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Description of the Spanish pelagic fishery of oceanic redfish (*Sebastes mentella* Travin) in the North Atlantic (1995-2001).

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Abstract

The examined period comprises from the beginning of the exploitation of this resource by the Spanish fleet in 1995 to the current time. Data come from the Spanish commercial fishery (hauls, effort, trawl time, locations, CPUE and length distributions) were recorded on board by scientific observers of the national sampling network (1995-2001).

The Spanish pelagic fishery of redfish in the ICES areas XII and XIV and in the NAFO Division 1F showed a significant seasonal pattern in terms of its geographical and depth distribution. The fishing season occurs mainly during the 2nd and 3rd quarter of every year.
In the second quarter the fleet works in the area XIV, between the Greenland and Iceland EEZs, in depths greater than 500 meters capturing fish of great size. Proportion of females in the catches is greater than the males. The catches length distributions present two modes that move along the time. The yields obtained in this quarter are larger and the mean trawl time of the hauls is smaller than in the third quarter.
In third quarter the fleet moves toward the south west to the ICES Division XII and NAFO Division 1F and depth of hauls is less than 500 meters. The length distributions of the catches are smaller than those of the second quarter and show only one mode rather stable in time. Proportion of the males in the catches is bigger than the females. The yields are smaller and the mean trawl time of the hauls is greater than those of the second quarter.

The fishery in NAFO area 1F is quite similar to that one carry out in ICES Division XII, particularly in the characteristics of the hauls (depth, duration, time, etc) and in the catches (distributions of sizes, sex ratio, etc). Because this reasons, the presence of an unique population widely distributed in both fishery areas is suggested.

Introduction

The reason of this work document is to provide a historical vision of the exploitation of the redfish (*Sebastes mentella*) in ICES areas XIV and XII and NAFO Division 1F by the Spanish fleet that allows to understand better the changes that are taking place in the fishery. The examined period comprises from the beginning of the exploitation of this resource by the Spanish fleet in 1995 to the current time. Information is reported on the characteristics of the fleet, distribution of the effort and CPUE, fishing areas, characteristic of the hauls and catches length distributions.

Material and Methods

Data from the Spanish commercial fishery (hauls, effort, trawl time, positions, CPUE and length distributions) were recorded on board by scientific observers of the national sampling network (1995-2001). Data records were characterised by the vessel, date, depth and division and they were available in tow-by-tow basis. The analysed CPUE data were not standardised.

Data were split in two depth strata, less than 500 meters and more than 500 meters shot depth. These strata were chosen because variation of the data within the strata is smaller than the variation of the data among the strata as may be observed in the results of this work.

It must be noted that the scientific observer coverage is not the 100% of the fishing effort. In the study period (1995-2001), the percentage coverage by the sampling network varies every year, the sampling covered the whole fishing season (2º and 3º trimester) annually, except in 1999. The table 2 shows the vessels that operated in this area every year, as well as the sampled ships by the scientific observers.
Table 1 shows the number of sampled hauls by division, year and depth strata. Despite the level of sampling coverage, the data are thought to be representative of the whole fleet.

Results

Fleet

The Spanish fleet began to exploit this resource with three vessels in the second semester of 1995. In 1996 the same boats fished during the whole year, in 1997 the fishing was concentrated on the second and third trimester and 4 vessels operated in the area, from 1998 until the present time, 6 boats fished in this area during the 2º and 3º trimester of every year as show table 2.

The technical characteristics of the ships that have fished in this area can be observed in table 3. All are large freezers with less than 15 years old and with great freezing capacity and all vessels were equipped with Gloria-type pelagic trawls with a vertical opening of 90-120 meters and a mesh size of 100 mm. in the cod end.

Effort

In table 4 the percentage of the effort is presented by year, quarter, division and depth strata. We can observe that most of the effort in hours is carried out in the XIV area and less in the XII one, but this is not distributed equally in the different quarters, the quarters with more percentage of effort are with difference the second and the third and in the last five years, the percentage carried out in the first and fourth quarter in the last years is minimum as show table 5. To noted that in the last two years the fishery extended to NAFO area 1F in the third quarter.

Table 6 present the distribution of the effort by Division, depth strata and year. Since 1997 most of the effort is carried out in the stratum of >500. We can observe in the figure 1 that the geographical distribution of the effort (hauls) has varied along the studied period, in the first years (1995-1997) the effort was carried out mainly in the XIV area in the two strata. In last years, the geographical area where the effort was exercised in depths bigger than 500 meters has remained more or less stable while the area where the effort is carried out to less than 500 meters has varied a lot. In the last years, this area has left displacing toward the south west reaching the division 1F of NAFO.

Since 1997, the effort distribution showed a significant seasonal pattern in terms of its geographical and depth distribution. Most of the effort is usually carried out during the second and third quarter of every

year. During the second quarter, the effort is carried out in international waters of ICES Division XIV between the Greenland and Iceland EEZs in depth greater than 500 meters. In third quarter the fleet moves toward the south west to the ICES Division XII and NAFO Division 1F where depth of hauls is less than 500 meters.

CPUE

In the table 7 the mean CPUE, standard deviation and variation coefficient are shown by year and depth stratum. The values of CPUE in the stratum of >500 are greater than those obtained in the stratum of <500. The mean CPUE values were accompanied by very high standard deviations and variation coefficient indicating high variations in individual values resulting from a patchy fish distribution.

