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Results on Argentine (*Argentina* spp.), Bluemouth (*Helicolenus dactylopterus*), Greater forkbeard (*Phycis blennoides*), Spanish ling (*Molva macrophthalma*) and ling (*Molva molva*) from 2014 Porcupine Bank (NE Atlantic) survey

O. Fernández-Zapico[1], S. Ruiz-Pico[1], F. Velasco[1] & F. Baldó[2]

Instituto Español de Oceanografía

(1)
Centro Oceanográfico de Santander
P.O. Box 240
39080 Santander, Spain
francisco.velasco@st.ieo.es

(2)
Centro Oceanográfico de Cádiz
Muelle de Levante (Puerto Pesquero)
P.O. Box 2609
11006 Cádiz, Spain

Abstract

This working document presents the results on four of the most significant deep fish species of the last Porcupine Spanish survey carried in 2014, as well as it updates previous documents presented with the information on the fourteen years (2001-2014) of the Spanish bottom trawl survey on the Porcupine Bank. The document presents total abundances in weight, length frequencies and geographical distributions for *Argentina* spp. (mostly *A. silus*, results on proportions by Argentine species distribution in last surveys are provided), Bluemouth (*Helicolenus dactylopterus*), Greater fork-beard (*Phycis blennoides*) and Spanish ling (*Molva macrophthalma*). *Argentina* spp. and Spanish ling presented a decrease in their abundances, whereas Bluemouth remained stable and Greater forkbeard increased slightly. In terms of recruitment 2014 showed larger values than previous years for *A. sphyraena*, *Helicolenus dactylopterus* and *Molva macrophtalma* but weaker for *Phycis blennoides*, and *A silus*. Furthermore results for ling (*Molva molva*) on the Spanish Porcupine Bank survey are summarized presenting the results to the WG so their utility for the assessment could be considered.

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 main target species for this survey series are hake, monkfish, white anglerfish and megrim, which abundance indices are estimated by age and/or length (Velasco *et al.*, 2005; Velasco *et al.*, 2007). Nevertheless data are also collected for all the fish species caught, Norway lobster (*Nephrops norvegicus*) and other benthic invertebrates according to the IBTSWG protocols (ICES, 2010a).

Last working document summarizing the results on the most common deep water fish species caught in Porcupine Survey (Velasco *et al.* 2013) was presented to the WGDEEP in 2013. Information is updated yearly since 2008 (Baldó *et al.* 2008, Velasco *et al.* 2011, 2012 and other working documents presented to WGDEEP meetings). The aim of the present working document is to update those results with the information from 2014 survey (abundance indices, length frequency distributions and geographic and bathymetric distributions).

As commented with the data submitted from the Porcupine 2013 survey, in that year a change in the start of trawling time protocol was performed, since in deeper hauls the gear took longer time to reach the ground, and therefore actually start trawling. To solve the bias in abundances from 2004-2013, these where weighted to new estimated tow duration: from the moment net reached the ground, till the start of pulling up the gear. The results of these changes meant an important increase in the actual figures, but the trends and general perception of the stock was coherent along the time series, so the total trends are maintained (see Figure 22).

Since in 2014 results on bluemouth and Spanish ling were not submitted to the group, the data presented in this document, and data submitted for the assessment, are different from those submitted in previous years, though trends in abundance and distribution shapes have not changed. Ling Catches have not been remarkable in the survey time series, nevertheless when considering the time series the abundance and geographical distribution present patterns that could be interesting for the assessment of the species.

2. Material and methods

The area covered in Porcupine surveys (Figure 1) is the Porcupine bank from longitude 12° W to 15° W and from latitude 51° N to 54° N. The survey covers depths between 180 and 800 m, and in 2014 was carried out between the 2° of September and the 30th of October on board the R/V "Vizconde de Eza", the stern trawler of 53 m and 1800 Kw that has been used along this series.

The sampling design used in this survey is random stratified (Velasco and Serrano, 2003), with two geographical sectors (North and South) and three depth strata defined by the 300, 450 and 800 m isobaths, resulting in 5 strata, given that there are no grounds shallower than 300 m in the Southern sector (Figure 1). As described in the IBTS manual for the Western and Southern areas (ICES, 2010b), sampling was random stratified and allocated proportionally to strata area using a buffered random sampling procedure (as proposed by Kingsley *et al.*, 2004) to avoid the selection of adjacent 5×5 nm rectangles. The gear used was the Porcupine baca 40/52, described in ICES (2010b), with 250 sweeps, 850 kg doors, 90 mm net mesh all along the gear and a and 20 mm liner covering the cod-end inner part. Vertical opening was 2.50±0.04 m while door spread was 149.0±2.7 m, both within the ranges of the survey. Gear horizontal opening is not recorded regularly due to the unavailability of sensors, but varies around 25.0±1.4 m ICES (2010b).

Two different methods were used to estimate abundance variability: (i) the parametric standard error derived from the random stratified sampling (Grosslein and Laurec, 1982), and (ii) a non parametric bootstrap procedure implemented in R (R Core Team 2014) re-sampling randomly with replacement stations within each stratum and maintaining the sampling intensity, and using 80% bootstrap confidence intervals from the 0.1 and 0.9 quantiles of the resultant distribution of bootstrap replicates (Efron and Tibshirani, 1993).

3. Results and discussion

A total of 237 species, 107 fish species, were captured in 2014, similar but a little larger than the number of species found last year (231 species) as well as the number of fish species (98 last year) and still larger than the mean in the whole time series for the fish species (96.57).

3.1 *Argentina* spp.

Argentina spp. showed a sharp decrease, returning to levels similar to 2007 to 2009 in terms of biomass and to levels similar to 2005 in terms of abundance in number, after the increasing trend from 2012 (Figure 2).

Abundances of *Argentina* spp. in biomass and number along the time series are shown in Figure 2. 2014 has shown a decrease in abundance after 2013 peak that almost reached the values shown at the beginning of the time series (2001-2004, though it has to be born in mind that from 2001-2003 tow duration values have not been reviewed since the information from the gear behaviour in those years were not available. Therefore 2001-2003 values are probably slightly underestimated, though in the case of *Argentina* spp. differences between revised tow duration and unreviewed are not as important as in other species). Therefore, 2014 survey *Argentina* spp. abundance indices have shown values that return to the levels of previous years.

Considering length distribution in 2014 there was an important increase in the range of the stratified length distribution, due to a remarkable capture of individuals under 10 cm (Figure 3). This range increase was clearly due to a recruitment peak of *A. sphyraena* (>100 inds per haul) that had not been found before in the time series. However, in the case of *A. silus* blooms in recruitment were found in 2012 and 2013, being smaller in 2014 (individuals ≤18 cm per haul: 192 and 82 in 2013 and 2014 respectively). The length distribution of *A. silus* presented two clear modes in 15-18 cm, and in 21-22 cm, being both of them less abundant than in the previous year (Figure 4).

The geographical distribution pattern of *Argentina* spp. (Figure 5) appears to be quite stable, being more abundant in the deeper hauls in the southern and western part of the bank. Nevertheless when the abundance of each species is considered separately (Figure 6), is clear that *A. silus* is the dominant species in the deeper hauls in the southern area, while *A. sphyraena* is more abundant around the central part of the bank and also is important in the hauls on the border of the Irish shelf, where the shoals are smaller.

In terms of biomass (Figure 7) it is clear that in 2014 the important decrease of Argentina spp. is due to the decrease of *A. silus*, while *A. sphyraena* has increased its abundance making up around 21% out of the both Argentina species, whereas it made up around 10.5 % the previous year.

3.2 *Helicolenus dactylopterus*

Bluemouth (*H. dactylopterus*) has shown an increase in abundance since 2011, in 2014 it showed levels quite similar, thought a bit smaller than the previous year (Figure 8). The length distribution shows a slight increase in the number of individuals smaller than ≤15 cm like in the first years of the time series (Figure 9). Geographical distribution of *H. dactylopterus* in 2014 does not show the clear western distribution pattern of the two previous years, and some specimens were found to the east the central mound (Figure 10). Nevertheless the species shows quite stable patterns in terms of geographical and length distribution.

In terms of recruitment, 2014 appears to be a good year for bluemouth, if we consider individuals smaller than 16 cm, that according to the results shown in Figure 9 seems to form a distinct mode when it shows up, in 2014 almost 4.8 individuals per haul were caught, a value higher than those found in the last decade (with a mean of 0.83 ind. per haul excluding 2014 value).

Revised abundance indices and those prior to the re-estimation of tow duration (Figure 22) also show the same patterns and peaks.

3.3 *Phycis blennoides*

Greater forkbeard (*P. blennoides*) keeps increasing in biomass terms, being 2014 the highest catch of the time series, nevertheless a decrease in abundance in numbers has been recorded after the increasing trend in the previous three years, which reached in 2013 the peak of the time series (Figure 11). This difference in the trends between biomass and abundance is due to the evolution of 2012 cohort that in 2013 produced the remarkable mode in 26-29 cm with more than 40 individuals per haul. In 2014 the main mode was between 37-40 cm with c.a. 22 individuals per haul (Figure 12). In 2014 there were almost no traces of recruits, with only 0.13 individuals smaller than 18 cm per haul, showing two years of poor recruitment (0.42 in 2013, while in 2012 there were ca. 8 recruits per haul.

Geographical distribution (Figure 13) shows, like in previous years, that forkbeard was spread almost uniformly along the bank, except the north-western parts of the central mound, and in areas shallower than 300 m, as the southern part of the central mound. Higher abundances seem to dwell in banks of the porcupine sea bight located southeasterly to the bank and the study area.

3.4 *Molva molva*

Ling is fished in ICES Subarea VII mainly in divisions b c and g-k, mainly by longline fisheries, however there are also important catches of ling as by-catches of the trawl fleets operating in the area, and Porcupine Bank is an area with an important trawling activity therefore the results from the Porcupine Bank Spanish groundfish survey could be useful as an indicator of the abundance and status of ling in the area.

As shown in Figure 14, the abundance indices of ling on the survey have been quite stable along the time series, from 2001 up to 2012 and 2013, when there was an increase of the abundance, specially in the last year when more than 10 kg and 3 individuals per tow were caught in stratified average. Nevertheless in 2014, levels went back to 2012, still larger than the rest of the time series but with no significant differences.

