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Maturity and Other Biological Aspects of Main Deep-water Squaloid Sharks, in the North and Northwest of the Iberian Peninsula (ICES Divisions VIIIc, IXa and IXb)

by

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Abstract

The aim of this poster is to compile different information concerning some biological aspects of deep-water sharks captured during between 500 and 1300 m depth off the continental slope in the north and northwest of the Iberian Peninsula (ICES Division VIIIc, IXa and IXb).

The catches and yields of the different deep water squaloid sharks (*Centrophorus squamosus, Centrophorus granulosus, Centroscymnus coelolepis, Deania calceus* and *Scimnodon ringen*) are reported as well as other aspects concerning their depth distribution, length distribution, sex ratio, length-weight relationship, fecundity and maturity.

Introduction

For the purpose of this study deep-water sharks are defined as demersal or benthopelagic sharks which inhabit at depths greater than 400 m. Data on specific deep-water sharks is scarce in the north and northwest of the Iberian Peninsula because the small fisheries developed with a notable local and seasonal character.

The aim of this study is to report the available information concerning deep-water sharks, their depth distribution and the main biological aspects obtained in commercial fisheries and exploratory surveys.

Material and Methods

Specimens were captured between 500 and 1300 m depth off the continental slope in the north and northwest of the Iberian Peninsula (ICES Division VIIIc, IXa and IXb) during two experimental surveys carried on commercial vessels (bottom trawlers and longliners). Additional information was provided by samplings conducted from 1996 to 1998 on board longliners from commercial fishery (Table 1, Fig. 1 and 2).

Length and depth distribution by sex of the main deep water squaloid sharks (*Centrophorus squamosus, Centrophorus granulosus, Centroscymnus coelolepis, Deania calceus* and *Scymnodon ringens*) are shown as well as the main biological aspects concerning to sex ratio, length-weight relationship, fecundity and maturity.

Length measurements (from the tip of the snout to the tip of the upper lobe of the caudal fin) were taken to the nearest centimetre and grouped by 3-cm length class.

Maturity was determined following the scale described by Stehmann (1987). This scale is based on macroscopic aspects: for mature males with claspers fully formed and stiff. For mature females with large ovaries, well rounded and the oocytes all to about the same size can easily be counted.

Ovarian fecundity was estimated by counting the number the ova in ripe females. Similarly uterine fecundity was determined from pregnant females with embryos more or less fully formed, pigmented and yolk sacks reduced. The size at birth was estimated by measuring the embryos without yolk.

Results

In general the female length range and size were greater than males in all species here considered. With the exceptions of *D. calceus* and *S. ringens*, the specimens smaller than 70 cm were absent in the catches (Table 2).

The sex-ratio varied along the different species, highlighting *C. granulosus* and *C. coelolepis* where the most part of the specimens were females (higher than 90%). On the other side, the males of C. *squamosus* were the predominant (up to 83%). *D. Calceus* and *S. ringens* showed different sex-ratio in relation with the gear used (close to 50% in bottom trawlers and greater presence of females in long liners (around of 80%) (Table 2).

The analysis of depth distribution from the species here studied was difficult due to the different gears used and different objectives of the vessels sampled (commercial or exploratory fishing surveys), (Fig. 3). However in general *S. ringens* and *D. calceus* presented a depth distribution shallower than the *C. granulosus, C. squamosus* and *C. coelolepis*.

The length-weight relationship showed for all species a $R^2 > 0.8$. (Fig. 4)

The percentage of maturity by sex, size at first maturity (L_{50}), the ovarian fecundity, uterine fecundity and size at birth are shown in tables 3 and 4. From some species, the small number of mature and immature individuals in the catches (*S. ringens* and *C. coelolepis* respectively) as well as the absence of a sex (*C. granulosus*) did not permit the estimation of these parameters. Moreover the percentage of maturity by sex and length class and the maturity ogives (adjusted by the method of maximum likelihood) were plotted whenever was possible (Fig. 5).

