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Abundance and Distribution of Elasmobranchs in NAFO Regulatory Area (Divisions 3MNO)

(Elasmobranch Fisheries – Oral)

by

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Abstract

Recently, the importance of elasmobranch fisheries has increased in the NAFO area due to the collapse of some important stocks like cod or American plaice; species like thorny skate are now one of the main resources in the NAFO Regulatory Area, especially in the Grand Bank. Nevertheless, in Flemish Cap (NAFO Div 3M), despite the weakness of the main stocks, elasmobranchs carry on being a resource without direct fishing that is mainly fished as by-catch.

Since 1988 a bottom trawl survey was carried out by the European Community in Flemish Cap waters. Furthermore, since 1995, another trawl survey was also carried out in the Regulatory Area of the Grand Bank (NAFO, Div. 3NO); the goal of these surveys is collecting data for the assessment of the main species but these surveys are also an important source of information on biology and population dynamics of other fish species like elasmobranchs.

The aim of this work is to show the present status and the recent changes in biomass of the main elasmobranch species in the areas covered by these surveys, with focus on their relative abundance, their spatial distribution and their size distribution. We have found out that thorny skate, that is the most important elasmobranchs in NAFO area, is widely distributed in both sampling areas without signs of stocks differentiation.

Introduction

Flemish Cap is a underwater plateau centred at about 47º N and 45º W with minimum water depths of 125 m. Flemish Cap is separated from the Grand Bank of Newfoundland to the West by the Flemish Pass, a region with minimum depth of about 1 100 m. Historically, the fishery in this area was directed towards cod and American plaice but these fisheries collapsed in the 1990s and were replaced by shrimp and redfish that are now the main target species.

As a result of an increasing in fishing effort towards non-regulated species added to the decline in the traditional groundfish resources in the area of the Grand Bank, in recent years the catches of non-traditional resources in the NAFO area have been increasingly important (Durán *et al*., 1997; Junquera and Paz, 1998).

The elasmobranchs have slow growth and late sexual maturation, very low egg production and long reproductive cycles. These attributes result in very low intrinsic rates of increases (Smith *et al*., 1998) and very low resilience to fishing mortality (Hoening and Gruber, 1990). Because of their low population resilience, most

elasmobranchs only withstand modest levels of fishing without depletion and stock collapse (Camhi *et al*., 1998; Musick, 1999a). Thus, they are highly susceptible to over-exploitation.

Material and Methods

Data used in this study come from two different surveys: the UE summer bottom trawl surveys for NAFO Div. 3M (Flemish-Cap survey) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO. The sampling area of both surveys is showed in Fig. 1.

The EU-Flemish Cap survey has been carried out since 1988 with the aim of evaluate the main commercial species in the area (Vázquez, 2002). The stratified random sampling, that usually has 120 hauls, follows the NAFO specifications as described by Doubleday (1981). The sampling area spreads out until 720 m covering an area of 10 555 square miles. Table 1 (upper panel) shows a short description of some survey features: the vessel used in this survey was always the *R/V Cornide de Saavedra* except for the years 1989 and 1990 when it was not available, but the gear characteristics were the same through all the years. The number of valid tows, depth range and time of survey for every year are also indicated.

Since 1995 the Spanish spring bottom trawl survey was performed in the NAFO Regulatory Area (Div. 3NO). The stratified-random sampling method of set selection was used. The area and strata covered by the surveys were based on the stratification charts and tables in Bishop (1994). The surveys, which covered offshore areas on the Grand Bank, were conducted following the same procedures and the same vessel and gear (Paz, *et al.*, 1995,1996,1997,1999, 2000 and Durán *et al*., 1998). Surveys characteristics are described in Table 1 (lower panel), the first survey, in 1995, just covered until 684 m depth with 77 valid tows, but in the last four years the maximum depth reached 1400 m with near 120 valid tows. Due to big differences in the area covered in the first three surveys these were excluded from this analysis.

Results and Discussion

The presence of elasmobranchs in both surveys areas is quite different. Meanwhile elasmobranchs in Flemish-Cap just represent about a 1.5% on total catch, ranging among 0.5 and 3.0% along the time series, elasmobranchs catch reached the 16% in the Div. 3NO surveys in 1997 and the medium catch in all the series was about 12% (Fig. 2).

In Table 2 we can see the elasmobranch species recorded in both surveys. The number of species is larger in the sampled area of Div. 3NO where 15 different species were classified, meanwhile in the Flemish-Cap survey just 9 species were found. This result can be explained since the Div. 3NO surveys cover a deeper area, 1400 m, against the 730 m in Flemish-Cap surveys. All species found in the Flemish-Cap surveys are also presented in the Div. 3NO surveys except white skate with 14 individuals recorded in Flemish-Cap.

The relative importance of these elasmobranchs is different in both areas (Fig. 3). The main species caught in both surveys is thorny skate, with 64% of total elasmobranchs catch in Flemish-Cap and 78% in Div. 3NO. Spinetail skate is the second species in Flemish-Cap with a 31%, meanwhile in the Div. 3NO survey represents only the 1% of total elasmobranchs. However, in the Div. 3NO survey the second specie in abundance is black dogfish with an 18% of total elasmobranchs, although this species hardly appears in Flemish-Cap (0.9%). The percentage of all others species is almost the same in both surveys (4% in Flemish-Cap and 3.5% in Div. 3NO surveys).

Table 3 shows the catch of all elasmobranchs by species and year in both surveys. The annual catch of elasmobranchs in Flemish-Cap fluctuates between 178 kg in the year 2000 and 623 kg in 1993, with a total catch in all the surveys of 5 532 kg. During the Div. 3NO survey in the last four years the annual catch oscillates among 14 291 kg in the year 1998 and 28 119 in 2000, with a total catch in all the series (1995-2001) of 101 404 kg. This big difference among the total catch in both areas, could be explained by the increase in the Div. 3NO surveyed depth that allows the high presence of species like black dogfish, mainly distributed in deeper waters. Nevertheless, as we have shown before (Fig. 3) the main species in both areas is the thorny skate that mainly occurs in shallower waters.

Thorny skate

Amblyraja radiata is the most abundant elasmobranch in both areas studied and it is the only one that has a directed fishery in the Div. 3NO area. The skate fishery in the Grand Bank and the Scotian Shelf within Canadian waters is regulated since 1994, through quota control (Simon and Frank, 1996), but the fishery in the Regulatory Area is currently unregulated. Since 1996, part of the Spanish fleet formerly targeting exclusively on Greenland halibut, started to undertake occasionally the skate fishery on the southern Grand Bank Regulatory Area in shallow waters. The estimated catches of thorny skate by the Spanish fleet in NAFO Div. 3N in 1999 were 4 700 tons. (Junquera *et al*., 2000) and increased to about 10 700 tons in 2000.

The biomass estimated by sweep area method in both surveys is presented in Fig. 4; the trend in Flemish Cap peaks in the years 1991-1994 with values higher than 2 500 tons. Nevertheless, since 1996 sweep area biomass never reached 1 500 tons and its lower value was 900 tons in the year 2000. In the Div. 3NO spring survey just the last four years were included in the calculus of sweep area biomass. The values estimated for this area oscillate approximately between 100 000 tons in 1998 and 200 000 tons in 2000.

Total catch, total numbers, number of hauls with presence, mean weight and depth distribution for thorny skate by year and area are showed in Table 4. The hauls with thorny skate presence in Flemish Cap are about a half, meanwhile in the Div. 3NO survey thorny skate appears in near all the hauls. In both surveys and every year the minimum and maximum depth with records of thorny skate matches the hauls depth range, which suggests that the thorny skate has a wide depth tolerance and its distribution could exceed the survey maximum depth. In Flemish-Cap, mean weight ranges between 1.4 kg in 2001 and 1.9 kg in 1991 and in the Div. 3NO survey, in the last four years mean weight oscillates between 1.1 kg and 1.5 kg, clearly lower than Flemish-Cap values.

Length-weight relationship for both surveys by year is presented in Table 5. The sampling of the last three years let us establish the length-weight relationship by sex (Fig. 5).

The length distributions of thorny skate in Flemish-Cap (1988-2001) and in the Div. 3NO survey (1998-2001) are shown in Fig. 6. In Flemish-Cap the length range in the catches is mainly between 10 and 85 cm, without any clear mode. In the Div. 3NO survey the length range is approximately between 12 and 90 cm, with a mode of 34 cm in 1998, 43 cm in 1999 and about 50 cm in 2000 and 2001. Both sexes appeared equally represented in the catches of both surveys. In the last three years the length distribution in the Div. 3NO survey shows a higher proportion of small skates than in Flemish-Cap. This large proportion of small fish explained that mean weight in Flemish-Cap is larger than Div. 3NO mean weight.

