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Atlantic Cod Population Indices Obtained from the Spring Surveys Conducted by Spain in the
NAFO Regulatory Area of Divisions 3NO, 1995-2003

by

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Abstract

Since 1995, a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Div. 3NO was conducted by Spain. In 2001, the trawl vessel was replaced; so, the time series indices were transformed. The transformed entire series of mean catches, abundance, biomass and length distribution for Atlantic cod are presented for the period 1995-2000, and the no-transformed data for the years 2001-2003. The standard deviations are shown for abundance and biomass. In years 1998 and 2001 some extreme catches occurred, so we present the series with and without those data. The summed abundance and biomass based on conversion of the length frequencies are presented and compared to the estimates from the method used to convert the CPUE. The results are quite the same. The biomass presents a non-clear trend and the abundance an increasing since 1998 and a decreasing last year.

Material and Methods

Survey design and gear used

The surveys on NAFO Regulatory Area of Div. 3NO was initiated by Spain in 1995. Until 2001, the surveys was carried out in spring (May), on board the Spanish vessel *C/V Playa de Menduiña* (338 GT and 800 HP) using bottom trawl net type *Pedreira*. Since that year, the *R/V Vizconde de Eza* replaced the *C/V Playa de Menduíña* as the research vessel for the survey, using bottom trawl net type *Campelen*. The main specifications and geometry of these gears, as the rigging profile and the net plan, and a sheet with the resume of the main technical data of the survey are described in previous paper (Walsh *et. al.*, 2001). In the Table 1 are presented the number of valid tows, the depth strata covered and the dates of the survey series. In the period 1998-2003, the surveyed depth strata was the same (extended to 1464 m). The survey area was stratified following the standard stratification schemes (Bishop, 1994). Set number was allocated to strata proportionally to their size, with a minimum of two planned hauls per stratum and the trawl positions were chosen at random (Doubleday, 1981).

Biomass and abundance indices were calculated by the swept area method (Cochran, 1997), assuming catchability factor of 1.

The catch from each haul was sorted by species and weighted. Random samples of Atlantic cod were measured to the total length to the nearest lower cm**.** Length distribution estimated from catches is presented for the period 1995-2003.

R/V *Vizconde de Eza* had replaced C/V *Playa de Menduíña* in 2001 survey, so, in order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop factors between the two

fishing vessel and gear combinations. A series of 92 paired hauls was carried out, 90 of then were valid hauls. Mean catch, stratified mean catch, abundance, biomass and their respective standard deviations, and length distribution, were transformed from C/V *Playa de Menduíña* series to R/V *Vizconde de Eza* series.

Atlantic cod stratified mean catches and SD

The mean catch ($\bar{y}_i$) and the variance (Var_i) are calculated by stratum by the following formulas:

$$\bar{y}_i = \sum_{j=1}^{T_i} \frac{y_j}{T_i}, \quad i = 1,...,h$$

$$Var_i = \sum_{j=1}^{T_i} \frac{(y_j - \bar{y}_i)^2}{T_i - 1}, \quad i = 1,...,h$$

where: y_j is the catch in haul j

T_i is the number of hauls in the stratum i

h is the total number of strata

and the stratified mean catch ($\bar{y}_i^{str}$) and the stratified variance (Var_i^{str}) by stratum are obtained as follow:

$$\bar{y}_i^{str} = \bar{y}_i n_i, \quad i = 1,...,h$$

$$Var_i^{str} = Var_i \frac{n_i^2}{T_i}, \quad i = 1,...,h$$

where: n_i is the area of the stratum i , $i = 1,...,h$

Then the total stratified mean catch ($\bar{y}$) and the variance (Var) by year are calculated according to the formulas:

$$\bar{Y} = \sum_{i=1}^{h} \frac{\bar{y}_i^{str}}{N}$$

$$Var = \sum_{i=1}^{h} \frac{Var_i^{str}}{N^2}$$

where: $N = \sum_{i=1}^{h} n_i$ is the total area by year

The stratified standard deviation (SD) by year is calculated as the square root of the stratified variance by year.

Conversion factors

To convert data series it was necessary to calculated the factor power correction (FPC), typically estimated by use of catch per unit of effort (CPUE) observations for the two vessels. In this case, a multiplicative model solved by generalized method by haul was adjusted to convert mean catch, abundance and biomass. Although there are many models to convert the CPUE, we choose one of them that has less error (Wilderbuer *et al.*, 1998, González Troncoso and Paz, 2003).

Robson (1966) proposed the following multiplicative model to establish the relationship between the CPUEs for the two ships:

$$CPUE_{ij} = e^{\mu + t_i + h_j + \varepsilon_{ij}}$$

where: t_i is the effect of the ship i, $i = 1, 2$

h_j is the effect of the haul j, $j = 1,...,90$

μ is the model parameter

ε is the model error

A logarithmic transformation is performed in order to obtain a linear expression:

$$\ln(CPUE_{ij}) = \mu + t_i + h_j + \varepsilon_{ij}$$

This equation was adjusted by generalized linear regression assuming the following restriction necessary to estimate all parameters:

$$\sum_{i=1}^{2} t_i = 0 \Rightarrow t_1 = t = -t_2$$

giving the following estimation of the FPC (Sissenwine and Bowman, 1978):

$$\overline{FPC} = \frac{\overline{CPUE_2}}{\overline{CPUE_1}} = e^{2t(1+0.5s^2)} \tag{1}$$

where s^2 is the variance obtained in the estimate of t.

This model was applied to convert mean catches and biomass. To convert abundance, we used the same formula but with abundance per unit of effort, instead of CPUE. We use, in all cases, only the hauls in which both vessels had non cero catch.

In the other hand, to convert the length distribution, the following multiplicative model, proposed by Warren (1997) was adjusted:

$$Ratio = \alpha l^{\beta} e^{\delta l} \tag{2}$$

where: $Ratio = \dfrac{Campelen\ Catch}{Pedreira\ Catch}$ by length

l is the length

$\alpha, \beta\ and\ \delta$ are the estimated parameters.

For more details, see Paz *et al.* (2002).

We use, in all cases, only the hauls in which both vessels had non cero catch.

Following the recommendations of the 2003 Scientific Council Meeting, abundance and biomass were obtained from the two methods and compared. For obtained the biomass from the length distribution, we use the following formula:

$$W = a(l + 0.5)^b N$$

where:
$W = weight$
$l = length$
$N = number$

Data series

For 1995-2000, transformed C/V *Playa de Menduíña* data series are presented. For 2002 and 2003, original R/V *Vizconde de Eza* data series are presented. In 2001, the deeper strata was not surveyed by the calibration experience. As the objective is to have data in all the strata surveyed last years, to obtained the more annual homogeneity possible in the series, in the no surveyed strata by the R/V *Vizconde de Eza* the transformed C/V *Playa de Menduíña* data are put. This was made to mean catch, stratified mean catch, abundance and biomass. In this way, in the strata surveyed the original R/V *Vizconde de Eza* data are presented and in the strata not surveyed the transformed C/V *Playa de Menduíña* are offered.

The method to convert the indices from the length distribution has some problems: no accurate variance and, as the fit is very poor in the extreme data, we must apply another parameters for the extreme lengths, and the cut points are choosing without objective criterion. Because of that, we do not consider this method the best one for estimating the indices.

Outliers

In 1998, a 8 tonnes catch occurs in the 724 stratum (C/V *Playa de Menduíña*), so the indices were calculated with that haul and without that haul. Quite the same occurs in 2001, when there were two hauls with catches of more than a tonne in 359 and 723 strata (R/V *Vizconde de Eza*). For identifying those outliers, we plot the Box Plot of de data. We present the indices with and without those two data.

In the other hand, when we adjust lengths, we find some outliers in the regression. In order to identifying those outliers, we used the Cook´s distance.

Results

Outliers

As we can see in the Fig. 1, in 1998 there is a clear extreme of 8 tonnes catch, corresponding 58th haul. And as we can see in Fig. 2, there are in 2001 two clear extremes of more than 1 tonne, corresponding 51th and 92th hauls. As in these years the biomass and abundance change drastically if we include those points or not, we decide to present the series with and without them. The extreme data are showing in Table 2.

In Table 3 and in Fig. 3 we can see the outliers of the length adjust. We eliminated of the regret the 109 and 17 lengths, that are the most outliers.

Atlantic cod Mean Catches

To convert mean catches, the CPUE was adjusted in model (1), giving the FPC_{bio} =0.34992321.

The Atlantic cod mean catches by stratum are presented in Table 4, included swept area, number of hauls and SD. Atlantic cod stratified mean catches and their SD are presented in Table 5 with and without outliers. Data from year 1995 are added, although in that year a few sets were made, so it is not representative. In Fig. 4 we present the data with all the hauls, and in Fig. 5 without the outliers in years 1998 and 2001. The Atlantic cod indices show a non-clear trend. The results are very sensitive to the highest catch values corresponding to a few hauls.

Atlantic cod Biomass

The entire time series (1995-2003) of biomass and their SD estimates of Atlantic cod are presented (updated and converted) in Table 6. For years 1998 and 2001, the data are presented with and without outliers. In Fig. 6 we present the data with all the strata, and in Fig. 7 without the outliers. The Atlantic cod indices show a non-clear trend.

