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Preliminary Results from the 96 Spanish Bottom Trawl Survey in the NAFO Regulatory Area for Divisions 3NO

by

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As the last year a stratified-random bottom trawl survey was performed in NAFO Regulatory Area (Divisions 3NO) during May: 7th to 24th.

The survey, wich covered offshore areas on the Grand Bank, was conducted following the sames procedures and the same vessel and gear of the 1995 survey (Paz, et al, 1995). The area and strata to be covered by the survey were based on the stratification charts and tables in Bishop (1994).

This year the area covered was extended until 600 fathoms including the strata: 752, 753, 756,757,760,761, 764, 765, 768, 769, 772,773. A total of 112 successful fishing sets were completed, 94 in Div 3N and 18 in Div 3O (Fig. 1).

At touchdown of the net a standard 30 min tow started at a mean speed of 3. Set with trawl damage were excluded from analysis.

From each set, catch for main species along with length frequency from American plaice, Greenland halibut, witch flounder, yellowtail flounder and cod were taken. Otoliths were collected from American plaice, Greenland halibut and cod.

Biomass indeces by strata for these species appear in tables 1 to 5

To compare the results obtain in this survey with those obtained in 1995 (Paz *et al.* 1995) we analized the changes in biomass and distribution in the surveyed area, for 5 species: A. plaice, yellowtail flounder, Greenland halibut, witch flounder and cod, by following the relative changes in the biomass indeces for the different strata sampled in both surveys, calculated as following:

$$Rc = (I95 - I96)/Mean$$

where,

Rc = relative change
I95 = 95 index
I96 = 96 index
Mean = average of I95 and I96

Rc, could range between -2, when, for a particular stratum there was detected some biomass in the 1995 survey and no biomass was detected in 1996, and 2 when the situation

was the opposite. All the positive figures implies increasing biomass index, whereas the negative ones implies reductions.

A table was elaborated for each species (tables 6 -10), showing the stratum code, the 1995 index, the 1996 index, the Rc and the percentage of increment between 1995 and 1996.

To follow whether they appear or not trends in the distributions, the different strata were sorted by depth, and plots of Rc vs. strata were made (fig. 1-5).

American plaice

The overall biomass index of A. plaice increase by an 84% between 1995 and 1996. This increase takes place in the shallower strata, but a reduction is also detected in the deepest ones. A 17 % of the total 1996 biomass appear in the strata not surveyed in 1995 (Table 6, Fig 2). Length distributions for the survey appears in table 11.

Yellowtail flounder

The biomass estimated for this species in 1996 cuadruplicates the 1995 value. The increment takes place in the strata shallower than 100 m depth . However, a reduction in the index occurs in depths between 93 and 185 m. But in 1996 the species also appears at depths deeper than 185 m (Table 7, Fig. 3). The length composition appears in table 12.

Greenland halibut

The overall index increases a 24 % from 1995 to 1996. As in the case of yellowtail flounder, the increase takes place in the shallowest strata, while in the deepest ones a reduction was detected. However, a 90% of the total biomass estimated in 1996, was observed outside the strata sampled in 1995 (Table 8, Fig. 4). length distribution appears in table 13.

Witch flounder

A 37% reduction was detected in the overall index between 1995 and 1996. The pattern of the change in the indices is the same that in the remainder flatfishes (table 9, fig. 5). A 76% of the biomass estimated was detected outside the strata sampled in 1995. Length composition appears in table 14.

Cod

A 21% overall reduction of the biomass index took place between 1995 and 1996. However, when we analyze the evolution by strata, we can observe that only in two of them this reduction effectively takes place. The species appears more widely distributed in 1996, as it was found in four strata that showed 0 abundance in 1995, and increased in eight of the others. A 37 % of the biomass appears outside the 1995 surveyed strata. 80% of the 1995 total biomass estimate appeared concentrated in strata 358. This event phenomenon may be an artifact produced by one or a few very good hauls, that artificially increase the estimate for this particular strata (Table 10 , Fig. 6). Length composition appears in table 15.

REFERENCES

Paz, J.; J. Martinez and E. De Cárdenas. 1995. Preliminary Results from the 95 Spanish Bottom Trawl Survey in the NAFO Regulatory Area for Divisions 3NO. *NAFO SC R Doc* 95/55, Serial N 2568, 9p.

Bishop, C.A..1994. Revisions and additions to stratification schemes used during research vessels surveys in NAFO Subareas 2 and 3. *NAFO SC R Doc* 94/43, Serial N 2413, 23p.

American plaice

Stratum	Area	Number of Hauls	Catch (Kg)	Area trawled	Biomass (Tm)
353	269	3	2085	0.037125	15107.5
354	246	3	1251.05	0.031875	9655.2
355	74	2	355	0.022125	1187.3
356	47	2	49.8	0.02025	115.6
357	164	2	41.25	0.02175	311.0
358	225	3	70.35	0.031875	496.6
359	421	5	724.3	0.05475	5569.5
360	2783	31	7179.2	0.376125	53119.9
374	214	2	74.6	0.02325	686.6
375	271	2	162.6	0.022875	1926.3
376	1334	14	1362.6	0.165	11016.4
377	100	2	151.6	0.022875	662.7
378	139	3	94.5	0.033	398.0
379	106	1	22.1	0.01125	208.2
380	96	2	44.1	0.022125	191.3
381	144	2	42.4	0.022875	266.9
382	343	3	85.9	0.03375	873.0
721	65	2	95.04	0.021375	289.0
722	84	2	46.8	0.020625	190.6
723	155	1	8.9	0.010875	126.9
724	124	2	60.6	0.02025	371.1
725	105	2	5.3	0.0225	24.7
726	72	2	15.1	0.02175	50.0
727	96	2	38.75	0.021	177.1
728	78	2	327.6	0.02175	1174.8
752	131	1	93.3	0.010875	1123.9
753	138	2	1402.2	0.019875	9736.0
756	101	2	141.6	0.021	681.0
757	102	2	545.2	0.01875	2965.9
760	154	2	98.3	0.021	720.9
761	171	2	0	0.019875	0.0
764	100	2	2.9	0.021	13.8
765	124	2	0	0.019875	0.0
33	**8776**	**112**	**16677.94**	**1.26525**	**119437.992**

