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11-14 June 2013

Caen, France

ICES International Council for the Exploration of the Sea

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Contents

Excecutive Summary

The Working Group on Cephalopod Fisheries and Life History (WGCEPH) 2013/2/SSGEF13, chaired by Marina Santurtún, Spain met at University of Caen in Caen, France, 11-14 June 2013, in addition to working by correspondence.

Back ground

Cephalopod resources in the ICES area have apparently fluctuating with no trend in the last 4 years (2008-2011) in Europe. In 2013, a new data call was launched through ICES to all European countries fishing in ICES areas (see Section 8.1). Data were delivered for the most important countries deploying cephalopod fisheries. A detailed Table on data availability is summarized in Annex 2.

Landing and survey data were collected for 2011 and 2012. 2012 data has to be considered preliminary and will be revised in 2014 group. France (which takes around 65% of the European Atlantic cuttlefish catch) has no validated data for 2009.

Due to the data call data for the last years have been delivered, however the catch matrix could show inconsistencies due to the lack of updated landings from all European countries for years prior to 2008. Despite this, cephalopod landings have no marked trends alternating years of increase and decrease in landings.

The aim of the ToR dedicated to métiers cpues and Surveys is to check whether catch trends of the commercial fishery are considered as good index of abundance of the stock. In case of some species and surveys (ARSA in Div. IXa) cpues appear to closely follow the abundances changes detected by the commercial fleet. Similar no-analytical approach for assessments would be tried in the future for other cephalopod species, under different segmentation (métiers) of the commercial fleets and restricted to the timing of the surveys. Ideally the group will look for the support of fisheries experts from each of the countries deploying cephalopod fisheries. Also, for trying analytical assessment some group experts will participate on the WKMCC (Working group on the need on Management of Cragon and Cephalopods) in which the possibility of assessment and management for some cephalopod species will be commonly discussed.

A wealth of recent research has focused on innovative research on abundance and distribution of cephalopod in relation to environmental variables, the role of cephalopods in the ecosystems and the possibility of use of cephalopods as indicators and descript tor of the GES (Good Environmental Status) under the Marine Strategy Framework Directive. The aim to integrate the scientific and advisory work for implementing an ecosystem approach based on qualitative descriptors (including healthy stocks and sustainable exploitation). This expert group could assure the baseline knowledge of the species status to secure the ecological sustainability of cephalopod stocks on which these fishing communities ultimately depend. Valuable revisions of the knowledge in the last years on those lines have been deployed. Understanding the effect of the environment on cephalopod biology and dynamics in the context of the global integrated research studies on the ecosystem is of great interest. There is still a need for assessment models for establishing the cephalopod population levels and exploitation rate. The ecosystem based fisheries assessment and management. And furthermore the Integrated Ecosystem Assessment should incorporate these species as fundamental piece of the ecosystem functioning.

The current low level of fishery data collection on European cephalopods in relation to the high data demands imposed by their short life cycles is a recurrent issue identified at the group as impeding further analytical assessment. Through the data call, the group was able to get cephalopod data prior to the meeting. For the second year, a preliminary data analysis for trends in abundances, based on cpues and Abundance Indices from surveys, was deployed setting the basis for continuous work and future data calls.

WGCEPH has deployed a complete plan for the next 3 years. ToRs have been defined and a clear direction of the group towards science and advice, based on two basic pillars: fisheries updating and stock status and knowledge revision and development.

Attendance

The WGCEPH meeting at Univ. Caen was attended by 7 of the currently 39 appointed WGCEPH members. These participants represented three ICES member states (France, Spain and UK). Four group members worked in the distance by correspondence giving their support to the group. Full details of the participants and contributors to the WGCEPH report can be found in Annex 1.

1 Section 1: WGCEPH Terms of Reference

The Working Group on Cephalopod Fisheries and Life History (WGCEPH) 2013/2/SSGEF13, chaired by Marina Santurtún, Spain met at University of Caen in Caen, France, 11-14 June 2013, in addition to working by correspondence. The meeting opened at 09.00 on the 11th and the Agenda was adopted. Terms of References:

a) Report on status and trends in cephalopod stocks.

i) Issue a data call at least 3 months ahead of the meeting

ii) Update, quality check and report relevant data prior to the working group meeting, including relevant fishery statistics (landings, directed effort, discards, survey catches, etc.) across the ICES area;

b) Review data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity-at-age, first maturity at length, growth, spawning season.

c) Produce and update cpue and survey dataseries for the main cephalopod métiers and species and assess the possibility of their use as abundance indices;

d) Conduct preliminary assessments of the main cephalopod species in the ICES area through examination of the above trends in relative exploitation rates (i.e., catch/survey biomass).

e) Review future options for stock assessment and their resource implications (e.g. for expertise required within WGCEPH).

f) Review and report on cephalopod research results in the ICES area, with particular attention to abundances and distributions and their relationships with environmental variables, the role of cephalopods in the ecosystem; indicators for cephalopods under the MSFD and assessment methods used in commercial cephalopod fisheries;

WGCEPH will report by 1 August 2013 (via SSGEF) for the attention of SCICOM.

2 Section 2. ToR a.ii) Update, quality check and report relevant data prior to the working group meeting, including relevant fishery statistics (landings, directed effort, discards, survey catches, etc.) across the ICES area.

2.1 Update of landing statistics

The present report provides new landing statistics for 2012 and updates numbers since 2000, for cephalopod groups caught in the ICES area (Tables 2.1.1 to 2.1.5). Data come from ICES STATLANT database, from additional national information supplied by Working Group members and from the data call on cephalopods launched by ICES in February 2013. The information supplied in these data call came from Spain, Portugal, France, Germany, The Netherland, Ireland, Sweden, UK and Scotland. The experts rely on data compiled in this report as the most precise information on cephalopod landings within the ICES area that can be obtained to date.

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 (2000–2012) per cephalopod group in each ICES division or subarea, separately for each nation, being the 2012 date provisional.

Table 2.1.1. presents landings of the 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. *S. elegans* has a high commercial value in Subdivision IXa south, and for this reason it appear separated in the landing date (WD 2). The most significant landings of these two families are in the southern and central areas, subareas VII, VIII and IX. In the last four years from 2009 to 2012 an increasing trend in landings is observed.

In Table 2.1.2. landings of groups species of common squid (including the long-finned squids *Loligo forbesi, L. vulgaris, Alloteuthis subulata*, and *A. media*) are shown. The main common squid landings are 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 subarea VII, and particularly divisions VIId,e. It is possible that some short-finned squid are currently grouped in this category. *Alloteuthis spp* is only separated in the landing of Subdivision IXa south due to the high commercial value, as it occurs with *S. elegans* in the same area (WD 2).

Table 2.1.3 contains landings of species group 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 subareas VII and VIII, particularly as result of Spanish catches.

Finally, Table 2.1.4 compiles octopod species group (including *Eledone cirrhosa, E. moschata* only in Subdivision IXa south 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. The proportion of landings from trawl and artisanal fleets change considerably within the area along the Atlantic coast of the Iberian Peninsula (WD 2; WD 4).

Table 2.1.5 summarizes total annual cephalopod landings in all ICES areas for main cephalopod groups. During the period of analysis (2000 to 2012), landings have been variable with a minimum of 21 400 t in 2009 and a maximum of 55 000 t in 2004. In 2012 landings increased to 52 900 t, with an increasing trend in the last four years from 2009 to 2012. The peak of total cephalopod landings was in 2004 with 55 500 t. Cuttlefish, traditionally providing the most significant landings, returned to values in the order of 15 000-25 000 t, after an exceptional year 2004. The mean percentage of cuttlefish from total cephalopod landings was around 44% until 2008**.** In 2009 an important decrease in cuttlefish percentage was observed. This drop is caused mainly to the lack of French data which comprises 63% of total cuttlefish landed. In all the time-series from 2000 to 2012, the landing proportions by species groups are: 43% cuttlefish, 32% octopods, 20% common squids and 6% short-finned squids.

Figure 2.1.1 provides information of total annual cephalopod landings in the whole ICES area for main cephalopod groups, per fishing nation. There are some annual fluctuations of landings per nation, but in general each nation maintains the similar proportional of the total share of annual landings. Data from 2012 have to be considered as preliminary causing changes in relative shares. It is expected that a increase in total landings will be registered when data will be updated next year.

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 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. From 2000 to 2008 France landed the 63% of cuttlefish and UK the 18%. They are followed by Spain and Portugal with the 9% of landings. 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, Scotland, Portugal and Spain, being France the one with highest share. In the years 2009 and 2010, due to the lack of data from France, Scottish landings became to be around 70% of total squid landings. However, France landings account for almost 12 000 t in 2011.

Short-finned Squid landings have suffered an important decrease with 5 500 t in 2000 to 970 t in 2007. This is the lowest valuable for any cephalopods species group. Landings are mainly from Spain with the 80% of share, followed by France with about 8% of total landings.

In the group of octopus landings, more than 95% are shared by two nations, Portugal and Spain. In the last twelve years from 2000 to 2012 Portuguese catches remain being the most important ones, in average around the 60% of total landings of the time-series.

It is important to note that despite of continuous fishing pressure, cephalopod resources in the ICES areas remain stable in trend catches, with some fluctuations, throughout the 32 years of recorded data. (See ICES WGCEPH Report 2007; ICES WGCEPH Report 2009, ICES WGCEPH Report 2012). In addition, it is important to emphasize the amount of fishing gear used in the capture of cephalopods in the ICES area, highlighting the fishery of octopus in the Iberian waters (WD 2).

In addition to the previous information, more disaggregated and detailed statistics of landings for different fisheries are presented as working documents. There are four working document attached in the ANNEX:

- WD 1: A two stage biomass model to assess the English Channel cuttlefish (*Sepia officinalis*) stock. Authors: Michaël Gras, Beatriz Roel, Franck Coppin, Eric Foucher and Jean-Paul Robin.
- WD 2: An update of cephalopod landings data of the Spanish fishing fleet operating in Ices area for 2000-2012 period. Authors: Luis Silva, Juan José Acosta and María del Mar Soriano.
- WD 3: Update of the Basque cephalopod fishery in the northeastern atlantic waters during the period 1994-2012. Authors: Ane Iriondo, Marina Santurtún, Estanis Mugerza, Jon Ruiz.
- WD 4: Portuguese cephalopod fishery statistics (tor a) and population parameters (tor b) – updating status and trends in ICES division IXa. Authors: Ana Moreno, Sílvia Lourenço, Ana Claudia Fernandes, Nuno Prista and João Pereira.
- WD 5: Note on Portuguese discard data submitted to WGCEPH13 data call. Authors: Nuno Prista, Ana Cláudia Fernandes, Ana Moreno.
- WD 6: Cephalopod fisheries in the SW Atlantic (2010-2012). Authors: Julio Portela.
- WD 7: Application of depletion methods to Mediterranean cephalopod stocks. Authors: S. Keller, JP Robin, M. Gras and A. Quetglas.

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	2010	2011	2012
ICES Division IIIa (Skagerrak and Kattegat)													
Denmark		2	6	18	21	29	58	50	37				
Germany													
Netherlands								0					
ICES Division IVa (Northern North Sea)													
Denmark		2	3	7	10	7	11	10	7				
Scotland					1			0	0				
France	0	0	0	0	1	0	4	2	2	0	3	0	
Germany													
ICES Division IVb (Central North Sea)													
Belgium	7	12	12	4	4	1	1	2	4				
France	0	0	0	0						1	4	1	2
Denmark		1	13	35	36	13	21	23	12				
England, Wales & Northern Ireland		0	3	0	1	1		0	0				0
Netherlands	0	0	3	3	1	1	0	1	0	1			
Scotland					1			0	0				
Germany													
ICES Division IVc (Southern North Sea)													
Belgium	12		206	64	103	57	57	33	53				
England, Wales & Northern Ireland	14	5	4	2	2	3	3	3	2				7
France	381	173	184	135	120	103	77	84	108	77	89	34	41
Netherlands	83	95	333	214	330	141	287	161	123	55	145		
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 & Northern Ireland	0			0				0	0				
France	1	0	0	4	0	1	0	1	0	10	0	0	
Scotland		5						0	0				
Spain	1	0	0	0	0			0	0	0		0	0
ICES Division VIIa (Irish Sea)													
Belgium	1	2	5	1	1	1		0	0				
England, Wales & Northern Ireland	1	0	0	1				0	0	0	0	0	
France	1	1	0	1	0	0	0	0	0	0	1	19	0
Netherlands											0		
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)													
England, Wales & Northern Ireland	0		0	0				0	0	4	1	0	1
France	0	0	1	14	13	1	0	2	0	1	2	2	3
Spain	3	17	3	5	10	12	9	9	19	11	73	29	1
Ireland										0	0	0	
ICES Divisions VIId, e (English Channel)													
Belgium	35	224	497	473	607	501	661	1331	801				
Channel Islands	26	8	11	9	7	7	3						
England, Wales & Northern Ireland	2910	2608	3407	4581	4858	2821	3412	4279	3416	1525	2637	2037	5222
France	8835	5672	10133	10970	12683	7582	8726	9663	5212	3555	6826	6229	7310
Netherlands	4	3	6	13	32	28	15	12	31	37	81		
Scotland								11	7				177
ICES Division VIIf (Bristol Channel)													
Belgium	1	12	4	7	38	16	5	6	7				
England, Wales & Northern Ireland	12	7	19	39	28	11	8	12	6				9
France	17	25	12	41	50	20	17	41	30	8	13	17	37
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)													
Belgium	2	3	6	15	55	20	5	5	4				
England, Wales & Northern Ireland	139	80	102	325	135	153	166	129	143	238	386	746	105
France	7	3	5	7	19	20	18	9	22	736	999	1.173	402
Ireland						3		0	1	0	0	1	22
Netherlands			0	1				0	0		1		
Spain	13	6	0	1	1	1		0		0	0	0	0
Germany													
ICES Subarea VIII (Bay of Biscay)													
Belgium	1	7	12	4	10	3		17	2				
England, Wales & Northern Ireland	0			29	18	19	1	0	0	0	0	0	0
France	5050	4908	2978	1156	6173	7753	3954	5586	2227	3.666	3.508	5.158	5.693
Netherlands		38						0	0	0			
Portugal	8	10	6	18	40	32	37					24	23
Spain	683	365	302	288	494	407	357	586	458	248	273	403	735
ICES Subarea IX													
Portugal	1357	1338	1362	1186	1514	1825	1822	1517	1453	1259	2009	1511	1165
Spain	1454	765	820	992	889	1112	1090	1036	935	965	1164	991	978
Total	**21059**	**16397**	**20458**	**20666**	**28313**	**22706**	**20826**	**24621**	**15122**	**12397**	**18212**	**18376**	**21936**

Table 2.1.2. Landings (in tonnes) of Common Squid (includes *Loligo forbesi, L. vulgaris* and *Alloteuthis subulata*).

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ICES Division IIIa (Skagerrak and Kattegat)													
Denmark	7												
Sweden*	0			1	5	3	10						1
Germany*										3	0	0	1
Netherlands*				0	0	0	0				1	2	2
ICES Division IVa (Northern North Sea)													
Denmark	3												
England, Wales & Northern Ireland	3	2	1	1	1	1		13	0				12
France	0	0	0	1	0	0	0	0	0	0	3	0	0
Germany*	0				1	0	1	1	2	0	1		1
Netherlands*			0										
Scotland*	547	349	688	1428	1442	344	676	864	675	1674	2105		671
ICES Division IVb (Central North Sea)													
Belgium	24	3	14	22	16	8	17	20	4				
Denmark	10												
England, Wales & Northern Ireland	29	36	70	159	162	161	85	65	30				23
France			0	0	0	1	54	15	2	7	44	30	2
Germany*	3			58	33	23	13	21	8	7	8	7	5
Netherlands*	3	5	40	33	24	28	16	15	10	5	11		
Scotland*	87	112	218	323	358	214	107	245	62				59
ICES Division IVc (Southern North Sea)													
Belgium	121	20	40	17	12	10	9	7	10				
England, Wales & Northern Ireland	4	12	5	2	2	3	2	2	2				
France	154	221	667	424	214	145	117	98	235	417	129	96	57
Germany*	2			4	4	1	1	0	0	0	0	0	0
Netherlands*	616	148	199	106	96	41	29	77	82	82	50		
Scotland*				1		1	2	1	0				
ICES Division Vb (Faroe Grounds)													
England, Wales & Northern Ireland	0	0	0	0				0	0	5	15	0	
Faroe Islands	0												
Scotland*	2			5	1			1	10	2	12		
France	0	0	0	0	1	0	0	1	0	1	0	0	0
ICES Division VIa (NW coast of Scotland and North Ireland)													
England, Wales & Northern Ireland	2	3	3	14	4		1	2	1				3
France	51	9	28	24	25	85	28	38	29	60	55	44	19
Germany								0	4				
Ireland*	38			63		49	20	29	15	34	41	57	26
Netherlands*	0								36		5	0	
Scotland*	210	192	196	367	321	72	88	71	69	145	323	455	59
Spain	3	0	3	10	2			10	3	3	0	0	
ICES Division VIb (Rockall)													
England, Wales & Northern Ireland	0	0	1	3				0	0				
Ireland*	3			5		8	18	13	139			25	17
Scotland*	5	34	59	86	23		4	12	703	239	585	700	
Spain	0		2									0	0
France	0	0	0	0	0	0	0	0	0	0		0	
ICES Division VIIa (Irish Sea)													
Belgium	3	2	9	2	1	3	1	1	1				
England, Wales & Northern Ireland	31	103	116	96	50	24	8	9	13	19	13	45	28
France	11	24	42	6	3	5	1	1	1	0	1	2	0
Ireland*	5		2	9		4	5	5	3	6	3	7	4
Isle of Man	0	1	0										
Netherlands*											1		
Scotland*	2			13	8	1		0	0				0
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)													
England, Wales & Northern Ireland	40	35	22	10	12	23	4	11	4	109	62	69	3
France	74	9	20	35	34	14	40	56	179	56	114	101	31
Ireland*	26	2	1	84		29	20	19	57	61	74	72	22
Netherlands*	0	0							13	0	0		
Scotland*	27		19	14	19	2	14	7	1				3
Spain	17	18	29	35	31	12	19	26	28	23	276	277	9
ICES Divisions VIId, e (English Channel)													
Belgium	254	22	59	72	54	36	46	106	76				
Channel Islands	9	1	2	1			2						
England, Wales & Northern Ireland*	449	439	553	435	481	321	273	369	313	295	253	371	353
France	2863	2318	3570	4926	4062	3139	3216	2960	2189	2.967	2.796	2.207	1.411
Netherlands*	10	20	20	59	123	111	128	196	195	237	262		
Scotland*													54
ICES Division VIIf (Bristol Channel)													
Belgium	8	1	5	10	14	9	5	4	5		10		
England, Wales & Northern Ireland	16	55	114	56	17	172	29	141	17	94	75	158	
France	86	248	153	145	123	243	116	179	117	103	187	218	178
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)													
Belgium	5	3	8	7	6	6	3	6	4				
England, Wales & Northern Ireland	202	166	116	35	134	51	44	51	73				22
France	30	60	55	24	20	35	19	18	30	273	197	266	174
Germany*										1			
Ireland*	67	12	37	164		172	52	75	84	20	21	152	181
Netherlands*	0	1	17				0	1	0	3	23	0	
Scotland*	100			75	70	57	45	3	7				76
Spain	77	14	3	2	2	2		0	0	0	1	0	
ICES Sub-area VIII (Bay of Biscay)													
Belgium	48	0	2	1	1	1		2	1				
England, Wales & Northern Ireland	0			18	18	6		1	0	0	0	0	14
France	670	856	814	834	1076	913	1609	1362		1172	2103	2207	3410
Netherlands*		8	44							2	0		
Portugal	1	1	1		9		1					4	17
Scotland*					1	61	12	0	0				
Spain	767	614	253	330	372	306	164	447	311	234	554	579	1273
ICES Sub-area IX													
France	42												
Portugal	619	898	686	328	1129	601	92	128	360	199	207	395	408
Spain	507	843	637	542	581	552	255	209	247	286	286	340	401
ICES Sub-area X (Azores Grounds)													
Portugal	58	137	196	536	261	272	3	721	664				
Total	**9054**	**8055**	**9840**	**12464**	**11939**	**8381**	**7525**	**8734**	**7124**	**8844**	**10906**	**8888**	**9032**

Country* - These countries report undifferentiated landings of Loliginids and Ommastrephids that were grouped here.
If 2 or more figures listed, the last one is the compound Loliginidae + Ommastrephidae.

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.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ICES Sub-area I + II (Barents Sea and Norwegian Sea)													
Norway					*			0	1				
France								0	0				
ICES Division IIIa (Skagerrak and Kattegat)													
Denmark					*								
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*													
France										0	2	11	0
ICES Division IVc (Southern North Sea)													
Germany*													
Netherlands*													
Scotland*								0	0				
France										15	5	19	7
ICES Division Va (Iceland Grounds)													
Iceland	1	0	0		1			0	7				
ICES Division Vb (Faroe Grounds)													
Faroe Islands				16		1		0	41				
Scotland*								0	0	0	0	0	
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)													
England, Wales & Northern Ireland		1	1	13	1	1		0	0	0	0	0	
Faroe Islands								0	250				
France	0	0	0	0	0	0	10	1	3	0	8	0	1
Ireland*				32		2	5	0	11	2	2	1	0
Scotland*								0	0				
Spain		0	11	0	0					0	0	0	0
ICES Division VIIa (Irish Sea)													
England, Wales & Northern Ireland				0				0	0	0	0	0	
France	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland*	0			6		7		0	1	0	0	0	
Scotland*								0	0	0	0	0	
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)													
England, Wales & Northern Ireland	35	19	25	16	26	1	1	1	0	0	0	0	0
France	28	11	27	61	20	14	46	9	34	9	16	9	10
Ireland*	29	75	63	27		8	15	1	2	14	49	6	6
Scotland*								0	0				
Spain	148	233	411	217	285	951	458	420	629	541	1413	1257	79
ICES Divisions VIId, e (English Channel)													
England, Wales & Northern Ireland*	0			1				0	0	0	0	0	0
France	3	4	8	2	19	13	10	9	10	277	215	384	114
Netherlands*													
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)													
England, Wales & Northern Ireland	151	173	144	85	66	18	9	17	7	0	0	0	21
France	2	1	1	2	2	5	0	0	4	100	75	53	40
Germany*											13		
Ireland*	83	60	91	49		19	4	12	16	1	1	13	12
Scotland*								0	0				
Spain	710	339	87	35	35	52	70	43	5	5	8	5	
ICES Sub-area VIII (Bay of Biscay)													
England, Wales & Northern Ireland	0			0				0	0	0	0	0	0
France	154	89	260	136	129	276	115	100	143	291	243	303	586
Portugal	2			1	5							1	79
Scotland*								0	0				
Spain	1400	868	584	474	495	634	326	251	395	430	898	1352	3784
ICES Sub-area IX													
Portugal	321	232	205	118	296	187	42	21	18	5	10	17	22
Spain	2461	2133	592	438	656	386	164	87	491	342	730	788	854
Total	**5529**	**4238**	**2509**	**1729**	**2040**	**2574**	**1275**	**971**	**2069**	**2034**	**3689**	**4220**	**5617**

Country* - These countries report undifferentiated landings of Loliginids and Ommastrephids that were grouped in Table 2.2. Here they are listed as “+”.

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	2010	2011	2012
ICES Division IIIa (Skagerrak and Kattegat)													
Sweden*													1
ICES Division IVa (Northern North Sea)													
Scotland	15	6	1	11	5	2	1	3	3				1
ICES Division IVb (Central North Sea)													
Belgium	5	6	2	2	2	2	2	1	2				
England, Wales & Northern Ireland	1	2	1	1	1	1	1	0	0				2
France												0	
Netherlands		1	0	0		0	0	0					
Scotland		0											1
ICES Division IVc (Southern North Sea)													
Belgium	1	1	1	1				1	0				
England, Wales & Northern Ireland			0	0				0	0				
Netherlands		0	2	0	0	0	0	0	0	0	0		
ICES Division VIa, b (NW coast of Scotland and North Ireland, Rockall)													
Belgium								0	0				
England, Wales & Northern Ireland				2	2			0	0	0	0	0	
Ireland	1							0	2	0	0	0	4
Scotland	0												1
Spain				0	0			0	0	0		0	0
ICES Division VIIa (Irish Sea)													
Belgium	5	11	31	20	5	1	2	0	1				
England, Wales & Northern Ireland		0	0	0				0	0	0	0	1	2
Ireland			1	1						0	1	0,1	
ICES Divisions VIIb, c (West of Ireland and Porcupine Bank)													
England, Wales & Northern Ireland	4	20	3	6	15	4	10	10	5	109	167	138	6
France	8	1	0	0		2	10					3	2
Ireland	4	5	1	6		1		0	0	1	17	21	0
Scotland		2		1				0	0				6
Spain	44	276	741	430	342	417	389	397	379	389	463	832	4
ICES Divisions VIId, e (English Channel)													
Belgium		0	2	2	2	1	3	5	8				
Channel Islands				3									
England, Wales & Northern Ireland	22	15	20	21	14	21	21	65	86	97	108	174	248
France	13	5	7	5		9	6				14	7	0
Netherlands					0					0	2		
Scotland													2
ICES Division VIIf (Bristol Channel)													
Belgium	13	1	9	13	24	10	16	20	9				
England, Wales & Northern Ireland	10	4	13	8	9	10	5	6	2				
France						1	1			0	1	0	0
Spain			2										
ICES Divisions VIIg-k (Celtic Sea and SW of Ireland)													
Belgium	16	6	12	13	12	5	6	6	3				
England, Wales & Northern Ireland	78	105	141	99	113	131	103	137	104	30	58	52	68
France	32	19	18	11		17	13				11	4	9
Ireland	7	9	11	17		29	3	3	7	2	1	23	34
Scotland	5	10	1	6		7	8	12	31				40
Spain	518	156	111	28	29	32	36	37	3	1	1		
ICES Sub-area VIII (Bay of Biscay)													
Belgium	4	5	13	1	5	3	6	15	8				
England, Wales & Northern Ireland	0			1	29	8		0	0				
France	104	54	60	45	130	103	95	114	205		106	134	109
Netherlands		6											
Portugal	250	70	70	98	164	102	73					15	68
Spain	1057	1272	1329	1144	1724	1572	1649	2238	1765	963	2260	1935	1541
ICES Sub-area IX													
Portugal	9019	7203	7288	10038	7784	11372	3368	8452	13258	7940	10471	7266	9654
Spain	5205	2163	2936	2804	2787	4010	3164	2027	2737	2421	3056	2355	4847
ICES Sub-area X (Azores Grounds)													
Portugal	9	14	16	16	15	10	13	19	13				
Total	**16451**	**11447**	**12841**	**14854**	**13214**	**17883**	**9003**	**13567**	**18630**	**11953**	**16737**	**12959**	**16649**

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	2010	2011	2012
Cuttlefish	21059	16397	20458	20666	28313	22706	20826	24621	15122	12397	18212	18376	21936
Long-finned squid	9054	8055	9840	12464	11939	8381	7525	8734	7124	8844	10906	8888	9032
Short-finned squid	5529	4238	2509	1729	2040	2574	1275	971	2069	2034	3689	4220	5617
Octopods	16451	11447	12841	14854	13214	17883	9003	13567	18630	11953	16737	12959	16649
Total	**52092**	**40136**	**45649**	**49712**	**55506**	**51544**	**38628**	**47894**	**42945**	**35228**	**49545**	**44442**	**53235**

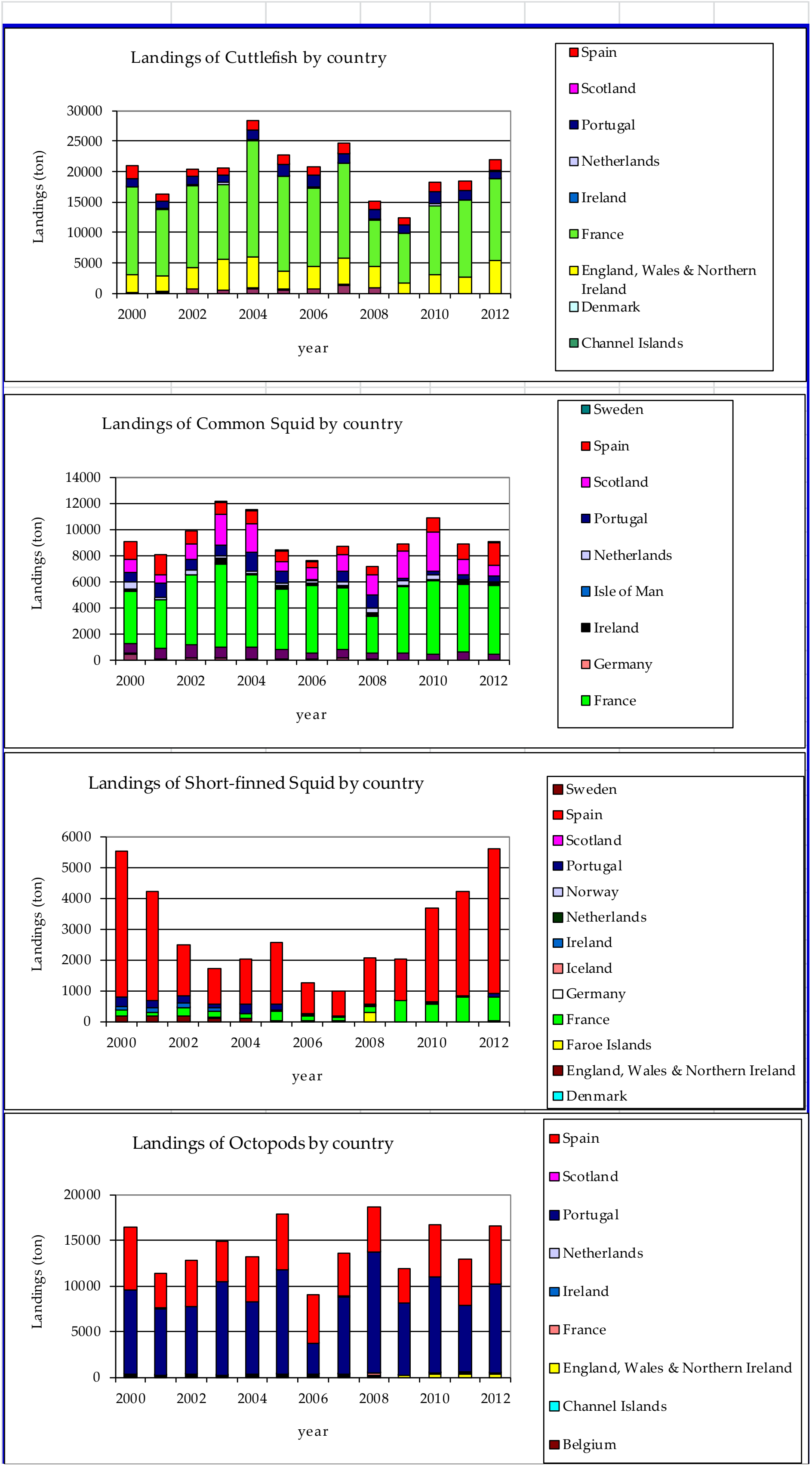


Figure 2.1.1. Total annual cephalopod landings (in tonnes) in whole ICES area by country and separated into major cephalopod .

2.2 Cephalopod direct effort

Information regarding the effort directed at the cephalopod fisheries is still scarce, although is important to collect this information in order to conduct assessment exercises regarding the targeting cephalopods fisheries. In Portugal and Spain, some information already exists although is necessary standardize the data requirements between countries. Effort data obtained comes from both, métiers targeting cephalopods and also métiers in which cephalopods are just a small part of the catch. Thus, a clarification in the effort data required should be done in relation to ask for the whole fleet effort fleets or just directed effort to cephalopods. If the former, the other catch, apart from cephalopods, would be also needed. Also, standardization of effort units between countries would be desirable.Also See Section 8.1 fisheries data requirements that need also to be addressed.

2.3 Cephalopod Discards

Cephalopod fisheries discard data in the ICES area has been collected since 2004 in the UK, France, Spain and Portugal under the Data Collection Regulation and Framework (DCF). 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 stratified random sampling, considering the métier as the stratum and the trip as the sampling unit. Sampling details may be found in the file: Decision_2010_93_EU_DCFfinal.

2.3.1 France

No update of discard information has been provided by France to the working group. Considering, the reports of previous years (WGCEPH 2013), the discard sampling programs in the English Channel, carried out both by Cefas and Ifremer (since 2002 and 2003 respectively), 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 considerably higher than previous observations carried out on board of offshore trawlers (Denis *et al.* 2002).

Ifremer coordinates an observer program called OBSMER (coordinator: Christian Dintheer) collecting discards data in France. Observers are deployed along the entire French coast to go onboard French fishing vessels. Data are available between 2003 and 2009. Concerning cephalopods, during this period, observers sampled 1442 fishing trips, 6346 fishing operations, collected 10445 samples about catch and measured 18760 specimens. Under OBSMER, are sampled 22 ICES divisions and 31 métiers.

2.3.2 Spain

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

Since 2002, under the National Sampling program of the Data Collection framework, the discard sampling programme has been conducted in different métiers for all species covered by the Regulation, including cephalopod species. At present the information has been compiled and processed. AZTI-Tecnalia is responsible for monitoring cephalopod discards, monthly by ICES 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 data for the trawl fleet is reported here, since the other segments of the Basque fleet in the Northeast Atlantic have negligible levels of discards. The discard sampling does not include information on length distributions. The sampling covers the four métiers of the basque trawl fleet: otter trawlers in Sub-area VI targeting hake, otter trawlers in Sub-area VII targeting anglerfish and megrim, otter trawlers in Div. VIIIa,b,d targeting a great variety of species (mixed fisheries) (OTB) and Pair trawls operating with VHVO nets in Div. VIIIa,b,d targeting hake (PTB).

In Table 2. 3.1. yearly cephalopods discard estimations for Spanish trawl fleets operating in Northeast Atlantic area (ICES VI, VII, VIII and IXa) over the period 2003-2012 are presented. Estimations are aggregated from métier to fishing ground level. The discard rate was estimated based on landing estimation per species, or groups of species and the total fleet discard rate raised to total fleet effort Only information for the most important species in terms of discarded biomass and those included in the Data Collection Framework directive are presented.

In general, in the Western Irish waters and Rockall bank fisheries Ommastrephidae is the most discarded cephalopods family but it must be noted a marked decrease in terms of biomass discarded during 2010 for this species. *Eledone cirrhosa* discards are estimated to be less than those obtained for Ommastrephidae, despite of showing a peak in discards for year 2012. In north Iberian waters (VIIIc) discard estimation were lower values than those obtained for the Western Irish waters and Rockall bank. Interannual discard estimate for the most discarded species in the area, *Eledone cirrhosa*, represents 105 tons per years, while Ommastrephidae discard estimates is found to be 71 tons per year. In the Gulf of Cadiz (IXa-south) only four species discards estimations are presented. In terms of biomass, *Octopus vulgaris* was the most discarded species, ranging between 25.8 and 235.1 tons in 2006 and 2009, respectively. Discards of *Eledone moschata*, the second most discarded species in terms of biomass, are reported since 2007 with a maximum value of 44.2 t in 2009.

In Table 2.3.2 the percentage of cephalopods discarded by Basque fleets, in relation to catches during 2003-2012 series is presented by métier. Until 2011 the results on percentages of cephalopod species discarded show that short finned squids and curled octopus (*Eledone cirrhosa*) species were the most discarded cephalopod species. For area VI, all short finned squids captured are discarded and no cephalopod discards are reported for area VII as no effort has been deployed. In 2012 no discard has been observed in Subarea VI due to the small number of samples (3 trips), and for Divisions VIIIa,b,d discard have almost disappeared because cephalopods have became a target species for the métier OTB_MCF targeting cephalopods.

2.3.3 Portugal

IPIMAR is responsible for discard sampling from ICES Division IXa under the DCF. The sampling covers the two Otter Bottom trawl commercial fleets: 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 operates mainly in the Southwest and South in deeper waters, from 100 to 750 m, while the trawl demersal fleet targeting fish and cephalopods (hake, horse mackerel, auxiliary sea breams, pouting, octopus, squids, blue whiting) operates off the entire Portuguese coast mainly at depths between 100 and 250 m.

The most important cephalopod discards are *Eledone* species, under-sized *Octopus vulgaris*, and *Alloteuthis* sp (Table 2.3.3). 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 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 behaviour for cephalopods: species with a market value show a much lower discard percentage, namely *Eledone cirrhosa*, *Sepia officinalis*, *Octopus vulgaris*, *Todaropsis eblanae* and *Loligo vulgaris* (ICES, 2010). The complete information on Portuguese discards is presented in WD 5.

The procedure generally used to raise discards from haul to fleet level in the Portuguese trawl fisheries is adapted from Fernandes *et al.* (2010) (Jardim and Fernandes, *in prep*.). This procedure is sensitive to the large number of zeros in the dataset (Jardim *et al.*, 2011) and species with low frequency of occurrence or abundance in discards (i.e. a large number of zeros in the dataset) are not reliably estimated. The frequency of occurrence and abundance of Cephalopod species (and species groups) in the discards of the Portuguese bottom-trawl fleet was below the 30%. Consequently, annual discard volumes at fleet level were only estimated for some species and species groups.

2.3.4 Germany

No update of discard information for 2012 was provided.There are no fisheries targeting cephalopod in German waters. Last years landings reported were by-catch landings mainly from bottom-trawl fisheries in area IVb. German discard data were based on a small number of trips conducted with an observer on board. Data in Table 2.3.4 represent single trips done on a yearly basis. This information reflects the sporadic nature of cephalopod catches by the trawl fleet in Germany and the limited opportunities to sample the trawl vessels. The amount of cephalopods discarded ranged between 0.and 100% of the catch. Nevertheless, long finned squids seem to be 100% discarded by the bottom-trawl fleet, like other undetermined cephalopod species.

2.3.5 The Netherlands

In the Dutch discard program, only one cephalopod species (*Loligo spp*.) was reported by family name in the ICES areas VI and VII. In few cases full species name is listed. Thus, to avoid misidentification all discards as reported by family name (Table 2.3.5).

Discards records only apply to the métier combinations which have been sampled. This means that a 0 in the table means that there was discard sampling but no catches were recorded.

2.3.6 United Kingdom (England and Wales)

As the discard data used to be raised to the total fleet is based on fleet effort, and there are some concerns about the UK effort, no updated of discard information in year 2012 has been presented in the report.

Discard information from United Kingdom is only available by species since the beginning of 2011. Data here presented is thus grouped under species groups. In case of Loginidae and Ommastrephidae also identification problems are detected and thus both families are pooled together. Thus, grouping of species is as follows: Loliginidae and Ommastrephidae ; Sepiidae; Octopodidae (Table 2.3.6).

2.3.7 Other countries (Ireland, Estonia, Lithuania, Latvia, Poland, Sweden and Denmark)

There is no requirement for Ireland under the Data Collection Framework to collect discard data on cephalopods other than cuttlefish in the areas fished by Irish vessels.

All cuttlefish recorded on discard trips were landed as well as various Ommmastrephidae, mainly *Illex spp*.

Some other cephalopod species are occasionally sampled in routinely discard sampling on board. Some data from year 2011 and 2012 have been deployed (Figure 2.3.7).

Estonia reported to the group that as no cephalopod fisheries are deployed by the country no data on cephalopod discards are reported in ICES area.

Sweden has almost no effort data on cephalopods in the ICES areas included in the data call. In 2011 and 2012 , Sweden landed approximately 520 kg and 240 kg respectively of not identified species from area IV.

Danish cephalopods landings and discards are mostly deployed in ICES areas III . In 2012, no data were provided to the group.

Table 2.3.1. Percentage of discards of cephalopod species in the trawl Spanish fleet in areas VI, VII, VIII and IX during 2003-2012.

			% discards from total landings									
Gear	Area	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
OTB	VI-VII	Eledone cirrhosa	59	34	51	46	67	60	72	39	71	97
		Loligo spp.	52	24	73	80	92	65	26	12	4	35
		Octopus vulgaris	0	100	100	91	0	0	0	37	0	0
		Ommastrephidae	90	79	69	71	79	74	77	29	11	74
		Sepia officinalis	77	9	6	77	5	22	2	0	1	95
	VIIIc + IXa north	Eledone cirrhosa	8	26	8	23	19	6	37	5	24	14
OTB_MIX		Loligo spp.	2	1	12	1	1	2	7	2	61	0
OTB_HOM		Octopus vulgaris	6	4	34	7	39	1	12	3	25	1
OTB_MAC		Ommastrephidae	11	27	19	11	21	19	14	7	27	6
		Sepia officinalis	61	1	13	60	1	1	18	6	34	11
PTB	VIIIc + IXa north	Eledone cirrhosa	0	0	64	63	94	32	90	96	37	1
		Loligo spp.	0	0	0	0	0	0	0	0	0	0
		Octopus vulgaris	0	0	0	0	0	0	0	0	0	0
		Ommastrephidae	2	2	10	4	3	3	9	0	1	0
		Sepia officinalis	0	0	0	0	0	0	100	0	100	0
OTB	IXa - south	Alloteuthis spp	-	-	0	0	0	0	3	4	7	0
		Eledone spp	-	-	0	0	1	5	17	19	11	0
		Loligo vulgaris	-	-	0	0	0	0	0	0	0	3
		Octopus vulgaris	-	-	0	3	0	19	35	0	2	2
		Ommastrephidae	-	-	0	0	0	0	2	6	0	0
		Sepia elegans	-	-	0	0	0	2	9	3	1	0
		Sepia officinalis	-	-	0	4	0	0	0	1	0	3

Table 2.3.2. Estimated cephalopod discard (% from total cephalopod catches) during 2003-2012 series in the Basque Country.

Gear	Area	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
OTB	VI	Short finned squid	100%	-	-	-	-	100%	100%	100%	100%	0%
		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%	31%	87%	0.2%
		Curled octopus	28%	5%	7%	0%	19%	2%	14%	5%	74%	0%
		Cuttlefish	0%	1%	2%	-	1%	-	8%	-	3%	0%

Table 2.3.3. Frequency of occurrence (%) of cephalopods species in the discards of hauls sampled in the OTB_CRU fishery and OTB_DEF fishery (2004-2012).

		CTC	EDT	EJE	EOI	OCC	OCT	OMZ	OUW	SQC
OTB- CRU	2004	2	4	11	59	2	1	38	16	0
	2005	1	7	7	46	1	0	34	4	1
	2006	0	17	7	40	0	0	3	0	0
	2007	1	3	4	22	0	0	7	5	0
	2008	2	2	6	14	9	0	5	11	2
	2009	1	2	5	8	4	1	1	10	0
	2010	3	9	4	10	2	0	12	3	8
	2011	2	12	5	14	4	5	30	12	4
	2012	4	1	1	16	4	1	6	3	3
OTB-DEF	2004	1	1	19	17	1	0	19	47	6
	2005	3	2	19	16	6	0	8	45	2
	2006	2	1	7	8	4	0	0	18	0
	2007	2	4	9	5	6	1	2	9	1
	2008	2	2	12	4	20	0	1	24	0
	2009	3	1	11	9	10	0	0	19	0
	2010	1	2	3	8	2	0	0	12	3
	2011	0	2	7	5	11	2	2	22	16
	2012	0	2	0	3	12	0	2	22	5

Species codes: CTC - Sepa officinalis; EDT - Eledone moschata; EJE – Sepia elegans; EOI – Eledone cirrhosa; OCC – Octopus vulgaris; OCT – Octopodidae nei; OMZ – Ommastrephidae; OUW – Alloteuthis spp.; SQC – Loligo spp.

Table 2.3.4 - Percentage of discards of cephalopod species, in the total hauls sampled in the trawl German fleet in areas between 2004 and 2011.

			% Discards from total landings							
Gear	Area	Species	2004	2005	2006	2007	2008	2009	2010	2011
OTB	IV a	cephalopods	100%	-	-	-	-	-	-	100%
		long finned squids	-	100%	100%	-	90%	-	-	-
	IV b	cephalopods	-	-	-	-	-	-	-	-
		long finned squids	-	-	-	100%	-	-	-	100%
	XIV b	cephalopods	-	-	-	0%	-	-	-	-
		long finned squids	-	-	-	-	-	-	-	-
TBB	IV b	cephalopods	-	0%	-	-	-	100%	-	-
		long finned squids	-	29%	-	-	-	-	-	-
	IV c	cephalopods	-	-	-	-	-	-	100%	-
		long finned squids	-	-	-	-	-	-	-	-
PTB	IV b	Other cephalopods	-	-	-	-	0%	-	-	-
		long finned squids	-	-	-	-	0%	-	-	-
SSC	IV a	Other cephalopods	-	-	-	-	-	100%	-	-
		long finned squids	-	-	-	-	-	-	-	-
OTM	VII j	Other cephalopods	-	-	-	-	-	-	-	-
		long finned squids	-	-	-	-	-	-	100%	-

Table 2.3.5 - Percentage of ocurrence of discards of cephalopod species in The Netherlands.

Gear	Area	Species	2009	2010	2011	2012
OTM	VI	Loliginidae	100%	8%		73%
	VIIbjck	Loliginidae	0%	45%	100%	0%
PTM	VIIe	Loliginidae	-	-	100%	

Table 2.3.6. Percentage of discards of cephalopod species in The UK (England and Wales).

Gear	Area	Species	2009	2010	2011
HMD	VIIe	Sepiidae	0%	0%	98%
	VIIa	Sepiidae			100%
		Loliginidae	2%	0%	0%
	VIIe	Loliginidae	1%	3%	0%
		Sepiidae	7%	3%	5%
		Octopodidae	0%	1%	47%
OTB	VIIfgh	Loliginidae	2%	0%	0%
		Sepiidae	3%	0%	0%
	VIIe	Loliginidae	0%	0%	0%
		Sepiidae	0%	0%	0%
		Octopodidae	0%	0%	74%
	VIIfgh	Loliginidae	0%	0%	0%
	VIIe	Loliginidae	0%	0%	1%
		Sepiidae	2%	1%	3%
		Octopodidae	0%	1%	8%
OTT	VIIfgh	Loliginidae	-	0%	1%
	VIIe	Loliginidae	0%	0%	0%
		Sepiidae	0%	1%	0%
PTB	VIIe	Sepiidae	0%	1%	0%
		Octopodidae	0%	82%	0%
	VIIe	Loliginidae	2%	4%	1%
		Sepiidae	3%	1%	2%
TBB		Octopodidae	0%	16%	8%
	VIIfgh	Loliginidae	22%	7%	12%
		Sepiidae	9%	2%	2%
		Octopodidae	55%	36%	41%

Table 2.3.7. Percentage of discards of cephalopod species in Ireland.

% of discards from total landing				
Gear	**Area**	**Species**	**2011**	**2012**
OTB	VI	Eledone cirrhosa		
		Loligo spp.	1%	0%
		Octopus vulgaris		
		Ommastrephidae		
		Sepia officinalis		
OTB	VII	Eledone cirrhosa		
		Loligo spp.	0%	1%
		Octopus vulgaris	26%	
		Ommastrephidae		
		Sepia officinalis		

2.4 Survey information on cephalopods

The surveys carried out in the Northeastern Atlantic IBTS area involved all countries of the European Atlantic coast. The IBTSWG has focused on improving the quality of the data collected during the surveys (including trawl, vessel, environmental, and catch parameters), as well as their availability by storing them in a common database at ICES headquarters, i.e. DATRAS (Database for TRAwl Surveys). The IBTSWG aims to make all data collected during IBT Surveys publicly available through this database.

Table 2.4.1 presents the different surveys conducted in the western and southern area as well as the country involved and the acronym used. The North Sea IBTS Q1 and Q3 surveys are carried out by several countries with their own research vessels, such as Sweden, Denmark, Norway, Scotland, England, France, Netherlands and Germany. In all surveys, abundance indices in weight or number are obtained for all cephalopod species during the time-series. Besides, the survey manual requires recording of several cephalopod species during surveys, including three species of sepia (*S. officinalis*, *S. elegans* and *S. orbignyana*) teuthoidea (*Illex coindeti* and *Todaropsis eblanae*), *Eledone cirrhosa* and *Octopus vulgaris*. In the case of bobtail squid, they are analysed together.

Table 2.4.1. Summary of IBTS surveys in western and southern area (Northeastern Atlantic waters)

Survey	Division	Acronym
Scottish Surveys		
Scottish Western Coast VIa Groundfish Survey - Quarter 1	VIa	SWCGFS6a
Rockall Survey ICES VIb (every second year) - Quarter 3,	VIb	SWCGFS6b
Scottish Western Coast VIa Groundfish Survey - Quarter 4	VIa	SWCGFS6a
Northern Ireland surveys		
Northern Ireland Groundfish Survey in the Irish Sea - Quarter 1	VIIa	NIGFS
Northern Ireland Groundfish Survey in the Irish Sea - Quarter 4	VIIa	NIGFS
Irish survey		
Irish Groundfish Surveys - Quarter 4	VIa - VIIbcgj	IGFS
English Survey		
English Western IBTS survey – Quarter 4	VIIa,e-h	Q4SWIBTS
French surveys		
Groundfish Survey in the Eastern Channel - Quarter 4	VIId	FR-.CGFS
Groundfish Survey in the Celtic Sea and Bay of Biscay - Quarter 4	VIIfghj, VIIIab	FR-EVHOE
Spanish surveys		
Spanish Groundfish Survey in the Porcupine bank - Quarter 3	VIIbck	SP-PorcGFS
Spanish Groundfish Survey in Northern Spanish Shelf - Quarter 4	VIIIc, IXaN	SP-NGFS
Spanish survey in the Gulf of Cadiz - Quarters 1 & 4	IXaS	SP-GCGFS
Portuguese surveys		
Portuguese Groundfish Survey in Portuguese shelf - Quarter 4	IXaMS	PGFS

In the past five years, the information of cephalopod species has increased due to the requirements imposed by the DCF. In 2012, Spain presented biological information for *Loligo vulgaris*, *S. officinalis*, *Octopus vulgaris*, *Eledone cirrhosa* and *E. moschata* from SPNGFS and SPSGCGFS surveys. *E. moschata* is only caught in SPGCGFS survey carried out in IXa-south (Gulf of Cadiz).

At present, Spain, France, Portugal, Germany, Ireland and UK have contributed with survey data regarding yields and abundances. Main information of the surveys presented by country is described below. Denmark informed this expert group about the availability of Danish survey data at the DATRAS Database, although cephalopod abundance appear to be anecdotical.

2.4.1 Spain

Spain carried out three survey in the fourth quarter: the Spanish Ground Fish Survey on the Porcupine bank (SPPGFS: "PORCUPINE"), the bottom-trawl survey on the Northern Spanish Shelf (SPNGFS: "DEMERSALES") and the bottom-trawl survey on the Gulf of Cádiz (SPGCGFS: "ARSA"). Information presented in each survey is compiled main commercial species. Abundances are presented as yield in biomass (kg/haul) and yield in number (indv./haul).).

2.4.1.1 SPPGFS "PORCUPINE survey"

The Porcupine Bank bottom-trawl survey has been carried out annually since 2001. The objective is to provide data and information for the assessment of the commercial fish species in the area (ICES divisions VIIc and VIIk) (ICES, 2010). During these 12 years of surveys, the cephalopods have occurred frequently but they have been little reported and assessed.

The most common species in the survey time-series are analysed in the present working document, namely *Eledone cirrhosa* and *Bathypolypus sponsalis* (fam. Octopodidae), *Haliphron atlanticus* (fam. Alloposidae), *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii* (fam. Ommastrephidae), *Loligo forbesi* (fam. Loliginidae) and *Rossia macrosoma* (fam. Sepiolidae).

Table 2.4.1.1. Biomass Indices (kg/30') of the Spanish Porcupine Survey in VII from 2001 is presented. Species in table are commercial species also landed by the commercial fleets.

	Eledone cirrhosa		*Loligo forbesii*		*Todaropsis eblanae*		*Illex coindetii*	
Year	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.
2001	0.23	0.03	0.00	0.00	0.13	0.03	0.01	0.01
2002	1.02	0.09	0.03	0.02	0.07	0.02	0.02	0.01
2003	0.40	0.05	0.00	0.00	0.07	0.01	0.01	0.00
2004	0.57	0.05	0.01	0.01	0.20	0.04	0.02	0.01
2005	2.64	0.32	0.02	0.01	0.22	0.04	0.00	0.00
2006	1.01	0.11	0.02	0.02	0.16	0.03	0.00	0.00
2007	5.19	0.30	0.03	0.01	0.01	0.00	0.14	0.02
2008	0.74	0.10	0.18	0.08	0.01	0.00	0.00	0.00
2009	0.20	0.03	0.60	0.23	0.06	0.02	0.50	0.34
2010	1.15	0.07	0.27	0.08	0.02	0.01	0.01	0.01
2011	0.26	0.04	0.22	0.12	0.00	0.00	0.01	0.01
2012	1.26	0.27	0.52	0.13	1.00	0.20	0.00	0.00

2.4.1.2 SPNGFS: "DEMERSALES survey"

The bottom-trawl survey on the Northern Spanish Shelf (SPNGFS: "DEMERSALES") aim to provide data and information for the assessment of the commercial species and the ecosystems on the Galician and Cantabrian Shelf (ICES Div. VIIIc and IXa North). The DEMERSALES Spanish survey has been carried out annually in autumn from 1983, although data on invertebrate species were collected mainly from 1990, and therefore results are presented from this year up to 2012.

Abundance indices on the most common cephalopod species sampled in these surveys, namely curled octopus (*Eledone cirrhosa*), broadtail shortfin squid (*Illex coindetii*), lesser flying squid (*Todaropsis eblanae*), common octopus (*Octopus vulgaris*), long finned squid (*Loligo forbesi*), common squid (*Loligo vulgaris*), European flying squid (*Todarodes sagittatus*), pink cuttlefish (*Sepia orbignyana*), common cuttlefish (*Sepia officinalis*) and elegant cuttlefish (*Sepia elegans*) from the DEMERSALES bottom-trawl survey's series,, are presented. (See more information in WD a.6).

Table 2.4.1.2.1. Biomass Indices (kg/30′) of the Spanish Demersal Survey in VIIIc from 1990 is presented. Species in table are commercial species also landed by the commercial fleets.

	Octopus vulgaris		*Eledone cirrhosa*		*Loligo vulgaris*		*Loligo forbesii*		*Sepia officinalis*		*Todaropsis eblanae*		*Illex coindetii*	
Year	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.
1990	1.12	0.39	0.82	0.12	0.02	0.01	0.07	0.03	0.07	0.05	0.84	0.15	1.47	0.17
1991	0.12	NA	0.68	NA	0.10	NA	0.11	NA	0.11	NA	0.33	NA	1.18	NA
1992	3.49	0.95	1.52	0.27	0.14	0.12	0.12	0.05	0.07	0.04	0.45	0.04	2.67	0.54
1993	0.21	0.05	1.59	0.13	0.08	0.07	0.18	0.09	0.04	0.03	0.86	0.10	0.24	0.08
1994	0.30	0.09	1.07	0.10	0.04	0.02	0.19	0.05	0.03	0.03	0.10	0.02	2.09	0.82
1995	0.49	NA	1.70	NA	0.20	NA	0.08	NA	0.07	NA	0.68	NA	0.30	NA
1996	0.14	NA	1.75	NA	0.36	NA	0.32	NA	0.20	NA	3.75	NA	0.75	NA
1997	0.80	0.29	2.46	0.19	0.30	0.21	0.17	0.04	0.01	0.01	3.10	0.49	1.45	0.15
1998	0.43	0.13	0.78	0.09	0.16	0.05	0.11	0.03	0.00	0.00	0.37	0.04	0.89	0.08
1999	0.48	0.12	1.12	0.11	0.11	0.04	0.31	0.13	0.04	0.02	1.90	0.36	1.63	0.24
2000	0.39	0.13	1.06	0.12	0.09	0.02	0.09	0.06	0.00	0.00	0.60	0.05	2.26	0.80
2001	0.73	0.21	1.57	0.16	0.13	0.04	0.08	0.02	0.00	0.00	0.48	0.10	0.30	0.04
2002	0.40	0.10	1.28	0.14	0.10	0.04	0.22	0.07	0.00	0.00	0.13	0.03	0.47	0.05
2003	0.19	0.07	0.80	0.09	0.09	0.04	0.39	0.12	0.02	0.02	0.34	0.09	0.95	0.45
2004	0.77	0.15	1.53	0.14	0.24	0.11	0.50	0.15	0.04	0.03	0.47	0.05	0.98	0.19
2005	0.12	0.04	1.47	0.11	0.05	0.02	0.40	0.11	0.00	0.00	1.30	0.12	0.61	0.12
2006	0.61	0.26	1.49	0.15	0.49	0.39	0.45	0.17	0.13	0.11	0.32	0.05	0.16	0.03
2007	0.84	0.23	1.20	0.10	0.32	0.08	0.04	0.03	0.01	0.01	0.43	0.04	0.20	0.03
2008	0.60	0.13	0.38	0.04	0.47	0.08	0.00	0.00	0.01	0.01	0.57	0.06	0.60	0.32
2009	0.16	0.06	0.81	0.08	0.28	0.12	0.19	0.06	0.02	0.02	0.62	0.06	0.46	0.10
2010	1.18	0.25	0.84	0.09	0.01	0.00	0.77	0.19	0.00	0.00	0.60	0.09	0.20	0.03
2011	0.36	0.10	0.42	0.05	0.09	0.02	0.76	0.22	0.01	0.01	1.35	0.44	1.32	0.39

2012	1.25		0.44	1.51		0.20	0.29		0.11	0.78		0.26	0.01		0.01	1.19		0.26	2.40		0.09

2.4.1.3 SPGCGFS: "ARSA survey"

Since 1997 the Spanish bottom-trawl survey ARSA has been carried out annually in autumn, during November, in the Gulf of Cádiz (ICES Subdivision IXa south) to study the distribution and relative abundance (in number and weight) of all demersal species in the area, as well to estimate biological parameters of main commercial species. Other similar survey is carried out in the same area since 1993("Spanish bottom-trawl survey spring ARSA") in March. The yield of this survey has been used to obtain the average yield of both survey in order to compare it with the LPUE series of commercial trawl fleets presented in the next section.

Most abundant species present in the survey are the cuttlefish *Sepia officinalis* and *Sepia elegans*, octopus: *Octopus vulgaris, Eledone moschata* and *Eledone cirrhosa*, the long-finned squids: *Loligo vulgaris, Loligo forbesii* and *Alloteuthis spp*., and the short-finned squids *Illex coindetii* and *Todaropsis eblanae*.

Table 2.4.1.3.1 Biomass Indices (kg/h) of the Spanish Demersal Survey in IXa-south (Gulf of Cádiz) from 1997 is presented. Species in table are commercial species also landed by the commercial fleets.

	Alloteuthis spp		***Loligo vulgaris***		***Loligo forbesii***		***Octopus vulgaris***		***Eledone cirrhosa***		***Eledone moschata***		***Sepia officinalis***		***Sepia elegans***		***Todaropsis eblanae***		***Illex coindetii***	
Year	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.
1997	0.84	0.03	0	0	0.32	0.02	0.76	0.08	0.47	0.03	2.69	0.15	0.24	0.01	4.75	0.22	0.47	0.04	9.93	1.17
1998	1.17	0.04	0	0	0.11	0	0.45	0.02	0.03	0	1.22	0.04	0.06	0	0.85	0.04	0.08	0.01	43.72	5.96
1999	0.62	0.02	0.4	0.06	0.92	0.04	2.59	0.11	0.18	0.01	1.84	0.03	0.08	0	1.25	0.05	0.12	0.01	0.79	0.03
2000	0.6	0.03	0.73	0.07	0.58	0.03	0.95	0.06	0.39	0.02	0.54	0.01	0.24	0.01	1.19	0.07	0.88	0.07	2.58	0.2
2001	1.35	0.05	0.19	0.01	1.72	0.05	1.1	0.06	0.42	0.02	0.69	0.02	0.03	0	1.43	0.07	1	0.03	6.03	0.53
2002	1.14	0.03	0.03	0	1.21	0.04	0.75	0.04	0.15	0.01	1.06	0.03	0.09	0	0.96	0.04	0.36	0.01	0.72	0.04
2003	1.2	0.04	0.15	0.02	0.78	0.03	0.91	0.06	1.2	0.05	1.24	0.03	0.04	0	2.6	0.1	0.19	0.01	0.1	0.01
2004	2.84	0.15	1.14	0.13	0.6	0.02	2.2	0.13	0.35	0.01	1.77	0.03	0.11	0	0.9	0.05	0.45	0.02	0.07	0
2005	0.66	0.02	0.66	0.07	1.77	0.09	7.56	0.23	0.81	0.02	1.02	0.02	0.32	0.01	2.46	0.09	0.67	0.03	0.25	0.01
2006	0.28	0.01	1.08	0.11	1.89	0.05	1.57	0.1	0.04	0	1.37	0.04	0.2	0.01	2.11	0.11	0.28	0.01	0.24	0.01
2007	1.51	0.05	0.12	0.02	1.3	0.05	4.03	0.29	0.14	0.01	1	0.03	0.15	0.01	1.03	0.05	0.07	0	0.64	0.06
2008	1.23	0.04	0.73	0.06	2.13	0.06	1.64	0.17	0	0	1.42	0.04	0.17	0.01	1.08	0.04	0.14	0.01	0.13	0.01
2009	1.74	0.07	1.4	0.1	0.87	0.04	3.82	0.27	0.04	0	1.97	0.04	0.21	0.01	0.76	0.04	0.06	0	0.08	0

2010	0.33	0.01	0.09	0.01	1.1	0.05	0.97	0.05	0.03	0	0.54	0.01	0.14	0	1.39	0.04	0.82	0.04	1.22	0.07
2011	0.54	0.02	0.04	0	0.5	0.03	1.39	0.08	0.44	0.02	1.13	0.03	0.09	0	1.61	0.05	0.24	0.01	2.18	0.08
2012	0.49	0.02	3.78	0.21	1.5	0.14	6.67	0.49	0.36	0.01	2.97	0.06	1.48	0.06	0.21	0.01	0.1	0.01	0.04	0

2.4.2 Portugal

In 2012, no Portuguese survey were deployed. Thus data on this section correspond to last year report related to Portuguese survey data just until 2011. PGFS surveys were carried out on the Portuguese continental coast on board R/V Noruega and occasionally on R/V Capricórnio in autumn. The sampling area covers latitudes 36.7º to 41.8º N and longitudes 7.47º to 10.0º W in the NE Atlantic. The main objective of these research surveys is to estimate indices of abundance and biomass of the most commercially important fish and crustacean species. The autumn cruises done with R/V Noruega employ a Norwegian Campbell Trawl type with bobbins and the cruises done with R/V Capricórnio used an FGAV019 bottom-trawling net, with a codend of 20 mm mesh size, a mean vertical opening of 2.5 m and a mean horizontal opening between wings of 25 m. These cruises follow a depth stratified sampling design, with ca. 70-80 hauls distributed along the Portuguese continental shelf and slope. The tow duration vary between 20 and 60 min.

In Table 2.4.2.1 Abundance indices of the important commercial cephalopod species are presented.

By species groups, the trends in abundance observed in the dataseries are described below. The only real case of concern relates to *Loligo vulgaris*. The causes for the severe decreasing in abundance since 1993 remain unresolved.

Long-finned squid abundance time-series from research surveys

Loligo vulgaris

This is the most abundant long-finned squid in Portugal. The abundance shows a declining tendency since 1987 to the very end of the series, more rapidly up to 1995 and slower from there on. This is in accordance with similar length landings time-series and we believe it represents the true situation of the stock.

Loligo forbesi

Our research has shown that *Loligo forbesi* is a relatively uncommon presence in Portuguese waters, with occasional strong migrations at times of greater than average abundance northwards of Portuguese continental waters. The research survey series reflects this situation, showing only occasional appearances other than the large influx in the late eighties.

Octopus abundance time-series from research surveys

Octopus vulgaris

Our research time-series groups different types of gear, most of which are inadequate to sample this species. However the yields obtained appears to show the difference in abundance between the latest plateau and the lesser abundance that preceded it.

Eledone cirrhosa

The time-series shows no abundance peak from the late nineties which appear to be real, but has decreased slightly in the latter decade.

Remaining species

Mostly, cephalopods collected in surveys in Portuguese waters appear to be in a relatively healthy status, without marked fluctuation in abundance, other than those resulting from migratory behaviours.

Table 2.4.2.1. Biomass Indices (Yield (kg/h)) of the Portuguese Ground Fish Survey (4thQ PGFS) since 1981 for the species more common in the landings.

	Sepia officinalis		*Sepia elegans*		*Sepia orbygniana*		*Alloteuthis* spp.		*Loligo vulgaris*		*Loligo forbesi*		*Illex coindetii*		*Todaropsis eblanae*		*Todarodes sagittatus*		*Octopus vulgaris*		*Eledone cirrhosa*		*Eledone moschata*	
Year	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.	Y (kg/h)	S.E.
1981	0.01	0	0.03	0.01	0	0	1.71	0.06	3.84	0.51	0	0	0.54	0	0.03	0.01	0	0	0.92	0.26	0.13	0.02	0	0
1982	0.04	0.02	0.01	0	0	0	1.2	0.13	1.6	0.26	0.26	0.06	0.63	0.12	0.03	0	0.01	0	0.09	0.02	0.02	0	0	0
1983	0	0	0.39	0.26	0	0	1.17	0.08	1.76	0.21	0.46	0	1.83	0.09	0.11	0.01	0	0	0.23	0.05	0.02	0	0	0
1985	0.2	0.06	0.01	0	0	0	0.94	0.24	0.43	0.06	0.17	0.07	0.07	0.01	0.02	0.01	0	0	0.17	0.04	0.08	0.03	0	0
1986	0	0	0.01	0	0.01	0.01	1.43	0.27	1.15	0.26	0.06	0.01	39.76	22.36	0.05	0.03	0	0	0.03	0.01	0.11	0.04	0.06	0.02
1987	0.01	0.01	0	0	0	0	0.09	0.03	6.28	1.94	4.84	3.68	2.99	0.42	0.02	0.01	0.03	0.01	0.42	0.11	0.17	0.07	0	0
1988	0.06	0.03	0.01	0.01	0	0	0.68	0.22	3.44	0.57	0.31	0.15	0.75	0.1	0	0	0	0	0.07	0.07	0.09	0.03	0.01	0.01
1989	0.12	0.08	0	0	0	0	0.84	0.07	4	0.97	0.29	0.11	0.48	0.08	0.01	0	0	0	0.17	0.04	0.01	0	0.12	0.03
1990	0.14	0.07	0.01	0	0	0	0.18	0.04	1.16	0.29	0.42	0.09	0.87	0.27	0.03	0.01	0	0	0.33	0.11	0.15	0.03	0.07	0.02
1991	0.02	0.02	0.01	0	0.02	0.01	0.1	0.03	2.64	0.53	0.26	0.05	1.62	0.95	0.01	0	0	0	0.04	0.02	0.03	0.03	0	0
1992	0	0	0	0	0	0	0.08	0.04	2.08	1	0.6	0.49	0.14	0.04	0.01	0.01	0	0	0.11	0.07	0.04	0.02	0	0
1993	0.03	0.02	0.01	0	0	0	0.1	0.03	0.81	0.37	0.07	0.06	0.01	0.01	0	0	0	0	0.17	0.05	0.12	0.05	0.01	0
1994	0.02	0.01	0	0	0	0	0.04	0.01	0.12	0.06	0.02	0.01	0	0	0	0	8.26	4.13	0.35	0.1	0.03	0.01	0.05	0.03
1995	0	0	0	0	0	0	0.18	0.04	0.28	0.07	0	0	0.01	0	0	0	0.01	0.01	0.11	0.04	0	0	0	0
1996	0.15	0.08	0.03	0.01	0.01	0	1.08	0.33	0.83	0.4	0	0	0.19	0.05	0.47	0.11	0.02	0.01	4.56	0.76	0.47	0.1	0.18	0.05
1997	0.09	0.04	0.01	0.01	0	0	0.02	0	0.66	0.21	0.05	0.04	0.81	0.23	0.02	0.01	0	0	0.22	0.09	0	0	0.13	0.02
1998	0	0	0	0	0	0	0.56	0.23	0.41	0.07	0	0	0.21	0.04	0.01	0	0	0	0.05	0.02	0	0	0	0
1999	0.07	0.05	0.01	0	0.01	0	0.22	0.04	0.76	0.22	0	0	0.15	0.03	0.18	0.03	0	0	1.39	0.29	0.2	0.08	0.13	0.05
2000	0.1	0.06	0.01	0	0.02	0	0.22	0.04	0.57	0.24	0	0	0.43	0.14	0.08	0.04	0.03	0.02	0.21	0.06	0.03	0.01	0.11	0.07
2001	0	0	0	0	0	0	0.47	0.18	0.57	0.21	0	0	0.41	0.2	0.03	0.01	0	0	0.25	0.13	0.02	0.01	0.05	0.03

2002	0	0	0	0	0	0	0.63	0.1	0.31	0.11	0	0	1.86	0.98	0.03	0.01	0.03	0.03	0.02	0.02	0.02	0.01	0.06	0.04
2003	0.07	0.04	0.21	0.08	0.09	0.02	1.21	0.38	0.46	0.08	0.01	0	0.54	0.08	0.37	0.04	0	0	1.99	0.35	2.28	0.23	0.17	0.06
2004	0	0	0.27	0.04	0.19	0.03	2.11	0.42	1.8	0.39	0.08	0.05	2	0.67	0.21	0.04	0.01	0.01	2.31	0.77	2.19	0.69	1.27	0.4
2005	0.02	0.02	0	0	0	0	0.77	0.27	0.35	0.07	0	0	0.09	0.02	0.03	0.01	0.02	0	0.27	0.09	0.09	0.04	0.1	0.03
2006	0.01	0.01	0	0	0	0	0	0	0.08	0.03	0	0	0.01	0	0	0	0.04	0.02	0.31	0.1	0.02	0.01	0.05	0.01
2007	0	0	0	0	0	0	3.5	0.68	0.06	0.03	0	0	0.01	0.01	0.01	0	0.03	0.01	0.04	0.02	0.07	0.04	0.05	0.03
2008	0.01	0.01	0	0	0	0	3.72	0.75	0.11	0.03	0	0	0.01	0.01	0.02	0.01	0.04	0.04	0.45	0.14	0	0	0.04	0.02
2009	0.06	0.05	0	0	0	0	3.45	0.6	0.23	0.04	0.01	0	0.03	0.01	0.04	0.02	0.04	0.03	0.13	0.06	0.01	0	0.07	0.03
2010	0	0	0	0	0	0	0.04	0.02	0.53	0.22	0.07	0.03	0.08	0.02	0.01	0	0.03	0.02	0.2	0.1	0.01	0.01	0.12	0.05
2011	0	0	0	0	0	0	2.1	0.31	0.43	0.17	0.01	0	0.17	0.03	0.02	0.01	0	0	0.04	0.03	0.01	0	0.02	0.01

2.4.3 France

France provided EVHOE survey data in the Bay of Biscay for *Illex coindetii, Loligo forbesi* and *Loligo vulgaris*.