To convert biomass, the CPUE was adjusted in model (1), giving the $\widehat{FPC}_{bio}$ =0.34992321. Besides the transformed biomass series, we present the biomass obtained from the length distribution. Parameters a and b are presented in Table 7, and in Table 6 we present the comparison between the two indices. The trend in both cases is the same (Fig. 8), and the values are very near. In this figure, we present the data for 1998 and 2001 without outliers.

Atlantic cod Abundance

As in biomass, the entire time series (1995-2003) of abundance and their SD estimates of Atlantic cod are presented (updated and converted) in Table 8. For years 1998 and 2001, the data are presented without outliers, too. In Fig. 9 we present the data with all strata, and a non-clear trend is detected. Although, the same data without outliers (Fig. 10) show an increasing of the Atlantic cod abundance since 1998, and a decreasing in the last year.

To convert abundance, the abundance per unit of effort was adjusted in model (1), giving the $\widehat{FPC}_{ab}$ =0.29140936. Besides the transformed abundance series, we present the abundance obtained summing the transformed length distribution. In Table 8 we present the comparison between the two indices. The trend in both cases is the quite same (Fig. 11), and the values are very near. Besides this, in this figure we present the data for 1998 and 2001 without outliers.

Atlantic cod Length Distribution

The result of the model proposed by Warren (2) for Atlantic cod was the following:

$$Ln(Ratio) = \exp(-7.3358+2.1637\ln(l)-0.479l)$$

Fig. 12 shows the ratios and their fit. In this figure, we observed that, above 56 cm, the fit is very poor, so another conversion factor is applied for these values. Like the trend of the values between 56-79 and the values above 80 are opposite, we calculated a factor for every length stage. So, three length classes are formed as follow (cf = conversion factor):

For $\quad l \leq 55$: cf = $\exp(-7.3358+2.1637\ln(l)-0.479l)$
For $56 \leq l \leq 79$: cf = 0.555
For $\quad l \leq 80$: cf = 0.125

In Table 9 is shown Atlantic cod length distribution per thousand, besides the sampled size and its catch for the period 1995-2003. In Fig. 13 we can see the length distribution evolution along the years. The population structure shows a very deflected situation. The SSB (i.e., lengths greater than 45 cm.) appears very low.

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TABLE 1.- Spanish spring bottom trawl surveys on NAFO Div. 3NO: 1995-2003

Year	Vessel	Valid tows	Depth strata covered (m)	Dates
1995	C/V Playa de Menduíña	77	>56-731	May 18-May 29
1996	C/V Playa de Menduíña	112	>56-1098	May 07-May 24
1997	C/V Playa de Menduíña	128	>56-1280	April 26-May 18
1998	C/V Playa de Menduíña	124	>56-1464	May 06-May 26
1999	C/V Playa de Menduíña	114	>56-1464	May 07-May 26
2000	C/V Playa de Menduíña	118	>56-1464	May 07-May 28
2001	R/V Vizconde de Eza	90	>56-1116	May 05-May 23
2002	R/V Vizconde de Eza	125	>56-1464	April 29-May 19
2003	R/V Vizconde de Eza	118	>56-1464	May 11-Jun 02

TABLE 2.- Extreme Atlantic cod catches. Years 1998 and 2001.

Year	Haul	Stratum	Catch (kg)
1998	58	724	8502
2001	51	723	1335.3
2001	92	359	1159.3

TABLE 3.- 2001 outliers in Atlantic cod lengths adjust

Case	Length	Cook´s distance
69	109	0.577168
1	17	0.493887
3	20	0.134327
2	18	0.126575
64	89	0.118535
67	94	0.081086
66	91	0.069938
4	21	0.068793
51	70	0.052857
68	98	0.046151
44	61	0.044665
61	83	0.037350
49	67	0.024593
57	77	0.024419
55	74	0.018265

TABLE 4.- Swept area, number of hauls and Atlantic cod mean catch (Kg) and SD (**) by stratum. Spanish Spring Survey on NAFO Div. 3NO: 1995-2003. Swept area in square miles. n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data, and 2001-2003 data are original from R/V *Vizconde de Eza.* In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*.

Stratum	1995				1996				1997			
	Swept area	Tow number	A. cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD
353	0.0353	3	0.00	0.000	0.0371	3	0.07	0.121	0.0480	4	0.00	0.000
354	0.0353	3	0.21	0.364	0.0319	3	2.59	3.231	0.0233	2	0.00	0.000
355	n.s.	n.s.	n.s.	n.s.	0.0221	2	4.02	1.670	0.0233	2	4.29	5.711
356	n.s.	n.s.	n.s.	n.s.	0.0203	2	3.66	2.697	0.0225	2	7.80	0.495
357	0.0109	1	2.50	-	0.0218	2	7.50	8.920	0.0443	4	91.55	174.202
358	0.0319	3	94.95	143.868	0.0319	3	11.33	6.501	0.0563	5	1.77	1.655
359	0.0345	3	0.00	0.000	0.0548	5	0.10	0.163	0.0690	6	1.13	2.385
360	0.3563	31	0.18	0.271	0.3761	31	3.50	14.209	0.3754	32	0.11	0.226
374	0.0225	2	0.04	0.062	0.0233	2	0.09	0.124	0.0353	3	0.06	0.099
375	0.0225	2	0.00	0.000	0.0229	2	0.16	0.223	0.0116	1	0.00	-
376	0.1729	15	0.13	0.216	0.1650	14	0.32	0.445	0.1583	14	0.00	0.000
377	0.0221	2	0.00	0.000	0.0229	2	1.78	0.445	0.0116	1	0.27	-
378	0.0435	4	5.42	4.209	0.0330	3	11.89	14.076	0.0210	2	2.34	3.316
379	0.0221	2	18.63	2.845	0.0113	1	6.96	-	0.0206	2	3.68	0.307
380	n.s.	n.s.	n.s.	n.s.	0.0221	2	1.50	0.445	0.0210	2	0.36	0.515
381	n.s.	n.s.	n.s.	n.s.	0.0229	2	1.17	0.173	0.0221	2	0.07	0.099
382	n.s.	n.s.	n.s.	n.s.	0.0338	3	0.87	1.424	0.0461	4	0.00	0.000
721	n.s.	n.s.	n.s.	n.s.	0.0214	2	6.83	3.204	0.0221	2	20.98	7.052
722	n.s.	n.s.	n.s.	n.s.	0.0206	2	64.82	91.674	0.0214	2	0.31	0.139
723	n.s.	n.s.	n.s.	n.s.	0.0109	1	9.62	-	0.0210	2	9.90	2.425
724	0.0105	1	0.00	-	0.0203	2	0.94	0.445	0.0225	2	1.30	1.269
725	0.0334	3	16.66	23.998	0.0225	2	33.41	6.421	0.0206	2	23.50	17.734
726	0.0214	2	0.17	0.247	0.0218	2	25.83	34.084	n.s.	n.s.	n.s.	n.s.
727	n.s.	n.s.	n.s.	n.s.	0.0210	2	3.53	1.794	0.0094	1	0.12	-
728	n.s.	n.s.	n.s.	n.s.	0.0218	2	44.79	63.343	0.0214	2	1.17	0.569
752	n.s.	n.s.	n.s.	n.s.	0.0109	1	0.00	-	0.0218	2	0.00	0.000
753	n.s.	n.s.	n.s.	n.s.	0.0199	2	0.00	0.000	0.0214	2	0.00	0.000
754	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.0330	3	0.00	0.000
755	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
756	n.s.	n.s.	n.s.	n.s.	0.0210	2	0.44	0.171	0.0109	1	0.00	-
757	n.s.	n.s.	n.s.	n.s.	0.0188	2	0.00	0.000	0.0304	3	0.00	0.000
758	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.0214	2	0.00	0.000
759	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
760	n.s.	n.s.	n.s.	n.s.	0.0210	2	0.00	0.000	0.0105	1	0.00	-
761	n.s.	n.s.	n.s.	n.s.	0.0199	2	0.00	0.000	0.0315	3	0.00	0.000
762	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.0308	3	0.00	0.000
763	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
764	n.s.	n.s.	n.s.	n.s.	0.0210	2	0.00	0.000	0.0206	2	0.00	0.000
765	n.s.	n.s.	n.s.	n.s.	0.0199	2	0.00	0.000	0.0206	2	0.00	0.000
766	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.0308	3	0.00	0.000
767	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

$$(**)\,SD = \frac{\sum (x_i - \bar{x})}{n-1}$$

TABLE 4 (cont.).- Swept area, number of hauls and Atlantic cod mean catch (Kg) and SD (**) by stratum. Spanish Spring Survey on NAFO Div. 3NO: 1995-2003. Swept area in square miles. n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data, and 2001-2003 data are original from R/V *Vizconde de Eza*. In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*.

