Results on main cephalopods from the Spanish Ground Fish Survey on the Porcupine bank (NE Atlantic) (Division 7c and 7k)

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Abstract

This working document presents the results of the most significant cephalopods caught in the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2019. Biomass, abundance, distribution and length frequency were analysed for *Eledone cirrhosa* (horned octopus), *Bathypolypus sponsalis* (globose octopus), *Todarodes sagittatus* (European flying squid), *Todaropsis eblanae* (lesser flying squid), *Loligo forbesi* (veined squid), *Illex coindetii* (broadtail shortfin squid), *Rossia macrosoma* (stout bobtail squid) and other scarce cephalopods. The biomass of the most common cephalopods decreased, except for *T. eblane* and *B. sponsalis*. *L. forbesi, I. coindetii, R. minor* and *R. macrossoma* were scarce as usual and a few specimens of *Histiouteuthis reversa*, *Haliphron atlanticus, Octopus salutii, Ancistroteuthis lichtensteini, Sepietta oweniana* and *Sepia orbignyana* were found, but *H. bonelli* was not.

Introduction

The Spanish bottom trawl survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been carried out annually on the third-quarter (September) since 2001 to study the distribution, relative abundance and biological parameters of commercial fish 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 cephalopods on Porcupine bottom trawl surveys after the results presented previously (Ruiz-Pico *et al.* 2019, Blanco *et al.* 2018, Ruiz-Pico *et al.* 2012). The species analysed were *Eledone cirrhosa* and *Bathypolypus sponsalis* (fam. Octopodidae), *Todarodes sagittatus*, *Todaropsis eblanae* and *Illex coindetii* (fam. Ommastrephidae), *Loligo forbesi* (fam. Loliginidae) and the scarce species *Histioteuthis reversa* and *H. bonnelli* (fam. Histtioteuthidae), *Haliphron atlanticus* (fam. Alloposidae), *Ancistroteuthis lichtensteini* (fam. Onychoteuthidae) and *Rossia macrosoma* (fam. Sepiolidae).

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, following the standard methodology for the IBTS North Eastern Atlantic surveys (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 reduction in the tow duration (20 instead of 30 minutes) applied in the last four surveys worked successfully. Now the catches have been reduced and are easier to handle for the team who sorts it, but they are still abundant enough to be representative. 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 maintain the consistency of the time series.

Results

The poor weather conditions posed problems during fishing operations and forced the vessel to stay on Galway harbour several days. At the end 79 valid standard hauls were carried out but none additional hauls could be done (Figure 1), when usually 5-8 additional hauls are performed each survey. Besides the north-western area of the strata 1E and the southern slope of sector 2F (Figure 1) were scarcely covered in comparison with other years.

Cephalopods represented a small percentage of the mean stratified biomass of invertebrates caught (3%), but were the 68% of the mean stratified biomass of molluscs. The species with the largest stratified biomass were *Todaropsis eblanae* (lesser flying squid), *Eledone cirrhosa* (horned octopus), *Todarodes sagittatus* (European flying squid), *Bathypolypus sponsalis* (globose octopus), then *Loligo forbesi* (veined squid), *Illex coindetii* (broadtail shortfin squid), *Rondeletiola minor* (lentil bobtail squid) and *Rossia macrosoma* (stout bobtail squid). Other scarce cephalopods were *Haliphron atlanticus, Octopus salutii* (spider octopus), *Histioteuthis reversa* (reverse jewell squid) *Ancistroteuthis lichtensteini* (angel squid) and *Sepietta oweniana* (common bobtail squid). *Sepia orbignyana* (pink cuttlefish) was barely found this last year and *Histioteuthis bonnellii* was not found.

In 2019, the biomass of the most common cephalopods followed the downward trend of previous years, especially *E. cirrhosa*, *T. sagittatus* and *L. forbesi,* which decreased to almost the lowest values of the time series. In contrast, an outstanding increase was found in *T. eblanae* and in *B. sponsalis* which is not as abundant, but equally striking. *L. forbesi*, *I. coindetii*, *R. minor* and *R. macrossoma* were scarce as usual.

Regarding distribution, *E. cirrhosa*, *T. eblanae*, *I, coindetii* and *R. macrosoma* appeared on the Irish shelf and/or in the shallowest strata around the bank, as usual but not as abundant, whereas *T. sagittatus*, *B. sponsalis* and *H. reversa* occurred mainly in the deeper southern strata.

***Eledone cirrhosa* (horned octopus)**

E. cirrhosa represented 26% of the cephalopods mean stratified biomass in 2019. Biomass and abundance have been dropping after the peak in 2016 and, in this last survey, remained equally low than the previous year (Figure 2).

The spots of biomass were again found around the bank and a few on the Irish shelf, but they were scattered and small (Figure 3).

The two smooth modes (around 2 cm and 7 cm) found in the previous year, were slightly showed in this last survey, as were the recruits (Figure 4).

***Todarodes sagittatus* (European flying squid)**

In 2019, the biomass of *T. sagittatus* was 16% of the cephalopods mean stratified biomass, half the value of the previous year. Biomass and abundance decreased further in this last survey, remaining among the lowest values of the time series (Figure 5).

T. sagittatus was distributed as usual, mainly in the deeper strata, but with fewer and smaller spots of biomass in the north and western area than previous years. In this last survey, *T. sagittatus* was found mainly in the southwest area (Figure 6).

The few specimens ranged from 14 cm to 42 cm, but none of them from 28 to 36 cm and nor small specimens (Figure 7).

***Todaropsis eblanae* (lesser flying squid)**

The biomass of *T. eblanae* was 37% of the mean stratified biomass of the cephalopods caught in this last survey, a three-fold increase compared to the previous year. Figure 8 showed that sharp rise in biomass and abundance, the highest peak in the time series.

The usual distribution on the Irish shelf was shown, but in addition, most of the biomass was found in the shallow depth strata around the bank, especially in the south, which is clearly shown more than ever in the time series (Figure 9).

The length distribution, so remarkable this last survey, showed that the specimens ranged from 3 to 14 cm and the most abundant sizes were around 5 cm (Figure 10).

***Bathypolypus sponsalis* (globose octopus)**

The biomass of *B. sponsalis*, which represented 15% of the cephalopods biomass caught, increased sharply in this last survey, reaching the highest value of the time series (Figure 11). *B. sponsalis* was distributed in the deepest southern area as usual, but bigger spots of biomass were found in the southeast this last survey (Figure 12). The specimens ranged from 5 to 12 cm, most of them of 6 cm (Figure 13).

***Loligo forbesi* (veined squid)**

L. forbesi represented only 2% of the mean stratified biomass of the cephalopods caught. Biomass and abundance decreased further in this last survey, reaching the lowest value in the last decade (Figure 14).

Only four specimens of *L. forbesi* were found, three (20-21 cm) around the bank at nearly 200 m, and one (28 cm) in the south at 344 m (Figure 15 and Figure 16).

***Illex coindetii* (broadtail shortfin squid)**

I. coindetii (only 1.2% of the cephalopods mean stratified biomass caught) increased slightly in this last survey (Figure 17). A total of fourteen specimens (13-15 cm) were found mainly in the south of the Irish shelf (Figure 18 and Figure 19).

***Rossia macrosoma* (stout bobtail squid)**

R. macrosoma (less than 1% of the cephalopods mean stratified biomass caught) decreased slightly in 2019, remaining among the low values of the time series (Figure 20). A total of seventeen specimens were found in the northwest area (Figure 21), ranging from 1 to 9 cm (Figure 22).

Other cephalopods species

Histiouteuthis reversa decreased in this last survey (Figure 23), only two specimens of *H. reversa* (5 and 6 cm) were found in two hauls in the southeast area (Figure 24). *H. bonnellii* was not found.

Haliphron atlanticus and *Octopus salutii* were found in this last survey, one specimen at 485 m in the east area and two specimens in the deep south strata, respectively (Figure 25, Figure 26, Figure 27 and Figure 28).

Four specimens of *Ancistroteuthis lichtensteini* were found in two hauls at about 300 m in the north of the bank and in one haul at 629 m in the west area, the largest specimen of 21 cm (Figure 29 and Figure 30).

The species of the family Sepiolidae, *Rondeletiola minor* and *Sepietta oweniana*, increased slightly in this last survey. Their biomasses were low but their abundances were high, especially in *R. minor* (Figure 31). Both were distributed near the Irish shelf, *R. minor* more widely in the east area. In addition, there was found one *S. oweniana* spot in the western part of the bank (Figure 32).

The scarce species *Sepia orbignyana* had not been found since 2015, but in this last year one specimen was found at 236 m in the northwest part of the bank (Figure 33 and Figure 34).

Acknowledgements

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Figures

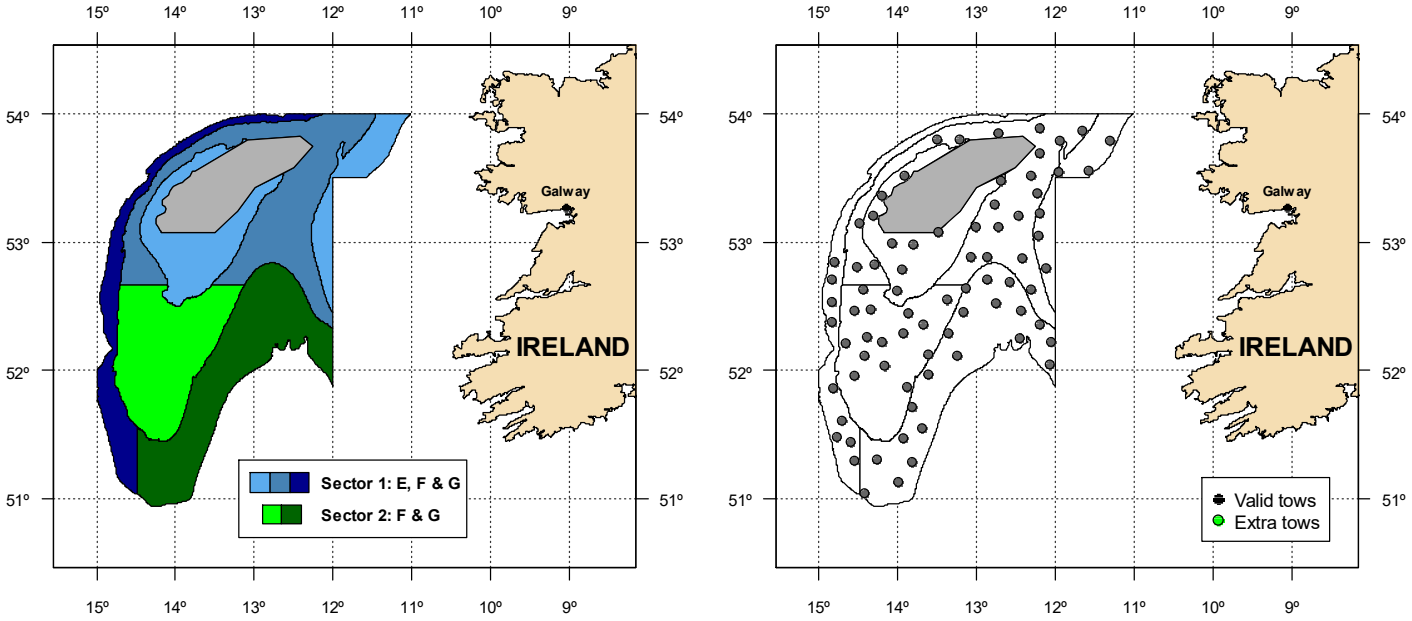

Figure 1. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed in 2019

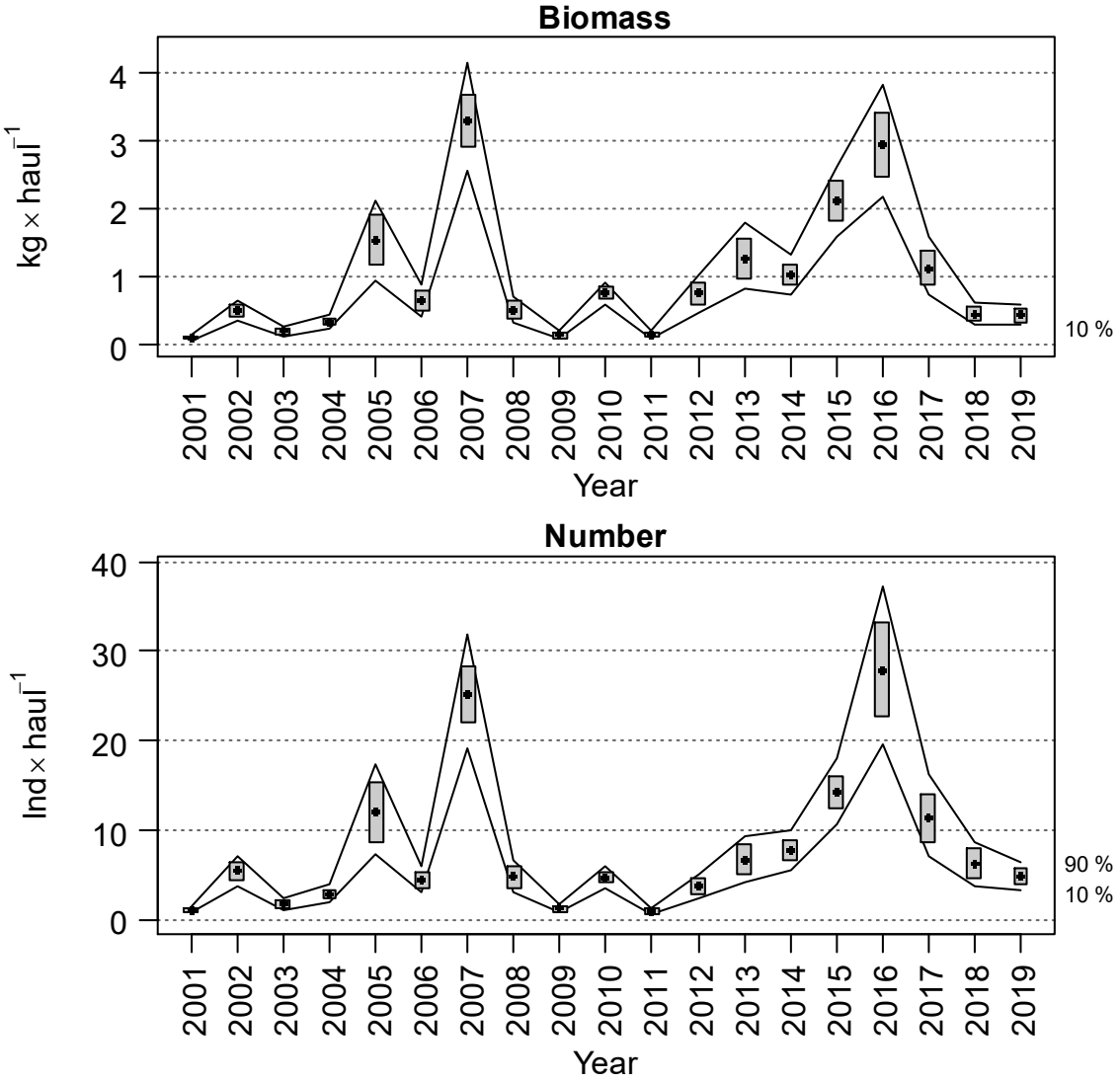

Figure 2. Evolution of *Eledone cirrhosa* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

