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PRELIMINARY DATA ON THE BY CATCH OF FISHES IN THE FRENCH FISHERY FOR Nephrops norvegicus IN THE CELTIC SEA.[1]

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SUMMARY

The fish by catch in the French fishery for Nephrops norvegicus in the Celtic Sea is currently surveyed at sea by fishery biology technicians. One hundred and one hauls were exhaustively sampled from December 1979 to March 1980. It appears that trawls using 55-60 mm mesh size caught on the average less than 30 hakes and less than 2 whittings per haul. The most abundant species in these hauls was milgrim (200 per haul). Thirty one per cent of milgrims, 28% of hakes and 0.5% of whittings were smaller than minimum legal size. Two per cent of milgrims were younger than age 2. A multivariate Correspondance Analysis tends to show that 60 mm trawls and 70 mm trawls are used on different types of

(1) Il existe une version française de cette communication.

fishing grounds and are directed towards different types of fish species.
Seventy mm trawls tend to be used inshore in shallower water for plaice,
sole and turbot while 60 mm nets tend to be used offshore on the Nephrops
and milgrim grounds.

The present results are still provisional being limited to
a few winter months. The survey will proceed for 18 months.

RESUME

Les captures accessoires de poisson dans la pêcherie fran-
çaise de langoustines en Mer Celtique sont évaluées en mer par des tech-
niciens biologistes des pêche. Cent un traits ont été échantillonés en
détail de décembre 1979 à Mars 1980. Il apparaît que les chaluts travai-
llant avec un maillage de 55-60 mm ont capturé en moyenne durant cette
période moins de 30 merlus et moins de 2 merlans par trait. L'espèce
la plus abondante est la cardine (en moyenne 200 par trait). Trente et
un pour cent des cardines, 28% des merlus et 0.5% des merlans avaient
une longueur inférieure à la taille légale. Deux pour cent des cardines
avaient moins de deux ans. Une analyse multivariable des correspondances
tend à faire apparaître que les chaluts de 60 mm et ceux de 70 mm sont
utilisés sur des fonds différents et qu'ils sont choisis pour la capture
de types de poissons différents. Les chaluts de 70 mm tendent à être
utilisés plus à terre dans des eaux moins profondes pour capturer plies,
soles, barbues et turbots, tandis que les chaluts de 60 mm tendent à
être utilisés plus au large sur les fonds à langoustine et à cardine.
Les résultats présentés sont encore préliminaires car ils sont limités
à quelques mois d'hiver. L'étude sera poursuivie sur 18 mois.

ACKNOWLEDGMENTS

INTRODUCTION

Preliminary estimates of the effects of changes in mesh size on the yield per recruit of Nephrops norvegicus in the French fishery for N. norvegicus in the Celtic Sea (fig. 1) have been provided for a range of fishing and natural mortalities by the ICES "working group on assessment of Nephrops stocks" (1979) and by Conan and Morizur (1979). Although a great deal of information is still lacking on the population parameters of N. norvegicus in the Celtic Sea, it does not appear very convincing that any long term gains in yield per recruit would occur if the mesh size was widened from 55-60 to 70 mm. Conan and Morizur (1979) even forecasted losses rather than gains.

It is frequently stated however that an increment in mesh size might greatly benefit to the yield per recruit of fishes caught in the Celtic Sea by N. norvegicus trawls, and that near by fisheries harvesting fish rather than N. norvegicus might also benefit of an increase in mesh size because many undersize fish are caught by the N. norvegicus trawls.

Up to recently little data was available on size and age frequency distributions of fish catch and fish discards in the Celtic Sea trawl fishery. The grounds are mainly harvested by French vessels which call at various harbours from Douarnenez to La Rochelle. The commercial statistics from these harbours do not represent accurately the commercial catch landed from the Celtic Sea. This is because vessels fishing on different fishing grounds such as the Irish Sea and the Bay of Biscay also call at these harbours. Landings from Western Ireland and from the Irish Sea are frequently regrouped with landings from the Celtic Sea under a generic name of "Pêches au Nord du 48° parallèle". Such statistics have little biological value because the species, age and size compositions as well as the abundance of the fishes are likely to differ widely on these different grounds.

This paper provides preliminary information on the results obtained after processing the data from 101 hauls exhaustively sampled in the Celtic Sea from December 1979 to March 1980. Two technicians supervised by CNEXO and ISTPM scientists currently embark on board of commercial trawlers and sample the catch at sea. About 600 hauls have already been sampled. Final results after processing 18 months of data will hopefully be available for 1981 ICES statutory meeting.

MATERIAL AND METHODS

The size frequency distributions of the most commonly caught species are sampled on board. The fishes are measured before sorting out the commercial categories and the discards. In most cases all fish caught within one haul are measured. In a few instances due to lack of time between two hauls only part of the fishes of one species are measured, the remaining ones are counted.

Samples of otoliths were taken for aging Lepidorhombus whiffiagonis and Glyptocephalus cynoglossus. In order not to interfere with commercialisation otoliths must be taken from discarded fish and from processed fish at the filetting factory. For age reading, otoliths are prepared by burning.

Von Bertalanffy growth curves are ajusted to data of total legth at age by Tomlinson's technique (1970a). The age frequency distribution of fishes in the catch are sorted out from the size frequency distributions by using the iterative log likelihood technique described by Hasselblad (1966) and modified by Tomlinson (1970b). The mean and standard deviation of sizes at age estimated from the data of size at age obtained by otolith reading are used as input preliminary estimates in Hasselblad's iterative technique.

Data on species abundance for each haul is processed by
multivariate descriptive analysis. The technique of Analysis of Corres-
pondences (Cordier, 1965; Chardy et al. 1975) was choosen as the most
appropriate for processing the data. A Principal Component Analysis
(Hotelling, 1933) would have been inadequate because many of the species
occur only very seldom, and therefore simultaneous occurences of null
frequencies would have been emphasized as correlations. A qualitative
analysis based on the criterion of occurence-non occurence of species
would also have been inadequate; this is because we intended to survey
spacial and seasonal fluctuations in abundance of commonly occuring
commercial species rather than rare species.

The index of abundance used for each species in each haul
is the number of individuals caught per hour of trawling. The most im-
portant commercial species were partitioned into size groups correspon-
ding approximately to age classes. Each size group was later processed
as a distinct species in order to survey the occurence of young indivi-
duals in the area. For _Scylliorhinus stellaris_ and for _Lophius_ spp. the
weight of the catch as well as the number of individuals caught were
used as indices of abundance.

RESULTS

A map of the geographic position of the hauls is given in
figure 2. A list of the most commonly occuring species used in the analy-
sis of correspondences is provided in table 1. The code numbers used for
each species and each age group of each species is given in the table.

The size frequency distributions of the most common commer-
cial species caught in 101 hauls are presented in table 1a to 1h and in
figures 13 to 23 together with legal minimum size when applicable. The
data of age determination by otolith reading is given in tables 2a and 2b.

The age distribution of L. whiff-iagonis and G. cynoglossus after analysis
of the size frequency distributions by Hasselblad's technique are given
in table 3.

Growth curves ajusted to the data of size at age obtained
by otolith reading are presented in figures 3 and 4 for L. whiff-iagonis
and G. cynoglossus.

Outputs for the multivariate Correspondance Analysis of
abundance of species in hauls are presented in figures 5 to 12. When all
the hauls are taken into account (figures 5, 6), the first axis explains
22% of the inertia, it is readly explained by the contribution of 70 mm
size hauls. The variables (species) corresponding are Solea solea of all
age classes, Scophthalmus maximus, Scophthalmus rhombus and Pleuronectes
platessa. The other stations and species are regrouped around the center of
gravity.Observation 69 (Station D3), distant from the center of gravity
is a 60 mm station close to the coast of Ireland, it has characteristics
similar to 70mm stations.

Actually the differences in 60 mm and 70 mm stations are
mostly explained by differences in geographic location. Seventy mm and
60 mm hauls appear to be drawn on fishing grounds having fish faunas of
different species composition. For subsequent analysis, data concerning
70 mm hauls were taken out. A log (x+1) transformation of abundances
was made, in order to give less weight to overabundant species (figures
7 to 12).

In the plane formed by the two first axes of inertia ex-
plaining respectively 24.1 and 14.1% of the inertia the observations
(stations) and the variables (species) are spread apart between 3 poles.

Axis 1 sets apart:
1) Stations along southern Ireland coast,
    D 3 (observation 57)
    A 2 (observation 17)
    D 2 (observation 90)
    D 1 (observation 54)

and the species associated: S. solea, S. rhombus, P. platessa (the points representing Merlangus merlangus are closely related but are associated with a group of stations towards the South West of the former ones, in Baltimore).

versus   2) stations in the banks,
              D 27 (observation 81)
              E 2 (observation 2)
              E 3 (observation 3)
              E 15 (observation 13)
              E 13 (observation 14)
              E 10 (observation 15)
              E 18 (observation 18)

and the associated species:

              small L. whiff-iagonis (smaller than 17 cm total length)
              small Merlucius merlucius (smaller than 22 cm total length)

and versus   3) other observations and variables around the center
                 of gravity.

The originality of two distinct types of geographic areas already appearing in the former analysis is better shown here: S.solea, P. platessa and Scophthalmus spp. tend to show up   closer inshore and in shallower areas than the other species. Further, M. merlangus appear mainly in Baltimore. A group constituted by young L. whiff-iagonis and M. merlucius appears at the other extremity of the axis. Possibly, younger age groups of these species tend to congregate in places for which we do not have yet sufficient information.

Axis 2:

Axis 2 is less readily explained. It tends to separate stations E 16(12), E 13(14) and mainly E 15(13) from the remaining ones. The variables associated with these observations are the younger age classes of M. merlucius (16) and S. solea (1), and to a lesser extent

large S. solea (2 and 3), S. rhombus (25) and small L. whiff-iagonis (35).
Opposite are found stations B 7 (37), D 15 (65) and D 20 (76) related
to Pollachius virens (29) and Lophius spp (33-34). However these points are
fairly close to the center of gravity. No distinctive characteristic strikin-
gly differs between these two sets of stations. Although, the sedimentary
composition of the bottom might be the discriminant factor. The first
area (Bec and Southwest Labadie) is an area of clayish sandy bottoms
while the other hauls (Galley and Baltimore) were drawn on bottoms rated
as pebbles and cobbles. Unfortunately we do not have yet accurate in-
formation concerning the type of sediment at each station.

Along the axis 3 and 4 (figure 10-12), the stations D 3
(57) and A 2 (17), related to variables 1,2, and 25 (small S.solea and
S. rhombus) are widely apart from the others. This finding confirms
the interpretation of the 1st axis, but does not bring any new informa-
tion.

DISCUSSION

The present analysis is still provisional because the data
was colected only during part of the year. The pattern of dispersion of
the fishing intensity of the French fishing fleet varies seasonally.
Certain age classes of fish may migrate seasonally in and out of the
grounds. However some conclusions can already be raised.

Very few hauls have been made close to the coast from
January to March. The boats sampled have been mainly working off-shore
on the banks of Galley, Baltimore, Bec, Labadie, Cockburn and Jones.
This sample well conforms with the general behavior of the Nephrops
fishing fleet according to fishermen interviewed...

Within the list of the most common species caught in hauls
with 55 to 60 mm mesh size, the protected species are:

Lepidorhombus whiff-iagonis
Merlucius merlucius
Glyptocephalus cynoglossus
Merlangus merlangus
Melanogrammus aeglefinus
Pollachius virens
Gadus morhua
Solea solea
Pleuronectes platessa
Scophthalmus maximus
Scophthalmus rhombus
Microstomus kitt

L. whiff-iagonis, G. cynoglossus, M. merlucius and M. merlangus are the only species with average frequencies higher than 2 individuals per haul. Only L. whiff-iagonis appears with average frequencies higher than 30 individuals per haul. Only 0.5% of M. merlangus caught are smaller than legal minimum size of 23 cm. Twenty eight per cent of M. merlucius caught are smaller than legal minimum size of 30 cm. Thirteen per cent of G. cynoglossus are smaller than legal minimum size of 28 cm. Thirty one per cent of L. whiff-iagonis are smaller than the legal size of 25 cm.

According to the otolith ring reading and to the analysis of the size frequency distributions (table 3) only 6% of G. cynoglossus are younger than age 4 and only 2% of L. whiff-iagonis are younger than age 2.

On the basis of the data collected from December to March, it does not appear that the Celtic Sea be a particularly important nursery ground for any of the commercial species caught. Save for L. whiff-iagonis and M. merlucius , and to a lesser extent save for G. cynoglossus, very few fish of protected species are caught before they reach the legal minimum size.

It appears that the incidence on yield per recruit of a change in mesh size from 55-60 to 70 mm would be worth assessing only for L. whiff-iagonis, M. merlucius and G. cynoglossus. Small M. merlangus are virtually absent from the catch.

