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Report of the Working Group on Cephalopod Fisheries and Life History (WGCEPH)

9–11 March 2010

Sukarrieta, Spain

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International Council for the Exploration of the Sea
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Executive summary

Despite of continuous fishing pressure, cephalopod resources in the ICES area have general shown an increasing trend in catches in the last 3 decades. An important caveat however is that up-to-date landings data are not available for most ICES countries and few if any survey abundance indices are available.

A wealth of recent research has focused on cephalopod paralarval ecology and effects of climate change. Environmental sensitivity can in some cases be utilised as a basis for fishery forecasting (e.g. in the case of *Octopus vulgaris*). Experimental work shows that while loliginid may suffer developmental abnormalities when exposed to high CO_2 concentrations in seawater, cuttlefish appear to be more robust to elevated CO_2 levels.

Although various cephalopod stocks are assessed in other parts of the world (e.g., the Falkland Islands), the current low level of fishery data collection on European cephalopods, coupled with the high data demands imposed by their short life-cycles, means that any analytical assessment is currently impractical. Therefore, the Group recommends a simple method that utilizes the existing data as a preliminary assessment step; the examination of trends in relative exploitation rates (i.e., catch/survey biomass), by seasonal cohort. The group also recommends a comparison of trends in maturity and length composition data by cohort, from research surveys versus the fishery, in order to assess trends in recruitment and length at 50% maturity (L50).

The group was unable to evaluate the efficacy of the current DCR for cephalopods due to the almost complete absence of data. However, some observations on the planned data collection can be made. In particular, given the short life cycles of most of these species (1 or 2 years), it is necessary to monitor biological variables regularly, ideally every week or month. Quarterly sampling is insufficient for cephalopod assessment and management. Even length composition sampling should be carried out on a more regular time basis in those metiers in which cephalopods are considered as G2 species. In order to avoid unnecessary sampling effort however, sampling should take into account the seasonality of cephalopod landings and discards, with a concentration of sampling during times when cephalopod catches are highest.

WGCEPH submitted the complete manuscript for a CRR on cephalopod fisheries earlier this year although the planned second CRR (species reviews) is currently delayed.

1 Introduction

The working group met at AZTI in Sukarrieta, Spain, 9–11 March 2010, in addition to working by correspondence. The meeting opened at 09.00 on 11 March and the Agenda was adopted.

1.1 Terms of Reference

2009/2/SSGEF09 The **Working Group on Cephalopod Fisheries and Life History (**WGCEPH), chaired by Graham Pierce, Spain, will meet at AZTI, Sukarrieta, Spain, 9–11 March 2010 to:

a) Update relevant fishery statistics (landings, directed effort, discards, etc) across the ICES area, and report on status and trends;

b) Review and report on innovative cephalopod research results in the ICES area, with particular emphasis on (i) studies on paralarval ecology and physiology and (ii) experimental studies on possible effects of climate change;

c) Review current approaches to cephalopod stock assessment and fishery management in North America and evaluate the feasibility of applying similar approaches in Europe;

d) Provide an overview of the outcomes of the current fishery (and survey) data collection programmes for cephalopods, with particular attention to (i) the success of the métier-based approach in relation to the previous fishery data collection system, (ii) utility of data currently collected for assessment purposes, and (iii) recommendations for improvements in the DCR and for any additional evaluation of the DCR that is thought to be needed;

e) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

f) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGCEPH will report by 10 May 2010 (via SSGEF) for the attention of SCICOM, ACOM (on ToRs c) and d)) and PGCCDBS (on ToR d)).

In addition to the above-listed terms of reference, the WGCEPH discussed the pending ICES Co-operative Research Reports on cephalopods.

1.2 Attendance

The WGCEPH meeting at AZTI was attended by 16 of the currently appointed WGCEPH members. These participants represented six ICES member states and one affiliated country (France, Germany, Portugal, Spain, UK, USA and Greece). Full details of the participants and contributors to the WGCEPH report can be found in Annex 1.

2 In response to ToR a)

ToR a) Update relevant fishery statistics (landings, directed effort, discards, etc.) across the ICES area, and report on status and trends

2.1 Update of landing statistics

The present report provides new landing statistics for 2009 and updates numbers since 2000, for cephalopod groups caught in the ICES area (Tables 2.1.1 to 2.1.6). The data originate from the ICES STATLANT database and from additional national information supplied by members of the Working Group. The information supplied by the Working Group members was from Spain, Portugal, France and UK. The data compiled in this report represent the best available information on cephalopod landings within the ICES area.

It is still difficult to be certain of the degree of comparability of current vs. older data, because the identification of species is not very precise within national landing statistics. No assurance can be obtained that the classification used in one year is exactly the same as that used in another. Different squid species and families are frequently lumped with each other in landing statistics. Tables 2.1.1 to 2.1.4 give information on annual catch statistics (2000–2009) per cephalopod group in each ICES division or subarea, separately for each nation. In the most recent years of the time series, information from some countries was not available and in some cases information was not provided by ICES division.

Table 2.1.1 groups species of cuttlefish and bobtail squid (families Sepiidae and Sepiolidae). The main landings summarized in this table are catches of *Sepia officinalis*, the common cuttlefish, plus smaller amounts of *S. elegans* and *S. orbignyana* and various species of bobtail squid (Sepiolidae) in southernmost regions. The most significant landings of these two families are in the southern and central areas, sub-areas VII, VIII and IX.

Table 2.1.2 groups species of common squid (including the long-finned squids *Loligo forbesi*, *L. vulgaris*, *Alloteuthis subulata*, and *A. media*). The main common squid landings are of *L. forbesi*, which is more important in the north, and *L. vulgaris*, more important in central and southern regions. Overall, long-finned squid landings concentrate in sub-area VII, and particularly divisions VIId,e. It is possible that some short-finned squid are currently grouped in this category.

Table 2.1.3 groups species of short-finned squid (*Illex coindetii* and *Todaropsis eblanae*), European flying squid (*Todarodes sagittatus*), neon flying squid (*Ommastrephes bartrami*) and occasionally a variety of species belonging to different decapod cephalopod families. This is commercially the least important group of the four defined, and its landings are more important in sub-areas VII and VIII, particularly as result of Spanish catches.

Table 2.1.4 groups octopod species (including *Eledone cirrhosa*, *E. moschata* and *Octopus vulgaris*, mostly, and some locally and temporally shallow-water species). The most significant proportion of landings in this group is the common octopus *Octopus vulgaris*, which is caught mainly in divisions VIII and IX, as a result of Portuguese and Spanish catches.

Table 2.1.5 summarizes total annual cephalopod landings in the whole ICES area for main cephalopod groups. During 2000–2008, landings have been variable with a minimum of 38500 tons in 2006 and a maximum of 62800 tons in 2004. In 2009, landings dropped to 18600 tons, but the low figure reflects incomplete information. Total cephalopod landings in 2004 were augmented by a significant increase in short-finned squids, due to a report of landings from Norway and Denmark only for this year of the time series. Cuttlefish, traditionally providing the most significant landings, returned to values in the order of 20000 tons, after an exceptional 2004. The mean percentage of cuttlefish from total cephalopod landings was around 44%, followed by octopus with 31% of total landings, long-finned squids with 18% and short-finned squids with 7%.

Table 2.1.6 provides information on total annual cephalopod landings in the whole ICES area for major cephalopod groups, per fishing nation. Annual fluctuations of landings per nation do not generally cause major changes in relative importance, each nation generally taking a proportional share of the total annual landings. Data from 2009 have to be considered as very preliminary.

If species landings are grouped into three groups, cuttlefish, squid (short-finned and long-finned) and octopus, each group can be seen to be exploited mainly by a few nations, and this situation does not change significantly over the years. In the case of cuttlefish, France has always landed the largest proportion of the total in the ICES area and generally only Spain and Portugal have landed in a comparable degree. For this group, the UK also began to land from 1989. This seems to indicate additional effort directed to this species, because the global amount of French, Portuguese and Spanish landings did not decrease and neither did the small shares of the remaining nations. The landings of these four nations have always accounted for over 95% of total cuttlefish landings in ICES area. In the case of squid, landings have also been shared mostly among France, Portugal and Spain, France having the highest share. In the group of octopus landings, more than 95% are shared by two nations, Portugal and Spain. The shares of the two nations have changed slightly over the time series, and only in 2006 were the catches of Spain higher than Portuguese catches.

Concerning Galicia (NWSpain), there are two independent fishery data collection programmes, one regional "Xunta de Galicia" and the other national "Instituto Español de Oceanografía" (IEO). Cephalopod landings data from these two different information sources show similar trends for the four taxonomic groups. Throughout the time series, the information from both sources is becoming more similar. It could be due to an improvement of the "Xunta de Galicia" monitoring system. However, the use of logbooks by IEO from 2008 onwards could lead to under-reporting of landings from artisanal fleets, since skippers of boats smaller than 10 metres are not obliged to provide the logbook information and these are important fleets targeting cephalopod species.

It is important to note that despite of continuous fishing pressure, cephalopod resources in the ICES area show an increasing trend in catches, with some fluctuations, throughout the 32 years of recorded data. (See ICES WGCEPH Reports 2007 and 2009).

More detailed statistics on landings and discards for different fisheries are presented as working documents. There are five working documents attached in Annexes 5–9:

WD1: Spanish cephalopod landing data of the fishing fleet operating in ICES area for 2000–2009 period.

WD2: Update of the Basque cephalopod fishery in the North eastern Atlantic waters during the period 1994–2009.

WD3: Cephalopod landings in Galicia during 2009

WD4: Portuguese fishery statistics (ICES division IXa) status and trends

WD5: Scottish (UK) Squid Landings

2.2 Cephalopod Discards

Cephalopods fisheries discard data in the ICES area have been collected at least since 2004 in the UK, France, Spain and Portugal under the *Data Collection for the Fisheries Sector* (DCF) program. Sampling is performed in order to evaluate the quarterly volume of discards and data are collected by métier. The observers-on-board program is based on a stratified random sampling, considering the métier as the stratum and the trip as the sampling unit. Sampling details may be found in Decision_2010_93_EU_DCFfinal.

2.2.1 UK and France

Discard sampling programs in the English Channel are carried out both by CEFAS and IFREMER (since 2002 and 2003 respectively) and suggest that the cuttlefish discarding rate can be significant, ranging from 6% to 23% of the catch of the UK fishing fleet and representing about 6% of French average catches. This is rather higher than suggested by previous on-board observations on offshore trawlers (Denis *et al*. 2002). The seasonality of French discards suggests that, most of the time, the discard rate is less than 10% and that the highest discarding rates occur in November which seems to be related to the recruitment of young of the year into the fishery. A more detailed analysis of these observations is needed. In particular, it seems necessary to look at the discarding behaviours of the different métiers that are catching cuttlefish.

2.2.2 Spain

IEO (Spanish Oceanographic Institute) is responsible for monitoring discards monthly by sea area and gear for the total Spanish fleet except for the Basque fleet, which is monitored by AZTI-Tecnalia.

Since 2002, under the National Sampling program of the Data Collection Regulation, discard sampling has been done in different métiers for all species specified in the Regulation, including cephalopod species. At present, the information has been compiled but has not yet been processed.

AZTI-Tecnalia is responsible for monitoring cephalopod discards monthly by sea area and gear for the Basque Country. Since 2001, a discard sampling program has been carried out and has continued since 2003 under the National Sampling program. Only results from the trawl fleet are reported here, since the other segments of the Basque fleet in the North East Atlantic have negligible levels of discards. The discard sampling does not include recording length distribution. The sampling covers the four metiers of the trawl fleet: Basque “Baka” bottom trawlers fishing in ICES Sub-area VI and targeting blue ling and witch, Basque “Baka” otter trawlers fishing in ICES Sub-area VII and targeting anglerfish and megrim, Basque “Baka” otter trawlers fishing in ICES Div. VIIIa,b,d and targeting a great variety of species (mixed fisheries) (OTB) and Basque Pair trawls operating with VHVO nets in ICES Div. VIII a,b,d and targeting hake (PTB).

Table 2.1.1. Landings (in tonnes) of Cuttlefish (Sepiidae) and Bobtail Squid (Sepiolidae).

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ICES Division IIIa (Skagerrak and Kattegat)										
Denmark		2	6	18	21	29	58	50	37	
ICES Division IVa (Northern North Sea)										
Denmark		2	3	7	10	7	11	10	7	
Scotland					1			0	0	
France	0.00	0.05	0.01	0.40	0.66	0.08	4.15	1.77	1.82	
ICES Division IVb (Central North Sea)										
Belgium	7	11.8	12	4.1	4	1	1	2	4	
France	0.4	0.1	0.1	0.4						
Denmark		1	13	35	36	13	21	23	12	
England, Wales & NI		0.1	3.1	0.4	1	1		0	0	
Netherlands	2		10.8	6		1		1	0	
Scotland					1			0	0	
ICES Division IVc (Southern North Sea)										
Belgium	12		205.9	64.4	103	57	57	33	53	
England, Wales & NI	14	4.7	4.2	2.3	2	3	3	3	2	
France	381	173	184	135	120	103	77	84	108	
Netherlands	97	118	363.3	229		146	295	174	133	
Scotland					2	1		1	0	
ICES Division Vb (Faroe Grounds)										
France					5	2				
ICES Division VIa,b (NW coast of Scotland and North Ireland, Rockall)										
England, Wales & NI	0			0.2				0	0	
France	1	0	0	4	0	1	0	1	0	
Scotland		4.8						0	0	
Spain	1	0	0	0	0			0	0	0
ICES Division VIIa (Irish Sea)										
Belgium	1	2	4.7	1	1	1		0	0	
England, Wales & NI	1	0.1	0	0.8				0	0	
France	1	1	0	1	0	0	0	0	0	
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)										
England, Wales & NI	0		0	0.02				0	0	
France	0	0	1	14	13	1	0	2	0	
Spain	3	17	3	4.6	9.9	11.5	9	9	19	0
ICES Divisions VIId, e (English Channel)										
Belgium	35	223.7	497.1	472.6	607	501	661	1331	801	
Channel Islands	26	8	11.3	9.4	7	7	3			
England, Wales & NI	2910	2607.8	3406.7	4581.3	4858	2821	3412	4279	3416	
France	8835	5672	10133	10970	12683	7582	8726	9663	5212	
Netherlands	2	2.6	6.4	14		27	15	41	31	
Scotland								11	7	
ICES Division VIIf (Bristol Channel)										
Belgium	1	11.7	3.8	7	38	16	5	6	7	
England, Wales & NI	12	6.9	18.8	39.2	28	11	8	12	6	
France	17	25	12	41	50	20	17	41	30	
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)										
Belgium	2	3.1	5.6	15	55	20	5	5	4	
England, Wales & NI	139	80.2	101.8	325.2	135	153	166	129	143	
France	7	3	5	7	19	20	18	9	22	
Ireland						3		0	1	
Netherlands			0.1	1				0	0	
Spain	13	6	0	1.4	1.1	0.5		0.1		0
ICES Subarea VIII (Bay of Biscay)										
Belgium	1	7.3	11.7	4	10	3		17	2	
England, Wales & NI	0			28.9	18	19	1	0	0	
France	5050.0	4907.6	2978.3	1155.9	6173.0	7752.9	3954.3	5586.2	2227.5	
Netherlands		41						0	0	
Portugal	8	9.6	6.2	18	40	32	37			
Spain	683	365	302	288.1	493.6	407	357	586.1	458	185.4
ICES Subarea IX										
Portugal	1357	1338.3	1361.6	1186.1	1514	1825	1822	1517.4	1452.9	1258.8
Spain	1454	765	820	992	889.4	1112	1090	1035.9	935	876
Total	**21072.7**	**16422.8**	**20496.2**	**20684.4**	**27950.1**	**22711.1**	**20834.3**	**24664.3**	**15131.4**	**2320.2**

Table 2.1.2. Landings (in tonnes) of Common Squid (includes *Loligo forbesi*, *L. vulgaris* and *Alloteuthis subulata*). (* These countries report undifferentiated landings of Loliginids and Ommastrephids that were grouped here. If two or more figures listed, the last one is the compound Loliginidae + Ommastrephidae).

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ICES Division IIIa (Skagerrak and Kattegat)										
Denmark	7									
Sweden*	+			1	5	3	10			
ICES Division IVa (Northern North Sea)										
Denmark	3									
England, Wales & NI	3	2.1	1.3	1.2	1	1		13	0	
France	0.127	0.0122	0.2675	0.7199	0.11	0.22	0.16	0.19	0.20	
Germany*	+				1	0.3	0.9	1	2	
Scotland*	547	348.9	687.9	1428	1442	344	676	864	675	
ICES Division IVb (Central North Sea)										
Belgium	24	3.2	14	22.1	16	8	17	20	4	
Denmark	10									
England, Wales & NI	29	35.5	70.4	159.3	162	161	85	65	30	
France			0.06	0.40	0.14	1.25	54.22	14.58	1.61	
Germany*	3			58	33	23	13	21	8	
Netherlands*	4			27		27	9	12	9	
Scotland*	87	112.1	218.3	323	358	214	107	245	62	
ICES Division IVc (Southern North Sea)										
Belgium	121	20.2	40	17.2	12	10	9	7	10	
England, Wales & NI	4	11.8	4.7	2.2	2	3	2	2	2	
France	154.3	220.9	666.6	424.1	213.9	145.0	117.0	98.4	235.2	
Germany*	2			4	4	1	1	0	0	
Netherlands*	758			104		38	27	83	77	
Scotland*				1		1	2	1	0	
ICES Division Vb (Faroe Grounds)										
England, Wales & NI	+	0.2	0	0.1				0	0	
Faroe Islands	+									
Scotland*	2			5	1			1	10	
France	0.1	0.0	0.0	0.0	0.6	0.0	0.0	0.5	0.0	
ICES Division VIa (NW coast of Scotland and North Ireland)										
England, Wales & NI	2	2.8	3.4	14	4		1	2	1	
France	50.8	8.6	27.7	23.7	25.3	85.3	27.8	37.6	29.0	
Germany								0	4	
Ireland*	38			33+30		49	20	29	15	
Scotland*	210	191.6	196.2	367	321	72	88	71	69	
Spain	3	0	3	9.6	1.6			9.8	3.2	2.7
ICES Division VIb (Rockall)										
England, Wales & NI	+	0.3	0.6	2.6				0	0	
Ireland*	3			4+1		8	18	13	139	
Scotland*	5	34.3	58.8	86	23		4	12	703	
Spain	+		2							
France	0.1	0.0	0.1	0.2	0.2	0.2	0.0	0.0	0.0	
ICES Division VIIa (Irish Sea)										
Belgium	3	2.3	9.4	2.3	1	3	1	1	1	
England, Wales & NI	31	102.6	116.3	96.3	50	24	8	9	13	
France	11.4	24.3	41.9	6.5	3.3	5.4	1.3	1.0	0.6	
Ireland*	5		2	2+7		4	5	5	3	
Isle of Man	+	0.8	0.4							
Scotland*	2			13	8	1		0	0	
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)										
England, Wales & NI	40	34.8	22	10.1	12	23	4	11	4	
France	74.4	8.8	20.2	34.7	33.9	13.6	39.9	56.0	178.5	
Ireland*	26	2	1	31+53		29	20	19	57	
Scotland*	27		19.2	14	19	2	14	7	1	
Spain	17	18	29	35	30.7	12	19	26	28.3	0
ICES Divisions VIId, e (English Channel)										
Belgium	254	22	59.3	72.4	54	36	46	106	76	
Channel Islands	9	1	2.3	1			2			
England, Wales & NI*	449	438.5	553.1	434.6	480+1	321	273	369	313	
France	2863.3	2317.7	3570.3	4926.1	4062.1	3138.7	3216.0	2960.1	2188.6	
Netherlands*	11			13+62		110	132	185	189	
ICES Division VIIf (Bristol Channel)										
Belgium	8	0.5	4.8	9.5	14	9	5	4	5	
England, Wales & NI	16	55	113.9	56.2	17	172	29	141	17	
France	85.6	247.7	153.0	144.7	123.2	242.5	115.5	179.0	117.5	
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)										
Belgium	5	2.6	7.9	7.4	6	6	3	6	4	
England, Wales & NI	202	166.4	116.1	35.4	134	51	44	51	73	
France	30.3	59.8	54.5	23.9	19.9	35.3	19.2	18.3	29.6	
Ireland*	67	12	37	51+113		172	52	75	84	
Scotland*	100			75	70	57	45	3	7	
Spain	77	14	3	1.9	2	2		0.1	0.1	1.5
ICES Sub-area VIII (Bay of Biscay)										
Belgium	48	0	1.8	0.9	1	1		2	1	
England, Wales & NI	+			18.2	18	6		1	0	
France	670.3	856.2	813.7	834.3	1075.8	912.7	1608.8	1362.2		
Portugal	1	1.1	0.6		9		1			
Scotland*					1	61	12	0	0	
Spain	767	614	253	329.7	371.9	306	164	447	311.1	214.9
ICES Sub-area IX										
France	42									
Portugal	619	897.6	686	328	1129	601	92	127.6	360.1	199.4
Spain	507	843	637	542	580.8	552	255	208.6	247.1	277.3
ICES Sub-area X (Azores Grounds)										
Portugal	58	137	196	536	261	272	3	720.9	664.4	
Total	**9196.7**	**7872.3**	**9520.0**	**12070.5**	**11215.4**	**8376.4**	**7518.9**	**8724.8**	**7063.0**	**695.8**

Table 2.1.3. Landings (in tonnes) of Short-finned Squid (*Illex coindetii* and *Todaropsis eblanae*), European Flying Squid (*Todarodes sagittatus*), Neon Flying Squid (*Ommastrephes bartrami*) and other less frequent families and species of Decapod cephalopods. (* These countries report undifferentiated landings of Loliginids and Ommastrephids that were grouped here. If two or more figures listed, the last one is the compound Loliginidae + Ommastrephidae).

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ICES Sub-area I + II (Barents Sea and Norwegian Sea)										
Norway	+				4638			0	1	
France								0	0	
ICES Division IIIa (Skagerrak and Kattegat)										
Denmark					4360					
Norway								0	1	
Sweden*				+	+					
ICES Division IVa (Northern North Sea)										
Germany*					+		+			
Norway					4			0	1	
Scotland*					+			0	0	
ICES Division IVb (Central North Sea)										
Germany*					+					
Netherlands*					+					
ICES Division IVc (Southern North Sea)										
Germany*					+					
Netherlands*					+					
Scotland*					+			0	0	
ICES Division Va (Iceland Grounds)										
Iceland	1	0	0.1		1			0	7	
ICES Division Vb (Faroe Grounds)										
Faroe Islands				16		1		0	41	
Scotland*				+	+			0	0	
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)										
England, Wales & NI	+	0.6	1.1	13	1	1		0	0	
Faroe Islands								0	250	
France	0.4	0.1	0.2	0.1	0.0	0.0	10.1	0.6	3.2	
Ireland*	+			32		2	5	0	11	
Scotland*				+	+			0	0	
Spain	+	0	11	0	0.3					0
ICES Division VIIa (Irish Sea)										
England, Wales & NI	+			0				0	0	
France	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	
Ireland*	0			6		7		0	1	
Scotland*				+	+			0	0	
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)										
England, Wales & NI	35	18.7	24.5	16	26	1	1	1	0	
France	27.9	11.0	26.5	60.8	20.3	14.0	45.8	8.5	33.7	
Ireland*	29	75	63	27		8	15	1	2	
Scotland*				+	+			0	0	
Spain	148	233	411	216.6	284.6	951	458	420.4	628.7	0
ICES Divisions VIId, e (English Channel)										
England, Wales & NI*	0			0.7				0	0	
France	2.9	3.9	7.7	2.2	18.7	12.6	9.7	9.1	10.4	
Netherlands*				+						
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)										
England, Wales & NI	151	173.2	143.7	85	66	18	9	17	7	
France	2.0	1.0	1.3	1.8	2.2	4.6	0.4	0.2	3.7	
Ireland*	83	60	91	49		19	4	12	16	
Scotland*					+			0	0	
Spain	710	339	87	35.4	35	52	70	42.8	5.3	4.8
ICES Sub-area VIII (Bay of Biscay)										
England, Wales & NI	0			0				0	0	
France	154.2	89.1	259.5	136.0	128.7	276.1	114.8	99.5	142.7	
Portugal	2			1	5					
Scotland*					+			0	0	
Spain	1400	868	584	474.2	495.1	634	326	250.8	394.7	230.2
ICES Sub-area IX										
Portugal	321	232	205	118	296	186.5	41.8	20.7	17.7	4.6
Spain	2461	2133	592	438.3	655.8	386	164	87.4	491.2	305.7
Total	**5528.6**	**4237.5**	**2508.6**	**1729.1**	**11037.9**	**2573.8**	**1274.5**	**971.2**	**2069.4**	**545.3**

Table 2.1.4. Landings (in tonnes) of Octopods (*Eledone* spp. and *Octopus vulgaris* mainly).

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ICES Division IVa (Northern North Sea)										
Scotland	15	6	1.3	11	5	2	1	3	3	
ICES Division IVb (Central North Sea)										
Belgium	5	5.5	1.5	2	2	2	2	1	2	
England, Wales & NI	1	1.7	0.6	0.52	1	1	1	0	0	
Netherlands		0.5					1			
Scotland	+	0.1								
ICES Division IVc (Southern North Sea)										
Belgium	1	0.6	1.2	1				1	0	
England, Wales & NI	+		0	0.03				0	0	
Netherlands		0.1		1		1				
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)										
Belgium	+							0	0	
England, Wales & NI	+			2.1	2			0	0	
Ireland	1							0	2	
Scotland	0									
Spain	+			0	0			0	0	0
ICES Division VIIa (Irish Sea)										
Belgium	5	10.9	31.1	20	5	1	2	0	1	
England, Wales & NI	+	0.4	0.1	0.3				0	0	
Ireland	+		1	1						
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)										
England, Wales & NI	4	20.2	2.5	6	15	4	10	10	5	
France	8.1	0.6	0.2	0		2	9.6			
Ireland	4	5	1	6		1		0	0	
Scotland		1.7		1				0	0	
Spain	44	276	741	429.6	341.9	417	389	397.4	379	0
ICES Divisions VIId, e (English Channel)										
Belgium	+	0.3	2	2	2	1	3	5	8	
Channel Islands	+			3						
England, Wales & NI	22	15.2	19.5	20.6	14	21	21	65	86	
France	13.2	5.1	7.3	5.3		9	5.6			
ICES Division VIIf (Bristol Channel)										
Belgium	13	0.5	8.6	13	24	10	16	20	9	
England, Wales & NI	10	4.2	13	7.7	9	10	5	6	2	
France	+					1	0.7			
Spain			2							
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)										
Belgium	16	6	12	13	12	5	6	6	3	
England, Wales & NI	78	105.2	140.8	99.2	113	131	103	137	104	
France	32.3	19.3	17.6	11.1		17.3	12.6			
Ireland	7	9	11	17		29	3	3	7	
Scotland	5	9.5	1.3	6		7	8	12	31	
Spain	518	156	111	27.6	29.2	32	36	36.6	2.9	0.8
ICES Sub-area VIII (Bay of Biscay)										
Belgium	4	4.9	13.4	1	5	3	6	15	8	
England, Wales & NI	0			0.5	29	8		0	0	
France	104.4	54.3	60.1	45.2	130.1	102.6	95.2	113.6	205.3	
Netherlands		4.8								
Portugal	250	69.5	69.7	98	164	102	73			
Spain	1057	1272	1329	1144.4	1723.5	1572	1649	2237.8	1764.6	611.2
ICES Sub-area IX										
Portugal	9019	7203.2	7287.9	10038	7784	11372	3368	8452	13257.7	7939.9
Spain	5205	2163	2936	2804.4	2787.3	4010	3164	2027.3	2736.7	1809.1
ICES Sub-area X (Azores Grounds)										
Portugal	9	14	16	16	15	10	12.6	18.6	12.8	
Total	**16451.0**	**11445.3**	**12839.7**	**14854.5**	**13213.0**	**17883.9**	**9003.3**	**13567.3**	**18630.0**	**10361.0**

Table 2.1.5. Total annual cephalopod landings (in tonnes) in the whole ICES area separated into major cephalopod species groups.

Cephalopod Group	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Cuttlefish	21073	16424	20497	20572	27950	22711	20834	24661	15196	4538
Common squid	9159	7736	9323	8423	10734	8379	7474	8739	6275	3202
Short-finned squid	5529	4238	2508	1590	10972	2387	1233	959	2066	582
Octopods	16453	11442	12836	12223	13213	17884	8981	13335	18399	10366
Total	**52213**	**39841**	**45165**	**42808**	**62870**	**51361**	**38522**	**47694**	**41936**	**18689**

Table 2.1.6. Total annual cephalopod landings (in tonnes) in whole ICES area by country and separated into major cephalopod species groups.

