Acoustic assessment and distribution of the main pelagic fish species in ICES Subdivision 9a South during the *ECOCADIZ 2018-07* Spanish survey (July-August 2018).

By

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ABSTRACT

The present working document summarises the main results obtained from the Spanish (pelagic ecosystem-) acoustic survey conducted by IEO between 31st July and 13rd August 2018 in the Portuguese and Spanish shelf waters (20-200 m isobaths) off the Gulf of Cadiz onboard the R/V *Miguel Oliver*. The 21 foreseen acoustic transects were sampled. A total of 25 valid fishing hauls were carried out for echo-trace ground-truthing purposes. A census of top predator species was also carried out along the sampled acoustic transects. Chub mackerel was the most frequent species in the fishing hauls, followed by sardine, anchovy, mackerel and bogue. *Trachurus* spp. showed a medium relative frequency of occurrence. Pearlside, snipefish and boarfish only occurred in hauls conducted in the deepest limit of the surveyed area. Anchovy was the most abundant species in these hauls, followed by pearlside, sardine and chub mackerel, with the remaining species showing negligible relative contributions. The estimate of total NASC allocated to the "pelagic fish species assemblage" has been the highest one ever recorded within the time series, denoting a high fish density during the survey. Anchovy was widely distributed over the surveyed area, although showing the highest densities in the Spanish shelf waters and in a secondary nucleus located over the western Portuguese shelf. Largest (and oldest) anchovies were distributed both in the westernmost and easternmost waters and the smallest (and youngest) ones were concentrated in the surroundings of the Guadalquivir river mouth and adjacent shallow waters, including those ones in front of the Bay of Cadiz. Anchovy acoustic estimates in summer 2018 were of 3 063 million fish and 34 908 t (i.e. the second historical biomass maximum in the time-series), well above the historical average (ca. 22 kt), but without showing any clear recent trend. Sardine recorded a very high acoustic echo-integration in summer 2018 as a consequence of the occurrence of very dense mid-water schools in the coastal fringe (20-50 m depth) comprised between Tavira and the surroundings of the Guadalquivir river mouth. The distribution pattern of acoustic densities is quite similar to the one provided by the *PELAGO 18* survey in spring although the occurrence of sardine in the surveyed area was more continuous in summer. These facts resulted in summer estimates of 7 955 million fish and 114 631 t, the historical maximum record in terms of abundance and the second maximum in biomass. Spanish waters concentrated the bulk of the population. Such an increasing trend seems to be the result of a greater accessibility of the species to the survey, with the occurrence of many dense schools (mainly Age-0 fish) in the shallowest limits of the surveyed area which are not usually recorded in the most recent years. In any case, this behaviour should be analysed in more detail between WGACEGG experts.

INTRODUCTION

The *ECOCADIZ* surveys constitute a series of yearly acoustic surveys conducted by IEO in the Subdivision 9a South (Algarve and Gulf of Cadiz, between 20 – 200 m depth) under the "pelagic ecosystem survey" approach, firstly onboard R/V *Cornide de Saavedra* (until 2013) and since 2014 on onboard R/V *Miguel Oliver*. This series started in 2004 with the *BOCADEVA 0604* pilot acoustic - anchovy DEPM survey. The following surveys within this new series (named *ECOCADIZ* since 2006 onwards) are planned to be routinely performed on a yearly basis, although the series, because of the available ship time, has shown some gaps in those years coinciding with the conduction of the triennial anchovy DEPM survey (the true *BOCADEVA* series, which first survey started in 2005).

Results from the *ECOCADIZ* series are routinely reported to ICES Expert Groups on both stock assessment (formerly in WGMHSA, WGANC, WGANSA, at present in WGHANSA) and acoustic and egg surveys on anchovy and sardine (WGACEGG).

The present Working Document reports the main results from the *ECOCADIZ 2018-07* survey. These results will refer to the acoustic estimates (age-structured for anchovy and sardine) and spatial distribution of the assessed species.

MATERIAL AND METHODS

The *ECOCADIZ 2018-07* survey was carried out between 31st July and 13rd August 2018 onboard the Spanish R/V *Miguel Oliver* covering a survey area comprising the waters of the Gulf of Cadiz, both Spanish and Portuguese, between the 20 m and 200 m isobaths. The survey design consisted in a systematic parallel grid with tracks equally spaced by 8 nm, normal to the shoreline (**Figure 1**).

Echo-integration was carried out with a *Simrad™ EK60* echo sounder working in the multi-frequency fashion (18, 38, 70, 120, 200 kHz). Average survey speed was about 10 knots and the acoustic signals were integrated over 1-nm intervals (ESDU). Raw acoustic data were stored for further post-processing using *Echoview™* software package. Acoustic equipment was previously calibrated during the *MEDIAS 2018* acoustic survey, a survey conducted in the Spanish Mediterranean waters just before the *ECOCADIZ* one, following the standard procedures (Demer *et al.*, 2015).

Survey execution and abundance estimation followed the methodologies firstly adopted by the ICES *Planning Group for Acoustic Surveys in ICES Sub-Areas VIII and IX* (ICES, 1998) and the recommendations given by the *Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES areas 7, 8 and 9* (WGACEGG; ICES, 2006a,b).

Fishing stations for echo-trace ground-truthing were opportunistic, according to the echogram information, and they were carried out using a ca. 15 m-mean vertical opening pelagic trawl (*Tuneado* gear) at an average speed of 4 knots. Gear performance and geometry during the effective fishing was monitored with *Simrad™ Mesotech FS20/25* trawl sonar and a *Marport^{TM} combi TE/TS* (Trawl Eye/Trawl Speed) sensor. Trawl sonar and sensors data from each haul were recorded and stored for further analyses.

Ground-truthing haul samples provided biological data on species and they were also used to identify fish species and to allocate the back-scattering values into fish species according to the proportions found at the fishing stations (Nakken and Dommasnes, 1975).

Length frequency distributions (LFD) by 0.5-cm class were obtained for all the fish species in trawl samples (either from the total catch or from a representative random sample of 100-200 fish). Only those LFDs based on a minimum of 30 individuals and showing a normal distribution were considered for the purpose of the acoustic assessment.

Individual biological sampling (length, weight, sex, maturity stage, stomach fullness, and mesenteric fat content) was performed in each haul for anchovy, sardine (in both species with otolith extraction), mackerel and horse-mackerel species, and bogue.

The following TS/length relationship table was used for acoustic estimation of assessed species (recent IEO standards after ICES, 1998 and recommendations by ICES, 2006a,b):

Species	b_{20}
Sardine (*Sardina pilchardus*)	-72.6
Round sardinella (*Sardinella aurita*)	-72.6
Anchovy (*Engraulis encrasicolus*)	-72.6
Chub mackerel (*Scomber japonicus*)	-68.7
Mackerel (*S. scombrus*)	-84.9
Horse mackerel (*Trachurus trachurus*)	-68.7
Mediterranean horse-mackerel (*T. mediterraneus*)	-68.7
Blue jack mackerel (*T. picturatus*)	-68.7
Bogue (*Boops boops*)	-67.0
Blue whiting (*Micromesistius poutassou*)	-67.5
Silvery lightfish (*Maurolicus muelleri*)	-72.2
Boarfish (*Capros aper*)	-66.2* (-72.6)

*Boarfish b_{20} estimate following to Fässler *et al*. (2013). Between parentheses the usual IEO value considered in previous surveys.

The *PESMA 2010* software (J. Miquel, unpublished) has got implemented the needed procedures and routines for the acoustic assessment following the above approach.

A *Continuous Underway Fish Egg Sampler* (CUFES, 151 stations), a *Sea-bird Electronics™ SBE 21 SEACAT* thermosalinograph and a *Turner™ 10 AU 005 CE Field* fluorometer were used during the acoustic tracking to continuously monitor some hydrographical variables (sub-surface sea temperature, salinity, and *in vivo* fluorescence). Vertical profiles of hydrographical variables were also recorded by night from 161 CTD casts by using *Sea-bird Electronics™ SBE 911+ SEACAT* (with coupled *Datasonics* altimeter, *SBE 43* oximeter, *WetLabs ECO-FL-NTU* fluorimeter and *WetLabs C-Star 25 cm* transmissometer sensors) and *LADCP T-RDI WHS* 300 kHz profilers (**Figure 2**). *VMADCP RDI 150 kHz* records were also continuously recorded by night between CTD stations.

Twenty two (22) *Manta trawl* hauls were also carried out to characterize the distribution pattern of micro-plastics over the shelf (**Figure 3**). These hauls did not follow a pre-established sampling scheme although the main goal was to have samples well distributed both in the coastal and oceanic areas of the shelf. Consequently, the hauls were opportunistically carried out taking the advantage of the conduction of fishing hauls, the start or end of an acoustic transect or whatever discrete station devoted to the sampling of either hydrographical or biological variables which were close to the preferred depths.

Information on presence and abundance of sea birds, turtles and mammals was also recorded during the acoustic sampling by one onboard observer.

RESULTS

Acoustic sampling

The acoustic sampling started on 01st August in the coastal end of the transect RA01 and finalized on 11th August in the oceanic end of the transect RA21 (**Table 1, Figure 1**). Transects were acoustically sampled in the E-W direction. The whole 21-transect sampling grid was sampled. The acoustic sampling usually started at 06:00 UTC although this time might vary depending on the duration of the works related with the hydrographic sampling. The foreseen start of transects RA14 and RA15 by the coastal end had to be displaced into deeper waters in order to avoid the occurrence of open-sea fish farming/fattening cages.

Groundtruthing hauls

Twenty five (25) fishing operations, all of them being considered as valid ones according to a correct gear performance and resulting catches, were carried out (**Table 2**, **Figure 4**).

As usual in previous surveys, some fishing hauls were attempted by fishing over an isobath crossing the acoustic transect as close as possible to the depths where the fishing situation of interest was detected over that transect. In this way the mixing of different size compositions (*i.e.*, bi-, multi-modality of length frequency distributions) was avoided as well as a direct interaction with fixed gears. The mixing of sizes is more probable close to nursery-recruitment areas and in regions with a very narrow continental shelf. This type of hauls is also conducted in depths showing hard and/or very irregular bottoms. Given that all of these situations were not very uncommon in the sampled area, 40% of valid hauls (10 hauls) were conducted over isobath.

Because of many echo-traces usually occurred close to the bottom, all the pelagic hauls were carried out like a bottom-trawl haul, with the ground rope working over or very close to the bottom. According to the above, the sampled depth range in the valid hauls oscillated between 41-185 m.

During the survey were captured 1 Chondrichthyan, 29 Osteichthyes, 5 Cephalopod and 3 Crustacean species. The percentage of occurrence of the more frequent species in the trawl hauls is shown in the enclosed **text table below** (see also **Figure 5**). The pelagic ichthyofauna was the most frequently captured species set and the one composing the bulk of the overall yields of the catches. Within this pelagic fish species set, chub mackerel was the most frequent captured species in the valid hauls (24 hauls, 96% presence index) followed by sardine, anchovy, mackerel and bogue (with relative occurrences between 60-92%). *Trachurus* spp. showed a medium relative frequency of occurrence (ca. 20-48%), whereas silver lightfish (*Maurolicus muelleri*, 16%), snipefish (*Macrorhamphosus scolopax*, 8%) and boarfish (*Capros aper*, 4%) showed either a low or very low occurrence in the whole surveyed area. Round sardinella and blue whiting were absent in the hauls of the present survey.

For the purposes of the acoustic assessment, anchovy, sardine, mackerel species, horse & jack mackerel species, bogue, silver lightfish and boarfish were initially considered as the survey target species. All of the invertebrates, and both bentho-pelagic (*e.g.*, manta rays) and benthic fish species (*e.g.*, flatfish, gurnards, etc.) were excluded from the computation of the total catches in weight and in number from those fishing stations where they occurred. Catches of the remaining non-target species were included in an operational category termed as "*Others*".

According to the above premises, during the survey were captured a total of 20.5 tonnes and 954 thousand fish (**Table 3**). 38% of this fished biomass corresponded to chub mackerel, 31% to sardine, 26% to anchovy, and contributions lower than 1% to the remaining species. The most abundant species in ground-

truthing trawl hauls was anchovy (39%) followed by silver light fish (27%), sardine (19%) and chub mackerel (15%), with the remaining species showing lower contributions than 0.1%.

Species	# of fishing stations	Occurrence (%)	Total weight (kg)	Total number
Scomber colias	24	96	7878,981	142227
Sardina pilchardus	23	92	6425,485	183976
Merluccius merluccius	23	92	101,66	874
Engraulis encrasicolus	22	88	5323,439	369728
Scomber scombrus	20	80	84,958	452
Boops boops	15	60	82,441	654
Loligo subulata	15	60	1,606	532
Spondyliosoma cantharus	13	52	51,951	356
Loligo media	13	52	1,696	583
Trachurus trachurus	12	48	74,959	703
Trachurus picturatus	12	48	5,301	76
Loligo vulgaris	9	36	1,427	37
Pagellus erythrinus	8	32	87,247	530
Diplodus bellottii	6	24	9,114	149
Diplodus vulgaris	6	24	47,125	296
Aphia minuta	6	24	0,119	203
Trachurus mediterraneus	5	20	48,755	275
Diplodus annularis	5	20	3,374	55
Spicara flexuosa	5	20	2,381	33
Alosa fallax	4	16	1,583	6
Pagellus acarne	4	16	6,491	33
Trachinus draco	4	16	0,518	4
Maurolicus muelleri	4	16	148,71	253722
Pagellus bellottii	3	12	5,815	31
Mola mola	2	8	13,5	4
Illex coindetii	2	8	0,134	4
Macroramphosus scolopax	2	8	0,056	16
Capros aper	1	4	1,375	304

The species composition, in terms of percentages in number, in each valid fish station is shown in **Figure 5**. A first impression of the distribution pattern of the main species may be derived from the above figure. Thus, anchovy showed a relatively wide distribution over the surveyed area, although the highest yields were recorded in the Spanish waters. The size composition of anchovy catches confirms the usual pattern exhibited by the species in the area during the survey season, with the largest fish inhabiting the westernmost waters and the smallest ones concentrated in the surroundings of the Guadalquivir river mouth and adjacent shallow waters (**Figure 6**). Sardine was also widely distributed in the surveyed area. Juvenile sardines were mainly captured in the shallowest hauls conducted in the coastal fringe between Tinto-Odiel river mouth and the Bay of Cadiz, with a secondary nucleus of occurrence in the surroundings of Cape Santa Maria (**Figure 7**). Chub mackerel, horse mackerel, blue jack mackerel and bogue, although they occurred in a great part of the study area, only showed relatively high yields in the Portuguese waters. Mediterranean horse mackerel was restricted to the easternmost Spanish waters. The size composition of these last species in fishing hauls is shown in **Figures 8** to **15**.

Back-scattering energy attributed to the "pelagic assemblage" and individual species

A total of 335 nmi (ESDU) from 21 transects has been acoustically sampled by echo-integration for assessment purposes. From this total, 218 nmi (11 transects) were sampled in Spanish waters, and 117 nmi (10 transects) in the Portuguese waters. The enclosed text table below provides the nautical area-scattering coefficients attributed to each of the selected target species and for the whole "pelagic fish assemblage".

S_A $(m^2 nmi^{-2})$	Total spp.	PIL	ANE	MAC	MAS	HOM	HMM	JAA	BOG	BOC	MAV
Total Area (%)	241648 (100,0)	117882 (48,8)	44153 (18,3)	27 (0,01)	51973 (21,5)	472 (0,2)	1585 (0,7)	41 (0,02)	3585 (1,5)	9 (0,004)	21920 (9,1)
Portugal (%)	65910 (27,3)	20194 (17,1)	4336 (9,8)	5 (19,1)	36521 (70,3)	436 (92,3)	0 (0,0)	34 (83,3)	1276 (35,6)	9 (100,0)	3100 (14,1)
Spain (%)	182864 (72,7)	97688 (82,9)	39817 (90,2)	22 (80,9)	15453 (29,7)	36 (7,7)	1585 (100,0)	7 (16,7)	2309 (64,4)	0 (0,0)	18819 (85,9)

For this "pelagic fish assemblage" has been estimated a total of 241 648 m^2 nmi^{-2}, the highest estimate ever recorded within the time-series (**Figure 16**). Portuguese waters accounted for 27% of this total back-scattering energy and the Spanish waters the remaining 73%. However, given that the Portuguese sampled ESDUs were almost the half of the Spanish ones, the (weighted-) relative importance of the Portuguese area (*i.e.*, its density of "pelagic fish") is actually much higher. The mapping of the total back-scattering energy is shown in **Figure 16**. By species, sardine (49%), chub mackerel (22%) and anchovy (18%) were the most important species in terms of their contributions to the total back-scattering energy. Silvery lightfish (9%), bogue (1.5%) and Mediterranean horse mackerel (1%) were the following species in importance. The remaining species contributed with less than 0.2% only.

Some inferences on the species' distribution may be carried out from regional contributions to the total energy attributed to each species: Mediterranean horse mackerel, anchovy, silvery lightfish, sardine, mackerel and bogue seemed to show greater densities in the Spanish waters, whereas chub mackerel, blue jack mackerel, horse mackerel and boarfish could be considered as typically "Portuguese species" in this survey.

According to the resulting values of integrated acoustic energy, the species acoustically assessed in the present survey finally were anchovy, sardine, mackerel, chub mackerel, blue jack mackerel, horse mackerel, Mediterranean horse mackerel, bogue.

Spatial distribution and abundance/biomass estimates

Anchovy

Parameters of the survey's length-weight relationship for anchovy are given in **Table 4**. The back-scattering energy attributed to this species and the coherent strata considered for the acoustic estimation are shown in **Figure 17**. The estimated abundance and biomass by size and age class are given in **Tables 5** and **6**, and **Figures 18** and **19**.

Anchovy was widely distributed over the surveyed area, although showing the highest densities in the Spanish shelf waters between El Rompido (RA10) and Bay of Cadiz (RA03), and in a secondary nucleus located over the Portuguese shelf, between Alfanzina (RA18) and Cape of Santa Maria (RA15) (**Figure 17**). This distribution pattern differed from the exhibited one during the *PELAGO* spring survey, when anchovy was restricted to a zone comprised between Vila Real de Santo Antonio (easternmost Portuguese waters) and the Bay of Cadiz.

Twelve (12) coherent post-strata have been differentiated according to the S_A value distribution and the size composition in the fishing stations (**Figure 17**). The acoustic estimates by homogeneous post-stratum and total area are shown in **Tables 5** and **6** and **Figures 18** and **19**. Overall acoustic estimates in summer 2018 were of 3 063 million fish and 34 908 tonnes. By geographical strata, the Spanish waters yielded 93% (2 839 million) and 88% (30 683 t) of the total estimated abundance and biomass in the Gulf, confirming the importance of these waters in the species' distribution. The estimates for the Portuguese waters were 224 million and 4 225 t. The current biomass estimate (34 908 t) becomes in the second historical maximum within the time-series (2006: 35 539 t; 2016: 34 184 t; see **Figure 31**). The *PELAGO 18* spring Portuguese survey previously estimated for this same area 23 473 t (2 157 million): 4 328 t (300 million) in Portuguese waters and 19 145 t (1 857 million) in Spanish waters.

The size class range of the assessed population varied between the 9.0 and 17.0 cm size classes, with one main modal class at 12.0 cm. The size composition of anchovy by coherent post-strata confirms the usual pattern exhibited by the species in the area during the spawning season, with the largest (and oldest) fish being distributed both in the westernmost and easternmost waters and the smallest (and youngest) ones concentrated in the surroundings of the Guadalquivir river mouth and adjacent shallow waters, including those ones in front of the Bay of Cadiz (**Table 5; Figures 18** and **19;** see also **Figure 6**).

The population was composed by fishes not older than 2 years. As it has been happening in the last years, during the 2018 survey some recruitment (age 0 fish) has also been recorded, probably as a consequence of the delayed survey dates. In fact, age 0 fish accounted for 46 and 35% of the total estimated abundance and biomass, respectively. Age 1 fish represented 53% and 62% of the total abundance and biomass (**Table 6**; **Figure 19**).

The Gulf of Cadiz anchovy egg distribution from CUFES sampling is shown in **Figure 20**. Anchovy egg distribution and densities in summer 2018 are quite coincident with that of adults. The estimated total egg density is at the same magnitude than the observed in the most recent years but such estimates are lower than the historical average. Notwithstanding the above, the extension of the spawning area was among the highest one ever recorded (the second historical peak in the series).

Sardine

Parameters of the survey's size-weight relationship for sardine are shown in **Table 4**. The back-scattering energy attributed to this species and the coherent strata considered for the acoustic estimation are shown in **Figure 21**. Estimated abundance and biomass by size and age class are given in **Tables 7** and **8** and **Figures 22** and **23**.

Sardine recorded a very high acoustic echo-integration in summer 2018 as a consequence of the occurrence of very dense mid-water schools in the coastal fringe (20-50 m depth) comprised between Tavira (RA13) and the surroundings of the Guadalquivir river mouth (RA05; see **Annex** figures). The distribution pattern of acoustic densities is quite similar to the one provided by the *PELAGO* survey in spring although the occurrence of sardine in the surveyed area was more continuous in summer (**Figure 21**).

Fourteen (14) size-based homogeneous sectors were delimited for the acoustic assessment (**Figure 21**). The estimates of Gulf of Cadiz sardine abundance and biomass in summer 2018 were 7 955 million fish and 114 631 t, the historical maximum record in terms of abundance and the second maximum in biomass (the historical maximum was reached in 2006: 123 849 t; see **Figure 31**). Spanish waters concentrated the bulk of the population (7 239 million and 90 214 t). The estimates for the Portuguese waters were 716 million and 24 417 t. The *PELAGO 18* spring Portuguese survey previously estimated for this same area 58 561 t (6 680 million): 22 627 t (1 097 million) in Portuguese waters and 35 934 t (5 583 million) in Spanish waters.

Sizes of the assessed population ranged between 8.0 and 20.5 cm size classes. The length frequency distribution of the population was clearly bimodal, with one main mode at 11.5 cm size class and a secondary one at 17.0 cm (**Table 7**; **Figure 22**). The 2018 summer estimate of mean size (122 mm) is among the lowest estimates within the series. This fact might be explained by the relative importance of the juvenile fraction in the estimated population (Age 0 fish, ≤11.5 cm, 94% in numbers), which was mainly located in relatively shallow waters in front of the Cape Santa Maria and especially along the coastal fringe comprised between the Guadiana and Guadalquivir river mouths and the Bay of Cadiz (**Tables 7** and **8**; **Figure 22**; see also **Figure 7**). Such a decrease in mean size was coupled with a similar decreasing trend in the mean weight (14.4 g), which was well below the historical average. The contribution in biomass of the adult fraction in the assessed population (around at a main modal size class at 17.5 cm) may be not enough to compensate the greater relative contribution of juveniles. The population was only structured by the 0, 1, 2 and 3 age groups.

Mackerel

Parameters of the survey's length-weight relationship are shown in **Table 4**. The distribution of the back-scattering energy attributed to this species is shown in **Figure 24**. Estimated abundance and biomass by size class are given in **Table 9** and **Figure 25**.

Atlantic mackerel showed very low acoustic records during the 2018 survey, which were mainly observed all over the shelf located in the central part of the Gulf of Cadiz (**Figure 24**).

Six (6) coherent post-strata were differentiated (**Figure 24**). The acoustic estimates by homogeneous post-stratum and total area are shown in **Table 9** and **Figure 25**. Overall acoustic estimates in summer 2018 were of 5 million fish and 1070 tonnes, with the 78% and 80% of the total of abundance and biomass respectively being recorded in the Spanish waters (4 million, 856 t). Sizes of the assessed population ranged between 22.0 and 34.5 cm size classes, with a modal size class at around 30.0-31.0 cm size classes (**Table 9**, **Figure 25**).

Chub mackerel

Parameters of the survey's length-weight relationship are shown in **Table 4**. The distribution of the back-scattering energy attributed to this species is shown in **Figure 26**. Estimated abundance and biomass by size class are given in **Table 10** and **Figure 27**.

