

Results on *Merluccius merluccius* (hake), *Lophius budegassa* (black anglerfish) and *Lophius piscatorius* (white anglerfish), *Lepidorhombus boscii* (four-spot megrim) and *Lepidorhombus whiffiagonis* (megrim) from the Spanish Ground Fish Survey on the Porcupine bank (NE Atlantic)

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Abstract

This working document presents the results of *Merluccius merluccius* (hake), *Lophius budegassa* (black anglerfish), *Lophius piscatorius* (white anglerfish), *Lepidorhombus boscii* (four-spot megrim) and *Lepidorhombus whiffiagonis* (megrim) caught on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2020. Biomass, abundance, distribution and length frequency were analysed. Biomass indices of these target species decreased in this last survey and recruitment remained low.

Introduction

The Spanish bottom trawl survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been carried out annually in the third-quarter (September) since 2001 to study the distribution, relative abundance and biological parameters of commercial species in the area (ICES 2017).

The aim of this working document is to update the results (abundance indices, length frequency and geographic distributions) of the species *Merluccius merluccius* (hake), *Lophius budegassa* (black anglerfish) and *L. piscatorius* (white anglerfish), *Lepidorhombus boscii* (four-spot megrim) and *L. whiffiagonis* (megrim) on Porcupine bottom trawl surveys after the results presented previously (Blanco *et al.* 2017; Ruiz-Pico *et al.* 2018, 2019, 2020).

Material and methods

The Spanish Ground Fish Survey on the Porcupine Bank (SP-PORC-Q3) has been carried out annually since 2001 onboard the R/V *Vizconde de Eza*, a stern trawler of 53 m and 1800 Kw. The area covered 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 2017). The sampling design was random stratified to the area (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 (2017).

The tow duration is 20 min since 2016, but the results were extrapolated to 30 min of trawling time to keep up the time series.

Results

Despite the problems created by the pandemic and the COVID-19 disruption, the Porcupine Groundfish Survey was carried out without major problems, apart from an initial 9-day delay that did not affect the overall survey duration.

In 2020, 81 valid standard hauls and 10 additional hauls were carried out. Among the additional hauls, three of them have been carried out into the standard stratification, to improve coverage in the gaps left by random sampling and seven of them, between 839 and 1425 m, to explore the continuity of the fish community in Porcupine Seabight (Figure 1).

The total stratified catch per haul increased significantly in 2020 compared to the previous year, becoming the second highest catch in the historical series below the year 2015 (Figure 2). Fish represented 96% of the total catch and the species analyzed in this report represented 5% of the total stratified fish catch, with the following percentages by species: hake (41%), anglerfishes (25%) and megrims (34%).

In 2020 the biomass of all these target species decreased compared to the previous year, going back to mean values of the time series, lower for hake and *L. budegassa* and higher for *L. piscatorius* and *L. whiffiagonis*. Recruitment was low for all the species and the abundance of the *L. boscii* juveniles (≤ 12 cm) fell sharply to the lowest level in the time series.

***Merluccius merluccius* (hake)**

The biomass of *M. merluccius* remained similar to the value of the previous two years, whereas abundance followed the downward trend of the last two years after the peak of 2017 (Figure 3).

M. merluccius was widespread in the study area, although fewer and smaller spots were found in the previous two years, and fewer further in the northeast of the bank in this last survey (Figure 4).

Isolated spots of recruits (< 23 cm) were found on the Irish shelf and south of the bank, even scarcer than the previous year (Figure 5).

The length distribution and length density plot showed a bimodal distribution with modes around 28 and 53 cm (Figure 6).

***Lophius budegassa* (black anglerfish) and *Lophius piscatorius* (white anglerfish)**

As usual, *L. budegassa* was scarcer than *L. piscatorius* in the area. In this last survey, the biomass and abundance values of both species dropped compared to the previous year, especially the abundance of *L. budegassa*, which approached the lowest values of the time series. *L. piscatorius* values, even having decreased, remained among the high values of the last seven years (Figure 7).

L. budegassa was found mainly on the Irish shelf and near the central bank, as usual, although in this last survey was especially abundant south of the bank. However, *L. piscatorius* was widely distributed, although predominantly in the deepest southern and western sectors (Figure 8). The few spots of *L. budegassa* recruits (< 21 cm) were found on the Irish shelf, in contrast to a few more *L. piscatorius* recruits around the bank (Figure 9).

Regarding the length distribution, very few individuals less than 39 cm was found for *L. budegassa* and the most abundant sizes were around 43 cm. However, a group of recruits between 6 and 18 cm is clearly distinguished for *L. piscatorius*, without a marked mode, and also another group of larger specimens with a mode around 67 cm (Figure 10).

***Lepidorhombus boscii* (four-spot megrim) and *Lepidorhombus whiffiagonis* (megrim)**

The biomass of both species has been quite similar in the area. However, the abundance of *L. whiffiagonis* has been higher. Both species have followed an upward trend since the beginning of the time series. In the last survey, the biomass and abundance of *L. boscii* decreased sharply, still remaining between the mean values of the time series. The biomass and abundance of *L. whiffiagonis* also decreased remarkably, although these values remained similar, but high, to the previous three years (Figure 11).

L. whiffiagonis was distributed around the bank and on the Irish shelf at less depth than *L. boscii*, as usual (Figure 12). Recruits followed a similar distribution, deeper those of *L. boscii*, although both were scarcer in the last three surveys (Figure 13 and Figure 14). The abundance of the *L. boscii* juveniles (≤ 12 cm) fell sharply to the lowest level in the time series (Figure 15). No individuals smaller than 9 cm of the species *L. boscii* were found and a mode was drawn at 19 cm. Individuals smaller than 9 cm were really scarce for *L. Whiffiagonis*, which presented a mode between 16 and 20 cm (Figure 16). The 1-year-old *L. whiffiagonis* recruits decreased compared to the previous year and reached low levels in the time series (Figure 17, Figure 18 and Figure 19).