Stratum	1998				1999				2000			
	Swept area	Tow number	A. Cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD
353	0.0465	4	0.00	0.004	0.0360	3	6.26	8.593	0.0356	3	8.59	9.984
354	0.0356	3	17.67	29.046	0.0218	2	4.92	3.192	0.0356	3	18.44	27.099
355	0.0221	2	27.05	3.662	0.0229	2	6.39	2.549	0.0233	2	94.83	76.209
356	0.0221	2	6.23	0.247	0.0229	2	41.19	0.346	0.0225	2	16.34	17.172
357	0.0240	2	7.45	0.742	0.0236	2	10.12	11.461	0.0124	1	9.15	-
358	0.0236	3	4.46	4.030	0.0349	3	9.98	4.006	0.0341	3	184.88	194.829
359	0.0698	6	0.39	0.858	0.0364	3	7.25	11.394	0.0469	4	18.26	17.367
360	0.2561	25	0.22	0.700	0.2325	19	2.33	3.801	0.2396	20	2.16	3.561
374	0.0353	3	0.00	0.000	0.0244	2	0.58	0.594	0.0240	2	0.00	0.000
375	0.0345	3	0.78	0.403	0.0236	2	0.97	0.579	0.0244	2	0.00	0.000
376	0.0930	10	0.20	0.187	0.1219	10	0.62	0.545	0.1200	10	0.90	1.852
377	0.0229	2	1.89	2.375	0.0240	2	0.21	0.302	0.0229	2	0.02	0.027
378	0.0120	2	3.46	0.940	0.0229	2	7.76	5.951	0.0233	2	10.65	11.169
379	0.0356	3	8.30	5.847	0.0236	2	5.22	4.147	0.0225	2	41.12	54.683
380	0.0113	2	2.33	1.361	0.0236	2	38.58	48.720	0.0236	2	8.21	3.236
381	0.0229	2	0.21	0.187	0.0229	2	0.87	0.388	0.0236	2	1.74	0.730
382	0.0229	3	0.32	0.336	0.0484	4	0.05	0.036	0.0499	4	0.71	0.561
721	0.0203	2	0.61	0.866	0.0244	2	88.29	106.743	0.0236	2	28.34	17.122
722	0.0101	2	0.00	0.000	0.0229	2	0.00	0.000	0.0218	2	0.90	1.277
723	0.0233	2	4.39	3.736	0.0229	2	16.87	20.735	0.0248	2	22.02	12.010
724	0.0206	2	1488.84	2101.820	0.0225	2	0.02	0.032	0.0233	2	0.70	0.341
725	0.0086	1	30.86	-	0.0229	2	13.65	19.102	0.0210	2	4.34	3.857
726	0.0094	2	4.74	5.617	0.0225	2	0.81	0.492	0.0221	2	8.85	12.221
727	0.0233	2	2.66	2.821	0.0236	2	9.20	4.701	0.0210	2	9.16	10.803
728	0.0206	2	1.54	2.177	0.0233	2	0.00	0.000	0.0210	2	0.90	1.267
752	0.0229	2	0.00	0.000	0.0233	2	0.00	0.000	0.0206	2	0.00	0.000
753	0.0218	2	0.00	0.000	0.0229	2	0.00	0.000	0.0218	2	0.00	0.000
754	0.0210	2	0.00	0.000	0.0206	2	0.00	0.000	0.0195	2	0.00	0.000
755	0.0206	2	0.00	0.000	0.0311	3	0.00	0.000	0.0431	4	0.00	0.000
756	0.0225	2	0.32	0.449	0.0225	2	0.24	0.334	0.0203	2	0.36	0.257
757	0.0206	2	0.00	0.000	0.0233	2	0.00	0.000	0.0214	2	0.00	0.000
758	0.0105	2	0.00	0.000	0.0214	2	0.00	0.000	0.0210	2	0.00	0.000
759	0.0214	2	0.00	0.000	0.0218	2	0.00	0.000	0.0210	2	0.00	0.000
760	0.0214	2	0.00	0.000	0.0225	2	0.00	0.000	0.0210	2	0.00	0.000
761	0.0206	2	0.00	0.000	0.0210	2	0.00	0.000	0.0221	2	0.00	0.000
762	0.0094	2	0.00	0.000	0.0210	2	0.00	0.000	0.0203	2	0.00	0.000
763	0.0218	2	0.00	0.000	0.0311	3	0.00	0.000	0.0416	4	1.08	2.170
764	0.0218	2	0.00	0.000	0.0225	2	0.00	0.000	0.0218	2	0.00	0.000
765	0.0098	2	0.00	0.000	0.0221	2	0.00	0.000	0.0203	2	0.00	0.000
766	0.0191	2	0.00	0.000	0.0218	2	0.00	0.000	0.0214	2	0.00	0.000
767	0.0109	2	0.00	0.000	0.0214	2	0.00	0.000	0.0210	2	0.00	0.000

$$(**) \, SD = \frac{\sum (x_i - \bar{x})}{n-1}$$

TABLE 4 (cont.).- Swept area, number of hauls and Atlantic cod mean catch (Kg) and SD (**) by stratum. Spanish Spring Survey on NAFO Div. 3NO: 1995-2003. Swept area in square miles. n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data, and 2001-2003 data are original from R/V *Vizconde de Eza*. In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*.

Stratum	2001				2002				2003			
	Swept area	Tow number	A. Cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD	Swept area	Tow number	A. Cod Mean catch	A. Cod SD
353	0.0341	3	7.33	8.145	0.0476	4	0.00	0.003	0.0334	3	0.00	0.000
354	0.0338	3	16.07	3.315	0.0356	3	0.01	0.012	0.0338	3	7.63	13.221
355	0.0240	2	56.11	64.898	0.0236	2	0.96	0.370	0.0229	2	3.02	2.390
356	0.0240	2	149.60	76.650	0.0233	2	15.20	10.889	0.0225	2	15.61	1.605
357	0.0244	2	27.20	36.062	0.0240	2	6.65	1.909	0.0229	2	5.28	7.460
358	0.0345	3	3.42	2.592	0.0345	3	2.63	1.429	0.0338	3	207.22	260.186
359	0.0803	7	176.35	433.935	0.0686	6	2.72	3.436	0.0791	7	1.03	1.522
360	0.2423	20	11.36	27.470	0.2865	25	0.82	2.887	0.2254	20	1.14	2.952
374	0.0240	2	0.00	0.000	0.0345	3	0.00	0.000	0.0225	2	0.00	0.000
375	0.0338	3	0.00	0.000	0.0353	3	0.47	0.503	0.0330	3	0.48	0.826
376	0.1155	10	0.04	0.119	0.1140	10	0.00	0.000	0.1125	10	0.65	1.987
377	0.0229	2	0.00	0.000	0.0229	2	0.00	0.000	0.0225	2	1.25	1.768
378	0.0236	2	11.98	15.726	0.0233	2	1.45	2.051	0.0225	2	19.18	19.141
379	0.0229	2	9.54	9.001	0.0229	2	24.83	32.492	0.0229	2	4.35	0.481
380	0.0206	2	(*) 6.00	(*) 2.895	0.0225	2	0.31	0.035	0.0229	2	1.09	0.976
381	0.0236	2	(*) 0.66	(*) 0.891	0.0229	2	0.04	0.057	0.0229	2	0.00	0.000
382	0.0469	4	(*) 0.12	(*) 0.145	0.0341	3	0.04	0.076	0.0454	4	0.00	0.000
721	0.0248	2	4.85	6.859	0.0233	2	1.01	1.430	0.0225	2	9.40	13.287
722	0.0233	2	0.00	0.000	0.0236	2	0.00	0.000	0.0221	2	1.73	2.447
723	0.0240	2	676.15	932.179	0.0233	2	55.60	69.155	0.0229	2	0.65	0.919
724	0.0353	3	6.16	10.254	0.0225	2	49.80	70.428	0.0225	2	10.46	14.786
725	0.0116	1	54.70	-	0.0225	2	9.25	7.849	0.0229	2	2.17	3.062
726	0.0116	1	0.00	-	0.0214	2	1122.95	1569.289	0.0225	2	0.00	0.000
727	0.0225	2	(*) 10.40	(*) 4.810	0.0233	2	2.80	3.960	0.0218	2	7.45	9.405
728	0.0229	2	(*) 0.00	(*) 0.000	0.0229	2	21.40	30.264	0.0225	2	0.00	0.000
752	0.0210	2	(*) 0.00	(*) 0.000	0.0116	1	0.00	0.000	0.0229	2	0.00	0.000
753	0.0214	2	(*) 0.00	(*) 0.000	0.0229	2	0.00	0.000	0.0229	2	0.00	0.000
754	0.0195	2	(*) 0.00	(*) 0.000	0.0341	3	0.00	0.000	0.0218	2	0.00	0.000
755	0.0416	4	(*) 0.00	(*) 0.000	0.0338	3	0.00	0.000	0.0221	2	0.00	0.000
756	0.0113	1	0.08	-	0.0229	2	0.00	0.000	0.0221	2	0.00	0.000
757	0.0233	2	(*) 0.00	(*) 0.000	0.0225	2	64.40	91.075	0.0221	2	0.00	0.000
758	0.0218	2	(*) 0.00	(*) 0.000	0.0225	2	2.80	3.960	0.0221	2	0.00	0.000
759	0.0221	2	(*) 0.00	(*) 0.000	0.0225	2	0.00	0.000	0.0113	1	0.00	-
760	0.0229	2	0.00	0.000	0.0229	2	0.00	0.000	0.0218	2	0.00	0.000
761	0.0225	2	0.00	0.000	0.0225	2	0.17	0.236	0.0225	2	0.00	0.000
762	0.0116	1	0.00	-	0.0225	2	0.15	0.212	0.0225	2	0.00	0.000
763	0.0330	3	(*) 0.00	(*) 0.000	0.0225	2	0.00	0.000	0.0311	3	0.00	0.000
764	0.0240	2	0.00	0.000	0.0236	2	0.00	0.000	0.0221	2	0.00	0.000
765	0.0113	1	0.00	-	0.0236	2	0.00	0.000	0.0113	1	0.00	-
766	0.0203	2	(*) 0.00	(*) 0.000	0.0233	2	0.00	0.000	0.0225	2	0.00	0.000
767	0.0218	2	(*) 0.00	(*) 0.000	0.0225	2	0.00	0.000	0.0229	2	0.00	0.000

$$(**) SD = \frac{\sum (x_i - \bar{x})}{n-1}$$

TABLE 5.- Stratified mean catches (Kg) by stratum and year and SD by year of Atlantic cod (1995-2003). n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data (by FPC). 2001-2003 data are original from R/V *Vizconde de Eza*. In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*, and (**) represent the original results of *R/V Vizconde de Eza* without the *C/V Playa de Menduíña* data.

