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REPORT OF THE SECOND AD HOC WORKING GROUP ON PELAGIC STOCKS OF THE SHERBRO STATISTICAL DIVISION (34.3.3)

Held at
Freetown, Sierra Leone
26-30 March 1985

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
UNITED NATIONS DEVELOPMENT PROGRAMME

Dakar,
October 1985

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1. INTRODUCTION

Following the recommendation of the Seventh Session of the CECAF Working Party on Resources Evaluation, the Second ad hoc Working Group on the Pelagic Resources of the Sherbro Statistical Division (34.3.3) was held at Freetown, Sierra Leone from 26 to 30 March 1985. The opening ceremony was performed by Hon. Ibrahim Sorie, Parliamentary Special Assistant, Ministry of Agriculture and Natural Resources, who was then acting as Minister of Agriculture and Natural Resources during the absence of the substantive minister. Scientists attended from Sierra Leone, USSR and the CECAF Project. A Liberian scientist was unable to attend. The list of participants is given as Appendix 1. After the election of Mr. K. Fergusson as Chairman of the Working Group and Messrs. F.C. Roest and J.J. Levenez as rapporteurs, the provisional agenda was adopted (Appendix 2).

2. DESCRIPTION OF THE FISHERIES

2.1 Sierra Leone

The only national fishery exploiting the pelagic stocks continues to be the artisanal fishery. By-catches of pelagic species are incidental in the national trawl fishery.

The coastline of Sierra Leone has a general North West-Southeast direction, measuring 340 kms and including indentations 600 km. The continental shelf has its greatest width of 100 kms (55 m contour)-150 kms (90 m contour) in the North and tapers down towards the South (Liberian border) where these widths are 13 and 20 kms respectively. The corresponding shelf areas are 17 000 and 27 000 km2.

The coastline is divided into six coastal districts, Kambia, Port Loko, Western Area, Moyamba, Bonthe and Pujehun. Artisanal fishing activities take place all along the coastline, but are of lesser importance in Pujuhun district because of the narrowness of the shelf and the straight coastline.

The number of artisanal landing sites has decreased from 554 in 1974 to 467 in 1981 and according to the preliminary results of a survey in 1985, this trend seems to continue.

The artisanal fishery is not equally divided between the six districts, in fact in the Port Loko, Western Area and Bonthe districts together are concentrated 76% of the total number of canoes and 72% of the fishermen. Bonthe, the main fishing district with 40% of all canoes, is caracterized by a very low percentage of motorization (0.3%, see Table 3). Most of the canoes used in this area are of the standard 1-3 type, using mostly passive gears like drift and set nets, hook and line and therefore can manage without outboard engine.

The six major types of artisanal gear used are castnets, ringnets driftnets, setnets, beach seines and hook and line. Their caracteristics and distribution by district are given in Table 1. Generally, the following combinations of canoes and gears exist : Ghana canoe-ringnets, standard 3-5 canoe-driftnet, set net, hook and line as well as small ringnets, standard 1-3 canoes-setnets, castnet and hook and line, Kru dugout canoes-hook and line. The numbers of Ghana and benefit boats specialising in pelagic species are decreasing because of their actual poor rentability due to poor catches, low fish prices and increasing cost of fishing operations (nets, fuel, increasing distance of fishing grounds from shore). The distribution of fishing canoes by type and district is given in Table 2. Numbers of fishermen and outboard engines can be found in Table 3.

Until recently, the coastal zone restricted to artisanal fishery was within the 2 mile limit from shore. This zone has now been increased to 5 miles (Fergusson, 1984).

Canoes are mostly operated on a family basis with occasional hired labour. Outside the Freetown area, all fish landed is sold locally by the fishermen's wives, sometimes after smoking. In the Freetown area, fresh fish is transported without any method of conservation to markets by means of local transport boats or vehicles.

The industrial fishery in Sierra Leone can be divided into two groups, the national fleet consists of a number of shrimp trawlers and some finfish bottom trawlers. The foreign industrial fleet is composed of British, Senegalese, Spanish, Italian and USSR vessels, of which only the latter fish pelagic species. The number of industrial vessels of all nationalities operating in the period 1980-1983 are as follows :

	1980	1981	1982	1983
Finfish trawlers	135	96	72	...
Shrimp trawlers		60*	25	...
Purse seiners	30	15	30	...
Liners	3	3	5	...
Motherships	5	3	7	...
Carriers	0	6	1	...
TOTAL	173	183	140	130

* Includes a number of vessels acquired from Continental Seafood, Liberia of which some were laid up.

In 1983, the distribution of vessels by nationality was as follows : Sierra Leone 20, USSR 74, British 12, Senegal 19, Spain 5.

2.2 USSR

Since 1979, Soviet pelagic fishing vessels operate mainly between 8-9°N, fishing at depths of 15-200 m. Sardinella spp. are caught at depths of 15-45 m by small purse seiners (300-500 HP) and Balistes are target of larger vessels (800-1 300 HP), using midwater trawls at 30-50 m depth.

All vessels operate individually, the seiners being limited in their autonomy as they offload catches to a mothership. Fish is detected by echosounders present on all vessels.

Fishing for Sardinella is seasonal, being best during the second and third quarter of the year. Balistes is caught all year round, but in somewhat higher quantities from April to October. Major species in the by-catch are Caranx, Vomer and Chloroscombrus.

Since 1979, 70-90% of the total annual catch of 60,000-100,000 tons was made up of pelagic species, mainly Sardinella and Balistes (75-85% of total pelagic catch).

The species composition of the catch has showed considerable changes as Balistes was discarded before 1980, and constituted about 50% of the catch in 1980 (43,700 tons), before dropping to 4% in 1982 (1,650 tons). The Sardinella catches, however, have been relatively stable and of the order of 30,000 to 45,000 tons.

The number of USSR vessels licensed to fish in Sierra Leone waters in 1983, 1984 and 1985 are as follows :

1983 : 74 (this being the total number licensed to fish including vessels replacing others during this year),

1984 and 1985 : 45, distributed as follows (can be replaced by other vessels of the same type) :

	1984	1985
SRTM	4	5
MRTR	15	16
Purse seiners	20	18
Motherships	3	3
Processing vessels	3	3

3. STATISTICS ON CATCH AND EFFORT

3.1 Introduction

In the Sherbro area, catches of pelagic fish species are of major importance as they constituted about 60% of the total catch in the period 1972-1975 and over 70% after this period, if we include Balistes (Figure 1). Among the pelagic species, Sardinella spp. are dominant and represented never less than 65% since 1972. During the whole period 1972-1982, their average contribution to the pelagic catch was close to 80%. Since 1977, Carangidae make up about 10%. Thus, Sardinella and Carangids together constitute over 90% of the total pelagic catch since 1979 (Figure 2).

The total Sardinella catch (Figure 3) was stable from 1970-1977 at a level of about 35,000 tons, followed by an increase to about 50,000 tons in 1978-1981 and a decreasing trend in 1982-1983. Total Carangid catches in the Sherbro area were at a very low level until 1976, never reaching 3,000 tons. After 1976, they reached a level as high as 12,000 tons, followed by a rapid decrease to below 6,000 tons.

The different trends in annual catches of these two species groups by fishing country deserve some comments. The Sierra Leone catches of Sardinella spp. show, after a big jump in 1969-1970, a gradual increase from 17,000 to 25,000 tons in 1976. After this year, catches dropped drastically to a level of 7,000 tons in 1978, coinciding with a peak of offshore Sardinella catches by the Soviet fleet which reached 45,000 tons. From 1978 onwards, Sierra Leonean catches are rather stable at a level of 7500 tons. At the same time, USSR catches show a decreasing trend from the peak of 45,000 tons to a level of 31,000 tons in 1982.

Figure 4 shows that the percentage of Sardinella catches by other countries decrease regularly from 1969 to 1978, after which they stabilize at a low level. The Sierra Leonean percentage of the Sardinella catch grew from 18% in 1969 to 80% in 1976, whereafter followed the same drastic decrease as already seen in the total catches of Sardinella. A level of 13% was reached in 1978 and until 1982 the 20% level was never attained. During this time, the contribution of the USSR to the total Sardinella catch was stable and of the level of 75%.

From 1976-1982, the artisanal total Carangid catches of the Sierra Leone fleet decreased from 2,400 to 300 tons. The catches of Carangids of the Soviet fleet showed a maximum in 1977 and 1978 of about 10,300 tons, followed by a rapid decrease of 4,500 in 1983 (Figure 5). As shown in Figure 6, over 80% of the total Carangid catches are made by the Soviet fleet.

3.2 Sierra Leone

Sierra Leonean catches since 1971 are summarized in Table 4. Pelagic catches make up 63-85% of the total artisanal catch and have since 1973 been of the order of 27,000-41,000 tons, a maximum of 40,984 tons being reached in 1976. Between 1973 and 1976 catches were stable and around 39,000 tons. In 1977-1979 a drop of 25% occurred, followed by a further decrease since 1980. This drastic fall is due essentially to Sardinella spp. of which catches fell from a level of 23,000 tons between 1973-1976 to 7,000-11,000 tons in 1977-1981, in spite of the increasing number of canoes (Table 2) and coinciding with the start of large scale industrial fishing operations in Sierra Leone. The number of fishing trips are available for Western Area from 1978 and for all districts since 1980 (Table 5). 1/

Industrial vessels fishing in Sierra Leone waters are expected to record their catches and the corresponding effort in logbooks and send this information to the Fisheries Division of the Ministry of Agriculture and Natural Resources. The rate of return of such logbooks, continues, however, to be surprisingly low and the information provided not enough detailed to be useful.

1/ To be compiled after the meeting

3.3 USSR

According to CECAF Statistical Bulletin 4 (FAO, 1984) and Statlant 34 forms, the total and pelagic catches by USSR vessels in the Sherbro area since 1972 have been as follows :

	TOTAL	PELAGIC*		TOTAL	PELAGIC*
1972	6,044 t	1,319 (22%)	1978	67,479 t	57,564 (85%)
1973	7,454 t	454 (6%)	1979	67,684 t	52,445 (77%)
1974	15,881 t	4,153 (26%)	1980	100,183 t	89,453 (89%)
1975	10,911 t	4,214 (39%)	1981	89,349 t	70,980 (79%)
1976	12,083 t	7,637 (63%)	1982	60,822 t	41,861 (69%)
1977	32,222 t	31,175 (97%)	1983	61,238 t	47,044 (77%)

* Includes Carangidae, Clupeidae, Scombridae, Engraulidae, Balistidae, Trichiuridae.

It appears from this Table that pelagic fishes have been predominant in the catches since 1976 and that intensive pelagic fishing started in 1977. Detailed monthly statistics on catches and fishing effort for pelagic fishes for the years 1979-1981 extracted from Statlant 34B forms are given in FAO (1983). Tables 6 and 7 summarize similar information by vessel type for the years 1982 and 1983.

Statistics on fishing effort are not available for the years prior to 1979.

Two main types of fishing gear are used by USSR vessels for catching pelagic species, viz. midwater trawls and purse seines. The purse seiners are directly oriented towards the capture of Sardinella spp. in the surface layers. In 1979-1980 and 1982-1983, purse seiners caught annually 30,000-34,000 tons of Sardinella, while in 1981 a peak of 42,000 tons was reached. As can be seen in Figure 7, Sardinella accounted for 75-95% of the total catches of these vessels, the remaining 5-25% being constituted principally by Brachydeuterus and Carangids. No Balistes appears in catch records of purse seiners.

Three measures of purse seine effort are given in Figure 8 ; days on fishing grounds, fishing days and number of net sets. During the period 1979-1983 for which data are available, the annual number of days on fishing grounds shows an irregular decrease from 4,600 to 3,050 with a linear correlation coefficient of $r^2 = 0.768$ ($p < 0.1$). The same trend was observed with a somewhat gentler slope in the number of fishing ($r^2 = 0.754$, $p < 0.1$) and in the number of net sets ($r^2 = 0.791$, $p < 0.05$) in relation to a general decrease of purse seine activities. It should be noted however, that in order to compensate for the decline in overall effort, the rate of activity of the purse seiners (fishing days : days on fishing ground) has shown an increase of 12% since 1981.

In the period 1979-1983, 1981 was an exceptional year with a peak of 25 tons of all species per fishing day, of which Sardinella constituted 95%. The overall trend in catch rates shows an increase from 12,500 tons to 16,500 tons. A similar trend is observed in Sardinella CPUE, but with a lower increase from 11,500 to 12,500 tons per fishing day. Apart from 1981, when catches per netset were as high as 16 tons, catch rates are stable at a level of about 9 tons. The difference in trends observed between overall and Sardinella catch rates, can be seen to be due to a decrease trend in the percentage of Sardinella in the catch (Figure 9).

According to USSR regulations and intergovernmental agreements, no fish is discarded. Large vessels usually have equipment onboard for direct processing into fish meal. Smaller ones freeze non-commercial fish for animal consumption. No details are available on species and length composition.

4. BIOLOGICAL DATA AND BRIEF HYDROMETEOROLOGICAL CHARACTERISTICS

Brief summaries of the biology of the main pelagic species resulting from joint USSR-Sierra Leone surveys were presented. They concern mainly the species composition of the catch, the distribution and migration pattern of stocks in the Sierra Leone waters, the size and weight limits in the catches as well as the size at maturity and the spawning period. These data can be found in Annexes 3 and 4, together with a detailed description of the hydrological conditions in the area. Ichthyoplankton sampling was also done, but results were not available to the Working group.

Some further data provided by USSR scientists and from other sources are as follows ;

- length-weight relationship

Sardinella aurita $W = 48.55 \times 10^{-3} \times L_F^{2.459}$ (W_g, $L_F$cm)

Balistes capriscus $W = 0.02\ L_F^{3.02}$ (W_g, $L_F$cm)

Other length-weight relationships are available in Nieland (1983) :

Sardinella maderensis	$W = 7.4 \times 10^{-3} \times L_F^{3.2726}$	(W_g, $L_F$cm)
Chloroscombrus chrysurus	$W = 16.3 \times 10^{-3} \times L_F^{2.9392}$	(W_g, $L_F$cm)
Brachydeuterus auritus	$W = 14.9 \times 10^{-3} \times L_F^{3.0568}$	(W_g, $L_F$cm)

- Growth

Sardinella aurita

Mean length at age : I 13-14 cm, II 15-19 cm, III 16-22 cm, max length 28 cm (5-6 years ?).

Sardinella maderensis

Maximum length 26-27 cm. Length frequency data are presently being analysed at AtlantNIRO for determining growth parameters.

Balistes

Mean length at age : I 17 cm, II 24 cm, III 26 cm, maximum length 40 cm.

- Fecundity

Data are being processed at AtlantNIRO.

- Spawning season

Sardinella aurita, 2 peaks, September and February-March
Sardinella maderensis, August. Nieland (1983) found two peaks, a main one in October-November and secondary one in April-June.
Caranx senegallus, May-July, October-November
Caranx chrysos, July
Chloroscombrus, main February-June, secondary July-September
Brachydeuterus, January-April

- Size at first maturity

Sardinella aurita and S. maderensis : 13-14 cm
Balistes : 19 cm
Caranx senegallus : 21 cm
Caranx chrysos : 19 cm

- Migrations

Sardinella spp. are thought to move extensively between Sierra Leone and Guinea, being in the North in December-April and moving southwards in May-August.

Balistes move South in the rainy season and North in the dry season.

It should be noted that no data were available to the Working Group on recruitments, length and age composition of the main species in the catches, growth parameters, mortality rates, long-term abundance cycles in relation to environmental changes, parasites and selectivity.

5. STOCK ASSESSMENT

5.1 Models

In the absence of sufficiently long time series on catches and especially effort, the Working Group did not attempt to apply a global production model. The still persisting lack of any length composition data of commercial catches prevented the application of analytical models.

5.2 Surveys

Since the survey of R/V "MONOCRYSTAL" in February-March 1982, of which the results are presented in Appendix 7 of the first ad hoc Working Group report, 4 more joint USSR-Sierra Leonean surveys have been made : 1) Belogorsk in winter 1982,2) Evrika in summer 1983, 3) Monocrystal and Evrika in 1984 and 4) Bakhchisarai, Monocrystal and Titani in 1985.

Of the combined Monocrystal-Evrika survey in 1984, only the main conclusions were available to the Working Group (Annex 3). In the absence of any further data on the state of the pelagic stocks of the Sherbro division, the Working Group compared these new estimates with those of R/V Monocrystal in February-March 1982 :

	Carangidae	Sardinella	Balistes	Others	TOTAL
February-March 1982	397.100	164.600	100.000	94.300	756.000
June 1984	300.000	100.000	400.000	200.000	1.000.000

This comparison shows a general increase in biomass of 30%, but the species contributions to the biomass show different trends. The main feature is the considerable increase in the biomass of Balistes and the other species respectively of the order of 400 and 100%. On the other hand, it can be seen that the biomass of the principal commercial species, ($>$90% of the pelagic catches) has dropped by 39% (Sardinella) and 25% (Carangidae).

Total catches of Sardinella spp. being around 40,000 tons in 1982-1983, the Soviet expert presented a model developed by Pauly which is based on the estimation of mortality coefficients from a von Bertalanffy growth curve, and which has the following form :

$$C_N = \frac{N.F.A}{Z}$$, with C_N = catch in numbers
F = fishing mortality
A = annual mortality rate (Ricker 1975)
Z = total mortality, being equal to M + F

This formula was transformed as follows :

$$B = \frac{C_W \cdot Z}{F.A}$$, in which B = biomass
C_W = catch in weight
Z, F, A = as above

M was estimated according to Pauly (1980) at 0.8. Considering that at optimum exploitation M equals F, values of 0,8 for F and 1.6 for Z were used. A can be found in Ricker to have a value of 0,7981. Substituting these values in the model gives for a total equilibrium catch of 40,000 an estimated biomass value of 100,000 tons of Sardinella which would be able to support these catches. According to these results, Sardinella stocks seem to be fully exploited in the Sherbro area. However this model was criticized as providing only a rough approximation and the applicability in its present form is questionable. At the same time, the assumption that F would be constant with age and effort could be erroneous. It should be emphasised that in 1982, year to which this model refers, the biomass of Sardinella was estimated acoustically at 165,000 tons, which would mean that at this time the stock was underexploited. If this would have been the case it is difficult to see why the biomass of Sardinella decreased from 165,000 to 100,000 during this period.

6. RECOMMENDATIONS

The Working Group formulated the following recommendations :

1. In view of the wealth of data collected since 1976 during the joint USSR-Sierra Leonean surveys, the Working Group therefore recommended that all detailed biometrical data (length-weight relationship, growth parameters, mortality) and series of length-frequency data obtained during these cruises as well as the detailed results of other ongoing research programmes (ichthyoplankton surveys for eggs and fish larvae, young fish surveys and age and size composition of the populations) be made available by USSR scientists to further ad hoc Working Groups on the pelagic stocks of the Sherbro Area.

2. In view of the fact that biological data are important for stock assessment purposes, it is recommended that length frequency measurements, and if possible other biological data be obtained on a continuous basis for the important commercial species of both the artisanal and industrial fisheries. 1/

3. In view of the unavailability of recent Sierra Leonean data to the first two ad hoc Working Groups, it is strongly recommended that the required statistical tables be prepared in advance and submitted at the beginning of the meeting.

4. The Working Group strongly recommends that all efforts should be made by the Fisheries Divisions of Sierra Leone and Liberia to ensure that fishing companies operating in the two countries send to them within reasonable lengths of time accurate records of their catches and corresponding efforts

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1/ Most scientists were in favour of this recommendation, except the Soviet participant who felt that this is impracticable.

5. The Working Group recommends that in view of the importance of Ethmalosa in the artisanal catches, detailed statistical and biological data be collected on this and other relatively important species in the Sherbro Division by all the countries concerned.

6. The Working Group recommends that CECAF through the CECAF Project find ways and means of conducting acoustic surveys in the Sherbro area in order to obtain more detailed information on seasonal changes in biomass and fish distribution.

7. As the data collected shows that the biomass of Balistes has considerably increased, the Working Group recommends that more attention be paid to the utilisation of this source of protein.

8. In view of the extensive movements of pelagic fish stocks in the Guinea-Sierra Leone-Liberia area, the Working Group recommends the continuation of regional research programmes through bilateral and multilateral assistance with the participation of the coastal countries.

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Appendix 1

LIST OF PARTICIPANTS

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Appendix 2

SECOND SESSION OF THE AD HOC WORKING GROUP ON THE PELAGIC STOCKS
OF THE SHERBRO STATISTICAL DIVISION
(26-30 March, Freetown, Sierra Leone)

ANNOTATED AGENDA

1. OPENING

2. ADOPTION OF THE AGENDA

3. DESCRIPTION OF THE FISHERIES

A detailed description of the fisheries for coastal pelagic species : Sierra Leone and Liberia (artisanal fleets) and the Soviet Union (industrial fleet). Changes over time ; numbers and types of vessels, fishing areas, seasons, gears and mesh sizes, target species, by-catch.

4. STATISTICS ON CATCH AND EFFORT

Detailed statistics on catch, species composition and fishing effort are to be summarized by country and fishing type. Sierra Leonean catches since 1981, Liberian and USSR data since 1982 are to be submitted. Trends in effort, different measures of effort ; catches per unit of effort, abundance indexes. Discards, species and length composition.

5. BIOLOGICAL DATA AND BRIEF HYDROLOGICAL CARACTERISTICS

All biological data on the coastal pelagic species are to be summarized including those of Ethmalosa from the artisanal fishery. All data obtained during joint USSR-Sierra Leonean surveys should be presented, including : length-weight relationship ; size and/or age of 50% maturity, spawning seasons and areas ; recruitments, migrations, geographical distribution and stock separation (Guinea-Sierra Leone-Liberia) ; length and age composition of the main species in the catches ; growth parameters ; mortality rates ; long-term abundance cycles in relation to environmental changes ; parasites ; selectivity studies.

6. STOCK ASSESSMENT

6.1 Production models and analytical models

Standardisation of fishing effort, possibility of applying global production models to the pelagic stocks ? Application of analytical models based on age or length structure of the catches.

6.2 Surveys : acoustic, fishing, eggs, and larval surveys, young fish surveys

Following the specific recommendations of the first Working Group, detailed results of all these surveys made jointly by USSR and Sierra Leone are to be presented.

7. RECOMMENDATIONS FOR FURTHER RESEARCH AND MANAGEMENT

8. ADOPTION OF THE REPORT

Appendix 3

MAIN RESULTS OF JOINT USSR-SIERRA LEONE INVESTIGATIONS OF PELAGIC FISHES

by

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1. INTRODUCTION

Joint fisheries research has been carried out in the Sierra Leonean waters since December 1976, after an agreement between the Governments of Sierra Leone and the USSR. Soviet vessels are used for this purpose and Sierra Leonean experts participate in the surveys. Research consisted of collecting and analyzing scientific data needed to determine the status of the marine resources which in its turn will lead to recommendations for management and further development of the fisheries. Trawl and acoustic surveys were made to study the distribution of the main species and their biomass. Catch statistics from the Soviet fleet fishing in Sierra Leonean waters were also used. Recently, the USSR catches have been of the order of 63-100,000 tons, mostly consisting of pelagic fish species (sardinella, balistes, Carangidae). Tuna were of little importance in the catches.