One may draw a few major elements of information from the analysis of correspondences:

The coastal area (South Ireland bank), and most likely, the other areas where 70 mm mesh sizes are used,widely differ in commercial species composition from the other areas of the Celtic Sea. The former areas with shallow water (70 m), sand, broken shell and clay-bottoms have characteristic species such as S. solea, P. platessa and S. rhombus. The latter areas are the true N. norvegicus fishing grounds where the most commonly caught fish species are L. whiff-iagonis and M. merlucius. Other species of fish such as Pollachius spp, G.morhua, M. aeglefinus, Lophius spp, G. cynoglossus may be caught indifferently in any location and with any mesh size. M. merlangus are caught very seldom, they are moderately abundant only on Baltimore Bank inshore as well as off-shore.

The only places where young age classes appeared more or less significantly were on the Banks of Bec and Labadie. Further sampling will be conducted in these places.In regard of the present data limited to winter months, the Celtic Sea appears to be more a feeding ground than a nursery for commercially exploited fish, although complementary information still needs to be processed for assessing species, age and size composition of the catch in spring, summer and fall hauls.

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Table 1   List of variables in the analysis of correspondences
            (abundances of the species)

        1 à 5 :   SOLEA SOLEA
       6 à 10 :   GLYPTOCEPHALUS CYNOGLOSSUS
      11 à 15 :   MERLANGUS MERLANGUS
      16 à 21 :   MERLUCIUS MERLUCIUS
          22 :   MICROSTOMUS KITT
          23 :   PLEURONECTES PLATESSA
          24 :   SCOPHTALMUS MAXIMUS
          25 :   SCOPHTALMUS RHOMBUS
          26 :   GADUS MORRHUA
          27 :   MELANOGRAMMUS AEGLEFINUS
          28 :   POLLACHIUS POLLACHIUS
          29 :   POLLACHIUS VIRENS
          30 :   MOLVA MOLVA
          31 :   SCYLLIORHINUS STELLARIS(Number)
          32 :   "   "   (Weight)
          33 :   LOPHIUS SP(Number)
          34 :   "   (Weight)
      35 à 39 :   LEPIDORHOMBUS WHIFF-IAGONIS

Table 1^a

Table 1ᵃ Tableau de fréquence de taille de cardines de mer
celtique : valeurs observées.
Size frequency distribution of Lepidorhombus.

Amplitude de classe:1   Valeur inf: 10   Valeur sup: 63
Nombre de classes: 63

CLASSE	FREQUENCE									
1	0.00	14	103.00	27	1001.00	40	291.00	53	57.00
2	0.00	15	106.00	28	1082.00	41	224.00	54	40.00
3	0.00	16	145.00	29	1125.00	42	240.00	55	41.00
4	0.00	17	308.00	30	1096.00	43	268.00	56	69.00
5	0.00	18	487.00	31	968.00	44	203.00	57	71.0
6	0.00	19	555.00	32	834.00	45	213.00	58	5.0
7	0.00	20	649.00	33	555.00	46	203.00	59	0.00
8	0.00	21	742.00	34	532.00	47	200.00	60	0.00
9	0.00	22	930.00	35	449.00	48	159.00	61	0.00
10	5.00	23	1045.00	36	419.00	49	109.00	62	0.00
11	14.00	24	1016.00	37	381.00	50	133.00	63	6.00
12	32.00	25	966.00	38	339.00	51	100.00		
13	61.00	26	1009.00	39	354.00	52	101.00		

MOYENNE   29.05386
S.D.   8.64443

CLASSES	%									
1	0.00	14	.51	27	4.99	40	1.45	53	.28
2	0.00	15	.53	28	5.40	41	1.12	54	.20
3	0.00	16	.72	29	5.61	42	1.20	55	.20
4	0.00	17	1.54	30	5.47	43	1.34	56	.34
5	0.00	18	2.43	31	4.83	44	1.01	57	.35
6	0.00	19	2.77	32	4.16	45	1.06	58	.2
7	0.00	20	3.24	33	2.77	46	1.01	59	0.
8	0.00	21	3.70	34	2.65	47	1.00	60	0.00
9	0.00	22	4.64	35	2.24	48	.79	61	0.00
10	.02	23	5.21	36	2.09	49	.54	62	0.00
11	.07	24	5.07	37	1.90	50	.66	63	.03
12	.16	25	4.82	38	1.69	51	.50		
13	.30	26	5.03	39	1.77	52	.50		

Table 1[b]   Size frequency distribution of <u>Merlucius</u>

Ensemble des merlus échantillonnés : tableau des fréquences de taille

Amplitude de classe:1 Valeur inf: 3 Valeur sup: 98
Nombre de classes: 98

CLASSE	FREQUENCE								
1	0.00	21	10.00	41	62.00	61	5.00	81	0.00
2	0.00	22	14.00	42	48.00	62	6.00	82	25.00
3	1.00	23	25.00	43	24.00	63	17.00	83	2.00
4	0.00	24	31.00	44	23.00	64	28.00	84	4.00
5	0.00	25	50.00	45	31.00	65	0.00	85	33.00
6	0.00	26	60.00	46	14.00	66	2.00	86	0.00
7	2.00	27	96.00	47	4.00	67	4.00	87	40.00
8	6.00	28	148.00	48	13.00	68	8.00	88	0.00
9	8.00	29	197.00	49	9.00	69	14.00	89	11.00
10	7.00	30	247.00	50	4.00	70	0.00	90	0.00
11	15.00	31	229.00	51	7.00	71	2.00	91	0.00
12	26.00	32	194.00	52	20.00	72	25.00	92	0.00
13	15.00	33	182.00	53	14.00	73	0.00	93	0.00
14	24.00	34	160.00	54	1.00	74	5.00	94	0.00
15	15.00	35	131.00	55	19.00	75	13.00	95	18.00
16	29.00	36	115.00	56	0.00	76	0.00	96	0.00
17	11.00	37	78.00	57	4.00	77	0.00	97	0.00
18	13.00	38	77.00	58	5.00	78	0.00	98	29.00
19	9.00	39	67.00	59	21.00	79	23.00		
20	9.00	40	41.00	60	5.00	80	0.00		

MOYENNE   36.71045
S.D.   16.81767

CLASSES	%								
1	0.00	21	.34	41	2.09	61	.17	81	0.00
2	0.00	22	.47	42	1.61	62	.20	82	.84
3	.03	23	.84	43	.83	63	.57	83	.07
4	0.00	24	1.04	44	.77	64	.94	84	.13
5	0.00	25	1.68	45	1.04	65	0.00	85	1.11
6	0.00	26	2.01	46	.47	66	.07	86	0.00
7	.07	27	3.22	47	.13	67	.13	87	1.34
8	.20	28	4.96	48	.44	68	.27	88	0.00
9	.27	29	6.60	49	.30	69	.47	89	.37
10	.23	30	8.28	50	.13	70	0.00	90	0.00
11	.50	31	7.67	51	.23	71	.07	91	0.00
12	.87	32	6.50	52	.67	72	.84	92	0.00
13	.50	33	6.10	53	.47	73	0.00	93	0.00
14	.80	34	5.36	54	.03	74	.17	94	0.00
15	.50	35	4.39	55	.64	75	.44	95	.60
16	.97	36	3.85	56	0.00	76	0.00	96	0.00
17	.37	37	2.61	57	.13	77	0.00	97	0.00
18	.44	38	2.58	58	.17	78	0.00	98	.97
19	.30	39	2.25	59	.70	79	.77		
20	.30	40	1.37	60	.17	80	0.00		

Valeur maximale de Y: 8.28

Table 1^C

Table 1[C]   Size frequency distribution of Merlangus.

Tableau des fréquences de taille
de l'ensemble des merlans échantillonnés.

Amplitude de classe:1 Valeur inf: 8 Valeur sup: 72
Nombre de classes: 80

CLASSE	FREQUENCE								
1	0.00	17	0.00	33	119.00	49	3.00	65	0.00
2	0.00	18	0.00	34	104.00	50	1.00	66	0.00
3	0.00	19	0.00	35	125.00	51	4.00	67	0.00
4	0.00	20	0.00	36	98.00	52	4.00	68	0.00
5	0.00	21	3.00	37	77.00	53	5.00	69	0.00
6	0.00	22	1.00	38	55.00	54	3.00	70	1.00
7	0.00	23	3.00	39	46.00	55	1.00	71	0.00
8	1.00	24	5.00	40	30.00	56	0.00	72	1.00
9	1.00	25	9.00	41	23.00	57	1.00	73	0.00
10	0.00	26	17.00	42	20.00	58	0.00	74	0.00
11	0.00	27	31.00	43	7.00	59	0.00	75	0.00
12	1.00	28	57.00	44	12.00	60	1.00	76	0.00
13	1.00	29	75.00	45	9.00	61	0.00	77	0.00
14	0.00	30	78.00	46	11.00	62	0.00	78	0.00
15	1.00	31	104.00	47	5.00	63	0.00	79	0.00
16	0.00	32	115.00	48	5.00	64	0.00	80	0.00

MOYENNE   33.64207
S.D.   5.45403

CLASSES	%								
1	0.00	17	0.00	33	9.34	49	.24	65	0.00
2	0.00	18	0.00	34	8.16	50	.08	66	0.00
3	0.00	19	0.00	35	9.81	51	.31	67	0.00
4	0.00	20	0.00	36	7.69	52	.31	68	0.00
5	0.00	21	.24	37	6.04	53	.39	69	0.00
6	0.00	22	.08	38	4.32	54	.24	70	.08
7	0.00	23	.24	39	3.61	55	.08	71	0.
8	.08	24	.39	40	2.35	56	0.00	72	.08
9	.08	25	.71	41	1.81	57	.08	73	0.00
10	0.00	26	1.33	42	1.57	58	0.00	74	0.00
11	0.00	27	2.43	43	.55	59	0.00	75	0.00
12	.08	28	4.47	44	.94	60	.08	76	0.00
13	.08	29	5.89	45	.71	61	0.00	77	0.00
14	0.00	30	6.12	46	.86	62	0.00	78	0.00
15	.08	31	8.16	47	.39	63	0.00	79	0.00
16	0.00	32	9.03	48	.39	64	0.00	80	0.00

Table 1ᵈ

Soles présentes dans les traits effectués avec le maillage de 55-60 mm :
Size frequency distributions of soles caught with cod ends of 55-60mm mesh size.
tableau des fréquences de taille

Effectif total = 118.00
Limite inf. 13.00 Limite sup. 47.00   Etendu: 34.00
Amplitude de classe=   1.00
Borne inf. axe X =   12.50 Borne sup.= 47.00
Nb. de classes: 35.00

SOLEA
classe effectif

13.0	1.0	20.0	0.0	27.0	5.0	34.0	8.0	41.0	6.0
14.0	1.0	21.0	0.0	28.0	7.0	35.0	9.0	42.0	7.0
15.0	0.0	22.0	1.0	29.0	8.0	36.0	5.0	43.0	5.0
16.0	0.0	23.0	2.0	30.0	5.0	37.0	8.0	44.0	3.0
17.0	0.0	24.0	0.0	31.0	3.0	38.0	4.0	45.0	4.0
18.0	2.0	25.0	2.0	32.0	2.0	39.0	6.0	46.0	1.0
19.0	0.0	26.0	2.0	33.0	3.0	40.0	6.0	47.0	2.0

Moyenne 34.7289 S.D. 6.9953

Classe pourcentage

13.0	0.8	20.0	0.8	27.0	4.2	34.0	6.8	41.0	5.1
14.0	0.8	21.0	0.0	28.0	5.9	35.0	7.6	42.0	5.9
15.0	0.0	22.0	0.8	29.0	6.8	36.0	4.2	43.0	4.2
16.0	0.0	23.0	1.7	30.0	4.2	37.0	6.8	44.0	2.5
17.0	0.0	24.0	0.0	31.0	2.5	38.0	3.4	45.0	3.4
18.0	1.7	25.0	1.7	32.0	1.7	39.0	5.1	46.0	0.8
19.0	0.0	26.0	1.7	33.0	2.5	40.0	5.1	47.0	1.7

Tableau des fréquence dc taille des lieus jaunes échantillonnés
avec un maillage de 55-60 mm.

Table 1e   Size frequency distribution of <u>Pollachius pollachius</u> caught with cod ends
of 55-60mm mesh size.

