

This paper not to be cited without prior reference to the author

International Council for
the Exploration of the Sea

C.M.1975/ J : 18
Pelagic Fish/Southern/
Committee

SARDINE IN POLISH CATCHES IN THE SPANISH
CABANA REGION DURING THE YEARS 1971 - 1974

by

K. Krzeptowski

Sea Fisheries Institute
Branch at Swinoujście
/Poland/

TAXONOMY

In the waters of the North-West Africa there occurs a species of sardine - Sardina pilchardus sardina, dividing further into two populations: the Morocco and Sahara ones. The former appears in the area between Gibraltar and Cap Juby, the latter on the other hand is spread approximately south of Cap Juby as far as Cap Blanc.

One of the criterions permitting to identify the races or local population is the number of vertebrae /Table I./.

Note: In the investigations carried out by the author the "last" vertebrae is that vertebrae which does not touch the urostyle directly.

Table I.

Number of vertebrae of the sardine occurring in the Spanish Sahara and Morocco region

Region	n	Number of vertebrae							Remarks
		48	49	50	51	52	53	\bar{X}	
20° 00' N. 24° 00' N.	300	-	106	187	7	-	-	49.7	Author's investigations
24° 00' N. 28° 00' N.	300	1	107	179	13	-	-	49.68	author's investigations
Agadir	367	-	8	136	200	23	-	50.65	H. Belveze, Institut des Pêches Mari- times du Maroc /oral informa- tion/.
Casablanca	325	-	1	84	204	35	1	50.85	
Cap Spørtef Cap Juby								51.0	D. Riedel "Die Europei- sche Sardine" Wittenberg 1968
Rio de Oro								50.3	

On the basis of data of Table I. it is possible to state that all the regions of the Spanish Sahara shelf is inhabited by a homogenous population. This population is the object of Polish catches. Investigations regarding the occurrence of the sardine belonging to Saharian population and its relation with the Moroccan population are carried out and the results obtained so far should be treated as preliminary.

CATCHES

In 1973 the Polish fishing fleet started the sardine catches in the region of the Spanish Sahara on a larger scale. At the beginning the freezer-stern trawler B-23 was used to that aim. During the following years, with the increasing demand for this valuable raw material, other types of fishing vessels were introduced in this region /freezing stern trawlers of type B-18, B-29 and B-418/.

Table II.

Technical data on Polish stern trawlers exploiting the sardine resources in the Spanish Sahara Region.

Type	Freezing capacity /tons/24H/ of demersal fish	Power /H.P/	Gross Tonnage	Net Tonn.	Capacity /T/	Speed /Knots/	Trawling speed /knots/	Fishing power
B-23	18	1600	1005	382	591	13.5	3.8	1.0
B-18	30	2250	2496	1041	1293	15.0	4.2	1.41
B-29	30	2500	1481	582	930	14.5	4.3	1.56
B-418	35	2700	2501	1067	1652	14.5	4.5	1.69

Note: In order to get comparable the effort and catch per unit effort of different types of ships, we have introduced the coefficients of fishing power resulting from differences which occur in the power of their main engines.

Fishing day of a B-23 unit has been taken as 1.0, whereas the fishing day of the other types have been respectively higher depending on their power.

The mentioned types of ships catch the sardine with pelagic trawl having a vertical opening of 15 to 24 m and a horizontal opening between the wings reaching 30 to 48 m. The mesh size stretched in the cod end amounts to 50 mm, and in the cover 100 mm.

Table III.

Polish catches of sardine in the years 1971 - 1974.

Year	Polish catches Total	including sardine	
		Tons	Percent
1971	32 074	315	0.1
1972	39 931	1 350	3.4
1973	34 344	15 354	44.7
1974 ^{x/}	25 500 ^{x/}	15 763 ^{x/}	61.8 ^{x/}

^{x/} first half-year - not official data.

The data presented in Table III. show the great importance of sardine in the Polish catches in the Spanish Sahara Shelf. The distribution in time and space of Polish sardine catches is presented in the figures No. 1 to 8. These figures show

Table IV.

Polish sardine catches in the years 1971 - 1974
according to months /in yearly catch percent/

Year	Sardine catches in tons	M o n t h s												Total percent
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1971	315	-	-	-	61.5	38.5	-	-	-	-	-	-	-	100.0
1972	1 350	-	-	16.5	34.9	35.7	12.7	0.2						100.0
1973	15 354		8.7	18.1	38.8	25.0	8.7	-	-	-	0.6	0.1	-	100.0
1974 ^{x/}	15 763	2.3	4.2	15.3	9.4	18.5	50.3							100.0

x/ first half year - data not official.

some regularities.