Total Variance (Biomass) : 19930236.95928 Error: 4464.3294

Table 1.- American plaice

Yellowtail flounder

Stratum	Area	Number of Hauls	Catch (Kg)	Area trawled	Biomass (Tm)
353	269	3	671.8	0.037125	4868
354	246	3	9.95	0.031875	77
355	74	2	1.5	0.022125	5
356	47	2	0	0.02025	0
357	164	2	0	0.02175	0
358	225	3	1.2	0.031875	8
359	421	5	13.7	0.05475	105
360	2783	31	13173.65	0.376125	97474
374	214	2	0	0.02325	0
375	271	2	247.6	0.022875	2933
376	1334	14	2989.45	0.165	24169
377	100	2	0	0.022875	0
378	139	3	0.5	0.033	2
379	106	1	0	0.01125	0
380	96	2	0	0.022125	0
381	144	2	0	0.022875	0
382	343	3	0	0.03375	0
721	65	2	0.2	0.021375	1
722	84	2	0	0.020625	0
723	155	1	0	0.010875	0
724	124	2	0	0.02025	0
725	105	2	0	0.0225	0
726	72	2	0	0.02175	0
727	96	2	0	0.021	0
728	78	2	0	0.02175	0
752	131	1	0	0.010875	0
753	138	2	0	0.019875	0
756	101	2	0	0.021	0
757	102	2	0	0.01875	0
760	154	2	0	0.021	0
761	171	2	0	0.019875	0
764	100	2	0	0.021	0
765	124	2	0	0.019875	0
33	**8776**	**112**	**17109.55**	**1.26525**	**129642**

Total Variance (Biomass) : 45210154.01030 Error: 6723.8496

Table 2.- Yellowtail flounder

Greenland halibut

Stratum	Area	Number of Hauls	Catch (Kg)	Area Trawled	Biomass (Tm)
353	269	3	6.5	0.037125	47.1
354	246	3	39.95	0.031875	308.3
355	74	2	120.7	0.022125	403.7
356	47	2	31.4	0.02025	72.9
357	164	2	96.95	0.02175	731.0
358	225	3	108.5	0.031875	765.9
359	421	5	21.6	0.05475	166.1
360	2783	31	4.3	0.376125	31.8
374	214	2	0	0.02325	0.0
375	271	2	0	0.022875	0.0
376	1334	14	0	0.165	0.0
377	100	2	28.75	0.022875	125.7
378	139	3	51.85	0.033	218.4
379	106	1	56.25	0.01125	530.0
380	96	2	74.3	0.022125	322.4
381	144	2	104.5	0.022875	657.8
382	343	3	25	0.03375	254.1
721	65	2	34.8	0.021375	105.8
722	84	2	66.55	0.020625	271.0
723	155	1	38.8	0.010875	553.0
724	124	2	52.5	0.02025	321.5
725	105	2	29	0.0225	135.3
726	72	2	32.85	0.02175	108.7
727	96	2	87.5	0.021	400.0
728	78	2	388.2	0.02175	1392.2
752	131	1	170.6	0.010875	2055.0
753	138	2	502.5	0.019875	3489.1
756	101	2	634	0.021	3049.2
757	102	2	1029.55	0.01875	5600.8
760	154	2	261.8	0.021	1919.9
761	171	2	650.6	0.019875	5597.6
764	100	2	476.1	0.021	2267.1
765	124	2	375.7	0.019875	2344.0
33	**8776**	**112**	**5601.6**	**1.26525**	**34245.5**

Total Variance (Biomass) : 3766773.16466 Error:1940.81765

Table 3.- Greenland halibut.

Witch flounder

Stratum	Area	Number of Hauls	Catch (Kg)	Area Trawled	Biomass (Tm)
353	269	3	33	0.037125	239.1
354	246	3	31.9	0.031875	246.2
355	74	2	277	0.022125	926.5
356	47	2	71.75	0.02025	166.5
357	164	2	58.2	0.02175	438.8
358	225	3	84.3	0.031875	595.1
359	421	5	15.4	0.05475	118.4
360	2783	31	52.8	0.376125	390.7
374	214	2	0	0.02325	0.0
375	271	2	0	0.022875	0.0
376	1334	14	2.6	0.165	21.0
377	100	2	0	0.022875	0.0
378	139	3	0	0.033	0.0
379	106	1	0	0.01125	0.0
380	96	2	0	0.022125	0.0
381	144	2	0.6	0.022875	3.8
382	343	3	0	0.03375	0.0
721	65	2	68.8	0.021375	209.2
722	84	2	194.5	0.020625	792.1
723	155	1	5.65	0.010875	80.5
724	124	2	29.55	0.02025	180.9
725	105	2	4.7	0.0225	21.9
726	72	2	4.15	0.02175	13.7
727	96	2	1.05	0.021	4.8
728	78	2	14.35	0.02175	51.5
752	131	1	22.9	0.010875	275.9
753	138	2	56.25	0.019875	390.6
756	101	2	3.4	0.021	16.4
757	102	2	66	0.01875	359.0
760	154	2	82.1	0.021	602.1
761	171	2	207.9	0.019875	1788.7
764	100	2	181.3	0.021	863.3
765	124	2	99.7	0.019875	622.0
33	**8776**	**112**	**1669.85**	**1.26525**	**9418.8**

