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IMPORTANCE OF BLUE WHITING (*Micromesistius poutassou*) DISCARDED IN THE DIET OF LESSER-SPOTTED DOGFISH (*Scyliorhinus canicula*) IN THE CANTABRIAN SEA

by

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Abstract

Blue whiting is the most important demersal species caught, in landed biomass as well as in discarded biomass, by the trawl fleet in the South part of the Gulf of Biscay. Dogfish is not commercial by-catch and it is discarded inmediately after sorting. During 1994 were accomplished analysis of 1 094 stomach contents of dogfish caught in commercial ships working in a discard sampling program and a cruise research. The results reveal that from 17 cm, this especie depredates on blue whiting along all the year. The length ranges found in the stomach contents (6-31 cm) is similar to the length ranges discarded in the fishery (7-39 cm). The average quantity of blue whiting in stomachs of dogfish between 40 and 60 cm constitutes the 25% of the stomachs volume. The state of digestion in which is found the blue whiting prey, and the comparative analysis of the size distributions of blue whiting of the stomachs and the one of the fishery, presuppose that the blue whiting consumed is dead material originated from discard. Finally it is discussed the importance that this supplementary material can have in dogfish abundance.

Keywords: blue whiting, diet, discard, dogfish, scavenger.

INTRODUCTION

In the Cantabrian Sea and North of Galicia there is a trawl fleet which lands around 20 000 t of fresh fish annually. By its catches it would appear to be targeted at blue whiting, but it is the accompanying commercial species (monkfish, hake, megrim) which maintain the resource, and there are some very abundant species which, either because of their sizes or because of their low commercial value, are discarded during fishing operations after their capture. Some of these discarded animals survive, though the majority die and provide an important food resource for scavenger organisms. Among these the dogfish stands out as one of the species most commonly caught by trawlers and as it is of no commercial interest and is large, it is usually discarded at the beginning of the capture sorting.

Discards by trawl vessels in VIIIc ICES Division in 1994 (Pérez *et al.*, 1995) indicate blue whiting is the species which presents the higest catch and discard. It makes up 33% of total caught weight and 22% of the total discarded; being the second highest discarded species in number (only the small silvery pout is higher). Dogfish is not a species of commercial interest and is almost wholly discarded as it is caught. This is the second most important discarded species. Blue whiting is the most abundant fish (Sánchez, 1993) and plays a fundamental role in the diets of the Cantabrian fish community and North of Spain (Olaso & Velasco, in prep.): these latter authors studied the diet of 28 fish species which made up the thophic demersal structure, and found that 19 of these species prey on blue whiting, eight of which are hunters which actively feed on blue whiting, while the other eleven are opportunist feeders, probably preying on dying, dead or decomposing fishes.

We considered it to be of interest to study the particular ecological role of the dogfish, a scavenger shark which consumes a wide variety of organisms (Olaso, I. & E. Rodríguez-Marín, 1995, 1996), and how the fishing activities influence this species (is it benefited by discards?. Does its mortality increase due to fishing activity?). Thus, the aims of this work were to determine the importance of the proportion of dogfish diet which may come from discards and to interpret the changes in the abundance of this species, which is the most commonly caught benthic shark in this Division.

MATERIAL AND METHODS

Discard sampling: The discard sampling programme (Pérez *et al.* 1995) was based on random stratified sampling of the trawl fleet by Division (VIIIc) and month in 1994. The assistance of 14 commercial trawl vessels was obtained which carried out 301 hauls in 33 trips during the 109 days of sampling. The duration of each commercial trip was about 3 days in which an average of 9.1 hauls were made, a daily average of 2.8 hauls. Data were standardized to 100 fishing hours (f.h.), with a mean of 3.2 f.h. per haul.

Two observer went on each sampled trip, taking data from each haul of the quantities discarded and quantities retained by species (fish and decapod crustaceans were identified to species level wherever possible, non commercial invertebrates were not always identified in such detail), and collecting length distributions of discarded blue whiting and dogfish, and those of blue whiting retained in the catch.

Stomach sampling and analysis: Stomachs were collected by hauls on board commercial vessels taking part in sampling, and in the bottom trawl research survey carried out in October 1994. On the commercial vessels hauls were made during the day and the night, and lasted between 6 and 9 hours, while on the bottom trawl survey all hauls, which had a duration of 30 min, were carried out during day time. From each sample, 10 dogfish stomachs were randomly selected. If there was any evidence of predation during the haul the predator was not considered and, whenever possible, another specimen of the same length range was taken.

Stomach contents were analyzed on board. The volume of prey from stomach contents was measured using a trophometer (Olaso, 1990) and the slope of the regression of weight on volume was 1.1. Prey were identified to the lowest possible taxa in decapod crustaceans, cephalopods and fish: remaining invertebrates were clasified by their zoological group. For each prey type the following data were taken; the percentage of stomach volume, the state of digestion (1 intact. prey: 2 partially digested prey: 3 very digested and skeletal material), and number of specimens. Fish, decapod crustaceans and cephalopods were measured to the mm. When the state of the prey would not permit the determination of total prey length, the otolith size was measured to the mm, and the regression equations were used (Pereda & Villamor, 1991).

Data analysis: Fishing intensity and the estimation and elaboration of data of catches, discards and landings by species are developed in the work of Pérez *et al.* (1995). The most representative data are seen in Table 1.

Species	Discard Weight Quarters				Total		Ratio Discarded	
	1	2	3	4	Catch	Discard	Total Discard	Total Catch
Blue whiting	1680	181	493	1056	13078	3410	24.4	12.2
Dogfish	708	204	348	199	1572	1459	10.4	5.2
Other species	3423	1560	1735	2384	13342	9102	65.2	32.5
Total	5811	1945	2576	3639	27982	13971	100	49.9

Table 1. Summary of Spanish fleet trawler estimated discards and catches in weight (t) in 1994 (Pérez *et al.*, 1995)

In order to establish the minimun number of stomachs for each length group (minimun length of the sample), the accumulated number of prey types was used in relation to the number of stomachs, in such a way as to consider an adequate number when the curve reaches its asymptote (Modde & Ross, 1983). The relative importance of individual prey taxa was assessed with indices of volume (Hyslop, 1980). Partial stomach fullness indices (PSFI) and total fullness (%BW) were calculated to permit comparison of quantities of prey in stomachs of dogfish of various sizes and quarters (Bowering & Lilly, 1992; Smyly, 1952). The relationship between prey size and predator size was analyzed by means of regressions analysis and analysis of variance.

Auxiliary information from the bottom trawl surveys (Sánchez, pers. comun.) and from the fishery (Pérez *et al.*, 1995) was used to compute catch rates (numbers per fishing hour) and length compositions, using length-weight relationships.

RESULTS

Sampling intensity: A total of 1094 stomach contents were examined. Sampling intensity throughout the year and the size class is homogeneous, except in the third quarter (Table 2).