Acknowledgements

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Figures

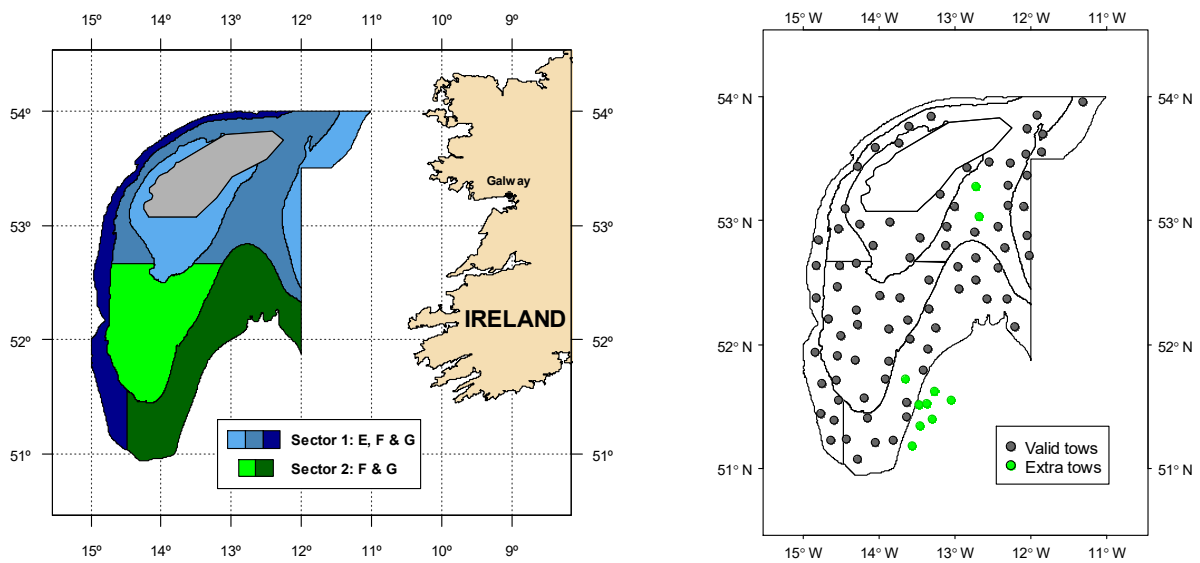


Figure 1. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed in 2020

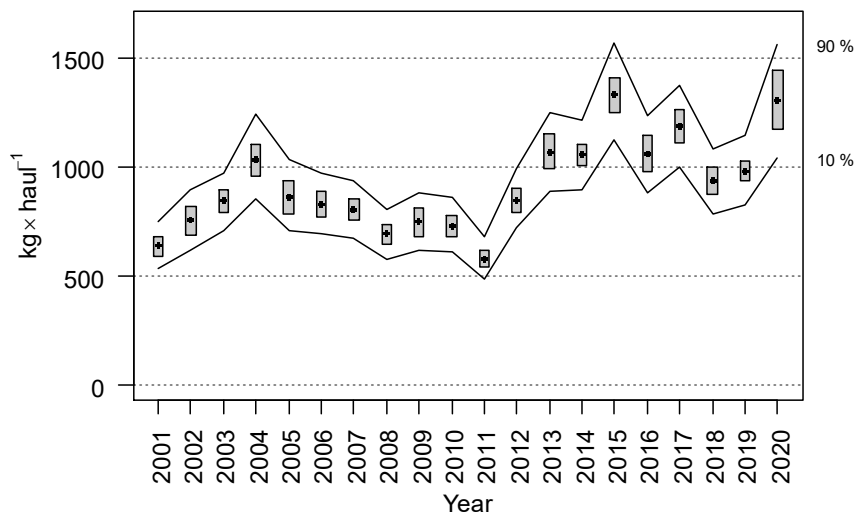


Figure 2. Evolution of the total catch in biomass on Porcupine surveys (2001-2020)

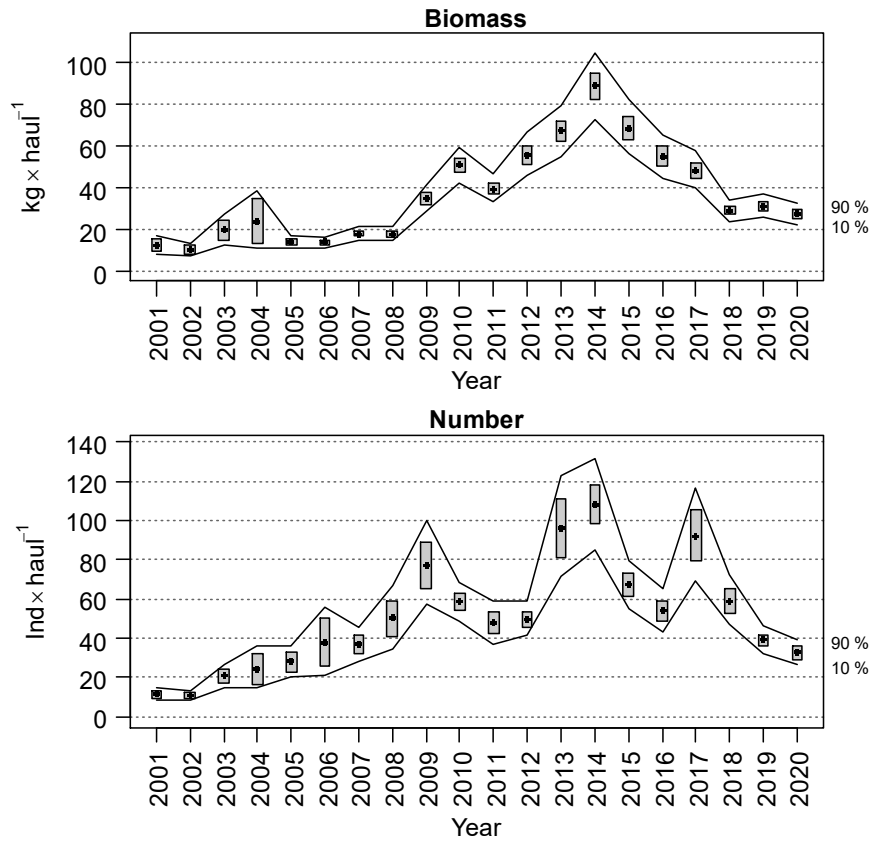


Figure 3. Evolution of *Merluccius merluccius* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

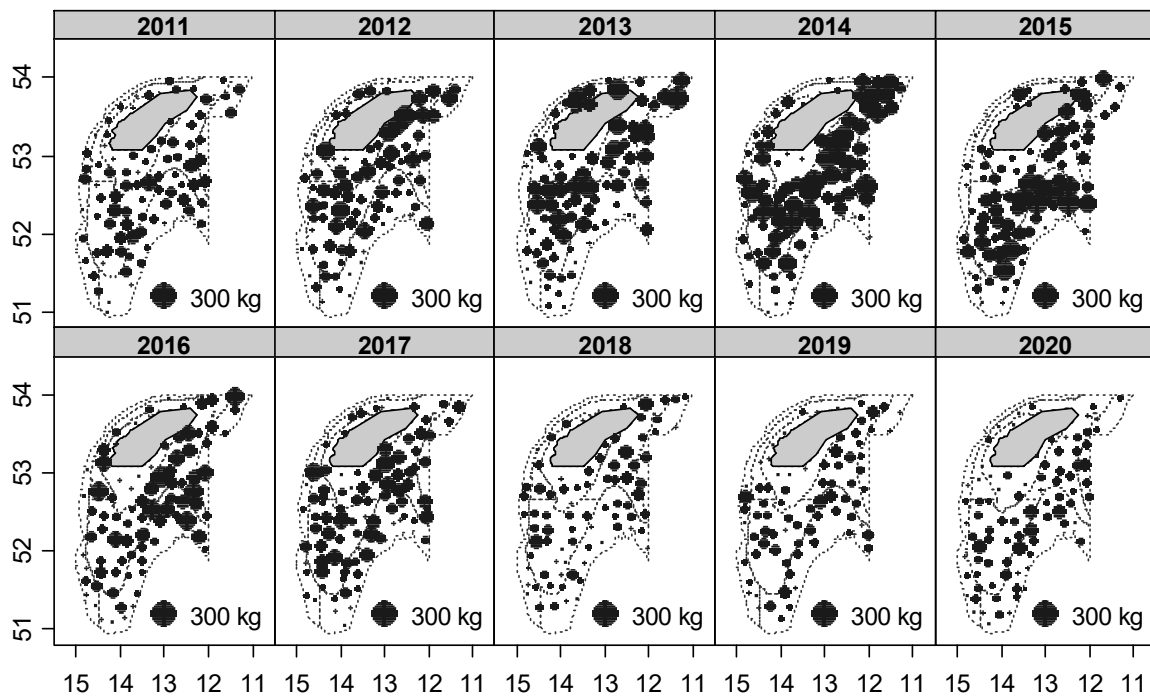


Figure 4. Geographic distribution of *Merluccius merluccius* catches (kg/30 min haul) in Porcupine surveys (2011-2020)

M. merluccius <23 cm

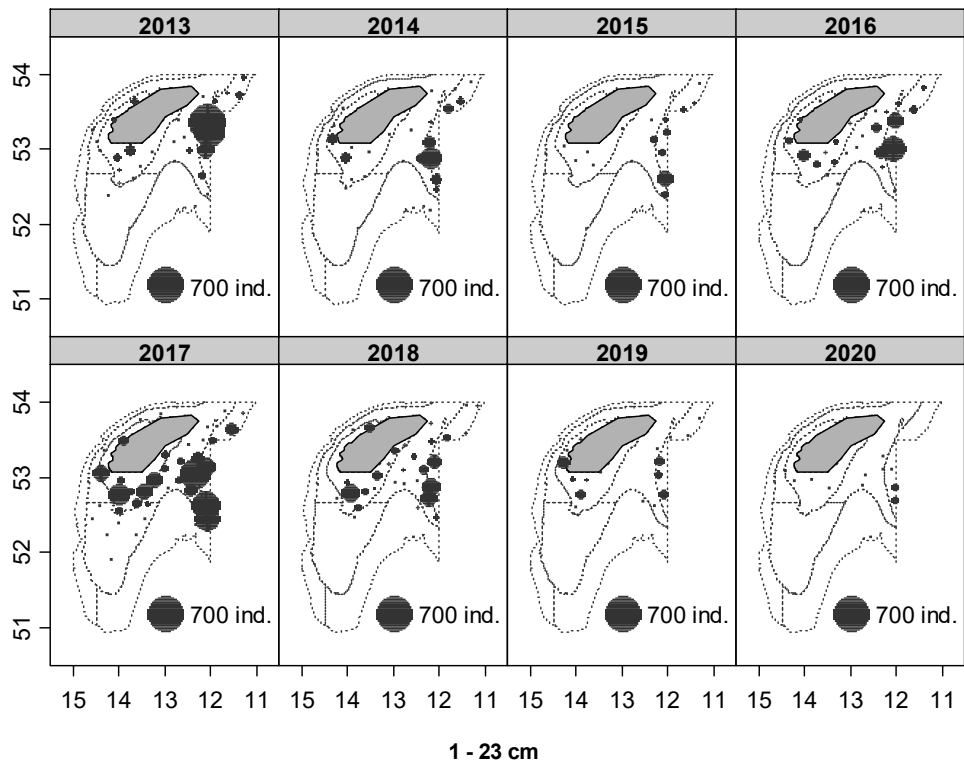


Figure 5. Geographic distribution of *Merluccius merluccius* recruits (<23 cm) in Porcupine surveys (2013-2020)

