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Depth Distribution of the Effort, CPUE, Proportion of Mature and Oversized in the Catches of the Spanish Fisheries in NAFO Area

by

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Abstract

This paper reports an analysis of the depth distribution of effort and CPUE of the Spanish fleet, as well as undersized fish proportions and mature rates in the Spanish catches of five different species (Greenland halibut, American plaice, cod, yellowtail flounder, skate). Data were collected by the Spanish scientific observer program in the areas NAFO Div. 3LMNO during the period 1996-2000.

More than 80% of the annual effort is carried out in the strata of 600-800, 800-1000 and >1000 meters. The species with highest yields in these strata is the Greenland halibut. 10% of the effort is carried out in the stratum of <200 meters and within this the highest yields correspond to skate and American plaice.

The proportion of mature fish in the catches depends on depth for Greenland halibut and skate, whilst for the rest of the species the proportions of mature fish are bigger and more stable. The percentage of oversized fish is quite high, bigger than 95% in all species and ranges of depth.

Introduction

The Scientific Council were requested to evaluate the distribution of the fishable biomass of the main commercial fish species in relation to depth. Separate values should be provided for fish above and below the length of 50% maturity and for fish above and below the current minimum landing size. This work seeks to contribute relevant information to answer this query through the analysis of the data collected by the Spanish scientific observers.

The selected depth strata to carry out the analysis of the information were 6: <199, 200-399, 400-599, 600-799, 800-999, >1000.

Spanish fleet formerly targeted exclusively Greenland halibut but, since 1996, part of the fleet started to undertake occasionally the skate fishery on the southern Grand Bank Regulatory Area in shallow waters. The analysed data belong to both fisheries.

Materials and Methods

Several sources of information were utilised in this study:

Data from the Spanish commercial fishery (catch, effort) were recorded by scientific observers of the national sampling network (1996-2000). Data records were characterised by the vessel, date, depth and NAFO division and

they were available in tow-by-tow basis. The analysed CPUE data were not standardised, but may be used as indices of abundance to obtain a global insight of the depth distribution of the fishable biomass of the study species.

Greenland halibut, American plaice, cod, skate and yellowtail flounder length distributions, by 200 meters intervals weighted to the sampled catch, were used to obtain the proportion of mature fish in the sample catches by applying the corresponding maturity ogive. Table 1 shows the number of samples and the number of specimens sampled by year, depth strata and species.

The same length distributions were used to obtain the proportion of undersized fish in the catches.

It must be noted that the scientific observer coverage is not 100% of the fishing effort. In the study period (1996-2000), the percentage coverage by the sampling network is about 5% of the total effort. Table 2 shows the fishing effort surveyed by observers by year and depth strata. Despite the low sampling coverage the data are thought to be representative of the whole fleet.

The length-weight relationship parameters of each species used in this work are presented in Table 3.

The maturity ogives used in this work are the following ones:

Greenland halibut	Junquera et al. (1999)
American plaice	J. Morgan (per. com.)
Skate	Del Rio J.L. and S. Junquera (2000)
Cod	Saborido –Rey F. et al. (1998)
Yellowtail flounder	Durán P. et al. (1999)

The legal minimum sizes employed are those that appears in Enforcement Conservation and Measures of NAFO Secretariat.

Results

Effort and CPUE

The distribution of the percentages of the annual effort by depth is presented in Fig. 1. The distribution of the annual effort among the different depth strata varies with the years, but a certain distribution pattern is apparent.

The strata in which the highest percentage of fishing effort occurs are those of depths bigger than 800 meters. Approximately 70% of the annual effort is carried out in these strata. The strata that in which least effort occurs are those between 200 and 600 meters deep. In these, the effort carried out is smaller than 5% of the total annual effort. In the strata of <200 and 600-800 the level of effort is very similar, being approximately 10% in each one.

In Table 4 is shown the CPUE by species, depth strata and year. In this table we can observe that in depths bigger than 600 meters the species with more yields is the Greenland halibut, while the CPUE of the other species analysed is much smaller. In the strata of less than 600 meters deep the CPUE of Greenland halibut is much smaller and they have a marked tendency to diminish with the decrease of the depth, while the CPUE of the other species analysed increases when decrease the depth with the biggest values in the stratum of <200 meters.

Next, we will analyse species by species the CPUE and the proportions of mature and oversized fish in the catches.

Greenland Halibut

The CPUE by depth strata of Greenland halibut is shown in the Fig. 2. Two types of strata can be distinguished clearly: below 600 meters the CPUE is very low, less than 50 kg/hour. In strata of more than 600 meters the CPUEs are much bigger, almost exceeding 200 Kg/hour every year. In the stratum of 400-600 meters, the yield is slightly bigger than the yields at <200 and 200-400. The CPUE in the stratum of 600-800 is slightly smaller than in the strata of 800-1000 and >1000.

In the Fig. 3 is presented the proportion in weight of mature fish, by depth stratum, in the Greenland halibut catches. This proportion increases with the depth, varying from 10% in the stratum 400-600 meters up to more than 25% in the stratum >1000 meters.

In the Fig. 4 is presented the proportion in weight of oversized fish by depth stratum of the Greenland halibut catches. In all the sampling strata the proportion is almost of 100%. The smallest proportion is in the stratum of 400-600 meters with a value of 99%.

