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Results on silver smelt (*Argentina silus* and *Argentina sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*) and ling (*Molva molva* and *Molva macrophthalma*) from 2001 to 2015 Porcupine Bank (NE Atlantic) survey

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Abstract

This working document presents the results on the most significant deep fish species of the Porcupine Spanish ground fish survey in 2015. Biomass, abundance, distribution and length ranges were analysed for greater silver smelt (*Argentina silus*), lesser silver smelt (*Argentine sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), ling (*Molva molva*) and Spanish ling (*Molva macrophthalma*). Both silver smelt species and bluemouth slightly increased whereas greater forkbeard and both ling species showed a marked decrease. A small recruitment signal of *M. molva* was found in the south-western Irish shelf sampled for first time in the overall time series.

1. Introduction

The Spanish bottom trawl survey in the Porcupine Bank (ICES Divisions VIIc and VIIk) has been carried out annually since 2001 to study the distribution, relative abundance and biological parameters of commercial fish in the area (ICES, 2010a, 2010b).

The aim of this working document is to update the results (abundance indices, length frequency and geographic distributions) on the most common deep water fish species in Porcupine bottom trawl surveys after the results presented previously (Baldó *et al.* 2008, Velasco *et al.* 2011, 2012, 2013, Fernández-Zapico *et al*., 2015). The species analysed were: *Argentina silus* (greater silver smelt), *Argentina sphyraena* (Lesser silver smelt), *Helicolenus dactylopterus* (bluemouth), *Phycis blennoides* (greater forkbeard), *Molva molva* (ling) and *Molva macrophtalma* (Spanish ling). Although results on *Helicolenus dactylopterus* and *Molva macrophtalma* were not requested, they are also updated as have been done in previous reports considering their remarkable abundance and geographical distribution in the area surveyed.

2. Material and methods

The area covered in the Spanish Ground Fish Survey on the Porcupine bank (SP-PorcGFS) extends from longitude 12° W to 15° W and from latitude 51° N to 54° N, following the standard IBTS methodology for the western and southern areas (ICES, 2010b).The sampling design was random stratified (Velasco and Serrano, 2003) with two geographical sectors (Northern and Southern) and three depth strata (> 300 m, 300 – 450 m and 450 - 800 m) (Figure 1). Hauls allocation is proportional to the strata area following a buffered random sampling procedure (as proposed by

Kingsley *et al*., 2004) to avoid the selection of adjacent 5×5 nm rectangles. More details on the survey design and methodology are presented in ICES (2010, 2011).

Trying to change the abundance estimation from time based to swept area, previous abundance estimates based on 30 min of trawling from the end of warp shooting, were corrected to time from net-ground contact to the start of net hauling, as reported in last year WD. During 2015 survey, the net monitoring system (SIMRAD ITI) was also used to detect the exact moment of ground contact and 30 minutes of effective trawling were performed. The problem detected in this last survey was that with the increment in total catch (**¡Error! No se encuentra el origen de la referencia.**), and bearing in mind that trawling during 30 minutes make it much longer and harder sorting tasks for people on board, see in **¡Error! No se encuentra el origen de la referencia.** that the increase in catch is even larger when trawling for 30 minutes and the remarkable increase in 2015. Trawling shorter, 20 min instead 30 min, could be a better methodology and a solution for the problems on board in this fertile area, also considering that catching more than 120 tones is more similar to what commercial vessels than scientific research vessels.

3. Results and discussion

In 2015, 80 standard hauls and 5 additional hauls were carried out (Figure 1).

As described above, the total catch of the whole time series was increasing sharply the previous last years, from a mean total catch per haul in the 12 first years around 780.1 Kg to 1329.8 Kg this last survey (**¡Error! No se encuentra el origen de la referencia.**), nearly the total catches has doubled over the last years.

In this last survey, fishes represented about 96% of the total catch and the deep water fish species made up ca. 14% of the total fish catch. The respective percentages of the deep water fish species studied in this document of the total stratified catch of these species were: *Argentina silus* (38%), *Argentina sphyraena* (11%), *Helicolenus dactylopterus* (28%), *Phycis blennoides* (13%), *Molva molva* (2%) and *Molva macrophtalma* (8%).

The most remarkable changes in 2015 compared to previous years were the steep decrease on the biomass of *P. blennoides* in the eastern area of the bank but larger catches of big specimens (around 46 cm) and small (around 19 cm) and the decreasing trend of *M. molva* and *M. macrophtalma* abundances. Nevertheless, the recruitment signals were good for *P. blennoides* and *H. dactylopterus* and new in the time series for *M. molva* in the southwestern part of the Irish shelf covered by the survey. Small specimens of *A. sphyraena* kept being much abundant than *A. silus*, although they sized around 15 cm this last year, instead 6 cm as in 2014.

***Argentina silus* (greater silver smelt) and *Argentina sphyraena* (Lesser silver smelt)**

A. silus and *A. sphyraena* were analysed separately in the present working document. Despite *A. sphyraena* was not requested, it is interesting to do a comparative analysis between these two species.

In the overall time series, biomass and abundance of *A. silus* was higher than *A. sphyraena* (**¡Error! No se encuentra el origen de la referencia.**). This last year biomass of *A. silus* nearly quadruples *A. sphyraena*, 72.6±15.6 Kg and 20.2±7.61 Kg respectively, and abundance hardly doubled it, 510.8±119.56 and 347.9±119.59 respectively. Differences between biomass and abundance were showed in the overall time series, due to the larger individuals of *A. silus*, which reached sizes around 45 cm instead of around 30 cm as *A. sphyraena*, and which contributed in the higher biomass.

Both species together, in biomass and abundance, slightly increased this last year (**¡Error! No se encuentra el origen de la referencia.**). *A. silus* increased although the biomass and abundances remained in the mean values of the time series after 2013 peak of and *A. sphyraena* has been increasing in the last four years, although the abundance of this last year remained steady (**¡Error! No se encuentra el origen de la referencia.**).
As shown before, larger individuals of *A. silus* than *A. sphyraena* were caught. In 2015, length size of the former species ranged from 12 cm to 45 cm, while the latter ranged from 11 cm to 30 cm. Similar size distribution than 2014 was found in *A. silus*, but in *A. sphyraena* was not the recruitment peak around 6 cm showed the previous year, although a mode around 15 cm was showed (**¡Error! No se encuentra el origen de la referencia.**; **¡Error! No se encuentra el origen de la referencia.**).
The geographical distribution of both species remained similar to 2014, being more abundant in the deeper hauls in the southwest area and in the western part of the bank (**¡Error! No se encuentra el origen de la referencia.**). However, higher concentration of *A. sphyraena* was found where it is usually frequent, in the shallower western part of the bank, and more specimens of *A. silus* was also found in this area than in the previous year, although in deeper hauls (**¡Error! No se encuentra el origen de la referencia.**). In 2015, *A. silus* was found between 198 m and 749 m, while *A. sphyraena* extended between 198 m and 485 m.

***Helicolenus dactylopterus* (bluemouth)**
Although bluemouth was not requested in ICES DCF Data Call, Porcupine Bank survey is considered valuable information for the assessment of the stock (ICES, 2015. Other deep species section WGDEEP Report). The biomass and abundance has been provided in previous years and they were useful for the assessment of the species. This last survey, biomass and abundance of *H. dactylopterus* remained steady around the high values caught in 2013 and 2014 (**¡Error! No se encuentra el origen de la referencia.**).

The length sizes also remained similar to previous years, ranged from 4 cm to 40 cm and showed individuals a bit larger, between 25 cm and 34 cm, than in the previous years (**¡Error! No se encuentra el origen de la referencia.**). Also a remarkable recruitment signal (individuals smaller than 10 cm) was observed in 2015, this recruitment is the first important mark since the first two years of the series (**¡Error! No se encuentra el origen de la referencia.**).

Geographical distribution of *H. dactylopterus* shows quite stable patterns and in 2015 was also found around the bank and in the southwest sector of the survey area, between 198 m and 749 m (Figure 13).

***Phycis blennoides* (greater forkbeard)**
A steep decrease in the biomass and abundance of *P. blennoides* was found in this last survey after the increasing trend from 2012. The biomass has not reached the lowest values of the time series, but the abundance dropped to around 31 individuals per haul, nearly close to the low values from 2008, 2009 and 2010 (Figure 14). Larger individuals contributed to a higher biomass than expected. This last survey, the main mode of the length sizes was around 46 cm instead around 39 cm in 2014. In addition, a little mode around 19 cm was caught, indicating a better recruitment than in 2014 (Figure 15).

Regarding geographical distribution, the high biomass of the eastern part of the bank in 2013 and 2014 was not found this last survey. In the south of the survey area the distribution was widespread but scarcer this last year (Figure 16).

***Molva molva* (ling) and *Molva macrophthalma* (Spanish ling)**

A comparative analysis between these two species was reported in this working document, although *M. macrophtalma* was not requested in the Data Call. The information is presented here since there have been an identification issue between Spanish ling and blue ling in former years, being Spanish ling considered as blue ling. The biomass and abundance of this species is notable to consider its assessment, even higher than *M. molva*. This last year, biomass of *M. macrophtalma* nearly quintupled *M. molva*, 15.9±2.09 Kg and 3±0.59 Kg respectively, and abundance nearly increased tenfold, 19.8±2.37 and 1.2±0.25 respectively.

