Exploitation of Tunas in Ceylon's Coastal Waters

By

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Introduction

CEYLON'S fishery for the tunas is presently limited to the coastal waters which in the present context has an off-shore limit of 15 miles and our contribution to the world tuna production is a little over one per cent.

Four varieties of tuna are largely exploited in the coastal waters. Of these, Baleya or the skipjack (*Katsuwonus pelamis* Linn. 1758) is the predominant variety followed by attavalla or mackerel tuna (*Euthynnus affinis*, Cantor, 1850), kelawalla or yellowfin (*Thunnus albacares*, Bonnaterre, 1788) and alagoduwa or frigate mackerel (*Auxis thazard* Lacepede, 1802). Other varieties like the thora-baleya or bonito (*Sarda orientalis*) and asgedi kelawalla or big eye tuna (*Thunnus obesus*) are also landed frequently but in extremely small quantities. Figure 1 illustrates the relative composition of the tuna varieties in the catch and their percentage composition further sub-divided according to the type of effort applied. It is evident that Ceylon's coastal fishery for tunas is greatly influenced by the production of smaller varieties of the tunas.

Fishing methods and catches

There are mainly four methods applied to exploit the coastal tuna resources. They are: tuna longline, pole and line, troll and gill-net. Though there are records of heavy catches of frigate mackerel in the beach seine fishery, the contribution by this method to the blood fish production is very insignificant now. In the Hambantota area handlining with live bait on hooks is becoming a popular method for fishing tunas.

Pole and line method has been in existence as far back as 1919 and there are numerous similarities in the equipments and the methods of operation by our fishermen and those of Minicoy, Laccadive and Maldive Islands where this method is stated to have been in operation in 1909. The barbless hook used in this method has undergone considerable modification over the last decade and though it is completely different from the Japanese type, it is equally efficient as seen from some of our trials.

Originally the pole and line method was operated only in the waters off the south-west coast but since mechanisation this method is being applied in the east coast too, by migrant fishermen from the south. The main factor limiting the popularity and development of this method are the availability and the fishery for live bait. The live bait used in Ceylon is red bait (*Dipterygonotus leucogrammicus*, Bleeker 1849). This is found congregating over large rocks at depths of 5-10 fathoms. A special dip net is used for catching the bait. Sometimes the fish appears at the surface, when they are caught with scoop net. In countries like Japan where the pole and line method is very well established, anchovies are popularly used as bait and they are caught by purse seining. Ceylon too produces a fairly large quantity of this variety by beach seining and it may be possible to modify this method or adopt other suitable methods to catch the anchovies and maintain them alive in pens to be utilized as live bait.

An average catch of 430 lbs. of tuna could be caught from a mechanized boat per day, using the pole and line method. At least in two per cent. of the cases the catch per boat would be over a short ton. The best season for this method of fishing is November to March off the south-west coast and July to September off the east coast. During these seasons the availability of bait determines the tuna production. Generally, during the pole and line fishing season the sea water is relatively clear and it is not easy to tempt the tuna to bite an artificial bait. Hence trolling during this period would not be very effective.

Trolling gear used in Ceylon is an adaptation of the salmon troll and hence different from the standard tuna troll used by the Japanese or the American fishermen. However, for Ceylon the existing type is most suitable because of the denseness of the schools of frigate mackerel

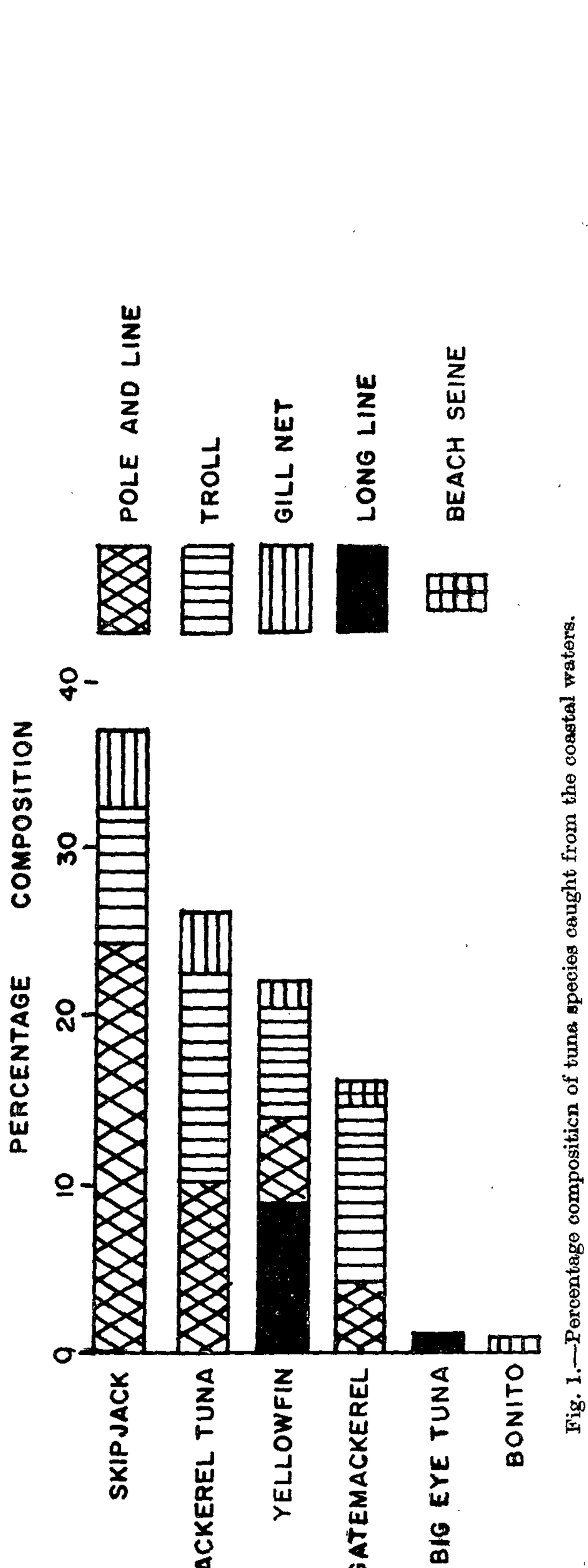

Fig. 1.—Percentage composition of tuna species caught from the coastal waters.

and mackerel tuna. The tuna catch per man hour of trolling is 20 lbs. off the U.S. coast, 20-22 lbs. off the coast of Japan and 26 lbs. off Ceylon waters. Our average catch per boat per day is only 78 lbs. But this method contributes a very significant quantity to the total tuna production of the island as a result of its wide-spread popularity and year round application.

This method is popular in all areas except the northern peninsular. This method involves no bait problem, very little repairs to the gear and requires minimum number of crew. Though it is expected that this method requires more fuel than the other methods of tuna fishing in Ceylon, in practice it is not so because trolling is generally limited to the morning hours and lasts about 3-5 hours. In Ceylon frigate mackerel and mackerel tunas are not fished more efficiently by any other method. These varieties respond less than the skipjacks to the pole and line fishing. During periods when the sea water is turbid this gear is very effective, hence popular during monsoons.

Longlining for tuna is a relatively new method in Ceylon. This gear hooks mainly the larger varieties like yellowfin and bigeye. Immediately after the commencement of mechanisation, fishermen all over the island bought this gear but the interest died rapidly because of the difficulties in obtaining good bait fish at reasonable price. The cost of bait in relation to the return from the catch is extremely high and fishermen sold each unit of the gear at Rs. 15 after having bought it at Rs. 90 a unit. The average catch per operation is 97 lbs. In terms of hooked rate it is 1.7 per cent. of sharks, 0.3 per cent. tuna and 0.2 per cent. spear-fish. The reasons for such a trend are (1) low density of distribution of yellowfin and bigeye tuna in the coastal waters, (2) use of cut pieces of meat as bait, (3) operation of the gear at night and mid day, (4) smallness of the number of units in each set, and (5) high rate of damage by sharks in these waters.