Regarding the stratum of >500 it is observed a decreased of CPUE in the last three years, passing of 1533 Kg/hour in 1999 to 1074 Kg/hour in the year 2001, while in the stratum of <500 a slight increment in the CPUE may be appreciate in the last years, spending of 584 Kg/Hour in the year 1997 to 813 Kg/Hour in the 2001 as show the figure 2.

Figure 3 present the CPUE by year and Division. The major yields are obtained every year in the Division XIV, in the last three years the CPUE trend in this division has decreased, from 1533 to 1074 kg/hour. In the XII division the CPUEs is smaller than in the XIV division and the biggest yields have been obtained in the last two years (840 Kg/hour). The division where smaller yields are obtained it is 1F, in the year 2000 were of 168 and in the 2001 it has been of 305 kg/hour.

Discards

Discard of *Sebastes mentella* are composed often of parasite fish by *Sphyrion lumpi*. The discards quantities vary annually, existing years in those that practically anything is not discarded and other where the discards it can represent 6% of total catches (1996) as it is show in the table 8. This variability can also be observed for depth strata, the discarded percentage is much larger in the stratum >500 meters.

Since 1997, this variability can be due to that the percentage of discards does not depend directly on parasite fish by *Sphyrion lumpi*, but it is related with the haul catch. When the haul catch is very much the fish is discarded under worse conditions by the lack of time to elaborate the whole catch. When the catches are between the standard values there is enough time to elaborate the whole fish, even the one infected, and there is not discards.
I.e. There is haul catch level which produces that as greater haul catch greater haul discards as we can see in figure 4.

Hauls

Figure 5 shows the hauls depth in relation to time, in the second quarter the hauls carry out in depths bigger than 500 meters, while in the third quarter the hauls depth is smaller than 500 meters as observed in this figure.

The mean shot depth of the hauls by stratum is variable every year (table 9), in the stratum of <500 meters it varies between 300 and 420 meters, in the stratum of >500 the annual means are between 550 and 770 meters. In the Division XIV the mean shot depth of the hauls is the same that in the stratum of >500, while the mean shot depth of the hauls in Division XII and 1F are quite similar to the stratum of <500 m.

In the first years (1995-1996) the mean trawl duration it was similar in the two strata and their value was of 10 hours, as you can see in figure 6. From 1997, the time trawl of the hauls increase in the two strata and it is usually larger in the stratum of <500 that it varies among 18-20 hours in the last years, while in the stratum of >500 the mean trawl duration of hauls in the last years it is among the 13-17 hours.
Figure 7 present the mean trawl time by division and is very similar to that of the strata, the Division XIV is similar to the stratum of >500 and the Division XII is similar to the stratum of <500. The division 1F in the year 2000 was similar to the stratum of >500 while in the year 2001 was similar to the stratum of <500.

Length distributions

The proportion of males and females for depth stratum are different and varies opposite, while in the stratum <500 the males are more abundant that the females, in the stratum >500 happens the opposite, the females they are more abundant than the males as observed in figure 8.

By Divisions, the proportion of males and females it is more variable than by strata of depth, to point out that in the division 1F the proportion of males is bigger than females and it is similar to that of the Division XII, as observed in figure 9.

The length distributions of catches in percentage by depth stratum and year are presented in figure 10, we can observe that length distributions in the stratum of <500 are quite stable with one mode around to the size 34-36 cm, while in the stratum of >500 the length distributions are bigger and present two modes around 37 and 42 centimetres that go moving in the time, in 1996 the mode value of 37 it is bigger than that of 42 and with the years the mode value of 37 centimetres diminishes and increasing that of 42 centimetres.
The length distributions of catches in percentage by Division and year are presented in the figure 11, to point out that the length distributions of the catches of the Division 1F are similar to the length distributions of the Division XII and these they are very similar to that of the stratum of <500 meters, since almost of all hauls of these two divisions they are carried out to depths smaller than 500 meters. The distributions of sizes of the XIV Division are very similar to that of the stratum of more 500 meters.

Conclusions

The Spanish pelagic fishery of redfish in the ICES areas XII and XIV and in the NAFO Division 1F showed a significant seasonal pattern in terms of its geographical and depth distribution. The fishing season is occurs mainly during the 2nd and 3rd quarter of every year.
In the second quarter the fleet operate in the area XIV, between the Greenland and Iceland EEZs, in depths greater than 500 meters capturing fish of more size. Proportion of females in the catches is greater than the males, the catches length distributions present two modes that move along the time. The yields obtained in this quarter are larger and the mean trawl time of the hauls is smaller than in the third quarter. Discards, when they exist, are bigger because discards depend on the total catch of the hauls and the hauls with more catches are presented in this season.
In the third quarter the fleet move toward the south west to the ICES Division XII and NAFO Division 1F and depth of hauls is less than 500 meters. The length distributions of the catches are smaller than those of the second quarter and show only one mode rather stable in time. Proportion of the males in the catches is larger than the females. The yields are smaller and the mean trawl time of the hauls is greater than those of the second quarter .

The fishery in NAFO area 1F is quite similar to that one carry out in ICES Division XII, in particularly in the characteristics of the hauls (depth, duration, time, etc) and in the catches (distributions of sizes, sex ratios, etc), Because this reasons, the presence of an unique population widely distributed in both fishery areas is suggested.

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ICES (2001): Report of North-Western Working Group. ICES C. M.