Regarding length distribution, Figure 15 presents the stratified length distributions along the whole time series, for most of the years there is no clear length structure in the samplings, with quite an stable length range from ca. 30 cm to ca. 130 cm. The mode tends to be around 70 cm, and no clear recruitment signals are found, revealing that Porcupine Bank is not a recruitment ground for ling, as can also be observed in Figure 17 that shows that some small lings tend to appear close to the central mound of the Porcupine Bank, and a few of them also in the Irish shelf slope to the east of the survey area. In 2012, when there was the peak of abundance of ling there were not caught any small individual (<30 cm). In general ling tends to dwell close to the central mound of the bank that can not be covered with the trawl, so there are no information from that area, were along the survey long-line vessels targeting ling are found, working inside this area, or on the north-northwestern limits of the sampling area. In the last two years there has been an expansion of the area covered by the species, and individuals are also found on the southern tip of the area, that from the substrate point of view is completely different from the rocky and abrupt areas on the north-western part.

3.5 *Molva macrophthalma*

Spanish ling (*M. macrophtalma*) presents a decrease in biomass and abundance after the striking increase in 2012-2013. Even so, the figure in 2014 did not return to the low values found between 2005 and 2011 (Figure 18). As in the case of forkbeard the decrease in abundance (in this case both in terms of biomass and number) is explained by the evolution of 2011 and 2012 cohorts, that produced important peaks of individuals between 40 and 55 cm (Figure 19), while in 2014 this mode was poorer in comparison. Despite this decrease, the individuals between 17 and 24 cm that mark the mode of small individuals (used as proxy to recruitment) showed the peak of the time series in 2014, with more than 5 individuals per haul foreboding an important recruitment of the species in this area at least.

Geographical distribution in 2014 keeps showing that Spanish ling has expanded its dwelling grounds out of the western slope of the bank, being also present in the south-central part of the bank, but few specimens are found in the northwestern part of the central mound unlike the two previous years (Figure 20). However, in abundance terms, geographical distribution of individuals smaller than 30 cm (Figure 21) show that in 2014 its distribution has shifted to t he Irish slope in comparison with previous years when it was located mainly around the central mound, but some clear grounds of concentration of recruits seem to occur within the Bank.

4. Conclusions

The results of Porcupine bottom trawl survey in 2014 present some variations in the abundance and size range for the most important deep species in the area. *Molva macrophtalma* (Spanish ling) and *Argentina spp.* presented a decrease in their abundances, though with an important recruitment signal in the first case, whereas *Helicolenus dactylopterus* (Bluemouth) remained stable and *Phycis blennoides* (Greater forkbeard) increased slightly but only in biomass, with poor recruitment signals. Ling presents stable abundance in the time series, with an increase in 2013 and an expansion of the dwelling area within the surveyed zone.

Good recruitment signals have been found for bluemouth and Spanish ling, while they seem to be poor in the case of forkbeard. No signals of recruits of ling are found in the case of ling, that contrary to Spanish ling, does not seem to have recruitment grounds within the Porcupine Bank.

5. References

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5. Tables and figures

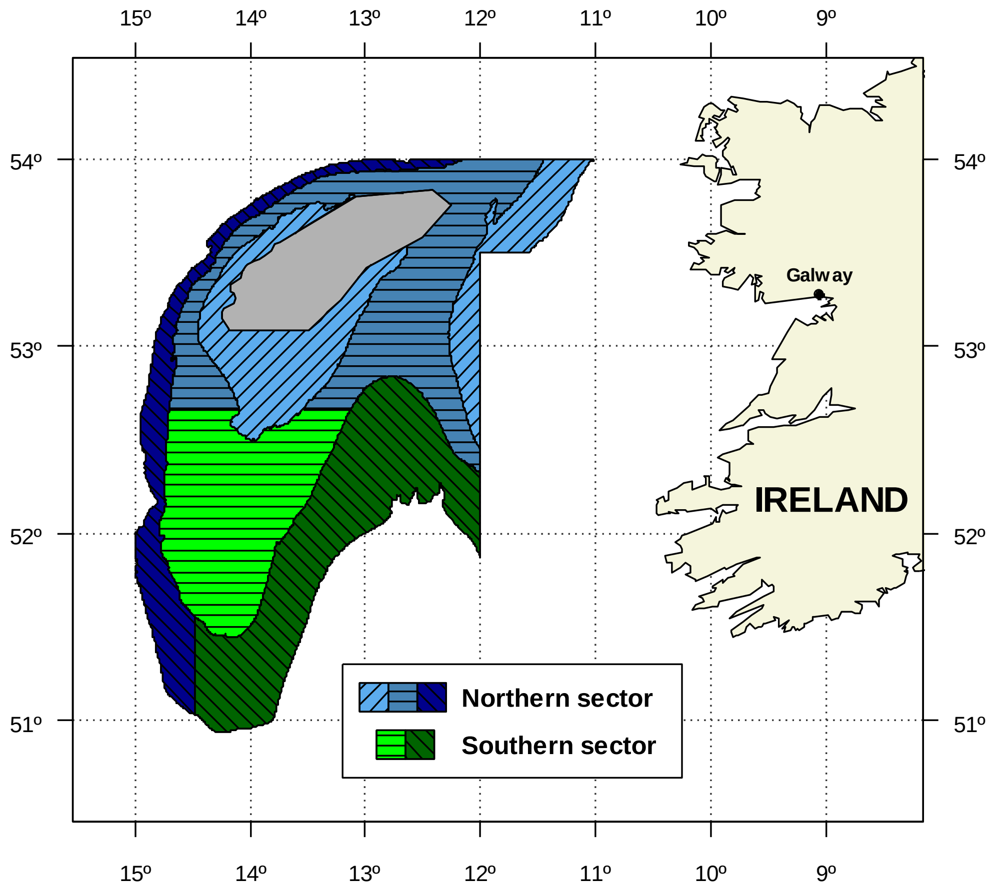

Figure 1. Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: A) shallower than 300 m, B) 301 – 450 m and C) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements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

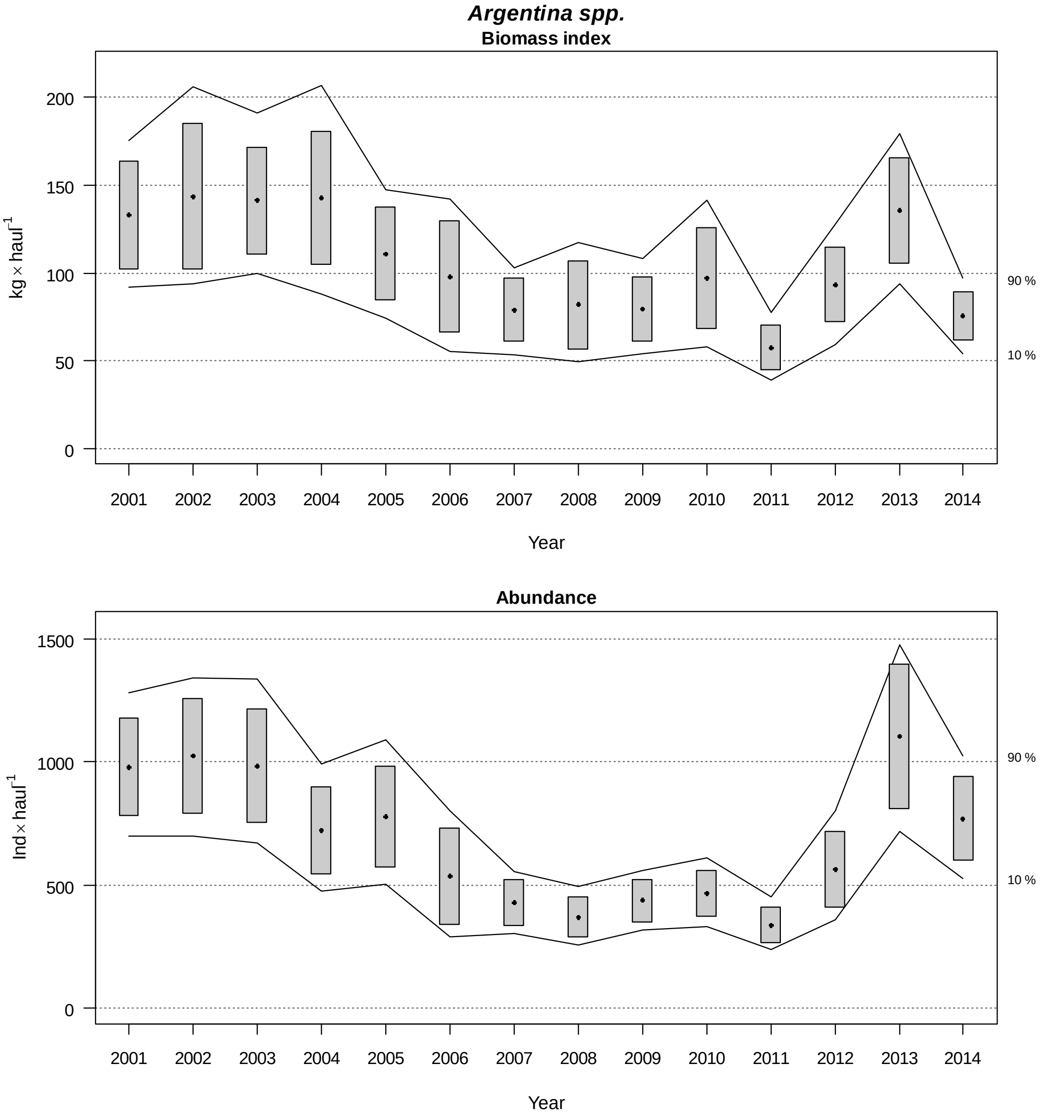

Figure 2. Changes in *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices during Porcupine Survey time series (2001-2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