Country	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
(a) Cuttlefish (*Sepiidae*)										
Belgium	59	260	741	541	818	599	729	1394	871	
Channel Islands	26	8	11	9	7	7	3	0.2	0.3	0.4
Denmark	0	5	22	0	67	49	90	85	71	
England, Wales & NI	3076	2700	3535	4978	5042	3008	3590	4429.7	3561.7	2217.0
France	14291.7	10783.1	13314.1	12328.3	19064.1	15482.1	12797.3	15387.8	7600.5	
Ireland						3	0	0	1	
Netherlands	101	162	381	249	0	174	310	216	164	
Portugal	1365	1348	1368	1186	1554	1857	1859	1517.4	1452.9	1258.8
Scotland	0	5	0	0	4	1	0	0.1	0.1	0.0
Spain	2154	1153	1125	1281	1394	1531	1456	1631.0	1473.1	1061.4
Total	**21072.7**	**16424.1**	**20497.1**	**20572.3**	**27950.1**	**22711.1**	**20834.3**	**24661.3**	**15195.6**	**4537.6**
(b) Common Squid (*Loliginidae*)										
Belgium	463	51	137	132	104	73	81	146	101	
Channel Islands	9	1	2		0	0	2	0.1	3.8	0.4
Denmark	20	0	0	0	0	0	0	0	0	
England, Wales & NI	776	850	1002	830	400	762	446	603.7	371.6	446.8
Faroe Islands	+				0	0	0	0	0	
France	3982.7	3744.1	5348.3	6419.3	5558.4	4580.1	5200.0	4727.8	2780.7	
Germany	5	0	0	58	38	24	15	23	15	
Ireland	101	14	40	0	0	264	115	144	298	
Isle of Man	+	1	0		0	0	0	0	0	
Netherlands	773	0	0	0	0	176	168	281	323	
Portugal	678	899	687	236	1399	873	96	929.5	277.3	199.4
Scotland	980	687	1180	0	2243	752	903	1192.7	1515.1	2059.5
Spain	1371	1489	927	748	987	872	438	691.5	589.7	496.4
Sweden	+				5	3	10			
Total	**9158.7**	**7736.1**	**9323.3**	**8423.3**	**10734.4**	**8379.1**	**7474.0**	**8739.3**	**6275.3**	**3202.4**
(c) Short-finned Squid										
Denmark	0	0	0	0	4360			0	0	
England, Wales & NI	186	193	169	1	27	20	10	5.4	3.8	7.0
Faroe Islands	0	0	0	16	0	1	0	0	291	
France	187.6	105.0	295.2	200.9	170.1	307.3	180.7	118.1	193.8	
Germany	0	0	0	0	0	0	0	0	0	
Iceland	1	0	0	0	1	0	0	0	7	
Ireland	112	135	154	0	0	36	24	13	30	
Netherlands	0	0	0	0	0	0	0	0	0	
Norway	+	0	0	0	4642	0	0	0	3	
Portugal	323	232	205	119	301	0	0	20.7	17.7	4.6
Scotland	0	0	0	0	0	0	0	0	0	0
Spain	4719	3573	1685	1253	1471	2023	1018	801.5	1519.9	570.7
Sweden	0	0	0	0	0			0	0	
Total	**5528.6**	**4238.0**	**2508.2**	**1589.9**	**10972.1**	**2387.3**	**1232.7**	**958.7**	**2066.2**	**582.3**
(d) Octopods										
Belgium	44	29	70	0	50	22	27	48	31	
Channel Islands	+	0	0	3	0	0	0	0	0	0
England, Wales & NI	115	147	177	137	183	175	140	0.2	0.1	6.0
France	158.0	79.3	85.2	61.6	130.1	131.9	123.7	113.6	205.3	
Ireland	12	14	13	0	0	30	3	3	9	
Netherlands	0	5	0	0	0	1	0	0	0	
Portugal	9280	7284	7369	7550	7963	11484	3441	8470.6	13270.5	7939.9
Scotland	20	17	3	0	5	9	8	0	0	0
Spain	6824	3867	5119	4471	4882	6031	5238	4699	4883	2420.5
Total	**16453.0**	**11442.3**	**12836.2**	**12222.6**	**13213.1**	**17883.9**	**8980.7**	**13334.5**	**18399.1**	**10366.4**

In Table 2.2.1 the percentage of cephalopod catches that were discarded during 2003-2009 is presented by metier. Preliminary analysis shows that short-finned squid and, to a lesser extent, curled octopus (*Eledone cirrhosa*) are the most frequently discarded species, because of their low price in the market. “Baka” otter trawlers operating in Subarea VI and pair trawlers operating in Divisions VIIIa,b,d have the lowest discarding rates.

Table 2.2.1. Estimated cephalopod discards (% of total catches) during 2003-2009 in the Basque Country.

			% discard from total catches						
Gear	**Area**	**Species**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
OTB	VI	Short finned squid	100%	-	-	-	-	100%	100%
		Curled octopus	-	-	-	-	-	-	-
		Cuttlefish	-	-	-	-	-	-	-
	VII	Short finned squid	61%	77%	19%	4%	52%	87%	-
		Curled octopus	33%	1%	38%	12%	56%	-	-
		Cuttlefish	12%	-	-	-	-	-	-
	VIIIabd	Short finned squid	59%	57%	17%	35%	38%	12%	15%
		Curled octopus	28%	5%	7%	0%	19%	2%	14%
		Cuttlefish	0%	1%	2%	-	1%	-	8%
PTB	VIIIabd	Short finned squid	16%	41%	9%	4%	7%	-	39%
		Curled octopus	-	-	-	-	-	-	-
		Cuttlefish	2%	-	-	-	-	-	-

2.2.3 Portugal

IPIMAR is responsible for discard sampling from ICES Division IXa under the DCF. The sampling covers two fleets: Otter Bottom Trawl for Crustaceans (OTB_CRU) and Otter Bottom Trawl for demersal fish (OTB_DEF).

Cephalopods represent a very small fraction of the total discards of the Portuguese Otter Bottom Trawlers in sub-area IXa. The most important cephalopod discards are *Eledone* species, under sized *Octopus vulgaris*, and *Alloteuthis* sp. Cephalopod discards are generally higher in the OTB-CRU fleet than in the OTB-DEF fleet. In the OTB-CRU fleet, which operates in deeper waters, 90–100% of cephalopod catches are discarded. The only exception is for *Octopus vulgaris*, with only around 60% of catches discarded. The OTB-DEF shows different discarding behaviour for cephalopods, whereby the species with some market value show a much lower discard percentage, namely *Eledone cirrhosa*, *Sepia officinalis*, *Octopus vulgaris*, *Todaropsis eblanae* and *Loligo vulgaris*.

Table 2.2.2. Percentage of discards of cephalopod species, in the total hauls sampled in the Otter Bottom Trawl for Crustaceans (OTB_CRU) fleet and the Otter Bottom Trawl for demersal fish (OTB_DEF) fleet, under the "Onboard Sampling Program" of the DCF in Portuguese waters of ICES area IXa.

		% discard from total catches				
Metier	**Species**	**2004**	**2005**	**2006**	**2007**	**2008**
OTB-CRU	Curled octopus	92%	86%	98%	100%	99%
	Short finned squid	91%	99%	100%	100%	100%
	Octopus	49%	93%	-	-	50%
	Long finned squid	100%	100%	-	100%	100%
	Cuttlefish	86%	100%	98%	100%	100%
OTB-DEF	Curled octopus	27%	29%	37%	30%	49%
	Short finned squid	14%	98%	-	100%	100%
	Octopus	9%	13%	37%	38%	29%
	Long finned squid	90%	64%	100%	100%	93%
	Cuttlefish	46%	98%	92%	100%	77%

3 In response to ToR b)

ToR b) Review and report on innovative cephalopod research results in the ICES area, with particular emphasis on (i) studies on paralaval (ELS, ELS) ecology and physiology and (ii) experimental studies on possible effects of climate change

The text for this section was written by a sub-group comprising: Ángel Guerra, Uwe Piatkowski, Jean-Paul Robin, Noussithé Koueta, Isobel Bloor, Daniel Oesterwind and Marcos Regueira. The authors have made extensive use of abstracts for presentations at the 2009 conference of the Cephalopod International Advisory Council, which was held in Vigo, Spain, in September 2009.

3.1 Early Life Stage ecology and ecophysiology

The early life stages (ELSs) of any cephalopod species are closely related with the recruitment process, and knowledge of recruitment to a fishery is particularly important mainly in short-lived species, such as most cephalopods, in which there is a complete turnover of biomass every 1 or 2 years. Recruitment success is related to both biotic and environmental conditions.

The efficiency of sampling of ELSs in the wild has to be improved. This will include the development of new types of nets and greater sampling effort to search for ELSs in more suitable water masses. This will demand improved collaboration with oceanographers and the selection of the appropriate times for sampling.

Both classical and innovative techniques are used to identify cephalopod species at the ELSs. The chromatophore pattern of cephalopods provides a quick and relatively easy means of identifying species. As shown by Fuentes *et al*. (2009), comparing the chromatophore patterns of *Octopus vulgaris* paralarvae from the Eastern Atlantic (Galicia, Spain) and the South-western Atlantic (Southern Brazil), substantial differences exist between the chromatophore patterns of paralarvae from both regions, which could provide support for the hypothesis of species differentiation.

The development of a robust and reliable DNA barcoding / species identification method has been completed for the identification to species of ELSs of *Loligo forbesi* and *Loligo vulgaris*. Due to high levels of sequence similarity in the DNA barcoding gene (COI) sequence of these two species, an RFLP or Taqman-based approach could not be perfected, so an alternative approach using species-specific primer PCR was developed. The species-specific PCR was tested with large numbers of individuals of both species and successfully identified all individuals to the correct species. The approach has the advantage of being more robust and technically less demanding than RFLP / Taqman approaches, and there is thus the potential to transfer the method to other less well-equipped or less-experienced laboratories, or even to develop a field-based procedure for fast identification of species. Initial steps have been taken to extend the procedure to other squid species (*Alloteuthis* spp.), now that suitable sample material has been made available. Development for these species should be easier as sequence divergence from the *Loligo* species is more extensive (Robin and Shaw, pers. comm.).

3.2 Effect of environmental parameters on ELSs

According to recent literature, temperature, salinity, and oxygen are the major factors that influence the traits of ELSs. For example, changes in environmental parameters (mainly temperature) and fishing pressure are the cause of changes in biological traits like size at first maturity as demonstrated in *Octopus vulgaris* in central African fisheries (Guerra, pers. comm.). Sudden salinity changes have been shown to affect *O. vulgaris* adults in two recent events. In the Douro estuary and Gulf of Cadiz (Borges and Silva, pers. comm.), mass mortality was exhibited by adults and sub-adult specimens which stranded on the beaches, following increased fresh water input from the rivers. The impact of these fresh water inputs on ELSs should also be investigated.

Otero *et al*. (2008) investigated the possible causes underlying the wide interannual fluctuations in catches of the common octopus *Octopus vulgaris* in Galicia (ICES area XIa). Wind stress structure during the spring–summer (prior to the hatching peak) and autumn–winter (during the planktonic stage) was found to affect the early life phase of this species, and explains up to 85% of the the year-to-year variability in catches of adults. Despite this bottom-up modulation via environmental conditions, the results also provide evidence for a between-cohort density-dependent interaction, probably caused by cannibalism and competition for habitat.

Otero *et al*. (2009) presents a general approach for assessing the influence of high-frequency upwelling events on *O. vulgaris* planktonic larvae in the NW Iberian coast (ICES area XIa), where upwelling events occur every 10 to 20 days from April to September. The analysis indicates that the increase in larval abundance and biomass is significantly correlated with the simultaneous decrease of nitrate, ammonium and chlorophyll levels. These conditions occur during the early part of the relaxation phase of coastal upwelling events.

González *et al*. (in press) studied age, growth and survival of *Loligo vulgaris* paralarvae collected off the Ría de Vigo (ICES area IXa) and showed that ELSs collected with Bongo nets varied in dorsal mantle length (DML) from 1.3 to 7.6 mm, and that their abundance decreased abruptly as they grew. ELSs are planktonic for at least three months and growth of DML during that period fitted an exponential equation. The instantaneous relative growth rates were 2.11, 2.15, and 1.82% DML d^{-1} for 2003, 2004, and 2005, respectively, and there were no significant differences in size-at-age between the three years. It was suggested that the lifespan of this species may previously have been underestimated by around 3 months. The analysis revealed interannual differences in length–weight relationships and survivorship, which might be related to external factors such as food availability. Conversely, length-at-age varied seasonally but not between years, suggesting that it relates primarily to seasonal patterns in growth rate, for instance in response to temperature differences.

Growth during the ELSs of *Loligo vulgaris* in waters off the NW Portuguese coast was analysed based on statolith increment measurements. The mean increment widths indicate that statolith growth is generally slow during the first month after hatching, increasing thereafter. Maximum growth rates occur at 2 to 3 months of age, occurring earlier in the life (9 weeks of age) of squid hatched during the warm season and later (13 weeks of age) in squid hatched during the cold season (Moreno *et al*., 2009a)

The distribution and abundances of cephalopod ELSs in relation to the regional oceanography off the western Iberian Peninsula were studied by Moreno *et al*. (2009b) Temperature and upwelling were shown to be the most important variables in modulating seasonality and distribution of the paralarvae of *L. vulgaris*, *O. vulgaris*, sepiolids and ommastrephid squids and indicated boundaries to geographic dispersal in an area of high cephalopod biodiversity.

New research is currently being undertaken to investigate the survival and recruitment of ELS and juvenile *Sepia officinalis* from different spawning and juvenile habitats in the English waters of the Channel. Using both laboratory and field research (scuba diving observations) this study aims to quantify the relative contribution of these different habitats to recruitment, cohort strength and stock size. This information will be useful to assess how population viability relates to the input of juveniles from different spawning and ELS habitats and, from this, to generate new recommendations for the sustainable management of these coastal habitats and the commercial cuttlefish stock within the English Channel (Bloor, pers. comm.)

Stable carbon and nitrogen isotopes analyses are a very powerful tool for trophic investigations, especially for cephalopods because they cut the prey into small pieces before ingestion. Unlike classical stomach content analyses, the approach indicates feeding over an extended period rather than a snapshot. The measurements can indicate trophic level during the last few weeks of an animal's life and, by measuring changes in isotopic composition along recording structures, it is possible to observe ontogenetic trophic shifts in one animal. However, the interpretation of measured signatures is still problematic. For comparisons of trophic position between species or for animals in different habitats or in different time periods it is necessary to know the stable isotope values at the base of the food web. Migrations between areas can also alter stable isotope ratios. Another problem is to get information about the prey composition. Stable isotope values of all potential prey items are necessary. Most of the models available to interpret diet can handle only two or three different prey items (since each animal provides values for only two variables, i.e. C and N ratios), which limits the information that can be extract on diet, especially for omnivorous predators such as cephalopods.

Stable isotope signatures have been analysed in *Loligo vulgaris* specimens collected from three fisheries: English Channel, Bay of Biscay and Portugal (Martin *et al*., 2009). Ongoing projects in the English Channel ecosystem include the analysis of trophic signatures in juvenile *Sepia officinalis* from different coastal spawning grounds and also from the subsequent recruits. The objectives are both to compare trophic ecology at a regional scale and also to test the possibility to trace the origin of recruits. A related project includes acquisition of isotopic signatures of finfish species and other ecosystem components. Such new data are sought firstly to improve food web models but also they can be useful for a better understanding of the role of cephalopods (Robin, pers. comm.).

Roura *et al*. (In press) validated the use of a molecular method based on *Artemia* COI to identify prey in the diet of the ELSs of *O. vulgaris*. The technique could be extended to identify other wild prey consumed by ELSs and offers a more accurate and less time consuming tool than the current classical approaches.

The study of Darmaillacq *et al*., (2006) showed that ELSs of *S. officinalis* preferred the prey to which they have been visually familiarized, when the amount of information was sufficient and only if such familiarization occurred during a short sensitive period. They also demonstrated that the effects of visual food imprinting overcame those of the first food ingested.

Conditions of illumination and prey density affect consumption rate and feeding success of newly hatched *O. vulgaris* preying on *Artemia sp*. larvae (Marquez *et al*., 2006).

Parasites are an important, but often neglected, component of any ecosystem. Their effects on hosts are diverse: they are known to affect behaviour, lower body condition, reduce fecundity and even cause mortality. Mathematical models suggest that parasite populations regulate stocks of their host, thus increasing the level of uncertainty in fisheries management (Pascual *et al*., 2007). A target for future research is identification of the parasite fauna infecting zooplankton communities in coastal areas inhabited by cephalopod ELSs. This could involve molecular identification of parasite forms in a wide variety of zooplankton groups (e.g. copepods, euphausiids) and the ecological aspects of parasite transmission from zooplankton to cephalopod ELSs(M. Gregori, S. Pascual and A.F. González, Pers. Comm.).

3.3 Experimental studies on possible effects of climate change

By the end of this century, anthropogenic carbon dioxide (CO_2) emissions are expected to decrease the surface ocean pH by as much as 0.3 units. At the same time, the ocean is expected to warm with an associated expansion of the oxygen minimum layer (OML). Thus, there is a growing demand to understand the response of the marine biota to these global changes.

Rosa and Seibel (2007) demonstrated that ocean acidification substantially depressed metabolic rates (31%) and activity levels (45%) of the jumbo squid, *Dosidicus gigas*. This effect is exacerbated by high temperature. Reduced aerobic and locomotory scope in warm, high-CO_2 surface waters will presumably impair predator–prey interactions with cascading consequences for growth, reproduction, and survival. In the absence of adaptation or horizontal migration, the synergism between ocean acidification, global warming, and expanding hypoxia is expected to compress the habitable depth range of the species in the eastern Pacific.

In contrast to studies on most other calcifying invertebrates, recent work on the cuttlefish *S. officinalis* has shown that this species actually mineralises more $CaCO_3$ in the cuttlebones during long-term exposure to CO_2 concentrations in excess of current climate change predictions. Preliminary results from Dorey *et al*., (2009) revealed that decreasing pH increased the egg weight at the end of the development in cuttlefish. The activity of 45Ca in the cuttlebone of embryos was higher in eggs exposed to the two lower pHs relative to those at normal pH, suggesting high physiological tolerance of high pCO_2.

Active cephalopods possess a certain level of pre-adaptation to long-term increments in carbon dioxide levels. For example, *Sepia officinalis* is capable of maintaining not only calcification but also growth and metabolism when exposed to elevated partial pressures of carbon dioxide (*p*CO2). Gutowska *et al*., (2008) found that, during a 6 wk period, juvenile *S. officinalis* maintained calcification under ~4000 and ~6000 ppm CO2, and grew at the same rate with the same gross growth efficiency as did control animals. Lyons *et al*., (2009) found that cuttlebone sections calcified during exposure to elevated seawater pCO_2 were less porous, owing to decreased lamellar spacing and a thickening of lamellar and pillar walls. It is possible that the observed changes could negatively influence buoyancy and increase locomotory energy expenditure.

To predict effects of future ocean acidification on ELSs of cephalopods, the general understanding of the mechanistic processes that limit calcification must be improved. To better understand the associated costs of increased calcification in *S. officinalis* a technique is being developed using a combination of multi-channel data loggers and respirometry to: (1) elucidate fine-scale behavioural differences between cuttlefish reared under control conditions and elevated levels of CO_2 and, (2) estimate the comparative costs of locomotion and buoyancy regulation under different climate change scenarios.

Ocean acidification also impacts squid species such as *L. vulgaris*, as shown by Frommel *et al*. (2009) who conducted studies on squid eggs hatched under three different CO_2 concentrations: 380 ppm (current), 1400 ppm and 4000 ppm. While all *L. vulgaris* reared at 380 ppm had normally developed statoliths, elevated CO_2 concentrations resulted in significant deformations. In addition to deformed statoliths, behavioural abnormalities ("spinning") were observed in the hatchlings reared at 4000 ppm, most of which lacked statoliths.

Effects of environmental temperature on mitochondrial energy coupling have been investigated in *S. officinalis* using *in vivo* spectroscopy (Mark *et al*., 2008). As efficient energy turnover needs sufficient oxygen supply, thermal effects on the blood oxygen binding capacities of the haemocyanin and the differential expression of its isoforms were also investigated.

Climate change will also affect biogeographic boundaries which are influenced by seawater temperature. An example of this is the appearance of mature female *Argonauta argo* in December 2000 in the Ria de Aldán (ICES area IXa). *A. argo* is a tropical species and its presence in that area seems to be related with the increase of the SST observed off the Galician coast in the last decade (Guerra *et al*., 2002).

Another important aspect of the ELSs is the dispersal capacity, which varies widely among cephalopods. For instance, in octopuses there are two major life-history strategies. The first is the production of relatively few, large eggs resulting in well-developed hatchlings that resemble the adults and rapidly adopt the benthic habit of their parents (e.g. *Eledone moschata*). The second is the production of numerous small eggs that hatch into planktonic, free-swimming hatchlings (e.g. *Octopus vulgaris*). These distinctive planktonic stages are termed *paralarvae* and differ from conspecific adults in their morphology, physiology, ecology and behaviour (Villanueva and Norman, 2008).

Specific gravity is an important parameter in the dispersal of many marine zooplankters. In yolk-sac larvae, the specific gravity changes during the yolk utilization phase and impacts their vertical distribution in the water column. This in turn determines the degree of transport by currents, as velocity is usually great near the surface. In the case of the commercially important *Loligo reynaudii* from South Africa, recruitment is thought to be influenced by the successful transport of paralarvae from the spawning grounds to a cold ridge some 100–200 km away. Martins *et al*. (2009) concluded that the specific gravity of early *L. reynaudii* paralarvae enhances survival by maintaining the paralarvae in productive shelf waters, avoiding advective losses to the open sea.

Chen *et al*., (2006) assembled fishery and research cruise data to examine the evidence for a shift in distribution of *L. forbesi* and *L. vulgaris* in North Atlantic waters and examined the relationship between abundance of these species and possible environmental correlates (October SST and winter NAO index). The decrease of *Loligo* abundance in the south area (France and Portugal) and the increase in *Loligo* abundance in the north area (Scotland) appears to be associated with the increase in SST after 1993 and subsequent high level.

Villanueva and Norman (2008) indicate that indirect effects of climate change may severely affect adult octopus populations. An example was provided by a prolonged harmful algal bloom (HAB) lasting nearly 2 months, which appears to have nearly eliminated the once-ubiquitous population of *Octopus*. cf. *mercatoris* in St. Joseph Bay, Florida. HABs seem to be increasing in frequency, duration and severity worldwide, influenced by anthropogenic impact and coinciding with trends in global warming. Such episodes may affect littoral octopus populations in the future.

A study of the effects of chronic (1 month) exposure of *S. officinialis* ELS to heavy metals (Cd and Zn) and organic compounds (herbicides and molluscicides) has recently commenced. The research will determine the effects of these pollutants on different organs and cells (from digestive glands, haemocytes to nervous systems). The results will be of importance to assess survival and distribution of ELSs of this species in the field and may serve to offer some recommendations to avoid potential losses to exploited stocks (Koueta *et al*., pers. comm.).

Twenty years ago the life-cycle of the English Channel *S. officinalis* population was described with a 2-year lifespan. A new French study is testing whether spawning at one-year old has increased in prevalence as a result of global warming. A macroscopic maturation key based on previous studies will be applied to samples collected from twelve French landing sites. A better knowledge of the age-structure in landings will be useful for stock assessments (Michael Gras, pers. comm.)

3.4 Recommended research on ELSs of cephalopods

1) Accurate taxonomy and development of identification tools.

2) Surveys and studies of the main characteristics of spawning grounds.

3) To improve understanding of life cycles and the influence of the environmental parameters, better ELSs rearing techniques are needed. *Sepiola atlantica* has been identified as a suitable species for rearing and, therefore, to undertake experiments under controlled conditions (M. Rodrigues, pers. Comm..).

4) Research on post-hatching settlement and dispersal processes and the effects of climate change and currents on these processes.

5) The direct physiological effects of seawater acidification and pollution on ELSs of cephalopods are poorly known and further research is required.

6) Studies on the nutrition and energy budget of ELSs of cephalopod species together with sensory physiology and immunology are needed to increase our understanding of the survival rate of the exploited stocks.

7) Promote multidisciplinary research projects in which oceanography offer a framework to understand zooplankton ecology (including that of cephalopod paralarvae). This synergy will facilitate application of an ecosystem approach to fishery assessment.

8) Improved research on trophic ecology, combining both classical methods (study of stomach contents) and new techniques (stable isotope signatures, fatty acids analyses and DNA barcoding).

9) Promote research for the identification of parasite fauna infecting zooplankton as a window for transmission of parasites to ELSs of cephalopod, and for assessing their negative effects on cephalopod populations.

WGCEPH expresses its interest in promoting multidisciplinary research projects where oceanography offers a framework to understand zooplankton ecology (including cephalopod *paralarvae*). This synergy will facilitate application of an ecosystem approach to fishery assessment.

4 In response to ToR c)

ToR c) Review current approaches to cephalopod stock assessment and fishery management in North America and evaluate the feasibility of applying similar approaches in Europe

The assessment of cephalopod stocks in the ICES region is not only important for sustainability of the directed cephalopod fisheries (i.e., English Channel *Sepia officianalis*, coastal fisheries for *Octopus vulgaris* and *Loligo vulgaris*, and *Loligo forbesi* fisheries in various locations along the UK coast), but also because cephalopods play a key role in the trophic dynamics of marine ecosystems, as both predator and prey. Commercially important cephalopods are eaten by a range of marine species in European waters. Long-finned pilot whales, Risso´s dolphins, and (to a lesser extent) Mediterranean monk seals are specialist cephalopod feeders, feeding mainly on ommastrephid squid and octopods (mainly octopods in the case of monk seals) (G.J. Pierce and co-authors, unpubl. data). Other toothed cetaceans and seals eat some cephalopods as well as fish, with species recorded including *Loligo* spp., *Sepia* spp., *Sepiola* spp. and *Eledone* spp. (e.g., Tollit & Thompson, 1996; Santos *et al.*, 2001, 2004a,b, 2007). Various seabirds are known to feed on ommastrephid squid (e.g., Furness, 1994). Large pelagic fish such as swordfish and tuna consume substantial amounts of cephalopods (e.g., Clarke *et al.*, 1996). Results from the ICES Year of the Stomach suggest that the small loliginid *Alloteuthis* is the most commonly recorded cephalopod species in stomachs of demersal fish (Hislop *et al.*, 1991), although sepioloids and *Loligo* spp. are also eaten by demersal fish (Daly *et al.*, 2001).

In the context of an Integrated Maritime Policy for the European Union (IMP, COM (2007) 575), interest in assessment and management of cephalopods must take a step further from the purely fisheries policy, towards an integrated approach: an ecosystem approach to marine management. This is being implemented through the Marine Strategy Framework Directive (COM (2008) 187), which is the environmental pillar of the IMP and sets the obligation for Member States to achieve Good Environmental Status in 2020. The EU also planning to fund research on ways of defining MSY variants such as maximum ecosystem yield, maximum social yield and maximum economic yield. Thus, future management of any exploited species must be set up to provide for the sustainability of the marine ecosystems in ecological, social and economic terms.

In analyses of marine trophic dynamics, a recurrent question about the cephalopod component of an ecosystem is "what is the average annual biomass?" However, using an average annual biomass ignores the unique life history characteristics of cephalopod species and can lead to highly biased estimates of the role played by these populations in the ecosystem. Most cephalopod species have an annual life cycle and are seasonal breeders, resulting in one or two primary cohorts (e.g., winter and summer breeders). Consequently, the estimated biomass depends strongly on the time of year when a cephalopod species is assessed. In addition, for each cohort, recruitment may take place over an extended period (e.g., 2–3 months), resulting in an apparently stable biomass estimate that could actually be masking substantial turnover. In order to obtain estimates of the cephalopod biomass component of an ecosystem, one should consider total annual production rather than average annual biomass. Fishery yields represent a lower boundary for production and more realistic estimates should take into account the high rates of natural mortality common to semelparous cephalopods.

Cephalopods are also likely important indicators of climate change (WGCEPH 2009; see also ToR b above). They are short-lived (i.e., one to two years) and their distribution, growth, maturation, and spawning periods are strongly influenced by environmental variables such as water temperatures, climatic oscillation indices (e.g., NAO), and large-scale oceanographic features (Arkhipkin and Middleton, 2002; Dawe *et al*., 2007; see Pierce *et al*., 2008 for a recent review).

Life history characteristics, such as short lifespans, extended periods of recruitment, semelparity, high natural mortality rates, and long-distance migrations (Boyle and Boletzky, 1996) present some unique challenges to the assessment of cephalopod stocks. For example, spawning (and recruitment) occur throughout the year, and often with seasonal peaks. As a result, stock assessment models need to incorporate time steps that are short enough to accurately characterize the major seasonal cohorts and their variable growth, maturation rates and natural mortality rates. Thus, weekly or monthly data sets of fishery catch, effort and biological data are needed for stock assessments, especially for stocks for which there are no seasonal research survey data available. Natural mortality rates are comprised of predation, disease, cannibalism, and post-spawning mortality (normally cephalopods die upon completion of spawning). Few studies have been conducted to quantify cephalopod natural mortality rates and one study that estimated post-spawning mortality suggests that this component is very high, as might be expected for a semelparous species (Hendrickson and Hart, 2006).

In addition to the complex life history characteristics of cephalopods, the fishery and survey data available for assessments of the ICES stocks are limited temporally and spatially. There are currently no research surveys devoted solely to sampling cephalopod stocks and existing multispecies bottom trawl surveys may cover various portions of the total stock areas of some species. Additionally, data on cephalopods are not always recorded, and where they are recorded, they are not always identified to species.

The Group examined the Data Collection Framework (DCF) relative to cephalopod species (refer to ToR d for details). However, as of the date of the WGCEPH meeting, the 2009 data from the DCF had not been received by the Group. Several important issues with respect to the DCF for cephalopod sampling restrict the Group's ability to conduct cephalopod stock assessments, such as: the lack of identification to the species level, coarse temporal and spatial data resolution, and inadequate sampling intensity for length composition of the landings and discards (despite the current classification of most cephalopod species in Sampling Group 2). Most of the commercially important catches of cephalopods are highly seasonal and it would be better to concentrate sampling effort during these time periods. Thus, the Group recommends more intensive sampling during periods of higher catches in order to ensure adequate characterizations of the length compositions of the multiple microcohorts that are often present.

The Group discussed the types of assessments most appropriate for cephalopods and in the context of the data available to perform them. Given the data limitations for many ICES cephalopod species, the Group recommends a simple method that utilizes the existing data as a preliminary assessment step; the examination of trends in relative exploitation rates (i.e., catch/survey biomass), by seasonal cohort. Such a method has been used to assess the data-limited *Illex illecebrosus* stock in NAFO Subareas 3+4 (Hendrickson and Showell, 2006). For this method, relative biomass indices can be used, but swept area biomass estimates (i.e., by bottom trawl gear) are preferable. If there are no surveys that can be used to derive biomass estimates, then commercial biomass indices should be computed (i.e., CPUE). Calculation of CPUE indices will vary depending on gear type. Trawl effort should be measured in terms of time fished. In the case of the trap/pot fishery for *Octopus vulgaris* stocks, the units of effort should account for the number of traps or pots per vessel. Effort data for this fishery are currently inadequate, but improvements are expected when the "Monitoring Programme for Small Scale Fisheries" component of the DCF is implemented. To provide context for the assessments, the Group will also need information about temporal and spatial distributions of the relevant fishing fleets and research survey catches, as well as complete information about fleet characteristics.

