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Results on main elasmobranch species captured in the bottom trawl surveys on the Northern Spanish Shelf

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Abstract

This working document presents the results on the most significant elasmobranch species captured in the Spanish Groundfish Survey on Northern Spanish shelf in 2014. The main species in decreasing order of biomass are *Scyliorhinus canicula* (Lesser spotted dogfish), Galeus *melastomus* (Blackmouth catshark), *Etmopterus spinax* (Velvet belly), *Raja clavata* (Thornback ray), *Raja montagui* (Spotted ray) and *Leucoraja naevus* (Cuckoo ray). Biomass, distribution and length ranges were analysed. The majority of the species showed a decrease in biomass with regard to 2013 when highest values of the time series were reached and a new vessel (R/V Miguel Oliver) was used. The results of this last survey, also on board of R/V Miguel Oliver, seem to return to the values previous to 2013.

Introduction

The bottom trawl survey on the Northern Spanish Shelf has been carried out every autumn since 1983, except in 1987, to provide data and information for the assessment of the commercial fish species and the ecosystems on the Galician and Cantabrian shelf (ICES Divisions VIIIc and IXa North) (ICES, 2010). In 2012 in order to replace the R/V *Cornide de Saavedra* with a new vessel, the R/V *Miguel Oliver,* owned by the Secretary General for Fisheries, an inter-calibration experience was performed. In 2013 the first survey on R/V *Miguel Oliver* was carried out after the results of the inter-calibration (Velasco, 2013). However, the results from this survey in 2013 departed from the trends in the previous years and the results had to be considered with caution. In 2014 a new inter-calibration experience was performed with the old vessel, R/V *Cornide de Saavedra*, to study the 2013 results and adjust again the gear in the new vessel R/V *Miguel Oliver* where the surveys are carried out.

The aim of this working document is to report the results (abundance and biomass indices, length frequency distributions and geographic and bathymetric distributions) of the most common elasmobranch fish species in 2014 survey, following the results presented in previous documents (Fernández-Zapico et al., 2012; Ruiz-Pico et al., 2013; Fernández-Zapico et al., 2014). The species analysed in this working document are: *Scyliorhinus canicula* (Lesser spotted dogfish), *Scyliorhinus stellaris* (Greater spotted dogfish)*, Galeus spp*. (*G. melastomus* and *G. atlanticus*), *Etmopterus spinax* (Velvet belly), *Deania calcea* (Birdbeak dogfish), *Deania profundorum* (Arrowhead dogfish), *Hexanchus griseus* (Bluntnose sixgill shark), *Scymnodon ringens* (Knifetooth dogfish), *Raja clavata* (Thornback ray), *Raja montagui* (Spotted ray), *Leucoraja naevus* (Cuckoo ray), *Raja undulata* (Undulate ray), *Raja brachyura* (Blonde ray) and *Leucoraja circularis* (Sandy ray).

Material and methods

The survey was carried out on board the R/V *Miguel Oliver*, between September 17th and October 22nd, 2014.

The standard IBTS methodology for the western and southern areas (ICES, 2010) was applied. The sampling design was random stratified with five geographical sectors (MF. Miño-Finisterre, FE. Finisterre-Estaca de Bares, EP. Estaca de Bares - Peñas, PA. Peñas - Ajo, AB. Ajo - Bidasoa) (Figure 1). Depth stratification was changed in 1997 from 30-100 m, 101-200 m, 200-500 m to 70-120 m, 121-200 m and 201-500 to overcome the shortage of grounds shallower than 70 m that hindered the coverage of this stratum.

Nevertheless, hauls shallower than 70 m and deeper than 500 m are performed every year if possible and considered as additional hauls. These additional hauls are plotted in the distribution maps, although they are not included in the calculation of the stratified abundance indices since the coverage of these grounds (deep and shallow) is not considered representative of the area. The information from these depths is considered relevant due to the changes in the depth distribution of fishing activities in the area (Punzón et al. 2011), and these hauls are also used to define the depth range of the species.

Results

Standard sampling carried out (Figure 1) consisted of 116 valid hauls and 21 hauls out of the standard sampling, 2 of them shallower than 70 m, 13 deeper than 500 m, 4 in French waters to undertake a multiannual calibration with the R/V *Thalassa* (within the standardization activities of the IBTSWG) and 2 in the buffer zone of the Le Danois Bank Marine Protected Area.

Mean total stratified catch per haul was 312.18 ±43.45 kg. Fishes represented about 70% of the total stratified catch, while elasmobranchs made up ca. 7% of the total fish catch.

The species caught in 2014 in the stratified sampling area (Table 1) and their respective percentages of the elasmobranchs stratified catch were: *S. canicula* (69%), *S. stellaris* (0.16%), *G. melastomus* (6%), *E. spinax* (0.66%), *R. clavata* (17%), *R. montagui* (6%), *L. naevus* (1.4%), *H. griseus* (0.41%), *R. undulata* (0.33%), *R. brachyura* (0.04%), *L. circularis* (0.04%). Besides, other elasmobranchs occurred also in additional hauls deeper than 500 m, namely *D. calcea*, *D. profundorum, S. ringens* and *G. atlanticus.*

The most remarkable changes in 2014 compared to previous years were the decrease on the biomass of *S. canicula*, the increase of *G. melastomus* in additional deeper hauls, the practically absence of *G. atlanticus,* the larger catches of small specimens of *E. spinax*, the decrease of *R. clavata* and the increase of *R. montagui* in the central area of the Cantabrian Sea.

***Scyliorhinus canicula* (Lesser spotted dogfish) and *Scyliorhinus stellaris* (*Greater spotted dogfish*)**

After the steep increase of the stratified biomass of *S. canicula* in the previous years, in IXaN Division in 2012 and in VIIIc Division in 2013, the value decreased this last survey in both areas although it remained within the higher values in the overall time series (Figure 2). *S. stellaris* only appear in VIIIc Division in 2014, like in 2013, and the stratified biomass decrease to 0.05 kg·haul^{-1} after the highest value of the time series reached in 2013 (0.18 kg·haul^{-1}) (Figure 2).

S. canicula was widespread in the sampling area, whereas *S. stellaris* was sparse and scarce. In 2014, *S. canicula* was found between 24 m and 600 m and the few specimens of *S. stellaris* extended from 117 m and 295 m in the central part of the Cantabrian Sea (Figure 3).

Lesser spotted dogfish length distribution in 2014 ranged from 11 cm to 67cm, with more individuals of around 30 cm in IXaN and around 38 cm in VIIIc, whereas Greater spotted dogfish showed a narrower length range, from 22 cm to 45 cm (Figure 4).

Galeus melastomus (Blackmouth catshark) and *Galeus atlanticus* (Atlantic sawtail cat shark)

These species are more abundant in additional hauls deeper than 500 m. In 2014, the biomass of *G. melastomus* increased in special hauls of both divisions, reaching the highest values of the last six years, whereas *G. atlanticus* was practically absent, with only two specimens caught in IXaN Division around 657 m (Figure 5). In the standard stratification, between 70 m and 500 m, *G. melastomus* decreased slightly and *G. atlanticus* was totally absent in contrast to the high biomass in 2013 (Figure 6).

Blackmouth catshark was found from 111 m to 829 m in 2014. It was widespread in the sampling area with no clear pattern in the geographical distribution (Figure 7).

Regarding length distribution, *G. melastomus* caught in 2014 ranged from 14 cm to 71 cm in the standard stratification (70-500 m). Marked differences were found between specimens found in the standard stratification (70-500 m) and the ones found in additional hauls deeper than 500 m. In IXaN, only one specimen of 63 cm was found in the standard stratification whereas in deeper hauls (>500 m) higher abundances of specimens between 36 cm and 42 cm was shown. In VIIIc, high abundances of individuals around 30 cm and a second smaller mode around 18 cm were found in the standard hauls, whereas in hauls deeper than 500 m, bigger individuals (around 44 cm) and a practically absence of small specimens were found (Figure 8, Figure 9).

Etmopterus spinax (Velvet belly)

Around a 65% of the biomass of this scarce elasmobranch was found in hauls deeper than 500 m. In IXaN Division, *E. spinax* was scarcer than 2013, appearing only in two additional hauls around 600 m. In VIIIc Division, the catches of this species in standard hauls have decreased to 0.2 kg·haul^{-1} after the highest value of the time series found in 2013 (0.44 kg·haul^{-1}) (Figure 10).

