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DISTRIBUTION AND RELATIVE ABUNDANCE OF CLUPEIDAE AND ENGRAULIDAE IN THE WATER OF THE CONTINENTAL SHELF OF SENEGAL AND GAMBIA

DURING 1969

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05-E17

05- E17

INTRODUCTION

The importance of fish eggs and larvae studies as a mean to evaluate the fisheries resources, to locate spawning areas and to determine spawning seasons has been widely discussed by the ACMRR working party (see Interim Reports on Fish eggs and larvae Surveys, Kiel 2-5 June and Salamboo 22-27 October 1969).

At present seasonal ichthyoplankton surveys off the West African coast are boing made by countries in which F.A.O. projects for Fisheries development are established (Senegal, Sierra Leone, Ivory Coast, Ghana and Congo-Brazzaville) in order to contribute to the evaluation of their fisheries appraisal. A Standard sampling method has been recently recommended by the F.A.O. consultant, Dr. Shermann (1969) to be adopted for ichthyoplankton surveys off West Africa , in order to obtain a more adequate sampling of eggs and larvae at different sizes , as well as more comparable results on the material collected by the different countries in the Gulf of Guinea.

In Senegal seasonal ichthyoplankton surveys had been initiated in late 1967 by the "Centre Océanographique de Dakar-Thiaroye" and continued trough 1969 in collaboration with the F.A.O. Fisheries development project. The material collected during 1968 was sorted and analyzed for larvae of Sardinella species as well as for the other fish larvae, which were identified by species, genus or family by Mr. CONAND, scientist of the Center ; the quantitative results were presented in the corresponding interim Reports (CONAND 1967 and 1968).

Only a few studies had been published so far on eggs and larvae of Clupeidae and Engraulidae of the West African coast. Marchal (1966) gave the description of eggs, larvae and post-larvae of Anchoviella (= Engraulis) guineensis as obtained from plankton material and from rearing of fertilized eggs, presenting as well the distribution

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of the larvae in the regions between Monrovia-Accra and Monrovia-Abidjan. Zei (1966) presented a general account on the distribution and abundance of Sardinella sp. and Anchoviella (= Engraulis guineensis) in the continental shelf of Ghana. A preliminary key for the identification of eggs and larvae of West African Clupeids (Ilisha africana, Harengula rouxi, Sardinella aurita, Sardinella eba and Ethmalosa fimbriata) and Engraulids (Engraulis guineensis) has been given Marchal in 1967. Recently Boely, Champagnat and Conand (1969) published their observations on the reproductive cycle of S. aurita which includes the quantitative distribution of the larvae in the continental shelf of Senegal during 1968 and in the waters between C. Blanc, C. Vert Islands and Dakar as found during the "JEAN CHARCOT" Cruise made in July of the same year. The results on ichthyoplankton, hydrography as well as observations on Tuna obtained in the area covered by the "JEAN CHARCOT" Cruise are given by Champagnat, Conand, Cremoux and Rebert (1969).

The objective of this preliminary report is to present the quantitative date on larvae of Sardinella aurita, S. eba and Engraulis guineensis collected during the ichthyoplankton surveys made in 1969 off Senegal and Mauritania and to relate the quantitative results to the environmental features. A more complete picture on the distribution of the larvae in the region and on the reproductive cycle of the species will be possible after comparison and discussion of all the data obtained in 1968 and 1969.

Acknowledgments

The suthor wishes te express here her a cknowl edgments to :

- Mr. CONAND ("Centre Océanographique de Dakar-Thiaroye") who has studied the ichthyoplankton material collected in 1968, some of his results have been discussed in the present report ;
- Mr. CHAMPAGNAT, director of the Center and Mr. ELWERTOWSKI, Project Manager, for thc outlining of ichthyoplankton programme for 1969 ;
- Mr. BOELY and Mr. GONZALEZ-ALBERDI, respectively biologists of the Center and of the F.A.O Pro ject, for the critical discussion of the results.

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- Mr. CREMOUX, hydrographer of the Center, for the hydrographical data presented here ;

- Mrs. M DIOP, Mr. T.SENE, and Mr. D.TOURE, technical assistants of the plankton Lais., for the sorting of the larvae. Thanks are due to each of the aforementioned persons as well as to the other colleagues of the Center, for their help in sampling at sea.

MATERIAL AND METHODS

The material consists of a series of plankton samples collected during severnl hydro-plankton Cruises made in 1969.

The hydro-plankton programme for 1969 has been basically the same as for 1968 (Champagnat, Boely, de Bondy and Cremoux, 1969) and included :

a) monthly cruises covering the continental shelf of Senegal and Gambia with 5 hydroplankton stations (over depths of 10,20,50,100 m. and at 10 miles from the isobnths of IOC m.) for each of the 9 sections across the coast, plus 3 intermediate stations (Fig. 1).

3) b[illegible]-monthly cruises off C. Vert peninsula with 13 hydroplankton stations distributed along a section perpendicular tothe coast, reaching off shore 20° long, W.

c) a summer cruise off Mauritanie and Northern coast of Senegal, from C. Blanc, 21°N, and C. Vert, 15°N

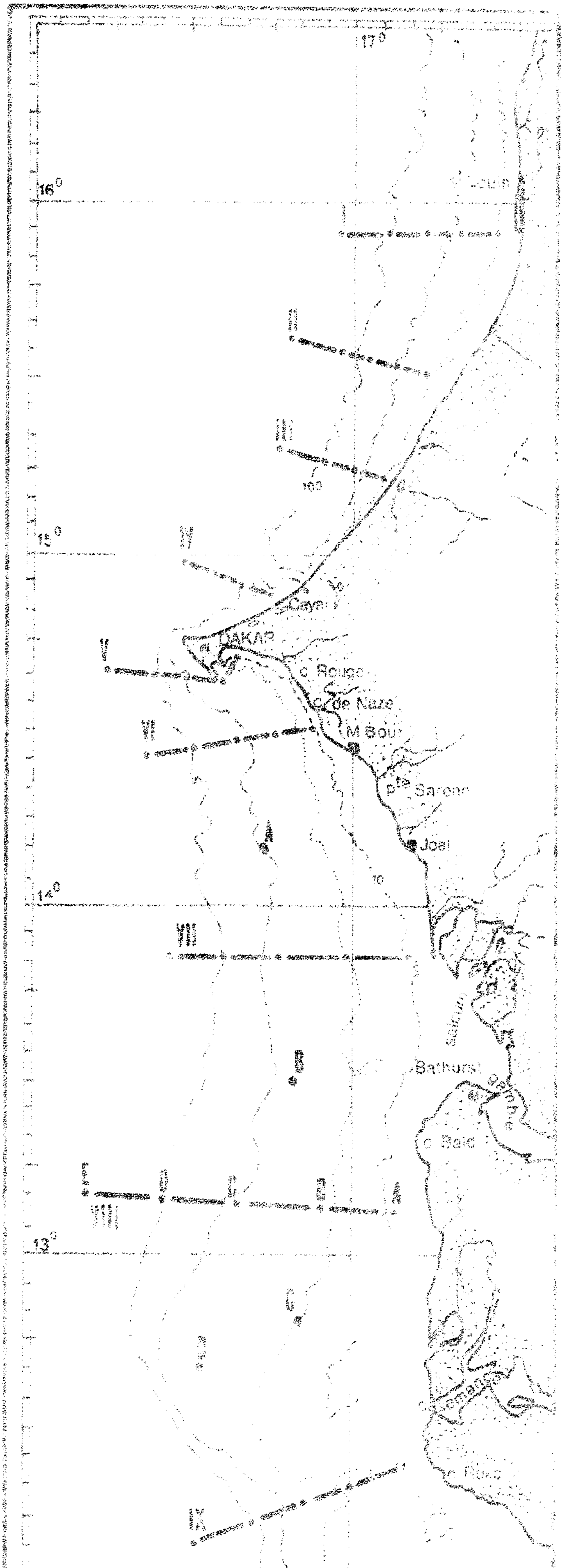
Unfortunately because a breakdown in the engin of the R/V LAURENT AMARO, the programme could not be fulfilled, the cruise actually made in 1969 has baen specified in Table I. More detailed informations about dnte, time and geographical position of each plankton station are in the corresponding interim reports of the Center.

POSITION DES RADIALES ET STATIONS

Modifiées à partir d'Avril 1969

I	Radiale de	SAINT LOUIS
II	"	15°30 N
III	"	NORD CAYAR
IV	"	SUD CAYARD
V	"	CAP VERT
VI	"	POPENGUINE
VII	"	SANGOMAR
VIII	"	BATHURST
IX	"	ROXO

... intermédiaires A B C D



... POSITION OF THE HYDROPLANCTON STATIONS IN 1969 CRUISES OVER THE CONTINENTAL SHELF OF SENEGAL AND GAMBIA (from Champagnat, Rebert, de Bondy, Conand and Domain, 1969)

TABLE I.- HYDRO-PLANKTON CRUISES IN 1969

CRUISE N°	DATES	R/VESSEL	LATITUDINAL EXTENSION	No. of Sects.	No. of plankton Sts
69.03	18-26 Feb.	L. AMARO	St.Louis (16°N)-C.Roxo(12°30'N)	9	41
69.06	12-17 Apr.	L. AMARO	St.Louis (16°N)-C.Roxo(12°30'N)	9	44
69.08	28-30 Apr.	L. AMARO	C.Vert "radiale prolongée"	1	6
69.10	17-23 May	L. AMARO	St.Louis (16°N)-Bathurst(13°15'N)	8	40
69.13	18-26 July	THUE JR.	C.Blanc (21°N) -C.Vert(14°40'N)	9	42
69.14	29Aug-4Sept	L. AMARO	St.Louis (16°N)-C.Roxo(12°30'N)	9	46
69.17	02-04 Oct.	L. AMARO	C.Vert "radiale prolongée"	1	10
69.18	22-30 Oct.	L. AMARO	St.Louis (16°N)-C.Roxo(12°30'N)	9	46
69.22	03-05 Dec.	L. AMARO	C.Vert "radiale prolongée"	1	14

Horizontal hauls of 10 minutes were made in the coastal stations (St.A, over 10 m depth and St.B, over 20 m depth) and oblique hauls, also of 10 minutes, at deeper stations, using 45 m cable at St.C, over 50 m depth, 90 m. of cable at St.D, and over 100 m depth, and 100 m cable at the offshore stations, the inclination of the cable baing approximately constant of 45° ; both horizontal and oblique hauls were made at a speed of 2,5 knots.

Two types of net were generally used in the offshore stations: "PK2" and "Thons" though only "PK2" in coastal stations:. The characteristics of the nets are as follows : "PK2" a conical net of approx. 4 m length, 1 m diameter, width of opening 0,785 m2, mesh size 500 microns ; the no-t "Thons" having the same characteristics but Seing cylinder-conical in shape.

In the February Cruise a net type "Grand Schmidt" (G.S), with square opening of 562 cm2 and mesh size of 1 mm, hauled at a speed of 1 knots was used in the last stations of thc Cruise (See indications in Fig. 2 and Table IV). In the July Cruise off Mauritania and Senegal, the

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PK2 net was lost during the survey, therefore only data collected with the "Thons" net are available for the second half of the stations (see indication in Table VI).

The quantitative distribution of the larvae, for cruises where PK2 samples are available for each station (Figs. 3-6) are based only on these, the material collected with other types of net having been used only for qualitative and biometric purposes. As no flowmeters were available at the time of sampling at sea it is not possible to know the exact amount of water filtercd at each station and by each net used. Nevertheless, in order to be able to express comparatively the data obtained in stations were only "Thons" samples were available, essays have been made during the last survey using the just arrived-flowmeters. Both nets, "PK2" and "Thons", with the flowmeter (TSK type) mounted in the center of the opening, were hauled in thr usual way. The experiment was conducted in order to find out the approximate volume of water filtered by both nets as well as to know whether their performance were comparable, in spite of the difference in shape.

Plowmeter readings for 10 minutes of oblique hauls (100-0m) for both nets hauled at the same stations, were as follows :

NET "PK2"			NET "THONS"	
Rev. Nº	Water filt. (m.3)		Rev. Nº	Water filt. (m.3)
4301	517		4329	534
3421	411		3564	439
2869	345		2751	339
3853	463		3397	467
Net mean.....	434 m3		.....	445 m3
		General mean.....440 m3		

It crin be seen that there are not any significative differences in the amount of water filtered by both nets at simultaneous stations.

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The flowmeter readings for 10 minutes of surface hauls for both nets, but hauled at different stations, were :

NET "PK2"			NET "THONS"	
Rev. N°	Water filt. (m.3)		Rev. N°	Water filt. (m.3)
4807	644		4092	562
4640	557		3925	485
2804	337		1861	229
Net mean.....	513 m3		.....	425 m3

General mean 469 m3

As surface hauls were not done simultaneously , the flowmeter reading of both nets are not directly comparable ; nevertheless, as it has been proved in oblique simultaneous hauls that the performance of both nets is similar, the same might be assumed for surface hauls.

Considering that there are no great differences between flowmeter readings of oblique and horizontal hauls, it might be assumed that approximately the same amount of water has been filtered by both nets in surface and oblique hauls.We consider therefore as appropriate to take the general mean of all data obtainedduring the essays with flowmeters, which includes stations where no clogging and heavy clogging of the net were registered, in order to express the horizontal distribution of the larvae as a number of larvae per 100 m3 of water sampled. The mean value of water filtered by both net is of 452 m3, which corresponds to the 75 % of the amount of water as computed matematically. The quantitative results expressed as no./100 m3 are shown in the distributional maps of Figs. 2-7 and 9, where the oblique and surface hauls are reoresented with different signs and where indication of night (Black square) and day (White square) stations are given for the surface hauls. The actual number of larvae caught in 10 minutes of surface and oblique hauls at different stations, is given in the Tables IV - VI, where the type of net used is also indicated.

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In the Laboratory, all fish larvae bave been sorted from the rest of the planktonic organisms. The Sardinella and Engraulidae l rvae were determined by species and counted , measurements at size interval of 1 mm, have been done only for the Sardinella species.

Identification of Engraulis guineensis larvae was done according to the description of Marchal (1966). Differenciaticn between larvae of S. aurita and S . eba at different stages was carried out according to the descriptions by Fage (1920) and D'Ancona (1936-1951) for S. aurita and t the identification key of Marchal (1966) ; unpublished drawing by Blache as well as persona1 biometric observations, to be presented in a later report helped in the identification task.