Discussion

The different objectives in the vessels sampled (commercial or exploratory fishing surveys) and the different gears used make difficult to compare the length and depth distribution in the study areas (Fig. 4).

The absence of small specimens in the catches of genus Centrophorus and Centroscymnus in both type of vessels (bottom trawlers and longliners) is an aspect pointed out by other authors (Conolly and Kelly, 1997; Kelly et. al., 1997). However the presence of pregnant females, close to the extruding (embryos without yolk), it would indicate a different pattern distribution of the smallest specimens at greater depths (Girard and Du Buit, 1998). However this hypothesis must be confirmed.

The size at first maturity in sharks is usually greater for females than males. Nevertheless the absence of adequate samplings scheme by sex in some of the studied species does not permit to analyse this aspect.

References

Conolly, P., and C. Kelly. 1997. Deep water trawl and longline surveys in 1995. *Fisheries Research Centre, Dublin*, 173, 20p.

Girard, M., and M.-H. Du Buit, 1999. Reproductive biology of two deep-water sharks from the British Isles, *Centroscymnus coelolepis* and *Centrophorus squamosus* (Chondrichthyes: Squalidae). *J. Mar. Biol. Ass. U.K.* 79. 923-931.

Kelly, C., M. Clark, and P. Connolly. 1997. Catch and discards from a deep-water trawl survey in 1996. *Fisheries Research Centre, Dublin*, 175, 16p.

Stehmann, M. 1987. Quick and dirty tabulation of stomach contents and maturity stages for skates Rajidae, squaloid and other ovoviviparous and viviparous species of sharks. *American Elasmobranch Society Newslwtter*. No.3, 5-9.

Table 1.- Exploratory surveys and commercial vessels from which data were obtained.

Ship	Survey Type	Zone	Gear	Date	Code	N- hauls (N-hooks)	Depth Range (m.)
Playa de Montalvo	Exploratory	VIIIc	Trawl	Jul-Sep-96	TE-VIIIc	75	512-1244
		IXa		Jul-Sep-96	TE-IXa	39	640-1171
Mar de Marín	Exploratory	VIIIc	Trawl	Jul-Sep-96	TE-VIIIc	78	580-1372
		IXa		Jul-Sep-96	TE-IXa	38	646-1098
Elenita2T	Commercial	IXa	Longline	April-97	L2C-IXa	1 (2880)	1163
		IXb		April-97	L2C-IXb	3 (5760)	1041-1145
		VIIIc		April-97	L2C-VIIIc	3 (8640)	1116-1165
La Polar	Commercial	VIIIc	Longline	June-97	L2C-VIIIc	1 (2000)	983
Playa del Rosal	Commercial	VIIIc	Longline	June-97	L2C-VIIIc	2 (4000)	732-769
Coruxo	Exploratory	IXb	Longline	August-97	L1E-IXb	21 (19200)	725-860
		IXb		October-97		15 (16000)	659-805
		IXb		April-98		10 (12800)	686-858
María Rosa	Exploratory	IXb	Longline	August-97	L2E-IXb	36 (15175)	686-1116
		IXb		October-97		15 (12100)	952-1072
		IXb		April-98		10 (9600)	946-1052
Elenita4T	Commercial	VIIIc	Longline	Nov-Dec-97	L2C-VIIIc	5 (10000)	1043-1208

Table 2.- Length range, mode length, mean length (cm) and sex-ratio from deep-water sharks species by sex, type of gear and Division.