Effectif total = 226.00
Limite inf. 37.00 Limite sup. 90.00   Etendue 53.00

Amplitude de classe= 2.00
Borne inf. axe X = 36.60 Borne sup.= 90.00
Nb. de classes: 27.00

POLLACHIUS POLLACHIUS
classe effectif

classe	effectif	classe	effectif	classe	effectif	classe	effectif	classe	effectif
37.0	1.0	49.0	5.0	61.0	8.0	73.0	10.0	85.0	3.0
39.0	1.0	51.0	13.0	63.0	10.0	75.0	8.0	87.0	1.0
41.0	4.0	53.0	11.0	65.0	13.0	77.0	5.0	89.0	2.0
43.0	5.0	55.0	16.0	67.0	20.0	79.0	8.0		
45.0	3.0	57.0	12.0	69.0	25.0	81.0	5.0		
47.0	6.0	59.0	5.0	71.0	18.0	83.0	2.0		

Moyenne 67.3097 S.D. 10.9167

Classe pourcentage

classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage
37.0	0.4	49.0	2.2	61.0	3.5	73.0	4.4	85.0	1.3
39.0	0.4	51.0	5.8	63.0	4.4	75.0	3.5	87.0	0.4
41.0	1.8	53.0	4.9	65.0	5.8	77.0	2.2	89.0	
43.0	2.2	55.0	7.1	67.0	8.8	79.0	3.5		
45.0	1.3	57.0	8.0	69.0	11.1	81.0	2.2		
47.0	2.7	59.0	2.2	71.0	8.0	83.0	0.9		

Tableau des fréquences de taille des lingues
échantillonnées avec un maillage de 55-60 mm.

Table 1f   Size frequency distribution of <u>Molva</u> caught with cod ends of 55-60mm mesh size.

Effectif total = 105.00
Limite inf. 38.00 Limite sup.160.00   Etendue122.00
Amplitude de classe= 2.00
Borne inf. axe X = 37.00 Borne sup.= 160.00
Nb. de classes: 62.00

MOLVA
classe effectif

classe	effectif	classe	effectif	classe	effectif	classe	effectif	classe	effectif
38.0	1.0	64.0	2.0	90.0	5.0	116.0	1.0	142.0	1.0
40.0	0.0	66.0	2.0	92.0	2.0	118.0	0.0	144.0	0.0
42.0	0.0	68.0	2.0	94.0	0.0	120.0	1.0	146.0	0.0
44.0	0.0	70.0	4.0	96.0	3.0	122.0	1.0	148.0	1.0
46.0	1.0	72.0	6.0	98.0	4.0	124.0	0.0	150.0	0.0
48.0	1.0	74.0	2.0	100.0	3.0	126.0	0.0	152.0	0.0
50.0	0.0	76.0	7.0	102.0	4.0	128.0	1.0	154.0	0.0
52.0	1.0	78.0	2.0	104.0	1.0	130.0	0.0	156.0	0.0
54.0	3.0	80.0	9.0	106.0	0.0	132.0	1.0	158.0	0.0
56.0	1.0	82.0	3.0	108.0	0.0	134.0	3.0	160.0	1.0
58.0	0.0	84.0	5.0	110.0	3.0	136.0	1.0		
60.0	2.0	86.0	3.0	112.0	1.0	138.0	1.0		
62.0	4.0	88.0	4.0	114.0	1.0	140.0	0.0		

Moyenne 87.0095 S.D. 23.5401

Classe pourcentage

classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage
38.0	1.0	64.0	1.9	90.0	4.8	116.0	1.0	142.0	1.0
40.0	0.0	66.0	1.9	92.0	1.9	118.0	0.0	144.0	0.0
42.0	0.0	68.0	1.9	94.0	0.0	120.0	1.0	146.0	0.0
44.0	0.0	70.0	3.8	96.0	2.9	122.0	1.0	148.0	1.0
46.0	1.0	72.0	5.7	98.0	3.8	124.0	0.0	150.0	0.0
48.0	1.0	74.0	1.9	100.0	2.9	126.0	0.0	152.0	0.0
50.0	0.0	76.0	6.7	102.0	3.8	128.0	1.0	154.0	0.0
52.0	1.0	78.0	1.9	104.0	1.0	130.0	0.0	156.0	0.0
54.0	2.9	80.0	8.6	106.0	0.0	132.0	1.0	158.0	0.0
56.0	1.0	82.0	2.9	108.0	0.0	134.0	2.9	160.0	1.0
58.0	0.0	84.0	4.8	110.0	2.9	136.0	1.0		
60.0	1.9	86.0	2.9	112.0	1.0	138.0	1.0		
62.0	3.8	88.0	3.8	114.0	1.0	140.0	0.0		

Table 1⁹ —

Table 19 Tableau des fréquences de taille des églefins échantillonnés avec un maillage de 55-60 mm.

Size frequency distribution of <u>Melanogrammus</u> caught with cod ends of 55-60mm mesh size.

```
 Effectif total = 162.00
Limite inf. 22.00  Limite sup. 84.00        Etendue 62.00

Amplitude de classe=  2.00
Borne inf. axe X =  21.00  Borne sup.=  84.00
Nb. de classes:  32.00

MELANOGRAMMUS
 classe effectif
```

classe	effectif	classe	effectif	classe	effectif	classe	effectif	classe	effectif
22.0	2.0	36.0	23.0	50.0	4.0	64.0	3.0	78.0	1.0
24.0	5.0	38.0	18.0	52.0	5.0	66.0	6.0	80.0	0.0
26.0	0.0	40.0	12.0	54.0	3.0	68.0	2.0	82.0	0.0
28.0	0.0	42.0	8.0	56.0	4.0	70.0	3.0	84.0	1.0
30.0	9.0	44.0	6.0	58.0	5.0	72.0	1.0		
32.0	11.0	46.0	4.0	60.0	7.0	74.0	1.0		
34.0	12.0	48.0	7.0	62.0	3.0	76.0	1.0		

```
Moyenne 44.7284  S.D. 12.6427

 Classe  pourcentage
```

Classe	pourcentage	Classe	pourcentage	Classe	pourcentage	Classe	pourcentage	Classe	pourcentage
22.0	1.2	36.0	14.2	50.0	2.5	64.0	1.9	78.0	0.6
24.0	0.0	38.0	11.1	52.0	3.1	66.0	3.7	80.0	0.0
26.0	0.0	40.0	7.4	54.0	1.9	68.0	1.2	82.0	0.0
28.0	0.0	42.0	4.9	56.0	2.5	70.0	1.9	84.0	0.6
30.0	5.6	44.0	3.7	58.0	3.1	72.0	0.6		
32.0	6.8	46.0	2.5	60.0	4.3	74.0	0.6		
34.0	7.4	48.0	4.3	62.0	1.9	76.0	0.6		

Table 1[h]   Tableau des fréquences de taille des plies
échantillonnées avec un maillage de 55-60 mm.
Size frequency distribution of Pleuronectes
caught with cod ends of 55-60mm mesh size.

Effectif total = 73.00
Limite inf. 27.00 Limite sup. 57.00   Etendue 30.00

Amplitude de classe= 1.00
Borne inf. axe X = 26.50 Borne sup.= 57.00
Nb. de classes: 31.00

PLEURONECTES PLATESSA
 classe effectif

classe	effectif	classe	effectif	classe	effectif	classe	effectif	classe	effectif
27.0	2.0	34.0	7.0	41.0	5.0	48.0	0.0	55.0	1.0
28.0	2.0	35.0	6.0	42.0	4.0	49.0	1.0	56.0	0.0
29.0	0.0	36.0	7.0	43.0	1.0	50.0	0.0	57.0	1.0
30.0	5.0	37.0	3.0	44.0	1.0	51.0	0.0		
31.0	3.0	38.0	6.0	45.0	0.0	52.0	0.0		
32.0	5.0	39.0	3.0	46.0	0.0	53.0	1.0		
33.0	4.0	40.0	2.0	47.0	0.0	54.0	2.0		

Moyenne 36.9178 S.D. 6.4324

 Classe pourcentage

classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage	classe	pourcentage
27.0	2.7	34.0	9.6	41.0	6.8	48.0	0.0	55.0	1.4
28.0	2.7	35.0	8.2	42.0	5.5	49.0	1.4	56.0	0.0
29.0	0.0	36.0	9.6	43.0	1.4	50.0	0.0	57.0	1.4
30.0	6.8	37.0	4.1	44.0	1.4	51.0	0.0		
31.0	4.1	38.0	8.2	45.0	0.0	52.0	0.0		
32.0	8.2	39.0	4.1	46.0	0.0	53.0	1.4		
33.0	5.5	40.0	2.7	47.0	0.0	54.0	2.7		

Table 1 I Tableau des fréquences de taille des limandes tourne à gauche.
Size frequency distribution of <u>Glyptocephalus cynoglossus</u>.

classe effectif

classe	effectif	classe	effectif	classe	effectif	classe	effectif	classe	effectif
15.5	4.0	23.5	19.0	31.5	208.0	39.5	167.0	47.5	15.0
16.5	12.0	24.5	33.0	32.5	219.0	40.5	121.0	48.5	6.0
17.5	19.0	25.5	53.0	33.5	233.0	41.5	78.0	49.5	4.0
18.5	24.0	26.5	67.0	34.5	211.0	42.5	84.0	50.5	1.0
19.5	24.0	27.5	104.0	35.5	253.0	43.5	62.0	51.5	0.0
20.5	36.0	28.5	159.0	36.5	240.0	44.5	48.0	52.5	0.0
21.5	34.0	29.5	193.0	37.5	206.0	45.5	32.0	53.5	0.0
22.5	25.0	30.5	232.0	38.5	163.0	46.5	18.0	54.5	0.0

Moyenne 33.9326 S.D. 5.8920

Classe pourcentage

Classe	pourcentage	Classe	pourcentage	Classe	pourcentage	Classe	pourcentage	Classe	pourcentage
15.5	0.1	23.5	0.5	31.5	6.1	39.5	4.9	47.5	0.4
16.5	0.4	24.5	1.0	32.5	6.4	40.5	3.6	48.5	0.2
17.5	0.6	25.5	1.6	33.5	6.8	41.5	2.3	49.5	0.1
18.5	0.7	26.5	2.0	34.5	6.2	42.5	2.5	50.5	0.0
19.5	0.7	27.5	3.1	35.5	7.4	43.5	1.8	51.5	0.0
20.5	1.1	28.5	4.7	36.5	7.0	44.5	1.4	52.5	0.0
21.5	1.0	29.5	5.7	37.5	6.0	45.5	0.9	53.5	0.0
22.5	0.7	30.5	6.8	38.5	4.8	46.5	0.5	54.5	0.0

Total length(cm) \ number of growth rings	1	2	3	4	5	6
12	4					
13	4	1				
14	12	2	1			
15	22	3				
16	7	2				
17	1	6				
18		6				
19	2	12				
20		30	1			
21		21	3			
22		13	4			
23		5	3			
24		2	5			
25		1	4			
26		1	3			
27			2			
28						
29						
30						
31		1				
32						
33			1			
34			2	2		
35			5			
36		1	5	5		
37		3	8	2		
38		1	6	6		
39		1	4			
40		1	5	3		
41			1	2		
42				2		
43				2		
44		1	2	4	1	2
45				1	2	
46				1	1	2
47				1	1	
48			1	1		1
49				1	1	
50				1	1	1
51				1	1	
52				2		

Table 2 a   Résultats de lecture des otolithes de cardine
                   Results of otoliths reading for Lepidorhombus.

Total length (cm) \ number of growth rings	1	2	3	4	5	6	7	8
9	2	2						
10	1	2	1					
11	1	1						
12	1	1						
13								
14								
15								
16								
17		1	2					
18		1	1	1				
19	1	2	4	1				
20		1	2					
21								
22			1	1				
23			1					
24			1					
25			1					
26								
27								
28								
29								
30								
31								
32								
33								
34				1	1			
35				1	1	2		
36				3		1		
37				3		1		
38			1	1	1			
39				1	2			1
40						1		

Table 2b Results of otolith reading for Glyptocephalus.

Résultats de la lecture des otolithes de plie cynoglosse.

TABLE 3

Age distribution of Lepidorhombus whiff-iagonis and Glyptocephalus cynoglossus estimated after size frequency distribution analysis by Hasselblad's technique.