Total Variance (Biomass) : 372456.76760 Error: 610.29236

Table 4.- Witch flounder

Cod

Stratum	Area	Number of Hauls	Catch (Kg)	Area trawled	Biomass (Tm)
353	269	3	0.6	0.037125	4.347
354	246	3	22.2	0.031875	171.332
355	74	2	22.95	0.022125	76.759
356	47	2	20.9	0.02025	48.509
357	164	2	42.85	0.02175	323.099
358	225	3	97.1	0.031875	685.412
359	421	5	1.4	0.05475	10.765
360	2783	31	309.75	0.376125	2291.883
374	214	2	0.5	0.02325	4.602
375	271	2	0.9	0.022875	10.662
376	1334	14	12.8	0.165	103.486
377	100	2	10.2	0.022875	44.59
378	139	3	101.95	0.033	429.426
379	106	1	19.9	0.01125	187.502
380	96	2	8.6	0.022125	37.315
381	144	2	6.7	0.022875	42.177
382	343	3	7.5	0.03375	76.222
721	65	2	39.05	0.021375	118.749
722	84	2	370.5	0.020625	1508.946
723	155	1	27.5	0.010875	391.954
724	124	2	3.6	0.02025	22.044
725	105	2	190.95	0.0225	891.1
726	72	2	147.65	0.02175	488.772
727	96	2	20.15	0.021	92.114
728	78	2	256	0.02175	918.069
752	131	1	0	0.010875	0
753	138	2	0	0.019875	0
756	101	2	2.5	0.021	12.024
757	102	2	0	0.01875	0
760	154	2	0	0.021	0
761	171	2	0	0.019875	0
764	100	2	0	0.021	0
765	124	2	0	0.019875	0
33	**8776**	**112**	**1744.7**	**1.26525**	**8991.86**

Total Variance (Biomass) : 1469280.2 5480 Error: 1212.1387

Table 5.- Cod

Str.	1995	1996	Incr.	%Incr.
375	165	1926	1.684	1067
376	2072	11016	1.367	432
353	5230	15108	0.971	189
360	27461	53120	0.637	93
374	201	687	1.094	241
354	8395	9555	0.129	14
359	6737	5590	-0.186	-17
377	231	663	0.966	187
358	1526	497	-1.018	-67
378	458	398	-0.141	-13
357	428	311	-0.316	-27
379	404	208	-0.639	-48
725	418	25	-1.777	-94
724	398	371	-0.070	-7
726	57	50	-0.127	-12
Total	54180	99524	0.590	84

Table 6.- American plaice, comparison of selected strata.

Str.	1995	1996	Incr.	%Incr.
375	107	2933	1.859	2645
376	12137	24169	0.663	99
353	398	4868	1.697	1122
360	14803	97474	1.473	558
374	0	0		
354	112	77	-0.367	-31
359	148	105	-0.338	-29
377	0	0		
358	0	8	2.000	***
378	0	2	2.000	***
357	0	0		
379	0	0		
725	0	0		
724	0	0		
726	0	0		
Total	27704	129636	1.296	368

Table 7.- Yellowtail flounder, comparison of selected strata.

Str.	1995	1996	Incr.	%Incr.
375	0	0		
376	0	0		
353	0	47	2.000	***
360	20	32	0.459	60
374	0	0		
354	88	308	1.112	251
359	39	166	1.239	325
377	7	126	1.782	1639
358	510	766	0.401	50
378	113	218	0.635	93
357	138	731	1.365	430
379	292	530	0.579	81
725	162	135	-0.178	-16
724	1075	322	-1.079	-70
726	378	109	-1.106	-71
Total	2822	3490	0.212	24

Table 8.- Greenland halibut, comparison of selected strata.

Str.	1995	1996	Incr.	%Incr.
375	0	0		
376	0	21	2.000	***
353	62	239	1.178	287
360	328	391	0.174	19
374	0	0		
354	491	246	-0.663	-50
359	155	118	-0.268	-24
377	0	0		
358	796	595	-0.289	-25
378	6	0	-2.000	-100
357	5	439	1.959	9587
379	18	0	-2.000	-100
725	108	22	-1.324	-80
724	1200	181	-1.476	-85
726	418	14	-1.873	-97
Total	3585	2266	-0.451	-37

Table 9.- Witch flounder, comparison of selected strata.

Str.	1995	1996	Incr.	%Incr.
375	0	11	2.000	***
376	44	104	0.813	137
353	0	4	2.000	***
360	127	2292	1.790	1709
374	2	5	0.636	93
354	13	171	1.727	1264
359	0	11	2.000	***
377	0	45	2.000	***
358	5745	685	-1.574	-88
378	198	429	0.737	117
357	108	323	0.999	200
379	510	188	-0.925	-63
725	449	891	0.659	98
724	0	22	2.000	***
726	3	489	1.973	14404
Total	7200	5669	-0.238	-21

Table 10.- Cod, comparison of selected strata.

