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The Spanish Fishery (1998, 2000-2002) and the Spanish 3NO Survey (1995-2002) in
Relation to the Skate Fishery in NAFO Divisions 3NO.

by

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Abstract

This paper analyses the data of the Spanish fishery (1998, 2000-2002) and the Spanish 3NO Survey (1995-2002) in relation to the Skate fishery in NAFO Div. 3NO. According to the distribution pattern of the fishing effort in 1998, 2000, 2001 and 2002, it may be concluded that the majority of the effort were performed in shallow waters of less than 100 m. and in the second half of the year.

The species composition of catches show that thorny skate is the target specie and American plaice is the main by-catch species Other less important species in the by-catch are yellowtail flounder, witch flounder and cod.

The percentage of SSB in the catches for yellowtail flounder is quite high and constant. For skate the values shows a increasing trend in biomass and abundance. For American plaice the values are very stables in all years excepting the last year where the percentage of abundance was rather low.

Survey data shows that almost the 100% of the biomass and abundance of Yellowtail flounder was found in the stratum 0-91 m. For American plaice the percentage in the last years is more than 70%. For skate the values are very variable between years. Most of biomass and abundance of Witch flounder are outside of this stratum.

Introduction

Thorny skate has been a traditional by-catch in groundfish fisheries of the Grand Bank (Durán *et al.*, 1996). However, it has become recently a target for the Spanish trawler fleet in this area. Thorny skate catches have raised as a result of the increase in fishing effort towards non-regulated species added to the decline in the traditional groundfish resources in the area of Grand Bank (Junquera and Paz, 1998). Since 1996 a part of Spanish fleet formerly targeting exclusively on Greenland halibut, started to undertake occasionally the skate fishery on the southern Grand Bank Regulatory Area (Div. 3NO) in shallow waters.

The skate fishery in the Grand Banks and the Scotian Shelf within Canadian waters is regulated since 1994 (Simon and Frank, 1996; Kulka and Mowbray, 1998), although the fishery outside 200 miles is unregulated.

According to previous results (Junquera and Paz, 1998; Kulka and Mowbray, 1998; del Río and Junquera, 2000), the pattern of aggregation observed in thorny skate shows seasonal differences in distribution, with a period of concentration in shallow waters of Div. 3N, mainly in the fall months.

Material and Methods

Fishery Data

All the information on fishing effort and catches for this study was obtained from NAFO Observers on board the commercial fleet in Div. 3NO. This paper analyses a total of 3461 hauls targeting thorny skate recorded in 1998, 2000, 2001 and 2002. In the year 2002 don't have the available data of the whole year. The hauls targeting skate were identified by the criterium of use a codend mesh size larger than 220 mm (280 mm in 2002), instead of the usual of 130 mm used when targeting for others species. Observers report data on fishing hours, hauls position, mesh size used, depth, catches and discards.

Spanish scientific observers recorded data from the skate fishery in Div. 3NO in the second half of the years 1997 to 2002. Those observers provided data on fishing activity and carried out biological sampling of this species and information on by-catches of other groundfish resources. All length distributions analysed in this paper are based on the data collected by the Spanish observers. The parameters used for the length-weight relationships by species are shown in Table 1.

The maturity ogives used in this work are the following:

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

Survey Data

Spanish Surveys on NAFO Regulatory Area of Div. 3NO were initiated in 1995. Until 2001, the surveys were carried out in spring (May), on the Spanish vessel *C/V Playa de Menduñña* (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 Menduñña* as the research vessel for the survey, using bottom trawl net (type *Campelen*).

The survey-cover depth up to 700 m in 1995, since 1998 the depth coverage was extended up to 1 400 m. Table 2 presents the maximum and minimum depths by year cover by the survey.

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

R/V Vizconde de Eza replaced *C/V Playa de Menduñña* in May 2001, hence comparative fishing trials were conducted in May 2001 in order to convert the data series obtained since 1995. A series of 92 paired hauls were carried out, 90 of them were valid hauls. Mean catch, stratified mean catch, abundance, biomass and length distribution, were transformed from *C/V Playa de Menduñña* series to *R/V Vizconde de Eza* series. The method used for this transformation for skate, American plaice and yellowtail flounder is presented in SCR. Doc. 02/05 and for witch flounder in SCR Doc. 03/05.

Results and Discussion

Fishing effort, by-catches and CPUE of the Fishery

The distribution of the Spanish fleet effort targeting skate in Div. 3NO by depth, as reported by the NAFO observers is presented in Table 3. According to the distribution pattern of the fishing effort in 1998, 2000, 2001 and 2002, it may be concluded that the majority of effort were performed in shallow waters of less than 100 m. Therefore we focus the analysis only in the stratum of 0-100 m of depth because is the most representative of the skate fishery.

Fishing effort percentage by months at depths less than 100 m in the Spanish skate fishery in Div. 3NO are shown in Table 4. Results show that more than 85% of fishing effort is performed between August and November. The highest percentages of fishing effort are found in October, with values greater than 45% in 1998, 2001 and 2002.

The species composition of catches (%) in the skate fishery at depths less than 100 m in Div. 3NO are presented in Table 5. In 1998, 2000 and 2001 the thorny skate percentage of the catches is approximately 80%, the percentage in 2002 is the highest (91.2%) for the analysed period. American plaice is the main specie in the by-catch, the percentage in the last year was the lowest of the series (5.4%). Other less important species in the by-catch are yellowtail flounder, witch flounder and cod.