The distribution of thorny skate catches in Flemish-Cap surveys and Div. 3NO surveys are presented in Fig. 7. Thorny skate in Flemish-Cap is widely distributed, although we can see that during the more abundant years (1991-1994), skate mainly occurs northwards at about 400 m depth. In the Div. 3NO survey the thorny skate also is widely distributed, although mainly occurs at shallower waters, specially bounding the EEZ in the limit between Div. 3N and 3O. High concentrations of thorny skate also were observed in depth water in the East slope.

Black Dogfish

Centroscyllium frabricii is a deep species that usually occurs beyond 500 m in the NAFO area (Durán *et al*., 1999). Black dogfish rarely occurs in Flemish-Cap, where only was recorded in six years of all the series (Table 6). In the Div. 3NO survey that reached 1400 m deep, black dogfish is more abundant. In the last four years total catch oscillated between 2 202 kg in 1999 and 5 876 kg in 2000.

The length distributions of black dogfish in the spring Div. 3NO surveys are shown in Fig. 9. The length range in the catches is mainly between 40 and 80 cm in the last four years. Males are larger and more abundant than females. Length-weight relationship for the spring Div. 3NO surveys by sex from 1997 to 2001 is presented in Table 7.

Black dogfish in the Div. 3NO survey appears in just a few hauls (22-28) usually in the deepest strata beyond 1000 m and around all the area surveyed (Fig. 10).

Spinetail ray

Bathyraja spinicauda is a species not very abundant in both areas. In the Div. 3NO survey the catches oscillated from 214 kg in 2000 to 504 kg in 1999(Table 8). In the Flemish-Cap survey the catches ranged among 265 kg in 1998 and 42 kg in 2000. It is a large species with mean weight that oscillates between 2 454 g in 2000 and 8 291 g in 1988. Length-weight relationship for Flemish-Cap surveys from 1990 to 2001 is presented in Table 9.

Spinetail ray is found in the deepest strata usually beyond 400 m, although in 1990 appears in shallower waters (Fig. 8).

Other elasmobranch

Table 10 shows a summary for other elasmobranchs much less abundant found in both surveys. Species like chimeras only appeared in the Div. 3NO survey, never in the Flemish-Cap survey series.

Conclusions

The information recorded of elasmobranch species in the summer Flemish-Cap surveys and spring Div. 3NO surveys are limited because the elasmobranchs aren't target species in both surveys and the sampling area covers only partially the depth range for the main elasmobranchs. Just for thorny skate, that is the more abundant elasmobranchs, we have got enough information. The geographic distribution of thorny skate in the Div. 3NO surveys, that appears at more than 1 300 m in the nose of the Grand Bank, indicates that Flemish Pass with 1 100 m depth would not be an impediment to move between Grand Bank and Flemish-Cap. The size distribution in both areas support this suggestion; both distributions are quite similar except in Div. 3NO where the small individuals are relatively more abundant than in Flemish-Cap, given that the sampling area in Div. 3NO survey covers shallower waters than the Flemish Cap survey.

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Table 1.- Description of the research surveys involved in this study.

A.- UE summer bottom trawl surveys for NAFO Div. 3M

Year	Period	Depth strata(m)	Vessel	Valid tows
1988	July	120 - 730	R/V Cornide de Saavedra	115
1989	July	120 - 730	R/V Cryos	116
1990	July-Aug	120 - 730	R/V Ignat Pavlyuchenkov	113
1991	June-July	120 - 730	R/V Cornide de Saavedra	117
1992	July	120 - 730	R/V Cornide de Saavedra	117
1993	June-July	120 - 730	R/V Cornide de Saavedra	101
1994	July	120 - 730	R/V Cornide de Saavedra	116
1995	July	120 - 730	R/V Cornide de Saavedra	121
1996	July	120 - 730	R/V Cornide de Saavedra	117
1997	July	120 - 730	R/V Cornide de Saavedra	117
1998	July	120 - 730	R/V Cornide de Saavedra	119
1999	July	120 - 730	R/V Cornide de Saavedra	117
2000	July	120 - 730	R/V Cornide de Saavedra	120
2001	July	120 - 730	R/V Cornide de Saavedra	120

B.- Spanish spring bottom trawl surveys for NAFO Div. 3NO

Year	Period	Depth strata(m)	Vessel	Valid tows
1995	May	42 - 684	C/V Playa de Menduiña	77
1996	May	41 – 1135	C/V Playa de Menduiña	112
1997	April-May	42 – 1263	C/V Playa de Menduiña	128
1998	May	56 – 1390	C/V Playa de Menduiña	124
1999	May	41 – 1381	C/V Playa de Menduiña	114
2000	May	42 – 1401	C/V Playa de Menduiña	118
2001	May	40 - 1343	C/V Playa de Menduiña	121

Table 2. List of elasmobranch species caught in the EU summer surveys in Div. 3M: 1988-01 (A) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1995-01 (B).

(A)

order	family	genus	specie	common name
ESQUALIFORMES	Squalidae	*Squalus*	*acanthias*	spiny dogfish
ESQUALIFORMES	Dalatiidae	*Centroscyllium*	*fabricii*	black dogfish
ESQUALIFORMES	Dalatiidae	*Etmopterus*	*princeps*	greatlaternshark
RAJIFORMES	Rajidae	*Amblyraja*	*radiata*	thorny skate
RAJIFORMES	Rajidae	*Bathyraja*	*spinicauda*	spinetail ray
RAJIFORMES	Rajidae	*Malacoraja*	*senta*	smooth skate
RAJIFORMES	Rajidae	*Dipturus*	*lintea*	white skate
RAJIFORMES	Rajidae	*Amblyraja*	*hyperborea*	arctic skate
RAJIFORMES	Rajidae	*Rajella*	*fyllae*	round skate

(B)

order	family	genus	specie	common name
ESQUALIFORMES	Squalidae	*Squalus*	*acanthias*	spiny dogfish
ESQUALIFORMES	Squalidae	*Squalus*	*cubensis*	Cuban dogfish
ESQUALIFORMES	Dalatiidae	*Centroscyllium*	*fabricii*	black dodfish
ESQUALIFORMES	Dalatiidae	*Centroscymnus*	*coelolepis*	Portuguese dogfish
ESQUALIFORMES	Dalatiidae	*Etmopterus*	*princeps*	greatlaternshark
CARCHARINIFORMES	Scyliorhinidae	*Apristurus*	spp	catshark
RAJIFORMES	Rajidae	*Amblyraja*	*radiata*	thorny skate
RAJIFORMES	Rajidae	*Bathyraja*	*spinicauda*	spinetail ray
RAJIFORMES	Rajidae	*Malacoraja*	*senta*	smooth skate
RAJIFORMES	Rajidae	*Amblyraja*	*hyperborea*	arctic skate
RAJIFORMES	Rajidae	*Rajella*	*fyllae*	round skate
CHIMAERIFORMES	Chimaeridae	*Hydrolagus*	*affinis*	smalled eyed rabbitfish
CHIMAERIFORMES	Chimaeridae	*Chimaera*	*monstrosa*	rabbit fish
CHIMAERIFORMES	Rhinochimaeridae	*Harriotta*	*raleighana*	narrownose rabbitfish
CHIMAERIFORMES	Rhinochimaeridae	*Rhinochimaera*	*atlantica*	spearnose rabbitfish

Table 3. Catch (kg) of the elasmobranch species by year. EU summer surveys Div. 3M: 1988-01 (A) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1995-01 (B).

(A)

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**total**
Squalus acanthias	2	0	0	2	1	2	2	0	2	3	4	2	7	0	27
Etmopterus princeps	5	0	0	1	10	0	4	3	0	0	0	0	0	0	23
Centroscyllium fabricii	0	0	31	1	0	0	4	0	0	1	8	0	0	2	47
Bathyraja spinicauda	265	103	160	144	167	152	128	68	116	85	63	92	42	126	1711
Amblyraja radiata	264	166	224	419	351	453	332	270	176	173	222	128	125	202	3505
Malacoraja senta	14	0	0	15	22	5	3	7	5	4	3	2	4	7	91
Dipturus lintea	0	0	0	0	2	9	4	0	0	2	0	0	0	0	17
Amblyraja hyperborea	0	0	0	0	0	0	0	0	0	0	0	2	0	6	8
Rajella fyllae	0	0	0	0	0	0	1	0	0	0	1	0	0	2	4
Rajiidae	64	31	4	0	0	0	0	0	0	0	0	0	0	0	99
total	614	299	419	582	553	623	477	348	298	268	302	227	178	344	5532

(B)

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**total**
Squalus acanthias						45	16	**60**
Centroscyllium fabricii		61	3339	2980	2202	5886	3746	**18213**
Squalus cubensis						2		**2**
Centroscymnus coelolepis						12	30	**43**
Etmopterus princeps							<1	**<1**
Apristurus spp						152	218	**370**
Amblyraja radiata	2081	7978	6418	10955	14922	20627	14904	**77886**
Bathyraja spinicauda			1	228	504	214	258	**1204**
Amblyraja hyperborea						482	177	**659**
Rajiidae			281		1138	187	142	**1748**
Hydrolagus affinis				39	17	79	62	**197**
Chimaera monstrosa		31	26					**58**
Harriotta raleighana						434	441	**875**
Rhinochimaera atlantica				90				**90**
total	2081	8070	10065	14291	18782	28119	19995	**101404**

Table 4. Summary of thorny skate. (A) EU summer surveys Div. 3M and (B) the Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1995-01.