American Plaice

In the Fig. 5 is shown the CPUE by stratum of depth of American plaice. The stratum in which bigger yields are taken is that of <200 meters. In this stratum a great increase of CPUE is observed over the years, from 100 Kg/hour in 1996 to more than 500 Kg/hour in 2000. This tendency is also observed in the strata of 200-400 and 400-600, but on a smaller scale. The CPUE of the strata of more than 400 meters never exceeds 35 Kg/hour in any year.

In the Fig. 6 is shown the proportion in weight of mature fish by depth strata of the American plaice catches. The strata of less than 600 meters have values around 90%, while the strata of more than 600 meters the values are around 80%. An increase in the percentages , from year to year, may be seen in almost all the strata.

In Fig. 7 is presented the proportion in weight of oversized fish by depth strata of the American plaice catches. In almost every year, the values of all the strata are between 99% and 100%.

Yellowtail Flounder

The CPUE by depth strata of yellowtail flounder is shown in Fig. 8. The highest values are observed in the stratum of <200 meters; in the other strata the values obtained are very low in comparison with the stratum of <200 meters. In this stratum a trend of increasing CPUE from year to year is observed, rising from less than 150 Kg/hour in 1996 to more than 300 Kg/hour in 2000.

In Fig. 9 is shown the proportion in weight of mature fish by depth strata of the yellowtail flounder catches and in Fig. 10 is presented the proportion by weight of oversized fish by depth strata of the cod catches. Practically 100% of the catches are from the stratum of <200 meters. These are mainly mature fish and the proportion in weight of oversized fish varies between 96 and 100%.

Skate

The CPUE by depth strata of skate is shown in the Fig. 11. The biggest CPUE was obtained in the stratum of <200 meters, the values decreasing down to 600 meters. In the strata of more than 600 meters depth the values obtained are very low and constant.

In the Fig. 12 is shown the proportion in weight of SSB by depth strata of the skate catches. There is information only for three strata. The biggest percentage of mature fish (80%) was observed in the stratum of 200-400 meters. At <200, the percentage was 60%, while in the stratum of 800-1000 meters the values were much smaller (20%). There is no minimum landing size for this species.

Cod

The Fig. 13 shows the cod CPUE by depth strata. Appreciable values have been observed only in depths less than 600 meters. In these strata, almost all the values of CPUE are smaller than 50 Kg/hour, exceptions beings in the strata of 200-400 and 400-600 in the year 2000 – both values being above the 100 Kg/hour.

In Fig. 14 is shown the proportion in weight of mature fish by depth strata of the cod catches and in the Fig. 15 is presented the proportion in weight of oversized fish by depth strata of the cod catches. Very few samples of captures of this species were taken and the results obtained are thus not very representative.

Discussion

More than 80% of the annual effort is carried out in the strata of 600-800, 800-1000 and >1000 meters. The species with highest yields in these strata is the Greenland halibut. 10% of the effort is carried out in the stratum of <200 meters and within this the highest yields correspond to skate and American plaice. The percentage of the effort carried out between the 200 and 600 meters is very small, less than 5%.

The proportion of mature fish in the catches increases with the depth for Greenland halibut.

For American plaice, the proportion of mature fish to depths bigger than 600 meters is a little smaller than below 600 meters.

The biggest percentages of mature fish in the skate catches were observed in the stratum of 200-400 (80%), while in the stratum of 800-1000 meters the percentage observed was of 20%.

For Yellowtail flounder the proportions of mature fish are bigger and more stable.

The percentage of oversized fish is quite high, bigger than 95% in all species and ranges of depth.

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Table 1.- Number of samples and number of specimens sampled by year, depth strata and species.

			Strata						
Year	Species	Data	<200	200-400	400-600	600-800	800-1000	>1000	Total
1996	Cod	Nº Samples							
		NºInd Sampled							
	Greenland halibut	Nº Samples				4	77	170	251
		NºInd Sampled				902	15298	30555	46755
	Yellowtail flounder	Nº Samples							
		NºInd Sampled							
	American plaice	Nº Samples					13	11	24
		NºInd Sampled					1555	1646	3201
	Skate	Nº Samples							
		NºInd Sampled							
1997	Cod	Nº Samples					1		1
		NºInd Sampled					206		206
	Greenland halibut	Nº Samples				18	40	67	125
		NºInd Sampled				4845	7845	12495	25185
	Yellowtail flounder	Nº Samples	11						11
		NºInd Sampled	2676						2676
	American plaice	Nº Samples	12			1	3	4	20
		NºInd Sampled	2626			147	635	1146	4554
	Skate	Nº Samples							
		NºInd Sampled							
1998	Cod	Nº Samples							
		NºInd Sampled							
	Greenland halibut	Nº Samples				23	73	64	160
		NºInd Sampled				3599	9953	10548	24100
	Yellowtail flounder	Nº Samples	5						5
		NºInd Sampled	359						359
	American plaice	Nº Samples	8		2		5	2	17
		NºInd Sampled	959		177		1231	500	2867
	Skate	Nº Samples					1		1
		NºInd Sampled					228		228
1999	Cod	Nº Samples	2						2
		NºInd Sampled	190						190
	Greenland halibut	Nº Samples				12	22	138	172
		NºInd Sampled				2004	4174	23761	29939
	Yellowtail flounder	Nº Samples	4						4
		NºInd Sampled	775						775
	American plaice	Nº Samples	14				1	1	16
		NºInd Sampled	2796				180	193	3169
	Skate	Nº Samples	10						10
		NºInd Sampled	2077						2077
2000	Cod	Nº Samples	6	1					7
		NºInd Sampled	956	22					978
	Greenland halibut	Nº Samples			4	44	122	108	278
		NºInd Sampled			394	8914	23989	19683	52980
	Yellowtail flounder	Nº Samples	36						36
		NºInd Sampled	6895						6895
	American plaice	Nº Samples	51	5	2	5	13	2	78
		NºInd Sampled	9121	1040	354	968	2556	291	14330
	Skate	Nº Samples	54	1			1		56
		NºInd Sampled	8436	154			114		8704

Table 2.- Fishing effort (hours) and percentage of fishing effort surveyed by observers by year and depth strata.