Size class	12 - 20 cm	20 - 30 cm	30 - 50 cm	50 - 70 cm	Total
Quarter 1	9*	48	104	121	282
Quarter 2	5*	35	127	130	297
Quarter 3	3*	5*	8*	39	55
Quarter 4	12*	71	197	180	460
Total	29	159	436	470	1094

Table 2. Number of stomachs sampled by dogfish size class, quarter and VIIIc ICES Division in 1994. In size classes by quarter where the asterisk (*) appears, there is no minimum sampling size.

Plots of cumulative taxa versus the number of stomachs examined indicated that sample sizes sufficient for description of prey type were obtained for all length groups with the exception of stomachs of the length group 12-20 cm, and in the third quarter the length groups 12-20 cm, 20-30 cm and 30-50 cm.

Dogfish diet: The composition of the diet of dogfish, in terms of the percentage volume, is seen in Table 3. Most of its diet is made up of decapod crustaceans and fish, the remainder being certain benthic invertebrate groups, such as polychaets and some cephalopods. Prey fish represent more than 50% of the percentage in volume, among which blue whiting is outstanding. Feeding of small dogfish (12-30 cm) reaches levels of over 60% of brachyuran crabs and shrimps and around 20% fish, having begun to prey on blue whiting. As size increases their consumption of crustaceans diminishes slightly while fish increase in their diet, reaching over 60% in dogfish of over half a metre in length.

	DIET DATA Size class					DISCARD DATA		
TAXA	12-20	20-30	30-50	50-70	TOTAL	Catch	Discard	Discard / Catch (%)
CRUSTACEA	71.36	62.53	41.76	24.04	31.54			
AMPHIPODA	3.01	0.56	0.15	0.05	0.11			
DECAPODA	41.81	43.69	37.72	20.50	27.12			
Anomura		15.98	14.63	8.30	10.65			
Anapagurus spp.			0.04	0.38	0.25			100
Anomura undetermined		0.22	1.04	0.88	0.90			
Galathea spp.			0.16		0.05			
Munida undetermined		2.62	3.43	1.12	1.93	138	138	100
Paguridae undetermined		1.92	0.29	0.82	0.69	1	1	100
Pagurus alatus				0.03	0.02	8	8	100
Pagurus prideauxi		11.22	9.68	5.07	6.81	33	33	100
Brachyura	12.95	11.50	10.58	2.19	5.34			
Atelecyclus rotundatus			0.28		0.09			100
Brachyura undetermined		5.36	3.63	0.08	1.45			
Goneplax rhomboides		2.59	0.45	0.08	0.31			100
Inachiidae undetermined			0.08		0.03			
Liocarcinus depurator		1.95	3.95	0.83	1.89	41	41	100
Liocarcinus undetermined	0.90	1.16	0.35	0.16	0.27			100
Macropipus tuberculatus			0.46		0.15	4	4	100
Polybius henslowi		0.44	1.14	1.03	1.04	83	83	100
Portunidae undetermined	12.05		0.24		0.11			
Decapoda undetermined		2.69	1.28	0.94	1.12	7	7	100
Macrura		0.23	0.10	0.08	0.09			
Macrura undetermined			0.06	0.03	0.04			
Polycheles typhlops				0.05	0.03	1	1	100
Scyllarus arctus		0.23	0.04		0.02			
Natantia	28.86	13.28	11.07	8.99	9.90			
Acantephira spp.			0.07		0.02			
Alpheus glaber	3.25	4.59	3.03	1.34	2.03			
Chlorotocus crassicornis			0.23	1.13	0.79	1	1	100
Crangonidae undetermined	2.41	1.16	0.40		0.19			100
Dichelopandalus bonnieri			0.38	0.04	0.15	3	2	45
Natantia undetermined	20.78	5.93	3.36	2.57	3.03			
Pasiphaea multidentata			1.10	0.87	0.90			100
Pasiphaea sivado		0.44	0.02	0.34	0.24			100
Plesionika heterocarpus				0.10	0.07	1	1	100
Processa spp.	2.41	0.50	1.18	0.44	0.69	1	1	100
Sergestes robustus				0.15	0.09			100
Solenocera membranacea		0.66	1.29	2.00	1.71	4	4	100
Upogebia spp.			0.06		0.02			
EUPHAUSIACEA	24.43	15.03	2.27	2.65	3.11			
Bentophausia gigas			0.01	0.04	0.03			
Euphausiacea undetermined	24.43	15.03	2.26	2.61	3.08			
ISOPODA		0.92	0.31	0.33	0.35			
MYSIDACEA		0.37	0.18	0.03	0.09			
Lophogaster typicus		0.37	0.16		0.07			
Mysidacea undetermined			0.01	0.03	0.02			
Crustacea undetermined	2.11	1.95	1.02	0.18	0.53			
STOMATOPODA			0.11	0.30	0.23			
Rissoides desmaresti			0.11	0.30	0.23			
ECHINODERMATA				0.09	0.06			
HOLOTHUROIDEA				0.09	0.06			
MOLUSCA	1.20	4.16	3.30	8.65	6.70			
BIVALVIA			0.08	0.12	0.10			
CEPHALOPODA	1.20	4.16	2.87	8.53	6.49			
Decapoda		1.53	1.50	5.47	4.00			
Alloteuthis spp.			0.06		0.02	2	2	100
Alloteuthis subulata			0.05		0.01			100

Table 3 . Diet (% of volume) of *Scyliorhinus canicula* by size class (cm) and fauna discarded and caught (k/100 fh) by the VIIIc trawl fleet in 1994.