(A)

	Total catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1988	264	148	62	1781	156	359	711
1989	166	101	46	1637	171	381	655
1990	224	114	52	1972	127	373	674
1991	419	212	80	1978	130	385	701
1992	351	179	74	1958	141	365	708
1993	453	258	69	1757	149	373	738
1994	332	213	68	1558	144	386	713
1995	270	146	72	1847	127	370	665
1996	176	106	48	1663	161	362	685
1997	173	106	54	1631	175	379	679
1998	222	128	62	1732	143	403	677
1999	128	83	52	1547	140	400	716
2000	125	80	52	1566	143	373	680
2001	202	143	74	1411	132	394	712

(B)

	Total Catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1995	2081	-	65	-	42	124	684
1996	7978	-	102	-	43	268	1066
1997	6418	-	123	-	42	363	1255
1998	10955	9277	115	1181	42	419	1339
1999	14922	9855	93	1514	41	362	1340
2000	20627	18801	97	1097	42	361	1314
2001	14904	11737	104	1270	40	370	1299

Table 5. Thorny skate length-weight parameters.

	Flemish			3NO		
	N	**a**	**b**	**N**	**a**	**b**
1990	12	0.0011	3.54			
1993	17	0.0028	3.30			
1994	109	0.0051	3.18			
1995	63	0.0021	3.40			
1996	66	0.0059	3.15			
1997	66	0.0142	2.92	220	0,0090	3,03
1998	110	0.0133	2.94	156	0,0112	2,97
1999	124	0.0078	3.07	86	0,0293	2,74
2000	90	0.0110	2.99	443	0,0349	2,69
2001	218	0.0083	3.06	1324	0,0080	3,05

Table 6. Summary of black dogfish in the (A) EU summer surveys Div. 3M and (B) the Spanish spring bottom trawl surveys in NAFO Div. 3NO.

(A)

	Total Catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1990	31	34	2	907	665	633	674
1991	1	1	1	940	263	263	263
1994	4	5	1	794	713	713	713
1997	1	1	1	745	719	719	719
1998	8	8	2	1055	655	677	685
2001	2	3	2	713	614	647	714

(B)

	Total Catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1996	61	-	5	-	719	887	1006
1997	3339	-	21	-	318	1088	1255
1998	2980	2508	22	1188	697	1131	1354
1999	2202	2033	24	1083	810	1151	1340
2000	5886	5407	28	1089	289	1139	1401
2001	3746	3236	28	1158	699	1142	1343

Table 7. Black dogfish size-weight parameters in the Spanish spring bottom trawl surveys in NAFO Div. 3NO.

	N	a	b
1997	166	0,0034	3,08
1999	212	0,0044	3,02
2000	683	0,0028	3,13
2001	735	0,0021	3,21

	Males			Females		
	a	**b**	**r^2**	**a**	**b**	**r^2**
1997	0,0073	2,88	0,96	0,0011	3,37	0,96
1999	0,0146	2,72	0,89	0,0018	3,25	0,92
2000	0,0041	3,04	0,93	0,0023	3,19	0,95
2001	0,0044	3,02	0,94	0,0016	3,28	0,96

Table 8. Spinetail skate summary. (A) EU summer surveys Div. 3M and (B) the Spanish spring bottom trawl surveys in NAFO Div. 3NO.

(A)

	Total catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1988	265	32	25	8291	229	425	712
1989	103	28	16	3668	178	454	699
1990	160	41	26	3895	161	342	647
1991	144	32	21	4492	301	508	709
1992	167	26	15	6382	354	469	717
1993	152	42	22	3620	149	458	651
1994	128	23	18	5518	299	471	713
1995	68	20	15	3383	258	482	720
1996	116	24	17	4826	316	463	687
1997	85	15	13	5665	319	479	719
1998	63	14	11	4488	301	477	614
1999	92	24	18	3847	332	517	714
2000	42	17	17	2454	281	422	631
2001	126	27	18	4677	282	444	702

(B)

	Total Catch (kg)	Total numbers	Hauls	Mean weight (g)	Min depth (m)	Mean depth (m)	Max depth (m)
1997	1	-	1	-	318	318	318
1998	228	-	13	-	660	971	1354
1999	504	-	24	-	548	1063	1340
2000	214	-	21	-	531	925	1391
2001	258	-	19	-	558	1069	1335

Table 9. Spinetail skate size-weight parameters in the EU summer surveys Div. 3M.

	N	a	b
1990	6	0.0062	3.03
1993	13	0.0046	3.05
1994	19	0.0050	3.04
1995	17	0.0058	3.00
1996	17	0.0033	3.13
1997	4	0.0028	3.16
1998	14	0.0024	3.19
1999	36	0.0090	2.87
2000	20	0.0027	3.16
2001	36	0.0034	3.13
total	182	0.0042	3.07

Table 10. Other elasmobranch sampling summary in the EU summer surveys Div. 3M: 1988-01 (A) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1995-01 (B).

(A)

specie		Total catch (kg)	Total numbers	Hauls	Mean weight (kg)	Min depth (m)	Mean depth (m)	Max depth (m)
Squalus acanthias	**1988**	2.45	1	1	2450	249	249	249
	1991	1.75	1	1	1750	259	259	259
	1992	1.38	1	1	1380	431	431	431
	1993	1.96	1	1	1955	246	246	246
	1994	1.93	1	1	1930	279	279	279
	1996	1.50	1	1	1500	237	237	237
	1997	3.33	2	2	1663	264	370	476
	1998	4.11	2	2	2055	270	289	307
	1999	2.20	1	1	2200	276	276	276
	2000	7.02	4	4	1754	243	321	408
Etmopterus princeps	**1988**	4.70	4	1	1175	653	653	653
	1991	1.47	3	1	490	681	681	681
	1992	9.75	13	1	750	717	717	717
	1994	4.00	4	1	1000	691	691	691
	1995	3.12	1	1	3120	697	697	697
Malacoraja senta	**1988**	13.86	28	17	495	166	262	468
	1991	15.19	11	8	1381	195	304	709
	1992	21.99	6	6	3665	269	398	497
	1993	5.40	8	5	674	246	435	612
	1994	3.01	3	3	1003	176	225	286
	1995	7.18	5	5	1436	182	280	337
	1996	5.23	4	3	1308	165	234	269
	1997	4.46	4	4	1115	175	246	326
	1998	3.05	3	3	1015	168	261	323
	1999	1.98	2	2	990	243	261	280
	2000	4.12	6	6	686	213	290	321
	2001	6.61	6	5	1178	245	366	706
Dipturus lintea	**1992**	1.90	1	1	1900	717	717	717
	1993	9.36	7	3	1337	646	686	738
	1994	3.94	4	4	985	286	340	441
	1997	1.55	2	2	775	679	699	719
Amblyraja hyperborea	**1999**	2.10	1	1	2100	628	628	628
	2001	5.60	1	1	5600	707	707	707
Rajella fyllae	**1994**	0.65	1	1	650	442	442	442
	1998	1.11	2	2	555	386	548	709
	2000	0.31	1	1	310	511	511	511
	2001	1.53	4	3	381	469	478	485

(B)

specie		Total catch (kg)	Total numbers	Hauls	Mean weight (kg)	Min depth (m)	Mean depth (m)	Max depth (m)
Apristurus spp	**2000**	152	97	12	1567	864	1187	1401
	2001	218	-	20	-	682	1167	1343
Amblyraja hyperborea	**2000**	482	-	14	-	920	1186	1401
	2001	177	-	18	-	840	1218	1343
Harriota raleighana	**2000**	434	-	20	-	373	1143	1401
	2001	441	-	22	-	831	1158	1343

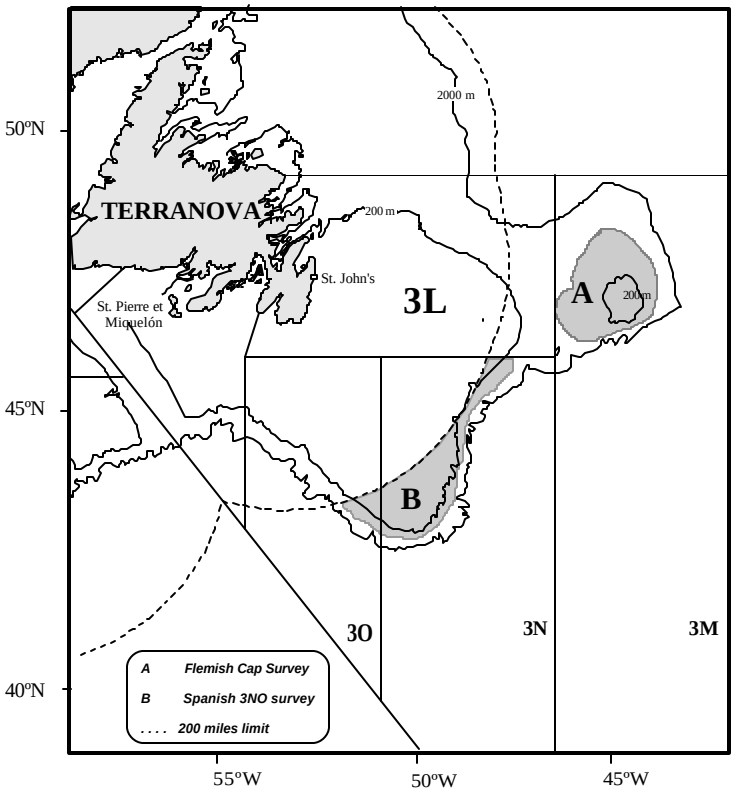


Fig. 1. Maps showing the study areas. Depths in m.