		Strata						
Year	Data	<200	200-400	400-600	600-800	800-1000	>1000	Total general
1996	Effort (hours)				91	1351	3366	4808
	% Effort				2	28	70	100
1997	Effort (hours)	975	323		354	1216	2075	4943
	% Effort	20	7		7	25	42	100
1998	Effort (hours)	128	63	82	662	1938	1910	4782
	% Effort	3	1	2	14	41	40	100
1999	Effort (hours)	603	9	57	256	429	4297	5652
	% Effort	11	0	1	5	8	76	100
2000	Effort (hours)	1387	177	188	1449	3327	3164	9692
	% Effort	14	2	2	15	34	33	100
Total general	Effort (hours)	3093	571	327	2812	8261	14812	29876
	% Effort	10	2	1	9	28	50	100

Table 3.- Value length-weight relationship parameters.

Specie	a	b
Cod	0.008	3.04
Greenland halibut	0.007403	3.031
Yellowtail flounder	0.0071	3.0903
American plaice	0.0046	3.1866
Skate	0.01115	2.9471

Table 4.- CPUE (Kg/hour) by species, depth strata and year.

		Estrata						
Year	Species	<200	200-400	400-600	600-800	800-1000	>1000	Total general
1996	Cod				0		0	0
	Greenland halibut				279	290	352	920
	Yellowtail flounder						0	0
	American plaice				10	11	7	28
	Skate				7	7	7	21
1997	Cod	20	1		0	0	0	22
	Greenland halibut	8	1		365	336	374	1084
	Yellowtail flounder	150			0			150
	American plaice	113	10		12	23	8	165
	Skate				4	6	5	16
1998	Cod	3	23	6				31
	Greenland halibut	3	12	64	165	163	320	726
	Yellowtail flounder	156				0	0	157
	American plaice	215	27	5	3	9	5	265
	Skate	376	136	102	31	27	16	688
1999	Cod	49	2	0		0		51
	Greenland halibut	1	7	14	240	281	244	787
	Yellowtail flounder	194		14		0	0	208
	American plaice	425		8	2	25	3	463
	Skate	214	32	5	2	1	0	255
2000	Cod	47	180	106	0	0	0	333
	Greenland halibut	0	8	22	261	302	263	857
	Yellowtail flounder	338	59	7	2	0	0	407
	American plaice	538	136	33	19	15	5	745
	Skate	649	97	2	1	3	3	755

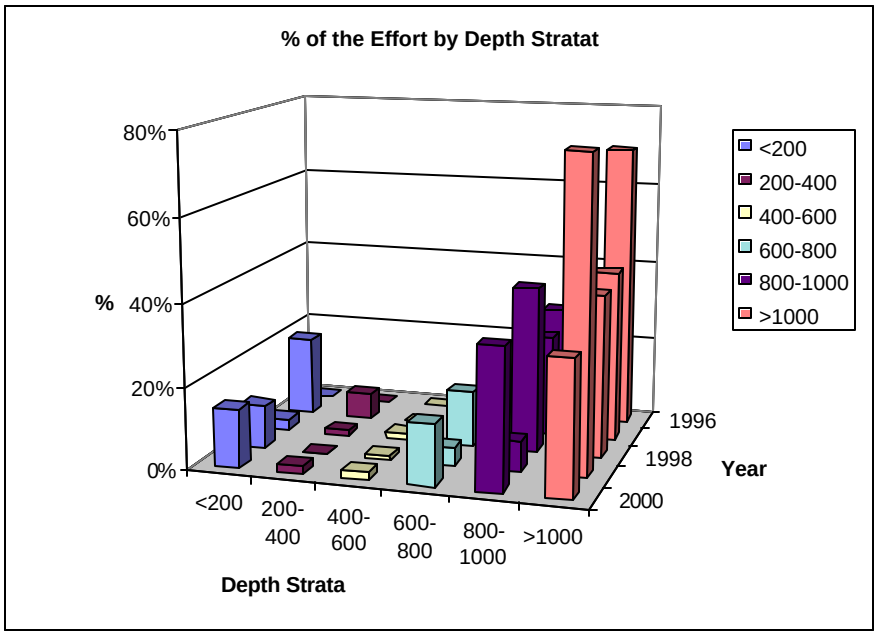

Figure 1.- Percentage of effort by depth strata and year.