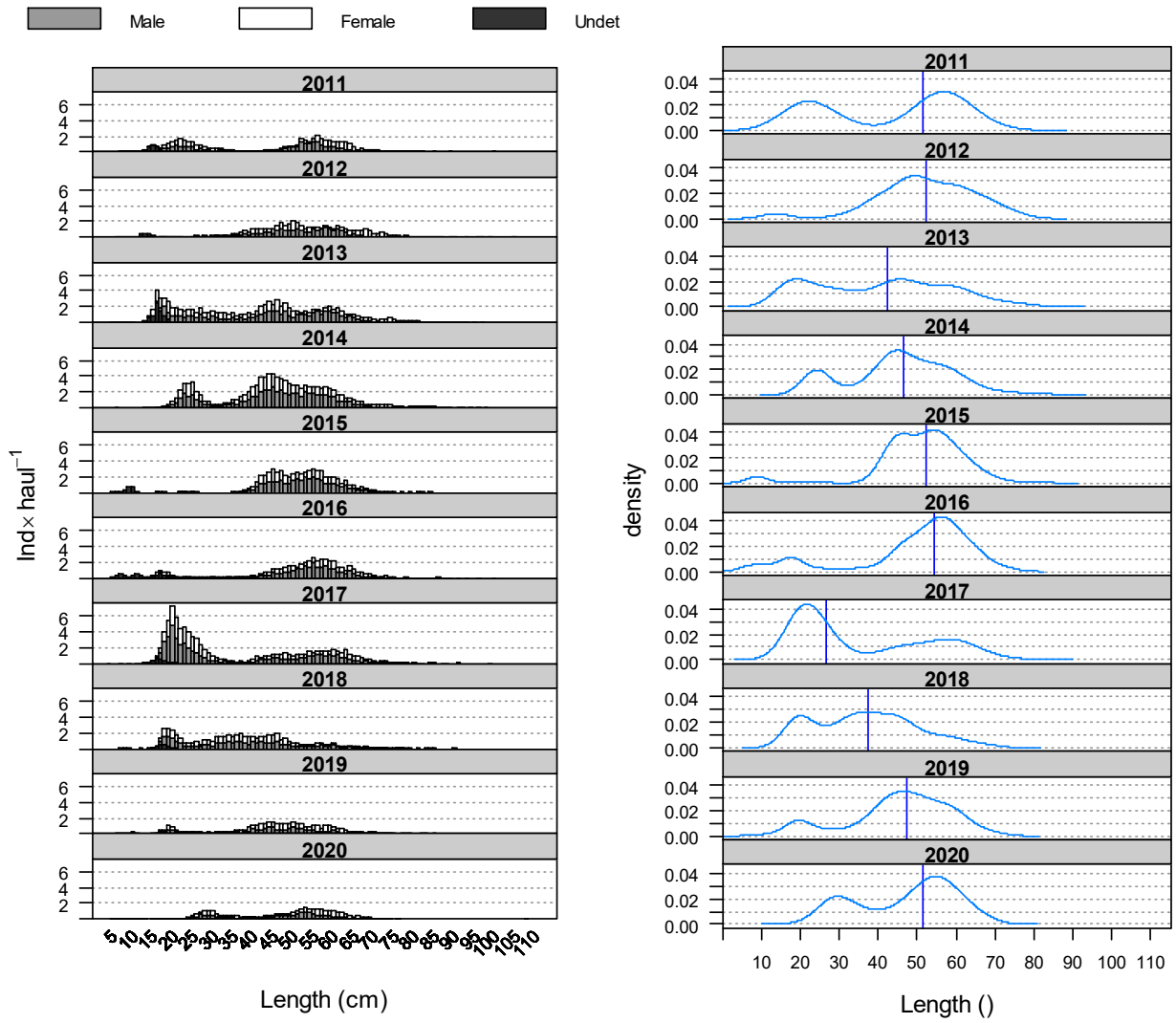


Figure 6. Mean stratified length distributions and length density plots of hake in Porcupine surveys (2011-2020)

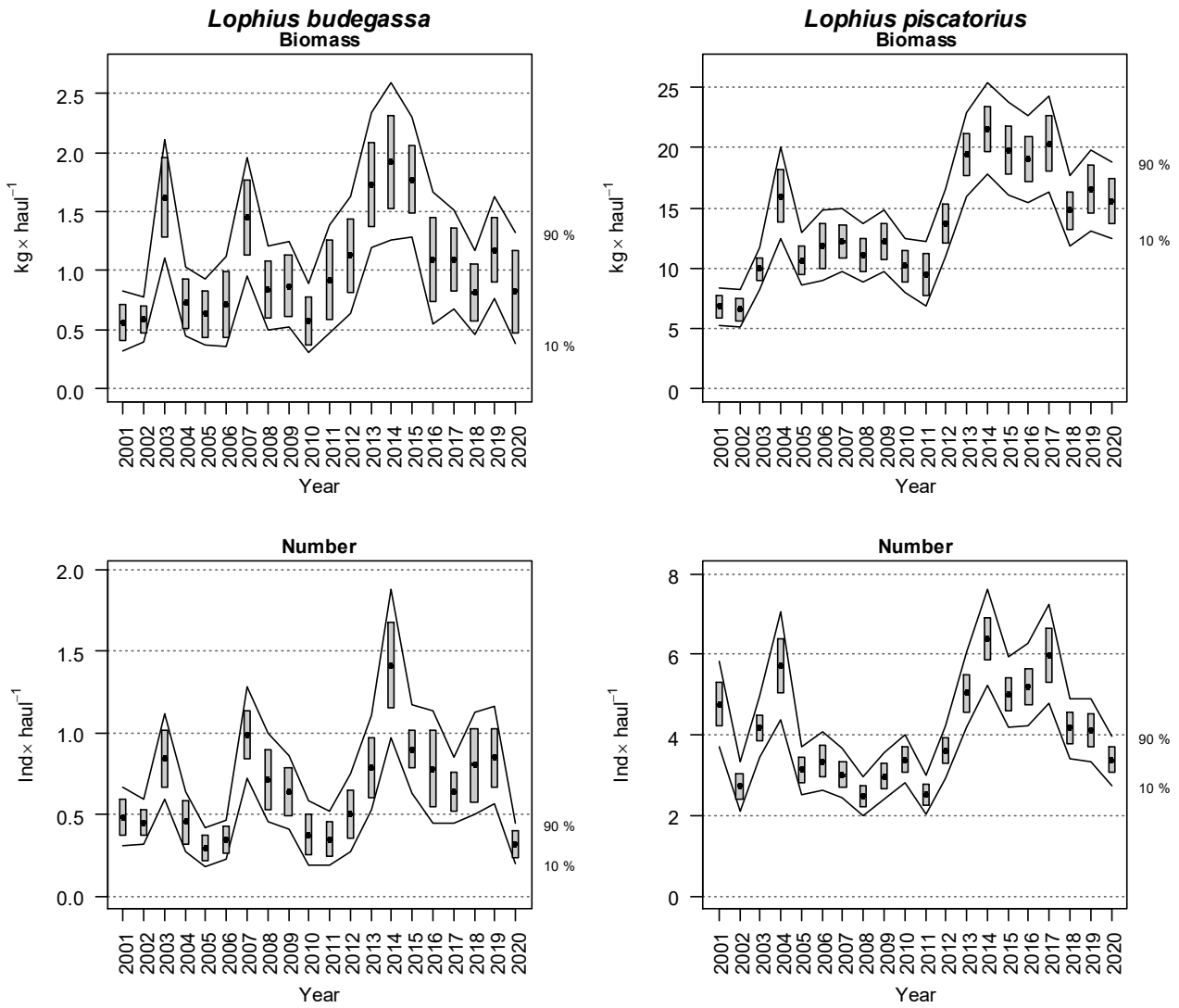


Figure 7. Evolution of *Lophius budegassa* and *Lophius piscatorius* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