E. spinax extended between 244 m and 705 m in 2014 and the main biomass remained in the north of Galicia like previous years (Figure 11).

Velvet belly length distribution caught in 2014 ranged between 12 cm and 36 cm. In contrast to the little abundance of the small sizes (around 15 cm) in the previous years, more abundance of specimens from 15 cm to 18 cm was shown in 2014 (Figure 12).

Other shark species

Other scarce shark species in the survey were *Deania* spp., *H. griseus* and *S. ringens*. They were common in additional deeper hauls (> 500 m) and scarce or absent on the stratified hauls (70-500 m), except *H. griseus*. All the species decreased in 2014, after the peak of the time series reached in 2013 (Figure 13). The results of the comparative analysis between *D. calcea* and *D. profundorum* in the last six years showed a decrease

in the catches of *D. calcea* in 2014 in VIIIc and an absence in IXaN, whereas *D. profundorum* increased in both divisons (Figure 14).
The small biomass in the catches and the scarcity of these species did not allow us to infer patterns in the spatial distribution, although larger abundance in the north of Galicia is frequent in some of them like *H. griseus* (Figure 15).

Raja clavata (Thornback ray)

This most abundant ray of the area decreases back to levels in 2012 around 4 kg·haul^{-1} after the high value around 7 kg·haul^{-1} reached in 2013. In IXaN Division the stratified biomass also decreased to reach the low values of the majority of the years of the time series, whereas in VIIIc Division although the capture registered an abrupt decrease, the biomass return to the values previous to 2013, with a small increase respect to 2012 (Figure 16).
R. clavata was widespread in the VIIIc Division and practically absent in IXaN Division and was found between 46 m and 273 m depth in 2014 (Figure 17).
Thornback ray caught in 2014 ranged from 14 cm to 92 cm, with the few specimens around 25 cm in IXaN and much more specimens around 25 cm and 37 cm in VIIIc (Figure 18).

Raja montagui (Spotted ray)

There was no record of this species in the IXaN Division in 2014 as it is happening throughout the time series. However, in VIIIc Division, the capture follows the increasing trend of the two previous years, reaching the highest value (1.7 kg·haul^{-1}) of the last twelve years (Figure 19).
R. montagui extended from 60 m to 175 m in 2014. Higher biomass was found in the central area of the Cantabrian Sea in contrast to the previous years (Figure 20).
Spotted ray length ranged from 21 cm to 66 cm in 2014 with a more marked mode around 53 cm than previous years and some small individuals around 27 cm (Figure 21).

Leucoraja naevus (Cuckoo ray)

As *R. montagui*, *L. naevus* has not been found in IXaN along the time series.
In VIIIc Division the capture registered an abrupt decrease (0.40 kg·haul^{-1}) in 2014 after the high value reached in 2013 (0.64 kg·haul^{-1}) (Figure 22)
This species was caught from 87 m to 273 m depth in 2014 and its spatial distribution was homogeneous throughout the VIIIc, no particularly abundant in the central area of the Cantabrian Sea in contrast to the previous year (Figure 23).
Cuckoo ray length distribution ranged from 19 cm to 63 cm in 2014 with lesser abundance of individuals under 44 cm in contrast to 2013 (Figure 24).

Other ray species

The other ray species found in the area in 2014 were the scarce *R. undulata*, *R. brachyura* and *L. circularis* while *Raja microocellata* was not found in contrast to 2013. *R. undulata* showed the highest biomass of these rays, *R. brachyura* was found this last year after the lack of specimens in the previous survey and *L. circularis* remain being the most recurrent every year. The low biomass in the catches and the scarcity of these species did not allow us to describe patterns in the spatial distribution, although some of them are found repeatedly in the same areas, like *R. undulata* around Cape Ajo and *L. circularis* in the north of Galicia (Figure 25)

Acknowledgements

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Tables

Table 1 The elasmobranchs caught in 2014 in decreasing order of stratified biomass ($kg \cdot haul^{-1}$) and their respective abundances ($n \cdot haul^{-1}$)

Species	Biomass	Abundance
Scyliorhinus canicula	16.65	60.41
Raja clavata	4.03	3.35
Galeus melastomus	1.48	13.27
Raja montagui	1.43	1.77
Leucoraja naevus	0.33	0.48
Etmopterus spinax	0.16	5.77
Hexanchus griseus	0.10	0.03
Raja undulata	0.08	0.01
Scyliorhinus stellaris	0.04	0.26
Raja brachyura	0.01	0.02
Leucoraja circularis	0.01	0.01
Deania profundorum	0.00	0.03

Figures

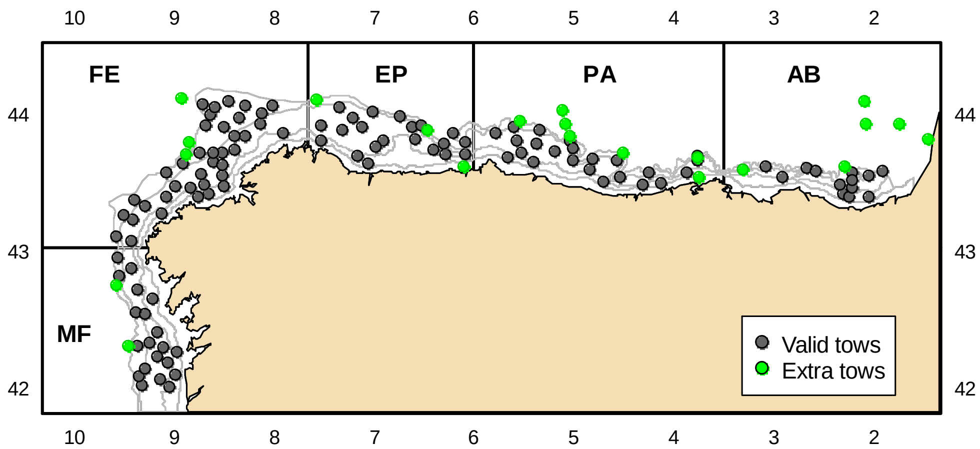

Figure 1 Stratification design and hauls on the Northern Spanish shelf groundfish survey in 2014; Depth strata are: A) 70-120 m, B) 121 – 200 m and C) 200 – 500 m. Geographic sectors are MF: Miño-Finisterre, FE: Finisterre-Estaca, EP: Estaca-cabo Peñas, PA: Peñas-cabo Ajo, and AB: Ajo-Bidasoa

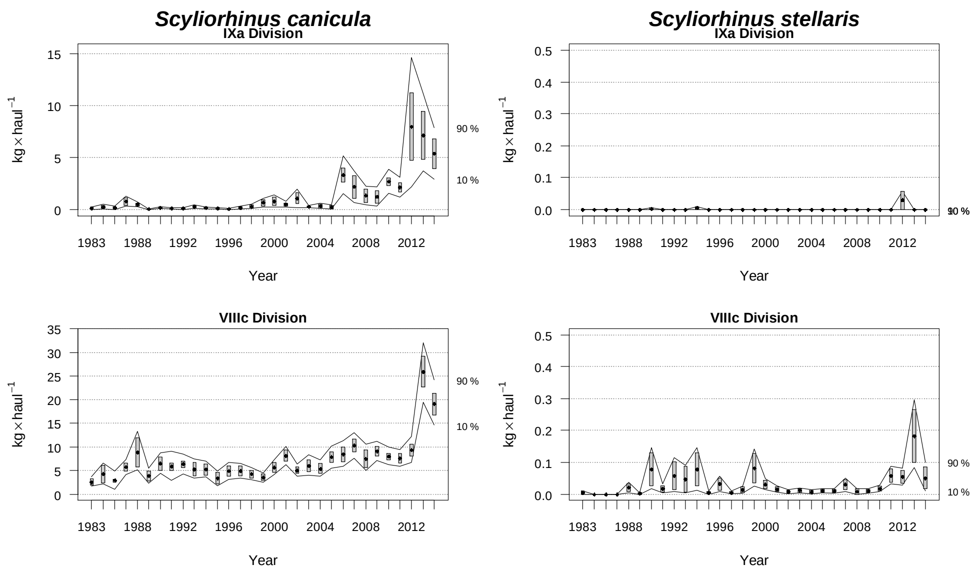

Figure 2 Changes in *Scyliorhinus canicula* and *Scyliorhinus stellaris* biomass index during the North Spanish shelf bottom trawl survey time series (1983-2014) in the two ICES divisions covered by the survey. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

