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Institut Català de
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State of fisheries in Catalonia 2022, Part 1:

Report on the monitoring of the commercial fishing fleet

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Glossary

CL: Cephalohtorax Length
CPUE: Catch Per Unit Effort
CS: Continental Shelf
GFCM: General Fisheries Commission for the Mediterranean
GSA: Geographical Sub-Area
GSI: Gonadosomatic index
GT: Gross Tonnage
HSI: Hepatosomatic index
LF: Length Frequency
LPUE: Landing Per Unit Effort
LS: Lowe Slope
MAP: Multi-Annual Plan
MCRS: Minimum Conservation Reference Size
MCRW: Minimum Conservation Reference Weight
ML: Mantle Length
OTB: Bottom Otter Trawl
PS: Purse Seine
SCS: Shallow Continental Shelf
STECF: Technical and Economic Committee for Fisheries
TL: Total Length
US: Upper Slope
VL: Vessel Length
VMS: Vessel Monitoring System
WF: Weight Frequency
WMS: Geoserver a Web Map Service

Executive summary

This report presents the state of fisheries in Catalonia in 2022. Section 1 describes the methods of biological and fisheries monitoring over the four years of the ICATMAR monitoring program, Section 2 describes the results of the bottom trawl fishery monitoring, Section 3 describes the results of the purse seine fishery monitoring and Section 4 describes the results of the small-scale fisheries monitoring (sand eel, common octopus and blue crab fisheries).

Section 1: Introduction and methods of biological and fishery monitoring

Sampling procedures varied according to the species studied and the fishing gear used. This section explains the methodology used for each gear sampled (bottom trawl, purse seine and small-scale fisheries). Regarding bottom trawling, eight species were monitored, chosen on the basis of their importance in terms of catch and economic value: hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), Norway lobster (*Nephrops norvegicus*), blue and red shrimp (*Aristeus antennatus*), deep-water rose shrimp (*Parapenaeus longirostris*), horned octopus (*Eledone cirrhosa*), spot-tail mantis shrimp and (*Squilla mantis*) and caramote prawn (*Penaeus kerathurus*). In the purse seine fishing, the two main target species of the fishery were monitored: European sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*). And in the case of small-scale fisheries, the species included in co-management plans were monitored: sand eels – including Mediterranean sand eel (*Gymnammodytes cicerelus*), smooth sand eel (*G. semisquamatus*) and transparent goby (*Aphia minuta*) –, common octopus (*Octopus vulgaris*) and blue crab (*Callinectes sapidus*).

Section 2: Bottom trawling

In 2022, a total of 99 bottom trawl sampling hauls were conducted. Of the total catch, 67% was landed, 28% was discarded, 3% was natural waste and 2% was marine litter. A total of 472 species were identified in the 2022 samples: 148 of them belonging to the landed fraction and 324 to the discarded fraction (some species occur in both fractions).

Within the commercial fraction in 2022, each depth had a different composition, with *Illex coindetii*, *Merluccius merluccius*, *Phycis blennoides*, and *Aristeus antennatus* being the most abundant species in the shallow continental shelf, continental shelf, upper slope and lower slope, respectively. For the discarded fraction, *Engraulis encrasicolus* and *Sardinella aurita* were the most abundant species in the shallow continental shelf. In the continental shelf and upper slope, the most abundant discarded species was *Scyliorhinus canicula,* while *Galeus melastomus* was the most abundant in the lower slope. In terms of natural debris, the most abundant element was marine organic debris at all depths, and for the marine litter fraction, the main categories were wood in the shallow continental shelf, wet wipes in the continental shelf and clinker in both slopes.

For each of the eight commercial species monitored, distribution maps, length frequency distribution charts, length-weight relationship parameters, length at first maturity (L_{50}) models, gonadal cycle and a table with the number of measured individuals for the previous period sampled (2019-2021) and for 2022 are presented.

Data on catch composition for the bottom trawl fishery are shown by port for each of the nine ports sampled from north to south: Roses, Palamós, Blanes, Arenys de Mar, Barcelona, Vilanova i la Geltrú, Tarragona, L'Ametlla de Mar and La Ràpita.

Section 3: Purse seine fishing

A total of 92 purse seine samplings were carried out in 2022, of which 59 were fish market samplings and 33 were on-board samplings. The catch composition of the on-board sampling in 2022 was 74% target species (either European sardine or anchovy), 19% other commercial species and 6% discards.

For each of the purse seine fishery target species – European sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) –, distribution maps, length frequency distribution charts, length-weight relationship parameters, length at first maturity (L_{50}) models, gonadal cycles, mesenteric fat content cycle and a table with the number of measured individuals for the previous period sampled (2019-2021) and for 2022 are presented.

Section 4: Small-scale fisheries

The monitoring of small-scale fisheries includes the sand eel fishery – including Mediterranean sand eel (*Gymnammodytes cicerelus*), smooth sand eel (*Gymnammodytes semisquamatus*), and transparent goby (*Aphia minuta*) –, the common octopus (*Octopus vulgaris*) fishery and the blue crab (*Callinectes sapidus*) fishery. The sand eel fishery is the subject of a co-management plan since 2014, the common octopus fishery is co-managed in two different areas of the territory (Central Catalonia and the Ebre Delta) and the blue crab fishery is also co-managed in the Ebre Delta area.

For each species of the small-scale sampled fisheries, map of sampling zones, a table with the number of individuals measured, length at first maturity (L_{50}) models (except for common octopus), length/weight-frequency charts and monthly proportion of maturity stages for the previous period sampled (2019-2021) and for 2022 are presented.

SECTION 1
Introduction and methods

Biological and fishery monitoring

Introduction

The Mediterranean Sea is an area with long-established oceanographic and fishing traditions. The exploitation of marine living resources started thousands of years ago becoming an area of observations and descriptions in which fishing has always been of main importance (Margalef, 1989). Within the Mediterranean Sea, fisheries activities are deeply rooted in the Catalan culture and have historically been the main source of income and identity for its coastal communities. However, to ensure future provision of marine resources, there's a need to develop science-based management strategies and implement monitoring programs. For this purpose, the Catalan Research Institute for the Governance of the Sea (ICATMAR; https://icatmar.cat/) was created in Catalonia in 2018 as a cooperation body between the General Directorate of Fisheries and Maritime Affairs and the Institute of Marine Sciences (ICM-CSIC). Its aim is to develop the program of the Maritime Strategy of Catalonia, which bases the governance of the maritime policies of the territory on scientific data, long-term monitoring, and the model of co-management.

Method

Based on their importance in terms of catch and economic value, the target species of the biological sampling are hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), Norway lobster (*Nephrops norvegicus*), blue and red shrimp (*Aristeus antennatus*), deep-water rose shrimp (*Parapenaeus longirostris*), horned octopus (*Eledone cirrhosa*), spot-tail mantis shrimp (*Squilla mantis*), caramote prawn (*Penaeus kerathurus*), common octopus (*Octopus vulgaris*), European pilchard (*Sardina pilchardus*), European anchovy (*Engraulis encrasicolus*), sand eels – including Mediterranean sand eel (*Gymnammodytes cicerelus*), smooth sand eel (*G. semisquamatus*) and transparent goby (*Aphia minuta*) – and blue crab (*Callinectes sapidus*). Within ICATMAR's continuous monitoring program, deep-water rose shrimp, red mullet and blue crab are analyzed for the first time in this report.

The sampling procedures varied depending on the species studied and the fishing modality used to catch them. An overview of the total sampling trips in the three fishing modalities during the year 2022 is shown in Figure 1.

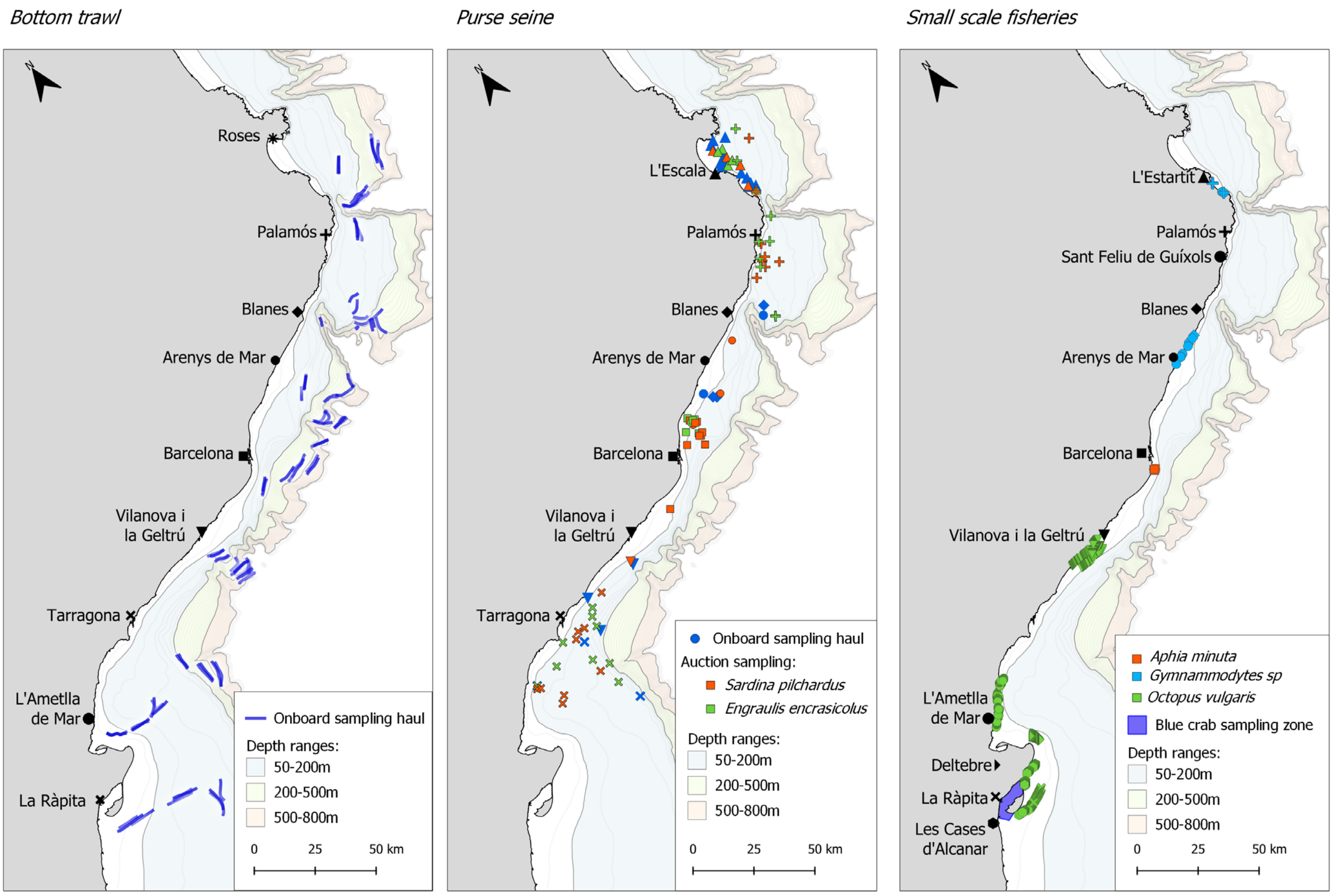

Figure 1. Fisheries monitoring sampling conducted in Catalonia in 2022.

Bottom trawling sampling

For the bottom trawl fishery, sampling was done through experimental hauls at different depths, in fishing grounds defined by high-fishing effort areas.

Sampling was carried out from 9 main commercial ports, with a quarterly frequency per port. The division of the study area in 3 zones (North, Center and South) is made according to oceanographic features and geomorphological traits occurring in the Catalan sea (Clavel-Henry et al., 2021). The ports of the zones where the sampling took place are:

North zone: Roses, Palamós, Blanes, and Arenys de Mar.

Center zone: Barcelona, Vilanova i la Geltrú and Tarragona.

South zone: L'Ametlla de Mar and La Ràpita (formerly Sant Carles de la Ràpita).

Each sampling day includes three experimental hauls on-board of the same vessel, each one at a different depth range. Each haul is GPS-recorded with a start and end point, fishing time and gear width. These measurements allow the calculation of the swept area to standardize species biomass and abundance values. The sampled depth ranges for the North and Center zones and their corresponding most common target species are:

Continental shelf (76 – 200 m): hake, horned octopus, caramote prawn and spot-tail mantis shrimp.

Upper slope (201 – 500 m): Norway lobster, deep-water rose shrimp, hake and horned octopus.

Lower slope (501 – 800 m): blue and red shrimp.

However, for the South zone the sampled depth differs due to the distinct geomorphological structure of the Ebre Delta, where commercial fishing activity takes place exclusively in the wide continental shelf, and thus requires a more detailed sampling of this area. The sampled depth ranges for the South zone and their most common corresponding target species are:

Shallow continental shelf (<40 m): spot-tail mantis shrimp and caramote prawn.

Middle continental shelf (40 – 75 m): spot-tail mantis shrimp and hake.

Continental shelf (76 – 200 m): spot-tail mantis shrimp and hake.

For the analysis of length and weight frequency distributions of the target species, the shallow and middle continental shelves of the South zone have been unified under the name of shallow continental shelf and cover a depth range from <40 to 75 m.

Average depth for each haul is then estimated by calculating an average point between the start and end points of each haul. Mesh size is 40-mm square for all hauls except in Palamós lower slope, where the co-management measures for the blue and red shrimp fishery require a 50-mm squared mesh. On-board, the fishermen sort the catch into two categories: commercial, i.e. individuals of commercial species to be sold at the fish market, and discard, which can include individuals of non-commercial species and/or undersized or damaged individuals of commercial species, as well as marine litter and natural debris. Fish, crustacean and cephalopod individuals of the commercial fraction are identified and measured on board (total length, cephalothorax length and mantle length, respectively). For the target species, a subsample of a little over 30 individuals is preserved in coolers to transport to the laboratory. As for the discard fraction, either the total sample or a subsample – depending on the total size of the catch – is preserved in coolers and transported to the laboratory for further analysis. The process is repeated for each of the three hauls.

Debris definition and composition

The samples used to characterize and analyze the debris and its composition, were obtained from the discard fraction gathered during the bottom trawling sampling.

The term debris includes two different types of items. On one side, the non-organic materials caught during fishing operations, also known as marine litter and, on the other, organic materials with terrestrial and marine origin such as shells, algae and plants. Debris have been classified following (REGULATION (EU) 2022/92) (ICATMAR, 22-04 and Balcells et al., 2023).

For the analysis and plots of the debris, the categories analyzed were the 10 with the highest weight and representing over 2% of the total catch.

Purse seine fishing sampling

For the purse seine fishery, sampling was done through the acquisition of batches of European pilchard and European anchovy at the fish market and, since 2022, also through sampling of these two species on-board purse seiners. Data gathered during on-board sampling allowed to complete the estimation of the biological parameters and the length-weight relationship of these target species. In addition, it allowed to describe the whole catch composition, including data on by-catch (non-target commercial species) and the discarded fraction, and to estimate the fishing effort of the purse seine fleet along the Catalan coast.

In both types of sampling, the fishing trips were not experimental but strictly planned by the vessel skippers according to their own interests. Furthermore, in neither of the two types was the area of the Ebre Delta sampled, as no significant catch of these species lands in ports south of Tarragona and thus the purse seine fleet does not usually labor there.

For the acquisition of batches, a standard batch of fish (approximately 10 kg) of each of the target species – when both were available – was bought directly at the sampled port market three times per month. Each of the three monthly batches was purchased in different ports, so that the entire length of the Catalan coast where this type of fishing takes place was covered. One of the batches was purchased in the northern port of Palamós, one in the central port of Barcelona, and one in the southern port of Tarragona. Data on the batch origin (vessel, catch coordinates and total catch) were gathered at the fish market or from the fisher who provided it.

On the other hand, sampling on-board purse seiners was carried out twice a month from five main commercial ports: L'Escala, Blanes, Arenys de Mar, Vilanova i la Geltrú and Tarragona. One of the monthly samplings was always carried out in the port of L'Escala, in the north, while the other alternated between ports of the more central area (Blanes or Arenys de Mar) and ports of the southernmost area (Vilanova i la Geltrú or Tarragona).

Once in the laboratory, at the ICM-CSIC, the same protocol was followed in both types of sampling: all the individuals from a subsample of approximately 3 kg from each of the target species – when both were available – were measured to the nearest 0.5 cm and classified by size categories to obtain size frequencies. Then, 30 individuals from each species, distributed by all size categories, were measured and weighed individually, their reproductive state and fat content was assessed and their gonads were weighed. However, only in the on-board sampling, if by-catch species were present in the samples, they were identified and their individuals measured and weighted.

Small-scale fisheries sampling

Small-scale fisheries sampling includes sand eels, common octopus and blue crab fisheries.

Sand eel fishery sampling

For the sand eel fishery, sampling was carried out on-board boat seine ("sonsera") fishing vessels where biological batches were obtained. The fishing trips were not experimental but strictly planned by the vessel skippers according to their own interests. During closure periods, one sampling per month was carried out to check the state of the population before the opening of the fishery.

Sampling for Mediterranean and smooth sand eel was carried out from the ports of l'Estartit, Sant Feliu de Guíxols, Palamós and Blanes, in the northernmost province of Girona, and from the port of Arenys de Mar, in the centralmost province of Barcelona. On the other hand, sampling for the transparent goby was carried out from the ports of Barcelona and Badalona.

Two monthly samplings were conducted where biological batches of 1 Kg of Mediterranean and smooth sand eel were obtained: one from the port of Arenys de Mar and the other from one of the ports in the province of Girona. Batches were preserved in coolers to transport to the laboratory. When transparent goby was available, two monthly batches of 1 Kg were obtained from the ports of Barcelona and Badalona (one from each location).

Once in the laboratory, at the ICM-CSIC, a random subsample of 100-200 individuals was classified by species (either Mediterranean or smooth sand eel), measured to the nearest 0.5 cm, and classified by size categories to obtain size frequencies. Then, 50 individuals, distributed by all size categories, were measured and weighed individually, and, for the ones with a length above 6 cm, their reproductive state was assessed. If discard species were present, they were identified and their individuals measured and weighted. For the transparent goby, the same protocol was followed.

Common octopus fishery sampling

For the common octopus fishery, sampling was carried out on-board fishing vessels, using pots and traps as fishing gears, where biological batches were obtained. The fishing trips were not experimental but strictly planned by the vessel skippers according to their own interests.

Sampling was carried out from five main ports, within the two zones that host a co-management plan for the species:

Central Catalonia: Vilanova i la Geltrú.

Ebre Delta: L'Ametlla de Mar, Deltebre and La Ràpita.

Six monthly samplings were conducted: four from the port of Vilanova i la Geltrú, two with pots and two with traps, and the other two alternating from the port of L'Ametlla de Mar, with traps, and the ports of Deltebre or La Ràpita, with pots. For every boarding, batches of up to 30 individuals of common octopus – above minimum conservation reference weight (MCRW), established at 1000 g – were obtained and preserved in coolers to transport to the laboratory. If more than 30 individuals were caught, the extra individuals were measured (mantle length), weighted and sexed in situ. All individuals below MCRW were weighed and sexed in situ and released back to the sea.

Once in the laboratory, at the ICM-CSIC, all individuals were measured (mantle length), weighed, sexed and their reproductive state was assessed.

Blue crab fishery sampling

For the blue crab fishery, sampling was exclusively carried out in the Ebre Delta area, where it is a non-indigenous species. Samples were collected once a month at the fishing auction in La Ràpita and data were taken from different vessels, ensuring that all sampling strata were represented for each sampling day. The depth and the approximate location of the catch was provided by the fishers (general fishing grounds or areas).

Between 30 and 50 individuals were sampled on each vessel and the total weight of individuals sampled per vessel was recorded. Prior to sale, samples were analyzed: individuals were measured (carapace length and width), sexed, assessed for maturity (adult or juvenile) and, in females, the presence of eggs and their developmental stage were determined.

Calculations and data analysis

The methods applied in this report for the calculation and analysis of the data were defined in (Ribera-Altimir et al. 2023), while he information and data systems used can be found in ICATMAR, 22-04.

For each target species, the annual length frequency (weight frequency in the case of Cephalopoda) by sampling strata was represented, as well as the size at first maturity (L_{50}), monthly proportion of each maturation stage and monthly average value of gonadosomatic index (GSI). The length/weight frequency is only shown for the strata where each species is naturally present. GSI and L_{50} values in the crustaceans analyzed are only presented for females, since males present stable GSI values throughout the year and the visual identification of immature males was not possible. A table with length-weight relationship parameters is provided for each species, using the relationship W = a*TLb, where W is weight (g) and TL is total length (cm).

Although the present report is focused on the year 2022, data are in general presented for the years 2019, 2020, 2021 and 2022. Information on previous years sampled is also available in previous reports (ICATMAR 22-04, 21-03, 19-01), but is presented here again in a unified format for clarity and ease of reference.

Figure 2 shows the number of samplings carried out, the on-board sampling time, the amount of sampled and dissected specimens, the number of identified species and the total covered distance during samplings stored in the data base from 2019 to 2022.

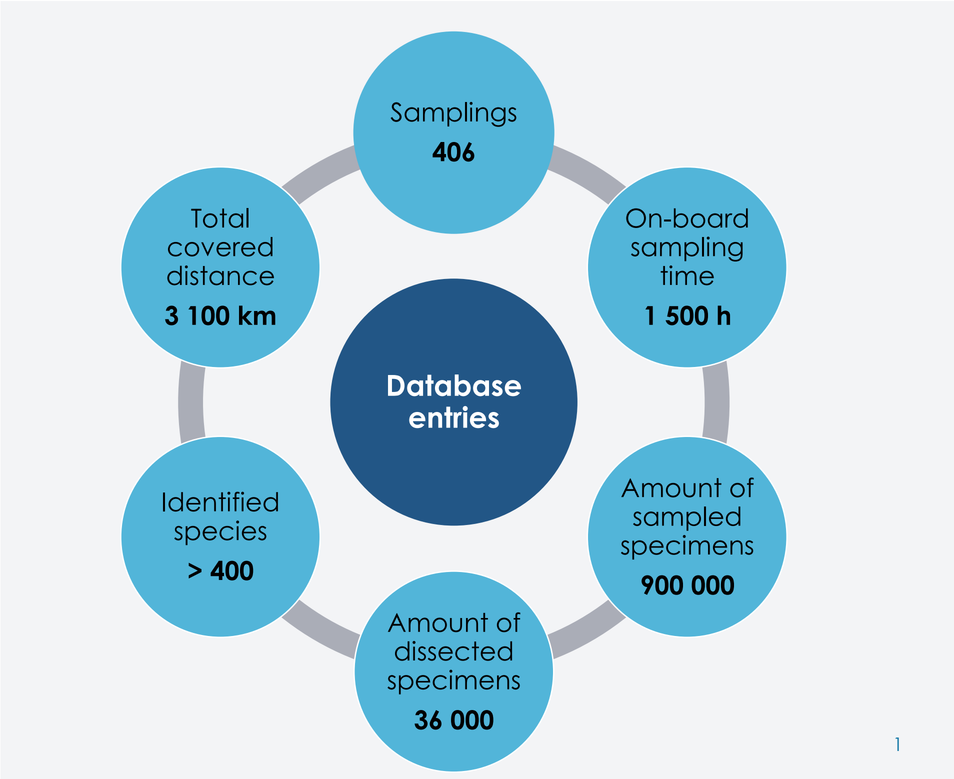

Figure 2. Amount of records of the fishing sampling data stored in the data base from 2019 to 2022.

SECTION 2
Bottom trawling

Fishery monitoring of bottom trawl fishery in Catalonia

Bottom trawl fishery in Catalonia

A total of 99 bottom trawling sampling hauls were carried out in 2022: 14 on the shallow continental shelf, 33 on the continental shelf, 26 on the upper slope and 26 on the lower slope (Figure 3).

Over the entire sampling period from 2019 to 2022, a total of 406 hauls were carried out: 58 on the shallow continental shelf, 134 on the continental shelf, 105 on the upper slope and 109 on the lower slope (Table 1).

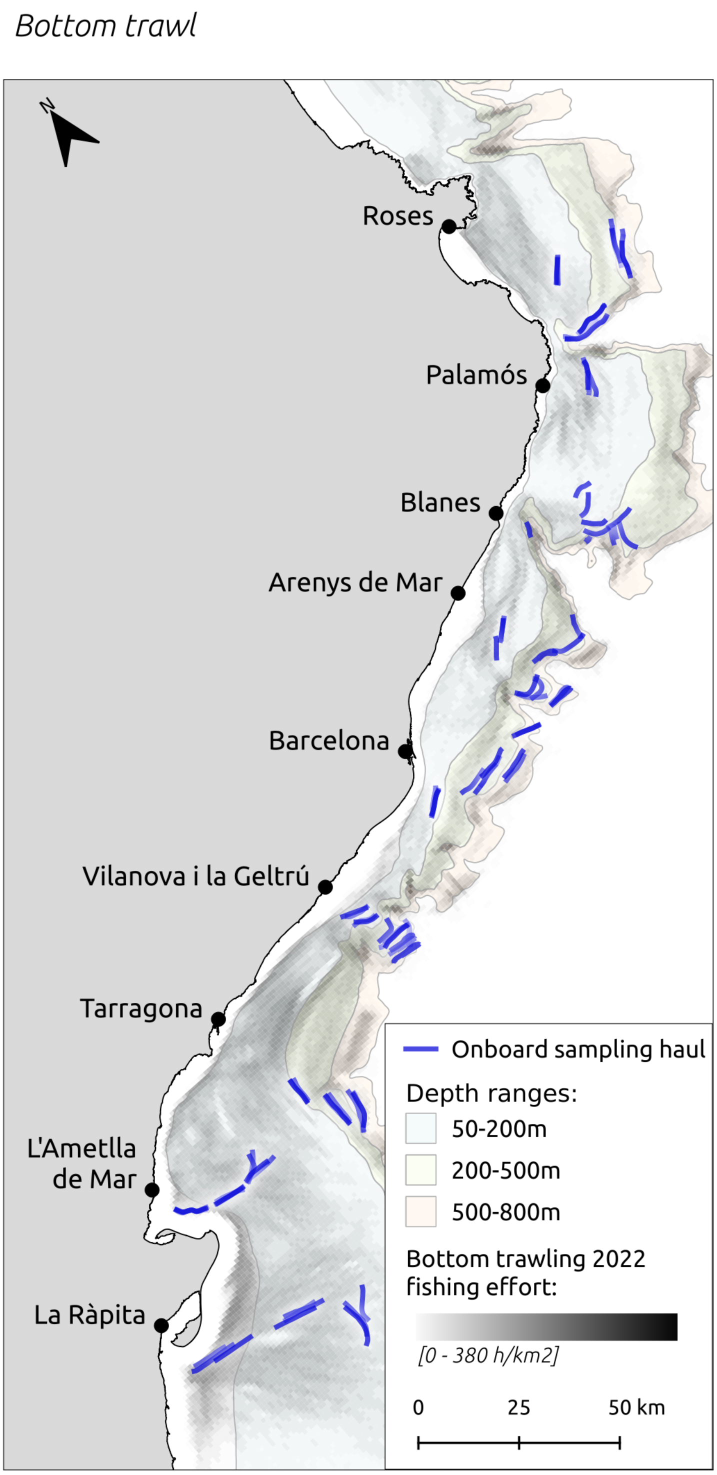

Figure 3. Bottom trawling hauls conducted in Catalonia in 2022.

Table 1. Number of bottom trawling sampling hauls carried out from 2019 to 2022 along the zones sampled in each season and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Fishery	Year	Zone	SCS				CS				US				LS			
			W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A
Bottom trawl	2019	North					1	7	4	4	1	7	4	4	1	6	4	4
Bottom trawl	2019	Center					3	3	2	4	3	3	2	4	3	3	2	4
Bottom trawl	2019	South	4	4	6	4	3	2	3	2	1				1		2	1
Bottom trawl	2020	North					3	2	4	4	3	2	4	4	3	2	3	4
Bottom trawl	2020	Center					2	2	3	3	2	2	3	3	2	2	3	3
Bottom trawl	2020	South	2	2	4	4	1	1	2	2					1		1	1
Bottom trawl	2021	North					4	4	4	4	4	4	4	4	4	4	4	4
Bottom trawl	2021	Center					3	3	3	2	3	3	3	2	3	3	3	2
Bottom trawl	2021	South	4	2	4	4	2	1	2	2								
Bottom trawl	2022	North					3	4	4	4	3	4	4	4	3	4	4	4
Bottom trawl	2022	Center					3	2	3	3	3	2	3	3	3	2	3	3
Bottom trawl	2022	South	2	4	4	4	1	2	2	2								
Total number of hauls per depth						58				134				105				109
Total number of hauls in the studied period																		406

In the period 2019-2021 the mean landed catch was 61%, while in 2022 67%. The mean discarded catch was 33% for the period 2019-2022 and 28% in 2022. The mean mass of natural debris was 5% for the period 2019-2022 and 3% for 2022. The mean mass of marine litter was 2% for both periods (Figure 4).

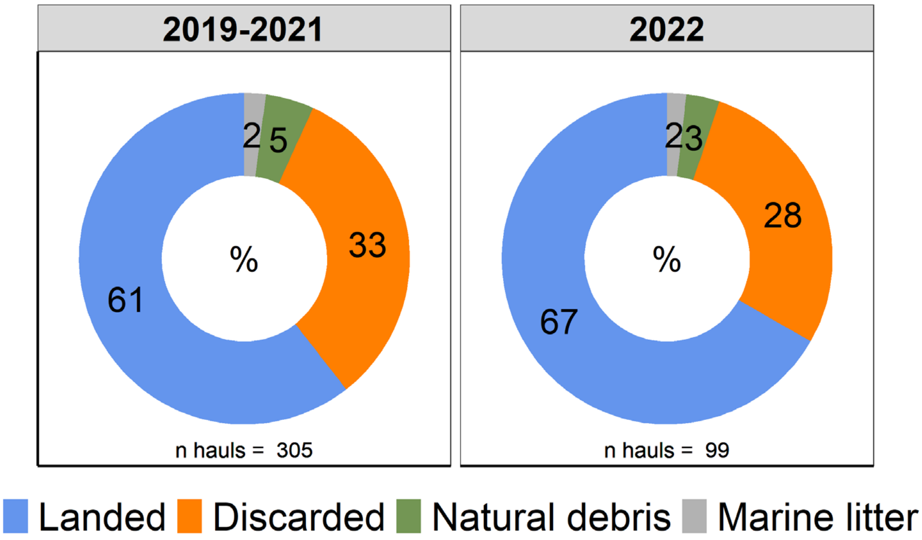

Figure 4. Catch composition in Catalonia. Percentage by weight of landings, discarded, natural debris and marine litter.

The number of commercialized species (without considering discards) was 182 in the period 2019-2021 and 148 in 2022 (Figure 5). At the level of Catalonia, comparing the period 2019-2021 with 2022, the most important species remained relatively constant over the years. However, it is worth noting the rise of *Micomesistius poutassou* and *Merluccius merluccius*. It is also worth mentioning the rise of *Parapenaeus longirostris*, the most important crustacean in terms of landed biomass in 2022, and the reduction of *Nephrops norvegicus* which, in 2022, no longer appeared in the top 10 most important commercialized species. For detailed tables on the landed catch composition at the lowest possible classification level, see Annex 1, Annex 3, Annex 2 and Annex 4.

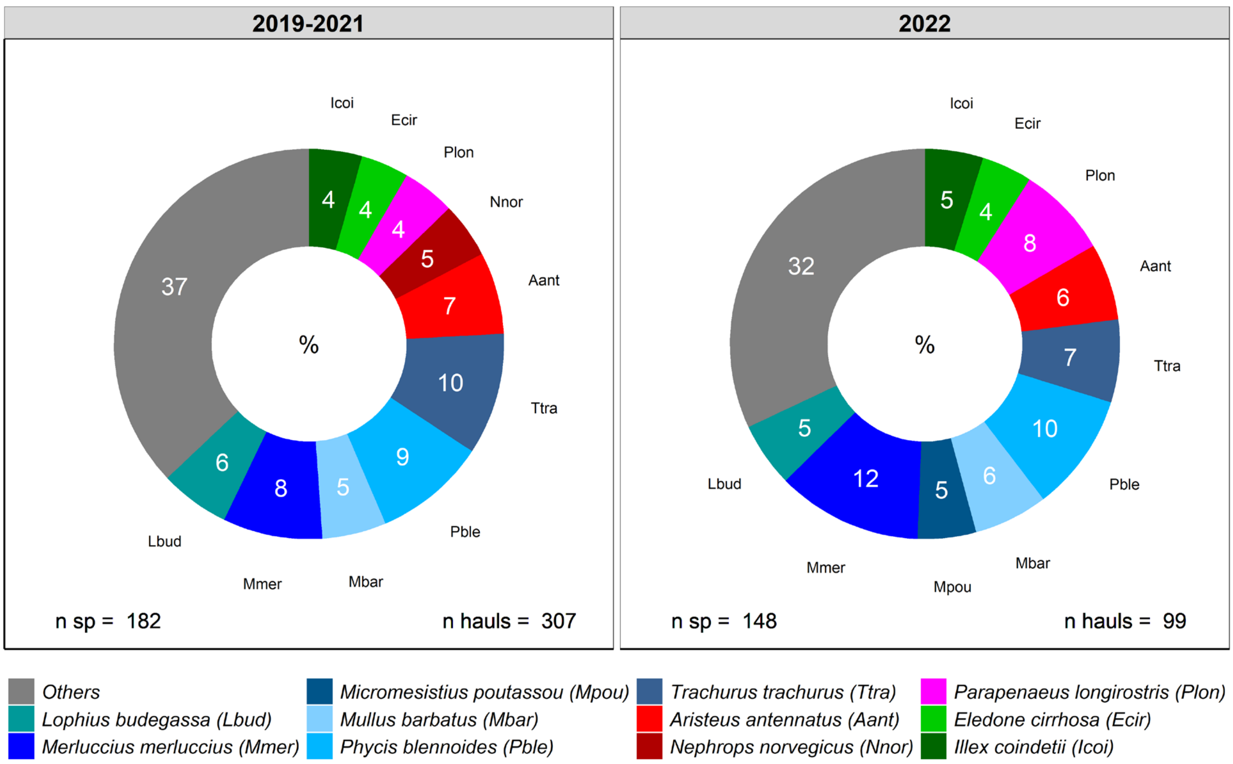

Figure 5. Landed species with most biomass including all hauls in each period.

The number of discarded species was 480 in the period 2019-2021 and 324 in 2022 (Figure 6). The most important species in the discarded fraction was *Scyliorhinus canicula* in both periods (Blanco et al., 2022), although a notable increase of its biomass was observed in 2022. Comparing both periods, it is worth noting the rise of *Merluccius merluccius* in 2022, which accounted for more than 10% of the discarded biomass. For detailed tables on the composition of the discarded fraction of the catch, see Annex 5, Annex 7, Annex 6 and Annex 8.

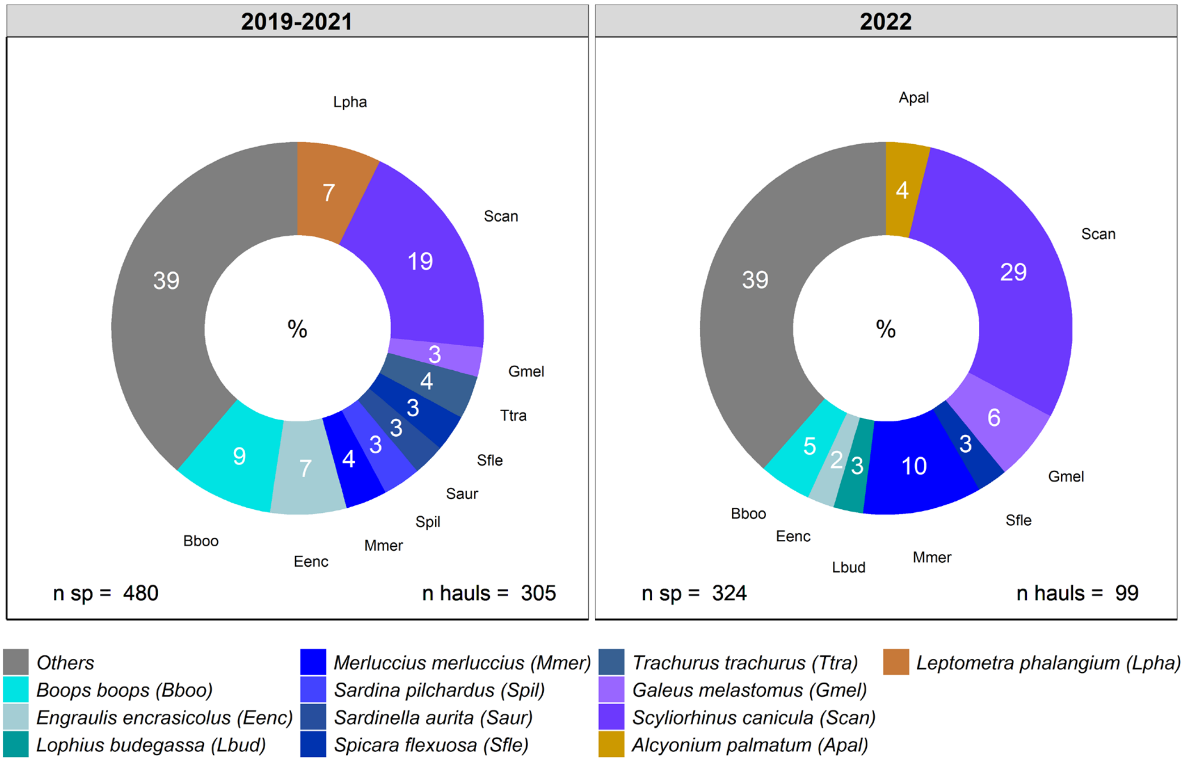

Figure 6. Discarded species with most biomass including all hauls in each period.

As for the natural debris, the predominant categories present in the bottom trawling samples were terrestrial plants, marine organic debris and shells in both periods analyzed (Figure 7). For detailed tables on the natural debris composition, see Annex 9 and Annex 10.

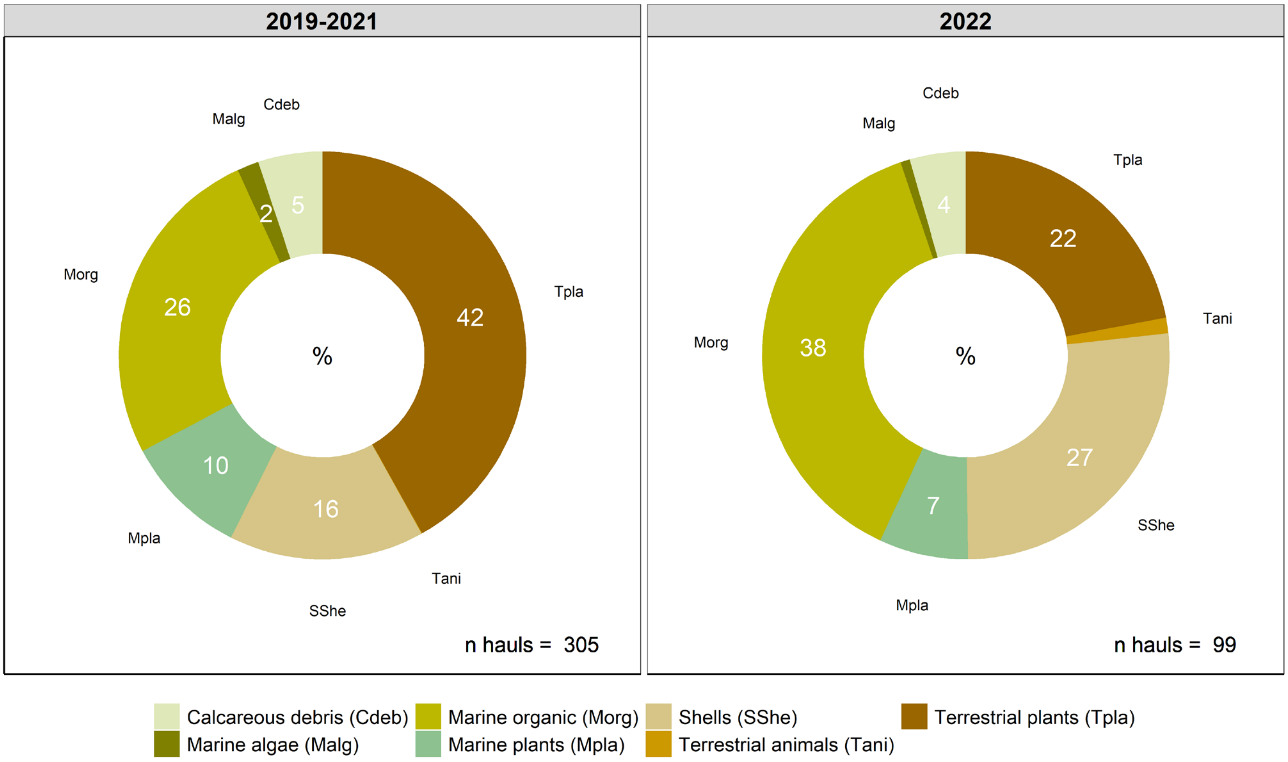

Figure 7. Categories of natural debris with higher biomass including all hauls in each period.

For marine litter, i.e. anthropogenic waste, the categories with the highest proportions were plastic and wet wipes in both periods compared (Figure 8). For detailed tables on the composition of marine litter, see Annex 11 and Annex 12.

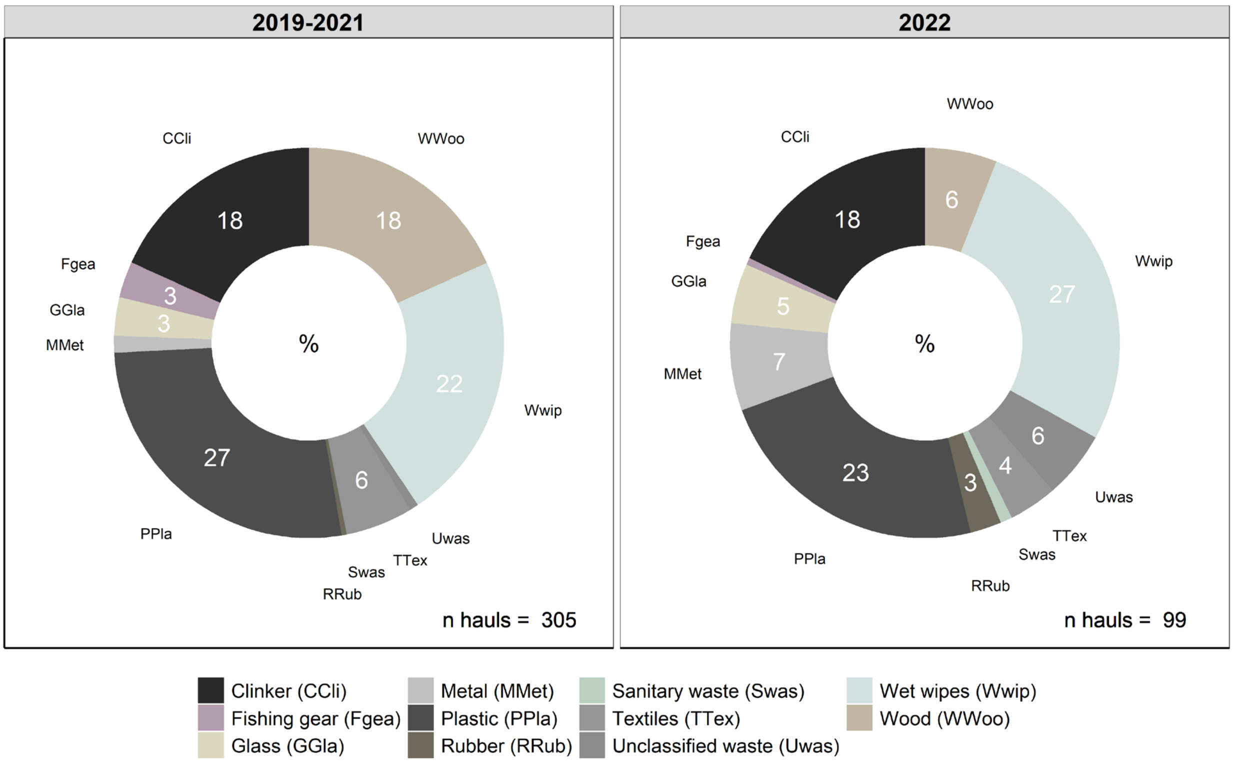

Figure 8. Categories of marine litter with higher mass including all hauls in each year.

Comparing the different fractions of the catch, the proportion of discards was similar in both periods, with the highest proportion found in the continental shelf (Figure 9). As for the proportion of natural debris, this was higher in the shallow continental shelf, as a large part of it (terrestrial plants) comes from river mouths after rainfall events.

As for the species with the highest biomass landed, the main species on the shallow continental shelf in the period 2019-2021 were *Squilla mantis* and *Pagellus erythrinus*, while in 2022 it was *Illex coindetii* (Figure 10). In the continental shelf, the main species in both periods compared was *Trachurus trachurus,* although its proportion decreased by 7% (21 to 15%) in 2022. It is also worth noting the case of *Merluccius merluccius,* which accounted for 10% of the landed biomass in the period 2019-2021 and increased to 18% in 2022. In the upper slope, the main species was *Phycis blennoides* accounting for 25% of the biomass landed in both periods analyzed, followed by *Micromesistius poutassou* which increased from 10 to 18% in 2022. *Nephros norvegicus*, the second species in biomass landed in the period 2019-2021, decreased by 5% (17 to 12%) in 2022, while another crustacean, *Parapenaeus longirostris,* increased by 5% (10 to 15%) its biomass landed in 2022. In the lower slope, *Aristeus antennatus* was the main species in both periods.

Regarding the discarded fraction of the catch, in the shallow continental shelf the main species in terms of biomass was *Engraulis encrasicolus,* although it declined from 25% in the period 2019-2021 to 12% in 2022 (Figure 11). The same pattern was observed in the also small pelagic fish *Sardina pilchardus* (from 15 to 6%) and *Sardinella aurita* (from 14 to 11%). This reduction is particularly evident in the port of L'Ametlla de Mar and could be related to the increased activity of the purse seine fleet in the area in 2022 (ICATMAR 23-03). In the continental shelf the main species in the discarded fraction of the catch was *Scyliorhinus canicula* in both periods. Of note is the increase of *Merluccius merluccius* from 5 to 19% in 2022. This increase could be related to increased recruitment of this species in 2022 which will be discussed later in this report (Figure 24). In the upper slope, *Scyliorhinus canicula* was also the most abundant discarded species in both periods, while *Galeus melastomus* was the main species in the lower slope in 2022, with a marked increase from 23 to 42% compared with the 2019-2021 period.

The composition of the natural debris shows that the main categories in both periods and across all depth strata were marine organic debris and terrestrial plants (Figure 12). As previously stated, the high proportion of terrestrial plants could come from river mouths following rainfall events. In terms of marine litter, plastic and wet wipes were the categories that accounted for a higher proportion in the continental shelf (Figure 13). In the upper and lower slope, clinker was the main category This type of marine litter is the coal that used to fuel ships in the past and is a type of waste that is no longer generated today. Wood is another relevant category in terms of mass, especially in the shallow continental shelf, as this type of items are heavy (Balcells et al., 2023).

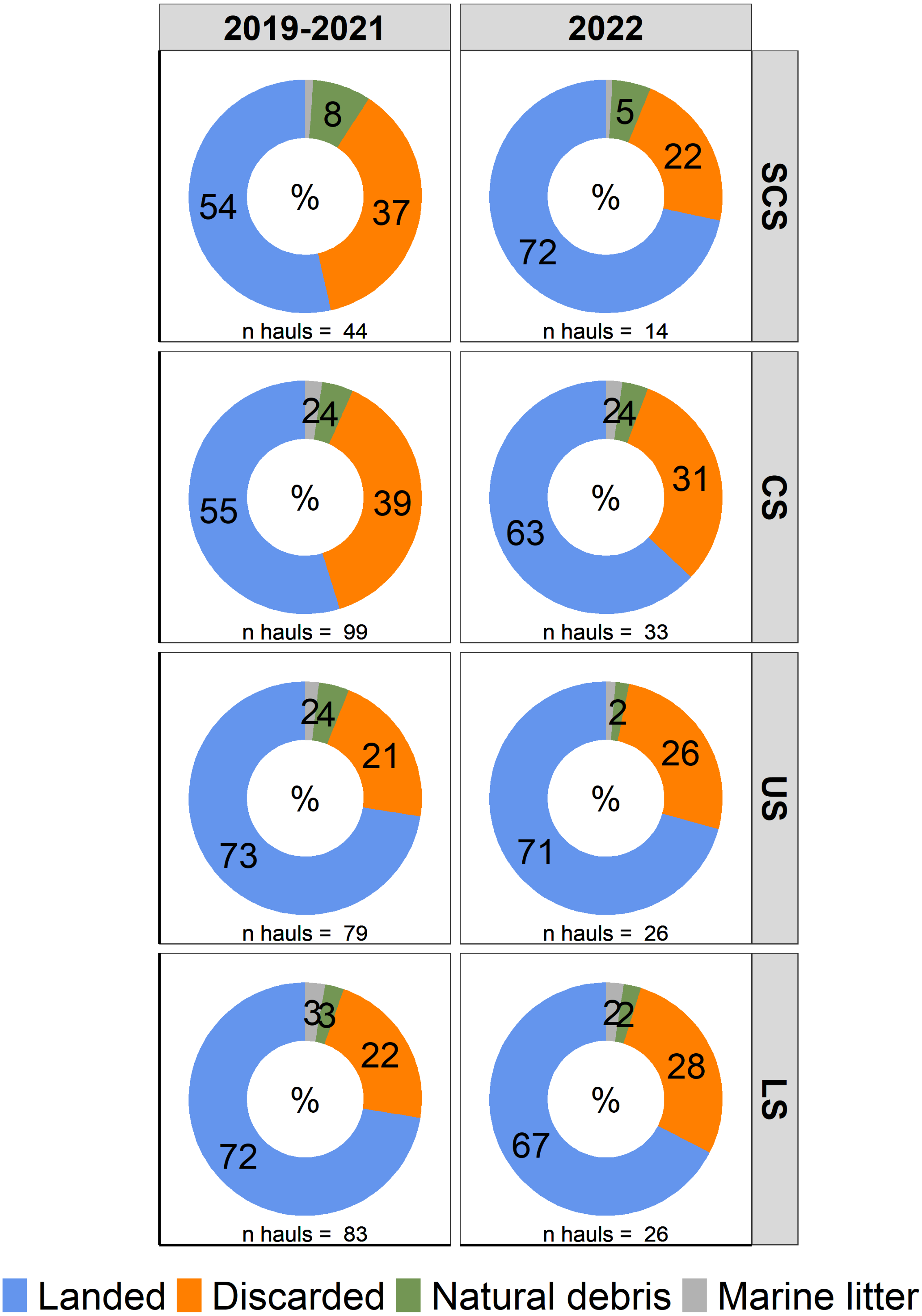

Figure 9. Catch composition in Catalonia. Percentage by weight of landings, discarded, natural debris and marine litter fraction in each fishing ground (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope) including all hauls in each period.

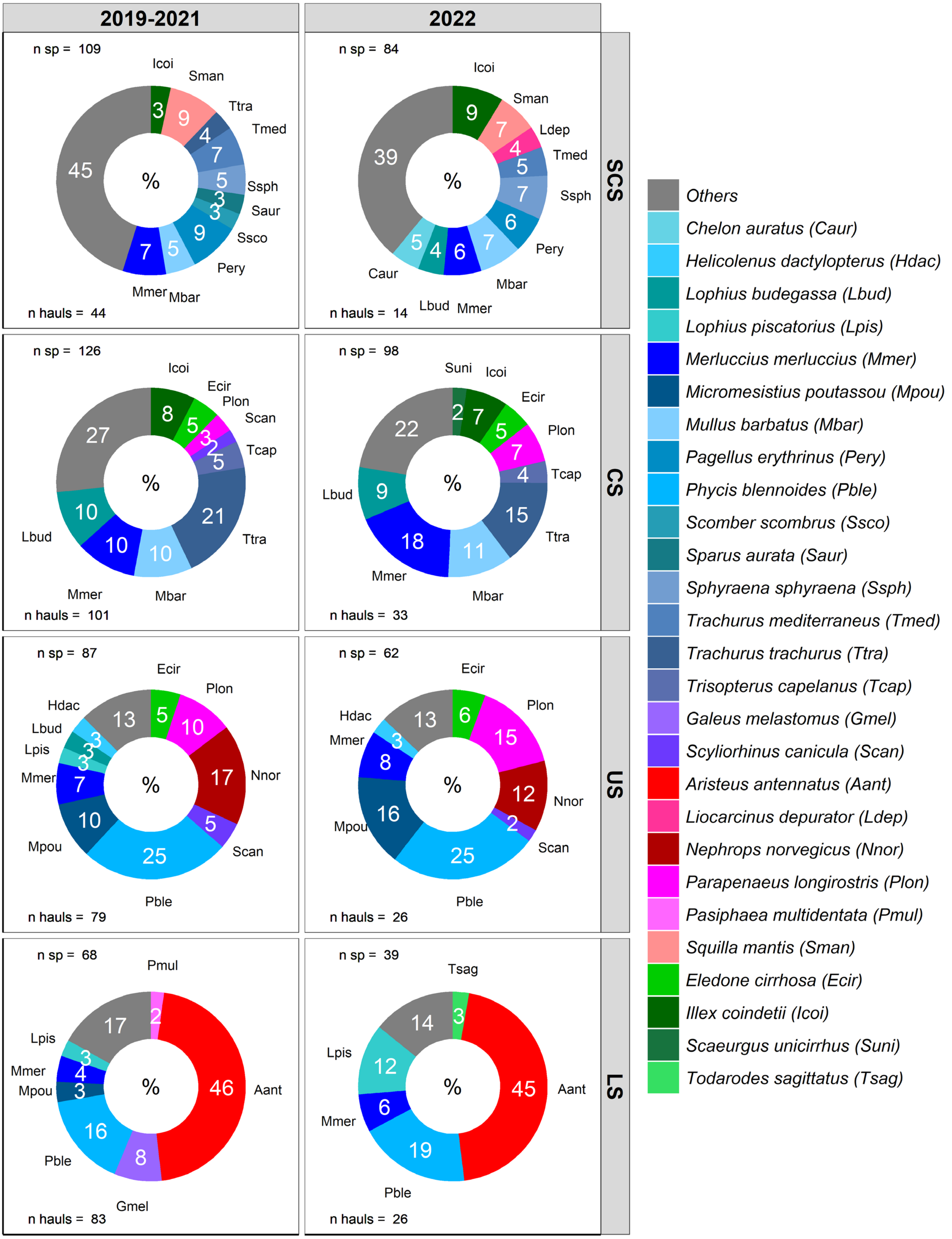

Figure 10. Landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

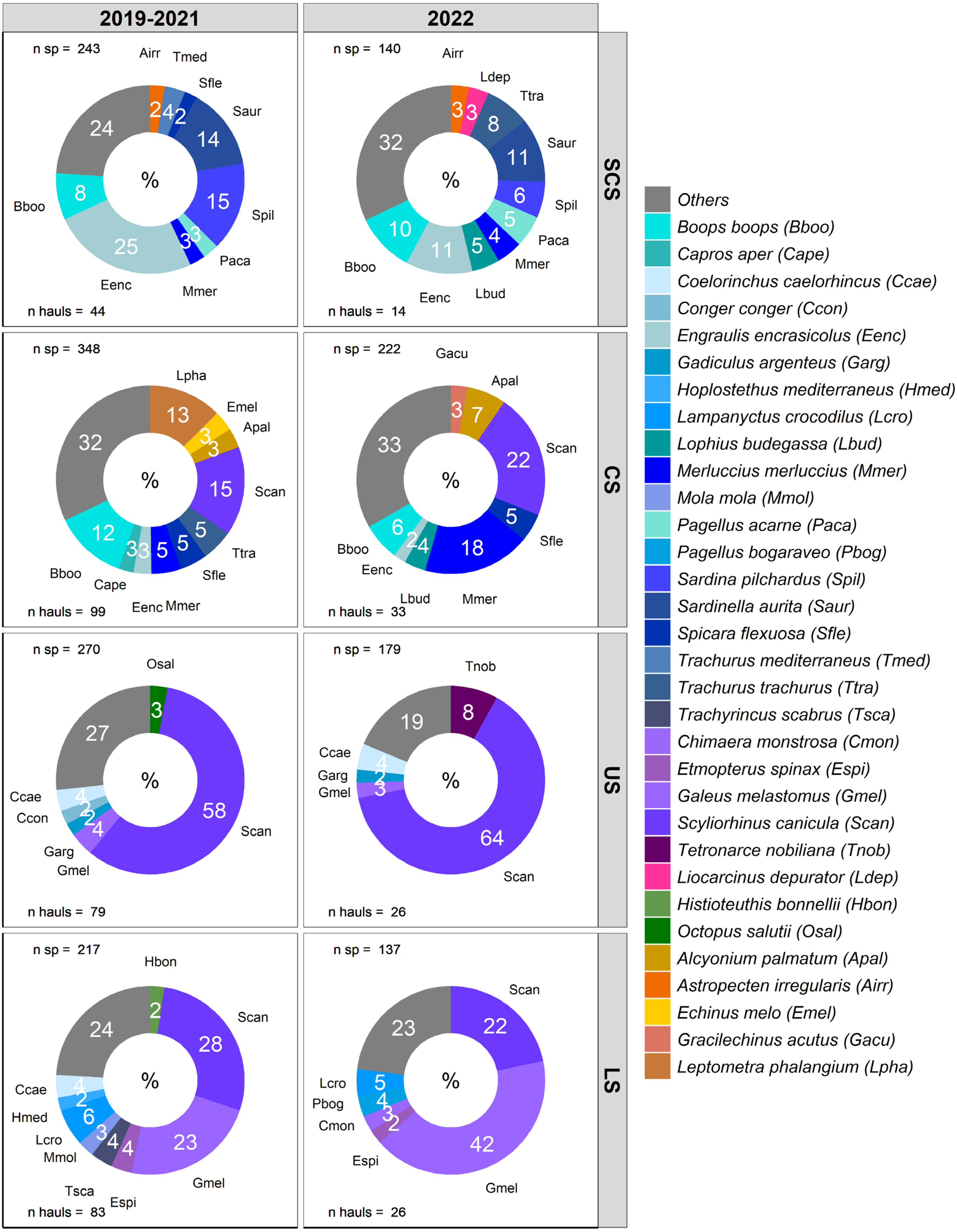

Figure 11. Discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

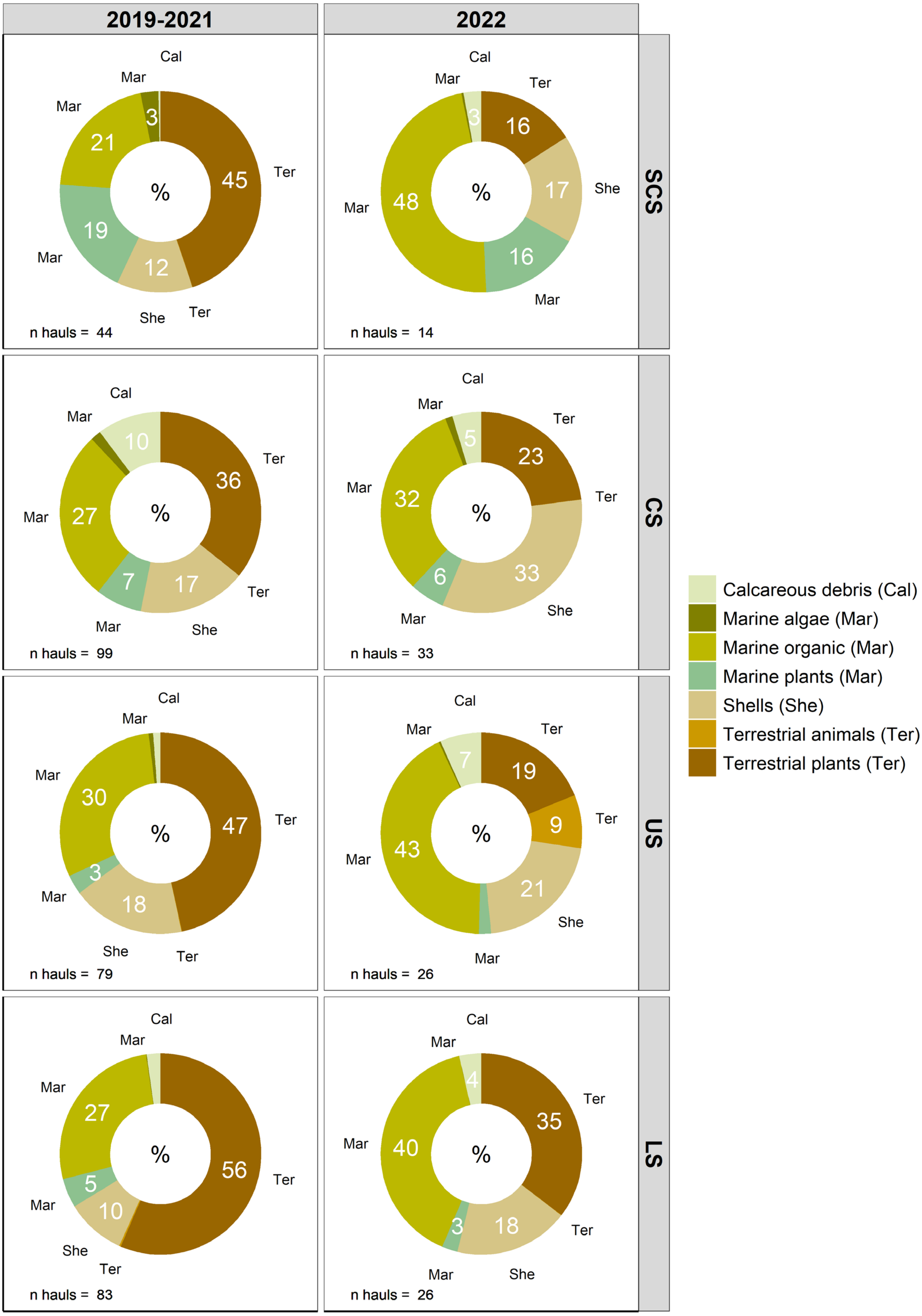

Figure 12. Categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

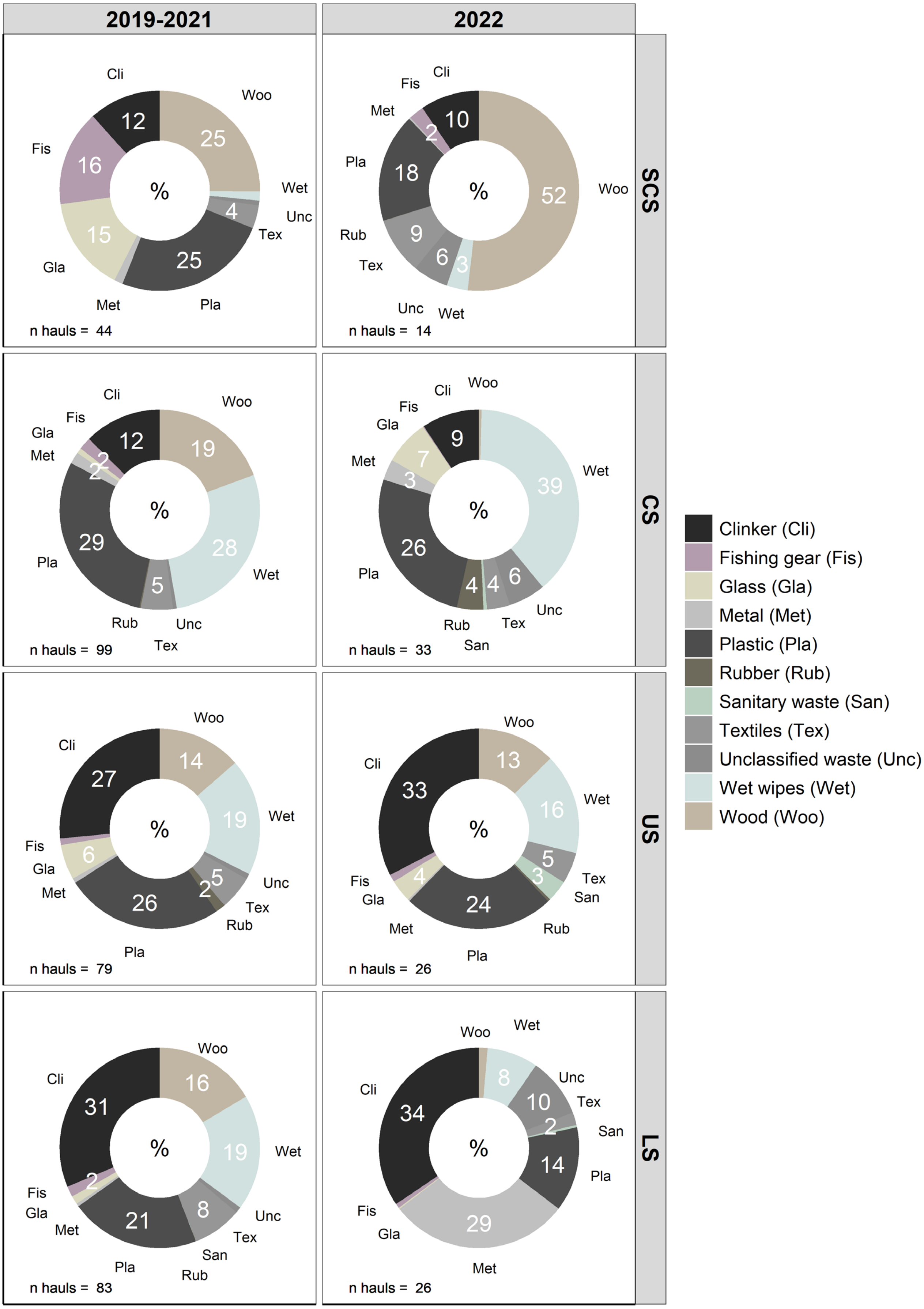

Figure 13. Categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figures 14 and 15 show the spatial representation of fishing effort (h/km^2) in 2022 and from 2017 to 2021, respectively. Fishing effort is generally focused on submarine canyons in the North and Center zones, with more emphasis in the shallow continental slope in the Ebre Delta.

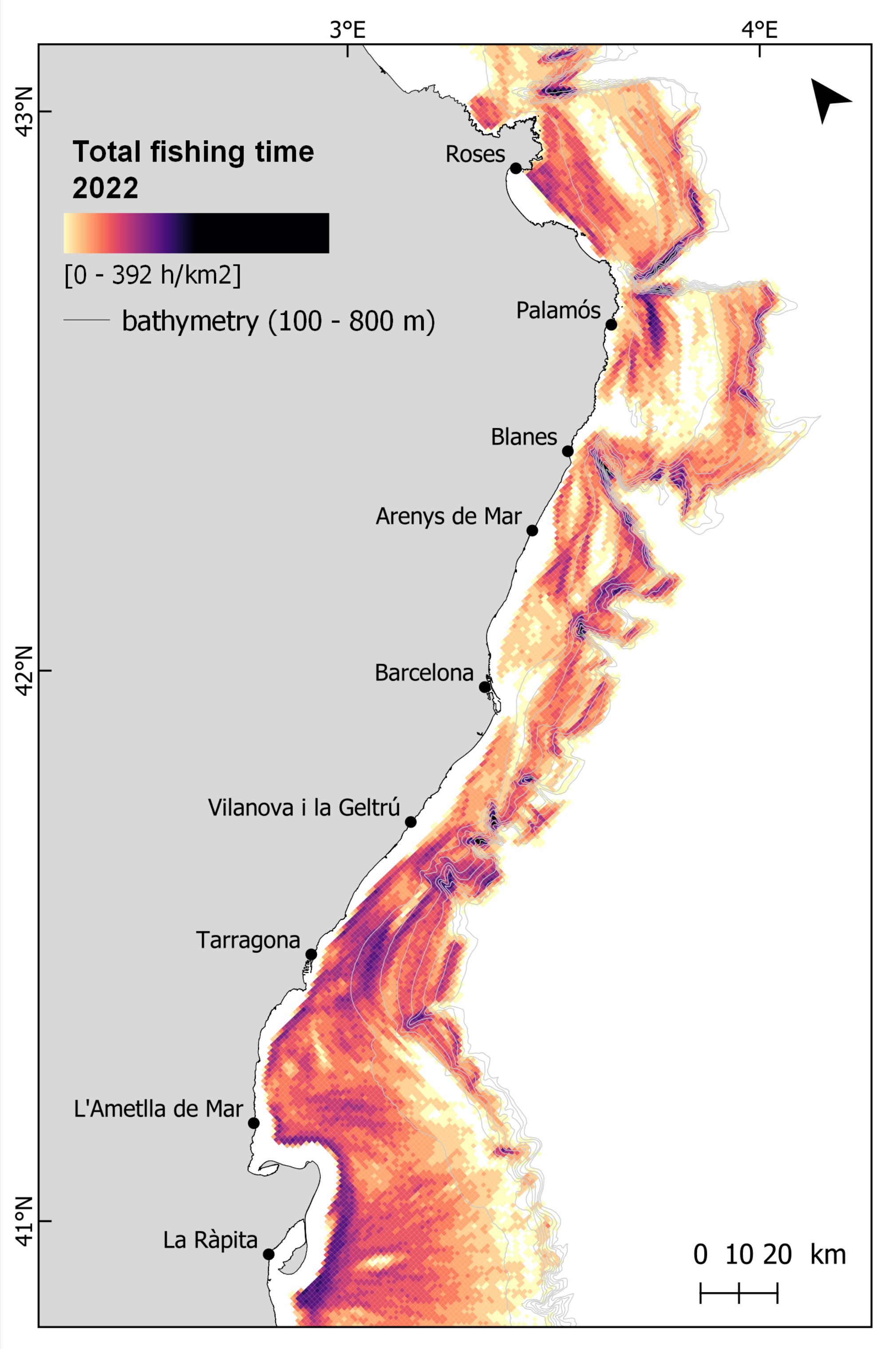

Figure 14. Spatial distribution of fishing effort (h/km^2) in 2022.

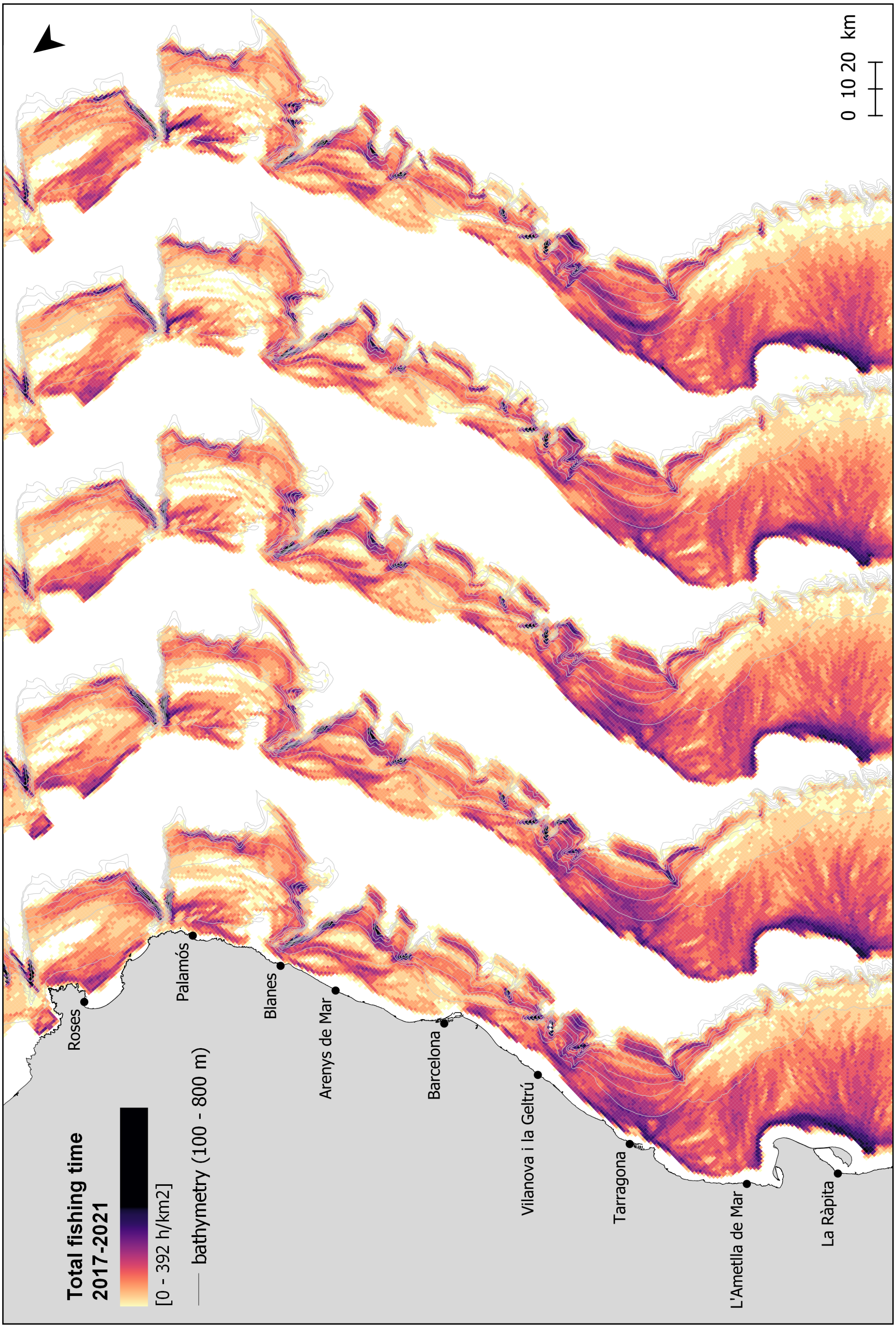

Figure 15. Spatial distribution of fishing effort (h/km²) from 2017 to 2021.

Figures 16 and 17 show the spatial representation of total catches (kg) in 2022 and from 2017 to 2021, respectively. Total catch is concentrated around the shallower waters of the Ebre Delta and along the Center zone.

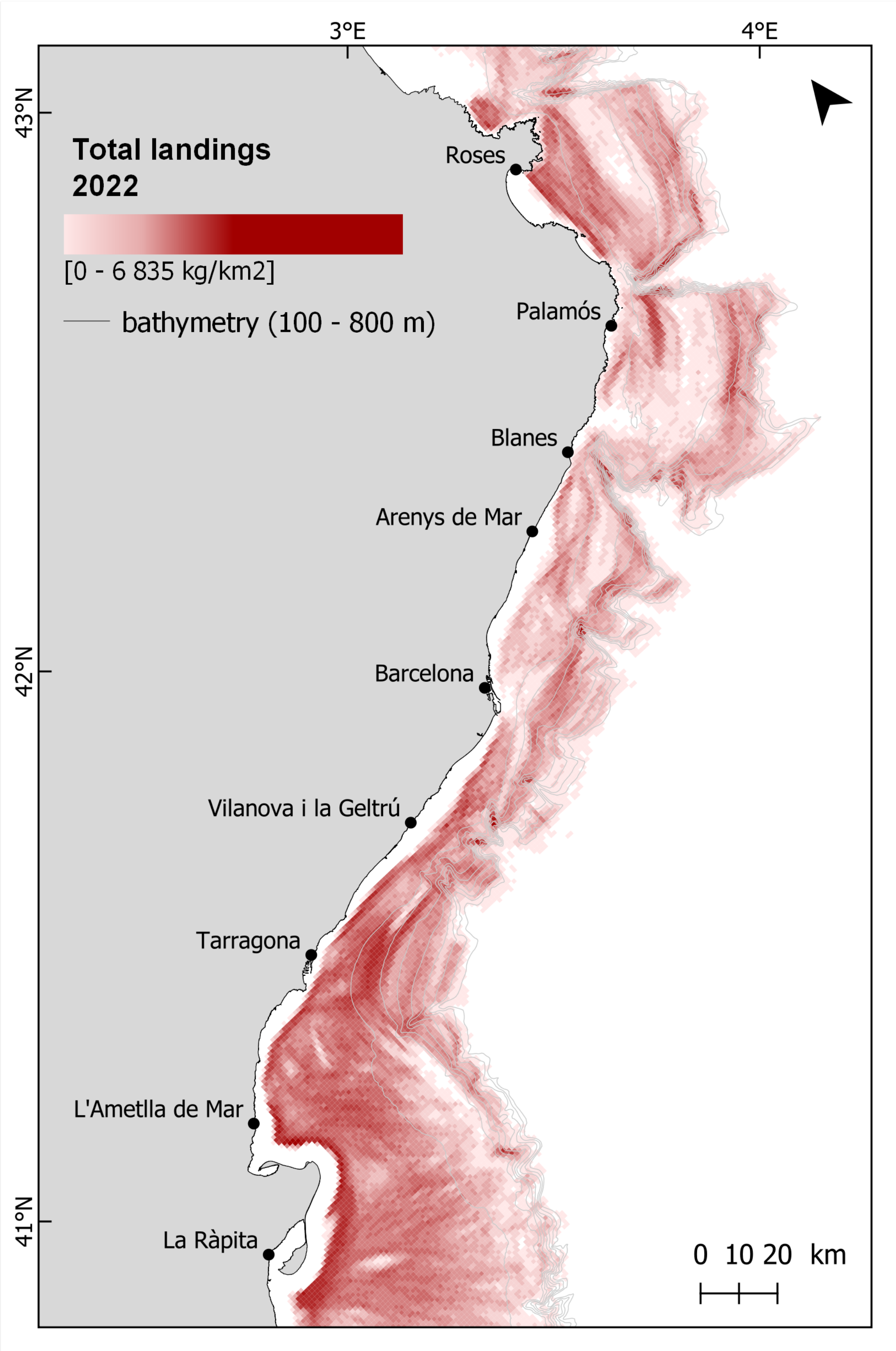

Figure 16. Spatial distribution of landings (kg) in 2022.

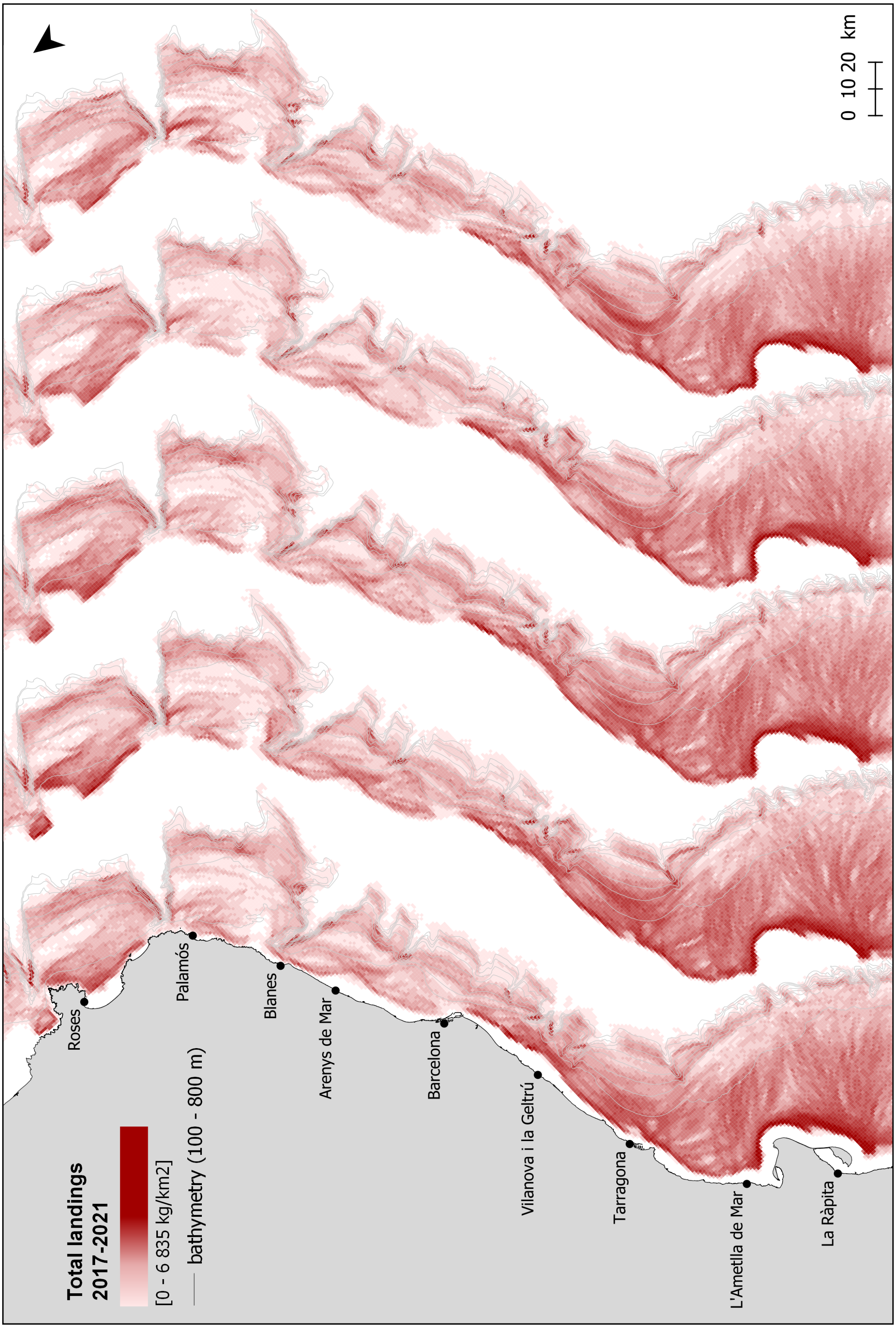

Figure 17. Spatial distribution of landings (kg) from 2017 to 2021.