Presently, longlining for tuna off Negombo is relatively the best around the island. Cut pieces of the frigate mackerel, caranx and dolphin and also hurulla are being utilized as bait but flying fish and squid should be extremely good tuna baits because these two varieties are most commonly observed in the stomach contents of tuna and the present production of these varieties is sufficient to satisfy the bait requirements of an off-shore tuna longline fishery (Fig. 2). The hooked rate of tuna and the size of the fish caught are too small to encourage this method of fishing in our coastal waters, especially in the light of the bait problem.

Gill nets are common in almost all areas except the south-west. The mesh size range is so wide that tunas are also being caught even though the fishermen do not carry out preferential fishery for them. However, considerable contribution to the tuna production is made by the gill net fishery (drift net). The percentage of tuna species in the species composition of the catch being small, of an average catch of 88 lbs. per boat per day with this gear only about 15 to 20 lbs. would be tuna varieties.

Biology of the exploited populations

The size model groups of the tuna exploited by each method seems to be different and the recruitment to each type of fishery is in successive stages of their growth. This is very clearly seen in the case of *yellowfin* (Fig. 3). The size model groups exploited by gill net is 36-45 cm, by troll is 46-55 cm, by pole and line is 66-75 cm, and that by longline is 116-125 cm, as well as 146-155 ch. 70 to 80 per cent. of the yellowfin exploited belong to O and I age groups (under two years). In the East Pacific it is illegal to fish yellowfins under 50 cm length. The II and III age groups are exploited by longline. Though the young fish entering the troll and pole and line fishery are the principal source of recruitment to the longline fishery, there is no evidence of relationship between the abundance of the small sized fish to that of the large sized ones. The large sized fish are commonly caught off Negombo in the west coast and off Trincomalee in the east coast. Off the west coast yellowfins are caught mainly between June and September. From September to February more bigeye tunas (155-200 cm) than yellowfin enter the fishery. In the south, small size ones are caught during the first half of the year and the larger and mature ones during the south-west monsoon. In the east coast, August and September brings in immature yellowfin and the mature fish from November to March. Around Beruwala 20-30 cm length group is common about May and this is the smallest size of yellowfin to be commercially exploited off Ceylon's coast. Very often the size groups of immature fish exploited are related to the size groups of other tuna varieties which generally aggregate. It is suspected that spawning of yellowfin off the west coast occurs around December.

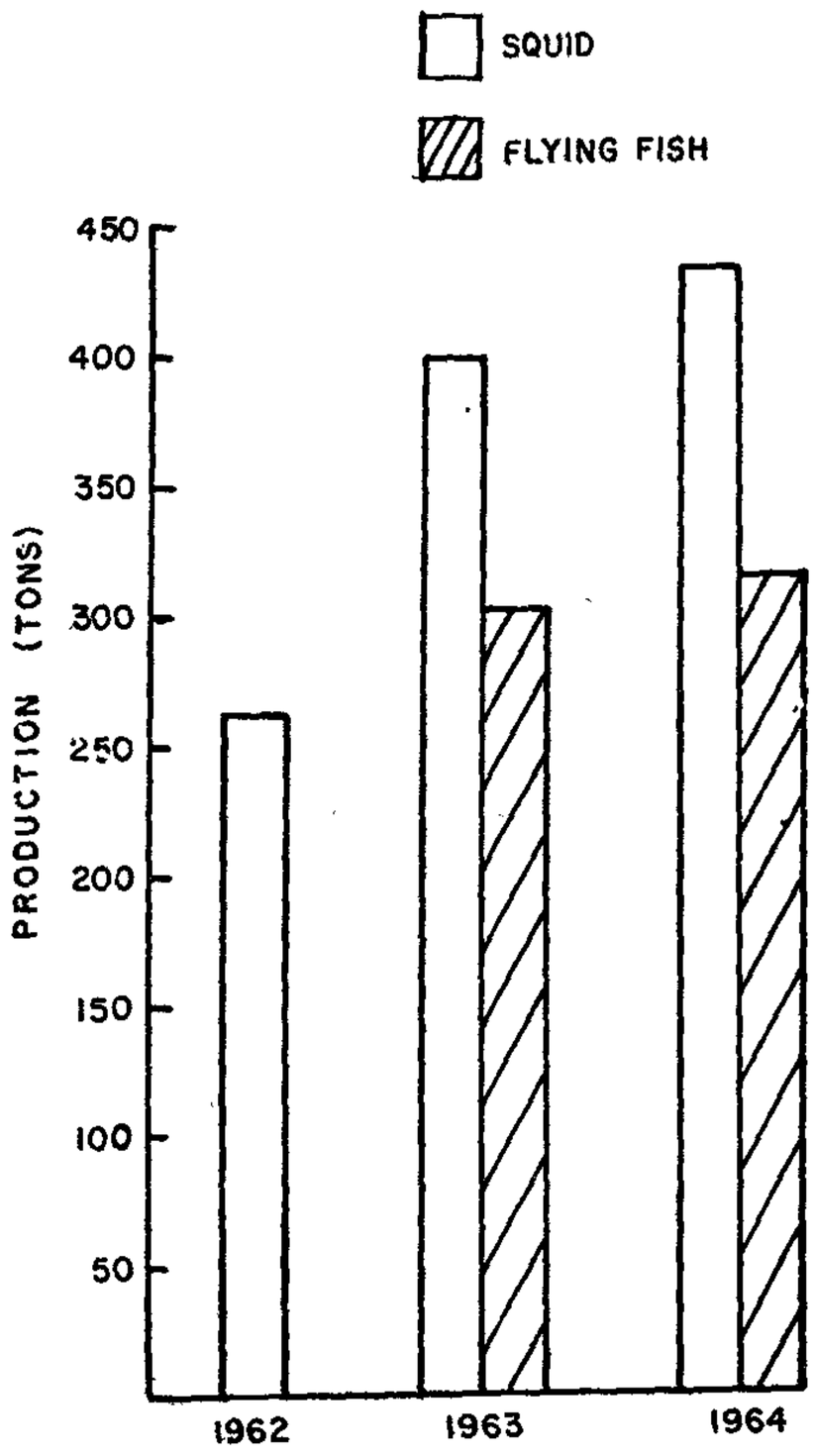

Fig. 2.—Annual production of squids and flying fish.