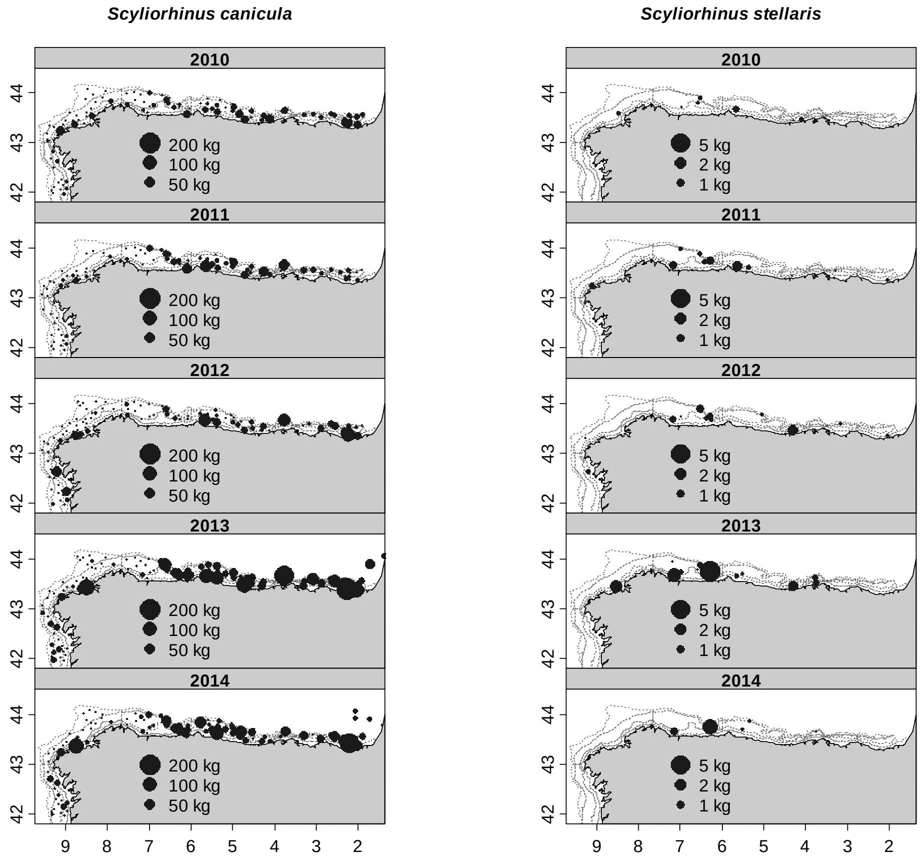

Figure 3 Geographic distribution of *Scyliorhinus canicula* and *Scyliorhinus stellaris* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2010 and 2014

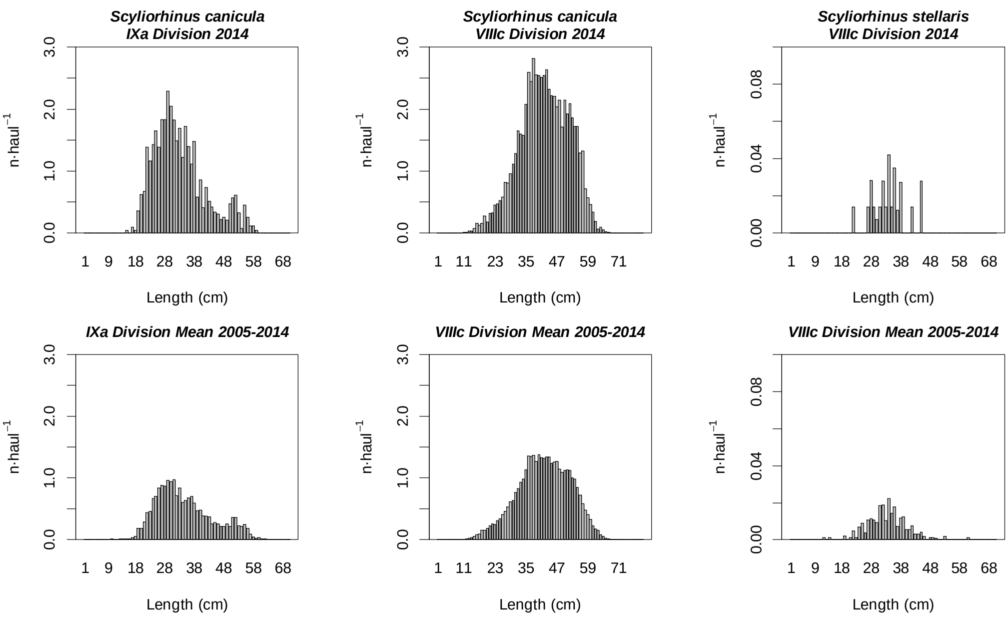

Figure 4 Stratified length distributions of *Scyliorhinus canicula* and *Scyliorhinus stellaris* in 2014 in the two ICES divisions covered by the North Spanish Shelf bottom trawl survey, and the mean values for the last decade in both areas (2005-2014)

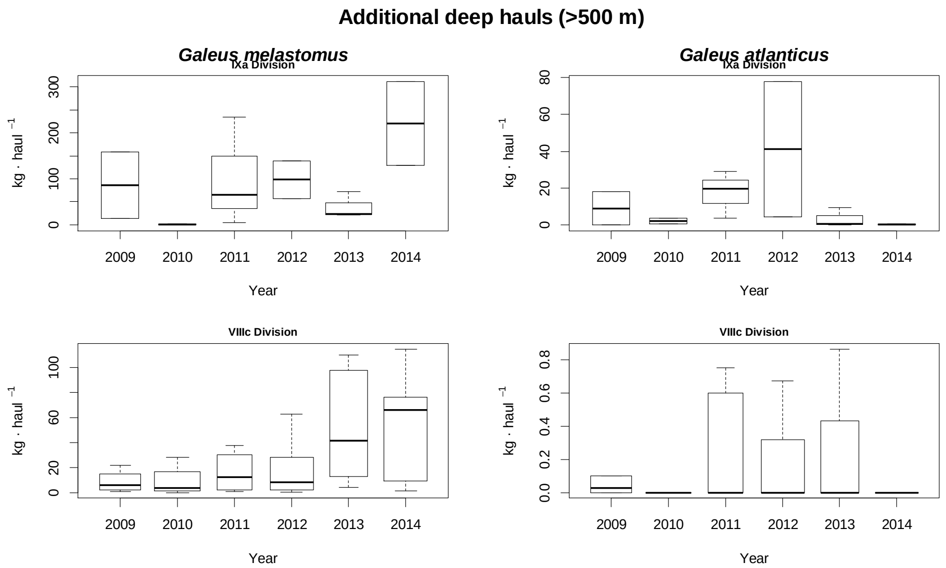

Figure 5 Evolution in the catches in biomass of *Galeus melastomus* and *Galeus atlanticus* in additional hauls out of the standard stratification (>500 m) between 2009 and 2014 in the two ICES divisions. Boxes mark parametric standard error of the biomass in additional hauls. Lines mark the median and whiskers the interquartile range.

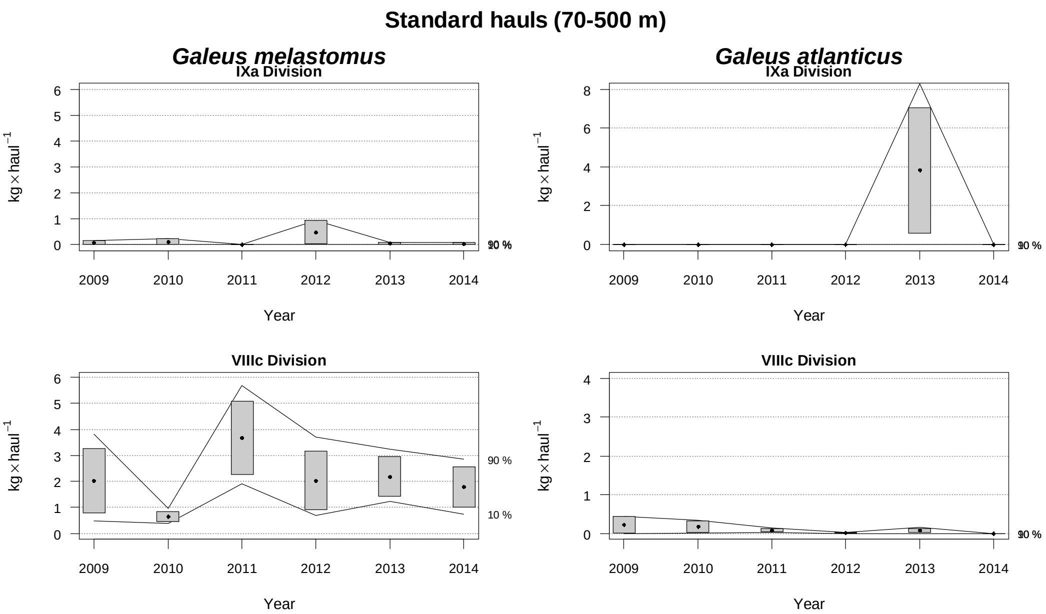

Figure 6 Changes in *Galeus melastomus* and *Galeus atlanticus* stratified biomass index (only with standard hauls between 70 and 500 m) during the North Spanish shelf bottom trawl survey between 2009 and 2014 in the two ICES divisions. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80 bootstrap iterations = 1000)

