Reprinted from the Proceedings of the National Institute of Sciences of India, Vol. XVIII, No. 6, 1952.

A PRELIMINARY STUDY OF THE FISH POPULATIONS ALONG THE MALABAR COAST.[1]

By B. S. BHIMACHAR, *F.N.I., and* G. VENKATARAMAN, *Central Marine Fisheries Research Sub-Station, Calicut.*

(*Received July 1; read August 1, 1952*).

CONTENTS.

INTRODUCTION.

The study on the inshore fish population of the Malabar Coast was undertaken with a view to ascertaining the species of fishes occurring in the coastal waters, their relative intra- and inter-specific fluctuations at different times of the year, their sizes, sex proportions, maturity, life histories and their behaviour in relation to the biological and physico-chemical environment. It is intended to form an introduction to the detailed investigations on the biology and bionomics of individual species of food fishes of this coast. In this communication data collected by an analysis of weekly fish collections made for a year from April, 1949 to March, 1950 in the inshore area of the sea near West Hill along the Malabar Coast, together with a few tentative observations on them are presented. Not until the data on fish populations over a longer period are collected will it be possible to discuss in detail the various problems connected with this study and to draw such correlations as may exist between the behaviour of the fish stocks and the environmental factors.

Study of the fish populations on the lines mentioned above is a new aspect of fishery biology, in which the work of Warfel and Merriman (1944 and 1948) on the analysis of fish populations in the American waters deserves special mention. The methods and problems have been clearly stated by these authors, whose contributions form a good basis for further work and they have also been discussed in detail in the nine papers on 'A Symposium on Fish Populations' published in the Bulletin of the Bingham Oceanographic Collection (1948) and by Kesteven (1950). Day (1865), in his classical work on the 'Fishes of Malabar', has given a systematic account of the different species of this area. Chidambaram and Venkataraman (1946) and Devanesan and Chidambaram (1948) have given some facts relating to the natural history and economic aspects of some of the fishes of this coast. In a recent paper Kow (1950) has given some valuable information on the inshore fisheries of Singapore Straits.

[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, S. India.

Material and Methods.

For fish collections utilised in this study, two of the most common types of nets of this coast, namely, the boat seine (*Paithuvala*) and the gill net (*Chala vala*) were used. The fishing operation with each net was carried out once a week between 6 a.m. and 9 a.m.; the actual time taken for fishing was one-and-a-half hours. The composite catch for each net was brought to the laboratory for analysis.[1] The reason for using two nets for sampling the population is given on page 642. The boat used for fishing was the rowing dug-out canoe 30 feet long, 3 feet wide and 2½ feet deep, which is the most common boat used for commercial fishing operations along this coast. Four departmental fieldmen, who are expert fishermen, were engaged in fishing. Two canoes were used while operating the boat seine. In order to understand the significance of the use of two different types of nets it would be necessary to give a brief description of the nets used.

The boat seine (*Paithuvala*) is a flat conical cotton net, 25 feet long, the hinder portion of which is a wide-mouthed bag. The bag portion of the net is 12 feet long and tapers backwards to the cod end and widens anteriorly where it opens by a wide mouth. The mesh at the anterior portion of the bag is ¼″ bar and at the cod end it is $\frac{1}{6}$″ bar. The floor of the bag extends forwards into a wide platform 13 feet long and 40 feet wide at the anterior margin. The mesh of the platform portion is ½″ bar. When the net is operated the sides of this platform are lifted up which drive the fish into the bag. To the front margin of the net is attached wide meshed coir netting as two tapering wings each 24 feet long. To the tapering anterior ends of these are fastened long ropes with which the net is dragged from the two boats. When the net is shot the mouth of the bag is opened by floats fastened to the head rope. On the foot rope of the coir wings are tied weights to sink the net. The net can be operated at any depth by adjusting the floats and weights.

To begin with the two boats are brought close to each other and half the net is taken in each boat. Then the boats are rowed and as they diverge from each other the net is shot from both the boats and when the end of the warp is reached, it is tied to one of the cross planks of the boat and the crew row the boats fast dragging the net at the required level. The net is hauled by drawing the warps. By the time the cod end of the net is drawn the two boats would have come close to each other. The fish caught are then transferred to the boat. The net is shot and hauled again in the same manner. Nets of more or less the same design but of bigger dimensions are used in commercial fishing along the coast.

The gill net used is locally called *Mathi chala vala*. It is a flat rectangular cotton net 50 feet long and 15 feet broad with mesh size $\frac{5}{8}$″ bar. Seven such pieces are laced together end to end. It is a floating net; floats are provided on the head rope and light weights on the foot rope at regular intervals and the net is shot in straight line. After the scheduled time the net is hauled and the gilled fishes removed from the net.

The weekly collections of fish brought to the laboratory were analysed for species, total weight, weight of individual species, their sizes, and sex proportions, wherever possible. The post-larvae which were obtained in large numbers during certain months were also studied in detail by another team. Each day a few specimens were examined in detail for stomach contents, gonad condition, etc., Total measurement of fish from the tip of the snout or the lower jaw whichever is longer to the end of the caudal fin, where the longer fluke is brought in alignment with the long axis of the body if the caudal fin is forked, was taken and recorded in millimetres. The other forms such as prawns, crabs, cuttle-fishes, *Squilla* and jelly fishes collected in the fishing nets and which along with the fishes form the biota of the inshore area were also analysed and recorded. The data for each day

[1] Analyses of individual fish hauls have been carried out in subsequent years.

were tabulated and recorded together with details of conditions of the sea and weather and records of salinity and temperature.

As a result of the discussion which followed the reading of this paper at the Indo-Pacific Fisheries Council Meeting held at Madras during February 1951, it was suggested that studies be made on the variability of the catches taken from various populations by certain methods and under specific conditions and that coefficients of variability be calculated in respect of certain factors as a means of selecting the most significant method for prolonged study. Based on this suggestion, a detailed programme of sampling the population with the method described in this paper was formulated and carried out during 1951-52. For purpose of taking the samples the inshore area was arbitrarily divided into 3 zones, namely 2, 4 and 6 fathom zones. In each zone 3 samples were taken at a time. The two nets, the boat seine and the gill net, were operated simultaneously for 15 minutes at each station. The collections were made between 6 a.m. and 10 a.m. and the fishing effort was constant throughout the period of this study. The 18 samples taken on each occasion were brought to the laboratory and analysed separately for total weight, species, weight and number of individual species, their sizes, etc.

The data collected so far in this study have shown that while there was some variability between the samples taken in the different zones in respect of species, their numbers and total weights, the successive hauls taken in one and the same zone tended to be almost similar to one another in all respects, variations between them being practically negligible. The variability between the replicate hauls taken in the same zone was not significant. This clearly indicates that the method of sampling the population used in this study can be relied upon to give satisfactory results in such studies.

Locality.—The fish samples were taken in the inshore area between two and four fathom lines near West Hill (Lat. 11° 17′ N., Long. 75° 46′ E.). The four fathom line is about two miles from the shore. This area is an open sea and is the eastern border of the Laccadive Sea. The coast line is straight. The sea is very calm except during June, July and August which is the period of South-West Monsoon. The sea bottom which is composed of soft clay is stirred up during the early part of the monsoon and settles down soon after.

Analysis of fishes and other animals.

51,700 specimens of fishes were collected during the year which belong to 14 orders, 37 families, 57 genera and 85 species, a list of which is given in Appendix 1. Appendix 2 gives monthly totals of the number of each species caught by the two nets. Those species which were represented by less than 10 specimens for the whole year are collectively included in the column—Other species.

A brief account of the important species which occurred commonly during the year is given below with special reference to their numbers, sizes and seasonal fluctuations.

Clupeidae.

The most abundant clupeids occurring in the inshore area during the year were *Kowala coval*, *Opisthopterus tardoore*, *Sardinella fimbriata* and *Pellona ditchoa*.

Fig. 1[1] shows the variation in abundance of *Kowala coval*, *Sardinella fimbriata* and *S. longiceps* during different parts of the year. All these species taken as a whole appeared abundantly during October, November and December and to a smaller degree in April-May. *Kowala coval*, popularly known as the white sardine was one of the most common species occurring in the inshore area. The peak of

[1] In figures 1 to 8 specimens less than 5 in number have been omitted.

occurrence was during the months of October and November. Specimens of size range 9·5 to 11·5 cms. with a narrow modal size range of 10 to 10·5 cms.

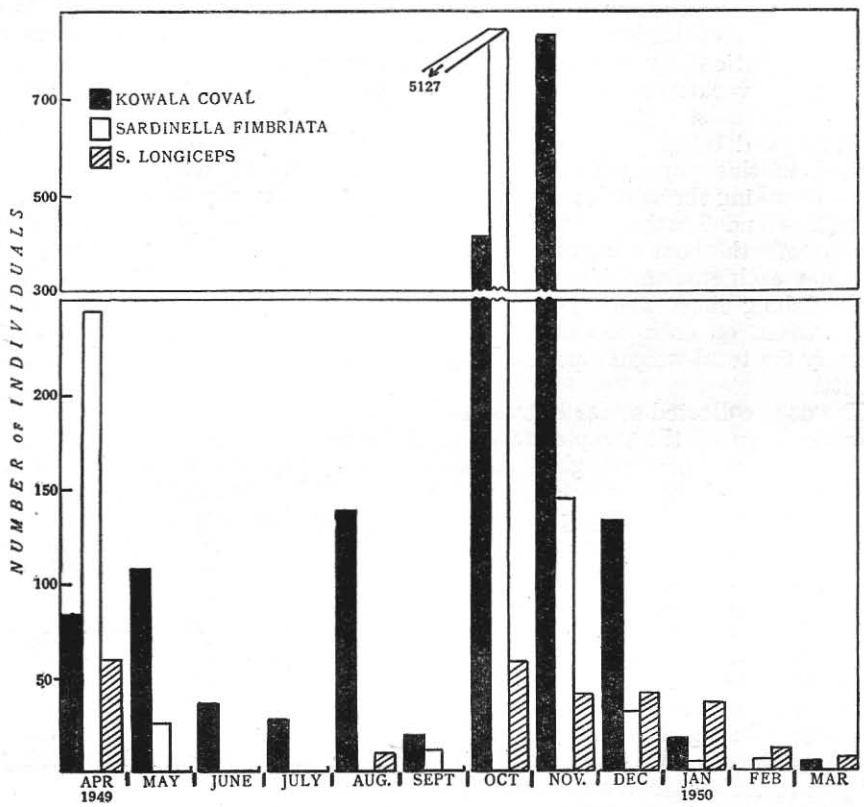

FIG. 1. Variation in abundance of *Kowala coval*, *Sardinella fimbriata* and *Sardinella longiceps*.

were obtained. *Sardinella fimbriata* occurred in April and May and again from September to December and was conspicuously absent during June, July and August with an exception of 3 specimens obtained in the third week of June. During the months of January, February and March, 1950 also, its catches were poor. Though it occupies third rank in the total abundance of all species, the high numerical value of this species is not due to its relative abundance but its chance occurrence of 5,086 specimens obtained on 13th October, 1949. Specimens of size range 9·4 to 17·1 cms. with a modal size range of 12·5 to 14 cms. were obtained in the gill net. The catches of this species in the boat seine were negligible. *Sardinella longiceps*, the oil sardine, commercially a very important fish of this coast, was scarce in the inshore catches. As this fish occurs in shoals the few specimens caught at irregular intervals may be regarded as stragglers into the inshore area. The fishery of the oil sardine beyond the region of the sampling area was fairly good during the year as was observed from the commercial catches. Specimens of size range 11 to 19 cms. with a modal size range of 13 to 15·5 cms. were obtained in the gill net. *Sardinella albella* was insignificant in the collections. Specimens of size range 12–17 cms. with a modal size range of 14 to 15 cms. were obtained.