Decapoda undetermined		0.88	0.40	5.43	3.59			
Omastrephidae undetermined			0.20		0.07			
Rossia macrosoma		0.66			0.03	10	10	100
Sepiidae undetermined			0.41		0.13	4	1	25
Sepiolidae undetermined			0.40	0.04	0.16			100
Octopoda		0.22	0.19	1.16	0.80			
Octopoda undetermined		0.22	0.19		0.07	2	1	26
Octopus defilippi				1.16	0.73			100
Cephalopoda undetermined	1.20	2.41	1.18	1.89	1.68			
GASTEROPODA			0.35		0.11			
Nudibranchia uneterminated			0.35		0.11			
CNIDARIA			0.03	0.22	0.15			
Actinauge richardi				0.09	0.06			
Anthozoa undetermined			0.03	0.13	0.09	71	71	100
CTENOPHORA			0.03		0.01			
POLYCHAETA	6.66	8.64	8.26	1.87	4.24			
Aphroditae aculeata			0.09		0.03	2	2	100
Aphroditidae undetermined		0.26			0.01			100
Polychaeta undetermined	6.66	8.38	8.17	1.87	4.20			
SIPUNCULIDA			1.39	0.74	0.92			
TUNICATA		0.31	0.11	0.51	0.37			
Invertebrates undetermined	5.12	1.51	1.04	1.61	2.84			
FISH	15.66	22.85	44.09	62.27	54.58			
ANACANTHINI					19.21			
Antonogadus macrophtalmus				0.29	0.18	1	1	100
Gadiculus argenteus		1.75	1.69	0.70	1.06	135	135	100
Micromesistius poutassou	12.05	10.96	12.44	19.81	17.03	2775	530	23
Trisopterus luscus				0.35	0.22	96	4	4
Trisopterus spp.				0.29	0.18	3	2	100
Merluccius merluccius		0.88	1.33	0.10	0.53	473	16	3
GOBIOIDEI					0.21			
Callionymus undetermined			0.29	0.12	0.17	10	10	100
Gobidae undetermined			0.13		0.04			100
Argentina sphyraena			0.05	0.15	0.11	26	12	45
Sardina pilchardus				0.59	0.37	1	1	100
Engraulis encrasicholus			1.36	3.82	2.85			100
MYCTOPHOIDEI					0.11			
Myctophoidei undetermined			0.34		0.11	2	2	100
NOTIDANOIDEI					0.78			
Scyliorhinus canicula				1.24	0.78	931	225	90
OPHIDIOIDEI					0.19			
Echiodon dentatus			0.17	0.22	0.19			100
PERCOIDEI					6.09			
Trachurus trachurus			1.40	6.68	4.67	578	10	36
Cepola rubescens			0.67	1.42	1.12	16	16	100
Signathydae undetermined				0.06	0.04			
Trachinus draco			0.81		0.26	5	5	100
PLEURONECTOIDEI					1.55			
Arnoglossus laterna			0.17		0.06	5	5	100
Pleuronectoidei undetermined			1.82	0.86	1.13			
Lepidorhombus boscii				0.58	0.37	119	31	26
SCOMBROIDEI					0.30			
Scomber scombrus			0.20	0.38	0.30	301	20	26
STOMIATOIDEI					0.50			
Stomiidae undetermined				0.78	0.50			
ZEOMORPHI					0.88			
Capros aper			0.57	1.10	0.88	63	63	100
Fish undetermined	3.61	9.26	20.63	22.73	21.45			
No of TAXA	13	34	70	63	87			
Average length (cm)	17.55	25.18	39.39	56.21	43.97			

Table 3 . Cont.

87 different taxa can be found in its diet, which shows it to be an opportunist feeder which consumes a wide variety of prey groups. 26 of these groups belong to fish species (Figure 1). The crustaceans, almost all of which are decapods, are present in 40 taxa. Small dogfish present smaller number of taxa, though as can be seen in Figure 1, the taxa in all prey groups (crustacea, Pisces and other invertebrates) increase up to 50 cm. In the diet of larger sized dogfish, crustaceans, the rest of the invertebrates and fishes diminish in specific richness.

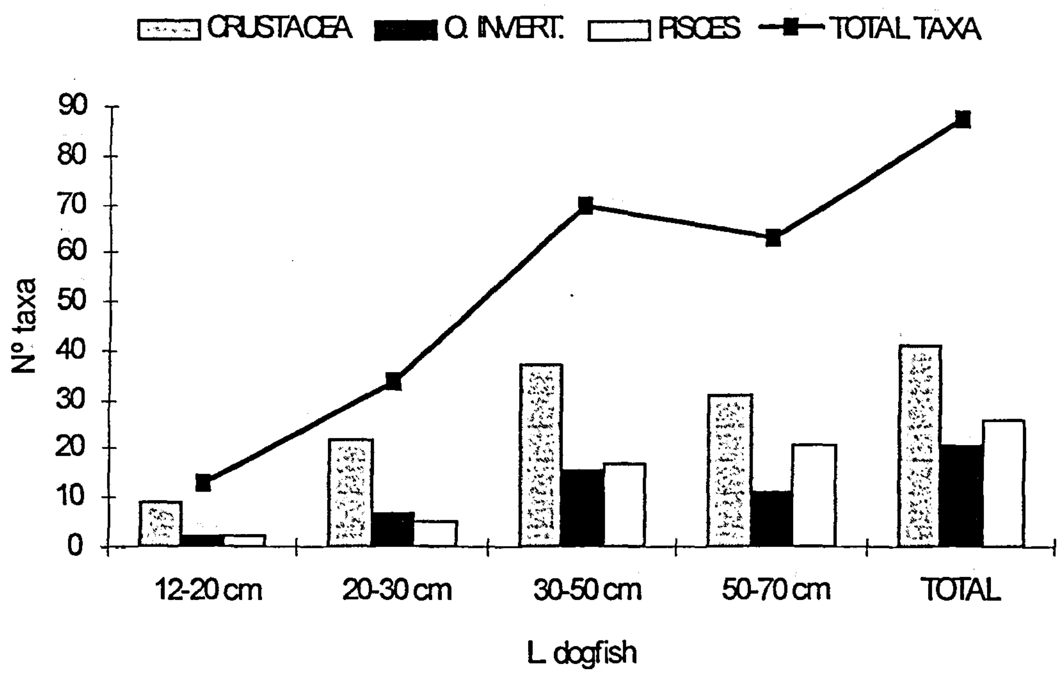


Figure 1. Relation between the size of dogfish and taxa prey.

We observe that the inmense majority of prey taxa are discarded by the trawl fleet, and specifically the 26 species of prey fish (Table 3).

The relative importance of the individual species varies seasonally. In Figure 2 we have shown the most representative prey groups, separating the fish species wich are important in discards and differentiating between other fish and undetermined fish since the state of digestion did not usually permit their full determination. The importance of the brachyuran crabs comes about in the first months of the year for dogfish of less than 30 cm, and as the year progresses decapod crustaceans come to dominate: at the same time it is in the summer when the percentage of brachyuran crabs is more significant in medium and large-sized dogfish, although they feed on decapod crustaceans throughout the year. The cephalopods appear in winter and a little in autumn, and other invertebrate groups are preyed on all year, but it is interesting to observe that small dogfish do not prey on them in summer while at this size the relative

