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Comparative Exercise of Efficiency Between C/V *Playa de Menduíña* and R/V *Vizconde de Eza* in the NAFO Divisions 3NO in May 2001

by

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Abstract

In 2002 the R/V *Vizconde de Eza* will replace the C/V *Playa de Menduíña* in conducting the *Platuxa* bottom trawl series carried out by the Centro Oceanográfico de Vigo (Oceanographic Center of Vigo) since 1995. So in May of 2001 a comparative fishing experience was conducted to transform the series of the indices previously obtained and maintain the continuity of the time series obtained by the C/V *Playa de Menduíña*. A 81 parallel hauls series was performed. For each of the main species: American Plaice, Yellowtail flounder, Cod, Witch flounder and Thorny skate, the catches of both vessels were compared and a linear fit for these catches is presented. Also, we performed a comparative study on the catches by length for American plaice and Yellowtail flounder by a probability variant of the logistic curve, assuming unequal catches between the two vessels, and a fit to transformed these data. As anticipated, the values of the new indices were lower than the previous values, because the *Pedreira* is approximately four times more efficient than the *Campelen* trawl gear.

Introduction

In may of 2001, the Centro Oceanográfico de Vigo carried out the *Platuxa* bottom trawl 2001, as a part of the *Platuxa* bottom trawl series carried out by this Oceanographic Center since 1995 with the C/V *Playa de Menduíña*, using a *Pedreira* otter trawl equipped with 15 cm. diameter rubber disc footgear. But in 2002, this vessel will be replaced by the R/V *Vizconde de Eza*, which uses a *Campelen* 1800 shrimp trawl, equipped with a 35 cm. diameter rockhopper footgear. A detailed description of the experimental design and analytical methodology can be found in Paz and Durán (1999), Durán *et. al.* (2001), Walsh *et. al.* (2001). In order to establish a link between the two sets of survey data, comparative fishing trials were conducted in May 2001 to develop factors between the two fishing gear combinations. A series of 81 paired hauls was carried out. The conversion factors derived were in terms of fish length, given the different selectivities of the trawls involved. Direct comparison of catches from vessel fishing side by side is based on the assumption that the number of fish in the trawl paths is more or less the same.

This paper is a continuation of a series published by the Centro Oceanográfico de Vigo over the last few years. In 1999, this center began conducting comparative fishing operations to estimate the efficiency of *Pedreira* trawl in an alternate haul experiment with the *Campelen*. In 2000, these comparative studies were continued and expanded to include side-by-side comparative fishing with the Canadian vessel *Wilfred Templeman*. In 2001, the Spanish-Canadian comparative fishing trials also included the R/V *Vizconde de Eza* (see Paz *et. al*., 2000; Román *et. al*., 2001, Walsh *et. al*., 2001). The objective of this paper is to present the data transformed from the *Pedreira* into the *Campelen* data.

All the data for the period 1995-2000 used in this paper has been published in previous papers (Paz *et. al*., 1999, Paz *et. al*., 2000, Durán *et. al*., 2001).

Methods

The comparative exercise was carried out from May 5th to May 23rd with the vessels carrying out 81 paired tows. The objective here was to reduce one source of variation in order to focus on the difference between vessel/net combinations *per se*. The vessels conducted fishing operations at the same time, along parallel courses, with a tow length of 30 minutes. The vessels operated at a speed of 3.0 knots. The ships remained as close to each other as safety considerations permitted. Depth was between 36 meters and 1150 meters.

For the five main species: American plaice (*Hippoglossoides Platessoides*), Yellowtail flounder (*Limanda Ferruginea*), Greenland halibut (*Reinhardtius Hippoglossoides*), Cod (*Gadus Morhua*) and Witch flounder (*Glyptocephalus Cynoglossus*), a linear fit was performed for the catches of each vessel, and confidence intervals were also estimated.

For American plaice and Yellowtail flounder, we present the original and transformed *Pedreira* abundance and biomass (Tables 1-8, Fig. 17-20). The abundance is given in miles and is the estimated number of fish. The biomass is calculated from the length distribution sample with the following formula:

$$Weight = al^b$$

when: -l is the length
-a, b are the estimated parameters

a and b are calculated from the biological samples for males and females separately. The values for the two species are shown in Tables 9 and 10.

A study of catches by length and vessel was performed for American plaice and Yellowtail flounder. Firstly, we attempted to estimate the relative efficiency of the two vessels. We fit the following values by length:

$$E = \frac{Pedreiracatches}{Pedreiracatches + Campelencatches} = \frac{Pc}{Pc + Cc}$$

To fit these values we use the probability variant of the logistic curve developed by Millar and Walsh (1992), as follows:

$$S(l) = \frac{pe^{c+dl}}{1 - p + e^{c+dl}}$$

when: -l is the length (by one cm.)
-p is the estimated split proportion in the *Pedreira* mesh. We assume that there is an unequal catch at length between the two trawls, so this parameter is estimated.
-c, d are the estimated parameters of the logistic curve.

For the two same species we convert the old *Pedreira* series into the new *Campelen* series. To do so, we use the formula proposed by Warren (1996), as follows:

$$\text{Ratio} = \alpha l^{\beta} e^{\gamma l}$$

when: -Ratio = $\frac{Campelencatch}{Pedreiracatch}$ by length
-l is the length
-a, ß and ? are the estimated parameters

To fit this curve, we transform this formula into logarithms, as follows:

$$\text{Ln(Ratio)} = \text{Ln}(\alpha) + \beta \text{Ln}(l) + \gamma l$$

From this formula we obtained the conversion factor to transform the old series into the new.

Results

The catches of the main species on each vessel are presented (Figures 1-5), and a linear fit for those catches is shown (Figures 6-10). In these figures we note how the catches on the C/V *Playa de Menduíña* are, in general, higher than the catches on the R/V *Vizconde de Eza*, but there is a similar tendency on the two vessels.

American plaice

For efficiency, we obtained the following values:

$$S(l) = \frac{0.7948 e^{-7.6613+0.4402l}}{1 - 0.7947 + e^{-7.6613+0.4402l}}$$

Figure 11 shows the observed and predicted data. Although the calculus was made for all the length data, in the figure we represent the data by length groups of two cm.. For lengths above 15 cm., the efficiency is greater than 0.5, indicating that the *Pedreira* is more efficient than the *Campelen* for American plaice in those lengths. For lengths less than 15 cm., the *Campelen* is more efficient. Efficiency is constant (0.795) for lengths greater than 40 cm..

So we fit the transformed *Pedreira* series into the *Campelen* series to obtain the following values:

$$\text{Ln(Ratio)} = 13.3892 - 5.722 \text{Ln}(l) + 0.1521 l$$

Figure 13 shows the ratios and their fit. In this figure, in the case of data bellow 21 and above 52, we observed that the fit is very poor, so another conversion factor is applied for this values. Also, in lengths between 10-12, the fit is extremely scattered. So four length class are formed as follows:

For $l < 12$: cf = 9
For $13 < l < 21$: cf = 0.63
For $22 < l < 51$: cf = $\exp(13.3892 - 5.722\text{Ln}(l) + 0.1521 l)$
For $51 < l$: cf = 0.4

These conversion factors are the mean of the ratios of each length class and the curve fitted. Figure 15 shows the original and converted data for the *Pedreira* in natural logarithms plus 1, because in decimal scale we see no difference in small lengths (juvenile individuals). The trend is the same for the two series, although the converted data are approximately four times lower than the original data. The increase in 2001 is also reflected in the original and in transformed series.

Yellowtail flounder

For efficiency, we obtained the following outcome:

$$S(l) = \frac{0.7756 e^{-10.838+0.6252l}}{1 - 0.7756 + e^{-10.838+0.6252l}}$$

Figure 12 shows the observed and predicted data. The calculus were made at the same manner as for American plaice. For lengths greater than 15 cm., efficiency is higher than 0.5, indicating that the *Pedreira* is more efficient than the *Campelen* for Yellowtail flounder in those lengths. For lengths less than 15 cm., the *Campelen* is more efficient. The efficiency is constant (0.776) for lengths greater than 38 cm..

The fit for the transformation series is as follows:

$$\text{Ln(Ratio)} = 11.4618 - 4.9801\text{Ln}(l) + 0.1388l$$

Figure 14 shows the ratios and their fit. As occurs in American plaice, for low and high lengths there is an important scatter, so we decide to establish the following length class:

For $l < 14$: cf = 2.74
For $15 < l < 21$: cf = 0.59
For $22 < l < 46$: cf = $\exp(11.4618 - 4.9801\text{Ln}(l) + 0.1388l)$
For $47 < l$: cf = 0.4

These conversion factors are the mean of the ratios of each length class and the curve fitted. Figure 16 shows the original and transformed *Pedreira* data for the Yellowtail flounder in natural logarithms plus 1, as in American plaice. Although *Campelen* catches are lower than *Pedreira* catches, the same trend is noted. At occurs for American plaice, an increase in catches has been observed over the last year.

Conclusions

The *Campelen* is, in general, less efficient than the *Pedreira*, except when applies to short lengths. *Pedreira* catches are in the order of four times greater than for *Campelen* catches. This is not surprising, and is in line with the results of the comparative experiments performed between the Spanish vessel *Playa de Menduíña* and the Canadian vessel *Wilfred Templeman* (Paz *et. al*., 2000, Román *et. al*., 2001).

The transformed series have a similar trend to the original series for the two species analyzed, although an important descent is noted in the catches in the new series. In forthcoming years, we expect to maintain these catches, so our historical abundance will decrease. Conversely, we anticipate an increase in recruitment, because the *Campelen* catches a great number of short lengths. As a result, the forthcoming years may show a considerable recruitment, since in recent years the recruitment has increased considerably, particularly in the case of American plaice.