All fish larvae of the 1969 February cruise have been an lized by Mr. CONAND, the author has reviewed the Clupeids m terial in order tc measure the larvae and included the results in the pr sent report.

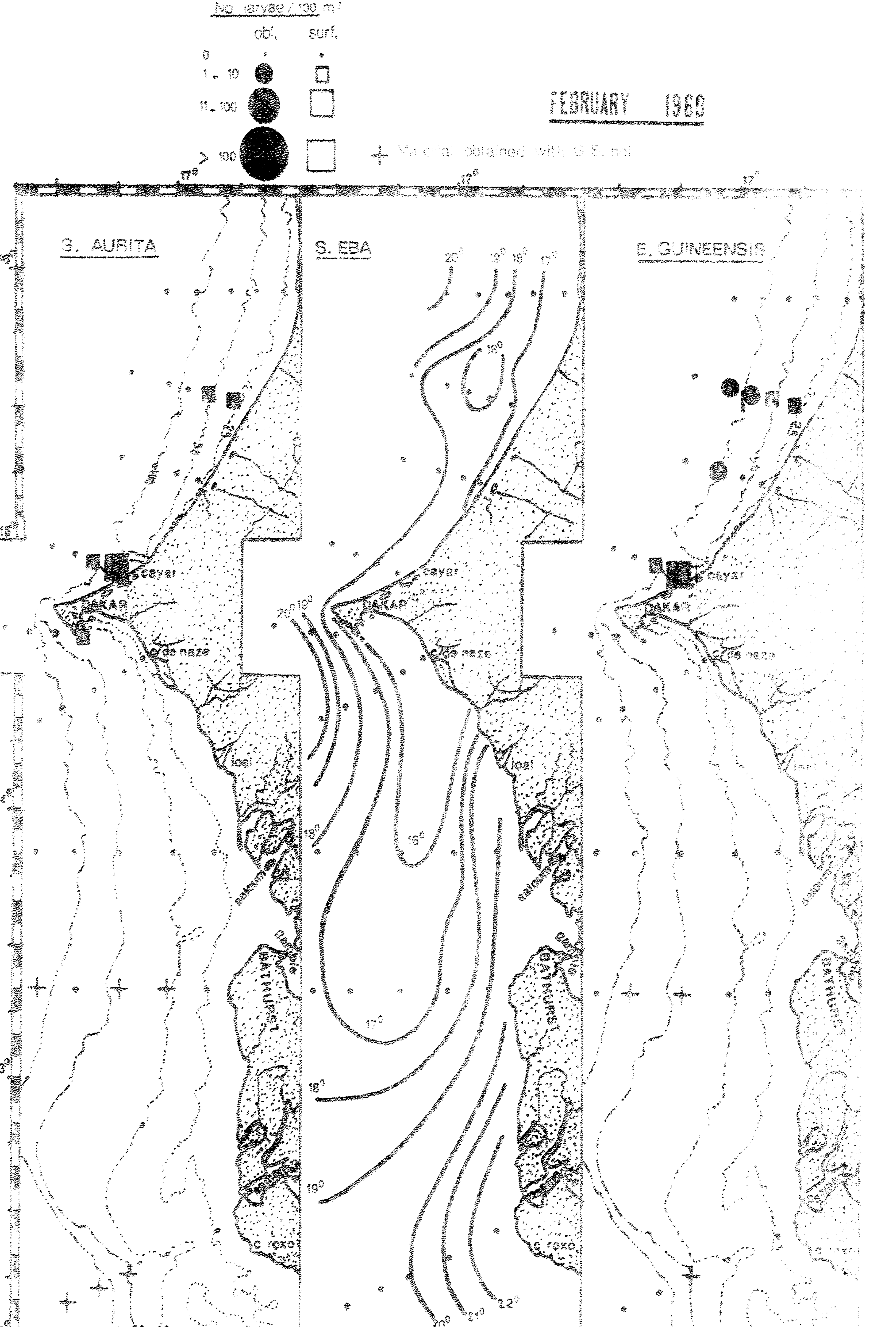
Unpublished hydrographical data were made available to the author by Mr. CREMOUX from the hydrographical Lab. of the Center.

QUANTITATIVE HORIZONTAL DISTRIBUTION OF Sardinella aurita, S. eba and Engraulis guineensis AS OBSERVED DURING THE 1969 CRUISES

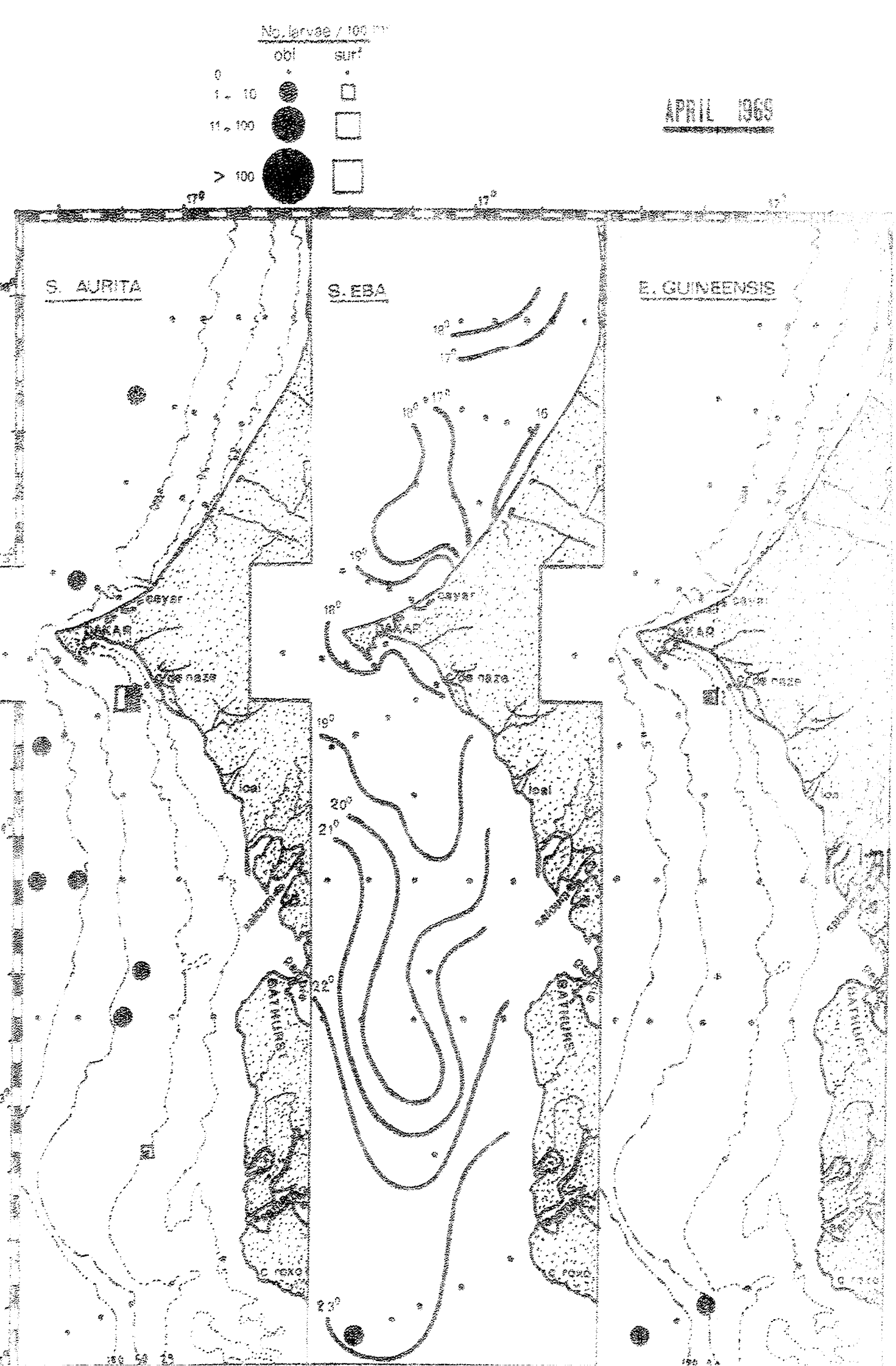
A. Cruises over the continental shelf of Senegal-Gambia

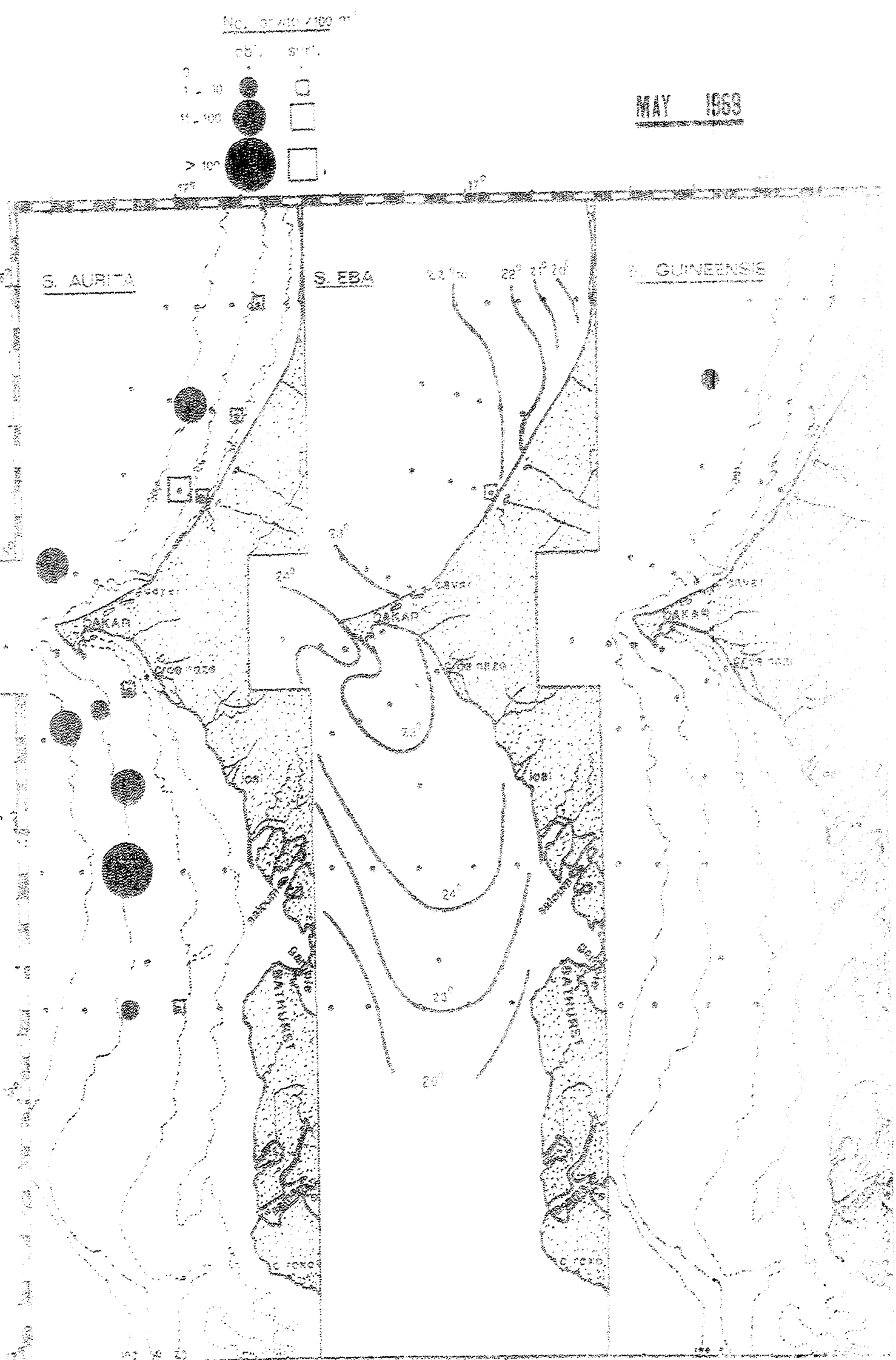
The quantitative distribution of the 3 species as observed in the different nonths of the year, is shown in Fig. 2 (February), Fig. 3 (April), Fig. 4 (May), Fig. 5 (Aug-September) and Fig. 6 (October). In each figure the stations occupiod as well as the surf ce isothermes and the iaobaths are shown.

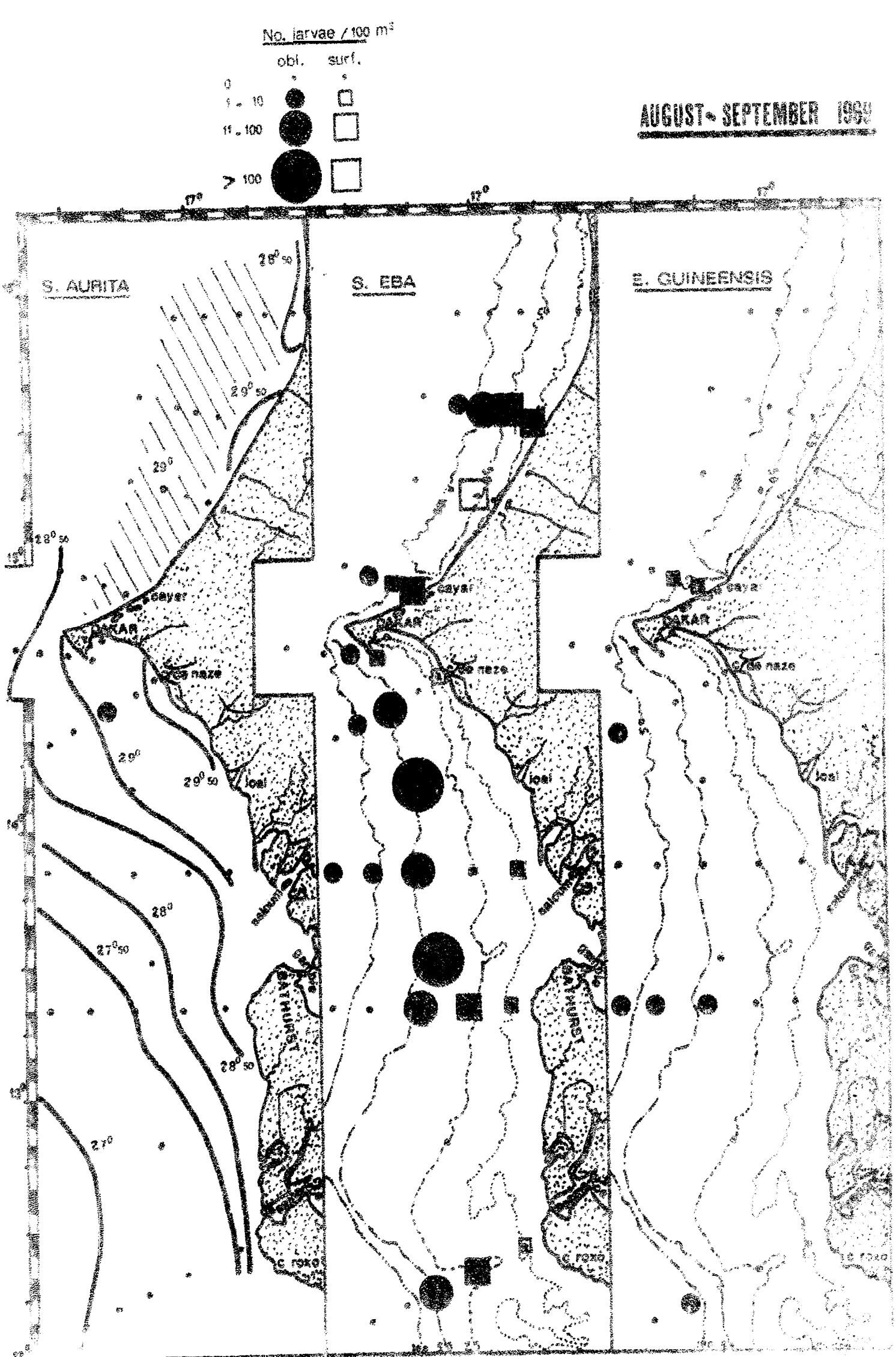
Bo larvae of S. eba have been found in the February Cruise (Fig.2) when surface isothermes show very low temperature values, r nging from 16°C in the proximity of the coast to 20°C offshore, the surface s linity being higher than 35,4 ‰ at every station (Min. 35,42 ‰ - Max. 35,80 ‰). Larvae of S. aurita and E. guineensis have been found sporadically in some of the stations located in regions with surface temperatures higher than 17°C, their number being nevertheless, still poor (Table IV).