In 2015, the biomass and abundance of both species kept decreasing, although seemed to return to the mean values of the time series, after the peak in 2013 (Figure 17).

Regarding length distributions, in 2015, *M. molva* ranged from 25 cm to 142 cm with a significative abundance of smaller individuals around 25 cm and 35 cm (Figure 18 and Figure 19). This recruitment was the most notable in the overall time series, although not so abundant than registered by *M. macrophtalma* in the same area (in the south of the Irish shelf) in the previous years (Figure 21). However, in 2015, juveniles (≤25 cm) abundance of *M. macrophtalma* was smaller than in 2014 and they were located in the north of the bank (Figure 19; Figure 21). That species ranged, this last year, from 12 cm to 126 cm (Figure 18).

The geographical distribution of both species remained similar to 2014, *M. molva* appeared close to the central mound, altough scarcer in this last survey than previous years, while *M. macrophtalma* was distributed mainly in the southern sector of the surveyed area, with scarce catches in the northwest area of the bank where they were reported in 2012 and 2013 (Figure 20). In 2015, *M. molva* depth extended between 189 m and 664 m, while *M. macrophtalma* appeared between 196 m and 764 m.

4. References

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Tables and figures

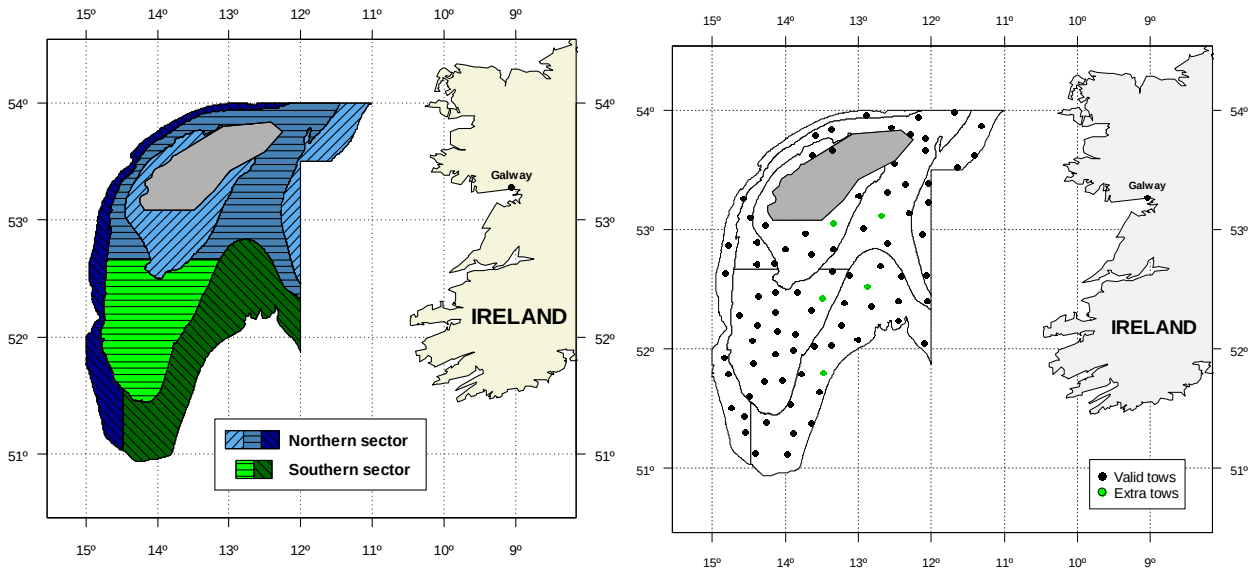

Figure 1. Left: stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: A) shallower than 300 m, B) 301 – 450 m and C) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed during 2015 Porcupine Bank survey.

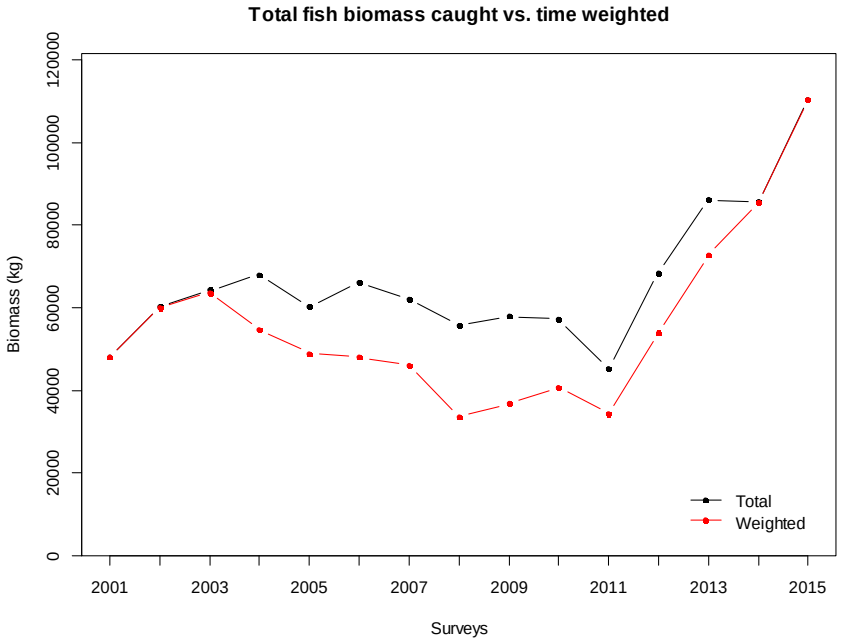

Figure 2 Evolution and comparison between total catch and weighted catch in Porcupine survey time series (2001-2015)

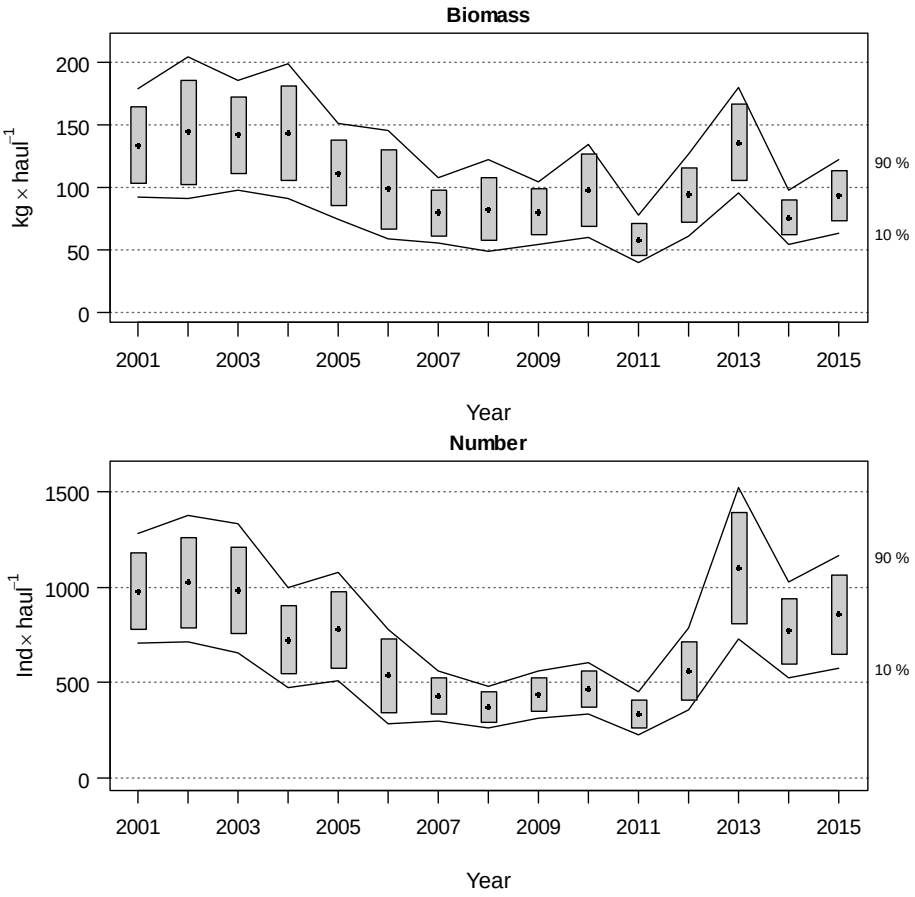

Figure 3 Evolution of *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time series (2001-2015). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