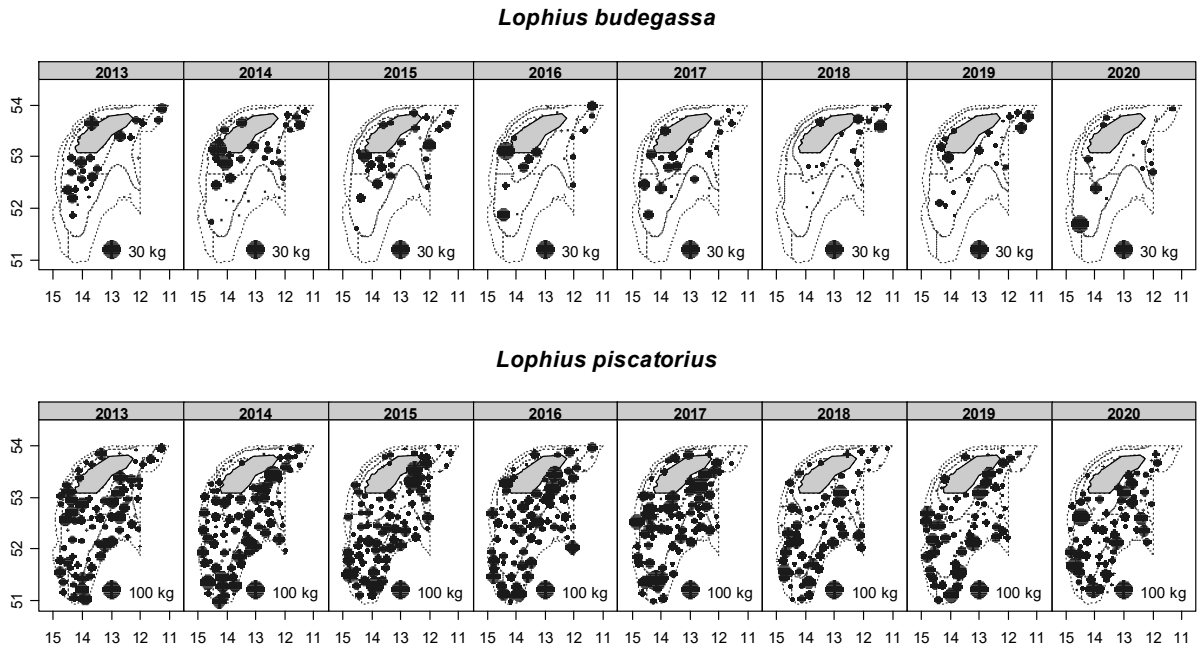


Figure 8. Geographic distribution of *Lophius budegassa* and *L.piscatorius* catches ($\text{kg} \times 30 \text{ min haul}^{-1}$) in Porcupine surveys (2013-2020)

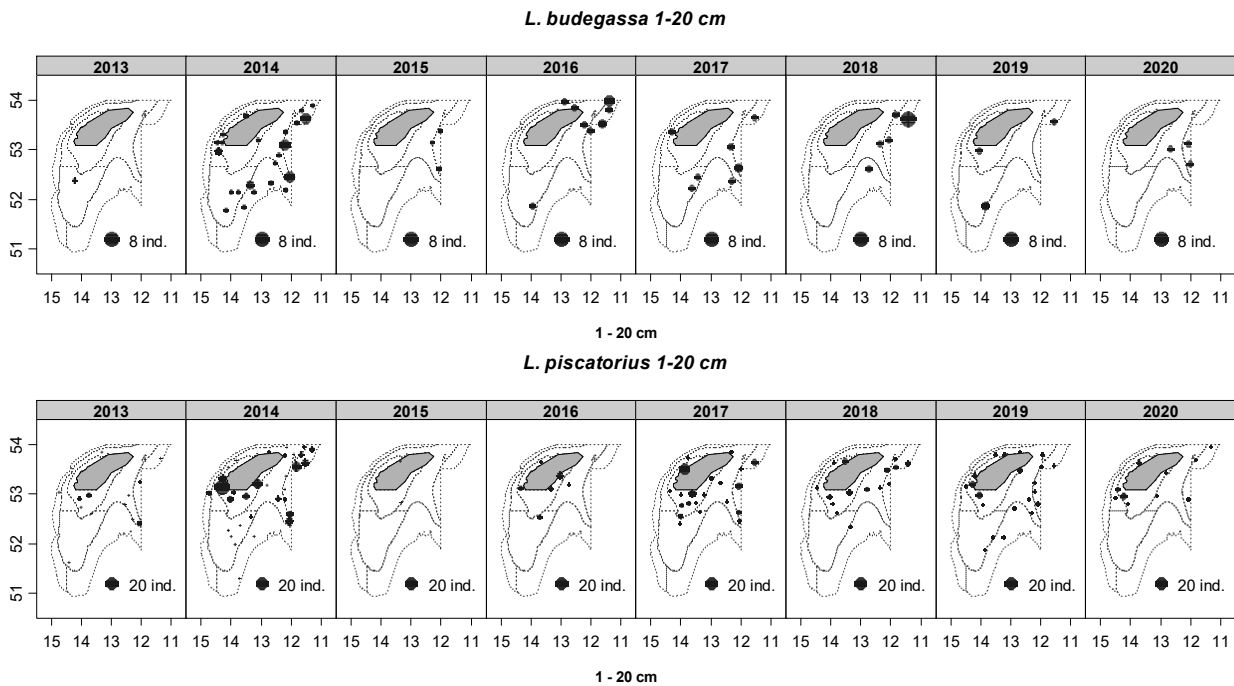


Figure 9. Geographic distribution of *Lophius budegassa* and *Lophius piscatorius* recruits in Porcupine surveys (2013-2020)