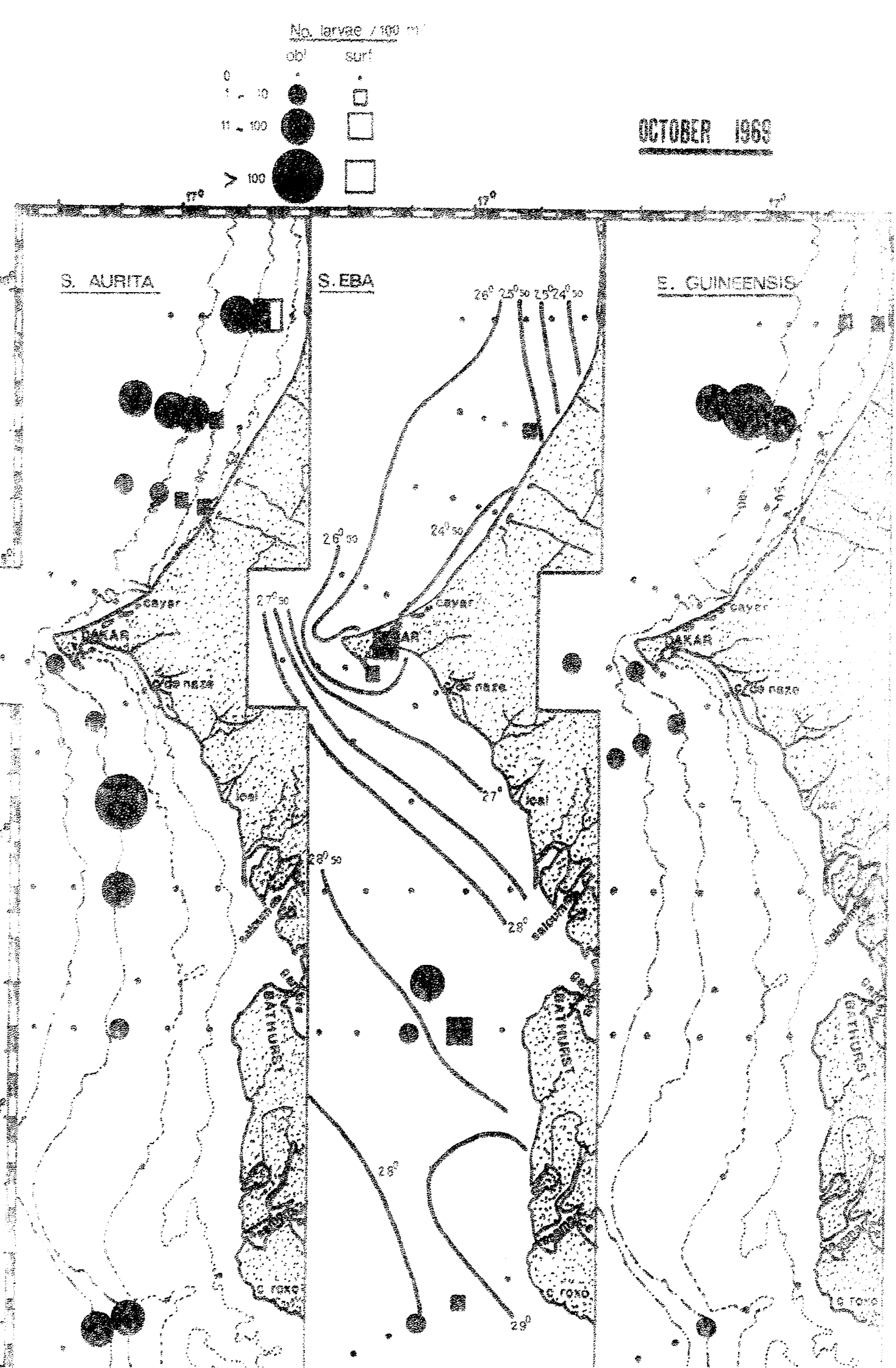


No larvae / 100 m²
obl.
surf.
0
1 – 10
11 – 100
> 100
FEBRUARY 1969
S. AURITA
S. EBA
E. GUINEENSIS
cayar
DAKAR
c. de naze
joal
BATHURST
c. roxo


No. larvae / 10 m²
obl
sur²
0
1 - 10
11 - 100
> 100
APRIL 1965
S. AURITA
S. EBA
E. GUINEENSIS
17°
18°
19°
20°
21°
22°
23°
Cayar
Joal
Saloum
Bathurst
C. Roxo


MAY 1969
S. AURITA
S. EBA
S. GUINEENSIS
DAKAR
BATHURST
C. PALMAS


No. larvae / 100 m³
obl.
surf.
0
1 - 10
11 - 100
> 100
AUGUST - SEPTEMBER 1950
S. AURITA
S. EBA
E. GUINEENSIS
17°
28° 50
29°
29° 50
28°
27° 50
27°
DAKAR
Cayar
Joal
BATHURST
C. roxo


No. larvae / 100 m³
obl
surf
0
1 - 10
11 - 100
> 100
OCTOBER 1969
S. AURITA
S. EBA
E. GUINEENSIS
17°
26° 25°30 25° 24°30
26°30
24°30
27°30
27°
28°30
28°
29°
DAKAR
Cayar
Cde naze
Joal
Saloum
BATHURST
C. ROXO

In April thermic conditions, as indicated by the surface isotherms of Fig. 3, gradually increased along the southern coast from 18°C off C. Vert to 23°C off C. Roxo, cold upwelling water being still present only off the northern coast. The salinity of the water did not change much from the previous cruise, in all the stations the salinity values being higher than 35,5 ‰ (Min. 35,53 ‰ - Max. 35,94 ‰). As observed in the previous Cruise, no finding of S. eba larvae was registered with the exception of a few specimens captured in the more southern and offshore stations ; S. aurita larvae were found in small number and in the offshore stations with surface temperatures higher thnn 18°C . Presence of E. guineensis larvae was quite sporadical and of very low quantitative value.

In May (Fig. 4) when the water temperature of the region increased to 20° - 23°C in the northern coast and to 23° - 26°C in the southern coast (Fig. 4) larvae of S. aurita were quite abundant being more frequently distributed in station:: with surface temperatures higher than 22,5°C. Salinity values registered during the cruise were higher than 35,6 ‰ (Min. 35,64 - Max. 36,31 ‰). The high number of larvae found, as well as their size ranges, (Figs. 12,13) indicate clearly that the spawning of the species took place during this season. S. eba and E. guineensis were practically absent in the collections of May.

In the Cruise from the end of August to the beginning of September, no larvae of S. aurita were captured while S. eba were found in great abundance and widely distributed over most of the stations. The great abundance of its larvae as well as their size ranges (Figs.12,13) indicates spawning of S. eba off both coasts of Senegal during this period when the highest sea temperature was registered (27° to 29°C) and when the most frequent salinity values were lower than 34 ‰. The highest concentrations of larvae were clearly located at stations with temperatures between 28° and 29°C and low salinity.

In the October Cruise (Fig. 6) larvae of the 3 studied species have been found along the whole explored coast, though S. aurita

was the most frequently and abundantly distributed. The size range of the larvae of both Sardinella species indicates that spawning of S. aurita was beginning along the whole coast and that the spawning of S. eba was still going on, but only off the southern coast where the higher temperature and lower salinity values were registered. Stations with S. eba larvae present surface salinity values ranging from 30,22 ‰ to 32,03 ‰ and were located at surface temperature higher than 28°C, while S. aurita larvae were more frequently found in the northern cooler stations, The highest number of larvae of E. guineensis was collected during the October survey when heavy concentrations were found in the northern region.

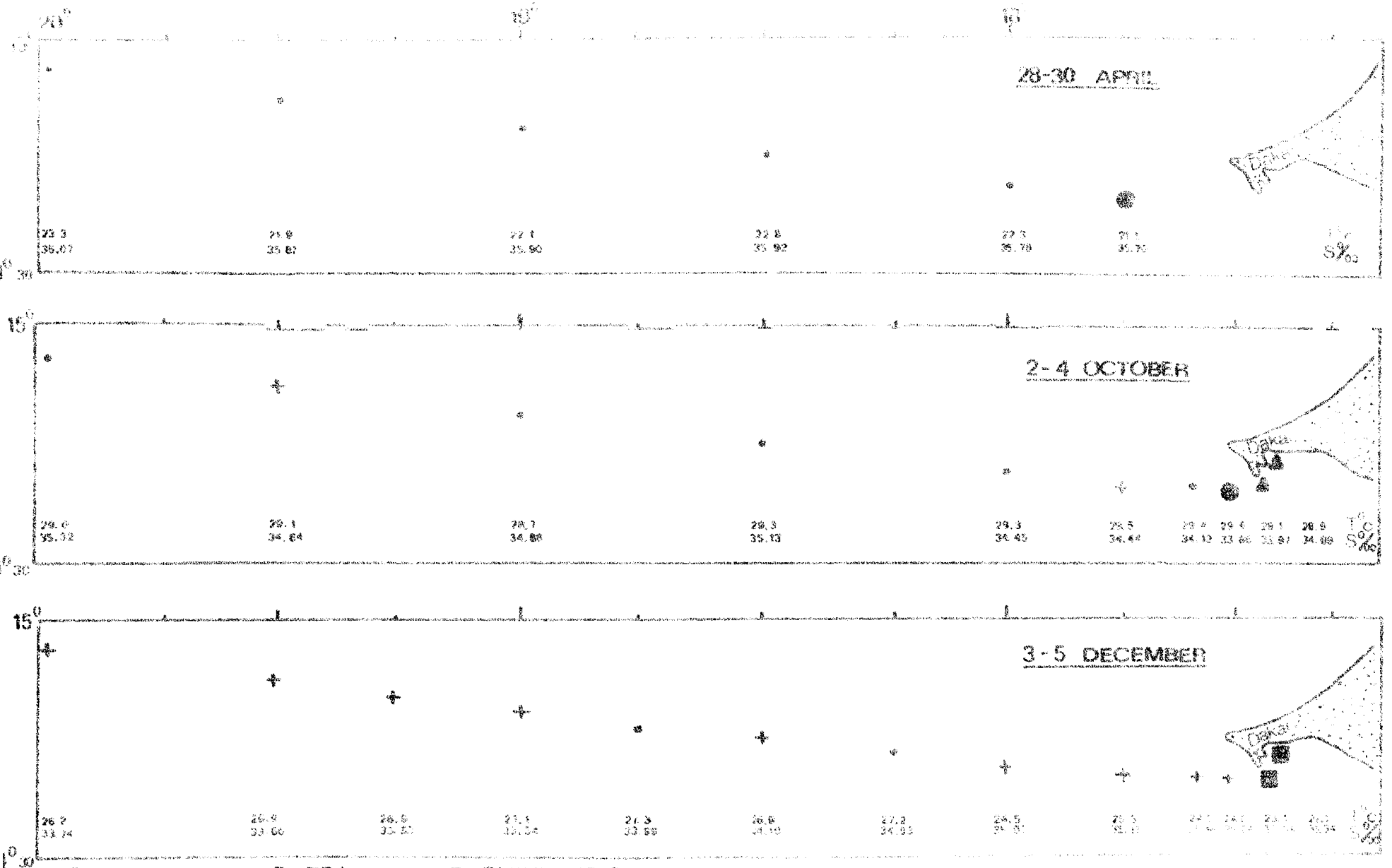
B. "Radiale prolongée" off C. Vert

The area covered by the cruise off C. Vert and the location of the hydroplankton stations as well as surface temperatures and salinities are shown in Fig. 7. Only 3 Cruises were made in 1969 (April, October and December). The observed distribution of larvae is shown in Fig. 7 and Table V.

It can be seen that Clupeidae larvae are distributed only over the continental shelf, as no larvae were found in stations further than St. E. On the contrary larvae of E. guineensis were collected even in the station at 20°W (approx. 100 miles off shore).

During the Cruises of April and December, only S. aurita larvae were collected in tlîn coastal stations cff C. Vert ; while during the October Cruise larvae of both Sardinella species were present in some of the stations occupied, as observed in the Cruise made in the same month, over the continental shelf of Senegal.

S. aurita larvae, of April and December Cruises, were captured at stations with relatively low temperatures : 21,0°to 23,1°C and salinities higher than 34 ‰, while the S. eba larvae, present only in the coastal stations (St. A and B) of October Cruise, were found at temperature of 29°C and salinities lower than 34,08 ‰. Size ranges of S. aurita



S. AURITA
no / m³
1-10 obl.
1-10 surf.

S. EBA
▲ present

E. GUINEENSIS
+ present

FIG. 7. Distribution of Clupeidae and Engraulidae off Cap Vert

larvae found off C. Vert are shown below (Fig. 8) ; the few specimens of [illegible] larvae found in October measured from 6 to 7 and from 11 to 13 mm.