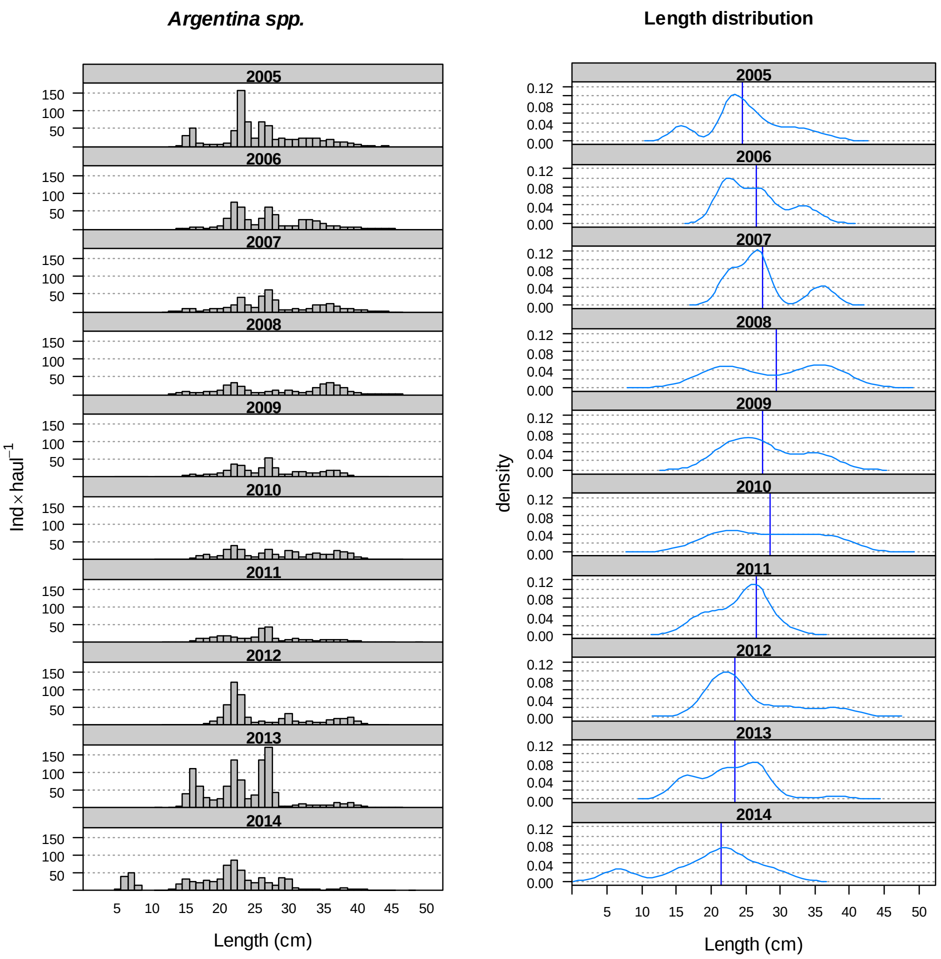

Figure 3. Mean stratified length distributions of *Argentina* spp. in Porcupine surveys during the last decade (2005-2014)

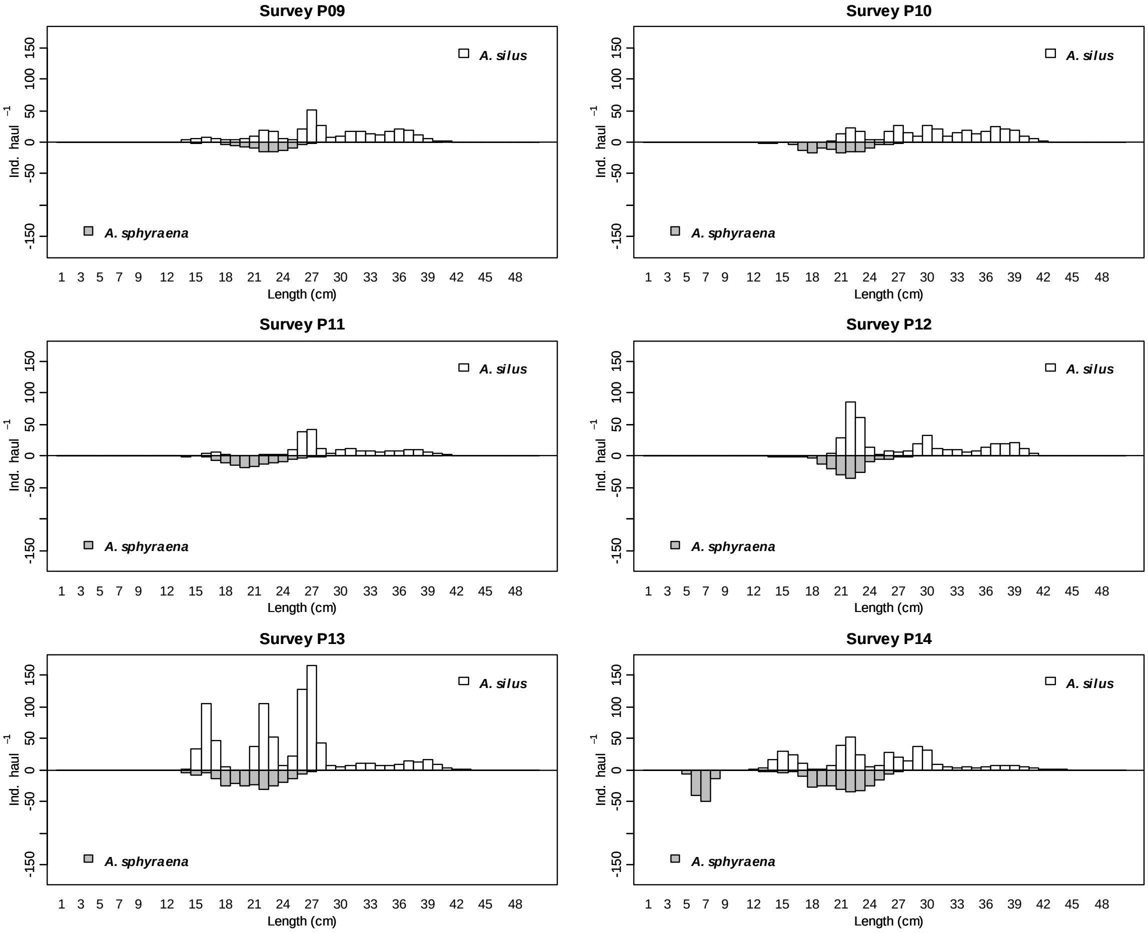

Figure 4. Mean stratified length distributions of *A. silus* and *A. sphyraena* in 2009-2014 surveys.

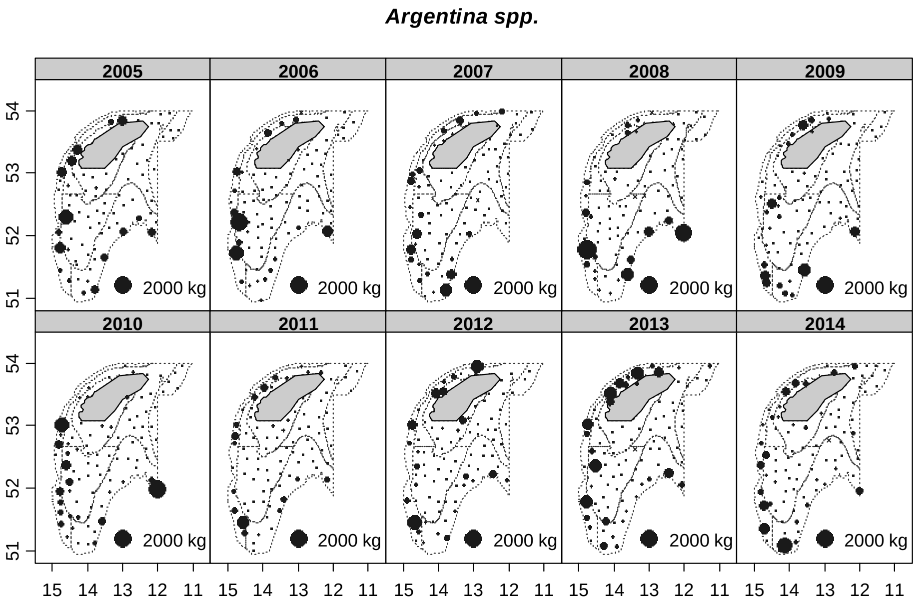

Figure 5. Geographic distribution of *Argentina* spp. catches (kg/30 min haul) in Porcupine surveys (2005-2014)

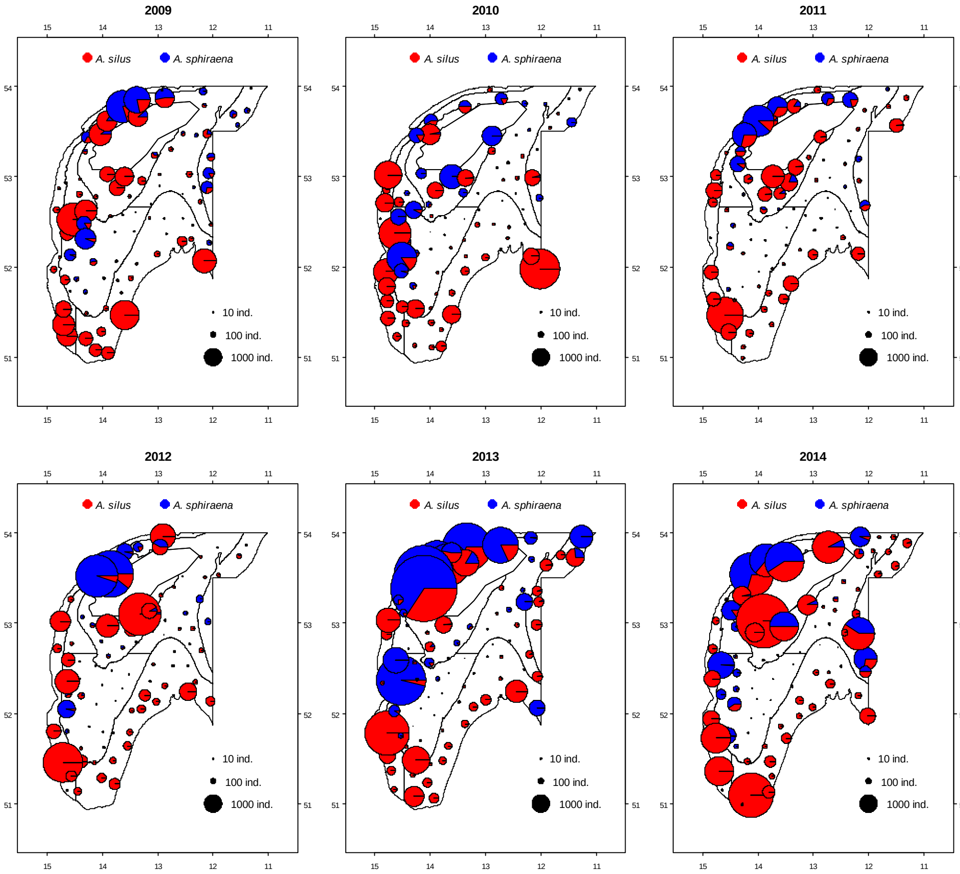

Figure 6. Distribution of *Argentina silus* and *A. sphyraena* in Porcupine surveys between 2009 and 2014 Porcupine Bank surveys