We also recommend a comparison of trends in maturity and length composition data by cohort, from research surveys versus the fishery, in order to assess trends in recruitment and length at 50% maturity (L50). It is recognized, however, that any resulting trends in L50 may not be easily attributed to fishery effects because growth and maturation rates vary inter-annually as well as seasonally and are generally dependent on environmental conditions (Moreno *et al*., 2005, 2007; Lefkaditou *et al*., 2007, 2008).

In conclusion, we recommend that the necessary data be made available to the Group prior to the 2011 meeting. This will allow the Group to review the available information, define assessment units, and where possible, undertake preliminary assessment analyses.

5 In response to ToR d)

ToR d) Provide an overview of the outcomes of the current fishery (and survey) data collection programmes for cephalopods, with particular attention to (i) the success of the métier-based approach in relation to the previous fishery data collection system, (ii) utility of data currently collected for assessment purposes, and (iii) recommendations for improvements in the DCR and for any additional evaluation of the DCR that is thought to be needed

In 2008, the European Council established the Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy (Council Regulation (EC) No 199/2008). This new framework takes into consideration the most recent developments in fisheries management, such as the fleet-based approach and the ecosystem approach, and also is based on the experience gained during the implementation of the previous data collection regulation (Council Regulation (EC) 1543/2000), in place since 2001. It also aims to provide support for scientific advice.

The major elements of the new Data Collection Framework (Council Reg. 199/2008, Commission Regulation 665/2008, Commission Decision 2008/949/EC), establish one Community Programme, instead of a Minimum and Extended Programme, and the programmes are multi-annual instead of annual (Council Reg. 199/2008; Article 3). Data quality aspects and improved data access are clearly emphasised (Commission

Regulation 199/2008, Article 1). The regional approach for data collection is implemented by defining the geographic regions (Baltic Sea, North Sea & East Arctic etc.; Article 1), and the corresponding Regional Co-ordination Meetings (RCMs; Article 4).

Under this new framework, in 2009, the Group identified a great opportunity for sampling cephalopods in countries where, in the worst of the cases, the species are frequent in catches but may not economically important overall. Cephalopods now tend to occur in many fishing trips in which all species will be completely sampled. Thus, cephalopods (which belong to species Group 2 (G2), see Appendix VII of the DCR) should now be sampled in the same way as other internationally regulated species and the major non-internationally regulated by-catch species.

The Group reviewed Member States National Plans in which cephalopods appear in metier definitions, e.g. as part of the targeted assemblage of species. National Sampling Plans were available from the Commission Decision 2008/949/EC. After this, the biological variables to be collected (by species/stocks) were also reviewed.

5.1 Review of Member State (MS) National Plans

5.1.1 DCF: Landings data collection

In the ICES area, only Spain, France, Portugal, United Kingdom and Estonia have defined metiers in which cephalopods are part of the targeted assemblage of species. The only countries identifying metiers targeting cephalopods are Spain and Portugal (Table 5.1). This lack of dedicated cephalopod metiers is because cephalopods are mainly a by-catch of the most important European fleets. Thus, they may be part of mixed catches, and could be included in metiers defined as targeting assemblages of demersal species or even molluscs. Further details of data collection in Spain appear in Working Document 6 (Fisheries and Biological Information on Cephalopods Obtained through the Spanish National Sampling Programme within the Framework of the EU Data Collection Regulation), which is attached as Annex 10.

Regarding the biological parameters, sampling is stock-based (G2), but in the case of cephalopods, species- and area (unit)-based. An overview of the planned number of individuals sampled by country, sea area and species is presented in Table 5.2. The minimum number of individuals to achieve the precision level established is also presented, and the time stratification for sampling. However, G2 sampling can be highly limited in relation to time available, which is often too low. This problem is aggravated when species belonging to Groups 1 & 2 are divided into several categories, resulting in a time-consuming sampling operation to cover all categories. This problem was already identified by the Workshop on Implementation Studies on Concurrent Length Sampling (WKISCON) as one of the common problems with the current sampling strategy (ICES CM 2008/ACOM:31). Table 5.3 presents sampling intensity for the Stock variables.

In the Mediterranean Sea, Greece, Italy, Spain, France are the countries involved in sampling cephalopod species and collecting biological parameters. Detailed tables on the level of sampling, periodicity, species, and biological parameters are given in Commission Regulation 199/2008. All cephalopod species to be sampled under DCF are included under the G2 group, and mantle length, weight, sex and maturity are included in the population–related variables that should be collected. It should be noted that species of group G2 are not required to be sampled during every sampling event. However the number of individuals measured must ensure quality and accuracy of resultant length frequency for the sampled species. The main difficulties found in carrying out the concurrent sampling are the same for these countries as for those sampling in the ICES area (ICES CM 2008/ACOM:31). At the time of the group meeting (March 2010), Greece had not yet commenced the 2009/2010 sampling programme.

5.1.2 DCF: Discard data collection

The discard sampling of metiers is based on the same system as landings. In any case, where discards of a given metier are estimated to exceed 10 % of the total volume of catches and this metier is not picked up by the ranking system, the metier must be sampled. The sampling unit is the fishing trip and the number of fishing trips to be sampled should ensure good coverage of the metier. Discards will be monitored for all species Groups defined in the Regulation to estimate the quarterly average weight of discards.

5.1.3 DCF: Survey data collection

Under the DCF, it is expected that Member States will guarantee, within their national programmes, continuity with previous survey designs. However, modification in the survey effort or sampling design can be proposed provided that this does not negatively affect the quality of the results.

No updated information is available in relation to surveys continuously or occasionally including data collection on cephalopods (e.g. German Northern Irish or Scottish surveys). Also, no information is available in relation to an English survey that involved sampling of cephalopods in 2009.

For the Mediterranean Sea, no updated information on continuing sampling of cephalopods on research cruises (e.g. Greece) is available.

Table 5.1. Metiers to be sampled in which cephalopods are considered as part of the target assemblage of species (absolute numbers could be preliminary).

MS	Year	ICES Fishing ground	Gear LVL4	Target Assemblage LVL5	Metier LVL6	Sampling scheme	Total no. of trips	Planned number of trips	Planned no. trips discards	Planned no. trips landings	Time strat	Recording of parameters conform to ecosystem indicator requirements
ESP	2009	VIIIabde	OTB	Mixed cephalopods and demersal fish	OTB_MCF_55-70_0_0	3		8	3	5	Q	Y
ESP	2010	VIIIabde	OTB	Mixed cephalopods and demersal fish	OTB_MCF_55-70_0_0	3		8	3	5	Q	Y
PRT	2009	X	LHM	Cephalopods	LHM_CEP_0_0_0	1	23076	470		470	M	NA
PRT	2010	X	LHM	Cephalopods	LHM_CEP_0_0_0	1	23076	470		470	M	NA

**** Sampling scheme: Concurrent-at-the-market and concurrent-at-sea**

***Sampling scheme: Concurrent-at-the-market**

Table 5.2. Planned sampling intensity by stock for 2009–2010 (absolute numbers could be preliminary).

MS	Year	Region	Fishing ground	*Species*	Species Group	Required Precision target (CV)	No. of fish necessary to achieve the precision target	Planned minimum No. of fish to be measured at the regional level	Planned minimum No. of fish to be measured at a national level	Time stratification
ESP	2009	Atlantico Norte (ICES)	VIIIc IXa	*Loligo vulgaris*	2	13%	-	-	800	Q
ESP	2010	Atlantico Norte (ICES)	VIIIc IXa	*Loligo vulgaris*	2	13%	-	-	800	Q
ESP	2009	Atlantico Norte (ICES)	VIIIc IXa	*Octopus vulgaris*	2	13%	-	-	2500	Q
ESP	2010	Atlantico Norte (ICES)	VIIIc IXa	*Octopus vulgaris*	2	13%	-	-	2500	Q
ESP	2009	Atlantico Norte (ICES)	VIIIc IXa	*Sepia officinalis*	2	13%	-	-	600	Q
ESP	2010	Atlantico Norte (ICES)	VIIIc IXa	*Sepia officinalis*	2	13%	-	-	600	Q
UK	2009	North East Atlantic	all areas	*Sepia officinalis*	2	-	-	-	1200	Q
FRA	2009	North East Atlantic and Western Channel	All areas	*Sepia officinalis*	2	13%	-	-	500	Y
FRA	2010	North East Atlantic and Western Channel	All areas	*Sepia officinalis*	2	13%	-	-	500	Y

Table 5.2 continued

MS	Year	Region	Fishing ground	Species	Species Group	Required Precision target (CV)	No. of fish necessary to achieve the precision target	Planned minimum No. of fish to be measured at the regional level	Planned minimum No. of fish to be measured at a national level	Time stratification
PRT	2009	North Atlantic and NAFO	IXa	*Loligo vulgaris*	2	20%	4500	4500	4500	Q
PRT	2010	North Atlantic and NAFO	IXa	*Loligo vulgaris*	2	20%	4500	4500	4500	Q
PRT	2009	North Atlantic and NAFO	IXa	*Octopus vulgaris*	2	20%	19000	19000	19000	Q
PRT	2010	North Atlantic and NAFO	IXa	*Octopus vulgaris*	2	20%	19000	19000	19000	Q
PRT	2009	North Atlantic and NAFO	IXa	*Sepia Officinalis*	2	20%	1500	(b)	1500	Q
PRT	2010	North Atlantic and NAFO	IXa	*Sepia Officinalis*	2	20%	1500	(b)	1500	Q
PRT	2009	North Atlantic	X	*Octopus vulgaris*	2	12,5%			600	M
PRT	2010	North Atlantic	X	*Octopus vulgaris*	2	12,5%			600	M

(b) to be planned minimum number of fish to be measured at the regional level (RCMs)

M: Monthly; Q: Quarterly; Y: Yearly

Table 5.3. Planned sampling intensity of the stock variables for 2009–2010 (absolute numbers could be preliminary).

MS	Year	Species	Species Group	Stock	Required precision target (CV)	Minimum required for age at national level	No of fish necessary to achieve the precision target	Planned minimum No of fish to be measured at the regional level	Planned minimum No of fish to be measured at a national level	No of individuals planned for Weight	No of individuals planned for Sex-ratio	No of individuals planned for maturity	Internat. guidelines	No of individuals conforms to ecosystem indicator 4 requirement	No of individuals planned for fecundity
ESP	2010	*Loligo vulgaris*	2	VIIIc, IXa	2.5%	NR	-	-	NA	600	1000	600	NA	Y	NR
ESP	2010	*Octopus vulgaris*	2	VIIIc, IXa	2.5%	NR	-	-	NA	400	500	500	NA	Y	NR
UK	2010	*Sepia officinalis*	2	all areas	12.5%	NA	-	-	-	-	250	250	N	Y	NA
FR	2009	*Sepia officinalis*	2	all areas	12.5%	Not applicable									NA
PRT	2009	*Loligo vulgaris*	2	IX a	20%	NR	-	-	4500	1000	1000	1000	Y	(a)	NA
PRT	2009	*Octopus vulgaris*	2	IX a	20%	NR	-	-	19000	1500	1500	1500	Y	(a)	NA

Table 5.3. continued

MS	Year	Species	Species Group	Stock	Required precision target (CV)	Minimum required for age at national level	No of fish necessary to achieve the precision target	Planned minimum No of fish to be measured at the regional level	Planned minimum No of fish to be measured at a national level	No of individuals planned for Weight	No of individuals planned for Sex-ratio	No of individuals planned for maturity	Internat. guidelines	No of individuals conforms to ecosystem indicator 4 requirement	No of individuals planned for fecundity
PRT	2009	*Sepia Officinalis*	2	IX a	20%	-	-	(b)	1500	600	600	600	-	(a)	NA
PRT	2009	*Octopus vulgaris*	2	X	12.5%	-	-	-	-	50	50	50	N	NA	NA

(a) This is possible; (b) not yet determined; NR = Not required; NA = Not available

5.2 Requesting cephalopod data from Member States

Once the review of likely cephalopod sampling programmes was available, the Group made a formal request for data to the National Correspondents of Member States. The Group asked for 2009 cephalopod data in order to assess the success of this new data sampling approach.

5.2.1 Success of the métier-based approach in relation to the previous fishery data collection system

The Group was unable to assess the success of the metier-based approach in comparison to the previous data collection system as no data were delivered by countries involved in the cephalopod sampling. Reasons were diverse but included:

a) 2009 was the first year of the full implementation of the DCF metier-based sampling. Most countries had already identified problems with carrying out the sampling (WKISCON, 2008). Some of these problems are expected to have remained unresolved during 2009. Thus, interpretation and implementation of the metier-based sampling should be given time to settle down.

b) The early timing of the 2010 Working Group meeting, at the beginning of the year, also contributes to the lack of data delivered to the Group, even preliminary data.

c) Many Group members are not affiliated with national fishery institutes and therefore have no direct access to national data. Therefore the only routes available to obtain the data are via National Correspondents of Member States or ICES.

5.2.2 Utility of data currently collected for assessment purposes

In general, the Group reaffirms the recommendations given last year until a complete assessment of cephalopod sampling can be carried out.

The Group expressed concern that sampling rates defined in the DCF for cephalopods were too low to permit use of the data for assessment purposes, even if the “simplest” assessment methods (in relation to data requirements) could be chosen (e.g. Depletion and Production models).

This concern is related to the life history of cephalopod species. Given the short life cycles of most of these species (1 or 2 years), it is necessary to monitor biological variables regularly, ideally every week or month. Quarterly sampling is insufficient for cephalopod assessment and management. Even length composition sampling should be carried out on a more regular time basis in those metiers in which cephalopods are considered as G2 species. Sampling should be based on the seasonality of the landings and discards with a concentration of sampling during times when cephalopod catches are highest.

Species identification (i.e. unsorted landings) is a drawback still existing both in the official statistics and the National Sampling Programs, despite the fact that the Regulation is clear in relation to carrying out additional biological sampling programs to estimate the share of various species. Members of the Group are working on simple identification guides to be used onboard fishing vessels, surveys, and at the main sampling ports.

In relation to fisheries data, estimates of commercial abundance indices should be computed (i.e. CPUE) in order to estimate time series trends. Of great importance is, in these cases, effort measurements which are collected under DCF. Thus, it is recommended that effort units should be adequate for the gear type exploiting the diverse cephalopod species. Thus, trawl fishing effort should be measured in terms of time fished while for trap/pot fisheries, the units of effort should account for the number of traps or pots per vessel.

In the case of survey data collected under DCF, relative biomass indices can be used, but swept area biomass estimates (using bottom trawl gear) are preferable.

5.2.3 Recommendations for improvements in the DCR (now, DCF) and for any additional evaluation of the DCR that is thought to be needed

The ICES Cephalopod Working Group, as one of the data end-users of the DCF, is in the position to provide feedback on data collection issues. Although neither assessments and nor benchmark workshops on cephalopods (where data used in assessment are evaluated and agreed) are currently carried out, preliminary assessment analyses are planned for the 2011 WGCEPH meeting (refer to ToR c for details).

The collection of adequate cephalopod data under DCF exemplifies the primary aim of the DCF: to provide support for scientific advice on valuable and important stocks/species. Assessments of cephalopods are important because, besides sustaining commercial fisheries of high economic value (i.e. *Sepia officinalis and Octopus vulgaris*) and supporting commercial fisheries with high socio-economic importance (i.e. *Loligo vulgaris*), cephalopods play an important trophic dynamics role in the ecosystem.

Based on all of the above facts, the Group recommends:

- Increases in the level of cephalopod sampling in metiers where these are highly valuable based on the short life cycle of cephalopods. Thus, sampling of cephalopod species on a quarterly basis is not adequate.
- Make fisheries and survey data available to the Group prior to the next WGCEPH meeting in 2011
- Use of the DCF data collected to assess species status to be used as part of the indicators of the state of the marine ecosystem.

6 In response to ToR e)

ToR e) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance

The group completed the relevant document and returned it to Pierre Petitgas during the meeting.

7 In response to ToR f)

ToR f) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health

This ToR was discussed during the meeting. Although the core terms of reference for this group do not currently cover these topics, some of the work presented during the meeting is relevant (see section 9, Other Business, below). The group will work on this during the period leading up to the ASC.

8 Cooperative Research Reports

The first cooperative research report is currently with ICES and all corrections requested to date have been made.

The second CRR, species reviews, remains well short of completion, principally due to the unavailability of several of the main authors during the last year or so. Nevertheless, around half of the original 2005 reviews have been updated.

Work is needed to standardise the formatting and to complete the updating. It is proposed to set up a small steering group (co-chaired by Graham Pierce, Uwe Piatkowski and Patrizia Jereb) organise work on these reviews and a dedicated workshop is suggested to facilitate their completion.

9 Other business

9.1 Presentations of recent and ongoing work

Several group members presented their work during the meeting, including:

- Ruben Rua: Assessment for *Loligo gahi* in the Falklands
- Lisa Hendrickson: Estimation of stock biomass for longfin inshore squid (*Loligo pealeii*) based on bounds for survey bottom trawl catchability
- Marina Santurtun: Overview of the outcomes of the current fishery (and survey) data collection program for cephalopods
- Luis Silva: Fisheries and biological information on cephalopods obtained though the Spanish national sampling program under the framework of the EU-data collection regulation
- Michael Gras: Study on the existence of two life cycles of *Sepia officinalis* in the English Channel
- Noussithé Koueta: Effects of metals on cuttlefish
- Isobel Bloor: Cuttlefish: habitat modelling and GIS
- Uwe Piatkowski: Effects of CO_2 on cephalopod early life stages

9.2 Workshop on Cephalopod Maturity Stages

The group was made aware of the forthcoming Workshop on Cephalopod Maturity Stages, to be held in November 2010 under the auspices of Working Group for Data Collection Regulation in the Mediterranean Sea.

9.3 Cephalopod red listing

Louise Allcock reported by e-mail on the red list assessment process for cephalopods, which is currently considering the Idiosepiidae and requested input from WGCEPH and the wider cephalopod community.

9.4 Marine mammal depredation on squid fisheries

Graham Pierce presented a recent request for advice circulated on the MARAM discussion list by colleagues at IMAR/Department of Oceanography and Fisheries (University of the Azores) about dolphin depredation in the Azores squid fishery.

"Squid fishing is carried out by the artisanal fleet, consisting of open boats from 5 to 9 m in length and equipped only with hand-lines and plastic fish jigs. The fishing takes place in daytime at depths of 160–250 m. The common squid, *Loligo forbesii*, is the only species of squid caught commercially in the Azores. In the last few years fishermen's have been complaining of dolphins stealing squid from the gear. To collect data on these interactions we made inquiries to the fishermen's in several ports and had observers onboard of fishing boats. It is confirmed that this interaction occurs, where dolphins steal squid hanging in the fishing gear, taking the whole body or just the mantle. One of the species that has been mostly sighted interacting in squid fishery is the Risso´s dolphin. This species are responsible for most of the depredation on squid fishery, which occurs very frequently. During fishing these dolphins stay in the fishing area around the boats for hours, approaching the boats and diving close to them to steal the squids from the gear. Dolphins steal the squids mostly when the fisherman is pulling the line, in the bottom and close to surface. We are asking for information on interactions between Risso´s dolphins and squid fishery or other information about depredation behaviour observed on Risso´s dolphins. We also ask for your knowledge or advice on mitigation measures that can be used in this type of fishery."

While WGCEPH is able to offer no specific adv in this instance, the issue of marine mammal depredation on cephalopod fisheries is worthy of further discussion in future WGCEPH meetings.

9.5 Future ICES ASC theme sessions

It is unlikely that WGCEPH will propose a theme session for 2011 or 2012 as the next Cephalopod International Advisory Council conference will be held in 2012.

9.6 WGCEPH meeting in 2011

Two venues were discussed for the next meeting, namely Lisbon and Woods Hole. Given the importance attached to progressing the assessment work (led by Lisa Hendrickson this year) there are advantages to Woods Hole. However, Lisbon remains the less expensive option.

9.7 Chair of WGCEPH

The current WGCEPH chair plans to step down following the 2010 WGCEPH meeting and the group unanimously agreed to recommend that the new chair should be Marina Santurtún from AZTI, a recommendation supported by AZTI.

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Annex 2: Agenda

AZTI, Sukarrieta, Spain, 9–11 March 2010

DAY 1

Opening of meetings and adoption of agenda

Introduction, planning, discussion and presentations/working papers related to each term of reference

- Tor a (landings)
- Tor b (research)
- Tor c (assessment)
- Tor d (dcr)
- Tor e (ICES Science Plan)
- Tor f (ICES SSGEF)

Co-operative Research Reports (in press and forthcoming reports)

Breakout groups, working on ToRs a and b

DAY 2

Research of cephalopod ecophysiology: effects of contaminants on early life stages (Noussithé Koueta, University of Caen)

Progress updates on ToRs a and b

Breakout groups, working on ToRs a, b, c, d

Research on cuttlefish spawning areas (Isobel Bloor, University of Plymouth)

Research on effects of ocean acidification on cephalopod early life stages (Uwe Piatkowski, University of Kiel)

Pictorial guide to North Sea cephalopods (Uwe Piatkowski, University of Kiel)

Breakout groups, working on ToRs a, b, c, d

Co-operative research report

DAY 3

Summary and discussion of terms of reference

- Tor a (landings)
- Tor b (research)
- Tor c (assessment)
- Tor d (dcr)
- Tor e (ICES Science Plan)
- Tor f (ICES SSGEF)
- Co-operative Research Reports

Any other business

- Workshop on cephalopod maturity stages
- Red listing for cephalopods
- Azores squid fisheries: depredation by cetaceans

- *Loligo forbesii* distribution shifts
- Future themes sessions

Discussion of Recommendations

Next meeting and Chair for WGCEPH

Breakout groups, completing text on ToRs a, b, c, d

Annex 3: WGCEPH Terms of Reference for the next meeting

The **Working Group on Cephalopod Fisheries and Life History (WGCEPH)**, chaired by Marina Santurtun, Spain, will meet at IPIMAR, Lisbon, Portugal, DATE [to be determined] to:

a) Update relevant fishery statistics (landings, directed effort, discards, survey catches, etc) across the ICES area, and report on status and trends;

b) Review and report on innovative cephalopod research results in the ICES area, with particular emphasis on trophic interactions of cephalopods, their role in marine ecosystems, and marine mammal depredation on cephalopod fisheries;

c) To conduct preliminary assessments of the main cephalopod species in the ICES area through examination of trends in relative exploitation rates (i.e., catch/survey biomass), by seasonal cohort;

d) Provide an overview of the outcomes of the current fishery (and survey) data collection programmes for cephalopods, with particular attention to (i) the success of the métier-based approach in relation to the previous fishery data collection system, (ii) utility of data currently collected for assessment purposes, and (iii) recommendations for improvements in the DCR and for any additional evaluation of the DCR that is thought to be needed;

e) Review the status of the ongoing compilation of a Co-operative Research report comprising species reviews of the main European fished cephalopods and make arrangements for this to be finalised.

WGCEPH will report by DATE to the attention of XXXXX Committee.

Supporting Information

Priority	Cephalopods are important components of marine ecosystems but European cephalopod fisheries remain outside CFP quota controls. However, directed cephalopod fisheries, especially small-scale fisheries, are increasingly important and it is necessary to have in place a system of data collection and stock evaluation that is adequate to support management.
Scientific justification	Specific comments on the Terms of Reference are: ToR a) Monitoring of fishery trends remains basic to the work of the Group and to ensure that these fisheries remain sustainable. In the last few years submission of new fishery data to the WG by national fisheries laboratories has at best been patchy and the WG has relied on data supplied via ICES itself. The specific inclusion of survey data in the proposed ToR for 2010 is to provide a basis for simple assessments (see ToR c). ToR b) There is an increasing need to integrate non-traditional resources species and top predators into ecosystem models which can be used to evalauate fishery management scenarios. It is therefore timely to review current knowledge on trophic interactions on cephalopods and their ecological role. There has been reent interest in marine mammal depredation on cephalopod fisheries, focused on the jigging fishery in the Azores. ToR c) Given the need to promote sustainable cephalopod fisheries, the likely importance of cephalopods as indicators of climate change, and importance as predator and prey species in marine ecosystems, it is necessary to conduct stock assessments of ICES cephalopod species. Therefore, WGCEPH has prepared a plan to conduct preliminary assessments for ICES cephalopod species for which the necessary data are available. It should be made clear that

	comletion of this ToR is contingent on data availability and, in particular, available data being provided to the Working Group. ToR d) The revision of the national fishery data collection (DCR) programme for 2009 offers the prospect for improved data collection on cephalopods. However, there is a need to evaluate its effectiveness for this group as well as to examine the current status of survey data collection on cephalopods. It is important to determine whether the new DCR is delivering the information that is/would be needed to assess cephalopod stocks, and to identify any shortcomings. This is a non-trivial task and may well not be achievable by WGCEPH alone, given the resources available. As in 2009, the group therefore suggests that such an evaluation could be made the subject of a DG fisheries tender (and recommends that ICES takes this suggestion forward), in which case WGCEPH could participate in reviewing the outcomes of the work thus supported. As with the previous ToR, successful completion is contingent on availability of data. ToR e) has been added to reflect the fact that a previously planned Cooperative Research Report on cephalopod species reviews remains to be delivered and WGCEPH can assist in itsproduction.
Resource requirements	As noted in the 2009 report and previously, participation in WGCEPH is limited by availability of funding, especially as many members and potential members are university staff with no access to “national funds” for attendance at ICES meetings. One suggested solution was to propose this Group for addition to a list of groups eligible to be funded by the European Commission.
Participants	The Group is normally attended by around 15 members and guests, although with a strong bias towards participants from the Iberian peninsula. The number of attendees from Europe is likely to be reduced if the meeting is held in the USA although thee would otherwise be benefits from doing so.
Secretariat facilities	None
Financial	
Linkages to advisory committees	Provision of information to SciCom and its satellite committees as required to respond to requests for advice/information from NEAFC and EC DG Fish.
Linkages to other committees or groups	None
Linkages to other organizations	None

Annex 4: Recommendations

RECOMMENDATION	FOR FOLLOW UP BY:
1. WGCEPH should have access to up-to-date data on cephalopod landings, directed effort, discards, and survey catch data, in order to complete its ToRs. Such data have generally not been available to the group in the last few years. While most landings data do ultimately become available in the ICES database, it is of lesser interest to evaluate the state of the fisheries 3-4 years previously. In addition, cephalopod survey catch data are poorly reprsented in the ICES IBTS database, even in cases where national fisheries labs collect the data.	ICES, the ICES Data Centre, national fisheries laboratories
2. Routine collection of cephalopod length–frequency data, by species, during research bottom trawl surveys (e.g. IBTS) is requested, in addition to provision of these data to the WGCEPH prior to the next meeting	ICES, national delegates, relevant EGs
3. In relation to the DCR, WGCEPH recommends that for major cephalopod stocks in which assessment and management are likely to be necessary in the near future (e.g. English Channel cuttlefish), data collection under the DCR should be modified to reflect the additional data requirements imposed by the short life cycles. We recommend: (a) Increases in the level of cephalopod sampling in metiers where these are highly valuable, based on the short life cycle of cephalopods. Thus, sampling of cephalopod species on a quarterly basis is not adequate. (b) Focus of the more intensive sampling (i.e. weekly or monthly) during periods of higher catches in order to ensure adequate characterizations of the length compositions of the multiple microcohorts that are often present, while avoiding unproductive sampling effort at times of low abundance. (c) Collection of maturity data for the most important cephalopod fisheries, to facilitate comparison of trends in maturity and length composition data by cohort, from research surveys versus the fishery, in order to assess trends in recruitment and length at 50% maturity (L50).	ICES, EU, National Correspondents

Annex 5: Working document 1. Spanish Cephalopod Landings Data of the Fishing Fleet Operating in ICES Area for 2000–2009 Period.

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Spanish cephalopod landings data on a annual basis were collected both by the *Instituto Español de Oceanografía's* (IEO) Sampling and Information Network, for catches from the ICES sub-areas VIIIabd, VIIIc and IXa, and by the *AZTI* Fundation, for catches from sub-areas VIab, VIIb-k and those catches from the VIIIc-East landed in the Euzkadi ports.

Table 1 shows the Spanish cephalopod annual landings (in tons) by species group (Octopodidae, Loliginidae, Ommastrephidae and Sepiidae) and for the total annual for the 2000–2009 period. The 2007 landings have been updated in relation to the information reported last year. Landings data in 2009 should be considered as highly provisional because of gaps of information still present in some subdivisions. For this reason, the 2009 landings will not be considered in further analysis of trends henceforth presented.

Table 1. Spanish Cephalopod annual landings (in tons) caught in the ICES Area by species group and total annual during the 2000–2009 period.

Year	Loliginidae	Octopodidae	Ommastrephidae	Sepioidea	Total
2000	675,6	4095,3	2017,1	1636,8	8424,8
2001	1052,2	3895,8	1305,2	1129,4	7382,6
2002	957,8	5150,0	1717,5	1133,3	8958,6
2003	917,4	4888,4	1164,5	1286,1	8256,4
2004	979,6	4881,9	1470,8	1394,0	8726,3
2005	880,3	6039,8	1949,9	1635,3	10505,3
2006	440,6	5237,5	1018,2	1456,0	8152,4
2007	691,5	4699,1	801,5	1631,0	7823,1
2008	765,4	4919,6	1636,2	1412,4	8733,6
2009(*)	496,4	2420,5	540,7	1061,4	4519,0

(*): highly provisional data

Figure 1 shows the trend of total annual landings through the analyzed time period (2000–2009). Total landings were around 8200 tons, with a minimum of 7383 t in 2001 and a maximum of 10505 tons in 2005. The highest landings correspond to the Octopodidae group which accounted for 57% of the averaged landings for the analyzed period, followed by Ommastrephidae (17%), Sepioidea (16.5%) and Loliginidae (9.5%).