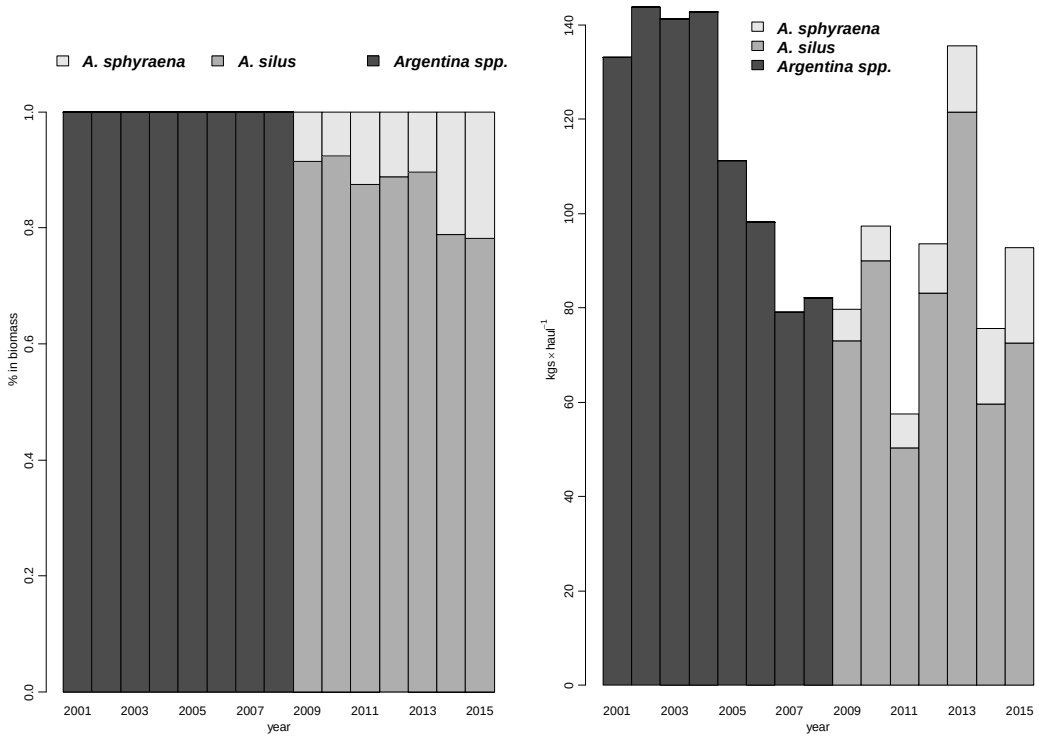

Figure 4 Share and abundance of Argentine species in Porcupine Bank surveys (2001-2015)

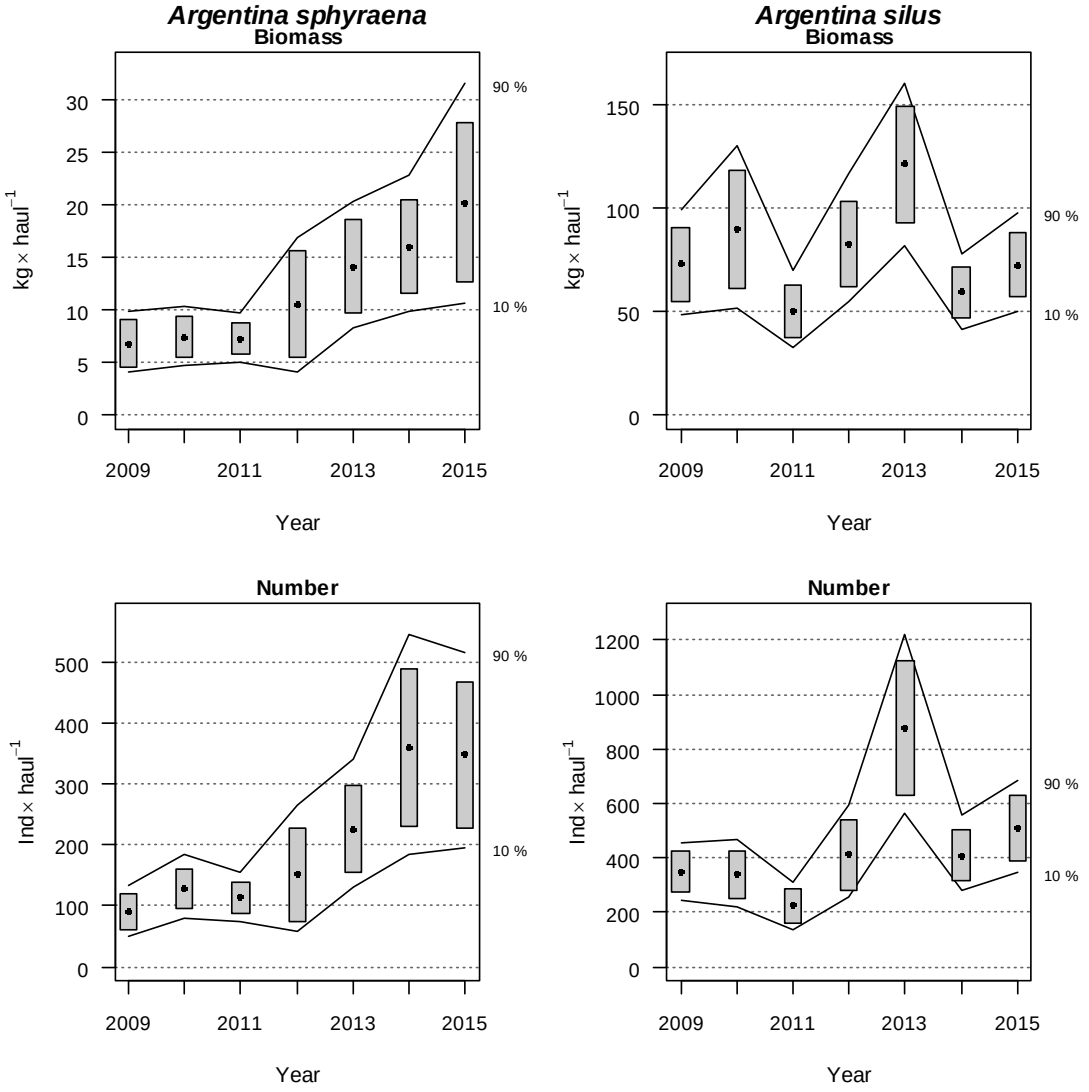

Figure 5 Evolution of *Argentina sphyraena* and *Argentina silus* biomass index (kg·haul^{-1}) from 2009 to 2015 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

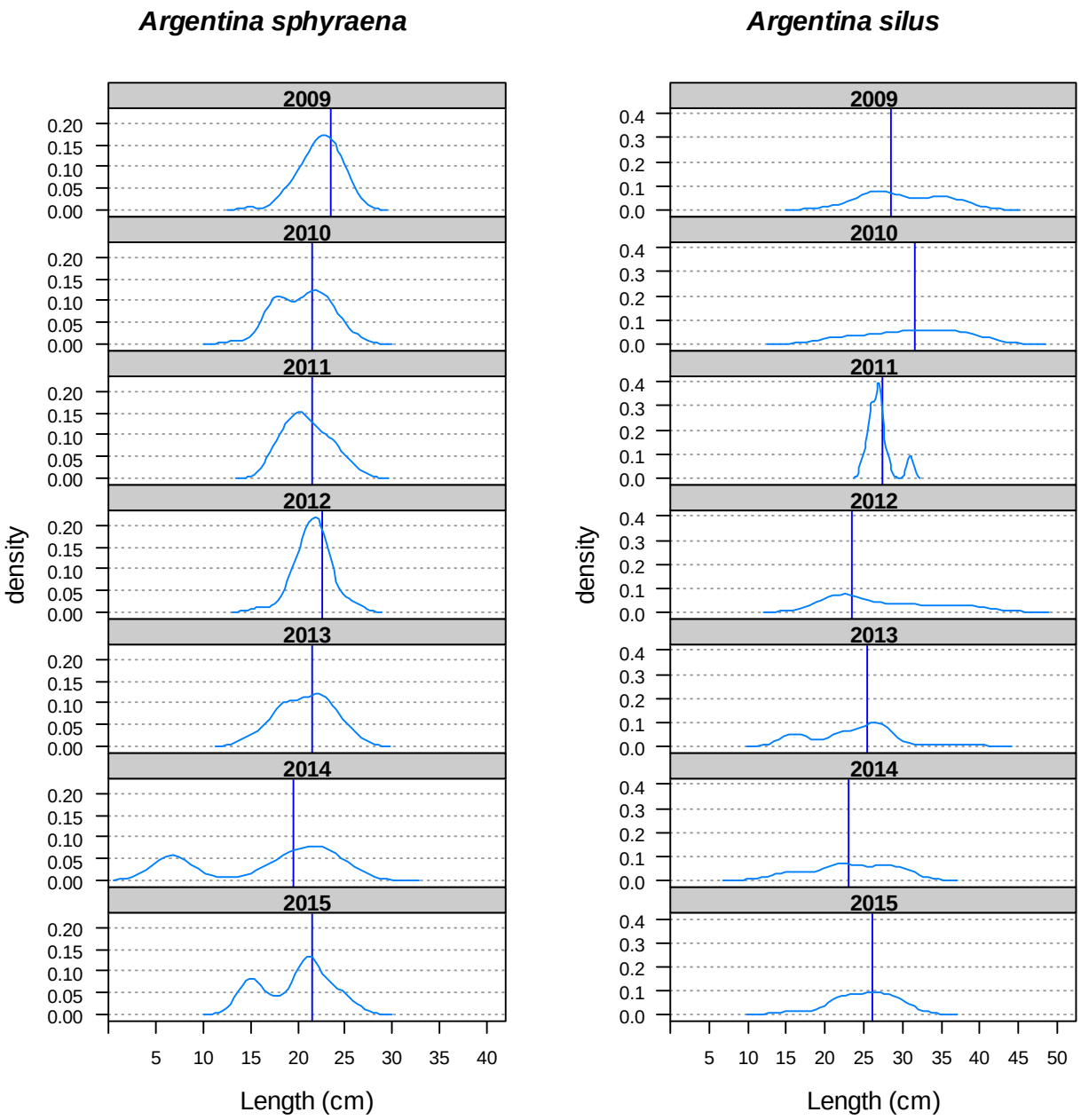

Figure 6 Mean stratified length distributions of *Argentina sphyraena* y *Argentina silus* in Porcupine surveys during 2009-2015