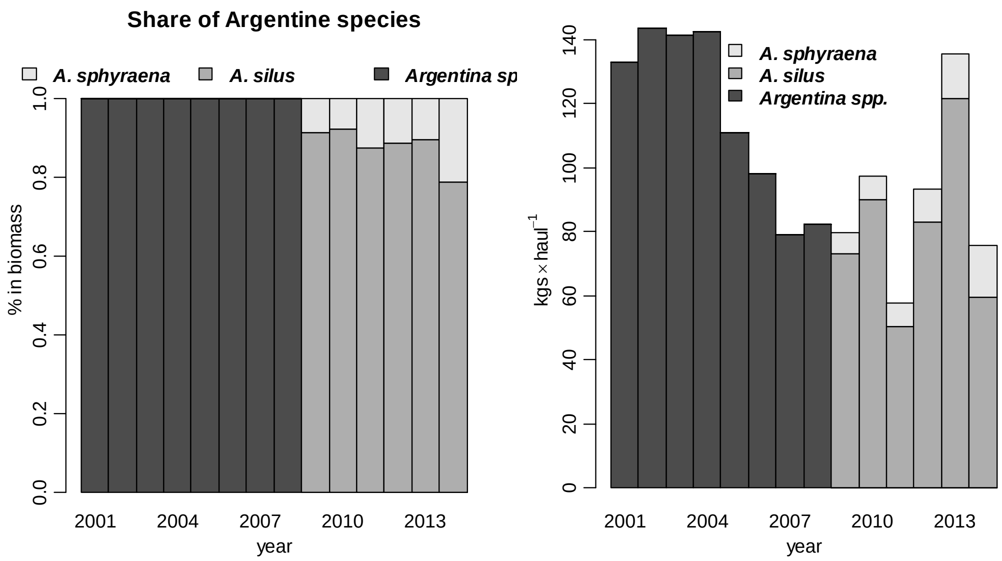

Figure 7. Share and abundance of Argentine species in Porcupine Bank surveys (2001-2014).

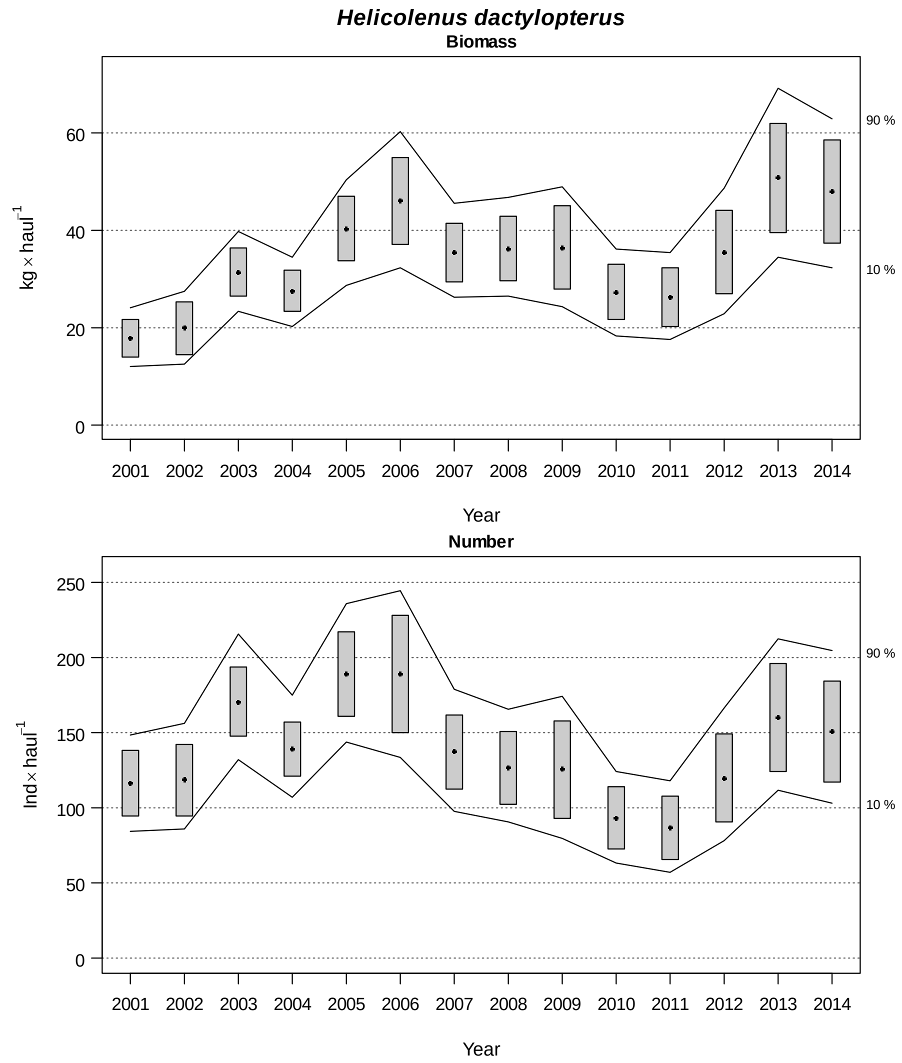

Figure 8. Changes in *Helicolenus dactylopterus* biomass and abundance indices during Porcupine Survey time series (2001-2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

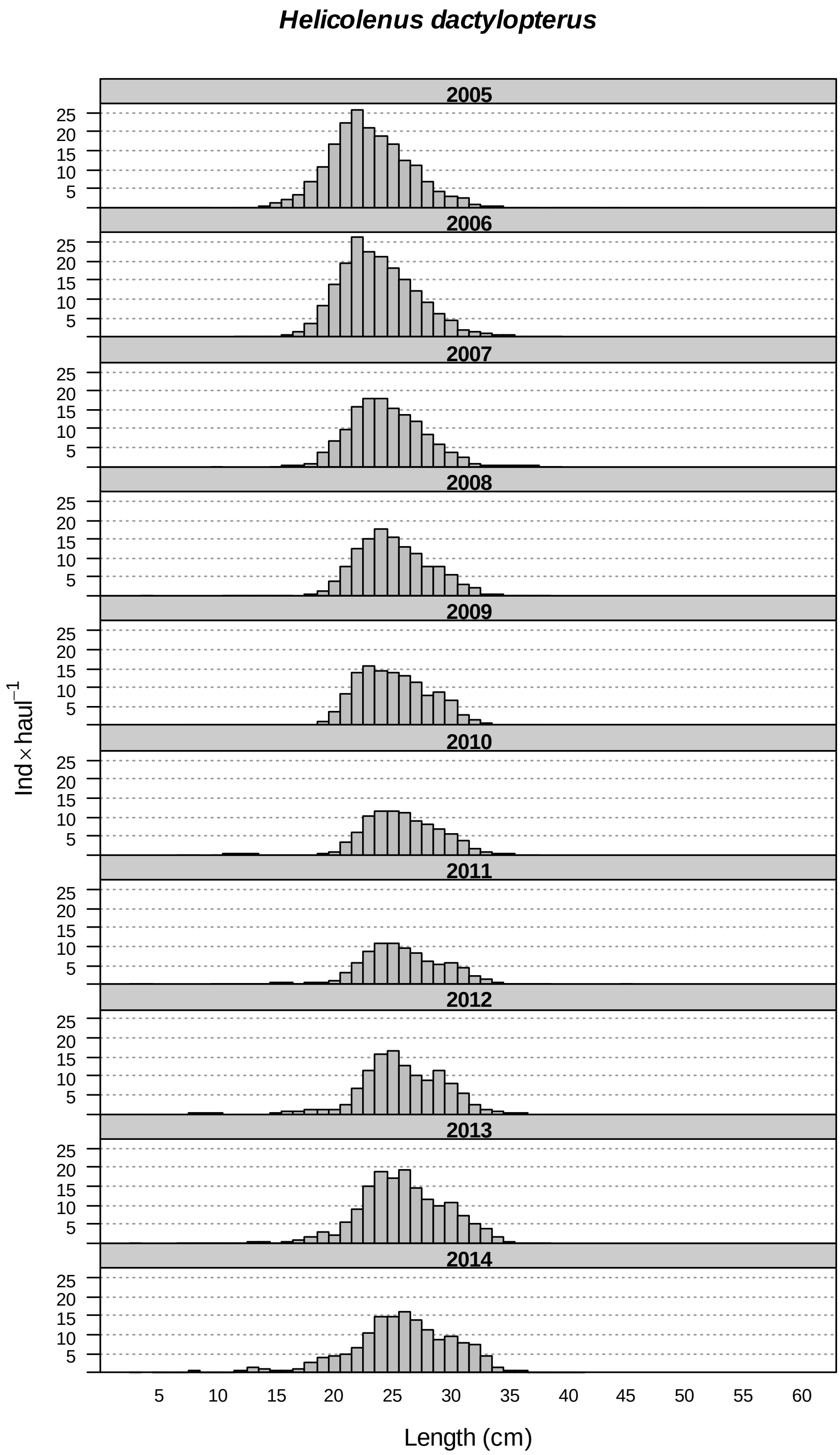

Figure 9. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys in the last decade (2005-2014).