G. cynoglossus					L. whiff-iagonis			
Age	Mean size	SD	%		Age	Mean size	SD	%
3	20.20	2.26	6		1	14.98	2.42	2
4	31.01	3.06	49		2	21.96	3.29	37
5	36.42	1.88	25		3	28.84	2.85	35
6	39.69	0.68	3		4	34.49	3.00	9
7+	41.59	3.06	17		5	37.95	2.45	6
					6	44.10	3.29	9
					7+	51.81	3.49	3

It is assumed that the first growth ring is laid at age 1 and that there is only one growth ring per year. The latter assuption is fairly well verified by the position of the modes in the SF distribution of the figures 13-14.
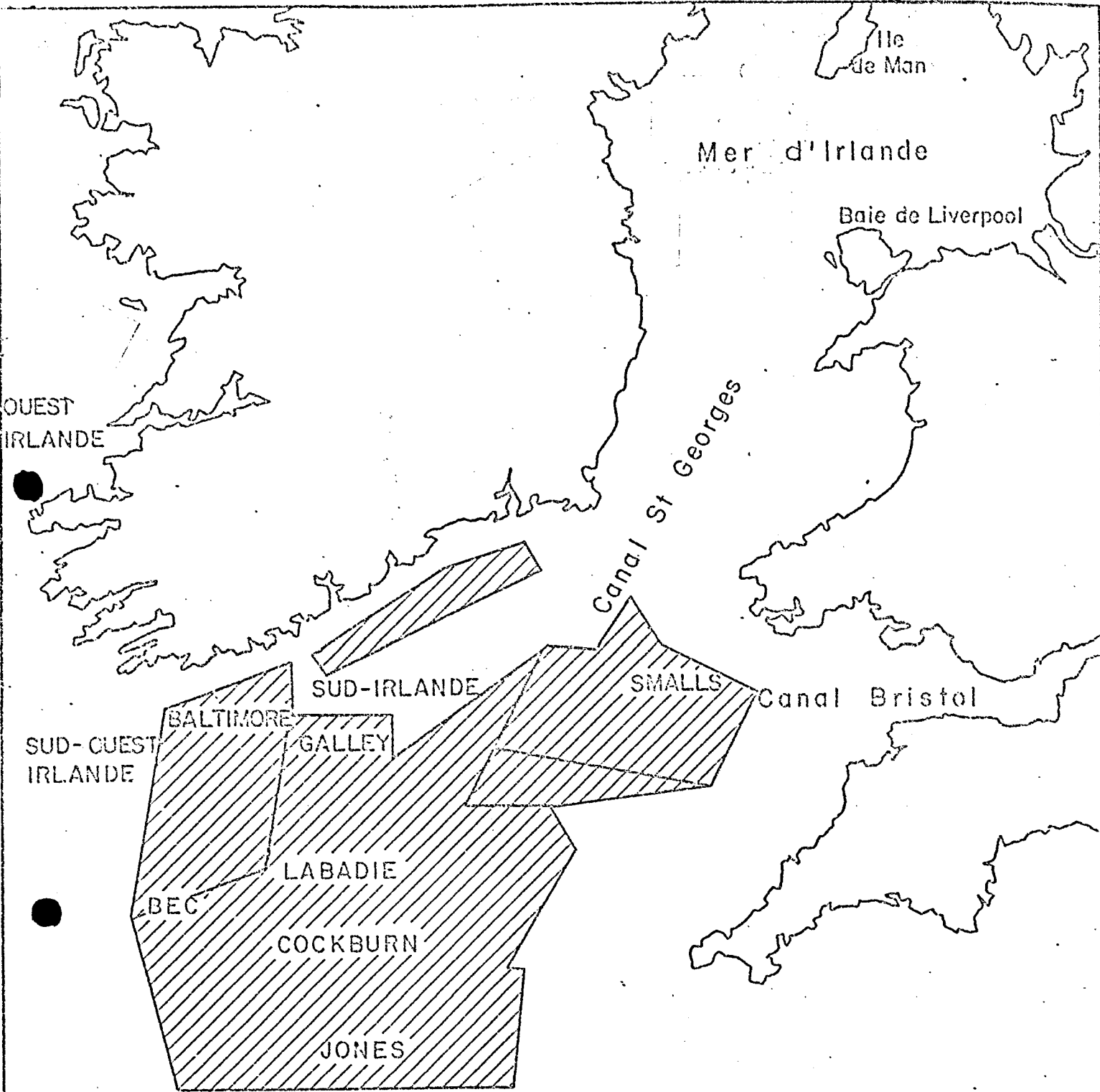
Figure 1

Fishing grounds harvested by French ships trawling for Nephrops
in the Celtic Sea.
    Bancs exploités par les navires français
chalutant des Langoustines en Mer Celtique.

Figure 2   LOCATION OF THE HAULS SAMPLED

CARTE DES STATIONS ECHANTILLONNEES
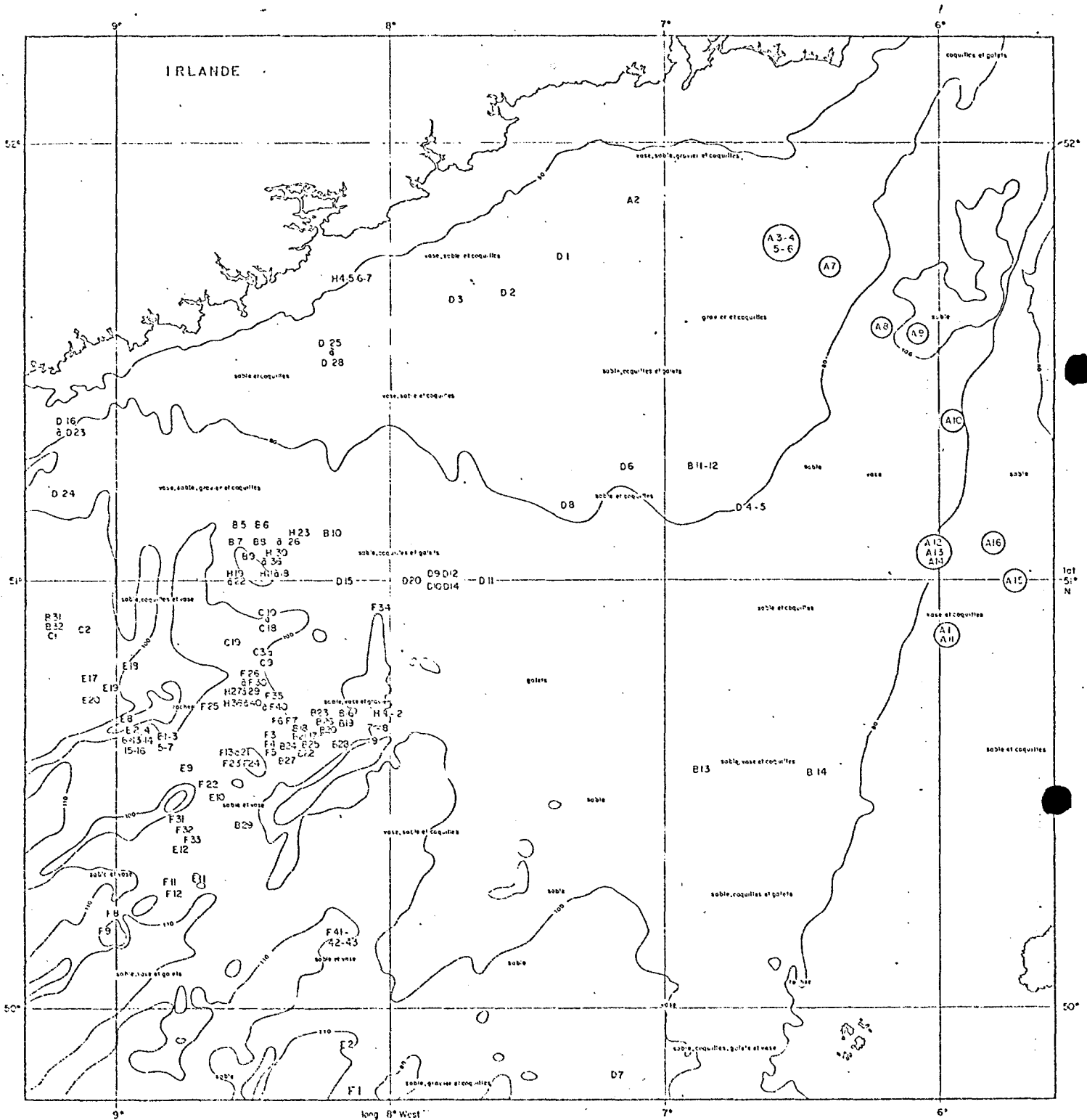
A 70mm mesh size was used in locations circumscribed within a circle.
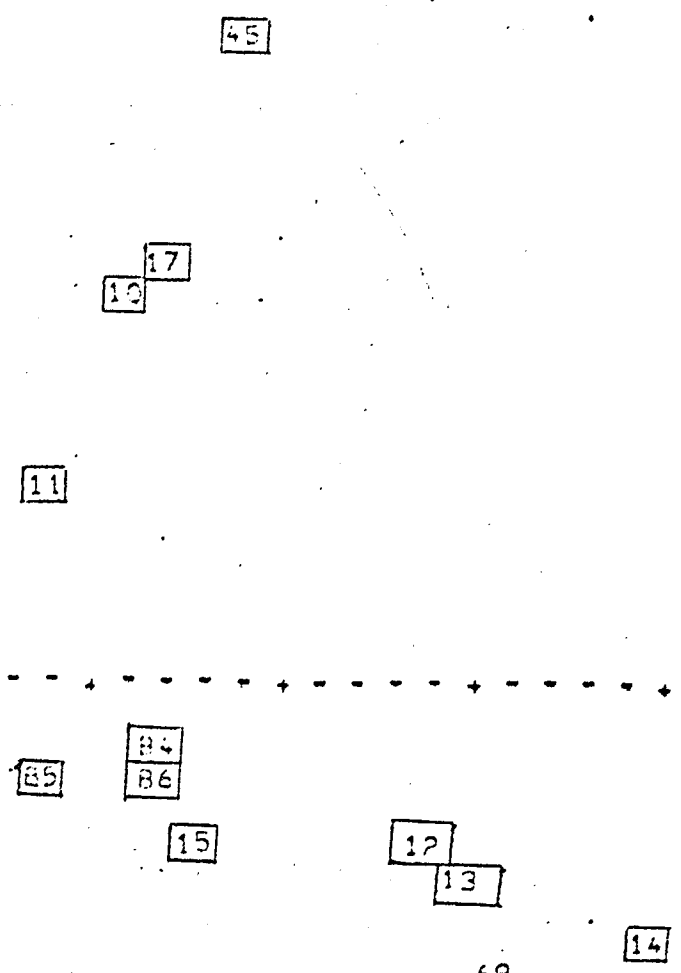Les stations encerclées correspondent à un maillage de 70 mm.
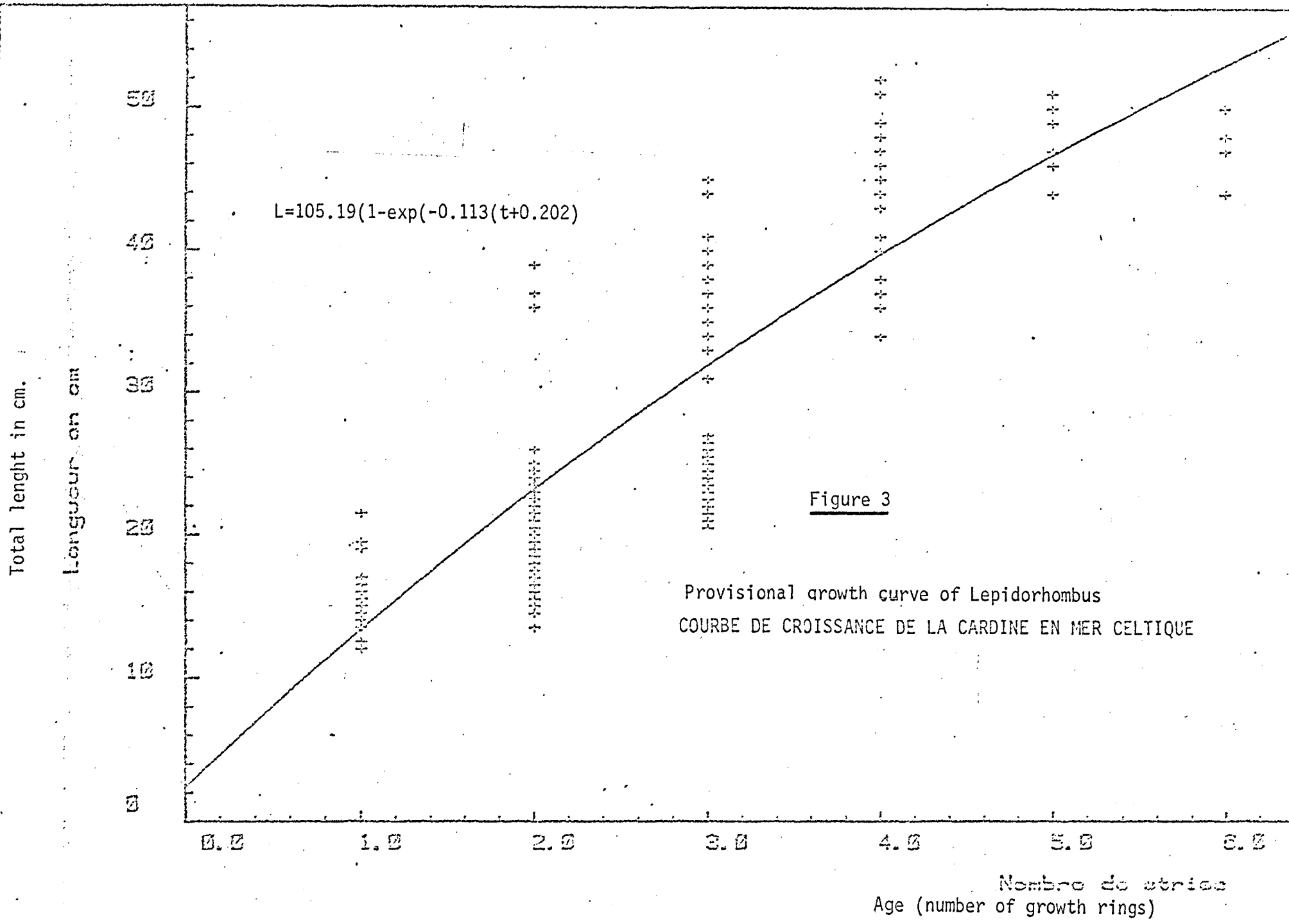
Figure 3

Provisional growth curve of Lepidorhombus

COURBE DE CROISSANCE DE LA CARDINE EN MER CELTIQUE

$L = 105.19(1 - \exp(-0.113(t + 0.202))$

Total lenght in cm.