Deania calceus

Divisions	**VIIIc + IXa**				**IXb**	
Survey type	**Expl.-Trawl**		**Comm.-Longline**		**Expl.-Longline**	
	males	females	males	females	males	females
Min-length	24	24	72	66	60	66
Max-length	102	117	111	114	93	117
Mode Length	84	105	84	102	84	90
Mean length	73	89	85	96	83	92
Sex ratio %	52.5	47.5	36.0	64.0	27.9	72.1
Number	777	702	300	533	106	274

Scymnodon ringens

Divisions	**VIIIc + IXa**		**IXb**	
Survey type	**Expl.-Trawl**		**Expl.-Longline**	
	males	females	males	females
Min-length	33	33	42	42
Max-length	78	105	72	111
Length Mode	72	39	69	81
Mean length	54	59	63	85
Sex ratio %	49.3	50.7	19.3	80.7
Number	176	181	17	71

Centroscymnus coelolepis

Divisions	**VIIIc + IXa**		**IXb**		
Survey type	**Comm.-Longline**		**Expl.-Longline**		**Comm.-Longline**
	males	females	males	females	females
Min-length	96	105	87	93	102
Max-length	96	117	99	120	117
Length Mode	96	111	93	111	111
Mean length	96	111	92	110	111
Sex ratio %	1.5	98.5	10.3	89.7	100.0
Number	1	64	30	260	38

Centrophorus granulosus

Divisions	**IXb**			
Survey type	**Comm.-Longline**		**Expl.-Longline**	
	males	females	males	females
Min-length	111	111	114	108
Max-length	111	159	114	165
Length Mode	111	141	114	153
Mean length	111	136	114	146
Sex ratio %	1.4	98.6	0.9	99.1
Number	1	69	2	216

Centrophorus squamosus

Divisions	**VIIIc + IXa**		**IXb**			
Survey type	**Comm.-Longline**		**Comm.-Longline**		**Expl.-Longline**	
	males	females	males	females	males	females
Min-length	87	87	87	102	87	96
Max-length	120	138	120	135	129	144
Length Mode	111	105	111	126	111	132
Mean length	109	115	110	124	83	92
Sex ratio %	75.6	24.4	83.0	17.0	83.1	16.9
Number	685	221	186	38	1015	207

Table 3.- Percentage by sex, and size at the first maturity (L_{50}) of the caught specimens.

Species	**Sample size (number)**		**% of mature**		**L_{50} of maturity**	
	males	females	males	females	males	females
C. squamosus	1265	272	95%	30%	98.5	127.0
C. granulosus	10	157	30%	52%		144.2
C. coelolepis	28	253	57%	98%		
D. calceus	380	614	56%	43%	79.8	98.6
S. ringens	70	140	6%	11%		

Table 4.- Ovarian fecundity (number of mature ova in ripe females), uterine fecundity (number of embryos in pregnant females) and size to birth of the studied species.

Species	**Sampled Specimens**	**Ovarian fecundity**	**Uterin Fecundity**	Size to born	
		Mean ova/female (range)	Mean embryos/female **(range)**	**Range**	**Average size**
C. squamosus	8	9 (7-12)	7	38-40	39.1
C. granulosus	39	5 (10-2)	3 (1-6)	35-42	39.9
C. coelolepis	52	-	14(5-22)	27-29	27.9
D. calceus	27	12 (8-19)	8 (2-13)	28-40	34.5
S. ringens	3	8 (7-8)	-	-	-