2. BRIEF HYDROMETEOROLOGICAL CHARACTERISTICS

The waters of the areas under study are subject to significant seasonal changes caused by changes in atmospheric conditions. The trade and monsoon winds are the main factors responsible for hydrological changes. River discharge, precipitations, evaporation and mixing process in the shallow shelf waters also contribute, although a gradual decrease of their influence is observed with increasing depth, especially outside the continental shelf.

During the northern winter period, the South Atlantic atmospheric maximum slackens and moves to the southeast, and the equatorial atmospheric depression also moves to the South, reaching the Gulf of Guinea and giving rise to a stronger NE trade wind in the area. Precipitations and river discharge are lower during this period. A general SE ward transport of waters is observed in the Sierra Leonean shelf area (Figure 1).

During the summer period the Azores maximum slackens while the South Atlantic maximum intensifies. The depression between those two shifts to the North. In this period, the waters of the Gulf of Guinea move Northward under the influence of heavy precipitations, river discharge and the intensification of the SE monsoon winds. A general NW and N movement of waters can be observed on the Sierra Leone shelf (Figure 2).

The water circulation in the area is further influenced by the presence of a quasi-steady anticyclonic gyral in the central part of the Sierra Leonean shelf (7°40'N) which persists throughout the year. Two cyclonic gyrals are clearly seen to the North and to the South of it. In the winter period these are more clearly pronounced.

Seasonal changes in surface temperatures are closely correlated with these changes in water circulation. Figure 3 illustrates the monthly changes in surface water temperatures above the 100 m isobath in the central part of the area. This graph clearly shows that in the winter season the Canary Current penetrates the area under the influence of the NE trade wind. In summer, the warm Liberian waters dominate influenced by the SE monsoon.

3. BIOLOGICAL CHARACTERISTICS OF THE MAIN PELAGIC SPECIES

3.1 *Sardinella* spp.

3.1.1 *Sardinella aurita*

Main concentrations are found at depths 15-200 m in the northern Sierra Leone waters. Fish of 14-24 cm, weighing 40-80 g predominate. Seasonal migrations have been observed (Figure 4).

At age 1, this species reaches 13-14 cm, at age 2, 15-19 cm, and 16-22 cm at age 3. 50% sexual maturity is attained at length 13-14 cm. Spawning is most intensive in September and February-March.

3.1.2 *Sardinella maderensis*

This species ranges widely at depths of 60-75 m near the shores. Most fish are 13-20 cm long, sexual maturation is at 13-14 cm and spawning takes place in June-August.

3.2 *Balistes capriscus*

In recent years, *Balistes* has shown great abundance in the Sherbro statistical division (Figure 5). Densest concentrations occur at 25-30 m depths. Fish lengths range between 12 and 38 cm, but sizes of 15-21 cm predominate (70-190 g). Sexual maturity is reached at 19 cm. At ages 1, 2 and 3, corresponding lengths are respectively 17, 24 and 26 cm.

The largest near-bottom concentrations are formed in the period April-October. These are mainly found at depths of 20-80 m. However, they also form pelagic concentrations in the upper 50 m water layer above the outer shelf or beyond it. This species moves along the shelf southward during the rainy season and northward during the dry season. The Sierra Leonean waters form the southern boundary of the massive distribution of Balistes (Figure 5). They show a clear seasonal pattern : in the summer months, concentrations usually occur North of 7°30'N. In autumn-winter they show a mosaic distribution pattern and extend their southern distribution border southward of Sherbro Island. In 1983-1984, period of increased abundance, large concentrations migrated southward to the Liberian border in the summer.

3.3 Caranx spp.

Among the Carangidae, Caranx senegallus and C. crysos are the most abundant. They are usually found together and form aggregations in different parts of the shelf. In recent years, a considerable increase in their abundance has been observed.

Lengths of C. senegallus range between 26-32 cm, weighing 400-600 g. Sexual maturity is reached at 21 cm. Spawning is all year round, with two peaks: May-July and October-November. C. crysos is usually 30-64 cm long, weighing 500-1 500 g. Sexual maturity is at 29 cm, most intensive spawning being in July.

3.4 Tunas

In purse seine catches, the following tuna species occurred : Thunnus albacares, Katsuwonus pelamis, Euthynnus alleteratus, Auxis thazard and Auxis rochei. Tunas form commercially interesting concentrations mainly above the continental slope in February- June. In February-March, they are concentrated in the southern part of the area, and move North in April-June (Figure 6). Tuna schools are usually fished around the upwelling zones and on the boundary of warm water influxes where suface temperatures are 26-28°C. Tunas rarely form schools consisting of only one species. Usually, schools are made up of 2-4 species, of which any one can be dominant.

3.4.1 Thunnus albacares

Two sizes groups are found in purse seine catches : 36-65 cm and 80-170 cm. The smallest size group consists of immature specimens and is not common in the catches, while the larger fish are mature. The mean lengths of immature and mature tunas are of the order of 50-55 cm and 110-130 cm respectively.

3.4.2 Katsuwonus pelamis

Aggregations vulnerable to purse seines are formed in April-May. In 1982-1984, their lengths ranged from 42-66 cm, the mean being 51.3-54.5 corresponding to the age of 2-5 years. Gonads are usually in the pre-spawning stage which could indicate that spawning occurs in the Sierra Leonean waters.

3.4.3 Euthynnus alleteratus

Lengths range from 35-54 cm, averaging 44.4- 45.1 cm in the catches. Prespawning and spawning concentrations occur in February-April. Fish of 2-3 years old predominate in the catches.

3.4.4 Auxis thazard

In February-June, lengths and weights in the catches vary between 26-49 cm and 0.27-2.20 kg. Mean monthly lengths vary between 37.7-40.9 cm, mean weight 0.97-1.28 kg. Tunas recorded in February are of smaller size than those caught in March-June. The observed tuna aggregations are mainly in spawning condition, and the proportion of pre-spawners and spawners increases from February to April. At ages 1, 2, 3 and 4 recorded lengths are 22.9 cm, 30.4 cm, 36.7 cm, 40.4 cm. The bulk of the catches consists of tunas aged 3 (50%) and 4 (45%).

4. STOCK ASSESSMENT

Acoustic and trawling surveys conducted in 1984 have indicated that the total biomass of pelagic fishery resources in Sierra Leone would be of the order of one million tons 1/. This total would consist of about 400,000 t of Balistes, 300,000 t of Carangids, 100,000 t of Sardinella and 200,000 t of other species.

However, the limited areas of investigation makes it difficult to understand migration patters, distribution and size of the stocks of the Sherbro division. It is recommended that a common fishery research programme be established for the whole subarea and that scientific efforts be coordinated.

1/ Note from the Secretariat : The Working Group regretted that no further information was available on the methods of estimation used and expressed its desire to see a detailed account of the surveys.

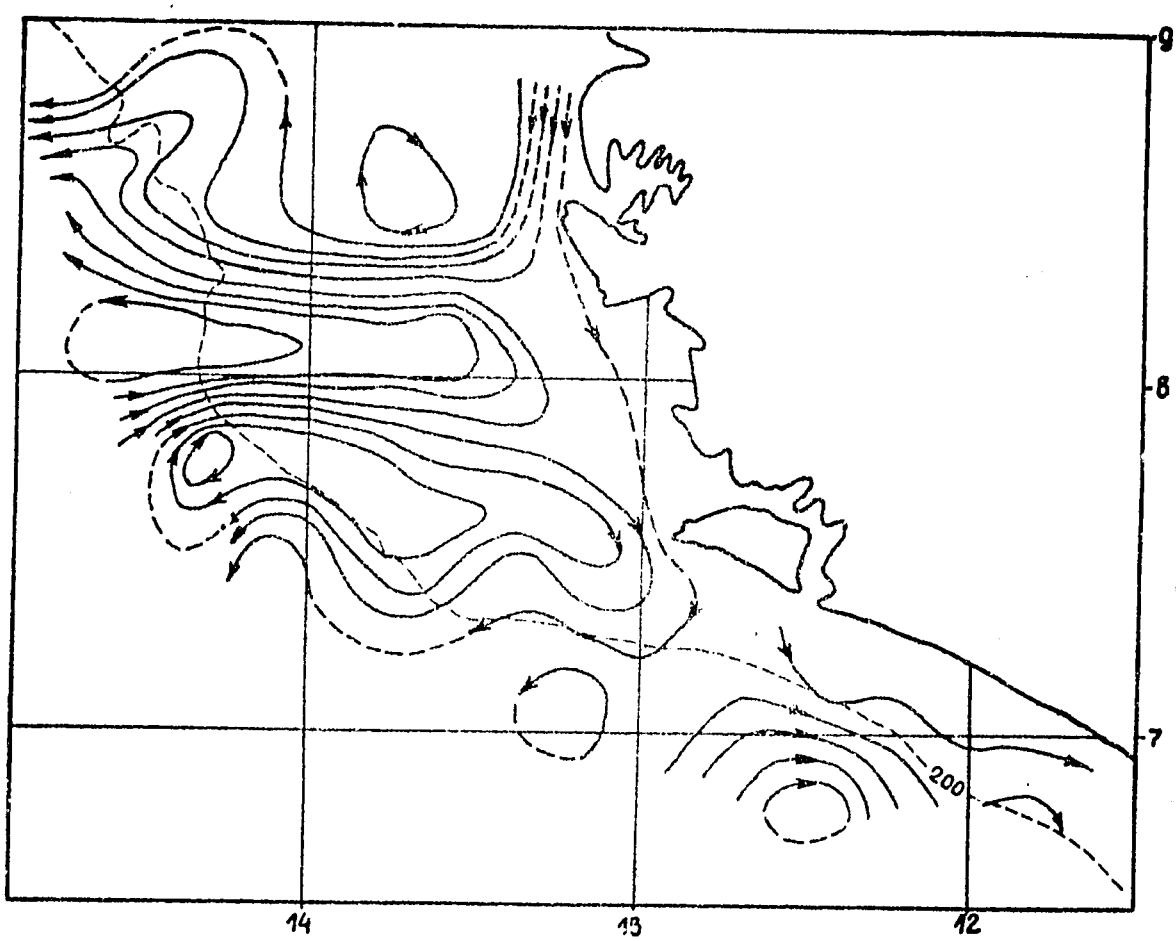


Figure 1 : Geostrophic circulation of surface waters on the Sierra Leonean shelf in the winter period (15-19 February 1981). Dynamic horizontal lines are drawn in 10 dyn. mm.

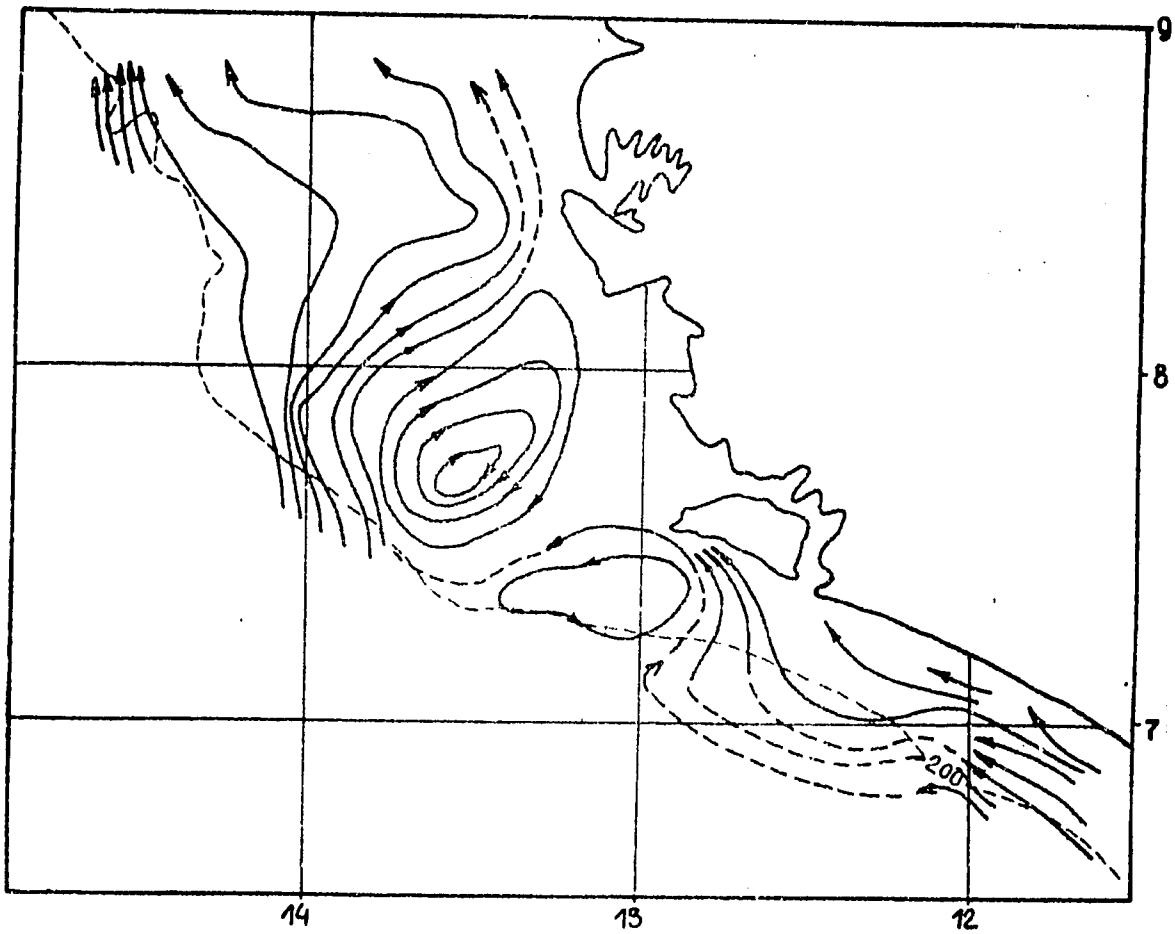


Figure 2 : Geostrophic circulation of surface waters on the Sierra Leonean shelf in the summer period (18 July-2 August 1981). Dynamic horizontal lines are drawn in 10 dyn. mm.

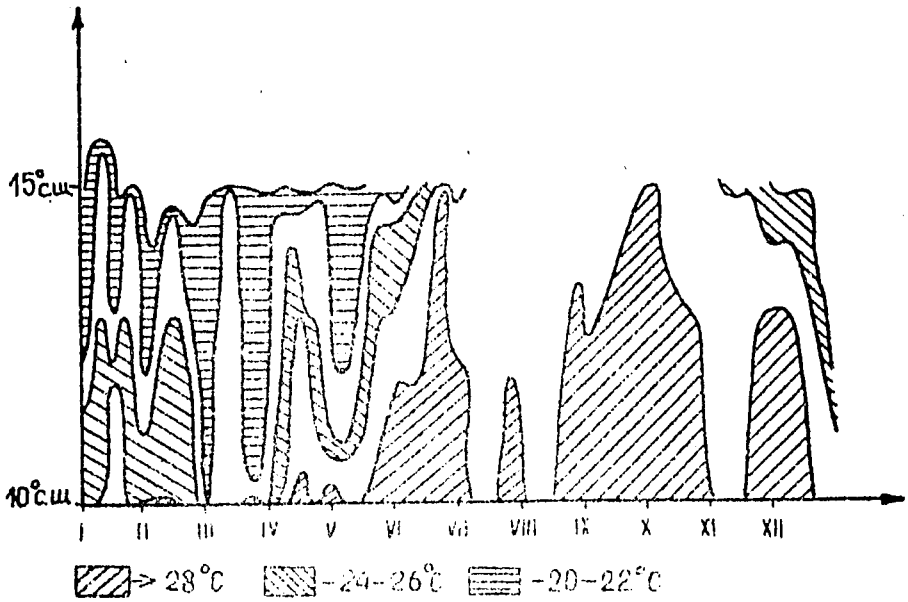


Figure 3 : Diagram of spatial and temporal variability of surface water temperatures above the 200 m isobath in 1984 (according to Dr. Sedgich)

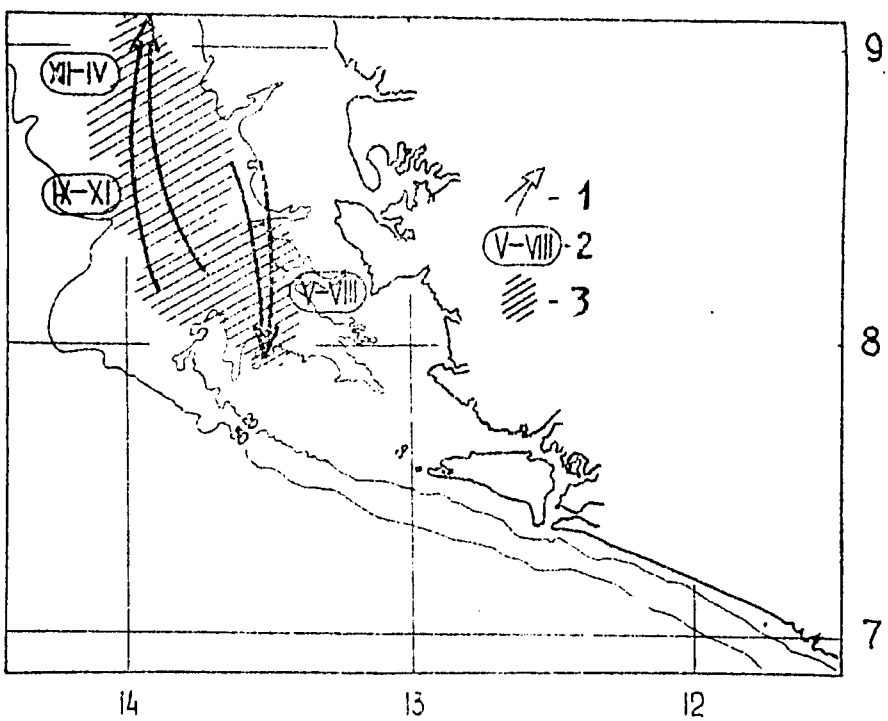


Figure 4 : Distribution of Sardinella aurita during the year (1-direction of movement ; 2-months ; 3-area of aggregations).

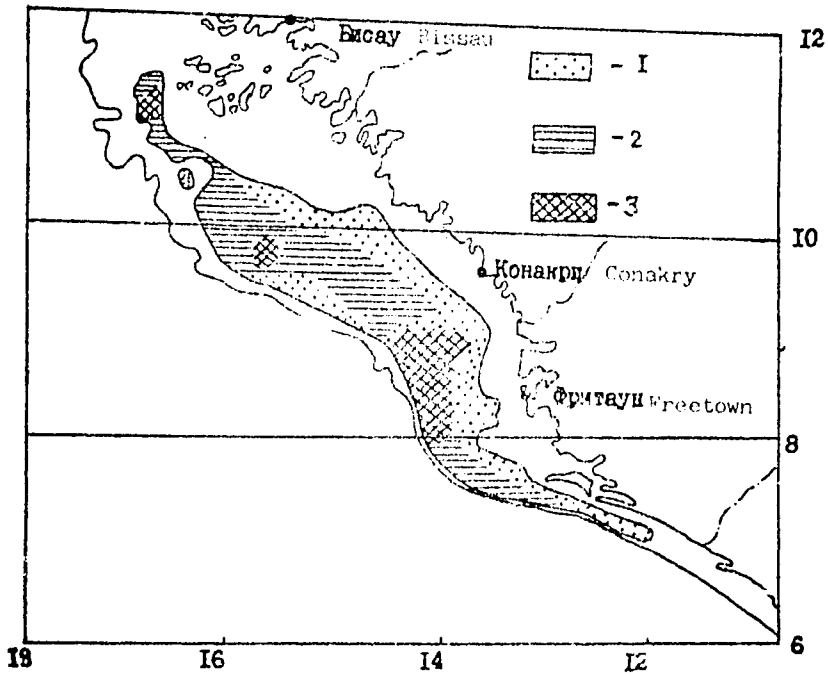


Figure 5 : Distribution of gray triggerfish in May-June 1984 (1,2,3 - gradation of density with its increase).

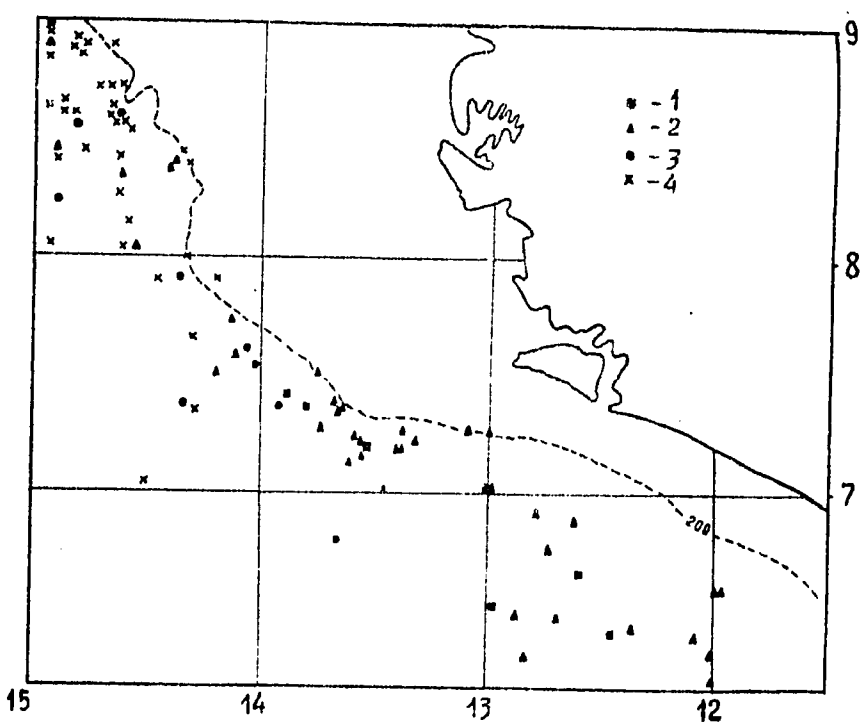


Figure 6 : Distribution of tunas caught with purse seines in February-June (1-February, 2-March, 3-April, 4-May, June)

Appendix 4

REPORT ON THE RESULTS OF FISHERY INVESTIGATIONS CONDUCTED BY THE R/V EVRIKA IN THE WATERS OF THE REPUBLIC OF SIERRA LEONE

8-28 June 1984

by

AtlantNIRO, Kaliningrad, USSR

1. INTRODUCTION

Joint fishery research continued in 1984, under the agreement between the Governments of USSR and Sierra Leone. The research programme adopted was similar to the previous ones, a new item being an acoustic survey. Principal objectives of the survey were : study of hydrometeorological conditions, ichthyofauna composition and distribution of commercial organismes, collection of biological data on commercially interesting fish species, estimation of abundance and status of fish stocks. Expedition leader was Mr. D.G. Bourdine, and scientific staff consisted of V.I. Bylin, L.N. Dobysheva, M.V. Domanevskaya, N.A. Dmitriev, S.L. Kalachev, F.P. Patikina, L.L. Romensky, I.N. Senina, V.P. Shapoval and G.V. Shishkina. Two representatives of Sierra Fishing Company (Messrs B. Stevens and R. Sawyerr) participated in the last part of the survey.