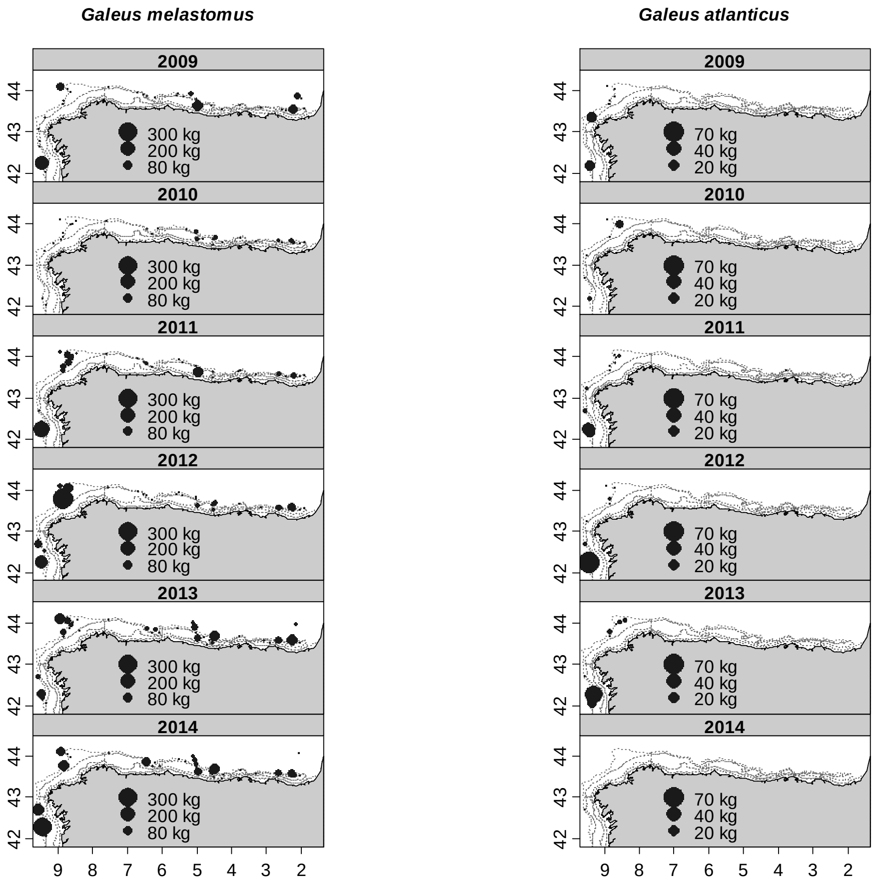

Figure 7 Geographic distribution of *Galeus melastomus* and *Galeus atlanticus* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014

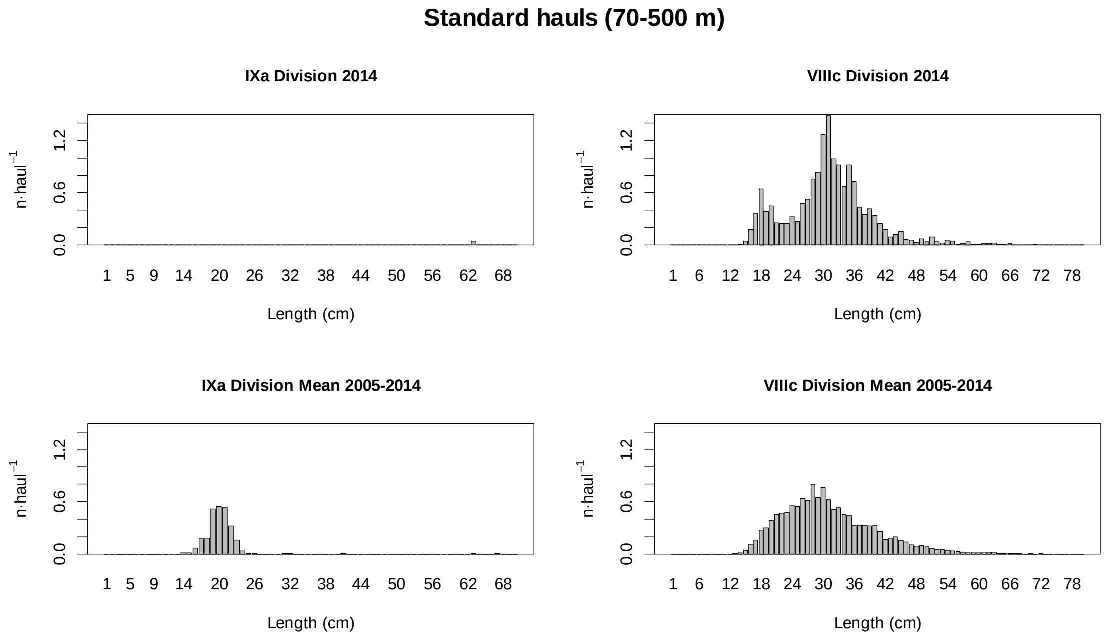

Figure 8 Mean stratified length distributions of *Galeus melastomus* in the North Spanish Shelf surveys (2005-2014)

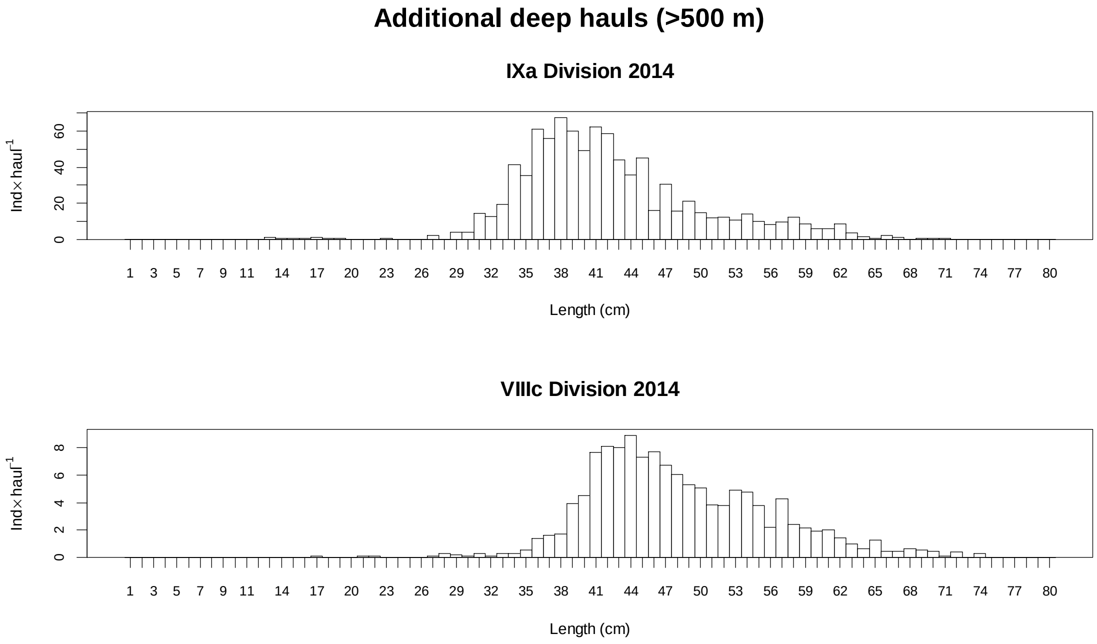

Figure 9 Mean length distributions of *Galeus melastomus* in additional hauls out of the standard stratification (>500 m) in the North Spanish Shelf survey 2014