Fig. 2 indicates the variation in abundance of a few more clupeids, *Opisthopterus tardoore*, *Dussumieria hasselti*, and *Pellona ditchoa*. Of these the

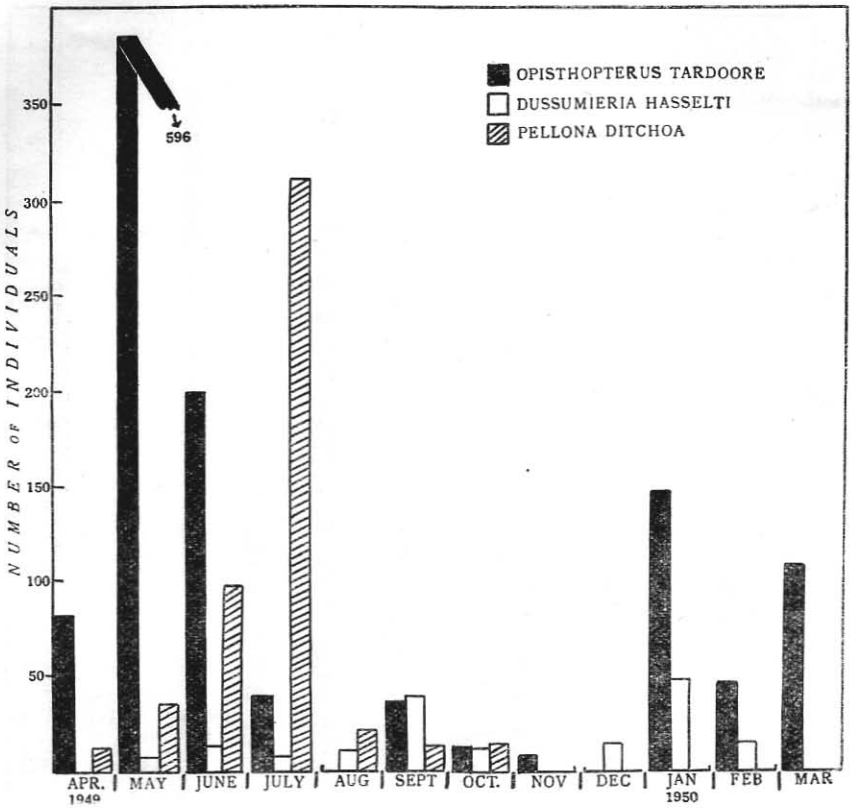

FIG. 2. Variation in abundance of *Opisthopterus tardoore*, *Dussumieria hasselti* and *Pellona ditchoa*.

most conspicuous species was *Opisthopterus tardoore*. This species occurred in fair abundance from April to July, 1949 and again to a smaller degree from January to March, 1950. The modal size of this species in the boat seine catches showed considerable fluctuation. The size range of the specimens caught in the gill net was 8 to 20 cms. and their modal size ranged from 10 to 13 cms. *Pellona ditchoa* occurred in good numbers during June and July. They were scarce in the gill net collections. Specimens of size range 5 to 7·5 cms., excluding the post-larvae, were frequently obtained in the boat seine. *Anodontostoma chacunda* was insignificant in the collections. It occurred in small numbers from April to September, 1949 and again in March, 1950. *Dussumieria hasselti* which occurs in considerable numbers during certain years was represented by very few specimens during the year under consideration.

ENGRAULIDAE.

This family was represented by five species of *Thrissocles* and four species of *Anchoviella*.

Fig. 3 shows the relative abundance of three species of *Thrissocles*, *T. mystax*, *T. malabaricus*, and *T. purava*. Of these the most dominant species

was *T. mystax* which was numerically 88·9 per cent of these anchovies. This species had two periods of dominance, one from April to August, 1949 when they

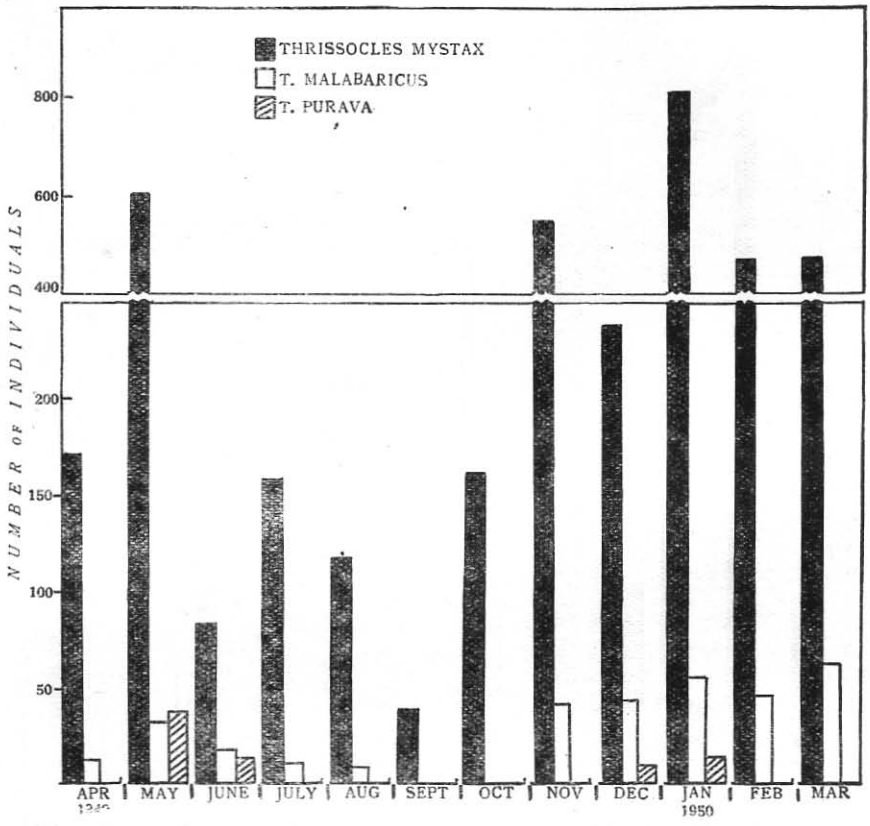

FIG. 3. Variation in abundance of *Thrissocles mystax*, *T. malabaricus* and *T. purava*.

were caught mostly in the boat seine with smaller modal size range 5 to 9·5 cms. excluding the post-larvae and the other from November, 1949 to March, 1950. During the latter period the fishery was both abundant and steady. Mostly large sized specimens with a modal size range 13·5 to 15·5 cms. were caught in the gill net. The catches in the boat seine during this period were insignificant. *T. malabaricus* was caught in limited numbers and followed the same pattern of occurrence as *T. mystax*. The other three species were insignificant. Only 4 specimens of *T. dussumieri* were caught during the year.

Fig. 4 represents variation in the occurrence of three species of *Anchoviella* popularly known as whitebaits. The species *A. tri* and *A. heterolobus* constitute a rich fishery along the Malabar coast during the rainy months from June to October when generally the other major fisheries are poor. *A. tri* was one of the abundant and common fish contributing considerably to the richness of the inshore fishery. It was present all through the year except in March but the peak of abundance was from June to September. The abundant but discontinuous catches particularly during the peak season indicate the behaviour pattern of this species namely the sudden incursion and the equally abrupt excursion of the shoals into and from the inshore area. The mean size ranged from 5·7 to 8·3 cms. excluding the post-larvae and the catches were mostly confined to the boat seine. The fishery of

A. heterolobus was less important compared with that of *A. tri.* It occurred in October, 1949 and again from December, 1949 to February, 1950. Its high numeri-

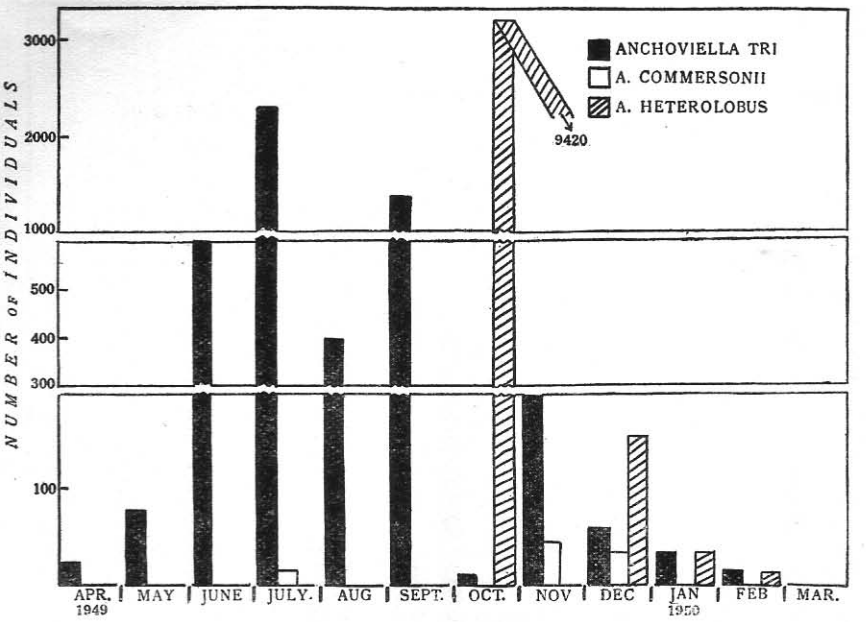

FIG. 4. Variation in abundance of *Anchoviella tri, A. commersonii* and *A. heterolobus.*

cal rank was only due to a heavy catch of 9,420 specimens during the last week of October. Specimens of size range 6·2 to 10·1 cms. excluding the post-larvae with a modal size range 7 to 8·5 cms. were obtained. *A. commersonii* was caught in limited numbers during November-December. Only 5 specimens of *A. indica* were caught during the first week of September.