2. METHODOLOGY

2.1 Hydrometeorological observations

Hydrometeorological data (air temperature, sea state, nebulosity, precipitations, etc.) were recorded daily at standard times (00, 06, 12 and 18 HRS GMT). Hydrological stations followed each trawl haul over a depth range of 20-500 m. At the trawling depth, temperature, salinity and oxygen measurements were made. During hydrological and simultaneous ichthyoplankton surveys, observations were made at standard depths. Ichthyological sampling was done using conical nets of type IKS-80, in the bottom to surface layer over the shelf, and 100-0 m outside the shelf area. Samples were preserved for further study at AtlantNIRO.

2.2 Trawl surveys

During the inventory bottom trawling survey half-hour hauls were made along a series of transects perpendicular to the coastline. The nets used were of the standard "HAKE-4M"type, and were fitted with a leaded ground rope. Hauls were made during the daytime at depths of 15-20, 30, 50, 75, 100, 200, 300 and 500 m. Towing velocity was 4 knots. At nighttime, over and outside the shelf area one hour hauls were made with a pelagic trawl (72/308 design), in the subsurface layers in order to determine species composition and distribution patterns of pelagic organisms. Towing velocity was 5 knots.

Species composition and weight was determined of the experimental catches. First large individual specimens were taken from the catches, which were weighed and counted separately. Then a representative sample was taken of the rest of the catch and the results obtained extrapolated. Length measurements and biological analyses followed of the major commercial or otherwise abundant species. Samples were taken of these species for later age determination in the laboratory. All cephalopods and shrimps were collected for identification and biological examination.

2.3 Other observations

During the entire survey, visual and acoustic observations were made. Acoustic observations were made in the upper 300 m water layer outside the shelf area. The location of fish concentrations, bird flocks and sea mammals was recorded during visual observations.

3. SURVEY RESULTS

3.1 Hydrometeorological observations

Bathythermograph stations and hydrological survey charts are presented as Figures 1 and 2. The investigated area is situated at the border of equatorial and marine tropical air masses. The Sierra Leonean waters are located in the eastern part of the subequatorial climatic zone where the monsoon type of atmospheric circulation prevails.

The survey timing coincided with the SE monsoon. During the entire investigation period the weather was dull, and nebulosity ranged from 7 to 10. Air temperatures varied between 25.2 and 29.1°C, and reached 30-32°C on some days. Temperate (force 3-4) winds of SW, W and NW direction were observed, and cloud development can be characterized as powerful cumulus and rainy-stratified, with heavy showers and frequent thunderstorms. Squally short-term winds with heavy precipitation were accompanied by a sharp decrease of air temperatures to 23°C, and strengthening of the wind to 12-15 m/sec. During the entire investigation period the sea state was 2-3 (Beaufort scale) with good visibility. However, visibility was temporarily reduced during heavy precipitation.

During the survey period, the Sierra Leonean waters comprised water masses differing in temperature, salinity and chemical parameters (Figures 3-6). Heavy precipitations, changes of temperatures and winds and the effect of river drainage created complex hydrological conditions.

The NE part of the area is occupied by warm low-salinity waters with temperatures over 28°C and salinity of 34‰. Oceanic tropical waters with a salinity of 35-5‰ arriving from the NW, form a frontal zone at 8°N. The low-salinity coastal waters meet with the approaching equatorial oceanic waters and for clearly pronounced frontal zones South of 8°N. In the southern part of the area, the upwelling and sinking of water generate currents taking the shape of eddies. The oxygen content of the water gradually decreases with increasing depth, but along the 8°N parallel well-oxygenated waters can be traced to the bottom at the edge of the shelf (Figures 6 and 7). It should be noted that on the average the salinity near the bottom is 1‰ higher than near the surface.

The vertical thermohaline structure show large fluctuations. Gradients in chemical parameters are usually not observed in warm coastal waters, but they can be found along the frontal mixing zones at 30-40 m depths.

3.2 Bottom trawl surveys

Ichthyological sampling was done during the bottom trawl survey and the nocturnal pelagic trawling (Figures 1 and 2). Over 200 fish species occured in the catches. A list of the main species together with their size range and most common lengths and mean weights is given in Table 1.

The diversity of biotopes typical of Sierra Leonean waters as well as the complex hydrological conditions arising from the monsoon rains greatly influence the distribution and the abundance of the fishery resources.

During the inventory survey, 52 hauls were made along 10 transects in depth ranges oF 16-510 m. The distribution of the main fish species in the catches is shown in Figure 9. Great differences in catch size and composition occured on different parts of the shelf. Catch volume varied between 0.13 and 40.2 100 kg units per 30 minute haul.

The investigated area can be divided into three zones differing in species composition. The first of these zones is situated in the NW part of the area and is under the influence of the relatively cold saline waters originating from the North. In the shallow waters of this zone, on sandy grounds mixed with shell debris, catches ranged from 0.17-0.99 100 kg units at depths of 17-30 m. Main species caught were young specimens of Decapterus punctatus, barracudas, Balistes and juvenile Sparus caeruleostictus. At depths of 30-50 m, on sandy grounds mixed with small shells and rocky outcrops, catches were mostly composed of prespawning and spawning specimens of Sparus caeruleostictus, Dentex canariensis and Lethrinus atlanticus, spent Pagellus bellottii and feeding Balistes. Catches were of the order of 1.0-2.8 units. Near the continental slope (70-90 m),

above rocky and coral grounds, particularly not far from canyons, fish concentrations mainly consisted of pelagic species : Boops boops, of 12-22 cm length (mostly 15-20 cm) and gonads in maturity stage 2 (pre- and postspawning), Trachurus trecae of 17-20 cm, Sardinella aurita of 14-18 cm and Decapterus punctatus. The catch of these species was of the order of 2.5 100 kg units per haul.

The second zone is the one of lowsaline and warm homogeneous waters northwest of Sherbro island, and covers the vast shallow areas and the middle part of the shelf (20-50 m depth). Here, prespawning and spawning concentrations of Alectis alexandrinus, Brachydeuterus auritus. Sparus caeruleostictus, Albula vulpes, Selene dorsalis, Chloroscombrus chrysurus and other species were caught over sandy bottoms. In the periphery of this zone, in its S and SW parts where coastal and oceanic waters mix and where sandy and silty grounds alternate, the catches consisted of Chloroscombrus, Galeoides, Selene, Hemicaranx bicolor and Ilisha. At 75-120 m depth, Dentex congoensis and D. angolensis, sea bass, sharks, especially Mustelus mustelus were caught. The coastal waters forming a front between the "Guinean" waters from the North and lowsaline waters from the South are of special importance. This front lies at depths of 20-30 m above the shelf between 8° OON and 8°30 N. Major concentrations of Balistes, the predominant fish species in the ichthyofauna of the N and central Sierra Leonean waters, occurred here. The catches of this species reached 17 100 kg units per haul. In the areas where Balistes had actually forced out all other inshore fish species, near bottom temperatures were characterized by high temperatures (29°C) and high oxygen content (4.8 mg/l). Dense Balistes concentrations consisted of spent fish, 14-34 cm in length, with a modal length of 16-17 cm.

The third zone is located in the SE part of Sierra Leonean shelf, where the continental shelf narrows and the upwelling and sinking of water become more evident over the slope. In the coastal part of this zone with prevailing silt grounds Ilisha, croakers, Galeoides, and Drepane africana predominated. At 30-40 m depth, the catches of these species varied from 1.2 to 8.2 100 kg units per haul. At 50-90 m depths, Dentex spp., large sea breams and sea basses were most common. Catches were of the order of 1.6 100 kg units. On the continental slope (250-300 m), in the areas of sinking warm surface waters, large prespawning concentrations of hairtails of 48-60 cm length and Cyttus hololepis of 8-11 cm were recorded. The catches of these species were 32.0-40.0 100 kg units per standard haul.

3.3 Biological characteristics of main fish species

3.3.1 Balistes

Balistes is the most abundant species in Sierra Leonean waters. It ranges over the entire shelf at depths of 19-75 m. Major concentrations, however, are found North of 8°N, in 20-40 m depths (Figure 10). Length of fish in the catch is 14-35 cm, most being 16-18 cm. Large specimens are caught at greater depths. During the survey period all specimens were at maturity stages 2, 6-2.

3.3.2 Dentex angolensis

This species occurs over the entire shelf and above the slope at depths ranging between 50 and 300 m, mainly at 75-100 m depth. Concentrations were recorded in the central part of the region, but were most abundant in the South (Figure 11). Lengths varied between 12 and 30 cm, most being 18-21 cm. Most of the catch consisted of prespawning specimens.

3.3.3 Dentex congoensis

D. congoensis was caught in the central and especially in the southern part of the region at depths of 60-190 m, mostly 70-100 m (Figure 12). The length of the fish in the catches was 11-22 cm, averaging 14-18 cm. A large proportion of the concentration spawned at 75-105 m. Spawning took place mainly in the southern area.

3.3.4 Sparus caeruleostictus

This species has a wide distribution within the depths of 16-95 m. Largest catches were made in the N part of the survey area, between 30 and 33 m (Figure 13), where concentrations consisted of prespawners of 17-38 cm length, most being 19-22 cm. Juveniles of 8-14 cm occurred at depths of 16-20 m in the coastal zone N of Sherbro Island. South of Sherbro Island, only larger specimens were found (23-43 cm, mostly 17-37 cm). Spawning concentrations occur at 50 m depth, sometimes down to 70-75 m. The majority of the females caught is the S regions were in spawning condition, with gonads in stages 4-5. Females from N regions had already spawned the first portion of their eggs, and their gonads were mostly in maturity stages 6-4.

3.3.5 Pagellus bellottii

P. bellottii occurs in small numbers throughout the area at depths of 16-95 m. Densest concentrations were found only in the northern region at 30-75 m depth (Figure 14), yielding catches of up to 0.7 100 kg units per haul. Lengths varied between 8 and 24 cm, mostly 14-18 cm. Most specimens, already spent, were feeding. Juveniles of 7-14 cm occurred at depths of 16-20 m.

3.3.6 Chloroscombrus chrysurus

Occurs at depths of 16-50 m. Main concentrations in coastal zone of Sherbro Island and S. of it. Caught individually in the N part of the area. The majority of the specimens were in prespawning condition.

3.3.7 Sardinella maderensis

Main concentrations in the shallow waters around Sherbro Island at 16-30 m depth. Small numbers were found in N and S part of the area at 20-35 m depth, sometimes in the pelagic area above 50-65 m depth. Gonads were in stages 4, 6-4 and 6-2.

3.3.8 Sardinella aurita

This species occurs in the N part of the area, at 16-25 m depths in the coastal area, and in the zone above the slope at 50-95 m, mainly above the shelf part between 8°10 and 8°40'N. Catches from the coastal area were of specimens 6-17 cm long, and 14-21 cm at greater depth (predominantly 18-19 cm). At night, S. aurita of 15-20 cm can also be caught in the pelagic area between 8°10 and 8°40'N. It does not form large concentrations and most specimens were immature (stages 2,6-2).

3.3.9 Brachydeuterus auritus

Occurs individually in the North, and in greater numbers in the central and southern part. Depth of occurence range from 16 to 40 m. Spawning concentrations were encountered in the southern part of the area at depths of 30-35 m. Fish lengths are 4-19 cm, most being 12-15 cm.

3.3.10 Dentex canariensis

This species is caught in the depth range of 19-75 m, mainly in the N part of the area. Lengths varied from 12 to 52 cm. Juveniles of 12-20 cm were observed at depths of 19-23 m. Fish of 28-40 cm length spawned at 60-75 m depth.

3.3.11 Selene dorsalis

Occurs at 16-75 m depth, mainly in the central and S part of the area. Young fish 4-17 cm long were observed in the coastal area at 16-40 m depth. Some specimens of 4-6 cm length were caught in the surface layers of the shelf zone and over the continental slope above depths of more than 1 500 m. Prespawning and spawning concentrations formed at 50-75 m depth. The majority of females had gonads in maturity stages 4, 4-5 and 6-4.

3.3.12 Alectis alexandrinus

Was found only in the central and southern parts of the area at 16-76 m depth. Lengths in the catch ranged from 9 to 65 cm, and most fish measured 23-36 cm. Juveniles of 9-13 cm were caught in the S of the area at 30-35 m deep. Spawning fish of 25-55 cm length were observed in the central area at 16-20 m. Spawning was also observed at night in surface water layers above depths of 50-65 m.

3.3.13 Galeoides decadactylus

Occurs in the shallow waters around Sherbro Island and in the Southern part of the area at 16-40 m depth. Fish lengths were 14-34 cm, and lengths of 18-30 cm dominated. Most specimens were in pre- or postspawning condition. Spawning was observed at 16-20 m depths.

3.3.14 Ilisha africana

This species is found, like the former species, in the shallow waters around Sherbro Island and in the S part of the area at 16-40 m depth. Fish of 12-20 cm formed dense prespawning and postspawning concentrations.

3.3.15 Albula vulpes

Was caught only in the central part of the area, at 16-50 m depth. Pre- and postspawning concentrations occurred at 50 m depth. Lengths in the catch ranged from 16-41 cm, most fish being 32-36 cm.

3.3.16 Caranx spp.

Catches of this genus contained mainly C. senegallus and C. crysos. These species did not form near bottom concentrations. At night, relatively large catches were made in the pelagic area (7°35'-8°15'N) above 50-75 m depths. Prespawning specimens made up the entire catch and measured 30-68 cm, most being 33-42 cm.

3.3.17 Decapterus punctatus

Occurred near the bottom both in the coastal zone at 17-20 m (mainly in the North), and along the shelf edge at 90-95 m. At night, the fish formed large concentrations of prespawners in the pelagic area above 50-75 m depths. Fish lengths varied from 5 to 21 cm, and maturity stages 6-4 dominated. Intensive spawning was recorded in the pelagic area, in the area of 8°13'N and 14°13'W above 50-65 m depths. Spawners were 15-20 cm long. Juveniles of 5-11 cm concentrated near the bottom in shallow waters, sometimes pelagically above 60-75 m depths.

3.3.18 Sphyraena afra

This species occurred regularly in small numbers in the catch over depths of 16-50 m. Concentrations were found at 16-30 m depths around Sherbro Island. Lengths varied from 10-110 cm. Juveniles of 10-23 cm occurred mainly in the S area near the bottom at 30-36 m and in the pelagic area over 58-65 m depths. On one occasion, a female of maturity stage 4, 135 cm in length and over 11 kg in weight was caught pelagically at 8°20'N over a depth of more than 380 m.

3.3.19 Epinephelus aeneus

Large by-catches of this species were recorded at depths of 17-300 m. Fish lengths varied between 33 and 98 cm. A small concentration of spawners of 36-65 cm was recorded near Sherbro Island at a depth of 50 m.

3.3.20 Pseudotolithus spp.

Fish of this family were not common in the catches. It is of considerable local importance in the southern regions and around Sherbro island, where it occurred at 16-40 m depths. Catches were composed of fish of 20-54 cm length, of which the lengths of 31-47 cm predominated, of maturity stages 4 and 6-4.

Length-frequency data of the main fish species are presented in Table 3.

3.4 Pelagic survey

Results of 17 pelagic hauls along 5 transects in the oceanic surface layers (5-40 m) over depths of 6-2 500 m showed the location of major pelagic fish concentrations (Figures 15 and 16). Data were obtained on the distribution of sailfish (Istiophorus albicans), Carangids, tunas (Auxis spp., Euthynnus spp.), Ariomma bondi and Paracubiceps multisquamis as well as Cubiceps pauciradiatus.

The densest concentrations were recorded between 8°15' and 7°55'N above 50-60 m depths, where catches were made of 27.5 100 kg units per hour trawling, mainly consisting of prespawning and spawning Caranx senegallus and C. crysos.

In the areas situated to the N and to the S of this region, catches were made of individual feeding specimens of sailfish of 140-155 cm, 20-25 kg in weight. Auxis spp. and Euthynnus were found almost everywhere on shelf and slope above 60-1 200 m depths. Catches of these species were as high as 1.5 100 kg units per hour.

In addition to food fish, Ariomma bondi and Cubiceps pauciradiatus were common in the catches. The former species was abundant in the N parts of the shelf above 60-120 m depth and the latter inhabited mainly the central part of the area above the continental slope (1 000-2 000 depths). Catches of these two species were respectively 0.2-0.8 and 0.05-2.2 100 kg units per haul.

Length frequency percentages of pelagic fish species are summarized in Table 4.

3.5 Study of Cephalopods and Shrimps

A total of 29 species of cephalopods and shrimps was found, of which 7 shrimp species and 4 cephalopods of great commercial importance. None of the species found formed commercially interesting concentrations. A possible explanation for low invertebrate catches could be the fact that a small meshed chafer was not inserted into the codend of the trawl.

3.5.1 Sepia spp.

This species was the most common in the catches. During the survey, it was mainly caught in the N part, at depts of 17-78 m, on sandy ground mixed with shells and pebbles. Catches were recorded up to 5.1 kg per 30 min haul, at 53-56 m depths (Figure 17). In the catches South of 8°N, the species occurred individually.

At the sampled depths, cuttlefish of both sexes occurred of 11-20 cm, most being 12-17 cm. Their mean weight 0.37 kg (Tables 5 and 6). Sex ratios varied with depth and were (females : males) : 0.26 : 1 in shallow waters and offshore, 1 : 1 at 40-60 m depth, averaging 0.41 : 1.

Gonads were in maturity stages 2-5. Over 61% of the males was in spawning condition, against 30% of the females. Feeding cuttlefishes were not found in the catches (Table 7).

Single specimens of juvenile S. bertheloti were mainly recorded in the S part of the survey area, at 19-105 m depths. Lengths ranged from 4.9-8.2 cm, weight from 20-70 g. (Tables 5, 6, 7).

3.5.2 Squids

Illex coindettii and Todaropsis eblanae were found in near bottom catches. In pelagic catches above 1 000 m depth and deeper, juvenile Thysanoteuthis rhombus as well as juvenile and adult Stenoteuthis pteropus occurred individually (Tables 5, 6 and 7).

Short finned squids were caught in small numbers throughout the investigated area over 71-100 m depths. Catches were as low as 3.5 kg per 30 min. haul. Juveniles of 4-9 cm length occurred above depths of 71-105 m, and mature specimens of all sizes were found offshore (150-400 m). Length of shortfish squids varied from 4-16 cm, averaging 7.8 cm, weighing 10.9 g. Adults of both sexes had lengths of 7-16 cm, modes for males being 9-13 cm, for females 9-10 cm.

Catches also contained some juveniles besides adults with gonads in maturity stages 1-4. The bulk of specimens sampled were juveniles (> 52%). Among the males, squids with gonad stages 1 and 5 (29.7% and 42.1% respectively) prevailed, and among females stages 1 and 2 (62.5 and 27.7%). Feeding was not intensive, stomachs contained debris of lanternfishes (Tables 5, 6, 7).

Todaropsis eblane were found individually, of lengths 4-15 cm. These squids were mostly in maturity stage 1 (tables 5, 6 and 7).

3.5.3 Shrimps

18 species of shrimps were recorded during the bottom trawl survey, of which Penaeus notialis was the most common. These large shrimps were caught on silty and silty-sandy grounds with a depth range of 32-54 cm S of Sherbro Island. Specimens of 8.5-17.5 cm occurred in the catches. Mean lengths of males and females were 11.1 and 13.7 cm respectively. During the survey period, most shrimps had already spawned and were in gonad stage 2 (60.0%), but 22% of large females had prespawning gonads. The shrimps did not feed intensively during the survey period.

The shrimp Aristeus antennatus occurred above the continental slope near the Sulima River estuary at 480-500 m depths. The catch of this species taken with non-specialized gears was 2.1 kg per 30 min. haul. Shrimp lengths were 10.5-16.5 cm, the mode being 12.5-13.5 cm. Mean weight was 31.3 g. Catches contained only females, 55% of which had prespawning gonads and were carrying spermatophores (Tables 5 and 8). Individual specimens of Plesiopenaeus edwardsianus of 15-18 cm length were observed in catches of A. antennatus (Tables 5 and 8).

3.6 Further observations

Visual and acoustic observations were recorded during the entire survey period in Sierra Leonean waters. Visually were observed in the N part of the area large concentrations of dolphins and surface swimming fish, probably small tunas. Also in the N area, considerable concentrations of Balistes were observed acoustically in shallow waters. Visual and acoustic exploration for Sardinella was not successful. Results of these observations are presented in Figure 1d.

Table 1 : Main species in the Sierra Leonean waters, their size and weights

Scientific names	Lengths (cm).		
	Range	Average	Mean weight
Ilisha africana	8-20	13-15	29.0
Brachydeuterus auritus	4-19	14-15	35.5
Galeoides decadactylus	13-34	23-25	354.9
Pseudotolithus spp.	20-83	30-45	592.9
Sparus caeruleostictus	11-40	(17-19	411.7
		(27-30	
Balistes capriscus	14-36	16-18	150.5
Dentex angolensis	12-30	18-21	156.9
Dentex congoensis	10-22	15-16	89.0
Lethrinus atlanticus	20-34	26-27	402.5
Sphyraena afra	16-111	30-40	124.8
Epinephelus aeneus	34-65	(41-42	1396.0
		(45-47	
Sardinella aurita	14-18	16	57.3
Sardinella maderensis	12-25	17-19	79.3
Ariomma bondi	8-15	12-13	34.2
Chloroscombrus chrysurus	10-22	16-17	72.3
Trichiurus lepturus	15-60	(30	65.0
		(50-55	
Caranx crysos	28-68	30-35	930.0
Selene dorsalis	8-29	21-23	169.0
Auxis rochei	21-36	24-26	280.0

Table 2 : List of species groupings corresponding to symbols in Figure 9. Names are those used in FAO Species Identification Sheets for CECAF area.