Contrarily to the pattern described for the Atlantic mackerel, the acoustic energy allocated to its close relative, Chub mackerel, accounted for 21.5% of the total acoustic energy attributed to fishes in the survey. The population was mainly concentrated in the westernmost waters of the Gulf, between Cape San Vicente and Cape Santa Maria, with a secondary nucleus of fish density in the easternmost waters, from the Bay of Cadiz to the Strait of Gibraltar (**Figure 26**).

A total of seven (7) coherent post-strata were differentiated (**Figure 25**). The acoustic estimates by homogeneous post-stratum and total area are shown in **Table 10** and **Figure 27**. Overall acoustic estimates were of 580 million fish and 31 811 t. A great part of the population was distributed over the Portuguese shelf, accounting for 71% of both the total estimated abundance (415 million) and biomass (22 609 t). The size range of the estimated population was comprised between the 15.0 and 28.0 cm size classes and showed a clear modal class at 18.0 cm. This modal class was also the dominant one in both the Portuguese and Spanish waters, although a secondary mode at about 19.5-20.0 cm size classes is also observed in both areas (**Table 10** and **Figure 27**).

Blue jack-mackerel

The survey's length-weight relationship for this species is given in **Table 4**. The distribution of the back-scattering energy attributed to this species is illustrated in **Figure 28**. Estimated abundance and biomass by size class are given in **Table 11** and **Figure 29**.

The distribution pattern of the very low acoustic densities attributed to Blue jack mackerel closely resembles to the described one below for horse mackerel (**Figure 28**).

Six (6) coherent post-strata were delimited for the acoustic assessment (**Figure 28**). The acoustic estimates by homogeneous post-stratum and total area are shown in **Table 11** and **Figure 29**. Overall acoustic estimates in summer 2018 were of 1 million fish and 23 t. At about 88% of both the total estimated abundance and biomass was recorded in the Portuguese waters. Sizes of the assessed population ranged between 11.5 and 27.5 cm size classes, but this size range was not well covered because the low species' abundance. For this same reason, modal size class were not clearly identified, although fishes belonging to the 16.5 cm size class relatively were the most frequent (**Table 11**, **Figure 29**).

Horse mackerel

The survey's length-weight relationship for horse mackerel is shown in **Table 4**. The back-scattering energy attributed to this species is shown in **Figure 30**. Estimated abundance and biomass by size class are given in **Table 12** and **Figure 31**.

Horse mackerel showed very low acoustic densities in the surveyed area, with the species being almost absent in the easternmost shelf and showing relatively higher densities in the shelf area comprised between Cape San Vicente and Cape Santa Maria (**Figure 30**).

Ten (10) coherent post-strata have been delimitated for the acoustic assessment purposes (**Figure 30**). The acoustic estimates by homogeneous post-stratum and total area are shown in **Table 12** and **Figure 31**. Overall acoustic estimates were of 4 million fish and 410 t. The bulk of the estimated population was located in the Portuguese shelf waters (96% of the total abundance, 4 million; 94% of the total biomass, 386 t). The size range of the estimated population was comprised between the 11.5 and 28.0 cm size classes and showed a bi-modal distribution, outstanding a main modal class at 20.5 cm (the dominant mode in Portuguese waters), and a secondary mode at 24.0 cm size class (the dominant one in Spanish waters), (**Table 12** and **Figure 31**).

Mediterranean horse-mackerel

The survey's length-weight relationship for this species is shown in **Table 4**. Back-scattering energy attributed to the species is represented in **Figure 32**. Estimated abundance and biomass by size class are given in **Table 13** and **Figure 33**.

Mediterranean horse mackerel was restricted, as usual, to the Spanish waters, with the highest densities being recorded in the inner shelf waters of the central part of the Gulf (**Figure 32**).

A single coherent post-stratum (located in Spanish waters) have been differentiated according to the S_A value distribution and the size composition in the fishing stations (**Figure 32**). Overall acoustic estimates in summer 2018 were of 8 million fish and 1 436 t. Sizes in the population ranged between 20.0 and 36.5 cm size classes, with three relatively well differentiated modes, the smallest and dominant one at 27.0 cm size class, the secondary mode at 29.5 cm, and the largest but less important one at 31.5 cm (**Table 13**, **Figure 33**).

Bogue

Parameters of the survey's length-weight relationship for bogue are shown in **Table 4**. Back-scattering energy attributed to bogue is shown in **Figure 34**. Estimated abundance and biomass by size class are given in **Table 14** and **Figure 35**.

Bogue was distributed practically all over the shelf of the surveyed area, although showed its highest densities over the inner shelf of both the central and westernmost waters of the Gulf (**Figure 34**).

Three (3) post-strata have been delimited for the acoustic assessment (**Figure 34**). Overall acoustic estimates in summer 2018 were of 18 million fish and 2 331 t. Fifty five per cent (55%) of the total abundance (10 million) and 68% of the biomass (1 585 t) was located in the Spanish waters. The size range of the estimated population was comprised between the 17.5 and 28.5 cm size classes, with a secondary mode at 21.5 cm and with not very well defined main modes at 25.0 cm and 26.5 cm size classes (**Table 14**, **Figure 35**).

Boarfish

The survey's length-weight relationship for this species is shown in **Table 4**. Back-scattering energy attributed to the species is represented in **Figure 36**. Estimated abundance and biomass by size class are given in **Table 15** and **Figure 37**.

Boarfish showed an incidental occurrence restricted to the outer shelf waters just to the west of Cape of Santa Maria (**Figure 36**).

A single coherent post-stratum (located in Portuguese waters) have been differentiated according to the S_A value distribution and the size composition in the fishing stations (**Figure 36**). Overall acoustic estimates in summer 2018 were of 1 million fish and 3 t. The size range of the estimated population was comprised between the 4.5 and 6.5 cm size classes, with the mode at 6 cm size class (**Table 15**, **Figure 37**).

Pearlside

The survey's length-weight relationship for this species is shown in **Table 4**. Back-scattering energy attributed to the species is represented in **Figure 38**. Estimated abundance and biomass by size class are given in **Table 16** and **Figure 39**.

The constant occurrence of pearlside in somewhat shallower waters than usual in the 2018 survey has resulted in its acoustic detection in the surveyed area (9% of the total acoustic energy), just in the transition between outer shelf and upper slope waters. Higher densities were recorded in the Spanish outer shelf (**Figure 38**).

Two (2) post-strata have been delimited for the acoustic assessment (**Figure 38**). Overall acoustic estimates in summer 2018 were of 10 183 million fish and 6 155 t. Eighty three per cent (83%) of both the total abundance and biomass (8 450 million, 5 108 t) was located in the Spanish waters. The size range of the estimated population was comprised between the 3.5 and 6.0 cm size classes, with a clear dominant mode at 4.0 cm size class (**Table 16**, **Figure 39**).

(SHORT) DISCUSSION

The total NASC estimated in this survey for "pelagic fish assemblage", 241 648 m^2 nmi^{-2}, is the highest estimate ever recorded within the time-series (**Figure 16**). Such a sharp increase in acoustic energy may be the result of the combination of several facts, namely, a very high NASC allocated to sardine because the occurrence during this survey of very dense schools in coastal (20-40 m) waters in the central part of the Gulf (see **Annex** figures); a very high NASC allocated to anchovy (mainly in Spanish waters) and chub mackerel (in Portuguese ones); and the high acoustic detection of pearlside in the shelf break, not detected in previous surveys, when its occurrence was occasional and detected in the shallow waters of the upper slope, but not penetrating in the deepest survey limit at 200 m depth.

The current anchovy biomass estimate (34 908 t) becomes in the second historical maximum within the time-series (2006: 35 539 t; 2016: 34 184 t; see **Figure 40**) and denotes a strong increase in relation to the previous year, up to levels well above the historical average (ca. 22 kt), but without showing any clear recent trend. Although the spring *PELAGO 18* survey also estimated increased population levels, such increase was not so pronounced as the estimated by its summer counterpart.

The estimates of Gulf of Cadiz sardine abundance and biomass in summer 2018 were 7 955 million fish and 114 631 t, the historical maximum record in terms of abundance and the second maximum in biomass (the historical maximum was reached in 2006: 123 849 t; see **Figure 40**). As described above, such an increasing trend seems to be the result of a greater availability of the species to the survey, with the occurrence of many dense schools (mainly composed by juvenile fish) in the shallowest limits of the surveyed area not usually recorded in the most recent years. In any case, these estimates should be analysed in more depth and compared with those ones provided by the Portuguese spring *PELAGO* survey in a standardisation exercise of echograms scrutiny.

ACKNOWLEDGMENTS

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Table 1. *ECOCADIZ 2018-07 s*urvey. Descriptive characteristics of the acoustic tracks.

Acoustic Track	Location	Date	Start				End			
			Latitude	Longitude	UTC time	Mean depth (m)	Latitude	Longitude	UTC time	Mean depth (m)
R01	Trafalgar	01/08/18	36º 12,968' N	06º 08,805' W	06:22	24	36º 02,075' N	06º 28,864' W	08:29	240
R02	Sancti-Petri	01/08/18	36º 08,505' N	06º 34,300' W	09:25	210	36º 19,420' N	06º 14,410' W	16:14	28
R03	Cádiz	02/08/18	36º 27,223' N	06º 19,149' W	06:03	26	36º 17,589' N	06º 36,655' W	09:31	222
R04	Rota	02/08/18	36º 23,300' N	06º 42,290' W	10:31	240	36º 34,510' N	06º 23,110' W	16:24	23
R05	Chipiona	03/08/18	36º 40,194' N	06º 29,819' W	06:00	24	36º 31,311' N	06º 46,083' W	09:34	188
R06	Doñana	03/08/18	36º 37,740' N	06º 51,950' W	10:37	177	36º 47,050' N	06º 34,916' W	14:02	19
R07	Matalascañas	04/08/18	36º 53,839' N	06º 40,548' W	06:01	22	36º 44,078' N	06º 58,368' W	09:43	200
R08	Mazagón	04/08/18	36º 48,740' N	07º 07,181' W	13:44	228	37º 01,260' N	06º 44,189' W	17:18	21
R09	Punta Umbría	05/08/18	37º 03,767' N	06º 56,501' W	06:01	29	36º 49,549' N	07º 06,669' W	09:58	210
R10	El Rompido	05/08/18	36º 50,130' N	07º 07,250' W	12:06	165	37º 07,233' N	07º 07,255' W	17:31	21
R11	Isla Cristina	06/08/18	37º 07,169' N	07º 16,685' W	06:07	23	36º 53,349' N	07º 16,699' W	08:58	234
R12	V.R. do Sto. Antonio	06/08/18	36º 56,200' N	07º 26,500' W	13:39	135	37º 06,350' N	07º 26,540' W	16:25	19
R13	Tavira	07/08/18	37º 04,820' N	07º 36,049' W	05:59	21	36º 56,959' N	07º 36,100' W	08:17	216
R14	Fuzeta	07/08/18	36º 55,881' N	07º 45,985' W	15:34	161	36º 59,267' N	07º 46,044' W	15:54	60
R15	Cabo Sta. María	08/08/18	36º 55,129' N	07º 55,978' W	06:00	70	36º 52,015' N	07º 55,999' W	06:18	178
R16	Cuarteira	08/08/18	36º 50,130' N	08º 05,910' W	11:29	202	37º 01,389' N	08º 05,842' W	14:28	20
R17	Albufeira	09/08/18	37º 02,494' N	08º 15,452' W	06:12	29	36º 49,338' N	08º 15,499' W	09:33	204
R18	Alfanzina	09/08/18	36º 50,370' N	08º 25,300' W	11:43	202	37º 03,750' N	08º 25,279' W	14:49	29
R19	Portimao	10/08/18	37º 05,785' N	08º 35,372' W	06:04	27	36º 50.381' N	08º 35,398' W	09:40	202
R20	Burgau	10/08/18	36º 52,340' N	08º 45,002' W	12:03	111	37º 03,200' N	08º 45,000' W	13:08	20
R21	Ponta de Sagres	11/08/18	37º 00,038' N	08º 54,980' W	06:01	23	36º 50,790' N	08º 55,000' W	08:12	202

Table 2. *ECOCADIZ 2018-07* survey. Descriptive characteristics of the fishing stations.

FISHING STATION	DATE	POSITION						TIMING				TRAWLED DISTANCE (nmi)	ACOUSTIC TRANSECT	ZONE/LANDMARK
		START			END			START	END	EFFECTIVE TRAWLING	TOTAL MANEOUVRE			
		LAT.	LON.	PROF.	LAT.	LON.	PROF.	UTC	UTC					
PE01	01-08-2018	36º 16.5388 N	6º 19.5235 W	43,4	36º 15.1167 N	6º 22.2324 W	49,85	11:13	11:50	0:37	1:00	2,611	R02	Sancti-Petri
PE02	01-08-2018	36º 12.8734 N	6º 26.3475 W	81,22	36º 11.1748 N	6º 29.4739 W	109,27	13:20	14:03	0:42	1:11	3,046	R02	Sancti-Petri
PE03	02-08-2018	36º 23.8087 N	6º 25.3450 W	56,12	36º 25.5262 N	6º 22.1794 W	45,31	07:05	07:49	0:44	1:05	3,077	R03	Cádiz
PE04	02-08-2018	36º 23.6157 N	6º 39.5761 W	185,48	36º 24.7228 N	6º 40.0975 W	178,73	11:56	12:13	0:17	0:46	1,183	R04	Rota
PE05	02-08-2018	36º 29.9443 N	6º 31.0648 W	61,33	36º 27.5509 N	6º 35.1775 W	91,93	13:54	14:51	0:57	1:21	4,088	R04	Rota
PE06	03-08-2018	36º 33.4984 N	6º 41.9919 W	103,93	36º 35.0322 N	6º 39.2943 W	77,67	07:53	08:31	0:37	1:07	2,659	R05	Chipiona
PE07	03-08-2018	36º 40.7883 N	6º 46.3366 W	93,12	36º 39.2739 N	6º 49.1025 W	115,33	11:37	12:15	0:37	1:02	2,69	R06	Doñana
PE08	03-08-2018	36º 43.6651 N	6º 41.0337 W	42,56	36º 42.1558 N	6º 43.8061 W	68,46	14:44	15:23	0:38	1:00	2,691	R06	Doñana
PE09	04-08-2018	36º 45.7464 N	6º 55.4163 W	115,32	36º 47.5804 N	6º 51.7888 W	89,78	07:54	8:42	0:47	1:14	3,442	R07	Matalascañas
PE10	04-08-2018	36º 45.3789 N	6º 56.0539 W	119,9	36º 47.1727 N	6º 52.6827 W	95,67	11:23	12:08	0:45	1:07	3,247	R07	Matalascañas
PE11	04-08-2018	36º 55.9969 N	6º 50.1088 W	43,19	36º 57.4765 N	6º 51.7540 W	43,34	15:40	16:08	0:27	0:47	1,981	R08	Mazagón
PE12	05-08-2018	36º 57.3658 N	6º 58.5016 W	61,49	36º 58.9450 N	7º 01.6909 W	60,04	07:52	08:34	0:42	1:03	3,003	S/D	Sin Datos
PE13	05-08-2018	36º 55.4889 N	7º 07.2582 W	99,23	36º 52.2136 N	7º 07.2657 W	128,88	13:03	13:49	0:45	1:12	3,271	R10	El Rompido
PE14	05-08-2018	36º 57.6004 N	7º 05.9353 W	82,83	36º 58.5603 N	7º 08.7571 W	80,93	15:41	16:16	0:34	1:00	2,456	R10	El Rompido
PE15	06-08-2018	37º 02.2915 N	7º 14.7397 W	54,41	37º 02.3526 N	7º 16.8729 W	53,8	07:18	07:41	0:23	0:47	1,709	R11	Isla Cristina
PE16	06-08-2018	36º 59.6457 N	7º 26.5813 W	99,83	36º 56.9236 N	7º 26.4835 W	131,28	14:29	15:07	0:38	1:01	2,72	R12	Vila Real do Santo Antonio
PE17	07-08-2018	37º 03.3214 N	7º 34.7989 W	52,5	37º 02.6311 N	7º 36.4885 W	53,06	06:55	07:16	0:21	0:50	1,518	R13	Tavira
PE18	07-08-2018	36º 57.8928 N	7º 36.0870 W	126,24	36º 59.0218 N	7º 36.0957 W	109,91	08:53	09:09	0:15	2:03	1,128	R13	Tavira
PE19	08-08-2018	36º 54.7846 N	7º 56.5828 W	73,27	36º 55.2130 N	7º 54.2592 W	77,05	07:14	07:41	0:27	0:49	1,912	R15	Cabo de Santa María
PE20	08-08-2018	36º 53.4466 N	8º 05.8354 W	96,92	36º 50.6529 N	8º 05.8903 W	123,2	12:24	13:03	0:39	1:10	2,791	R16	Cuarteira
PE21	08-08-2018	36º 58.7931 N	8º 06.8914 W	41,79	36º 58.2543 N	8º 04.7586 W	41,45	15:19	15:44	0:25	0:42	1,792	R16	Cuarteira
PE22	09-08-2018	36º 54.9072 N	8º 15.7515 W	91,9	36º 54.3112 N	8º 13.7479 W	91,7	08:13	08:37	0:24	0:45	1,713	R17	Albufeira
PE23	09-08-2018	36º 54.1354 N	8º 25.2601 W	120	36º 51.6123 N	8º 25.2973 W	135,35	12:36	13:12	0:36	1:02	2,52	R18	Alfanzina
PE24	09-08-2018	36º 59.8305 N	8º 24.4468 W	43,17	37º 00.1414 N	8º 26.8555 W	46,94	15:50	16:18	0:27	0:50	1,954	R18	Alfanzina
PE25	10-08-2018	36º 54.4809 N	8º 35.3532 W	104,35	36º 56.5975 N	8º 35.3839 W	78,75	08:15	08:44	0:28	1:00	2,114	R19	Portimao

Table 3. *ECOCADIZ 2018-07* survey. Catches by species in number (upper panel) and weight (in kg, lower panel) from valid fishing stations.

Fishing station	ANE	PIL	MAS	MAC	HOM	JAA	HMM	BOG	BOC	MAV	SNS	OTHERS SPP	TOTAL
						ABUNDANCE (nº)							
01	27	490	25920	0	0	0	119	6	0	0	0	185	**26747**
02	19266	0	9887	2	0	0	0	0	0	0	0	36	**29191**
03	15273	8419	408	1	0	0	25	13	0	0	0	230	**24369**
04	0	0	4	26	0	0	0	0	0	253693	0	46	**253769**
05	36523	23	15335	10	0	0	23	11	0	0	0	117	**52042**
06	29669	718	8	11	2	8	0	0	0	0	0	116	**30532**
07	48902	8105	117	32	5	2	0	0	0	4	0	21	**57188**
08	21463	228	5	9	0	0	59	7	0	0	0	37	**21808**
09	25261	4028	189	21	0	1	0	0	0	6	0	31	**29537**
10	32494	3985	452	1	0	0	0	0	0	0	0	1	**36933**
11	9200	4455	1	23	1	0	49	109	0	0	0	273	**14111**
12	7699	56273	5864	112	0	0	0	11	0	0	0	4	**69963**
13	68793	4563	1140	45	0	1	0	0	0	0	0	36	**74578**
14	1308	318	1	15	11	1	0	0	0	0	0	47	**1701**
15	20	46472	9536	15	0	0	0	23	0	0	0	20	**56086**
16	4576	82	151	22	0	0	0	0	0	19	0	137	**4987**
17	272	39164	1100	68	21	1	0	112	0	0	0	72	**40810**
18	2427	25	228	0	0	12	0	0	0	0	0	31	**2723**
19	410	160	0	0	2	0	0	9	0	0	0	62	**643**
20	11413	65	302	14	160	7	0	67	304	0	15	71	**12418**
21	0	3000	2137	0	52	8	0	202	0	0	0	704	**6103**
22	13629	472	2673	17	48	3	0	8	0	0	0	41	**16891**
23	21065	57	578	5	42	6	0	19	0	0	1	29	**21802**
24	0	1591	3258	0	8	0	0	48	0	0	0	17	**4922**
25	38	1283	62933	3	351	26	0	9	0	0	0	9	**64652**
TOTAL	369728	183976	142227	452	703	76	275	654	304	253722	16	2373	954506

Table 3. *ECOCADIZ 2018-07* survey. Cont'd.

Fishing station	ANE	PIL	MAS	MAC	HOM	JAA	HMM	BOG	BOC	MAV	SNS	OTHERS SPP	TOTAL
01	0,449	23,950	1386,650	0,000	0,000	0,000	20,600	0,761	0,000	0,000	0,000	29,882	**1462,292**
02	344,300	0,000	549,900	0,282	0,000	0,000	0,000	0,000	0,000	0,000	0,000	3,809	**898,291**
03	173,727	117,273	19,590	0,334	0,000	0,000	5,086	2,296	0,000	0,000	0,000	32,878	**351,184**
04	0,000	0,000	0,269	3,140	0,000	0,000	0,000	0,000	0,000	148,661	0,000	4,746	**156,816**
05	584,022	0,302	646,427	1,703	0,000	0,000	4,285	2,144	0,000	0,000	0,000	108,574	**1347,457**
06	296,350	7,200	0,345	1,514	0,040	0,225	0,000	0,000	0,000	0,000	0,000	12,597	**318,271**
07	595,072	97,677	9,850	4,476	0,088	0,061	0,000	0,000	0,000	0,009	0,000	1,633	**708,866**
08	144,720	21,250	0,540	1,558	0,000	0,000	10,284	1,475	0,000	0,000	0,000	3,337	**183,164**
09	314,500	47,514	13,550	3,730	0,000	0,027	0,000	0,000	0,000	0,010	0,000	3,444	**382,775**
10	431,200	48,700	21,350	0,114	0,000	0,000	0,000	0,000	0,000	0,000	0,000	4,000	**505,364**
11	87,450	50,870	0,044	3,838	0,027	0,000	8,500	18,100	0,000	0,000	0,000	33,309	**202,138**
12	96,991	1793,266	265,111	20,200	0,000	0,000	0,000	1,934	0,000	0,000	0,000	1,052	**2178,554**
13	1090,220	63,131	60,710	8,012	0,000	0,026	0,000	0,000	0,000	0,000	0,000	13,210	**1235,309**
14	17,700	6,630	0,040	3,328	0,213	0,039	0,000	0,000	0,000	0,000	0,000	6,531	**34,481**
15	0,246	1860,916	473,984	3,360	0,000	0,000	0,000	3,150	0,000	0,000	0,000	1,795	**2343,451**
16	56,300	1,140	12,400	3,466	0,000	0,000	0,000	0,000	0,000	0,030	0,000	15,950	**89,286**
17	3,572	2012,077	84,041	18,100	2,212	0,156	0,000	15,150	0,000	0,000	0,000	13,142	**2148,45**
18	34,700	0,582	17,900	0,000	0,000	0,353	0,000	0,000	0,000	0,000	0,000	5,200	**58,735**
19	5,610	2,492	0,000	0,000	0,236	0,000	0,000	1,250	0,000	0,000	0,000	10,625	**20,213**
20	187,750	1,143	24,850	2,223	23,312	0,887	0,000	8,700	1,375	0,000	0,052	7,264	**257,556**
21	0,000	119,350	136,850	0,000	4,340	0,225	0,000	19,150	0,000	0,000	0,000	102,678	**382,593**
22	306,100	9,650	166,800	3,966	6,218	0,073	0,000	0,836	0,000	0,000	0,000	5,085	**498,728**
23	551,600	1,439	51,650	0,836	4,967	0,506	0,000	2,632	0,000	0,000	0,004	3,634	**617,268**
24	0,000	77,850	145,100	0,000	0,625	0,000	0,000	4,007	0,000	0,000	0,000	1,279	**228,861**
25	0,860	61,083	3791,030	0,778	32,681	2,723	0,000	0,856	0,000	0,000	0,000	0,856	**3890,867**
TOTAL	**5323,439**	**6425,485**	**7878,981**	**84,958**	**74,959**	**5,301**	**48,755**	**82,441**	**1,375**	**148,710**	**0,056**	**426,510**	**20500,970**

Table 4. *ECOCADIZ 2018-07* survey. Parameters of the size-weight relationships for survey's target species. FAO codes for the species: ANE: *Engraulis encrasicolus*; PIL: *Sardina pilchardus*; MAS: *Scomber colias*; MAC: *Scomber scombrus*; HOM: *Trachurus trachurus*; JAA: *Trachurus picturatus;* HMM: *Trachurus mediterraneus*; BOG: *Boops boops*; BOC: *Capros aper*; SNS: *Macrorhamphosus scolopax*; MAV: *Maurolicus muelleri*.