Length	Males	Females	Indetermin
14	0.05	0.39	0.21
16	0.97	2.31	0.20
18	3.65	7.75	0.10
20	5.73	13.51	0.32
22	14.83	17.41	0.29
24	43.04	24.97	0.29
26	90.22	58.40	0.29
28	82.90	88.97	0.00
30	48.87	91.38	0.00
32	30.41	82.02	0.00
34	19.71	74.31	0.10
36	12.78	58.74	0.00
38	4.81	36.07	0.00
40	2.30	23.16	0.00
42	2.42	19.03	0.00
44	0.42	11.77	0.00
46	0.52	6.45	0.00
48	0.04	5.71	0.00
50	0.06	3.34	0.00
52	0.00	2.57	0.00
54	0.00	2.29	0.00
56	0.00	0.95	0.00
58	0.00	0.95	0.00
60	0.00	0.32	0.00
62	0.00	0.55	0.00
64	0.00	0.85	0.00
66	0.00	0.04	0.00
68	0.00	0.25	0.00
70	0.00	0.04	0.00
TOTAL	363.72	634.49	1.79
Nº sampled	6538	10101	21
Nº Sampling	99		
Total Catch	16678		
Catch samp	15468		
Total hauls	112		

Table 11.- Length distribution of American plaice.

Length	Males	Females	Indetermin
10	0.0	0.0	0.3
12	0.0	0.0	0.4
14	0.0	0.0	3.0
16	0.6	6.6	10.7
18	5.8	38.1	7.7
20	15.3	78.0	2.2
22	27.9	105.7	0.2
24	39.5	116.3	0.0
26	37.2	65.8	0.0
28	38.3	48.3	0.0
30	31.5	43.1	0.0
32	29.1	27.7	0.0
34	25.9	31.9	0.0
36	19.5	44.3	0.0
38	9.8	31.1	0.0
40	3.4	23.2	0.0
42	3.2	14.8	0.0
44	0.4	6.8	0.0
46	0.3	4.2	0.0
48	0.0	1.2	0.0
50	0.0	0.1	0.0
52	0.0	0.2	0.0
54	0.0	0.1	0.0
TOTAL	287.9	687.7	24.4
Nº sampled	1837	4584	249
Nº Sampling	33		
Total Catch	17110		
Catch samp	16250		
Nº Hauls	112		

Table 12.- Length distribution of yellowtail flounder.

Length	Males	Females	Indetermin
12	0.0	0.0	1.1
14	0.0	0.9	3.3
16	0.3	0.6	0.0
18	5.4	7.8	0.0
20	29.7	51.6	0.6
22	46.1	83.0	1.6
24	19.0	30.2	0.4
26	18.6	25.6	0.0
28	21.5	37.0	0.0
30	18.0	29.1	0.0
32	22.0	36.0	0.0
34	27.8	39.7	0.0
36	31.6	41.6	0.0
38	27.9	47.7	0.0
40	28.4	42.2	0.0
42	18.6	32.5	0.0
44	16.6	35.5	0.0
46	9.1	17.4	0.0
48	10.1	24.3	0.0
50	4.1	9.3	0.0
52	2.3	6.0	0.0
54	1.6	9.5	0.0
56	3.8	6.5	0.0
58	1.0	4.9	0.0
60	0.5	2.6	0.0
62	0.0	2.1	0.0
64	0.2	2.3	0.0
66	0.0	0.2	0.0
68	0.0	0.3	0.0
70	0.0	0.4	0.0
72	0.0	0.5	0.0
74	0.0	0.2	0.0
76	0.0	0.2	0.0
78	0.0	0.2	0.0
80	0.0	0.2	0.0
82	0.0	0.3	0.0
84	0.0	0.2	0.0
86	0.0	0.2	0.0
88	0.0	0.2	0.0
90	0.0	0.1	0.0
TOTAL	364.0	629.0	7.0
Nº sampled	2867	4667	60
Nº Sampling	52		
Total Catch	5602		
Catch samp	5496		
Nº Hauls	112		

Table 13.- Length distribution of Greenland halibut.

Length	Males	Females	Indetermin
20	0.0	0.4	1.1
22	0.0	1.5	0.0
24	2.9	2.6	1.5
26	4.3	9.6	1.1
28	18.3	29.0	1.1
30	37.1	59.0	0.0
32	49.1	103.0	0.0
34	77.1	128.1	0.0
36	52.3	115.4	0.0
38	28.5	71.9	0.0
40	20.2	48.9	0.0
42	14.3	34.1	0.0
44	7.7	19.1	0.0
46	3.4	19.9	0.0
48	1.1	14.1	0.0
50	1.1	9.4	0.0
52	0.4	3.3	0.0
54	0.0	3.1	0.0
56	0.0	1.5	0.0
58	0.0	3.2	0.0
60	0.0	0.0	0.0
62	0.0	0.4	0.0
TOTAL	317.8	677.3	4.9
Nº sampled	504	1095	13
Nº Sampling	15		
Total Catch	1670		
Catch samp	849		
Nº Hauls	112		

Table 14.- Length distribution of witch flounder.

Length	Number
18	2.3
21	23.9
24	86.9
27	110.1
30	76.6
33	114.7
36	209.1
39	167.9
42	81.0
45	32.3
48	27.7
51	16.7
54	16.5
57	11.8
60	9.7
63	4.7
66	3.6
69	2.1
72	1.9
75	0.3
78	0.2
TOTAL	1000
Nº sampled.	2262

Nº Sampling	34
Total Catch	1745
Catch sampl	1665
Nº Hauls	112

Table 14.- Length distribution of cod.