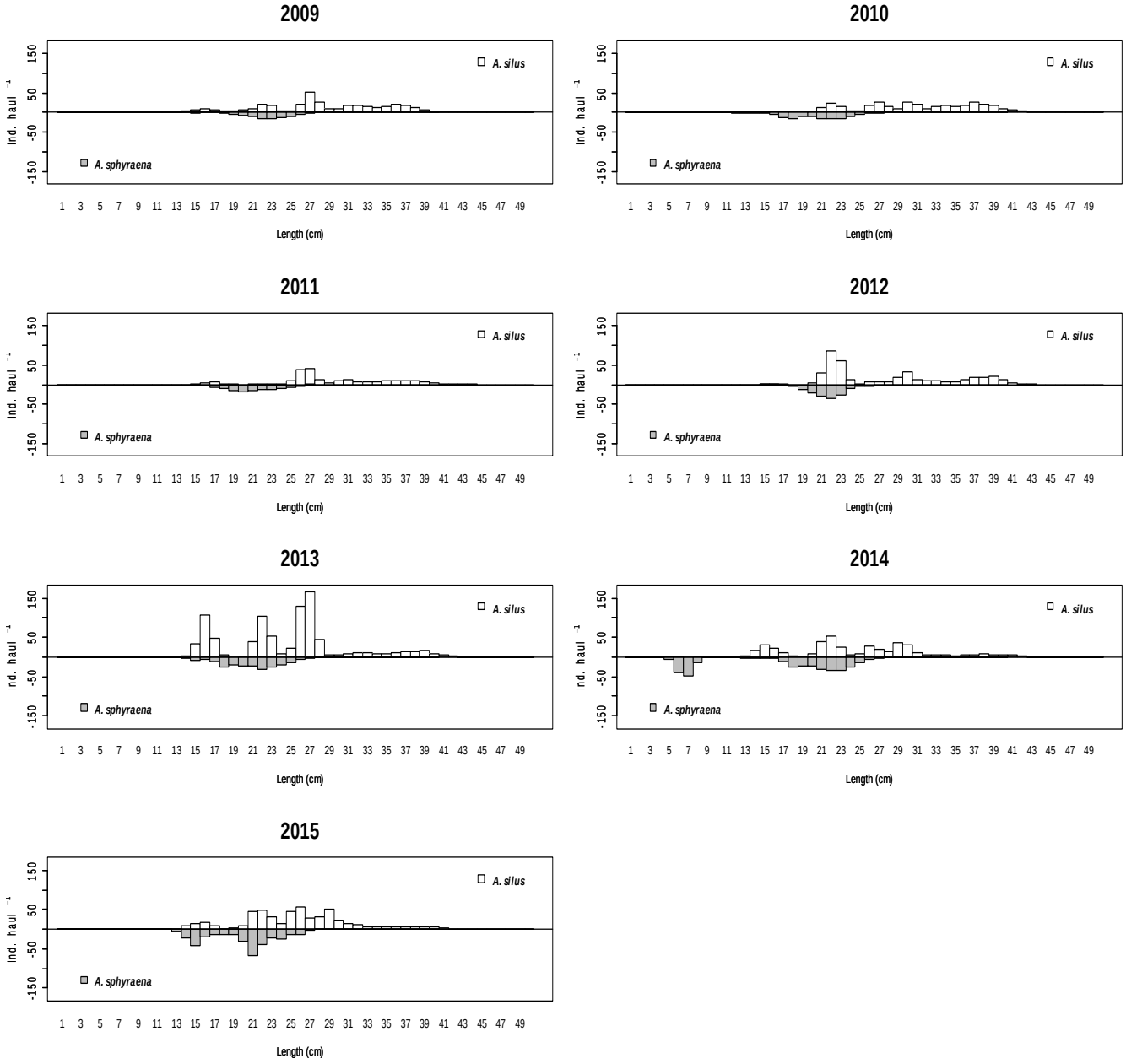

Figure 7 Mean stratified length distributions of *Argentina silus* and *Argentina sphyraena* in 2009-2015 surveys

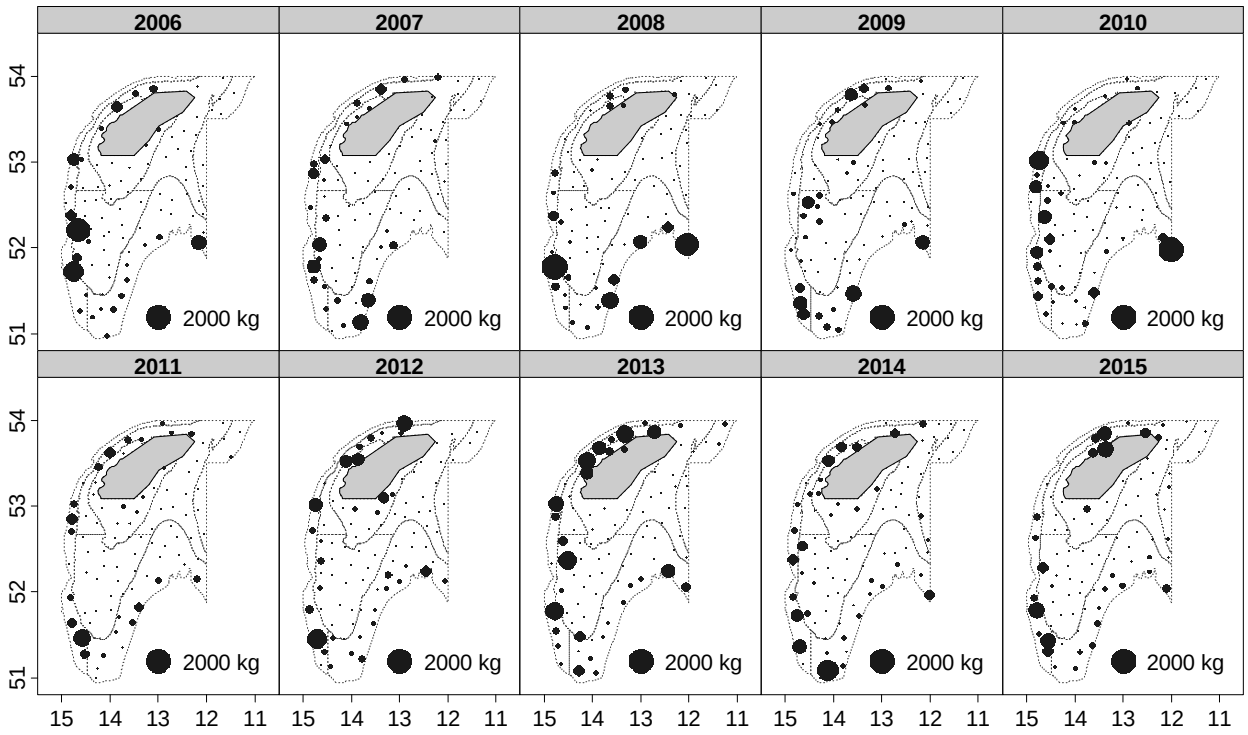

Figure 8 Geographic distribution of *Argentina* spp. catches (kg/30 min haul) during Porcupine surveys 2006-2015