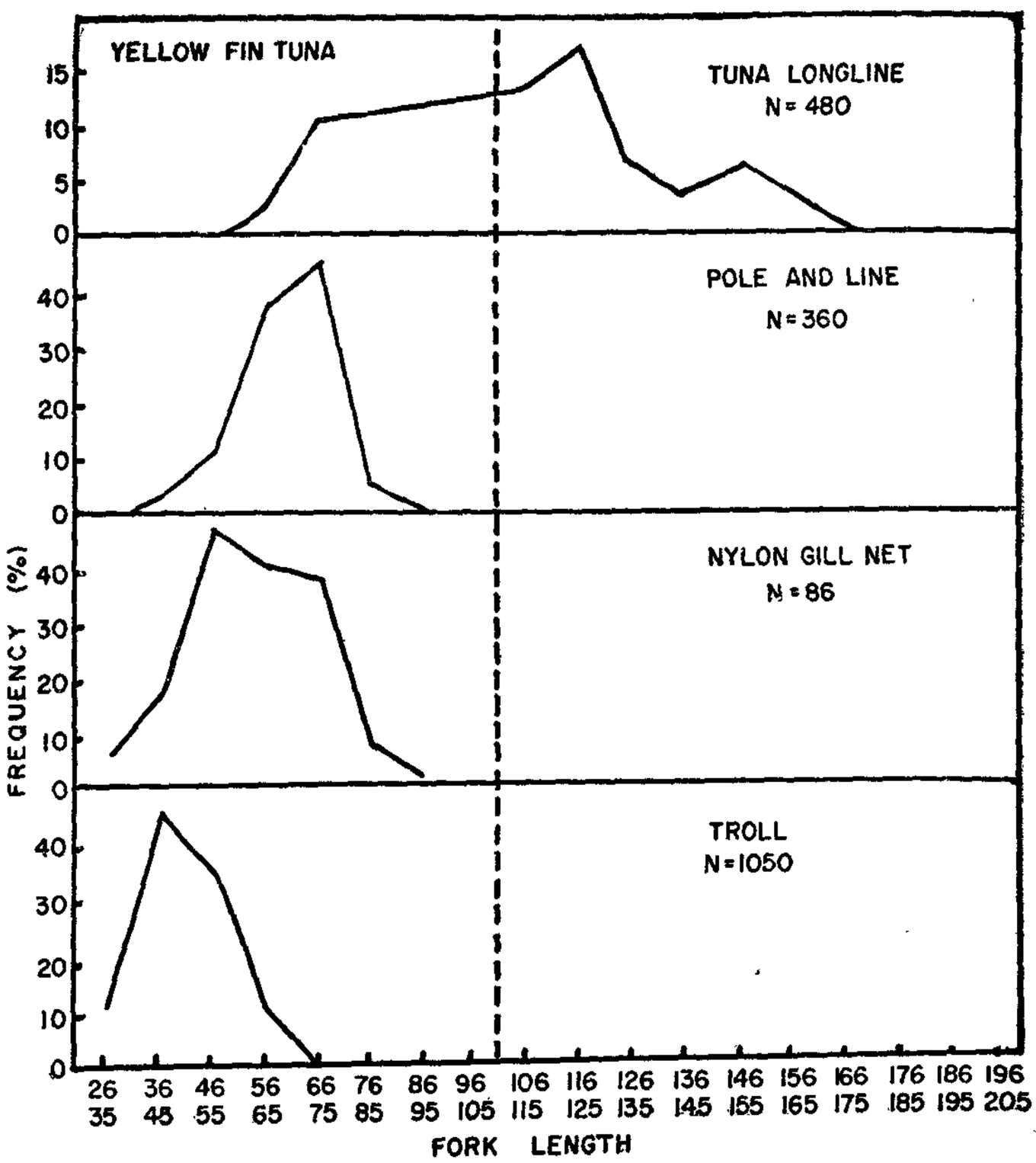

Fig. 3.—Length frequency distributions of yellow fin tuna caught during 1964/65, using different methods.

Skipjack.—Though 16-20 cm. length group of this fish appears in the catches off the east coast, generally steady recruitment to any of the existing fisheries commences after they reach the 20 25 cm size range. This variety is exploited most efficiently by the pole and line method. The maximum size landed off the south-west coast is over 70 cm and in the east coast and north-west it rarely exceeds 65 cm with a single mode at 45.55 cm dominating the size distribution for all areas. In the south it is bimodal with an additional mode around the 65 to 70 cm range (Fig. 4). In the south-west coast skipjacks appear in vast shoals from November to March. Similarly, off the east coast they are abundant from July to September. In the south west coast large percentage of the fish appearing from November to January have spent ovaries and feed very actively that these fish appear in these areas during the post-spawn migration.

There is a large variance in the annual production of the skipjack and there are two main reasons for it: (1) The annual variation in the spawning stock, and (2) the availability of live bait. 1963 was the best year over the last decade because the above two factors were favourable, but in 1964 it was just the reverse. Except during these good seasons the size of the skipjack landed is dependent on the size of the yellowfin, frigate mackerel and mackerel tuna which are often in aggregation. There is evidence of a resident and migratory types of population.

Mackerel tuna.—The size frequency distribution is polymodal even when stratified. During the first half of their second year of life and during the third year this fish enters mainly the troll fishery. It enters the pole and line fishery mainly during the second half of the 2nd year and first half of the 3rd year. This variety reaches maturity when about 45 cm long. Gill nets bring in the 1st, 2nd and the 3rd years. Off Negombo juveniles (10-12 cm) are caught in October along with herring-like forms. Thus there is indication of atavalla spawning off the west coast. In the west coast atavalla is best fished between November and January. In the south the fishery is scattered throughout the year. Off the east coast April to September is the best part of the year for fishing them (Fig. 5).

Frigate mackerel.—This is the smallest member of the tuna group. Maximum weight about 7 lbs. (55 cm). The model size groups exploited are 26-28, 32-34, 36-38, 44-46 and 48-50 cm. The second and the last groups are exploited during the pole and line fishery for baleya. The remaining three groups are caught by trolling. The variety is relatively most abundant in the south-west coast and declines along the north-west and east coast. Smallest size appear in the waters off Beruwela or south of Beruwela. Schools of this fish move very close to the shore and are caught with the beach seine, off Tangalle, Udapu and Trincomalee. This variety is distinctly dominant in the catches off the south-west coast during the south-west monsoon. There is very little knowledge on the biology of this fish even in the outside world. (Fig. 6).

Relative density of distribution and abundance

The density of distribution of tunas is highest in the waters off the southernmost projection of the Island and also off Batticaloa. The baleya forms the most significant portion of the production from these areas. On either side of these main centres the density decreases steadily. There is no noticeable landing of tuna from the south-east corner of the Island. The second best areas are off Negombo, Balapitiya and Trincomalee and of these three, the first and the last are distinctly yellowfin grounds (Fig. 7). Relationship between the population on the east and the west coasts are being investigated using both morphmetric and chromatographic methods.

A very simple method of studying the abundance of skipjacks, frigate mackerel, mackerel tuna and young yellowfins is to observe the surface schools. The following observations were made from mechanized boats operated by fishermen. The schools are almost always mixed, probably because of the commonness in the feeding behaviour of the same sized ones. Chances of meeting at least two schools are extremely high and when pole and line method is used. fishing is from one or two schools. But trolling may involve more schools because lesser number of fish are caught from each school. It is difficult to estimate the size of a school, however approximate estimation made is illustrated in the figure 8. The number of fish taken from each school applying the pole and line and troll methods is shown in the figure 9.