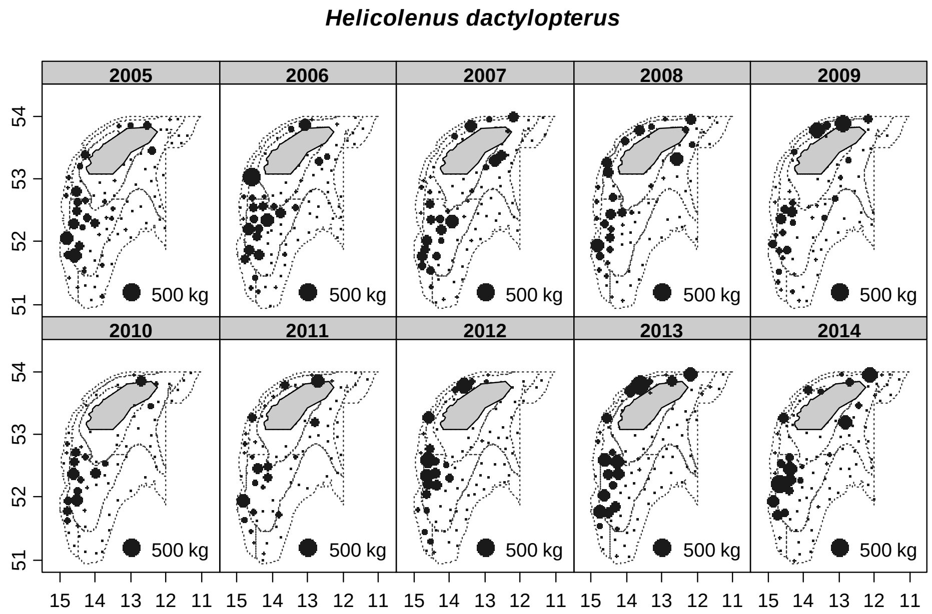

Figure 10. Geographic distribution of *Helicolenus dactylopterus* catches (kg×30 min $haul^{-1}$) in the last decade of Porcupine surveys (2005-2014)

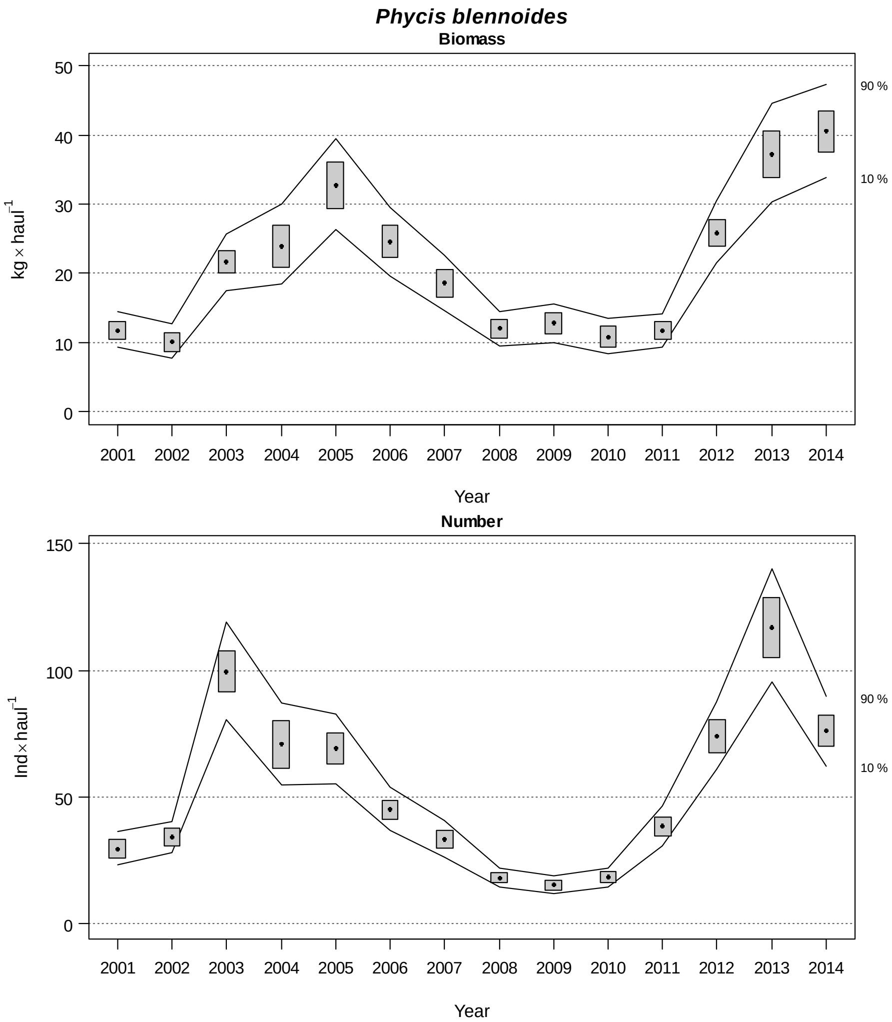

Figure 11. Changes in *Phycis blennoides* biomass and abundance indices during Porcupine Survey time series (2001-2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

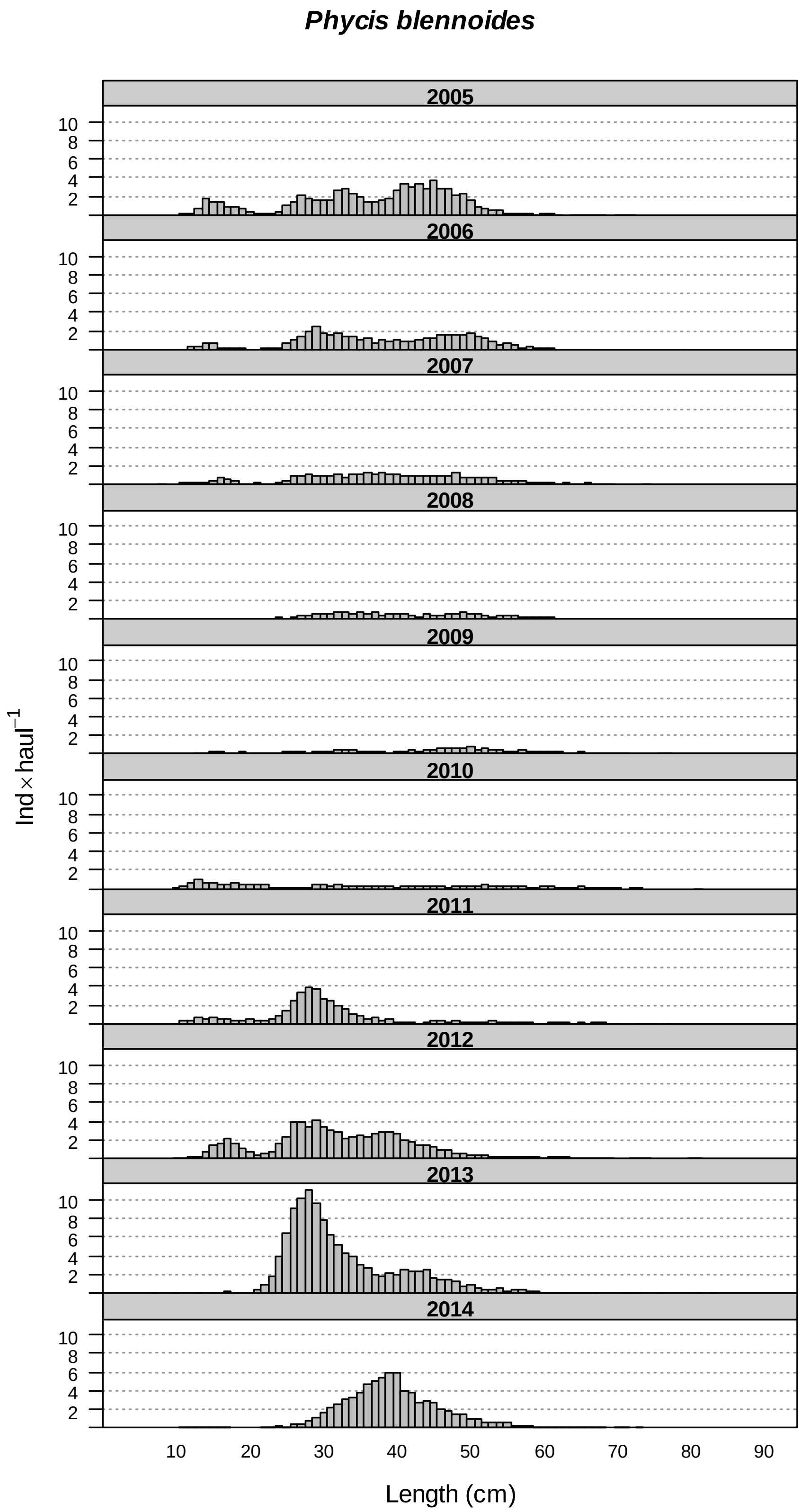

Figure 12. Mean stratified length distribution of *Phycis blennoides* in the last decade of Porcupine surveys (2005-2014)

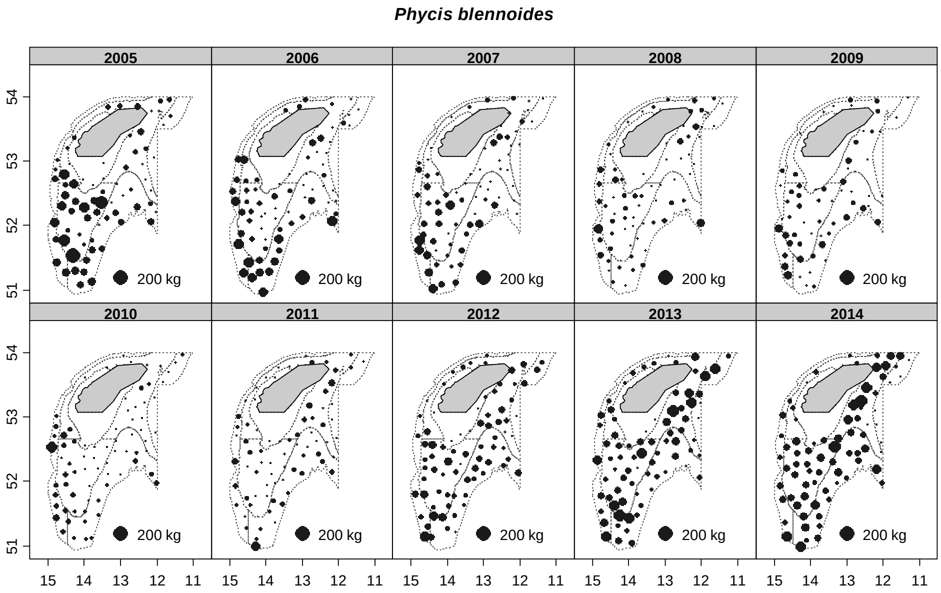

Figure 13. Geographic distribution of *Phycis blennoides* catches (kg×30 min haul^{-1}) in Porcupine surveys during the last decade (2005-2014)