Strata	1995	1996	1997	1998	1999	2000	2001	2002	2003
353	0.00	18.83	0.00	0.59	1684.29	2310.56	1972.67	0.40	0.00
354	51.65	0.01	0.00	4347.10	1209.44	4536.47	3954.04	1.64	1877.80
355	n.s.	0.05	317.46	2001.63	472.57	7017.36	4152.14	71.15	223.48
356	n.s.	0.08	366.75	292.75	1935.74	768.05	7031.20	714.40	733.44
357	410.32	1229.53	15014.55	1222.35	1659.07	1500.68	4460.80	1090.60	865.10
358	21364.12	2548.32	397.76	1002.53	2246.51	41597.12	768.75	592.50	46625.25
359	0.00	41.25	473.87	164.50	3052.91	7687.04	74245.15	1146.52	435.31
360	502.94	9733.65	301.58	616.24	6478.57	6017.33	31605.14	2283.17	3169.28
374	9.36	18.72	12.23	0.00	124.31	0.00	0.00	0.00	0.00
375	0.00	42.67	0.00	211.79	261.73	0.00	0.00	126.47	129.18
376	176.14	426.79	0.00	263.27	822.50	1202.94	50.03	0.00	864.70
377	0.00	178.46	26.59	188.96	21.35	1.92	0.00	0.00	125.00
378	753.79	1652.93	325.88	481.53	1078.58	1480.09	1665.22	201.55	2665.33
379	1975.14	738.13	390.21	880.31	553.41	4358.29	1010.71	2631.45	461.10
380	n.s.	144.45	34.94	223.39	3703.59	788.08	(*) 576	30.19	104.64
381	n.s.	168.80	10.08	30.36	125.22	250.68	(*) 96	5.76	0.00
382	n.s.	300.06	0.00	108.42	18.00	243.65	(*) 41	14.98	0.00
721	n.s.	444.10	1363.56	39.80	5738.57	1842.35	315.25	65.75	610.68
722	n.s.	5445.16	26.16	0.00	0.00	75.84	0.00	0.00	145.32
723	n.s.	1491.55	1534.94	680.69	2614.28	3413.20	104803.25	8618.00	100.75
724	0.00	117.15	161.20	184615.64	2.82	87.21	764.25	6175.20	1296.42
725	0.16	3507.94	2467.77	3240.64	1432.94	455.78	5743.50	971.25	227.33
726	12.60	1859.98	n.s	341.39	58.07	637.55	0.00	80852.04	0.00
727	n.s.	338.45	11.42	255.30	883.49	879.12	(*) 998	268.80	715.20
728	n.s.	89.58	91.43	120.09	0.00	69.87	(*) 0.00	1669.20	0.00
752	n.s.	0.00	0.00	0.00	0.00	0.00	(*) 0.00	0.00	0.00
753	n.s.	0.00	0.00	0.00	0.00	0.00	(*) 0.00	0.00	0.00
754	n.s.	n.s.	0.00	0.00	0.00	0.00	(*) 0.00	0.00	0.00
755	n.s.	n.s.	n.s	0.00	0.00	0.00	(*) 0.00	0.00	0.00
756	n.s.	44.35	0.00	32.07	23.86	36.40	585.80	0.00	0.00
757	n.s.	0.00	0.00	0.00	0.00	0.00	(*) 0.00	6568.80	0.00
758	n.s.	n.s.	0.00	0.00	0.00	0.00	(*) 0.00	277.20	0.00
759	n.s.	n.s.	n.s	0.00	0.00	0.00	(*) 0.00	0.00	0.00
760	n.s.	0.00	0.00	0.00	0.00	0.00	5821.20	0.00	0.00
761	n.s.	0.00	0.00	0.00	0.00	0.00	41.90	28.56	0.00
762	n.s.	n.s.	0.00	0.00	0.00	0.00	0.00	31.80	0.00
763	n.s.	n.s.	n.s	0.00	0.00	283.12	(*) 0.00	0.00	0.00
764	n.s.	0.00	0.00	0.00	0.00	0.00	34.50	0.00	0.00
765	n.s.	0.00	0.00	0.00	0.00	0.00	12.40	0.00	0.00
766	n.s.	n.s.	0.00	0.00	0.00	0.00	(*) 0.00	0.00	0.00
767	n.s.	n.s.	n.s	0.00	0.00	0.00	(*) 0.00	0.00	0.00
TOTAL	25256.22	30580.97	23328.40	201361.35	36201.79	87540.73	250748.89	114437.38	61375.29
							(**) 249037.89		
$(\overline{Y})$	3.84	3.48	2.50	19.47	3.50	8.46	24.25	11.07	5.93
							(**) 24.08		
S.D.	2.85	1.13	1.54	17.82	0.75	2.58	12.05	7.82	3.29

$(\overline{Y})$ Without outliers				1.63			3.31		
S.D. Without outiers				0.41			0.63		

TABLE 6.- Survey estimates (by the swept area method) of Atlantic cod biomass (t) and SD by stratum and year on NAFO Div. 3NO. n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data. 2001-2003 data are original from R/V *Vizconde de Eza*. In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*, and (**) represent the original results of *R/V Vizconde de Eza* without the *C/V Playa de Menduíña* data. The last row presents the biomass obtained from the length distribution.

Strata	1995	1996	1997	1998	1999	2000	2001	2002	2003
353	0	2	0	0	140	195	173	0	0
354	4	60	0	366	111	382	351	0	167
355	n.s.	27	27	181	41	604	346	6	20
356	n.s.	17	33	26	169	68	586	61	65
357	38	113	1357	102	140	121	366	91	76
358	2011	240	35	86	194	3657	67	52	4144
359	0	4	41	14	252	656	6476	100	39
360	44	802	26	53	529	502	2609	199	281
374	1	2	1	0	10	0	0	0	0
375	0	4	0	18	22	0	0	11	12
376	15	36	0	23	67	100	4	0	77
377	0	16	2	17	2	0	0	0	11
378	69	150	31	41	95	127	141	17	237
379	179	66	38	74	47	387	88	230	40
380	n.s.	13	3	20	314	67	(*) 56	3	9
381	n.s.	15	1	3	11	21	(*) 8	1	0
382	n.s.	27	0	10	1	20	(*) 4	1	0
721	n.s.	42	123	4	471	156	25	6	54
722	n.s.	528	2	0	0	7	0	0	13
723	n.s.	137	146	59	229	276	8734	741	9
724	0	12	14	17902	0	8	65	549	115
725	157	312	239	376	125	43	494	86	20
726	1	171	n.s.	33	5	58	0	7565	0
727	n.s.	32	1	22	75	84	(*) 89	23	66
728	n.s.	321	9	12	0	7	(*) 0	146	0
752	n.s.	0	0	0	0	0	(*) 0	0	0
753	n.s.	0	0	0	0	0	(*) 0	0	0
754	n.s.	n.s.	0	0	0	0	(*) 0	0	0
755	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
756	n.s.	4	0	3	2	4	1	0	0
757	n.s.	0	0	0	0	0	(*) 0	584	0
758	n.s.	n.s.	0	0	0	0	(*) 0	25	0
759	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
760	n.s.	0	0	0	0	0	0	0	0
761	n.s.	0	0	0	0	0	0	3	0
762	n.s.	n.s.	0	0	0	0	0	3	0
763	n.s.	n.s.	n.s.	0	0	27	(*) 0	0	0
764	n.s.	0	0	0	0	0	0	0	0
765	n.s.	0	0	0	0	0	0	0	0
766	n.s.	n.s.	0	0	0	0	(*) 0	0	0
767	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
TOTAL	2519	3151	2131	19444	3054	7576	20698 (**) 20528	10502	5455
S.D.	1787	889	1322	18206	655	2566	10596	7971	3016
Warren Method	2352	4715	3017	24781	4026	7160	24931	10191	5368
TOTAL without outliers				1573			5996		
S.D. without outliers				391			1492		

TABLE 7. Length weight relationships in the calculation of Atlantic cod biomass. The equation is $Weight = a(l+0.5)^b$
Spanish Spring Surveys on NAFO Div. 3NO: 1995-2003.