The basic region of sardine fisheries is comprised between latitudes $22^{\circ} 00' N$ and $27^{\circ} 00' N$. in the depths of 25 m to 100 m. The greatest intensity of catches during the first half-year occurs in the southern and central part of the discussed area, i.e. between lat. $23^{\circ} 00' N$. and $25^{\circ} 30' N$. During the second half-year, as the current observations show, the region of main fisheries is shifting northward to the area off Cap Bojador and Cap Juby. Here, in July and August high rate of catch per unit of effort are obtained being 20 - 30 tons per day for trawlers of the B-23 type and 70 - 80 tons per day in case of bigger trawlers.

It should be noted, that sardine concentrations permit to obtain much higher yield but the freezing capacity of the trawlers is limiting the catches. Due to the lack of detailed investigations it is difficult to precise the migration patterns of the Saharian population. It is, however, an indisputable fact, that the Polish fishing fleet changes the grounds from south to north during the fishing season and this might show that there probably exist the seasonal shifting of the sardine shoals from south to north and inversely.

LENGTH COMPOSITION

The analysis of the length composition of the Polish sardine catches shows that those catches are composed of individuals from 10.0 to 25.0 cm. The basic quantity of fish caught has a length of 19.5 cm to 20.5 cm which corresponds

to the III age group /Fig. 9./. Smaller fish /17.5 to 18.5 cm - II age group/ as well as bigger /over 21 cm belonging to the IV and higher age groups/ occur in smaller quantities. In catches taken in the southern part of the discussed area, a little presence of small sardine, 0 and I age group, may be noted. The catches from Cap July - Cap Bojador area are characterized by a higher frequency of fish of a size longer than 20.5 cm. According to length composition data it is possible to state that Polish sardine catches in the Spanish Sahara waters are based on exploitation of older year classes, /mainly age group III/. This would indicate that there exists some possibility to develop a more intensive exploitation without danger of overfishing the local population.

The relation between the length and the age of the sardine has been based on the analogy with the Moroccan population, since actually own studies in this field have not been completed yet.

1. Age and Growth Rate of Sardine

1.1. Linear growth

Investigations of linear growth were conducted separately for males and females, also for both sexes, together.

The following results were attained:

Table VI.

Mean lengths of sardine in particular age groups,
calculated from direct readings.

Sex	I	II	III	IV	V
♀	14.50	16.05	20.02	21.00	22.22
♂	13.81	17.65	19.50	20.36	22.00
♀+♂	14.08	17.82	19.80	20.87	22.00

It can be seen from the table that there is very little difference between the growth rate of males and females, and that the most intensive growth rate in length is up to the second year.

1.2. Weight increase

The mean weights for the particular length classes for both sexes were established empirically from material collected in the II quarter of 1974 ~~XXXXXXXXXX~~.

Table VII

Mean weight of sardines in the particular length classes.

Total length in cm.	12	13	14	15	16	17	18	19	20	21	22
Mean weight in gr.	18	22	27	33	41	49	58	69	82	96	110

The length/weight dependency in sardine is expressed by:

$$W = k \cdot L^N$$

The coefficients k and n were calculated by the least square method, which gave:

$$k = 0.00901$$

$$n = 3.0512$$

$$\text{hence: } W = 0.00901 \cdot L^{3.0512}$$

1.5. The growth factor of sardine using the von Bertalanffy equation.

The von Bertalanffy growth equation was applied to compare the linear and weight growths and their joint characteristics:

$$l_t = L_{\infty} [1 - e^{-k/t-t_0}]$$

The following gives the von Bertalanffy growth equation parameters calculated by the least square method:

♀♀:	♂♂:	♀♀+♂♂:
$L_{\infty} = 23.52$	$L_{\infty} = 22.96$	$L_{\infty} = 22.96$
$k = 0.4824$	$k = 0.5226$	$k = 0.5172$
$t_0 = -0.9559$	$t_0 = -0.6833$	$t_0 = -0.8455$

Substituting the values calculated for both sexes the following equation is obtained:

$$l_t = 22.96 [1 - e^{-0.5172(t+0.8455)}]$$

Fig.10 gives a graphic illustration of this equation.

Basing on the previously established length/weight dependency, it was calculated that

$$W_{\infty} = 128.03 \text{ gr.}$$

hence the weight increase in the particular sardine age groups is:

$$W_t = 128.03 [1 - e^{-0.5172(t+0.8455)}]^{3.0512}$$

This dependence is illustrated in Fig.10.