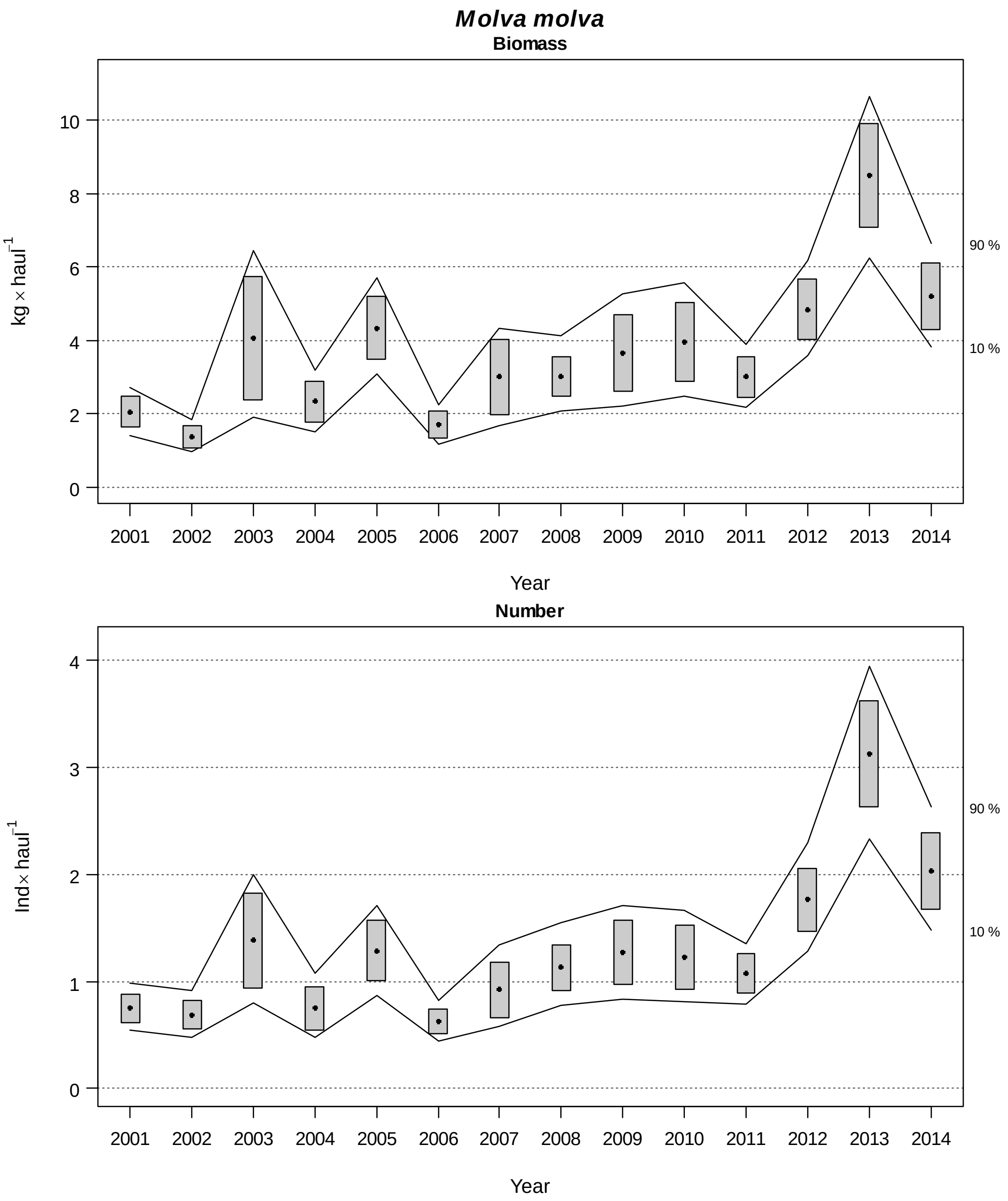

Figure 14. Evolution of *Molva molva* biomass and abundance indices during Porcupine Survey time series (2001-2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

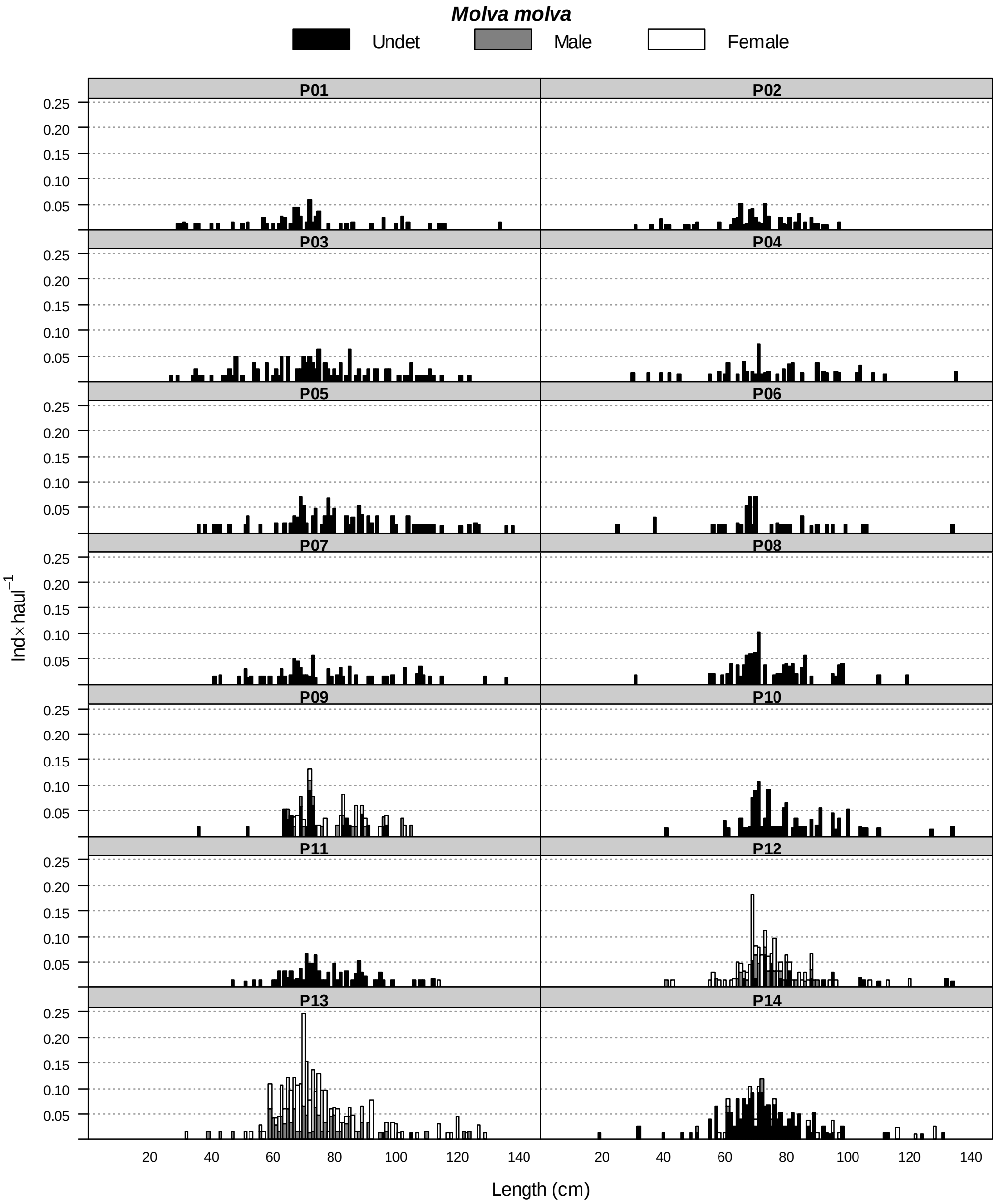

Figure 15. Mean stratified length distributions of ling (*M. molva*) in Porcupine Bank Spanish survey (2001-2014).