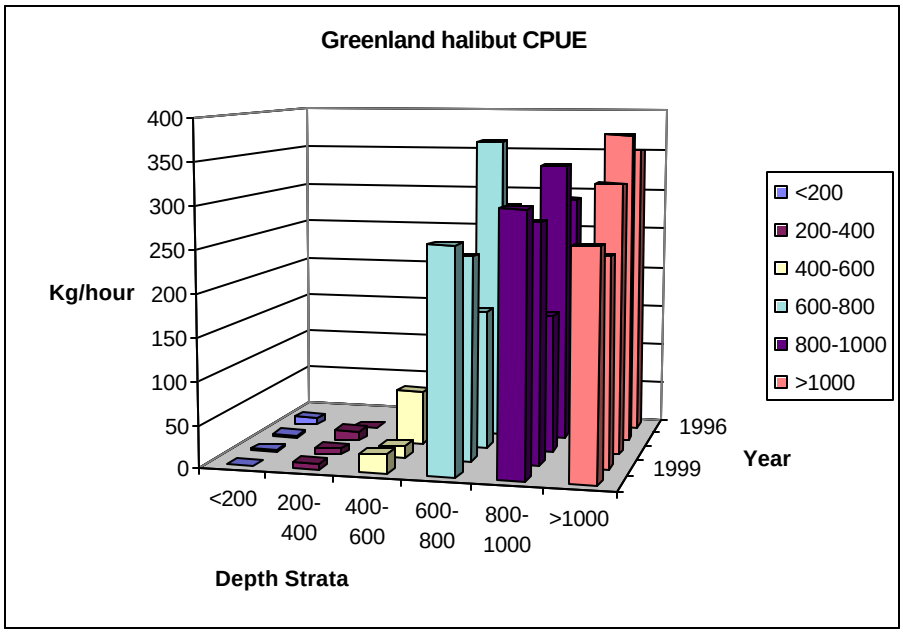

Figure 2.- Greenland halibut CPUE (Kg/hour) by depth strata and year.

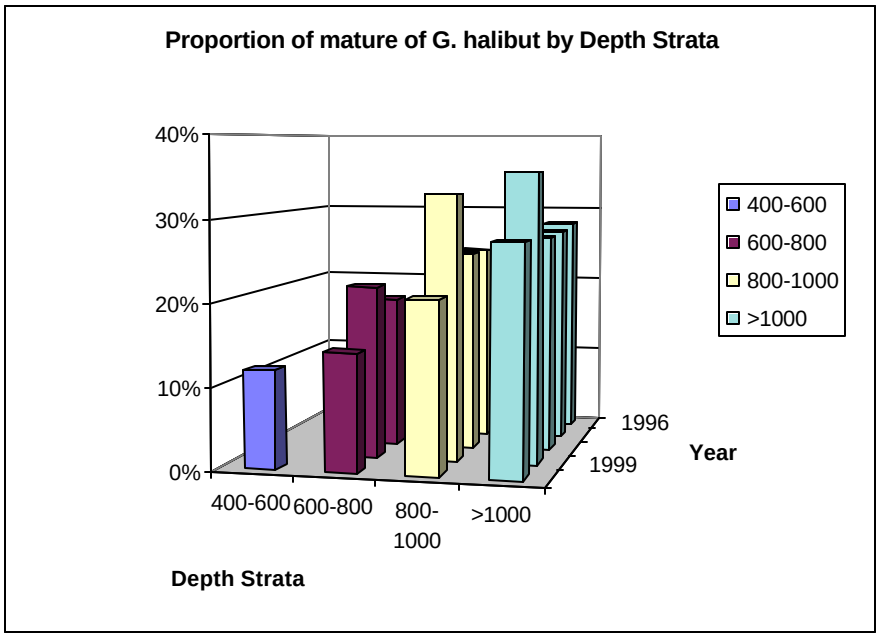

Figure 3.- Proportion of mature fish in weight, by depth strata and year, in the Greenland halibut catches.

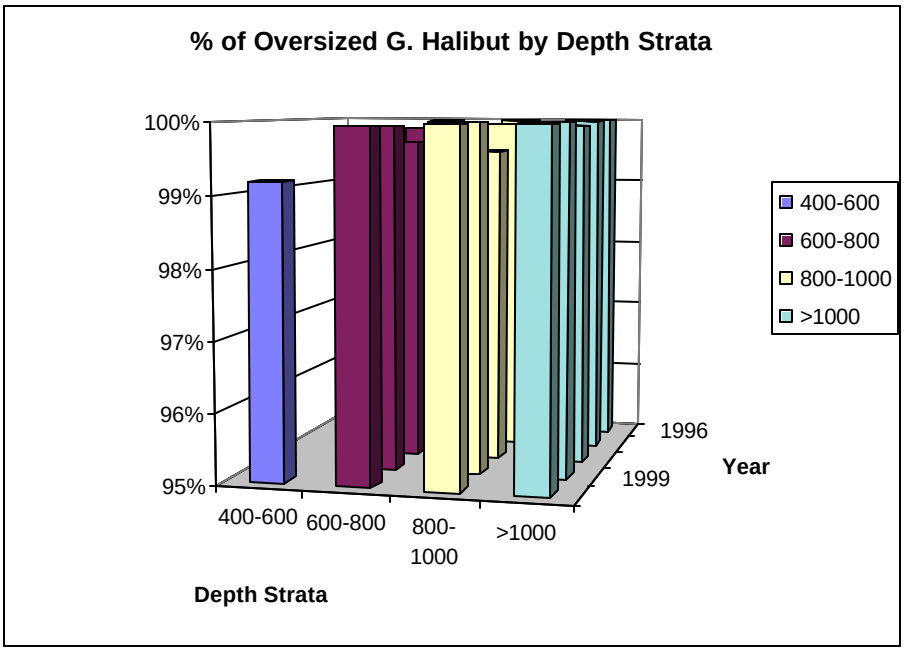

Figure 4.- Proportion in weight of oversized fish by depth stratum and year, of the Greenland halibut catches.