PARAMETER	ANE	PIL	MAS	MAC	HOM	JAA	HMM	BOG	BOC	SNS	MAV
Size range (mm)	93-182	98-198	157-283	247-355	111-267	115-277	224-366	181-313	47-70	78-99	35-66
n	1028	1223	970	402	283	58	189	358	110	15	238
a	0,002053	0,001571	0,001545	0,000313	0,005194	0,002359	0,044915	0,009061	0,018507	0,002166	0,006447
b	3,447416	3,608874	3,515858	3,943451	3,169538	3,423360	2,468256	3,010727	3,068089	3,410636	3,090835
r^2	0,97	0,98	0,97	0,93	0,99	0,99	0,93	0,95	0,93	0,87	0,97

Table 5. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 17**.

													ECOCADIZ 2018-07 . Engraulis encrasicolus . ABUNDANCE (in numbers and million fish)					
														n			Millions		
Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	3092703	0	0	0	3092703	3092703	0	3	3
9,5	0	0	0	0	0	0	0	0	0	24643444	0	0	0	24643444	24643444	0	25	25
10	0	0	0	0	0	0	805120	0	7495873	248690533	0	0	0	256991526	256991526	0	257	257
10,5	0	0	0	279874	0	0	4842219	273907	18776791	238778047	2845438	1142264	279874	266658666	266938540	0,3	267	267
11	0	0	0	0	1695995	1425718	23197540	3933829	142570020	287493489	59691670	5032808	3121713	521919356	525041069	3	522	525
11,5	0	0	0	373165	3502507	6790532	43635623	11221744	210107094	137739025	162033647	7426674	10666204	572163807	582830011	11	572	583
12	0	0	0	2636920	5649342	16094442	88777424	28770876	232594712	88787017	142115578	22451378	24380704	603496985	627877689	24	603	628
12,5	0	86228	0	8144470	2838486	19680783	42357980	18970712	48760283	15288697	56846231	17624068	30749967	199847971	230597938	31	200	231
13	0	1976512	0	14875864	836649	15021479	40522176	15532654	14991746	6129396	45495746	52734027	32710504	175405745	208116249	33	175	208
13,5	309445	4381698	506320	7101674	167695	4644606	28152542	7475060	7495873	0	5690877	33297682	17111438	82112034	99223472	17	82	99
14	1856669	10049423	3037919	3130785	389462	2866133	12482417	6943991	0	0	2845438	38401012	21330391	60672858	82003249	21	61	82
14,5	5413390	5061003	8857496	466938	0	352755	4111361	4889397	0	3036693	0	25449273	20151582	37486724	57638306	20	37	58
15	8043039	8249726	13160181	746812	0	352755	1648760	1191053	0	0	0	9750018	30552513	12589831	43142344	31	13	43
15,5	5259299	2491415	8605370	351044	0	0	0	730000	0	0	0	5190226	16707128	5920226	22627354	17	6	23
16	4021520	771123	6580091	117574	0	0	0	499474	0	0	0	8472777	11490308	8972251	20462559	11	9	20
16,5	928334	428675	1518959	0	0	0	0	0	0	0	0	3378713	2875968	3378713	6254681	3	3	6
17	772981	86228	1264766	117574	0	0	0	0	0	0	0	3378713	2241549	3378713	5620262	2	3	6
17,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL *n*	26604677	33582031	43531102	38342694	15080136	67229203	290533162	100432697	682792392	1053679044	477564625	233729633	224369843	2838731553	3063101396	224	2839	3063
Millions	27	34	44	38	15	67	291	100	683	1054	478	234						

Table 5. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Cont'd.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	PORTUGAL	SPAIN	TOTAL
							ECOCADIZ 2018-07 . Engraulis encrasicolus . BIOMASS (t)								
6	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
6,5	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
7	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
7,5	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
8	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
8,5	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**
9	0	0	0	0	0	0	0	0	0	13,596	0	0	**0**	**13,596**	**13,596**
9,5	0	0	0	0	0	0	0	0	0	129,897	0	0	**0**	**129,897**	**129,897**
10	0	0	0	0	0	0	5,042	0	46,946	1557,512	0	0	**0**	**1609,500**	**1609,500**
10,5	0	0	0	2,066	0	0	35,738	2,022	138,58	1762,28	21,000	8,430	**2,066**	**1968,050**	**1970,116**
11	0	0	0	0	14,641	12,308	200,257	33,96	1230,764	2481,844	515,300	43,447	**26,949**	**4505,572**	**4532,521**
11,5	0	0	0	3,742	35,126	68,101	437,616	112,541	2107,137	1381,367	1625,015	74,481	**106,969**	**5738,157**	**5845,126**
12	0	0	0	30,531	65,410	186,346	1027,89	333,117	2693,047	1028,001	1645,454	259,948	**282,287**	**6987,457**	**7269,744**
12,5	0	1,146	0	108,244	37,725	261,567	562,957	252,129	648,046	203,194	755,512	234,232	**408,682**	**2656,070**	**3064,752**
13	0	29,994	0	225,743	12,696	227,952	614,928	235,709	227,501	93,014	690,402	800,244	**496,385**	**2661,798**	**3158,183**
13,5	5,335	75,550	8,730	122,448	2,891	80,083	485,408	128,885	129,244	0	98,122	574,121	**295,037**	**1415,780**	**1710,817**
14	36,208	195,978	59,244	61,055	7,595	55,894	243,425	135,418	0	0	55,490	748,874	**415,974**	**1183,207**	**1599,181**
14,5	118,896	111,157	194,540	10,256	0	7,748	90,299	107,388	0	66,696	0	558,951	**442,597**	**823,334**	**1265,931**
15	198,166	203,259	324,244	18,40	0	8,691	40,623	29,345	0	0	0	240,223	**752,760**	**310,191**	**1062,951**
15,5	144,823	68,605	236,963	9,667	0	0	0	20,102	0	0	0	142,921	**460,058**	**163,023**	**623,081**
16	123,337	23,650	201,806	3,606	0	0	0	15,318	0	0	0	259,853	**352,399**	**275,171**	**627,570**
16,5	31,607	14,595	51,715	0	0	0	0	0	0	0	0	115,034	**97,917**	**115,034**	**212,951**
17	29,126	3,249	47,657	4,430	0	0	0	0	0	0	0	127,310	**84,462**	**127,310**	**211,772**
17,5													**0**	**0**	**0**
18													**0**	**0**	**0**
18,5													**0**	**0**	**0**
TOTAL	**687,498**	**727,183**	**1124,899**	**600,188**	**176,084**	**908,690**	**3744,183**	**1405,934**	**7221,265**	**8717,401**	**5406,295**	**4188,069**	**4224,542**	**30683,147**	**34907,689**

Table 6. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Estimated abundance (thousands of individuals) and biomass (tonnes) by age group. Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 17** and ordered from west to east.

Age class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	PT	ES	TOTAL
	N	N	N	N	N	N	Nr	N	N	N	N	N	N	N	N
0	135	705	221	4185	4686	12540	75088	19756	292222	804922	169500	24026	22472	1385513	1407986
I	21702	30463	35509	33232	10272	53845	211646	78746	386744	247267	304962	194840	185024	1424206	1609230
II	4767	2414	7801	926	122	844	3800	1931	3826	1490	3102	14863	16874	29012	45886
III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	26605	33582	43531	38343	15080	67229	290533	100433	682792	1053679	477565	233730	224370	2838732	3063101

Age class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	PT	ES	TOTAL
	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
0	3	12	5	57	49	149	800	225	2818	6150	1731	301	276	12024	12299
I	542	653	887	524	125	746	2885	1143	4356	2549	3635	3479	3479	18047	21526
II	142	62	233	19	2	13	60	37	47	19	41	409	470	613	1083
III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	688	727	1125	600	176	909	3744	1406	7221	8717	5406	4188	4225	30683	34908

Table 7. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.,* coherent or homogeneous post-strata) numbered as in **Figure 21**.

									ECOCADIZ 2018-07 . *Sardina pilchardus* . ABUNDANCE (in numbers and million fish)											
Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	POL13	POL14	*n*			Millions		
															PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	762681	0	0	0	0	0	0	0	0	762681	0	762681	1	0	1
8,5	0	0	0	0	0	762681	0	0	0	0	0	0	0	0	762681	0	762681	1	0	1
9	0	0	0	0	0	2288043	0	0	0	0	0	0	0	0	2288043	0	2288043	2	0	2
9,5	0	0	0	0	0	26693832	0	0	0	0	0	6208375	22645897	0	26693832	28854272	55548104	27	29	56
10	0	0	0	0	2300	11440214	0	0	0	0	62070	49127140	118366037	0	11442514	167555247	178997761	11	168	179
10,5	0	0	0	0	9199	7626809	0	0	0	0	62070	185130871	388409046	0	7636008	573601987	581237995	8	574	581
11	0	0	0	0	9199	2288043	70670	2812518	0	901486	248278	833809930	911089263	0	5180430	1746048957	1751229387	5	1746	1751
11,5	0	0	1415804	0	11499	7626809	610331	2625017	1529007	4885678	1179323	1343572214	478386991	0	12289460	1829553213	1841842673	12	1830	1842
12	0	0	1415804	0	9199	5338766	1002227	4875032	11082956	4520040	1303462	1303507414	209844468	8254	12641028	1530266594	1542907622	13	1530	1543
12,5	1351	319070	4601364	2950	16098	6864128	1149991	2812518	12841380	6694955	2048297	749698288	60446836	0	15767470	831729756	847497226	16	832	847
13	1351	413563	12034338	2950	27597	11440214	1291331	1687511	19261163	7419927	2917272	234898989	4644563	8254	26898855	269150168	296049023	27	269	296
13,5	4052	3800270	76099490	8849	22998	11440214	539661	187501	8046507	3076401	1365532	77678310	3235128	8254	92103035	93410132	185513167	92	93	186
14	20259	9256076	31147698	44243	13799	7626809	321227	187501	3615393	901486	1489671	20170679	4644563	8254	48617612	30821792	79439404	49	31	79
14,5	20259	13879593	25484480	44243	18398	11440214	179887	187501	1275071	359334	2110367	6338665	7879691	8254	51254575	17971382	69225957	51	18	69
15	27012	13081213	7432973	58991	6899	762681	109217	0	849547	0	3475898	0	3235128	8254	21478986	7568827	29047813	21	8	29
15,5	2701	7188060	7432973	5899	0	7626809	0	0	7051645	0	2731063	0	0	105233	22256442	9887941	32144383	22	10	32
16	0	6328816	0	0	0	0	10581205	0	9041739	0	620696	0	0	160944	16910021	9823379	26733400	17	10	27
16,5	0	13590154	0	0	0	0	21155986	0	18084956	0	0	0	0	328079	34746140	18413035	53159175	35	18	53
17	0	28315306	0	0	2300	0	110322077	0	35798430	0	0	0	0	191895	138639683	35990325	174630008	139	36	175
17,5	0	28701776	0	0	0	0	68003680	0	25549634	0	0	0	0	96979	96705456	25646613	122352069	97	26	122
18	0	23156153	0	0	0	0	31737192	0	9748444	0	0	0	0	33014	54893345	9781458	64674803	55	10	65
18,5	0	7316354	0	0	0	0	4535720	0	1446401	0	0	0	0	24761	11852074	1471162	13323236	12	1	13
19	0	2927936	0	0	0	0	0	0	1059163	0	0	0	0	8254	2927936	1067417	3995353	3	1	4
19,5	0	319070	0	0	0	0	0	0	0	0	0	0	0	16507	319070	16507	335577	0,3	0,02	0,3
20	0	567837	0	0	0	0	0	0	0	0	0	0	0	0	567837	0	567837	1	0	1
20,5	0	267217	0	0	0	0	0	0	0	0	0	0	0	8254	267217	8254	275471	0,3	0,01	0,3
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL *n*	76985	159428464	167064924	168125	149485	122028947	251610402	15375099	166281436	28759307	19613999	4810140875	2212827611	1015190	715902431	7238638418	7954540849	716	7239	7955
Millions	0,1	159	167	0,2	0,1	122	252	15	166	29	20	4810	2213	1	716	7239	7955	716	7239	7955

Table 7. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Cont'd

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	POL13	POL14	PORTUGAL	SPAIN	TOTAL
									ECOCADIZ 2018-07 . Sardina pilchardus . BIOMASS (t)								
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	2,431	0	0	0	0	0	0	0	0	2,431	0	2,431
8,5	0	0	0	0	0	3,006	0	0	0	0	0	0	0	0	3,006	0	3,006
9	0	0	0	0	0	11,021	0	0	0	0	0	0	0	0	11,021	0	11,021
9,5	0	0	0	0	0	155,482	0	0	0	0	0	36,162	131,904	0	155,482	168,066	323,548
10	0	0	0	0	0,016	79,815	0	0	0	0	0,433	342,746	825,806	0	79,831	1168,985	1248,816
10,5	0	0	0	0	0,076	63,189	0	0	0	0	0,514	1533,832	3218,017	0	63,265	4752,363	4815,628
11	0	0	0	0	0,090	22,337	0,690	27,457	0	8,801	2,424	8139,914	8894,339	0	50,574	17045,478	17096,052
11,5	0	0	16,170	0	0,131	87,106	6,971	29,981	17,463	55,800	13,469	15345,061	5463,701	0	140,359	20895,494	21035,853
12	0	0	18,794	0	0,122	70,870	13,304	64,714	147,122	60,002	17,303	17303,554	2785,604	0,110	167,804	20313,695	20481,499
12,5	0,021	4,893	70,568	0,045	0,247	105,271	17,637	43,134	196,940	102,676	31,413	11497,654	927,035	0	241,816	12755,718	12997,534
13	0,024	7,287	212,048	0,052	0,486	201,579	22,754	29,734	339,386	130,741	51,403	4138,973	81,838	0,145	473,964	4742,486	5216,45
13,5	0,082	76,539	1532,67	0,178	0,463	230,410	10,869	3,776	162,059	61,960	27,502	1564,468	65,157	0,166	1854,987	1881,312	3736,299
14	0,464	212,068	713,632	1,014	0,316	174,740	7,360	4,296	82,833	20,654	34,130	462,135	106,413	0	1113,89	706,165	1820,055
14,5	0,526	360,144	661,264	1,148	0,477	296,847	4,668	4,865	33,085	9,324	54,759	164,474	204,460	0,214	1329,939	466,316	1796,255
15	0,791	382,821	217,525	1,726	0,202	22,320	3,196	0	24,862	0	101,722	0	94,676	0,242	628,581	221,502	850,083
15,5	0,089	236,332	244,384	0,194	0	250,757	0	0	231,847	0	89,793	0	0	3,460	731,756	325,1	1056,856
16	0	232,925	0	0	0	0	389,429	0	332,771	0	22,844	0	0	5,923	622,354	361,538	983,892
16,5	0	557,976	0	0	0	0	868,609	0	742,521	0	0	0	0	13,47	1426,585	755,991	2182,576
17	0	1292,746	0	0	0,105	0	5036,795	0	1634,39	0	0	0	0	8,761	6329,646	1643,151	7972,797
17,5	0	1452,727	0	0	0	0	3441,975	0	1293,183	0	0	0	0	4,909	4894,702	1298,092	6192,794
18	0	1295,63	0	0	0	0	1775,755	0	545,444	0	0	0	0	1,847	3071,385	547,291	3618,676
18,5	0	451,307	0	0	0	0	279,784	0	89,221	0	0	0	0	1,527	731,091	90,748	821,839
19	0	198,603	0	0	0	0	0	0	71,843	0	0	0	0	0,560	198,603	72,403	271,006
19,5	0	23,741	0	0	0	0	0	0	0	0	0	0	0	1,228	23,741	1,228	24,969
20	0	46,241	0	0	0	0	0	0	0	0	0	0	0	0	46,241	0	46,241
20,5	0	23,763	0	0	0	0	0	0	0	0	0	0	0	0,734	23,763	0,734	24,497
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,997	6855,743	3687,055	4,357	2,731	1777,181	11879,796	207,957	5944,970	449,958	447,709	60528,973	22798,95	43,296	24416,817	90213,856	114630,673

Table 8. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Estimated abundance (thousands of individuals) and biomass (tonnes) by age group. Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 21** and ordered from west to east.

Age class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	POL13	POL14	PT	ES	TOTAL
	N	N	N	N	N	N	Nr	N	N	N	N	N	N	N	N	N	N
0	69	49593	151929	150	141	117837	20244	15321	72750	28329	18054	4799769	2210869	275	355285	7130045	7485330
I	8	62350	15136	18	8	4192	139616	54	58740	431	1482	10372	1959	502	221381	73486	294867
II	0	43201	0	0	1	0	88798	0	33531	0	78	0	0	208	132000	33817	165817
III	0	4284	0	0	0	0	2952	0	1260	0	0	0	0	31	7236	1290	8527
TOTAL	77	159428	167065	168	149	122029	251610	15375	166281	28759	19614	4810141	2212828	1015	715902	7238638	7954541

Age class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	POL11	POL12	POL13	POL14	PT	ES	TOTAL
	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
0	2	1411	3338	4	2	1670	705	207	1551	441	402	60326	22755	9	7339	85484	92823
I	0.2	2911	350	0.5	0.2	108	6599	1	2666	9	43	217	49	22	9970	3006	12976
II	0	2254	0	0	0.03	0	4414	0	1655	0	3	0	0	10	6668	1668	8336
III	0	281	0	0	0	0	165	0	75	0	0	0	0	2	446	77	523
TOTAL	2	6857	3688	4	3	1778	11883	208	5946	450	448	60543	22804	43	24422	90235	114657

Table 9. *ECOCADIZ 2018-07* survey. Atlantic mackerel (*S. scombrus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 21**.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	*n* PORTUGAL	*n* SPAIN	*n* TOTAL	Millions PORTUGAL	Millions SPAIN	Millions TOTAL
							n			Millions		
							PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
21	0	0	0	0	0	0	0	0	0	0	0	0
21,5	0	0	0	0	0	0	0	0	0	0	0	0
22	9551	49	0	0	0	18364	9600	18364	27964	0,01	0,02	0,03
22,5	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
23,5	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
24,5	0	0	0	0	0	0	0	0	0	0	0	0
25	25894	132	0	0	0	49787	26026	49787	75813	0,03	0,05	0,1
25,5	16343	84	0	0	0	31423	16427	31423	47850	0,02	0,03	0,05
26	47754	244	304	3261	20719	91820	51563	112539	164102	0,1	0,1	0,2
26,5	70889	363	0	0	0	136302	71252	136302	207554	0,1	0,1	0,2
27	65370	334	488	5241	33298	125692	71433	158990	230423	0,1	0,2	0,2
27,5	107607	550	672	7220	45877	206902	116049	252779	368828	0,1	0,3	0,4
28	59852	306	1226	13160	83614	115082	74544	198696	273240	0,1	0,2	0,3
28,5	39477	202	1963	21078	133931	75905	62720	209836	272556	0,1	0,2	0,3
29	33959	174	2332	25038	159089	65294	61503	224383	285886	0,1	0,2	0,3
29,5	50301	257	3427	36800	233824	96717	90785	330541	421326	0,1	0,3	0,4
30	27167	139	6920	74299	472087	52236	108525	524323	632848	0,1	0,5	1
30,5	36718	188	3970	42623	270821	70600	83499	341421	424920	0,1	0,3	0,4
31	13583	69	7700	82684	525363	26118	104036	551481	655517	0,1	0,6	1
31,5	6792	35	3601	38663	245663	13059	49091	258722	307813	0,05	0,3	0,3
32	0	0	3655	39246	249363	0	42901	249363	292264	0,04	0,2	0,3
32,5	0	0	2614	28066	178328	0	30680	178328	209008	0,03	0,2	0,2
33	0	0	607	6522	41437	0	7129	41437	48566	0,01	0,04	0,05
33,5	0	0	911	9782	62156	0	10693	62156	72849	0,01	0,1	0,1
34	0	0	607	6522	41437	0	7129	41437	48566	0,01	0,04	0,05
34,5	0	0	304	3261	20719	0	3565	20719	24284	0,004	0,02	0,02
35	0	0	0	0	0	0	0	0	0	0	0	0
35,5	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL *n*	611257	3126	41301	443466	2817726	1175301	1099150	3993027	5092177	1	4	5
Millions	1	0,003	0,04	0,4	3	1						

ECOCADIZ 2018-07 . Scomber scombrus . ABUNDANCE (in numbers and million fish)

Table 9. *ECOCADIZ 2018-07* survey. Atlantic mackerel (*S. scombrus*). Cont'd.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	PORTUGAL	SPAIN	TOTAL
21	0	0	0	0	0	0	0	0	0
21,5	0	0	0	0	0	0	0	0	0
22	0,615	0,003	0	0	0	1,182	0,618	1,182	1,800
22,5	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0
23,5	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0
24,5	0	0	0	0	0	0	0	0	0
25	2,744	0,014	0	0	0	5,276	2,758	5,276	8,034
25,5	1,871	0,010	0	0	0	3,598	1,881	3,598	5,478
26	5,898	0,030	0,038	0,403	2,559	11,341	6,369	13,900	20,268
26,5	9,432	0,048	0	0	0	18,135	9,480	18,135	27,615
27	9,356	0,048	0,069848	0,750149	4,76597	17,990	10,224	22,756	32,981
27,5	16,547	0,085	0,103334	1,110222	7,054521	31,815	17,845	38,870	56,715
28	9,875	0,050	0,202277	2,171259	13,795417	18,987	12,299	32,783	45,082
28,5	6,980	0,036	0,347075	3,726764	23,680107	13,421	11,089	37,101	48,190
29	6,427	0,033	0,441326	4,73839	30,107268	12,357	11,639	42,464	54,103
29,5	10,177	0,052	0,693383	7,445728	47,309505	19,569	18,368	66,878	85,247
30	5,870	0,030	1,495236	16,054123	102,005989	11,287	23,449	113,293	136,742
30,5	8,464	0,043	0,915104	9,824806	62,425541	16,274	19,247	78,699	97,946
31	3,337	0,017	1,891447	20,310702	129,051467	6,416	25,556	135,467	161,023
31,5	1,776	0,009	0,941698	10,110765	64,243354	3,415	12,838	67,658	80,496
32	0	0	1,017	10,916	69,355	0	11,932	69,355	81,288
32,5	0	0	0,773	8,294	52,701	0	9,067	52,701	61,768
33	0	0	0,190	2,046	13,000	0	2,237	13,000	15,236
33,5	0	0	0,303	3,255	20,682	0	3,558	20,682	24,240
34	0	0	0,214	2,300	14,611	0	2,514	14,611	17,125
34,5	0	0	0,113	1,217	7,735	0	1,331	7,735	9,066
35	0	0	0	0	0	0	0	0	0
35,5	0	0	0	0	0	0	0	0	0
TOTAL	99,368	0,508	9,748	104,674	665,083	191,062	214,299	856,144	1070,443