Longueur en cm.

Age (number of growth rings)

Nombre de stries

Figure 4

COURBE DE CROISSANCE DE LA PLIE CYNOGLOSSE EN MER CELTIQUE
Provisional growth curve of Glyptocephalus
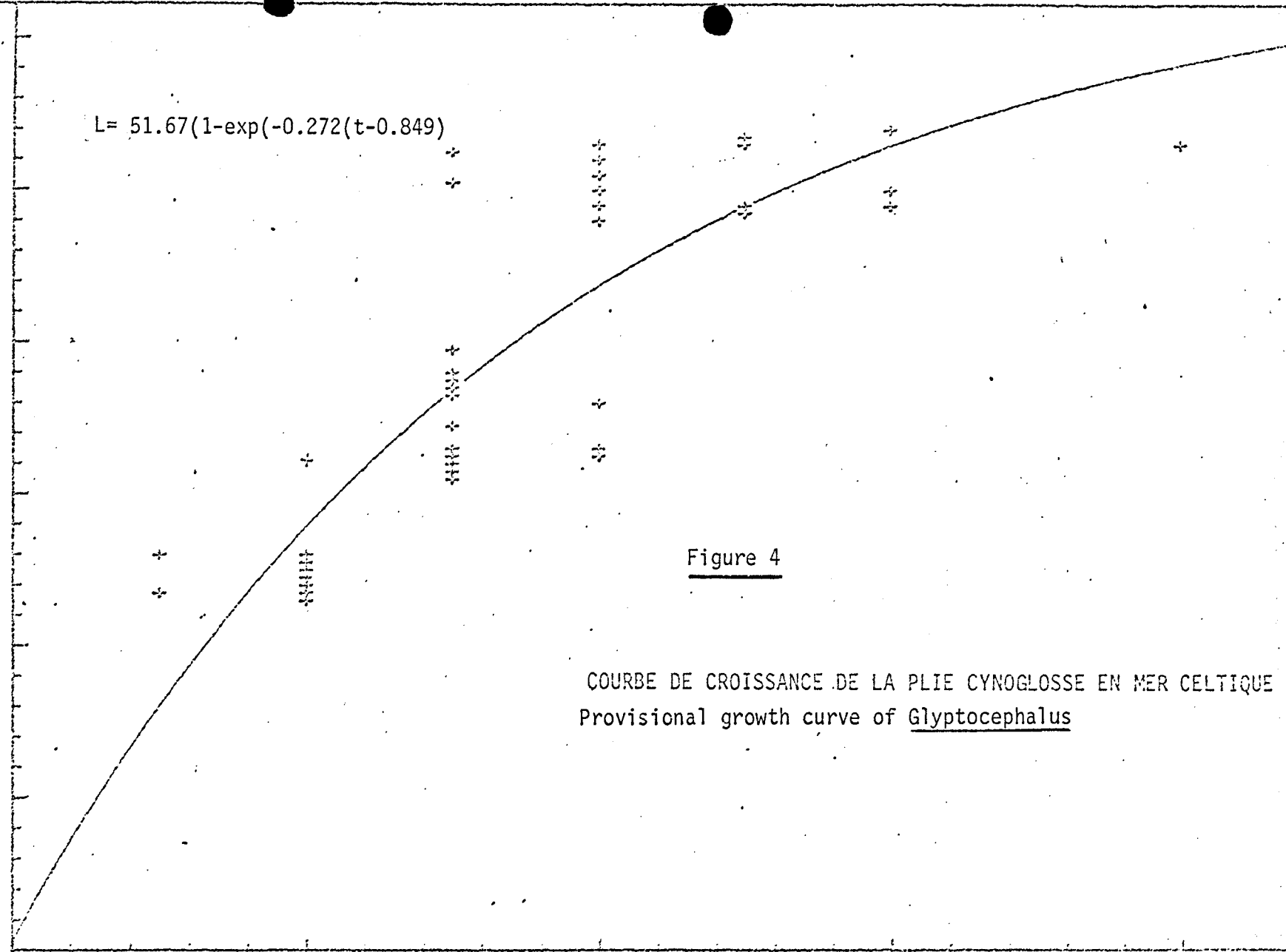
RESULTATS DE LA PREMIERE ANALYSE D'INERTIE

AXE DES X : 1

AXE DES Y : 2

RESULTS OF THE FIRST CORRESPONDEN CE ANALYSIS

ENSEMBLE DES OBSERVATIONS

SET OF STATIONS

45

17

13

34   8951
      7049
      19091
   92   A2
      71
6576
8072
83
-9686   60
9521   26
A9B394
78CA4
2342
93

11

16

84
85   86

15   12
            13

14

Figure 5

A 70mm mesh size was used in locations circumscribed within a square.   69

Les stations encadrées correspondent au maillage de 70 mm.

SELON L AXE DES X UN INTERVALLE = .13E-02   SELON I AXE DES Y = .13E-02

RESULTATS DE LA PREMIERE ANALYSE D'INERTIE
            AXE DES X : 1
            AXE DES Y : 2

RESULTS OF THE FIRST CORRESPONDENCE ANALYSIS
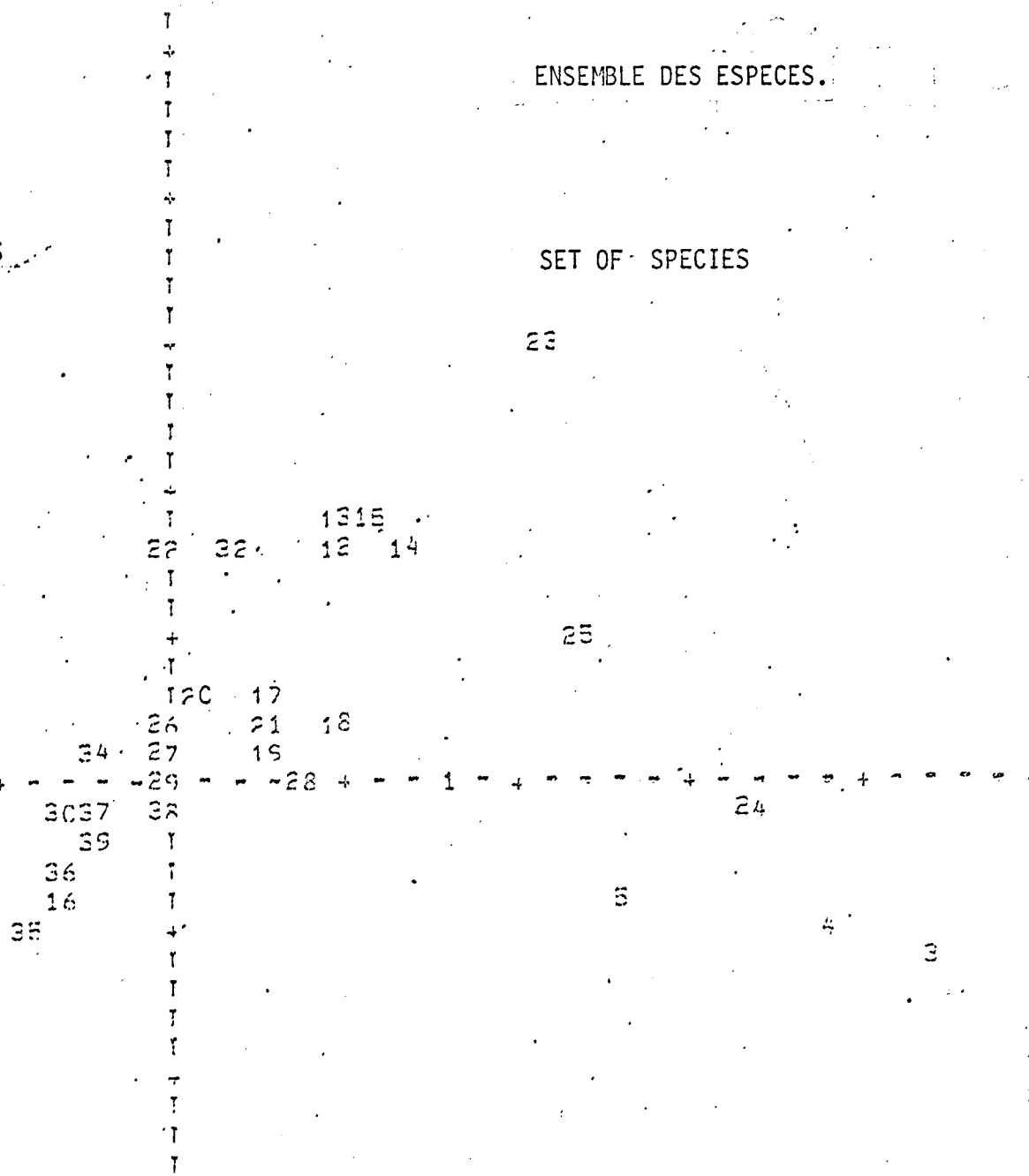
ENSEMBLE DES ESPECES.

SET OF SPECIES

23

1315
22   32   12   14

25

120   17
26   21   18
34   27   19
29   28   1   24
3037   38
39
36
16   5
35   4
                                                    3