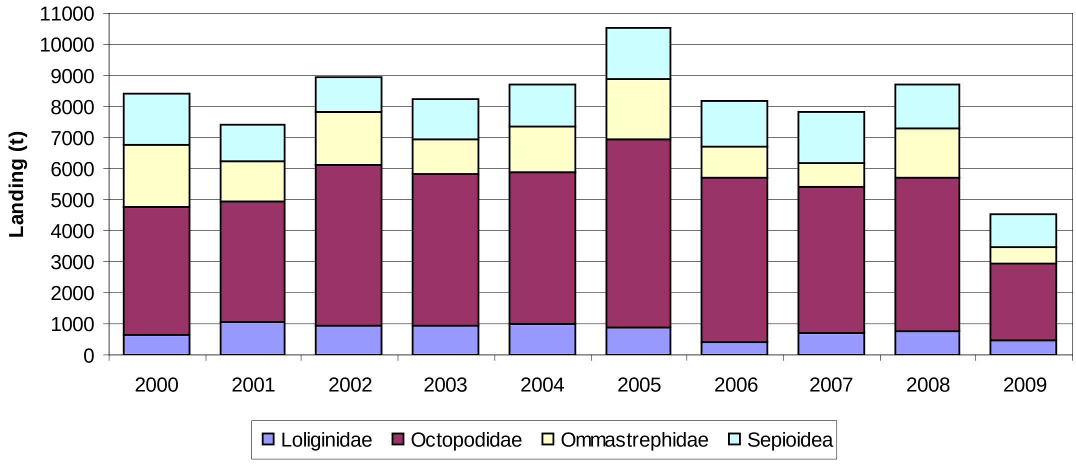
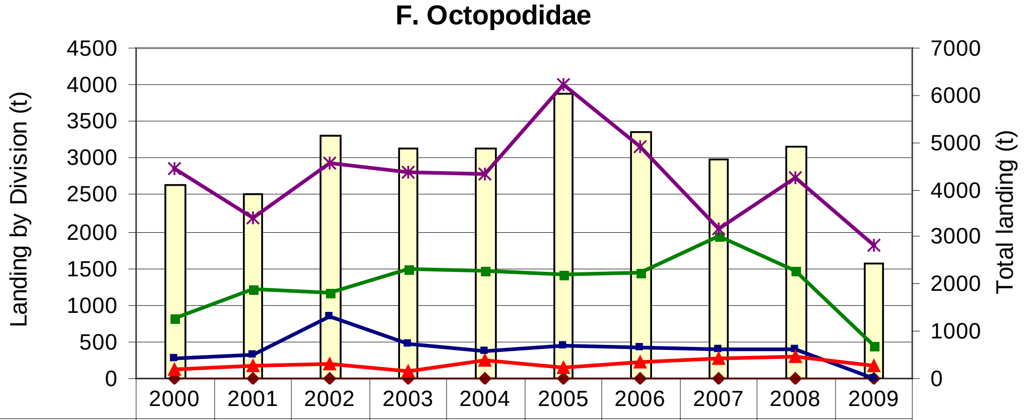


Figure 1. Spanish cephalopod annual landings (in tons) caught in the ICES area by species group during the 2000–2009 period.

Commercial landings of octopods (Fam. Octopodidae) comprise common octopus *Octopus vulgaris* and horned octopus *Eledone cirrhosa*, plus musky octopus *Eledone moschata* in Division IXa-South. Figure 2 shows the trend of total octopods landings and by Subarea/Division. Total annual catch ranged between 6039 t in 2005 and 3895 t in 2001. Since 2000, landings increased to 2005 and then decreased to remain stable in 2007-2008 at around 4700 t. More than 87% of octopods were caught along the Spanish coast (Divisions IXa and VIIIc), where common octopus *O. vulgaris*, mainly caught by the artisanal fleet using traps, comprises more than 60% of octopod landings. However, this species is caught by the bottom trawler fleet in the Subdivision IXa-South, Gulf of Cadiz, reporting around the 70% of total catch. Subdivision IXa-South contributes to the total landings from the Division with variable percentages that ranged between 20 % (572 t) in 2004 and 73% (2941 t) in 2005. Possibly, such oscillations are related with environmental changes (Sobrino *et al*., 2002)

Most of the horned octopus is caught by the trawler fleet, and represents the major part of the octopod landings in Subarea VII (about 400 t) and Subdivisions VIIIa,b,d (200 t). Horned octopus landings in Divisions IXa and VIIIc account mainly for 5% of total landings of octopods. They are not caught in Subarea VI.

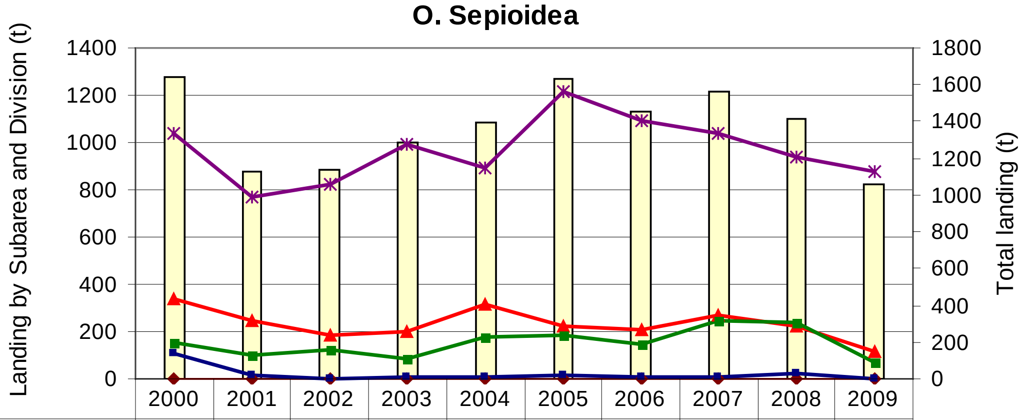


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	4095,3	3895,8	5150,0	4888,4	4881,9	6039,8	5237,5	4642,6	4919,6	2420,5
VI	0	0	0	0	0	0	0	0	0	0
VII	285,6	326,1	851,4	474,5	371,1	448,8	424,9	400,3	398,9	0,2
VIIIabd	130,5	181,9	196,9	111,5	257,0	160,5	216,0	282,3	308,4	163,8
VIIIc	824,9	1209,2	1165,3	1498,0	1466,5	1420,6	1432,9	1932,7	1475,6	447,4
IXa	2854,3	2178,6	2936,5	2804,4	2787,3	4009,9	3163,8	2027,3	2736,7	1809,1

Figure 2. Spanish landings (in tons) of octopus species (Fam. Octopodidae) by ICES Subarea/Division during the 2000–2009 period.

Cuttlefish (O. Sepioidea) landings mainly comprise common cuttlefish *Sepia officinalis*, also elegant cuttlefish *Sepia elegans* and pink cuttlefish *Sepia orbignyana* for Subarea VII and Divisions VIIIabd. Bobtail squid *Sepiola* spp. is not identified in landings. Only *Sepia officinalis* and *Sepia elegans* are presented in landings from Divisions IXa and VIIIc-West. Data on the proportion of each species are available only for Division IXa-South, where *Sepia officinalis* makes up about 93% of cuttlefish landed.

Figure 3 shows the trend of total cuttlefish annual landings and by Subarea/Division. Total catch ranged between 1636 t in 2000 and 1129 t in 2001. Since 2001, landings increased to 2005 where it is reached a new maximum value similar to 2000. After that, landings decreased slightly, oscillating between 1450 t and 1550 t. Division IXa contributed with 70% of total cuttlefish landings, corresponding to the Subdivision IXa-South (Gulf of Cadiz) the 70% of total landings in the Division IXa. Landings in Division VIIIc increased at the end of analysed period, reaching 245 t, whereas in Division VIIIabd they showed more or less constant, around 220 t in average. In Subarea VII landings were below 20 t, except in 2000 with 110 t, and almost absent in the Subarea VI.

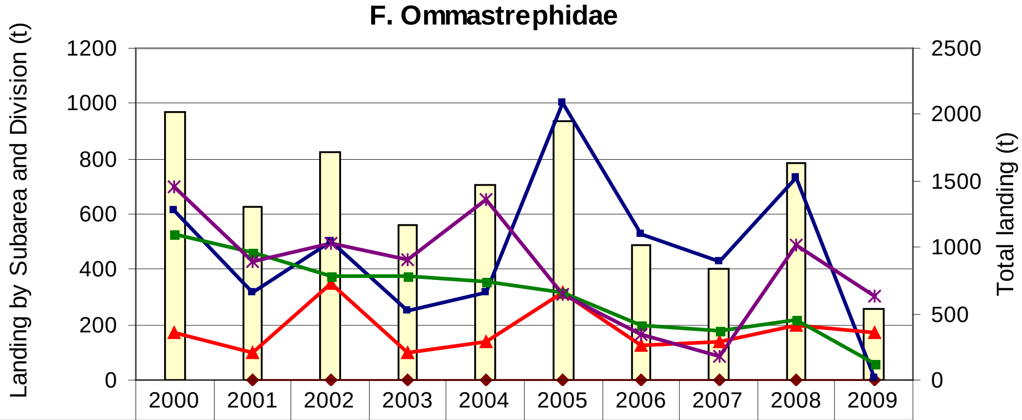


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	1636,8	1129,4	1133,3	1286,1	1394,0	1635,3	1456,0	1563,1	1412,4	1061,4
VI	0	0	0,5	0	0	0	0	0	0	0
VII	110,3	17,5	3,0	6,1	10,9	12,4	9,1	9,1	19,4	0
VIIIabd	335,6	247,5	187,0	200,5	317,6	225,9	207,7	272,2	220,6	112,7
VIIIc	153,6	99,0	122,6	87,6	176,0	181,9	149,2	245,9	237,1	72,7
IXa	1037,3	765,4	820,2	992,0	889,4	1215,2	1089,9	1035,9	935,3	876

Figure 3. Spanish landings (in tons) of cuttlefish species (O. Sepioidea) by ICES Subarea/Division during the 2000–2009 period.

Short-finned squid landings (Fam. Ommastrephidae) comprise mainly broad-tail short-finned squid *Illex coindetii* and lesser flying squid *Todaropsis eblanae*. European flying squid *Todarodes sagitattus* also appears in catches, but it is very scarce. Figure 4 illustrates the trends of both total landings of short-finned squids and by Subarea/Division. Total landings presented two maxima values in 2000 and 2005 with 2000 t. After, landings dropped quickly reaching a minimum in 2007 with 834 t. In 2008, this value doubled in relation to the previous year.

The analysis by area shows scarce landings in Subarea VI throughout the time series. From 2000 to 2004, the Division IXa contributed with the highest landings, ranging between 700 and 430 t. Since 2004, on the Subarea VII increased the landings, reaching two maxima in 2005 and 2008 with 1000 and 730 tons, respectively. The rest of Divisions showed decreased landings, sharing similar levels below 200 t., with only the División IXa experiencing a significant recovery in 2008.



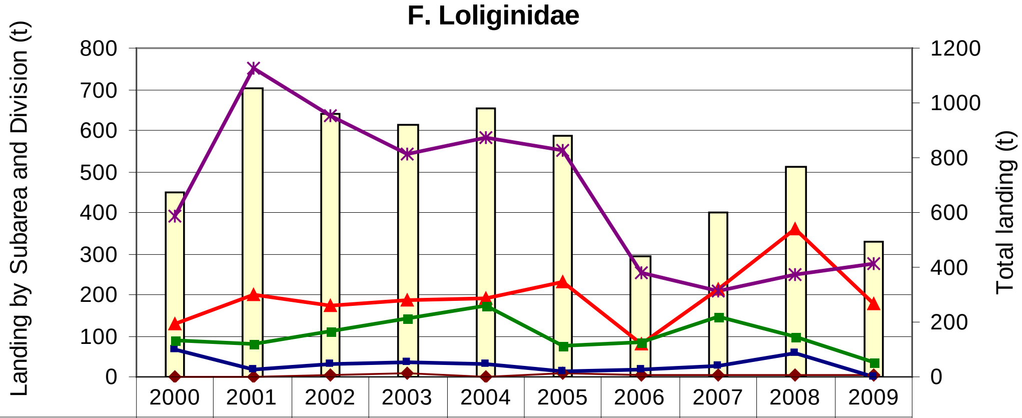
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	2017,1	1305,2	1717,5	1164,5	1470,8	1949,9	1018,2	833,91	1636,2	540,7
VI		0	0	0	0,285	0	0	0,0085	0	0
VII	615,73	313,28	501,27	251,97	319,65	1003,3	528,32	425,7	730,7	4,8
VIIIabd	172,45	101,22	350,59	97,611	135,92	315,33	126,72	141,1	195,6	169,3
VIIIc	529,79	461,57	373,35	376,63	359,15	318,98	199,46	179,7	218,7	60,9
IXa	699,11	429,1	492,32	438,25	655,83	312,24	163,7	87,4	491,2	305,7

Figure 4. Spanish landings (in tons) of short-finned squid species (Fam. Ommastrephidae) by ICES Subarea/Division during the 2000–2009 period.

Long-finned squid landings (F. Loliginidae) consist mainly of common European squid *Loligo vulgaris*. Three other species are present in unknown proportions. Of these, veined squid *Loligo forbesi* is currently thought to be very scarce, with variable presence in landings. Squids of the genus *Alloteuthis* (*Alloteuthis media* and *Alloteuthis subulata*) are present in squid landings from Divisions IXa-South (and are known to occur elsewhere). In this Division the average landings in the time series were 142 t and their commercial importance is high.

Figure 5 shows the trend of total long-finned squid landings and by Subarea/Division. Total landings presented a maximum value in 2001 with 1052 t, then remain more o less stable around 900 t until 2006 when they showed a drop, reaching the minimum value in the time series of 440 t. An increase is observed from this year to 2008 (since 2009 data are provisional).

The analysis by Subarea/Division shows that the Division IXa presents the highest landings from 2001 to 2005, with values ranging between 753 and 552 t, respectively. The 2007 landings fell to 200 t and remained stable in the next year. Division VIIIabd and VIIIc showed values lower than IXa, oscillating between 128 t in 2000 and 360 t in 2006, and between 76 t in 2005 and 145 t in 2007, respectively. Landings in Subarea VII were low compared with other areas, showing an average value of 30 t. The Subarea VI showed scarce landings, below 10 t, like in the other analysed species groups.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	675,6	1052,2	957,8	917,4	979,6	880,3	440,6	597,6	765,4	496,4
VI	0,3	0,8	3,5	9,6	1,6	7,6	2,5	3,2	3,2	2,7
VII	68,4	19,4	32,0	37,0	32,8	14,6	19,4	26,1	57,8	1,5
VIIIabd	128,9	200,6	171,9	185,2	189,5	230,2	78,8	214,0	360,2	177,3
VIIIc	87,7	78,1	113,1	143,6	174,9	76,0	84,8	145,7	97,1	37,6
IXa	390,4	753,3	637,3	542,0	580,8	551,8	255,1	208,6	247,1	277,3

Figure 5. Spanish landings (in tons) of long-finned squid species (Fam. Loliginidae) by ICES Subarea/Division during the 2000–2009 period.

Annex 6: Working document 2. Update of the Basque Cephalopod Fishery in the North-eastern Atlantic Waters during the period 1994–2009.

Ane Iriondo[1], Jon Ruiz, Marina Santurtún,, Lucia Zarauz

Introduction

Up to 2009 AZTI-Tecnalia has continued monitoring cephalopod landings monthly and fishing effort by sea area and gear of the Basque Country. Compilation and updating of the cephalopods catches made by the Spanish and Basque fleets landed at the Basque Country ports is updated every year.

Cephalopod catches are considered as by-catches of other directed demersal fisheries operated by the Basque fleet, targeting hake, anglerfish and megrim. These demersal fisheries operate in different sea areas – ICES Sub-areas VI, VII and Divisions VIIIa,b,d (Bay of Biscay) and VIIIc (eastern Cantabrian Sea)- and different gears: bottom trawl, pair-trawlers, longliners, purse-seiners, nets, artisanal hook and lines and traps or pots. However, cephalopods obtained in mixed fisheries ("Baka" Otter trawls) are becoming more important in relation to the species composition of the catch.

In this document, data of the Basque Country cephalopod landings from 1994 to 2009 are presented. Catch data correspond to groups of similar species comprising more than two or three species, with similar appreciation in the markets. Data available were compiled in the following commercial species groups according to local names:

- Squid: mainly Loligo vulgaris and also, L.forbesi, Alloteuthis media and A.subulata
- Cuttlefish: mainly Sepia officinalis and also S.elegans and S.orbignyana
- Short-finned squid: mainly Illex coindetii and also Todaropsis eblanae, and European flying squid: Todarodes sagitattus,
- Octopus: mainly Eledone cirrhosa and also Octopus vulgaris.

Most of the large trawlers of the Basque Country catch cephalopods mainly in the Bay of Biscay (Div. VIIIa, b, d), but also in Sub-area VII (Celtic Sea and Porcupine Bank) and in Sub-area VI (both in the western part of Scotland and around Rockall Bank). Local trawls, artisanal longliners and some pots or trap vessels work usually in the eastern Cantabrian Sea (Div. VIIIc).

The target species are usually mixed demersal fish, mainly hake, megrim or anglerfish, but together with those, variable quantities of cephalopods are caught. The proportion of these catches varies in relation to the sea area, the gear used and the distinct seasonality of these species.

Landings of cephalopods in Sub-areas VI, VII and Divisions VIIIa,b,d and VIIIc.

During 2009 and in Div. VIIIa,b,d, the largest landings of squids were recorded during December and January and for cuttlefish mainly during the first quarter. Squid landings reached 66 t in January while cuttlefish landings reached a peak of around 46 t in February. Short-finned squid maximum landings occurred in May being around 41 t. Landings of octopus were higher in Div. VIIIa,b,d during November and December reaching around 51 t (Figure 1).

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In Figure 2 percentage of landings by species groups and sea area in 2009 are presented. Landings from Div. VIIIa,b,d comprise 97 % of the total landings for squids and cuttlefish, respectively, 87% for short-finned squid and octopus landings from Div. VIIIa,b,d involve 95 % of the total landings (Figure 2).

For 2009, each of the cephalopod groups contributed evenly to the total cephalopod catches, 22% squids, 35% cuttlefish, 21% short-finned squid and 21% octopus. 83% of total cephalopod landings came from Div. VIIIa,b,d (Figure 3).

Looking at the catch evolution of squid and cuttlefish during the period 1994–2009, the most remarkable feature is the outstanding seasonality of the landings in all areas (Figure 4). The largest landings occur from October to February for all cephalopod species, and also a marked alternancy of years of rather high and low landings is observed mainly in squids. For all data series, no cuttlefish and octopus landings were registered in Sub-area VI. The great fishery *reservoir* for all species groups appears to be the sea area comprises within Div. VIIIa,b,d. Catches evolution of short-finned squid does not present the marked seasonality described for the other species groups, however maxima landings are registered from April till June. Octopus higher landings are registered during autumn and winter months (Figure 4).

Cephalopod historical landings deployed by Basque vessels show an important decreasing trend from 1994 to 1998. From 1999 onwards, the total landings of cephalopods remain quite stable but with inter-annual fluctuations (Figure 5). This landing decrease may be due to a reduction of fishing effort, (Figure 6) or the interactions of other different factors.

Nowadays, the most important Basque fleet targeting cephalopods are "baka" bottom otter trawlers in the division VIIIa,b,d. Within this fleet four different metiers have been defined and the landings of the species have been included in one or other metier following this segmentation: demersal fish, small pelagic, mixed cephalopods and demersal and others. The analysis done in the last five years shows that the percentages of each of the metiers are quite constant in the time series. The metier that shows more fluctuations is the small pelagic metier (Figure 7).

Landings per unit of effort of cephalopods in Sub-areas VI, VII and divisions VIIIa,b,d.

Fleets selected

A total of 6 fleets landing their catches in Ondarroa or Pasajes have been selected. Just the corresponding catches (landings) have been used for each fleet. Data on some other fleets have not been included because their significance in the cephalopod total catches is markedly small compared to those of the "Baka" Otter trawl and Pair Trawls with Very High Vertical Opening (VHVO) nets. The fleets considered are:

- BAKA-trawl-Ondarroa in Div. VIIIa,b,d
- BAKA-trawl-Ondarroa in Sub-area VII
- BAKA-trawl-Ondarroa in Sub-area VI
- VHVO P. Trawl-Ondarroa in Div. VIIIa,b,d
- VHVO P. Trawl-Pasajes in Div. VIIIa,b,d
- VHVO P. Trawl-Pasajes in Sub-area VII

All of them, together considered, represented close to 94% total cephalopod landings in the Basque Country ports in 2008.

It has to be mentioned that from 2005 onwards the VHVO P. Trawl-Pasajes in Sub-area VII fleet disappears and from 2008 onwards VHVO P. Trawl-Pasajes in Div. VIIIa,b,d fleet also disappears. In spite of that, the 6 fleets selected above will be used to show time series trends in CPUE data.

Effort for each fleet was obtained from the information provided yearly by the log books filled out by the skippers of most of vessels landing in Ondarroa and Pasajes, and processed by AZTI. The effort unit used has been the fishing days.

In Tables 1 to 4 the evolution of each of the cephalopod species is presented for the six fleets considered. Landings, fishing effort and LPUE (kg/day) information is presented by fleet from 1994 to 2008.

In Figure 8 the graphical representation of each species LPUE trends by fleet are shown. For squids, all fleet show fluctuations in the abundance indices each year, one year up and the next one down, but for the "baka" bottom trawlers in Div VIIIa,b,d an increasing trend could be observed (apart from a sharp decrease in 2006) from 2001 onwards. For cuttlefish the fleet with higher LPUE is "baka" bottom trawlers in Div VIIIa,b,d with high fluctuations from year to year but with an increasing trend in the analyzed years. For the other fleets no important trend is observed. Octopus maxima LPUE were registered for "Baka" otter trawlers in Sub-area VII in 1995 and after that year a decreasing trend is observed. The highest LPUE data for short-finned squids were shown in 1994 by "baka" otter trawlers in Sub-area VII, and for next years fluctuation is observed in LPUE data for all fleets.

When summing up all cephalopod landings and they are divided by main fleets fishing efforts, the landing per unit of effort are obtained (LPUE) (Figure 9). This figure shows a decreasing trend in LPUE from 1994 till 2000. Then an increasing trend starts with a minimum LPUE value in the times series in 2003 and after that in the last two years the maximum LPUE data of the times series for total cephalopods are obtained.

Discard estimation of cephalopods

Since 2001, a discard sampling program has been carried out by the AZTI- Tecnalia on the Basque fleet (North Spain). Sampling developed during 2001 and 2002 correspond to the Study Contract (98/039). 2003 onwards, AZTI has continued sampling discards onboard commercial fleet under the National Sampling program. Only the trawl fleet is considered in this study, since the rest of the segments of the Basque fleet in the North East Atlantic like purse seine, etc. (Ruiz, *et al*. 2009) have negligible levels of discard.

The sampling strategy and the estimation methodology used in the "Discard Sampling Programme" have been established following the "Workshop on Discard Sampling Methodology and Raising Procedures" guidelines (Anon., 2003). The observers-on-board programme is based on a stratified random sampling, considering the Fishery Unit as stratum and the trip as sampling unit.

The trawl fleet operating in the ICES Sub-area VII and Div. VIIIa,b,d was segmented in the following Fishery Units taken into account fishing area, gear and target species (described in the Report of the EC Study Contract 98/095; Santurtún *et al*., 2003):

- Basque "Baka" bottom trawlers fishing in the ICES Sub-area VI targeting blue ling and witch.
- Basque "Baka" otter trawlers fishing in the ICES Sub-area VII targeting anglerfish and megrim.
- Basque "Baka" otter trawlers fishing in the ICES Div. VIIIa,b,d targeting a great variety of species (mixed fisheries).
- Basque Pair trawls operating with VHVO nets in ICES Div. VIIIa,b,d targeting hake.

Landings and effort are used in the raising procedure; nevertheless, only discard estimates using effort as raising procedure are presented in this document.

Although the sampling tried to cover all species retained and discarded in the different fleets, no length sampling was carried out for all of them. Thus, no length distribution and numbers of all discarded and retained cephalopod species were estimated whilst weights retained and discarded were obtained.

Table 5 presents annual discards sampling level on board for sampled Fishery Units. In Table 6 the amount of estimated cephalopods discarded (kg) during 2003–2009 series is presented.

In general terms, it can be said that:

- Short-finned squid mainly and curled octopus (*Eledone cirrhosa)* in a lesser extent are the most discarded species because of their low price in market.
- The lower discarding percentage was deployed in "baka" otter trawlers operating in Subarea VI and pair trawlers operating in Divisions VIIIabd, this may be because they catch less non target commercial species.
- Data presented in this document has to be considered as very preliminary. Thus, discard data here presented has to be taken just as reflect of the discard practices carried out by these fleets and never as absolute numbers.

Prices of cephalopods in Basque ports

Cephalopod prices in Basque ports from 2001 to 2009 are presented in Figure 10. The price given is the mean value of both landing ports Ondarroa and Pasaia. It can be observed that the mean value has remained quite stable in the last nine years. Squids has the best price of landed cephalopod that goes from 6 euros in 2001 to 7.5 euro in 2009. Cuttlefish is the second better paid which goes from 2.50 euro in 2001 to 3.10 euro in 2009. Octopus hd the peak in price in 2003 but after that it has decrease some years and in 2009 it is around 3.10 euro. Finally the short-finned squid, which is the cephalopod with lower prices in the time series and shows a price of 0.64 euro in 2009.

In general terms, prices of cephalopods hardly have increased in the last nine years. Only in squids is observed a slight increase.

Conclusions and further work

Cephalopod historical landings decreasing trend from 1994 to 2009 should be more in detail analyzed. A study should be desirable to actually define if changes in landings are due to changes in fisheries/metiers (fishing strategies due to market reasons), real decrease in fishing capacity or a real decrease in the abundance of these species. The comparison of the historical landings of cephalopods and LPUE data shows that LPUE data do not present the same decreasing trend as landing data. Therefore, one conclusion could be that despite the landings decrease, the abundance indices (LPUE data) of the fleets analyzed do not show this decreasing trend in the abundance of cephalopods.

Studies on discards practices could support evidences to some of the possible scenarios described above. First discard studies deployed in AZTI started in 2000 under Study Contract (98/039) partly financed by the EU and the Basque Government. AZTI continues sampling discards on board commercial fleets under the National Sampling Programs since 2002. A more detail study on discard practices deployed by fisheries targeting cephalopod is still to be accomplished.

The contribution of the different cephalopods species groups to the total landing composition has been updated from 2005 to 2009. From previous studies, cephalopod proportion in the landings markedly increased from around 8 % in 1997 to almost twice in 2001 in “Baka” otter trawls operating in Div. VIIIa,b,d (Santurtun *et al.*, 2005, WD). In the last studied five years, the cephalopod proportion in landings is around 15% with a peak of 28% in year 2007.

The analysis of prices shows that in the last nine years there has been hardly increase in prices of cephalopods. The squids remains being the cephalopod with highest price and the short-finned squid is the one with lowest price.

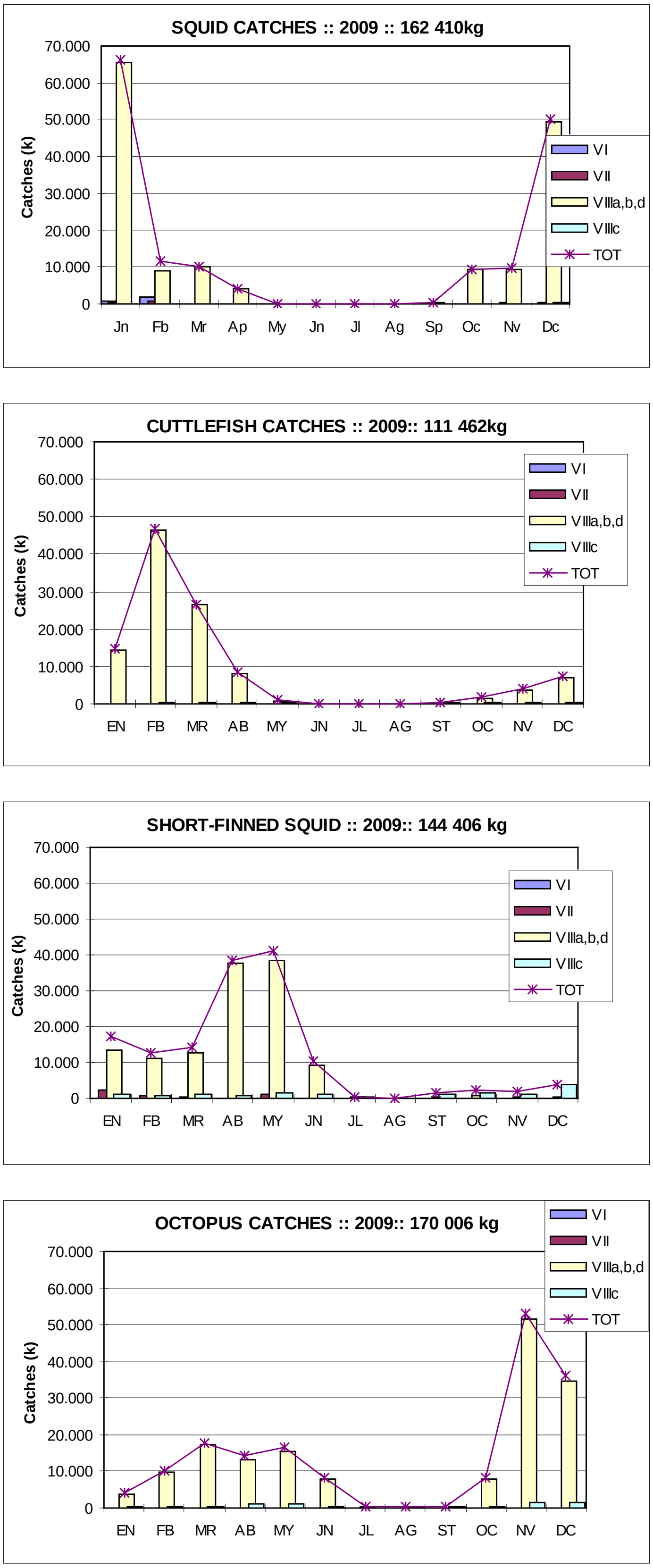
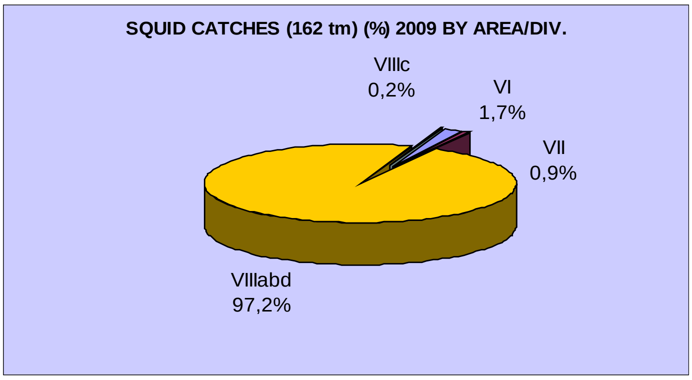
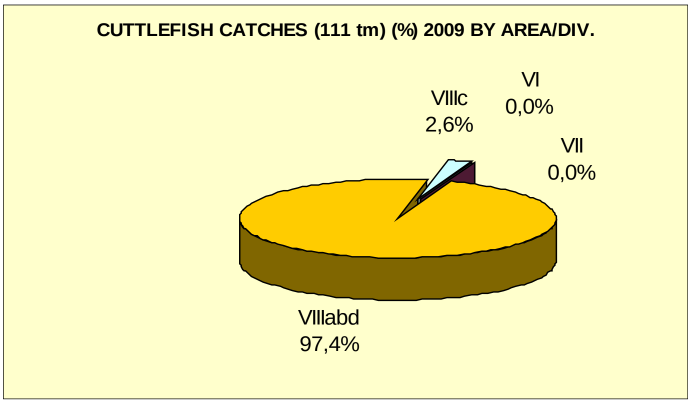
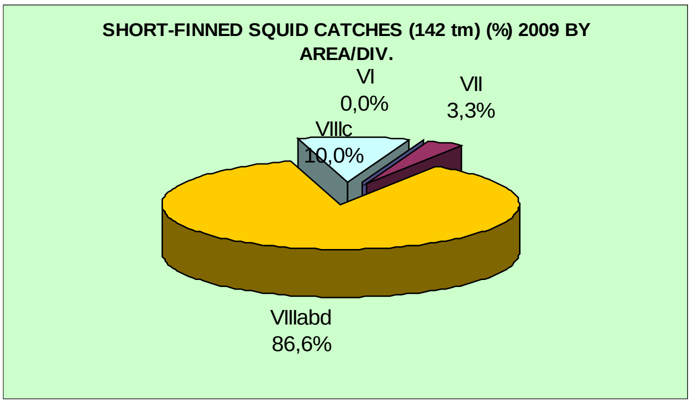


Figure 1. Monthly distribution of the Basque Country Catches (landings in kg) of Squid, Cuttlefish, Short-finned squid and Octopus by sea area, in 2009.