The unstandardized catch rates (kg/hour) by year at depths less than 100 m are show in Table 6. The highest yield is for thorny skate, around 900 kg/h, and it is very stable for the whole period. CPUE of American plaice and yellowtail flounder are stable for the period 1998-2001 however they have rather declined in 2002. Cod and witch flounder CPUE are quite low (around 10 kg/h) and they are stable during the whole period.

Fishery Length Distributions

The catches length distributions in percentage of thorny skate, American plaice, yellowtail flounder, witch flounder and cod of the Spanish skates fishery are presented in Fig. 1 to 5, respectively. Table 7 shows the proportions of SSB (in abundance and biomass) of the catches. The percentage of SSB in the catches for yellowtail flounder is more than 95%. For skate the values shows a increasing trend in biomass (from 57% to 76%) and abundance (from 34% to 53%). For American plaice the values in biomass are very stable (around 90%) in all years except the last year where the percentage was 80%. The results obtained for the Cod are very variable, probably due to the low number of samplings available.

Survey data

Figure 6 and Fig. 7 show the abundance and biomass for all strata and for the stratum of <91 m. Table 8 shows the percentage of the total abundance and biomass found in the depth stratum of <91 m. Almost 100% of the biomass and abundance of Yellowtail flounder was found in the stratum 0-91 m. For American plaice the percentage in the last years is more than 70%. For skate, the values were very variable between years. Most of biomass and abundance of witch flounder are outside of this stratum.

The Survey length distributions in the stratum 0-100 m by year and specie are presented in Fig. 8 to 11. Table 9 shows the percentage of SSB in abundance and biomass for the survey. Regarding American plaice, less than 60% of the abundance is mature, in biomass this percentage is between 50 and 80%. Yellowtail flounder presents more than 90% of SSB in biomass and in abundance more than 80%.The percentage of SSB in abundance for Skate is lower than 50%, although regarding the biomass the percentage is more than 60%.

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Table 1. The parameters values of the length-weight relationships used by specie

Species	Witch flounder	Cod	American plaice	Yellowtail flounder	Skate
a	0.004	0.008	0.004	0.0071	0.01115
b	3.186	3.04	3.186	3.0903	2.9471

Table 2. Maximum and minimum depths cover by the 3NO Spanish Survey

	Maximum and minimum depths (m) of the 3NO Spanish Survey							
	1995	1996	1997	1998	1999	2000	2001	2002
Min. Depth (m)	42	41	42	56	41	42	40	42
Max.Depth (m)	684	1135	1263	1390	1381	1401	1343	1401

Table 3.- Fishing effort (%) by strata in the years 1998-2002 in the Spanish skate fishery Div. 3NO.

Depth (m)	1998	2000	2001	2002	Total
0- 100	93.3	87.5	91.6	94.0	90.7
101- 200	2.3	4.6	3.7	3.5	3.8
201- 300	1.3	0.2	1.6	0.1	0.8
301- 400	0.3	0.5	0.0	0.0	0.3
401- 500	0.2	0.0	0.3	0.0	0.1
501- 600	0.0	0.1	0.1	0.0	0.1
601- 700	0.0	0.0	0.1	0.0	0.0
701- 800	0.2	0.1	0.1	0.5	0.2
801- 900	1.5	0.0	0.2	0.2	0.4
901-3000	1.0	7.0	2.3	1.8	3.8

Table 4.- Fishing effort (%) by months at depths less than 100 m in the Spanish skate fishery in Div 3NO (1998-2002).

Month	1998	2000	2001	2002	TOTAL
JAN.				0.1	0.0
FEB.					
MAR.					
APRIL					
MAY			0.1		
JUNE		0.9	1.8		0.9
JULY		4.7	11.8		5.0
AUG.	2.4	14.9	12.1	4.0	10.1
SEPT.	28.6	23.8	8.3	20.0	19.9
OCT.	46.4	26.7	54.0	47.9	41.1
NOV.	18.9	28.1	11.2	24.9	21.4
DEC.	3.7	0.7	0.6	3.1	1.6

Table 5.- Species composition (%) of the catches by year in the Spanish skate fishery in Div. 3NO at depths less than 100 m.

	1998	2000	2001	2002
Cod	0.6	0.6	0.7	0.7
Greenland halibut	0.0	0.0	0.0	0.0
American plaice	14.1	11.9	13.8	5.4
Thorny skate	77.5	81.2	79.0	91.2
Witch flounder	1.0	0.6	0.4	1.1
Yellowtail flounder	6.7	5.7	6.0	1.5

Table 6.- CPUE (kg/h) in the Spanish skate fishery in DIV. 3NO at depths less than 100 m.

	1998	2000	2001	2002
Cod	7.0	7.9	7.8	7.4
American plaice	157.9	147.0	156.0	53.2
Thorny skate	867.8	998.1	891.9	897.6
Witch flounder	10.9	6.8	5.0	10.7
Yellowtail flounder	75.2	69.6	67.7	14.8

Table 7.- Proportions of the SSB (abundance and biomass) by year and species in the Spanish skate fishery catches.

% SSB (Abundance) <100 m. 3NO Spanish Survey						
	1997	1998	1999	2000	2001	2002
Thorny skate	34		42	46	49	53
Yellowtail Flounder	90	100	100	97	99	96
American Plaice	76	84	85	84	84	53
Cod				99	26	

% SSB (Biomass) <100 m. 3NO Spanish Survey						
	1997	1998	1999	2000	2001	2002
Thorny skate	57		64	68	70	76
Yellowtail Flounder	96	100	100	99	100	98
American Plaice	87	89	90	92	92	80
Cod				100	35	

Table 8.- Proportions of the abundance and biomass by year and specie in the depth stratum <91 m in the 3NO Spanish survey.