Table 10. *ECOCADIZ 2018-07* survey. Chub mackerel (*S. colias*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 26**.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	n PORTUGAL	n SPAIN	n TOTAL	Millions PORTUGAL	Millions SPAIN	Millions TOTAL
14	0	0	0	0	0	0	0	0	0	0	0	0	0
14,5	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	651978	0	0	0	651978	651978	0	1	1
15,5	0	0	0	59497	232182	0	2426	0	294105	294105	0	0,3	0,3
16	1053963	0	147053	201432	631030	3874	7278	1201016	843614	2044630	1	1	2
16,5	4237363	671690	710996	440789	2354053	14868	2426	5620049	2812136	8432185	6	3	8
17	7442272	7412070	999197	1239692	13218860	37852	7278	15853539	14503682	30357221	16	15	30
17,5	35038906	19981026	1206716	2723935	21616744	63455	4852	56226648	24408986	80635634	56	24	81
18	11679635	28042797	1787978	5139198	37513026	196825	2426	41510410	42851475	84361885	42	43	84
18,5	4237363	26560734	1705876	3907914	24777600	312853	9704	32503973	29008071	61512044	33	29	62
19	3183400	32955974	1278597	1269022	20628809	271274	9704	37417971	22178809	59596780	37	22	60
19,5	2129436	29919159	1105121	720833	8165632	97176	7278	33153716	8990919	42144635	33	9	42
20	1053963	38281452	1920572	660502	4977706	41098	7278	41255987	5686584	46942571	41	6	47
20,5	0	27232399	4240508	540824	9582556	26488	9704	31472907	10159572	41632479	31	10	42
21	0	32742723	5188371	1010786	7053453	61351	14556	37931094	8140146	46071240	38	8	46
21,5	0	20133707	3555602	435574	6306844	57847	33964	23689309	6834229	30523538	24	7	31
22	0	10762539	3064181	233218	2661030	85589	65503	13826720	3045340	16872060	14	3	17
22,5	0	6846061	2807377	216823	1575833	73599	31538	9653438	1897793	11551231	10	2	12
23	0	2822361	2802796	377359	1131671	58104	14556	5625157	1581690	7206847	6	2	7
23,5	0	1357414	1675833	194288	460218	42610	7278	3033247	704394	3737641	3	1	4
24	0	0	1118153	97144	232182	3874	14556	1118153	347756	1465909	1	0,3	1
24,5	0	536064	1099498	0	232182	0	16982	1635562	249164	1884726	2	0,2	2
25	0	0	412454	45715	0	7747	9704	412454	63166	475620	0,4	0,1	0,5
25,5	0	0	818631	45715	0	3874	4852	818631	54441	873072	1	0,1	1
26	0	0	241450	0	0	0	0	241450	0	241450	0,2	0	0,2
26,5	0	0	303710	0	0	0	0	303710	0	303710	0,3	0	0,3
27	0	0	224275	0	0	0	0	224275	0	224275	0,2	0	0,2
27,5	0	0	158869	0	0	3874	0	158869	3874	162743	0,2	0,004	0,2
28	0	0	107635	0	0	0	0	107635	0	107635	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL n	70056301	286258170	38681449	19560260	164003589	1464232	283843	394995920	185311924	580307844	395	185	580
Millions	70	286	39	20	164	1	0,3						

Table 10. *ECOCADIZ 2018-07* survey. Chub mackerel (*S. colias*). Cont'd.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	PORTUGAL	SPAIN	TOTAL
14	0	0	0	0	0	0	0	0	0	0
14,5	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	14,566	0	0	0	14,566	14,566
15,5	0	0	0	1,489	5,810	0	0,061	0	7,360	7,360
16	29,439	0	4,107	5,626	17,626	0,108	0,203	33,546	23,563	57,109
16,5	131,663	20,871	22,092	13,696	73,145	0,462	0,075	174,626	87,378	262,004
17	256,440	255,399	34,430	42,716	455,485	1,304	0,251	546,269	499,756	1046,025
17,5	1334,933	761,249	45,974	103,778	823,567	2,418	0,185	2142,156	929,948	3072,104
18	490,631	1178,005	75,108	215,884	1575,825	8,268	0,102	1743,744	1800,079	3543,823
18,5	195,746	1226,977	78,803	180,527	1144,605	14,452	0,448	1501,526	1340,032	2841,558
19	161,314	1669,995	64,791	64,306	1045,334	13,746	0,492	1896,1	1123,878	3019,978
19,5	118,086	1659,144	61,284	39,973	452,819	5,389	0,404	1838,514	498,585	2337,099
20	63,817	2317,918	116,289	39,993	301,397	2,488	0,441	2498,024	344,319	2842,343
20,5	0	1796,550	279,751	35,679	632,171	1,747	0,640	2076,301	670,237	2746,538
21	0	2348,687	372,170	72,505	505,955	4,401	1,044	2720,857	583,905	3304,762
21,5	0	1567,276	276,780	33,907	490,946	4,503	2,644	1844,056	532,000	2376,056
22	0	907,487	258,369	19,665	224,376	7,217	5,523	1165,856	256,781	1422,637
22,5	0	624,165	255,953	19,768	143,671	6,710	2,875	880,118	173,024	1053,142
23	0	277,758	275,832	37,137	111,372	5,718	1,433	553,59	155,660	709,250
23,5	0	143,964	177,735	20,606	48,810	4,519	0,772	321,699	74,707	396,406
24	0	0	127,602	11,086	26,496	0,442	1,661	127,602	39,685	167,287
24,5	0	65,726	134,807	0	28,467	0,000	2,082	200,533	30,549	231,082
25	0	0	54,254	6,013	0	1,019	1,276	54,254	8,308	62,562
25,5	0	0	115,368	6,443	0	0,546	0,684	115,368	7,673	123,041
26	0	0	36,407	0	0	0	0	36,407	0	36,407
26,5	0	0	48,936	0	0	0	0	48,936	0	48,936
27	0	0	38,568	0	0	0	0	38,568	0	38,568
27,5	0	0	29,124	0	0	0,71	0	29,124	0,710	29,834
28	0	0	21,010	0	0	0	0	21,01	0	21,010
28,5	0	0	0	0	0	0		0	0	0
29	0	0	0	0	0	0		0	0	0
TOTAL	2782,069	16821,171	3005,544	970,797	8122,443	86,167	23,296	22608,784	9202,703	31811,487

Table 11. *ECOCADIZ 2018-07* survey. Blue jack mackerel (*T. picturatus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 28**.

Size class	POL01	POL02	POL03	POL04	POL05	*n* PORTUGAL	SPAIN	TOTAL	Millions PORTUGAL	SPAIN	TOTAL
10	0	0	0	0	0	0	0	0	0	0	0
10,5	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0
11,5	30297	0	41121	0	0	71418	0	71418	0,1	0	0,1
12	0	0	0	0	0	0	0	0	0	0	0
12,5	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0
13,5	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	2062	2362	2062	2362	4424	0,002	0,002	0,004
14,5	41659	0	56541	1546	1771	99746	1771	101517	0,1	0,002	0,1
15	22723	2746	30840	24227	27751	80536	27751	108287	0,1	0,03	0,1
15,5	22723	0	30840	18557	21256	72120	21256	93376	0,1	0,02	0,1
16	11362	0	15420	5670	6495	32452	6495	38947	0	0,01	0,04
16,5	53020	0	71961	8763	10038	133744	10038	143782	0	0,01	0,1
17	0	0	0	13402	15352	13402	15352	28754	0	0,02	0,03
17,5	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
18,5	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
19,5	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
20,5	0	17086	0	0	0	17086	0	17086	0,02	0	0,02
21	0	0	0	0	0	0	0	0	0	0	0
21,5	0	3204	0	0	0	3204	0	3204	0,003	0	0,003
22	0	10221	0	0	0	10221	0	10221	0,01	0	0,01
22,5	0	0	0	0	0	0	0	0	0	0	0
23	0	4882	0	0	0	4882	0	4882	0,005	0	0,005
23,5	0	11289	0	0	0	11289	0	11289	0,01	0	0,01
24	0	0	0	0	0	0	0	0	0	0	0
24,5	0	2746	0	0	0	2746	0	2746	0,003	0	0,003
25	0	0	0	0	0	0	0	0	0	0	0
25,5	0	0	0	0	0	0	0	0	0	0	0
26	0	2746	0	0	0	2746	0	2746	0,003	0	0,003
26,5	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0
27,5	0	2746	0	0	0	2746	0	2746	0,003	0	0,003
28	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
TOTAL *n*	181784	57666	246723	74227	85025	560400	85025	645425	**1**	**0,1**	**1**
Millions	**0,2**	**0,1**	**0,2**	**0,1**	**0,1**						

Table 11. *ECOCADIZ 2018-07* survey. Blue jack mackerel (*T. picturatus*). Cont'd.

Size class	POL01	POL02	POL03	POL04	POL05	PORTUGAL	SPAIN	TOTAL
10	0	0	0	0	0	0	0	0
10,5	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
11,5	0,329	0	0,447	0	0	0,776	0	0,776
12	0	0	0	0	0	0	0	0
12,5	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
13,5	0	0	0	0	0	0	0	0
14	0	0	0	0,043	0,050	0,043	0,050	0,093
14,5	0,986	0	1,338	0,037	0,042	2,360	0,042	2,402
15	0,603	0,073	0,818	0,642	0,736	2,136	0,736	2,871
15,5	0,673	0	0,913	0,550	0,629	2,136	0,629	2,765
16	0,374	0	0,508	0,187	0,214	1,070	0,214	1,284
16,5	1,938	0	2,631	0,320	0,367	4,890	0,367	5,257
17	0	0	0	0,542	0,621	0,542	0,621	1,163
17,5	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
18,5	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
19,5	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
20,5	0	1,300	0	0	0	1,300	0	1,300
21	0	0	0	0	0	0	0	0
21,5	0	0,286	0	0	0	0,286	0	0,286
22	0	0,988	0	0	0	0,988	0	0,988
22,5	0	0	0	0	0	0	0	0
23	0	0,548	0	0	0	0,548	0	0,548
23,5	0	1,364	0	0	0	1,364	0	1,364
24	0	0	0	0	0	0	0	0
24,5	0	0,382	0	0	0	0,382	0	0,382
25	0	0	0	0	0	0	0	0
25,5	0	0	0	0	0	0	0	0
26	0	0,467	0	0	0	0,467	0	0,467
26,5	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
27,5	0	0,565	0	0	0	0,565	0	0,565
28	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
TOTAL	**4,903**	**5,974**	**6,654**	**2,321**	**2,659**	**19,853**	**2,659**	**22,511**

Table 12. *ECOCADIZ 2018-07* survey. Horse mackerel (*T. trachurus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 30**.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	n PORTUGAL	n SPAIN	n TOTAL	Millions PORTUGAL	Millions SPAIN	Millions TOTAL
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11,5	0	0	0	0	5605	0	219	1577	0	55	5824	1632	7456	0,01	0,002	0,01
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	59879	0	5711	0	0	1197	0	65590	1197	66787	0,1	0,001	0,1
18,5	0	0	0	29939	0	2855	0	0	599	0	32794	599	33393	0,03	0,001	0,03
19	0	0	0	29939	0	2855	0	0	599	0	32794	599	33393	0,03	0,001	0,03
19,5	0	13722	0	119757	0	11422	0	0	2395	0	144901	2395	147296	0,1	0,002	0,1
20	0	260713	0	359271	0	34265	0	0	7184	0	654249	7184	661433	1	0,01	1
20,5	0	246991	0	179636	0	17133	0	0	3592	0	443760	3592	447352	0,4	0,004	0,4
21	6314	260713	4231	209575	5605	19988	219	1577	4191	55	506645	5823	512468	1	0,01	1
21,5	1579	205826	1058	209575	0	19988	0	0	4191	0	438026	4191	442217	0,4	0,004	0,4
22	3157	192104	2116	59879	7287	5711	284	2049	1197	71	270538	3317	273855	0,3	0,003	0,3
22,5	6314	96052	4231	29939	5605	2855	219	1577	599	55	145215	2231	147446	0,1	0,002	0,1
23	17365	137217	11635	0	21299	0	830	5991	0	209	188346	6200	194546	0,2	0,01	0,2
23,5	11050	13722	7404	89818	48764	8566	1901	13716	1796	478	181225	15990	197215	0,2	0,02	0,2
24	7893	82330	5289	119757	89121	11422	3475	25066	2395	874	319287	28335	347622	0,3	0,03	0,3
24,5	7893	82330	5289	29939	113223	2855	4415	31845	599	1110	245944	33554	279498	0,2	0,03	0,3
25	4736	27443	3173	29939	124434	2855	4852	34998	599	1220	197432	36817	234249	0,2	0,04	0,2
25,5	0	0	0	0	65580	0	2557	18445	0	643	68137	19088	87225	0,1	0,02	0,1
26	0	0	0	0	33070	0	1289	9301	0	324	34359	9625	43984	0,03	0,01	0,04
26,5	0	0	0	0	13452	0	525	3784	0	132	13977	3916	17893	0,01	0,004	0,02
27	0	0	0	0	3363	0	131	946	0	33	3494	979	4473	0,003	0,001	0,004
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	1682	0	66	473	0	16	1748	489	2237	0,002	0,0005	0,002
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL *n*	66301	1619163	44426	1556842	538090	148481	20982	151345	31133	5275	3994285	187753	4182038	**4**	**0,2**	**4**
Millions	0,1	2	0,04	2	1	0,1	0,02	0,2	0,03	0,01						

Table 12. *ECOCADIZ 2018-07* survey. Horse mackerel (*T. trachurus*). Cont'd.

Size class	POL01	POL02	POL03	POL04	POL05	POL06	POL07	POL08	POL09	POL10	PORTUGAL	SPAIN	TOTAL
10	0	0	0	0	0	0	0	0	0	0	0	0	0
10,5	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0
11,5	0	0	0	0	0,072	0	0,003	0,020	0	0,001	0,075	0,021	0,095
12	0	0	0	0	0	0	0	0	0	0	0	0	0
12,5	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0
13,5	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0
14,5	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0
15,5	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0
16,5	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0
17,5	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	3,093	0	0,295	0	0	0,061838	0	3,388	0,062	3,450
18,5	0	0	0	1,685	0	0,161	0	0	0,033713	0	1,846	0,034	1,879
19	0	0	0	1,832	0	0,175	0	0	0,036645	0	2,006	0,037	2,043
19,5	0	0,911	0	7,947	0	0,758	0	0	0,158926	0	9,615	0,159	9,774
20	0	18,727	0	25,806	0	2,461	0	0	0,516025	0	46,995	0,516	47,511
20,5	0	19,167	0	13,940	0	1,330	0	0	0,278751	0	34,437	0,279	34,716
21	0,528	21,818	0,354	17,539	0,469	1,673	0,018	0,132	0,35073	0,005	42,399	0,487	42,887
21,5	0,142	18,543	0,095	18,880	0	1,801	0	0	0,37756	0	39,461	0,378	39,839
22	0,306	18,599	0,205	5,797	0,706	0,553	0,027	0,198	0,115891	0,007	26,193	0,321	26,514
22,5	0,656	9,978	0,440	3,110	0,582	0,297	0,023	0,164	0,062226	0,006	15,085	0,232	15,317
23	1,933	15,271	1,295	0	2,370	0	0,092	0,667	0	0,023	20,962	0,69	21,652
23,5	1,316	1,634	0,882	10,694	5,806	1,020	0,226	1,633	0,213828	0,057	21,576	1,904	23,480
24	1,004	10,471	0,673	15,231	11,335	1,453	0,442	3,188	0,304609	0,111	40,609	3,604	44,212
24,5	1,071	11,171	0,718	4,062	15,363	0,387	0,599	4,321	0,081275	0,151	33,371	4,553	37,924
25	0,685	3,967	0,459	4,328	17,989	0,413	0,701	5,059	0,086594	0,176	28,542	5,322	33,864
25,5	0	0	0	0	10,088	0	0,393	2,837	0	0,099	10,482	2,936	13,418
26	0	0	0	0	5,407	0	0,211	1,521	0	0,053	5,618	1,574	7,192
26,5	0	0	0	0	2,335	0	0,091	0,657	0	0,023	2,426	0,680	3,106
27	0	0	0	0	0,619	0	0,024	0,174	0	0,006	0,643	0,180	0,823
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0,347	0	0,014	0,098	0	0,003	0,361	0,101	0,462
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7,640	150,257	5,119	133,945	73,488	12,775	2,865	20,669	2,679	0,720	386,089	24,068	410,158

ECOCADIZ 2018-07 . Trachurus trachurus . BIOMASS (t)

Table 13. *ECOCADIZ 2018-07* survey. Mediterranean horse mackerel (*T. mediterraneus*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 32**.

ECOCADIZ 2018-07 . *Trachurus mediterraneus* . ABUNDANCE (in numbers and million fish)							
Size class	POL01	*n*			Millions		
		PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
19	0	0	0	0	0	0	0
19,5	0	0	0	0	0	0	0
20	22068	0	22068	22068	0	0,02	0,02
20,5	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
21,5	0	0	0	0	0	0	0
22	22068	0	22068	22068	0	0,02	0,02
22,5	22068	0	22068	22068	0	0,02	0,02
23	22068	0	22068	22068	0	0,02	0,02
23,5	66578	0	66578	66578	0	0,1	0,1
24	154849	0	154849	154849	0	0,2	0,2
24,5	154475	0	154475	154475	0	0,2	0,2
25	186001	0	186001	186001	0	0,2	0,2
25,5	315630	0	315630	315630	0	0,3	0,3
26	502379	0	502379	502379	0	0,5	0,5
26,5	439328	0	439328	439328	0	0,4	0,4
27	819505	0	819505	819505	0	0,8	0,8
27,5	512211	0	512211	512211	0	0,5	0,5
28	369597	0	369597	369597	0	0,4	0,4
28,5	440076	0	440076	440076	0	0,4	0,4
29	622176	0	622176	622176	0	0,6	0,6
29,5	742347	0	742347	742347	0	0,7	0,7
30	644244	0	644244	644244	0	0,6	0,6
30,5	296715	0	296715	296715	0	0,3	0,3
31	372376	0	372376	372376	0	0,4	0,4
31,5	475502	0	475502	475502	0	0,5	0,5
32	110714	0	110714	110714	0	0,1	0,1
32,5	133530	0	133530	133530	0	0,1	0,1
33	44510	0	44510	44510	0	0,04	0,0
33,5	142613	0	142613	142613	0	0,1	0,1
34	111088	0	111088	111088	0	0,1	0,1
34,5	89020	0	89020	89020	0	0,1	0,1
35	0	0	0	0	0	0	0
35,5	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0
36,5	44510	0	44510	44510	0	0,04	0,04
37	0	0	0	0	0	0	0
37,5	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0
TOTAL *n*	7878246	0	7878246	7878246	0	8	8
Millions	8	0					

Table 13. *ECOCADIZ 2018-07* survey. Mediterranean horse mackerel (*T. mediterraneus*). Cont'd.

ECOCADIZ 2018-07 . *Trachurus mediterraneus* . BIOMASS (t)			
Size class	POL01	PORTUGAL	SPAIN	TOTAL
19	0	0	0	0
19,5	0	0	0	0
20	1,662	0	1,662	1,662
20,5	0	0	0	0
21	0	0	0	0
21,5	0	0	0	0
22	2,098	0	2,098	2,098
22,5	2,216	0	2,216	2,216
23	2,338	0	2,338	2,338
23,5	7,434	0	7,434	7,434
24	18,202	0	18,202	18,202
24,5	19,096	0	19,096	19,096
25	24,157	0	24,157	24,157
25,5	43,026	0	43,026	43,026
26	71,812	0	71,812	71,812
26,5	65,793	0	65,793	65,793
27	128,467	0	128,467	128,467
27,5	83,981	0	83,981	83,981
28	63,329	0	63,329	63,329
28,5	78,742	0	78,742	78,742
29	116,165	0	116,165	116,165
29,5	144,524	0	144,524	144,524
30	130,692	0	130,692	130,692
30,5	62,677	0	62,677	62,677
31	81,855	0	81,855	81,855
31,5	108,700	0	108,700	108,700
32	26,304	0	26,304	26,304
32,5	32,953	0	32,953	32,953
33	11,403	0	11,403	11,403
33,5	37,907	0	37,907	37,907
34	30,619	0	30,619	30,619
34,5	25,430	0	25,430	25,430
35	0	0	0	0
35,5	0	0	0	0
36	0	0	0	0
36,5	14,598	0	14,598	14,598
37	0	0	0	0
37,5	0	0	0	0
38	0	0	0	0
TOTAL	1436,180	0	1436,180	1436,180

Table 14. *ECOCADIZ 2018-07* survey. Bogue (*B. boops*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 34**.

	ECOCADIZ 2018-07 . Boops boops . ABUNDANCE (in numbers and million fish)								
Size class	POL01	POL02	POL03	*n*			Millions		
				PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
16	0	0	0	0	0	0	0	0	0
16,5	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
17,5	0	6807	0	6807	0	6807	0,01	0	0,01
18	179256	6807	0	186063	0	186063	0,2	0	0,2
18,5	160828	0	0	160828	0	160828	0,2	0	0,2
19	682514	0	0	682514	0	682514	1	0	1
19,5	806821	0	0	806821	0	806821	1	0	1
20	802130	0	0	802130	0	802130	1	0	1
20,5	820558	0	0	820558	0	820558	1	0	1
21	967649	38608	0	1006257	0	1006257	1	0	1
21,5	962958	79450	0	1042408	0	1042408	1	0	1
22	606791	99973	0	706764	0	706764	1	0	1
22,5	165519	113588	0	279107	0	279107	0,3	0	0,3
23	245933	163574	359226	409507	359226	768733	0,4	0,4	1
23,5	0	177290	359226	177290	359226	536516	0,2	0,4	1
24	0	325117	987873	325117	987873	1312990	0,3	1	1
24,5	0	163574	987873	163574	987873	1151447	0,2	1	1
25	0	145490	1616519	145490	1616519	1762009	0,1	2	2
25,5	0	79552	1167486	79552	1167486	1247038	0,1	1	1
26	0	61366	987873	61366	987873	1049239	0,1	1	1
26,5	0	13614	1796132	13614	1796132	1809746	0,01	2	2
27	0	18186	987873	18186	987873	1006059	0,02	1	1
27,5	0	0	0	0	0	0	0	0	0
28	0	18186	359226	18186	359226	377412	0,02	0,4	0,4
28,5	0	13614	179613	13614	179613	193227	0,01	0,2	0,2
29	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0
TOTAL *n*	6400957	1524796	9788920	7925753	9788920	17714673	8	10	18
Millions	6	2	10						

Table 14. *ECOCADIZ 2018-07* survey. Bogue (*B. boops*). Cont'd.

Size class	POL01	POL02	POL03	PORTUGAL	SPAIN	TOTAL
ECOCADIZ 2018-07 . *Boops boops* . BIOMASS (t)						
16	0	0	0	0	0	0
16,5	0	0	0	0	0	0
17	0	0	0	0	0	0
17,5	0	0,356	0	0,356	0	0,356
18	10,185	0,387	0	10,572	0	10,572
18,5	9,913	0	0	9,913	0	9,913
19	45,538	0	0	45,538	0	45,538
19,5	58,152	0	0	58,152	0	58,152
20	62,334	0	0	62,334	0	62,334
20,5	68,625	0	0	68,625	0	68,625
21	86,940	3,469	0	90,409	0	90,409
21,5	92,794	7,656	0	100,450	0	100,450
22	62,614	10,316	0	72,930	0	72,930
22,5	18,262	12,532	0	30,794	0	30,794
23	28,969	19,268	42,314	48,237	42,314	90,550
23,5	0	22,265	45,113	22,265	45,113	67,378
24	0	43,473	132,093	43,473	132,093	175,565
24,5	0	23,258	140,464	23,258	140,464	163,722
25	0	21,971	244,116	21,971	244,116	266,086
25,5	0	12,744	187,027	12,744	187,027	199,771
26	0	10,417	167,687	10,417	167,687	178,104
26,5	0	2,446	322,707	2,446	322,707	325,153
27	0	3,455	187,666	3,455	187,666	191,121
27,5	0	0	0	0	0	0
28	0	3,851	76,064	3,851	76,064	79,914
28,5	0	3,039	40,095	3,039	40,095	43,134
29	0	0	0	0	0	0
29,5	0	0	0	0	0	0
30	0	0	0	0	0	0
TOTAL	544,325	200,901	1585,346	745,226	1585,346	2330,572

Table 15. *ECOCADIZ 2018-07* survey. Boarfish (*C. aper*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 36**.

