Results on main elasmobranches species from 2001 to 2018 Porcupine Bank (NE Atlantic) bottom trawl surveys

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Abstract

This working document presents the results of the most significant elasmobranch species caught on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2018 and also updates previous documents presented. Biomass, abundance, distribution and length frequency were analysed for *Galeus melastomus* (blackmouth catshark), *Deania spp.*, *Scymnodon ringens* (knifetooth dogfish), *Scyliorhinus canicula* (lesser spotted dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Dalatias licha* (kitefin shark), *Hexanchus griseus* (bluntnose sixgill shark), *Dipturus nidarosiensis* (Norwegian skate), *Dipturus cf. flossada* (common skate), *Dipturus intermedius* (common skate), *Leucoraja circularis* (sandy ray) and *Leucoraja naevus* (cuckoo ray). The abundance of *G. melastomus*, and *D. cf. flossada* reached the highest value of the time series in 2018. Biomass index of *S. ringens*, *S. canicula*, *L. naevus* and *D. intermedius* increased slightly, while the rest of the species decreased or remained similar to the previous year. Some other scarce elasmobranchs such as *Squalus acanthias*, *Raja clavata* and *Raja montagui* were found.

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 provide data and information for the assessment of the commercial fish 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 most common elasmobranch species on Porcupine bottom trawl surveys, after the results presented previously (Ruiz-Pico *et al.* 2014; Fernández-Zapico *et al.* 2015; Ruiz-Pico *et al.* 2016; Fernández-Zapico *et al.* 2017; Ruiz-Pico *et al.* 2018). The species analysed were: *Galeus melastomus* (blackmouth catshark), *Deania calcea* (birdbeak dogfish), *Deania profundorum* (arrowhead dogfish), *Scymnodon ringens* (knifetooth dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Scyliorhinus canicula* (lesser spotted dogfish), *Dalatias* *licha* (kitefin shark), *Hexanchus griseus* (bluntnose sixgill shark), *Leucoraja circularis* (sandy ray), *Leucoraja naevus* (cuckoo ray), *Dipturus nidarosiensis* (Norwegian skate), *Dipturus cf. flossada* and *Dipturus intermedius* (common skate).

Material and methods

The Spanish Ground Fish Survey on the Porcupine bank (SP-PORC-Q3) has been annually carried out 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 (Figure 1), 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 2). 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).

Biomass, geographical distribution and length compositions were analysed, and the mean stratified biomass of the most abundant species of the last two years was compared with the mean of the previous five years.

The reduction in the tow duration (20 instead of 30 minutes) applied since 2016 worked successfully. Now the catches have been reduced and are easier to handle for the team who sort it, but they are still abundant enough to be representative samples. The biomass indices of the entire time series are not affected by this reduction because the results of these last surveys were extrapolated to 30 minutes of trawling time to keep up the time series.

Results and discussion

In 2018, 80 standard hauls and 3 additional hauls were carried out (Figure 2).

The total mean catch per haul decreased slightly the last year (Figure 3). Fish represented about 93% of the total stratified catch and the elasmobranchs considered constituted the 8% of that total fish catch, with the following percentages per species: *Galeus melastomus* (77%), *Deania calcea* (6.6%), *Scymnodon ringens* (4.7%), *Scyliorhinus canicula* (4.7%), *Etmopterus spinax* (1.4%), *Hexanchus griseus* (0.6%), *Dalatias licha* (0.2%) and *Squalus acanthias* (0.1%). The skate and rays species were: *Leucoraja naevus* (0.6%), *Leucoraja circularis* (0.8%), *Raja montagui* (0.08%), *Raja clavata* (0.01%), *Dipturus nidarosiensis* (1.5%), *Dipturus cf. flossada* (1.4%) and *Dipturus intermedius* (0.09%).

In 2018, the biomass of *G. melastomus*, *S. ringens*, *L. naevus* and *D. cf flossada* increased, *S. canicula* and *E. spinax* remained similar to the previous year and *Deania* spp., *H. griseus*, *L. circularis* and *D. nidarosiensis* decreased. Only a few specimens of *D. licha*, *S. acanthias*, *D. intermedius*, *R. clavata* and *R. montagui* were found. Regarding recruitment, small specimens remained low in general, except for *D. cf flossada*, with the most remarkable peak in abundance of small/juveniles specimens in the time series and for *E. spinax* with a slight rise of juveniles.

***Galeus melastomus* (blackmouth catshark)**

The biomass and abundance of *G. melastomus* increased this last year, reaching the highest value of the time series (Figure 4). Although in 2017 there was a decrease, values have been high since 2012, when a remarkable rise was found (Figure 5).

The species was distributed in the southern deepest area, similarly to the previous year but with larger spots of biomass (Figure 6).

Blackmouth catshark length distribution ranged from 10 cm to 78 cm. The usual three modes were not clearly shown in this last survey. The remarkable increase in biomass is reflected in more specimens by size in general, specifically specimens around 28 cm, from 34 to 45 cm, around 51 cm and around 64 cm (Figure 7). However, small specimens (<20 cm) remained low.

***Deania calcea* (birdbeak dogfish) and *Deania profundorum* (arrowhead dogfish)**

Although *D. profundorum* was rather scarcer than *D. calcea* in the area, it has been found every survey since *D. profundorum* was first identified in 2012.

The biomass and abundance of *Deania spp.* (mainly *D. calcea*) have followed a downward trend since 2016, further decreasing this last survey (Figure 8 and Figure 9). The biomass and abundance of *D. profundorum* were negligible (Figure 10).

The specimens of *D. calcea* were distributed in the southern and western deepest strata of the study area this last survey (Figure 11) and ranged from 67 cm to 112 cm, most of them from 83 to 92 cm (Figure 12). Only two specimens of *D. profundorum* of 34 and 67 cm were found in one haul in the west and another in the south. The usual spot of biomass for both species in the north was not found.

***Scymnodon ringens* (knifetooth dogfish)**

The biomass and abundance of *S. ringens* have followed an up and down trend since 2012. In the last survey, the values increased after the decrease of the previous year (Figure 13). Even so, the mean biomass of the last two years remained lower than the previous five years (Figure 14).

As usual *S. ringens* was mainly found in the deepest strata in the southeast of the study area, although two spots of biomass were also shown in the west (Figure 15).

The length distribution of *S. ringens* remained similar to the previous years, with specimens from 34 cm to 77 cm and seven large specimens from 93 cm to 112 cm. Specimens around 75 cm, the usual mode throughout the time series, remained low in this last survey (Figure 16).

***Scyliorhinus canicula* (lesser spotted dogfish)**

The biomass and abundance of *S. canicula* increased this last survey, reaching the third highest value of the time series (Figure 17). The rise in abundance was slightly higher than in biomass due to the increase of juveniles this last survey. The mean biomass of the last two years was very similar to the previous five years (Figure 18).

The geographical distribution of *S. canicula* remained similar to the previous year, around the bank and on the Irish shelf (Figure 19).

Signs of recruits (around 20 cm) were found in 2016 but were not in 2017 or in 2018. However, this last survey, juveniles from 30 to 50 cm were more abundant than previous year. The usual mode of adults around 62 cm was also found (Figure 20).

***Etmopterus spinax* (velvet belly)**

The biomass and abundance of *E. spinax* remained low in the last survey since the peak in 2016 (Figure 21). The mean biomass of the last two years was lower than the previous five years (Figure 22). A small rise in abundance was shown due to the slight increase of juveniles.

The specimens of *E. spinax* were mainly found southeast of the bank, as usual. There were also a few spots of biomass in the deepest west strata of the study area and one in the north of the bank (Figure 23).

The length distribution of *E. spinax* showed more abundance of specimens around 23 cm than previous years and fewer large specimens (> 41 cm) and recruits (around 14 cm) (Figure 24).

***Hexanchus griseus* (bluntnose sixgill shark)**

The biomass and abundance of this scarce shark have further decreased in 2018 (Figure 25). The mean biomass of the last two years was far below the value of the five previous years (Figure 26).

The geographical distribution remained without an unclear pattern, some specimens north of the bank, some southeast of the bank and some in the deepest south of the study area (Figure 27).

A total of eight specimens were found. Seven were from 63 to 98 cm and one larger of 130 cm (Figure 28).

***Dalatias licha* (kitefin shark)**

The biomass and abundance of *D. licha*, scarcer than *H. griseus*, decreased this last survey. The abundance followed the decreasing trend from 2016, whereas biomass decreased sharply after the 2017 increase (Figure 29). Only 5 specimens were found, the largest (97 cm) in the deepest west of the study area and the other from 44 to 54 cm in the deepest south and east of the study area (Figure 30 and Figure 31).

***Squalus acanthias* (picked dogfish)**

This last year, the biomass and abundance of this scarce elasmobranch *S. acanthias* decreased sharply after the peak of the previous year (Figure 32). Only two specimens of 37 cm and 89 cm were found in one haul in the shallow strata in the south of the bank (Figure 33).

***Leucoraja circularis* (sandy ray) and *Leucoraja naevus* (cuckoo ray)**

L. naevus has been slightly scarcer than *L. circularis* in the area, although in the last survey, the abundance of the former is higher and the biomass of both species was quite similar, around 0.5 kg haul^{-1}. The biomass and abundance of *L. naevus* slightly increased while *L. circularis* decreased following the downward trend from 2016 (Figure 34).

In 2018, as usual, the specimens of *L. naevus* were found in the shallower strata around the bank, whereas *L. circularis* was in the western area, deeper than *L. naevus* (Figure 35, Figure 36 and Figure 37).

This last survey, specimens of *L. naevus* mainly ranged from 39 to 60 cm as usual, although two small specimens of 23 and 28 cm were found. In contrast, only fourteen large specimens of *L. circularis* were found while small/juveniles were not. They ranged from 65 to 97 cm (Figure 38 and Figure 39).

***Dipturus* spp. (common skate)**

Dipturus nidarosiensis, *Dipturus cf. flossada* and *Dipturus cf. intermedia* were comparatively analysed since 2011 as in previous reports, when *D. batis* was split into *D. cf. flossada* and *D. cf. intermedia.* The three rays together as *Dipturus* spp. were also analysed.

The biomass of *Dipturus* spp. remained similar whereas abundance increased sharply (Figure 40). The mean biomass of the last two years was lower than the previous five years (Figure 41). *D. cf. flossada* and *D. intermedius* increased while *D. nidarosiensis* decreased following the downward trend of the three previous years. The most remarkable rise was the abundance of *D. cf. flossada* due to the increase of small/juvenile specimens (Figure 42).

Some spots of biomass of *Dipturus spp.* were distributed around the bank and other in the southeast of the study area (Figure 43). In particular, a total of five specimens of *D. nidarosiensis* were found in the southeastern area, 39 specimens of *D. cf. flossada* around the bank, mainly in the south, and two of *D. intermedius* in the northernmost area of the Irish shelf (Figure 44). The spots of biomass shown in the previous year, in the north of the bank and in the deepest south of the study area, were not found in this last survey. As usual, *D. cf. flossada* and *D. intermedius* were found shallower than *D. nidarosiensis* (Figure 45).

The length distribution of *D. nidarosiensis* showed a specimen of 29 cm, the smallest of the time series, and other four specimens which ranged from 116 to 153 cm (Figure 46). An increase in the abundance of small/juveniles of *D. cf. flossada* was shown, the most remarkable in the time series. Most of them were from 50 to 71 cm and a few smaller from 31 to 40 cm (Figure 47). In contrast, only two specimens of *D. intermedius* of 60 and 74 cm were shown (Figure 48).

***Raja clavata* (thornback ray) and *Raja montagui* (spotted ray)**

One specimen of *R. clavata* and three of *R. montagui* were found in the last survey. The latter had not been found since 2002, while *R. clavata* has been frequent, although scarce, in the time series (Figure 49). The specimen of *R. clavata* (44 cm) was found in the northernmost area of the Irish shelf and the three specimens of *R. montagui* (48, 55 and 60 cm) were on the Irish shelf as well, but also in the south of the bank (Figure 50).

Acknowledgements

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Figures

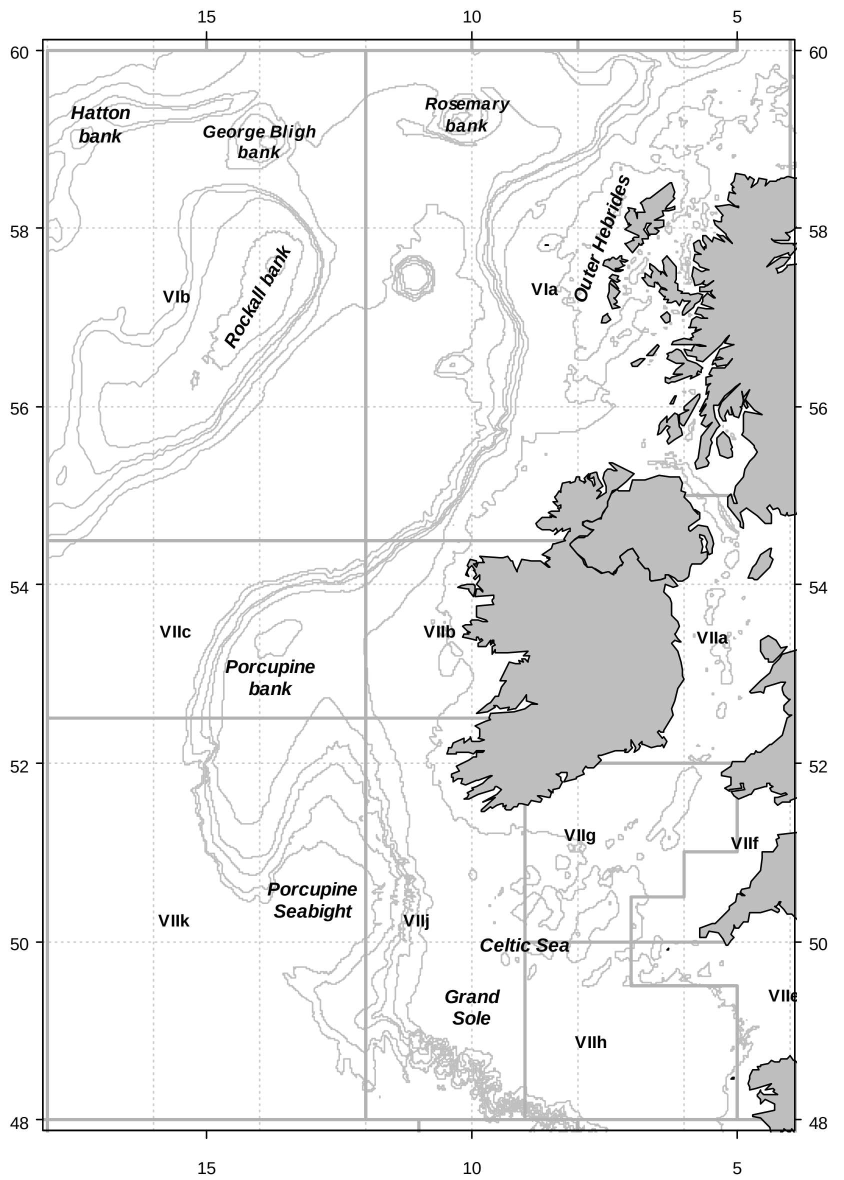


Figure 1 North eastern Atlantic showing the Porcupine bank, Porcupine Seabight, and ICES divisions

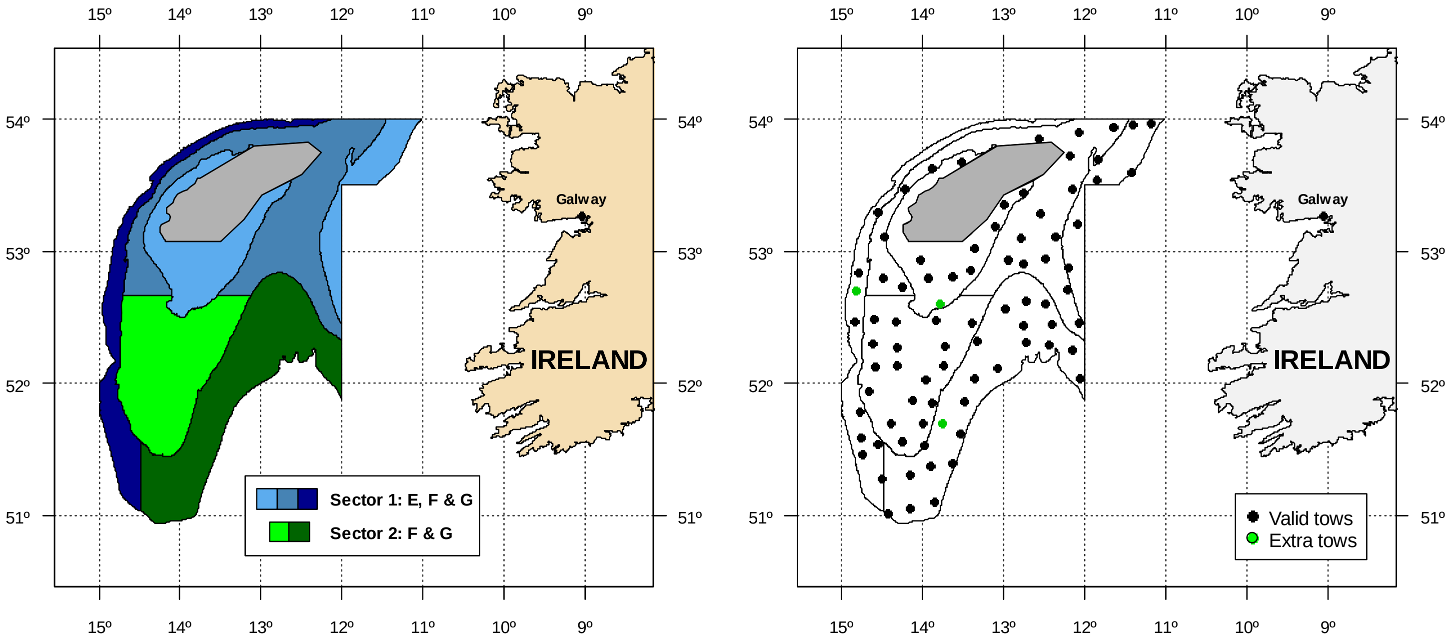


Figure 2 Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed in 2018

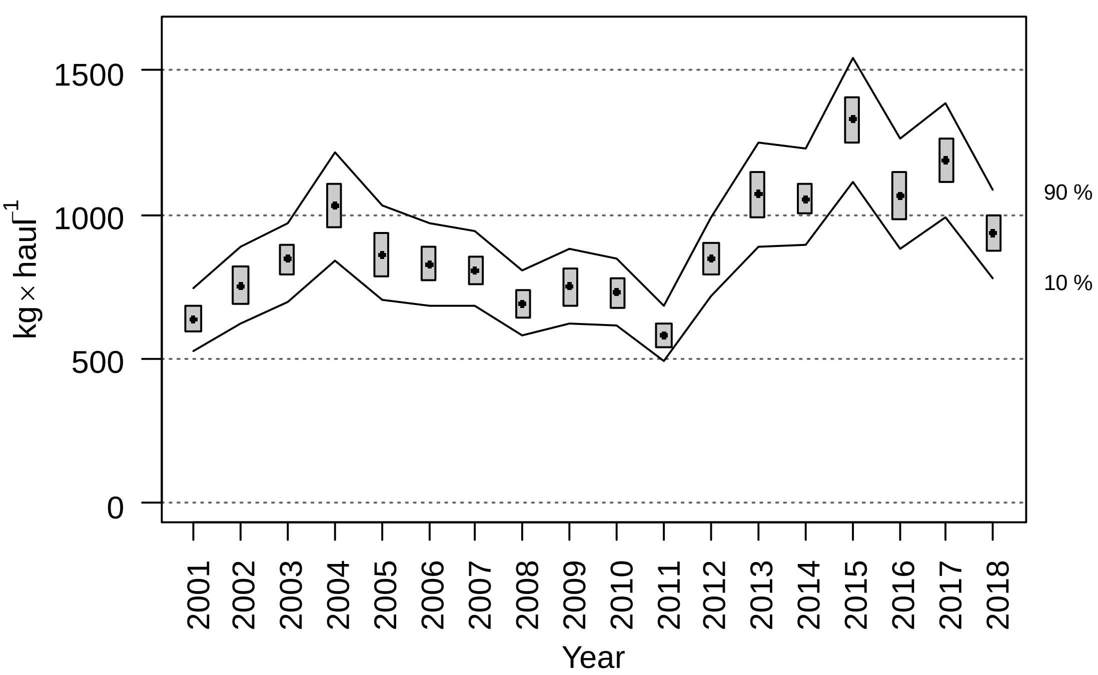


Figure 3 Evolution of the total stratified catch in Porcupine surveys (2001-2018)