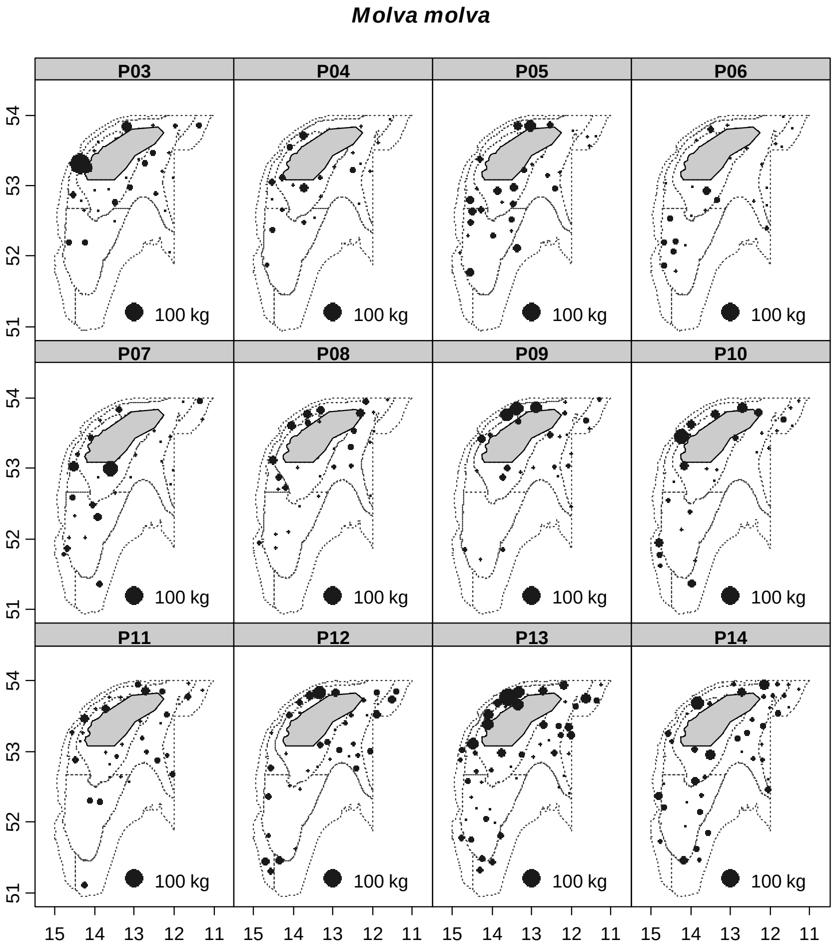

Figure 16. Catches in biomass of ling on the Spanish Porcupine Bank bottom trawl survey during the last twelve years: 2003-2014

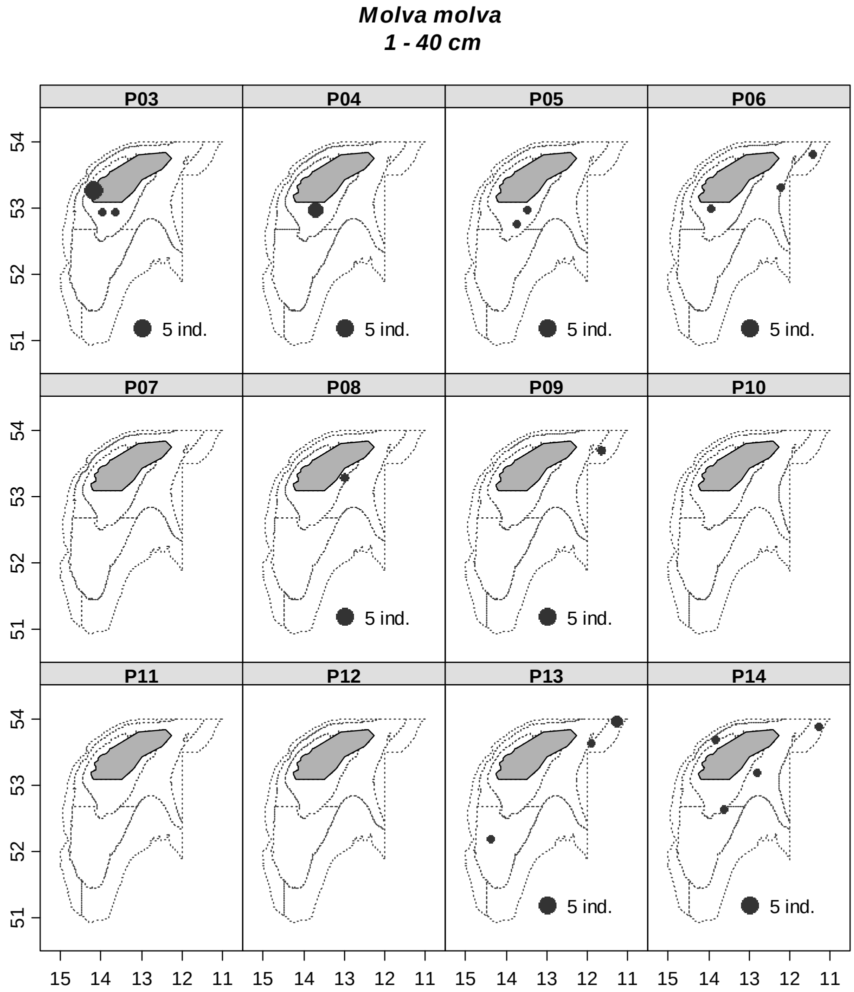

Figure 17. Catches of ling recruits (proxy ≥ 40 cm, ICES WGDEEP 2014) on the Spanish Porcupine Bank bottom trawl survey during the last twelve years: 2003-2014

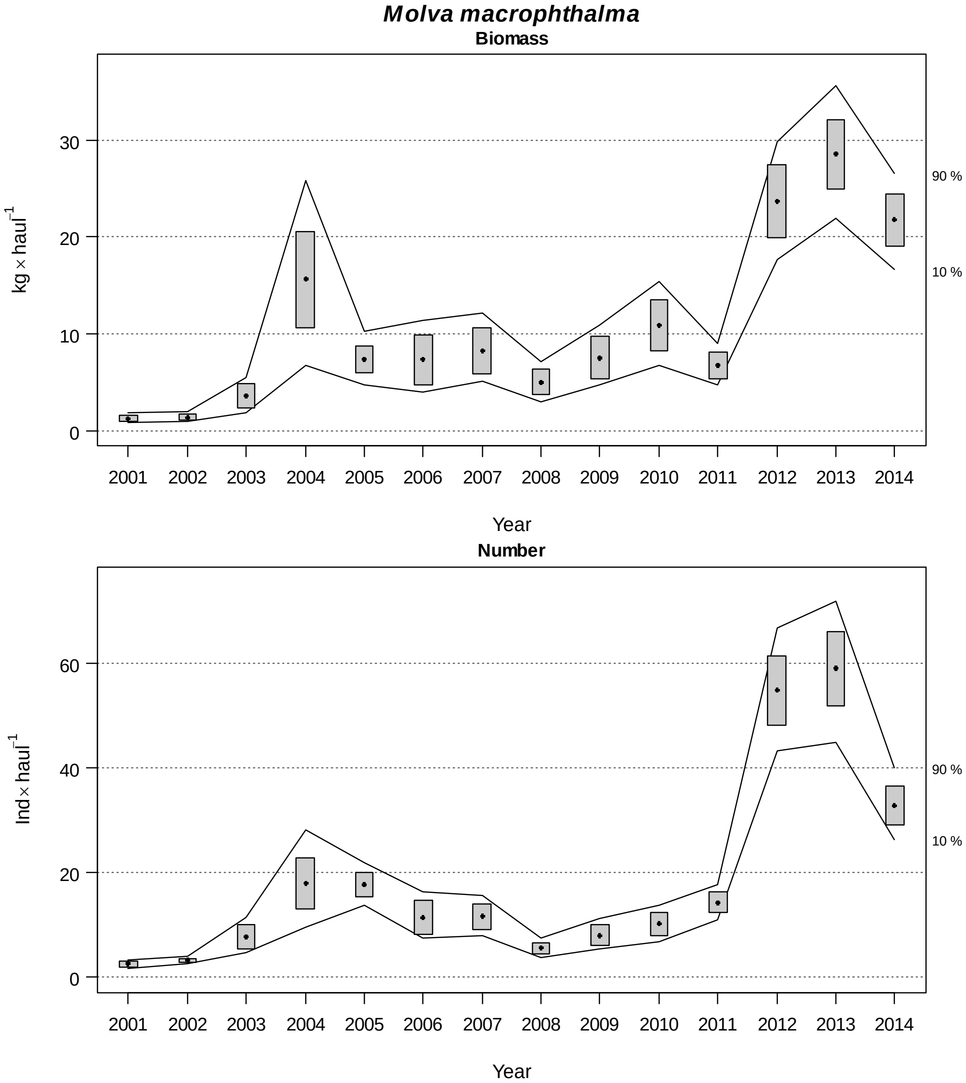

Figure 18. Changes in *Molva macrophthalma* biomass and abundance indices during Porcupine Survey time series (2001-2014). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

Molva macrophthalma

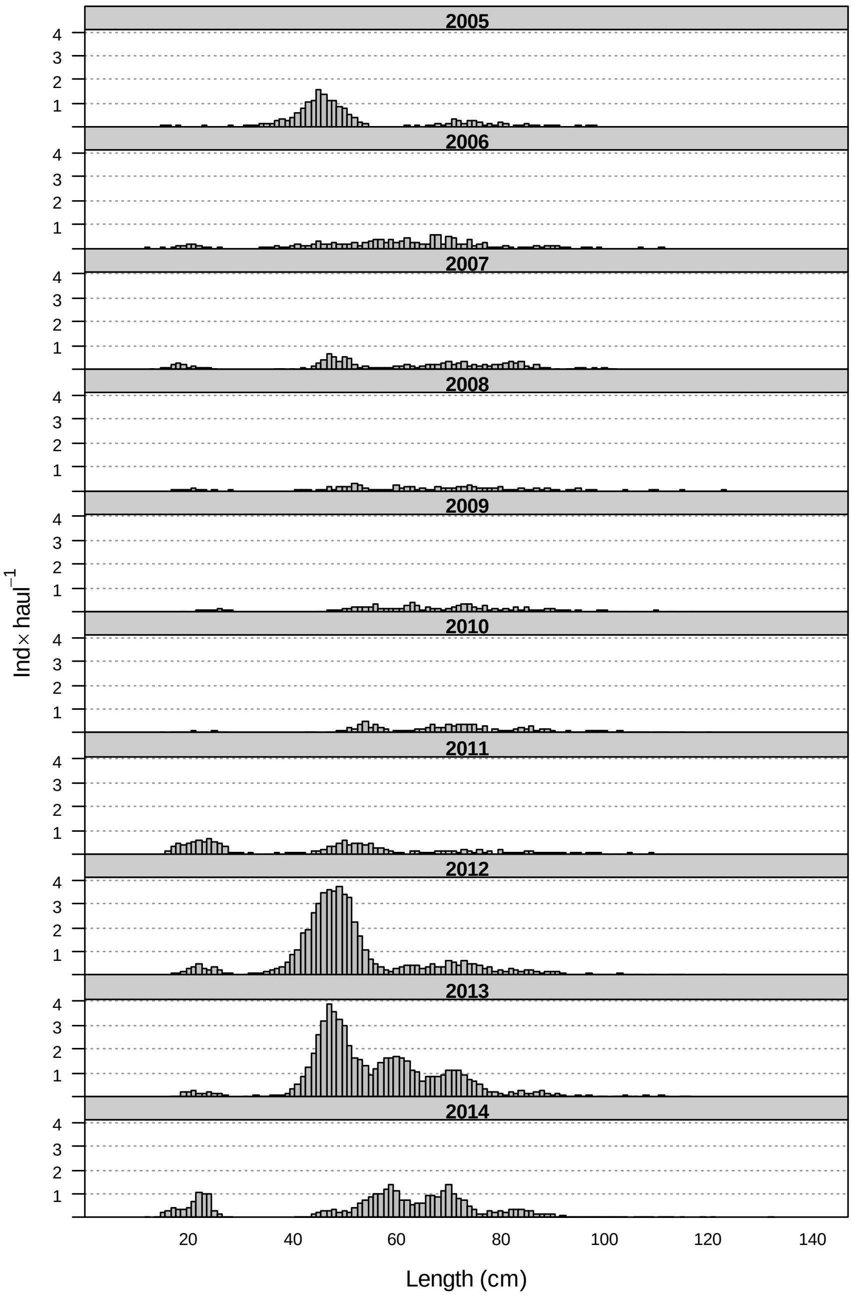

Figure 19. Mean stratified length distributions of *Molva macrophthalma* in Porcupine surveys in the last decade (2005-2014)