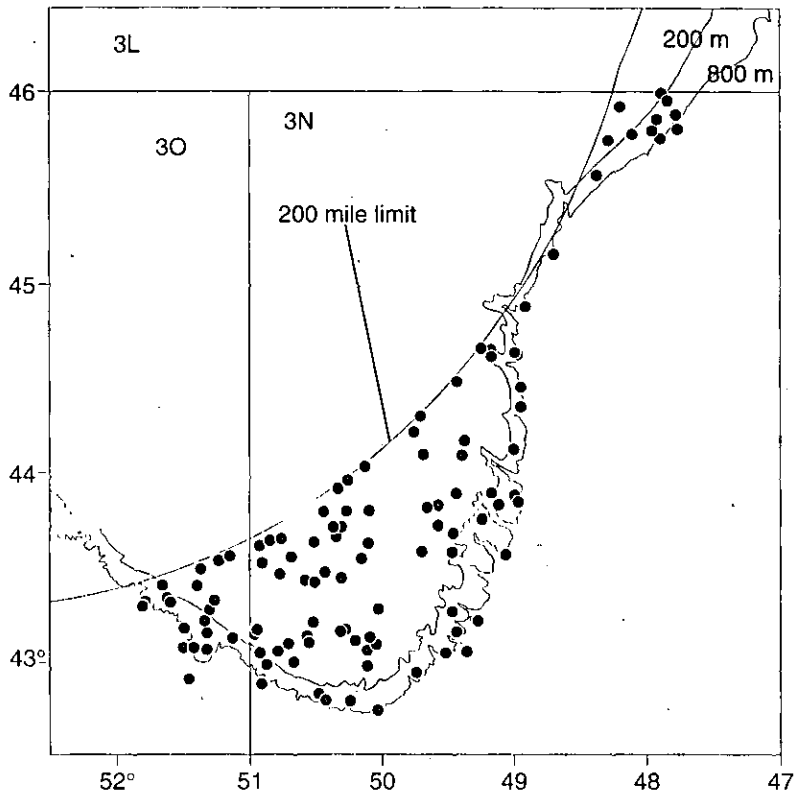

Figure 1 : Distribution of fishing stations during 1996 Spanish trawling survey in 3NO