% Biomass <91m. 3NO Spanish Survey								
	1995	1996	1997	1998	1999	2000	2001	2002
Yellowtail Flounder	99	100	100	100	100	100	100	100
American Plaice	65	69	41	67	76	74	76	79
Thorny skate	67	73	45	39	89	83	76	54
Witch flounder	11	7	3	3	29	34	5	7

% Abundance <91m. 3NO Spanish Survey								
	1995	1996	1997	1998	1999	2000	2001	2002
Yellowtail Flounder	100	100	100	100	100	100	100	100
American Plaice	64	67	40	64	73	77	80	71
Thorny skate	85	no data	58	no data	88	79	77	46
Witch flounder	7	no data	1	1	17	26	3	4

Table 9.- Proportions of the SSB (abundance and biomass) by year and specie in the Spanish 3NO Survey.

% SSB (Abundance) <100 m. 3NO Spanish Survey						
	1997	1998	1999	2000	2001	2002
Thorny skate	28		31	41	37	46
Yellowtail Flounder	71	85	85	85	86	88
American Plaice	37	57	56	47	25	19

% SSB (Biomass) <100 m. 3NO Spanish Survey						
	1997	1998	1999	2000	2001	2002
Thorny skate	62		60	68	67	77
Yellowtail Flounder	82	92	93	94	94	96
American Plaice	57	73	73	79	66	53

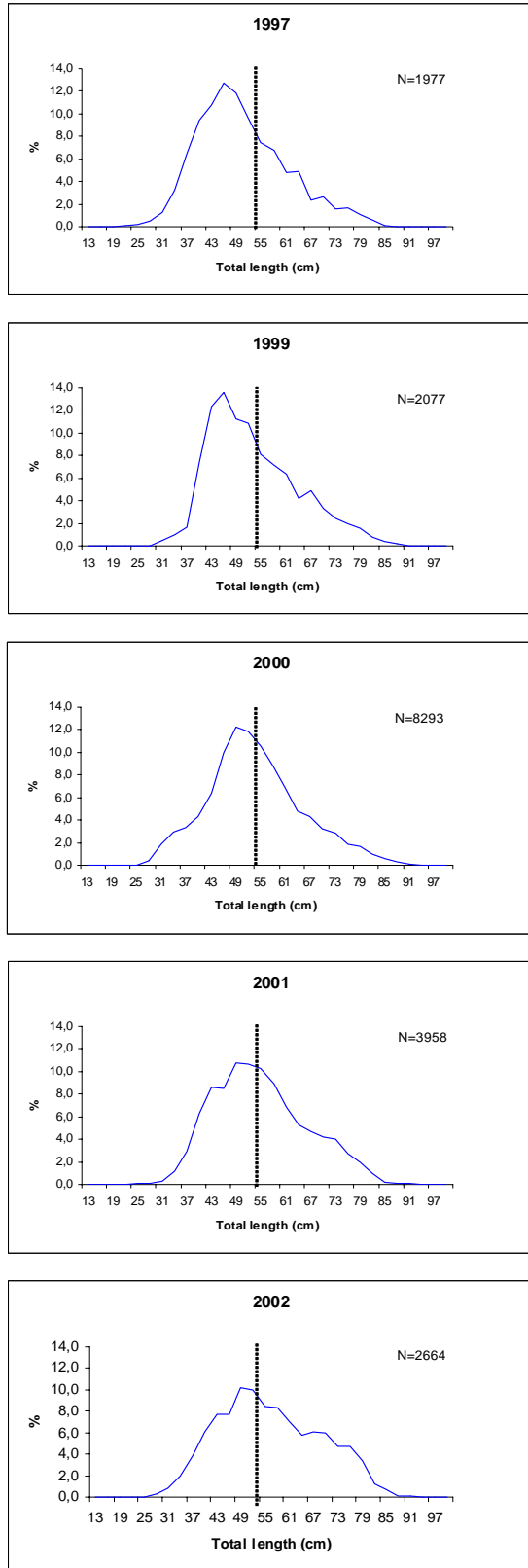


Fig. 1. Length frequencies (%) by year of the thorny skate in the Spanish commercial catches (NAFO Div. 3NO) at depths less than 100 m: 1997-2002. The vertical line represents the size at maturity.