Figures 18 and 19 show the spatial representation of revenues per unit effort (€/h·km^2) in 2022 and from 2017 to 2021, respectively. Revenue per unit effort is higher in the northernmost parts of the studied area, with similar values near the shelf break of the Ebre Delta as well.

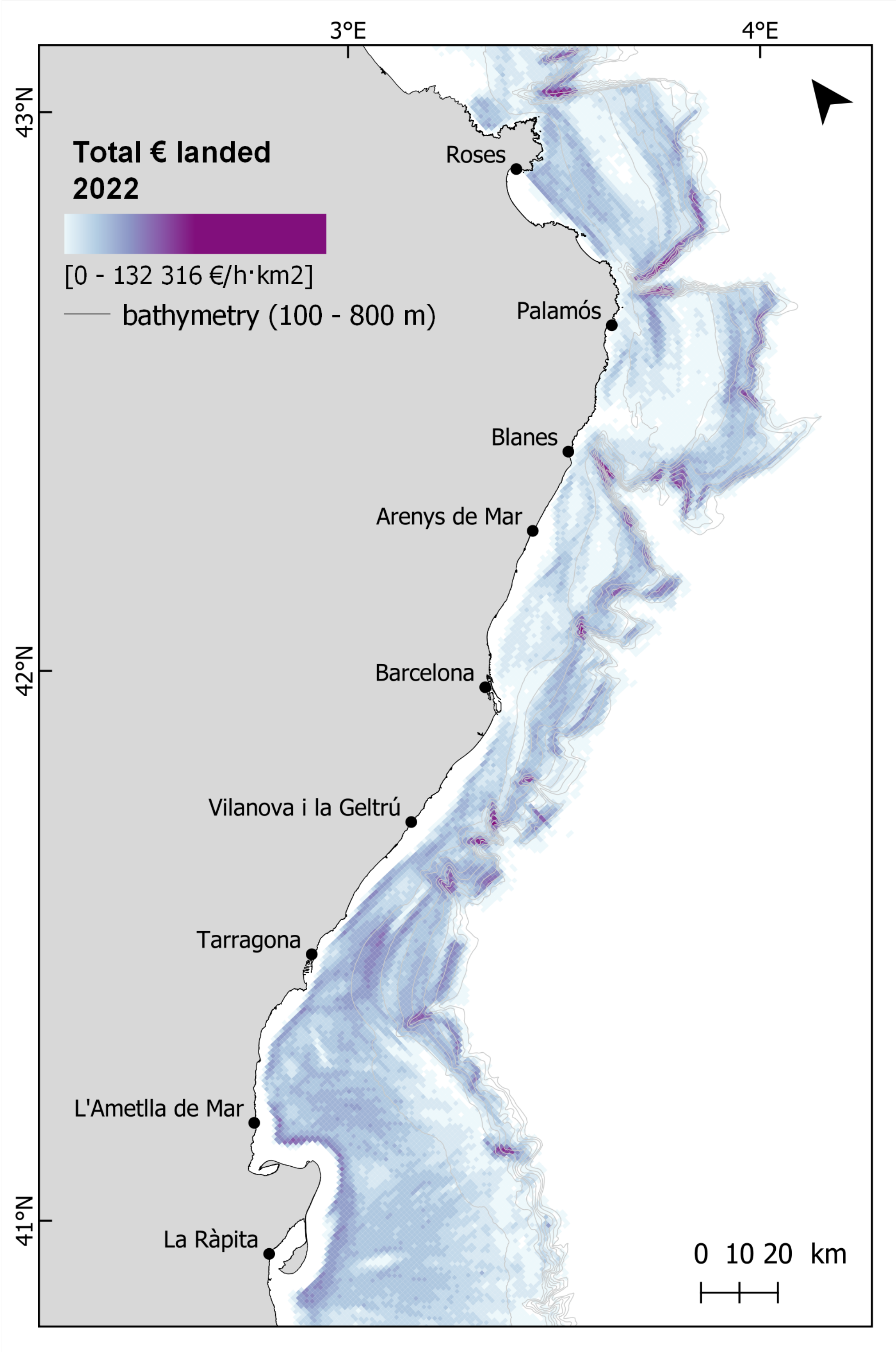

Figure 18. Spatial distribution of revenues per unit of effort (€/h*km²) in 2022.

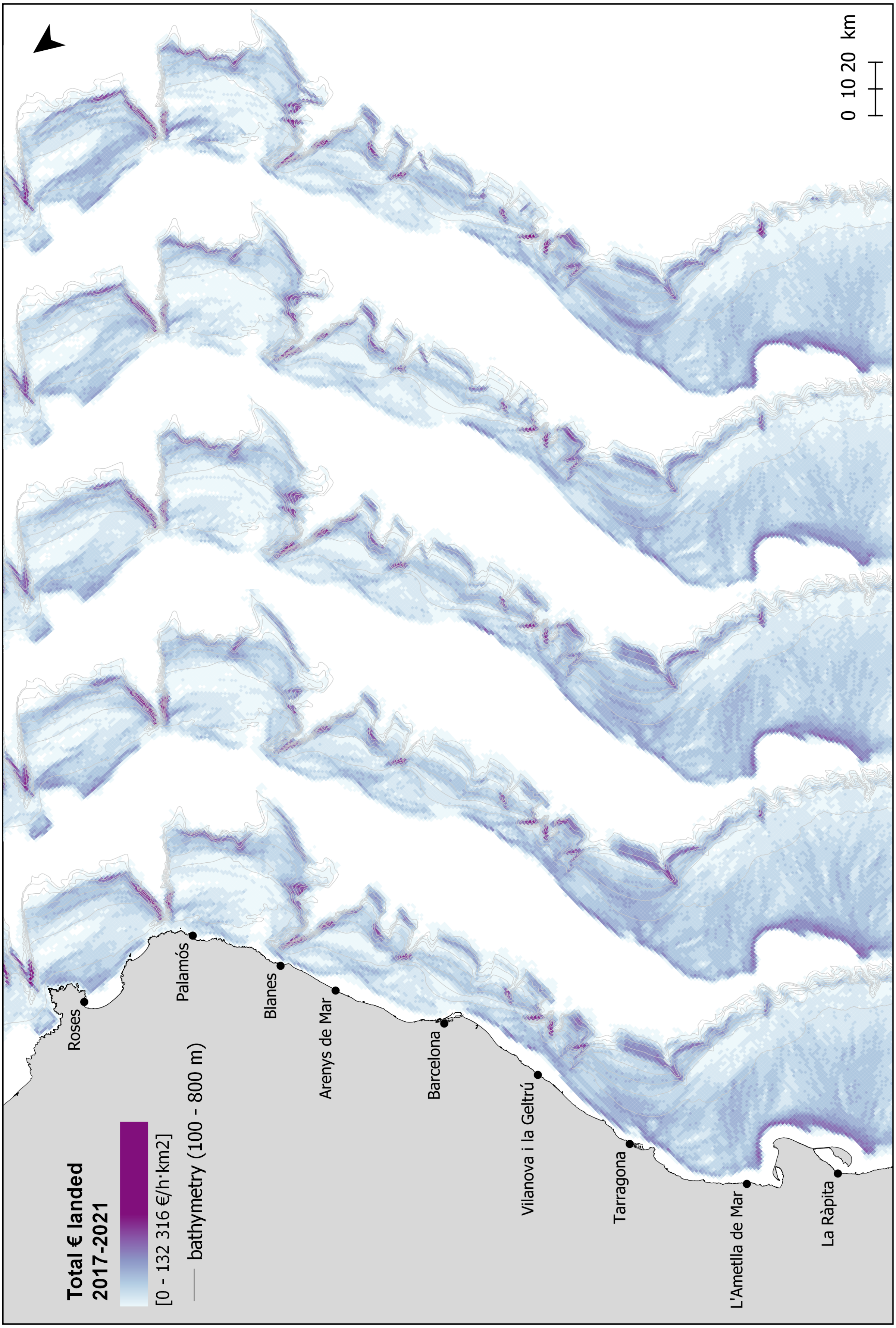

Figure 19. Spatial distribution of revenues per unit of effort (€/h*km²) from 20217 to 2021.

Hake (*Merluccius merluccius*) HKE

The total hake catch in Catalonia in 2022 was 873 t, of which approximately 92% were caught by bottom trawling and 6% by small-scale fisheries (ICATMAR, 23-03).

Figure 20 and Figure 21 show the spatial distribution of the species landings in 2022 and in the period 2017-2021 along the Catalan coast. A constant trend is observed over the years, with a maximum of 506 kg/km² in 2018, followed by 417 kg/km² in 2022.

All parameters analyzed in this report for hake were calculated using only individuals obtained by bottom trawling sampling (Table 3).

According to length-weight relationship parameters for both sexes combined, hake displayed an isometric growth (b=3) in 2022 (Table 2). When comparing the total weight with the eviscerated weight, no differences were found in the length-weight relationship, as well as when analyzing the two sexes separately, both showing isometric growth with similar *a* and r^2 values. Also, comparing hake length-weight relationships for both total weight and eviscerated weight, for both sexes combined and separately from 2019 to 2022 (Figure 22 and Figure 23), the results show similar trends with isometric growth in all cases.

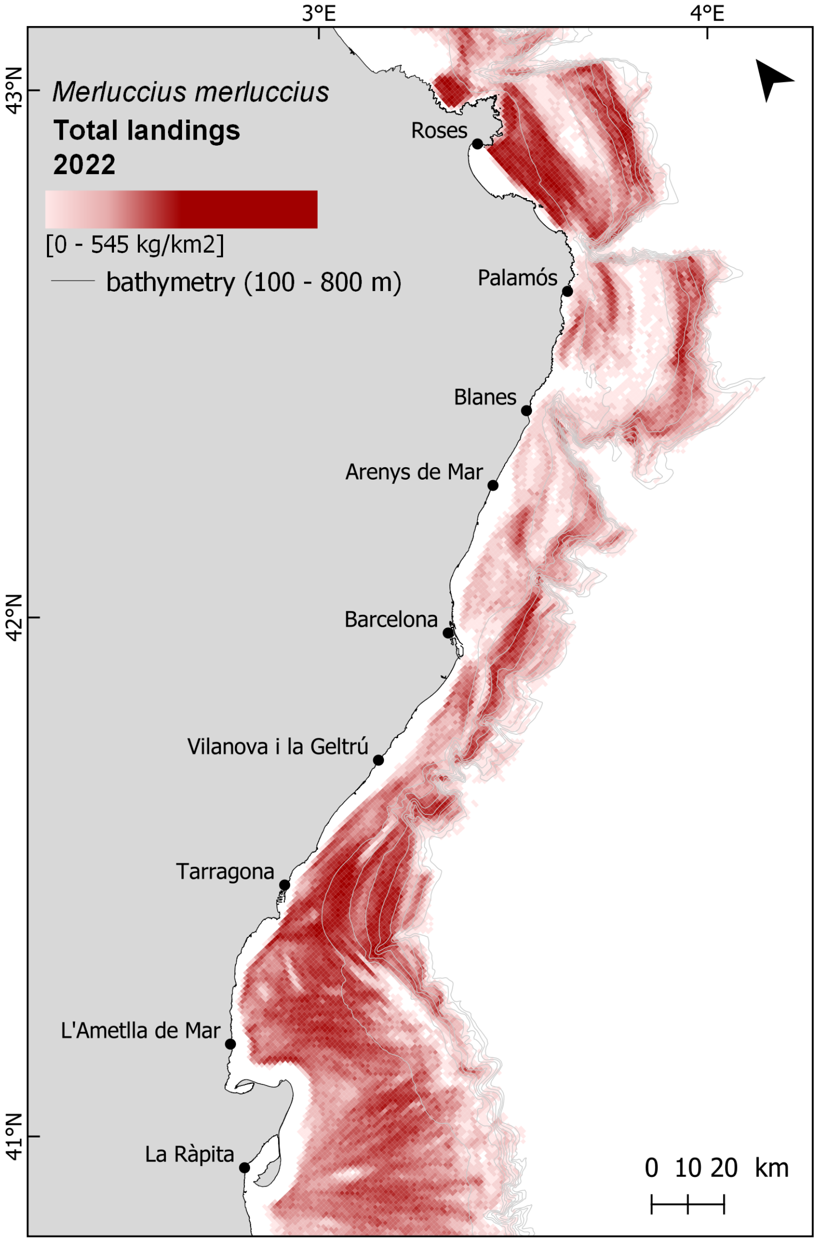

Figure 20. Spatial distribution of landings per unit of effort (LPUE) for hake in the Catalan fishing grounds (North GSA6) in 2022.

Table 2. Hake length-weight relationship and size at first maturity (L_{50}) in 2022.

Length – total weight relationship					
2022	a	b	r²	n	L_{50}
Combined	0.0059	3.0605	0.98	2 449	27.53
Females	0.0059	3.0600	0.98	1 203	31.26
Males	0.0063	3.0403	0.97	1 113	24.25
Length – eviscerated weight relationship					
2022	a	b	r²	n	
Combined	0.0054	3.0660	0.98	2 459	
Females	0.0055	3.0601	0.98	1 209	
Males	0.0058	3.0442	0.97	1 117	

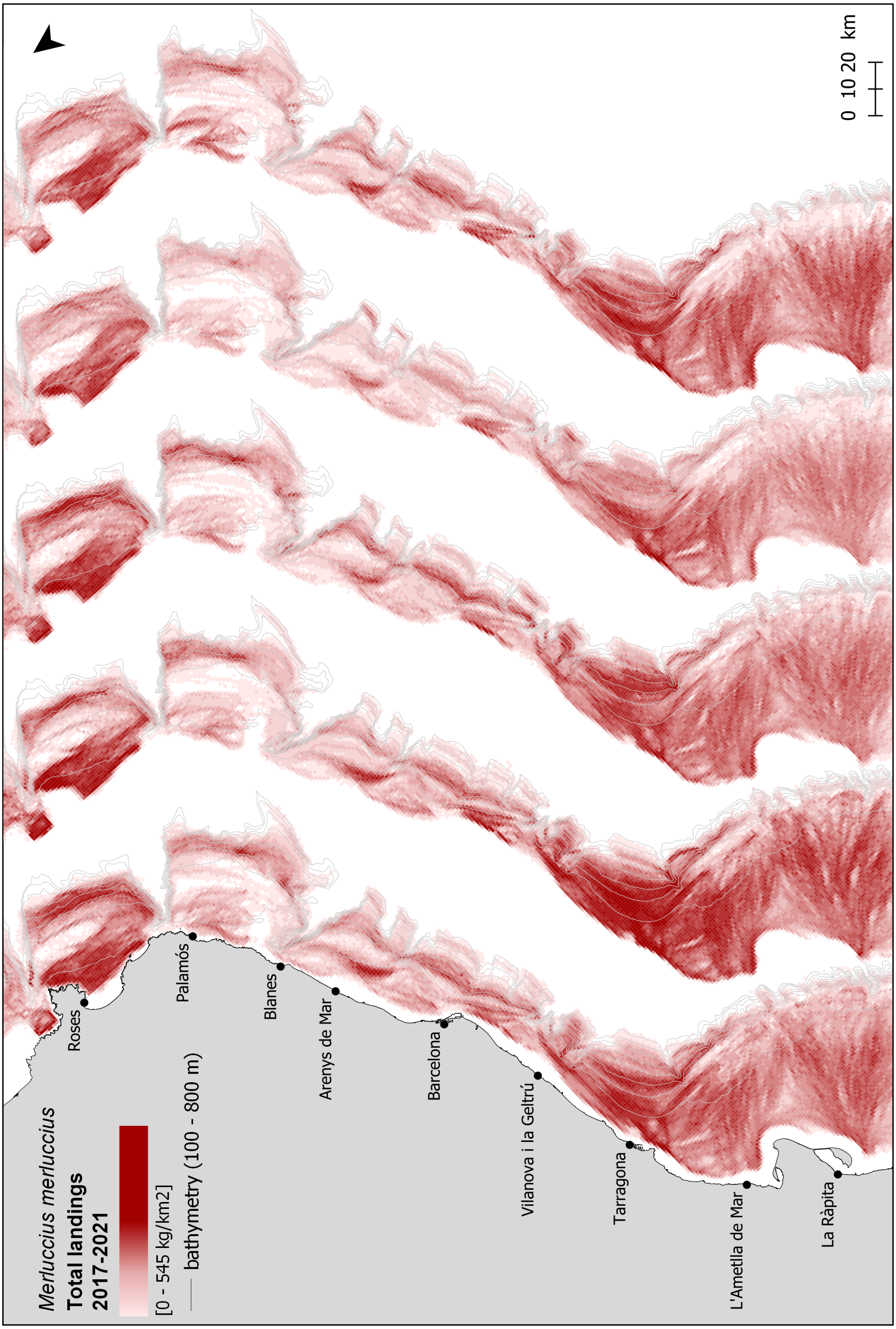

Figure 21. Spatial distribution of landings per unit of effort (LPUE) for hake in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

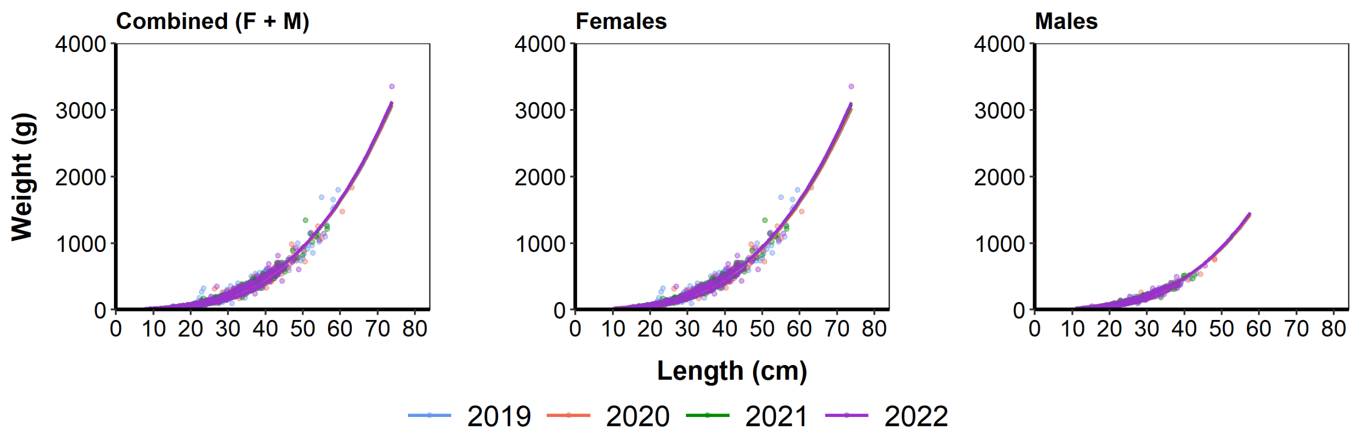

Figure 22. Hake length-weight relationship for the years sampled.

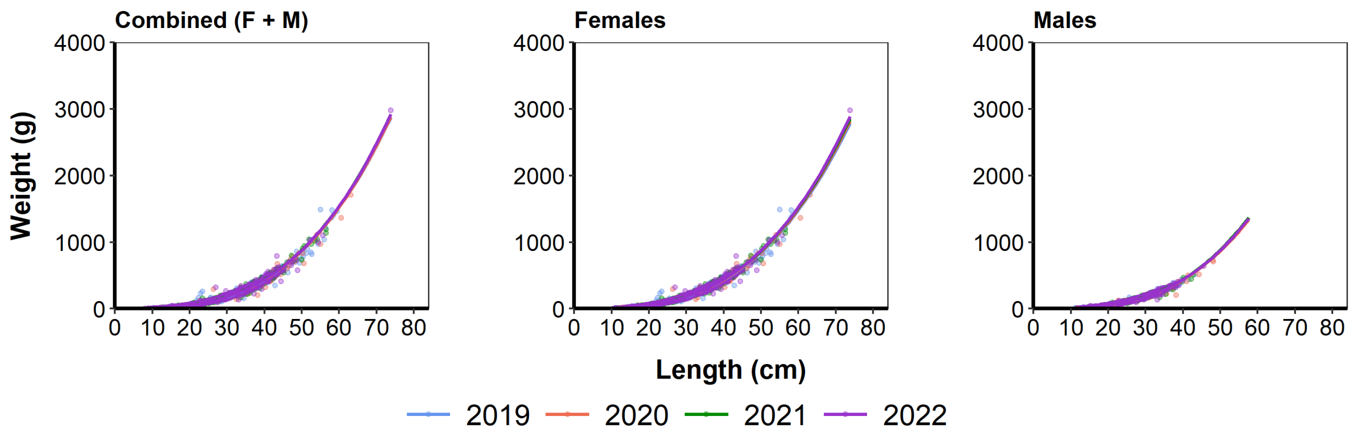

Figure 23. Hake length- eviscerated weight relationship for the years sampled.

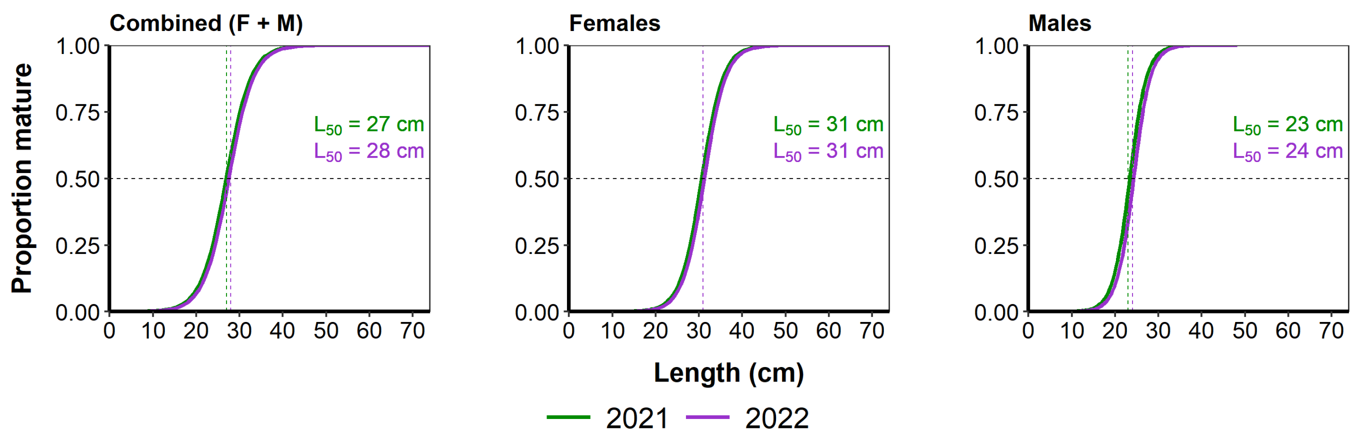

Figure 24. Hake size at first maturity (L_{50}) for all years sampled. Only data from 2021 and 2022 were consider due to a change in the criteria of maturity state classification in the previous years.

Table 3. Number of hake individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls/fishing trips
			Number individuals sampled				
Artisanal fisheries	2019	Center	1	0	0	0	1
Bottom trawl	2019	North	19	636	216	201	42
Bottom trawl	2019	Center	474	417	211	446	32
Bottom trawl	2019	South	525	181	305	218	31
Bottom trawl	2020	North	104	87	253	227	30
Bottom trawl	2020	Center	208	130	466	310	29
Bottom trawl	2020	South	56	197	370	328	19
Bottom trawl	2021	North	320	390	487	293	43
Bottom trawl	2021	Center	190	528	751	325	27
Bottom trawl	2021	South	141	56	641	441	20
Bottom trawl	2022	North	181	449	755	643	41
Bottom trawl	2022	Center	464	216	507	394	31
Bottom trawl	2022	South	92	165	353	306	18
Purse seine	2020	North	5	0	0	0	4
Purse seine	2021	North	0	0	0	1	1
Purse seine	2022	North	3	0	0	0	2

The size at first maturity (L_{50}) for hake in 2022 was 27.53 cm of TL for both sexes combined (Table 2 and Figure 24). When comparing 2021 and 2022, no differences were observed between the two years, but differences were observed between sexes in both years, with males maturing earlier than females.

The spatiotemporal length-frequency distribution of hake from 2019 to 2022 indicates that the species was more abundant on the continental shelf for all years, despite being also present in the shallow continental shelf, the upper slope and, with the lowest abundances, in the lower slope (Figure 25). In terms of catch size, a significant proportion of individuals, especially in both continental shelves, were caught below the minimum conservation reference size (MCRS) for the species, established at 20 cm of TL.

When comparing between years, maximum abundances of hake recruits (<10 cm) were found in the continental shelf in 2021 and 2022, suggesting an acceptable recruitment for the species during the preceding years. The abundance of hake recruits varied with bathymetric distribution, decreasing with increasing depth. Thus, juvenile individuals were concentrated in both continental shelves and progressively reduced in abundance in the slope. Young adults (30-40 cm) were present in all depth strata, while larger individuals (>50 cm) predominated in the slopes.

For monthly length-frequency distribution of hake at different depth strata in 2022 see Annex 11.

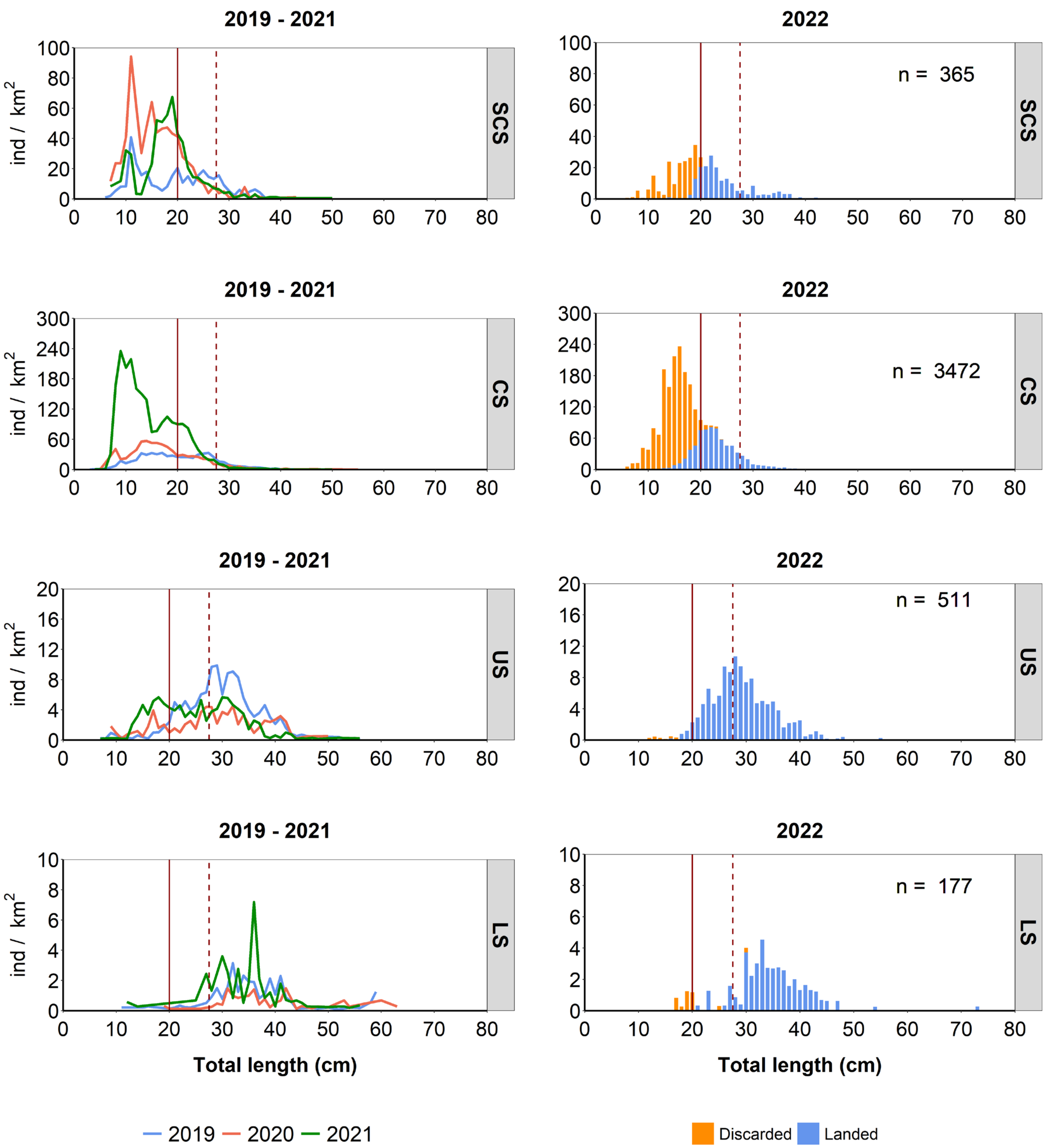

Figure 25. Annual length-frequency distribution of hake at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: Minimum Conservation Reference Size (MCRS).

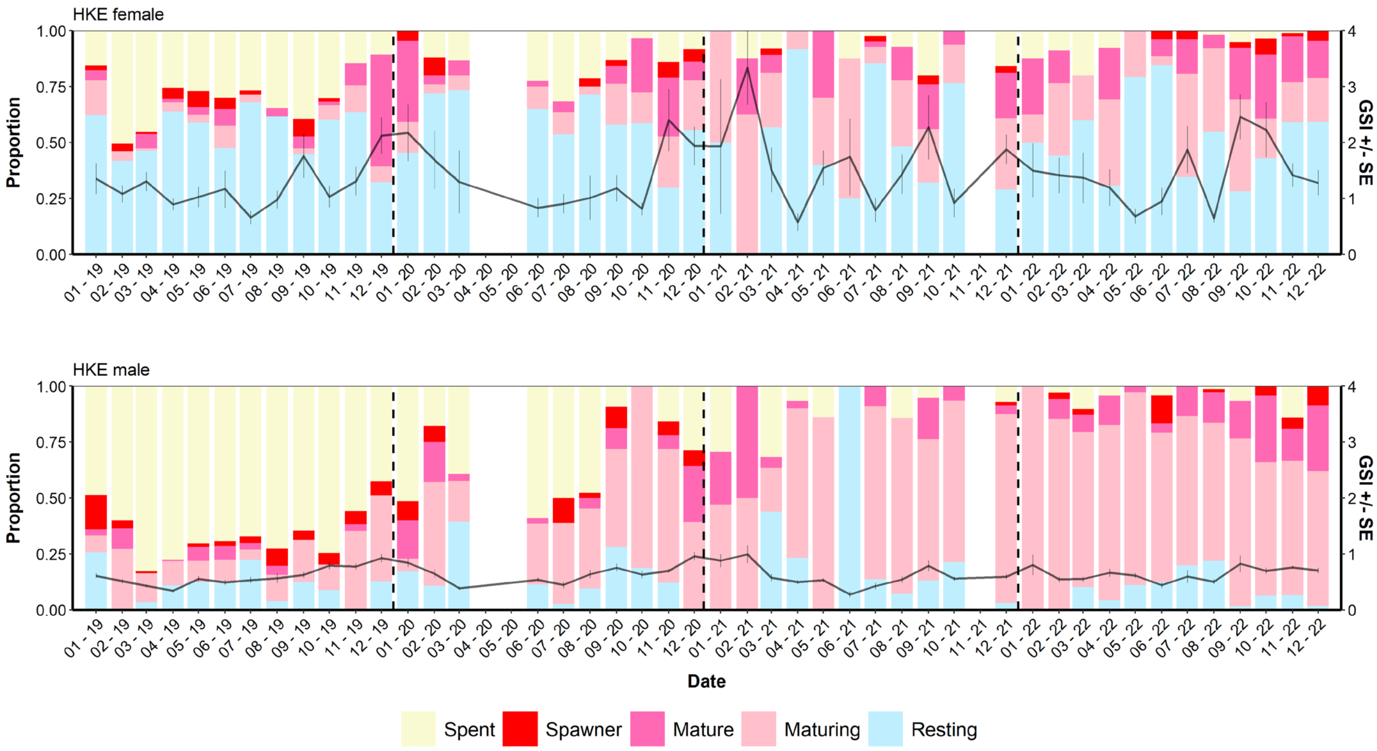

Figure 26. Hake monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

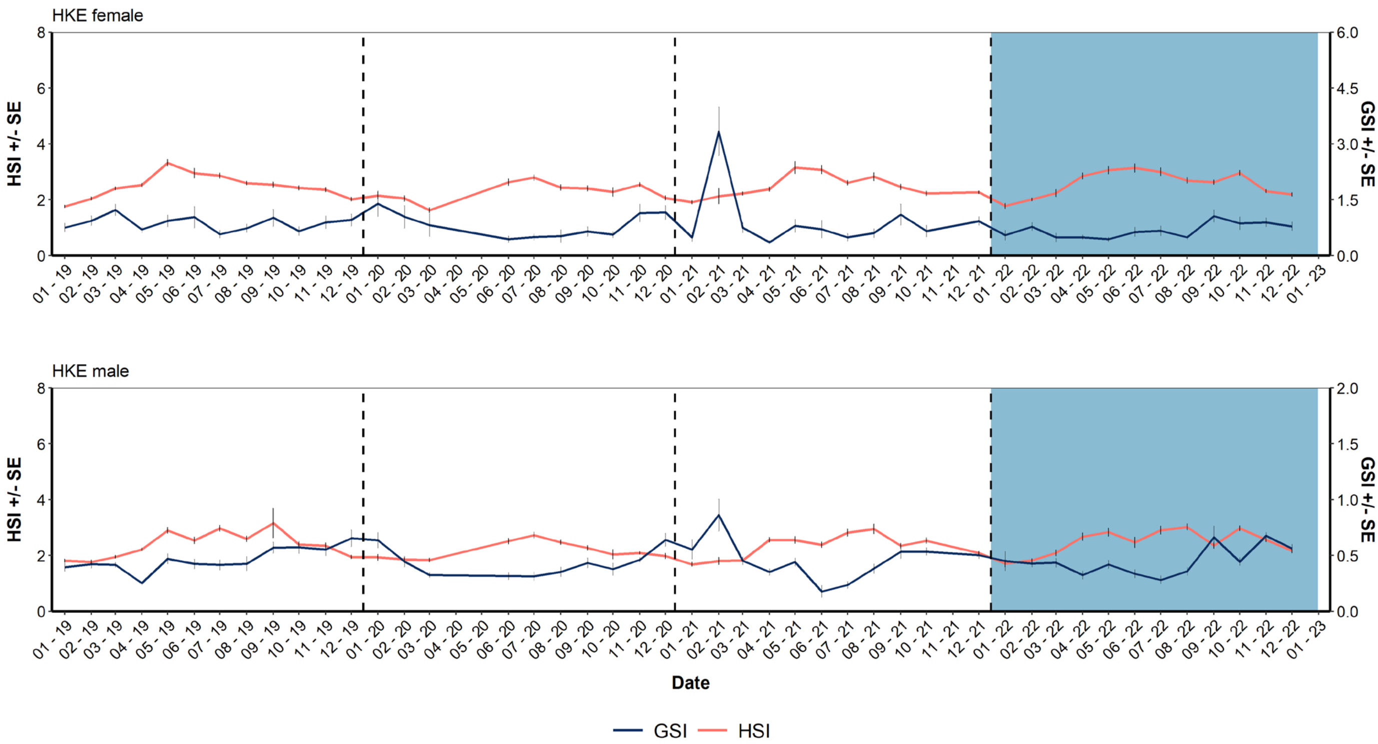

Figure 27. Hake monthly hepatosomatic index (HSI +/-SE (Standard Error)) and gonadosomatic index (GSI +/- SE) for females (top) and males (bottom) from 2019 to 2022. Blue shaded area indicates latest analyzed year.

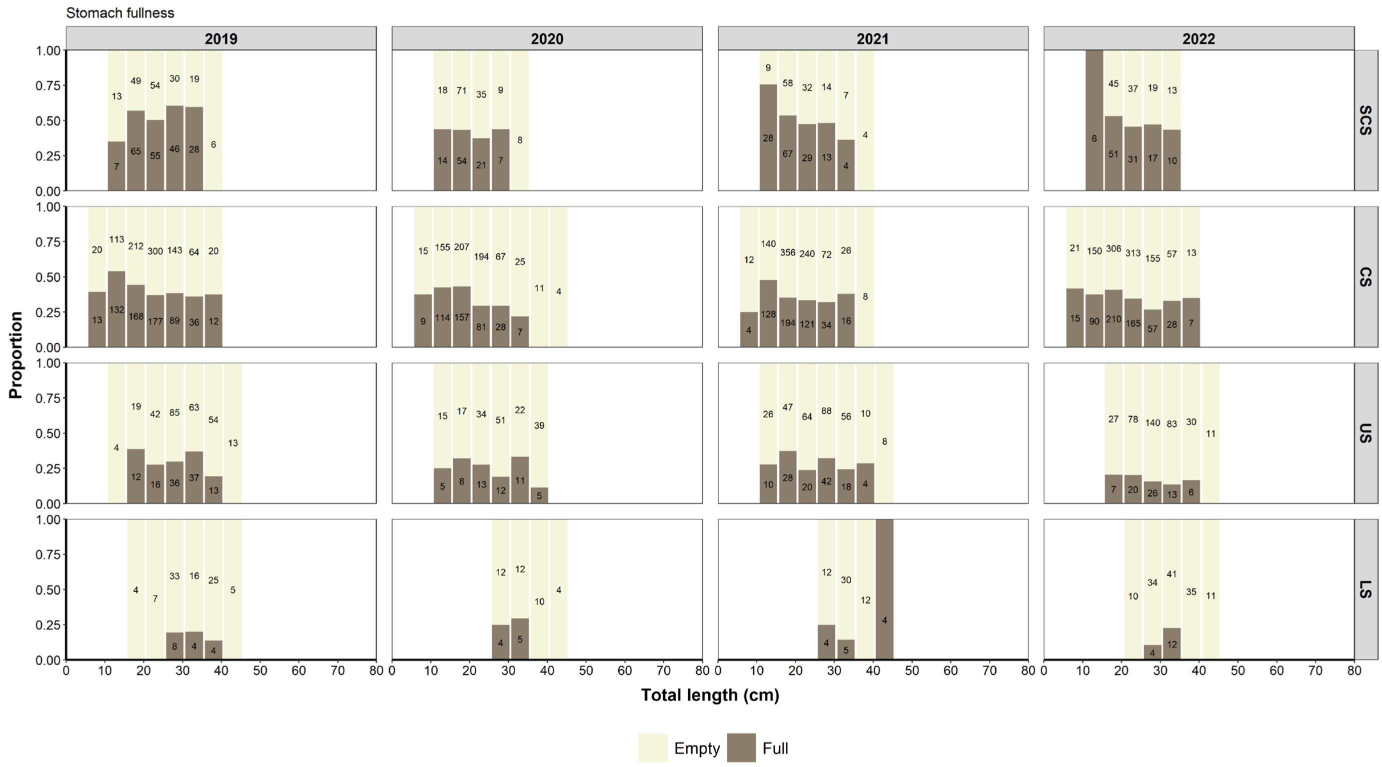

Figure 28. Proportion of stomach fullness of hake from 2019 to 2022 at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope). Black numbers inside bars indicate the number of individuals sampled. Only lengths with more than 3 individuals sampled are shown.

The gonadal cycle of hake was analyzed monthly from 2019 to 2022 (Figure 26). The species, both males and females, showed a continuous reproductive activity as individuals in advanced maturity stages were present every month sampled throughout the years, confirming a continuous spawning period, Females showed higher GSI values during autumn and winter months, coinciding with their maximum reproductive activity, but GSI values for males were relatively constant throughout the months.

Plotting hake HSI and GSI together for all years sampled and for the two sexes separately shows that there is no clear relationship between these two parameters, as the reproductive activity of the species is not restricted to a specific spawning season (Figure 27).

The stomach fullness proportion of hake is represented for all years sampled and for the four depth strata studied (Figure 28). Results indicate that the proportion of individuals with full stomachs was higher in both continental shelves, corresponding to juvenile individuals, and decreased progressively with increasing depth, with empty stomachs being more abundant in the slopes where adult individuals are concentrated. A higher proportion of full stomachs in small-sized individuals, i.e. recruits, in the continental shelf may be related to this stratum acting as a feeding ground for juveniles. Also, recruits have higher energy demands than adults and need to allocate the energy obtained from feeding on growth to improve their survival in early life stages.

Red mullet (*Mullus barbatus*) MUT

The total red mullet catch in Catalonia in 2022 was 732 t, of which approximately 87% of were caught by bottom trawling and 11% by small-scale fisheries (ICATMAR, 23-03).

Figure 29 and Figure 30 show the spatial distribution of red mullet landings in 2022 and in the period 2017-2021 along the Catalan coast. It should be noted that the data correspond to the two species of red mullet present in the area combined, *Mullus barbatus* and *Mullus surmuletus,* as they are not easily distinguishable in the fish auction. Annual landings for these species typically range between 1 000 and 2 000 kg/km^2, with a maximum of 2 016 kg/km^2, reached in 2018.

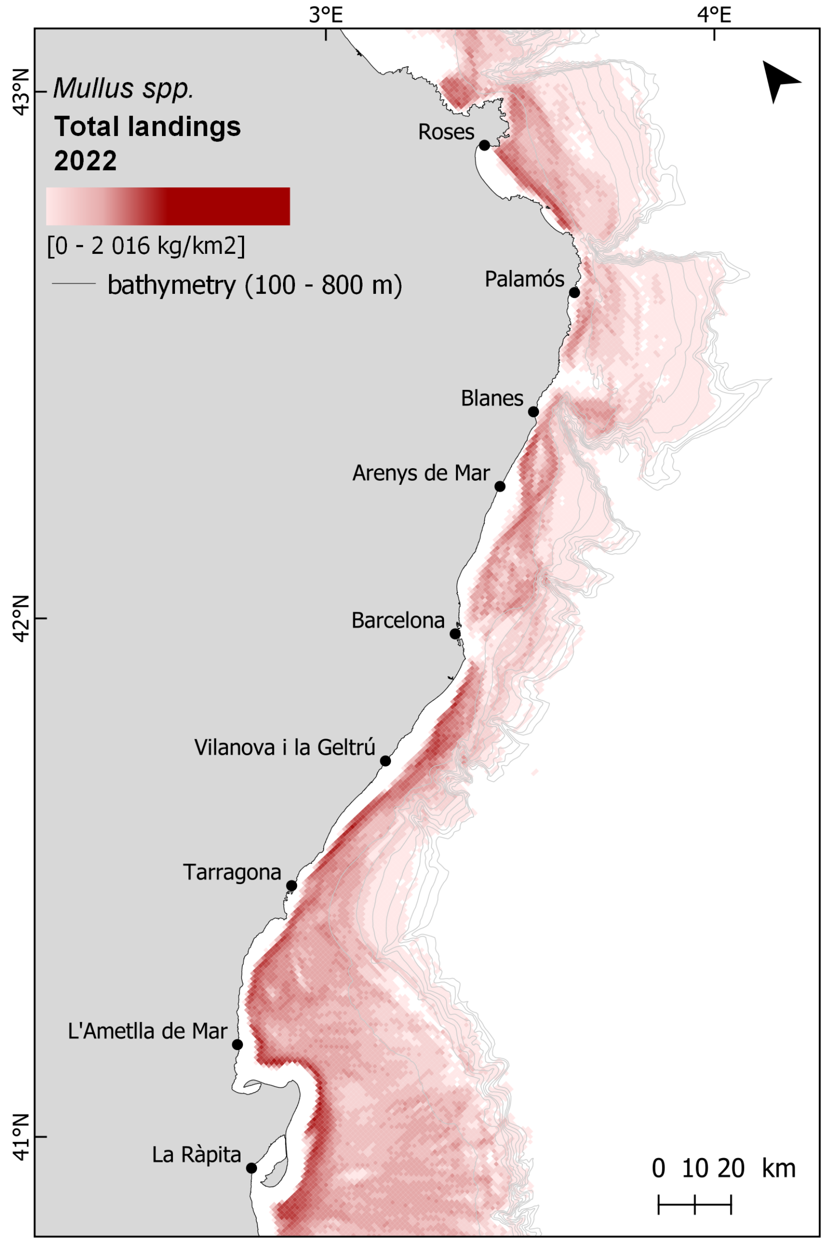

Figure 29. Spatial distribution of landings per unit of effort (LPUE) for red mullet (*Mullus spp.*) in the Catalan fishing grounds (North GSA6) in 2022.

The spatiotemporal length-frequency distribution of red mullet from 2019 to 2021 and in 2022 shows differences in the bathymetric distribution of the species depending on the size/age of the individuals (Figure 31). In the shallow continental shelf, the abundance of small-sized individuals, below the MCRS of the species (11 cm of TL), peaked but decreased with increasing depth. In contrast, mature individual, although present in both shelves, were more abundant in the continental shelf. Slopes are not represented as they are below the bathymetric range of the species.

For monthly length-frequency distribution of red mullet at different depth strata in 2022 see Annex 12.

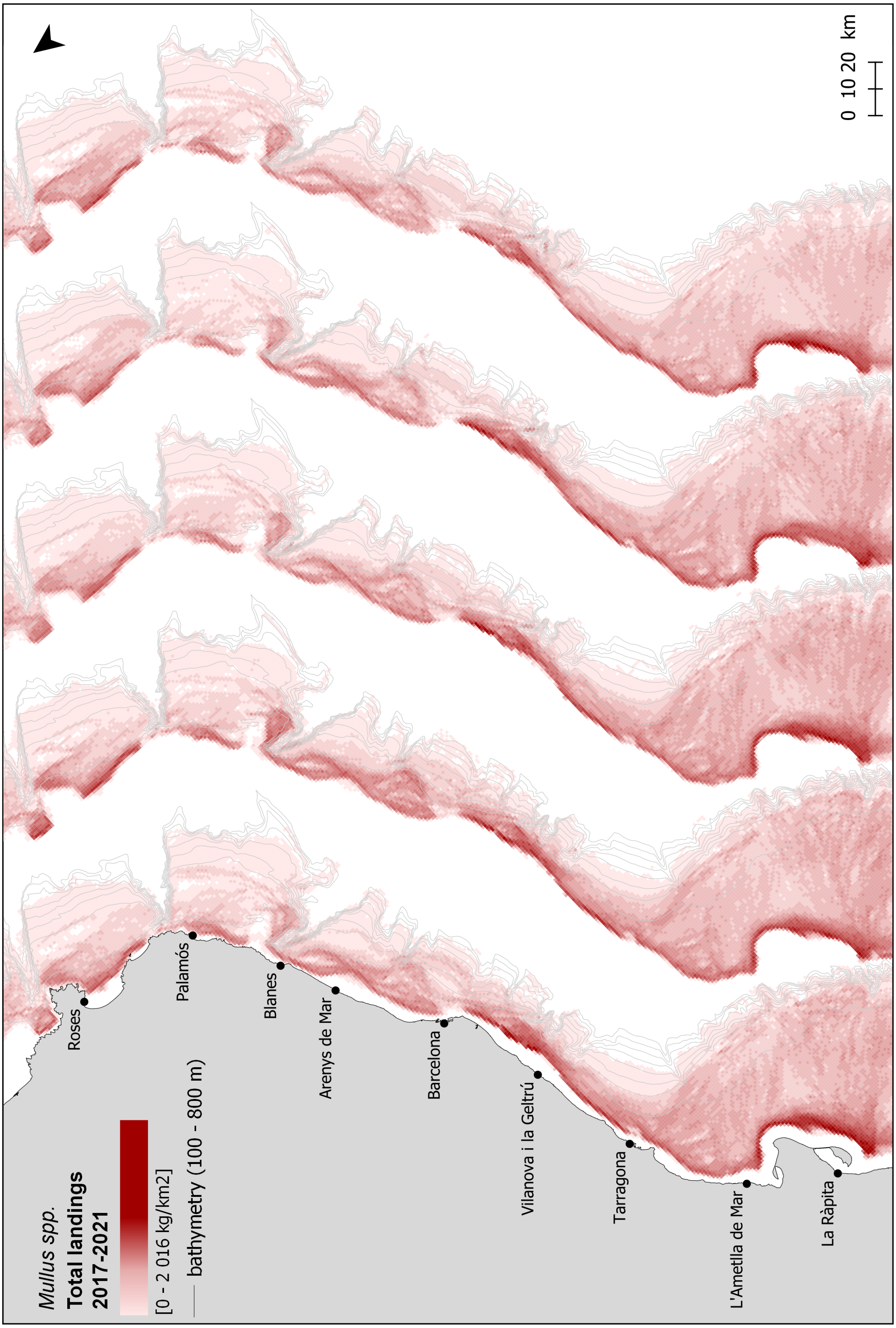

Figure 30. Spatial distribution landings per unit of effort (LPUE) for red mullet (*Mullus spp.*) in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

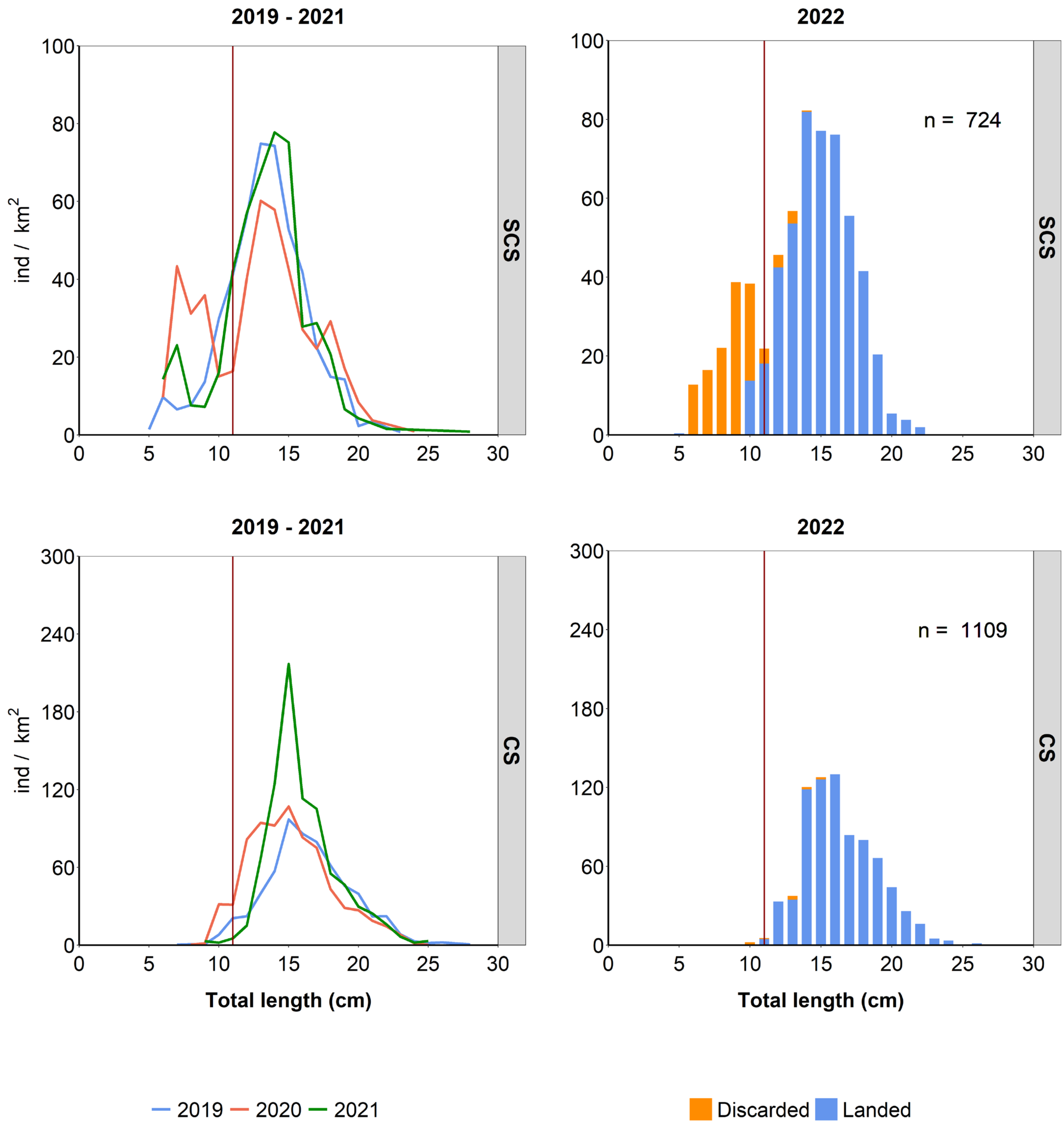

Figure 31. Annual length-frequency distribution of red mullet at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS).

Norway lobster (*Nephrops norvegicus*) NEP

The total Norway lobster catch in Catalonia in 2022 was 134 t, 100% of which were caught by bottom trawling (ICATMAR, 23-03).

Figure 32 and Figure 33 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast. A constant decreasing trend is observed over the years with an annual maximum of 292 kg/km² in 2017 to a minimum of 160 kg/km² in 2022.

All parameters analyzed in this report for Norway lobster were calculated using only individuals obtained by bottom trawling sampling (Table 5).

According to length-weight relationship parameters for both sexes combined, Norway lobster displayed a positive allometric growth (b>3) in 2022 (Table 4), Likewise, when applying the growth curves separately for males and females, both sexes exhibited positive allometric growth. Of the measured individuals, there was a higher proportion of males which are larger in size and weight than females. Comparing the growth curves between the years sampled for both sexes combined and separately, similar results can be observed over the years with positive allometric growth in all cases (Figure 34).

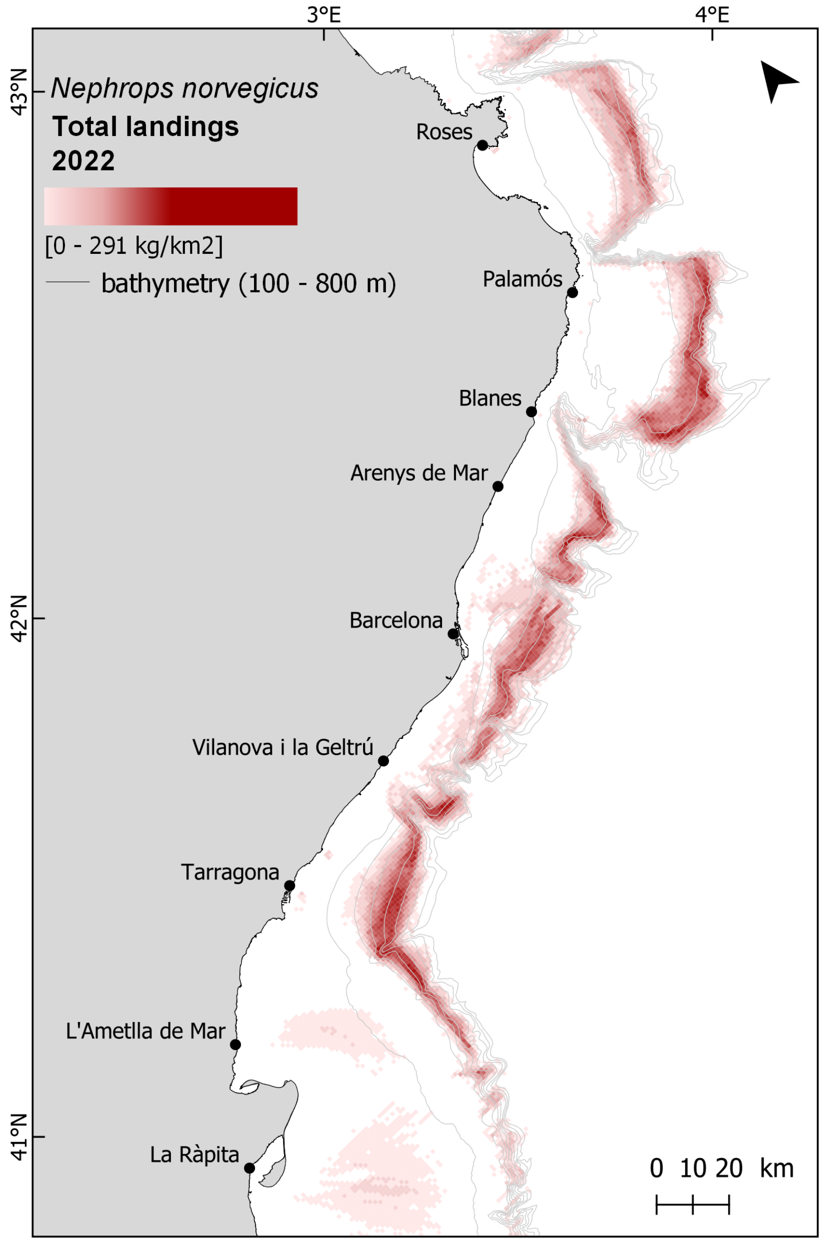

Figure 32. Spatial distribution of landings per unit of effort (LPUE) for Norway lobster in the Catalan fishing grounds (North GSA6) in 2022.

Table 4. Norway lobster length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r²)	n	L_{50}
Combined	0.0004	3.1906	0.96	2062	-
Females	0.0004	3.1482	0.94	787	24.77
Males	0.0003	3.2318	0.96	1275	-

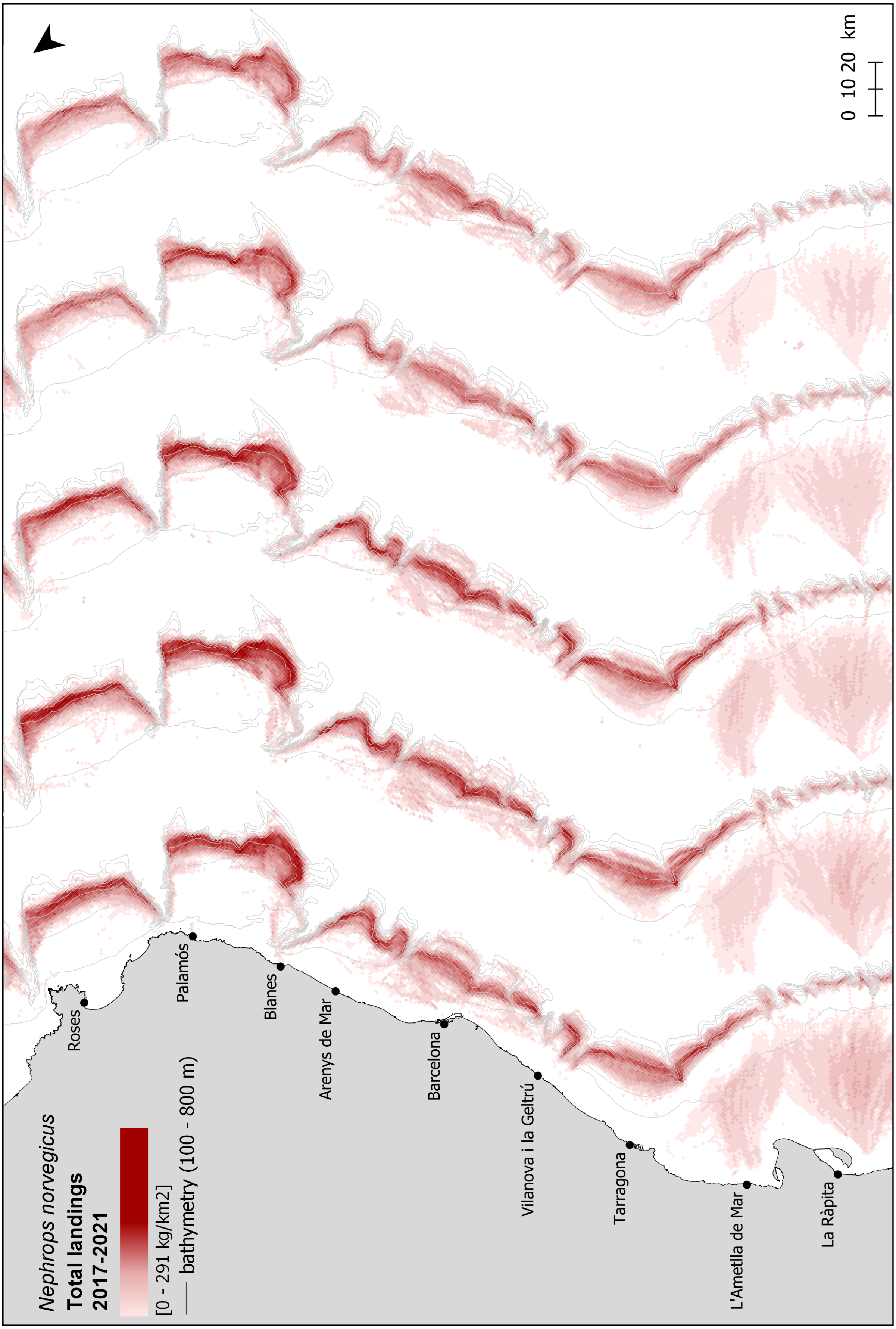

Figure 33. Spatial distribution of landings per unit of effort (LPUE) for Norway lobster in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

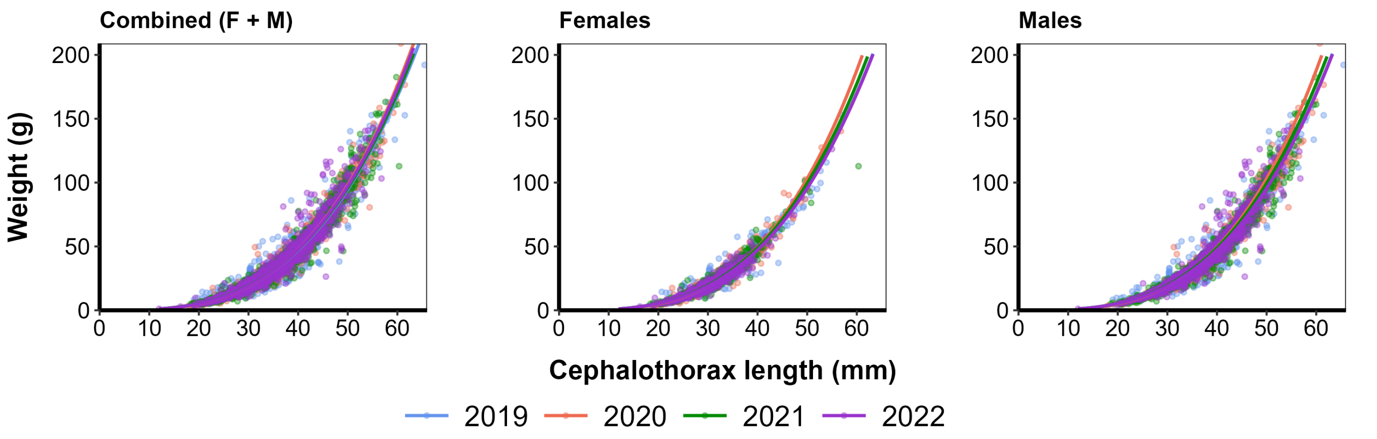

Figure 34. Norway lobster length-weight relationship for the years sampled.

The size at first maturity (L_{50}) for Norway lobster in 2022 was 24.77 cm of CL for both sexes combined (Table 4 and Figure 35). Females showed earlier maturation than males in 2022, with L_{50} of 11.3 and 10.9 cm of CL respectively, a trend also observed in the previous years sampled. Comparing between years for both sexes combined, 2019 had the lowest L_{50} and 2021 the highest.

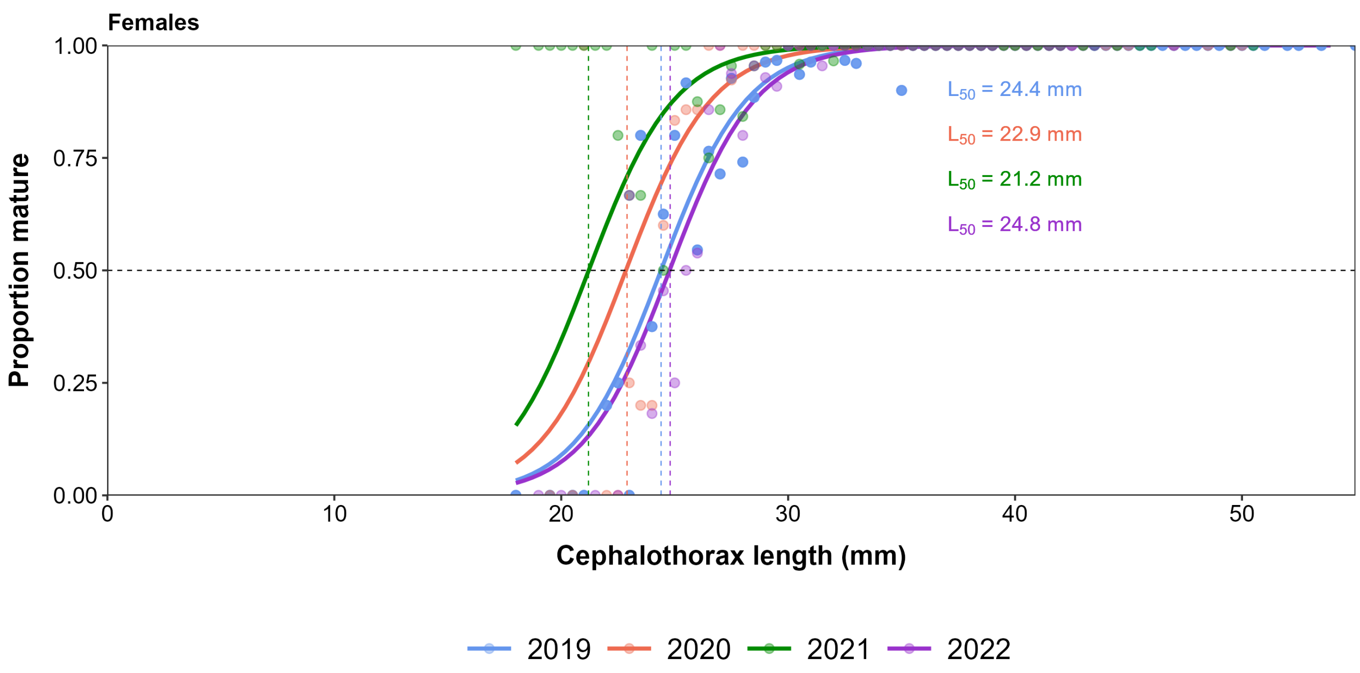

Figure 35. Norway lobster size at first maturity (L_{50}) for all years sampled.

Table 5. Number of Norway lobster individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls
			Number individuals sampled				
Bottom trawl	2019	North	16	1968	906	545	23
Bottom trawl	2019	Center	497	639	621	642	20
Bottom trawl	2019	South	183	23	187	6	12
Bottom trawl	2020	North	633	483	747	618	25
Bottom trawl	2020	Center	433	376	556	450	20
Bottom trawl	2020	South	75	1	12	2	9
Bottom trawl	2021	North	348	666	892	676	30
Bottom trawl	2021	Center	732	484	807	417	16
Bottom trawl	2021	South	15	1	6	2	8
Bottom trawl	2022	North	273	642	724	713	27
Bottom trawl	2022	Center	446	313	573	844	22
Bottom trawl	2022	South	1	1	2	0	4

Table 5. Number of Norway lobster individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

The spatiotemporal length-frequency distribution of Norway lobster from 2019 to 2022 shows that the upper slope is the main habitat of these species (Figure 36). Accordingly, the maximum abundance of Norway lobster was found on the upper slope in all years sampled, reaching a maximum of 250 ind/km^2 in 2019 which progressively decreased in 2020 and 2021 and rebounded slightly in 2022.

Very few individuals were caught in both shallow continental and continental shelves in 2022, 3 and 13 respectively. In contrast, 4 252 individuals were caught in the upper slope with a maximum abundance of over 150 ind/km^2 of sizes between 26 and 32 mm of CL. Individuals in the upper and lower slopes showed a wider size distribution, ranging from 16 to 53 mm of CL. The lower slope showed lower abundance compared to previous years with the largest individuals found at this depth stratum.

Norway lobster discards were very low in 2022, especially in the upper slope, given that individuals under the MRCS were still commercialized. In the other depth strata, discards were slightly higher, mainly due to the lack of sufficient individuals caught to be commercialized.

For monthly length-frequency distribution of Norway lobster at different depth strata in 2022 see Annex 13.

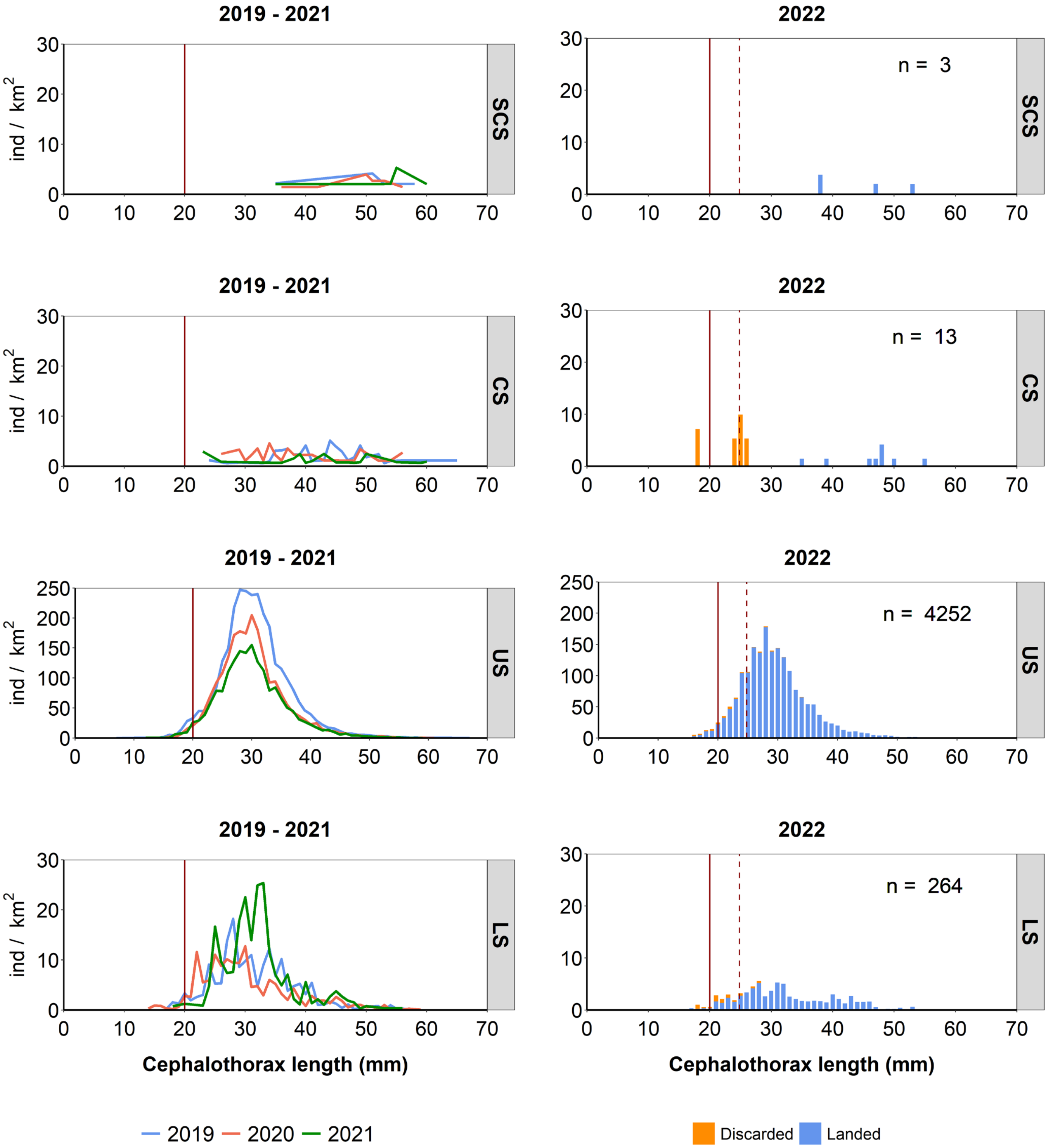

Figure 36. Annual length-frequency distribution of Norway lobster at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS) and red dashed line: length at first maturity (L_{50}).

The gonadal cycle of female Norway lobster was analyzed monthly from 2019 to 2022 (Figure 37). The species showed a seasonal reproductive cycle with the highest abundance of mature females from April to September in all years sampled, except 2020, as there was no sampling neither in April nor May. A reproductive peak was observed between June and August, coinciding with the highest GSI values found and the known reproductive season of the species. The highest abundance of resting females and the lowest GSI values were found from October to December.

For Norway lobster, the proportion of ovigerous females over the years sampled is also represented (Figure 38). The eggs were graded according to their maturity stage by color: dark blue/dark green (eggs I), light green (eggs II) and orange/brown (eggs III). It can be observed that females started to release their eggs at the end and right after the reproductive peak, coinciding with the decrease of the GSI values after August, while mature eggs (eggs III) were only found during the winter months.

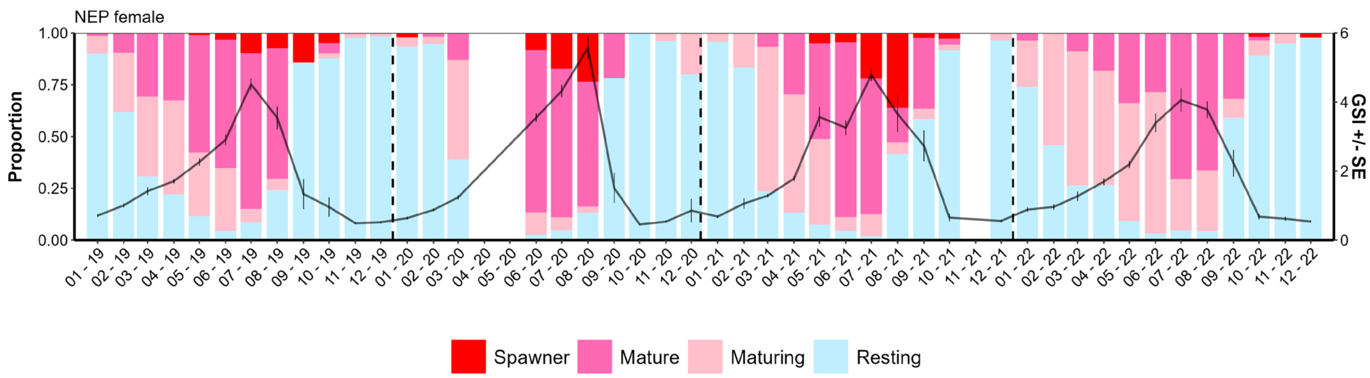

Figure 37. Norway lobster monthly gonadal cycle for females from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

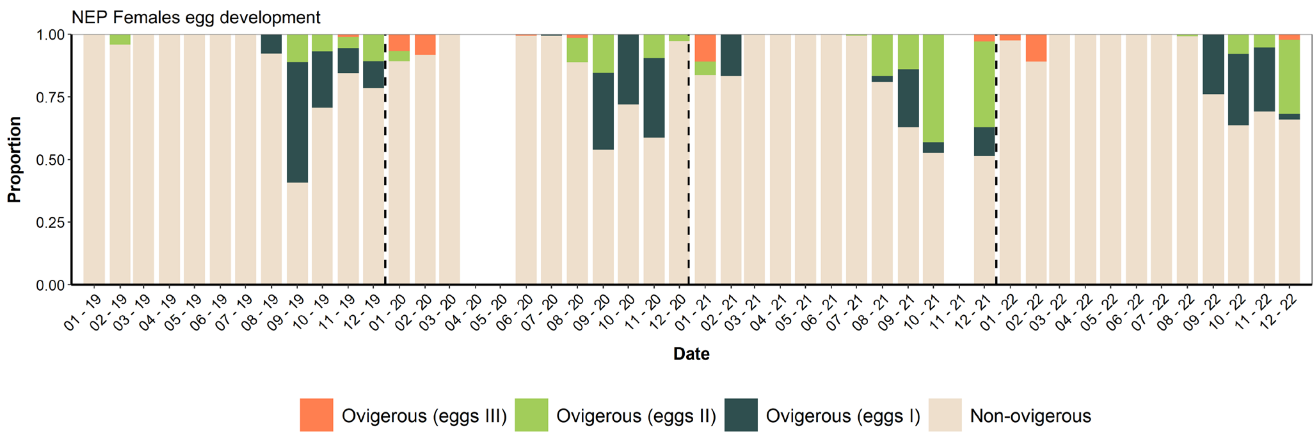

Figure 38. Norway lobster monthly proportion of different egg development stages from 2019 to 2022.

Deep-water rose shrimp (*Parapenaeus longirostris*) DPS

The total deep-water rose shrimp catch in Catalonia in 2022 was 469 t, 100% of which were caught by bottom trawling (ICATMAR, 23-03).

Figure 39 and Figure 40 show the spatial distribution of the species landings in 2022 and the period 2017-2021 along the Catalan coast. An increasing trend is observed over the years, with a maximum of 864 kg/km^2 in 2021, but with a slight decrease to 685 kg/km^2 in 2022.

All parameters analyzed in this report for deep-water rose shrimp were calculated using only individuals obtained by bottom trawling sampling (Table 7).

According to length-weight relationship parameters for both sexes combined and separately, deep-water rose shrimp displayed a negative allometric growth (b<3) in 2022 (Table 6). Comparing the growth curves between the years sampled for both sexes combined and separately, similar results are observed over the years with negative allometric growth in all cases (Figure 41). It is worth noting that, as other species within the suborder *Dendrobranchiata*, females reach larger sizes than males.