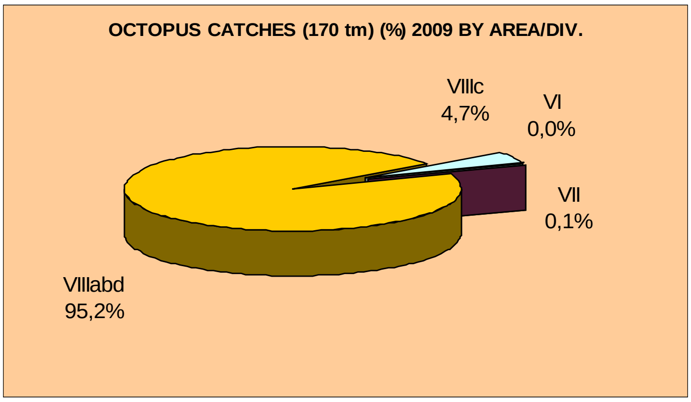
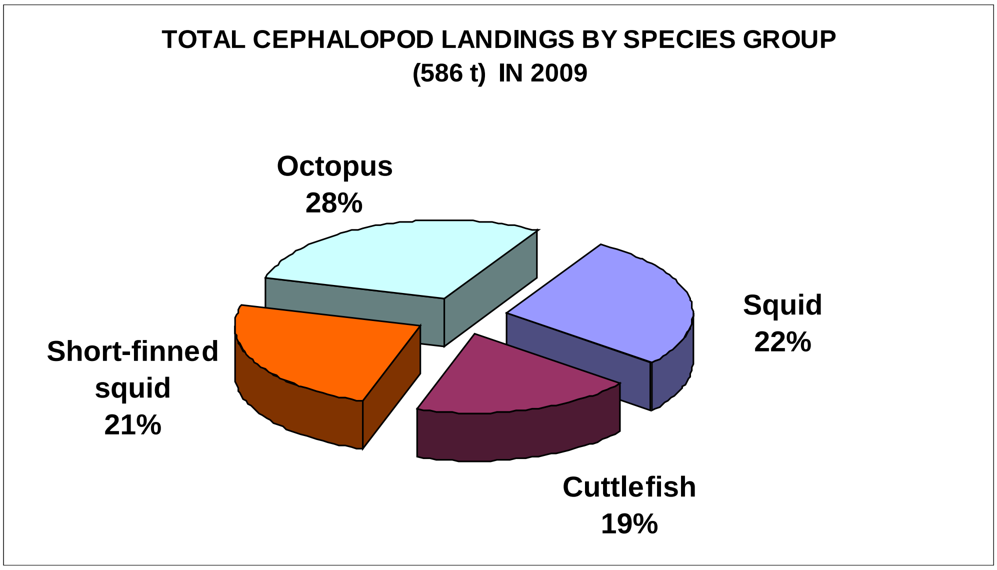


Figure 2. Percentage of the Basque Country landings of Squid, Cuttlefish, Short-finned squid and Octopus by sea area, in 2009.



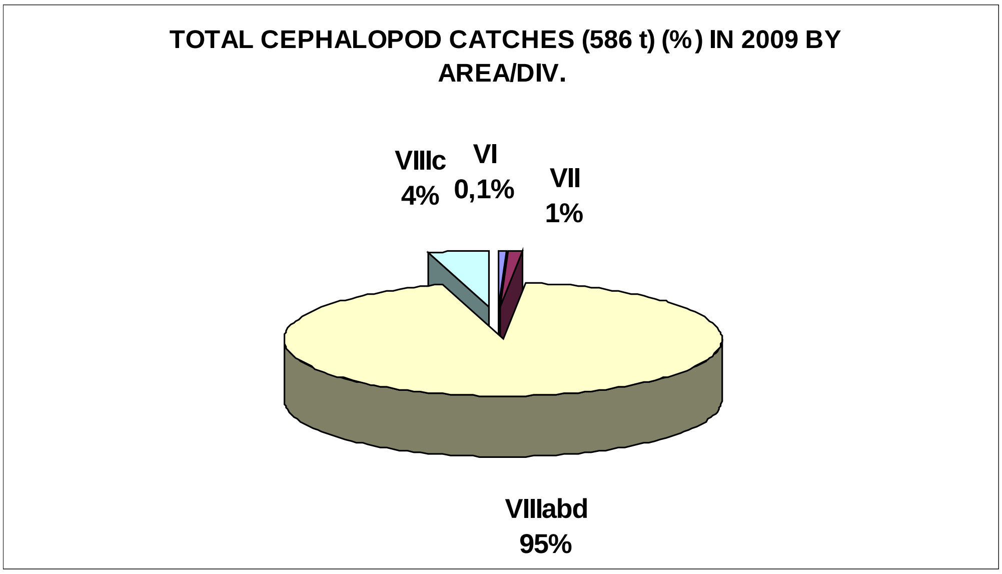
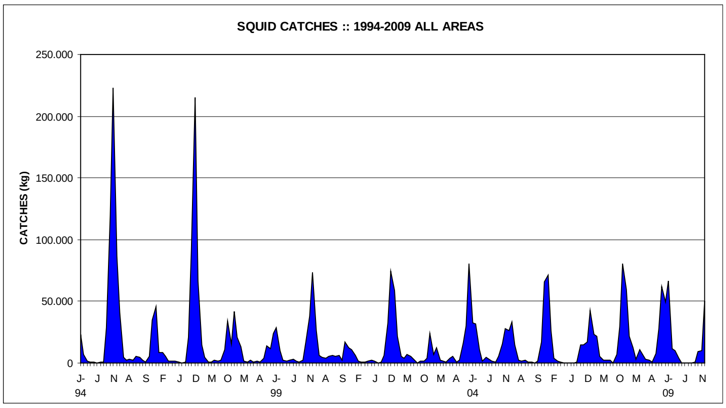
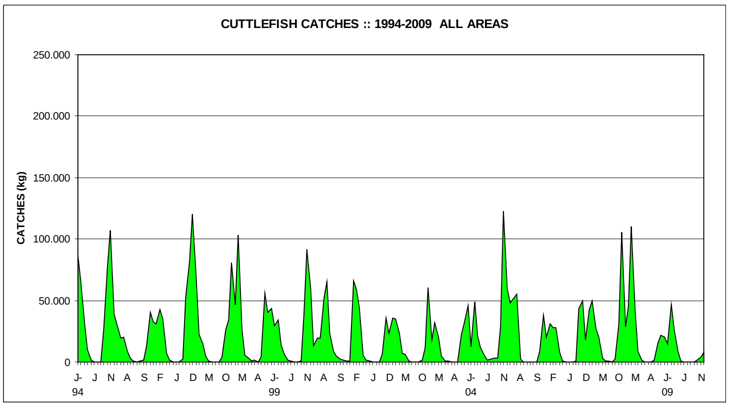
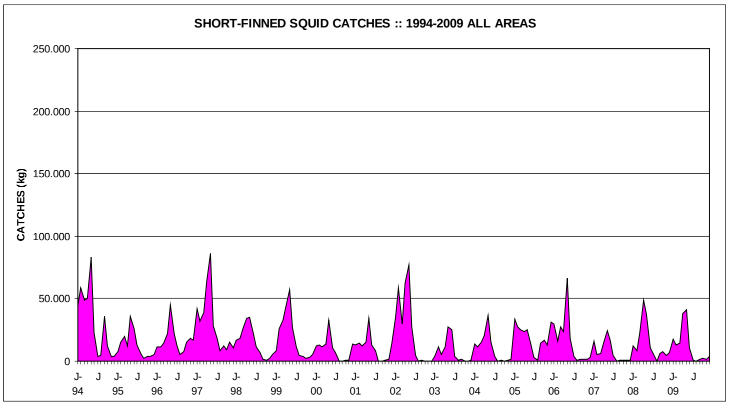


Figure 3. Total composition in percentage of the Basque Country landings. Above: By species group. Below: By sea area for 2009.







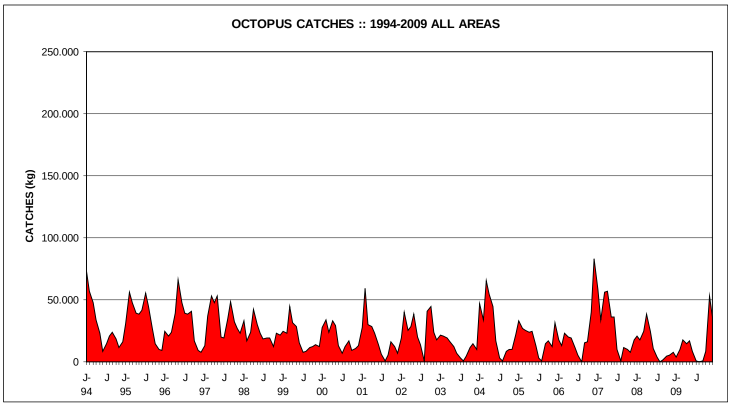


Figure 4. Cephalopods landing (in kg) evolution of the Basque Country by specie group considering all Areas and Divisions together (VI, VII, VIIIa,b,d and VIIIc) for the total period 1994–2009.

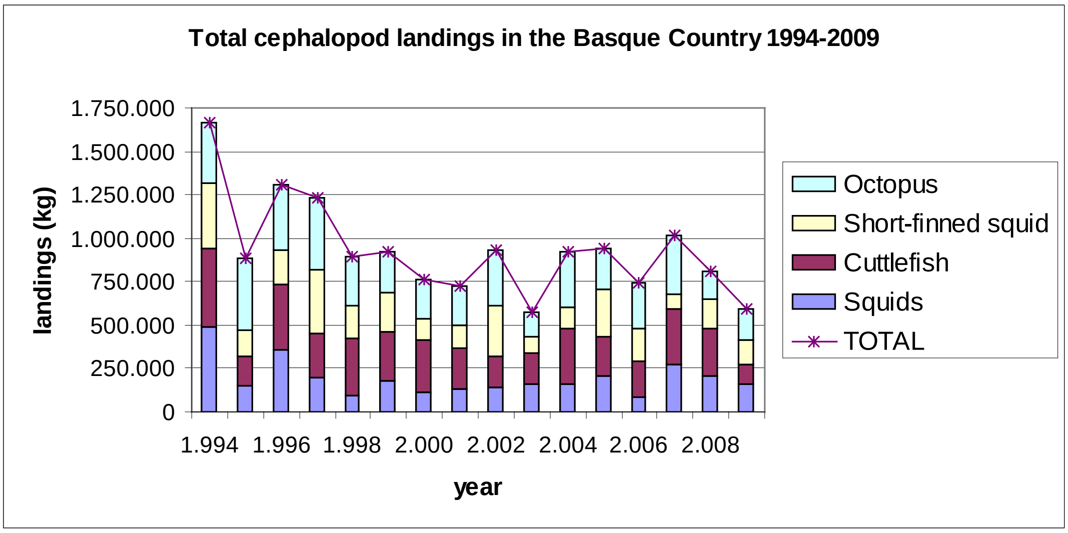


Figure 5. Cephalopods landing evolution of the Basque Country by species group for the total period 1994–2009.

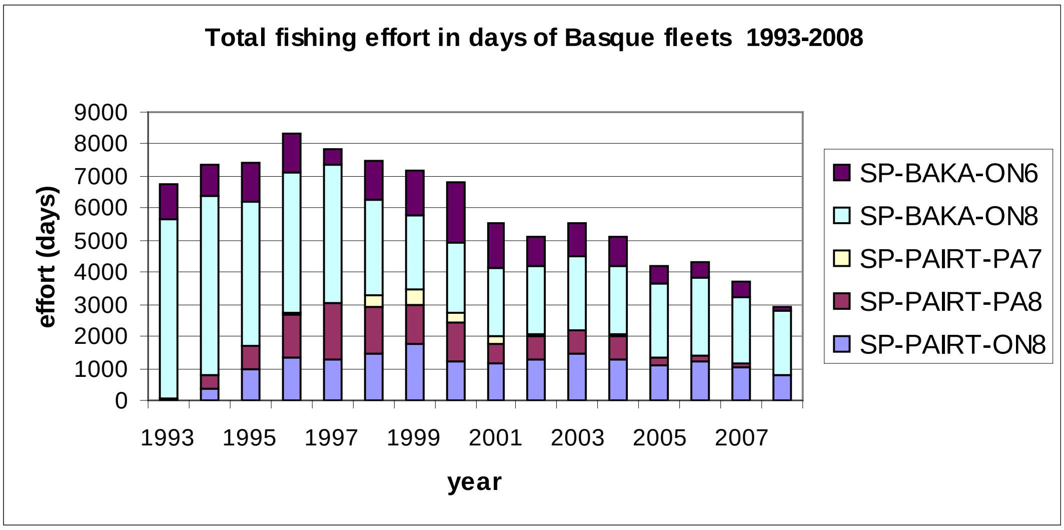


Figure 6. Total fishing effort of the Basque fleets from 1993 to 2008.

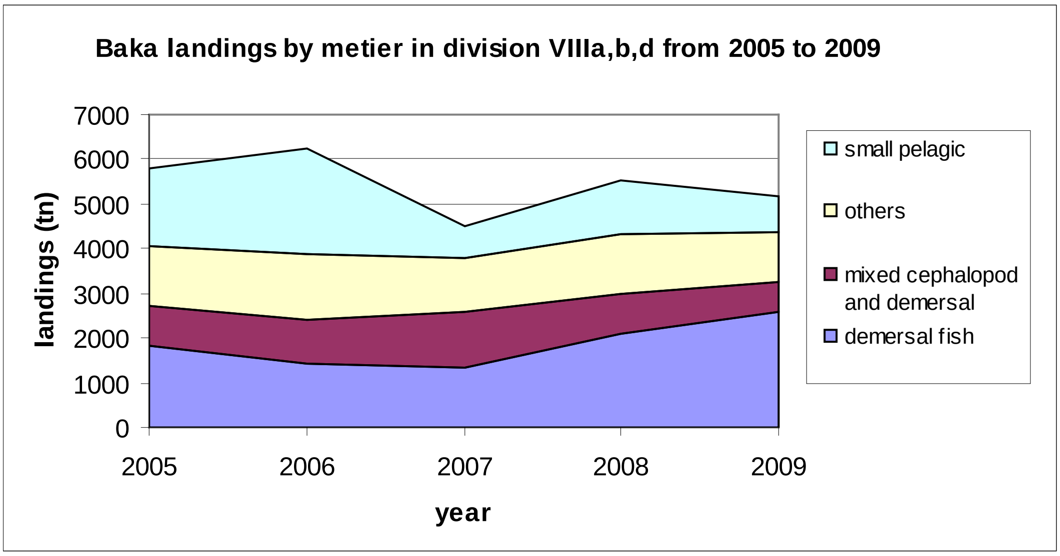
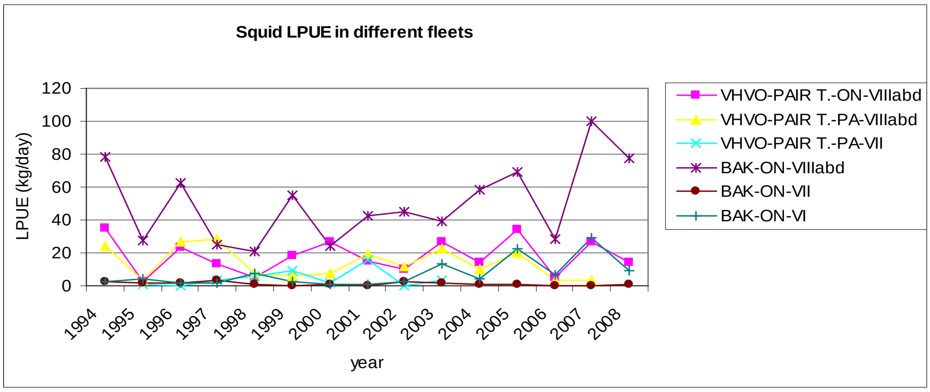
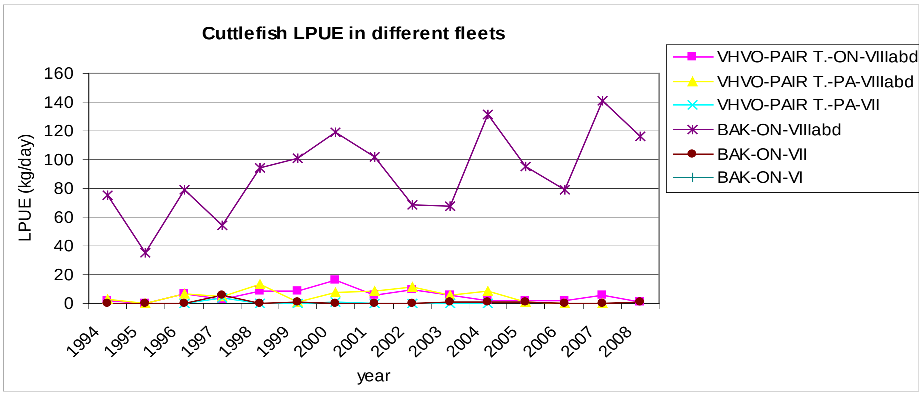
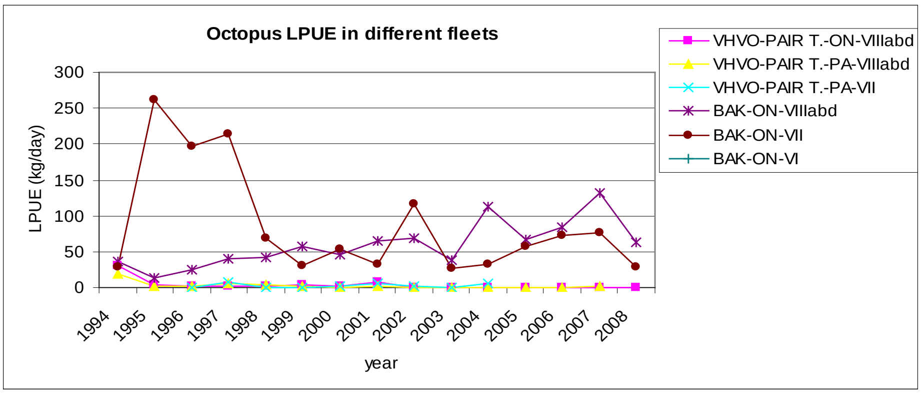


Figure 7. Baka landings by metier in division VIIIa,b,d from 2005 to 2009.







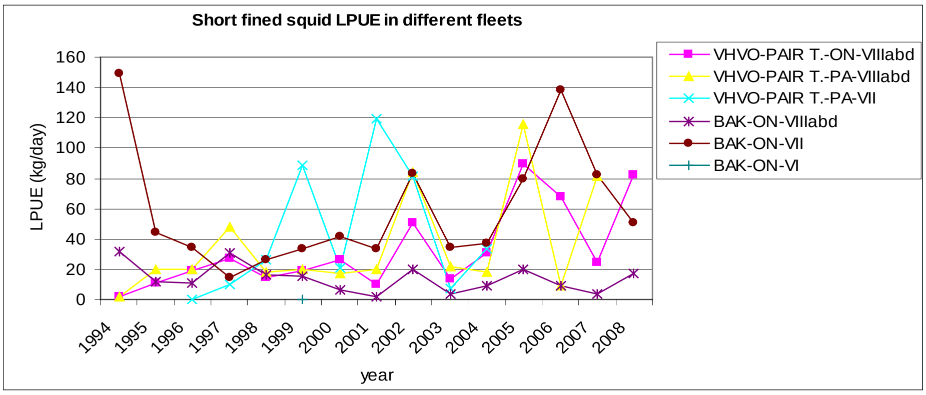


Figure 8. Cephalopods LPUE (landing in kg/day) evolution of the Basque Country ports by species in different fleets for the total period 1994–2008.

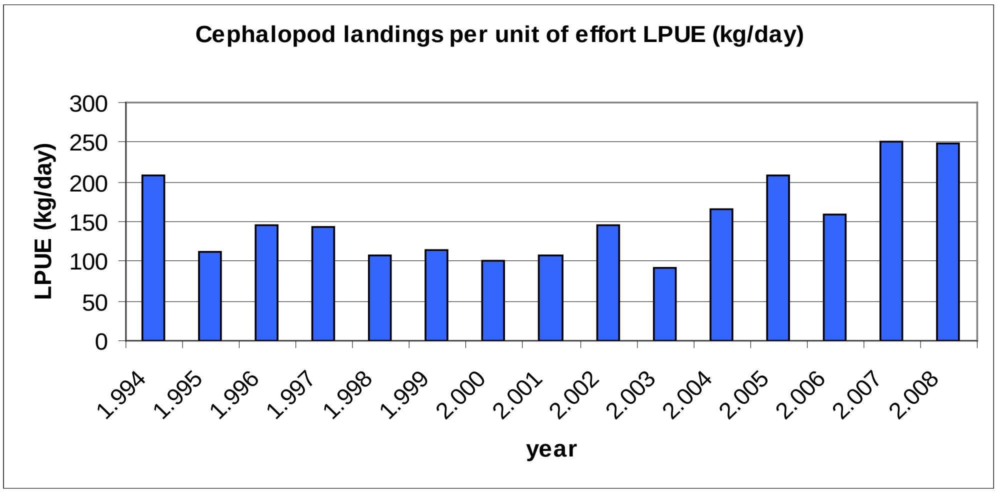


Figure 9. Cephalopod landings per unit of effort (kg/day) of the Basque fleet from 1994 to 2008.

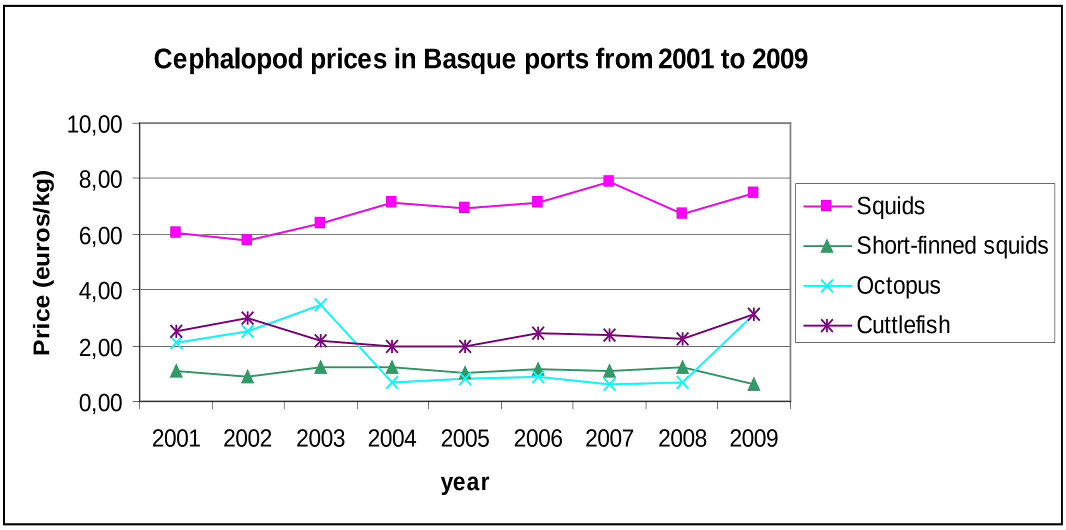


Figure 10. Cephalopod prices in Basque ports from 2001 to 2009.

Table 1. Squid landings (kg), effective effort (trips*(days/trip)) and LPUE (landings in kg/day) of different fleets landing in the Basque Country (Spain) ports in the period 1994–2008.

(a) Baka Otter trawl of Ondarroa (ON) fishing in Divisions VIIIa,b,d, Sub-area VII and Sub-area VI.

(b) Pair trawl with nets of very high vertical opening (VHVO) of Ondarroa and Pasajes, fishing in Div. VIIIa,b,d, and Sub-area VII.

(a)	BAKA trawl-ON-VIIIa,b,d			BAKA trawl-ON-VII			BAKA trawl-ON-VI		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	441436	5619	79	2490	980	3	1761	635	3
1995	123040	4474	28	2044	1214	2	2443	624	4
1996	274668	4378	63	1595	1170	1	1118	695	2
1997	107951	4286	25	1761	540	3	1386	710	2
1998	61299	3002	20	1088	1196	1	5894	750	8
1999	128825	2337	55	569	1384	0	1812	855	2
2000	52933	2227	24	1533	1850	1	336	763	0
2001	90374	2118	43	501	1451	0	829	1123	1
2002	95068	2107	45	2489	949	3	3080	1234	2
2003	89864	2296	39	1718	1022	2	9625	718	13
2004	125079	2159	58	857	910	1	1640	411	4
2005	155633	2263	69	234	544	0	7646	337	23
2006	68631	2398	29	153	487	0	2468	368	7
2007	210626	2098	100	21	476	0	9717	335	29
2008	156827	2017	78	67	105	1	3157	349	9

(b)	VHVO P. trawl-ON-VIIIa,b,d			VHVO P. trawl-PA-VIIIa,b,d			VHVO P. trawl-PA-VII		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	12712	362	35	10137	423	24	0	0	
1995	2081	959	2	2485	746	3	0	0	
1996	30873	1332	23	36487	1367	27	28	57	0
1997	17584	1290	14	50073	1752	29	1	3	0
1998	7417	1482	5	10542	1462	7	1165	340	3
1999	33428	1787	19	7266	1180	6	2797	476	6
2000	32481	1214	27	9056	1233	7	2376	271	9
2001	16813	1153	15	11327	587	19	423	253	2
2002	12526	1281	10	8196	720	11	930	59	16
2003	38470	1436	27	16719	754	22	0	9	0
2004	18195	1288	14	7419	733	10	124	35	4
2005	37788	1107	34	4950	252	20	11	0	
2006	6017	1236	5	570	182	3	0	0	
2007	27589	1034	27	371	105	4	0	0	
2008	11175	791	14	0	0		0	0	

Table 2. Cuttlefish landings (kg), effective effort (trips*(days/trip)) and LPUE (landings in kg/day) of different fleets landing in the Basque Country (Spain) ports in the period 1994–2008.
(a) Baka Otter trawl of Ondarroa (ON) fishing in Divisions VIIIa,b,d, Sub-area VII and Sub-area VI.

(b) Pair trawl with nets of very high vertical opening (VHVO) of Ondarroa and Pasajes, fishing in Div. VIIIa,b,d, and Sub-area VII.

(a)	BAKA trawl-ON-VIIIa,b,d			BAKA trawl-ON-VII			BAKA trawl-ON-VI		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	422678	5619	75	141	980	0	0	635	0
1995	158780	4474	35	298	1214	0	0	624	0
1996	344482	4378	79	366	1170	0	0	695	0
1997	232530	4286	54	3103	540	6	0	710	0
1998	283395	3002	94	130	1196	0	0	750	0
1999	236715	2337	101	1786	1384	1	0	855	0
2000	265227	2227	119	310	1850	0	0	763	0
2001	215219	2118	102	547	1451	0	0	1123	0
2002	144309	2107	68	102	949	0	0	1234	0
2003	155318	2296	68	1423	1022	1	0	718	0
2004	283899	2159	131	1006	910	1	0	411	0
2005	215892	2263	95	357	544	1	0	337	0
2006	189970	2398	79	76	487	0	0	368	0
2007	295164	2098	141	50	476	0	0	335	0
2008	234221	2017	116	67	105	1	0	349	0

(b)	VHVO P. trawl-ON-VIIIa,b,d			VHVO P. trawl-PA-VIIIa,b,d			VHVO P. trawl-PA-VII		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	703	362	2	1195	423	3	0	0	
1995	333	959	0	52	746	0	0	0	
1996	8353	1332	6	9171	1367	7	0	57	0
1997	3080	1290	2	8594	1752	5	10	3	3
1998	13038	1482	9	20163	1462	14	0	340	0
1999	14539	1787	8	1249	1180	1	88	476	0
2000	19129	1214	16	9178	1233	7	279	271	1
2001	6217	1153	5	5268	587	9	57	253	0
2002	11847	1281	9	8078	720	11	0	59	0
2003	8639	1436	6	4375	754	6	0	9	0
2004	2513	1288	2	6367	733	9	0	35	0
2005	2004	1107	2	152	252	1	0	0	
2006	2529	1236	2	2	182	0	0	0	
2007	6000	1034	6	0	105	0	0	0	
2008	997	791	1	0	0		0	0	

Table 3. Octopus landings (kg), effective effort (trips*(days/trip)) and LPUE (landings in kg/day) of different fleets landing in the Basque Country (Spain) ports in the period 1994–2008.