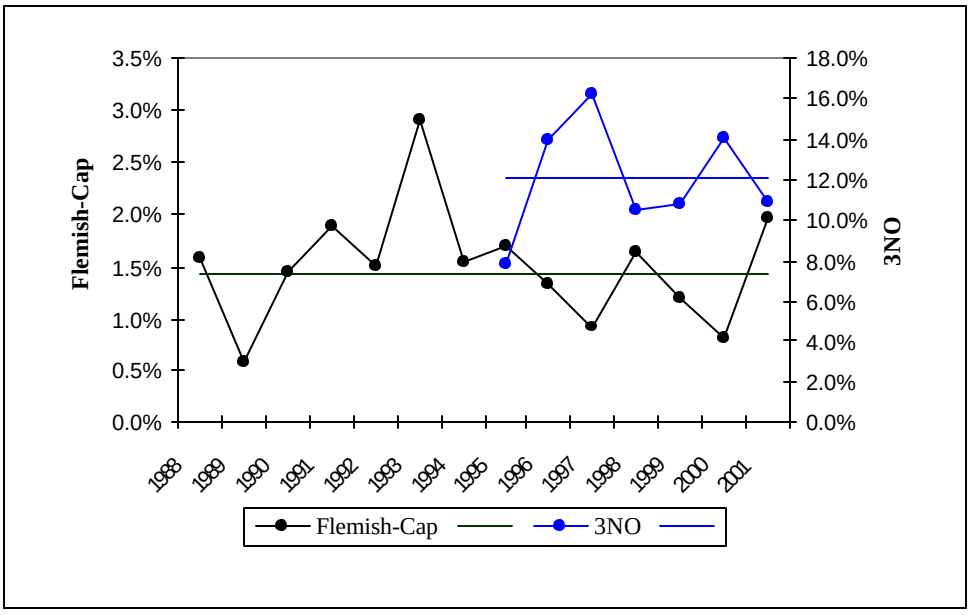
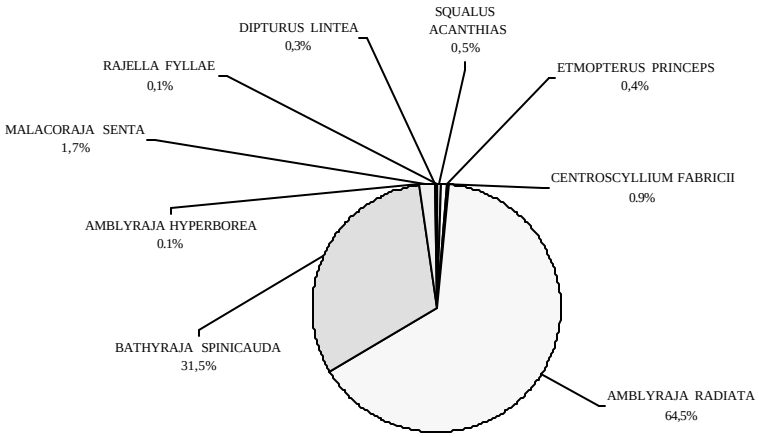


Fig. 2. Year elasmobranch proportions related with total catch.

(A)



(B)

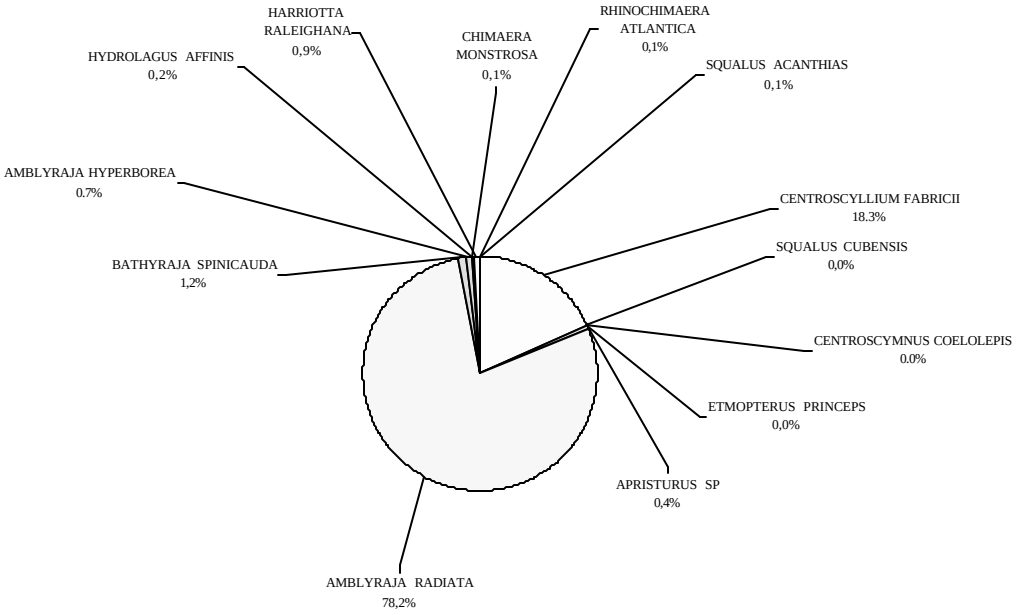
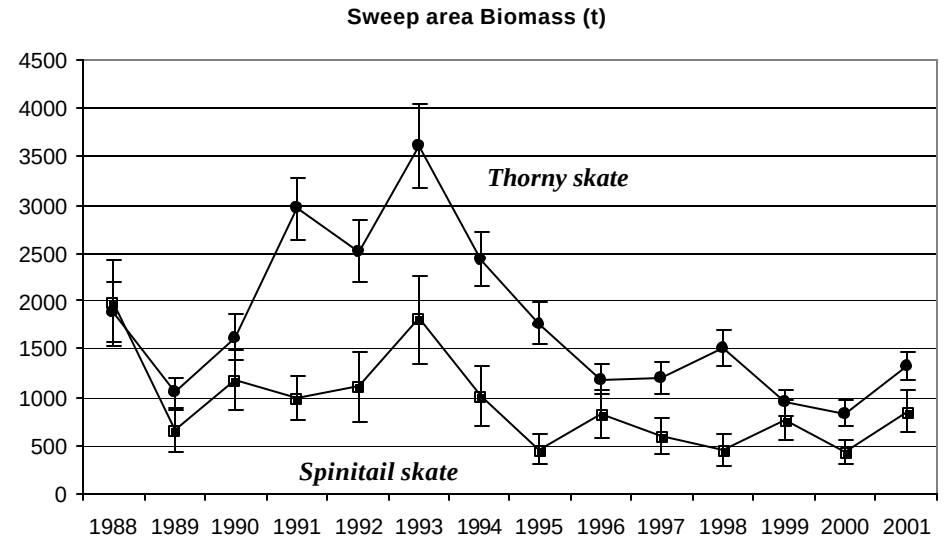


Fig. 3. Elasmobranch proportions (in weight) in the EU summer surveys in Div. 3M, (A) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO (B).