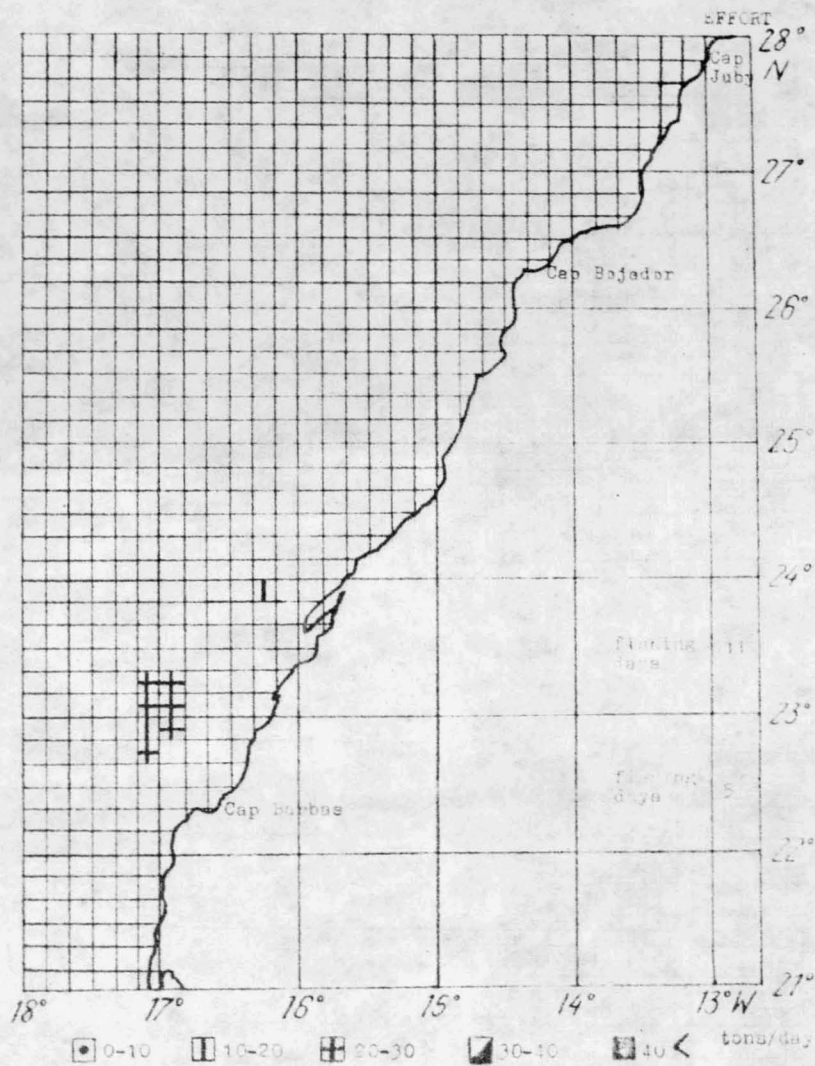


Fig. 1. January 1974.

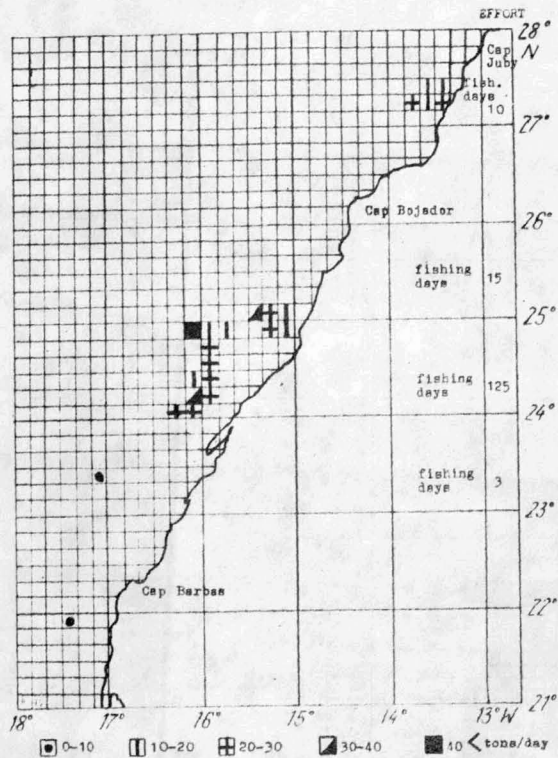
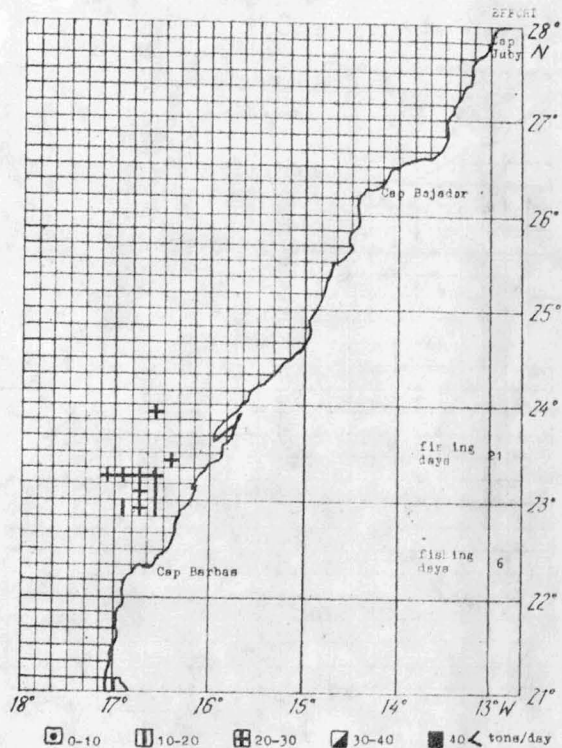