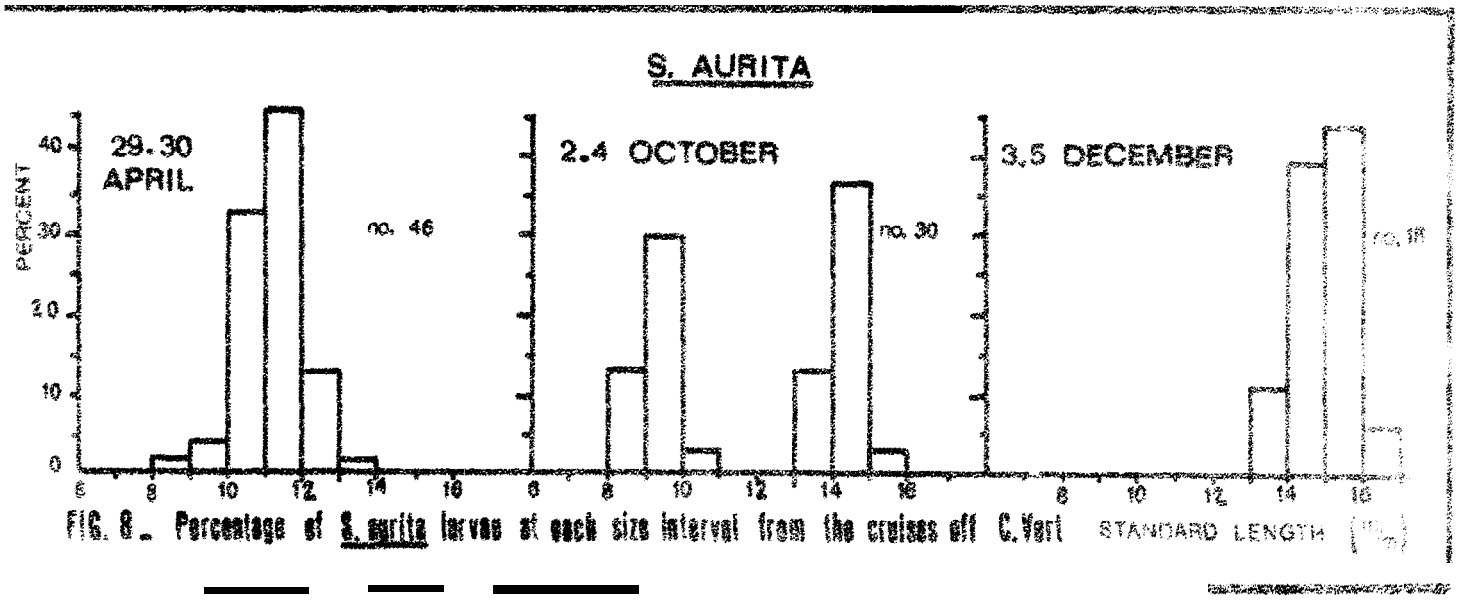


FIG. 8 - Percentage of S. aurita larvae at each size interval from the cruises off C. Vert

C. Cruise THUE JR from C. Blanc to C. [illegible] Vert, July 1959

The July survey by the "THUE JR" covered the continental shelf of Mauritania and of northern Senegal, from C. Blanc to C. Vert. Location of hydrological stations, surface isotherms and quantitative distribution of S. aurita and S. eba larvae are shown in Fig. 9 The number of Engraulidae and Clupeidae larvae per haul is given in Table VI.

As it can be seen from the isotherme's distribution, the oceanographical conditions of the northern and southern part of the explored area were quite different : in the northern limit (21°N to 20°N) the sea temperatures were still low, ranging from 21°C in coastal stations, to 25°C in the more offshore stations ; a steady warming up of the water takes place southwards with temperature values as high as 30°C in the southern most stations off C. Vert. Salinity values were approximately constant over the whole region, from 35,7 ‰ to 36,0 ‰ in the North and between 35,2 ‰ and 35,7 ‰ south of Saint-Louis.

The larvae of S. aurita presented their highest concentrations (Fig. 9 and Table VI) in the cold water off C. Blanc and distributed

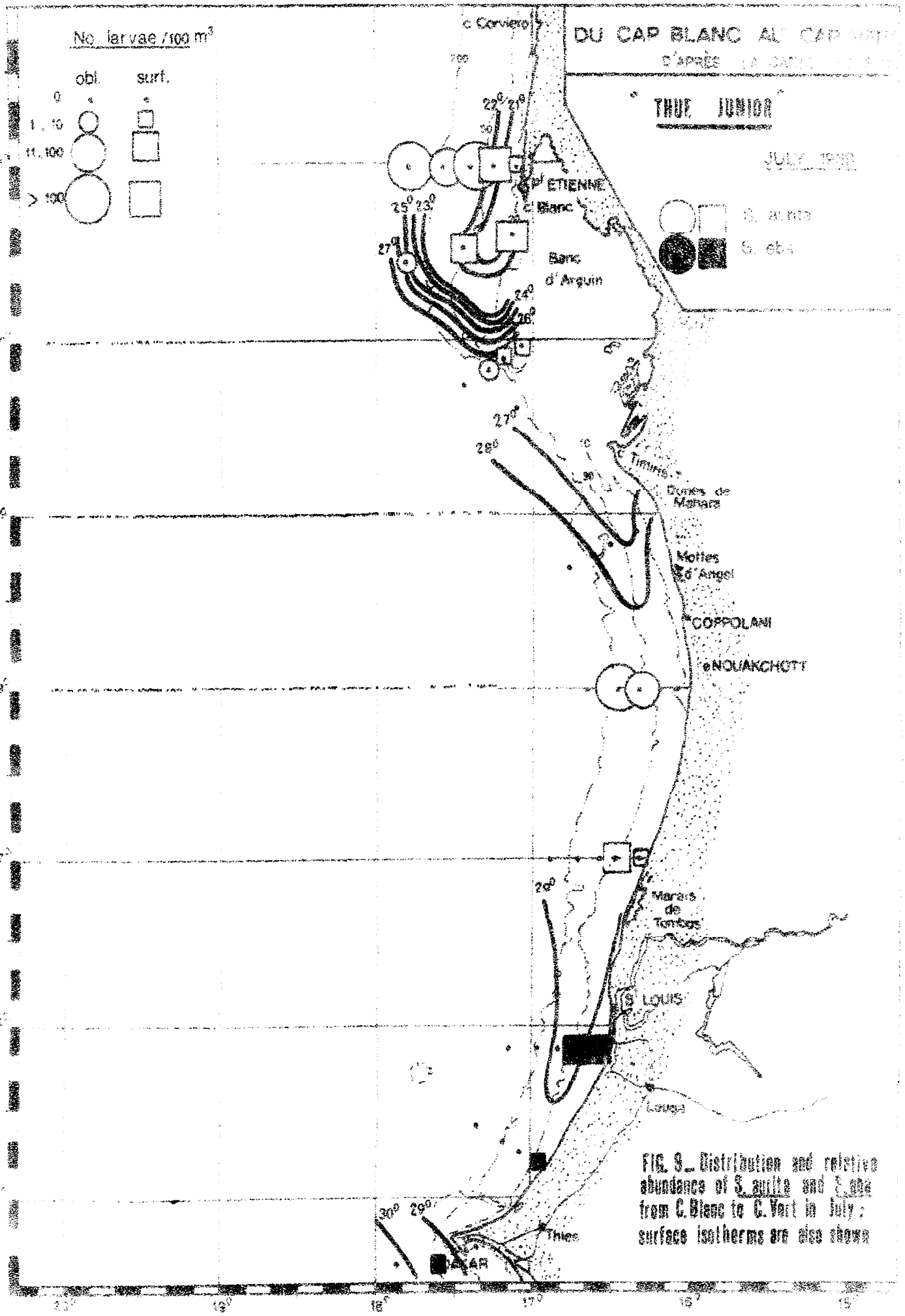


FIG. 9 — Distribution and relative abundance of S. surita and S. ebe from C. Blanc to C. Vert in July ; surface isotherms are also shown

southwards until 17°N. In the samples collected in the warmer southern water Off Senegal , only the larvae of S. eba have been sampled. This indicates a northwards movement of the spawning population of S. aurita at the time that the water is warming up off the senegalese shelf. The same phenomendn was observed in July-August 1968 (Boely, Champagnat and Conand, 1969) during the "JEAN CHARCOT" survey in thc ssme area.

In spite of the lack of a montly continuity in the 1969 collections, the plankton sampling was scattered over the different oceanographical seasons, described by Rossignol (1965) :

A -- Season of coastal upwelling, from January to May, characterized by very low tempernture, 16°-24°C and high salinities, 35,3-36,0 ‰.

B - Warm and cslm season, July-August-Septcmber, with a maximum warming up of the water, Temp. 26°-29°C, and salinity still higher than 35 ‰ in July, but decreasing from July to December.

C - Transitional season, from the end of September t.:: Decemb er when the warm dessalinated waters are replaced by cold water of high salinity

Comparing thc quantitative distribution of the Clupeids larvae with ths seasonal oceanographical regime off Senegnl , it can be concluded tha t :

a) no massive spawning tnkes place during the cold upwelling season for both Sardinella species, as observed in the Cruises of February and April ;

b) the massive spawning of S. aurita was registered during the two transitional seasons : in May, when the waters starts warming up off the senegalese coast and in October, when the waters of tha warm season are replaced by colder waters of higher salinity ;

c) the massive spnwning of S. eba, August-Sep tem ber seems to take place only during the warm season and after the decreasing of the solinity ;

...../.....

d) at the beginning of the warm season off the senegalese coast, the spawning population of S. aurita seems to move northwards, impelled by the front of warm water.

TEMPERATURE AND SALINITY RELATIONS

Berrit (1961) distinguished for the surface layers cf the Gulf of Guinea, four categories of waters, defined by the isotherm of 24°C and the isohaline of 35 ‰ :

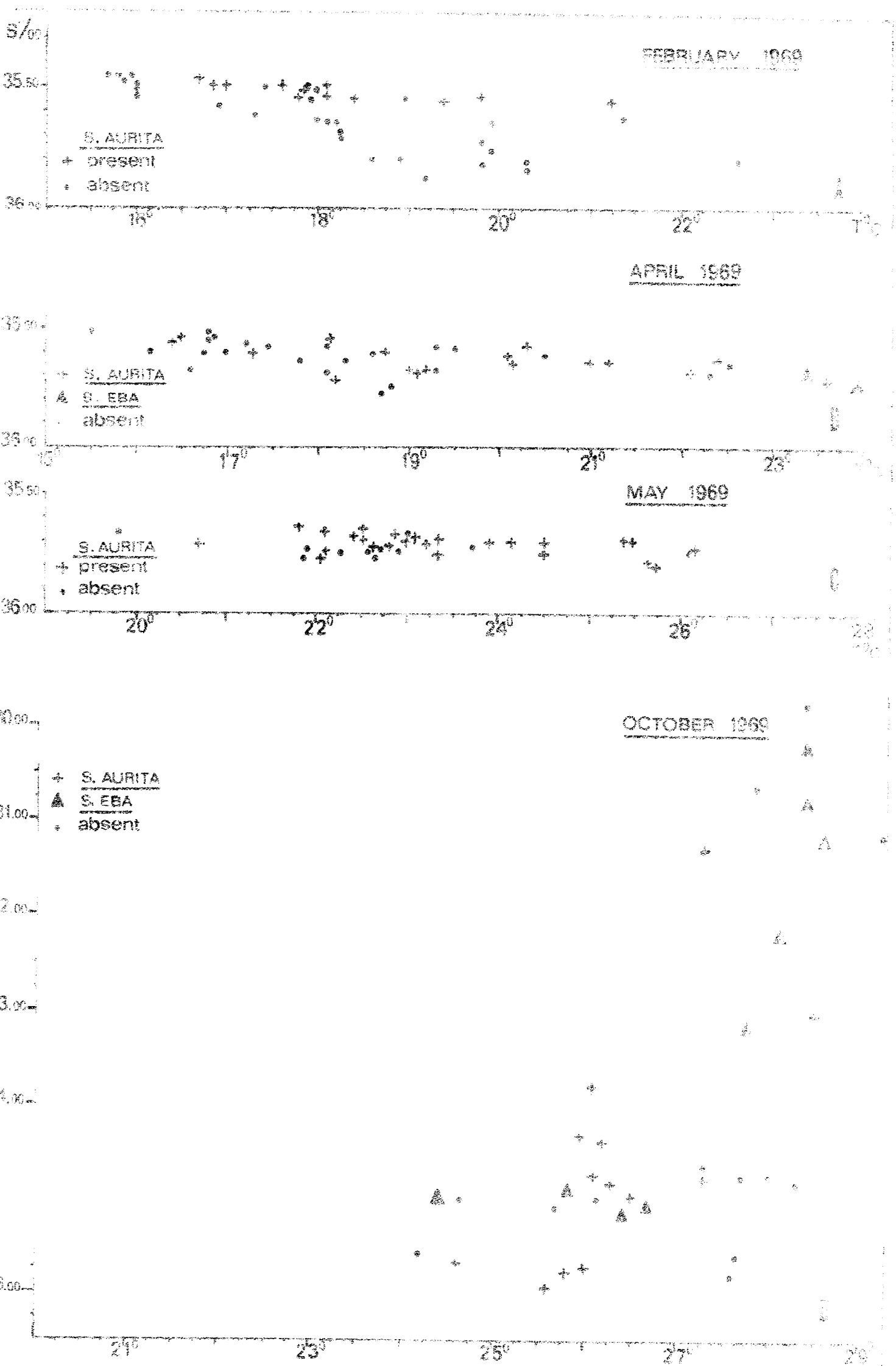
A - "Warm water of low salinity" $t > 24°C$ Sal. $< 35‰$
B - "Warm water of high salinity" $t > 24°C$ Sal. $> 35‰$
C - "Cold water of high salinity" $t < 24°C$ Sal. $> 35‰$
D - "Cold water of low salinity" $t < 24°C$ Sal. $< 35‰$

Only the three first named water musses have been found over the continental shelf of Senegal at diîfarent seasons of the year.