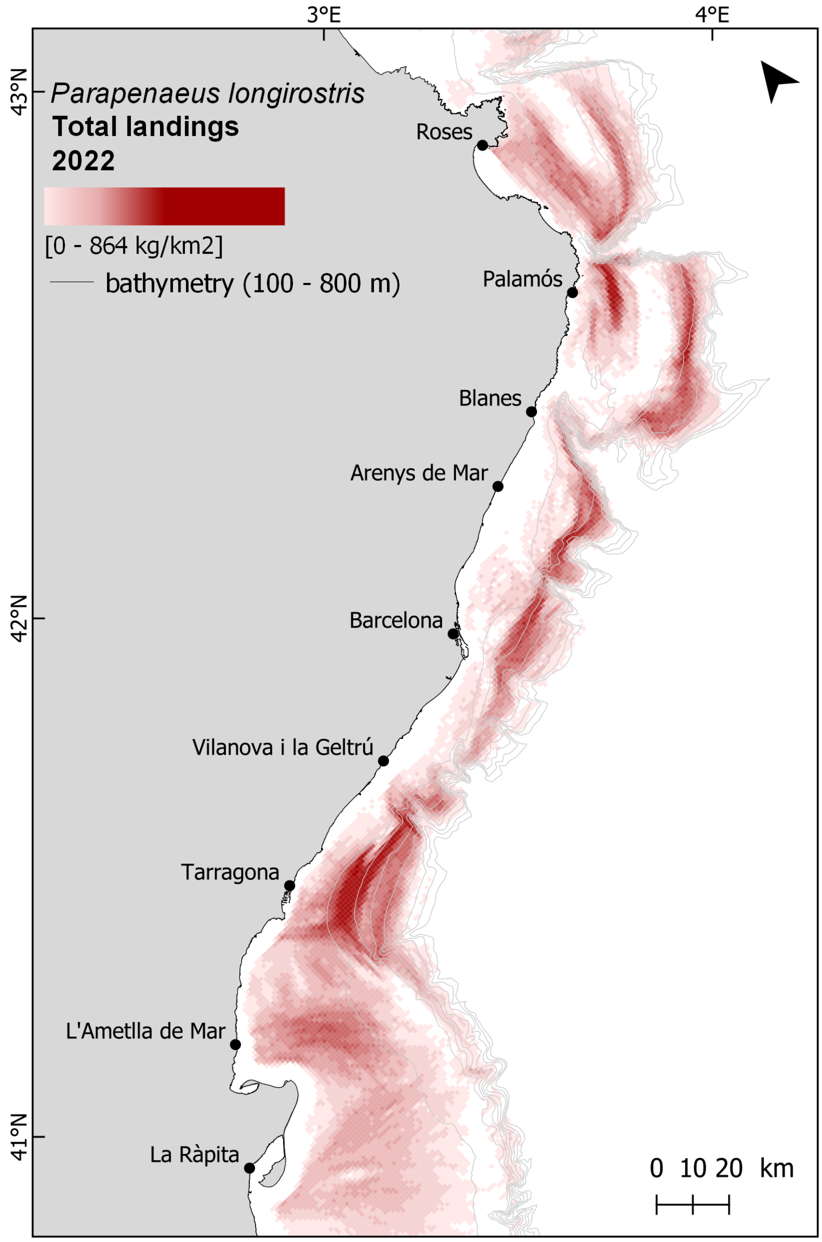

Figure 39. Spatial distribution of landings per unit of effort (LPUE) for deep-water rose shrimp in the Catalan fishing grounds (North GSA6) in 2022.

Table 6. Deep-water rose shrimp length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	a	b	r^2	n	L_{50}
Combined	0.0033	2.4616	0.93	1381	
Females	0.0042	2.4005	0.92	935	17.05
Males	0.0037	2.4212	0.87	444	

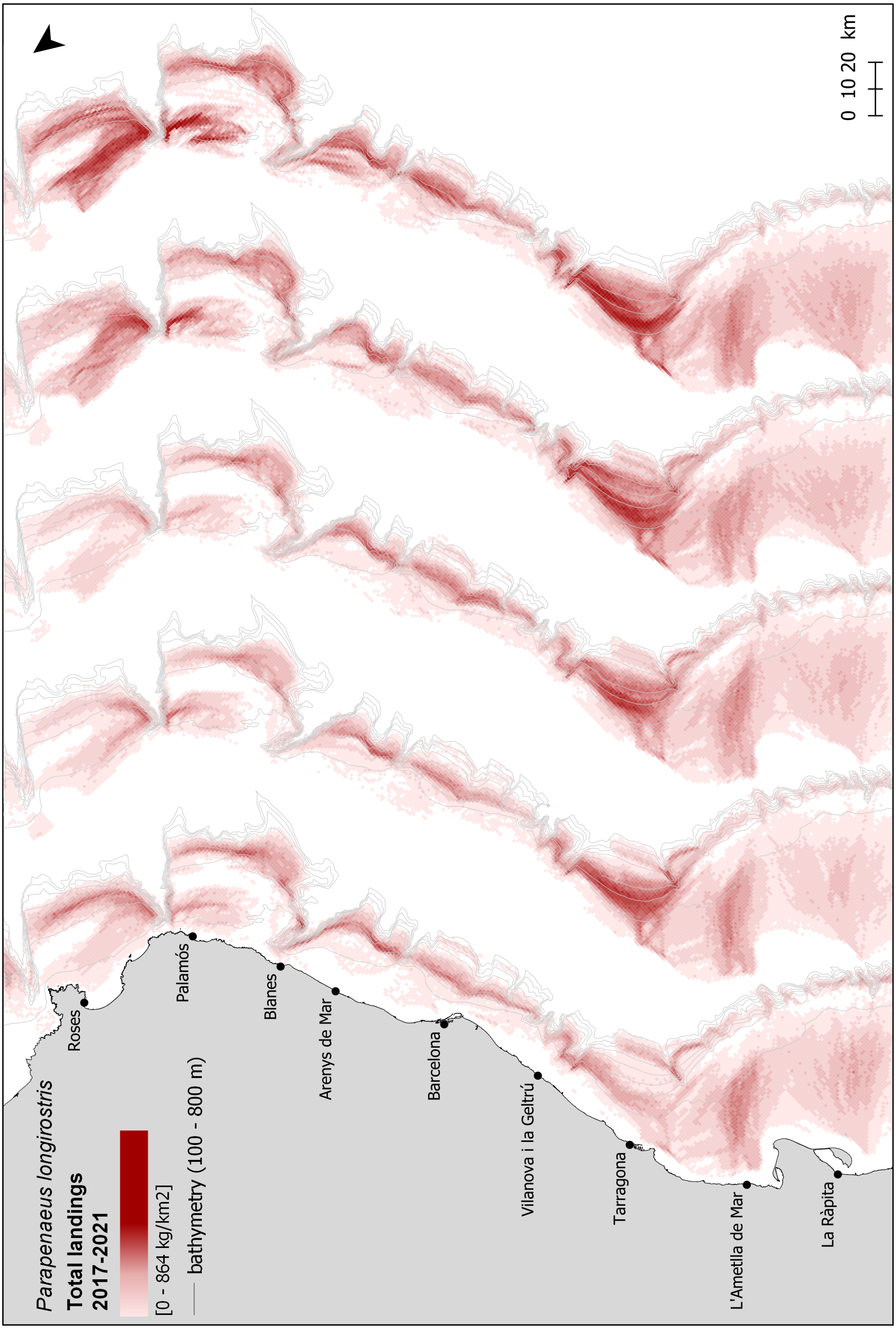

Figure 40. Spatial distribution of landings per unit of effort (LPUE) for deep-water rose shrimp in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

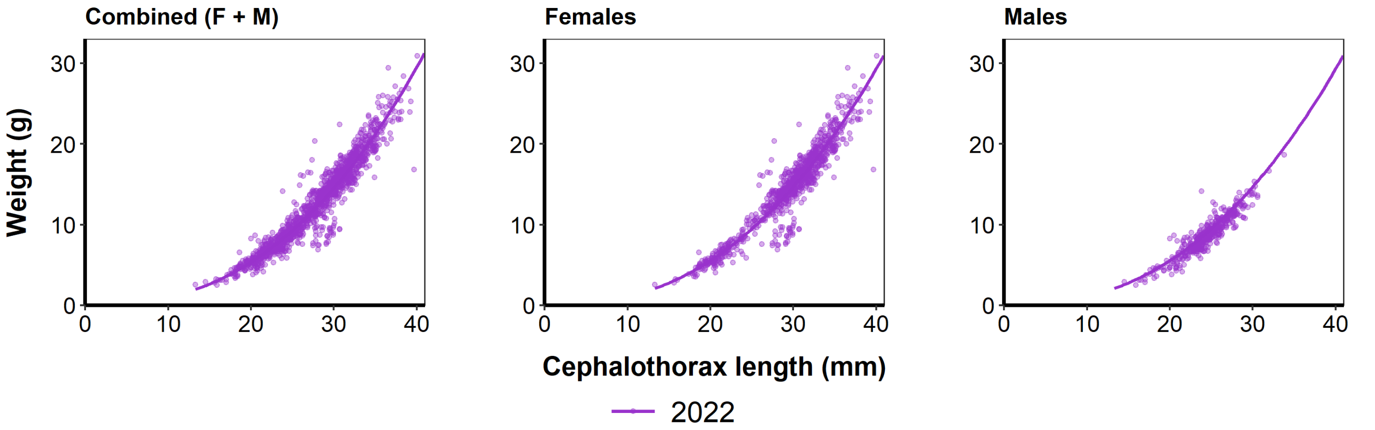

Figure 41. Deep-water rose shrimp length-weight relationship for the years sampled.

The size at first maturity (L_{50}) for deep-water rose shrimp in 2022 was 17.05 of carapace length cm for females (Table 6 and Figure 42). The calculated L_{50} (17.05 cm of CL) is consistent with that obtained in previous studies. Given that this species has become an important fishing resource on the Catalan coast due to the considerable increase in its catches over the last decade, it will be interesting to see how its L_{50} evolves over time, as variations in this parameter are useful for assessing the level of exploitation of a species.

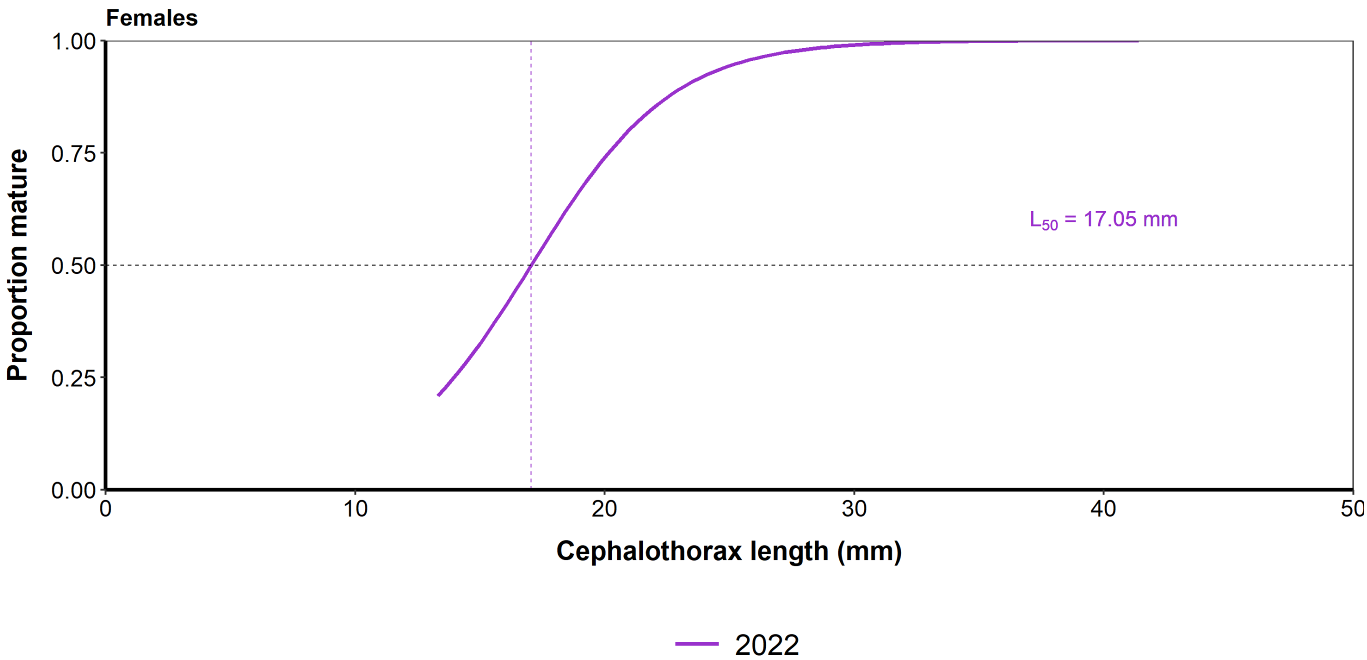

Figure 42. Deep-water rose shrimp size at first maturity (L_{50}) for all years sampled.

Table 7. Number of deep-water rose shrimp individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls
			Number individuals sampled				
Bottom trawl	2019	North	206	459	212	328	30
Bottom trawl	2019	Center	204	263	157	553	21
Bottom trawl	2019	South	402	170	285	272	23
Bottom trawl	2020	North	206	236	405	532	24
Bottom trawl	2020	Center	292	308	364	425	23
Bottom trawl	2020	South	368	77	156	340	15
Bottom trawl	2021	North	518	676	818	591	34
Bottom trawl	2021	Center	402	404	387	214	19
Bottom trawl	2021	South	297	41	204	224	16
Bottom trawl	2022	North	397	419	931	983	32
Bottom trawl	2022	Center	311	239	1197	659	19
Bottom trawl	2022	South	186	242	380	753	13

The spatiotemporal length-frequency distribution of deep-water rose shrimp from 2019 to 2022 indicates that the species was present in all depth strata sampled, but showed the highest abundances in the continental shelf and upper slope, especially in 2022 (Figure 43). The smallest individuals were concentrated in the shallower strata, while sizes increased with depth. The lowest abundances were found in the lower slope where only adult individuals (above the L_{50} and the MCRS) were caught. Comparison between years seems to show an increase in abundance over time, except in the lower slope.

For monthly length-frequency distribution of deep-water rose shrimp at different depth strata in 2022 see Annex 14.

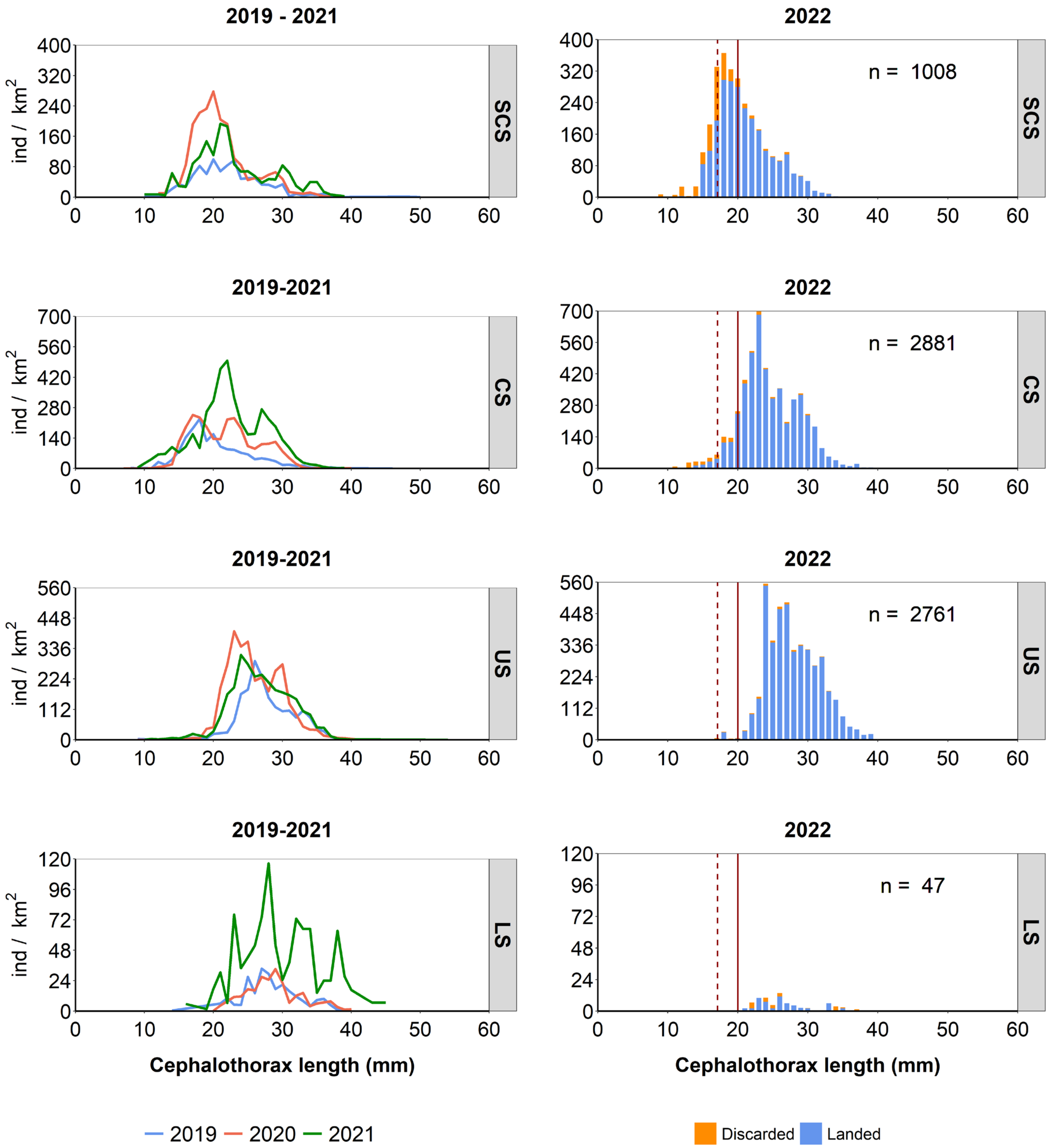

Figure 43. Annual length-frequency distribution of deep-water rose shrimp at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: Minimum Conservation Reference Size (MCRS) and red dashed line: length at first maturity (L_{50}).

In the case of deep-water rose shrimp, only five months of biological data from 2022 are available to assess the reproductive cycle of the species and therefore no clear pattern can be observed. (Figure 44). However, existing literature indicates that, unlike other crustacean species of commercial interest, deep-water rose shrimp does not have a marked reproductive cycle, but prsents individuals at different stages of maturity throughout the year, which could be related to the rapid expansion capacity of the species.

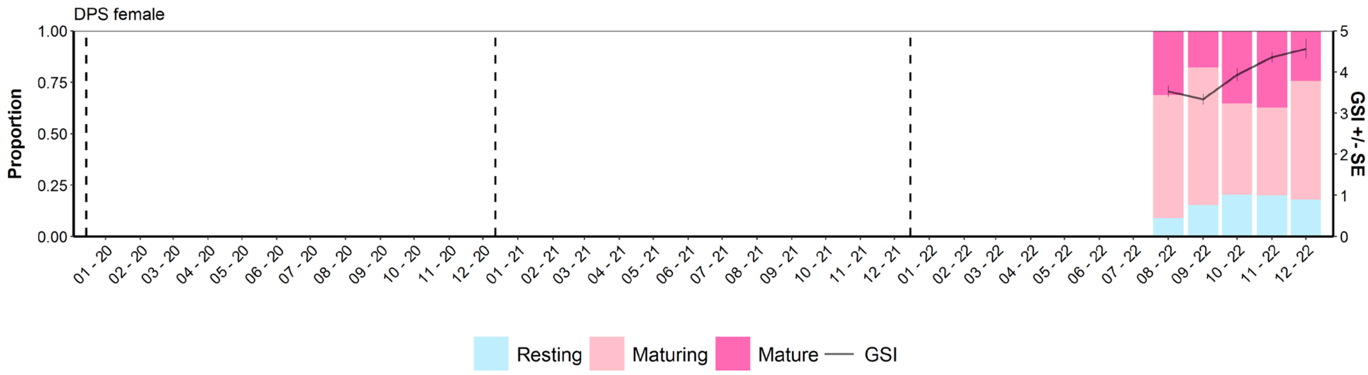

Figure 44. Deep-water rose shrimp monthly gonadal cycle for females from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

Blue and red shrimp (*Aristeus antennatus*) ARA

The total blue and red shrimp catch in Catalonia in 2022 was 372 t, 100% of which were caught by bottom trawling (ICATMAR, 23-03).

Figure 45 and Figure 46 show the spatial distribution of the species landings in 2022 and in the period 2017-2021 along the Catalan coast, where the fishing effort is mainly concentrated around submarine canyons. A decreasing trend is observed over the years, with a maximum of 2 919 kg/km² in 2018 and a minimum of 1 190 kg/km² in 2022. It is worth noting the increase in landings in the fishing grounds off L'Ametlla de Mar over the years, where only one vessel exploits the area.

All parameters analyzed in this report for blue and red shrimp were calculated using only individuals obtained by bottom trawling sampling (Table 9).

According to length-weight relationship parameters for both sexes combined and separately, blue and red shrimp displayed a negative allometric growth (b<3) in 2022 (Table 8). Comparing the growth curves between the years sampled for both sexes combined and separately, similar results can be observed over the years with negative allometric growth in all cases (Figure 47). As shown in the length-weight relationship separated by sexes, females reach larger sizes than males.

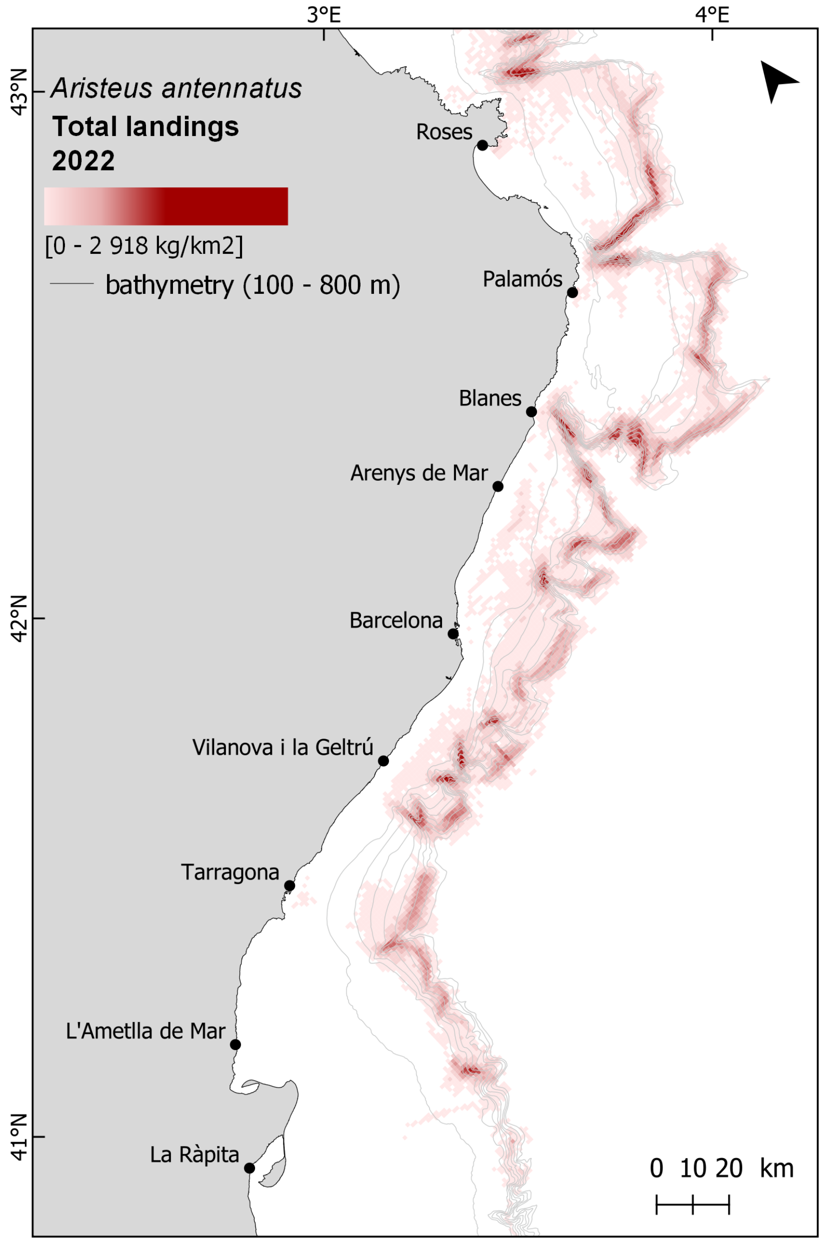

Figure 45. Spatial distribution of landings per unit of effort (LPUE) for blue and red shrimp in the Catalan fishing grounds (North GSA6) in 2022.

Table 8. Blue and red shrimp length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r²)	n	L_{50}
Combined	0.0033	2.4286	0.97	2 006	
Females	0.0034	2.4174	0.96	1 851	23.51
Males	0.0057	2.2473	0.88	154	

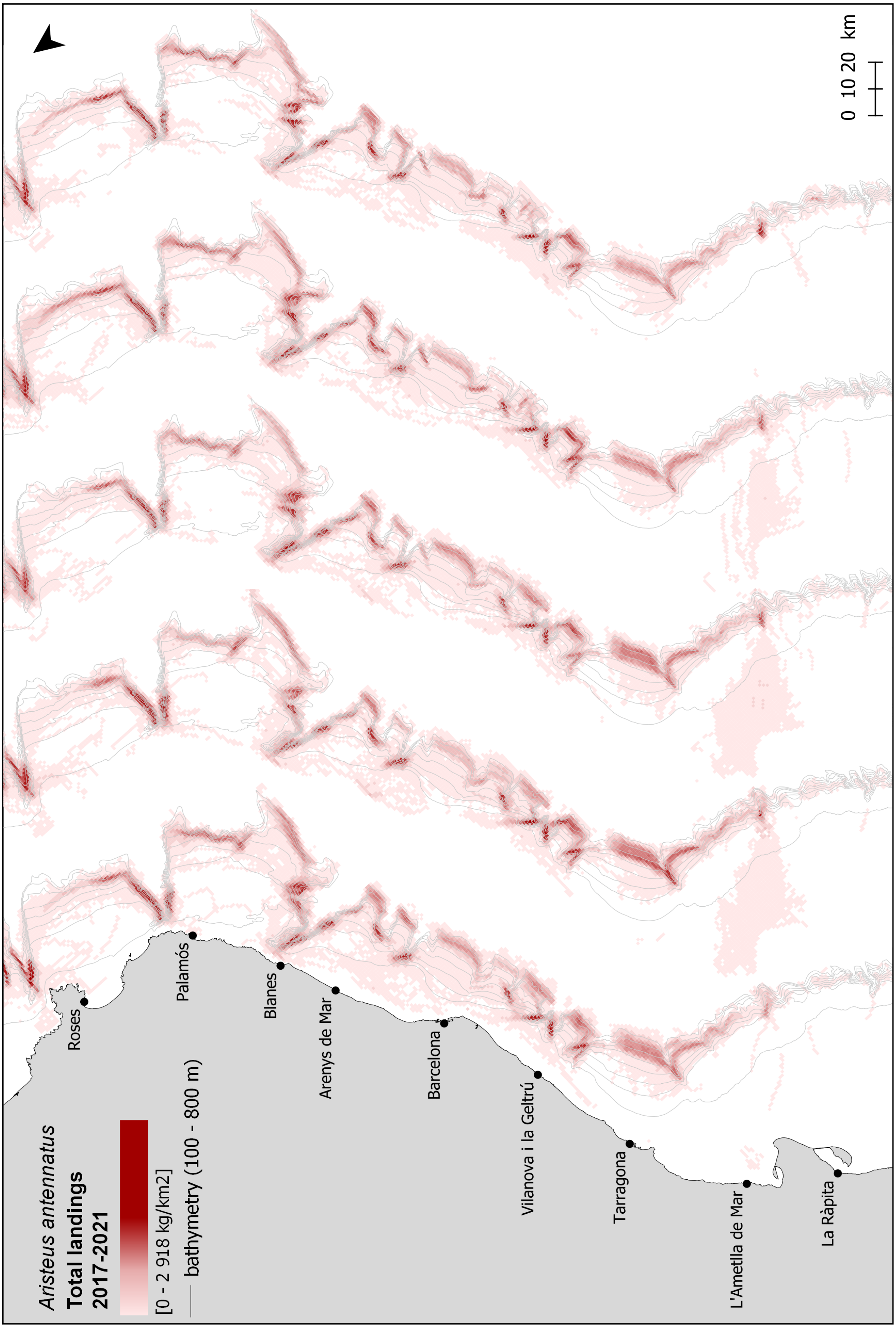

Figure 46. Spatial distribution of landings per unit of effort (LPUE) for blue and red shrimp in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

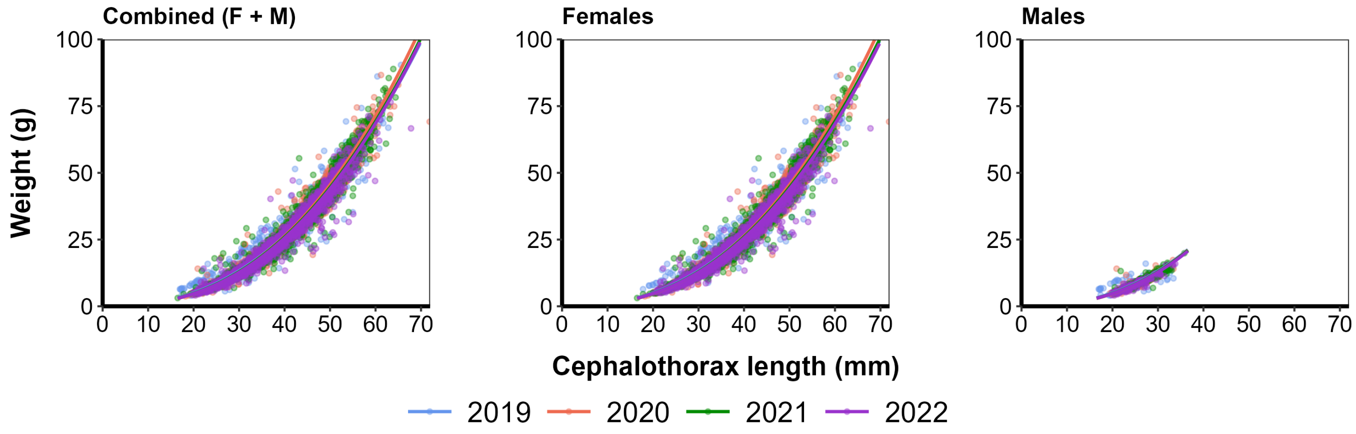

Figure 47. Blue and red shrimp length-weight relationship for all years sampled.

The size at first maturity (L_{50}) for blue and red shrimp in 2022 was 23.51 cm of carapace length (Table 8 and Figure 48). Comparing between years, a decreasing trend from 2019 to 2021 can be observed, especially in 2021, when the L_{50} decreased by almost 1 mm. However, in 2022 it increased to 23.5 mm of CL.

It should be noted that the calculated L_{50} is just a rough estimation as the number of immature females sampled was very low, so the curve does not adjust properly. Even so, the catch of a low number of immature individuals in the samples is a good indication for improving the sustainability of the fishery. Indeed, a potential management measure is to improve the selectivity of trawl gear to reduce the catch of immature individuals.

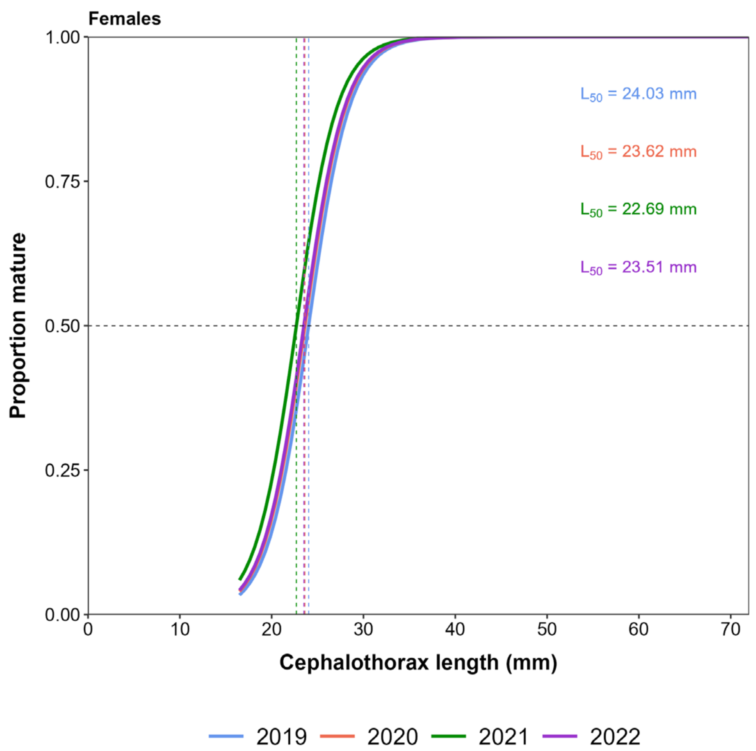

Figure 48. Blue and red shrimp size at first maturity (L_{50}) for all years sampled.

Table 9. Number of blue and red shrimp individuals measured from 2019 to 2022 in bottom trawl fishery along the zones sampled in each season (the values include all depth strata sampled). Blue and red shrimp sampling in the South zone ceased from 2021.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls
			Number individuals sampled				
Bottom trawl	2019	North	181	1796	1102	900	17
Bottom trawl	2019	Center	1005	848	483	1049	12
Bottom trawl	2019	South	490	0	898	433	5
Bottom trawl	2020	North	697	502	1040	1056	16
Bottom trawl	2020	Center	467	655	894	991	10
Bottom trawl	2020	South	537	0	477	335	3
Bottom trawl	2021	North	1053	979	1146	1100	16
Bottom trawl	2021	Center	1067	974	552	467	12
Bottom trawl	2022	North	889	921	934	746	15
Bottom trawl	2022	Center	835	532	663	431	11

The spatiotemporal length-frequency distribution of blue and red shrimp from 2019 to 2022 are only shown for the upper and lower slopes, as these are the depth strata the species inhabits (Figure 49). The highest abundances were found in the lower slope in all years sampled. In 2022, the sizes ranged from 25 to 62 mm of CL, with a mean size of 25 mm of CL in the upper slope and 28 mm on the lower slope. Very few individuals were discarded in 2022, as blue and red shrimp does not have a MCRS and all the catch of the species can be commercialized, although a considerable proportion of the individuals sampled were below the L_{50}.

When compared between years, 2022 showed the highest abundance both in the upper and lower slopes. It should be noted that the size distribution on the lower slope in 2021 was very similar to that of 2022, sharing the same mean size (28 mm of CL).

For monthly length-frequency distribution of blue and red shrimp at different depth strata in 2022 see Annex 15.

The gonadal cycle of female blue and red shrimp was analyzed monthly from 2019 to 2022 (Figure 50). The species showed a highly seasonal reproductive cycle with a peak in its reproductive activity during the spring and summer months, coinciding with the highest GSI values. In contrast, females were in resting state during most of the autumn and winter months.

Throughout their life cycle, blue and red shrimp females store the spermatophore deposited by a male in their telycum. The presence or absence of spermatophore is related to the sexual maturity of females. Figure 51 shows the monthly spermatophore occurrence by size category in blue and red shrimp females over the years sampled and it can be observed that 100% of females showed presence of spermatophore during the spring and summer months, coinciding with the species reproductive season (Figure 50). In contrast, during the autumn and winter months, the proportion of females with presence of spermatophore was lower.

Regarding the size category, larger individuals had more presence of spermatophore compared to smaller ones. Furthermore, larger individuals presented spermatophore all year round, regardless of their sexual maturity stage (Sardà and Demestre, 1987). The presence of spermatophore throughout the year could be related to the fact that larger individuals undergo less molting processes than smaller ones and therefore do not lose their spermatophore. On the contrary, the proportion of smaller individuals with spermatophore presence increased from spring onwards and decreased after summer, as they undergo multiple molting processes throughout the year. When comparing between years, the results are similar for all years sampled.

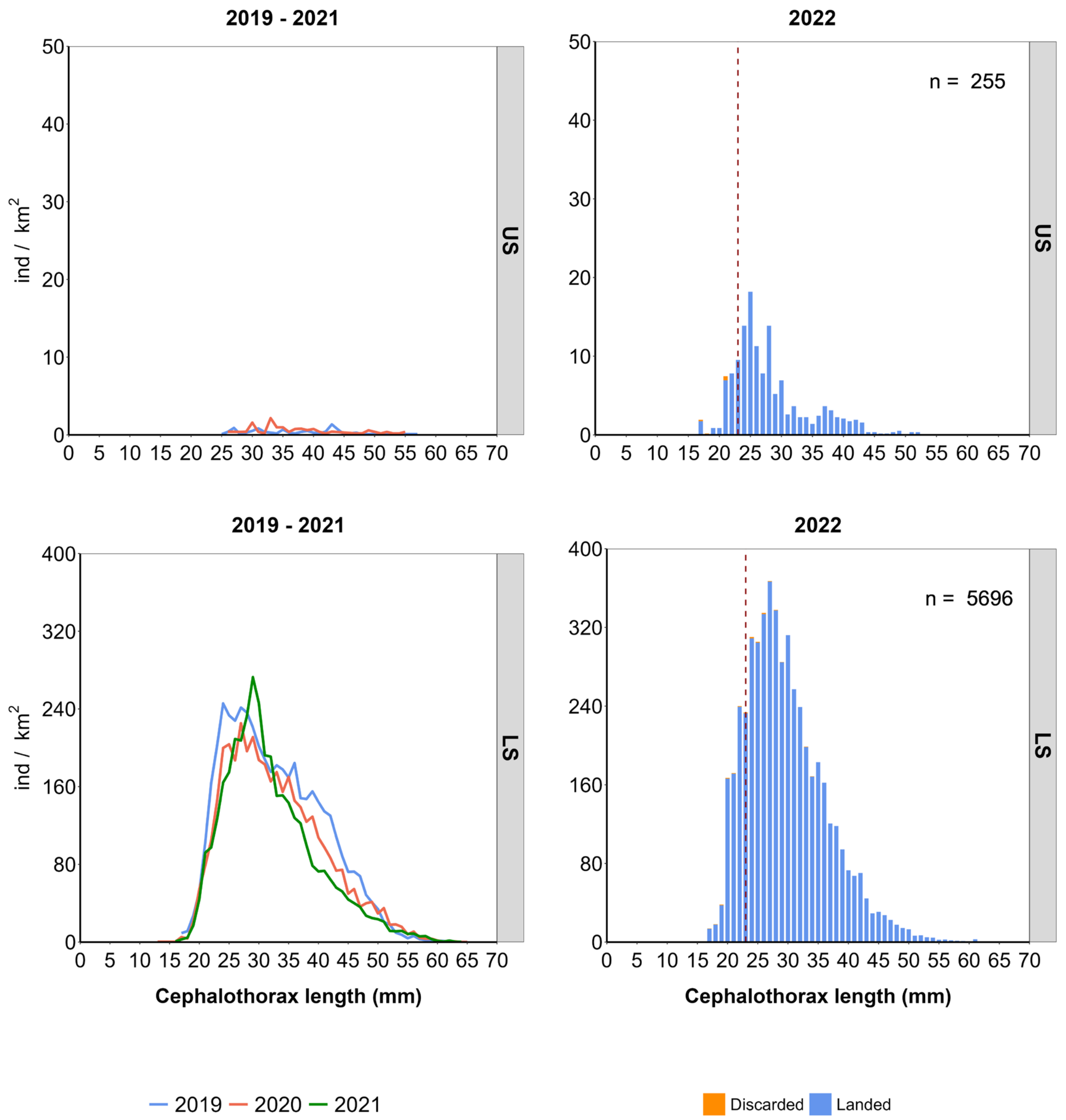

Figure 49. Annual length-frequency distribution of blue and red shrimp at different depth strata (US; Upper Slope and LS; Lower Slope). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: length at first maturity (L_{50}).

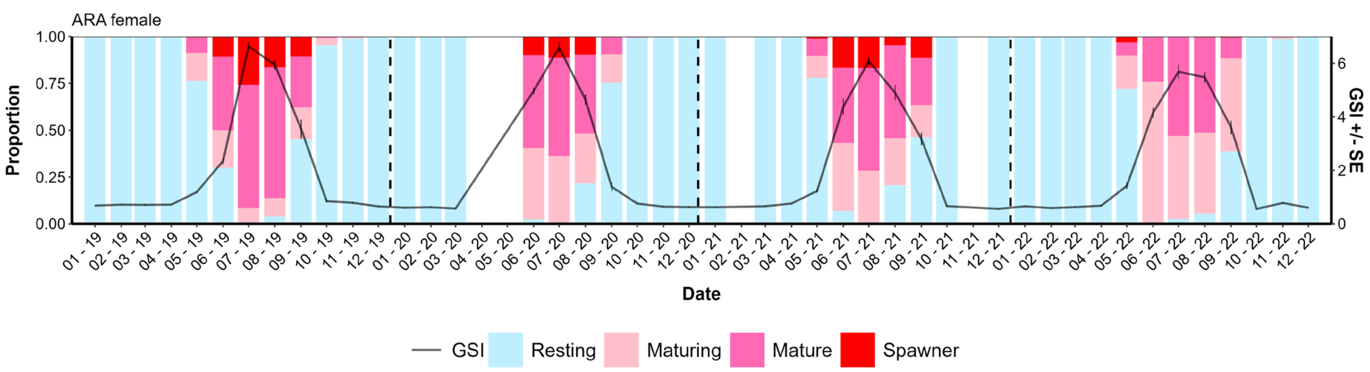

Figure 50. Blue and red shrimp monthly gonadal cycle for females from 2019 to 2022. Gonadosomatic index (GSI +/-SD (Standard Error)) and proportion of different maturity stages.

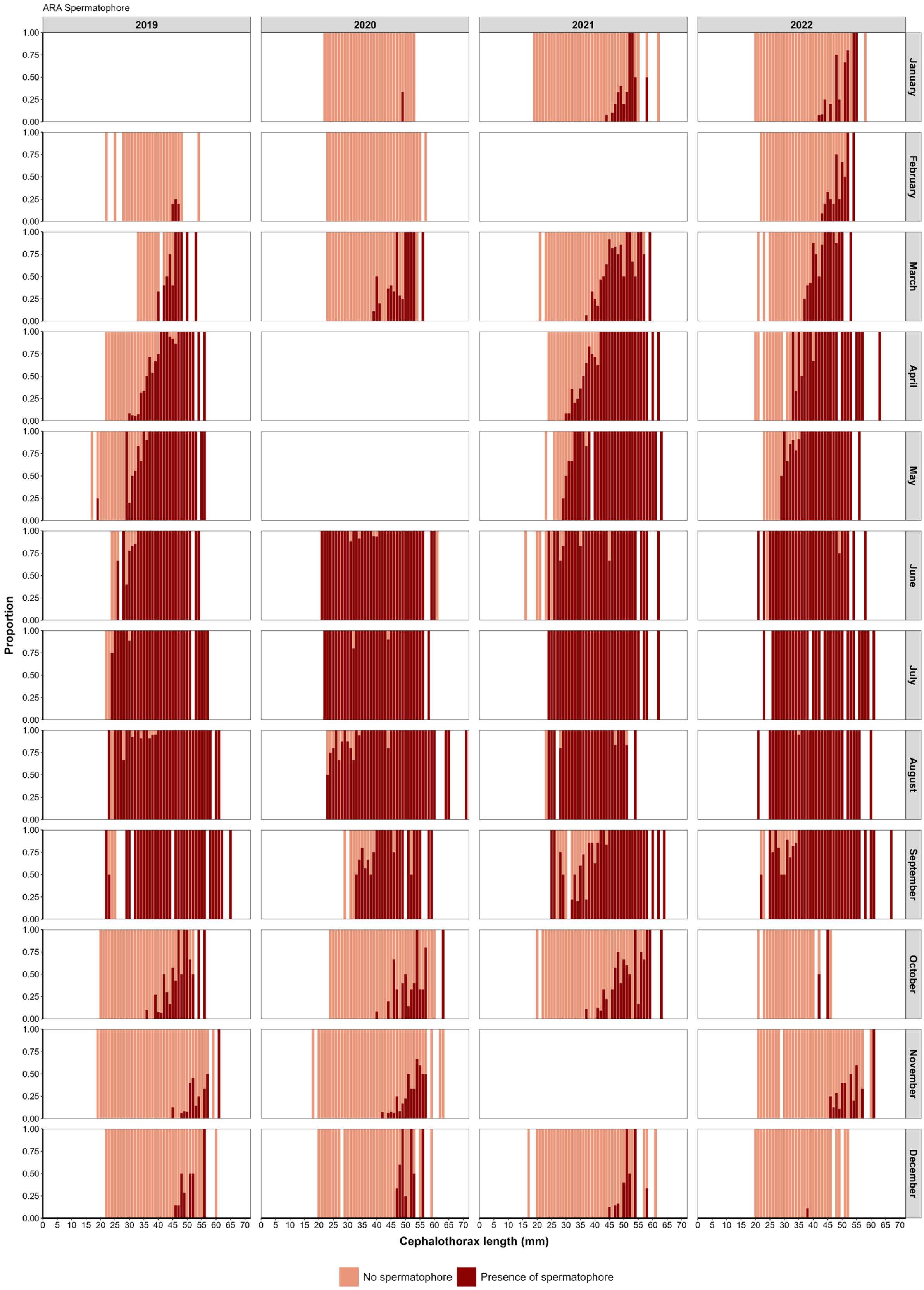

Figure 51. Monthly proportion of females with attached spermatophore of blue and red shrimp from 2019 to 2022 at different lengths.

Horned octopus (*Eledone cirrhosa*) EOI

The total horned octopus catch in Catalonia in 2022 was 456 t, 100% of which were caught by bottom trawling (ICATMAR, 23-03).

Figure 52 and Figure 53 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast. Maximum annual landings were reached in 2018 with 588 kg/km^2, mainly off Roses and Tarragona, and remained stable in the following years at around 400 kg/km^2.

All parameters analyzed in this report for horned octopus were calculated using only individuals obtained by bottom trawling sampling (Table 11).

According to length-weight relationship parameters for both sexes combined and separately, horned octopus displayed a negative allometric growth (b<3) in 2022 (Table 10). When comparing between the years sampled, a similar growth trend for both sexes combined can be observed (Figure 54). However, the growth trend was slightly lower in 2019 when comparing the two sexes separately.

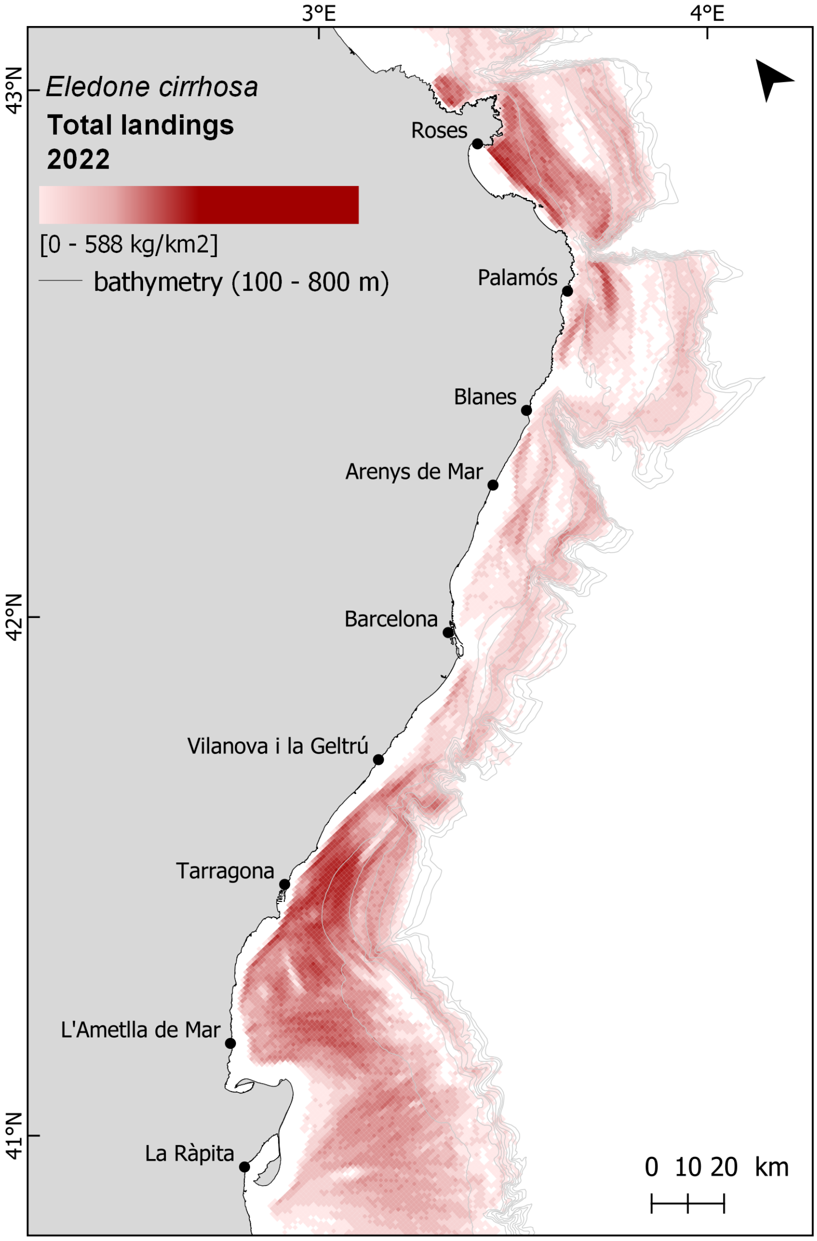

Figure 52. Spatial distribution of landings per unit of effort (LPUE) for horned octopus in the Catalan fishing grounds (North GSA6) in 2022.

Table 10. Horned octopus length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.6529	2.6616	0.9	734	6.21
Females	0.7799	2.5885	0.89	404	6.88
Males	0.6293	2.6724	0.88	323	5.97

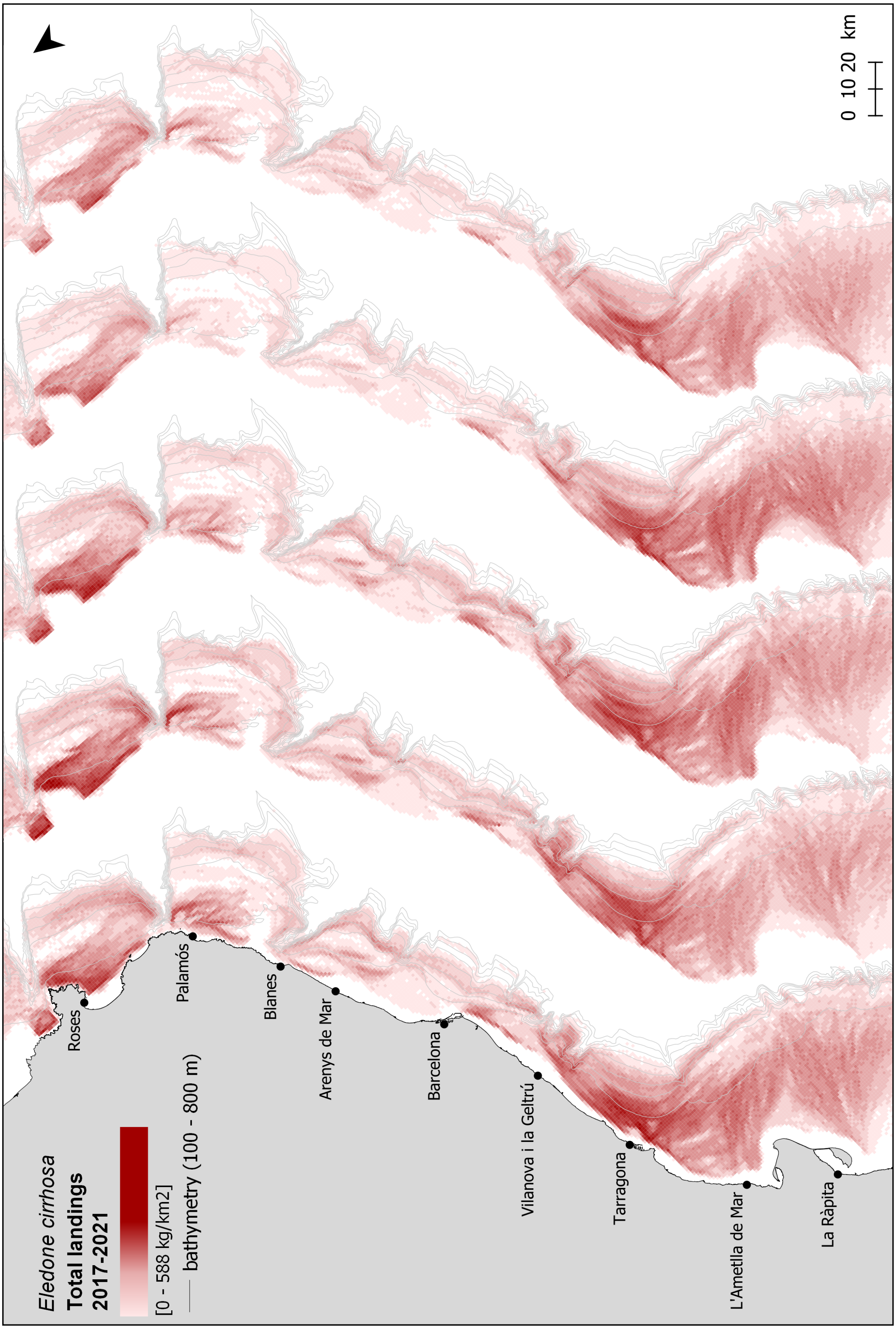

Figure 53. Spatial distribution of landings per unit of effort (LPUE) for horned octopus in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

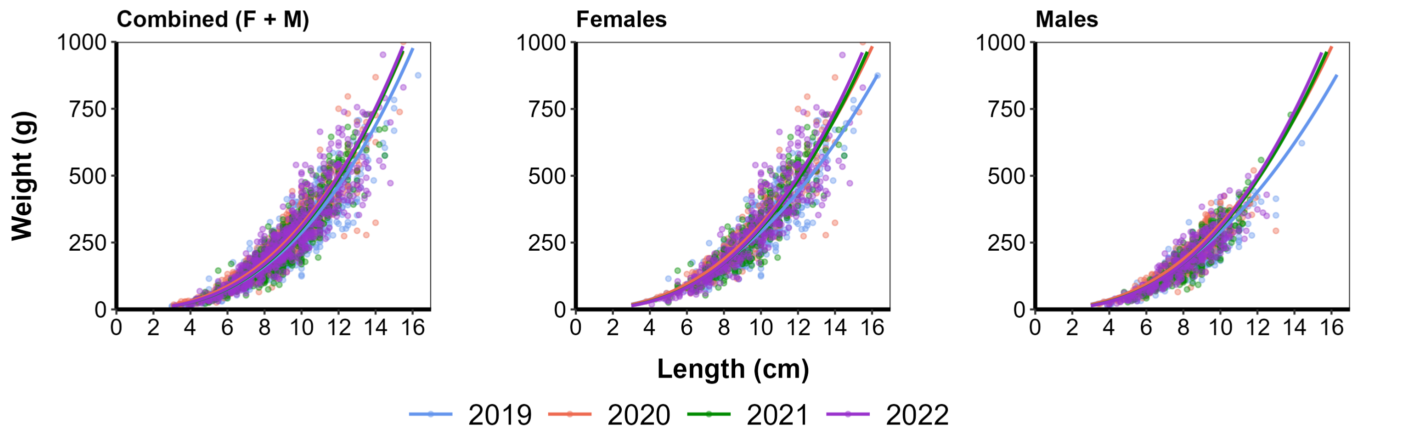

Figure 54. Horned octopus length-weight relationship for the previous years sampled.

The size at first maturity (L_{50}) for horned octopus in 2022 was 6.22 cm of ML for both sexes combined (Figure 55). Males showed earlier maturation than females in 2022, with a L_{50} of 5.99 and 6.88 cm of ML respectively. When comparing between the years sampled, 2019 showed the lowest L_{50} for both sexes combined and separately, although differences were not significant.

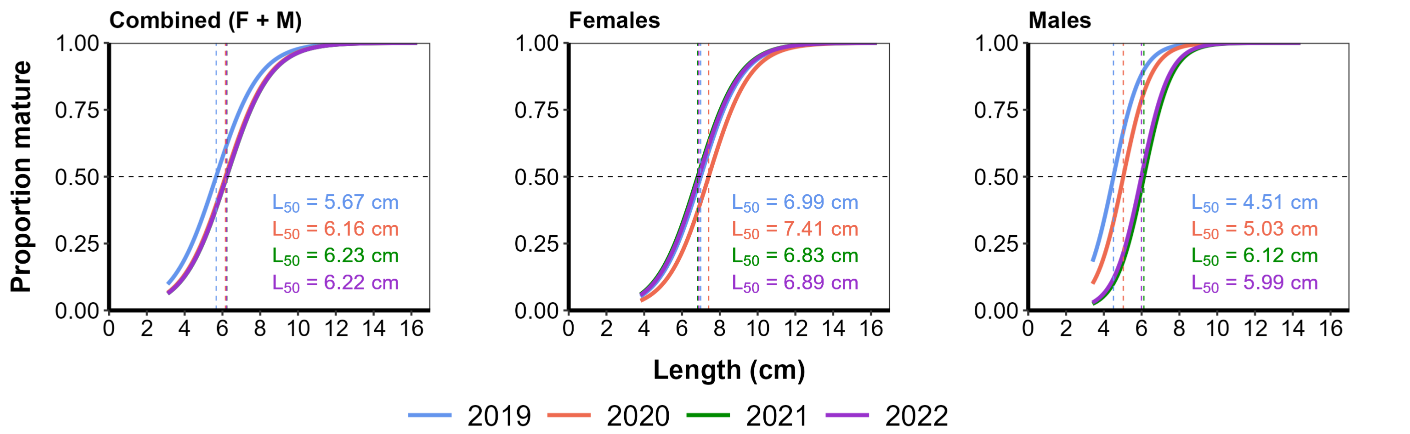

Figure 55. Horned octopus size at first maturity (L_{50}) for all years sampled.

The spatiotemporal weight-frequency distribution of horned octopus in 2022 indicates that the species was more abundant in the continental shelf and the upper slope (Figure 56). In the continental shelf, weights ranged between 50 and 750 g in all years sampled, with the mode at 150 g. In the upper slope, the weight distribution was wider with the mode at 250 g in 2022, which contrasts with that of 2019, at 200 g.

The monthly weight-frequency distribution by depth in 2022 showed similar spatial trends, with the highest abundances in the continental shelf and the upper slope. Both depth strata showed similar temporal trends (Annex 16). Weight frequencies remained similar, with the mode between 150 and 200 g. However, during the second trimester (April to June), the distributions showed the highest weights (600-700 g) and the mode at around 300 g.

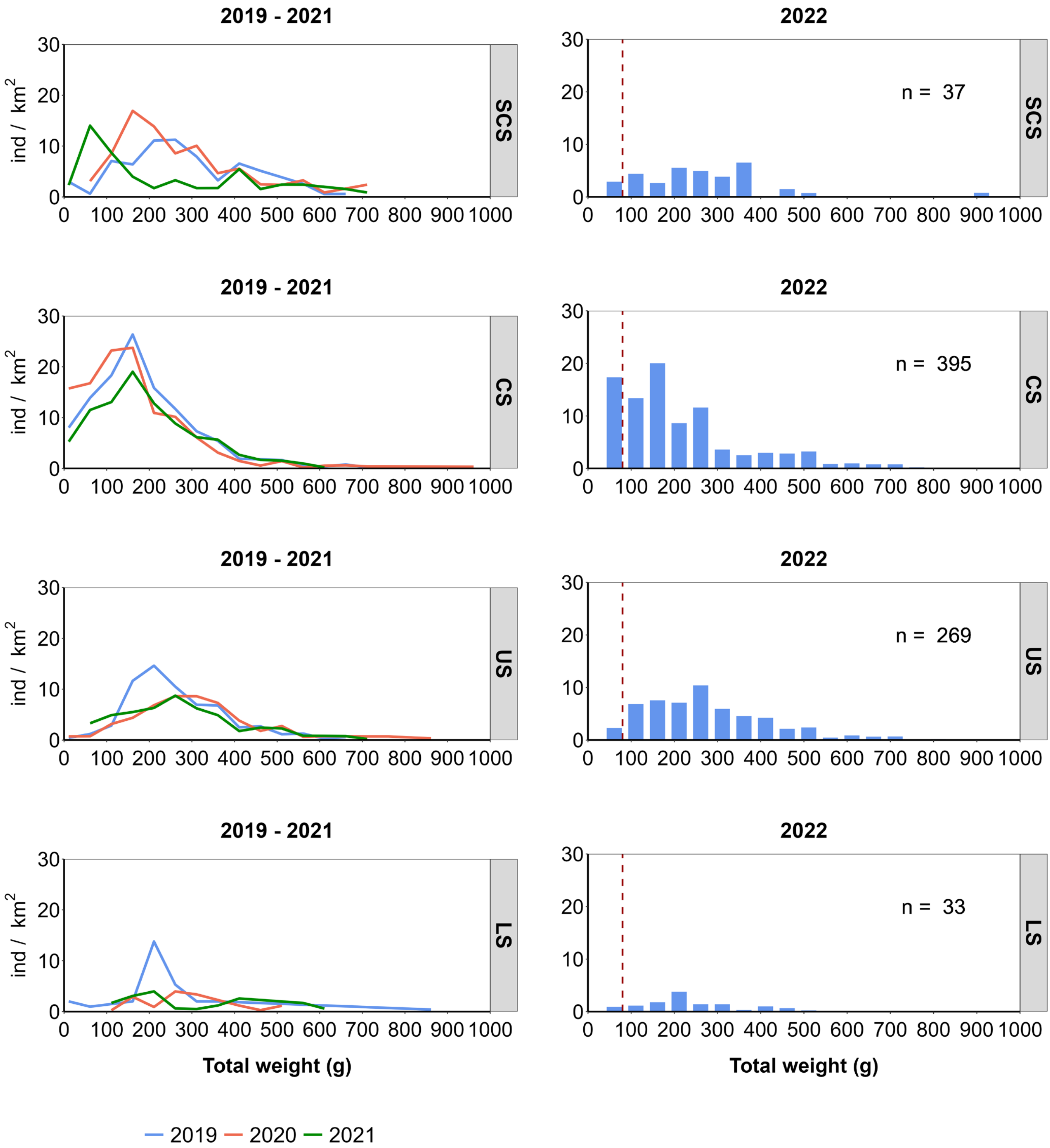

Figure 56. Annual weight-frequency distribution of horned octopus at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: Minimum Conservation Reference Weight (MCRW).

Table 11. Number of horned octopus individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N_hauls
			Number individuals sampled				
Bottom trawl	2019	North	19	182	24	107	26
Bottom trawl	2019	Center	32	81	37	99	23
Bottom trawl	2019	South	98	27	135	69	19
Bottom trawl	2020	North	20	46	13	57	21
Bottom trawl	2020	Center	119	19	104	40	22
Bottom trawl	2020	South	55	24	117	82	15
Bottom trawl	2021	North	117	86	46	67	30
Bottom trawl	2021	Center	64	28	30	30	21
Bottom trawl	2021	South	62	5	61	51	14
Bottom trawl	2022	North	85	93	82	112	36
Bottom trawl	2022	Center	72	70	50	44	25
Bottom trawl	2022	South	25	24	53	94	15

The gonadal cycle of horned octopus was analyzed monthly from 2019 to 2022 (Figure 57). The species showed a seasonal reproductive cycle with the highest proportion of mature individuals (also spawners in the case of males) between March and July. When comparing between years, the reproductive peak in 2022 occurred in June instead of July as in previous years. It should be noted that, although spawning females were almost absent, their monthly reproductive pattern was consistent with that of males.

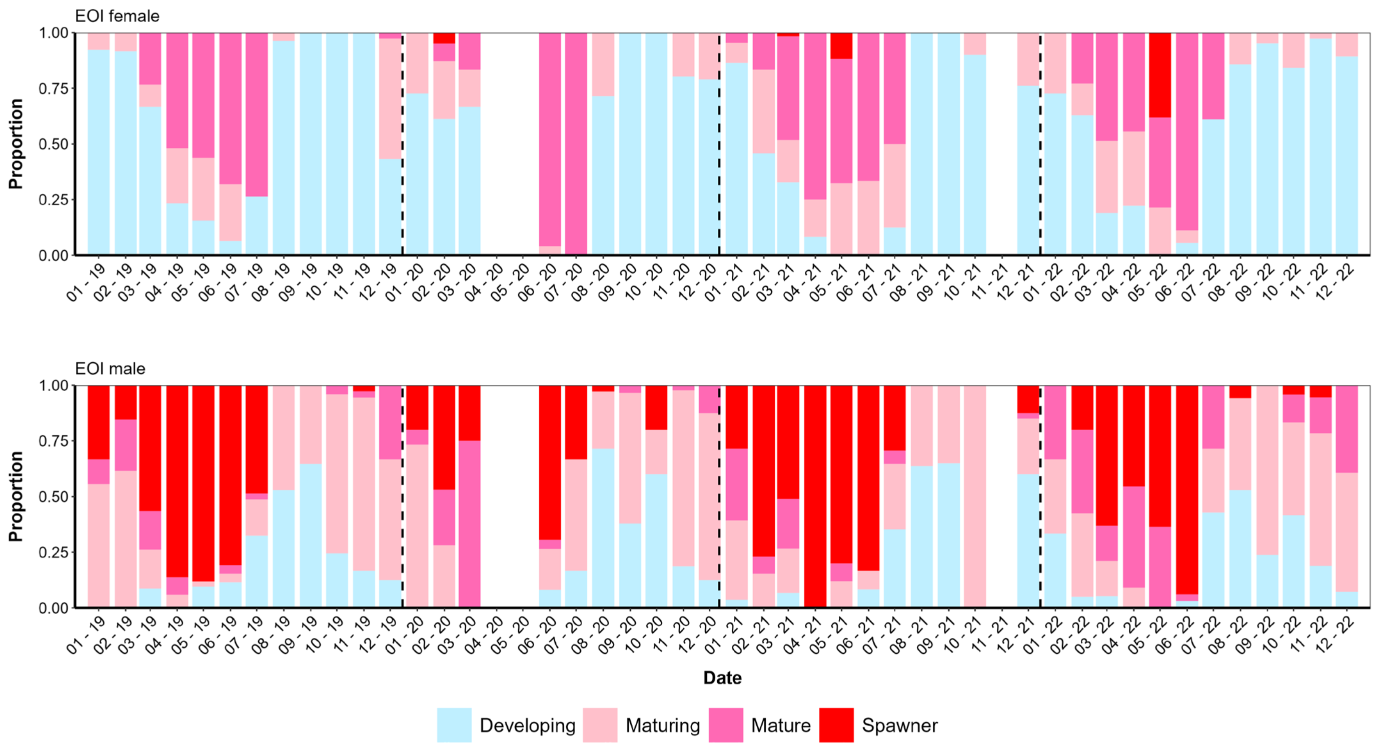

Figure 57. Horned octopus monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Proportion of different maturity stages.

Spot-tail mantis shrimp (*Squilla mantis*) MTS

The total spot-tail mantis shrimp catch in Catalonia in 2022 was 340 t, 94% of which were caught by bottom trawling and 6% by artisanal fisheries (ICATMAR, 23-03).

Figure 58 and Figure 59 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast, centered around the Ebre Delta area. A stable trend is observed over the years with an annual maximum of 1 325 kg/km^2 in 2018.

All parameters analyzed in this report for spot-tail mantis shrimp were calculated using only individuals obtained by bottom trawling sampling (Table 13).

According to length-weight relationship parameters for both sexes combined and separately, the species showed an isometric growth (b=3) but with significant weight variations at equal size (Table 12 and Figure 60). Therefore, its length-weight relationship is not well adjusted, which could be related to the short life cycle of the species. When comparing growth curves for both sexes combined and separately from 2019 to 2022 (Figure 60), the results show a similar trend over the years. However, the growth trend was slightly lower in 2019 when comparing the two sexes separately.

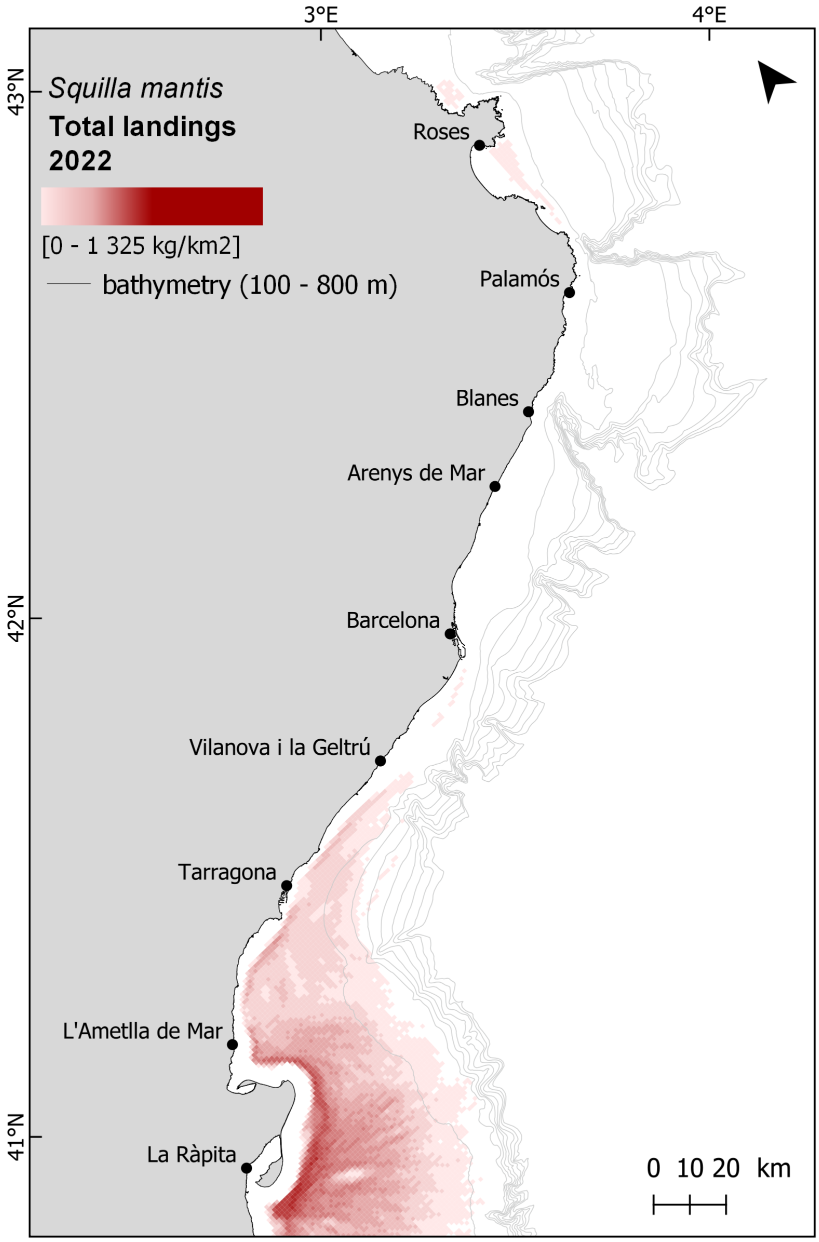

Figure 58. Spatial distribution of landings per unit of effort (LPUE) for spot-tail mantis shrimp in the Catalan fishing grounds (North GSA6) in 2022.

Table 12. Spot-tail mantis shrimp length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	a	b	r^2	n
Combined	0.0018	2.9527	0.78	531
Females	0.0019	2.9390	0.78	292
Males	0.0016	2.9887	0.78	239

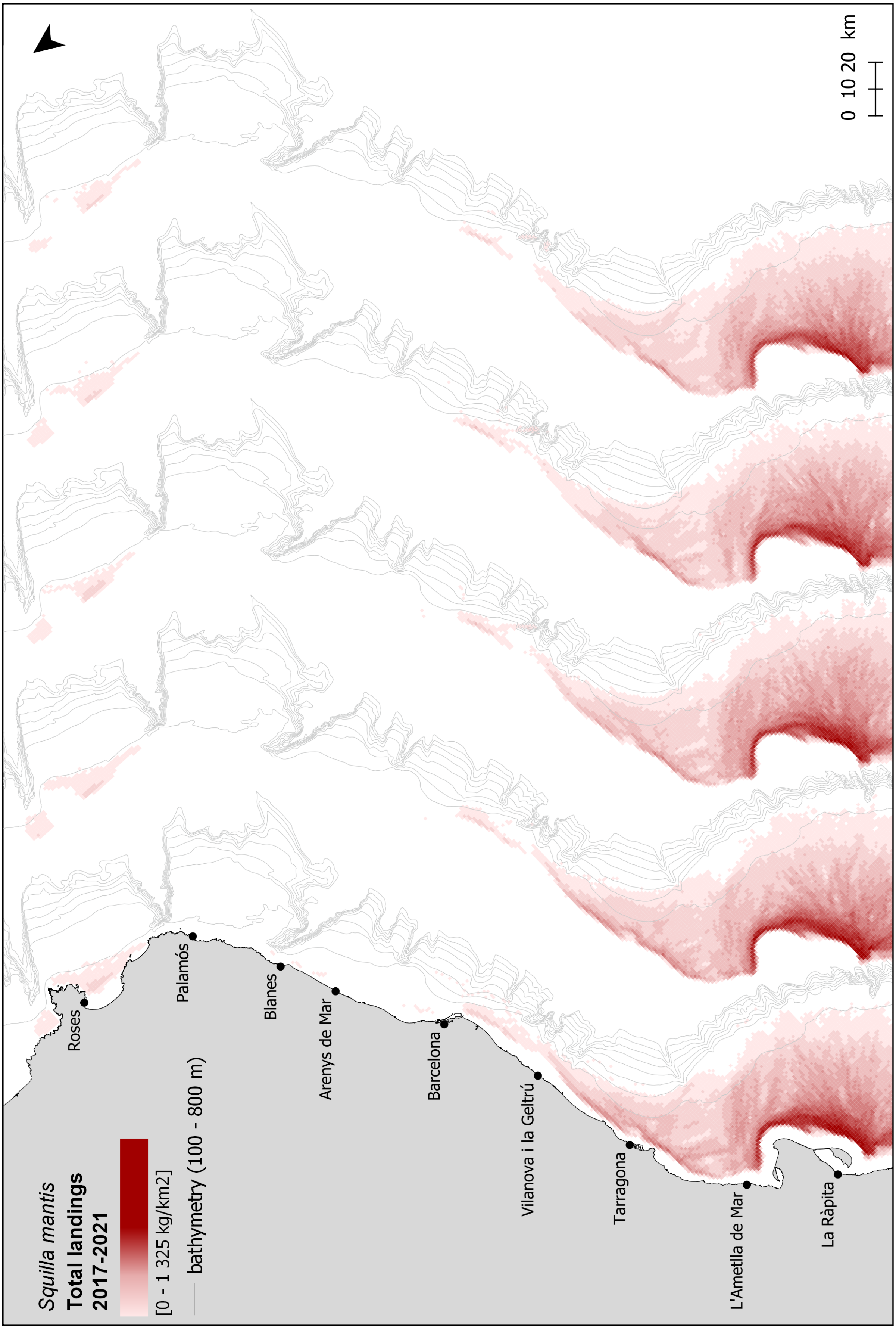

Figure 59. Spatial distribution of landings per unit of effort (LPUE) for spot-tail mantis shrimp in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

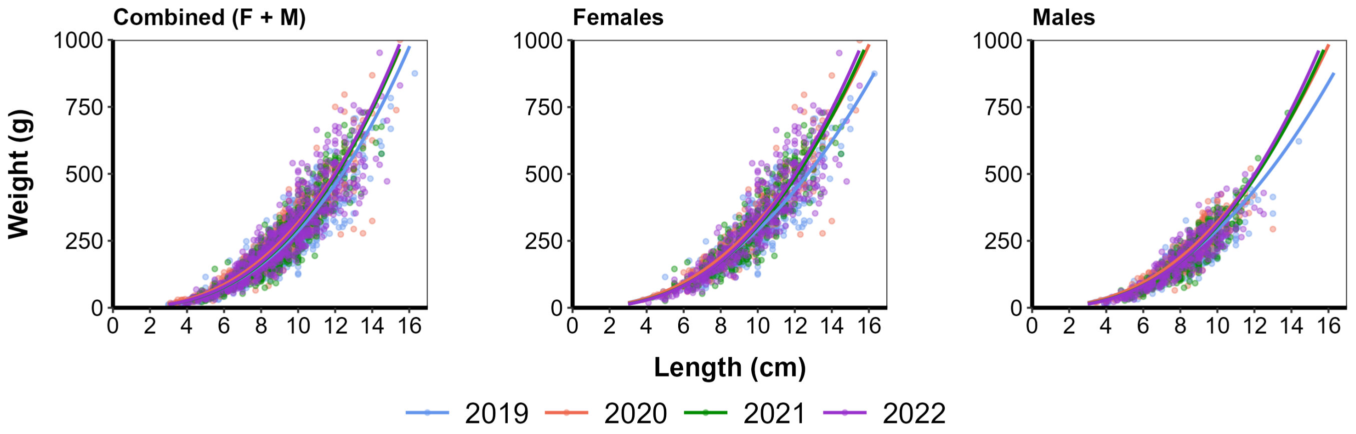

Figure 60. Spot-tail mantis squillid length-weight relationship for all years sampled.

Table 13. Number of spot-tail mantis shrimp individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls
			Number individuals sampled				
Bottom trawl	2019	North	0	1	0	8	2
Bottom trawl	2019	Center	0	1	1	0	2
Bottom trawl	2019	South	693	420	960	402	27
Bottom trawl	2020	North	0	0	1	5	2
Bottom trawl	2020	Center	0	0	4	0	2
Bottom trawl	2020	South	265	78	577	347	18
Bottom trawl	2021	Center	1	1	0	0	2
Bottom trawl	2021	South	573	85	647	613	21
Bottom trawl	2022	Center	1	0	0	0	1

The spatiotemporal length-frequency distribution of spot-tail mantis shrimp from 2019 to 2022 indicates that the species was more abundant in the shallow continental shelf in all years (Figure 61). In this depth stratum the distribution shows that most of the population size categories were sampled. When comparing, it can be observed that the size ranges and the mode were practically the same in all years sampled.

For monthly length-frequency distribution of spot-tail mantis shrimp at different depth strata in 2022 see (Annex 17).

The gonadal cycle of spot-tail mantis shrimp was analyzed monthly from 2019 to 2022 (Figure 62). The species showed a marked reproductive cycle with maturing and mature individuals during winter and spring, which is consistent with its described reproductive cycle. The spot-tailed mantis shrimp is a species with a short life cycle, in which adults die after spawning and, for this reason, only immature individuals were found after the reproductive peak during summer and autumn. This characteristic, together with a rapid growth, makes this species able to withstand the fishing pressure to which it is subjected.

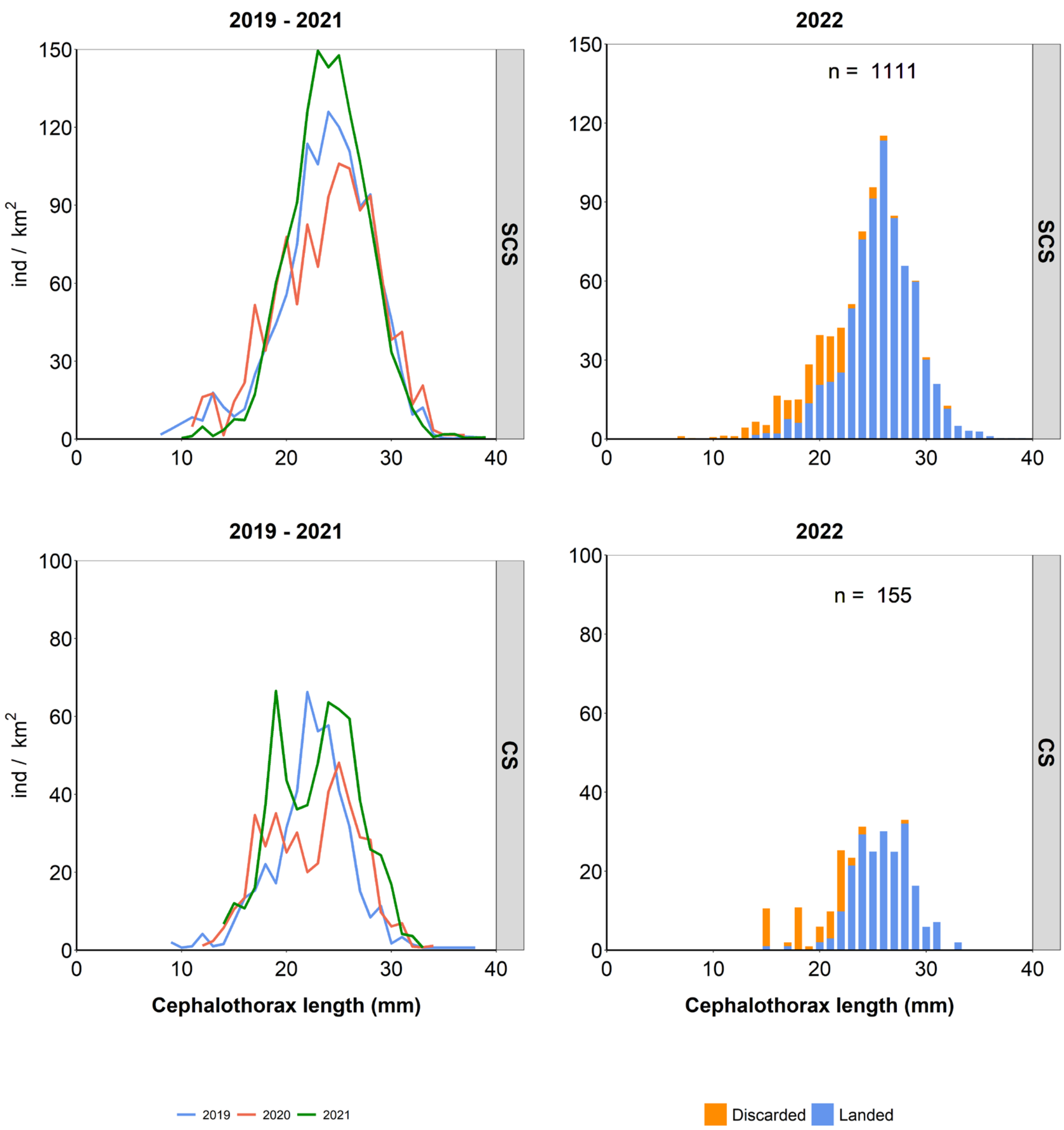

Figure 61. Annual length-frequency distribution of spot-tail mantis squillid at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals.