(A)



(B)

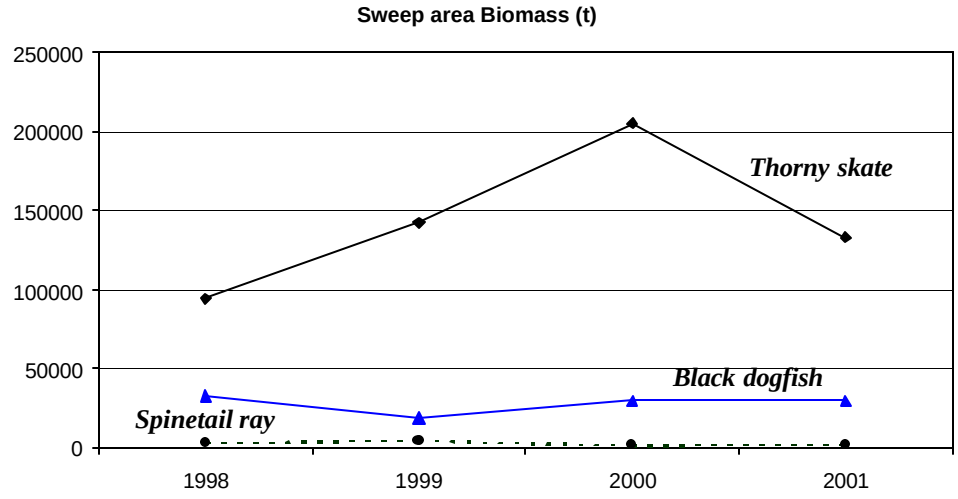


Fig. 4. Biomass indexes (tons) in the EU summer surveys in Div. 3M: 1988-01 (A) and the Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1998-01 (B).

(A)

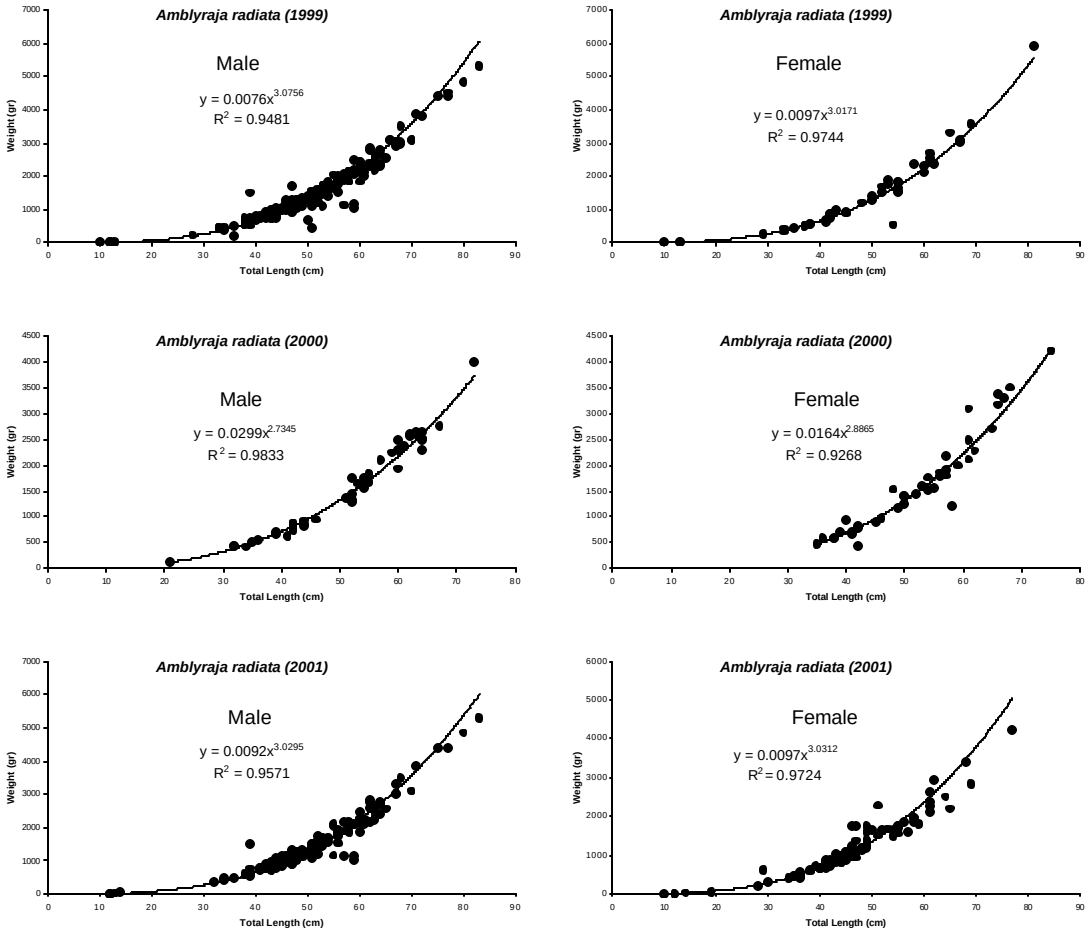


Fig. 5a. Thorny skate length-weight relationship by sex in the UE summer bottom trawl surveys.

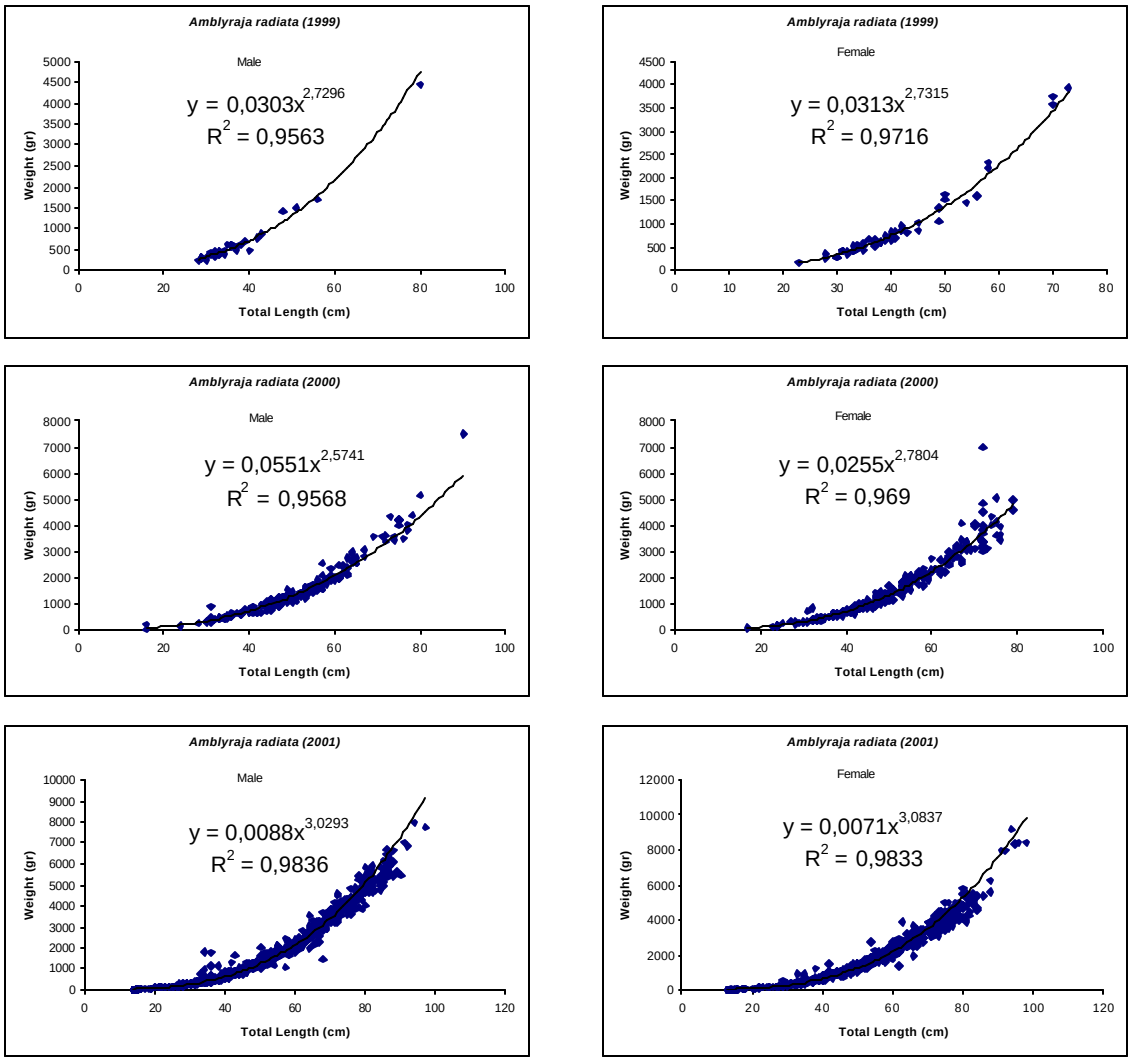


Fig. 5b. Thorny skate length-weight relationship by sex. Spanish spring bottom trawl surveys in Div. 3NO.