Fig.2. February 1972/73.



February 1974.

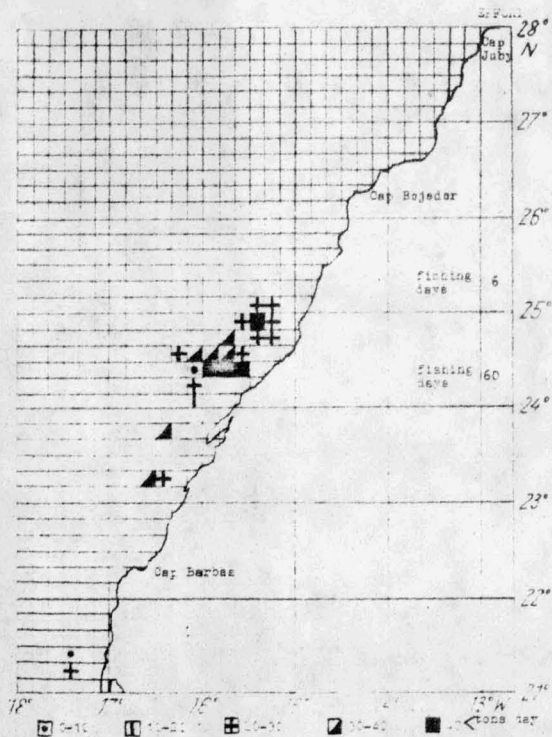
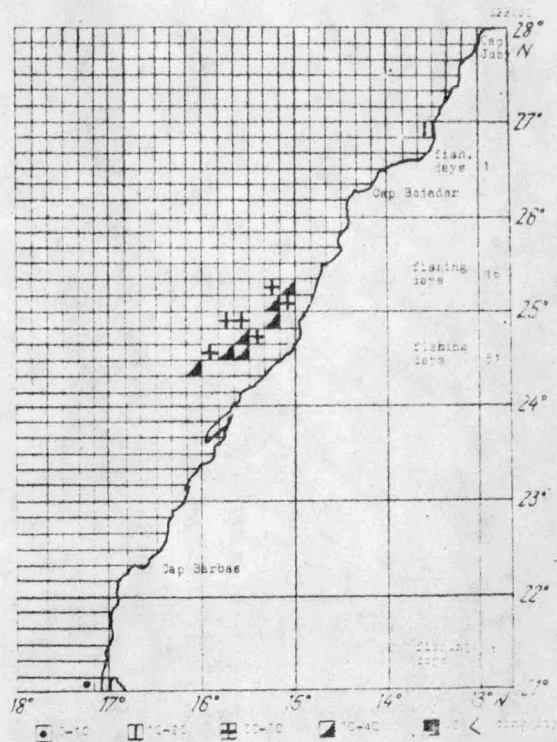


Fig. 3. March 1970-71.



March 1971.