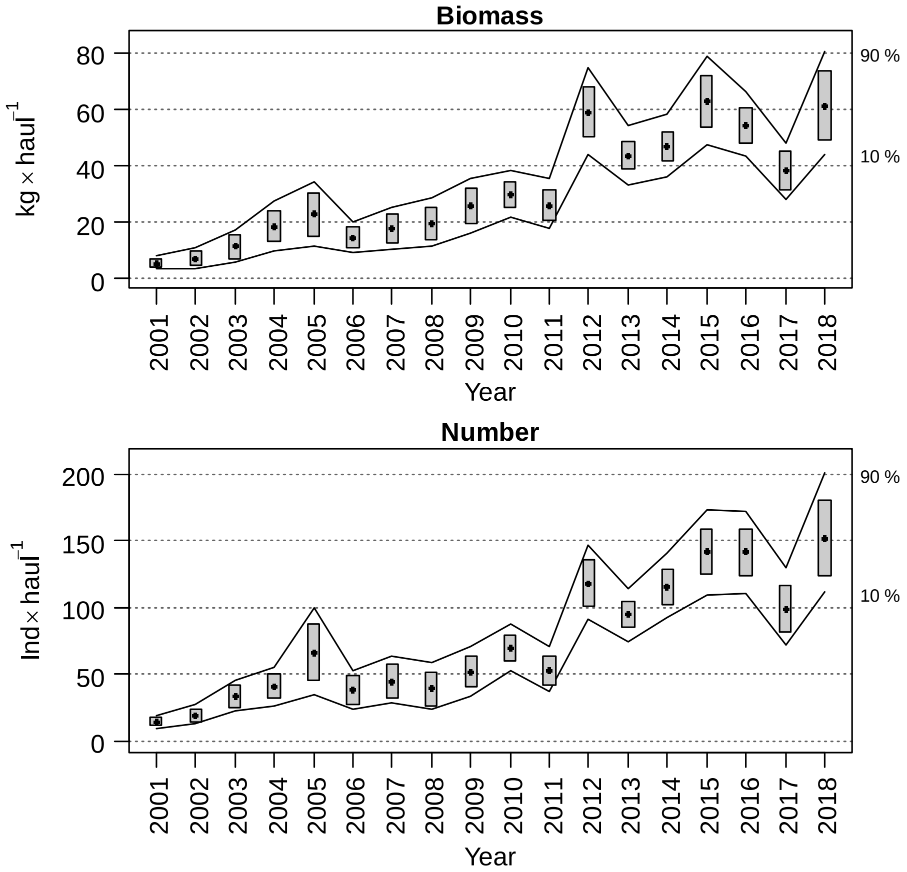


Figure 4 Evolution of *Galeus melastomus* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

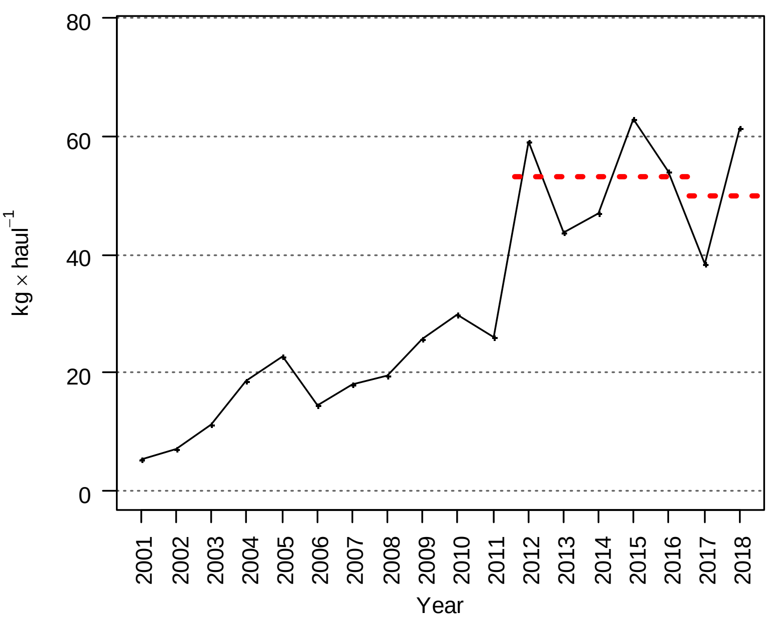


Figure 5 Evolution of *Galeus melastomus* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

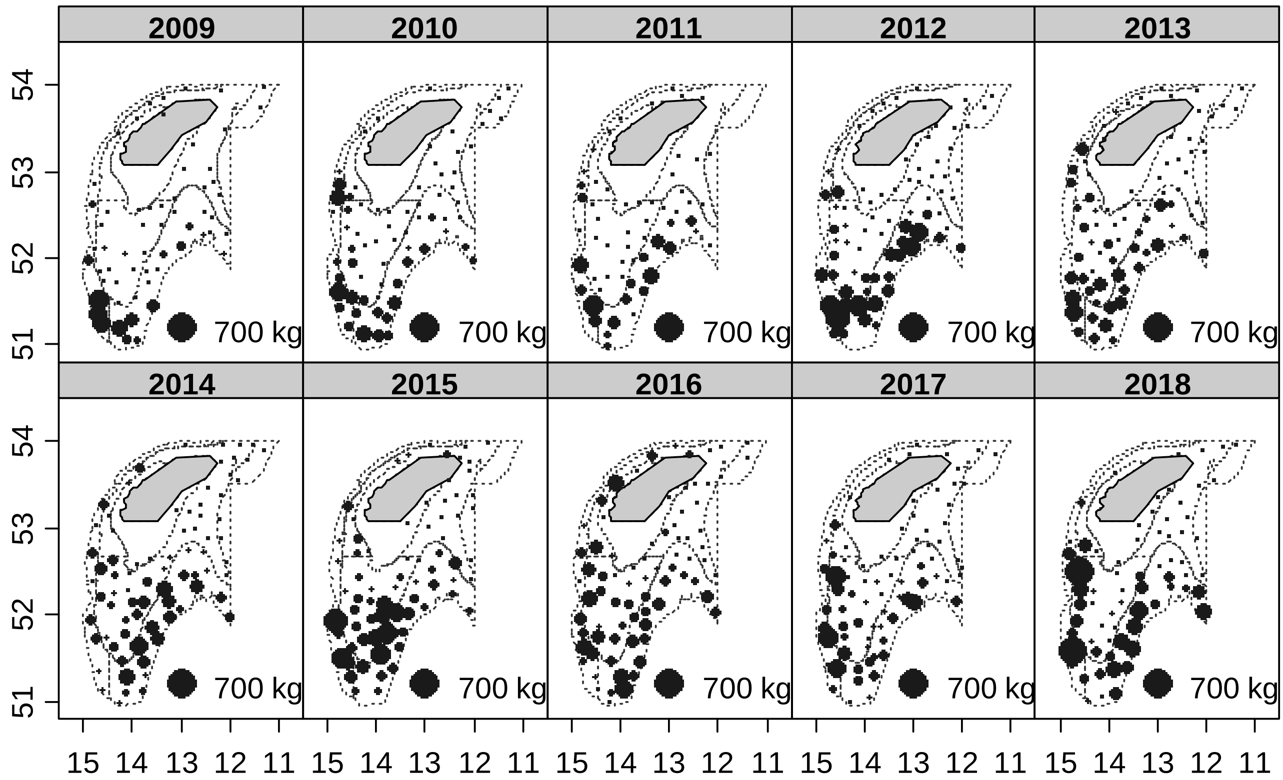


Figure 6 Geographic distribution of *Galeus melastomus* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

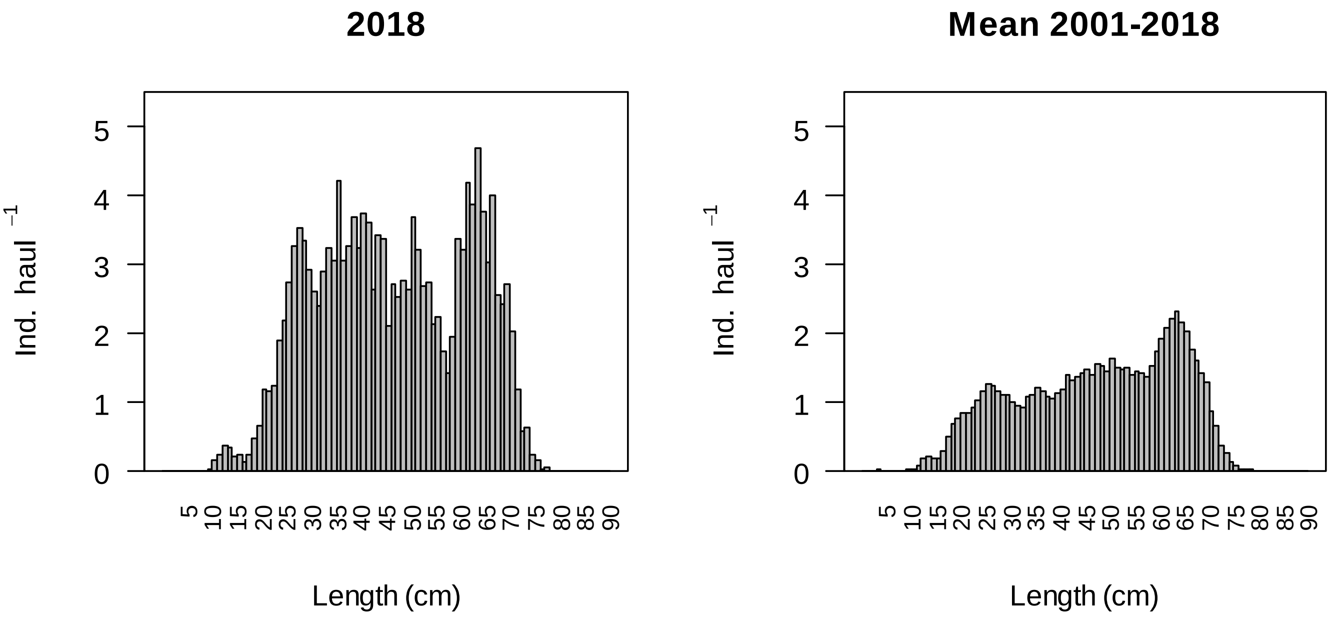


Figure 7 Stratified length distributions of *Galeus melastomus* in 2018 Porcupine survey, and mean values in Porcupine surveys (2001-2018)

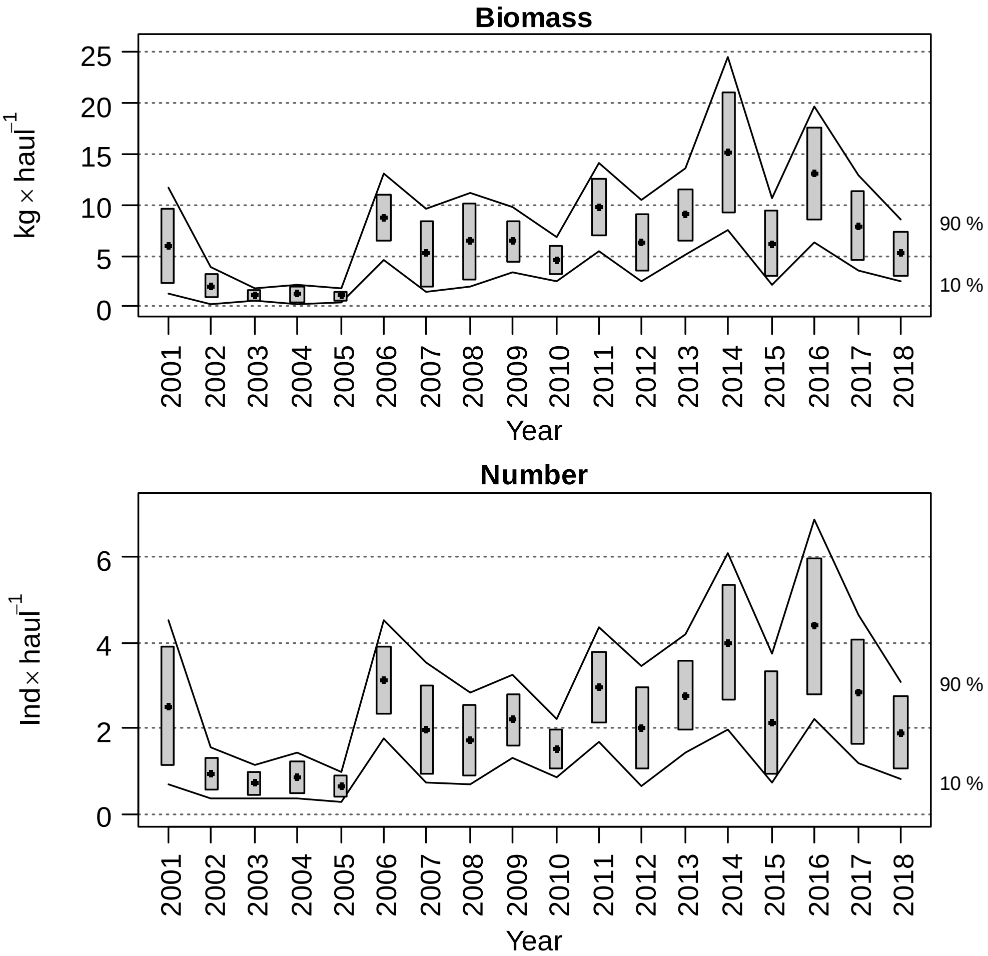


Figure 8 Evolution of *Deania* spp. (mainly *D. calcea)* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

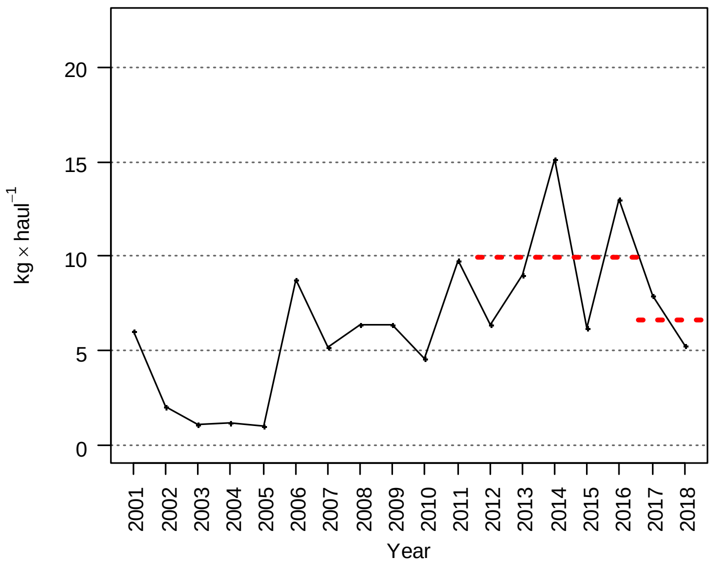


Figure 9 Evolution in *Deania* spp. (mainly *D. calcea)* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

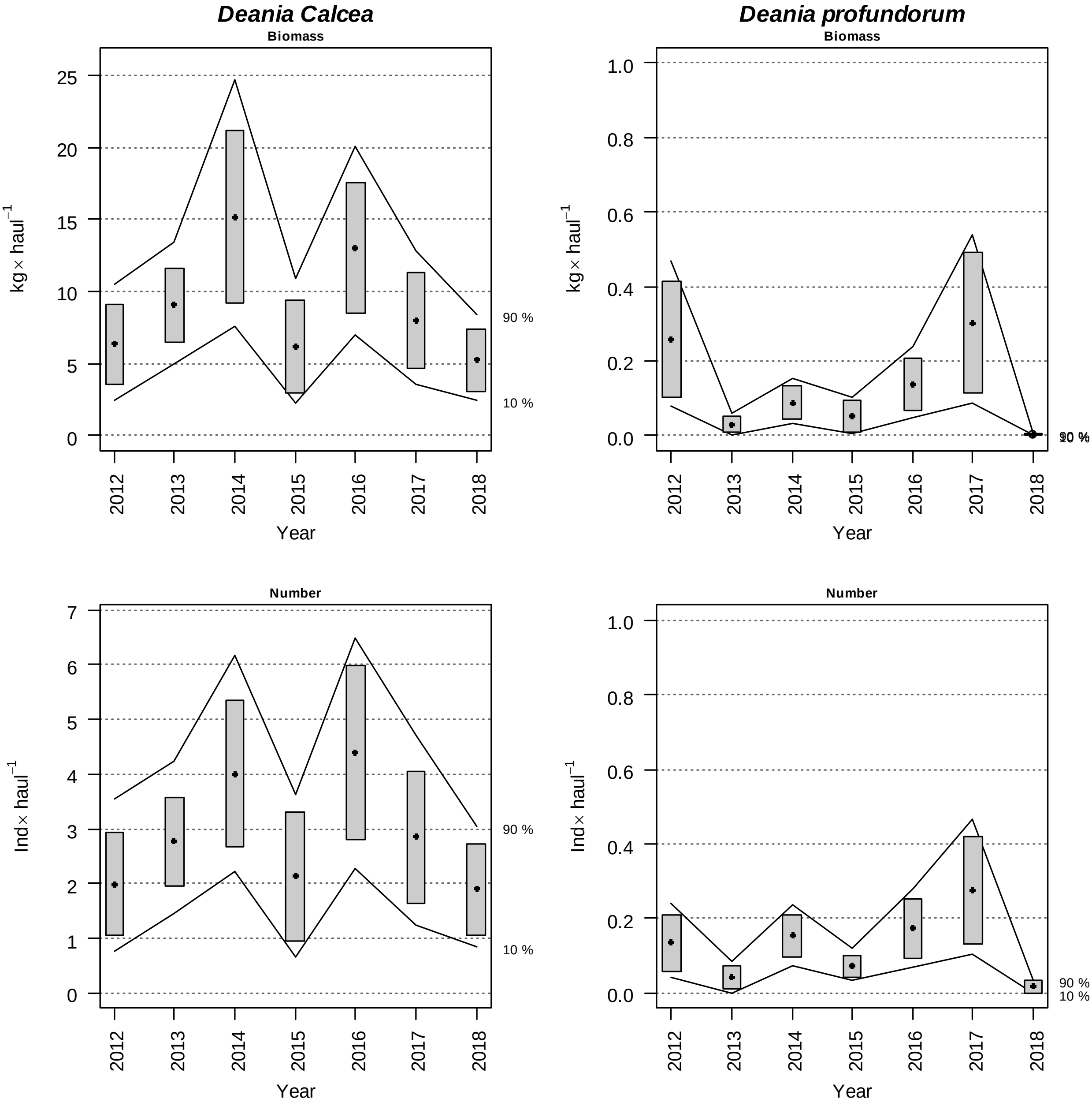


Figure 10 Evolution of *Deania calcea* and *Deania profundorum* biomass and abundance indices from 2012 and 2018 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