ECOCADIZ 2018-07 . Capros aper . ABUNDANCE (in numbers and million fish)							
Size class	POL01	*n*			Millions		
		PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
1	0	0	0	0	0	0	0
1,5	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
2,5	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
3,5	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
4,5	12214	12214	0	12214	0,01	0	0,01
5	67176	67176	0	67176	0,1	0	0,1
5,5	219847	219847	0	219847	0,2	0	0,2
6	230026	230026	0	230026	0,2	0	0,2
6,5	83461	83461	0	83461	0,1	0	0,1
7	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
TOTAL *n*	612724	612724	0	612724	1	0	1
Millions	1	1					

Table 15. *ECOCADIZ 2018-07* survey. Boarfish (*C. aper*). Cont'd.

ECOCADIZ 2018-07 . Capros aper . BIOMASS (t)				
Size class	POL01	PORTUGAL	SPAIN	TOTAL
1	0	0	0	0
1,5	0	0	0	0
2	0	0	0	0
2,5	0	0	0	0
3	0	0	0	0
3,5	0	0	0	0
4	0	0	0	0
4,5	0,027	0,027	0	0,027
5	0,201	0,201	0	0,201
5,5	0,871	0,871	0	0,871
6	1,177	1,177	0	1,177
6,5	0,541	0,541	0	0,541
7	0,049	0,049	0	0,049
7,5	0	0	0	0
8	0	0	0	0
8,5	0	0	0	0
9	0	0	0	0
TOTAL	2,867	2,867	0	2,867

Table 16. *ECOCADIZ 2018-07* survey. Pearlside (*M. muelleri*). Estimated abundance (absolute numbers and million fish) and biomass (t) by size class (in cm). Polygons (*i.e.*, coherent or homogeneous post-strata) numbered as in **Figure 38**.

Size class	POL01	POL02	n			Millions		
			PORTUGAL	SPAIN	TOTAL	PORTUGAL	SPAIN	TOTAL
1	0	0	0	0	0	0	0	0
1,5	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
2,5	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
3,5	463555815	2260522504	463555815	2260522504	2724078319	464	2261	2724
4	827777753	4036644949	827777753	4036644949	4864422702	828	4037	4864
4,5	364221938	1776122445	364221938	1776122445	2140344383	364	1776	2140
5	22075713	107651859	22075713	107651859	129727572	22	108	130
5,5	33113569	161477789	33113569	161477789	194591358	33	161	195
6	22075713	107651859	22075713	107651859	129727572	22	108	130
6,5	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
7,5	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
8,5	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
TOTAL *n*	1732820501	8450071405	1732820501	8450071405	10182891906	1733	8450	10183
Millions	1733	8450						

Table 16. *ECOCADIZ 2018-07* survey. Pearlside (*M. muelleri*). Cont'd.

Size class	POL01	POL02	PORTUGAL	SPAIN	TOTAL
1	0	0	0	0	0
1,5	0	0	0	0	0
2	0	0	0	0	0
2,5	0	0	0	0	0
3	0	0	0	0	0
3,5	177,703	866,566	177,703	866,566	1044,269
4	467,215	2278,368	467,215	2278,368	2745,584
4,5	289,915	1413,768	289,915	1413,768	1703,683
5	23,942	116,754	23,942	116,754	140,696
5,5	47,574	231,995	47,574	231,995	279,569
6	41,040	200,130	41,040	200,130	241,170
6,5	0	0	0	0	0
7	0	0	0	0	0
7,5	0	0	0	0	0
8	0	0	0	0	0
8,5	0	0	0	0	0
9	0	0	0	0	0
TOTAL	1047,390	5107,581	1047,390	5107,581	6154,971