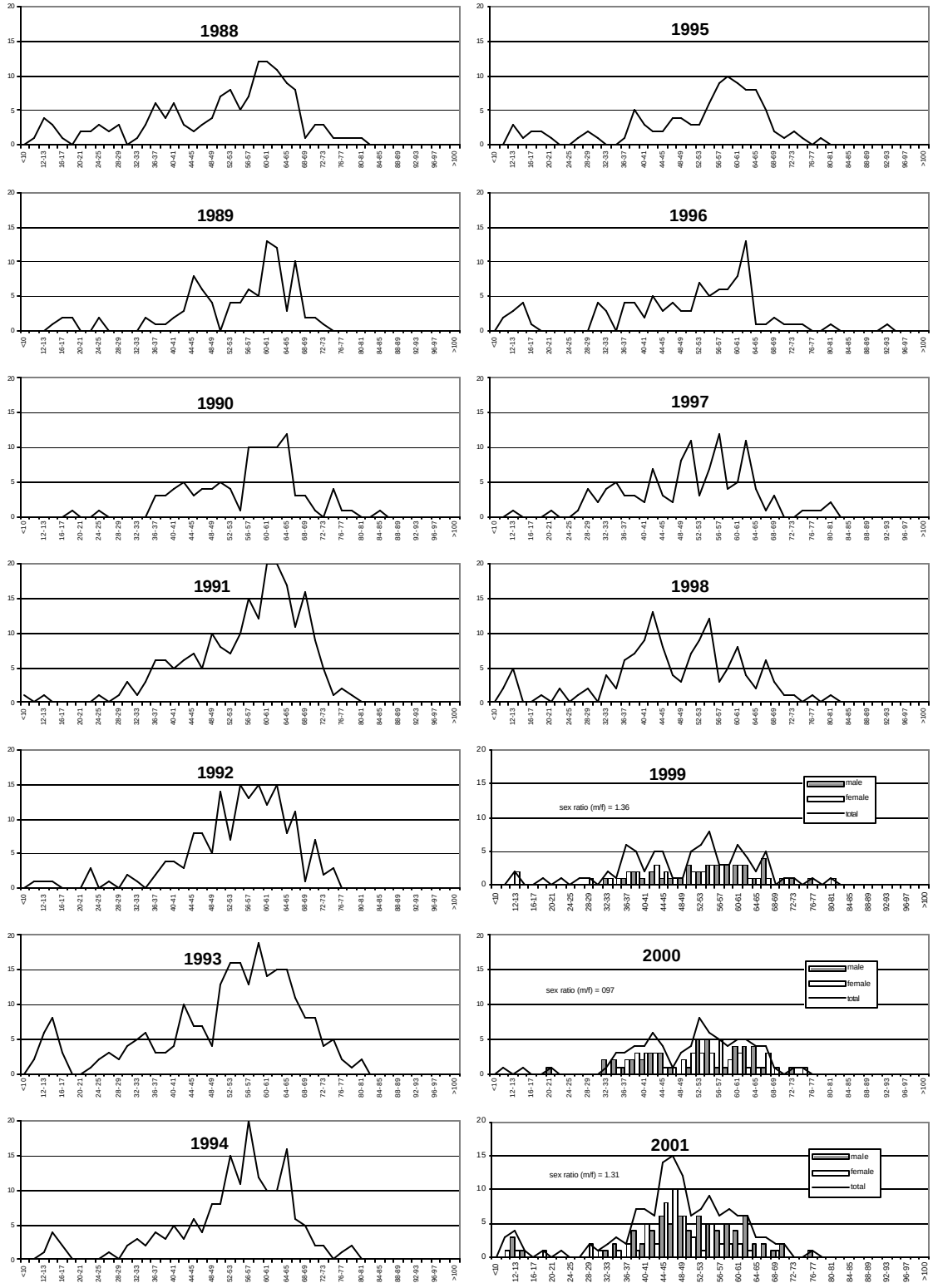


Fig. 6a. Length distribution of thorny skate in the UE summer bottom trawl surveys: 1988-2001. (absolute frequencies).

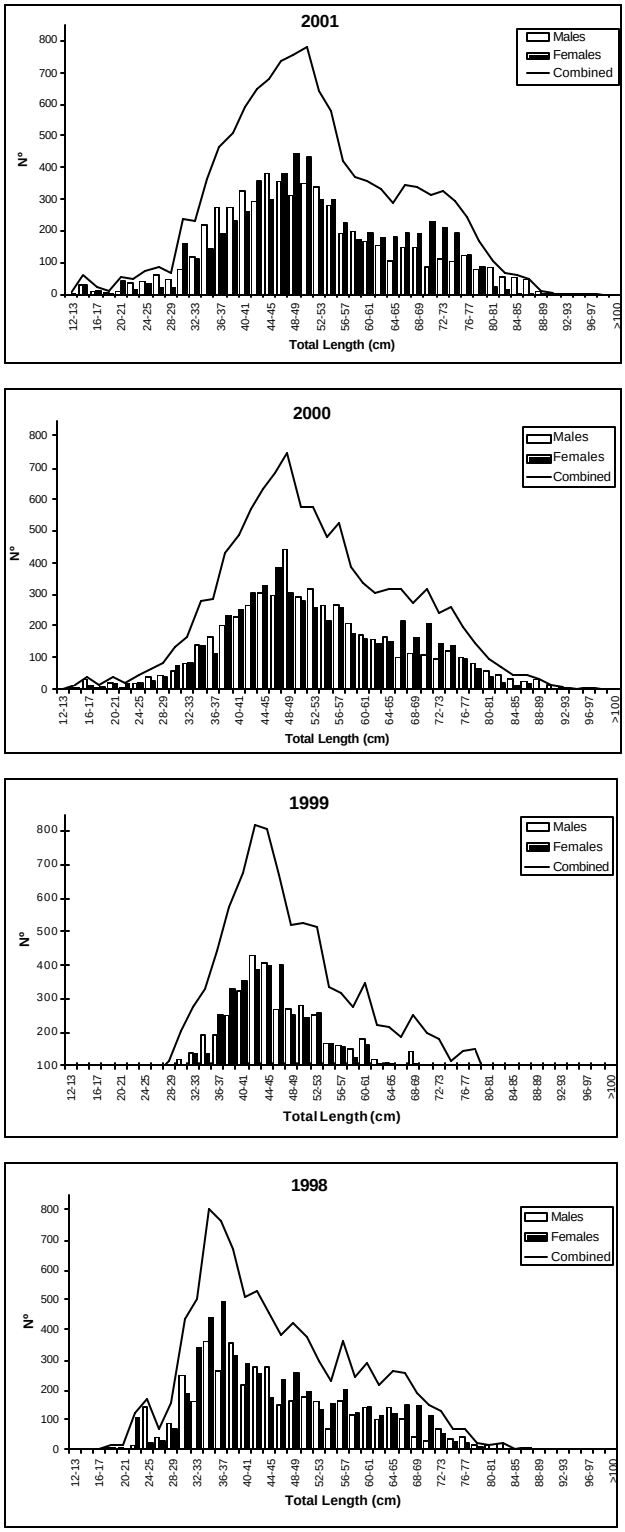


Fig. 6b. Length distribution of thorny skate. Spanish spring bottom trawl surveys: 1998-2001.