LACTARIDAE.

Lactarius lactarius popularly known as big-jawed jumper occurred intermittently throughout the year in small numbers. It was dominant in the catches during June and July (Fig. 5). The size range of the specimens in the gill net was 8·5 to 18 cms. with a modal size range of 11 to 14 cms. whereas the size range of those caught in the boat seine was 5 to 12 cms. excluding the post-larvae with a modal size range 6 to 9·5 cms. Except that it occurs in small numbers along with other species of fish *Lactarius lactarius* does not form a fishery as such along the Malabar Coast. But further south along the west coast in Travancore this species contributes to a rich fishery with larger sized fish.

CARANGIDAE

Eight species of this family were recorded during the year of which two species—*Caranx kalla* and *C. djedaba* occurred at frequent intervals.

The variation in abundance of *C. kalla* and *C. djedaba* is shown in fig. 5. *Caranx kalla* occurred from April to July and again from the end of September, 1949 to March, 1950. The size of the specimens ranged from 8 to 13 cms. with a

modal range of 9 to 11 cms. They were caught mostly in the gill net. *C. djedaba* was a minor fish in the inshore area and occurred in April and May, 1949 and from

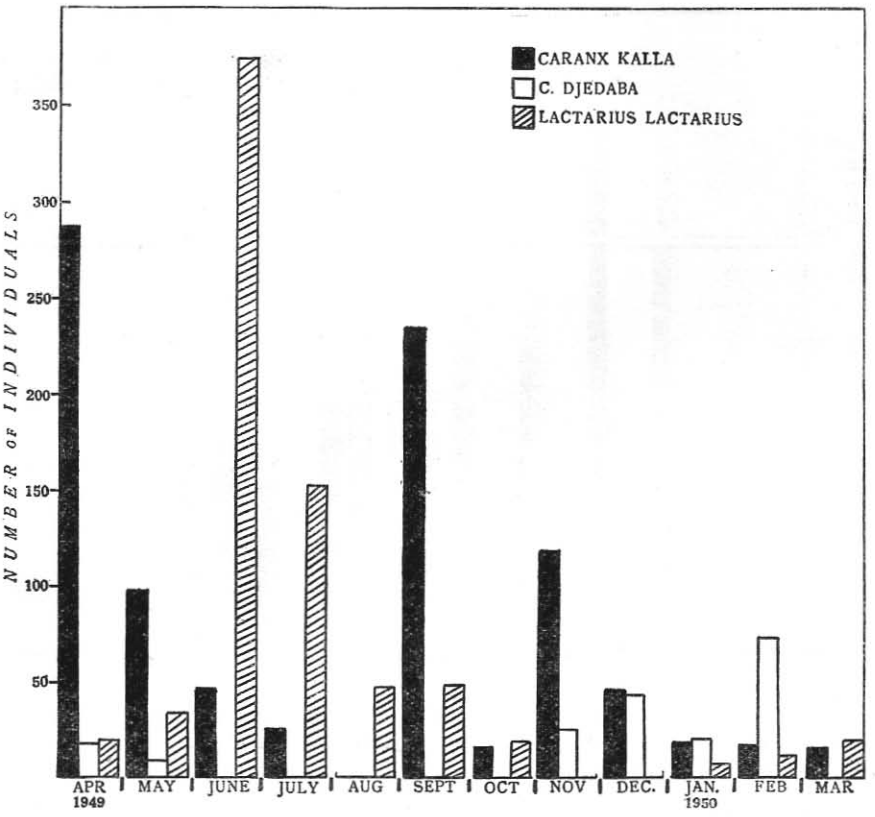

FIG. 5. Variation in abundance of *Caranx kalla*, *C. djedaba* and *Lactarius lactarius*.

November, 1949 to March, 1950, with a size range 7 to 14·5 cms. and a modal size range 8 to 10 cms.

LEIOGNATHIDAE

This family was represented by six species of *Leiognathus*, *L. splendens*, *L. insidiator*, *L. blochi*, *L. ruconius*, *L. equulus* and *L. bindus*, popularly known as silver bellies, and *Gazza minuta* and *Gerres punctatus*. Of these *L. splendens*, was the dominant species, while fair numbers of *L. insidiator*, *L. blochi* and *L. ruconius* were also obtained. All these species considered as a whole appeared abundantly and more or less steadily from June to October, 1949 (Fig. 6). From the trend of the commercial fisheries at Calicut it was observed that the silver bellies formed a dominant fishery during the same period. The regression in abundance during the latter half of August is attributed to the occurrence of 'red water' in the area during the period.

Leiognathus splendens ranked first among the silver bellies (Fig. 6). This species was seasonal in occurrence being abundant from the last week of June to the middle of September. The size ranged from 5 to 11·5 cms. excluding the post-larvae, with a modal size range 6·5 to 8 cms. *L. insidiator* occurred in fair numbers

during September and October. *L. blochi* was also collected in fair numbers in June and again in September and October. Though the fishery of *L. ruconius*

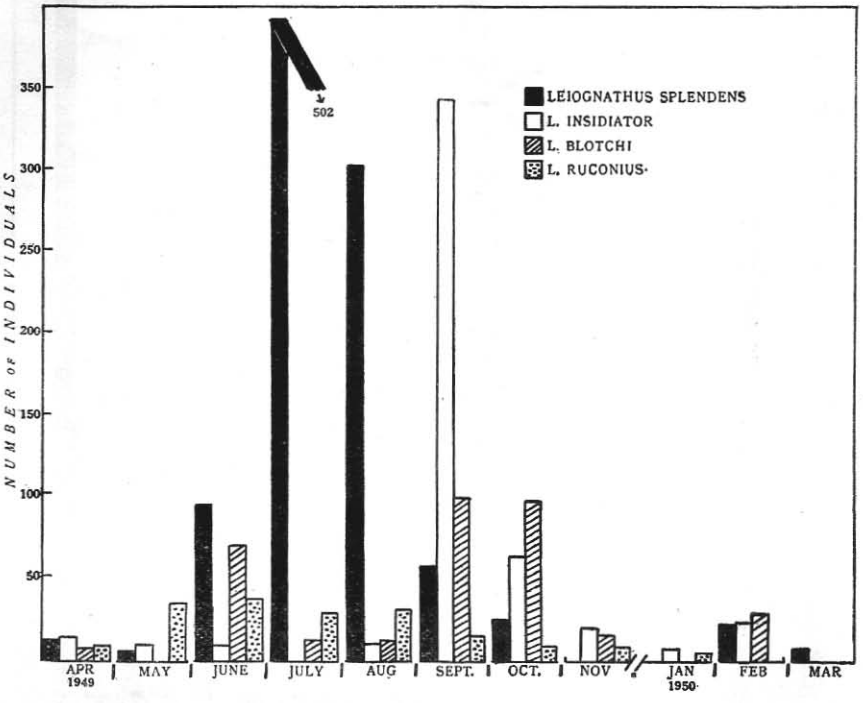

FIG. 6. Variation in abundance of *Leiognathus splendens*, *L. insidiator*, *L. blochi* and *L. ruconius*.

NOTE.—The authors regret that *L. Blochi* is wrongly spelt in the figure.

and *L. bindus* have been noticed to be rich in certain years they occupied a low rank during the year under consideration. As is usual with the fishery of silver bellies it was poor during April-May and from November, 1949 to March, 1950.

SCIAENIDAE.

Family Sciaenidae was represented by *Pseudosciaena sina*, *Johnius belengeri*, *Otolithes ruber*, *O. argenteus* and doubtful species of *Pseudosciaena*. The pattern of occurrence of the members of this family is very different from that of other groups of fishes. The Sciaenids are particularly dominant from January to July when other fisheries are generally poor. They are very poorly represented from August to December. They were caught mostly in the boat seine.

Pseudosciaena sina occurred in good numbers during April and May, 1949 and again in fairly large numbers in March, 1950. (Fig. 7). The trend of occurrence of *Johnius belengeri* was the same as that of *P. sina*. They were similar in sizes also. The size ranged from 5 to 17 cms. excluding the post-larvae. *Otolithes ruber* was dominant in the catches from April to August, 1949 and again in March, 1950. The size ranged from 5 to 21 cms. excluding the post-larvae. Except for two weeks, one in April and another in October, when *O. argenteus* was collected in fair numbers this species was insignificant during the rest of the year.

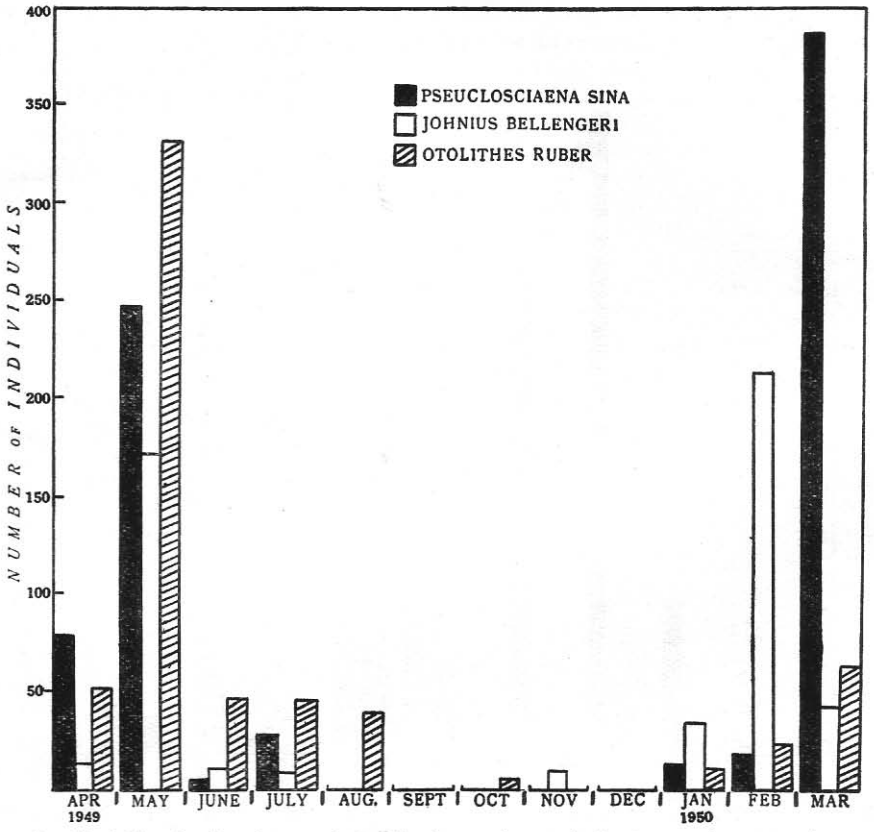

FIG. 7. Variation in abundance of *Pseudosciaena sina*, *Johnius belengeri* and *Otolithes ruber*. (NOTE.—The authors regret that *Pseudosciaena sina* and *Johnius belengeri* are wrongly spelt in the figure.)