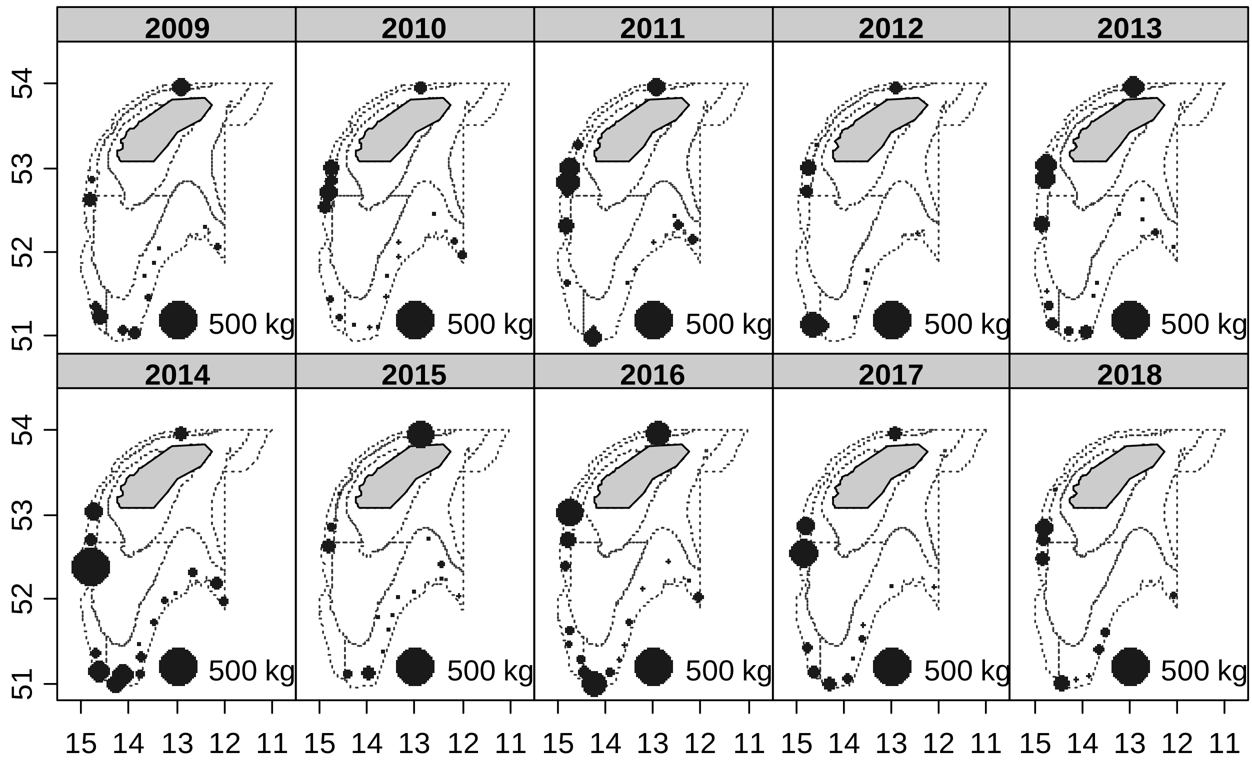


Figure 11 Geographic distribution of *Deania* spp. (mainly *D. calcea*) catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

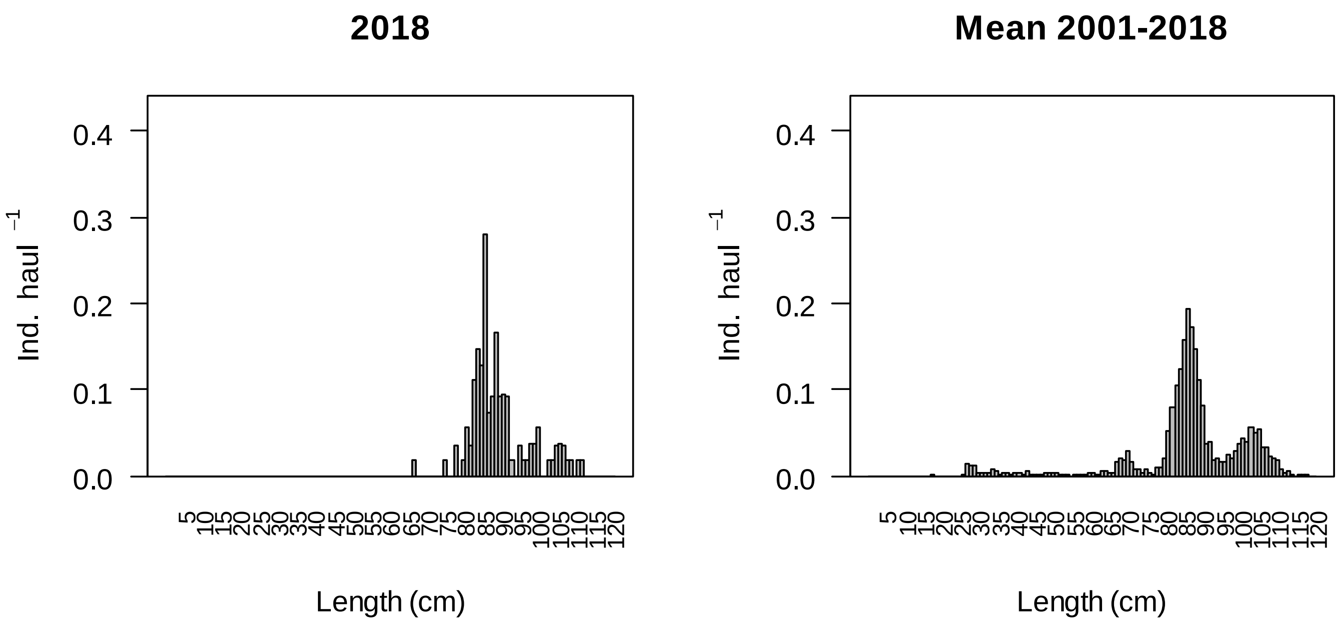


Figure 12 Stratified length distribution of *Deania calcea* in 2018 compared with mean values in Porcupine surveys (2001-2018)

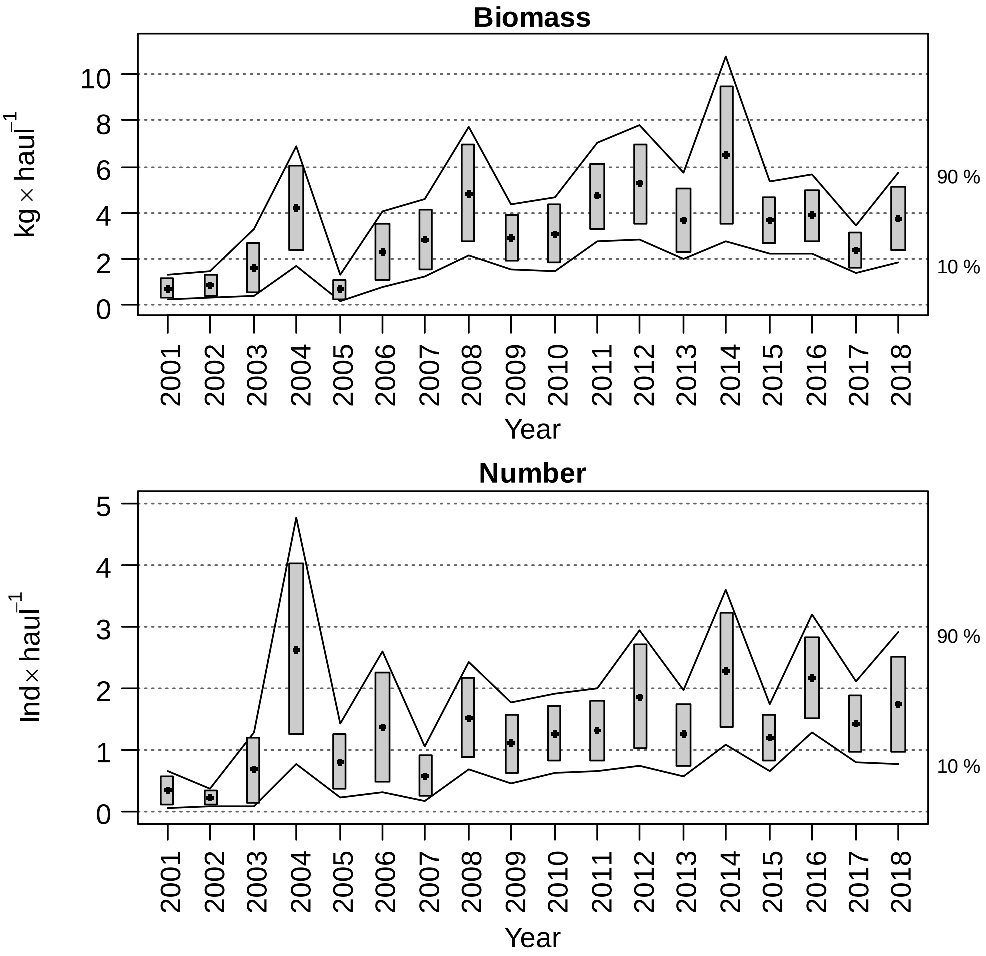


Figure 13 Evolution of *Scymnodom ringens* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

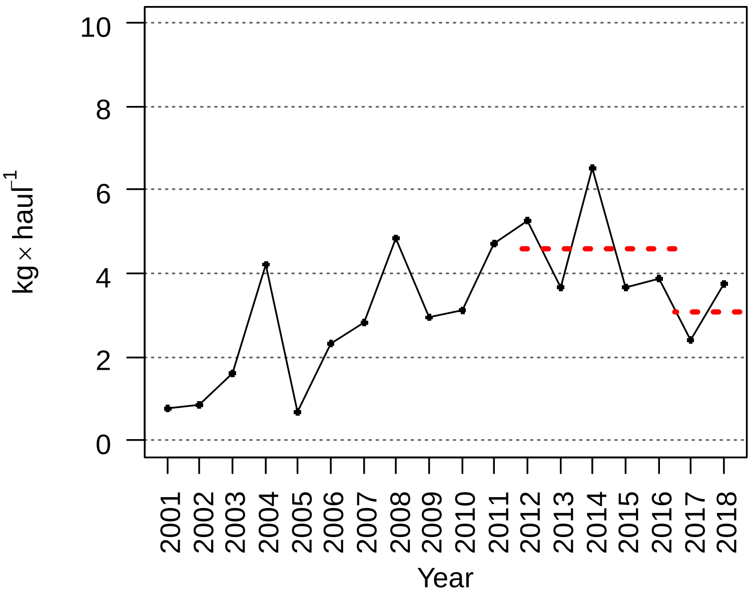


Figure 14 Evolution in *Scymnodom ringens* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

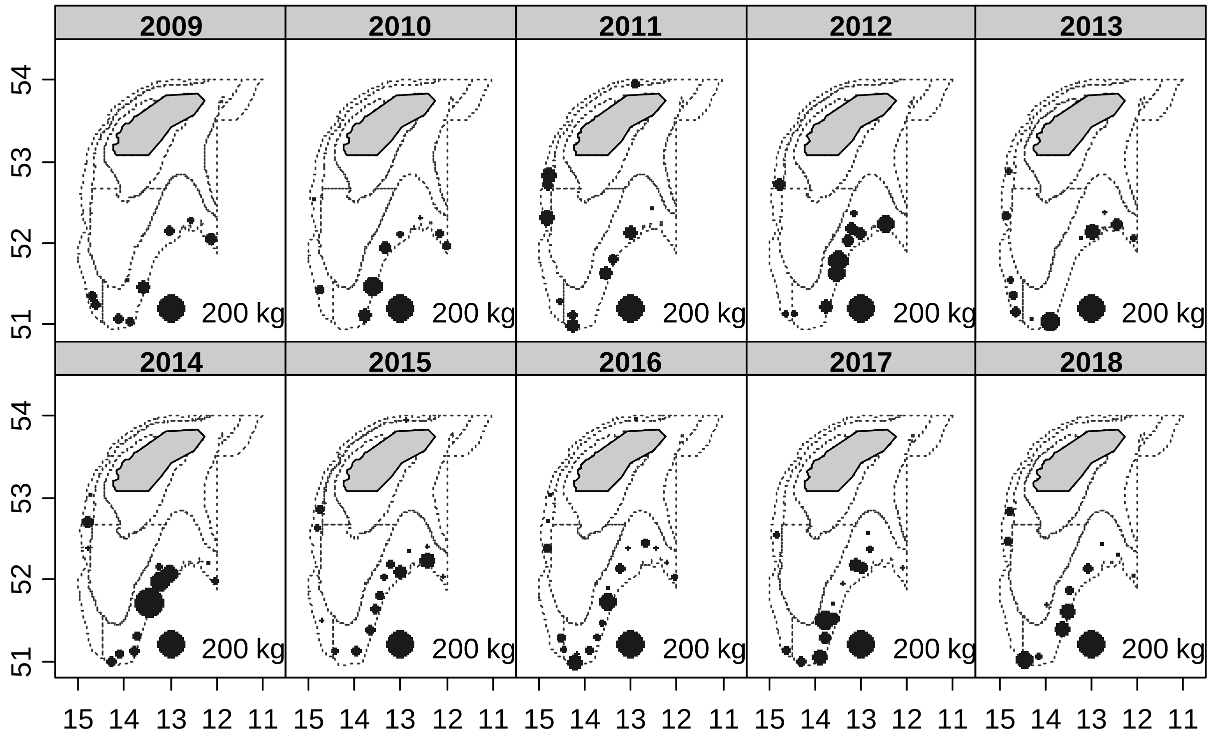


Figure 15 Geographic distribution of *Scymnodon ringens* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

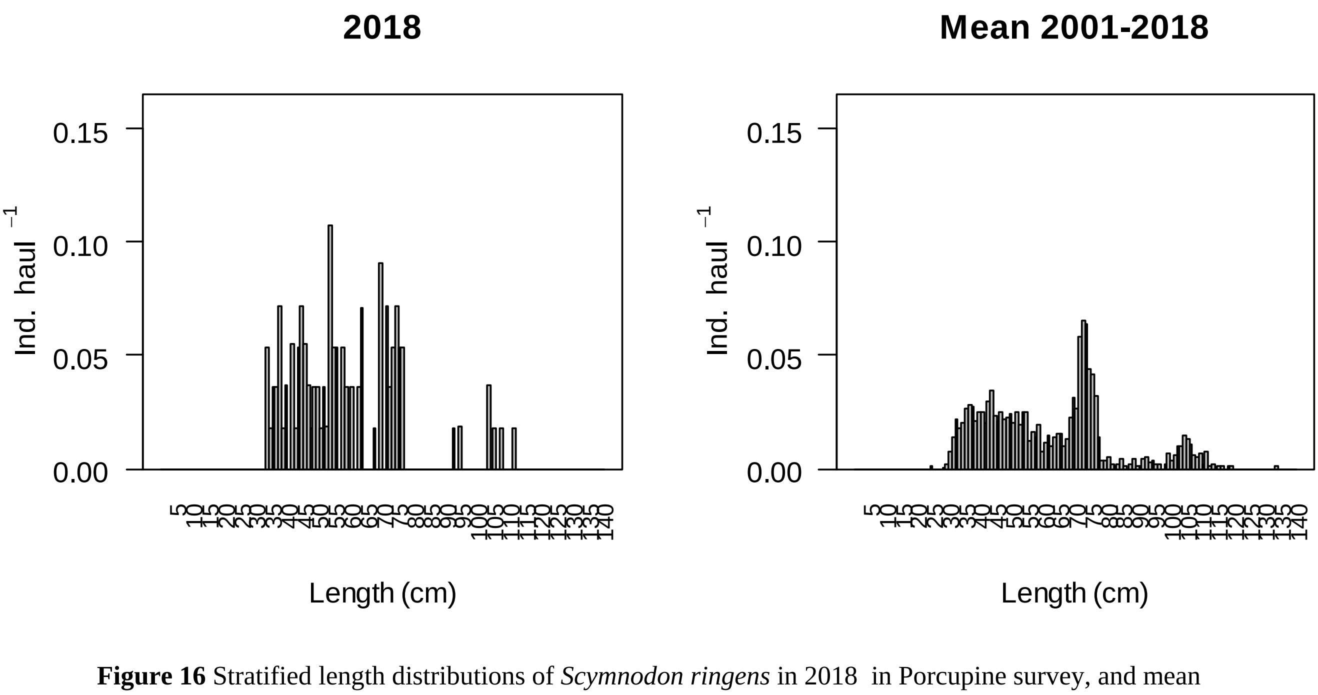


Figure 16 Stratified length distributions of *Scymnodon ringens* in 2018 in Porcupine survey, and mean values in Porcupine surveys (2001-2018)