In order to define the physicochemical characteristics of the water and its relation with Clupeids larvae as observed in 1969, the occurrence of S. aurita and S. eba wns plotted against the temperature and sslinity of thc surface 1 ayer found in the different plankton Cruises of 1969 (Figs. 10 and 11).

The temperature and salinities plotted correspond with surface value as no data for the standard depth of 10 m were avail able for all the plankton stations, which would have been certainly more representative as not so much affected by diurnal and local anomalies.

A comparison of the Fig. 10 and 11 shows great differences in the distribution of temperature and salinity at the different seasonal collections. In surveys made during February and April (Fig. 10,A and B), all stations show temperature below 24°C and salinities between 35,4 ‰ and 35,8 ‰, values corresponding to the "cold water of high salinity" as described by Berrit. Between these limits of physico-chemical variables, finding of S. aurita larvae are scattered and of very


S/oo
FEBRUARY 1969
35.50
S. AURITA
present
absent
36.00
15°
18°
20°
22°
T°C
APRIL 1969
S. AURITA
S. EBA
absent
17°
19°
21°
23°
MAY 1969
S. AURITA
present
absent
20°
22°
24°
26°
OCTOBER 1969
S. AURITA
S. EBA
absent
25°
27°

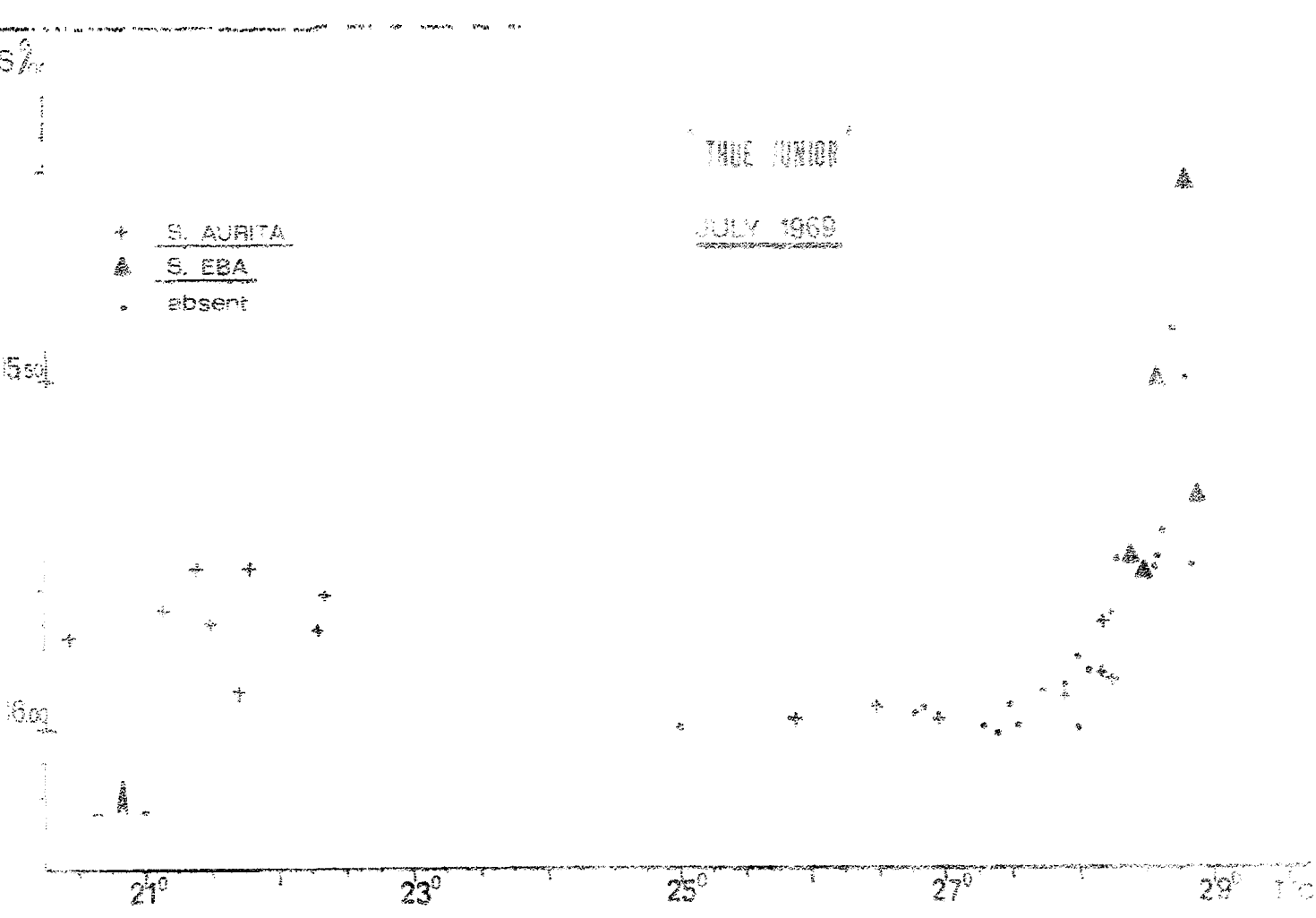
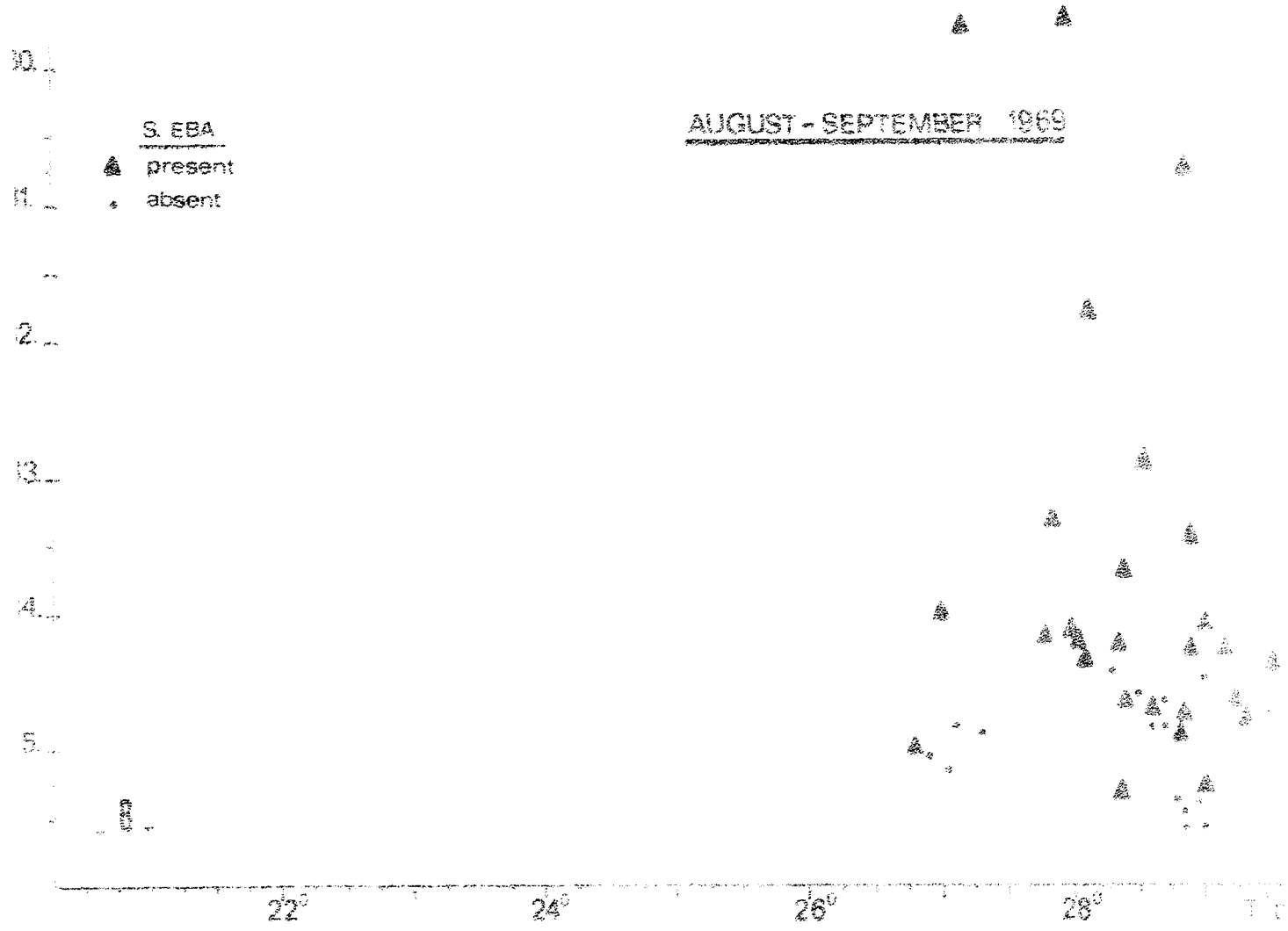


FIG. 11 - Temperature and Salinity relation of S. aurita and S. eba larvae in July Cruise from C. Blanc to C. Vert (A) and in September Cruise off Senegal and Gambia (B)



low quantitative value ; the very few specimens of S. eba (Tot . 12) were caught in water warmer than 23°C and measured bstween 18 and 23 mm in standard length.

The temperature (20° to 26°C) and salinity (35,6 ‰ to 36,8 ‰) values of the stations occupied during the May Cruise (Fig. 10, C) show the presence along the Senegalese coast of the "warmer water of high salinity" ; larvae of S. aurita have been captured in most of the stations and in great number (Table IV).

The widest ranges of temperature and saiinity have been found during the July Cruise (Fig. 11,A) which extended beycnd the northern limit of the warm water masses. The stations located in the more northern area were still in "cold water cf igh salinity", while the southern stations reached the "warm desalinated water" masses. During this cruise larvae of S. aurita were found in great abundance and associated with the cold water of high salinity, extending southwards also in warmer waters, but always at salinity values higher than 35,5 ‰. On the other hand, larvae of S. eba were associated with water of higher temperature (> 28°C).

The association of S. eba with water masses defined by Berrit as "warm water of low salinity" is still more evident from data of the Cruise made in August-September (Fig. 11,B) where most of the positive stations are at temperature higher than 27°C and saiinity values lower than 35,0 ‰.

In October (Fig. 10,D) when the sea temperature is still high (24°C) and the snlinity ranges are quite wide (30 ‰ to 36 ‰) larvae of both species of Sardinella have been found : Sardinella eba larvae were distributed mainly at stations of low salinity (< 35 ‰) and S. aurita mainly at stations with lower temperatures (< 27°C).

SIZE OF CLUPEIDAE LARVAE

Before considering the size composition of the larval population it is necessary to mention that our data have some limitations mainly due to the problem presented by the sampling of larvae.

Ahlstrom (1354) pointed out the difficulty due to net selectivity and tested the way to determine, though sampling with gears of different mesh sizes, the proportion of larvae of each size categories usually retained by the standard gear used. The smaller larvae are not fully sampled by net of regular size meshes as they escape from the meshes. On the other hand it was proved that the larger Sardina larvae are undersampled during the daylight hours as they avoid the net. As our material was collected with nrts of a single mesh size (500 microns) and at night as well as at day time, it must be assumed that a great proportion of small larvae has escaped and that the bigger larvae were undersampled in daylight hauls.

The minimum category size found in our material for the larvae of both Sardinella species, was of 3-4 mm in standard length, but this size was observed in quite a limited number of stations, being the size range of 4-5 mm the minimum usually sampled. The biggest larvae measured from 23-24 mm, but their number was so small that they never reached even the 1 % of the whole population sampled at the same station.

The size composition of the larvae sampled and measured at each station has been grouped by area and presented in Fig. 12 (Northern coast of Senegal), Fig. 13 (Southern coast of Senegal) and Fig. 14 (from C. Blanc to C. Vert). When larvae of both species have been collected during a same cruise, their size composition is generally quite different : (see Fig. 1.3 April, southern area and Fig. 12 October, northern area), as can be supposed knowing that the reproductive periods for both species in the same geographical area, is different.

The monthly number of larvae of each species captured in the northern and southern coast (Table II), as well as their size composition, (Fig. 12 and 13) is not always similar for both areas sampled. In fact, as the oceanographical conditions off the northern and southern coast are slightly different, the spawning time can be delayed for one of the two areas sampled in a same month. This is the case of the size

NORTHERN AREA

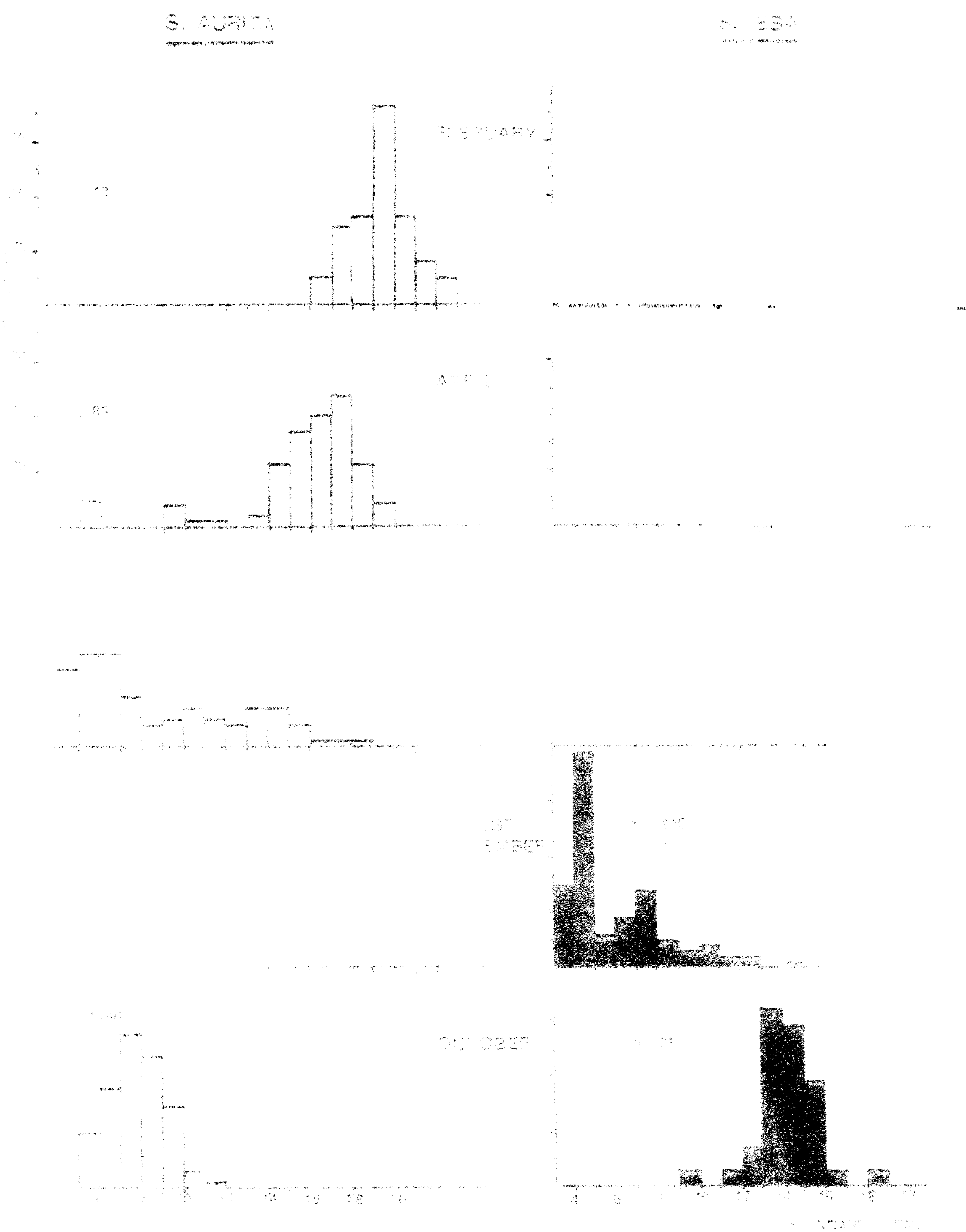


FIG. [illegible] - Percentage of S. aurita and S. eba [illegible] at each size [illegible] in the Northern coast of Senegal