SOLEIDAE.

Solea ovata indicated a very restricted occurrence. (Fig. 8.) It appeared in the catches in appreciable numbers in August and again in the second week of October. The size of the specimens ranged from 6 to 8·7 cms.

CYNOGLOSSIDAE.

This family was represented by *Cynoglossus semifasciatus*, *C. dubius* and *C. puncticeps* of which *C. semifasciatus* contributed to a rich fishery in the inshore area and appeared in large numbers while the other two species were practically insignificant in the catches.

The variation in abundance of *Cynoglossus semifasciatus* is shown in fig. 8. This species, which is popularly known as the Malabar sole was the most persistent and abundant fish of the inshore area constituting 21 per cent of the total fish catch for the year. It was caught mostly in the boat seine. The Malabar sole appeared in fair numbers in April and early part of May after which its number diminished in the catches till October. October recorded very heavy catches of this fish and again there was a regression in its occurrence till January, 1950. From January to March the catches were abundant and steady. The pattern of its occurrence in the departmental catches was similar to that of the commercial fishery of the Malabar sole along this coast. From January to March there was practically a

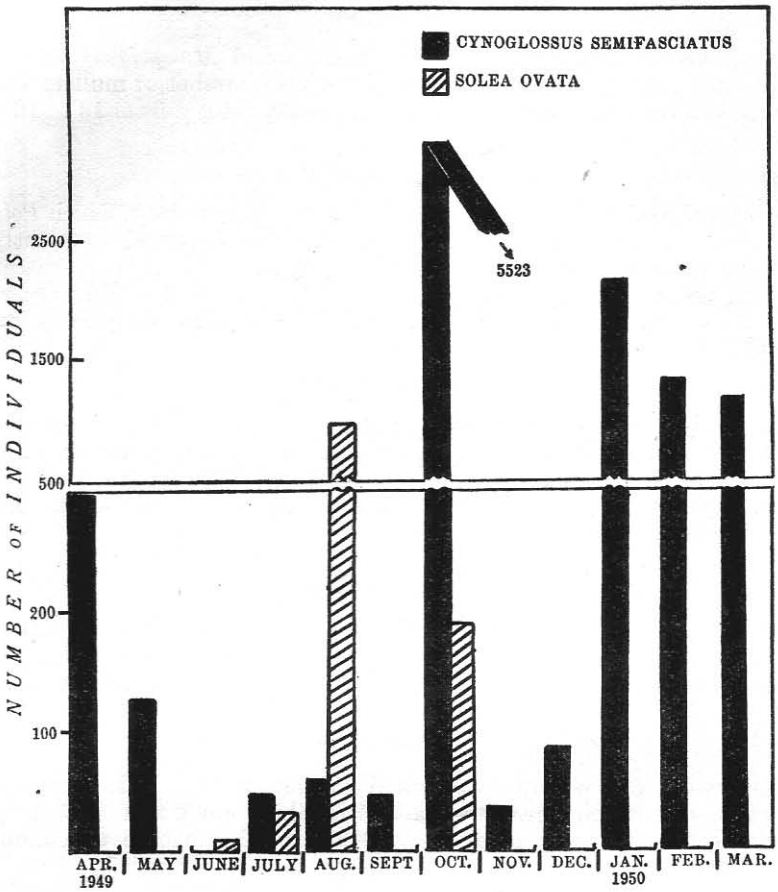

FIG. 8. Variation in abundance of *Cynoglossus semifasciatus* and *Solea ovata*.

continuous recruitment of juvenile forms of this species into the inshore fishery. The size of specimens ranged from 5 to 15 cms. excluding the post-larvae with a modal size range of 7 to 11·5 cms.

CARCHARHINIDAE.

Three species of this family were recorded of which *Scoliodon sorrakowah* was prominent in the collections. 188 specimens of this fish were obtained at wide intervals. But they were represented in the collections continuously from January to March, 1950, in limited numbers. Only juvenile specimens with size range 11 to 30 cms. were generally caught in the inshore area.

ARIIDAE.

Two species of this family *Tachysurus dussumieri* and *Osteogeneiosus militaris* were recorded, of which the latter was more abundant during the year. A total of 443 specimens was obtained mostly in the boat seine. The size ranges for *Tachysurus dussumieri* were 5 to 10·9 cms. and those for *O. militaris* were generally from 5 to 11·5 cms.

Mugilidae

Two species of Mugilidae, *Mugil longimanus* and *M. speigleri* were recorded, of which the latter was more abundant. The total number of mullets obtained in the catches was relatively poor. The sizes generally ranged from 13 to 16 cms.

Polynemidae

Three species of this family were present in the collections of which *Polydactylus heptadactylus* was the most common. The fish was obtained frequently in the inshore collections the total number caught being 529. It showed a discontinuous distribution and was more abundant in the boat-seine hauls. The size ranges of the specimens were from 5 to 10·5 cms. in the boat seine samples excluding the post-larvae.

Centropomidae

This family was represented by a single species, viz. *Ambassis gymnocephalus*. It is a very common perch of this region and was present in 45 out of 52 weeks. This small fish, though unimportant as a food fish, richly supported the inshore fishery throughout the year. It was caught mostly in the boat seine. The modal size fluctuated from 5 to 7·5 cms.

Trichiuridae

This family was represented by *Trichiurus haumela* which is an important fish of this coast. It was present abundantly during September and October, 1949. Specimens of size range from 12 to 52 cms. were obtained in the collections.

Scombridae

This family was poorly represented in the catches. The mackerel, *Rastrelliger kanagurta*, which contributes to a rich fishery along this coast in 8 fathoms area and beyond was very poorly represented in the inshore collections. Only eight specimens were obtained for the entire year.

Cybiidae

This family was represented by two species, *Scomberomorus commerson* and *Scomberomorus guttatus*. They were scarce in the collections, the total number obtained being 31 and 44 respectively. They were all small sized, their maximum length not exceeding 28 cms.

Prawns and Crabs.

TABLE 1.

The weight of prawns in pounds and the number of crabs caught in the fishing nets during different months of the year.

Months.	Apr. 1949	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1950	Feb.	Mar.
Prawns, wt. in pounds ..	21·2	28·0	2·2	4·2	7·0	Nil	·2	·1	·9	37·1	38·0	51·7
Crabs, Nos. ..	171	257	2	14	4	Nil	3	Nil	5	123	112	85

Prawns and crabs formed a considerable part of the catches especially in the boat-seine. Table 1 shows the weight of prawns in pounds and the total number of crabs caught during the twelve months. Both prawns and crabs occurred abundantly for five months, April and May, 1949 and from January through March, 1950. During the other seven months they were practically absent except for stray specimens. The species of prawns caught were *Parapenaeopsis stylifera*, *Metapenaeus dobsoni*, *M. affinis* and *Penaeus indicus* in the order of abundance. It may be mentioned here that good quantities of a small shrimp, *Acetes dispar*, which forms a favourite food of several species of fishes in the inshore area, were caught in the boat seine during the hot months, March, April and May. When this shrimp is caught in large quantities it is utilised as food by the people of this coast.

The species of crabs obtained in the collections were *Neptunus sanguinolentus*, *N. pelagicus* and *Charybdis natator*. Of these *N. sanguinolentus* was the most abundant species.

Animals which have no economic value.

TABLE 2.

The number of other animals caught in the fishing net during the different months of the year.

Months.	Sea anemone.	*Squilla.*	*Cavernularia.*	*Sepia.*	*Loligo.*	Jelly fish.	Ctenophore.
Apr., 1949	242	66	81	33	3	..	..
May ,, ..	..	41	36	20	2	26	..
June ,, ..	..	..	..	..	..	..	..
July ,, ..	..	..	4	..	38	1	..
Aug. ,, ..	..	..	..	..	5	..	..
Sept. ,, ..	..	..	..	..	8	..	..
Oct. ,, ..	..	..	..	..	..	..	..
Nov. ,, ..	..	..	4	..	..	..	..
Dec. ,, ..	..	..	..	..	..	..	Plenty.
Jan., 1950	1	9	15	..	5	3	Plenty.
Feb. ,, ..	1	19	317	..	7	3	..
Mar. ,, ..	..	57	59	41	12	..	..

Other animals such as the sea anemone, *Squilla*, *Cavernularia*, *Sepia*, *Loligo*[1] and a Ctenophore (*Pleurobrachia sp.*) caught in the fishing net have no economic value. They were mostly caught in the boat seine and occurred in fair numbers, as shown in Table 2 during the months, April and May of 1949 and January, February and March of 1950. Except for *Loligo*, they are practically absent during the other months. The occurrence of large numbers of sea anemones in the inshore area during April, 1949 is interesting. They must have been uprooted from their habitat elsewhere and come to the inshore area along the currents. During December and January a large number of ctenophores were caught in the boat seine. These elements seem to dominate in the inshore area during the months when prawns and crabs are caught abundantly. The only two uneconomical fish caught occasionally were the species of *Triacanthus* and *Tetraodon*.

Post-larvae and immature fishes.

Post-larvae of several species of fishes occurred in the boat seine collections in considerable numbers during April, May, June and December of 1949 and

[1] *Loligo* which is utilised elsewhere, is not generally used as food along the Malabar Coast.

January, February and March, 1950 and the peak month of their occurrence was March. Those caught in appreciable numbers were the post-larvae of *Kowala coval, Pellona ditchoa, Opisthopterus tardoore, Anchoviella tri, Thrissocles mystax, Polynemus spp., Ambassis gymnocephalus, Lactarius lactarius, Pomadasys hasta, Chorinemus tala, Leiognathus blochi, L. insidiator, L. ruconius, L. splendens, Pseudosciaena sina, Johnius belengeri, Otolithes ruber, Cynoglossus semifasciatus* and *Solea ovata*. There was considerable variation in the numbers of the post-larvae of these fishes and the period over which they occurred in the inshore area. Amongst the forms mentioned above, *Opisthopterus tardoore, Thrissocles mystax, Leiognathus splendens* and *Ambassis gymnocephalus* appeared in abundance during the peak season. Some species like *Megalops cyprinoides, Mene maculata, Scatophagus argus, Epihippus orbis, Epinopholus diacanthus, Lutjanus argentimaculatus* and *Lutjanus marginatus*, were caught only in the post-larval stage and the later stages of these species did not occur in the inshore area. It is significant that the post-larval stages of the mackerel, *Rastrelliger kanagurta* and the oil sardine, *Sardinella longiceps*, the two commercially important fishes of this coast, were completely absent in the departmental catches.