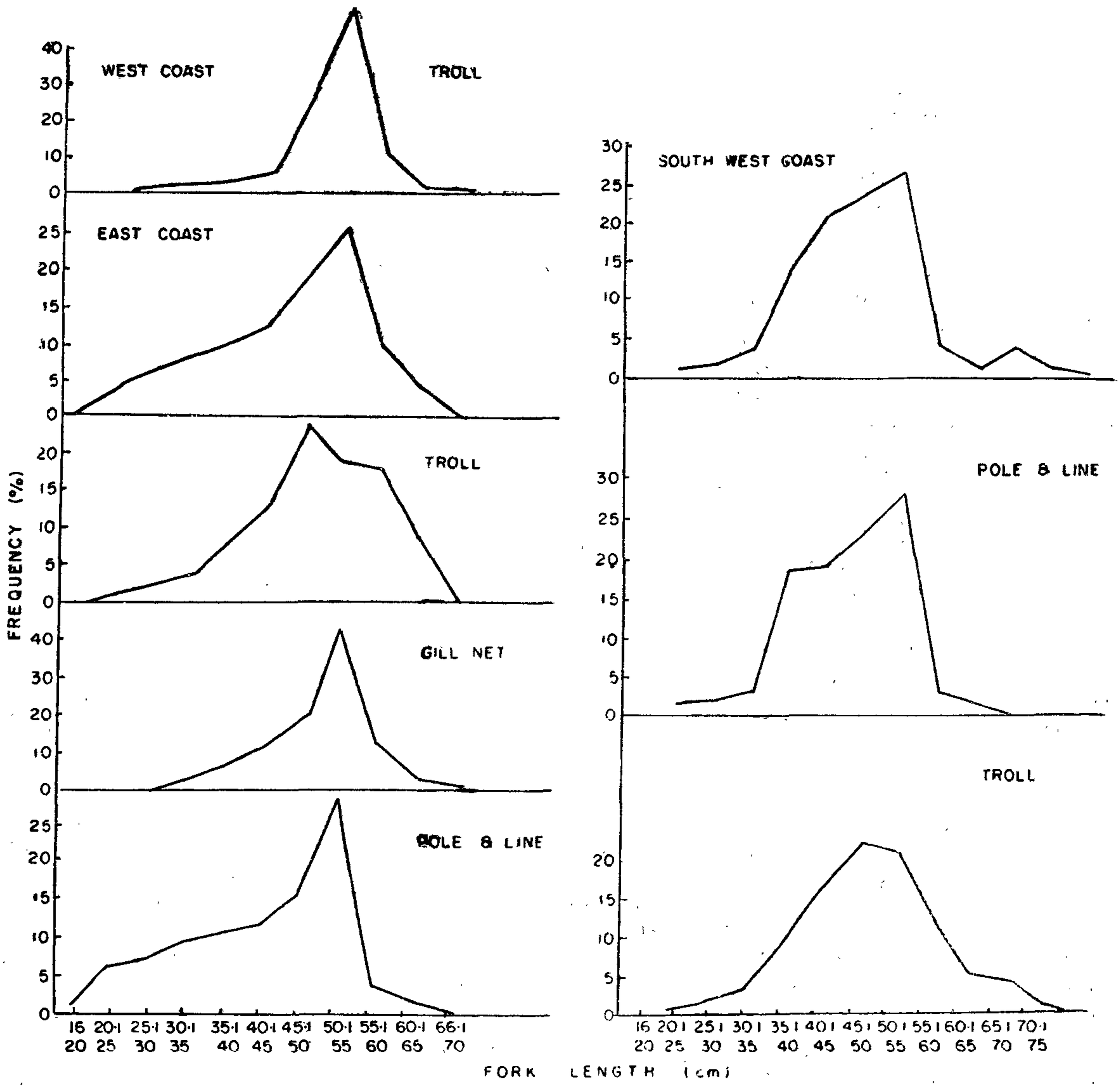

Fig. 4.—Length frequency distributions of skip jack tuna caught off the south-west and east coast.