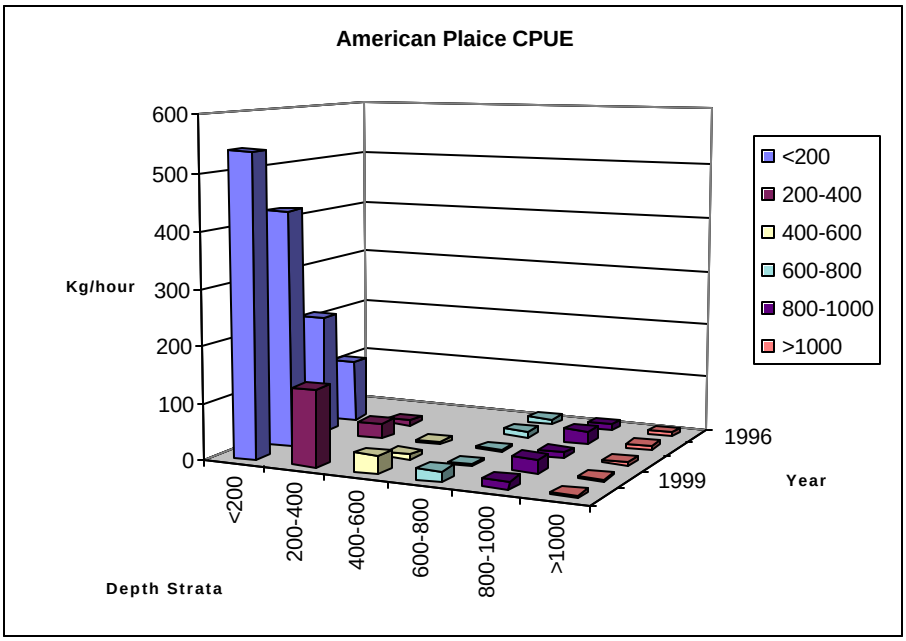

Figure 5.- American plaice CPUE (Kg/hour) by depth strata and year.

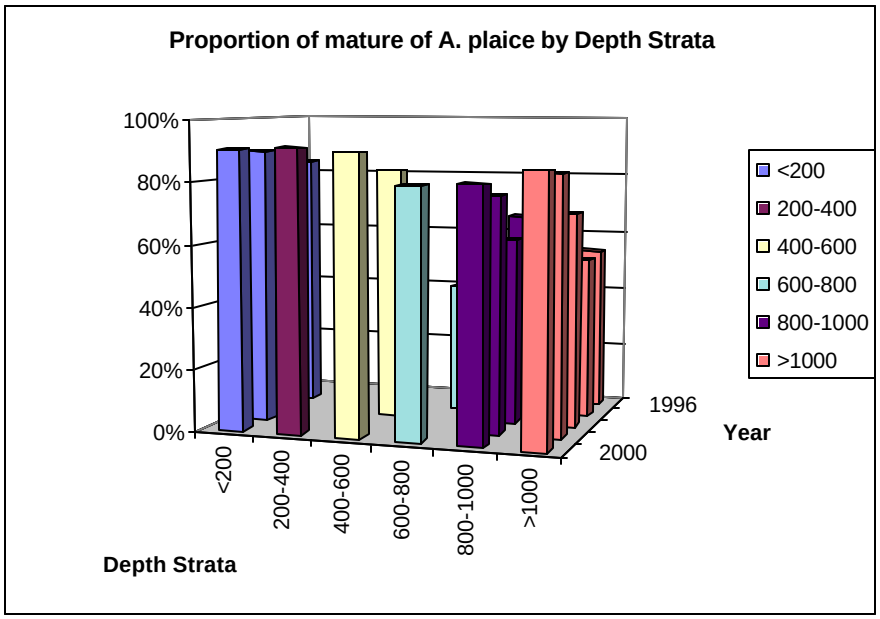

Figure 6.- Proportion of mature fish in weight, by depth strata and year, in the American plaice catches.

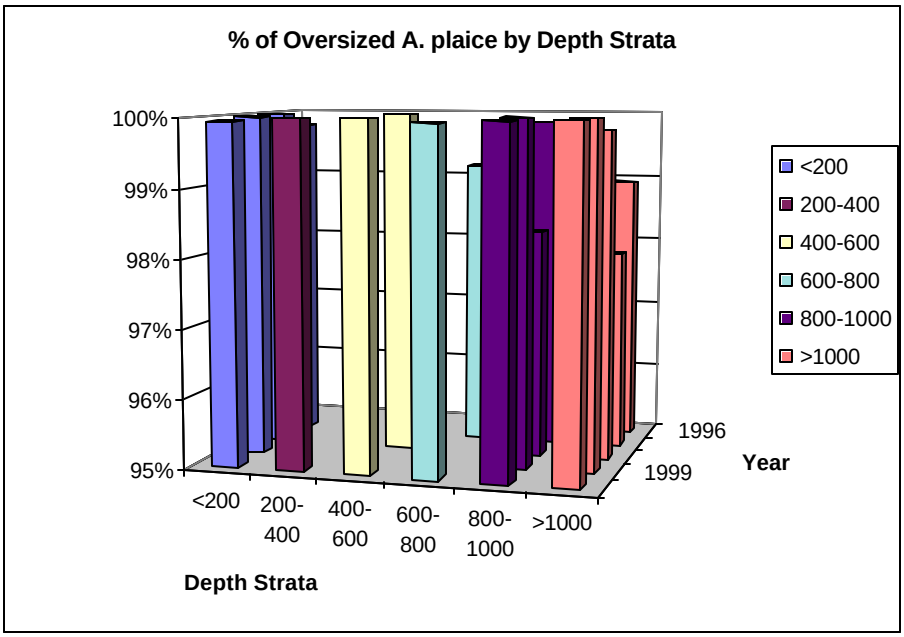

Figure 7.- Proportion in weight of oversized fish by depth stratum and year, of the American plaice catches.