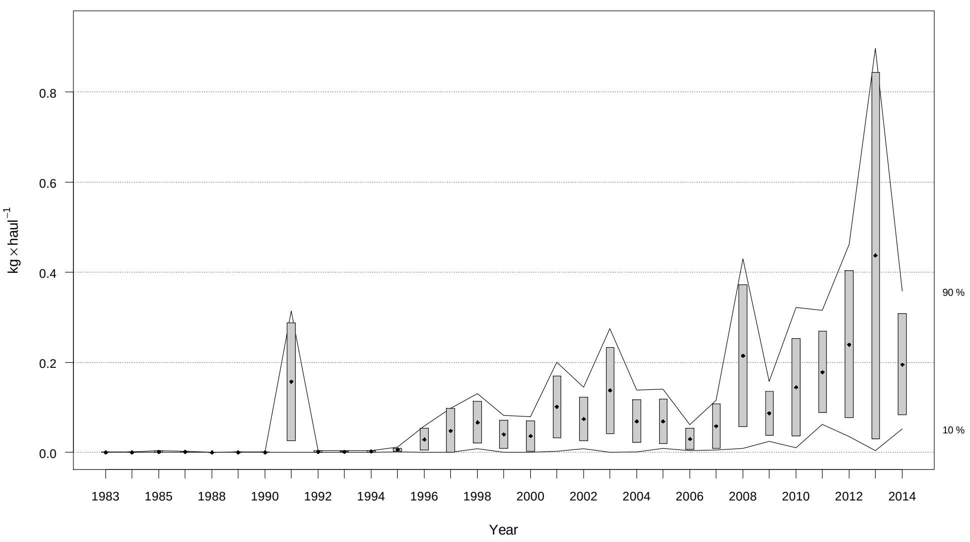

Figure 10 Changes in *Etmopterus spinax* stratified biomass index during the North Spanish shelf bottom trawl survey time series (1983-2014) in the VIIIc division covered by the survey. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

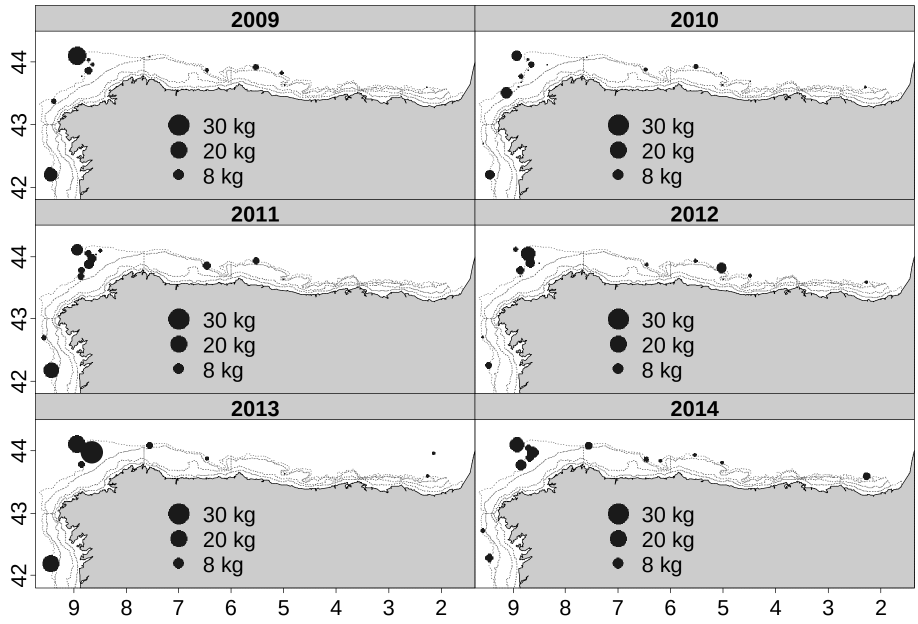

Figure 11 Geographic distribution of *Etmopterus spinax* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014

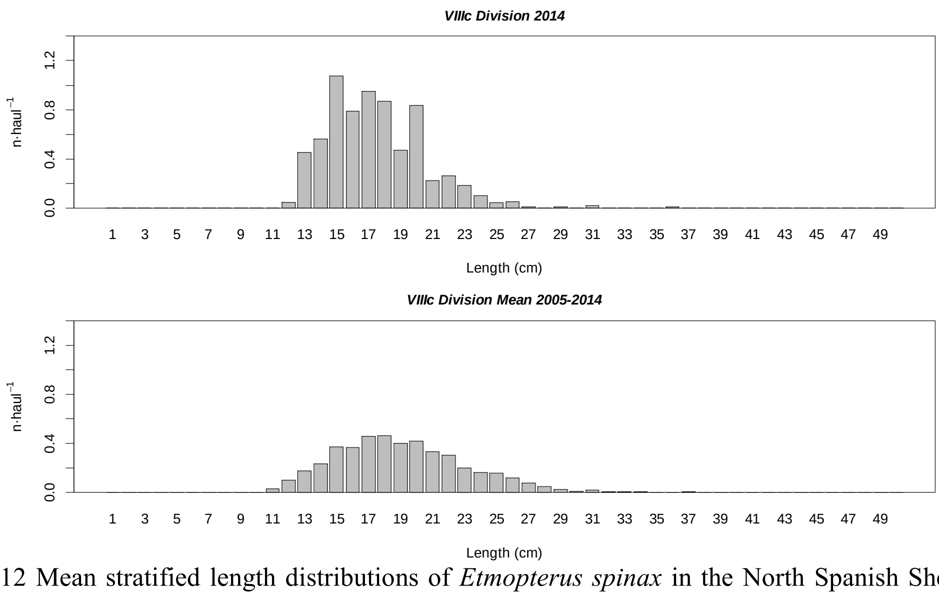

Figure 12 Mean stratified length distributions of *Etmopterus spinax* in the North Spanish Shelf surveys (2005-2014)

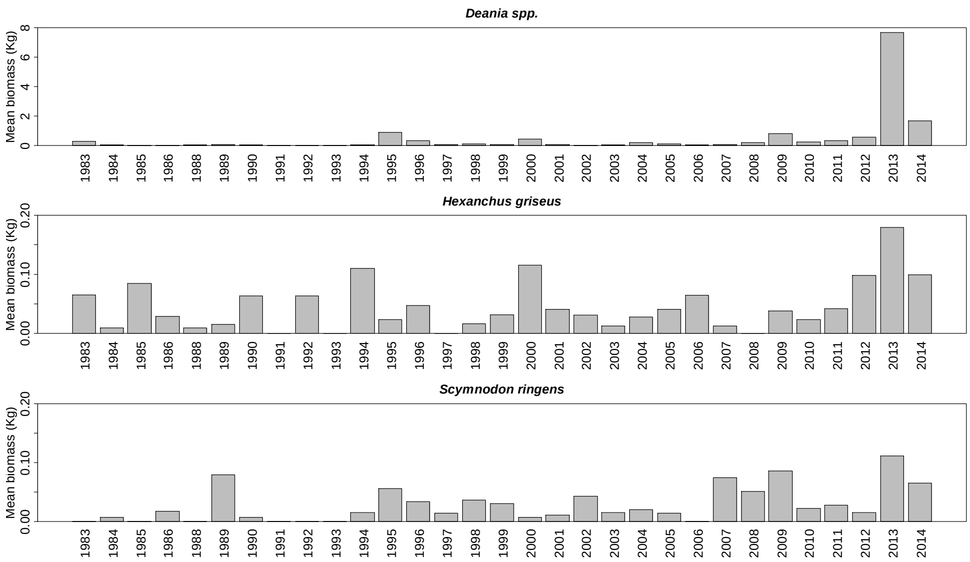

Figure 13 Evolution in the catches in biomass of *Deania* spp., *Hexanchus griseus* and *Scymnodon ringens* including all additional hauls out of the standard stratification (>500 m) during the last decade of the North Spanish shelf bottom trawl surveys time series (1983-2014)