Species like *Scoliodon sorrakowah, S. palasorrah, S. walbeehmi, Scomberomorus guttatus, Tachysurus dussumieri, Chorinemus tala* and *Parastromateus niger* which form rich fisheries beyond the 6 fathom area along this coast, occurred in the inshore region only in their juvenile stages.

Some Aspects of Physical and Biological Environment.

Physical environment.

Fig. 9 shows the monthly average salinity and temperature readings for the year. The range in salinity was from 26·4‰ to 36·1‰. During the summer months of April and May the salinity reading was high. There was a sharp fall in salinity with the commencement of the South-West monsoon in June. From July to October it indicated an upward trend after which it was more or less steady till the end of the period ranging from 33·35‰ to 35·66‰.

During April and May the average water temperature was 30·02°C. There was a lowering of the temperature after the commencement of the monsoon and it continued to be low during July, August and September with an average of 26·49°C. The temperature rose up to 28·87°C. in November and there was again a slight fall in December and January after which there was an upward trend showing a reading of 28·66°C. in February and 30·20°C. in March.

There seems to be a definite relationship between the salinity values and the extent of fish catches. During June, July and August salinity not only showed a lower value but fluctuated considerably from week to week. During this period the fish catches were also poor. The fish catches improved considerably in the months of September and October when it is seen that there is a rise in the salinity reading. With the steadiness in higher salinity value from the middle of November there is a correspondingly uniform good fish catches.

There does not seem to be any perceptible relationship between the temperature readings and the fish catches. Perhaps when data on these are available for a few years it may be possible to find out if temperature has any relation to the behaviour of the fish populations. Both salinity and temperature readings do not give any indication as to why there was lesser number of species of fishes during the months of October, November and December (vide Table 3).

Rainfall.—The total rainfall at Calicut for the different months is shown in fig. 9. The heavy rainfall along the West Coast is one of the factors which affect the physico-chemical condition of the coastal waters. The total rainfall at Calicut during the year under consideration was 129·19 inches and it was spread

over 33 weeks. Unusually there were a few good rains during April, 1949. The heaviest rainfall in the year was during the months of May, June and July.

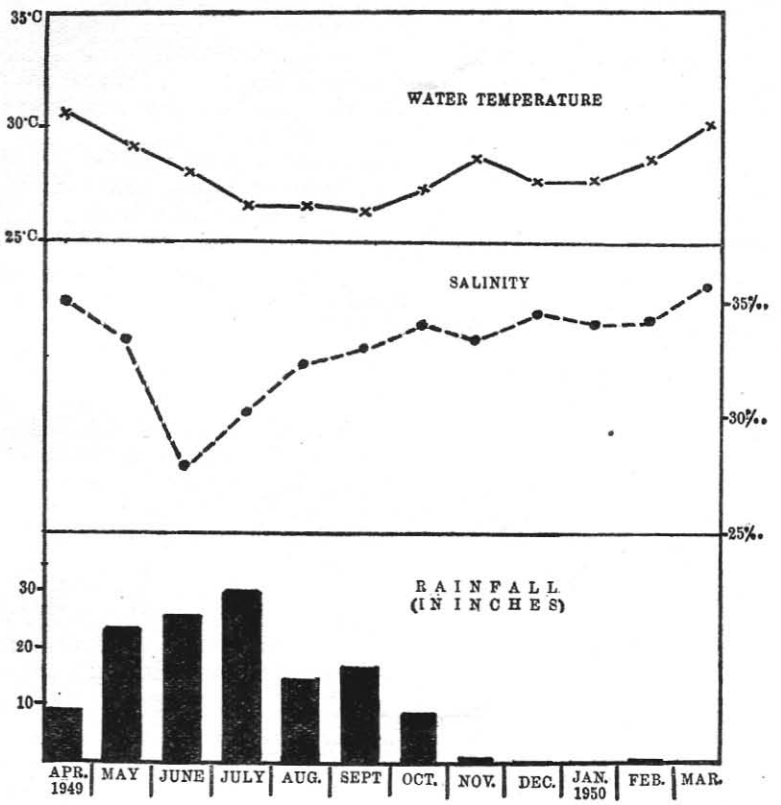

FIG. 9. Average monthly water temperature and salinity and monthly total rainfall.

Turbidity and light conditions.—From the records maintained on the weather condition such as the sky being cloudy, foggy, clear, etc., there does not seem to be any relationship between variations in these factors and the fish catches. The water was slightly turbid, turbid or very turbid during 37 weeks and it was clear or very clear on 14 weeks of the year. For two weeks in June at the period of commencement of the South-West monsoon the bottom clay had been stirred up resulting in the extreme turbidity of water, almost to the extent of forming a slush, when, the fish catches were very low. The condition of water from November to March was either slightly turbid or turbid and the fish catches during these months were uniformly good. The fish catches were normally low on days when the water was clear.

Currents.—It has not been possible to correlate the fish catches with the currents as there is no precise knowledge of sea currents along this coast. The nature of the tidal currents has, however, been noted for different dates. The rising tidal current is roughly from north to south and the falling tidal current is from South to North. The rising tides have generally shown a tendency towards higher catches when other adverse factors have not intervened.

Biological environment.

The quantity of edible plankton available in the inshore waters was moderate during April and May though appreciably better in the latter month. There was a marked decline in the zooplankton during the monsoon months. From the end of July to the end of December edible planktonic elements such as copepods, cladocerans, larval and adult pelagic polychaetes and larval bivalves occurred in large numbers except during about three weeks in August when there was a swarm of *Noctiluca*. From January to April the plankton was dominated by non-food elements such as medusae, chaetognaths and combjellies.

During the monsoon months the inshore sea bottom was practically devoid of animals, only occasional members of a few forms such as *Cavernulâria sp.*, *Lucina vesicula*, *Theora opalina* and a nemertine species occurring now and then. From September onwards there was a rapid colonisation of the mud bottom, chiefly by polychaetes and a phoronid species. The dominant member among these was *Prionospio pinnata* a polychaete of very high fish-food value. By November the bottom fauna had grown very rich and continued to be rich till April though there was a gradual decline in numbers.

While the fishery was poor during the monsoon months it recovered considerably from September onwards. The poverty of the monsoon fishery is correlated among other factors with the absence of fish food in the area. During the time of recovery of the fishery there was rich planktonic food available and the bottom fauna was also developing. During August and September, however, there was a depression in the fishery for some weeks and this was correlated with the abundance of *Noctiluca* and on some occasions with large swarms of *Nitzschia sigma* and a species of Chloromonadineae. Again there were good catches of fishes during October and November and the plankton food was also rich during this period. Recovery of the demersal fish *Cynoglossus semifasciatus* occurred from January onwards and this change could be correlated with the growth of polychaete and other soft bodied bottom animals in the area during that period.

General Observations.

A few general observations made during the course of this investigation are given below. Any conclusion drawn from these is tentative and will have to be confirmed by further study on the subject.

Sampling method.—Considerable difficulty was experienced in devising a suitable method for sampling the fish population for this study. If the population study was confined to a single species of fish it would have been comparatively easy to devise a sampling method as a gear best suited for the particular species could have been used. But to sample all the species in the area with varied sizes and habits was found to be very difficult. Different types of nets used along this coast were experimented in this connection and it was observed that each type of net proved to be selective both in respect of species of fishes and also the different sizes of one and the same species of fish. After a number of experimental trials, two nets, a boat seine and a gill net, were selected for taking out the fishes. While each of these nets was observed to be selective in certain respects, each proved to be complementary to the other; and the collections made by these nets together provided to be a reliable approximation of the condition of the population in the sea. Every precaution was taken to avoid any working error in the operation of the nets. The boat seine collected mostly the small sized species, bottom species, species with sluggish habit, smaller sizes and post-larval stages of shoaling species, prawns and others while the gill net caught mostly the large sized shoaling fishes.

To illustrate the selective nature of the two nets, the total number of ten species of fishes caught during the year with the two nets is given below.

No.	Species.	Number caught in Gill net.	Number caught in Boat seine.
1	*Sardinella fimbriata*	5,553	45
2	*S. longiceps*	258	9
3	*Kowala coval*	1,760	53
4	*Caranx kalla*	909	15
5	*Leiognathus blochi*	325	20
6	*Anchoviella heterolobus*	6	9,616
7	*A. tri*	16	5,068
8	*Cynoglossus semifasciatus*	700	10,132
9	*Ambassis gymnocephalus*	156	1,334
10	*Polydactylus heptadactylus*	38	491

The first five species were caught mostly in the gill net while the last five mostly in the boat seine. It is obvious from this that the use of only one net would have given an erroneous picture of the population in the sea.

Further, the size composition of the same species differs in the two nets as could be seen from below :

Period.	Species.	Gill net catch.			Boat seine catch.		
		No. of specimens.	Size range.	Mean size.	No. of specimens.	Size range.	Mean size.
Fourth week of June, 1949 ..	*Lactarius lactarius.*	89	86–183 mm.	126·43 ± ·23 mm.	251	54–105 mm.	75·66 ± ·65 mm.
Second week of March, 1950	*Thrissocles mystax.*	73	64–185 mm.	152·38 ± ·10 mm.	25	51–70 mm.	56·56 ± ·12 mm.

From the above it is clear that at the same period different sizes of the same species were caught in the two nets. This was generally true of several other species also. Mean size and standard deviation calculated for any species would therefore be applicable only to the fish caught in any particular net and not to its population in the sea. It is for this reason that a detailed discussion on the size frequency factor of the various species of fishes has not been attempted in this paper.

Major groups.—The fishes collected in the inshore area can broadly be grouped into Clupeoids, Pleuronectids, Leiognathids, Sciaenids and Carangids which together formed 91·6 per cent and the miscellaneous fishes consisting of other species constituted 8·4 per cent of the total number of fish caught. The number of fish included under each group and its percentage in the total number are given below:

	Total number.	Percentage in total number.
Clupeoids	29,142	56·4
Pleuronectids	12,093	23·4
Leiognathids	2,116	4·1
Sciaenids	2,038	3·9
Carangids	1,955	3·8
Miscellaneous	4,356	8·4

The number of weeks during which the different groups occupied the first ranks were—Clupeoids 32, Pleuronectids 10, Miscellaneous species 4, Leiognathids 3, Carangids 2 and Sciaenids 1.

Number of species.—There was a good variety of species occurring in the inshore area throughout the year. Altogether 85 species of fish were caught during the year.

TABLE 3.

Showing the number of species of fishes caught during the 52 weeks and the totals for the 12 months.