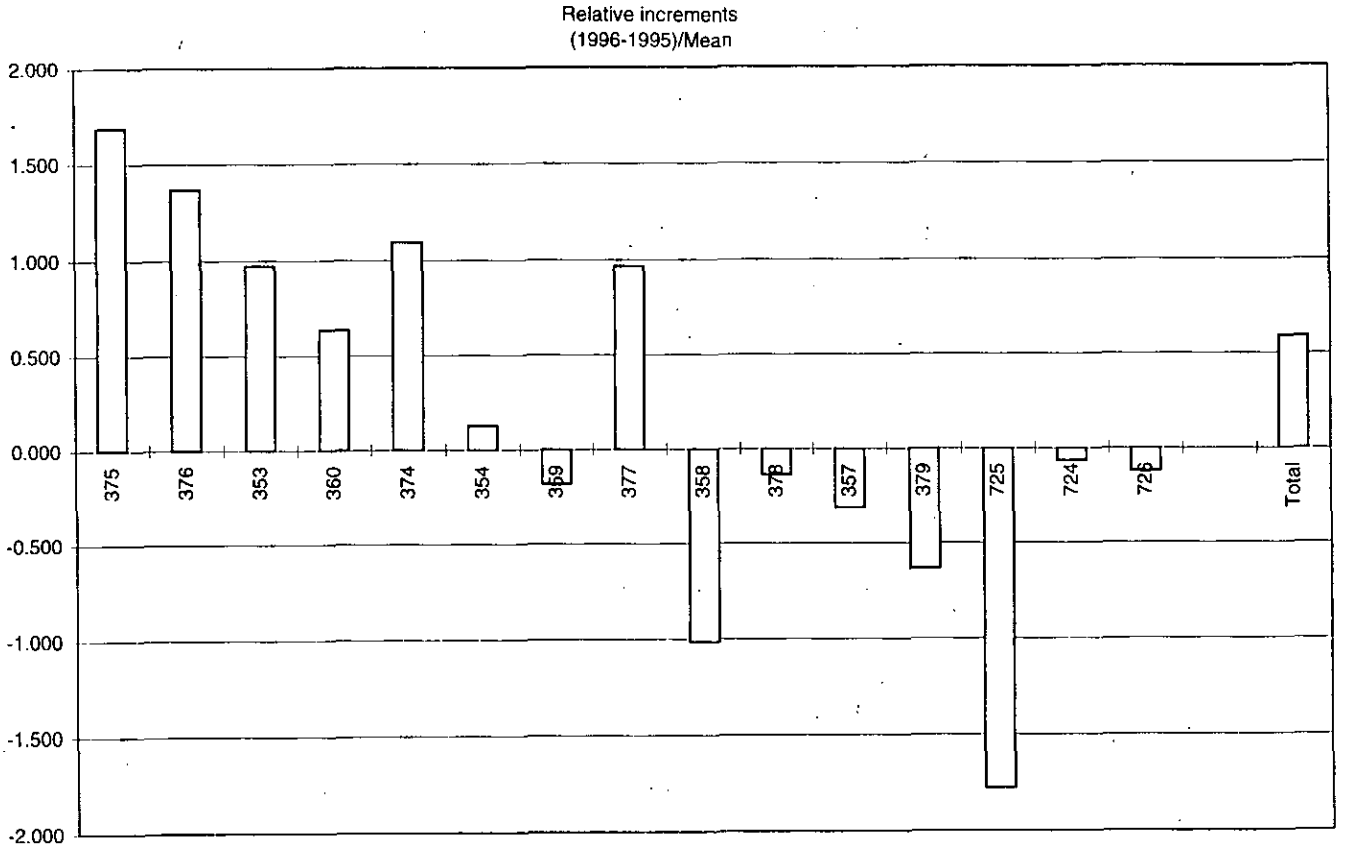

Fig. 2.- Comparison of A. plaice biomass between 1995 and 1996 surveys

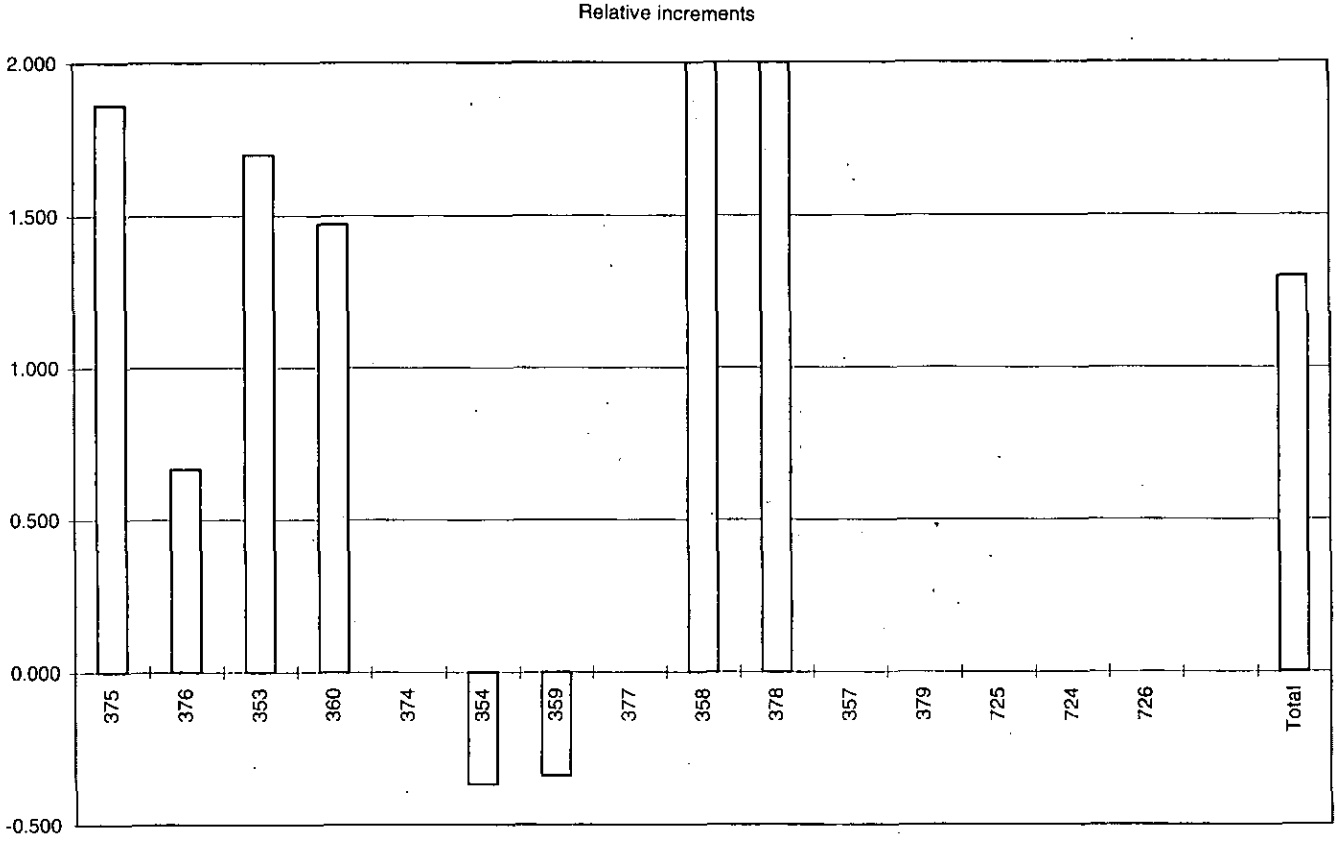

Fig. 3.- Comparison of yellowtail flounder biomass between 1995 and 1996 surveys.