	1995	1996	1997	1998	1999	2000	2001	2002	2003
a	0.0131	0.0055	0.0102	0.0061	0.0048	0.0060	0.0048	0.0057	0.0046
	Error = 0.1241	Error = 0.117	Error = 0.2480	Error = 0.0748	Error = 0.0788	Error = 0.0706	Error = 0.0893	Error = 0.1025	Error = 0.0581
b	2.8547	3.0868	2.9387	3.0671	3.1313	3.0822	3.1198	3.0783	3.1370
	Error = 0.0338	Error = 0.0303	Error = 0.0629	Error = 0.0197	Error = 0.0203	Error = 0.0179	Error = 0.0228	Error = 0.0274	Error = 0.0153
	R^2 = 0.994	R^2 = 0.994	R^2 = 0.975	R2 = 0.997	R^2 = 0.997	R^2 = 0.997	R^2 = 0.996	R^2 = 0.995	R^2 = 0.998
	N = 192	N = 467	N = 431	N = 687	N = 430	N = 877	N = 488	N = 678	N = 516

TABLE 8.- Survey estimates (by the swept area method) of Atlantic cod abundance (,000) and SD by stratum and year on NAFO Div. 3NO. n.s. means stratum not surveyed. 1995-2000 data are transformed C/V *Playa de Menduíña* data. 2001-2003 data are original from R/V *Vizconde de Eza*. In 2001, (*) indicates transformed data from C/V *Playa de Menduíña*, and (**) represent the original results of *R/V Vizconde de Eza* without the *C/V Playa de Menduíña* data. The last row presents the biomass obtained from the length distribution.

Strata	1995	1996	1997	1998	1999	2000	2001	2002	2003
353	0	0	0	2	1338	123	102	6	0
354	0	106	0	217	409	272	343	8	22
355	n.s.	34	5	122	61	704	558	9	13
356	n.s.	24	16	14	110	65	3801	61	36
357	26	150	738	72	399	108	740	211	36
358	1520	246	29	56	417	3914	157	103	2507
359	0	0	4	5	448	385	5455	61	43
360	132	3459	30	30	1239	294	1078	156	457
374	0	0	2	0	38	0	0	0	0
375	0	0	0	14	40	0	0	15	8
376	18	0	0	26	296	144	0	0	36
377	0	22	3	13	8	1	0	0	9
378	130	250	42	40	174	124	800	29	618
379	336	91	39	58	129	379	343	760	65
380	n.s.	33	3	50	1344	449	(*) 328	21	118
381	n.s.	36	2	6	51	137	(*) 27	12	0
382	n.s.	56	0	6	8	106	(*) 11	10	0
721	n.s.	29	160	3	184	77	24	6	38
722	n.s.	347	3	0	0	5	0	0	11
723	n.s.	158	140	47	128	164	11336	692	7
724	0	13	14	9340	2	5	56	573	72
725	201	443	438	326	169	80	930	214	18
726	0	3205	n.s.	31	3	90	0	7749	0
727	n.s.	87	6	52	287	304	(*) 164	54	119
728	n.s.	491	5	10	0	2	(*) 0	300	0
752	n.s.	0	0	0	0	0	(*) 0	0	0
753	n.s.	0	0	0	0	0	(*) 0	0	0
754	n.s.	n.s.	0	0	0	0	(*) 0	0	0
755	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
756	n.s.	4	0	3	0	3	0	0	0
757	n.s.	0	0	0	0	0	(*) 0	639	0
758	n.s.	n.s.	0	0	0	0	(*) 0	44	0
759	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
760	n.s.	0	0	0	0	0	0	0	0
761	n.s.	0	0	0	0	0	0	8	0
762	n.s.	n.s.	0	0	0	0	0	9	0
763	n.s.	n.s.	n.s.	0	0	35	(*) 0	0	0
764	n.s.	0	0	0	0	0	0	0	0
765	n.s.	0	0	0	0	0	0	0	0
766	n.s.	n.s.	0	0	0	0	(*) 0	0	0
767	n.s.	n.s.	n.s.	0	0	0	(*) 0	0	0
TOTAL	2364	9284	1679	10541	7284	7969	26254 (**) 25724	11749	4230
S.D.	1358	4097	727	9495	1941	3190	12806	8093	1922
Warren Method	2459	8676	2163	14755	6104	7743	25754	11749	4230
TOTAL without outliers				1222			9526		
S.D. without outliers				245			3675		

TABLE 9.- Atlantic cod length distribution. Estimated numbers in frequency in ‰. Spanish Spring Survey on NAFO 3NO: 1995-2003. 1995-2000 data are transformed C/V *Playa de Menduíña* data. 2001-2003 data are original R/V *Vizconde de Eza* data. (*) indicates untransformed data.

Lenght (cm.)	1995	1996	1997.	1998	1999	2000	2001	2002	2003
8	0.000	0.000	0.000	0.000	0.000	0.000	0.361	0.000	0.000
10	0.806	0.000	0.000	0.000	0.111	0.000	0.000	0.984	0.000
12	1.045	0.000	0.000	0.032	0.000	0.000	0.000	0.663	1.517
14	0.473	0.000	0.000	0.270	1.508	0.351	0.000	1.023	10.621
16	2.218	0.000	0.000	0.369	13.468	1.754	0.000	0.645	4.552
18	0.623	0.827	0.000	0.224	35.981	3.833	1.083	1.255	10.621
20	0.360	0.433	0.000	0.195	29.735	7.604	0.361	0.000	10.730
22	4.646	11.390	0.000	0.145	16.809	18.052	3.068	0.967	13.765
24	8.599	21.711	0.388	0.078	59.332	25.698	6.136	4.192	18.371
26	19.433	54.092	0.404	0.687	161.472	27.827	9.205	7.381	23.251
28	20.116	67.158	3.227	1.581	191.521	33.271	15.881	7.418	36.907
30	12.776	50.891	2.801	2.838	111.371	52.478	10.287	12.893	34.036
32	30.899	45.282	14.684	2.766	43.014	39.162	9.570	18.064	33.927
34	25.738	63.916	25.942	2.023	17.332	44.468	7.940	29.010	15.501
36	31.538	125.171	49.998	2.189	15.205	58.838	20.594	36.831	18.426
38	27.386	131.641	75.262	2.575	12.170	79.862	40.471	46.875	27.749
40	35.932	132.407	59.206	7.833	19.576	128.377	64.126	46.922	15.446
42	36.450	69.479	36.003	5.099	10.796	107.532	65.570	71.542	21.515
44	61.084	54.412	36.410	13.469	6.807	77.233	85.628	90.994	23.230
46	80.263	18.995	30.710	31.091	9.075	38.947	76.962	112.064	23.700
48	81.344	27.152	27.812	57.545	3.777	29.257	114.169	111.080	39.213
50	62.052	16.153	24.311	50.898	5.254	16.691	116.325	78.008	27.292
52	67.887	10.433	17.295	54.469	8.088	9.771	100.589	90.676	63.993
54	68.354	11.718	26.683	73.507	10.717	7.744	86.487	81.922	85.829
56	84.417	15.356	40.616	122.217	16.111	8.213	64.453	59.260	85.107
58	89.077	17.869	96.420	133.718	24.407	10.824	36.829	34.634	67.028
60	41.646	13.985	93.171	129.803	36.372	13.277	25.092	20.384	75.553
62	58.529	11.780	121.266	71.562	28.481	13.308	1.444	18.454	51.079
64	21.545	9.283	60.533	47.031	31.465	14.403	3.610	4.533	41.614
66	9.559	3.508	52.597	53.655	20.610	21.493	6.498	4.533	42.192
68	1.304	4.484	63.963	37.625	21.778	23.568	2.710	0.323	15.316
70	6.950	3.137	21.273	9.858	14.723	17.041	4.873	4.210	18.929
72	6.950	2.895	4.306	32.809	4.799	19.243	1.807	0.968	15.894
74	0.000	2.657	9.012	24.532	6.454	18.010	1.625	0.000	0.000
76	0.000	0.552	2.158	11.213	4.719	10.798	0.180	0.000	4.552
78	0.000	0.728	0.000	5.493	3.509	11.884	4.152	0.323	3.035
80	0.000	0.419	1.077	5.901	0.859	2.920	1.805	0.000	5.491
82	0.000	0.000	1.258	1.136	0.255	1.101	4.696	0.000	2.456
84	0.000	0.000	0.243	1.034	0.127	1.236	0.541	0.000	1.517
86	0.000	0.000	0.000	0.204	0.545	1.554	0.903	0.322	2.456
88	0.000	0.000	0.243	2.222	0.509	0.687	0.541	0.000	1.517
90	0.000	0.086	0.000	0.000	0.127	0.273	0.722	0.323	1.517
92	0.000	0.000	0.244	0.000	0.127	0.596	0.180	0.000	0.000
94	0.000	0.000	0.000	0.051	0.382	0.182	0.180	0.000	0.000
96	0.000	0.000	0.000	0.000	0.000	0.091	0.722	0.000	1.517
98	0.000	0.000	0.000	0.000	0.255	0.091	0.361	0.000	0.000
100	0.000	0.000	0.000	0.000	0.127	0.091	0.000	0.000	0.000
102	0.000	0.000	0.000	0.000	0.000	0.091	0.000	0.000	1.517
104	0.000	0.000	0.000	0.051	0.000	0.091	0.000	0.322	0.000
106	0.000	0.000	0.000	0.000	0.000	0.091	0.000	0.000	1.517
108	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
110	0.000	0.000	0.000	0.000	0.000	0.000	0.541	0.000	0.000
112	0.000	0.000	0.000	0.000	0.000	0.000	0.361	0.000	0.000
114	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
116	0.000	0.000	0.244	0.000	0.000	0.000	0.000	0.000	0.000
118	0.000	0.000	0.243	0.000	0.000	0.091	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
122	0.000	0.000	0.000	0.000	0.136	0.000	0.000	0.000	0.000
124	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
126	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
132	0.000	0.000	0.000	0.000	0.000	0.000	0.361	0.000	0.000
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000
Nº Ind. (*):	758	2271	742	967	2770	2753	1591	1030	539
Nº samples:	16	40	40	55	72	70	32	41	42
Range:	9-72	18-89	24-118	12-104	9-121	13-118	8-132	9-104	12-106
Total catch:	405	611	537	3239	613	1274	3487	2806	846
Sampled catch:	182	373	248	410	527	752	1107	776	654
Total hauls:	77	112	128	124	114	118	83	125	122