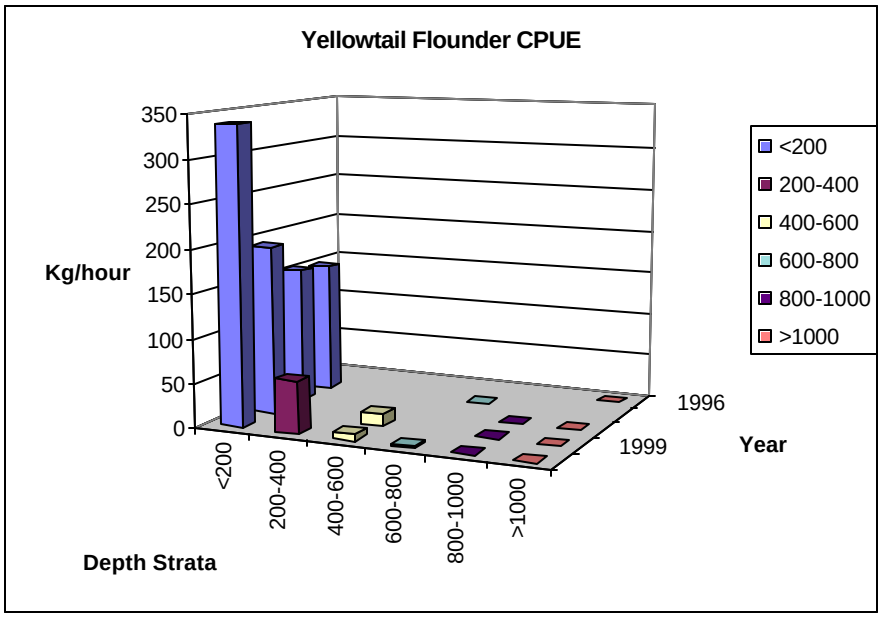

Figure 8.- Yellowtail flounder CPUE (Kg/hour) by depth strata and year.

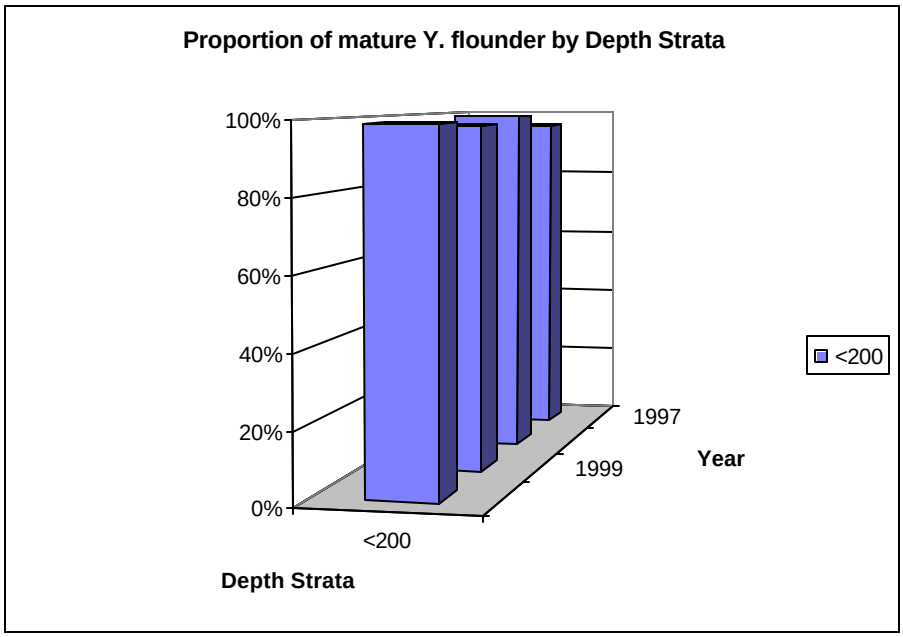

Figure 9 .- Proportion of mature fish in weight, by depth strata and year, in the yellowtail flounder catches.