(a) Baka Otter trawl of Ondarroa (ON) fishing in Divisions VIIIa,b,d, Sub-area VII and Sub-area VI.

(b) Pair trawl with nets of very high vertical opening (VHVO) of Ondarroa and Pasajes, fishing in Div. VIIIa,b,d, and Sub-area VII.

(a)	BAKA trawl-ON-VIIIa,b,d			BAKA trawl-ON-VII			BAKA trawl-ON-VI		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	203033	5619	36	27937	980	29	0	635	0
1995	63195	4474	14	317424	1214	261	0	624	0
1996	106053	4378	24	230637	1170	197	0	695	0
1997	174988	4286	41	115544	540	214	0	710	0
1998	128079	3002	43	81384	1196	68	0	750	0
1999	132382	2337	57	41747	1384	30	0	855	0
2000	101184	2227	45	98124	1850	53	0	763	0
2001	137027	2118	65	48005	1451	33	0	1123	0
2002	145028	2107	69	110645	949	117	0	1234	0
2003	87865	2296	38	27489	1022	27	0	718	0
2004	244262	2159	113	29052	910	32	0	411	0
2005	152737	2263	67	30855	544	57	0	337	0
2006	203840	2398	85	35412	487	73	0	368	0
2007	277281	2098	132	36597	476	77	0	335	0
2008	127092	2017	63	2912	105	28	0	349	0

(b)	VHVO P. trawl-ON-VIIIa,b,d			VHVO P. trawl-PA-VIIIa,b,d			VHVO P. trawl-PA-VII		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	11049	362	31	8155	423	19	0	0	
1995	2944	959	3	1096	746	1	0	0	
1996	2780	1332	2	3071	1367	2	0	57	0
1997	2767	1290	2	10345	1752	6	20	3	7
1998	4247	1482	3	5402	1462	4	131	340	0
1999	8316	1787	5	3079	1180	3	258	476	1
2000	3362	1214	3	988	1233	1	269	271	1
2001	7801	1153	7	1312	587	2	1552	253	6
2002	324	1281	0	301	720	0	95	59	2
2003	129	1436	0	138	754	0	0	9	0
2004	753	1288	1	124	733	0	191	35	5
2005	60	1107	0	0	252	0	0	0	
2006	755	1236	1	0	182	0	0	0	
2007	74	1034	0	144	105	1	0	0	
2008	0	791	0	0	0		0	0	

Table 4. Short-finned squid landings (kg), effective effort (trips*(days/trip)) and LPUE (landings in kg/day) of different fleets landing in the Basque Country (Spain) ports in the period 1994–2008.

(a) Baka Otter trawl of Ondarroa (ON) fishing in Divisions VIIIa,b,d, Sub-area VII and Sub-area VI.

(b) Pair trawl with nets of very high vertical opening (VHVO) of Ondarroa and Pasajes, fishing in Div. VIIIa,b,d, and Sub-area VII.

(a)	BAKA trawl-ON-VIIIa,b,d			BAKA trawl-ON-VII			BAKA trawl-ON-VI		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	176266	5619	31	145868	980	149	0	635	0
1995	52974	4474	12	53415	1214	44	0	624	0
1996	47924	4378	11	40377	1170	35	0	695	0
1997	130402	4286	30	7746	540	14	0	710	0
1998	48218	3002	16	31084	1196	26	0	750	0
1999	35375	2337	15	46585	1384	34	86	855	0
2000	14425	2227	6	76690	1850	41	0	763	0
2001	3450	2118	2	48526	1451	33	0	1123	0
2002	42411	2107	20	78866	949	83	0	1234	0
2003	7581	2296	3	34910	1022	34	0	718	0
2004	19058	2159	9	33426	910	37	0	411	0
2005	44893	2263	20	43075	544	79	0	337	0
2006	22419	2398	9	67245	487	138	0	368	0
2007	8398	2098	4	39273	476	82	9	335	0
2008	35485	2017	18	5302	105	50	0	349	0

(b)	VHVO P. trawl-ON-VIIIa,b,d			VHVO P. trawl-PA-VIIIa,b,d			VHVO P. trawl-PA-VII		
Year	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)	Landings (kg)	Effort (days)	LPUE (kg/days)
1994	523	362	1	821	423	2	0	0	
1995	10362	959	11	14552	746	20	0	0	
1996	24716	1332	19	26649	1367	20	0	57	0
1997	34569	1290	27	83294	1752	48	29	3	10
1998	21985	1482	15	26634	1462	18	8976	340	26
1999	34619	1787	19	23856	1180	20	42175	476	89
2000	32111	1214	26	21366	1233	17	5623	271	21
2001	11085	1153	10	11828	587	20	30271	253	119
2002	65048	1281	51	60702	720	84	4808	59	81
2003	19025	1436	13	16293	754	22	63	9	7
2004	39151	1288	30	12998	733	18	1156	35	33
2005	98696	1107	89	29265	252	116	0	0	
2006	83368	1236	67	1665	182	9	0	0	
2007	25378	1034	25	8495	105	81	0	0	
2008	65347	791	83	0	0		0	0	

Table 5. Annual discards sampling level on board for sampled Fishery Units.

Gear	Area	Sampling effort	2003	2004	2005	2006	2007	2008	2009
OTB	VI	Sampled trips	3	3	2	3	2	2	6
		Total trips	117	70	64	63	66	60	65
	VII	Sampled trips	2	3	1	4	2	2	
		Total trips	146	155	95	70	70	13	0
	VIIIabd	Sampled trips	6	4	11	10	12	14	13
		Total trips	528	458	505	537	437	475	640
PTB	VIIIabd	Sampled trips	6	7	7	7	7	7	7
		Total trips	409	370	321	319	232	192	212

Table 6. Estimated cephalopod discard (kg) during 2003–2009 series is presented.

Gear	Area	Species	2003	2004	2005	2006	2007	2008	2009
OTB	VI	Short finned squid	1,554	-	-	-	-	61,641	1,397
		Curled octopus	-	-	-	-	-	-	-
		Cuttlefish	-	-	-	-	-	-	-
	VII	Short finned squid	55,256	114,255	10,189	2,611	42,197	34,486	
		Curled octopus	13,820	242	19,121	4,775	47,498	-	
		Cuttlefish	202	-	-	-	-	-	
	VIIIabd	Short finned squid	11,015	25,016	9,459	12,129	5,051	4,726	12,870
		Curled octopus	33,762	13,714	11,025	185	65,448	2,280	25,645
		Cuttlefish	297	1,944	3,461	-	2,405		8,912
PTB	VIIIabd	Short finned squid	6,723	36,989	13,224	3,905	2,368	-	34,190
		Curled octopus	-	-	-	-	-	-	-
		Cuttlefish	317	-	-	-	-	-	-

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Annex 7: Working document 3. Cephalopod Landings in Galicia during 2009.

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INTRODUCTION

Cephalopods are an important marine resource in Galicia. The aim of this report is to summarize the cephalopods landings in Galicia during 2009. Only cephalopods caught in fishing grounds of Galicia were considered. Cephalopods are caught in Galician by a wide variety of fishing gears: trawl, longliners, purse-seiners, nets, hooks and artisanal lines, traps, etc. Landings were grouped by type of fleet as follow:

1) Inshore vessels that fish in the inland water zone situated inside the base lines of the territorial waters. Rights over these waters belong to the Galicia Autonomous Community. This fleet (4,202 vessels) used a wide variety of gears (*"artes menores"*): hooks and artisanal lines, traps, trammel, etc.

2) Fishing fleet (467 vessels) that fish in offshore waters jurisdictional zone, ranging from the base lines of the territorial sea to 12 miles. The Spanish State has the rights over these.

The landings of cephalopods from the Galicia fishing grounds correspond to the following species:

- Loliginidae: *Loligo vulgaris*, *L.forbesi*, *Alloteuthis media* and *A.subulata*
- Octopodidae: mainly *Octopus vulgaris* and also *Eledone cirrhosa*
- Ommastrephidae: *Todaropsis eblanae*, *Illex coindetii* and *Todarodes sagitattus*
- Sepiidae: *Sepia officinalis* and S. *elegans*

The Galician coast is placed between the river Eo mouth (43º 32' N - 7º 01'W) and the river Miño estuary (41º 50' N - 9º 40' W). This coast is divided into nine administrative areas I to IX (Figure 1). For this study, they were grouped in two areas according to the ICES division (Figure 2):

1) ICES sub-area IXa North (IXa-N) corresponding to *Rías Baixas* between River Miño estuary and Cabo Touriñán (Galicia administrative zones I toV).

2) ICES sub-area VIIIc West (VIIIc-W) from Cabo Touriñán to River Eo mouth (Galicia administrative zones VI to IX).

Landings (in tons) and economic value (in euros) of cephalopods caught in Galician fishing grounds were obtained from the official fishery databases (Servizo de Análise e de Rexistros, Consellería do Mar, Xunta de Galicia, www.pescadegalicia.com). Landings of the ICES sub-areas VIIIc-w and IXa-n were analysed separately.

RESULTS

Cephalopods represented the third taxonomic group in landings, 8,350.1 t (4.26%) and a value 20.53 x 10^6€ (4.86) of the total fresh landings in Galicia. The 39% (2,876.3) of cephalopod landings came from the national fishing grounds. Of the 12 species landed, the main species caught were common octopus (*Octopus vulgaris),* common cuttlefish (*Sepia officinalis*), flying squid (*Todaropsis eblanae*), horned octopus (*Eledone cirrhosa*) and European squid (*Loligo vulgaris*). Over the 81% was caught by the artisanal fleet (Table I). Figure 1 and Table II shown landings by taxonomic group and the ICES zones.

Octopus vulgaris

The common octopus *Octopus vulgaris* represents the 65.7% of cephalopods from the fishing grounds of Galicia in 2009. In that year, 1890.3 t were landed in ports of that community. 67% of catches (1,265 t) were landed at ports in the ICES sub-area IXa-N. In the ICES sub-area VIIIc-W, 625 t were landed (33%). 99.7% of landings correspond to catches of the artisanal fleet. Octopus is caught in the Galician coast mainly with traps targeted to different species. The octopus trap (called *nasa de polbo*) is the more specific octopus gear, with estimated octopus annual catches being between 80–90% in weight of the total catches. Evolution of annual landings by ICES sub-area area among 2002 and 2009, and the variations of monthly landings during 2009 are shown in Figures 2 and 3 respectively. The fishing season covers all year round, excepting in years when a closed season was laid down during spring - summer months (from May 8th to July 6th in 2009).

Sepia officinalis

Landings of cuttlefish during the past 7 years displayed an upward trend, which was broken in 2008 (Figure 4). 442 t were landed in 2009 (15,4% of cephalopod landings). Higher landings were obtained in the ICES sub-area IXa-N, 346 t (78%) whereas 96 t (22%) were caught in the ICES sub-area VIIIc-W. Evolution of annual landings by ICES sub-area area among 2002 and 2009, and the variations of monthly landings during 2009 are shown in Figures 4 and 5 respectively.

The artisanal fleet caught the 98.8% of landings. Cuttlefish is mainly captured with two trammel net types: *trasmallos* (height ≤ 2 m), and *miños* (height ≤ 3 m). In different ports of inner area of the *rías*, cuttlefish is also caught with fyke nets (*butróns*) and cuttlefish traps (*nasa de choco*). Seasonal changes in production were observed in both ICES area (Figure 5). Higher landings take place from January to May (June) in both areas, during the main reproductive period. In this period small vessels (≤ 2.5 GRT) are authorized to work with trammel nets in the most internal area of the *rías*, where cuttlefishes were concentrated with reproductive intentions.

Todaropsis eblanae

The flying squid *Todaropsis eblanae* represents 9.2% of cephalopods landings from the fishing grounds of Galicia in 2009. In that year, 263.2 t were landed in ports of Galicia. 40.8% of catches (107.3 t) were landed in ports of the ICES sub-area IXa-N. In the ICES sub-area VIIIc-W 115.9 t were landed (59.2%). 99.8% of landings correspond to catches of trawlers. Evolution of annual landings by ICES sub-area area among 2002 and 2009, and the variations of monthly landings during 2009 are shown in Figures 6 and 7 respectively.

Eledone cirrhosa

The horned octopus *Eledone cirrhosa* represents 8.7% of cephalopods from the fishing grounds of Galicia in 2009. In that year, 250.7 t were landed in ports of that community. 71.3% of catches (178.8 t) were landed in ports of the ICES sub-area IXa-N. In the ICES sub-area VIIIc-W, 71.9 t were landed (28.7%). 98.7% of landings correspond to catches of trawlers. Evolution of annual landings by ICES sub-area area among 2002 and 2009, and the variations of monthly landings during 2009 are shown in Figures 8 and 9 respectively.

Loligo spp

Squids (*Loligo* spp) are the fifth cephalopod species in importance (0.77% of the total cephalopod). In 2009, 22.3 t were landed in the Galician fishing grounds. The 53.5% of landings were caught by trawlers whereas the small-scale fishery caught the 48.2%. Landings correspond to two species of squid: *L. vulgaris* and *L. forbesi*, but landings cannot discriminate by species. Higher landings were obtained in the ICES sub-area IXa-N 11.7 t (52.6%) whereas 10.6 t were caught in the ICES sub-area VIIIc-W (47.4%). Evolution of annual landings by ICES sub-area area among 2002 and 2009, and the variations of monthly landings during 2009 are shown in Figures 10 and 11 respectively.

Table I. Cephalopod landings from Galicia fishing grounds by taxonomic group (2002–2009).

Cephalopod group	ICES Division	2002	2003	2004	2005	2006	2007	2008	2009
Fam.	**VIIIc-W**	8	7	20	21	18	16	15	11
Loligindae	**IXa-N**	20	27	42	20	5	7	33	14
Fam.	**VIIIc-W**	621	377	785	836	726	1278	1076	697
Octopodidae	**IXa-N**	1331	1455	1684	948	1105	1709	1962	1443
Fam.	**VIIIc-W**	87	49	156	206	107	74	146	156
Ommastrephidae	**IXa-N**	162	301	304	171	118	142	169	112
Or.	**VIIIc-W**	61	27	56	144	92	98	123	97
Sepioidea	**IXa-N**	141	162	302	335	325	449	300	345

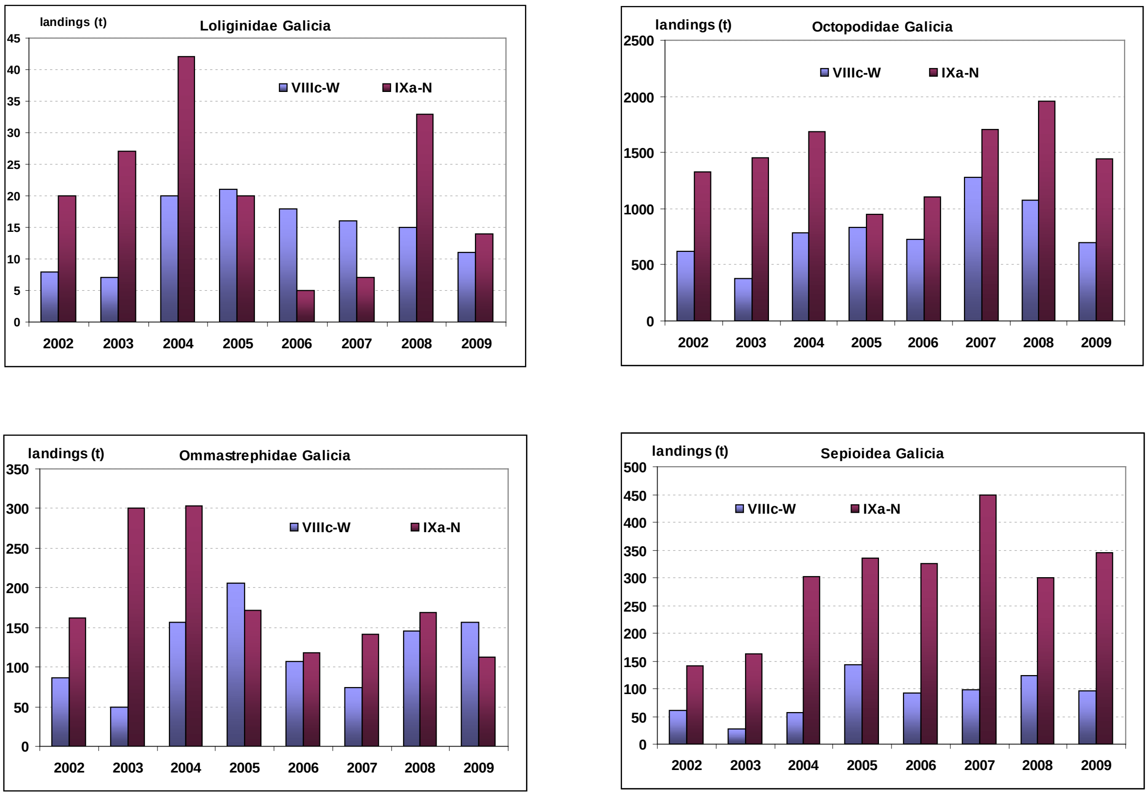

Figure 1. Cephalopod landings from Galicia fishing grounds by taxonomic group and ICES sub-area (2002–2009).

Table II. Fresh landings (in tons) of cephalopods fished by fleet type and species catches in the Galician fishing grounds during 2009.

Scientific Name	Trawl	Artisanal fisheries	Purse seine	Nets	Longline	Total	%
Octopus vulgaris	6.0	1883.9	0.2	0.1	0.07	**1,890.3**	**65.71**
Sepia oficcinalis	1.3	437.3	2.9	0.8	0.05	**442.3**	**15.38**
Todaropsis eblanae	262.7	0.4	0.002	0.1		**263.2**	**9.15**
Eledone cirrhrosa	248.1	2.6	0.03			**250.7**	**8.72**
Loligo vulgaris	11.9	8.4	2.0	0.02	0.004	**22.3**	**0.77**
Todarodes sagittatus	4.3	0.01		0.3		**4.7**	**0.16**
Alloteuthis spp	2.1	0.1	0.1			**2.3**	**0.08**
Sepiola rondeletii	0.6		0.01			**0.6**	**0.02**
Illex coinndetti	0.2	0.03				**0.2**	**0.01**
Total	**537.2**	**2332.6**	**5.2**	**1.3**	**0.1**	**2,876.5**	**100**
(%)	**18.68**	**81.09**	**0.18**	**0.05**	**0.00**	**100.00**	

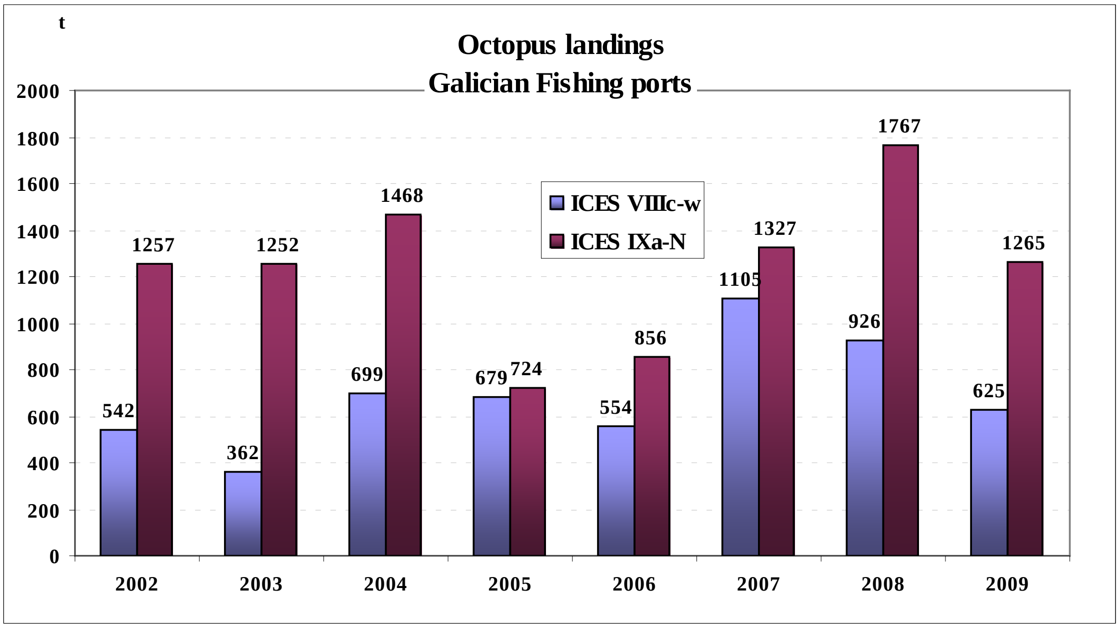

Figure 2. *Octopus vulgaris* landings by ICES sub-area from 2002 to 2009.

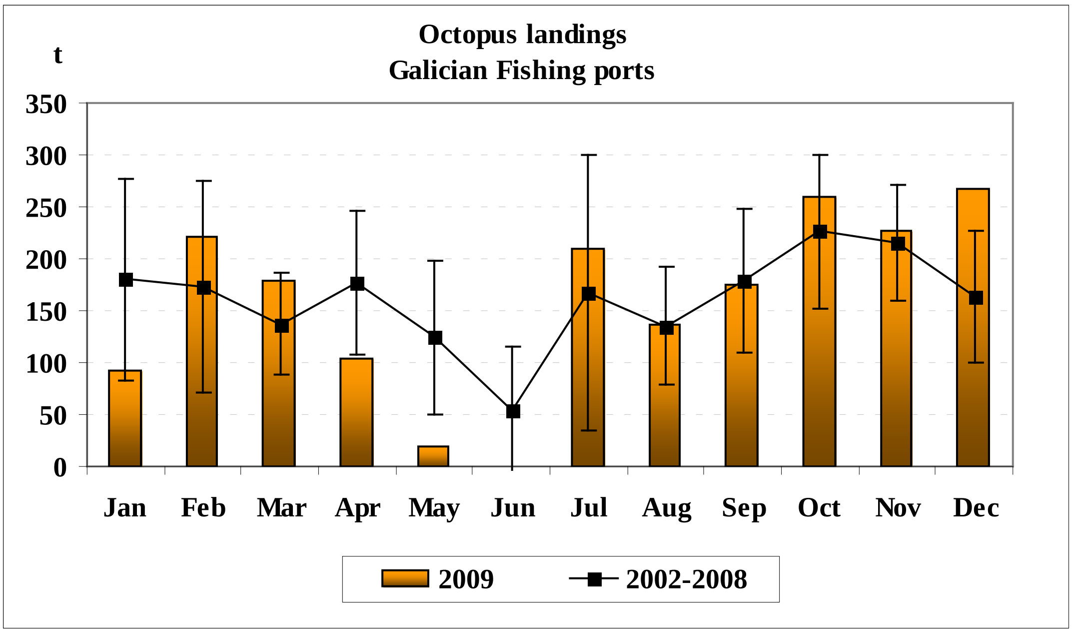

Figure 3. Monthly *Octopus vulgaris* landings in 2009 compare to 2002–2008 (mean ± sd).

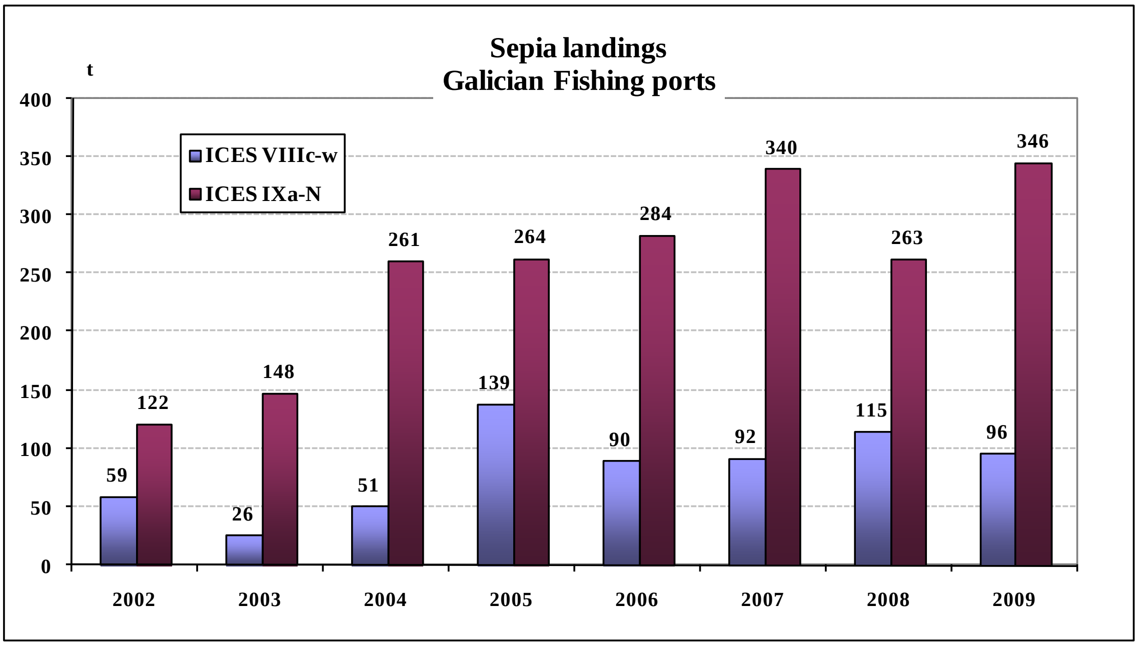

Figure 4. *Sepia officinalis* landings by ICES sub-area from 2002 to 2009.

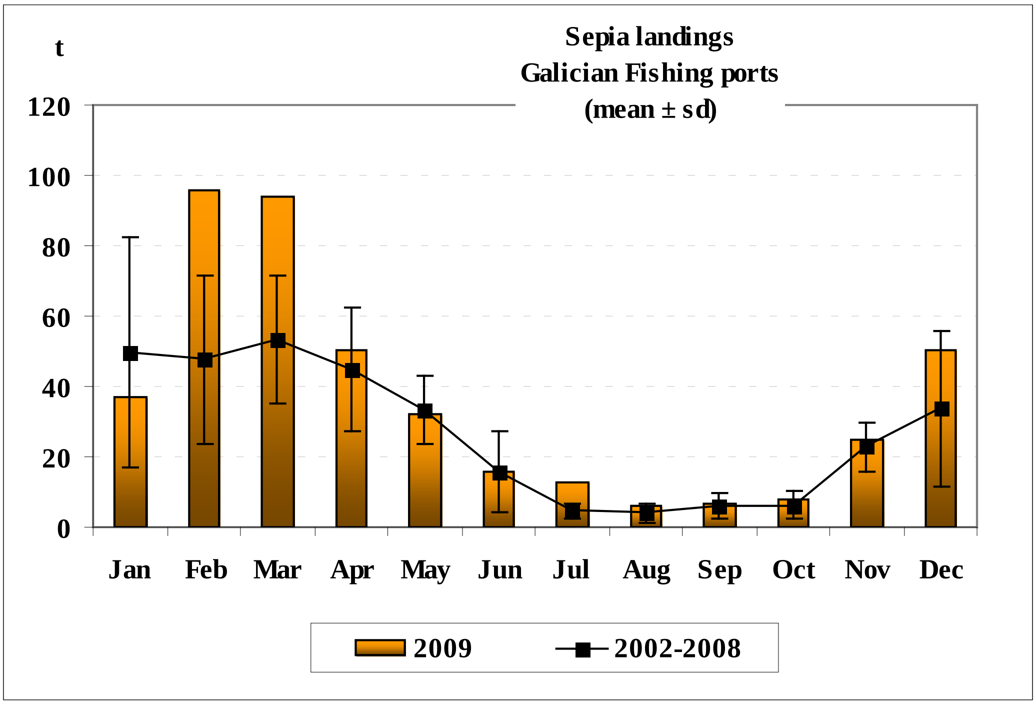

Figure 5. Monthly *Sepia officinalis* landings in 2009 compare to 2002-2008 (mean ± sd).

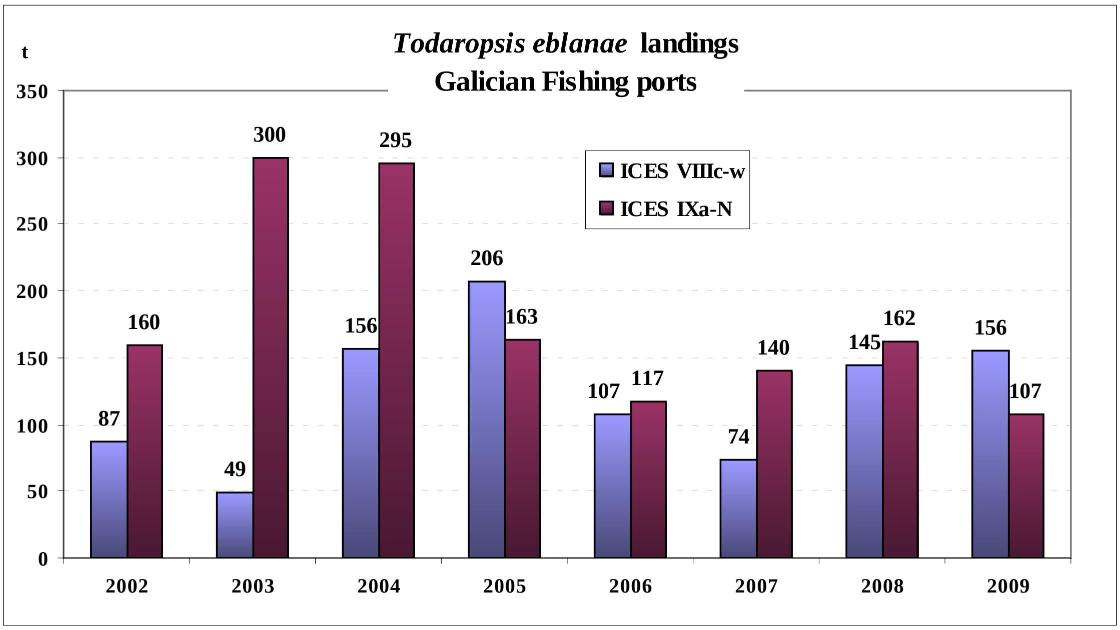

Figure 6. *Todaropsis eblanae* landings by ICES sub-area from 2002 to 2009.