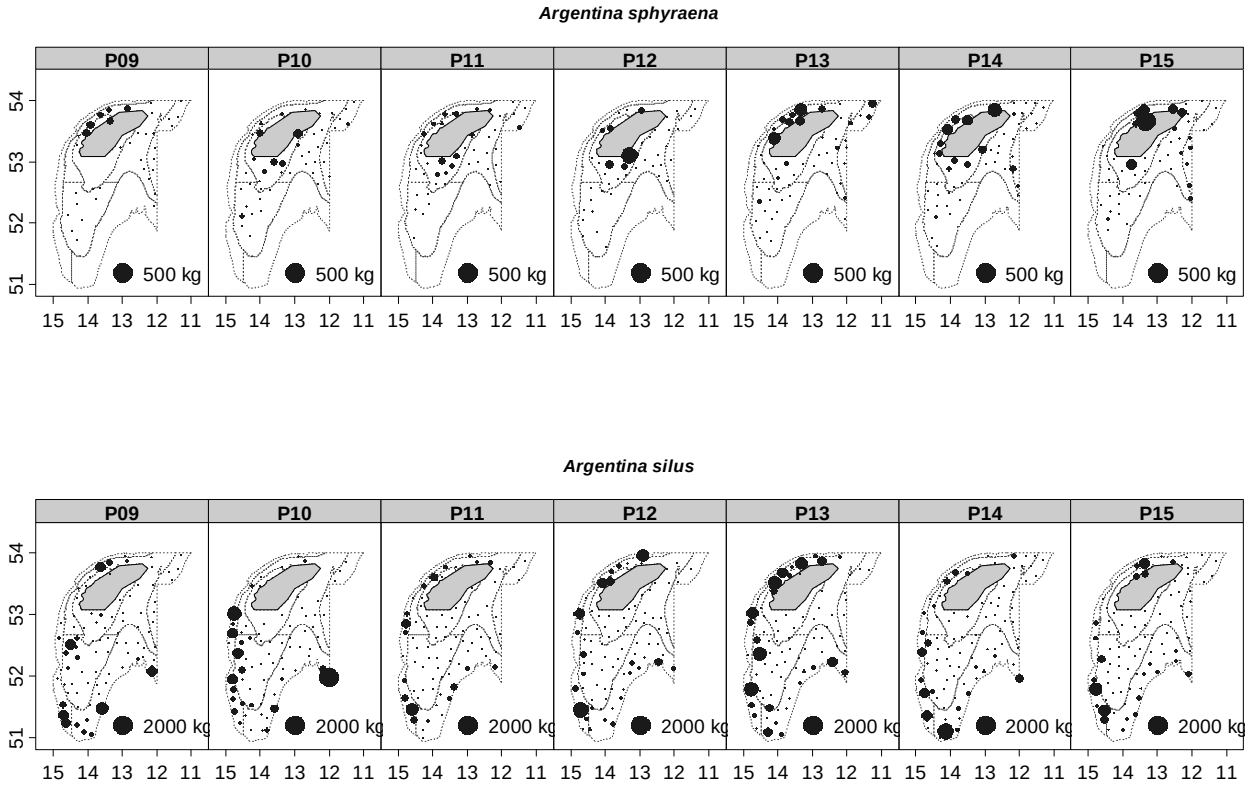

Figure 9 Geographic distribution of *Argentina silus* and *Argentina sphyraena* catches (kg/30 min haul) in Porcupine surveys between 2009 and 2015 Porcupine Bank surveys

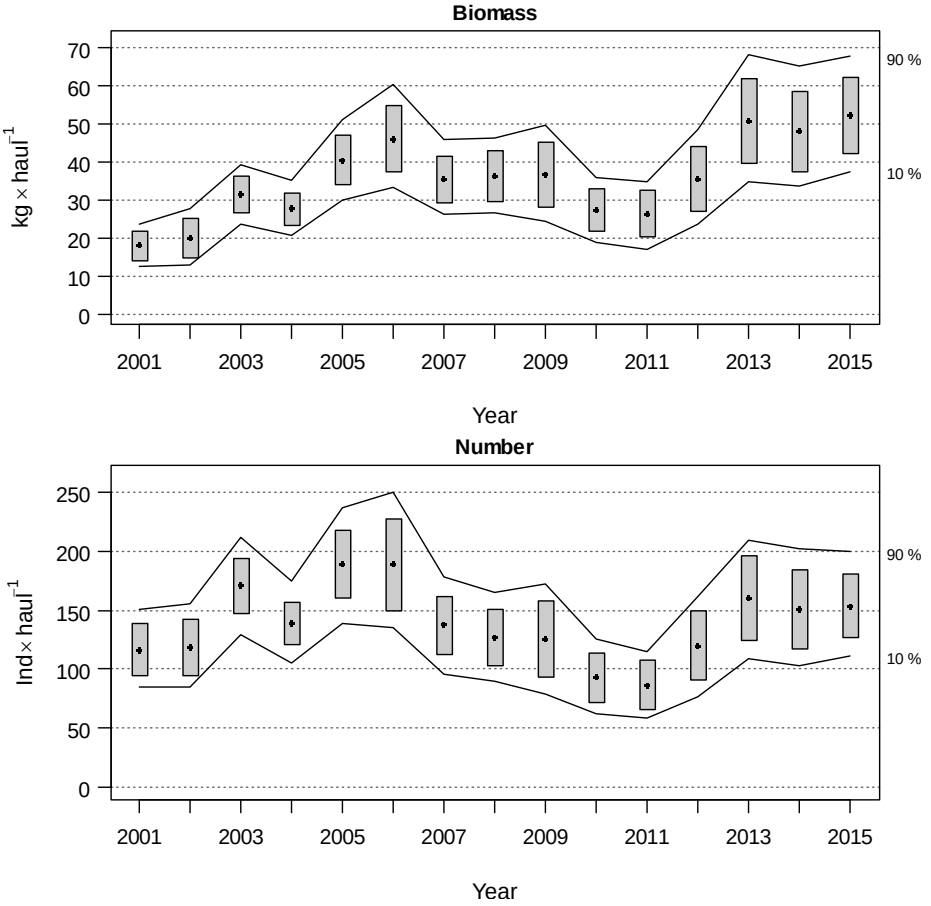

Figure 10 Evolution of *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time series (2001-2015). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

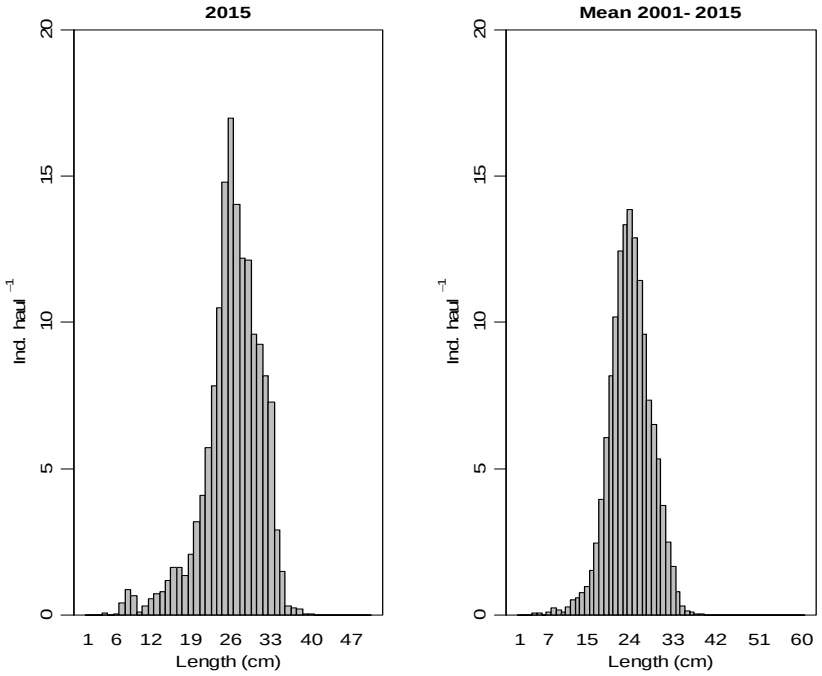

Figure 11 Stratified length distributions of *Helicolenus dactylopterus* in 2015 Porcupine survey, and mean values during Porcupine survey time series (2001-2015)

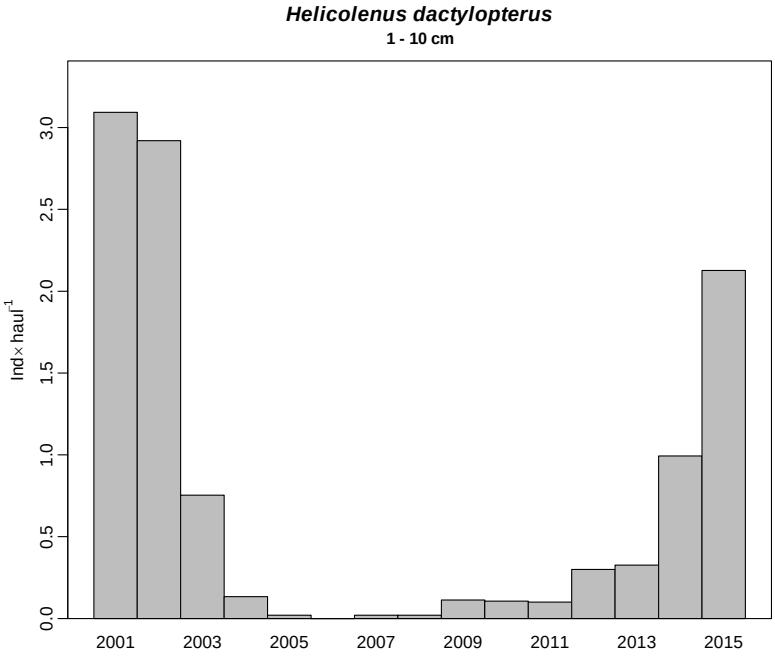

Figure 12 Mean stratified abundance of *Helicolenus dactylopterus* recruits along Porcupine Bank survey series.