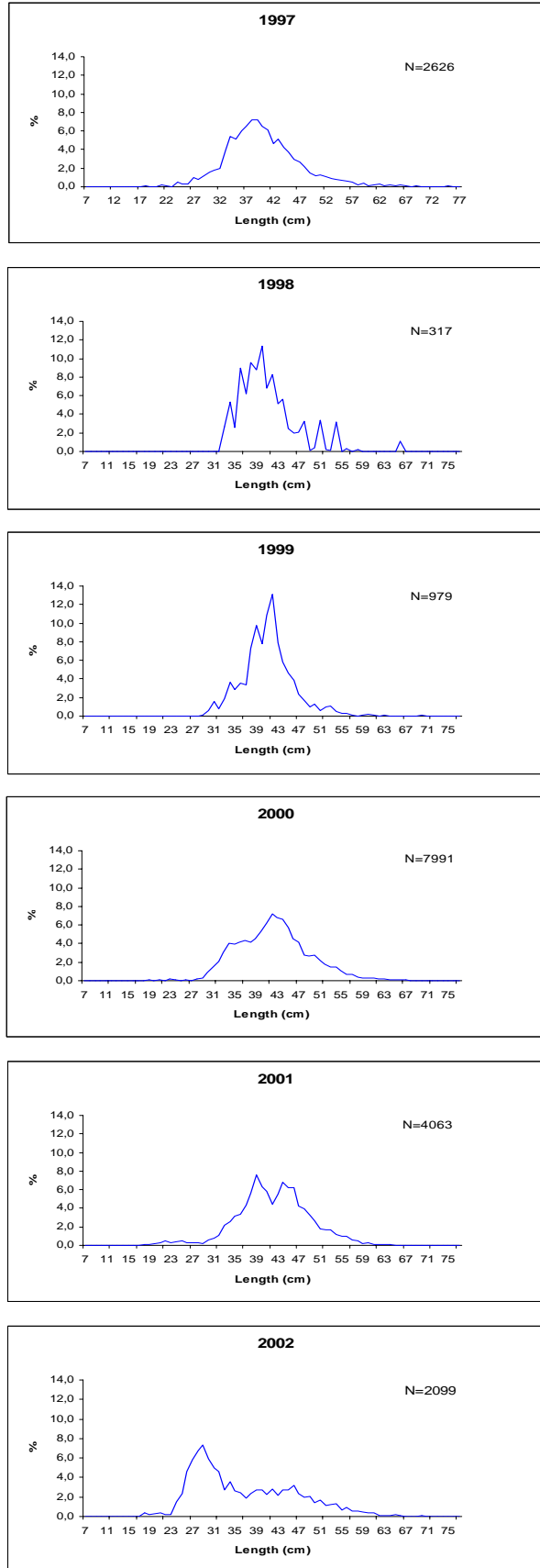


Fig. 2. Length frequencies (%) by year of the American plaice in the Spanish commercial catches (NAFO Div. 3NO) at depths less than 100 m: 1997- 2002.

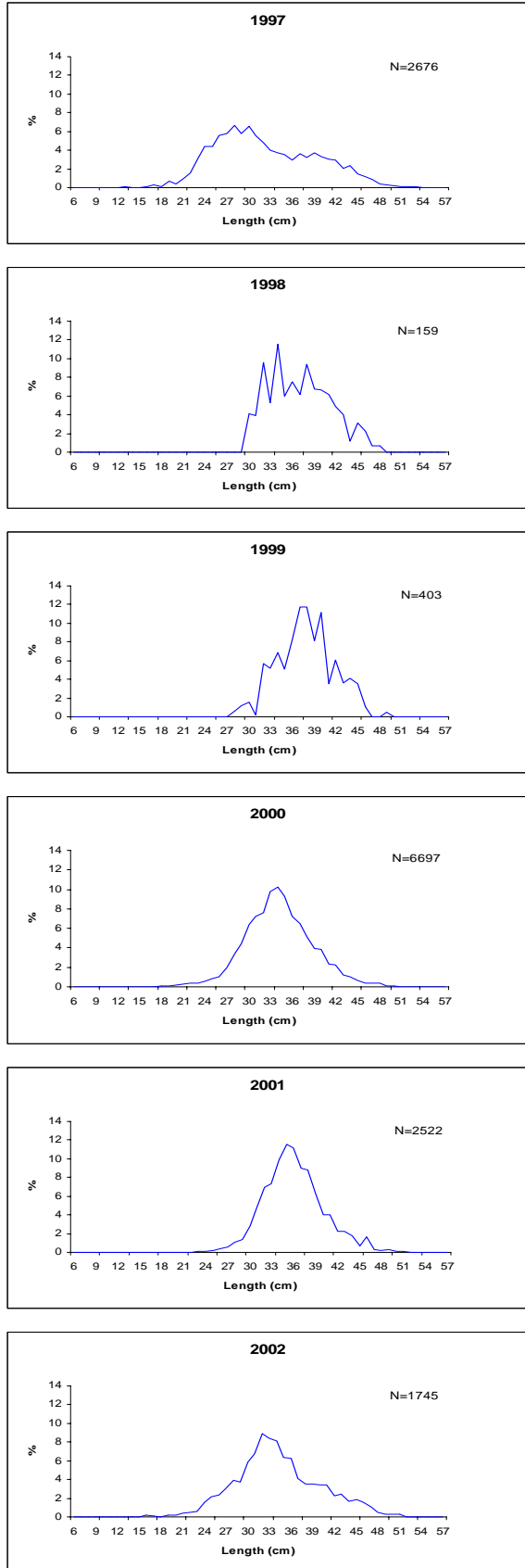


Fig. 3. Length frequencies (%) by year of the yellowtail flounder in the Spanish commercial catches (NAFO Div. 3NO) at depths less than 100 m: 1997- 2002.

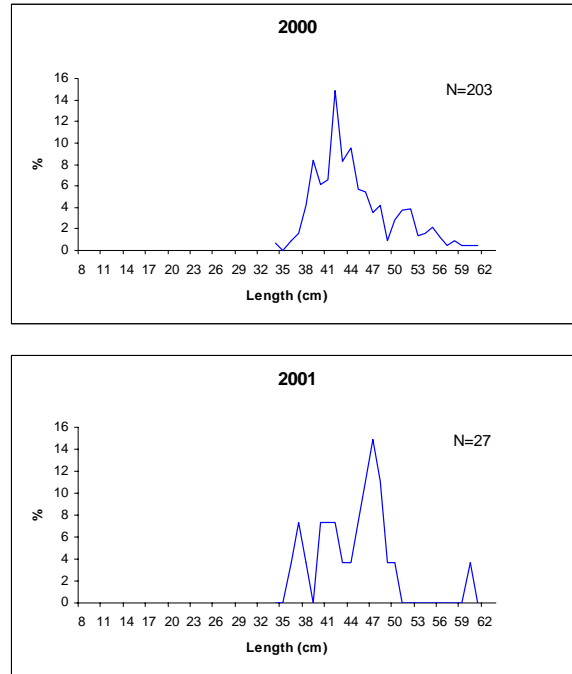


Fig. 4. Length distribution (%) by year of the witch flounder in the Spanish commercial catches (NAFO Div. 3NO) at depths less than 100 m: 2000 and 2001.