Months.	Apr. 1949	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1950	Feb.	Mar.
I week ..	29	29	24	21	27	15	22	4	18	25	32	27
II ,, ..	21	27	11	15	17	24	12	19	20	22	33	30
III ,, ..	26	28	32	30	8	21	15	18	23	23	30	27
IV ,, ..	23	26	37	28	16	26	11	16	23	22	25	25
V ,, ..	..	20	..	..	16	..	..	22	..	35	..	..
Total for the month ..	45	48	45	44	44	42	33	34	32	49	47	44

Table 3 shows the number of species of fish caught during different weeks of the year and also over different months. The lowest number of species caught was 4 in the first week of November and the highest number was 37 in the fourth week of June. From the monthly totals of number of species it is seen that there was a fair uniformity of variety of species over major part of the year. The number of species per month ranged from 42 to 49 except during October, November and December when it was 33, 34 and 32 respectively. The lower number of species during these months appears to be due to the very poor catches in the boat seine which usually collects a large variety of species and also to the saturation of the inshore area during the period with a few shoaling fishes in exceptional numbers to the exclusion of other species.

Abundance.—In reckoning the abundance of a species of fish Warfel and Merriman (1944) have made a distinction between its relative and total abundance. Relative abundance of a species is determined by its frequency of occurrence in good numbers. From the fishery point of view a sustained yield of a species in a fishery is more important than its exceptional abundance if the latter is due to an erratic appearance for a short duration. The high rank obtained by *Sardinella fimbriata* and *Anchoviella heterolobus* during the year was due to their appearance in very large numbers (5,086 and 9,416 respectively) just once for each species.

The species which occupied a high rank in respect of relative abundance during the year were *Cynoglossus semifasciatus*, *Anchoviella tri*, *Opisthopterus tardoore*, *Kowala coval*, *Ambassis gymnocephalus*, *Thrissocles mystax*, *Caranx kalla*, *Leiognathus splendens* and prawns and crabs. The relative abundance of various species of fishes can be seen in figures from 1 to 8 and also in Appendix 2.

Distribution.—The only permanent resident of the inshore area was *Ambassis gymnocephalus* which was caught practically throughout the year. Further this was the only species which was observed to spawn in the inshore area. All other species were migrants to this area and the period of their stay differed for different species. *Cynoglossus semifasciatus* and *Thrissocles mystax* indicated prolonged stay for nearly 6 to 8 months. Species of *Anchoviella*, *Sardinella* and *Leiognathus* were just transient residents in the area with abrupt incursions into and excursions from this area. The only demersal fish of the area was *Cynoglossus semifasciatus* and most of the other fish may be regarded as 'pelagic' species moving about in

schools or sometimes in large shoals. Individuals of shoals of species of *Anchoviella, Sardinella, Thrissocles, Leiognathus* and others after entry into the inshore area were sometimes observed to get scattered. From the trend of occurrence of the species and their numbers from week to week it was observed that the inshore fishery was characterised by a constantly shifting population. The recruitment of the post-larvae and juvenile stages of several species of fishes into the inshore area from January to May was considerable. The inshore area during this period formed a 'nursery' for the young fish.

From an examination of the gonad conditions of the various species during different seasons of the year it is observed that while most of the species occurring in this area attain maturity in this biotope, they migrate just before spawning perhaps to the offshore area. Fishes with gonads beyond maturity stage IV have rarely been met with except in the case of *Cynoglossus semifasciatus* in which stages V and VII have also been observed. This is corroborated by comparative scarcity of fish eggs in this area.

Seasonal Fluctuations.—There was considerable fluctuation in the extent and the nature of the inshore fishery during different periods of the year.

Fig. 10 indicates monthly fluctuations in the total weight of fish catches in the two nets, the boat seine and the gill net. It shows two regressions in the fishery,

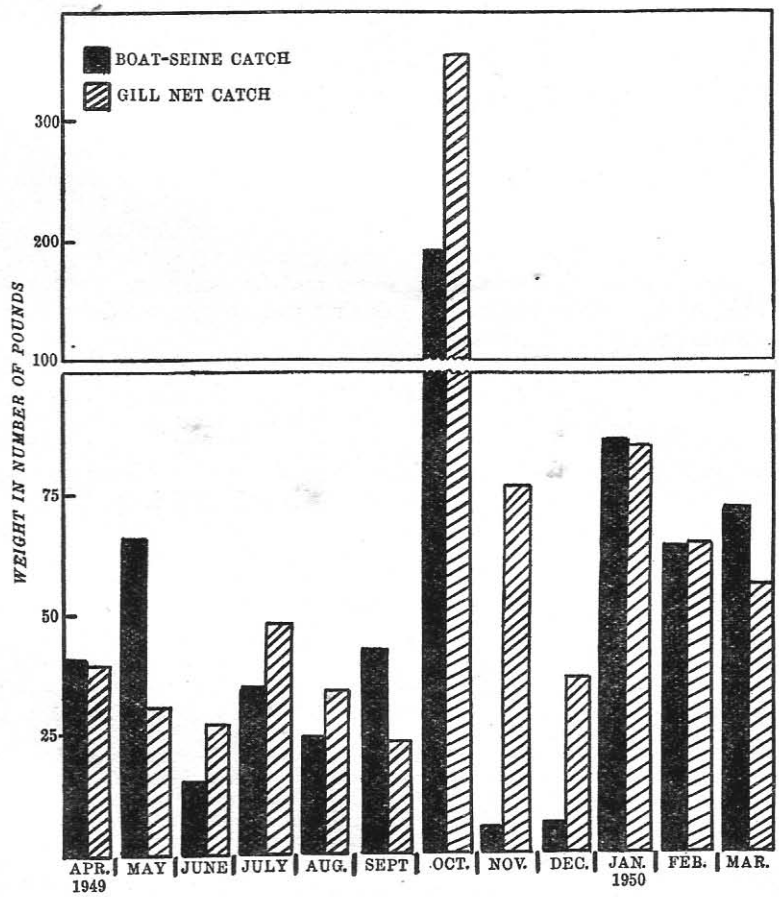

FIG. 10. Variation in the total weights of fish catches obtained in the two nets, the boat seine and the gill net.

one in the month of June and another in August-September. The poor catch in June was due to the extreme turbidity of water caused by the stirring up of the bottom mud at the commencement of the South-West monsoon bringing about a physical intolerance to the fishes in the area and the comparatively low catches in August-September was attributed to the occurrence of 'red water' caused by the abundance of *Noctiluca* and also the blooming of certain phytoplankton forms like *Nitzschia sigma var. indica, Oscillatoria erythraea, O. thebauti* and a species of Chloromonadinae in the area. The low catches in the boat seine in November and December were due to the absence in the area during the period of species of fish, prawns and crabs caught in that net. The fishery was uniformly good in April and May of 1949 and again from January to March, 1950. Fishes were caught throughout the year although there was fluctuation in their numbers from week to week. In temperate countries, on the other hand, the fish population is practically absent in the foreshore area during the winter months, from December to February, when the water temperature goes down to sub-zero level (Warfel and Merriman, 1944).

It has been observed that the majority of fishes have fairly well-marked seasons of occurrence. The seasons of occurrence of various species and the succession of their fisheries in the inshore area during the year followed, more or less, the same trend as in other years.

Nature of the Inshore Fishery.—As a result of this study it has been possible to assess, to some extent, the fishery value of the inshore area. The principal species contributing to the bulk of the inshore fishery are the Malabar sole, the Whitebait, Silver bellies, Anchovies, the white sardine and prawns and crabs. All the other species constitute the miscellaneous fishery in this area. It is significant that the most important commercial species of this coast, the mackerel, *Rastrelliger kanagurta* and the oil sardine, *Sardinella longiceps* did not occur in the area studied except as stragglers. Thick shoals of these appeared in the commercial fishing grounds beyond the 6 fathom line. Large populations of these two species are well known to come close to the coast in the northern portion of South Kanara and North Kanara districts. Similarly certain other species like *Tachysurus dussumieri, Parastromateus niger, Caranx kurra* and *Scomberomorus guttatus* which form the bulk of the commercial catches during certain seasons did not occur in the inshore waters except in immature sizes.

At present the inshore fishery is not being sufficiently exploited as the fishermen generally prefer to fish in the 8 to 10 fathom area for mackerels, sardines and other species. It is only when these more lucrative fisheries are not being operated or when there are occasional thick concentrations of sole, silver bellies, whitebait or prawns close to the shore, that they fish in the inshore area. There is, however, a good scope for a more intensive exploitation of the inshore fishery.

Summary.

The study on the fish populations of the Malabar Coast is based on the analyses of the weekly fish catches taken in the inshore area near Calicut for a year from April, 1949 to March, 1950. The method used for sampling the fish populations is described. A brief accout is given of the main groups of fishes occurring in the area, indicating the species, their size ranges and seasonal fluctuations and also of the prawns and crabs caught in the fishing nets. There is a chapter on the physical and biological environment in the inshore area and their probable relation to the fluctuations in the fisheries.

Eighty-five species of fishes were recorded during the year. The major species supporting the inshore fishery were *Thrissocles mystax, Anchoviella tri, A. heterolobus, Kowala coval, Sardinella fimbriata, Opisthopterus tardoore, Pellona ditchoa, Polydactylus heptadactylus, Ambassis gymnocephalus, Caranx kalla,* species of *Leiognathus, Otolithes ruber, Pseudosciaena sina, Johnius belengeri, Cynoglossus semifasciatus,* and also to some extent the smaller sizes of *Scoliodon sorrakowah, Tachysurus dussumieri, Lactarius lactarius, Trichiurus haumela,* and *Scomberomorus guttatus.*

Remarks are offered in the paper on the sampling method, distribution and abundance of various species of fishes and the nature of the inshore fishery.

ACKNOWLEDGEMENTS.

We are thankful to Dr. N. Kesava Panikkar, Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, Dr. H. Srinivasa Rao, Dr. S. L. Hora and Dr. G. L. Kesteven for helpful criticism. As the material collected was vast and varied and the problems diverse we had to indent on the help of all our colleagues at this Research Station at different phases of this investigation and we take this opportunity of expressing our gratitude to them.

REFERENCES.

Berg, L. S. (1940). Classification of Fishes, both Recent and Fossil. *Trav. Inst. Zool. Acad. Sci. l'urss.*, **5** (2).

Bhimachar, B. S., and George, P. C. (1950). Abrupt setbacks in the Fisheries of the Malabar and Kanara coasts and 'Red Water' phenomenon as their probable cause. *Proc. Ind. Acad. Sci.*, **31** (6), 339–350.

Chidambaram, K., and Venkataraman, R. S. (1946). Tabular Statements on the Natural History of certain Marine Food Fishes of the Madras Presidency—West Coast. *Madras Government Publication.*

Day, F. (1865). *The Fishes of Malabar*, London.

——— (1889). *Fauna of British India—Fishes*, **1** and **2**, London.