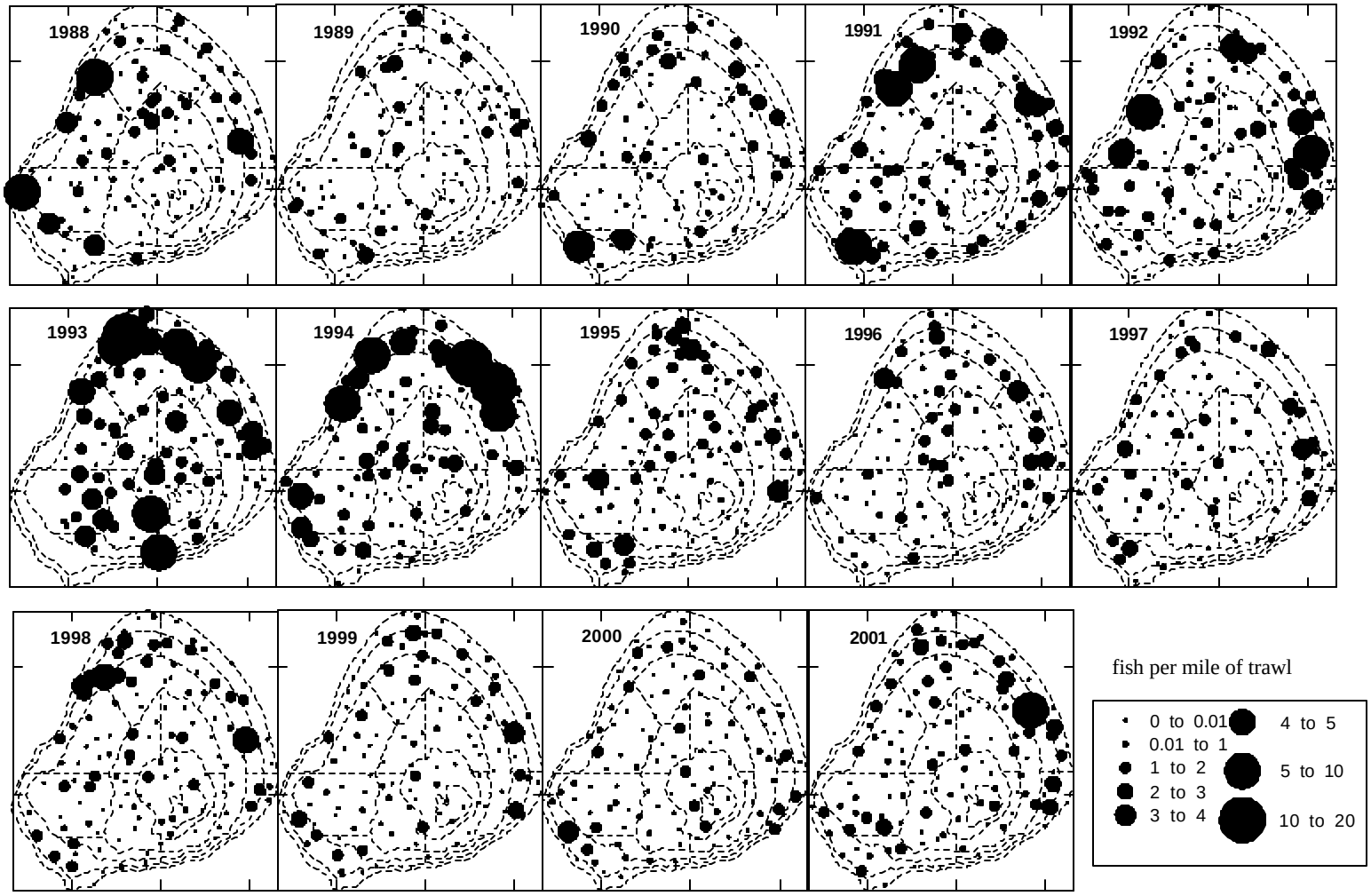


Fig. 7a. Thorny skate spatial distribution in the UE summer bottom trawl surveys: 1988-2001.

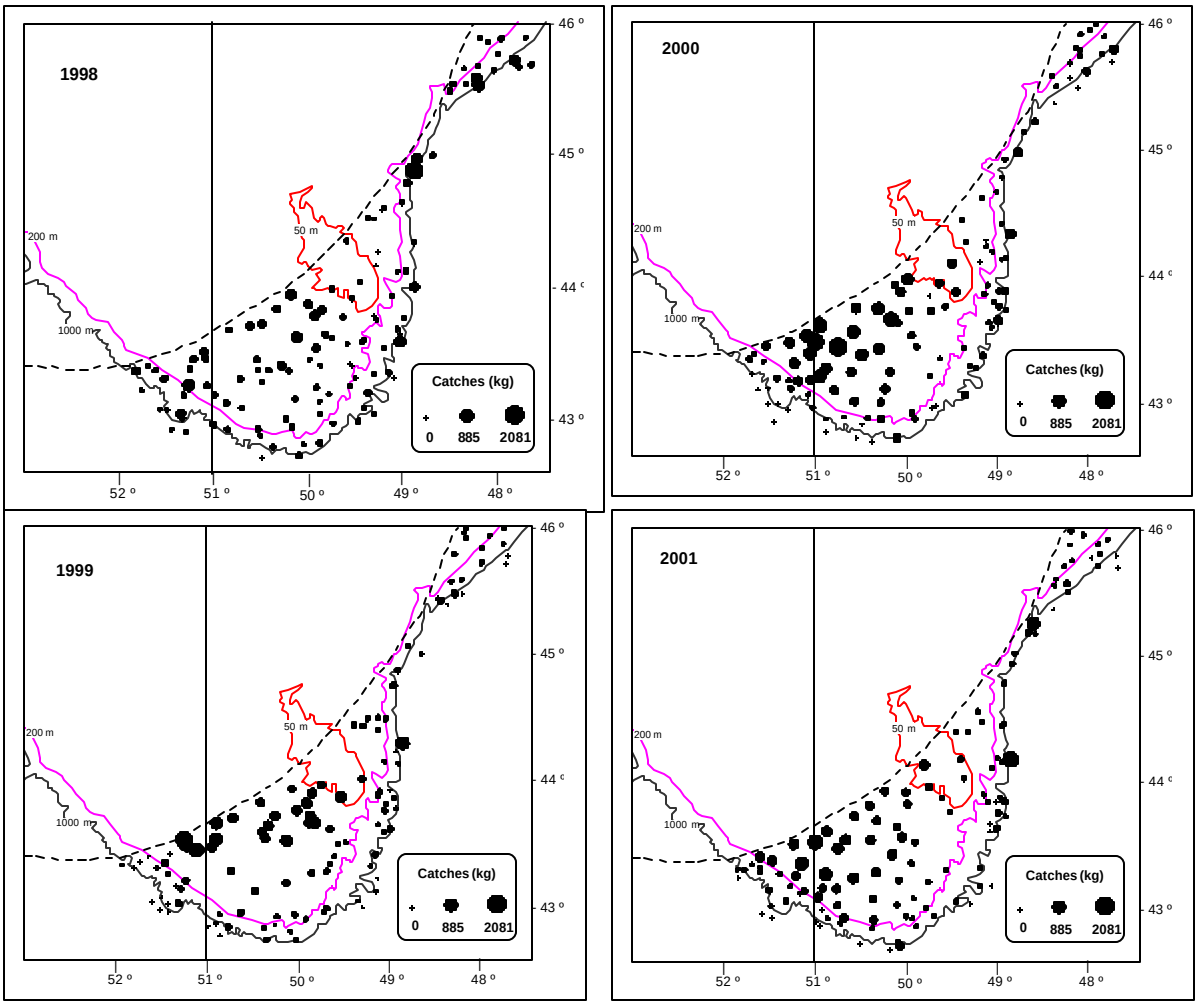


Fig. 7b. Catch distribution of thorny skate performed during Spanish spring bottom trawl. Surveys in NAFO Div. 3NO: 1998 – 2001. Symbols represent catch in weight (Kg) per tow (Root Square scale).

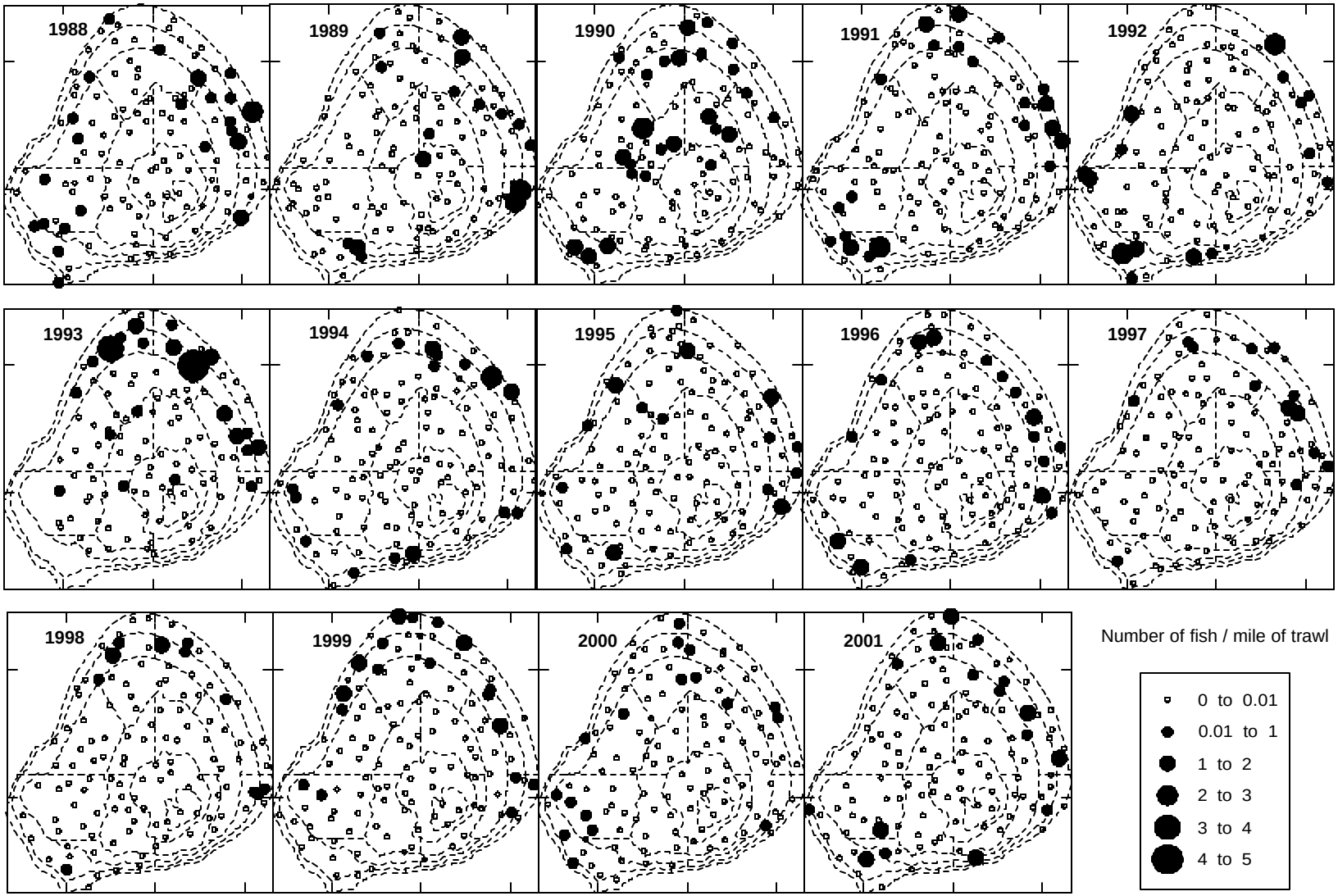


Fig. 8. Spinetail skate spatial distribution in the UE summer bottom trawl surveys: 1988-2001.