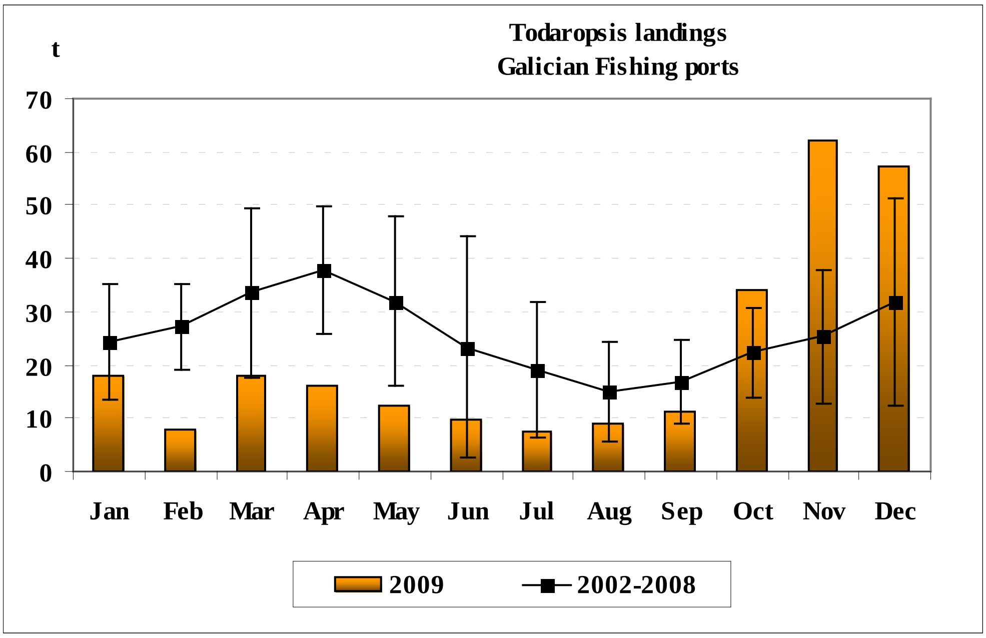

Figure 7. Monthly *Todaropsis eblanae* landings in 2009 compare to 2002–2008 (mean ± sd).

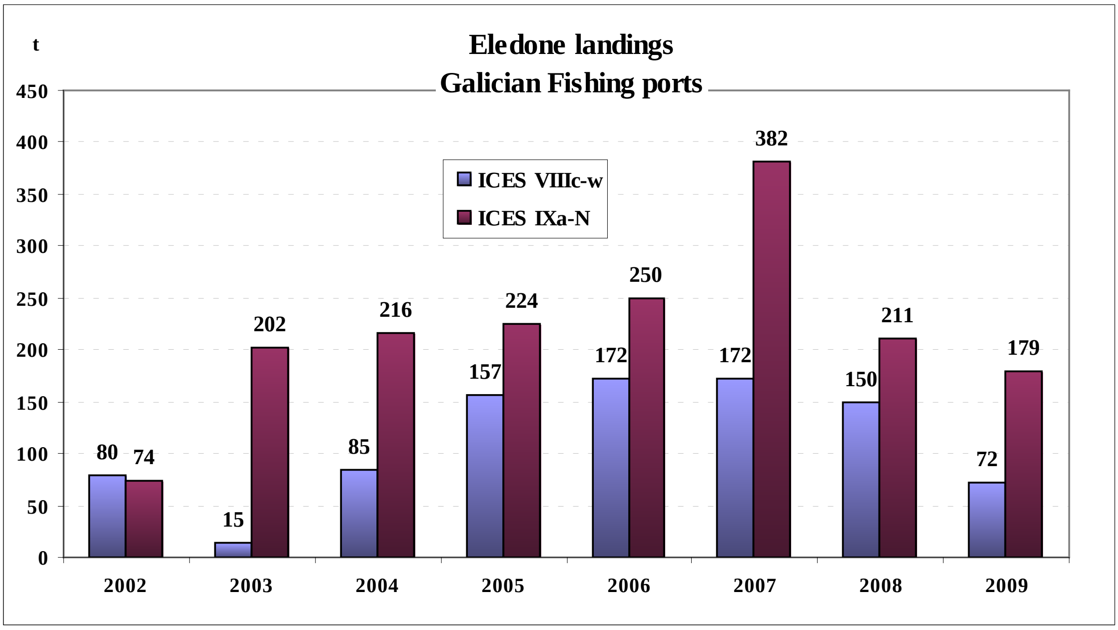

Figure 8. *Eledone cirrhosa* landings by ICES sub-area from 2002 to 2009.

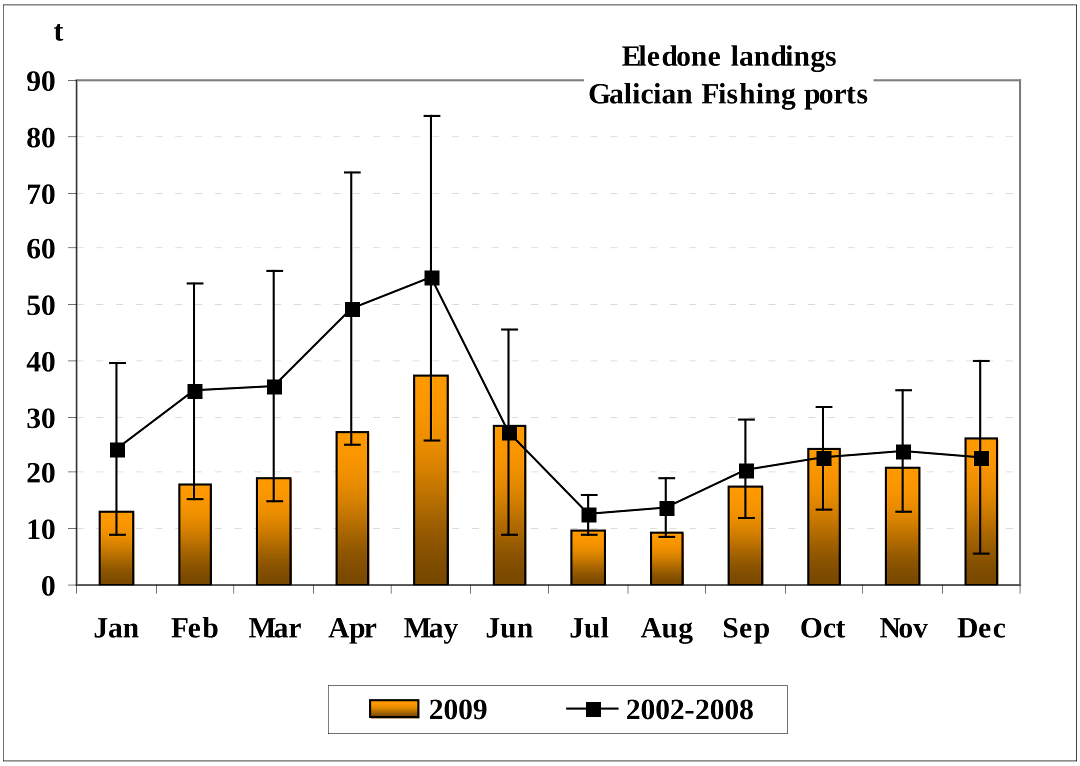

Figure 9. Monthly *Eledone cirrhosa* landings in 2009 compare to 2002–2008 (mean ± sd)

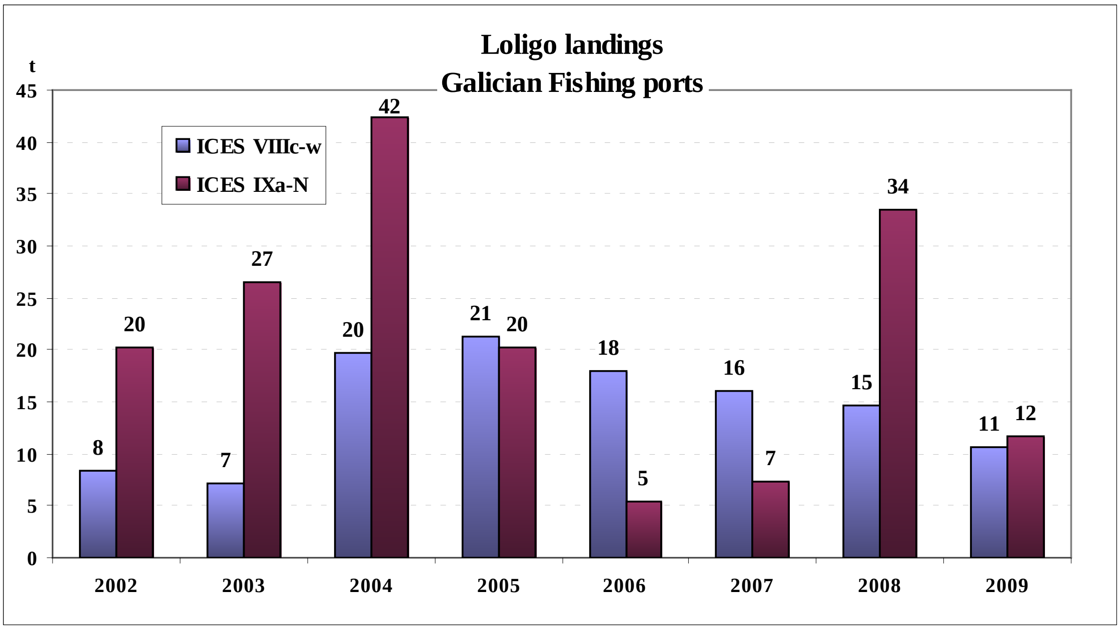

Figure 10. *Loligo vulgaris* landings by ICES sub-area from 2002 to 2009.

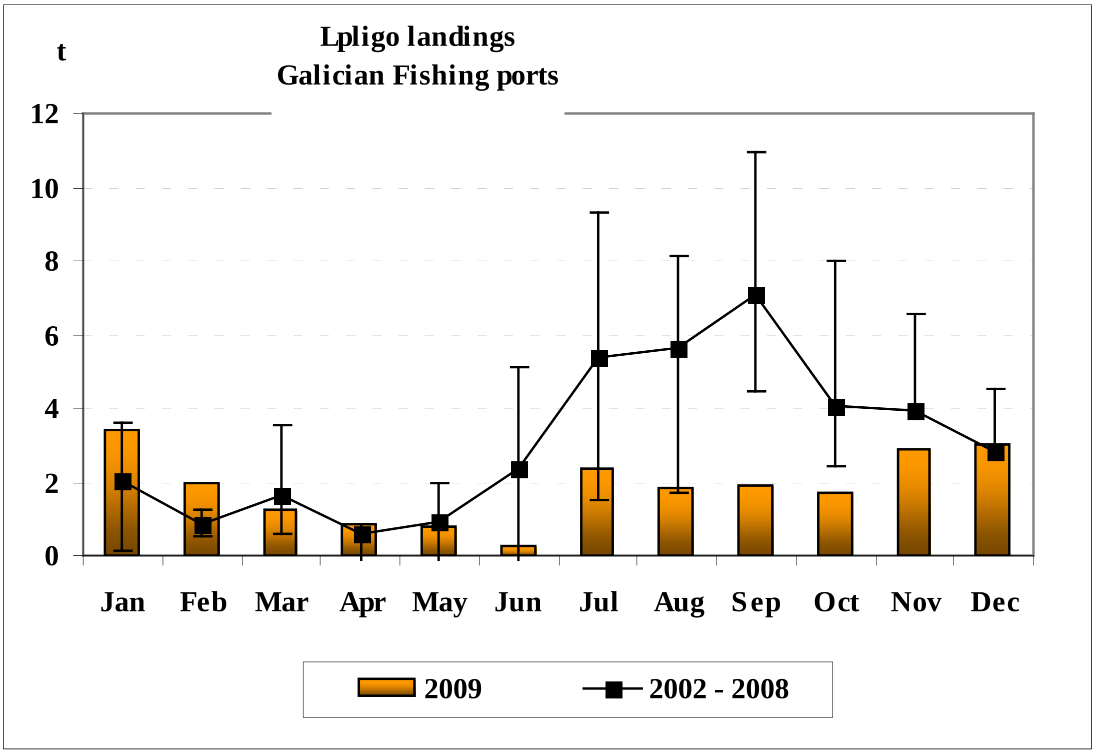

Figure 11. Monthly *Loligo vulgaris* landings in 2009 compare to 2002–2008 (mean ± sd).

Annex 8: Working document 4. Portuguese fishery statistics (ICES division IXa) - status and trends.

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Instituto Nacional de Recursos Biológicos, L-IPIMAR, Portugal

Cephalopods are an important fishery resource in Portugal. The main commercial species are the common octopus *Octopus vulgaris*, the cuttlefish *Sepia officinalis* and the common squid *Loligo vulgaris*. Other species, such as *Eledone cirrhosa*, *Loligo forbesi*, *Illex coindetii*, *Todaropsis eblanae* and *Todarodes sagittattus* are also marketable species but have a low amount of landings. *E. cirrhosa* is recorded in the fisheries statistics often together with *O. vulgaris* in the species group "octopodidae". *Loligo forbesi* is not discriminated from *Loligo vulgaris*, and the short-finned species appear together in a species group. On this document cephalopod fisheries data of the Portuguese fleets operating in Portuguese and Spanish waters of the ICES division IXa, for the period 2000 to 2009 is presented.

1. Cephalopod Landings from ICES division IXa

The relative importance of cephalopod species in landings from Portuguese waters (ICES IXa) is constant throughout the years with significantly higher landings of octopus (81%), followed by cuttlefish (14%), long-finned squid (4%) and short-finned squid (1%) (Table 1). Landings of cephalopods from Spanish waters remain low (Table 2).

Table 1 - Portuguese waters (ICES IXa) - Landings (tons)

Year	Cephalopods	Cuttlefish	Octopus	Long-finned squid	Short-finned squid
2000	11085.0	1348.8	8802.0	613.1	321.1
2001	9662.9	1338.3	7231.0	862.1	231.5
2002	10332.4	1361.2	8088.6	678.4	204.2
2003	11315.4	1279.9	9600.9	288.4	146.2
2004	11035.9	1643.5	8143.8	1008.1	240.5
2005	13163.9	1770.6	10724.6	482.2	186.5
2006	8877.8	1750.2	6997.4	89.0	41.2
2007	10043.1	1487.6	8407.4	127.6	20.5
2008	15005.5	1424.1	13203.6	360.1	17.7
2009	9297.7	1227.5	7867.5	198.0	4.6

Table 2 - Spanish waters (ICES IXa) - Landings (tons)

Year	Cephalopods	Cuttlefish	Octopus	Long-finned squid	Short-finned squid
2000	261.0	8.3	250.0	0.6	2.1
2001	81.5	9.8	69.5	1.2	1.0
2002	77.6	6.6	69.7	0.6	0.7
2003	117.2	18.0	98.3	0.4	0.5
2004	89.7	21.1	67.3	0.9	0.4
2005	133.3	31.7	101.5	0.1	0
2006	111.0	37.0	73.4	0	0.6
2007	74.6	29.8	44.6	0	0.2
2008	82.9	28.8	54.1	0	0
2009	105.1	31.3	72.4	1.4	0.0

In the last 10 year an average of 11 000 tons of cephalopods were landed by the Portuguese fleets from ICES IXa catches.

The landings of cuttlefish and octopus from division IXa didn’t vary much between 2000 and 2009 (Figure 1). Cuttlefish landings ranging between 1259 and 1802 tons (mean = 1485 tons), and octopus landings ranging between 7071 and 13258 tons (mean = 8997 tons). On the other hand, squid landings decreased significantly in the last 10 years, recording rather low amounts since 2006.

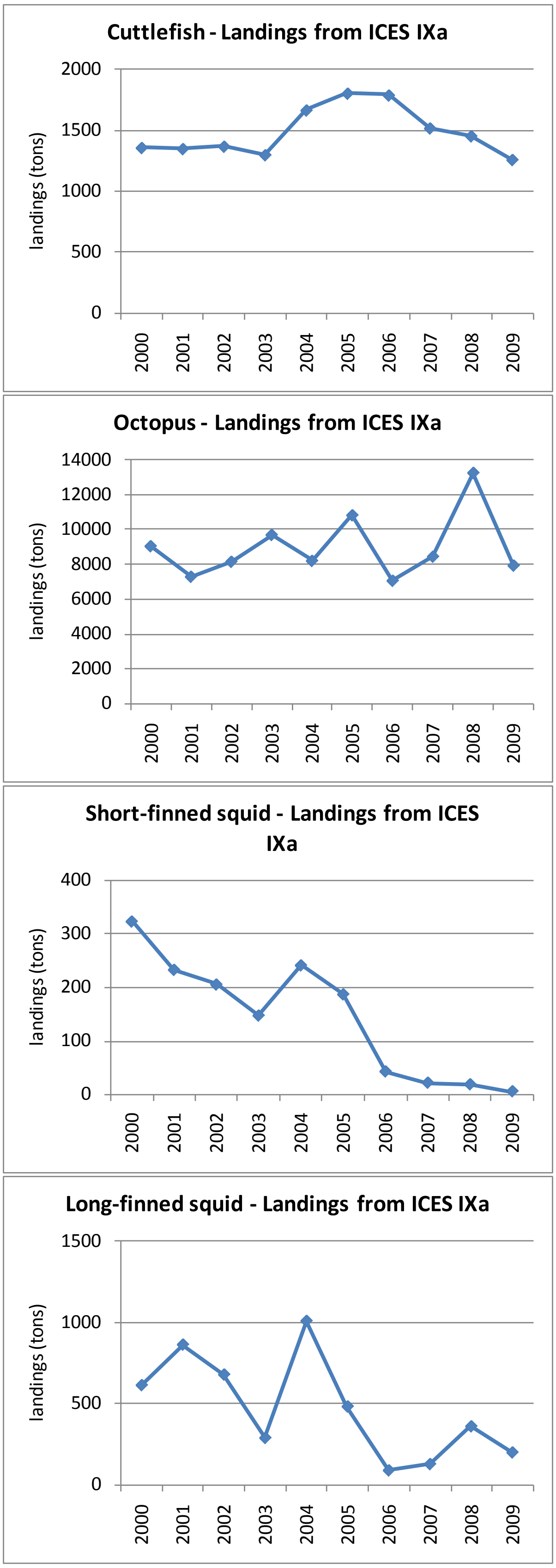

Figure 1. Cephalopod annual landings from ICES area IXa between 2000 and 2009.

The cephalopod monthly landings from ICES area IXa (mean: years 2000 to 2009), highlight the marked seasonality of the cuttlefish and long-finned squid fishery (Figure 2).

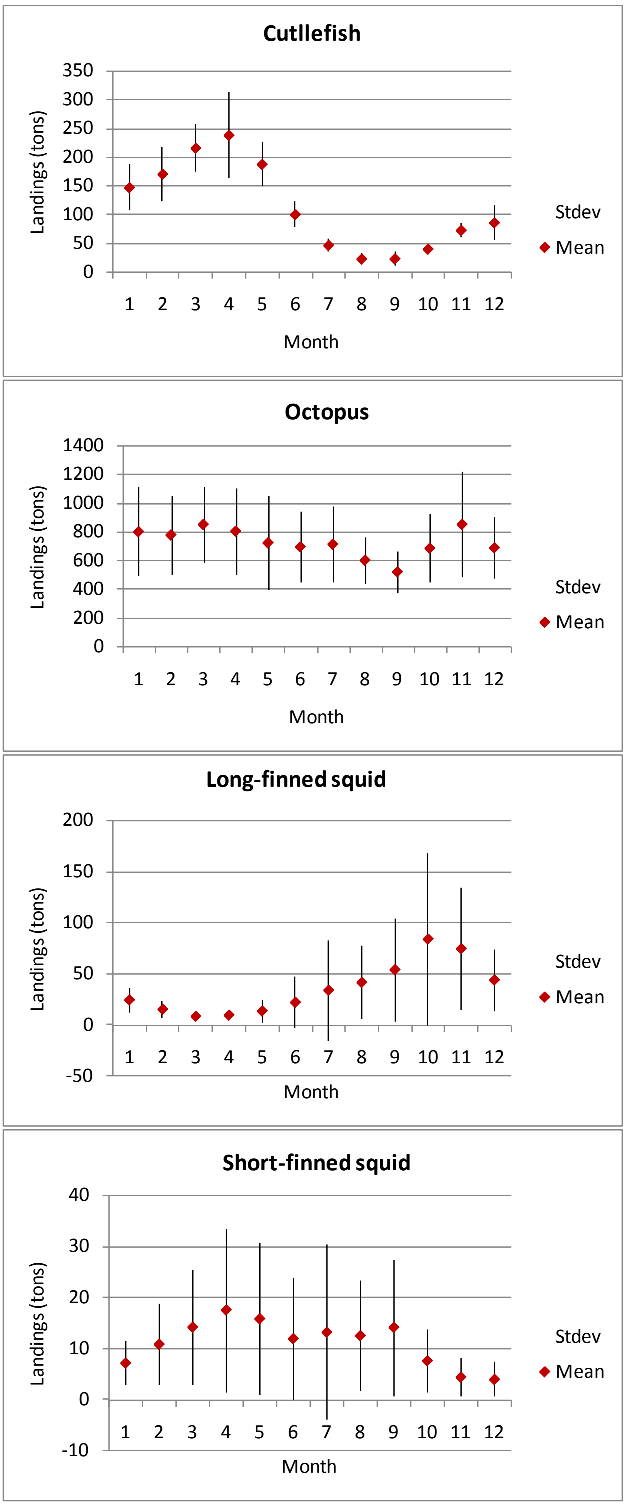

Figure 2. Cephalopod monthly landings from ICES area IXa (mean: years 2000 to 2009).

Landings of Octopus by species

With the DCF implementation an effort was made to discriminate cephalopod species in fisheries statistics. In Table 3 are presented the yearly landings of *Octopus vulgaris* and *Eledone cirrhosa* from Portuguese waters (ICES IXa) between 2006 and 2009. Nevertheless there is still a fraction of octopus landings which is presently not split by species (e.g. 1107 tons in 2009). Monthly landings of the two species show a marked seasonality of *Eledone cirrhosa* landings, which presents much higher landings during spring months (Figure 3).

Table 3. Landings of *Octopus vulgaris* and *Eledone cirrhosa* from Portuguese waters (ICES IXa).

Year	octpodidae nep	*Octopus vulgaris*	*Eledone cirrhosa*
2006	3245.5	3682.3	146.2
2007	3617.5	4688.8	146.1
2008	4387.7	8755.4	118.1
2009	1107.1	6598.1	162.4

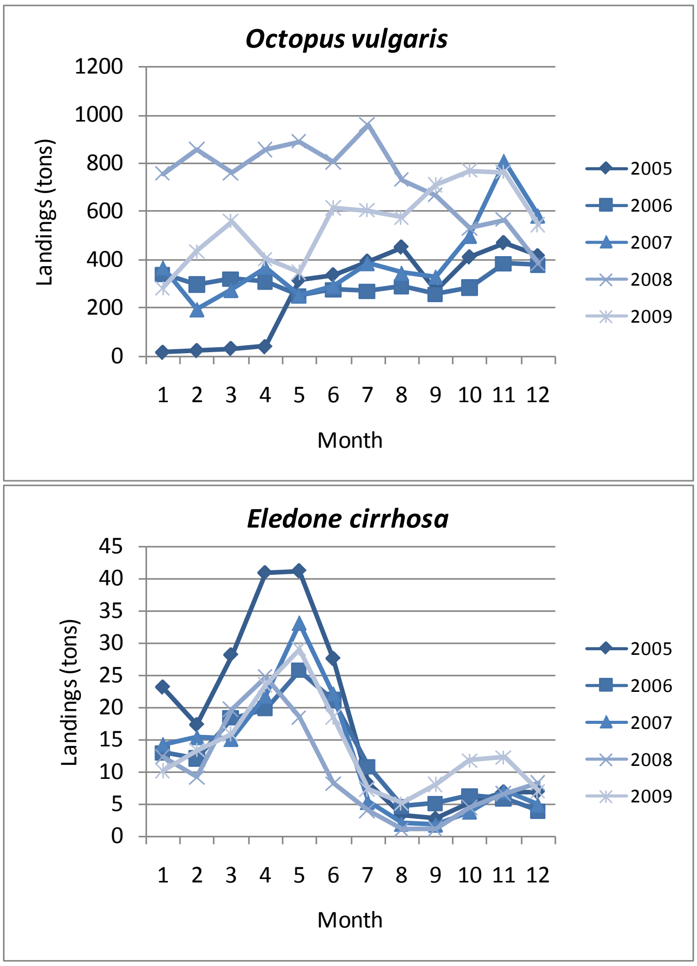

Figure 3. *Octopus vulgaris* and *Eledone cirrhosa* monthly landings from ICES area IXa.

Landings of Long-finned squid by species

Landings of long-finned squid started also to be split into species; in this case, a fraction of landings is presently identified as common squid, *Loligo vulgaris*. Monthly landings of *L. vulgaris* (Figure 4) for the years 2007 to 2009 show a marked seasonality, with higher landings during late summer and autumn.

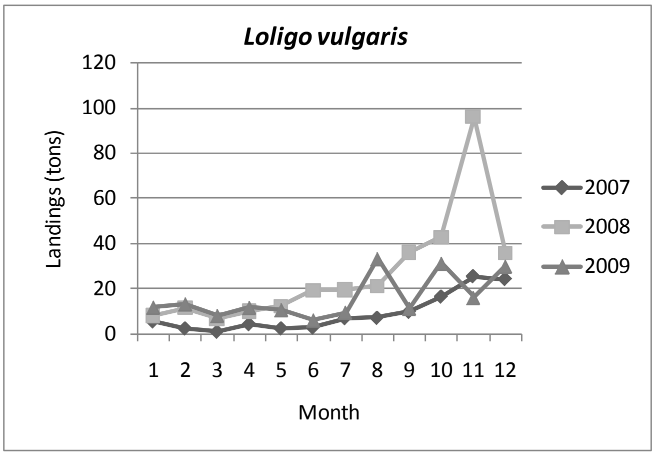

Figure 4. ***Loligo vulgaris*** **monthly landings from ICES area IXa.**

2. Cephalopod Discards in the trawl fleet

The following results concern data collected on board the Otter Bottom Trawl commercial fleet. This fleet comprises two components: the Otter Bottom Trawl for Crustaceans (OTB_CRU) (>=55 mm mesh size for shrimps and above 70 mm for Norway lobster) and the Otter Bottom Trawl for demersal fish (OTB_DEF) (65-mm mesh size). The trawl fleet targeting crustaceans (Norway lobster and rose shrimp) operates mainly in the Southwest and South in deeper waters, from 100 to 750 m, while the trawl fleet targeting fish and cephalopods (hake, horse mackerel, axillary sea breams, pouting, octopus, squids, blue whiting) operates off the entire Portuguese coast mainly at depths between 100 and 250 m. In table 4 achieved sampling levels are presented.

Cephalopods represent a very small fraction of the total discards of the Otter Bottom Trawl fisheries. The species which appear in discards are listed in Table 5. The most important cephalopod discards in weight are *Eledone* species and under sized *Octopus vulgaris* and in number is *Alloteuthis* sp. Cephalopod discards are generally higher in the OTB-CRU fleet than in the OTB-DEF fleet. This is also highlighted in the relationship between discards and landings of each cephalopod species, in the total hauls sampled each year, presented in Table 6.

Some species appear in catches very rarely, such as *Histioteuthis bonnelli*, *Ommastrephes bartrami* or *Octopus defilippi*, because of their low abundance and they are always discarded. These particular species are also only caught by the OTB-CRU fleet which operates in deeper waters (Tables 6 and 7). In this fleet 90 to 100% of cephalopod catches are discarded. The only exception is for *Octopus vulgaris*, with only around 60% of catches discarded.

The OTB-DEF shows a different discarding behavior for cephalopods, where the species with some a market value show a much lower discard percentage, namely *Eledone cirrhosa*, *Sepia officinalis*, *Octopus vulgaris*, *Todaropsis eblanae* and *Loligo vulgaris*.

Table 4. Trawl fleet sampling levels in Portuguese waters under the "Onboard Sampling Program" for the period 2004–2008.

Year/Metier	Trips		Hauls		Fishing hours	
	OTB_CRU	OTB_DEF	OTB_CRU	OTB_DEF	OTB_CRU	OTB_DEF
2004	17	24	111	126	476	317
2005	15	39	74	160	372	349
2006	7	42	30	194	133	374
2007	12	38	72	169	255	383
2008	12	34	66	128	305	317

Table 5. Mean percentage of cephalopod species discards in relation to the total discarded in samples taken under the "Onboard-observers Sampling Program" in Portuguese waters of ICES area IXa, from the Otter Bottom Trawl for Crustaceans (OTB_CRU) and the Otter Bottom Trawl for demersal fish (OTB_DEF) fleets.