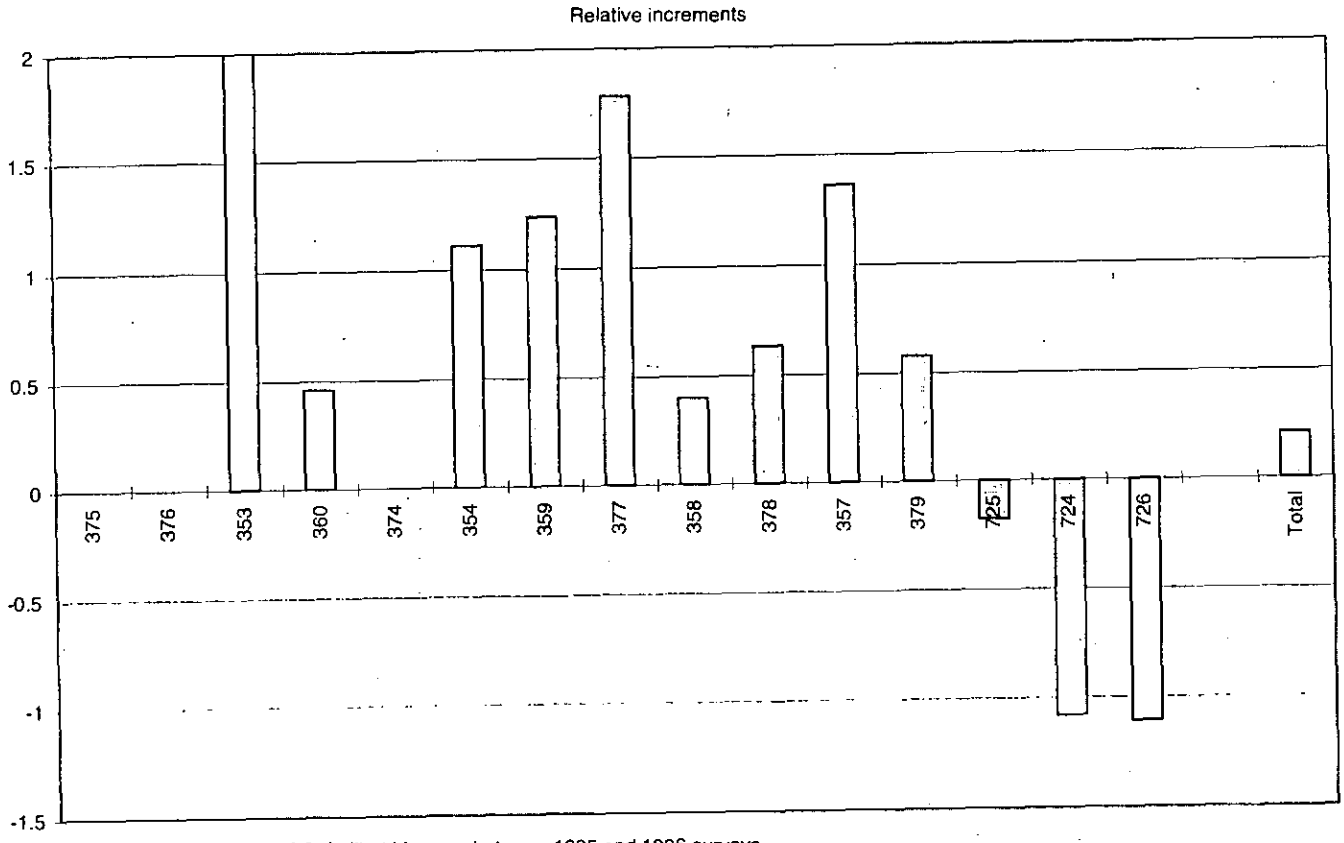

Fig 4.- Comparisons of G. halibut biomass between 1995 and 1996 surveys

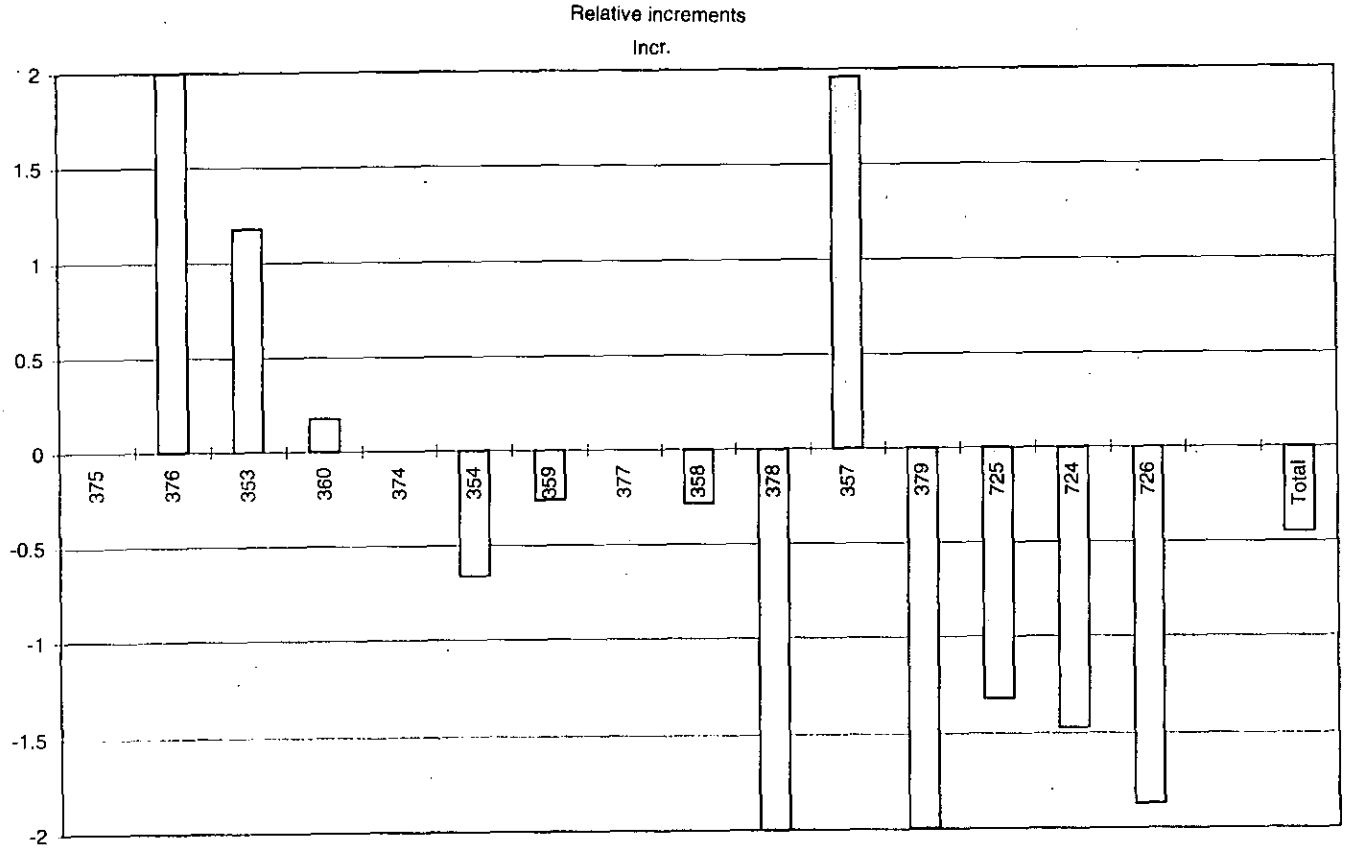