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TABLE 1.- Abundance (,000) at length of American plaice from Spanish Spring Surveys on NAFO 3NO: 1995-2001. Data in original *Pedreira* units

Length	1995	1996	1997	1998	1999	2000	2001
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	387.35	0.00	65.50
12	31.39	0.00	0.00	0.00	1034.35	1575.79	285.98
14	304.16	38.05	22.07	24.22	327.58	20594.91	9029.13
16	861.70	800.89	54.53	682.31	2331.72	105032.81	15528.80
18	2157.28	2485.22	904.22	224.22	3742.64	133854.50	86549.61
20	8656.36	6700.92	1937.39	701.67	404.99	44658.25	301335.96
22	30373.62	10034.59	4135.97	1688.49	2615.76	9638.23	307866.38
24	48076.87	18341.67	7470.69	7726.76	4236.59	7281.13	130576.57
26	42305.07	43037.10	11817.46	19903.36	16088.85	9949.68	29807.39
28	32696.30	69582.76	20476.93	29784.33	49879.29	13022.43	19980.26
30	22725.54	63157.00	31028.26	44529.81	85620.67	40875.90	25423.78
32	18782.93	50213.87	27767.10	54877.49	103239.16	81474.49	53570.52
34	14629.03	38958.78	27579.65	64704.53	82771.79	99085.01	66764.00
36	9650.57	33202.42	23807.40	69424.05	71577.61	87457.82	63460.86
38	6631.67	22132.19	18282.47	66618.33	77561.86	78262.69	58958.18
40	4722.54	13560.86	13192.00	48775.20	66998.93	88358.81	53153.26
42	3619.09	9143.67	8190.30	34973.15	60255.36	87062.68	53524.32
44	2225.35	6278.90	5419.08	23463.64	39444.69	74974.57	46398.89
46	1593.16	3510.79	2334.11	13872.36	23027.72	51766.74	42970.98
48	937.80	2314.38	1911.42	9008.03	13918.19	31311.22	22328.59
50	900.12	1931.31	1551.91	4099.41	10331.14	18552.03	15871.00
52	403.66	1166.50	329.18	1967.22	4728.32	15306.97	10661.86
54	244.91	1025.74	242.55	913.84	3320.66	7542.63	8152.36
56	220.78	616.06	140.88	922.84	2410.90	5607.89	3608.49
58	81.05	292.44	71.59	589.95	1020.68	2908.15	1706.28
60	124.63	241.58	74.51	709.78	676.98	2275.59	994.68
62	143.02	162.54	37.73	161.41	441.46	2256.00	618.97
64	7.97	307.76	47.77	183.64	365.42	1046.13	76.03
66	85.97	158.59	54.09	118.56	107.20	646.47	216.90
68	0.00	68.84	22.79	93.86	0.00	0.00	63.24
70	0.00	30.14	0.00	0.00	0.00	95.93	0.00
72	17.54	14.31	0.00	0.00	0.00	29.86	0.00
74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	37.31	0.00	0.00
TOTAL	253.21	399.51	208.90	500.74	728.91	1122.51	1429.55

TABLE 2.- Abundance (,000) at length of Yellowtail flounder from Spanish Spring Surveys on NAFO 3NO: 1995-2001. Data in original *Pedreira* units

Length	1995	1996	1997	1998	1999	2000	2001
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	241.49	0.00	0.00
10	65.91	7.98	0.00	0.00	1047.12	0.00	0.00
12	146.98	186.74	90.31	639.56	5419.12	508.30	497.17
14	1387.01	473.40	644.55	0.00	11146.17	4071.63	1210.34
16	3717.46	4014.55	2955.03	1943.69	27869.64	19441.75	3763.53
18	6503.11	18636.18	7476.44	10719.91	37212.47	36435.07	24381.88
20	6758.10	39985.94	32104.02	37225.15	30354.97	48067.13	85708.73
22	10303.37	58540.63	72532.41	65283.06	78162.88	68510.86	142248.10
24	18672.92	80889.28	126188.32	160068.97	160472.86	77330.24	155728.06
26	12584.67	70424.43	128108.95	330761.06	295315.18	134240.55	141807.07
28	7608.07	44744.10	111609.64	426560.50	469434.43	226015.08	229554.65
30	11509.73	44712.33	65353.41	367447.00	461096.95	275032.39	338229.36
32	12997.68	32934.74	30150.00	230250.61	365676.81	259215.28	394015.73
34	11051.56	30736.99	19377.46	125571.84	214180.19	191481.01	317726.94
36	6156.93	33759.72	12246.01	80636.18	124465.90	107263.89	233781.73
38	3893.66	27228.35	9188.50	44450.75	74303.12	68362.76	135793.07
40	3441.89	17327.52	7530.54	33286.57	36810.57	40842.86	62281.45
42	1923.11	11024.27	3804.10	19437.74	23230.34	25857.16	33245.74
44	1000.70	6363.65	1839.84	8839.41	10964.42	15227.74	18815.79
46	400.98	3612.24	455.85	2459.39	4023.79	7004.61	10861.53
48	247.89	760.64	79.48	2013.88	2423.14	2479.01	4395.81
50	185.03	486.23	166.96	401.68	913.03	1159.42	1110.23
52	78.28	122.93	0.00	0.00	97.36	387.20	151.13
54	29.84	0.00	45.68	0.00	0.00	71.89	166.38
56	7.86	75.43	0.00	0.00	0.00	0.00	432.83
TOTAL	120.67	527.05	631.95	1948.00	2434.86	1609.01	2335.91

TABLE 3.- Abundance (,000) at length of American plaice from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data converted to *Campelen* units. For 2001, we present the original *Campelen* data.

Length	1995	1996	1997	1998	1999	2000	2001
6	0.00	0.00	0.00	0.00	0.00	0.00	531
8	0.00	0.00	0.00	0.00	0.00	0.00	2081
10	0.00	0.00	0.00	0.00	3486.15	0.00	876.40
12	282.50	0.00	0.00	0.00	9309.16	14182.15	2428.91
14	191.62	23.97	13.91	15.26	206.38	12974.79	10278.79
16	542.87	504.56	34.35	429.85	1468.98	66170.67	10876.62
18	1359.09	1565.69	569.66	141.26	2357.86	84328.34	41229.69
20	5453.50	4221.58	1220.56	442.05	255.14	28134.70	103059.48
22	14517.72	4863.17	1943.86	819.02	1259.25	4615.22	88805.44
24	16003.03	6048.24	2477.65	2547.94	1397.14	2442.80	36254.85
26	11979.74	12065.11	3313.79	5616.82	4486.81	2819.70	8780.66
28	8139.15	17286.17	5074.88	7380.46	12315.74	3204.26	4757.36
30	5136.91	14253.95	7006.53	10039.74	19239.57	9172.08	7864.07
32	3953.65	10548.12	5835.18	11531.93	21717.19	17094.41	14012.32
34	2933.22	7800.39	5527.55	12950.71	16587.22	19844.73	18348.84
36	1881.20	6469.23	4639.02	13523.77	13939.64	17035.23	17662.25
38	1279.55	4270.40	3527.45	12853.52	14964.88	15100.22	14270.10
40	917.14	2633.69	2561.99	9471.31	13017.20	17172.55	13156.77
42	718.81	1816.91	1624.93	6935.18	11951.32	17280.67	12317.19
44	456.63	1289.86	1112.52	4817.61	8097.30	15393.02	12404.77
46	343.79	755.53	500.07	2982.34	4944.28	11131.90	10419.18
48	213.80	528.33	433.59	2056.30	3167.32	7127.76	6171.71
50	219.32	470.47	380.75	999.75	2523.98	4519.08	3376.46
52	145.12	386.45	110.15	625.04	1523.53	4801.43	2084.16
54	97.97	410.29	97.02	365.54	1328.26	3017.05	1264.91
56	88.31	246.43	56.35	369.13	964.36	2243.16	1045.86
58	32.42	116.98	28.64	235.98	408.27	1163.26	356.46
60	49.85	96.63	29.81	283.91	270.79	910.24	386.98
62	57.21	65.02	15.09	64.56	176.58	902.40	329.50
64	3.19	123.10	19.11	73.45	146.17	418.45	96.52
66	34.39	63.44	21.63	47.42	42.88	258.59	0.00
68	0.00	27.54	9.11	37.55	0.00	0.00	70.93
70	0.00	12.06	0.00	0.00	0.00	38.37	19.95
72	7.02	5.73	0.00	0.00	0.00	11.95	0.00
74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	14.93	0.00	0.00
TOTAL	77.04	98.97	48.19	107.66	171.57	383.51	445.62

TABLE 4.- Abundance (,000) at length of Yellowtail flounder from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data converted to *Campelen* units. For 2001, we present the original *Campelen* data.

Length	1995	1996	1997	1998	1999	2000	2001
6	0.00	0.00	0.00	0.00	0.00	0.00	95.73
8	0.00	0.00	0.00	0.00	661.68	0.00	704.00
10	180.60	21.85	0.00	0.00	2869.11	0.00	2263.63
12	402.72	511.66	247.45	1752.39	14848.39	1392.73	2431.35
14	3800.42	1297.11	1766.08	0.00	30540.50	11156.25	3071.42
16	2193.30	2368.58	1743.47	1146.78	16443.08	11470.63	4256.84
18	3836.83	10995.35	4411.10	6324.75	21955.35	21496.69	11626.37
20	3987.28	23591.70	18941.37	21962.84	17909.43	28359.61	27999.97
22	5030.27	28713.09	35320.54	30902.25	37748.13	34996.38	45860.21
24	6893.84	29756.51	46505.06	58803.45	58834.37	28531.20	44210.16
26	4107.43	22885.80	41585.58	106774.82	95423.71	43229.70	43114.26
28	2228.02	13137.80	32848.09	125360.60	137613.94	66259.42	66205.75
30	3139.44	12221.87	17901.06	100412.91	125967.28	75132.49	95725.90
32	3384.76	8572.57	7850.73	59933.09	95205.98	67455.93	110543.92
34	2793.55	7764.39	4900.21	31729.75	54139.58	48417.07	91932.56
36	1538.36	8433.41	3059.30	20146.13	31098.10	26799.96	63043.26
38	976.88	6832.33	2305.63	11164.33	18643.10	17150.74	42287.46
40	879.44	4430.16	1924.59	8524.70	9407.07	10439.13	21997.99
42	507.00	2908.43	1001.43	5119.47	6125.80	6813.81	10983.20
44	276.41	1746.32	504.65	2435.60	3019.39	4191.91	5944.64
46	115.66	1050.85	131.43	709.87	1165.11	2035.44	2894.87
48	99.16	304.26	31.79	805.55	969.25	991.60	1530.50
50	74.01	194.49	66.78	160.67	365.21	463.77	342.46
52	31.31	49.17	0.00	0.00	38.94	154.88	71.99
54	11.94	0.00	18.27	0.00	0.00	28.76	46.88
56	3.14	30.17	0.00	0.00	0.00	0.00	0.00
TOTAL	46.49	187.82	223.06	594.17	780.99	506.97	699.19

TABLE 5. American plaice biomass (,000) at length from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data in original *Pedreira* units.