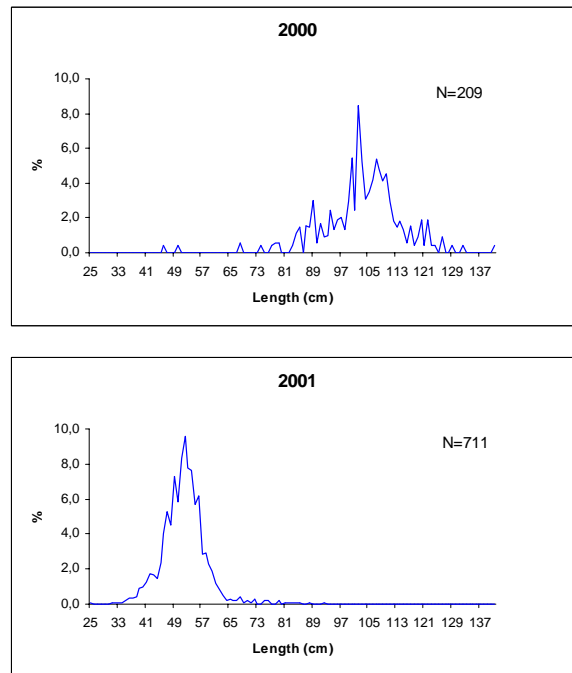


Fig. 5. Length distribution (%) by year of the cod in the Spanish commercial catches (NAFO Div. 3NO) at depths less than 100 m: 2000 and 2001.

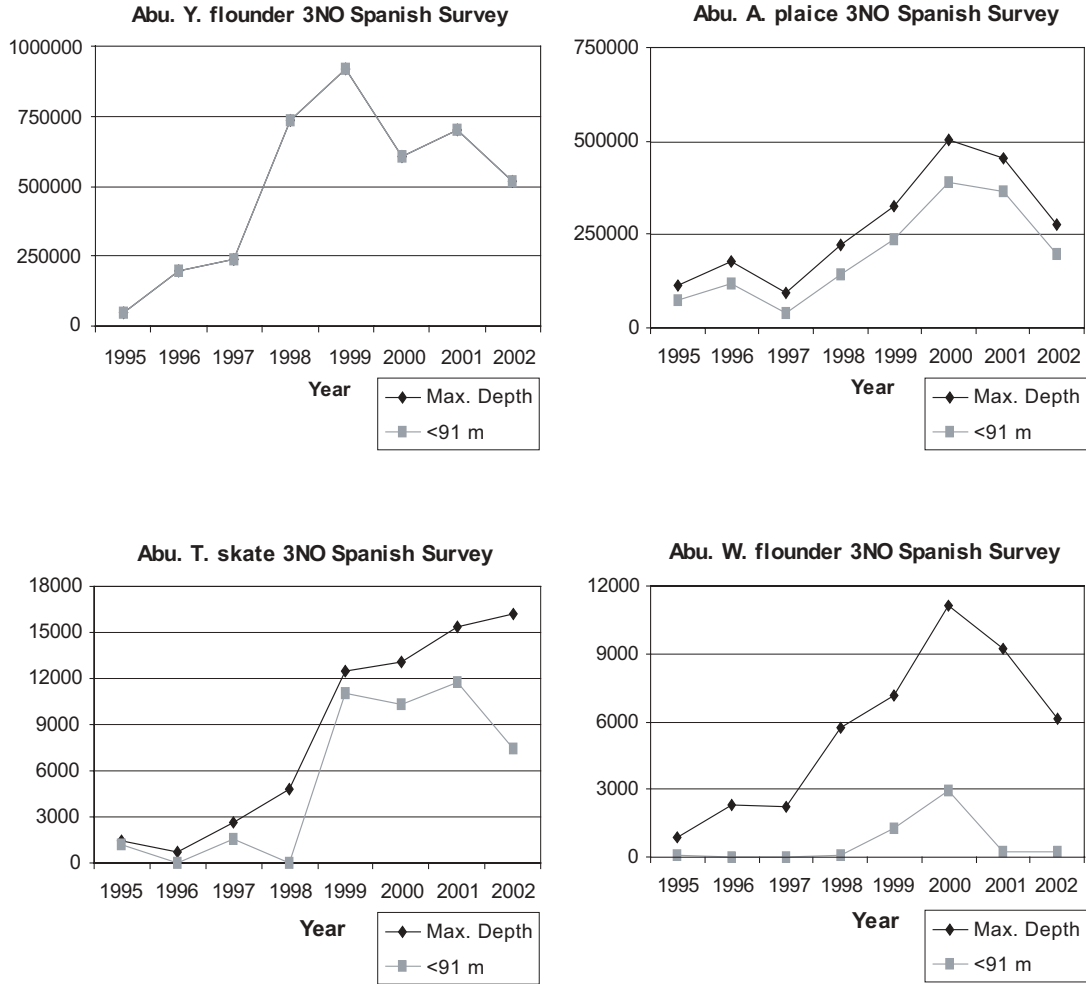


Fig. 6. Abundance in all strata and in the strata of <91 of the Spanish 3NO Survey