ECOCADIZ 2018-07 . Maurolicus muelleri . BIOMASS (t)
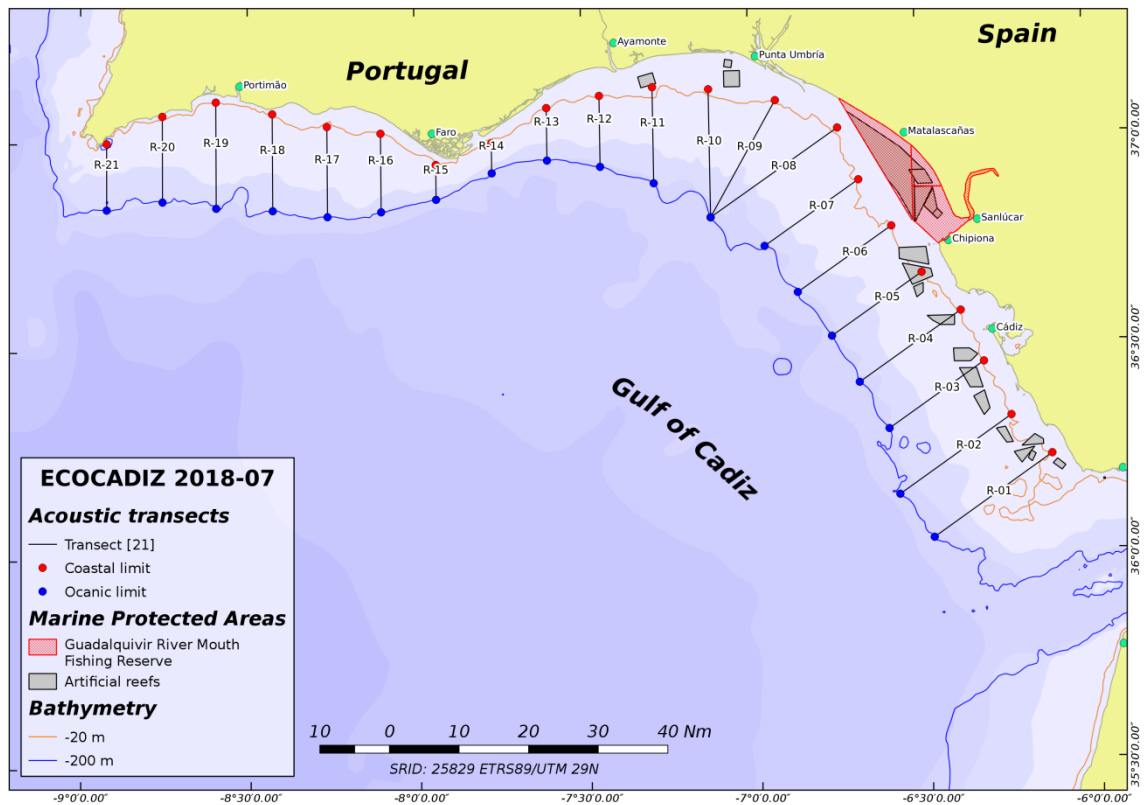
Figure 1. *ECOCADIZ 2018-07* survey. Location of the acoustic transects sampled during the survey. The different protected areas inside the Guadalquivir river mouth Fishing Reserve and artificial reef polygons are also shown.
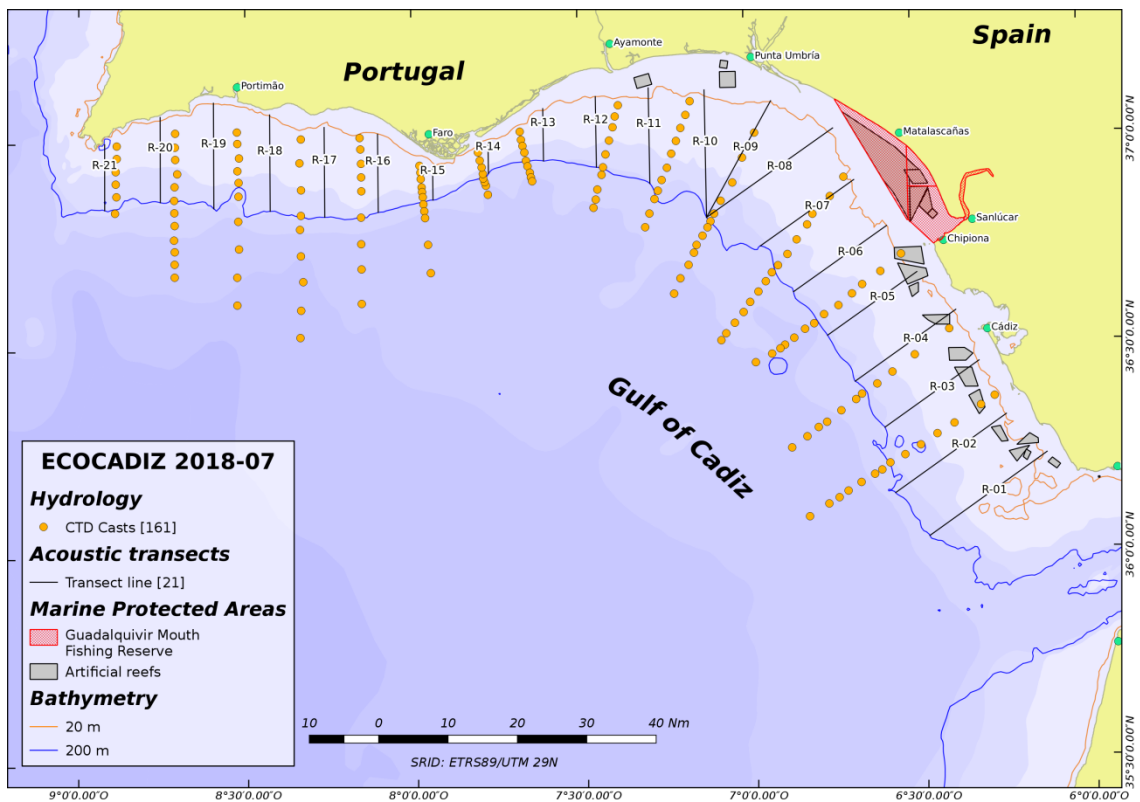
Figure 2. *ECOCADIZ 2018-07* survey. Location of CTD-LADCP stations.
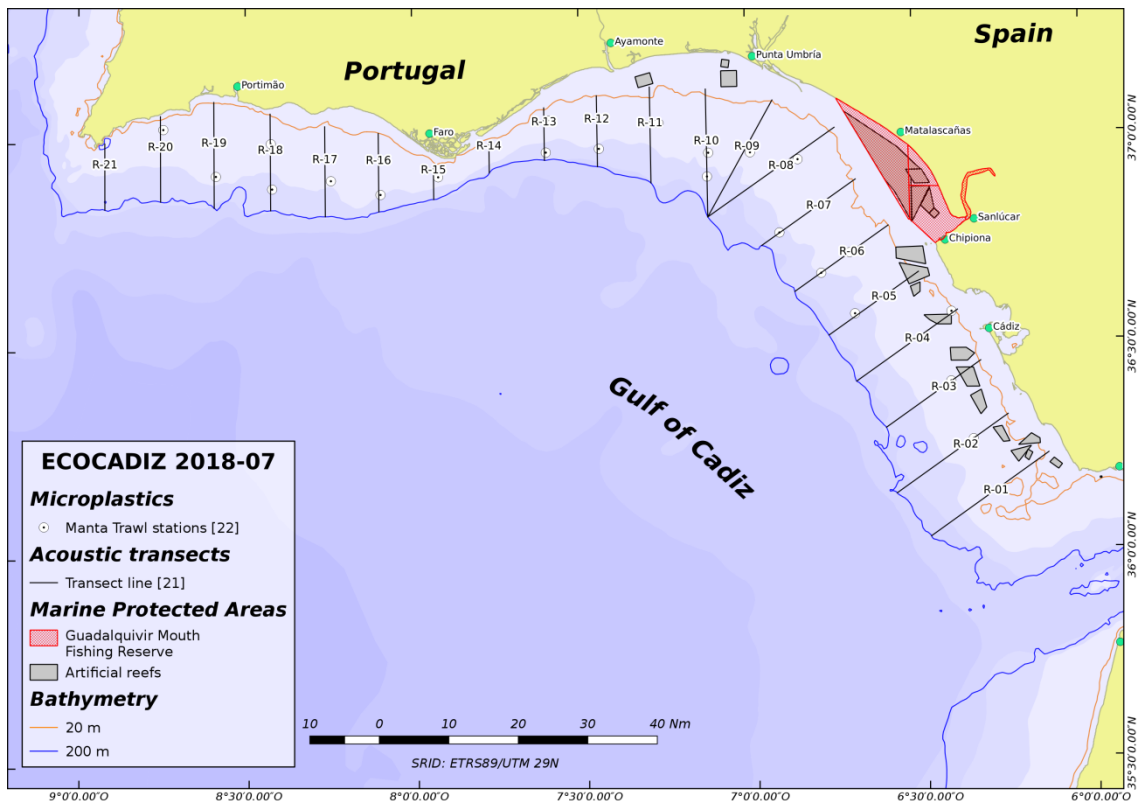
Figure 3. *ECOCADIZ 2018-07* survey. Location of Manta trawl hauls (micro-plastics).
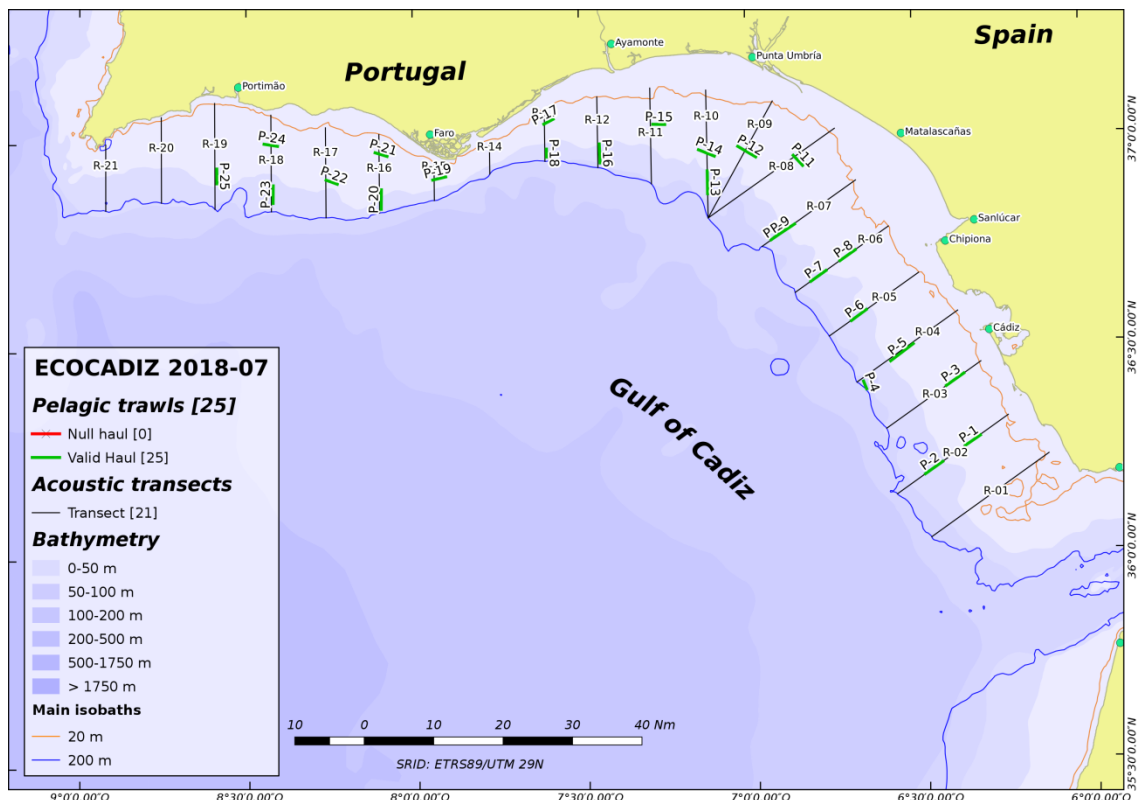
Figure 4. *ECOCADIZ 2018-07* survey. Location of ground-truthing fishing hauls.
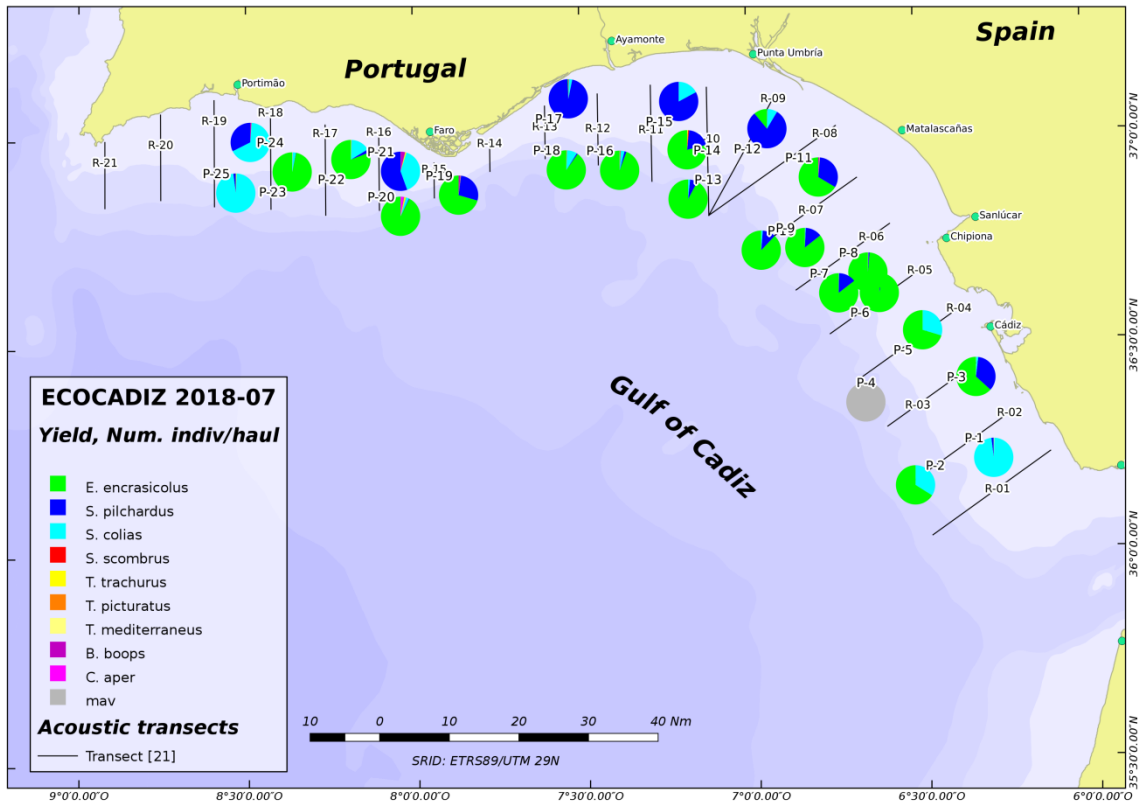
Figure 5. *ECOCADIZ 2018-07* survey. Species composition (percentages in number) in fishing hauls.
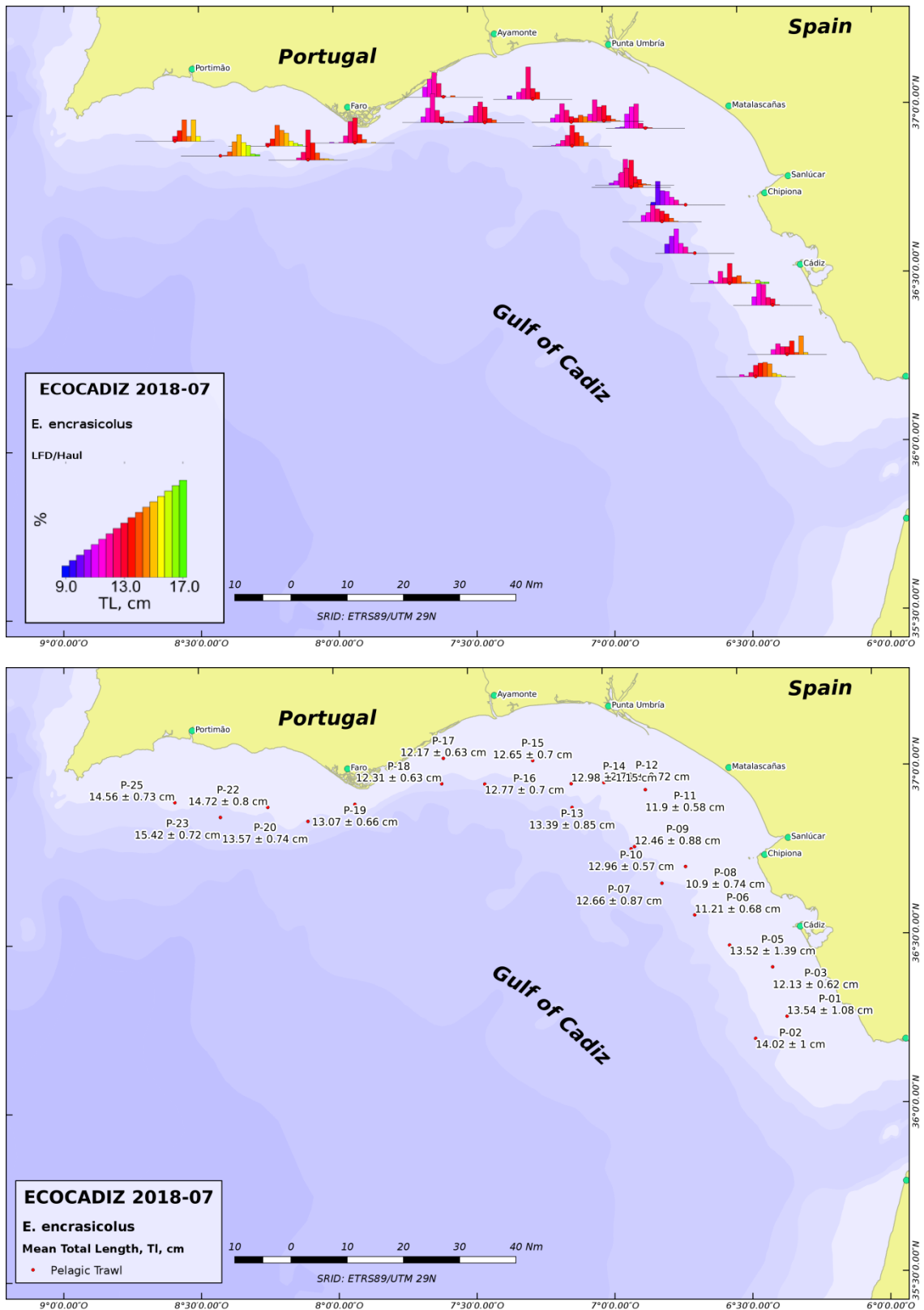
Figure 6. *ECOCADIZ 2018-07* survey. *Engraulis encrasicolus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
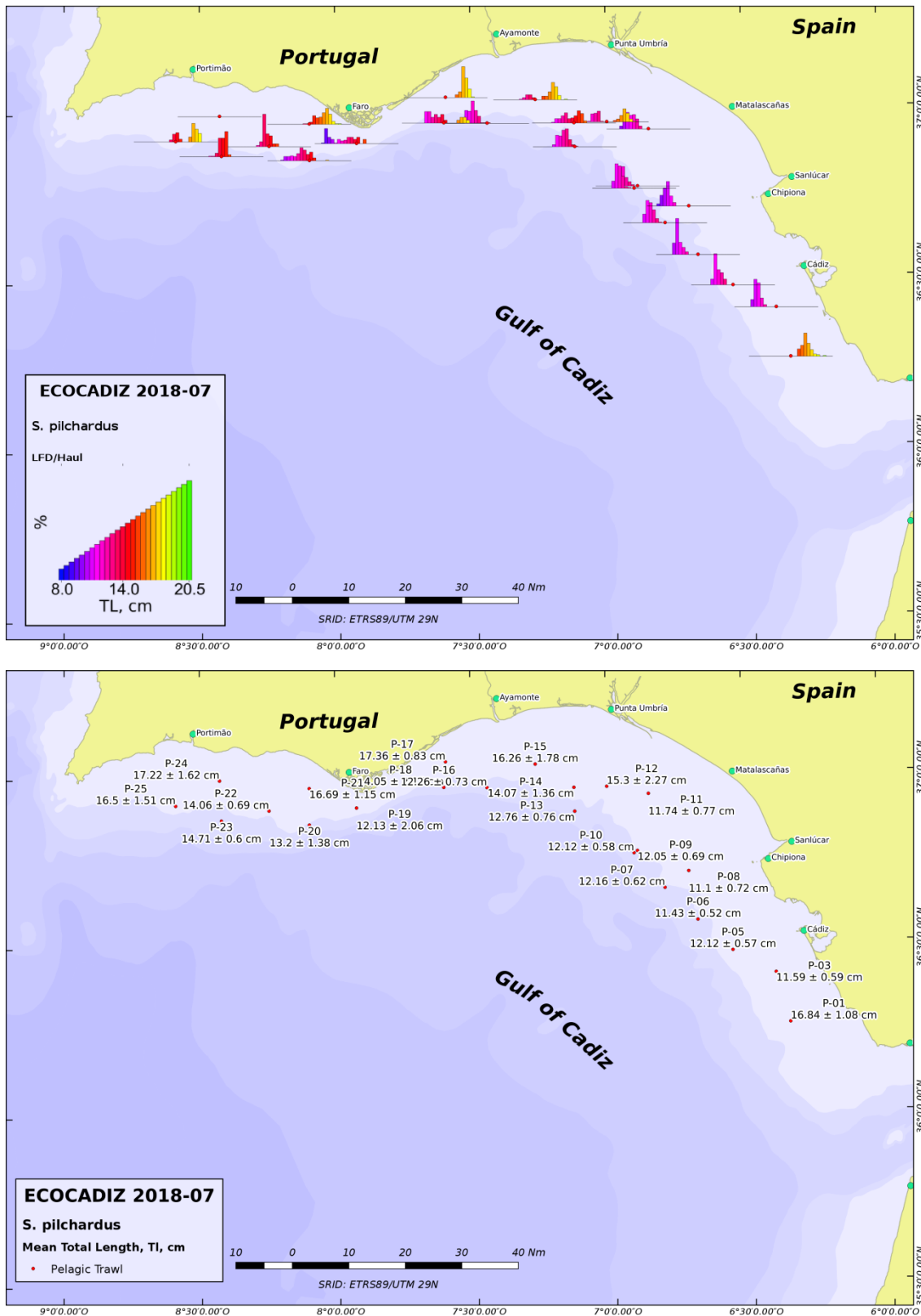
Figure 7. *ECOCADIZ 2018-07* survey. *Sardina pilchardus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
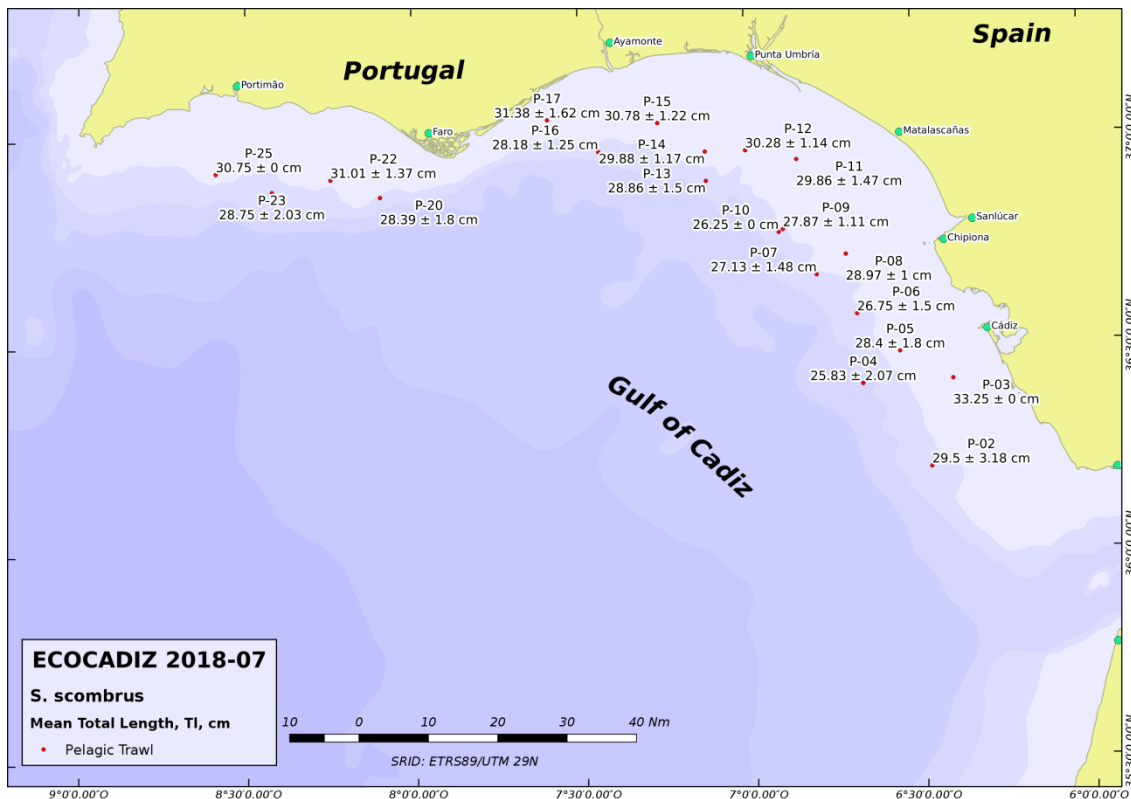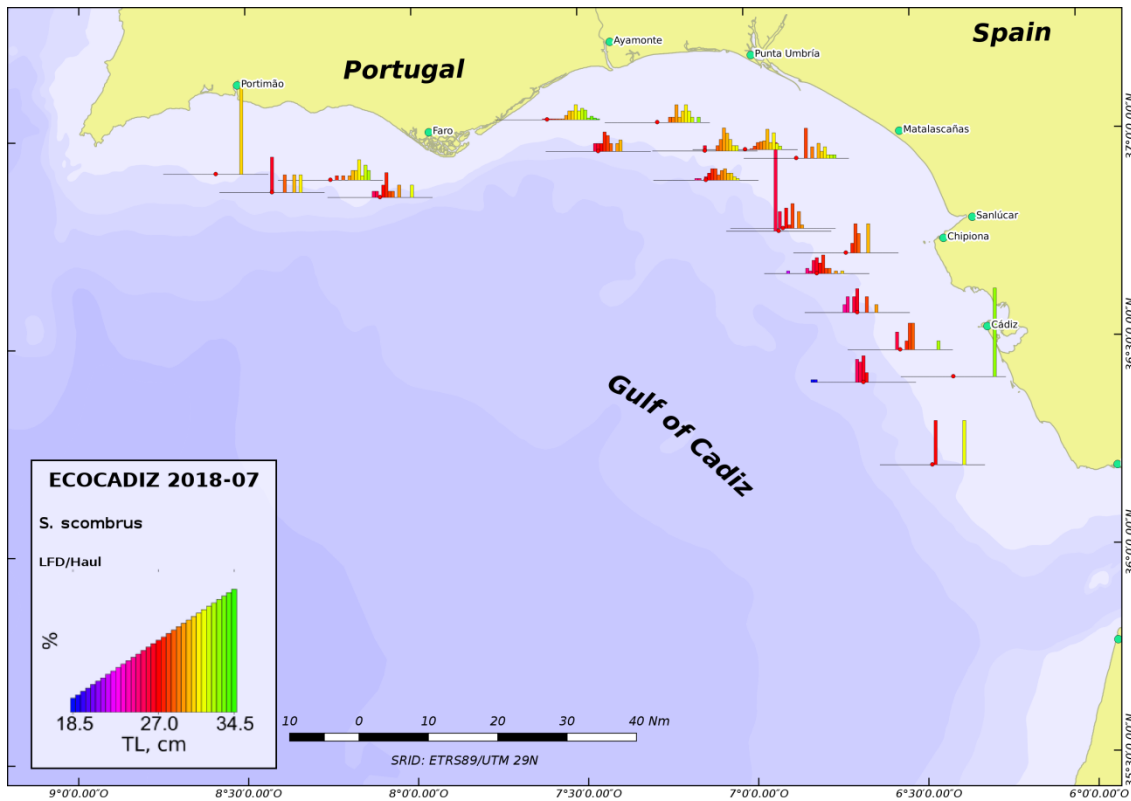
Figure 8. *ECOCADIZ 2018-07* survey. *Scomber scombrus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
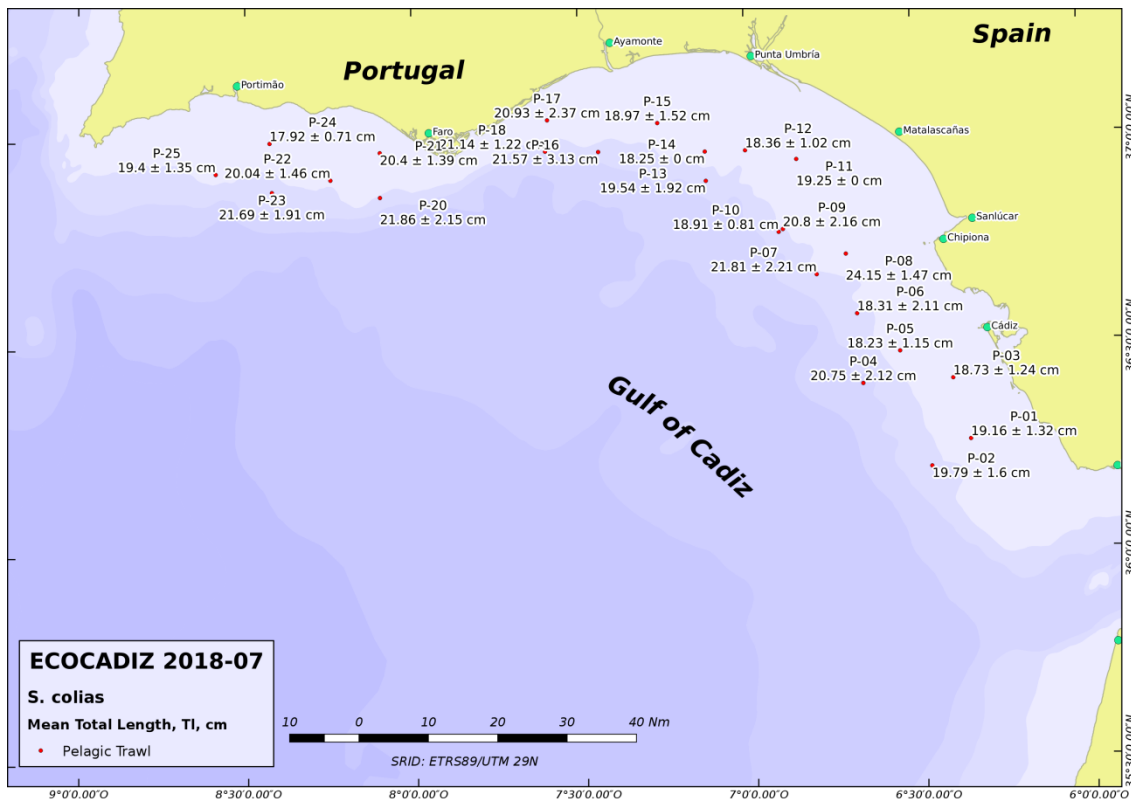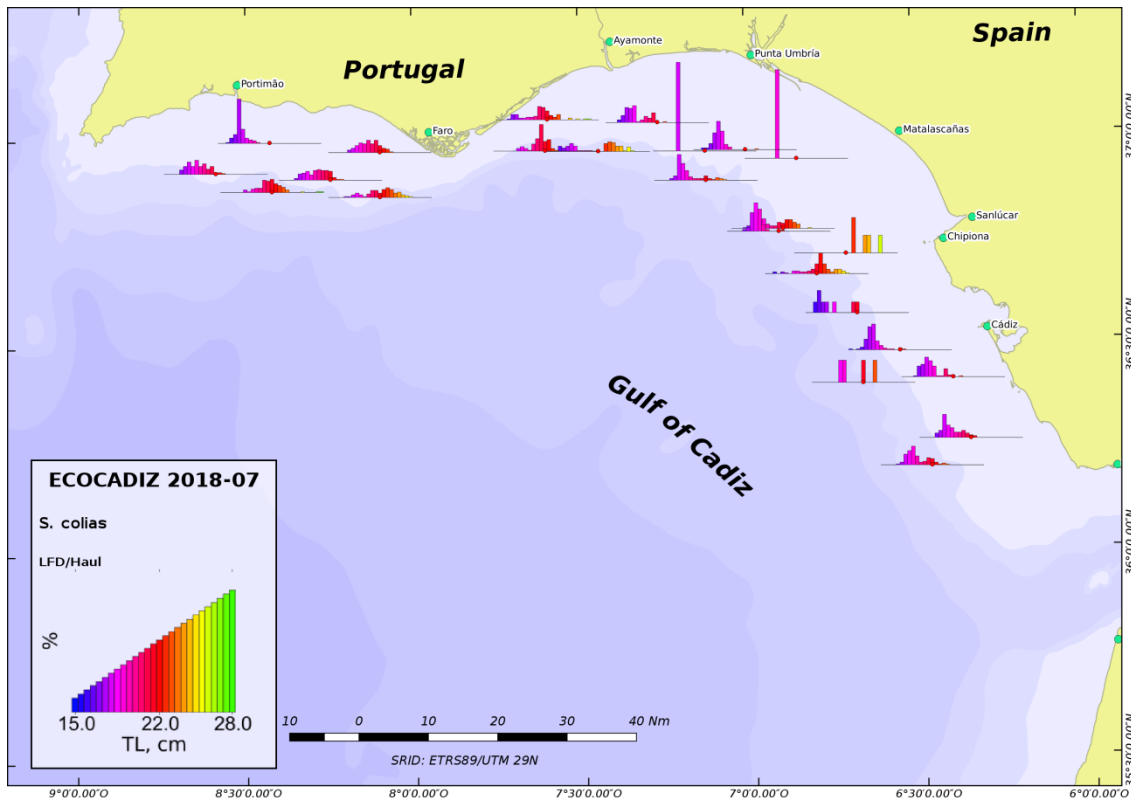
Figure 9. *ECOCADIZ 2018-07* survey. *Scomber colias*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
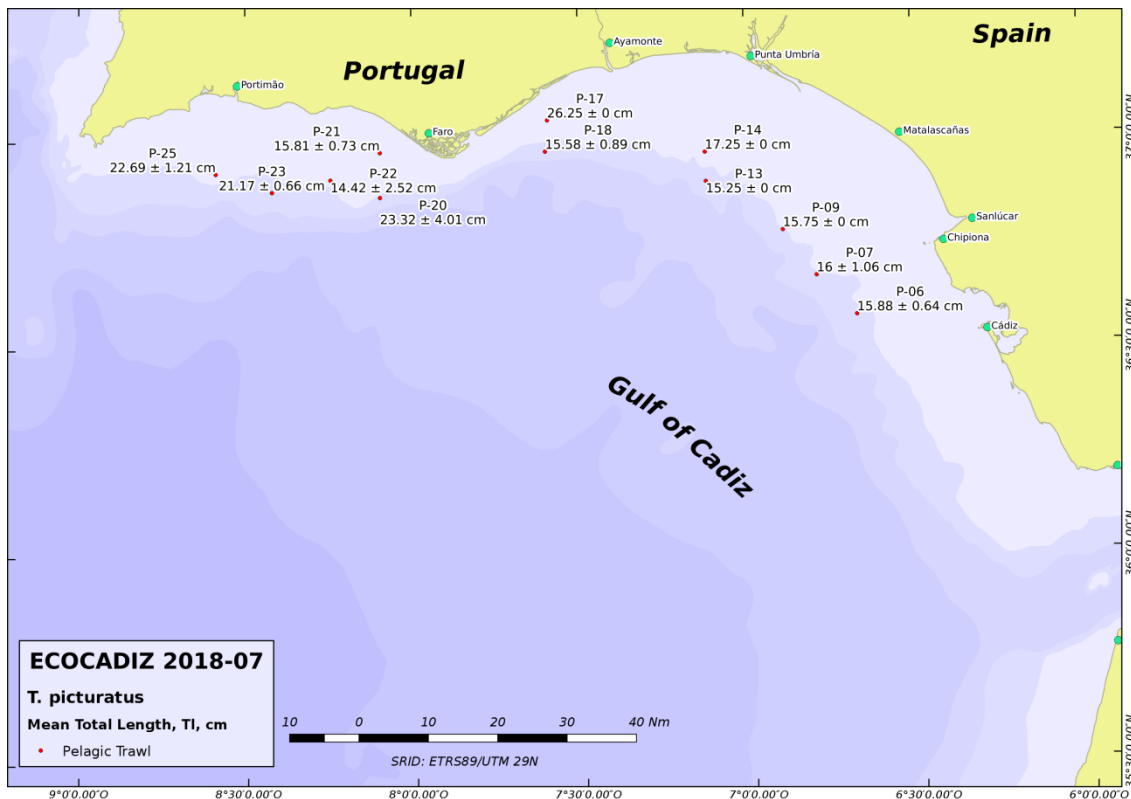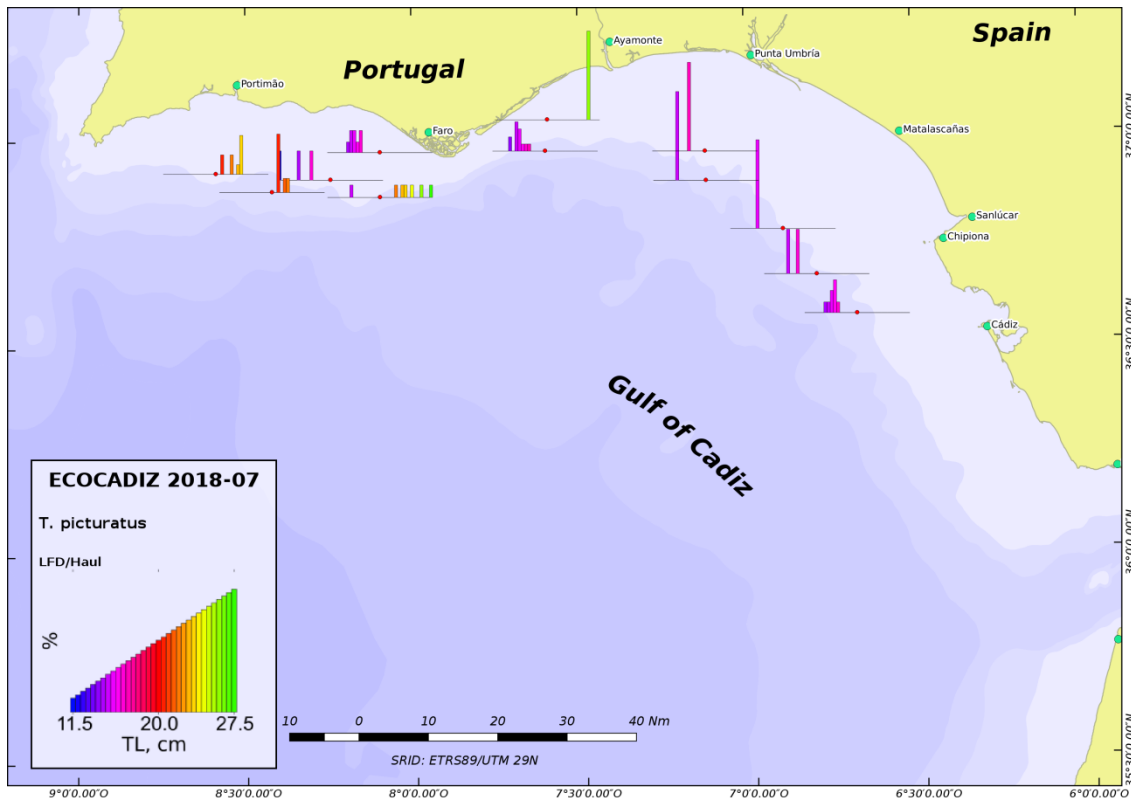