Length/Year	1995	1996	1997	1998	1999	2000
10	0.00	0.00	0.00	0.00	2736.02	0.00
12	390.36	0.00	0.00	0.00	11101.48	13569.49
14	5812.59	829.45	405.27	379.12	6738.78	322409.79
16	24021.91	23348.13	1308.50	19303.32	66889.83	2538320.53
18	92504.10	105682.69	34980.30	7535.20	150647.11	4616377.21
20	523102.70	391053.53	105530.15	37278.85	23683.87	2162336.22
22	2489928.51	803718.43	314180.55	125235.99	210469.88	692272.54
24	5143704.59	1946017.02	745052.31	764935.35	443170.21	687009.86
26	5846313.58	5885727.35	1549269.68	2541080.73	2178018.81	1245103.42
28	5754261.13	11918275.16	3396406.70	4880794.94	8553428.54	2162317.64
30	4992424.88	13494003.85	6374014.09	9099106.30	18254689.38	8516523.76
32	5092053.57	13286333.68	7115813.01	13848241.55	26652094.89	20955179.83
34	4836414.93	12578403.04	8632827.14	20133670.48	26039378.23	31200054.93
36	3839937.86	12884336.91	9065845.39	26208002.50	27528388.11	33560974.34
38	3163265.30	10247325.73	8458801.07	30260222.72	36007507.73	36170413.97
40	2667318.22	7474435.52	7238653.50	26294396.13	36997442.41	49174951.51
42	2418584.79	5965905.31	5333906.52	22246115.25	38883171.52	57069683.78
44	1718009.49	4740268.24	4111845.98	17489084.92	29580850.04	57479172.11
46	1437231.05	3069813.60	2022117.46	11979902.14	19828849.87	46207304.98
48	971197.77	2334399.73	1937394.99	9027466.71	13787885.12	32300069.18
50	1061802.94	2221140.71	1845177.32	4699854.10	11730162.84	22036633.18
52	552344.13	1538290.35	444737.69	2569338.37	6073948.34	20776470.97
54	370835.39	1536436.21	370456.96	1365612.68	4836596.64	11791751.29
56	377965.73	1033070.57	241213.71	1533482.42	3942078.60	9751164.06
58	159882.70	557194.65	139761.85	1127761.73	1851339.96	5833378.86
60	265004.21	502217.97	165423.92	1520383.62	1362648.53	5127881.30
62	344376.93	383402.69	94228.65	378590.62	975535.87	5700609.51
64	20651.59	804101.60	128242.83	485328.35	926896.04	2908728.95
66	250359.18	445864.18	158078.84	345444.45	288874.42	1953301.83
68	0.00	222851.06	76255.96	310140.65	0.00	0.00
70	0.00	102295.06	0.00	0.00	0.00	373051.14
72	66975.39	53278.05	0.00	0.00	0.00	127823.23
74	0.00	0.00	0.00	0.00	0.00	0.00
76	0.00	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	172048.97	0.00
TOTAL	54486.68	116550.02	70101.93	209298.69	317367.27	473454.84

TABLE 6.- Biomass (,000) at length of Yellowtail flounder from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data in original *Pedreira* units

Length	1995	1996	1997	1998	1999	2000
6	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	1041.73	0.00
10	467.60	67.06	0.00	0.00	8355.23	0.00
12	1940.53	2342.38	1285.29	9002.75	71224.77	4991.78
14	29840.94	10547.52	12693.54	0.00	245288.16	69221.48
16	122056.22	135560.23	99945.43	64578.59	909826.80	497330.32
18	305153.06	894112.02	346845.55	503207.53	1701557.59	1404457.79
20	444287.54	2658264.57	2097690.77	2341212.74	1958027.07	2605248.74
22	922940.31	5226975.92	6304855.38	5655122.47	6858324.47	5087824.93
24	2169884.54	9489762.28	14266929.82	17912774.54	18362500.20	7753962.59
26	1854117.82	10533204.95	18530182.70	47517294.53	43030618.63	17845675.00
28	1445640.38	8482537.44	20336489.82	76515388.09	85878423.50	38047495.32
30	2711192.93	10522659.31	14772426.71	81951711.36	104125801.46	57993316.45
32	3706610.47	9468399.38	8368235.66	62742435.24	100791321.14	68081193.79
34	3817832.88	10699137.66	6475973.18	41642693.58	71433029.77	61773064.79
36	2539062.57	14259259.23	4975672.67	31936384.39	49449487.63	42375258.08
38	1904942.08	13606180.15	4413709.64	21045028.38	34962078.13	32398389.50
40	1974399.52	10217825.14	4283057.53	18542745.13	20347611.72	23052173.64
42	1291145.49	7647217.49	2518486.39	12389378.66	15002399.23	17283060.25
44	789755.47	5030594.60	1402395.16	6594363.89	8180320.30	12011263.61
46	354387.80	3362999.77	400089.86	2073847.03	3428472.51	6444180.01
48	259789.26	797904.06	80530.15	1939570.98	2348192.21	2629980.07
50	212342.37	577647.56	192749.72	433030.07	1010025.94	1386522.06
52	105654.32	172768.73	0.00	0.00	126161.14	523030.12
54	43926.29	0.00	66212.04	0.00	0.00	117608.90
56	13507.29	128182.16	0.00	0.00	0.00	0.00
TOTAL	27020.88	123924.15	109946.46	431809.77	570230.09	399385.25

TABLE 7. American plaice biomass (,000) at length from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data converted to *Campelen* units.

Length/Year	1995	1996	1997	1998	1999	2000
10	0.00	0.00	0.00	0.00	24624.14	0.00
12	2790.57	0.00	0.00	0.00	99913.33	122125.45
14	2953.38	522.55	255.32	238.85	4245.43	203118.17
16	14938.95	14709.32	824.35	12161.09	42140.59	1599141.93
18	58277.58	66580.09	22037.59	4747.18	94907.68	2908317.64
20	329554.70	246363.73	66483.99	23485.68	14920.84	1362271.82
22	1169408.80	382684.84	145133.22	59669.89	99592.32	325479.67
24	1706883.13	639873.34	246327.66	251492.24	145771.59	229749.74
26	1651807.48	1646653.45	433512.59	715461.70	606285.84	352003.02
28	1430078.94	2956053.60	840421.80	1207502.72	2108687.14	531305.42
30	1127208.77	3041945.77	1437529.76	2049121.95	4097586.08	1908925.41
32	1071029.54	2788847.06	1494218.24	2907801.34	5602362.04	4393257.57
34	969304.18	2517322.93	1729379.91	4027909.44	5215909.18	6245754.03
36	748374.80	2509907.34	1766128.21	5104213.70	5359909.62	6535652.65
38	610329.27	1977196.55	1632037.26	5838424.19	6947254.52	6978740.39
40	518083.45	1451844.26	1406022.03	5106707.76	7189333.88	9558626.00
42	480504.18	1185767.59	1058512.17	4412641.16	7714421.30	11330780.06
44	352669.46	974199.09	844439.49	3592340.63	6074617.20	11805769.59
46	310294.33	660913.94	433433.03	2576699.87	4259334.33	9941253.75
48	221531.48	533216.39	439692.09	2061887.47	3139269.40	7356922.08
50	258863.05	541363.93	452964.38	1146879.71	2867466.03	5371199.05
52	199570.13	513022.98	149832.38	822069.78	1970221.62	6562924.01
54	148334.16	614574.48	148182.78	546245.07	1934638.66	4716700.52
56	151186.29	413228.23	96485.49	613392.97	1576831.44	3900465.62
58	63953.08	222877.86	55904.74	451104.69	740535.98	2333351.55
60	106001.68	200887.19	66169.57	608153.45	545059.41	2051152.52
62	137750.77	153361.08	37691.46	151436.25	390214.35	2280243.81
64	8260.64	321640.64	51297.13	194131.34	370758.41	1163491.58
66	100143.67	178345.67	63231.54	138177.78	115549.77	781320.73
68	0.00	89140.42	30502.38	124056.26	0.00	0.00
70	0.00	40918.03	0.00	0.00	0.00	149220.46
72	26790.16	21311.22	0.00	0.00	0.00	51129.29
74	0.00	0.00	0.00	0.00	0.00	0.00
76	0.00	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	68819.59	0.00
TOTAL	13976.88	26905.27	15148.65	44748.15	69421.18	113050.39

TABLE 8. Yellowtail flounder biomass (,000) at length from Spanish Spring Surveys on NAFO 3NO: 1995-2000. Data converted to *Campelen* units.

Length/Year	1995	1996	1997	1998	1999	2000
6	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	2854.34	0.00
10	1281.22	183.74	0.00	0.00	22893.32	0.00
12	5317.05	6418.13	3521.69	24667.55	195155.86	13677.48
14	81764.16	28900.22	34780.31	0.00	672089.57	189666.84
16	72013.17	79980.54	58967.80	38101.37	536797.81	293424.89
18	180040.31	527526.09	204638.87	296892.44	1003918.98	828630.09
20	262129.65	1568376.09	1237637.55	1381315.52	1155235.97	1537096.76
22	445091.18	2531597.64	3032570.00	2647271.50	3272993.36	2564926.75
24	799175.22	3482613.99	5245377.35	6565240.08	6717095.97	2853476.43
26	604171.80	3417164.94	6004807.84	15314305.37	13881442.44	5737132.54
28	422866.39	2487723.65	5978154.31	22460180.89	25145910.20	11140342.94
30	738940.66	2874032.48	4043251.45	22377124.93	28423905.20	15829439.14
32	964789.15	2463360.99	2178009.98	16323979.54	26229043.95	17707658.65
34	964832.91	2702042.55	1637299.52	10519905.30	18052523.08	15615788.20
36	634386.01	3561942.44	1242981.34	7978711.22	12354680.34	10587132.48
38	477987.31	3414603.53	1107655.37	5286311.50	8773266.58	8129120.19
40	504601.58	2613132.41	1094882.86	4750010.18	5201155.14	5893510.41
42	340513.14	2018192.05	663198.70	3264310.24	3957538.74	4556165.28
44	218236.98	1381154.39	384790.88	1817808.84	2253665.01	3308063.48
46	102258.97	978822.44	115383.26	598809.79	993159.52	1873595.65
48	103915.71	319161.62	32212.06	775828.39	939276.88	1051992.03
50	84936.95	231059.03	77099.89	173212.03	404010.38	554608.82
52	42261.73	69107.49	0.00	0.00	50464.45	209212.05
54	17570.52	0.00	26484.82	0.00	0.00	47043.56
56	5402.91	51272.86	0.00	0.00	0.00	0.00
TOTAL	8074.48	36808.37	34403.71	122593.99	160239.08	110521.70