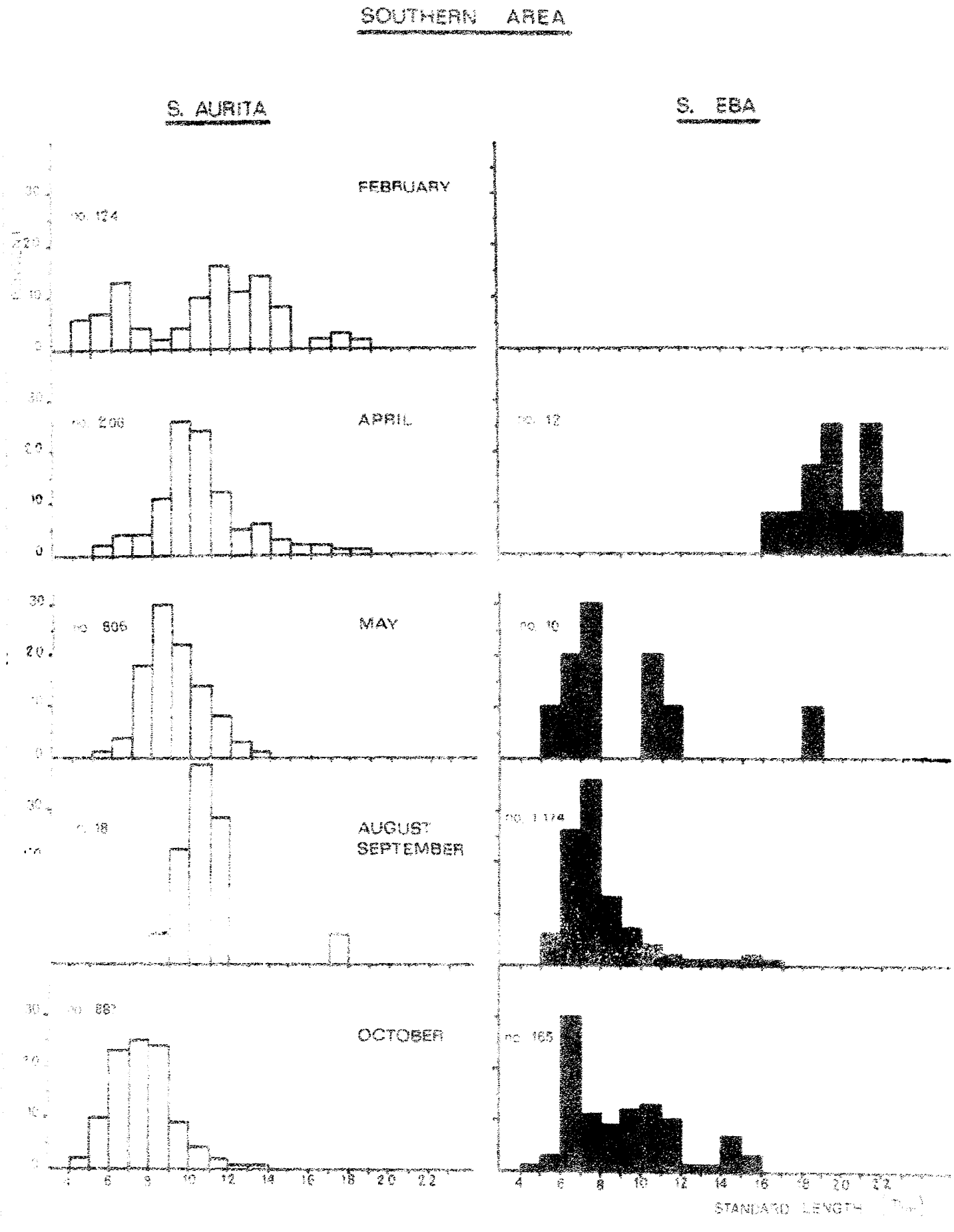


FIG 13 - Percentage of S aurita and S eba larvae at each size interval at different months, for the Southern coast at Senegal.

composition for S. aurita as obtained in February : off the colder southern coast the few larvae found were longer than 16 mm, while in the warmer water off the northern coast 3 size groups are present, one of which is made up by larvae of small size (4-8 mm). On the other hand S. eba shows the case inverse during August-September : the higher percent of larvae captured in the southern area was represented by size range of 7-8 mm, while in the northern area the higher percent is given by larvae of the smaller size (4-5 mm). In October, on the contrary, larvae of S. eba at intermediate size (13-14 mm) are found in the northern region where the temperature were lower than 25°C, while in the southern region, with temperatures still higher than 27,5°C, the highest percent was represented by larvae of small size (G-7 mm). Most of the larvae of S. eba were confined to the southern region (Table II).

TABLE.II.- Total number of larvae collected by the different 1969 Cruises off the northern and southern coast of Senegal (Data from 10 minutes haul with net "PK2).

	S. aurita		S. eba		E. guineensis	
	North	South	North	South	North	South
Feb.	374	156	20	0	149	22
Apr.	80	150	8	9	10	6
May	339	1727	10	12	2	17
Sept.	0	12	1439	1999	68	100
oct.	1630	2045	5	235	877	

Fig. 14 gives the size composition of the larvae of S. aurita from the coast of Mauritania and of S. eba from the northern coast of Senegal obtained during the July cruise of the "THUN JR". The size of the larvae of both species, shows that each one is spawning in the same period of the year, but in different regions : S. aurita in colder waters and S. eba in warmer waters.

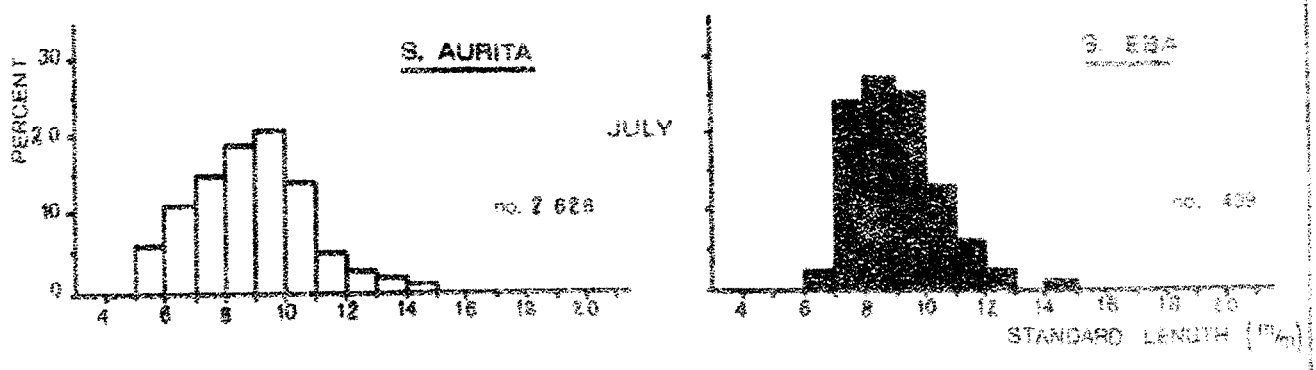


FIG. 14_ Percentage of S aurita and S. eba larvae at each size interval as found off Mauritania and Northern Senegal.

In spite that the data available are not spaced at regular monthly interval, the frequency diagrams for S. eba shows a certain succession of class size while the frequency diagrams of S. aurita are more irregular even if more larvae have been measured (Figs. 12 and 13). Boely and Champagnat (1969) analysing the adult population of S. aurita of the same area, found that there are 3 maxima of size classes in cold season which mix later and renew constantly until June. The migrating character of the Sardinella aurita population could therefore also be responsible for the lack of a more definite size pattern.

On the other hand the absence of a size pattern, which could have given an index of the growth of the larvae may be due to the possible selectivity of the gear used and to the wide interval of sampling at sea.

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as commented before, as well as to the possible prolonged spawning by the adults and to the rapid growth of the larvae.

As no experimental work has been done on the larval development of the West African Sardinella species and as the survey data in size composition are still toomuch limited, it is not possible to determine the age of the larvae captured in our samples. Neverthless, a rough idea can be obtained if considering the data estimcted for other areas. Ahlstrom (1954) gave the estimation of growth for the north pacific Sardina (Sardinops caerulea). This species develops (Ahlstrom, 1959) ut mean sea temperature of 14,5° - 15,99°C, during the major spawning period, and of 18,1°C in the late spawning period. An average duration of 3,5 days was estimated for the yolk-sac stage and a size of 4,5 to 5 mm. for the larva that has completed this stage. The sardina larva should require, according Ahlstrom (1954) between 1 to 2 months to develop to 24 mm. length. The development of the larva of the african Sardinella species should be shorter becnuse of the higher temperature of its habitat, particularly for S. eba. The smallest larvae found in our samples, less than 4 mm in lenght, have already completed the yolk-sac stage.

MONTHLY FLUCTUATION OF CLUPEIDS AND ENGRAULIDS LARVAE IN THE WATER OF THE CONTINENTAL SHELF OF SENEGAL AND GAMBIA

The quantitative data on fish larvae collected during 1968 are presented in the interim reports of the Center (Conand, 1968). The ichthyoplankton cruises of 1968, as well as the ones made in 1969, were scattered in time, therefore there is not a regular series of monthly observations available for each of both years. In order to achieve a preliminary general knowledge on the reproductive period of the species over a biological year, we grouped the data obtained during the two years sampling.

In tableIII are resumed the total numbers of larvae of each species of Clupeids and Engraulids, collected at different months during 1968 and 1969 over the continental shelf of Senegal and Gambia. As the number of Plankton stations and of hauls per station varied from cruise to cruise, the average number of larvae was also computed in order to make the data comparable.

TABLE III.- Comparison of relative abundance of Sardinella aurita, S. eba and Engraulis guineensis larvae in the continental shelf of Senegal, based on monthly summaries of the number of larvae obtained by all plankton collections made during Cruises of 1968 and 1969. (Data obtained with different nets : "PK2", "Thons", and "Grand Schmidt").

Years	Month	N° of Samples	S.aurita Total N°	S.aurita N°/ haul	S.eba Total N°	S.eba N°/ haul	Clupeidae Total	E.guineensis Total N°	E.guineensis N°/ haul
1968	Jan.	80	111	1.38	25	0.31	136	369	4.61
1969	Feb.	60	568	9.47	-	-	568	208	3.47
1968	March	61	8	0.13	1	0.02	9	68	1.11
1969	Apr.	75	407	5.43	14	0.15	421	36	0.48
1968	May	68	1329	19.54	-	-	1329	1	0.01
1969	May	54	2074	38.41	19	0.35	2093	16	0.30
1968	June	69	2567	37.20	-	-	2567	75	1.09
1969	July	16	-	-	661	41.31	661	70	4.38
1968	Aug.	68	154	2.26	2658	39.09	2812	155	2.28
1969	Sept	46	12	0.26	4213	91.59	4235	12	0.26
1969	Oct.	46	1775	38.59	256	5.57	3031	349	7.59
1968	Nov.	64	3540	55.31	312	4.88	3852	608	9.50

In Fig. 15 the average monthly number of larvae per haul is graphed in logarithmic scale. Only tho larvae of S. aurita and S. eba reached values higher than 10 specimens per haul , while the larvae of E. guineensis were always very scarce and did not exc ed the mean value of 10 larvae per haul, even in the months of their greatest abundance (January, July and November). Due to the small number of larvae as well as to the lack of size measurement it is not yet possible to say whether the 3 peaks of E. guineensis are related to spawning period.