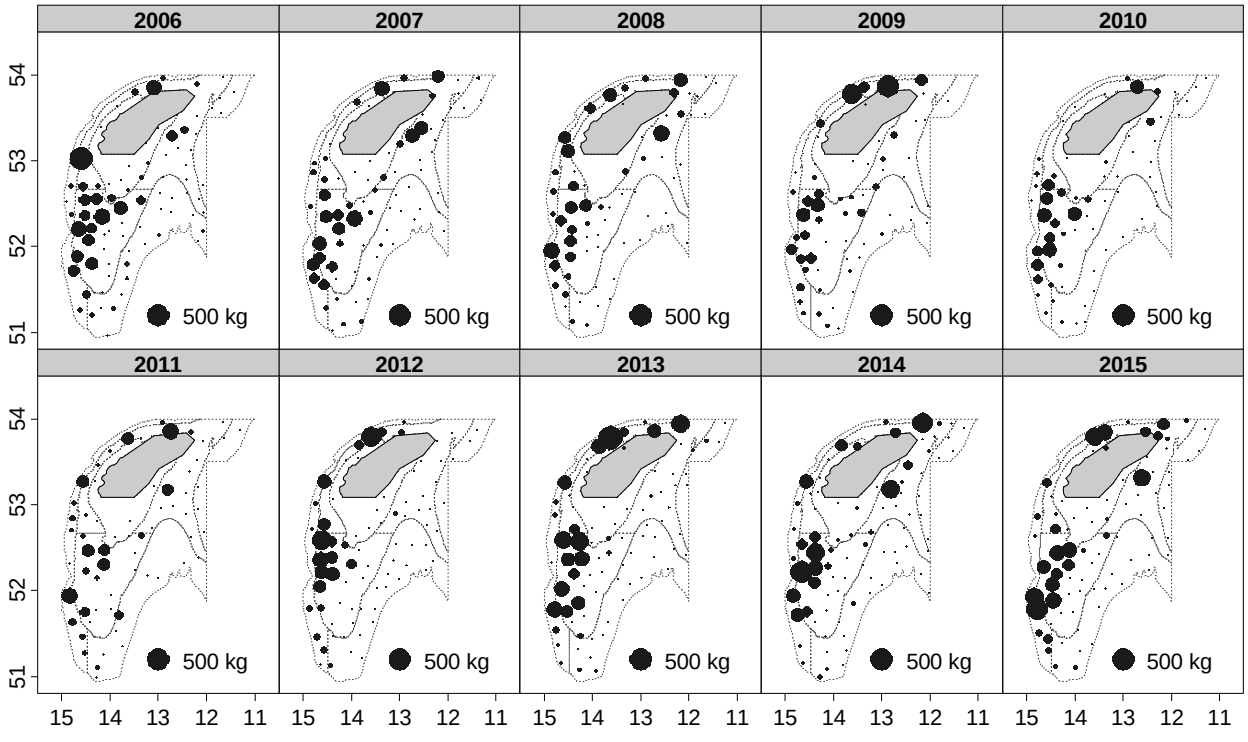

Figure 13 Geographic distribution of *Helicolenus dactylopterus* catches (kg×30 min haul^{-1}) during Porcupine surveys 2006-2015

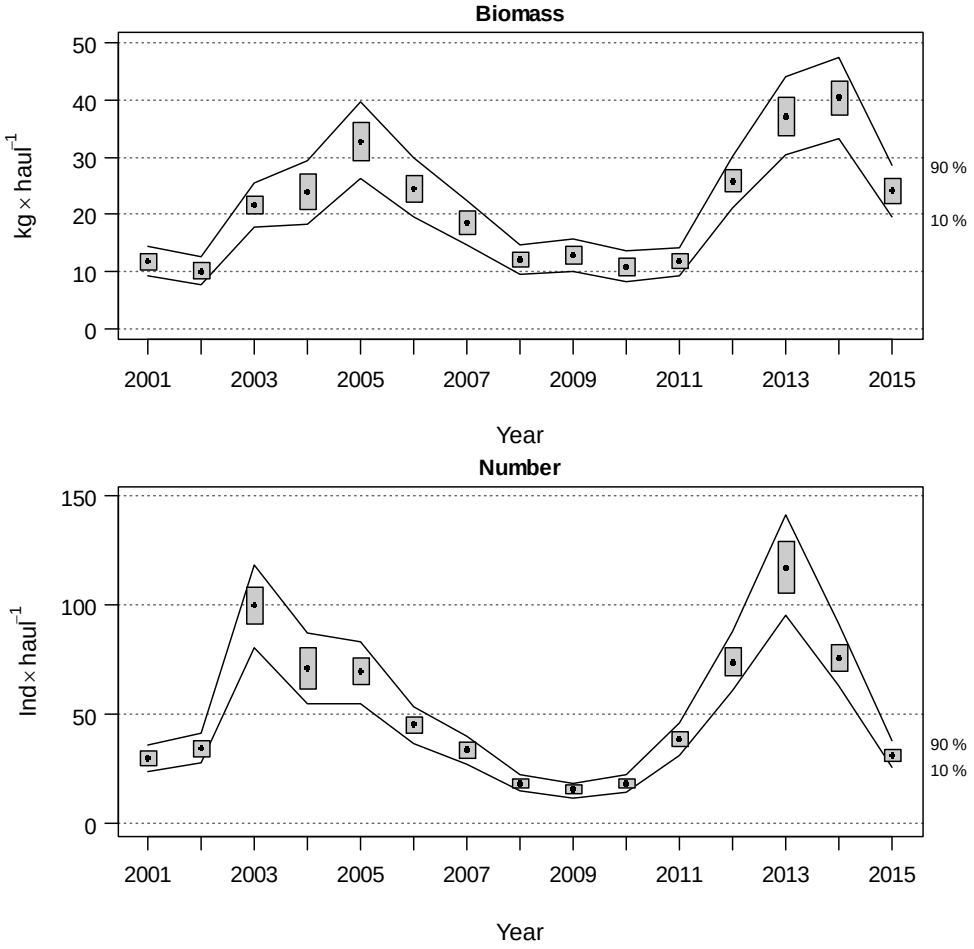

Figure 14 Evolution of *Phycis blennoides* biomass and abundance indices during Porcupine Survey time series (2001-2015). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

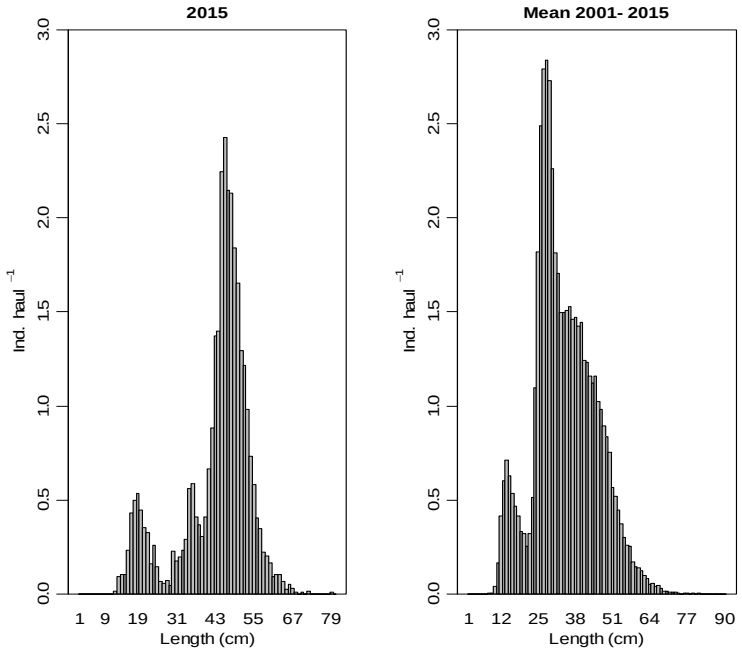

Figure 15 Stratified length distributions of *Phycis blennoides* in 2015 Porcupine survey, and mean values during Porcupine survey time series (2001-2015)

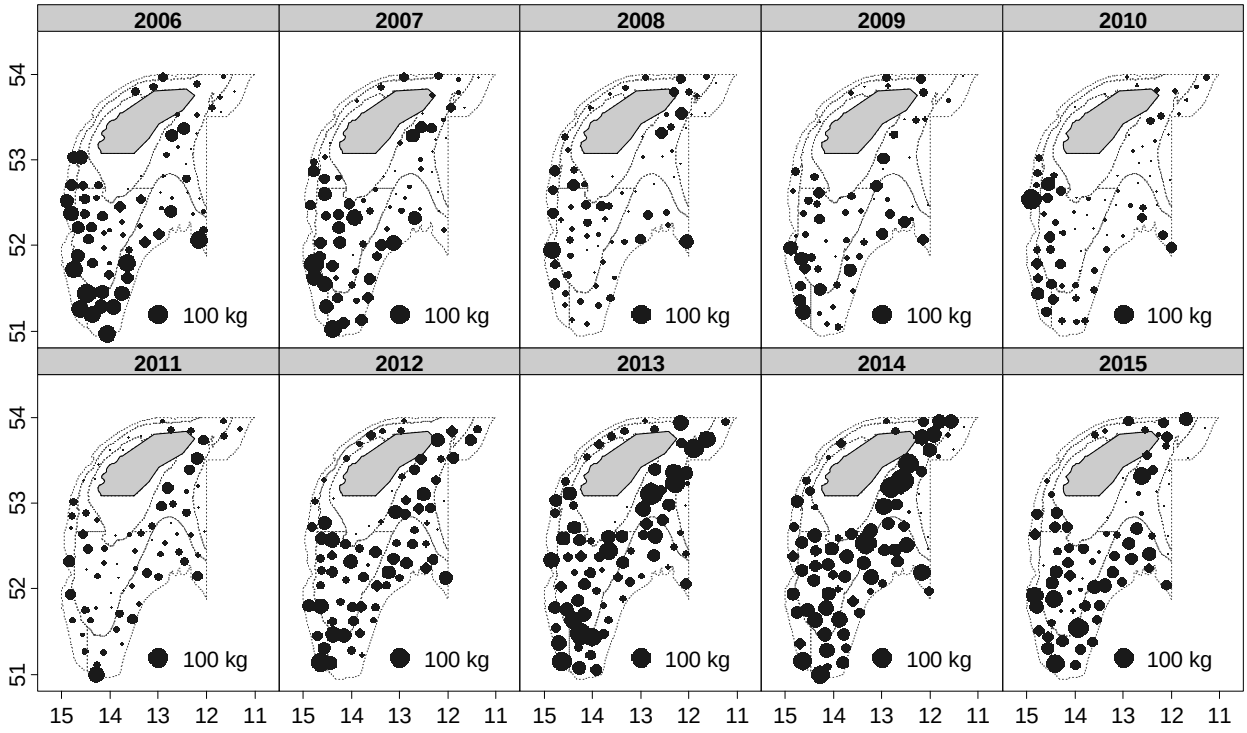

Figure 16 Geographic distribution of *Phycis blennoides* catches (kg×30 min haul^{-1}) in Porcupine surveys during 2006-2015