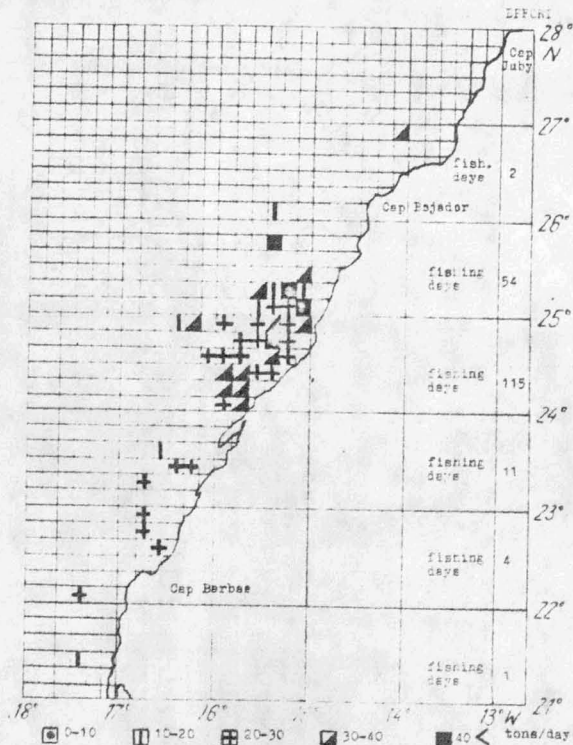
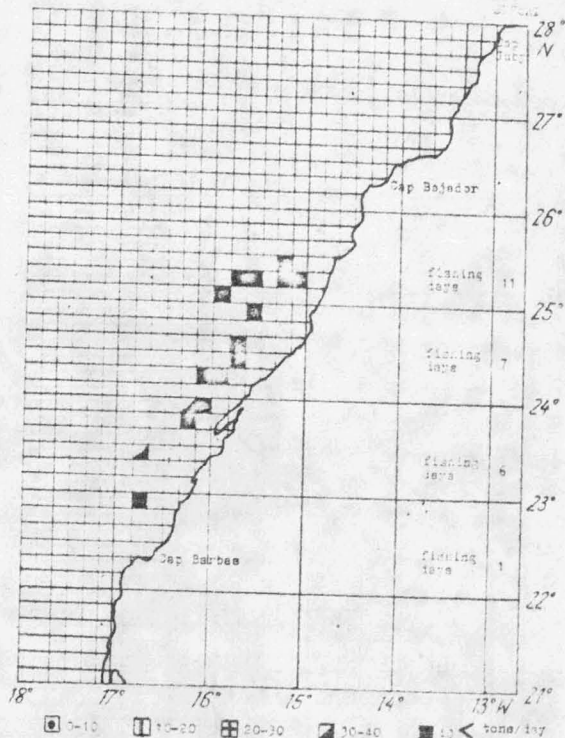


Fig. 4. April 1972/73.



April 1974.

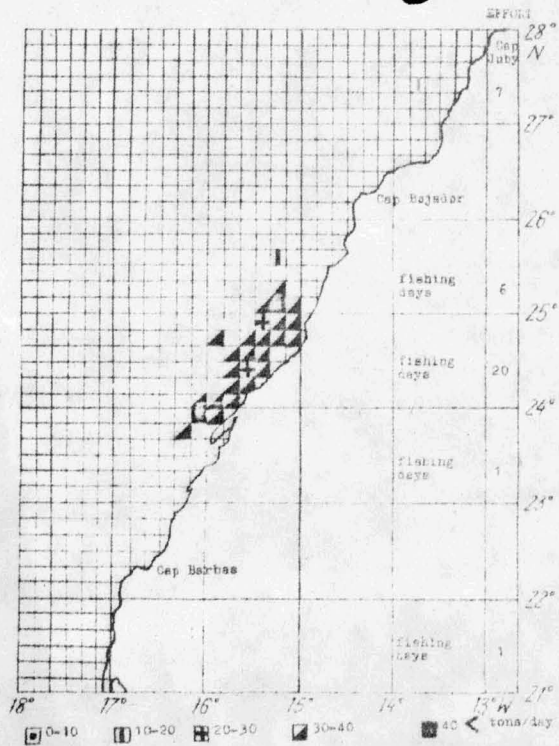
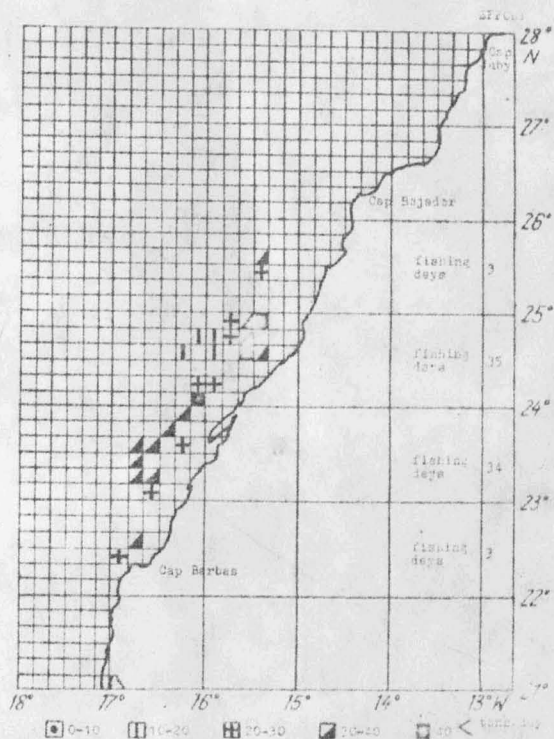


Fig. 5, May 1972/73.