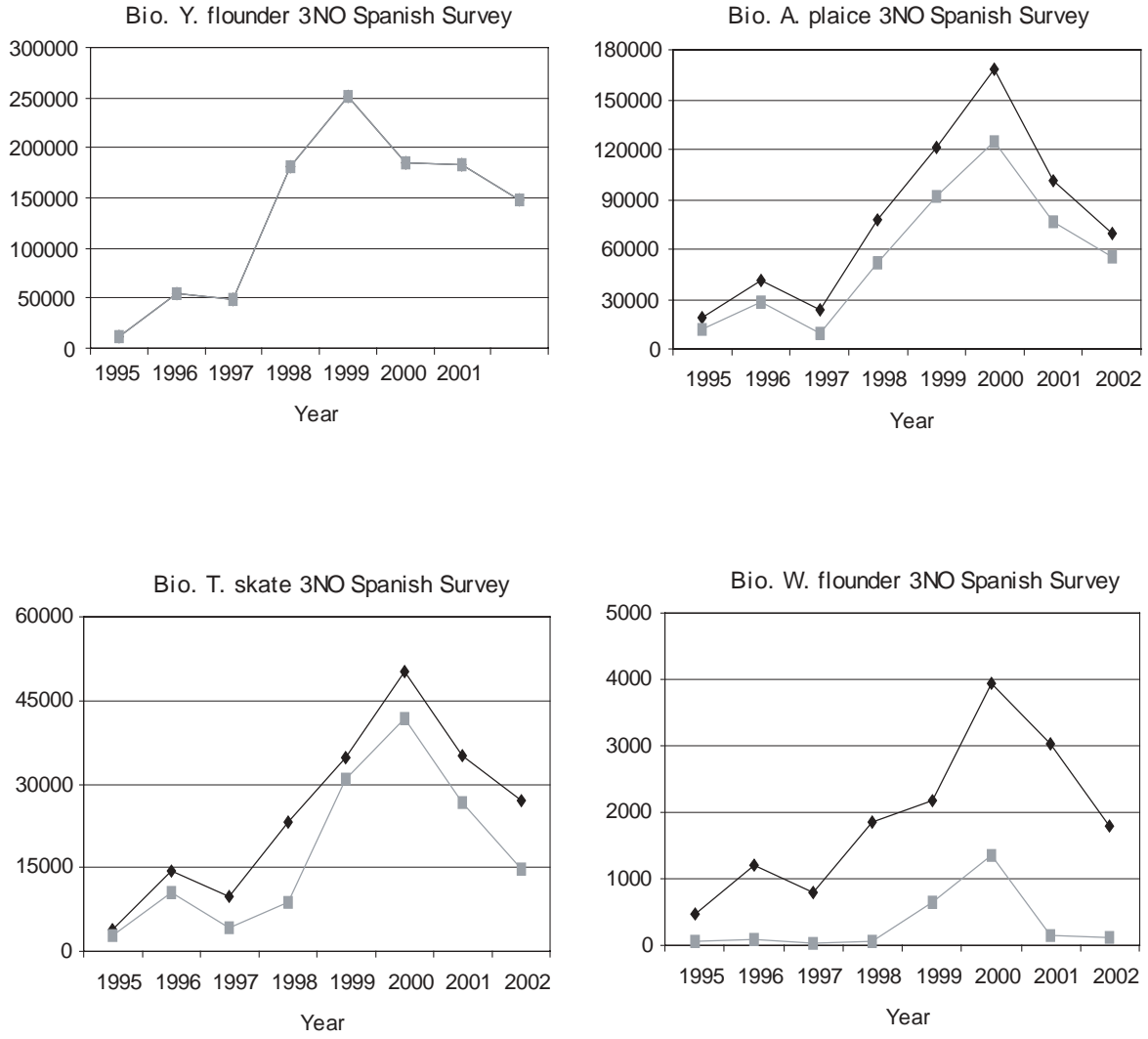


Fig. 7. Biomass in all strata and in the strata of <91 of the Spanish 3NO Survey

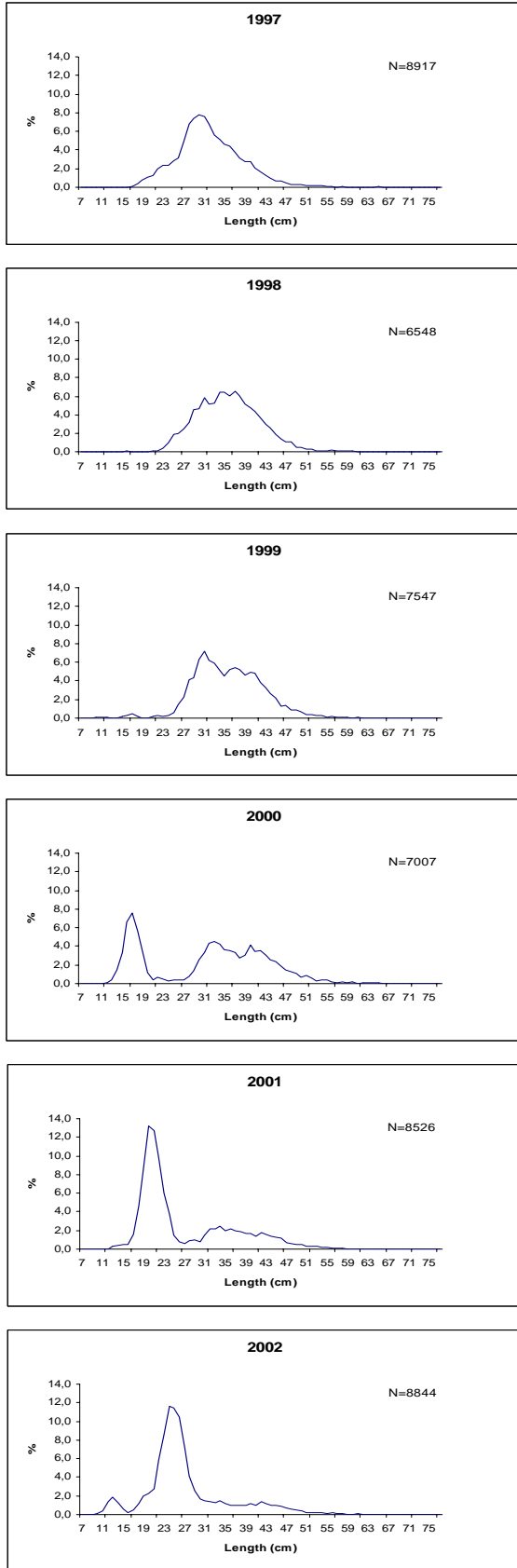


Fig. 8. Length frequencies (%) by year of the American plaice in the Spanish