Devanesan, D. W., and Chidambaram, K. (1948). The common Food Fishes of the Madras Presidency. *Madras Government Publication.*

Kesteven, G. L. (1950). Essay Review. *Jour. de Cons.*, **16** (2), 228–236.

Kow, T. A. (1950). The Food and Feeding relationships of the Fishes of Singapore Straits. *Colonial Office Fishery Publications*, **1** (1), 1–35, London.

Merriman, D., and Warfel, H. E. (1948). Studies on the Marine Resources of Southern New England VII. Analysis of a Fish Population. *Bull. Bingham Ocean. Coll.*, **11**, 131–164.

Misra, K. S. (1947). A Check List of the Fishes of India, Burma and Ceylon II. *Rec. Ind. Mus.*, **45** (4), 377–431.

Warfel, H. E., and Merriman, D. (1944). Studies on the Marine Resources of Southern New England I. An analysis of the Fish Population of the Shore Zone. *Bull. Bingham Ocean. Coll.*, **9**, 1–91.

Weber, M., and Beaufort, L. F. (1911–1940). *The Fishes of the Indo-Australian Archipelago*, **1-8**, Leiden.

Composite Authorship, (1948). A symposium on Fish Populations. *Bull. Bingham Ocean. Coll.*, **11**.

APPENDIX 1.

**List of Fishes obtained in the departmental collections in the inshore area off West Hill.*

Class ELASMOBRANCHII
Sub-Class SELACHII
Order LAMNIFORMES
Sub-Order LAMNOIDEI
Family Orectolobidae
Chiloscyllium griseum Mull. & Henle.
Sub-Order SCYLIORHINOIDEI
Family Carcharhinidae
Scoliodon sorrakowah (Cuvier)
Scoliodon palasorrah (Cuvier)
Scoliodon walbeehmi Bleeker
Family Sphyrnidae
Sphyrna blochii (Cuvier)
Order RAJIFORMES
Family Trygonidae
Dasyatis (*Pastinachus*) *sephen* (Forsk.)
Order TORPEDINIFORMES
Family Torpedinidae
Narke dipterygia (Schn.)

Class TELEOSTOMI
Sub-Class ACTINOPTERYGII
Order CLUPEIFORMES
Sub-Order CLUPEOIDEI
Family Clupeidae
Dussumieria hasselti Bleeker
Sardinella albella (C. & V.)
Sardinella fimbriata (C. & V.)
Sardinella longiceps C. & V.
Hilsa kanagurta (Bleeker)
Kowala coval (C.)
Pellona ditchoa C. & V.
Opisthopterus tardoore (C.)
Anodontostoma chacunda (Ham.)

* The classification of fishes is after Berg.

Family Engraulidae
Coilia dussumieri C. & V.
Anchoviella commersonii (Lac.)
Anchoviella heterolobus (Rupp.)
Anchoviella indica (v. Hass.)
Anchoviella tri (Bleeker)
Thrissocles dussumieri (C. & V.)
Thrissocles malabaricus (Bleeker)
Thrissocles mystax (Schn.)
Thrissocles purava (Ham.)
Thrissocles setirostris (Brouss.)
Sub-Order CHIROCENTROIDEI
Family Chirocentridae
Chirocentrus dorab (Forsk.)

Order SCOPELIFORMES
Family Synodidae
Saurida tumbil (Bl.)

Order CYPRINIFORMES
Sub-Order SILUROIDEI
Family Ariidae
Tachysurus dussumieri (C. & V.)
Osteogeneiosus militaris (L.)
Family Bagridae
Mystus gulio (Ham.)

Order ANGUILLIFORMES
Sub-Order ANGUILLOIDEI
Family Muraenesocidae
Muraenesox sp.

Order GADIFORMES
Sub-Order GADOIDEI
Family Bregmacerotidae
Bregmaceros macclellandi Thompson

Order MUGILIFORMES
Sub-Order SPHYRAENOIDEI
Family Sphyraenidae
Sphyraena obtusata C. & V.
Sub-Order MUGILOIDEI
Family Mugilidae
Mugil longimanus Gunther
Mugil speigleri Bleeker

Order POLYNEMIFORMES
Family Polynemidae
Polydactylus plebeius (Brouss.)
Polydactylus heptadactylus (C.)
Eleutheronema tetradactylum (Shaw)

Order PERCIFORMES
Sub-Order PERCOIDEI
Family Centropomidae
Ambassis gymnocephalus (Lac.)
Family Theraponidae
Therapon jarbua (Forskal)
Therapon puta C. & V.
Family Sillaginidae
Sillago sihama (Forsk.)
Family Lactariidae
Lactarius lactarius (Bl. Schn.)
Family Carangidae
Caranx (Selar) djedaba (Forsk.)
Caranx (Selar) kalla C. & V.
Caranx (Carangoides) malabaricus (Bl. Schn.)
Caranx (Caranx) sexfasciatus Q. G.
Megalaspis cordyla (L.)
Decapterus russelli (Rupp.)
Chorinemus tala (C. & V.)
Psenes indicus (Day)
Family Nemipteridae
Nemipterus japonicus (Bl.)
Family Leiognathidae
Leiognathus bindus (C. & V.)
Leiognathus insidiator (Bl.)
Leiognathus ruconius (H. B.)
Leiognathus equulus (Forsk.)
Leiognathus splendens (Cuv.)
Leiognathus blochi (C. & V.)
Gazza minuta (Bl.)
Gerres punctatus C. & V.
Family Pomadasyidae
Pomadasys hasta (Bl.)
Family Sciaenidae
Otolithes ruber (Bl. Schn.)
Otolithes argenteus (C. & V.)
Pseudosciaena sina (C. & V.)
Pseudosciaena sp.
Johnius belengeri (C. & V.)
Family Drepanidae
Drepane punctata (L.)
Sub-Order ACANTHUROIDEI
Family Acanthuridae
Teuthis oramin Gunth.
Sub-Order TRICHIUROIDEI
Family Trichiuridae
Thichiurus haumela (Forsk.)
Sub-Order SCOMBROIDEI
Family Scombridae
Rastrelliger kanagurta (Russell)
Family Cybiidae
Scomberomorus commerson (Lac.)
Scomberomorus guttatus (Schn.)
Sub-Order STROMATEOIDEI
Family Stromateidae
Parastromateus niger (Bl.)
Chondroplates chinensis (Euphr.)
Sub-Order GOBIOIDEI
Family Gobiidae
Gobius sp.
Trypauchen vagina (Bl. Schn.)

Order PLEURONECTIFORMES
Sub-Order PLEURONECTOIDEI
Family Soleidae
Solea ovata Rich.
Brachirus albomaculatus (Kaup.)

Family Cynoglossidae
Cynoglossus dubius Day
Cynoglossus puncticeps (Rich.)
Cynoglossus semifasciatus Day

Order TETRODONTIFORMES
Sub-Order BALISTOIDEI
Family Triacanthidae
Triacanthus brevirostris Temm. & Schl.

Sub-Order TETRODONTOIDEI
Family Tetrodontidae
Tetraodon (Chelonodon) patoca Ham.

Order BATRACHOIDIFORMES
Family Batrachoididae
Batrachus grunniens (Bloch.)

APPENDIX 2.

Table showing the number of each species of fish caught in the boat seine and the gill net during different months of the year.

Numbers without the brackets indicate the number of specimens caught in the boat-seine.

Numbers within the brackets indicate the number of specimens caught in the gill net.

Species.	Apr. 1949	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1950	Feb.	Mar.	Totals	Total
Dussumieria hasselti ..	..	5	13	1	11	32	..	..	1	27	5	..	95	168
	..	(2)	..	(7)	..	(7)	(11)	(2)	(12)	(20)	(10)	(2)	(73)	..
Sardinella albella ..	20	..	..	..	..	..	..	..	..	..	..	..	20	..
	(50)	(5)	..	..	..	(4)	(54)	(2)	..	(1)	..	..	(116)	136
Sardinella fimbriata ..	27	..	3	..	..	5	1	..	9	..	..	..	45	..
	(217)	(25)	..	..	..	(6)	(5,126)	(145)	(22)	(5)	(6)	(1)	(5,553)	5,598
Sardinella longiceps ..	..	..	..	..	9	..	..	..	..	..	..	..	9	..
	(60)	..	..	..	..	..	(59)	(41)	(42)	(36)	(13)	(7)	(258)	267
Kowala coval	..	2	16	25	3	4	2	..	1	..	..	..	53	..
	(84)	(106)	(20)	(2)	(134)	(15)	(408)	(833)	(132)	(18)	(3)	(5)	(1,760)	1,813
Pellona ditchoa ..	11	34	93	310	12	10	..	..	..	..	..	..	470	..
	(1)	(1)	(3)	(1)	(9)	(3)	(14)	(1)	..	..	..	..	(33)	503
Anadontostoma chacunda ..	..	1	10	2	4	..	..	..	..	..	..	..	17	..
	(7)	(64)	(15)	(10)	(1)	(2)	..	..	..	..	..	(81)	(180)	197
Opisthopterus tardoore ..	61	583	144	31	3	30	7	1	..	89	34	78	1,061	..
	(20)	(13)	(55)	(8)	(1)	(6)	(5)	(7)	(4)	(56)	(12)	(30)	(217)	1,278
Anchoviella commersonii ..	..	..	..	15	..	3	..	44	33	1	..	..	96	..
	..	..	..	..	..	..	..	(1)	..	..	..	..	(1)	97
Anchoviella heterolobus ..	..	..	..	..	..	..	9,416	..	155	35	10	..	9,616	9,622
	..	..	..	..	..	..	(4)	..	(1)	..	(1)	..	(6)	..