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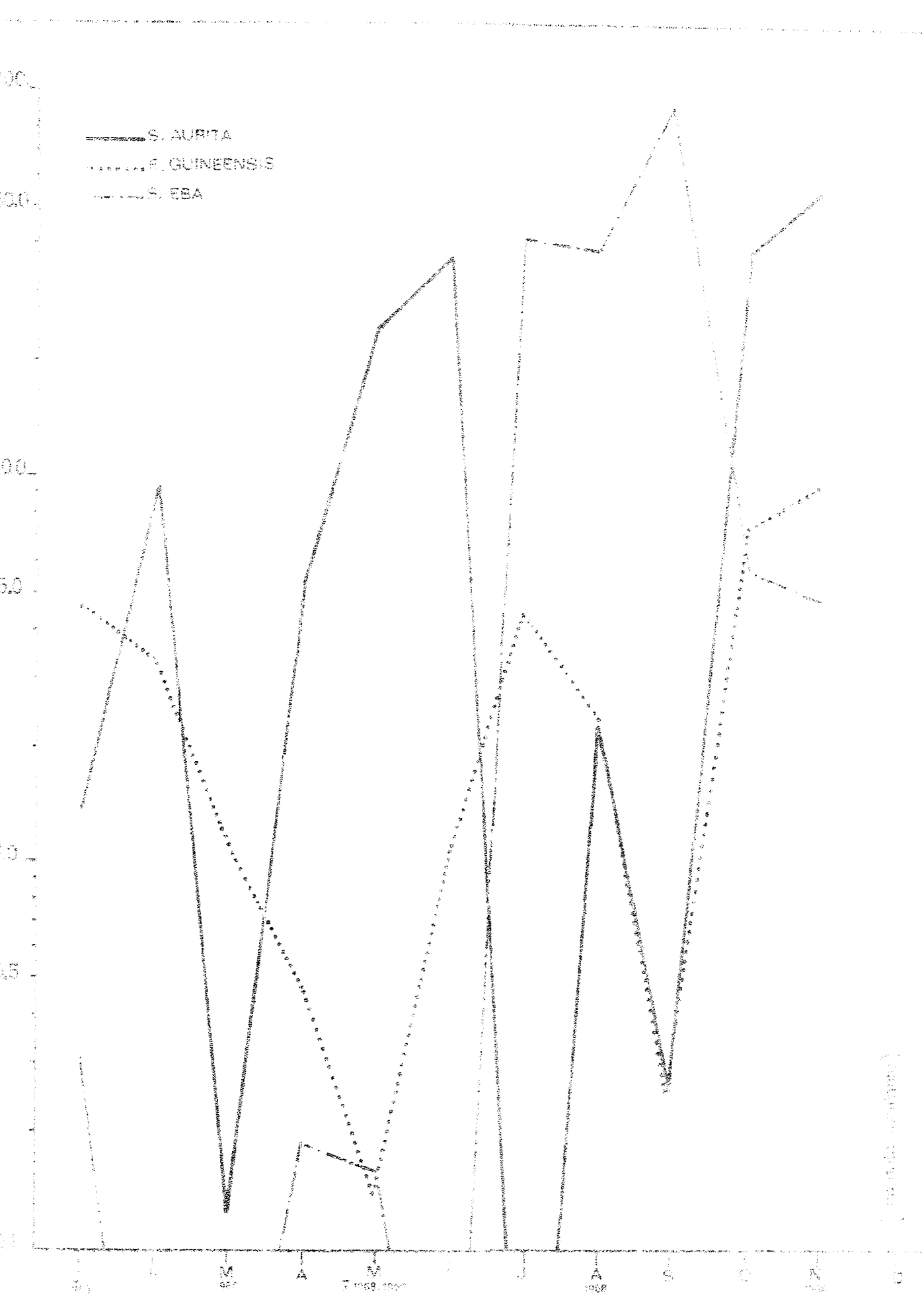

FIG. 13 Monthly mean number of larvae per sample (Glossinidae and Tryreuliidae) based on adjusted material obtained with different nets in 1966 (data from Corsani) and 1969

The periodical and successive increase in number of the larvae of S. aurita and S. eba shows, on the contrary, quite clearly the reproductive period of each species. Their reproductive season does not overlap and are rather well defined : S. eba larvae are abundant during three consecutive months, July-August-September while S. aurita larvae show two annual peaks, distributed during the months of May-June and October-November.

In Fig. 17 is plotted ths monthly percentual abundance of S. aurita and S. eba larvae in relation to the total larvae of Clupeids obtained monthly over a year period. S. aurita larvae represented the highest percent of the Clupeids larvae during most of tho monthly cruises, with the exception of July, August and September when S. eba larvae were the most abundant. Neverthless the siee composi tion of the larval population of S. aurita as weli as their numerical abundance per haul (Fig. 15) shows that its massive spawning takes place over two definite periods.

In Fig. 16 are shown the monthly average surface temperatures registered at a fixed station during 1968 ond 1969 (data from Hydrographical Lab. of the Conter). A comparison between tha distribution of the larvae of both Sardinella species (Fig. 15) and the monthly average temperatures (Fig. 16) shows a fairly good correlation ; the highest concentration of S. eba larvae coincide with the warmest waters while the two peaks for S. aurita larva are registered immediately before cnd after, when a gradual increasing and decreasing of tht: sea temperatureis taking place.

These results confirm the previous observations on the reproductive cycle of S. aurita (Boely, Champagnat et Conand, 1969) and coincide with the seasonal distribution over the continental shelf of the adults of both species of Sardinella, as described recently by Boely and Champagnat (1969).

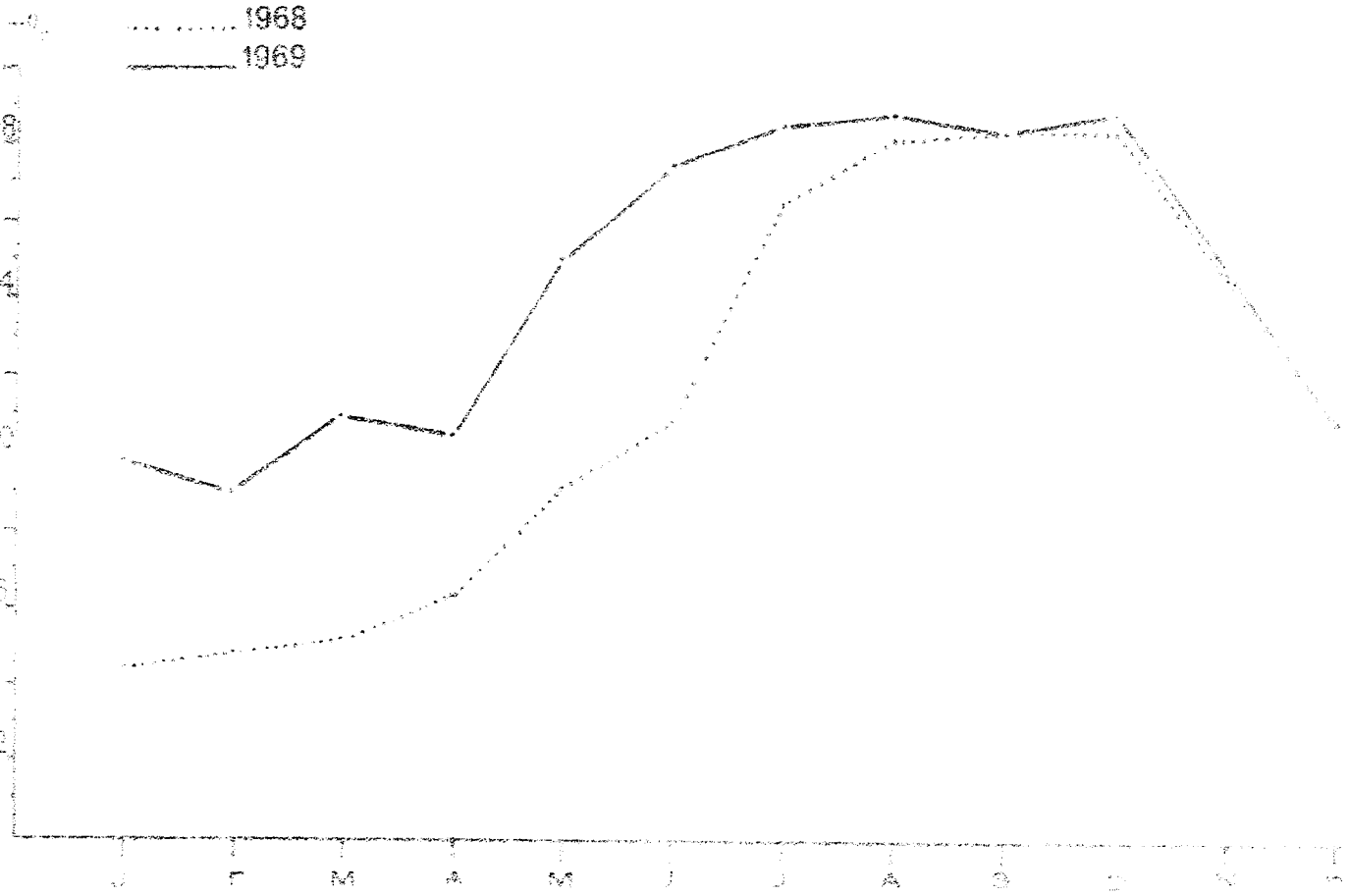

FIG. 16 - Monthly mean surface temperature at M'bour (14° 24' S'N) in 1968 and 1969.

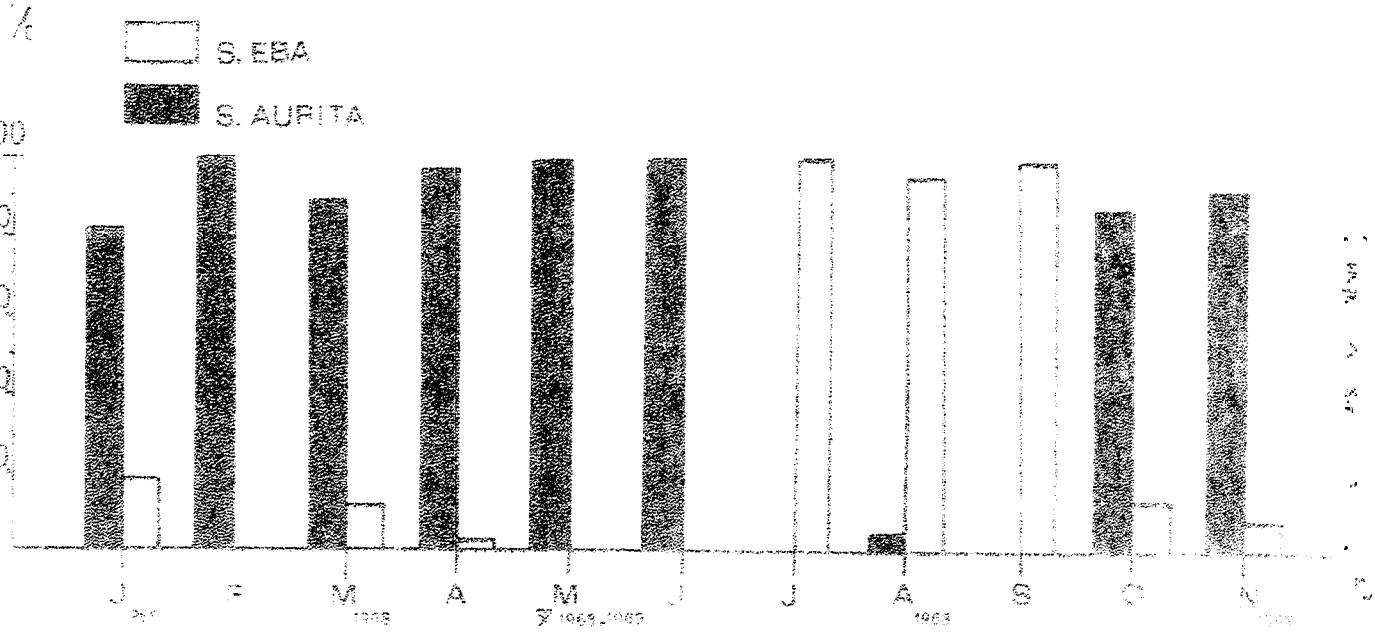

FIG. 17 - Monthly relative abundance of S. aurita and S. eba larvae in 1968 (data from Conand) and 1969 samples expressed as percent of the total number of Clupeidae larvae.

SUMMARY AND CONCLUSIONS

I.- The ichthyoplankton material studied in this preliminary report was collected in 1969, during :

a) 5 cruises over the continental shelf of Senegal and Gambia, with about 45 hydroplankton stations each ;

b) 3 long sections off. C. Vert until 20 long. W, with 13 hydroplankton stations each ;

c) a summer Cruise over the continental shelf of Mauritania and Northern Senegal, from C. Blanc to C. Vert, with 45 stations.

Two type of nets were generaly used : "PK2" conical and "Thons" cylinder-conical, both with an opening diameter of 1 m, a length of about 4 m, and mesh size of 500 microns. At each station, one of the two nets ("PK2" in staticns A and B) or both (Sts. C, D and E) were hauled during 10 minutes, in surface at coastal Stations (over 10 m and 20 m depth) and obliquely at deeper stations, with 45 m of cable over 50 m depth (St. C), 90 m over 100 m depth (St. D) and 100 m for the deeper offshore stations.

In the Lab. all fish larvae have been sorted from the other planktonic organisms ; larvae of Sardinella aurita, S. eba and Engraulis guineensis have been identified and counted. Measurements, at size intervals of 1 mm, have been taken for both species of Sardinella larvae.

The quantitative distribution of each species expressed as n°/100 m3 of water filtered, has been shown for each cruise in the corresponding maps, in which the surface isotherms were also represented.

II.- In the waters of the continental shelf of Senegal and Gambia, the greatest number of S. aurita larvae have been collected by the cruises made in May and October, while larvae of S. eba were most abundant in the August-September Cruise when the highest temperatures and lowest salinities values were registered. Very few larvae of both Sardinella

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species were obtained during the February and April cruises, made during the cold season of coastal upwellings. Larvae of E. guineensis were always less abundant than Sardinella ones, the highest number having been captured during October cruise.

In the summer cruise (July) over the continental shelf of Mauritania and Northern Senegal larvae of both species of Sardinella were found though showing a disjunctive geographical distribution : larvae of S. aurita, were collected in the cooler water of the northern part of the explored area, while larvae of S. eba were found only in the warmer desalinated water, present over the continental shelf of Senegal. This would indicate a northern movement of the spawning population of S. aurita, during the senegalese warm season, as previously observed (Champagnat, Boely and Conand, 1969).

III.- The T/S diagrams of each cruise, show that 3 different water masses covered the continental shelf of Senegal at the different seasons when the 1969 ichthyoplankton surveys were made. In February and May, when very few larvae of Clupeids and Engraulids were captured, all the plankton stations presented temperatures below 24°C and salinities $>$ 35 ‰, corresponding to the "cold water of high salinity" described by Berrit (1961) The S. eba larvae were found associated with "warm desalinited waters", mainly at temperature between 27° and 29°C while the larvae of S. aurita distributed mainly in waters of high salinity 35,5 ‰ and in wider ranges of temperatures (21°-26°C).

IV.- Sizes of larvae ranged from the lowest category of 3-4 mm in standard length to a maximum of 23-24 mm. When larvae of both species were collected at a same cruise, their size frequency compositions did not overlap. Limitations due to the sampling at sea have been discussed in relation to the absence of a clear size pattern in the frequency diagrams of each larval species. The size ranges of S. aurita and S. ebalarvae obtained during the cruise from C. Blanc to C. Vert, proved that both species were spawning at the same time but in two geographical areas with different oceanographical conditions.

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V.- A comparison of the average number of larvae from monthly collections over the continental shelf of Senegal, based in data obtained in 1968 by F. Conand and in 1969, showed that :

a) spawning of S. eba takes place during the warm season, July August and September ;

b) spawning of S. aurita takes place immediately before(May-June) and after (October-November).