1998 cod catches Box Plot
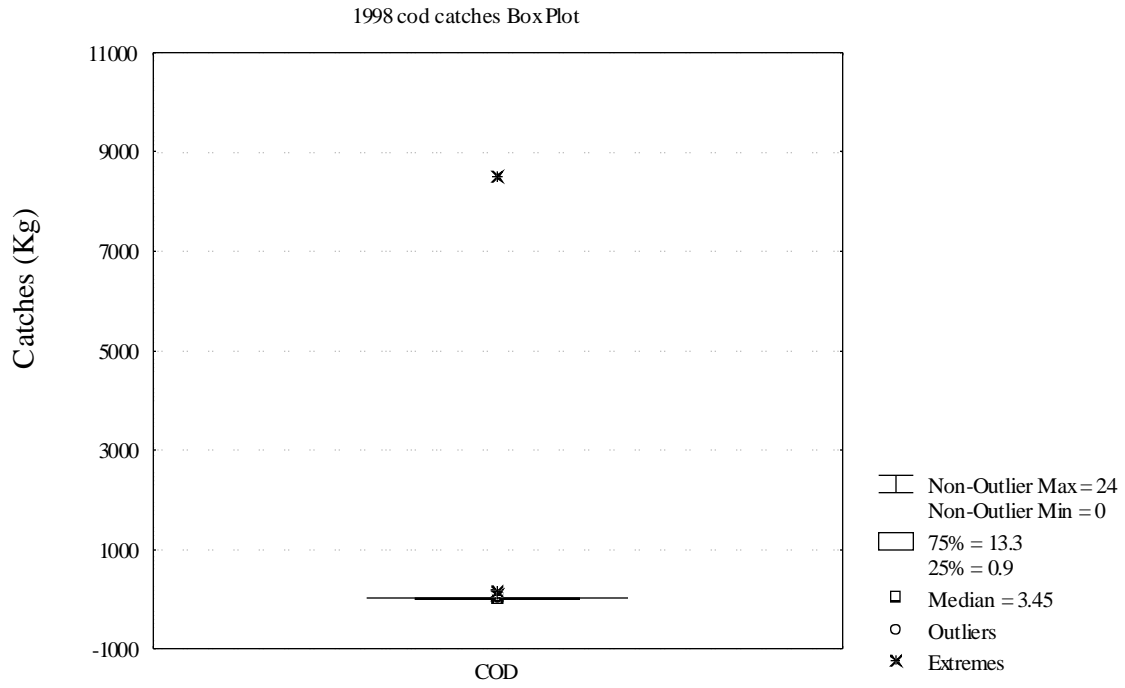
FIG. 1. BoxPlot of the Atlantic cod catches in 1998.

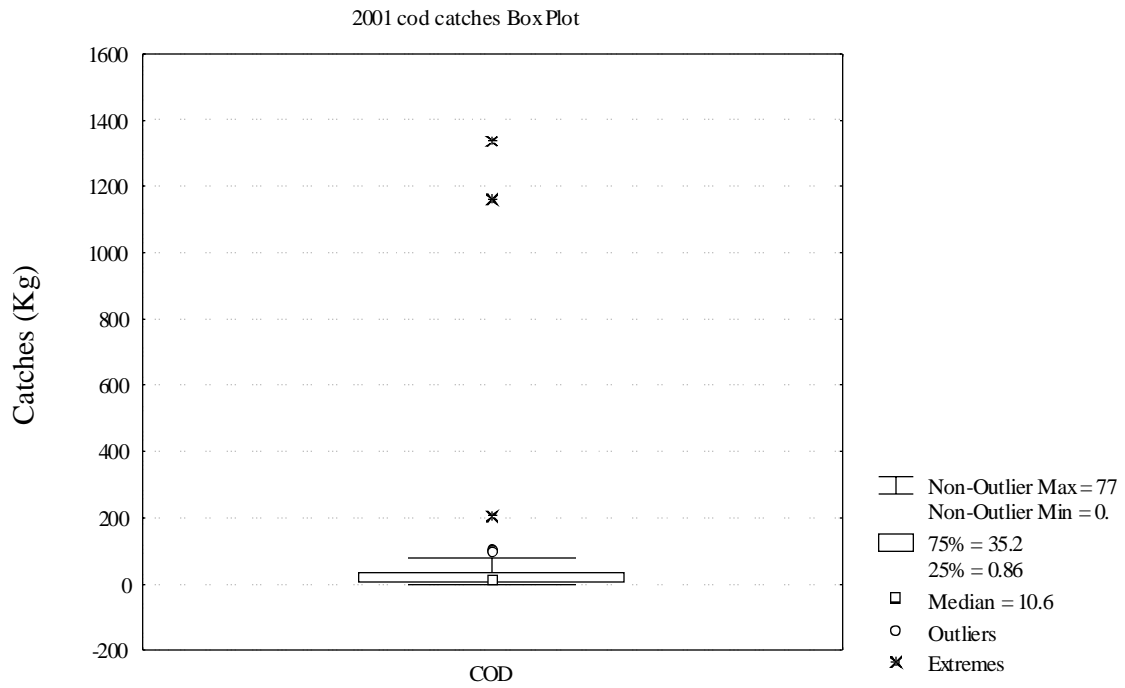2001 cod catches Box Plot

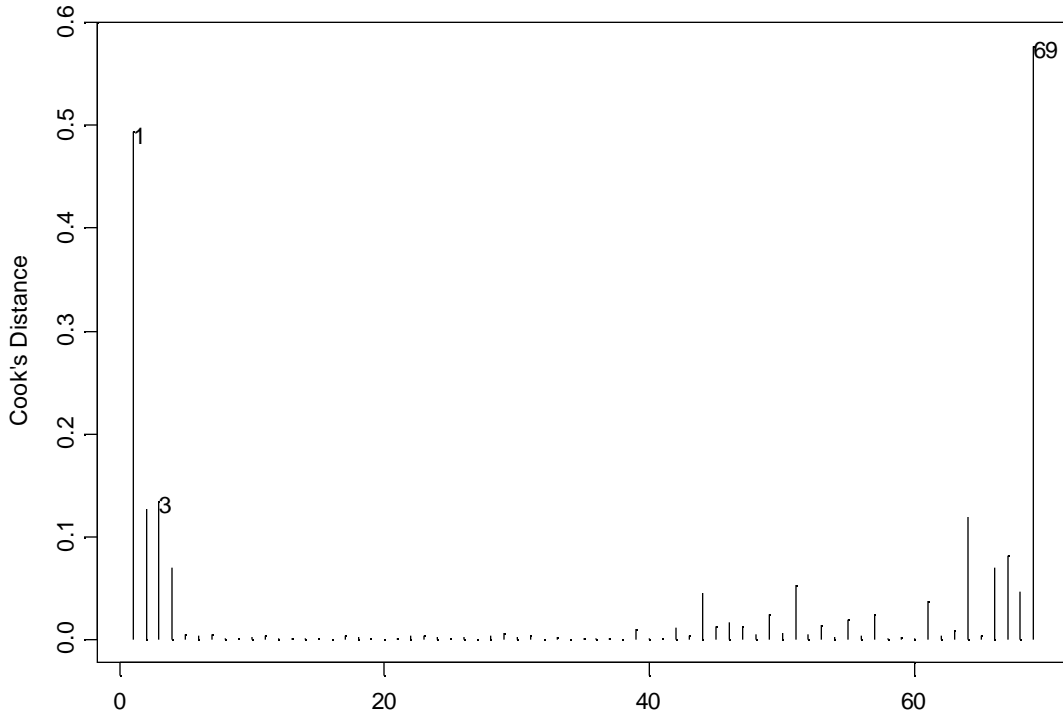**FIG. 2.** BoxPlot of the Atlantic cod catches in 2001

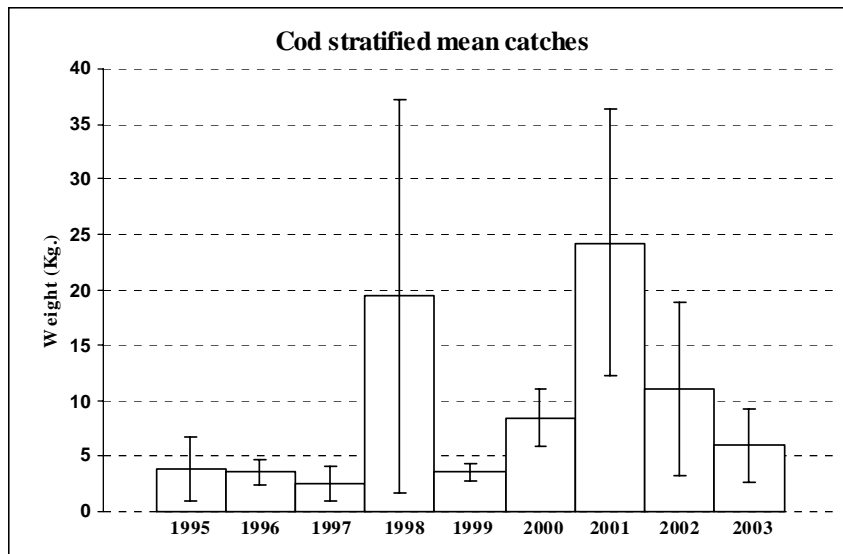**FIG. 3.** 2001 outliers in Atlantic cod length adjust