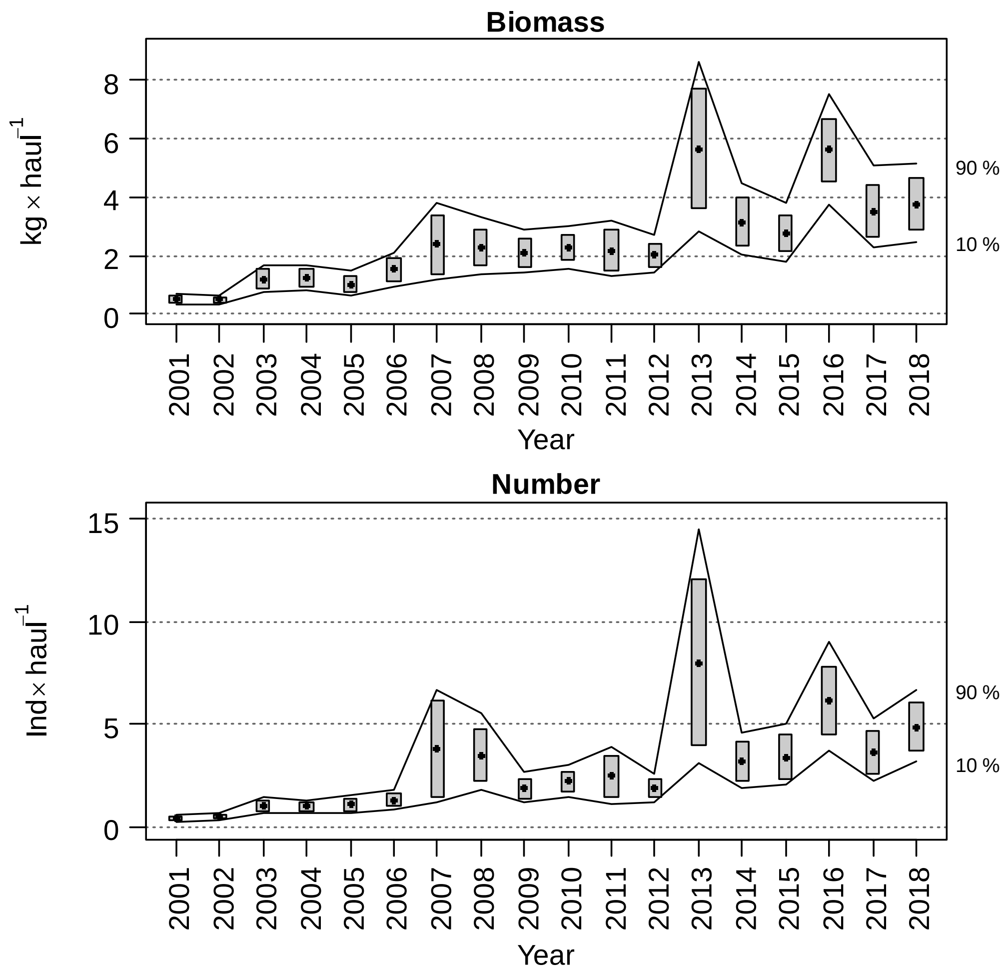


Figure 17 Evolution of *Scyliorhinus canicula* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

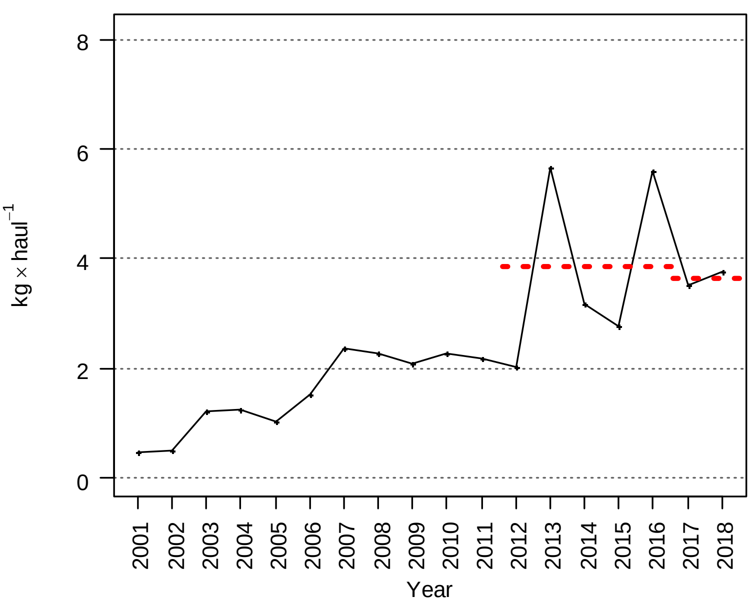


Figure 18 Evolution in *Scyliorhinus canicula* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

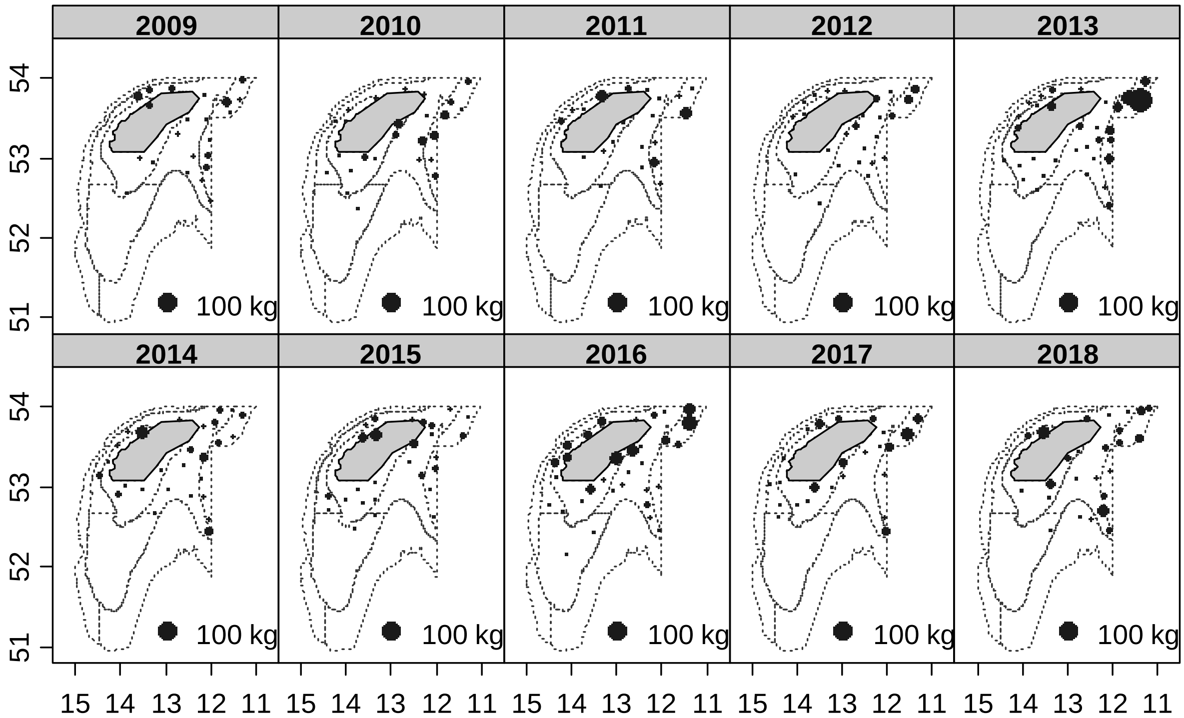


Figure 19 Geographic distribution of *Scyliorhinus canicula* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

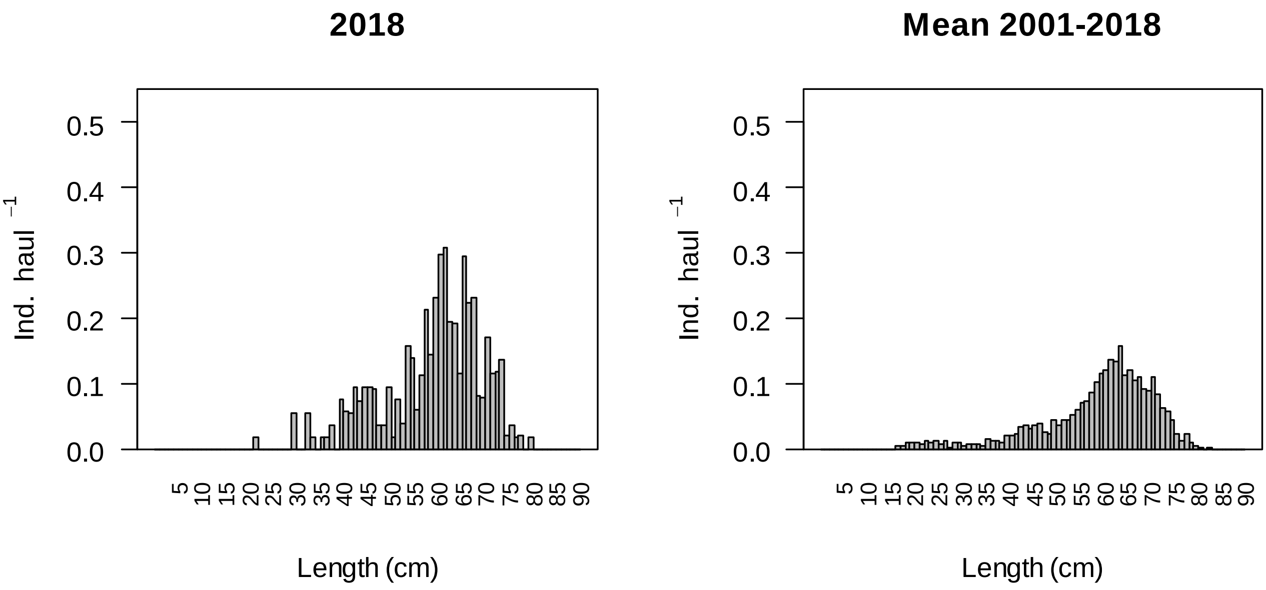


Figure 20 Stratified length distribution of *Scyliorhinus canicula* in 2018 in Porcupine survey, and mean values in Porcupine surveys (2001-2018)

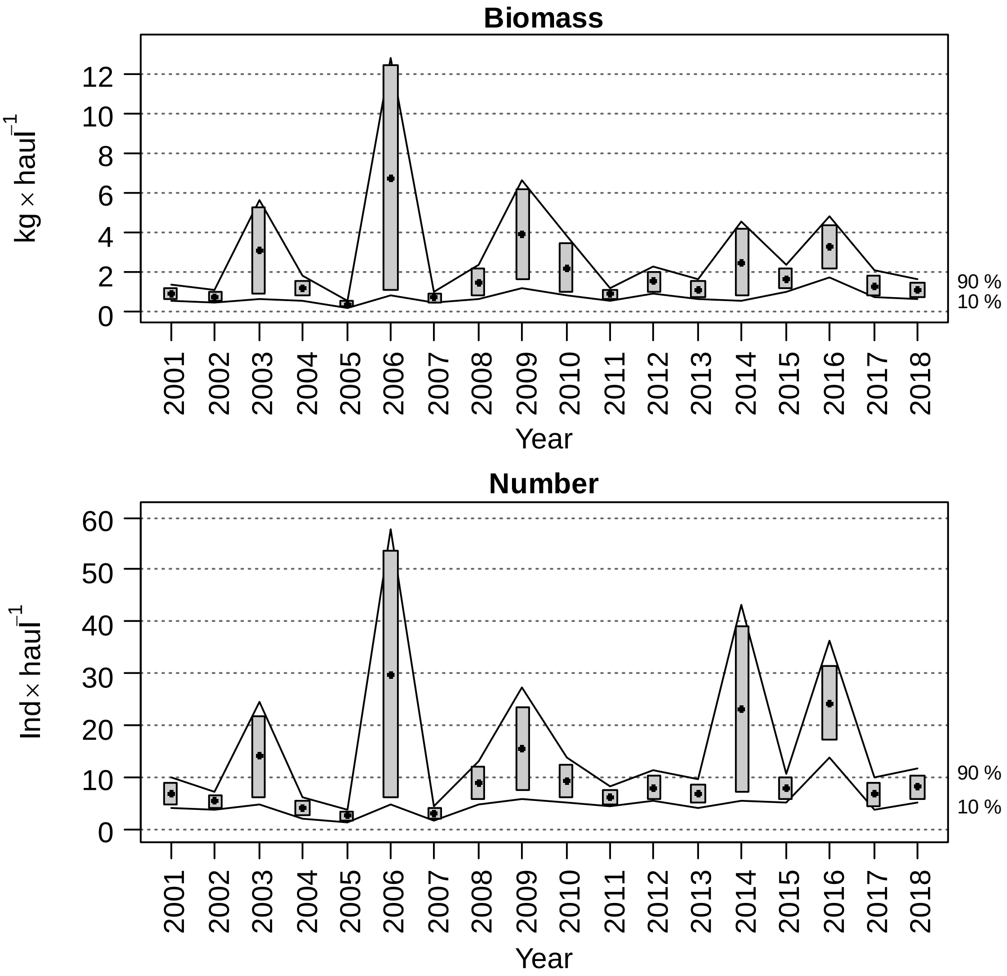


Figure 21 Evolution of *Etmopterus spinax* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

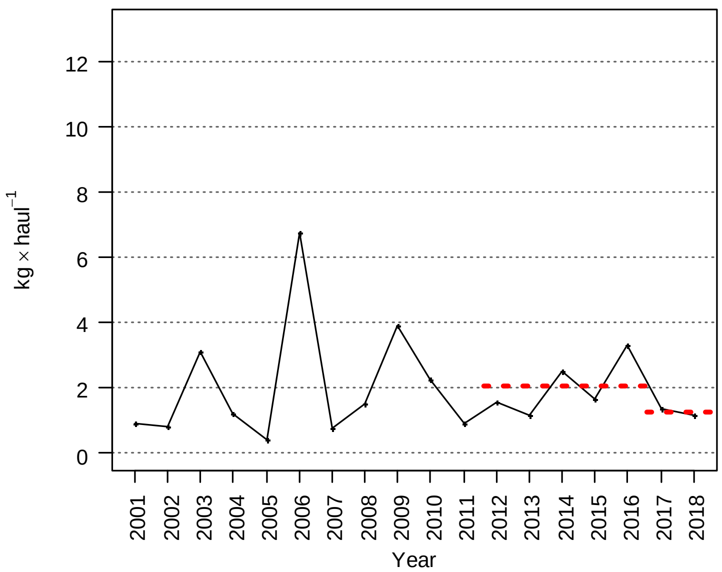


Figure 22 Evolution in *Etmopterus spinax* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

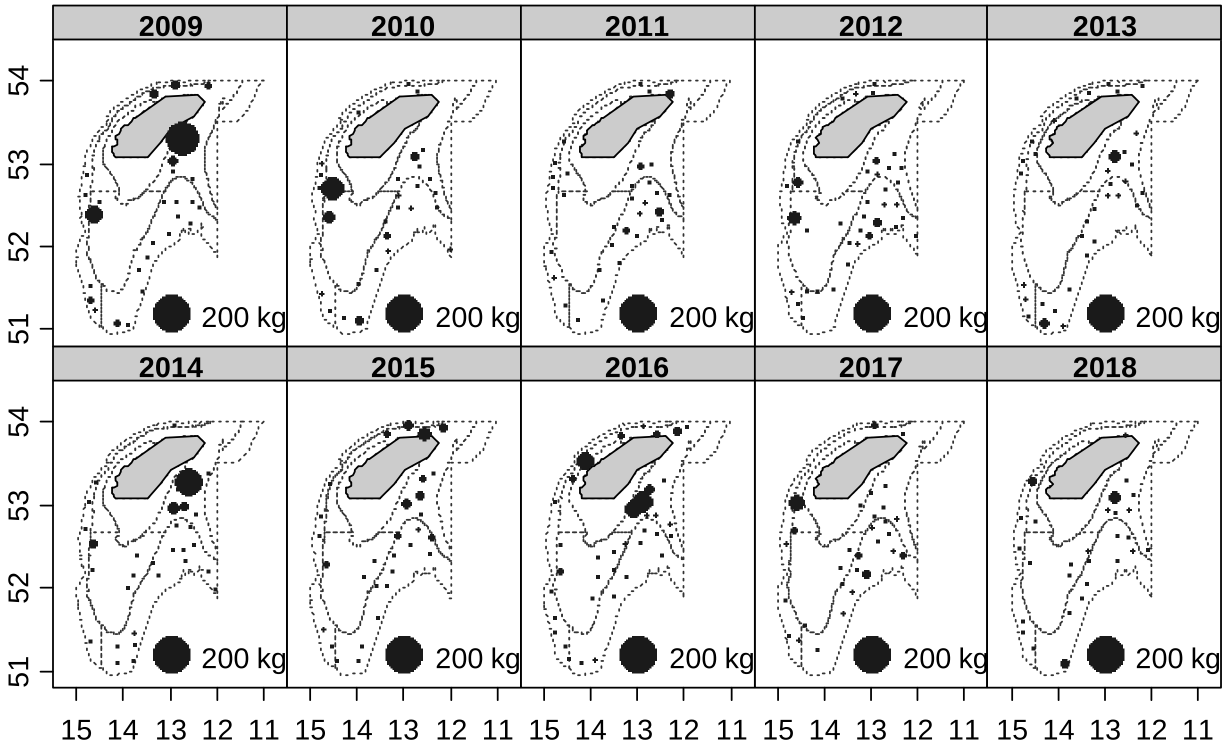


Figure 23 Geographic distribution of *Etmopterus spinax* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

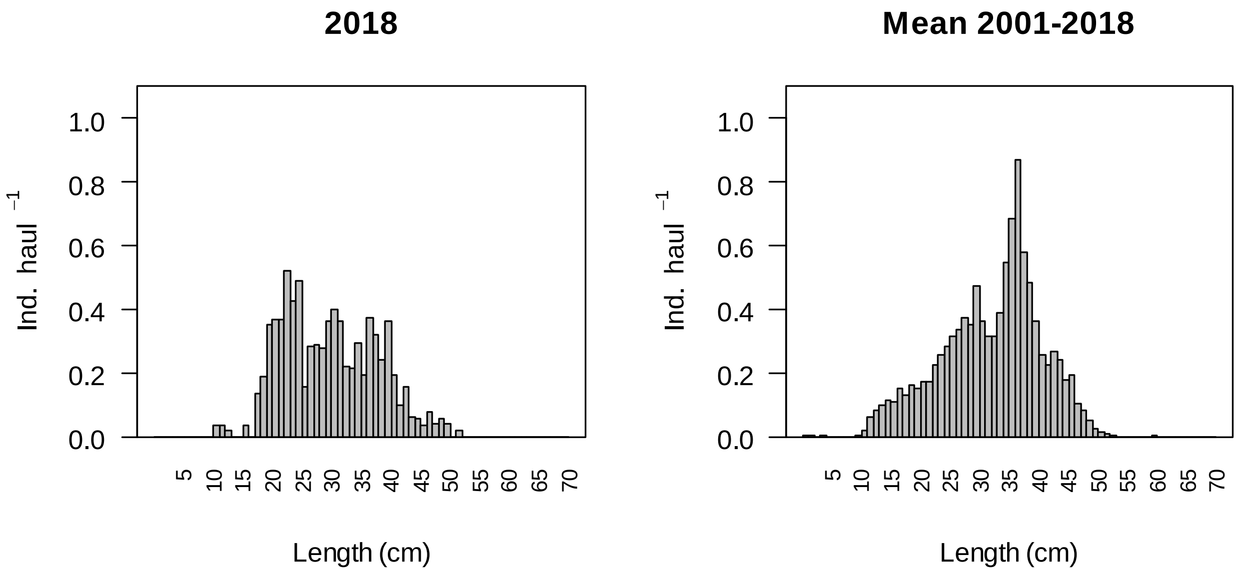


Figure 24 Stratified length distribution of *Etmopterus spinax* in 2018 in Porcupine survey, and mean values in Porcupine surveys (2001-2018)