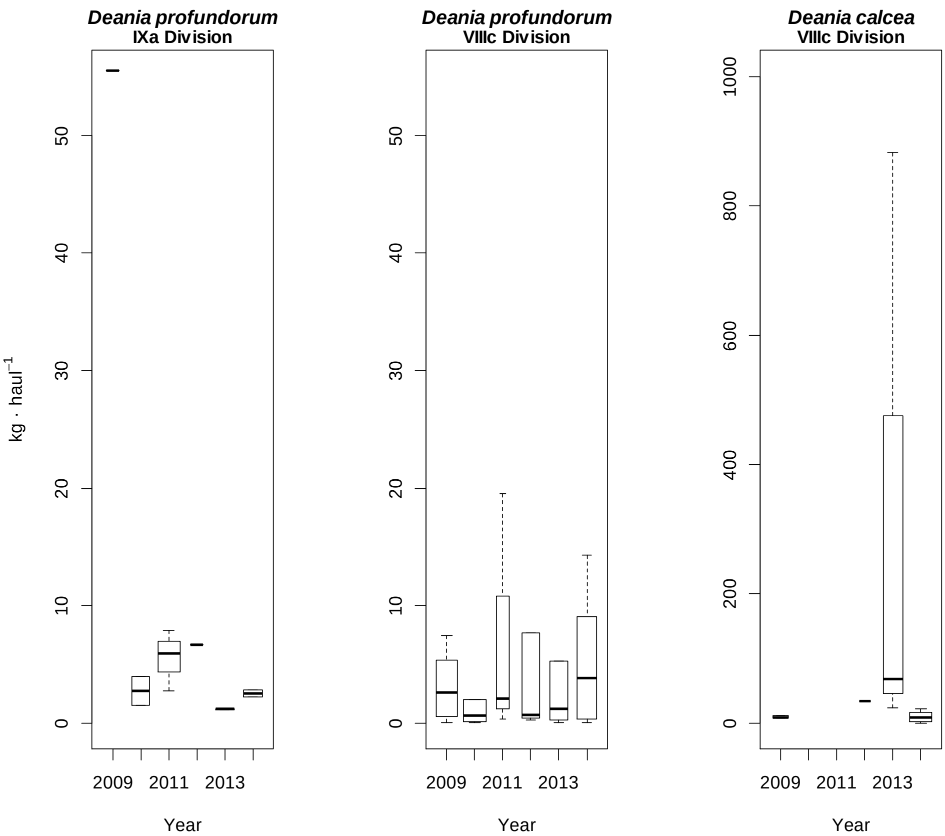

Figure 14 Evolution in the catches in biomass of *Deania profundorum* and *Deania calcea* in additional hauls out of the standard stratification (>500 m) between 2009 and 2014 in the two ICES divisions. Boxes mark parametric standard error of the biomass in additional hauls. Lines mark the median and whiskers the interquartile range.

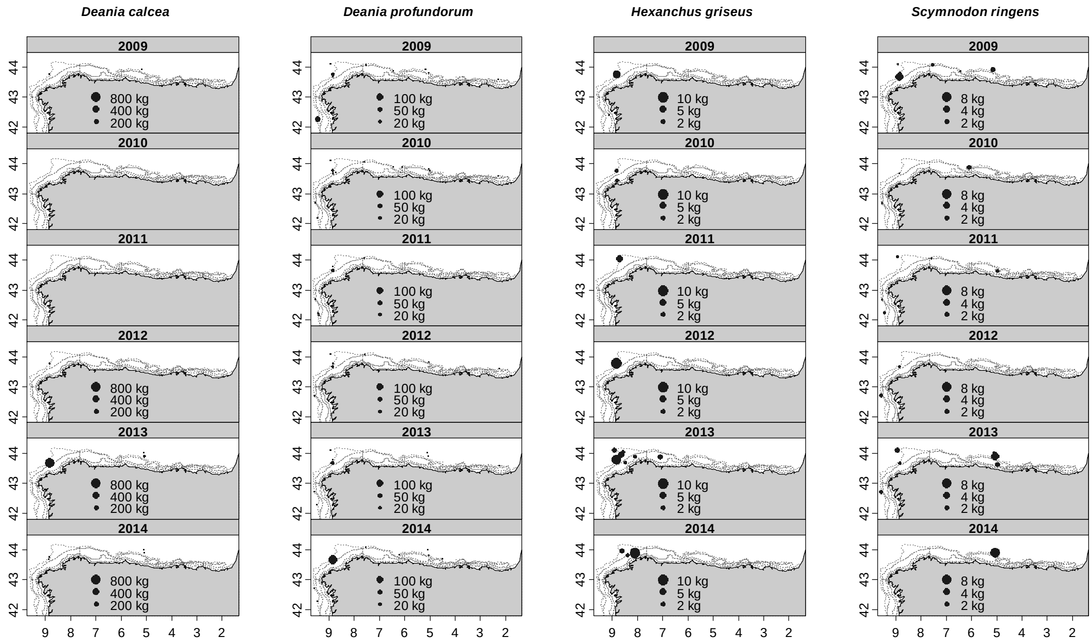

Figure 15 Geographic distribution of Deania calcea, Deania profundorum, Hexanchus griseus and Scymnodon ringens catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014

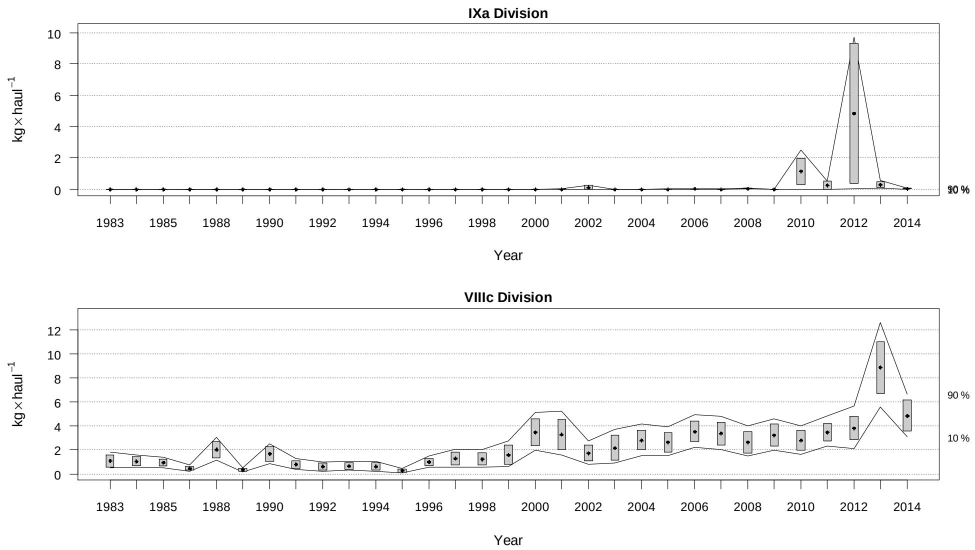

Figure 16 Changes in *Raja clavata* biomass index during the North Spanish shelf bottom trawl survey time series (1983-2014) in the two ICES divisions covered by the surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

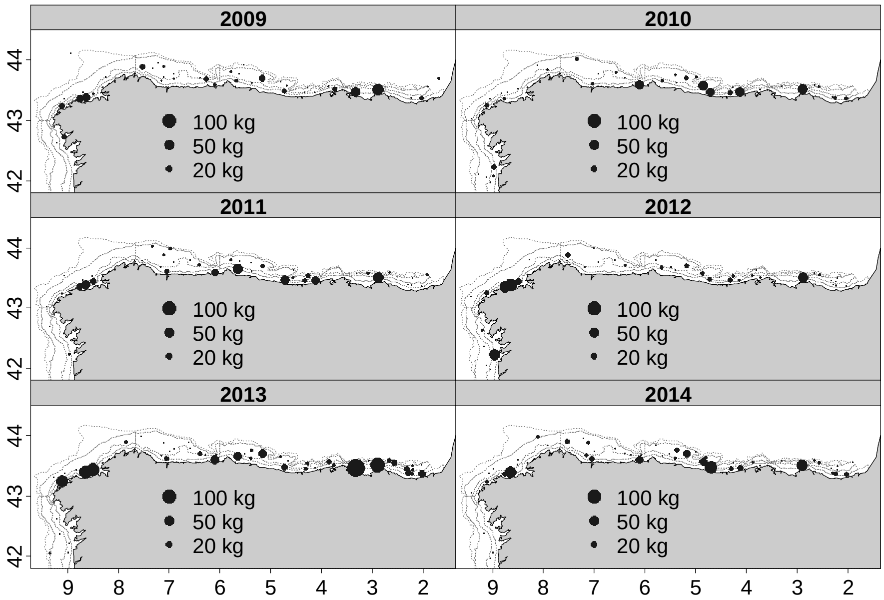

Figure 17 Geographic distribution of *Raja clavata* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014