TABLE 9. Length-Weight relationship in the calculation of American plaice biomass. Spanish Spring Surveys on NAFO 3NO: 1995-2000. The indeterminated (Indet.) data was calculated by mean of males and females. The equation used is:

$$Weight = a * length^{b}$$

		1995	1996	1997	1998	1999	2000
Males	a	0.0055 Error = 0.1552	0.0075 Error = 0.1349	0.0043 Error = 0.1296	0.0041 Error = 0.1200	0.0049 Error = 0.2799	0.0024 Error = 0.1281
	b	3.1272 Error = 0.0447	3.0239 Error = 0.0392	3.1794 Error = 0.0378	3.1943 Error = 0.0348	3.1454 Error = 0.0817	3.3523 Error = 0.0382
		R2 = 0.994 N = 590	R2 = 0.994 N = 233	R2 = 0.995 N = 1050	R2 = 0.996 N = 573	R2 = 0.983 N = 183	R2 = 0.995 N = 321
Females	a	0.0039 Error = .1112	0.0038 Error = 0.1204	0.0027 Error = 0.1058	0.0027 Error = 0.0595	0.0048 Error = 0.1420	0.0020 Error = 0.0981
	b	3.2383 Error = 0.0307	3.2354 Error = 0.0326	3.3263 Error = 0.0291	3.3218 Error = 0.0162	3.1704 Error = 0.0389	3.4049 Error = 0.0271
		R2 = 0.996 N = 477	R2 = 0.994 N = 367	R2 = 0.998 N = 1396	R2 = 0.999 N = 937	R2 = 0.993 N = 201	R2 = 0.998 N = 402
Indet.	a	0.0047	0.0056	0.0035	0.0034	0.0049	0.0022
	b	3.1827	3.1297	3.2528	3.2580	3.1579	3.3786

TABLE 10. Length-Weight relationship in the calculation of Yellowtail flounder biomass. Spanish Spring Surveys on NAFO 3NO: 1995-2000. The indeterminated (Indet.) data was calculated by mean of males and females. The equation used is:

$$Weight = a * length^{b}$$

		1995	1996	1997	1998	1999	2000
Males	a	0.0079 Error = 0.2653	0.0080 Error = 0.0907	0.0081 Error = 0.0936	0.0075 Error = 0.1034	0.0084 Error = 0.2119	0.0036 Error = 0.0994
	b	3.0416 Error = 0.0799	3.0342 Error = 0.0269	3.0197 Error = 0.0281	3.0376 Error = 0.0313	3.0098 Error = 0.0610	3.2403 Error = 0.0300
		R2 = 0.984 N = 137	R2 = 0.998 N = 430	R2 = 0.997 N = 556	R2 = 0.997 N = 523	R2 = 0.994 N = 56	R2 = 0.997 N = 270
Females	a	0.0063 Error = 0.1251	0.0056 Error = 0.0632	0.0056 Error = 0.0517	0.0067 Error = 0.1290	0.0073 Error = 0.2607	0.0026 Error = 0.0914
	b	3.1083 Error = 0.0367	3.1496 Error = 0.0179	3.1382 Error = 0.0152	3.0788 Error = 0.0384	3.0577 Error = 0.0739	3.3504 Error = 0.0267
		R2 = 0.995 N = 246	R2 = 0.999 N = 735	R2 = 0.999 N = 910	R2 = 0.994 N = 682	R2 = 0.989 N = 62	R2 = 0.998 N = 344
Indet.	a	0.0071	0.0068	0.0069	0.0071	0.0079	0.0031
	b	3.0749	3.0919	3.0790	3.0582	3.0338	3.2954

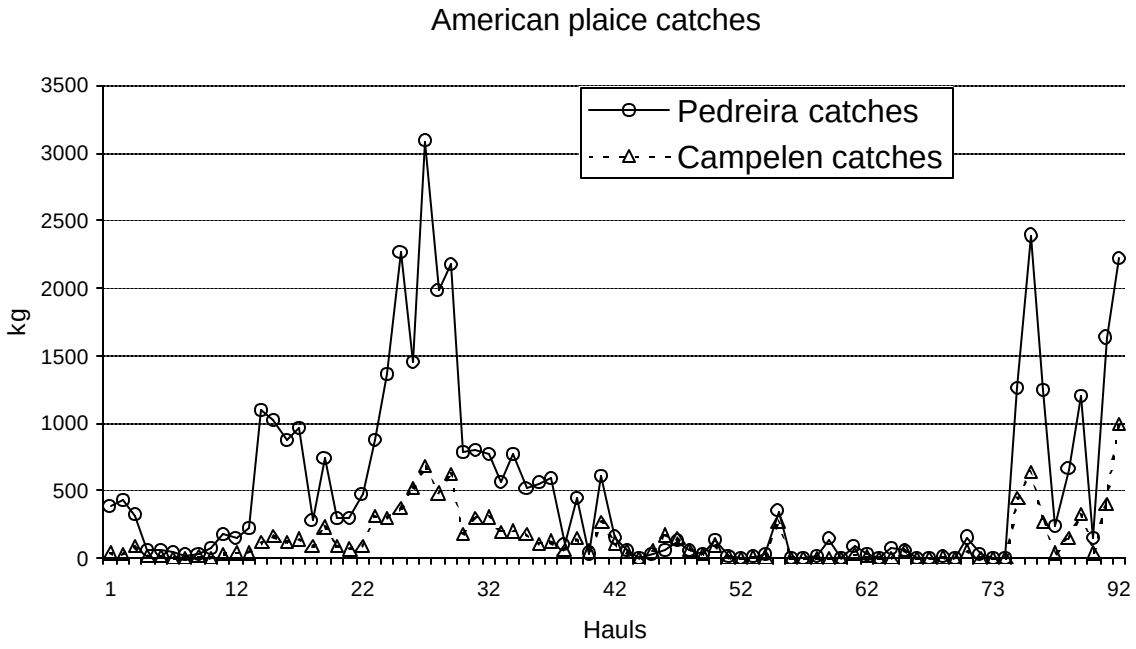

FIG. 1. American plaice comparative catches between *Playa de Menduíña* (*Pedreira* catches) and *Vizconde de Eza* (*Campelen* catches) from paired hauls. Spanish Spring Survey on NAFO 3NO in May 2001.

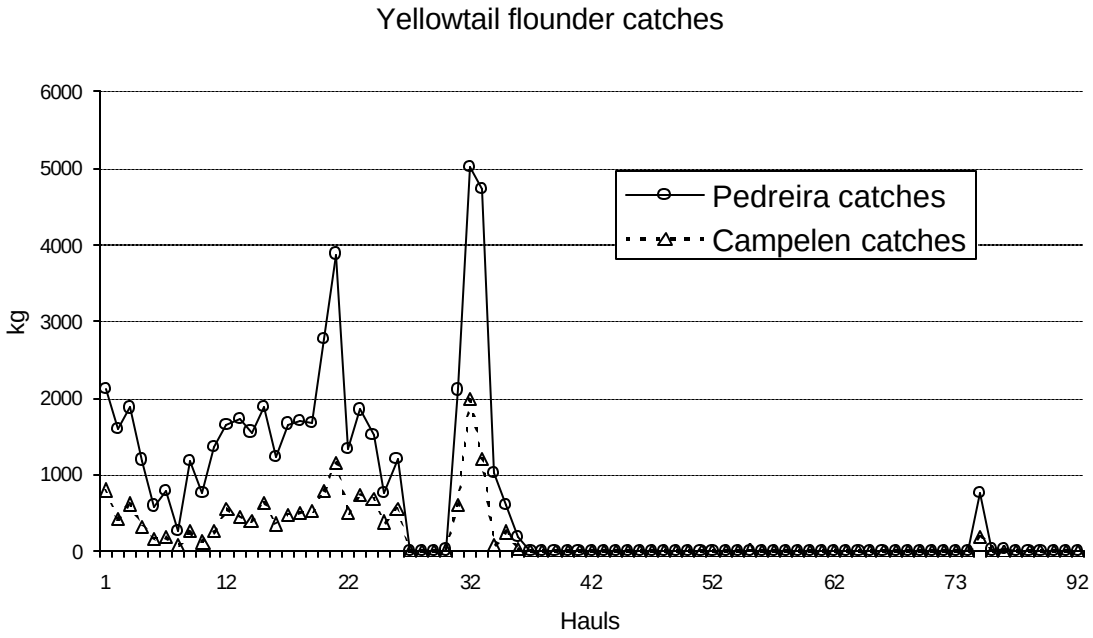

FIG. 2. Yellowtail flounder comparative catches between *Playa de Menduíña* (*Pedreira* catches) and *Vizconde de Eza* (*Campelen* catches) from paired hauls. Spanish Spring Survey on NAFO 3NO in May 2001.

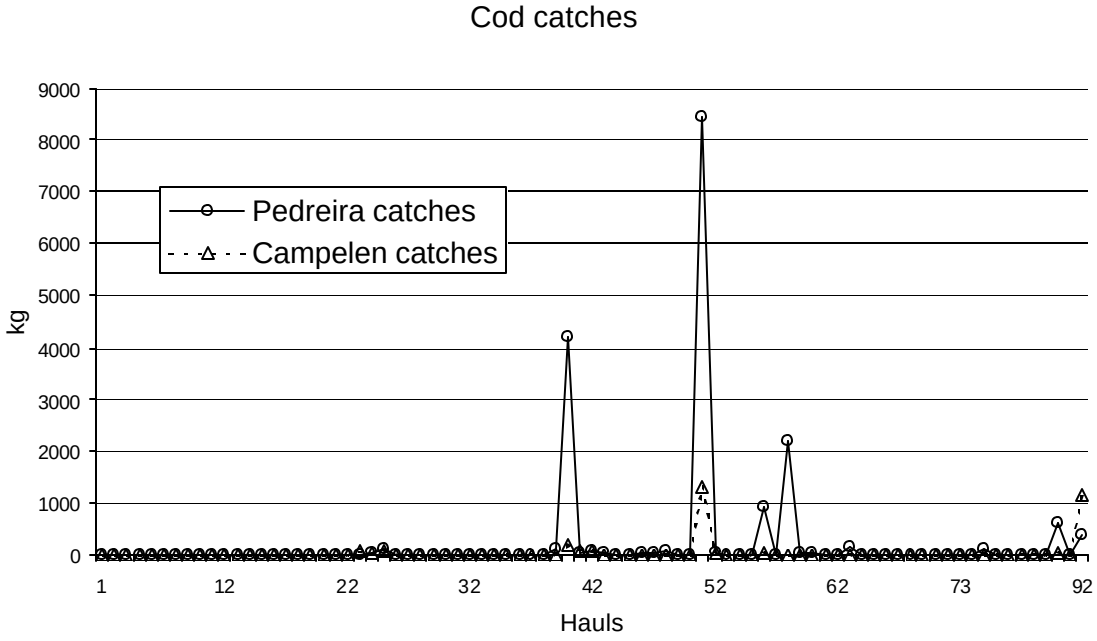

FIG. 3. Cod comparative catches between *Playa de Menduíña* (*Pedreira* catches) and *Vizconde de Eza* (*Campelen* catches) from paired hauls. Spanish Spring Survey on NAFO 3NO in May 2001.