May 1974.

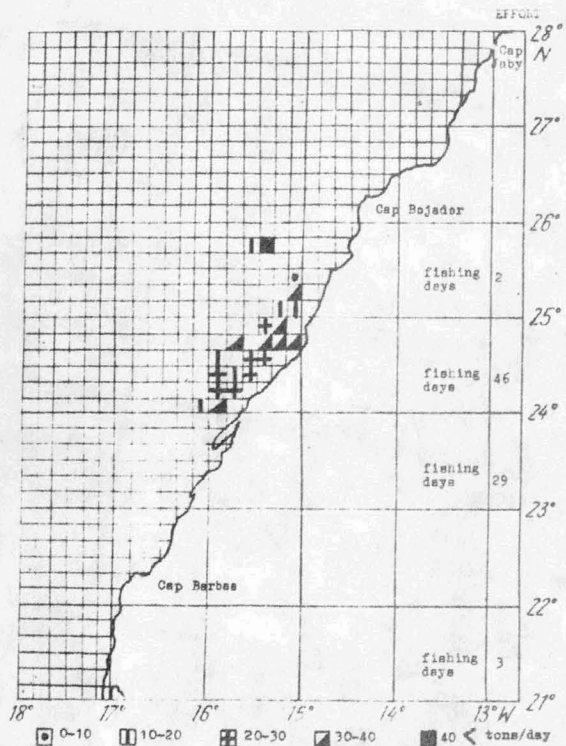
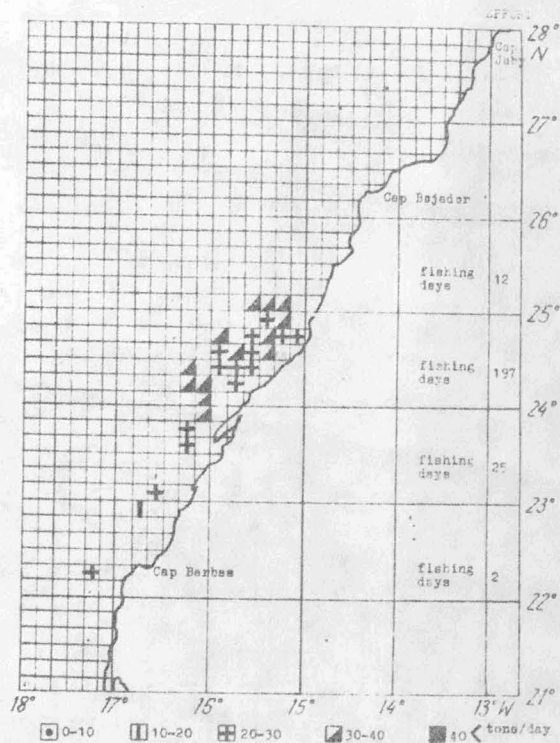


Fig. 6. June 1972/73.



June 1974.