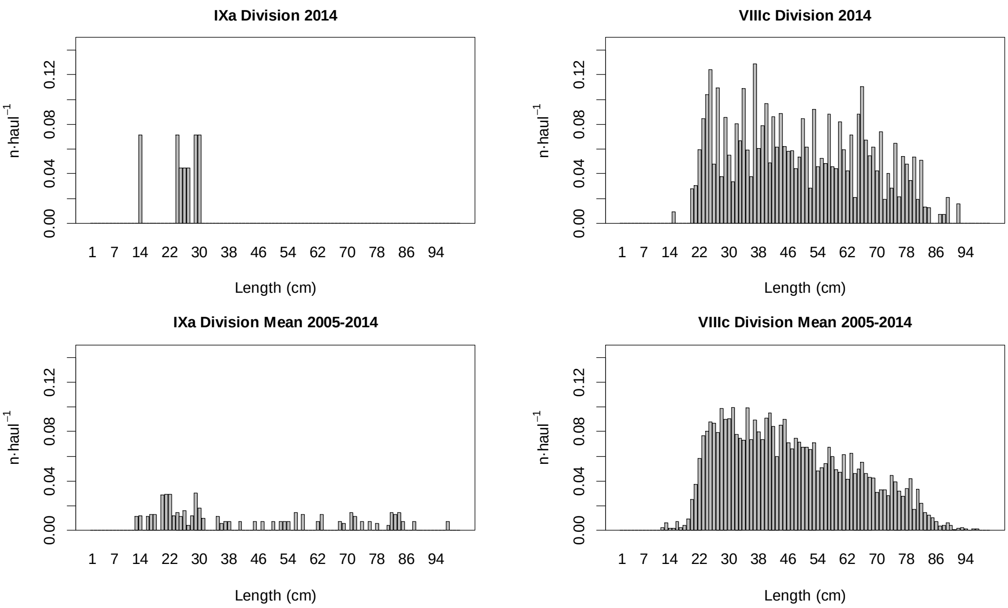

Figure 18 Mean stratified length distributions of *Raja clavata* in the last decade of the North Spanish Shelf surveys (2005-2014)

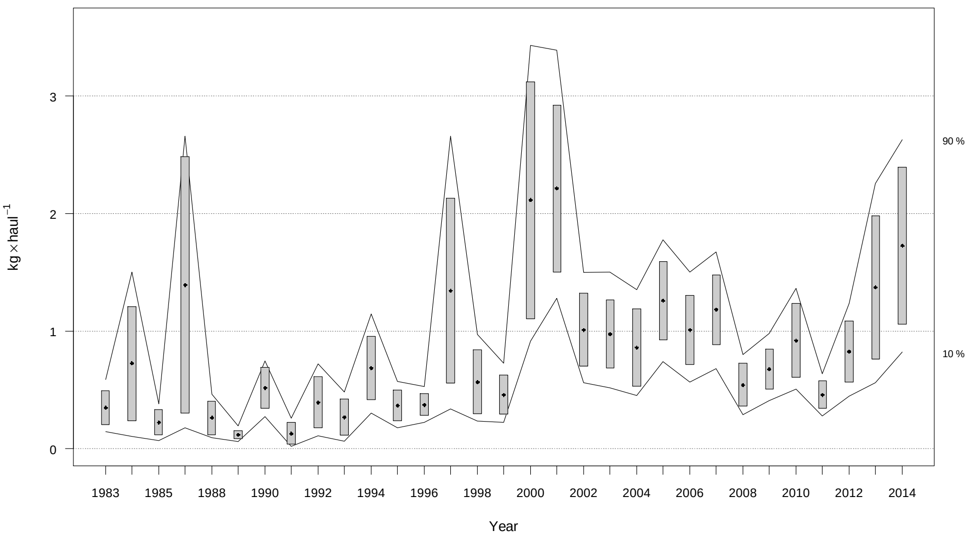

Figure 19 Changes in *Raja montagui* biomass index during the North Spanish shelf bottom trawl survey time series (1983-2014) in the VIIIc division covered by the survey. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

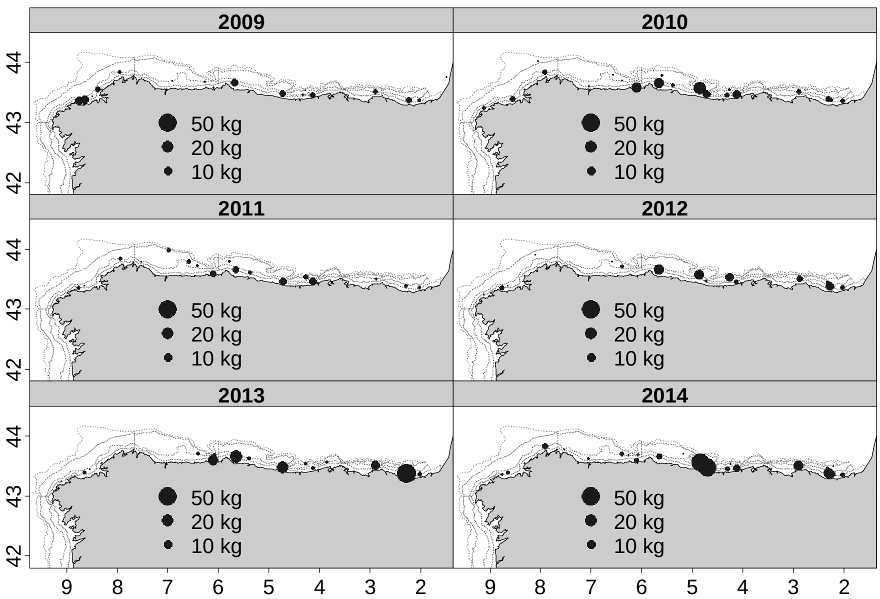

Figure 20 Geographic distribution of *Raja montagui* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014

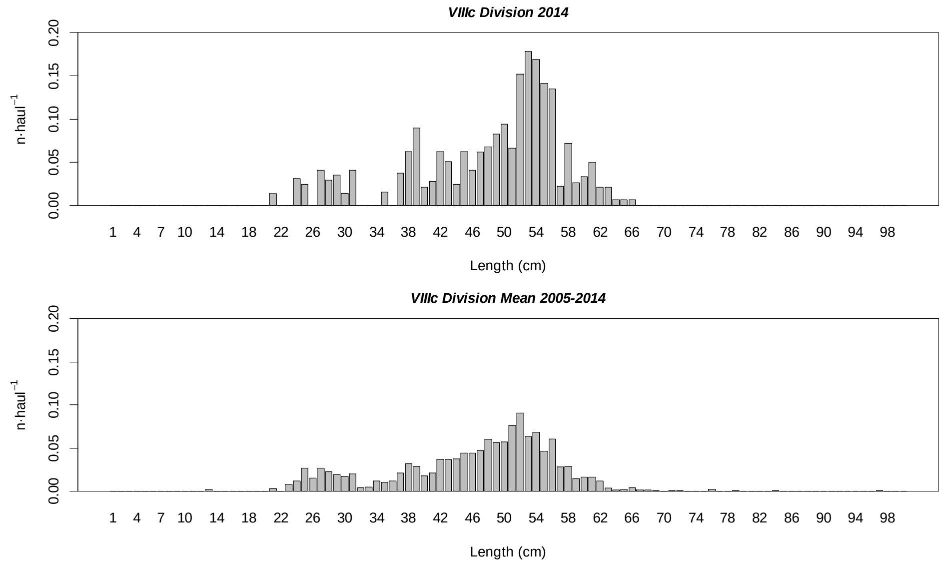

Figure 21 Mean stratified length distributions of *Raja montagui* in the North Spanish shelf surveys (2005-2014)