1.	Balistes capriscus	100%
2.	Balistes capriscus	95-98%
3.	Chlorophthalmus atlanticus	50%
	Cyttus hololepis	20%
	Synagrops microlepis	10%
4.	Sparus caeruleostictus	40%
	Dentex canariensis	30%
	Lethrinus atlanticus	10%
5.	Boops boops	60%
	Trachurus trecae	15%
	Decapterus punctatus	15%
	Sardinella aurita	5%
6.	Ariomma bondi	90%
	Smaris macrophthalmus	5%
7.	Decapterus punctatus	10-30%
	Sphyraena afra	25%
	Sparus caeruleostictus	15-20%
	Balistes capriscus	10-20%
8.	Alectis alexandrinus	20-50%
	Sparus caeruleostictus	20-30%
	Albula vulpes	10-40%
	Lethrinus atlanticus	25%
9.	Galeoides decadactylus	45%
	Chloroscombrus chrysurus	10%
10.	Chloroscombrus chrysurus	40%
	Selene dorsalis	10%
	Hemicaranx bicolor	20%
11.	Brachydeuterus auritus	40%
	Drepane africana	20%
	Ilisha africana	20%
	Galeoides decadactylus	10%
12.	Trichiurus lepturus	100%
13.	Merluccius polli	60%
14.	Dentex congoensis	80%
	Dentex angolensis	15%
15.	Cyttus hololepis	65%
	Trichiurus lepturus	25%
16.	Dentex angolensis	60%
	Dentex congoensis	30%
	Squatina oculata	10%
17.	Dentex congoensis	90%
	Dentex angolensis	10%
18.	Selene dorsalis	20-80%
	Dentex angolensis	20%
	Dentex congoensis	10-50%
19.	Dentex angolensis	50%

Table 3 : **Length frequency of main fish species (%) from the data of bottom trawling survey.**

Species	Length, cm																			
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Ilisha africana							1,6	2,6	5,2	4,4	9,9	16,0	16,2	17,8	9,9	8,4	4,0	2,4	1,6	
Brachydeuterus auritus			0,3	2,1	9,2	7,4	4,4	2,7	6,8	5,6	12,2	12,2	15,3	14,6	4,7	2,1	1,2	1,2		
Galeoides decadactylus												0,6	0,6	0,6	0,6	1,2	4,3	6,7	5,5	3,2
Selene dorsalis							0,2	5,0	6,9	3,2	1,6	0,6	1,7	3,6	3,0	2,2	3,6	4,9	5,9	11,8
Trachurus trecae																25,6	68,6	5,4		
Decapterus punctatus				0,2	0,3	1,4	1,0	3,2	10,5	7,7	10,5	13,0	11,7	7,7	5,2	6,5	8,8	6,1	2,8	1,4
Caranx crysos																				
Sparus caeruleostictus										0,3	4,9	4,6	2,8	2,4	2,6	5,2	5,7	5,9	4,1	3,6
Pagellus bellottii							1,2	3,3	4,9	2,9	0,9	0,7	6,5	13,4	20,6	17,4	10,3	8,0	5,4	2,2
Balistes capriscus													0,2	4,0	28,3	27,3	16,2	7,0	2,4	3,0
Dactyiopterus **volitans**												0,8	10,4	22,2	13,1	7,9	3,6	4,4	4,2	3,8
Dentex angolensis											0,9	1,7	4,0	3,9	4,9	8,6	14,3	13,9	15,1	14,5
Dentex canariensis											1,1	3,3	11,3	6,8	2,2	3,3	–	–	1,1	–

Table 3 (continued)

Species	Length, cm																					No of sp.
	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	Total, %	
lisha africana																					I00	544
rachydeuterus auritus																					I00	337
aleoides decadactylus	3,7	7,4	8,0	8,0	4,9	I0,4	4,9	9,2	5,5	4,3	6,2	2,4	I,8								I00	I0[illegible]
Selene dorsalis	I5,6	I0,7	I0,0	5,4	2,7	I,3	0,7	0,2													I00	8I[illegible]
rachurus ieche																					I00	[illegible]
ecapterus punctatus																					I00	[illegible]
aranx hrysos									4,7	4,7	I6,5	44,7	2I,2	7,0	-	I,2					I00	57I
parus aeruleostictus	5,7	3,2	2,5	3,6	3,8	5,2	4,6	5,5	3,8	2,8	3,6	3,7	2,6	2,6	I,6	I,4	0,5	0,4	0,8		I00	85
agellus ellottii	I,2	0,9	0,2																		I00	757
allateg apriscus	2,1	I,6	2,0	I,2	I,2	0,7	0,9	0,5	0,1	0,3	0,3	0,1	0,2	0,3	0,1						I00	447
actylopterus olitans	5,5	6,8	6,0	3,8	2,5	2,2	I,4	0,3	0,5	-	0,3	-	-	-	-	-	-	0,3			I00	I46
entex angolensis	9,8	3,7	I,4	I,5	0,5	0,5	0,4	0,2	0,2												I00	365
entex guariensis	3,3	3,3	I,I	4,4	3,3	5,6	3,3	3,3	3,3	6,8	4,4	4,4	-	2,2	-	5,6	-	2,2	2,2	5,6	I00	I05
	4[illegible] - 45	4[illegible] - 52	33 - 65																			
	I,I - I,I	I,I - I,I	I,I - I,I																			
																					I00	[illegible]0

Table 3 (continued)

Species	Length, cm																					
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Dentex congoensis							0,3	1,6	3,8	8,8	15,2	17,8	21,7	15,5	9,0	4,2	1,6	0,3	0,2	
Chlorophthalmus atlanticus									0,5	3,6	28,0	39,3	25,0	3,1	0,5					
Lethrinus atlanticus																	1,7	0,6	4,5	1,7
Sardinella maderensis									0,9	-	-	1,4	8,8	27,8	19,4	25,0	6,9	6,0	2,8	0,5
Sardinella aurita											1,4	10,9	54,8	31,5	1,4					
Ariomma bondi				2,6	10,6	4,5	4,5	25,6	40,2	9,4	2,6									
Chlorosscombrus chrysurus						0,2	-	-	0,9	3,9	13,7	19,2	25,3	18,1	10,5	5,6	2,1	0,3	-	

Species	Length, cm																				Total, %	No. of sp.
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41				
Dentex congoensis																					100	1817
Chlorophthalmus atlanticus	4,5	7,4	14,8	14,8	13,6	11,9	14,8	6,2	2,3	0,6	0,6										100	196
Lethrinus atlanticus	-	0,5																			100	176
Sardinella maderensis																					100	216
Sardinella aurita																					100	73
Ariomma bondi	0,2																				100	266
Chlorosc. chrysurus																					100	569

Table 3 (continued)

Species	Length, cm																		
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Alectis alexandrinus	0,3	-	0,3	2,6	4,6	4,2	2,6	3,2	3,2	5,3	8,6	9,2	9,6	5,6	5,6	6,7	3,6	2,6
Epinephelus aeneus															2,8	-	2,8	-

Species	Length, cm																					Total, %	No. of sp.
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56-65				
Alectis alexandrinus	2,8	2,8	4,2	2,1	2,6	1,4	0,7	1,1	1,1	0,7	0,7	-	0,7	0,3	0,7	-	-	0,3				100	283
Epinephelus aeneus	8,3	-	5,6	8,3	8,3	5,6	5,6	8,3	5,5	8,3	5,5	2,8	2,8	2,8	2,8	-	2,8	2,8	5,5	2,8		100	36

Table 4 : **Length frequency of** pelagic **fish species (%) from the data of** the pelagic survey

Species	Length, cm																				
	I	2	3	4	5	6	7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9	20	2I
Auxis rochei																					0,2
Ariomma bondi									0,2	0,I	0,8	I3,5	36,9	26,2	I4,4	7,3	0,6				
Paracubiceps multisquamis											I,4	8,2	8,2	3I,5	37,0	8,2	5,5				
Cubiceps pauciradiatus							0,I	I,2	I,8	4,4	6,3	35,0	45,7	5,4	0,I						
Sardinella aurita															I,2	6,3	23,0	42,9	23,4	3,2	
Selar crumenophthalmus																			3,6	I2,9	I0,4

Species	Length, cm																Total, %	No. of sp.
	22	23	24	25	26	27	28	29	30	3I	32	33	34	35	36			
Auxis rochei	0,2	2,0	I3,6	36,3	23,6	I0,0	4,5	2,2	2,2	I,0	I,6	I,4	0,6	0,3	0,3		I00	[illegible]
Caranx senegalus							5,2	7,6	37,7	I9,5	2[illegible],0	6,5	I,3				I00	[illegible]
Ariomma bondi																	I00	I183
Paracubiceps multisquamis																	I00	73
Cubiceps pauciradiatus																	I00	83I
Sardinella aurita																	I00	252
Selar crumenophth.	7,8	6,2	20,8	30,0	8,3												I00	I93

Table 4 (continued)

Species	Length, cm																		
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
Caranx crysos	0,2	0,2	2,9	7,9	11,2	13,0	11,4	9,7	11,4	7,9	5,3	2,5	3,8	2,5	-	1,8	-	0,3	

Species	Length, cm																			Total, %	No. of sp.
	46	47	48	49	50	51	59	60	61	62	63	64	65	66	67	68					
Caranx crysos	-	1,0	-	-	0,2	-	0,6	1,0	0,2	0,6	1,0	1,0	0,6	-	-	0,2				100	393

Table 5 : Most common lengths and weights of main species of invertebrates (shrimps*, squids and cuttlefish) in catches taken with bottom and midwater trawls in the Sierra Leonean zone. RV "Evrika", 8-27 June 1984.

Scientific name	Length, cm	Weight, kg
Bottom trawl		
Cuttlefish		
Sepia officinalis	I2,0-I7,0	0,22-0,4[illegible]
Sepia bertheloti	5,0-8,0	0,02-0,07
Squids		
Illex coindeti	5,0-I0,0	0,005-0,0[illegible]
Todarodes sagittatus	4,0-8,0	0,0I-0,04
Shrimps		
Penaeus notialis	II,0-I2,0	0,0I5-0,02
Aristeus antennatus	I2,5-I4,0	0,02-0,0[illegible]9
Midwater trawl		
Squids		
Thysanoteuthis rhombus	8,0-I0,0	0,09-0,I5
Stenoteuthis pteropus	8,0-II,0;22,0	0,08-0,I0;0,37

*Shrimp length was measured from orbit to telson

Table 6 : **Length frequences of main cephalopod species from the catches of bottom and pelagic trawls taken in Sierra Leone waters, RV "Evrika".**

Scientific name	Length, cm																							Total, %	No. of sp.
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27		
Bottom trawl																										
Sepia officinalis	-	-	-	-	-	-	-	4,8	12,7	1,6	15,9	31,7	14,3	9,5	1,6	6,3	1,6								100	63
Sepia bertheloti	9,1	10,1	45,5	9,1	18,2																				100	11
Illex coindeti	0,2	8,9	17,4	19,6	17,0	15,3	9,1	2,6	2,2	5,1	3,4	1,2	0,4												100	495
Todaropsis eblanae	12,5	-	37,5	12,5	12,5	-	-	-	-	12,5	-	12,5													100	8
Midwater trawl																										
Thysanoteuthis rhombus			4,5	-	45,4	27,3	13,6	9,2																		
Stenoteuthis pteropus				6,9	15,5	25,9	14,1	10,3	3,5	5,2	5,2	1,7	-	-	-	1,7	-	1,7	8,6	-	-	-	1,7		100	58

Table 7 : **State of gonads in most abundant species of invertebrates in bottom and midwater trawl catches from Sierra Leone waters, RV "Evrika", 8-27 June, 1984.**

Species	Maturity stages of female gonads, %					Total, %	No. of sp.
	I	II	III	IV	V		
			Bottom trawl				
Cuttlefish							
Sepia officinalis	-	50,0	5,0	I5,0	30,0	I00	20
Sepia bertheloti	II,2	33,3	33,3	22,2	-	I00	9
Squids							
Illex coindeti	62,5	27,7	2,7	5,3	I,8	I00	II0
Todaropsis eblanae	83,3	-	I6,7	-	-	I00	6
Shrimps							
Penaeus notialis	9,6	60,6	4,8	22,I	2,9	I00	83
Aristeus antennatus	-	2I,3	8,5	55,3	I4,9	I00	47
			Midwater trawl				
Thysanoteuthis rhombus	I00,0	-	-	-	-	I00	I2
Stenoteuthis pteropus	40,0	6,7	-	I3,3	40,0	I00	I5

Table 8 : **Length frequences of main shrimp* species in bottom trawl catches from Sierra Leone waters, RV "Evrika".**

Species	Length, mm																			Total, %	No. of sp.
	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175		
Penaeus notialis	2,0	0,5	1,5	4,0	6,0	10,9	16,9	13,9	4,4	5,0	1,0	2,5	4,0	5,5	7,5	8,4	2,5	3,0	0,5	100	207
Aristeus antennatus					2,1	8,5	-	8,5	21,3	19,1	14,9	8,5	6,4	-	2,1	4,3	4,3			100	47

Shrimp length was measured from orbit to telson

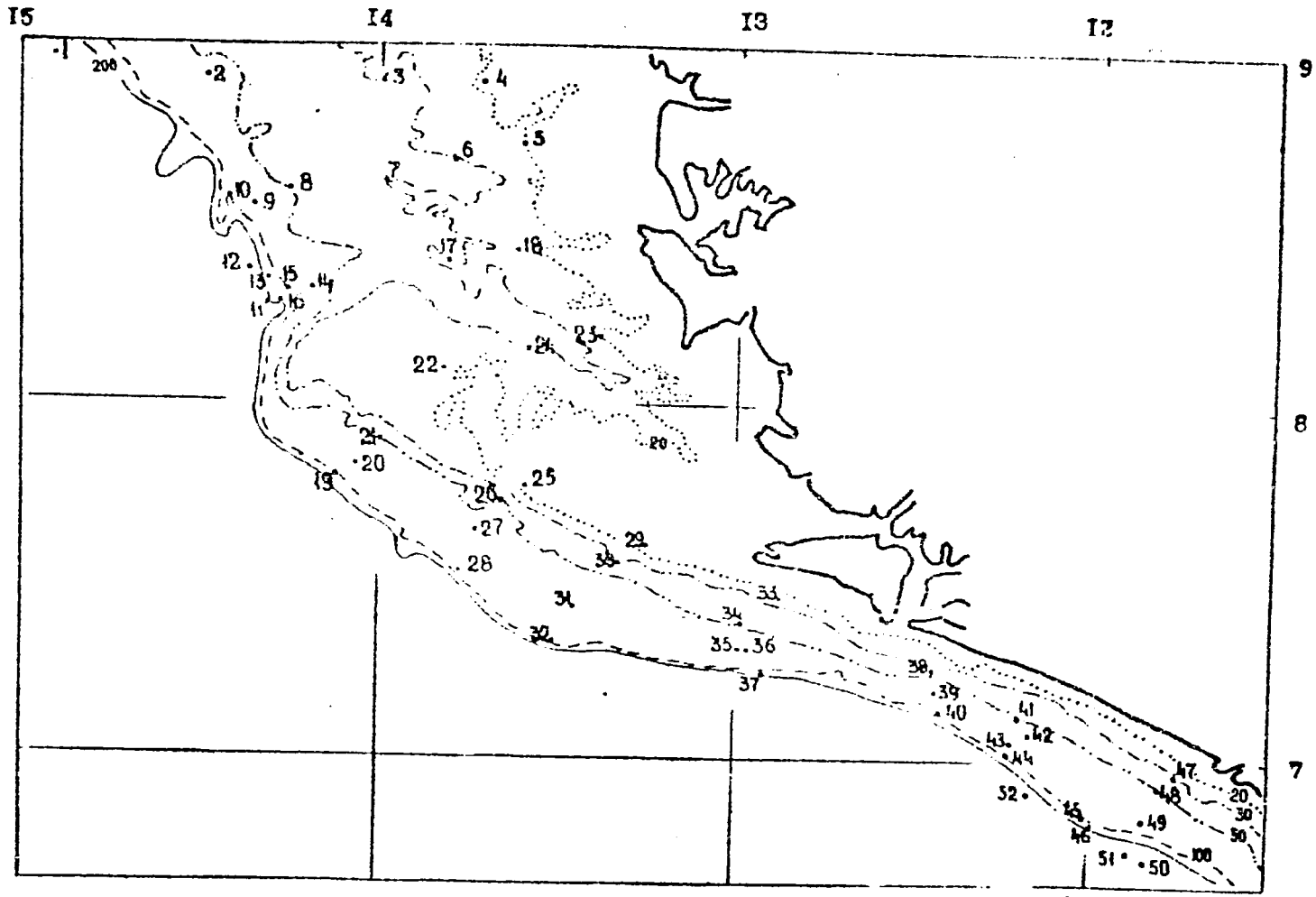


Figure 1 : Map of inventory bottom trawlings and BT stations

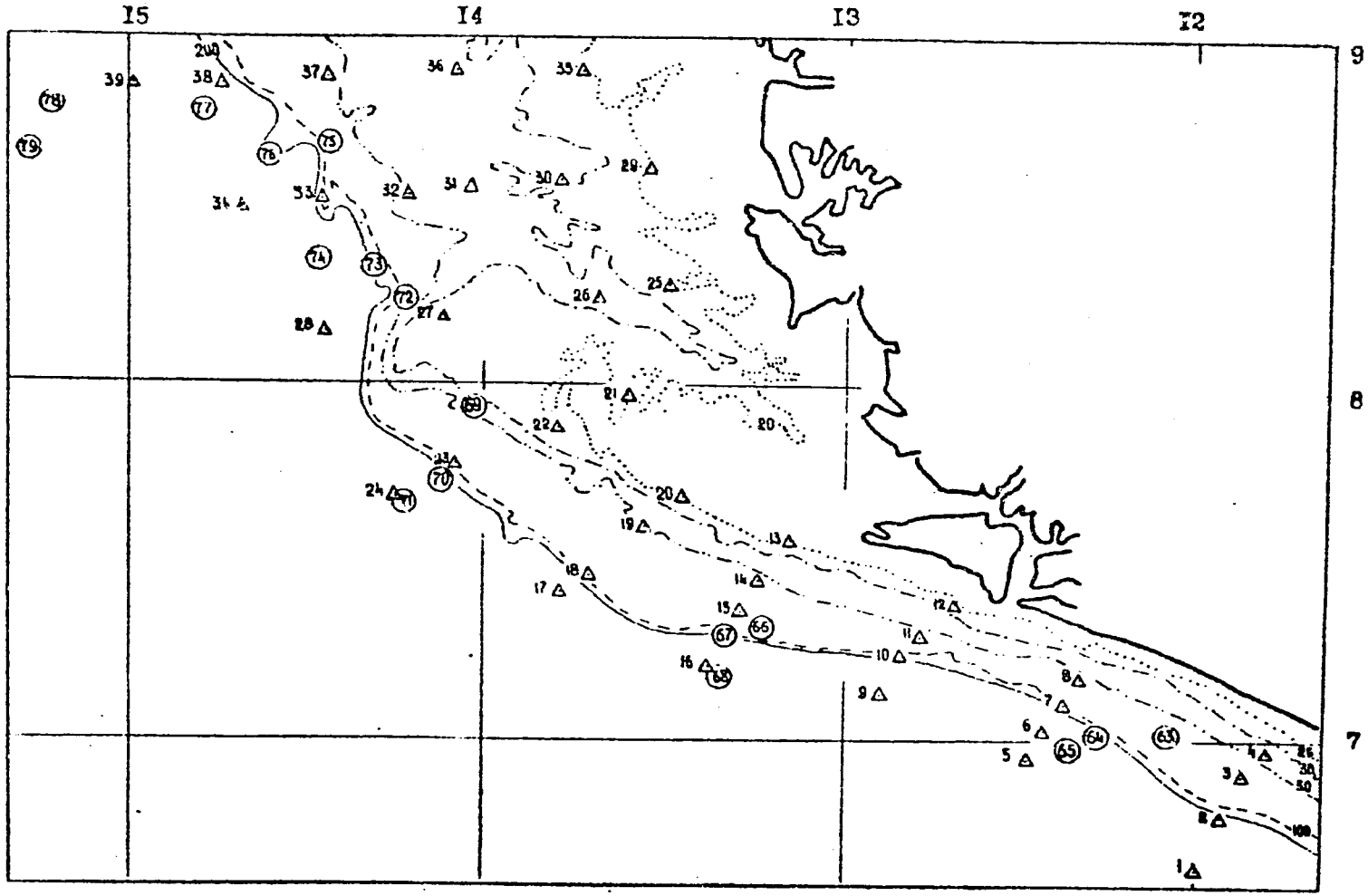


Figure 2 : Map of stations occupied during the combined hydrological, ichthyoplankton and pelagic trawl survey, 21-27 June, 1984. △ hydrological and ichthyoplankton stations, (77) pelagic trawlings