Figure 6

RESULTATS DE L'ANALYSE D'INERTIE
AXE DES X : 1
AXE DES Y : 2

RESULTS OF THE ANALYSIS OF CORRESPONDENCES

ENSEMBLE DES OBSERVATIONS

SET OF STATIONS

Figure 7

RESULTATS DE L'ANALYSE D'INERTIE
                AXE DES X : 1
                AXE DES Y : 2

RESULTS OF THE ANALYSIS OF CORRESPONDENCES

ENSEMBLE DES ESPECES
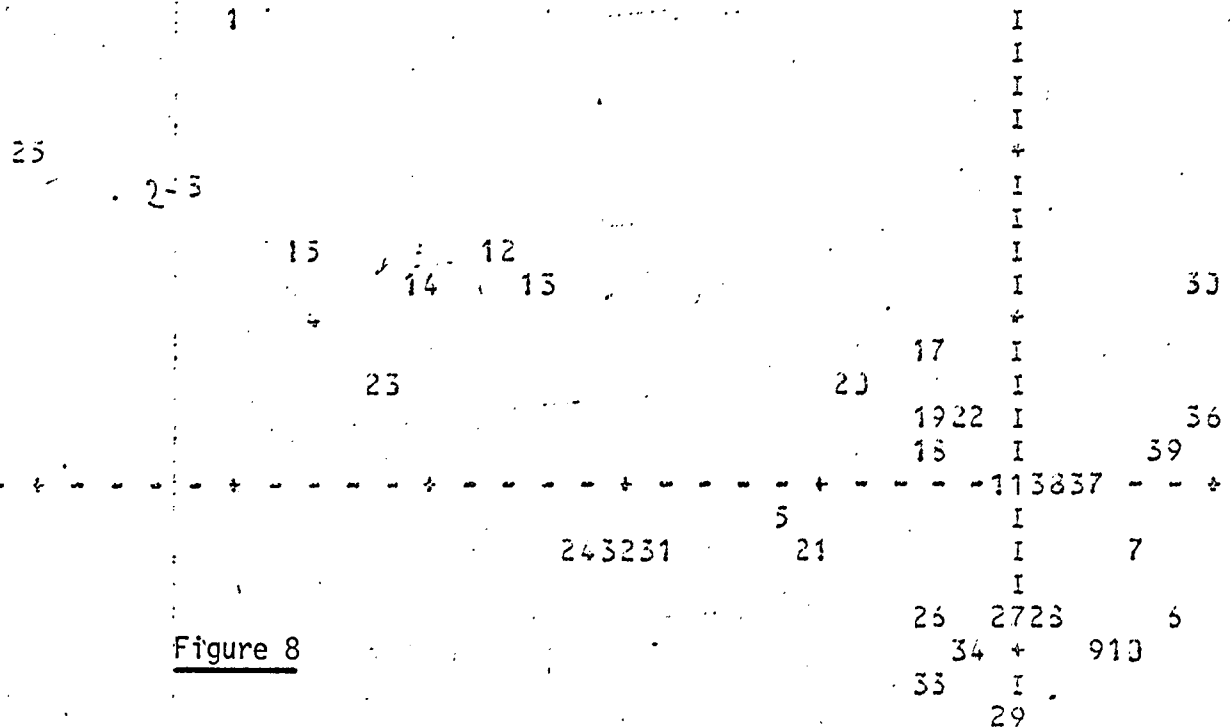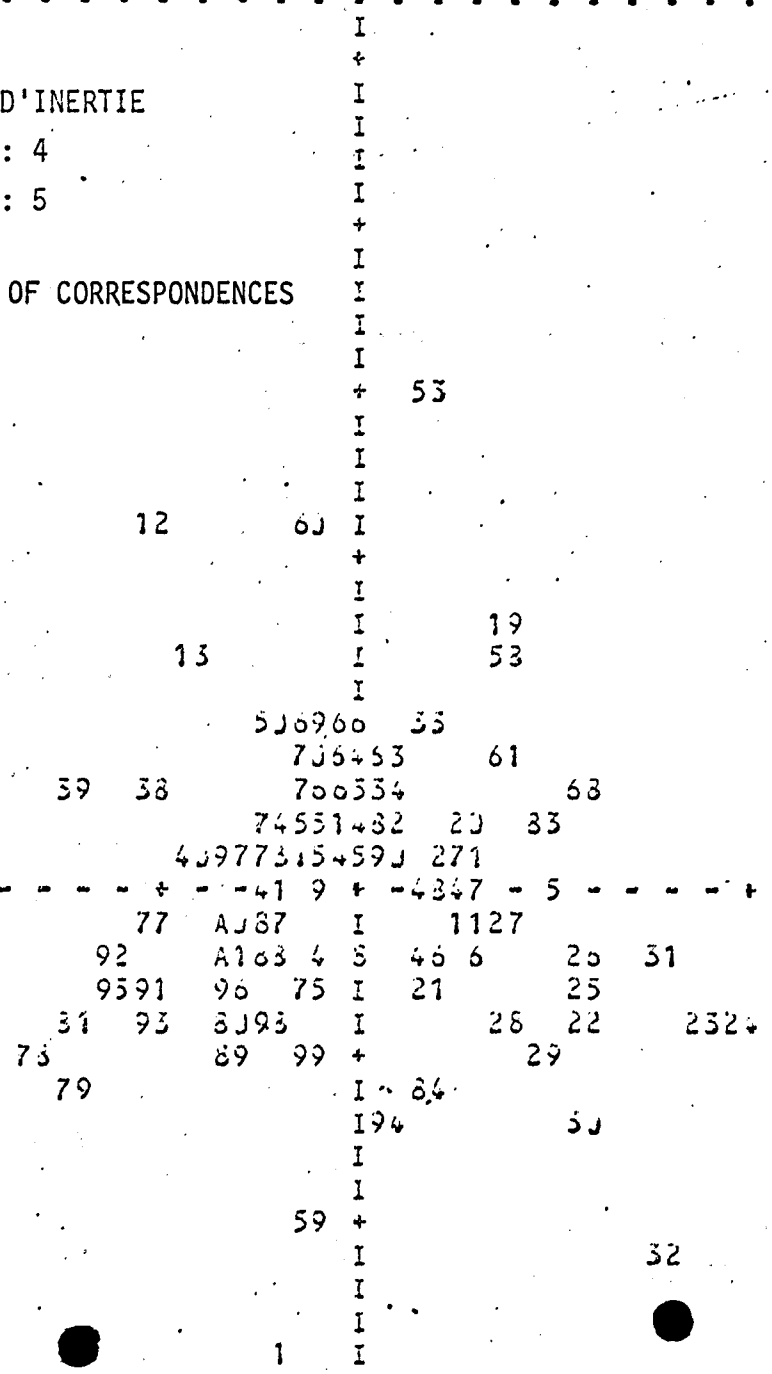
SET OF SPECIES (VARIABLES)

Figure 8

SELON L AXE DES X UN INTERVALLE = .16E-02   SELON L AXE DES Y = .16E-02

```
                                                    I
          57                                        +
                        RESULTATS DE L'ANALYSE D'INERTIE    I              ENSEMBLE DES OBSERVATIONS
             17                   AXE DES X : 1             I.
                                  AXE DES Y : 3             I
                                                    I
                                                    +
                        RESULTS OF THE ANALYSIS OF CORRESPONDENCES I
                                                    I                      SET OF STATIONS
                                                    I
                                                    I
                                                    +
                                                    I
                                                    I
                                                    I
             90                                     I              92              61
                                                    +              9193
                                                    I
                                                    I                     95
                                                    I               66
                                                    I               87    979839
                                                   +75          AJA1
                                                    I       41
             54                           65 135           99
                                       597+  183  5142     12
                                        7072 I  8455  50    8210
- - + - - - + - - - - - -60 - - - + - - -60 + -76 - - +60 -6552 + - - - - + -3413 - + - - - - - + - - - +
            33                             73  I  454948              1116   2
                                      62   I   67  47          3
                         61       64       I                  533  13
          503979                     71  50                 9    14
                 77                                   +
             53  73                536319   21    2729   26
                 59                       20 I    26  50
                                          I22      23
        Figure 9                   32     1 I  31
                                          +    24
                                          I25
                                          I
                                          I
                                          I
```
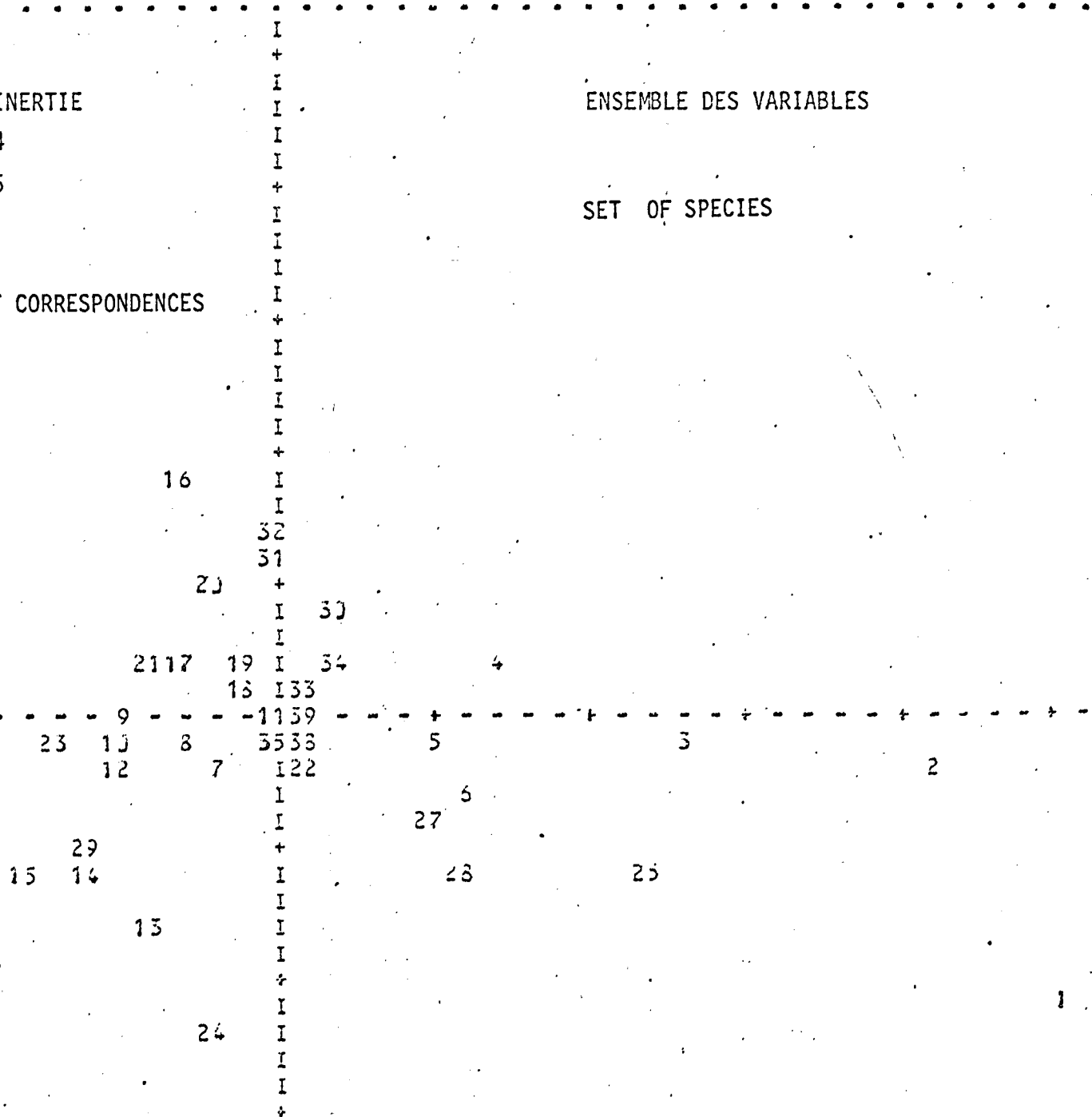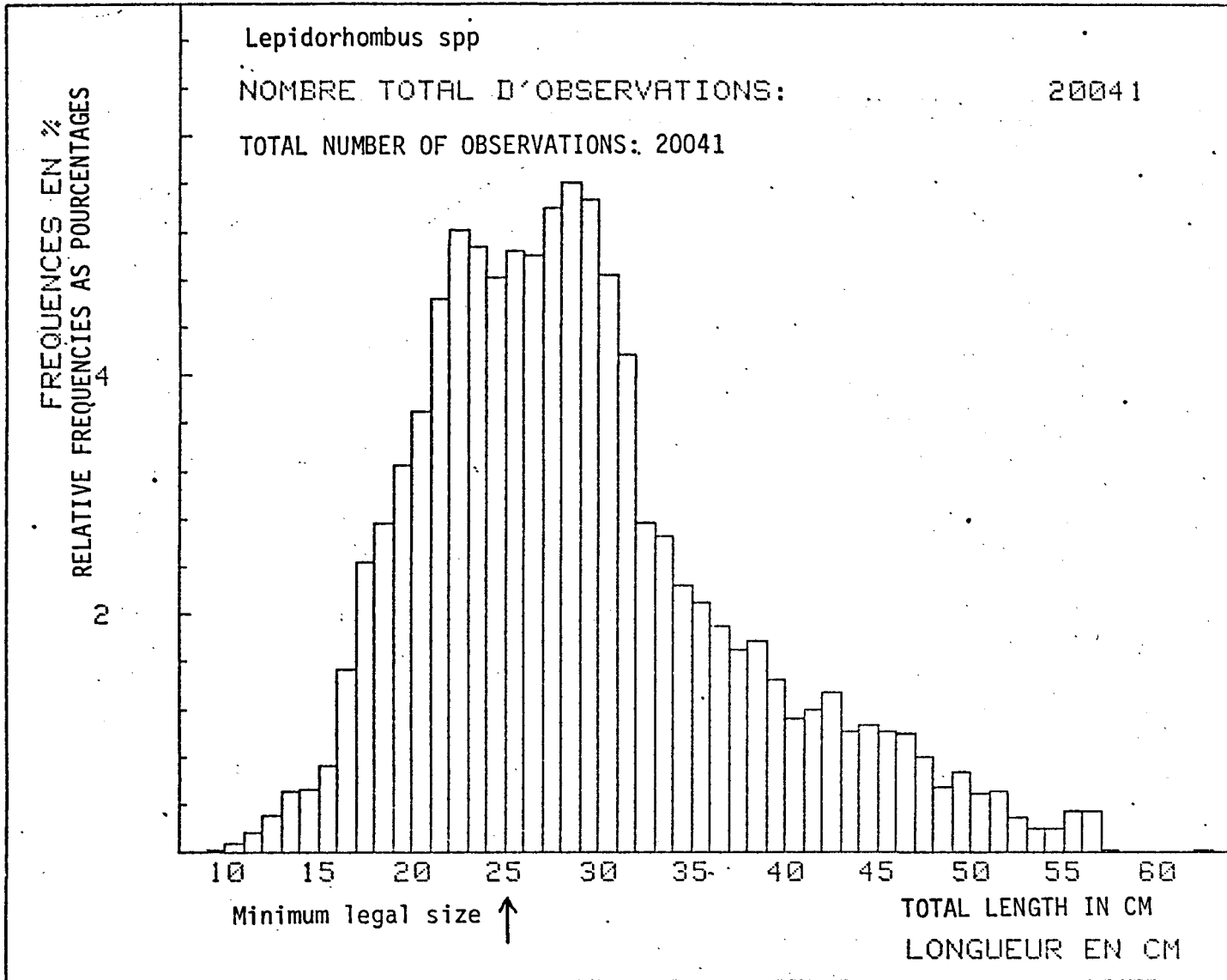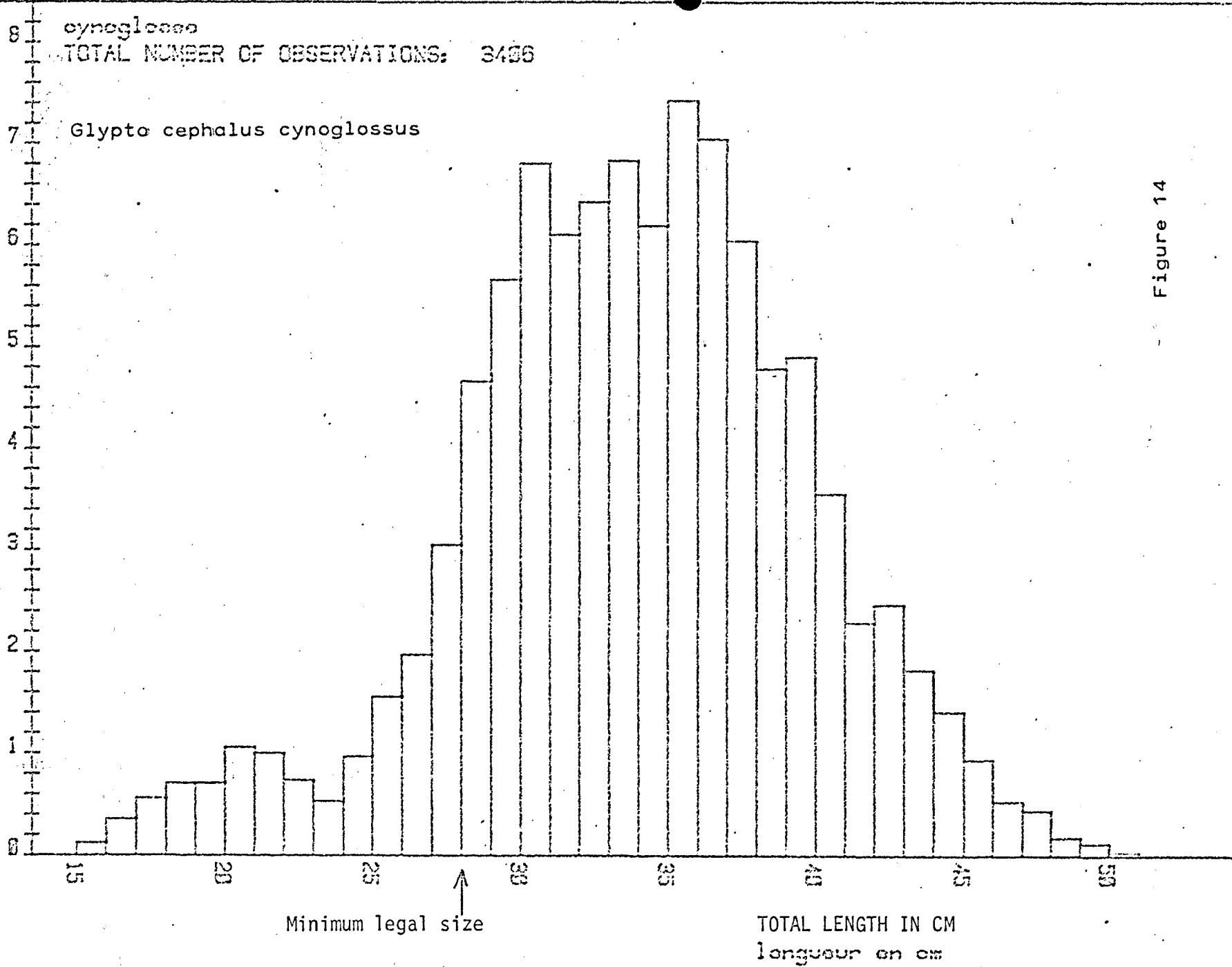
RESULTATS DE L'ANALYSE D'INERTIE