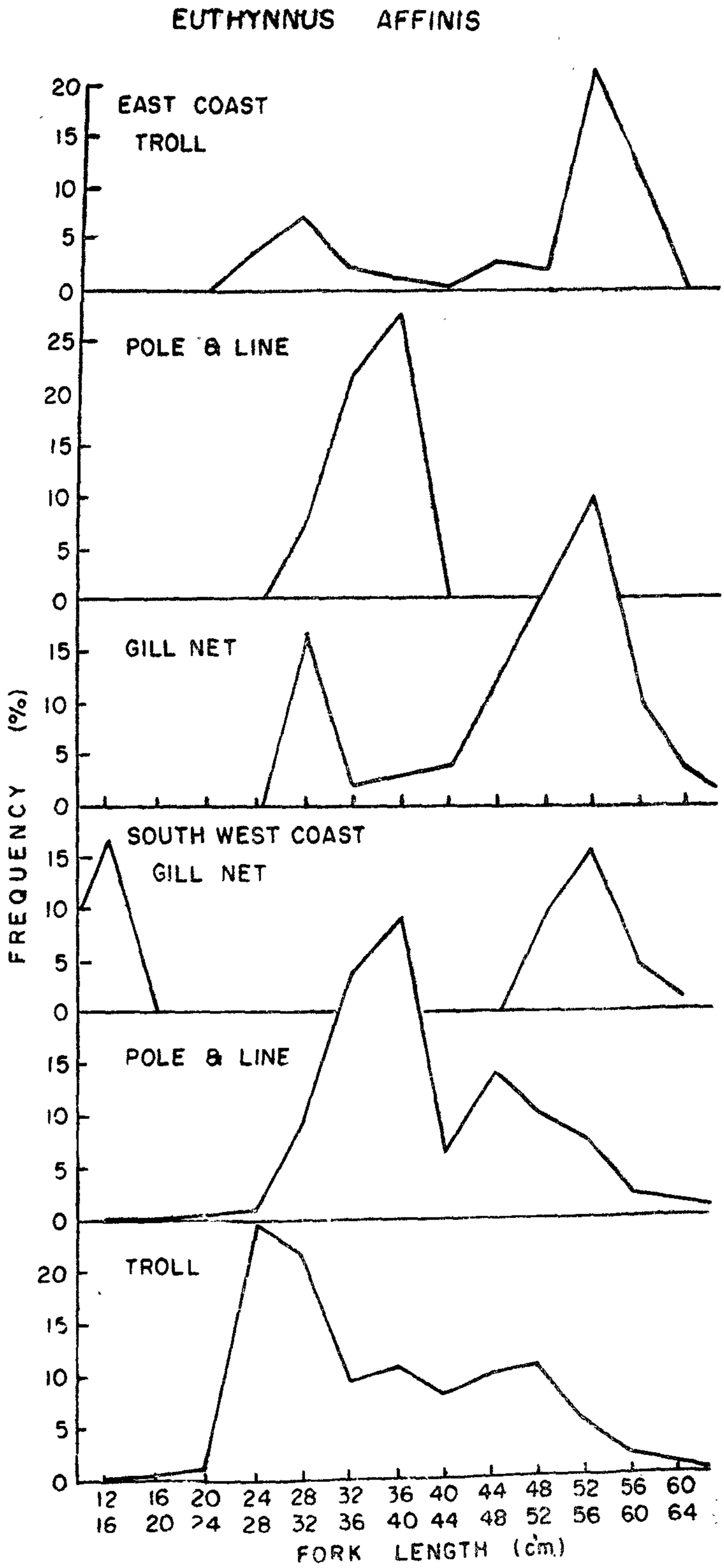

Fig. 5.—Length frequency distributions of Mackerel tuna caught during 1964–65

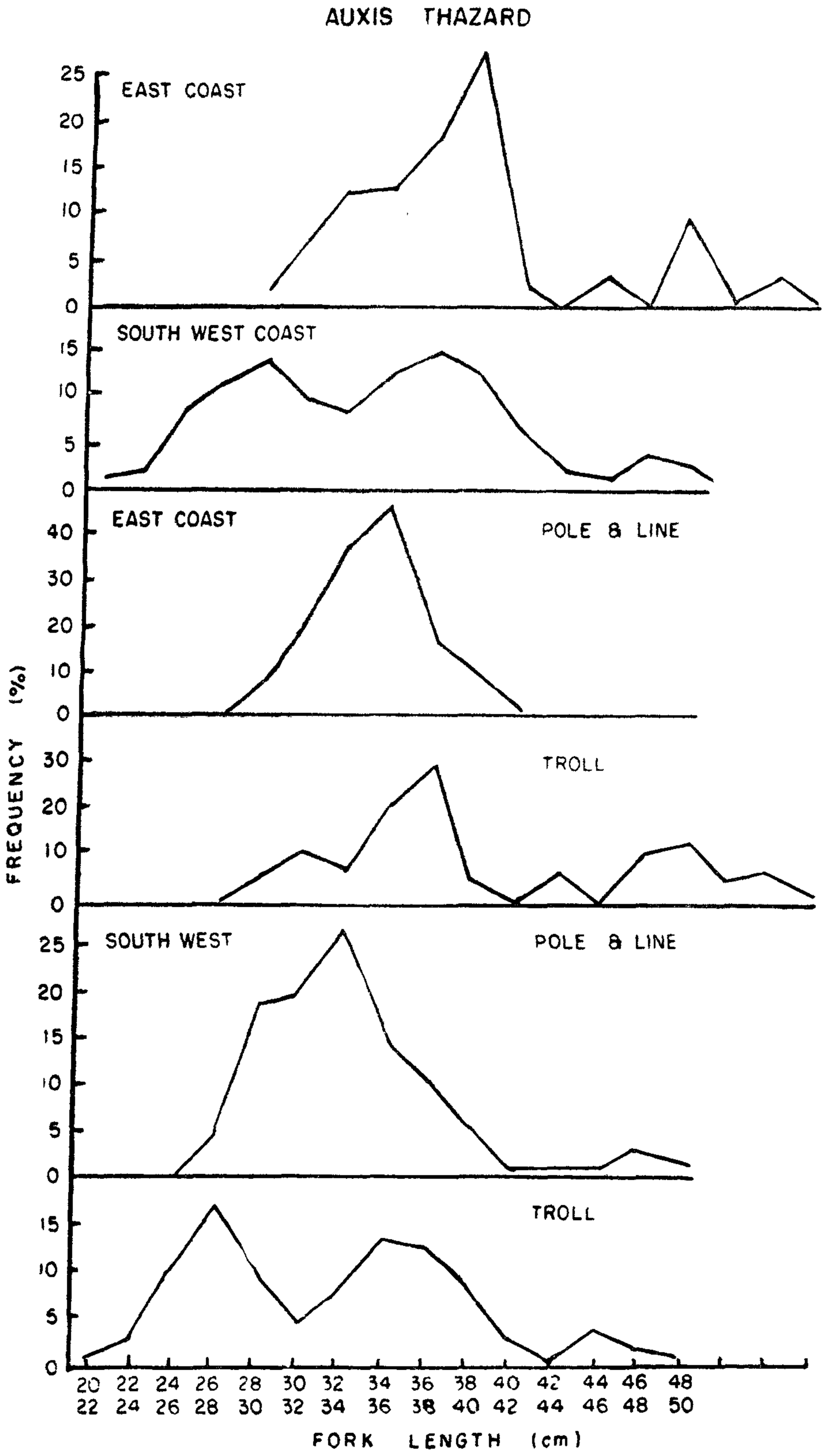

Fig. 6.—Length frequency distributions of frigate Mackerel caught during 1964/65.

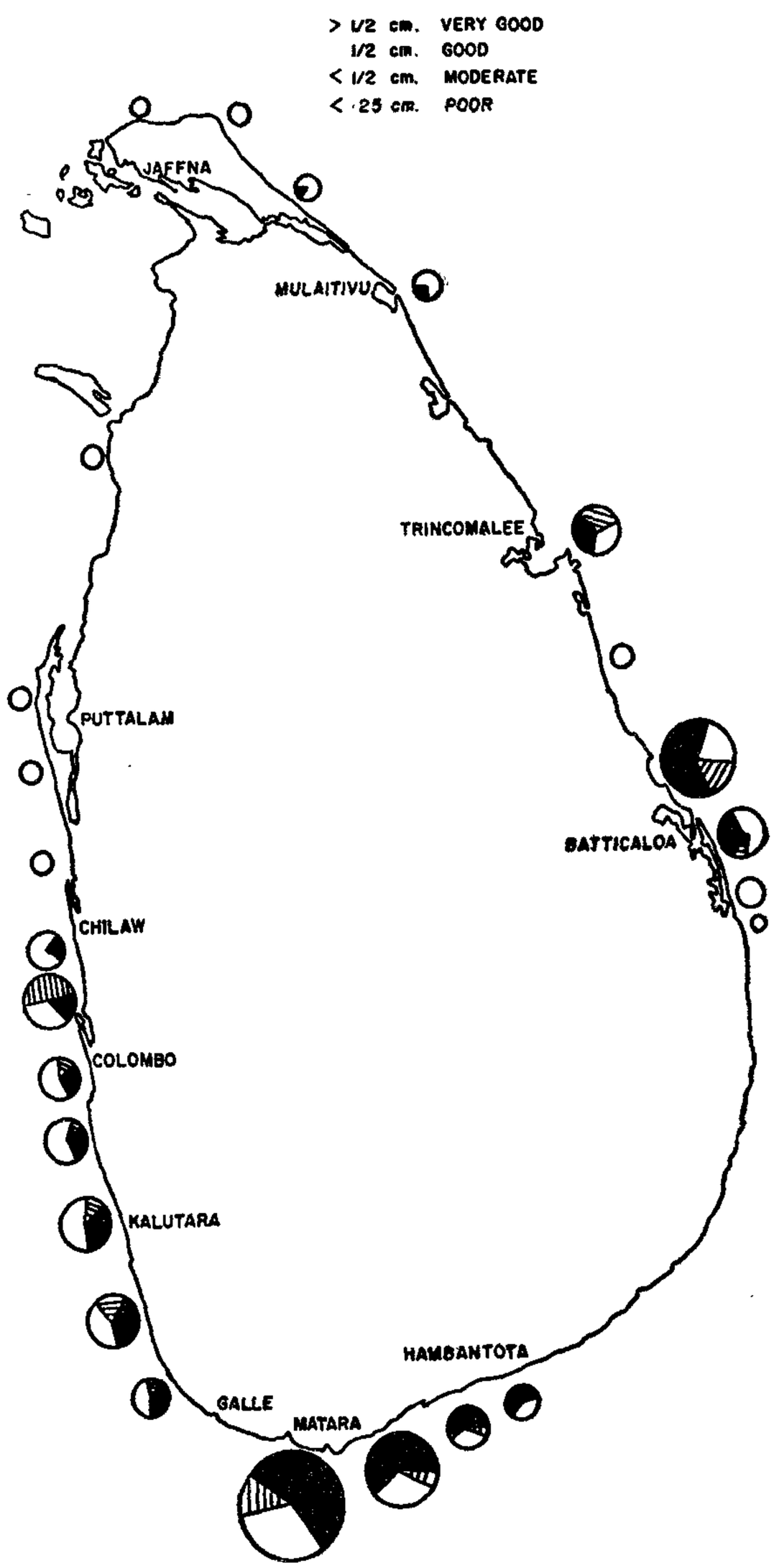

Fig. 7.—Densities of distribution of the main varieties of tuna found in the coastal waters.

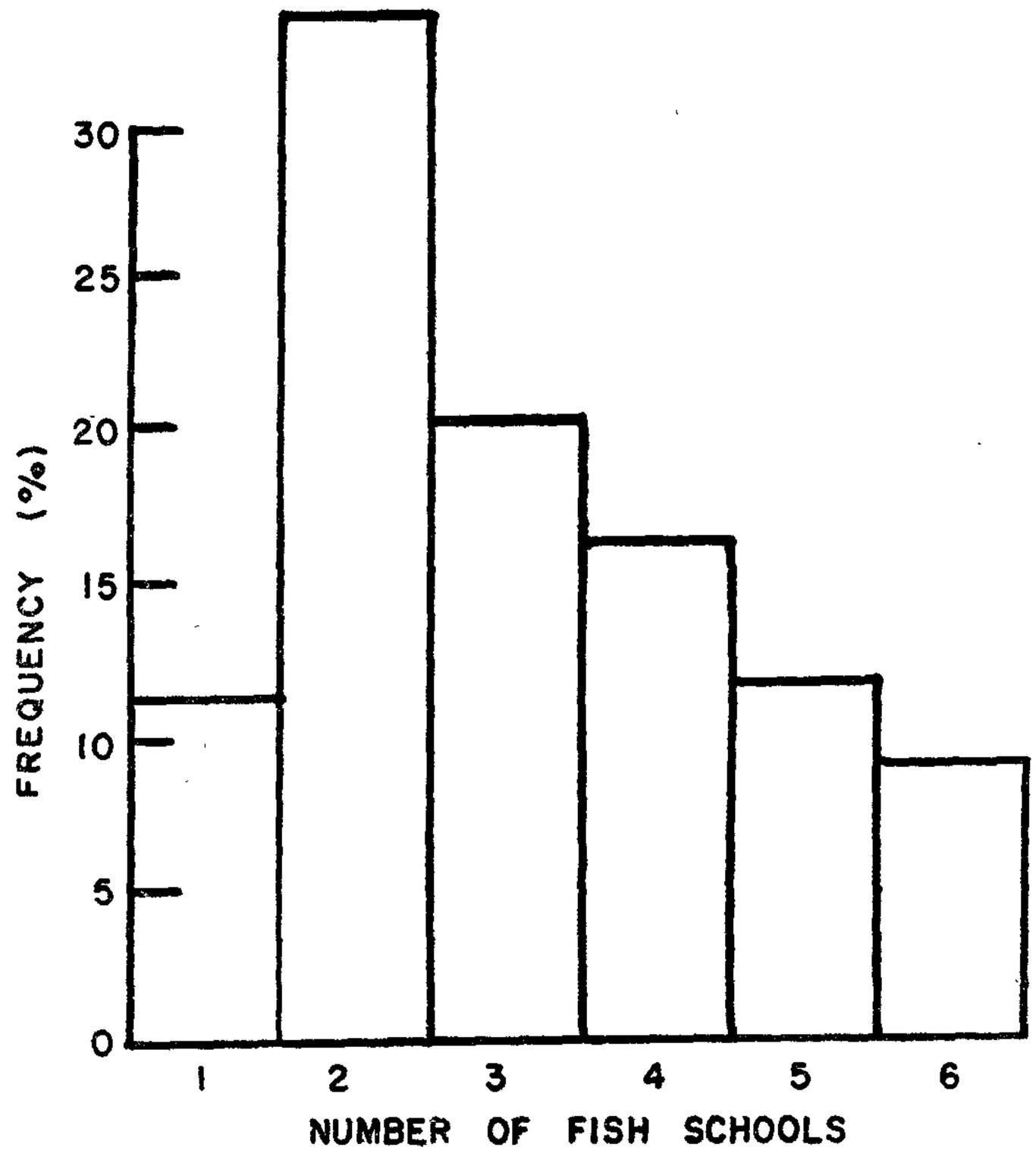

Fig. 8.—Frequency distribution of the number of tuna shcools located per day.