Table 2.4.3.1. Biomass Indices (number/h) of French EVHOE survey in Bay of Biscay from 2010 to 2012 is presented.

	Illex coindetii	Loligo forbesi	*Loligo vulgaris*
Year	Yield (number/h)	Yield (number/h)	Yield (number/h)
2010	426	1707	590
2011	365	574	759
2012	2314	334	548

2.4.4 Germany

In 2013, Germany has contributed with survey data regarding yields and abundance indices from 2009 to 2012. In Table 2.4.4.1 yields of the Germany North Sea IBTS is presented. Just yields of *Loligo spp, Loligo forbesi, Loligo vulgaris* and Loliginidae are presented as *Loligo vulgaris* is the unique species in the landings for the same period of time. Moreover, German Survey delivered yields obtained in the same survey from 2009 to 2012 for the following cephalopod species: *Eledone cirrhosa; Sepiola atlantica; Sepietta oweniana; Eledone spp.*; Others; *Alloteuthis subulata; Rossia macrosoma; Loligo spp; Todarodes sagittatus; Loligo forbesi; Illex coindetii; L. vulgaris; Loliginidae; Todaropsis eblanae.*

Table 2.4.4.1 Biomass Indices (kr/h) of the Germany North Sea IBTS from 2009 to 2012 2011. Species here presented are that most common in the landings and species belonging to the same Family group

		Quarter 1		Quarter 3	
	Year	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.
Loligo spp	2011			0.04	0.03
Loligo forbesi	2009	0.43	0.15	0.41	0.36
	2010	0.99	0.37	0.11	0.05
	2011	0.28	0.10	0.29	0.13
	2012	28.46	0.00	6.06	0.50
Loligo vulgaris	2009	0.05	0.03	0.00	0.00
	2010	0.05	0.02		
	2011			0.08	0.07
	2012	0.17	0.00	0.66	0.20
Loliginidae	2009	0.47	0.18	0.41	0.36
	2010	0.99	0.37	0.11	0.05
	2011	0.28	0.10	0.41	0.23
	2012	7.50	0.00	4.15	0.64

2.4.5 Ireland

Ireland provided yield and abundance Indices for the following species and/or species groups: *Sepia officinalis; S. elegans; Eledone cirrhosa; Octopus vulgaris; Alloteuthis subulata; Todarodes sagittatus; Loligo forbesi; Illex coindetii; L. vulgaris and Todaropsis* *eblanae.* A slope stratum was added to the Irish Ground Fish Survey (IGFS) in VIa, VIIb and VIIj from 2005 deployed in Quarter 4. From 2005, survey coverage was extended into deeper waters. Some concerns remain in the survey data. *Octopus vulgaris* records are, in the Irish platform, very unusual, so some individuals are identified as belonging to this species but this fact could be a misidentification of species. It appears that those individuals might be deep water species of Benthoctopus. Furthermore, *Eledone cirrhosa* records only begin in 2008 – that species is pretty much ubiquitous on Irish shelf- so catches before 2008 are also expected to have occurred. Identification problems could be caused by both wrong codification and/or some data extraction problem. Further revision of the data will be carry out in the next future.

Table 2.4.5.1. Biomass Indices (kg/h) of the Irish Ground Fish Survey (IGFS) from 2003 is presented. Species in table are the more common ones also in the landings.

	Eledone cirrhosa		*Alloteuthis subulata*		Loligo forbesi		*Illex coindetii*	
Year	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.	Yield (kg/h)	S.E.
2003	1.42	0.43	1.22	0.43	4.56	1.31	2.70	1.80
2004	7.60	6.03	7.38	3.12	5.48	1.95	0.91	0.71
2005	4.10	1.02	0.75	0.31	6.17	2.00	7.60	3.73
2006	1.30	0.41	0.69	0.42	7.74	2.47	1.25	0.40
2007	5.69	1.40	1.60	0.76	4.32	1.62	13.47	6.60
2008	4.27	0.91	0.87	0.48	6.48	2.40	9.38	3.62
2009	4.86	1.24	0.35	0.19	8.10	2.40	6.46	2.16
2010	9.88	2.01	0.94	0.53	8.03	2.42	4.10	2.95
2011	4.06	1.02	0.31	0.15	10.71	4.22	0.09	0.03
2012	-	-	3.70	52.00	329.40	52.00	562.50	52.00

2.4.6 United Kingdom

UK provided data on abundance indices for the Scottish West coast VIa Groundfish Survey- Quarter 1 and Quarter 4 (SWCGF6a); for the Rockall Survey ICES deployed every second year during Quarter 3 (SWCGF6b); and for the English Western IBTS Survey (Q4SWIBTS) deployed during Quarter 4. For this last survey, also biomass indices (kg/h) were provided since 2005. In case of SWCGFS surveys, no cpue (biomass indices) equivalent of the survey abundance index is available. UK also provided abundance and biomass indices for other species and/or species groups: *Sepia officinalis, S. elegans , Eledone cirrhosa, S. orbignyana, Alloteuthis subulata, Loligo forbesi, Illex coindetii, Loligo vulgaris, Todaropsis eblanae.* In the Table below just yields for the species and species groups more abundant in the landings are presented.

In 2010, no SWCGFS6a in Quarter 4 or SWCGF6b in Quarter 3 were deployed due to vessel breakdown. For the SWCGFS surveys, short-finned squid are recorded as Ommastrephidae, so although listed in the table as *Illex coindetii*, it may also include *Todaropsis eblanae* and other species. For English Q4WIBTS, any species not measured for length, the number of individuals caught is recorded. No data are provided from Northern Ireland Goundfish Survey in the Irish Sea in Quarter 1 and 4 (NIGFS Q1, Q4). Information required in DCF for species and countries has been updated and provided as much as possible.

Table 2.4.6.1. Biomass Indices (kg/h) of the English Western IBTS Survey Quarter 4 (Q4SWIBTS) from 2005 is presented. Species in table are the more common ones also in the landings.

	Year	Yield (kg/h)	S.E.
Sepia officinalis	2006	0.80	0.67
	2008	0.05	0.05
	2010	0.67	0.46
	2011	0.07	0.00
	2012	NA	NA
Sepia elegans	2005	0.01	0.01
	2007	0.05	0.02
	2008	0.01	0.01
	2009	0.02	0.01
	2010	0.01	0.01
	2011	0.01	0.00
	2012	NA	NA
*Alloteuthis subulat*a	2005	1.76	0.63
	2006	2.47	0.94
	2007	5.61	2.27
	2008	2.06	0.76
	2009	2.96	1.85
	2010	1.05	0.64
	2011	2.78	1.32
	2012	NA	NA
Loligo forbesi	2005	10.95	3.86
	2006	37.86	14.04
	2007	16.12	5.58
	2008	9.48	4.28
	2009	13.38	5.41
	2010	15.01	5.80
	2011	29.91	11.24
	2012	13.41	6.79
Loligo vulgaris	2005	0.18	0.18

2.5 General comparison of commercial species cpues and Indices of biomass from surveys

Data concerning to survey and commercial catches of groundfish resource assessment carried out in various area (ICES divisions IVa and IVb. Subarea VIIb, k; Divisions VII a,e-h. Divisions VIIIc; IXa North and IXa South) have been presented. Data available are the values of average yields (kg/hour or kg/0.5 hour) for main commercial species or species groups of cephalopods in surveys and kg of cephalopods by fishing day or hours for the commercial indices used.

Complete survey dataseries have been plotted jointly with annual dataseries coming from the commercial fleet. Information is presented by ICES sea areas and main fleets. The analysis of surveys and cpues of this section has to be considered as a first step in the analysis. Specifically, for some areas and métiers the use of survey and commercial catches offers as indices of abundances appears to be promising.

3 Section 3: Sepiidae in Subarea II, IV, V, VI, VII, VIIIabd, VIIIc and IXa

3.1 Sepia spp.

Introduction

Sepia officinalis and *Sepia elegans* are distributed from ICES Subarea III to Div. IXa, Mediterranean waters and North African coast. Abundances in Subarea III are comparatively lower than in the rest of the areas based on the data provided by countries deploying fisheries. Main countries exploiting this species are France, Spain and Portugal, with lower catches recorded by UK and Ireland. It is usually exploited in a target fishery (i.e. traps by France) and also multispecific and mix fisheries trawlers bottom and twin otter trawlers.

Catches of Sepia spp. are usually composed by *Sepia officinalis* and *Sepia elegans.* No species identification has been provided for all countries and areas for commercial catches.

Sweden provided data of *Sepia officinalis* catches for 2012; these data are not included in the analysis as amount reached a maximum of 38 kg for 2012 caught by Otter trawlers.

3.1.1 Biological parameters and other research

A compilation of the most distinct biological parameters and population variables and dynamics are included for the two most abundant Sepia species in the ICES area.

3.1.1.1 *Sepia officinalis*

3.1.1.1.1 Length distribution and maximum size

Table 1. *Sepia officinalis*. Maximum mantle length (mm) for females (F) and males (M) in different geographic areas of the east Atlantic Ocean and the Mediterranean Sea.

Region ML (mm) Reference			
	F	M	
Bay of Biscay	290	350	Le Goff and Daguzan, 1991a
Ría de Vigo	235	205	Guerra and Castro, 1988
Biscay Gulf	280		Santurtun *et al.*, 2002
Catalan Sea	250	300	Mangold-Wirtz, 1963
Tyrrhenian Sea	230		Belcari *et al.*, 2002
Thracian Sea	264	320	Lefkaditou *et al.*, 2007
Izmir Bay (east Aegean)	241	324	Onsoy and Salman , 2005
Iskenderun Bay (Levant)	200		Duysak *et al.*, 2008

3.1.1.1.2 Length distribution and maximum size

Table2. *Sepia officinalis*. Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	A	B	Sex	Reference
English Channel	0.243	2.78	F	Dunn, 1999a
	0.305	2.64	M	

Spain, Ría de Vigo	0.264	2.70	F	Guerra and Castro, 1988
	0.265	2.70	M	
Portugal, Ria de Aveiro	0.242	2.74	F	Jorge and Sobral, 2004
	0.264	2.66	M	
Portugal, Ria de Sado	0.366	2.60	F	Serrano, 1992
	0.275	2.69	M	
	0.069	3.15	F	Neves *et al.*, 2009
	0.464	2.35	M	
Adriatic Sea	0.220	2.773	All	Manfrin Piccinetti and Giovanardi, 1984
Hellenic Seas	0.0064	2.18	F	Lefkaditou *et al.*, 2007
	0.0025	2.37	M	
Izmir Gulf (east Aegean)	0.0867	3.1571	All	Akyol and Metin, 2001
Iskenderun Bay (Levant Sea)	0.1082	2.9226	F	Duysak *et al.*, 2008
	0.1415	2.7832	M	
	0.1159	2.8771	All	

3.1.1.1.3 Growth rate and growth (age–length)

Growth is strongly seasonal, reflecting the seasonal life cycle. Forsythe and Van Heukelem (1987) indicate that daily growth in weight of this species declines, with increasing size from 5.5% BW d^{-1} to 3.75% BW d^{-1} The highest monthly rates of growth in length in (post-recruits) recorded by Dunn (1999) occurred during July to October in males (32.7 $mm.month^{-1}$) and during August to December in females (25 $mm.month^{-1}$). Based on the modal sizes of animals sampled in each month, specific daily growth rates (% ML d^{-1}) during the period of peak growth ranged from 1.20% down to 0.57% in males and 0.67% down to 0.39% in females.

3.1.1.1.4 Sex ratio

Dunn (1999a) found that the overall sex ratio of cuttlefish in commercial trawl catches was not significantly different from 1:1.

Zatylny (2000) observed spawning aggregations in the West Cotentin area (Normandy, France) and considered that unbalanced sex-ratio (with more males around Chausey Islands and more females close to the continental shore) could correspond to different areas for mating and egg-laying.

3.1.1.1.5 Size and age at first (and 50%) maturity

Common cuttlefish attain sexual maturity at a wide range of sizes. In the English Channel, 4% of males matured at 8.1-9.1 cm ML in August, at an age of approximately 1 year. Of the remaining males, the first matured at 11.4 cm ML, MLm50% was reached at 14.6 cm ML, and all were mature at 17.0 cm ML. In females, the smallest sexually mature individuals were 14.2 cm ML, MLm50% was 16.4 cm ML, and all females were mature at 23.0 cm ML (Dunn, 1999a).Life cycle patterns in the English Channel population have been updated (Gras, 2013). Actual size at 50% maturity is smaller than previously estimated (in 2011: 12.9 cm ML and 12.0 cm ML in females and males respectively). However, the proportion of specimens maturing at an age of 1 year remains very low and the bulk of this population still undergoes a 2 year life cycle

3.1.1.1.6 Lifespan

This species lives for approximately two years (Dunn, 1999a). In the English Channel, all animals appear to overwinter twice before spawning (Boucaud-Camou and Boismery, 1991; Boucaud-Camou *et al.*, 1991). In the Bay of Biscay, early season hatchlings may develop to maturity after a single winter, spawning late in the season, whereas other individuals may spawn early in the season having overwintered twice (Le Goff and Daguzan, 1991a).In the southern part of the distribution range the majority of the populations seem to have a one year life cycle (Mangold, 1966; Guerra and Castro, 1988; Coelho and Martins, 1991)

3.1.1.1.7 Spawning season and spawning habitat

Spawning extends from early spring to late summer in south and central Portugal and the Atlantic and Mediterranean coasts of south Spain, with a spawning peak in June and July (Villa, 1998; Tirado *et al.*, 2003; Jorge and Sobral, 2004). A similar spawning season is found northwest of the Iberian Peninsula, but winter spawning has also been recorded here (Guerra and Castro, 1988). In the Bay of Biscay and the Gulf of Morbihan spawning occurs from mid-March to late June (Le Goff and Daguzan, 1991a). Along both the north and the south coast of the English Channel the spawning season of *S. officinalis* extends from February to July (Dunn, 1999a; Royer, 2002; Royer *et al.*, 2006; Wang *et al.*, 2003).

3.1.1.1.8 Fecundity

Estimates of fecundity for females vary widely, although some of this variation probably relates to how fecundity is measured. According to Mangold-Wirz (1963), females lay between 150 and 4000 eggs, depending on their size.

3.1.1.1.9 Migrations

Seasonal migrations between shallow and deeper waters are a well-known ecological feature of *S. officinalis*.

3.1.1.2 *Sepia elegans*

3.1.1.2.1 Length distribution and maximum size

Sepia elegans is a small-sized species, with adult males growing up to 75 mm ML (Ciavaglia and Manfredi, 2009) and females up to 89 mm ML (Adam, 1952). Maximum total weight is about 60 g.

3.1.1.2.2 Length weight relationship

Table 1. *Sepia elegans*. Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	A	b	Sex	Reference
Ría de Vigo	0.374	2.272	F	Guerra and Castro, 1989
	0.327	2.311	M	
Portuguese waters	0.289	2.420	F	A. Moreno, Unpublished data
	0.356	2.190	M	
Gulf of Cadiz	0.239	2.476	F	Ramos *et al.*, 2009
	0.227	2.577	M	

3.1.1.2.3 Growth rate and growth (age–length)

Growth in mantle length was 2.8 mm per month for males and 3.0 mm for females in the Sicilian Channel (central Mediterranean) (Ragonese and Jereb, 1991), i.e. slightly faster than estimated in the west Mediterranean by Mangold-Wirz (1963) and in the Ría de Vigo by Guerra (1984) (2-2.5 mm per month).

3.1.1.2.4 Sex ratio

In the Ría de Vigo, males outnumbered females in spring and autumn and the overall sex ratio recorded by Guerra and Castro (1989) was 1.18:1 in favour of males.

3.1.1.2.5 Size and age at first (and 50%) maturity

The smallest mature males measure 20 mm ML (Volpi *et al.*, 1990) and the smallest mature females 30 mm ML (Guerra and Castro, 1989). In Portuguese waters about 60-70% of males and females are mature at about 35 and 45 mm ML respectively (A. Moreno, Unpublished data)

3.1.1.2.6 Lifespan

It lives 12-18 months.

3.1.1.2.7 Spawning season and spawning habitat

Although this species spawns all year round, seasonal migrations and seasonal peaks of spawning have been described in some areas.

3.1.1.2.8 Fecundity

Mature females may carry up to 250 eggs (larger than 1 mm) in their ovaries; however, as is usually the case for "large" eggs in cephalopods, only a proportion of the eggs will reach maturity (Mangold-Wirz, 1963). Total fecundity in females from the Gulf of Cadiz varied between 61 and 942 oocytes (specimens of 34 mm and 64.2 mm ML respectively).

3.1.1.2.9 Migrations

A spring-summer migration of the whole population to coastal spawning grounds (40-70 m depth) has been described for this species in some areas, e.g. the west Mediterranean (Mangold-Wirz, 1963; Guerra, 1992) but is not present in others, e.g. the ría de Vigo (northwest Spain; Guerra and Castro, 1989).

3.1.2 ICES Subareas VI and VII

3.1.2.1 The Fishery

3.1.2.1.1 Catches in 2012

Catches of Sepia spp. in Subarea VI are not accounted due to the lowest values recorded.

Sepia spp. catches in Subarea VII are mostly concentrated in the English Channel, reaching a total amount of 12 709 t in Divisions VIId and e. Catches of these species were also present in ICES Divisions VIIg-k (Celtic Sea and SW of Ireland) accounting for 530 t.

In the Bristol Channel (ICES Subarea VIIf) Sepiidae catches were 46 t.

Catches in the English Channel accounted for 95 % of the total of *Sepia spp*. catches of the total Subarea VII.

3.1.2.1.2 Commercial landing series

France comprises 58% of the Sepia spp. landings in Division VIId,e. Landings have increased from 6229 t in 2011 to 7310 t in 2012. England, Wales and Northern Ireland account for 42% of the catch in that same area with a remarked increase in sepia spp. landings from 2 637 t in 2011 to 5 222 t in 2012. Scotland accounts for a very small quantity of the catches in that area. The Netherlands have not provided catches of Sepia in this area in 2012 as for last year 2011. Belgium has not provided landings of these species in these sea areas since 2009.

France comprises 81% of catches of species in the Bristol Channel (Division VIIf), rest of the catches are deployed by England, Wales and Northern Ireland. Belgium do not provide landings for these species in the Bristol Channel since 2009.

3.1.2.1.3 Commercial discards

Several countries have provided discard data in relation to *Sepia spp.* UK did not provide kilograms discarded of *Sepia spp*. but numbers. No percentage is available for these species and no total numbers of individuals provided are provided for such a calculation. In 2011 the percentage of *Sepia spp*. discarded by dredges ranged from 5% in Division VIIe to 100% in VIIa. Discard percentages in UK trawls were at maximum 3 % in Division VIIe.

UK recorded discards for Twin Otter trawls, Pair Otter trawls and Beam trawls are less than 3 % in all Subarea VII.

Ireland, The Netherlands, Germany and the Basque Trawl component of the Spanish Fishery did not reported discards in Subarea VII. Ninety five percept of the sepia caught in Subarea VI and VII by Spanish vessels were discards in 2012 in trawlers. In 2011 just 1% of these species were discarded by that country in that area

3.1.2.1.4 Commercial catch-effort data

Landing data for Sepiidae was provided for otter trawlers, pairtrawlers and Scotish Seiners from 2009 to 2011 for UK, Ireland and Spain. In case of UK and Ireland, and for 2012, landing data by fleet/métier was provided, however no effort data were provided for the same métier, consequently, no cpue data for 2012 could be updated.

Spain provided cpues dataseries since 2005. A remarkable peak in 2010 is detected by al gears deployed in Subarea VII. Followed by a decrease, that in the case of Spanish and for otter trawlers, reached almost 0 values in 2012.

French cpue data can only be computed for otter bottom trawlers. COST extractions of effort data do not include details per rectangles and so preliminary (rough) estimates at the scale of ICES Subareas are computed. Annual trends in the period 2009-2012 are similar to total landings trends and suggest that abundance is increasing (VIIe) stable or decreasing (VIId and VIIh) in this period..

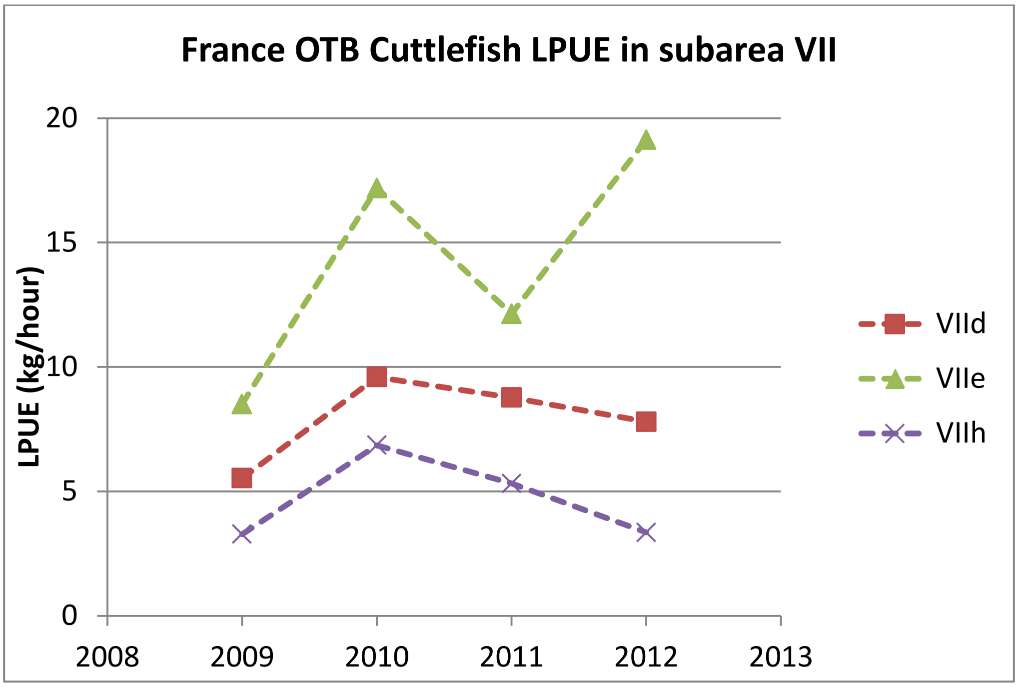


Figure 3.1.2.1.4.1. Sepiidae LPUEs (kg/h) for French Otter Bottom Trawl in Subarea VII and VIII. In 2009-2012.

At a monthly scale OTB LPUE underline that cuttlefish look more abundant in autumn-winter and in spring (Figure 3.1.2.1.4.1). These two periods correspond to concentrations on inshore spring-spawning grounds and offshore wintering grounds. Autumn abundance peaks earlier in division VIId than in VIIe which is not surprising because VIIe is the deepest part of the Channel (reached during the coldest winter months). In division VIIh a peak was observed in spring 2010 which is quite surprising and should be checked as it could represent that all the population do not always migrate inshore to spawn?

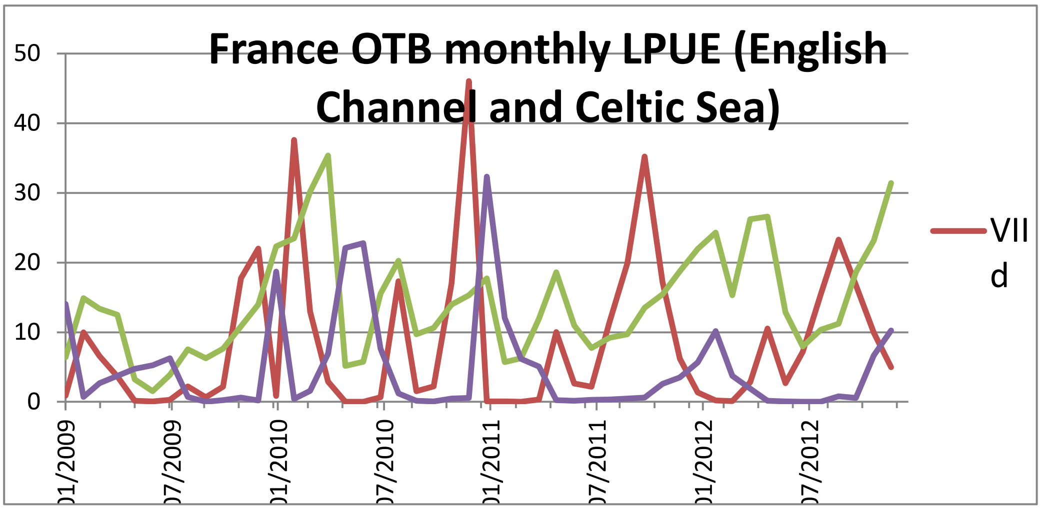


Figure 3.1.2.1.4.2.. Monthly Sepiidae LPUEs (kg/h) for French Otter Bottom Trawl in Subarea VII.

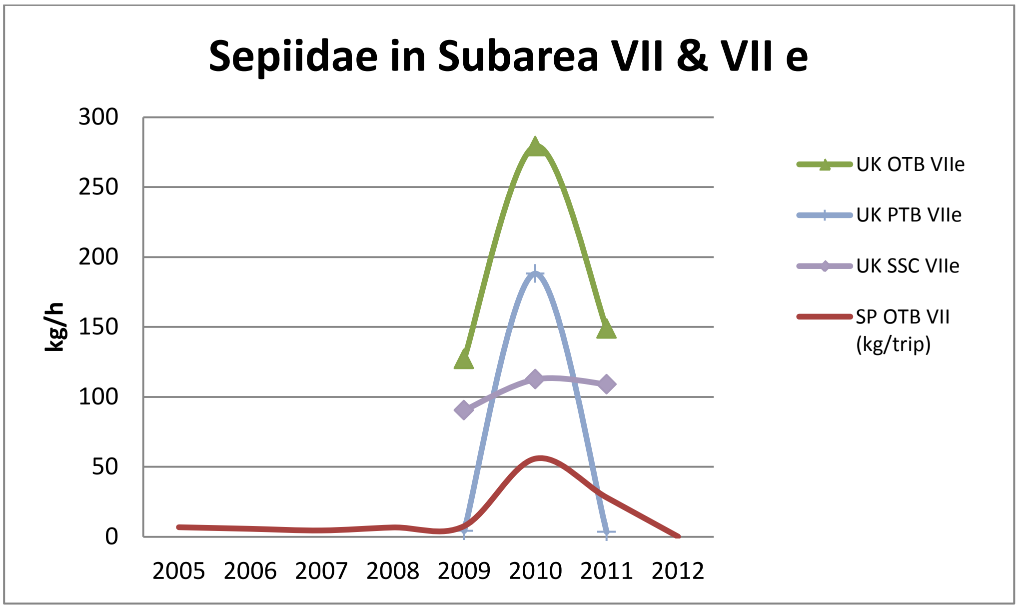


Figure 3.1.2.1.3. Sepiidae LPUEs (kg/h) for Spanish and English fleets in Subarea VII and VIIe.

3.1.2.2 Fishery-independent information and recruitment

UK, Ireland and Spain provided data of abundances of cephalopods in Subarea VII. However no Sepia spp. was found in the areas during the surveys time for Spain and Ireland. UK provided abundance indices in kg per hourfor 2005, 2006 and 2010 and 2011 of *Sepia spp* from the IBTS Survey in Division VIIe carried out during the 4th quarter of the year.

In Division VIId the French survey CGFS is carried out by Ifremer in October each year. However, average abundance indices have not been collected for this report.

3.1.2.3 Analysis of species trends/Assessment of Sepiidae or Stock trends

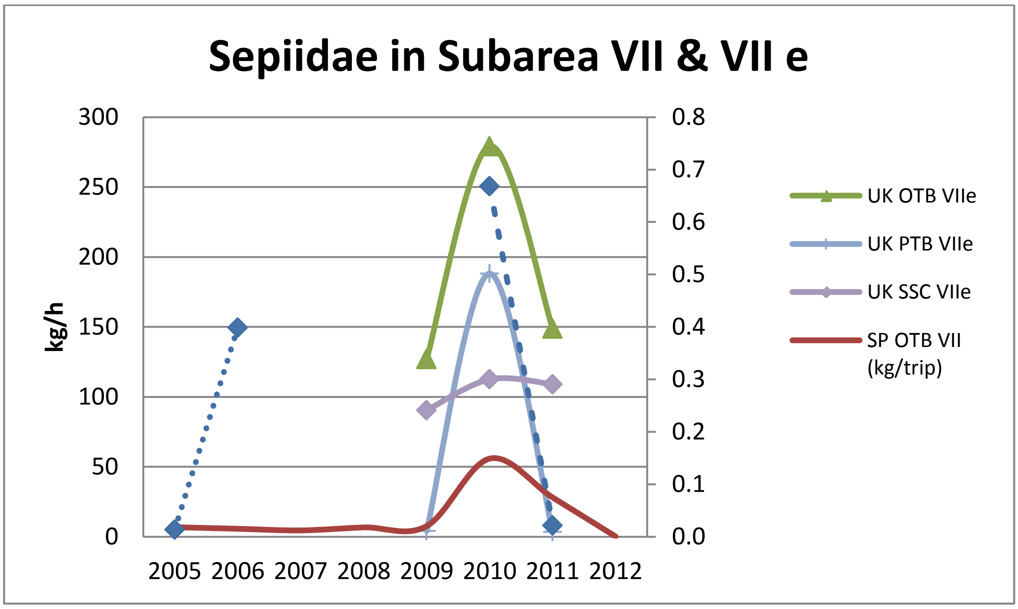


Figure 3.1.2.3.1. Graphical comparision between Commercial LPUEs (kg/h) trends for Spanish (kg/trip) and English fleets and the UK Survey (kg/h) in Subarea VII and VIIe.

Commercial cpues for the main fleets exploiting *Sepia spp.* were calculated for the last 3 years (2009, 2010 and 2011). Yields (kg/h) were plotted jointly with the Abundance indices of the English Western IBTS Survey (Q4SWIBTS) deployed during the 4th quarter every year since 2005 and covering ICES Divisions VII a, e-h. Abundance Indices for surveys were calculated as kg per hour. Series of abundances were plotted by grouping Families and areas coincident between commercial cpues and Surveys. For the commercial cpues, fleets with the highest abundance of cephalopods were used. In case of UK these were: OTB: Otter trawls, PTB: Bottom Pair trawl and SSC: Fly shooting (Scottish) seine. In case of Spain just OTB (Otter traw) LPUEs are estimated.

Due to the shortness of the commercial cpues series, just three years of data, no analysis of trends could be deployed. However, it is worth to point out that if cpues dataseries could be recovered and a more detailed work could be done taking into account the seasonality of some of the commercial fleets. Then, it is expected that some signal of abundance could be extracted from both dataseries.

The comparison of France LPUEs with UK or Spain indices is hampered by the poor quality of France 2009 data. However, it seems that in the area VII abundance was higher in 2010 than in 2011. (

3.1.2.3.1 Exploratory Assessment

No preliminary analyses could be conducted during this working group to check whether abundance indices obtained in the groundfish survey could be indicative of the abundances of Sepia spp.

3.1.2.4 Data requirement

The lack of data from UK Survey in Division VIIe from year 2006 to 2009 limited the comparison between indices. Commercial data should be worked out at métier level. Also it would be interesting to compare those series with those surveys covering the whole actual sea area of fishing operation of the Spanish, Irish and UK at species level. Further work should be devoted to the identification of species and correct possible wrong assignations of some species to Families.

3.1.2.5 Management Considerations

Sepia ofiicinalis is managed only in inshore areas in Divisions VIIe and VIId. Along the coast of Normandy a license system is supposed to limit the effort to be deployed on the population and the accessibility to the fishery. Concerns have been raised about the actual effect of these management measures on the population status and no stock assessment of the *Sepia officinalis* population has been updated since 2008. In France inshore trawling is banned within the 3 miles limit but exemptions are given in some French coastal zones in spring (boats fishing targeting cuttlefish spawners) and in late summer (boats fishing for juveniles).

It is worth to keep in mind that inshore catches depend on the proportion of cohorts that escape offshore exploitation on wintering grounds (Royer et al 2006). There is no specific regulation of offshore trawling related to the cuttlefish stock but regulations defined for groundfish apply.

3.1.3 ICES Division VIIIabd

3.1.3.1 The Fishery

3.1.3.1.1 Catches in 2012

Countries contributing to Sepia spp. catches in Division VIIIabd are France and Spain. France generally comprises about 90% of these total catches (average 2000-2012). In 2012 the amount landed by France from this area was 5 693t (88%) (and 5 688t excluding division VIIIIc)

3.1.3.1.2 Commercial landing series

For Spain, landings in Division VIIIabd show a fluctuating constant level around 220 t in average, with a decrease in 2009 and 2010, and showing an increase in the two last year with the highest values of the time series in 2012 with 548 t. Commercial fishery in Division VIIIabd (Bay of Biscay) is mostly composed by vessels with base port in the Basque country.

France takes the bulk of Bay of Biscay landings (Divisions VIIIa,b,c,d) which were in 2011-2012 above 5,000t : a level that had not been observed since 2000. Increasing landings seem to be related to increasing abundance on the wintering grounds but also to higher fishing in periods of peak abundance.

3.1.3.1.3 Commercial discards

AZTI-Tecnalia is responsible for monitoring cephalopod discards, monthly in Div. VIIIabd by gear, for the Basque Country (around 95 % of the Spanish fleet operating in the Bay of Biscay).

The discard rate was estimated based on landing estimation per species, or groups of species and the total fleet discard rate raised to total fleet effort. *Sepia spp.* is discarded in very low percentages ranging from a maximum of 8% in 2009 to no discards in 2012.

France discards observer programme "Obsmer" includes 2012 observations of commercial fishing trips in the Bay of Biscay with records of discarded cuttlefish. However, these data were not collected and analysed for this report.

3.1.3.1.4 Commercial catch-effort data

Basque LPUEs were calculated for Sepia spp., aggregated by gear. This is, Bottom Otter trawl and Bottom pair trawl LPUEs were pooled together. cpues were available as kg/days of fishing. Abundance indices are presented at Family level for Div. VIIIabd.

It has to be pointed out that in Div. VIIIabd, the percentage of effort for each of the gears (Bottom Otter trawl and Bottom Pair trawl) changes along the dataseries (WD 3). In the next future would be possible to discern between cpues of both gears and also it is expected that a more detailed analysis based on métiers and species could be deployed.

Nowadays, the most important Basque fleet targeting cephalopods are “Baka” bottom otter trawlers in the Division VIIIa,b,d. Within this fleet three different métiers have been defined following the criteria defined in the European Data Collection Framework:

-OTB_DEF_>=70 (otter trawlers targeting demersal fish).

-OTB_MCF_>=70 (otter trawlers targeting mixed cephalopod and demersal fish).

-OTB_MPD_>=70 (otter trawlers targeting mixed pelagic and demersal).

Landings of the different species have been included in one or other métier following the segmentation above. In the last four years from 2009 to 2012, the métier targeting cephalopods OTB_MCF has increased its number of trips and its cephalopods catches (WD 3. Figure 7). The increase in the OTB_MCF métier seems to be related to the decrease in OTB_DEF métier targeting demersal species like hake, megrim or anglerfish.

France OTB LPUE in the Bay of Biscay show a slow but steady increase in the most recent years (figure 3.1.3.1.1)

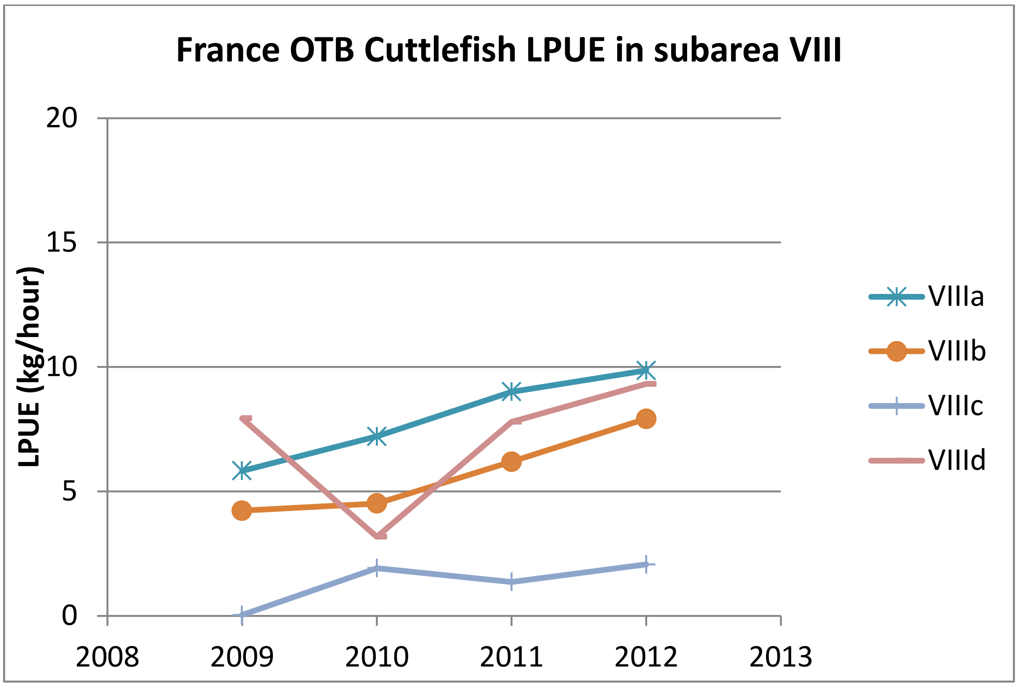


Figure 3.1.3.1.4.1. Sepiidae LPUEs (kg/h) for French Otter Bottom Trawl in Subarea VIII in 2009-2012.

At a monthly scale (figure 3.1.3.1.2) several outliers are observed but the general picture confirms a slow increase in abundance indices rather than a high interannual variability. Seasonal patterns are less visible than in the case of the English Channel but this seems clearly due to the spatial resolution of the analysis (LPUE inidices computed by division) and in particular to the fact that divisions VIIIa and VIIIb include both inshore and offshore rectangles.

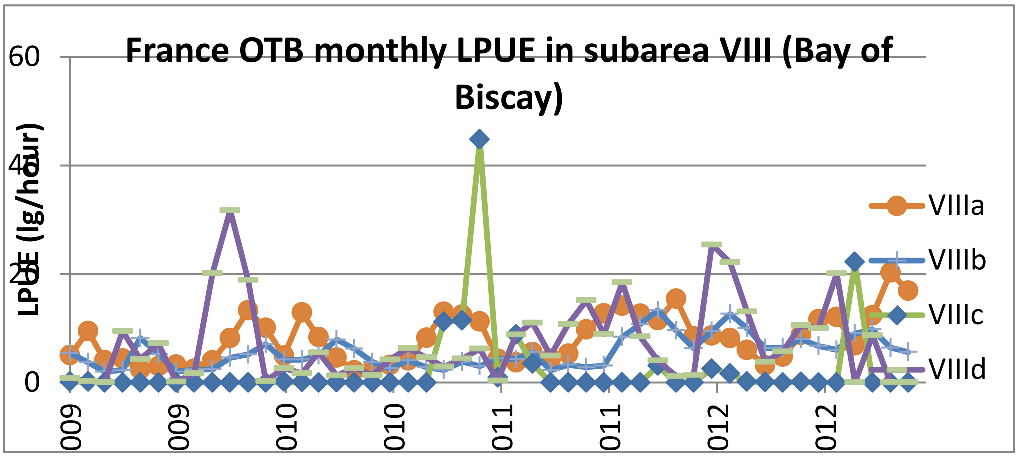


Figure 3.1.3.1.4.2. Sepiidae LPUEs (kg/h) for French Otter Bottom Trawl in Subarea VIII in 2009-2012.

3.1.3.2 Fishery-independent information and recruitment

No survey data are presented in this section. Data from survey taking place in Div. VIIIabd, FR-EVHOE, for this species was not delivered to the group for discussion. Thus, in this section just, commercial cpues are presented.

3.1.3.3 Analysis of species trends/Assessment of Sepiidae or Stock trends

Overall, a slight increasing trend, alternating years of increase and decrease, is detectable for Sepiidae LPUEs from the beginning of the series till 2008 reaching a maximum of around 90 kg per day. After 2008, a sharp decreased was observed. Yield in 2010 reached the lowest value of the series (close to 24 kg(day)). Up to 2012, Sepiidae yield markedly increased till around 225 kg/day, which is the highest value recorded in the historic dataseries.

A similar exercise using French OTB data would require to re-run extractions from the national database and to check that landings and effort categories are similar before 2009 and after.

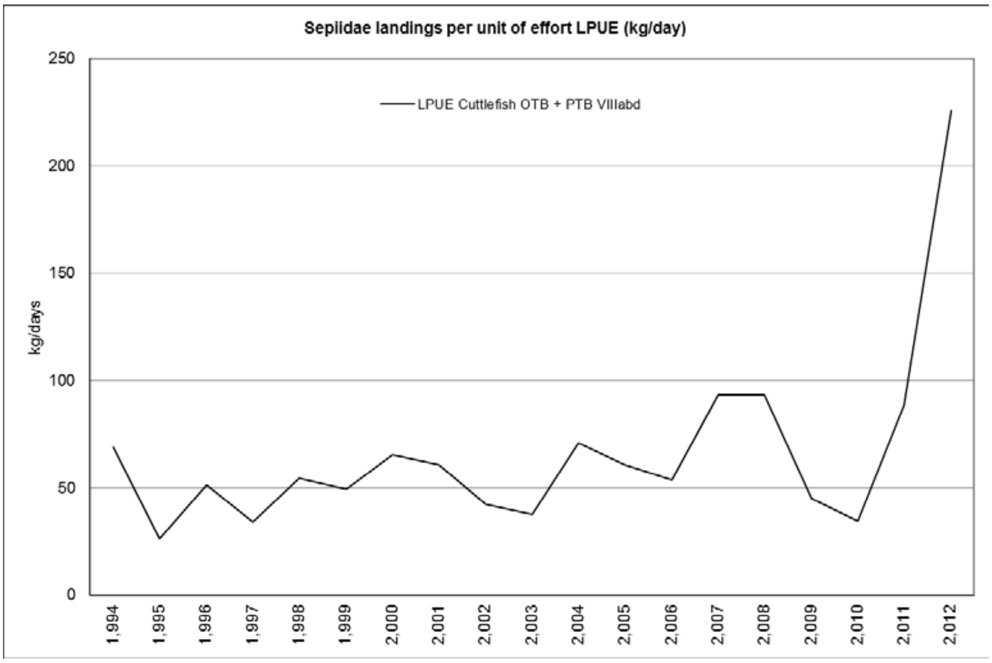


Figure 3.1.3.3.1. Commercial LPUEs (kg/days) trends for Spanish trawl fishery in Division VIIIabd.

3.1.3.3.1 Exploratory Assessment

No exploratory analysis was deployed due to the lack of availability of French Survey data in Div. VIIIabd for this species (EVHOE survey)..

3.1.3.4 Data requirement

The lack of French data both commercial and survey indices limit the capacity of the group to carry out any assessment of trends.

3.1.4 ICES Division VIIIc and IXa

3.1.4.1 The Fishery

3.1.4.1.1 Catches in 2012

Catches in these ICES Divisions are comprised mostly by Spain and Portugal, reaching a total amount of 2200 t of Sepia spp. Contribution of each of the countries is close to 50% to the total catches.

3.1.4.1.2 Commercial landing series

Only *Sepia officinalis* and *Sepia elegans* are present in landings from Divisions IXa and VIIIc-West. Data on the proportion of each species are only available for Subdivision IXa-South, where *Sepia officinalis* makes up about 93% of cuttlefish landed (WD 2: Figure 5). In this Subdivision *Sepia elegans* and *Sepia orbignyana* appear mixed in landings, although the last species is quite scarce. The commercial value of *Sepia elegans* is high, and for this reason is separated in the catch.

Division IXa contributed with 70% of total cuttlefish landed by Spanish fleet, with the 70% of landings in this Division corresponding to the Subdivision IXa-South (Gulf of Cadiz). Spanish landings in this Division reached a maximum of 1215 t in 2005 and fluctuating around 900 t along the rest of the years. In 2012, landings reached the amount of 978 t. Spanish landings in Division VIIIc increased at the end of the analysed period, reaching a total of 245t.

Portuguese landings of Sepia are restricted to Div. IXa, and landings of cuttlefish, here presented, include only landings of *Sepia officinalis. A*verage Portuguese landings between 1996 and 2012 amounted for 1500±241 tons. Annual landings of cuttlefish show slight fluctuations, and the trend since 1996 is slightly positive

3.1.4.1.3 Commercial discards

Percentage of *Sepia spp*. discarded by Spanish otter trawlers in Div. VIIIc and IXa highly fluctuates along the years of the series here presented. Thus from a 60% discarded of Sepia spp. in 2006, ratio was decreased in subsequent year to almost nil. In the last 2 years of the dataseries, Sepiidae discard rate accounted for 34 and 11 % respectively.

In WD 4, Table 4a and 4b display the frequency of occurrence of cephalopods in the discards of Portuguese OTB vessels. The frequencies of occurrence of most species are low, e.g. in comparison to other commercial species such as hake (42-89% in OTB, Prista and Fernandes, 2013) or blue whiting (56-91% in OTB_CRU, Prista *et al*., 2012), *Sepia officinalis* occurrences in 2012 was 4 %. For the time being and until a more sophisticated estimation method is implemented (see Fernandes and Prista, 2013), the discards of the remaining species are better assumed as low or negligible for assessment purposes. The main reasons for cephalopod discarding in the Portuguese OTB fishery are mainly related to the low commercial value of some species or their low abundance which rends their commercialization marginal

3.1.4.1.4 Commercial catch-effort data

Spain provided LPUE data for Otter trawls operating in VIIIc and IXa, kilograms per trip are at low levels except for 2008 when a increase is detected. However LPUEs for Spanish fleets are very low for this species in the area.

LPUEs provided by Portugal are, for the years provided of higher values than the Spanish LPUEs. In general and for the 2 years of data provided, Otter trawls are the fleet with higher LPUEs.

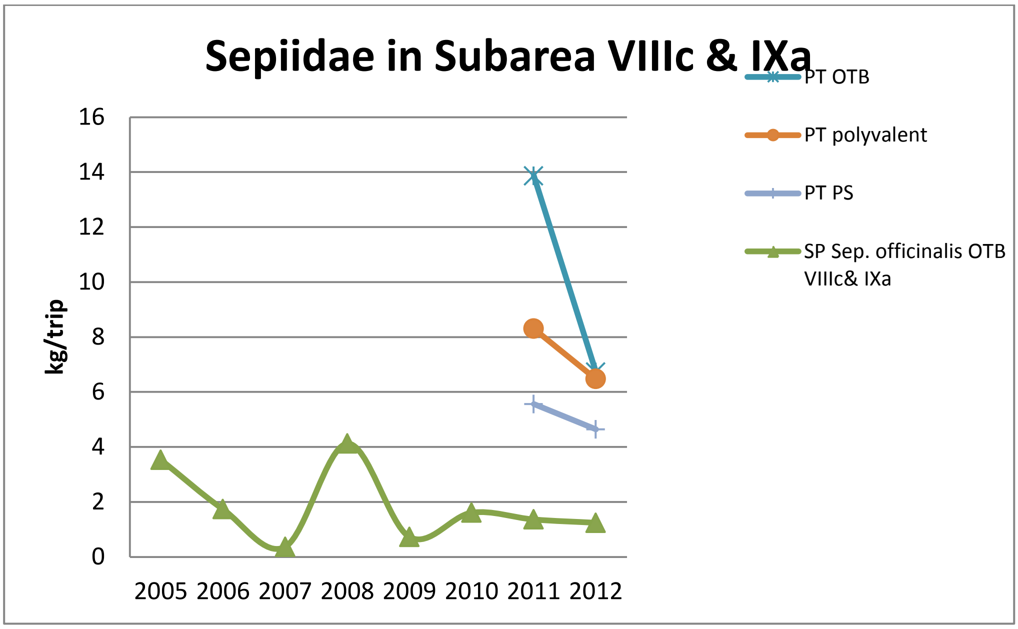


Figure 3.1.4.1.1 Commercial LPUEs (kg/trip) trends for Spanish and Portuguese fleets in Divisions VIIIc and IXa..

A separately analysis of commercial trends has been carried out for otter trawls operating in Division IXa south. As commented before, *Sepia elegans* and *S.officinalis* are separated in the landings due to the commercial different prices that these two species attain in the market .*S.officinalis* comprises more than 90% of the landings in average.

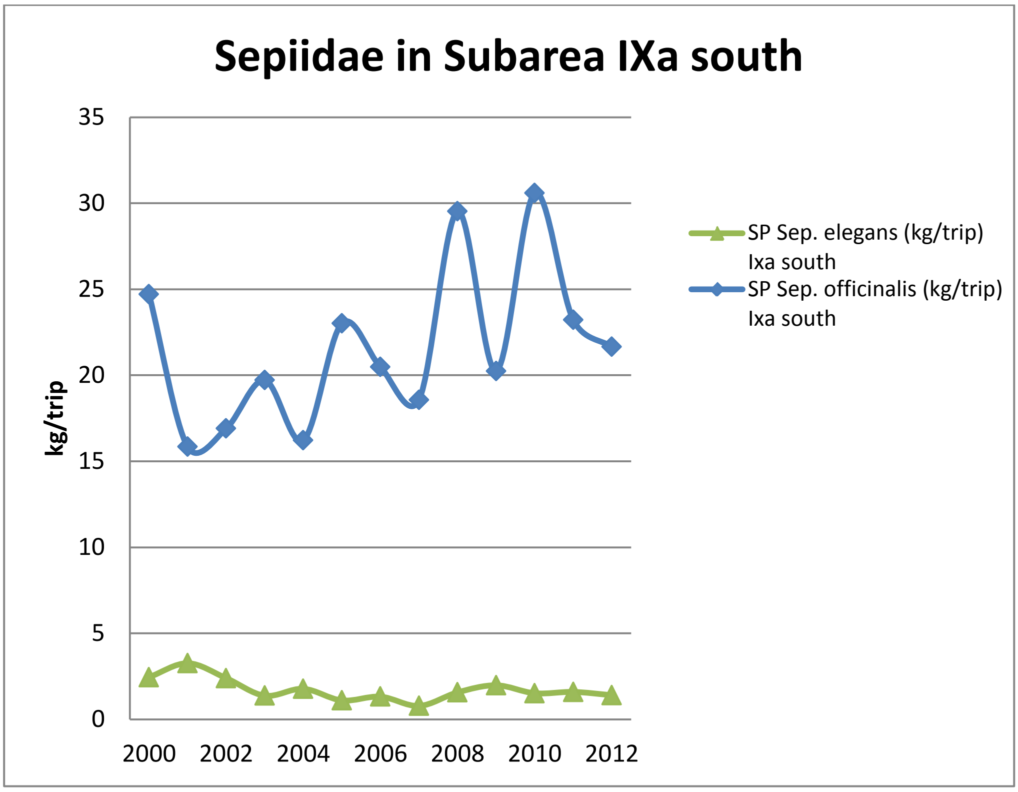


Figure 3.1.4.1.2 Commercial LPUEs (kg/trip) trends for Spanish and Portuguese otter trawlers in Divisions VIIIc and IXa.

Large fluctuation in LPUEs appears in *S. officinalis* alternate years. Discards higher and lower ratios appear to coincide with these peaks and valleys in the trends. For comparative reasons related to abundance of each of the species in the catch, both trends are plotted together and S.elegan trends are difficult to observe in the plot, however oscillations could also be detected.

3.1.4.2 Fishery-independent information and recruitment

The northern Spanish groundfish survey (SPGFN) covered ICES Division VIIIc and the northern part of IXa corresponding to the Cantabrian Sea and off Galicia waters. The surveys are conducted from 35 to 700 m. depths during the 3rd and the 4th quarter (September – October).Abundances of Sepia spp. in this survey are almost ne-glectable.

Portuguese survey presented as the northern component of the SPGFS a very low abundance index. Peaks of abundance for both surveys appear to coincide in 2009. Both surveys coincide in the signal of higher and lesser abundances given.

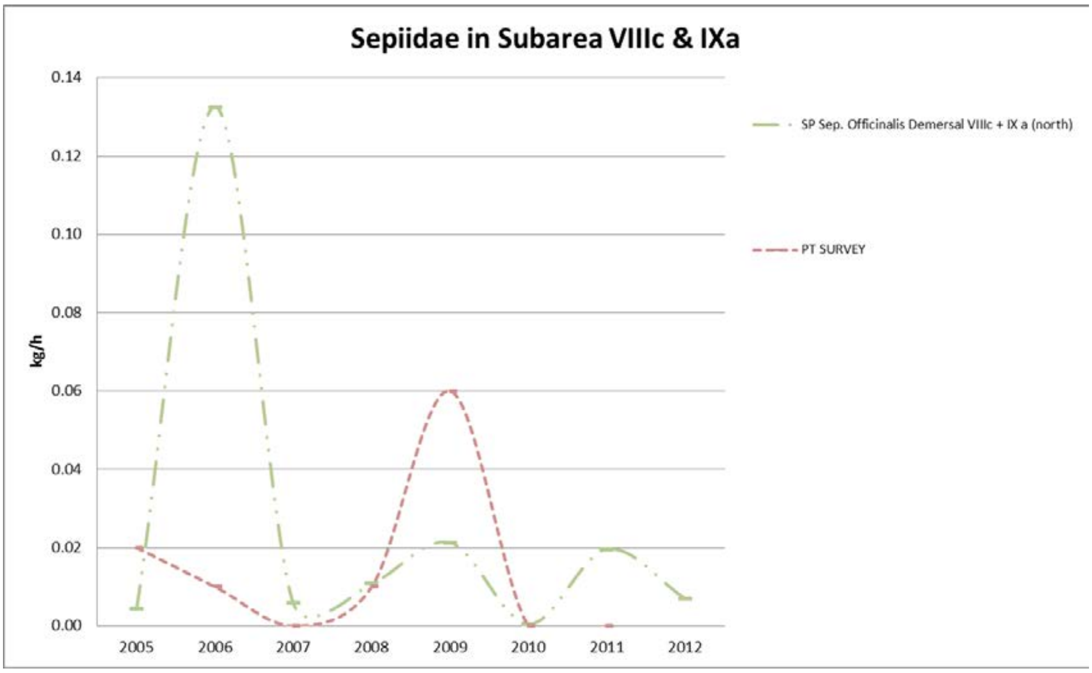


Figure 3.1.4.2.1 Spanish (kg/h) and Portuguese Scientific surveys (kg/h) abundance index (kg/h) in Divisions VIIIc and IXa..

As for commercial LPUEs, separately analysis of surveys trends has been carried out for the Spanish GFS in IXa south. Abundance indices of both species are presented in the following graph..

The Spanish Ground Fish South (ARSA/SPGFS) is conducted in the southern part of ICES Division IXa, the Gulf of Cadiz. The covered area extends from 15 m to 800 m depth, during spring (March) and autumn (November). SPGFS aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Gulf of Cadiz area (ICES Division IXa). Abundances estimated by this survey for *S.officinalis* are still very low reaching a maximum of 2.5 kg/h in 2003 and 2010.

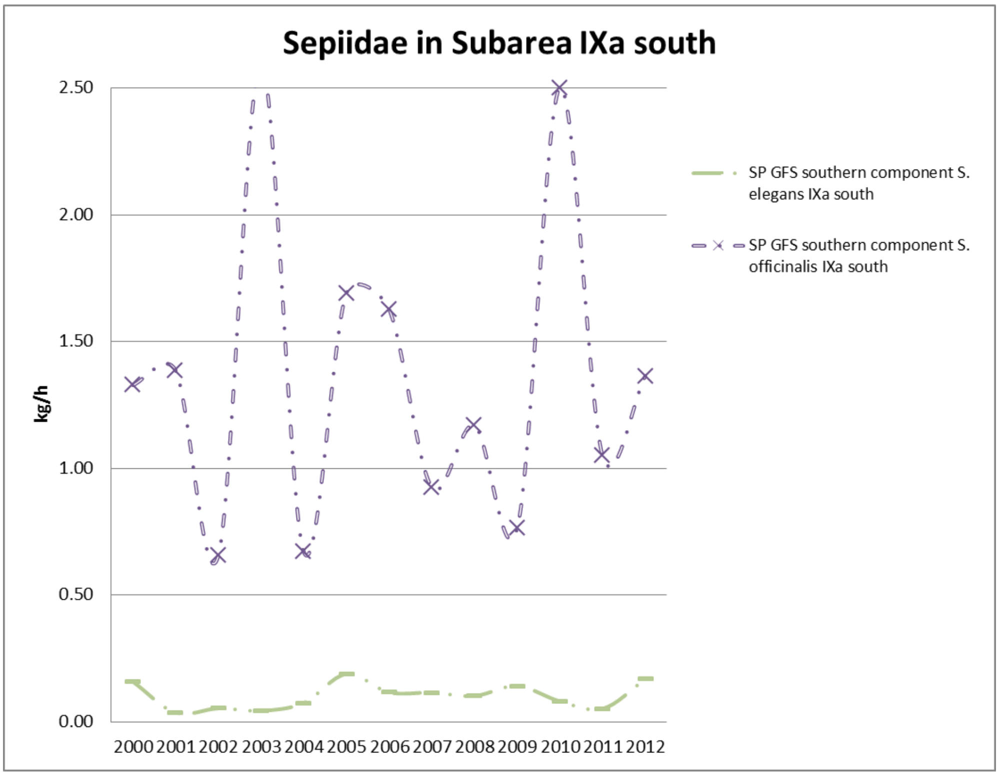


Figure 3.1.4.2.2 Spanish (kg/h) and Portuguese Scientific surveys (kg/h) abundance index (kg/h) in Divisions IXa south.

3.1.4.3 Analysis of species trends/Assessment of Sepiidae or Stock trends

There are not similar trends between both commercial and survey series. Spanish otter trawl commercial fleet show higher abundances where surveys indicate low ones. Just Portuguese commercial fleets for the only two years available seem to follow a decreasing trend shown by surveys. Discard highest ratio of Sepia spp.(60%) coincides with the highest abundance detected by the Spanish GFS in 2006.

For *S. officinalis*, commercial catches by 85% corresponds to the trawl fleet. However for the overall trawl fleet, these species represents only 1% of total catch. Thus, commercial indices hardly could represent abundance of such low bycatch species. Also, the index obtained in the survey may not be representative of the abundances, either by not covering the area of distribution of the species (working from 6 miles of coastline) or because the dates of surveys are not the most appropriate to this species. In the case of *S. elegans*, the area of the survey covers perfectly the area of distribution of the species.

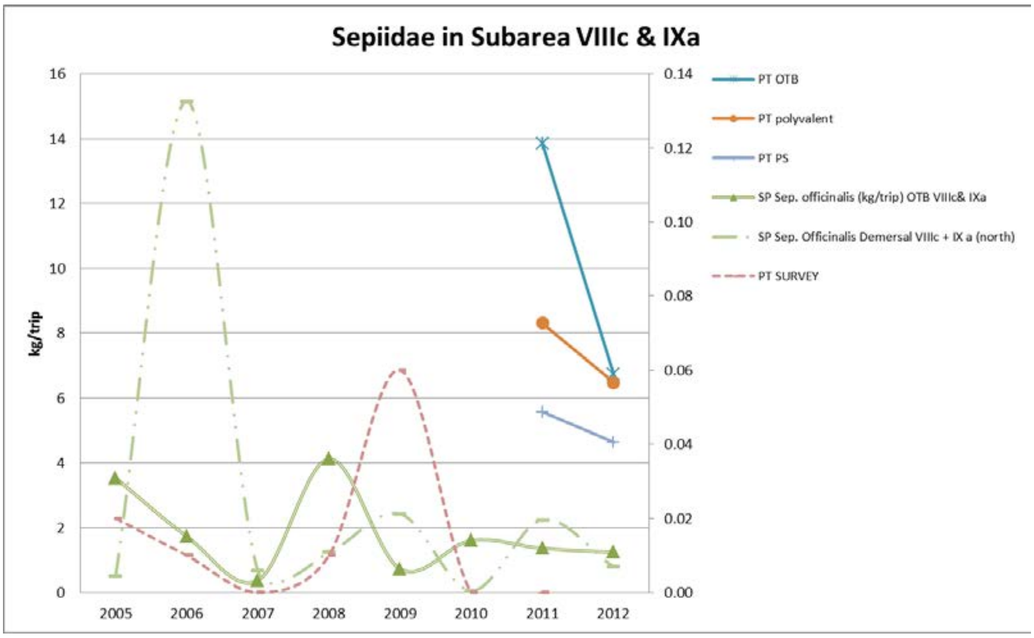


Figure 3.1.4.3.1 Comparison between trends in commercial LPUEs of the Spanish and Portuguese fleets (kg/trip) and the abundance indices from the Spanish and Portuguese Scientific surveys (kg/h) surveys in Divisions VIIIc and IXa.

Analysing trends for both commercial and surveys indices for the Spanish component of the fisheries in IXa, in 2003, 2005 and 2010, the coincidence of peaks in abundance of both series are remarkable. However the low abundance of *S.officinalis* in both commercial fleets and surveys might indicate no convenience of the use of either index for abundances.

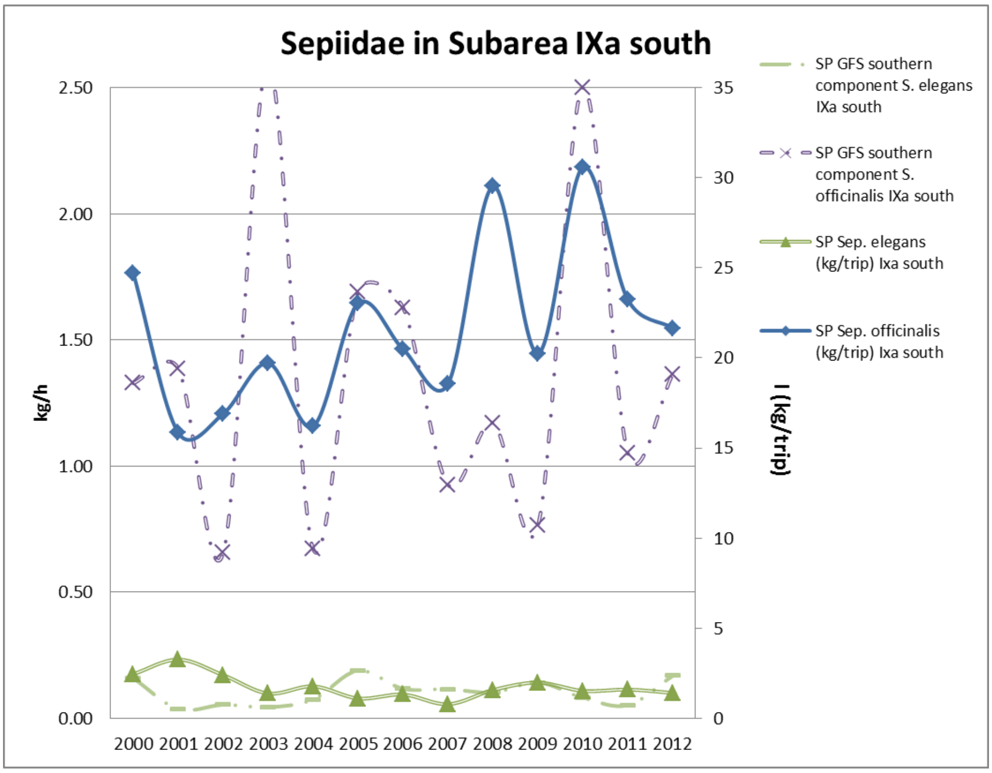


Figure 3.1.4.3.2 Comparison between trends in commercial LPUEs of the Spanish fleets (kg/trip) and the abundance indices from the Spanish Scientific surveys (kg/h) surveys in Divisions IXa south.

3.1.4.3.1 Exploratory Assessment

3.1.4.4 Data requirement

Catches of both Sepia species are of relatively very low ratio compared to other species in the catch (approx. 1%). Thus, although the fleet catching the highest abundance of Sepia has been chosen for the analysis, cpues appears to be of no value. Coincidences of peaks of abundances are remarkable in some of the dataseries and years but some concerns about the appropriateness of dataseries arises due to low abundances of both species. In case of surveys, usual problems in relation to the coverage of the distribution area of the stock, seasonality and no dedicated survey to Sepia limits the capacity of extracting any useful abundance indices for *Sepia spp*. in the area.

3.2 References

Reference in relation to the biology and dynamics of these species can be found in Reference of Section of *this section 7.3: Review data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity at age, first maturity at length, growth, spawning season, of this report*.

Coelho, M. L. and Martins, M. C. (1991). Preliminary observations on the biology of*Sepia officinalis* in Ria Formosa, Portugal. In Boucaud-Camou, E., editor, La seiche /The Cuttlesh, pages 131{140. Centre de Publications de l'Universite de Caen, Caen,France.

Guerra, A. and Castro, B. G. (1988). On the life-cycle of *Sepia officinalis* in the Ria deVigo. Cahiers de biologie marine, 29:395-405.

Gras M. (2013). Contributions des frayères côtuères au recrutement du stock de seiche *Sepia officinalis* de Manche : lien entre le success de la phase pré-recritée et l'abondance de la ressource. PhD Thesis Université de Caen Basse-Normandie

Mangold (1966). *Sepia officinalis* de la mer Catalane. Vie Et Milieu - Life and Environment, 17:961-1012.

Royer J., Pierce G.J., Foucher E., Robin J.P., 2006. The English Channel Stock of *Sepia officinalis*: variability in abundance and impact of the fishery. Fisheries Research, 78: 96-106.