AXE DES X : 1

AXE DES Y : 3

ENSEMBLE DES VARIABLES

SET OF SPECIES

RESULTS OF THE ANALYSIS OF CORRESPONDENCES

Figure 10

RESULTATS DE L'ANALYSE D'INERTIE
        AXE DES X : 4
        AXE DES Y : 5

RESULTS OF THE ANALYSIS OF CORRESPONDENCES

ENSEMBLE DES OBSERVATIONS

SET OF STATIONS

Figure 11

RESULTATS DE L'ANALYSE D'INERTIE
AXE DES X : 4
AXE DES Y : 5

RESULTS OF THE ANALYSIS OF CORRESPONDENCES

ENSEMBLE DES VARIABLES

SET OF SPECIES

Figure 12
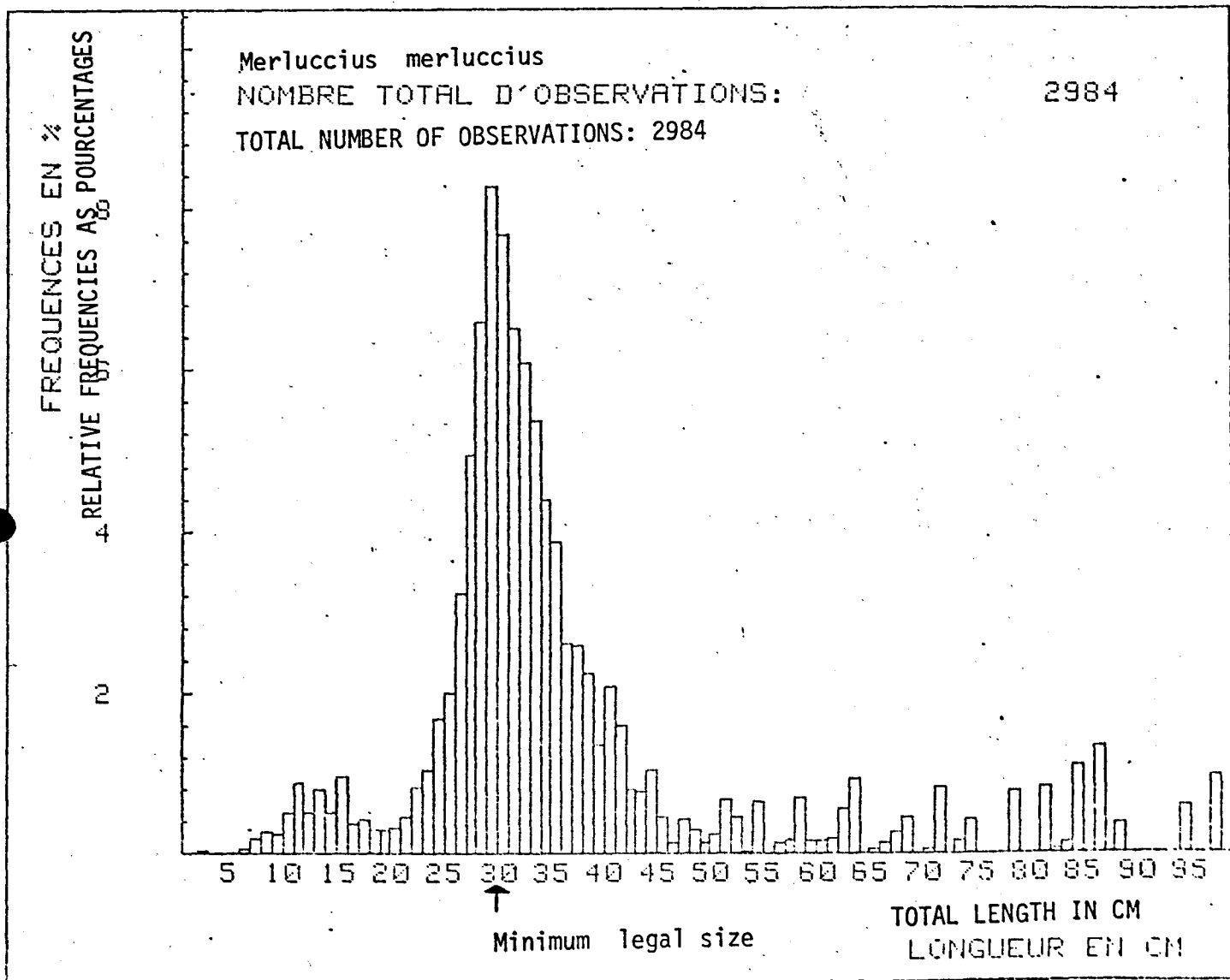
Lepidorhombus spp

NOMBRE TOTAL D'OBSERVATIONS: 20041

TOTAL NUMBER OF OBSERVATIONS: 20041

Minimum legal size

TOTAL LENGTH IN CM

LONGUEUR EN CM

FREQUENCES EN % RELATIVE FREQUENCIES AS POURCENTAGES
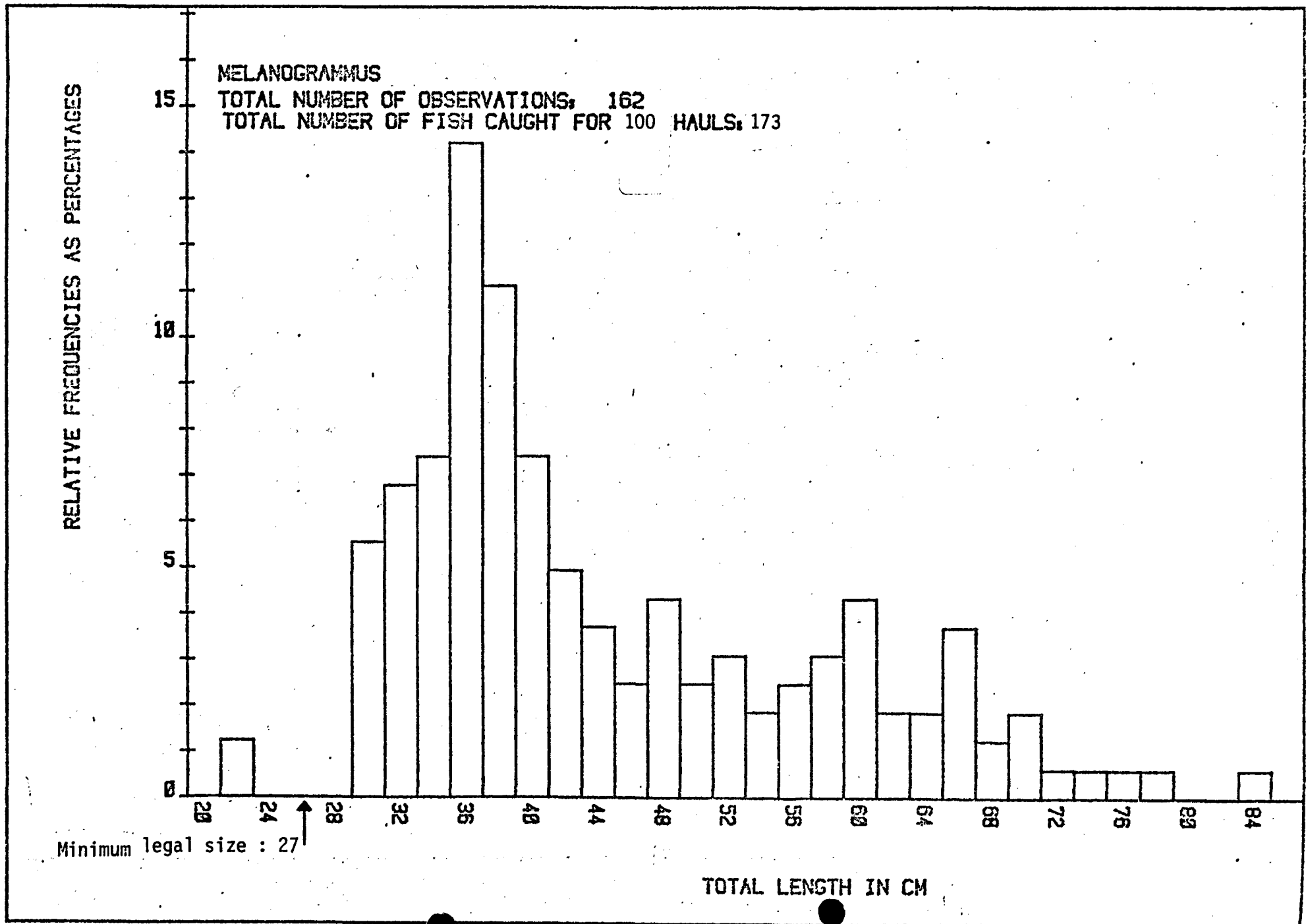
Figure 13