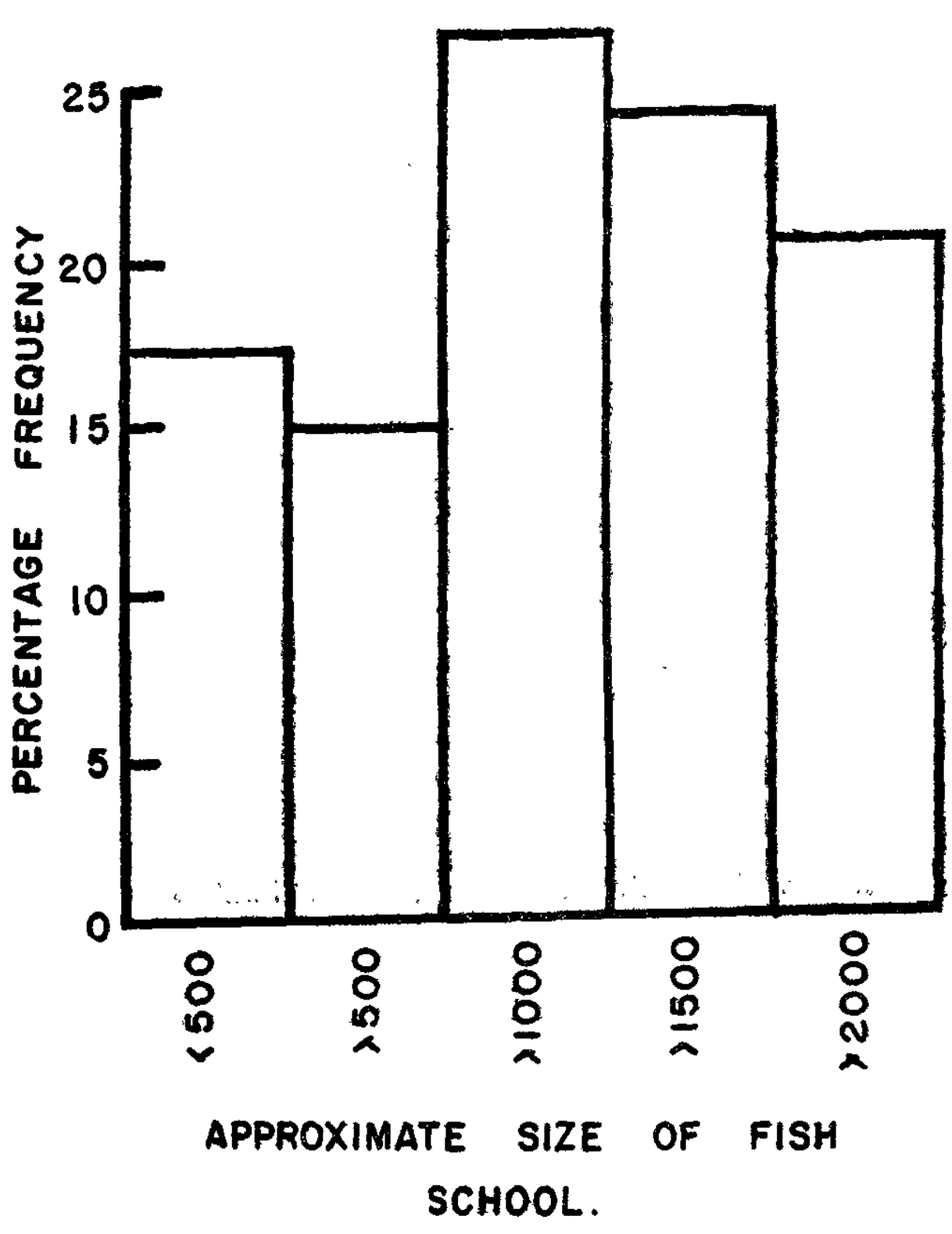

Fig. 8.—Frequency distribution of the approximate size of schools sighted in the coastal waters.

It has been estimated that only about 15 to 20 per cent. of the school is fished out by the pole and line method. This is very low compared to the Japanese standard which is about 40 per cent. The reason for our poor result is the primitiveness of the method and equipment. Our fishermen are efficient in accelerating the biting response of the tuna but are not able to maintain that level of response long enough (Fig. 10). The response generally dies within half an hour unless of course the fish are extremely starved. Actively feeding schools move slowly; as a result it is possible to fish them in the morning and return again to fish them in afternoon. Drifting schools move faster and their response is uncertain. Location of tuna schools is easy because of the birds. It is possible to say whether a school is feeding or not, from the behaviour of the birds.

PRODUCTION—Past, present and future.—From 1951 to 1960 the percentage of bloodfish in the total production declined steadily. Since 1960 the production and the percentage composition showed increase but 1964 was again a poor year (Fig. 11) and the reasons were discussed earlier in the paper. This year again the fishery has improved; the spawned migrants were abundant but unfortunately instead of spreading their arrival over a period of one month or more, the fish appeared all together and the fishery was confined to a week only. Further the effort was insufficient and the price of tuna was too low (20 cents a lb.) to encourage the fishermen to intensify the fishing effort.

Examination of the production of tuna revealed a very interesting trend in the regional distribution of landings. Since 1952, though the south coast was producing the highest percentage of bloodfish, the production of bloodfish off the north peninsula showed gradual increase. By 1955 the north-west coast dominated the Island in bloodfish production. Over five years the dominance shifted gradually southwards and by 1962 south coast had excelled all other areas. But in 1963 the dominance shifted to the east coast which showed a 700 per cent. increased production. In 1964, though the total production dropped by 77 per cent. east coast maintained its dominance more distinctly. The reason for this trend is not very clear but could be probably attributed to the migratory pattern of the tunas and the fishermen (Fig. 12).

Since mechanisation, the percentage of bloodfish in the total catch has increased over the entire east coast from Pottuvil to Thalayady. Whereas in the west and south coast only Balapitiya and Dodanduwa have shown increase.

An analysis of the performance of the existing mechanized boats was made to explore the possibilities of increasing the production without increasing the strength of the fishing fleet. Table 1 shows the avearge number of fishing days per month, for the four main regions. There is considerable room for increasing this value especially for southern and western areas. The ratio of the total number of hours of active fishing to the number of hours of sailing is very low. These two factors could be improved to a very much better level mainly by improving the shore facilities, especially the price per pound of fish realised by the fisherman. This value declines with the time of the day and also with increase of catch per boat.

Establishment of a bait Fishery.—It would be worth even with a state subsidy; suitable live bait tank could be accommodated on board mechanized vessels. A pump could also be carried to circulate the water in the bait tank and to spray water during chumming. Improvements along these lines would be a quicker and cheaper means of increasing bloodfish production in our country.