spring bottom trawl surveys (NAFO Div. 3NO): 1997- 2002.

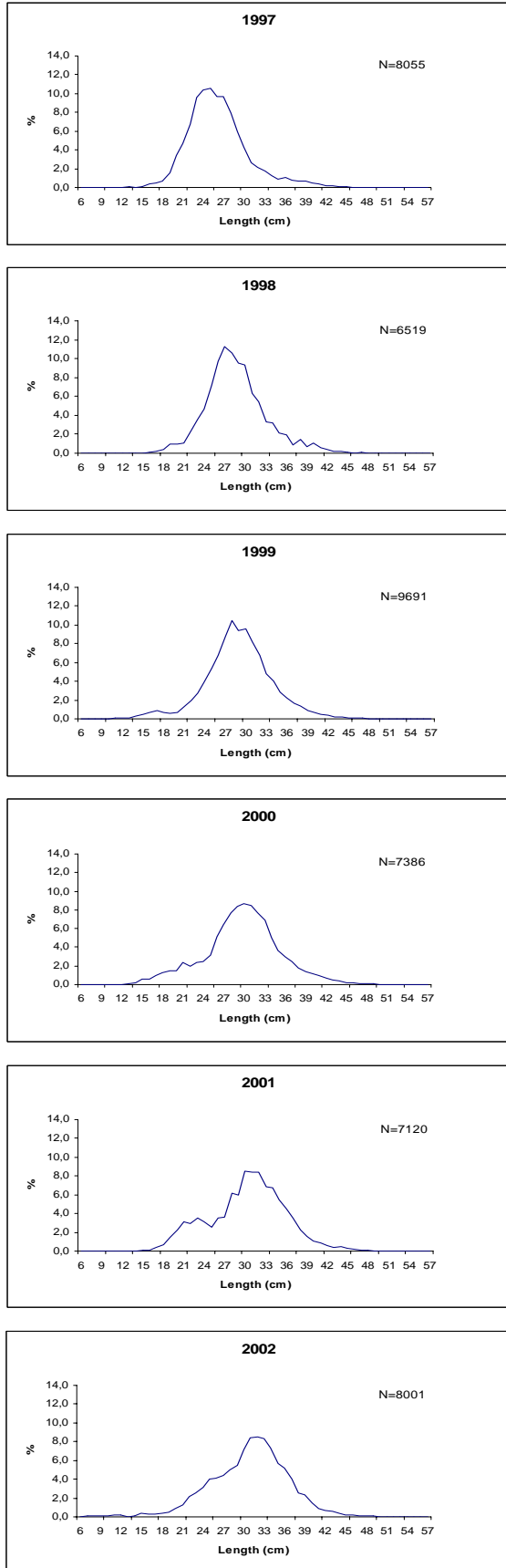


Fig. 9. Length distribution (%) by year of the yellowtail flounder in the Spanish spring bottom trawl surveys (NAFO Div. 3NO): 1997- 2002.