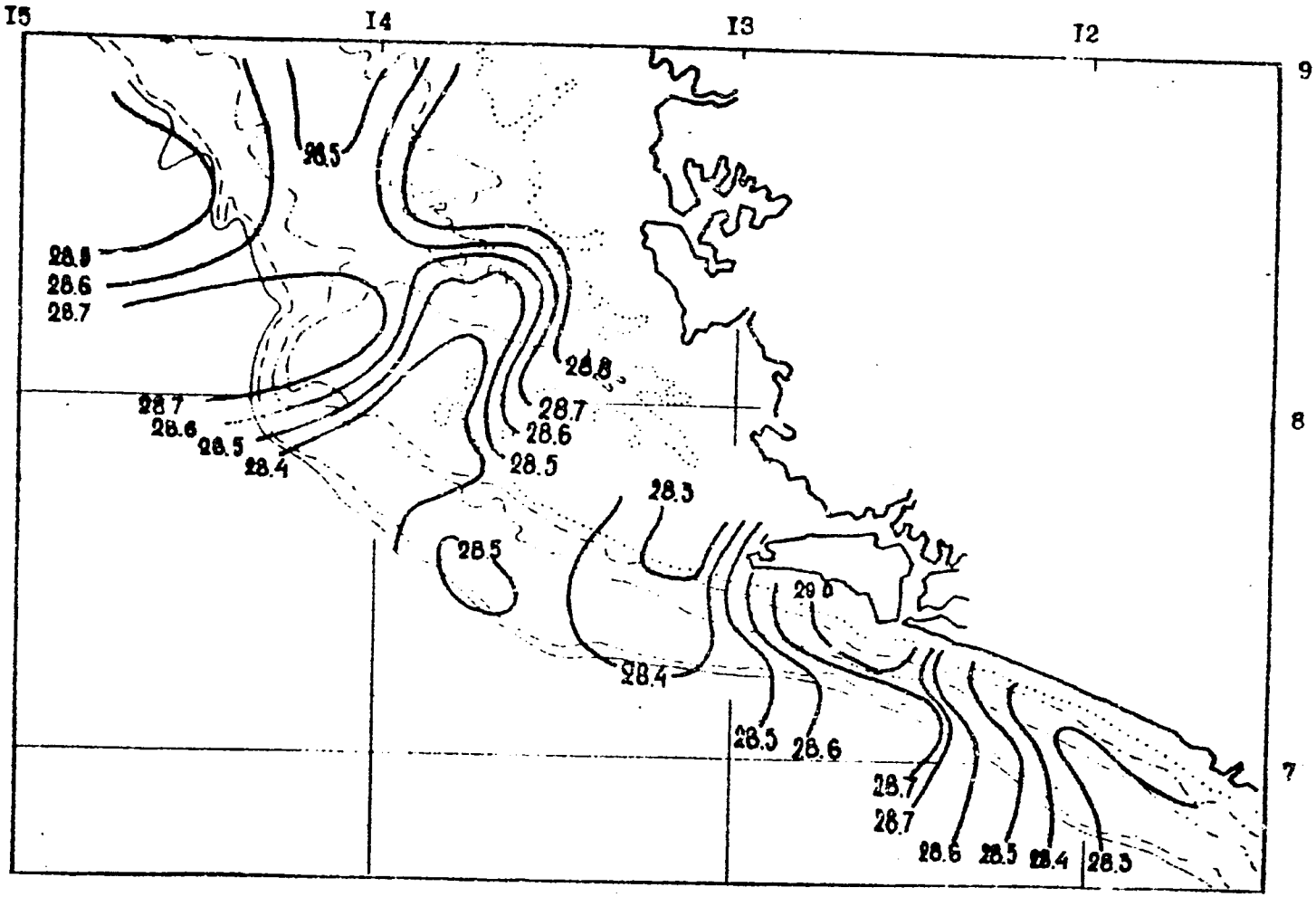


Figure 3 : Distribution of water surface temperatures, 21-27 June, 1984

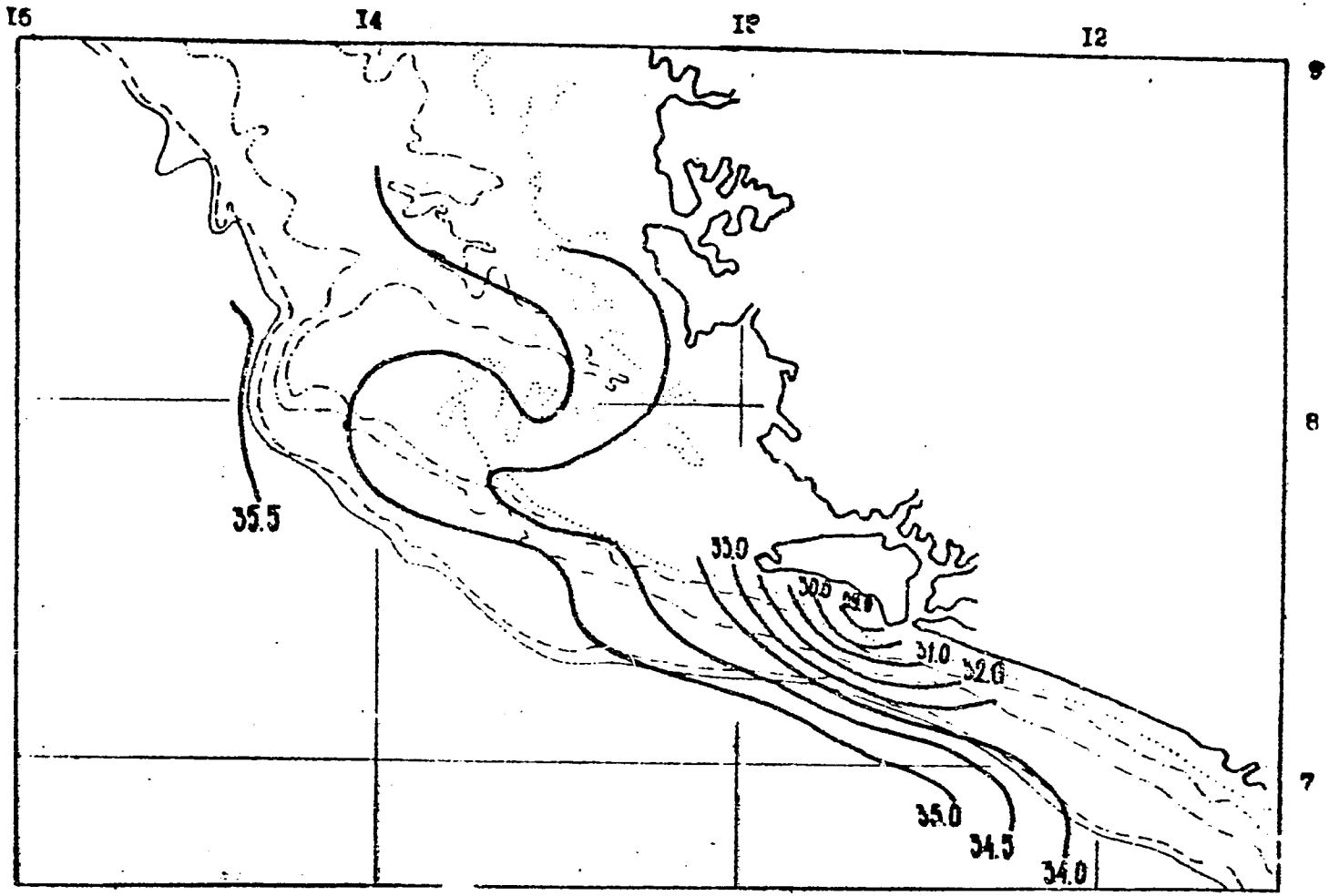


Figure 4 : Distribution of salinity in the surface layer, 21-27 June, 1984.

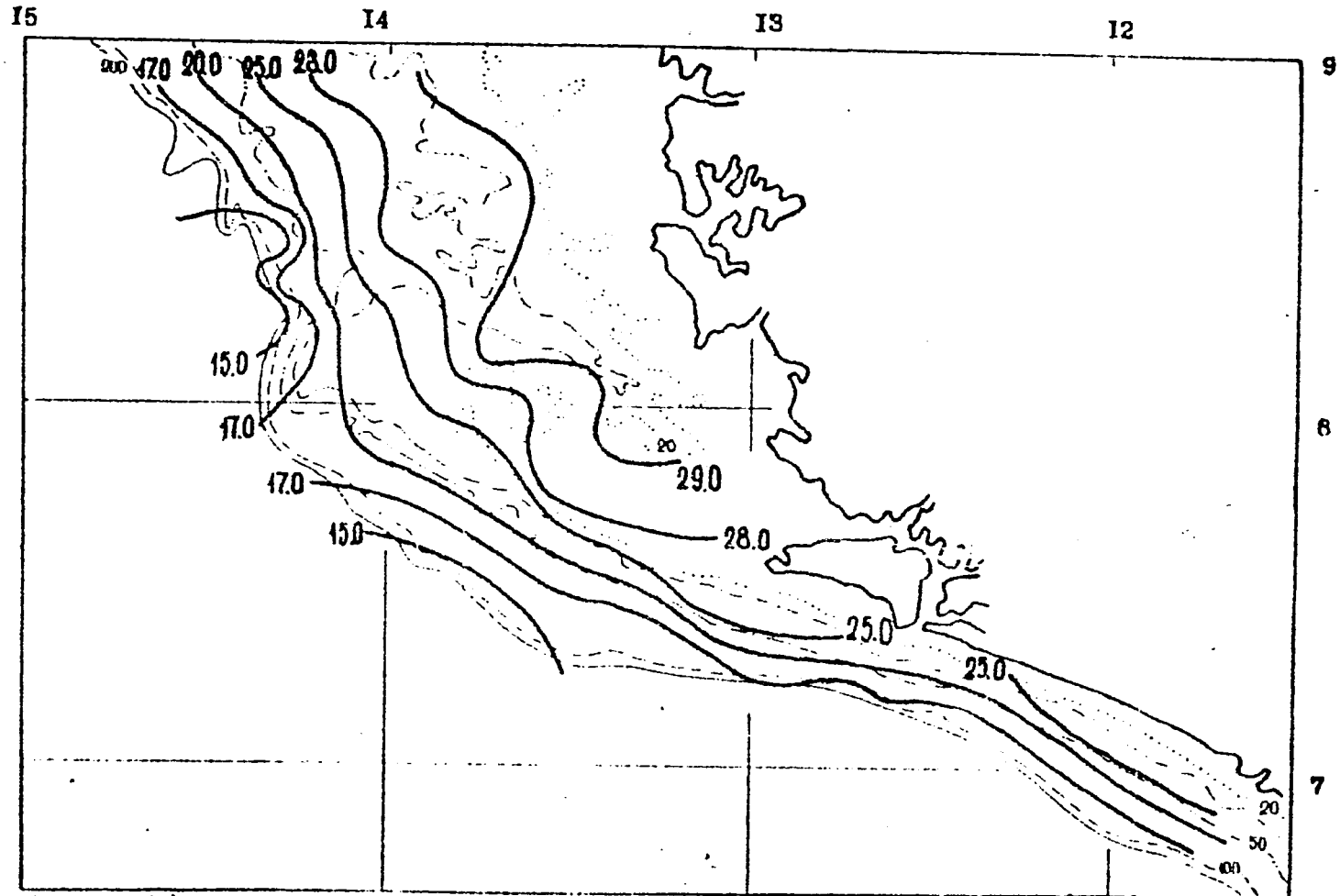


Figure 5 : **Distribution of temperatures in** the near-bottom layer, 8-22 June, 1984

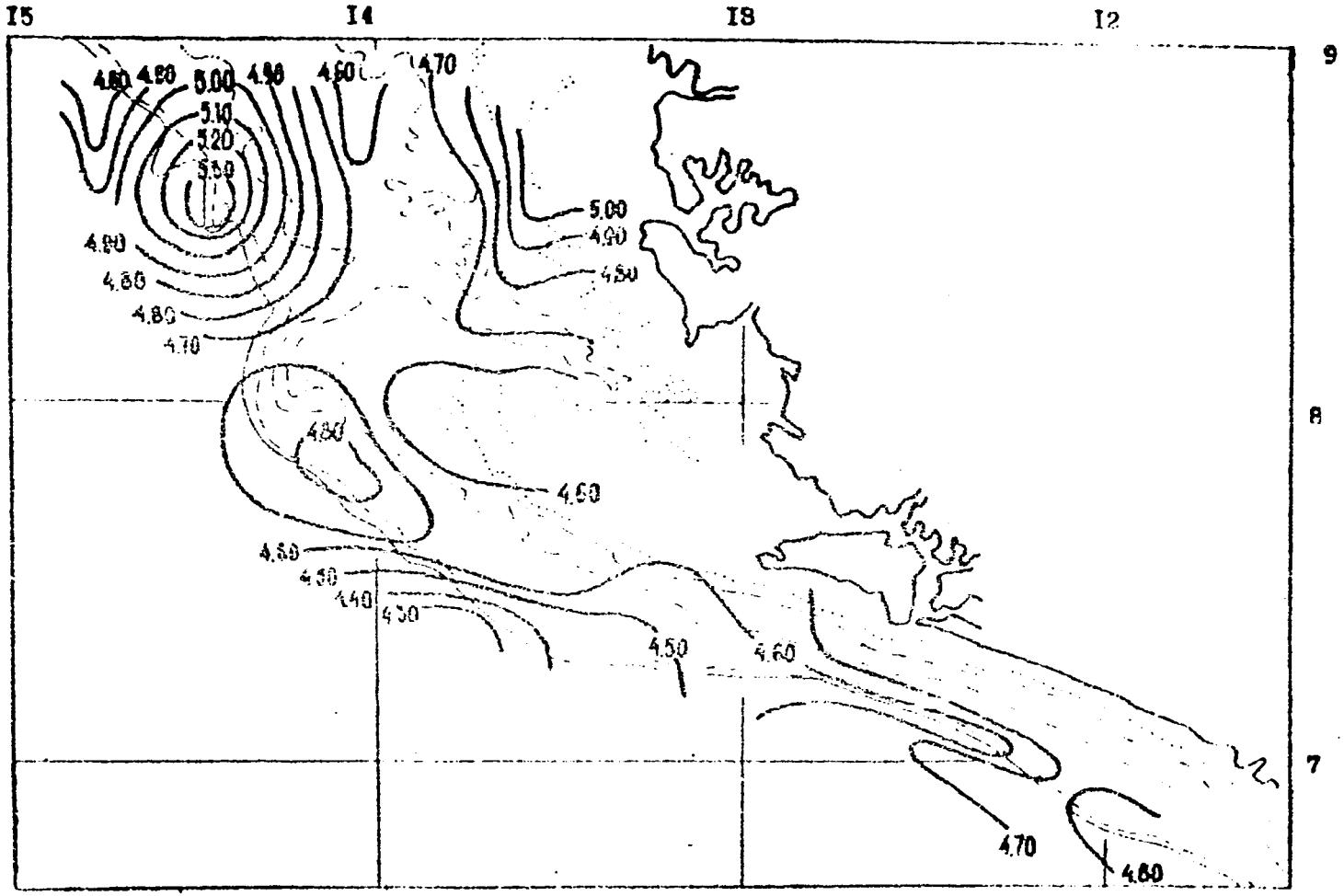


Figure 6 : Distribution of oxygen content in the surface layer, 21-27 June, 1984.

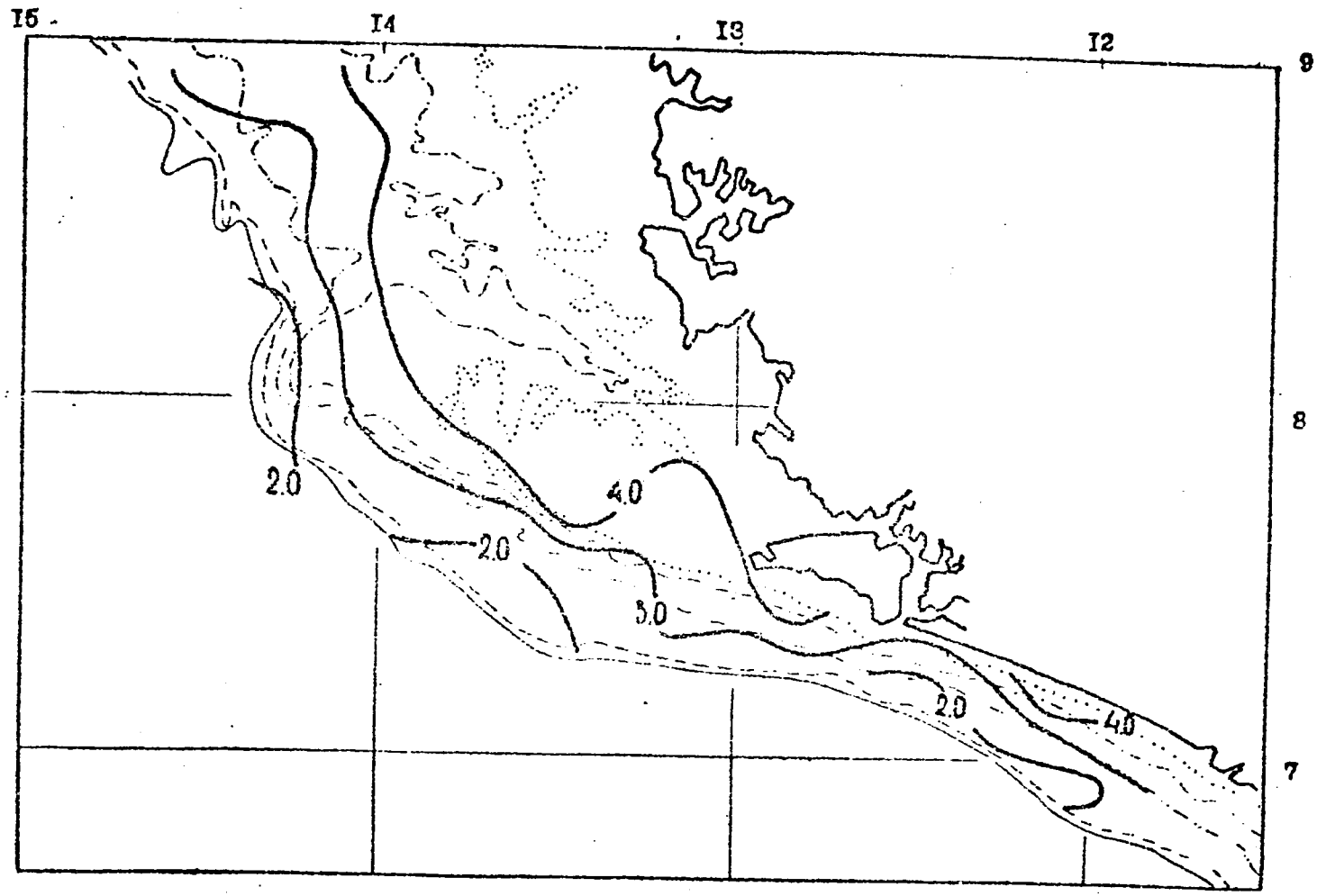


Figure 7 : Distribution of oxygen (mg/l) in the near-bottom layer, 8-22 June, 1984.

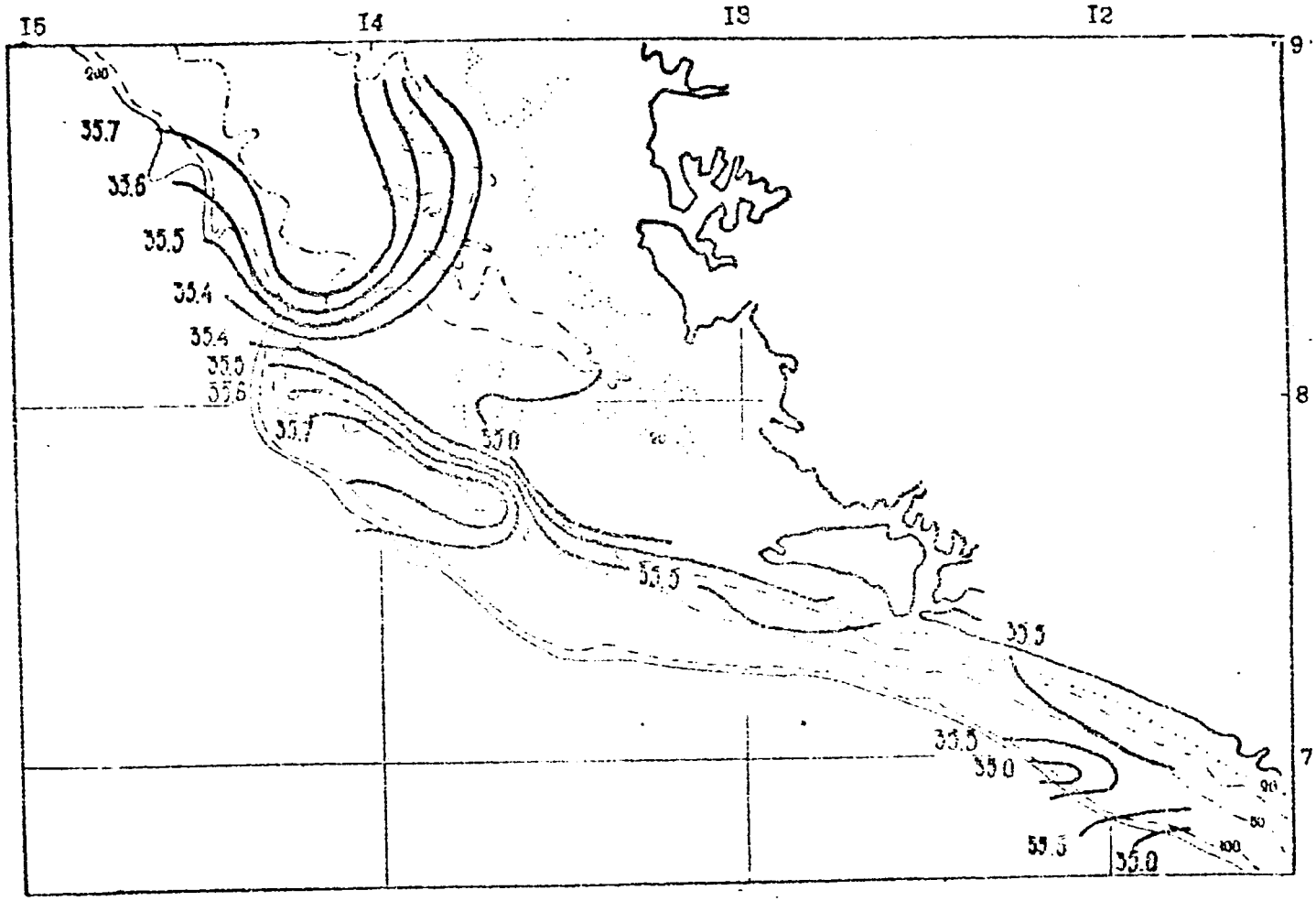


Figure 8 : Distribution of salinity in the near-bottom layer, 8-22 June, 1984.

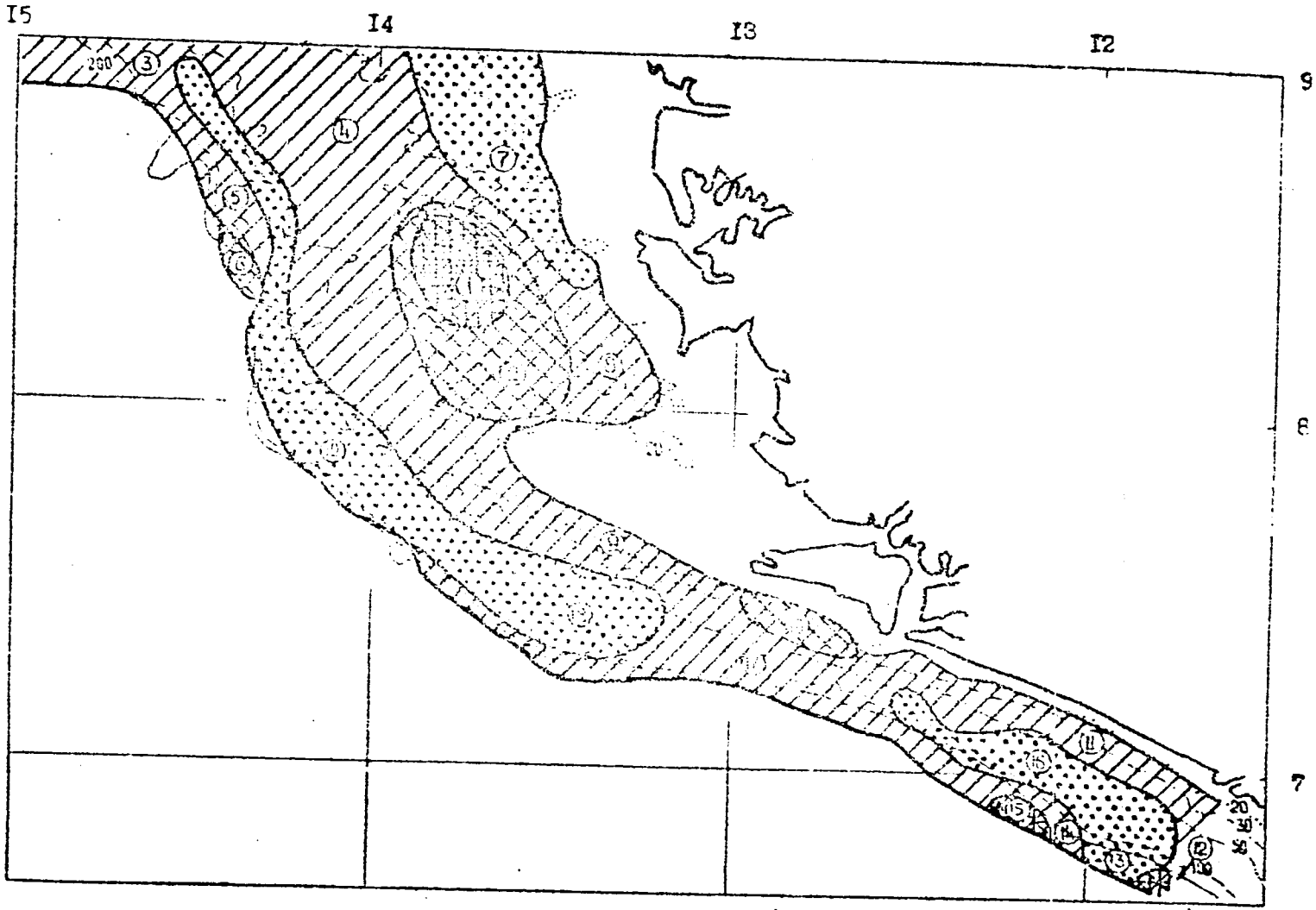


Figure 9 : **Distribution of catches of main fish species in the Sierra Leone area, 8-22 June, 1984** in 100 kg units per 30 min. **trawling:** - < 1.0, - 1.0-5.0, - > 10.0, - 5.0-10.0 / Numbers in circles correspond to species groupings in Table 2.