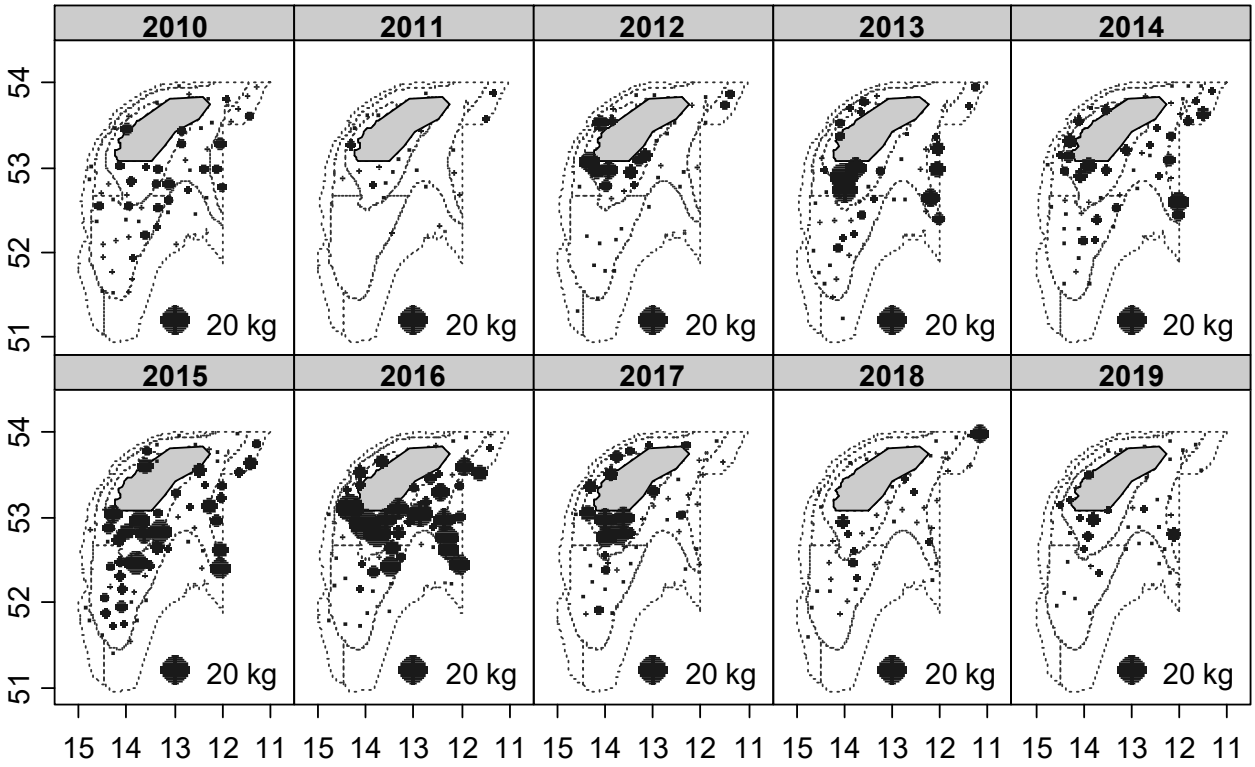

Figure 3. Geographic distribution of *Eledone cirrhosa* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

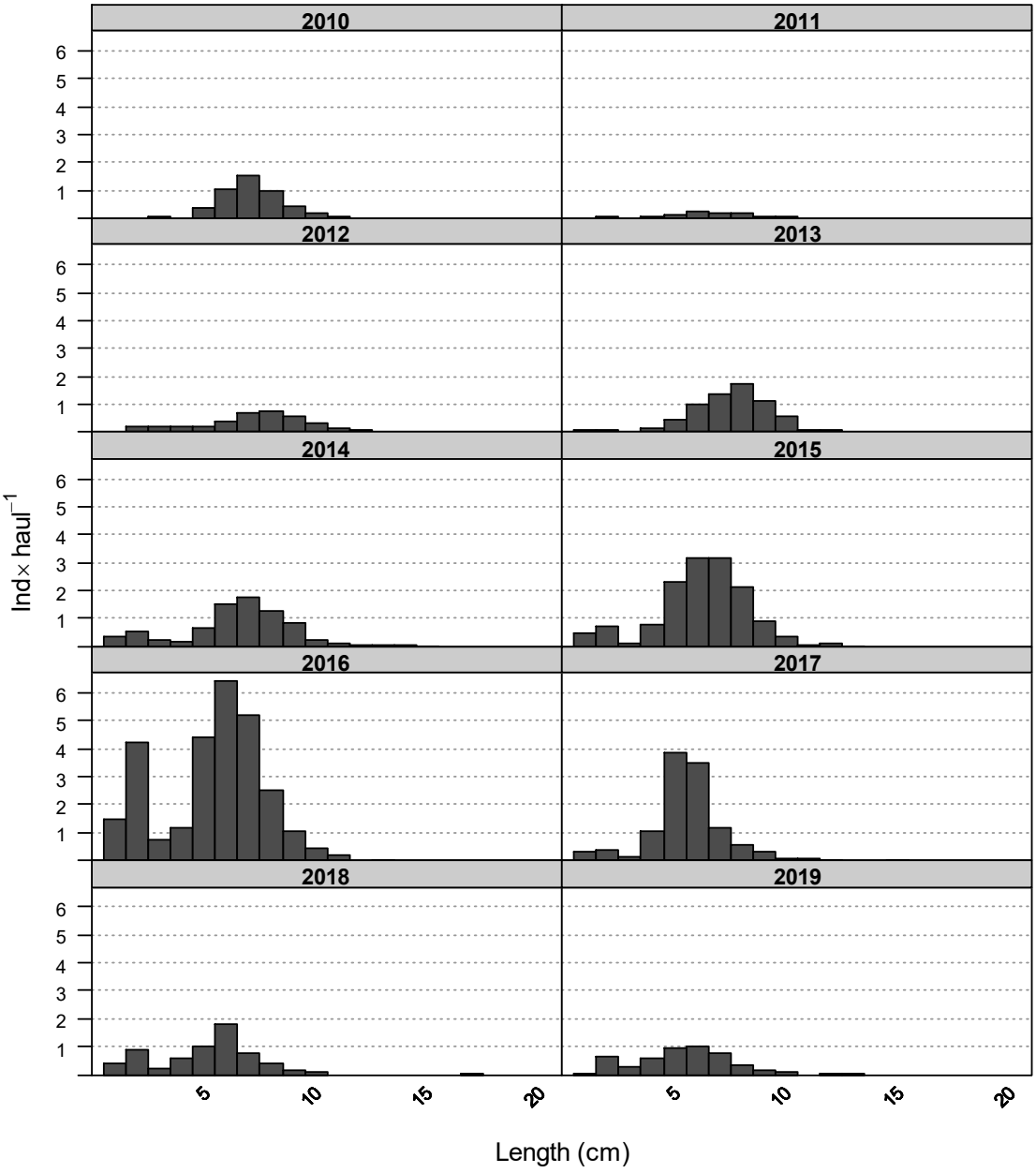

Figure 4. Mean stratified length distributions of *Eledone cirrhosa* in Porcupine surveys (2010-2019)

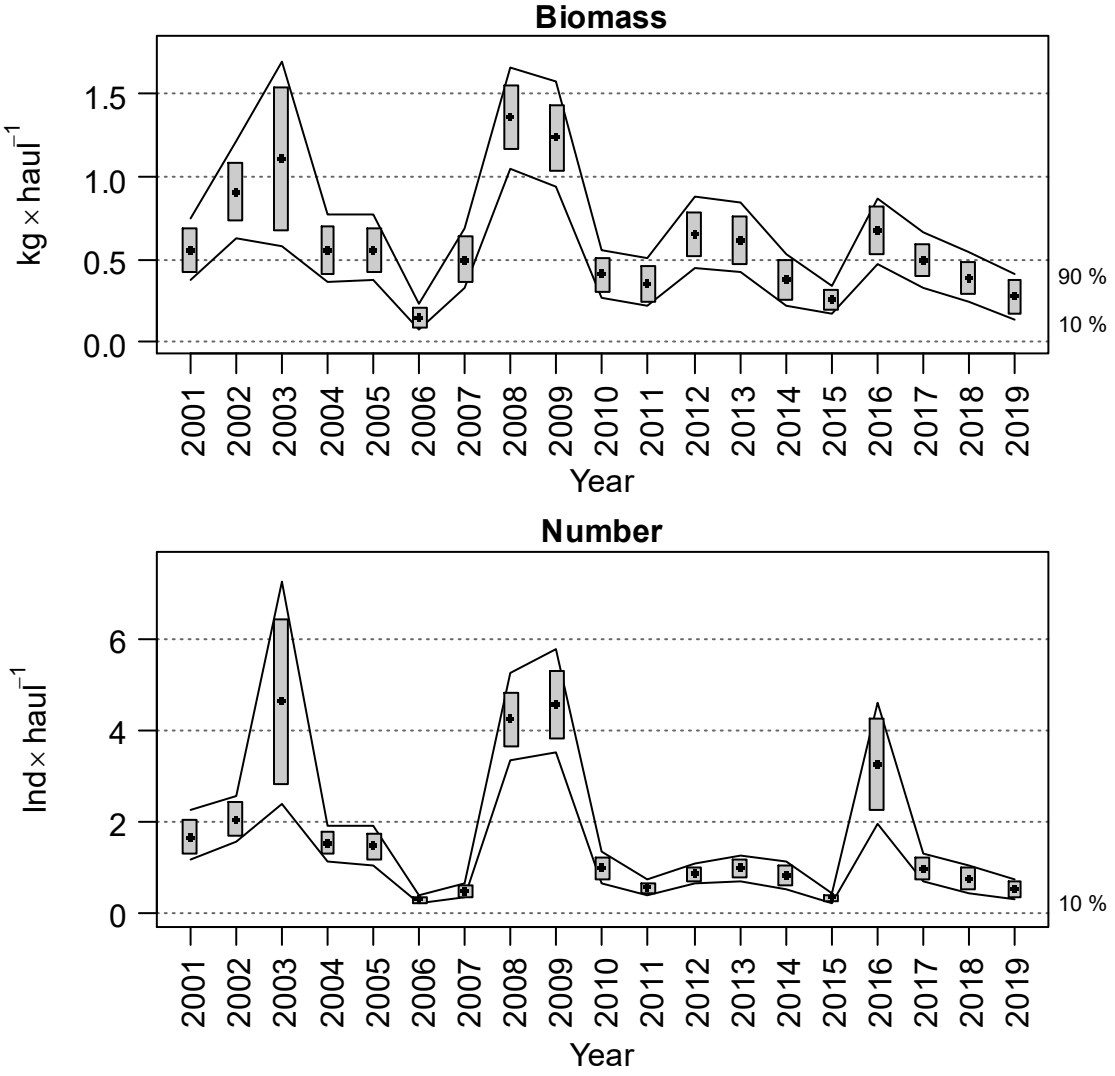

Figure 5. Evolution of *Todarodes sagitattus* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

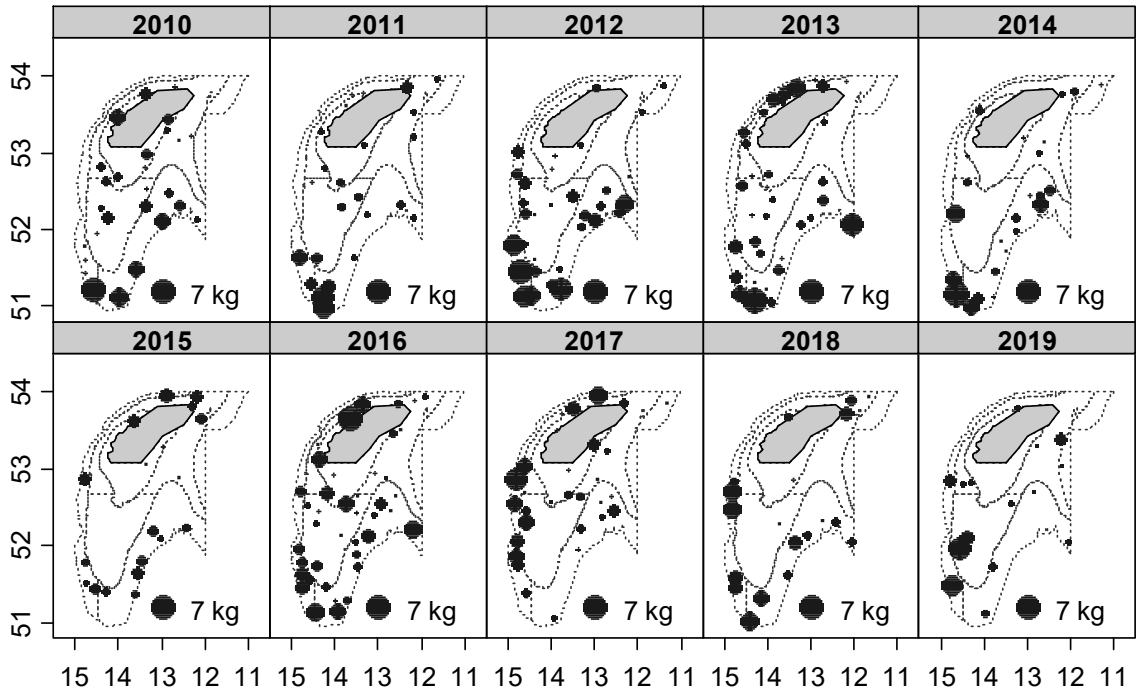

Figure 6. Geographic distribution of *Todarodes sagittatus* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