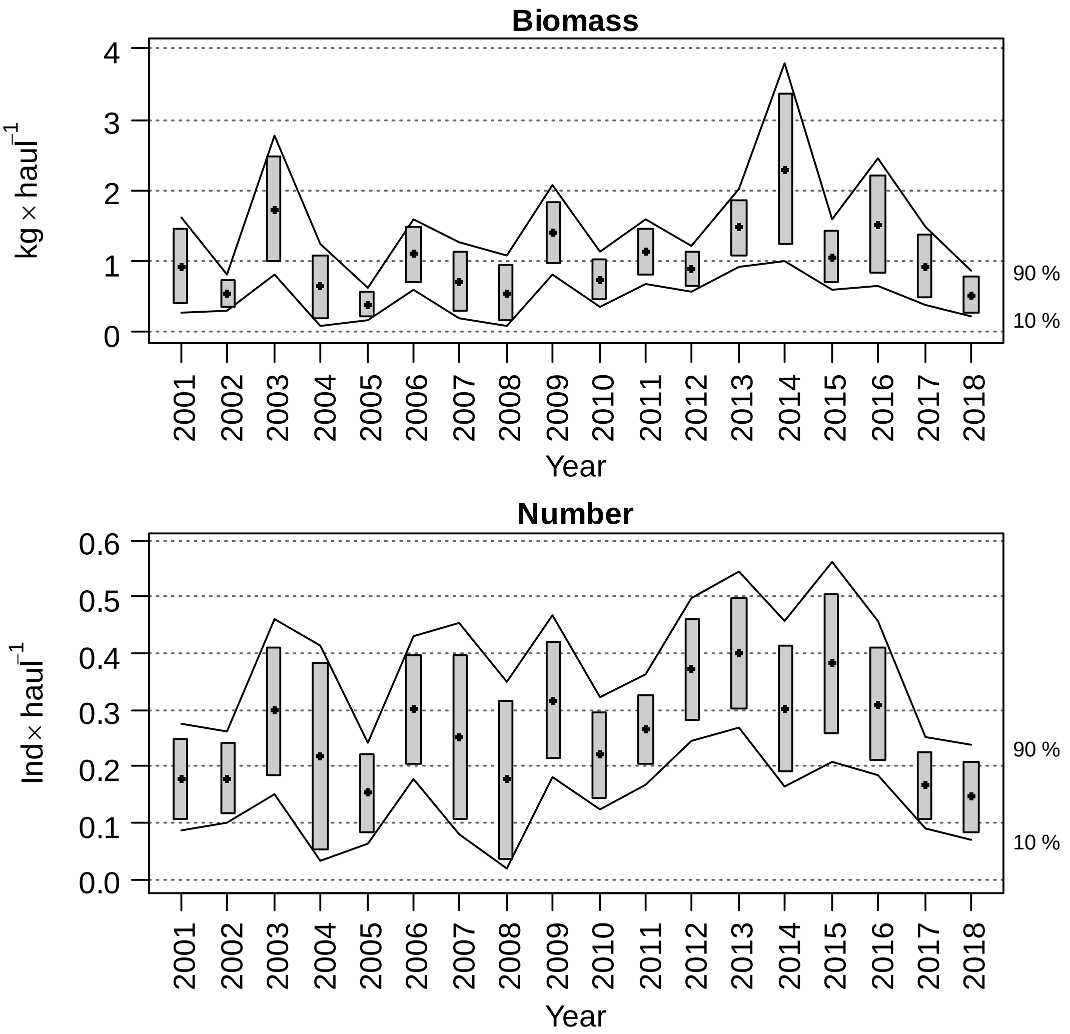


Figure 25 Evolution of *Hexanchus griseus* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

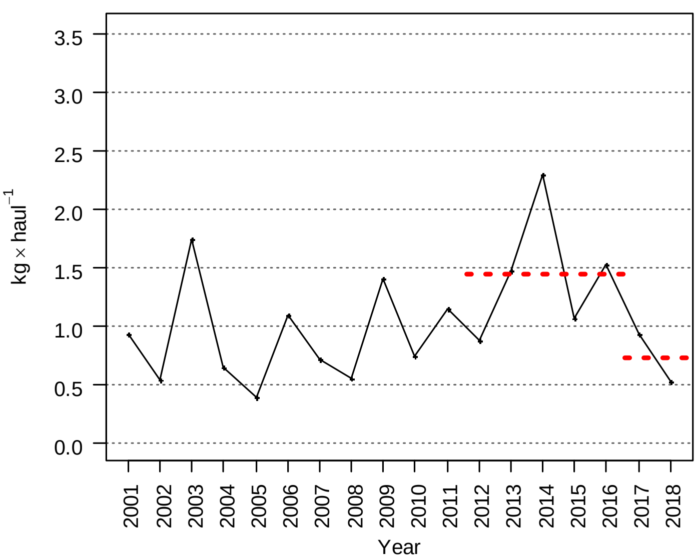


Figure 26 Evolution in *Hexanchus griseus* biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

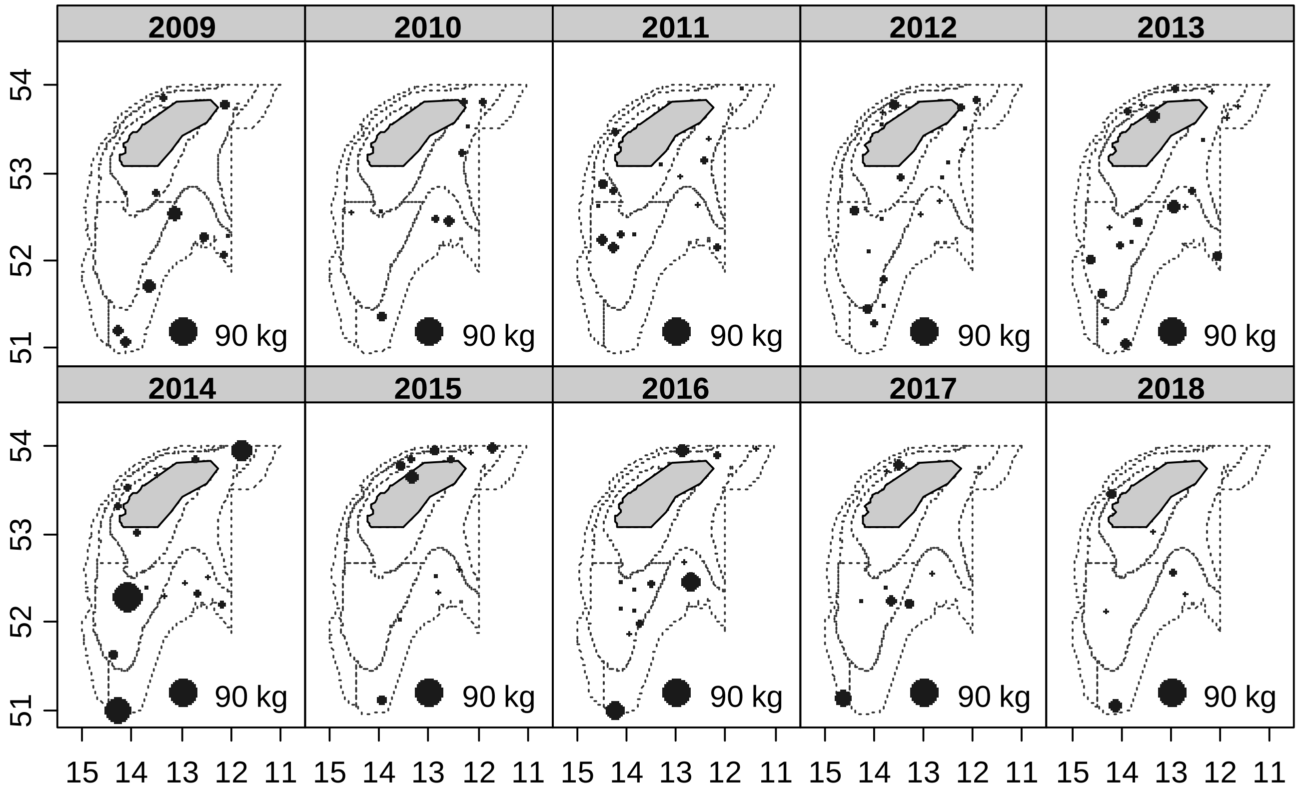


Figure 27 Geographic distribution of *Hexanchus griseus* catches (kg×30 min haul^{-1}) in Porcupine surveys (2009-2018)

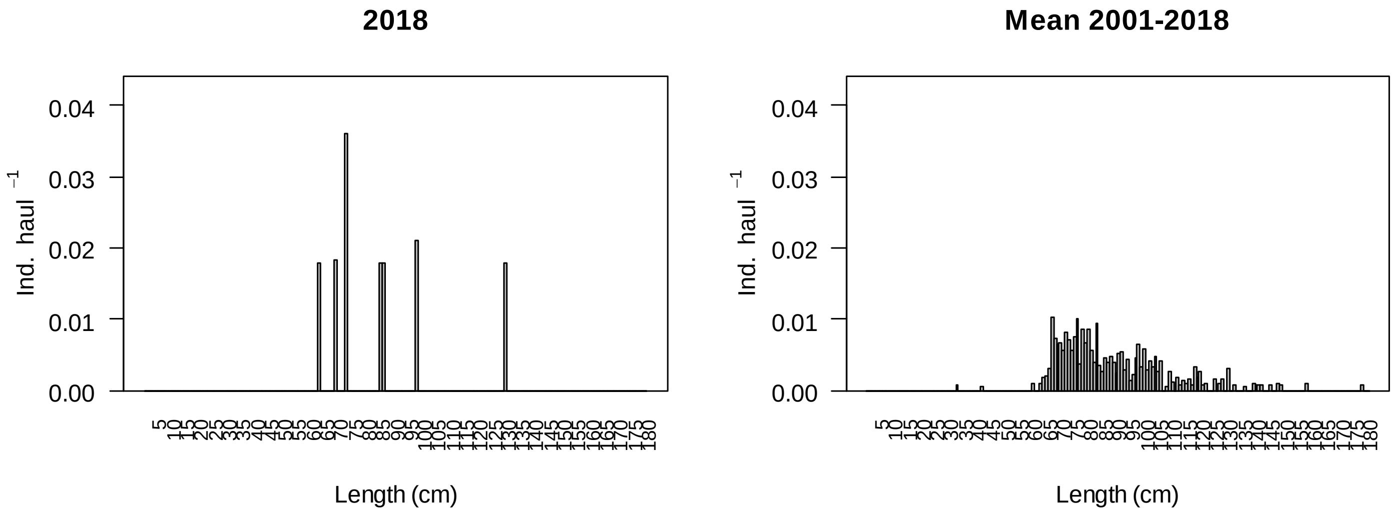


Figure 28 Stratified length distribution of *Hexanchus griseus* in 2018 Porcupine survey, and mean values in Porcupine surveys (2001-2018)

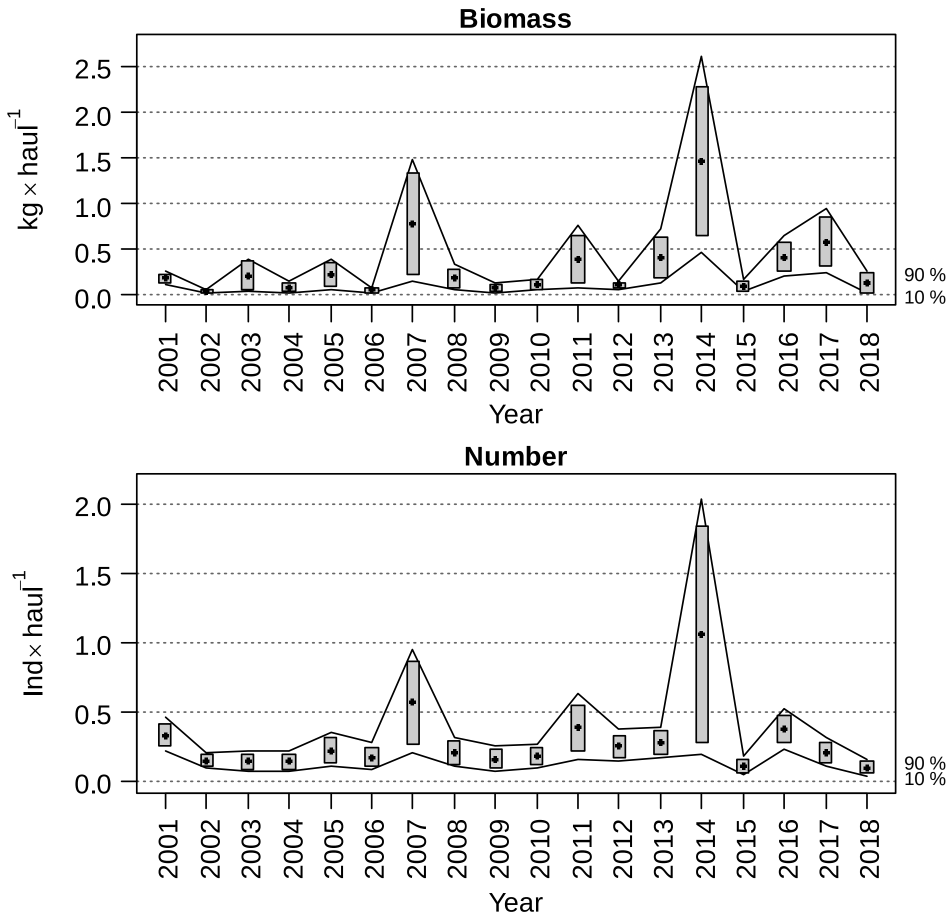


Figure 29 Evolution of *Dalatias licha* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

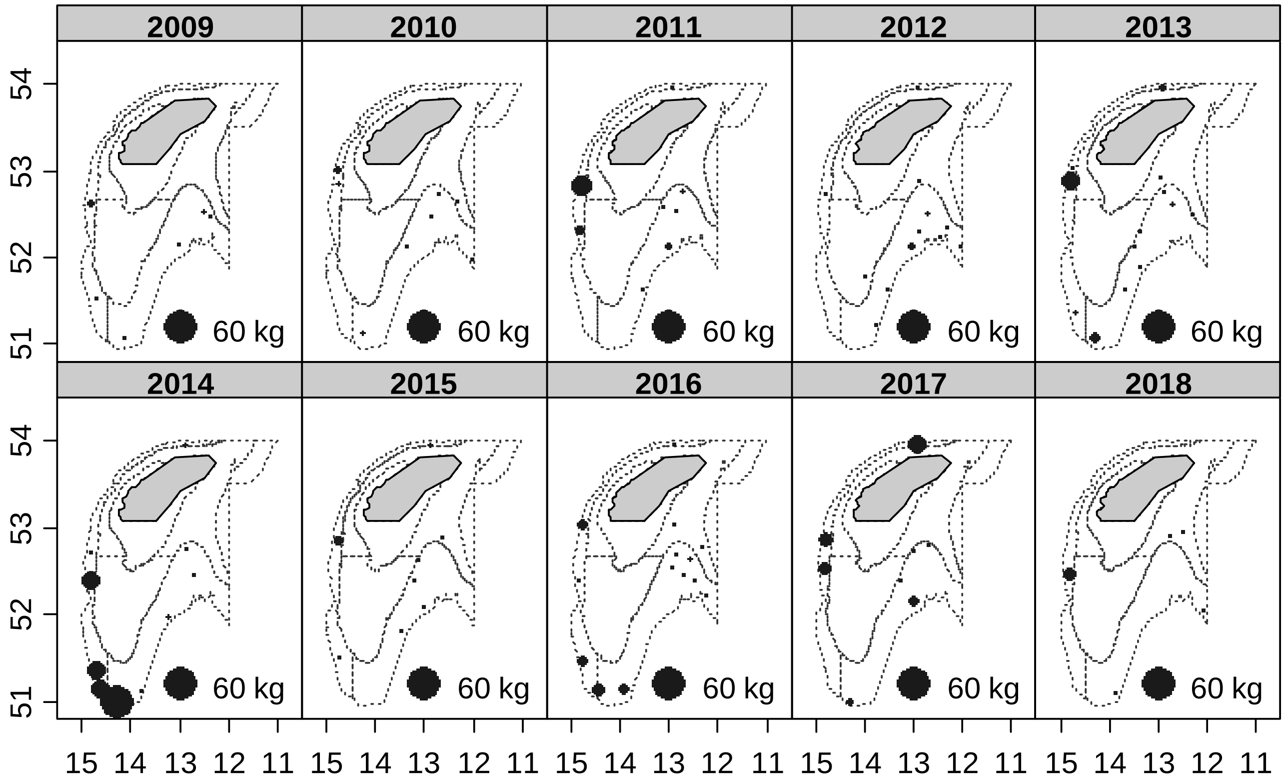


Figure 30 Geographic distribution of *Dalatias licha* catches (kg×30 min haul^{-1}) in Porcupine surveys (2009-2018)

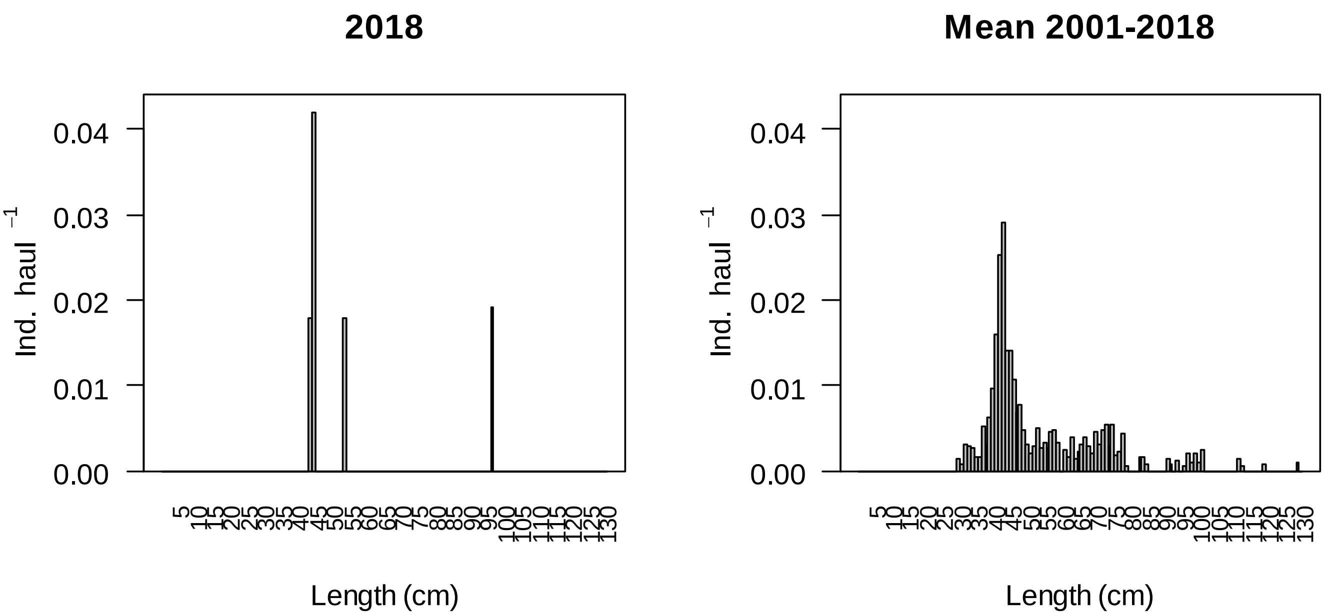


Figure 31 Stratified length distribution of *Dalatias licha* in 2018 Porcupine survey, and mean values in Porcupine surveys (2001-2018)