Nº Sample Hauls		DIV Strata						
		XIV		XII		1F		Total
Year	Quarter	<500	>500	<500	>500	<500	>500	
1995	Q - 1							
	Q - 2							
	Q - 3	99	3	9				111
	Q - 4	366	2					368
1996	Q - 1	50	8					58
	Q - 2	7	296					303
	Q - 3	110	111	114				335
	Q - 4	128						128
1997	Q - 1							
	Q - 2	10	128					138
	Q - 3	40	33	21				94
	Q - 4							
1998	Q - 1							
	Q - 2		106					106
	Q - 3	20	17	7				44
	Q - 4							
1999	Q - 1							
	Q - 2		89					89
	Q - 3							
	Q - 4							
2000	Q - 1							
	Q - 2		107					107
	Q - 3		26	30				56
	Q - 4					5		5
2001	Q - 1							
	Q - 2		105					105
	Q - 3		11	45		3		59
	Q - 4			11				11
Total		830	1042	237		8		2117

Table 1. Number of sample hauls by year, Division and depth strata.

Vessels	1995	1996	1997	1998	1999	2000	2001
V1	X	X	X	X	X	X	X
V2			X	X	X	X	X
V3				X	X	X	X
V4	X	X	X	X	X	X	X
V5				X	X	X	X
V6	X	X	X	X	X	X	X

X Sampled vessels

Table 2. Vessels fishing in the area and sampled vessels by year.

Vessels	HP	GRT	Built	Length (meters)	Freezing Capacity (tons/day)
V1	2000	1866	1987	84	45
V2	2000	703	1988	67	30
V3	1950	1075	1988	68	30
V4	2000	995	1987	74	50
V5	2000	1236	1986	64	25
V6	1950	1393	1986	68	40

Table 3. Technical characteristics of the vessels.

%Effort		DIV Strata						
		XIV		XII		1F		Total
Year	Quarter	<500	>500	<500	>500	<500	>500	
1995	Q - 1							
	Q - 2							
	Q - 3	89%	3%	8%				100%
	Q - 4	99%	1%					100%
1996	Q - 1	87%	13%					100%
	Q - 2	2%	98%					100%
	Q - 3	32%	35%	34%				100%
	Q - 4	100%						100%
1997	Q - 1							
	Q - 2	7%	93%					100%
	Q - 3	50%	24%	26%				100%
	Q - 4							
1998	Q - 1							
	Q - 2		100%					100%
	Q - 3	46%	38%	16%				100%
	Q - 4							
1999	Q - 1							
	Q - 2		100%					100%
	Q - 3							
	Q - 4							
2000	Q - 1							
	Q - 2		100%					100%
	Q - 3		45%	55%				100%
	Q - 4					100%		100%
2001	Q - 1							
	Q - 2		100%					100%
	Q - 3		16%	78%		6%		100%
	Q - 4			100%				100%
Total		36%	50%	13%		1%		100%

Table 4. Percentage of the effort is by year, quarter, division and depth strata.

%Effort	Quarter				
Year	Q - 1	Q - 2	Q - 3	Q - 4	Total
1995			21%	79%	100%
1996	7%	34%	41%	18%	100%
1997		49%	51%		100%
1998		60%	40%		100%
1999		100%			100%
2000		60%	37%	3%	100%
2001		57%	37%	6%	100%
Total	2%	40%	35%	22%	100%

Table 5. Percentage of effort by year and quarter.

%Effort	Division			
Year	XIV	XII	1F	Total
1995	98%	2%	0%	100%
1996	86%	14%	0%	100%
1997	87%	13%	0%	100%
1998	94%	6%	0%	100%
1999	100%	0%	0%	100%
2000	77%	21%	3%	100%
2001	63%	35%	2%	100%
Total	86%	13%	1%	100%

%Effort	Strata		
Year	<500	>500	Total
1995	99%	1%	100%
1996	52%	48%	100%
1997	42%	58%	100%
1998	25%	75%	100%
1999		100%	100%
2000	23%	77%	100%
2001	37%	63%	100%
Total	50%	50%	100%

Table 6. Percentage of effort by year Division and strata.

CPUE (Kg/Hour)	Strata								
	<500			>500			Total Mean	Total SD	Total VC
Year	Mean	SD	VC	Mean	SD	VC			
1995	910	630	0.69	885	1365	1.54	910	639	0.70
1996	601	523	0.87	1412	1029	0.73	1009	912	0.90
1997	584	439	0.75	1082	600	0.55	930	601	0.65
1998	785	586	0.75	969	738	0.76	936	715	0.76
1999				1533	774	0.50	1533	774	0.50
2000	748	460	0.61	1299	746	0.57	1184	730	0.62
2001	813	454	0.56	1074	601	0.56	986	568	0.58
Total	757	582	0.77	1264	862	0.68	1007	776	0.77

Table 7. Mean CPUE standard deviation and variation coefficient by year and depth stratum.

	Strata								
	<500			>500			Catch (t)	Discards (t)	%
Year	Catch (t)	Discards (t)	%	Catch (t)	Discards (t)	%			
95	4381	132.7	3.0	78	12.6	16.1	4459	145.3	3.3
96	2816	97.7	3.5	5720	457.1	8.0	8536	554.8	6.5
97	588	0.0	0.0	1791	0.0	0.0	2379	0.0	0.0
98	414	0.0	0.0	1294	0.0	0.0	1707	0.0	0.0
99				1705	0.0	0.0	1705	0.0	0.0
00	559	0.1	0.0	2670	0.8	0.0	3229	0.9	0.0
01	855	10.3	1.2	1825	108.1	5.9	2680	118.4	4.4
Total	9613	240.8	2.5	15083	578.6	3.8	24696	819.4	3.3

Table 8. Catches, discards and percentage by year and depth strata.