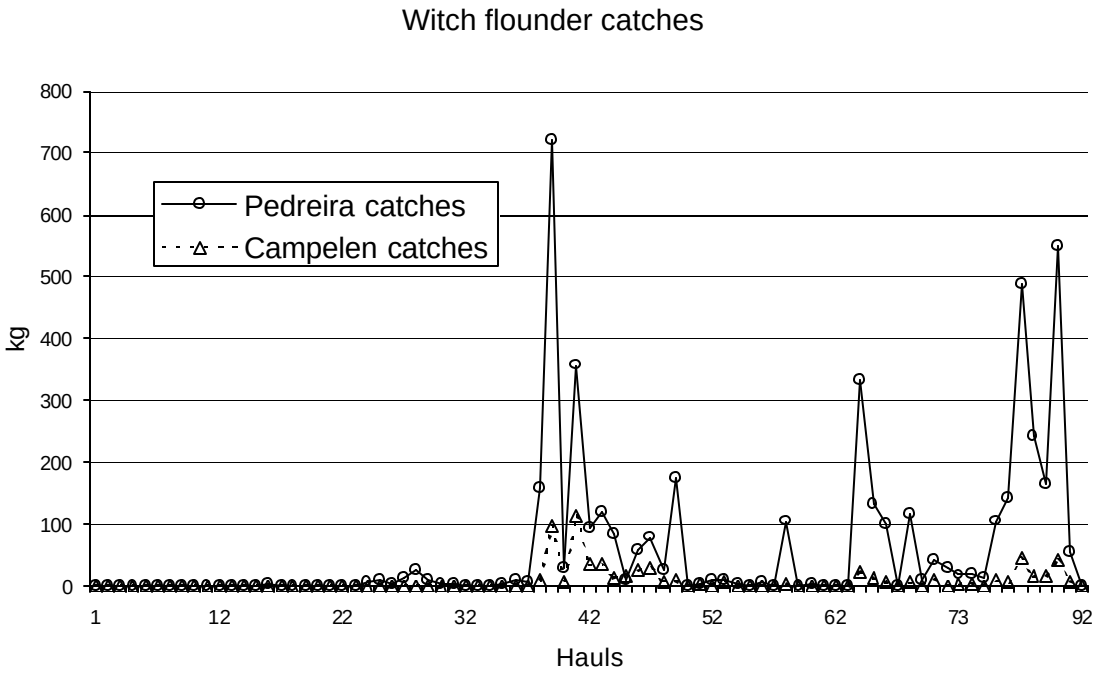

FIG. 4. Witch flounder comparative catches between *Playa de Menduíña* (*Pedreira* catches) and *Vizconde de Eza* (*Campelen* catches) from paired hauls. Spanish Spring Survey on NAFO 3NO in May 2001.

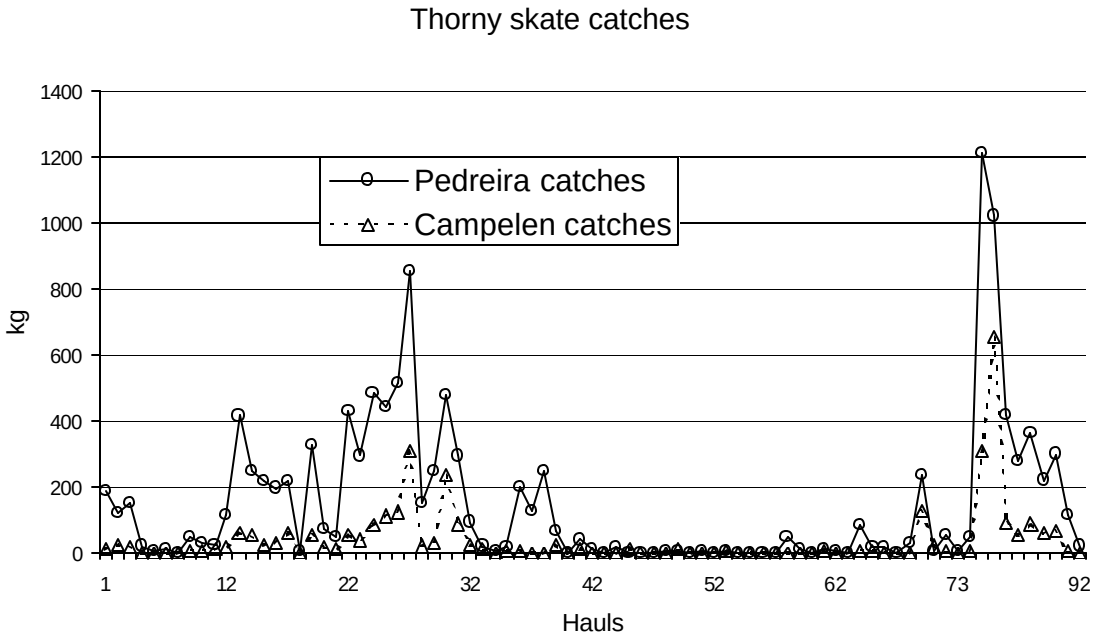

FIG. 5. Thorny skate comparative catches between *Playa de Menduíña* (*Pedreira* catches) and *Vizconde de Eza* (*Campelen* catches) from paired hauls. Spanish Spring Survey on NAFO 3NO in May 2001.

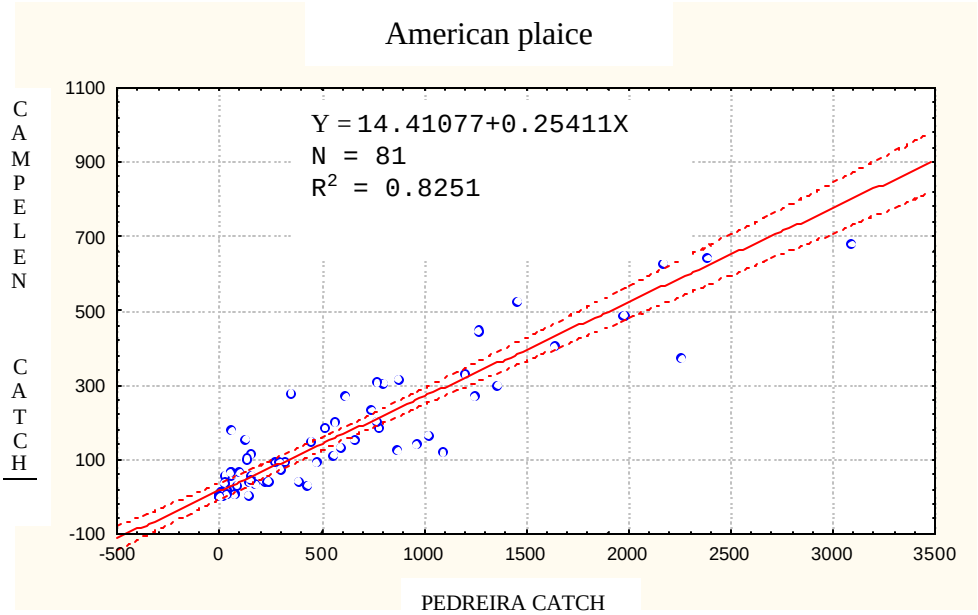

FIG. 6. Regression of *Campelen* catches relative to *Pedreira* catches (both in Kg.) of American plaice. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*. Spanish Spring Survey on NAFO 3NO in May 2001.

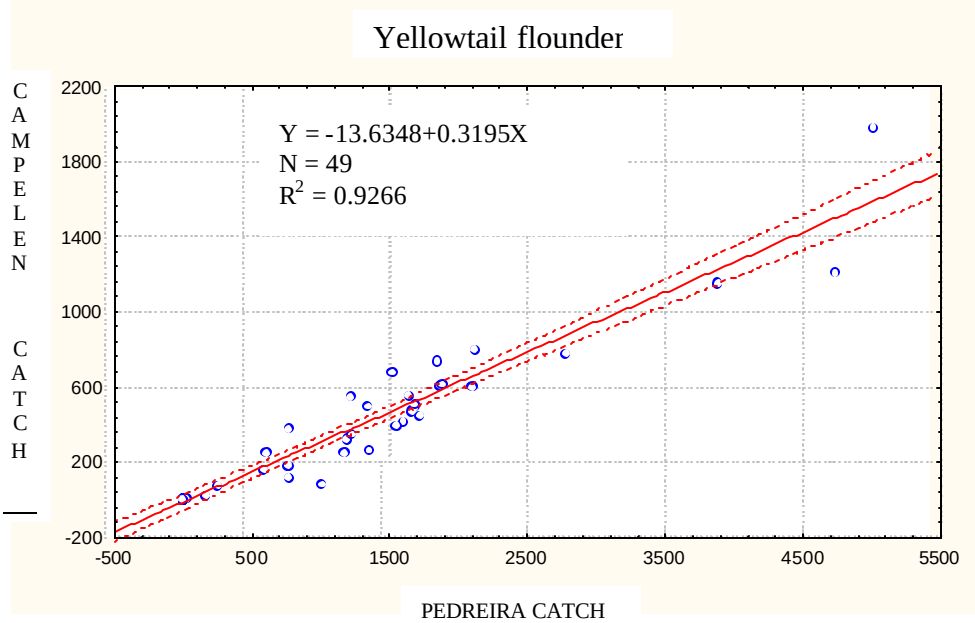

FIG. 7. Regression of *Campelen* catches relative to *Pedreira* catches (both in Kg.) of Yellowtail flounder. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*. Spanish Spring Survey on NAFO 3NO in May 2001.