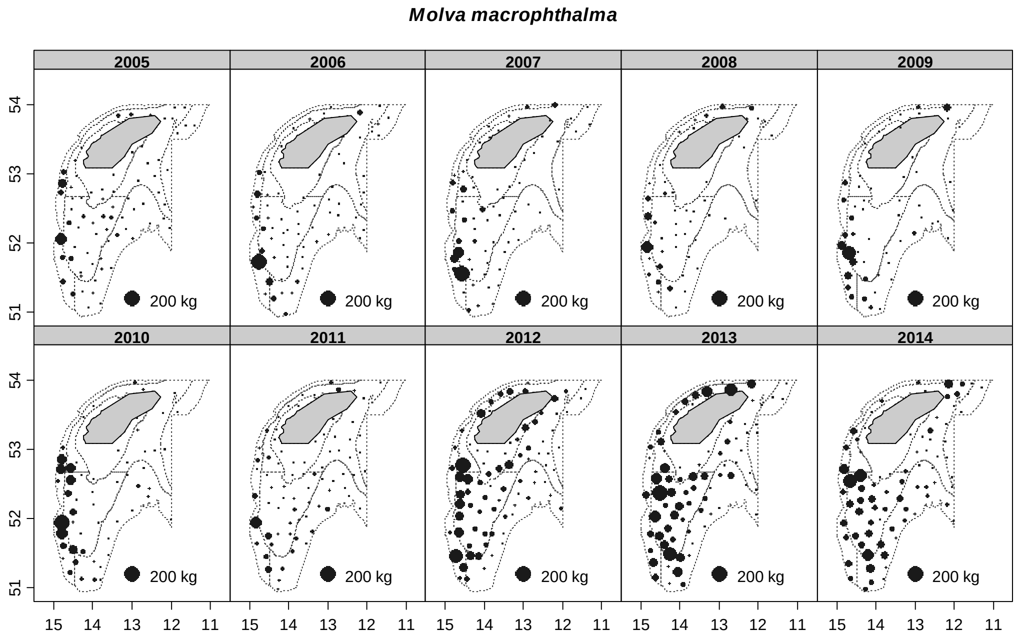

Figure 20. Geographic distribution of *Molva macrophthalma* catches (kg×30 min haul^{-1}) in Porcupine surveys during the last decade (2005-2014)

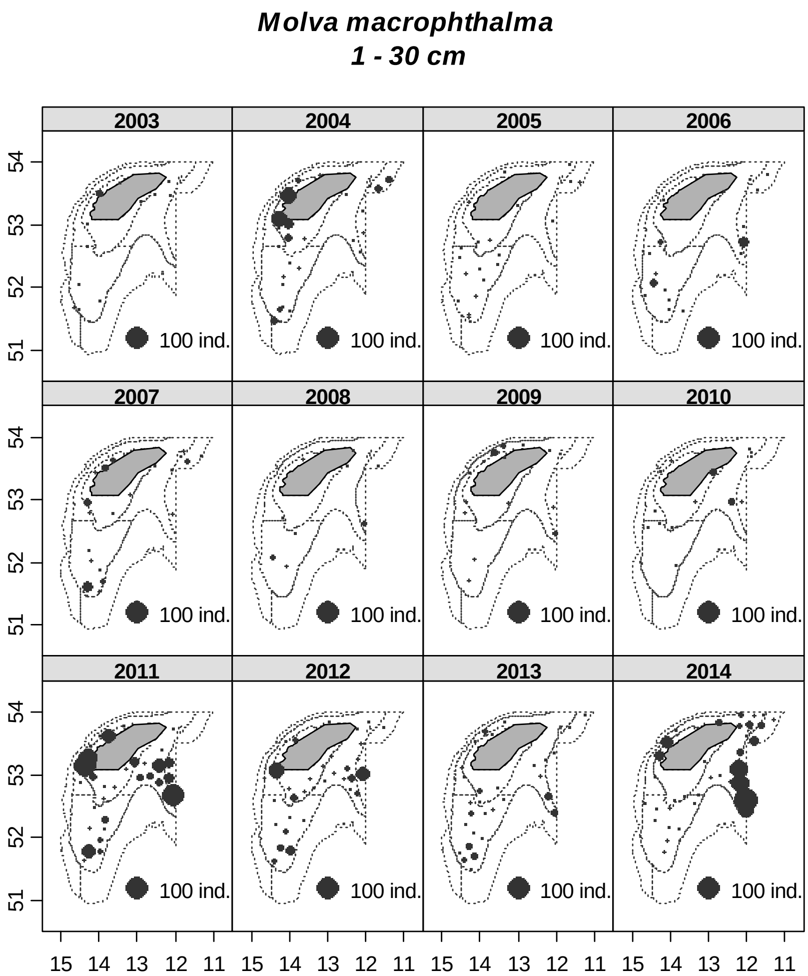

Figure 21 Geographic distribution of *Molva macrophthalma* individuals≤ 30 cm (recruitment proxy) in Porcupine surveys last twelve years (2003-2014)

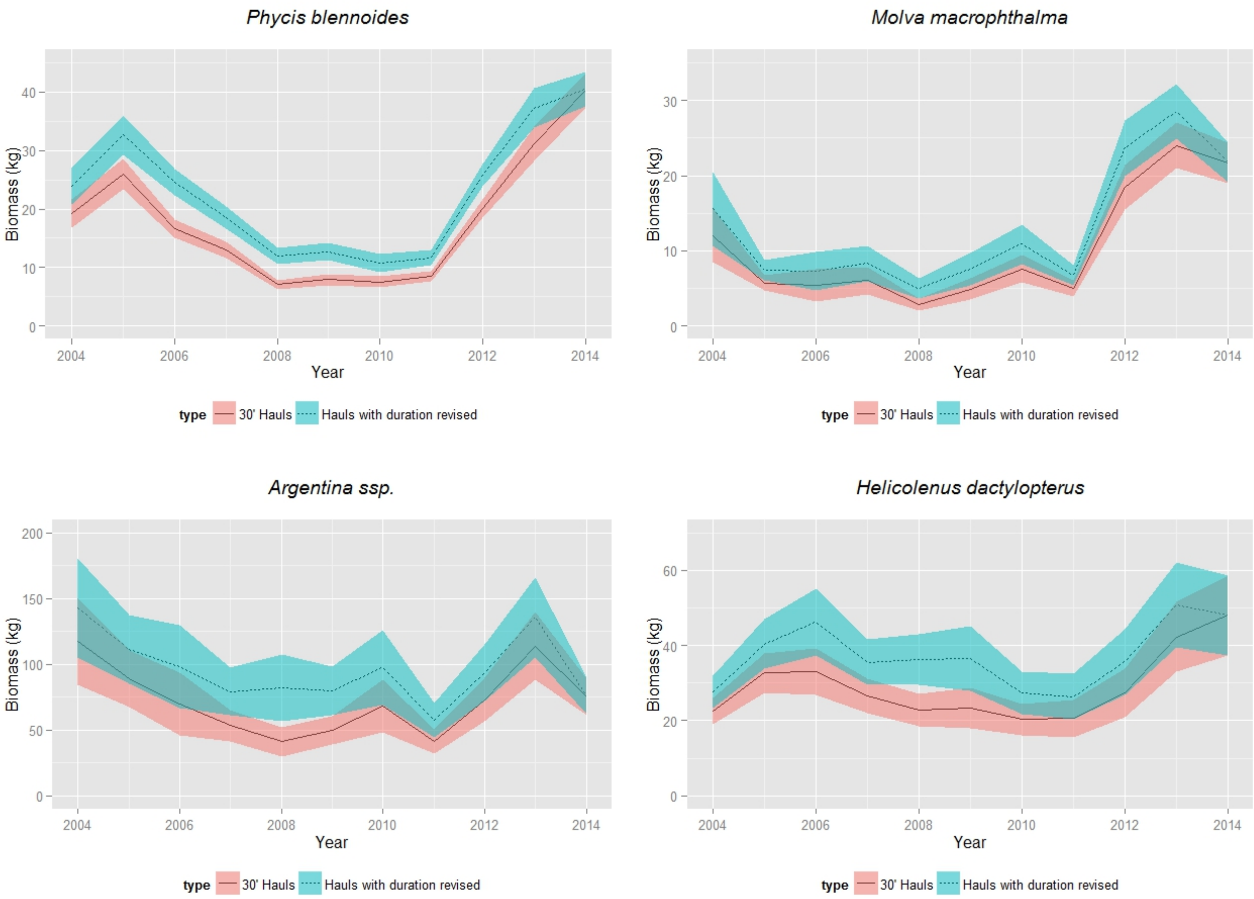

Figure 22. Comparison of the species presented evolution in biomass indices during Porcupine Survey time series (2001-2014) with "standard" 30 min tow duration and with the tow duration corrected with ground contact. Lines mark parametric standard error (F. Velasco, pers. com.)