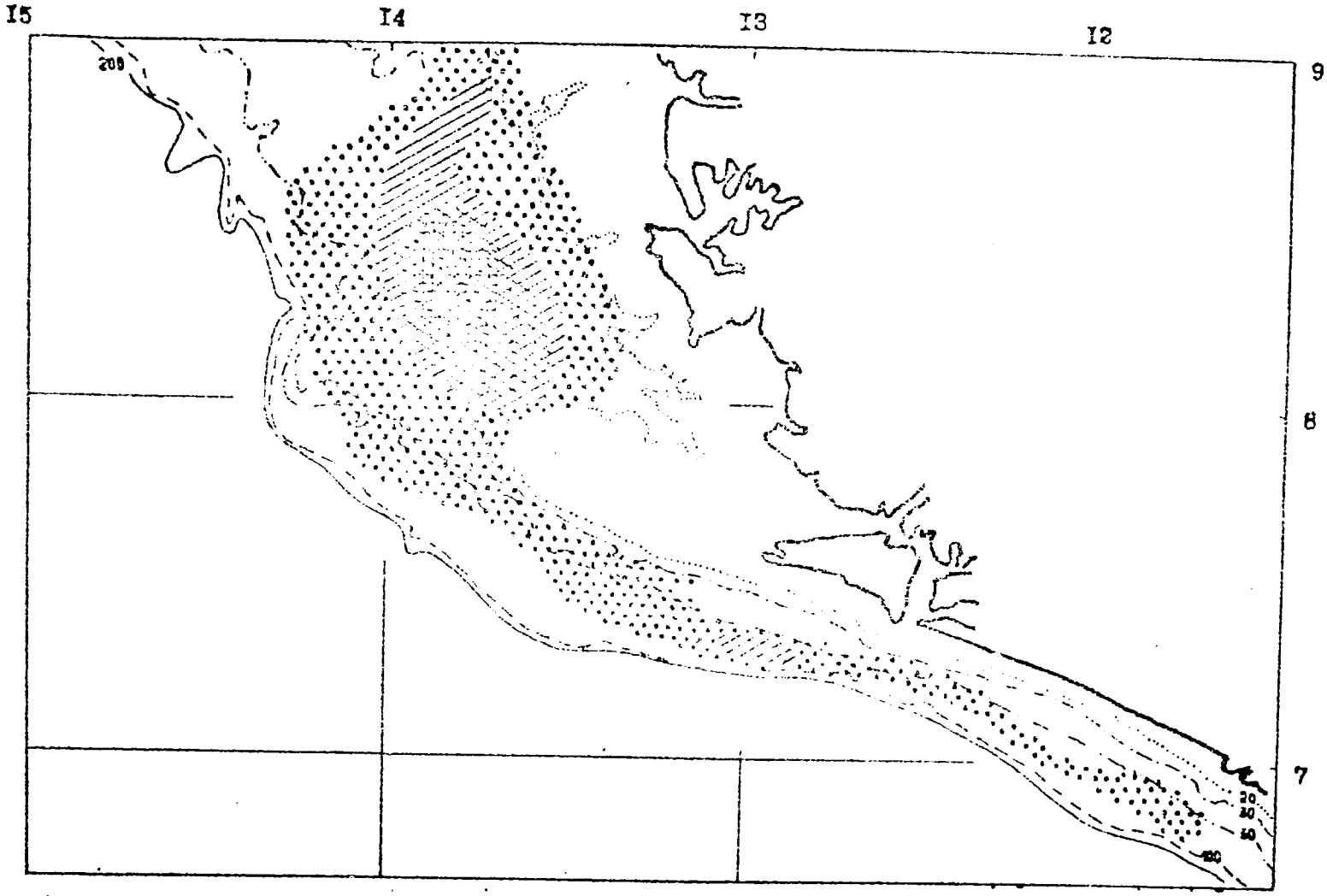


Figure 10 : **Distribution of** Balistes in 100 kg units **per 30 min. trawling:** - 0.1, - 0.1-5.0, - 5.0-10.0, - > 10.0.

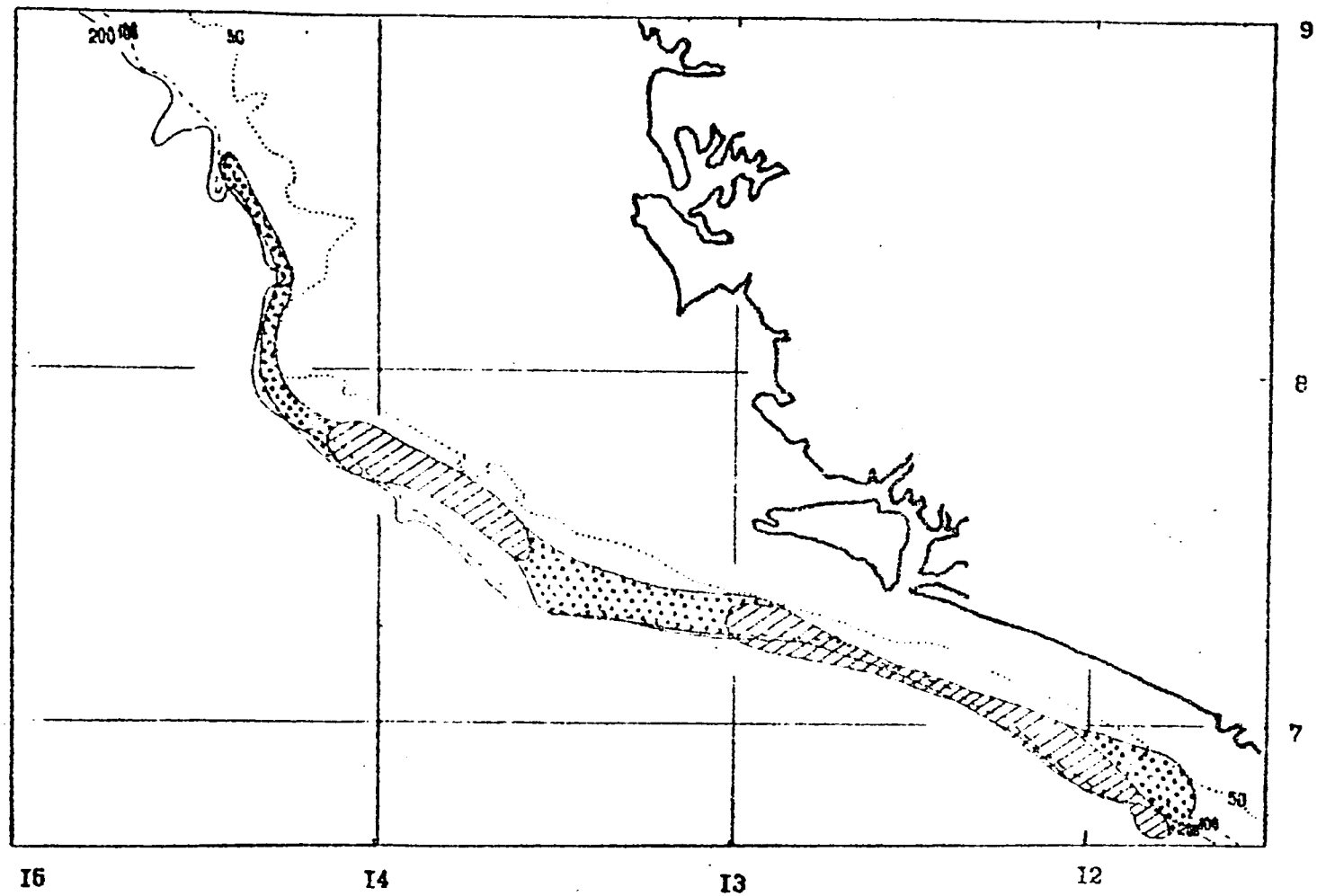


Figure 11 : **Distribution of Dent angolensis /See symbols in** Figure 10)

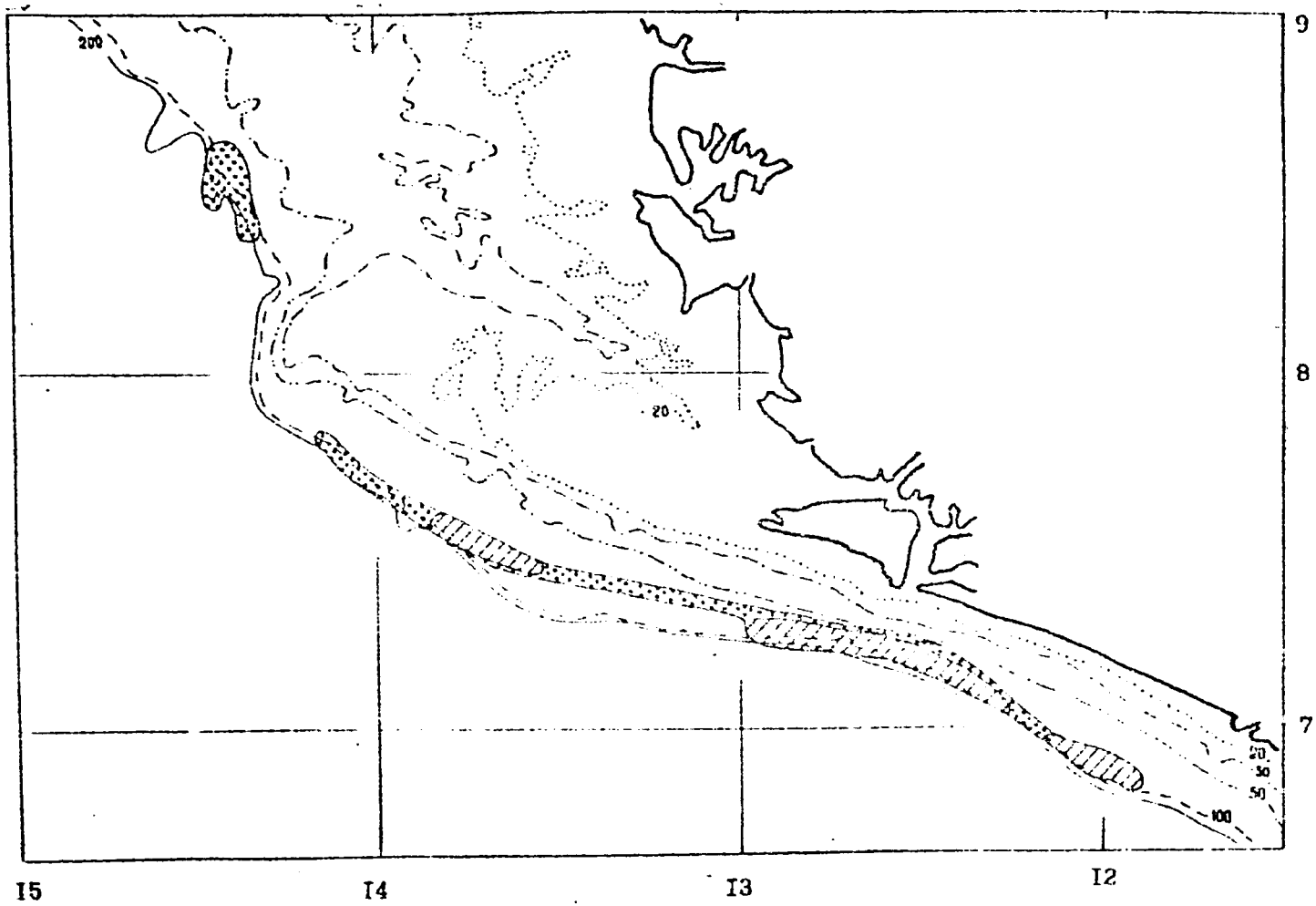


Figure 12 : **Distribution of <u>Dentex congoensis</u> (Symbols see in** Figure 10)

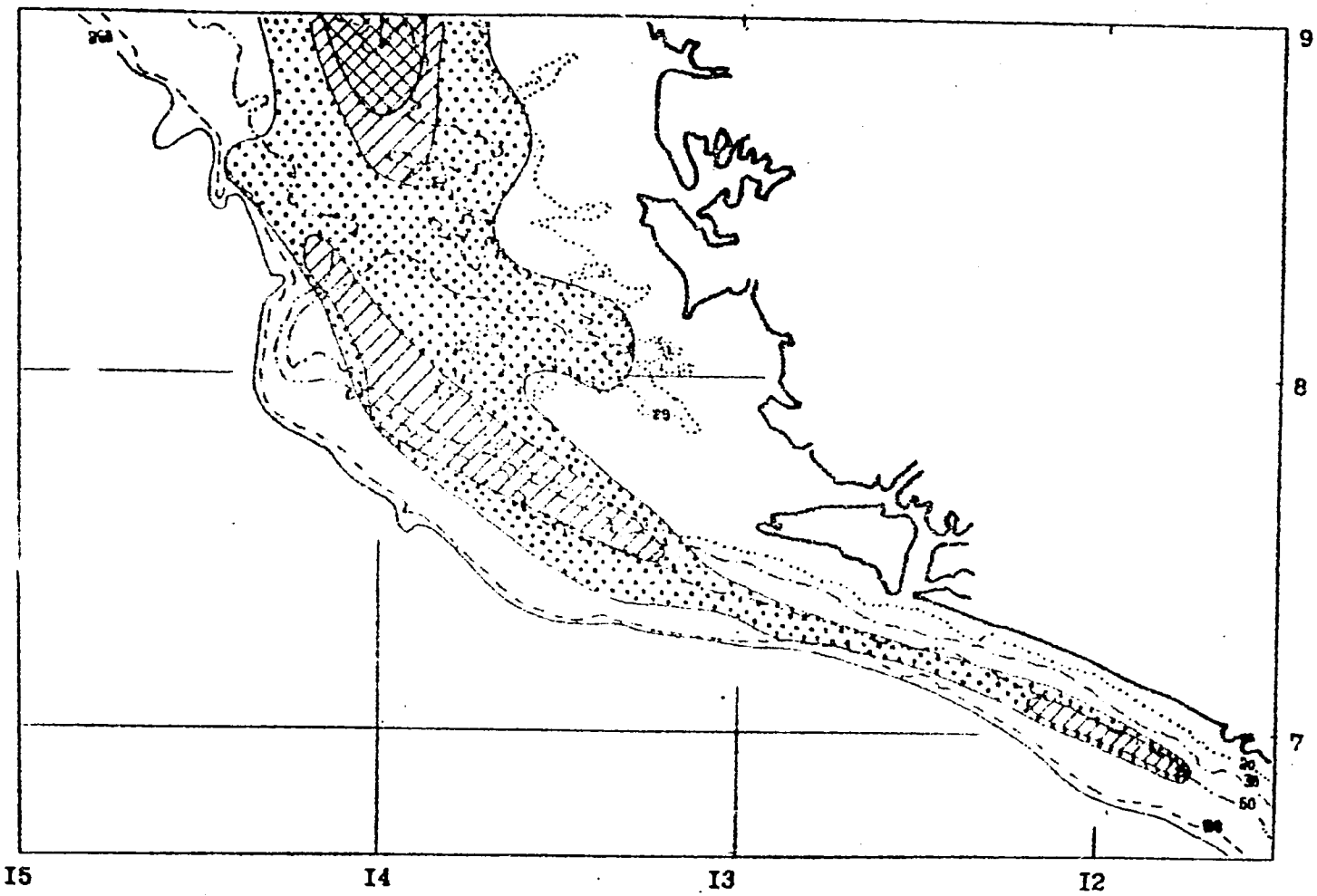


Figure 13 : **Distribution of** Sparus caeruleostictus **(Symbols see in** Figure 10)

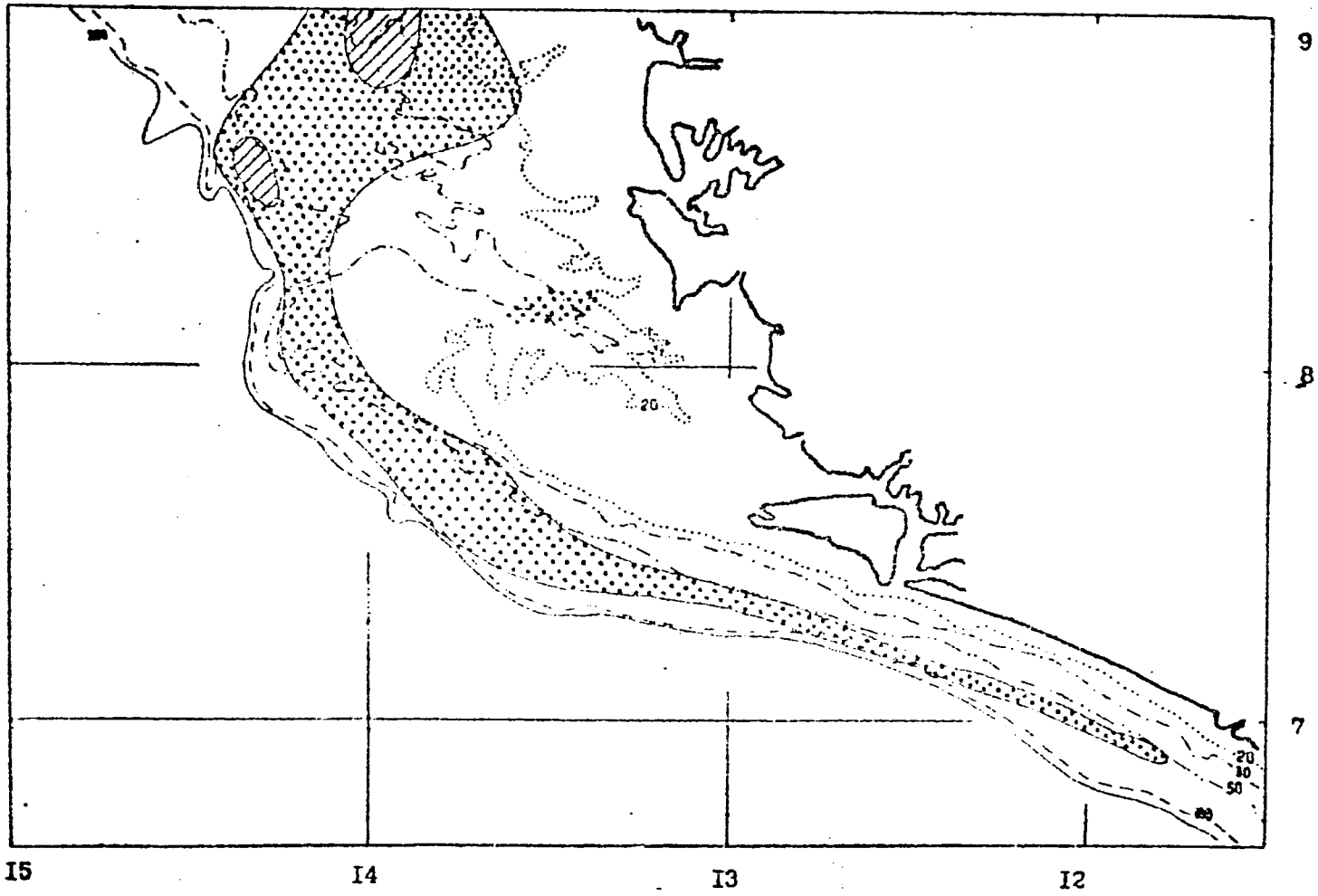


Figure 14 : **Distribution of <u>Pagellus</u> bellottii (Symbols see in** Figure 10)

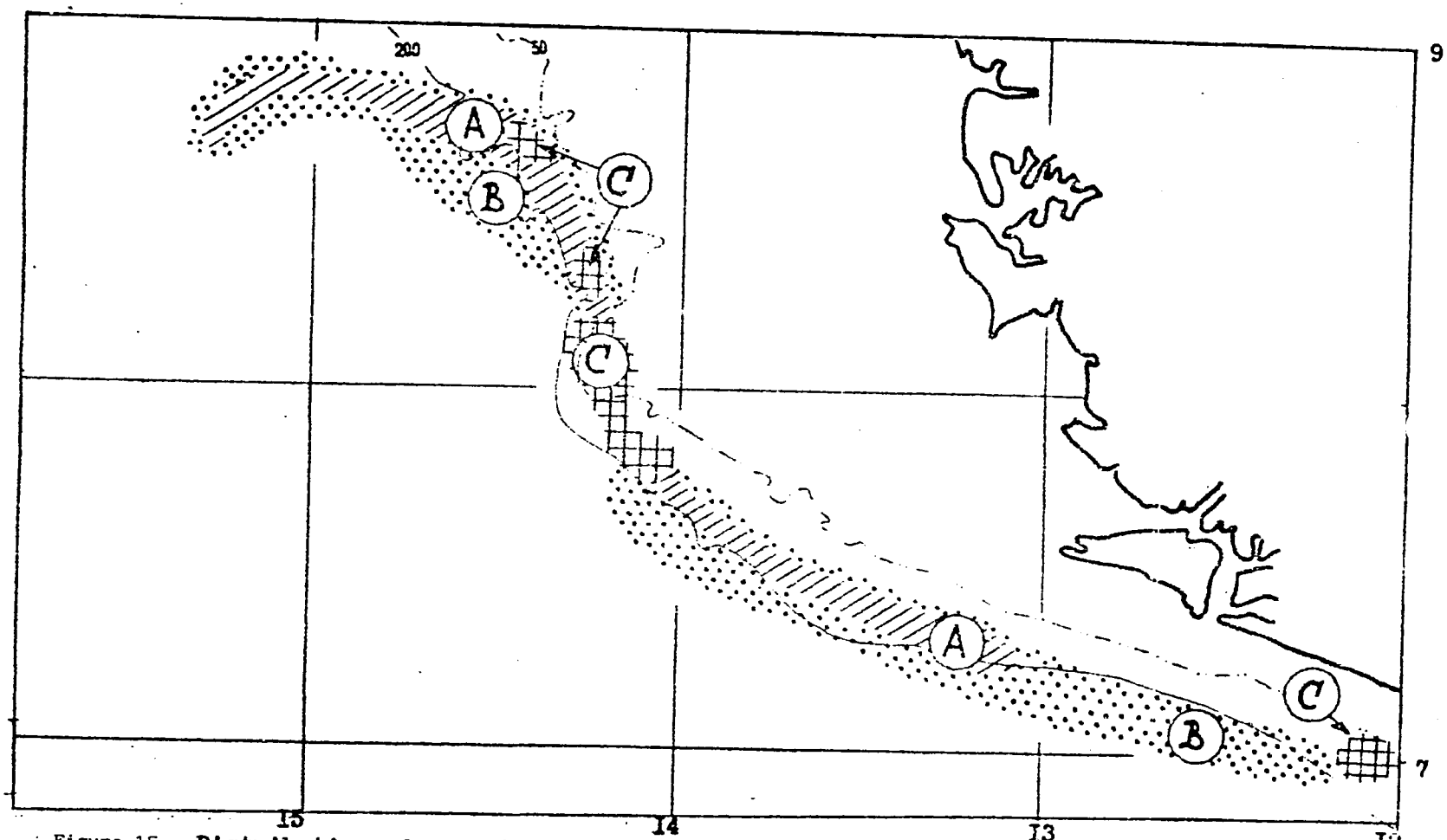


Figure 15 : **Distribution of main pelagic fish species (pelagic trawlings) A - Istiophorus albicans, B - Cubiceps sp., Ariomma sp., C - Caranx sp.**