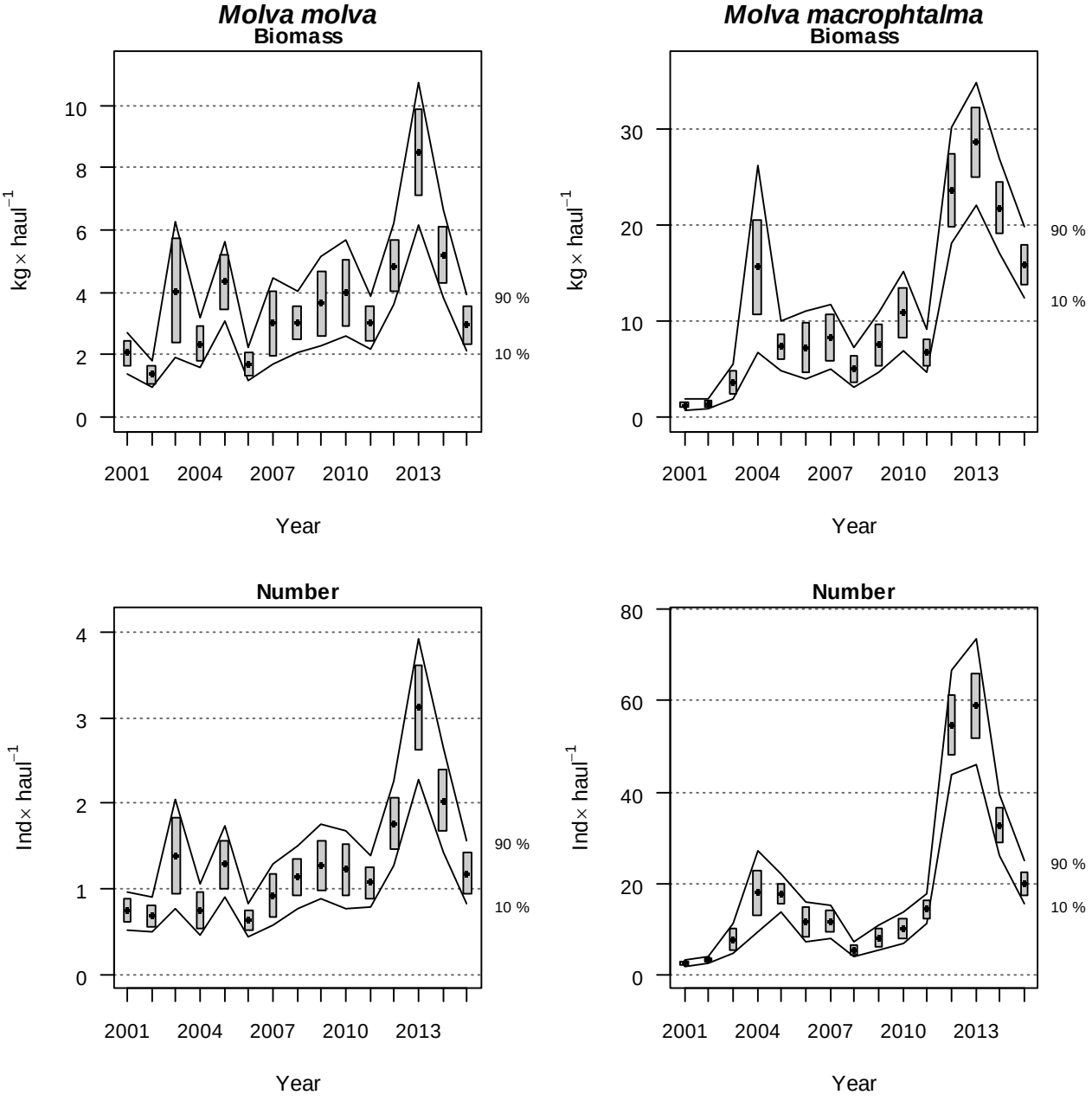

Figure 17 Evolution of *Molva molva* and *Molva macrophtalma* biomass and abundance indices during Porcupine Survey time series (2001-2015). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

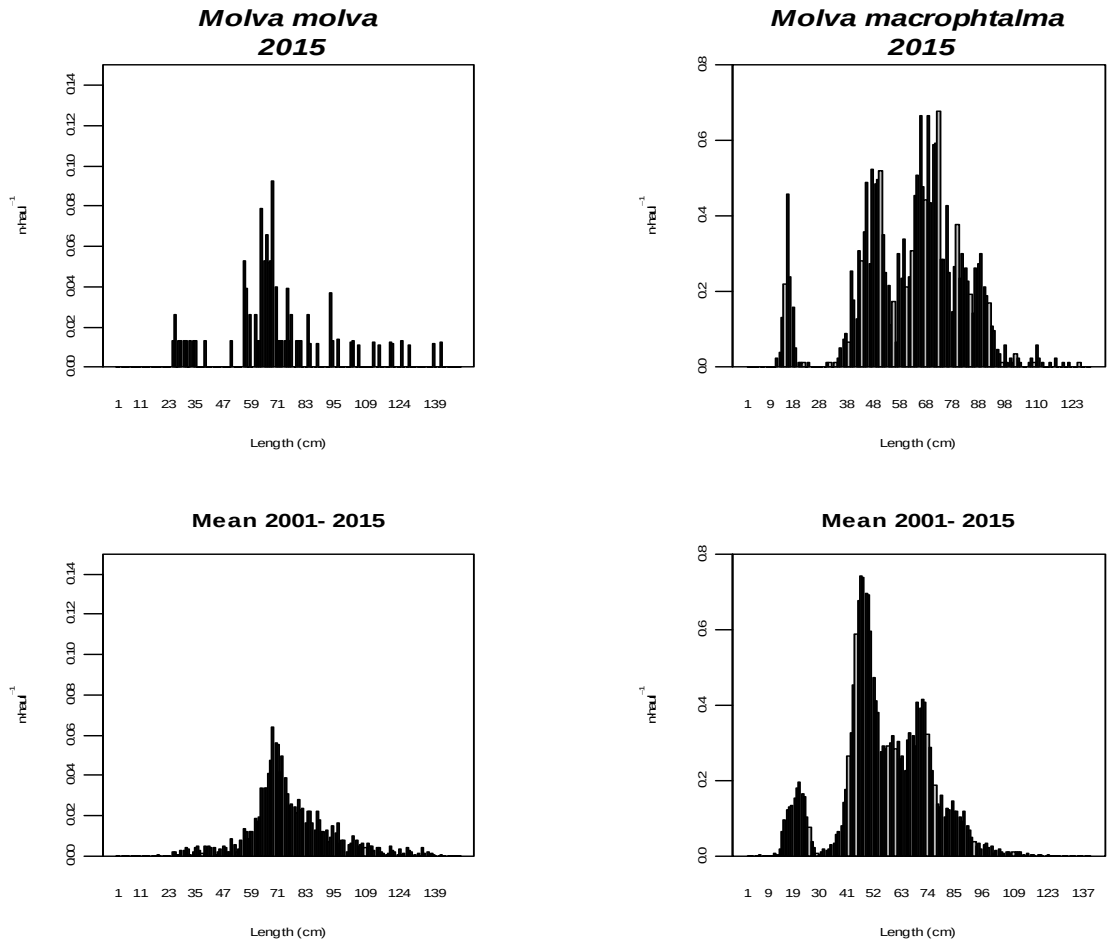

Figure 18 Stratified length distributions of *Molva molva* and *Molva macrophtalma* in 2015 Porcupine survey and mean values during Porcupine survey time series (2001-2015)