FIG. 4. Atlantic cod stratified mean catches in Kg and ±SD by year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2003 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*).
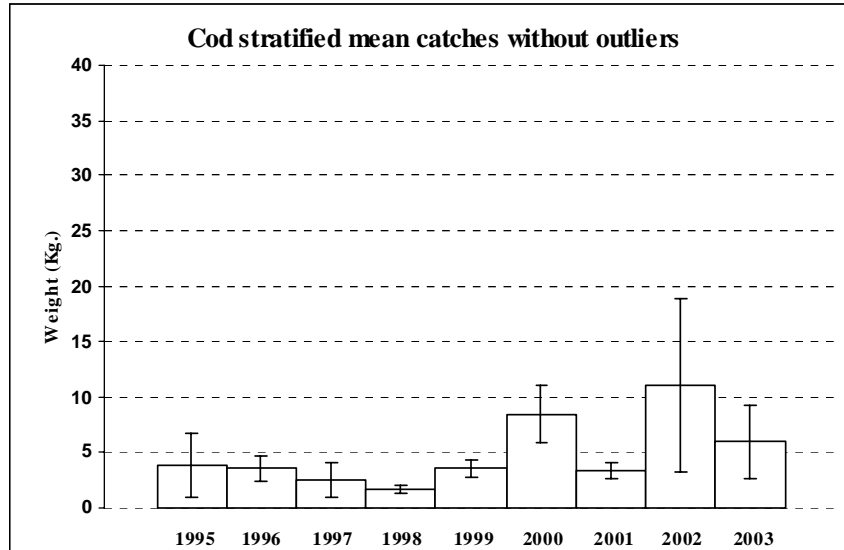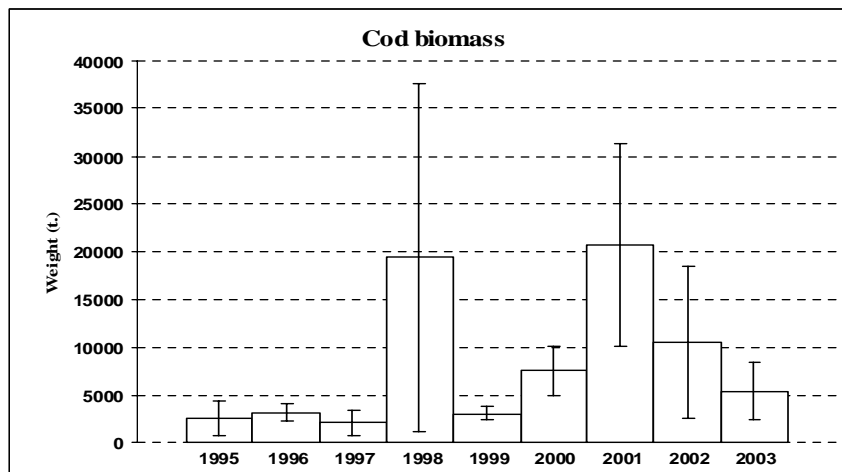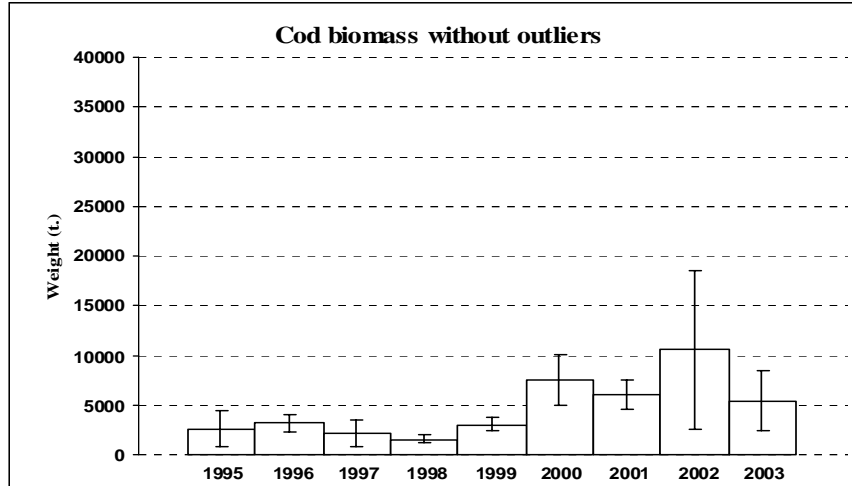
FIG. 5. Atlantic cod stratified mean catches in Kg and ±SD by year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2003 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*). In year 1998, a 8 tonnes catch was avoided, and in year 2001, two of more than 1 tonne catches were avoided.

FIG. 6. Atlantic cod biomass in tons and ±SD by year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2003 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*).
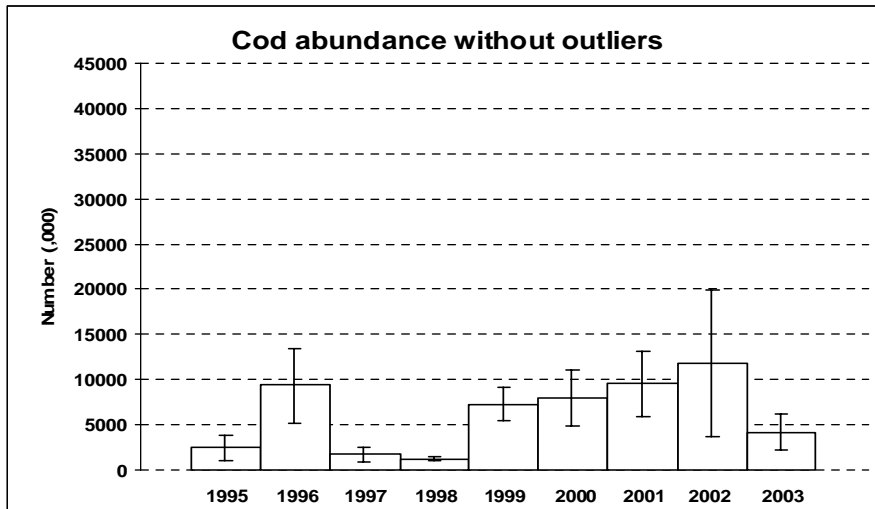
FIG. 7. Atlantic cod biomass in tons and ±SD by year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2003 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*). In year 1998, a 8 tonnes catch was avoided, and in year 2001, two of more than 1 tonne catches were avoided.
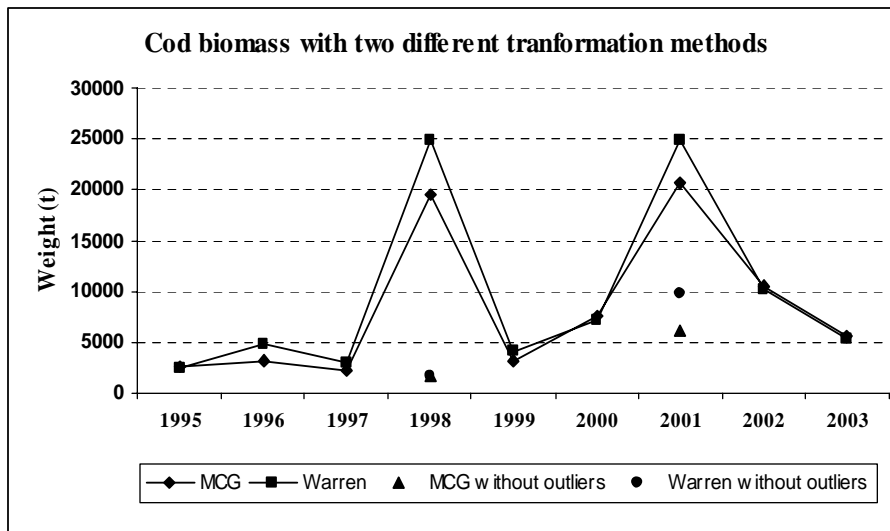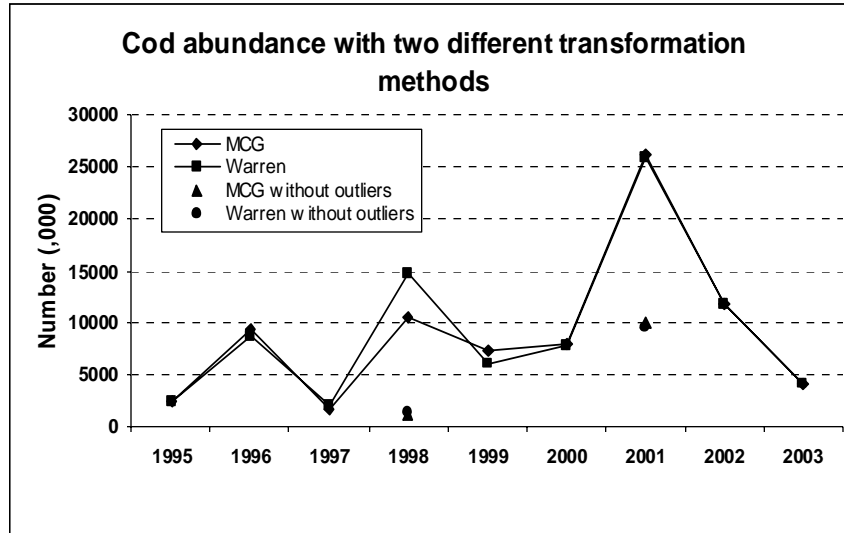