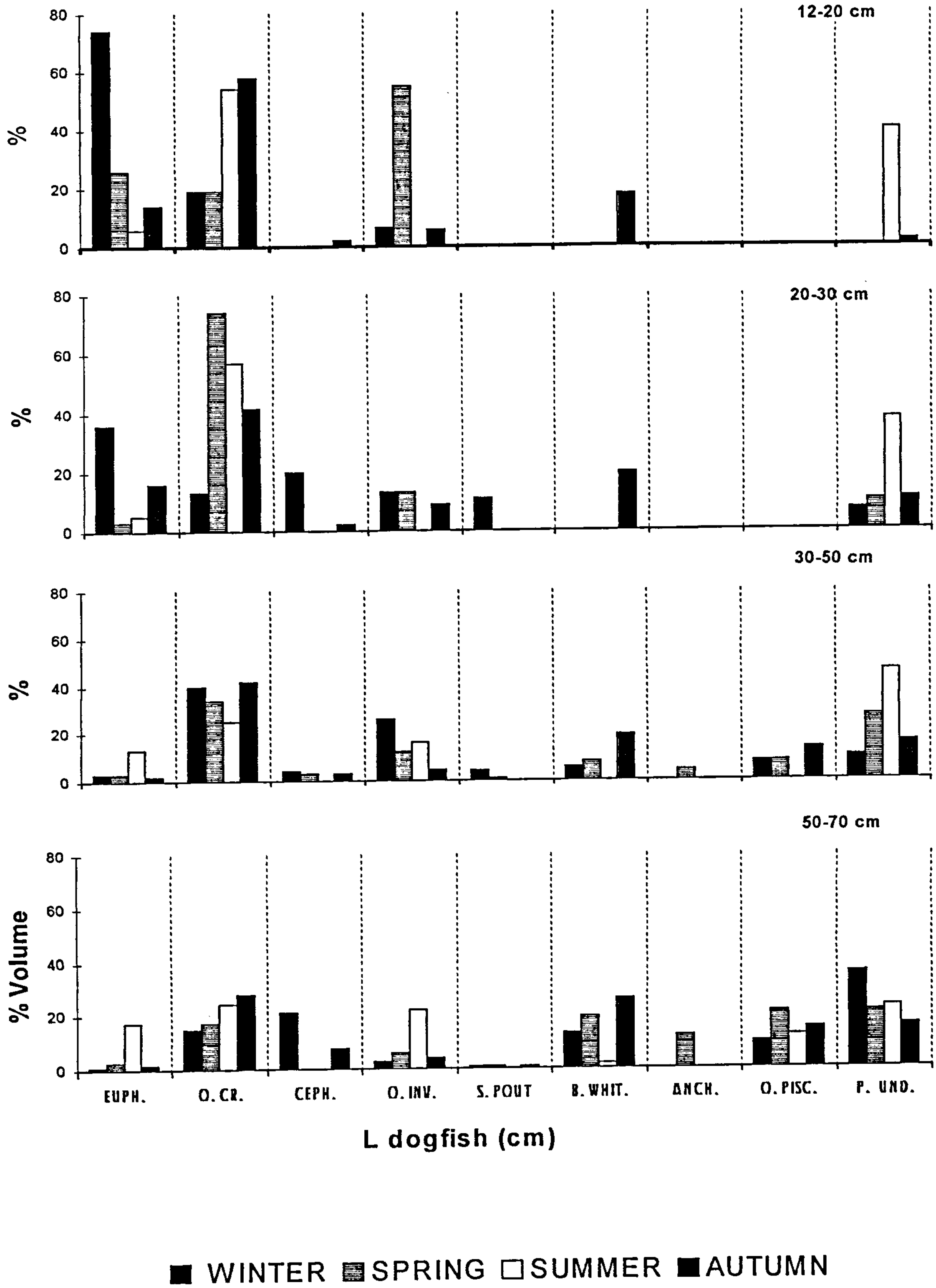


Figure 2. Percentage volume of major prey taxa in each predator size class and quarter (EUPH = EUPHAUSIACEA; O. CR. OTHER CRUTACEA; CEPH. = CEPHALOPODA; O. INV. = OTHER INVERTEBRATA; S. POUT = SILVERY POUT; B. WHIT. = BLUE WHITING; ANCH. = ANCHOVY; O: PISC: = OTHER PISCES; P. UND. = PISCES UNDETERMINED).

importance of prey fish is found in summer and autumn. The blue whiting is consumed by all length groups in autumn, and only in dogfish of 30 cm or over we see blue whiting prey throughout the year. For this reason it must be considered that dogfish of less than 30 cm have a high percentage of undetermined fish in their diet, for which it would not be unreasonable to assume that, given the great difficulties in reaching a more exhaustive determination in seasons other than autumn a high percentage of the undetermined fish belong to the species *M. poutassou* since, due to the smaller mouth size of small dogfish, they bite the dead fishes. Silvery pout (*Gadiculus argenteus*) is only found in winter in dogfish of between 20 and 50 cm. Anchovy (*Engraulis encrasicholus*) is only found in the second quarter in dogfish of over 30 cm.

The incidence of empty stomachs and state of food digestion: As can be seen in Table 4, 86% of dogfish stomachs contained food, and significant differences between quarters are not found except in winter and spring with respect to larger-sized dogfish. Taking into account the fact that dogfish from commercial vessels are caught in hauls of long duration those coming from the fourth quarter are compared with those of the research cruise and the emptiness percentage is clearly coincident.

Size class	12 - 20 cm	20 - 30 cm	30 - 50 cm	50 - 70 cm	Total
Quarter 1	*	10	13	19	**16**
Quarter 2	*	0	7	19	**15**
Quarter 3	*	*	*	15	*
Quarter 4 Cruise Surv.	* *	10 10	11 11	14 13	**12** **12**
Total	**13**	**8**	**11**	**14**	**14**

Table 4. Percentage of empty stomachs of dogfish, by length group and quarter in 1994. In length groups by quarter where the asterisk (*) appears, there is no minimum sampling size.

The stomach contents were found in a high digested state (Figure 3). Comparing autumn stomach contents, from both the survey and the commercial vessels, they result to be very similar. As the dogfish does not have a swiming bladder, only those stomachs which were gutted were considered regurgitated. This happens very infrequently, and given the low percentage of emptiness of this species all year, regugitation do not seem to be very important.

The fullness index = % BW, is 2.92 wich is quite low. On transforming blue whiting length to real live weigth, it is found that it only makes up 24% of stomach content weight. This low quantity is due on one hand to the fact that they are found, in general, in a highly digested state, and on the other the dogfishes have often only consumed part of the body.

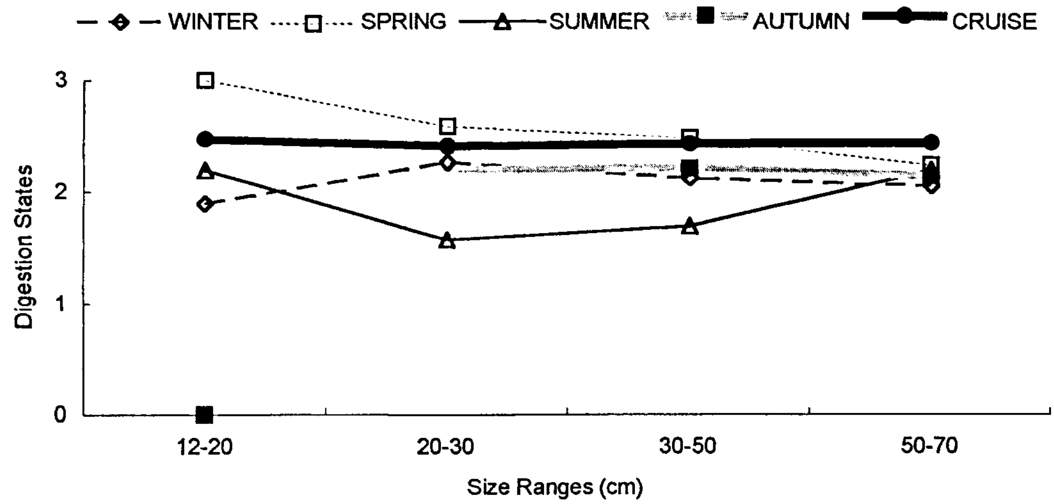


Figure 3. Linear representation of digestion states of dogfish stomach contents, by length range and quarters.