No encugh observations are so far available to establish the spawning period, if there is any, for E. guineensis in the explored area.

RESUME ET CONCLUSIONS

I.- Les échantillons d'ichthyoplancton étudiés dans ce rapport préliminaire, ont été recueillis pendant l'année 1969, au cours de :

a) 5 missions sur le plateau continental sénégambien ; à chaque mission environ 45 stations d'hydroplancton ont été exécutées.

b) 3 radiales prolongées à la latitude du Cap Vert jusqu'à 20° longitude Ouest, avec 13 stations d'ichthyoplancton chacune

c) 1 mission d'été sur le plateau continental de Mauritanie et du Nord Sénégal, du Cap Vert au Cap Blanc, comprenant 45 stations et exécutée à bord du "THUE JR", navire de l'Enquête Régionale.

Deux types de filets ont été généralement utilisés : le"IK2" conique et le "Thons" conique-cylindrique, avec chacun une ouverture de 1 mètre de diamètre et une longueur approximative de 4 m ; mesure des mailles : 500 microns.

Aux 2 stations côtières (A et B, profondeur du fond 10 et 20 m) un trait de 10' était effectué on surface à 'l'aide du Pli2. Aux stations C, D et E (profondeur du fond 50, 100, 500 m) des traits obliques de 10' (avec 45 m de câble pour la station C, 90 m pour la station D, 100 m pour la station E), étaient effectués à l'aide des 2 filets.

Au laboratoire, toutes les larves de poissons ont été séparées de l'ensemble des micro-organismes du plancton ; les larves de Sardinella aurita, S. eba et Engraulis guineensis ont été identifiées et comptées. Les mesures des deux espèces de Sardinella ont été prises à l'intervalle de taille de 1 mm.

Pour chaque mission la distribution quantitative des espèces (exprimée en nb/100 m3 d'eau filtrée) est portée sur des cartes où sont également représentés les isothermes de surface.

II.- Sur le plateau continental sénégambien, le plus grand nombre de larves de S. aurita ont été recueillies pendant les missions faites en mai et en octobre, tandis que les larves de S. eba ont été plus abondantes pendant la mission d'août-septembre au moment où on enregistre les températures les plus chaudes et la salinité la plus basse. Très peu de larves des 2 espèces de Sardinella ont été obtenues pendant les missions de février et avril, effectuées pendant la saison froide des "up-wellings" côtiers. Les larves de E. guineensis ont toujours été moins abondantes que celles de Sardinella, la plus grosse quantité de leur capture se situant pendant la mission d'octobre.

Au cours de la mission d'été (juillet) sur le plateau continental de Mauritanie et du Nord Sénégal, les deux espèces de larves de Sardinella ont été trouvées en même temps, mais avec une distribution géographique différente : les larves de S. aurita ont été recueillies dans les eaux plus froides de l'extrême Nord de la région explorée, tandis que les larves de S. eba ont été trouvées seulement dans les eaux chaudes dessalées du plateau continental du Sénégal. Cela semble indiquer un mouvement vers le Nord des reproducteurs de S. aurita pendant la saison chaude comme l'ont déjà observé Champagnat, Booly et Conand en 1969.

III.- Les T/S diagrammes de chaque mission montrent que 3 masses d'eau se succèdent sur le plateau continental du Sénégal aux différentes saisons pendant lesquelles ont été faites les missions d'hydroplancton en 1969. En février et en mai, très peu de larves de Clupeidés et d'Engraulides ont été capturées ; toutes les stations de plancton indiquaient alors une température de 20°C environ et une salinité $\geq$ 35 ‰, correspondant aux "eaux froides salées" décrites par Berrit en 1961. En revanche,

les larves de S. eba ont été trouvées associées aux "eaux chaudes dessalées", principalement avec des températures variant entre 27° et 29°C, tandis que les larves de S. aurita se rencontrent le plus souvent dans les eaux de haute salinité ≥35,5 ‰, avec de plus grands écarts de températures (21° à 26°C).

Les tailles des larves (longueur standard) sont comprises entre les intervalles de 3-4 mm minimum et de 23-24 mm maximum. Lorsque les larves des 2 espèces étaient recueillies au cours d'une même mission, leur distribution de taille n'étaient pas les mêmes.

Le manque de régularité dans la distribution de fréquence de taille pour chacune des 2 espèces a conduit à discuter essentiellement du problème des conditions de l'échantillonnage en mer et à définir les limites de sa validité.

Les tailles de S. aurita et S. eba obtenues pendant la mission du C. Blanc au C. Vert prouvent que les 2 espèces se reproduisent pendant la même période mais dans deux régions géographiques caractérisées par des conditions hydrologiques différentes.

V. La comparaison du nombre moyen de larves recueillies chaque mois, basée sur les données obtenues en 1968 par F. Conand et en 1969, montre que :

a) la ponte de S. eba a lieu pendant la saison chaude (juillet-août-septembre) ;

b) la ponte de S. aurita précède (mai-juin) et mit immédiatement après (octobre-novembre) celle de S. eba

Les observations effectuées jusqu'à présent sont insuffisantes pour préciser les conditions de la reproduction, si elle existe, de E. guineensis dans la région étudiée

L I T E R A T U R E C I T E D

AHLSTROM E.H

1954 - Distribution and abundance of eggs and larval population of the Pacific Sardina-U.S. Fish and Wildlife Service. Fish Bull. 93, Vol.56, pp83-140.

AHLSTROM E.H

1959 - Distribution and abundance of eggs of the Pacific Sardina 1952-1956. U.S Fish and Wildlife Service. Fish Bull. 165, Vol. 60,pp. 185-213

BERRIT G.R

1961 - Contribution à la connaissance des variations saisonnières dans le Golfe de Guinée. Cah. Océanogr., 13 (10) : 715-727

BOELY Th. & CHAMPAGNAT Ch.

1969 - La pêche industrielle au Sénégal des poissons pélagiques côtiers en 1967 et 1968.

CHAMPAGNAT Ch., CONAND F., CREMOUX J.L & REBERT J.P

1969 - Campagne Océanographique du "Jean Charcot" (Dakar-Cap Blanc-Iles du Cap Vert) du 28-7 au 5-8-68. Centre de Recherches Océanogr. Dakar/Thiaroye. Doc. Sci. Provisoire N°17 : 1-87.

CHAMPAGNAT Ch., BOELY Th., de BONDY E., CONAND F. & CREMOUX J.L

1969 - Observations Océanographiques exécutées en 1968. Centre de Recherches Océanog. Dakar-Thiaroye. Doc. Sci. Provisoire N°19 : 1-169.

CHAMPAGNAT Ch., BOELY Th., & CONAND F.

1969 - Reproduction et cycle biologique des Sardinella aurita (C.et V.) des côtes sénégalaises. Centre de Recherches Océanogr. Dakar/Thiaroye. Doc. Sci. Provisoire N°21 : 1-13.

CONAND F.

1967-1968 - Etude des larves et juveniles des poissons des côtes du Sénegal. Rapport sur la campagne CODT 67/020, 68/002, 68/009, 68/014, 68/015, 68016, 68/017.

D' ANCONA F.

1936-1951 - Clupeidae in Uova larve e stadi giovanili di Teleostei. Fauna e Flora del Golfo di Napoli. Vol. 1 , Monog. 38.

FAGE L.

1920 - Engraulidae, Clupeidae. Rep. Dan. Ocean. Exp. 1908-10, Vol. II, Biol. A.9

MARCHAL E.G

1966 - Oeufs, larves et post-larves de l'Anchois du Golfe de Guinée, Anchoviella guineensis Blache et Rossignol. Centre Recherches océanogr. Abidjan. Doc. Sci. Provisoire N° 005 SR : 1-15

MARCHAL E.G

1967 - Clé provisoire de détermination des oeufs et larves des Clupeidés et Engraulides ouest-africains. Centre Recherches océanogr. Abidjan. Doc. Sci. Provisoire N°014 SR : 1-4

ROSSIGNOL M. & ABOUSSOUAN M.T

1965 - Hydrologie Marine côtière de la presqu'île du Cap Vert. Pub. ORSTOM Provisoire.

SHERMAN K.

1969 - A plan for sampling the eggs and larvae Pelagic Fishes of the Gulf of Guinea. FAO Interim Report.

ZEI M.

1966 - Distribution des oeufs et larves de Sardinella et Anchoviella dans les eaux du Ghana. Proc. Symposium Oceanography and fishery resources of Tropical Atlantic.

TABLE IV

Actual number of larvae of Sardinella aurita, S. eba and Engraulis guineensis obtained in 30' of surface (Sts. A and B) and oblique (Sts. C,D and E) hauls during 1969 Cruises in the continental shelf of Senegal and Gambia (Data from net PK2 unless otherwise indicated.

		SAINT-LOUIS - CAP ROXO - R/V "LAURENT AMARO"														
		February			April			May			September			October		
Oct. St.		S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin.
I	A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	21
	B	0	0	0	0	0	0	27	0	0	0	0	0	893	0	31
	C	0	0	0	0	0	0	0	0	1	0	2	0	53	0	0
	D	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
I	A	17	0	11	0	2	0	23	0	0	0	338	0	0	4	0
	B	25	0	26	0	0	0	1	0	0	0	176	1	4	0	0
	C	0	0	10	0	0	2	68	0	0	0	36	0	157	0	79
	D	0	0	4	2	0	1	0	0	2	0	13	1	392	0	7
	E	0	0	2	33	0	0	2	0	5	0	0	10	85	0	17
I	A	0	0	0	0	0	0	12	0	1	0	0	0	3	1	1
	B	0	0	0	0	0	0	148	9	2	0	790	0	17	0	0
	C	2	0	11	0	0	0	0	0	0	0	0	0	5	0	-
	D	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0
V	A	322	0	76	2	0	0	2	0	1	0	49	1	0	0	0
	B	6	0	6	0	0	1	0	0	0	0	33	4	0	0	0
	C	2	0	0	39	0	0	0	0	0	0	4	0	0	0	0
	D	0	0	0	2	0	2	56	0	0	0	0	0	2	0	0
	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	A	0	0	3	0	0	0	4	0	0	0	1	0	0	20	0
	B	4	0	0	0	0	0	1	0	0	0	5	0	2	7	0
	C	0	0	0	3	0	0	2	0	0	0	9	0	15	1	10
	D	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0
	E	0	0	0	0	0	0	2	0	1	0	0	3	0	0	3
	A	-	-	-	0	0	0	0	6	0	0	21	0	0	0	0
	B	-	-	-	51	0	9	4	0	0	0	0	0	1	0	0
	C	0	0	0	0	0	0	12	0	0	11	82	0	9	0	13
	D	0	0	0	0	0	0	336	0	1	0	5	0	0	0	4
	E	0	0	0	5	0	1	2	0	0	0	0	7	0	0	38
It	A	-	-	-	-	-	-	278	0	0	1	51	0	1293	0	0
		Net GS														
II	A	0	0	0	1	0	0	4	0	0	0	32	0	0	0	0
	B	0	0	0	0	0	0	3	0	0	0	5	0	0	0	0
	C	0	0	3	0	0	0	1064	0	0	0	34	0	218	0	0
	D	0	0	0	13	0	0	3	0	0	0	12	0	0	0	0
	E	0	0	0	42	0	3	1	0	0	0	7	0	0	0	0
	B	-	-	-	10	0	0	0	4	0	0	1114	0	0	14	0
I	A	0	0	0	0	0	0	0	0	0	0	44	0	0	0	0
	B	4	0	0	0	0	0	4	0	0	0	51	0	0	80	0
	C	8	0	5	7	0	0	11	0	0	0	273	4	25	1	1
	D	0	0	6	1	0	0	0	0	0	0	0	24	0	0	0
	E	7	0	0	0	0	0	3	0	0	0	0	7	0	0	0
	C	-	-	-	15	0	0	-	-	-	3	0	0	0	0	0
	A	0	0	0	0	3	0	-	-	-	0	21	0	0	0	0
	B	0	0	0	2	0	1	-	-	-	0	100	0	0	15	0
	C	5	0	5	0	0	5	-	-	-	0	82	0	433	11	31
	D	58	0	0	0	0	1	-	-	-	0	0	21	49	0	0
	E	75	0	0	0	7	4	-	-	-	0	0	0	0	0	1
AL		530	0	171	236	12	30	2071	9	14	1234	38	85	3675	240	977

TABLE V

Actual number of larvae of Sardinella aurita, S. eba and Engraulis guineensis obtained in 10' of surface (Sts. "a" B) and oblique (Sts. C,D and E) hauls during the 1969 cruises off C.Vert (Data from not PK2 only

"RADIALES CAP VERT PROLONGEES" R/V "LAURENT AMARO

A			B			C			D			E			F			G			H			I			J		
S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	E. gu.	S. aur.	S. eba	
–	–	–	–	–	–	–	–	–	–	–	–	43	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	14	2	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
10	0	0	6	0	0	2	0	1	1	0	1	0	0	14	0	0	1	0	0	2	0	0	0	0	0	10	0	0	1

TABLE VI

Actual number of larvae of Sardinella aurita, S. eba and Engraulis guineensis obtained in 10' of surface (Sts. A and B) and oblique (Sts. C,D and E) hauls during the THUE JR. Cruise from C. Blanc to C.Vert, July 1969 (Data from net PK2 : Sts. between 21° and 20° Lat. N. and net "Thons" : Sts. south of 20° Lat. N.)

CAP BLANC - CAP VERT - R/V "THUE YUNIOR" - JULY 1969

21°00'N			20°30'N			20°00'N			19°00'N			13°00'N			17°00'N			ST-LOUIS			M'BORO			CAP VERT		
S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	S. guin	S. aur.	S. eba	E. guin	S. aur.	S. eba	E. guin
12	0	1	-	-	-	38	0	0	0	0	0	-	-	-	18	0	0	0	402	0	0	15	0	0	0	0
876	0	11	1676	0	505	2	0	34	0	0	0	0	0	0	165	0	0	0	237	45	0	0	0	0	0	0
468	0	0	≠35	0	0	5	0	532	0	0	0	348	0	95	0	0	0	0	0	0	0	0	0	0	1	0
129	0	0	25	0	0	0	0	105	0	0	0	1291	0	0	0	0	1	0	0	25	0	0	0	0	6	0
1006	0	33	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2491	0	45	1701	0	505	45	0	671	0	0	0	1639	0	95	183	0	1	0	639	70	0	15	0	0	7	0

ble non quantitative