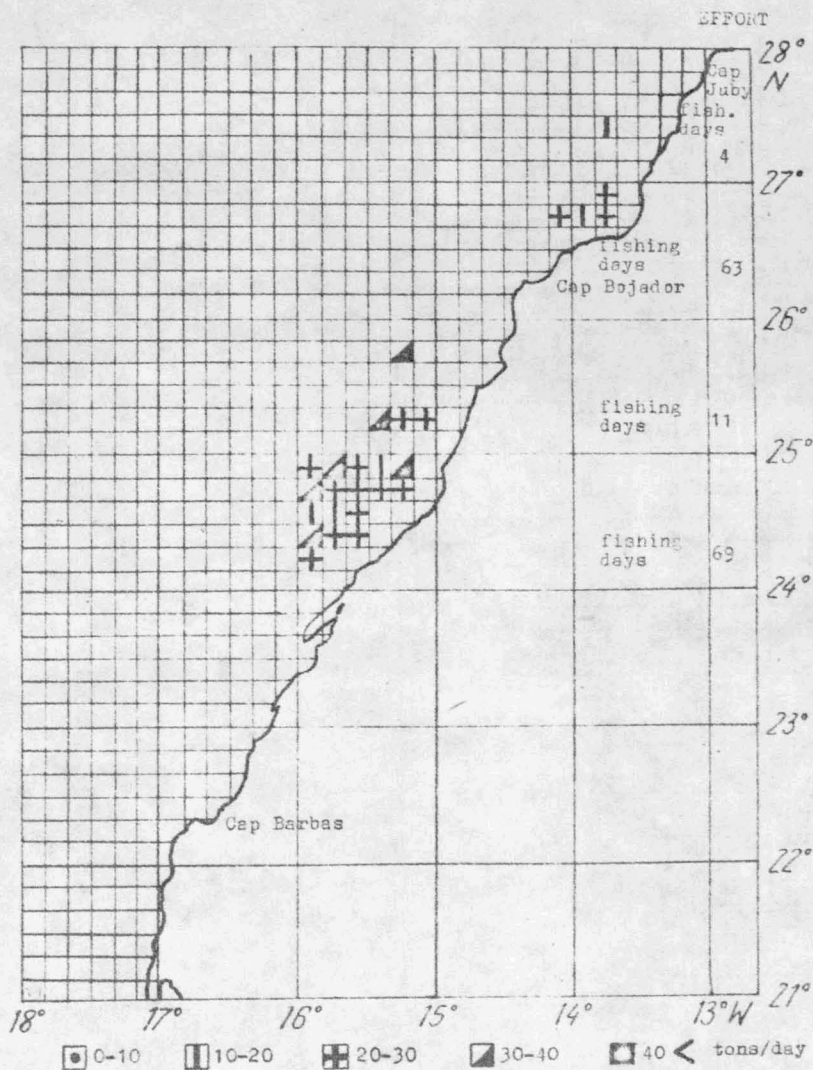


Fig.7. July 1974.

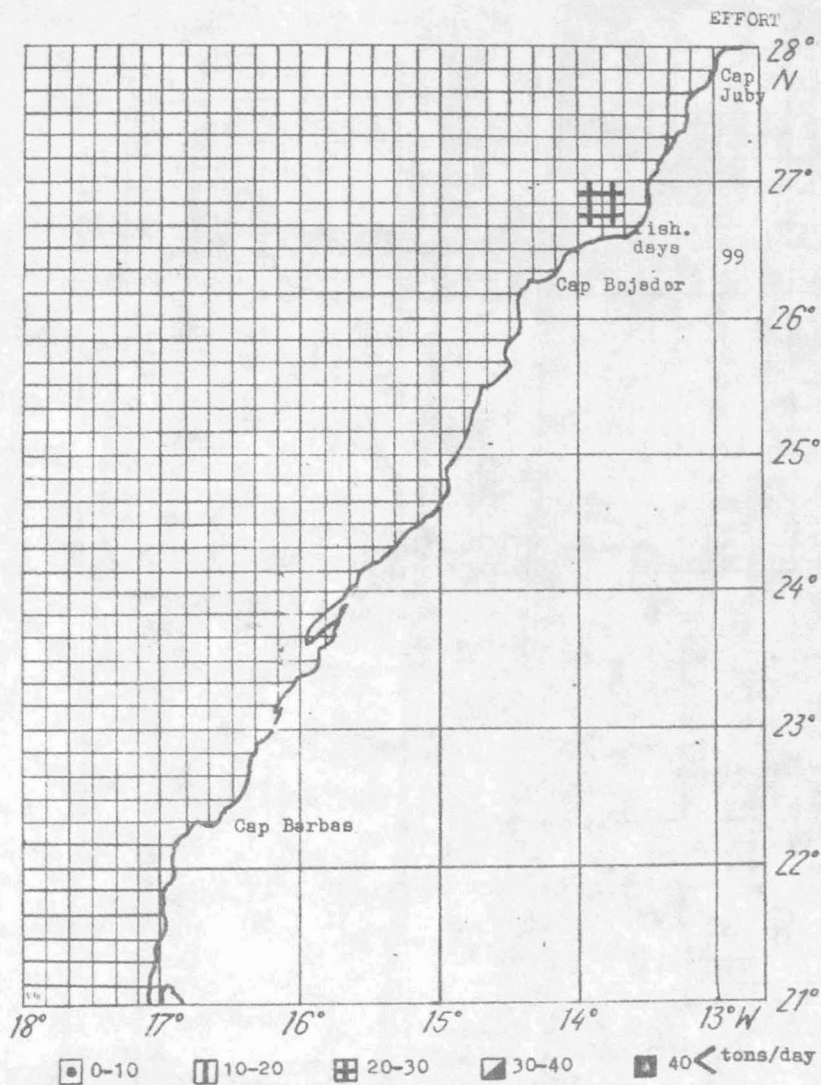


Fig. 8. August 1974.