Zatylny C. (2000) Etude du contrôle de la ponte chez la seiche *Sepia officinalis* L. : applications à la conservation des stocks et au repeuplement dans l'Ouest Cotentin. PhD Thesis Université de Caen, 119 pp

4 Section 4: Loliginidae in Subarea II, IV, V, VI, VII, VIIIabd, VIIIc and IXa

4.1 Loligo spp. and Alloteuthis spp.

Introduction

Loligo vulgaris, Loligo forbesii, Alloteuthis subulata and *Alloteuthis media* are distributed from ICES Subarea III to Div. IXa, Mediterranean waters and North African coast. Abundances in Subarea III are comparatively lower than in the rest of the areas based on the data provided by countries deploying fisheries. Main countries exploiting this species are France, Spain and Portugal, with lower catches recorded by England, Scotland and Ireland and mostly concentrated in more northern areas. Loliginidae are usually exploited in a multispecific and mix fisheries trawlers.

Catches of Loliginidae are usually composed by *Loligo vulgaris, Loligo forbesii, Alloteuthis subulata* and *Alloteuthis media*. No species identification has been provided for all countries and areas for commercial catches. Although most expected species in the catch are expected to be *Loligo spp*.

Sweden and Germany provided data in relation to discards, landings and effort in Subarea III and IV, for at least 2011 and 2012. UK and The Netherlands provided data on LPUEs of *Loligo spp.* in Subarea VI for trawlers and Scottish Seiners. Also for both areas survey data are provided. These data are not included in the main body of the report but compiled in an annex due to the small amount of this cephalopod group detected in commercial vessels and surveys.

4.1.1 Biological parameters and other research

A compilation of the most distinct biological parameters and population variables and dynamics are included for the four most common Loliginidae species in the ICES area.

4.1.1.1 *Loligo vulgaris*

4.1.1.1.1 Length distribution and maximum size

Male *L. vulgaris* attain greater lengths and weights than females. In the Northeast Atlantic maximum mantle length is 546 mm in males (Moreno *et al.*, 2007) and 372 mm in females (A. Moreno, pers. comm.).

4.1.1.1.2 Length weigth relationship

Table 1. *Loligo vulgaris*. Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	A	B	Sex	Reference
English Channel	0.192	2.38	F	Moreno *et al.*, 2002
	0.301	2.20	M	
northwest Spain	0.104	2.54	F	Guerra and Rocha, 1994
	0.164	2.37	M	
northwest Portugal	0.104	2.54	F	Moreno *et al.*, 2002
	0.154	2.41	M	
south Portugal	0.135	2.43	F	Coehlo *et al.*, 1994

0.144	2.38	M

4.1.1.1.3 Growth rate and growth (age–length)

As in other squid species, paralarval growth rates are highly variable and strongly related to temperature. Reported average rates of growth in length in the first 75 days post-hatching were 0.05 mm.day-1 (1.2% ML.d-1) under winter temperatures and 0.17 mm.d-1 (3% MLd-1) under summer conditions (Boletzky, 1979; Villanueva, 2000b). The increase in weight during this period of life is more pronounced. Villanueva (2000b) measured instantaneous relative growth rates of 3-4% BW.d-1 at winter temperatures (11°C) and 6-8% BW.d-1, under summer conditions (19.2°C).

Between the ages of 4 and 12 months, males generally grow at 1.2-1.6 mm day-1 and females at slower growth rates of 0.9-1.0 mm day-1. Instantaneous growth rate relative to ML was 0.8-1.0% d-1 for males and 0.7-0.9% d-1 for females. Differences between male and female growth rates were observed in most studies which adequately sampled the full size range of animals (Natsukari and Komine, 1992; Arkhipkin, 1995; Bettencourt *et al.*, 1996; Raya *et al.*, 1999; Rocha and Guerra, 1999; Moreno *et al.*, 2007).

4.1.1.1.4 Sex ratio

The sex ratio is generally around 1:1 across the distribution range although seasonal shifts in sex ratio are also reported (Baddyr, 1988; Guerra and Rocha, 1994; Raya *et al.*, 1999; Moreno *et al.*, 2002; Šifner and Vrgoč, 2004) as well as differences in sex ratio between size classes: Raya *et al.* (1999) found that the proportion of males was highest in the smallest size classes, which is consistent with findings for *L. forbesii*

4.1.1.1.5 Size and age at first maturity

Moreno *et al.* (2002) calculated the size at which 50% of individuals are mature (MLm50%) as 168 mm in males and 188 mm in females. However, the fit for males is misleading, since two modes in size at maturity were detected in males from most areas in the Northeast Atlantic, the first around 180 mm, and the second from 300-330 mm, at which size all males are mature (Coelho *et al.*, 1994, Guerra and Rocha 1994, Moreno *et al.* 1994). Size at maturity (MLm50%) of females appears to be higher in the south of the range within the Northeast Atlantic (220-230 mm; Bettencourt, 1994; Raya *et al.*, 1999) than in the north (176-195 mm; Guerra and Rocha, 1994; Moreno *et al.*, 2005).

In Portugal, males reach maturity at a mean age of nine months and spawning takes place at a mean age of ten months

4.1.1.1.6 Lifespan

Loligo vulgaris is an annual species with a maximum lifespan of around 15 months.

4.1.1.1.7 Spawning season and spawning habitat

It usually spawns in winter in the north and east of its range and all year round with seasonal peaks elsewhere. The eggs are generally deposited on a fixed support in relatively shallow water (from 20 to 50 m depth), and sometimes attached to floating objects in coastal waters (Worms, 1983a).

4.1.1.1.8 Fecundity

Worms (1983a) estimated maximum fecundity as 7 000 eggs but this was based on counting only ripe eggs in the oviduct. Other studies that considered the yolk oocyte stock in the ovary and oviduct have estimated maximum fecundity to be between 10 150 and 42 000 eggs (Baddyr, 1988; Coelho *et al.*, 1994; Guerra and Rocha, 1994; Lopes *et al.*, 1997; Laptikhovsky, 2000). However, this may still be an underestimate if we consider that the protoplasmic oocytes potentially also contribute to the total fecundity of an individual. On this basis, Laptikhovsky (2000) estimated a potential fecundity of 28 500 to 74 200 eggs, with higher values generally in larger squid (fitted regression: potential fecundity = 136.84 ML1.11).

4.1.1.1.9 Migrations

Horizontal migratory movements in this species are mainly related to sexual maturation and spawning (Worms, 1983b). Onshore and offshore migrations, related to reproduction, are well-described for Mediterranean populations. In the Atlantic, *L. vulgaris* performs long migrations (south-north and north–south), possibly over distances up to 500 km. According to Tinbergen and Verwey (1945), this species actively migrates northwards in spring, probably entering the North Sea from the English Channel and migrating along the Belgian, Dutch, northwest German and Danish coasts, where it is found in late summer..

4.1.1.2 *Loligo forbesii*

4.1.1.2.1 Length distribution and maximum size

Typically, adult body size reaches 100–650 mm ML in males (weight range 155g–3.7kg) and 175–350 mm ML in females (weight range 200–1 150 g) throughout the continental shelf range. However, there is wide variation within both sexes and, in particular, some males mature at around 120 mm in length and probably never grow much larger (Pierce *et al.*, 1994b; Porteiro and Martins, 1994; Boyle *et al.*, 1995). In the Azores population, males reach 937 mm ML and 8.3 kg, compared to 462 mm ML and 2.2 kg for females (Martins, 1982)..

4.1.1.2.2 Length weight relationship

Loligo forbesii. Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	A	b	Sex	Reference
Faroe Islands	0.074 - 0.088	2.61 - 2.66	F	Gaard, 1987
	0.133 - 0.180	2.30 - 2.45	M	
Rockall (ICES Area VIb)	0.113	2.61	F	Ngoile, 1987
	0.175	2.43	M	
Scotland	0.201	2.33	All	Young *et al.*, 2004
Scotland west coast	0.151	2.51	F	Ngoile, 1987
	0.214	2.37	M	
Scotland	0.138	2.49	F	Boyle and Ngoile, 1993b
	0.192	2.36	M	
Scotland	0.151	2.43	F	Pierce *et al.*, 1994b
	0.206	2.29	M	
north North Sea	0.161	2.53	F	Ngoile, 1987
	0.268	2.33	M	
mid North Sea	0.164	2.45	F	Ngoile, 1987
	0.232	2.55	M	

English Channel	0.449	2.43	F	Holme, 1974
	0.527	2.29	M	
	0.166	2.448	F	Thomas *et al.*, 2004
	0.274	2.253	M	
northwest Spain	0.111	2.57	F	Guerra and Rocha, 1994
	0.138	2.44	M	
Portugal	0.102	2.60	F	Moreno *et al.* 1994
	0.103	2.58	M	
Portugal	0.104	2.59	F	Cunha, 2000
	0.111	2.54	M	
Azores	0.425	2.18	F	Martins, 1982
	0.548	2.08	M	

4.1.1.2.3 Growth rate and growth (age–length)

Over the course of the life cycle, growth rate gradually declines, from 5.4 %BW d-1 in the smallest individuals to 1.4 in the largest (Forsythe and Van Heukelem, 1987). Forsythe and Hanlon (1989) give the final growth rate as 1–2% BW d-1. Based on statolith data collected from post-recruit animals, Collins *et al.* (1995) reported growth rates of 0.98% ML d-1 and 2.48% BW d-1 in males, and 0.85% ML d-1 and 2.26% BW d-1 in females,. This corresponded to growth of around 1 mm per day for females and 1-5 mm per day for males. Growth rates estimated from modal progression analysis using monthly length–frequency data were slightly lower.

The comparison of Scottish and English Channel juveniles from 1993 and 1998 cohorts showed both spatial and interannual differences in growth rates (Challier *et al.*, 2006a). Instantaneous growth rate estimates corresponded to a relative increase in DML per day (percentage d^{-1}) and ranged from 0.0022 to 0.0059.

In adults, the 1993 cohort did not show significant differences between sampling months. The high inter-individual variability was taken into account with quantile regression techniques which enable to fit several growth curves that are used to derive a stochastic age–length key (Challier *et al.*, 2006b).

4.1.1.2.4 Sex ratio

There seems to be an annual cycle in the sex ratio, with females being more abundant than males during the spawning season, e.g. during November to February in Scotland. There was also evidence of males outnumbering females during the recruitment period in Scotland and in Spain (Holme, 1974; Guerra and Rocha, 1994; Pierce *et al.*, 1994; Collins *et al.*, 1999). English Channel samples did not show significant differences from the equilibrium between males and females (Thomas *et al.*, 2004)

4.1.1.2.5 Size and age at first (and 50%) maturity

Table 2. Reported ranges of size-at-maturity for male and female *L. forbesii* (from size at first detection of maturity to 100% of sample mature). Where multiple microcohorts were detected, separate estimates are given for each.

Area	Male ML (mm)	Female ML (mm)	Reference
Faroe Islands	200 – 250	180 – 200	Gaard, 1987
Scotland + Faroe Islands		220	Howard, 1979

Scotland (west coast)	120 – 450	160 – 310	Boyle *et al.*, 1995
Scotland (west coast)	180 – 220, 250 – 320, >400	180 – 220, 280 – 320	Collins *et al.*, 1999
Scotland (area IVa)	180-350	192-250	Wangvoralak, 2011
Ireland	120 – 400	150 – 300	Collins *et al.*, 1995a
England (southwest)	130 – 420	160 – 320	Holme, 1974
Galicia (NW Spain)	160 – 380	160 – 380	Guerra and Rocha, 1994
Portugal	145 – 450	175 – 315	Moreno *et al.*, 1994
Azores Islands	<310 – 490	<250 - 326	Martins, 1982
Azores Islands	<240 – 611	<200 – 390	Porteiro and Martins, 1994

In females, length at maturity (DML_{50}) does not show significant differences between northern fisheries (Scotland and the English Channel) or between southern fisheries (Portugal and Azores) DML_{50} is significantly higher in the south than in the north (Thomas, *et al.*, 2004).

4.1.1.2.6 Lifespan

There is general consensus that L. forbesii typically lives for up to around 15-16 months, with most sampled animals being no more than 1 year old. The largest male recorded in Scotland to date (ML = 735 mm) was estimated to be 420 days old (i.e. around 14 months; G. J. Pierce, unpublished data).

In English Channel samples, the oldest specimen was estimated to be 424 days old (Challier L., unpublished data).

4.1.1.2.7 Spawning season and spawning habitat

The timing of peak spawning activity varies across the range and additional (usually secondary) peaks are observed in some areas (Roper *et al.*, 1984; Lum-Kong *et al.*, 1992; Boyle and Ngoile, 1993a; Guerra and Rocha, 1994; Moreno *et al.*, 1994; Pierce *et al.*, 1994b; Boyle *et al.*, 1995; Collins *et al.*, 1995b), possibly due to the presence of both winter and summer breeders (Holme, 1974). In Scottish waters, L. forbesii spawns mainly from December to February although at least some mature specimens can be found throughout the year, suggesting that spawning is not limited to a specific period (Pierce *et al.*, 1994b).

4.1.1.2.8 Fecundity

The number of oocytes present (or potential fecundity) in L. forbesii females has been estimated to range from 1000 to 23 000 eggs (Guerra and Rocha, 1994; Boyle *et al.*, 1995).

4.1.1.2.9 Migrations

Several authors have reported evidence of inshore-offshore movements associated with the breeding cycle in Scottish waters (Pierce *et al.* 1998; Stowasser *et al.*, 2005; Viana *et al.*, 2009) and there is also evidence of movements parallel with the coast in several regions (Holme, 1974; Waluda and Pierce, 1998; Sims *et al.*, 2001; Oesterwind *et al.*, 2010). Most evidence seems to suggest that post-hatching L. forbesii migrate away from the coast, moving further offshore as they grow in size, but subsequently returning to shallow waters to breed

4.1.1.3 *Alloteuthis subulata*

4.1.1.3.1 Length distribution and maximum size

According to Roper *et al.* (1984), maximum mantle length (ML) is around 200 mm. Hastie *et al.* (2009a) give maximum ML as 215 mm in males and 150 mm in females while Jereb *et al.* (2010) reported maximum ML as 184 mm for males and 140 mm for females; in both cases figures are based on examination of available literature

4.1.1.3.2 Length weight relationship

Alloteuthis subulata. Length-weight relationships in different geographic areas for females (F) and males (M). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm). From Hastie *et al.* (2009**b**).

Region	A	B	Sex
Irish Sea	0.291	1.39	M
Irish Sea	0.150	1.84	F
North Sea	0.184	1.59	M
North Sea	0.160	1.77	F
Portugal	0.420	1.20	M
Portugal	0.167	1.83	F

4.1.1.3.3 Growth rate and growth (age–length)

On the West African shelf, absolute growth rates ranged between 0.5 and 1.0 mm.d-1 in length and from around 0.03 to 0.06 g.d-1 in weight. Instantaneous relative daily growth rates fell from approximately 2.2% ML.d-1 and 3.5% BW.d-1 at age 90 days to around 0.8% ML.d-1 and 0.5% BW.d-1 at 210 days of age (Arkhipkin and Nekludova, 1993; see their Figures 8 and 9).

4.1.1.3.4 Sex ratio

Hastie *et al.* (2009) reported seasonal variation in sex ratio, with a slight overall preponderance of males (M/F = 1.04 to 1.14 depending on region), although females were relatively more abundant in spring in Portugal (M/F = 0.76) and during summer in the North Sea and Irish Sea (M/F = 0.76 and 0.78, respectively).

4.1.1.3.5 Size and age at first (and 50%) maturity

Sexual maturity can be reached at 40-50 mm ML in both sexes (North Sea: 44 mm ± 9 mm in females; 43 mm ± 10 mm in males). Fifty percent of females are mature at a length of 75–80 mm while MLm50% for males is 70–75 mm. However, the length of mature animals varies considerably in both sexes, with mature males having a wider range of sizes than mature females (Moreno, 1995). The maximum size-at-maturity of female *A. subulata* is around 120 mm ML (Yau, 1994).

4.1.1.3.6 Lifespan

Individuals are thought to live about 12 months (Rodhouse *et al.*, 1988).

4.1.1.3.7 Spawning season and spawning habitat

In the English Channel there are three spawning groups of females, which spawn in spring, summer and autumn respectively, with young individuals being recruited to the population twice during the year in spring and summer. In the Irish Sea, spawning occurs in spring and summer, with a possible minor spawning period in Autumn (Nyegaard, 2001). In the North Sea, spawning occurs in June-July, with hatchlings appearing in plankton samples towards the end of July (Yau, 1994). Spawning probably occurs earlier off the west of Scotland than in the North Sea (Yau, 1994).

4.1.1.3.8 Fecundity

The average number of oocytes present (potential fecundity) in 11 mature females examined by Nyegaard (2001) was 5705 (range 1234 to 18 770). This contrasts with 'batch counts' which indicated an average of 148 eggs laid in any one session and that actual fecundity was between 400 and 1500 eggs (Nyegaard, 2001).

4.1.1.3.9 Migrations

In some parts of its range, *A. subulata* is present all year round (e.g. in the English Channel, Rodhouse *et al.*, 1988) while in others it is thought to be migratory. In the North Sea, juvenile *A. subulata* migrate from the spawning grounds in the southeast to the deeper (and, in winter, relatively warmer) waters in the central parts during late autumn/winter, perhaps as a response to cooling. In spring, as the waters are warming, the young adults return from the Danish Coast to the shallow waters off the Belgian and southeast British coasts to spawn (De Heij and Baayen, 1999, 2005; Oesterwind *et al.*, 2010).

4.1.1.4 *Alloteuthis media*

4.1.1.4.1 Length distribution and maximum size

A.media is a small-sized member of the Loliginidae, not exceeding 13.2 cm in ML (Laptikovsky *et al.*, 2002). There is morphometric sexual dimorphism with females attaining larger sizes than males (Katsanevakis *et al.*, 2008; Alidromiti *et al.*, 2009).

4.1.1.4.2 Length weight relationship

Table 1. ***Alloteuthis media.*** **Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to W=a.ML^b, where W is body mass (g) and ML is dorsal mantle length (cm).**

Region	A	b	Sex	Reference
south Portugal	0.099	2.22	F	Moreno, 1990
	0.185	1.79	M	

4.1.1.4.3 Growth rate and growth (age–length)

Growth rate (mantle length vs. age) is higher in females, which also reach a larger size. Best fit growth equations (ML in mm and age in days) are as follows:

Females: ML = 1.096*AGE0.7538 , R=0.830 , N=73

Males: ML = 0.911*AGE0.7666 , R=0.841 , N=46

4.1.1.4.4 Sex ratio

No data found

4.1.1.4.5 Size and age at first (and 50%) maturity

The MLm50% estimated for *A. media* in the Tyrrhenian and the Adriatic Seas is about 50 mm in males and 60 mm in females (Auteri *et al.*, 1987; Soro and Manfrin-Piccineti, 1989).

4.1.1.4.6 Lifespan

Recent direct ageing of *A. media* in the northwest Aegean Sea, based on enumeration of daily increments in statoliths, has shown that the lifespan of females reaches up to 11 months, whereas the males can reach 9 months of age (Alidromiti *et al.*, 2009)

4.1.1.4.7 Spawning season and spawning habitat

In the North Sea spawning takes place in June and July (Zuev and Nesis, 1971).

4.1.1.4.8 Fecundity

The potential fecundity has been estimated at about 950-1400 eggs for the western Mediterranean whereas typical values in the eastern Mediteranean (1500-2500) are higher.

4.1.1.4.9 Migrations

Alloteuthis media undertakes seasonal migrations between offshore (in winter) and inshore (in spring) areas, where juveniles are also recruited mainly during summer and autumn (Mangold-Wirtz, 1963; Belcari, 1999

4.1.2 ICES Subareas VII

4.1.2.1 The Fishery

In subarea VII, 2012 catches reach a total of 2 550 t which is only 57% of the average observed in 2000-2011. Catches are mostly concentrated in divisions VIId and VIIe (English Channel 71 %). A second fishing ground is in divisions VIIg-k (Celtic sea and SW of Ireland 18%) followed by VIIf (Bristol Channel 7%).

Low catches in 2012 seem to concern mainly the English Channel and divisions VIIb-c (West of Ireland and Porcupine Bank) whereas VIIg-k (Celtic Sea and SW of Ireland) is increasing

After the increase in catches of common squid in 2010, catches for this species in 2011 and 2012 remain at similar levels 418 t and 453 t respectively.

4.1.2.1.1 Commercial landing series

France comprises 78% of the common squid landings in ICES Divisions VIId, e (English Channel) .Landings have decreased from 2 207 t in 2011 to 1411 t in 2012. England, Wales and Northern Ireland account for 20% of the catch in that same area with a slight decrease in common squid landings from 371 t in 2011 to 353 t in 2012. Scotland accounts for the rest of the catches in that area.

4.1.2.1.2 Commercial discards

Several countries have provided discard data in relation to common squids in Subarea VII. Germany, The Netherlands, Ireland and the Basque country reported percentages of discards from 0-1% reflecting the anecdotic catches of these species in their fisheries in Subarea VII. UK provided numbers of individuals discarded at sampling levels. In 2011 the percentage of common squid discarded in Beam trawls increased from 7 to 12% in Division VIIfgh.

Spanish Fisheries in Subarea VII reported an increase of common squid discards from 4% in 2011 to 35 % in 2012.

4.1.2.1.3 Commercial catch-effort data

Landing data for common squid was provided for otter trawlers, pairtrawlers and Scottish Seiners from 2009 to 2011 for UK, The Netherlands (2009-2011) and Spain (2005-2012). In case of UK and Ireland, and for 2012, landing data by fleet/métier was provided, however no effort data were provided for the same métiers, consequently, no LPUE data for 2012 could be updated.

Spain provided LPUEs dataseries since 2005. A remarkable increase in 2010 is detected as well as a peak in 2011 by otter trawlers gears deployed in Subarea VII. Followed by a decrease, that in the case of Spanish and for otter trawlers, reached almost 0 values in 2012.

For available fleets in VIIghk, conflicting trends are shown between Spanish otter trawls abundances and the rest of the fleets along dataseries.

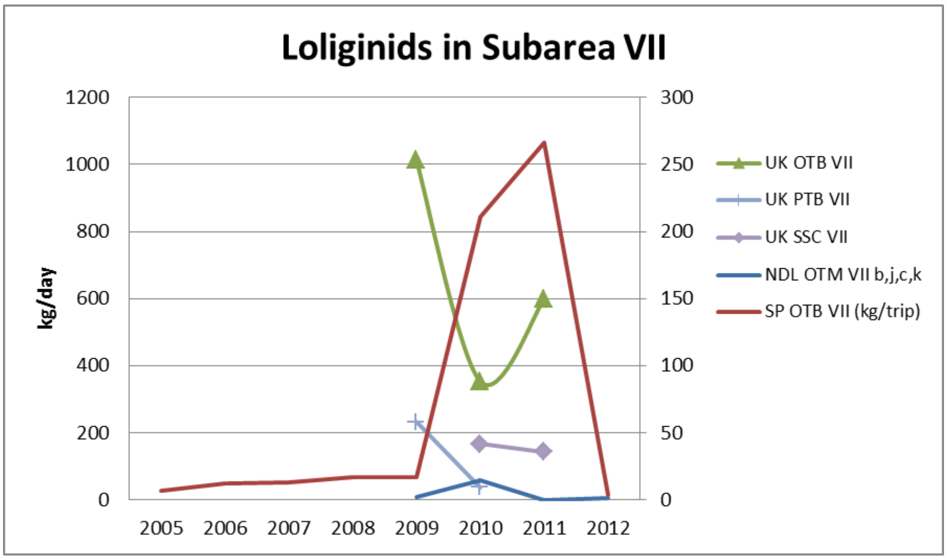


Figure 4.1.2.1.3.1. Commercial LPUEs (kg/day) for the English, Dutch and Spanish (kg/trip) fleets operating in Subarea VII.

LPUEs data were also available for Div. VIIe, this was plotted in a separate graph to check for any possible differences between the sea areas composing Subarea VII. Just 3 years of data from UK in relation to common squid's yields were provided. As for gears in VIIghk, conflicting trends are shown between otter trawls and pair trawls and Scottish seiners in 2010.

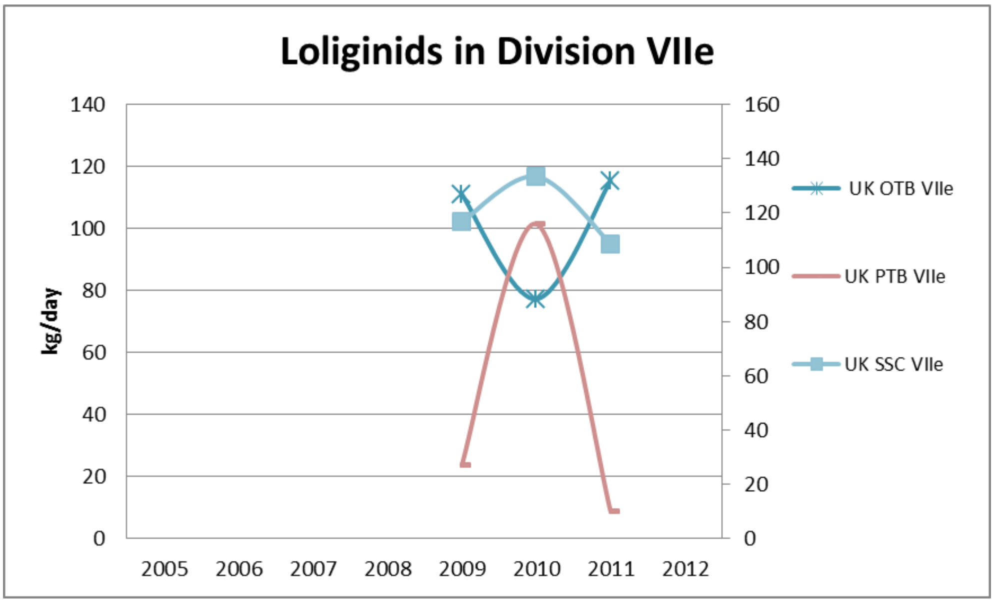


Figure 4.1.2.1.3.2. Commercial LPUEs (kg/day) of the English fleets operating in Division VIIe.

France Otter Bottom Trawl LPUE show decreasing trend in Loliginid squid abundance in this subarea VII in the period 2009-2012 (Figure 4.1.2.1.3.3.). This is similar to the trend in total landings (ToR a table 2.1.2).

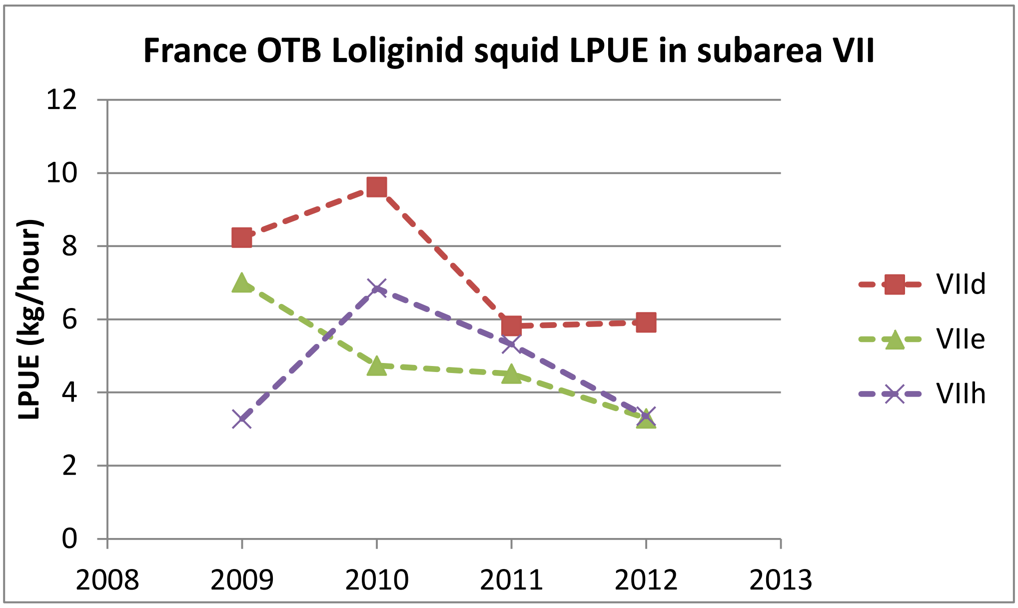


Figure 4.1.2.1.3.3. Commercial LPUEs (kg/day) of French Otter Bottom Trawl operating in Divisions VIId, VIIe and VIIh (annual averages in 2009-2012)

At the monthly scale, seasonal variations enable to estimate the contribution of the two Loligo species in this area. The timing of life cycles and the depth preferences are well known (Royer, 2002) and as described by Holme (1974) early summer abundance is mainly due to the recruitment of *Loligo forbesii* in the Western part of the Channel (ICES division VIIe) whereas *Loligo vulgaris* recruits appear only in autumn and dominate in the Eastern Channel (ICES division VIId). Figure 4.1.2.1.3.4. reveals shifts in the peaks that are quite consistent with this scheme. It suggests between 2009-2010 and 2011-2012 fishing seasons both species seem to have decreased.

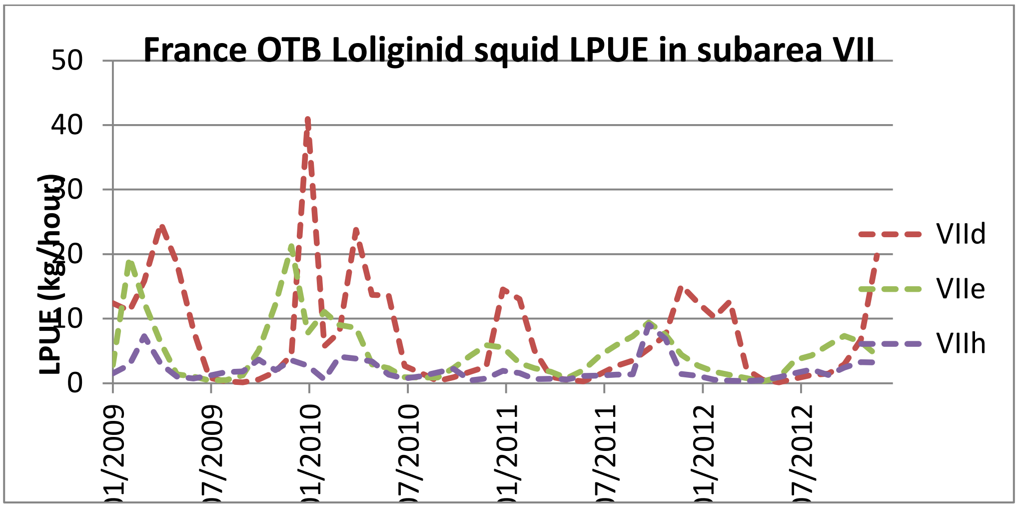


Figure 4.1.2.1.3.4. Commercial LPUEs (kg/day) of French Otter Bottom Trawl operating in Division VIId, VIIe and VIIh (monthly averages in 2009-2012)

4.1.2.1.4 Fishery-independent information and recruitment

UK and Spain provided data of abundances of common squids in Subarea VII. Spanish indices in the Porcupine area were neglectable. In 2012, no common squid was found in this area during the IBTS Survey in the fourth quarter. Abundances of common squid remain quite stable at low levels around 5 kg/h.

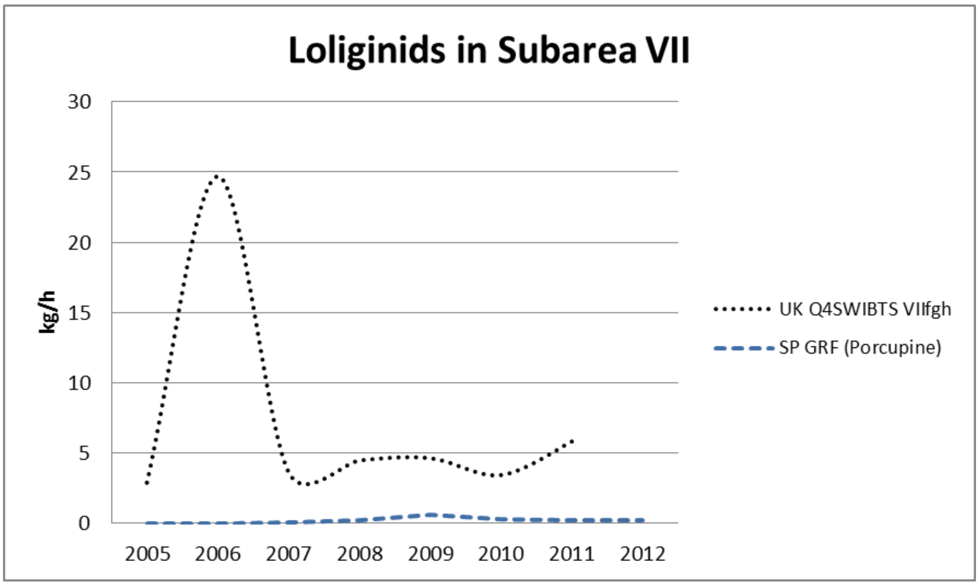


Figure 4.1.2.1.4. Abundance indices (kg/h) of the Spanish and English Scientific Surveys in Subarea VII.

France EVHOE survey was obtained via DATRAS for the years 2010-2012.

The EVHOE manual indicates that this survey is carried out in 3 sectors of the Celtic Sea and 2 sectors of the Bay of Biscay (Figure 4.1.2.2.2).

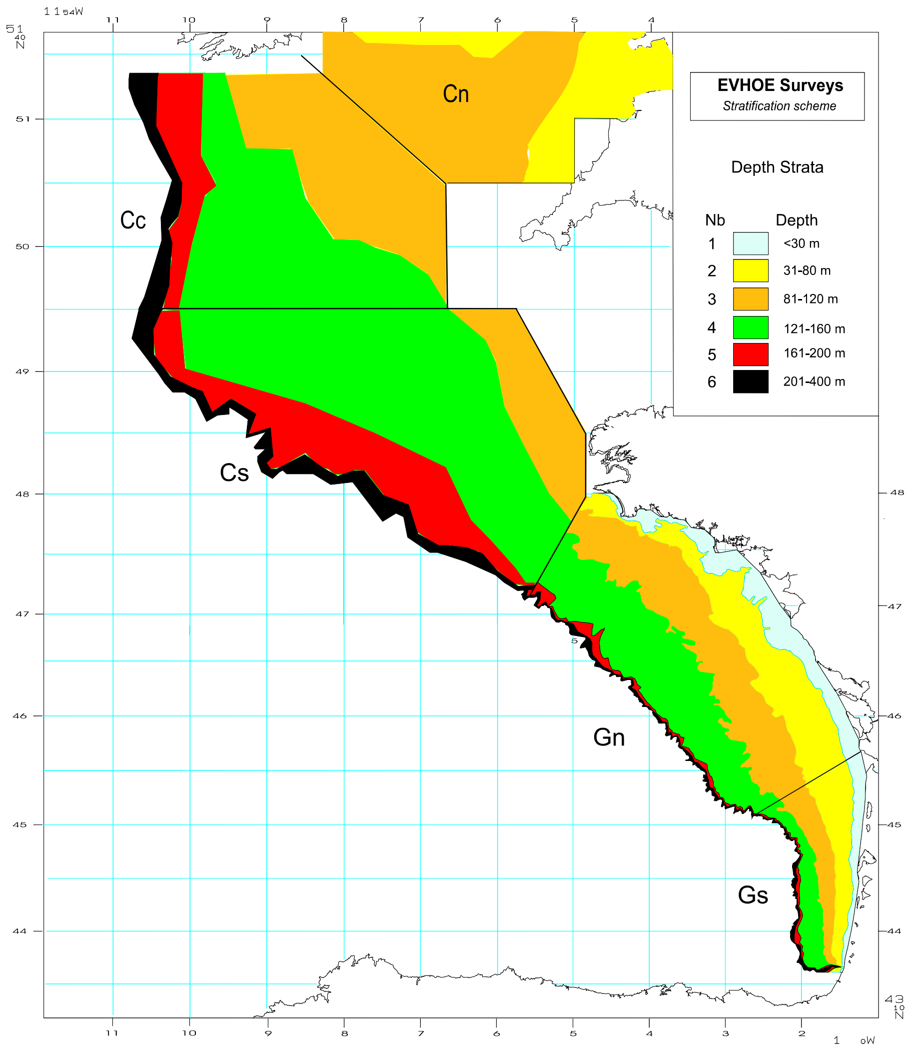


Figure 4.1.2.1.5: Area covered and stratification used in the EVHOE surveys

Abundance trends in the 3 sectors of the Celtic Sea (Cc, Cn, Cs Figure 4.1.2.2.3) underline the high proportion of *Loligo forbesii* squid that are in the Cn sector in October. The absence of *Loligo vulgaris* in the Celtic Sea during these 3 surveys is likely related to the depth of the strata explored suggesting that *Loligo vulgaris* distribution in October is shallower than 80 m.

In the 3 available years (2010-2012) EVHOE indices show a decrease in *Loligo forbesi* abundance in the Cn sector. This is quite consistent with commercial LPUE trend in division VIIh (Figure 4.1.2.1.5). Commercial LPUE include catch and effort in all the months of a given year which indicates that lesser abundance in October (during the EVHOE survey) is not due to a temporal shift in the peak but rather to a lower cohort strength. However *L. forbesii* abundance seems rather stable in the other sectors of the Celtic Sea.

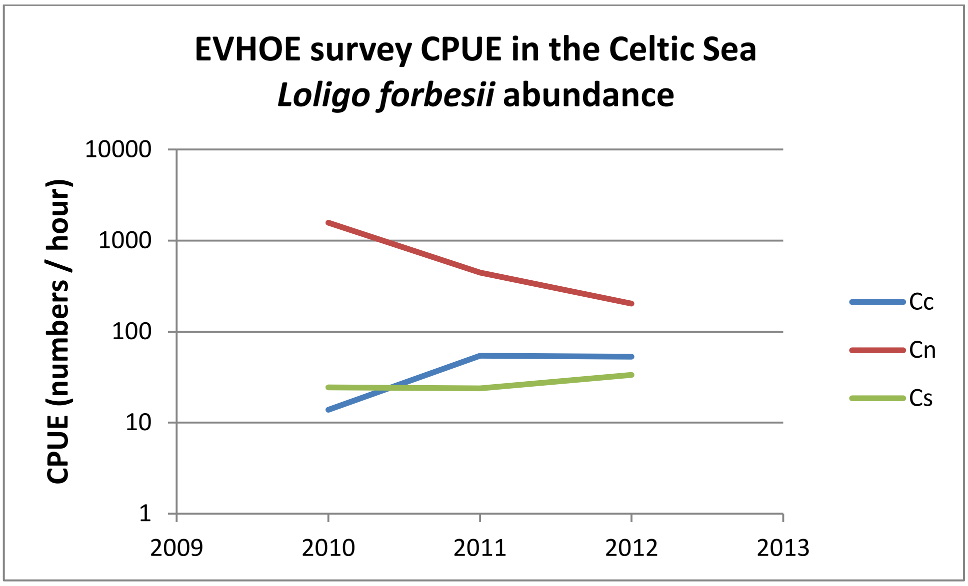


Figure 4.1.2.1.6: Abundance indices derived from EVHOE stations carried out in 2010-2012. (Cc, Cn and Cs refeer to the 3 sectors -central, north and south- described in Figure 4.1.2.2.2).

It should be noted that the CGFS survey data are desirable to better understand changes in species abundance in the English Channel which is the main fishing ground for *Loliginid squid.*

4.1.2.1.5 Analysis of species trends/Assessment of Loliginidae or Stock trends

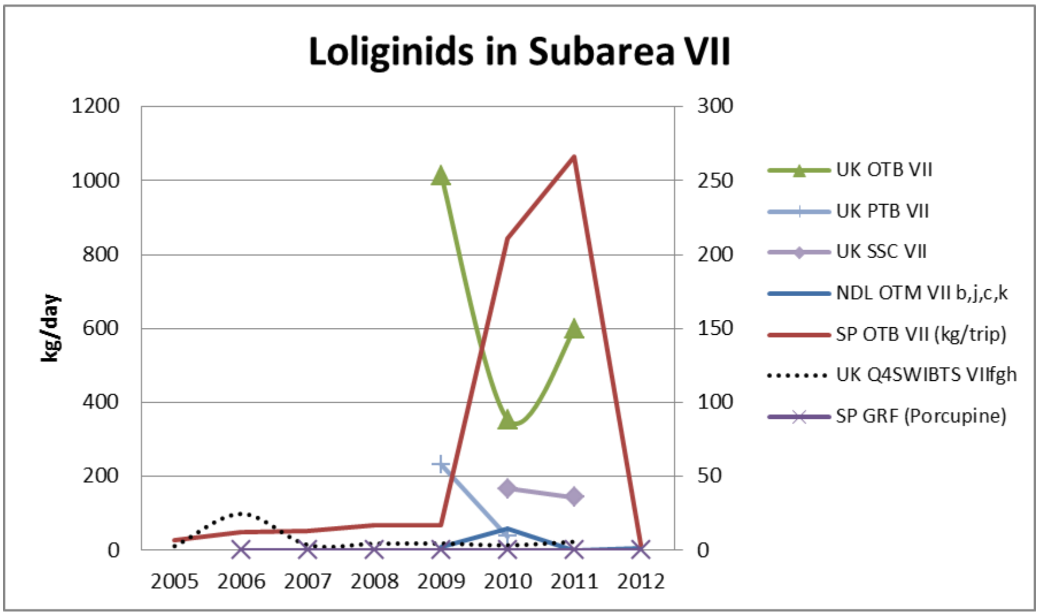


Figure 4.1.2.1.5.1. Comparision of trends between abundance indices (kg/h) of the Spanish and English Scientific Surveys and the commercial Spanish (kg/trip) and English fleets (kg/day) in Subarea VII.

Commercial cpues for the main fleets exploiting common squid were calculated for the last 3 years (2009, 2010 and 2011) and for Spanish Otter trawlers from 2005 to 2012. Yields (kg/d) were plotted jointly with the Abundance indices of the English Western IBTS Survey (Q4SWIBTS) deployed during the 4th quarter every year since

2005 and covering ICES Divisions VIIfgh and the Spanish GFS in Subarea VII covering Porcupine Bank. Abundance Indices for surveys were calculated as kg per hour.

Series of abundances were plotted by grouping families and areas coincident between commercial LPUEs and Surveys. For the commercial LPUEs, fleets with the highest abundance of cephalopods were used. In case of UK these were: OTB: Otter trawls, PTB: Bottom Pair trawl and SSC: Fly shooting (Scottish) seine. In case of Spain just OTB (Otter traw) LPUEs are estimated.

Due to the shortness of the commercial cpues series, just three years of data, no analysis of trends could be deployed. For longer time-series, as for Spanish Survey and commercial Otter fishery, signals do not seem to follow same trends. It has to be remarked that the Otter Spanish fishery in Subarea VII covers an area to the south of the actual Spanish Porcupine Survey.

As indicated above, reduced landings in subarea VII in 2011 and 2012 are likely related to lower recruitment in *Loligo forbesi*. Abundance indices from English Channel surveys are needed to check if *Loligo vulgaris* cohorts were also weaker.

4.1.2.1.6 Exploratory Assessment

No preliminary analyses could be conducted during this working group to check whether abundance indices obtained in the Groundfish Surveys could be indicative of the abundances of *Loliginid squids*.

4.1.2.1.7 Data requirement

The lack of data from UK Commercial fleets along wider period of time limited the comparison between indices. Commercial data should be worked out at métier level. Also it would be interesting to compare those series with those surveys covering the whole actual sea area of fishing operation of the Spanish, Irish and UK at species level. Further work should be devoted to the identification of species and correct possible wrong assignations of some species to Families.

4.1.3 ICES Division VIIIabd

4.1.3.1 The Fishery

4.1.3.1.1 Catches in 2012

Countries contributing to common squid catches in Division VIIIabd are France and Spain. France generally comprises between 45 and 90% of these total catches (72% in 2012). Spain contributes around 21% of catches while England, Wales and Northern Ireland percentage of catches is less than 1

4.1.3.1.2 Commercial landing series

French landings of common squid in Div. VIIIabd has followed an increasing trend from values of 913 t in 2005 to the maximum landings recorded in 2012 reaching 3400 t landed.

Spanish commercial fishery in Division VIIIabd (Bay of Biscay) is mostly composed by vessels with base port in the Basque country.

For Spain, landings in Division VIIIabd are fluctuating since 2000 around a level of 411 t till 2011. In 2012 a sharp increase is recorded reaching 1273 t of common squid landed.

4.1.3.1.3 Commercial discards

No discard estimation of common squids has been delivered to the group by France.

AZTI-Tecnalia is responsible for monitoring cephalopod discards, monthly in Div. VIIIabd by gear, for the Basque Country (around 95 % of the Spanish fleet operating in the Bay of Biscay).

Common Squid appear not to be discarded in the trawls operating in the Bay of Biscay in all dataseries provided starting in 2001.

4.1.3.1.4 Commercial catch-effort data

Basque LPUEs were calculated for common squid,, aggregated by gear. This is, Bottom Otter trawl and Bottom Pair trawl LPUEs were pooled together. cpues were available as kg/days of fishing. Abundance indices are presented at Family level for Div. VIIIabd.

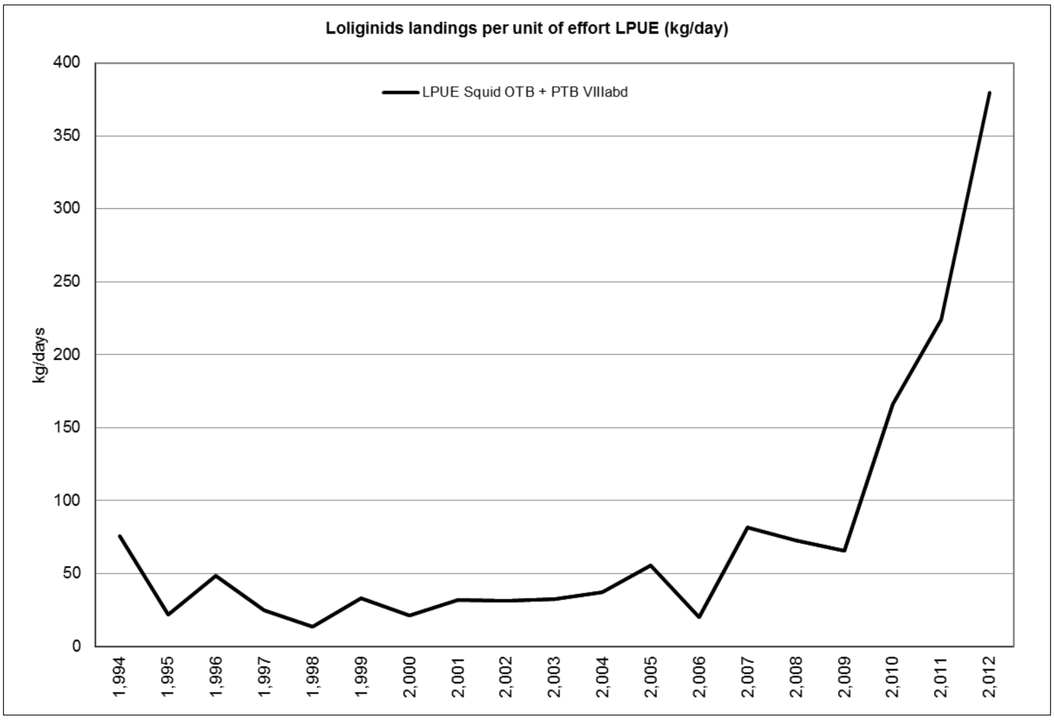


Figure 4.1.3.1.4.1 LPUE trends (kg/days) of the Spanish commercial trawl fleets operating in Division VIIIabd.

As for *Sepia spp.*, the most important Basque fleet targeting cephalopods are "Baka" bottom otter trawlers in the Division VIIIa, b, d. Within this fleet three different métiers have been defined following the criteria defined in the European Data Collection Framework:

-OTB_DEF_>=70 (otter trawlers targeting demersal fish).

-OTB_MCF_>=70 (otter trawlers targeting mixed cephalopod and demersal fish).

-OTB_MPD_>=70 (otter trawlers targeting mixed pelagic and demersal).

In the last four years from 2009 to 2012, the métier targeting cephalopods OTB_MCF has increased its number of trips and its cephalopods catches (WD 3. Figure 7). The increase in the OTB_MCF métier seems to be related to the decrease in OTB_DEF métier targeting demersal species like hake, megrim or anglerfish.

French LPUEs are available for 2009 to 2012. Otter bottom trawl LPUE indicate that a peak of high abundance is observed in 2012 (Figure 4.1.3.1.4.1). Abundance seems also much higher in the southern part of the Bay of Biscay (division VIIIb) than in other areas.

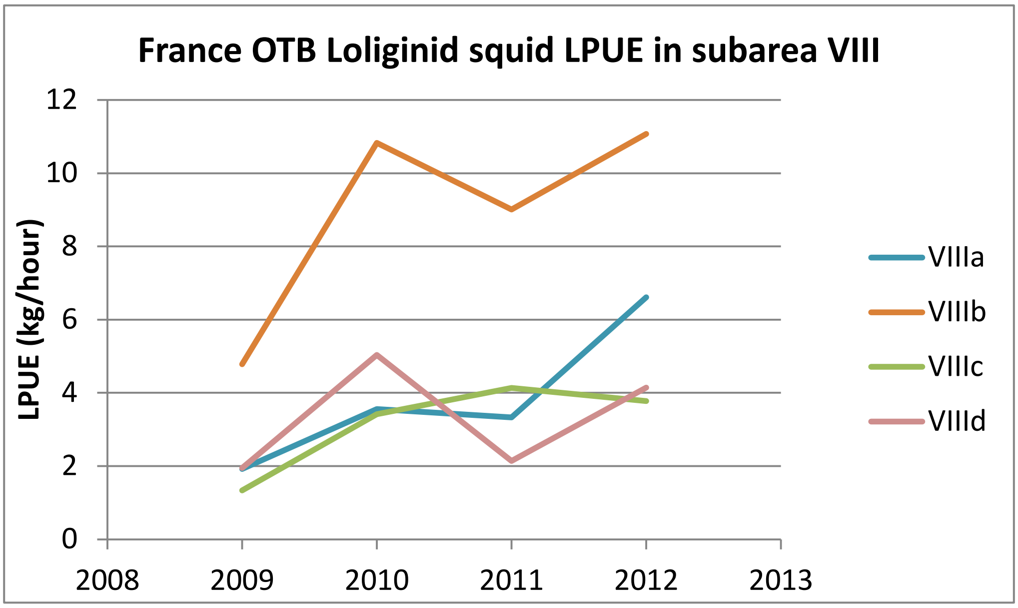


Figure 4.1.3.1.4.2. Commercial LPUEs (kg/day) of French Otter Bottom Trawl operating in Division VIIIa, VIIIb, VIIIc and VIIId (annual averages in 2009-2012)

At the monthly scale (Figure 4.1.3.1.4.3) one can see that low abundances in 2009 are likely related to an "early peak" in the fishing season 2008-2009 and a "late peak" in 2009-2010. The series of cohorts follow a rather regular seasonal pattern although some peaks in spring should be considered with caution since they do not match Loliginids life cycle.

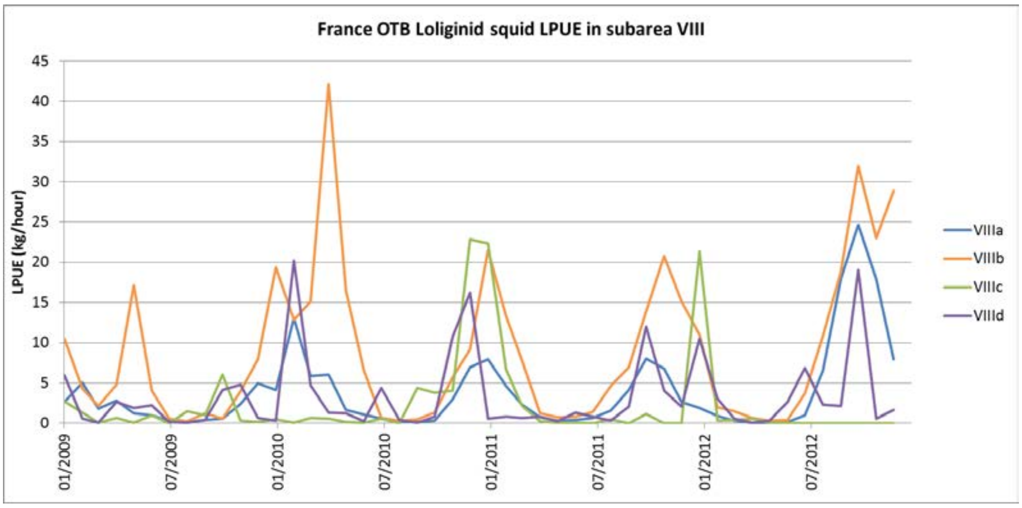


Figure 4.1.3.1.4.3. Commercial LPUEs (kg/day) of French Otter Bottom Trawl operating in Division VIIIa, VIIIb, VIIIc and VIIId (monthly averages in 2009-2012)

4.1.3.1.5 Fishery-independent information and recruitment

Data from survey taking place in Div. VIIIabd, FR-EVHOE, was delivered to the group for discussion. The spatial extent of the EVHOE survey was presented in Figure 4.1.2.3.2. During this 3 year period abundance seems to be decreasing in the northern part of the Bay of Biscay and stable or slightly increasing in the north. This is clearly different from the increasing trends in landings and in commercial LPUE.

To look at differences between *L. forbesii* and *L. vulgaris* one must pay attention to the fact that units for the abundance indices are numbers per hour. At the time of the EVHOE surveys (October) *L. vulgaris* recruits enter the fishery when *L. forbesii* are larger and already maturing specimens.

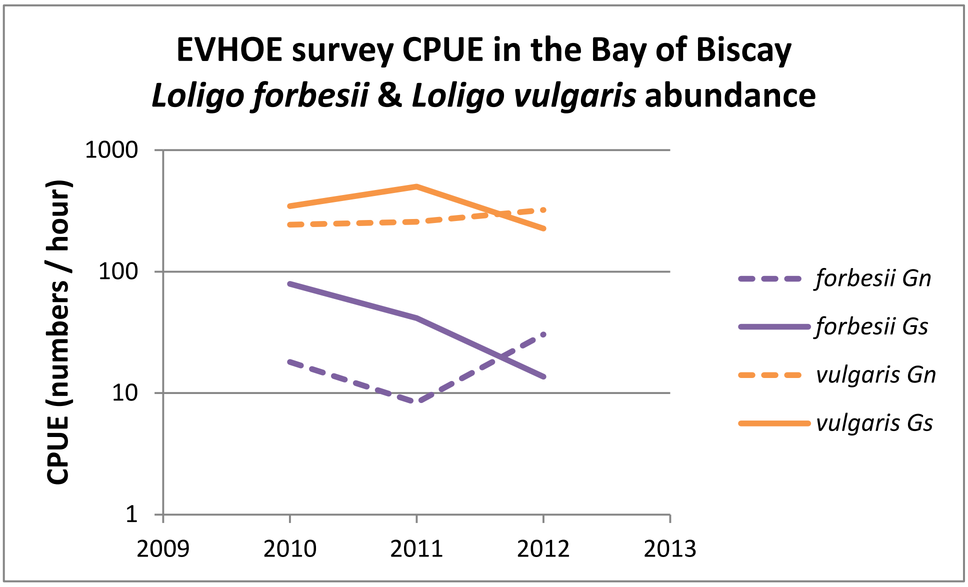


Figure 4.1.3.1.5.1: Abundance indices derived from EVHOE stations carried out in 2010-2012. (Cc, Cn and Cs refeer to the 3 sectors -central, north and south- described in Figure 4.1.2.2.2) for Loliginid species.

4.1.3.1.6 Analysis of species trends of Loliginids

Overall, a remarkable increasing trend is observed for common squid LPUEs (just Basque fleet) from 2007 to the end of the dataseries in 2012, reaching a maximum of around 380 kg per day.

4.1.3.1.7 Exploratory Assessment

The comparison of landings , commercial and survey cpue trends in the last years (Figure 4.1.3.3.1) provides a summary of previous indications: the rise in 2012 landings appears related to an increase in abundance in the North of the Bay of Biscay where *L. forbesii* is the species that shows widest fluctuations.

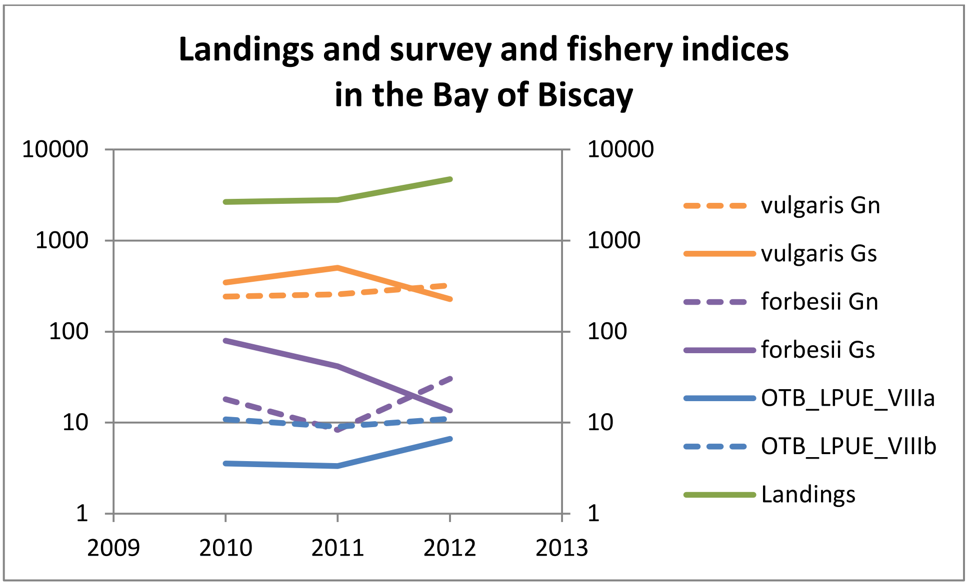


Figure 4.1.3.1.7.1. Comparison of trends in landings, commercial and survey abundance indices for the Bay of Biscay. (*forbesii* and *vulgaris* Gn and Gs are derived from EVHOE surveys, OTB LPUE uses French trawlers data, and landings are by all countries).

As shown above with monthly estimates of commercial LPUE, temporal trends should consider the timing of recruitment and the schedule of fishing seasons in order to compare definite (almost non-overlapping) cohorts.

4.1.3.1.8 Data requirement

It has to be pointed out that in Div. VIIIabd, the percentage of effort for each of the gears (Bottom Otter trawl and Bottom Pair trawl) changes along the dataseries (WD 3). In the next future would be possible to discern between cpues of both gears and also it is expected that a more detailed analysis based on métiers and species could be deployed.

The change shift in métiers in the Basque trawl fleet deserves to be considered and analysed in the next future as to check whether there is a real change in trawlers fishing strategy targeting, in the last years, species without TAC and Quota or it is just a tactical situation in response to a likely high abundance of the cephalopod resource.

4.1.4 ICES Division VIIIc and IXa

4.1.4.1 The Fishery

4.1.4.1.1 Catches in 2012

Catches in ICES Divisions VIIIc are comprised mostly by Spain and Portugal, reaching a total amount of 2033 t of Common squids. Contribution of each of the countries varies depending on the ICES Division. Spain comprises 99 % of the catches of common squids in Div. VIIIc. However, for Subarea IXa, Spanish and Portuguese catches are more evenly distributed in similar percentages (50/50). It has to be pointed out that the bulk of the catches are deployed in Div. VIIIc with 1220 t landed while in Div. IXa landings reached 800 t in 2012.

4.1.4.1.2 Commercial landing series

Spanish landings of Loligo spp. has been fluctuating around 423 t. In 2012, common squid landings duplicate landing of the previous year, reaching a historical maximum of 1200 t. Portuguese landings of commons squids in Div. VIIIc are scatter along the dataseries. In any case, in 2012 more than 3 times (17 t) the landings of 2011 were landed from these species.

Data on the proportion of each species are only available for Subdivision IXa and IXa-South, where *Loligo vulgaris* comprises most of the percentage landed. In this Division, from 2000, landings of squid has decreased to an average around 1 700 t to levels at around 300 – 400 t during 2006 to 2009. In 2010 landings start increasing again. In 2012, common squid landed reached 800 t.

4.1.4.1.3 Commercial discards

Percentage of *Loligo vulgaris* discarded in Div. VIIIc by Spanish trawlers is null.

Discard of these species are concentrated in Div. IXa. Spanish discards by trawlers in that division are low reaching a maximum of 3 % in 2012.

In WD 4, Table 4a and 4b display the frequency of occurrence of cephalopods in the discards of Portuguese OTB vessels. The frequencies of occurrence of most species are low, e.g. in comparison to other commercial species. Common squid (*Alloteuthis spp*.) occurrences in 2004 was 47 %, this percentage has decreased to at around 20 % in 2011 and 2012. For *Loligo vulgaris* occurrence in discards trips is sporadic and very low, close to 13% in 2011 and 5% in 2012. For the time being and until a more sophisticated estimation method is implemented, the discards of *Alloteuthis spp.* are assumed as medium while for *Loligo vulgaris* are better assumed as low or negligible for assessment purposes.

4.1.4.1.4 Commercial catch-effort data

Spain provided LPUE (kg/trip) data for Otter trawls operating in VIIIc and IXa, kilograms per trip are at low levels except for 2012 when an increase is detected. However LPUEs for Spanish fleets are very low for this species in the area.

LPUEs provided by Portugal for all gears together are, for the years provided of higher values than the Spanish LPUEs. It has to be marked that yield of this species are calculated in kr per hour. Trends appear opposite to those shown by the Spanish Otter fleet. It has to bear in mind that Spanish commercial indices represent fleets operating mostly along the Cantabrian sea and the more northern part of Div. IXa . On the contrary Portuguese fleets are distributed all along Div. IXa.

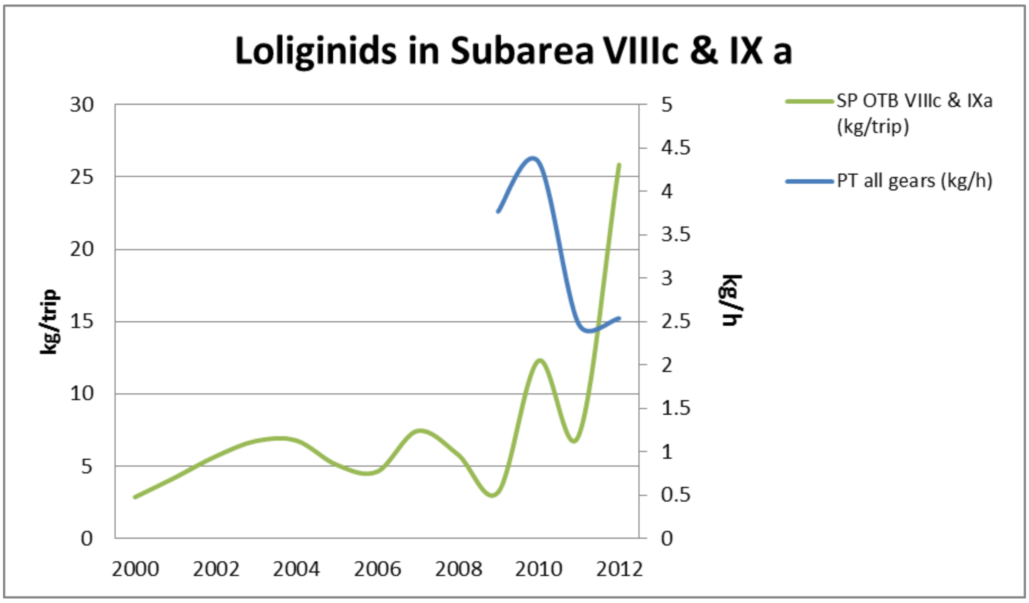


Figure 4.1.4.1.4.1 LPUEs of the Spanish (kg/trip) and Portuguese (kg/h) commercial fleets operating in Divisions VIIIc and IXa.

LPUEs from Spanish Otter trawls operating in the IXa south (Gulf of Cadiz) are presented. From the beginning of the LPUE series a decrease in yield is achieved, being maintained at low levels of yield from 2002 to 2010. From 2010, a slight increasing trend in yield is shown.

As for the previous plot, LPUEs provided by Portugal for all gears together are, for the years provided, of higher values than the Spanish LPUEs. It has to be marked that yield of this species are calculated in kr per hour. Trends appear opposite to those shown by the Spanish Otter fleet with a coincident in the increase in yield in 2012.

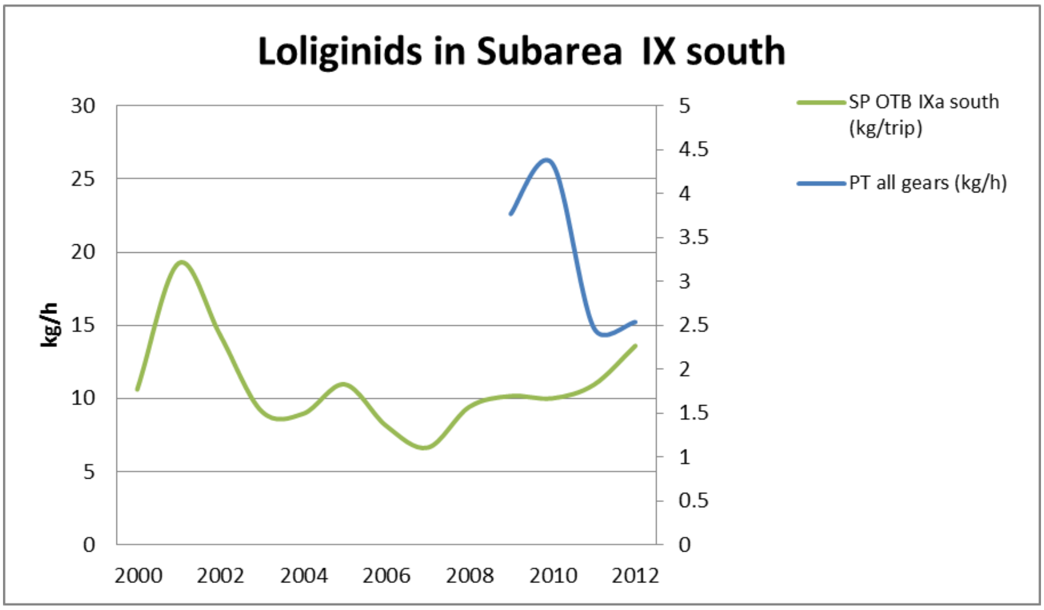


Figure 4.1.4.1.4.2 LPUEs of the Spanish (kg/trip) and Portuguese (kg/h) commercial fleets operating just in Divisions IXa.

4.1.4.1.5 Data available and quality

It has to bear in mind that Spanish commercial indices represent fleets operating mostly in the Gulf of Cadiz (Div. IXa-south). On the contrary, Portuguese fleets operate along waters comprised under the whole Div. IXa area.

4.1.4.1.6 Fishery-independent information and recruitment

The northern Spanish groundfish survey (SPGFN) covered ICES Division VIIIc and the northern part of IXa corresponding to the Cantabrian Sea and off Galicia waters. Abundances of Loliginids in this survey are very low reaching a maxium of 1,7 kg/h in 2011..

Portuguese survey presented as the northern component of the SPGFS a very low abundance index.