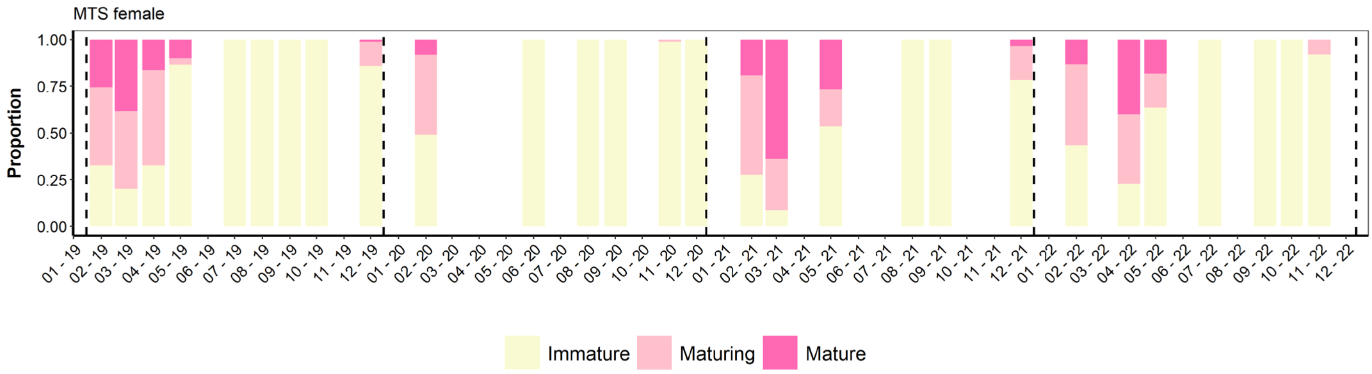

Figure 62 Spot-tail mantis squillid monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022.

Caramote prawn (*Penaeus kerathurus*) TGS

The total caramote prawn catch in Catalonia in 2022 was 63 t, 29% of which were caught by bottom trawling and 71% by artisanal fisheries (ICATMAR, 23-03).

Figure 63 and Figure 64 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast. A stable trend is observed over the years, with similar maximum annual landings.

All parameters analyzed in this report for caramote prawn were calculated using only individuals obtained by bottom trawling sampling (Table 15).

According to length-weight relationship parameters for both sexes combined and separately, caramote prawn displayed a negative allometric growth (b<3) in 2022 (Table 14). When comparing the growth curves for both sexes combined and separately from 2019 to 2022 (Figure 65), the results show similar trends with negative allometric growth in all cases. Sampling depths for this species ranged between 20 and 40 m, where individuals are adults and, as with other crustacean species, females are larger and heavier due to sexual dimorphism.

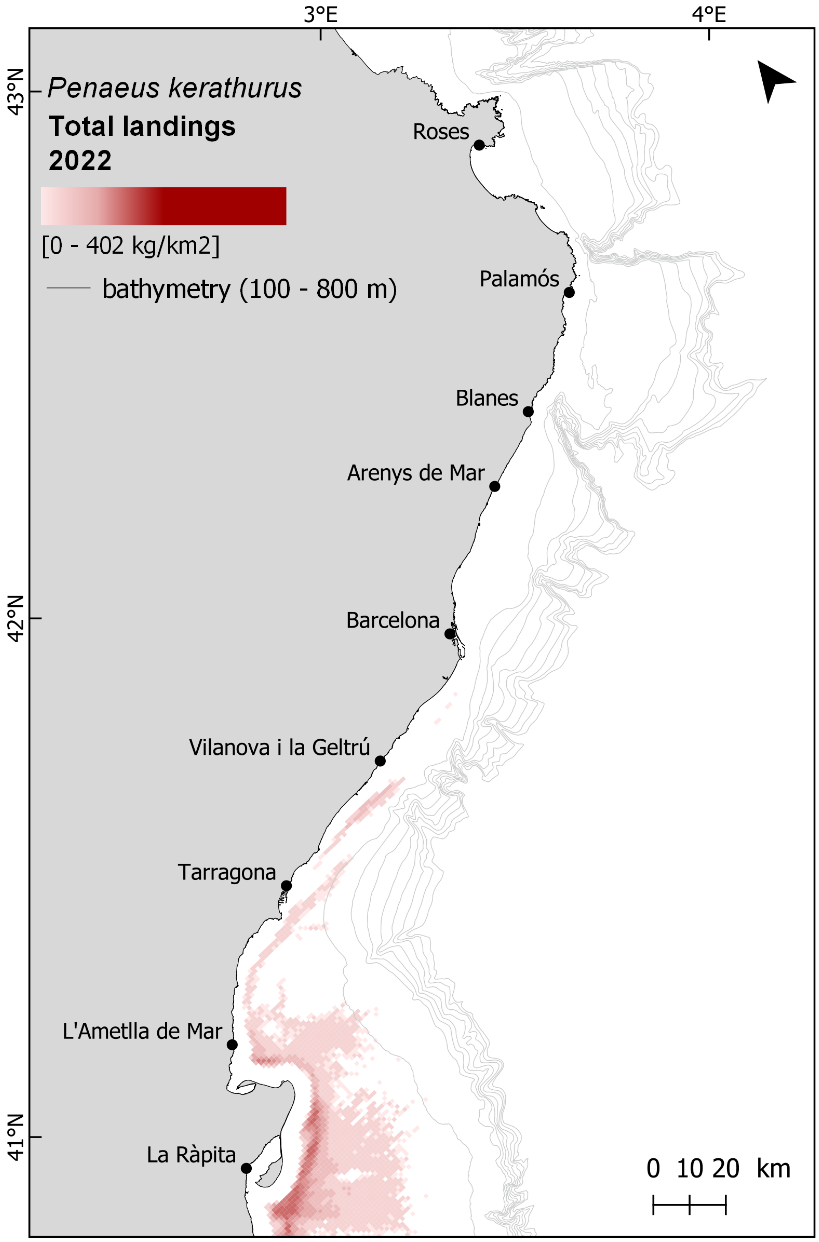

Figure 63. Spatial distribution of landings per unit of effort (LPUE) for caramote prawn in the Catalan fishing grounds (North GSA6) in 2022.

Table 14. Caramote prawn length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	a	b	r^2	n
Combined	0.0045	2.4205	0.97	198
Females	0.0048	2.4043	0.97	129
Males	0.0021	2.6515	0.96	69

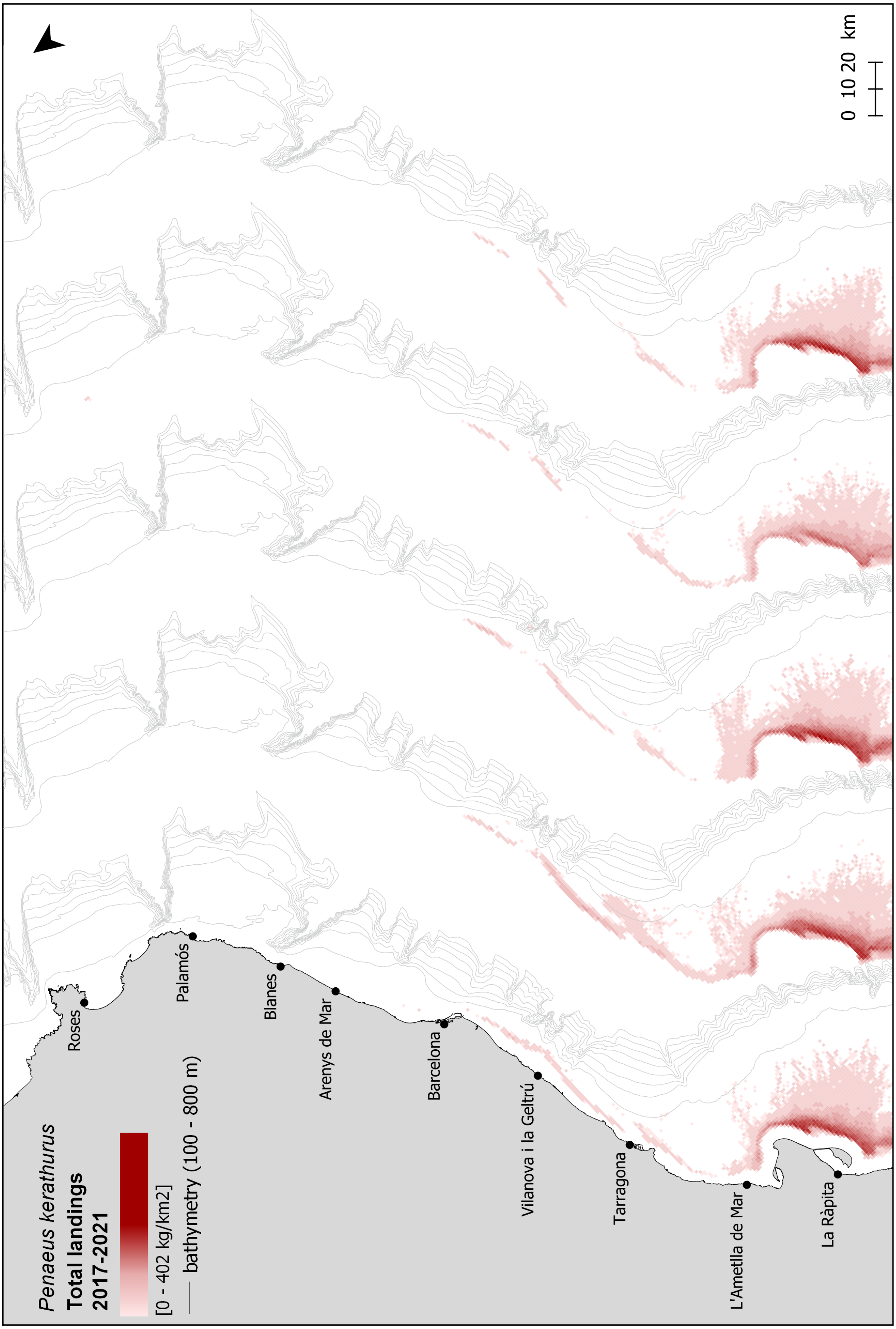

Figure 64. Spatial distribution of landings per unit of effort (LPUE) for caramote prawn in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

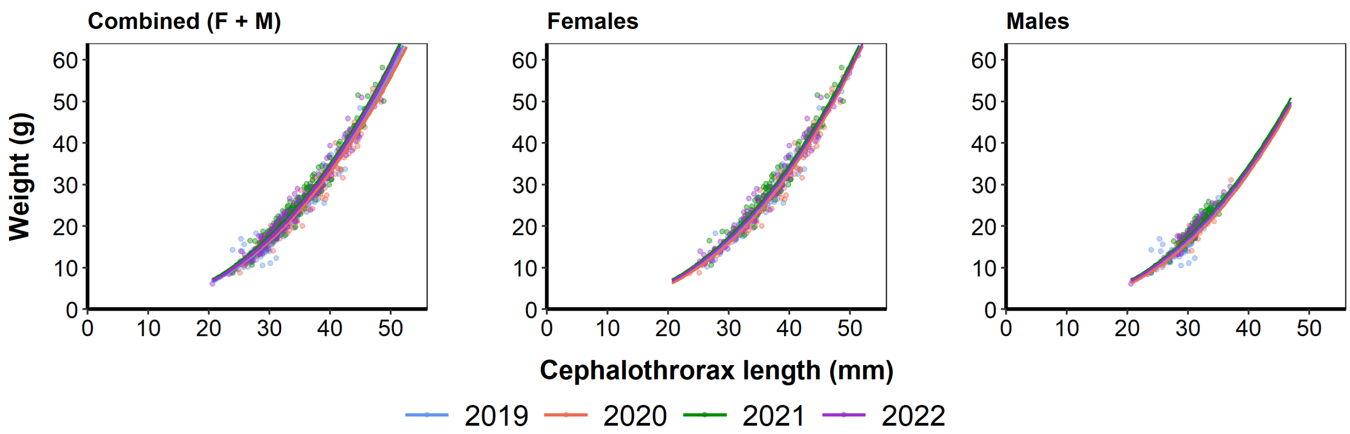

Figure 65. Caramote prawn length-weight relationship for the previous years sampled.

Table 15. Number of caramote prawn individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls
			Number individuals sampled				
Bottom trawl	2019	Center	0	0	1	0	1
Bottom trawl	2019	South	95	1	264	248	10
Bottom trawl	2020	South	1	0	155	179	7
Bottom trawl	2021	South	45	0	143	120	6
Bottom trawl	2022	South	39	2	121	361	6

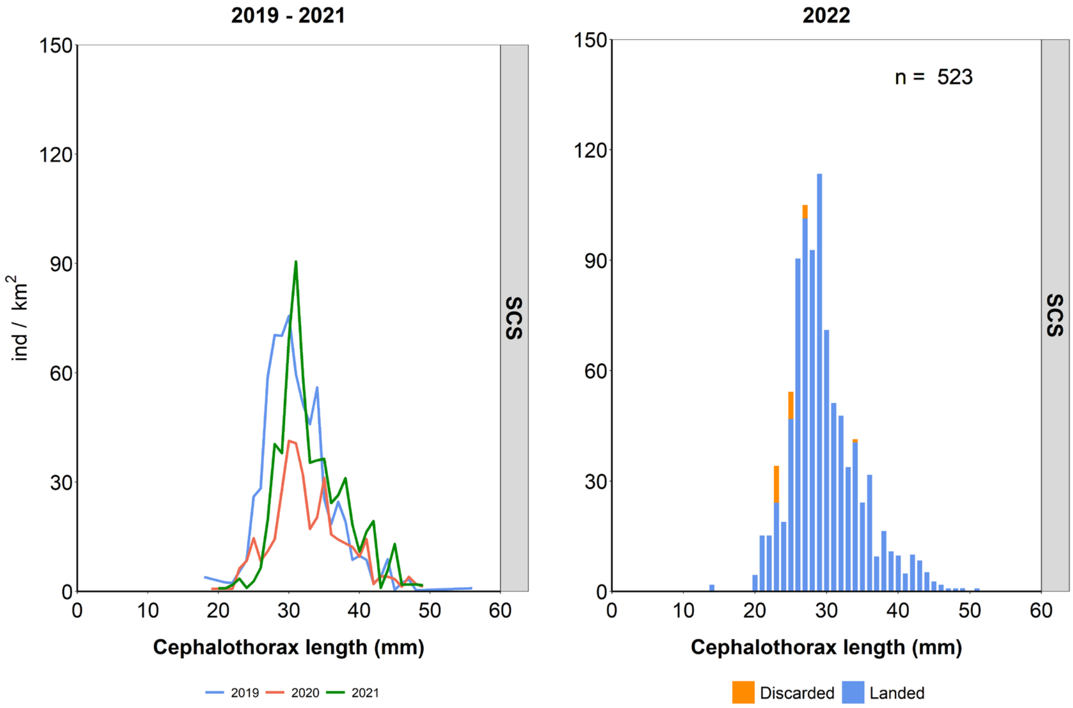

Figure 66. Annual length-frequency distribution of caramote prawn at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals.

The spatiotemporal length-frequency distribution of caramote prawn from 2019 to 2022 indicates that the size range of the species extended from 20 to 50 mm of CL in all years sampled, with the mode located at around 30 mm of CL (Figure 66). Smaller individuals of this species are found close to the river mouth at shallower depths (<20 m), in a bathymetry not covered by this sampling design.

The reproductive cycle of caramote prawn was not analyzed because mature individuals move to shallower depths prior to spawning (between April and August) to a bathymetry not covered by this sampling design.

Bottom trawling by port

In this section, the sampling hauls carried out in 2022 are shown for each zone. In addition, within each zone, the catch composition, landed species with higher biomass, discarded species with higher biomass, categories of natural debris with higher biomass and categories of marine litter with higher biomass are shown for each depth interval in the ports where bottom trawling samplings were conducted in the period 2019-2021 and in 2022.

North Zone

North zone: Figure 67.

Roses: Figure 68, Figure 69, Figure 70, Figure 71 and Figure 72.

Palamós: Figure 73, Figure 74, Figure 75, Figure 76 and Figure 77.

Blanes: Figure 78, Figure 79, Figure 80, Figure 81 and Figure 82.

Arenys de Mar: Figure 83, Figure 84, Figure 85, Figure 86 and Figure 87.

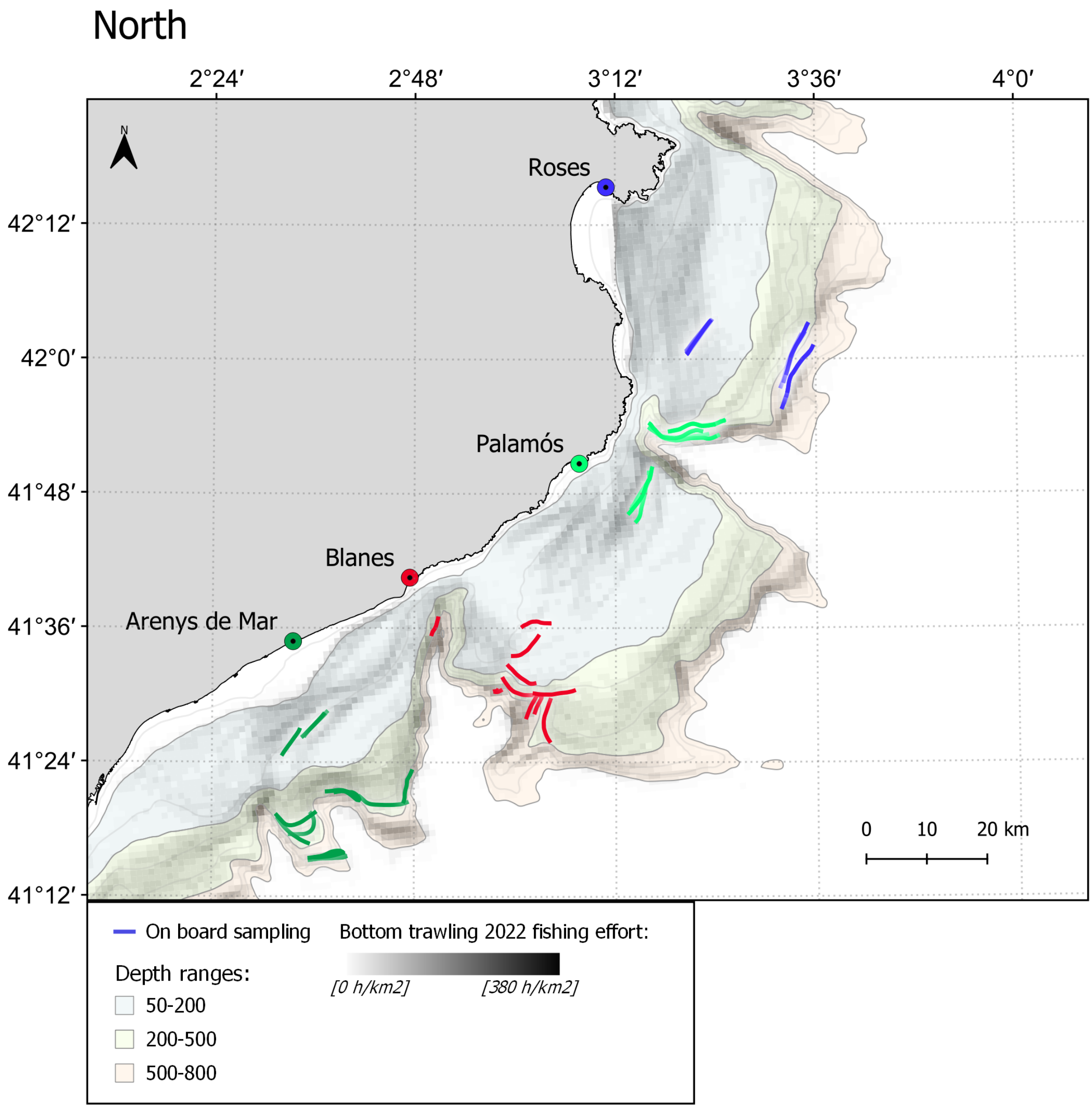

Figure 67. Noth zone sampling hauls in 2022.

Roses

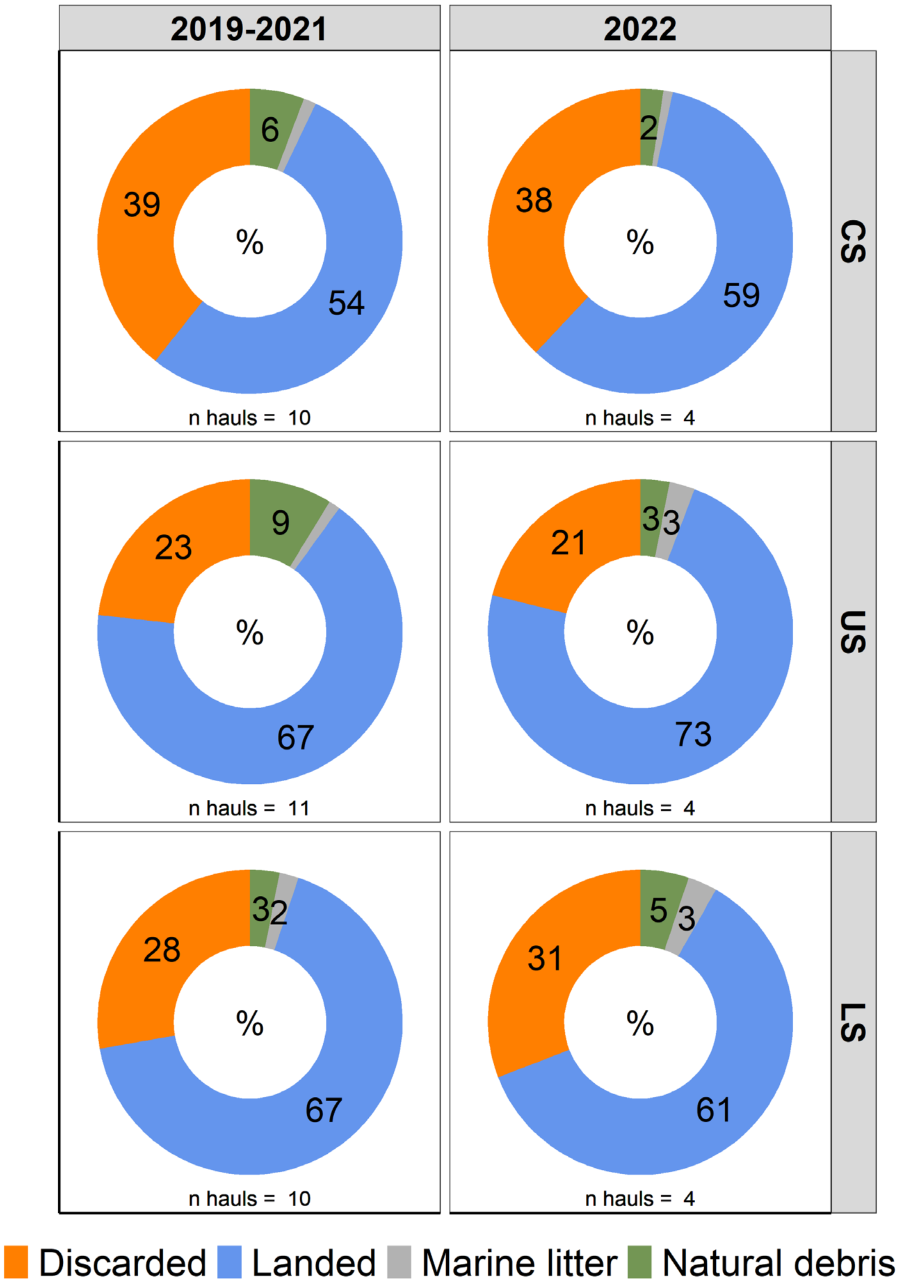

Figure 68. Roses catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

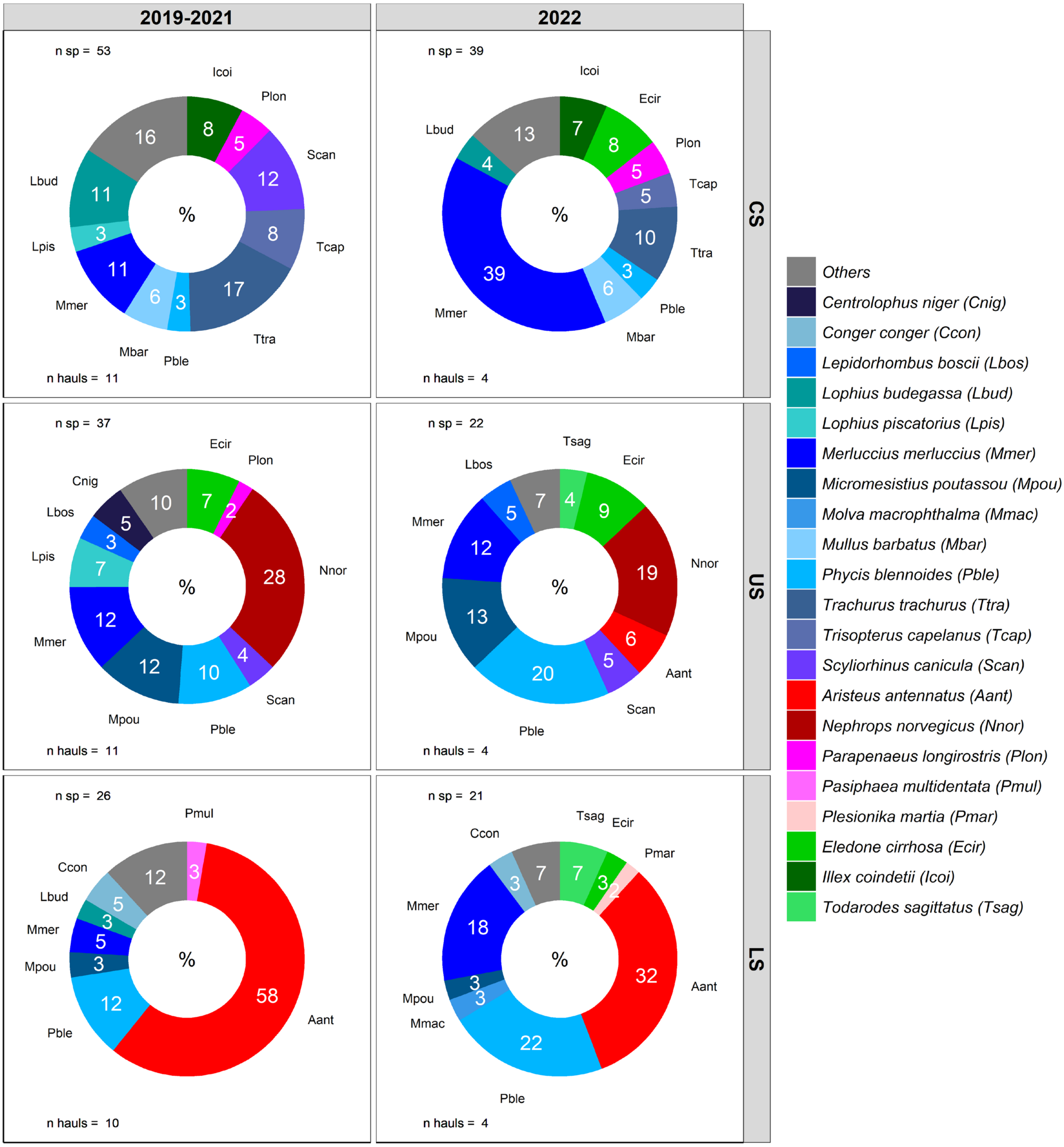

Figure 69. Roses landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

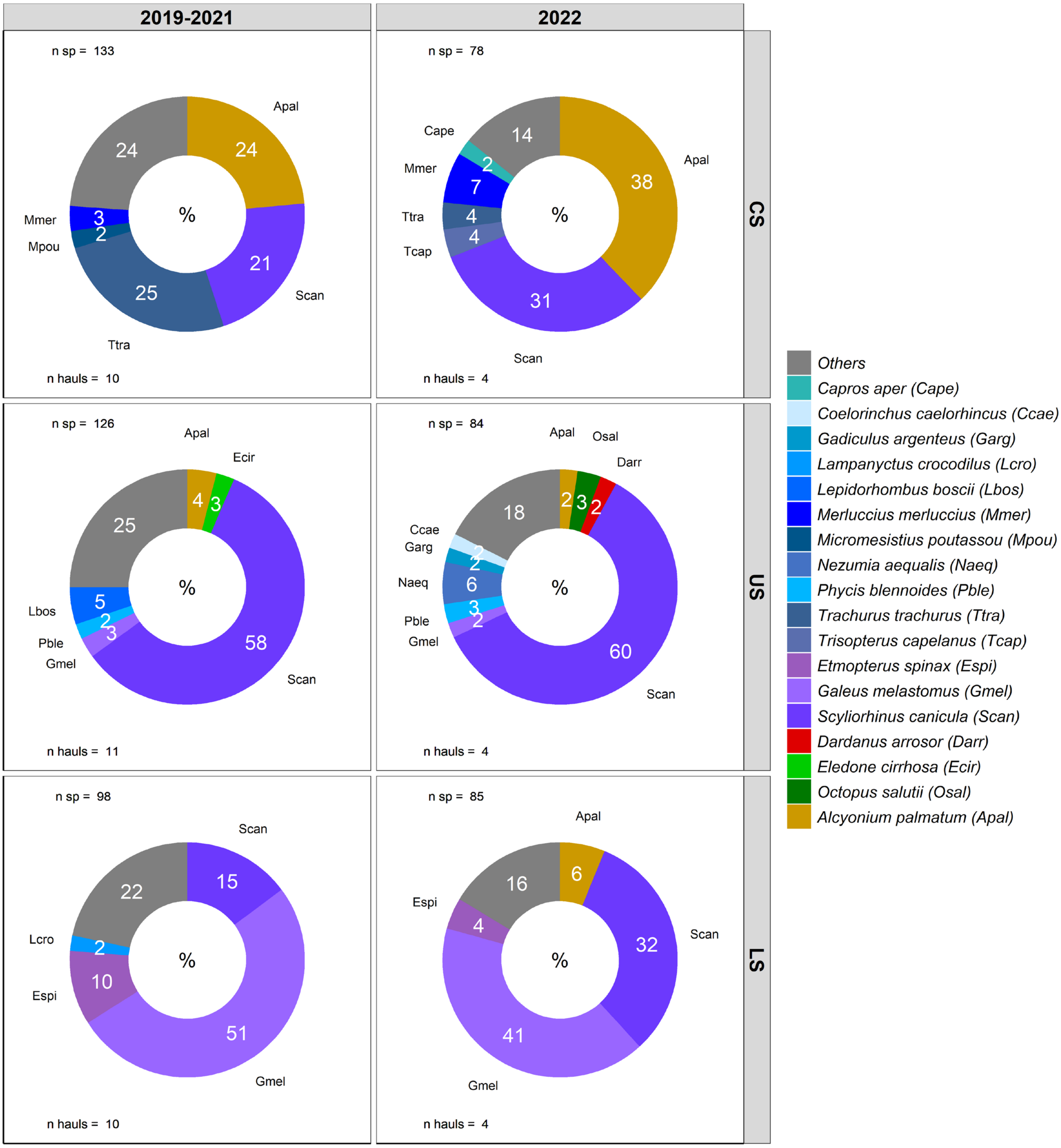

Figure 70. Roses discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 71. Roses categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

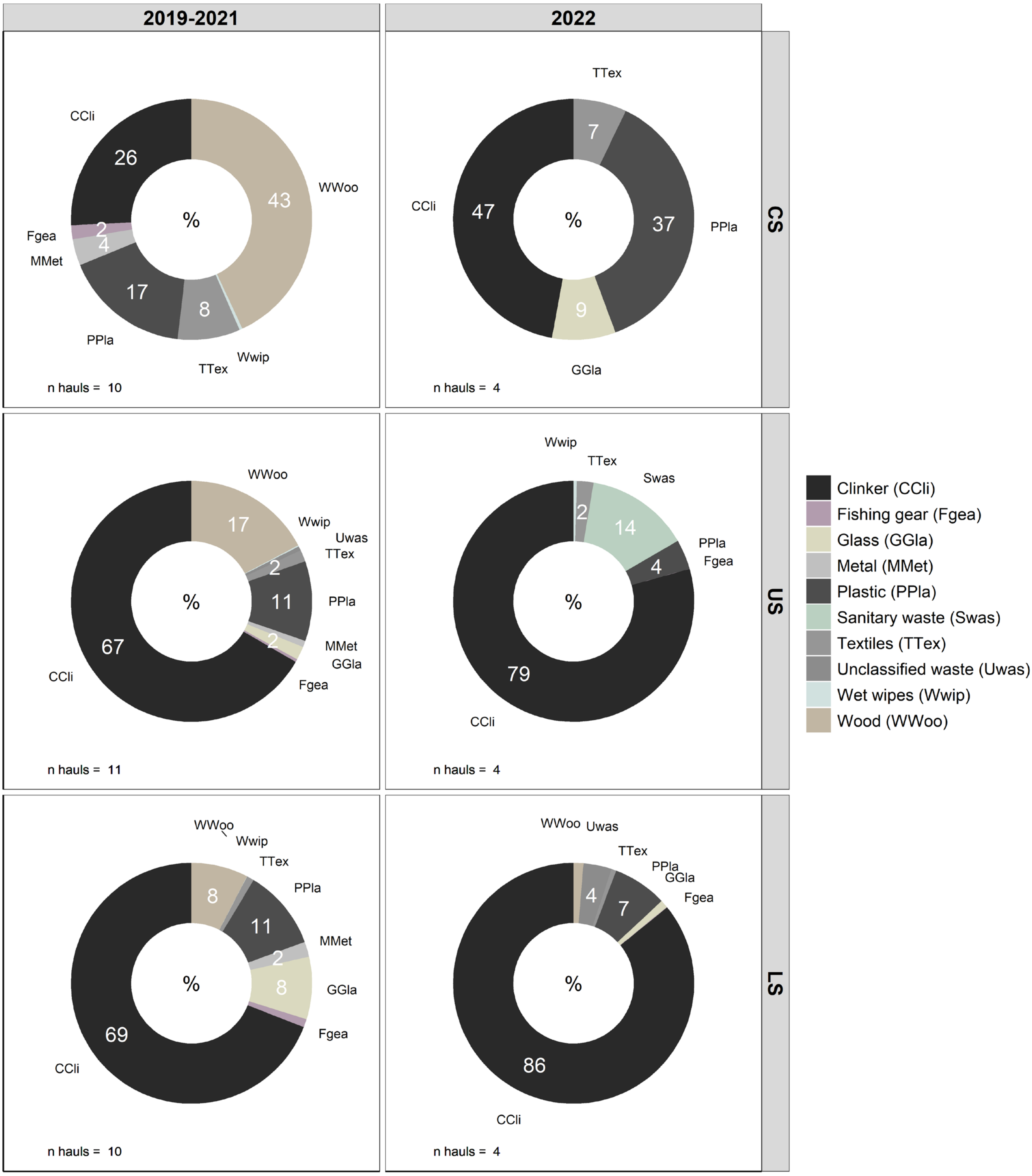

Figure 72. Roses categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Palamós

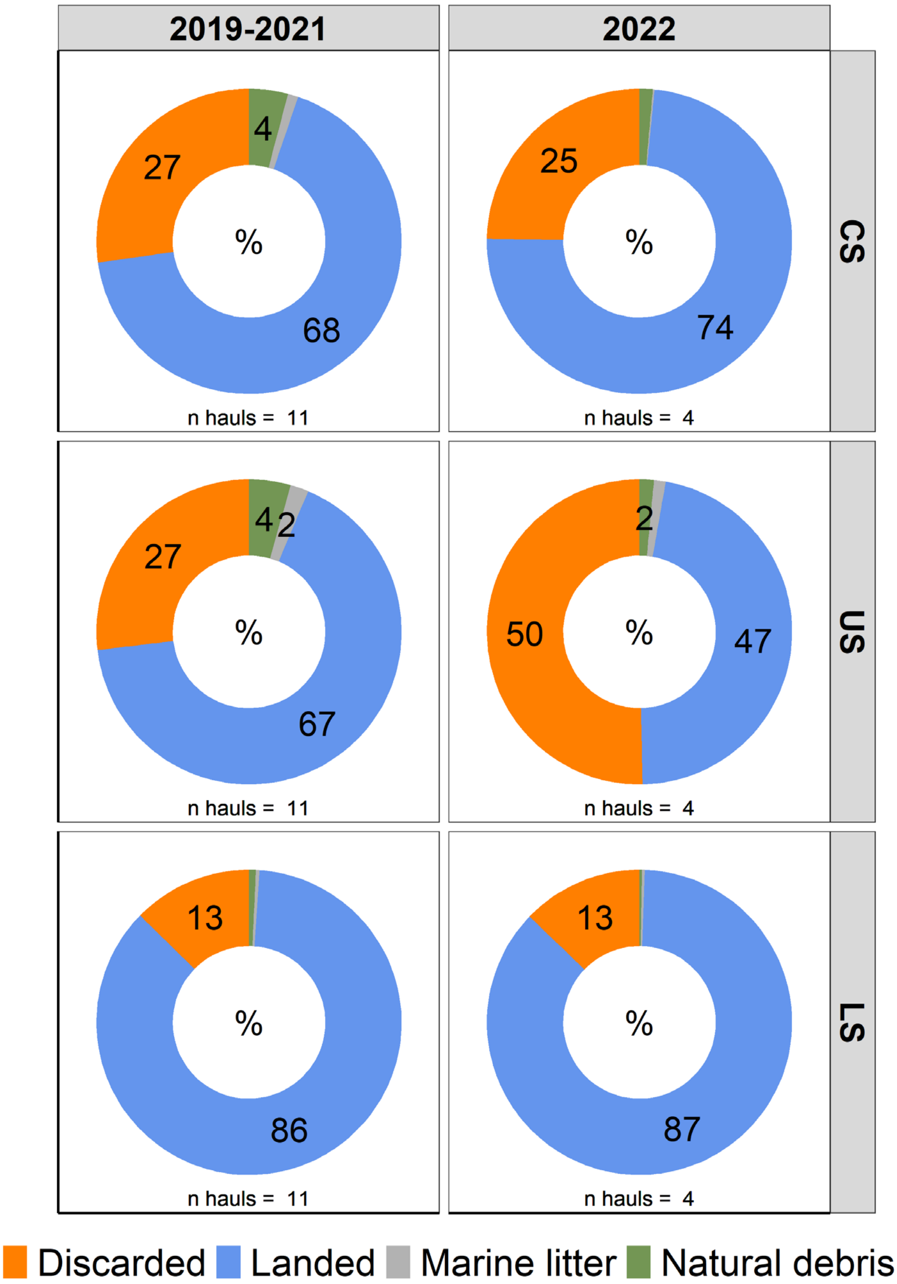

Figure 73. Palamós catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

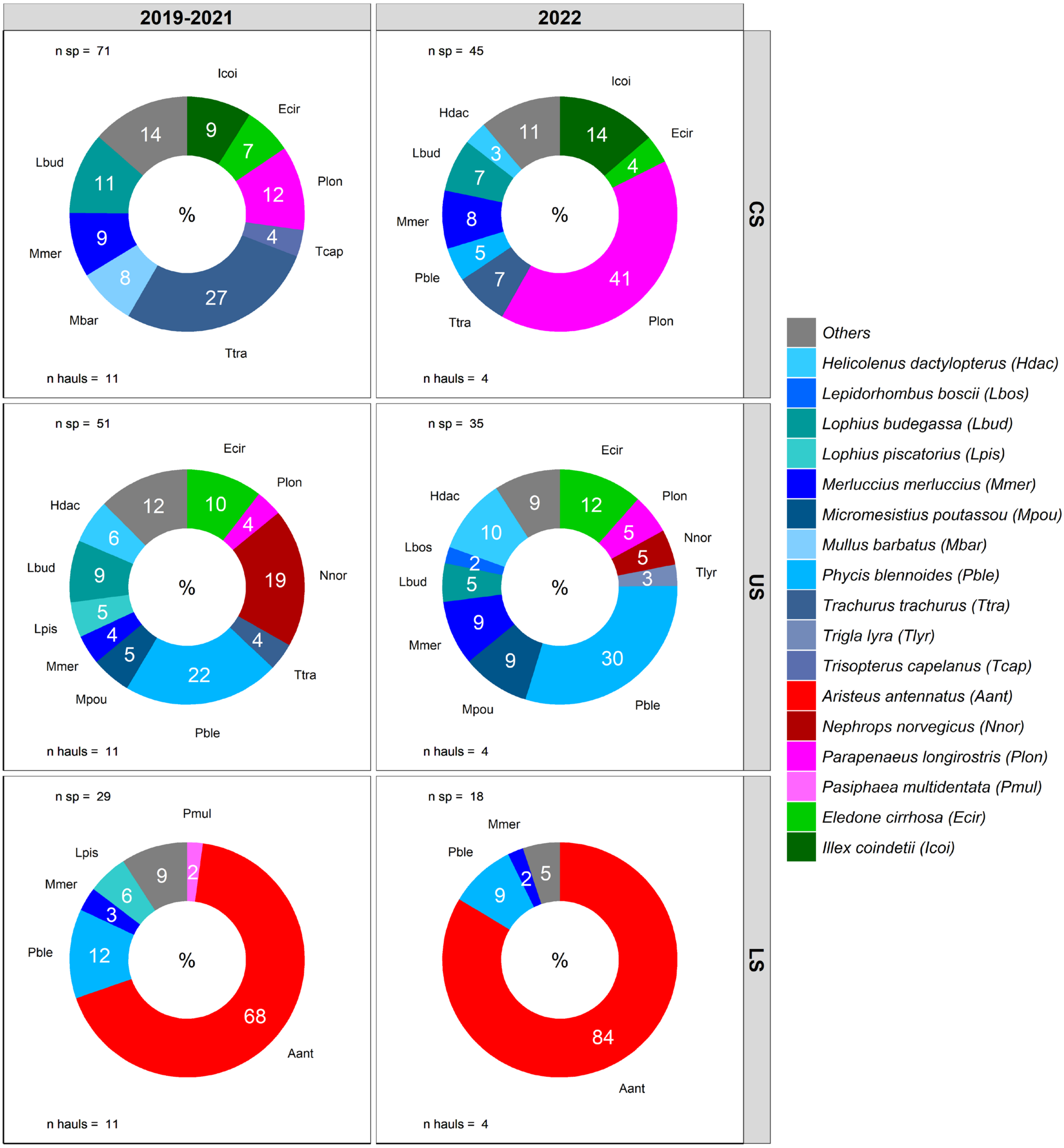

Figure 74. Palamós landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

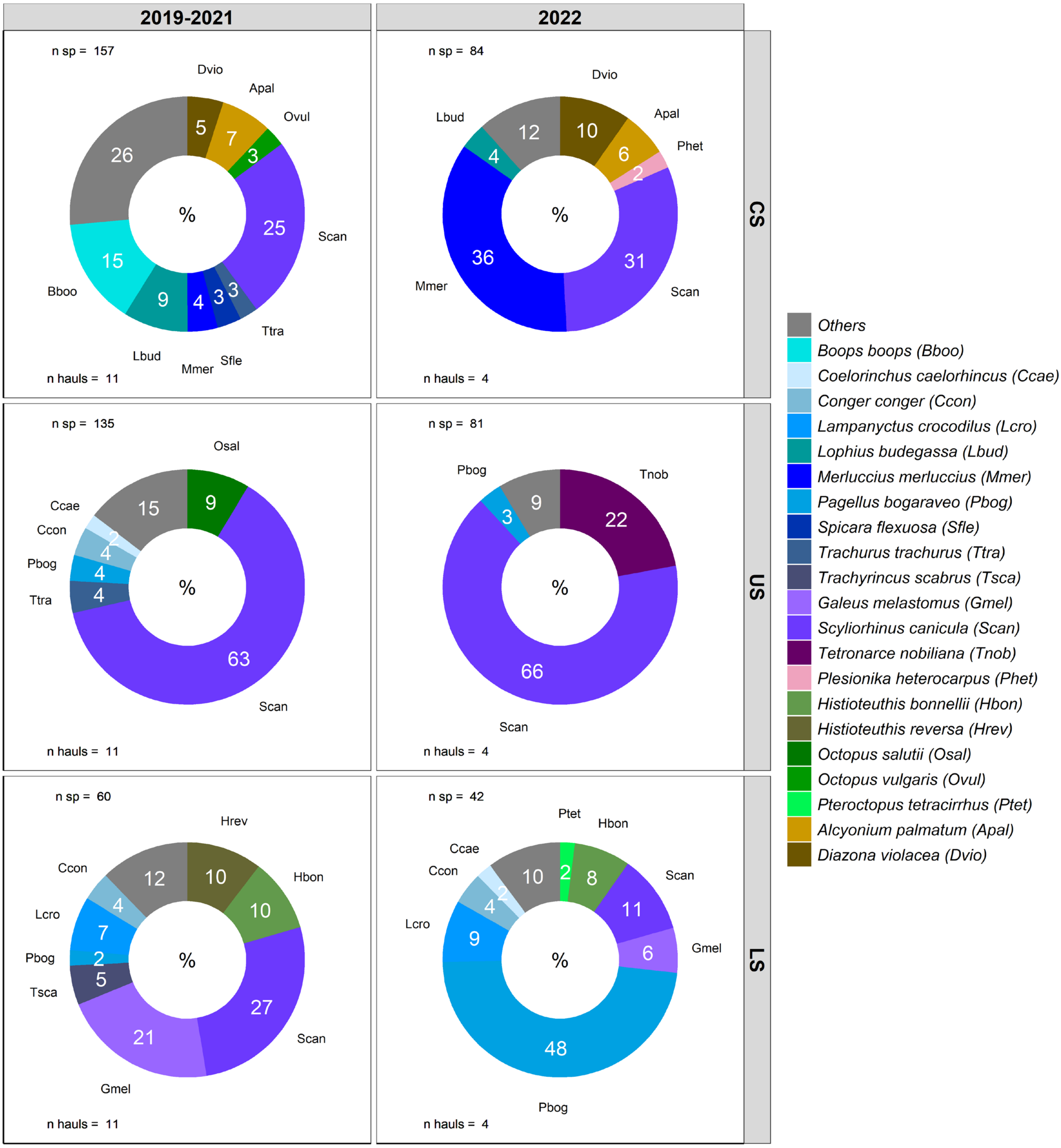

Figure 75. Palamós discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

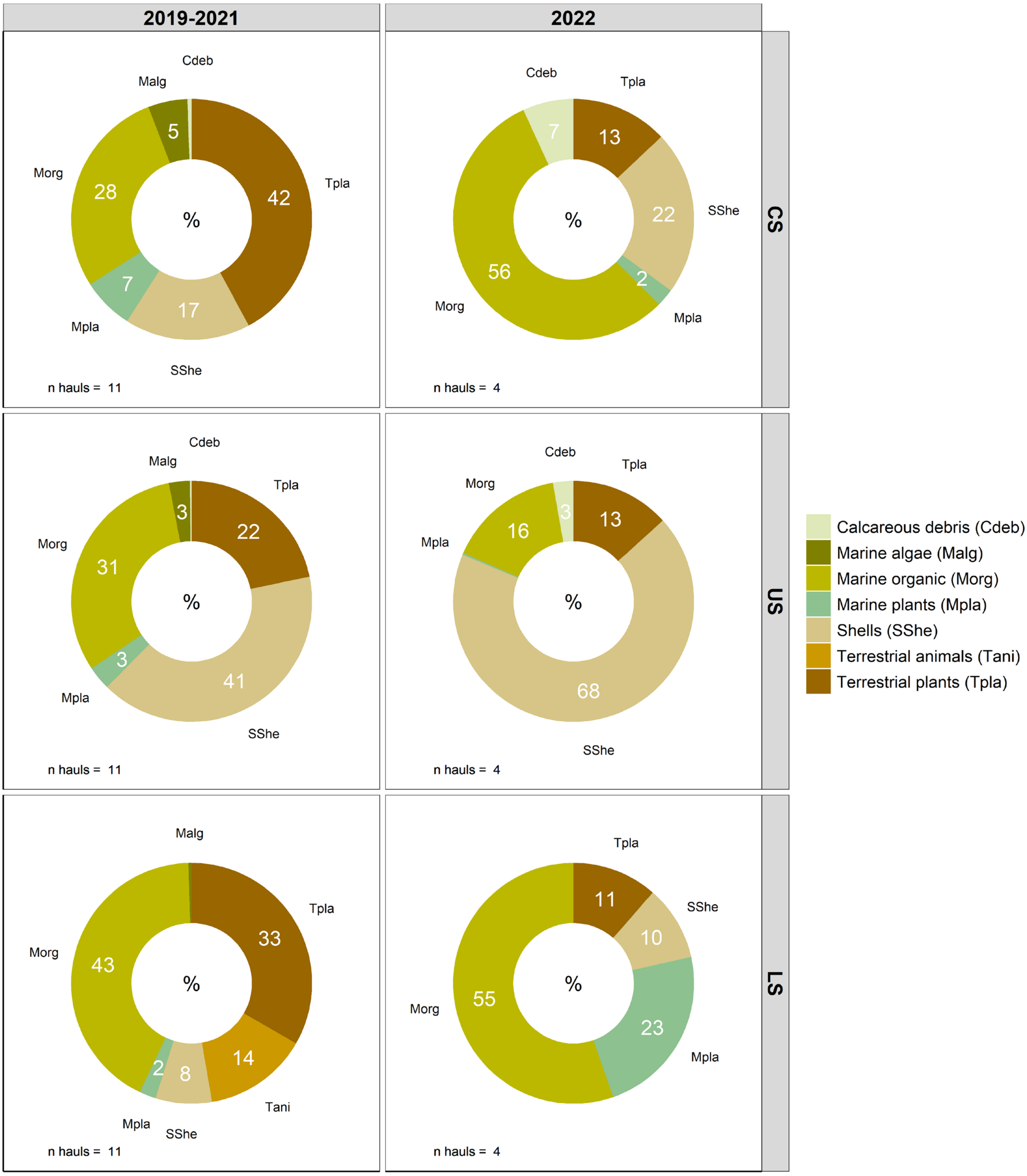

Figure 76. Palamós categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

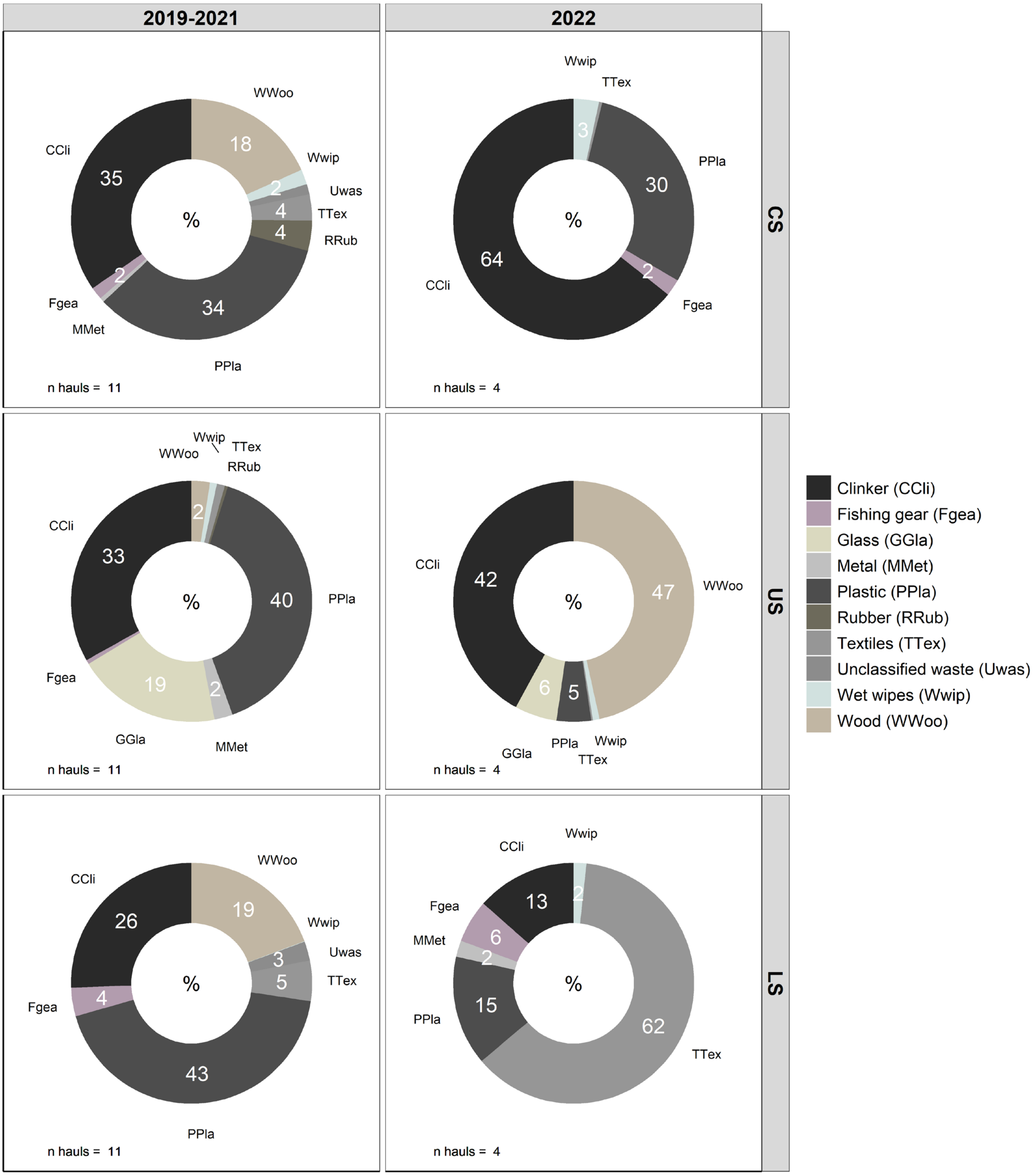

Figure 77. Palamós categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Blanes

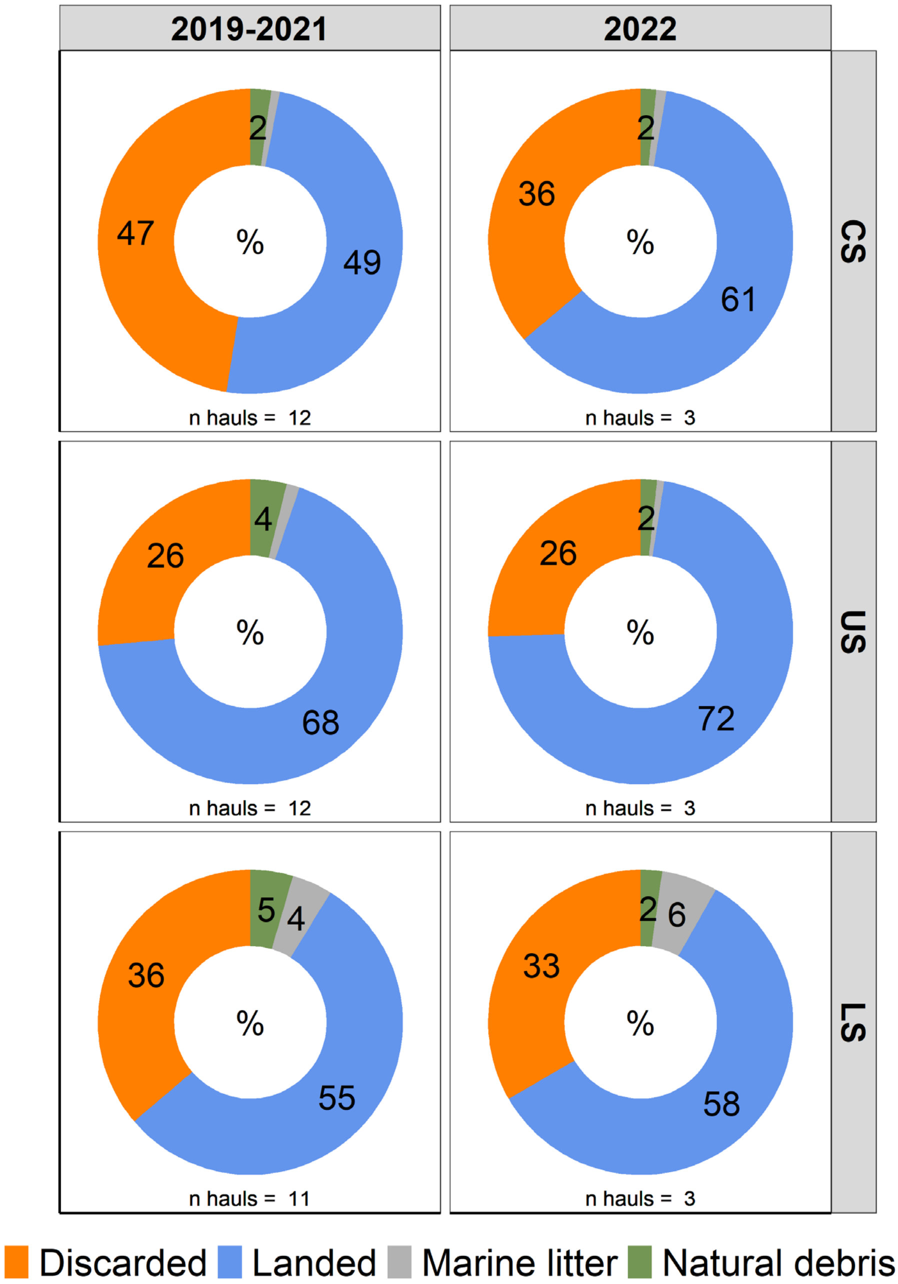

Figure 78. Blanes catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 79. Blanes landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

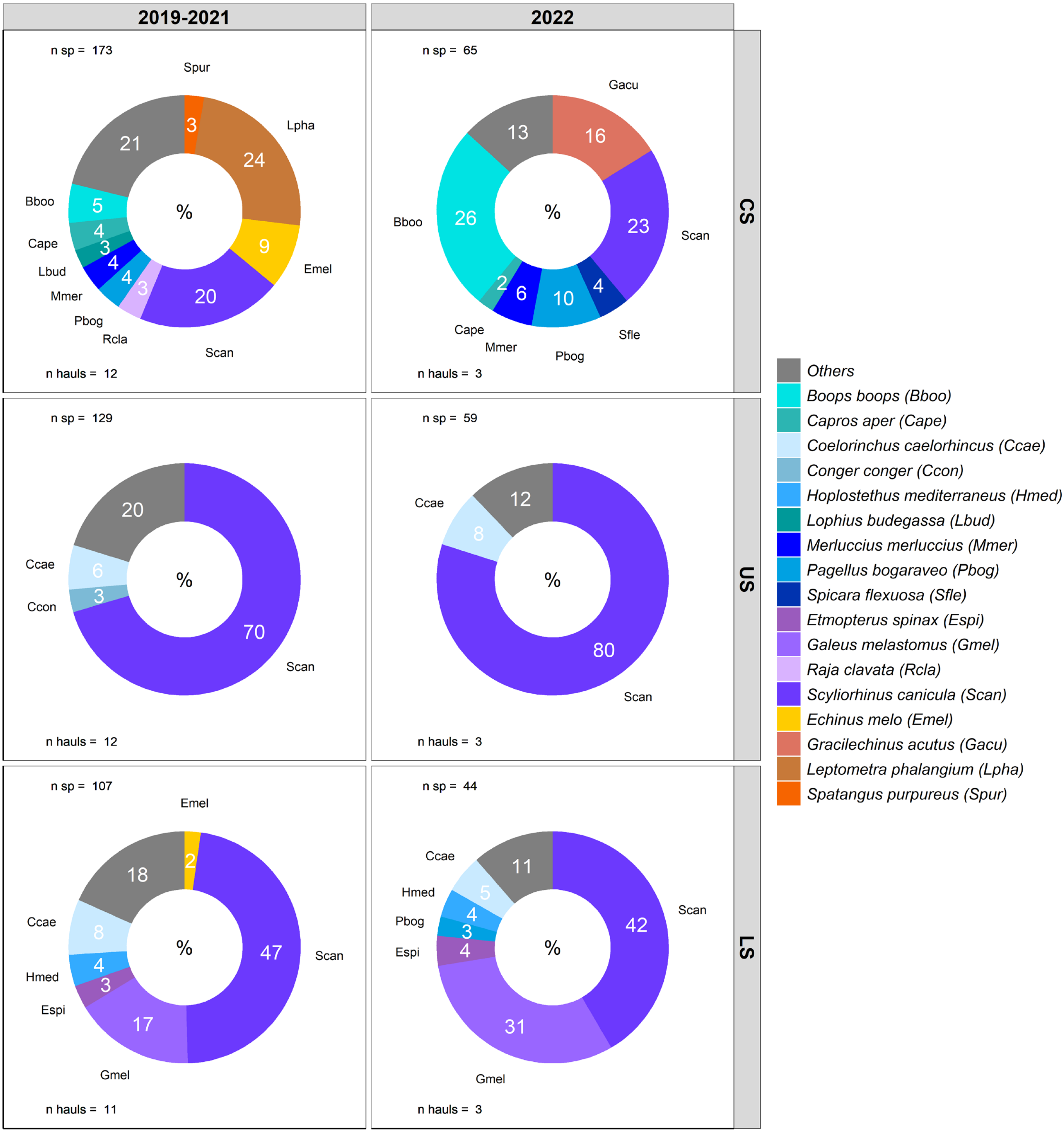

Figure 80. Blanes discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

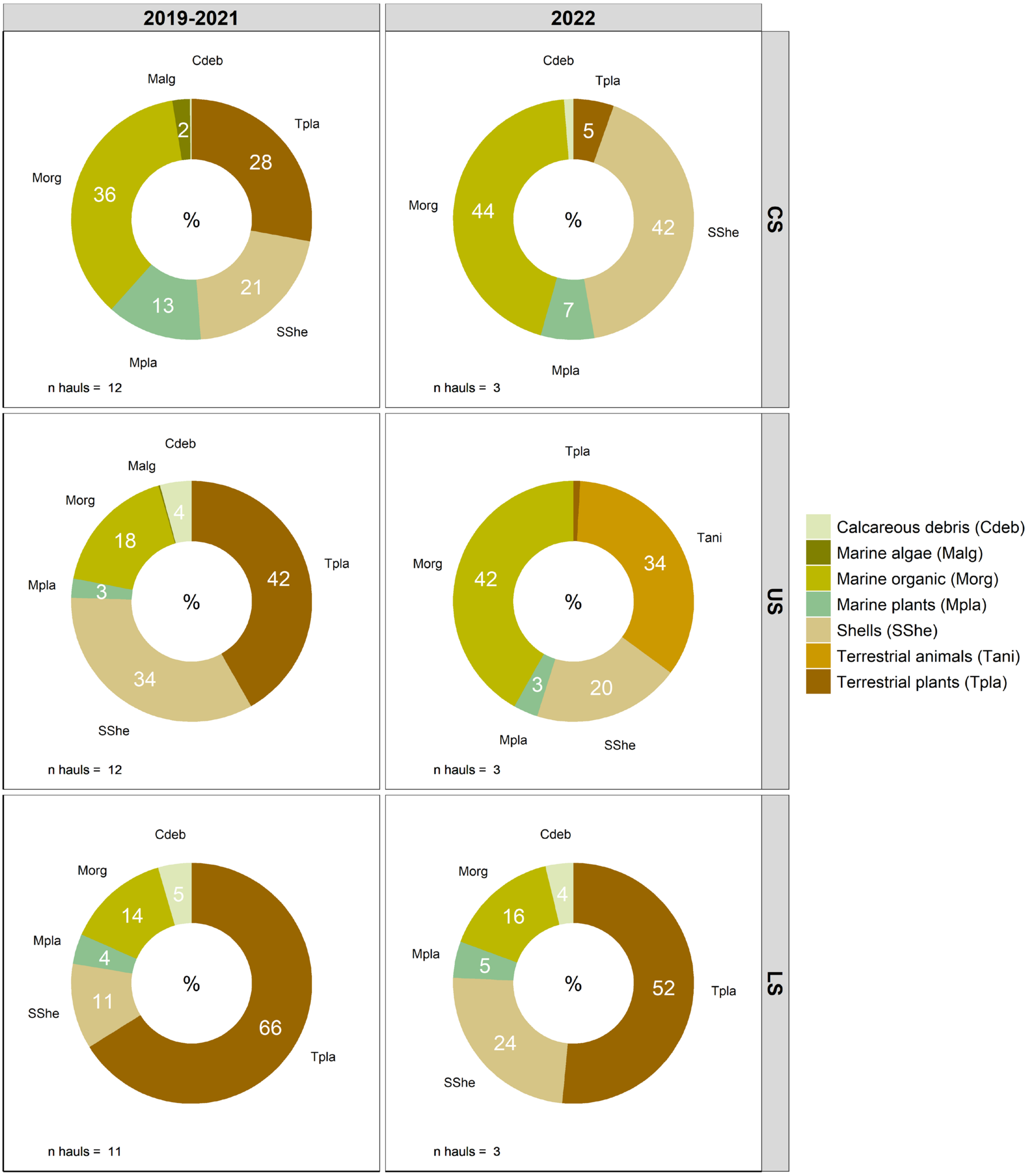

Figure 81. Blanes categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

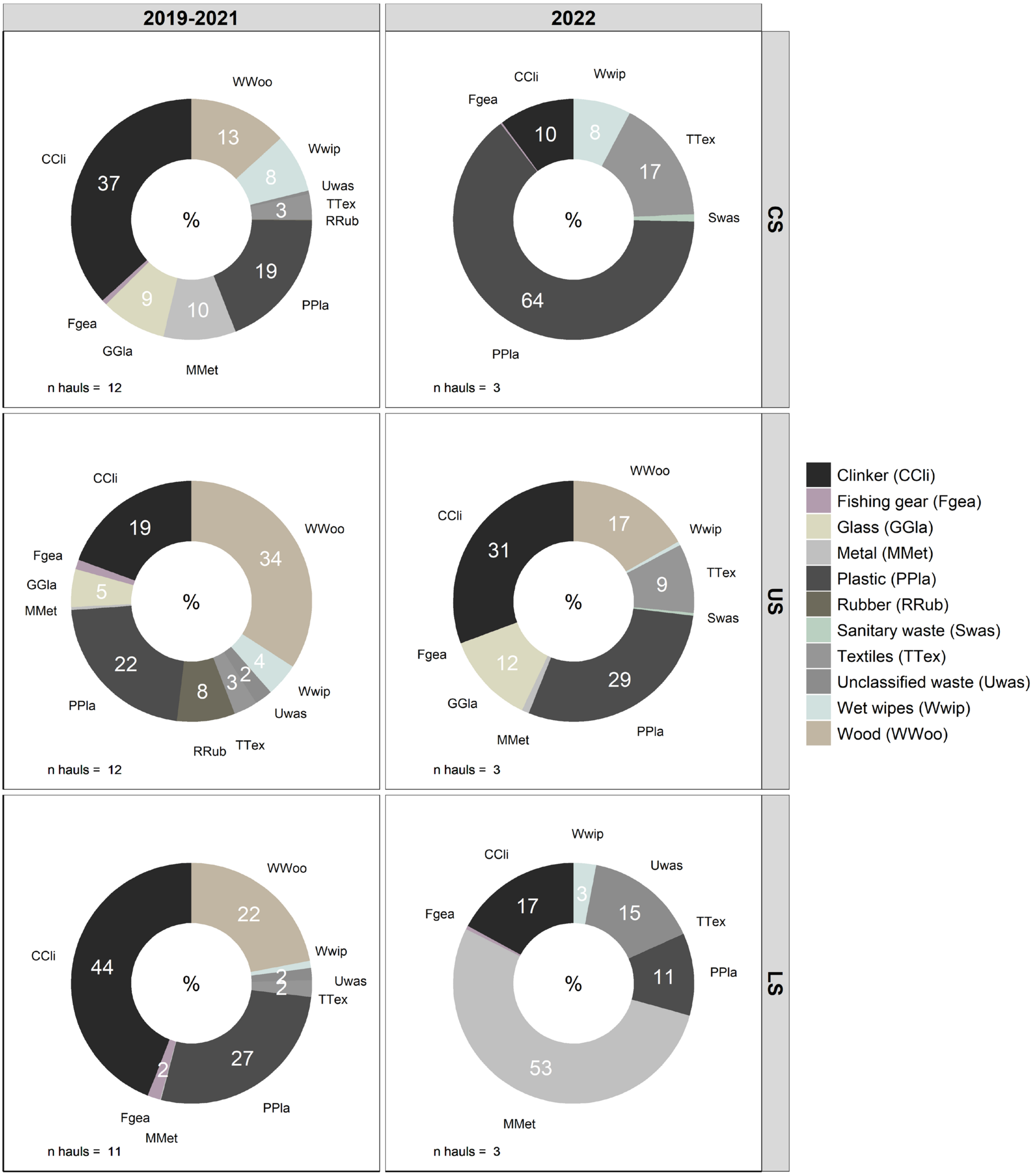

Figure 82. Blanes categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Arenys de Mar

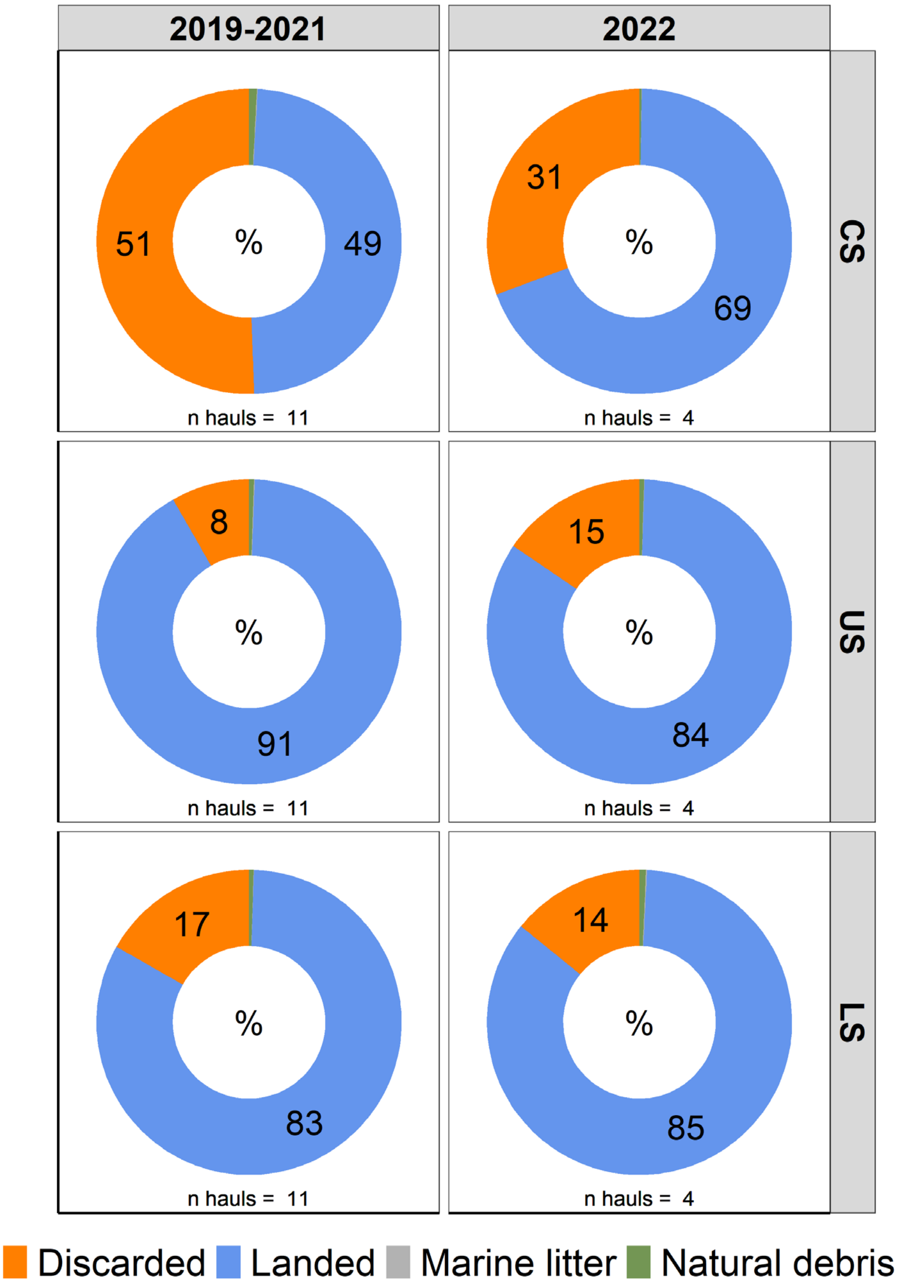

Figure 83. Arenys de Mar catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

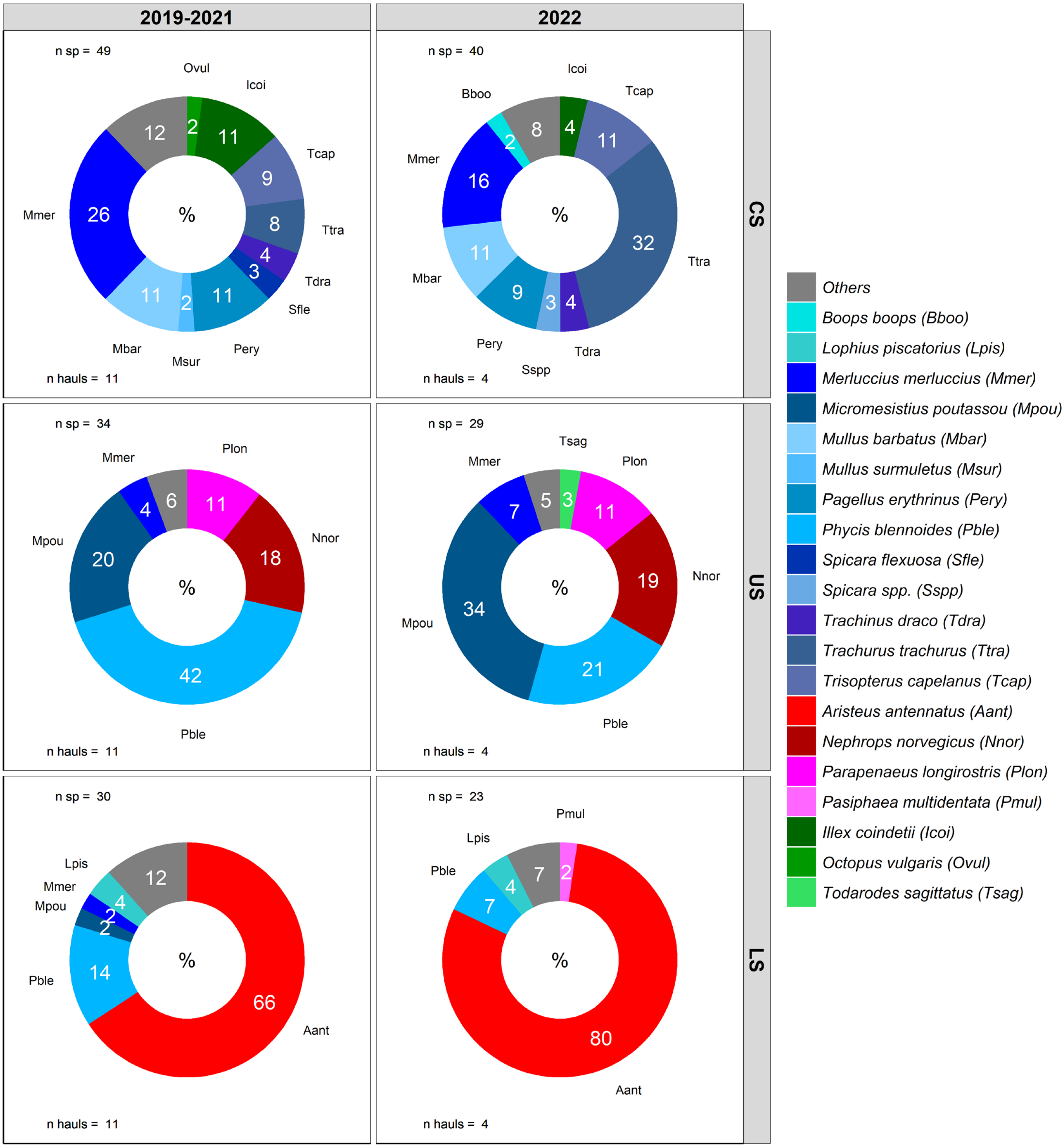

Figure 84. Arenys de Mar landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

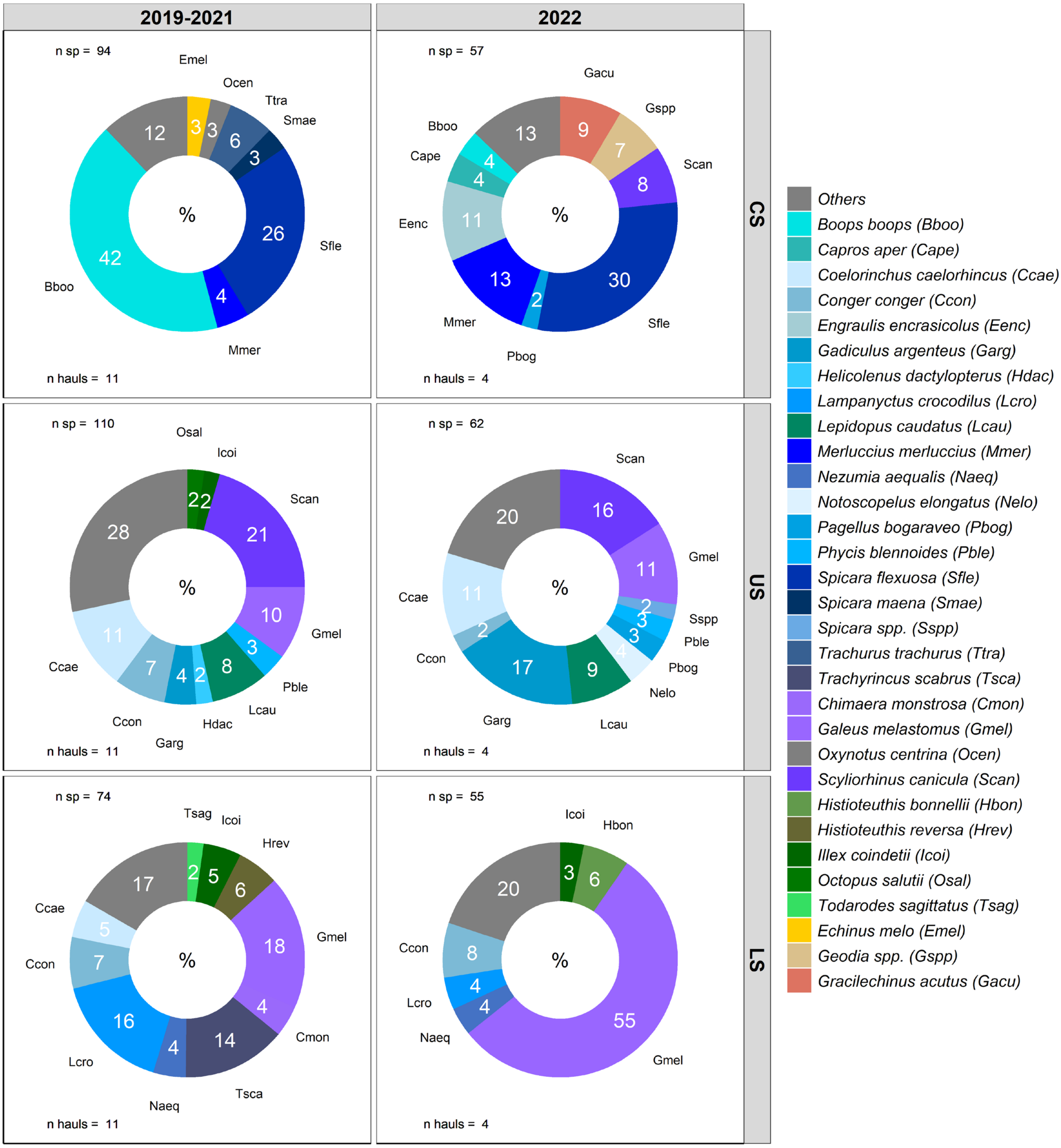

Figure 85. Arenys de Mar discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 86. Arenys de Mar categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

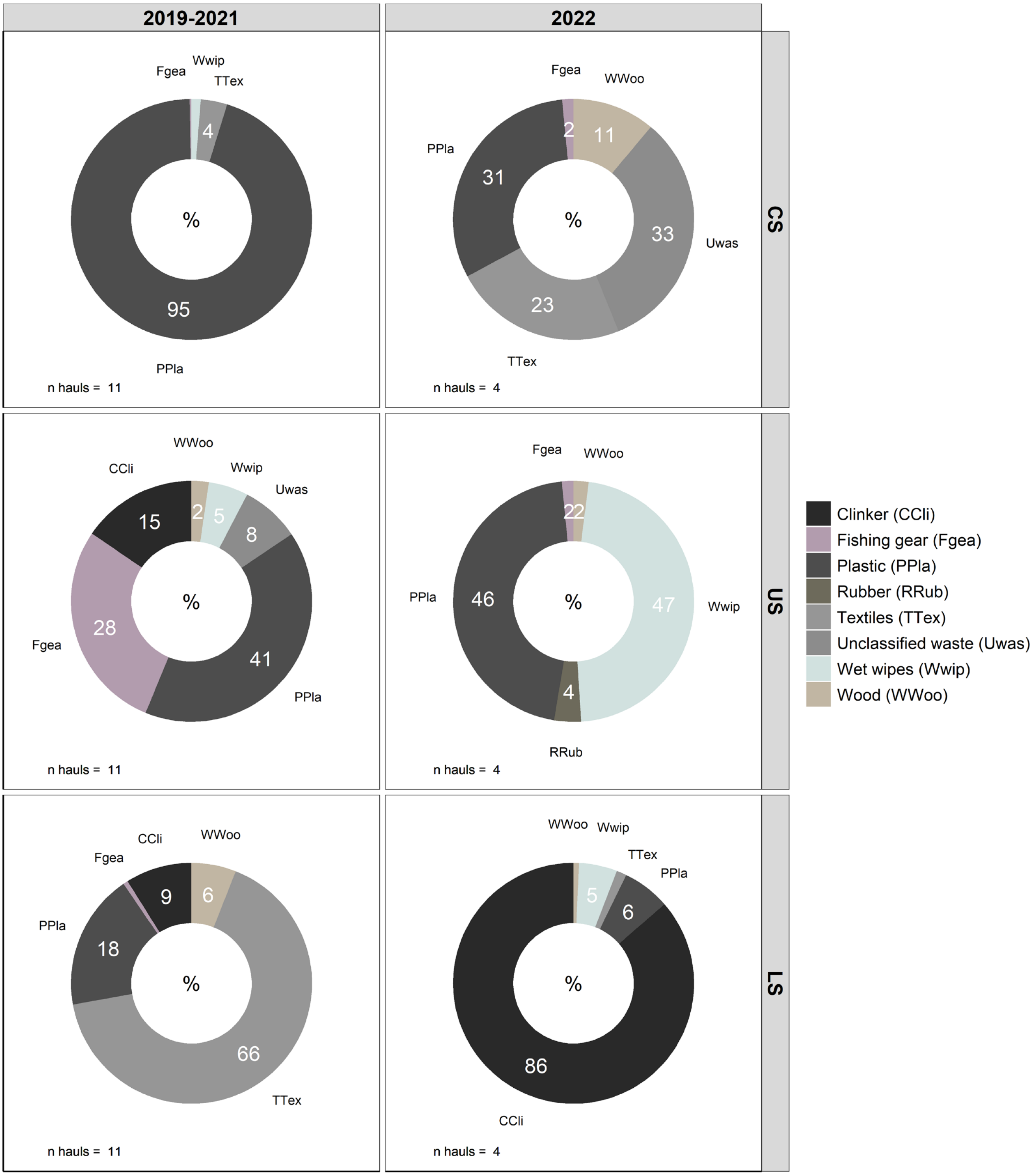

Figure 87. Arenys de Mar categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Center Zone

Center zone: Figure 88.