Mean Shot Depth	Strata	
Year	<500	>500
1995	332	559
1996	300	680
1997	416	699
1998	394	768
1999		763
2000	404	713
2001	407	657
Total	333	701

Mean Shot Depth	Division		
Year	XIV	XII	1F
1995	335	267	
1996	527	268	
1997	637	365	
1998	716	382	
1999	763		
2000	713	400	429
2001	657	408	389
Total	538	330	414

Table 9. Mean shot depth by year, strata and division

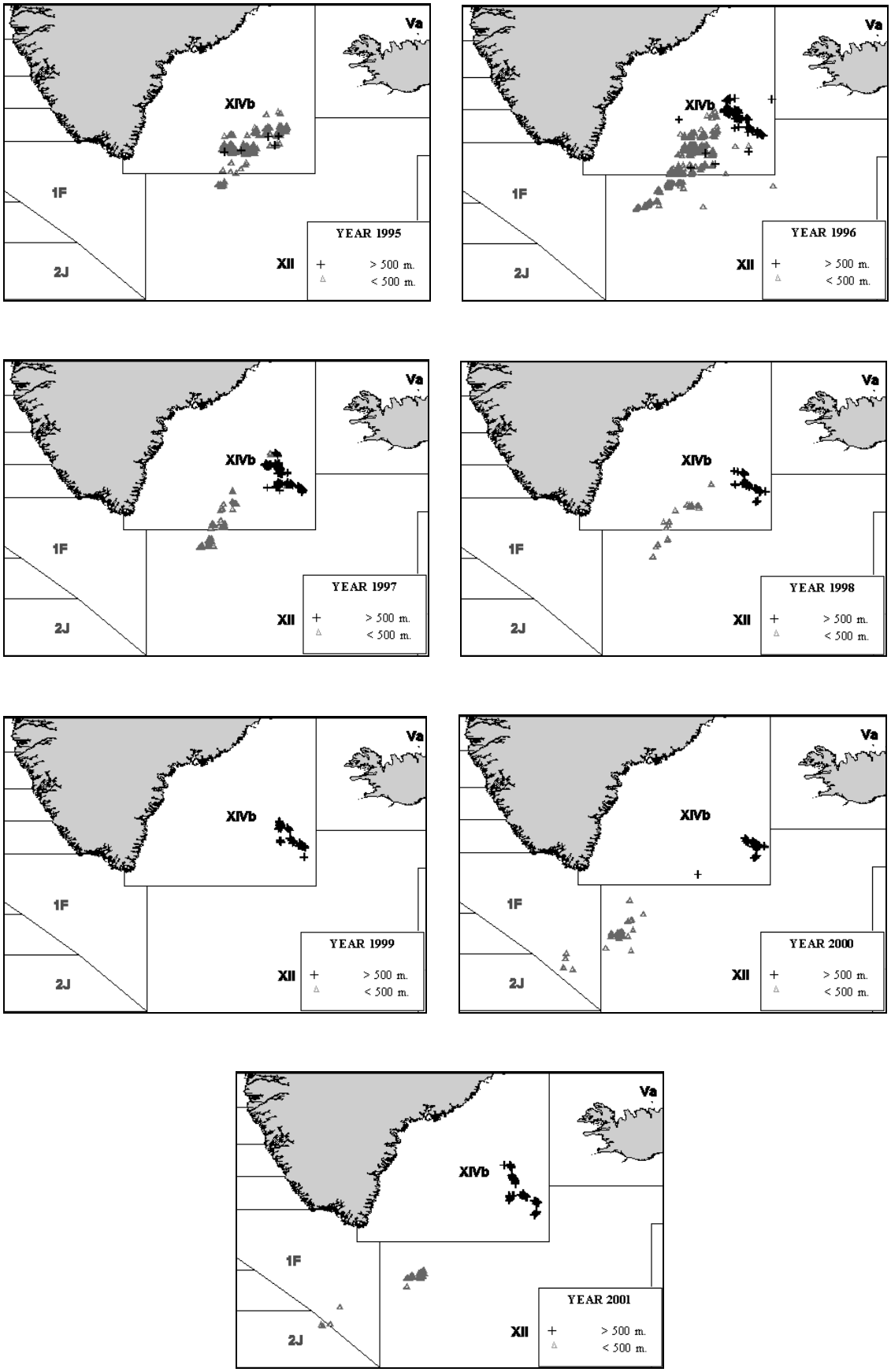

Figure 1. Geographical distribution of the hauls by year, division and depth strata.

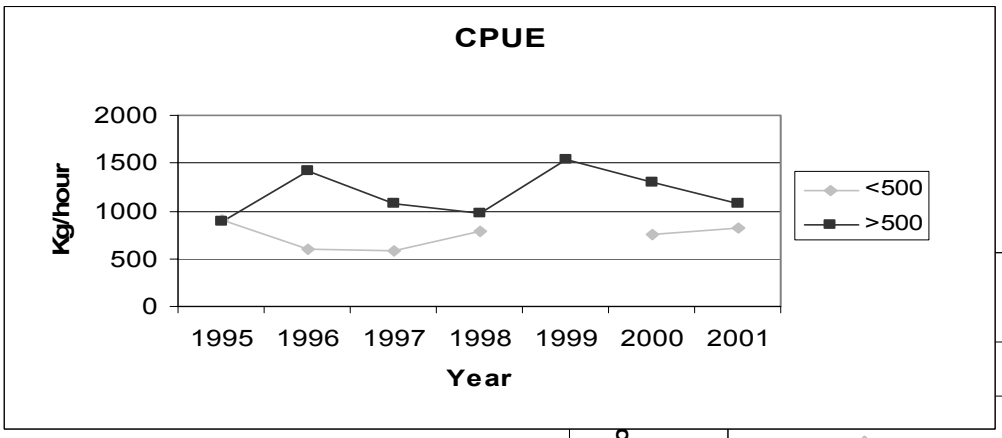

Figure 2. CPUE (Kg/Hour) by year and depth strata.