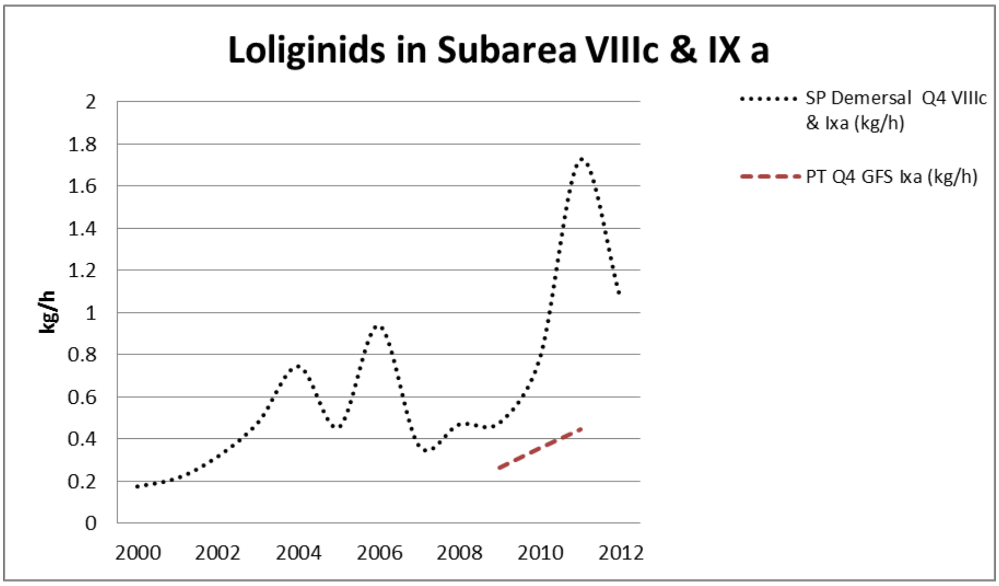


Figure 4.1.4.1.6.1. Abundance Indices the Spanish and Portuguese Scientific Surveys in Divisions VIIIc and IXa

The Spanish Groung Fish South (ARSA/SPGFS) is conducted in the southern part of ICES Division IXa, the Gulf of Cadiz. SPGFS aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Gulf of Cadiz area (ICES Division IXa). Abundances estimated by this survey are still very low reaching a minimum of 0,5 kg/h of common squid in 2011 and in 2012, maximum of 3.5 kg/h.

The Portuguese survey has been also include jointly with the SP GFS Southern component. Abundances of common squids are neglectable.

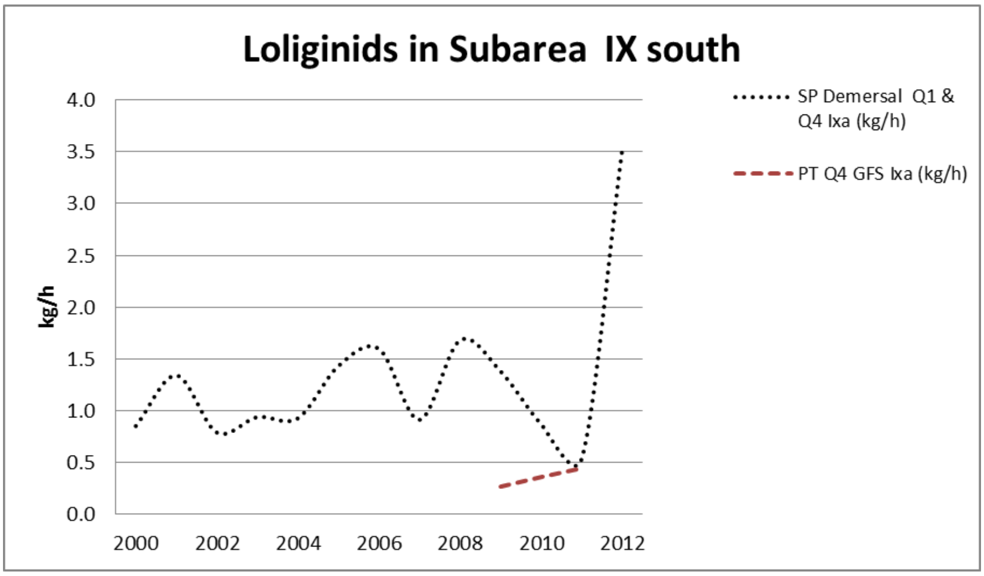


Figure 4.1.4.1.6.2. Abundance Indices the Spanish and Portuguese Scientific Surveys just in Divisions IXa

4.1.4.1.7 Analysis of species trends/Assessment of Sepiidae or Stock trends

It appears to be a similar fluctuating trend between Spanish and Portuguese commercial and Spanish and Portuguese survey series for common squids However in the final year's signals from all series are opposite.

The index obtained in the Spanish survey and the commercial fleet appear to closely follow increasing trends. This has to be taken with cautious as survey and commercial indices may not be representative of the abundances, either by not covering the whole area of distribution of the species or because the dates of surveys are not the most appropriate to these species. In the case of Common Squid, the compiled series of LPUEs may not be representative of the abundance due to low volume of captures

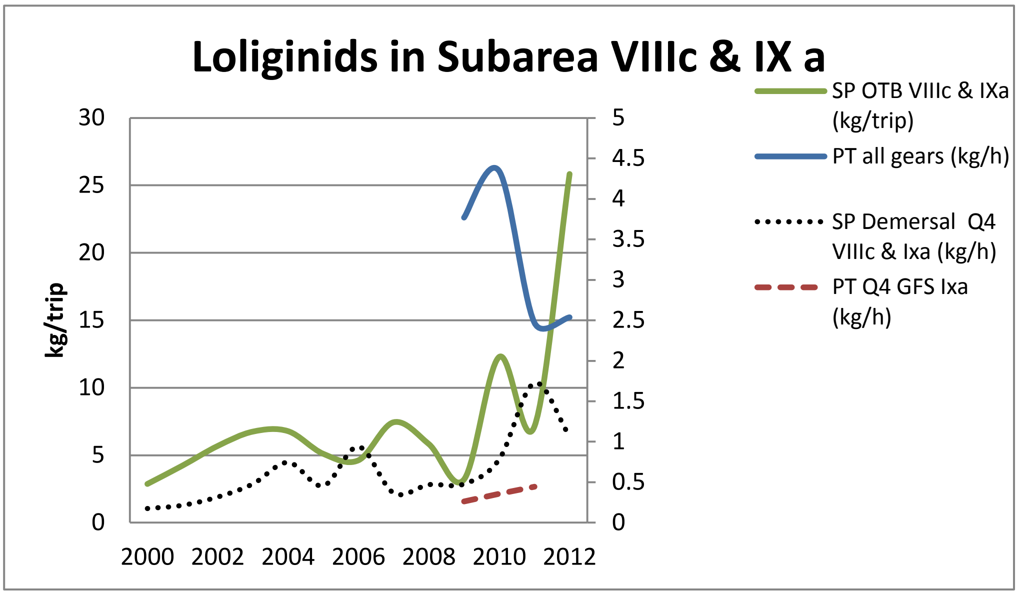


Figure 4.1.4.1.7.1. Comparison between LPUE and Abundance Indices trends of the Spanish and Portuguese commercial fleets and the Spanish and Portuguese Scientific Surveys in Divisions VIIIc and IXa

For the indices analysed in Div, IXa-south, it appears to be a similar fluctuating trend between Spanish commercial and scientific survey. Peaks of abundances are detected by both dataseries. Even the increasing trends in abundance of Loligo spp. are detected in both dataseries.

The shortage of Portuguese survey dataseries limited the capacity of any trend analysis

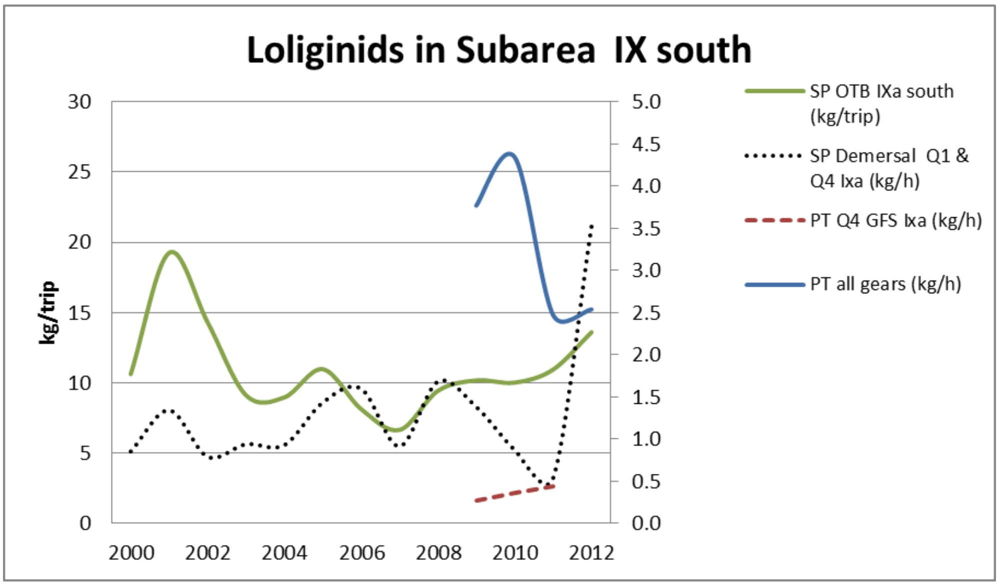


Figure 4.1.4.1.7.2. Comparison between LPUE and Abundance Indices trends of the Spanish and Portuguese commercial fleets and the Spanish and Portuguese Scientific Surveys just in Divisions IXa.

4.1.4.1.8 Exploratory Assessment

Commercial and Survey dataseries provided by Spain appear to coincide in trends and in peaks of abundance detection. These promising results enhance the possibility of using these dataseries as abundance indices for Loligo spp.

4.1.4.1.9 Data requirement

These dataseries showed a promising result for exploring more in depth, species disaggregation, métiers further segmentation and area coverage of commercial fishery and survey.

4.2 References

Reference in relation to the biology and dynamics of these species can be found in Reference of Section of this *section 7.3: Review data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity at age, first maturity at length, growth, spawning season, of this report.*

Challier L., Pierce G.J., Robin J.P., 2006 a. Spatial and temporal variation in age and growth in juvenile *Loligo forbesi* and relationships with recruitment in the English Channel and Scottish waters. J. Sea Res., 55, 217-229.

Challier L., Orr P., Robin J.P., 2006 b. Introducing inter-individual growth variability in the assessment of cephalopod population: application to the English, Channel squid *Loligo forbesi*. Oecologia 150 : 17 28

Royer J., 2002. Modélisation des stocks de Céphalopodes de Manche. PhD Thesis Université de Caen Basse-Normandie. 242 pp.

Thomas M., Challier L., Santos M.B., Pierce G.J., Moreno A., Pereira J., Cunha M.M., Porteiro F., Gonçalves J., Robin J.P. 2004. Spatial differences in biological characteristics of *Loligo forbesii* (Cephalopoda Loliginidae) in the Northeast Atlantic. ICES CM 2004 / CC : 23 (poster)

5 Section 5: Ommastrephidae in Subarea II, IV, V, VI, VII, VIIIabd, VIIIc and IXa

5.1 *Ommastrephidae* and other decapod cephalopods.

Introduction

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 are included in this section. All these species are distributed from ICES Subarea III to Div. IXa, Mediterranean waters and North African coast. Abundances in Subarea III, IV, V and VI are comparatively lower than in the rest of the areas, based on the data provided by countries deploying fisheries.

Catches in Div. VIIb,c are mainly deployed by Spain. France comprises all catches of ommastrephids in Div. VIId and e. Traditionally catches of this species groups reached in average 1 700 t along dataseries, however in 2012 a marked decreased is presented mostly due to the sharp decrease in Spanish catches in Div. VIIb,c from 1 257 t to 79 t in 2011 and 2012 respectively. Also French catches in Division VIId and e presented a marked decrease in 2011 and in 2012 from 384 t to 114 t.

For more southern areas (Div. VIIIabd, VIIIc and IXa), main countries exploiting these species are France, Spain and Portugal, with null catches recorded by England, Scotland and Ireland and mostly concentrated in more northern areas but, in any case neglectable. Ommastrephidae are usually exploited in a multispecific and mix fisheries trawlers.

Catches of Ommastrephidae are usually composed by *Illex coindetii* and *Todaropsis eblanae* and *Todarodes sagittatus*. No species identification has been provided for all countries and areas for commercial catches.

Sweden and Ireland provided data in relation to discards, landings and effort in Subarea III, VI and VII respectively for at least 2011 and 2012. Also for both areas survey data are provided. These data are not included in the main body of the report due to the small amount of this cephalopod group detected in commercial vessels and surveys.

5.1.1 Biological parameters and other research

A compilation of the most distinct biological parameters and population variables and dynamics are included for the four most common Ommastrephid species in the ICES area.

5.1.1.1 *Illex coindetiis*

5.1.1.1.1 Length distribution and maximum size

Illex coindetii is a medium-sized squid, commonly reaching 200 to 250 mm ML throughout its distributional range (Roper *et al.*, 2010). The maximum mantle lengths recorded for females and males are 379 and 279 mm respectively (e.g. Gonzalez *et al.*, 1994b, 1996a). Females are larger than males, and maximum sizes vary depending on the population examined.

5.1.1.1.2 Length weigth relationship

Table 3. *Illex coindetii*. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to W=a.ML^b, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	A	b	Sex	Reference
south Celtic Sea-Bay of Biscay	0.058	2.76	F	Arvanitidis *et al.*, 2002
	0.296	3.17	M	
northwest Spanish waters	0.033	2.91	F	González *et al.*, 1996a
	0.022	3.16	M	
	0.016 - 0.017	3.09 - 3.12	F	Sánchez *et al.*, 1998
	0.006 - 0.007	3.57 - 3.58	M	
Portuguese waters	0.046	2.76	F	Arvanitidis *et al.*, 2002
	0.016	3.30	M	

5.1.1.1.3 Growth rate and growth (age–length)

González *et al.* (1996a) measured instantaneous relative growth rate as well as absolute growth rate. Although there was considerable variation, the fastest relative growth rate was recorded in 6-month old individuals of both sexes (1.33% ML.d-1 and 4.49 %BW.d-1 in males, 1.73 % ML.d-1 and 5.06% BW.d-1 in females) and the slowest growth in 13- month old males (0.10% ML.d-1 and 0.03% BW.d-1) and 14-month old females (0.18% ML.d-1 and 0.81% BW.d-1).Sex ratio

The sex ratio is generally around 1:1 across the distribution range although seasonal shifts in sex ratio are also reported (Baddyr, 1988; Guerra and Rocha, 1994; Raya *et al.*, 1999; Moreno *et al.*, 2002; Šifner and Vrgoč, 2004) as well as differences in sex ratio between size classes: Raya *et al.* (1999) found that the proportion of males was highest in the smallest size classes, which is consistent with findings for *L. forbesii*

5.1.1.1.4 Size and age at first maturity

Table 4. *Illex coindetii*. Size at 50% maturity (MLm$_{50\%}$) in populations from different geographical areas of the east Atlantic Ocean and the Mediterranean Sea.

Region	MLm50% (mm)		Reference
	Females	Males	
south Celtic Sea - Bay of Biscay	248	153	Arvanitidis *et al.*, 2002
Galician waters	184	128	González and Guerra, 1996
Portuguese waters	191	129	Arvanitidis *et al.*, 2002
east Atlantic	172-218	127-166	Hernández-García, 2002

In Portugal, males reach maturity at a mean age of nine months and spawning takes place at a mean age of ten months

5.1.1.1.5 Lifespan

The life cycle of *Illex coindetii* is probably annual, although shorter (6-8 months) and longer (18 months) lifespans have been estimated by using different techniques, in different areas.

5.1.1.1.6 Spawning season and spawning habitat

Spawning occurs all year long, but seasonal peaks exist and vary with area throughout the Mediterranean Sea and the Atlantic Ocean (e.g. Gonzalez and Guerra, 1996; Sánchez *et al.*, 1998; Belcari, 1999; Ceriola *et al.*, 2006; Lefkaditou *et al.*, 2007). This variability is thought to be related to differences in water temperature (e.g. Arvanitidis *et al.*, 2002; Hernandez-Garcia 2002).

5.1.1.1.7 Fecundity

Potential fecundity in males and females varies with body size. Approximately 800 000 oocytes were recorded in a 250 mm ML female (Laptikovsky and Nigmatullin, 1993.

5.1.1.1.8 Migrations

Adults, at least, undergo vertical migrations from the bottom to the upper layers at night, although they remain below the thermocline (Sánchez *et al.*, 1998). Seasonal migrations have been observed in the French Mediterranean and the Catalan Sea (Mangold Wirz, 1963; Sánchez *et al.*, 1998), with the bulk of the population seeking shallow waters (70-150 m) in spring, where they remain all summer. In autumn and winter the population spreads over a wide bathymetric range.

5.1.1.2 *Todarodes sagittatus*

5.1.1.2.1 Length distribution and maximum size

A maximum mantle length of 75 cm was reported for an unsexed specimen from North Atlantic waters (probably a female), while the maximum recorded mantle length for a male in this area was 64 cm (Roper *et al.*, 2010)

5.1.1.2.2 Length weight relationship

Table 1. *Todarodes sagittatus*. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	a	b	Sex	Reference
North Sea	0.0078	3.29	F	Oesterwind, 2011
	0.0075	3.27	M	
southwest Portugal, Madeira	0.0158	3.12	F	Piatkowski *et al.*, 1998
	0.0164	3.09	M	

(Note: some other published regressions excluded due to data aresues)

5.1.1.2.3 Size and age at first (and 50%) maturity

Table 2. *Todarodes sagittatus*. Minimum size of mature females and males (with values of $MLm_{50\%}$, when known, in parenthesess) in populations from different geographical areas.

Region	ML (mm)		Reference
	Females	Males	
Off Norway	350	300	Wiborg *et al.*, 1982
Northeast Atlantic	310 (~480)	280 (340)	Lordan *et al.*, 2001a

5.1.1.2.4 Lifespan

While most individuals probably live 12-14 months, the lifespan of the largest individuals may approach 2 years

5.1.1.2.5 Fecundity

Potential fecundity (PF) estimates were considerably lower in the northeastern Atlantic, ranging from 205 000- 532 500 for females of 415-520 mm ML (Lordan *et al.*, 2001a), than in mature females from the Sahara bank (ML: 253-341 mm; PF: 215 000-950 000) and an immature female from the western Mediterranean (ML 288 mm; PF: 2 370 000) (Laptikhovsky and Nigmatullin, 1999)

5.1.1.2.6 Migrations

Todarodes sagittatus undertakes pronounced migrations, probably mainly related to feeding and spawning (Shimko, 1989). From June onwards, large schools appear off the south and southwest coast and in the northwestern fjords of Iceland, the Faroe Islands, Norway and, in some years, Scotland, where they stay until about December (e.g. Stephen 1937; Wiborg 1972, 1979, 1987; Sundet, 1985; Joy, 1990; Boyle *et al.*, 1998; Jónsson, 1998; Lordan *et al.*, 2001b; Bjørke and Gjøsæter, 2004; Roper *et al.*, 2010). In early winter, the animals migrate into deeper offshore waters.

5.1.1.3 *Todaropsis eblanae*

5.1.1.3.1 Length distribution and maximum size

Maximum mantle lengths have been registered in North Atlantic waters: 290 mm and 220 mm for females and males, respectively (Robin *et al.*, 2002). There is morphometric sexual dimorphism, with females attaining larger sizes than males due to (Mangold-Wirtz, 1963b) (see Table 1).

Table 1. *Todaropsis eblanae*. Maximum mantle length (mm) for females (F) and males (M) in different geographic areas of the east Atlantic Ocean and the Mediterranean Sea.

Region	ML (mm)		Reference
	F	M	
Scottish waters	205	141	Hastie *et al.*, 1994
North Sea	190	160	Zumholz and Piatkowski, 2005
Bay of Biscay - Celtic Sea	290	220	Robin *et al.*, 2001

5.1.1.3.2 Length weight relationship

Table 2. *Todaropsis eblanae*. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations were converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	a	b	Sex	Reference
Scottish waters	0.126	2.723	F	Hastie *et al.*, 1994
	0.115	2.777	M	
North Sea	0.142	2.660	F	Zumholz and Piatkowski, 2005
	0.094	2.854	M	
Bay of Biscay - Celtic Sea	0.330	2.41	F	Robin *et al.*, 2001
	0.670	2.15	M	
Northwest Spain	0.148	2.671	F	González *et al.*, 1994

	0.088	2.917	M	
Portuguese waters	0.179	2.65	F	IPIMA
	0.218	2.56	M	

5.1.1.3.3 Growth rate and growth (age–length)

Daily growth rate is higher in females (Table 3) and decreases in both sexes upon maturity (Belcari *et al.*, 1999; Arkhipkin and Laptikhovsky, 2000) .

Table 3. *Todaropsis eblanae*. Daily growth rate (DGR, mm·day^{-1}) and lifespan (months) of females (F) and males (M) in populations from the east Atlantic Ocean and the Mediterranean Sea. (DA = direct ageing, MPA = modal progression analysis)

Method	DGR		Lifespan		Region	Reference
	F	M	F	M		
DA	1.14	0.62	8.5	7.7	South Celtic Sea - Bay of Biscay	Robin *et al.*, 2001
MPA	0.41	0.25	8.5		South Celtic Sea - Bay of Biscay	Robin *et al.*, 2001

5.1.1.3.4 Sex ratio

The sex ratio of *Todaropsis eblanae* is not substantially different from 1:1.

5.1.1.3.5 Size and age at first (and 50%) maturity

Sexual maturity starts at a larger size in females than in males. Estimates of the size at maturity in different areas range from 120 to 150 mm ML for males and from 140 to 200 mm ML for females (Table 4). (Mangold-Wirz, 1963; Gonzalez *et al.*, 1994; Hastie *et al.*, 1994; Joy, 1989, Arkhipkin and Lapthikhovsky, 2000; Robin *et al.*, 2002; Zumholz and Piatkowski, 2005).

Table 4. *Todaropsis eblanae*. Minimum size at maturity and $ML_{m50\%}$ (in parenthesess) for females and males of populations from different geographical areas.

Region	ML (mm)		Reference
	Females	Males	
Scottish waters	110 (157.3)	92 (120.8)	Hastie *et al.*, 1994
North Sea	120 (164?)	85 (123?)	Zumholz and Piatkowski, 2005
South Celtic Sea - Bay of Biscay	(165)	(135)	Robin *et al.*, 2001

5.1.1.3.6 Length-weight relationships

Table 2. *Todaropsis eblanae*. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations were converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	a	b	Sex	Reference
Scottish waters	0.126	2.723	F	Hastie *et al.*, 1994
	0.115	2.777	M	
North Sea	0.142	2.660	F	Zumholz and Piatkowski, 2005
	0.094	2.854	M	
Bay of Biscay - Celtic Sea	0.330	2.41	F	Robin *et al.*, 2001
	0.670	2.15	M	
Northwest Spain	0.148	2.671	F	González *et al.*, 1994

	0.088	2.917	M	
Portuguese waters	0.179	2.65	F	IPIMA
	0.218	2.56	M	

5.1.1.3.7 Lifespan

The life cycle of *Todaropsis eblanae* is probably annual, as estimated values for the lifespan range from 7-8 months to 1 year

5.1.1.3.8 Spawning season and spawning habitat

The spawning season probably extends throughout the year, with peaks varying according to geographical location (Belcari, 1999). *Todaropsis eblanae* spawns mainly during summer and early autumn in northern Atlantic waters (Hastie *et al.*, 1994; Robin *et al.*, 2002; Zumholz and Piatkowski, 2005; Oesterwind *et al.*, 2010), whereas it spawns in early spring and early autumn in Atlantic waters south of 44 °N (González *et al.*, 1994; Arkhipkin and Laptikovsky, 2000).

5.1.1.3.9 Fecundity

Potential fecundity (PF) varies from 4,500 to 28,000 for mature females in Scottish waters (Hastie *et al.*, 1994). Rasero *et al.* (1995) estimates PF to vary from 99,979-143,792 for females of 136-196 mm ML caught off northwest Spain. The number of ripe oocytes in the oviducts is up to 37 000 off northwest Spain and from 355 to 13 157 (mature eggs) in Scottish waters (Hastie *et al.*, 1994), indicating as for potential fecundity, a decreasing trend of reproductive output with increase of latitude.

5.1.1.3.10 Migrations

This species is probably the least mobile of the ommastrephid squids in terms of migratory habit

5.1.2 ICES Division VIIIabd

5.1.2.1 The Fishery

5.1.2.1.1 Catches in 2012

In 2012, France contributes around 91% of catches. Spain comprised in around 9% of these total catches. France landed 586 t of ommastrephids from Div. VIIIabd, while Spain landings amounted for 55 t.

5.1.2.1.2 Commercial landing series

Countries contributing to ommastrephids catches in Division VIIIabd are France and Spain.

French landings of ommastrephids in Div. VIIIabd has followed an stable trend from an average of 170 t for most of the years of the dataseries to an increasing trend from values of 243 t in 2010, 303 t in 2011 to the maximum landings recorded in 2012 reaching 586 t landed.

Spanish commercial fishery in Division VIIIabd (Bay of Biscay) is mostly composed by vessels with base port in the Basque country.

For Spain, landings in Division VIIIabd show a fluctuating trend since the beggining of the dataseries from a minimum of 25 t in 2007 and 2008 to an actual value of 55 t, in the average of the whole landings dataseries.

5.1.2.1.3 Commercial discards

No discard estimation of common squids has been delivered to the group by France.

AZTI-Tecnalia is responsible for monitoring cephalopod discards, monthly in Div. VIIIabd by gear, for the Basque Country (around 95 % of the Spanish fleet operating in the Bay of Biscay).

Ommastrephids discards appear to be highly variable along dataseries available. With a minimum of 0,2 % of the ommastrephids discarded in 2012, to a maximum of 87% of discards in 2011. The average percentage of discards of ommastrphids in the discard dataseries is 39%.

5.1.2.1.4 Commercial catch-effort data

Basque LPUEs were calculated for common squid,, aggregated by gear. This is, Bottom Otter trawl and Bottom Pair trawl LPUEs were pooled together. cpues were available as kg/days of fishing. Abundance indices are presented at Family level for Div. VIIIabd.

LPUEs show fluctuating trend of high and low abundance of landings in alternative years. Year with high discards coincide with years of high landings of ommastrephids. In any case, yields vary form 2 kg per day to maximum of 60 kg/day. Minimum yields are averaged to at around 1o kg per day while peaks in landings per unit effort reached at average at around 50 kg per day.

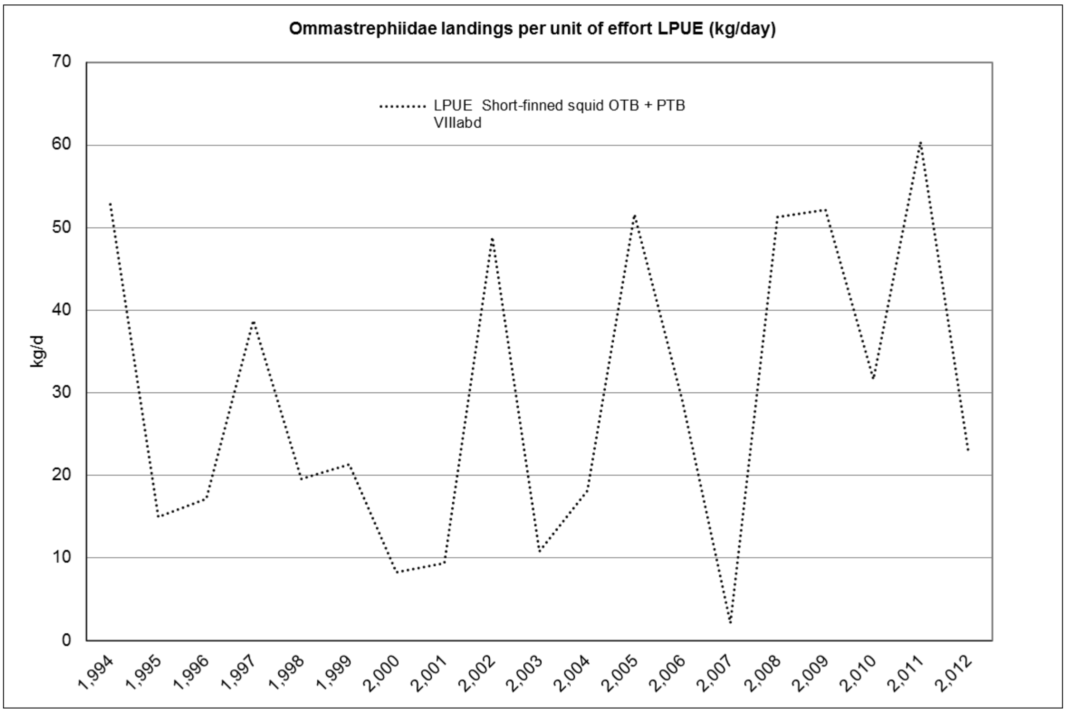


Figure 5.1.4.1.1. LPUE trends of the Spanish commercial trawls (kg/d) in Division VIIIabd.

As for the rest of cephalopods species, the most important Basque fleet targeting cephalopods are "Baka" bottom otter trawlers in the Division VIIIa,b,d. Within this fleet three different métiers have been defined following the criteria defined in the European Data Collection Framework:

-OTB_DEF_>=70 (otter trawlers targeting demersal fish).

-OTB_MCF_>=70 (otter trawlers targeting mixed cephalopod and demersal fish).

-OTB_MPD_>=70 (otter trawlers targeting mixed pelagic and demersal).

In the last four years from 2009 to 2012, the métier targeting cephalopods OTB_MCF has increased its number of trips and its cephalopods catches (WD 3. Figure 7). The increase in the OTB_MCF métier seems to be related to the decrease in OTB_DEF métier targeting demersal species like hake, megrim or anglerfish.

French LPUEs were not provided to the group.

5.1.2.2 Fishery-independent information and recruitment

Data from survey taking place in Div. VIIIabd, FR-EVHOE, was delivered to the group for discussion.

5.1.2.3 Analysis of species trends

Overall, a remarkable increasing and decrease fluctuating trend is observed for ommastrephids LPUEs from 1994 to the end of the dataseries in 2012

5.1.2.4 Data requirement

It has to be pointed out that in Div. VIIIabd, the percentage of effort for each of the gears (Bottom Otter trawl and Bottom Pair trawl) changes along the dataseries (WD 3). In the next future would be possible to discern between cpues of both gears and also it is expected that a more detailed analysis based on métiers and species could be deployed.

The change shift in métiers in the Basque trawl fleet deserves to be considered and analysed in the next future as to check whether there is a real change in trawlers fishing strategy targeting, in the last years, species without TAC and Quota or it is just a tactical situation in response to a likely high abundance of the cephalopod resource.

5.1.3 CES Division VIIIc and IXa

5.1.3.1 The Fishery

5.1.3.1.1 Catches in 2012

Overall, landings of ommastrephids amounted 4 684 t. Mostly caught by Spain. It has to be pointed out that the bulk of the catches are deployed in Div. VIIIc.

Catches in ICES Divisions VIIIc are comprised mostly by Spain and Portugal, reaching a total amount of 3 808 t of Ommastrephids. Contribution of each of the countries varies depending on the ICES Division. Spain comprises 98 % of the catches of these species in Div. VIIIc. For Subarea IXa, catches reached 876 t. Spanish catches comprises again 98% of total landings accounted in Subarea IXa.

5.1.3.1.2 Commercial landing series

Spanish landings of ommastrephids have been follow a decreasing trend since 2000 with 1200 t landed towards a minimum of 225 t in 2007. The last 3 years, 2010, 2011 and 2012 a sharp increase is shown in the landings reaching 3 700 t landed. In 2012, ommastrephids landings almost triplicate landing of the previous year. Portuguese landings of commons squids in Div. VIIIc are anecdotal and almost nil along the dataseries.

Spanish landings of ommastrephids in Div. IXa follow same pattern described for Div. VIIIc. Relatively high landings (2 400t) in 2000, a steady decrease until a minimum of landings was reached in 2007 and from the, a sharp increase reaching a total of 840 t.

Data on the proportion of each species are not available for either Division VIIIc or IXa.

5.1.3.1.3 Commercial discards

Percentage of ommastrephids discarded in Div. VIIIc by Spanish trawlers is almost neglectable (max. 6% in 2010).

In WD 4, Table 4a and 4b display the frequency of occurrence of cephalopods in the discards of Portuguese OTB vessels. The frequencies of occurrence of most species are low, e.g. in comparison to other commercial species. Ommastrephids occurrences in discards dataseries provided appears to follow landings trends in Div. IXa already commented before. This is, high occurrences at the beginning of the dataseries, decreasing to lesser occurrences in the mid years and an increase of occurrences in the most recent years. 2012. For the time being and until a more sophisticated estimation method is implemented, the discards of ommastrephids are assumed as medium-low for assessment purposes.

Data available and quality

5.1.3.1.4 Commercial catch-effort data

Spain provided LPUE data for Otter trawls operating in VIIIc and IXa, kilograms per trip are at high levels for both commercial fleets at the beginning and the end of the dataseries. Maximum is reached in 2012 for the fleets operating in Div. VIIIc and IXa north reaching around 145 kg per trip. In case of trawl fleets operating in Div. IXa , maximum is reached in 2011 at the same level that for 2012 in the previous area. In Div. IXa another maximum of 120 kg per trip was reached in 2001. For the rest of the mid years of the LPUE dataseries, yields are at maintained at medium (40 kg/trip) to lower levels (20 kg/trip).

LPUEs were not provided for this group of species for Portugal.

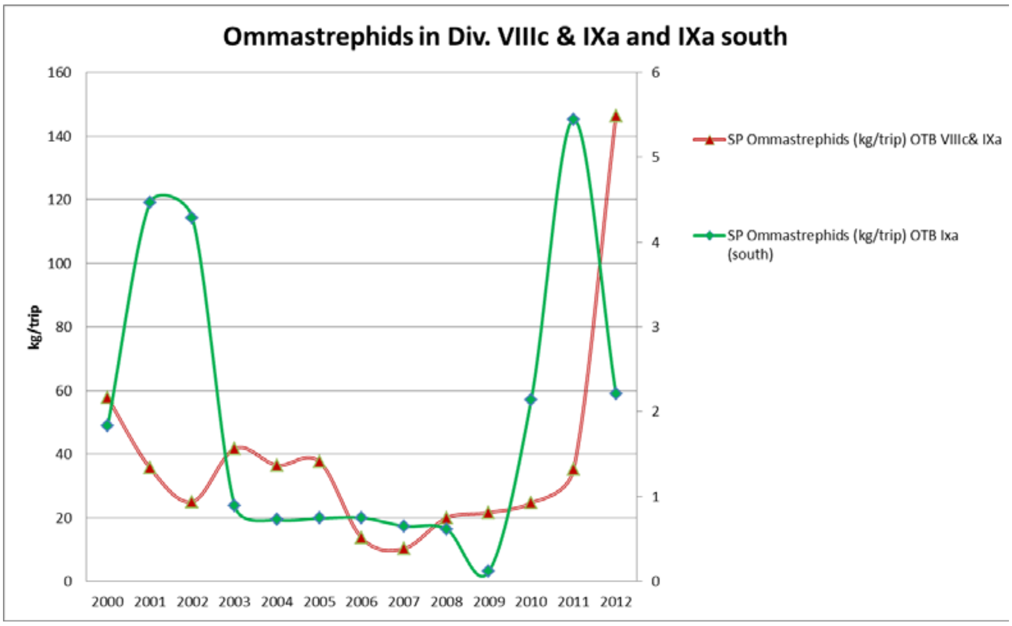


Figure 5.1.3.1.4.1. LPUE trends of the Spanish commercial trawls (kg/trip) in Divisions VIIIc and IXa.

Data available and quality

Although trends for both commercial dataseries in both areas coincide, it has to bear in mind that Spanish commercial indices represent fleets operating from the Basque country to the Gulf of Cadiz covering the whole waters of the Iberian peninsula, There for a better métier disaggregation could facilitate any LPUEs analysis. Also species identification is crucial to this kind of trend examination.

5.1.3.2 Fishery-independent information and recruitment

The northern Spanish groundfish survey (SPGFN) covered ICES Division VIIIc and the northern part of IXa corresponding to the Cantabrian Sea and off Galicia waters. Abundances of ommastrephids in this survey are very low reaching a maximum at around 5,3 kg per hour in 2011. An increasing trend in abundance is also detected in the last years of the dataseries.

The Spanish Ground Fish South (ARSA/SPGFS) is conducted in the southern part of ICES Division IXa, the Gulf of Cadiz. SPGFS aims to collect data on the distribution and relative abundance, and biological information of commercial fish in the Gulf of Cadiz area (ICES Division IXa). Abundances estimated by this survey are comparatively lower than from the more northern Spanish survey for most of the dataseries. Despite this, yields reached a maximum of 8,7 kg per hour in 2011. An increasing trend in abundance is also detected in the last years of the dataseries.

Portugal did not provide data on ommastrephids abundance calculated in surveys for Div. IX a..

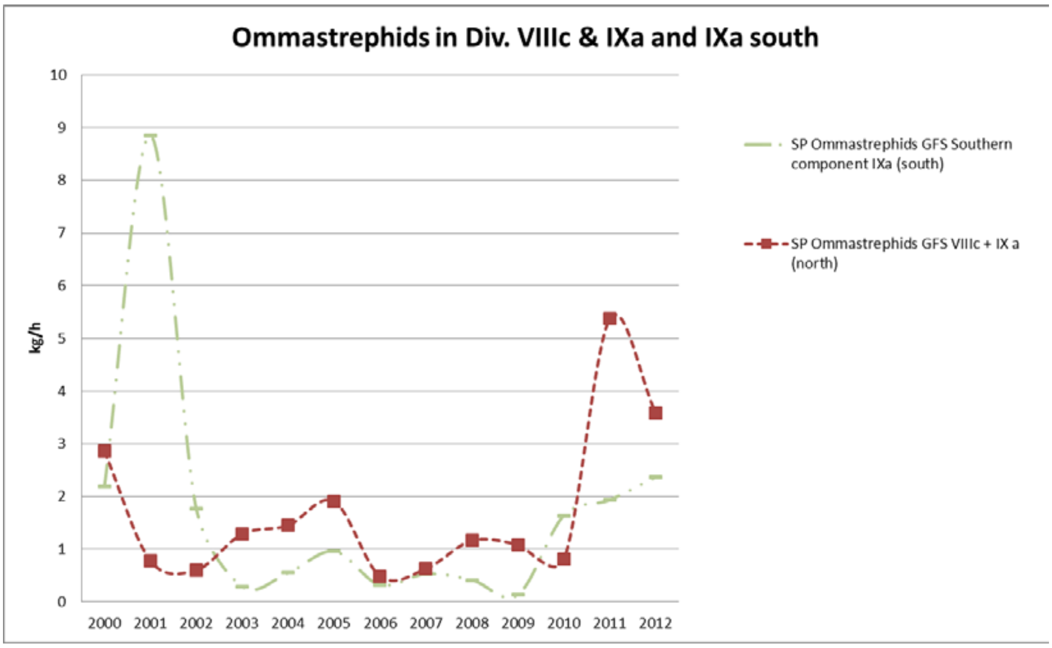


Figure 5.1.3.2.1. Abundance Indices (kg/h) of the Spanish Scientific Surveys in Div. IXa south and Divisions VIIIc and IXa

5.1.3.3 Analysis of species trends/Assessment of Ommastrephidae or Stock trends

It appears to be a similar fluctuating trend between both Spanish and Portuguese survey series for ommastrephids. Surveys again, appear to follow the trends described in the commercial landings dataseries. This is,, high abundances at the beginning of the dataseries, low abundance for intermediate years and increasing abundance at the end of the dataseries. Both surveys appear to detect high and low abundance in the whole distribution sea area of the ommastrphids.

The coincidence in trends of the indices obtained in the Spanish surveys has to be taken with cautious. The survey will well representative of the abundances, either by covering the whole area of distribution of the species and gear and timing of survey being adequate to the dynamics of the species. However, a problem still persists as at least 2 to 3 species are represented in these indexes.

5.1.3.3.1 Exploratory Assessment

Commercial and Survey dataseries provided by Spain for Div. VIIIc and IXa appear to coincide in trends and in peaks of abundance detection. These promising results enhance the possibility of using these dataseries as abundance indices for ommastrephids. As commented above high abundances are shown at the first years of the dataseries (2000) and at the end (2001 and 2012)

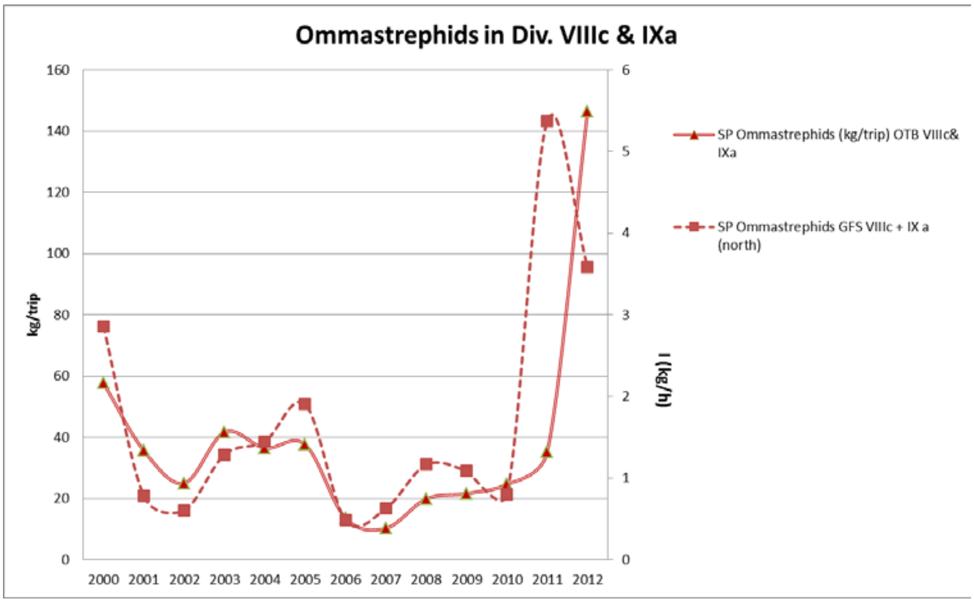


Figure 5.1.3.3.1. Comparison between LPUEs (kg/trip) and Abundance Indices (kg/h) trips of the Spanish commercial fleet and Scientific Surveys in Divisions VIIIc and IXa

For Div. IXa south, commercial and survey dataseries provided by Spain appear to coincide also in trends and in peaks of abundance detection. For these dataseries comparison, survey indices do not shown the marked high abundances shown by the commercial LPUEs series in 2011. Discards are negletable for these species.As commented above, for Div. VIIIc and IXa, high abundances are shown at the first years of the dataseries (2000) and at the end (2001 and 2012). These promising results enhance the possibility of using these dataseries as abundance indices for ommastrephids.

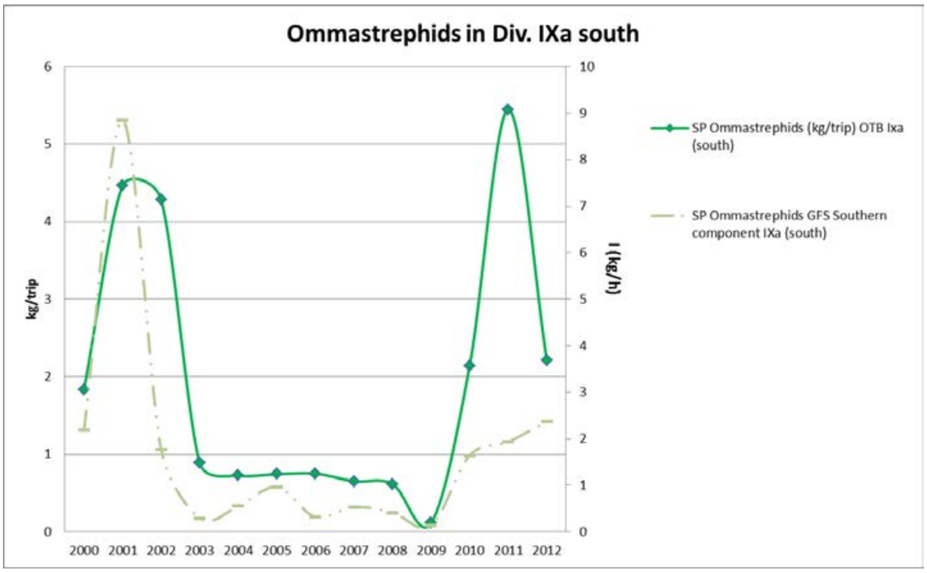


Figure 5.1.3.3.2. Comparison between LPUEs (kg/trip) and Abundance Indices (kg/h) trips of the Spanish commercial fleet and Scientific Surveys in Divisions IXa south

5.1.3.4 Data requirement

These dataseries showed a promising result for exploring more in depth, species disaggregation, métiers further segmentation and area coverage of commercial fishery and survey.

5.2 References

Reference in relation to the biology and dynamics of these species can be found in Reference of Section of this *section 7.3: Review data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity at age, first maturity at length, growth, spawning season, of this report.*

6 Section 6: Octopodidae in Subarea II, IV, V, VI, VII, VIIIabd, VIIIc and IXa

6.1 *Octopus vulgaris, Eledone cirrhosa and Eledone moschata*

Introduction

Octopus (*Octopus vulgaris*), Horned Octopus (*Eledone cirrhosa*) and Musky octopus (*Eledone moschata* are included in this section. The first two species are distributed from ICES Subarea III to Div. IXa, Mediterranean waters and North African coast.*Eledone moschata* inhabits southern waters from Div. IXa towards south. Abundances of octopus and horny octopus in Subarea III, IV, V and VI are almost anecdotical compared to abundances in the rest of the ICES areas, based on the data provided by countries deploying fisheries.

Catches in Div. VIId,e almost completely (99%) deployed by England Wales and Northern Ireland. France catches in these Divisions are anecdotic. Traditionally English catches of this species groups in average were around 19 t from 200 to 2006. Since then catches has largely increased with a maximum of 248 t in 2012. Catches in ICES Divisions VIIg-k (Celtic Sea and SW of Ireland) are comprised in 2012, by 63 % of English catches and 25 % coming from Scotland. Irish catches comprises 22 % of the whole catches in 2012. France contributes with very small amount to the catches. Spain presented important catches of Octopodidae in the first years of the dataseries, but since 2008 catches decreased and no data are provided for 2011 and 2012. Level of catches for the most important contributor (England) was at around 107 t in average, decreasing in the last years of the series to at 68 t.

Octopodidae catches here described usually comprise 2 species: *Octopus vulgaris* and *Eledone cirrhosa*. In case of the above, most of the catches were recorded in trawlers and so the most abundance species here is *Eledone cirrhosa*.

For more southern areas (Div. VIIIabd, VIIIc and IXa), main countries exploiting these species are Spain, Portugal and France, with neglectable catches recorded by The Netherlands.

No species identification has been provided for all countries and areas for commercial catches except for Spain and Portugal in Div. VIIIc and IXa.

Sweden, UK, The Netherlands, Germany and Ireland provided data in relation to discards, landings and effort in Subarea III, VI and VII respectively for at least 2011 and 2012. Also for both areas survey data are provided. The Netherlands and Germany did not record any octopodidae records in its waters. These data are not included in the main body of the report due to the small amount of this cephalopod group detected in commercial vessels and surveys.

6.1.1 Biological parameters and other research

A compilation of the most distinct biological parameters and population variables and dynamics are included for the four most common Octopodidae species in the ICES area.

6.1.1.1 *Octopus vulgaris*

6.1.1.1.1 Length distribution and maximum size

Adults reach 40 cm ML and 140 cm total length.

6.1.1.1.2 Length weigth relationship

Octopus vulgaris. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm). Only records from the ICES area are included.

Region	a	b	Sex	Reference
Galicia	0.442	2.918	F	Guerra, 1981
	0.296	3.029	M	
	0.365	2.961	All	
	2.9	2.17	All	Otero *et al.*, 2007
Gulf of Cadiz	3.277	2.267	F	Silva *et al.*, 2002
	2.489	2.369	M	
	2.895	2.313	All	

6.1.1.1.3 Growth rate and growth (age–length)

Growth rates in captivity vary with temperature and diet as well as between individuals They seem to be typically 1-2% of body weight per day, but up to 5% has been recorded over short periods.

6.1.1.1.4 Sex ratio

Approximately 1:1 in the Atlantic and Mediterranean although results from South Africa suggest a seasonal cycle with fewest males in November

6.1.1.1.5 Size and age at first maturity

Males mature at smaller sizes than females; smaller sizes at maturity reported in Mediterranean compared to Atlantic

Parameter	Females	Males
Length at first maturity	12 cm	9.4, 10 cm
Length at 50% maturity	17.6 cm	10.4 cm
Weight at first maturity	394, 580g	250, 323 g
Weight at 50% maturity	1788, 2023g	671, 903 g
Age at maturity” (range)*	210-390 days	170-470 days

* Mediterranean data

6.1.1.1.6 Lifespan

Generally thought to be 12-15 months although lifespans up to 20 months suggested off Senegal.

6.1.1.1.7 Spawning season and spawning habitat

The spawning season extends throughout the year with two peaks in spring and autumn in Northeast Atlantic populations.

Fecundity

The potential fecundity of mature females ranges from 70,000 to 634,445 oocytes (Mangold-Wirz, 1963; Otero *et al.*, 2007; Silva *et al.*, 2002).

6.1.1.1.8 Migrations

This species undertakes limited seasonal migrations. According to Rees and Lumby (1954), octopuses appear to move away from inshore waters in late summer and spend the winter in deeper offshore waters.

6.1.1.2 *Eledone cirrhosa*

6.1.1.2.1 Length distribution and maximum size

Eledone cirrhosa is a medium-sized species with a maximum body mass less than 1 kg in the Mediterranean and up to 2 kg in the northern parts of its distribution. Most specimens caught are less than 160 mm mantle length (ML), although, occasionally, individuals of larger size, up to 175 mm ML, are captured, both in the Mediterranean (Belcari and Sartor, 1999; Cuccu, 2003) and in the Atlantic off Portugal (A. Moreno, pers. comm.

6.1.1.2.2 Length weight relationship

Table 1. *Eledone cirrhosa*. Length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	a	B	Sex	Reference
North Galicia	0.862	2.38	M	Regueira *et al.* 2013
	0.556	2.60	F	
West Galicia	0.490	2.61	M	
	0.404	2.76	F	
West Portugal	0.848	2.30	M	
	0.377	2.73	F	

6.1.1.2.3 Size and age at first (and 50%) maturity

In the Atlantic, off Portugal, 50% of females are mature at 105 mm ML while 50% of males are mature at 80 mm ML (A. Moreno, pers. comm.). Along the Iberian Atlantic coast, animals mature at larger sizes at higher latitudes. Size at 50% maturity (MLm50%) for males was 108.9 mm on the north coast of Galicia, 99.25 mm on the west coast of Galicia (i.w., further south) and 91.4 mm in Portugal. The corresponding values for females were 134.5 mm, 121.4 mm and 100.8 mm, respectively (Regueira *et al.*, 2013).

6.1.1.2.4 Lifespan

Eledone cirrhosa probably typically lives for two years. A combination of a one-and two-year cycle was proposed for the North Sea, depending, respectively, on fast-growing early maturing animals and slower-growing individuals (Boyle and Knobloch, 1982a; Boyle, 1983; Boyle *et al.*, 1988).

6.1.1.2.5 Fecundity

Regueira *et al.* (2013) estimated potential fecundity in the northwest Iberian Peninsula as 2452.88 □36.4 oocytes per ovary, based on a sample of almost 700 females. They found that potential fecundity was positively correlated with both mantle length and body weight.

6.1.1.2.6 Migrations

While the deep-water population (100-200 m) normally has equal numbers of males and females, trawls in shallower water (60-90 m) in spring catch an increased number of maturing females. This seasonal sex segregation is interpreted as a shoreward (shallower) migration of females for breeding (Boyle, 1997).

6.1.1.3 *Eledone moschata*

6.1.1.3.1 Length distribution and maximum size

Eledone moschata reaches a maximum size of 150 mm mantle length and 640 g body weight in the Atlantic (Silva *et al.*, 2004).

6.1.1.3.2 Length weight relationship

Table 1. *Eledone moschata.* Length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Region	a	b	Sex	Reference
Portugal	1.0048	2.4	F	Lourenço *et al.*, 2008
	0.6325	2.5	M	
	0.8652	2.46	All	
Gulf of Cádiz	0.3573	2.660	F	Silva *et al.*, 2004
	0.2613	2.794	M	
	0.3233	2.702	All	

6.1.1.3.3 Growth rate and growth (age–length)

Boletzky (1975) reared this species, recording a growth rate of 6.6% BW.d-1 for the first month after hatching and 3.6% BW.d-1 for the subsequent three months. Hatchlings weighed 0.3 g, reaching 2.2 g BW after one month and 55 g at four months. Forsythe and Van Heukelem (1987) give figures for instantaneous relative growth rates ranging from 6.94% BW.d-1 in the smallest animals to 0.99 % BW.d-1 in animals of 50g BW

6.1.1.3.4 Sex ratio

The sex ratio apparently varies seasonally and in relation to depth, as well as between areas, perhaps indicating the occurrence of geographic variation in the timing of life cycle events, reproductive migrations, and differential survival of the sexes - but also suggesting an incomplete understanding of the life cycle in many areas.

6.1.1.3.5 Size and age at first (and 50%) maturity

Weight and size at maturity vary geographically. In the Gulf of Cádiz the length and weight at maturity (MLm50% and BWm50%) were estimated to be 12 cm (274 g) in females and 7.8 cm (97 g) in males (Silva *et al.*, 2004).

6.1.1.3.6 Lifespan

The proposed life cycle model of this species in the northwest Mediterranean is based on the alternation of short-living and long-living life cycles (Mangold, 1983; Silva *et al.*, 2004). Lifespan is probably up to two years (e.g. Mangold, 1983).

6.1.1.3.7 Spawning season and spawning habitat

In the Gulf of Cádiz, the spawning season extends throughout most of the year, although there is little or no spawning during summer (Silva *et al.*, 2004). Most spawning occurs from February to May and a secondary peak occurs in September in southern Portuguese waters (Lourenço *et al.* 2008) or in October in the Gulf of Cádiz (Silva *et al.*, 2004).

6.1.1.3.8 Fecundity

Mean total fecundity was estimated at between 187 and 944 oocytes (mean = 443 ± 154) in the Gulf of Cádiz (Silva *et al.*, 2004).

6.1.1.3.9 Migrations

In the Mediterranean Sea, *E. moschata* seems to undergo horizontal migrations related to reproduction, moving inshore to spawn (Mangold, 1983; Mandić and Stjepcević, 1981).

6.1.2 ICES Division VIIIabd

6.1.2.1 The Fishery

6.1.2.1.1 Catches in 2012

In this ICES Division, the catches of octopodidae species are scarce. Mainly, *Eledone cirrhosa* account for more than 95% of the total catches, and it appear in the logbooks a a percentage grouped by octopodidae, which are not identified. Fishery is deployed by otter trawlers.

The catches in Division VIIIc are reduced. Spain contributes in 68% of the catches while France in 35 %. Spain landed 236 t while France landed 107 tonnes. Spain reported landings as *Octopus vulgaris* of less than one ton. In both cases were caught by trawler

6.1.2.1.2 Commercial landing series

Countries contributing to Octopodidae catches in Division VIIIabd are France and Spain. French landings of octopodidae in Div. VIIIabd has followed an stable trend from an average of 124 t for most of the years of the dataseries with a peak of 205 t in 2008.

Spanish commercial fishery in Division VIIIabd (Bay of Biscay) is mostly composed by vessels with base port in the Basque country.

For Spain, landings in Division VIIIabd show very variable values from no cathes to a peak of 601 t in 2020 flluctuating since then and reaching 236 t in 2012. Cathes in the area are supposed to be mostly *Eledone cirrhosa* caught in trawlers.

6.1.2.1.3 Commercial discards

No discard estimation of octopodidae has been delivered to the group by France.

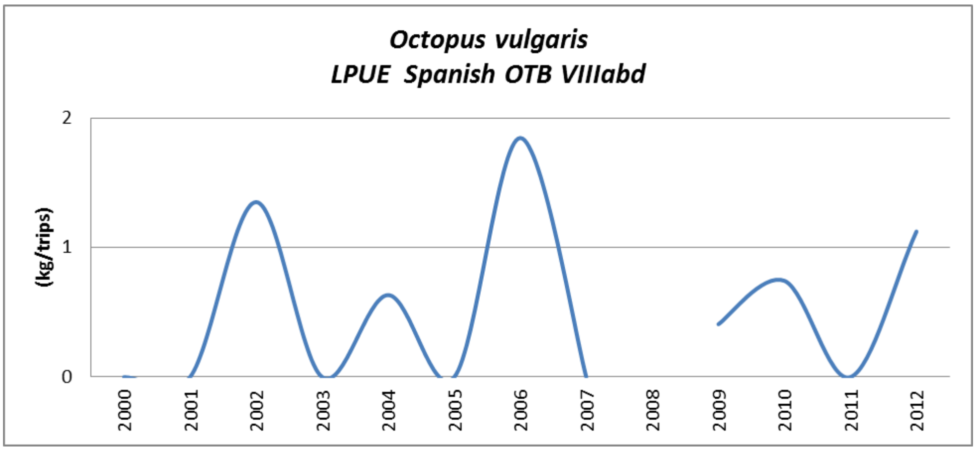
AZTI-Tecnalia is responsible for monitoring cephalopod discards, monthly in Div. VIIIabd by gear, for the Basque Country (around 95 % of the Spanish fleet operating in the Bay of Biscay).

Octopodidae discards appear to be highly variable along dataseries available. With a minimum of 2% in 2008, to a maximum of 74% of discards in 2011..

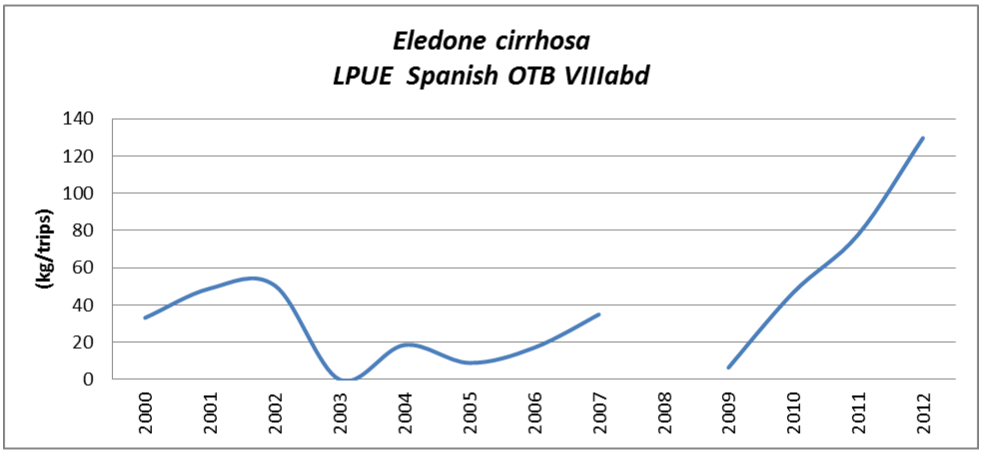
6.1.2.1.4 Commercial catch-effort data

Basque LPUEs were calculated for *Octopus vulgaris* and *Eledone cirrhosa* separately, aggregated by gear. This is, Bottom Otter trawl and Bottom Pair trawl LPUEs were pooled together. cpues were available as kg per fishing trip. Abundance indices are presented at species level for Div. VIIIabd.

Octopus LPUEs show fluctuating abundances of relatively higher and lower values of landings in alternative years. Year with the minimum discard coincide with the year in which no record of landings are presented (2008). In any case, yields vary form 1,5 to 2 kg per trip as a maximum to no octopus or 0,5 kg per trip as a minimum.



Horny octopus LPUEs show less fluctuating abundances of much higher abundances than octopus. It is to point out the increasing yield from 0 kg per trip to more than 120 kg per trip..



The increasing yields in octopodidae, as for the rest of cephalopods in Div. VIIIabd could be due to the shift of some tradition demersal and pelagic métiers ("Baka" trawlers, towards métiers targeting a mixture of cephalopods and demersal species.

In the last four years from 2009 to 2012, the métier targeting cephalopods OTB_MCF has increased its number of trips and its cephalopods catches (WD 3. Figure 7). The increase in the OTB_MCF métier seems to be related to the decrease in OTB_DEF métier targeting demersal species like hake, megrim or anglerfish.

6.1.2.2 Fishery-independent information and recruitment

No survey data are presented in this section. Data from survey taking place in Div. VIIIabd, FR-EVHOE, was not delivered fro Octopodidae to the group for discussion. Thus, in this section just, commercial cpues are presented.

6.1.2.3 Analysis of species trends

Overall, remarkable increasing and decrease fluctuating trend is observed for both octopodidae species LPUEs along the whole dataseries with a remarkable incresed trend for the most recent years.

6.1.2.3.1 Exploratory Assessment

No exploratory analysis was deployed due to the lack of French Survey data in Div. VIIIabd.

6.1.2.4 Data requirement

The lack of French data both commercial and survey indices limit the capacity of the group to carry out any assessment of trends.

It has to be pointed out that in Div. VIIIabd, the percentage of effort for each of the gears (Bottom Otter trawl and Bottom Pair trawl) changes along the dataseries (WD 3). In the next future would be possible to discern between cpues of both gears and also it is expected that a more detailed analysis based on métiers and species could be deployed.

The change shift in métiers in the Basque trawl fleet deserves to be considered and analysed in the next future as to check whether there is a real change in trawlers fishing strategy targeting, in the last years, species without TAC and Quota or it is just a tactical situation in response to a likely high abundance of the cephalopod resource.

6.1.3 ICES Division VIIIc and IXa

6.1.3.1 The Fishery

In Spain, *Octopus vulgaris* is caught by artisanal and trawler fleet. In Cantabrian sea, Division VIIIc and Galicia waters, Subdivision IXa north, the artisanal fleet account for most of the O. vulgaris by traps, comprising more than 98% of octopus landings. .In Portuguese waters, Subdivision IXa-center, a large percentage of O. vulgaris come from the polyvalent fleet (91-97%),, using a collection of gears which includes gillnets, trammelnets, traps, pots and hooks (lines), classified under the polyvalent gear type group (which roughly equates to artisanal fisheries). However, in Subdivision IXa south located in the Spanish waters of the Gulf of Cádiz, this species is caught by the bottom-trawl fleet, accounting for around 60% of total catch on average, and the remaining 40% by the artisanal fleet using mainly clay pots and hand-jigs.

Eledone cirrhosa is caught by trawler in both Divisions, mainly as a bycatch due its low commercial values. In Portugueses waters, Subdivision IXa center, a percentage lesser than 12% is caught by vessels using a collection of gears which includes gillnets, trammelnets, traps, pots and hooks (lines), classified under the polyvalent gear type group (which roughly equates to artisanal fisheries). Monthly landings in IXa-center of E. cirrhosa show a marked seasonality, with much higher landings during spring months.

In Subdivision IXa south, the landing are considered as Eledone spp because in this area inhabit E. cirrhosa with E. moschata, and they appear together in the fishing notes. In the rest of area only inhabit E.cirrhosa. Therefore, both species are considered together, although E. moschata only appear in the Subdivision IXa south

6.1.3.1.1 Catches in 2012

For the whole are here considered, Div. VIIIc and IXa, in 2012 Portugal comprises around 68 %. Landings are mostly concentrated in Division IXa from which Portugal participates in 61 % and Spain 39 %.

Total catches of *Octopus vulgaris* in Division VIIIc and IXa were 14 976 tonnes, being lesser than 0,5% the catches belonging to discard. Subdivision IXa centre (Portuguese waters) and IXa south provide the highest values with 9514 and 3242tonnes, respectively, followed by the landing in Subdivision IXa north and Division VIIIc, with 1089 and 1112 tonnes. The most of landing was provide by artisanal fleet in all area..

Total catches of Eledone spp in Division VIIIc and IXa were 964 tonnes. , with 81 tonnes of estimated discard from OTB métier in VIIIc and IXa north. PTB métier accounted for 47 tonnes in VIIIc, with no significant discard. Subdivision IXa south provide the highest values with 320 tonnes, follow by VIIIc with 300 t and IXa north wth 199 t. Subdivision IXa center (Portuguese waters) provide the lowest values with 68 t. In this Subdivision is not available the discard in tonnes

6.1.3.1.2 Commercial landing series

The series of landing data in Spain cover a range of thirteen years, from 2000 to 2012. In Portugues waters (Subdivision IXa center) the series start in 2003. The total landing ranged from 10451 t in 2006 to 16977 t in 2008. Figure a showed the trend landing of O. vulgaris by Subdivision-Division and total Iberian area.

The main landings are provided by Portugal with high landing in Subdivision IXa-center, followed by IXa-south Subdivision. In figure a, it can be observed strong fluctuations in the octopus landing trend along the time-series. Possibly, such oscillations may be related with environmental changes such as rainfall and dis-charges of rivers, as it was demonstrated in waters of the Gulf of Cádiz (Sobrino *et al.*, 2002).

The series of landing data in Spain cover a range of thirteen years, from 2000 to 2012. In Portugues waters (Div.IXa center), dataseries start in 2003. The total landing ranged from 1432 t in 2003 to 578 t in 2008. Landings follow a decrease trend from 2003 to 2008 in all areas, with a slight increase at the end of the time-series.

6.1.3.1.3 Commercial discards

Commercial discards of octopus in Iberian waters are only available in different bottom otter trawl métiers that operates in this area. The data were collected by the Spanish and Portuguese on-board sampling programme (EU-DCR) during last eight years. In VIIIc and IXa north is also sampled the métier pair bottom trawler (PTB), although the discard of octopus is nil. The employed methodologies are showed in the WDa.3 (Spain) and WDa.4 (Portugal) of the report WGCEPH 2012.

In 2012, the percentage of occurrence of discard of *Octopus vulgaris* in métier sampled in Portuguese waters was similar to the previous year in the two sampled métier, being higher in OTB_DEF that in OTB_CRU (see WD5). In Spanish waters, no discard was obtained in PTB métier sampled in VIIIc and IXa-south Division. However, it was obtained low level of discard in OTB métier of 2% of total catch, corresponding to almost 1 tonne. In Subdivision IXa south, the percentage of discard was similar to the previous year with low values of about 1.3 % of total catch, corresponding to 18 tonnes. Possibly, the reason of this discard was related with the presence of illegal immature individuals in the catch.

In 2012, the percentage of occurrence of discard of Eledone spp in métier sampled in Portuguese waters was similar to the previous year in the two sampled métier. In general, they are low values being higher in OTB_DEF that in OTB_CRU (see WD5). The volumes of total discard in tonnes have not been estimated due the low frequency of occurrence. In any case, these volumes are not significant.

In Div. VIIIc and IXa for 2012,, the Spanish estimated discard of horny octopus in PTB métier was 0,6% of the total catch (0,3 t). However, it was obtained the high level of discard in OTB métier in these areas of 14% of total catch, corresponding of 81 tonnes, which fluctuates along de time-series. In Subdivision IXa south, the percentage of discard in 2012 was zero, with values around the 12-19% in the four last years.

Total amount of estimated discards of horny octopus were 81 tonnes of estimated discard from OTB métier in VIIIc and IXa north. PTB métier accounted for 47 tonnes in VIIIc, with no significant discard. Subdivision IXa south provide the highest values with 320 tonnes, follow by VIIIc with 300 t and IXa north with 199 t. Subdivision IXa center (Portuguese waters) provide the lowest values with 68 t. In this Subdivision is not available the discard in tonnes

Data available and quality

6.1.3.1.4 Commercial catch-effort data

Data effort is available for Spanish OTB métier, in terms of fishing trip, in all areas of the Iberian waters. Trend of cpue series (Octopus catches/nº fishing trp) of the OTB métier in Division VIIIc and IXa and Div. IXa-south, show conflicting signals in year 2011 and 2012. Thus, in Div. IXa-south the trend is opposite to the north of Spain, with a decreasing trend from 2005 to 2011 where is reached the minimum values of the time-series. In 2013, it is detected a significant increase.

However, Portuguese LPUEs compared to those of Spanish otter trawlers in Div. VIIIc (mainly) show same pattern of high peaks of yield in 2010 (75 kg/d) with a decrease yield in 2011 and increasing again in 2012. This maximum in 2010 is at the same level than the other historical yield in 2000 reached by the Spanish trawlers.