Figure 14

Figure 15

Figure 16

Figure 17

Figure 18

SOLEA
TOTAL NUMBER OF OBSERVATIONS: 118
TOTAL NUMBER OF FISH FOR 100 HAULS: 120
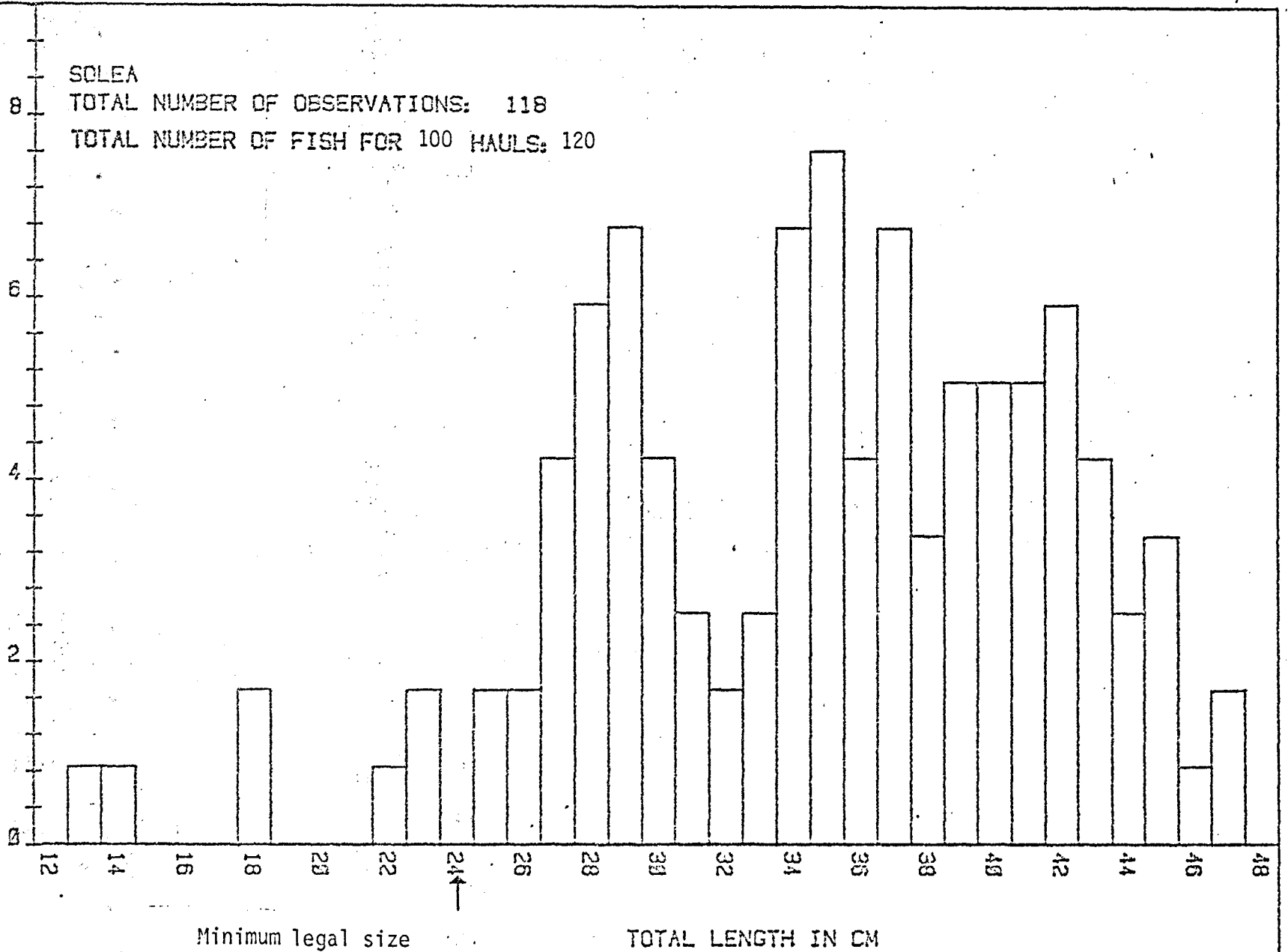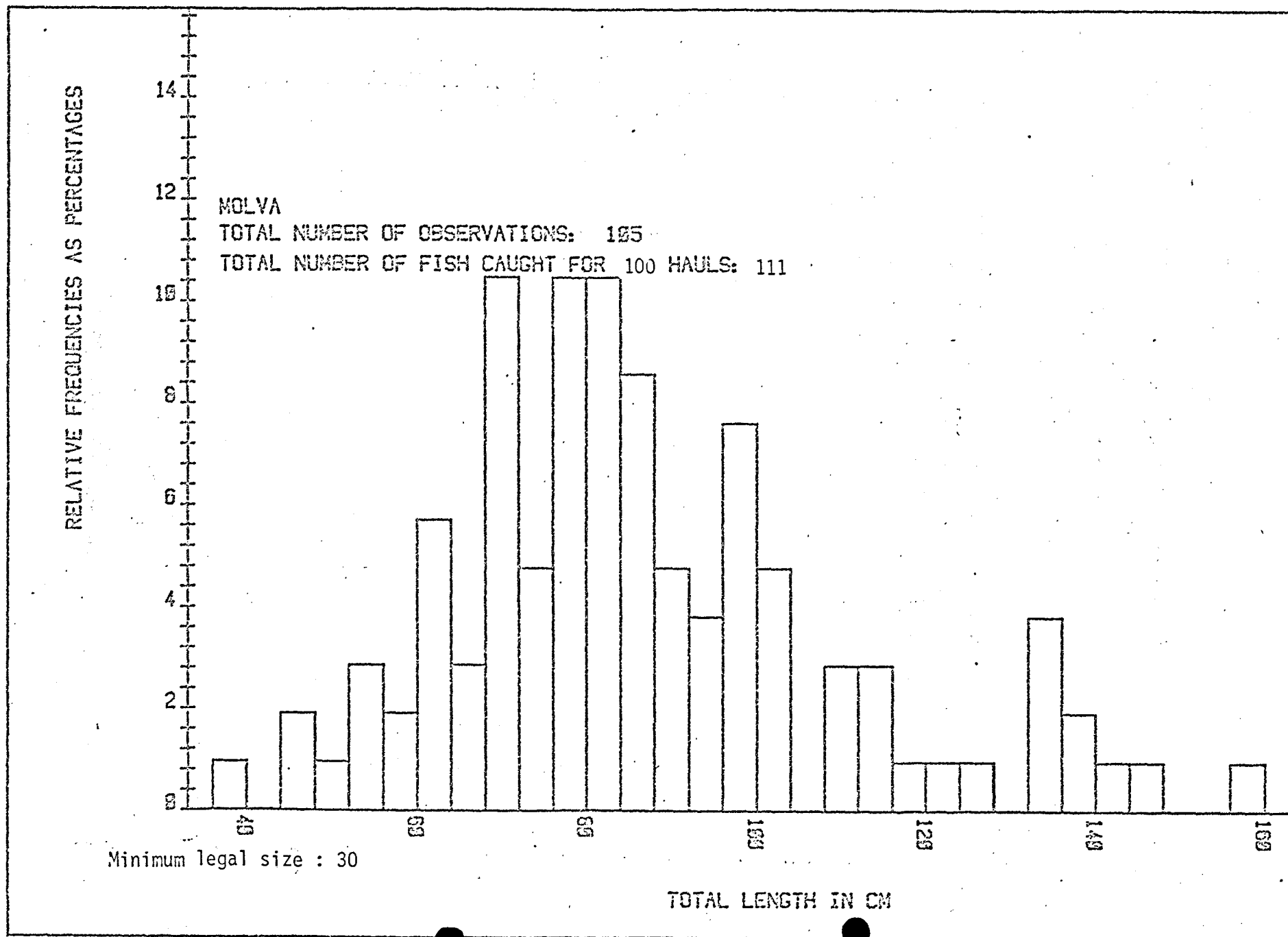
RELATIVE FREQUENCIES AS PERCENTAGES

Minimum legal size   TOTAL LENGTH IN CM

Figure 19

MOLVA
TOTAL NUMBER OF OBSERVATIONS: 185
TOTAL NUMBER OF FISH CAUGHT FOR 100 HAULS: 111

RELATIVE FREQUENCIES AS PERCENTAGES

TOTAL LENGTH IN CM

Minimum legal size : 30

Figure 20

Figure 21

Figure 22

CONGER CONGER
TOTAL NUMBER OF OBSERVATIONS: 17
TOTAL NUMBER OF FISH CAUGHT IN 100 HAULS: 27

RELATIVE FREQUENCIES AS PERCENTAGES
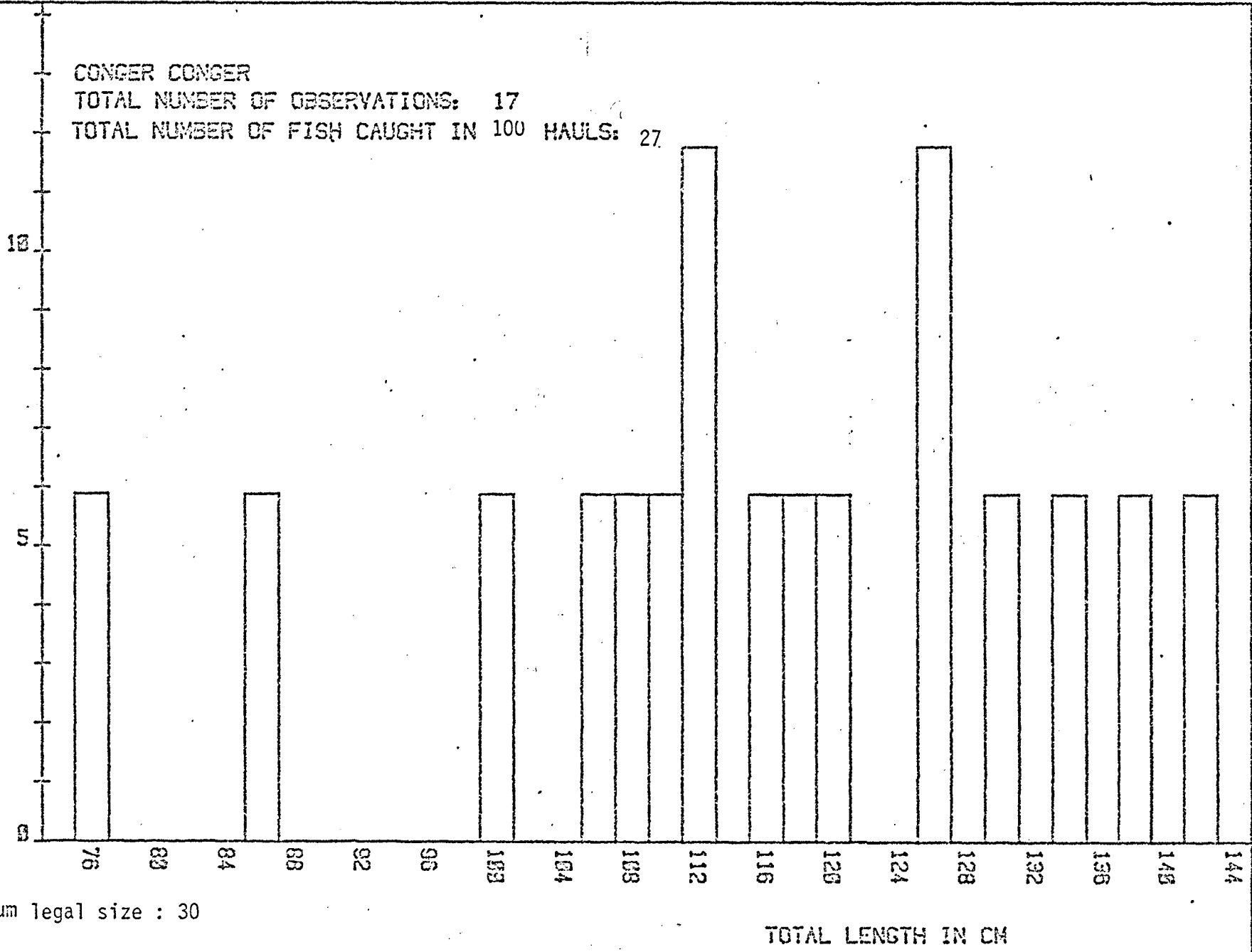
Minimum legal size : 30

TOTAL LENGTH IN CM

Figure 23