Fig. 5.- Comparison of wich flounder biomass between 1995 and 1996 surveys

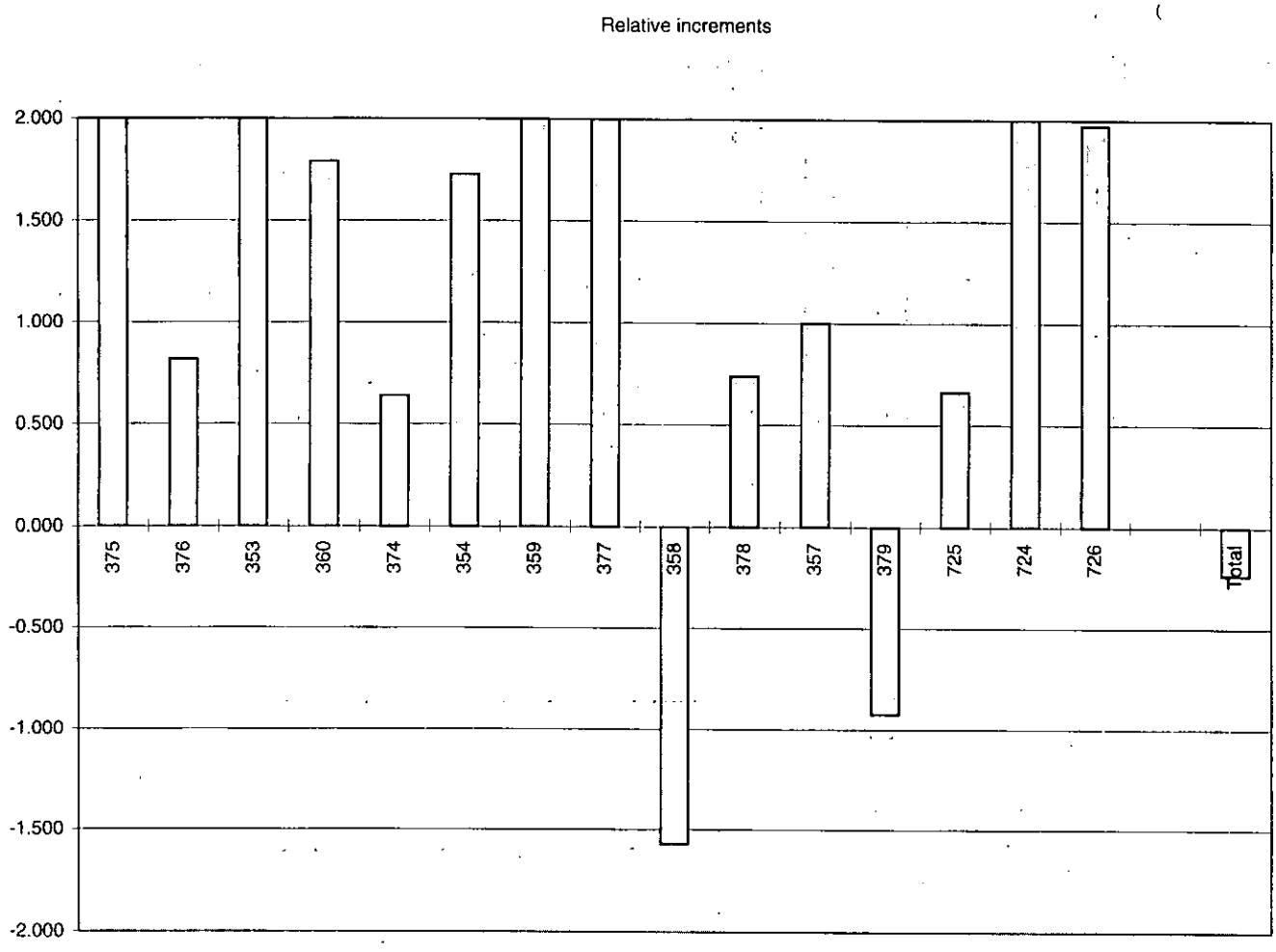

Fig. 6.- Comparison of cod biomass between 1995 and 1996 surveys