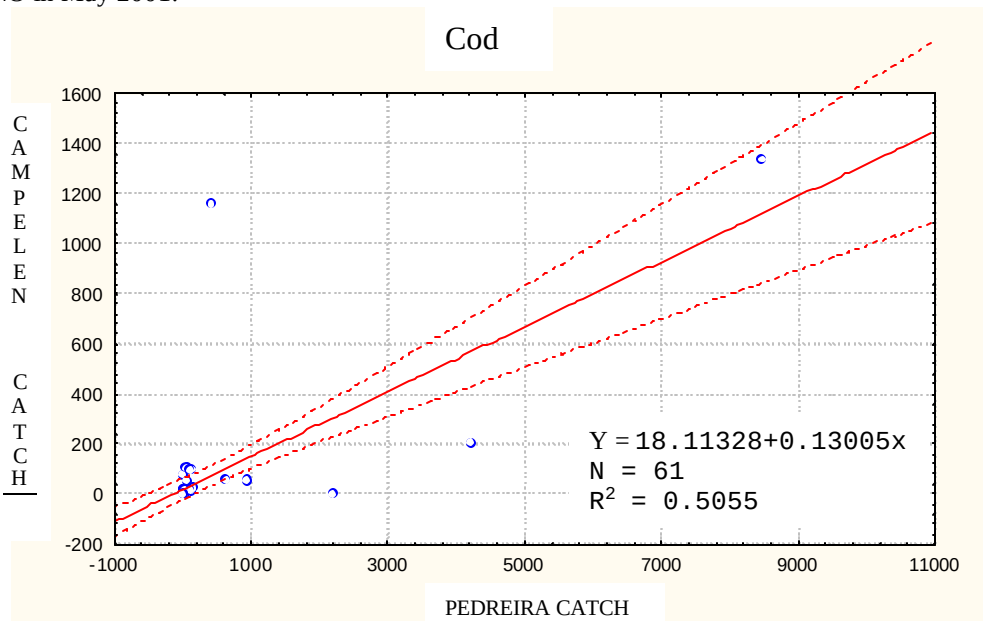

FIG. 8. Regression of *Campelen* catches relative to *Pedreira* catches (both in Kg.) of Cod. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*. Spanish Spring Survey on NAFO 3NO in May 2001.

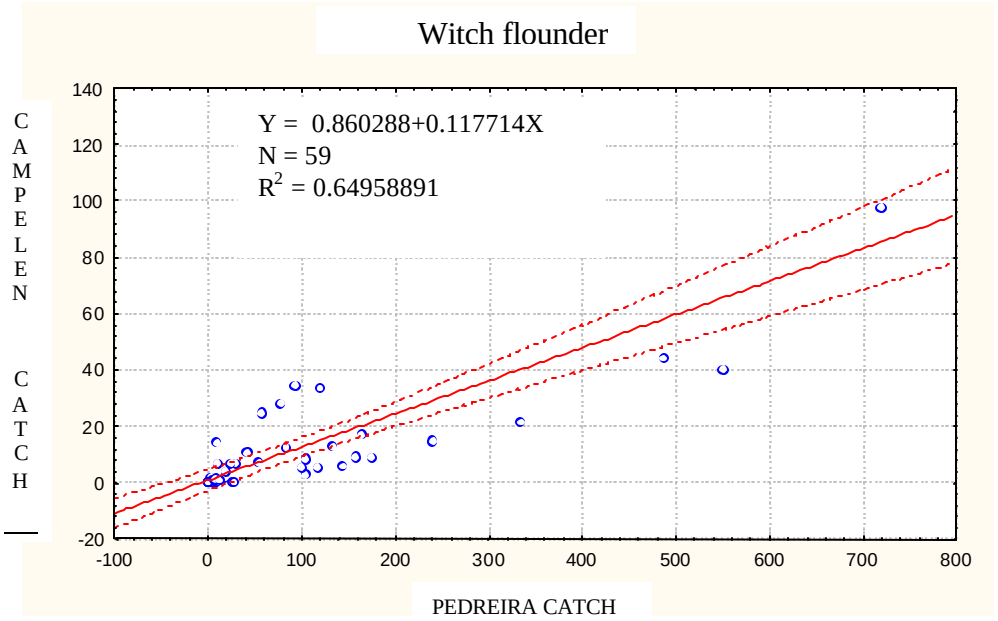

FIG. 9. Regression of *Campelen* catches relative to *Pedreira* catches (both in Kg.) of Witch flounder. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*. Spanish Spring Survey on NAFO 3NO in May 2001.

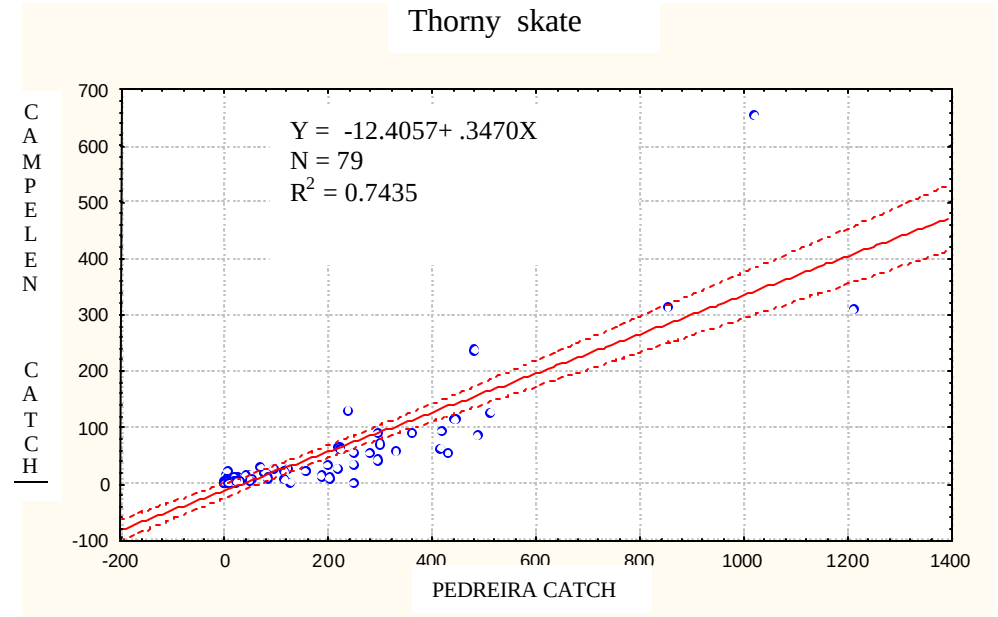

FIG. 10. Regression of *Campelen* catches relative to *Pedreira* catches (both in Kg.) of Thorny skate. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*. Spanish Spring Survey on NAFO 3NO in May 2001.

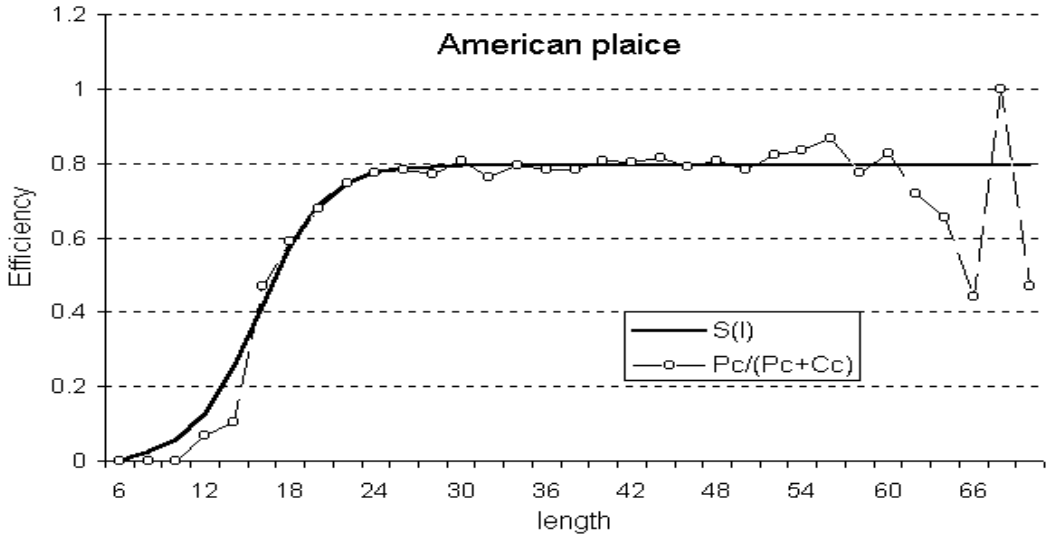

FIG. 11. Efficiency of the *Pedreira* trawl as a function of the *Campelen* trawl for American plaice based in paired hauls between *Playa de Menduíña* and *Vizconde de Eza* on NAFO 3NO in May 2001 using the formulation:

$$E = \frac{Pedreiracatch}{Pedreiracatch + Campelencatch}$$

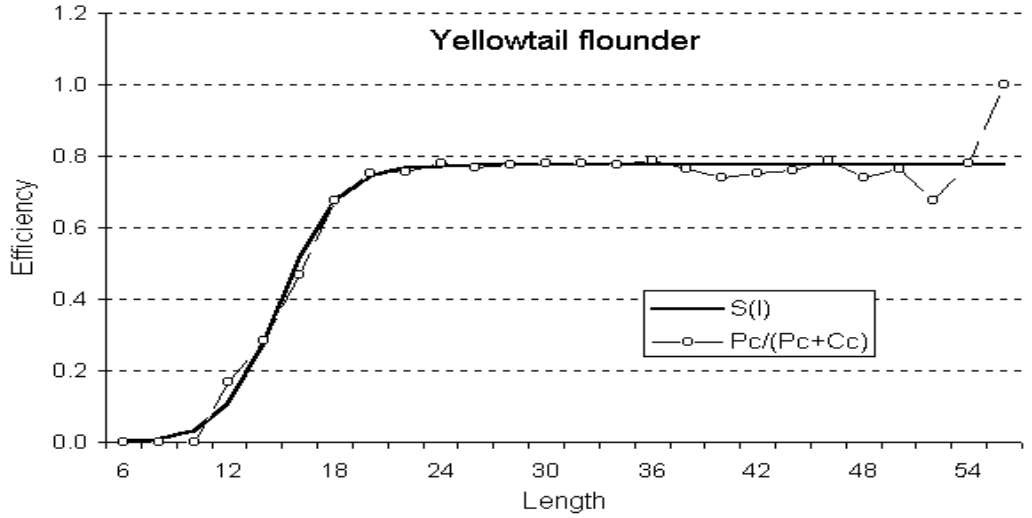

FIG. 12. Efficiency of the *Pedreira* trawl as a function of the *Campelen* trawl for Yellowtail flounder based in paired hauls between *Playa de Menduíña* and *Vizconde de Eza* on NAFO 3NO in May 2001 using the formulation:

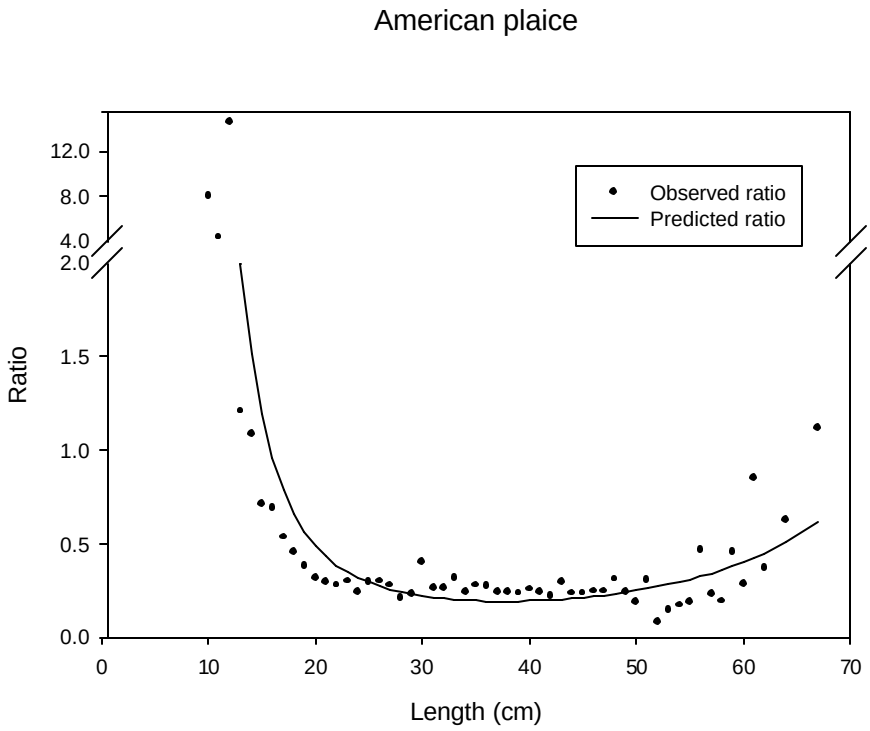

FIG. 13. Ratios of *Campelen* catch to *Pedreira* catch, by length group, of American plaice, from comparative fishing trials between the two gears on the *Playa de Menduíña* and *Vizconde de Eza*. The dots are the observed ratios and the curve is the fitted line.

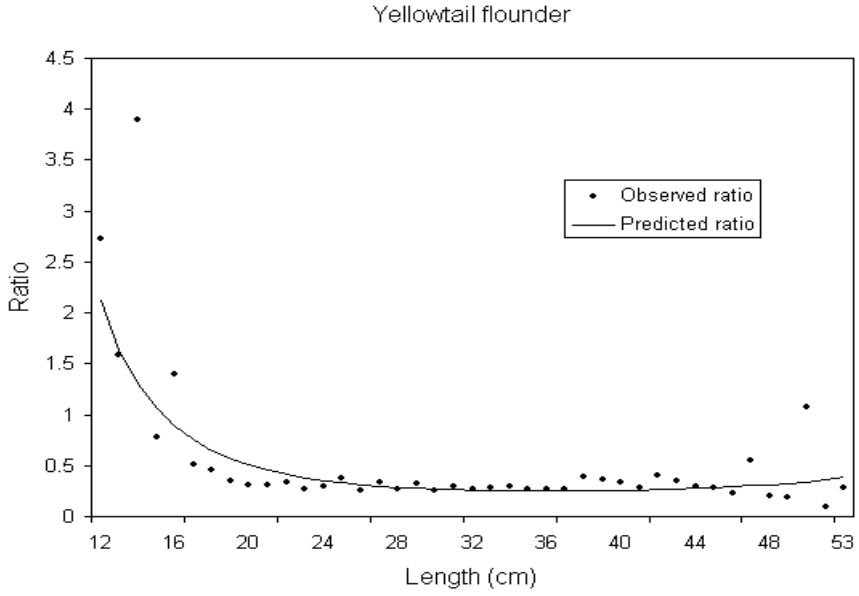

FIG. 14. Ratios of *Campelen* catch to *Pedreira* catch, by length group, of Yellowtail flounder, from comparative fishing trials between the two gears on the *Playa de Menduíña* and *Vizconde de Eza*. The dots are the observed ratios and the curve is the fitted line.

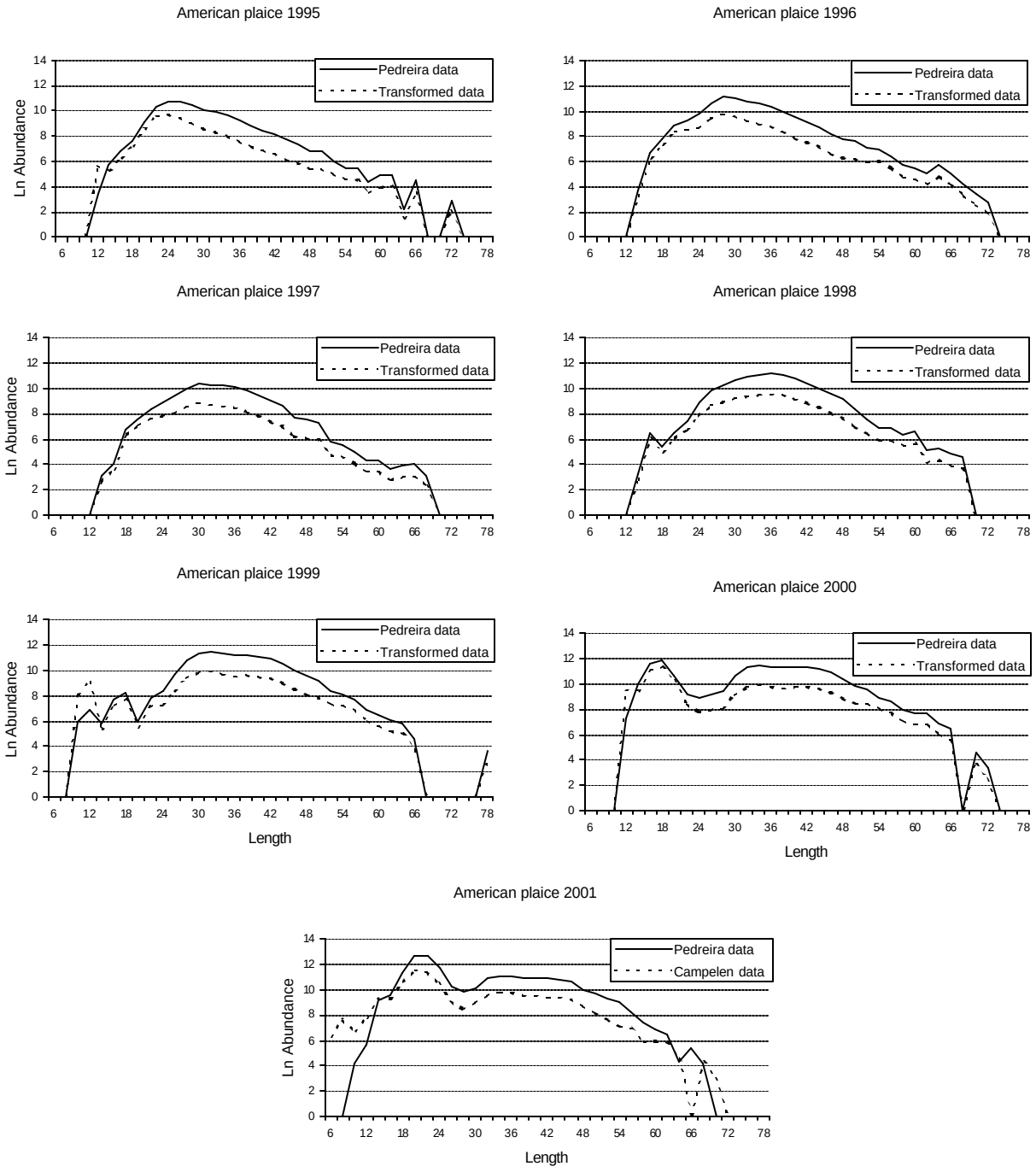

FIG. 15.- American plaice abundance at length since 1995 until 2000 for converted and original *Pedreira* data in logarithms plus 1. For 2001, we present the original *Pedreira* and *Campelen* data. Spanish Spring Surveys on NAFO 3NO. The solid lines shows the original *Pedreira* data, and the dashed lines indicate the transformed into *Campelen* data. Data from paired hauls between *Playa de Menduíña* and *Vizconde de Eza*.