Figure 10. *ECOCADIZ 2018-07* survey. *Trachurus picturatus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
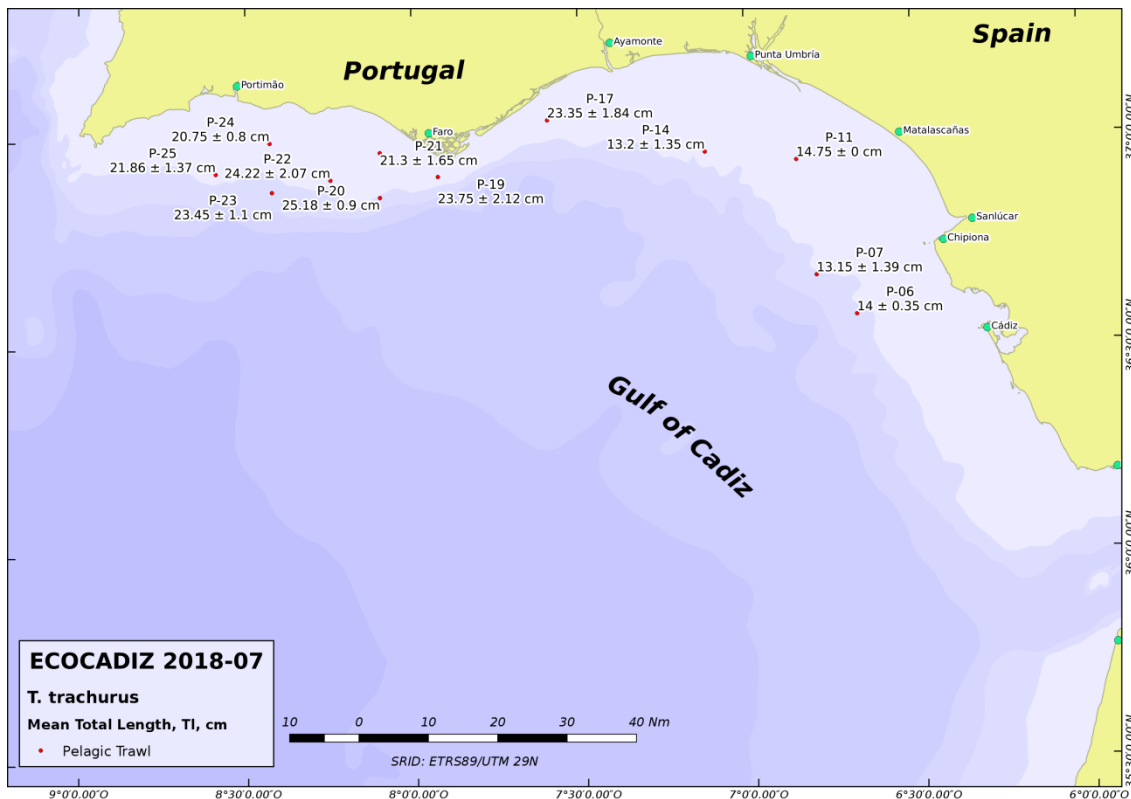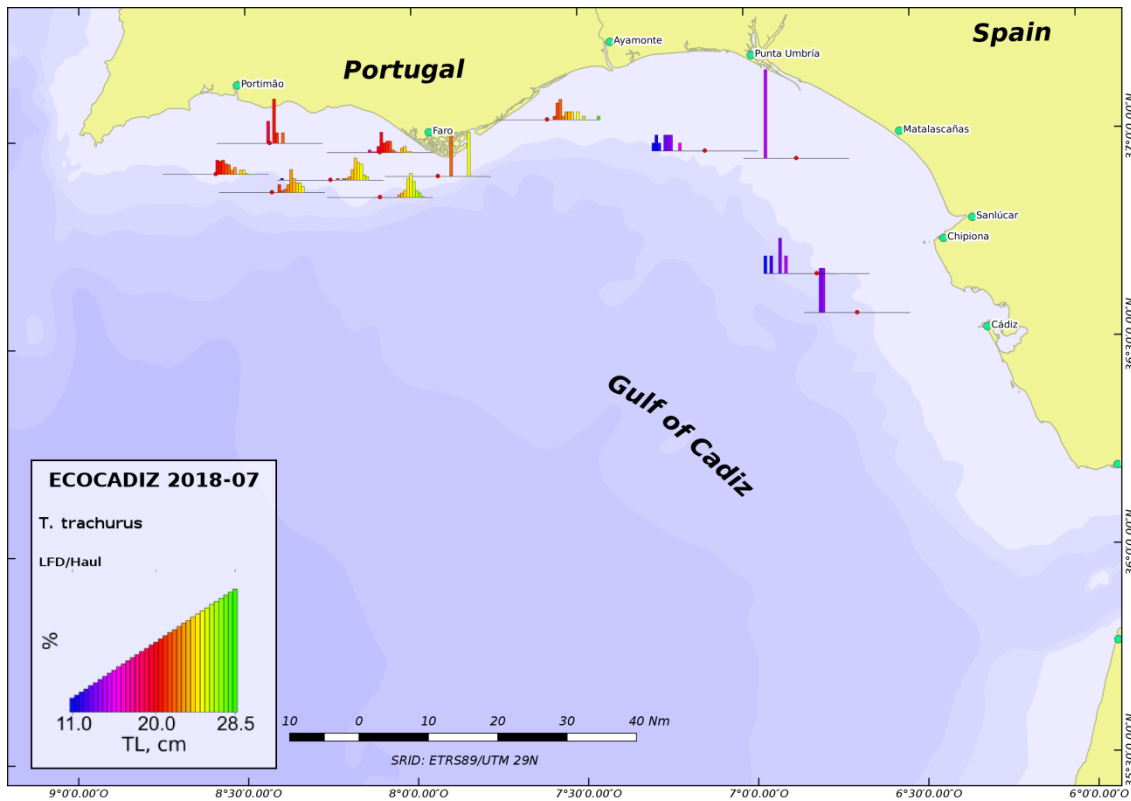
Figure 11. *ECOCADIZ 2018-07* survey. *Trachurus trachurus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
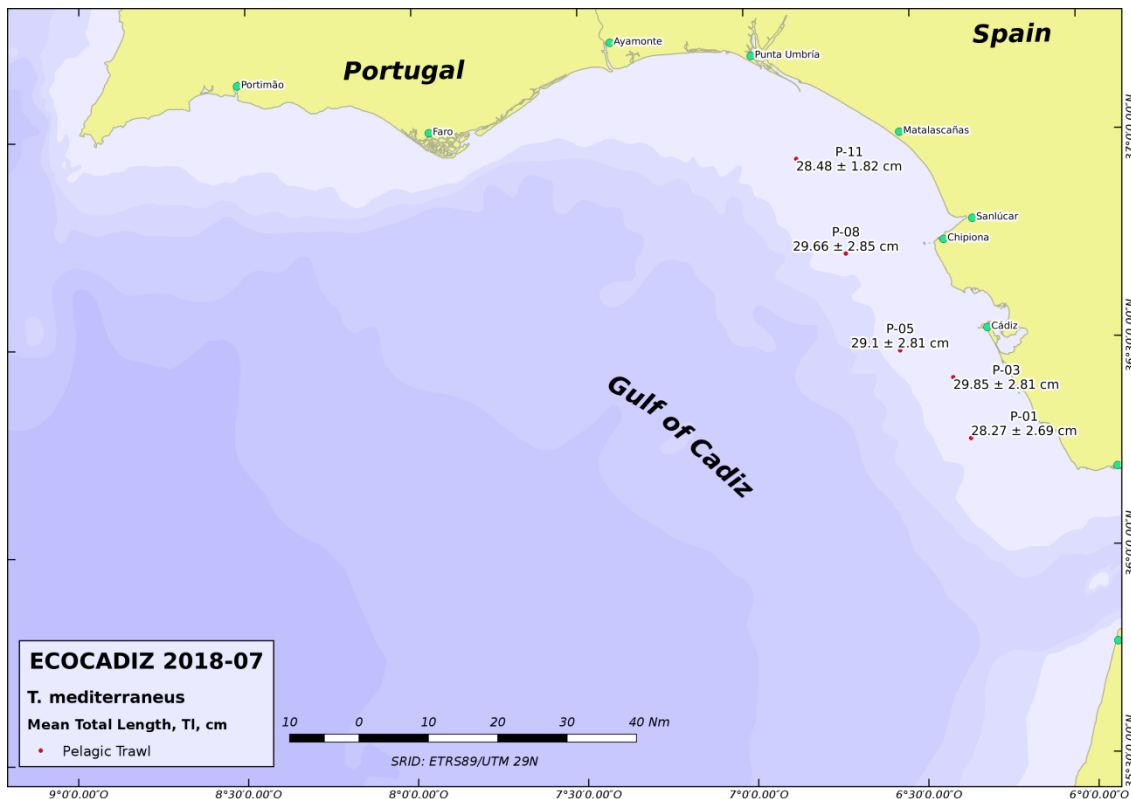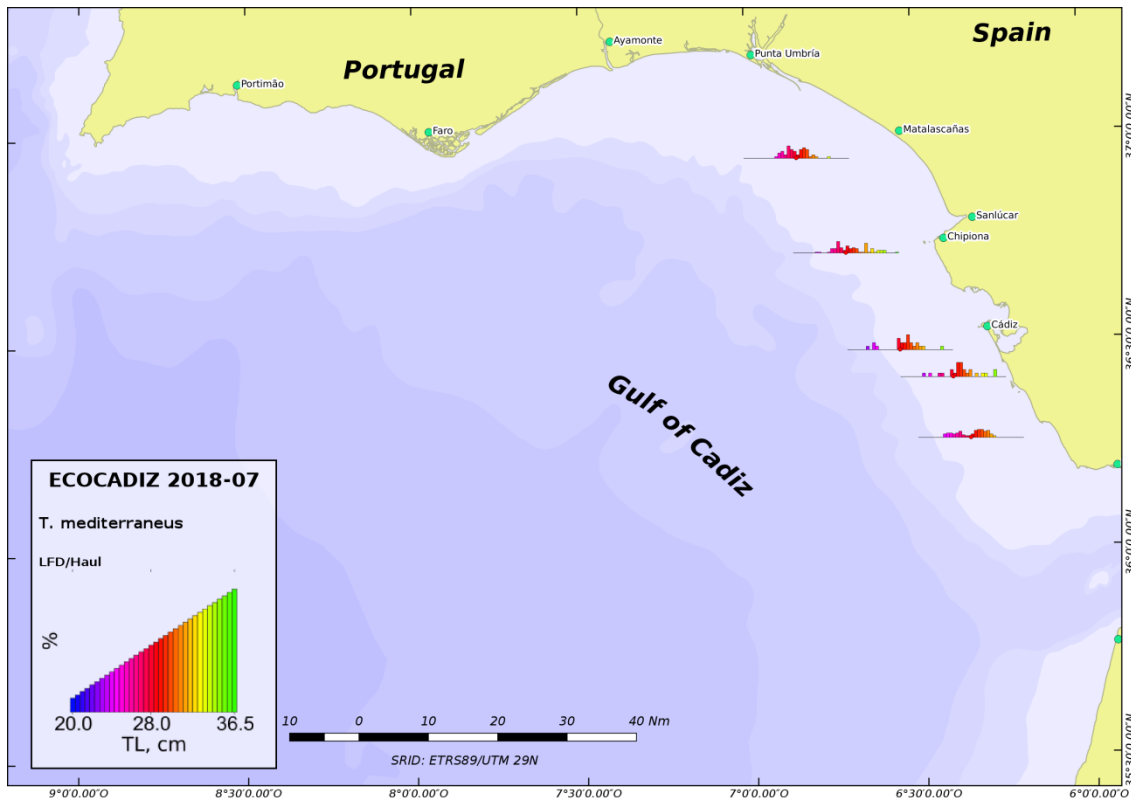
Figure 12. *ECOCADIZ 2018-07* survey. *Trachurus mediterraneus*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
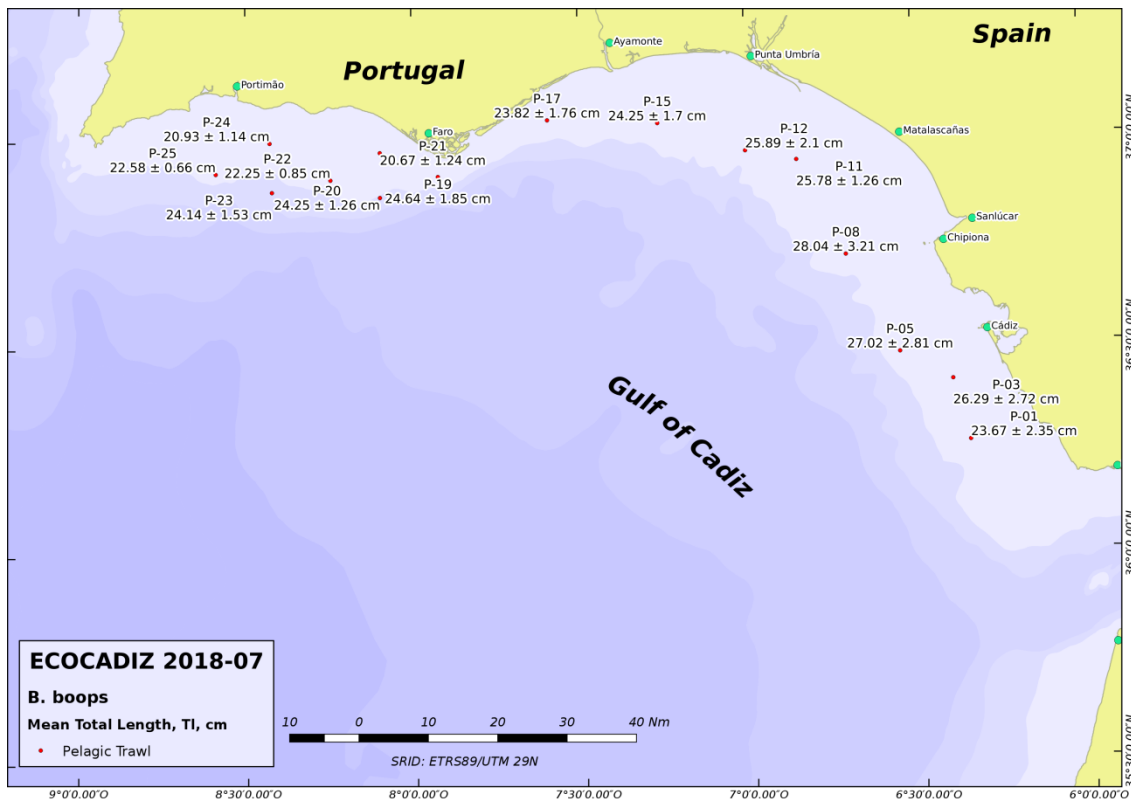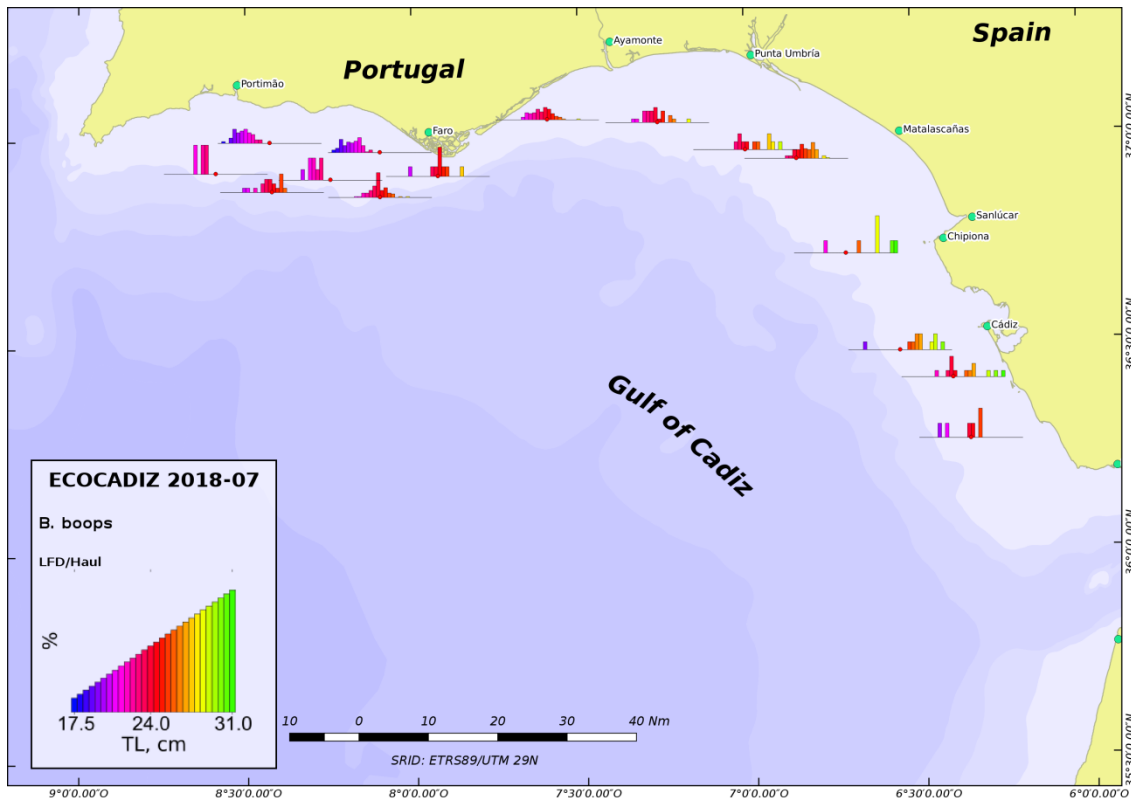
Figure 13. *ECOCADIZ 2018-07* survey. *Boops boops*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
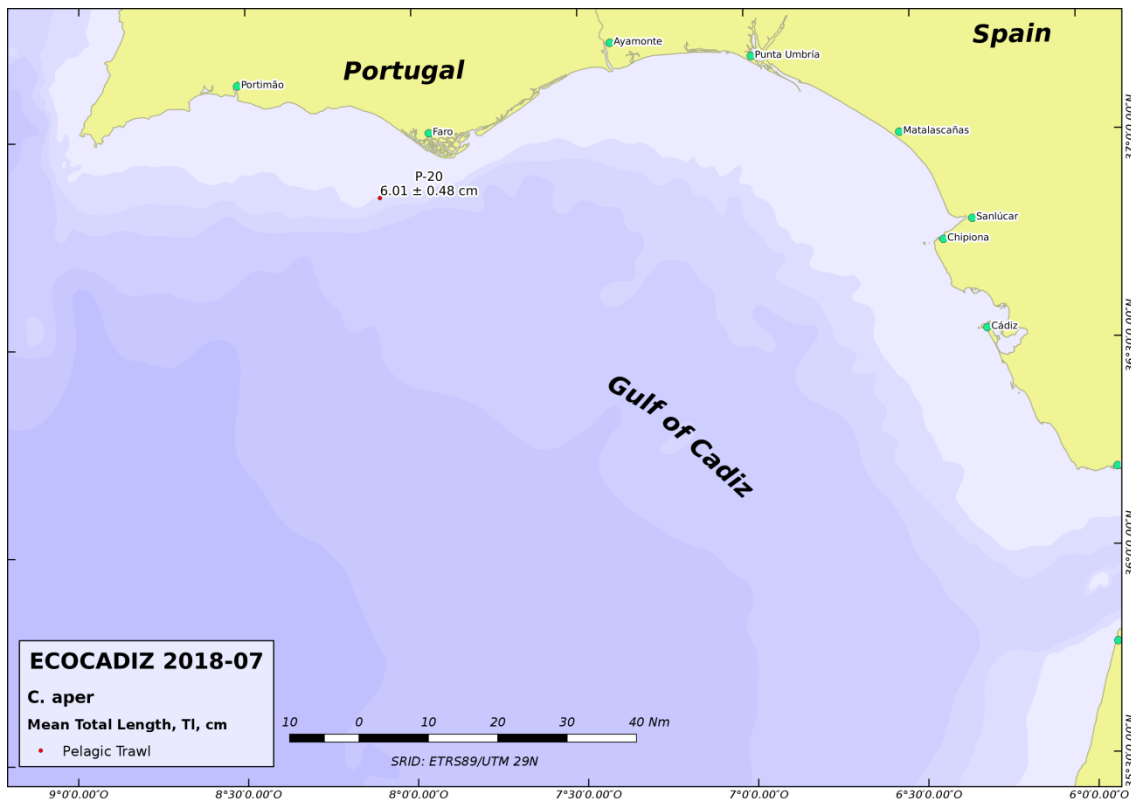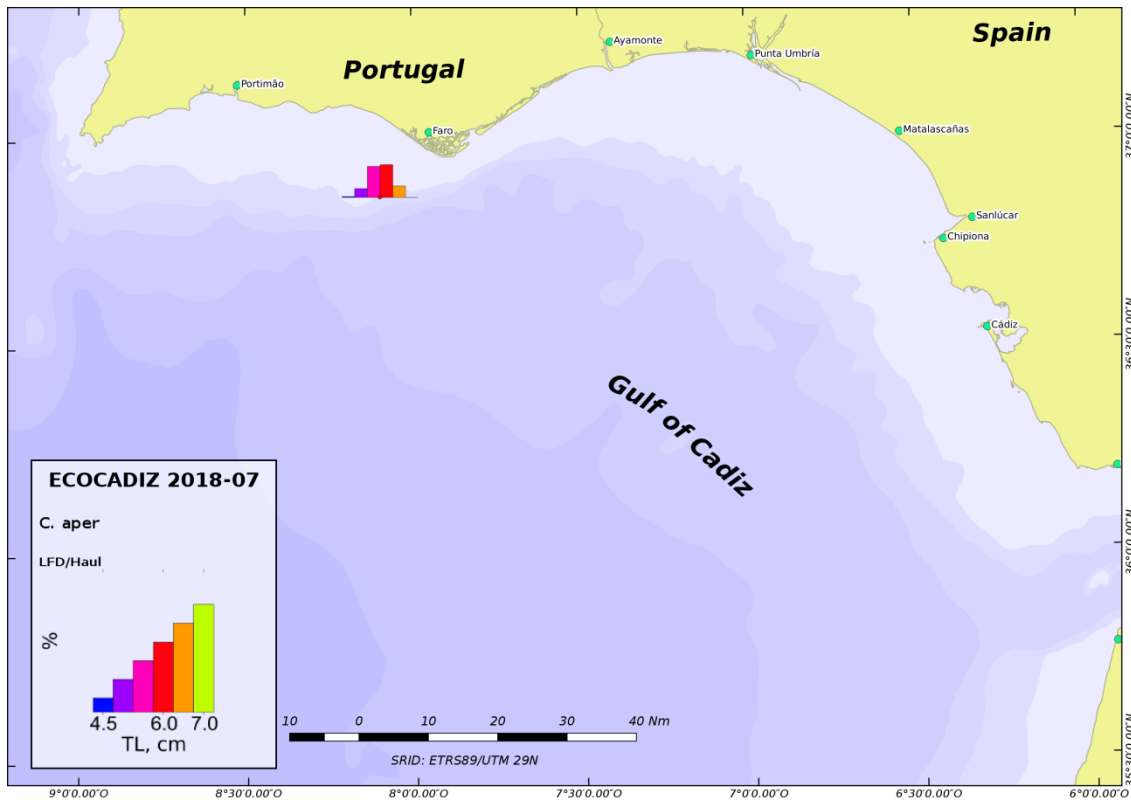
Figure 14. *ECOCADIZ 2017-07* survey. *Capros aper*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
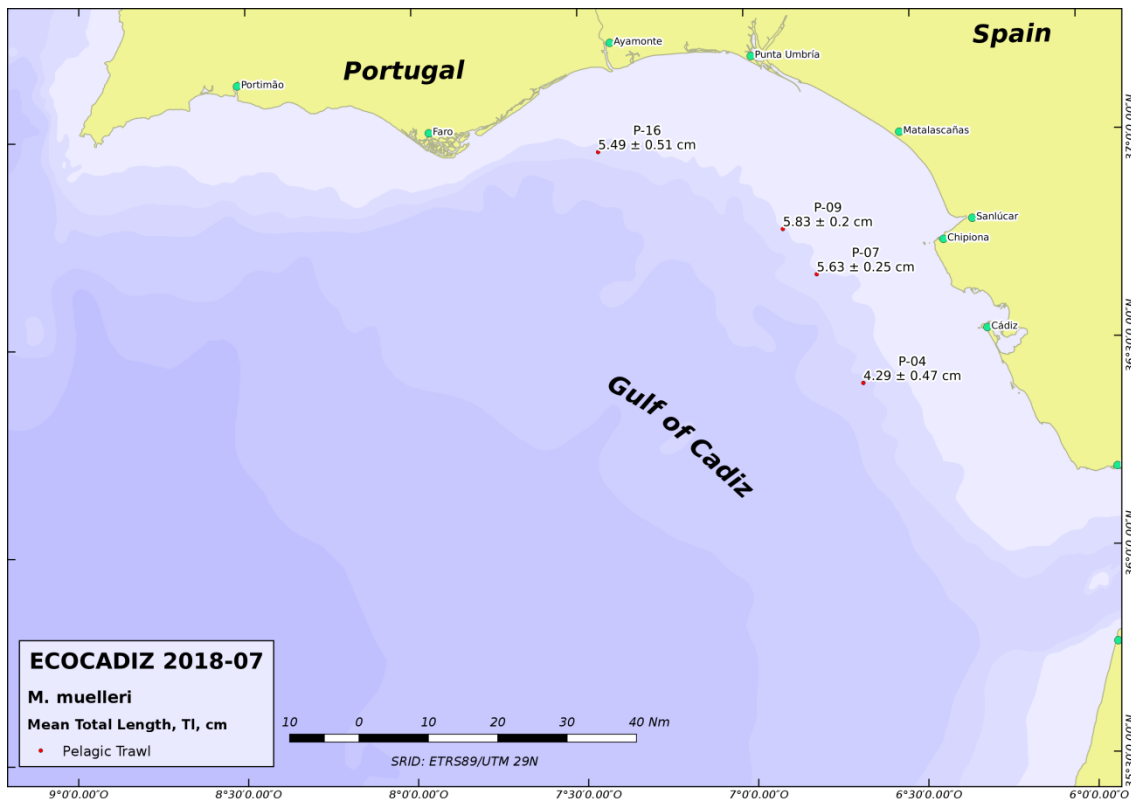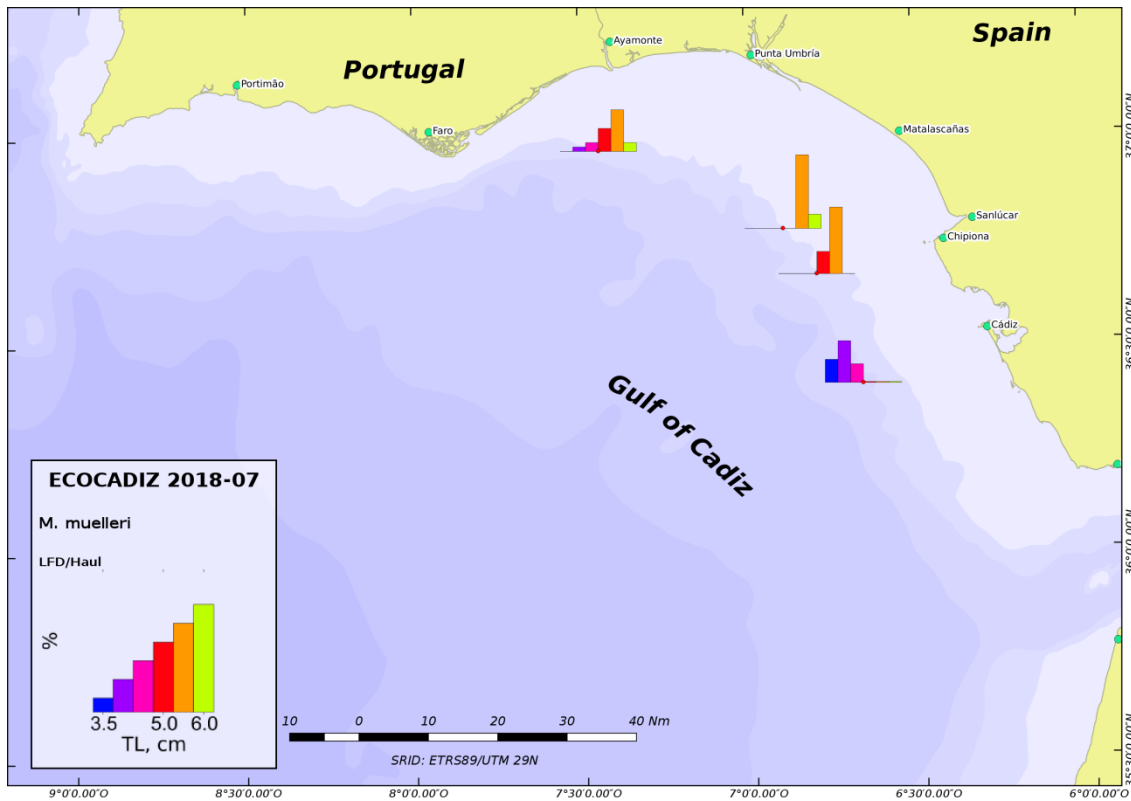
Figure 15. *ECOCADIZ 2017-07* survey. *Maurolicus muelleri*. Top: length frequency distributions in fishing hauls. Bottom: mean ± sd length by haul.
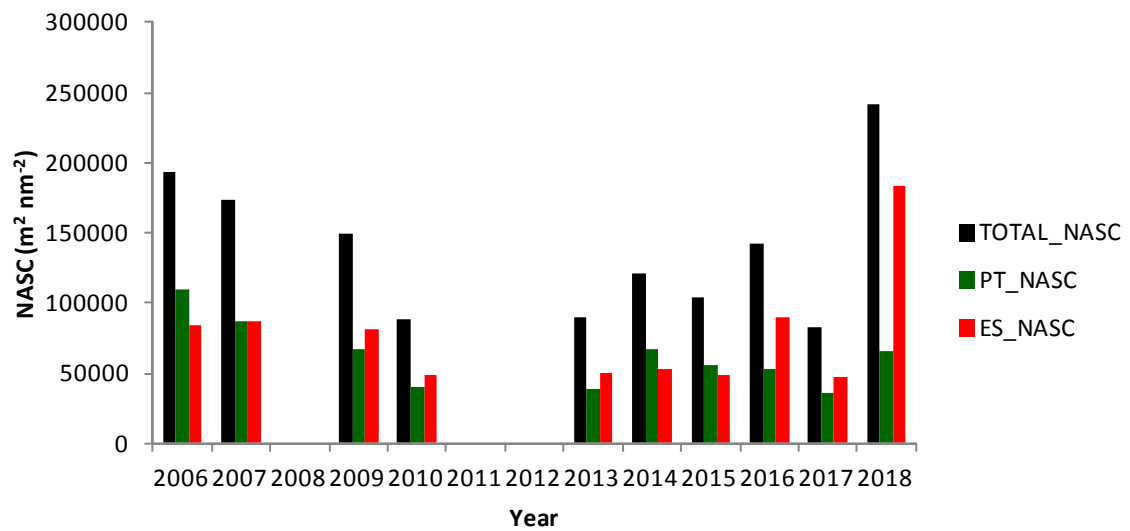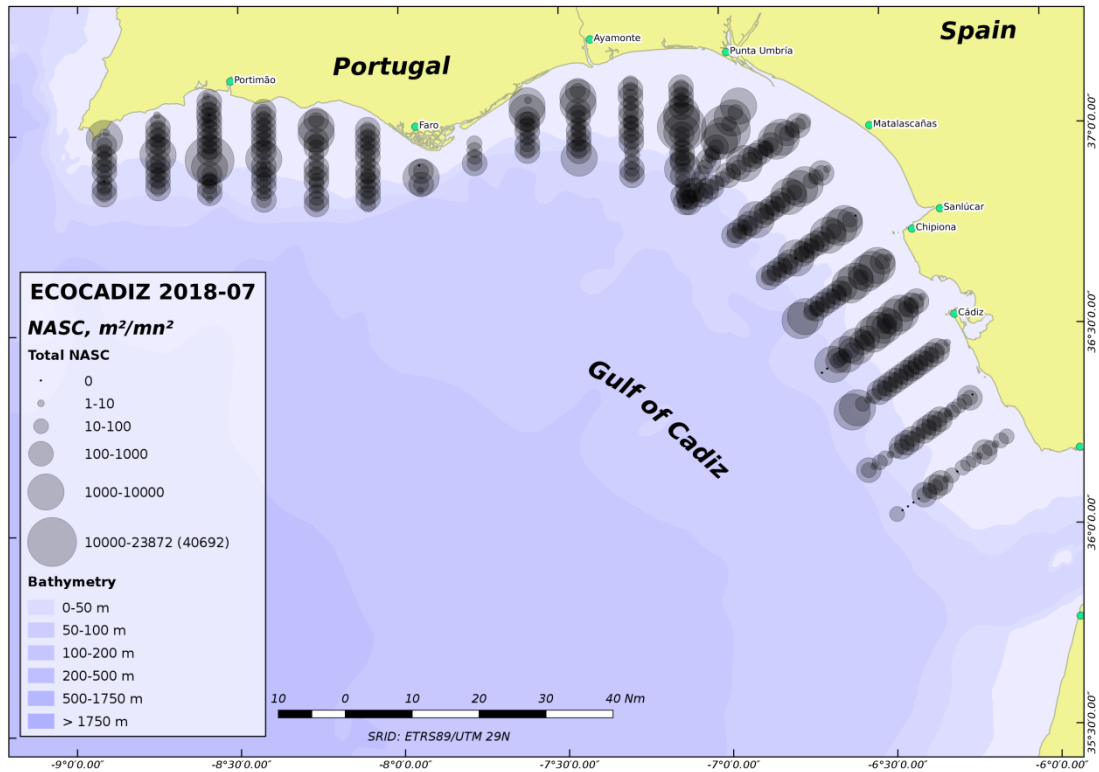
Figure 16. *ECOCADIZ 2018-07* survey. Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the pelagic fish species assemblage. Bottom: time-series of total NASC estimates per survey.
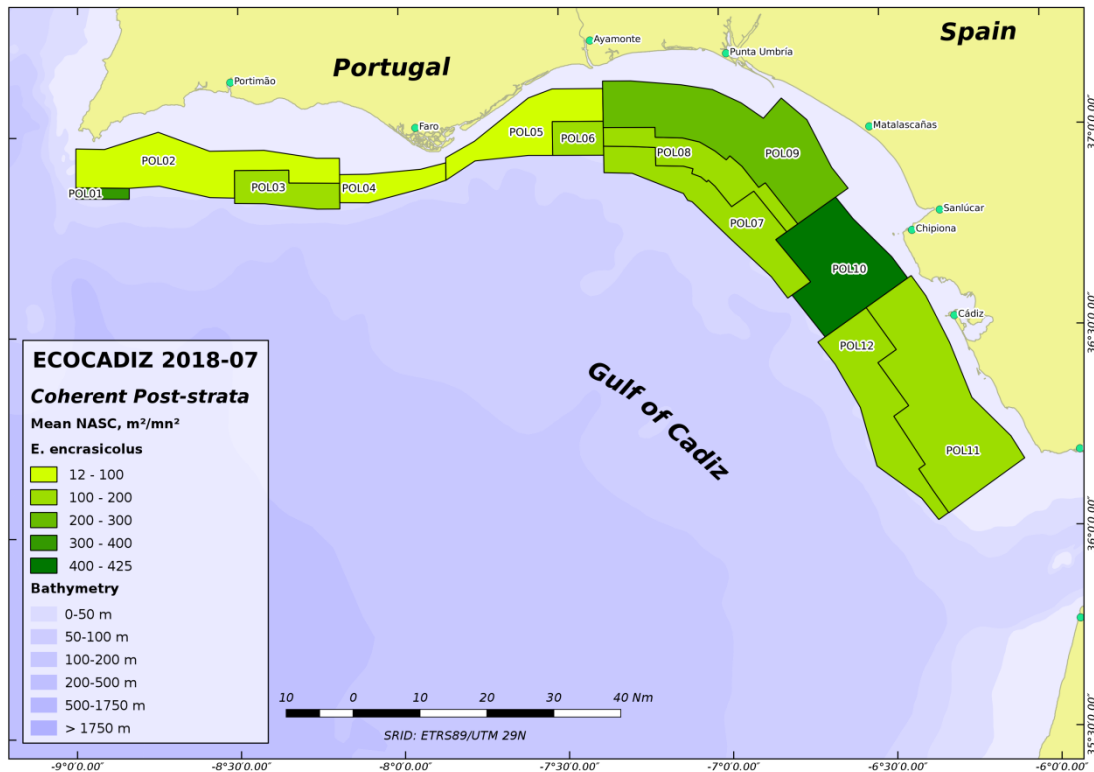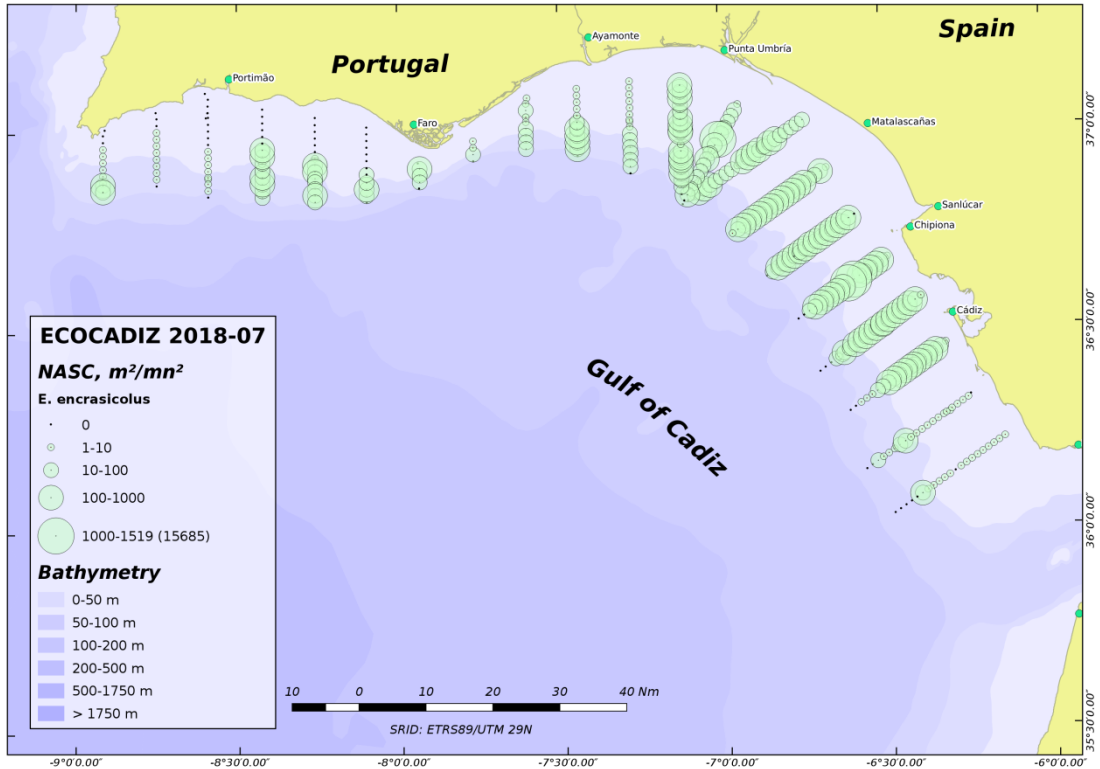
Figure 17. *ECOCADIZ 2018-07* survey. Anchovy (*Engraulis encrasicolus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.