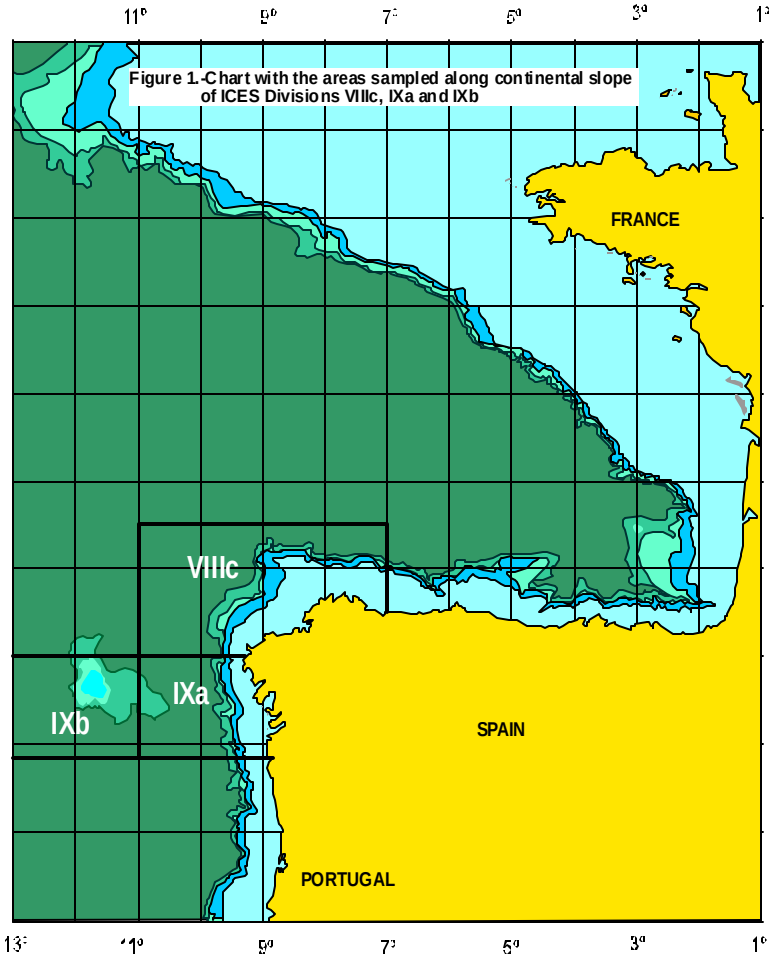
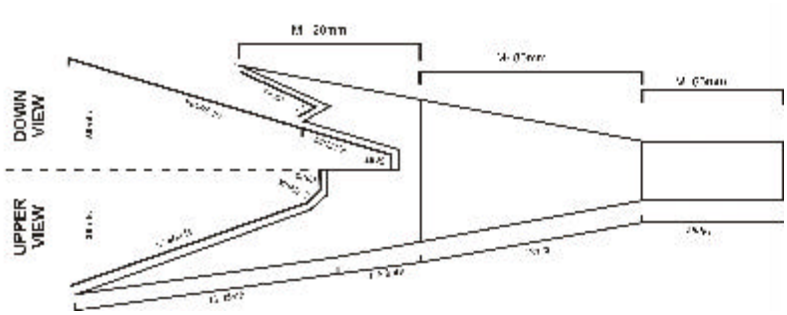
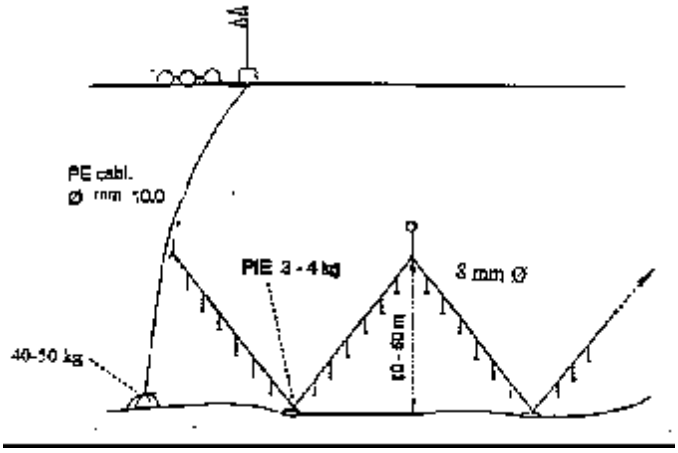


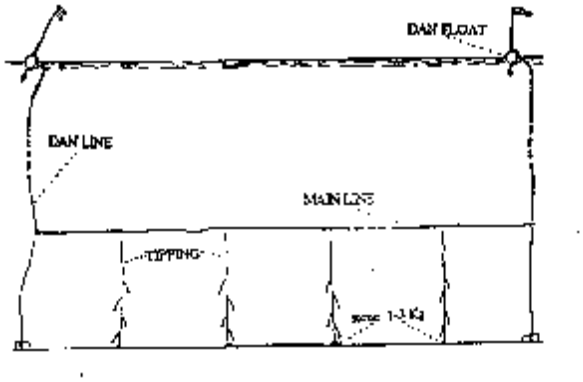
Fig. 1.- Chart with the area sampled along continental slope of ICES Divisions VIIIc, IXa and Ixb.