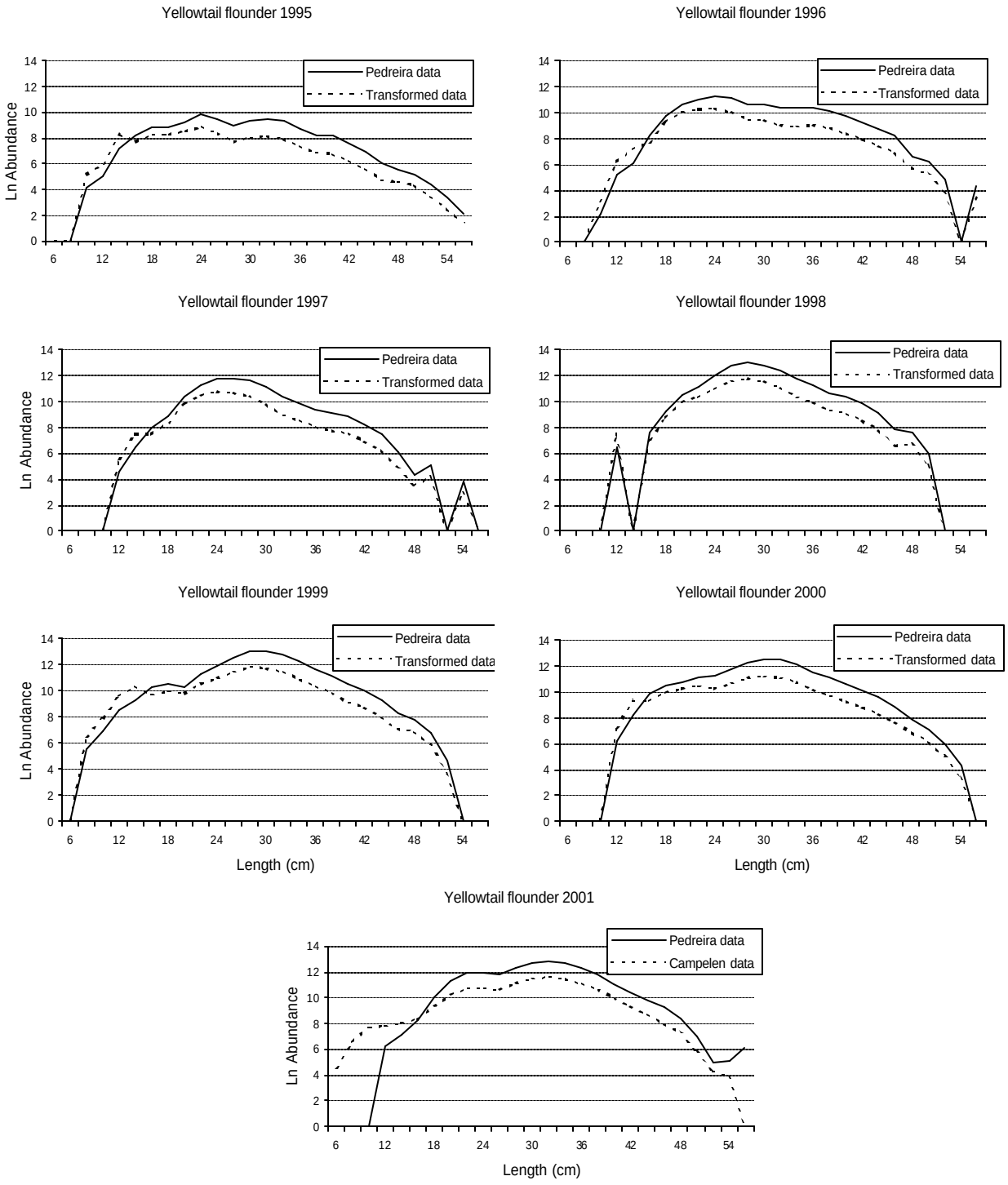

FIG. 16. Yellowtail flounder abundance at length since 1995 until 2000 for converted and original *Pedreira* data in logarithms plus 1. For 2001, we present the original *Pedreira* and *Campelen* data. Spanish Spring Surveys on NAFO 3NO. The solid lines shows the original *Pedreira* data, and the dashed lines indicate the transformed into *Campelen* data. Data from paired hauls between Playa de Menduíña and Vizconde de Eza.

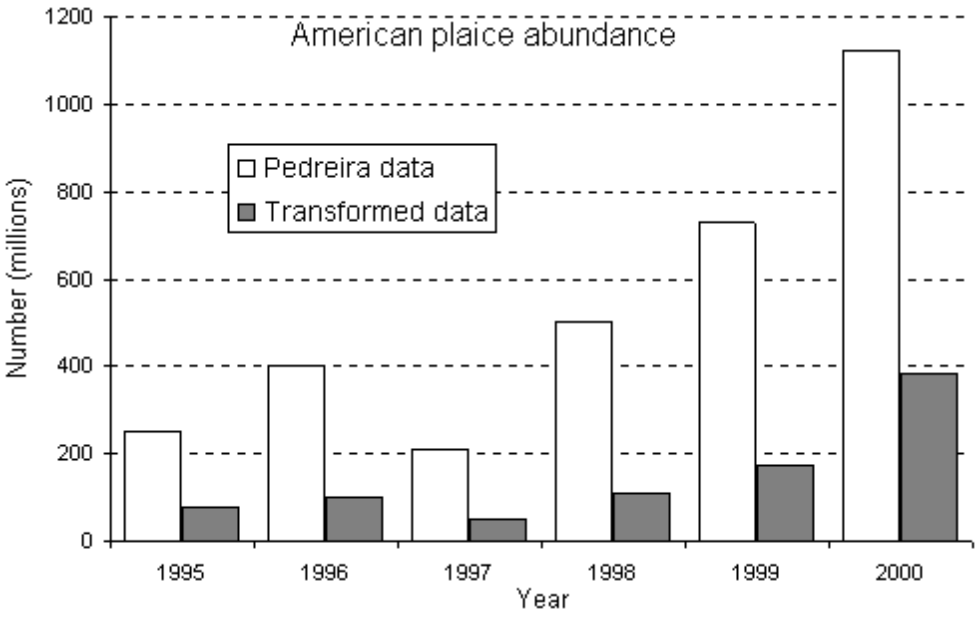

Fig. 17. American plaice abundance for converted and original *Pedreira* data. Spanish Spring Surveys on NAFO 3NO: 1995-2000.

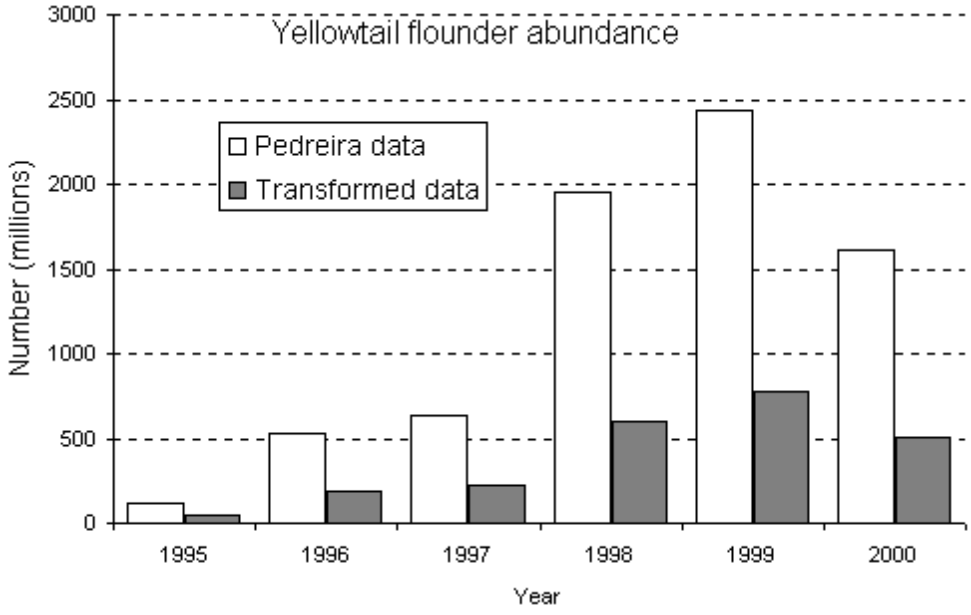

Fig. 18. Yellowtail flounder abundance for converted and original *Pedreira* data. Spanish Spring Surveys on NAFO 3NO: 1995-2000

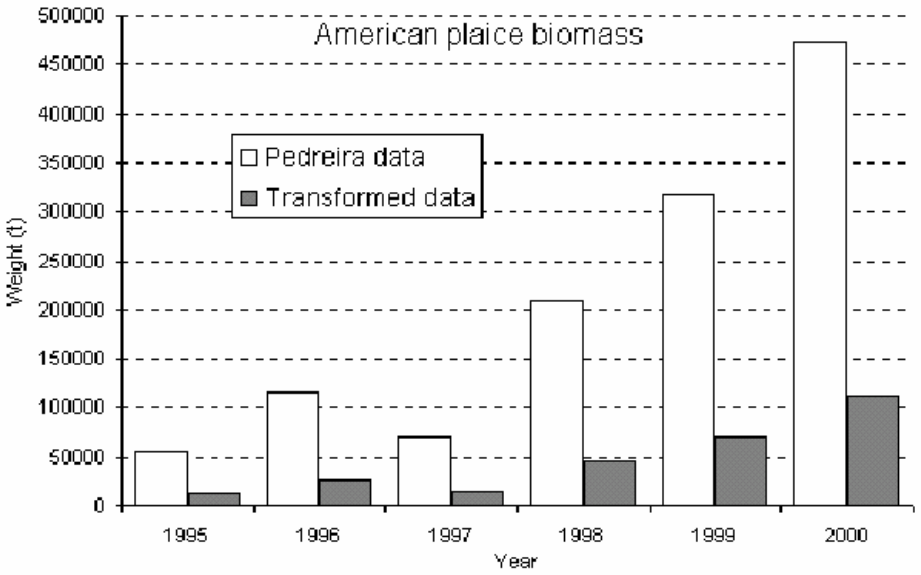

FIG. 19.- American plaice biomass for converted and original *Pedreira* data. Spanish Spring Surveys on NAFO 3NO: 1995-2000

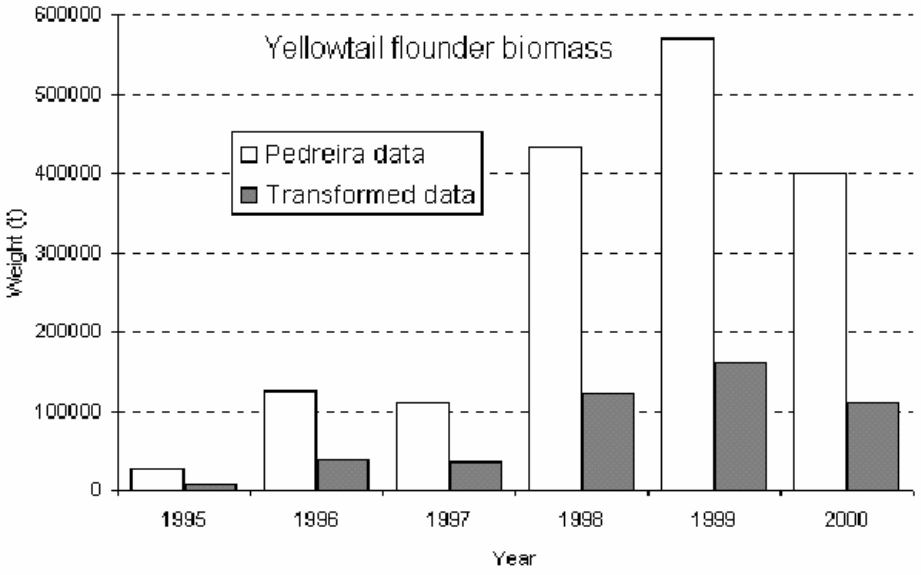

FIG. 20.- Yellowtail flounder biomass for converted and original *Pedreira* data. Spanish Spring Surveys on NAFO 3NO: 1995-2000