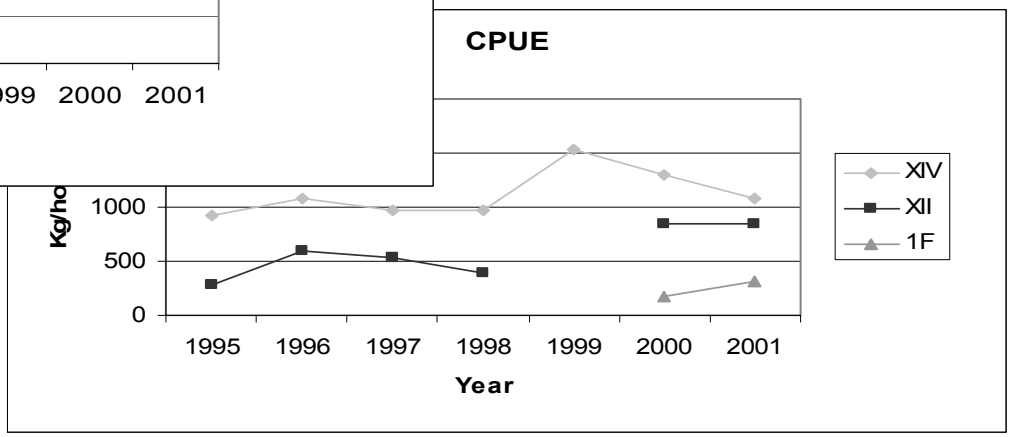

Figure 3. CPUE (Kg/Hour) by year and Division.

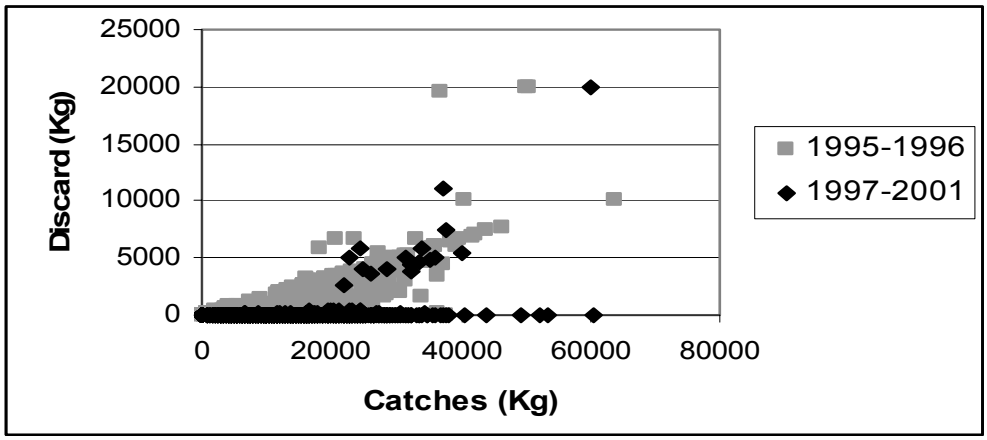

Figure 4. Discards vs catches.