The importance of blue whiting in the diet of dogfish: From a length of 17 cm, dogfish prey on blue whiting of between 7 and 32 cm, though no relationship was found between dogfish length and blue whiting length found in their stomachs (Figure 4). However a tendency for prey length to increase as predator length increased was found.

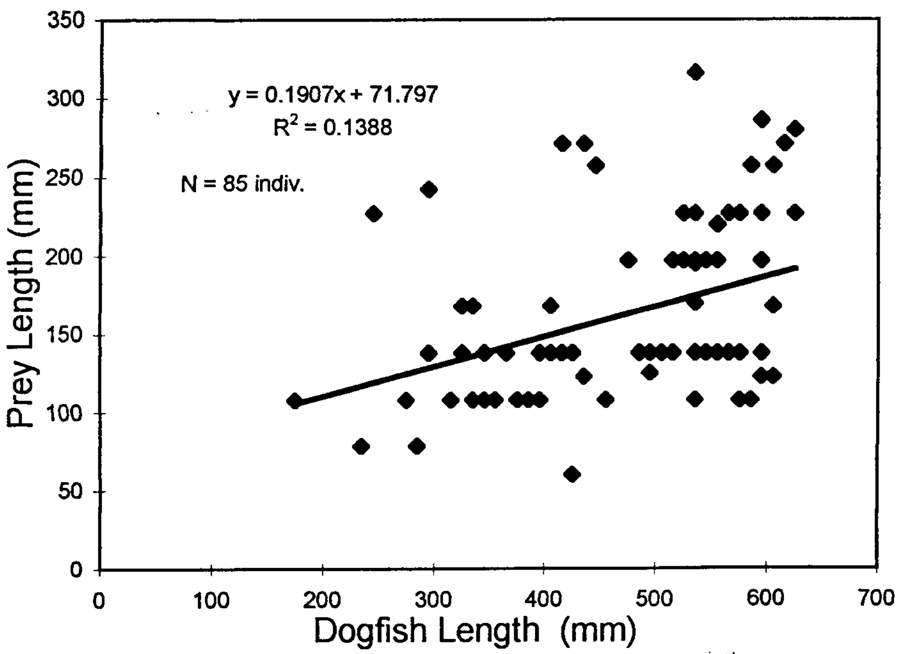


Figure 4. Predator prey relationships between dogfish and blue whiting lengths.

We obtained the length distributions of blue whiting in discards, landings and as prey for the whole of 1994 (Figure 5). The similarity in length distributions of blue whiting discarded and blue whiting as prey is observed with length ranges (6-31 cm for blue whiting found in stomachs and 7-39 cm for the discarded blue whiting) and similar modes.

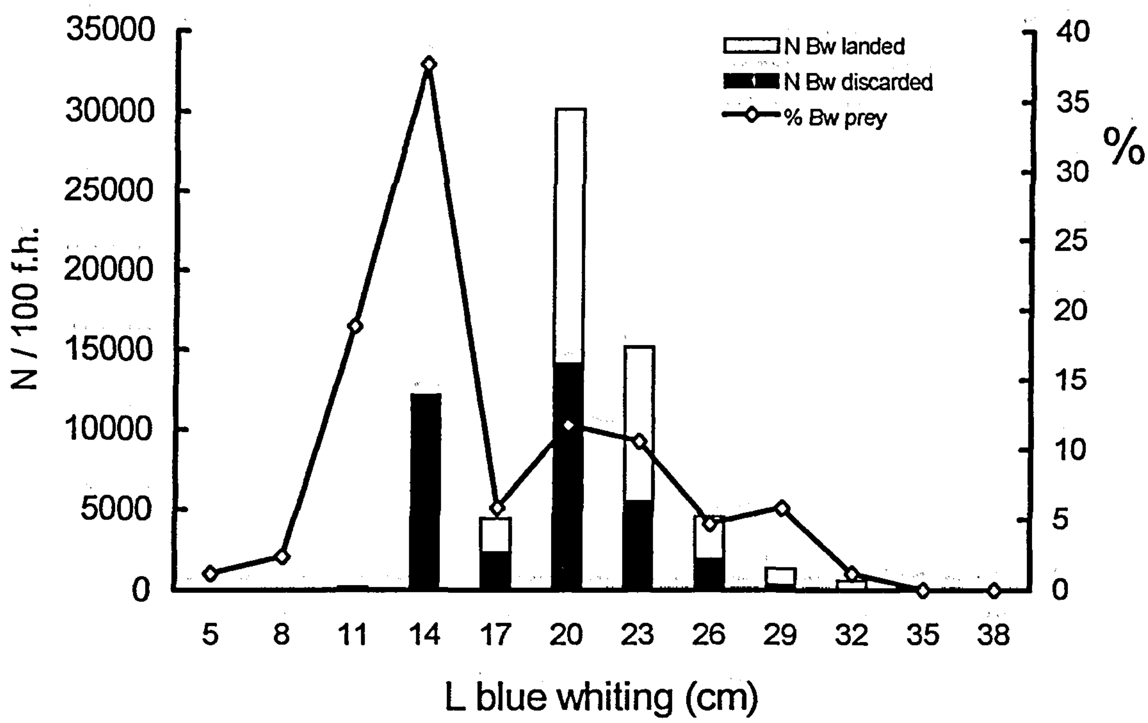


Figure 5. Length distribution of blue whiting in dogfish stomachs, discarded and landed in 1994. In the sample there were 85 blue whiting prey, 6305 blue whiting discarded and 5178 blue whiting landed.

To be able to determine the importance of blue whiting in the diet of dogfish throughout the year and at different sizes we used the fullnees index PFI. Figure 6 shows only four groups of taxa, since a large proportion of the fish were unidentified and many of these were probably blue whiting. For this reason we separated prey fish into three groups and left another for invertebrates which have already been explained in the section prior to the diet of dogfish and which are not a main aim of this paper. The total fullness index increases thoughout the year varying from 0.47 in winter to 1.55 in autumn in the smallest specimens with fish bearing very little importance in the first six months of the year, and only invertebrates (others) form the main part of their feeding. From summer there is an increase in the fullness index due to the supply of blue whiting and undetermined fish. Dogfish of over 30 cm consume undetermined fish and blue whiting all year round (although in the third quarter the only fish analyzed were undetermined) and its total fullness index is very homogeneous throughout the year at between 0.41 and 0.43 except in summer when it was 0.21.