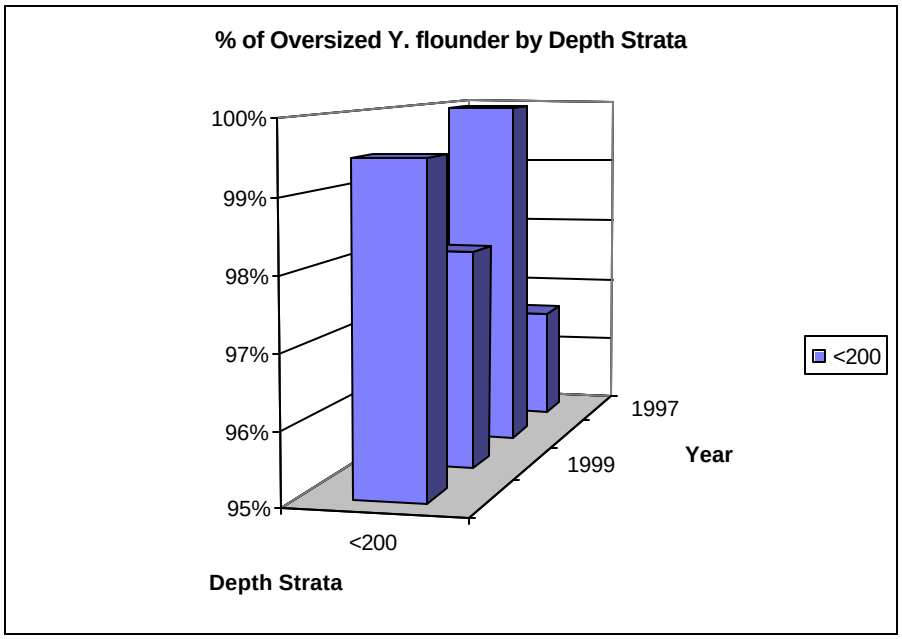

Figure 10.- Proportion in weight of oversized fish by depth stratum and year, of the yellowtail flounder catches.

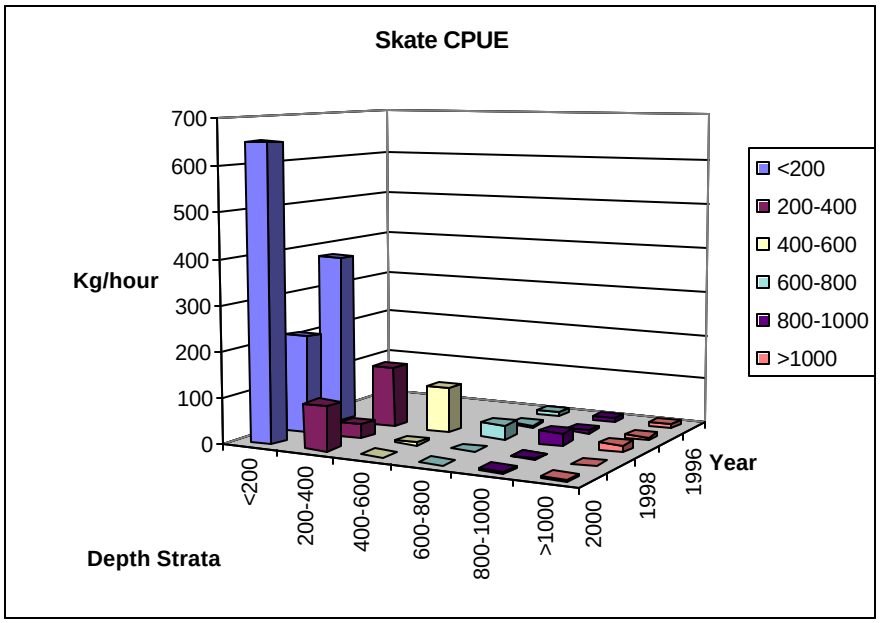

Figure 11.- Skate CPUE (Kg/hour) by depth strata and year.

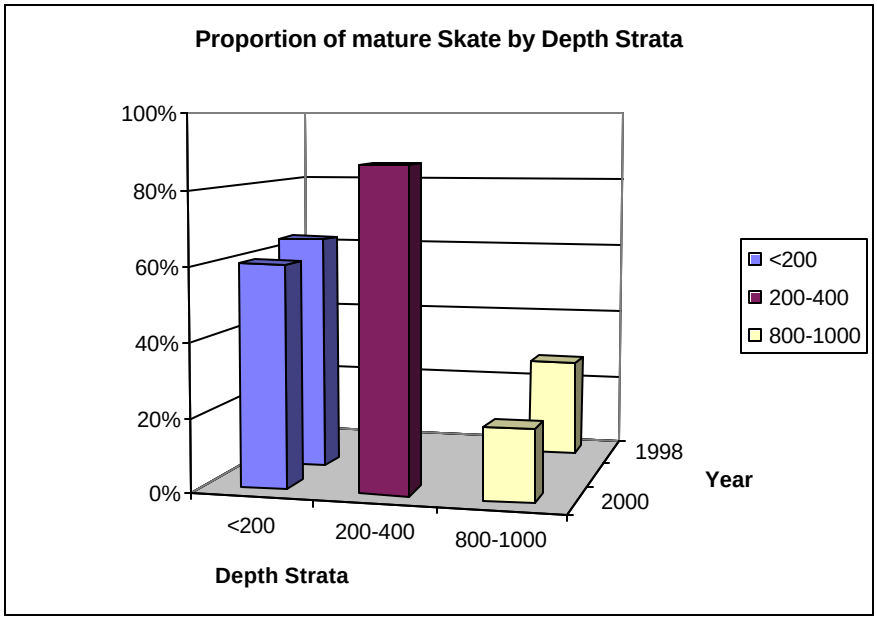

Figure 12.- Proportion of mature fish in weight, by depth strata and year, in the skate catches.