TABLE 1

Region	*Average number of days operated per month*	*Average gross income per month* Rs. c.	*Average gross income per day* Rs. c.
North ..	21·02	1,183 50	56 30
East ..	16·05	1,020 27	63 56
South ..	14·08	1,071 50	72 39
West ..	11·05	705 0	61 30
All ..	15·08	995 0	63 38

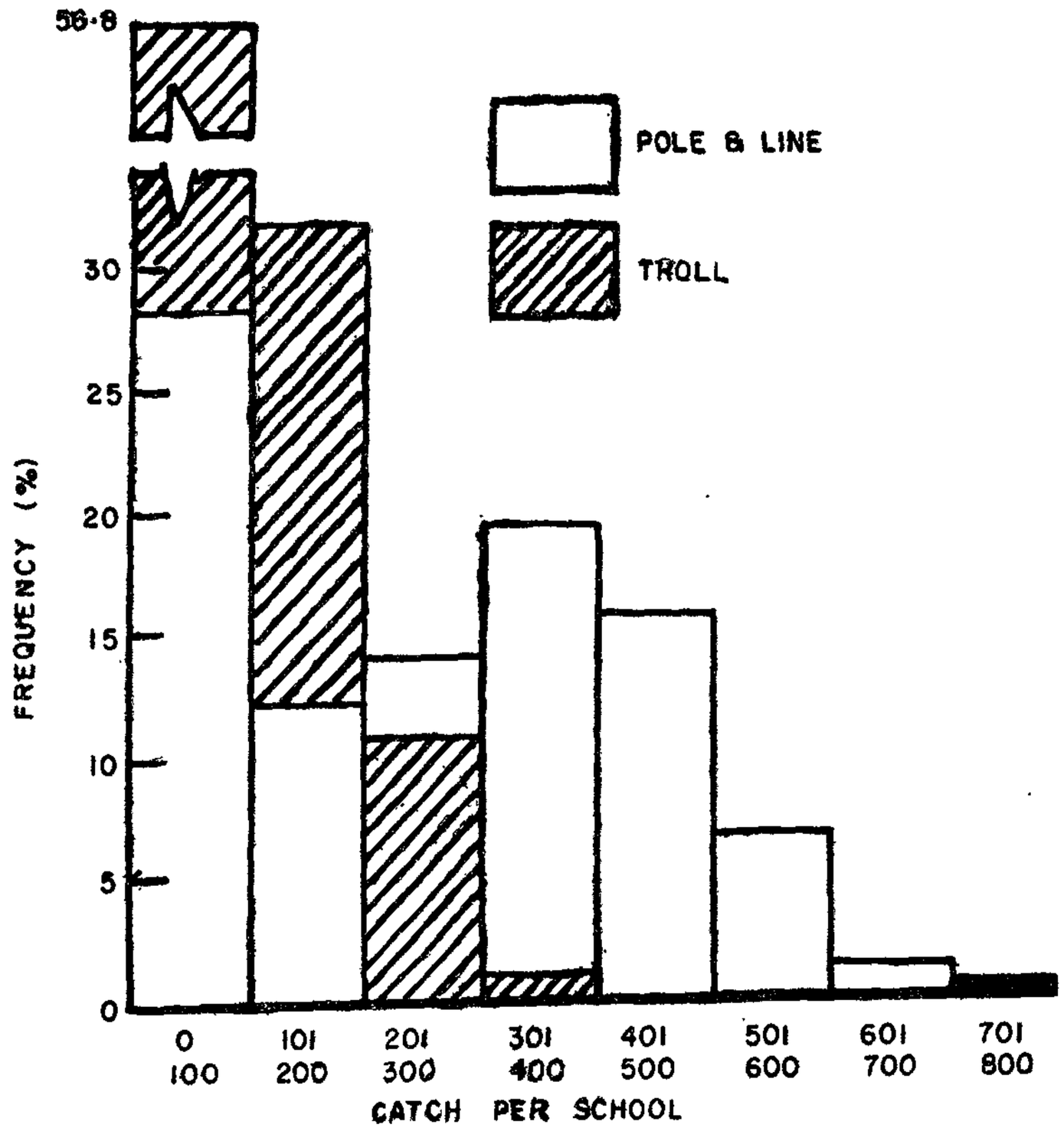

Fig. 9.--Frequency distribution of the number of tunas taken per school per operation, using the two popular methods.

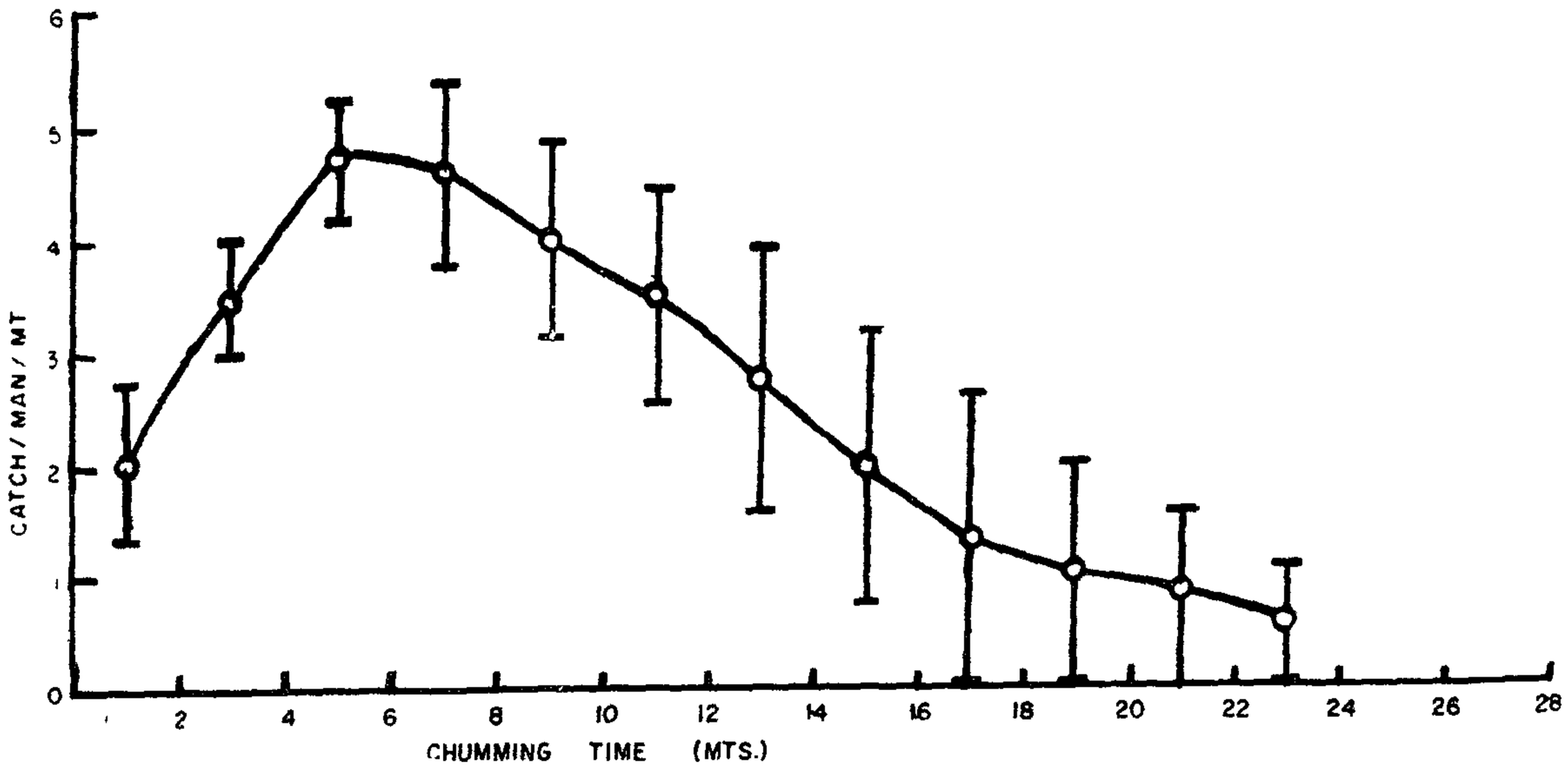

Fig. 10.—Relationship between catch rate and chumining time for the pole and line fishery in the coastal waters (95% confidence limit also given)