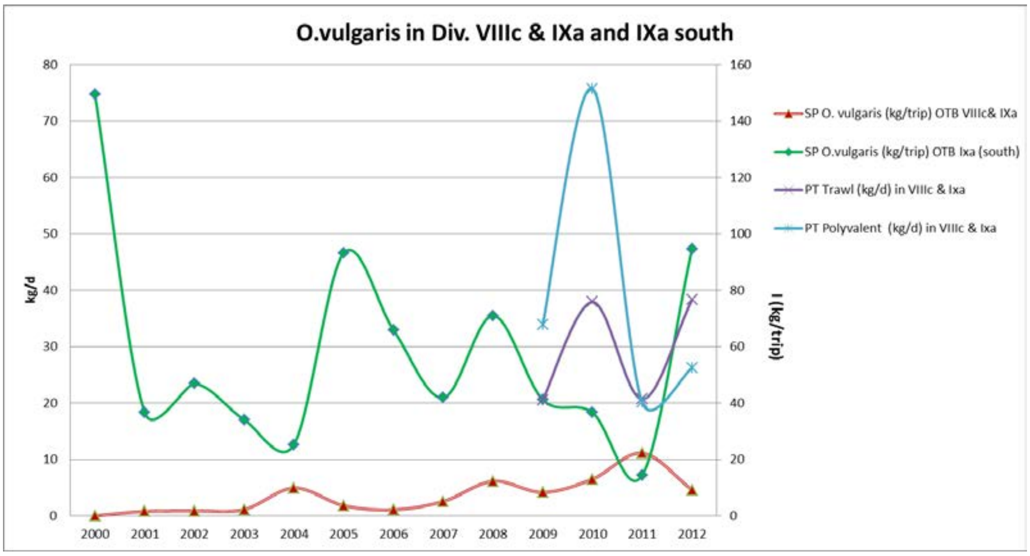


Figure 6.1.3.1.4.1 Commercial LPUE trends of the Spanish (kg/trip) and Portuguese (kg/d) fleets in Div. VIIIc and IXa .

Data effort is available in OTB métier, in terms of fishing trip, in all areas of the Iberian waters. Figures below shows show the trend of cpue series (Eledone spp./nº fishing trp) of the OTB métier in Division VIIIc, Subdivision IXa-south and IXa-north. The cpue series in all areas show different trends. In VIIIc and IXa north, the series present fluctuations along the whole series, with a decrease in the last two years. However, the series in IXa south show low values to remain stable through 2007 with an increasing trend from 2008 to 2012.

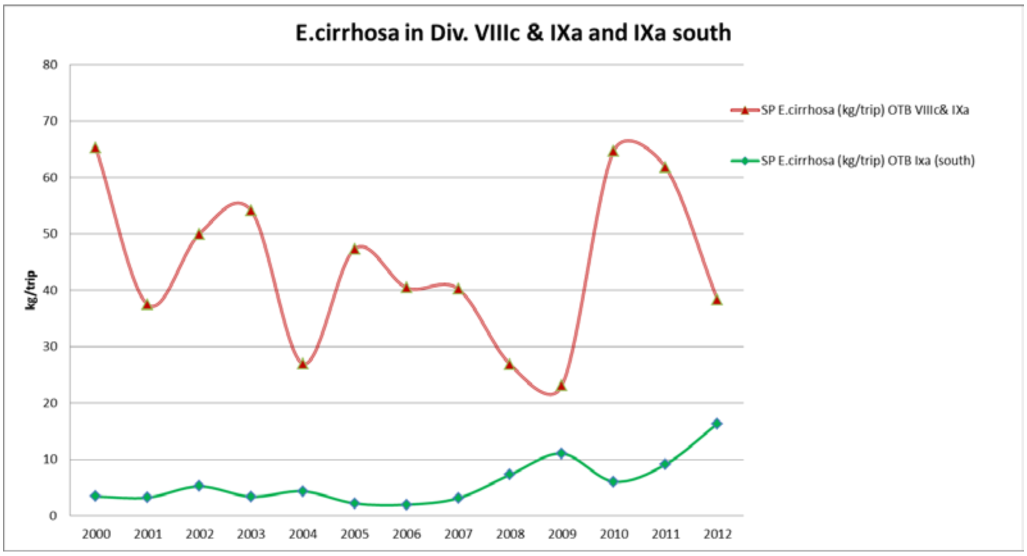


Figure 6.1.3.1.4.2 Commercial LPUE trends of the Spanish (kg/trip) fleets in Div. VIIIc and IXa .

Data available and quality

6.1.3.2 Fishery-independent information and recruitment

Fishery-independent information is supplied by different survey carried out annually in the four quarter in the Iberian waters by Portugal and Spain: SPNGPS "DEMERSALES survey" carried out in VIIIc and IXa north, PGFS survey in IXa-center by Portugal and SPGCGFS "ARSA survey". The information of biomass indices estimated in this survey along the time-series are showed in the table 1.4.1.3.in Section 2.

The estimated yields (kg/hour) in Demersal survey showed an increase in 2012, in relation to the previous years. In ARSA survey, it also was observed a sharp increase, reaching the highest values of the time-series (6 kg/h). Portuguese survey, despite the shortness of the series capture the same trend of increasing abundance than the southern component of the GFS in 2009 and 2010. No survey was conducted in 2012 due to technical problems.

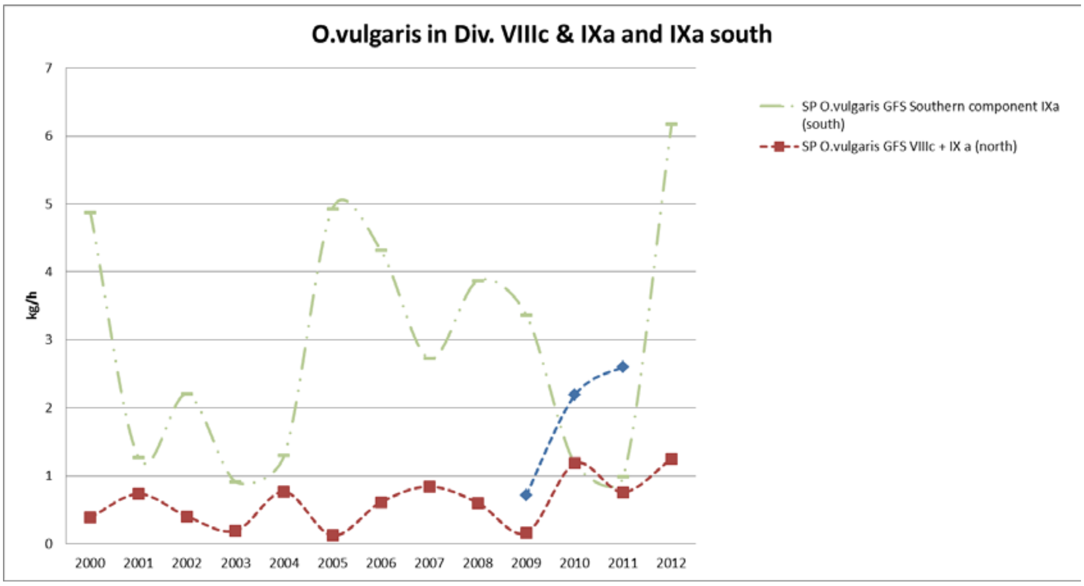


Figure 6.1.3.2.1 Abundance Indices (Kg/h) of the Spanish Scientific Survey in Div. VIIIc and IXa .

The estimated yields (kg/hour) of *E. cirrhosa* in Demersal survey showed an increase in relation to de previous years like for O. vulgaris, showing fluctuating values along the time-series. In ARSA survey, it also was observed a sharp increase, reaching a estimated values of 4.4 kg/h. In all years of the ARSA survey time-series, the yields of *Eledone moschata* was higher than the yields of *Eledone cirrhosa*. (Table 1.4.1.3. Section 2).

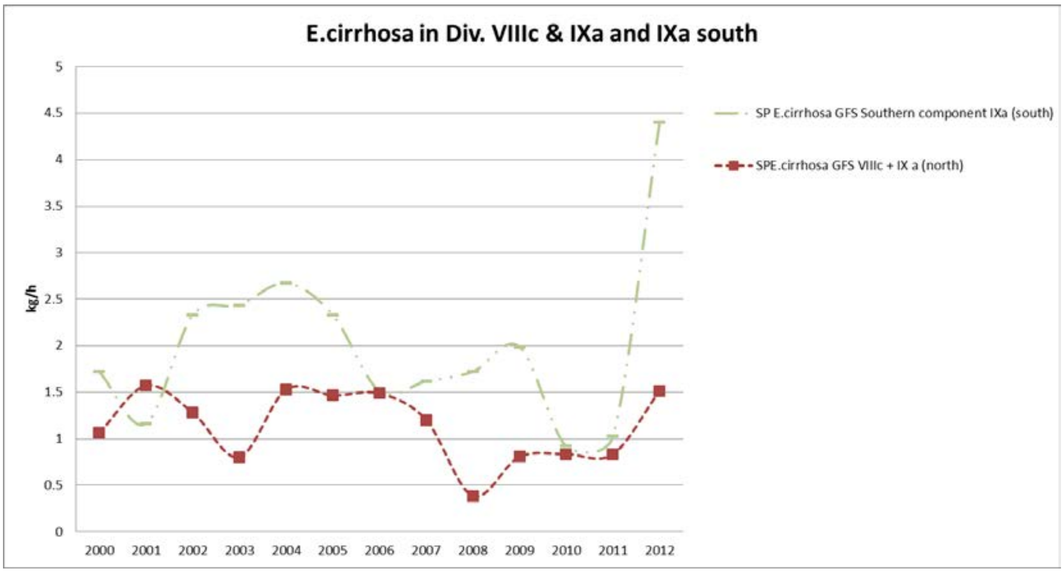


Figure 6.1.3.2.2 Abundance Indices (Kg/h) of the Spanish Scientific Survey in Div. VIIIc and IXa .

6.1.3.3 Analysis of species trends/Assessment of Octopodidae or Stock trends

The biomass indices obtained in the different survey could be used as an abundance index of this species in each area. In order to test their quality as abundance index, these have been plot with the corresponding fishing cpue series deployed in the same area. For the commercial cpue indices just data from "Baca"Otter trawlers are used in the analysis. In all series, it should be taken into account that the efforts used in the different cpue series are not directed effort to *Octopus vulgaris*. Furthermore, the cpue series in the north of Spain has been obtained for the total area, VIIIc and IXa together, due to the "Demersal" survey cover these two Divisions. In division IXa south, Gulf of Cádiz, the survey index used is the average value of the two survey carried out along de year in this area (Spring-Autumn).

Figure 6.1.3.3.1. Shows the Spanish Demersal survey biomass index and Portuguese one plotted jointly with annual dataseries coming from Spanish commercial bottom-trawl fleet "Baca" (OTB) in VIIIc and IXa north and Portuguese trawl and polyvalent gears. In this species can be observer some similarities in the trend in the final years of the dataseries though the last year of the commercial "Baka" trawl, the trends is the opposite.

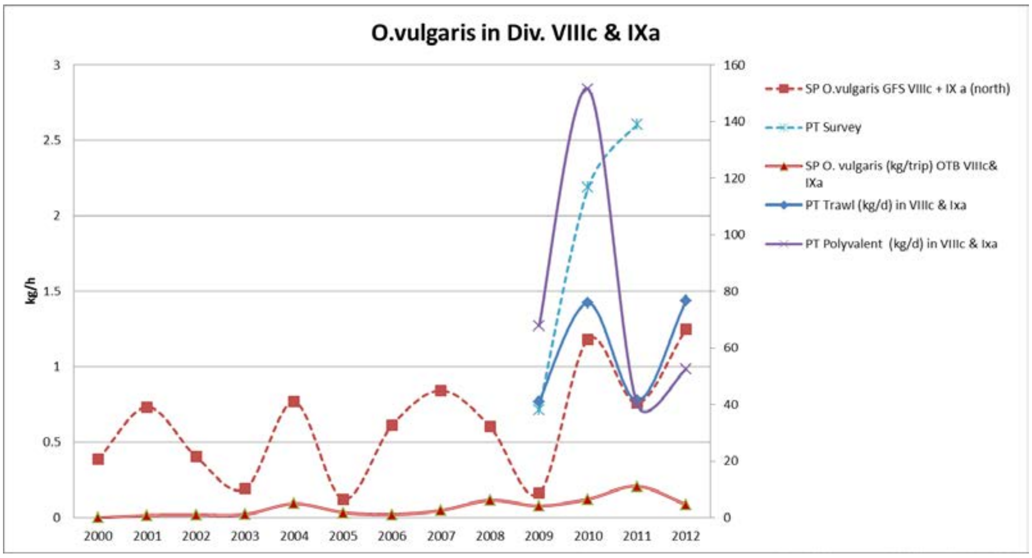


Figure 6.1.3.3.1 Comparison of Commercial LPUE trends of the Spanish (kg/trip) fleets and Spanish Scientific Survey (kg/h) in Div. VIIIc and IXa .

The series of commercial fleet (OTB) and ARSA survey biomass index in Div. IXa south are showed. In this case, the trend of both sets of data show high similarities along the all-time-series.

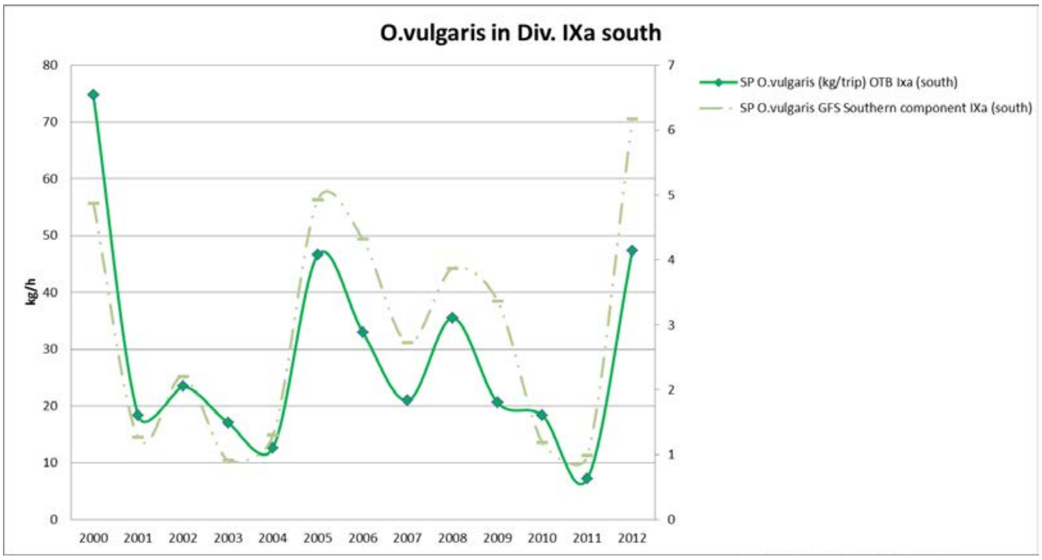


Figure 6.1.3.3.2 Comparison of Commercial LPUE trends of the Spanish (kg/trip) fleets and Spanish Scientific Survey (kg/h) in Div. IXa south .

The demersal survey biomass index for E.cirrhosa is plotted jointly with annual data cpue series coming from commercial bottom-trawl fleet "Baca" (OTB) in VIIIc and IXa north (Figure 6.1.3.3.3). In this species can be observer some similarities in the trend of the series in same periods, although in the two last years the trends are opposite.

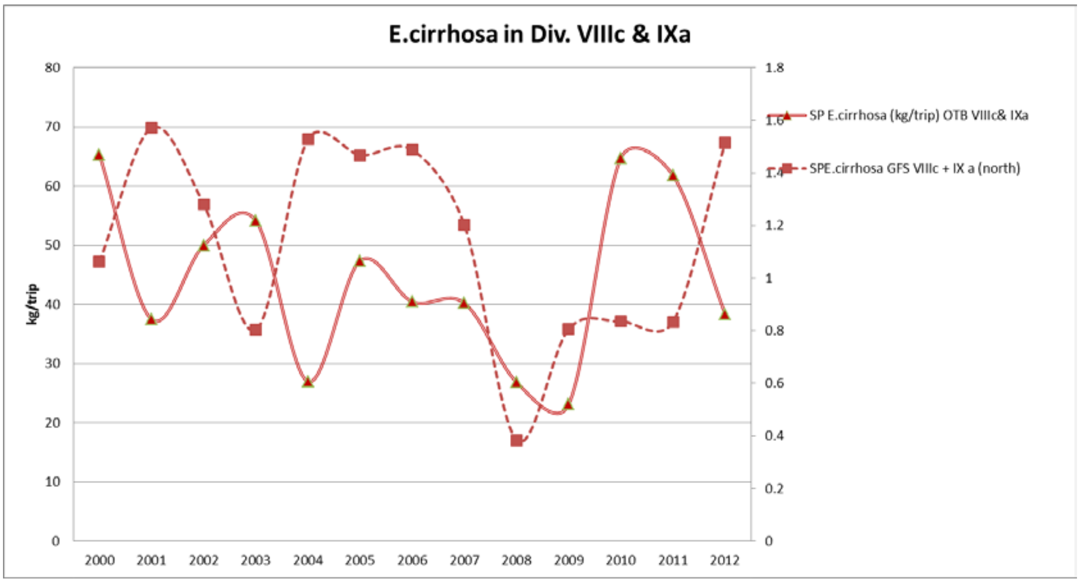


Figure 6.1.3.3.3 Comparison of Commercial LPUE trends of the Spanish (kg/trip) fleets and Spanish Scientific Survey (kg/h) in Div. VIIIc and IXa .

In figure 6.1.3.3.4, the ARSA survey biomass for *E.cirrhosa* and cpue series of the otter bottom-trawl fleet "Baca" (OTB métier) are plotted togther. As in other species of cephalopods, such as *O. vulgaris*, the trend of both sets of data show high similarities along the whole-time-series.

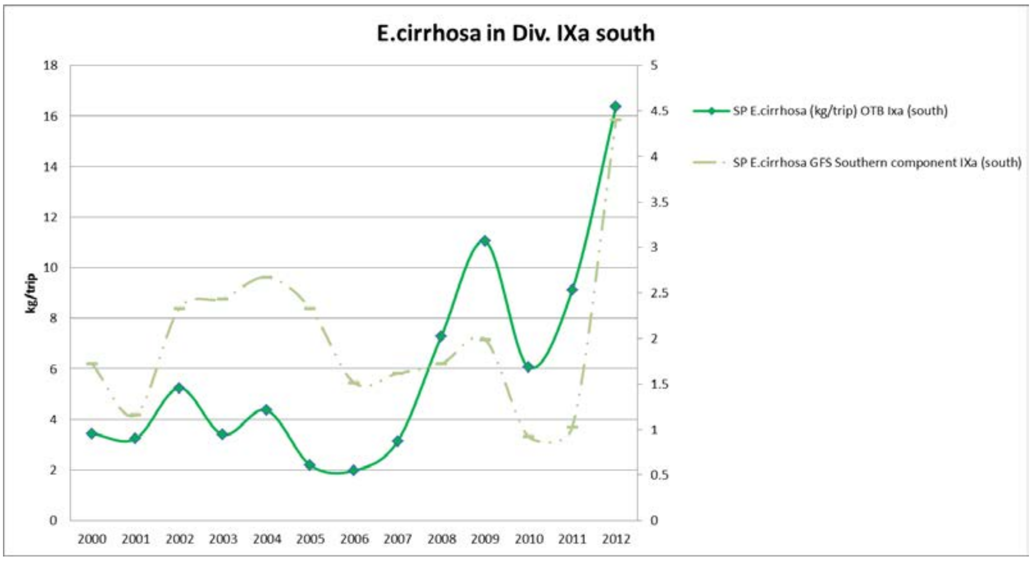


Figure 6.1.3.3.4 Comparison of Commercial LPUE trends of the Spanish (kg/trip) fleets and Spanish Scientific Survey (kg/h) in Div. IXa south .

6.1.3.3.1 Exploratory Assessment

When looking to the figures and in a no analytical approach, just based in the behaviour of both dataseries, the close similarities between trends and shapes would reflect that cpues commercial are able to catch up the changes in abundances detected by the surveys series. This fact is more evident in IXa south that in other areas. Thus, it could be concluded that changes in cpues appear to be real reflection of changes in the abundances. The idea would be to use these cpues as a proxy of abundances

For Div. IXa south, commercial and survey dataseries provided by Spain appear to coincide also in trends and in peaks of abundance detection fro both species.. For these dataseries comparison, survey indices showed the marked high and low abundances shown by the commercial LPUEs series.. Discards are negletable for these species. As commented above, for Div. VIIIc and IXa, high abundances are shown at the last of the dataseries (2001 and 2012). These promising results enhance the possibility of using these dataseries as abundance indices for octopods..

6.1.3.4 Data requirement

These dataseries showed a promising result for exploring more in depth, species disaggregation, métiers further segmentation and area coverage of commercial fishery and survey.

6.2 References

Reference in relation to the biology and dynamics of these species can be found in Reference of Section of this *section 7.3: Review data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity-at-age, first maturity at length, growth, spawning season, of this report.*

7 Research highlights (Tor e, f and b)

7.1 Review future options for stock assessment and their resource implications (e.g. for expertise required within WGCEPH

The group agreed on the need for vigilance and active searching in relation to the possibilities of obtaining funding to carry out new cephalopod research. Two possibilities were identified:. i) additional funding to improve the current sampling level included in DCF through Pilot Studies presented directly to Regional Coordination meetings and ii) proposing topics to be covered by the traditional European Calls for Tender directly to the DG Mare.

The other possibility for funding is to get support from multidisciplinary marine research teams in Europe. The group is aware of the lack of specific topic research on cephalopods but the group is also aware about the research potential of working together with food technologist and biotechnologist. Occasions to work within multidisciplinary teams of researches should not be wasted.

7.2 Review and report on cephalopod research results in the ICES area: abundances and distributions and their relationships with environmental variables, role of cephalopods in the ecosystem; cephalopods as indicators (MSFD) and assessment methods used in commercial cephalopod fisheries.

Journal special issues

In addition to the special issue described below, special journal issues arising from the 2012 CIAC conference are pending.

Recent papers and journal special issues

The role of squid in pelagic ecosystems: an overview (Special Issue of Deep-Sea Research II, edited by Jock Young, Robert Olson and Paul Rodhouse) (Young *et al.*, In Press)

The description here is an abbreviated version of Jock Young's introduction to the special issue. While the focus is on *Dosodicus gigas* and other pelagic squids, the results are very relevant to our understanding of squids generally.

Squid are important as prey and predators in all the oceans, yet difficult to study due to their size and mobility. The special issue presents a range of new findings on this taxonomic group from around the world. Highlights include a broader understanding of the role of squid in pelagic ecosystems, particularly the important role of ommastrephid species in the foodwebs leading to top predators in the world's oceans and improved understanding of their physiology including a novel study of flight in squid. Ecosystem models show squid are commonly at the centre of foodwebs, underlining the importance of squid in marine ecosystems. Particular emphasis is given to the ommastrephid species *Dosidicus gigas*, which has undergone a large increase in biomass and range expansion off the west coast of the Americas in the past decade. Biochemical techniques are also crucial to a number of results presented, allowing for new insight into foodwebs, but also highlighting the need for standardization of nitrogen isotopic ratios of bulk tissue of not only squid but other fauna, when comparing between oceans. Although more research is needed, squid are possible beneficiaries from climate change, although variable physiological responses suggest this may not be the case for some species. Characterized by short life spans and high growth rates, squid may respond more readily to changes in the environment and in the trophic structure than perhaps any other mid-trophic-level organism in the open ocean (Rodhouse, In Press).

Squid as prey: Logan *et al.* (In Press) found cephalopods in nine fish predators from the Atlantic, with ommastrephid squid the most ubiquitous prey group across predators and sampling years. Secondary cephalopod prey included octopods, histioteuthids, and architeuthids. Staudinger *et al.* (In Press) demonstrated that although pelagic predators consumed a broad range of cephalopod species, octopods and squid from the families Argonautidae and Ommastrephidae dominated the diets of pelagic teleosts in the Atlantic. In the western Indian Ocean, cephalopods were important prey of twelve predators, particularly for swordfish (*Xiphias gladius*) and bigeye tuna (*Thunnus obesus*) (Ménard *et al.*, In Press). The study also noted cephalopods as important prey for seabirds. As in the Atlantic Ocean, ommastrephid squid were the most important prey, particularly the purpleback flying squid (*Sthenoteuthis oualaniensis*). Ménard and his colleagues also showed that fish predators could be grouped, based on their cephalopod prey. In the eastern Pacific Ocean cephalopods played an important role in the diet of a range of shark species (Galvan Magana *et al.*, In Press). The study also showed how important ecological information on the horizontal and vertical distribution of sharks can be gleaned from an understanding of their cephalopod prey. In the Southern Ocean cephalopods were preyed on by odontocetes, seals, seabirds and fish (Rodhouse, In Press) were the most important prey for sperm whales, and probably other odontocetes, some albatross species and, on the basis of beak data, elephant seals.

Squid as predators: Pethybridge *et al.* (In Press), studied the feeding ecology of *Todarodes filippovae*, an abundant oceanic squid in the Southern Ocean, using signature lipid/fatty acid and stomach content analyses. Both techniques showed a diet that was closely linked to prey availability and abundance, particularly myctophid fish. They noted that lipid content correlated with satellite-derived sea surface chlorophyll, illustrating that the diet was closely linked to temporal changes in primary productivity. Some larger cephalopods in the Atlantic Ocean, however, had similar δ15N values to tunas and billfish, indicating that they occupied a comparable trophic position to their fish predators (Logan and Lutcavage, In Press). In the Californian Current system, *Dosidicus gigas* consumed a broad range of prey (mainly mesopelagic fish and squid, whereas in more coastal waters it foraged on a much broader mix that included coastal fish (Pacific herring and northern anchovy). Osmerid and salmonids were common prey as well as groundfish (Pacific hake, several species of rockfish and flatfish) in more northern waters (Field *et al.*, In Press). In the Chilean marine ecosystem *D. gigas* was a significant predator on fish, particularly hake, but predation did not explain reductions in hake catches by the fishery(Neira and Arancibia, In Press).

The role of squid in marine ecosystems: Coll *et al.* (In Press) synthesized available information on squid from ecological models at local and regional scales to obtain a global picture of their trophic position and ecological role in marine ecosystems. Their results showed that squid occupied a large range of trophic levels in marine foodwebs, reflecting the versatility in their feeding behaviors and trophic connections with the foodweb. Results also showed that squid can have a large trophic impact on other elements of the foodweb, and top–down control from squid to their prey can be high. Navarro *et al.* (In Press) synthesized the available information for two intrinsic markers (δ15N and δ13C isotopic values) in squid for all oceans and several types of ecosystems to obtain a global view of the trophic niches of squid in marine ecosystems. To correctly compare among systems and oceans, they adjusted squid δ15N values for the isotopic variability of phytoplankton at the base of the foodweb in the same locations. This paper is the first of its kind to use model-generated baseline δ15N values to provide direct comparisons among consumers worldwide. The study showed the importance of considering the natural variation in isotopic values among ecosystems. Arkhipkin (In Press) determined population parameters including individual growth rates, duration of ontogenetic phases and mortalities of three abundant nektonic squid species from the Southwest Atlantic. He found that squid were major nutrient vectors and played a key role as transient 'biological pumps' linking spatially distinct marine ecosystems. *Illex argentinus* had the greatest ecosystem impact due to its high abundance and productivity. He concluded that the variable nature of squid populations increased their vulnerability to overfishing and environmental change.

Squid physiology and behaviour: O'Dor *et al.* (In Press) reported squid that fly "like rockets", accelerating through the air by forcefully expelling water out of their mantles. They compared the cost of transport in both water and air and found that acceleration and velocity in air were significantly faster than in water. They suggested that squid fin flaps could function as ailerons whilst aloft and concluded that flight in squid could be employed to reduce migration costs and for predation avoidance. Trübenbach *et al.* (In Press) investigated the energy expenditure rates and the antioxidant stress strategies of juvenile *Dosidicus gigas* under conditions of normoxia and hypoxia, by quantifying oxygen consumption rates and antioxidant enzyme activities. The understanding of such physiological strategies that are linked to oxygen deprivation and reoxygenation phases will provide valuable information about how this species responds to the impacts of environmental stressors coupled with global climate change. Trueblood and Seibel (In Press) described a novel ship-board swim tunnel respirometer to measure the effects of oxygen deprivation on metabolizm in adult squid. Excursions into the oxygen minimum zone in the Gulf of California would require metabolic suppression, which likely restricts feeding and growth. Solé *et al.* (In Press) explored the impact of increasing anthropogenic noise on oceanic fauna via a series of novel experiments on cephalopod statocysts. They showed exposed individuals presented lesions on their statocysts consistent with a massive acoustic trauma. They urge further studies to understand the impacts of anthropogenic noise in increasingly busy pelagic environments to these and other marine fauna.

Dosidicus gigas: Seibel (In Press) analysed the oxygen-binding properties of the jumbo squid's respiratory protein and found a high oxygen affinity, strong temperature dependence, and pronounced pH sensitivity which may facilitate night-time foraging in the upper water column, and support suppressed oxygen demand in hypoxic waters at greater depths during daylight hours. This analysis suggested that ocean acidification could limit oxygen carrying capacity in squid at warmer temperature leading to reduced activity levels and altered distributions. Field *et al.* (In Press) described seasonal movement patterns of *D. gigas*, based on size and maturity distributions along with qualitative patterns of presence and absence. They discussed the relevance of the movement and distribution of these squid over space and time. Stewart et al (In Press) studied *D. gigas* in the northern California Current and the Gulf of California and proposed that shoaling oxygen minimum zones are likely to be favorable to these squid and could be a key factor behind their recent range expansion. They also reported, using archival tags, significant inshore-offshore movements underlining the range of habitats that *D. gigas* can occupy. Neira and Arancibia (In Press) modelled the impact of *D. gigas* on fish stocks in the Chilean marine ecosystem and found that, even with the dramatic increase in the biomass of this species, there was less impact than that predicted by the model for fish predators.

Climate change: Smith *et al.* (In Press) showed the value of detailed habitat and population data for understanding how environmental changes can effect populations of *Loligo forbesii*. They established baseline environmental tolerance data which will be increasingly needed at the species level if the impacts of ocean warming are to be understood. Rodhouse (In Press) used published modelling data on the effects of climate change in the Southern Ocean to assess the potential effects on cephalopods. It seems likely there will be little effect from the relatively small increases in ocean temperatures that are predicted, other than changes in distribution near the limits of their range. Ocean acidification may have a significant impact on these fauna via effects on statoliths. Reduction in sea ice is likely to have large effects on ecosystems, because of the loss of habitat, especially for krill, and this will impact on squid. He concludes that cephalopods are ecological opportunists, and given their potential to evolve fast, potential changes in the Southern Ocean pelagic ecosystem might enable them to flourish in competition with less ecologically opportunistic groups.

Journal papers

O'Dor (2013) reviews locomotion costs for swimming and flying in squid. Squid have been studied extensively since 1982 to quantitatively measure their locomotion costs and compare them with costs for fish that are their primary competitors in the ocean. Early work focused on oxygen consumption in swim tunnels and led to the use of jet pressure tags to relate captive studies to behaviour in nature. Dosidicus gigas is used to illustrate how "live fast, die young" squid can out compete fish in changing times by both swimming and flying. Recent work has provided quantitative data on the costs of flying and this report provides some comparisons. Accelerometry tags can now provide similar and perhaps better data on travel rate in nature, both in water and in air. These tags work on both squid and fish, so more and better comparisons are becoming possible. Further information on flight in squid can be found in O'Dor (2012).

MacLeod *et al.* (In Press) evaluated the use of habitat models for *Eledone cirrhosa* as an aid to defining marine protected areas for oRisso'sdolphin, the diet of which is dominted by *Eledone*. However, While good models of the relationship between the distribution of E. cirrhosa and environmental variables were obtained, there was no evidence of a relationship between modelled octopus distribution and the occurrence of Risso's dolphins.

Recent PhDs

Michaël Gras: "Contribution of inshore spawning areas to the recruitment of English Channel cuttlefish *Sepia officinalis* stock: relationship between pre-recruit stage success and resource abundance." (Université de Caen Basse-Normandie)

The text here is based on the abstract of the thesis.

Marine resources have been exploited for centuries and finfish stocks have largely decreased during the second half of the XXth century. In this context, cephalopod stocks are alternative resources for fishers. Due to their particular biological characteristics (short lifespan, high growth rate and high inter-annual abundance variability), their management cannot be carried out with common tools. The English Channel cuttlefish is the most important cephalopod stock of the N-E Atlantic and is shared between French and UK fishers. In spite of the publication of various stock assessment exercises and the stock importance, no routine assessment neither management measure have been implemented. The objectives of the work are therefore to (i) check if the life cycle of the cuttlefish is still 2 year long considering the high fishing pressure and the English Channel warming contexts, (ii) highlight how the trawling effort is spread in the English Channel and how the fuel price increase context has influenced it, (iii) develop a two stage biomass model to assess the English Channel cuttlefish stock and (iv) estimate the contribution of the spawning/nursery areas to the recruitment in the offshore exploited stock.

The investigation of the resource life cycle is an important prerequisite to the development of a stock assessment model. The global warming has been highlighted for decades in oceans of the world and could be at the origin of changes in marine species life history traits, such as fishing pressure which is known to use size-selective gears. The cuttlefish lifespan varies with the temperature and when exposed to a warming and a high fishing pressure, it is worth exploring if its life cycle has changed since its descriptions in the 80s and the 90s which highlighted a quasi exclusive 2 year lifespan. A two year sampling programme was thus performed in French landing sites of the English Channel during the reproduction season in 2010 and 2011 to highlight if one year old specimens were mature. Age determination was carried out by coupling polymodal decomposition and lipofuscin measurement in the mantle. Size-at-maturity for each year and each sex were estimated by fitting a binomial error GLM. Results highlight that a variable percentage of males and females belonging to the first cohort are mature and that size-at-maturity has decreased since the last study performed more than one decade ago. Finally, different parameters, such as temperature and fishing pressure are explored to explain changes in life history traits suggesting that cuttlefish could be an indicator of the regime shift in the English Channel.

A second prerequisite of the population dynamic modelling is the exploration of the trawling effort spatial allocation to highlight the suitability of the selected gear to estimate abundance indices. Fuel price increase during the 2000-2008 is one of the parameters launching the financial crisis and creating financial difficulties in the fishing sector, trawlers being the most vulnerable as fuel is one their major costs. English Channel, situated in the N-E Atlantic, is an important fishing ground exploited by French and UK (UK) trawlers. Trawling is a multispecies métier targeting mainly squids and cuttlefish which are the first sources of income in this area. Other demersal fish stocks (sea bass, red mullet...) enable fishers to complete their income. Fishing effort localization (declared by fishers using the coarse resolution of statistical rectangles) and trawler income data extracted from the Système d'Information Halieutique (SIH) database managed by the Ifremer were analysed using indicators, maps, Principal Component Analysis (PCA) and Partial Triadic Analysis (PTA) to highlight the temporal trend in revenue, spatial and temporal trends in fishing effort and the influence of the fuel price on the fishing activity. Results highlight that, in a context of quasi constant income for trawlers, the tax free fuel price has doubled. As the profit decreases, the fishing effort was correlated to the number of active fishing vessels but the distance covered by the fishers to reach fishing grounds is negatively correlated to the fuel price. The slight movement of the fishing effort closer to the landing sites is corroborated by an increase in trawling effort displayed in inshore statistical rectangles. This phenomenon has influenced the spatial origin of cephalopod length frequency samplings made in the Port-en-Bessin landing site and used in age structured stock assessment models. Finally, limits of the methodology are mentioned as well as the influence of subsidies provided by the government to compensate the fuel price increase on the fishing activity.

After highlighting that the life cycle of the cuttlefish presents no large modifications and that the trawling is a suitable métier to derive fishery dependent abundance indices, a stock assessment model can be developed. Cephalopod stocks are highly productive resources and developing a stock assessment model taking into consideration their specific biological characteristics is a challenge. Depletion methods and age structured models were applied to the cuttlefish stock in trials but have shown their limits, related to the model assumptions or data demand. A two stage biomass model is therefore proposed as a solution to assess this resource. Four abundance indices derived from survey and commercial trawl data collected by Ifremer and Cefas were derived, standardized and used as input data to fit the two stage biomass model. The model fits well the abundance indices and results highlight a large interannual variability during the 17 year period studied and a decreasing trend during the last studied years. Indicators based on model outputs highlight that the recruitment strength is not correlated with the Spawning-stock biomass (SSB) but rather seems to be influenced by the environmental conditions (Sea Surface Temperature, SST) encountered at the beginning of the life cycle. Trends in exploitation rate did not show evidence of overexploitation, nevertheless reference points are proposed and management advice is discussed in order to keep the English Channel cuttlefish fishery within a sustainable range.

The stock assessment model enabled the estimation of the annual recruitment strength but does not highlight the spatial origin of the recruits. Numerous marine species, such as cephalopods, perform migration between spawning and feeding areas and understanding this behaviour is of importance for the stock management. Estimating the contribution of each spawning area to the formation of the central exploited cuttlefish stock is of importance to understand and monitor the cuttlefish recruitment into the fishery. Three different markers of the coastal environment were analysed in both pre-recruits and recruits: trace element composition, isotopic signature and statolith shape described using Elliptical Fourier Descriptors (EFDs). In a first step, a MANOVA and a descriptive Discriminant Linear Analysis (LDA) were performed to look for differences between prerecruits coming from the different spawning areas. In a second step, a predictive LDA was performed to attribute sampled recruits to a coastal spawning area. These estimations of the contribution of each spawning area to the formation of the central exploited stock underline that recruits actually mix in the central part of the Channel. Results highlight that the Bay of Seine spawning area contributes less than West Cotentin and that the United Kingdom (UK) spawning ground of Torbay seems to provide a major contribution to the stock renewal. Finally, the influence of environmental factors on the contribution of coastal spawning grounds is discussed and management implications commented.

This work therefore improved the knowledge of the English Channel cuttlefish population dynamic. The main points of this work are summarized in this paragraph. During the prerecruit phase, we underlined the influence of the environmental conditions on the recruitment strength and the variable contribution of the studied spawning/nursery grounds. Using the two stage biomass model, the recruitment strength can now be monitored as well as the stock–recruitment relationship. During, the exploitation phase, the stock assessment model enables the abundance and exploitation rate estimations. Finally, the Spawning-stock biomass can now be estimated and we highlighted that spawning population is now made up of both one year old and two years old specimens, even if the first one is in large minority. An application software of the two stage biomass model will now be developed and provided to the ICES WGCEPH who will be in charge of providing the scientific advice about the stock status of the English Channel cuttlefish resource.

Isobel Bloor: "The ecology, distribution and spawning behaviour of the commercially important common cuttlefish (*Sepia officinalis*) in the inshore waters of the English Channel" (University of Plymouth) (Bloor, 2013; see also Bloor *et al.* 2013, In Press).

The text here is based on the abstract of the thesis.

Over the last 50 years there has been a rapid increase in global landings of cephalopods (octopus, squid and cuttlefish). In European waters, cuttlefish are among the most important commercial cephalopod resources and within the Northeast Atlantic, the English Channel supports the largest cuttlefish fishery, with the common cuttlefish, *Sepia officinalis* (Linnaeus, 1758), dominating landings. *S. officinalis* has a short (2 year) life cycle in the English Channel that is punctuated by seasonal migrations inshore and offshore. Using a combination of different métiers including beam trawling, otter trawling and coastal trapping, this shared fisheries resource is targeted at nearly every phase of the life cycle. Despite this continuing increase there remain only minimal management measures in place, with no quotas, no total allowable catches, no closed areas, no minimal landing size and no routine assessment of stocks. In order to provide sustainable fisheries management advice for *S. officinalis* populations it is essential that a thorough understanding of the ecology and life history of this species, in particular the factors affecting spawning and recruitment variability, is attained.

The thesis examined critical gaps in our understanding of the distribution, movements, habitat use and behaviours of spawning and subadult *S. officinalis*. This research provides baseline data for this species within the inshore waters of the English Channel and uses a combination of novel field-based electronic tracking techniques, *in situ* subtidal observations of spawning patterns within natural environments and presence-only species distribution modelling. A maximum entropy (MaxEnt) modelling approach was used to predict the distribution of benthic egg clusters using presence-only data. The model showed very good performance in terms of predictive power and accuracy and among the explanatory variables used to build the model, depth, chlorophyll-a concentration (used here as a proxy for turbidity) and distance from coastline were shown to be the greatest determining factors for the distribution of *S. officinalis* spawning. As part of the model output, maps (logistic and binary) of the predicted spawning distribution of *S. officinalis* within the English Channel were produced.

Subtidal observation were undertaken at spawning grounds on both the North and South coast of the English Channel to investigate spawning habitat and structure use. A total of 15 types of natural spawning structures were identified. The range of spawning structures used varied among sites with *Zostera marina* identified as the dominant spawning structure at two of the UK sites (Torbay and Poole Bay), potentially indicating a 'preference' for this structure within localities. Fractal dimension analysis of the seagrass beds at Torbay revealed that the spatial dynamics of seagrass beds within this site varied significantly between 2011 and 2012 as a result of both anthropogenic and natural disturbance. Interannual changes in the spatial dynamics of these beds could affect the annual pattern and intensity of spawning at a site. The use of structures with small diameters was found to occur, with cuttlefish adapting the device to their requirements by utilising multiple leaves or thalli in order to achieve a suitable diameter for egg attachment, this was evident in their use of both

Chorda filum and *Z. marina*. The research also provided the first data on the fine-scale movements and behaviours of adult and subadult individuals, tracked within their natural environments, using electronic tagging methodologies. That expected patterns of short-term spawning site fidelity at a local level were observed in only two individuals, whilst larger scale movements (up to 35 km) along the coastline were observed in three individuals, indicated that a range of behaviours and movement patterns could occur among spawning adults. Similarly varied patterns of site fidelity were also observed in tagged subadults, tracked over an extended period (up to 73 days), using a static acoustic array. These results highlight the complex range of patterns and plasticity in behaviour that exist within natural populations.

In summary, a series of different approaches was used within this thesis in an effort to improve our understanding of the fine-scale movement, behaviours and habitat use of *S. officinalis* (in both spawning adults and non spawning subadults), as well as their potential spawning distribution within the inshore waters of the English Channel. Observing the movements and behaviours of small marine animals like *S. officinalis* in their natural environments has traditionally been difficult. Recent developments in technologies and techniques however, including those used within this thesis (e.g. electronic tagging), have highlighted the potential capacity of novel tools to monitor the in situ movements and behaviour of cuttlefish. By providing important insights into the ecology of this species these new tools can aid conservation and management advice for this important commercial fishery species, both within the English Channel and further afield.

<u>Gillian Lyons: "The Behavioural and Physiological Ecology of the Common Cuttlefish *Sepia officinalis* in Relation to Present and Future Oceans (Queen's University Belfast)</u> (Lyons, 2012)

A study by Payne *et al.* (2011) was the first to use accelerometers to explore the behaviour of cephalopods, providing valuable insights into energy expenditure patterns of giant Australian cuttlefish (*Sepia apama*) during the breeding season. Lyons *et al.* (2013) built on this work developing methods for attaching devices to much smaller species i.e. *Sepia officinalis* and highlighting the potential of accelerometers to tease apart subtly different behaviours in cuttlefish. The study used accelerometers to tease apart discrete behaviours in cuttlefish using four key derivatives (depth, body pitch and roll and overall dynamic body acceleration, ODBA).

Lethal levels of physiological damage from noise have been implicated in cephalopod strandings (Guerra *et al.*, 2004) and demonstrated in the laboratory (André *et al.*, 2011). Lyons (2012) used some of the well known stereotypical behaviours of cuttlefish to determine the impacts of anthropogenic noise pollution at sublethal levels. *S. officinalis* not only changed their behaviour in response to noise, but their response also varied with the type of background noise. An anthropogenic noise playback elicited a stronger response than a playback of waves breaking in the surf zone, suggesting that cuttlefish distinguish between different types of noise. Experimental studies provide a starting point to test the effects of noise. However, care must be taken when extrapolating results from tank-based experiments to meaningful implications for individuals living in the wild.

Ocean acidification has a direct effect on calcifying organisms including cuttlefish. Previous work by Gutowska *et al.* (2008) found that *Sepia officinalis* calcification was enhanced in subadult cuttlefish reared at 6,000 ppm CO_2 whilst they found no evidence of reduced growth or metabolic depression. Further to this Lyons (2012) examined the change in cuttlebone microstructure in animals exposed to elevated pCO_2 as embryos and juveniles (in treatment from egg to four weeks old). She found that growth is stunted in elevated pCO_2 treatments both at environmentally relevant levels (1120 ppm pCO_2) and extreme high conditions (4000 ppm pCO_2). The proportion of animal mass contributed by the cuttlebone increased in both elevated pCO_2 treatments. Gross cuttlebone morphology was affected under such conditions and cuttlebones of hypercapnic animals were proportionally shorter. No differences were found in larval shell morphology between treatments; however, shell morphology is changed immediately post-hatching, and hypercapnic animals have denser cuttlebone laminae. Juvenile cuttlefish in acidified environments experience a trade-off between growth and increased calcification of their internal shell. This work indicates that directly developing invertebrates are buffered against increased acidification within the egg, but may still undergo morphological changes when exposed to the outside environment post-hatching.

Katja Trübenback: "Hypoxia tolerance of jumbo squids (Dosidicus gigas) in the Eastern Pacific oxygen minimum zones: physiological and biochemical mechanizms" (Faculdade de Ciências de Universidade de Lisboa - advisor Rui Rosa, and GEOMAR, Kiel – co-advisor Frank Melzner)

The aim of the thesis was to identify physiological and biochemical mechanizms that D. gigas uses to tolerate the harsh conditions prevailing in OMZs. As oceanic dead zones are currently expanding horizontally and vertically with a steady decrease in O2 level, the habitat of D. gigas might be endangered. Therefore, the potential to tolerate hypoxia and to adapt to a changing ocean is important to forecast its future survival and competitiveness. Squids are thought to live chronically 'on the edge of O2 limitation', as their oxygen-carrying capacity is limitative and therefore are not well poised to adapt to low ambient O2 levels. In order to determine the aerobic regulatory capacity of juvenile D. gigas diverse ventilatory parameters and mechanizms were examined. Moreover, to understand the potential of D. gigas to suppress its metabolizm under severe hypoxia, both aerobic and anaerobic ATP production pathways were thoroughly investigated. Other point of interest was if D. gigas reduces its level of activity as strategy to conserve energy under severe hypoxia although locomotion and respiration in cephalopods are closely tied. To answer to that question, individual respiratory runs and video tapes were analysed and synchronized under normoxic and severe hypoxic conditions. Finally, In diel vertical migrators of OMZs (like D. gigas), the formation of reactive oxygen species (ROS) is expected i) during upward migrations (the transition between hypoxia and reoxygenation states), as temperature and concomitantly O2 consumption increases with each cell generating about 0.1% ROS per molecule O2 consumed, and (2) hypoxia exposure itself, as low O2 supply changes the mitochondrial redox state resulting in reduced electron transport in the lower part of the respiratory chain. Consequently, the antioxidant defense system of juvenile jumbo squids, namely the different antioxidative enzyme activities and heat shock response were also determined.

Georges Safi: "Spatial and temporal variability of cuttlefish *Sepia officinalis L.* physiological characteristics in its early life stages in the English Channel" (University of Caen).

The common cuttlefish *Sepia officinalis*, is a major exploited marine resource in the English Channel. It has strong seasonal and interannual variations in recruitment.

Mechanizms affecting the renewal of the stock by the arrival of new "recruits" and their number need to be better understood. Thus the study of the spatial and temporal variability of "prerecruits" physiological characteristics was conducted in four spawning sites of the Channel [i.e. Agon Coutainville (FR), Baie de Seine (FR), Selsey (UK) and Torbay (UK)]. The studied parameters were the eggs quality and hatching rate then, the digestive and immune performance of juveniles in relation to local environmental conditions. English eggs have a delayed hatching time and higher hatching rate when compared to the French ones. Temperature and salinity are important in understanding these differences. The digestive performance of hatchlings varied according to the site. The study of immune enzyme activities showed local vulnerabilities of early stages which corresponded to episodes of high mortality. These mortalities are correlated with low protein content and low immune activities in eggs. These results underline how variability of the spatio-temporal characteristics of the early life stages of cuttlefish can influence the contribution of spawning sites to *S. officinalis* stock in the English Channel

New books

Advances in squid biology, ecology and fisheries, Volumes 1 (Loliginids) and 2 (Oegopsids). (Edited by Rui Rosa, Ron O'Dor and Graham Pierce; Nova Science Publishers) (Rosa *et al.*, In Press a,b).

These volumes gather and synthesize research conducted on the biology (early life history stages, age and growth, maturation and fecundity), ecology (distribution, migrations, diet, predators and parasites) and fisheries (fishing areas, methods, landings, management and stock assessment) of the most economically important myopsid and oegopsid squids.

The loliginids (myopsids) are typically associated with the seabed of the inshore coastal zone, usually resting or feeding to the bottom during day, and moving upwards during night-time. The use of substratum for the attachment of the spawned egg masses is a key aspect of the myopsid's biology. The spawning behaviour is complex, and females commonly mate with multiple males over short periods. The squid aggregations are targeted by a commercial handline jig fishery or caught as a bycatch of the commercial inshore demersal trawl fishery. Managing and forecasting myopsid fisheries in highly variable coastal environments constitutes a particular challenge because recruitment processes are mostly driven by the environment.

"Cephalopod culture", edited by José Iglesias, Lidia Fuentes and Roger Villanueva, published by Springer (Iglesias *et al.*, In Press)

This book compiles reviews work on the culture of various cephalopod species from around the world. It is divided into three sections: Introduction, Main Cultured Cephalopods, and Conclusions and Future Trends. The Introduction reviews the biology of the cephalopods, the state of fisheries and the market for cephalopods; and provides a historical review of studies on aquaculture of various species of cephalopods, covering topics such as nutrition, population enhancement, and by-products from cephalopods. The section "Main Cultured Cephalopods" describes experiences with the culture of different groups of cephalopods: nautilus, cuttlefish (*Sepia officinalis*, *Sepia pharaonis*, *Sepiella inermis*, *Sepiella japonica*) squids (*Euprymna hyllebergi*, *Euprymna tasmanica*, *Loligo vulgaris*, *Loligo opalescens*, *Sepioteuthis lessoniana*) and octopus (*Amphioctopus aegina*, *Enteroctopus megalocyathus*, *Octopus maya*, *Octopus mimus*, *Octopus minor*, *Octopus vulgaris*, *Robsonella fontanianus*). Finally, conclusions are drawn and future research discussed, especially in relation to cephalopod species with great relevance in the world market.

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7.3 Data availability for the main commercial exploited cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity-at-age, first maturity at length, growth, spawning season.

The text in this/these section(s) derives mainly from the forthcoming ICES CRR Cephalopod biology and fisheries in European waters: species accounts, edited by Jereb *et al.* While the CRR describes 17 species, here we focus on the 12 of greatest important for European fisheries. These species are: (1) *Octopus vulgaris* (2) *Eledone cirrhosa*, (3) *Eledone moschata* (4) *Sepia officinalis*, (5) *Sepia elegans*, (6) *Loligo vulgaris* (7) *Loligo forbesii*, (8) *Alloteuthis subulata*, (9) *Alloteuthis media* (10) *Illex coindetii*, (11) *Todarodes sagittatus*, and (12) *Todaropsis eblanae.* The original CCR work includes contributions from many members of WGCEPH and other colleagues, especially Patrizia Jereb, Louise Allcock, Eugenia Lefkaditou, Uwe Piatkowski and Lee Hastie.

The only ICES subdivision in which all these species are known to occur is IXa, although most ae present in subdivions IV. VI, VII, VIIIabd and VIIIc (Table 1).

A summarized text of this section is also included for each of the species sections (Section 3; 4; 5 and 6). The expert group have considered of importance to include the complete reviewed text in the present section as some of the reviewed species are not included in previous ones.

Table 8.3.1. ICES areas of occurrence for the 12 species

	ICES Subdivision								
Species	II + III	IV	V	VI	VII	VIIIabd	VIIIc	IXa	X
Octopus vulgaris	-	X	-	-	X	X	X	X	-
Eledone cirrhosa	X	X	X	X	X	X	X	X	-
Eledone moschata	-	-	-	-	-	-	-	X	-
Sepia officinalis	-	X	-	X	X	X	X	X	-
Sepia elegans	-	X	-	X	X	X	X	X	-
Loligo vulgaris	-	X	-	X	X	X	X	X	-
Loligo forbesii	-	X	X	X	X	X	X	X	X
*Alloteuthis subulat*a	-	X	-	X	X	X	X	X	-
Alloteuthis media	-	X	-	X	X	X	X	X	-
Illex coindetii	-	X	-	X	X	X	X	X	-
Todarodes sagittatus	X	X	X	X	X	X	X	X	X

Todaropsis eblanae	X	X	-	X	X	X	X	X	-

7.3.1 *Octopus vulgaris*

Maximum size: Adults reach 40 cm ML and 140 cm total length.

Sex ratio: Approximately 1:1 in the Atlantic and Mediterranean although results from South Africa suggest a seasonal cycle with fewest males in November.

Size at maturity: Males mature at smaller sizes than females; smaller sizes at maturity reported in Mediterranean compared to Atlantic

Table. 8.3.1.1. *Octopus vulgaris*: Size at maturity

Parameter	Females	Males
Length at first maturity	12 cm	9.4, 10 cm
Length at 50% maturity	17.6 cm	10.4 cm
Weight at first maturity	394, 580g	250, 323 g
Weight at 50% maturity	1788, 2023g	671, 903 g

Length-weight relationships: The table below gives length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm). Only records from the ICES area are included.

Table. 8.3.1.2. *Octopus vulgaris*: length weigth relationship

Region	a	b	Sex	Reference
Galicia	0.442	2.918	F	Guerra, 1981
	0.296	3.029	M	
	0.365	2.961	All	
	2.9	2.17	All	Otero *et al.*, 2007
Gulf of Cadiz	3.277	2.267	F	Silva *et al.*, 2002
	2.489	2.369	M	
	2.895	2.313	All	

Growth rate: Growth rates in captivity vary with temperature and diet as well as between individuals. They seem to be typically 1-2% of body weight per day, but up to 5% has been recorded over short periods.

Lifespan: Generally thought to be 12-15 months although life spans up to 20 months suggested off Senegal.

Spawning season: The spawning season extends throughout the year with two peaks in spring and autumn in Northeast Atlantic populations.

Fecundity: The potential fecundity of mature females ranges from 70,000 to 634,445 oocytes (Mangold-Wirz, 1963; Otero *et al.*, 2007; Silva *et al.*, 2002).

Migrations: This species undertakes limited seasonal migrations. According to Rees and Lumby (1954), octopuses appear to move away from inshore waters in late summer and spend winter in deeper offshore waters.

7.3.2 *Eledone cirrhosa*

Maximum size: *Eledone cirrhosa* is a medium-sized species with a maximum body mass less than 1 kg in the Mediterranean and up to 2 kg in the northern parts of its distribution. Most specimens caught are less than 160 mm mantle length (ML), although, occasionally, individuals of larger size, up to 175 mm ML, are captured, both in the Mediterranean (Belcari and Sartor, 1999; Cuccu *et al.*, 2003) and in the Atlantic off Portugal (A. Moreno, pers. comm.).

Sex ratio: In samples collected by Boyle and Knobloch (1982) in Scottish waters, females were always more numerous than males, the ratio of females to males being 7:1 overall during September 1976-December 1979. This could be at least partly related to difference in catchability due to different body sizes: in 1978 the average female size was 594 g compared with 290 g for males. Regueira *et al.* (2013) also found that the overall sex ratio (around 3:1) in their sample from the Northwest Iberian Peninsula was biased towards females. Boyle (1997) suggested that a predominance of females in shallow waters of the Mediterranean in spring could represent migration to breeding grounds.

Size at maturity: In the Atlantic, off Portugal, 50% of females are mature at 105 mm ML while 50% of males are mature at 80 mm ML (A. Moreno, pers. comm.). Along the Iberian Atlantic coast, animals mature at larger sizes at higher latitudes. Size at 50% maturity ($MLm_{50\%}$) for males was 108.9 mm on the north coast of Galicia, 99.25 mm on the west coast of Galicia (i.e. further south) and 91.4 mm in Portugal. The corresponding values for females were 134.5 mm, 121.4 mm and 100.8 mm, respectively (Regueira *et al.*, 2013).

Length-weight relationships: The table gives length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.2.1. ***Eledone cirrhosa*****: Length weigth relationship**

Region	a	b	Sex	Reference
North Galicia	0.862	2.38	M	Regueira *et al.* 2013
	0.556	2.60	F	
West Galicia	0.490	2.61	M	
	0.404	2.76	F	
West Portugal	0.848	2.30	M	
	0.377	2.73	F	

Gowth rate: Forsythe and Van Heukelem (1987) reported instantaneous relative growth rates of between 2.8% $BW.d^{-1}$ in the smallest individiauls and 0.7% $BW.d^{-1}$ in the largest. Boyle and Knobloch (1982) observed that, at 10 °C, this species can grow from 10 g to 1 kg in 270 days. In captivity they recorded growth rates of up to 3.5% $BW.d^{-1}$ in individuals of 100 g BW, falling to around 1.5% $BW.d^{-1}$ at body sizes above 500 g.

Lifespan: *Eledone cirrhosa* probably typically lives for two years. A combination of a one-and two-year cycle was proposed for the North Sea, depending, respectively, on fast-growing early maturing animals and slower-growing individuals (Boyle and Knobloch, 1982; Boyle, 1983; Boyle *et al.*, 1988).

Spawning season: Breeding is seasonal with the peak of spawning varying according to region.

Fecundity: Regueira *et al.* (2013) estimated potential fecundity in the northwest Iberian Peninsula as 2452.88 ± 36.4 oocytes per ovary, based on a sample of almost 700 females. They found that potential fecundity was positively correlated with both mantle length and body weight.

Migrations: While the deep-water population (100-200 m) normally has equal numbers of males and females, trawls in shallower water (60-90 m) in spring catch an increased number of maturing females. This seasonal sex segregation is interpreted as a shoreward (shallower) migration of females for breeding (Boyle, 1997).

7.3.3 *Eledone moschata*

Maximum size: *Eledone moschata* reaches a maximum size of 150 mm mantle length and 640 g body weight in the Atlantic (Silva *et al.*, 2004).

Sex ratio: The sex ratio apparently varies seasonally and in relation to depth, as well as between areas, perhaps indicating the occurrence of geographic variation in the timing of life cycle events, reproductive migrations, and differential survival of the sexes - but also suggesting an incomplete understanding of the life cycle in many areas.

Size at maturity: Weight and size at maturity vary geographically. In the Gulf of Cádiz the length and weight at maturity ($MLm_{50\%}$ and $BWm_{50\%}$) were estimated to be 12 cm (274 g) in females and 7.8 cm (97 g) in males (Silva *et al.*, 2004).

Length-weight relationships: The table below lists length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.3.1. ***Eledone moschata*: Length weight relationships**

Region	a	b	Sex	Reference
Portugal	1.0048	2.4	F	Lourenço *et al.*, 2008
	0.6325	2.5	M	
	0.8652	2.46	All	
Gulf of Cádiz	0.3573	2.660	F	Silva *et al.*, 2004
	0.2613	2.794	M	
	0.3233	2.702	All	

Growth rate: Boletzky (1975) reared this species, recording a growth rate of 6.6% BW.d^{-1} for the first month after hatching and 3.6% BW.d^{-1} for the subsequent three months. Hatchlings weighed 0.3 g, reaching 2.2 g BW after one month and 55 g at four months. Forsythe and Van Heukelem (1987) give figures for instantaneous relative growth rates ranging from 6.94% BW.d^{-1} in the smallest animals to 0.99 % BW.d^{-1} in animals of 50g BW.

Lifespan: The proposed life cycle model of this species in the northwest Mediterranean is based on the alternation of short-living and long-living life cycles (Mangold, 1983; Silva *et al.*, 2004). Lifespan is probably up to two years (e.g. Mangold, 1983).

Spawning season: In the Gulf of Cádiz, the spawning season extends throughout most of the year, although there is little or no spawning during summer (Silva *et al.*, 2004). Most spawning occurs from February to May and a secondary peak occurs in September in southern Portuguese waters (Lourenço *et al.* 2008) or in October in the Gulf of Cádiz (Silva *et al.*, 2004).

Fecundity: Mean total fecundity was estimated as between 187 and 944 oocytes (mean = 443 ± 154) in the Gulf of Cádiz (Silva *et al.*, 2004).

Migrations: In the Mediterranean Sea, *E. moschata* seems to undergo horizontal migrations related to reproduction, moving inshore to spawn (Mangold, 1983; Mandić and Stjepcević, 1981).

7.3.4 *Sepia officinalis*

Maximum size: The table below gives maximum mantle length (mm) for females (F) and males (M) in different geographic areas of the east Atlantic Ocean

Tale 8.3.4.1. ***Sepia officinalis*: Maximum size**

Region	ML (mm)		Reference
	F	M	
Bay of Biscay	290	350	Le Goff and Daguzan, 1991
Ría de Vigo	235	205	Guerra and Castro, 1988
Biscay Gulf	280		Santurtun *et al.*, 2002

Sex ratio: Dunn (1999) found that the overall sex ratio of cuttlefish in commercial trawl catches was not significantly different from 1:1.

Aat maturity: Common cuttlefish attain sexual maturity at a wide range of sizes. In the English Channel, 4% of males matured at 8.1-9.1 cm ML in August, at an age of approximately 1 year. Of the remaining males, the first matured at 11.4 cm ML, $MLm_{50\%}$ was reached at 14.6 cm ML, and all were mature at 17.0 cm ML. In females, the smallest sexually mature individuals were 14.2 cm ML, MLm50% was 16.4 cm ML, and all females were mature at 23.0 cm ML (Dunn, 1999).

Length-weight relationships: The table indicates length/weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.4.2 ***Sepia officinalis*****: Length Weight relationships**

Region	a	b	Sex	Reference
English Channel	0.243	2.78	F	Dunn, 1999
	0.305	2.64	M	
Spain, Ría de Vigo	0.264	2.70	F	Guerra and Castro, 1988
	0.265	2.70	M	
Portugal, Ria de Aveiro	0.242	2.74	F	Jorge and Sobral, 2004
	0.264	2.66	M	
Portugal, Ria de Sado	0.366	2.60	F	Serrano, 1992
	0.275	2.69	M	
	0.069	3.15	F	Neves *et al.*, 2009
	0.464	2.35	M	

Growth rate: Growth is strongly seasonal, reflecting the seasonal life cycle. Forsythe and Van Heukelem (1987) indicate that daily growth in weight of this species declines, with increasing size from 5.5% BW d^{-1} to 3.75% BW d^{-1} The highest monthly rates of growth in length in (post-recruits) recorded by Dunn (1999) occurred during July to October in males (32.7 $mm.month^{-1}$) and during August to December in females (25 $mm.month^{-1}$). Based on the modal sizes of animals sampled in each month, specific daily growth rates (% ML d^{-1})during the period of peak growth ranged from 1.20% down to 0.57% in males and 0.67% down to 0.39% in females.

Lifespan: This species lives for approximately two years (Dunn, 1999). In the English Channel, all animals appear to overwinter twice before spawning (Boucaud-Camou and Boismery, 1991; Boucaud-Camou *et al.*, 1991). In the Bay of Biscay, early season hatchlings may develop to maturity after a single winter, spawning late in the season, whilst other individuals may spawn early in the season having overwintered twice (Le Goff and Daguzan, 1991).

Spawning season: Spawning extends from early spring to late summer in south and central Portugal and the Atlantic and Mediterranean coasts of south Spain, with a spawning peak in June and July (Villa, 1998; Tirado *et al.,* 2003; Jorge and Sobral, 2004). A similar spawning season is found northwest of the Iberian Peninsula, but winter spawning has also been recorded here (Guerra and Castro, 1988). In the Bay of Biscay and the Gulf of Morbihan spawning occurs from mid-March to late June (Le Goff and Daguzan, 1991). Along both the north and the south coast of the English Channel the spawning season of *S. officinalis* extends from February to July (Dunn, 1999; Royer, 2002; Royer *et al.*, 2006; Wang *et al.*, 2003).

Fecundity: Estimates of fecundity for females vary widely, although some of this variation probably relates to how fecundity is measured. According to Mangold-Wirz (1963), females lay between 150 and 4000 eggs, depending on their size.

Migrations: Seasonal migrations between shallow and deeper waters are a well-known ecological feature of *S. officinalis*.

7.3.5 *Sepia elegans*

Maximum size: *Sepia elegans* is a small-sized species, with adult males growing up to 75 mm ML (Ciavaglia and Manfredi, 2009) and females up to 89 mm ML (Adam, 1952). Maximum total weight is about 60 g.

Sex ratio: In the Ría de Vigo, males outnumbered females in spring and autumn and the overall sex ratio recorded by Guerra and Castro (1989) was 1.18:1 in favour of males.

Size at maturity: The smallest mature males measure 20 mm ML (Volpi *et al.*, 1990) and the smallest mature females 30 mm ML (Guerra and Castro, 1989). In Portuguese waters about 60-70% of males and females are mature at about 35 and 45 mm ML respectively (A. Moreno, Unpublished data)

Length-weight relationships: Length/weight relationships in different geographic areas are given below for females (F), males (M) and the sexes combined (All). Original equations converted to $W=aML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.5.1: *Sepia elegans*: length weight relationships

Region	a	b	Sex	Reference
Ría de Vigo	0.374	2.272	F	Guerra and Castro, 1989
	0.327	2.311	M	
Portuguese waters	0.289	2.420	F	A. Moreno, Unpublished data
	0.356	2.190	M	
Gulf of Cadiz	0.239	2.476	F	Ramos *et al.*, 2009
	0.227	2.577	M	

Growth rate: Growth in mantle length was 2.8 mm per month for males and 3.0 mm for females in the Sicilian Channel (central Mediterranean) (Ragonese and Jereb, 1991), i.e. slightly faster than estimated in the west Mediterranean by Mangold-Wirz (1963) and in the Ría de Vigo by Guerra (1984) (2-2.5 mm per month).

Lifespan: It lives 12-18 months.

Spawning season: Although this species spawns all year round, seasonal migrations and seasonal peaks of spawning have been described in some areas.

Fecundity: Mature females may carry up to 250 eggs (larger than 1 mm) in their ovaries; however, as is usually the case for "large" eggs in cephalopods, only a proportion of the eggs will reach maturity (Mangold-Wirz, 1963). Total fecundity in females from the Gulf of Cadiz varied between 61 and 942 oocytes (specimens of 34 mm and 64.2 mm ML respectively).

Migrations: A spring-summer migration of the whole population to coastal spawning grounds (40-70 m depth) has been described for this species in some areas, e.g. the west Mediterranean (Mangold-Wirz, 1963; Guerra, 1992) but is not present in others, e.g. the ría de Vigo (northwest Spain; Guerra and Castro, 1989).

7.3.6 *Loligo forbesii*

Maximum size: Typically, adult body size reaches 100–650 mm ML in males (weight range 155g–3.7kg) and 175–350 mm ML in females (weight range 200–1 150 g) throughout the continental shelf range. However, there is wide variation within both sexes and, in particular, some males mature at around 120 mm in length and probably never grow much larger (Pierce *et al.*, 1994; Porteiro and Martins, 1994; Boyle *et al.*, 1995). In the Azores population, males reach 937 mm ML and 8.3 kg, compared to 462 mm ML and 2.2 kg for females (Martins, 1982).

Sex ratio: There seems to be an annual cycle in the sex ratio, with females being more abundant than males during the spawning season, e.g. during November to February in Scotland. There was also evidence of males outnumbering females during the recruitment period in Scotland and in Spain (Holme, 1974; Guerra and Rocha, 1994; Pierce *et al.*, 1994; Collins *et al.*, 1999).

Size at maturity. The table below lists reported ranges of size-at-maturity for male and female *L. forbesii* (from size at first detection of maturity to 100% of sample mature). Where multiple micro-cohorts were detected, separate estimates are given for each.