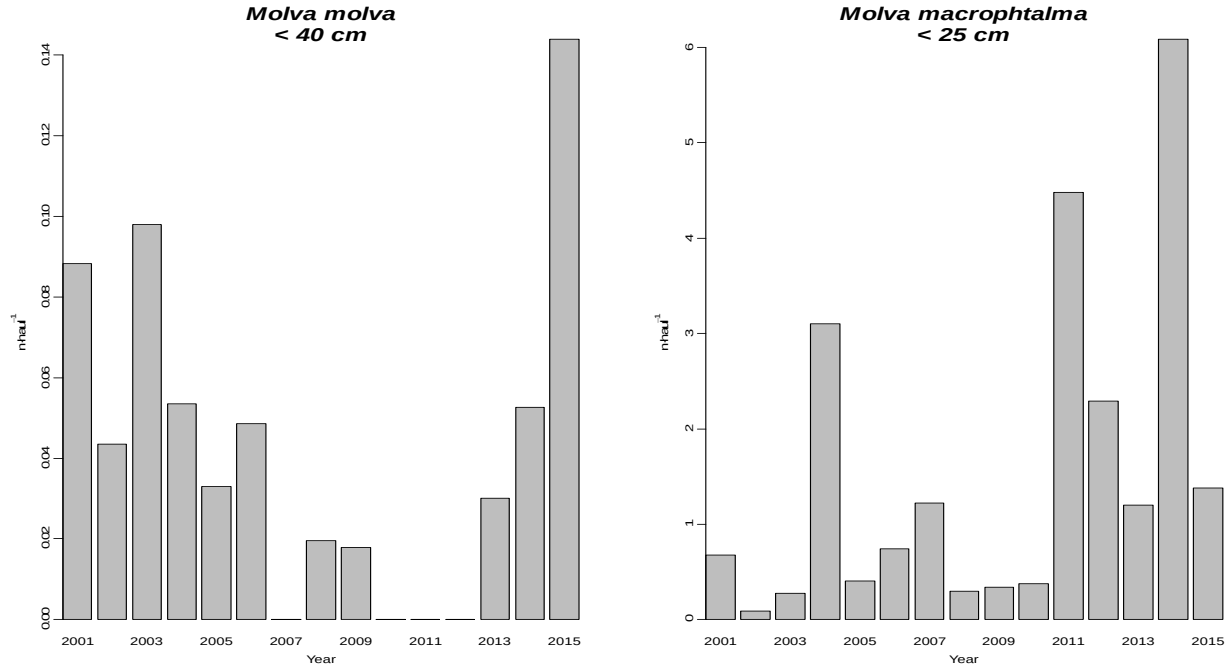

Figure 19 Mean stratified abundance of ling juveniles (<40 cm) and Spanish ling (<25 cm) along the Porcupine survey time series (2001-2015).

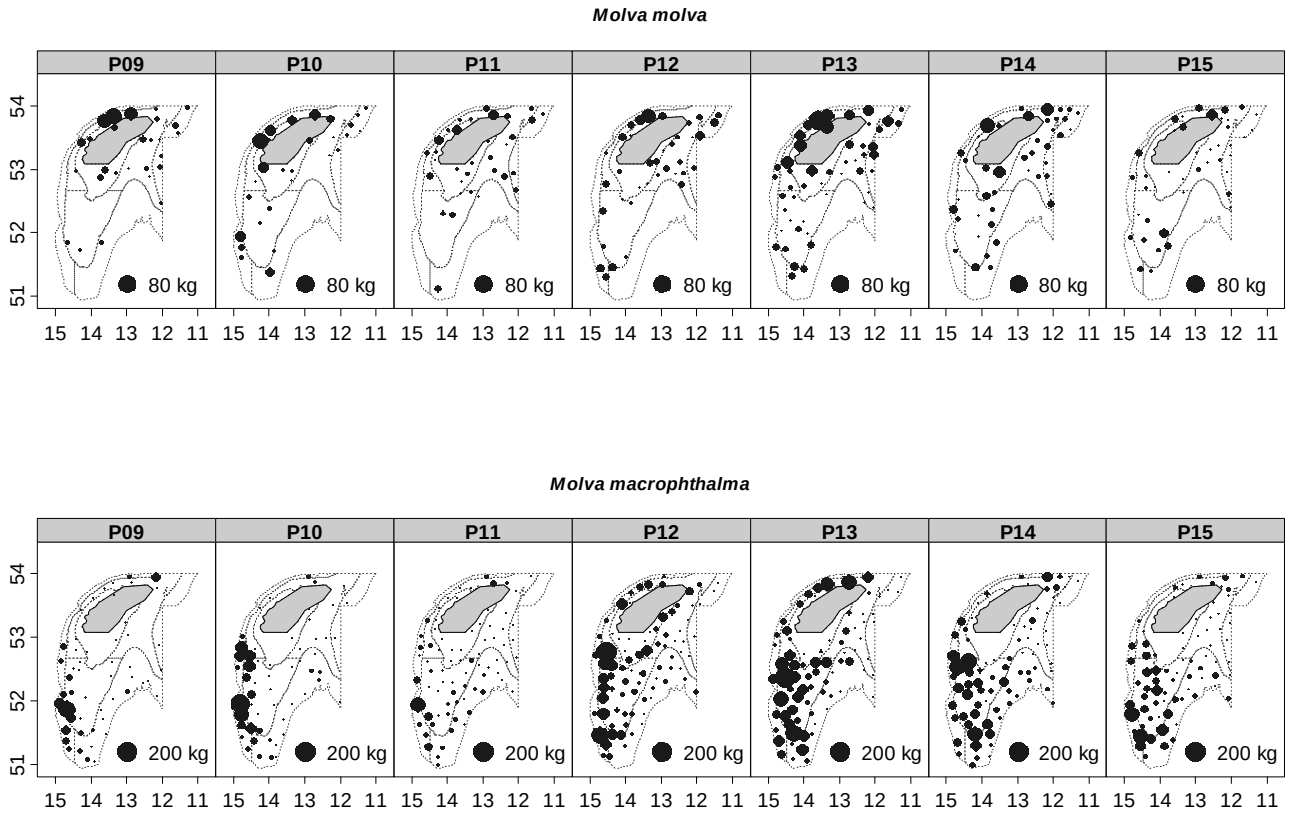

Figure 20 Geographic distribution of *Molva molva* and *Molva macrophtalma* catches (kg×30 min haul^{-1}) in Porcupine surveys during 2009-2015

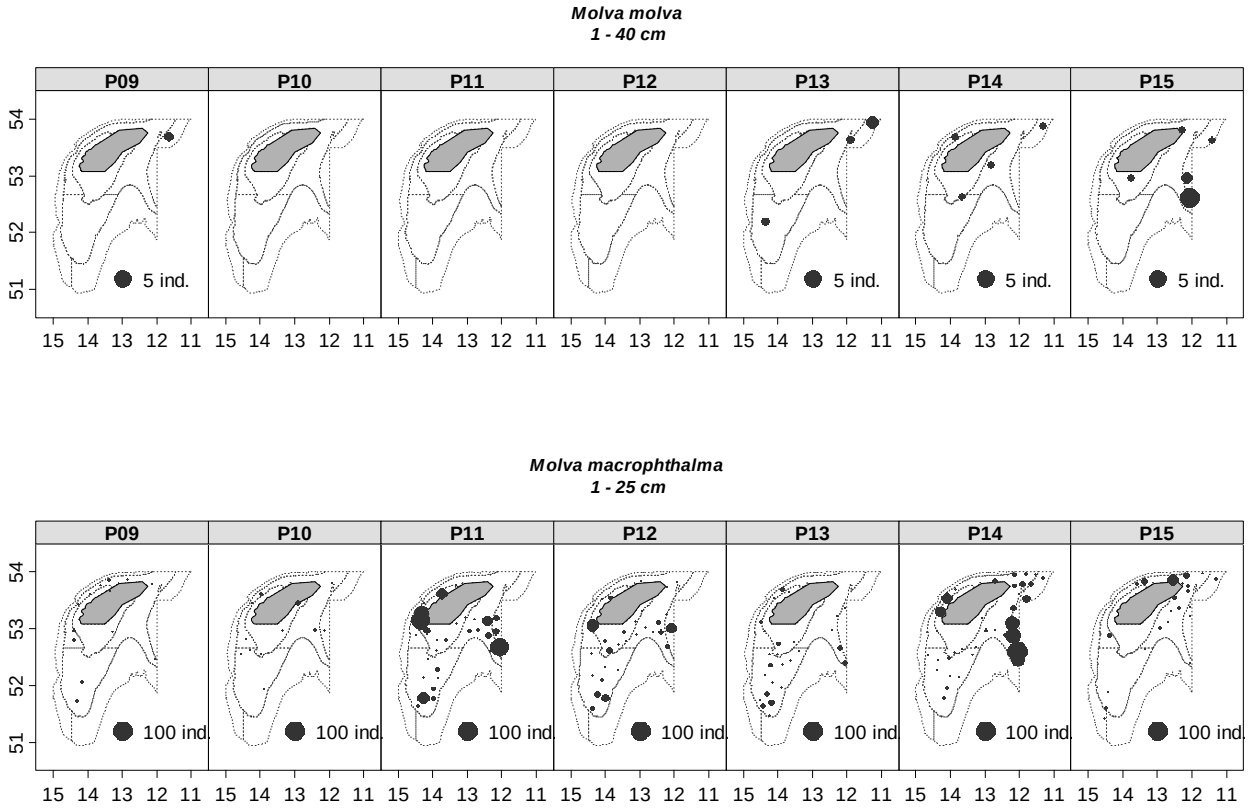

Figure 21 Geographic distribution of *Molva molva* individuals ≤ 40 cm and *Molva macrophtalma* individuals ≤ 25 cm (recruitment proxy) on the Spanish Porcupine Bank bottom trawl survey during 2009-2015