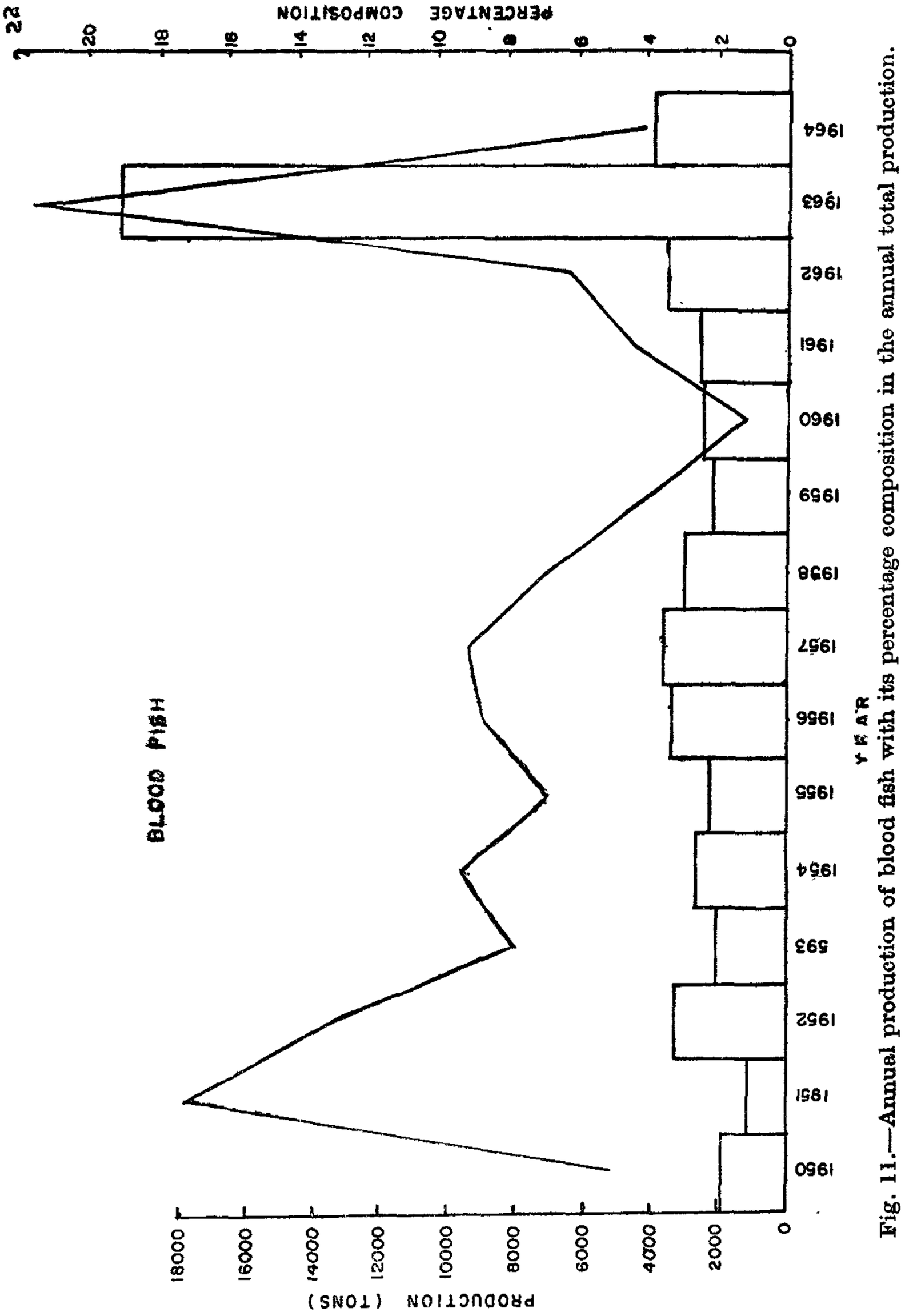

Fig. 11.—Annual production of blood fish with its percentage composition in the annual total production.

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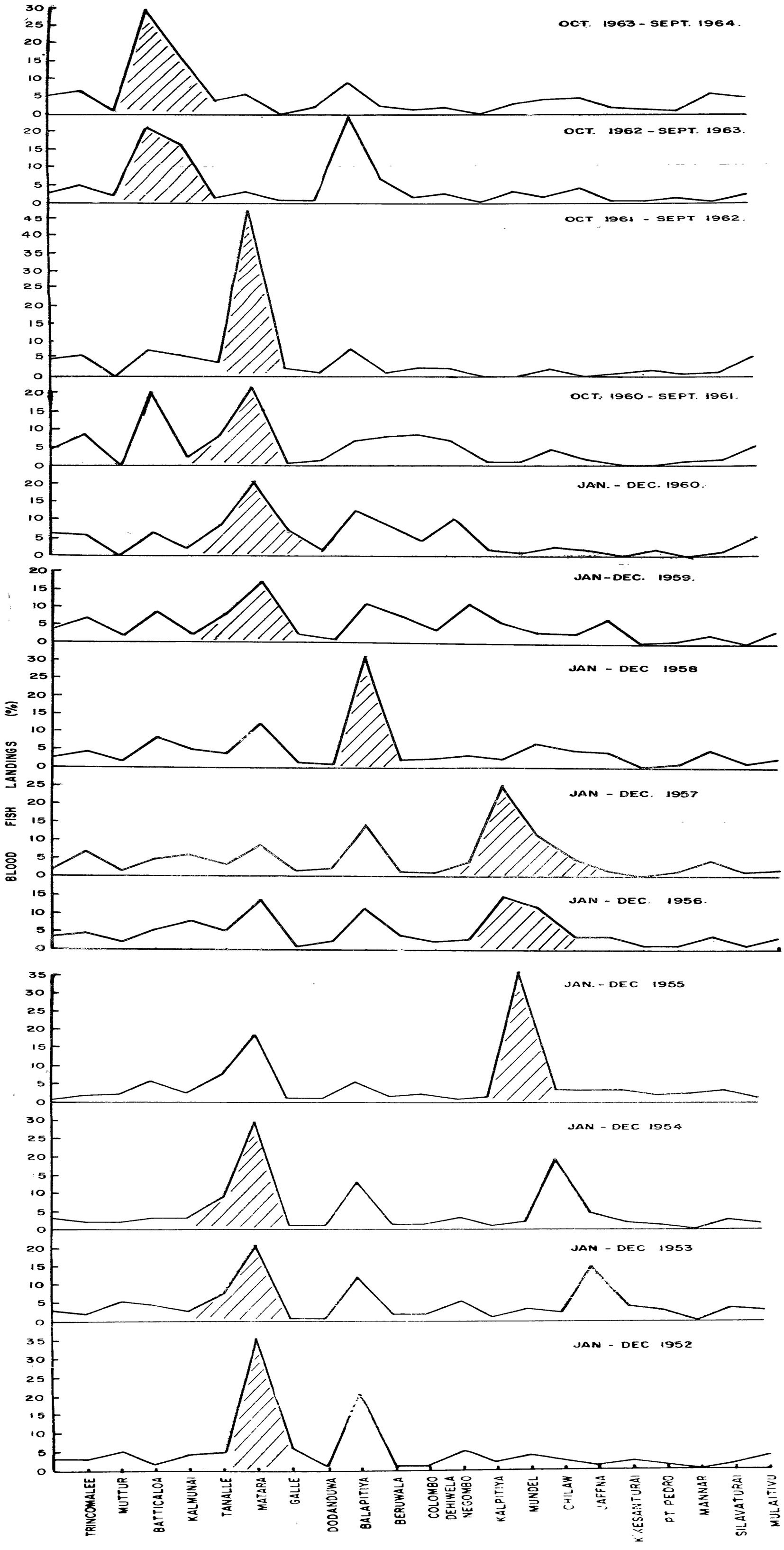

Fig. 12.—Annual blood fish production by area for the period 1952–64.