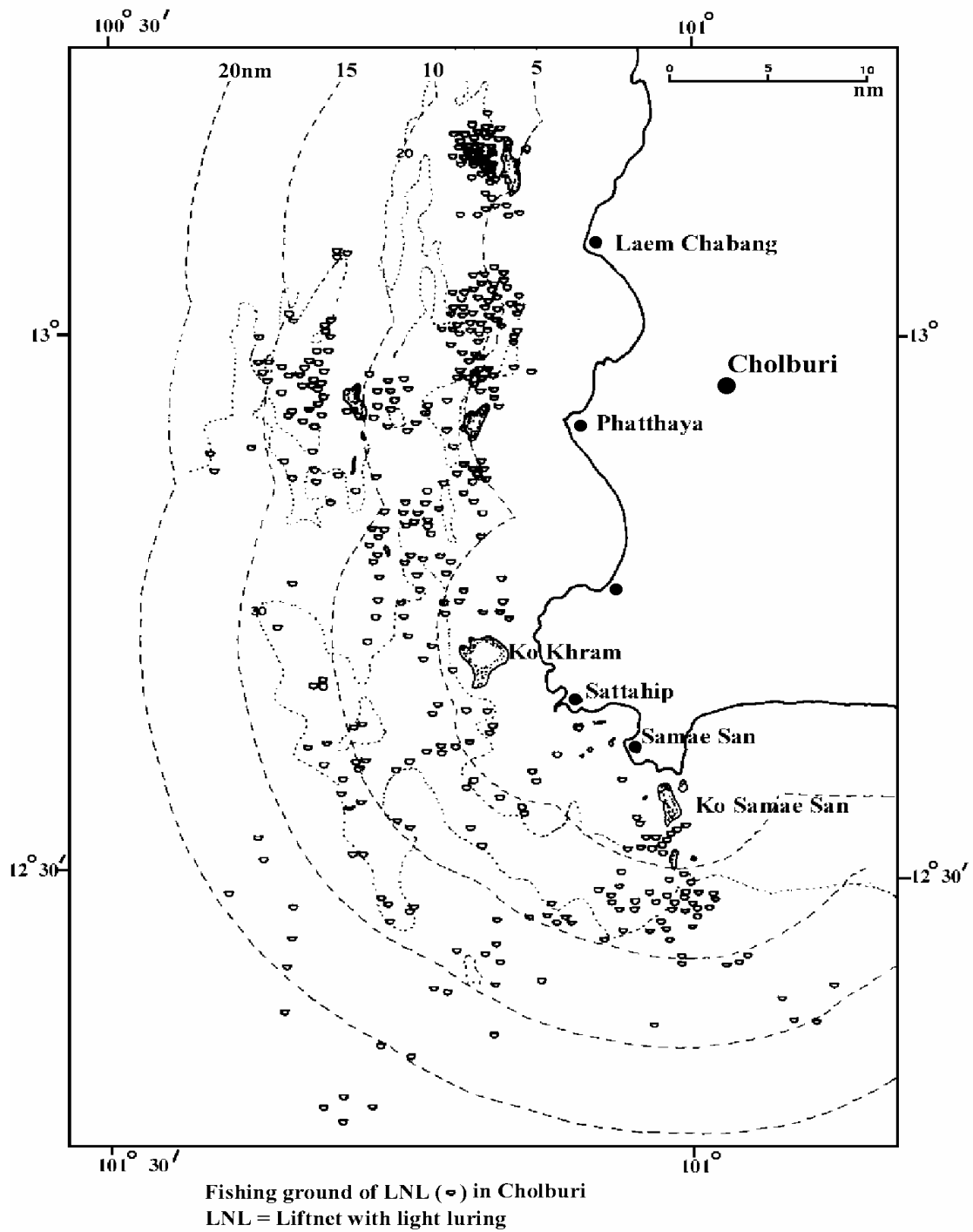


Fig. 16. The fishing ground of lift net with light luring (LNL), or cast net with light luring in Choburi Province

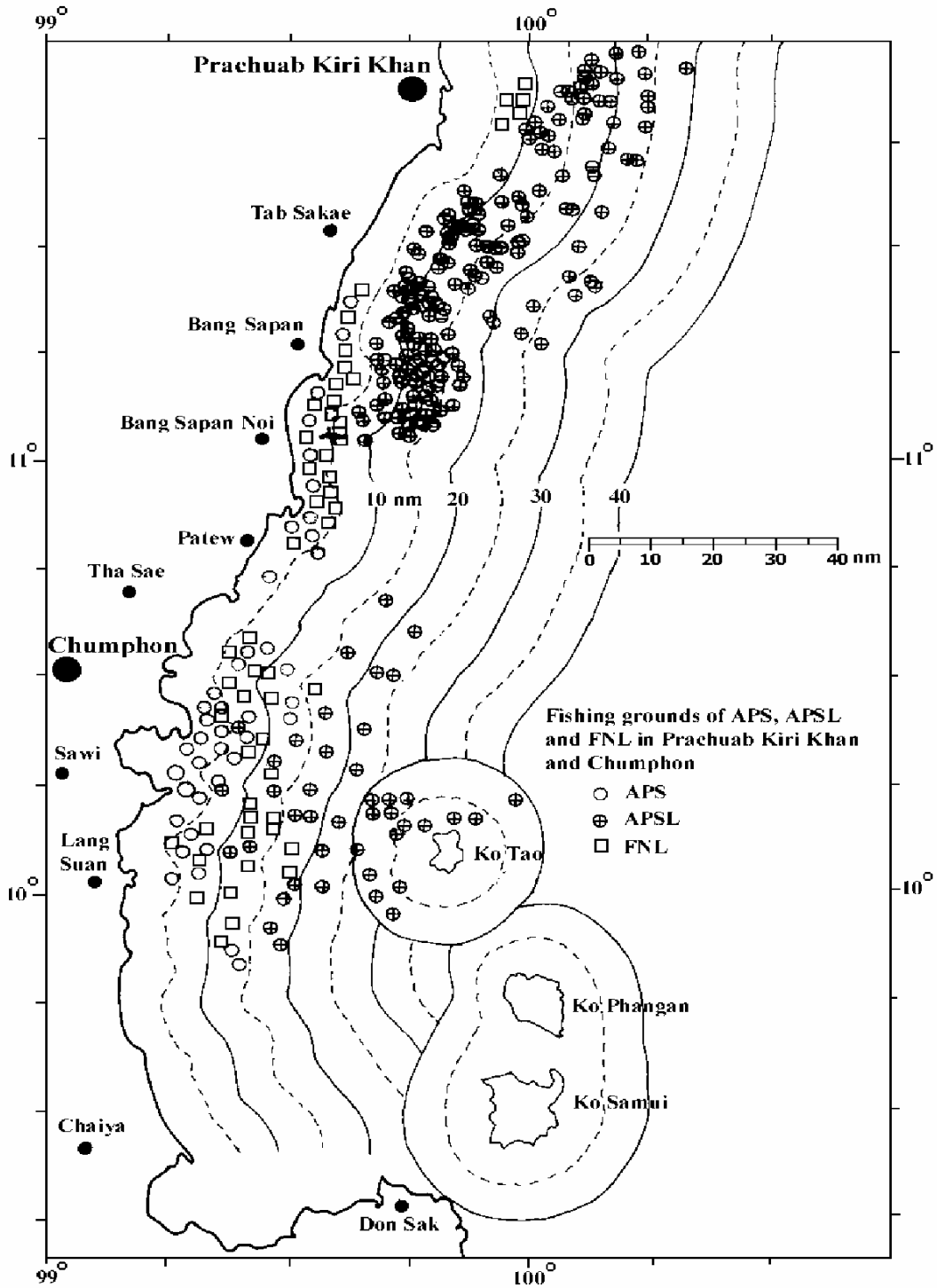