Anchoviella tri ..	21 ..	78 ..	596 (5)	2,300 ..	388 (7)	1,363 ..	10 ..	208 (1)	58 (1)	35 ..	11 (2)	.. ..	5,068 (16)	.. 5,084
Thrissocles malabaricus ..	.. (12)	16 (16)	4 (13)	.. (10)	4 (4)	.. ..	.. ..	.. (41)	.. (44)	.. (56)	.. (47)	.. (63)	24 (306)	.. 330
Thrissocles mystax ..	146 (25)	564 (44)	78 (6)	149 (10)	53 (65)	39 ..	3 (158)	.. (544)	6 (232)	7 (808)	26 (443)	58 (417)	1,129 (2,752)	.. 3,881
Thrissocles purava ..	1 (1)	8 (30)	12 ..	2 (1)	.. (1)	.. ..	.. ..	.. (1)	.. (10)	.. (14)	.. (1)	.. (3)	23 (62)	.. 85
Thrissocles setirostris ..	.. (8)	1 ..	.. ..	.. ..	.. (1)	10 (24)	.. ..	.. ..	.. (1)	.. (4)	.. (5)	.. (13)	11 (56)	.. 67
Solea ovata	.. ..	3 ..	.. (8)	27 (4)	908 (80)	.. (4)	188 ..	.. ..	.. ..	.. ..	1 ..	.. ..	1,127 (96)	1,223 ..
Cynoglossus puncticeps ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. (1)	2 (6)	.. ..	15 ..	17 (7)	.. 24
Cynoglossus semifasciatus	300 ..	126 (1)	.. (1)	1 (45)	39 (20)	6 (38)	5,503 (20)	.. (35)	9 (76)	2,003 (138)	1,064 (239)	1,081 (87)	10,132 (700)	.. 10,832
Cynoglossus dubius ..	.. ..	3 ..	.. ..	2 ..	1 ..	.. ..	.. ..	.. ..	.. ..	.. ..	1 ..	6 ..	13 ..	.. 13
Megalaspis cordyla ..	.. (3)	.. (1)	.. (2)	.. ..	.. (3)	.. (1)	.. ..	.. ..	5 (1)	1 (4)	.. (3)	.. (7)	6 (25)	.. 31
Caranx djedaba ..	1 (16)	.. (8)	.. ..	.. ..	.. (2)	.. ..	.. ..	19 (6)	24 (19)	.. (20)	1 (73)	.. (3)	45 (147)	.. 192
Caranx kalla	1 (286)	.. (98)	1 (45)	.. (25)	.. ..	1 (235)	1 (15)	.. (119)	7 (39)	4 (14)	.. (17)	.. (16)	15 (909)	.. 924
Caranx sexfasciatus ...	1 (1)	.. (5)	5 (5)	3 ..	.. (4)	4 (1)	.. ..	1 ..	5 ..	.. ..	1 (4)	.. (2)	20 (22)	.. 42
Chorinemus tala ..	.. (1)	.. (3)	2 ..	.. ..	.. ..	.. (7)	.. ..	.. (1)	2 (1)	.. ..	4 ..	.. (1)	8 (14)	.. 22
Lactarius lactarius ..	17 (2)	25 (8)	285 (90)	112 (41)	14 (33)	38 (10)	4 (14)	1 (2)	.. ..	7 ..	11 ..	9 (10)	523 (210)	.. 733

APPENDIX 2—*Continued.*

Table showing the number of each species of fish caught in the boat seine and the gill net during different months of the year.

Numbers without the brackets indicate the number of specimens caught in the boat-seine.

Numbers within the brackets indicate the number of specimens caught in the gill net.

Species.	Apr. 1949	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1950	Feb.	Mar.	Totals	Total
Leiognathus insidiator ..	5	6	3	1	7	337	2	1	..	2	..	..	364	..
	(8)	(2)	(6)	(2)	(3)	(5)	(61)	(19)	(4)	(5)	(23)	(3)	(141)	505
Leiognathus ruconius ..	..	17	9	13	..	15	7	..	..	4	1	..	66	..
	(8)	(17)	(28)	(16)	(30)	..	(1)	(8)	..	(1)	(3)	..	(112)	178
Leiognathus equulus ..	..	..	3	6	..	..	..	..	..	4	..	..	13	..
	..	..	(5)	(2)	(2)	..	..	..	..	..	..	..	(9)	22
Leiognathus splendens ..	11	..	4	310	46	..	7	..	..	..	19	..	397	..
	(1)	(5)	(89)	(192)	(256)	(56)	(18)	..	..	..	(3)	(9)	(629)	1,026
Leiognathus blochii ..	..	1	2	11	..	2	1	..	..	..	3	..	20	..
	(6)	(1)	(67)	(1)	(12)	(96)	(95)	(16)	..	(1)	(26)	(4)	(325)	345
Leiognathus bindus ..	..	15	..	..	..	2	..	..	..	..	..	..	17	..
	(2)	..	..	..	..	..	(1)	..	..	..	..	..	(3)	20
Gerres filamentosus ..	..	2	8	3	..	2	..	..	..	..	..	..	15	..
	..	..	(4)	..	..	..	..	..	..	..	..	..	(4)	19
Otolithes ruber ..	44	305	6	12	27	1	5	..	..	10	20	58	488	..
	(7)	(26)	(40)	(33)	(12)	(2)	..	..	..	(1)	(4)	(5)	(130)	618
Otolithes argenteus ..	31	..	..	..	..	..	62	..	..	11	6	4	114	..
	..	..	..	(4)	(3)	..	..	(1)	..	..	..	..	(8)	122
Pseudosciaena sina ..	77	244	4	4	3	..	..	..	..	13	13	384	742	..
	(2)	(2)	(1)	(23)	..	..	..	..	..	(1)	(4)	(3)	(36)	778
Pseudosciaena sp. ..	2	3	..	..	..	..	2	..	..	..	..	7	14	..
	..	(1)	..	..	..	..	..	..	..	..	..	..	(1)	15

Johnius belengeri ..	12 ..	170 (1)	8 (3)	5 (4)	.. (3)	.. (1)	1 ..	.. (10)	.. ..	30 (2)	208 (5)	30 (12)	464 (41)	.. 505
Scoliodon sorrakowah ..	.. ..	6 (1)	.. (5)	.. (1)	.. (1)	.. (5)	3 ..	1 (5)	.. (14)	.. (60)	2 (28)	4 (52)	16 (172)	.. 188
Scoliodon palasorrah ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	2 (11)	.. (5)	.. (12)	2 (28)	.. 30
Scoliodon walbeehmi ..	1 (23)	.. (6)	.. ..	1 (3)	.. (1)	.. ..	.. ..	.. ..	.. ..	.. (1)	.. ..	.. ..	2 (34)	.. 36
Tachysurus dussumieri ..	18 (1)	1 ..	.. ..	.. ..	7 (5)	.. (2)	.. ..	.. ..	.. ..	22 ..	7 ..	1 ..	56 (8)	.. 64
Osteogeneiosus militaris ..	.. (1)	.. ..	.. (2)	1 ..	.. ..	.. ..	.. ..	.. ..	1 ..	209 ..	25 (2)	196 (6)	432 (11)	.. 443
Muraenesox sp. ..	3 (1)	1 ..	.. ..	6 ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	2 ..	.. ..	12 (1)	.. 13
Eleutheronema tetradactylum	.. (1)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. (10)	.. (23)	.. (15)	.. (6)	.. (55)	.. 55
Polydactylus plebius ..	.. (1)	45 (6)	2 (6)	.. (1)	.. ..	.. ..	.. ..	.. (1)	.. ..	.. ..	.. (1)	.. (4)	47 (20)	.. 67
Polydactylus heptadactylus	15 (1)	412 (2)	15 (17)	5 (13)	.. (1)	.. (1)	.. ..	.. (2)	.. ..	4 ..	9 ..	31 (1)	491 (38)	.. 529
Sphyraena obtusata ..	.. ..	.. ..	11 ..	3 ..	.. ..	1 ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	15 ..	.. 15
Mugil speigleri ..	.. (1)	1 (1)	85 (2)	.. ..	.. (2)	.. ..	.. (1)	.. (20)	.. ..	.. (1)	.. (1)	.. ..	86 (29)	.. 115
Mugil longimanus ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. (1)	5 (1)	1 (2)	.. ..	1 (2)	7 (6)	.. 13
Bregmaceros macclellandi ..	4 ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	4 (1)	14 ..	22 (1)	.. 23
Ambassis gymnocephalus ..	74 (9)	295 (14)	23 (53)	17 (1)	46 (6)	42 (10)	226 ..	166 (12)	202 (7)	90 (6)	117 (30)	36 (8)	1,334 (156)	.. 1,490

APPENDIX 2—*Continued.*

Table showing the number of each species of fish caught in the boat seine and the gill net during different months of the year.

Numbers without the brackets indicate the number of specimens caught in the boat-seine.

Numbers within the brackets indicate the number of specimens caught in the gill net.

Species.	Apr. 1949	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1950	Feb.	Mar.	Totals	Tota
Therapon jarbua ..	..	1	6	15	6	3	1	..	..	..	..	..	32	..
	..	..	(3)	(1)	..	..	..	..	(1)	..	..	..	(5)	37
Therapon puta ..	..	..	..	..	..	..	..	..	..	49	..	..	49	..
	..	..	(9)	..	..	..	..	..	..	..	..	..	(9)	58
Sillago sihama ..	15	..	2	..	..	..	..	..	10	3	3	..	33	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	33
Scomberomorus commerson	..	..	2	..	..	..	..	..	..	..	..	..	2	..
	(10)	(5)	(2)	..	..	..	..	..	..	(3)	(3)	(6)	(29)	31
Scomberomorus guttatus ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	(5)	(7)	(13)	(1)	(3)	..	..	(1)	..	(5)	(5)	(4)	(44)	44
Trypauchen vagina ..	..	56	..	..	..	..	..	..	..	..	..	..	56	..
	..	..	..	..	..	..	..	..	..	..	..	..	..	56
Parastromateus niger ..	..	2	3	..	..	..	..	..	..	..	2	..	7	..
	..	..	(3)	..	..	..	..	..	..	..	..	..	(3)	10
Trichiurus haumela ..	1	..	2	12	18	381	138	..	..	6	71	22	651	..
	..	..	(6)	(102)	(29)	(7)	..	(1)	..	..	..	(2)	(147)	798
Teuthis oramin ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	..	..	(13)	(1)	(3)	..	..	..	..	..	..	..	(17)	17
Pomadasys hasta ..	..	..	..	45	..	..	..	..	..	12	..	1	58	..
	..	..	(5)	(10)	(2)	(8)	..	(1)	..	..	..	..	(26)	84
Triacanthus brevirostris ..	..	..	..	..	..	..	2	3	3	8	..	..	16	..
	..	..	..	..	(2)	(1)	..	..	..	..	(1)	..	(4)	20

Tetraodon (Chelonodon) patoca.	.. ..	.. ..	2 ..	3 ..	1 ..	32 ..	4 ..	.. ..	.. ..	3 ..	.. ..	.. ..	45 ..	.. 45
Other species ..	1 (2)	8 ..	.. (3)	3 (5)	3 (1)	16 (5)	4 (1)	1 ..	2 (3)	7 (1)	1 (1)	2 (1)	48 (23)	.. 71
Total number of specimens caught in each net ..	921 (884)	3,040 (527)	1,462 (653)	3,456 (580)	1,613 (742)	2,379 (562)	15,600 (6,066)	446 (1,880)	538 (678)	2,701 (1,324)	1,682 (1,040)	2,038 (888)	35,876 (15,824)	.. 51,700
Total number of specimens for each month ..	1,805	3,567	2,115	4,036	2,355	2,941	21,666	2,326	1,216	4,025	2,722	2,926	..	51,700