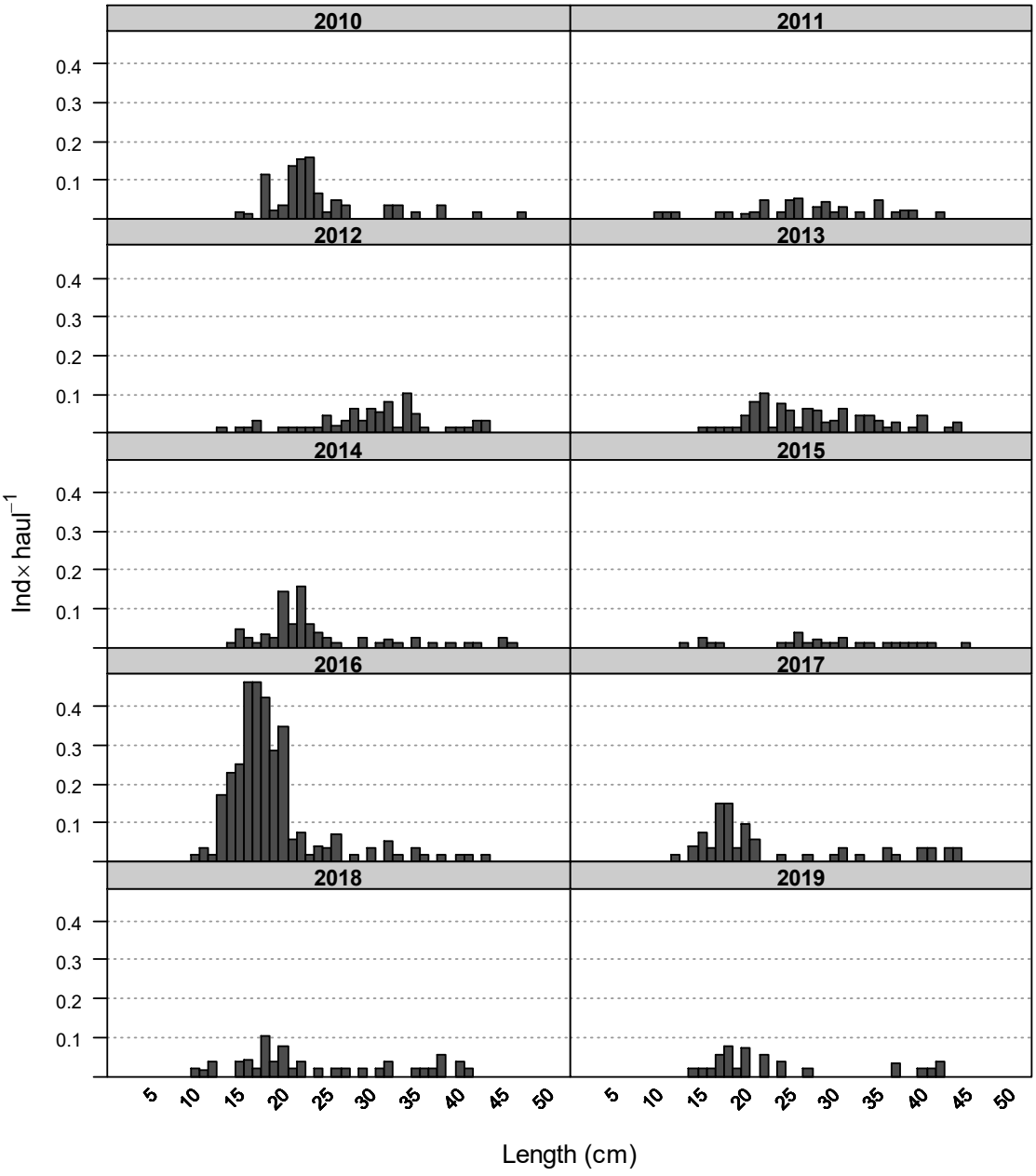

Figure 7. Mean stratified length distributions of *Todarodes sagitattus* in Porcupine surveys (2010-2019)

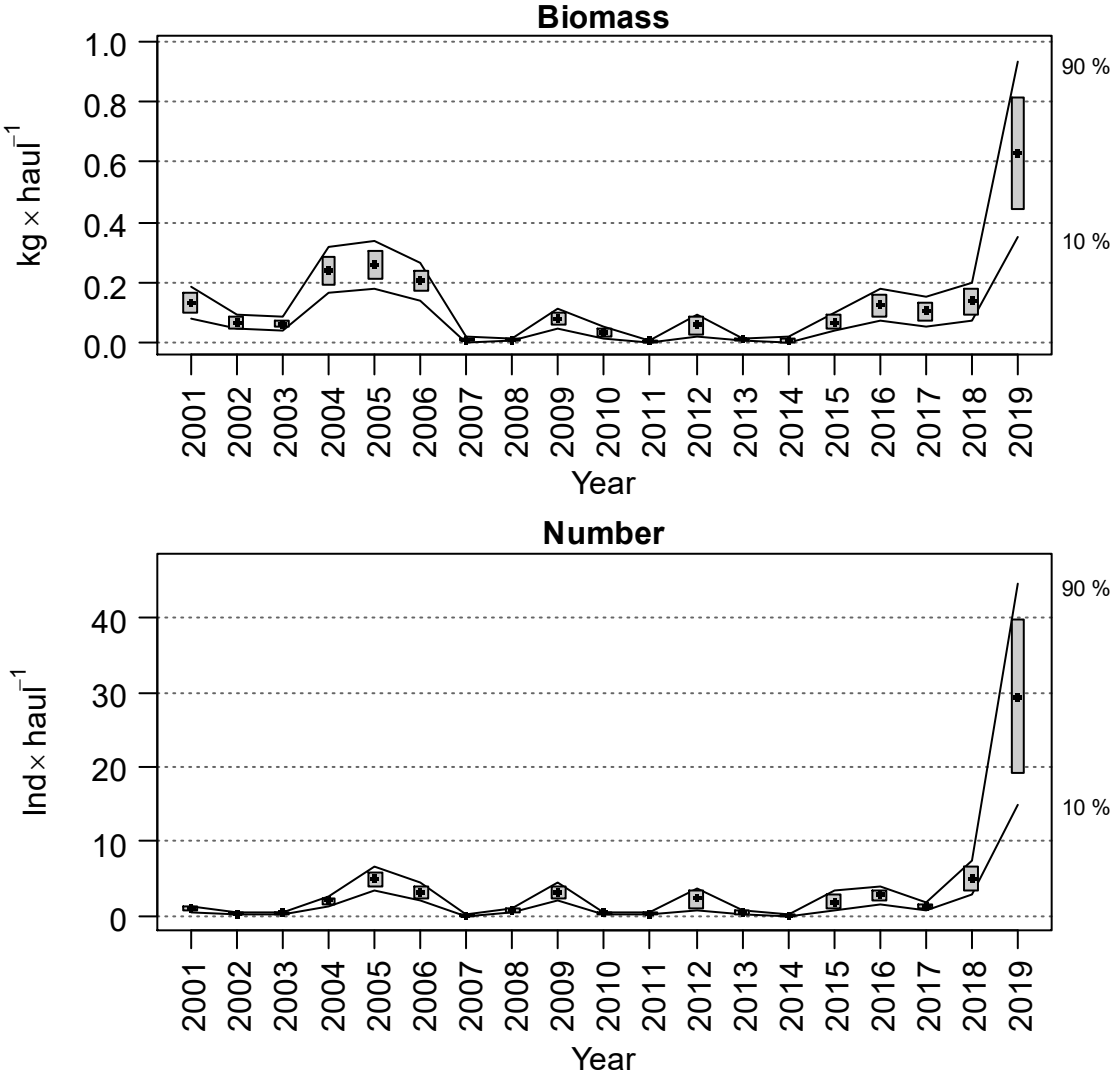

Figure 8. Evolution of *Todaropsis eblanae* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

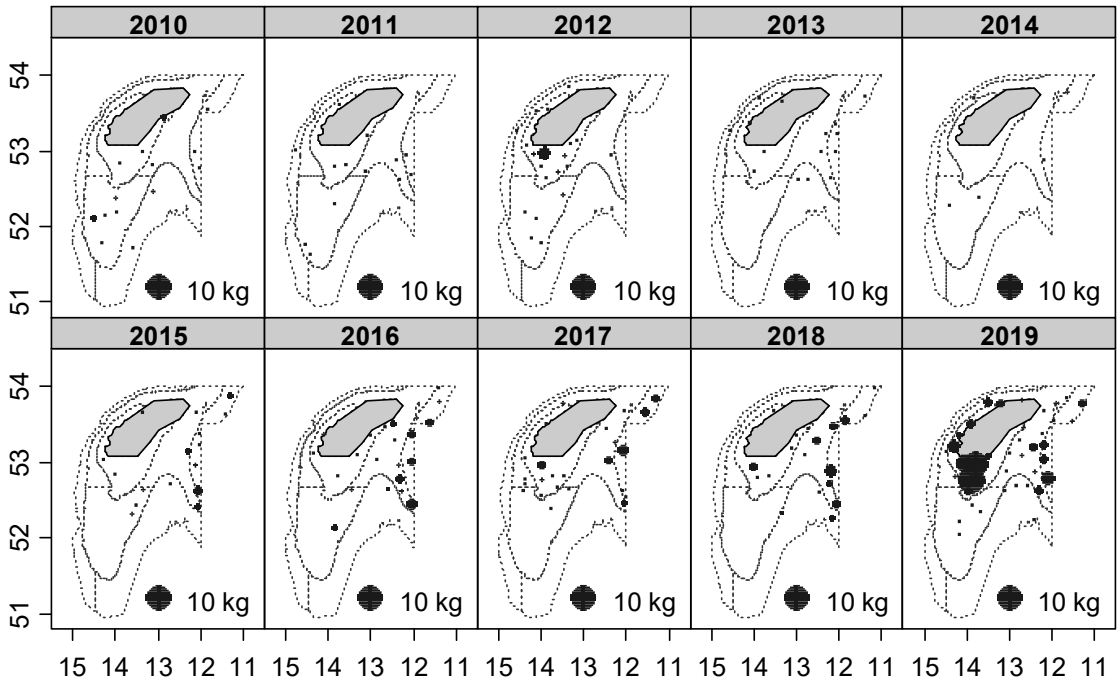

Figure 9. Geographic distribution of *Todaropsis eblanae* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

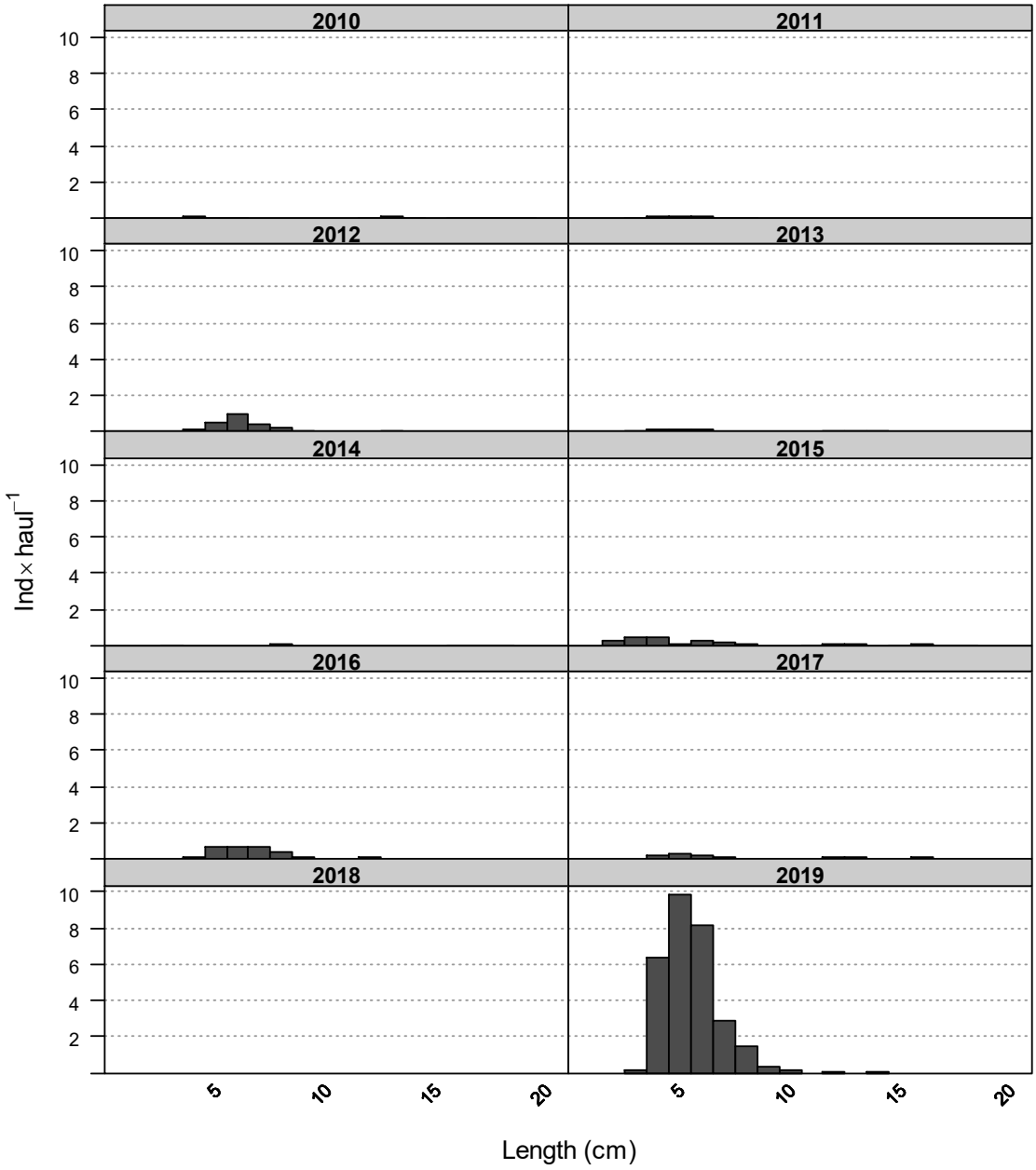

Figure 10. Mean stratified length distributions of *Todaropsis eblanae* in Porcupine surveys (2010-2019)