Bottom trawl using during exploratory survey in ICES Division VIIIc and IXa



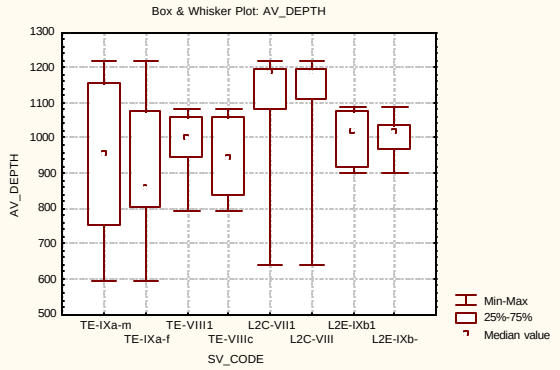
**Longline used in exploratory surveys (L1)
in depths lesser than 800 meters**



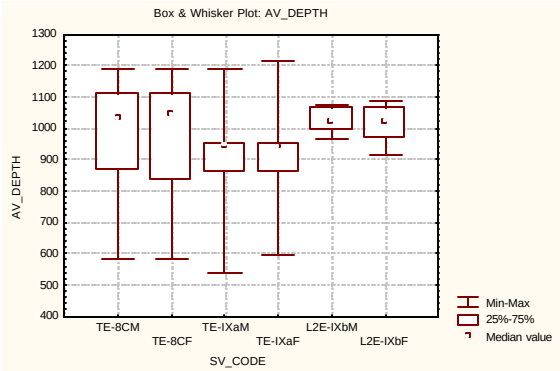
**Longline used in exploratory surveys and comercial fisheries
(L2) in depths greater than 800 meters.**

Fig. 2.- Gears used in Exploratory and Commercial fisheries.

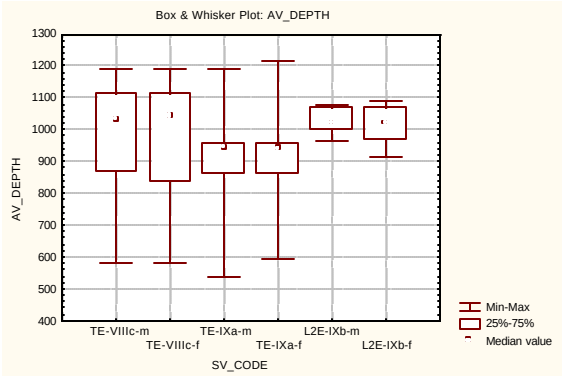
Deania calceus



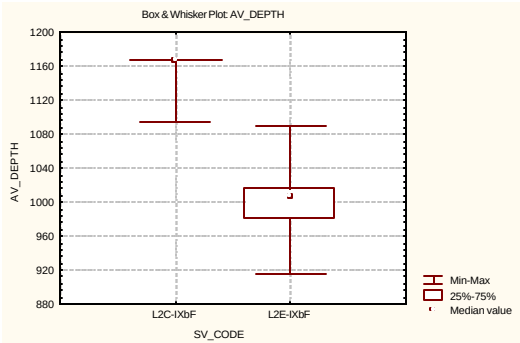
Scymnodon ringens



Centroscymnus coelolepis



Centrophorus granulosus



Centrophorus squamosus

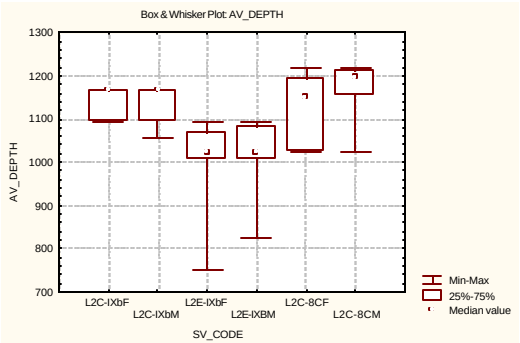


Fig. 3.- Depth distribution by sex, area, gear type and activity (TE: Botton Trawl Exploratory; L2C: Longline directed to deep-water sharks from Commercial Fisheries; L2E: Longline directed to deep-water sharks from Exploratory Surveys).

