Results on main cephalopods from the 2021 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 on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2021. Biomass, abundance, geographical distribution and length frequencies 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 have been analysed. The species E. cirrhosa, R. macrosoma and L. forbesi increased in terms of biomass and abundance, especially R. macrosoma, reaching the highest biomass value in the time series, whereas T. sagitattus increased only in abundance terms but decreased slightly in biomass terms. In contrast, T. eblanae and B. sponsalis decreased strongly after the high values of the previous two years, as did I. coindetii. Most of the usually scarce species increased their biomass, with the exception of H. reversa.

Introduction

The Spanish Bottom Trawl Survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been annually carried out 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, geographic distributions and length frequencies) of the most common cephalopods on Porcupine Bottom Trawl Surveys after the results presented previously (Fernández-Zapico *et al.* 2021, Ruiz-Pico *et al.* 2020, Ruiz-Pico *et al.* 2019, Blanco *et al.* 2018, Ruiz-Pico *et al.* 2012). The species analysed were *Eledone cirrhosa* (horned octopus) and *Bathypolypus sponsalis* (globose octopus) (fam. Octopodidae), *Todarodes sagittatus* (European flying squid), *Todaropsis eblanae* (lesser flying squid) and *Illex coindetii* (broadtail shortfin squid) (fam. Ommastrephidae), *Loligo forbesi* (veined squid) (fam. Loliginidae), *Rossia macrosoma* (stout bobtail squid) (fam. Sepiolidae) and the scarce species *Histioteuthis reversa* (reverse jewel squid) (fam. Histioteuthidae), *Ancistroteuthis lichtensteinii* (angel clubhook squid) (fam. Onychoteuthidae), *Rondeletiola minor* (lentil bobtail squid), Sepia elegans (elegant cuttlefish) and *Sepietta oweniana* (common bobtail squid) (fam. Sepiolidae).

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 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 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 continuing the problems created by the pandemic and the COVID-19 disruption, Porcupine Groundfish survey was carried out without major problems.

In 2021, 80 valid standard hauls and 14 additional hauls were carried out. Among the additional hauls, five of them have been carried out into the standard stratification, to improve coverage in the gaps left by random sampling and nine of them, between 994 and 1484 m, to explore the continuity of the fish community in Porcupine Seabight (Figure 1).

Cephalopods represented a small percentage of the mean stratified biomass of invertebrates caught (1%), but they were 74% of the mean stratified biomass of molluscs in this last survey. The species with the largest stratified biomass were *Eledone cirrhosa* (horned octopus), *Todarodes sagittatus* (European flying squid), *Todaropsis eblanae* (lesser flying squid), *Rossia macrosoma* (stout bobtail squid), *Bathypolypus sponsalis* (globose octopus) and *Loligo forbesi* (veined squid). Other scarce cephalopods were *Histioteuthis reversa* (reverse jewell squid), *Illex coindetii* (broadtail shortfin squid), *Ancistroteuthis lichtensteinii* (angel clubhook squid), *Rondeletiola minor* (lentil bobtail squid), Sepia elegans (elegant cuttlefish) and *Sepietta oweniana* (common bobtail squid). *Histioteuthis bonnellii*, *Haliphron atlanticus* and *Sepia orbignyana*, occasionally caught, were not found this last year.

In 2021, the species *E. cirrhosa, R. macrosoma* and *L. forbesi* increased in terms of biomass and abundance, especially *R. macrosoma*, reaching the highest biomass value in the time series, whereas *T. sagitattus* increased only in abundance terms but decreased slightly in biomass terms. In contrast, *T. eblanae* and *B. sponsalis* decreased sharply after the high abundances of the previous two years, as did *I. coindetii*.

Most of the usually scarce species increased their biomass, with the exception of *H. reversa*.

Regarding distribution, *E. cirrhosa*, *T. eblanae*, *I. coindetii* and *R. macrosoma* occurred on the Irish shelf and/or in the shallower strata around the bank, as usual, whereas *T. sagittatus*, *B. sponsalis* and *H. reversa* occurred mainly in the deeper strata to the south.

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

E. cirrhosa represented 44% of the mean stratified cephalopod biomass in 2021. Biomass and abundance increased moderately, slightly recovering from the low values of recent years after de drop from the 2016 peak (Figure 2).

Biomass spots were again found on the Irish shelf and also around the bank, increasing in the latter survey to the south of the bank (Figure 3).

Length distribution is very similar to last two years, showing a mode around 6 cm. A slight increase in small individuals can be observed (Figure 4).

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

In 2021, the biomass of *T. sagittatus* was 29% of the mean stratified cephalopod biomass. Although the biomass decreased marginally in the latest survey, it remained slightly below the average values of the time series. However, abundance in number increased moderately, reaching a rather high value in the time series (Figure 5).

T. sagittatus was distributed as usual, mainly in the deeper strata (Figure 6).

The lack of individuals below 10 cm, that were found in the previous year, is noted, as well as a considerable increment in the abundance of 11-14 cm length individuals. The mode is drawn in 13 cm (Figure 7).

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

The biomass of *T. eblanae* was 8% of the mean stratified biomass of the cephalopods caught in this last survey. Both biomass and abundance of this species has continued decreasing after the peak reached two years ago, coming back to average values in the time series (Figure 8).

The usual distribution on the Irish shelf and also around the bank was shown (Figure 9). Recruitment has increased slightly, but the abundance of individuals between 6 and 10 cm decreased considerably compared to the previous year. However, the length range has widened to 17 cm (Figure 10).

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

In 2021, *R. macrosoma* (around 6% of the mean stratified biomass of cephalopods caught) again increased strongly in biomass terms, reaching the highest value of the time series, and it also increased in abundance terms, reaching values relatively large in the temporal series (Figure 11).
It has been mainly caught in the northeastern area, showing some large biomass patches also to the southwesternmost peak of the bank in this last survey (Figure 12).
The length distribution ranged from 1 cm to 7 cm, with a mode at 4 cm (Figure 13).

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

The biomass of *B. sponsalis* represented 6% of the biomass of cephalopods caught. Both biomass and abundance have continued to decline since the peak in 2019, reaching rather low values in the time series (Figure 14).
B. sponsalis was distributed in the deepest southern area, as usual (Figure 15). The specimens ranged from 3 to 9 cm, with a mode in 8 cm (Figure 16).

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

L. forbesi represented only 5% of the mean stratified biomass of the cephalopods caught. Both biomass and abundance kept the low values from the previous three years, although abundance increased slightly (Figure 17).

This species is distributed, as usual, in the northern part of the study area, mainly around the central mound of the bank (Figure 18).

Sizes ranged between 11 cm and 33 cm in 2021, with the mode in 15 cm and quite a few gaps in some intermediate sizes (Figure 19).

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

I. coindetii (only 1% of the mean stratified biomass of cephalopods caught) fell sharply in 2021, after the peak of the previous year, returning to the usual low values of the time series (Figure 20). This species has been caught to the west and southeast of the bank on this latest survey (Figure 21).
Only two individuals, 13 and 21 cm in length have been caught in the latest survey (Figure 22).

Other scarce cephalopods species

H. reversa has decreased slightly in 2021 after the small increase in the previous year, returning to the usual scarce values of the time series (Figure 23). It was caught in three hauls in the deeper southern area, as usual (Figure 24), and sizes ranged between 6 and 7 mm. However, the species *H. bonnelli* was not captured in this last survey, neither was *Haliphron atlanticus.*

The species *Ancistroteuthis lichtensteinii* in 2021 increased remarkably, considering its historical values, both in biomass and abundance, also *Rondeletiola minor* did increase in 2021 survey, although less markedly than the previous species (Figure 25). Angel clubhook squid (*A. lichtensteinii*) was caught in nine hauls, between 466 and 1165 m deep, whereas lentil bobtail squid (*R. minor*) was wider and shallower distributed around the study area, between 275 and 647 m deep (Figure 26). The length range was between 5 and 18 cm for the first species.

In 2021, the remaining species of the Sepiolidae family, *Sepia elegans* and *Sepietta oweniana*, also increased in both biomass and abundance compared to the previous year. Especially *S. elegans*, that has reached the second highest value in the time series (Figure 27). They were distributed near the Irish shelf and also around the bank (Figure 28).

Acknowledgements

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References

Blanco, M., Ruiz-Pico, S., Velasco, F., Baldó, F. and Silva, L. 2018. Results on main cephalopods species captured in the bottom trawl surveys in the Porcupine Bank (Division 7c and 7k). Working Document presented to ICES WGCEPH 2018. 25 pp.

Fernández-Zapico O., Ruiz-Pico, S., Blanco, M., Velasco, F., Baldó, F. 2021. Results on main cephalopods from the Spanish Ground Fish Survey on the Porcupine Bank (NE Atlantic) (Division 7c and 7k). Working Document presented to ICES WGCEPH 2021. 23 pp.

ICES, 2017. Manual of the IBTS North Eastern Atlantic Surveys. Series of ICES Survey Protocols SISP 15. 92 pp. http://doi.org/10.17895/ices.pub.35

Kingsley, M.C.S.; Kanneworff, P. and Carlsson, D.M. 2004. Buffered random sampling: a sequential inhibited spatial point process applied to sampling in a trawl survey for northern shrimp Pandalus borealis in West Greenland waters. ICES Journal of Marine Science, 61: 12-24.

Ruiz-Pico, S., Fernández-Zapico O., Blanco, M., Velasco, F., Baldó, F. 2020. Results on main cephalopods from the Spanish Ground Fish Survey on the Porcupine Bank (NE Atlantic) (Division 7c and 7k). Working Document presented to ICES WGCEPH 2020. 35 pp.

Ruiz-Pico, S., Blanco, M., Fernández-Zapico O., Velasco, F., Baldó, F. 2019. Results on main cephalopods from the Spanish Ground Fish Survey on the Porcupine Bank (NE Atlantic) (Division 7c and 7k). Working Document presented to ICES WGCEPH 2019. 24 pp.

Ruiz-Pico, S., Velasco, F., Baldó, F. and Silva, L. 2012. Results on main cephalopods species captured in the bottom trawl surveys in the Porcupine Bank. Working Document presented to ICES WGCEPH 2012. 16 pp.

Velasco, F. and Serrano, A. 2003. Distribution patterns of bottom trawl faunal assemblages in Porcupine bank: Implications for Porcupine surveys stratification design. Working Document presented to IBTSWG 2003. 19 pp.

Figures

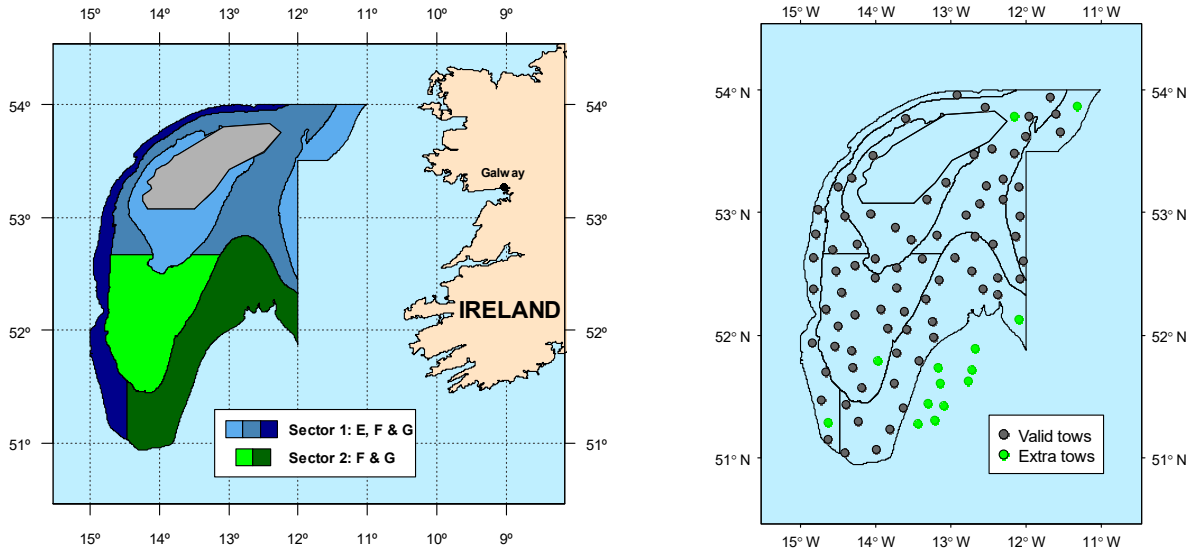

Figure 1. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: distribution of hauls performed in 2021

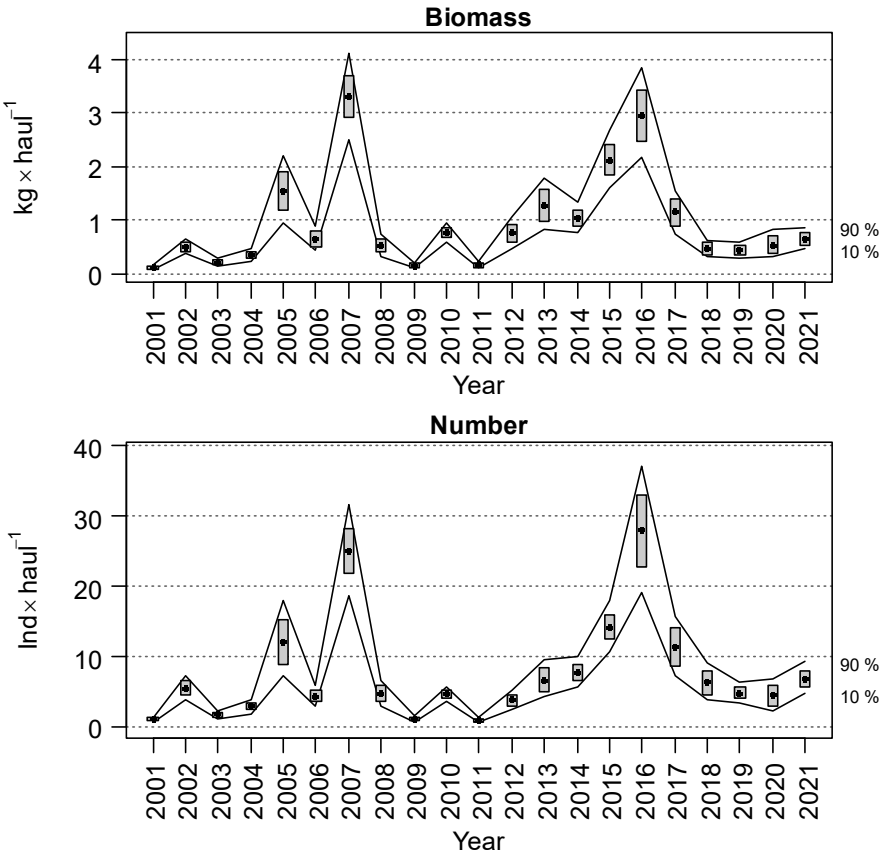

Figure 2. Evolution of *Eledone cirrhosa* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

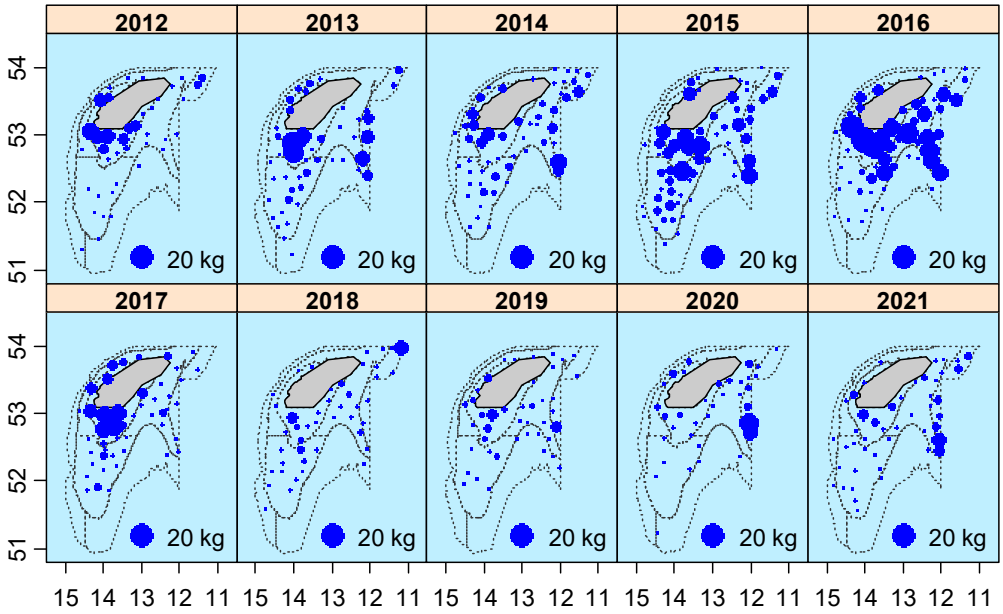

Figure 3. Geographic distribution of *Eledone cirrhosa* catches (kg/30 min haul) in Porcupine surveys during the last decade (2012-2021)

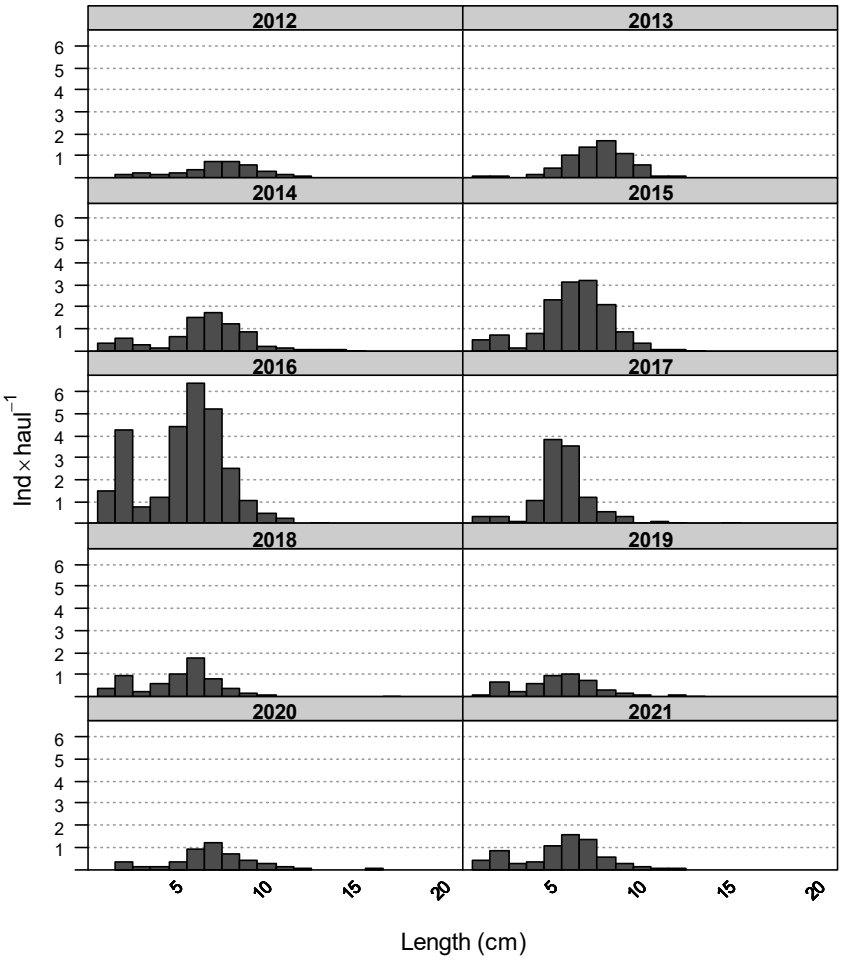

Figure 4. Mean stratified length distributions of *Eledone cirrhosa* in Porcupine surveys (2012-2021)

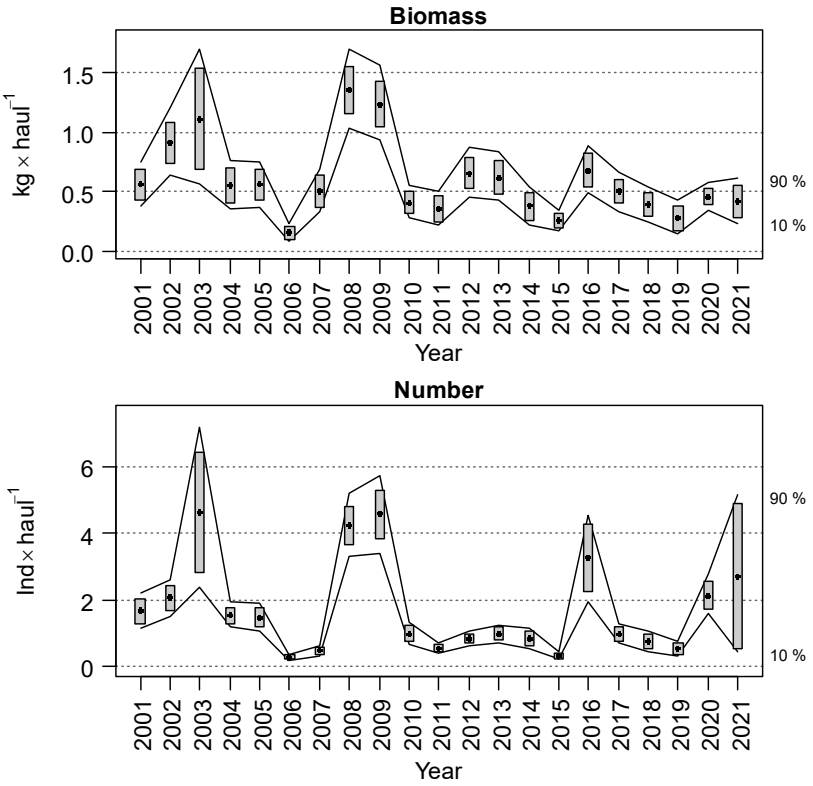

Figure 5. Evolution of *Todarodes sagitattus* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

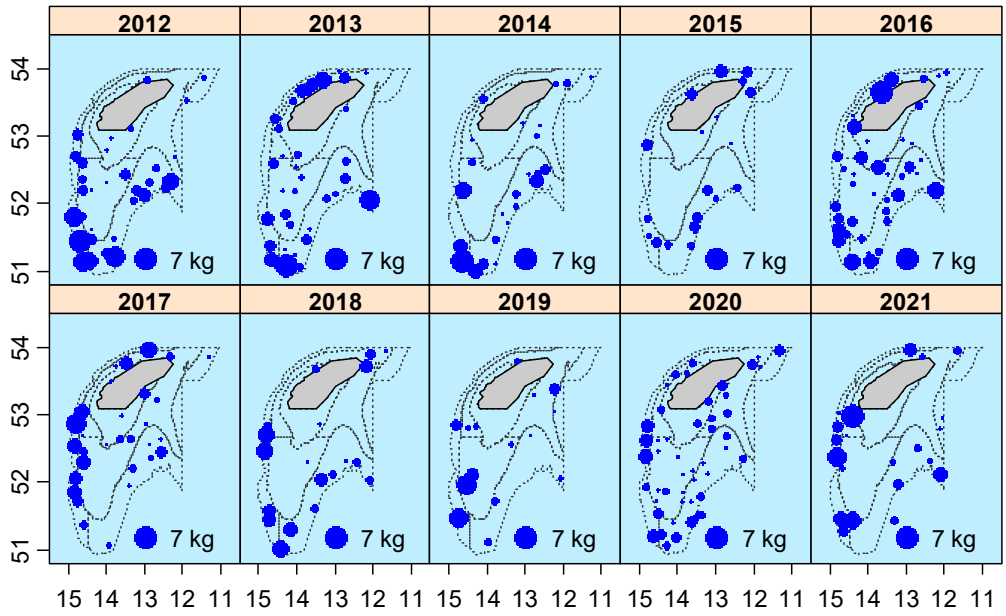

Figure 6. Geographic distribution of *Todarodes sagittatus* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

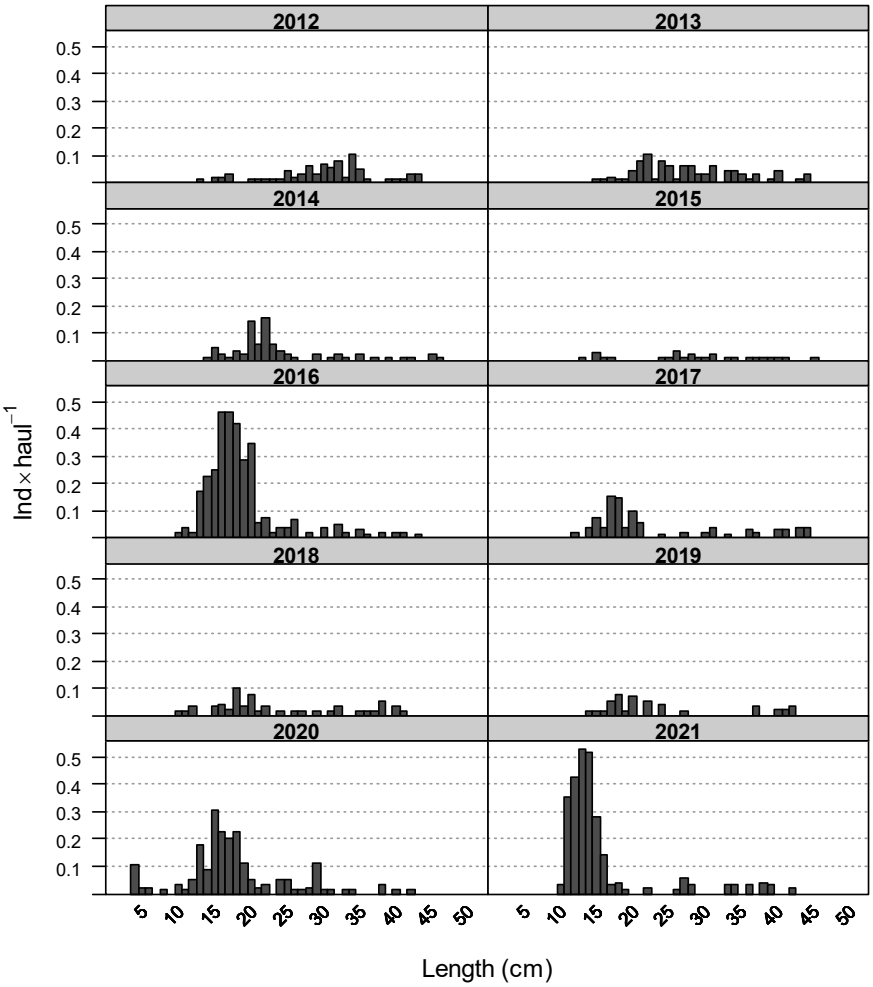

Figure 7. Mean stratified length distributions of *Todarodes sagitattus* in Porcupine surveys (2012-2021)

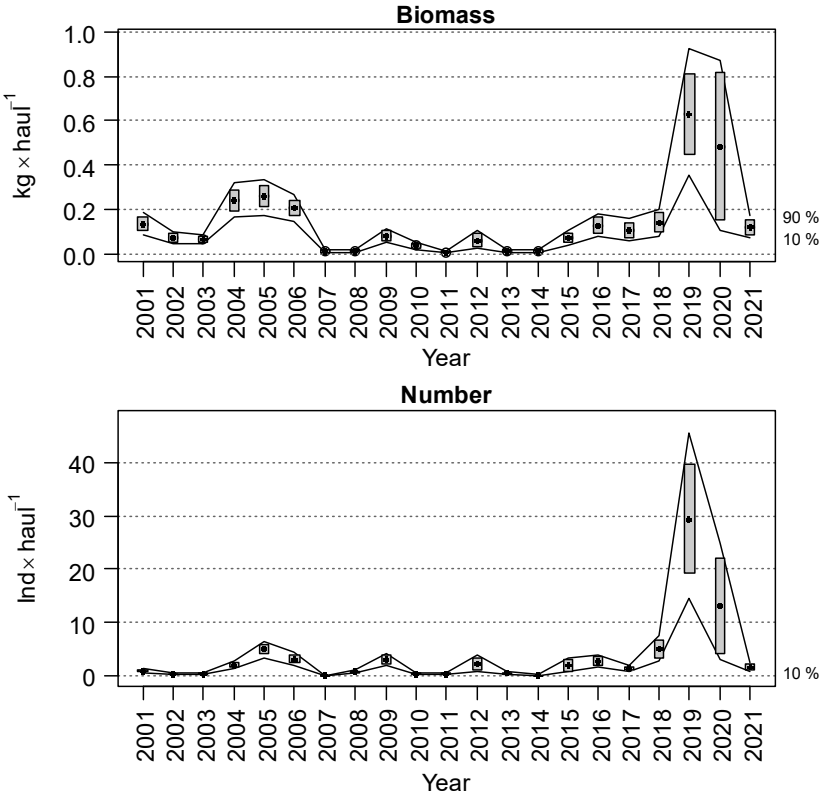

Figure 8. Evolution of *Todaropsis eblanae* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

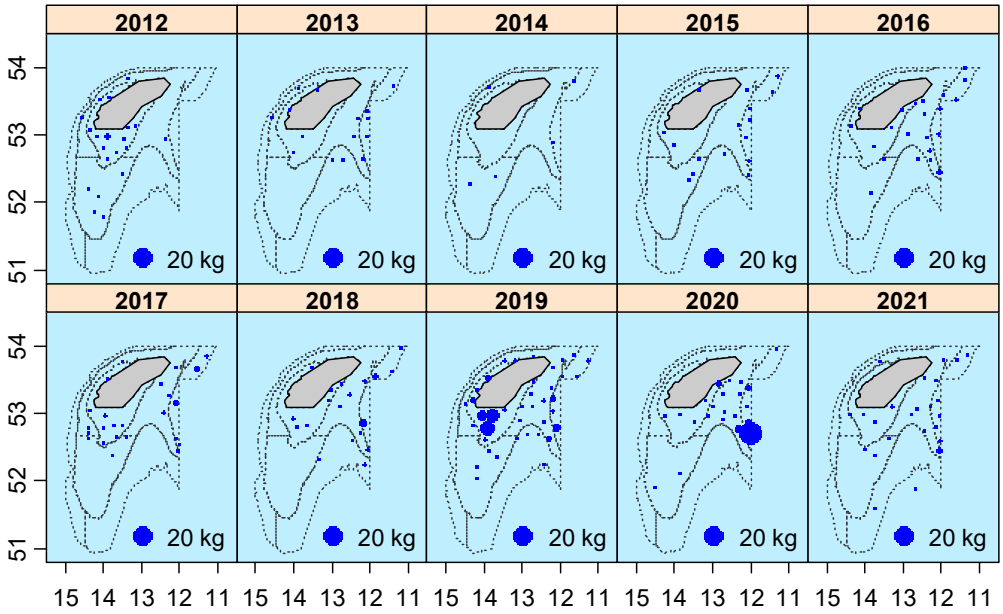

Figure 9. Geographic distribution of *Todaropsis eblanae* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

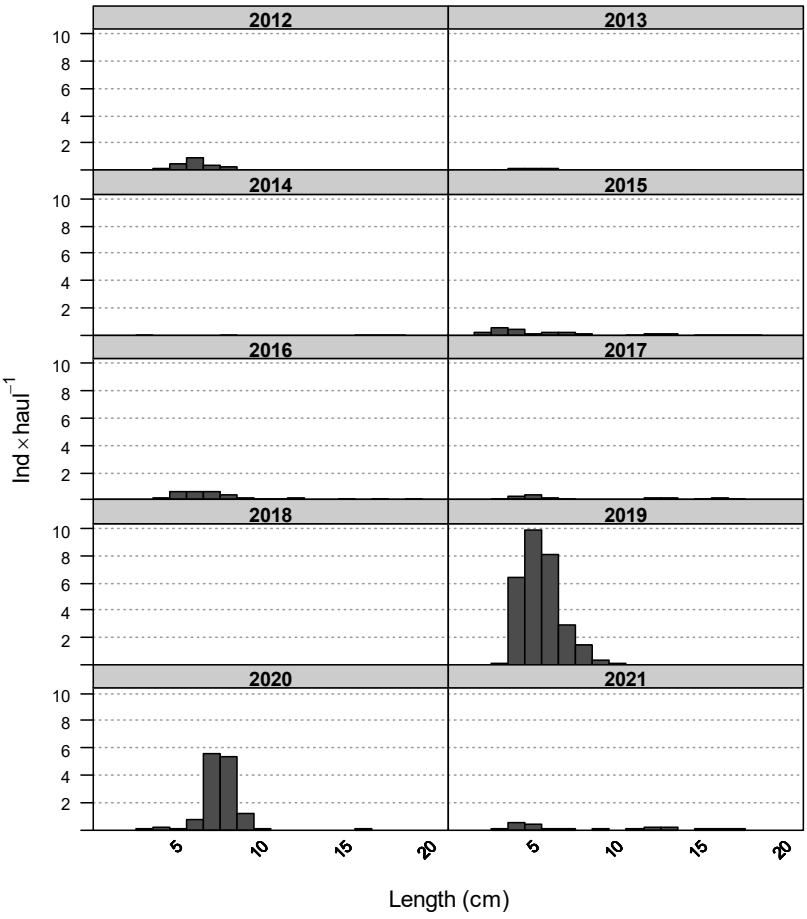

Figure 10. Mean stratified length distributions of *Todaropsis eblanae* in Porcupine surveys (2012-2021)

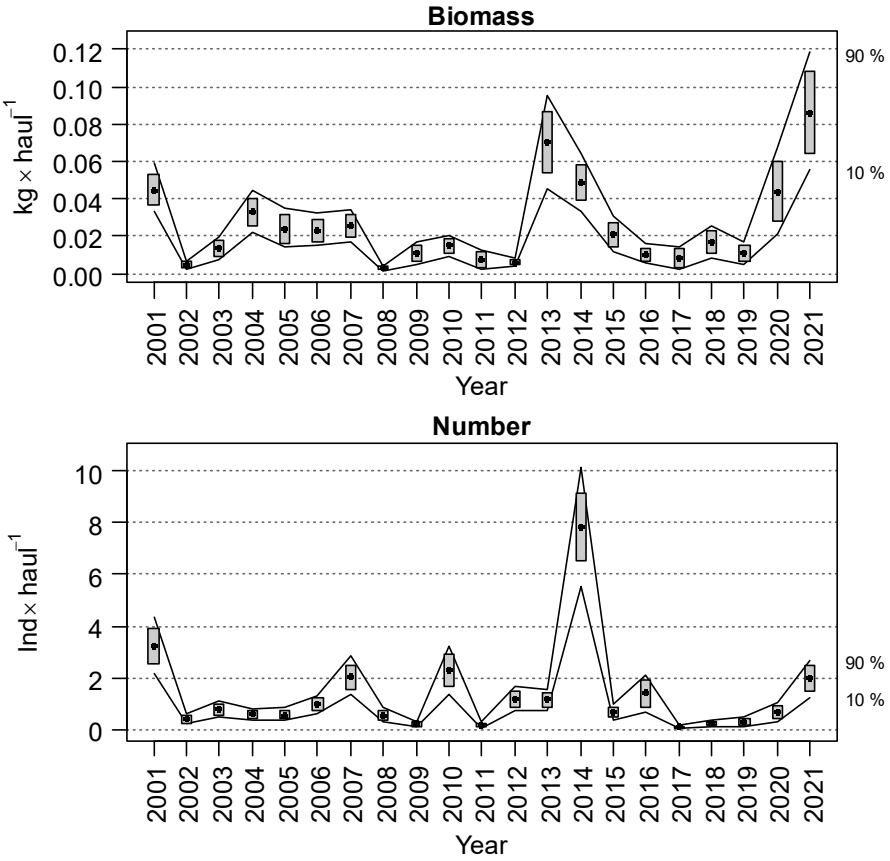

Figure 11. Evolution of *Rossia macrosoma* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

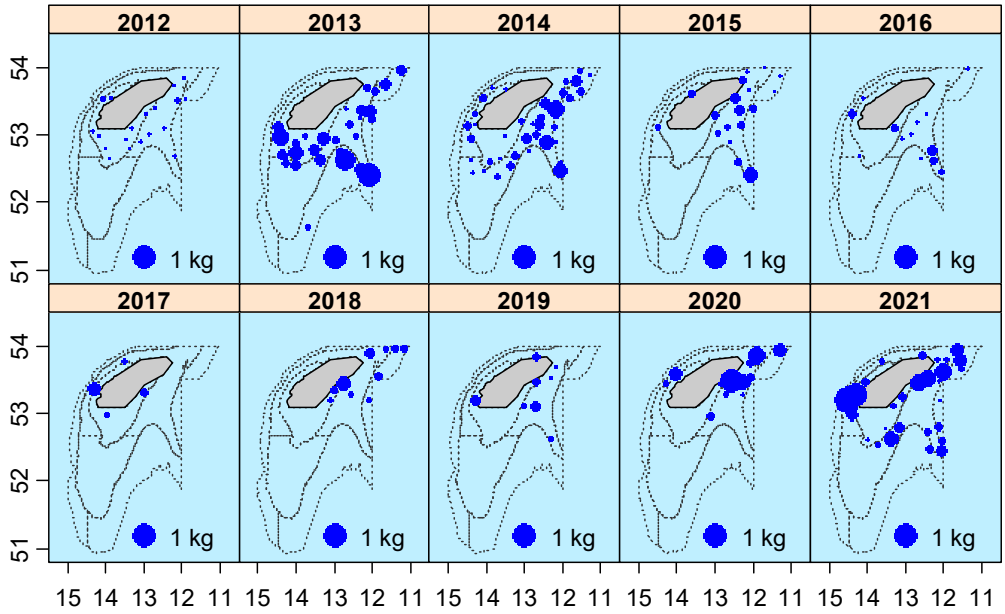

Figure 12. Geographic distribution of *Rossia macrosoma* catches (ind/30 min haul) in Porcupine surveys (2012-2021)

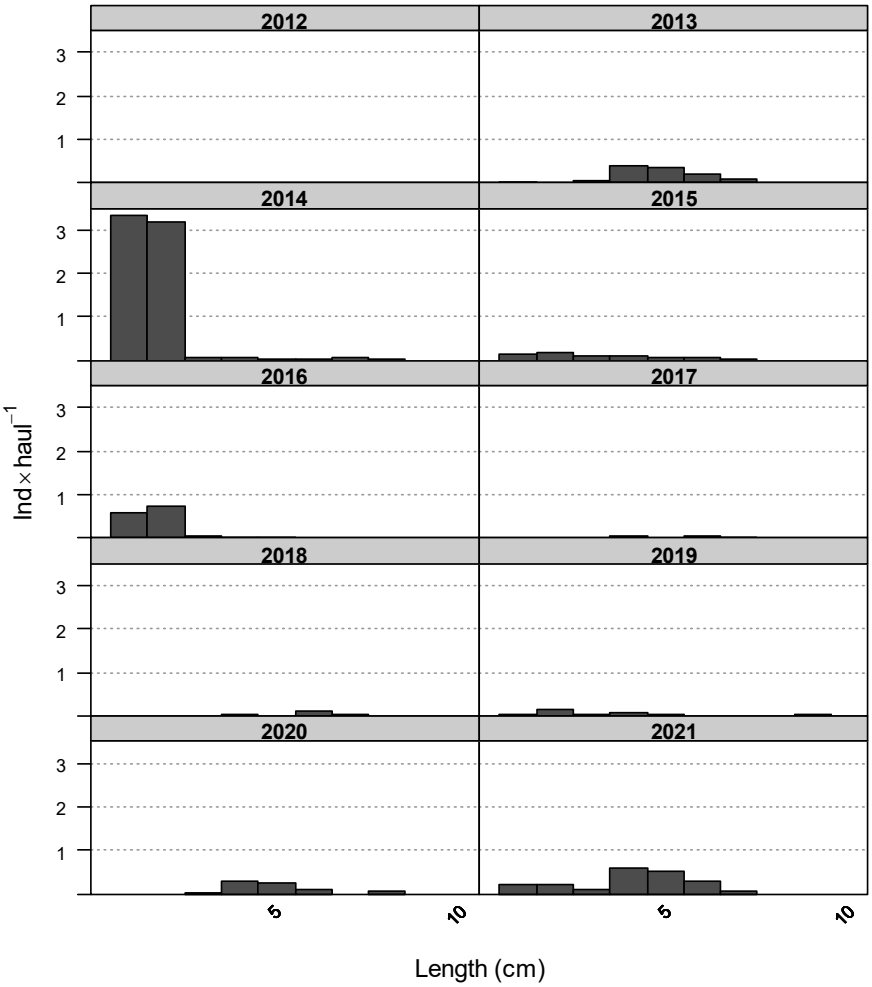

Figure 13. Mean stratified length distributions of *Rossia macrosoma* in Porcupine surveys (2012-2021)

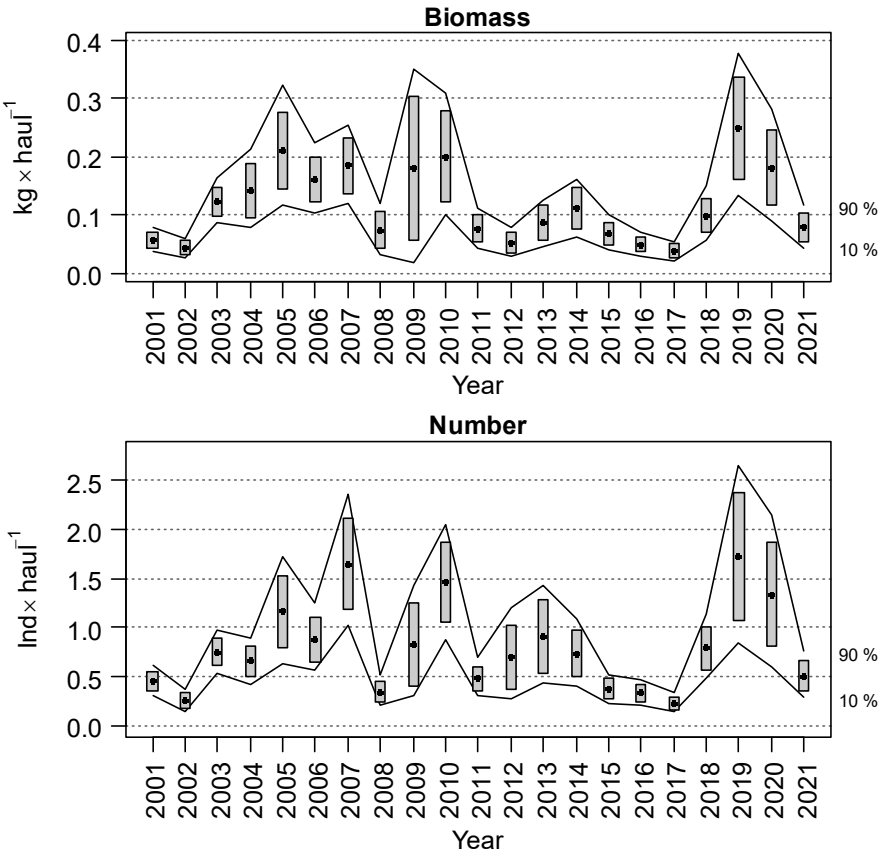

Figure 14. Evolution of *Bathypolypus sponsalis* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

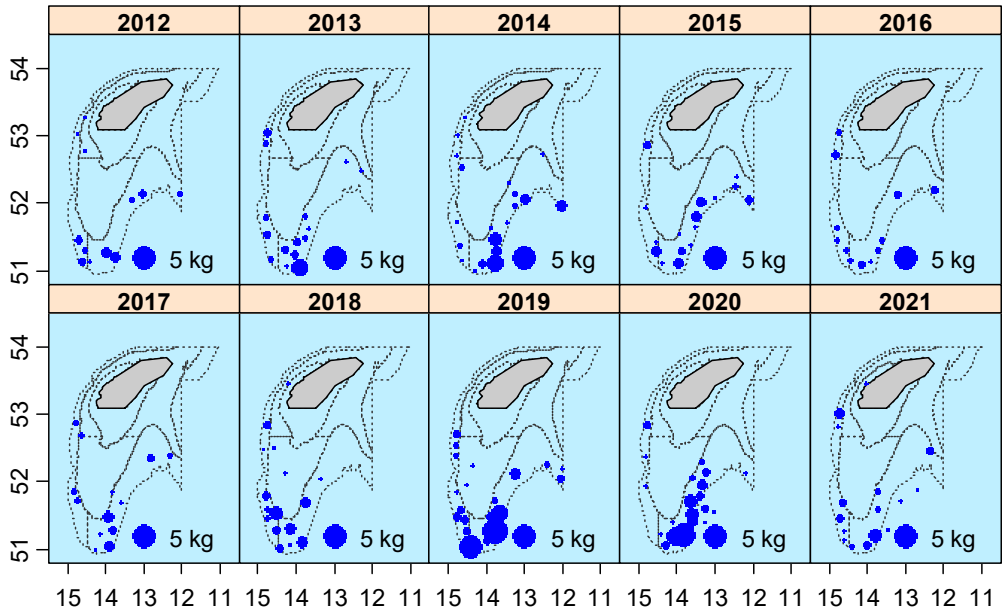

Figure 15. Geographic distribution of *Bathypolypus sponsalis* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

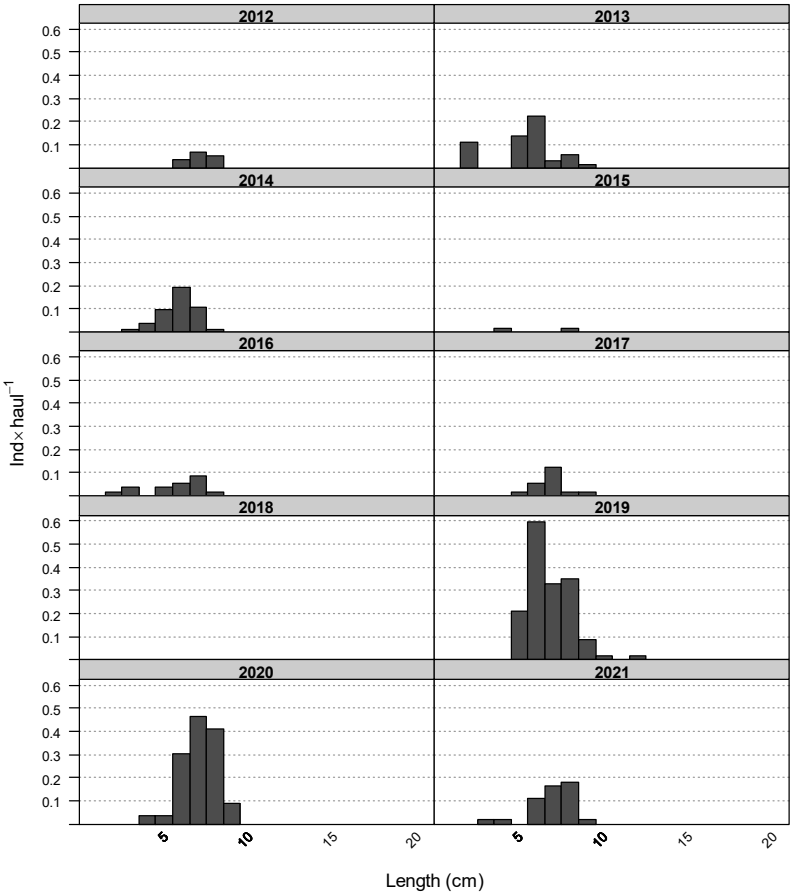

Figure 16. Mean stratified length distributions of *Bathypolypus sponsalis* in Porcupine surveys (2012-2021)

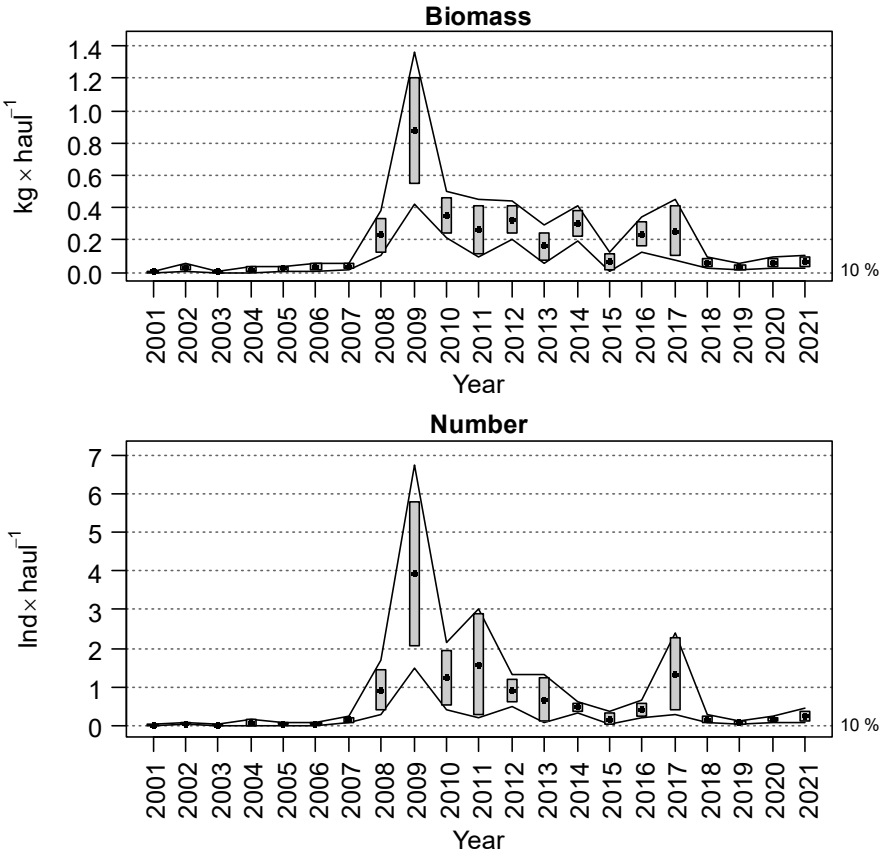

Figure 17. Evolution of *Loligo forbesi* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

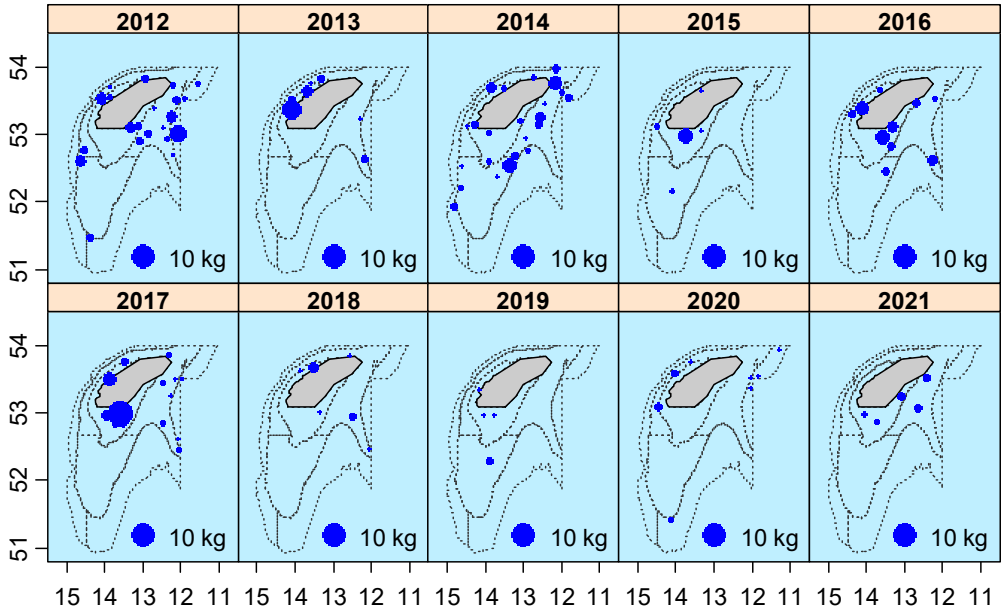

Figure 18. Geographic distribution of *Loligo forbesi* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

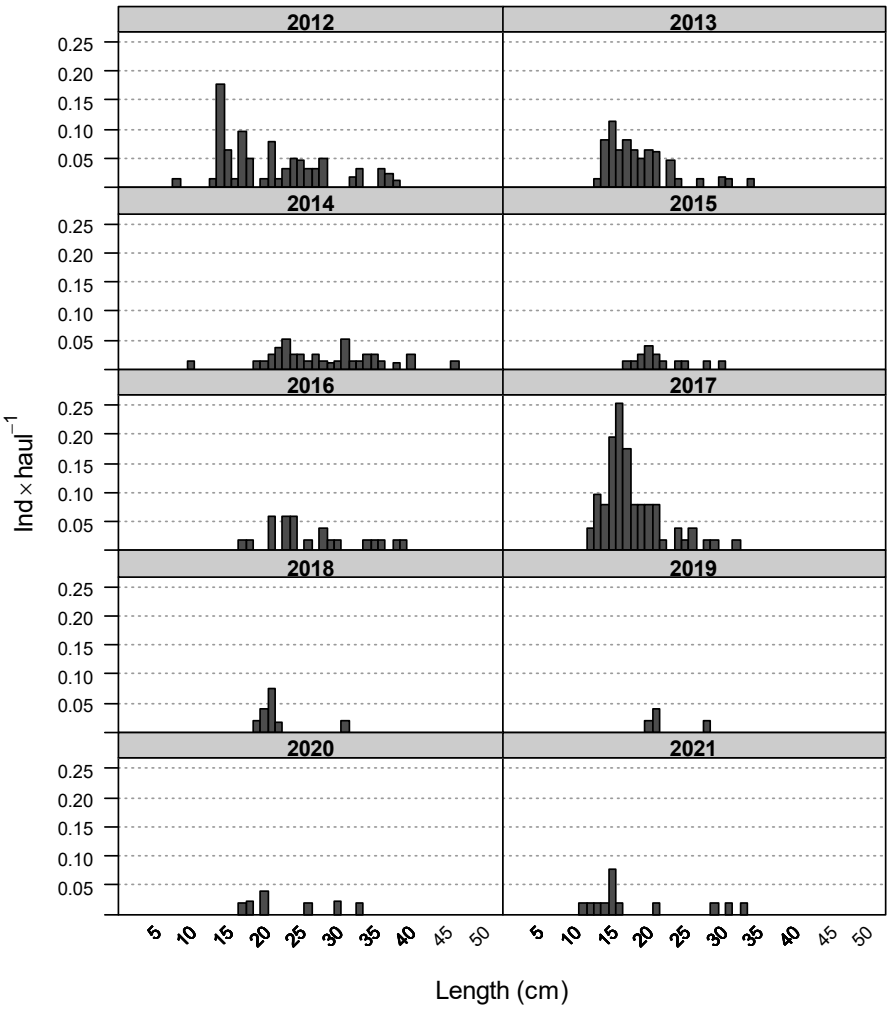

Figure 19. Mean stratified length distributions of *Loligo forbesi* in Porcupine surveys (2012-2021)

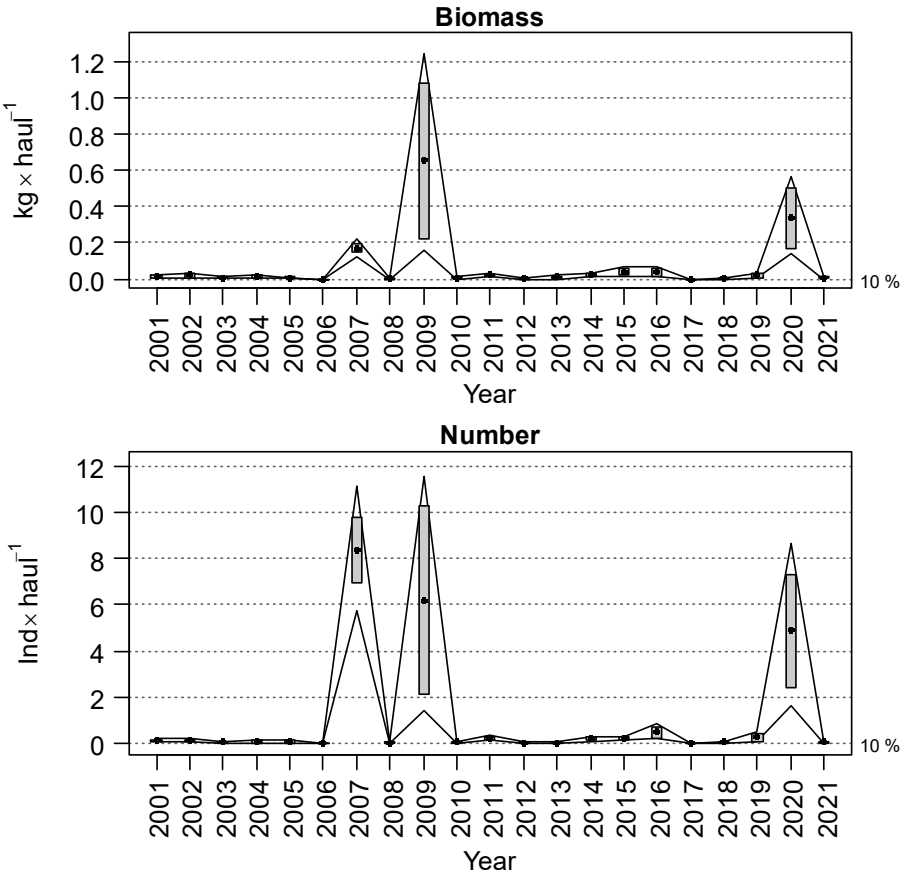

Figure 20. Evolution of *Illex coindetii* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

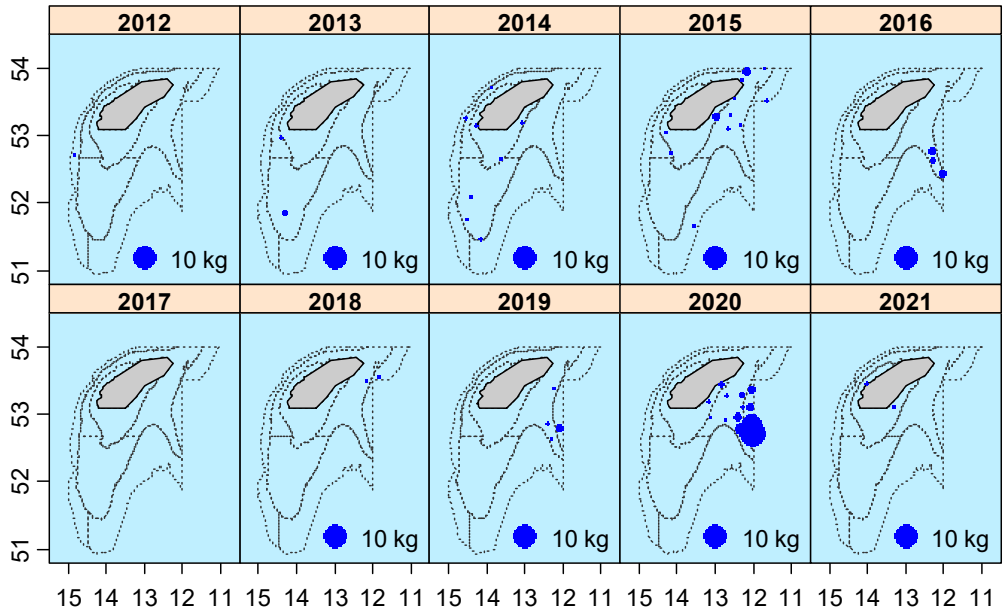

Figure 21. Geographic distribution of *Illex coindetii* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

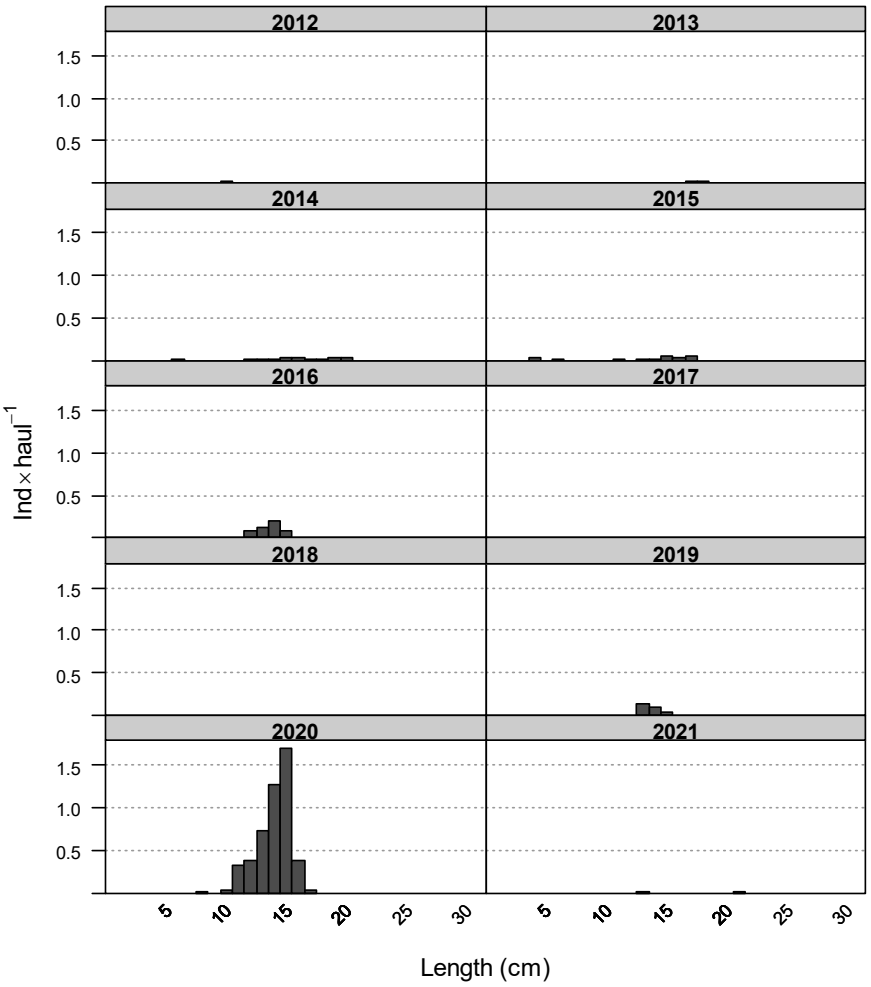

Figure 22. Mean stratified length distributions of *Illex coindetii* in Porcupine surveys (2012-2021)

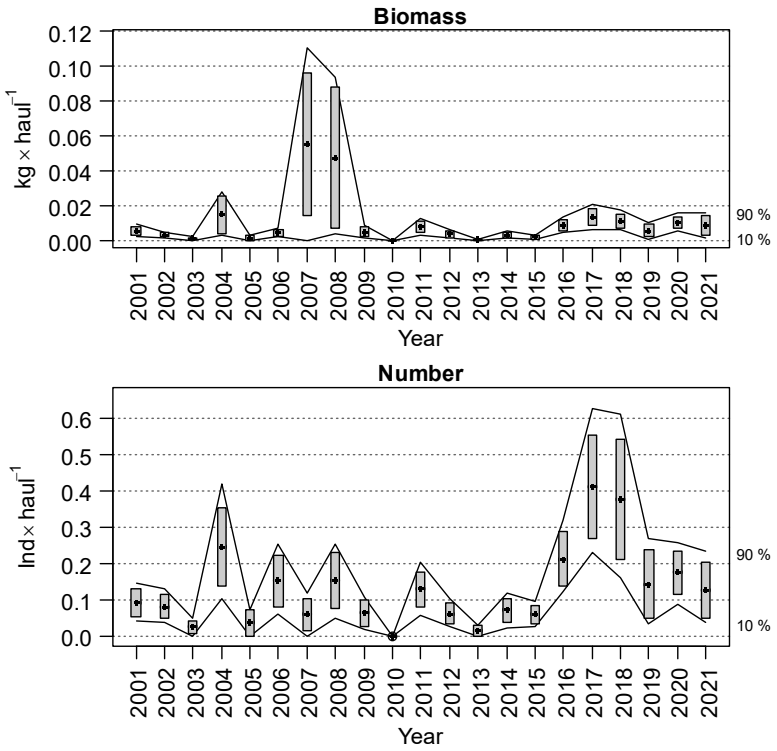

Figure 23. Evolution of *Histioteuthis reversa* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

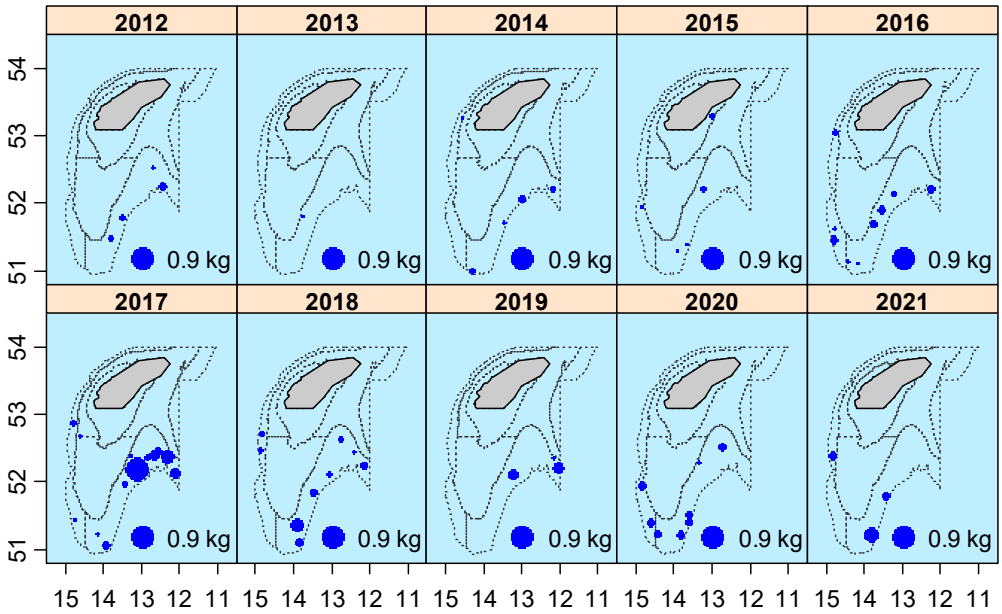

Figure 24. Geographic distribution of *Histioteuthis reversa* catches (kg×30 min haul-1) in Porcupine surveys (2012-2021)

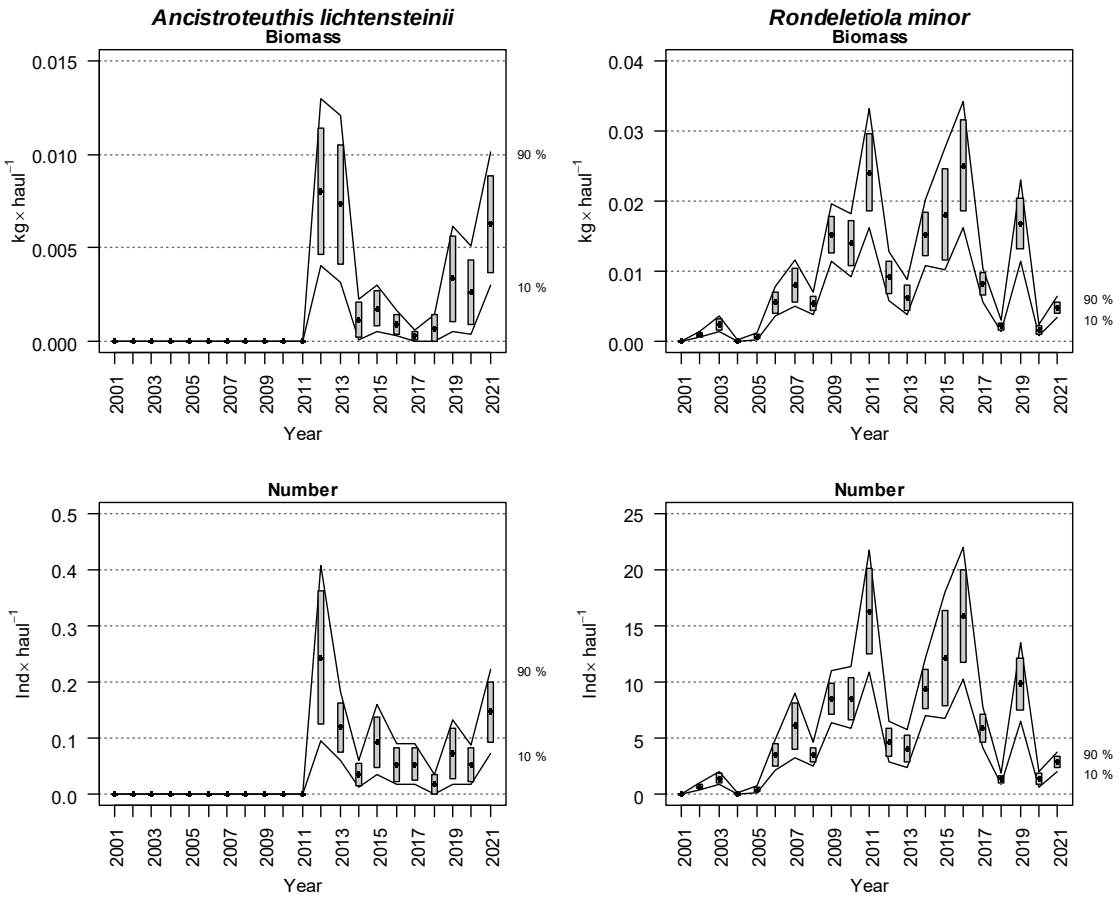

Figure 25. Evolution of *Ancistroteuthis lichtensteinii* and *Rondeletiola minor* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

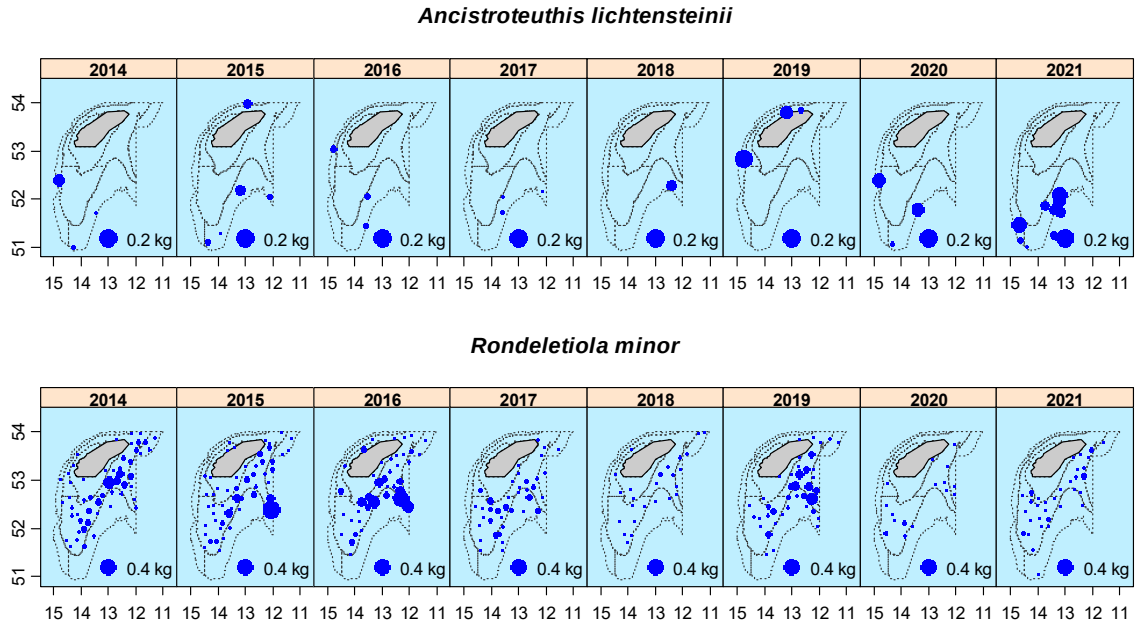

Figure 26. Geographic distribution of *Ancistroteuthis lichtensteinii* and *Rondeletiola minor* catches (kg×30 min haul-1) in the last eight years of the Porcupine time series (2014-2021)

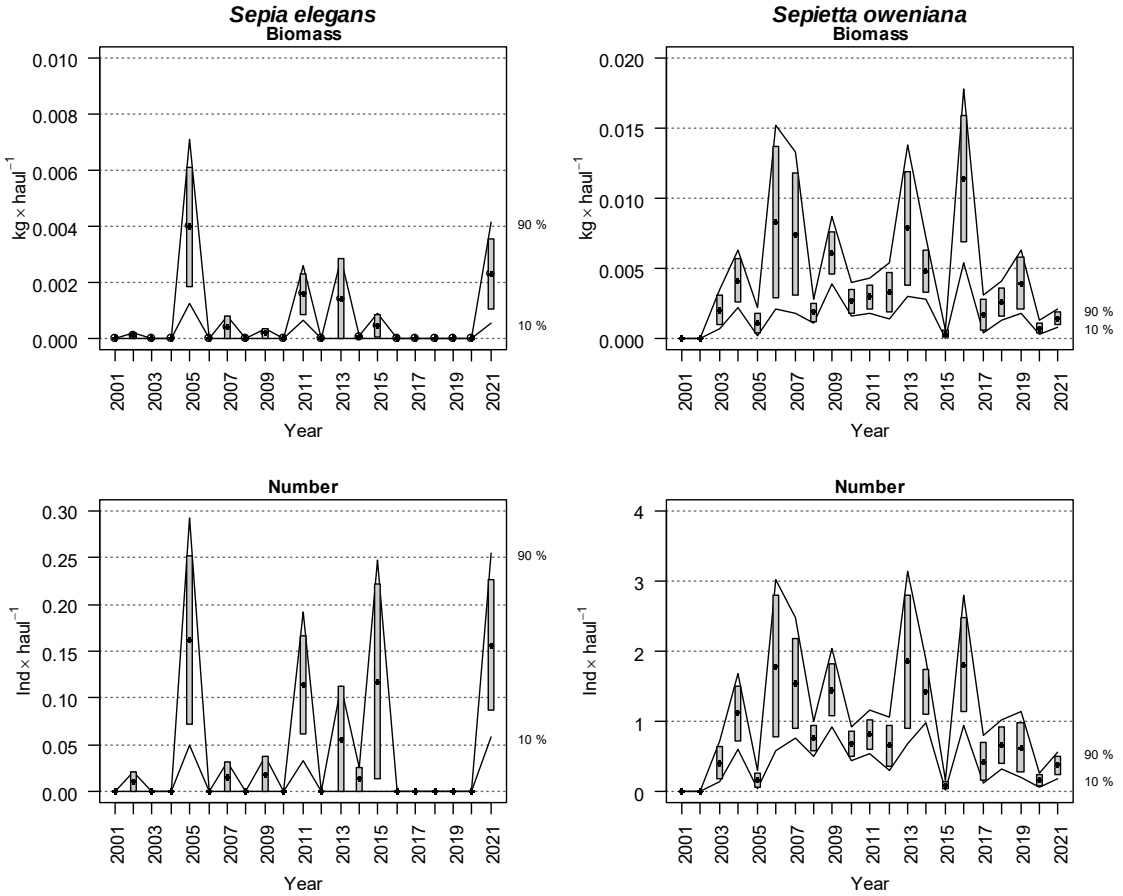

Figure 27. Evolution of *Sepia elegans* and *Sepietta oweniana* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α= 0.80, bootstrap iterations = 1000)

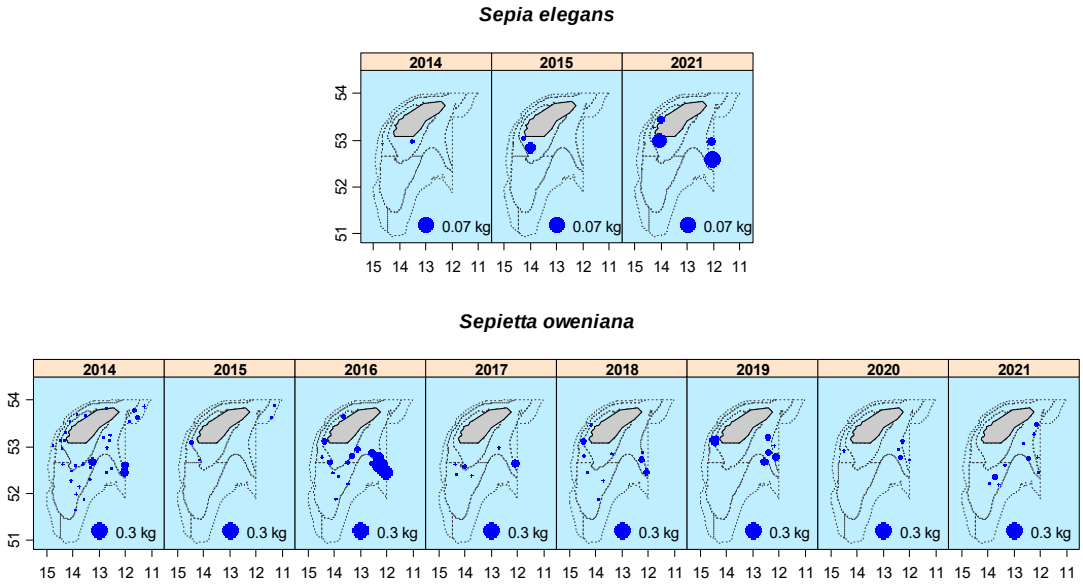

Figure 28. Geographic distribution of *Sepia elegans* and *Sepietta oweniana* catches (kg×30 min haul-1) in the last eight years of the Porcupine time series (2014-2021)