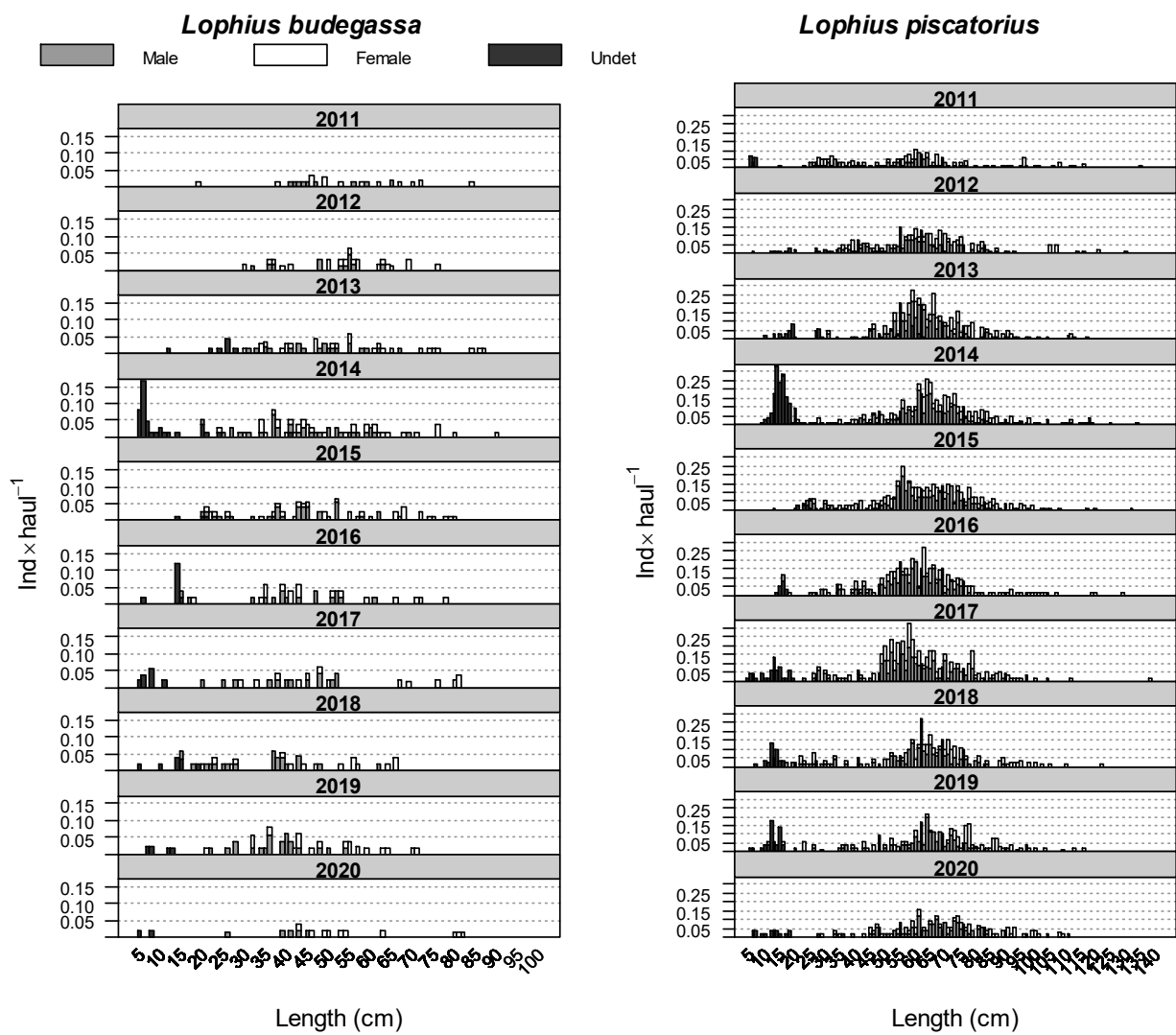


Figure 10. Mean stratified length distributions of *Lophius budegassa* and *Lophius piscatorius* in Porcupine surveys (2011-2020)

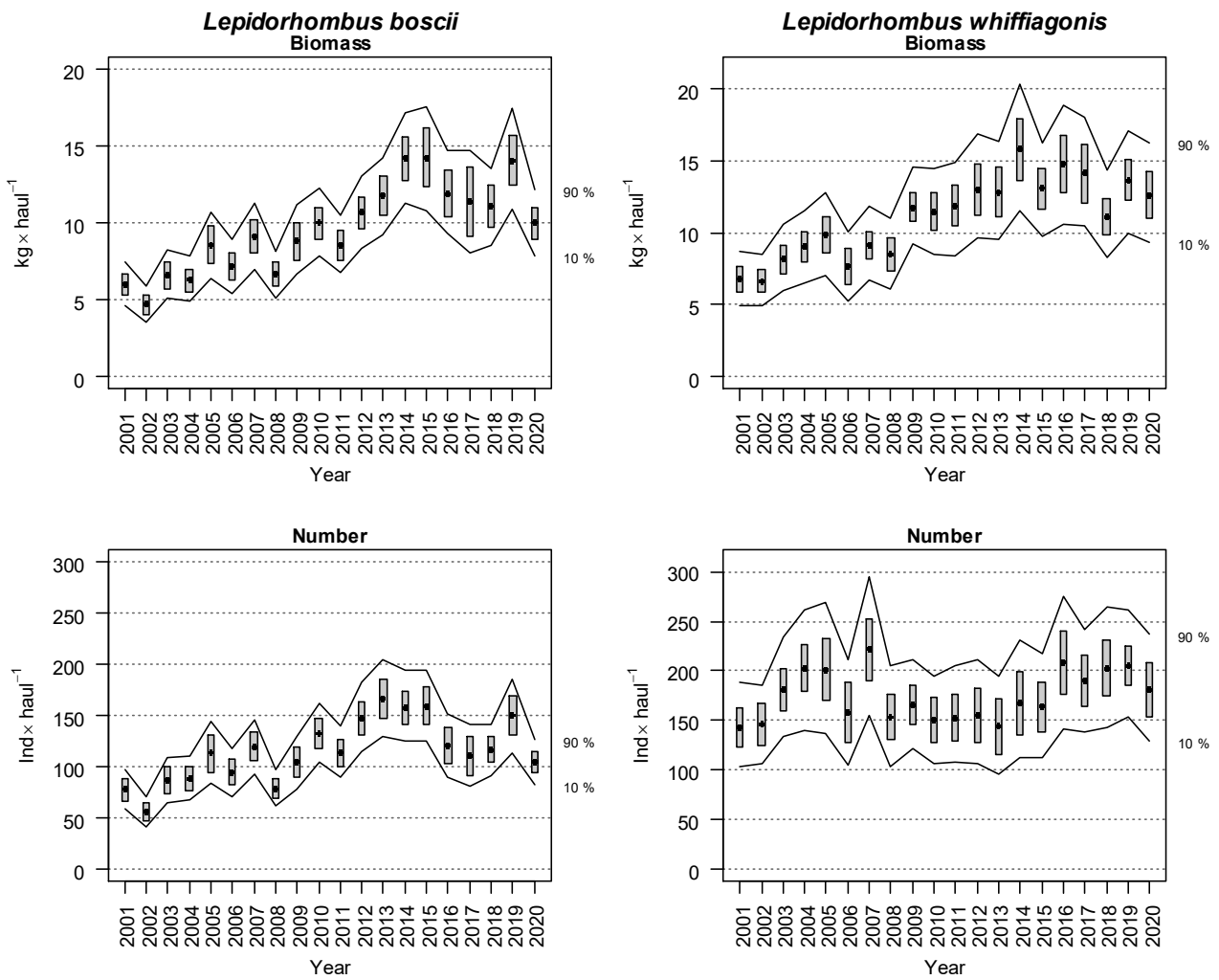
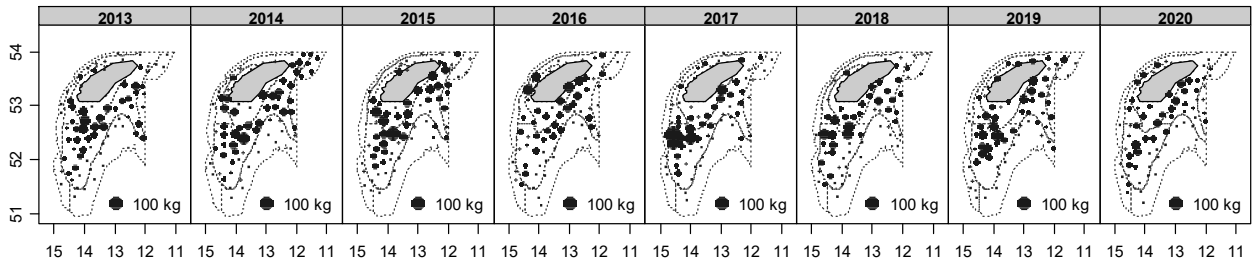


Figure 11. Evolution of *Lepidorhombus boscii* and *Lepidorhombus whiffiagonis* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals ($\alpha = 0.80$, bootstrap iterations = 1000)

Lepidorhombus boscii



Lepidorhombus whiffiagonis

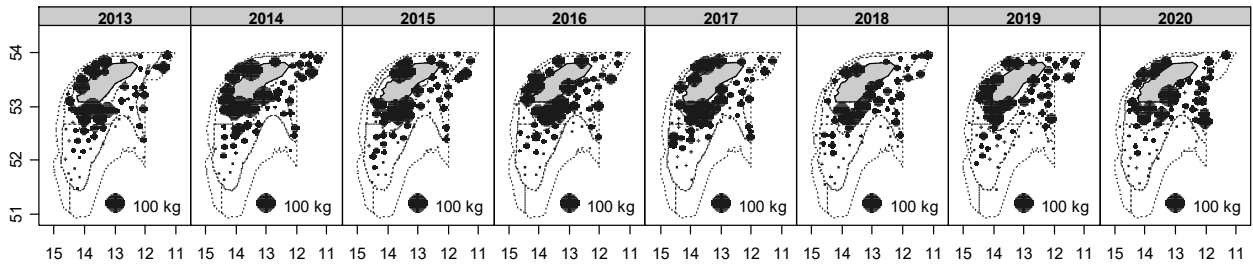


Figure 12. Geographic distribution of *Lepidorhombus boscii* and *L. whiffiagonis* catches ($\text{kg} \times 30 \text{ min haul}^{-1}$) in Porcupine surveys (2013-2020)