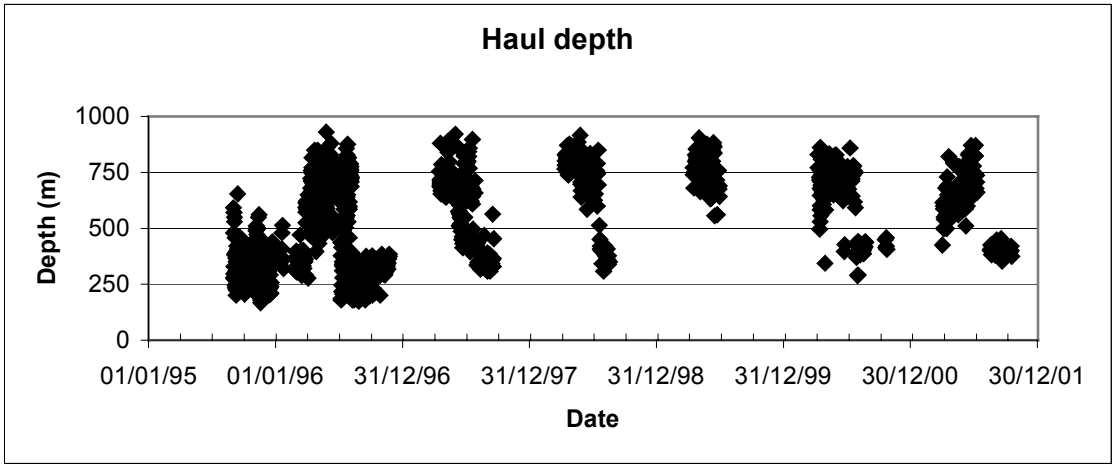

Figure 5. Haul depth

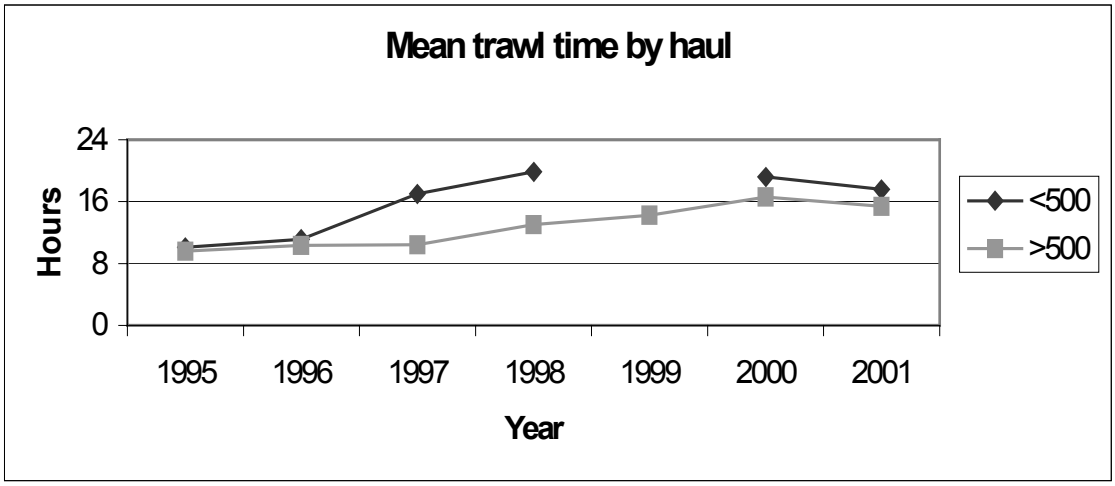

Figure 6. Mean trawl time by haul, strata and year.

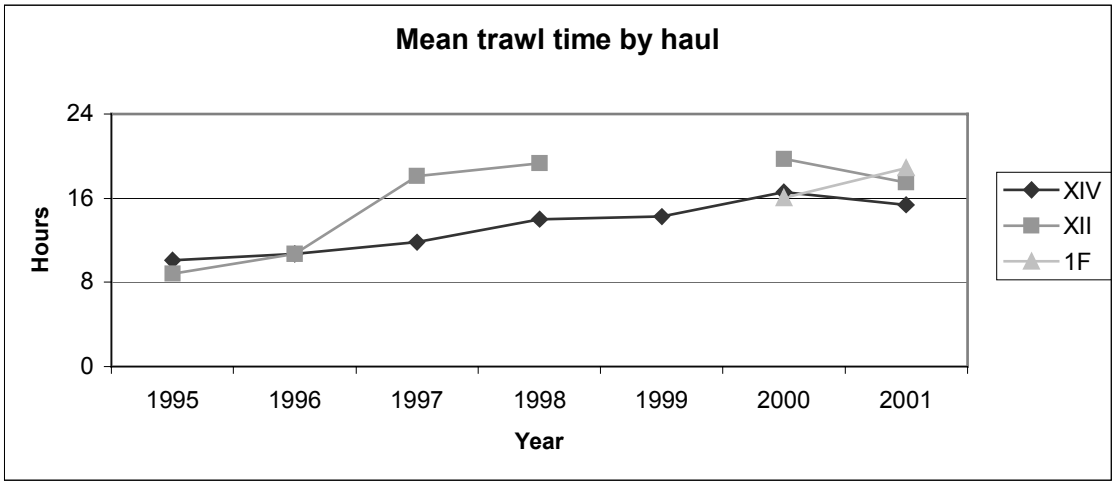

Figure .7. Mean trawl time by haul, Division and year.

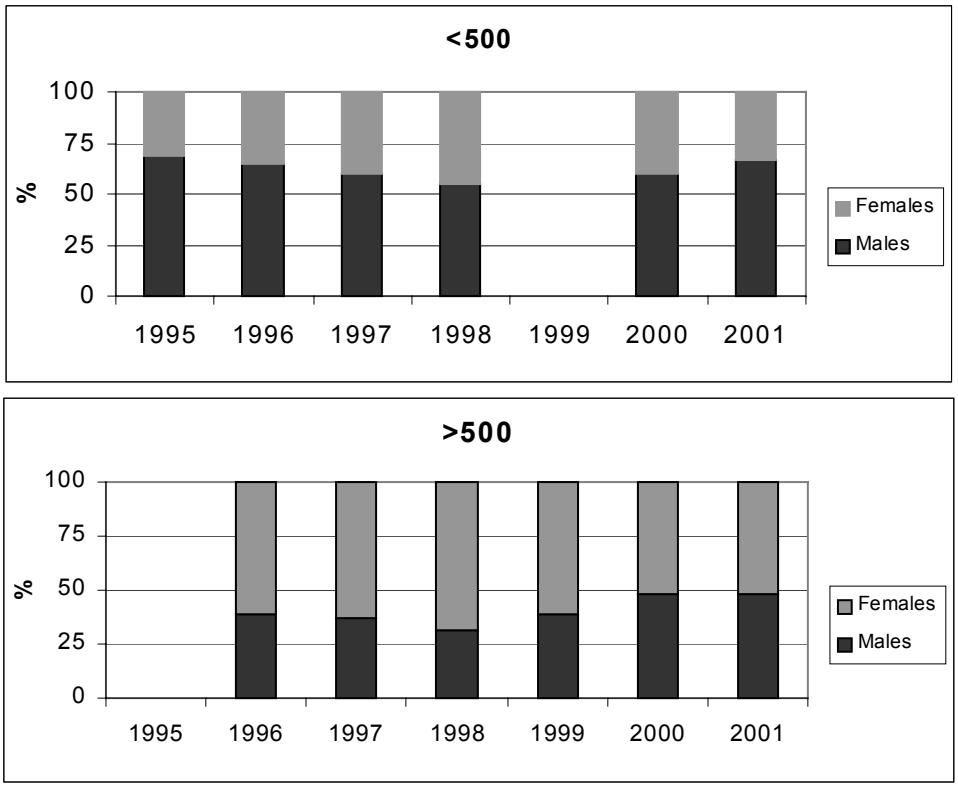

Figure 8. Proportion of males and females by depth stratum and year.