Barcelona: Figure 89, Figure 90, Figure 91, Figure 92 and Figure 93.

Vilanova i la Geltrú: Figure 94, Figure 95, Figure 96, Figure 97 and Figure 98.

Tarragona: Figure 99, Figure 100, Figure 101, Figure 102 and Figure 103.

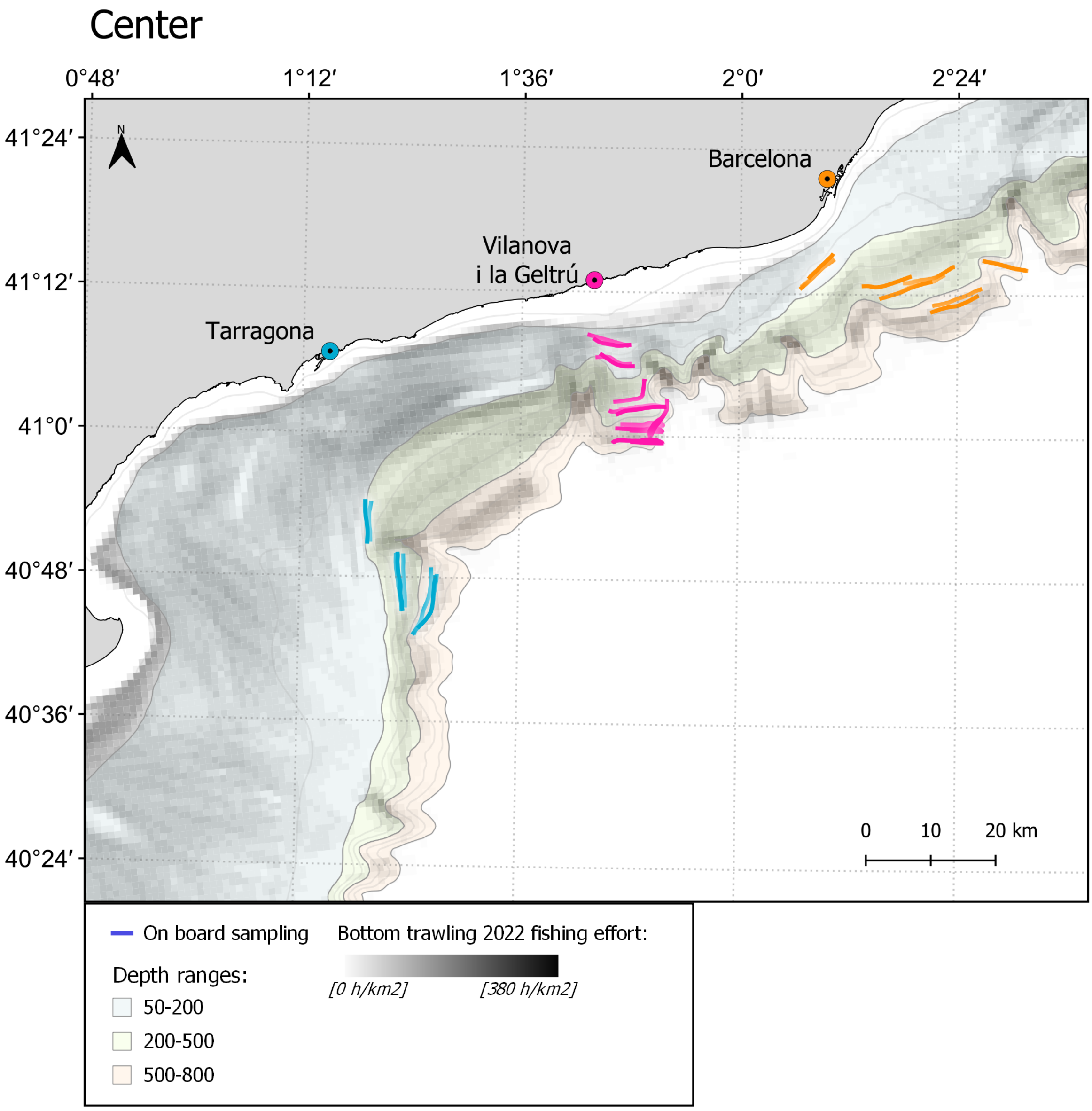

Figure 88. Center zone samplig hauls in 2022.

Barcelona

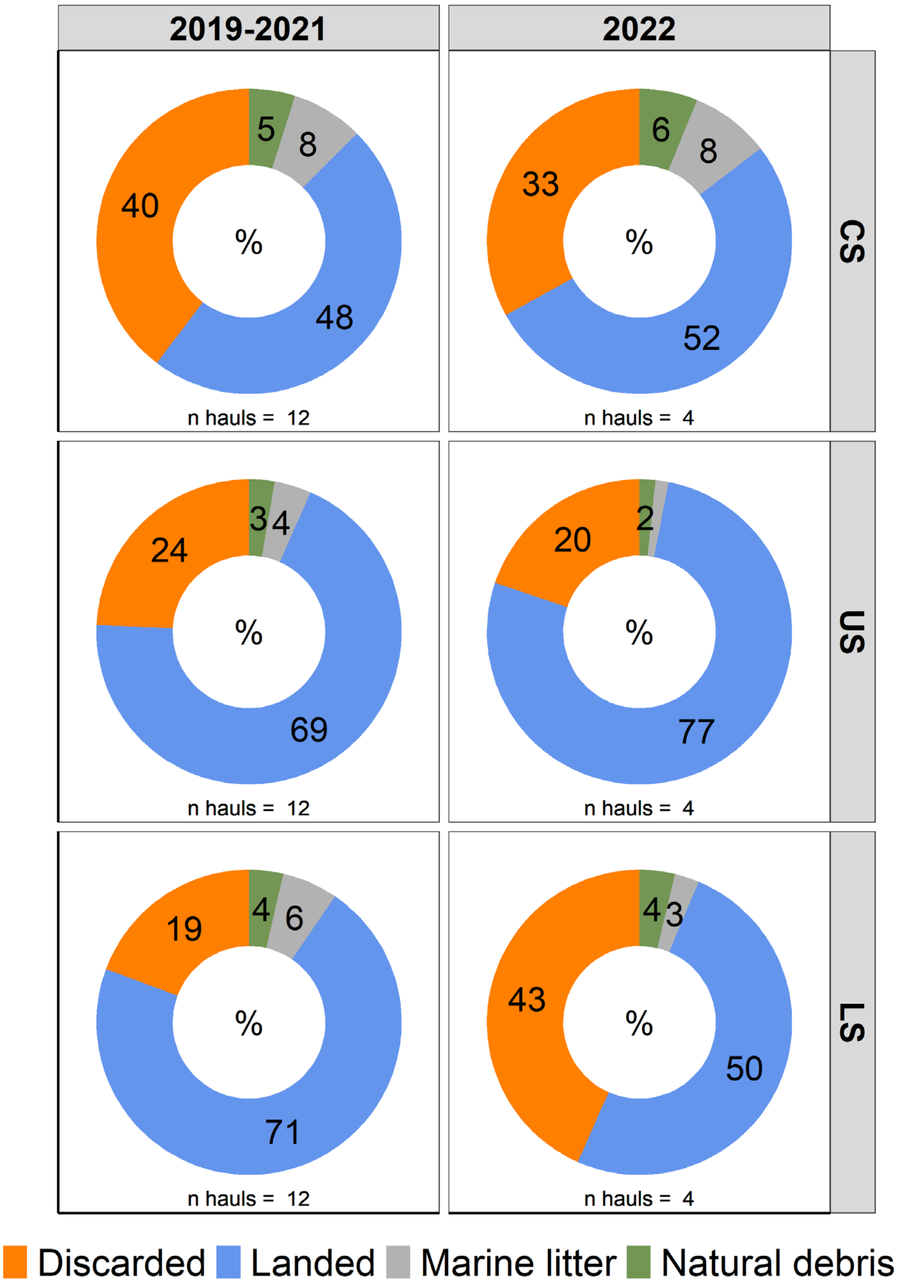

Figure 89. Barcelona catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

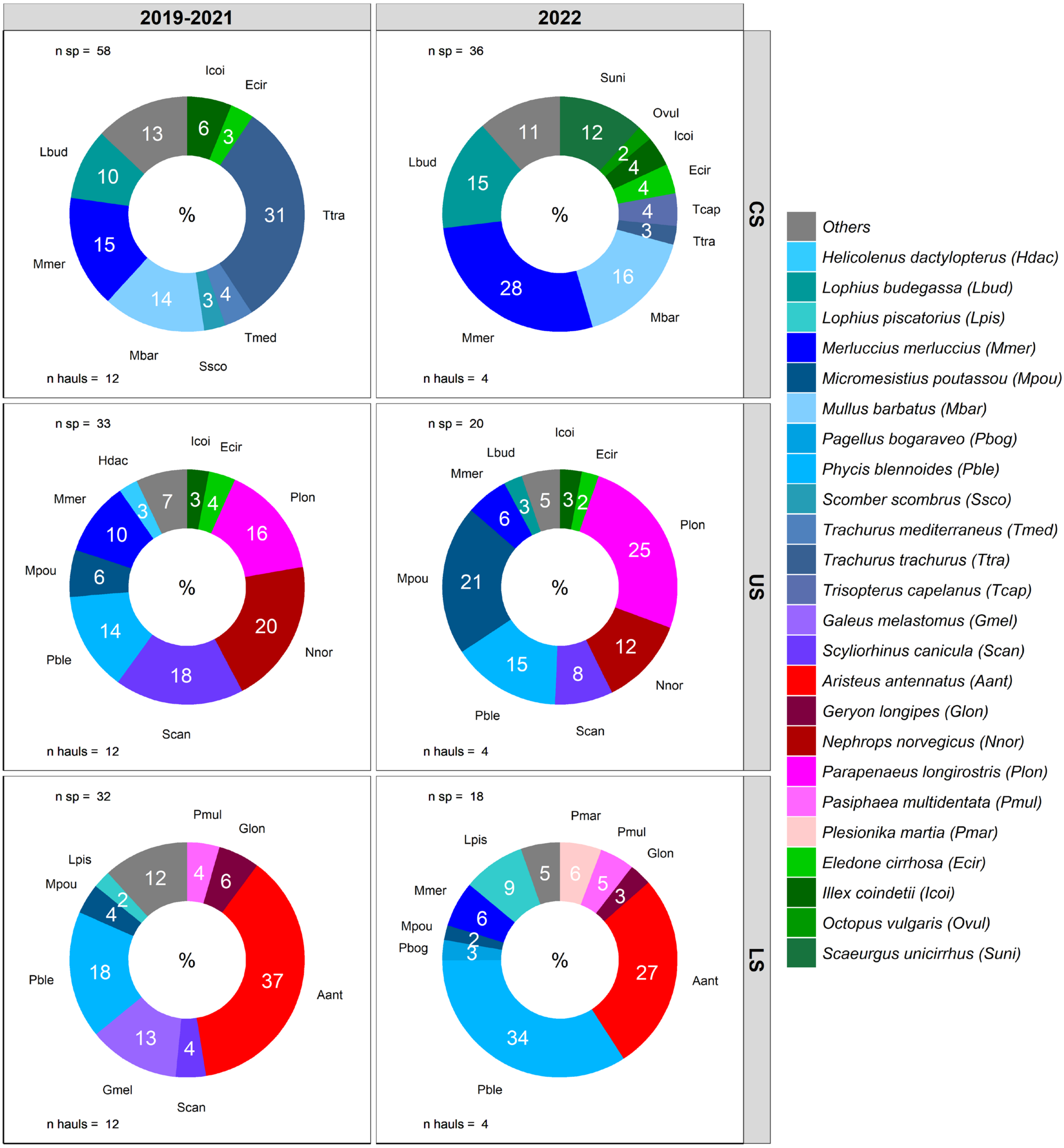

Figure 90. Barcelona landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

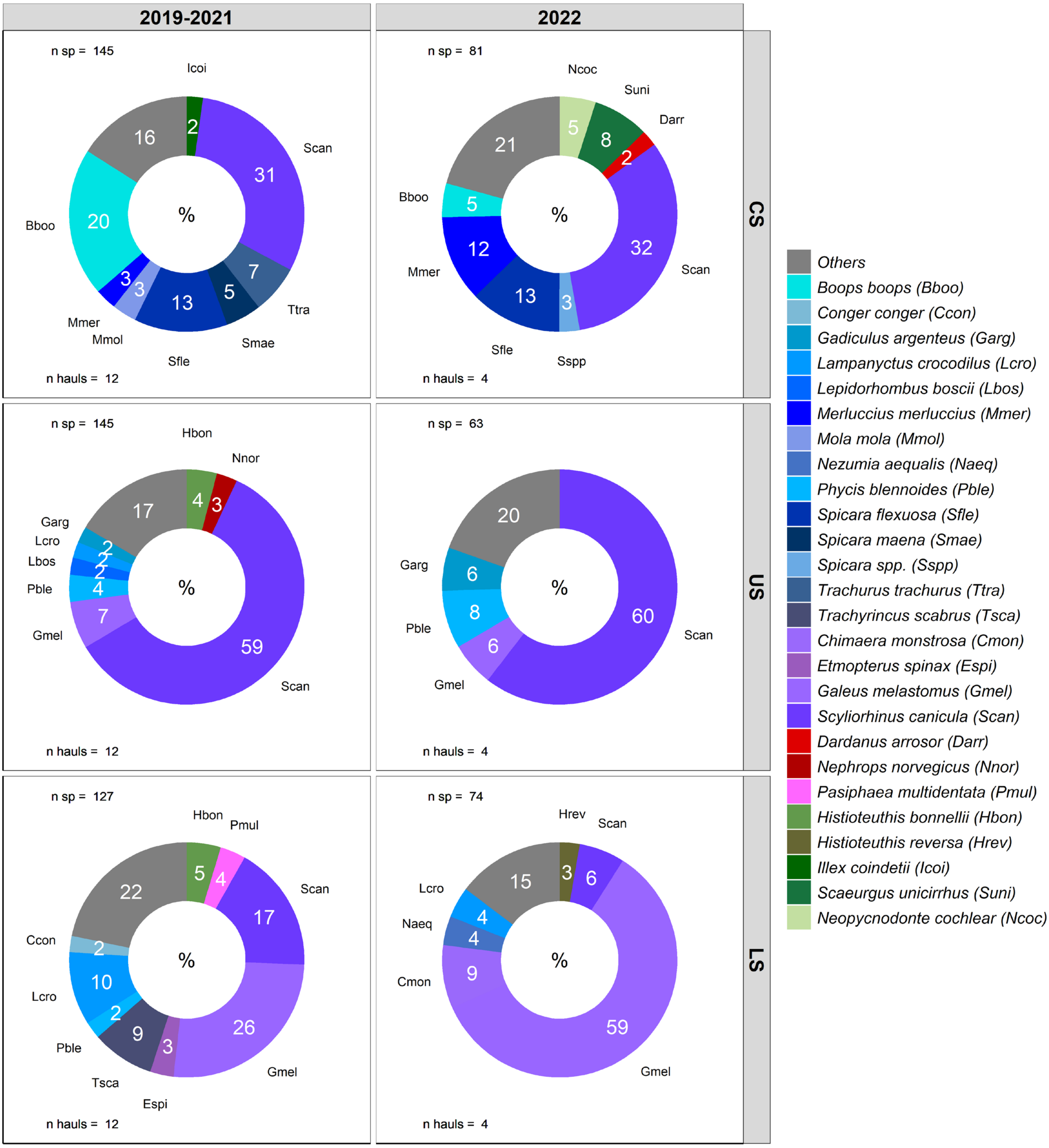

Figure 91. Barcelona discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

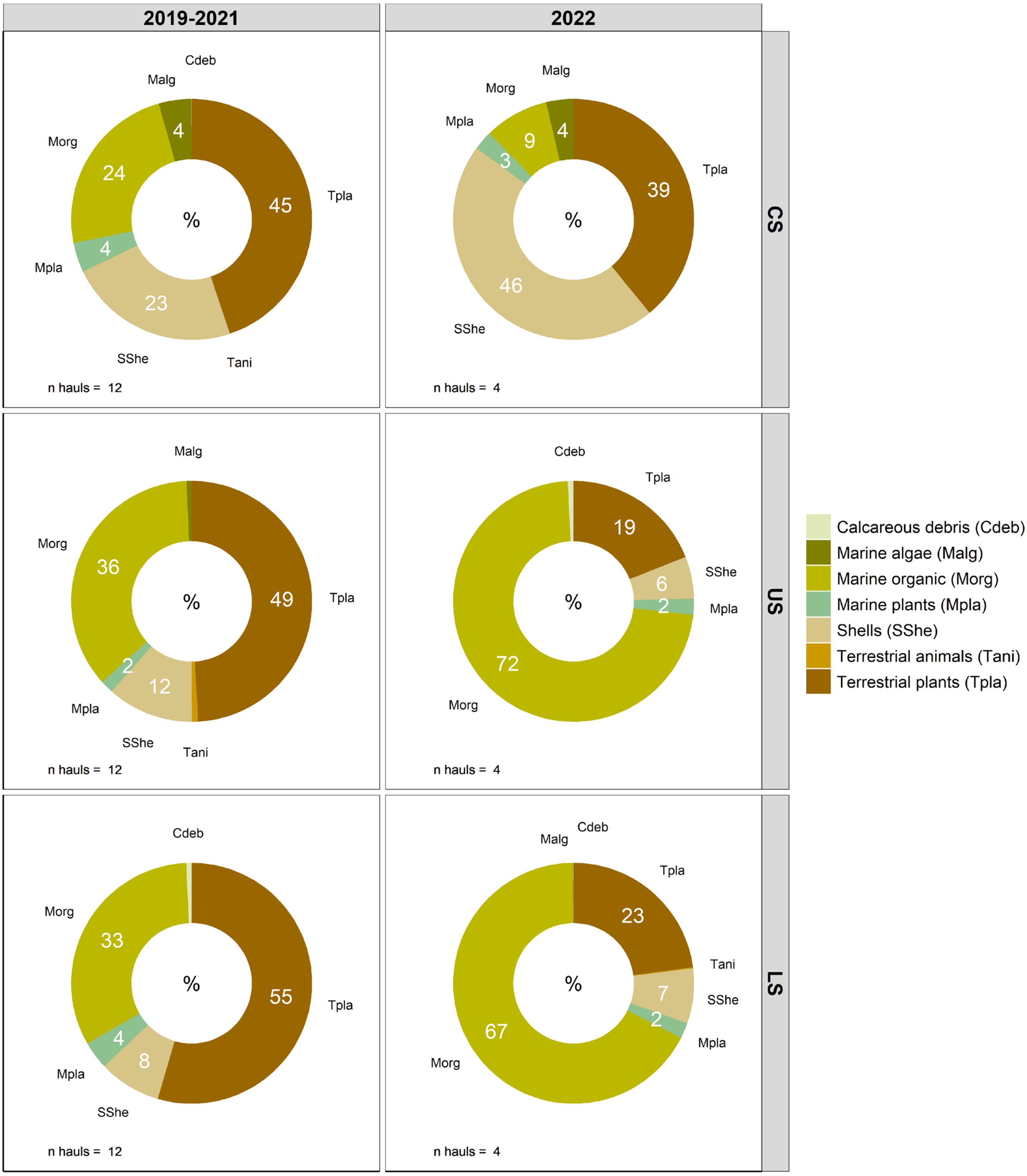

Figure 92. Barcelona categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

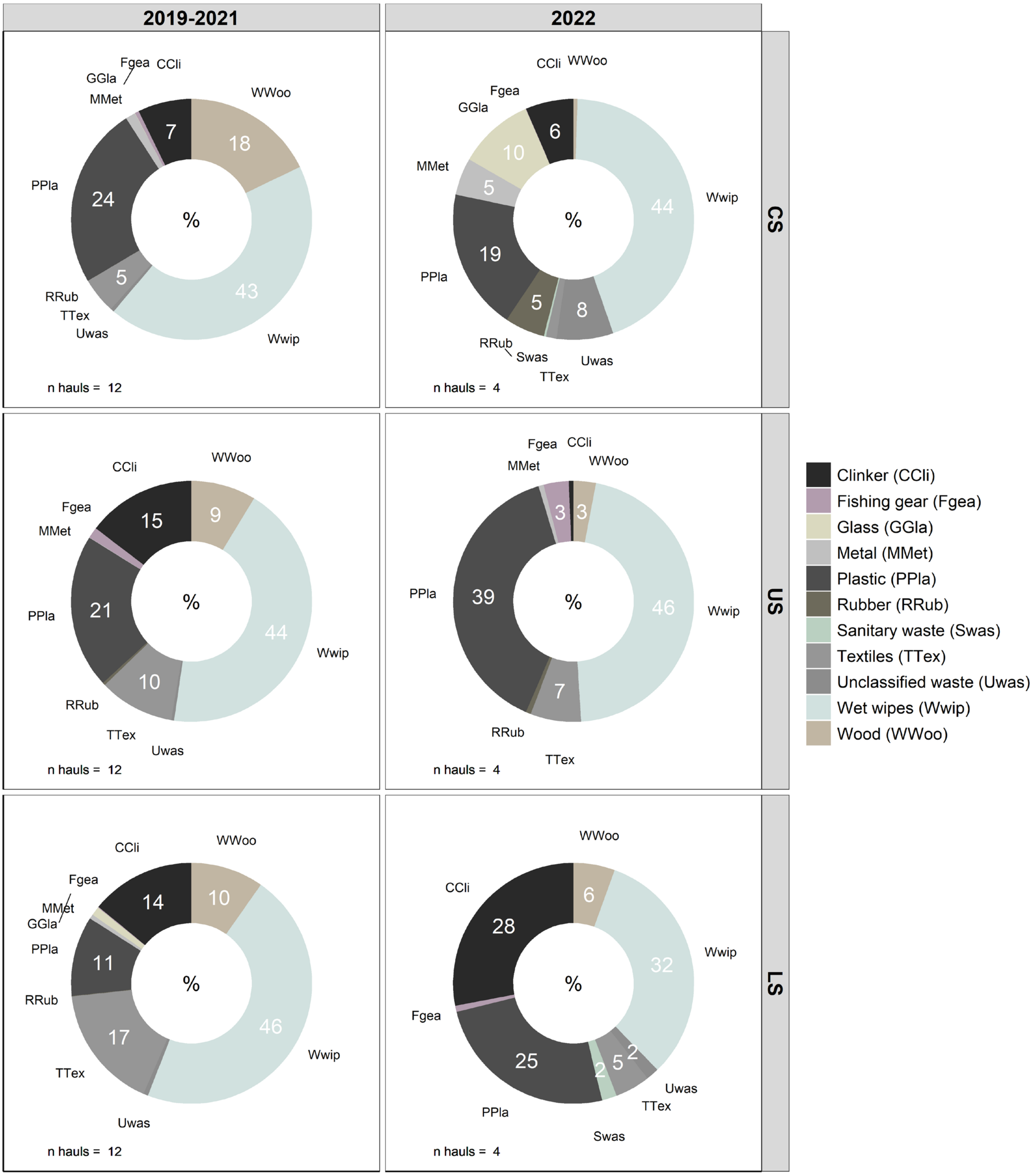

Figure 93. Barcelona categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Vilanova i la Geltrú

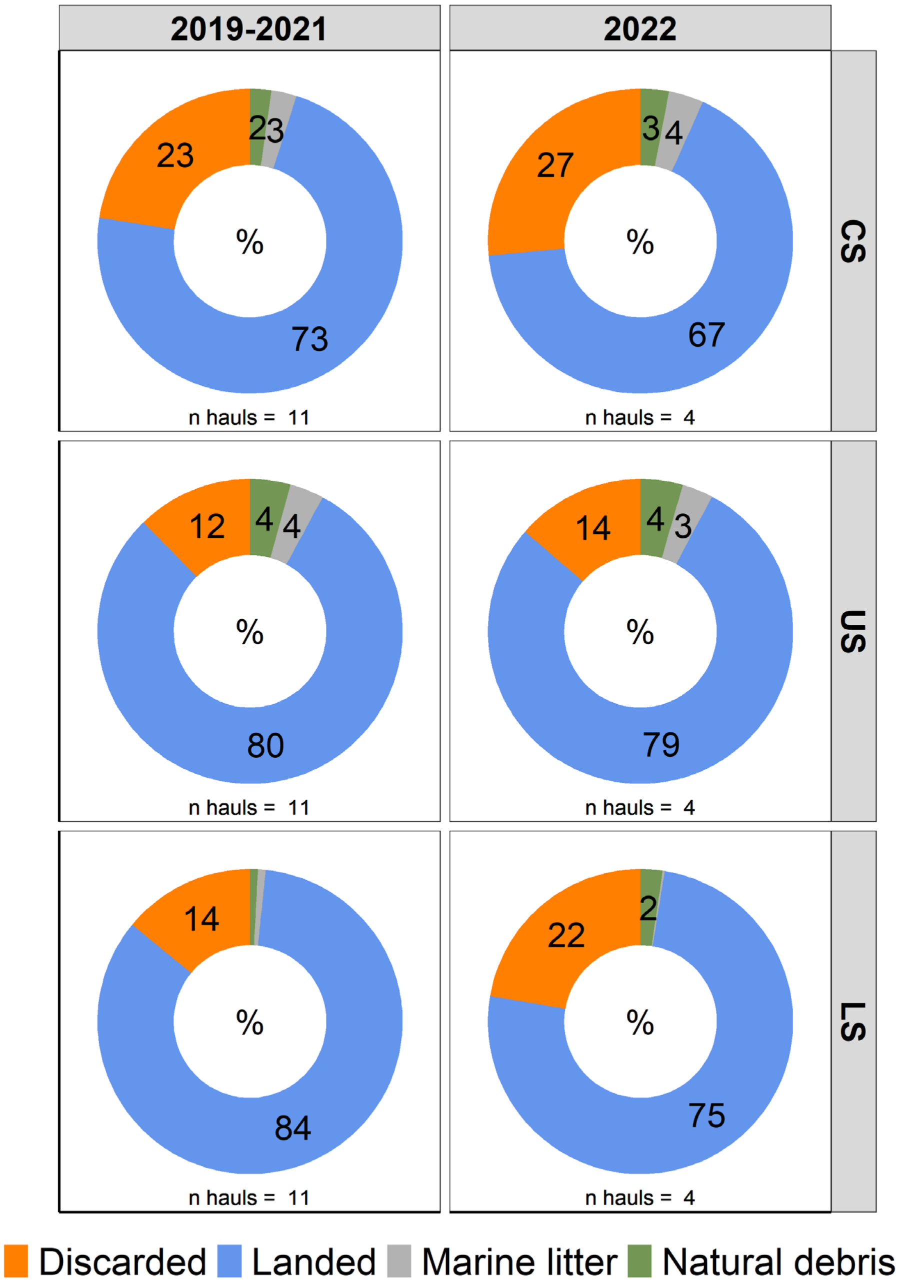

Figure 94. Vilanova i la Geltrú catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

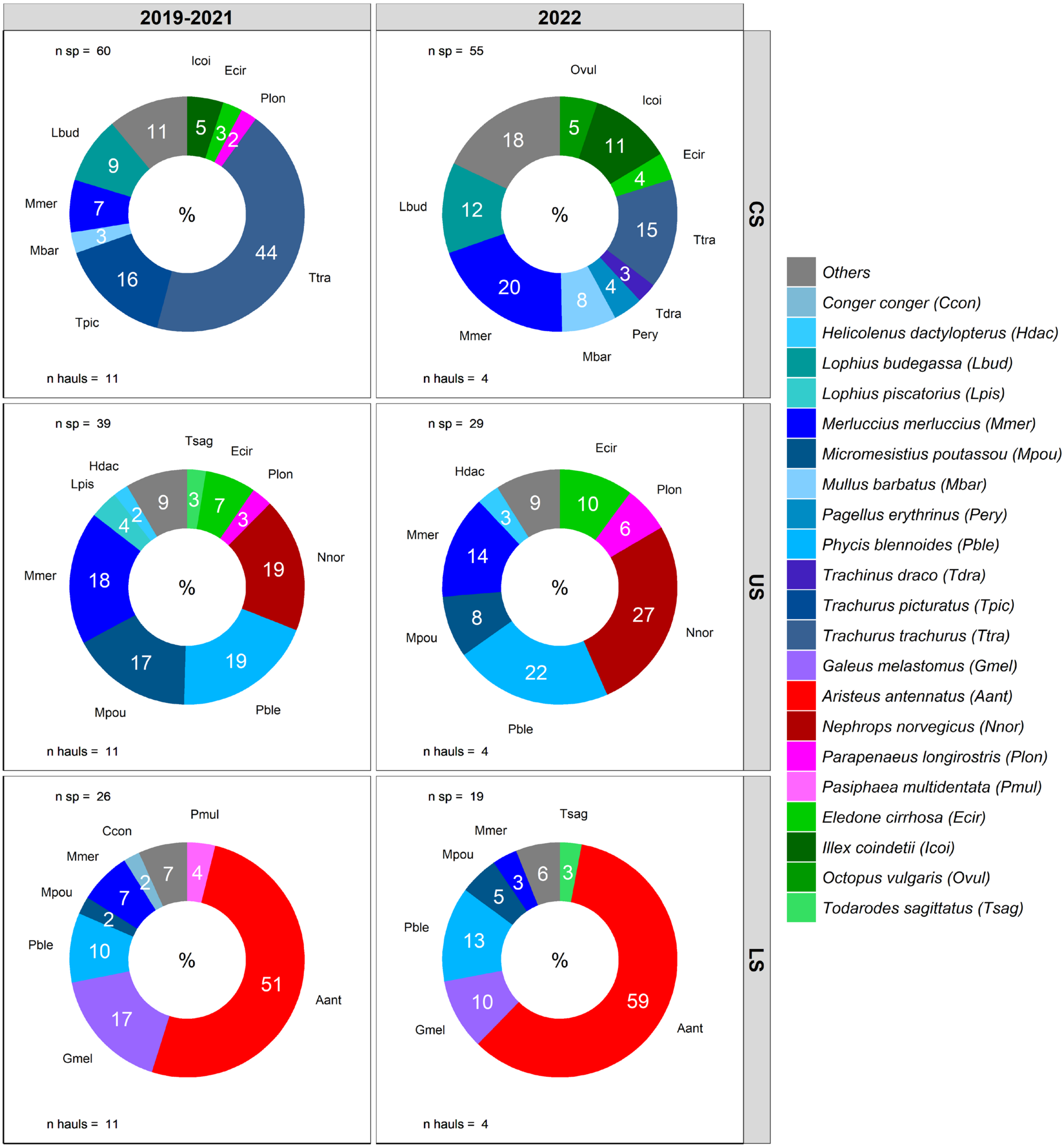

Figure 95. Vilanova i la Geltrú landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 96. Vilanova i la Geltrú discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

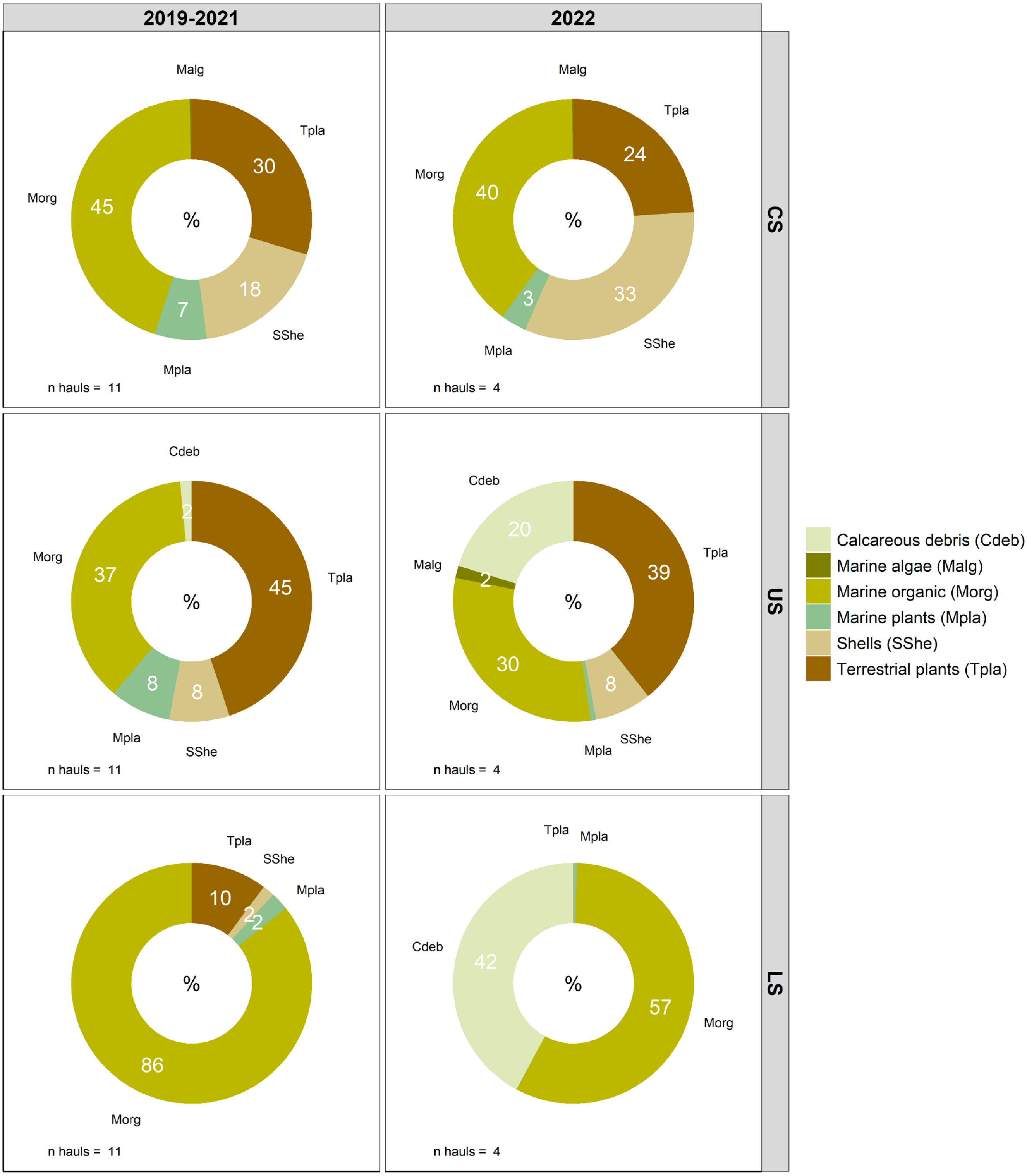

Figure 97. Vilanova i la Geltrú categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

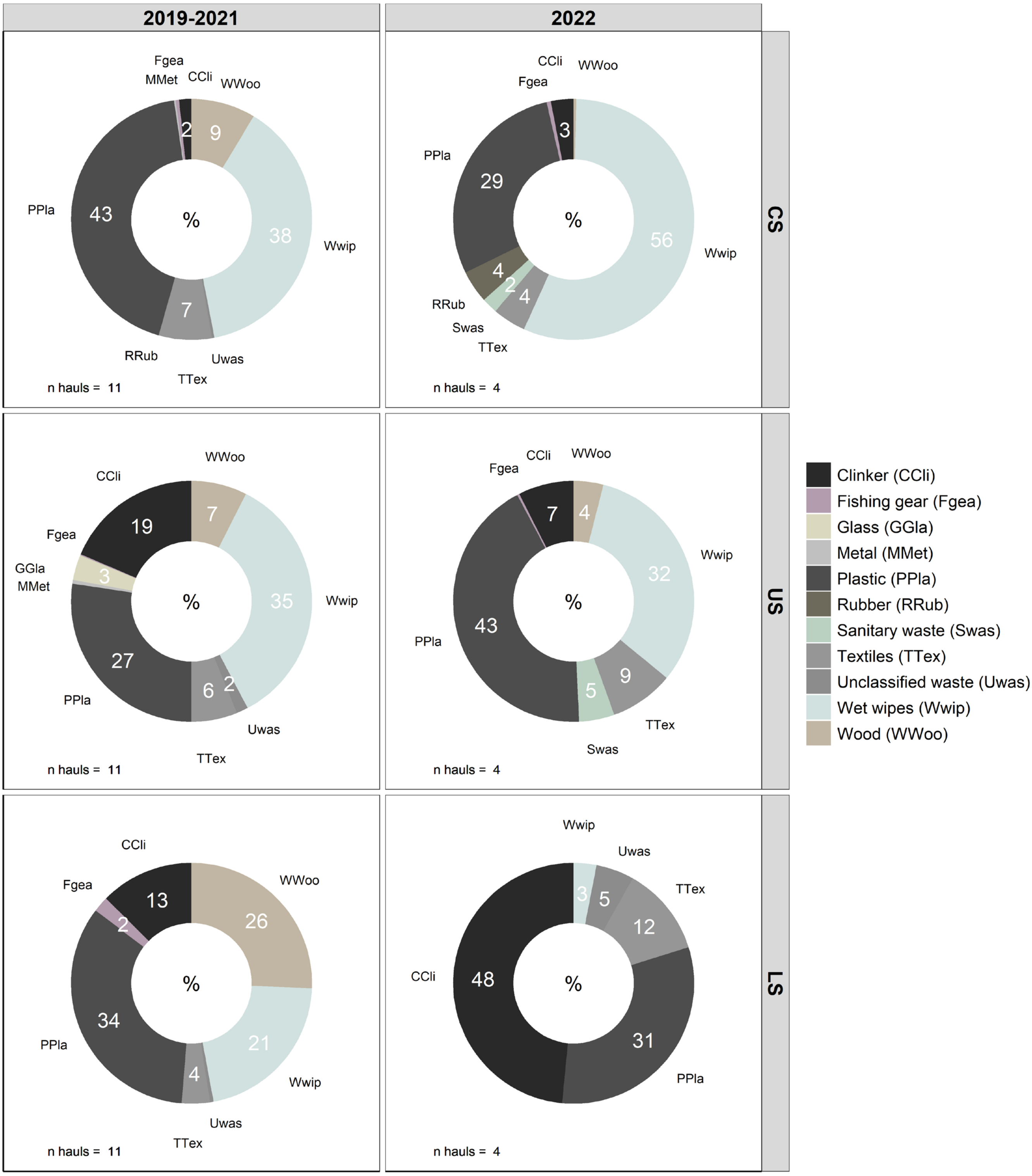

Figure 98. Vilanova i la Geltrú categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Tarragona

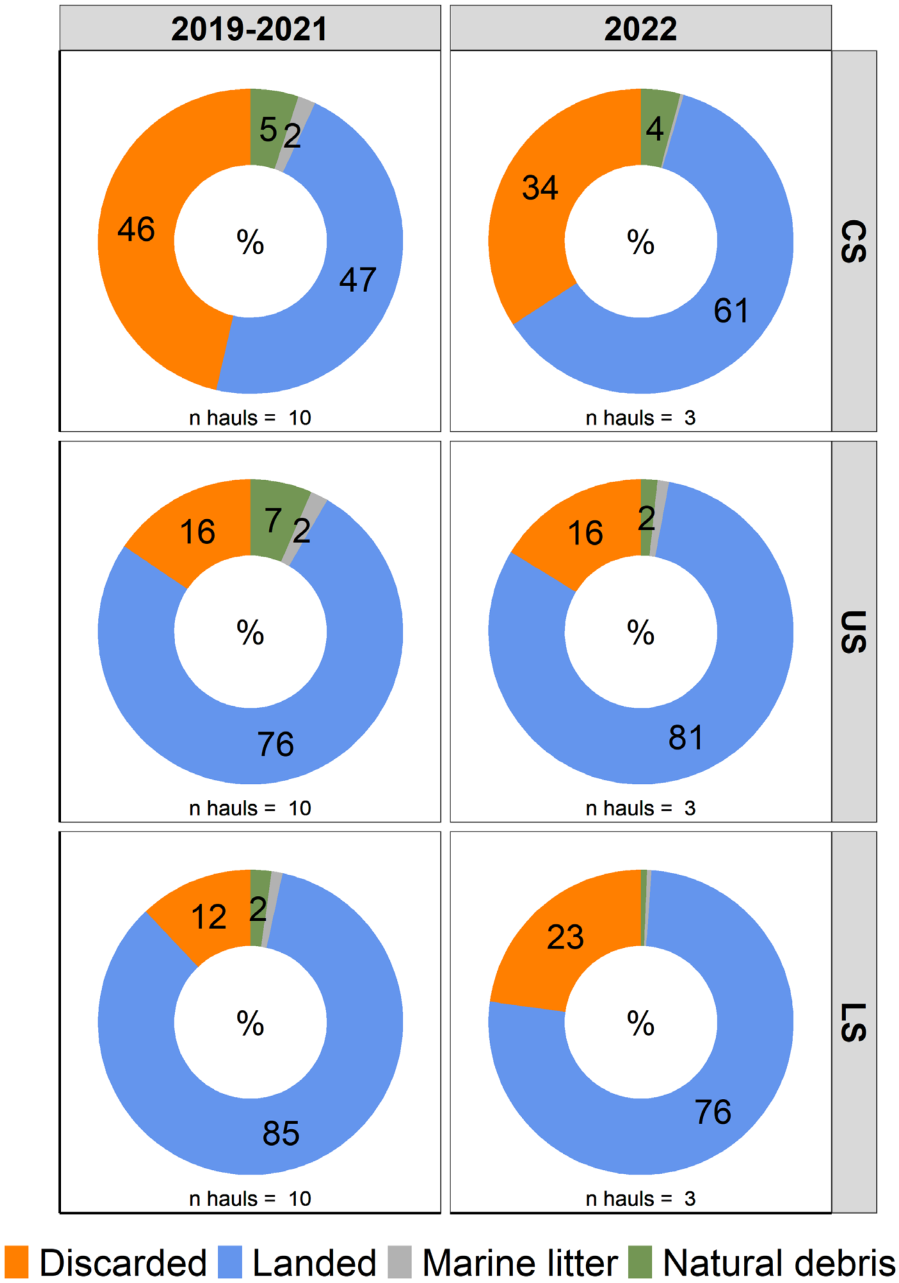

Figure 99. Tarragona catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 100. Tarragona landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 101. Tarragona discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

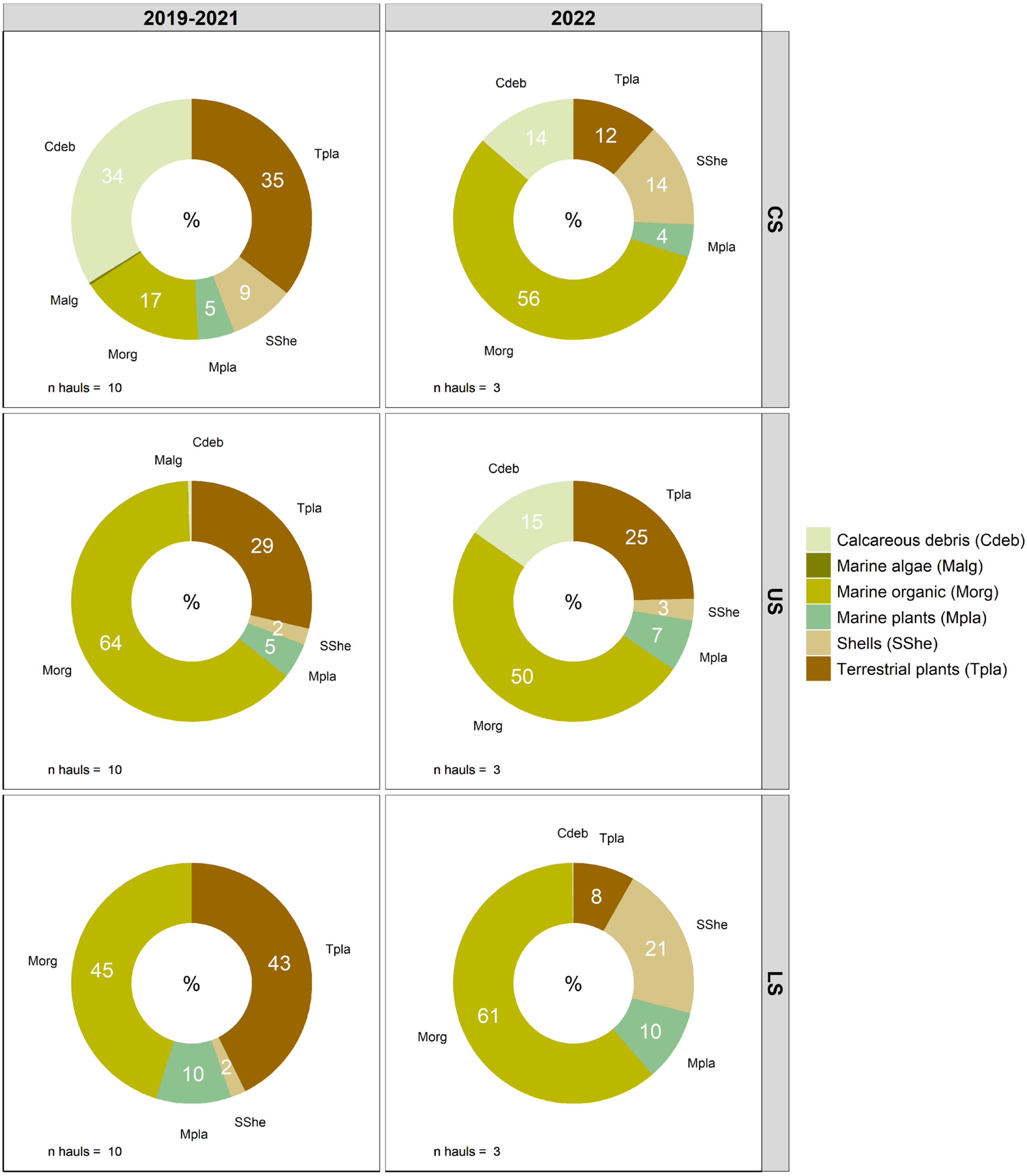

Figure 102. Tarragona categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

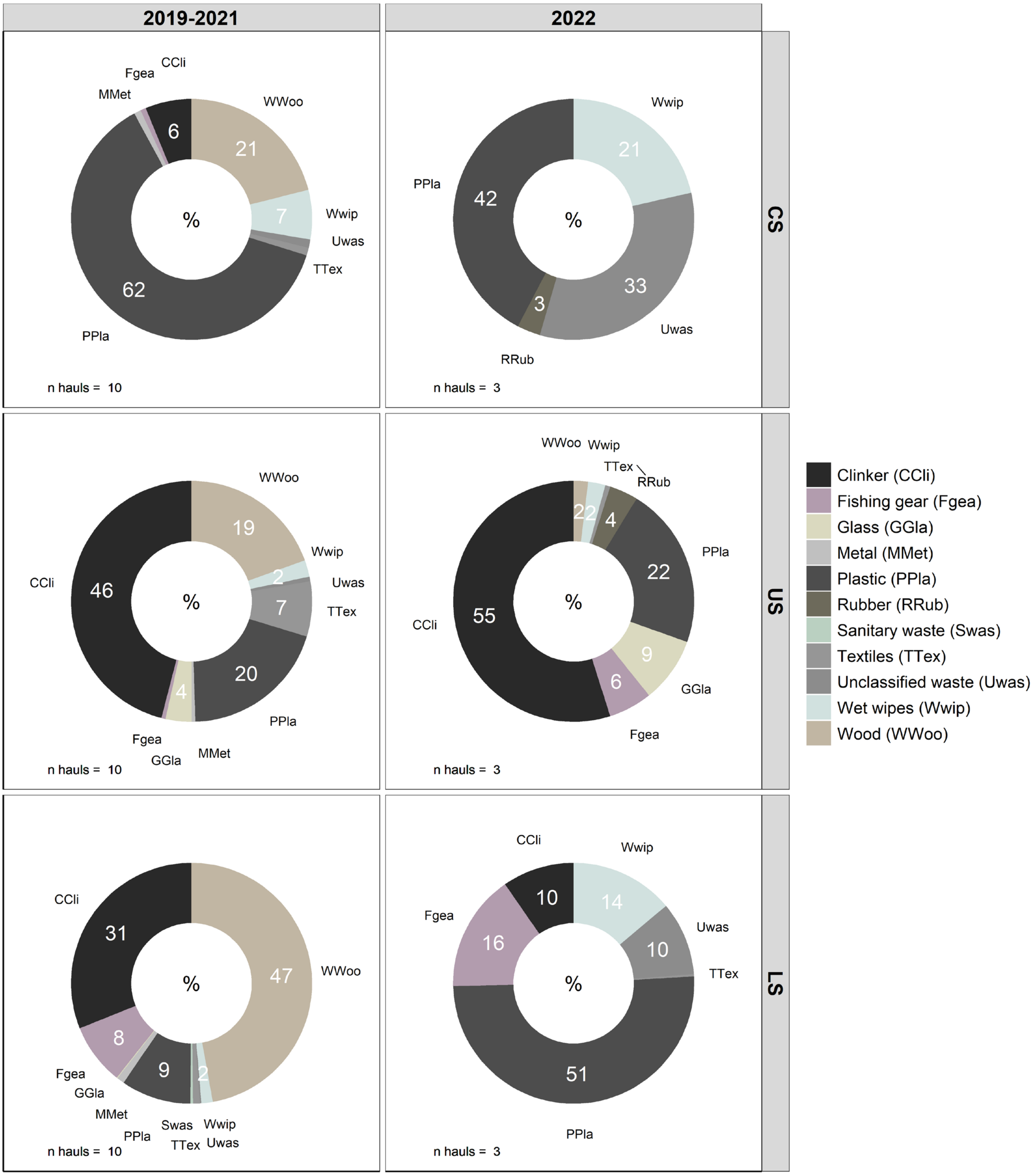

Figure 103. Tarragona categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

South Zone

South zone: Figure 104.

L'Ametlla de Mar: Figure 105, Figure 106, Figure 107, Figure 108 and Figure 109.

La Ràpita: Figure 110, Figure 111, Figure 112, Figure 113 and Figure 114.

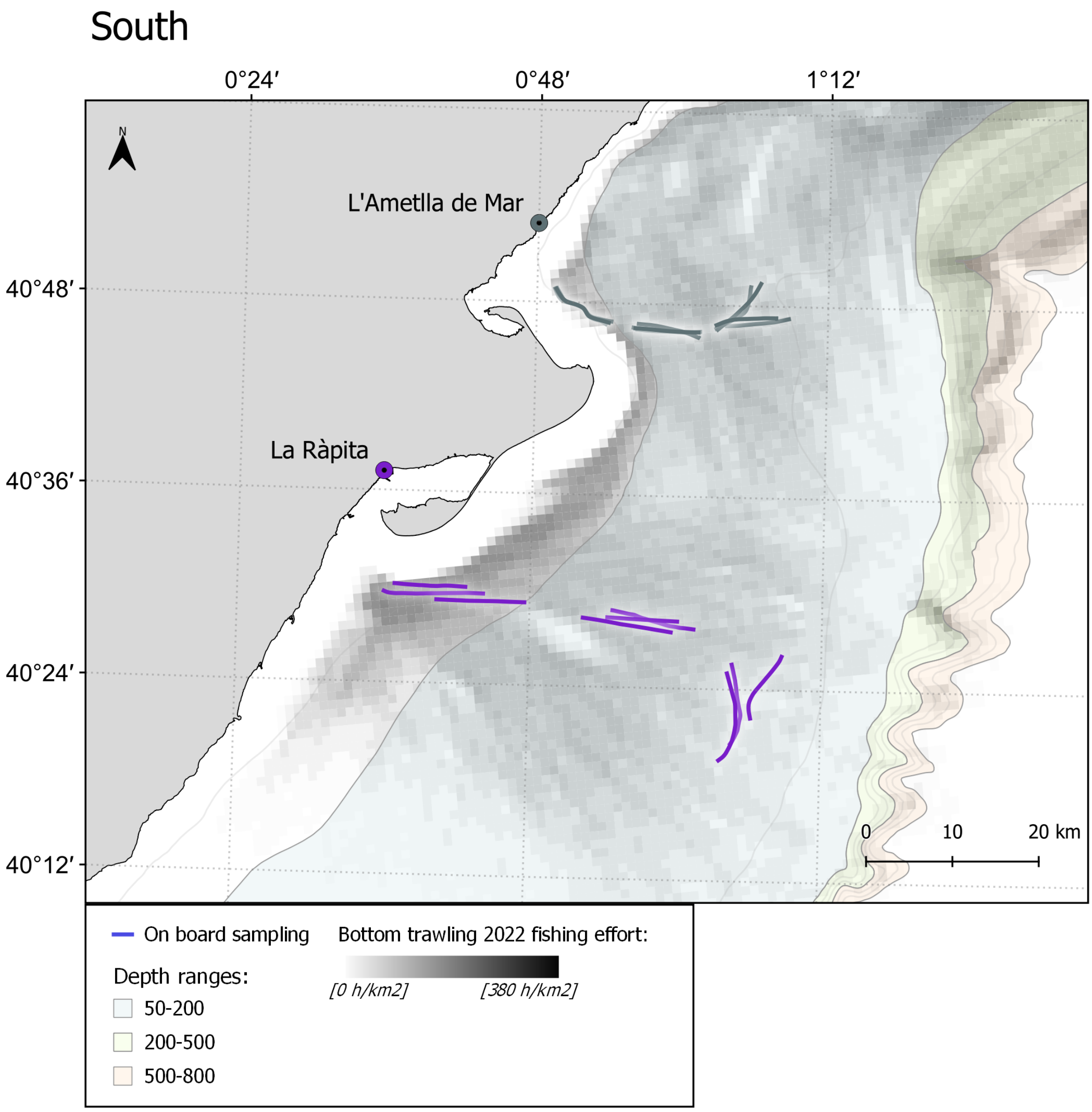

Figure 104. South zone sampling hauls in 2022.

L'Ametlla de Mar

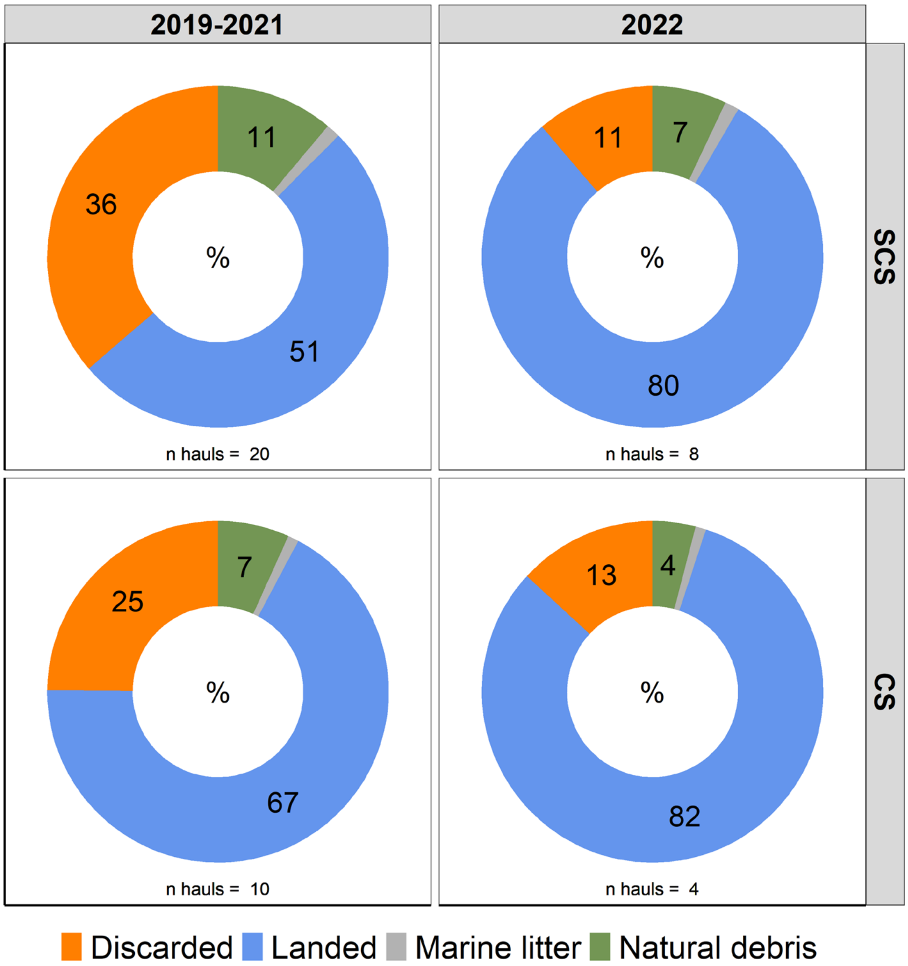

Figure 105. L'Ametlla de Mar catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

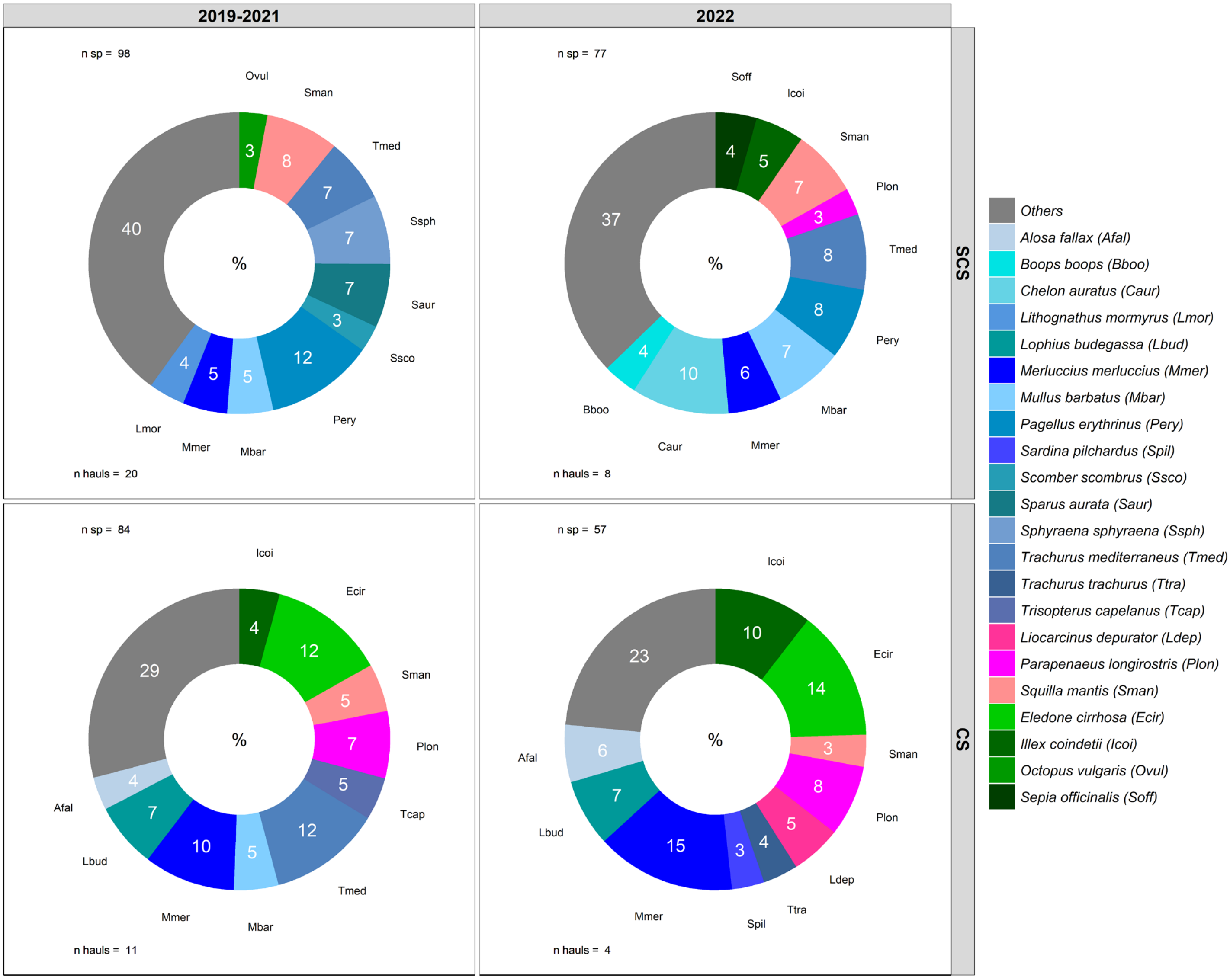

Figure 106. L'Ametlla de Mar landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

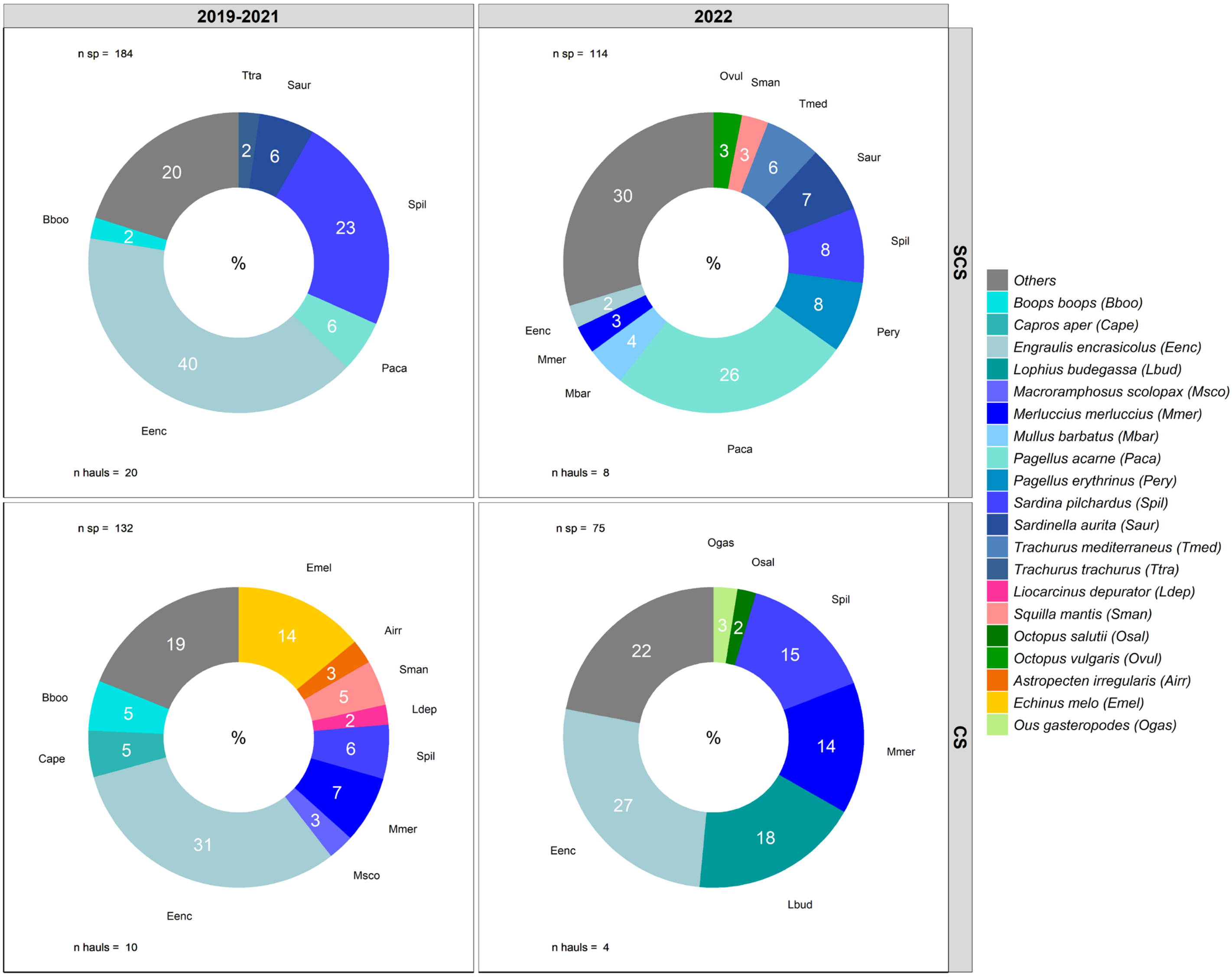

Figure 107. L'Ametlla de Mar discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

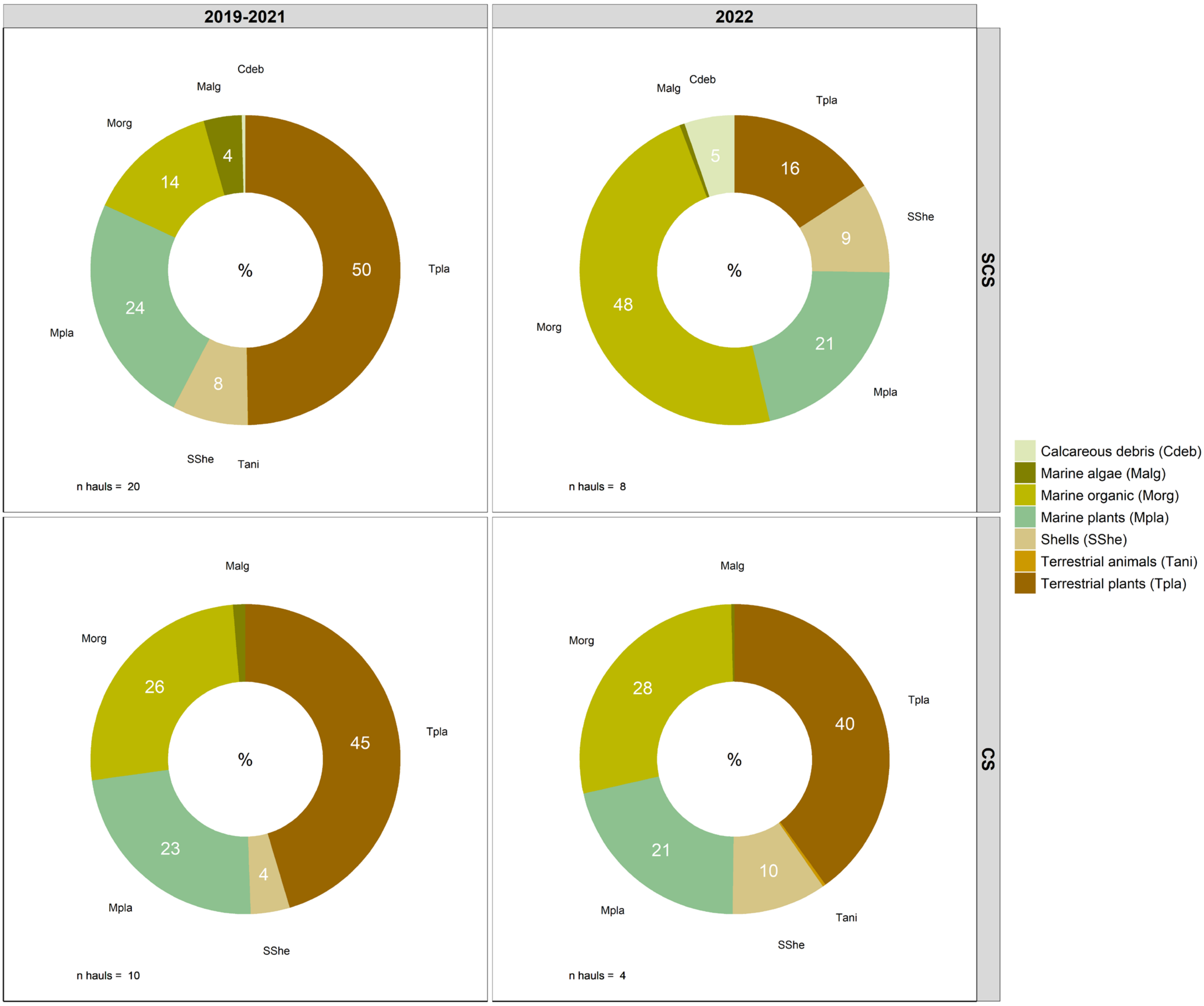

Figure 108. L'Ametlla de Mar categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

Figure 109. L'Ametlla de Mar categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

La Ràpita

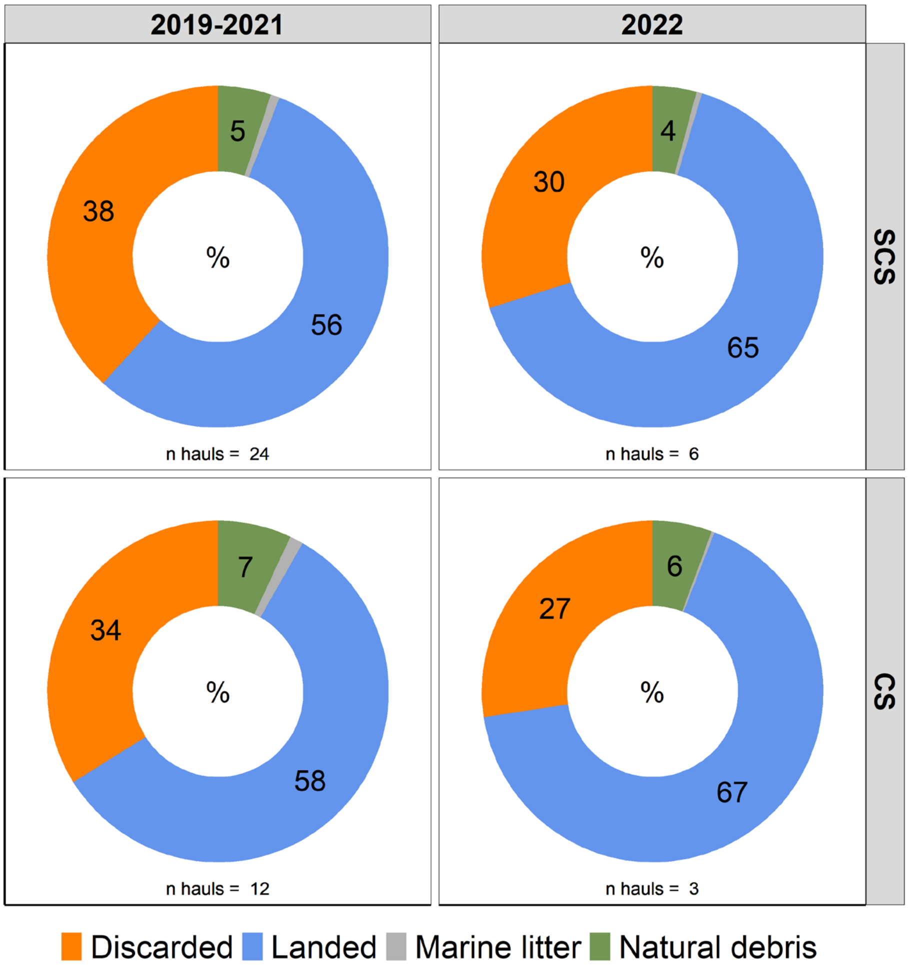

Figure 110. La Ràpita catch composition. Percentage by weight of landings, discarded, natural debris and marine litter fraction including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

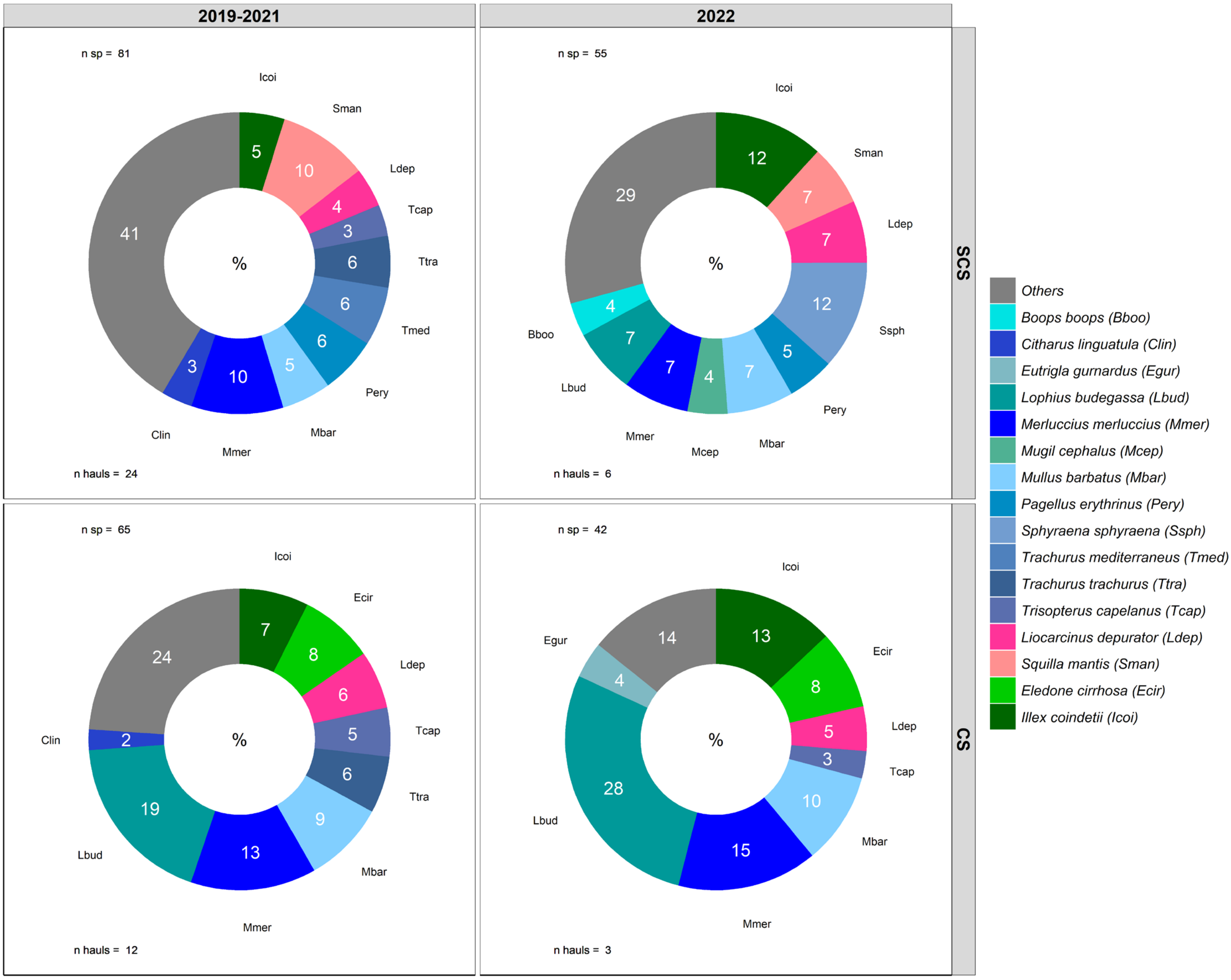

Figure 111. La Ràpita landed species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

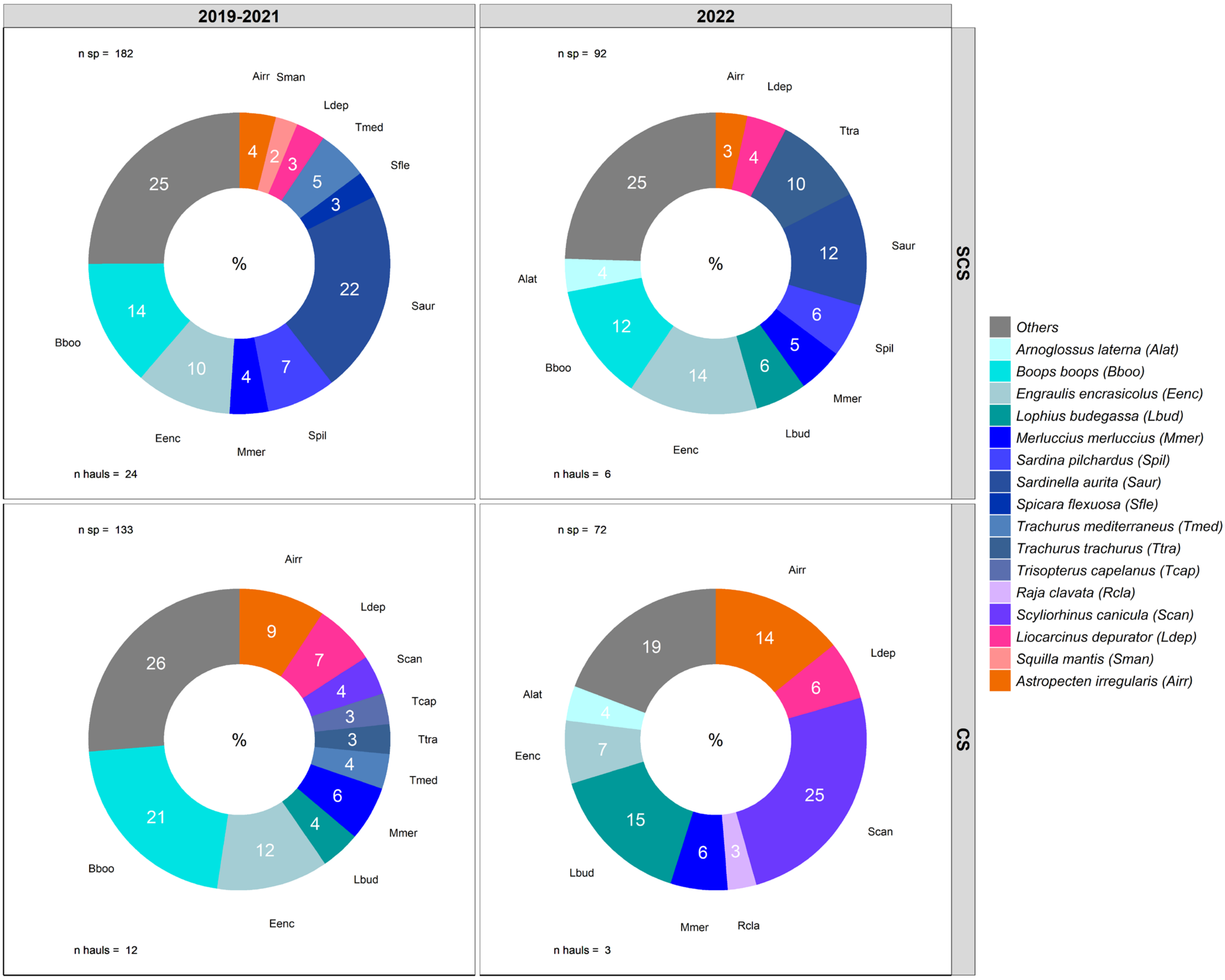

Figure 112. La Ràpita discarded species with most biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

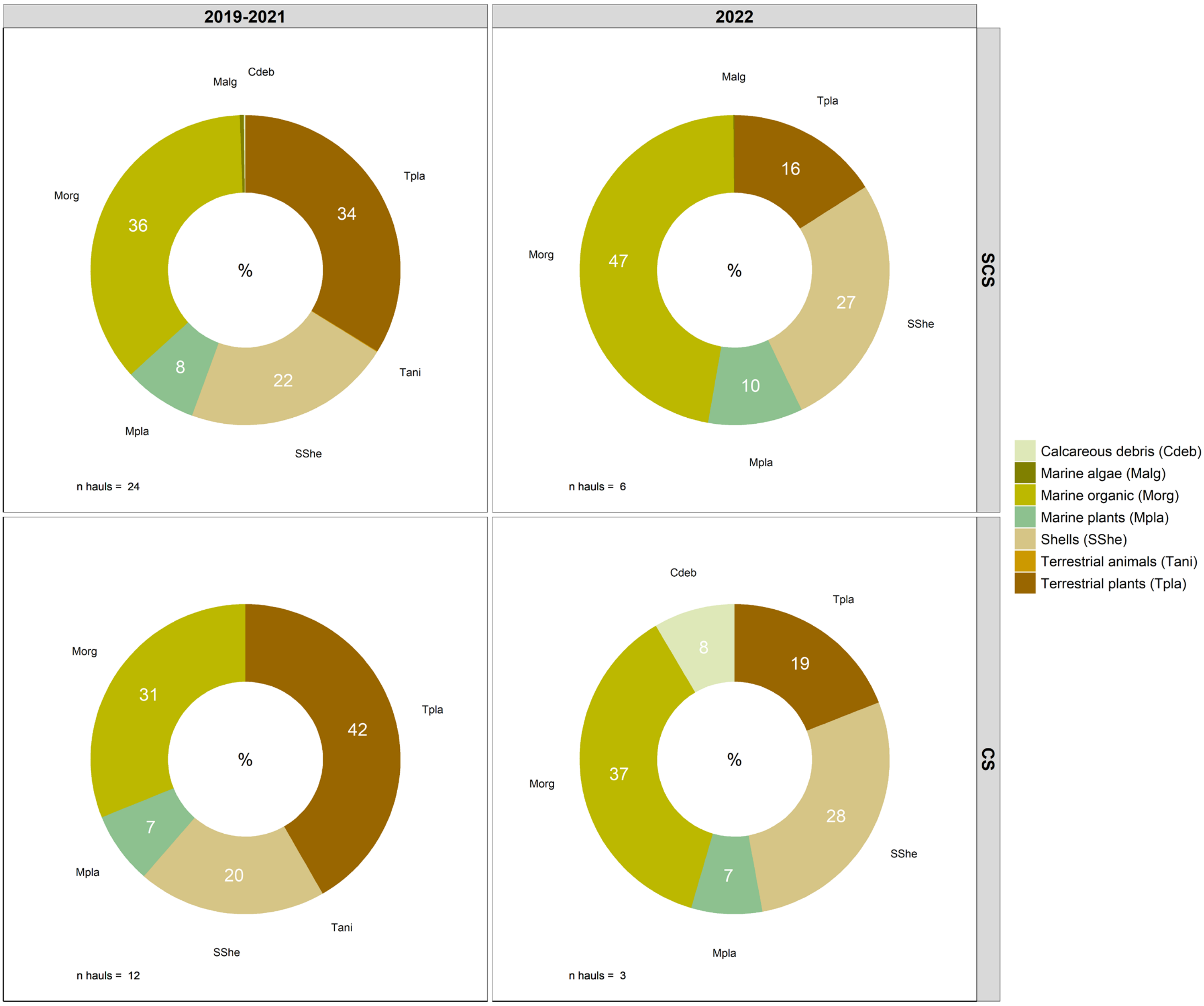

Figure 113. La Ràpita categories of natural debris with higher biomass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

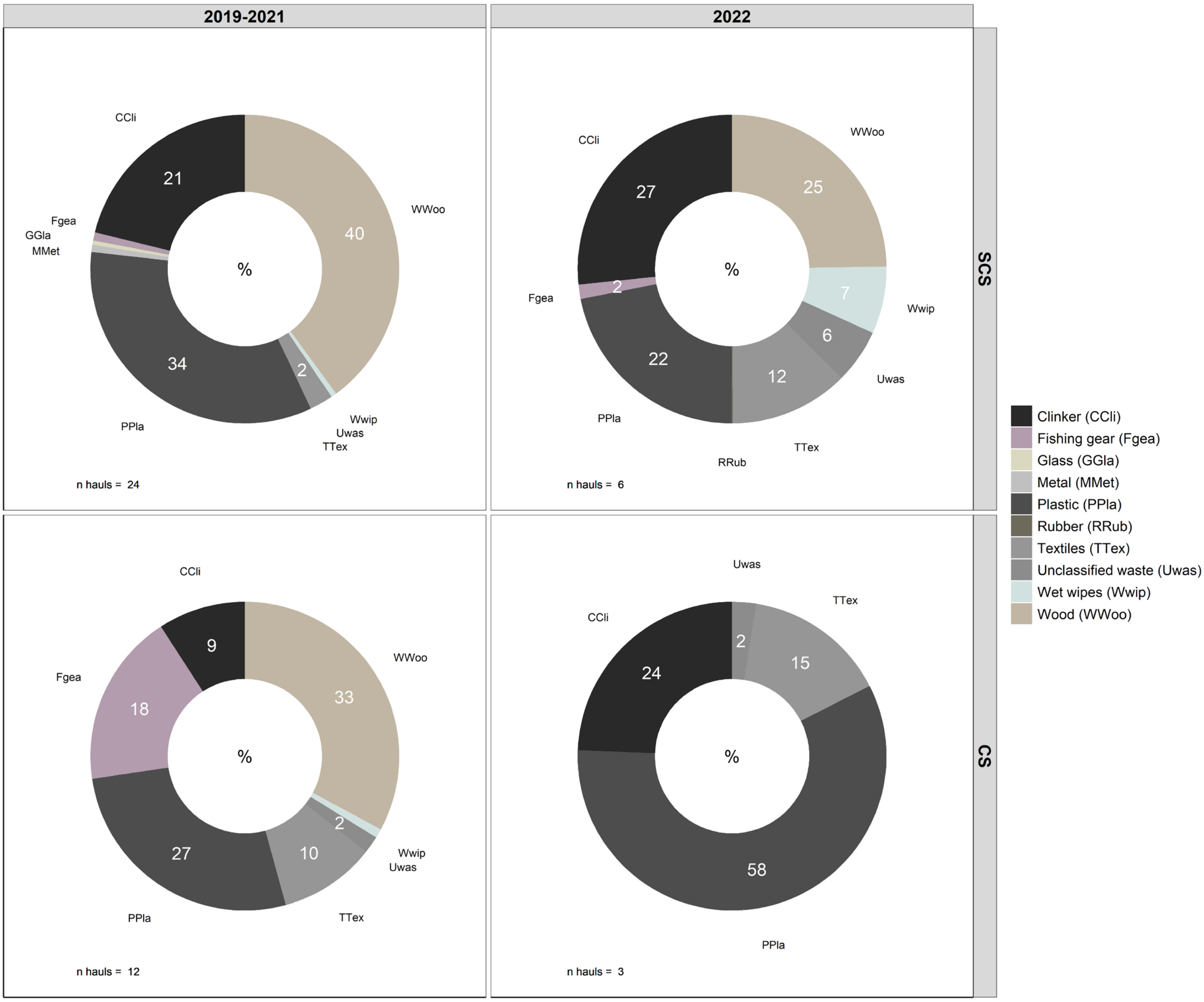

Figure 114. La Ràpita categories of marine litter with higher mass. Percentage in weight including all hauls within each period and depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope).