Lepidorhombus whiffiagonis
Age 1

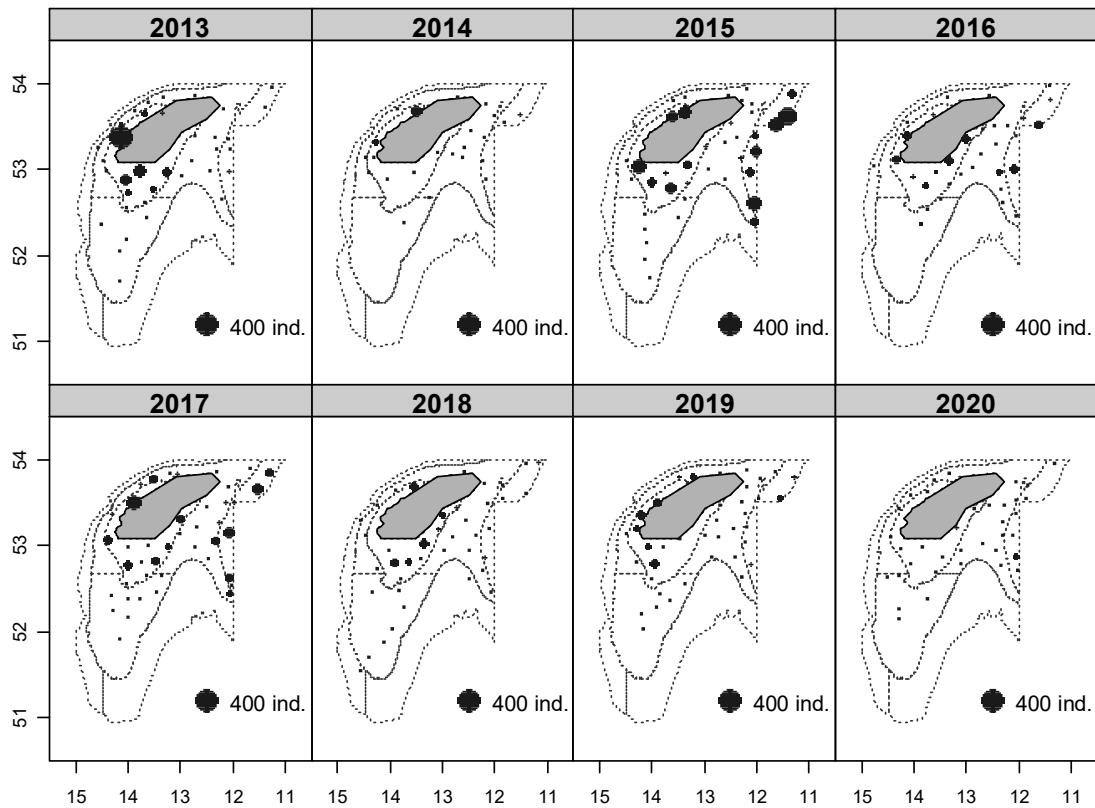


Figure 13. Geographic distribution of *Lepidorhombus whiffiagonis* recruits (age 1) in Porcupine surveys (2013-2020)

***L. boscii* 1-12 cm**

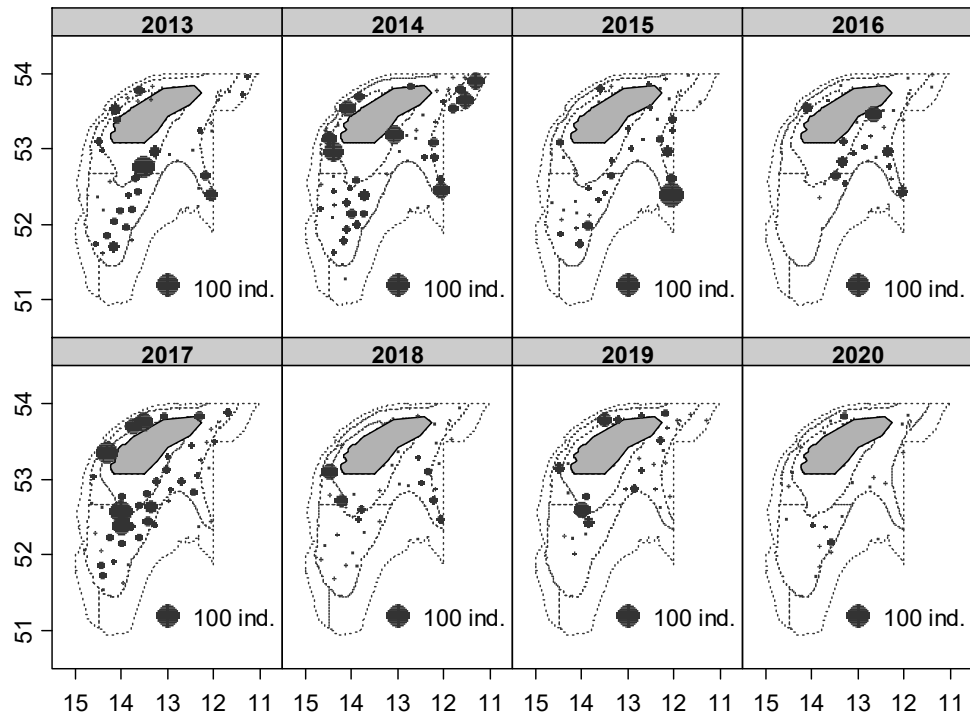


Figure 14. Geographic distribution of *Lepidorhombus boscii* juveniles (≤12 cm) in Porcupine surveys (2013-2020)

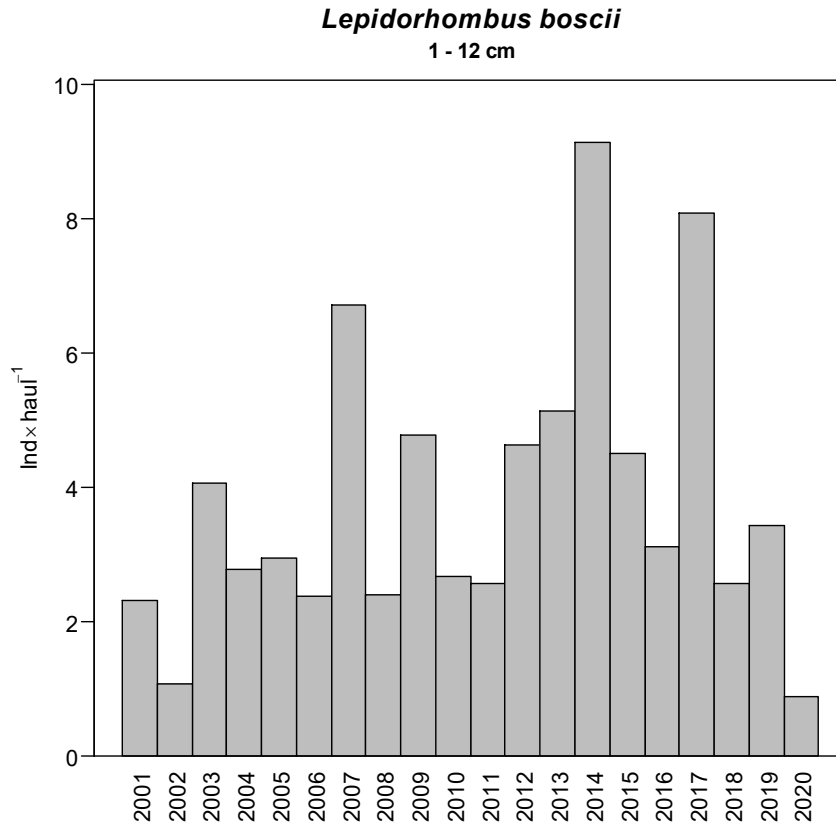


Figure 15. Evolution of the *Lepidorhombus boscii* juveniles (≤12 cm) on Porcupine surveys (2001-2020)