Table 8.3.6.1 *Loligo forbesii*: Maximun length

Area	Male ML (mm)	Female ML (mm)	Reference
Faroe Islands	200 – 250	180 – 200	Gaard, 1987
Scotland + Faroe Islands		220	Howard, 1979
Scotland (west coast)	120 – 450	160 – 310	Boyle *et al.*, 1995
Scotland (west coast)	180 – 220, 250 – 320, >400	180 – 220, 280 – 320	Collins *et al.*, 1999
Scotland (area IVa)	180-350	192-250	Wangvoralak, 2011
Ireland	120 – 400	150 – 300	Collins *et al.*, 1995a
England (southwest)	130 – 420	160 – 320	Holme, 1974
Galicia (NW Spain)	160 – 380	160 – 380	Guerra and Rocha, 1994
Portugal	145 – 450	175 – 315	Moreno *et al.*, 1994
Azores Islands	<310 – 490	<250 - 326	Martins, 1982
Azores Islands	<240 – 611	<200 – 390	Porteiro and Martins, 1994

Length-weight relationships: The length-weight relationships in different geographic areas are given below for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.6.2. *Loligo forbesii*. Length weight relationship

Region	a	b	Sex	Reference
Faroe Islands	0.074 - 0.088	2.61 - 2.66	F	Gaard, 1987
	0.133 - 0.180	2.30 - 2.45	M	
Rockall (ICES Area VIb)	0.113	2.61	F	Ngoile, 1987
	0.175	2.43	M	
Scotland	0.201	2.33	All	Young *et al.*, 2004

Scotland west coast	0.151	2.51	F	Ngoile, 1987
	0.214	2.37	M	
Scotland	0.138	2.49	F	Boyle and Ngoile, 1993a
	0.192	2.36	M	
Scotland	0.151	2.43	F	Pierce *et al.*, 1994
	0.206	2.29	M	
north North Sea	0.161	2.53	F	Ngoile, 1987
	0.268	2.33	M	
mid North Sea	0.164	2.45	F	Ngoile, 1987
	0.232	2.55	M	
English Channel	0.449	2.43	F	Holme, 1974
	0.527	2.29	M	
northwest Spain	0.111	2.57	F	Guerra and Rocha, 1994
	0.138	2.44	M	
Portugal	0.102	2.60	F	Moreno *et al.* 1994
	0.103	2.58	M	
Portugal	0.104	2.59	F	Cunha, 2000
	0.111	2.54	M	
Azores	0.425	2.18	F	Martins, 1982
	0.548	2.08	M	

Growth rate: Over the course of the life cycle, growth rate gradually declines, from 5.4 %BW d^{-1} in the smallest individuals to 1.4 in the largest (Forsythe and Van Heukelem, 1987). Forsythe and Hanlon (1989) give the final growth rate as 1–2% BW d^{-1}. Based on statolith data collected from post-recruit animals, Collins *et al.* (1995b) reported growth rates of 0.98% ML d^{-1} and 2.48% BW d^{-1} in males, and 0.85% ML d^{-1} and 2.26% BW d^{-1} in females,. This corresponded to growth of around 1 mm per day for females and 1-5 mm per day for males. Growth rates estimated from modal progression analysis using monthly length–frequency data were slightly lower

Lifespan: There is general consensus that *L. forbesii* typically lives for up to around 15-16 months, with most sampled animals being no more than 1 year old. The largest male recorded in Scotland to date (ML = 735 mm) was estimated to be 420 days old (i.e. around 14 months; G. J. Pierce, unpublished data).

Spawning season: The timing of peak spawning activity varies across the range and additional (usually secondary) peaks are observed in some areas (Roper *et al.*, 1984; Lum-Kong *et al.*, 1992; Boyle and Ngoile, 1993b; Guerra and Rocha, 1994; Moreno *et al.*, 1994; Pierce *et al.*, 1994; Boyle *et al.*, 1995; Collins *et al.*, 1995a), possibly due to the presence of both winter and summer breeders (Holme, 1974). In Scottish waters, *L. forbesii* spawns mainly from December to February although at least some mature specimens can be found throughout the year, suggesting that spawning is not limited to a specific period (Pierce *et al.*, 1994).

Fecundity: The number of oocytes present (or potential fecundity) in *L. forbesii* females has been estimated to range from 1000 to 23 000 eggs (Guerra and Rocha, 1994; Boyle *et al.*, 1995).

Migrations: Several authors have reported evidence of inshore-offshore movements associated with the breeding cycle in Scottish waters (Pierce *et al.* 1998; Stowasser *et al.*, 2005; Viana *et al.*, 2009) and there is also evidence of movements parallel with the coast in several regions (Holme, 1974; Waluda and Pierce, 1998; Sims *et al.*, 2001; Oesterwind *et al.*, 2010). Most evidence seems to suggest that post-hatching *L. forbesii* migrate away from the coast, moving further offshore as they grow in size, but subsequently returning to shallow waters to breed.

7.3.7 *Loligo vulgaris*

Maximum size: Male *L. vulgaris* attain greater lengths and weights than females. In the Northeast Atlantic maximum mantle length is 546 mm in males (Moreno *et al.*, 2007) and 372 mm in females (A. Moreno, pers. comm.).

Sex ratio: The sex ratio is generally around 1:1 across the distribution range although seasonal shifts in sex ratio are also reported (Baddyr, 1988; Guerra and Rocha, 1994; Raya *et al.*, 1999; Moreno *et al.*, 2002) as well as differences in sex ratio between size classes: Raya *et al.* (1999) found that the proportion of males was highest in the smallest size classes, which is consistent with findings for *L. forbesii*.

Size at maturity: Moreno *et al.* (2002) calculated the size at which 50% of individuals are mature ($MLm_{50\%}$) as 168 mm in males and 188 mm in females. However, the fit for males is misleading, since two modes in size at maturity were detected in males from most areas in the Northeast Atlantic, the first around 180 mm, and the second from 300-330 mm, at which size all males are mature (Coelho *et al.*, 1994; Guerra and Rocha, 1994; Moreno *et al.* 1994). Size at maturity ($MLm_{50\%}$) of females appears to be higher in the south of the range within the Northeast Atlantic (220-230 mm; Bettencourt, 1994; Raya *et al.*, 1999) than in the north (176-195 mm; Guerra and Rocha, 1994; Moreno *et al.*, 2005). In Portugal, males reach maturity at a mean age of nine months and spawning takes place at a mean age of ten months.

Length-weight relationships: The table gives length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Tabla. 8.3.7.1. *Loligo vulgaris*. Length weight relationships

Region	a	b	Sex	Reference
English Channel	0.192	2.38	F	Moreno *et al.*, 2002
	0.301	2.20	M	
northwest Spain	0.104	2.54	F	Guerra and Rocha, 1994
	0.164	2.37	M	
northwest Portugal	0.104	2.54	F	Moreno *et al.*, 2002
	0.154	2.41	M	
south Portugal	0.135	2.43	F	Coehlo *et al.*, 1994
	0.144	2.38	M	

Growth rate: As in other squid species, paralarval growth rates are highly variable and strongly related to temperature. Reported average rates of growth in length in the first 75 days post-hatching were 0.05 $mm.day^{-1}$ (1.2% $ML.d^{-1}$) under winter temperatures and 0.17 $mm.d^{-1}$ (3% MLd^{-1}) under summer conditions (Boletzky, 1979; Villanueva, 2000). The increase in weight during this period of life is more pronounced. Villanueva (2000) measured instantaneous relative growth rates of 3-4% BW.d^{-1} at winter temperatures (11°C) and 6-8% BW.d$^{-1,}$ under summer conditions (19.2°C). Between the ages of 4 and 12 months, males generally grow at 1.2-1.6 mm day^{-1} and females at slower growth rates of 0.9-1.0 mm day^{-1}. Instantaneous growth rate relative to ML was 0.8-1.0% d^{-1} for males and 0.7-0.9% d^{-1} for females. Differences between male and female growth rates were observed in most studies which adequately sampled the full size range of animals (Natsukari and Komine, 1992; Arkhipkin, 1995; Bettencourt *et al.*, 1996; Raya *et al.*, 1999; Rocha and Guerra, 1999; Moreno *et al.*, 2007).

Lifespan: *Loligo vulgaris* is an annual species with a maximum lifespan of around 15 months.

Spawning season: It usually spawns in winter in the north and east of its range and all year round with seasonal peaks elsewhere. The eggs are generally deposited on a fixed support in relatively shallow water (from 20 to 50 m depth), and sometimes attached to floating objects in coastal waters (Worms, 1983a).

Fecundity: Worms (1983a) estimated maximum fecundity as 7 000 eggs but this was based on counting only ripe eggs in the oviduct. Other studies that considered the yolk oocyte stock in the ovary and oviduct have estimated maximum fecundity to be between 10 150 and 42 000 eggs (Baddyr, 1988; Coelho *et al.*, 1994; Guerra and Rocha, 1994; Lopes *et al.*, 1997; Laptikhovsky, 2000). However, this may still be an underestimate if we consider that the protoplasmic oocytes potentially also contribute to the total fecundity of an individual. On this basis, Laptikhovsky (2000) estimated a potential fecundity of 28 500 to 74 200 eggs, with higher values generally in larger squid (fitted regression: potential fecundity = 136.84 ML$^{1.11}$**).**

Migrations: Horizontal migratory movements in this species are mainly related to sexual maturation and spawning (Worms, 1983b). Onshore and offshore migrations, related to reproduction, are well-described for Mediterranean populations. In the Atlantic, *L. vulgaris* performs long migrations (south-north and north–south), possibly over distances up to 500 km. According to Tinbergen and Verwey (1945), this species actively migrates northwards in spring, probably entering the North Sea from the English Channel and migrating along the Belgian, Dutch, northwest German and Danish coasts, where it is found in late

7.3.8 *Alloteuthis subulata*

Maximum size: According to Roper *et al.* (1984), maximum mantle length (ML) is around 200 mm. Hastie *et al.* (2009**a**) give maximum ML as 215 mm in males and 150 mm in females while Jereb *et al.* (2010) reported maximum ML as 184 mm for males and 140 mm for females; in both cases figures are based on examination of available literature

Sex ratio: Hastie *et al.* (2009a) reported seasonal variation in sex ratio, with a slight overall preponderance of males (M/F = 1.04 to 1.14 depending on region), although females were relatively more abundant in spring in Portugal (M/F = 0.76) and during summer in the North Sea and Irish Sea (M/F = 0.76 and 0.78, respectively).

Size at maturity: Sexual maturity can be reached at 40-50 mm ML in both sexes (North Sea: 44 mm ± 9 mm in females; 43 mm ± 10 mm in males). Fifty percent of females are mature at a length of 75–80 mm while $MLm_{50\%}$ for males is 70–75 mm. However, the length of mature animals varies considerably in both sexes, with mature males having a wider range of sizes than mature females (Moreno, 1995). The maximum size-at-maturity of female *A. subulata* is around 120 mm ML (Yau, 1994).

Length-weight relationships: The table gives length-weight relationships in different geographic areas for females (F) and males (M). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm). From Hastie *et al.* (2009**b**).

Table 8.3.8.1. ***Alloteuthis subulata*** **Length weigth relationship**

Region	a	b	Sex
Irish Sea	0.291	1.39	M
Irish Sea	0.150	1.84	F
North Sea	0.184	1.59	M
North Sea	0.160	1.77	F
Portugal	0.420	1.20	M
Portugal	0.167	1.83	F

Growth rate: On the West African shelf, absolute growth rates ranged between 0.5 and 1.0 $mm.d^{-1}$ in length and from around 0.03 to 0.06 $g.d^{-1}$ in weight. Instantaneous relative daily growth rates fell from approximately 2.2% $ML.d^{-1}$ and 3.5% $BW.d^{-1}$ at age 90 days to around 0.8% $ML.d^{-1}$ and 0.5% $BW.d^{-1}$ at 210 days of age (Arkhipkin and Nekludova, 1993; see their Figures 8 and 9).

Lifespan: Individuals are thought to live about 12 months (Rodhouse *et al.*, 1988).

Spawning season: In the English Channel there are three spawning groups of females, which spawn in spring, summer and autumn respectively, with young individuals being recruited to the population twice during the year in spring and summer. In the Irish Sea, spawning occurs in spring and summer, with a possible minor spawning period in Autumn (Nyegaard, 2001). In the North Sea, spawning occurs in June-July, with hatchlings appearing in plankton samples towards the end of July (Yau, 1994). Spawning probably occurs earlier off the west of Scotland than in the North Sea (Yau, 1994).

Fecundity: The average number of oocytes present (potential fecundity) in 11 mature females examined by Nyegaard (2001) was 5705 (range 1234 to 18 770). This contrasts with 'batch counts' which indicated an average of 148 eggs laid in any one session and that actual fecundity was between 400 and 1500 eggs (Nyegaard, 2001).

Migrations: In some parts of its range, *A. subulata* is present all year round (e.g. in the English Channel, Rodhouse *et al.*, 1988) while in others it is thought to be migratory. In the North Sea, juvenile *A. subulata* migrate from the spawning grounds in the southeast to the deeper (and, in winter, relatively warmer) waters in the central parts during late autumn/winter, perhaps as a response to cooling. In spring, as the waters are warming, the young adults return from the Danish Coast to the shallow waters off the Belgian and southeast British coasts to spawn (De Heij and Baayen, 1999, 2005; Oesterwind *et al.*, 2010).

7.3.9 *Alloteuthis media*

Maximum size: *A. media* is a small-sized member of the Loliginidae, not exceeding 13.2 cm in ML (Laptikovsky *et al.*, 2002). There is morphometric sexual dimorphism with females attaining larger sizes than males (Katsanevakis *et al.*, 2008; Alidromiti *et al.*, 2009).

Sex ratio: No data are available.

Size at first maturity: The $MLm_{50\%}$ estimated for *A. media* in the Tyrrhenian and the Adriatic Seas is about 50 mm in males and 60 mm in females (Auteri *et al.*, 1987; Soro and Piccineti-Manfrin, 1989).

Length-weight relationships: The table below lists length-weight relationships for the species in Portugal. Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.9.1. *Alloteuthis media*. Length weight relationship

Region	a	b	Sex	Reference
south Portugal	0.099	2.22	F	Moreno, 1990
	0.185	1.79	M	

Growth rate: Growth rate (mantle length *vs*. age) is higher in females, which also reach a larger size. Best fit growth equations (ML in mm and age in days) are as follows:

Females: $ML = 1.096*AGE^{0.7538}$, R=0.830 , N=73

Males: $ML = 0.911*AGE^{0.7666}$, R=0.841 , N=46

Lifespan: Recent direct ageing of *A. media* in the northwest Aegean Sea, based on enumeration of daily increments in statoliths, has shown that the lifespan of females reaches up to 11 months, whereas the males can reach 9 months of age (Alidromiti *et al.*, 2009).

Spawning season: In the North Sea spawning takes place in June and July (Zuev and Nesis, 1971).

Fecundity: The potential fecundity has been estimated at about 950-1400 eggs for the western Mediterranean whereas typical values in the eastern Mediteranean (1500-2500) are higher.

Migrations: *Alloteuthis media* undertakes seasonal migrations between offshore (in winter) and inshore (in spring) areas, where juveniles are also recruited mainly during summer and autumn (Mangold-Wirtz, 1963; Belcari, 1999).

7.3.10 *Illex coindetii*

Maximum size: *Illex coindetii* is a medium-sized squid, commonly reaching 200 to 250 mm ML throughout its distributional range (Roper *et al.*, 2010). The maximum mantle lengths recorded for females and males are 379 and 279 mm respectively (e.g. Gonzalez *et al.*, 1994b, 1996a). Females are larger than males, and maximum sizes vary depending on the population examined

Sex ratio: Sex ratio values close to 1:1 have been recorded in most of the studied populations (e.g. Jereb and Ragonese, 1995; Arvanitidis *et al.*, 2002; Ceriola *et al.*, 2006); significant deviations have been recorded only in Galician waters (González and Guerra, 1996) and in the Ionian Sea (Tursi and D'Onghia, 1992).

Size at maturity: Size at 50% maturity ($MLm_{50\%}$) in populations from different geographical areas of the east Atlantic Ocean.

Table 8.3.10.1 *Illex coindetii*: Maximun Length

Region	MLm50% (mm)		Reference
	Females	Males	
south Celtic Sea - Bay of Biscay	248	153	Arvanitidis *et al.*, 2002
Galician waters	184	128	González and Guerra, 1996
Portuguese waters	191	129	Arvanitidis *et al.*, 2002
east Atlantic	172-218	127-166	Hernández-García, 2002

Length-weight relationships: The table gives length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.10.2 *Illex coindetii*: Length weigth relationship

Region	a	b	Sex	Reference
south Celtic Sea-Bay of Biscay	0.058	2.76	F	Arvanitidis *et al.*, 2002
	0.296	3.17	M	
northwest Spanish waters	0.033	2.91	F	González *et al.*, 1996a
	0.022	3.16	M	
	0.016 - 0.017	3.09 - 3.12	F	Sánchez *et al.*, 1998
	0.006 - 0.007	3.57 - 3.58	M	
Portuguese waters	0.046	2.76	F	Arvanitidis *et al.*, 2002
	0.016	3.30	M	

Growth rate: González *et al.* (1996a) measured instantaneous relative growth rate as well as absolute growth rate. Although there was considerable variation, the fastest relative growth rate was recorded in 6-month old individuals of both sexes (1.33% $ML.d^{-1}$ and 4.49 %$BW.d^{-1}$ in males, 1.73 % $ML.d^{-1}$ and 5.06% $BW.d^{-1}$ in females) and the slowest growth in 13- month old males (0.10% $ML.d^{-1}$ and 0.03% $BW.d^{-1}$) and 14-month old females (0.18% $ML.d^{-1}$ and 0.81% $BW.d^{-1}$).

Lifespan: The life cycle of *Illex coindetii* is probably annual, although though shorter (6-8 months) and longer (18 months) lifespans have been estimated by using different techniques, in different areas.

Spawning season: Spawning occurs all year long, but seasonal peaks exist and vary with area throughout the Mediterranean Sea and the Atlantic Ocean (e.g. González and Guerra, 1996; Sánchez *et al.*, 1998; Belcari, 1999b; Ceriola *et al.*, 2006; Lefkaditou *et al.*, 2007). This variability is thought to be related to differences in water temperature (e.g. Arvanitidis *et al.*, 2002; Hernandez-Garcia, 2002).

Fecundity: Potential fecundity in males and females varies with body size. Approximately 800 000 oocytes were recorded in a 250 mm ML female (Laptikovsky and Nigmatullin, 1993)

Migrations: Adults, at least, undergo vertical migrations from the bottom to the upper layers at night, although they remain below the thermocline (Sánchez *et al.*, 1998). Seasonal migrations have been observed in the French Mediterranean and the Catalan Sea (Mangold Wirz, 1963a; Sánchez *et al.*, 1998), with the bulk of the population seeking shallow waters (70-150 m) in spring, where they remain all summer. In autumn and winter the population spreads over a wide bathymetric range.

7.3.11 *Todarodes sagittatus*

Maximum size: A maximum mantle length of 75 cm was reported for an unsexed specimen from North Atlantic waters (probably a female), while the maximum recorded mantle length for a male in this area was 64 cm (Roper *et al.*, 2010)

Sex ratio: No data were found.

Size at maturity: The table shows minimum size of mature females and males (with values of $MLm_{50\%}$, when known, in parenthesess) in populations from different geographical areas.

Table 8.3.11.1. ***Todarodes sagittatus*****. ,Maximun length**

Region	ML (mm)		Reference
	Females	Males	
Off Norway	350	300	Wiborg *et al.*, 1982
Northeast Atlantic	310 (~480)	280 (340)	Lordan *et al.*, 2001a

Length-weight relationships: The table gives length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.11.2. ***Todarodes sagittatus*****. , Length weight relationship**

Region	a	b	Sex	Reference
North Sea	0.0078	3.29	F	Oesterwind, 2011
	0.0075	3.27	M	
southwest Portugal, Madeira	0.0158	3.12	F	Piatkowski *et al.*, 1998
	0.0164	3.09	M	

Growth rate: Rosenburg *et al.* (1981) estimated a mean absolute growth rate of 2 mm/day for individuals with a dorsal mantle length range of 15-52 cm. Moustahfid (2002) estimated that daily growth rates in squid aged 4-6 months ranged from 0.4 mm d^{-1} to 1.3 mm d^{-1} and 0.3 g d^{-1} to 2.7 g d^{-1}. Instantaneous relative growth rates (G) were 0.6% for ML and 3.4% for BW. Borges and Wallace (1993) estimated growth rates in Norwegian waters from monthly length–frequency distributions. Results varied between years, being 0.8 -1.2 $mm.d^{-1}$ in females and 0.6-1.0 $mm.d^{-1}$ in males. Instantaneous growth rates (in terms of weight) were estimated as between 1.1 and 1.6% $BW.d^{-1}$ for animals in the weight range 252-322 g.

Lifespan: While most individuals probably live 12-14 months, the lifespan of the largest individuals may approach 2 years.

Spawning season: Spawning is seasonal, the timing varying with geographical location

Fecundity: Potential fecundity (PF) estimates were considerably lower in the north-eastern Atlantic, ranging from 205 000- 532 500 for females of 415-520 mm ML (Lordan *et al.*, 2001a), than in mature females from the Sahara bank (ML: 253-341 mm; PF: 215 000-950 000) and an immature female from the western Mediterranean (ML 288 mm; PF: 2 370 000) (Laptikhovsky and Nigmatullin, 1999)

Migrations: *Todarodes sagittatus* undertakes pronounced migrations, probably mainly related to feeding and spawning (Shimko, 1989). From June onwards, large schools appear off the south and southwest coast and in the northwestern fjords of Iceland, the Faroe Islands, Norway and, in some years, Scotland, where they stay until about December (e.g. Stephen 1937; Wiborg 1972, 1979, 1987; Sundet, 1985; Joy, 1990; Boyle *et al.,* 1998; Jónsson, 1998; Lordan *et al.,* 2001b; Bjørke and Gjøsæter, 2004; Roper *et al.*, 2010). In early winter, the animals migrate into deeper offshore waters.

7.3.12 *Todaropsis eblanae*

Maximum size: Maximum mantle lengths have been registered in North Atlantic waters: 290 mm and 220 mm for females and males, respectively (Robin *et al.*, 2002). There is morphometric sexual dimorphism, with females attaining larger sizes than males due to (Mangold-Wirtz, 1963b). The table below gives maximum mantle length (mm) for females (F) and males (M) in different geographic areas of the east Atlantic Ocean.

Table 8.3.12.1 ***Todaropsis eblanae*****. Maximum size.**

Region	ML (mm)		Reference
	F	M	
Scottish waters	205	141	Hastie *et al.*, 1994
North Sea	190	160	Zumholz and Piatkowski, 2005
Bay of Biscay - Celtic Sea	290	220	Robin *et al.*, 2001

Sex ratio: The sex ratio of *Todaropsis eblanae* is not substantially different from 1:1.

Size at maturity: Sexual maturity starts at a larger size in females than in males. Estimates of the size at maturity in different areas range from 120 to 150 mm ML for males and from 140 to 200 mm ML for females. (Mangold-Wirz, 1963a; Gonzalez *et al.*, 1994; Hastie *et al.*, 1994; Joy, 1989, Arkhipkin and Lapthikhovsky, 2000; Robin *et al.*, 2002; Zumholz and Piatkowski, 2005). The table indicates minimum size at maturity and $MLm_{50\%}$ (in parenthesess) for females and males of populations from different geographical areas.

Table 8.3.12.2 ***Todaropsis eblanae*****. Maximum size.**

Region	ML (mm)		Reference
	Females	Males	
Scottish waters	110 (157.3)	92 (120.8)	Hastie *et al.*, 1994
North Sea	120 (164?)	85 (123?)	Zumholz and Piatkowski, 2005
South Celtic Sea - Bay of Biscay	(165)	(135)	Robin *et al.*, 2001

Length-weight relationships: Significant between-sex differences have been found in length-weight relationships in most of the studied regions. In general, the values of the regression coefficient b are lower than 3 in both sexes. The table below shows length-weight relationships in different geographic areas for females (F), males (M) and the sexes combined (All). Original equations were converted to $W=a.ML^b$, where W is body mass (g) and ML is dorsal mantle length (cm).

Table 8.3.12.3 *Todaropsis eblanae*. Length weight relationships.

Region	a	b	Sex	Reference
Scottish waters	0.126	2.723	F	Hastie *et al.*, 1994
	0.115	2.777	M	
North Sea	0.142	2.660	F	Zumholz and Piatkowski, 2005
	0.094	2.854	M	
Bay of Biscay - Celtic Sea	0.330	2.41	F	Robin *et al.*, 2002
	0.670	2.15	M	
Northwest Spain	0.148	2.671	F	González *et al.*, 1994
	0.088	2.917	M	
Portuguese waters	0.179	2.65	F	IPMA
	0.218	2.56	M	

Growth rate: Daily growth rate is higher in females and decreases in both sexes upon maturity (Belcari *et al.*, 1999; Arkhipkin and Laptikhovsky, 2000). The table gives daily growth rate (DGR, mm·day^{-1}) and lifespan (months) of females (F) and males (M) in populations from the east Atlantic Ocean and the Mediterranean Sea. (DA = direct ageing, MPA = modal progression analysis)

Table 8.3.12.4 *Todaropsis eblanae*. Lifespan.

Method	DGR		Lifespan		Region	Reference
	F	M	F	M		
DA	1.14	0.62	8.5	7.7	South Celtic Sea - Bay of Biscay	Robin *et al.*, 2002
MPA	0.41	0.25	8.5		South Celtic Sea - Bay of Biscay	Robin *et al.*, 2002

Lifespan: The life cycle of *Todaropsis eblanae* is probably annual, as estimated values for the lifespan range from 7-8 months to 1 year.

Spawning season: The spawning season probably extends throughout the year, with peaks varying according to geographical location (Belcari, 1999c). *Todaropsis eblanae* spawns mainly during summer and early autumn in northern Atlantic waters (Hastie *et al.*, 1994; Robin *et al.*, 2002; Zumholz and Piatkowski, 2005; Oesterwind *et al.*, 2010), whereas it spawns in early spring and early autumn in Atlantic waters south of 44 °N (González *et al.*, 1994; Arkhipkin and Laptikhovsky, 2000).

Fecundity: Potential fecundity (PF) varies from 4,500 to 28,000 for mature females in Scottish waters (Hastie *et al.*, 1994). Rasero *et al.* (1995) estimates PF to vary from 99,979-143,792 for females of 136-196 mm ML caught off northwest Spain. The number of ripe oocytes in the oviducts is up to 37 000 off northwest Spain and from 355 to 13 157 (mature eggs) in Scottish waters (Hastie *et al.*, 1994), indicating as for potential fecundity, a decreasing trend of reproductive output with increase of latitude.

Migrations: This species is probably the least mobile of the ommastrephid squids in terms of migratory habits.

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8 Other business

8.1 Result of the Data Call launched in February 2013.

The group is generally pleased with the answers obtained from most of the European countries in relation to the data call. Just one country, Denmark, did not answer to the data call and so no data were supplied to the group. However it is to pointed out that as derived from last year Danish cephalopods Data Call, no cephalopod fisheries are deployed in Subarea where Danish fisheries operated. Cephalopod catches are anecdotal.

The amount of information received previous to the group was large and of enough quality to try preliminary trend analysis. The group was able to review and update some preliminary LPUE trends and survey indices based on submitted data. This is the second year of the data call and basis for future work in relation to assessment are being already established.

There is still a data clarification request process to be deployed in relation to:

g) Species identification in the catches.

h) Landings: need to be clarified if data from just flagged vessels landing in their own country are submitted or data from flagged vessels landing in all European countries.

i) Discards: sampled level for discard would be advisable for submission. It is important to point out that all data should be raised.

j) Effort: Data obtained comes from both, métiers targeting cephalopods and also métiers in which cephalopods are just a small part of the catch. Thus, a clarification in the effort data required should be done in relation to ask for the whole fleet effort fleets or just directed effort to cephalopods. If the former, the other catch, apart from cephalopods, would be also needed. Also, standardization of effort units between countries would be desirable.

k) Cephalopods métiers identification

l) Spatial distribution of catches in surveys and commercial fisheries: at the moment, countries supply these data at very different resolution levels (Lat-Long / Statistical Rectangle / ICES areas…)

m) Catches seasonality: based on the seasonality of the catches and the short lifespan of the species, monthly data should be submitted. However, this would increase enormously: the amount data received by the group, limiting experts' capacity of analysis and also, for data providers, time for data obtaining will be highly increased. So, at least quarterly data should be submitted.

n) Submission of data in the Data Call format agreed: France has not delivered data in the Data Call format. This is important because the format chosen for the Data Call was a compromise between the COST file format used by the countries and the Excel format which can be easily use by the group members. An important issue of a Data Call is the standardization of the formats in the way that all countries send data in the same way to be able to be worked out together. The lack of the Data Call format complicates analysis, visibility and workability of the data. So, it is highly recommended that countries sent data in the agreed Data Call forma.

Next year is intended to request a new data call with clarifications in the issues described above.

8.2 WGCEPH contribution to ICES Science Plan

The WGCEPH expert group members as part of the SCICOM, were invited to provide written comments for consideration and inclusion in the draft ICES Science Plan (SP).

The current ICES Science Plan expires at the end of 2013. The ICES Science Committee has been developing a new draft Science Plan and this is the first opportunity for the science EGs to provide comments on a complete draft. WGCEPH considers essential, as part of the scientific community, its active participation in the development of a plan that will provide focus for ICES science for the next 4 years.

Below a list of comments are included for their consideration:

1) The approach for comments on the SP is being based on what the group can provide as experts on cephalopods and thinking broadly about the role of these species in the ecosystems and the need of assessment and management of these last ones. Some comments are generic and others are more specifically related to cephalopods.

2) The introduction indicates that Integrated Ecosystem Assessment "does not invalidate research based on individual species" but corresponds to a "challenge to provide better context to management advice". The group agrees that looking separately at "assessment" and "management" it could be indicated here that a wider range of species may require assessment of population status to take into account ecosystem effect of the management of some resources (like EU quota species). Thus, it is a good opportunity for cephalopods to be included in the Integrated Ecosystem Assessment.

3) In the section "The role of ICES in a changing environment" on can read (p. 7) "ICES has identified the future of Arctic and sub-Artic ecosystems and their resources as a priority". The obvious consequence is that more southern areas (where Cephalopod populations are more abundant and sensitive to environmental variation) will be considered with lower priority. It could be worth to indicate that "faster" warming can only be observed compared with other areas and that this may not be only a question of absolute temperature increase.

   It could be advocated that boundaries of biogeographic provinces (or Marine Eco regions according to Spalding et al 2007) could also be a useful indicator of climate change and its consequences on marine resources.

4) About the Ecosystem Processes and Dynamics (the internalities)

   The need to take into account spatial patterns "at local, regional and basin scales" is mentioned but we could insist on temporal scales (which are important to take into account in our short living species).

   "Appropriate temporal scales" is mentioned several times (8) in the document. However, it is often about monitoring climate change or collecting environmental data.

   Clearly all components of the ecosystem cannot be quantified only on annual basis like long lived finfish stocks and this should be indicated (with the idea behind that Cephalopods need to be studied, sampled, and monitored according to relevant temporal scales).

About spatial patterns it could be added that movements of all migrating resources are far from being well known and that, the way resources move between areas is important in a context of regional seas that are more and more becoming a mosaic of "conservation zones" with many different levels of conservation.

In this section (page 11) one can read "ICES research needs to embrace society driven needs". May be it could be indicated that across the ICES countries, needs (or their ranking) can vary and that attention paid to social needs should lead to different ways to consider humans as components of the ecosystem.

5) The background idea here is to indicate that there cannot be only one model of Ecosystem Processes and Dynamics and only one optimum equilibrium status, where society needs are fulfilled.

About the Ecosystem Pressures and Impacts (the externalities).

This section of the document is rather heterogeneous or at least it is ambiguous because in the previous section it was indicated that humans were a component of marine ecosystem and now they appear as external pressures.

A consequence is that among the objectives there is "2.3. Provide evidence in support of the sustainable management of ecosystem goods and services"

Under this heading the sound idea to "optimize ecosystem use and minimize environmental impact, in relation to ecosystem carrying capacity" could be slightly modified or complemented with the need to develop tools suitable for non-equilibrium situations.

The underlying idea about our species is that either we do not know if population biomass is close to carrying capacity (or to 1/2 of K) of if this capacity is so much fluctuating that it may not be relevant to consider "long-term average targets".

Another "external" point that could be mentioned and that concerns our species is the consequence of trade and exchanges on the economic value of the resource. This is, as an example, considering the relatively high price of squid in Northern countries which is not related to local demand but to exportations to other consumers.

6) About the Encapsulating objective and the "enabler" (Integrated Ecosystem Observation and Monitoring Programmes)

The expert group has some doubts about how comment or enrich these objectives specifically:

"4.1. Identify and prioritize ICES monitoring and data collection needs"

"4.3 Identify knowledge and methodological monitoring gaps, and develop strategies to fill these gaps.

However, it should be made clear that the existing minimum data collection protocols is clearly insufficient at this moment to monitor Cephalopod populations (with two main issues: species identification and frequency of observations). Any improvement in monitoring and data collections will be clearly evolve in a better knowledge of the ecosystem to be managed.

7) About the Science Delivery one can read (p. 22-23) "Key ICES science collaborators include:" ... followed by a list of organizations

One must be careful that some of these organizations work with lists of species in which Cephalopods are very seldom included. This can be a real problem especially when for example such lists become a basis for EU regulations.

8) About the evaluation of Expert Groups (self-evaluation + SCICOM evaluation) this seems logical although in the "SCI" of SCICOM we may need not to be considered only from the "stock assessment and management" point of view but also from ecosystem functioning and habitats use.

8.3 Future ICES ASC theme sessions

WGCEPH is proposing a Cephalopod Theme Session during the 2014 ICES ASC. The last cephalopod theme session took place in Vigo in 2004. In 2014, the Annual Scientific Conference will be hold in A Coruña, placed in Galicia, one of the European regions with most tradition in cephalopod fisheries and culture. Tittle, proposed conveners and thematic session description are included below.

Title: Operational solutions for cephalopod fisheries and culture

Conveners:

Marina Santurtun (Spain), Joao Pereira (Portugal), Cristina Pita (Portugal), Begoña Santos (Spain), Graham Pierce (UK), Jean-Paul Robin (France)

Description:

Cephalopods have important ecological roles as predators and prey, reflecting their fast-growth and high productivity, and they are increasingly important as a fishery source in Europe, in small-scale and large-scale fisheries. Cuttlefish, octopus and squid are all targeted by small-scale coastal fisheries, especially in southern Europe, and these fisheries have an important social role as well as high economic value. Historically in Europe, cephalopods have mainly been a bycatch of large-scale fisheries, although opportunistic targeting of squid during periods of high abundance has been seen (e.g. in Norway and at Rockall). Recently however, the decrease in catch possibilities of traditionally exploited species (e.g. hake in the Bay of Biscay) has led to some commercial fleets to move into targeting of squid. Key aspects of the importance of cephalopods as resources are:

iii) *the dependence of some artisanal and commercial fisheries on cephalopods, either as target species, as accompanying species or as prey for other important commercial species. A recent global review highlighted the indirect importance of cephalopods as food of fishery target species*

iv) *environmental sensitivity and trophic role: understanding effects of environmental variables on cephalopod distribution and abundance will help us to explain and predict the wide fluctuations in cephalopod abundance, and hence variation in fishery catches and effects on the abundance of predators and prey of cephalopods.*

v) *potential as cultured species and thus as a source of marine proteins*

We welcome papers on topics related to these themes, including but not limited to:

- *Practical applications of environmental impacts on cephalopods*
- *Directed cephalopods fisheries: e.g. small-scale fisheries and their socio-economic importance*
- *Environmental and human impacts on cephalopods in small-scale fisheries.*
- *Management strategies for cephalopod fisheries, accounting for essential habitats.*
- *Optimal culture conditions*
- *Key issues for successful culture: artificial diets; quality product for human consumption.*

8.4 WGCEPH meeting in 2014

One venue was proposed for the next meeting, namely Lisbon, Portugal. WGCEPH meeting dates were proposed to be, as for 2013, preferably during the 3rd or 4th week of June, meeting for 4 full days. However, dates remains to be confirmed.

Annex 1: List of participants

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Annex 2: Data provided by countries in relation to Data Call 2013

		GER	GBR	IRL	FRA	ESP	PRT	DNK	NLD	LTU	LVA	POL	EST	SWE
Landings	Year	X	X	X	X	X	X		X	**				X
	Quarter	X	X	X	X	X	X		X					X
	Month	X			X	X	X							X
	Area	X	X	X	X	X	X		X					X
	Statist. Rectangle	X			X									X
	Subpolygon	X												
	Species	X	X	X	X	X	X		X					X
	Landing category	X	X	X		X	X		X					X
	Commercial size	X					X		X					
	Fishing activity category National*				X	X								X
	Fishing activity category European lvl 5*			X		X	X							X
	Fishing activity category European lvl 6*	X	X			X			X					X
	Harbour	X	X		X	X	X							X
	Vessel length category	X	X	X	X		X		X					X
	Unallocated catch weigth	X	X	X			X		X					X
	Area misreported catch weigth	X	X	X			X		X					X
	Official Landings weigth	X	X	X	X	X	X		X					X
	Landing multiplier	X												
	Official landing value	X	X	X			X							X
Effort	Year	X	X	X	X	X	X		X					X
	Quarter	X	X	X	X	X	X		X					X
	Month	X		X	X	X								X
	Area	X	X	X	X	X	X		X					X
	Statist. Rectangle	X			X	X								X
	Subpolygon	X		X										
	Fishing activity category National*				X	X								X
	Fishing activity category European lvl 5*			X		X	X		X					X
	Fishing activity category European lvl 6*	X	X			X								X
	Harbour*	X	X	X	X	X	X							X
	Vessel length category*	X	X	X	X	X	X		X					X
	Number of trips	X	X			X	X		X					X
	Number of sets/hauls	X			X									X
	Fishing time/soaking time	X		X	X									X
	kW-days	X				X	X							X
	GT-days	X				X	X							X
	Days at sea	X	X	X		X	X		X					X

Discards	Year	X				X	X		X	**				X
	Quarter*	X		X		X			X					X
	Month*	X												X
	Area*	X		X		X			X					X
	Statistical rectangle*	X				X								
	Subpolygon*	X												
	Species*	X		X					X					X
	Vessel length category*					X			X					X
	Fishing activity category National*			X		X								
	Fishing activity category European lvl 5*					X	X		X					
	Fishing activity category European lvl 6*	X				X								
	Harbour*	X												
	Discard weigth	X		X		X			X					X
	Number of trips	X		X		X	X		X					X
	Number of sets/hauls	X		X		X								
	Fishing time/soaking time	X		X										
	kW-days	X												
	GT-days	X												
	Days at sea	X		X					X					
Surveys	Year	X	X	X	DATRAS	X	X	DATRAS	*	+	+	+	+	X
	Quarter*	X	X	X		X	X							X
	Month*	X				X	X							X
	Area*	X	X	X		X	X							X
	Statistical rectangle*	X	X	X										X
	Subpolygon*													
	Species*	X	X	X		X	X							X
	Abundance indice*	X	X	X		X	X							X
	S.E.	X	X	X		X	X							X
	Year	X	X	X	DATRAS	X	X	DATRAS	*	+	+	+	+	X
	Quarter*	X	X	X		X	X							X
	Month*	X				X	X							X
	Area*	X	X	X		X	X							X
	Statistical rectangle*	X	X	X										X
	Subpolygon*													
	Species*	X	X	X		X	X							X
	cpue	X	X	X		X	X							X
	S.E.	X	X	X		X	X							X

NP Danish data for Cephalopods. The Danish IBTS data are uploaded to DATRAS, and can be retrieved from there.

***Netherlands some additional information.**

Information for cephalopods for 2009-2012 on landings, discards and effort in the requested area(s) in the Northeast Atlantic. The following points give some additional information:

As well in landing as discard records, only one cephalopod species (Loligo spec) was reported by family name in the areas requested.

In a few cases a full species name is listed. However, it is doubtful whether the identification is correct. Therefore, all catches are reported as SQU.

The table with landings (from logbooks) contains only records of landings in the Netherlands of both Dutch flagged and foreign flagged vessels for the requested areas.

This means that when no landings were observed for a specific métier, this has not been included in the table.

For discards the records only apply to the métier combinations which have been sampled. This means that a 0 in this file means that there was sampling but no discards.

Within the discards sampling programme occasionally foreign flagged vessels are sampled. As discards have been raised by métier, effort is needed for the fleet by métier

For foreign flagged vessels we do not have complete information on effort. Therefore, as it can be assumed that foreign flagged vessels exhibit the same fishing behaviour as Dutch flagged vessels; all sampled trips were treated as if they belonged to the Dutch fleet.

The table with effort is total effort per quarter/métier/fishing ground whereas effort in discards table sheet is effort sampled per quarter/métier/fishing ground.

**** Lithuania, Latvia, Poland and Estonia**

Estonian: there were no catches of Cephalopods in ICES area and therefore we have no data to submit.

Annex 3: Cephalopods working group meeting draft resolution for multi-annual ToRs (Category 2)

A **Working Group on Cephalopod Biology and Life History (WGCEPH)**, chaired by Marina Santurtún, Spain and Jean-Paul Robin, France, will meet in Lisbon, Portugal, XX June 2013, in addition to working by correspondence, to work on ToRs and generate deliverables as listed in the Table below.

WGCEPH will report on the activities of 2014 (the first year) by 1st August 2014 to SSGEF.

ToR descriptors

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Report on status and trends in cephalopod stocks: Update, quality check and report relevant data on: European fishery statistics (landings, directed effort, discards and survey catches) across the ICES area and if feasible in waters other than Europ . Produce and update cpues and survey dataseries for the main cephalopod métiers and species and assess the possibility of their use as abundance indices. Examine the above trends in relative exploitation rates (i.e. catch/survey biomass) to evaluate stock status. Start exploring economic data collected under Data Call.	Data call is part of the justification of this ToR. Discussion of the data collected is important to be hold in a framework of experts. The results of the ToR are an output of this discussion. Some of the outputs are also the identification of cephalopod stocks to be assessed or even managed, the need of more data (spatial, temporal) and the level of species information required. Thus, the baseline work of the ToR is the result of the data call.	Use codes	Year 1, 2 and 3	Peer-review paper in relation to status and trends (Year 3: 2016).

b	Conduct preliminary assessments of the main cephalopod species in the ICES area. Assess production and/or depletion methods utility, if feasible (YEAR 1). Explore other possible assessment methods if needed (e.g. early season assessment) (YEAR 2). Carry out assessment of species with the methods chosen (YEAR 3).	Data are being collected with the purpose of assess the status of the cephalopods stocks for Integrated Ecosystem Assessment (IEA).	Use codes	Year 1, 2 and 3s	Report on the cephalopods assessed (Year 1: 2014, Year 2: 2015 and Year 3: 2016).
c	Implications of the application of some Policies and Directives on cephalopods: e.g. Implication of PPC (no discards) on cephalopods exploitation, how it has been applied in other places and how it has affected them; New regulation of Manipulation of Animals for research; Natura 2000, Blue growth (wind farms)	There are no policies or management measures directed to cephalopods but many other pressures and activities would affect them. These directives and policies are essential to assess the ecosystem in its whole (IEA)	Use codes	Year 1, 2 and 3	Report on effects of directives and policies on cephalopod assessment (Year 1: 20145, year 2: 2015 and year 3: 2016)
d	Review data availability for the main cephalopod species in relation to the main population parameters: length distribution, sex ratio, first maturity-at-age, first maturity at length, growth, spawning season (YEAR 2);	There is a need for updating main population parameters to be able to relate them to the most recent fisheries data collected through Data calls and to assess stock status.	Use codes	Year 2	Peer review paper in relation to population dynamics, biology. . (Year 2: 2015) . Report (and/or first draft) of a methodological paper about sampling resolution for best data collection for each stock/species. (Year 2: 2015)

e	Review and report on cephalopod research results in the ICES area, and if feasible in waters other than Europe, including all relevant aspects of: biology, ecology, physiology and behavior, in field and laboratory studies (YEAR 1, YEAR 2 and YEAR 3)	Experts should be able to assess population status, and give management advice, if needed, for stocks/populations. Also there is a need for understanding response to stress, factors causing changes in cephalopod abundances and distribution. In this way the expert group will have to be able to inform ICES about population status; dynamics and their relationship with environmental variables; the role of cephalopods in the ecosystem; possible indicators for cephalopods under the MSFD and assessment methods used in commercial cephalopod fisheries.	Use codes	Year 1, 2 and 3	. Database on scientific articles in relation to the topic worked out every year. This database will make use of the already existing tools (Mendelei, Research Gate…). (Year 1: 20145, year 2: 2015 and year 3: 2016) . Report. (Year 1: 20145, year 2: 2015 and year 3: 2016)

Summary of the Work Plan

Year 1: 2014	report on the cephalopods assessed report on effects of directives and policies on cephalopod assessment database on scientific articles in relation to the topic worked out every year.
Year 2: 2015	Report on the cephalopods assessed Report on effects of directives and policies on cephalopod assessment Peer review paper in relation to population dynamics, biology Report (and/or first draft) of a methodological paper about sampling resolution for best data collection for each stock/species. Database on scientific articles in relation to the topic worked out every year.
Year 3: 2016	Peer-review paper in relation to status and trends (Year 3: 2016). Report on the cephalopods assessed Report on effects of directives and policies on cephalopod assessment Database on scientific articles in relation to the topic worked out every year.

Supporting information

Priority	The current activities of this Group will lead ICES into issues related to Cephalopods role in the ecosystem and importance as part of directed and indirected fisheries. Cephalopods are important components of marine ecosystemsThus, for promoting the sustainable use of the seas and conserving marine ecosystems, cephalopod biology and life history has to be understood. As an example, directed cephalopod fisheries, especially small-scale fisheries, are increasingly important and it is necessary to have in place a useful system of data collection and stock evaluation that would be adequate to support managementthese activities are considered. These activities are believed to have a very high priority.
Resource requirements	As noted in the 2012 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. Effords to attend to the group are ackowledged. The future direction of the group focusing more into assessment would hopefully lead to group to be applicable for DCF funding. The group is willing that effort started in 2010 could be recognised in that way. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group was reduced in number of attendees form around 15 members and guests to 9 members. In 2013, number of attendes was even reduced to 6 full time attendes. With a strong bias towards participants from the Iberian peninsula. It is desirable that more researcher working on National Fisheries Institution would have the chance to know the group work and participate in it.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are obvious direct linkages with assessment groups WGHMM, WGCS as cephalopods are caugth in stocks/fisheries considered in thos groups. Also WGNEW is linkage to this group PGCCDBS IBTSWG 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	There is a starting working relationship with WGCRAGON as a common workshop on the nned of assessment and management on cephalopods and cragon will be deployed in October 2013. It is also a relevant linkage with groups under SCICOM..
Linkages to other organizations	

Annex 4: Recommendations

Recommendation	For follow up by:
1. WGCEPH would launch another Data Call reviewing templates and clarifying variable contents. The, group will get in contact with National correspondants to inform about WGCEPH work procedure from 2014 in relation to data required.	PGCCDBS Chair and National correspondants.
2. Routine collection of cephalopod length–frequency data, by species, during research bottom-trawl surveys (e.g. IBTS) is suggested, in addition to provision of these data to the WGCEPH prior to the next meeting	ICES IBTS Chair, PGCCDBS Chair and National correspondant.
3. In relation to sampling and monitoring for achieving Integrated Ecosystem Assessment, WGCEPH recommends that for major cephalopod stocks in which assessment and management are likely to be necessary in the near future, data collection under the DCF 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 métiers 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 vs. the fishery, in order to assess trends in recruitment and length at 50% maturity (L50).	National Correspondents
4. Presentation of cephalopod assessment trends in assessment WG under ACOM (WGHMM, WGCS and WGNEW) to raise attention about catches and possible status of these populations.	WGHMM, WGCS and WGNEW

Annex 5: Working Documents presented at the meeting

WD1: A two stage biomass model to assess the English Channel cuttlefish (*Sepia officinalis*) stock..

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Introduction

Due to the depletion in finfish stocks observed during the last decades (FAO, 2012), the cephalopod resources have become more and more important for fishers (Royer *et al.*, 2006). In the N-E Atlantic, the English Channel cuttlefish (*Sepia officinalis*) is the most important cephalopod resource. It is mainly shared between French and UK fishers who annually landed 11,000 tons on the period 2000-2010 for an annual average income of 20 M € (Royer *et al.*, 2006; Portail CHARM III - Interreg IV, 2012). In spite of the publication of different stock assessment exercises an its importance, the English Channel cuttlefish stock is only managed with local measures and no European management is carried out (Pierce *et al.*, 2010). The depletion (Leslie-DeLury) method is the most popular stock assessment method to assess cephalopod stocks (Pierce and Guerra, 1994). It was applied to the cuttlefish stock but the assessment was only based on the UK landings which represent the third of the total landings (Dunn, 1999). VPA, the most popular method to assess finfish stocks, was also applied to the cuttlefish stock on a monthly basis (Royer *et al.*, 2006). However, difficulties in month age estimation (Bettencourt and Guerra, 2001) lead to the conclusion that a routine assessment was not possible. We therefore propose the use of a two stage model, giving consistent results with a VPA using poor age data (Mesnil, 2003). A two stage biomass model has already given excellent results in the assessment of the South African Chokka Squid (Roel and Butterworth, 2000) and the Irish Sea Herring (Roel *et al.*, 2009).

Material and methods

Fishery dependent (landings of trawlers and by all gears) and independent (BTS and CGFS surveys) data were extracted from the Cefas and Ifremer databases for the period 1992-2008 to derive abundance indices (survey abundance indices and Landings Per Unit Effort). LPUE were then standardized using the Delta-GLM method which combines a binomial error GLM and a Gaussian error GLM (Le Pape *et al.*, 2003; Acou *et al.*, 2011). The two stage biomass model for the cuttlefish stock is made of 4 equations describing a simplified life cycle of the English Channel cuttlefish stock. The life cycle is considered to start in July of a year Y, the recruitment occurs in July of the year Y+1 and, as the cuttlefish is a 2 year lifespan semelparous species, the life cycle ends at the end of June of the year Y+2. The catch is assumed to occur as a pulse in the middle of the exploitation season. BTS abundance index describes the recruitment in July each year while CGFS one describes the population one quarter later. Standardized LPUE are then used to describe the population dynamic all along the fishing season. The model is then fitted using the 4 abundance indices by minimizing the Sum of Squares Residuals (SSR). Finally, model outputs enable the use of two indicators of the fishing impact on the cuttlefish stock, the stock–recruitment relationship and the estimation of an exploitation rate for each cohort of the time-series.

Results

Results highlight that the model fits well the data (residuals does not highlight any trend). Abundance indices and biomass trends indicate that from 1992 to 2000, cuttlefish stock presents a high inter-annual variability without any significant trend before a drop in 2001. The cuttlefish recovered a high abundance in 2002 but then followed a decreasing trend until 2008. Despite this decreasing trend, no stock–recruitment relationship was highlighted nor temporal trend in exploitation rate. Finally, the recruitment strength seems to be influenced by the temperature during the early life stages of the cuttlefish (i.e. summer temperature occurring after the hatching).

Discussion

These results lead to the conclusion that, on the 1992-2008 period, the resource is fully exploited and presents no evidence of overexploitation, a consistent conclusion with the results of Royer *et al.* (2006). Several authors have highlighted the role of the environmental parameters in the inter-annual variability of the cephalopod abundance (Pierce *et al.*, 2008; Wang *et al.*, 2003), particularly during the early life stages, a consistent observation with our results. Moreover, in France, by way of exemption from the law, inshore trawling to target juveniles is allowed (Pierce *et al.*, 2010). Considering the sensitivity of the early life stages, this fishery likely impacts the recruitment strength of the cuttlefish stock.

Perspectives

As the two stage biomass model gave interesting results and is not time consuming and data demanding, we are going to develop a software application in R. It will be developed to use the European standard exchange format for fisheries data (COST, Jansen *et al.*, 2009) as input data for the model and will be tested with the time-series completed until 2012. It will then be provided to the ICES Working Group concerned (most likely the WGCEPH) to carry out the stock assessment of the English Channel cuttlefish. This software development is funded by the French Fisheries Department (DPMA) and France Filière Pêche association.

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Caen, France, 11-14 June 2013

AN UPDATE OF CEPHALOPOD LANDINGS DATA OF THE SPANISH FISHING FLEET OPERATING IN ICES AREA FOR 2000-2012 PERIOD.

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Data of Spanish landings of cephalopods on an annual basis were collected both by the *Instituto Español de Oceanografía's* (IEO) Sampling and Information Network, for catches from the ICES Subareas VII, VIIIabd, VIIIc and IXa, and by the *AZTI* Fundation, for catches from subareas VIab, VIIb-k and those ones from the VIIIc-East landed in the Euzkadi ports.

Table 1 shows the Spanish annual landings (in tons) by species group (Octopodidae, Loliginidae, Ommastrephidae and Sepiidae) and for the total annual for the 2000-2012 period. The 2011 landings have been updated in relation to the information reported last year. Landings data in 2012 should be considered as provisional because of gaps of information still present in some subdivisions. However, the 2012 landings will 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 2000-2012 period.

Year	Loliginidae	Octopodidae	Ommastrephidae	Sepioidea	TOTAL
2000	675.6	7031.8	2017.1	1636.8	11361.3
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	597.6	4642.6	833.9	1563.1	7637.2
2008	765.4	4919.6	1636.2	1412.4	8733.6
2009	546.0	3935.3	1314.0	1223.9	7019.3
2010	1109.1	5776.2	3023.0	1535.3	11443.6
2011	1196.4	5122.2	3396.8	1423.0	11138.4
2012	1682.7	6390.6	4717.5	1713.7	14504.5

(*2012 year): Provisional data

Figure 1 shows the trend of total annual landings through the analysed period (2000-2012). Average annual landings along the time-series were around 8950 tons, with a minimum of 7019 t in 2009 and a maximum of 14504 tons in 2012 despite being provisional dates. The highest landings correspond to the Octopodidae group which accounted for 54.8% of the averaged landings for the analysed period, followed by

Ommastrephidae (20.6%), Sepioidea (14.9%) and Loliginidae (9.5%). The trend present a drop of landings from 2000 to 2001, followed by a slight increase until to reach a peak in 2005 of 10500 t. Afterwards, a new decrease appear until 2009, with a great increase in 2010 of about 63% with regard to 2009. In 2011, the landings showed similar values to previous year, with a new increase in 2012 reaching the highest value of the time-series.

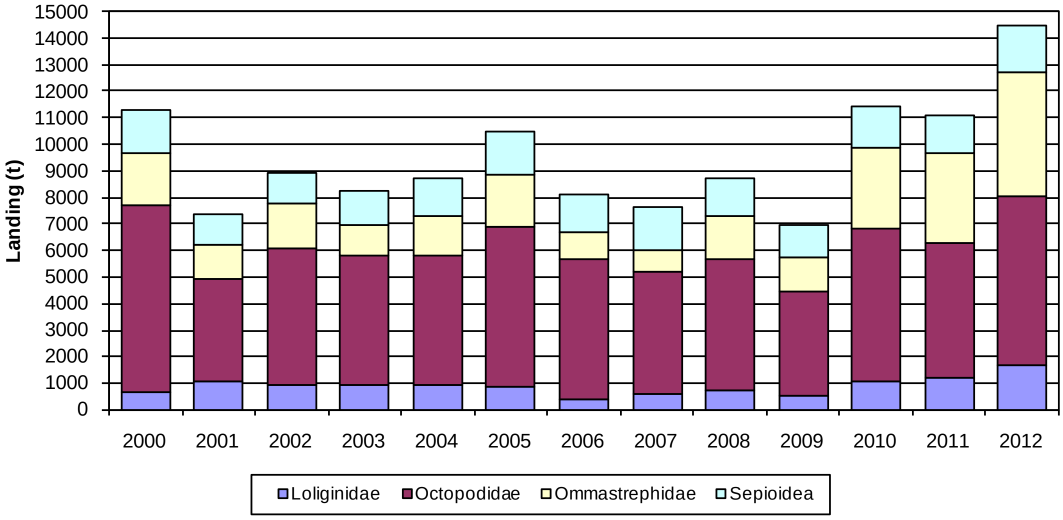
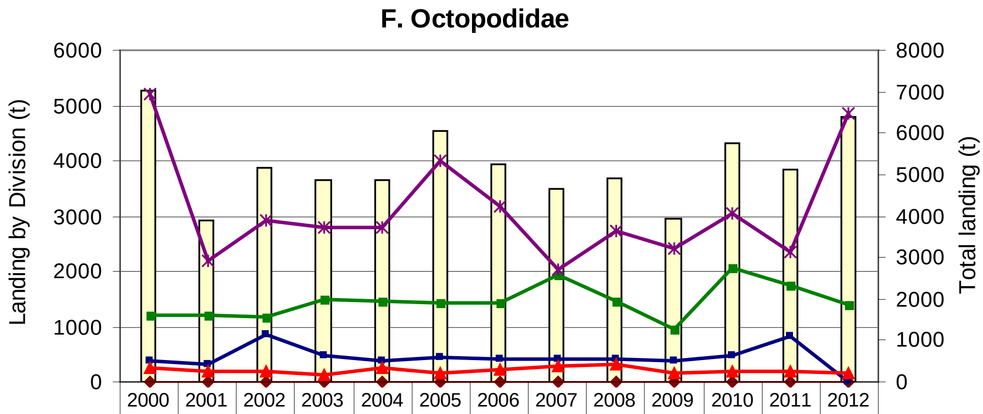


Figure 1. Spanish cephalopod annual landings (in tons) caught in the ICES area by species group during the 2000-2012 period. (2012: provisional data)

Octopodidae

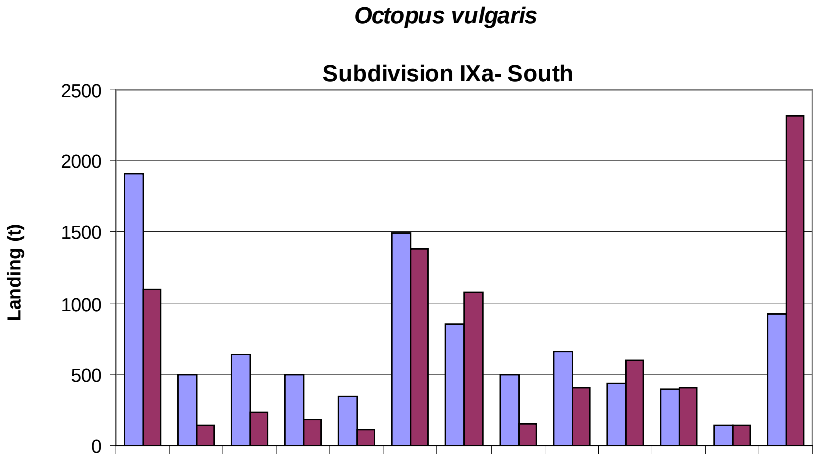
Commercial landings of octopods (Fam. Octopodidae) comprise common octopus *Octopus vulgaris* and horned octopus *Eledone cirrhosa*, plus musky octopus *Eledone moschata* in Subdivision IXa-South. Figure 2 shows the trend of total octopods landings and by Subarea/Division in the last thirteen years. Total annual catch ranged between 7031 t in 2000 and 3895 t in 2001, which represents the highest decrease along the time-series. A slight increase until reaching a peak in 2005 of 6039 t can be observed. Afterwards, a new decreasing trend appear until 2009 with 3935 t, followed by a great increase in 2010 of about 46% with regard to 2009, until to reach the second higthest values of the time-series in 2012 with 6391 t. More than 87% of octopodidae were caught along the Spanish coast (Divisions IXa and VIIIc), where common octopus *O. vulgaris* is the main species caught. In Division VIIIc and Subdivision IXa-north most of the *O. vulgaris* were caught by the artisanal fleet using traps, comprising more than 98% of octopus landings (Figure 3). The rest of landings is reported by the trawl fleet. However, this species is caught by the bottom-trawl fleet in the Subdivision IXa-South (Gulf of Cadiz), accounting for around 60% of total catch on average, and the remaining 40% by the artisanal fleet using mainly clay pots and handjigs (Figure 3). Subdivision IXa-South contributes to the total landings from the Division IXa with variable percentages that ranged between 29 % (454 t) in 2004 and 80% (2871 t) in 2005, with a 46% on average through the time-series. In figure 3, it can be observed these strong fluctuations in the octopus landing along the time-series, with the minimum values in 2011 (285 t) and maximum values in 2012 (3242 t). In this last year, the artisanal fleet accounted for the 70% of total octopus landings. Possibly, such oscillations may be related with environmental changes such as rainfall and discharges of rivers (Sobrino *et al.*, 2002).

Most of the horned octopus *E. cirrhosa* is caught by the bottom-trawl fleet, with their landings accounting for the bulk of the octopod landings in Subarea VII (448 t of average) and Subdivisions VIIIabd (209 t) (Figure 2). Horned octopus landings in Division VIIIc account for 27%, on average, of total octopods landings. In Subdivision VIIIc-east the fishery statistics for the 'octopodidae' mixed species group correspond to *E. cirrhosa* landings in the case of the trawl fleet and to *O. vulgaris* for the artisanal fleet. The contribution of *Eledone* spp in the total cephalopod landings from Division IXa is higher in Subdivision IXa north, with 23% (370 t) of total landings, than in Subdivision IXa south, with only 13% (133 t) (Figure 4). In this last Subdivision, the main landed species is the musky octopus *Eledone moschata* instead of *E. cirrhosa*, that is caught in the Gulf of Cadiz by the trawl fleet as a bycatch due its scarce commercial value (Silva *et al.*, 2004).

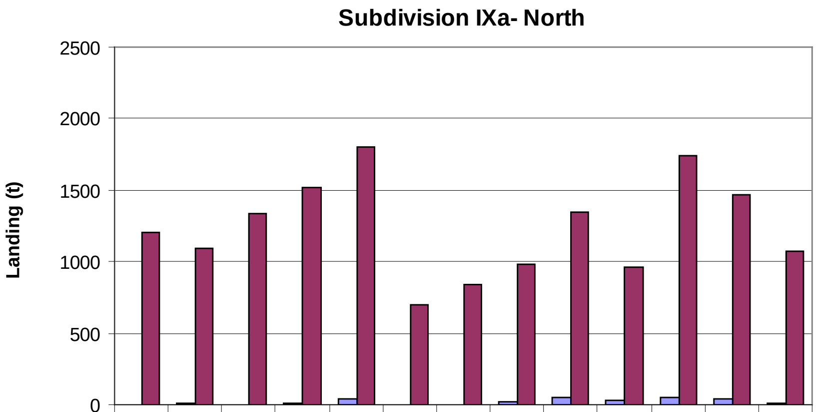


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	7032	3896	5150	4888	4882	6040	5238	4643	4920	3935	5776	5122	6391
VI	0	0	0	0	0	0	0	0	0	0	0	0	0
VII	387	326	851	475	371	449	425	400	399	389	464	832	4
VIIIabd	247	182	197	112	257	161	216	282	308	164	181	191	153
VIIIc	1193	1209	1165	1498	1466	1421	1433	1933	1476	961	2075	1743	1387
IXa	5205	2179	2936	2804	2787	4010	3164	2027	2737	2421	3056	2355	4847

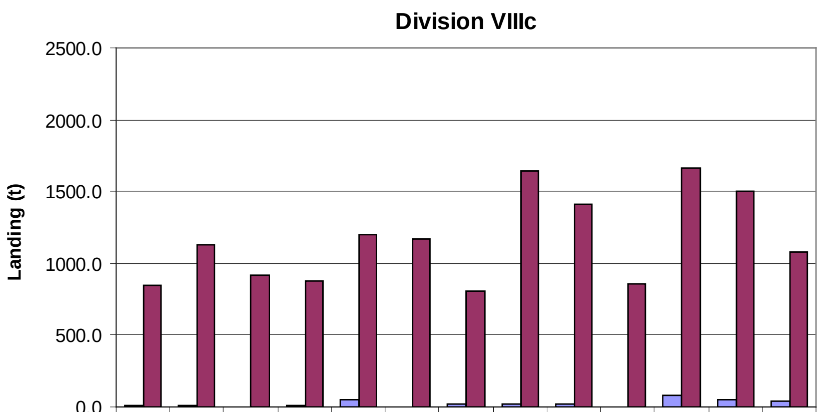
Figure 2. Spanish landings (in tons) of octopus species (Fam. Octopodidae) by ICES Subarea/Division during the 2000-2010 period.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Trawler fleet	1915	498	645	496	342	1490	855	497	663	434	396	146	927
Artisanal fleet	1101	139	234	182	112	1381	1077	149	402	595	403	139	2315

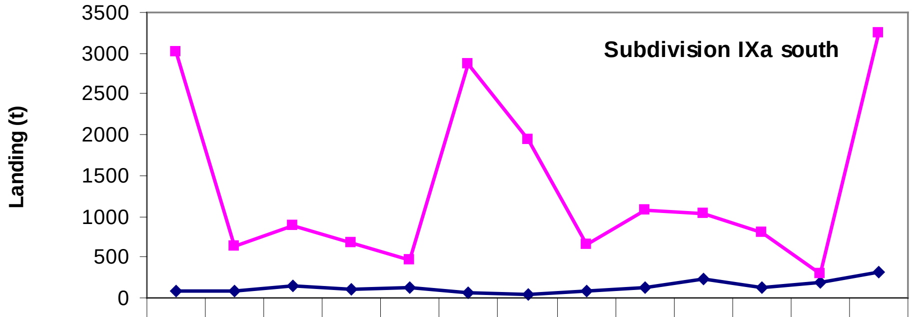


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Trawler fleet	0.0	6.5	4.9	9.8	37.3	4.2	3.8	18.2	53.9	28.8	49.6	42.5	11.8
Artisanal fleet	1200.	1097.	1336.	1518.	1797.	700.8	836.6	977.4	1341.	957.8	1741.	1462.	1077.

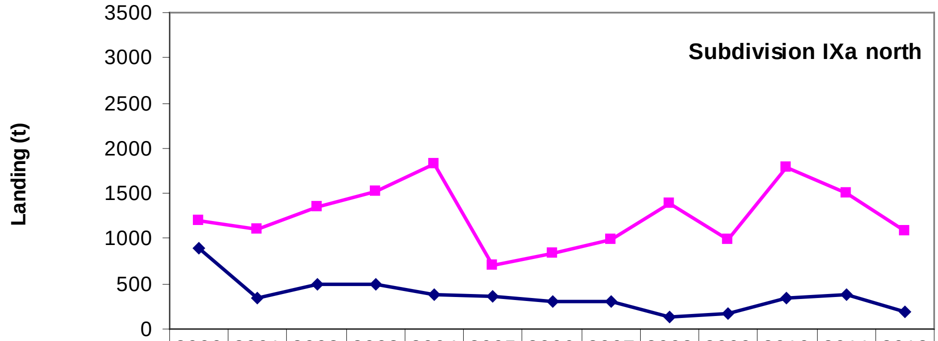


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Trawler fleet	5.8	7.4	3.9	5.3	50.9	4.0	22.9	15.5	15.8	3.0	79.6	55.1	36.6
Artisanal fleet	842.9	1125.	914.3	881.0	1195.	1168.	802.2	1647.	1412.	859.5	1659.	1502.	1075.

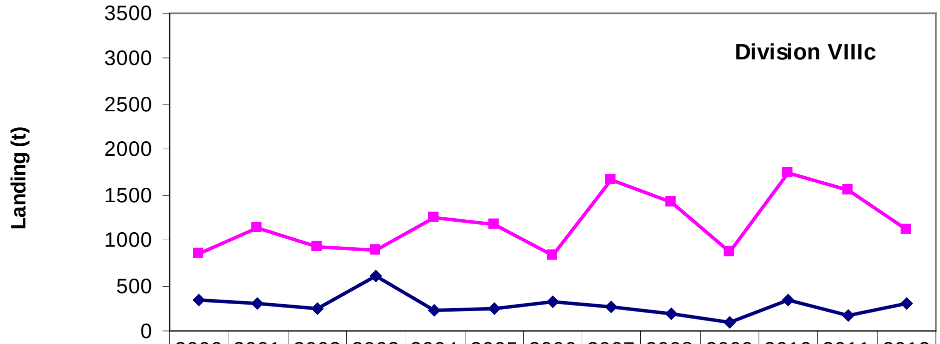
Figure 3. ***O. vulgaris*** **landings (in tons) by fleet in Subdivision IXa south, Subdivision IXa-north and Division VIIIc during the 2000-2012 period.**



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Eledone spp	88.4	87.7	144.2	98.7	118.1	70.0	51.0	74.5	136.0	234.8	131.7	184.3	320.3
O. vulgaris	3015.	637.6	878.9	677.1	454.5	2871.	1932.	646.0	1064.	1028.	798.5	285.2	3242.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Eledone spp	900.6	349.6	486.1	500.5	379.6	363.8	300.9	311.3	140.6	170.3	335.1	380.3	194.3
O. vulgaris	1200.	1103.	1341.	1528.	1835.	705.0	840.5	995.6	1395.	986.6	1791.	1505.	1089.