SECTION 3
Purse seine

Fishery monitoring of purse seine fishing in Catalonia

Purse seine fishery in Catalonia

A total of 293 purse seine fishery samplings were carried out in the period 2019-2022, 247 were fish market samplings, through the purchase of batches, and 46 were on-board samplings (Table 16). Most of the on-board samplings were carried out in 2022 (33 saplings) (Figure 115).

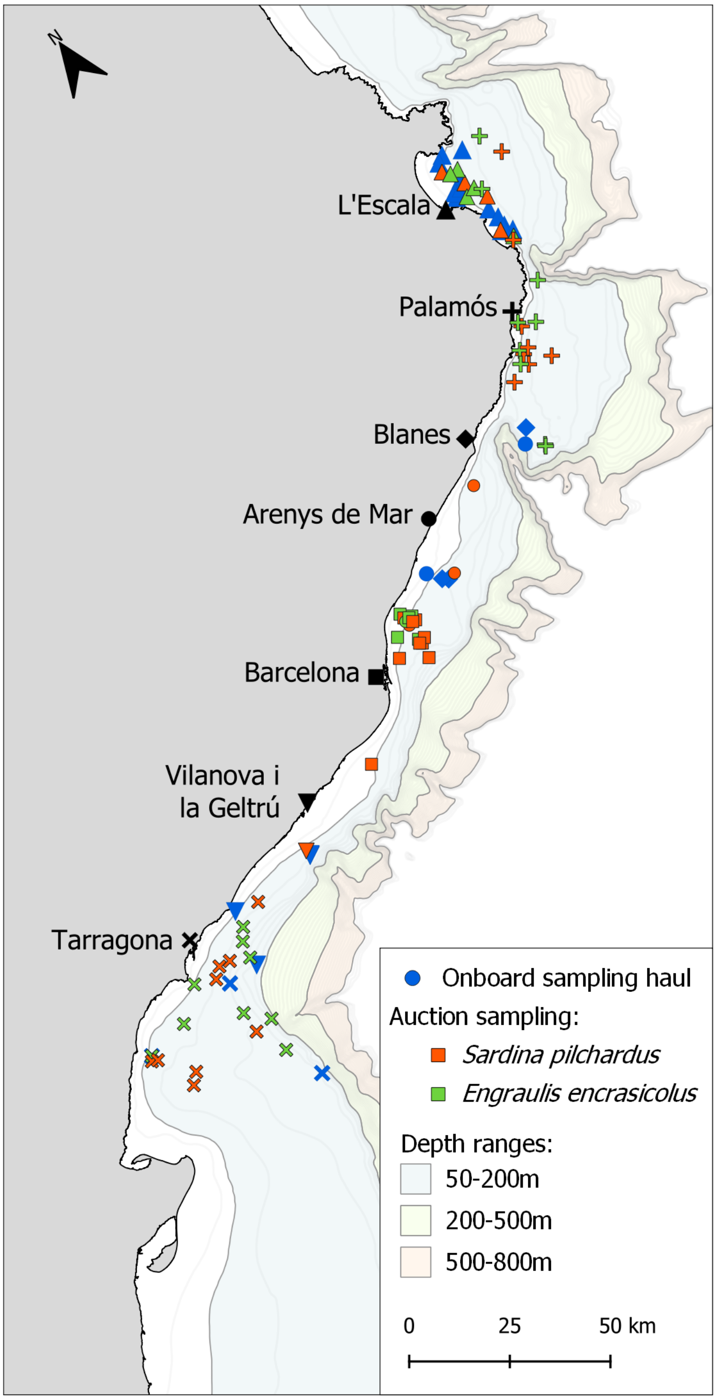

Figure 115. Purse seine sampling conducted in Catalonia in 2022.

Table 16. Number of samplings of purse seine. Fish market (samples obtained from the fish market) and boat sampling (samples obtained on-board commercial fishing boats).

Fishery	Year	Zone	Winter	Spring	Summer	Autumn
			Number of samplings			
Purse seine (fish market)	2019	North	9	13	11	6
Purse seine (fish market)	2019	Center	8	8	9	7
Purse seine (fish market)	2020	North	6	6	10	8
Purse seine (fish market)	2020	Center	3	5	8	9
Purse seine (fish market)	2021	North	8	8	9	4
Purse seine (fish market)	2021	Center	8	7	10	8
Purse seine (fish market)	2022	North	6	9	8	6
Purse seine (fish market)	2022	Center	6	9	9	6
Purse seine (on board sampling)	2020	North	5	0	0	0
Purse seine (on board sampling)	2020	Center	1	0	0	0
Purse seine (on board sampling)	2021	North	0	0	0	5
Purse seine (on board sampling)	2021	Center	0	0	1	1
Purse seine (on board sampling)	2022	North	7	4	9	4
Purse seine (on board sampling)	2022	Center	2	3	2	2
Total number of samplings per season			69	72	86	66
Total number of samplings in the studied period						293

The catch composition, in terms of biomass, of the purse seine fishery in the on-board sampling in 2022 consisted of 74% target species (either European sardine or anchovy), 19% other commercial species and 6% discards (Figure 116).

Regarding the target species catch composition in terms of biomass of the on-board sampling in 2022, anchovy accounted for 57%, while European sardine accounted for 43% (Figure 117).

Twelve species were identified within the by-catch fraction of the on-board purse seine fishery sampling in 2022 (Figure 118). The non-target commercial species with higher biomasses were *Sardinella aurita* (31%) and *Scomber colias* (28%), followed by *Boops boops* (10%).

From the discarded fraction of the on-board purse seine fishery sampling, 46 species were identified (Figure 119). Of these, the species that accounted for the highest biomasses were *Chelon auratus* (31%) and *Lophius budegassa* (11%).

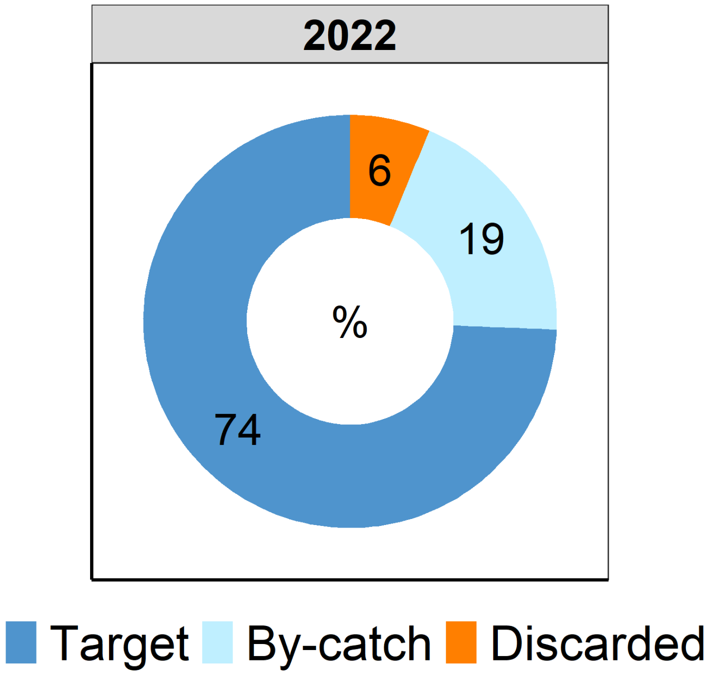

Figure 116. Purse seine fishery catch composition. Percentage by weight of target species (European sardine and Anchovy), by-catch (other species commercialized) and discarded catch (species not commercialized).

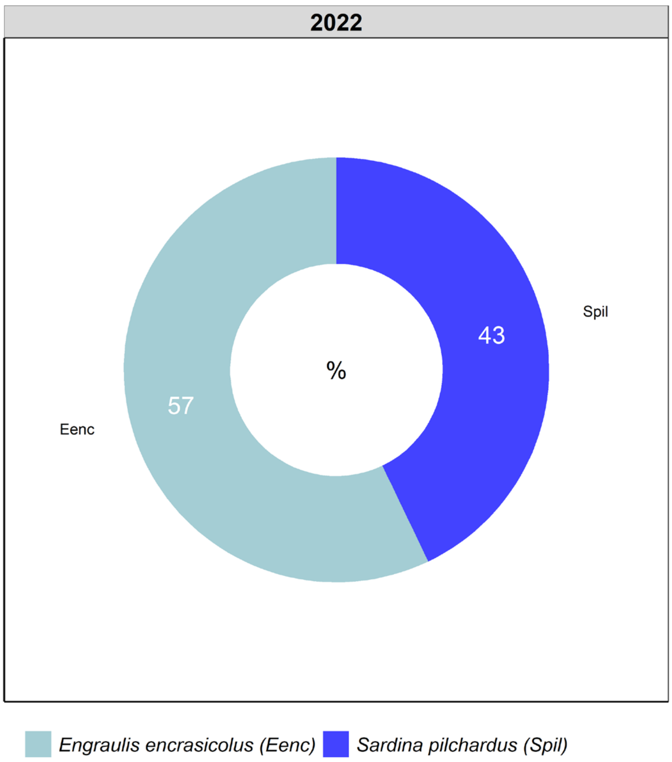

Figure 117. Purse seine fishery target species composition. Percentage by weight of each target species.

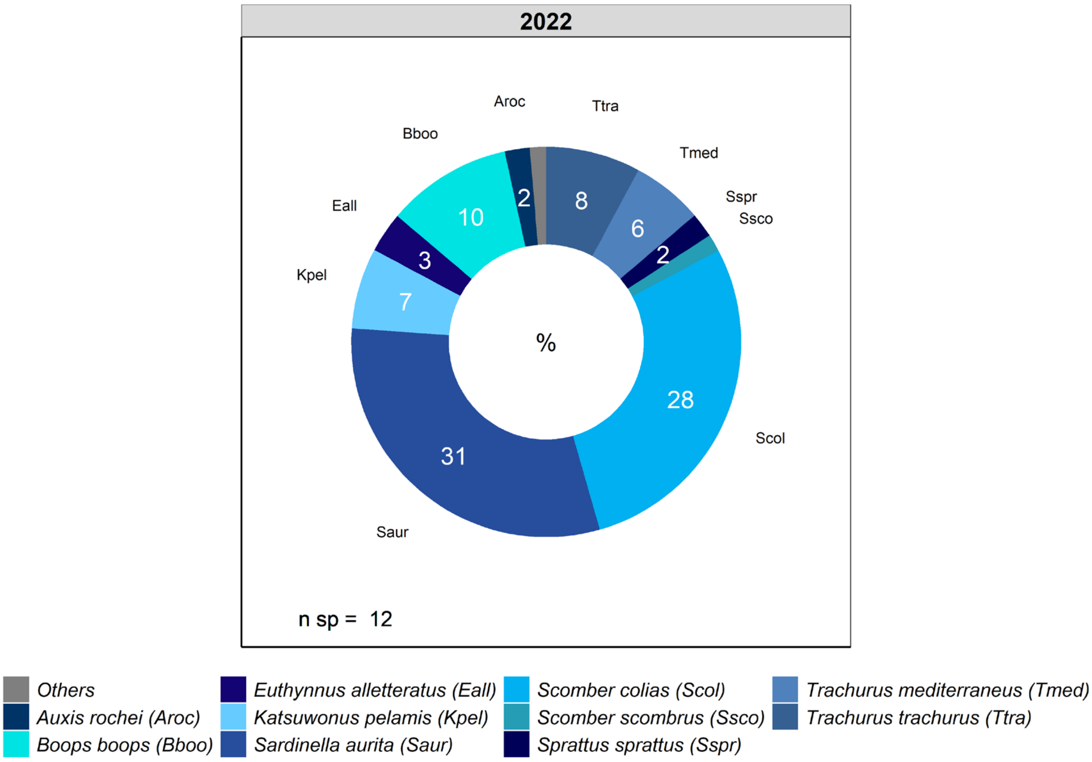

Figure 118. Purse seine fishery by-catch species composition. Percentage by weight of each by-catch species.

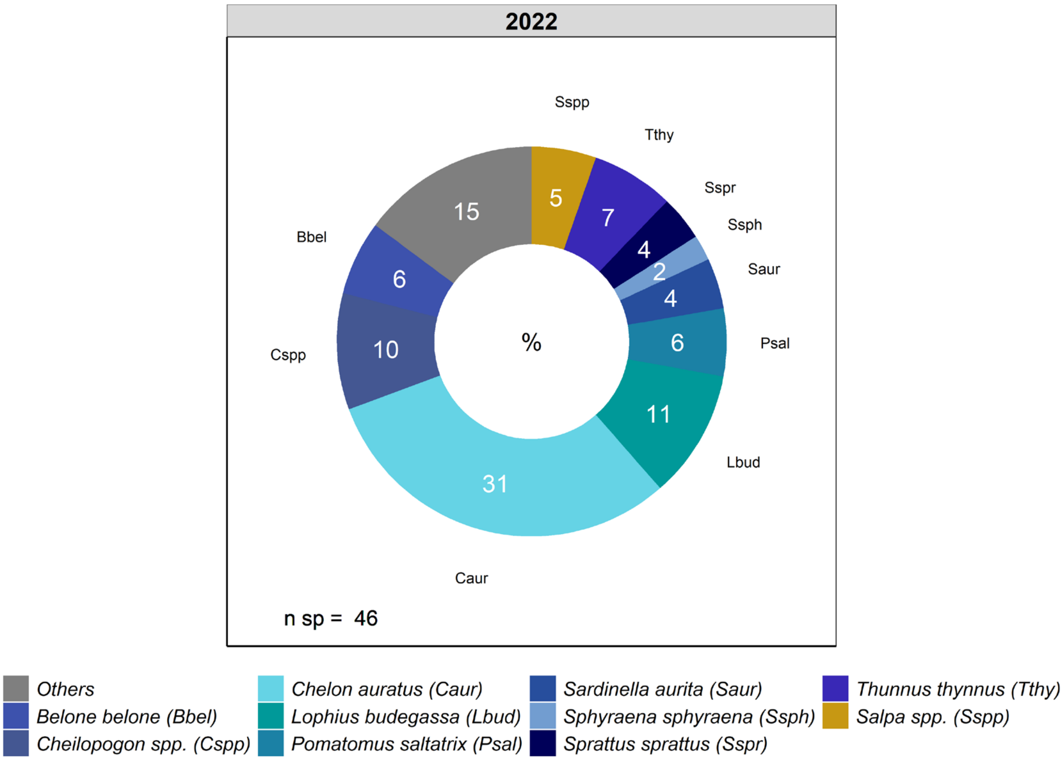

Figure 119. Purse seine fishery discarded species. Percentage by weight of species with most biomass discarded.

European sardine (*Sardina pilchardus*) PIL

The total European sardine catch in Catalonia in 2022 was 5308 t, 99% of which were caught by purse seine (ICATMAR, 23-03).

Figure 120 and Figure 121 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast. The annual maximum was reached in 2020 with 41 393 kg/km², followed by 2022 with 35 625 kg/km². In 2022, landings were more concentrated off Barcelona.

All parameters analyzed in this report for European sardine were calculated using only individuals obtained by purse seine sampling (Table 18).

According to length-weight relationship parameters for both sexes combined and separately, European sardine displayed a positive allometric growth (b>3) in 2022 (Table 17). Comparing the growth curves between the years sampled for both sexes combined and separately, similar results can be observed over the years with positive allometric growth in all cases (Figure 122).

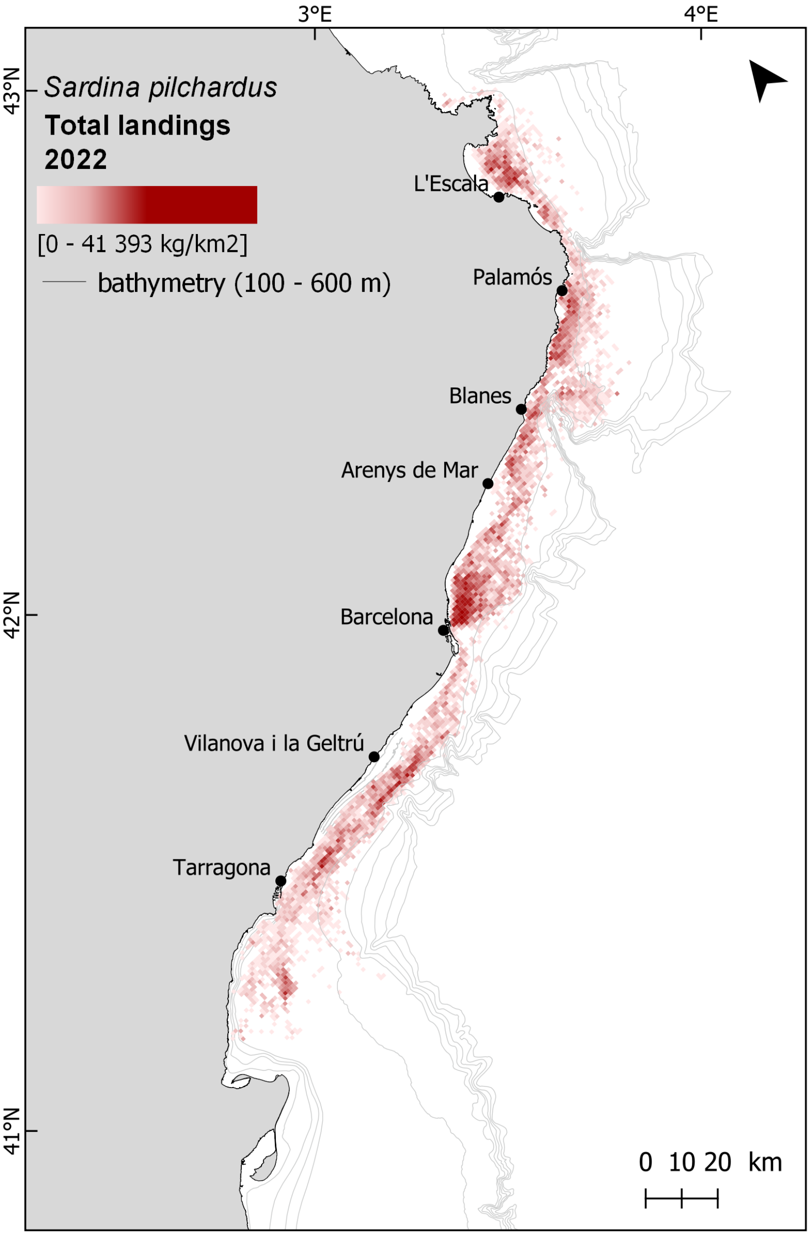

Figure 120. Spatial distribution of landings per unit of effort (LPUE) for European sardine in the Catalan fishing grounds (North GSA6) in 2022.

Table 17. European sardine length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.0039	3.242	0.97	1590	11.15
Females	0.0043	3.205	0.97	865	11.31
Males	0.0038	3.256	0.94	647	10.86

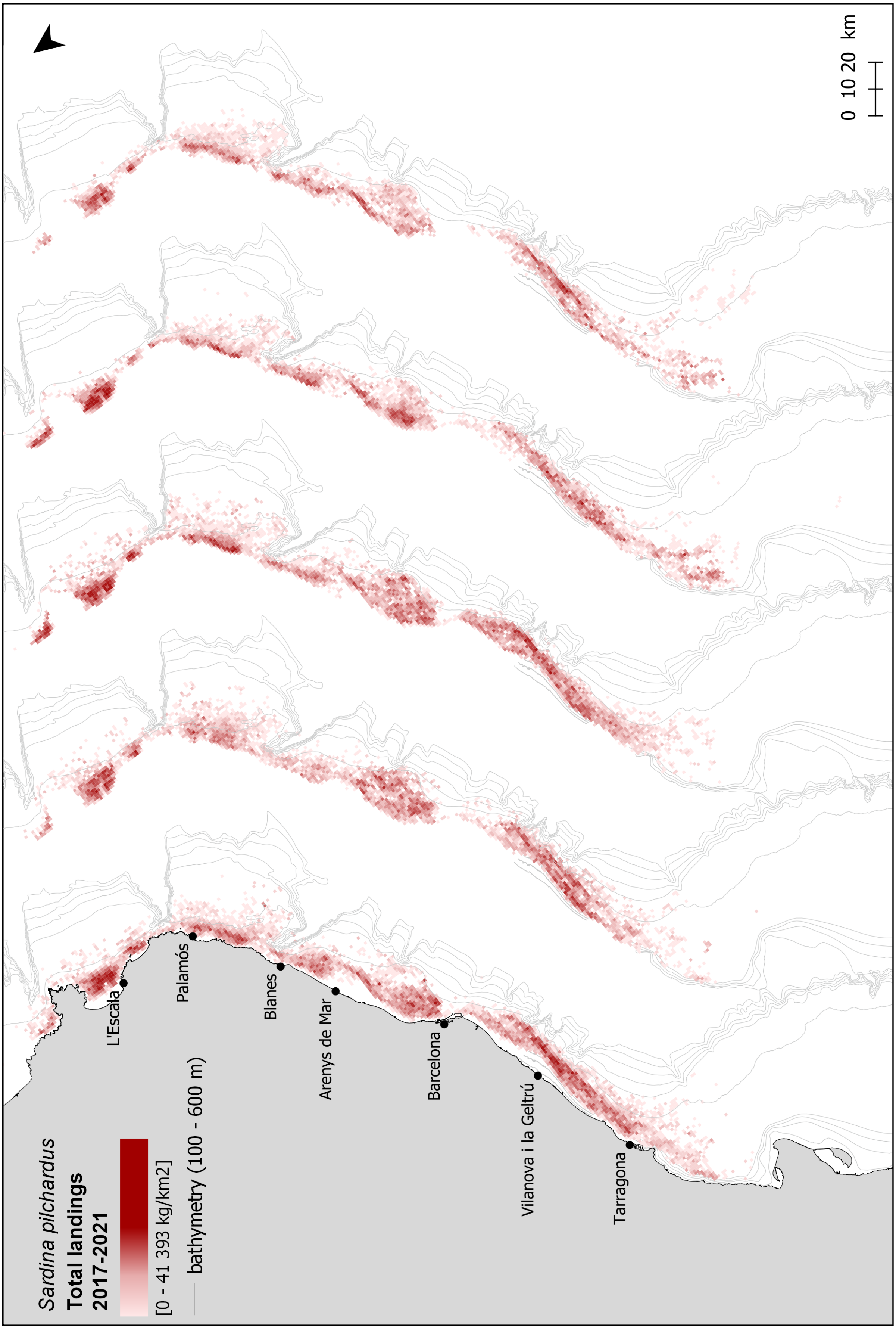

Figure 121. Spatial distribution of landings per unit of effort (LPUE) for European sardine in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

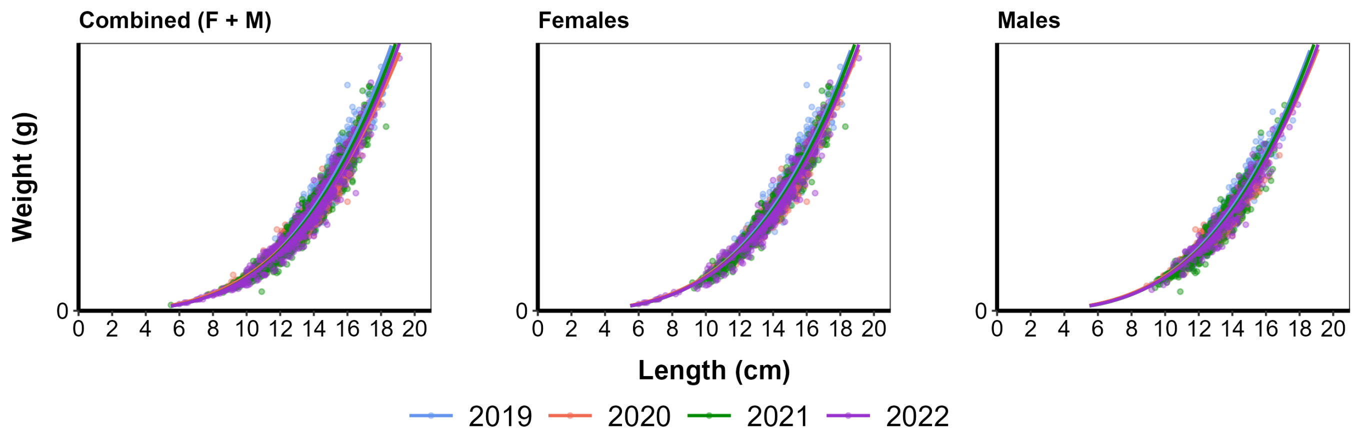

Figure 122. European sardine length-weight relationship for the previous years sampled.

The size at first maturity (L_{50}) for European sardine in 2022 was 11.5 cm of TL for both sexes combined (Table 17 and Figure 123). Females showed earlier maturation than males in 2022, with a L_{50} of 11.3 and 10.9 cm of TL respectively, a trend also observed in previous years sampled. Comparing between years for both sexes combined, 2019 had the lowest L_{50} and 2021 the highest.

It should be noted that immature individuals may be missing in the sampling, as most of the sampled individuals come from the fish market through the purchase of batches and are therefore above the MCRS of the species. This could imply a higher calculated L_{50} than the real one.

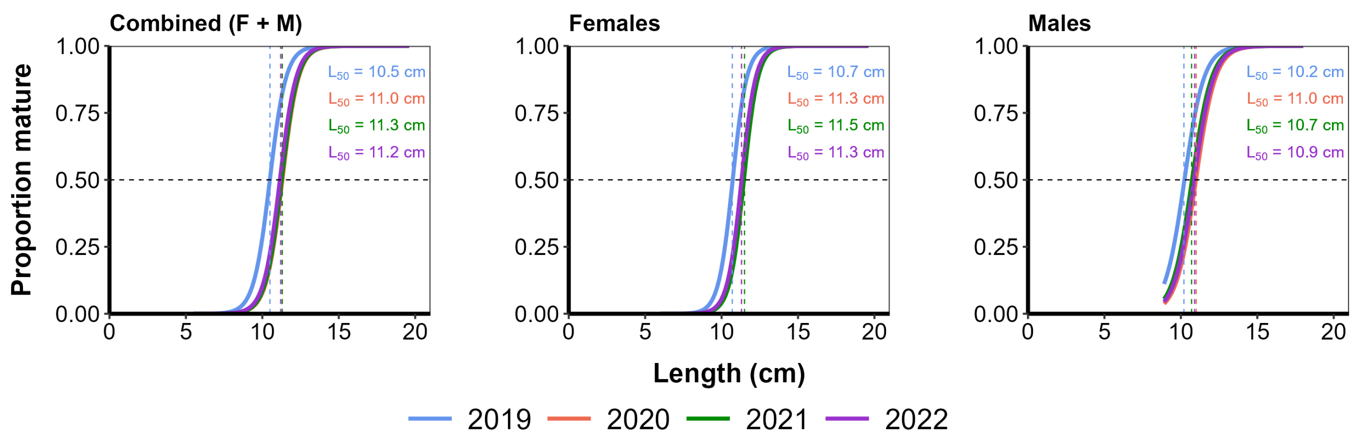

Figure 123. European sardine size at first maturity (L_{50}) for all years sampled.

Table 18. Number of European sardine individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls / on board sampling
			Number individuals sampled				
Artisanal fisheries	2019	North	0	0	1	0	1
Artisanal fisheries	2019	Center	32	3	0	0	2
Artisanal fisheries	2021	North	1	0	0	0	1
Bottom trawl	2019	South	38	122	404	53	18
Bottom trawl	2020	North	0	0	3	1	2
Bottom trawl	2020	Center	0	0	30	1	2
Bottom trawl	2020	South	7	96	132	94	14
Bottom trawl	2021	North	4	0	4	0	4
Bottom trawl	2021	Center	9	1	15	11	6
Bottom trawl	2021	South	16	85	352	191	17
Bottom trawl	2022	North	0	5	2	1	4
Bottom trawl	2022	Center	4	0	0	38	2
Bottom trawl	2022	South	0	31	182	166	12
Purse seine (fish market)	2019	North	826	990	724	610	22
Purse seine (fish market)	2019	Center	800	861	725	690	19
Purse seine (fish market)	2020	North	722	393	936	681	18
Purse seine (fish market)	2020	Center	354	465	817	836	15
Purse seine (fish market)	2021	North	867	878	925	557	21
Purse seine (fish market)	2021	Center	623	370	921	526	17
Purse seine (fish market)	2022	North	979	785	500	407	17
Purse seine (fish market)	2022	Center	699	905	663	561	19
Purse seine (on board)	2022	North	581	497	750	11	17
Purse seine (on board)	2022	Center	0	267	193	0	4

99% of the total European sardine landed in Catalonia in 2022 was caught by the purse seine fleet (ICATMAR, 23-03). Consequently, most of the individuals sampled were caught by purse seiners (Table 18). Some of the sampled individuals were also caught by bottom trawling, especially in the southern part of the sampling area, although their numbers were considerably low.

The annual length-frequency distribution of European sardine from 2019 to 2022 shows a clear mode at around 13 cm of TL in all years sampled (Figure 124). In 2022, most of the fish market samples were above the MRCS of the species (11 cm of TL). In the case of the on-board sampling, although most of the individuals were also above the MRCS, the smallest individuals were found, 7 cm compared to 10 cm of TL in the fish market sampling.

For monthly length-frequency distribution of European sardine at different depth strata in 2022 see Annex 18.

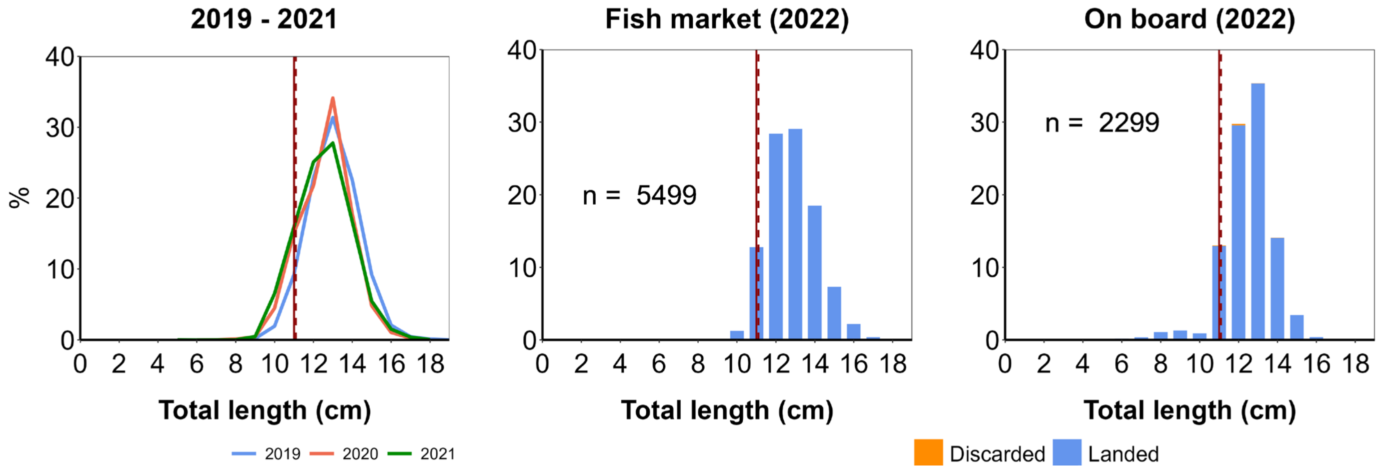

Figure 124. Annual length-frequency distribution of European sardine. Left: from 2019 to 2021, center: 2022 Fish market samples, right: 2022 On board samples. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS) and red dashed line: Size at first maturity (L_{50}).

The gonadal cycle of European sardine was analyzed monthly from 2019 to 2022 (Figure 125). The species, both males and females, showed a seasonal reproductive cycle as individuals in advanced maturity stages were present from November to February, which is consistent with the reproductive cycle described for the species in the study area in Palomera et al., (2007). On the other hand, the highest proportion of resting individuals was observed from April to September. The highest GSI values for both males and females were also found between November and February, coinciding with the reproductive peak of the species.

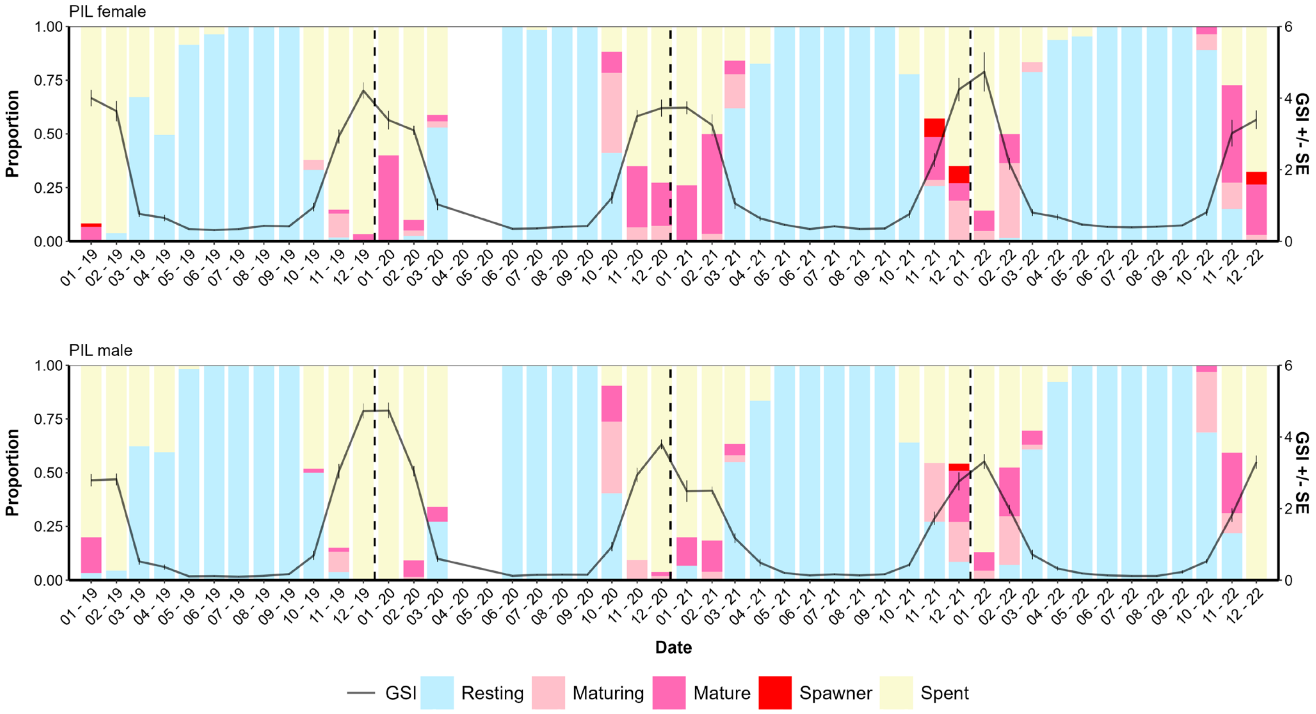

Figure 125. European sardine monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

The annual cycle of mesenteric fat content of European sardine was analyzed monthly from 2019 to 2022 (Figure 126). As shown, females and males followed the same pattern, with the highest proportion of individuals with medium and high fat content from April to October. Notably, GSI followed an opposite pattern, with the lowest values during spring and summer, confirming that European sardine stores fat before the reproductive season as described by Zorica et al., (2019).

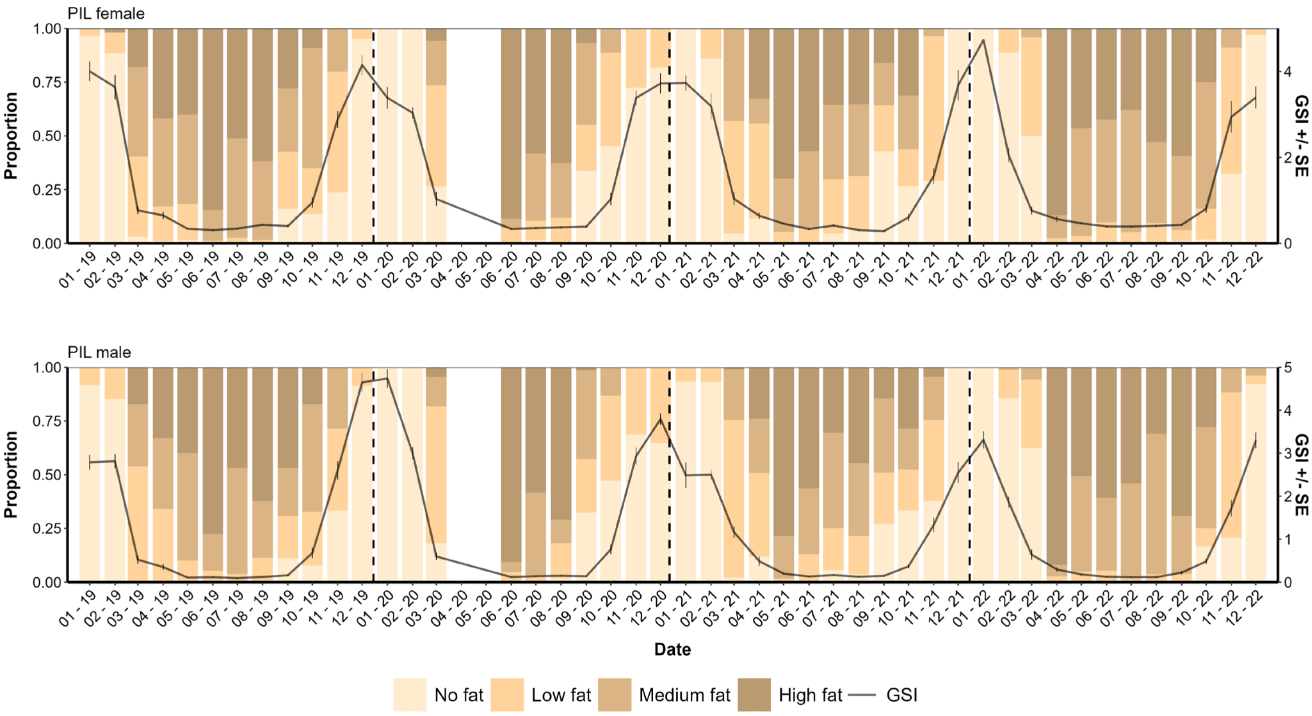

Figure 126. European sardine annual cycle for mesenteric fat content for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and monthly proportion of different mesenteric fat content.

Anchovy (*Engraulis encrasicolus*) ANE

The total anchovy catch in Catalonia in 2022 was 4494 t, 99% of which were caught by purse seine (ICATMAR, 23-03).

Figure 127 and Figure 128 show the spatial distribution of the species landings in 2022 and from 2017 to 2021 along the Catalan coast. A decreasing trend is observed over the years, especially in landings south of Barcelona.

All parameters analyzed in this report for anchovy were calculated using only individuals obtained by purse seine sampling (Table 20).

According to length-weight relationship parameters for both sexes combined, anchovy displayed a negative allometric growth (b<3) in 2022 (Table 19). However, when considering the two sexes separately, males showed an isometric growth (b=3), while that of females was negative (b<3). Comparing the growth curves between the years sampled for both sexes combined and separately, similar trends are observed (Figure 129).

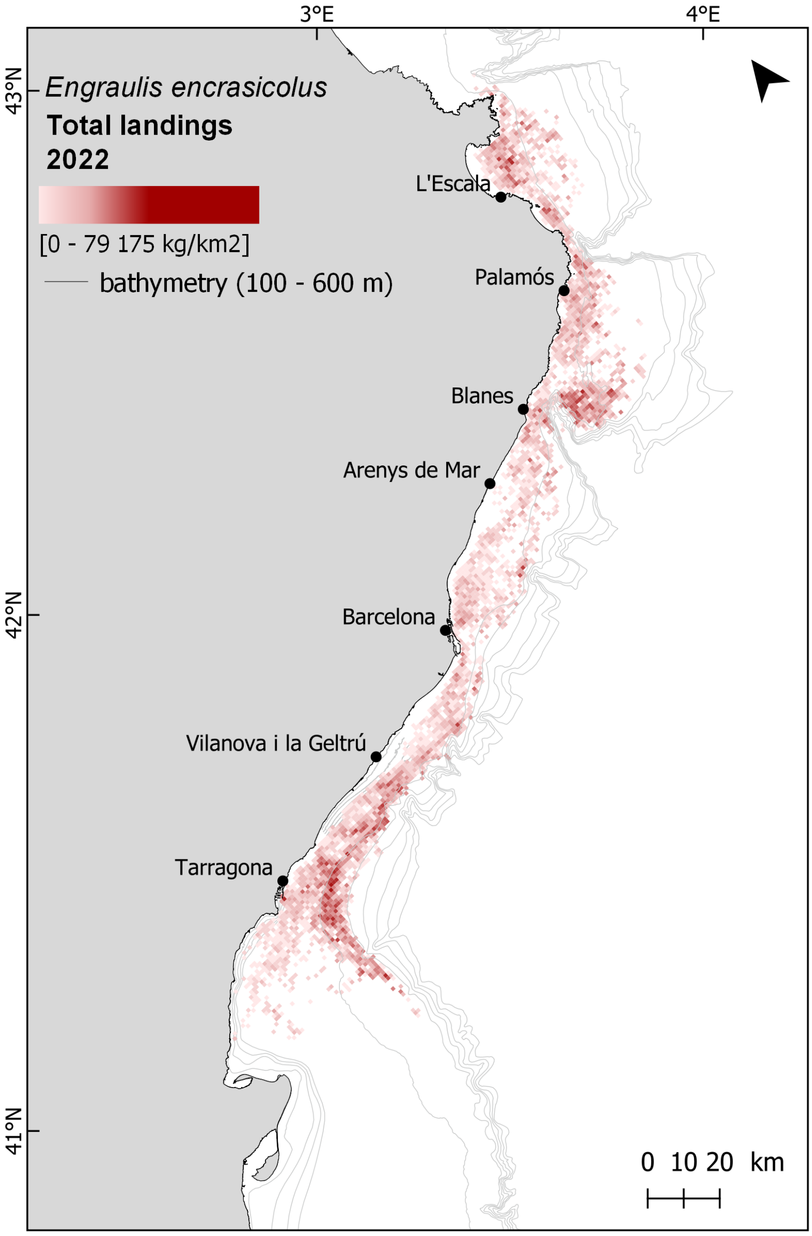

Figure 127. Spatial distribution of landings per unit of effort (LPUE) for anchovy in the Catalan fishing grounds (North GSA6) in 2022.

Table 19. Anchovy length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.0145	2.657	0.84	1582	9.74
Females	0.0285	2.391	0.76	888	9.71
Males	0.0055	3.045	0.96	639	9.57

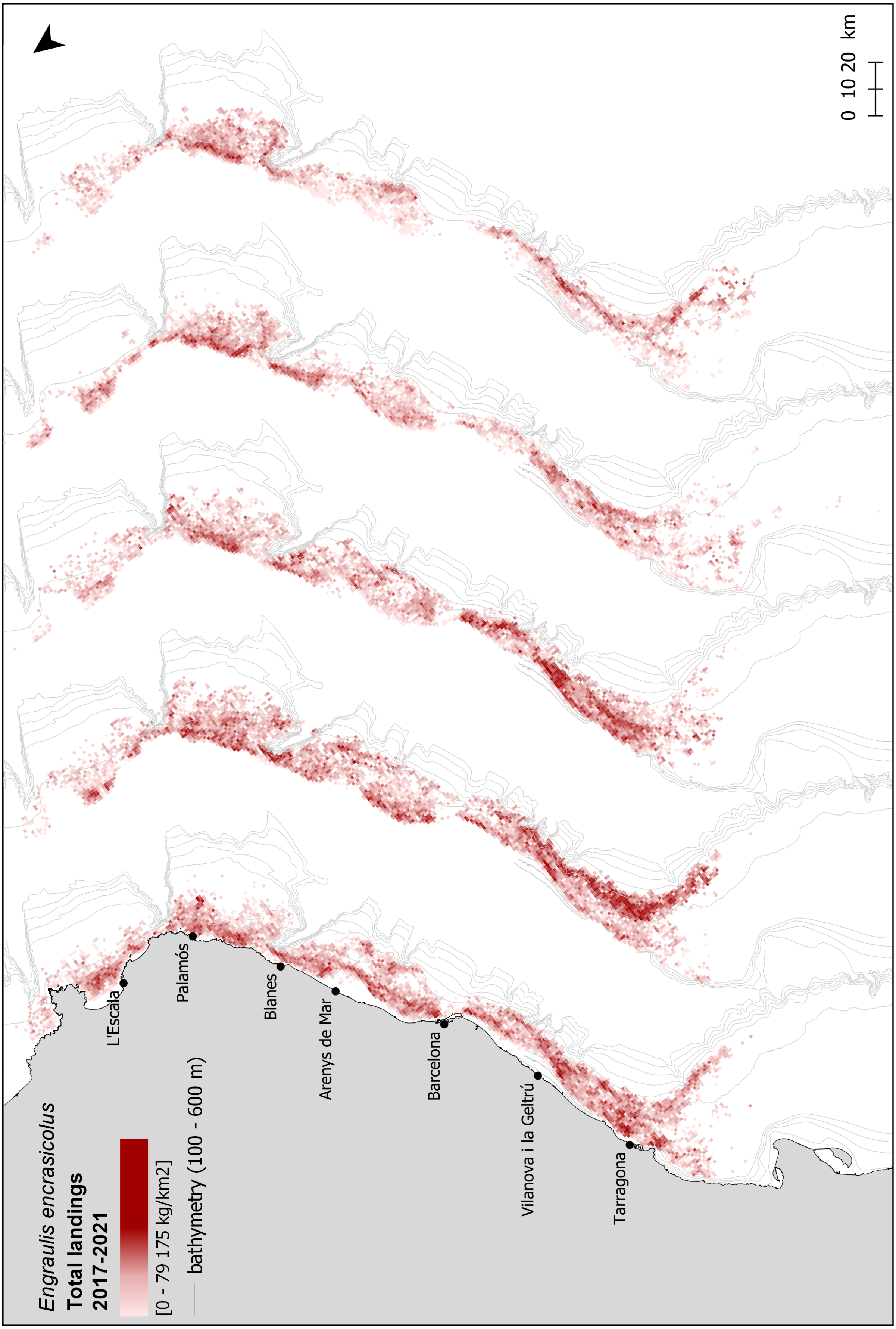

Figure 128. Spatial distribution of landings per unit of effort (LPUE) for anchovy in the Catalan fishing grounds (North GSA6) from 2017 to 2021.

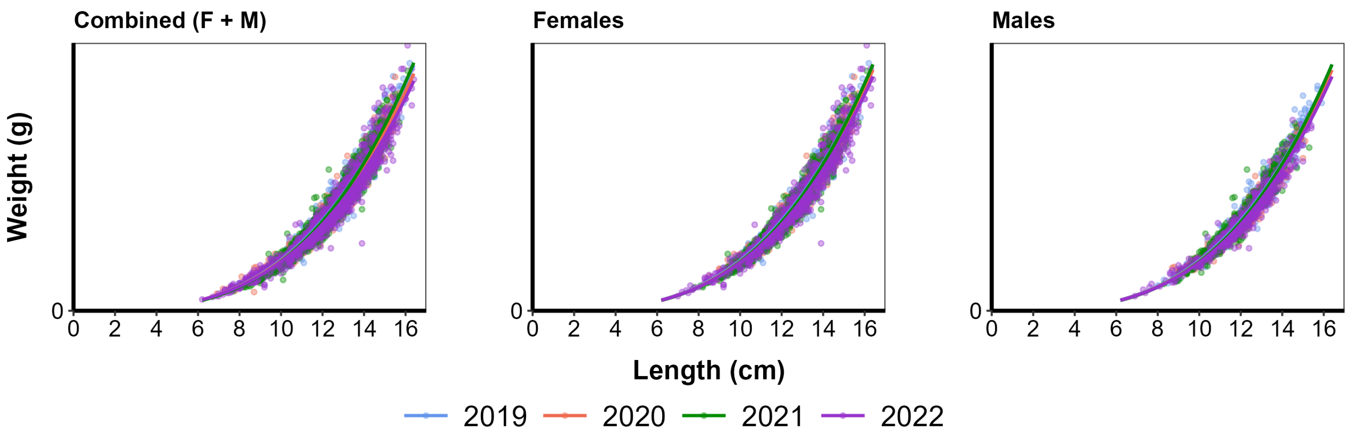

Figure 129. Anchovy length-weight relationship for the previous years sampled.

The size at first maturity (L_{50}) for anchovy in 2022 was 9.74 cm of TL for both sexes combined (Table 19 and Figure 130). Males showed earlier maturation than females in 2022, with L_{50} of 9.57 and 9.71 cm of TL respectively, a trend also observed in previous years sampled except for 2021, when the L_{50} for females was 10.0 cm and for males 9.9 cm of TL. Comparing between years for both sexes combined, 2022 had the lowest L_{50} and 2020 and 2021 the highest.

It should be noted that immature individuals may be missing in the sampling, as most of the sampled individuals come from the fish market through the purchase of batches and are therefore above the MCRS of the species. This could imply a higher calculated L_{50} than the real one.

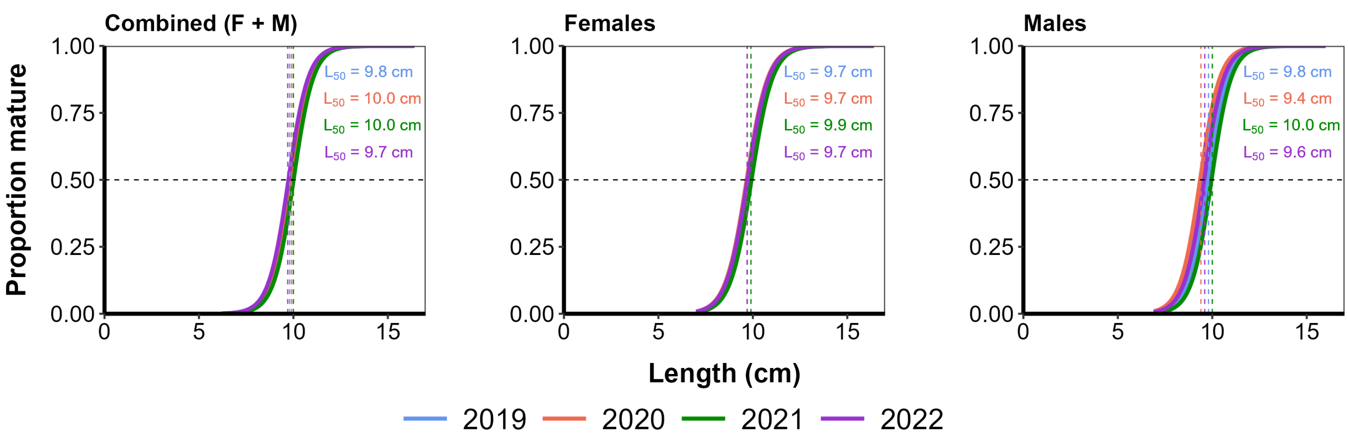

Figure 130. Anchovy size at first maturity (L_{50}) for all years sampled.

Table 20. Number of anchovy individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N hauls/ on board sampling
			Number individuals sampled				
Artisanal fisheries	2019	Center	0	1	0	0	1
Artisanal fisheries	2020	North	0	0	0	19	1
Artisanal fisheries	2021	North	0	3	0	1	2
Artisanal fisheries	2021	Center	105	0	0	0	3
Artisanal fisheries	2022	Center	0	13	0	0	1
Bottom trawl	2019	North	0	2	81	0	3
Bottom trawl	2019	Center	1	0	163	25	4
Bottom trawl	2019	South	428	372	582	238	27
Bottom trawl	2020	North	0	0	5	0	3
Bottom trawl	2020	Center	0	1	1	51	3
Bottom trawl	2020	South	10	273	266	177	14
Bottom trawl	2021	North	3	52	5	0	8
Bottom trawl	2021	Center	56	6	30	47	4
Bottom trawl	2021	South	72	143	192	297	19
Bottom trawl	2022	North	3	40	91	0	4
Bottom trawl	2022	Center	0	13	0	0	1
Bottom trawl	2022	South	8	259	155	180	17
Purse seine (fish market)	2019	North	1052	1729	1282	929	20
Purse seine (fish market)	2019	Center	929	1278	944	1078	17
Purse seine (fish market)	2020	North	1333	649	1562	1129	17
Purse seine (fish market)	2020	Center	1008	496	677	854	13
Purse seine (fish market)	2021	North	1307	1100	1416	565	19
Purse seine (fish market)	2021	Center	778	1037	1302	968	19
Purse seine (fish market)	2022	North	576	1637	867	752	16
Purse seine (fish market)	2022	Center	710	1337	1135	399	16
Purse seine (on board)	2022	North	1755	153	939	573	15
Purse seine (on board)	2022	Center	430	383	471	834	9

99% of the total anchovy landed in Catalonia in 2022 was caught by the purse seine fleet (ICATMAR, 23-03). Consequently, most of the individuals sampled were caught by purse seiners (Table 20). Some of the sampled individuals were also caught by bottom trawling, especially in the south, although their numbers were considerably low. Individuals from on-board sampling were mainly captured in the northern part of the sampling area.

The annual length-frequency distribution of European sardine from 2019 to 2022 shows a mode at between 11 and 12 cm of TL in all years sampled (Figure 124). In the case of 2022, fish market samples showed a mode at 11 cm, while on board samples showed it at 11-12 cm of TL. Most of the fish market samples were above the MRCS of the species (9 cm of TL). In the case of the on-board sampling, although most of the individuals were also above the MRCS, the smallest individuals were found, 7 cm compared to 8 cm of TL in the fish market sampling.

For monthly length-frequency distribution of anchovy at different depth strata in 2022 see Annex 19.

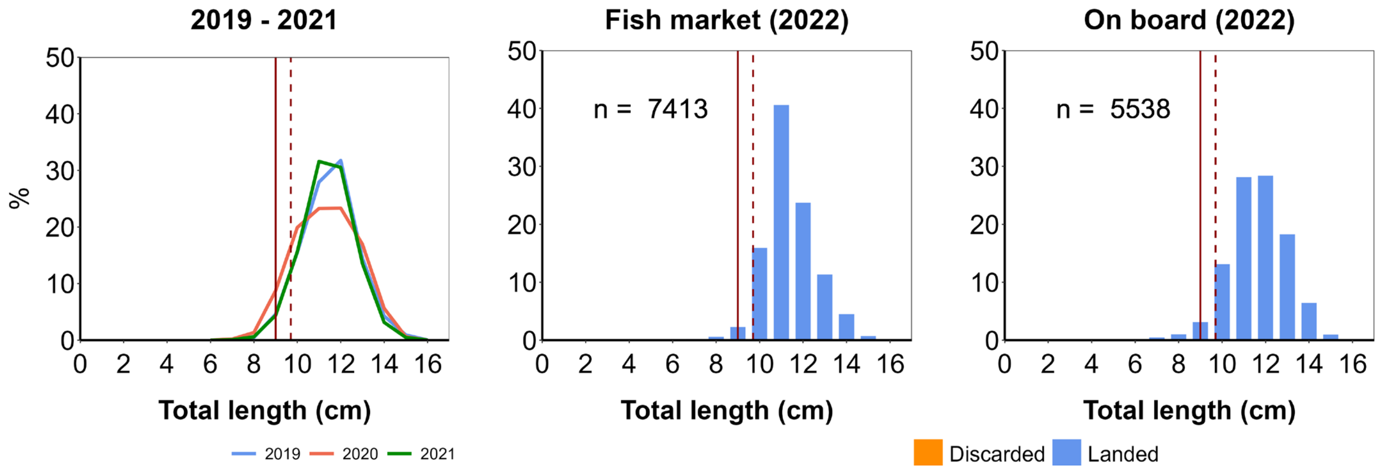

Figure 131. Annual length-frequency distribution of anchovy. Left: from 2019 to 2021, center: 2022 Fish market samples, right: 2022 On board samples. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS) and red dashed line: Size at first maturity (L_{50}).

The gonadal cycle of anchovy was analyzed monthly from 2019 to 2022 (Figure 132). The species, both males and females, showed a seasonal reproductive cycle as individuals in advanced maturity stages were present from May to September, which is consistent with the reproductive cycle described for the species in the study area in Palomera et al., (2007). On the other hand, the highest proportion of resting individuals was found from November to April. The highest GSI values for both males and females were also found between May and September, coinciding with the reproductive peak of the species.

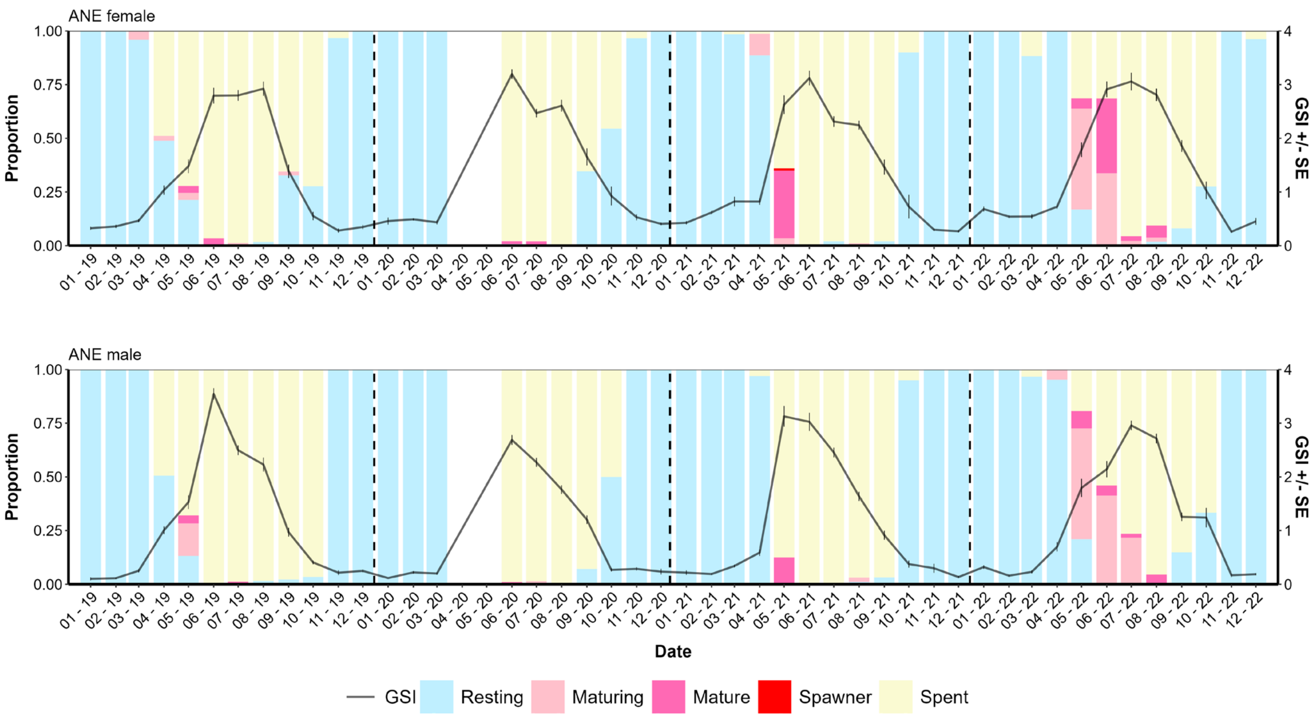

Figure 132. Anchovy monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

The annual cycle of mesenteric fat content of anchovy was analyzed monthly from 2019 to 2022 (Figure 133). It can be observed that females and males followed the same pattern, with the highest proportion of individuals with medium and high fat content from October to April/May. Notably, GSI followed an opposite pattern, with the lowest values during autumn and winter.

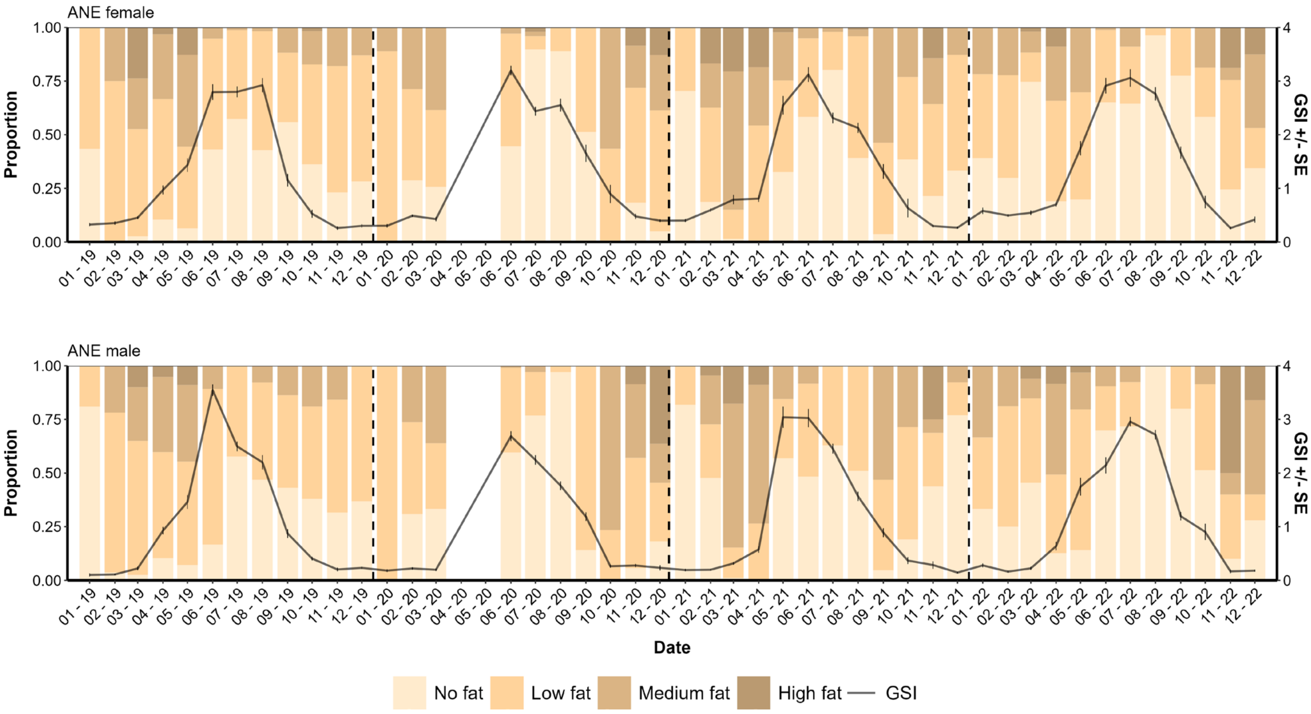

Figure 133. Anchovy annual cycle for mesenteric fat content for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and monthly proportion of different mesenteric fat content.

SECTION 4
Small-scale fisheries

Fishery monitoring of sand eel, common octopus and blue crab fishery in Catalonia

The monitoring of small-scale fisheries includes the sand eel fishery – including Mediterranean sand eel (*Gymnammodytes cicerelus*), smooth sand eel (*Gymnammodytes semisquamatus*), and transparent goby (*Aphia minuta*) –, the common octopus (*Octopus vulgaris*) fishery and the blue crab (*Callinectes sapidus*) fishery. The sand eel fishery is the subject of a co-management plan since 2014, the common octopus fishery is co-managed in two different areas of the territory (Central Catalonia and the Ebre Delta) and the blue crab fishery is also co-managed in the Ebre Delta area.

Table 21. Number of on-board samplings of small-scale fisheries monitored (sand eel and common octopus fisheries). In this table samplings of blue crab were not included (see table 31).

Fishery	Type	Year	Zone	Winter	Spring	Summer	Autumn
				Number of samplings			
Artisanal fisheries	Sandeel seiner	2019	North	6	7	10	7
Artisanal fisheries	Sandeel seiner	2019	Center	1	1	0	0
Artisanal fisheries	Sandeel seiner	2020	North	3	2	6	12
Artisanal fisheries	Sandeel seiner	2020	Center	2	0	0	0
Artisanal fisheries	Sandeel seiner	2021	North	3	6	6	2
Artisanal fisheries	Sandeel seiner	2021	Center	3	0	0	0
Artisanal fisheries	Sandeel seiner	2022	North	5	6	10	7
Artisanal fisheries	Sandeel seiner	2022	Center	0	1	0	0
Artisanal fisheries	Pots	2019	Center	6	7	8	5
Artisanal fisheries	Pots	2020	Center	5	8	7	6
Artisanal fisheries	Pots	2020	South	0	0	2	7
Artisanal fisheries	Pots	2021	Center	9	10	6	18
Artisanal fisheries	Pots	2021	South	5	6	6	4
Artisanal fisheries	Pots	2022	Center	12	8	8	18
Artisanal fisheries	Pots	2022	South	4	1	6	11
Artisanal fisheries	Traps	2019	Center	6	6	11	0
Artisanal fisheries	Traps	2020	Center	16	9	10	7
Artisanal fisheries	Traps	2021	Center	7	6	12	11
Artisanal fisheries	Traps	2022	Center	9	11	12	13
Artisanal fisheries	Traps	2022	South	2	6	0	0
Total number of samplings per season				104	101	120	128
Total number of samplings in the studied period							453

Sand eel fishery in Catalonia

In Catalonia, the main target species by the boat seines "sonsera" are *Gymnammodytes cicerelus*, *Gymnammodytes semisquamatus*, and *Aphia minuta*. The two species of the genus *Gymnammodytes* are coastal species found on the continental shelf on shallow waters, on sand, shells and fine gravel bottoms, inhabiting burrows dug on sandy substrates and living in large groups.

The sand eel fishery is regulated by quotas and fishing effort limitations (number of vessels and fishing days per vessel). Fishing has a regulated closure during the spawning season, from December 15th to March 1st. However, the transparent goby is only allowed to be fished during the closed fishing period for the sand eels.

The total sand eel catch in Catalonia in 2022 was 134.39 t, all of it caught by boat seines "*sonsera*" within the co-management plan (ICATMAR, 23-03).

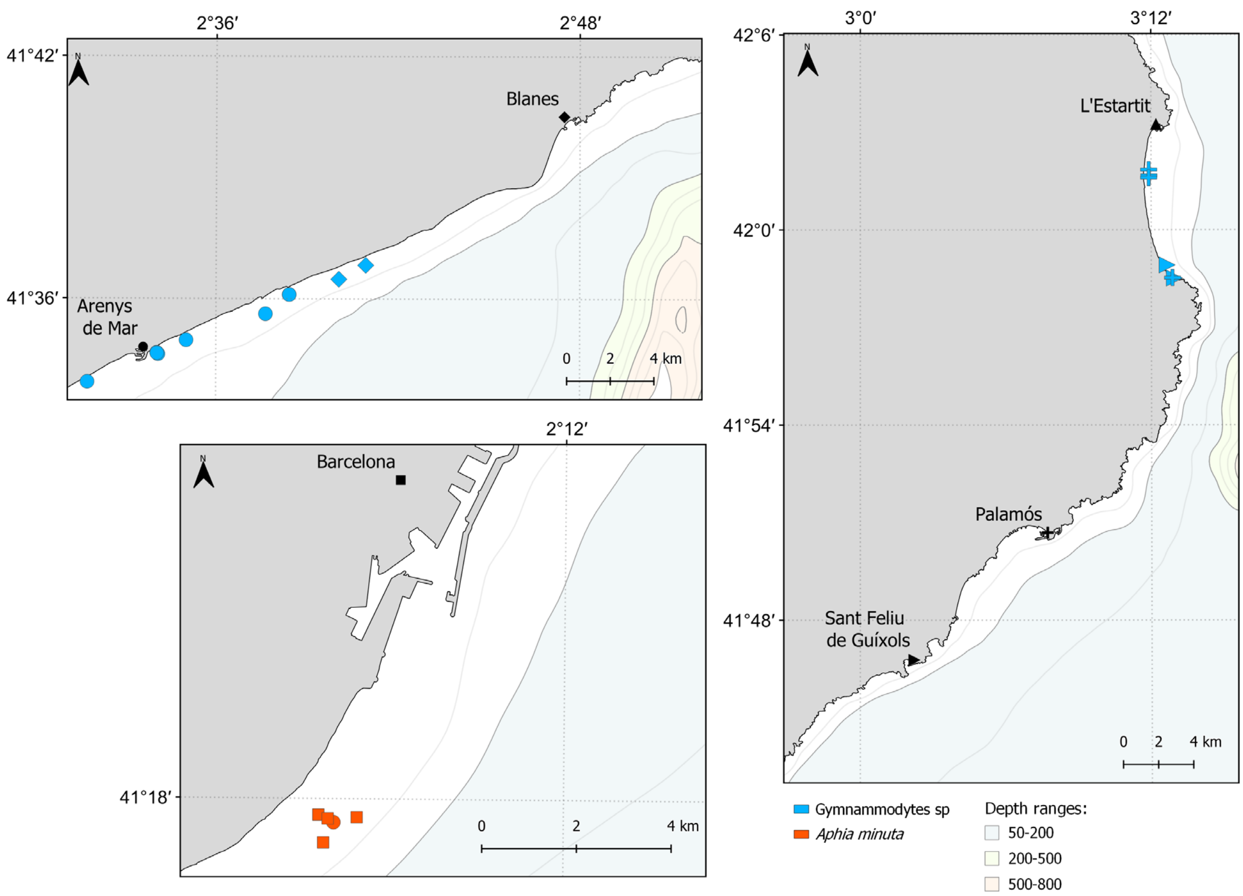

Figure 134. Sand eel samplings in 2022.