FIG. 8. Atlantic cod biomass in tons transformed with the two different methods: MCG and Warren. The values without outliers in years 1998 and 2001 are marked.
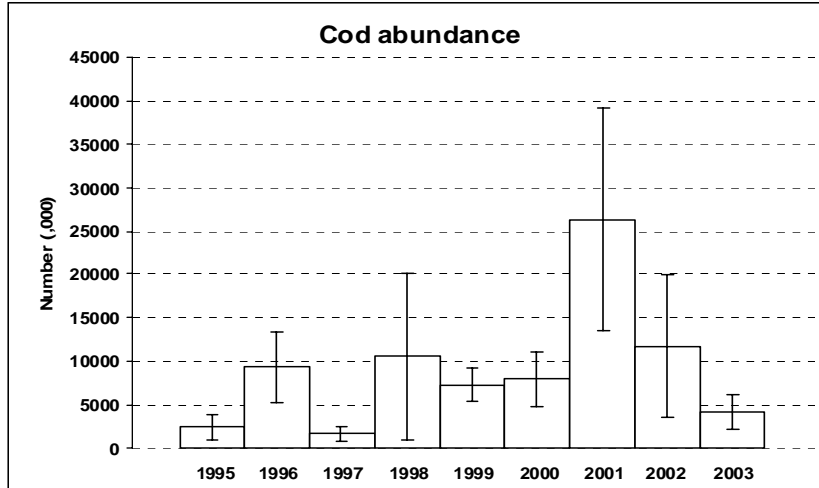
FIG. 9. Atlantic cod abundance in thousand and ±SD by stratum and year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2003 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*).

FIG. 10. Atlantic cod abundance in thousand and ±SD by stratum and year. Spanish Spring surveys on NAFO Div. 3NO: 1995-2002 (1995-2000 transformed data from C/V *Playa de Menduíña*; 2001-2003 original data from R/V *Vizconde de Eza*). In year 1998, a 8 tonnes catch was avoided, and year 2001, two of more than 1 tonne catches were avoided.

FIG. 11. Atlantic cod abundance in thousand transformed with the two different methods: MCG and Warren. The values without outliers in years 1998 and 2001 are marked.
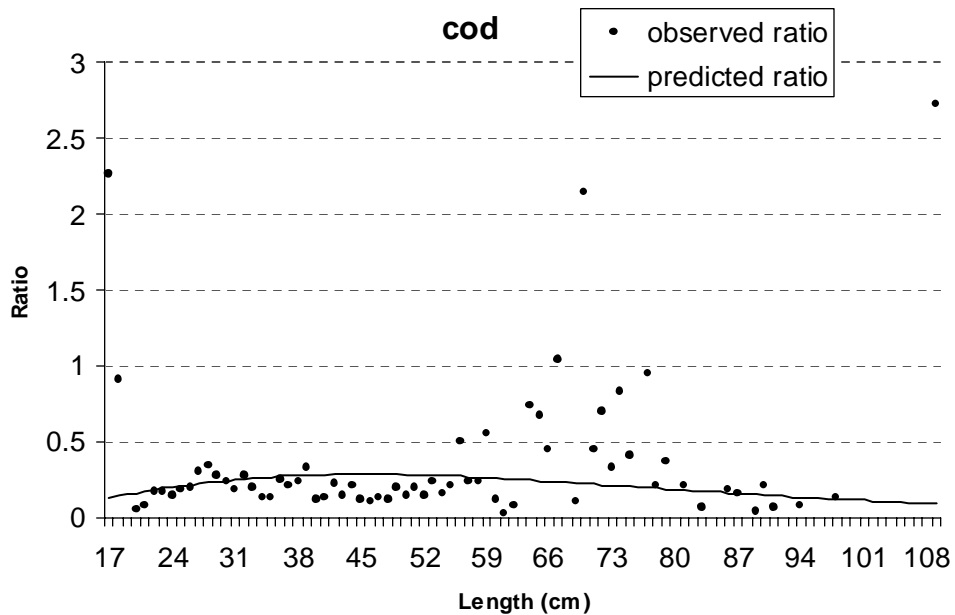

FIG. 12. Ratios of *Campelen* catch to *Pedreira* catch, by length group, of Atlantic cod, from comparative fishing trials between the two gears on the C/V *Playa de Menduíña* and the R/V *Vizconde de Eza*. The dots are the observed ratios and the curve is the fitted line. The dotted vertical lines show the three length classes made for doing the transformation.
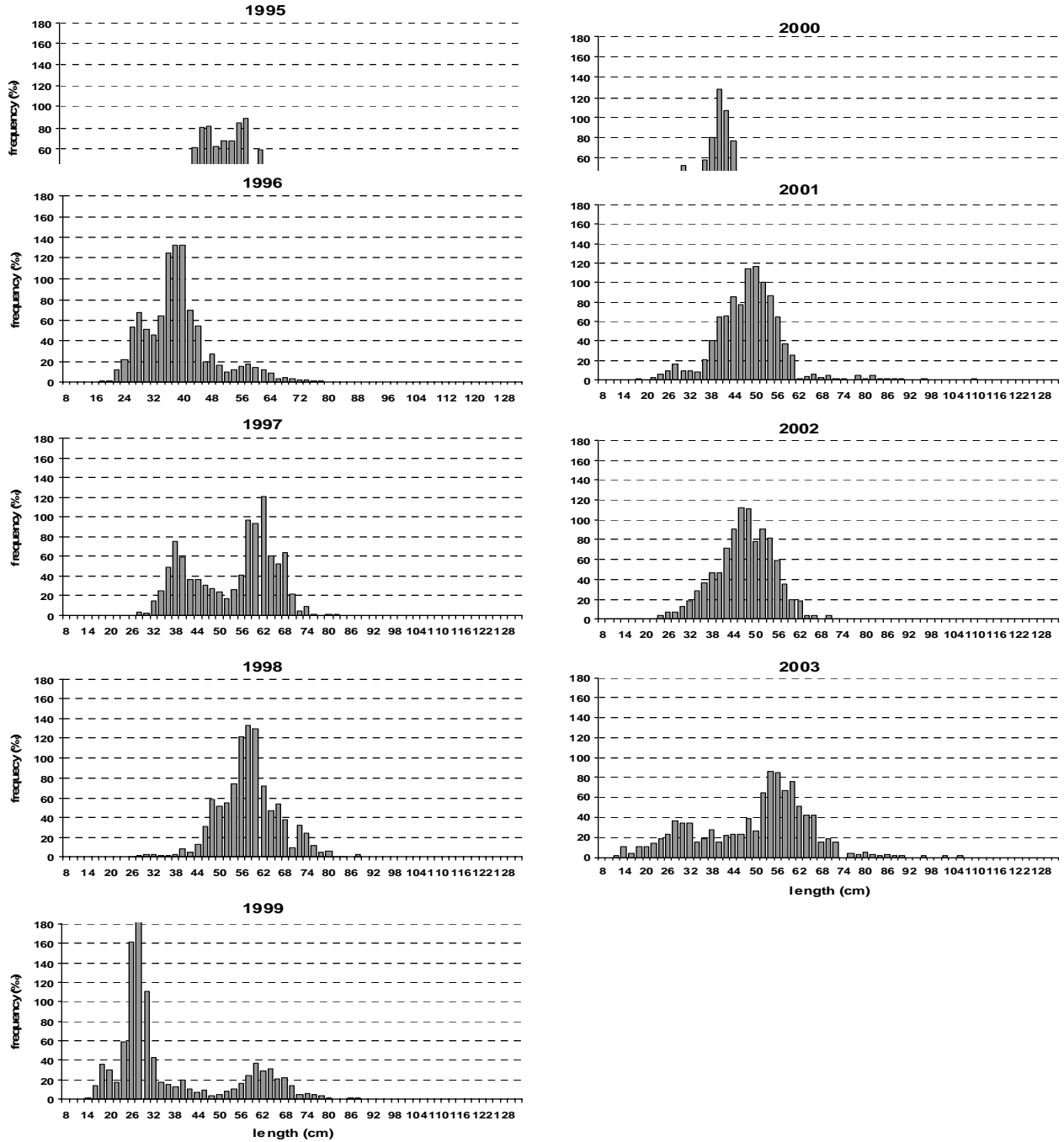
FIG. 13. Atlantic cod length distribution (cm) on NAFO 3NO: 1995-2003. Frequency in ‰. 1995-2000 data are transformed data from C/V *Playa de Menduíña*, and 2001-2003 data are original from R/V *Vizconde de Eza*.