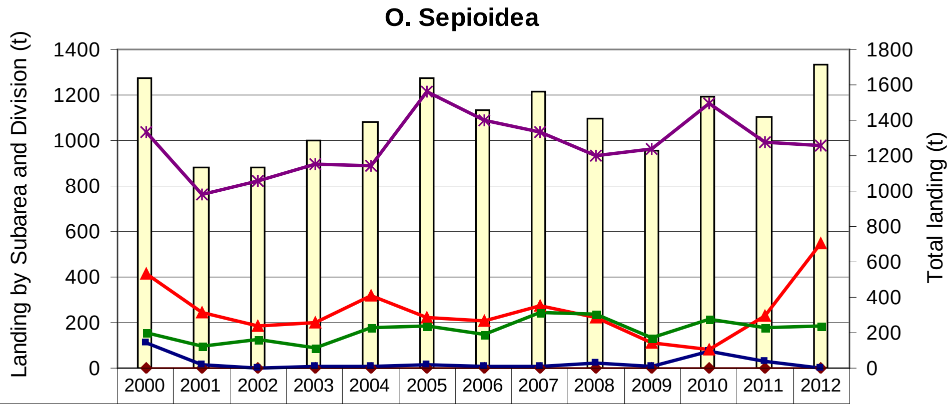


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Eledone spp	343.9	308.5	246.8	612.4	220.1	248.7	326.2	264.3	183.6	98.6	336.6	176.9	300.0
O. vulgaris	848.8	1132.	918.3	886.3	1246.	1172.	825.1	1663.	1428.	862.5	1738.	1558.	1112.

Figure 4. Octopodidae landings by species in Division VIIIc and IXa (north and south) during 2000-2010 period.

Sepiidae

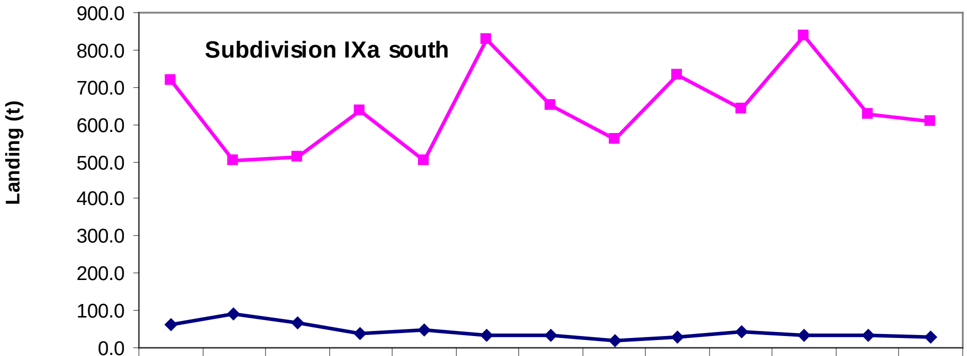
The trend of cuttlefish annual landings by Subarea/Division is shown in Figure 5. Total landings ranged between 1714 t in 2012 and 1129 t in 2001. Since 2001, landings increased to 2005 and 2007, when they reached two new maxima values similar to 2000. Afterwards, landings decreased slightly up to 1224 t in 2010, reaching the highest values of the time-series in 2012. Division IXa contributed with 70% of total cuttlefish landed by Spanish fleet, with the 70% of landings in this Division corresponding to the Subdivision IXa-South (Gulf of Cadiz). Landings in Division VIIIc increased at the end of the analysed period, reaching 245 t, whereas in Division VIIIabd they showed more or less constant, around 220 t in average, with a decrease in 2009 and 2010, and showing a increase in the two last year with the highest values of the time-series in 2012 with 548 t. Landings in Subarea VII were below 20 t, except in 2000 with 110 t, and they were almost absent in the Subarea VI.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	1636.8	1129.4	1133.3	1286.1	1394.0	1635.3	1456.0	1563.1	1412.4	1224	1535	1423	1714
VI	0	0	0.5	0	0	0	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	10.6	73.2	29.1	0.6
VIIIabd	417.7	247.5	187.0	200.5	317.6	225.9	207.7	272.2	220.6	114	82.9	227.4	548.1
VIIIc	153.6	99.0	122.6	87.6	176.0	181.9	149.2	245.9	237.1	134.2	215.6	175.9	187.3
IXa	1037.3	765.4	820.2	898.6	889.4	1215.2	1089.9	1035.9	935.3	965.1	1164	990.6	977.7

Figure 5. Spanish landings (in tons) of cuttlefish species (O. Sepioidea) by ICES Subarea/Division during the 2000-2012 period.

Cuttlefish (*O. sepioidea*) landings from Subarea VII and Divisions VIIIabd mainly comprise common cuttlefish *Sepia officinalis* and, in a lesser amount, also elegant cuttlefish *Sepia elegans* and pink cuttlefish *Sepia orbignyana*. Bobtail squid *Sepiola* spp. is not identified in landings. Only *Sepia officinalis* and *Sepia elegans* are present in landings from Divisions IXa and VIIIc-West. Data on the proportion of each species are only available for Subdivision IXa-South, where *Sepia officinalis* makes up about 93% of cuttlefish landed (Figure 5). In this Subdivision *Sepia elegans* and *Sepia orbignyana* appear mixed in landings, although the last species is quite scarce. The commercial value of *Sepia elegans* is high, and for this reason is separated in the catch.



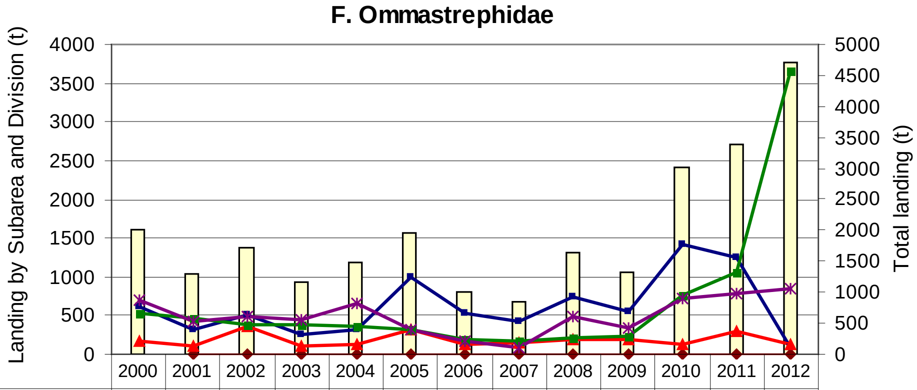
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
S.elegans	63.2	88.7	65.9	40.1	48.1	35.2	34.3	18.6	29.3	41.7	32.9	32.2	27.5
S.officinalis	718.3	500.3	514.0	637.0	500.7	830.2	652.1	560.9	731.1	642.3	839.3	629.2	609.0

Figure 6. Sepiidae landings by species in Subdivision IXa south during the 2000-2012 period.

Ommastrephidae

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 7 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. Afterwards, landings quickly dropped reaching a minimum in 2007 with 834 t. In 2008, this value doubled in relation to the previous year, with a new decrease in 2009. In the three last years of the time-series occurs a strong increase, reaching then the maximum values in 2012 with 4718 tonnes, as in the rest of cephalopod groups.

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, landings from Subarea VII increased, 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. In 2010, all the Subareas and Divisions reached the maxima values, except Division VIIIabd which presented a slightly decrease in relation to the previous years. At the end of the time-series, both Division IXa and VIIIc showed considerable increases, mainly in Division VIII c, reaching a value in 2012 of about 300% with regard to 2011 (3651 tonnes). Subdivision IXa–South accounts for the lower values of the time-series with landings below of 1% of the total of short-finned squid species landings.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	2017	1305	1718	1164	1471	1950	1018	833.9	1636	1314	3023	3397	4718
VI		0	0	0	0.285	0	0	0.009	0	0	0	0	0
VII	615.7	313.3	501.3	252	319.6	1003	528.3	425.7	730.7	541.2	1413	1257	79.3
VIIIabd	172.5	101.2	350.6	97.61	135.9	315.3	126.7	141.1	195.6	190.1	123.7	289	133
VIIIc	529.8	461.6	373.4	376.6	359.2	319	199.5	179.7	218.7	240.3	756.1	1062	3651
IXa	699.1	429.1	492.3	438.3	655.8	312.2	163.7	87.4	491.2	342.4	729.8	788.4	854.3

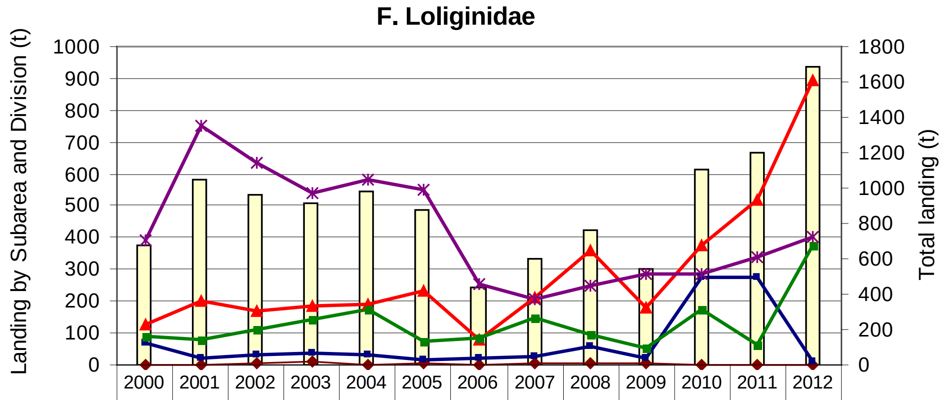
Figure 7. Spanish landings (in tons) of short-finned squid species (Fam. Ommastrephidae) by ICES Subarea/Division during the 2000-2010 period.

Loliginidae

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 mainly present in squid landings from Subdivision IXa-South, showing low catch levels in Subdivision IXa north during the same years.

Figure 8 shows the trend of total long-finned squid landings and by Subarea/Division. Total landings presented a maximum value in 2001 with 1052 t, and then they remain more o less stable at around 900 t until 2006, when they showed a drop, reaching the minimum value in the time-series with 440 t. An increasing trend is observed from this year to 2012, reaching the maximum values in this year with 1683 tonnes, indicating a considerable recovery of landings.

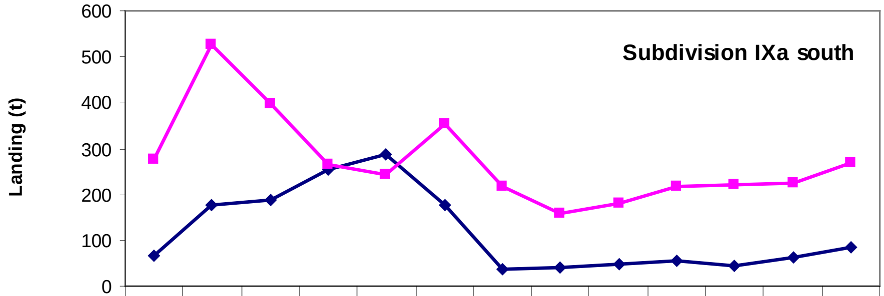
The analysis by Subarea/Division shows that the Division IXa recorded the highest landings from 2001 to 2005, with values ranging between 753 and 552 t, respectively. The 2007 landings fell to 200 t and remained stable during three years with an increasing trend up to the last year where is reached the maximum values (401 t). Landings in Division VIIIabd and VIIIc were lower than in IXa, excep at the end of the time-series, oscillating between 128 t in 2000 and 895 t in 2012, and between 76 t in 2005 and 378 t in 2012, respectively. Landings in Subarea VII were also very low as compared with other areas, with average annual landings of only 30 t, but they showed a significant increase in 2010 and 2011, as also happened in Division VIIIc and VIIIabd. The Subarea VI showed very scarce landings, below 10 t, as it was also abovementioned described for the other analysed groups of cephalopod species, without landing in the last years.



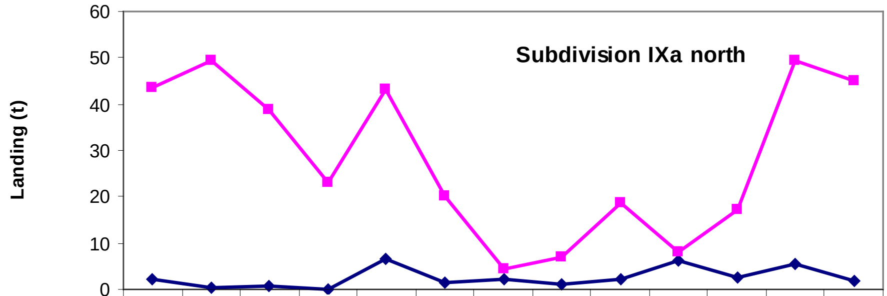
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	676	1052	958	917	980	880	441	598	765	546	1109	1196	1683
VI	0	1	3	10	2	8	2	3	3	3	0	0	0
VII	68	19	32	37	33	15	19	26	58	23	277	277	9
VIIIabd	129	201	172	185	190	230	79	214	360	180	373	516	895
VIIIc	88	78	113	144	175	76	85	146	97	55	173	63	378
IXa	390	753	637	542	581	552	255	209	247	286	286	340	401

Figure 8. Spanish landings (in tons) of long-finned squid species (Fam. Loliginidae) by ICES Subarea/Division during the 2000-2012 period.

Both in Subdivisions IXa south and north, *Loligo spp* and *Alloteuthis* spp landings appear separated due to their high commercial importance. Figure 9 shows the proportion of each species group by Subdivision. Both groups yielded higher landings in IXa south than in IXa north. *Alloteuthis* spp landings in IXa south ranged between 286 t in 2004 (i.e. higher landings than *Loligo* spp ones in this year) and 38 t in 2006, whereas in IXa north the highest record was 6.5 t in 2004. In both Subdivisions, the first half of the time-series in both Subdivisions recorded the highest landings, although *Loligo* spp. showed an importat increase in 2011-2012 in Subdivision IXa-noorth, with landing around 45 tonnes. In the last years *Alloteuthis africana* is also occasionally present in the Gulf of Cadiz (IXa-South) landings, mixed with the other *Alloteuthis* species (Silva *et al.*, 2011).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Alloteuthis spp	68.0	178.4	188.2	252.5	286.8	175.8	38.5	40.9	47.5	53.4	46.0	60.9	83.4
Loligo spp	276.8	524.8	395.8	266.3	244.4	354.4	215.6	159.9	178.7	218.0	220.2	224.1	270.5



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Alloteuthis spp	2.1	0.5	0.8	0.1	6.5	1.3	2.1	1.0	2.3	6.1	2.6	5.31	1.65
Loligo spp	43.4	49.5	38.8	23.2	43.1	20.3	4.5	6.8	18.6	8.1	17.3	49.44	44.87

Figure 9. Long finned squid landings by species in Subdivision IXa south and north during 2000-2012 period.

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WORKING DOCUMENT 3

ICES Working Group on the Cephalopod Fisheries and Life History

Caen (France), 11-14 June 2013

UPDATE OF THE BASQUE CEPHALOPOD FISHERY IN THE NORTHEASTERN ATLANTIC WATERS DURING THE PERIOD 1994-2012

by

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1. INTRODUCTION

Up to 2012 AZTI-Tecnalia is monitoring monthly cephalopod landings, catch, and discards, and fishing effort by gear and sea area of the Basque Country ports. 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 were considered as bycatches of other directed demersal fisheries operated by the Basque fleet, targeting hake, anglerfish and megrim and more than other 30 species until some years ago. These demersal fisheries operate in different sea areas – ICES Subareas VI, VII and Divisions VIIIa,b,d (Bay of Biscay) and VIIIc (eastern Cantabrian Sea)- and different gears: bottom-trawl, pairtrawlers, longliners, purse-seiners, nets, artisanal hook and lines and traps or pots. However, in the last years cephalopods obtained in mixed fisheries (mainly "Baka" Otter trawls) are becoming more important in relation to the species composition of the catch and for some trips nowadays they are target species.

In this document, data of the Basque Country cephalopod landings from 1994 to 2012 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

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Bank) and in Sub-area VI (both in the western part of Scotland and around Rockall Bank). Local trawls, artisanal gillneters and some pots or trap vessels working usually in the eastern Cantabrian Sea (Div. VIIIc) also catch some cephalopods.

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.

2. RESULTS

2.1. Landings of cephalopods in Sub-areas VI, VII and Div. (VIIIa,b,d, c)

During 2012 and in Div. VIIIa,b,d, the largest landings of squids were recorded during October, November and for cuttlefish mainly during January and February. Squid landings reached 317 t in November while cuttlefish landings reached a peak of around 125 t in January. Short-finned squid maximum landings occurred in April being around 10 t. Landings of octopus were higher in Div. VIIIa,b,d during February reaching around 24 t (Figure 1).

In Figure 2 percentage of landings by species groups and sea area in 2012 are presented. Landings from Div. VIIIa,b,d for squids comprise 96% and for cuttlefish 98%. In the case of short-finned squid 53% and for octopus the 87% of landings came from Div. VIIIa,b,d.

For 2012, each of the cephalopod groups contributed evenly to the total cephalopod catches, 54% squids, 31% cuttlefish, 6% short-finned squid and 9% octopus. 93% of total cephalopod landings came from Div. VIIIa,b,d (Figure 3).

Looking at the catch evolution of squid and cuttlefish during the period 1994-2012, the most remarkable feature is the continuous 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 alternation of years of rather high and low landings is observed mainly in squids. For all dataseries, no cuttlefish, short finned squid 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 March and April almost till June. Octopus higher landings are registered during autumn and winter months.

Cephalopod historical landings deployed by Basque vessels show an important decreasing trend from 1994 to 2001 (Figure 5). From 2002 onwards, the total landings of cephalopods remain quite stable but with interannual fluctuations. From 2009 and increasing trend is observed and in year 2012 landings are close to the maximum level of the time-series with the peak in 1994. Focusing on fishing effort (Figure 6) it shows a decreasing trend from 1996 to 2012 which is caused by the disappearance of some Basque vessels in the last years due to regulation implementation and other different factors. In 2010 and 2011 an increasing trend in effort is observed in the number of days of the pairtrawlers and some trips deployed in Subarea VII by the “Baka” otter trawler but in year 2012 pairtrawlers effort has been reduced and no “Baka” otter trawler effort was observed in Subarea VII.

Nowadays, the most important Basque fleet targeting cephalopods are “Baka” bottom otter trawlers in the Division VIIIa,b,d. Within this fleet three different métiers have been defined following the criteria defined in the European Data Collection Framework:

-OTB_DEF_>=70 (otter trawlers targeting demersal fish).

-OTB_MCF_>=70 (otter trawlers targeting mixed cephalopod and demersal fish).

-OTB_MPD_>=70 (otter trawlers targeting mixed pelagic and demersal).

Landings of the different species have been included in one or other métier following the segmentation above. In the last four years from 2009 to 2012, the métier targeting cephalopods OTB_MCF has increased its number of trips and its cephalopods catches (Figure 7). The increase in the OTB_MCF métier seems to be related to the decrease in OTB_DEF métier targeting demersal species like hake, megrim or anglerfish.

2.2. LPUE of cephalopods in Sub-areas VI, VII and Div. (VIIIa,b,d)

In the last years, fleet composition has changed in the Basque ports and nowadays there are mainly four fleets targeting cephalopods.

. Baka-trawl-Ondarroa in Div. VIIIa,b,d

. Baka-trawl-Ondarroa in Sub-area VII

. Baka-trawl-Ondarroa in Sub-area VI

. VHVO Pair Trawl-Ondarroa in Div. VIIIa,b,d

. VHVO Pair Trawl-Pasajes in Div. VIIIa,b,d

. VHVO Pair Trawl-Pasajes in Sub-area VII

All of them, together considered, represented close to 94% total cephalopod landings in the Basque Country ports in 2012.

It has to be mentioned that from 2005 onwards the VHVO Pair Trawl-Pasajes in Sub-area VII fleet disappears and from 2008 onwards VHVO Pair Trawl-Pasajes in Div. VIIIa,b,d fleet also disappears. In 2009 the Baka-trawl-Ondarroa in Sub-area VII did no effort and change its fishing area to Division VIIIa,b,d. Despite that, the 6 fleets selected above will be used to show time-series trends in cpue data but it must be considered that for the last years only 3 of them will be active and will provide effort information.

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.

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 8). This figure shows a stable situation in LPUE from 1995 till 2002. Some fluctuations with high and low abundances are observed in the dataseries. During the last period of the series, and in relation to Div. VIIIabd, LPUEs for squid and cuttlefish have markedly increased whilst, octopus and short-finned squid have, in general, decreased. In Subarea VII, Octopus LPUEs have markedly decreased since 2007, mainly driven by the decrease in the effort deployed by the Basque fleet in that area. Octopus caught in this area is mainly *Eledone cirrhosa* catches of this species in the last year are nil. Short finned squids LPUEs are maintained at low levels along dataseries despite a sharp increase in 2010 due to a high catch in a unique trip deployed by “Baka” otter trawlers in Subarea VII.

2.3. 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). From 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 Northeast 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 Subarea 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 otter trawlers fishing in the ICES Subarea VI targeting blue ling and witch.
- Basque "Baka" bottom otter trawlers fishing in the ICES Subarea VII targeting anglerfish and megrim.
- Basque "Baka" bottom otter trawlers fishing in the ICES Div. VIIIa,b,d targeting a great variety of species (mixed fisheries).
- Basque Pairtrawlers 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 any of them. Thus, no length distribution and numbers of all discarded and retained cephalopod species were estimated whilst weights retained and discarded were obtained.

In Table 1 the amount of estimated cephalopods discarded (in percentage) during 2003-2012 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. Short-finned squid are mainly discarded in Subarea VI.
- In Subarea VII, there is no effort deployed by the fleet during 2012, so no discard information is available.
- During year 2012 an important change in the exploitation pattern of cephalopods was observed. Discards in all fleets of the Basque fleets have been reduced to 0% what could be explained with a change in target species for these fleets.
- 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.

2.4. Prices of cephalopods in Basque ports

Cephalopod prices in Basque ports from 2001 to 2012 are presented in Figure 9. The price given is the mean value of both landing ports Ondarroa and Pasajes. It can be observed that the mean value has remained quite stable in the last eleven years. Squids have the best price of landed cephalopod that goes from 6 euro in 2001 to 7.7 euro in 2012. Cuttlefish is the second better paid which goes from 2.50 euro in 2001 to 3.20 euro in 2011. Octopus had the peak in price in 2003 but after that it has decrease some years and in 2009 it was around 3.10 euro. Finally, the short-finned squid, which is the cephalopod with lower prices in the time-series, shows a price of 1.31 euro in 2012.

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

3. CONCLUSIONS

Cephalopod historical landings trend from 1994 to 2012 should be more in detail analysed. A study should be desirable to actually define if changes in landings are due to changes in fisheries/métiers (fishing strategies due to market reasons), differences in fishing capacity or a real change in the abundance of these species. The comparison of the historical landings of cephalopods and LPUE data shows that LPUE data present in the last three years of the time-series the same increasing trend as landing data. Therefore, one conclusion could be that landings increase and the abundance indices (LPUE data) of the fleets analysed do show this increasing trend in the abundance of some cephalopods mainly squids and cuttlefish.

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 2012. 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), coinciding with the bad shape of the hake stock.. In the last studied five years, the cephalopod proportion in landings is around 15% with a peak of 28% in year 2007. Cephalopods appears to be an important accessory species for the baka trawlers in division VIIIa,b,d due to, specially, reduction of quotas of some traditional demersal species during the period 2002-2005, with apparent constant availability and relatively good market prices. In the last four years 2009-2012 effort of the mixed cephalopod métier (OTB_MCF) has yearly increased and landings of the métier have also increased. This shows a change in the fishing exploitation pattern if the Basque trawlers having cephalopods as target species in some periods of the year due to the good price of these species and the lack of quota for them.

The analysis of prices shows that in the last eleven years there has been hardly increase in prices of cephalopods, as it has also occurred for the rest of the main demersal commercial species. The squids remain being the cephalopod with highest price and the short-finned squid is the one with lowest price.

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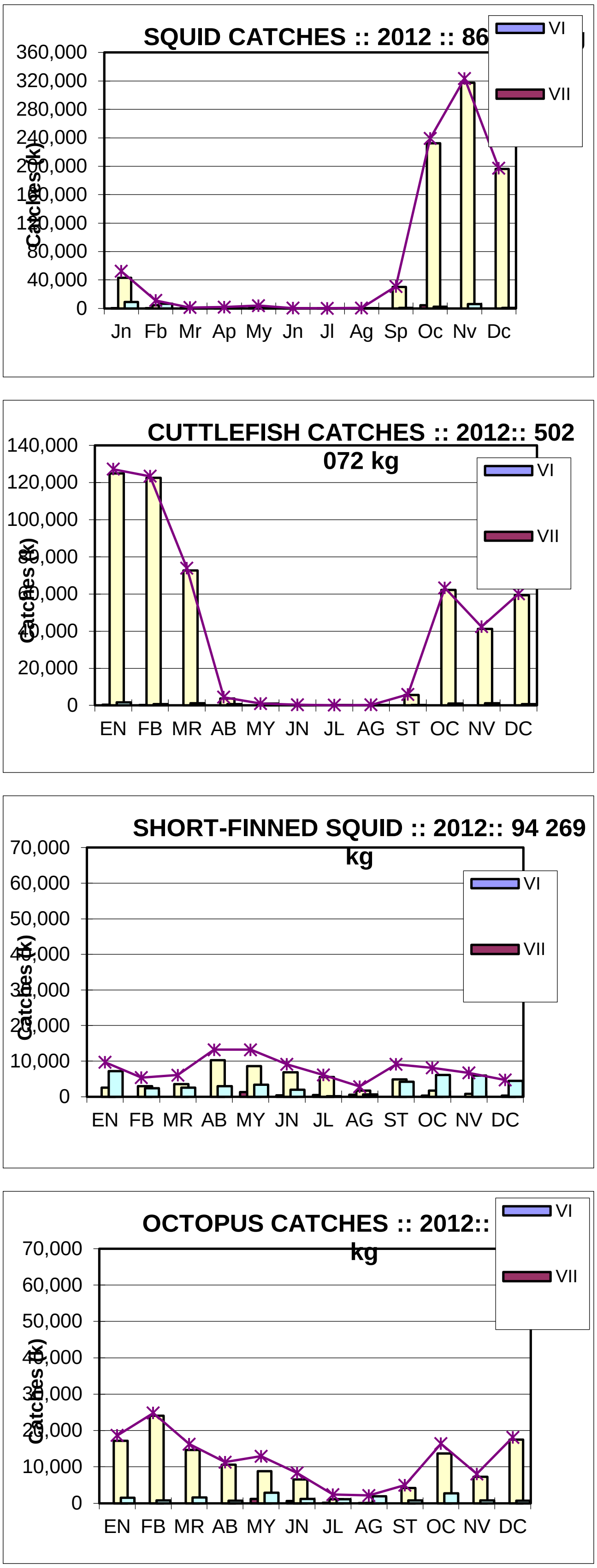


Figure 1. Monthly distribution of the Basque Country Catches (landings in kg) of Squid, Cuttlefish, Short-finned squid and Octopus by sea area, in 2012.

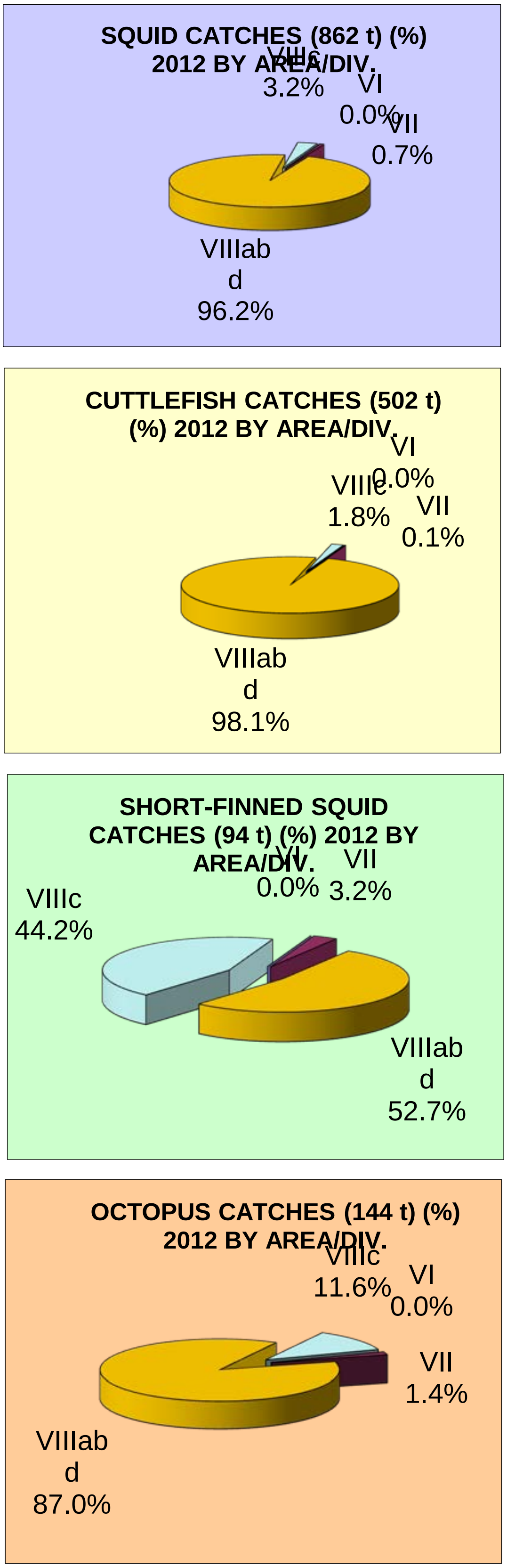
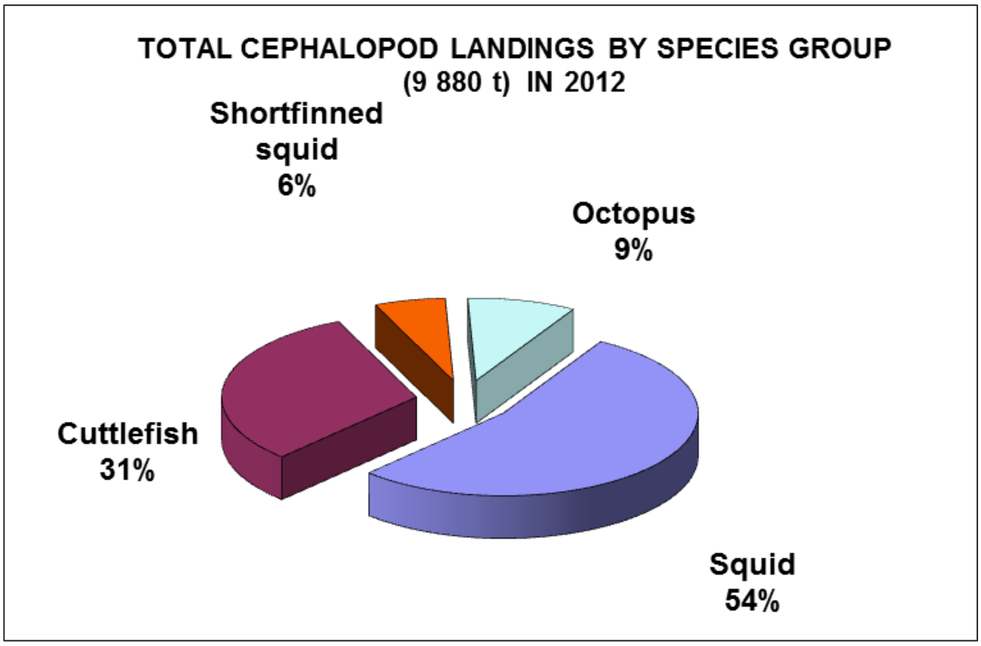


Figure 2. Percentage of the Basque Country landings of Squid, Cuttlefish, Short-finned squid and Octopus by sea area, in 2012.



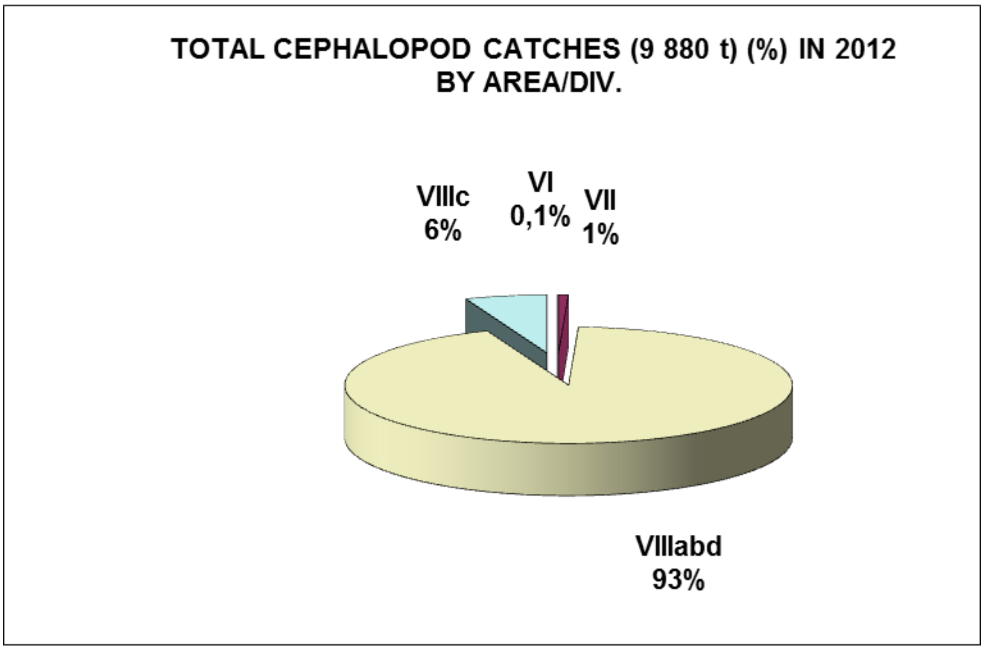


Figure 3. Total composition in percentage of the Basque Country landings. Above: By species group. Below: By sea area for 2012.

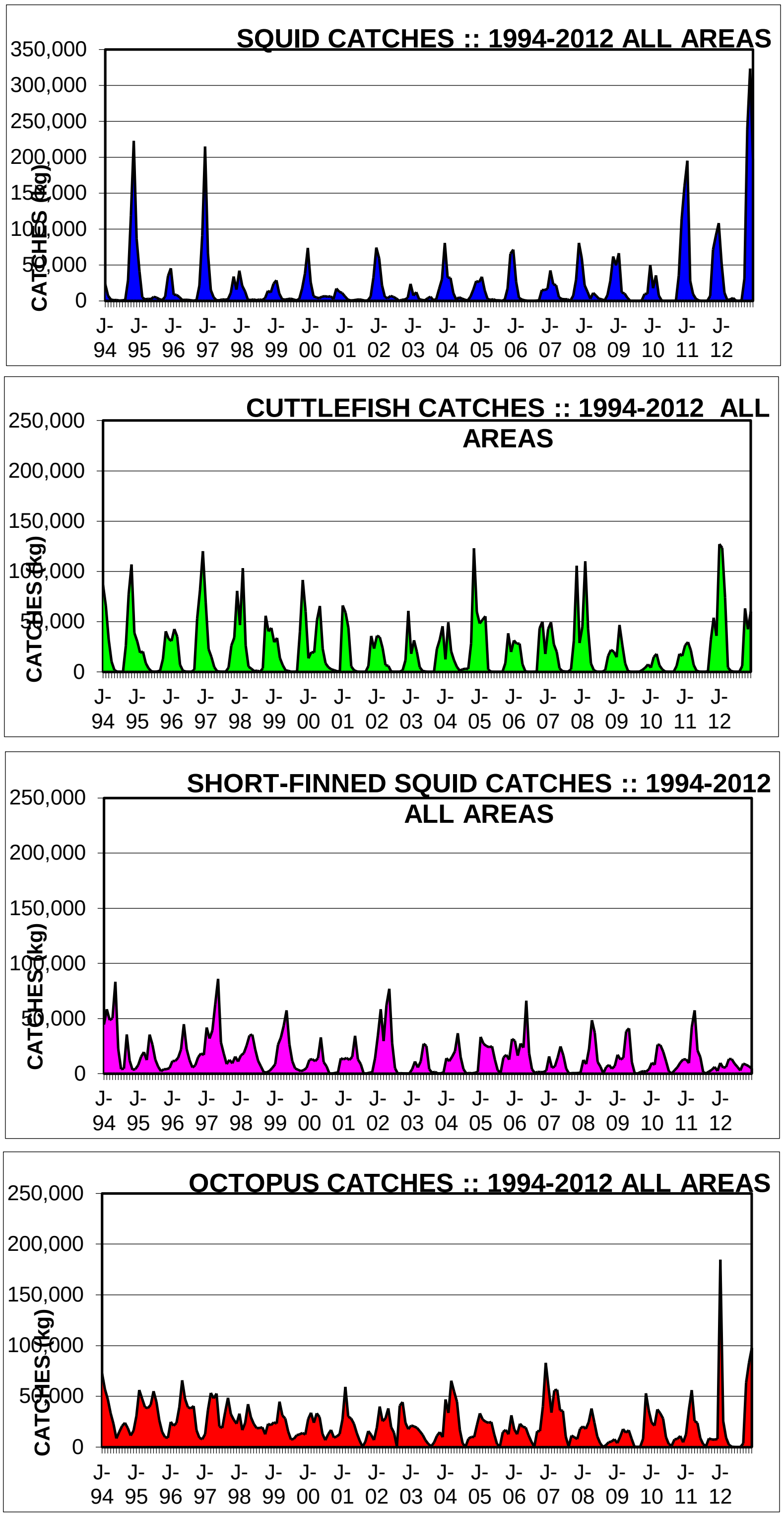


Figure 4. Cephalopods landing (in kg) evolution of the Basque Country by species group considering all areas together (VI, VII, VIIIabd and VIIIc) for the total period 1994-2012.

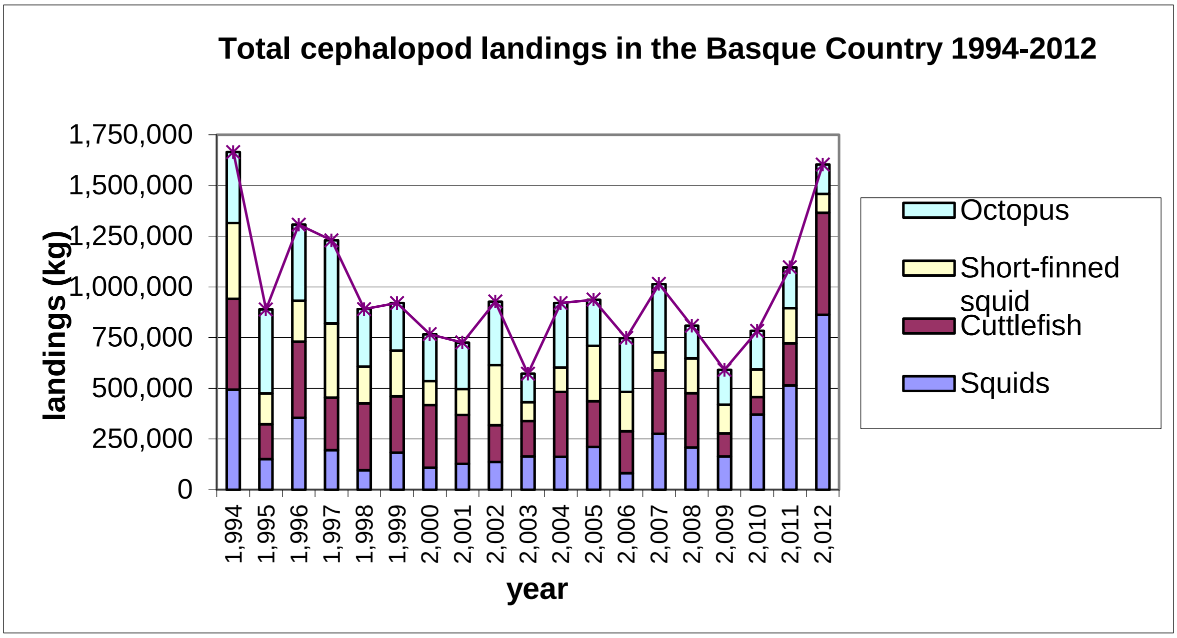


Figure 5. Cephalopods landing evolution of the Basque Country by species group for the total period 1994-2012.

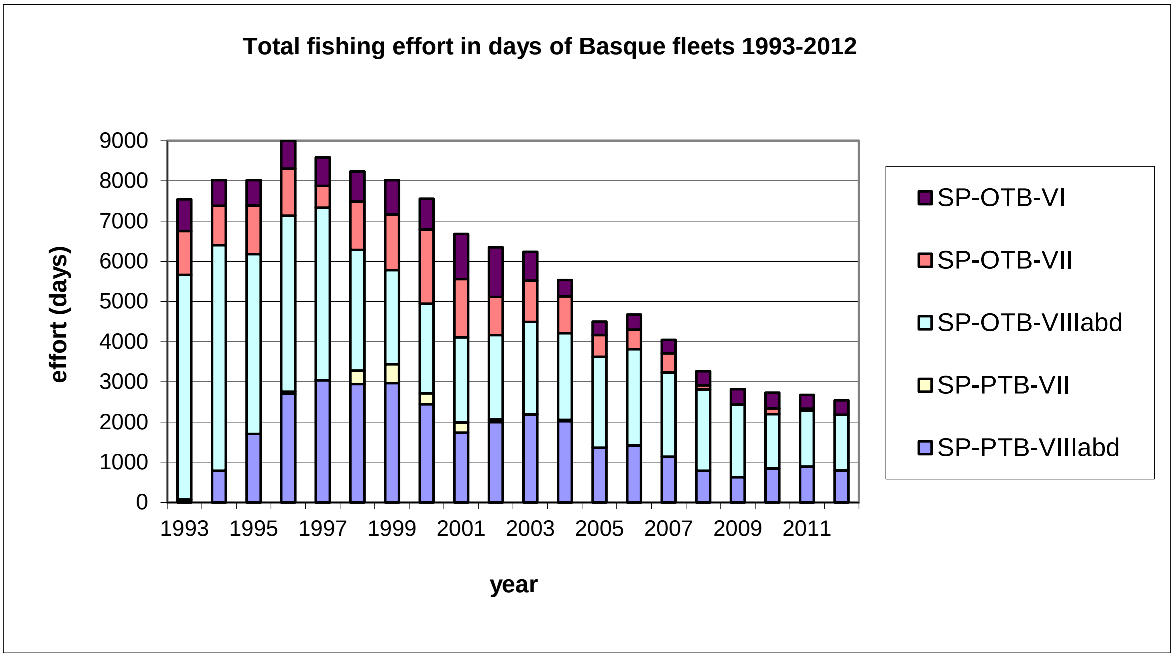


Figure 6. Total fishing effort of the Basque fleets from 1993 to 2012.

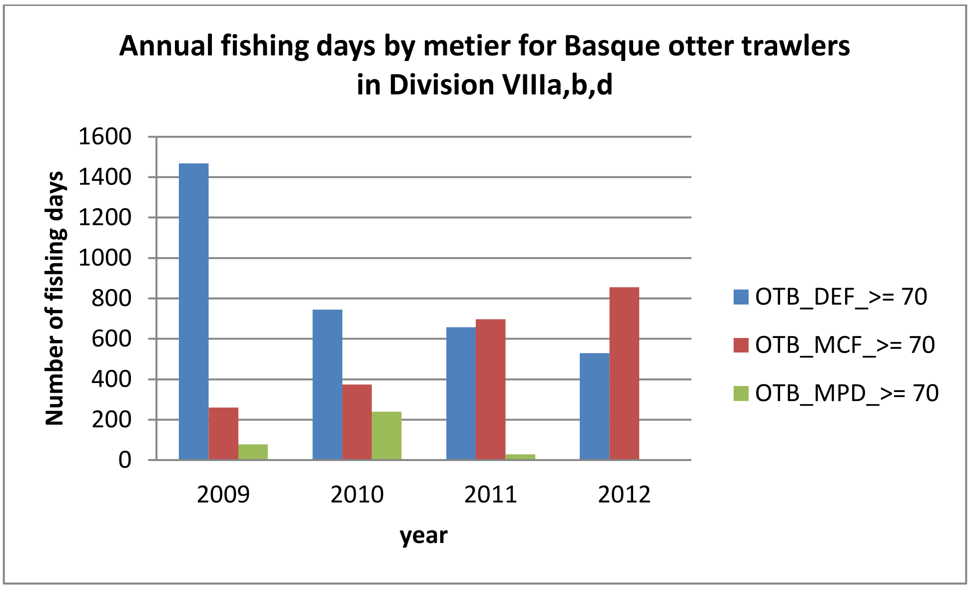


Figure 7. Annual fishing days by métier for Basque bottom otter trawlers operating in Division VIIIa,b,d during 2009 to 2012.

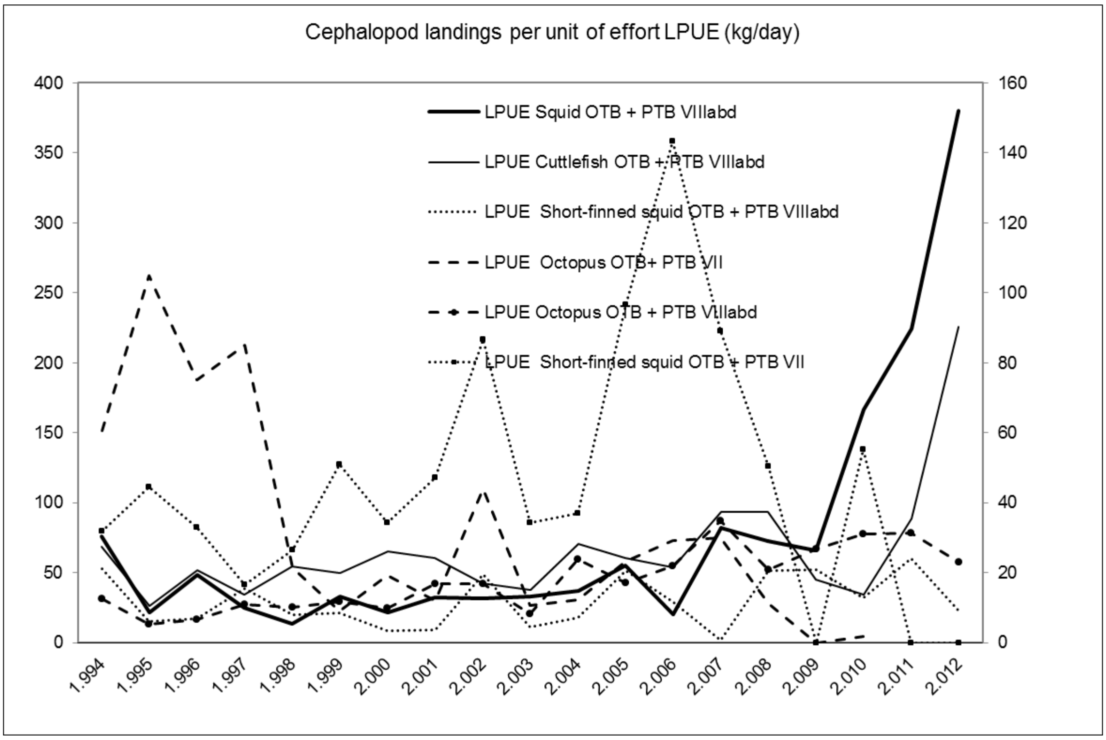


Figure 8. Cephalopod landings per unit of effort (kg/day) of the Basque fleet from 1994 to 2012.

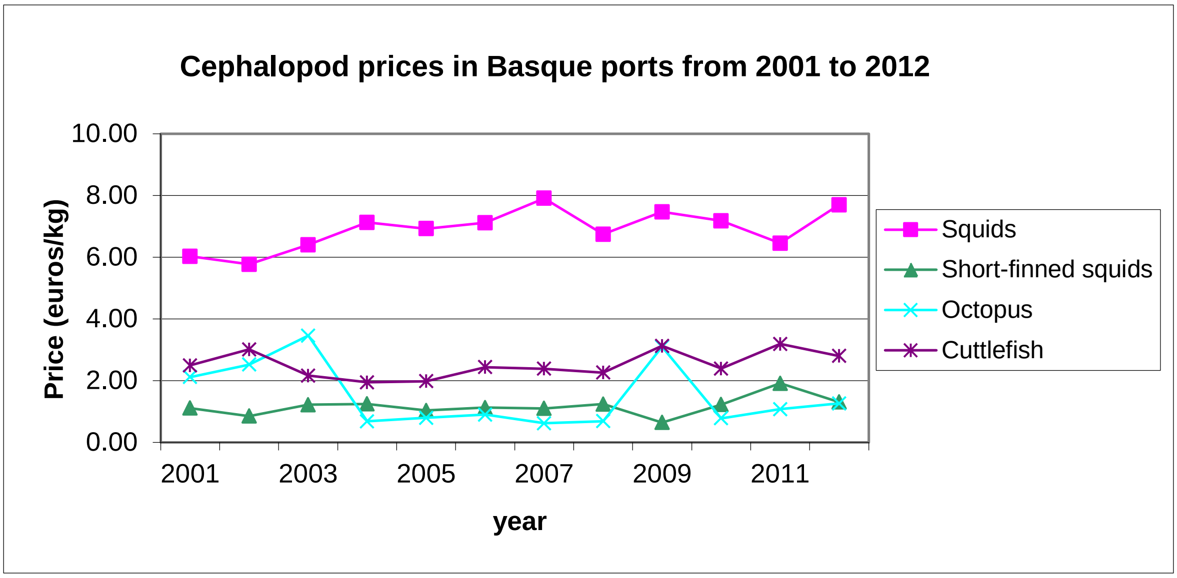


Figure 9. Cephalopod prices in Basque ports from 2001 to 2012.

Table 1. Estimated cephalopod discard (kg) during 2003-2012 series is presented.

Gear	Area	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
OTB	VI	Short finned squid	100 %	-	-	-	-	100 %	100 %	100 %	100 %	0%
		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%	31%	87%	0.2%
		Curled octopus	28%	5%	7%	0%	19%	2%	14%	5%	74%	0%
		Cuttlefish	0%	1%	2%	-	1%	-	8%	-	3%	0%

Working Document 4 for the ICES WGCEPH Working Group on Cephalopod Fisheries and Life History.

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Portuguese cephalopod fishery statistics (tor a) and population parameters (tor b) – updating status and trends in ICES division IXa

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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. On this document cephalopod fisheries data for the Portuguese fleets operating in ICES division IXa are presented and the main trends in landings, discards, fishing effort and mean length are analysed.

1. Cephalopod landings from ICES division IXa

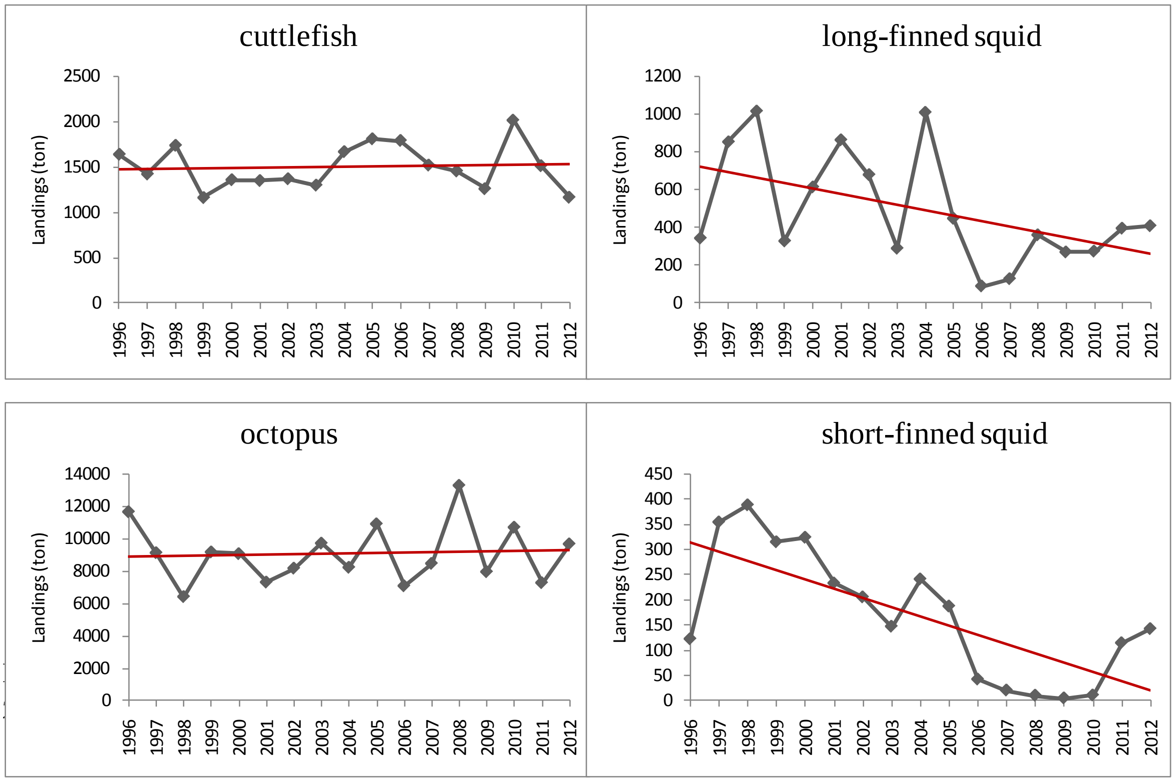
The relative importance of cephalopod species in landings from Portuguese waters (ICES IXa) is constant along the years with significantly higher landings of octopus, followed by cuttlefish, long-finned squid and short-finned squid (1%) (Table 1). Landings of cuttlefish include only landings of *Sepia officinalis* (FAO code CTC); landings of long-finned squid include landings of *Loligo* sp. (FAO code SQC), *Loligo vulgaris* (FAO code SQR), *Alloteuthis subulata* (FAO code OUL), *Alloteuthis* sp. (FAO code OUW); landings of octopus include landings of *Octopus vulgaris* (FAO code OCC), *Eledone cirrhosa* (FAO code EOI) and octopus nei (FAO code OCT); landings of short-finned squid include landings of ommastrephids not specified (FAO code OMZ). Long-finned squid landings may also contain *Loligo forbesi* ad *Alloteuthis media*; short-finned squid landings may contain *Illex coindetii, Todaropsis eblanae*, *Todarodes sagittatus* and *Ommastrephes bartrami*.

Since 1996, an average of 11 216 tons of cephalopods were landed by the Portuguese fleets from ICES Subarea IXa. Most cephalopod catches are made by vessels using a collection of gears which includes gillnets, trammelnets, traps, pots and hooks (lines), classified under the polyvalent gear type group (which roughly equates to artisanal fisheries). Octopus landings represent ca. 81% of the total cephalopod Portuguese landings, with average landings between 1996 and 2012 of 9056±1794 tons. Annual landings of octopus show a significant fluctuation, and the trend since 1996 is slightly positive (Figure 1). Cuttlefish landings represent ca. 13% of the total cephalopod landings, with average landings between 1996 and 2012 of 1500±241 tons. Annual landings of cuttlefish show much less fluctuations, and the trend since 1996 is also slightly positive. Landings of squid represent only 4% (long-finned squid, average 492±294 tons) and 1% (short-finned squid, average 168±127 tons) of the total cephalopod landings. Annual landings of both long-finned and short-finned squid decreased significantly since 1996, recording rather low amounts since 2006. However, long-finned squid landings show a slow but consistent increase since then, and short-finned squid show an increase since 2011.

Table 1 – Landings by Portuguese fleets from ICES subarea IXa between 1996 and 2012.

Year	Cephalopods	Cuttlefish (Sepiidae)	Long-finned Squid (Loliginidae)	Octopus (Octopodidae)	Short-finned squid (Ommastrephidae)
1996	13735	1635.5	342.7	11635.0	122.0
1997	11738	1419.8	852.7	9112.1	353.6
1998	9544	1734.0	1015.8	6407.0	387.5
1999	10961	1161.5	327.5	9157.4	314.2
2000	11346	1357.1	613.7	9052	323.2
2001	9744	1348.1	863.3	7300.5	232.5
2002	10410	1367.8	679.0	8158.3	204.9
2003	11434	1297.9	288.8	9700.2	146.7
2004	11126	1664.8	1009.0	8211.6	240.5
2005	13329	1805.4	447.4	10889.4	186.8
2006	8992	1787.3	89.1	7074	42.0
2007	10118	1517.5	127.6	8452.3	20.2
2008	15084	1453.0	360.1	13261.2	9.9
2009	9473	1258.8	269.2	7940.5	4.6
2010	12975	2009.4	273.5	10681.5	10.4
2011	9285	1510.6	395.0	7265.5	16.8
2012	11369	1165.0	408.0	9654	21.6

An effort was made to discriminate cephalopod species in fisheries official statistics with the DCF implementation, enabling the analysis of landings by species.



1.1. Octopus by species

The annual landings from ICES subarea IXa (only Portuguese waters) of *Octopus vulgaris* and *Eledone cirrhosa* (plus the fraction of octopus landings which is not split by species) are presented in Table 2 for the period 2003 to 2012. We may observe that *Eledone cirrhosa* landings did not vary according to the progressively correct identification of octopus species in the official landings (opposed to *O. vulgaris*). This fact and its considerable lower value at first sale compared to *O. vulgaris* or octopus nei indicate that the official landings of octopus nei probably correspond almost exclusively to *O. vulgaris*. Therefore, base on this assumption total *O. vulgaris* landings for the period 2003 to 2012 are estimated as the sum of the official octopus nei and *O. vulgaris* landings. *O. vulgaris* landings represent ca. 98% of the total octopus Portuguese landings, with average landings between 2003 and 2012 of 9089±1911 tons. A large percentage of *O. vulgaris* come from the polyvalent fleet (91-97%) (Figure 2). *E. cirrhosa* landings averaged 159±56 tons in the same period, mostly from the trawl fleet (88-98%).

Table 2 – Landings of *Octopus vulgaris* and *Eledone cirrhosa* from ICES subarea IXa (only Portuguese waters) between 2003 and 2012 and mean value at first sale (€) for 2011 and 2012.

Year	Octopus nei (tons)	€	*Octopus vulgaris* (tons)	€	*Eledone cirrhosa* (tons)	€	% non identified octopus	Estimated O. vulgaris (tons)
2003	8199		1182		220		85	9382
2004	7442		487		215		91	7930
2005	7388		3188		213		68	10575
2006	3172		3682		146		45	6854
2007	3573		4689		146		42	8262
2008	4334		8755		118		33	13089
2009	1107		6599		162		14	7706
2010	100		10309		211		1	10409
2011	49	5.8	7116	5.4	87	1.4	1	7165
2012	7	5.0	9507	4.5	68	1.5	0	9514

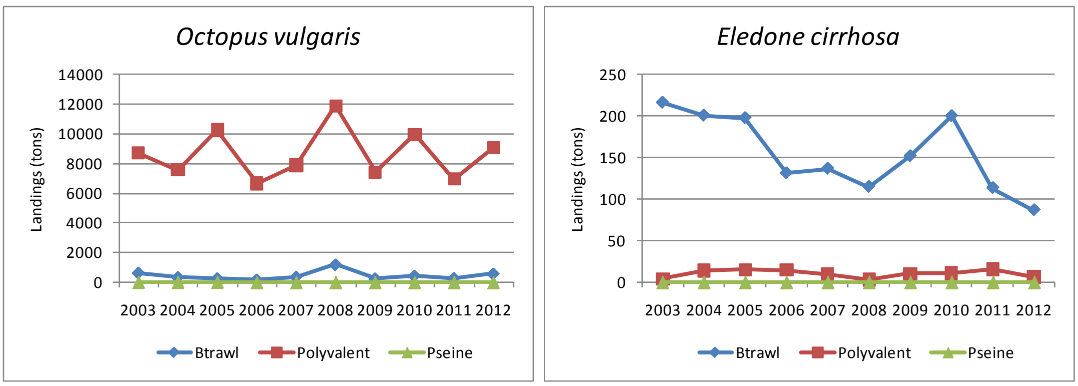
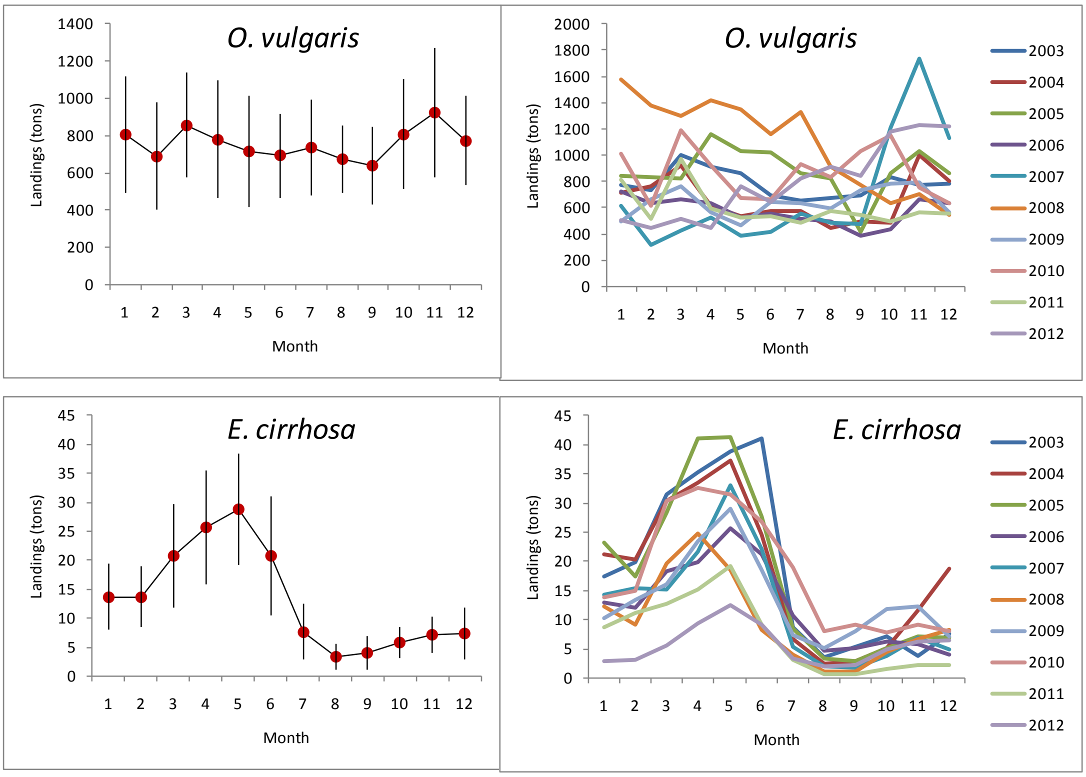


Figure 2 – *Octopus vulgaris* and *Eledone cirrhosa* landings by fleet from ICES subarea IXa (Portuguese waters only), between 2003 and 2012.

Monthly landings of *O. vulgaris* show little seasonality (Figure 3). Nevertheless, landings generally peak in March and November each year. Considerably high landings from November 2007 until July 2008 disrupted the usual seasonal pattern, but in 2009 landings again showed the general seasonal pattern. The seasonal pattern derives mainly from the polyvalent fleet landings, which accounts for ca. 96% of the total O. *vulgaris* landings. Monthly landings of *E. cirrhosa* show a marked seasonality, with much higher landings during spring months. The larger *E. cirrhosa* are generally landed during summer (Figure 3).



FigFigure 3 – *Octopus vulgaris* and *Eledone cirrhosa* monthly landings from ICES subarea IXa (only Portuguese waters), between 2003 and 2012 (mean±SD on the left and by year on the right).

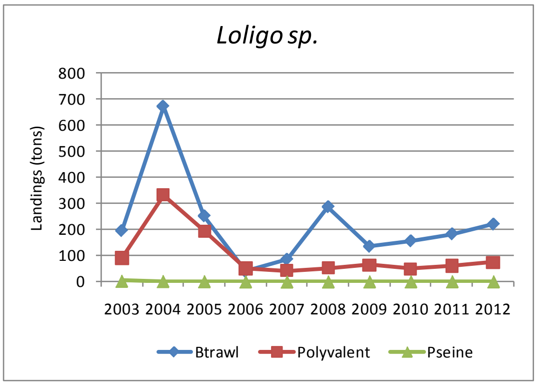
1.1 Long-finned squid by species

The effort to identify the species among long-finned squid landings is noticeable since 2005 (Table 3). However, due to the reappearance of *Loligo forbesi* in Portuguese waters in the last couple of years, and the difficulty in the distinction between the two species, it is expected that the recent official landing statistics reported as *L. vulgaris* may contain some *L. forbesi*. Nonetheless, *Alloteuthis* sp. and *A. subulata* landings started to be recorded since July 2008, separated from *Loligo* species. Despite this, both *Alloteuthis* sp. and *A. subulata* landings should be joined and regarded as *Alloteuthis* sp., because of the co-occurring *A. media*.

In the last 4 years (2009-2012), *L. vulgaris* plus *Loligo* sp. landings represent only ca. 72% of the total long-finned Portuguese landings and *Alloteuthis* species ca. 28%. *L. vulgaris* plus *Loligo* sp. landings averaged 318±263 tons between 2003 and 2012, 60-80% of it taken by the bottom-trawl fleet and 20-40% by the polyvalent fleet (Figure 4). *Alloteuthis* sp. and *A. subulata* landings averaged 86±20 tons between 2009 and 2012, mostly taken by the trawl fleet (82-92%). The mean value per kilogramme of *Alloteuthis* species was around half of that of *Loligo* species (table 3).

Table 3 – Landings of *Loligo* sp. and *Alloteuthis* sp. from ICES subarea IXa (only Portuguese waters) between 2003 and 2012 and mean value at first sale (€) for 2011 and 2012.

Year	Loligo nei (tons)	€	*Loligo vulgaris* (tons)	€	Alloteuthis nei (tons)	€	*Alloteuthis subulata* (tons)	€	% non identified species
2003	289		0		0		0		100
2004	1009		0		0		0		100
2005	242		205		0		0		54
2006	37		52		0		0		42
2007	18		110		0		0		14
2008	18		322		2		18		6
2009	4		195		34		36		14
2010	6		201		46		21		19
2011	4	9.1	213	9.7	102	5.1	5	4.5	33
2012	3	9.1	256	9.4	89	4.9	10	4.3	26



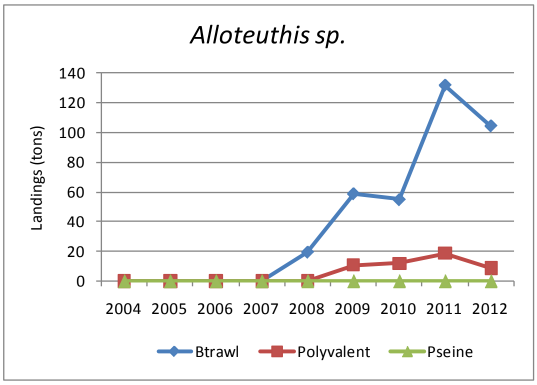


Figure 4 – *Loligo* sp. and *Alloteuthis* sp. landings by fleet from ICES subarea IXa (Portuguese waters only), between 2003 and 2012.

Figure 5 presents the *Loligo* sp. and *Alloteuthis* sp. monthly landings. In both cases the landings pattern reflect a marked seasonality. In the case of *Loligo* sp. higher landings occur generally during autumn each year. However, in some years important landings also occur in September or in January. The landings seasonality was different in the years with the highest landings (2004 and 2005), when the highest landings were verified during summer. In the case of *Alloteuthis* sp., only 4 years were analysed and the seasonality was not constant, higher landings occurred in April and May in 2009 and 2012, and in July and August in 2010 and 2011.