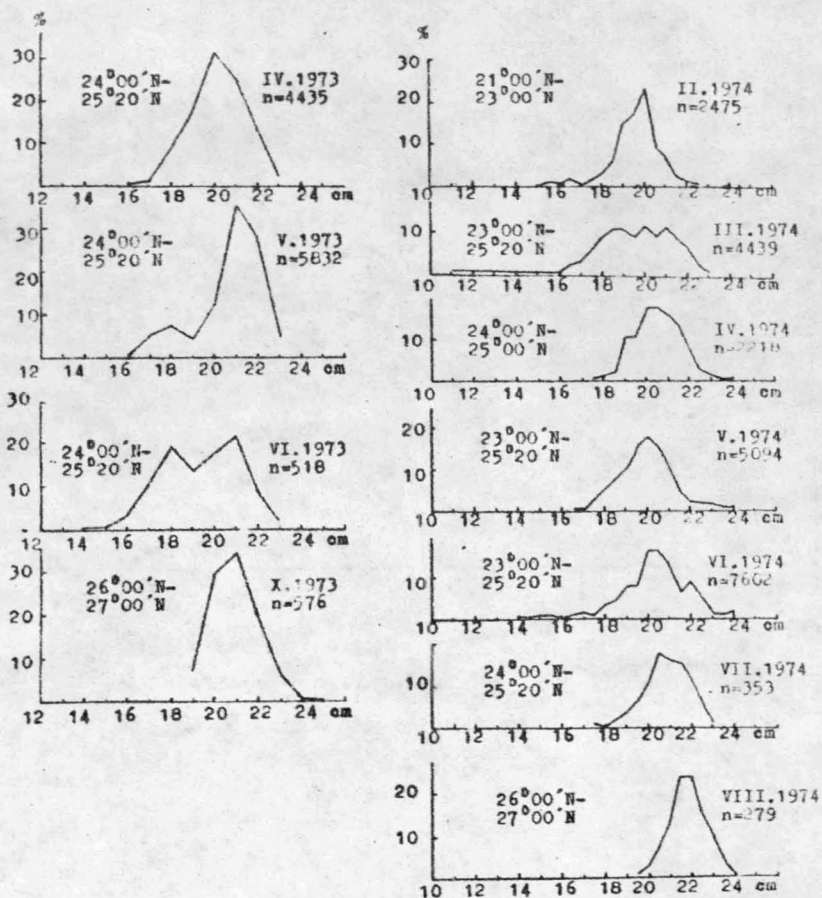


Fig. 9. Length composition of sardine catches in the Spanish Sahara waters in 1973-1974.

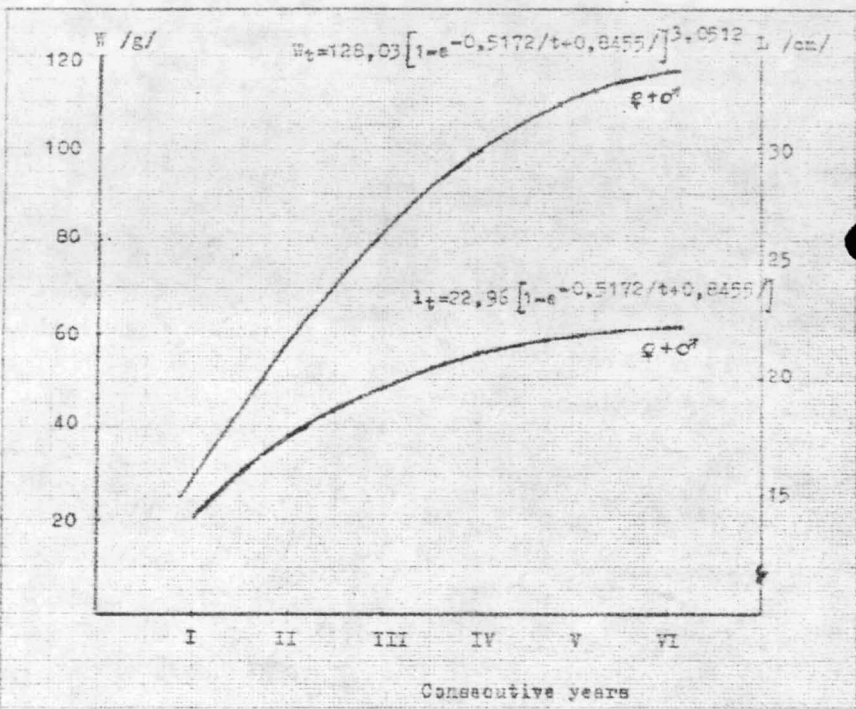


Fig.10. Theoretical growth curves of sardine in length and weight /according to von Bertalanffy formula/.