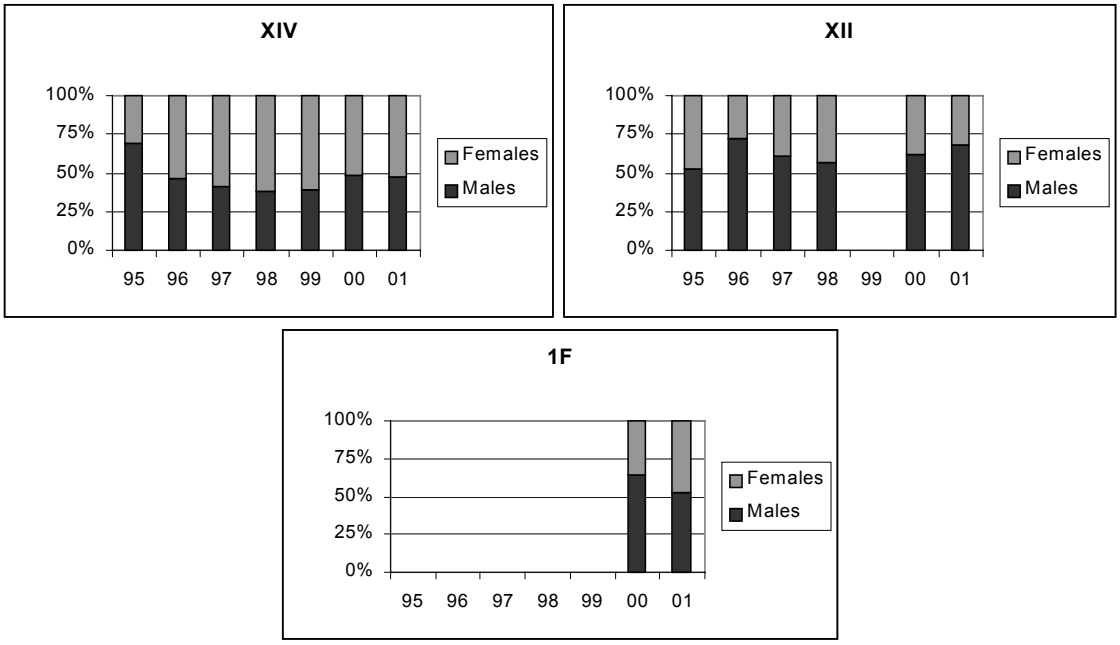

Figure 9. Proportion of males and females by division and year.