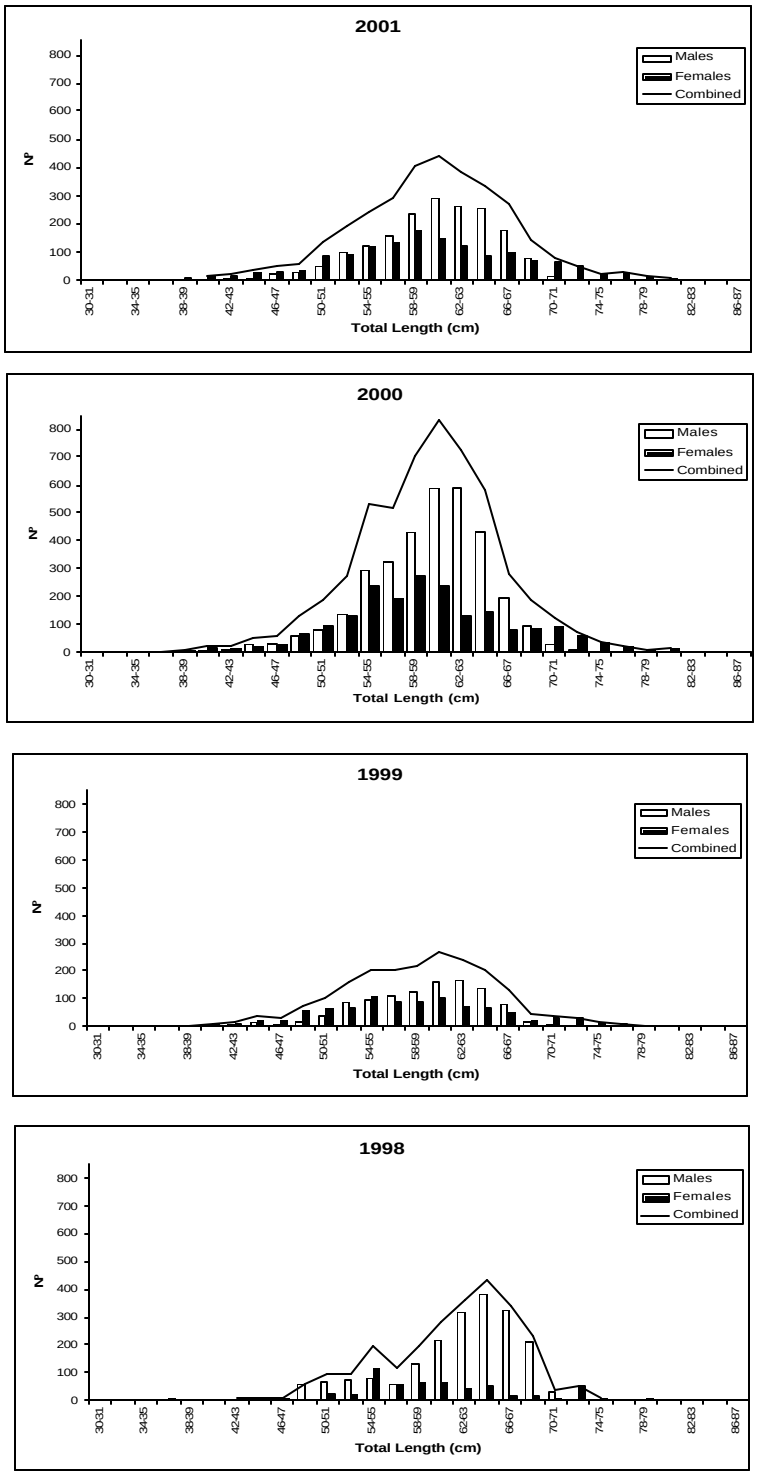


Fig. 9. Length distribution of black dogfish. Spanish spring bottom trawl surveys: 1998-2001.

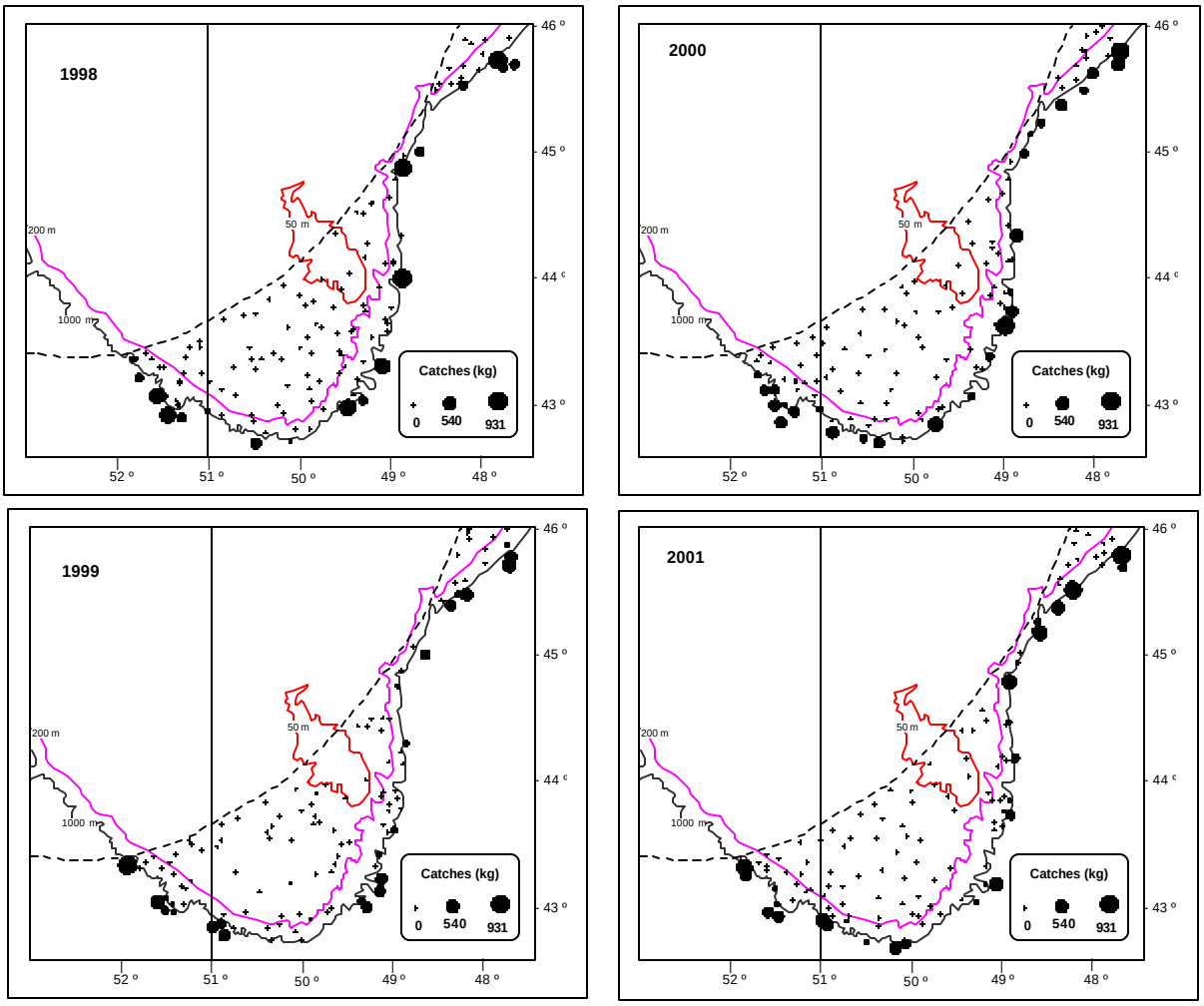


Fig. 10. Catch distribution of black dogfish performed during Spanish spring bottom trawl surveys in NAFO Div. 3NO: 1998-2001. Symbols represent catch in weight (Kg) per tow (Root Square scale).