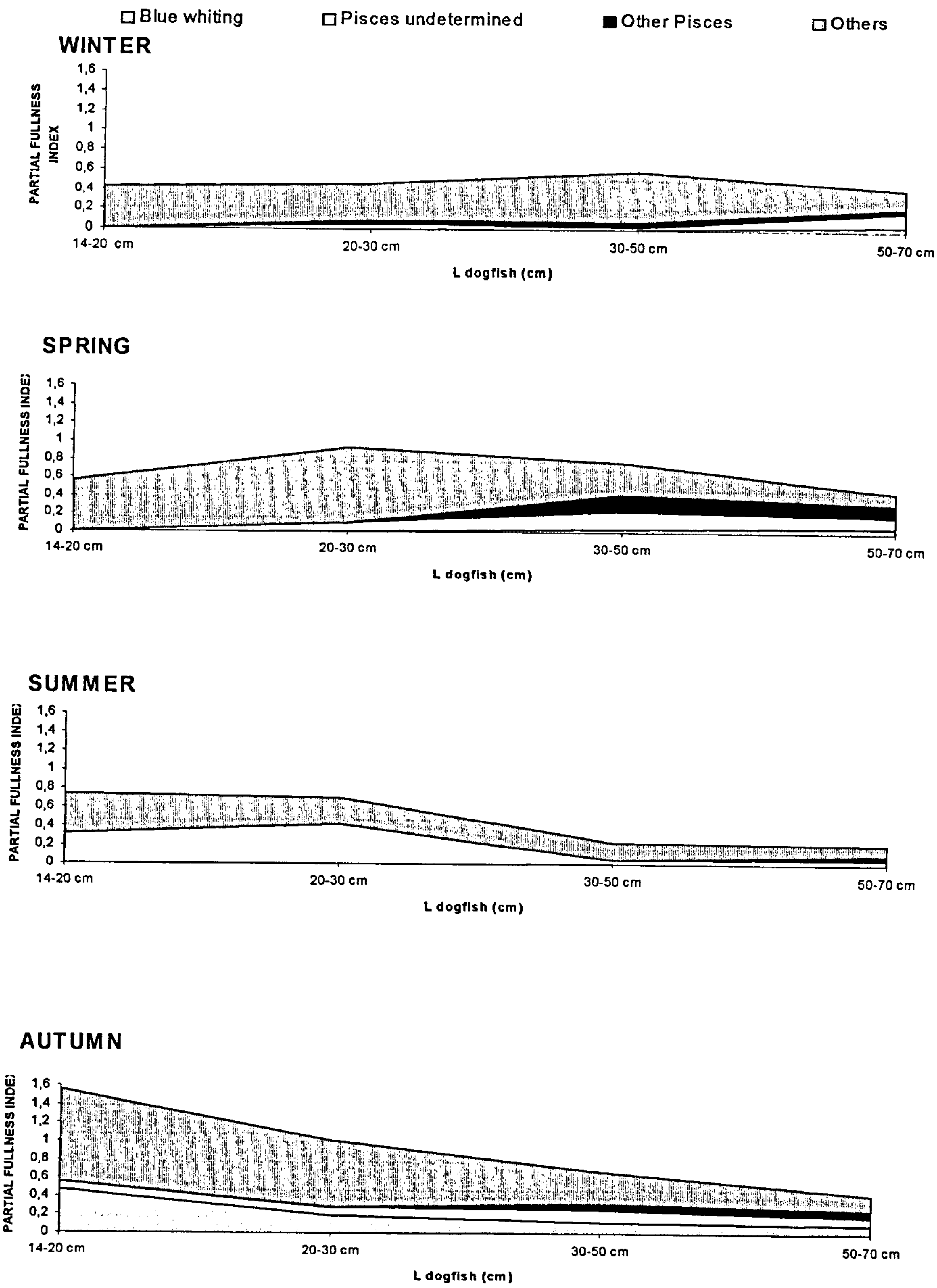
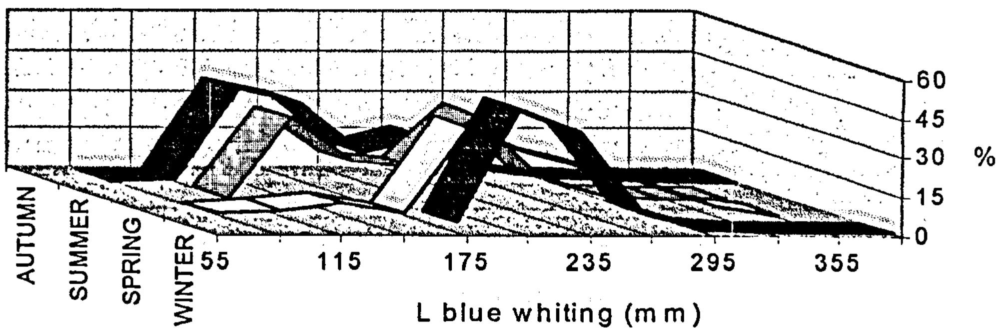


Figure 6. Seasonal variation in total fullness index for major prey groups, with increasing dogfish length during 1994.