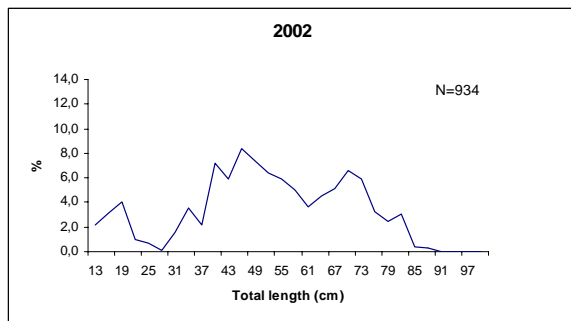
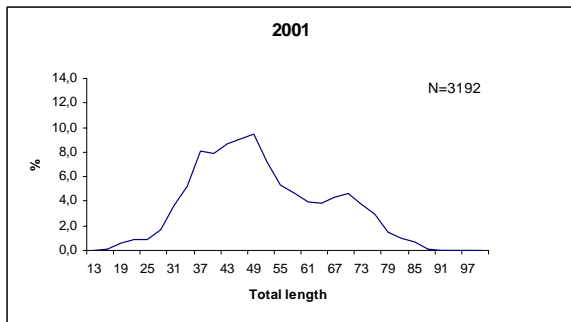
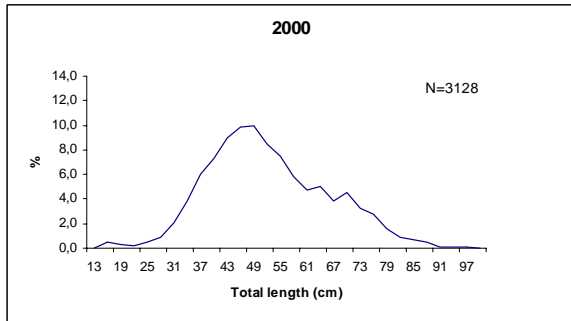
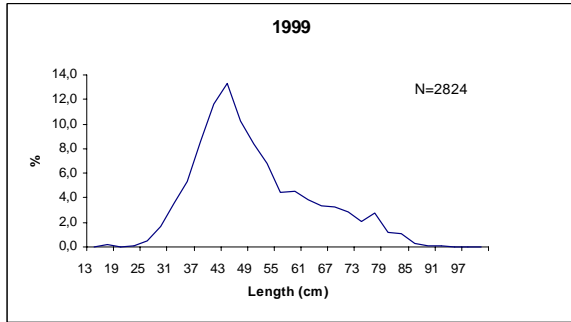
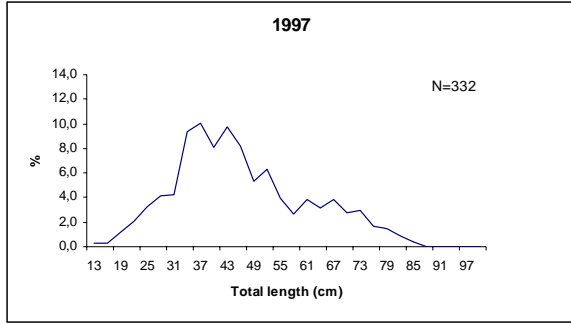


Fig. 10. Length frequencies (%) by year of the thorny skate in the Spanish spring bottom trawl surveys (NAFO Div. 3NO): 1997-2002.

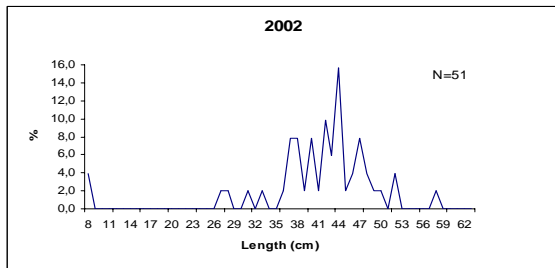
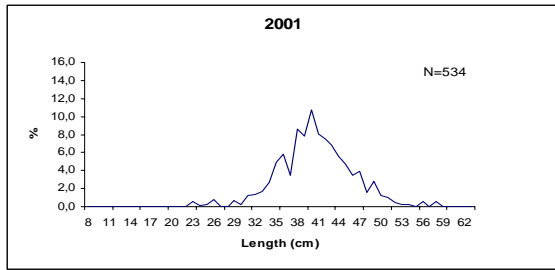
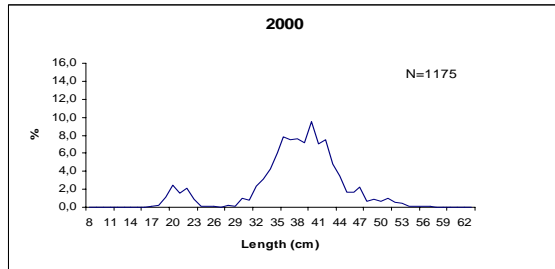
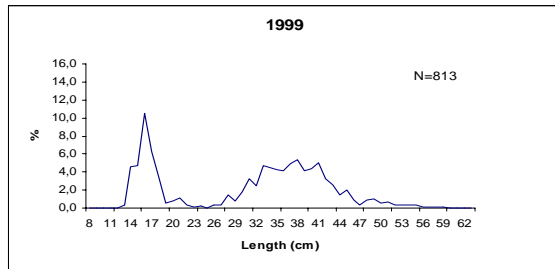
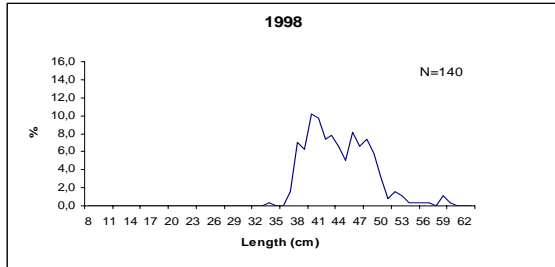
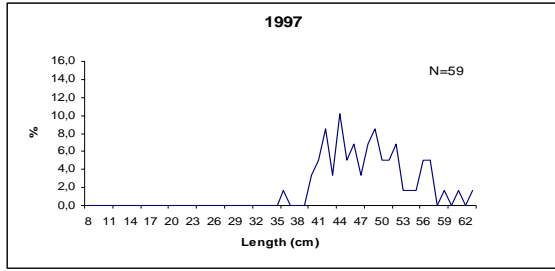


Fig. 11. Length frequencies (%) by year of the witch flounder in the Spanish spring bottom trawl surveys (NAFO Div. 3NO): 1997- 2002.