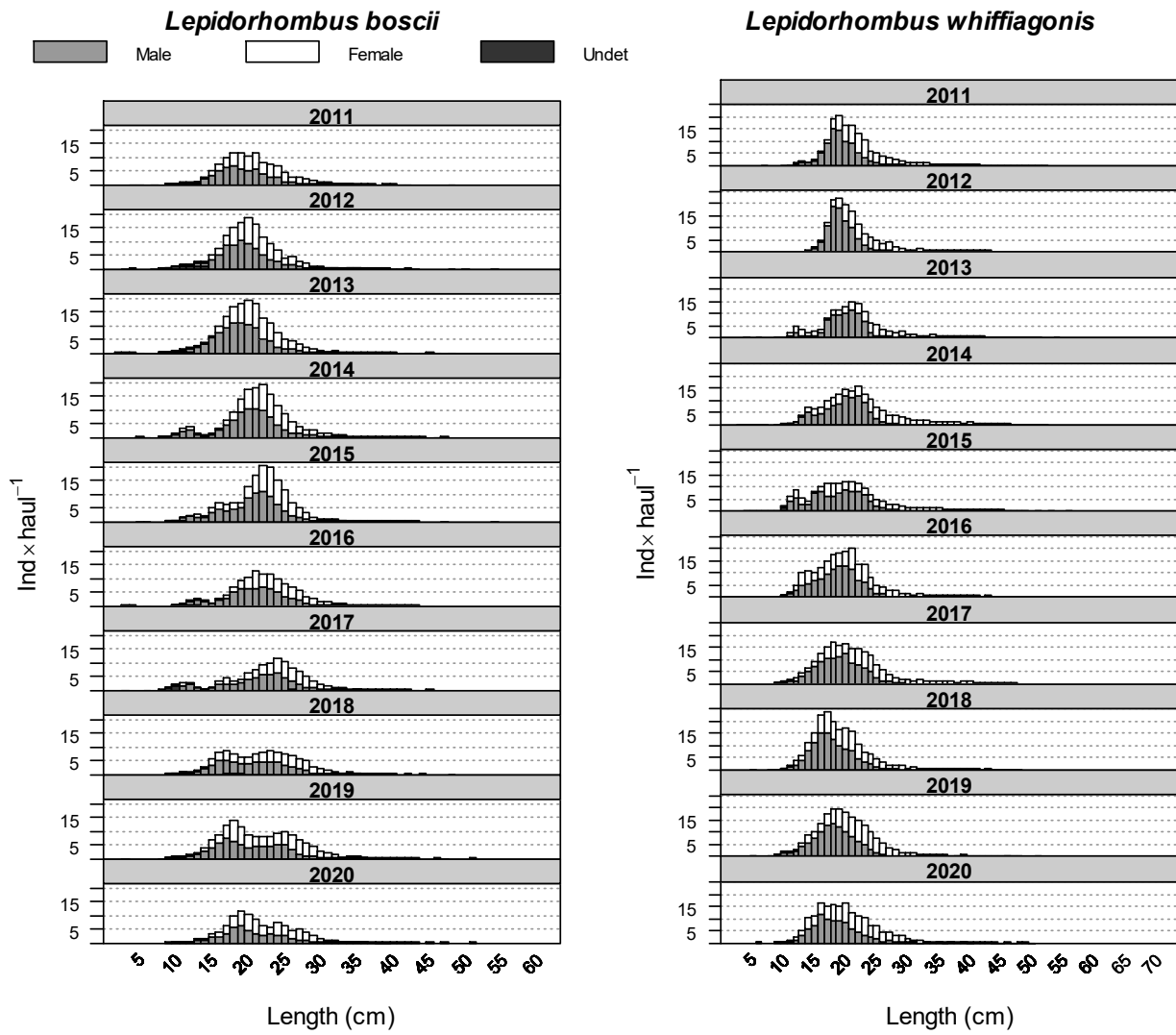


Figure 16. Mean stratified length distributions of *Lepidorhombus boscii* and *Lepidorhombus whiffiagonis* in Porcupine surveys (2011-2020)

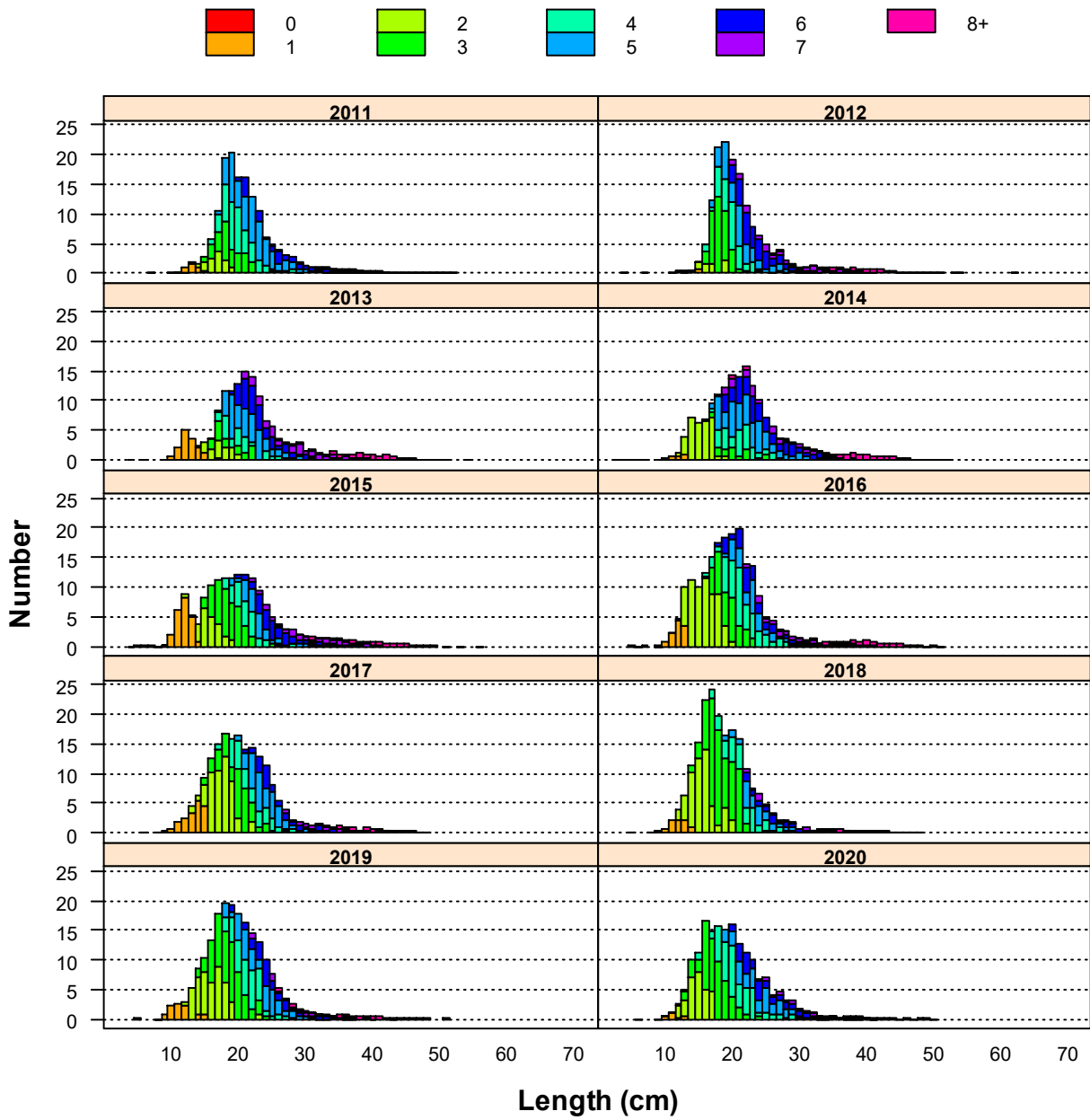


Figure 17. Mean stratified length distributions of *Lepidorhombus whiffiagonis* with the age classes in Porcupine surveys (2011-2020)