CATCH Wint. 2602 t; Spr. 654 t; Summ. 1425 t; Aut. 2113 t

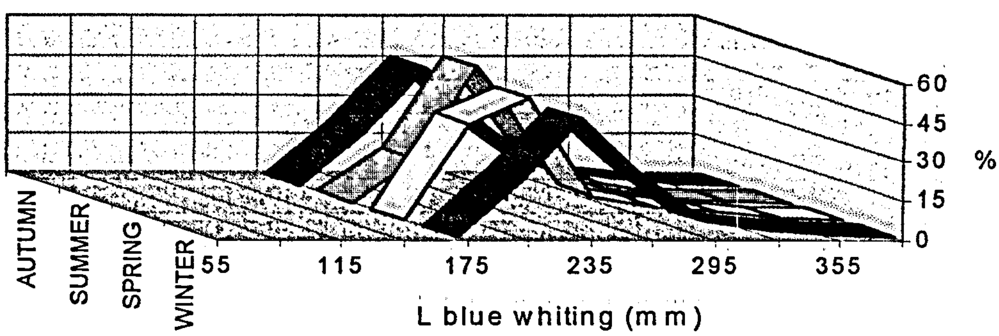
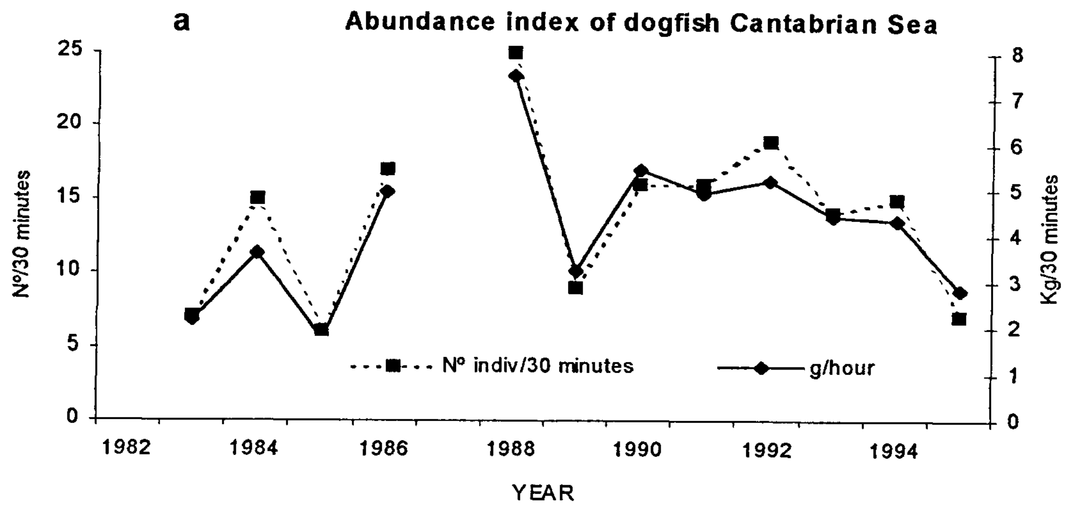
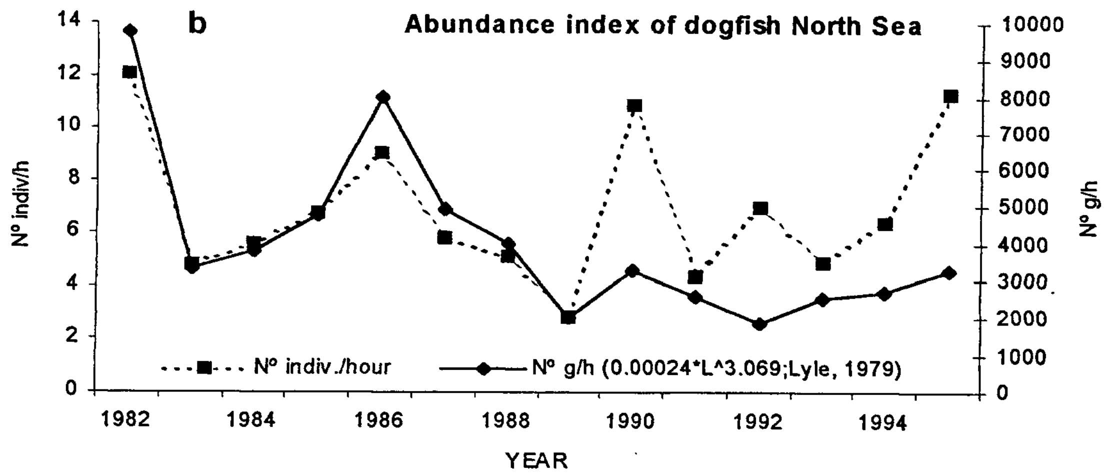


Figure 7. Seasonal variation of blue whiting discarded and landed by the VIIIc trawl fleet in 1994 length distributions.

Figure 7 shows the seasonal length distributions of blue whiting discarded and landed by the trawl fleet. The length range landed does not vary over the year, remaining above 16 cm. It can be appreciated that throughout the year the length of blue whiting discarded diminishes; from specimens greater than 20 cm in winter which have a mode of around 22 cm to specimens with a more open length range in the second half of the year with a mode of around 15 cm. These oscillations in the length of blue whiting discarded are related to the results shown in Figure 6. In winter the importance of blue whiting prey is not observed in small dogfish, while in spring it begins to be observed that they prey on undetermined fish. In summer and autumn the increase in small sized blue whiting discarded coincides with the comsumption of undetermined fish and blue whiting in small dogfish, while those of greater size continue to prey on blue whiting.

Effect of Fishing activity on dogfish: Dogfish, which is initially benefited by discards created by fishing activity, also suffers an increase in its mortality. To observe tendencies in its abundance, Figure 8a shows data of historical series of abundance from botton trawl surveys carried out in Division VIIIc.





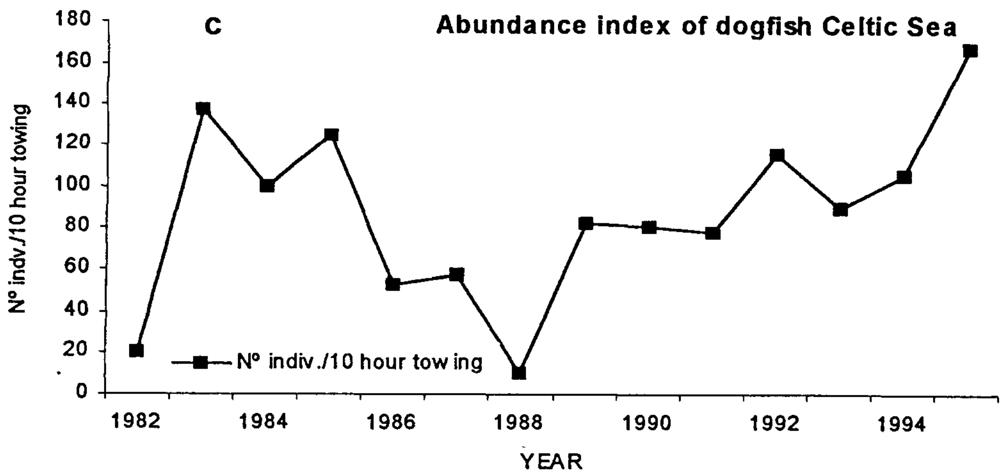


Figure 8. Estimated quantities of dogfish caught in bottom trawl surveys. a Cantabrian Sea (data in De la Gandara, 1993; index comp. as mean of means by rectangle). b North Sea (data in Statistical of ICES; index comp. as mean of means by rectangle). c Celtic Sea (data in Anon. 1995a; *Abundance index in Fish per 10 hour towing*).

Although there are some ups and downs in the population, threre are no signs that dogfish are falling in abundance. Even in the Celtic Sea there are indications that the population is increasing. In the North Sea, however, catches in weight fall throughout the 1980's, and have maintained their level in recent years.

DISCUSSION

Relationships between dogfish diet and material discarded in trawling: Dogfish prey on a wide range of megabentic fauna (echinoderms, polychaets, molluscs, sipunculids.....), though decapod crustaceans and fish are their main food source. This kind of general feeding, opportunistic and scavenger is described in other works (Lyle, 1979; Olaso & Rodríguez-Marín, 1996) but Kaiser & Spencer, 1993, were the first researchers to experimentally prove that dogfish feed on damaged or dead animals from fishing operations or on other scavengers attracted to the trawled area.