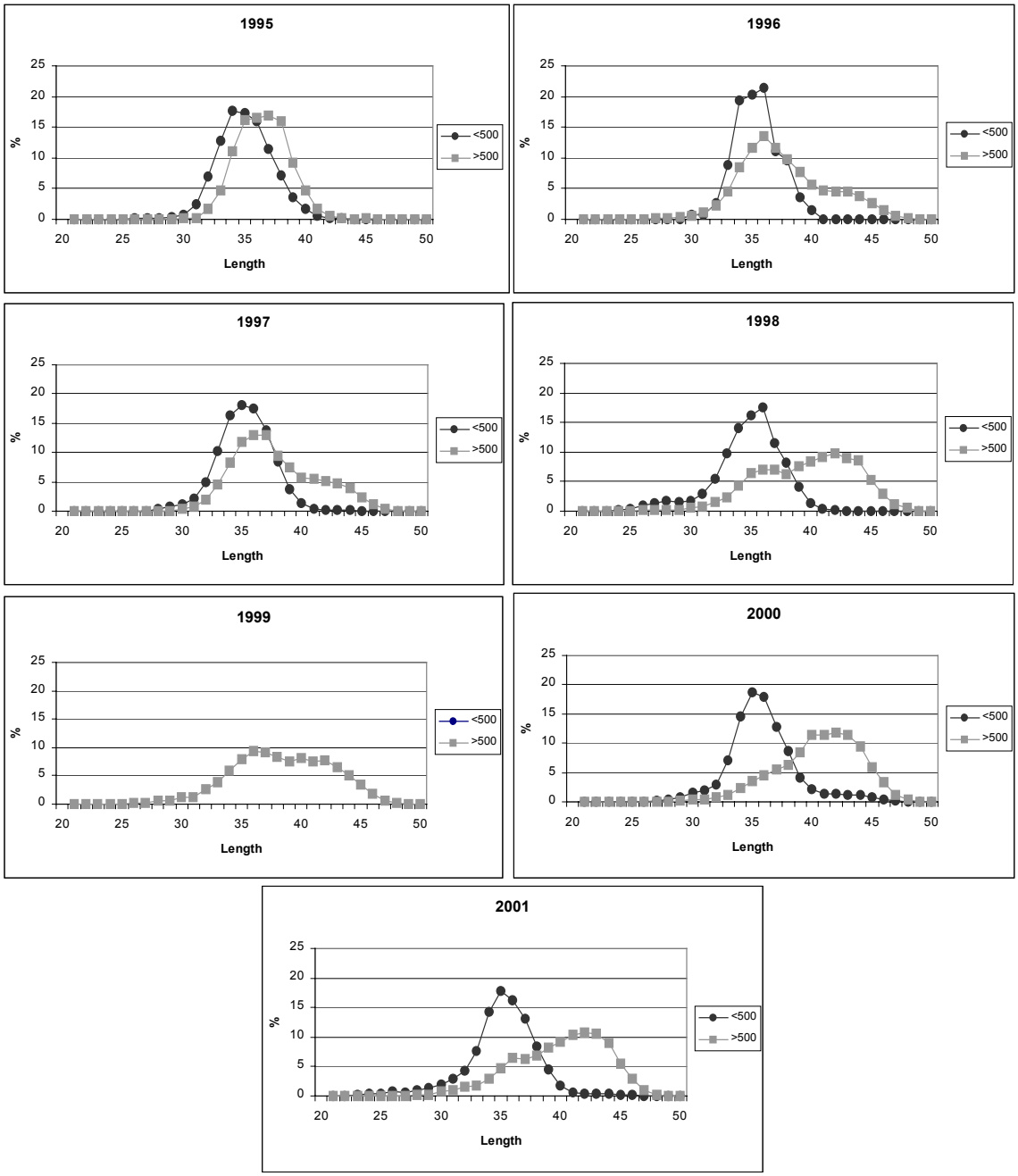

Figure 10. Catches length distributions in percentage by year and depth strata.

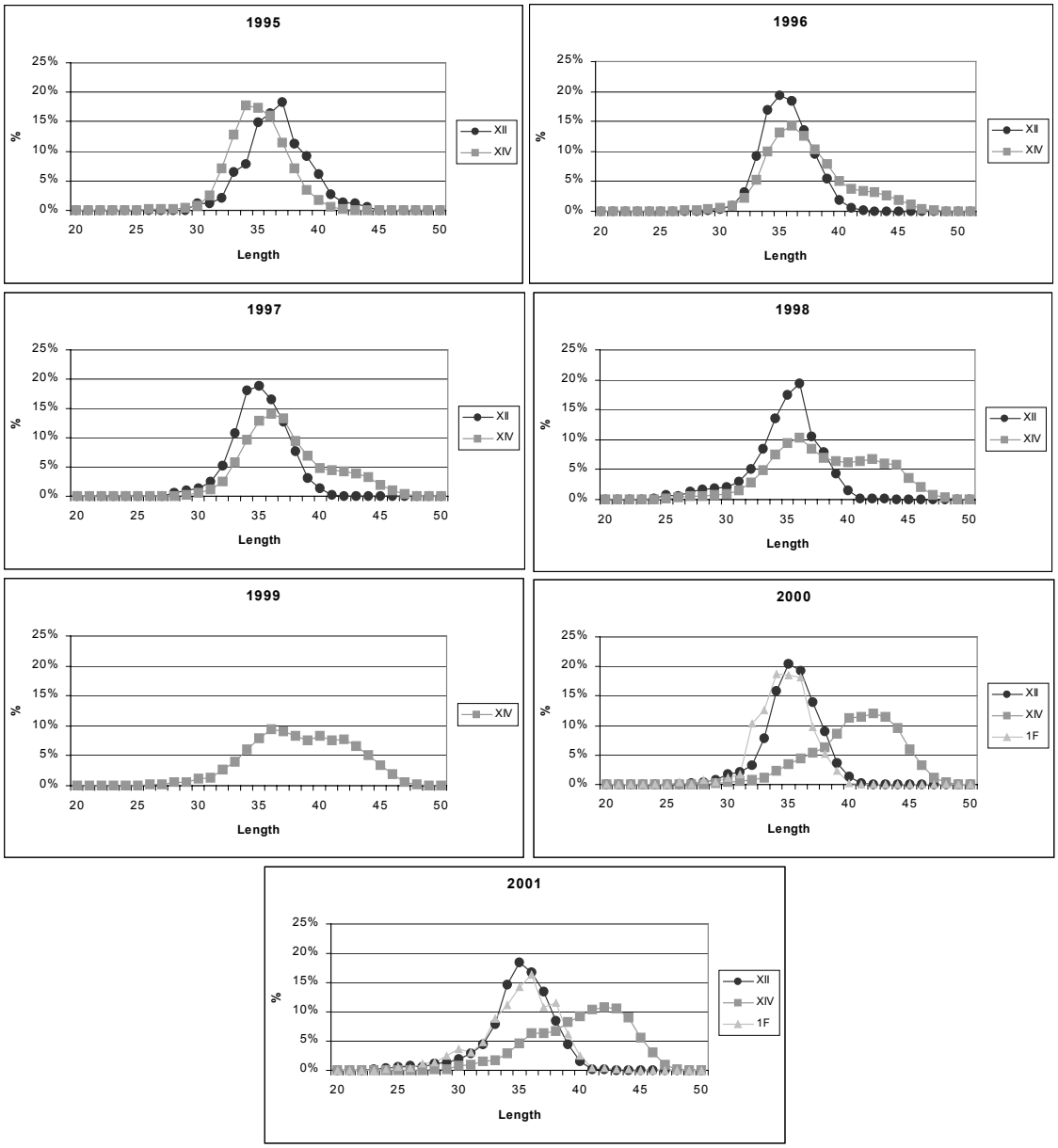

Figure 11. . Catches length distributions in percentage by year and Division.