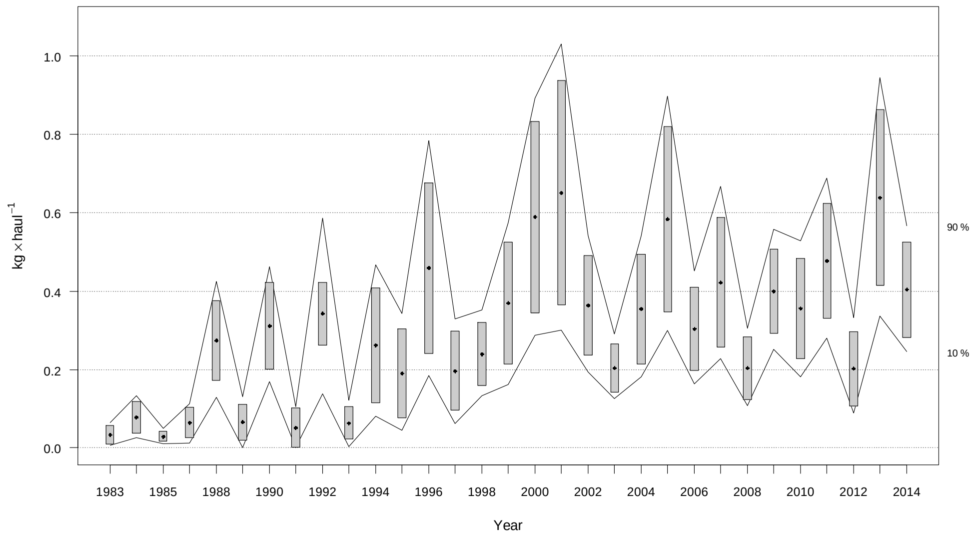

Figure 22 Changes in *Leucoraja naevus* biomass index during the time series of the North Spanish shelf bottom trawl surveys (1983-2014) in the VIIIc division covered by the survey. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

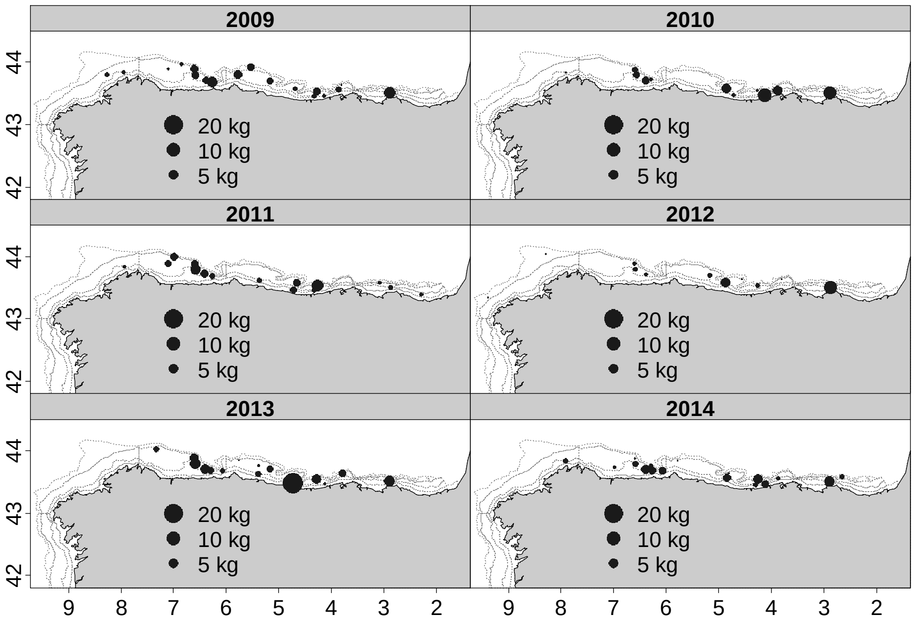

Figure 23 Geographic distribution of *Leucoraja naevus* catches (kg/30 min haul) in North Spanish shelf bottom trawl surveys between 2009 and 2014

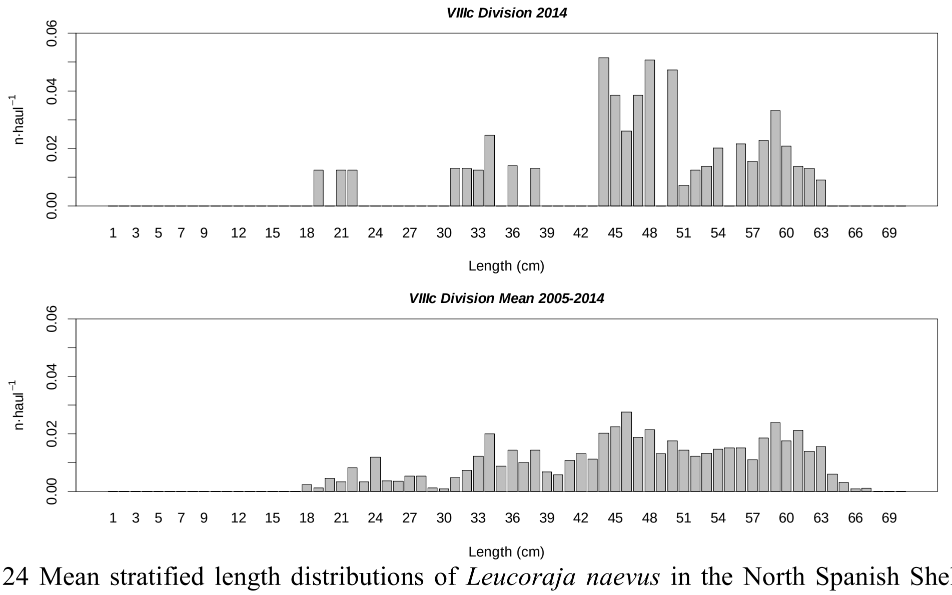

Figure 24 Mean stratified length distributions of *Leucoraja naevus* in the North Spanish Shelf surveys (2005-2014)

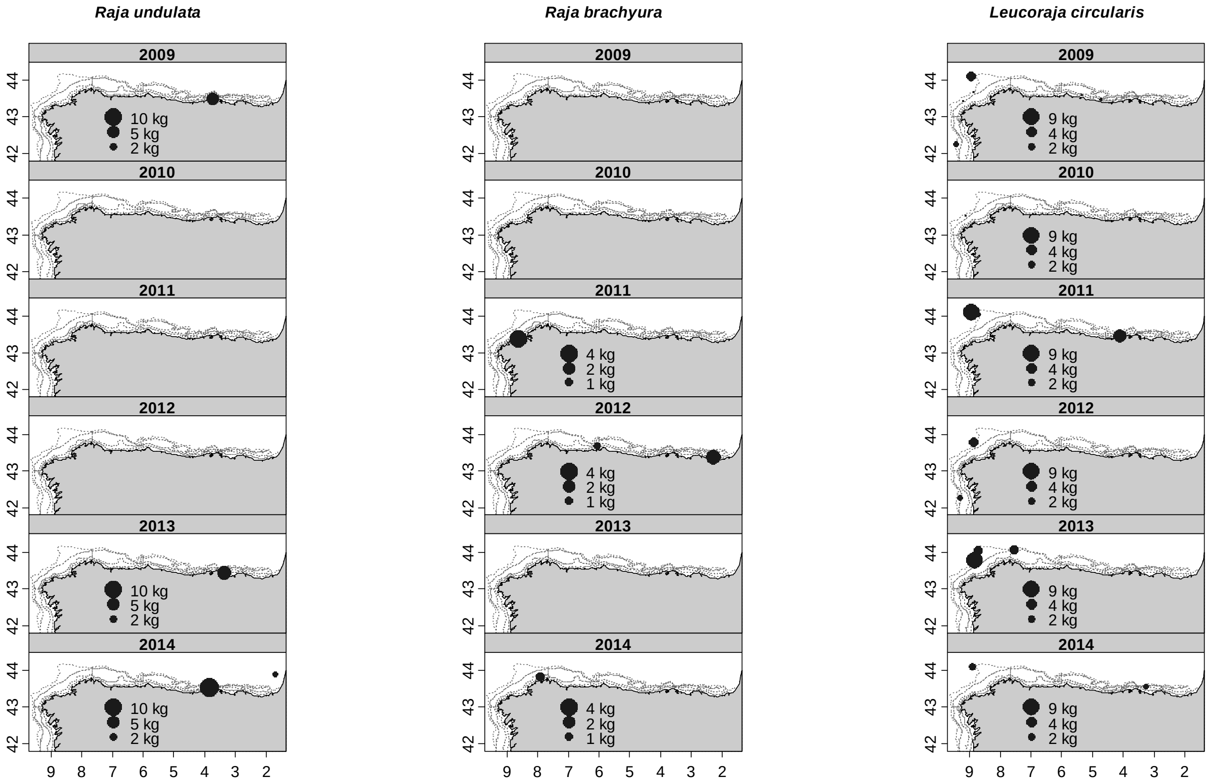

Figure 25 Geographic distribution of *Raja undulata*, *Raja brachyura* and *Leucoraja circularis* catches (kg/30 min haul) in North Spanish Shelf bottom trawl surveys between 2009 and 2014