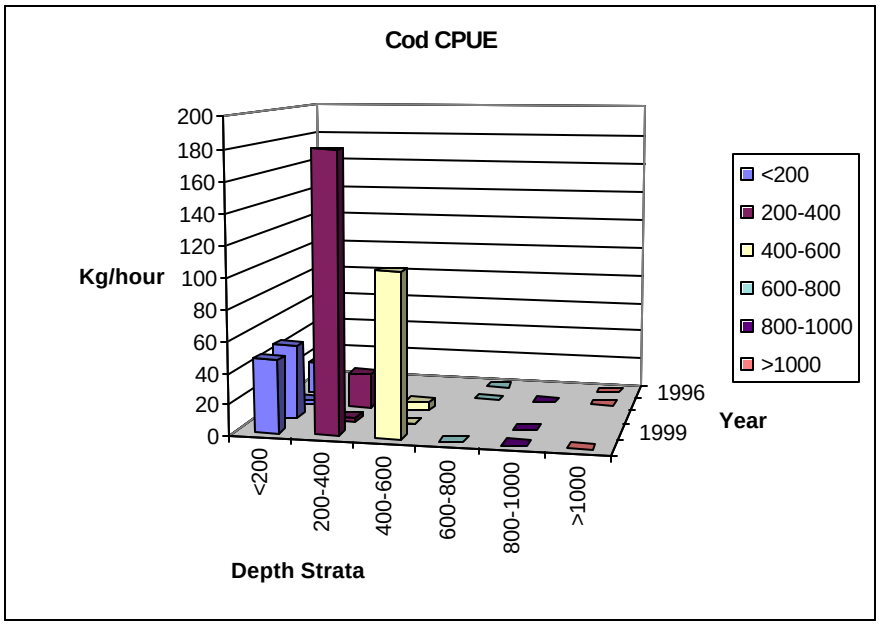

Figure 13.- Cod CPUE (Kg/hour) by depth strata and year.

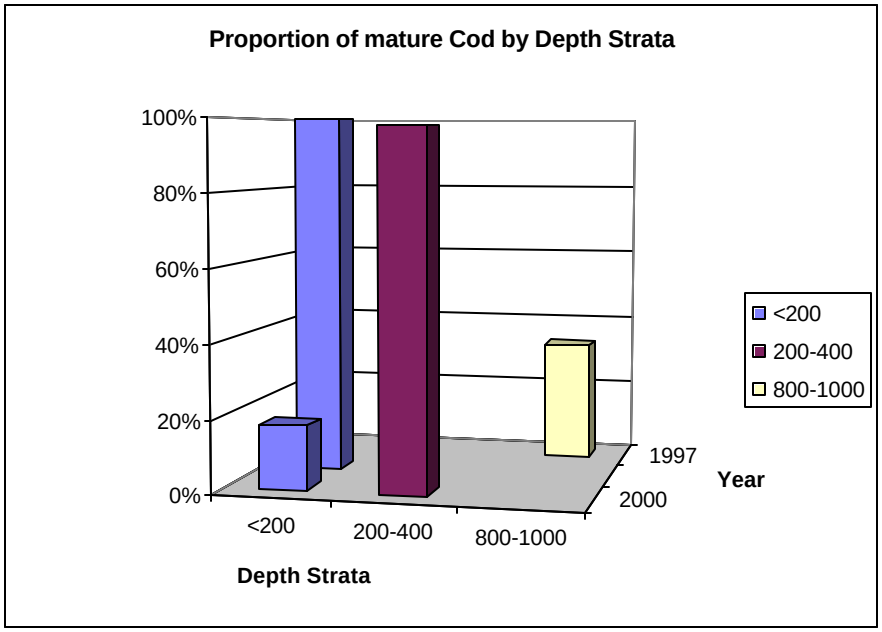

Figure 14.- Proportion of mature fish in weight, by depth strata and year, in the cod catches.

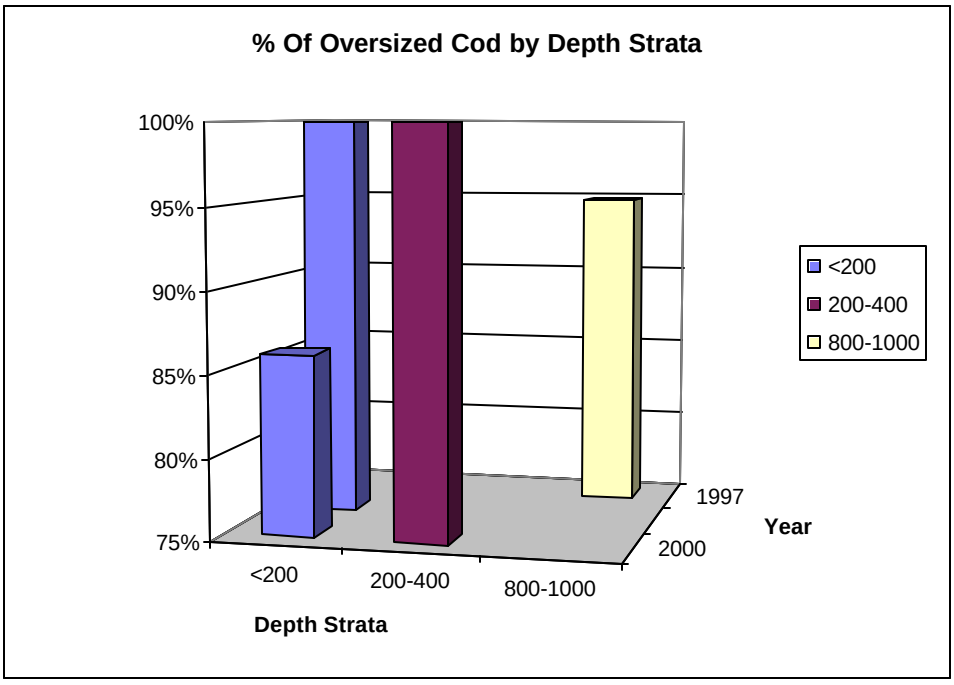

Figure 15 .- Proportion in weight of oversized fish by depth stratum and year, of the Cod catches.