A total of 29 samplings were carried out in 2022 (Table 21 and Figure 134). For the sand eel fishery, 98% of the catch were target species and 2% were discards (Figure 135). The most important target species was Mediterranean sand eel (69% in the period 2019-2021 and 81% in 2022), with transparent goby (*Aphia minuta*) and *Pseudaphya ferreri* accounting for less than 2% in both periods (Figure 136). The most abundant species in sand eel discards was *Scomber colias* for the period 2019-2021 and *Dasyatis pastinaca* in 2022 (Figure 137).

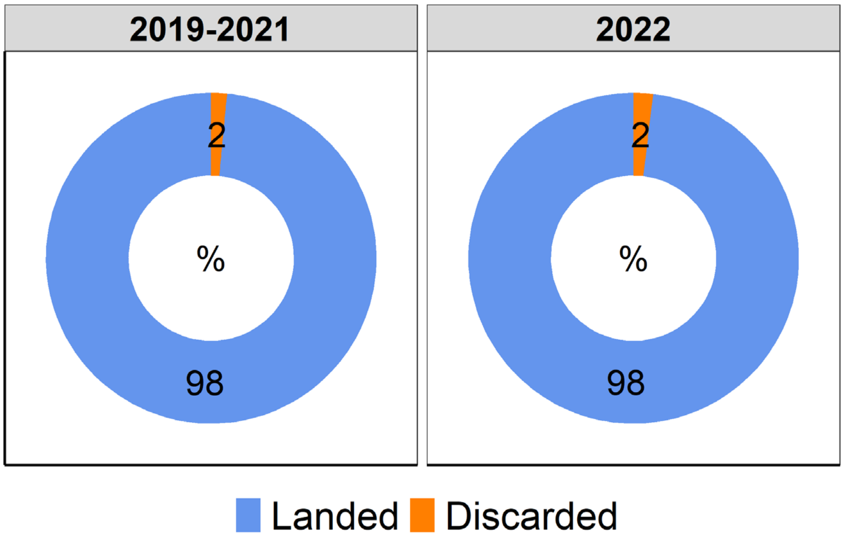

Figure 135. Sand eel fishery catch composition. Percentage by weight of landed and discarded catch.

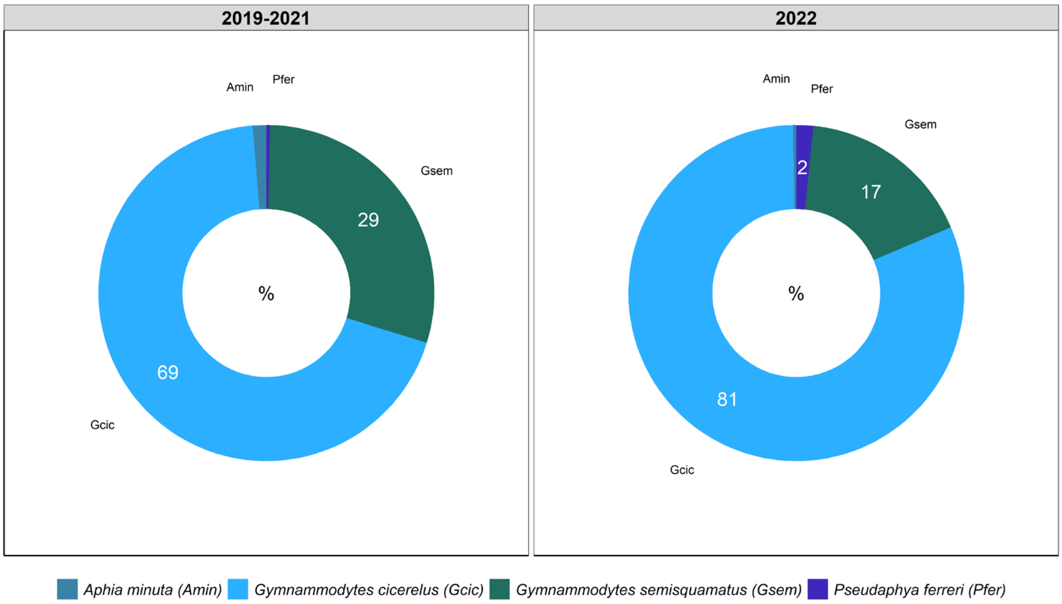

Figure 136. Sand eel target species composition. Percentage by weight of each target species.

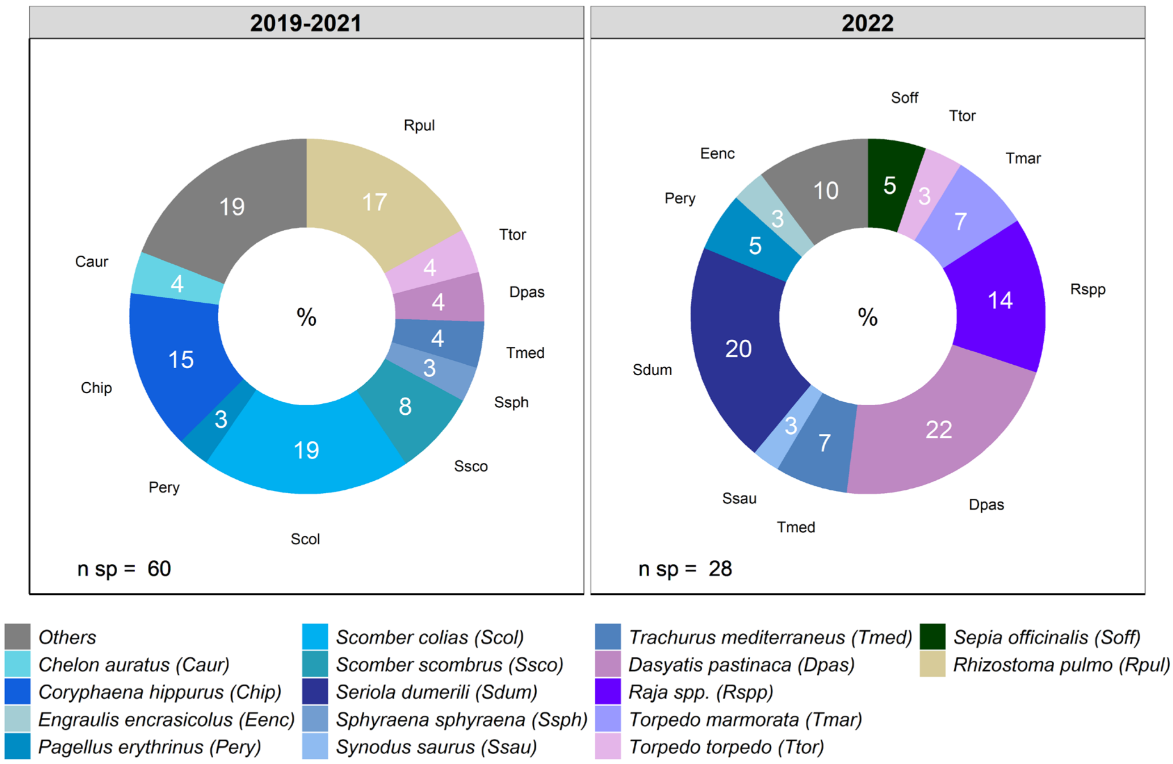

Figure 137. Sand eel discarded species composition. Percentage by weight of each discarded species.

Mediterranean sand eel (*Gymnammodytes cicerelus*) ZGC

According to length-weight relationship parameters for both sexes combined and separately, Mediterranean sand eel displayed a positive allometric growth (b>3) in 2022 (Table 22). Also, when comparing length-weight relationships for both sexes combined and separately from 2019 to 2022, results show similar trends for all years sampled with positive allometric growth in all cases (Figure 138).

Table 22. Mediterranean sand eel length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.0013	3.3335	0.98	1050	9.26
Females	0.0021	3.1192	0.97	270	
Males	0.0015	3.2396	0.95	84	

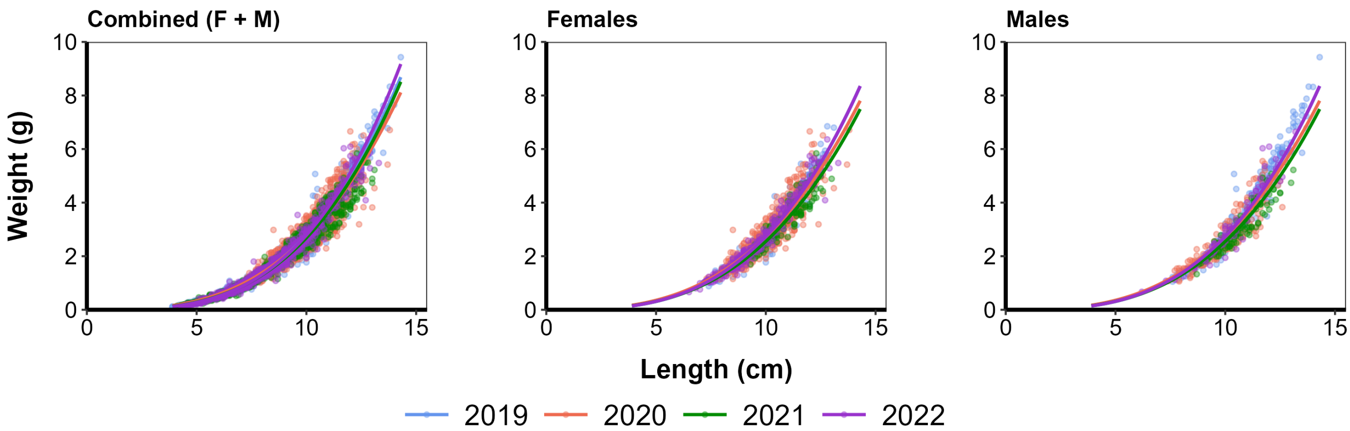

Figure 138. Mediterranean sand eel length-weight relationship for all years sampled.

The size at first maturity (L_{50}) for Mediterranean sand eel in 2022 was 9.23 cm of TL for both sexes combined (Figure 139). When comparing between the years sampled, differences were observed: 2020 showed the lowest L_{50} value, with 7.8 cm, and 2021 the highest, with 10 cm of TL.

All the Mediterranean sand eel sampled were caught by artisanal fisheries throughout the four years sampled (Table 23).

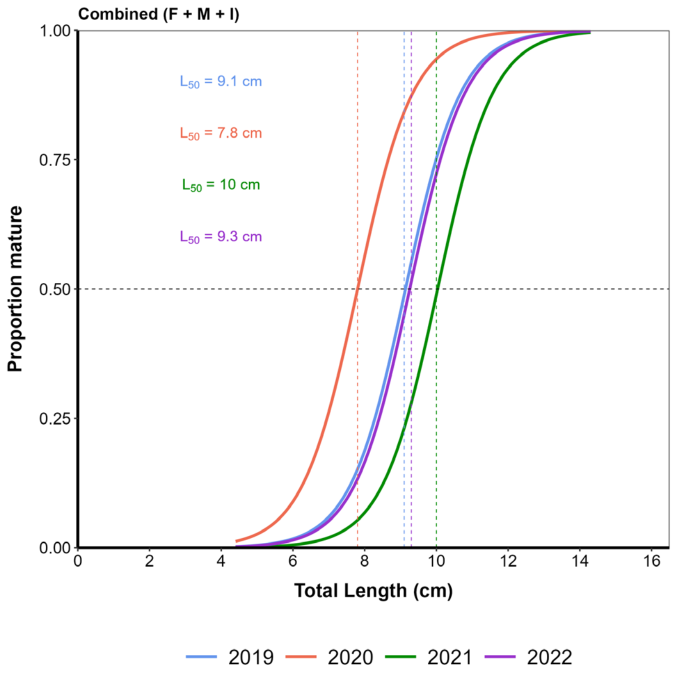

Figure 139. Mediterranean sand eel size at first maturity (L_{50}) for all years sampled.

Table 23. Number of Mediterranean sand eel individuals measured from 2019 to 2022 along the zones sampled in each season.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N on board sampling
			Number individuals sampled				
Artisanal fisheries	2019	North	727	2358	1775	1041	20
Artisanal fisheries	2020	North	1038	562	1427	1122	17
Artisanal fisheries	2021	North	723	1935	1335	301	17
Artisanal fisheries	2022	North	749	1884	1418	999	21

The annual length-frequency distribution of Mediterranean sand eel from 2019 to 2022 ranged between 3.5 and 14 cm of TL (Figure 140). Sizes varied over the four years sampled. In 2019, 15% of individuals were small (6 to 8 cm of TL). In contrast, in 2020 most individuals reached 9 cm of TL. In 2021 a bimodal distribution was observed with a high percentage of 6 and 10 cm individuals, although with a high percentage of small individuals. In 2022 the size pattern was similar to that observed in 2019 with a higher number of 6-8 cm individuals.

Monthly size frequency distributions of Mediterranean sand eel in 2022 showed an evolution of sizes throughout the year (Annex 20). It started with a higher abundance of small individuals in February and sizes increased over the months until reaching the largest individuals in January.

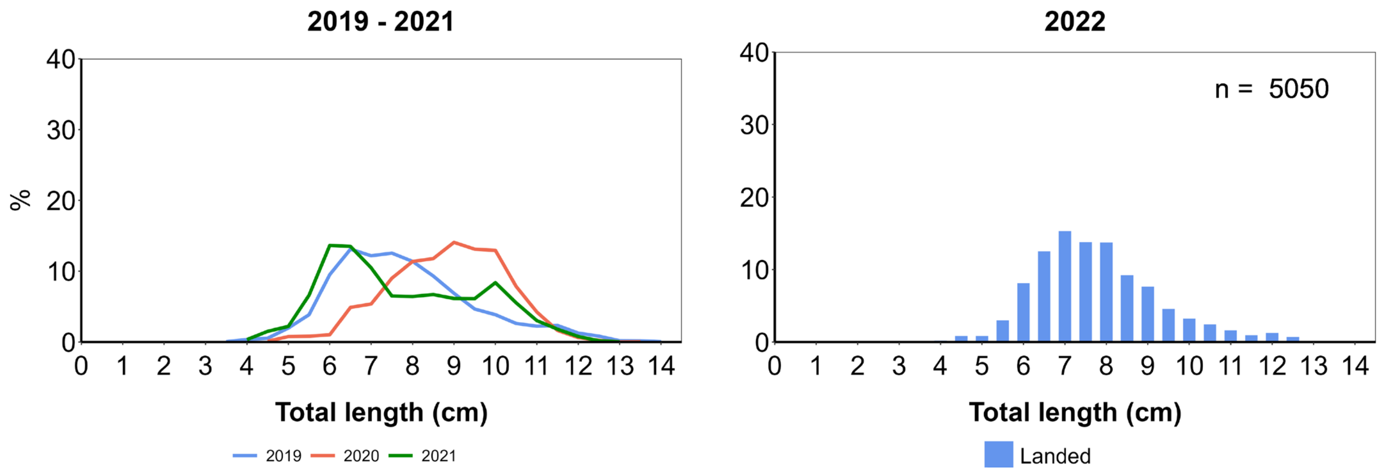

Figure 140. Annual length-frequency distribution of Mediterranean sand eel. Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals.

The gonadal cycle of Mediterranean sand eel was analyzed monthly from 2019 to 2022 (Figure 141). The species showed a seasonal reproductive cycle with spawning females present from November to March, with a peak in January. The highest GSI values both for females and males were found from December to March, with a peak in January, coinciding with the species maximum reproductive activity.

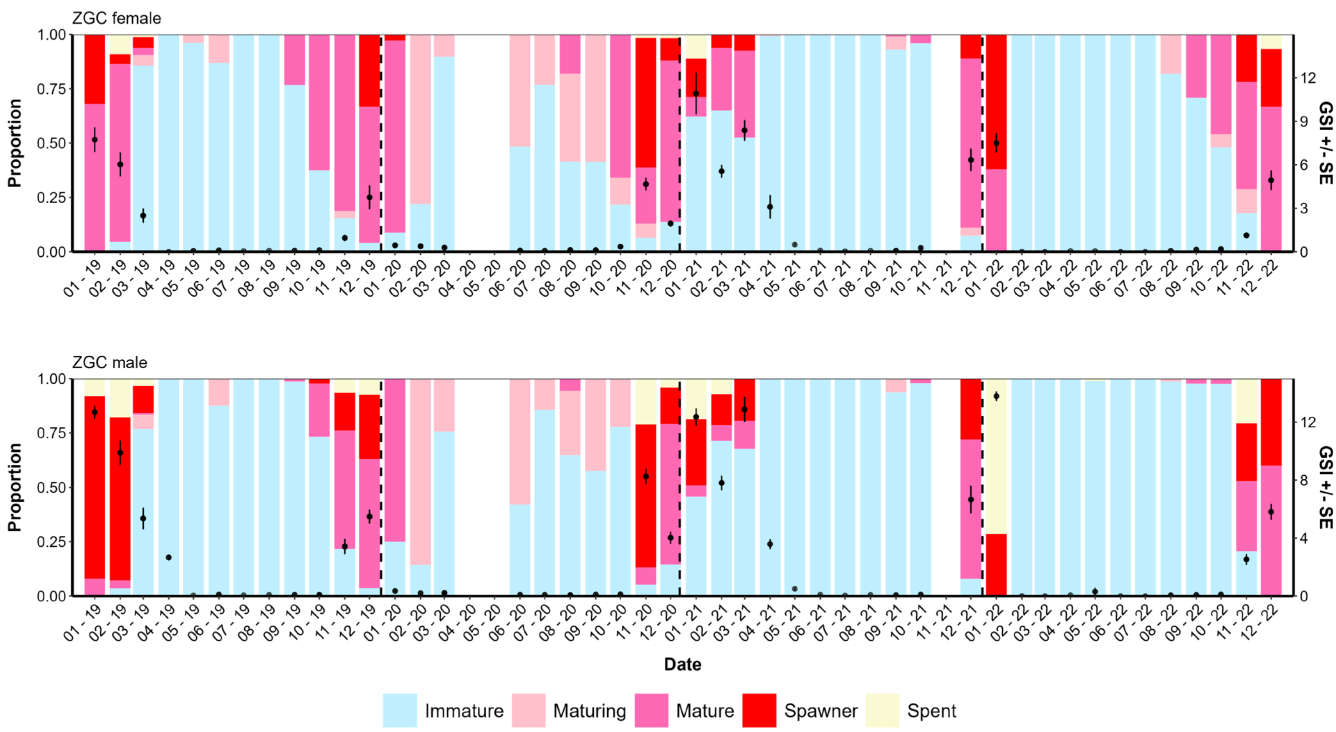

Figure 141. Mediterranean sand eel monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

Smooth sand eel (*Gymnammodytes cicerelus*) ZGS

According to length-weight relationship parameters for both sexes combined and separately, smooth sand eel displayed a positive allometric growth (b>3) in 2022 (Table 24). Also, when comparing length-weight relationships for both sexes combined and separately from 2019 to 2022, results show similar trends for all years sampled with positive allometric growth in all cases (Figure 142).

Table 24. Smooth sand eel length-weight relationship and size at first maturity (L_{50}) in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.0038	28.164	0.83	142	8.48
Females	0.0024	30.038	0.95	67	
Males	0.0012	32.659	0.87	47	

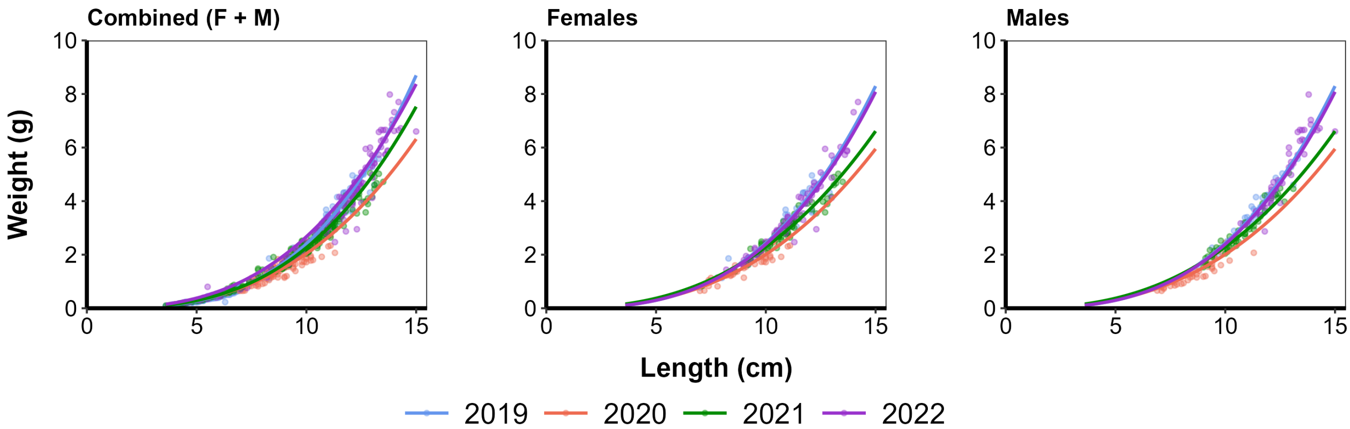

Figure 142. Smooth sand eel length-weight relationship for all years sampled.

The size at first maturity (L_{50}) for smooth sand eel in 2022 was 8.5 cm of TL for both sexes combined (Figure 139). When comparing between the years sampled, differences were observed: 2020 showed the lowest L_{50} value, with 6.4 cm, and 2021 the highest, with 8.7 cm of TL.

All the smooth sand eel sampled were caught by artisanal fisheries throughout the four years sampled (Table 25).

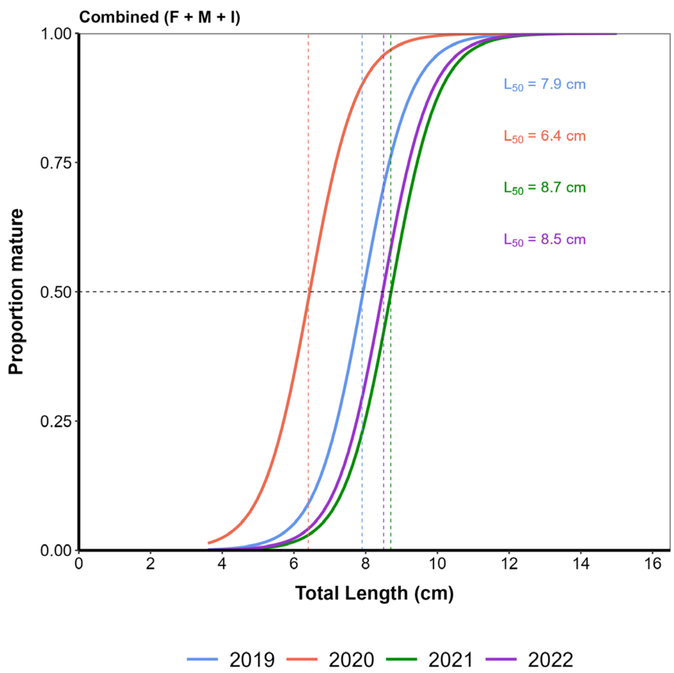

Figure 143. Smooth sand eel size at first maturity (L_{50}) for all years sampled.

Table 25. Number of smooth sand eel individuals measured from 2019 to 2022 along the zones sampled in each season.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N on board sampling
			Number individuals sampled				
Artisanal fisheries	2019	North	343	170	3	12	10
Artisanal fisheries	2020	North	32	2	5	122	8
Artisanal fisheries	2021	North	251	27	16	122	11
Artisanal fisheries	2022	North	129	25	0	164	7

The annual length-frequency distribution of smooth sand eel from 2019 to 2022 ranged between 3 and 14 cm of TL (Figure 144). Sizes varied over the four years sampled. In 2019, two modes were observed, with 20% of individuals measuring 6 cm and 10% measuring 11 cm of TL. In contrast, in 2020 only one mode was observed, located at 9 cm of TL (30% of individuals), while in 2021 the mode shifted to larger sizes, as 20% of individuals measured between 10 and 11 cm of TL. In 2022 the size pattern was similar to that observed in 2021 with a major number of individuals from 9 to 13.5 cm of TL.

Monthly size frequency distributions of smooth sand eel in 2022 showed the highest abundance of small individuals in May and the highest abundance of large individuals in February (Annex 20).

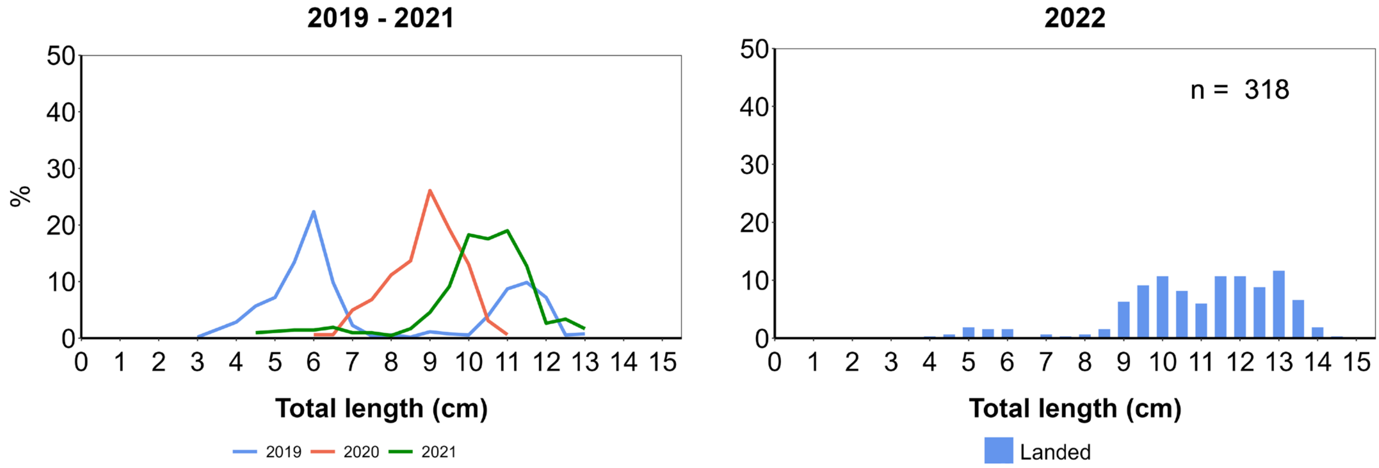

Figure 144. Annual length-frequency distribution of smooth sand eel. Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals.

The gonadal cycle of smooth sand eel was analyzed monthly from 2019 to 2022 (Figure 145). The species showed a seasonal reproductive cycle with spawning females present from December to April, with a peak in January. Spawning males showed a similar pattern, with a peak in January and February.

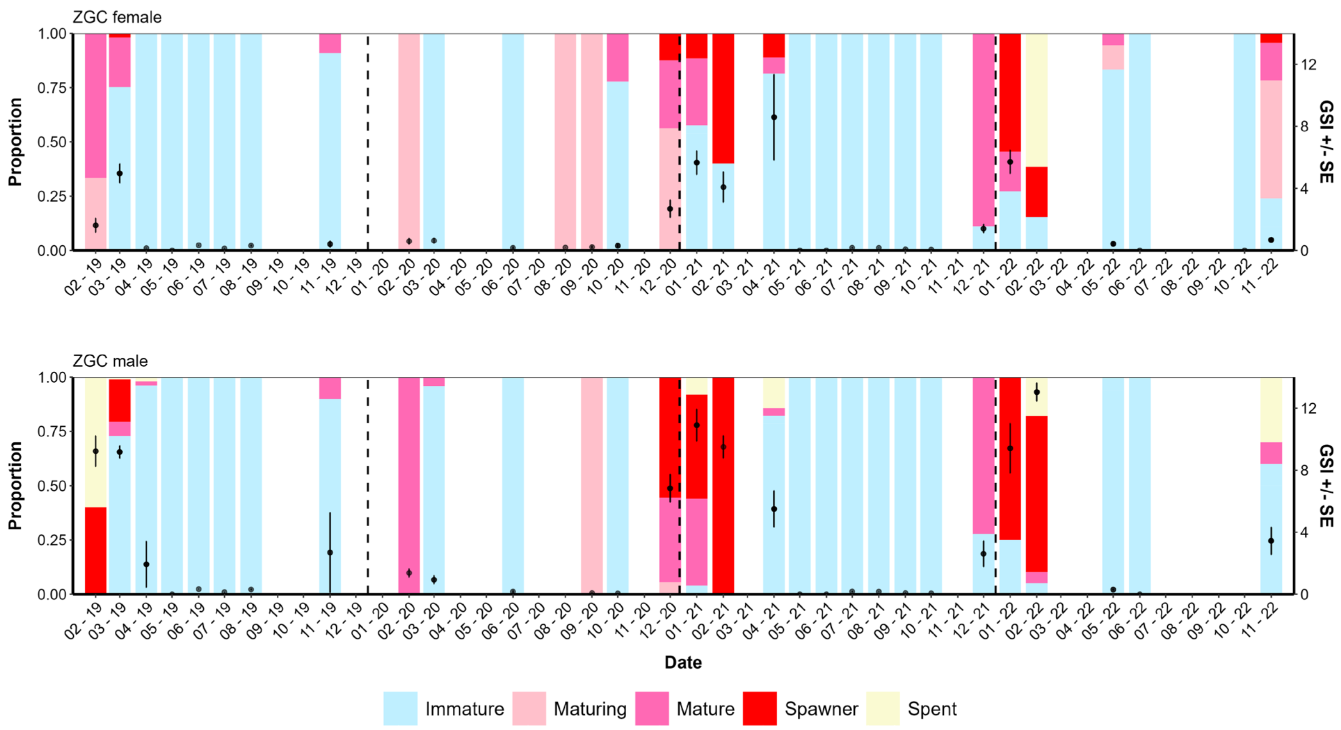

Figure 145. Smooth sand eel monthly gonadal cycle for females (top) and males (bottom) from 2019 to 2022. Gonadosomatic index (GSI +/- SE (Standard Error)) and proportion of different maturity stages.

Transparent goby (*Aphia minuta*) FIM

According to length-weight relationship parameters for both sexes combined and separately, transparent goby displayed a positive allometric growth (b>3) in 2022 (Table 26). Also, when comparing length-weight relationships for both sexes combined and for females from 2019 to 2022, results show similar trends for all years sampled with positive allometric growth in all cases (Figure 146). However, in 2022 the regression line for females did not follow the same pattern as in other years, possibly due to the low number of females sampled and the fact that most of them were concentrated in the same size range.

Table 26. Transparent goby length-weight relationship in 2022.

2022	L-W (a)	L-W (b)	L-W (r^2)	n	L_{50}
Combined	0.0031	3.4094	0.88	100	
Females	0.0568	1.3877	0.44	22	

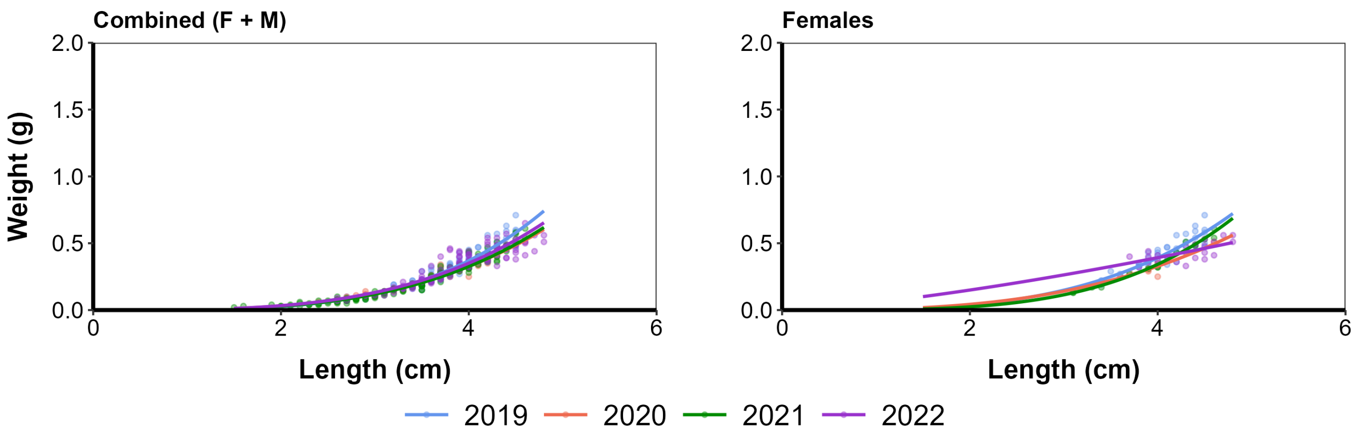

Figure 146. Transparent goby length-weight relationship for the previous years sampled.

All the transparent goby sampled were caught by artisanal fisheries throughout the four years sampled (Table 27). The transparent goby fishing season includes winter and sometimes spring, so catches of this species are concentrated in these two seasons.

Table 27. Number of transparent goby individuals measured from 2019 to 2022 along the zones sampled in each season.

Fishery	Year	Zone	Winter	Spring	Summer	Autumn	N samplings
			Number individuals sampled				
Artisanal fisheries	2019	Center	114	220	0	0	2
Artisanal fisheries	2020	Center	325	0	0	0	1
Artisanal fisheries	2021	Center	777	0	0	0	3
Artisanal fisheries	2022	North	117	0	0	0	1
Artisanal fisheries	2022	Center	0	86	0	0	1

The annual length-frequency distribution of transparent goby from 2019 to 2022 ranged between 1.5 and 4.5 cm of TL (Figure 147). The largest individuals (4.5 cm of TL) were found in 2022.

Monthly size frequency distributions of transparent goby in 2022 showed the highest abundance of small individuals in February and the highest abundance of large individuals in April (Annex 20). The transparent goby can only be fished during the sand eel closure period (December to March), so the months not shown in the graph were not sampled.

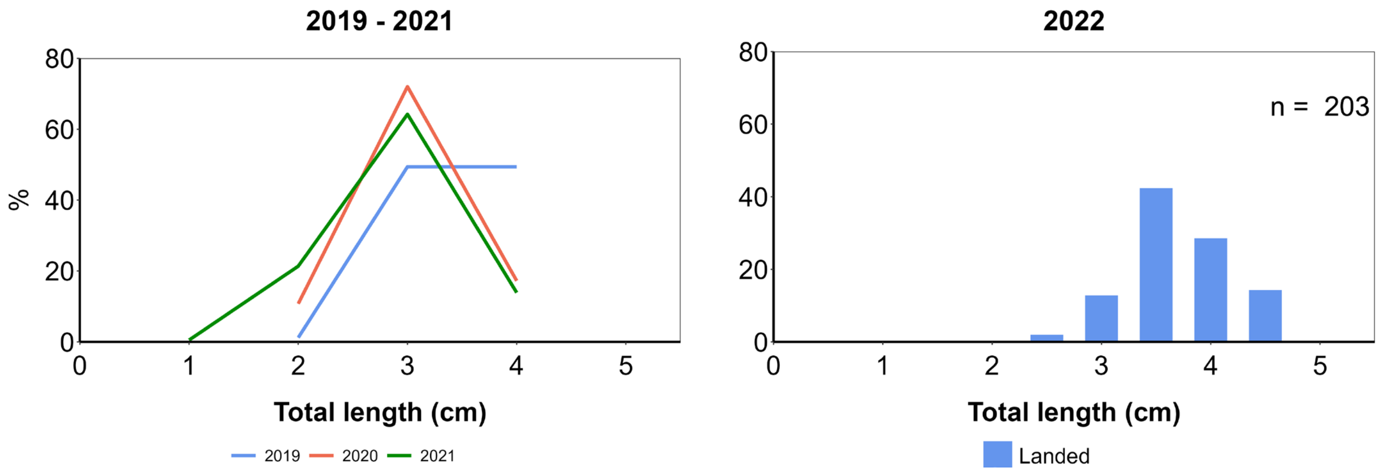

Figure 147. Annual length-frequency distribution of transparent goby. Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals.

Common octopus fishery in Catalonia

A total of 121 artisanal fisheries samplings were carried out for the common octopus fishery in 2022 (pots and traps), within the co-management areas of Central Catalonia and Ebre Delta (Table 21 and Figure 148). Individuals below 1 kg weight were measured on-board but not sold in auction, as explained by current regulation (ARP/222/2020).

The total common octopus catch in Catalonia in 2022 was 303 t, approximately 54% of which were caught by small-scale fisheries and 28% by bottom trawling (ICATMAR, 23-03).

All parameters analyzed in this report for common octopus were calculated using only individuals obtained by artisanal fisheries sampling, although a few measured individuals were caught by bottom trawling sampling (Table 29).

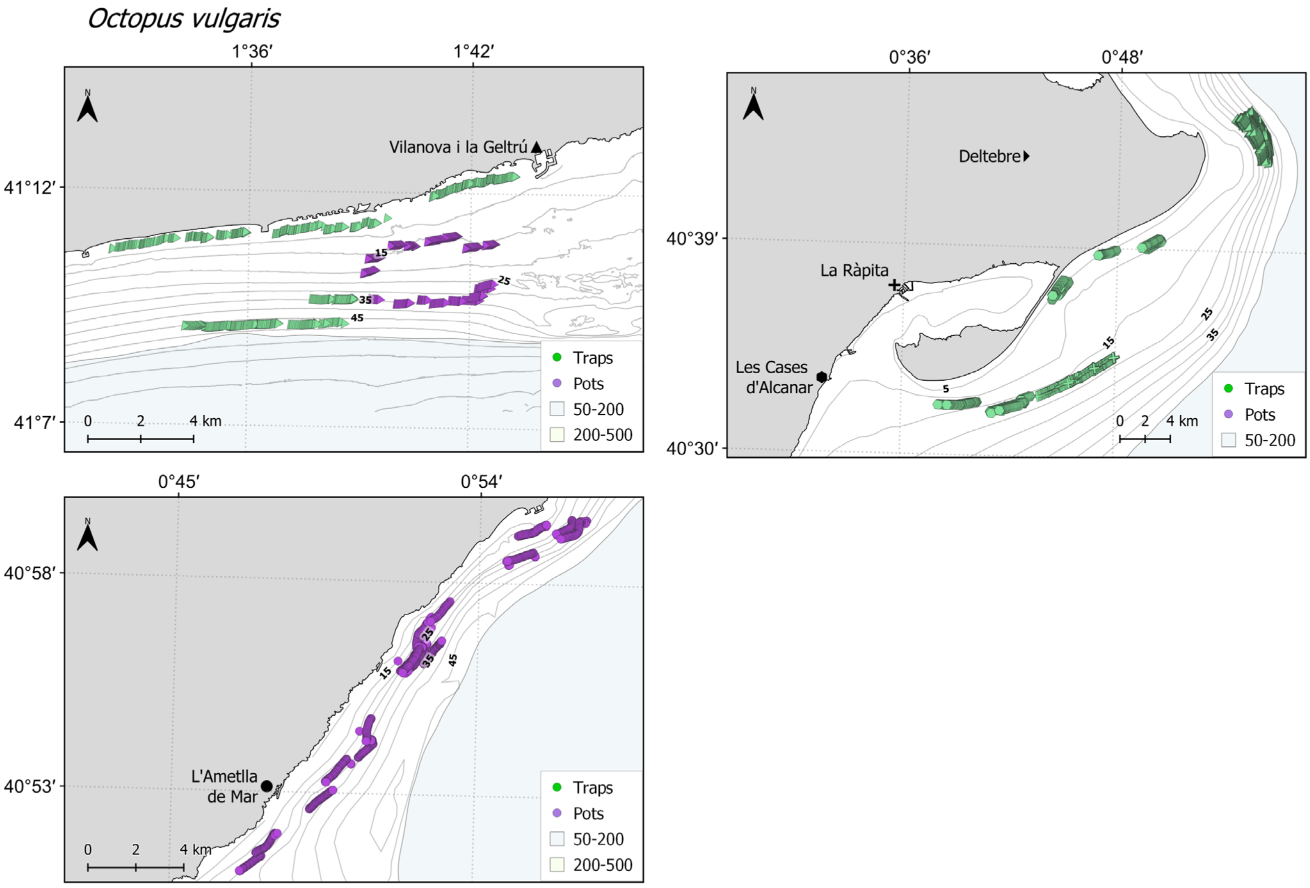

Figure 148. Common octopus sampling in 2022. Central Catalnonia (top-left), Ebre delta (top-right and bottom-felt).

Common octopus (*Octopus vulgaris*) OCC

Individuals with missing arms were excluded from the calculations of length-weight parameters of common octopus in 2022.

According to length-weight relationship parameters for both sexes combined, Central and South Catalonia common octopus displayed a negative allometric growth (b<3) in 2022 (Table 28). Also, when comparing length-weight relationships for both sexes combined and separately for Central and South Catalonia from 2019 to 2022, results show similar trends for all years sampled with negative allometric growth in all cases Figure 149 and Figure 150).

The difference in the length-weight parameters and growth curves between the Central and South Catalonia common octopus is due to the fact that in the former all individuals were measured when the animal was already dead, while in the latter many of them were still alive. The soft structure of the octopus itself means that, while they are alive, the variability in the measurement is much higher, as they contract and expand.

Almost all of the common octopus sampled were caught by artisanal fisheries over the four years sampled, mainly through traps and pots (Table 29). Throughout the years, the gear and zone with the most individuals sampled were traps in the center, except in autumn 2022 with pots, with the highest record of individuals sampled of all years. It should be noted that many of these differences are partly due to differential sampling effort.

Table 28. Common octopus length-weight relationship in 2022 for Central Catalonia and South Catalonia. Only individuals with 8 arms were considered.

Length – weight relationship (Center Catalonia)				
2022	**a**	**b**	**r^2**	**n**
Combined	5.3691	2.0647	0.69	729
Females	5.7575	2.0220	0.72	350
Males	2.8923	2.3113	0.72	379
Length – weight relationship (South Catalonia)				
2022	**a**	**b**	**r^2**	**n**
Combined	13.1136	1.7972	0.65	367
Females	14.5447	1.7549	0.67	187
Males	11.2814	1.8572	0.64	180

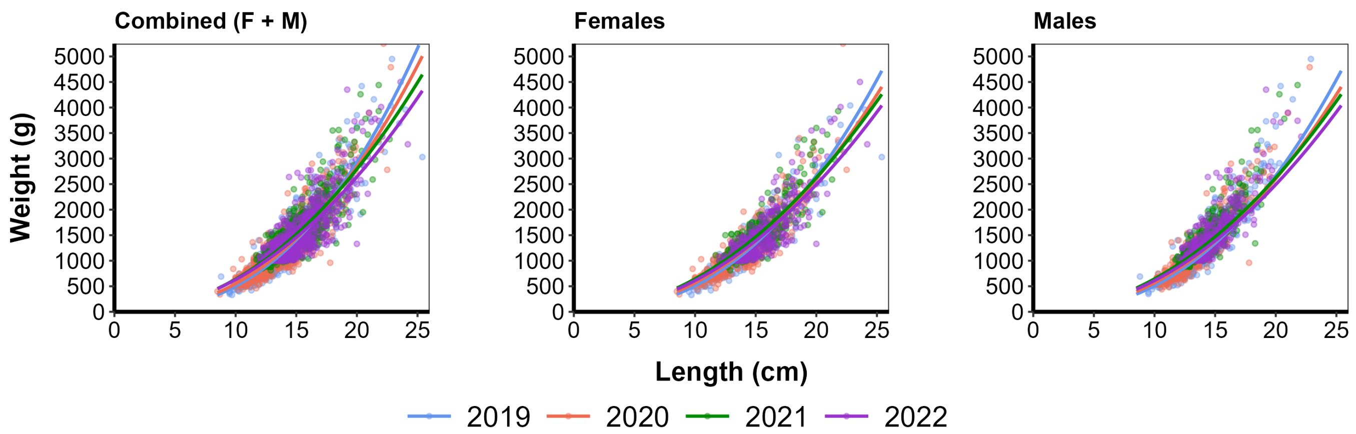

Figure 149. Common octopus length-weight relationship for Central Catalonia individuals from 2019 to 2022.

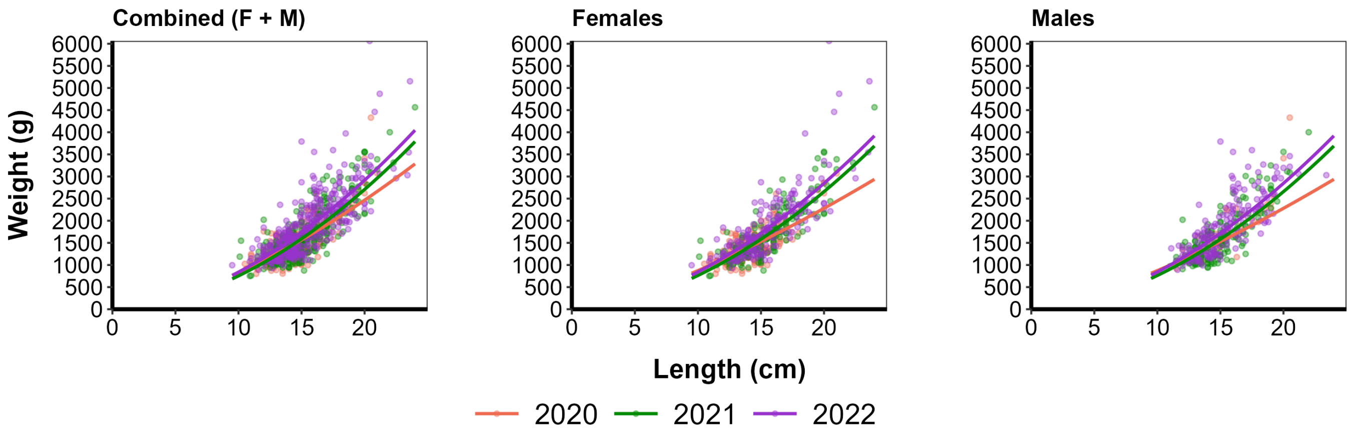

Figure 150. Common octopus length-weight relationship for South Catalonia individuals from 2019 to 2022.

Table 29. Number of common octopus individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season.

Fishery	Fishing gear	Year	Zone	Winter	Spring	Summer	Autumn	N on boad sampling
				Number individuals sampled				
Artisanal fisheries	Pots	2019	Center	87	144	48	19	26
Artisanal fisheries	Sandeel seiner	2019	North	0	0	3	0	3
Artisanal fisheries	Traps	2019	Center	111	180	113	0	23
Artisanal fisheries	Pots	2020	Center	24	175	99	161	26
Artisanal fisheries	Pots	2020	South	0	0	18	141	9
Artisanal fisheries	Sandeel seiner	2020	North	0	0	0	1	1
Artisanal fisheries	Traps	2020	Center	133	195	128	135	42
Artisanal fisheries	Pots	2021	Center	93	85	91	155	42
Artisanal fisheries	Pots	2021	South	96	77	207	104	21
Artisanal fisheries	Sandeel seiner	2021	North	0	0	1	0	1
Artisanal fisheries	Traps	2021	Center	81	169	159	64	36
Artisanal fisheries		2021	Center	10	0	0	0	1
Artisanal fisheries	Pots	2022	Center	74	102	112	95	46
Artisanal fisheries	Pots	2022	South	115	19	83	330	22
Artisanal fisheries	Traps	2022	Center	112	202	218	57	45
Artisanal fisheries	Traps	2022	South	5	61	0	0	8
Bottom trawl		2019	North	0	36	10	3	11
Bottom trawl		2019	Center	8	5	0	1	5
Bottom trawl		2019	South	5	1	12	13	12
Bottom trawl		2020	North	1	6	4	0	7
Bottom trawl		2020	Center	0	1	0	3	3
Bottom trawl		2020	South	0	0	27	7	7
Bottom trawl		2021	North	8	1	2	0	7
Bottom trawl		2021	Center	2	2	4	6	8
Bottom trawl		2021	South	5	0	16	15	9
Bottom trawl		2022	North	2	1	2	1	6
Bottom trawl		2022	Center	11	0	1	10	7
Bottom trawl		2022	South	3	3	8	5	8

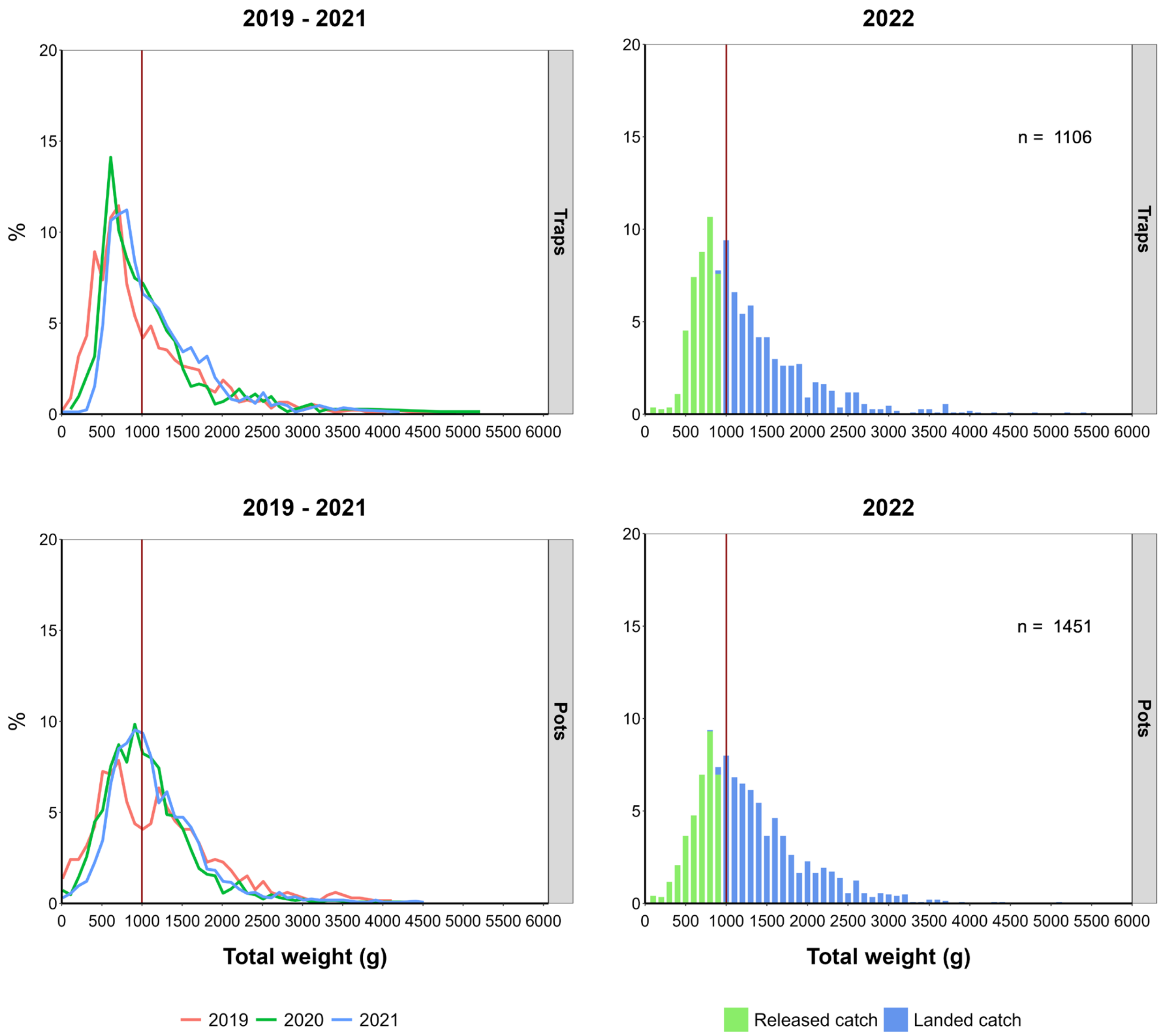

Figure 151. Annual weigth-frequency distribution of common octopus at different fishing gear (Traps and Pots). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Weight (MCRW).

The annual weight-frequency distribution of common octopus from 2019 to 2022 indicates that most of the individuals caught were below the MCRW, especially in the case of traps (Figure 151). The temporal distributions (2019-2021) show an increase in abundances near the MCRW and a decrease in landed larger individuals over the years. It should be noted that in 2019 only the Central area was sampled, so the individuals sampled are fewer (Table 29). Comparing between gears, in 2022, traps showed the mode around 800 g, below the MRCW. In the case of pots, a similar trend is observed, with the mode at 800 g, but with lower frequencies.

For monthly weight-frequency distribution of common octopus at different depth strata in 2022 see Annex 21.

The gonadal cycle of common octopus was analyzed monthly from 2019 to 2022 (Figure 152). Both sexes show a spawning period during late spring and summer, with the highest presence of mature and spawning individuals from May to August. However, sexual differences were observed. The reproductive cycle of the females showed a marked seasonality, with the spawning period in late spring and summer. On the contrary, males showed a continuous reproductive cycle, as mature and spawning individuals occurred all year-round. The lower presence of spawning and spent females may be caused by a faster senescence process after spawning than in males which leads to an earlier death.

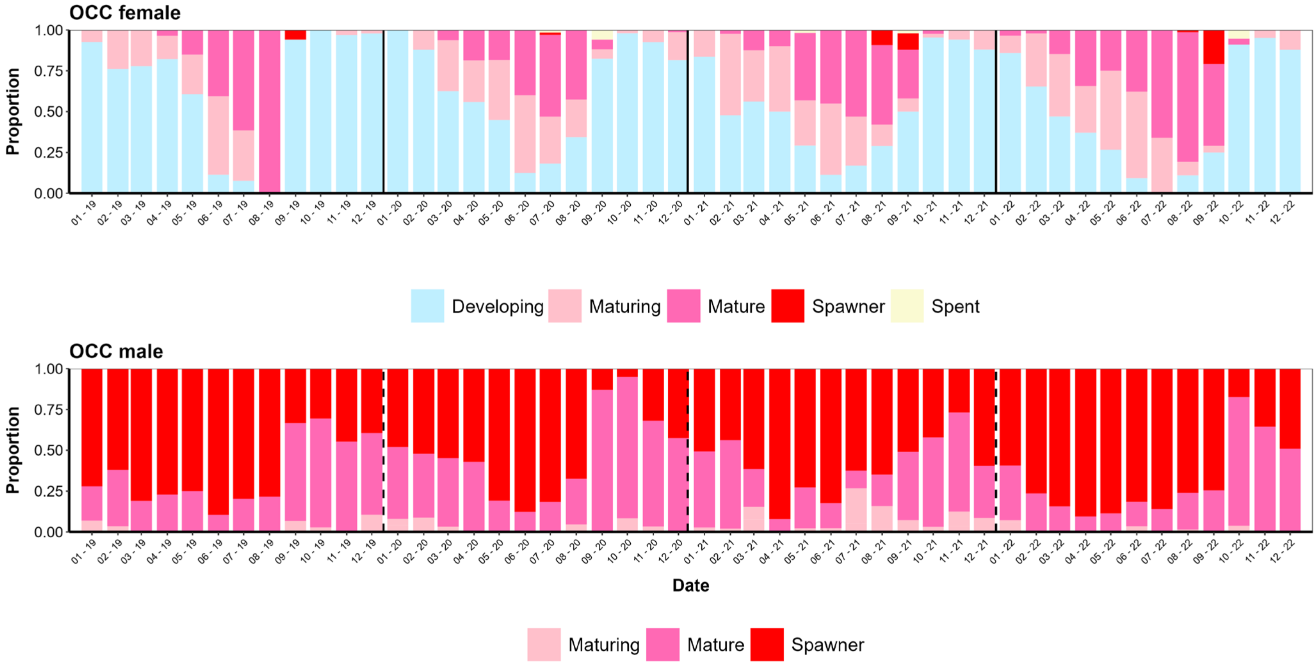

Figure 152. Common octopus monthly gonadal cycle for females and males from 2019 to 2022.

Female common octopus can accumulate sperm from several males in their spermathecae for a period of time before fertilizing their eggs. In this way, they increase the genetic variability of their offspring. Thus, they can mate and store sperm while they are still developing, and use it when they mature. Figure 153 shows, as in Figure 152, that this species shows a marked reproductive cycle. Although mating occurs throughout the year, the period with the highest proportion of mated females with sperm stored in their spermathecae coincided with the reproductive period throughout the years.

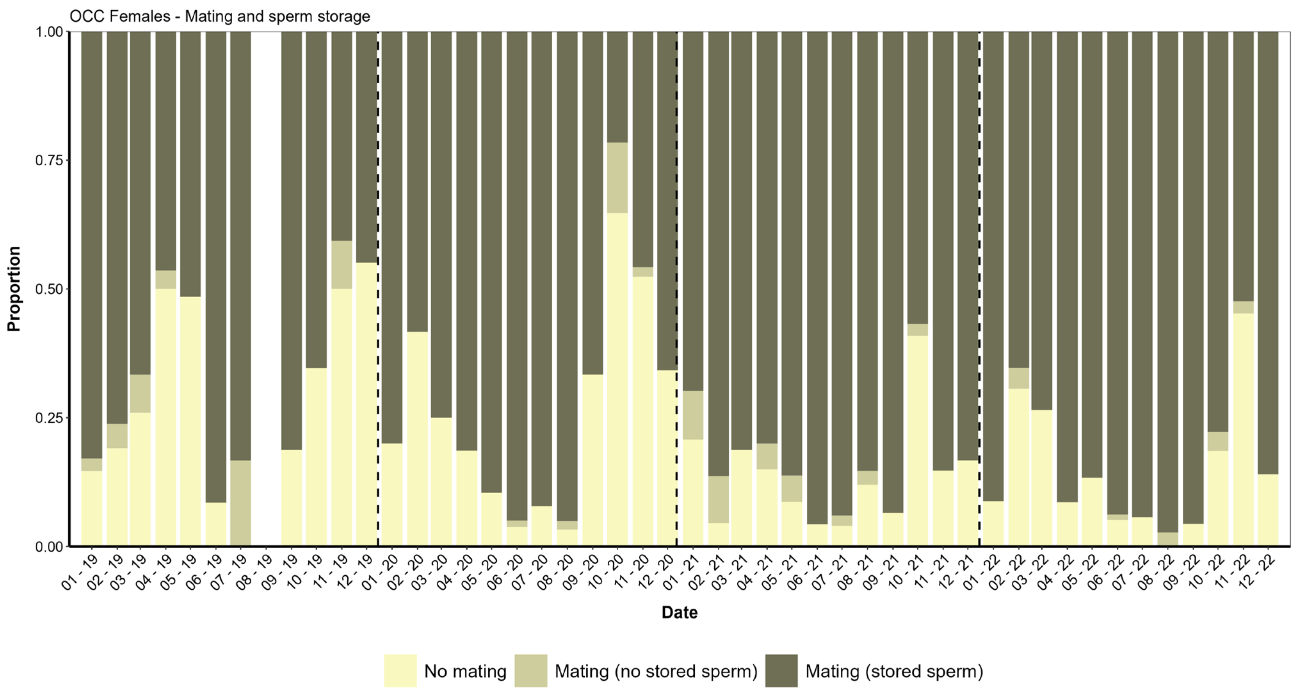

Figure 153. Common octopus monthly mating cycle for females from 2019 to 2022.

Common octopus fishery in Central Catalonia

The annual weight-frequency distribution of common octopus in Central Catalonia showed similar values between fishing gears (Figure 154). For both fishing gears, distributions showed the maximum abundance below the MCRW, with the mode at 800 g.

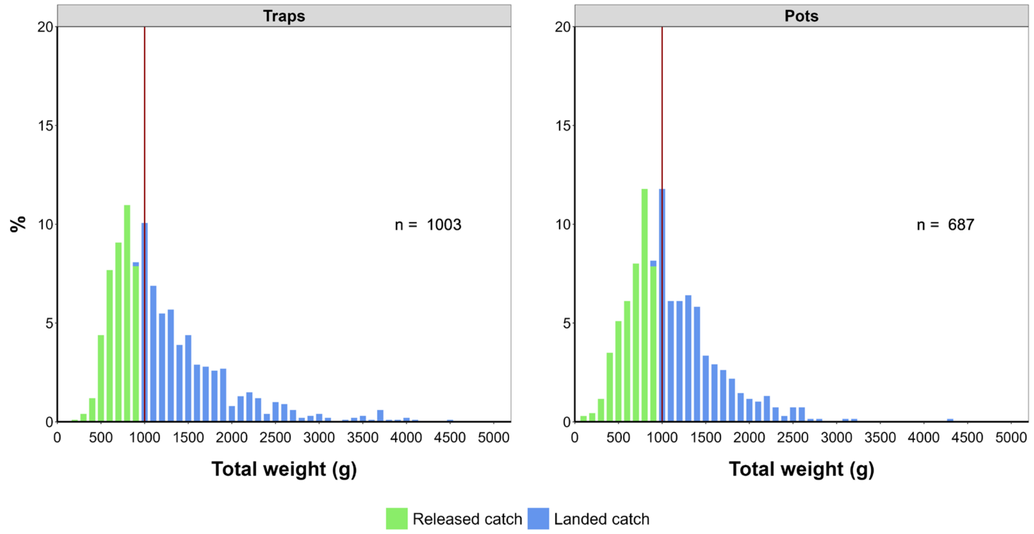

Figure 154. Annual weight-frequency distribution of common octopus at different fishing gear (Traps and Pots) in Central Catalonia in 2022. Red solid line: Minimum Conservation Reference Weight (MCRW).

The gonadal cycle of common octopus in Central Catalonia was analyzed monthly for 2022 (Figure 155). Both sexes showed a spawning period during late spring and summer, with the highest presence of mature and spawning individuals from May to August. However, sexual differences were observed. The reproductive cycle of females showed a marked seasonality, with the spawning period in late spring and summer, while males showed a continuous reproductive cycle with presence of mature individuals throughout the year.

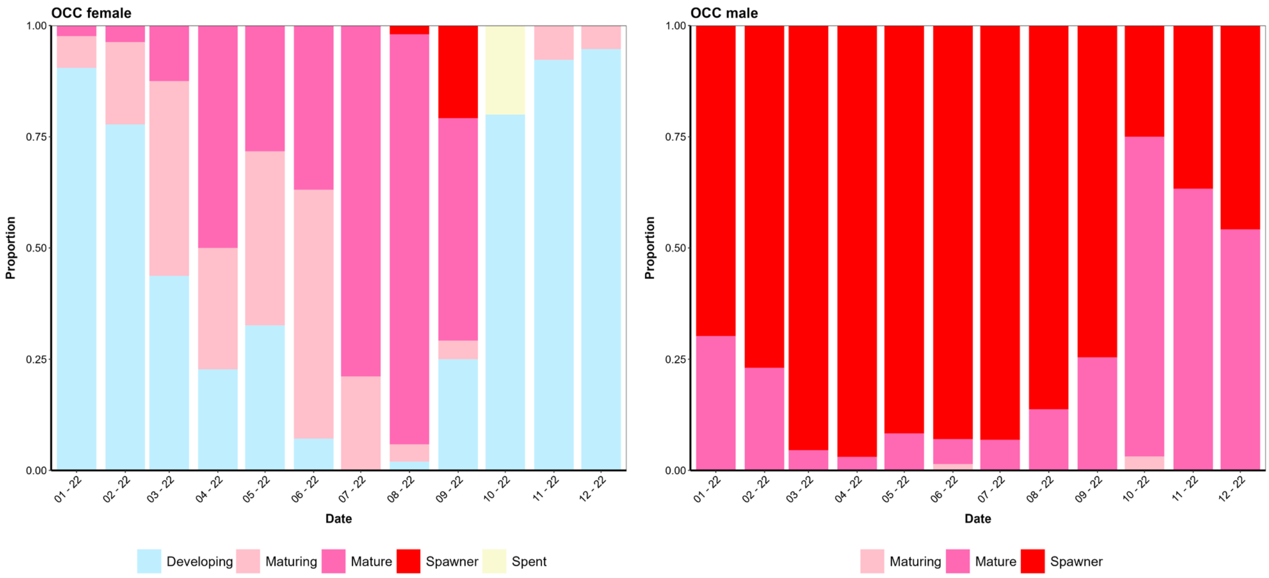

Figure 155. Common octopus monthly gonadal cycle for females and males from 2022 in Central Catalonia.

Common octopus fishery in the Ebre Delta

The annual weight-frequency distribution of common octopus in the Ebre Delta showed different values between fishing gears (Figure 156). In the case of traps, no clear normal distribution with a mode was observed, which could be related to the low number of sampled individuals compared to Central Catalonia. On the other hand, in the case of pots, a normal distribution was observed similar to that of pots from Central Catalonia. In both fishing gears, highest abundances were found above and below the MCRW.

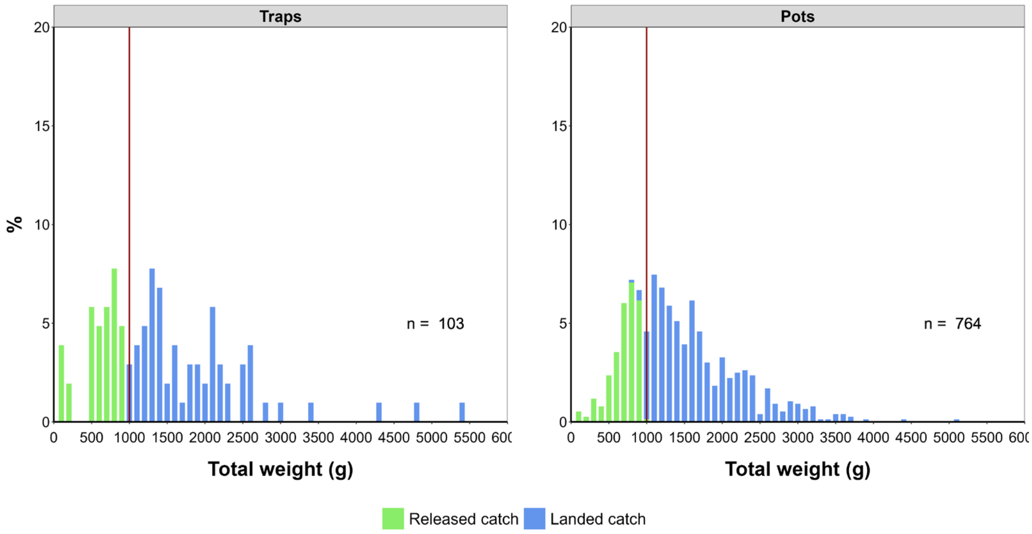

Figure 156. Annual weight-frequency distribution of common octopus at different fishing gear (Traps and Pots) in South Catalonia in 2022. Red solid line: Minimum Conservation Reference Weight (MCRW).

The gonadal cycle of common octopus in the Ebre Delta was analyzed monthly for 2022 (Figure 157). Both sexes show a spawning period during late spring and summer, with the highest presence of mature and spawning individuals from May to August, but the cycle was not as marked as in Central Catalonia, probably due to the lower number of individuals sampled. On the other hand, sexual differences were also observed. The reproductive cycle of females showed a marked seasonality, with the spawning period in late spring and summer, while males showed a continuous reproductive cycle with presence of mature individuals throughout the year.

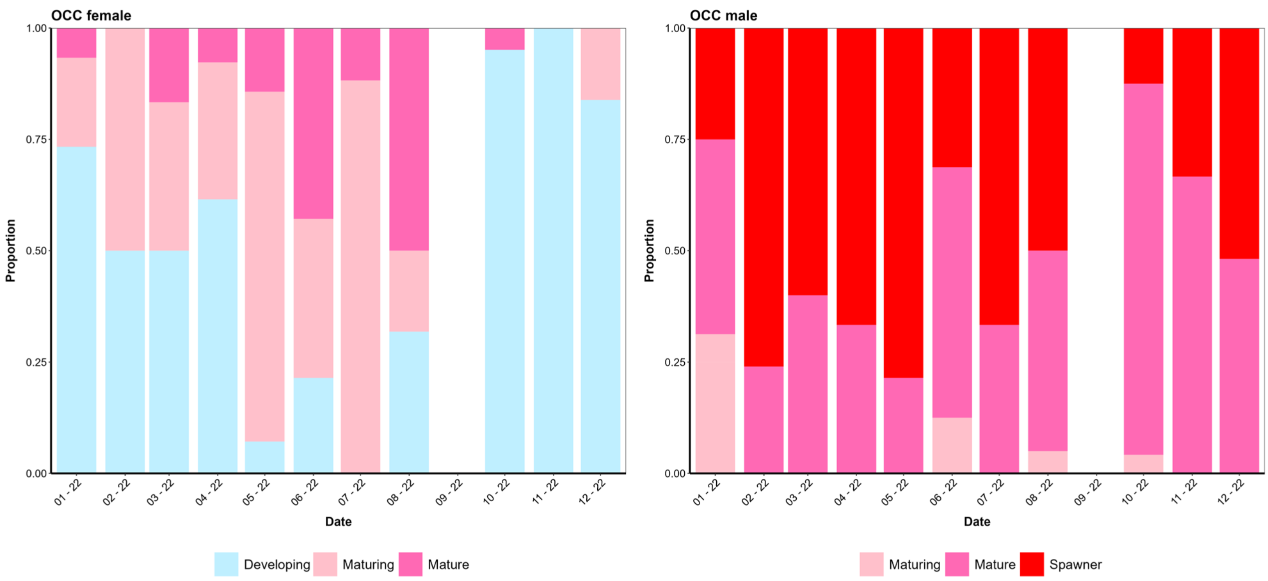

Figure 157. Common octopus monthly gonadal cycle for females and males from 2022 in South Catalonia.

Blue crab fishery in Catalonia

It should be noted that the results obtained for the sampling of the blue crab fishery are still preliminary and therefore different from those of the other species analyzed in this report.

The blue crab fishery sampling is exclusively carried out in the Ebre Delta zone, where it is a non-indigenous species. It was first detected in 2012 and has been turned into a new fishing resource since 2016, with an average price of 4.78 €/kg during 2022 (ICATMAR, 23-03). It is fished with bottom trawling, dredge ("rastell"), trammel nets and a specific kind of traps used in La Ràpita ("monetes"). The sampling strata are defined both by location inside or outside Alfacs Bay and by depth (Figure 158):

Inside the bay: deep bay (DB, starting at 5 m depth), shallow bay North (SBN, up to 5 m depth), and shallow bay South (SBS, up to 5 m depth).

Outside the bay: open water (OW).

Transition zone between the bay and the open water: channel (CH).

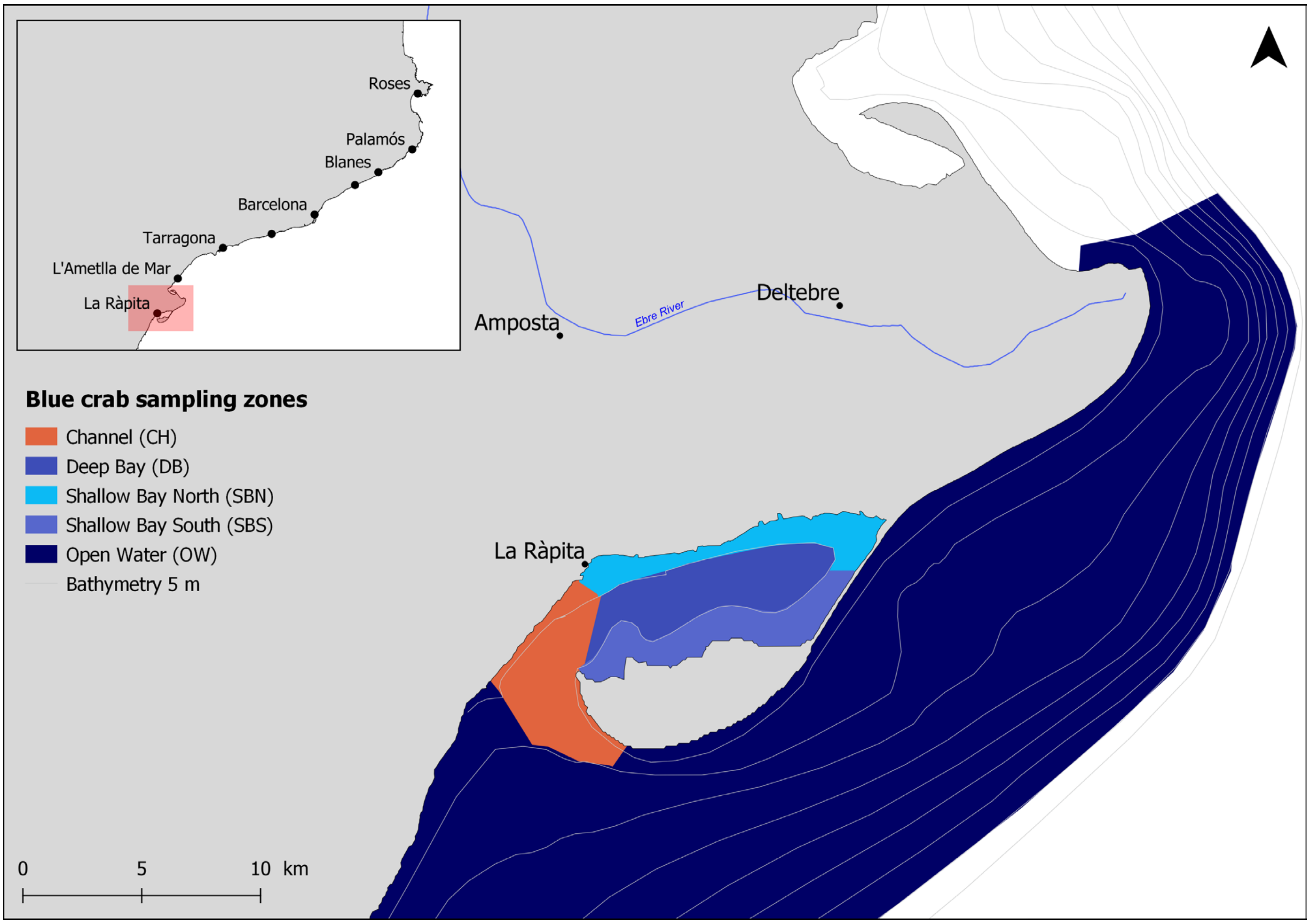

Figure 158. Map of the sampling zones of blue crab.

Most of the individuals sampled from the bay (shallow and deep waters) came from artisanal fisheries, such as traps and trammel nets (Table 30). Individuals sampled from the channel, connecting the bay and the open sea, were captured with trammel nets, while individuals sampled in the open sea came from dredges, bottom trawls and, to a lesser extent, trammel nets and longlines.

Table 30. Number of blue crab samplings from 2019 to 2022 by season and strata according to fishery and zone.

Fishery	Type	Year	SBN				SBS				DB				CH				OW			
			W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A	W	Sp	Su	A
Artisanal fisheries	Moneta	2019		4	12	17				1			2	3								
Artisanal fisheries	Trammel net	2019		1				1				1	1				1			3	4	4
Artisanal fisheries	Longline	2019										1						1		1		2
Artisanal fisheries	Dredge	2020																		1	3	4
Bottom trawl		2020																			2	20
Artisanal fisheries	Moneta	2020	12	10	18	12	2		1		2		1									
Artisanal fisheries	Trammel net	2020				1				2					1	1	1		2	4	1	2
Artisanal fisheries	Longline	2020																				
Artisanal fisheries	Dredge	2020																		9	5	3
Bottom trawl		2020																	2			
Artisanal fisheries	Moneta	2021	13	17	14	13	1				3	2		3								
Artisanal fisheries	Trammel net	2021			1			1								1			6			1
Artisanal fisheries	Longline	2021																				
Artisanal fisheries	Dredge	2021																		2	3	5
Bottom trawl		2021																				
Artisanal fisheries	Moneta	2022	9	10	18	11	2	1		1	4	1	2	3								
Artisanal fisheries	Trammel net	2022	1	2			2						2		2				1			
Artisanal fisheries	Longline	2022																				
Artisanal fisheries	Dredge	2022																			2	1
Bottom trawl		2022																				
Total number of sampling per season						196				15				31				8				93
Total number of sampling in the period sampled																						343

Blue crab (*Callinectes sapidus*) CRB

The total blue crab catch in Catalonia in 2022 was 380 t, approximately 80% of which were caught by small-scale fisheries, 23% by shellfish and less than 0.01% by bottom trawling (ICATMAR, 23-03).

Almost all of the individuals sampled were caught by artisanal fisheries during the four years sampled (Table 31). In the case of bottom trawling, dredges and longline, blue crab was a by-catch. Similar trends are observed over the four years for individuals measured in all seasons.

Table 31. Number of blue crab individuals measured from 2019 to 2022 in the different fisheries along the zones sampled in each season (the values include all depth strata sampled).

Fish market sampling								
Fishery	Fishing gear	Year	Zone	Winter	Spring	Summer	Autumn	N samplings
				Number individuals sampled				
Artisanal fisheries	Dredge	2019	South	0	2	31	22	8
Artisanal fisheries	Longline	2019	South	0	11	0	39	5
Artisanal fisheries	Moneta	2019	South	0	182	717	977	39
Artisanal fisheries	Trammel net	2019	South	0	101	155	121	16
Artisanal fisheries	Dredge	2020	South	0	79	61	15	17
Artisanal fisheries	Moneta	2020	South	592	446	786	501	58
Artisanal fisheries	Trammel net	2020	South	68	89	56	82	15
Artisanal fisheries	Dredge	2021	South	0	23	42	66	10
Artisanal fisheries	Moneta	2021	South	695	852	694	687	66
Artisanal fisheries	Trammel net	2021	South	84	59	32	3	10
Artisanal fisheries	Dredge	2022	South	0	0	32	1	3
Artisanal fisheries	Moneta	2022	South	593	559	769	673	62
Artisanal fisheries	Trammel net	2022	South	174	89	39	0	10
Bottom trawling		2019	South	0	0	33	66	25
Bottom trawling		2020	South	2	0	9	0	3

The size at first maturity (L_{50}) for female blue crab for 2020, 2021 and 2022 was estimated at 11, 12 and 11 cm of carapace width, respectively, showing similar results between years (Figure 159).

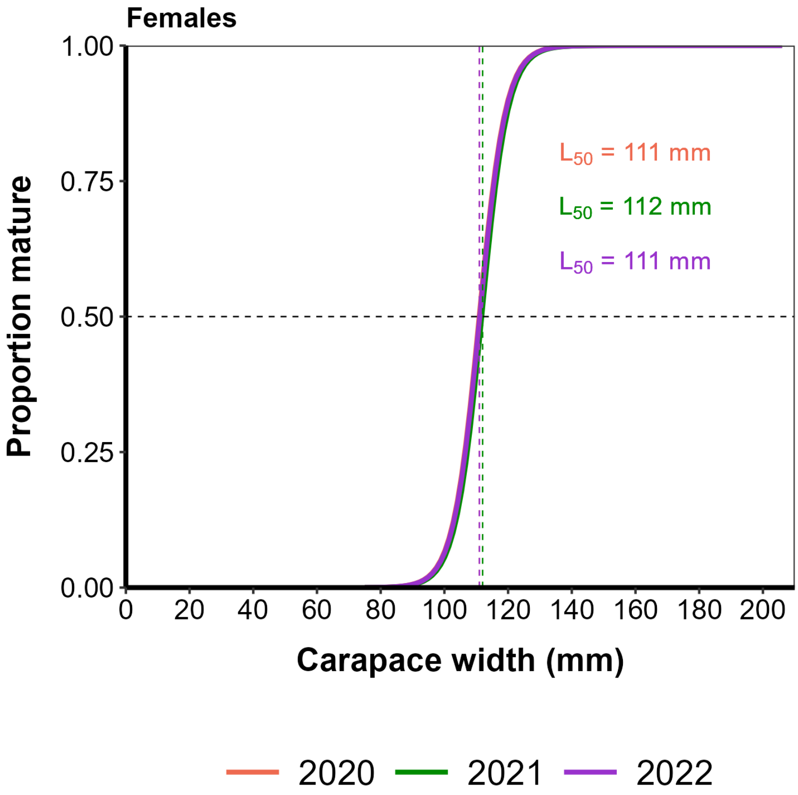

Figure 159. Blue crab size at first maturity (L_{50}) for all years sampled.