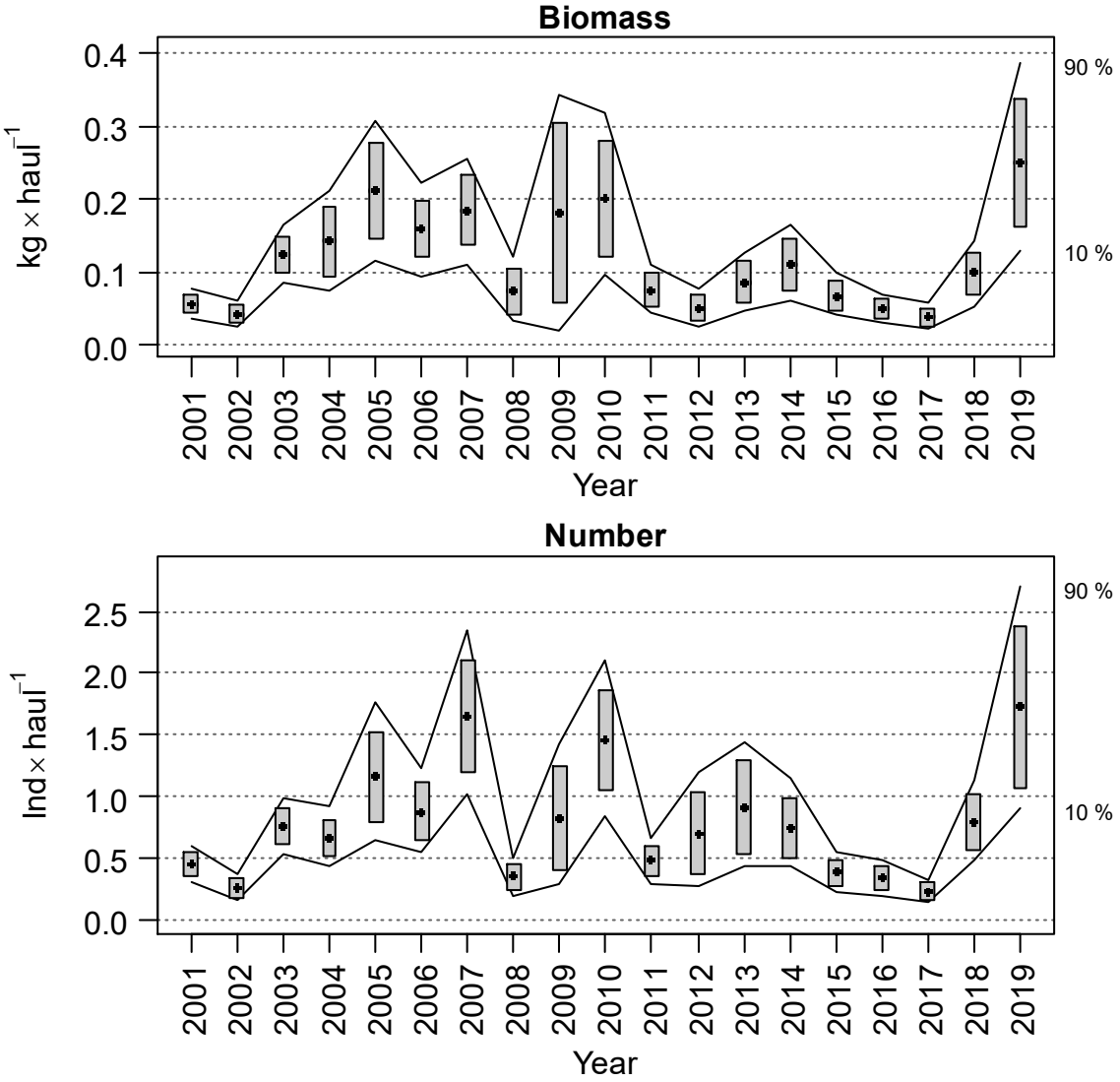

Figure 11. Evolution of *Bathypolypus sponsalis* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

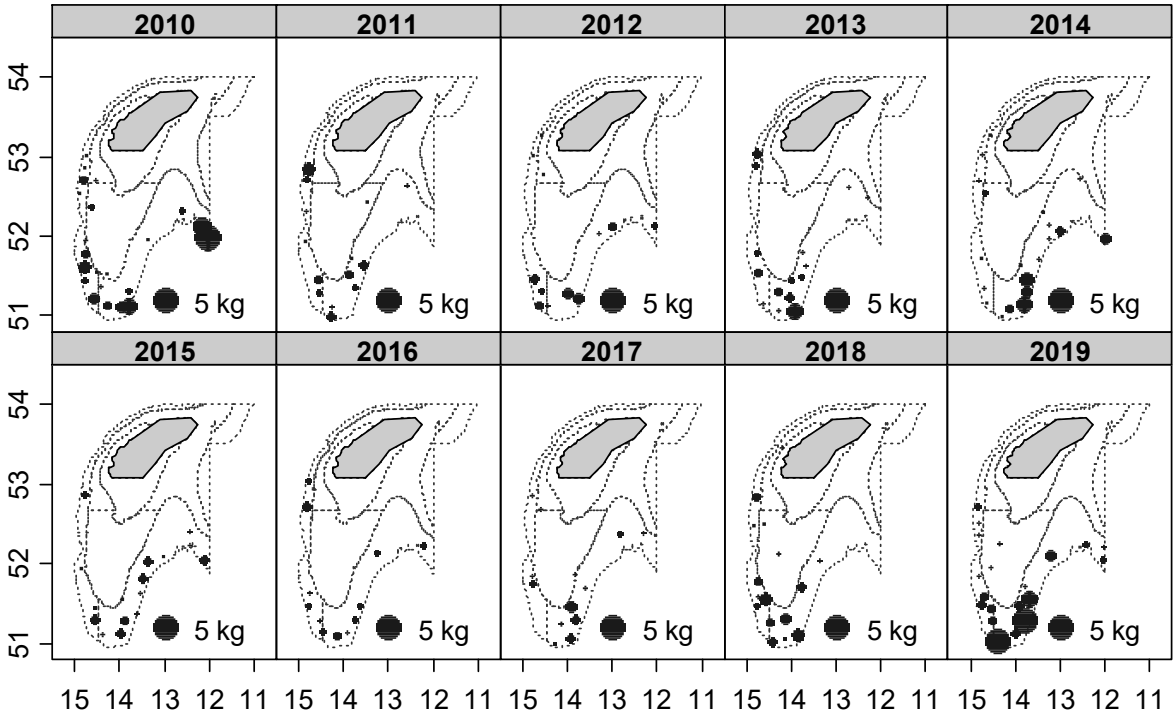

Figure 12. Geographic distribution of *Bathypolypus sponsalis* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

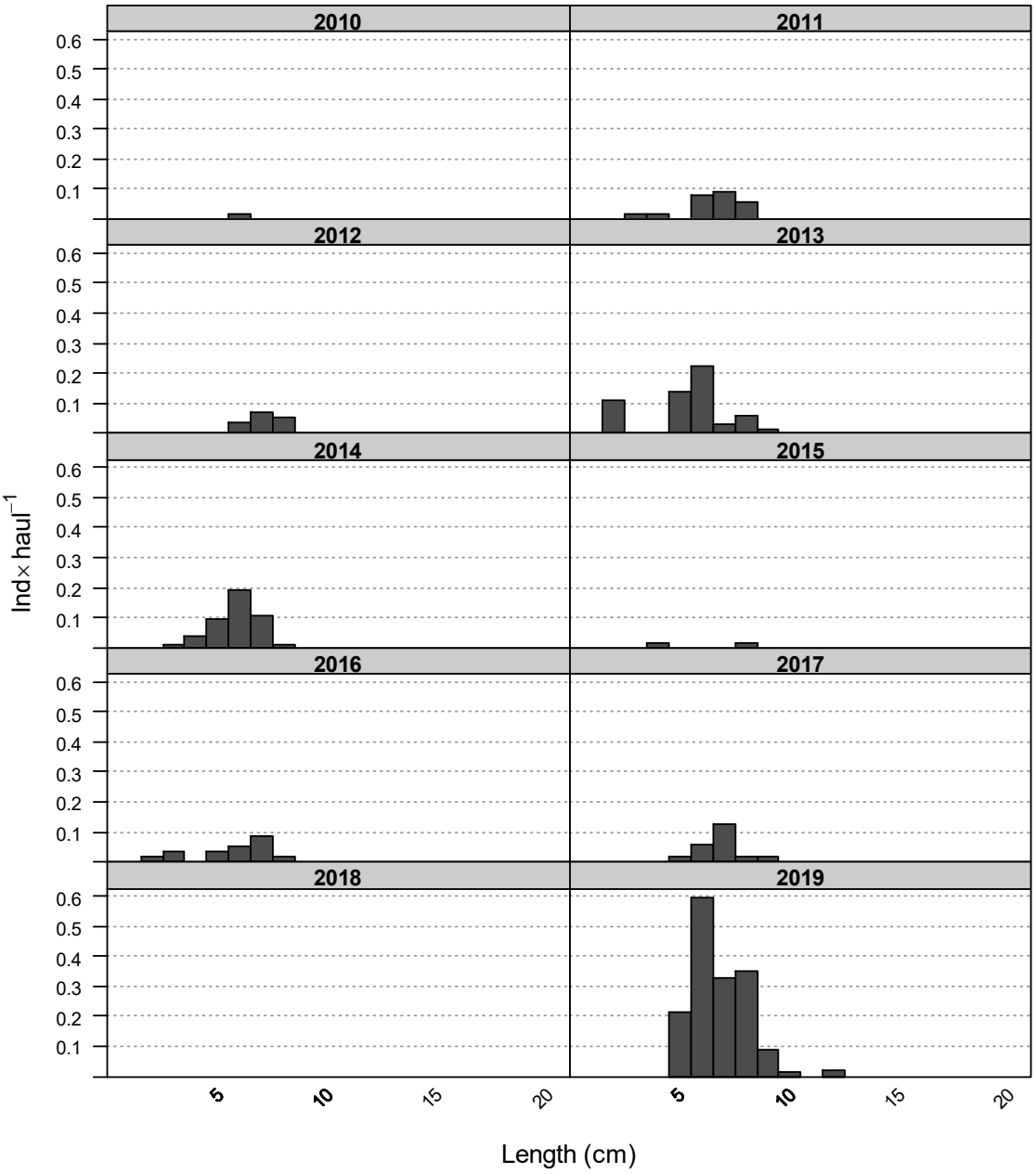

Figure 13. Mean stratified length distributions of *Bathypolypus sponsalis* in Porcupine surveys (2010-2019)

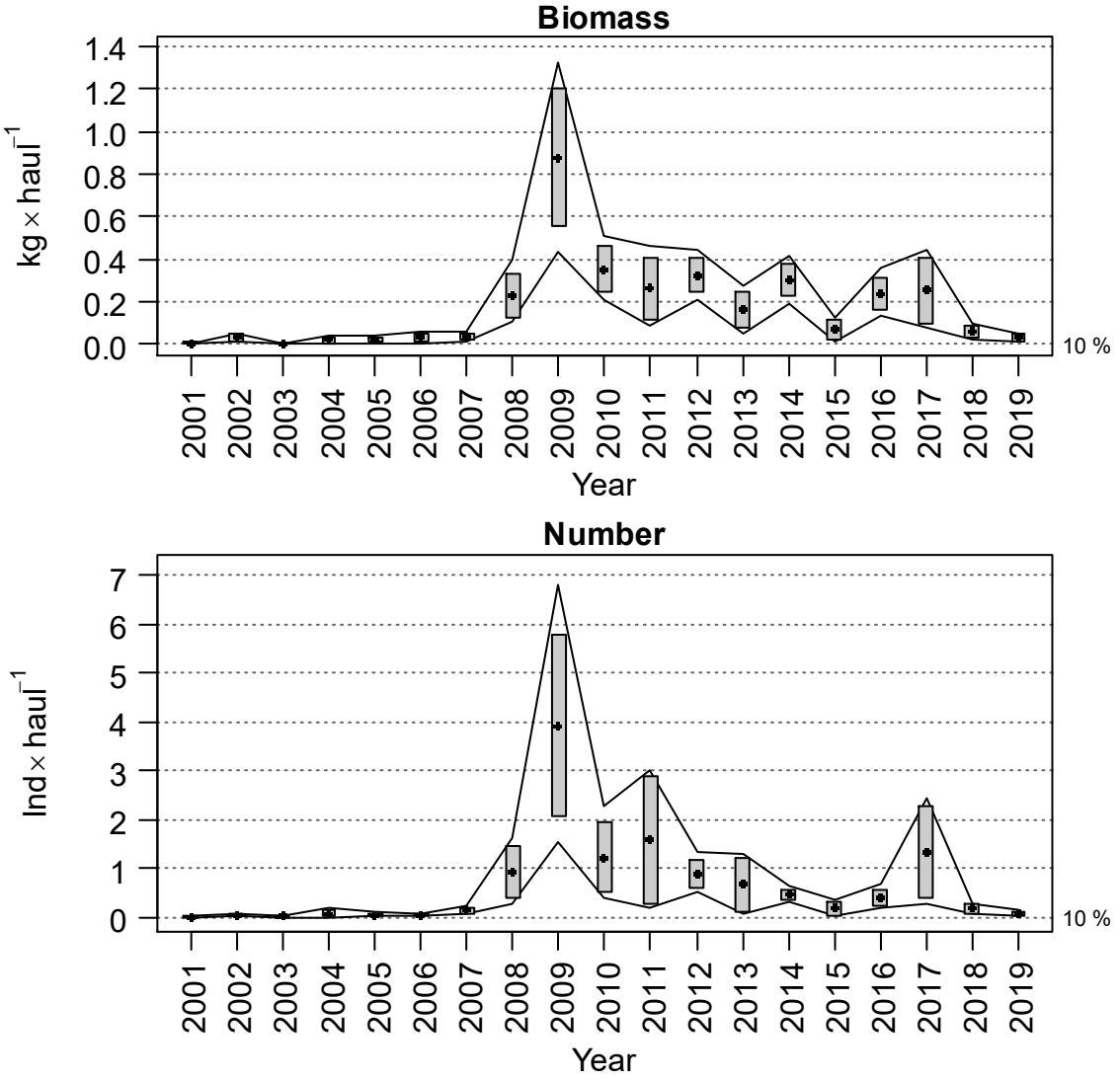

Figure 14. Evolution of *Loligo forbesi* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

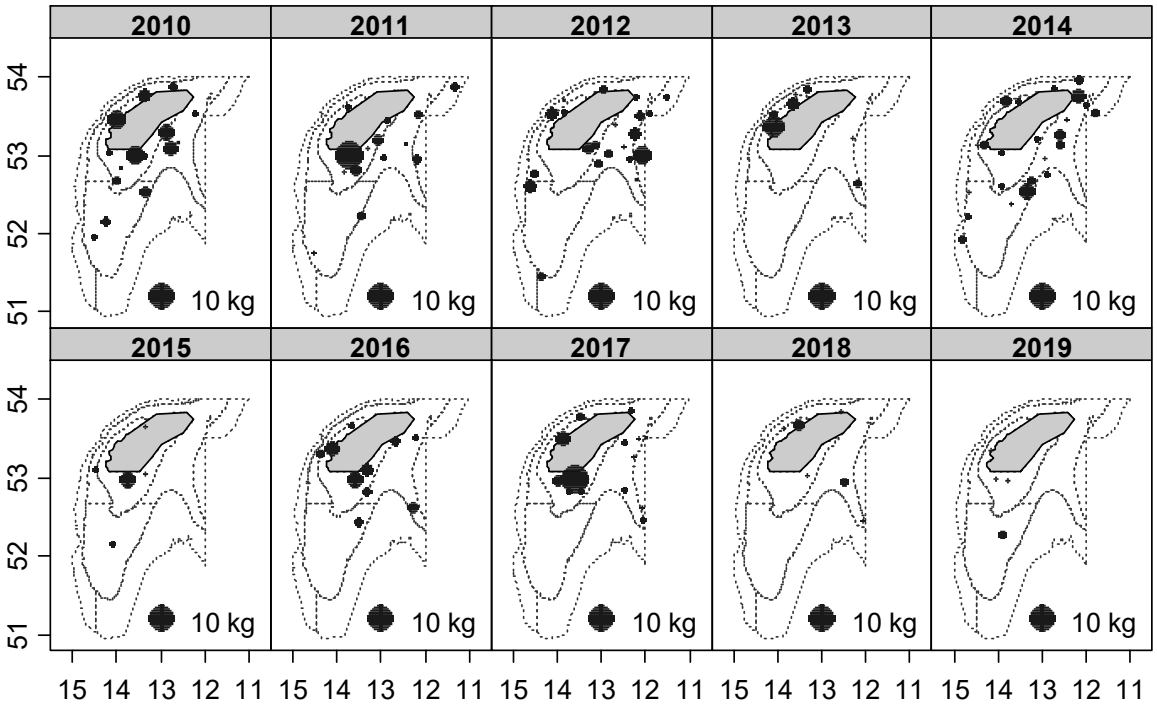

Figure 15. Geographic distribution of *Loligo forbesi* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

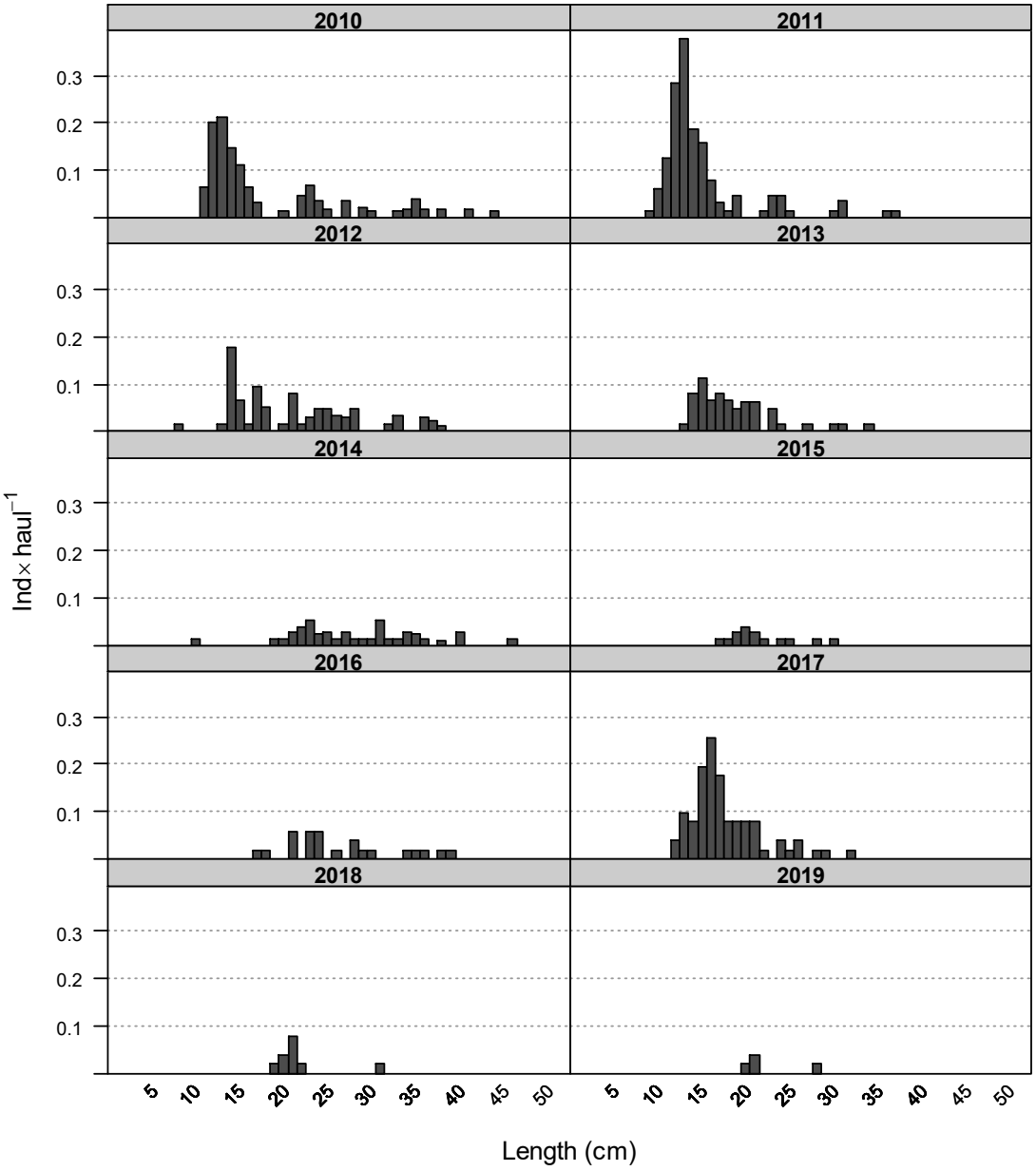

Figure 16. Mean stratified length distributions of *Loligo forbesi* in Porcupine surveys (2010-2019)

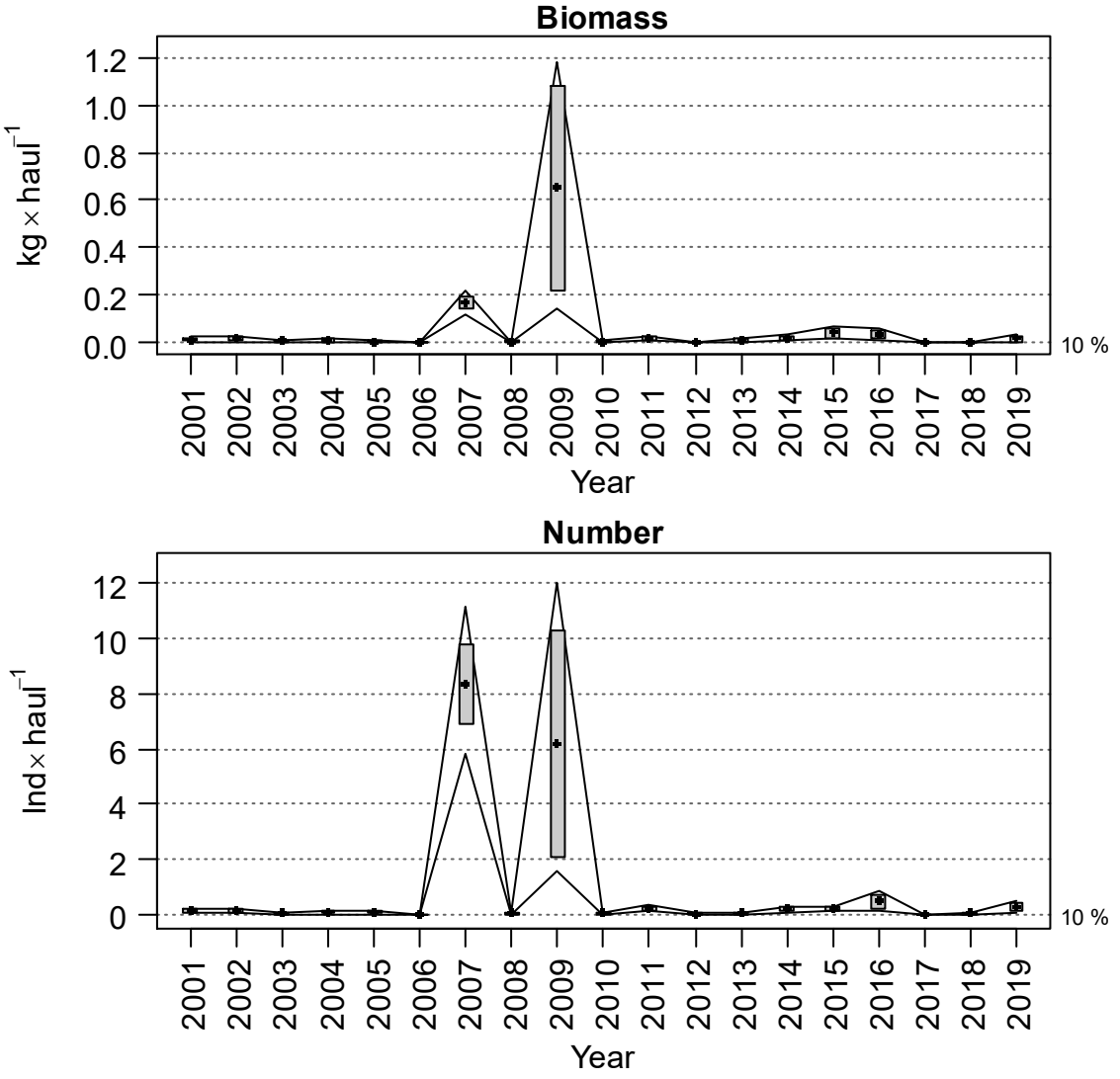

Figure 17. Evolution of *Illex coindetii* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

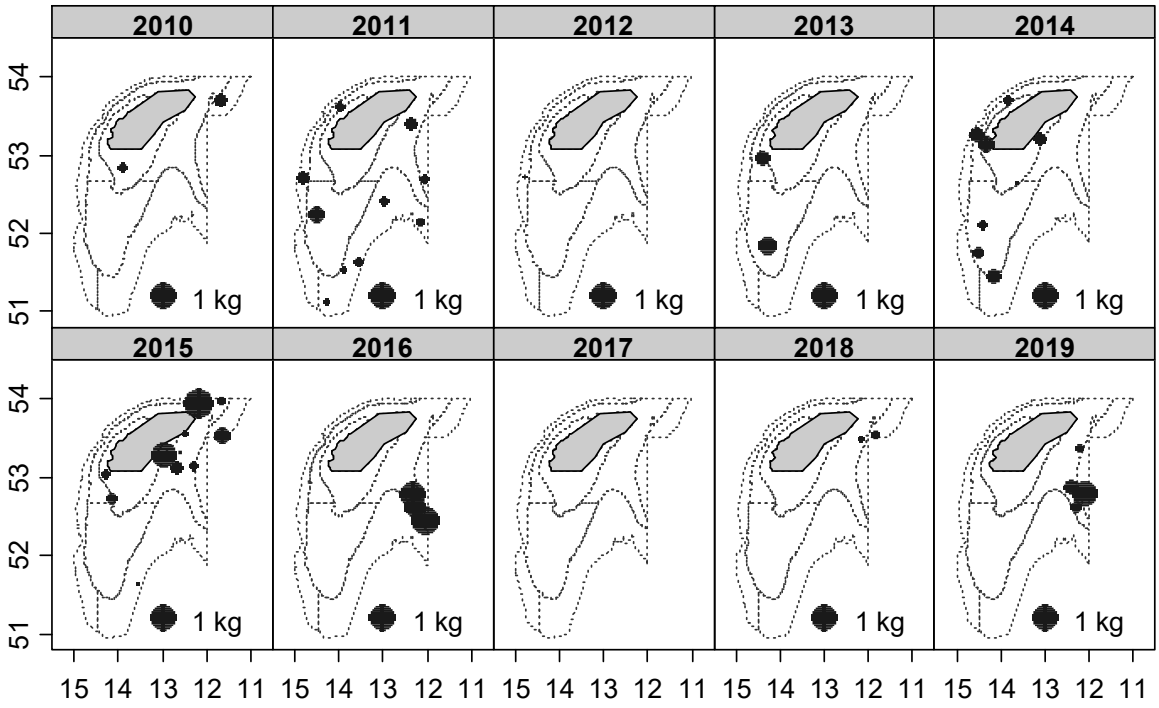

Figure 18. Geographic distribution of *Illex coindetii* catches (kg/30 min haul) in Porcupine surveys (2010-2019)

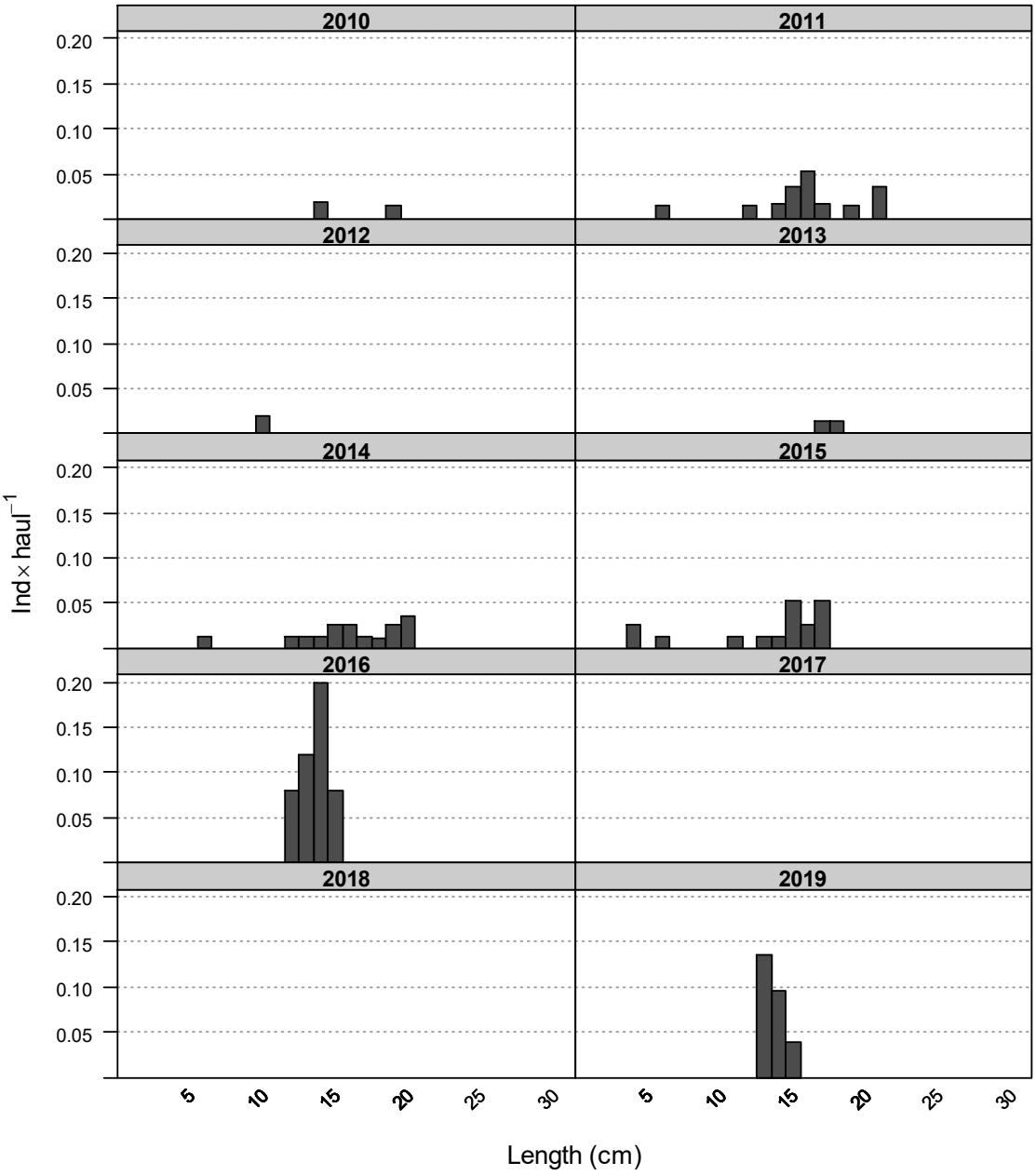

Figure 19. Mean stratified length distributions of *Illex coindetti* in Porcupine surveys (2010-2019)

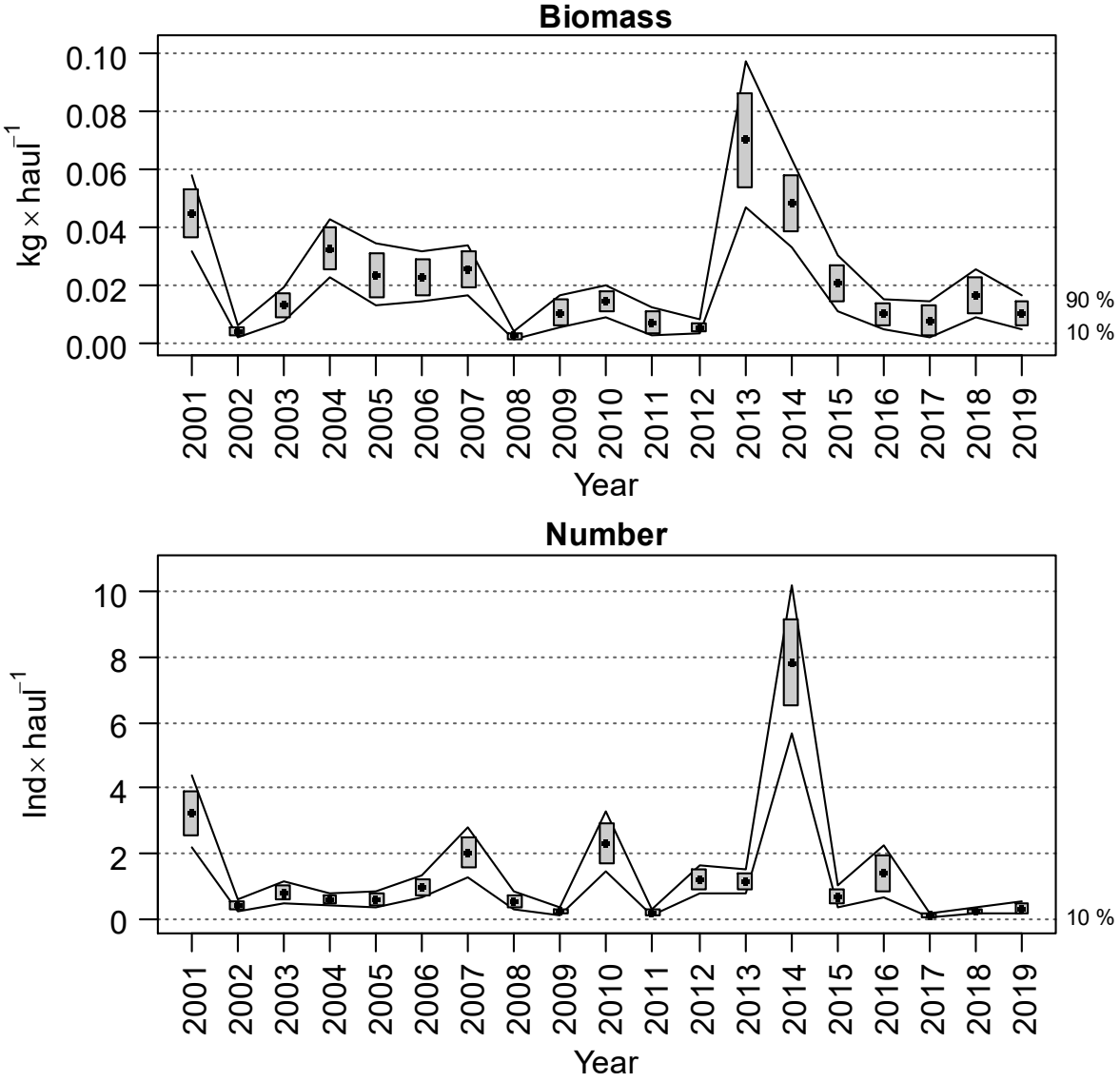

Figure 20. Evolution of *Rossia macrosoma* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

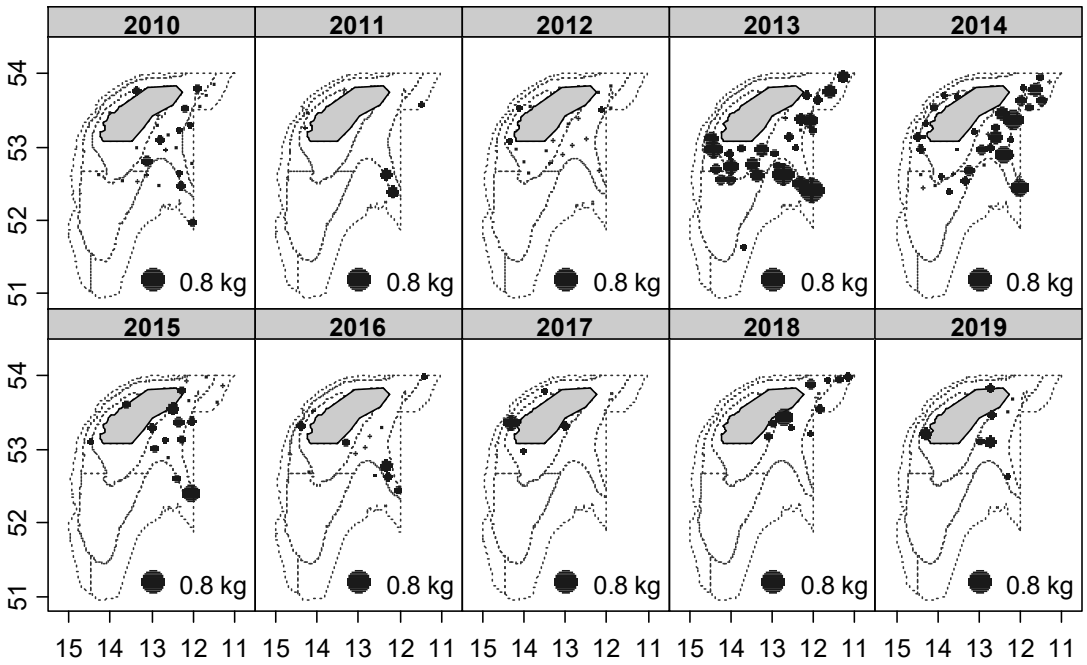

Figure 21. Geographic distribution of *Rossia macrosoma* catches (ind/30 min haul) in Porcupine surveys (2010-2019)

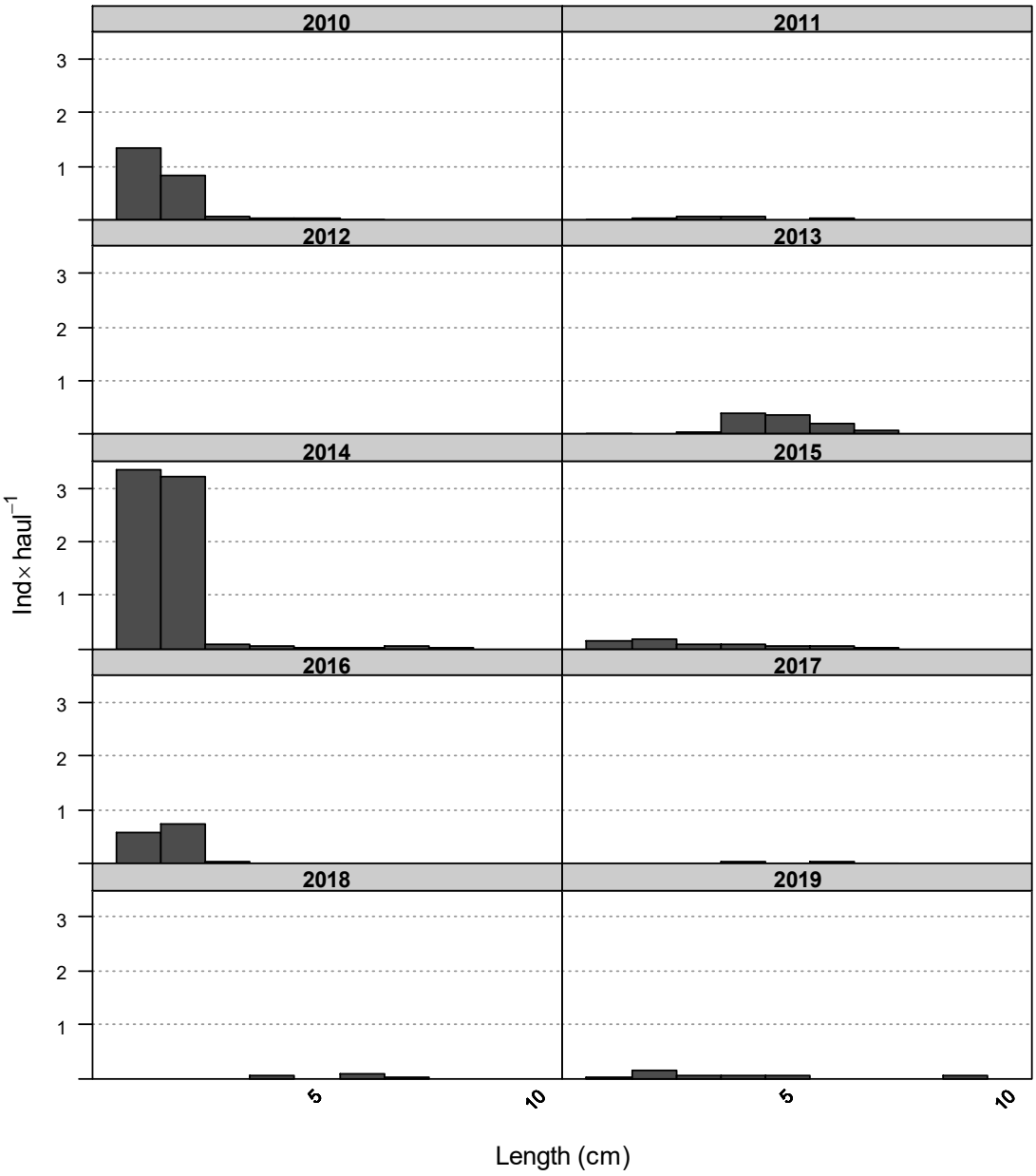

Figure 22. Mean stratified length distributions of *Rossia macrosoma* in Porcupine surveys (2010-2019)

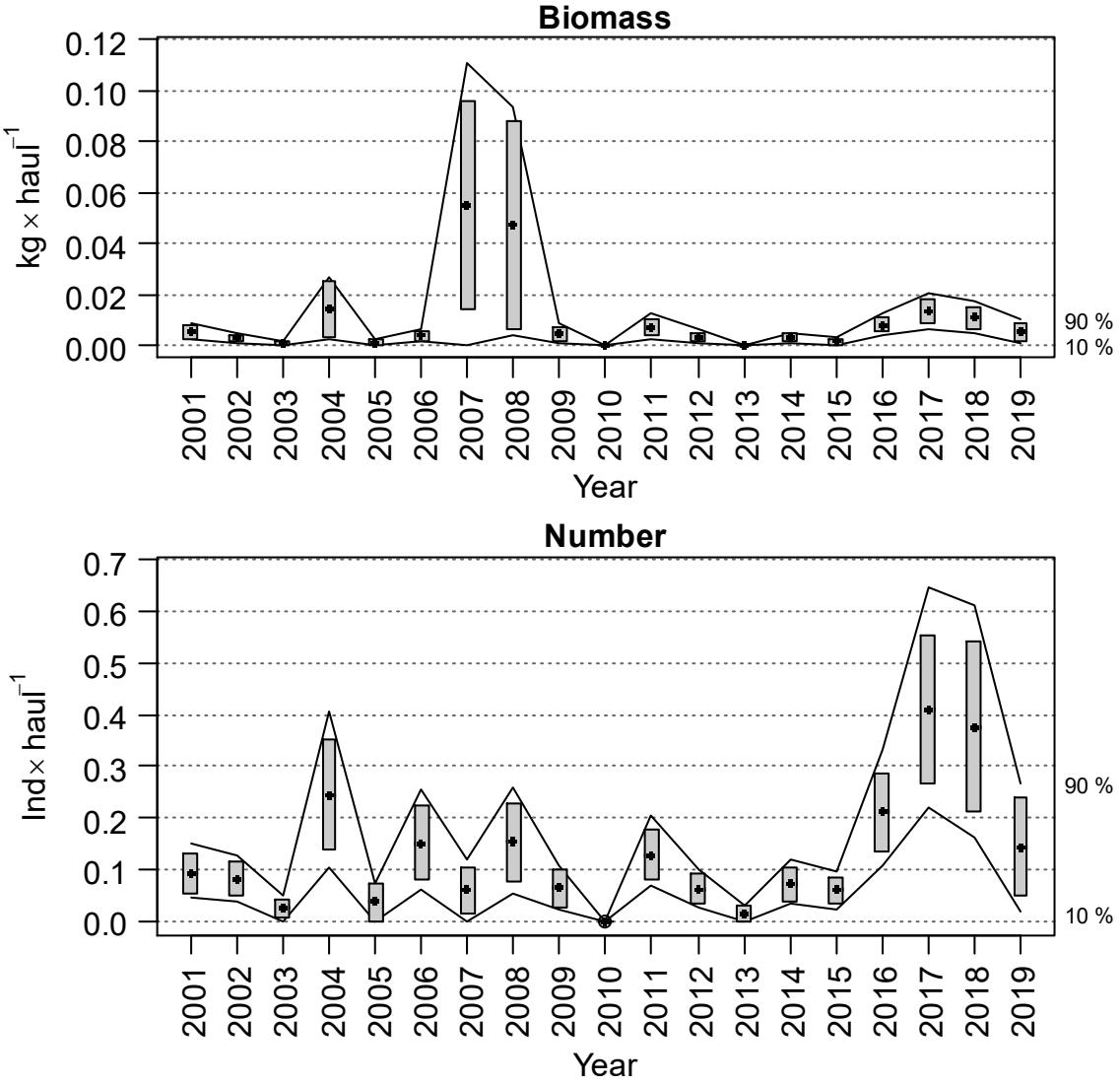

Figure 23. Evolution of *Histioteuthis reversa* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

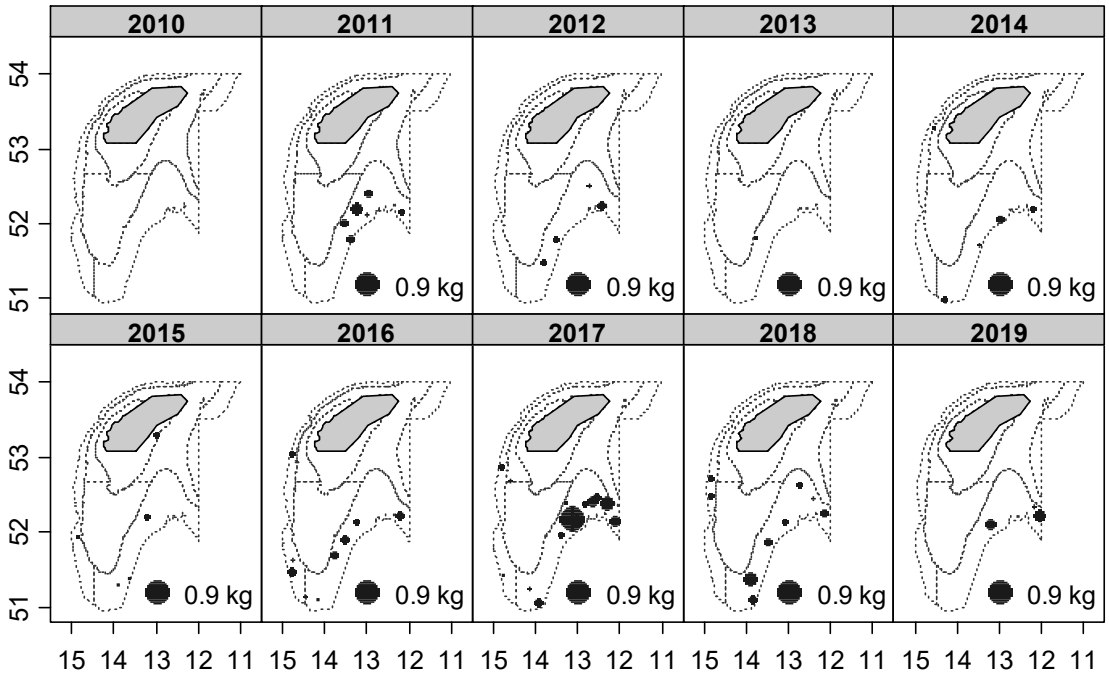

Figure 24. Geographic distribution of *Histioteuthis reversa* catches (kg×30 min haul-1) in Porcupine surveys (2010-2019)

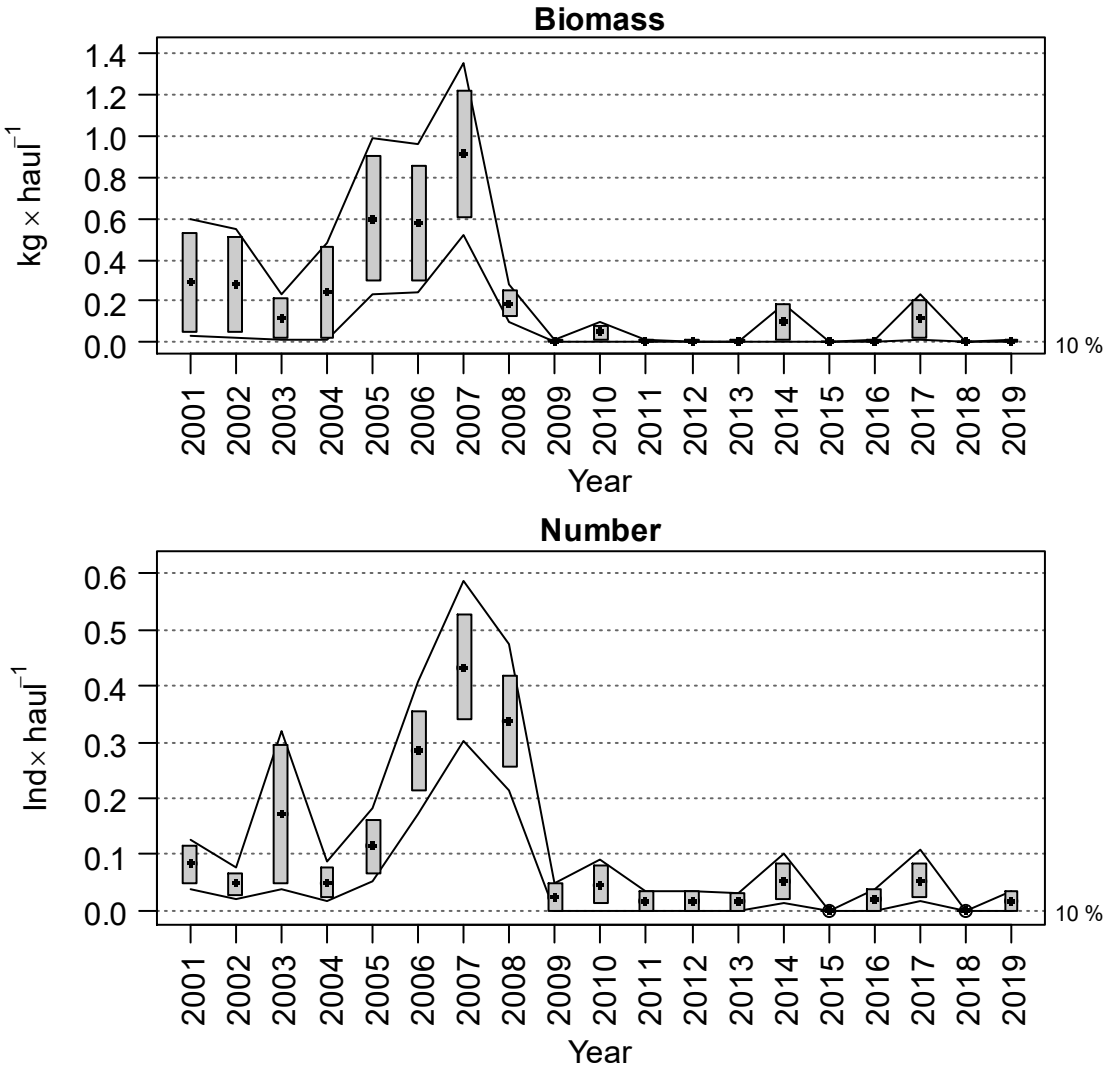

Figure 25. Evolution of *Haliphron atlanticus* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

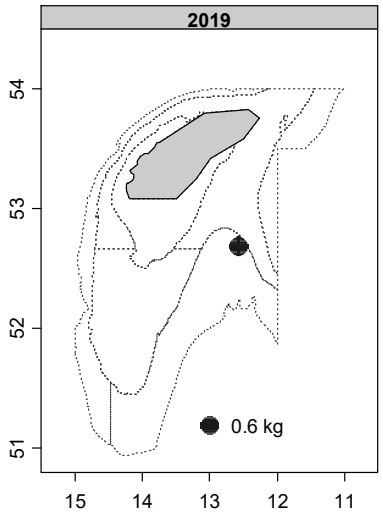

Figure 26. Geographic distribution of *Haliphron atlanticus* catches (kg×30 min haul-1) in Porcupine survey 2019

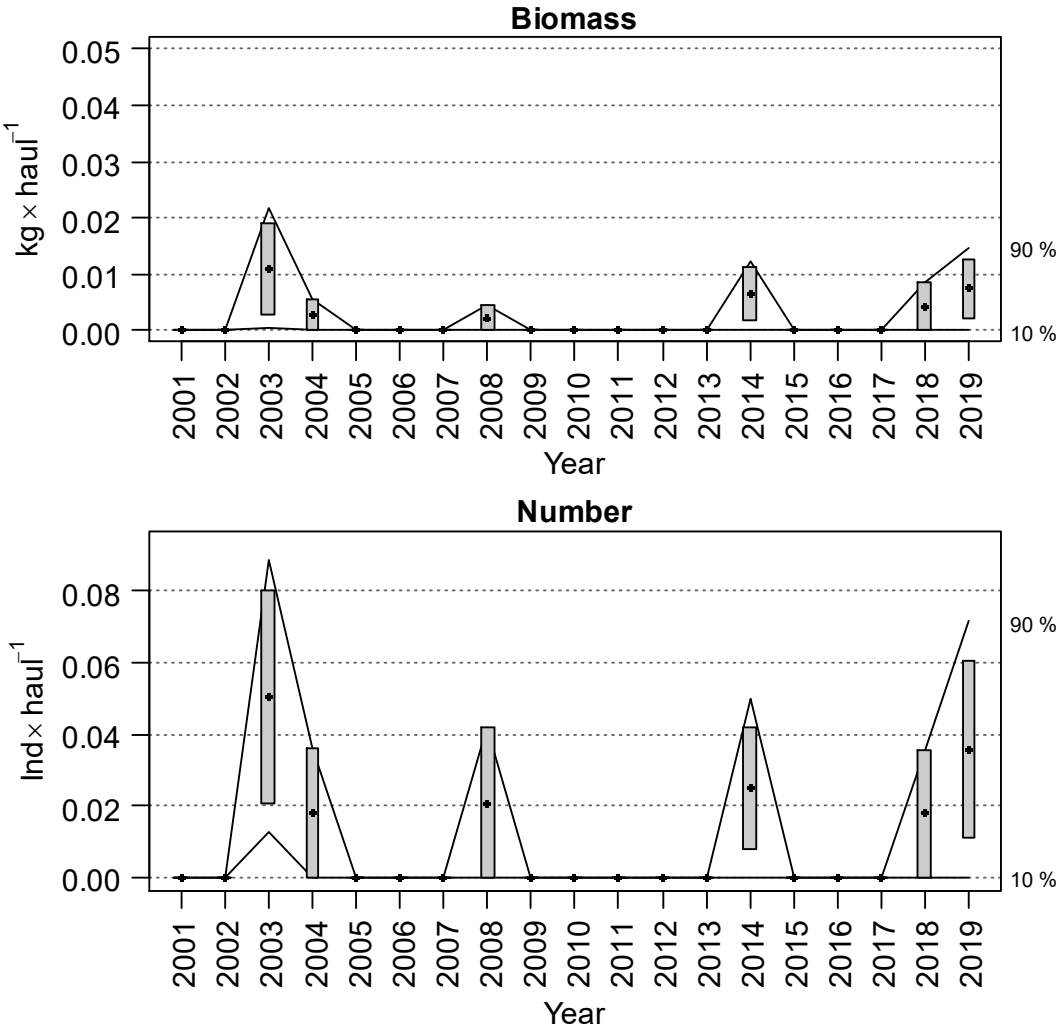

Figure 27. Evolution of *Octopus salutii* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

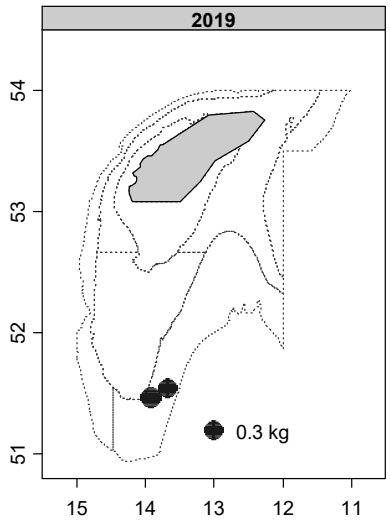

Figure 28. Geographic distribution of *Octopus salutii* catches (kg×30 min haul-1) in Porcupine survey 2019

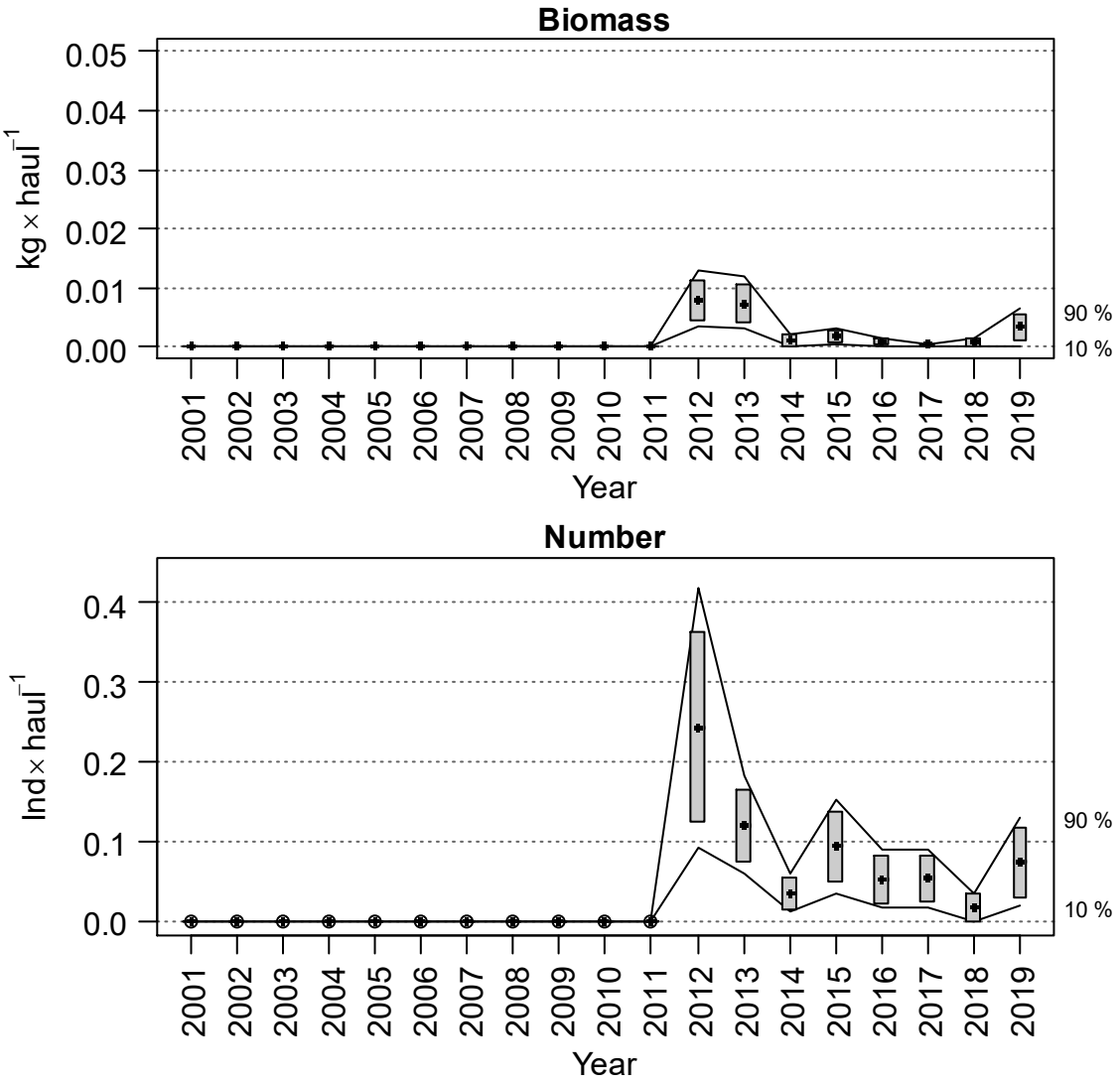

Figure 29. Evolution of *Ancistroteuthis lichtensteini* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

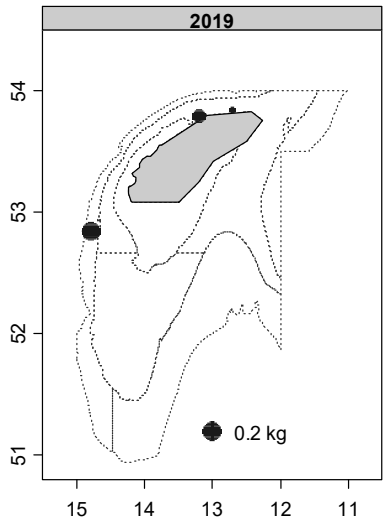

Figure 30. Geographic distribution of *Ancistroteuthis lichtensteini* catches (kg×30 min haul-1) in Porcupine survey 2019

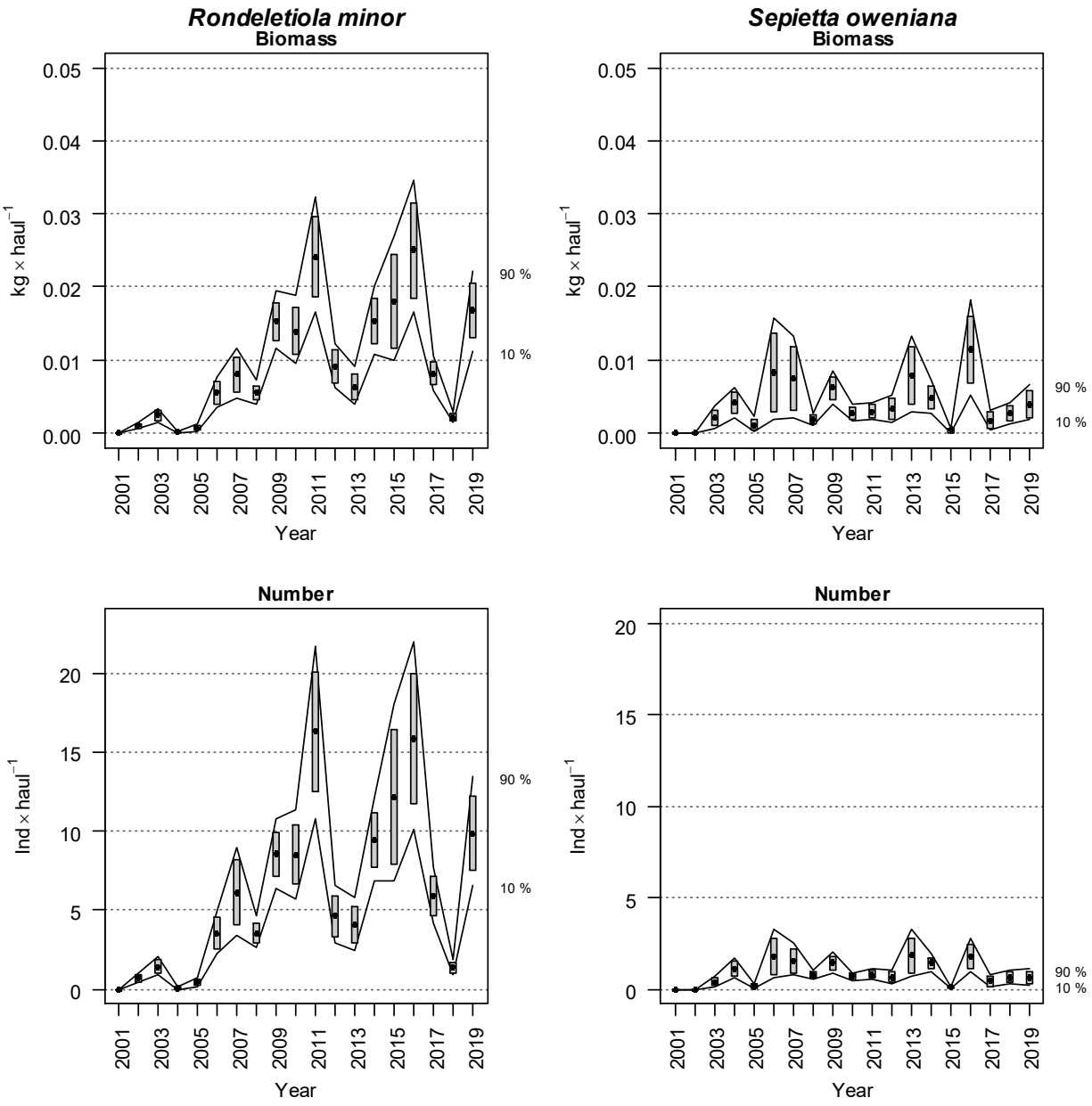

Figure 31. Evolution of *Rondeletiola minor* and *Sepietta oweniana* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

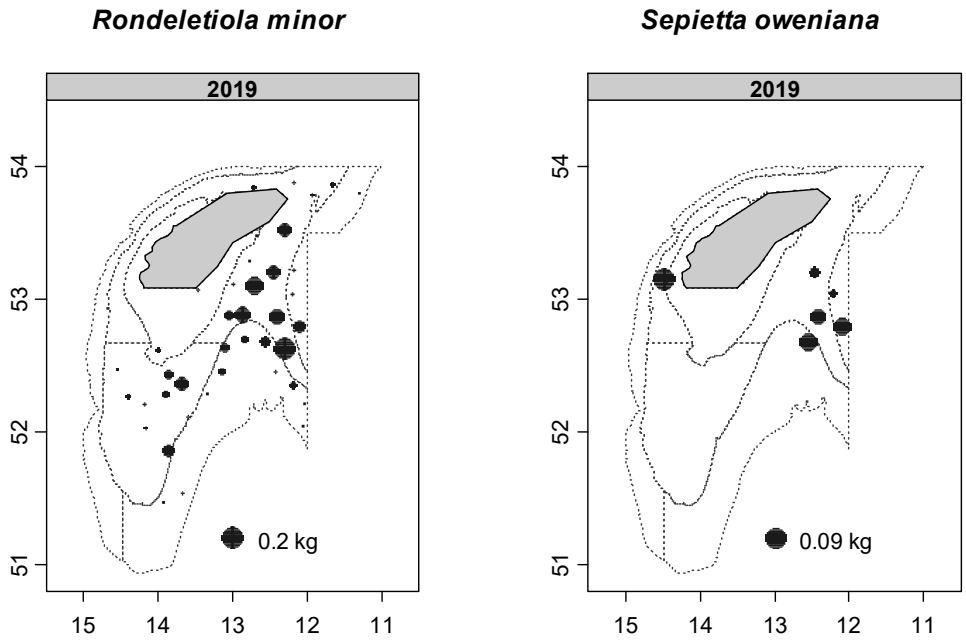

Figure 32. Geographic distribution of *Rondeletiola minor* and *Sepietta oweniana* catches (kg×30 min haul-1) in Porcupine survey 2019

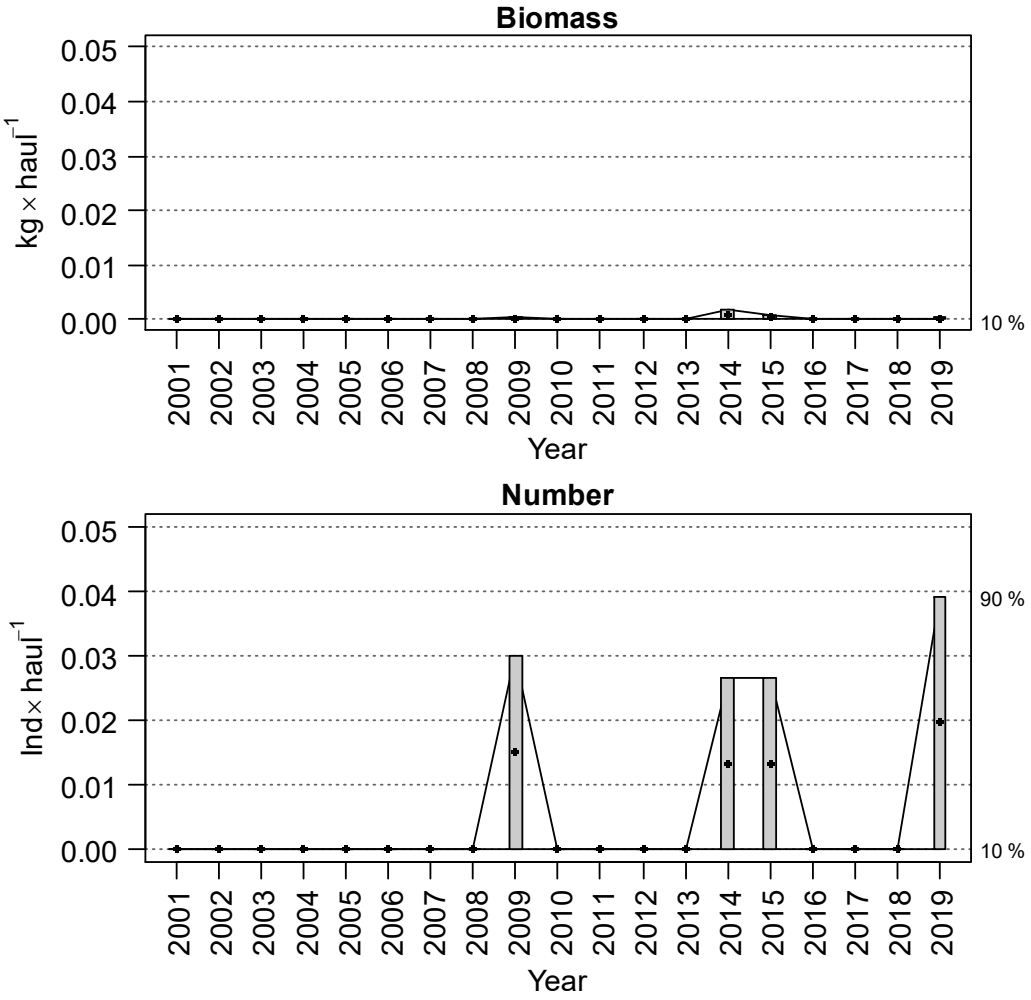

Figure 33. Evolution of *Sepia orbignyana* biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

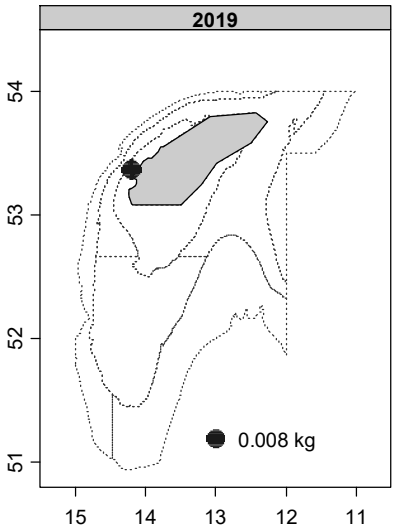

Figure 34. Geographic distribution of *Sepia orbignyana* catches (kg×30 min haul-1) in Porcupine survey 2019