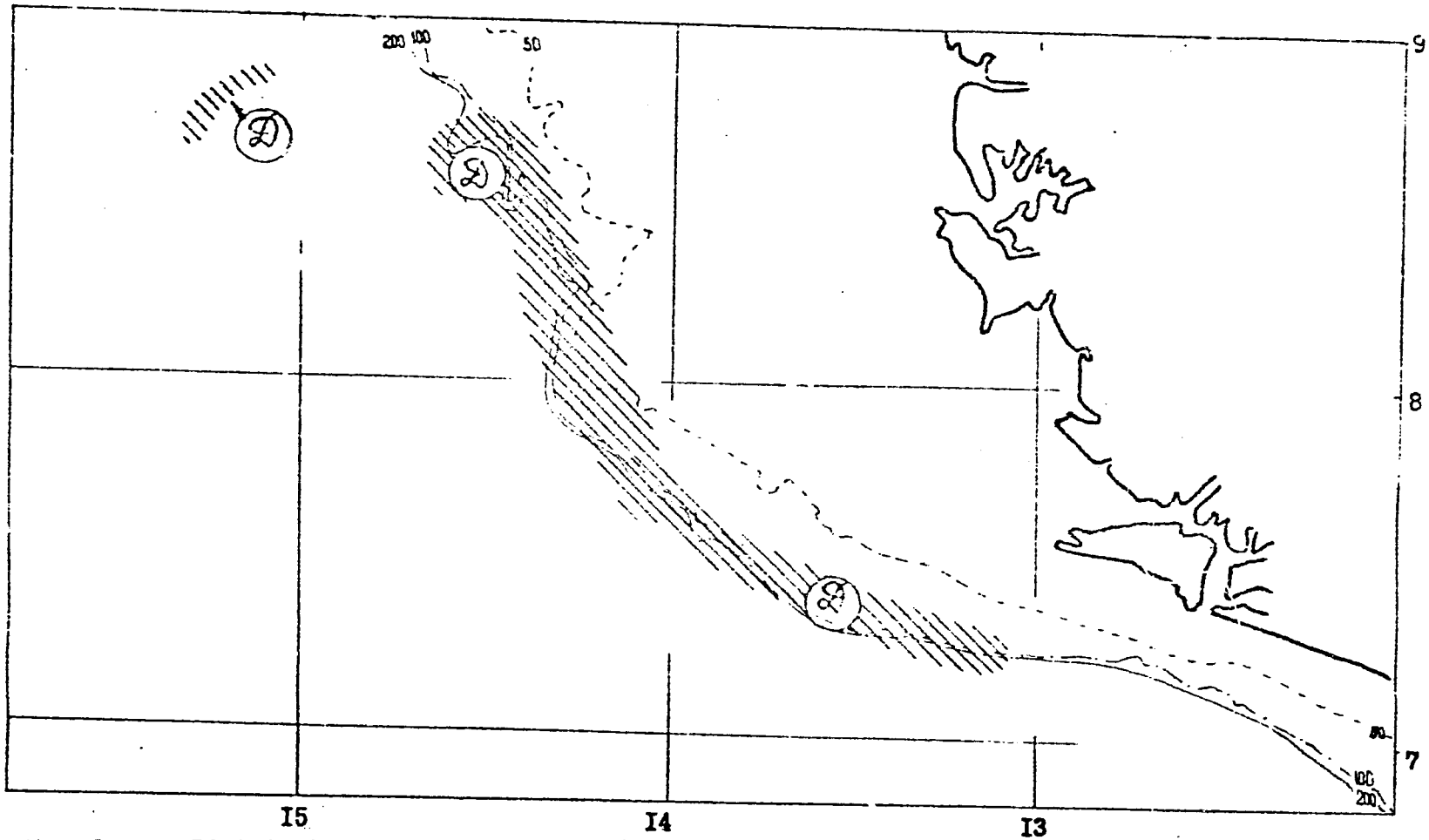


Figure 16 : **Distribution of <u>Auxis sp.</u> - D, pelagic** trawl haul locations

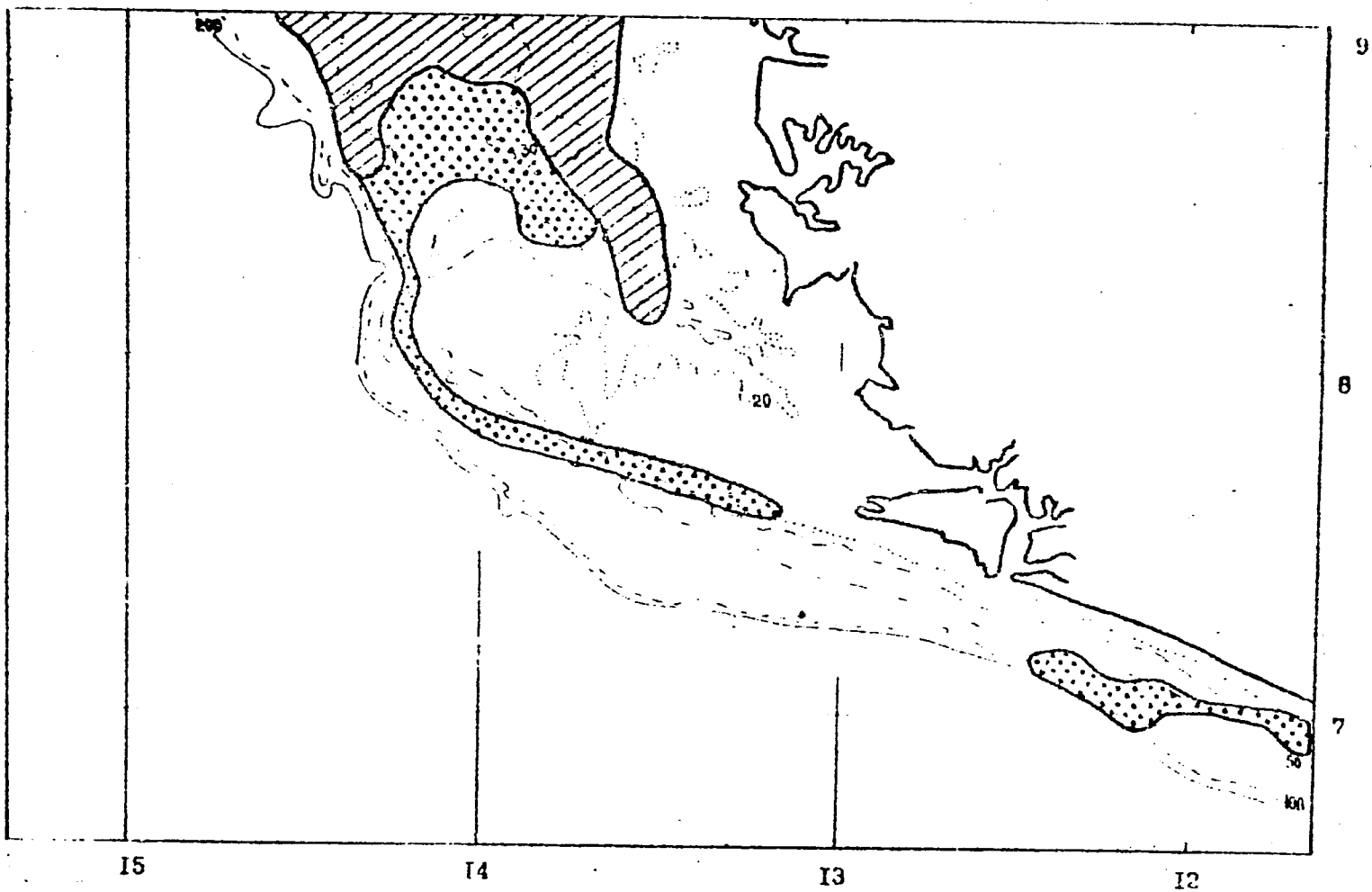


Figure 17 : **Distribution of** Sepia officinalis **(kg per 30 min. trawling: ⊡ - < 1.0, ▨ - 1.0-5.0).**

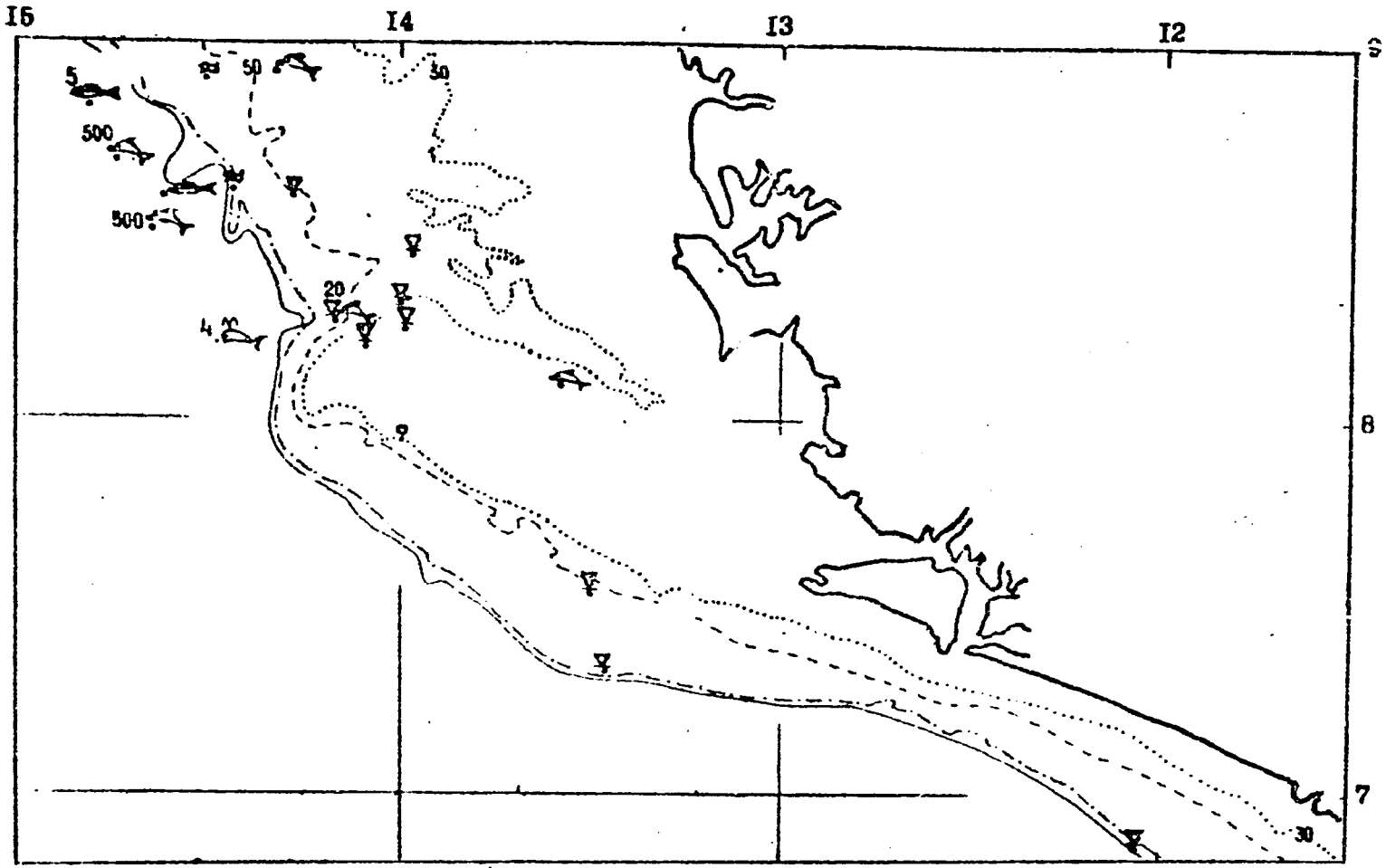


Figure 18 : Results of visual and acoustic exploration in Sierra Leone waters, 7-27 June, 1984.

≈ - fish keeping to the surface,
▽ - fish records on the ground,
- foreign shrimpers.
- dolphins,
○ - fish records in the pelagial,
- whales,
- tunas,

Table 1 : Characteristics and geographical distribution (1981) of the Sierra Leonian artisanal fishing gears

	Ring net	Drift net	Set net	Beach seines
Length (yds)	200-1200	100-600	100-600	wings:200-400 ; mouth:6-12 ; bag:10-12
Depth (yds)	12-24	4-8	4-6	wings:6 ; mouth:6-8 ; bag width:2-8
Mesh (cm)	3-5	3-5	5-9	
Effective period	late neap early spring	estuary	rainy season early dry season	lead rope : 400-2000 yds

DISTRICT	Castnet	Ringnet	Driftnet	Setnet	Beach seine	Hook and line	TOTAL
KAMBIA	198	125	172	123	18	139	775
P. LOKO	289	235	601	327	83	258	1,793
W. AREA	54	414	453	92	32	443	1,428
MOYAMBA	63	172	359	296	93	91	1,074
BONTHE	439	61	976	1,125	25	694	3,318
PUJEHUN (*)	49	7	28	343	10	75	512
TOTAL	1,092	1,014	2,589	2,304	261	1,700	8,960

(*) Under inland fisheries administration

Table 2 : Total number of artisanal fishing canoes and types of boat by district in 1981

1974 :	6,150	1978 :	6,818
1975 :	6,382	1979 :	6,896
1976 :	6,334	1980 :	6,998
1977 :	6,730	1981 :	7,090

District	KRU	ST 1-3	ST 3-5	GHANA	BENEFIT	OTHER	TOTAL	%
KAMBIA	10	334	195	30	0	39	608	8.6
PORT LOKO	58	895	346	8	0	34	1,341	18.9
W. AREA	207	590	292	126	13	0	1,228	17.30
MOYAMBA	19	390	213	108	0	14	744	10.5
BONTHE	50	2,517	237	12	0	0	2,816	39.7
PUJEHUN (*)	10	300	43	0	0	0	353	5.00
TOTAL	354	5,026	1,326	284	13	87	7,090	
%	5.0	70.9	18.7	4.0	0.2	1.2		

(*) Under inland fisheries administration

Table 3 : Number of artisanal fishermen and outboard engines (1981)

District	Full time	Part time	TOTAL	%
KAMBIA	1,745	321	2,066	11.50
PORT LOKO	3,449	794	4,243	23.62
W. AREA	3,120	496	3,616	20,13
MOYAMBA	1,981	197	2,178	12.12
BONTHE	4,690	446	5,136	28.6
PUJEHUN (*)	596	130	726	4.04
TOTAL	15,581	2,384	17,965	

Engines by district :

		% engines	% motorisation
KAMBIA	145	21.4	23.9
PORT LOKO	198	29.2	14.8
W. AREA	221	32.6	18.0
MOYAMBA	104	15.4	14.0
BONTHE	9	1.3	0.3
PUJEHUN (*)	0	0	0
TOTAL	667	100	9.6

(*) see Table 2

Table 4 : National fisheries statistics, Sierra Leone

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Sardinella spp.			22700	23040	23800	24500	10662	6920	7935	8922	10651		
Ethmalosa			15100	15360	15300	15300	18952	19600	21860	16865	16142		
Other clupeidae (Ilisha africana)						230	428	2697	783	827	507		
Elopidae (2 spp.) Albulidae (A. vulpes)						246	474	254	155	-	5		
Carangidae (Trachinotus goreensis) Chloroscombrus chrysurus Selene dorsalis						618	599	116	156	26	9		
TOTAL PELAGIC CATCH			37800	38400	39100	40894	31125	29587	30889	26640	27314		
TOTAL ARTISANAL CATCH	22764	43129	52669	59456	61945	50275	46772	41881	45166	31554	31554	34616	
NATIONAL INDUSTRIAL CATCH	2174	2918	2864	3065	1751	2417	4680	5669	1071	1668	1668	1938	3161
INLAND CATCH	1000*	1000*	1000*	1000*	1100*	1100*	1200*	2500*	11355	14982	14982*	16480*	
TOTAL NATIONAL CATCH	25938	47047	56533	63521	64796	52792	52652	50080	57592	48204	48204	53034	

(*) estimate

Table 5 : Available catch and effort data by area for the Sierra Leonean artisanal fishery
Effort in number of trips

District		1978	1979	1980	1981	1982	1983
KAMBIA	catch			...	1,259		
	effort			21,368	15,781		
PORT LOKO	catch				2,780		
	effort			32,530	47,971		
W. AREA	catch	7,428	9,170		9,889		
	effort	27,598	33,261	42,165	37,332		
MOYAMBA	catch				7,924		
	effort			26,689	19,494		
BONTHE	catch				5,462		
	effort			30,801	30,145		
TOTAL	catch				27,314		
	effort			154,003	150,723		

Tables 6.1–6.5 : USSR catches and efforts in the Sherbro area by vessel size and gears used

Table 6.1 : Midwater trawl catches and effort, 250–499.9 GRT

1982/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Hours fished			578	47								983	1608
Days fished			41	4								74	119
Days on grounds			49	4								92	145
TOTAL CATCH			862	161								923	1946
Trachurus spp.			233									4	237
Caranx spp.			4									29	33
Sardinella spp.			474	149								617	1240

Source : STATLANT 34 b

Table 6.2 : Bottom trawl catches and effort, 100–149.9 GRT

1982/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Hours fished	1749	1356	3283	4762	3430	2367	2148	1320	1158	776	49	0	22,398
Days fished	98	81	179	245	180	140	119	87	68	44	3	0	1,244
Days on grounds	166	150	222	279	307	214	157	116	86	85	6	0	1,788
TOTAL CATCH	717	556	1576	1619	1475	1136	752	594	498	435	46	0	9,404
Brachydeuterus	164	60	150	457	296	339	82	27	45	222	17	0	1,859
Balistes		15	24	43	68	81							231
Trachurus spp.	45	134	624	138	129		83	64	41				1,258
Caranx spp.	240	43	28	57	34	28	4	8	6	19			467
Sardinella spp.	2	18	127	74	122	5	8						356

Source : Statlant 34 b

Table 6.3 : Bottom trawl catches and effort, 50-99.9 GRT

1982/month	J	F	M	A	M	J	JJ	A	S	O	N	D	TOTAL
Hours fished	2713	3624	4814	6171	5918	5185	4859	2874	2172	1091	2640	3811	45872
Days fished	172	222	277	346	358	320	295	193	141	71	135	239	2769
Days on grounds	227	296	341	376	441	510	385	261	157	104	178	270	3546
TOTAL CATCH	417	597	796	864	1022	1179	977	754	680	319	641	1029	9275
Brachydeuterus	48	124	124	206	189	277	90	106	135	95	162	190	1746
Balistes	8	114	182	50	159	128	392	168	78				1279
Trachurus spp.	13	13	13				31	30	35	1	50	112	299
Caranx spp.	15	64	65	39	38	45	53	53	39	13	19		443
Sardinella spp.	1			8	7	3	6	5		9	13	17	69

Source : Statlant 34 b

Table 6.4 : Purse seine catches and effort, 100- 149.9

1982/month	J	F	M	A	M	J	JI	A	S	O	N	D	TOTAL
Number of sets	243	206	250	524	446	504	443	207	109	165	120	38	3255
Days fished	161	160	178	334	334	360	337	162	82	122	96	11	2337
Days on grounds	245	240	251	451	515	537	503	312	109	147	147	23	3480
TOTAL CATCH	2892	2998	4996	6190	5295	6599	5435	3247	516	839	718	188	39913
Brachydeuterus	565	581	753	850	723	859	465	459	170	230	220	0	5915
Balistes		47	26										73
Trachurus spp.	12	498	114	122	53	30	10	12			12		863
Caranx spp.	6	116	66	361	37	151	46						783
Sardinella spp.	2100	1388	3768	4673	4290	5369	4787	2635	322	540	376	55	30303

Source : Statlant 34 b

Table 6.5 : Research vessel catches, USSR

1982/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
TOTAL CATCH			108	64	44	20							236
Sphyraena				3									3
Brachydeuterus				5									5
Chloroscombrus				6									6
Sardinella spp.			108	50	44	20							222

Source : Statlant 34 b

Tables 7.1-7.6 : USSR catches and effort in the Sherbro area by vessel size and gears used in 1983

Table 7.1 : Midwater trawl catches and effort, 250-499.9 GRT

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Hours fished	496		185								36	134	851
Days fished	30		14								2	10	56
Days on grounds	30		20								4	10	64
TOTAL CATCH	342		132								150	838	1462
Brachydeuterus	24												24
Trachurus spp.	2		19										21
Caranx spp.	218		24									102	344
Sardinella spp.	9												9
Balistes											134	695	838

Source : Statlant 34 b

Table 7.2 : Bottom trawl catches and effort, 100–149.9 GRT

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Hours fished	395	1207	1568		987								4157
Days fished	26	85	104		59								274
Days on grounds	28	197	149		84								458
TOTAL CATCH	80	439	622		412								1553
Balistes			52		155								207
Trachurus spp.	21	127	239		141								528
Caranx spp.	5	28	47										80

Source : Statlant 34 b

Table 7.3 : Bottom trawl catches and effort, 50-99.9 GRT

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Hours fished	2780	2074	4725	4886	4934	5895	5155	4547	3937	4952	2084	3621	49590
Days fished	187	136	329	331	362	366	329	299	299	295	128	202	3263
Days on grounds	261	200	361	366	409	390	373	327	335	326	174	242	3764
TOTAL CATCH	820	712	1734	1443	1555	1274	1607	2322	2008	1238	792	869	16354
Brachydeuterus	86	98	94	92	108	87	34	33	24	10	33	33	732
Balistes	232	64	926	677	798	653	1061	1661	1520	816	408	504	9220
Trachurus spp.	32	42	45	43	55	32	12	13					274
Caranx spp.	53	49	56	62	54	35	25	28	12	8	15		397
Sardinella spp.			14	7			1						22
Scomber japonicus	7			1									8

Source : Statlant 34 b

Table 7.4 : Purse seine catches and effort, 100-149.9 GRT

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Number of sets		27	68	494	264	507	279	238	83				1960
Days fished		29	43	339	193	389	210	167	58				1428
Days on grounds		50	62	434	285	546	284	228	87				1976
TOTAL CATCH		48	183	8295	3934	5747	2777	3008	1490				25482
Caranx spp.				47	139	107							293
Sardinella spp.				6823	3240	4051	2481	2794	884				20273
Scomber japonicus				12	17								29

Source : Statlant 34 b

Table 7.5 : Purse seine catches and effort, 50-99.9 GRT

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
Numbers of sets				115	148	171	96	112	122	179	261	107	1311
Days fished				66	111	129	79	78	79	98	111	79	830
Days on grounds				76	145	149	109	100	101	138	148	110	1076
TOTAL CATCH				1886	2438	1972	951	1306	1187	1094	758	815	12407
Brachydeuterus					108	104		15				3	230
Trachurus spp.				57							21		78
Caranx spp.				207		83	55	14		16	42	11	428
Sardinella spp.				1607	1723	1699	810	1277	1139	1040	638	750	10603
Scomber japonicus					12						18		30