On the basis of the above information, the 1994 discard data of the trawl fleet of VIIIc Division were analyzed, and it was observed that of 247 taxa caught (Pérez *et al.*, 1995), 223 taxa were discarded, of which 95 were fish, 43 were decapod crustaceans, 42 were molluscs, 20 were echinoderms and 23 belonged to other groups of invertebrates. If we compare these results with the 87 taxa found in dogfish diet (Table 3), we find that all the fish prey and a large majority of the other phyllum prey are discarded, with the exception of the groups of small size, as is the case of non-decapod crustaceans. But many megabhentic species, such as *Munida intermedia, Pagurus prideauxi, Liocarcinus depurator, Solenocera membranacea, Rossia macrossoma, Sepia orbignyana*,..., are abundant, although their abundance in the environment (Olaso, 1990; García-Castrillo & Olaso, 1995) should be taken into account as they can be consumed live. However the presence in the dogfish diet of infaunal species (*Alpheus glaber, Goneplax rhomboides,* polychaets ...), benthopelagic fish species with a high discard (*M. poutassou, G. argenteus*) or pelagic species which suffer slipping, like *E. encrasicholus,* shows that they are eaten by indirect effects of fishing. The highest percentage in volume of anchovy comes about in spring, which is when fishing for this species is at its most active, and so at this time discards and slippings take place.

It is observed that as dogfish size increases, its taxa prey widens, the greatest variety being found from 30 cm, which may suggest that it is from this length that discarded material becomes particularly beneficial, since small dogfish feed on a limited number of taxa (Table 3 and Figure 1), given that their smaller mouth size cannot consume large prey whole. The mean length of prey varied from 138 mm in fish to 33-38 mm in crustaceans and other invertebrates, and it is these latter two groups which smaller dogfish base their feeding on. Nevertheless, we must consider that these small sized preys may remain as available food as they are favoured by the effect of the trawler on the sea bottom, as is the case of the amphipod *Ampelisca spinipes* (Kaiser & Spencer, 1994a). The importance of fish prey increases with the size of dogfish , but even though many of the fish prey could not be determined, the immense majority of them are problably blue whiting, since the mean weight of a blue whiting is 10.47 g, them are problably blue whiting, since the mean weight of a blue whiting is 10.47 g, compared with 5.8 g for other fish species, while the mean of the undetermined fish is 9.9 g, a figure which is much more similar to that of blue whiting than to that of the other fish species.

We have seen that the length of blue whiting discarded is similar to the size of blue whiting prey, and the percentage of blue whiting prey found by quarter and by dogfish length group (Fig. 6) bears an intimate relationship to the seasonal variations of blue whiting discarded by the trawl fleet (Fig. 7).

Influence of the supply of blue whiting prey on the feeding habits of dogfish: The type of sampling carried out in this study does not allow the determination of the rate of food ingestion, but taking into account that dogfish is an elasmobranch, the percentage of stomach content in relation to predator weight is high in all dogfish length groups (3.3% for 12-20 cm, 2.6% for 20-30 cm, 1.9% for 30-50 cm and 1.3% for 50-70 cm). The importance of fish prey must influence this, since these constitute larger sized prey than those found in other dogfish diets (Lyle, 1979; Ellis *et al.*, 1996). The small quantity of empty stomachs and the high digestion states of the preys, both in half hour hauls and in hauls of several hours duration, seem to indicate that they eat few times with a very slow digestion rate. According to the type and size of the prey, digestion will be faster or slower; Lyle (1979) also considered that the near absence of empty stomachs and the different states of digestion of the prey is because they eat intermittently throughout the day, but the diet of dogfish which this autor studies only contains between 2% and 4% of fish, 90% being made up of crustaceans and shell-less molluscs, which, due to their lower energy content, can be digested more quickly (Macpherson *et al.*, 1989) in such a way that a fish like silvery pout is digested in twice the time of a Natantia crustacean. Feeding experiments carried out in the laboratory using dogfish show that there is a closed relationship between the gastric evacuation rate and the return of the appetite, in such a way that a single meal is evacuated 2 to 5 times more quickly than a double meal (Sims *et al.*, 1996).

Thus the supply of fish prey in the diet of dogfish, brought about by discards above all of blue whiting, modifies the quantify of food ingested, and dogfish may reach an overfed state.

Indirect Effect of Fishing on Dogfish Stocks: Sharks are considered typical k strategist which have low growth, late sexual maturity and produce relatively few offspring with low natural mortality after their long reproductive cycles and furthermore have a long life. These characteristics make sharks very prone to changes in the areas influenced by fishing, and we know that the catch of skarks in many fisheries has increased or fallen due to the to the mortality caused by fishing activities (Anon., 1995). Dogfish show a series of characteristics which present it as a good indicator species to monitor the changes coming about in the abundance of species in exploited systems. On the one hand its natural diet is modified and it benefits from food provided by discards, and on the other it is discarded and returned to its natural state with a survival rate of over 90% in half hour hauls, according to data from Kaiser & Spencer (1995). In personal observations on board commercial vessels with hauls of greater duration, live dogfish are still seen in the catch, although this event has not been quantified. Statistical data of catches of this species are not available as they are discarded in the sea, but the historical series beginning in 1983 of the abundance in number and biomass (Fig. 8a) indicates a stable state of the stock. Its percentage in biomass even increases with respect to more abundant species, going from 4% un 1983 to 9% in 1993 (De la Gandara *et al.*, 1994).

This same situation may have come about in other dogfish stocks, such as in the North Sea (Fig. 8b) and the Celtic Sea (Fig. 8c). In the last report of the study group on elasmobranch fishes (Anon. 1995), although the data of *S. canicula* are not separated, we find landed catch data of dogfish from the French fleet and by looking at the historical series of landings in the Divisions VIIIa and VIIIb catches are observed (higher in Division VIIIa) which are continuous and stable. There are also historical series in grouped data of landed catch of several sea bottom skarks (*Galeus melastomus, Deania calceus, S. Canicula, S. stellaris, Etmopterus spinax*, ...), but which are not of use to us as we do not know their individual fishing mortality. This working group considers the importance of dogfish and propose a new section under the heading *S. canicula* for the next meeting.

The presumable change in the feeding habits of this species due to the supply of energy received from fishing activities means that our study area studies of dogfish stomach contents should be continued, since, as Sims *et al*., 1996 point out, the fish which adapt to a new feeding strategy have evolved in such a way that their feeding response coincides with the availability of its natural prey. It is also important that these first observations open up the way to a deeper investigation into the biological parameters of this species, above all in growth and fecundity, such as those which are being carried out in our study area (Rodríguez-Cabello *et al.*, in prep).

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