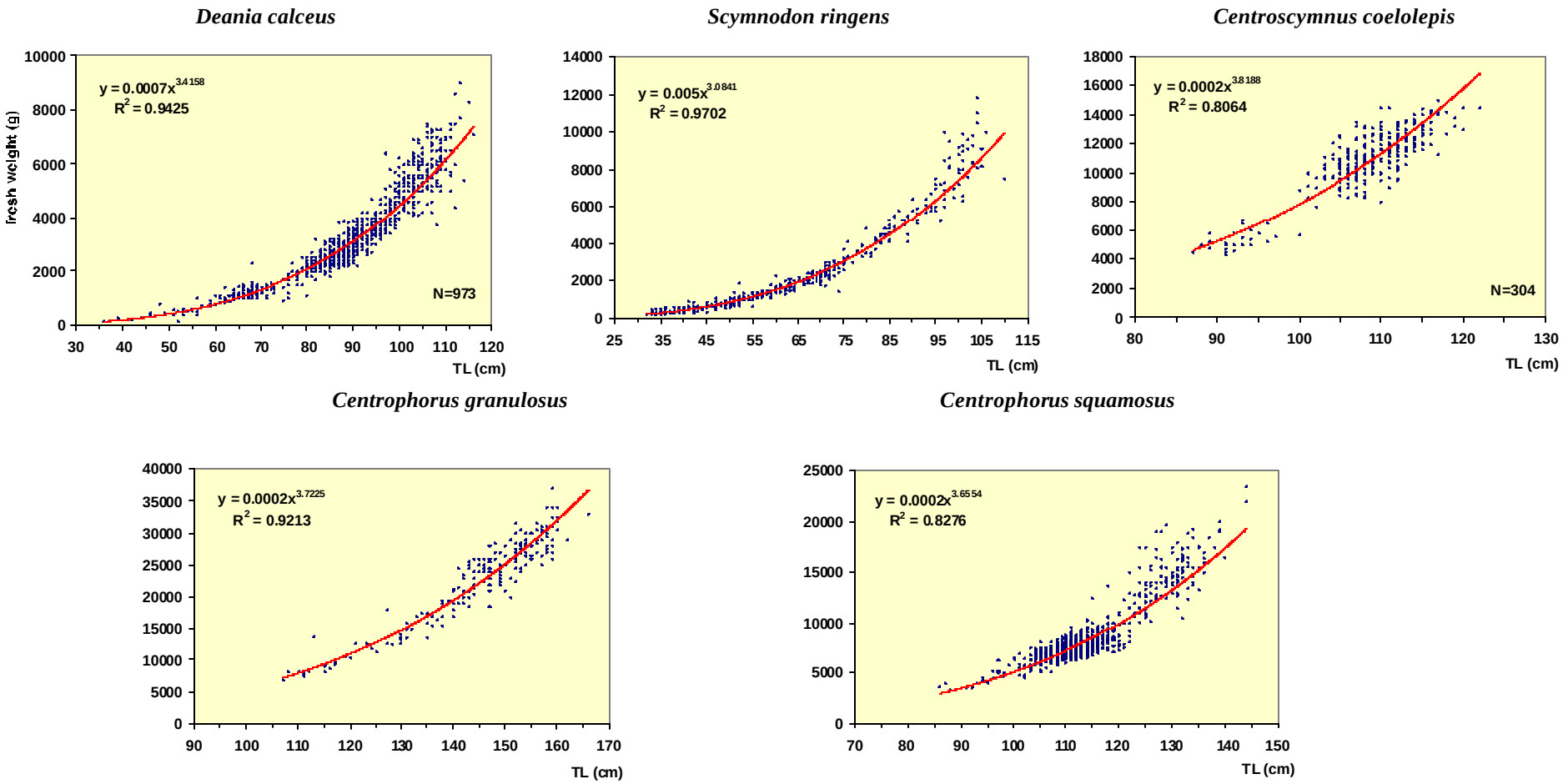
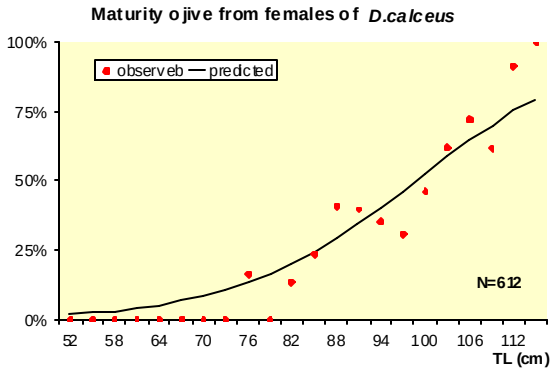
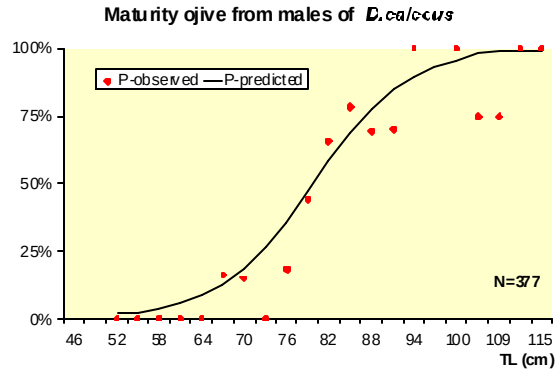
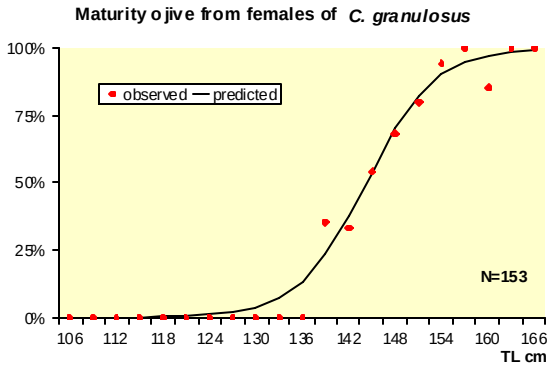
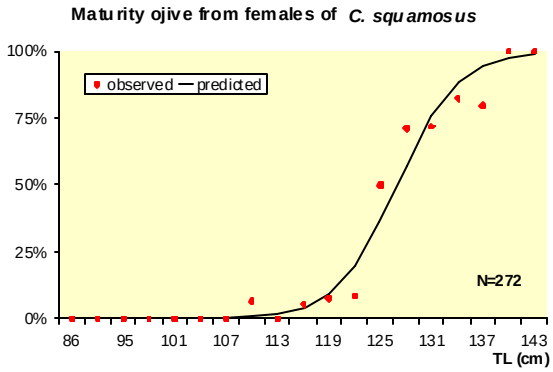


Fig. 4.- Length-weight relationships for both sexes and different areas joined.









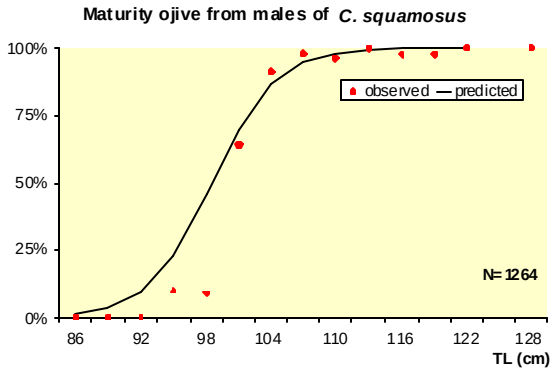


Fig. 5.- Maturity ogives from the species studied.