Source : Statlant 34 b

Table 7.6 : Research vessels catches, USSR

1983/month	J	F	M	A	M	J	Jl	A	S	O	N	D	TOTAL
TOTAL CATCH	40	22	69	10	37	57	228	319	262	145			1189
Brachydeuterus							11	11	13	8			43
Balistes	18	9	37	4	37	57	101	171	109	57			600
Trachurus spp.	10	5	13	6					5				39
Caranx spp.	8	4	14				6	9		2			43

Source : Statlant 34 b

Figure 1 : Annual total contribution of pelagic fish to the total fish catch in Sierra Leone, 1972-1982

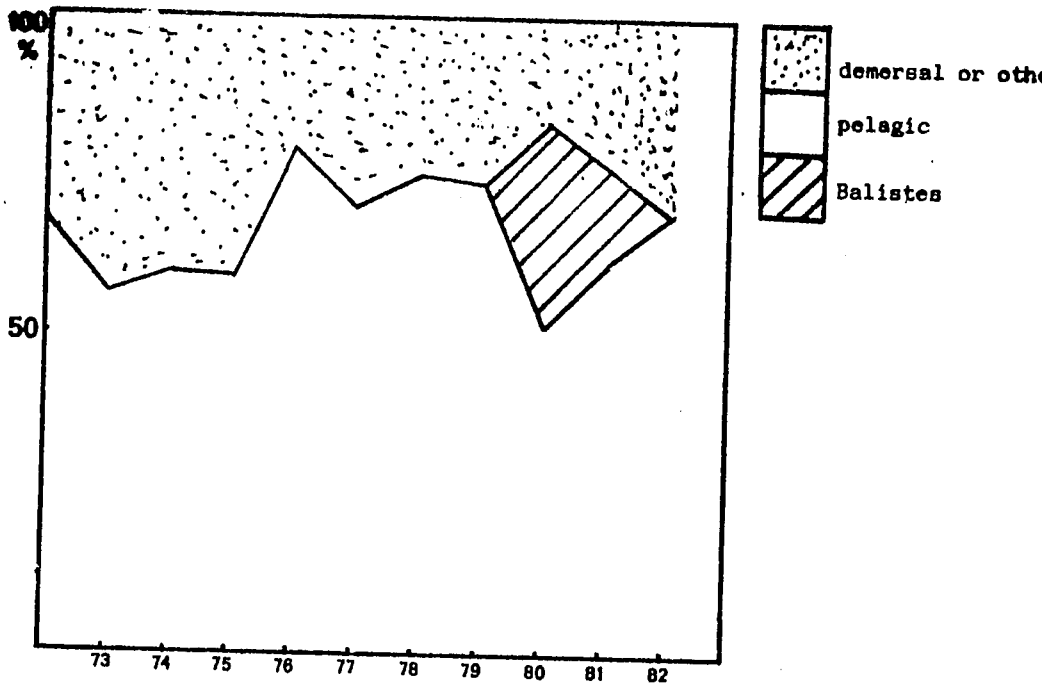


Figure 2 : Percentage contribution of Sardinella spp. and Carangids to the annual pelagic catch in Sierra Leone, 1972-1982

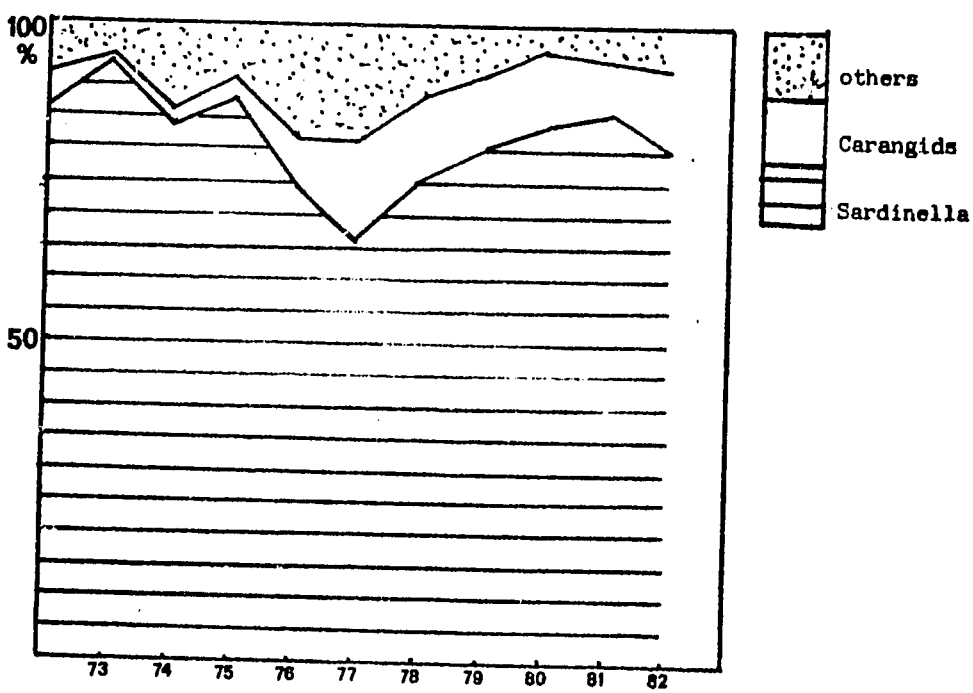


Figure 3 : Total catch of Sardinella spp. (in tons)

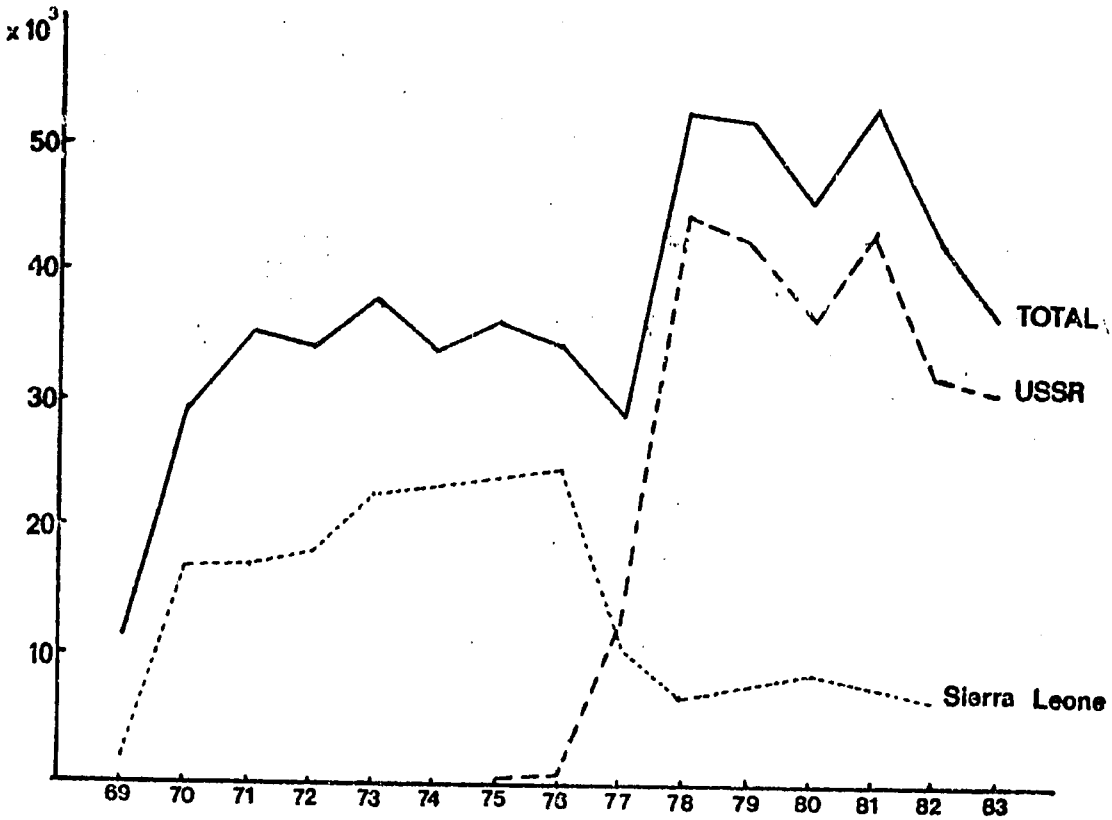


Figure 4 : Percentage distribution of Sardinella catch by country

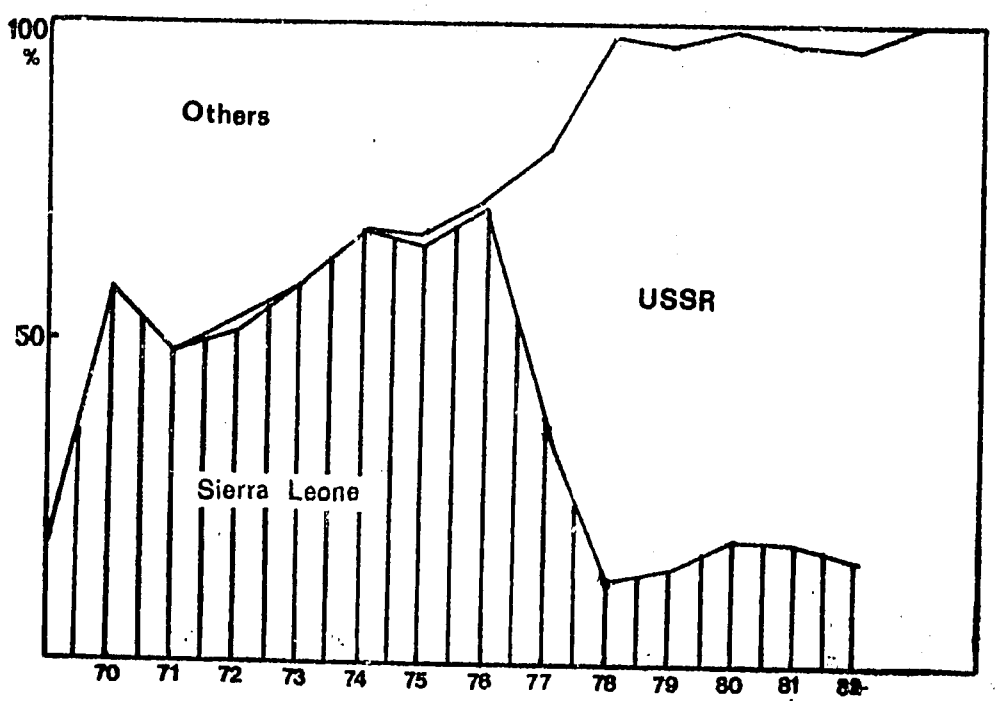


Figure 5 : Total catches of Carangids (in tons)

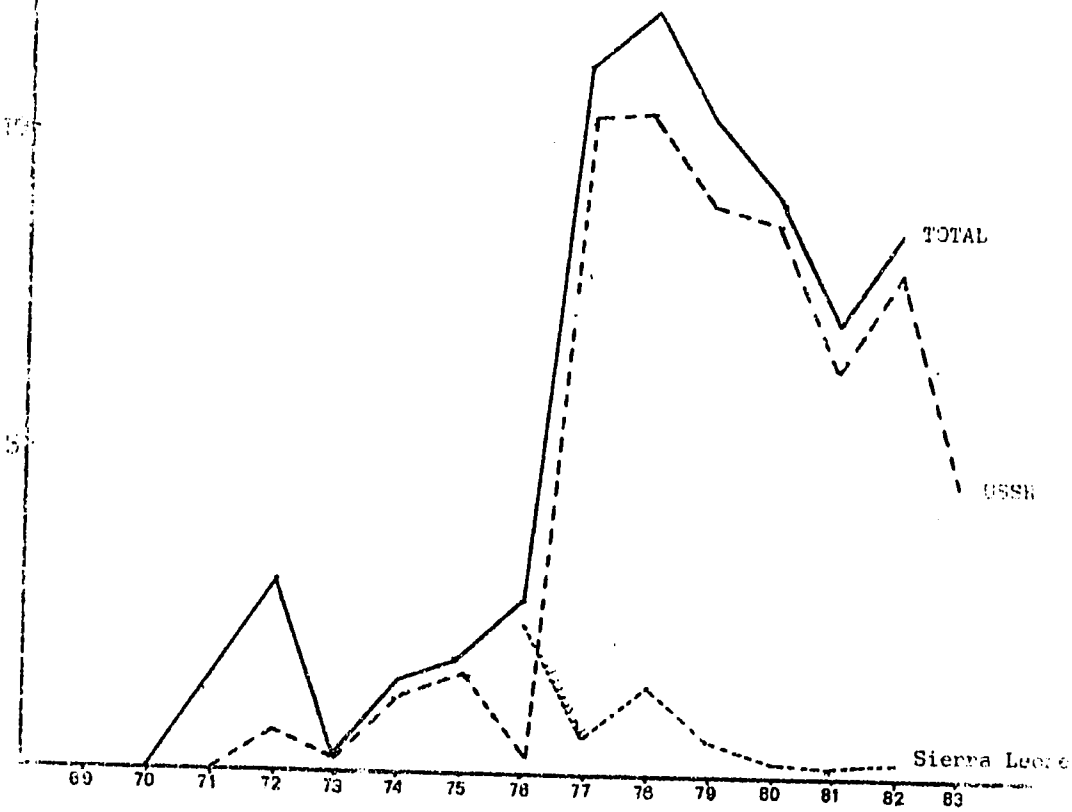


Figure 6 : Percentage distribution of Carangid catches by country

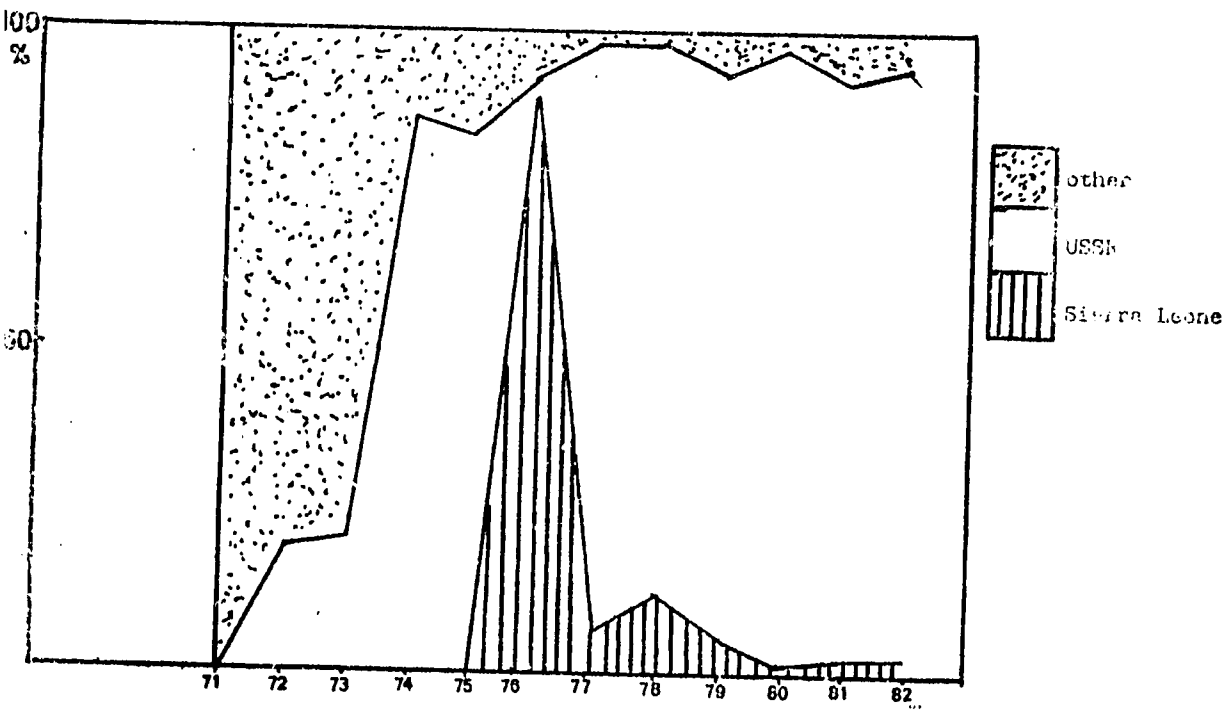


Figure 7 : USSR purse seine (PS4 + PS5) catches of Sardinella spp. and total catch, 1979-1983

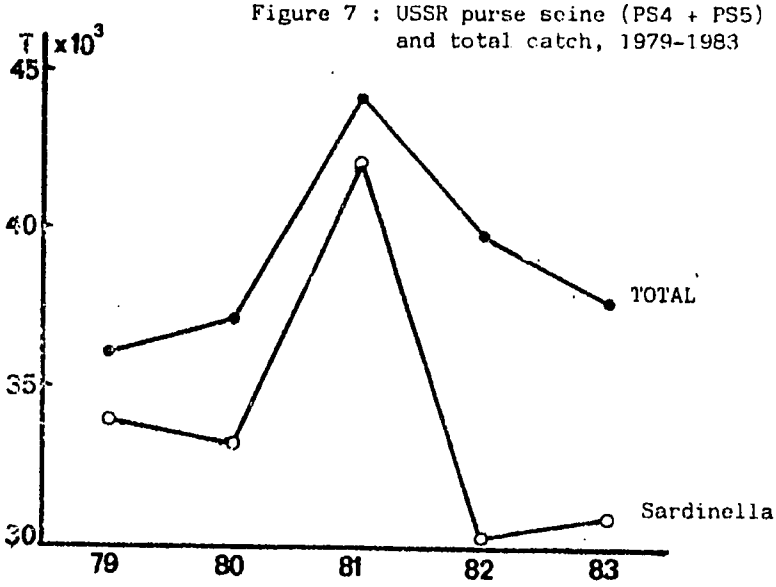


Figure 8 : Effort levels of PS4 and PS5 vessels, 1979-1983

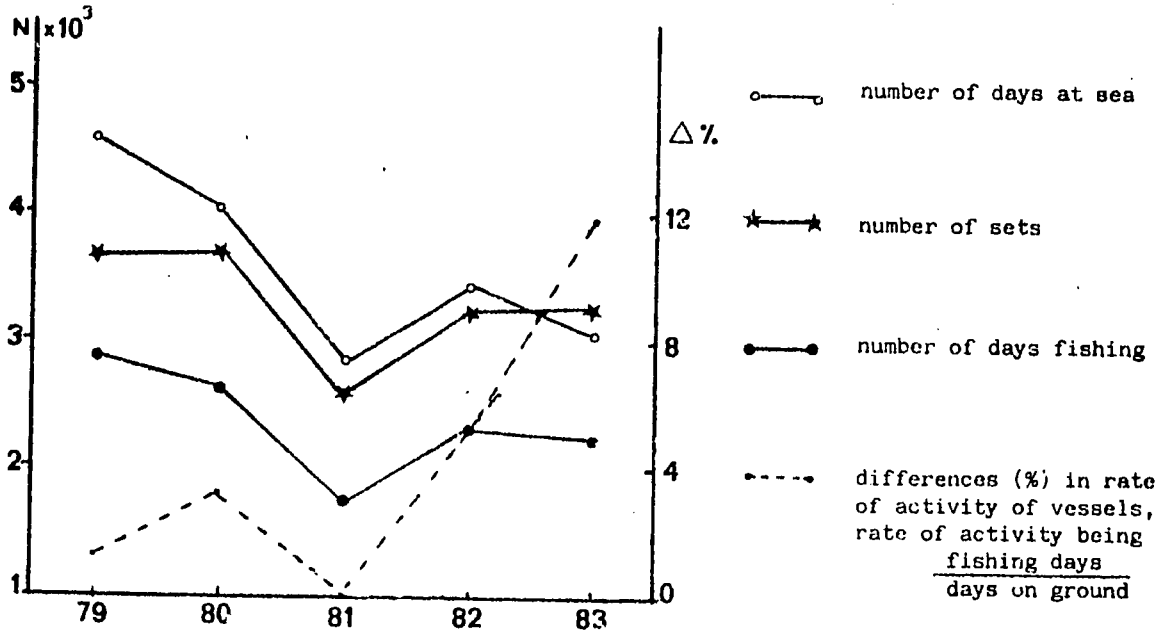
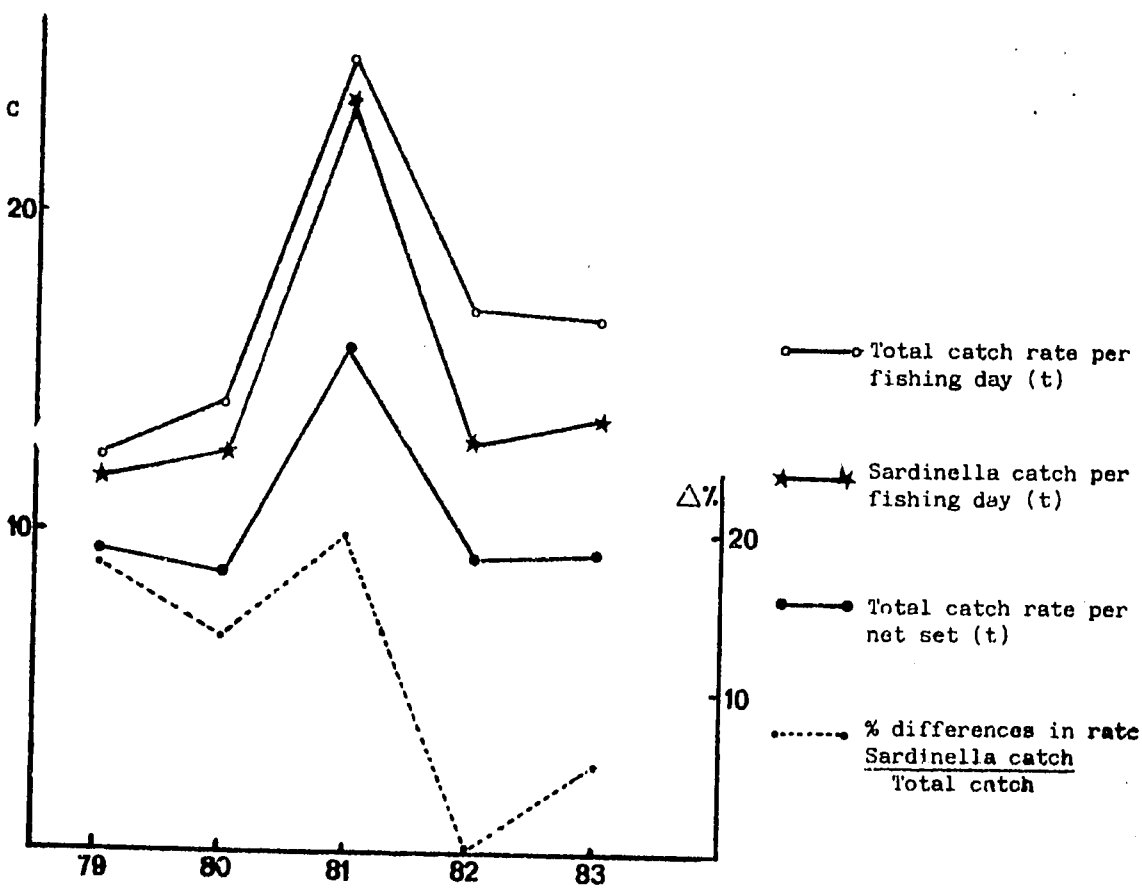


Figure 9 : Catch rates (C in tons) of PS4 and PS5 seiners combined



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