Species	OTB_CRU mean % discards		OTB_DEF mean % discards	
	Weight	Number	Weight	Number
Sepia officinalis	0.1	0.2	0.17	0.40
Sepiolidae	0.8	0.9	0.35	0.55
Eledone moschata	3.7	0.8	0.47	0.28
Sepia elegans	0.4	0.7	0.17	0.69
Eledone cirrhosa	5.0	1.2	1.17	0.47
H. bonnellii	0.6	0.1	0	0
Alloteuthis sp.	0.2	0.8	1.33	3.99
Sepia orbignyana	0.2	0.3	0.17	0.28
Octopus vulgaris	5.0	0.2	1.76	0.28
O. bartrami	6.5	0.4	0	0
Octopus defilippi	0.5	0.1	0	0
Rossia macrosoma	0.6	0.8	0.17	0.28
Todaropsis eblanae	1.5	0.2	0.30	0.59
Illex coindetii	1.5	0.2	0.85	1.04
Loligo vulgaris	1.4	0.1	0.38	0.09
Todarodes sagittatus	1.2	0.4	0.72	0.22

Table 6. Discards (D) and landings (L) of cephalopod species, in the total hauls sampled each year in the Otter Bottom Trawl for Crustaceans (OTB_CRU) fleet and the Otter Bottom Trawl for demersal fish (OTB_DEF) fleet, under the "Onboard Sampling Program" of the DCF in Portuguese waters of ICES area IXa.

Species		*Sepia officinalis*		Sepiolidae		*Eledone moschata*		*Sepia elegans*		*Eledone cirrhosa*		*H. bonnellii*		*Alloteuthis sp.*		*Loligo vulgaris*	
FAO code		CTC		CTL		EDT		EJE		EOI		HQB		I_ALL		SQR	
Year	**Fleet**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**
2004		0.6	0	16.6	16.9	51.3	0	11.0	0	2034.1	185.2	-	-	13.5	0	-	-
2005		0.7	0	3.0	0	66.1	0	1.2	0	455.9	85.0	40	0	1.6	0	6.0	0
2006	OTB_CRU	-	-	-	-	42.9	0	11.6	1.0	95.7	3.0	-	-	-	-	-	-
2007		0.9	0	22.8	0	69.5	0	0.5	0	277.8	0	-	-	1.7	0	-	-
2008		0.5	0	0.5	0	4.9	0	2.4	0	110.8	1.0	-	-	1.8	0	3.4	0
2004		2.3	56.1	5.0	1.5	-	-	17.3	0	109.6	295.8	-	-	353.9	22.0	29.5	20.0
2005		0.9	1.0	-	-	12.2	50.0	26.3	0	94.9	206.4	-	-	321.5	0	12.4	189.0
2006	OTB_DEF	11.1	0	7.8	3.0	8.8	0.0	11.8	0	86.0	164.5	-	-	38.7	0	-	-
2007		1.7	0	-	-	28.0	0.5	10.5	0	53.8	193.0	-	-	47.2	0	21.4	0
2008		5.3	8.0	-	-	12.0	0	14.1	0	38.5	52.0	-	-	284.6	22.0	-	-

Species		*Sepia orbignyana*		*Octopus vulgaris*		*O. bartrami*		*Octopus defilippi*		*Rossia macrosoma*		*Todaropsis eblanae*		*Illex coindetii*		*Todarodes sagittatus*	
FAO code		IAR		OCC		OFJ		OQD		ROA		SQE		SQM		TDQ	
Year	**Fleet**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**	**D**	**L**
2004		31.3	4.0	7.0	11.0	-	-	3.4	0	68.4	0	23.2	0	12.2	16.5	133.3	0
2005		-	-	26.3	2.7	11.2	0	-	-	42.7	0	16.6	0	200.8	4.0	82.8	0
2006	OTB_CRU	3.5	0	-	-	-	-	-	-	30.9	0	-	-	8.1	0	-	-
2007		-	-	-	-	-	-	-	-	34.1	0	-	-	28.3	0	2.0	0
2008		1.1	0	64.9	64.0	-	-	-	-	13.4	0	0.7	0	2.2	0	4.0	0
2004		24.5	0.4	24.8	256.8	-	-	-	-	-	-	1.6	12.2	37.3	109.2	20.5	23.4
2005		7.4	0	79.0	534.4	-	-	-	-	24.6	0	-	-	13.1	5.3	278.9	0.9
2006	OTB_DEF	1.1	0	161.2	278.3	-	-	-	-	0.6	0	-	-	-	-	-	-
2007		7.0	0	157.3	163.5	-	-	-	-	6.7	0	-	-	7.7	0	-	-
2008		7.2	0	588.9	1436	-	-	-	-	0.8	0	-	-	1.4	0	26.7	0

Table 7. Percentage of discards of cephalopod species, in the total hauls sampled in the Otter Bottom Trawl for Crustaceans (OTB_CRU) fleet and the Otter Bottom Trawl for demersal fish (OTB_DEF) fleet, under the "Onboard Sampling Program" of the DCF in Portuguese waters of ICES area IXa.

Species	OTB_CRU	OTB_DEF
Sepia officinalis	100	58.5
Sepiolidae	87.4	74.6
Eledone moschata	100	79.4
Sepia elegans	98.4	79.4
Eledone cirrhosa	95.1	31.4
H. bonnellii	100	-
Alloteuthis sp.	100	97.4
Sepia orbignyana	96.2	99.7
Octopus vulgaris	60.0	26.6
O. bartrami	100	-
Octopus defilippi	100	-
Rossia macrosoma	100	100
Todaropsis eblanae	100	11.3
Illex coindetii	88.1	74.2
Loligo vulgaris	100	55.3
Todarodes sagittatus	100	82.1

Annex 9: Working document 5. Scottish (UK) Squid Landings.

Squid samples caught in Scottish waters primarily consist of *Loligo forbesi*, although it is possible to find examples of *Loligo vulgaris* and *Alloteuthis subulata* on occasion. Squid fisheries in UK waters are not currently regulated or managed, and although there has been a general increasing trend in landings over the past decade, catch has been somewhat variable, including a drastic decline in landings beginning in 2003 for Scotland as a whole, and starting during the 2005 fishing season in the Moray Firth region, specifically (Figure 1, Table 1).

The Moray Firth is a triangular inlet of the North Sea situated on Scotland's north-eastern coast. The commercial squid fishery in the Moray Firth typically materializes during the months of August through November. Squid is landed primarily in the ports of Fraserburgh and Buckie, with nominal catch landed in the smaller ports of Burghead and Macduff. Historically, the fishery has been small-scale, with 2–3 vessels off each fishing area participating in the directed fishery each year. During 2003, a large directed fishery was established approximately 50 metres offshore from Buckie, with increased landings also seen in Fraserburgh, partially a result of high catches off of Trouphead. The fishery sustained comparable landings in tonnes through to 2005, and during the same year fishing effort off of Buckie alone yielded over 700 tonnes of squid with a market value of over GBP£ 1 000 000, with highest landings during the month of September, and directed catch continuing as late as December.

The directed fishery in 2006 failed to yield the landings of the previous seasons (see Figure 2). Across Scotland, total landings (directed and by-catch) decreased by over 50% from the previous year, with total market revenue decreasing by over GBP £ 1 000 000 (Figure 3, Table 2). Scottish Fisheries Protection Agency (SFPA) officers in Buckie reported large (> 10 m) vessels arriving and changing to squid gear in early August, but also reported the presence of unfavourable weather. A combination of strong tides and easterly gales occurred in September, and the Buckie fishery failed to materialize, with the exception of a few small vessels (< 10 m) fishing off Burghead. It was hypothesized that the environmental conditions had contributed to the low catch, as approximately 18 years ago when similar weather conditions were present over a prolonged period, squid and lobster were observed washed up along the shoreline in the area.

The fishing season in 2006 was identified by fishers as being anywhere from June to August, with June as the most frequent response given. Fishers all reported that active squid fishing began at least a month earlier than in previous years. As the fishery did not produce landings comparable with past seasons, the majority of the fishers surveyed stopped directed squid fishing during the months of September, October or November. All fishers then went back to targeting prawns, with the addition of haddock and monkfish by the larger vessel which lands in Buckie.

Squid landings in the Moray Firth in 2007 were higher than those of the previous fishing season, but failed to reach the quantity landed during the years immediately prior to the 2006 fishery decline (e.g., 2003–2005 landings), and decreased in amount during 2008. Although total squid landings have decreased for the Moray Firth, landings in 2007 and 2008 continued to follow a seasonal pattern (Figure 2).

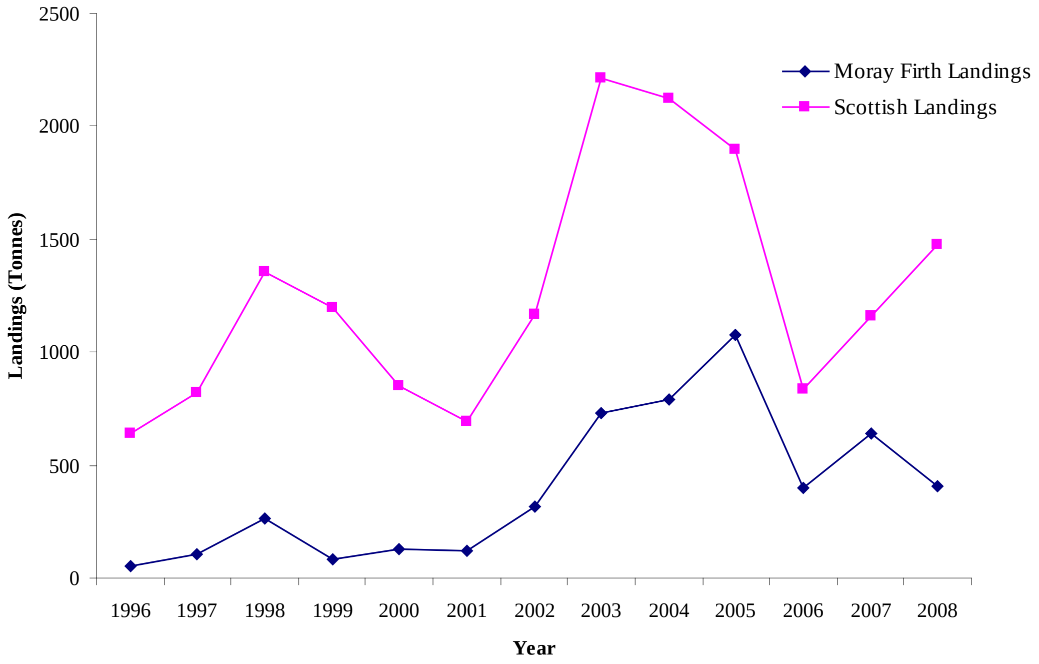

Figure 1. Yearly total squid landings for all of Scotland and for the Moray Firth.

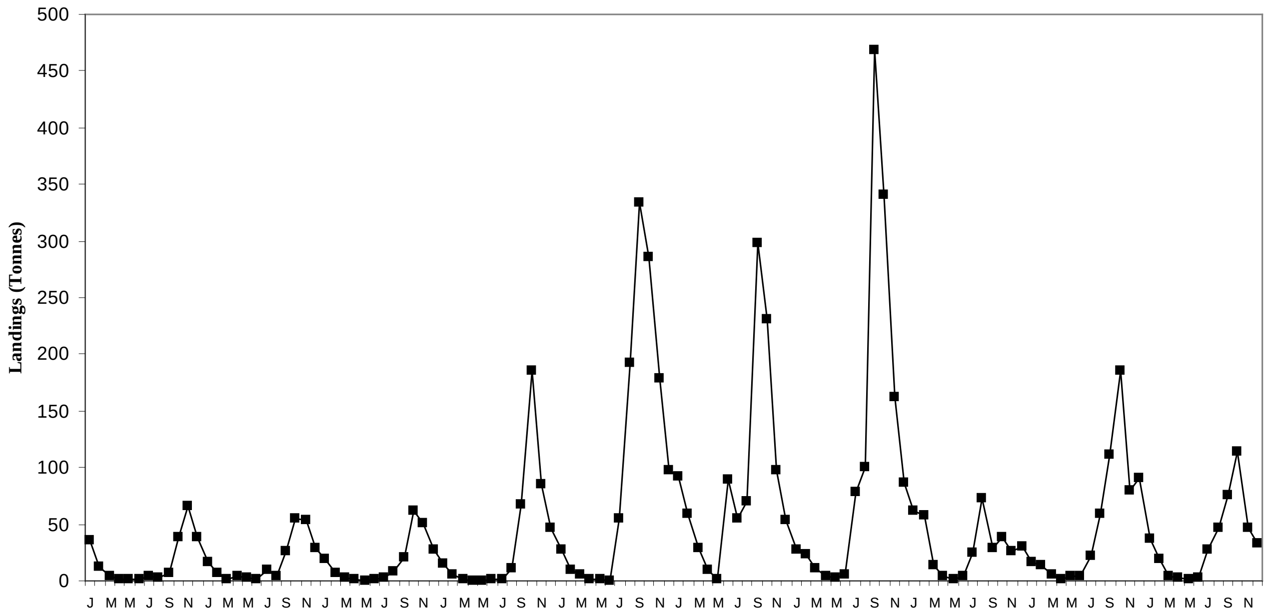

Figure 2. Monthly combined squid landings for all Moray Firth ports from 1999–2008.

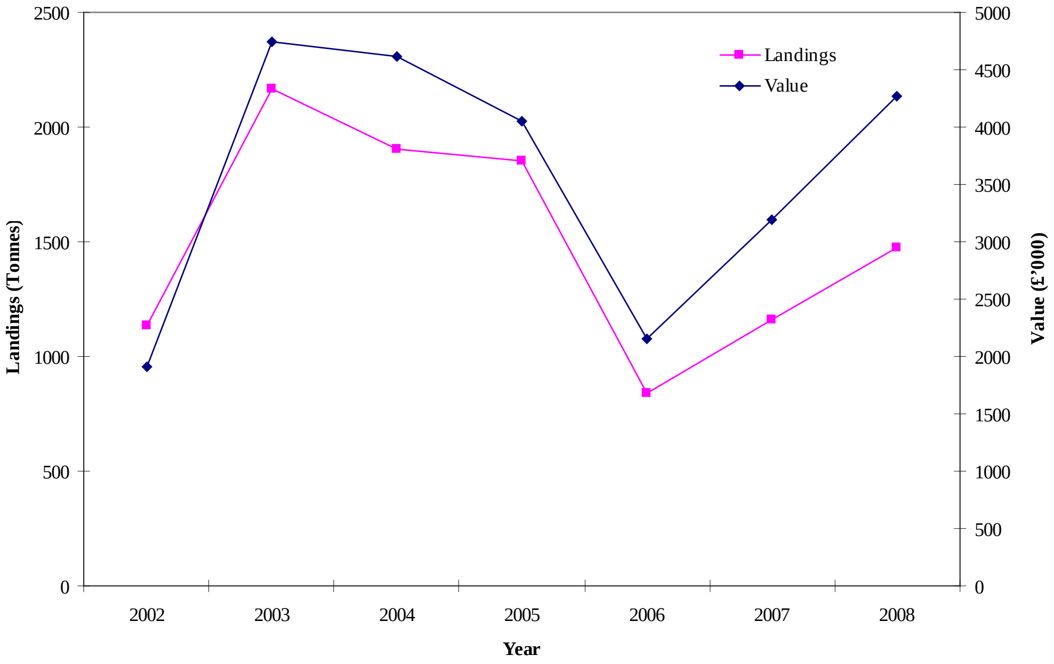

Figure 3. Total landings and market value of squid for Scottish ports in the years 2002–2008.

Table 1. Yearly Landings of Squid (in Tonnes) at Scottish Ports.

Port	2002	2003	2004	2005	2006	2007	2008
Eyemouth	184	256	671	74	41	78	29
Pittenweem	NA	NA	67	NA	20	112	NA
Aberdeen	58	76	219	189	53	35	NA
Peterhead	98	153	275	125	141	157	235
Fraserburgh	285	632	1480	571	283	372	223
Buckie	158	534	1276	735	80	220	187
Wick/Scrabster	104	125	NA	69	38	46	133
Shetland	66	52	81	55	136	104	130
Lochinver	51	150	135	NA	NA	NA	NA
Kinlochverbie	53	124	321	33	47	34	199
Ullapool	38	44	93	NA	NA	NA	314
Mallaig	NA	NA	NA	NA	NA	NA	23
Portree	41	21	NA	NA	NA	NA	NA
TOTAL	1136	2167	4618	1851	839	1158	1473

Table 2. Value (in £'000) of Yearly Squid Landings at Scottish Ports.

Port	2002	2003	2004	2005	2006	2007	2008
Eyemouth	249	688	671	182	102	210	83
Pittenweem	NA	NA	67	NA	72	324	NA
Aberdeen	104	157	219	371	174	119	NA
Peterhead	171	303	275	273	317	432	702
Fraserburgh	479	1432	1480	1272	722	1023	592
Buckie	249	1150	1276	1574	199	594	445
Wick/Scrabster	197	272	NA	178	82	105	395
Shetland	105	103	81	142	407	323	401
Lochinver	108	285	135	NA	NA	NA	NA
Kinlochverbie	70	197	321	64	78	64	551
Ullapool	74	99	93	NA	NA	NA	1044
Mallaig	NA	NA	NA	NA	NA	NA	262
Portree	102	55	NA	NA	NA	NA	NA
TOTAL	1908	4741	4618	4056	2153	3194	4275

Annex 10: Working document 6. Fisheries and Biological Information on Cephalopods Obtained through the Spanish National Sampling Programme within the Framework of the EU Data Collection Regulation.

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A new National Sampling Programme (PNDB, in their Spanish abbreviation) have been carried out since 2009, according to the multiannual Community programme (Commission Decision 2008/949/EC) pursuant to Council Regulation (EC) 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy. Following this Community Program, the metiers to be sampled have been previously identified following a ranking system. Furthermore, a concurrent sampling strategy has been established for both landings at market and samplings onboard commercial vessels. This concurrent strategy involves the sampling of all the species caught by fishing trip, following the selected sampling scheme, starting with the species belonging to Group 1, followed by the ones belonging to Group 2 and finally by those of Group 3. Allocation of species to Group 1 and 2 is specified in Appendix VII of the Commission Decision 2008/949/EC. Main commercial cephalopods species are included in Group 2.

Table 1 shows the metiers corresponding to the Spanish fleet operating in the ICES area that have been identified for sampling purpose into the Spanish National Programme. Those metiers where cephalopods have been sampled are indicated, as well as the sampling frequency and sampling intensity in 2009.

The greater numbers of metiers with cephalopods samplings are located in IXa and VIIIc Divisions. The metier "Otter bottom trawl demersal fish" (OTB) is the one with the higher number of fishing trips with cephalopods samplings, as well as the one with the higher number of cephalopods samplings. Almost the 100% of the sampled fishing trips in the metier "Trap molluscs" (FPO) included cephalopods sampling, due to the monoespecific character of this metier that specifically targets *Octopus vulgaris*. The 20% (254 fishing trips) of all the fishing trips sampled in 2009 included cephalopod samplings. However, only the 8,3% (487 samplings) of the total samplings carried out were for cephalopods.

The cephalopod species sampled by ICES Area during 2009 are showed in Table 2, with indications of the total number of samplings and the total number of individuals sampled by metier. A total number of 487 samplings were carried out in 2009. More than 20200 individuals of the different cephalopod species were measured. The greater number of species has been sampled in the metier "Bottom Otter Trawl demersal fish" (OTB_DEF), in all the sampling zones. The main sampled species in the different areas were *Octopus vulgaris, Loligo vulgaris, Sepia officinalis* and *Eledone cirrhosa. Eledone moschata* only appeared in the Subdivision IXa-South, where it has been broadly sampled in the metier "Bottom Otter Trawl demersal fish, crustaceans and molluscs" (OTB_FCM_IXaS). Most of the samplings of *Sepia elegans* were also carried out in the metier OTB_FCM_IXaS. *Octopus vulgaris* constituted the only species caught and sampled in the metier "Traps molluscs" (FPO_MOL), in both the

VIIIc W and the IXa N Subdivisions. Samplings carried out in the metiers "Pair Trawl pelagic and demersal fish" (PTB_FIF) and "Gillnet demersal fish" (GSN_DEF) were scarce, being Ommastrephidae and *Loligo vulgaris* the only cephalopods sampled. The cephalopod group "Ommastrephidae", which was sampled in most of the metiers, probably included a mixture of the species *Illex coindetii* and *Todaropsis eblanae*.

Biological sampling

The species required in the DCR (listed in Appendix VII) for biological samplings are *Octopus vulgaris, Sepia officinalis* y *Loligo vulgaris.* The stocks of these species belonging to the IXa and VIIIc Divisions have been sampled. The periodicity required for providing the biological information of these species is every three years. Biological variables studied include length/weight relationship, sex and maturity. Periodicity of samplings of the three species since the beginning of the National Program (2002) until 2013, is shown in Table 3.

Research surveys

The research surveys at sea carried out by Spain and covered by the National Program are the Western IBTS 4th quarter, including Porcupine survey (VI, VII), Demersal survey (VIIIc, IXa North) and ARSA Survey (IXa South). Fishery and biological information obtained from these surveys during 2009 is shown in Table 4.

Table 1. Metiers sampled in the Spanish National Sampling Programme in 2009 by ICES Division, indicating if cephalopod samplings were made or not in that metier (YES/NO), number of sampled fishing trips by metier (A), number of sampled fishing trips with cephalopod samplings by metier (B), percentage of sampled fishing trips with cephalopod samplings in relation to the total number of sampled fishing trips (C), number of species sampled by metier (D), number of cephalopod samplings by metier (E) and percentage of cephalopod sampling in relation to the total number of samplings by metier.

Area-Division	Metier		Ceph Sampling	A(nº)	B(nº)	C(%)	D(nº)	E(nº)	F(%)
Division VIa	Long Line demersal fish	LLS_DEF_VIa	NO	1			2		
Division VIIj	Gillnet demersal fish	GSN_DEF_VIIj	NO	2			10		
Division VIIIab	Bottom Otter Trawl demersal fish	OTB_DEF_VIIIab	YES	37	1	2,7	225	3	1,3
	Gillnet demersal fish	GSN_DEF_VIIIab	NO	19			61		
	Long Line demersal fish	LLS_DEF_VIIIab	NO	5			8		
Subárea VI	Long Line demersal fish	LLS_DEF_VI	NO	2			3		
Subárea VII	Bottom Otter Trawl demersal fish	OTB_DEF_VII	YES	77	27	35,1	557	38	6,8
	Gillnet demersal fish	GSN_DEF_VII	NO	23			94		
	Long Line demersal fish	LLS_DEF_VII	NO	36			97		
Subdivision IXa-Center	Bottom Otter Trawl demersal fish	OTB_DEF_IXa C	YES	20	19	95,0	422	58	13,7
	Purse seine small pelagic fish	PS_SPF_IXa C	YES	14	1	7,1	29	1	3,4
Subdivision IXa-North	Bottom Otter Trawl demersal and pelagic fish	OTB_MPD_IXaN	YES	24	3	12,5	86	5	5,8
	Bottom Otter Trawl demersal fish	OTB_DEF_IXa N	YES	63	40	63,5	730	80	11,0
	Pair Trawl pelagic and demersal fish	PTB_FIF_IXa N	YES	44	3	6,8	100	3	3,0
	Purse seine small pelagic fish	PS_SPF_IXa N	NO	150			247		
	Small Gillnet demersal fish	GSN_DEF_IXa N	NO	24			130		
	Traps molluscs	FPO_MOL_IXa N	YES	32	31	96,9	32	31	96,9
	No assigned	No assigned	YES	1	1	100,0	1	1	100,0
Subdivision IXa-South	Small Gillnet demersal fish	GSN_DEF_IXa S	NO	17			50		
	Hand Line deep water species	LHM_DWS_IXa S	NO	18			74		
	Long Line deep water species	LLS_DWS_IXa S	NO	24			24		
	Bottom Otter Trawl demersal fish, crustaceans and molluscs	OTB_FCM_IXa S	YES	48	46	95,8	634	141	22,2
	Purse seine small pelagic fish	PS_SPF_IXa S	NO	67			99		
Subdivision VIIIc-East	Bottom Otter Trawl demersal and pelagic fish	OTB_MPD_VIIIc E	NO	4			29		
	Bottom Otter Trawl demersal fish	OTB_DEF_VIIIc E	YES	24	1	4,2	193	2	1,0
	Pair Trawl pelagic and demersal fish	PTB_FIF_VIIIc E	YES	9	1	11,1	59	4	6,8
	Purse seine small pelagic fish	PS_SPF_VIIIc E	NO	88			105		
	Small Gillnet demersal fish	GSN_DEF_VIIIc E	YES	48	1	2,1	154	1	0,6
	Hand Line pelagic fish	LHM_SPF_VIIIc E	NO	38			38		
	Long Line demersal fish	LLS_DEF_VIIIc E	NO	27			82		
Subdivision VIIIc-West	Bottom Otter Trawl demersal fish	OTB_DEF_VIIIc W	YES	53	45	84,9	713	85	11,9
	Pair Trawl pelagic and demersal fish	PTB_FIF_VIIIc W	YES	16	15	93,8	68	15	22,1
	Purse seine small pelagic fish	PS_SPF_VIIIc W	NO	69			94		
	Small Gillnet demersal fish	GSN_DEF_VIIIc W	YES	124	1	0,8	578	1	0,2
	Traps molluscs	FPO_MOL_VIIIc W	YES	18	18	100,0	18	18	100,0
	Long Line demersal fish	LLS_DEF_VIIIc W	NO	3			8		
Total				1269	254	20,0	5854	487	8,3

A(nº)= Number of sampled trips by metier
B(nº)= Number of sampled trips with cephalopod sampling by metier
C(%)= Percentage of sampled trip with cephalopod sampling in relation to the total number of sampled trips
D(nº)= Number of species samplings by metier
E(nº)= Number of cephalopod samplings by metier
F(%)= Percentage of cephalopod samplings in relation to the total number of species samplings by metier

Table 2. Cephalopod species sampled in the Spanish metier from ICES Area in 2009 showing the number of samples and the total number of cephalopod by metier.

Area-Division	Metier	Species	Total samplings	Nº ceph. sampled
Divisions VIIIab	Bottom Otter Trawl demersal fish OTB_DEF_VIIIab	*Eledone cirrhosa*	1	30
		Loligo vulgaris	1	38
		Ommastrephidae	1	347
Subarea VII	Bottom Otter Trawl demersal fish OTB_DEF_VII	*Eledone cirrhosa*	9	552
		Loligo vulgaris	7	315
		Ommastrephidae	18	1126
		Sepia officinalis	3	96
		Todaropsis eblanae	1	22
Subdivision IXa-Center	Bottom Otter Trawl demersal fish OTB_DEF_IXa C	*Alloteuthis spp*	3	151
		Eledone cirrhosa	18	798
		Illex coindetii	3	92
		Loligo spp	1	28
		Loligo vulgaris	4	39
		Octopus vulgaris	8	122
		Ommastrephidae	10	407
		Sepia elegans	1	0
		Sepia officinalis	3	118
		Todarodes sagittatus	5	126
		Todaropsis eblanae	2	69
	Purse seine small pelagic fish PS_SPF_IXa C	*Loligo vulgaris*	1	1
Subdivision IXa-North	Bottom Otter Trawl demersal and pelagic fish OTB_MPD_IXaN	*Eledone cirrhosa*	1	44
		Octopus vulgaris	1	54
		Ommastrephidae	2	127
		Sepia officinalis	1	47
	Bottom Otter Trawl demersal fish OTB_DEF_IXa N	*Alloteuthis spp*	4	311
		Eledone cirrhosa	34	1867
		Loligo spp	1	82
		Loligo vulgaris	4	33
		Octopus vulgaris	9	137
		Ommastrephidae	15	724
		Sepia elegans	2	70
		Sepia officinalis	5	146
		Todarodes sagittatus	1	2
		Todaropsis eblanae	5	273
	Pair Trawl pelagic and demersal fish PTB_FIF_IXa N	*Illex coindetii*	1	67
		Ommastrephidae	2	123
	Traps molluscs FPO_MOL_IXa N	*Octopus vulgaris*	31	2017
	No assigned	*Octopus vulgaris*	1	168
Subdivision IXa-South	Bottom Otter Trawl demersal fish, crustaceans and molluscs OTB_FCM_IXa S	*Eledone cirrhosa*	4	41
		Eledone moschata	28	1640
		Illex coindetii	9	51
		Loligo vulgaris	26	1071
		Octopus vulgaris	26	166
		Sepia elegans	20	1032
		Sepia officinalis	27	976
		Todarodes sagittatus	1	4
Subdivision VIIIc-East	Bottom Otter Trawl demersal fish OTB_DEF_VIIIc E	*Loligo spp*	1	46
		Todaropsis eblanae	1	91
	Pair Trawl pelagic and demersal fish PTB_FIF_VIIIc E	*Eledone cirrhosa*	1	2
		Loligo spp	1	15
		Todarodes sagittatus	1	5
		Todaropsis eblanae	1	128
	Small Gillnet demersal fish GSN_DEF_VIIIc E	*Octopus vulgaris*	1	1
Subdivision VIIIc-West	Bottom Otter Trawl demersal fish OTB_DEF_VIIIc W	*Cephalopoda*	10	86
		Eledone cirrhosa	36	1148
		Illex coindetii	1	71
		Loligo vulgaris	2	7
		Octopus vulgaris	1	40
		Ommastrephidae	35	1162
	Pair Trawl pelagic and demersal fish PTB_FIF_VIIIc W	*Cephalopoda*	1	15
		Ommastrephidae	14	751
	Small Gillnet demersal fish GSN_DEF_VIIIc W	Ommastrephidae	1	1
	Traps molluscs FPO_MOL_VIIIc W	*Octopus vulgaris*	18	892

Table 3. Biological sampling carried out (2002–2009) and planned (2010–2013) under the DCR.

Sp (*)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Octopus vulgaris				X	X				X			X
Sepia officinalis			X	X			X			X		
Loligo vulgaris				X		X			X		X	

(*: Biological sampling have been carried out in Subdivision IXa South, Gulf of Cadiz)

Table 4. Cephalopod species sampled in Porcupine, Demersal and ARSA Survey during 2009, showing the different information obtained (□=No , ■= Yes) in relation to length frequency (A), biological parameters (B), yield in number (C) and yield in weight (D).

	Porcupine				**Demersal**				**ARSA**			
sp	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Octopus vulgaris	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eledone moschata	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Eledone cirrhosa	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sepia officinalis	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Sepia elegans	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Sepia orbignyana	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Loligo vulgaris	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Loligo forbesii	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Illex coindetii	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Todaropsis eblanae	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Todarodes sagittatus	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Rosia macrosoma	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Bathypolipus sponsalis	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Opistoteuthis agassizii	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Octopus salutii	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
Rest of species	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes