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Results on silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater forkbeard (*Phycis blennoides*), roughsnout grenadier (*Trachyrincus scabrus*), Spanish ling and ling (*Molva macrophthalma* and *Molva molva*) from the 2021 Porcupine Bank Survey (NE Atlantic)

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Abstract

This working document presents the results of the most significant deep fish species caught in 2021 on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3). Biomass, abundance, geographical distribution and length ranges were analysed for silver smelt (*Argentina silus* and *A. sphyraena*), bluemouth (*Helicolenus dactylopterus*), greater fork-beard (*Phycis blennoides*), roughsnout grenadier (*Trachyrincus scabrus*), Spanish ling and ling (*Molva macrophthalma* and *Molva molva*) and other scarce deep sea species. Both the biomass and abundance of *A. sillus* fell sharply in this last survey whereas *A. sphyraena* and *T. scabrus* decreased slightly. However *P. blennoides* and especially *H. dactylopterus* have increased. The species *M. molva* and *M. macrophtalma* have remained quite similar values to the previous year. Signs of recruitment have been found for *P. blennoides*, *M. macrophtalma* and *H. dactylopterus*.

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 deep water fish species on the Porcupine Bottom Trawl Survey after the results presented previously (Baldó *et al.* 2008, Velasco *et al.* 2009, 2011, 2012, 2013, Fernández-Zapico *et al*. 2015, 2017, 2021, Ruiz-Pico *et al.* 2016, 2018, 2019, 2020). The species analysed were: *Argentina silus* (greater silver smelt), *Argentina sphyraena* (lesser silver smelt), *Helicolenus dactylopterus* (bluemouth), *Phycis blennoides* (greater forkbeard), *Trachyrincus scabrus* (roughsnout grenadier), *Molva molva* (ling), *Molva macrophthalma* (Spanish ling) and some other scarce deep sea species as *Aphanopus carbo* (black scabbardfish), *Coryphaenoides rupestris* (roundnose grenadier), *Hoplostethus atlanticus* and *Beryx spp.* (alfonsinos).

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 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 and discussion

In spite the problems created by the pandemic, the 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).

The total stratified catch per haul decreased considerably in 2021 compared to the previous year (Figure 2). Fish represented 96% of the total catch, and the selected deep water fish represented 9% of that total fish catch, with the following percentages per species: *Argentina silus* (14%), *Helicolenus dactylopterus* (37%), *Argentina sphyraena* (27%), *Trachyrincus scabrus* (11%), *Phycis blennoides* (9%), *Molva macrophtalma* (2%) and *Molva molva* (0.2%).

In 2021, both the biomass and abundance of *A. silus* fell sharply compared to the previous year whereas *A. sphyraena* and *T. scabrus* decreased slightly. However *P. blennoides* and especially *H. dactylopterus* have increased. The species *M. molva* and *M. macrophtalma* have quite similar values to the previous year. On the other hand, signs of recruitment have been found for *P. blennoides* and *M. macrophtalma* despite their low biomass, as well as for *H. dactylopterus,* though it has decreased in the last two years, after the peak of recruitment in 2019. Only a few specimens of *Aphanopus carbo, Coryphaenoides rupestris, Hoplostethus atlanticus* and *Beryx spp*. were found, mostly outside the standard stratification with the exception of *Beryx spp*.

***Argentina silus* (greater silver smelt) and *Argentina sphyraena* (lesser silver smelt)**

In 2021, both the biomass and the number of *A. silus*, which is the species that historically contributes the most to the genus in the Porcupine survey, fell sharply, breaking the upward trend of recent years and reaching the lowest values of the time series. The species *A. sphyraena*, however, decreased slightly compared to last year (Figure 3; Figure 4 and Figure 5).

A. sphyraena was found mainly in the north of the bank, as usual, but *A. silus* was mostly in the south. It is remarkable the lack of points of biomass found last year in the northwest of the bank for this species and also the decline in the southwest (Figure 6 and Figure 7).

The abundance of small individuals of *A. silus* remained similar to the previous year, although a slight decrease can be appreciated, with a mode at 16 cm, whereas the abundance around a second mode at 22 cm greatly decreased. *A. sphyraena* kept a similar size distribution to the 2020 survey, with a single mode at 23 cm (Figure 8).

***Helicolenus dactylopterus* (bluemouth)**

Although bluemouth is not requested in the ICES DCF Data Call, the biomass and abundance are significant in the area and useful for the assessment of the species (ICES, 2015).

The abundance of this species has been increasing since 2017, reaching the highest value of the time series again in 2021 and the biomass has increased slightly in the last survey, keeping medium values in the series (Figure 9). After a substantial decrease in this last survey, recruitment for bluemouth returned to medium values in time series (Figure 10).

The geographical distribution of *H. dactylopterus* was similar to that of the previous year, although without the biomass points of the northwest of the bank. Recruits were distributed both on the Irish shelf and in the southeast area of the bank, mostly between 200 and 600 m (Figure 11).

The figure 12 shows two well defined modes in 12 cm and 17 cm. The maximum size caught in the time series is extended, by capturing an individual 53 cm long.

***Trachyrincus scabrus* (roughsnout grenadier)**

T. scabrus has been included in this report since 2020.

Biomass and abundance are significant in the area. Although both values have been falling slightly for the last two years, they are still quite high values within the time series (Figure 13).

The species was found in the deepest southeastern area and in the deepest western area, as usual in the time series (Figure 14).

The length distribution in 2021 was similar to the previous year but there were no sizes below 7 cm. There is also a decrease in the abundance of sizes below 110 cm, as well as a decline in the abundance of the modal size (Figure 15).

***Phycis blennoides* (greater fork-beard)**

The biomass and abundance of *P. blennoides* continue the upward trend of the last two years, although the values are still among the lowest in the time series. (Figure 16). In this last survey, the recruitment for greater fork-beard has also increased (Figure 17).

Biomass patches were widely found in the south, west and eastern area, but scarcely in the north, as in previous years. However, recruits were captured in the north and in the south-east area (Figure 18).

Two modes are drawn in this last survey: one of recruits, more abundant, at 21 cm and another one of adults at 37 cm (Figure 19).

***Molva molva* (ling) and *Molva macrophthalma* (Spanish ling)**

These two species were comparatively analysed in this working document as in previous reports.

M. molva was scarcer than *M. macrophtalma* in the area, as usual, although in recent years, after the steady decline since 2014, both the abundance and biomass of the two species have come quite close. *M. molva* has increased slightly in this last survey after reaching the minimum of the time series last year, whereas *M. macrophthalma* has declined marginally, keeping the low values of recent years (Figure 20). However, recruitment has increased very slightly (Figure 21).

M. molva, though scarce, showed a geographical distribution around the northern part of the study area, whereas *M. macrophtalma* showed biomass patches around the bank, especially in the south (Figure 22).

The size distribution of *M. macrophtalma* showed a mode in 66 cm and some signs of recruitment can be seen for this species despite its low abundance. On the other hand, the size range was

widened for *M. molva* with respect to the previous year, remaining between 22 and 103 cm, with a central size group between 63 and 69 cm, all size groups with a similar abundance (Figure 23).

Other deep water fish species

In 2021, the deep water species *Aphanopus carbo, Coryphaenoides rupestris, Hoplostethus atlanticus* and *Beryx splendens* have been scarcely found in the study area.

The species *C. rupestris* and *Hoplostethus atlanticus* were only found in the deep hauls out of the standard stratification (the first species was captured between 994 and 1484 m and between 1348 and 1484 m the second one), carried out to explore the continuity of the fish community in Porcupine Seabight, in the southeast part of the bank. The species *A. carbo*, although it was found mostly in these deep hauls in Porcupine Seabight too, was also caught in four hauls within the standard stratification, between 609 and 751 m.

Two individuals of the species *B. splendens*, with sizes 27 and 34 cm, were found in the standard stratification, in two hauls of the southern part of the bank.

The species *Beryx decadactylus*, very scarce when it is found, not every year, has been caught in just one haul, at 519 m depth. It was a single individual, 27 cm length.

Acknowledgements

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Figures

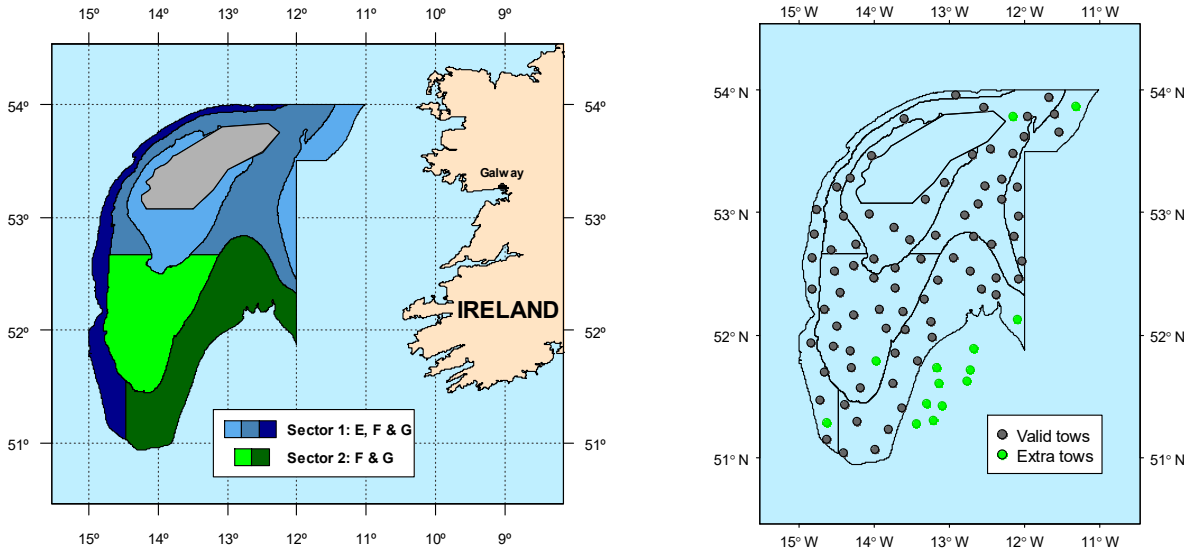

Figure 1. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301 – 450 m and G) 451 – 800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements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

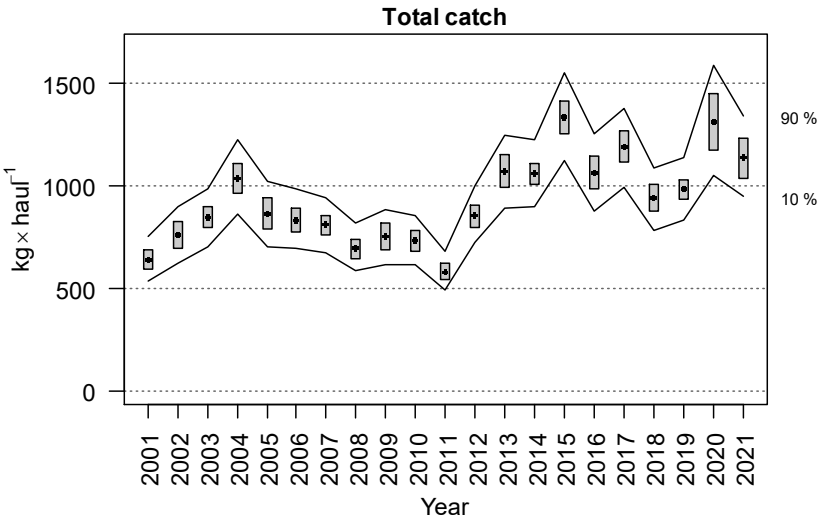

Figure 2. Evolution of the total catch in Porcupine surveys (2001-2021)

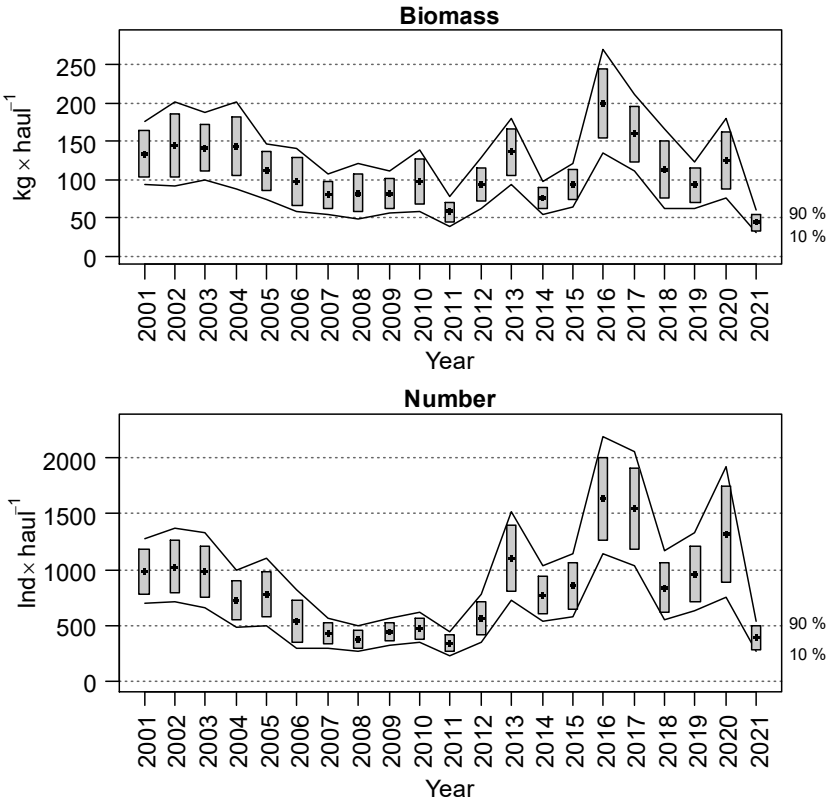

Figure 3. Evolution of *Argentina* spp. (mainly *Argentina silus*) biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

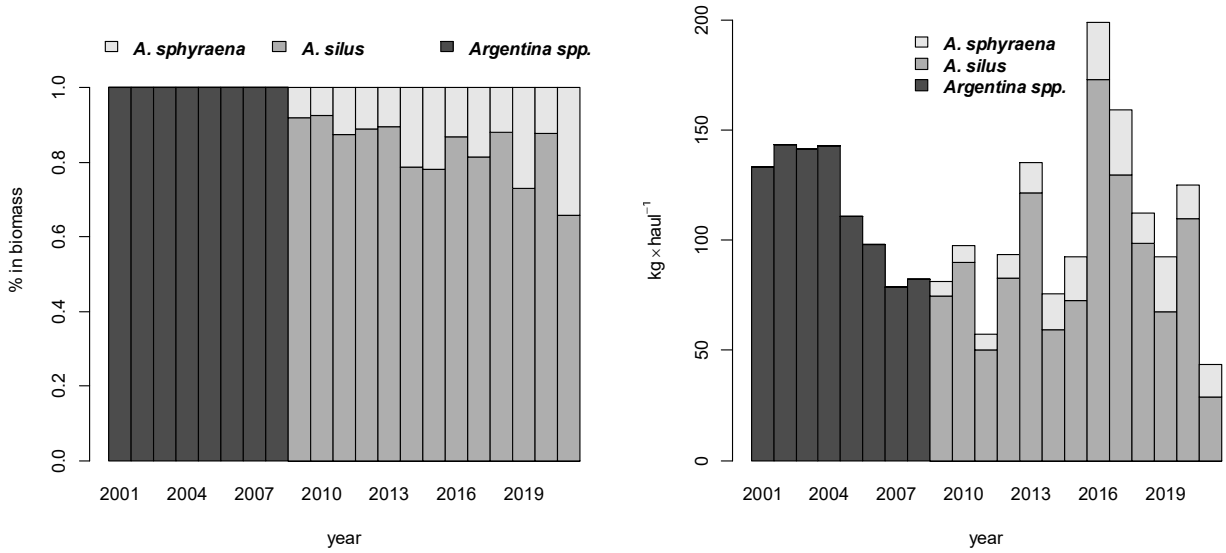

Figure 4. Share and abundance of Argentine species in Porcupine surveys (2001-2021)

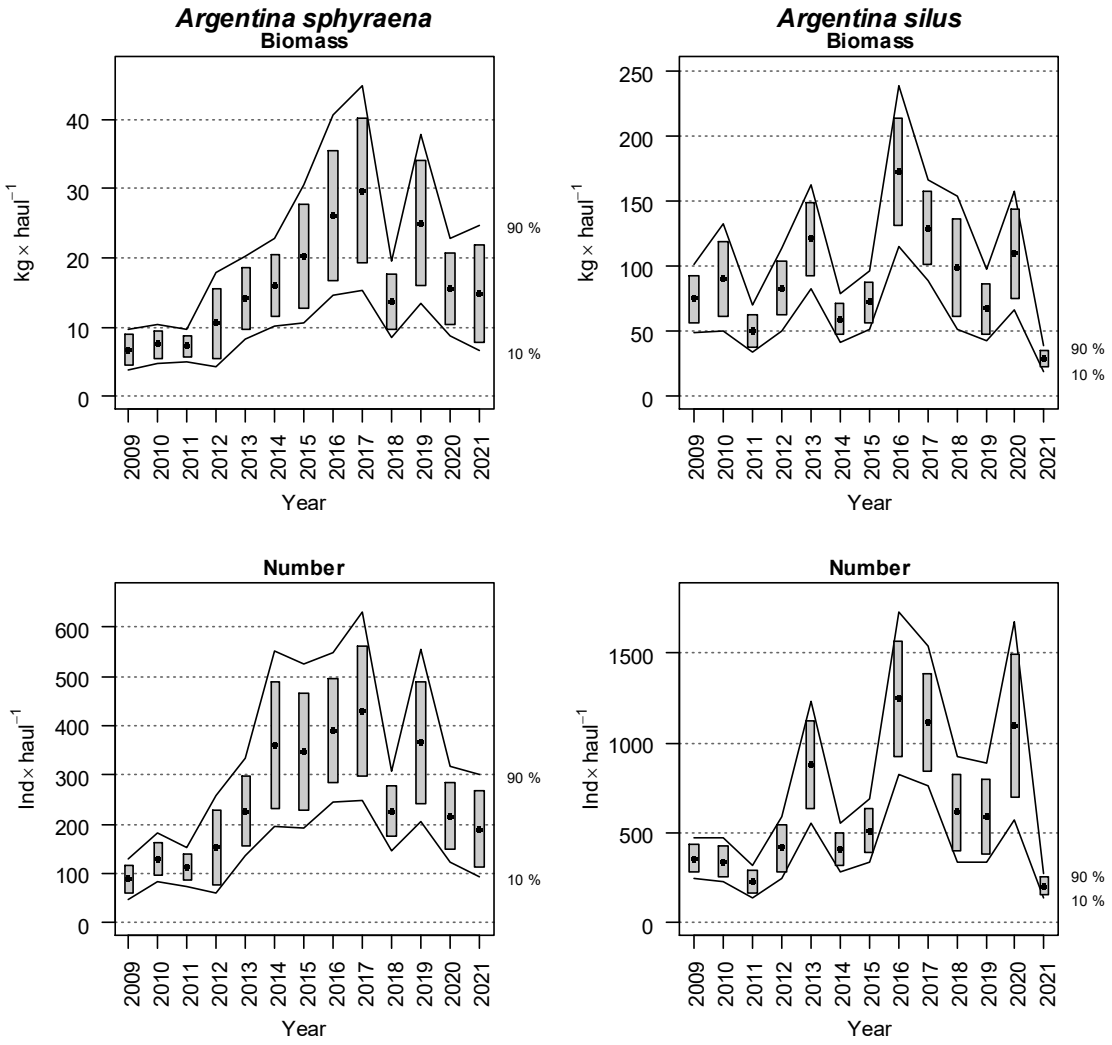

Figure 5. Evolution of *Argentina sphyraena* and *Argentina silus* biomass and abundance indices in Porcupine surveys (2009-2021). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

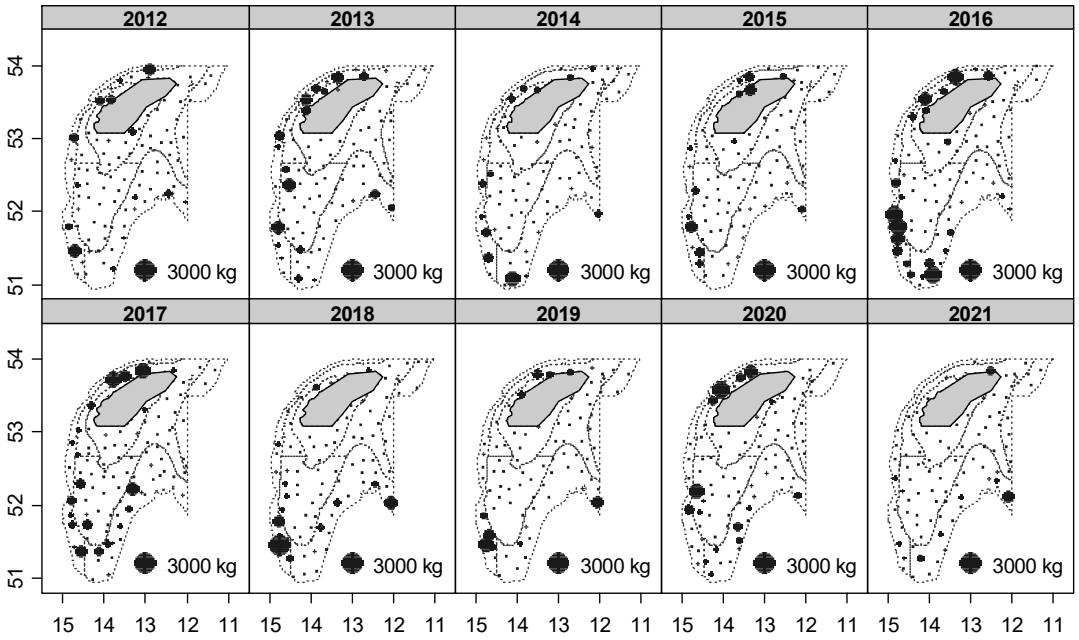

Figure 6. Geographic distribution of *Argentina* spp. catches (kg/30 min haul) in Porcupine surveys (2012-2021)

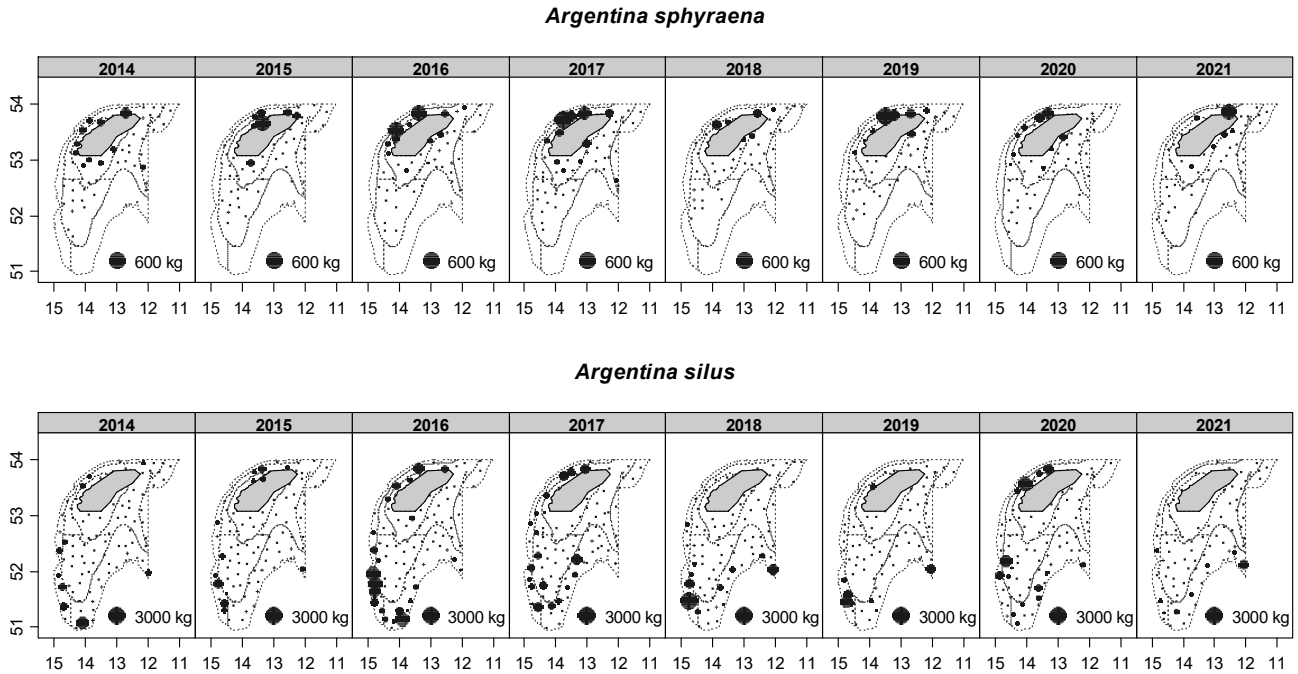

Figure 7. Geographic distribution of *Argentina sphyraena* and *Argentina silus* catches (kg/30 min haul) in Porcupine surveys (2014 - 2021)

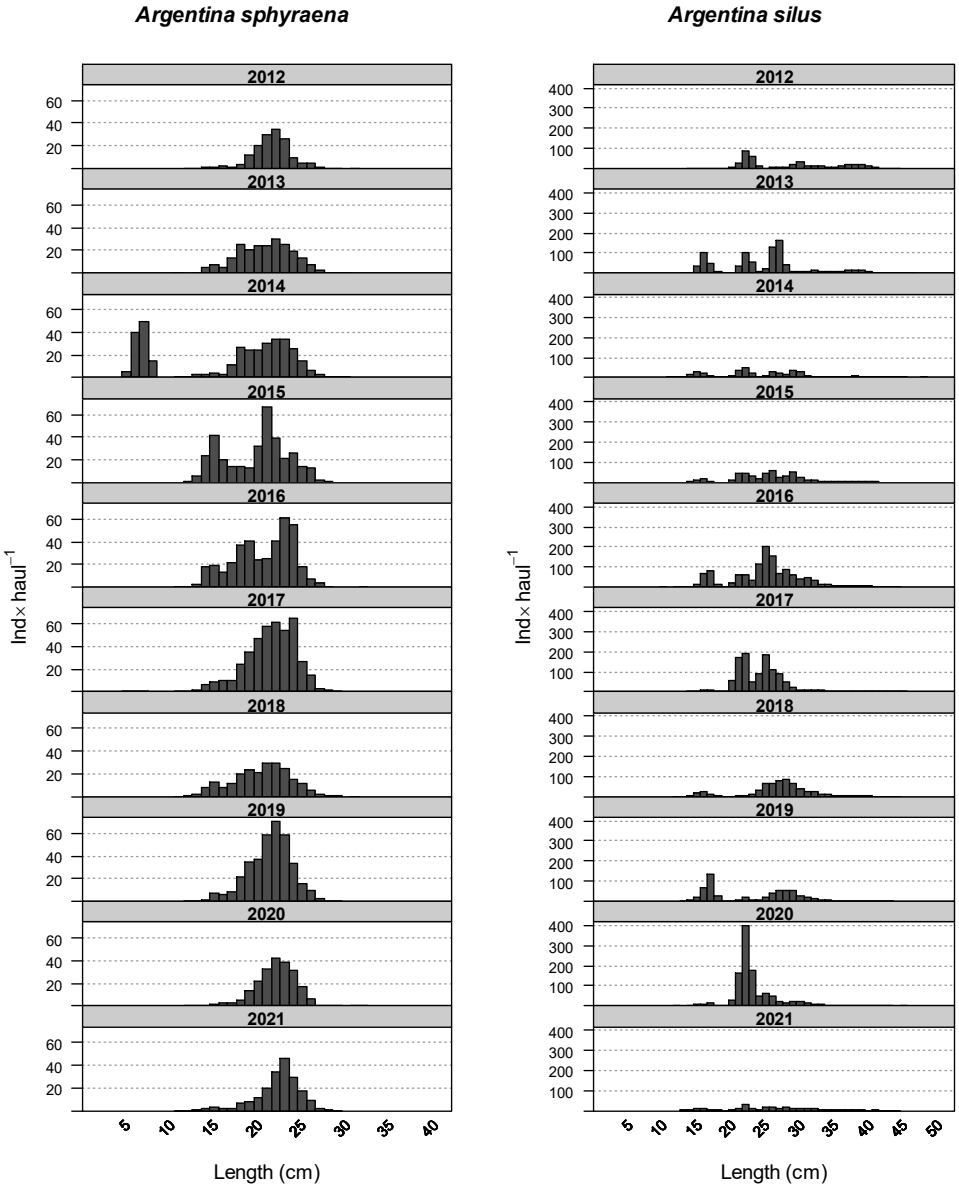

Figure 8. Mean stratified length distributions of *Argentina sphyraena* and *Argentina silus* in Porcupine surveys (2012-2021)

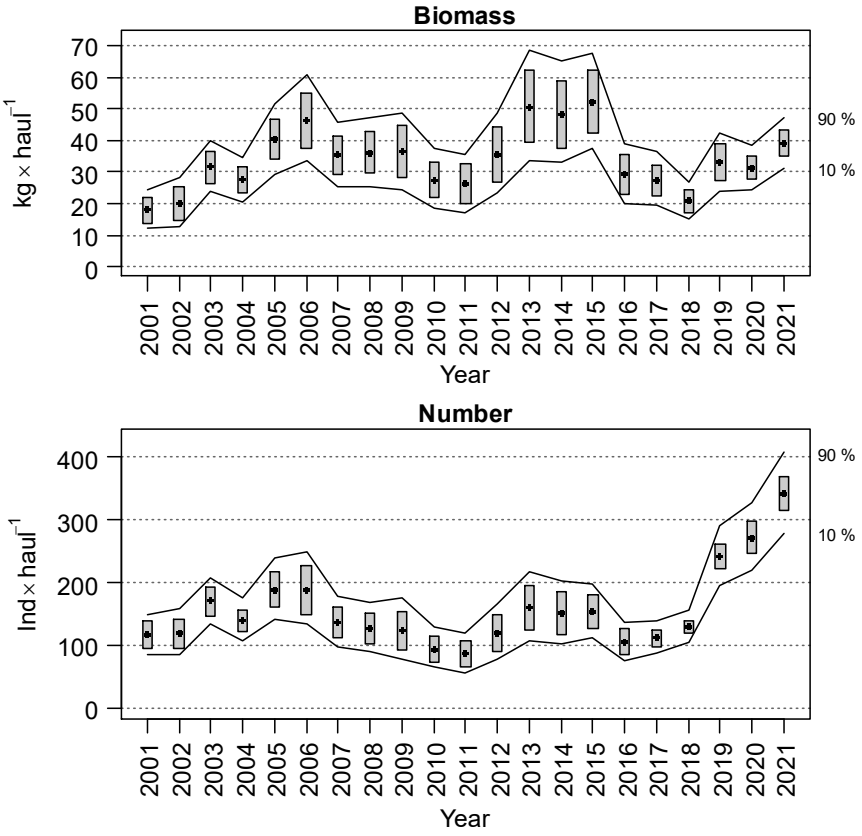

Figure 9. Evolution of *Helicolenus dactylopterus* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

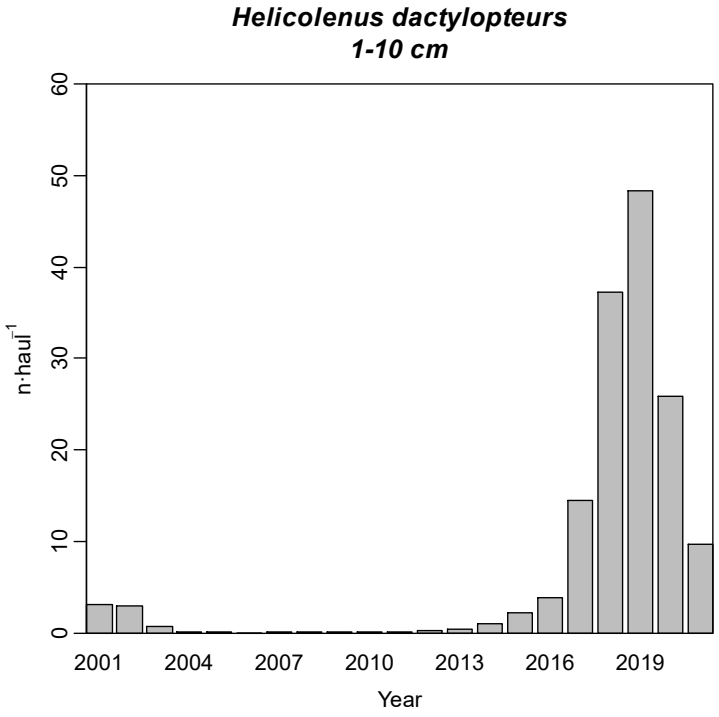

Figure 10. Mean stratified abundance of *Helicolenus dactylopterus* recruits (1-10 cm) in Porcupine surveys (2001-2021)

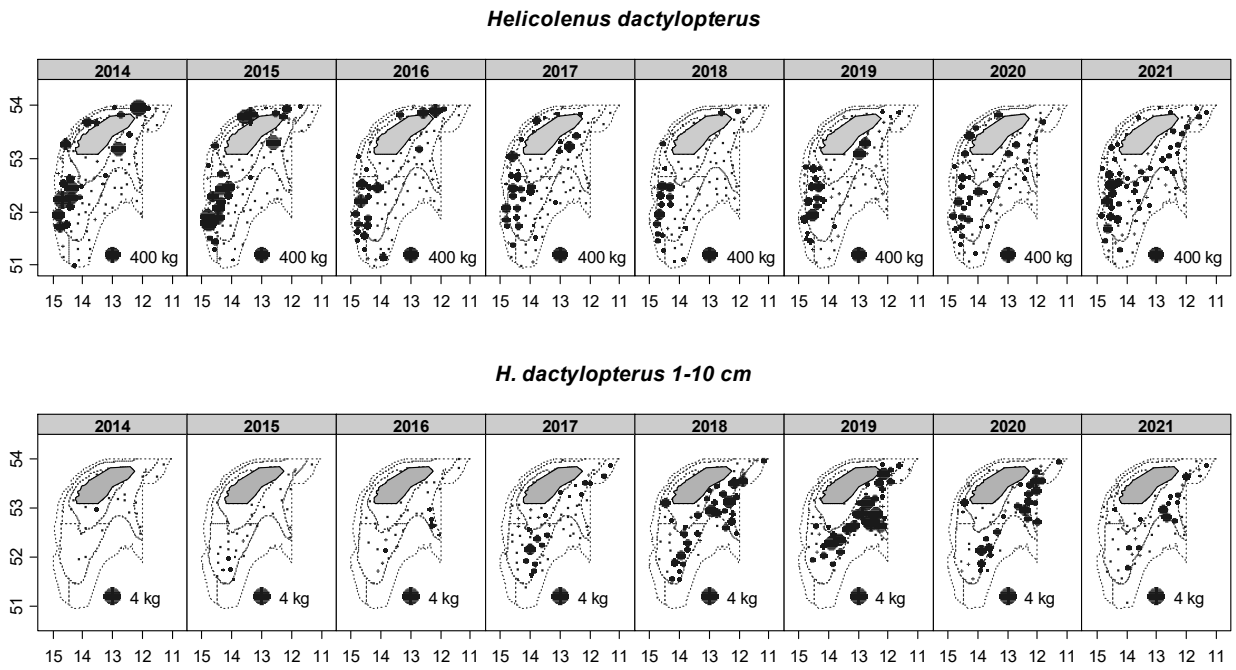

Figure 11. Geographic distribution of *Helicolenus dactylopterus* catches (kg×30 min haul-1) and recruits (1-10 cm) in Porcupine surveys (2014-2021)

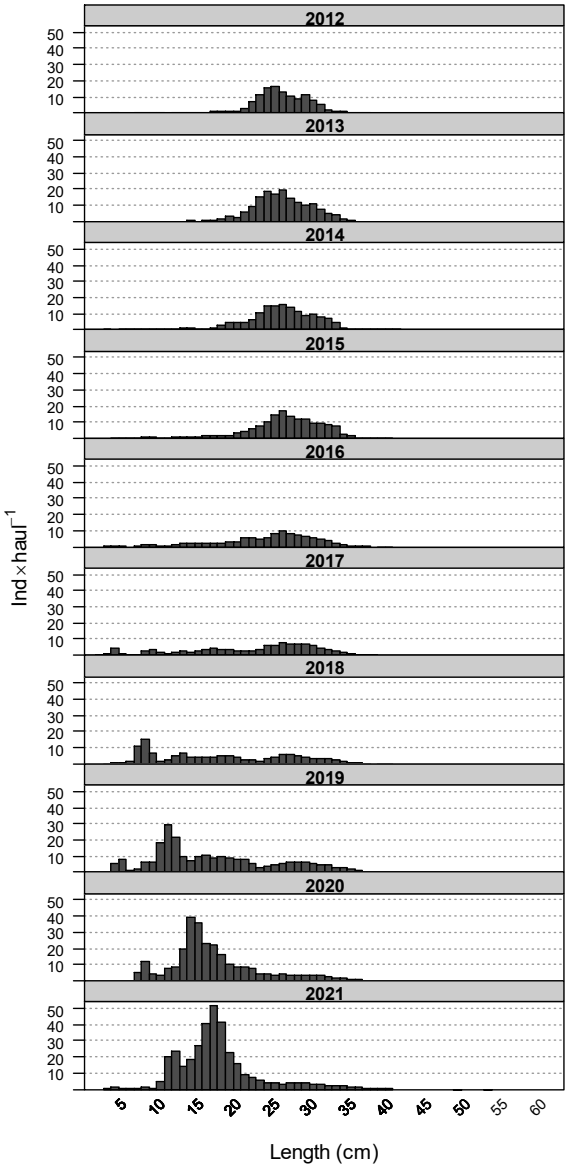

Figure 12. Mean stratified length distributions of *Helicolenus dactylopterus* in Porcupine surveys (2012-2021)

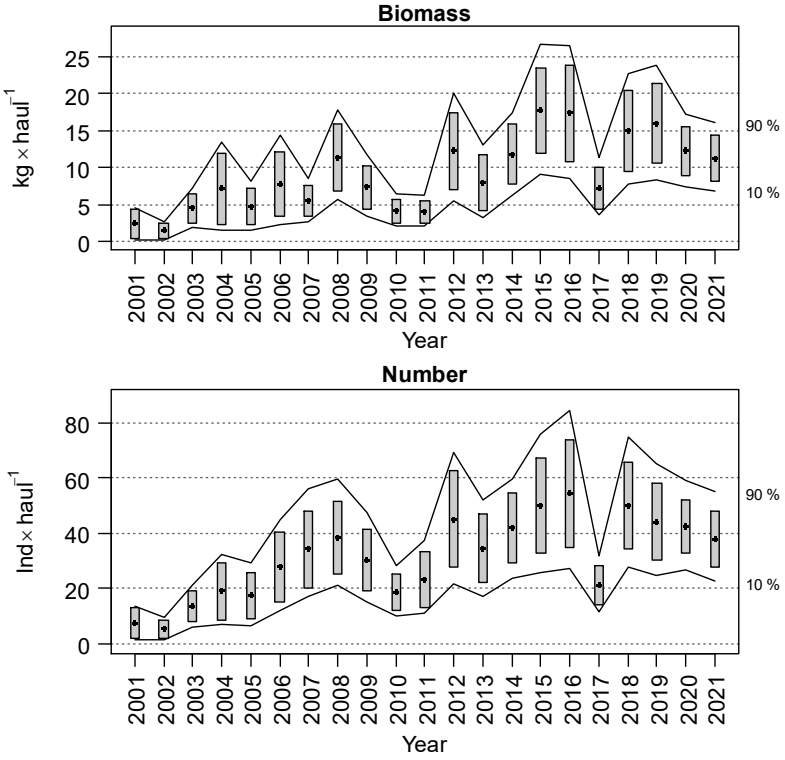

Figure 13. Evolution of *Trachyrincus scabrus* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

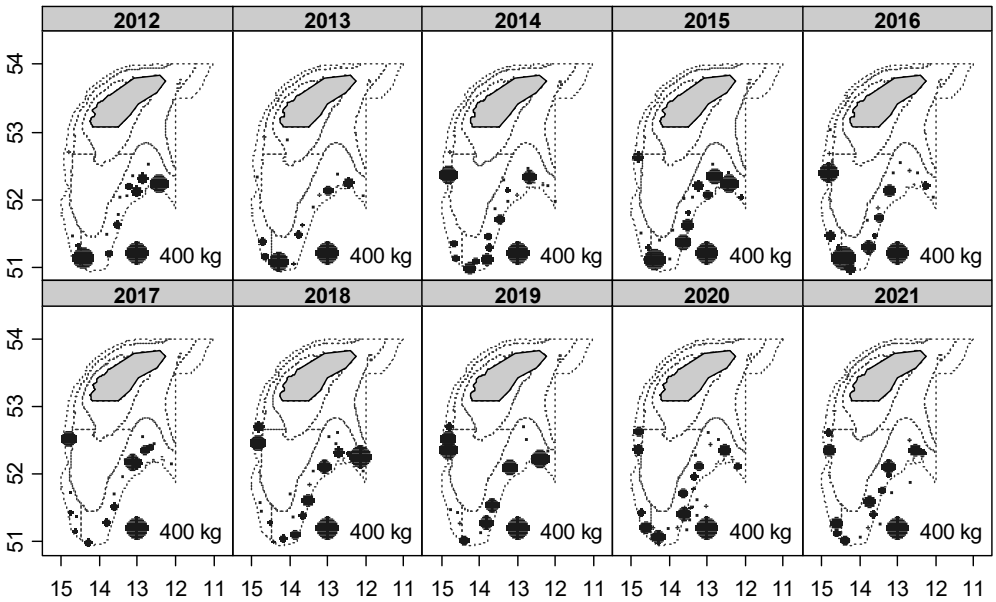

Figure 14. Geographic distribution of *Trachyrincus scabrus* catches (kg/30 min haul) in Porcupine surveys (2012-2021)

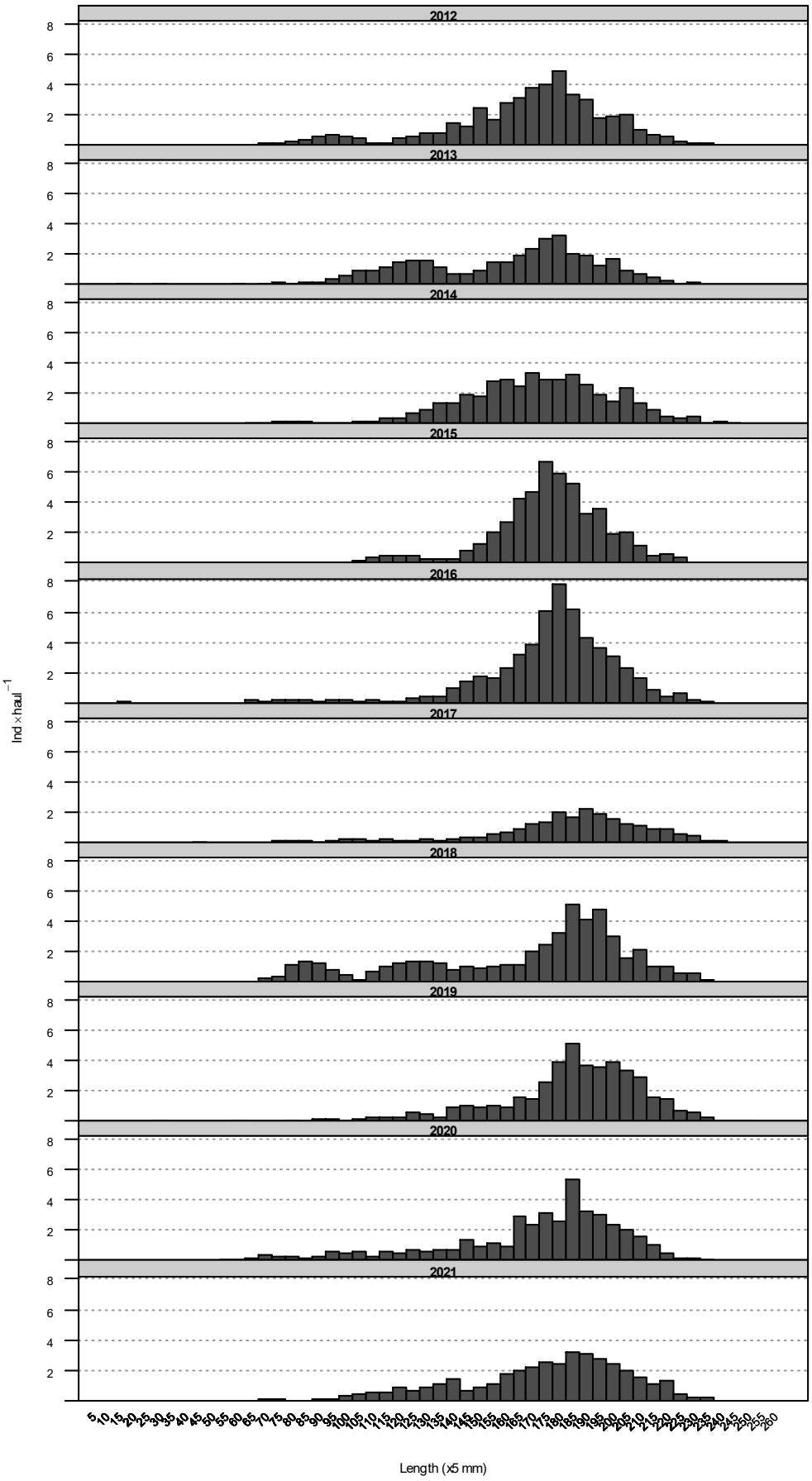

Figure 15. Mean stratified length distributions of *Trachyrincus scabrus* in Porcupine surveys (2012-2021)

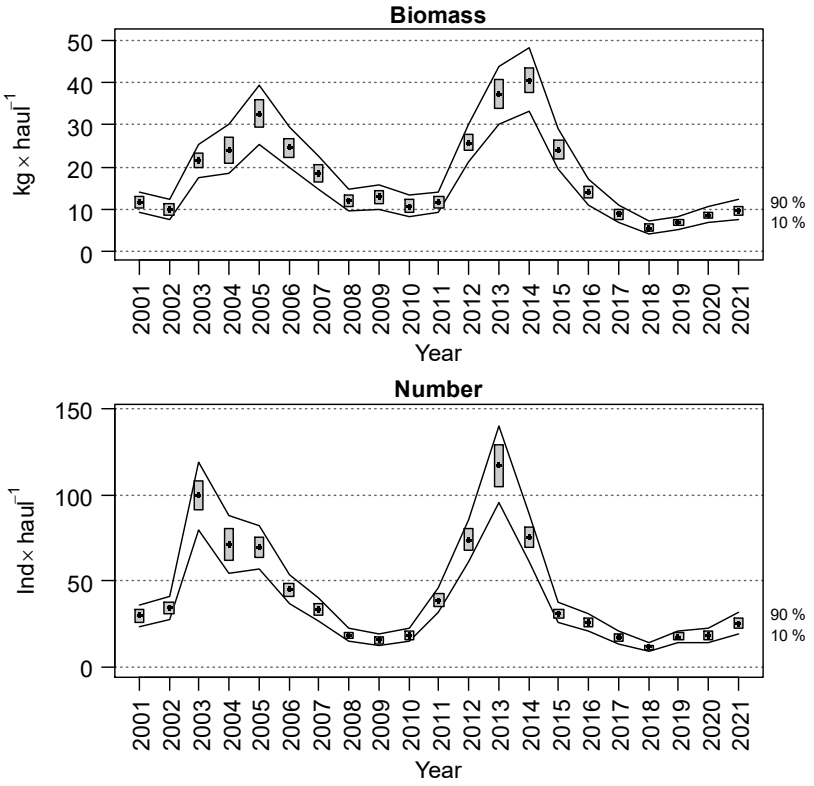

Figure 16. Evolution of *Phycis blennoides* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

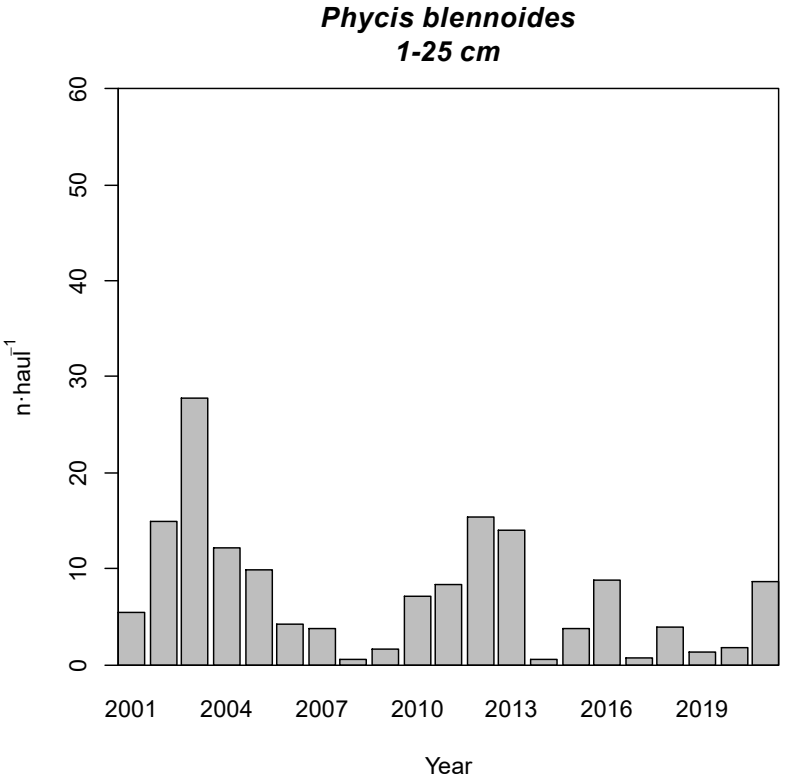

Figure 17. Mean stratified abundance of *Phycis blennoides* recruits (1-25 cm) in Porcupine surveys (2001-2021)

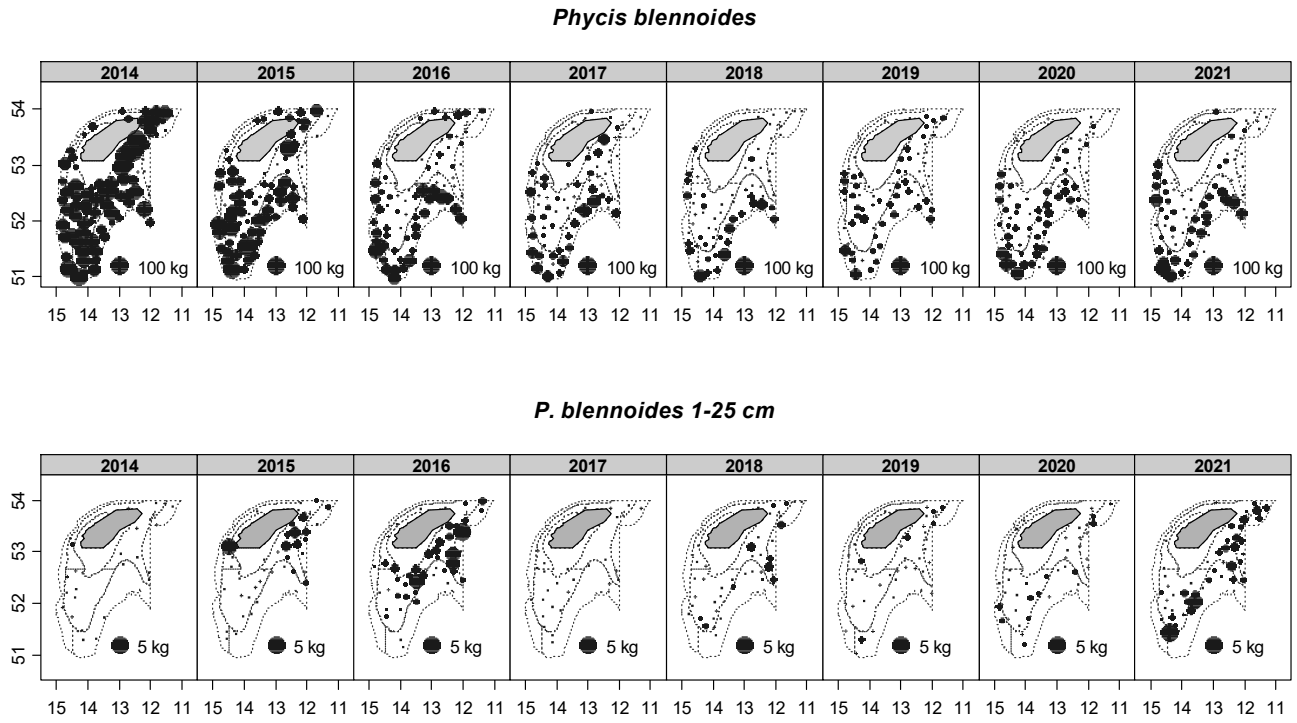

Figure 18. Geographic distribution of Phycis blennoides catches (kg×30 min haul-1) and recruits (1-25 cm) in Porcupine surveys (2014-2021)

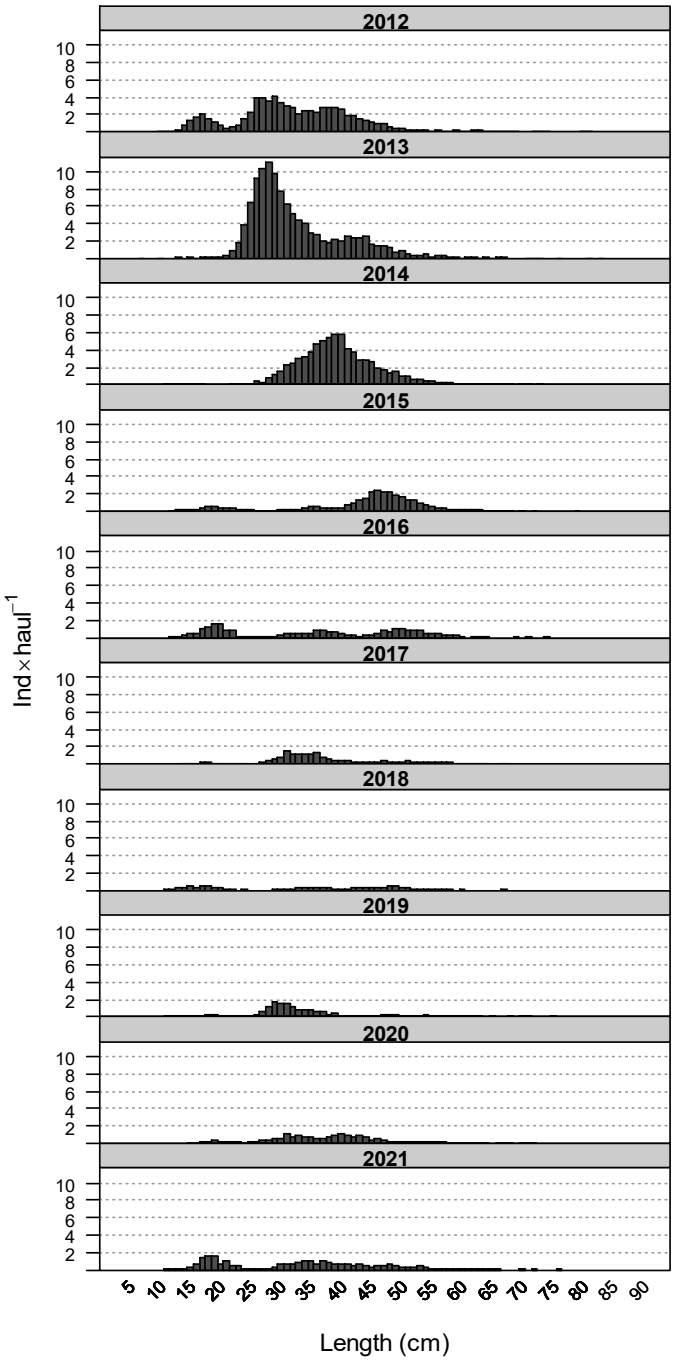

Figure 19. Mean stratified length distributions of *Phycis blennoides* in Porcupine surveys (2012-2021)

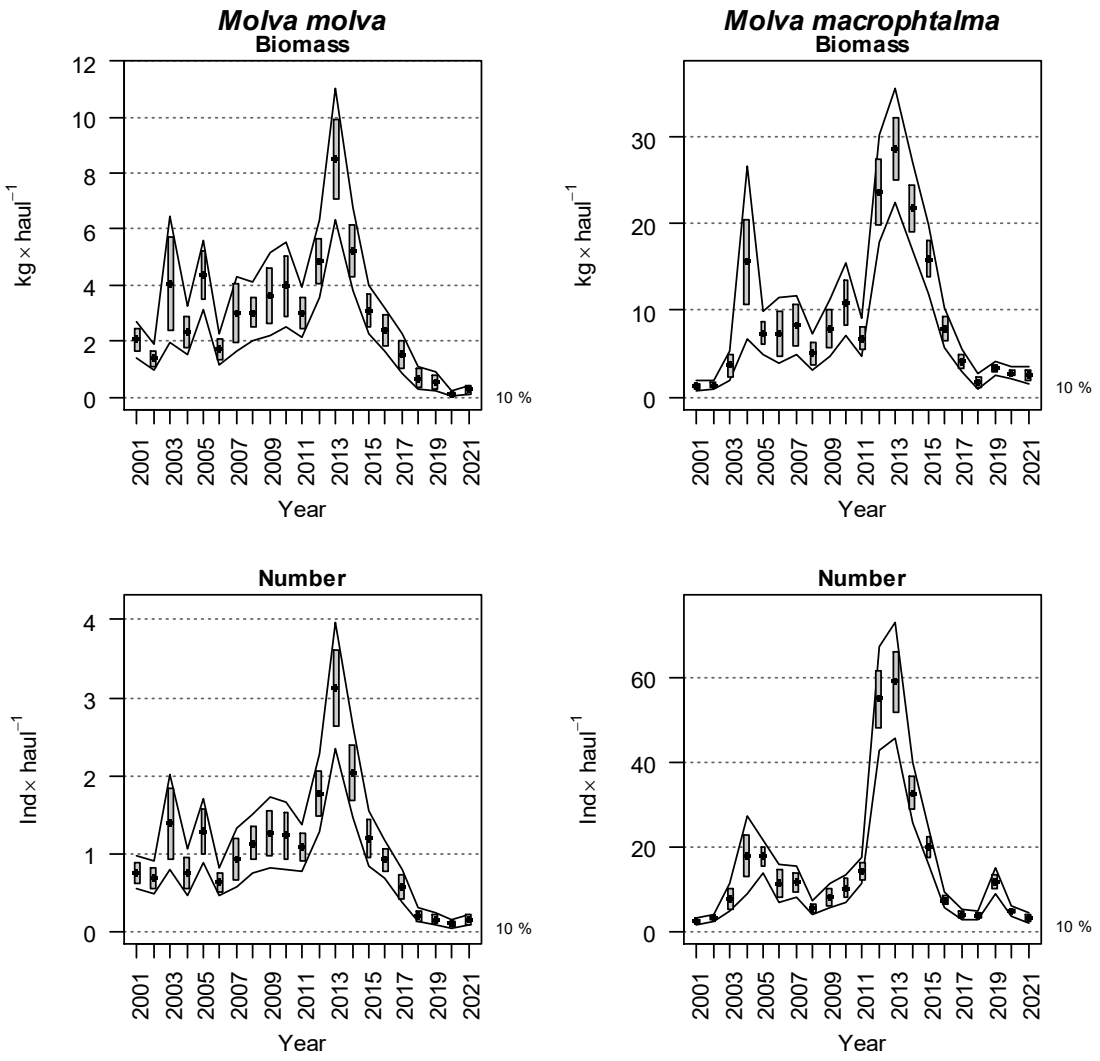

Figure 20. Evolution of *Molva molva* and *Molva macrophtalma* biomass and abundance indices in Porcupine surveys (2001-2021). Boxes mark parametric standard error of the stratified abundance index. Lines mark bootstrap confidence intervals (α = 0.80, bootstrap iterations = 1000)

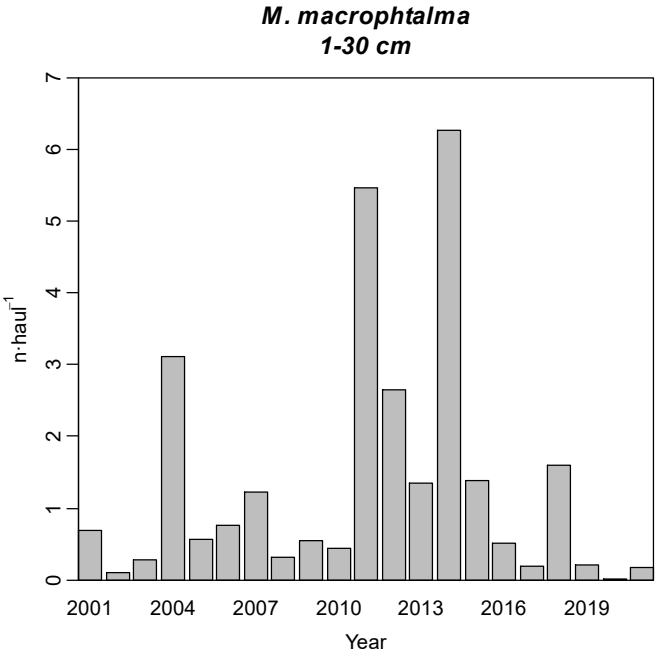

Figure 21. Mean stratified abundance of *M. macrophtalma* recruits (1-30 cm) in Porcupine surveys (2001-2021)

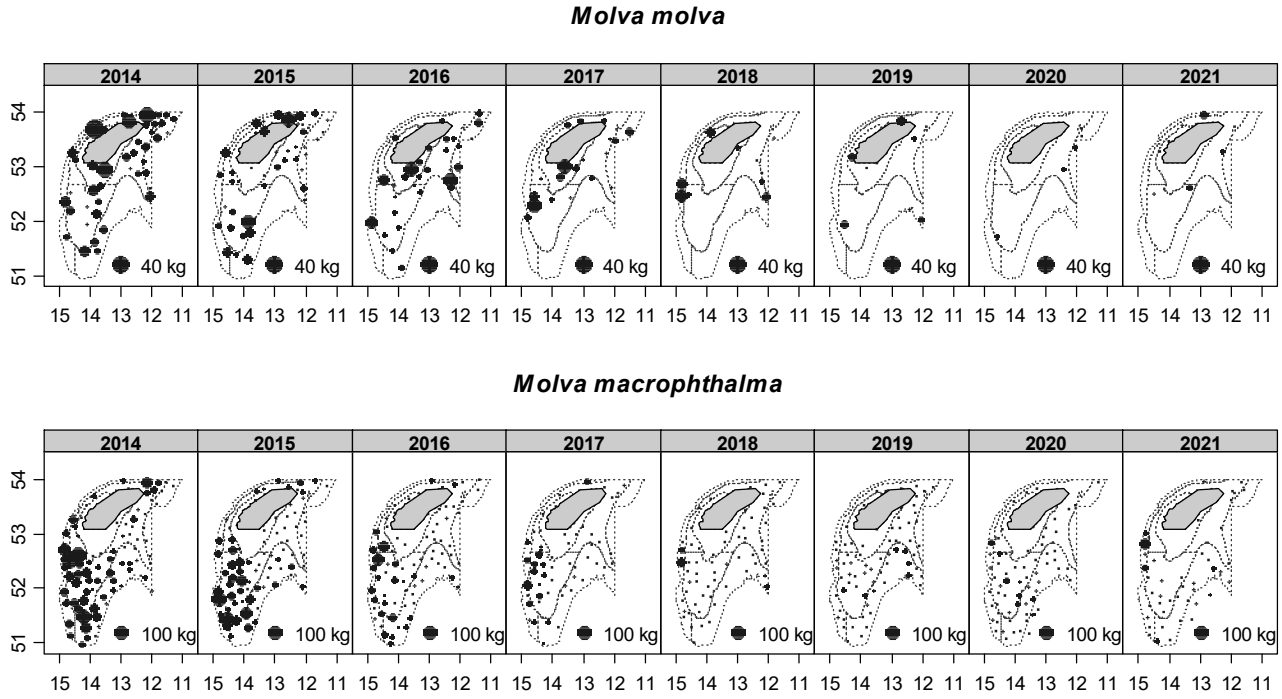

Figure 22. Geographic distribution of *Molva molva* and *Molva macrophtalma* catches (kg×30 min haul^{-1}) in Porcupine surveys (2014-2021)

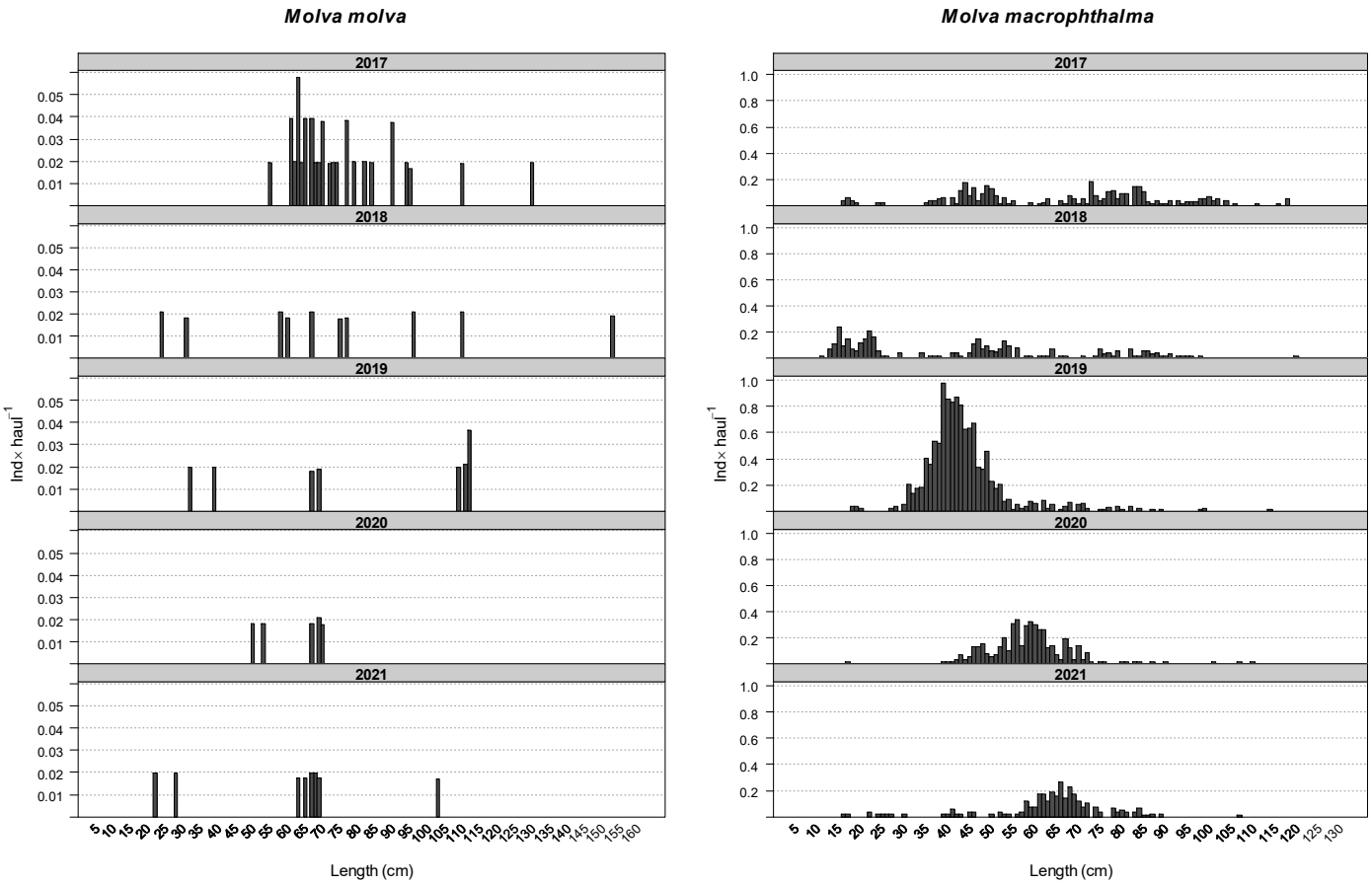

Figure 23. Mean stratified length distributions of *Molva molva* and *Molva macrophtalma* in Porcupine surveys (2017-2021)