The annual length-frequency distribution of blue crab from 2019 to 2022 showed a similar trend over the years (Figure 160). The highest number of individuals were caught in shallow waters inside the bay. Notably, the species showed a differential distribution by sex, with males mainly found within the bay, especially in shallow waters, while non-ovigerous females predominated in deep areas within the bay or in the channel linking the bay and the open sea. On the other hand, ovigerous females were only caught in open water. Most of the individuals measured were above the size at first maturity (L_{50}).

For monthly weight-frequency distribution of blue crab at different depth strata in 2022 see Annex 22.

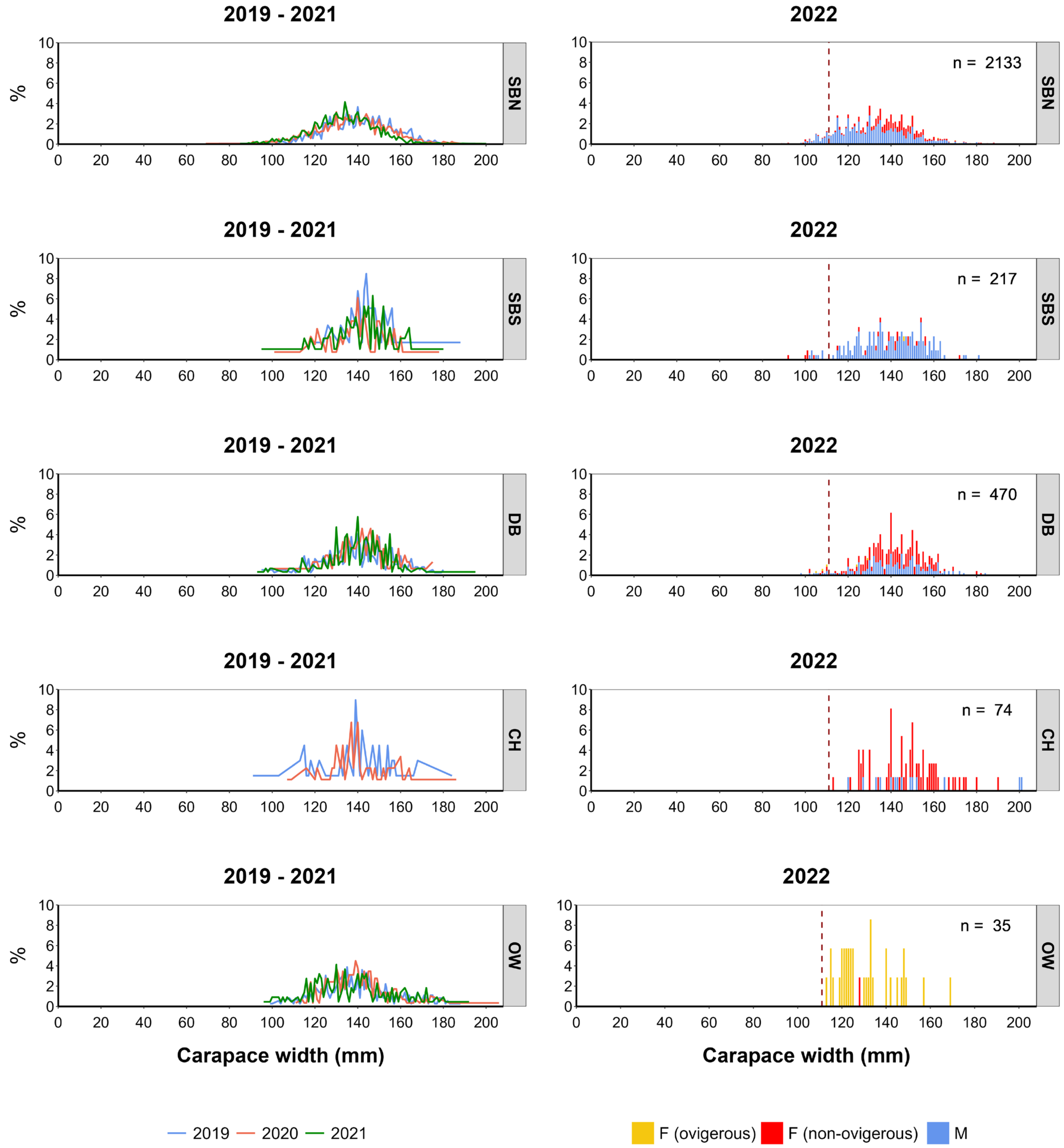

Figure 160. Annual length-frequency distribution of blue crab at different depth strata (SBN; Shallow Bay North, SBS; Shallow Bay South, BD; Deep Bay, CH; Channel and OW; Open Water). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: size at first sexual maturity (L_{50}).

Figure 161 shows the proportion of blue crab females with eggs and their developmental stages from 2019 to 2022. The species did not show a clear reproductive pattern over the years. Females with eggs at all developmental stages were found throughout the year in different proportions, except in the winter months, which could indicate a semi-continuous reproductive cycle for the species.

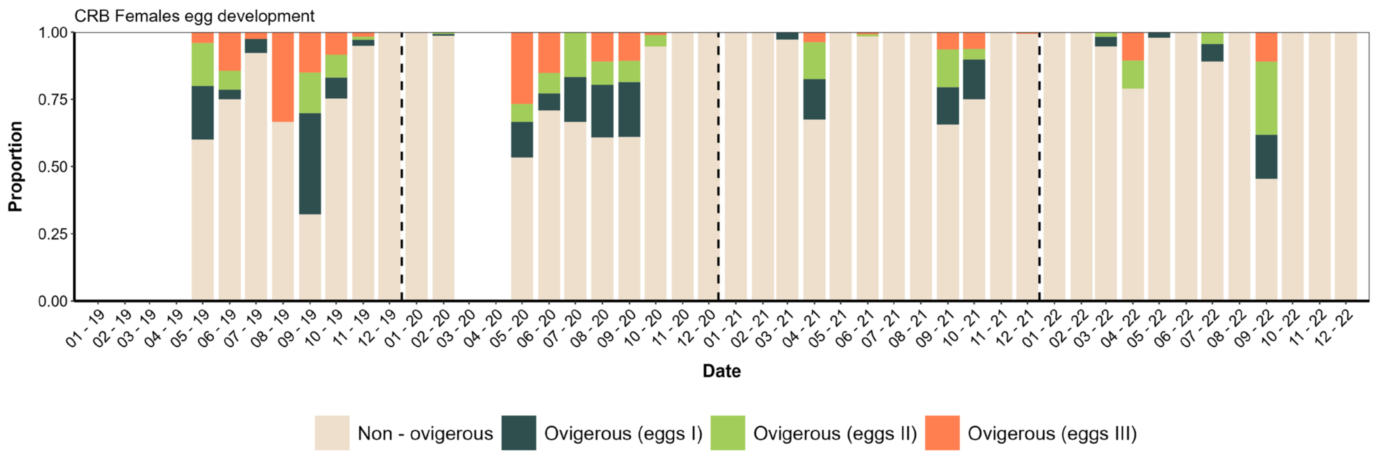

Figure 161. Blue crab monthly proportion of different egg development stages from 2019 to 2022.

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Annexes

Annex 1. Landed species with higher biomass for 2019-2021. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	*Phycis blennoides*	0.04	0.02	5.34	0.99	74.35	15.68	26.21	3.65
	Trachurus trachurus	10.86	3.08	85.09	16.85	2.54	1.37	0.05	0.04
	Merluccius merluccius	22.68	3.82	43.39	3.88	20.63	2.26	7.22	1.35
	Lophius budegassa	5.34	1.50	41.47	4.04	8.92	1.82	2.12	0.88
	Mullus barbatus	15.72	3.04	41.14	5.08	0.48	0.17		
	Micromesistius poutassou			0.62	0.38	28.22	5.82	5.66	1.57
	Pagellus erythrinus	26.82	7.74	4.45	1.18	0.05	0.04	0.06	0.04
	Trachurus mediterraneus	20.21	5.22	7.55	4.12			0.01	0.01
	Trisopterus capelanus	7.96	1.76	18.88	2.32	0.04	0.02	0.03	0.02
	Lophius piscatorius	1.04	0.76	3.00	1.42	7.86	2.30	4.66	1.46
	Sphyraena sphyraena	15.88	5.44	0.04	0.04				
	Helicolenus dactylopterus			1.79	0.68	8.83	1.62	2.04	0.56
	Scomber scombrus	8.75	2.02	3.45	1.31				
	Lepidorhombus boscii			3.62	0.69	7.77	0.84	0.72	0.19
	Citharus linguatula	7.37	1.33	4.20	0.52	0.03	0.01		
	Mullus surmuletus	2.95	0.79	7.28	1.95	0.59	0.21	0.20	0.20
	Sparus aurata	10.12	5.49						
	Boops boops	5.56	2.08	1.98	0.94				
	Trachurus picturatus			6.68	4.30	0.03	0.03		
	Conger conger	0.85	0.18	0.49	0.13	2.38	0.41	2.20	0.43
	Lithognathus mormyrus	5.77	3.45						
	Scomber colias	4.35	1.63	0.96	0.58	0.01	0.01		
	Scorpaena elongata	0.03	0.02	2.88	0.99	1.41	0.32	0.75	0.30
	Chelidonichthys lucerna	4.02	0.83	0.91	0.14				
Elasmobranchii	*Scyliorhinus canicula*			9.11	4.60	13.31	3.79	1.90	0.80
	Galeus melastomus					0.96	0.51	13.26	3.16
Malacostraca	*Aristeus antennatus*					0.19	0.08	75.08	4.98
	Nephrops norvegicus	0.31	0.12	0.43	0.14	50.09	5.09	2.80	0.72
	Parapenaeus longirostris	5.84	1.19	13.80	2.63	28.10	3.87	1.91	0.76
	Squilla mantis	26.99	2.95	2.49	0.62				
	Liocarcinus depurator	6.94	2.73	3.96	1.32	0.11	0.05	0.00	0.00
	Penaeus kerathurus	6.49	1.79	0.00	0.00				
Cephalopoda	*Illex coindetii*	10.26	2.25	31.49	4.06	4.54	0.98	0.64	0.25
	Eledone cirrhosa	8.33	1.75	19.69	1.77	14.71	2.49	1.55	0.41
	Octopus vulgaris	5.50	1.72	3.50	0.81	0.10	0.07	0.15	0.15
	Sepia officinalis	5.91	1.38	0.26	0.13				
	Alloteuthis spp.	4.32	0.56	1.42	0.41			0.03	0.03
	Todarodes sagittatus			0.05	0.04	3.25	0.51	1.69	0.33
Gastropoda	*Bolinus brandaris*	4.87	1.05	0.20	0.14				
Holothuroidea	*Parastichopus regalis*	0.10	0.07	5.95	1.61	0.05	0.03	0.02	0.02

Annex 2. Landed species with higher biomass for 2022. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	*Merluccius merluccius*	4.33	2.49	38.52	19.17	0.04	0.02	0.20	0.12
	Boops boops	9.91	5.67	13.58	5.56	0.03	0.03		
	Engraulis encrasicolus	11.16	7.18	4.45	1.70				
	Lophius budegassa	4.68	3.55	7.76	2.52	0.44	0.13	0.02	0.01
	Trachurus trachurus	7.57	5.31	4.11	1.75	0.41	0.27	0.01	0.01
	Sardinella aurita	10.80	8.28	0.01	0.01				
	Spicara flexuosa	0.61	0.59	10.07	3.18	0.06	0.04		
	Pagellus bogaraveo	0.07	0.05	3.24	2.46	1.83	0.85	2.43	1.73
	Sardina pilchardus	6.06	2.67	1.29	0.57				
	Coelorinchus caelorhincus			0.11	0.06	5.04	2.16	1.17	0.76
	Pagellus acarne	5.34	2.41	0.06	0.05				
	Phycis blennoides			2.25	1.84	2.01	0.72	0.60	0.11
	Arnoglossus laterna	2.74	1.09	1.21	0.45	0.04	0.03	0.00	0.00
	Capros aper			2.96	0.93	0.66	0.52	0.02	0.02
	Trachurus mediterraneus	2.84	1.41	0.75	0.64				
	Lampanyctus crocodilus					0.15	0.07	3.01	1.00
	Spicara spp.	0.32	0.23	2.57	1.31	0.14	0.14		
	Gadiculus argenteus			0.17	0.11	2.59	1.07	0.09	0.03
	Pagellus erythrinus	2.12	0.76	0.33	0.21				
	Trisopterus capelanus	0.33	0.21	1.89	1.09				
	Nezumia aequalis					0.50	0.44	1.30	0.48
Elasmobranchii	*Scyliorhinus canicula*			45.01	8.17	72.78	25.43	14.42	5.01
	Galeus melastomus			0.06	0.06	2.99	0.94	27.86	5.90
	Tetronarce nobiliana					9.22	9.04		
	Etmopterus spinax					0.11	0.09	1.62	0.62
Holocephali	*Chimaera monstrosa*					0.02	0.01	1.83	1.35
Malacostraca	*Liocarcinus depurator*	3.36	2.11	1.51	0.82	0.01	0.00	0.01	0.00
	Dardanus arrosor	0.34	0.16	1.31	0.61	0.50	0.19	0.47	0.21
	Parapenaeus longirostris	0.98	0.58	0.76	0.28	0.59	0.15	0.08	0.05
Cephalopoda	*Illex coindetii*	0.81	0.35	1.68	0.50	0.64	0.33	0.49	0.17
	Scaeurgus unicirrhus	0.02	0.02	3.22	3.04	0.13	0.12	0.03	0.03
	Octopus vulgaris	1.63	0.99	0.36	0.17	0.14	0.09		
	Octopus salutii			0.25	0.12	1.62	0.55	0.16	0.16
Bivalvia	*Neopycnodonte cochlear*			2.47	1.22	0.03	0.03		
Anthozoa	*Alcyonium palmatum*	0.38	0.10	14.07	6.91	0.30	0.14	0.77	0.50
Crinoidea	*Leptometra phalangium*	0.00	0.00	4.00	3.45	0.00	0.00		
Asteroidea	*Astropecten irregularis*	3.02	1.07	4.11	1.84	0.09	0.03	0.03	0.02
Echinoidea	*Gracilechinus acutus*			5.93	3.48				
Thaliacea	*Salpa* spp.	0.98	0.56	0.28	0.08	0.21	0.17	0.22	0.13
Ascidiacea	*Diazona violacea*			2.41	1.10	0.04	0.04		

Annex 3. Landed species with higher abundance for 2019-2021. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	*Trachurus trachurus*	167.48	46.86	1 819.65	342.09	13.59	5.56	0.35	0.25
	Phycis blennoides	0.60	0.33	90.86	17.28	870.27	117.12	249.45	37.04
	Mullus barbatus	391.26	94.17	708.97	91.13	7.04	2.50		
	Trisopterus capelanus	267.85	64.77	606.93	67.79	0.75	0.34	0.62	0.42
	Merluccius merluccius	197.26	36.80	390.56	46.00	93.21	13.41	17.55	3.01
	Trachurus mediterraneus	246.09	56.43	149.54	76.01			0.07	0.07
	Citharus linguatula	260.72	44.20	125.23	18.73	0.51	0.25		
	Micromesistius poutassou			17.48	10.68	279.46	50.51	57.27	18.88
	Pagellus erythrinus	278.20	83.83	41.70	11.01	0.43	0.37	0.34	0.22
	Lepidorhombus boscii			66.98	10.96	204.79	32.73	13.62	3.48
	Helicolenus dactylopterus			48.48	16.69	130.50	21.29	24.20	7.57
	Sardina pilchardus	190.85	104.05	4.92	2.83				
	Lepidotrigla cavillone	48.81	16.98	113.76	22.98				
	Arnoglossus laterna	106.86	20.56	44.95	10.12				
	Trigla lyra			49.70	13.60	85.34	15.99	6.70	4.31
	Eutrigla gurnardus	38.74	14.67	102.37	23.98	0.10	0.10		
	Lophius budegassa	16.37	6.02	104.46	10.23	17.02	3.07	1.73	0.47
	Boops boops	99.49	36.05	32.61	15.41				
	Mullus surmuletus	40.57	9.24	84.28	26.23	3.31	1.08	1.08	1.02
	Scomber scombrus	81.57	21.65	39.65	20.71				
	Serranus hepatus	29.96	7.13	80.12	28.95				
	Diplodus annularis	95.31	26.64	0.06	0.06				
Elasmobranchii	*Scyliorhinus canicula*			58.71	34.96	73.68	21.70	9.42	4.04
Malacostraca	*Parapenaeus longirostris*	748.10	154.57	1 823.59	331.14	2 496.38	386.92	129.79	43.88
	Aristeus antennatus					7.87	3.31	4 140.31	275.33
	Nephrops norvegicus	3.20	1.25	7.07	2.54	2 202.45	236.23	107.72	30.26
	Liocarcinus depurator	825.51	326.72	456.43	143.60	8.72	3.98	0.12	0.12
	Squilla mantis	903.75	95.99	95.92	25.24				
	Pasiphaea multidentata					4.70	1.53	538.47	71.65
	Plesionika martia					95.43	27.83	224.17	26.84
	Penaeus kerathurus	302.01	86.00	0.07	0.07				
	Plesionika heterocarpus			56.35	40.14	86.94	32.57	6.46	2.99
	Macropipus tuberculatus			10.82	4.47	104.79	26.14	4.07	2.01
	Plesionika edwardsii					83.50	54.14	22.24	21.07
Cephalopoda	*Illex coindetii*	254.02	64.02	850.72	170.78	74.41	17.40	8.86	2.63
	Eledone cirrhosa	32.10	6.27	99.36	9.20	53.28	8.11	4.96	1.45
	Alloteuthis spp.	115.71	16.34	48.22	15.76			0.06	0.06
	Sepia elegans	54.89	16.69	45.92	9.07	0.20	0.11		
	Sepia orbignyana	0.40	0.23	79.15	12.00	3.15	1.10		
Gastropoda	*Bolinus brandaris*	292.64	60.08	11.00	8.32				

Annex 4. Landed species with higher abundance for 2022. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Shallow	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	***Trachurus trachurus***	67.20	39.13	1 366.46	417.20	8.03	4.35		
	Phycis blennoides			71.87	22.04	1 016.89	198.98	238.16	37.87
	Mullus barbatus	491.91	114.54	774.37	157.26	0.84	0.68		
	Merluccius merluccius	147.69	44.85	722.81	119.90	117.89	21.92	31.17	9.40
	Micromesistius poutassou			171.23	152.36	513.18	165.85	25.23	4.73
	Trisopterus capelanus	85.51	24.91	518.57	80.07	0.91	0.76		
	Helicolenus dactylopterus			322.46	121.31	166.29	56.07	7.81	2.79
	Pagellus erythrinus	209.87	53.55	73.47	22.20				
	Citharus linguatula	165.22	52.33	50.57	10.93	0.14	0.14	0.39	0.26
	Boops boops	180.96	57.87	30.79	14.20				
	Lepidorhombus boscii			82.01	31.19	103.74	23.30	15.91	6.04
	Trigla lyra			104.67	31.56	93.31	22.91	2.96	2.91
	Lophius budegassa	42.63	15.34	140.63	38.26	9.31	2.15	1.50	0.81
	Trachurus mediterraneus	176.98	77.92	9.90	6.62				
	Eutrigla gurnardus	40.55	19.84	119.81	57.75				
	Sardina pilchardus	68.42	65.93	81.20	57.57				
	Lepidotrigla cavillone	58.16	24.99	79.18	28.93				
	Mullus surmuletus	26.11	11.01	64.25	37.75	10.24	8.23	0.16	0.16
	Diplodus annularis	99.73	41.13	0.38	0.25				
	Arnoglossus laterna	54.79	17.57	24.82	8.12				
	***Spicara* spp.**	29.80	8.72	43.84	27.55				
	Lithognathus mormyrus	69.53	53.61						
	Parapenaeus longirostris	1 416.88	498.35	3 167.90	964.26	3 860.48	1 058.36	21.98	15.53
	Aristeus antennatus					138.33	135.64	4 492.51	1 204.29
	Nephrops norvegicus	1.65	0.84	1.92	1.70	1 773.84	321.79	50.60	17.86
	Liocarcinus depurator	971.87	548.68	359.29	150.05	55.35	54.27	0.16	0.16
Malacostraca	***Squilla mantis***	716.16	133.98	38.33	26.85				
	Plesionika martia					81.35	33.94	405.07	88.29
	Pasiphaea multidentata					6.28	4.76	404.31	108.16
	Plesionika heterocarpus			301.86	205.09	65.16	45.11		
	Penaeus kerathurus	348.58	165.43						
	Macropipus tuberculatus			21.35	13.77	106.21	70.66		
	Illex coindetii	467.79	223.05	671.27	155.55	48.81	22.05	2.92	1.04
Cephalopoda	***Eledone cirrhosa***	19.32	7.36	107.04	18.92	59.58	10.02	6.95	1.81
	***Alloteuthis* spp.**	83.24	22.37	42.56	14.42	0.15	0.15		
	Sepia elegans	60.84	29.84	56.69	16.26				
	Sepia officinalis	67.76	28.21	3.64	2.50				
	Alloteuthis media	67.92	53.60	0.58	0.57				
	Sepia orbignyana			55.01	13.87	5.23	3.31		
	Bolinus brandaris	91.69	19.10	1.21	0.68				

Annex 5. Discarded species with higher biomass for 2019-2021. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	*Engraulis encrasicolus*	53.55	24.98	8.82	2.83	0.01	0.01	0.00	0.00
	Boops boops	17.19	6.37	35.61	7.64	0.09	0.05	0.05	0.03
	Sardina pilchardus	32.66	18.74	1.60	0.51	0.00	0.00	0.01	0.01
	Sardinella aurita	30.02	10.06	0.27	0.20				
	Trachurus trachurus	4.05	2.17	15.36	6.65	1.36	0.45	0.14	0.06
	Merluccius merluccius	5.77	2.03	14.57	3.17	0.44	0.19	0.08	0.04
	Spicara flexuosa	4.70	1.77	13.46	2.51	0.17	0.07	0.01	0.01
	Trachurus mediterraneus	7.52	2.80	2.21	1.13	0.00	0.00		
	Lophius budegassa	0.67	0.28	6.81	1.27	0.63	0.12	0.10	0.07
	Capros aper	0.04	0.02	7.31	3.01	0.69	0.24	0.02	0.01
	Spicara maena	2.67	0.87	3.61	1.48	0.11	0.05	0.00	0.00
	Pagellus acarne	5.95	3.45	0.11	0.04				
	Macroramphosus scolopax			5.72	4.44	0.01	0.00	0.00	0.00
	Coelorinchus caelorhincus					3.12	0.75	1.96	0.67
	Pagellus bogaraveo	0.08	0.07	3.22	1.24	1.06	0.40	0.46	0.34
	Trisopterus capelanus	1.32	0.50	2.77	0.70	0.03	0.01		
	Lampanyctus crocodilus			0.00	0.00	0.45	0.23	3.16	0.76
	Arnoglossus laterna	2.19	0.37	1.21	0.25	0.01	0.01	0.00	0.00
	Diplodus annularis	3.33	1.31	0.01	0.01				
	Conger conger			0.26	0.11	2.07	0.57	0.96	0.25
	Mola mola			1.77	1.61			1.42	1.41
	Phycis blennoides			0.55	0.20	1.60	0.25	0.51	0.09
	Pagellus erythrinus	1.78	0.51	0.69	0.27	0.04	0.02		
	Trachurus picturatus	0.23	0.18	1.88	1.71	0.33	0.31		
Elasmobranchii	*Scyliorhinus canicula*	0.05	0.05	43.61	9.32	49.92	7.38	13.90	4.31
	Galeus melastomus			0.03	0.02	3.56	0.68	11.53	3.00
	Raja clavata			2.65	2.62	0.01	0.01		
Malacostraca	*Liocarcinus depurator*	3.59	1.34	2.55	1.12	0.03	0.01	0.01	0.00
	Plesionika heterocarpus			5.67	5.35	0.31	0.08	0.01	0.00
	Squilla mantis	4.25	0.80	0.70	0.27	0.00	0.00		
	Dardanus arrosor	0.46	0.10	0.97	0.21	0.51	0.11	0.22	0.14
Cephalopoda	*Octopus vulgaris*	2.20	0.64	1.43	0.36	0.07	0.05		
	Illex coindetii	0.29	0.07	2.31	0.51	0.56	0.10	0.43	0.11
	Octopus salutii	0.05	0.05	0.29	0.16	2.53	0.90	0.32	0.19
Echinoidea	*Echinus melo*			9.94	3.46			0.49	0.45
	Spatangus purpureus	0.04	0.04	2.13	2.06				
Asteroidea	*Astropecten irregularis*	5.28	1.05	4.10	1.07	0.11	0.02	0.03	0.01
Anthozoa	*Alcyonium palmatum*	0.42	0.09	9.58	2.98	0.75	0.37	0.14	0.09
Crinoidea	*Leptometra phalangium*			35.77	21.46	0.02	0.01	0.00	0.00
Ascidiacea	*Diazona violacea*	0.00	0.00	2.28	0.70	0.03	0.02	0.01	0.01

Annex 6. Discarded species with higher biomass for 2022. SE: standard error.

Class	Species	Shallow shelf		Continental shelf		Upper slope		Lower slope	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Actinopterygii	*Merluccius merluccius*	4.33	2.49	38.52	19.17	0.04	0.02	0.20	0.12
	Boops boops	9.91	5.67	13.58	5.56	0.03	0.03		
	Engraulis encrasicolus	11.16	7.18	4.45	1.70				
	Lophius budegassa	4.68	3.55	7.76	2.52	0.44	0.13	0.02	0.01
	Trachurus trachurus	7.57	5.31	4.11	1.75	0.41	0.27	0.01	0.01
	Sardinella aurita	10.80	8.28	0.01	0.01				
	Spicara flexuosa	0.61	0.59	10.07	3.18	0.06	0.04		
	Pagellus bogaraveo	0.07	0.05	3.24	2.46	1.83	0.85	2.43	1.73
	Sardina pilchardus	6.06	2.67	1.29	0.57				
	Coelorinchus caelorhincus			0.11	0.06	5.04	2.16	1.17	0.76
	Pagellus acarne	5.34	2.41	0.06	0.05				
	Phycis blennoides			2.25	1.84	2.01	0.72	0.60	0.11
	Arnoglossus laterna	2.74	1.09	1.21	0.45	0.04	0.03	0.00	0.00
	Capros aper			2.96	0.93	0.66	0.52	0.02	0.02
	Trachurus mediterraneus	2.84	1.41	0.75	0.64				
	Lampanyctus crocodilus					0.15	0.07	3.01	1.00
	Spicara spp.	0.32	0.23	2.57	1.31	0.14	0.14		
	Gadiculus argenteus			0.17	0.11	2.59	1.07	0.09	0.03
	Pagellus erythrinus	2.12	0.76	0.33	0.21				
	Trisopterus capelanus	0.33	0.21	1.89	1.09				
	Nezumia aequalis					0.50	0.44	1.30	0.48
Elasmobranchii	*Scyliorhinus canicula*			45.01	8.17	72.78	25.43	14.42	5.01
	Galeus melastomus			0.06	0.06	2.99	0.94	27.86	5.90
	Tetronarce nobiliana					9.22	9.04		
	Etmopterus spinax					0.11	0.09	1.62	0.62
Holocephali	*Chimaera monstrosa*					0.02	0.01	1.83	1.35
Malacostraca	*Liocarcinus depurator*	3.36	2.11	1.51	0.82	0.01	0.00	0.01	0.00
	Dardanus arrosor	0.34	0.16	1.31	0.61	0.50	0.19	0.47	0.21
	Parapenaeus longirostris	0.98	0.58	0.76	0.28	0.59	0.15	0.08	0.05
Cephalopoda	*Illex coindetii*	0.81	0.35	1.68	0.50	0.64	0.33	0.49	0.17
	Scaeurgus unicirrhus	0.02	0.02	3.22	3.04	0.13	0.12	0.03	0.03
	Octopus vulgaris	1.63	0.99	0.36	0.17	0.14	0.09		
	Octopus salutii			0.25	0.12	1.62	0.55	0.16	0.16
Bivalvia	*Neopycnodonte cochlear*			2.47	1.22	0.03	0.03		
Anthozoa	*Alcyonium palmatum*	0.38	0.10	14.07	6.91	0.30	0.14	0.77	0.50
Crinoidea	*Leptometra phalangium*	0.00	0.00	4.00	3.45	0.00	0.00		
Asteroidea	*Astropecten irregularis*	3.02	1.07	4.11	1.84	0.09	0.03	0.03	0.02
Echinoidea	*Gracilechinus acutus*			5.93	3.48				
Thaliacea	*Salpa* spp.	0.98	0.56	0.28	0.08	0.21	0.17	0.22	0.13
Ascidiacea	*Diazona violacea*			2.41	1.10	0.04	0.04		

Annex 7. Natural debris mass for 2019-2021. SE: standard error.

Type	Shallow shelf		Continental shelf		Upper slope		Lower slope	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Plastic	1.57	0.37	5.27	1.23	1.99	0.35	1.34	0.38
Wet wipes	0.09	0.05	5.00	2.11	1.48	0.40	1.20	0.49
Wood	1.58	0.35	3.47	0.62	1.06	0.34	1.05	0.44
Clinker	0.73	0.23	2.24	0.40	2.07	0.26	2.01	0.90
Textiles	0.24	0.07	0.94	0.40	0.43	0.12	0.51	0.30
Glass	0.97	0.56	0.16	0.14	0.44	0.19	0.09	0.04
Fishing gear	0.98	0.94	0.36	0.24	0.08	0.03	0.11	0.04
Metal	0.09	0.04	0.34	0.14	0.06	0.03	0.03	0.01
Unclassified waste	0.05	0.04	0.11	0.05	0.07	0.03	0.06	0.04
Rubber			0.04	0.03	0.12	0.11	0.00	0.00
Sanitary waste							0.00	0.00

Annex 8. Natural debris mass for 2022. SE: standard error.

Type	Shallow shelf		Continental shelf		Upper slope		Lower slope	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Wet wipes	0.13	0.09	6.03	3.61	0.93	0.41	0.48	0.20
Plastic	0.68	0.15	4.12	1.28	1.38	0.40	0.80	0.23
Clinker	0.37	0.22	1.45	0.49	1.85	0.51	2.03	0.55
Wood	2.02	1.44	0.07	0.03	0.72	0.32	0.08	0.06
Metal	0.01	0.01	0.52	0.51	0.02	0.01	1.72	1.68
Unclassified waste	0.22	0.15	0.93	0.78			0.57	0.48
Glass			1.15	1.05	0.21	0.12	0.01	0.01
Textiles	0.36	0.13	0.59	0.16	0.29	0.12	0.12	0.05
Rubber	0.00	0.00	0.67	0.39	0.03	0.02		
Sanitary waste			0.09	0.05	0.20	0.14	0.02	0.02
Fishing gear	0.10	0.05	0.02	0.01	0.07	0.04	0.04	0.01

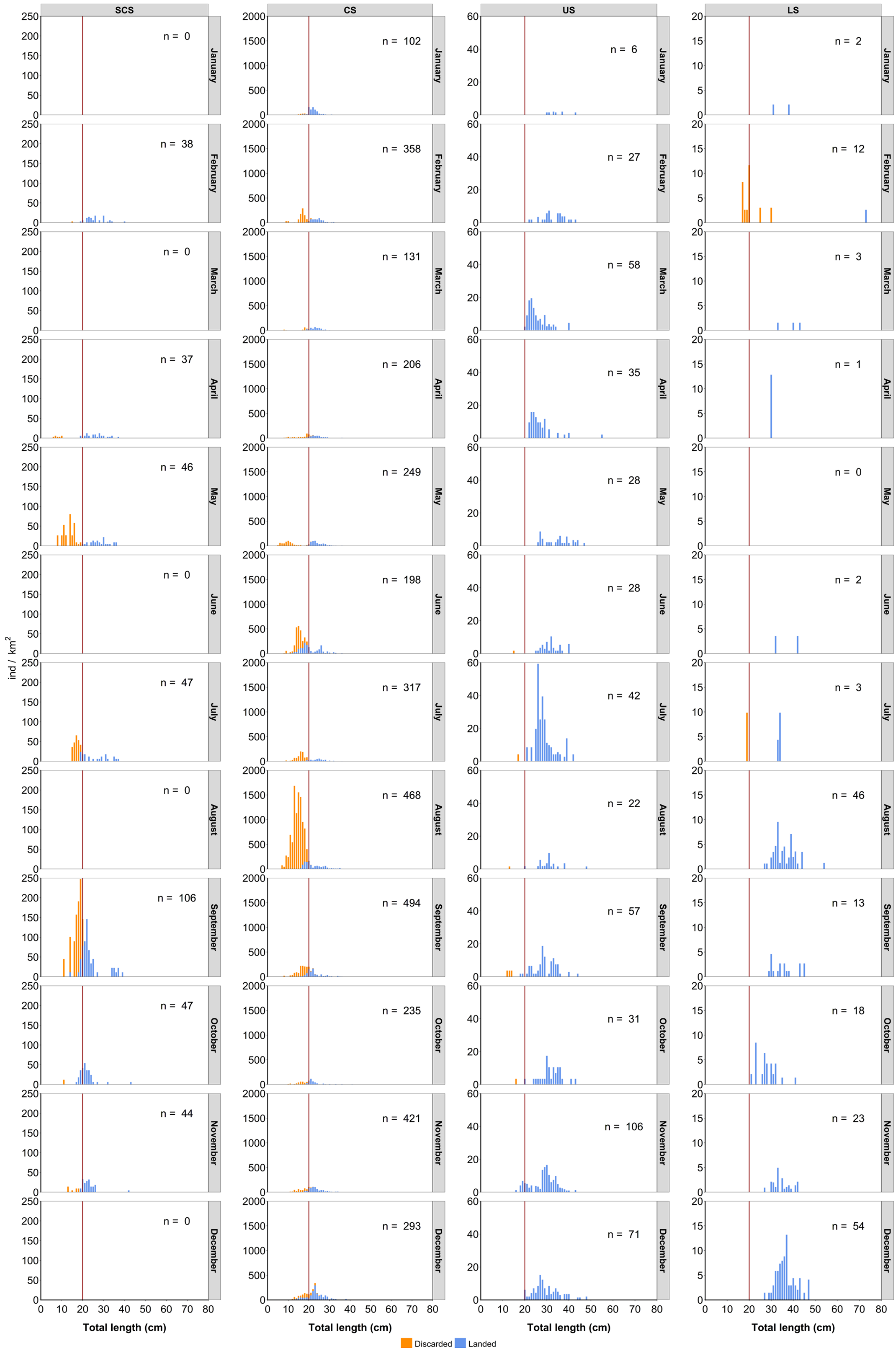
Annex 9. Marine litter mass for 2019-2021. SE: standard error.

Type	Shallow shelf		Continental shelf		Upper slope		Lower slope	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Terrestrial plants	20.79	11.71	11.62	1.91	7.90	2.22	3.37	1.45
Marine organic	9.57	1.40	8.91	1.11	5.11	1.33	1.60	0.23
Shells	5.65	0.90	5.65	0.63	3.10	0.79	0.57	0.20
Marine plants	8.86	3.08	2.42	0.46	0.53	0.09	0.28	0.07
Calcareous debris	0.15	0.12	3.34	1.77	0.20	0.15	0.13	0.08
Marine algae	1.33	0.88	0.54	0.23	0.12	0.06	0.01	0.00
Terrestrial animals	0.02	0.01	0.00	0.00	0.01	0.01	0.02	0.02

Annex 10. Marine litter mass for 2022. SE: standard error.

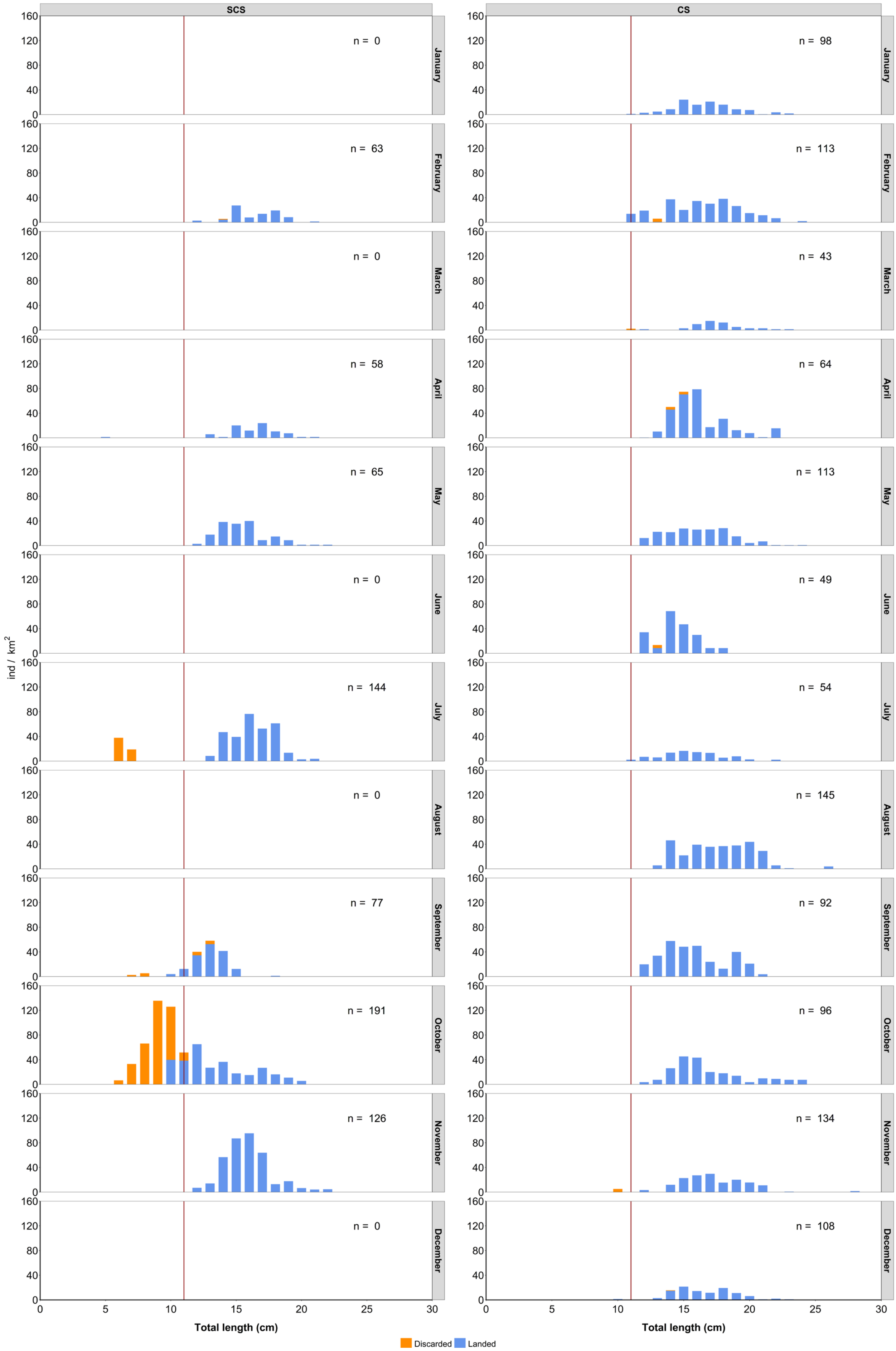
Type	Shallow shelf		Continental shelf		Upper slope		Lower slope	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Marine organic	11.21	2.42	7.80	2.25	3.49	0.68	2.30	0.57
Shells	4.09	1.10	8.07	1.91	1.73	0.51	1.06	0.35
Terrestrial plants	3.75	0.68	5.54	1.68	1.54	0.41	2.04	0.61
Marine plants	3.78	0.73	1.35	0.29	0.16	0.06	0.14	0.05
Calcareous debris	0.68	0.40	1.13	0.57	0.55	0.31	0.20	0.15
Terrestrial animals			0.00	0.00	0.70	0.69	0.00	0.00
Marine algae	0.08	0.05	0.28	0.27	0.02	0.02	0.00	0.00

Hake (*Merluccius merluccius*) HKE



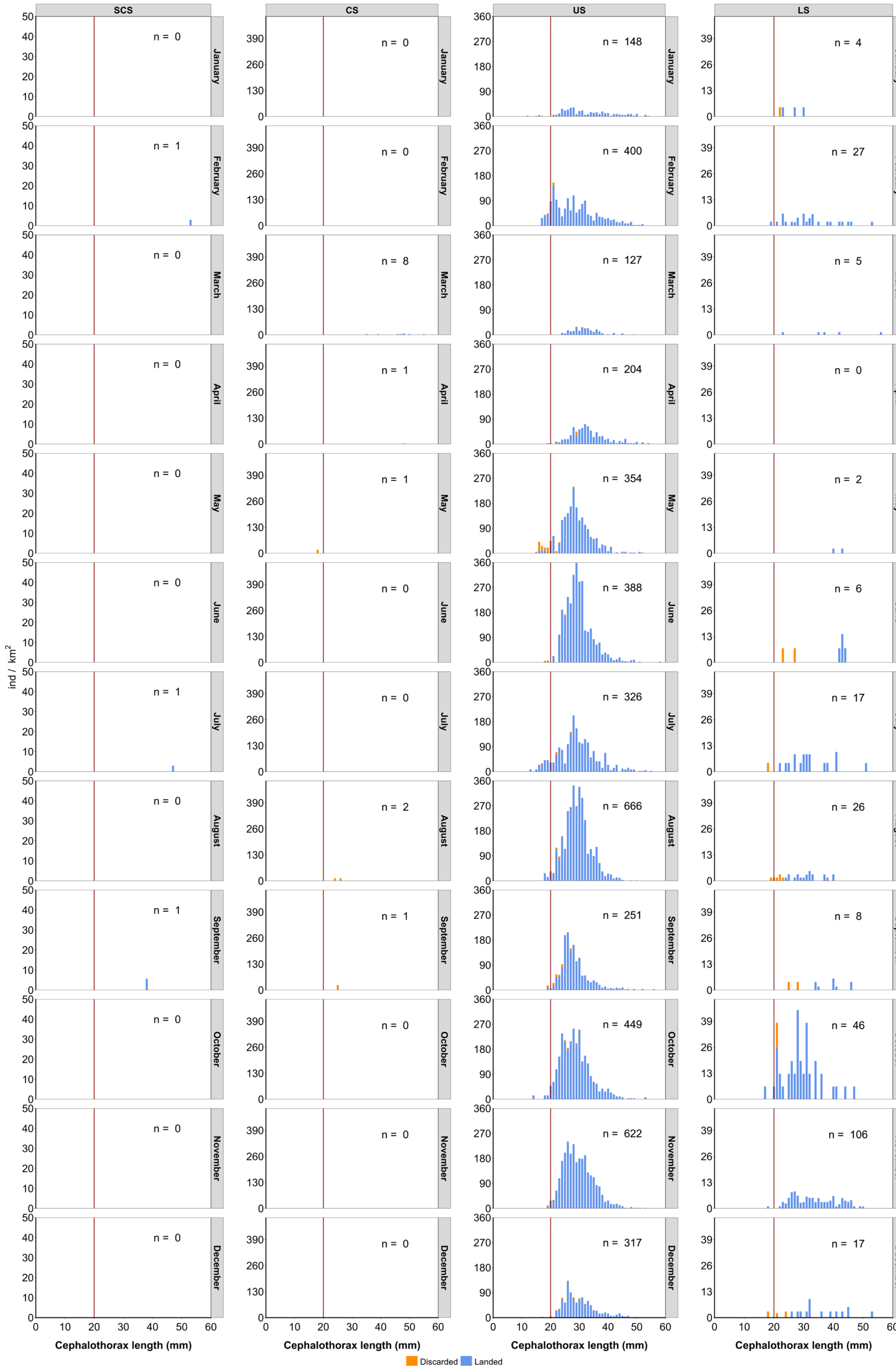
Annex 11. Monthly length-frequency distribution of Hake at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope) in 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS).

Red Mullet (*Mullus barbatus*) MUT



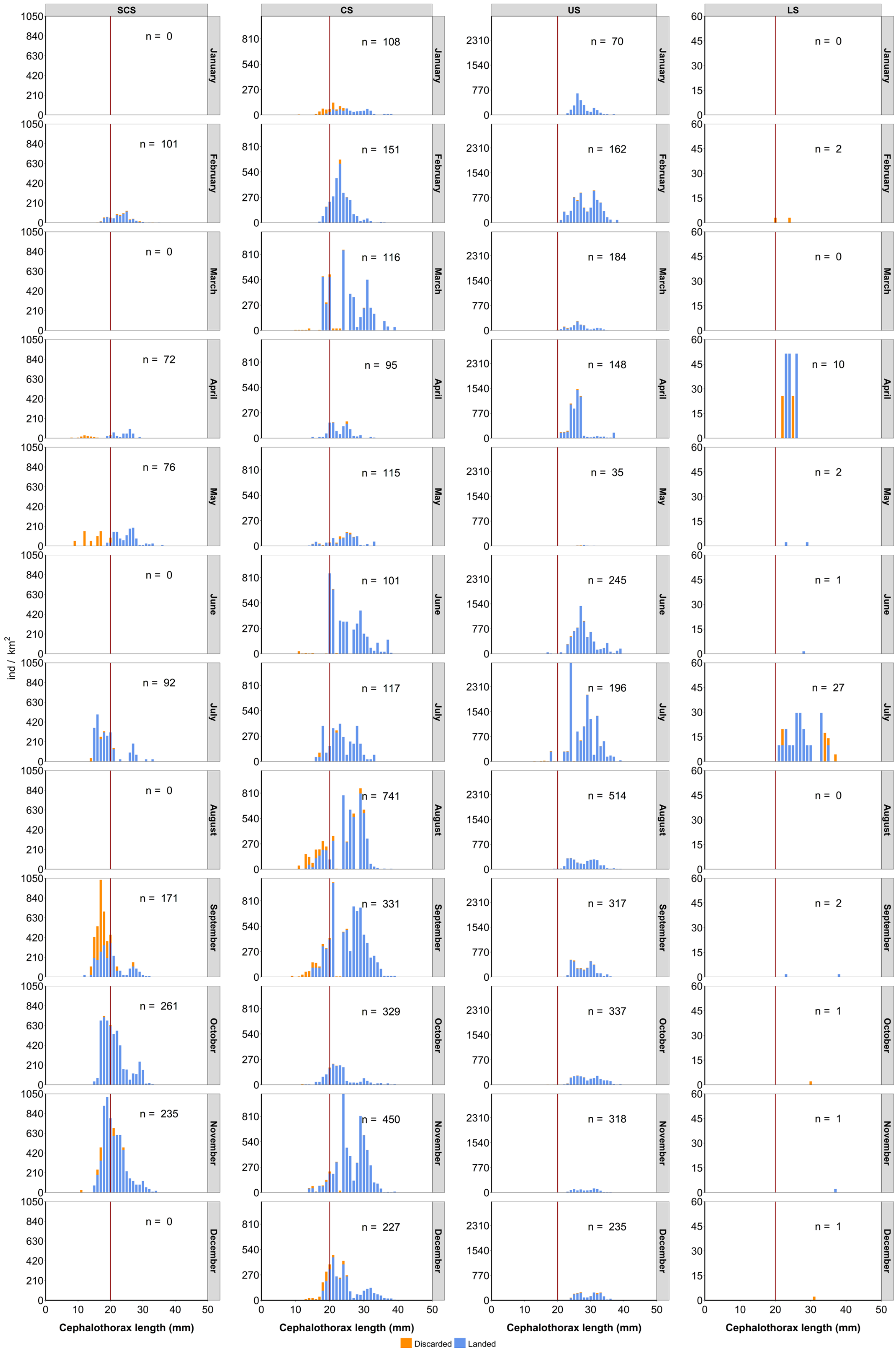
Annex 12. Monthly length-frequency distribution of Red mullet at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf) in 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS).

Norway lobster (*Nephrops norvegicus*) NEP



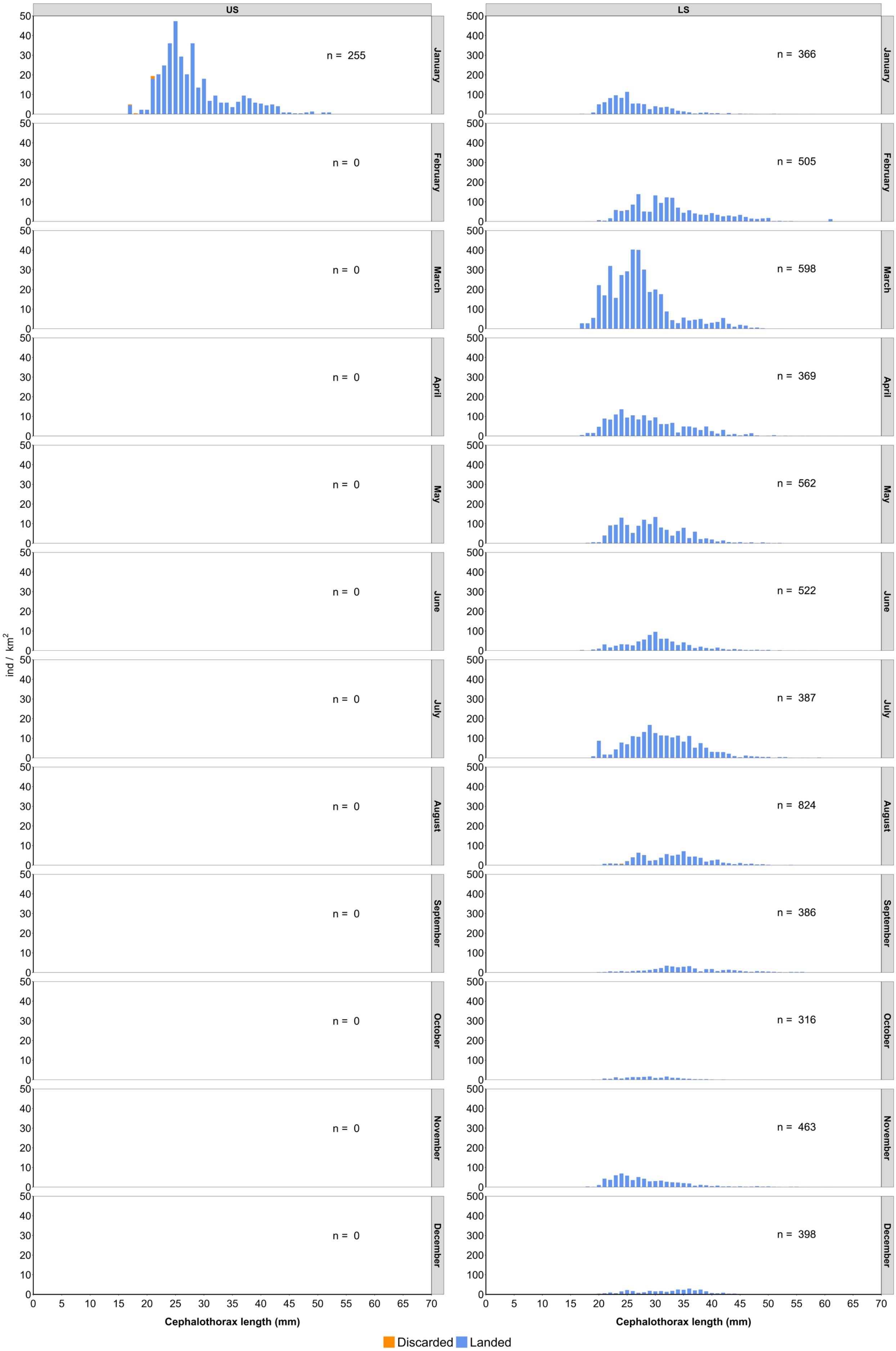
Annex 13. Monthly length-frequency distribution of Norway lobster at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope) in 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS).

Deep-water rose shrimp (*Parapenaeus longirostris*) DPS



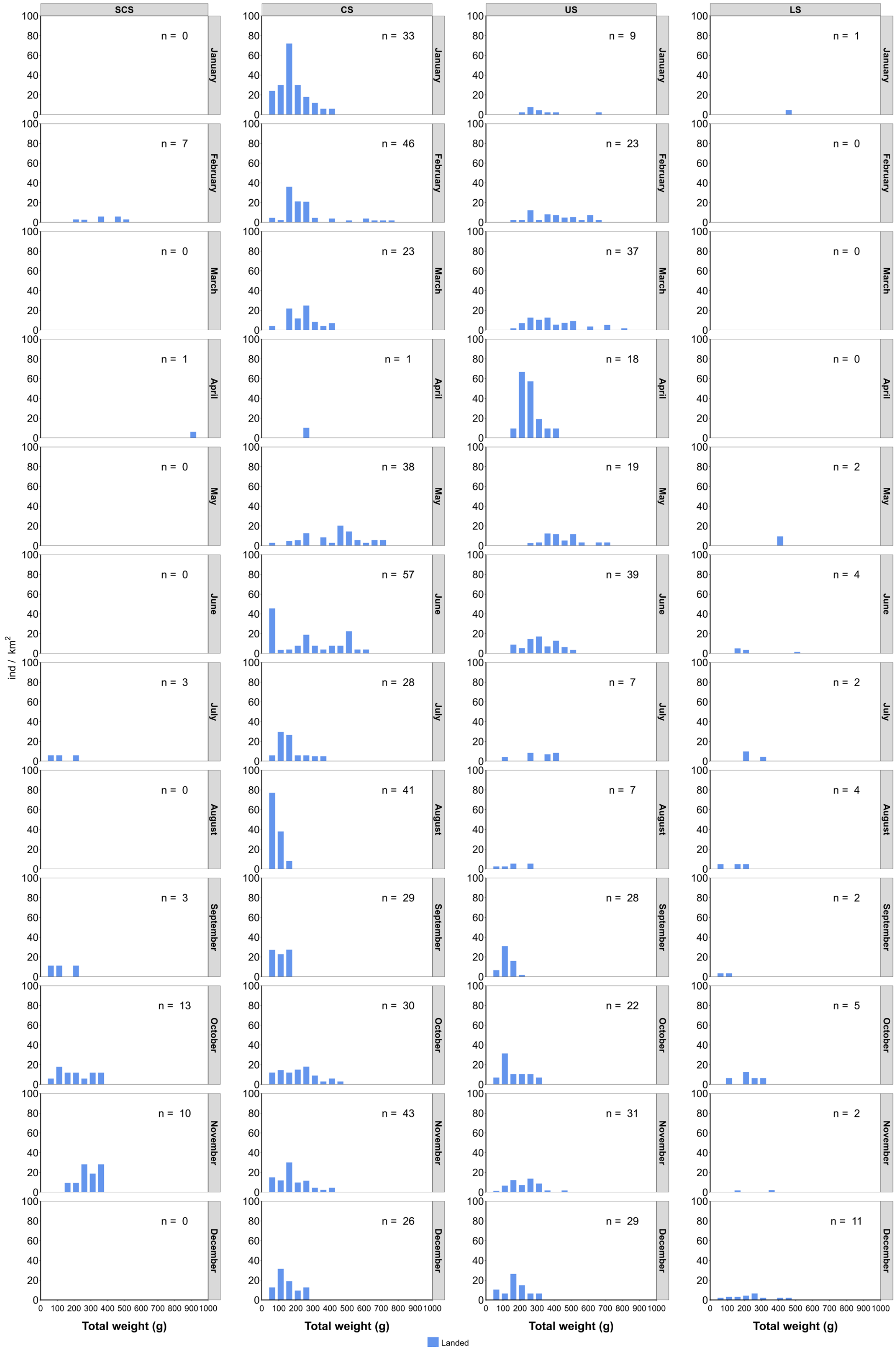
Annex 14. Monthly length-frequency distribution of Deep-water rose shrimp at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope) in 2022. (n) Total number of measured individuals. Red solid line: Minimum Conservation Reference Size (MCRS).

Blue and red shrimp (*Aristeus antennatus*) ARA



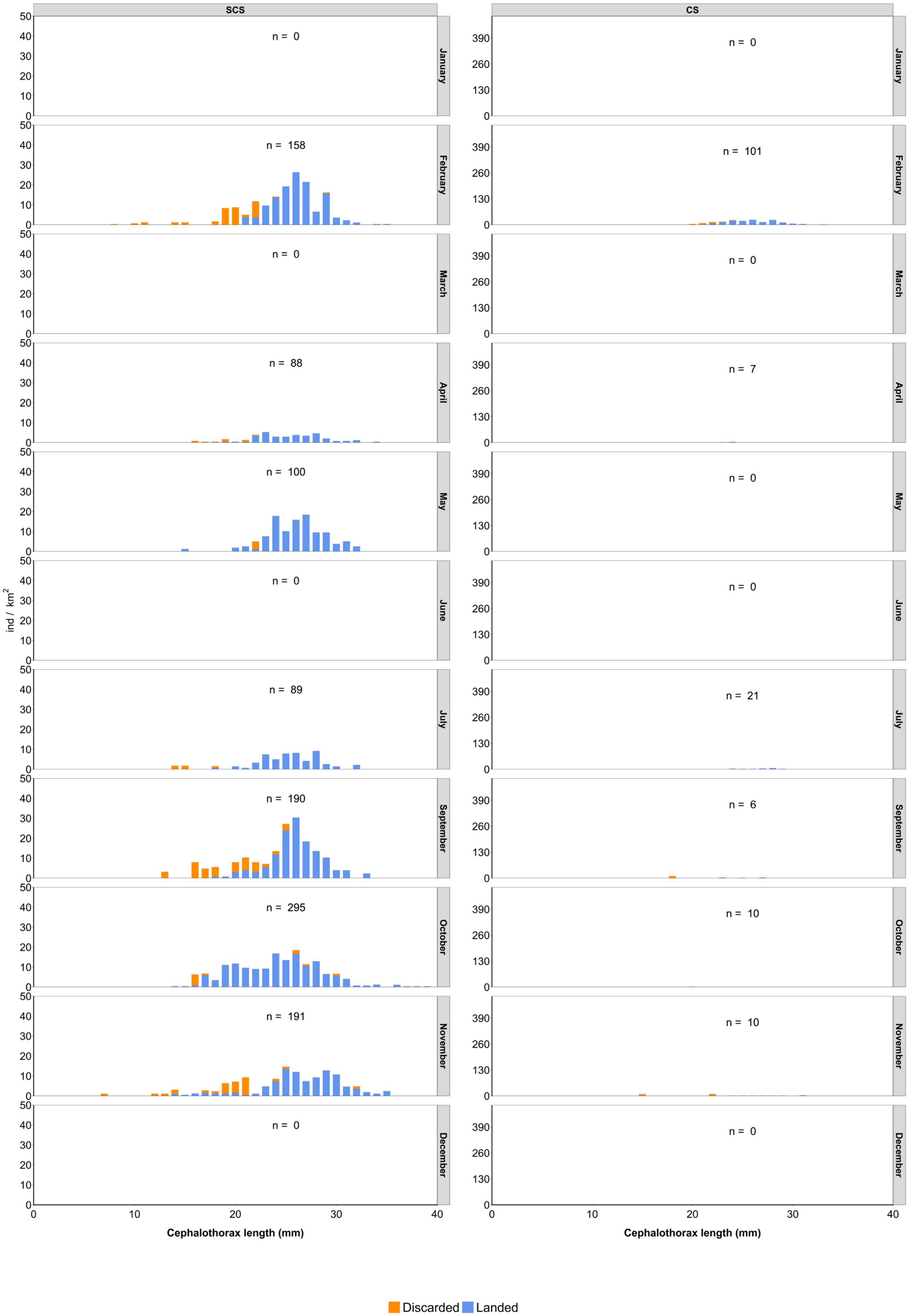
Annex 15. Monthly length-frequency distribution of Blue and red shrimp at different depth strata (US; Upper Slope and LS; Lower Slope) in 2022. (n) Total number of measured individuals.

Horned octopus (*Eledone cirrhosa*) EOI



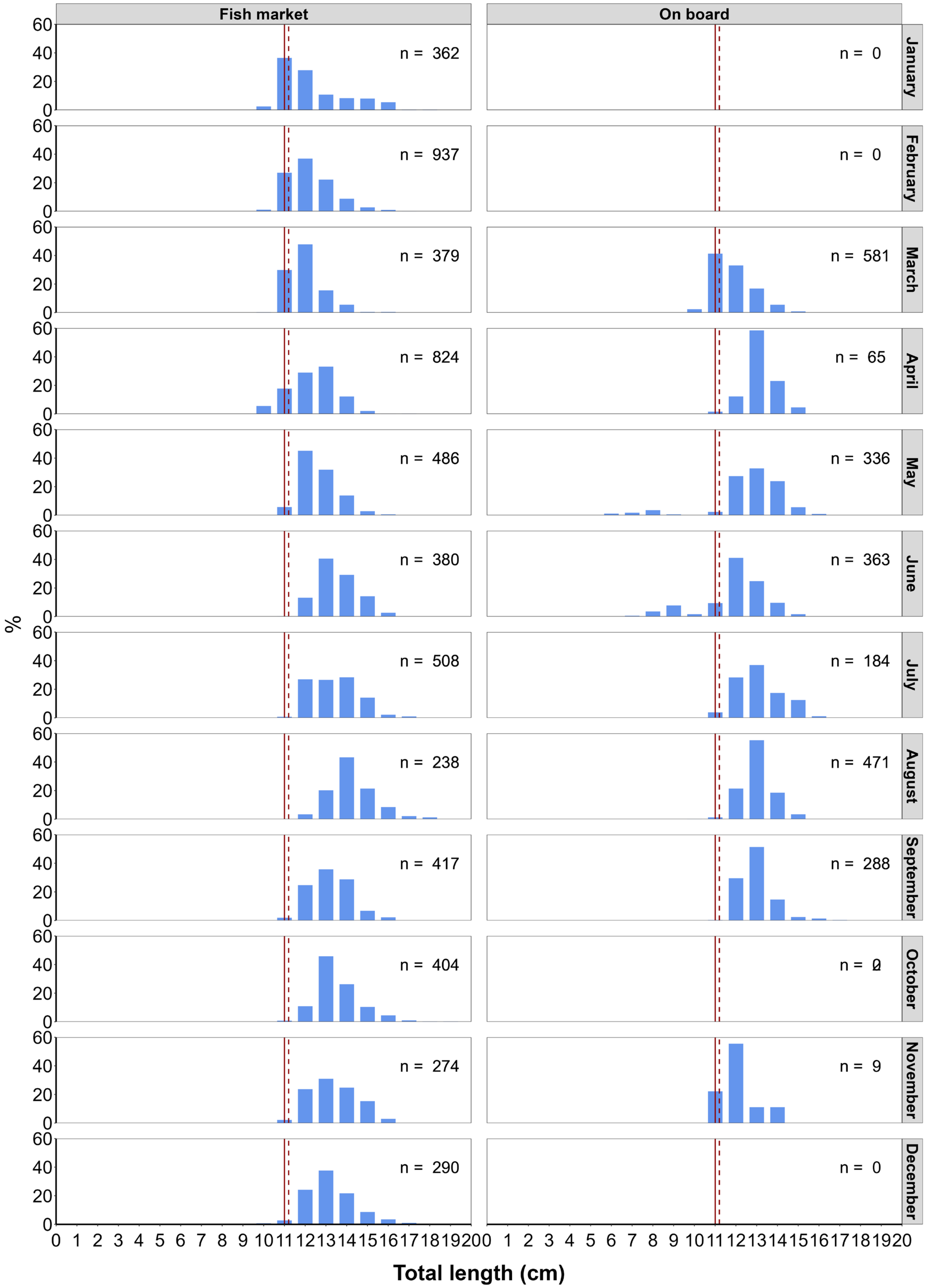
Annex 16. Monthly weight-frequency distribution of Horned octopus at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf, US; Upper Slope and LS; Lower Slope) in 2022. (n) Total number of measured individuals.

Spottail mantis shrimp (*Squilla mantis*) MTS



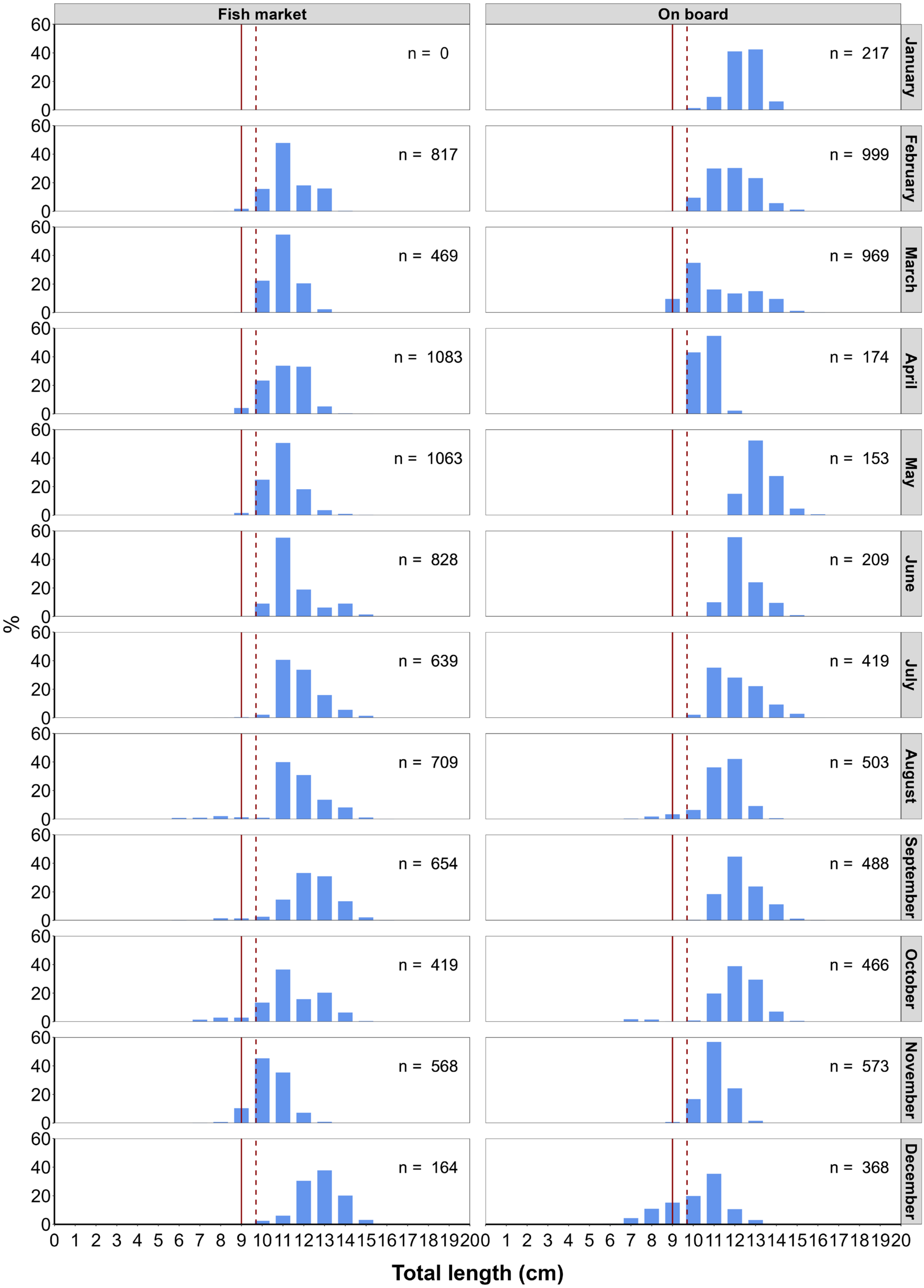
Annex 17. Monthly length-frequency distribution of Spottail mantis squillid at different depth strata (SCS; Shallow Continental Shelf, CS; Continental Shelf) in 2022. (n) Total number of measured individuals.

European sardine (*Sardina pilchardus*) PIL



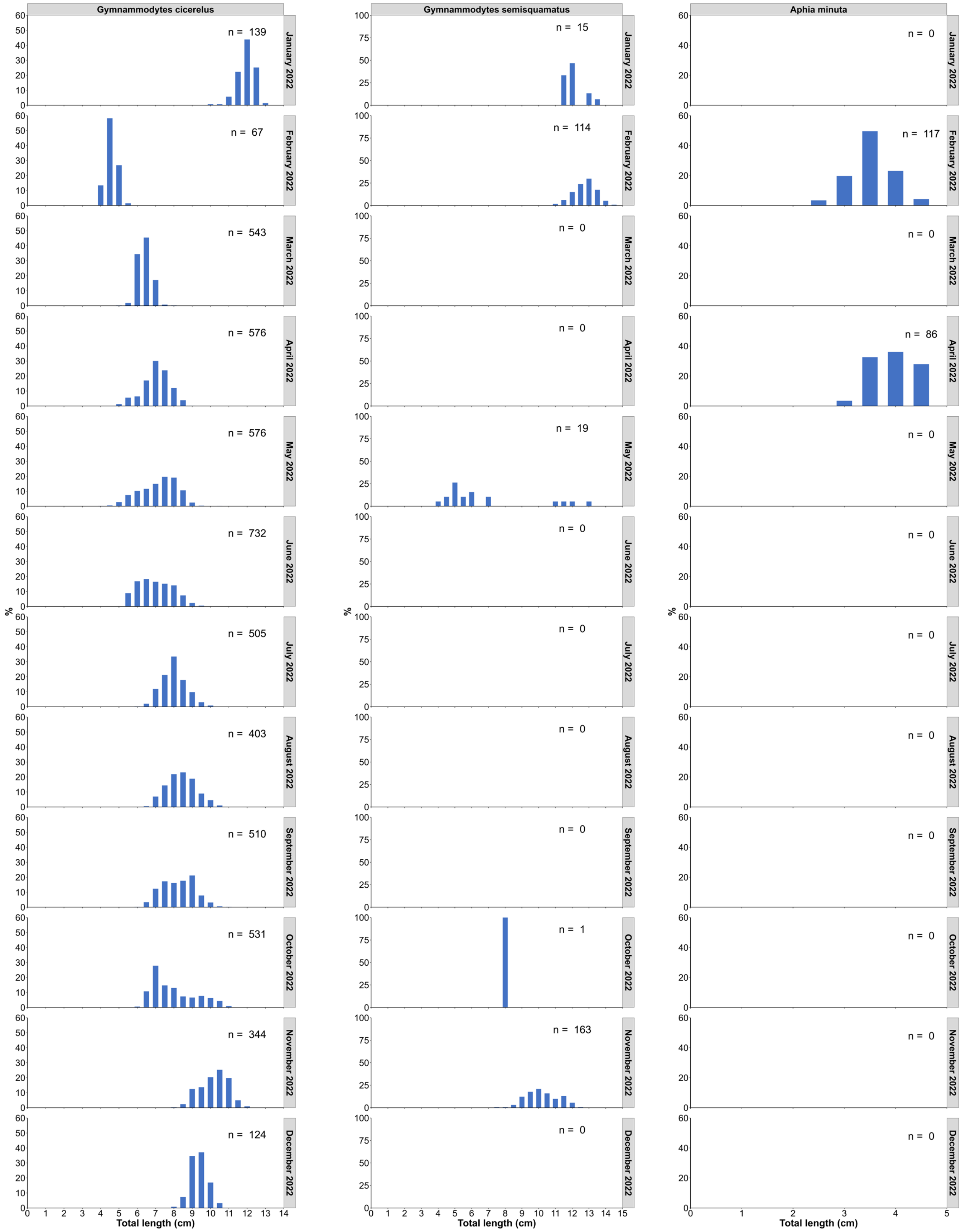
Annex 18. Monthly length-frequency distribution of European sardine, left: fish market sampling and right: on-board sampling. (n) Total number of measured individuals. Red dashed line: Minimum Conservation Reference Size (MCRS).

Anchovy (*Engraulis encrasicolus*) ANE



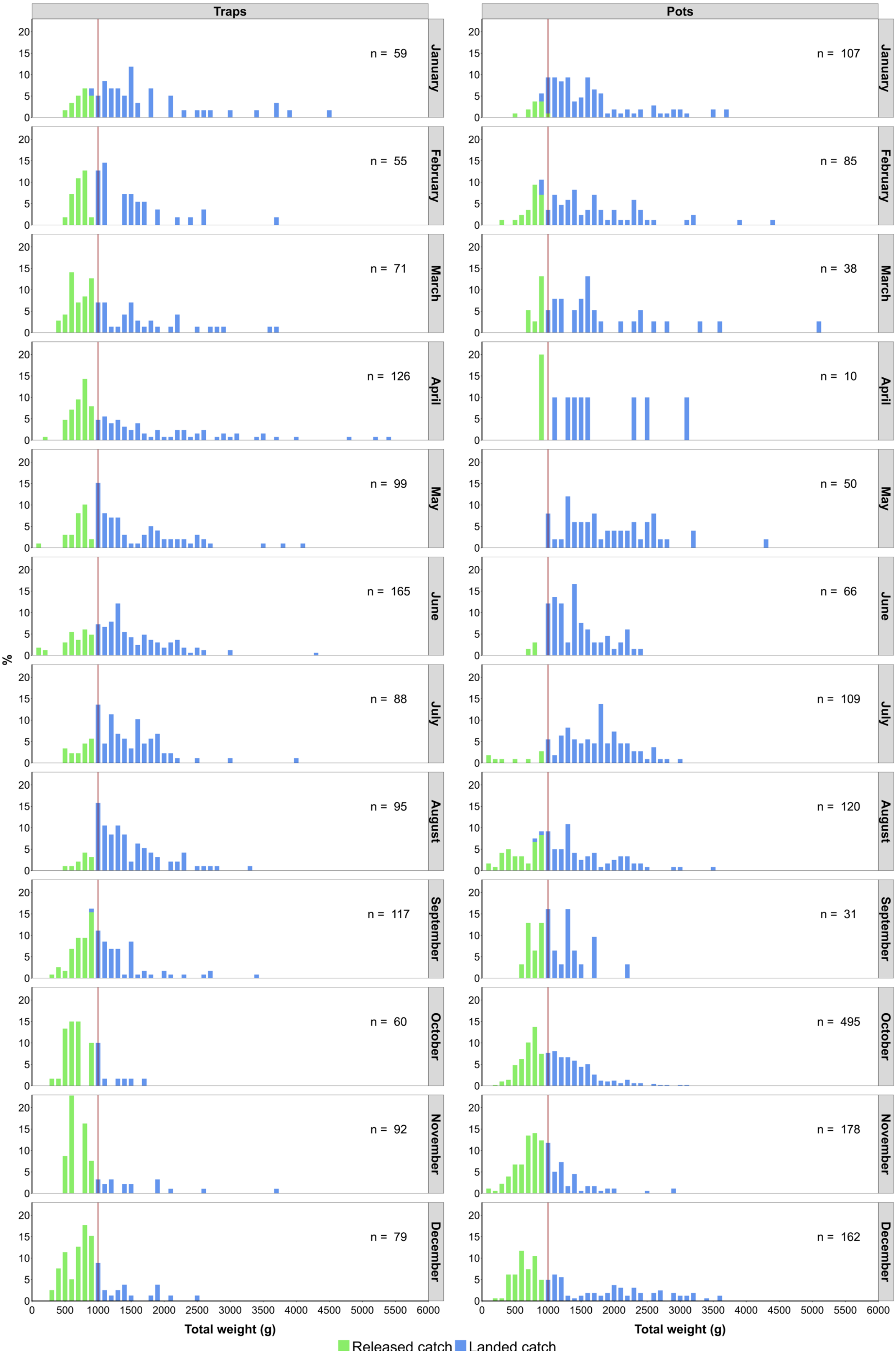
Annex 19. Monthly length-frequency distribution of Anchovy, left: fish market sampling and right: on-board sampling. (n) Total number of measured individuals. Red dashed line: Minimum Conservation Reference Size (MCRS).

Target species in Sand eel fishery (ZGC, ZGS, FIM)



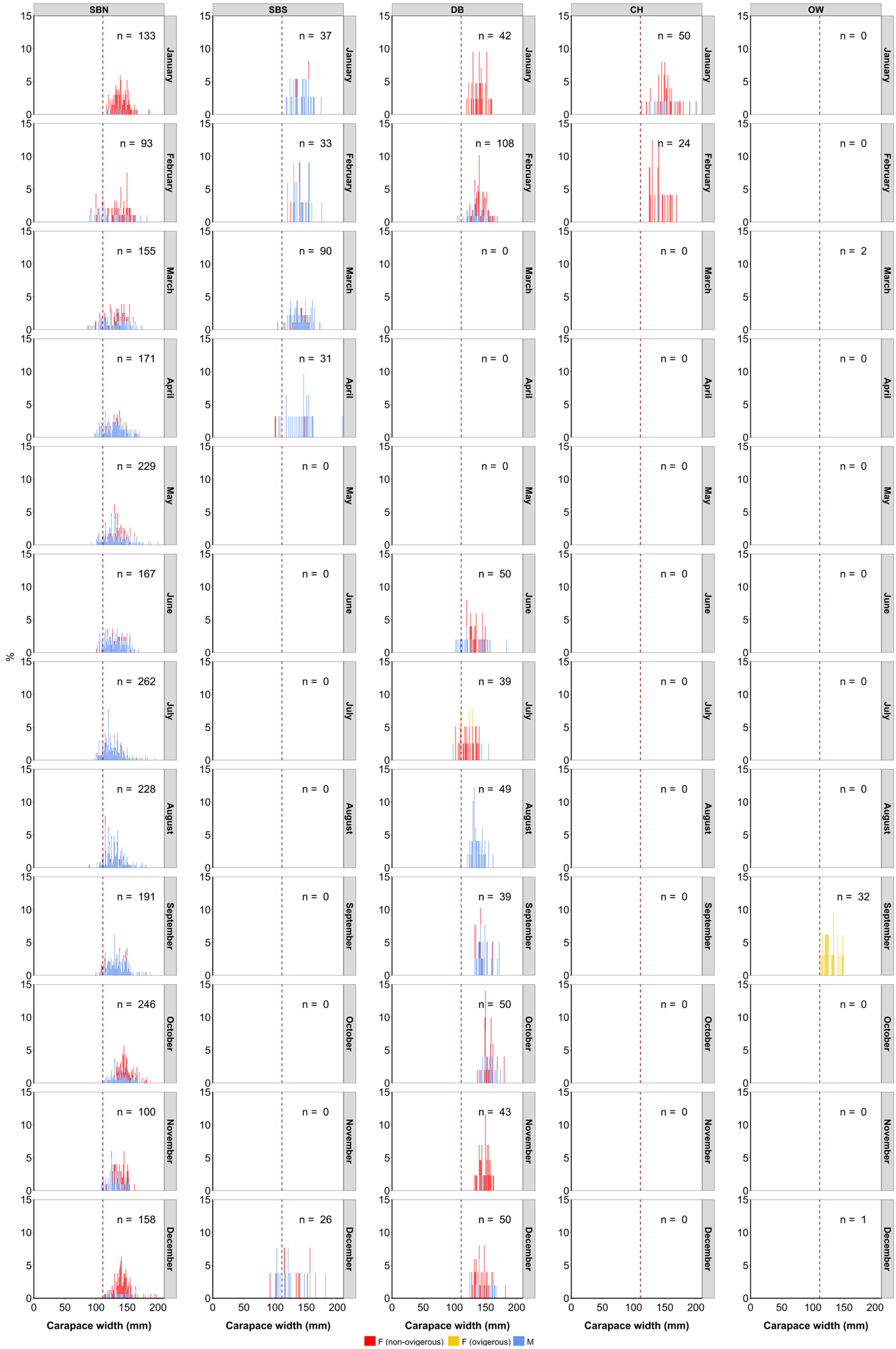
Annex 20. Monthly length-frequency distribution of the main target species of the sand eel fishery in 2022. (n) Total number of measured individuals.

Common octopus (*Octopus vulgaris*) OCC



Annex 21. Monthly weight-frequency distribution of common octopus at different fishing gear (Traps and Pots) in Central Catalonia in 2022. Red solid line: Minimum Conservation Reference Weight (MCRW).

Blue crab (*Callinectes sapidus*) CRB



Annex 22. Monthly length-frequency distribution of Blue crab at different depth strata (SBN; Shallow Bay North, SBS; Shallow Bay South, BD; Deep Bay, CH; Channel and OW; Open Water). Left: from 2019 to 2021, right: 2022. (n) Total number of measured individuals. Red dashed line: size at first sexual maturity (L_{50}).

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