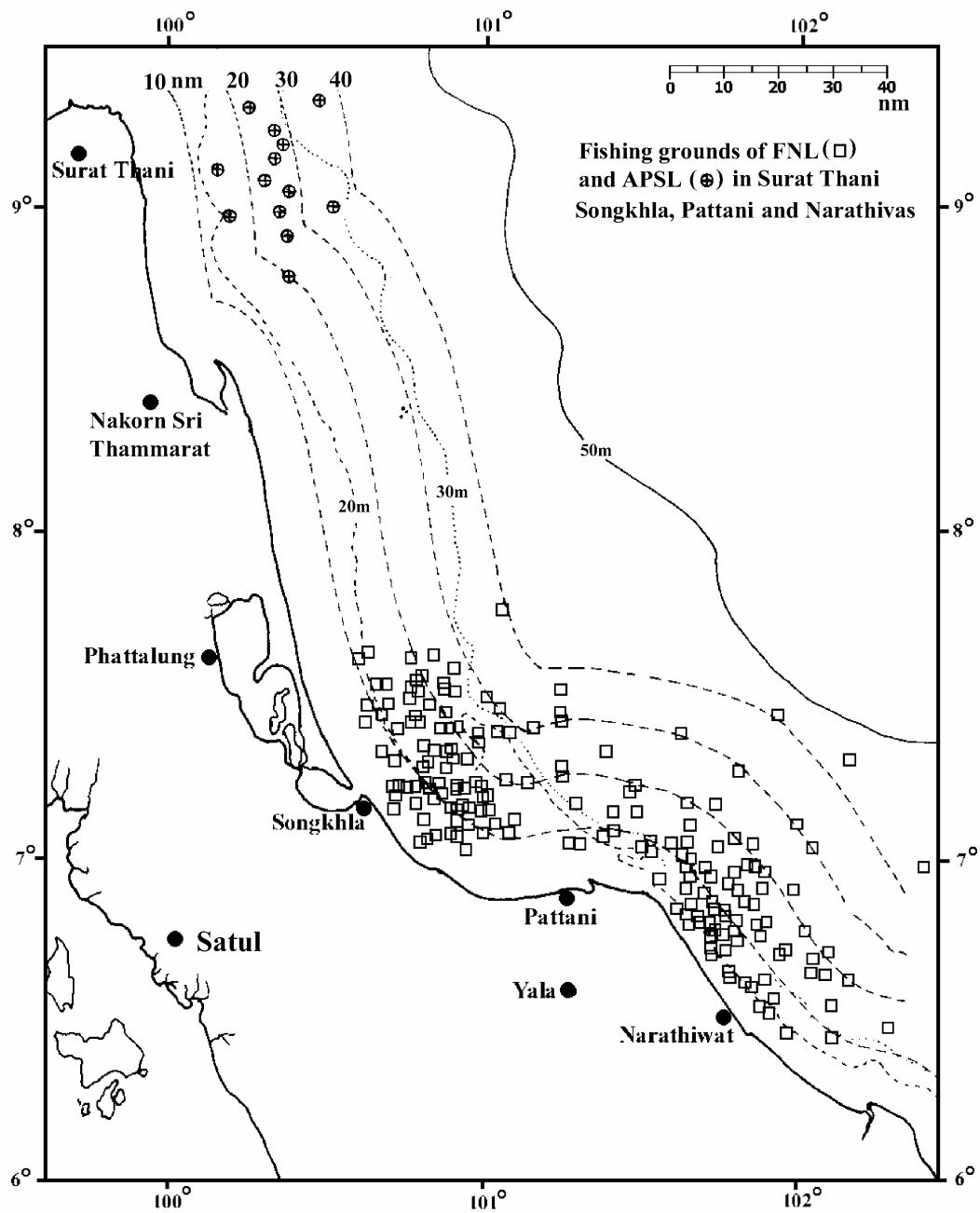


Fig. 17. The fishing grounds of anchovy purse seine (APS), anchovy purse seine with light luring (APSL) and falling net with light luring (FNL) in Prachuab Kiri Khan and Chumphon Provinces



**Fig. 18. The fishing grounds of anchovy purse seine with light (APSL) in Surat Thani and falling net with light luring (FNL) in Songkhla, Pattani and Narathiwat Provinces**