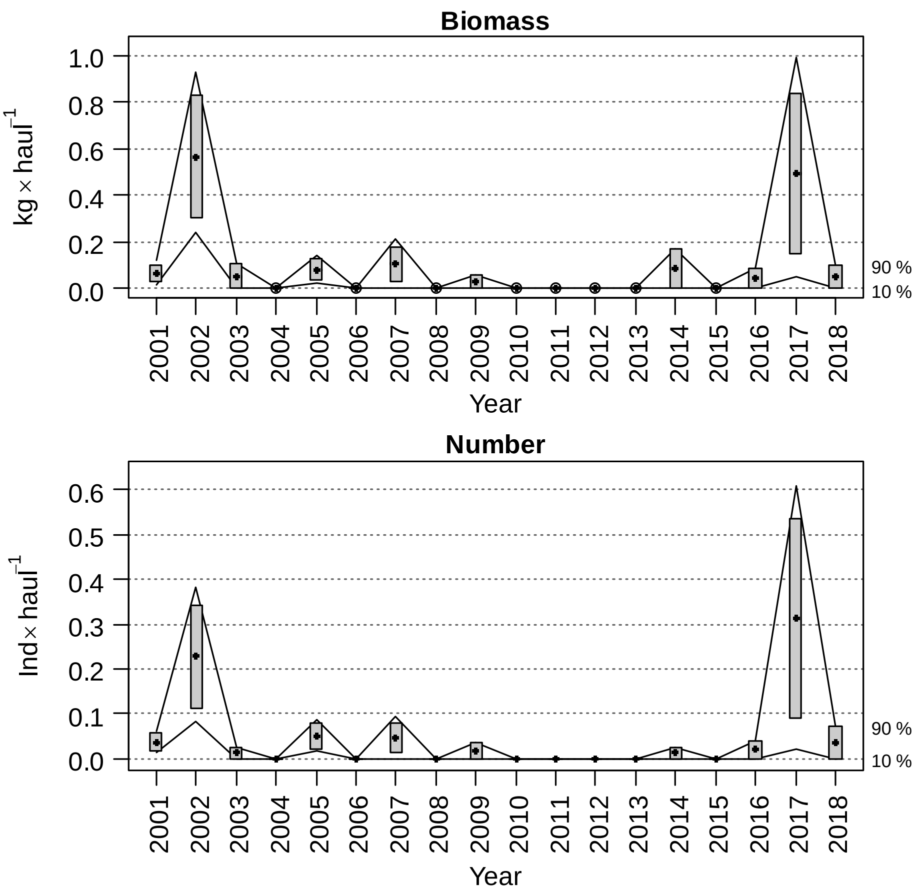


Figure 32 Evolution of *Squalus acanthias* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

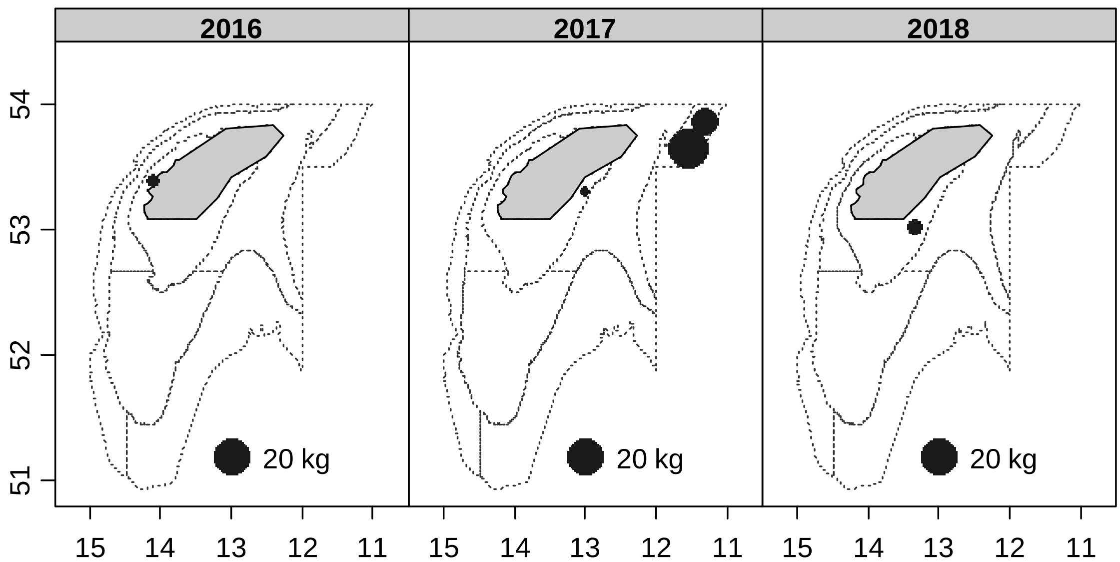


Figure 33 Geographic distribution of *Squalus acanthias* catches (Kg· $haul^{-1}$) in Porcupine surveys 2016-2018

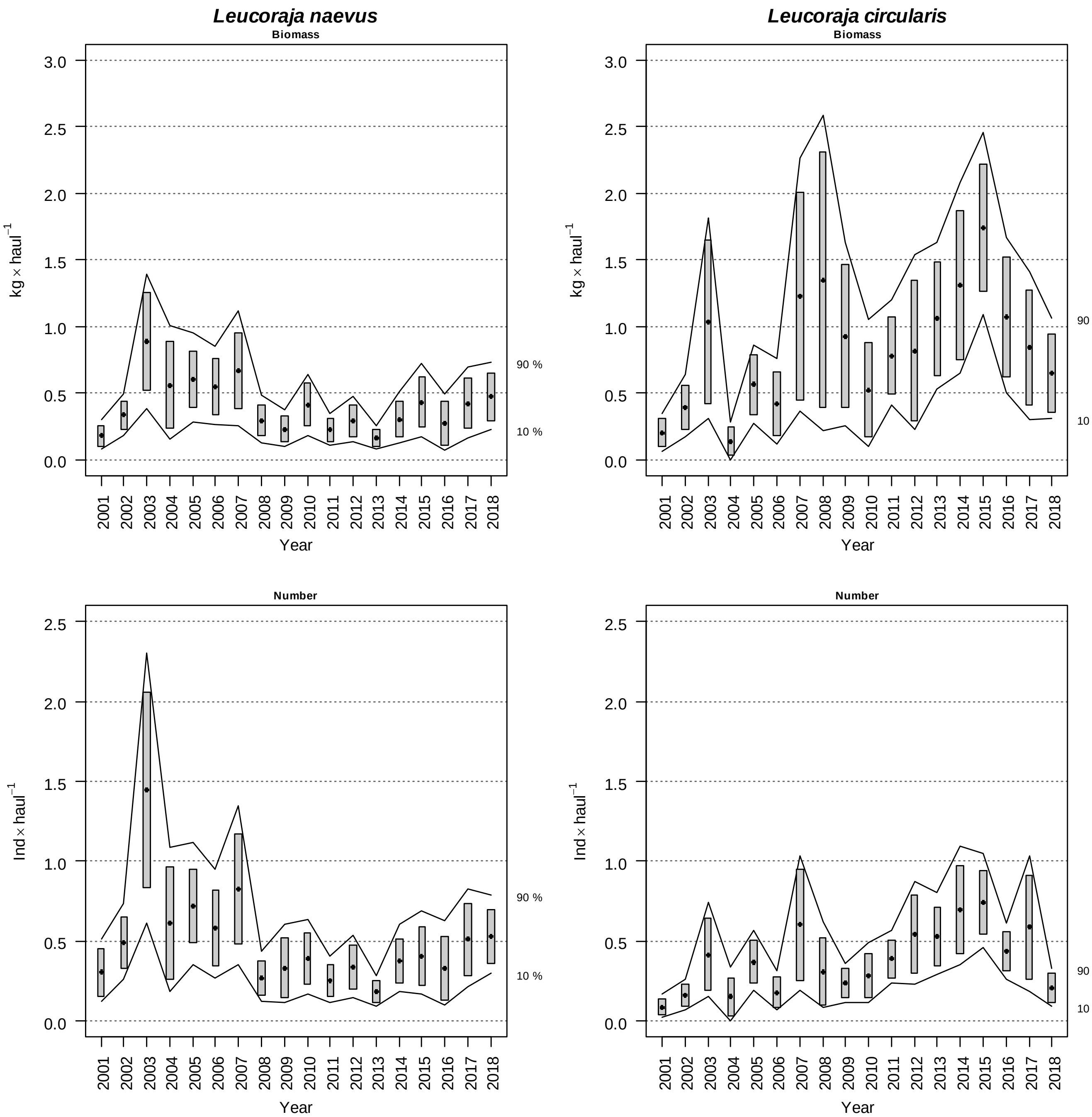


Figure 34 Changes in *Leucoraja naevus* and *Leucoraja circularis* biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

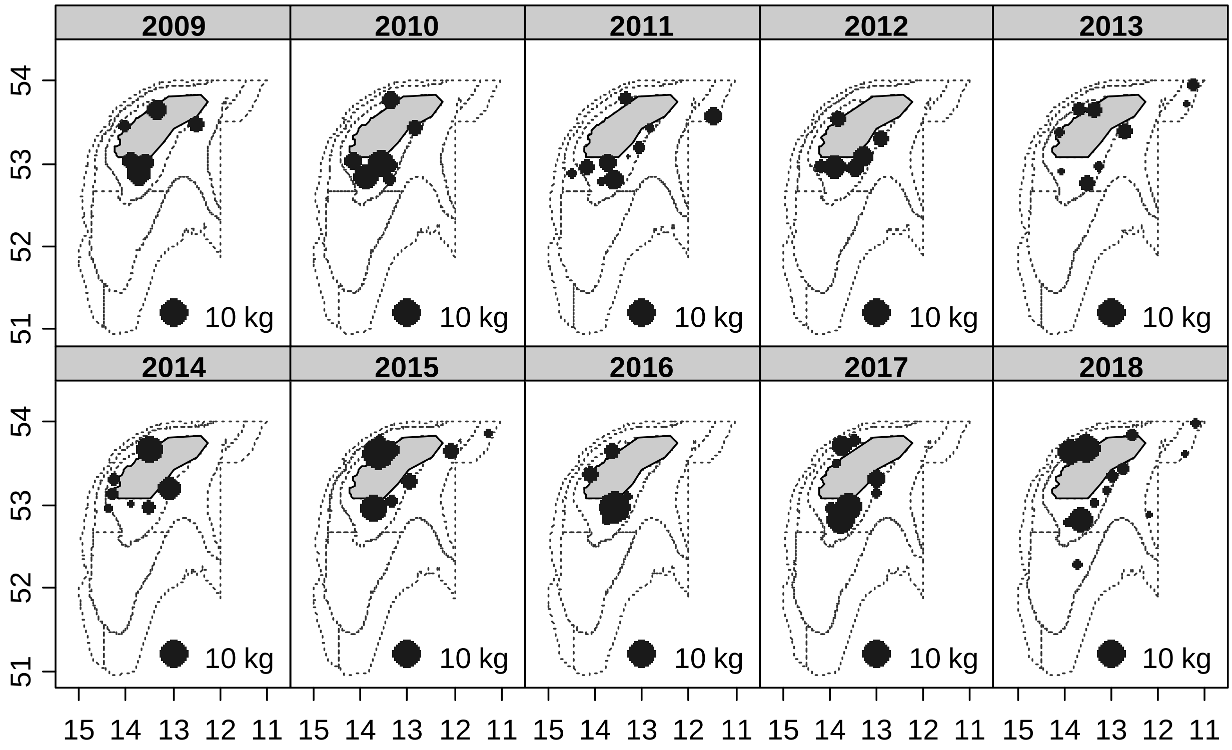


Figure 35 Geographic distribution of *Leucoraja naevus* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

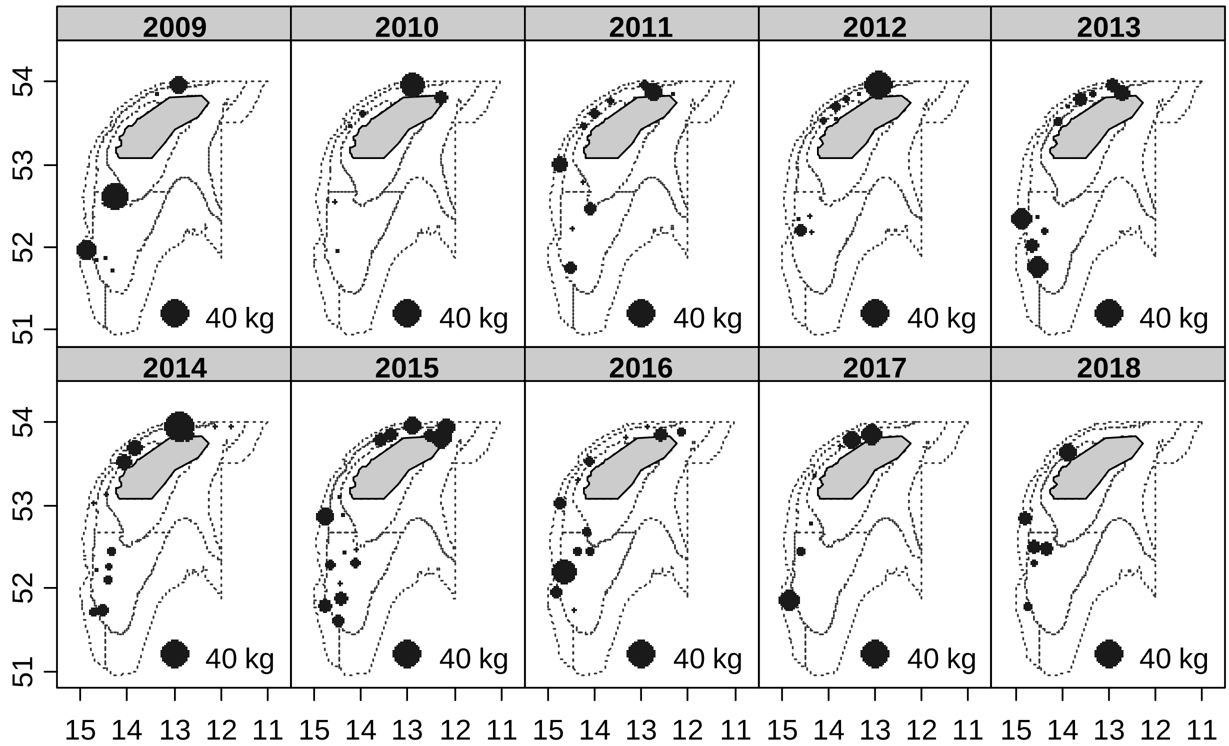


Figure 36 Geographic distribution of *Leucoraja circularis* catches (kg·haul^{-1}) in Porcupine surveys (2009-2018)

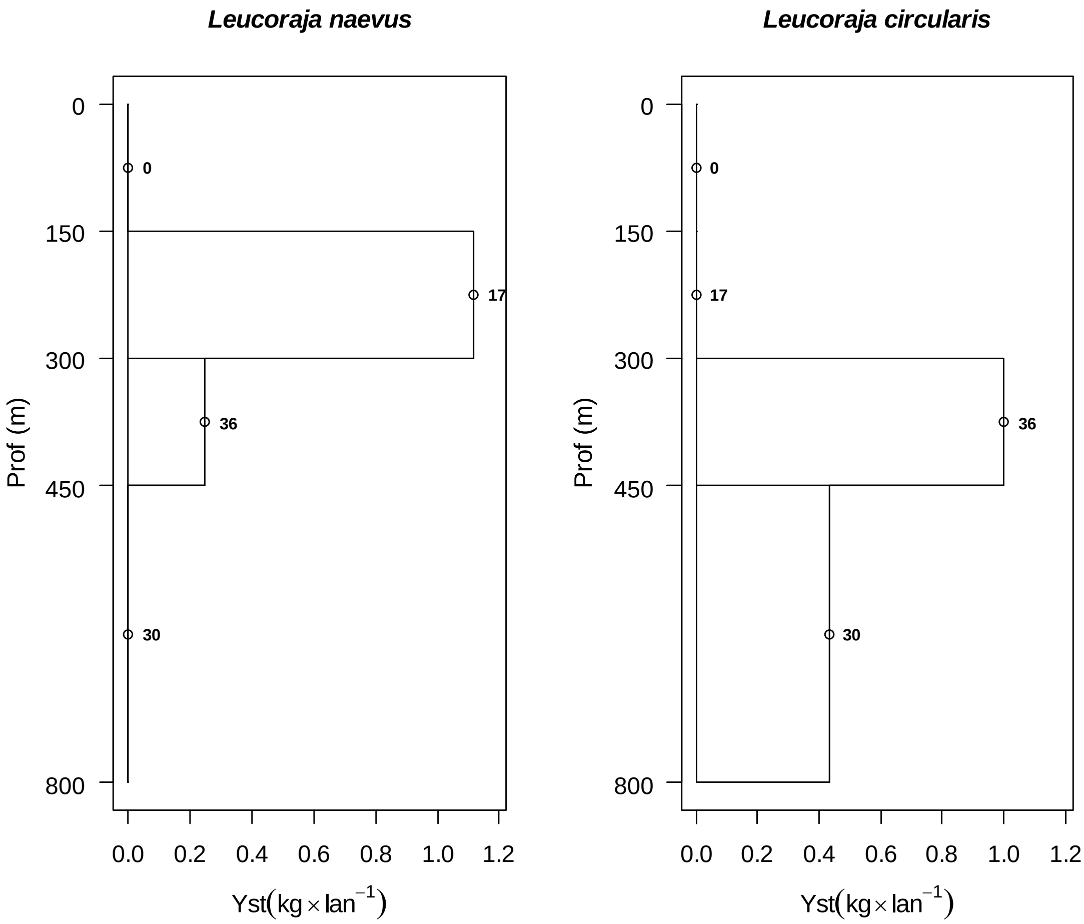


Figure 37 Depth distribution of *Leucoraja naevus* and *Leucoraja circularis* in Porcupine survey 2018. Numbers mark total hauls

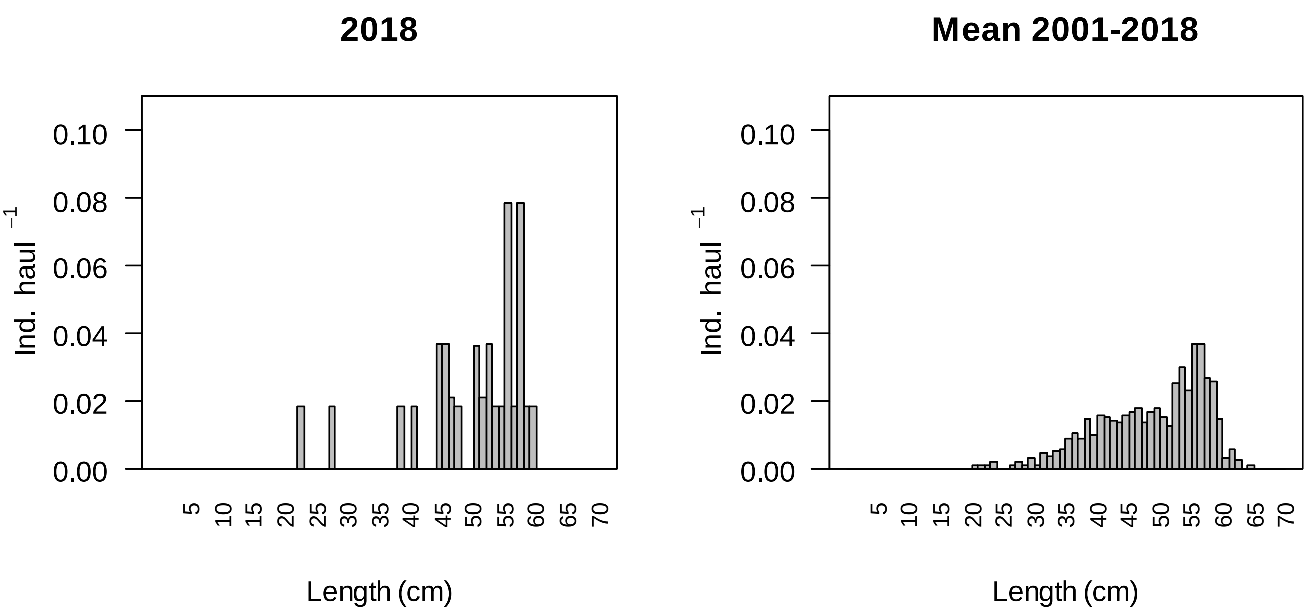


Figure 38 Stratified length distribution of *Leucoraja naevus* in 2018 Porcupine survey, and mean values in Porcupine surveys (2001-2018)