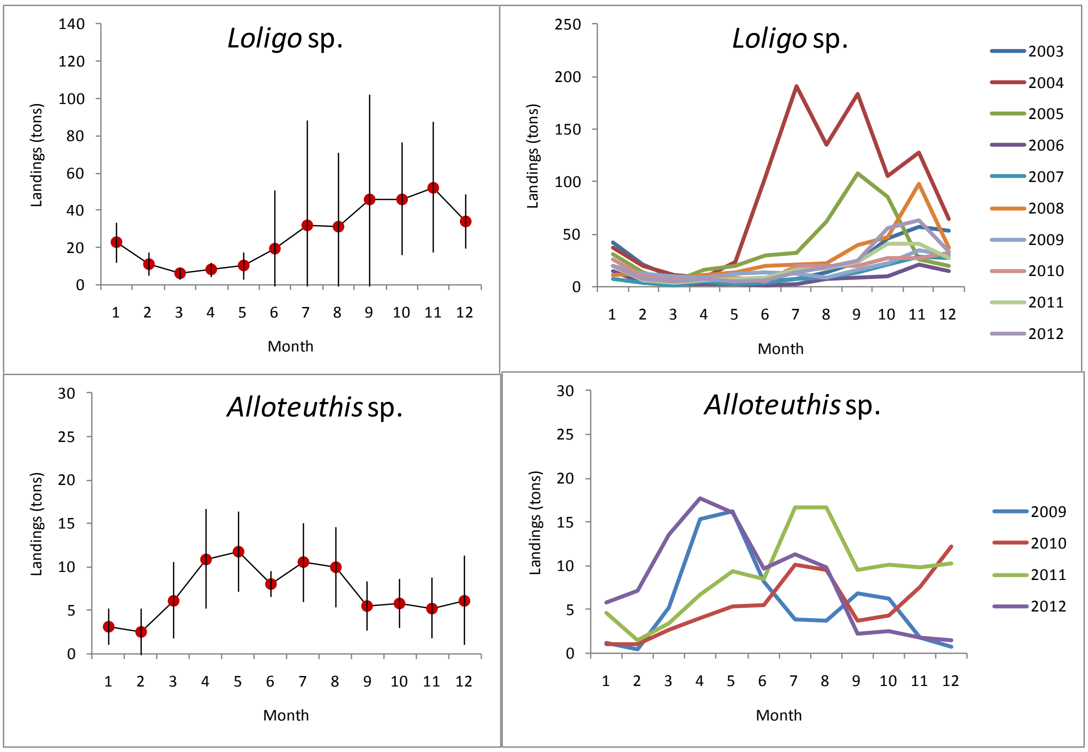


Figure 5 – *Loligo* sp. and *Alloteuthis* sp. monthly landings from ICES subarea IXa (only Portuguese waters), between 2003 and 2012 (mean±SD on the left and by year on the right).

1.2 Cuttlefish

The landings of cuttlefish, *Sepia officinalis*, from the Portuguese waters of ICES area IXa averaged 1550 tons per year between 2003 and 2012. Most catches are made by the polyvalent fleet (vessels using a collection of gears), which land 95% of the total cuttlefish landings (Figure 6). Trammelnets and traps are the main fishing gears utilized to catch cuttlefish.

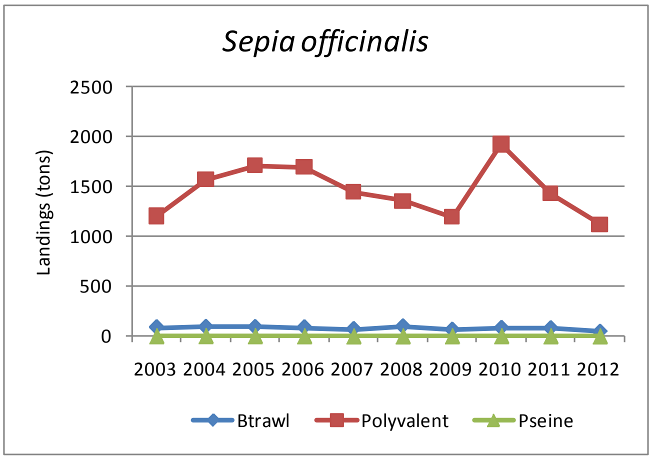


Figure 6 – *Sepia officinalis* landings by fleet from ICES subarea IXa (Portuguese waters only), between 2003 and 2012.

The cuttlefish landings are markedly seasonal, with most of the landings conducted in the first semester of the year. A constant peak in April was verified until 2007, but this peak have been varying between March, April and May since 2008 (Figure 7).

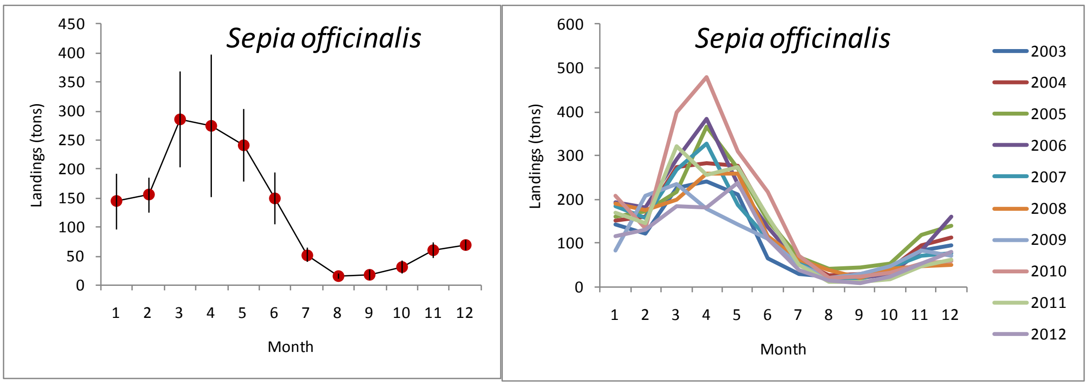


Figure 7 – *Sepia officinalis* monthly landings from ICES subarea IXa (only Portuguese waters), between 2003 and 2012 (mean±SD on the left and by year on the right).

2. Cephalopod discards in the trawl fleet

Estimates of cephalopod discards are available from IPMA´s on-board sampling programme carried out under DCF. Full details on the sampling programme, estimation methods and quality assurance alongside results on the full list of discarded species are shown in Fernandes and Prista (2013). Here, we synthesize the discard information available on the main commercial groups caught by Portuguese vessels operating with bottom otter trawl (OTB) within the Portuguese reaches of ICES Division IXa.

Table 4a and 4b display the frequency of occurrence of cephalopods in the discards of Portuguese OTB vessels. The frequencies of occurrence of most species are low, e.g. compared with other commercial species such as hake (42-89% in OTB, Prista and Fernandes, 2013) or blue whiting (56-91% in OTB_CRU, Prista *et al.*, 2012), with exception of certain year*fleet combinations of *Eledone cirrhosa*, Ommastrephidae and *Alloteuthis spp* (Table 5). For the time being and until a more sophisticated estimation method is implemented (see Fernandes and Prista, 2013), the discards of the remaining species are better assumed as low or negligible for assessment purposes. The main reasons for cephalopod discarding in the Portuguese OTB fishery are mainly related to the low commercial value of some species (e.g. *Eledone cirrhosa*) or their low abundance (e.g. *Alloteuthis spp.*) which rends their commercialization marginal

Table 4a - Frequency of occurrence (%) of cephalopods species in the discards of hauls sampled in the OTB_CRU fishery (2004-2012). Species codes: CTC - *Sepa officinalis*; EDT - *Eledone moschata*; EJE – *Sepia elegans*; EOI – *Eledone cirrhosa*; OCC – *Octopus vulgaris*; OCT – Octopodidae nei; OMZ – Ommastrephidae; OUW – *Alloteuthis* spp.; SQC – *Loligo* spp.

	CTC	EDT	EJE	EOI	OCC	OCT	OMZ	OUW	SQC
2004	2	4	11	59	2	1	38	16	0
2005	1	7	7	46	1	0	34	4	1
2006	0	17	7	40	0	0	3	0	0
2007	1	3	4	22	0	0	7	5	0
2008	2	2	6	14	9	0	5	11	2
2009	1	2	5	8	4	1	1	10	0
2010	3	9	4	10	2	0	12	3	8
2011	2	12	5	14	4	5	30	12	4

2012	4	1	1	16	4	1	6	3	3

Table 4b - Frequency of occurrence (%) of cephalopods species in the discards of hauls sampled in the OTB_DEF fishery (2004-2012). Species codes: CTC- *Sepa officinalis*; EDT- *Eledone moschata*; EJE – *Sepia elegans*; EOI – *Eledone cirrhosa*; OCC – *Octopus vulgaris*; OCT – Octopodidae nei; OMZ – Ommastrephidae; OUW – *Alloteuthis* spp.; SQC – *Loligo* spp.

	CTC	EDT	EJE	EOI	OCC	OCT	OMZ	OUW	SQC
2004	1	1	19	17	1	0	19	47	6
2005	3	2	19	16	6	0	8	45	2
2006	2	1	7	8	4	0	0	18	0
2007	2	4	9	5	6	1	2	9	1
2008	2	2	12	4	20	0	1	24	0
2009	3	1	11	9	10	0	0	19	0
2010	1	2	3	8	2	0	0	12	3
2011	0	2	7	5	11	2	2	22	16
2012	0	2	0	3	12	0	2	22	5

Table 5 – Volume (in metric tons) and CVs (%, in brackets) of cephalopod species in the trawl fisheries (2004-2012). Species codes: EOI – *Eledone cirrhosa*; OMZ – Ommastrephidae; OUW – *Alloteuthis* spp.. "(a)" = low frequency of occurrence.

	OTB_CRU		OTB_DEF
	EOI	OMZ	OUW
2004	277 (32%)	289 (30%)	155 (28%)
2005	99 (38%)	133 (37%)	61 (37%)
2006	45 (10%)	(a)	(a)
2007	(a)	(a)	(a)
2008	(a)	(a)	(a)
2009	(a)	(a)	(a)
2010	(a)	(a)	(a)
2011	(a)	(a)	(a)
2012	(a)	(a)	(a)

3. Population parameters

The achieved sampling of population parameters in 2012 for the main commercial exploited cephalopod species is reported in Table 6. Figure 8 depicts the mean number of specimens measured (mantle length) by month from the start of concurrent sampling in 2009 to 2012 (market sampling). The monthly variation in the numbers of specimens measured is related to the seasonality of landings. Only in cuttlefish were detected monthly samples below 200 individuals (during summer). No age sampling is underway for any species. Information available on growth and age-at-maturity for the Portuguese waters (ICES Subarea IXa) concerns only *Loligo vulgaris*. This information may be found in published literature (Bettencourt *et al.*, 1996; Moreno *et al.* 2005; Moreno *et al.*, 2007).

Table 6 – Market sampling and on-board sampling of population parameters in 2012 for the main commercial exploited cephalopod species under DFC.

		achieved length sampling			weight	maturity	sex ratio
Species	Time stratification	retained catches or landings	discards	total N	N	N	N
Octopus vulgaris	Q	21543	10	21553	739	739	739
Loligo vulgaris	Q	5098	3	5098	444	444	444
Sepia officinalis	Q	4638	1	4639	229	229	229

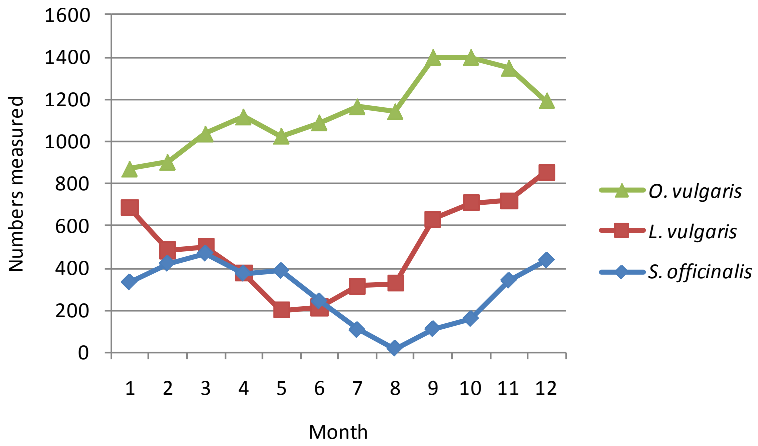


Figure 8 – Market sampling for length frequencies from ICES subarea IXa (only Portuguese waters): mean monthly number of specimens measured from 2009 to 2012.

3.1 Length frequencies

The *O. vulgaris* mean length in landings between 2004 and 2012 was 14.3±0.6 cm ML. The mean length increased slightly in the trawl landings, but decreased in the landings by the polyvalent fleet (Figure 9). The trawl fleet generally lands larger octopus in winter. The larger *O. vulgaris* were landed by the polyvalent fleet also in winter between 2004 and 2007, but since 2008 the larger specimens were landed in spring. In most years and in both fleets smaller *O. vulgaris* are landed in summer or early autumn.

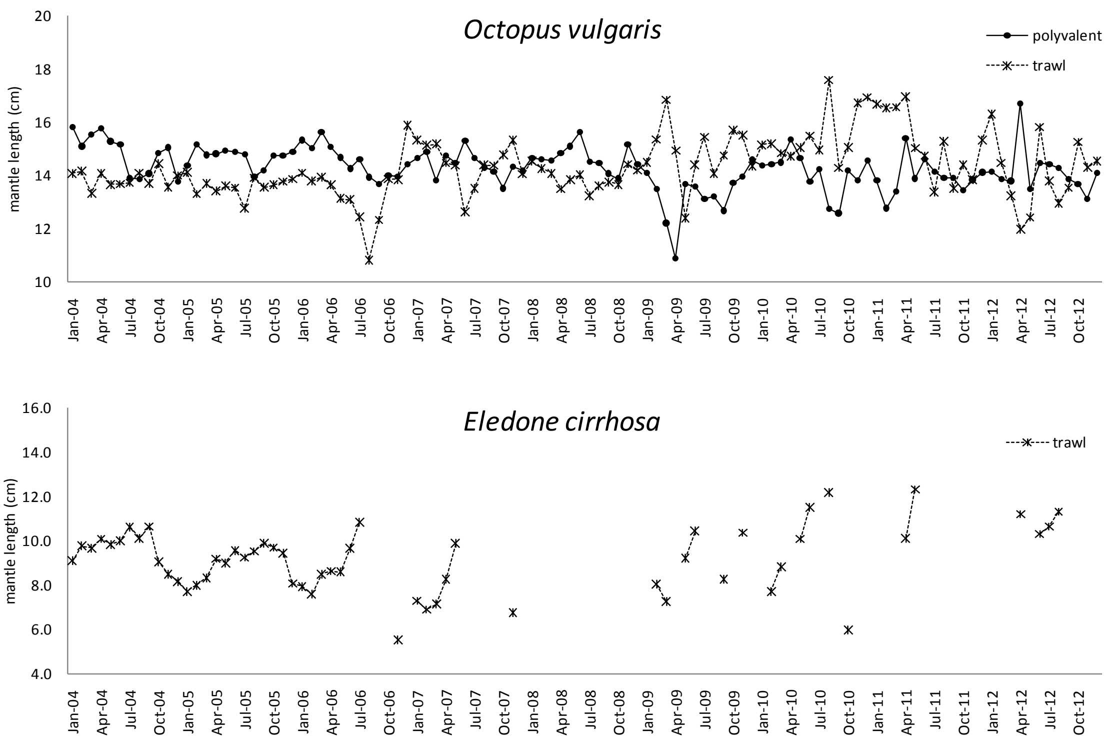


Figure 9 - ***Octopus vulgaris*** **and** ***Eledone cirrhosa*** **mean mantle length by month between Jan-2004 and Dec-2012, landed by the bottom-trawl and polyvalent fleets.**

The mean length in landings was 17.0±1.8 cm ML between 2008 and 2012, with no relevant trend. The trawl fleet generally lands larger *L. vulgaris* in summer and smaller animals in winter (Figure 10).

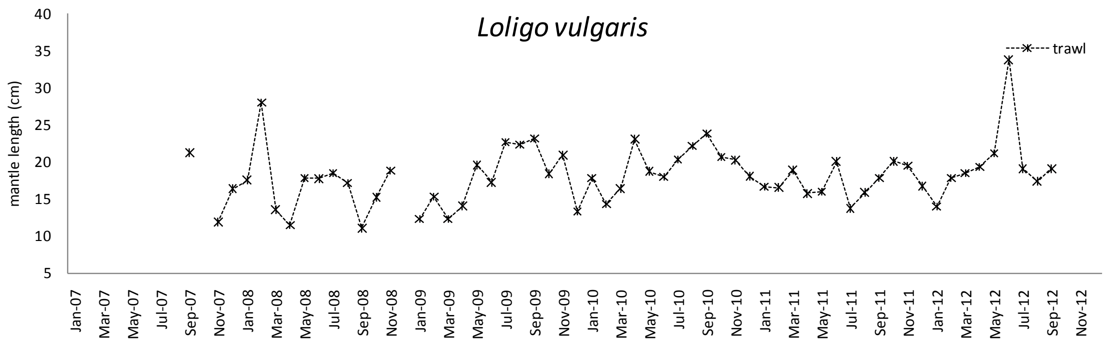


Figure 10 - ***Loligo vulgaris*** **mean mantle length by month between Jan-2004 and Dec-2012, landed by the bottom-trawl fleet.**

The mean length is generally higher in landings by the polyvalent fleet (16.7±1.1 cm ML) than by the bottom-trawl fleet (14.6±2.4 cm ML). No relevant trend is observed through the time-series (2003-2012). The trawl fleet generally lands larger cuttlefish in September-October and smaller in late autumn or winter. The polyvalent fleet show an inverse general pattern, landing larger cuttlefish from December until March and smaller animals generally between June and September (Figure 11).

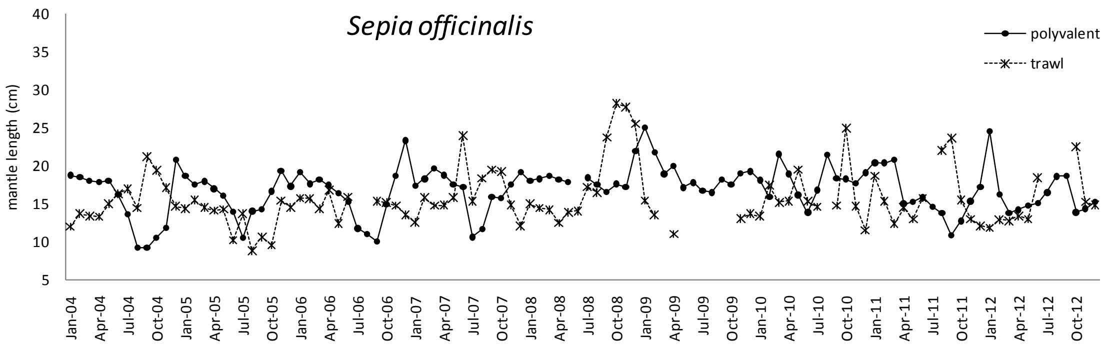


Figure 11 - ***Sepia officinalis*** **mean mantle length by month between Jan-2004 and Dec-2012, landed by the polyvalent and bottom-trawl fleets.**

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Caen, France, 11-14 June 2013.

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WORKING DOCUMENT 5

ICES Working Group on the Cephalopod Fisheries and Life History

Caen (France), 11-14 June 2013

Note on Portuguese discard data submitted to WGCEPH13 data call

Nuno Prista, Ana Cláudia Fernandes, Ana Moreno

In 2012, IPMA reviewed its 2004-2011 data on discards of WGCEPH species by the Portuguese bottom otter trawl fleet operating in Portuguese waters of ICES Division IXa (Prista *et al.*, 2012b). As mentioned in the WGCEPH report, and in working documents submitted to other working groups (Fernandes and Prista, 2012; Prista and Fernandes, 2012a,b,c; Prista *et al.*, 2012a,c), the statistical procedures used to raise onboard observations to fleet level are sensitive to large number of zeros and, consequently, estimates can only be obtained when species are discarded in more than 30% of observed hauls.

In its preparation for the 2012 WGCEPH data call, IPMA analysed 2012 sampling effort and the frequency of occurrence of WGCEPH species in Bottom Otter Trawl discards (Table 1). The outcome of these analyses showed that the frequency of occurrence of all WGCEPH species, similar to what happened in 2011, was below 30% and therefore total discards could not be properly estimated. Similar analyses were carried out with the species aggregated into higher level taxa but the same results took place (Table 2).

Considering this, IPMA can not supply data for table 3. Discards database (CD) of Annex 1 required by the WGCEPH Data Call. IPMA will however still contribute to WGCEPH13 work by submitting to the WG a working document with updated descriptive information on species occurrence in discards.

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Table 1. Sampling effort and cephalopod occurrence in the Portuguese bottom otter trawl fisheries that target crustaceans (OTB_CRU_>=55_0_0) and demersal fish (OTB_DEF_>=55_0_0). FAO codes according to FAO Asfis database except "I_OPG" = Opisthoteutis agassizi and "I_HIT" = Histioteuthis spp

Year	Fishery	FAO code	no. hauls sampled	no. hauls with occurrence	% occurrence
2012	OTB_CRU	SQC	68	0	0
2012	OTB_CRU	EJE	68	1	1
2012	OTB_CRU	OFJ	68	0	0
2012	OTB_CRU	IAR	68	1	1
2012	OTB_CRU	OCC	68	3	4
2012	OTB_CRU	ROA	68	11	16
2012	OTB_CRU	OCT	68	1	1
2012	OTB_CRU	SQE	68	2	3
2012	OTB_CRU	HQB	68	0	0
2012	OTB_CRU	TDQ	68	0	0
2012	OTB_CRU	CTL	68	1	1
2012	OTB_CRU	EOI	68	11	16
2012	OTB_CRU	I_OPG	68	0	0
2012	OTB_CRU	I_HIT	68	0	0
2012	OTB_CRU	SQU	68	2	3
2012	OTB_CRU	EDT	68	1	1
2012	OTB_CRU	SQM	68	2	3
2012	OTB_CRU	CTC	68	3	4
2012	OTB_CRU	SQR	68	0	0
2012	OTB_CRU	CTR	68	0	0
2012	OTB_CRU	OMZ	68	0	0
2012	OTB_CRU	CEP	68	1	1
2012	OTB_CRU	OUW	68	2	3
2012	OTB_CRU	OQD	68	0	0
2012	OTB_CRU	OUL	68	0	0
2012	OTB_DEF	SQR	60	0	0
2012	OTB_DEF	SQE	60	0	0
2012	OTB_DEF	I_OPG	60	0	0
2012	OTB_DEF	OUL	60	1	2
2012	OTB_DEF	SQC	60	1	2
2012	OTB_DEF	HQB	60	0	0
2012	OTB_DEF	OMZ	60	0	0
2012	OTB_DEF	SQU	60	2	3
2012	OTB_DEF	CTL	60	0	0
2012	OTB_DEF	CTR	60	0	0
2012	OTB_DEF	SQM	60	0	0
2012	OTB_DEF	OFJ	60	0	0
2012	OTB_DEF	OCT	60	0	0
2012	OTB_DEF	CTC	60	0	0
2012	OTB_DEF	IAR	60	2	3
2012	OTB_DEF	ROA	60	0	0
2012	OTB_DEF	EDT	60	1	2
2012	OTB_DEF	EJE	60	0	0
2012	OTB_DEF	I_HIT	60	0	0
2012	OTB_DEF	OUW	60	12	20
2012	OTB_DEF	OCC	60	7	12
2012	OTB_DEF	CEP	60	0	0
2012	OTB_DEF	EOI	60	2	3
2012	OTB_DEF	OQD	60	0	0
2012	OTB_DEF	TDQ	60	1	2

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Table 2. Sampling effort and cephalopod occurrence (aggregated taxa) in the Portuguese bottom otter trawl fisheries that target crustaceans (OTB_CRU_>=55_0_0) and demersal fish (OTB_DEF_>=55_0_0). FAO codes according to FAO Asfis database.

Year	Fishery	FAO code	no. hauls sampled	no. hauls with occurrence	% occurrence
2012	OTB_CRU	CTL	68	17	25
2012	OTB_CRU	CEP	68	1	1
2012	OTB_CRU	SQU	68	8	12
2012	OTB_CRU	OCT	68	16	24
2012	OTB_DEF	CTL	60	2	3
2012	OTB_DEF	CEP	60	0	0
2012	OTB_DEF	OCT	60	10	17
2012	OTB_DEF	SQU	60	17	28

Working Document 6 for the ICES WGCEPH on Cephalopod Fisheries and Life History. Caen, France, 11-14 June 2013.

Cephalopod fisheries in the SW Atlantic (2010-2012)

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ABSTRACT

The Spanish bottom-trawler fishing fleet operating in the SW Atlantic targets two cephalopod species: the Ommastrephid *Illex argentinus* caught both in the High Seas and within Falkland Islands waters, and the Loliginid *Doryteuthis* (former *Loligo*) *gahi*, more abundant in the so-called the *Loligo* Box, to the south of the Falkland Islands. This working document presents a brief description of these fisheries and catches of the aforementioned species between 2010 and 2012 within Falkland waters.

INTRODUCTION

Fishing for cephalopods in the SW Atlantic occur in three well defined geographic areas, namely within Argentinean waters inside the 200 miles limit, around the Falkland Islands, and on the High Seas located to the east and north of the two former areas. *Illex* fishery takes place in the three areas both by jiggers from Asia and by trawlers mainly sailing under Argentinean, Spanish and Falkland flags, while trawlers targeting *Doryteuthis* get most of their catches around the *Loligo* Box and operate with Falkland flag. The Spanish fishing fleet only operates in the High Seas and within Falkland waters, so, this working document only refers to these two areas.

Illex argentinus **(Short finned squid)**

This species is targeted by the Asian jigging fleets (mainly from Korea, Taiwan and Japan) and also by trawlers (mainly from Spain) in February-June, following its feeding migration throughout the Patagonian shelf brake.

Illex argentinus is a nektonic species inhabiting three different ecosystems: shelf, slope and open pelagic waters of the Southwest Atlantic. It is composed of four intraspecific groups: the Spring-spawning group (SpSG), the Summer-spawning group (SSG), the Autumn-spawning group (ASG) and the Winter-spawning group (WSG), being the last one the most abundant, with the longest ontogenetic migrations (Arkhipkin, 2011).

The Spanish fleet targets the WSG, whose migrations have been described by Arkhipkin (2011): hatching takes place in August in the northern part of the Patagonian shelf, pelagic larvae and juvenile stages in September-November and start the migration to the shelf in December at about 160 days of age and mantle length (ML) of 12-13 cm. Spend his life on the shelf between January-April growing in size and maturing. Them, these holdover subadults mature into a prespawning stage and migrate northerly along the Patagonian slope in the late austral autumn (May) when they are around 280 days and ML is 28 cm, finishing this migration by June-July (Arkhipkin 2000; Chen *et al.*, 2007) (Figure 1).

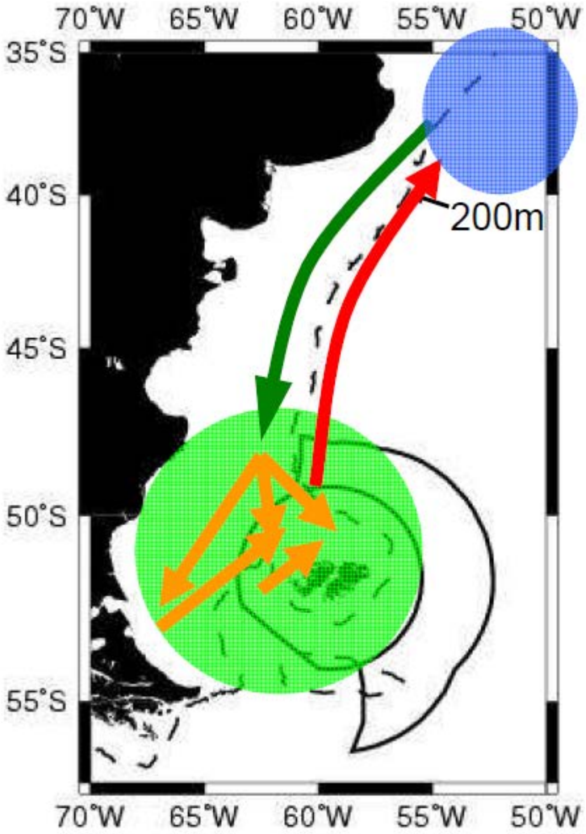

Figure 1.- Life cycle of *Illex argentinus* (courtesy of A. Arkhipkin)

The main fishing area is situated in the in the High Seas and in the northern and northwestern parts of the Falkland waters (north of 51-52°S). During recent years, *Illex* squid stocks have shown high variability of abundance. Periods of high abundance (2000-2001 and 2006-2008) alternated with periods of low abundance (2002-2005 and 2009-2011). Survival of larvae and juveniles in the offshore spawning grounds might be affected by climate change. Overfishing throughout the Southwest Atlantic has perhaps also contributed to recent decreases of *Illex* stocks (Falkland Islands Government, 2013).

Doryteuthis (Former *Loligo*) *gahi* (Patagonian squid)

The Patagonian squid undertakes horizontal ontogenetic migrations on the Falkland shelf: juveniles move from spawning grounds located in shallow, inshore waters (20–50 m depths) to feeding grounds near the shelf edge (200–350 m depths) and upon maturation, they migrate back to inshore waters to spawn. The Patagonian squid is targeted almost exclusively by the Falkland-registered trawlers in the southern and eastern parts of the Falkland Shelf. Lower quantities of this species are also caught mainly by Spanish trawlers as a bycatch in other areas within Falkland waters and in the High Seas.

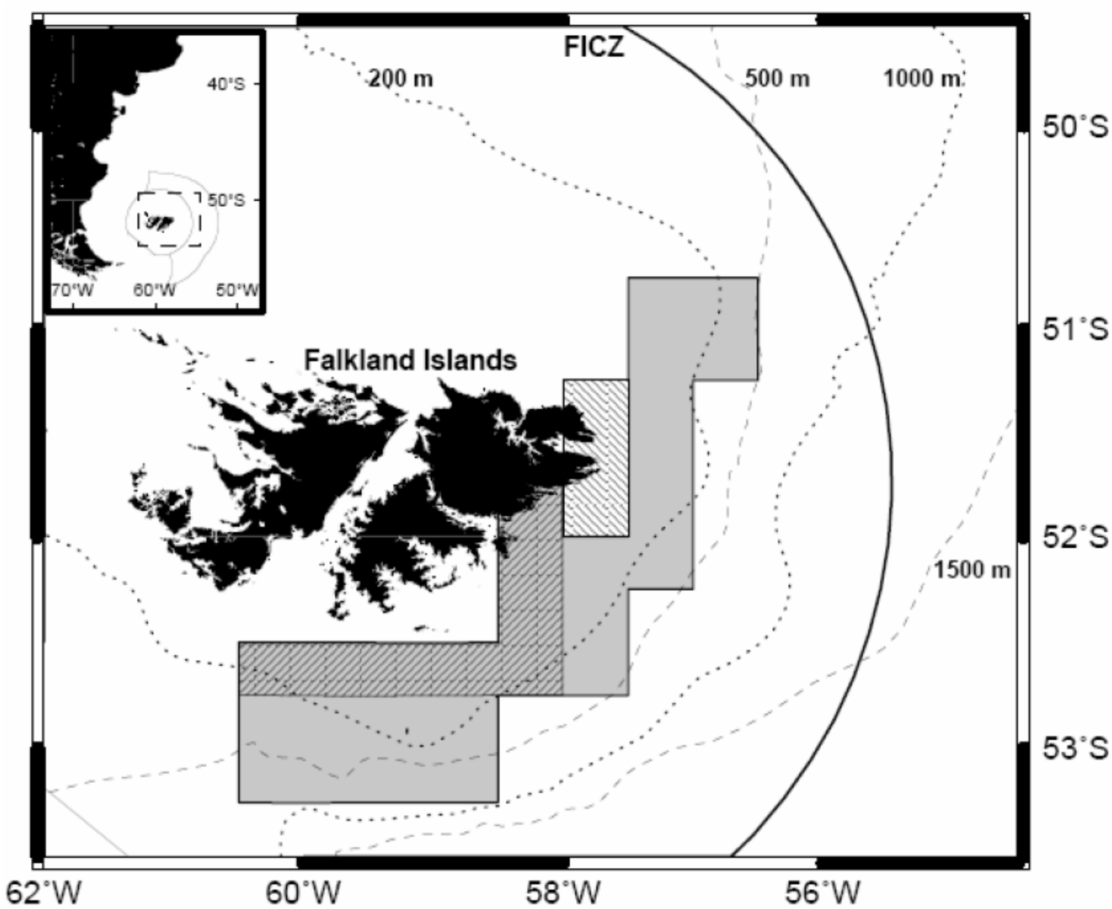

Figure 2.- ***Loligo*** **Box (courtesy of A. Arkhipkin)**

CATCHES 2010-2012

Illex argentinus (Short finned squid)

a) Falkland Islands

Catch of *Illex* in 2010 amounted to a total of 12,105 t. This was the fourth lowest catch of this squid since the beginning of the Falkland fishery in 1987. Overall, the commercial situation in the *Illex* fishery in 2010 was quite similar to that observed in 2002, when the South Patagonian Stock of *Illex* had low abundance and their migration to the southern parts of their species range on the Patagonian Shelf was restricted by unfavourably low water temperatures (STECF, 2010).

In 2011, comparing with the previous season of 2010, the South Patagonian Stock had higher abundance that resulted in a total catch of 79,361 t of *Illex* taken within the Falkland Conservation Zones (STECF, 2011).

Overall in 2012 season, the South Patagonian Stock had medium abundance that resulted in a total catch of 87,023 t of *Illex* taken within the Falkland Conservation Zones (slightly higher than in previous year) (STECF, 2012).

b) High Seas

Illex is the most important cephalopod species in the area and plays a significant role in the ecosystem. The main fishing area on the High Seas is between parallels 44-47º S. Currently, this squid species is considered as one of the target species for the Spanish fleet operating in the Southwest Atlantic, with mean annual catches of about

35,000 t. As an annual species, its catches fluctuate markedly from year to year depending on environmental conditions. Catches of short finned squid by Spanish trawlers were not available when preparing this WD.

***Doryteuthis* (Former *Loligo*) *gahi* (Patagonian squid)**

a) Falkland Islands

In 2010, the abundance of both cohorts of *Doryteuthis* was high. The first season yielded 28,682 t, and the second season 36,961 t, amounting for a total annual catch of 65,643 t (STECF, 2010).

The first season of 2011 yielded 15,437 t, and the second season 19,129 t with the total annual catch of 34,566 t. The fishery in the first season was quite unstable, with several relatively small peaks in abundance both in the northern and southern parts of the *Loligo* box. During the second season, only one significant peak in *Doryteuthis* biomass was observed at the end of July - beginning of August. Then, quite unusual environmental conditions with rare westerly winds did not favour aggregations of *Doryteuthis* (STECF, 2011).

In 2012, the abundance of both cohorts of *Doryteuthis* was record high for the last ten years. The first season yielded 34,997 t, and the second season 35,739 t with the total annual catch of 70,736 t (twice of the previous year) (STECF, 2012).

b) High Seas

Doryteuthis gahi is caught in relatively small quantities as bycatch by bottom-trawlers during hake and Illex fisheries. The main fishing area is around parallel 42º S, where big catches of mainly juvenile Patagonian squid have been reported in different years by observers on board of Spanish vessels. Catches of Patagonian squid by Spanish trawlers were not available when preparing this WD.

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WD 7. Application of depletion methods to Mediterranean cephalopod stocks

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Stock assessments using depletion methods were carried for Mediterranean stocks of *Sepia officinalis* and *Loligo* spp. around Mallorca, Balearic Islands. The analyses were carried out with the CEDA program (MRAG) and are based on least square minimization. An indexed recruitment model was used. A sensitivity analysis was conducted to value the influence of different mortality rates (M) and different error models. The residuals were evaluated and a bootstrap procedure was applied to get confidence intervals of the parameter estimates.

Sepia

Sensitivity analysis (data from 2007)

- Error model (Figure 1): Least square (LSQ) error model gave best residuals, smaller confidence intervals and a good fit; the Gamma model gave very big estimates for N1 and the log error model (LOG) always gave quite small numbers of recruits (Lambda)
- Mortality: trials with 0.01, 0.02, 0.03 for weekly mortality, model not very sensitive to changes in M (Figure 2); final M selected: 0.02, according to a calculation of Royer et al (2006) for the Channel sepia

Input data:

- Analysed fishing seasons: 2007-2010 in weekly time-steps (weeks 11-29 = depletion period starting at highest cpue) (Figure 3)
- Catches: Landings of weeks 11-29 from daily catch per vessel data from Fishery auction of Mallorca
- Mean weights (MW): data for 2007 and 2008 taken from monthly biological sampling from the fish market of Mallorca (see figure 4); from observer data for the rest of the years. MW go down during the depletion event for most years, but in 2009 they first rise till week 11 before they decrease
- Recruitment index: calculated as monthly ratio of animals between 5 and 10 cm (=recruits) to all recruits entering the fishery during the depletion period. Quite different for 2007 and 2008 (figure 5). For 2009 and 2010, the recruitment index of 2007 was taken for the analysis.
- Abundance index: standardized cpue obtained by running a Delta-GLM with all catch data of the respective fleet from 2000-2011; explaining variable: Vessel class (HP), Area, Month, Fishing season (Figure 6)

Loligo

- Analysed fishing seasons: 2008-2011 in monthly time-steps (March-July = depletion period, see figure 10)
- Catches: monthly landings from March-July, from daily catch per vessel data from the fishery auction of Mallorca; in the commercial statistic, catches of *L. vulgaris* and *L. forbesi* are combined, therefore also for the rest of the input data we take the means of the data from both species (Figure 7).

- Mean weights (*L. vulgaris* and *L. forbesi* combined): for 2009 taken from monthly biological sampling from the fish market of Mallorca (trawl fishery data, Figure 8); from observer data for the rest of the years.
- Recruitment index (Figure 9): calculated as monthly ratio of animals ≤ 9 cm (=recruits) to all recruits entering the fishery during the depletion period. The recruitment index of 2009 was taken for the analysis of 2007, 2008 and 2010 as well.
- Abundance index: standardized cpue obtained by running a Delta-GLM with all catch data of the respective fleet from 2000-2011; explaining variable: Vessel class (HP), Area, Month, Fishing season; both *Loligo* species combined (Figure 10)
- Monthly mortality used: 0.2
- Error model: LOG, only this one gave a fit in all years

Results of the analysis

Sepia:

The estimated monthly mean weights (kg) for 2007 and 2008 (derived from the biological sampling) follow a similar pattern in both years, first going up and then decreasing from March/April on (figure 4). The calculated abundance index (standardized cpue) shows a very similar pattern in both years (figure 6), whereas the monthly recruitment indices for 2007 and 2008 are very different (figure 5).

The outcomes of the model differ widely depending on the year, mostly the estimates of the estimated recruitment numbers (Lambda, figure 11, M = 0.02). N1 varies between 70 000 and 149 000 and final population is estimated always between around 25000 -32000. Lambda estimates vary between 42 and 74000. Confidence intervals are big. The years with biological data (2007/2008) differ significantly in all parameters, which is partly due to the use of a different error model (2007= LSQ Error model, 2008= LOG error model). These were the only error models that fitted the data for each respective year. Estimated vs. observed cpue are given in figure 12. Weekly population numbers (estimated) vs. total weekly catches (numbers) are given in figure 13.

***Loligo* spp:**

The estimated monthly mean weights (kg) for 2009 (derived from the biological sampling) show a general upwards trend during the analysed period (figure 8). The calculated abundance index (standardized cpue) decreases over time (figure 10), as well as does the monthly recruitment index calculated from the biological sampling (figure 9), which only rises slowly from June onwards.

Model estimates differ widely between years. N1 varies between 95 000 and 641 000 and final population between around 4.790 - 65.000. (Figure 14, M = 0.2). Confidence intervals are big. The year 2010 was very different, with very low N1 (95.000) and very high Lambda (191.000). The final population estimate was very low (4790 animals). Estimated vs. observed cpue are given in figure 15. Monthly population numbers (estimated) vs. total weekly catches (numbers) are given in figure 16.

Possible concerns regarding the quality of input data and modelling:

- Species related

- Mean weights in Sepia go down over time, which could be due to the emigration of moribund and big animals or just animals leaving the area after spawning. So catch in numbers will raise and may result in a seemingly slower depletion of the stock
- Recruitment takes place all year round -> leads to the measurement of different cohorts when calculating the mean weights
- The *Sepia* population is subject to a strong migration -> no closed population, mixing of different parts of the population at different times, e.g. bigger animals return to deeper waters earlier
- In *Loligo,* there are only six data points as there is only a short depletion period (cpue decline) due to a recruitment peak in September (possibly of *L. forbesi)*
- The mortality for the species is only estimated from Atlantic stock
    - Fishery data
- Observer data show a different trend in mean weights than do biological data
- Observer data missing for some months and often constitute very few samples
- Only joined landing records for the two *Loligo* species (which have different spawning and recruitment periods)
- Only biological available data for 1-2 years
- Only monthly weight and length data available, preventing a sound weekly analysis
    - General points, analysis
- The same gear that depletes the stock is used for obtaining the abundance index (AI), which is not optimal (see Hilborn and Walters, 1992)
- Delta GLM with 4 variables may have caused many additional artificial data points

Suggestions / possible improvements:

1) More complete dataset of the Mediterranean fleet

2) Improve observer sampling scheme, enforcing a certain minimum sample size each month

3) Find a ratio of *L. vulgaris* / *L. forbesi* catches for each month

4) Continued monthly biological sampling of animals from the fish market (weight, length)

5) Research cruise to get biomass estimates

6) Measure of migration? (Looking at sex ratio and maturity, catch rates inside and outside fishing ground)

7) Getting a better idea of the spatio-temporal distribution of the fishery. As fisher follow aggregations, there might be different depletion events at different locations/times

8) Instead of cpue, maybe use catch and effort? (Roa-Ureta and Arkhipkin 2007)

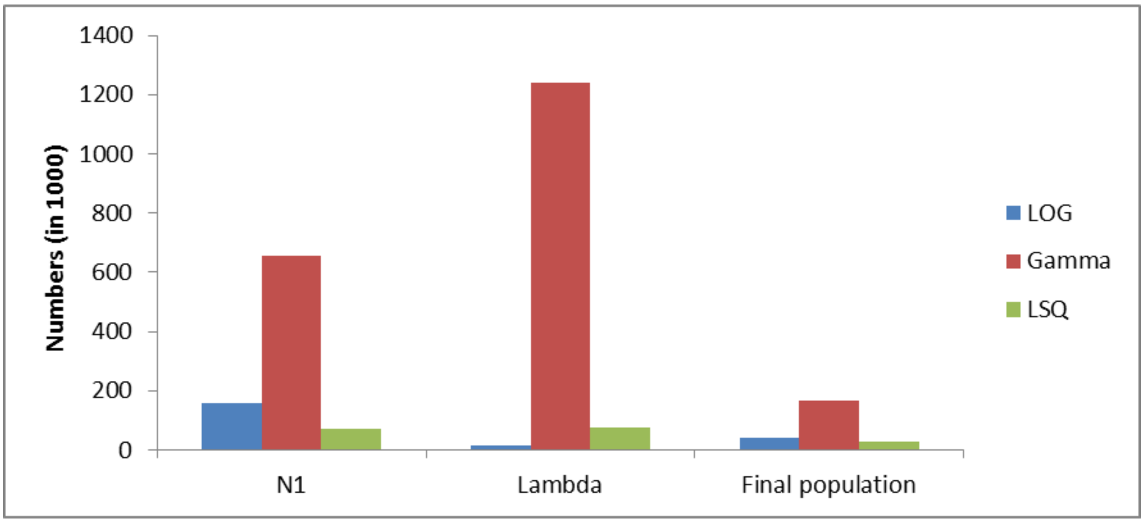

Figure 1: Estimated initial population (N1), recruitment (Lambda) and final population (all in numbers) for different error models used (least square (LSQ), log-transformed least square (LOG) and gamma error model (Gamma))

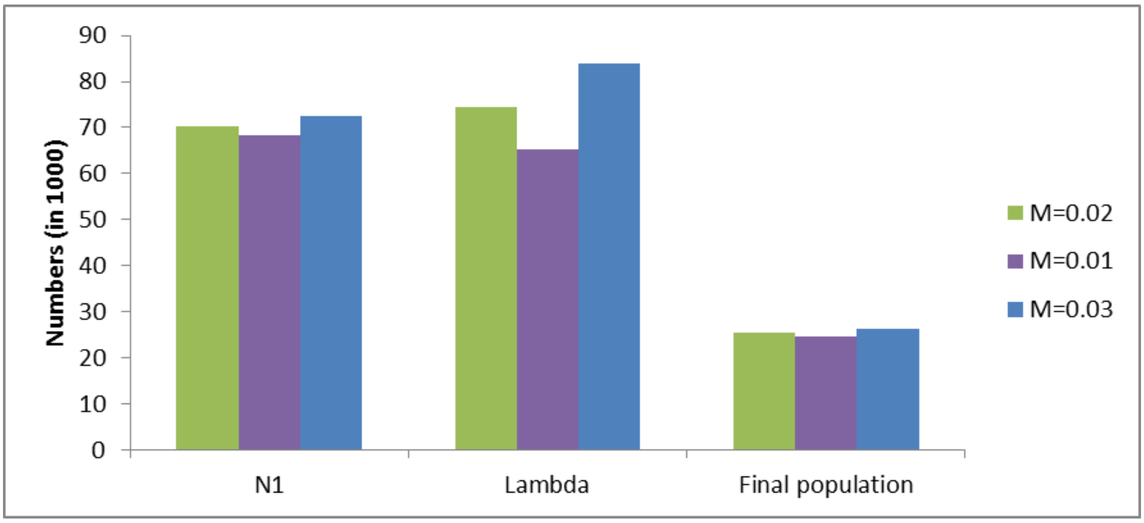

Figure 2: Estimated initial population (N1), recruitment (Lambda) and final population (all in numbers) for different values of weekly mortality M (0.01-0.03)

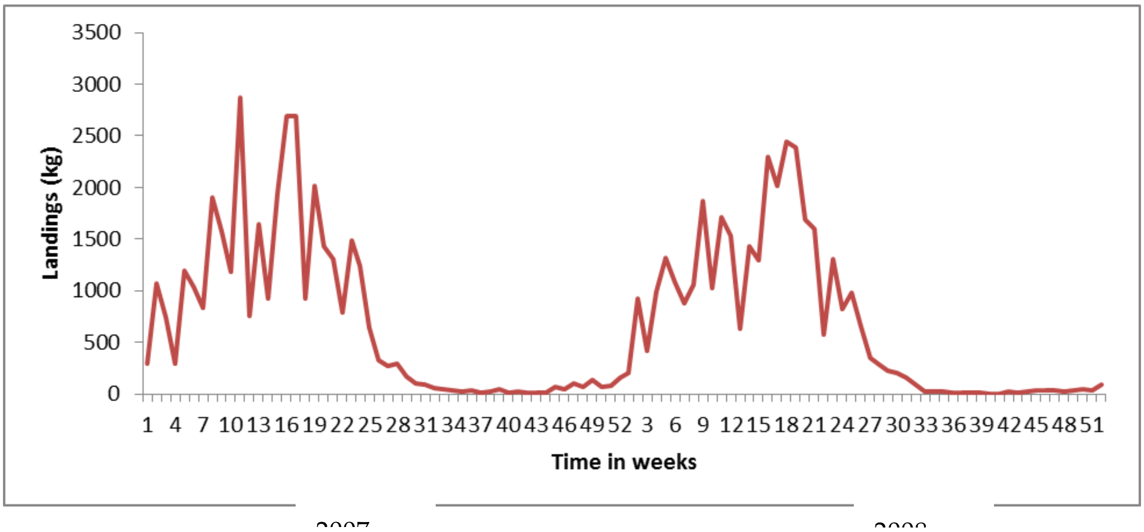

Figure 3: Weekly cuttlefish landings (in kg) for 2007 and 2008

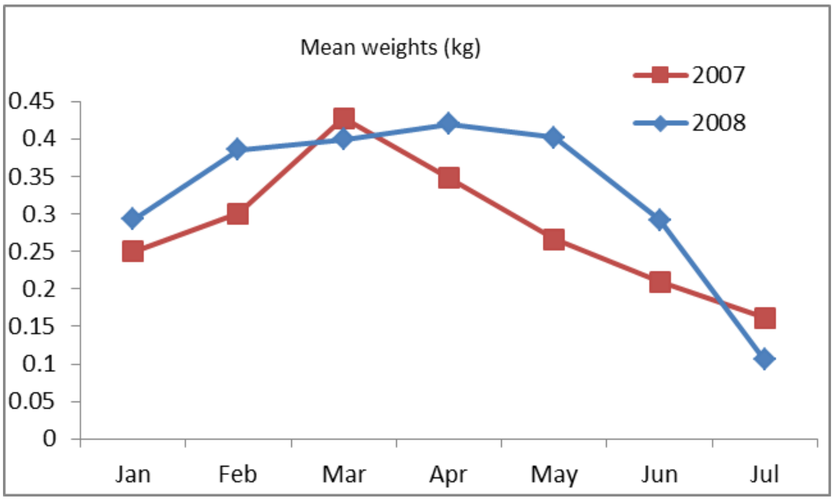

Figure 4: Monthly mean weights (kg) for 2007 and 2008 derived from the biological sampling of *Sepia officinalis* from the fish auction of Palma de Mallorca.

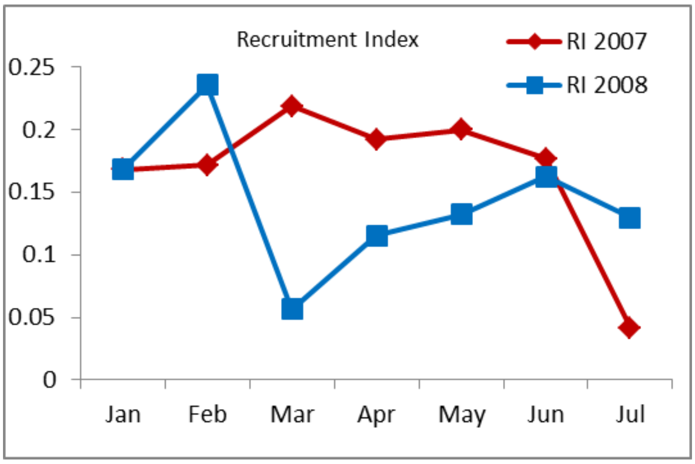

Figure 5: Monthly recruitment index for 2007 and 2008 derived from the biological sampling of *Sepia officinalis* from the fish auction of Palma de Mallorca.

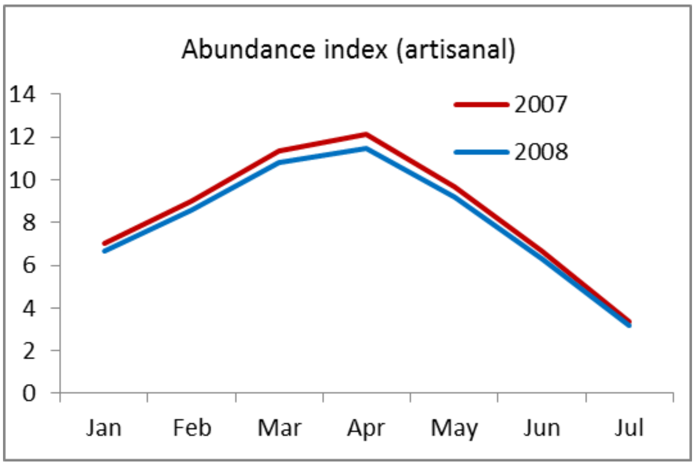

Figure 6: Calculated abundance index (standardized cpue) of *Sepia officinalis* artisanal caches for 2007 and 2008

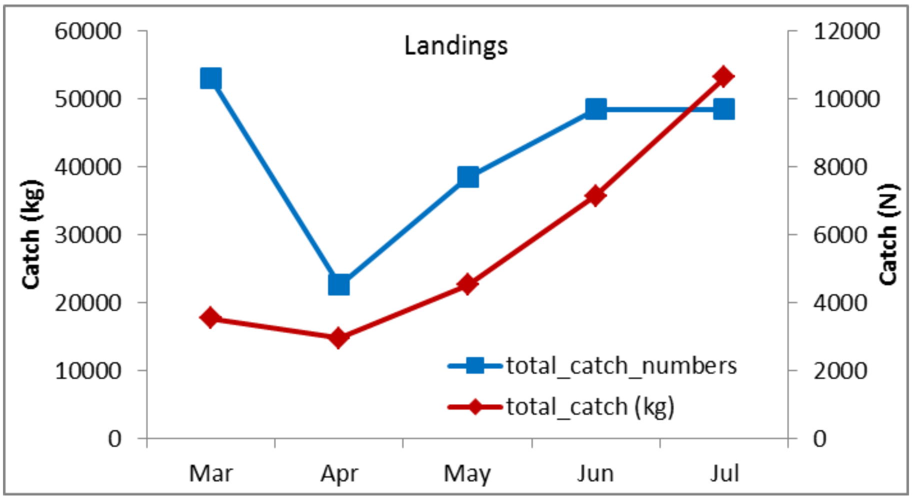

Figure 7: Monthly landings of *L. spp* (in kg and numbers) for 2009

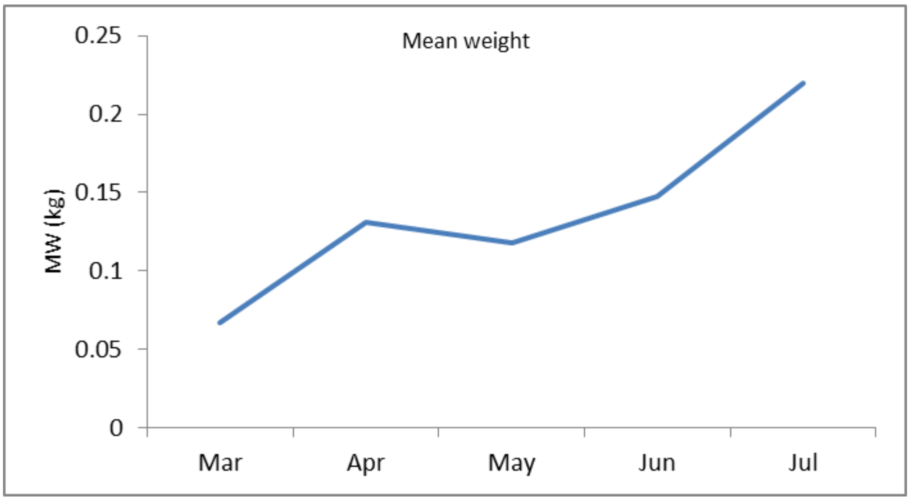

Figure 8: Monthly mean weights (kg) for 2009 derived from the biological sampling of *L. vulgaris* and *L. forbesi* from the fish auction of Palma de Mallorca.

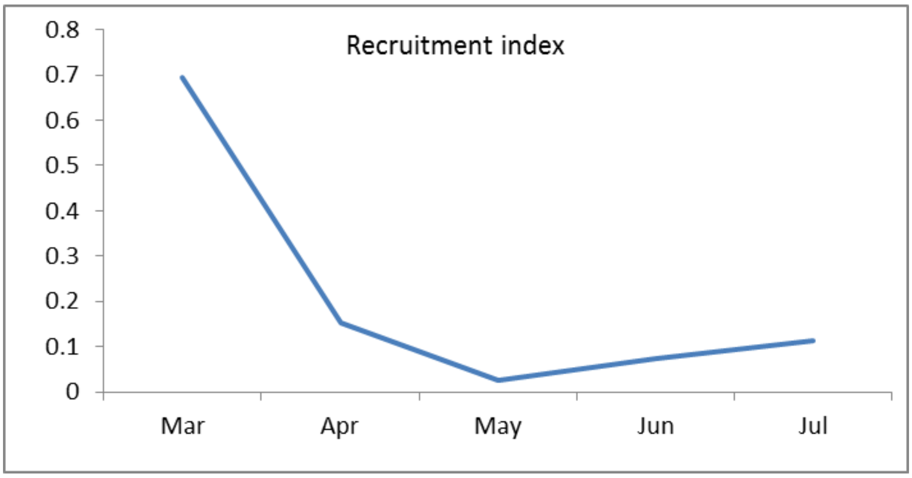

Figure 9: Monthly recruitment index for 2009 derived from the biological sampling of *L. vulgaris* and *L. forbesi* from the fish auction of Palma de Mallorca.

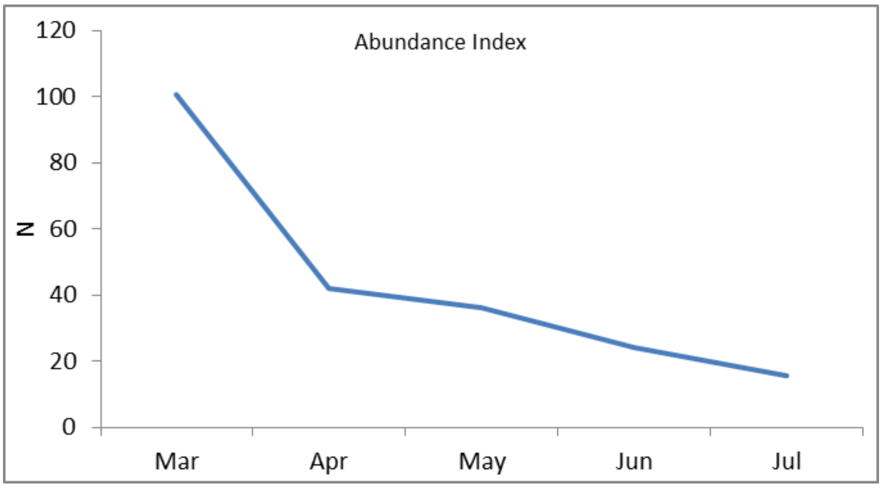

Figure 10: Calculated standardized abundance index (standardized cpue) of *L. spp.* for 2009

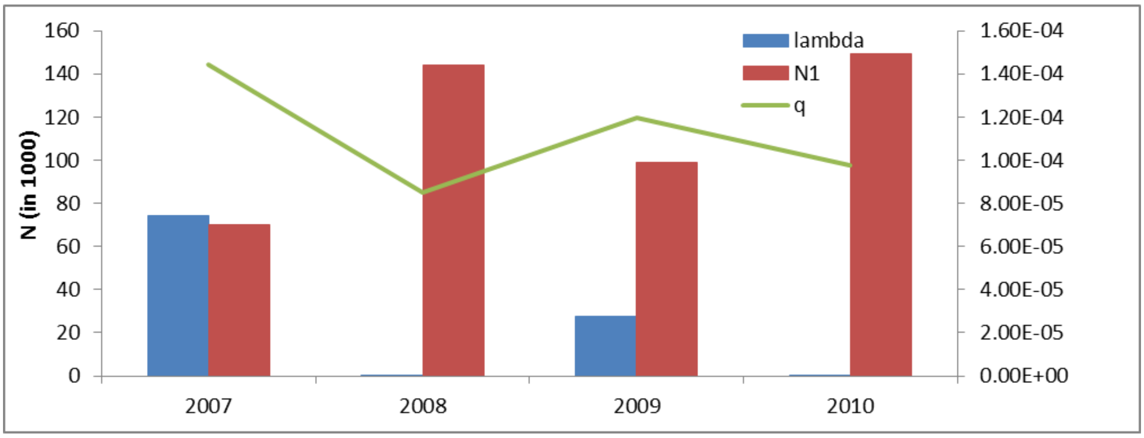

Figure 11: Graphical summary of the modelling results for *Sepia officinalis*. Shown are initial population numbers N1, number of recruits per year (lambda, both left axis) and the catchability coefficient q (right axis).

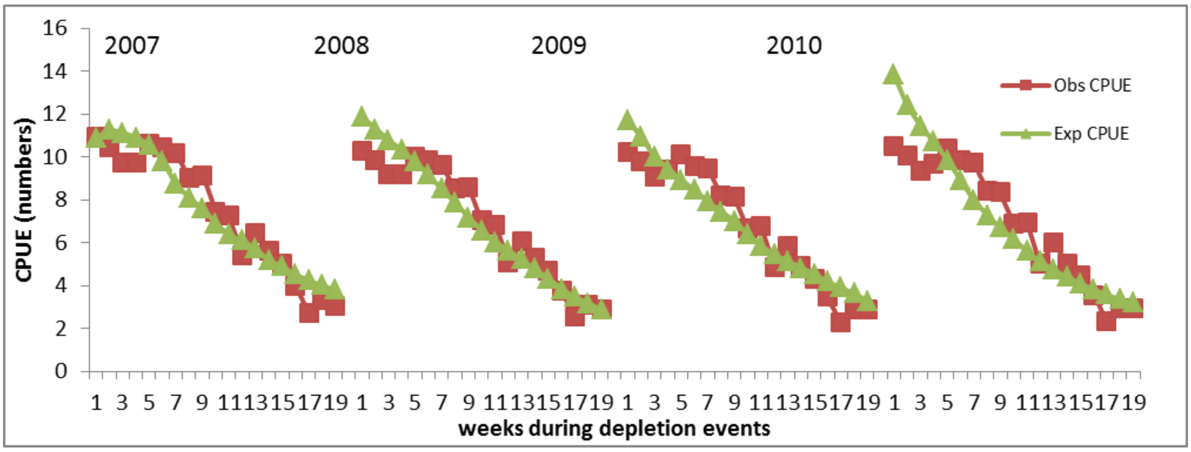

Figure 12: Estimated and observed weekly cpue (numbers per unit effort) of *Sepia officinalis* in Mallorca (M=0.02)

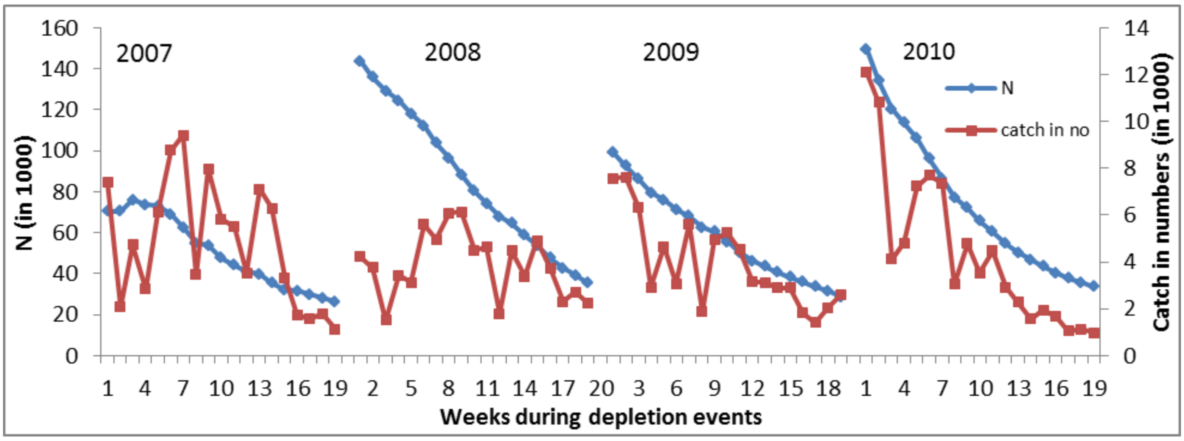

Figure 13: Estimated weekly stock size and observed catch (both in numbers) from 2007-2010 (M=0.02)

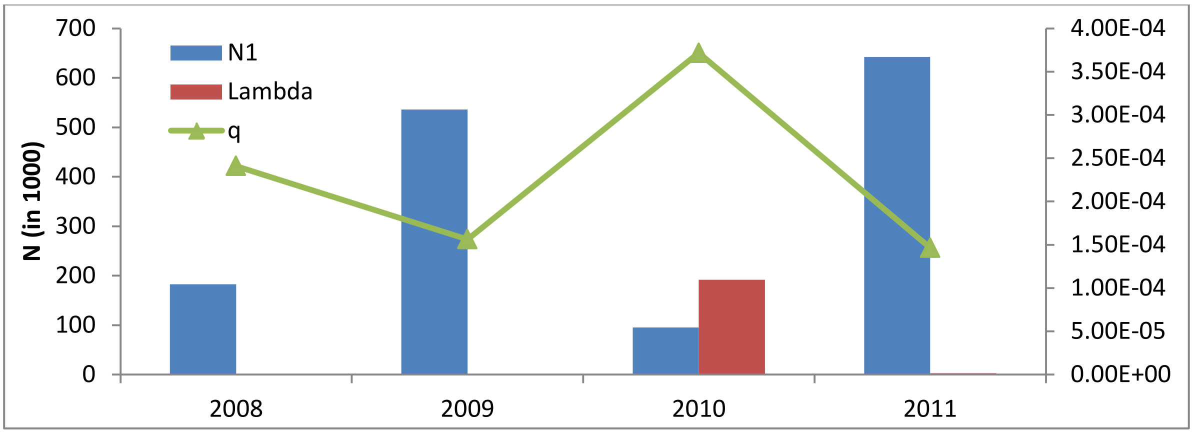

Figure 14: Graphical summary of the modelling results for *Loligo spp*. Shown are initial population numbers N1, number of recruits per year (lambda, both left axis) and the catchability coefficient q (right axis).

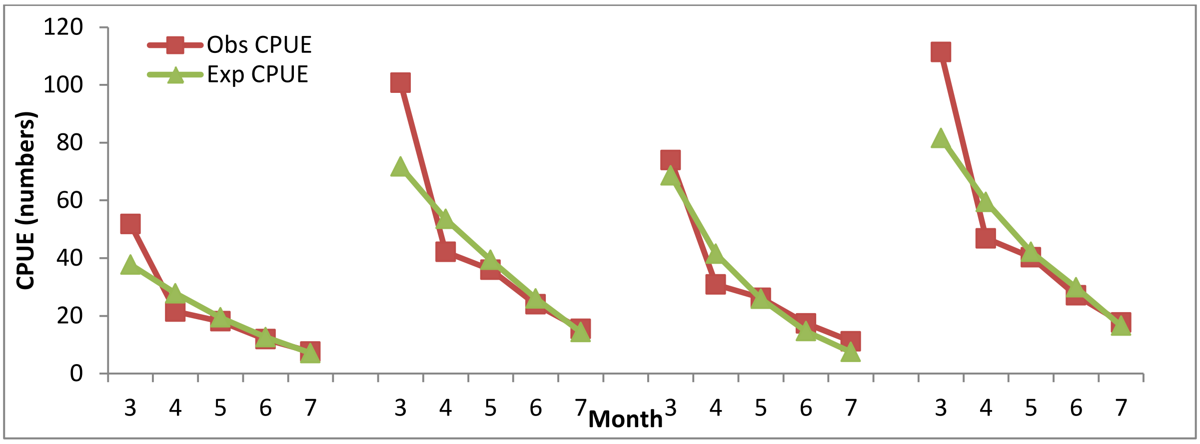

Figure 15: Estimated and observed monthly cpue (numbers per unit effort) of *Loligo spp.* in Mallorca (M=0.2)

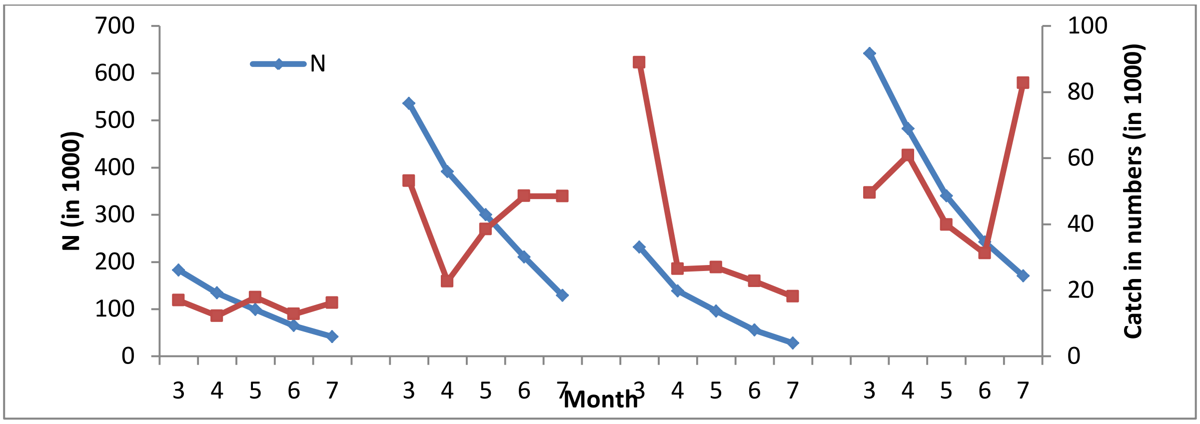

Figure 16: Estimated monthly stock size and observed catch (both in numbers) from 2008-2011 (M=0.2)