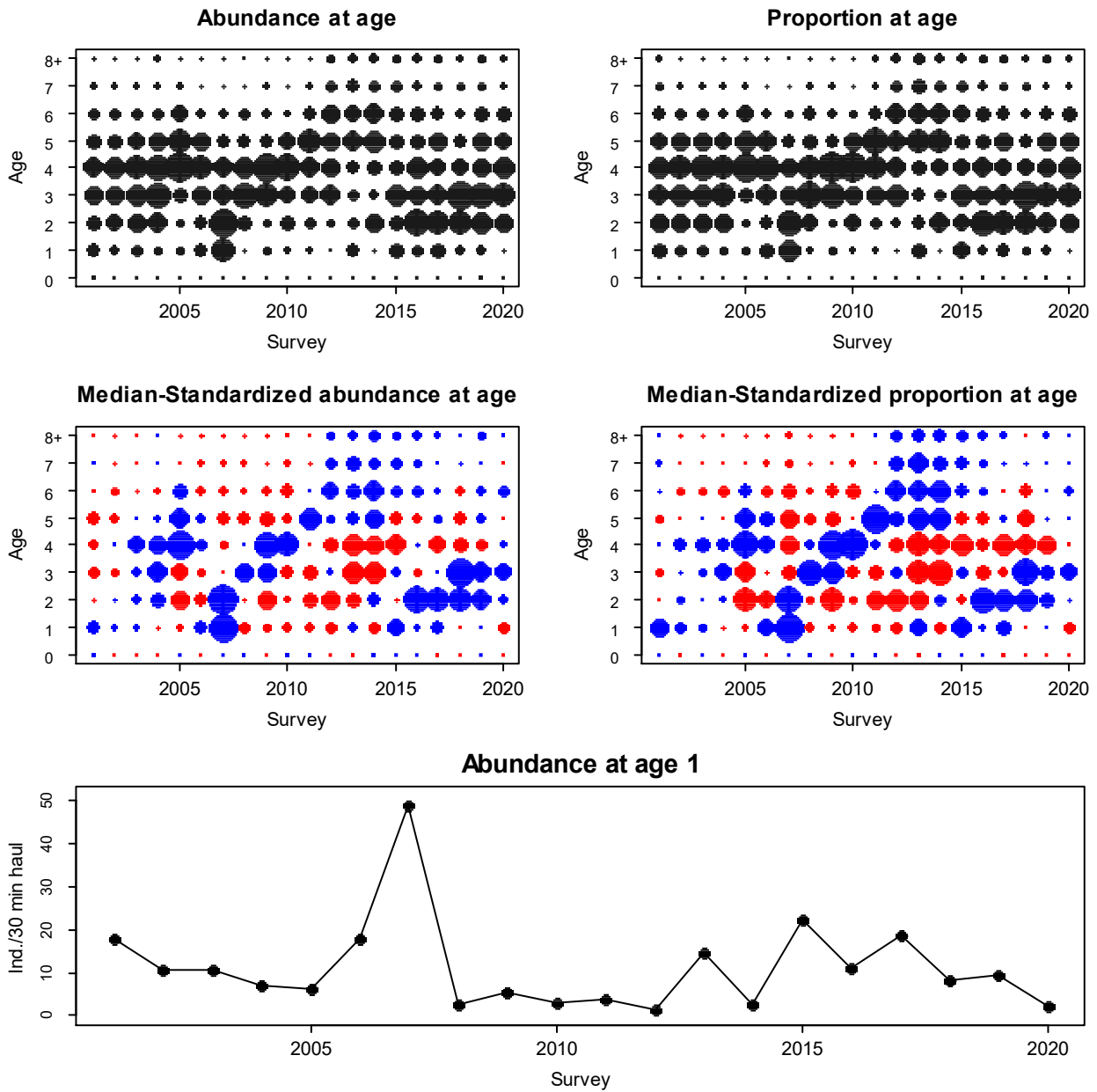


Figure 18. Bubble-plot of *Lepidorhombus whiffiagonis* abundances at age, proportion at age, median standardized abundances at age (year-median years) and median standardized proportion at age in Porcupine surveys time series. Blue bubbles are above the median value, red ones are below it and the cross marks the year with the median value.

Abundance along age by cohort

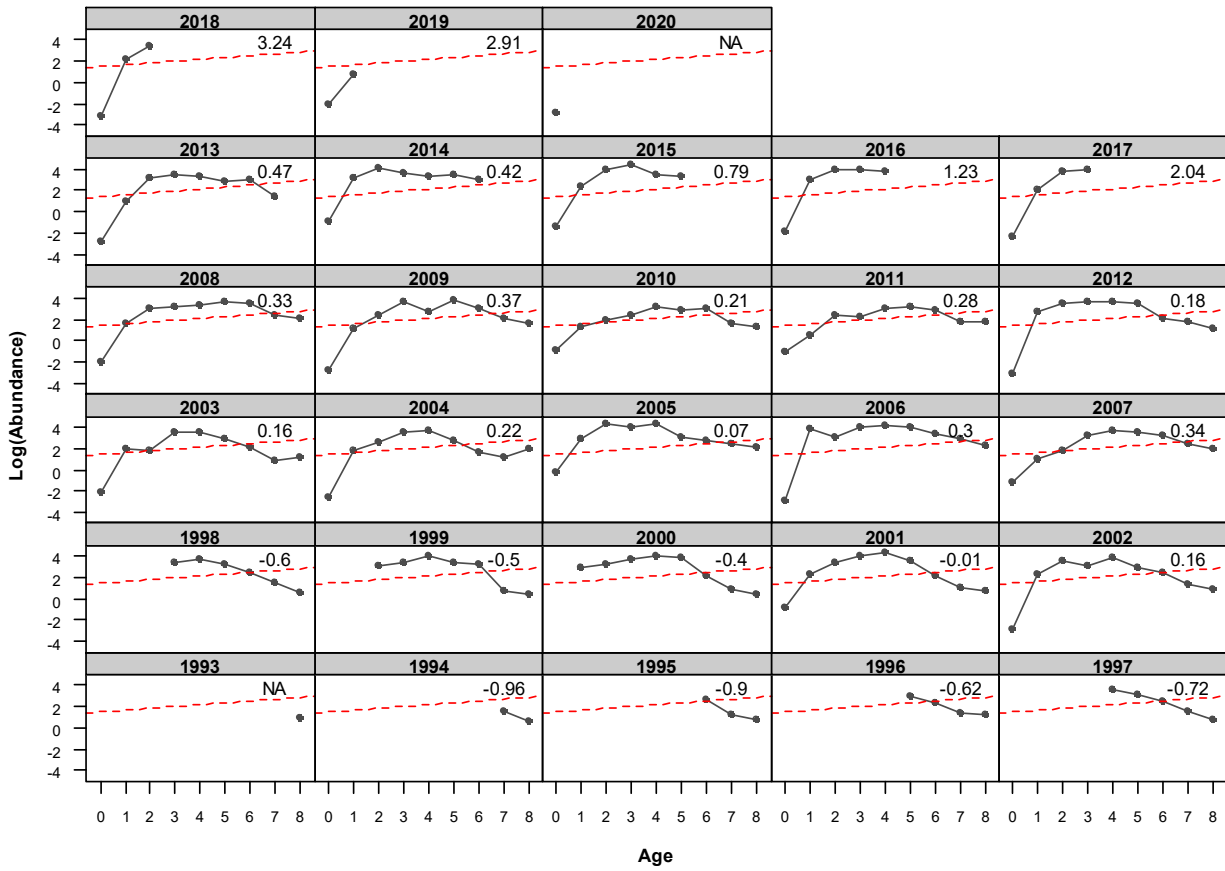


Figure 19. *Lepidorhombus whiffiagonis* abundance (No./30 min haul) evolution in logarithmic scale along each cohort sampled in Porcupine surveys time series. Solid lines mark the linear regression fitted by cohort to the log(abundance)~age, the figure in the lower right corner of each panel corresponds to the slope. Dashed line marks the linear regression fitted to the overall time series.