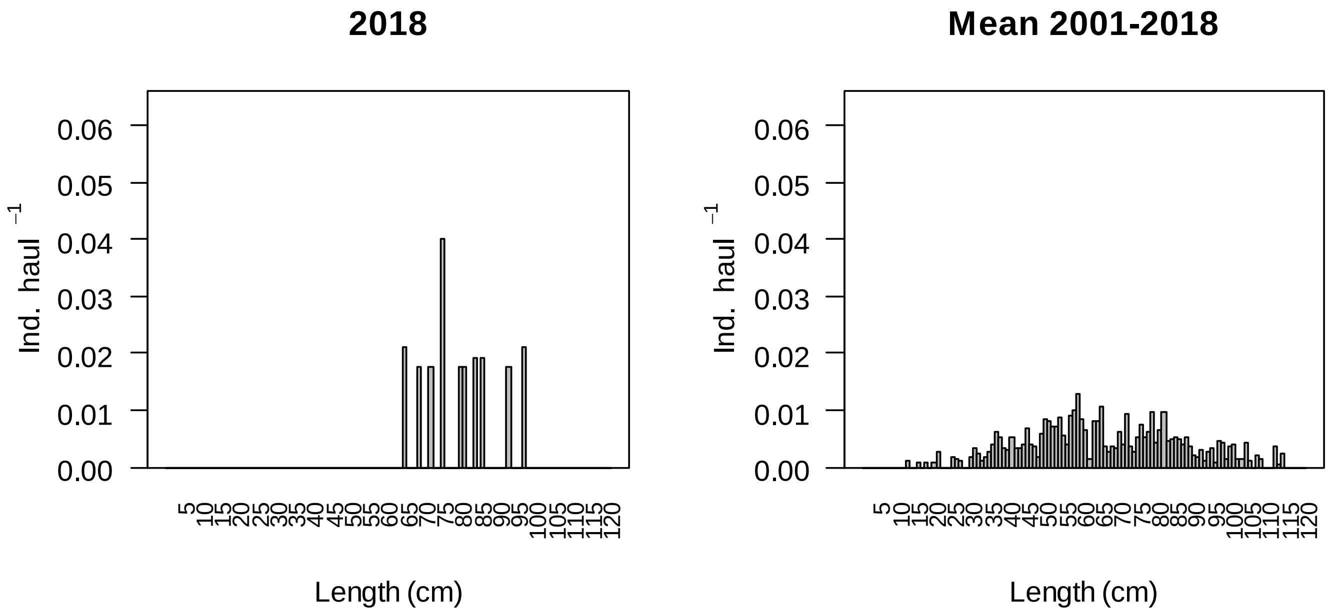


Figure 39 Stratified length distribution of *Leucoraja circularis* in 2018 Porcupine survey, and mean values in Porcupine surveys (2001-2018)

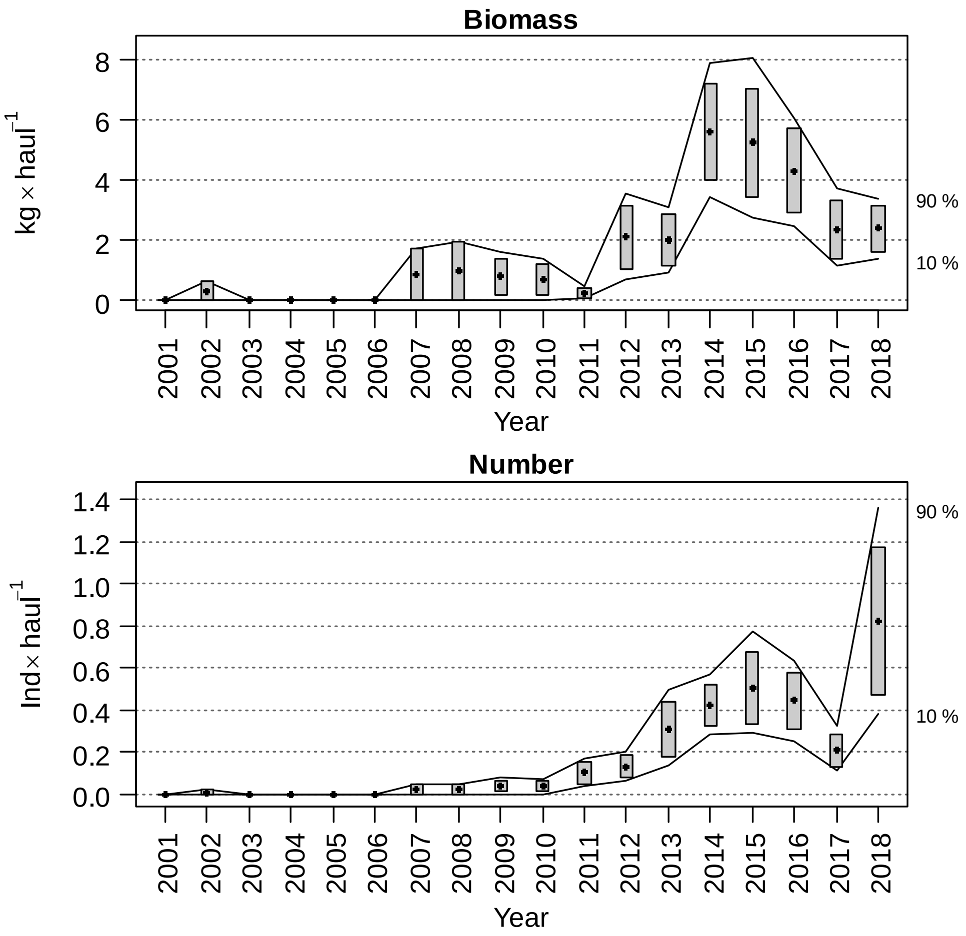


Figure 40 Evolution of *Dipturus* spp. biomass and abundance indices in Porcupine surveys (2001-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

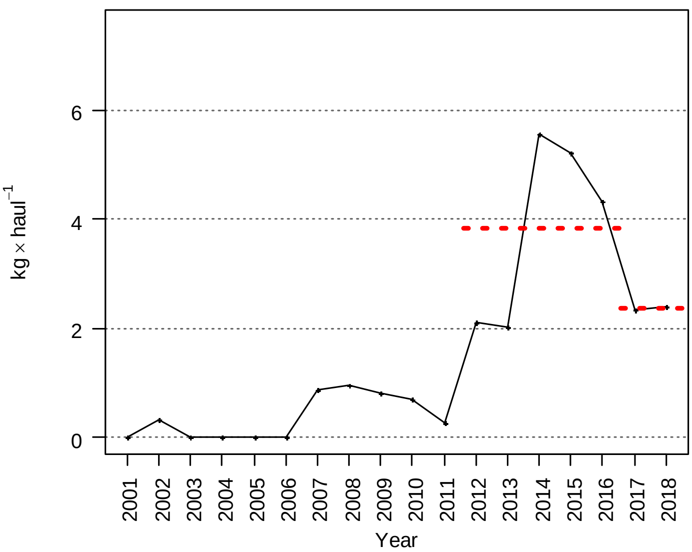


Figure 41 Evolution in *Dipturus* spp. biomass index in Porcupine surveys (2001-2018). Dotted lines compare mean stratified biomass in the last two years with the five previous years

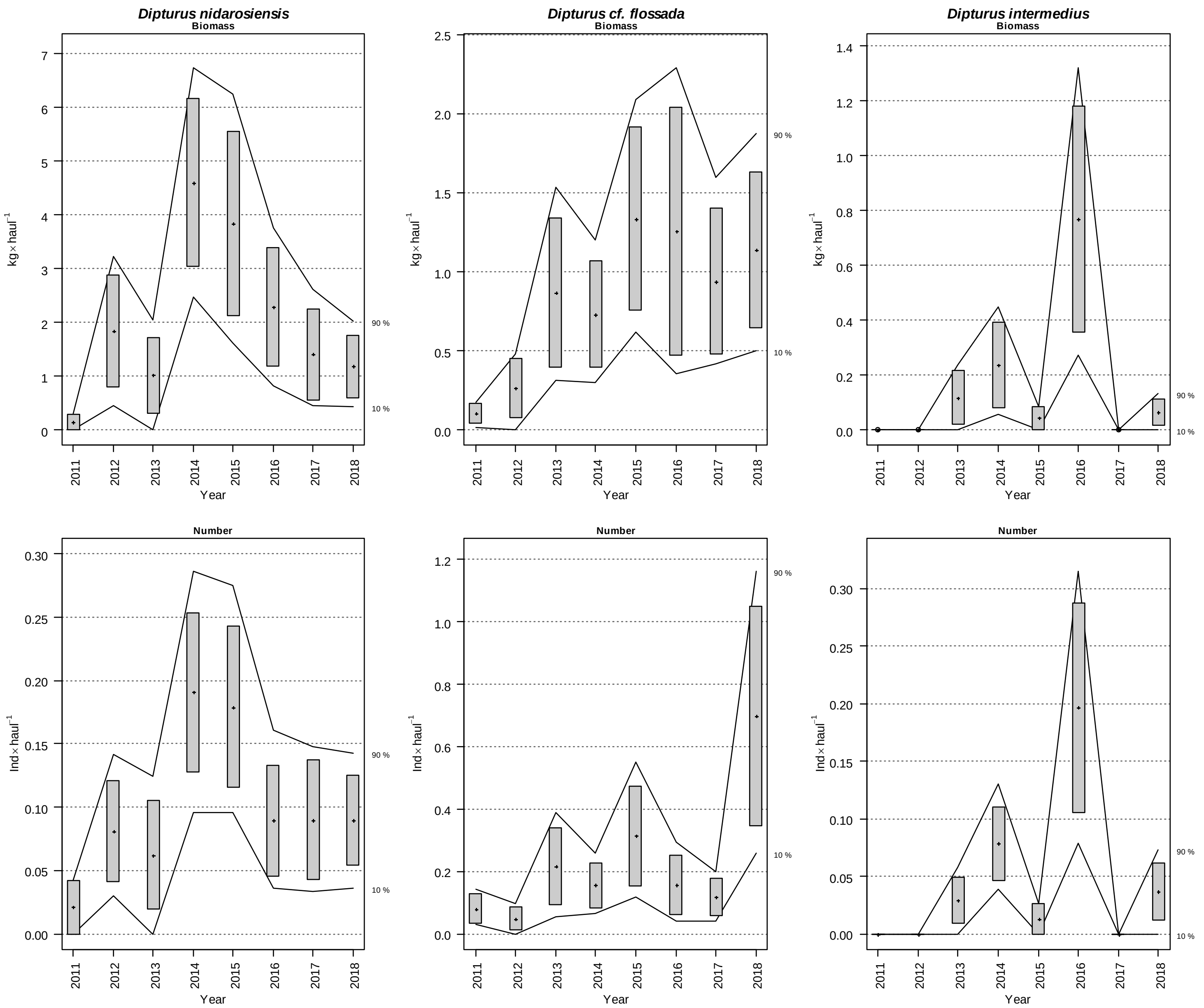


Figure 42 Evolution of *Dipturus nidarosiensis*, *Dipturus cf. flossada* and *Dipturus intermedius* biomass and abundance indices in Porcupine surveys (2011-2018). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

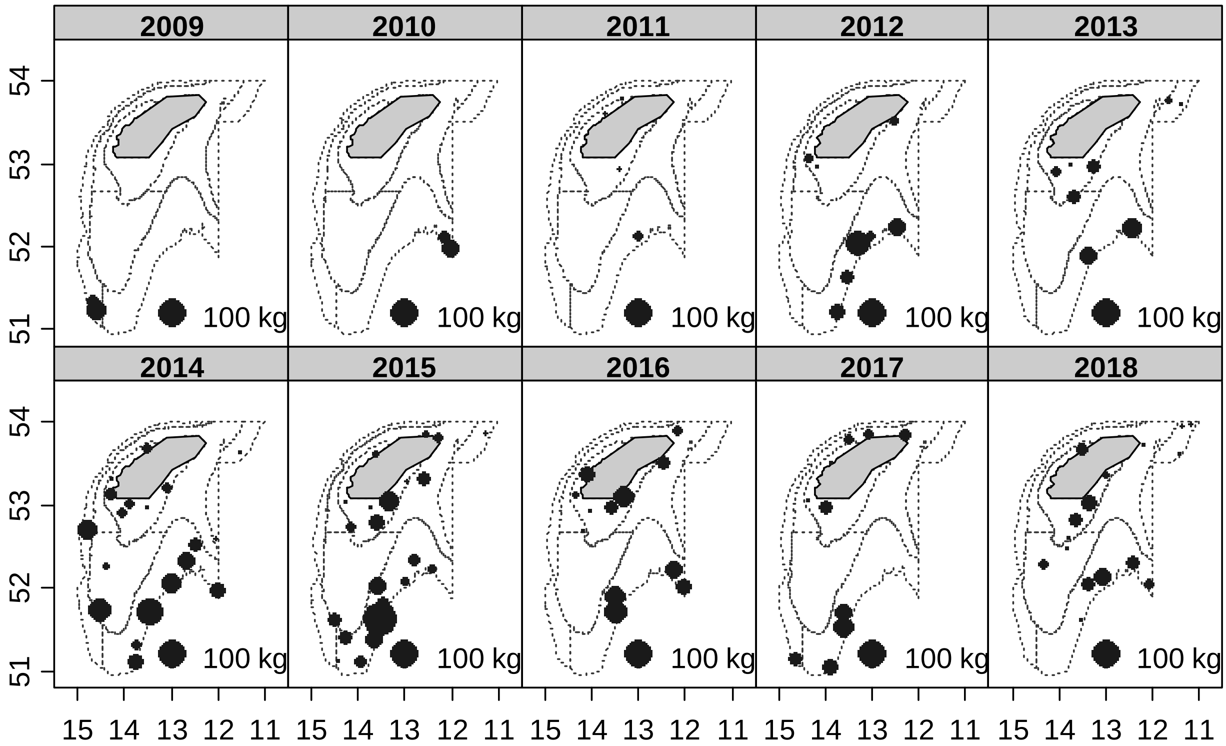


Figure 43 Geographic distribution of *Dipturus* spp. catches (Kg· haul^{-1}) in Porcupine surveys (2009-2018)

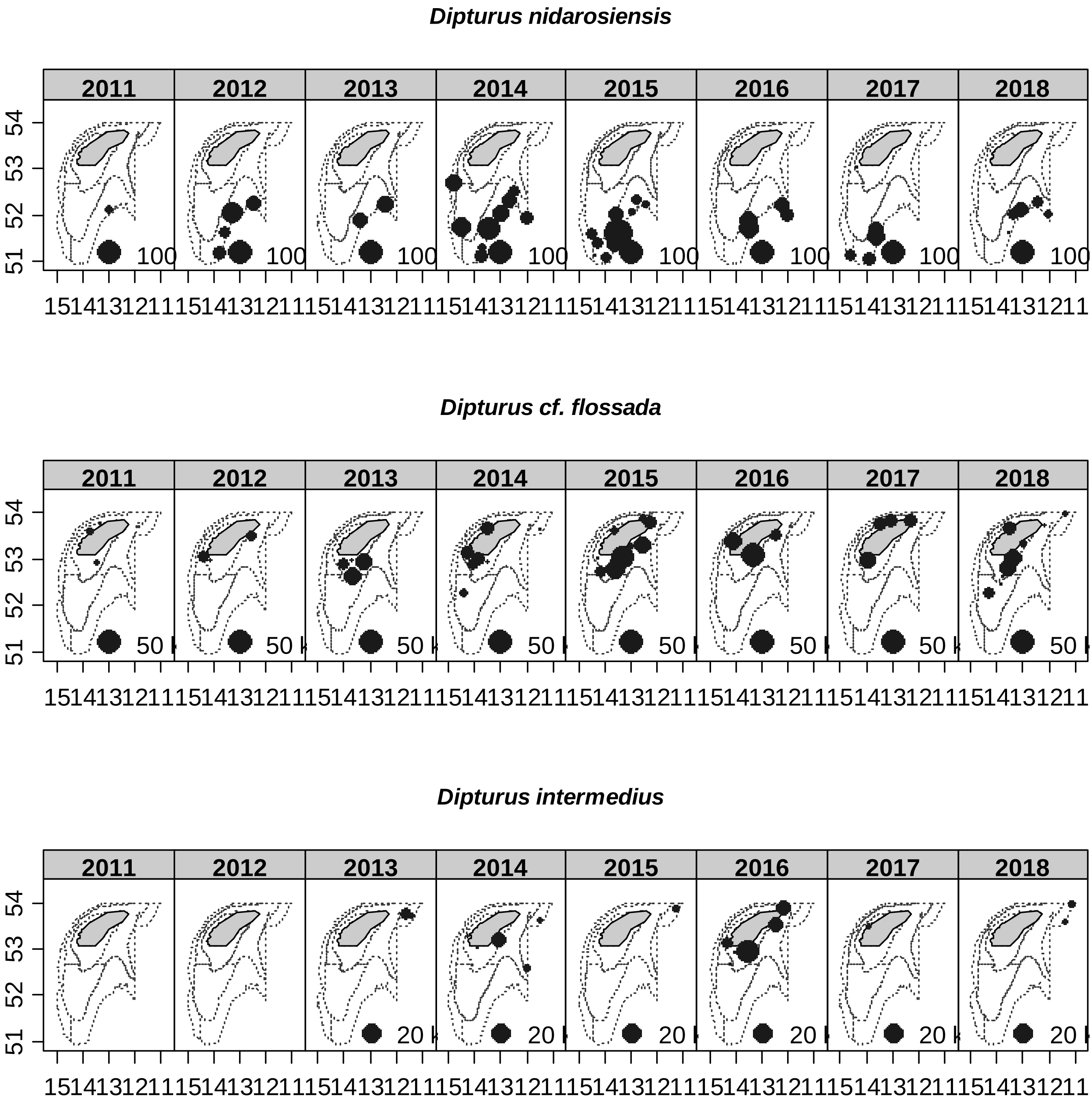


Figure 44 Geographic distribution of *Dipturus nidarosiensis*, *Dipturus cf. flossada* and *Dipturus cf. intermedia* catches (Kg· haul^{-1}) in Porcupine surveys (2011-2018)

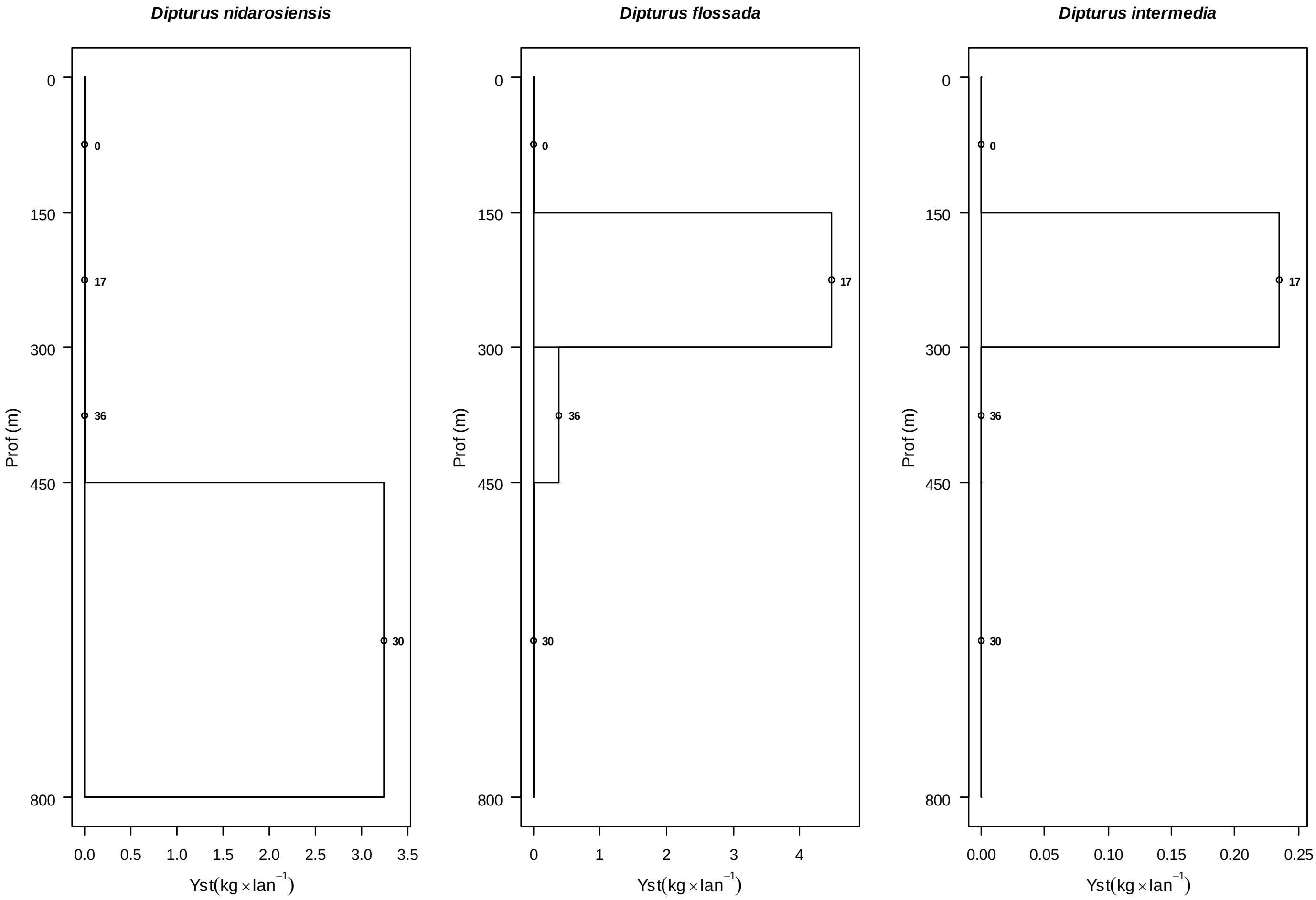


Figure 45 Depth distribution of *Dipturus nidarosiensis*, *Dipturus cf. flossada* and *Dipturus cf. intermedia* catches (kg/30 min haul) in Porcupine surveys 2018. Numbers mark total hauls

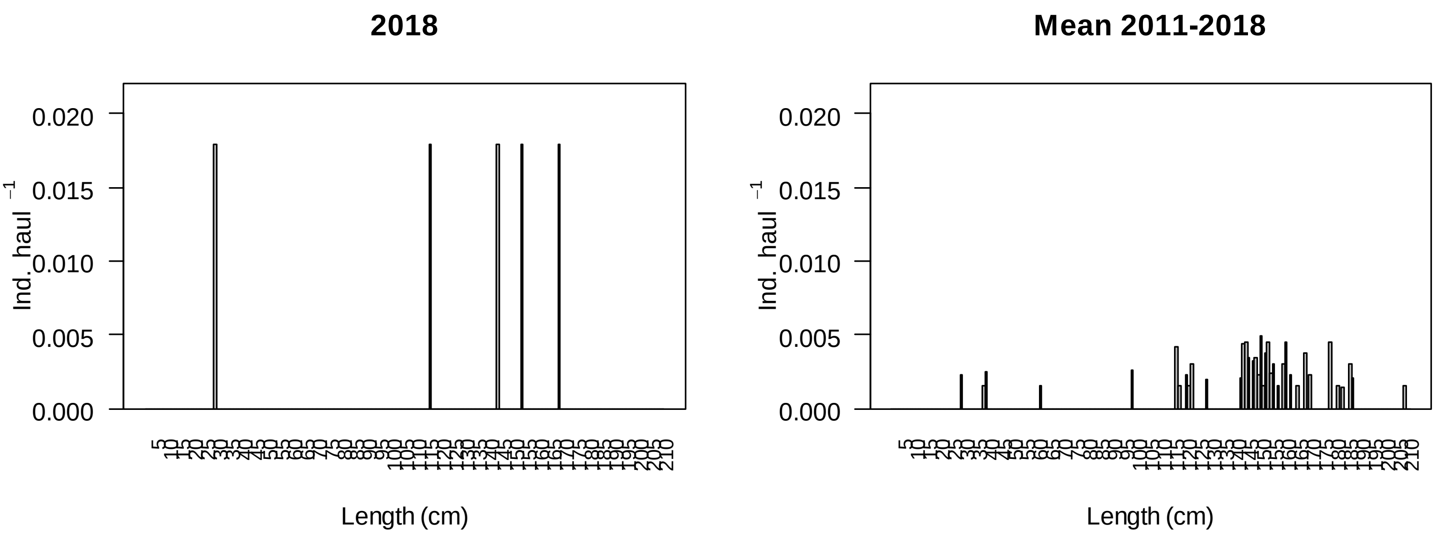


Figure 46 Stratified length distribution of *Dipturus nidarosiensis* in 2018 Porcupine survey, and mean values in Porcupine surveys (2011-2018)

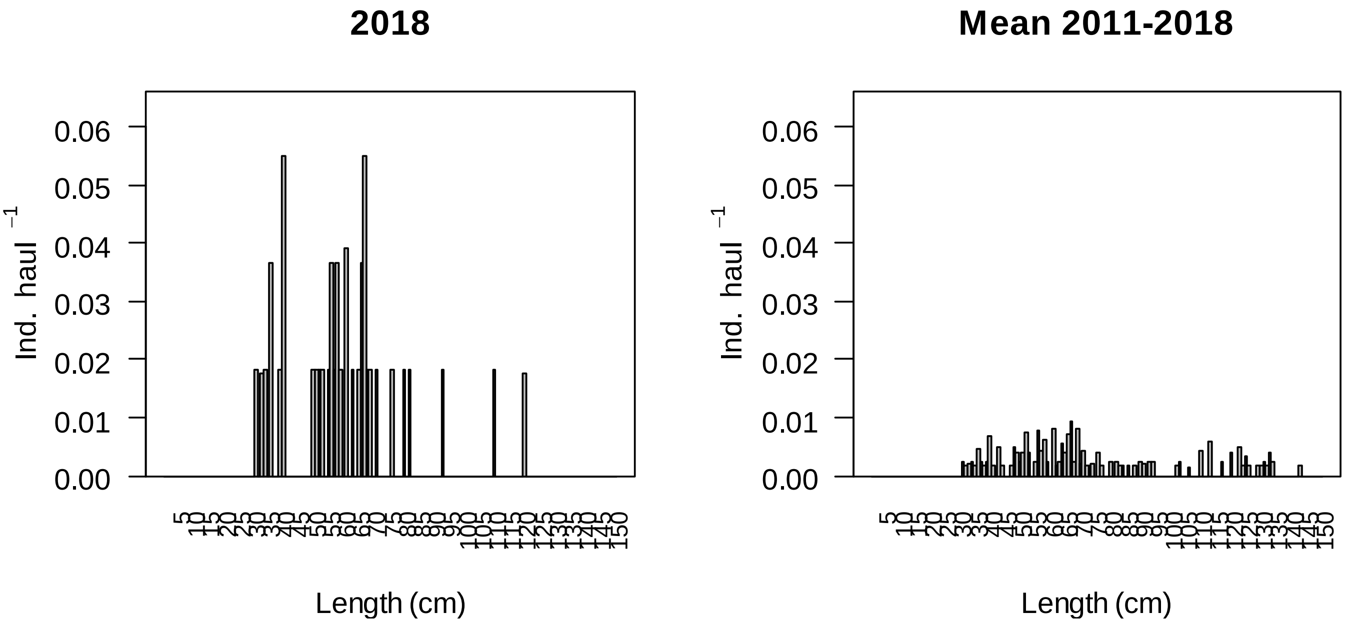


Figure 47 Stratified length distribution of *Dipturus cf. flossada* in 2018 Porcupine survey, and mean values in Porcupine surveys (2011-2018)

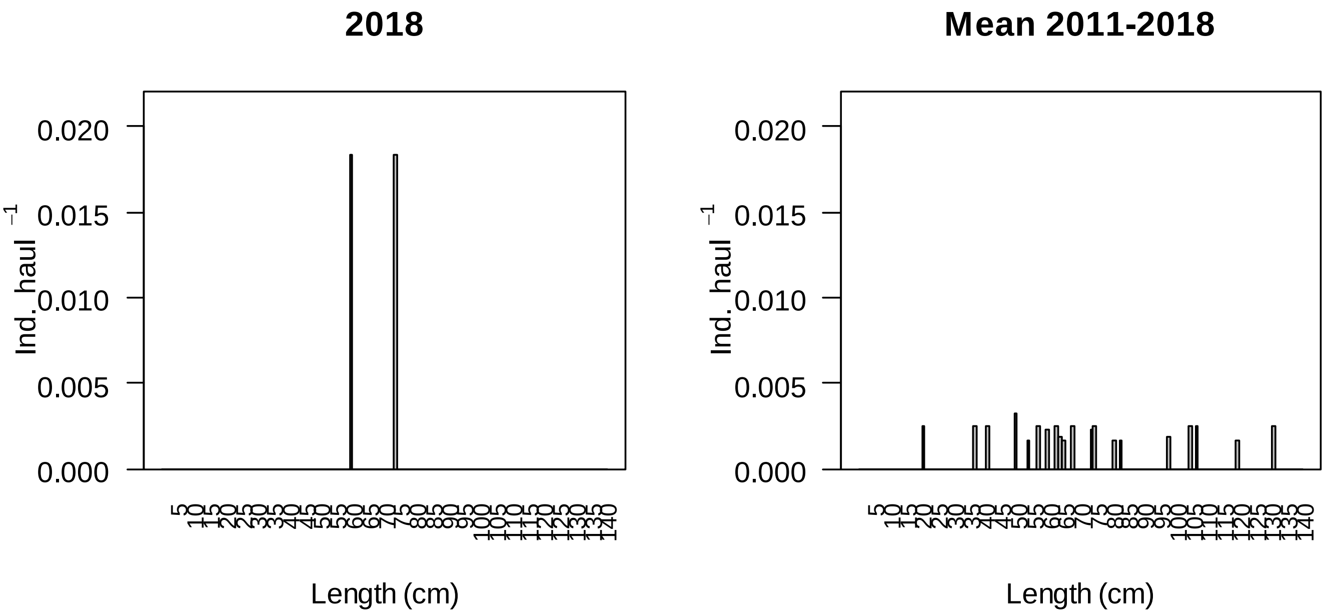


Figure 48 Stratified length distribution of *Dipturus intermedius* in 2018 Porcupine survey, and mean values in Porcupine surveys (2011-2018)

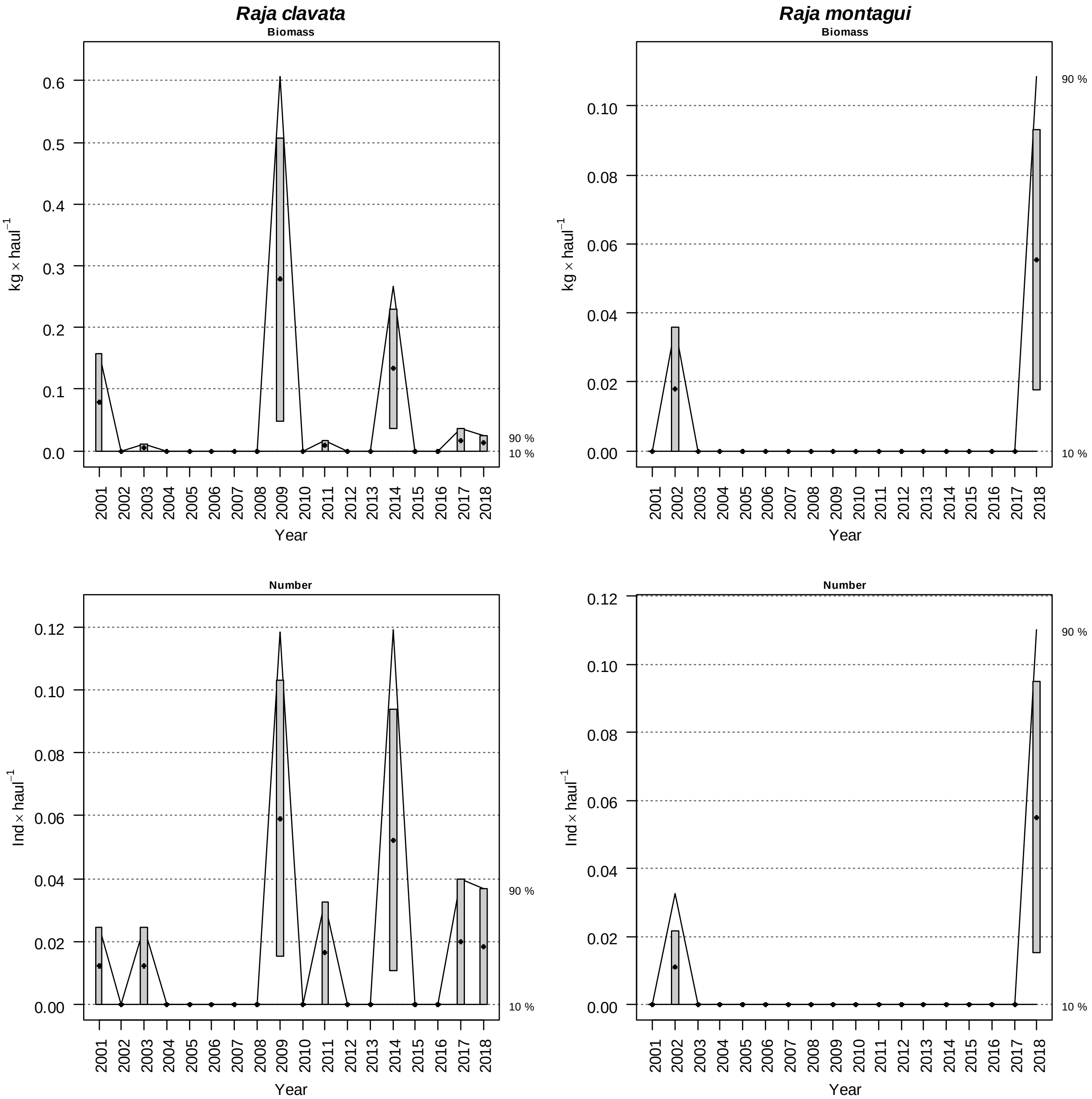
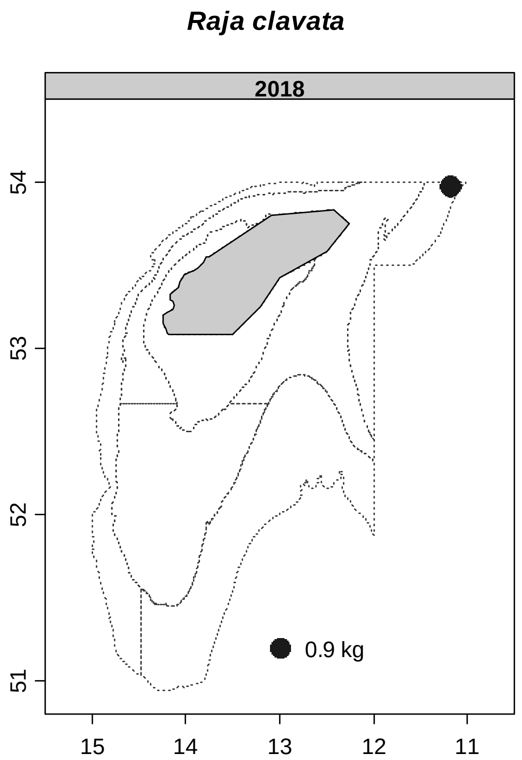


Figure 49 Evolution of *Raja clavata* and *Raja montagui* biomass and abundance indices from 2001 and 2018 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)



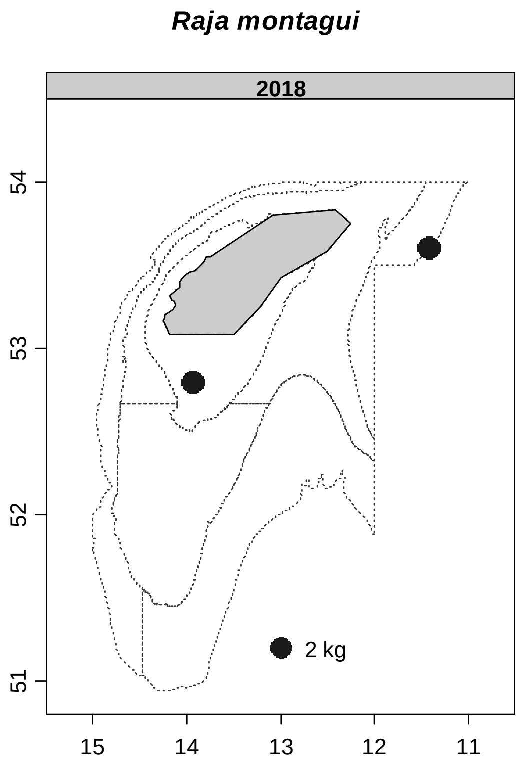


Figure 50 Geographic distribution of *Raja clavata* and *Raja montagui* catches (Kg· $haul^{-1}$) in Porcupine surveys 2018