ECOCADIZ 2018-07: Anchovy (*E. encrasicolus*)

Figure 18. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 17**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Anchovy (*E. encrasicolus*)

Figure 18. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Cont'd.

ECOCADIZ 2018-07: Anchovy (*E. encrasicolus*)

POL 01

POL 02

POL 03

POL 04

POL 05

POL 06

Figure 19. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Estimated abundances (number of fish in millions) by age group (years) by homogeneous stratum (POL01-POLn, numeration as in **Figure 17**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by age group for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Anchovy (*E. encrasicolus*)

POL 07

POL 08

POL 09

POL 10

POL 11

POL 12

Figure 19. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Cont'd.

ECOCADIZ 2018-07: Anchovy (*E. encrasicolus*)

9a S (PT)

9a S (ES)

9a S (TOTAL ABUNDANCE)

9a S (TOTAL BIOMASS)

Figure 19. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Cont'd.

ECOCADIZ 2018-07	
CUFES st	151
Positive anchovy st	111 (73.5 %)
Max number eggs by st	485
Total anchovy eggs (in number)	8331
Max density by st (eggs/100 m^3)	40.5
Total density (eggs/100 m^3)	766

Figure 20. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Top: distribution of anchovy egg densities sampled by CUFES (eggs m^{-3}). Bottom: main descriptors of the CUFES sampling. Bottom: historical series of GoC anchovy egg densities as sampled by CUFES.

Anchovy eggs by CUFES
(Gulf of Cadiz)

	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
Tot number	21109	2955	5723	26770	8219	9885	9615	37831	10005	41941	8606	6298	7630	8331
Tot density	2108	257	641	2374	530	901	1176	2565	786	3657	1010	672	656	766

	2004	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017	2018
Spawning area	5934	4962	9064	9879	9172	10152	6678	7251	7922	8535	7906	11855	9634	11498
Surveyed area	10846	10891	12394	14150	12246	11635	8837	11776	11774	14045	11243	13348	14335	15078

Figure 20. *ECOCADIZ 2018-07* survey. Anchovy (*E. encrasicolus*). Cont'd. Top: historical series of GoC anchovy egg total numbers and densities (eggs * m^{-3}) sampled by CUFES. Bottom: historical series of estimates of the extension of the GoC anchovy spawning area (in km^2).
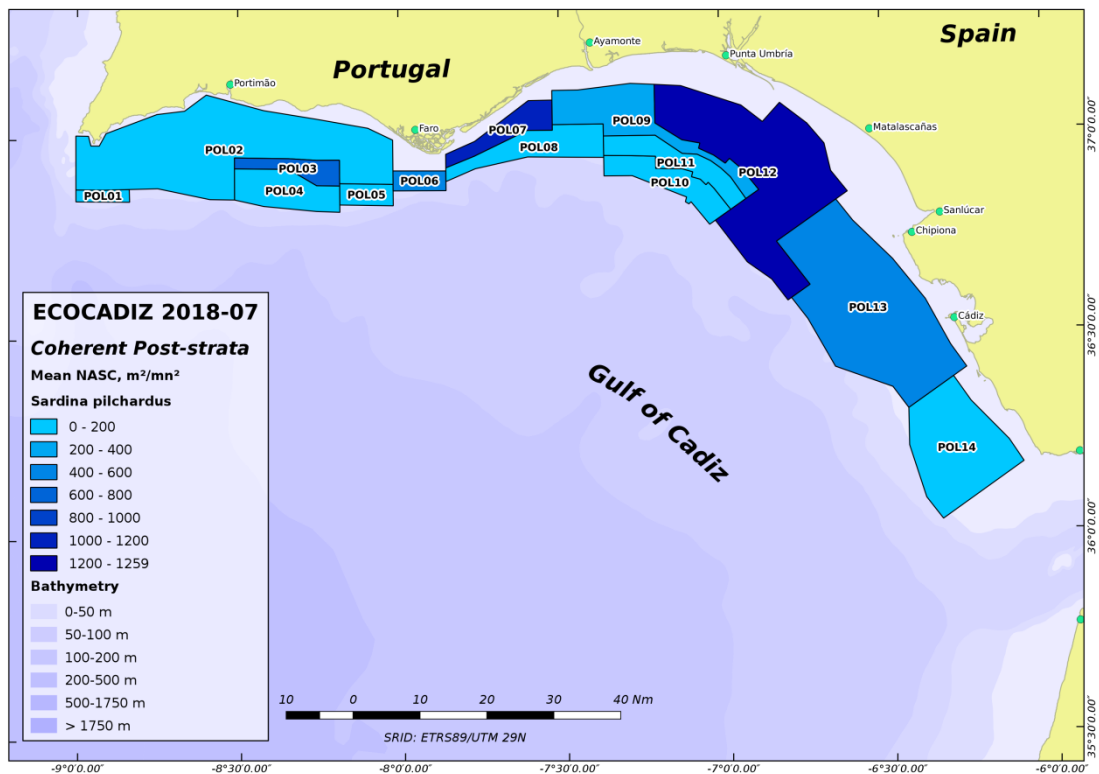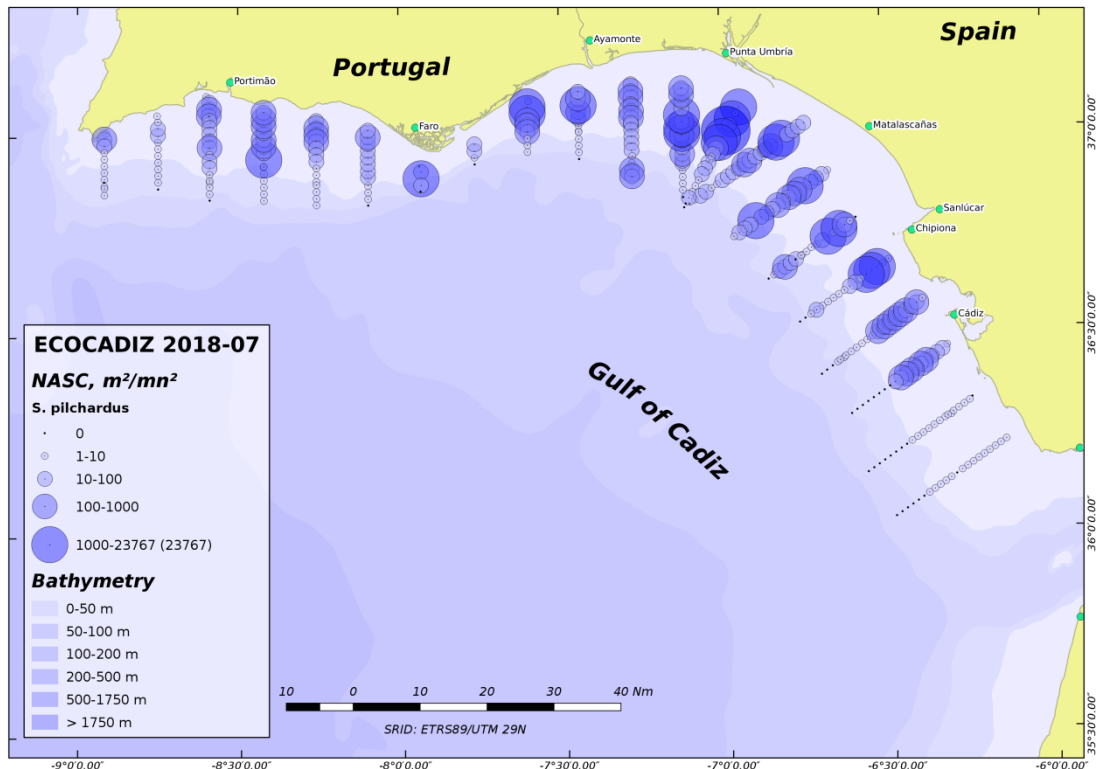
Figure 21. *ECOCADIZ 2018-07* survey. Sardine (*Sardina pilchardus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.
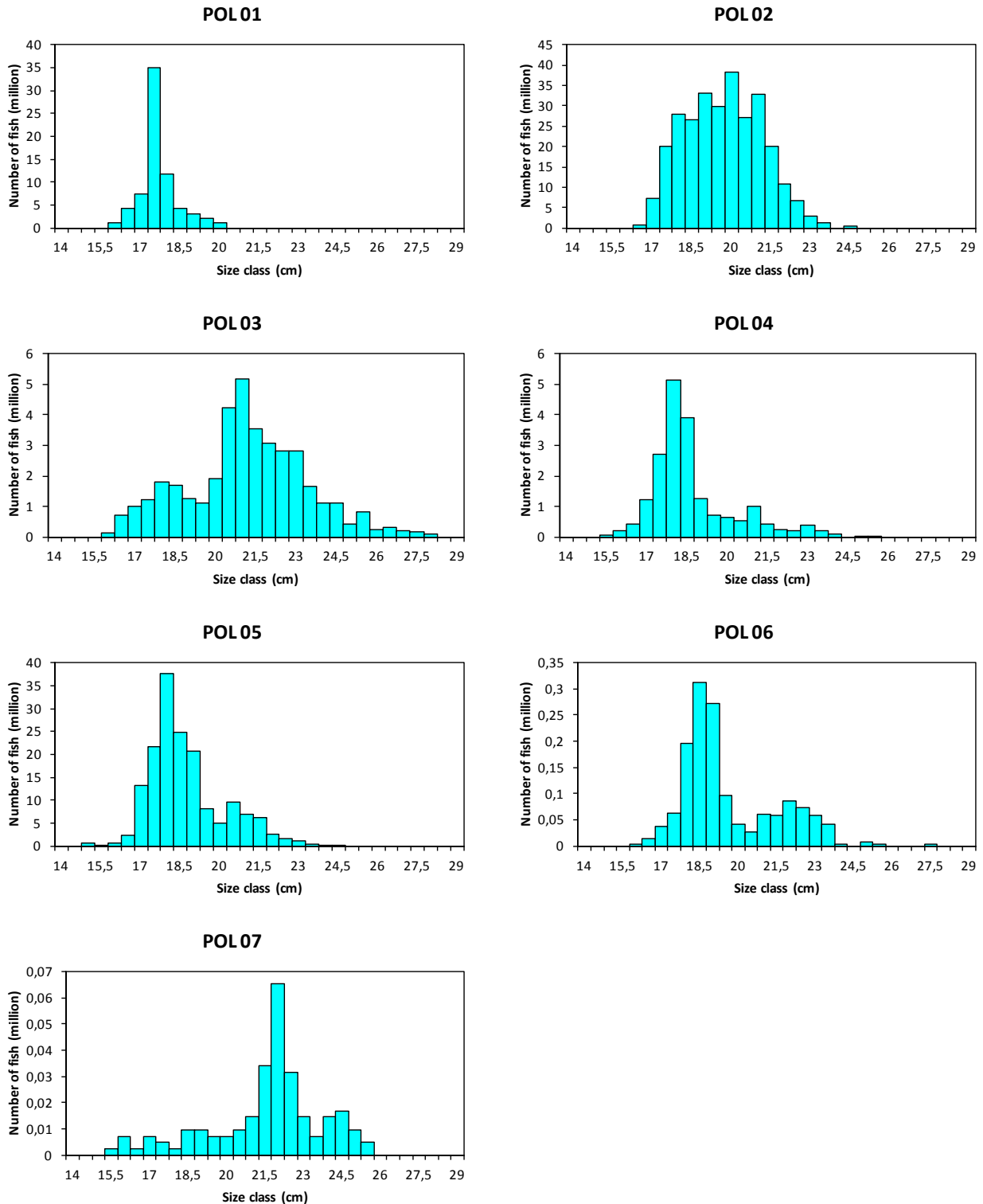
Figure 22. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 21**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Sardine (*S. pilchardus*)

Figure 22. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Cont'd.

Figure 22. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Cont'd.

ECOCADIZ 2018-07: Sardine (*S. pilchardus*)

Figure 23. *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*).. Estimated abundances (number of fish in millions) by age group (years) by homogeneous stratum (POL01-POLn, numeration as in **Figure 21**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by age group for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Sardine (*S. pilchardus*)

**Figure 23.** *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Cont'd.

ECOCADIZ 2018-07: Sardine (*S. pilchardus*)

**Figure 23.** *ECOCADIZ 2018-07* survey. Sardine (*S. pilchardus*). Cont'd.

Figure 24. *ECOCADIZ 2018-07* survey. Mackerel (*Scomber scombrus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.

ECOCADIZ 2018-07: Mackerel (*S. scombrus*)
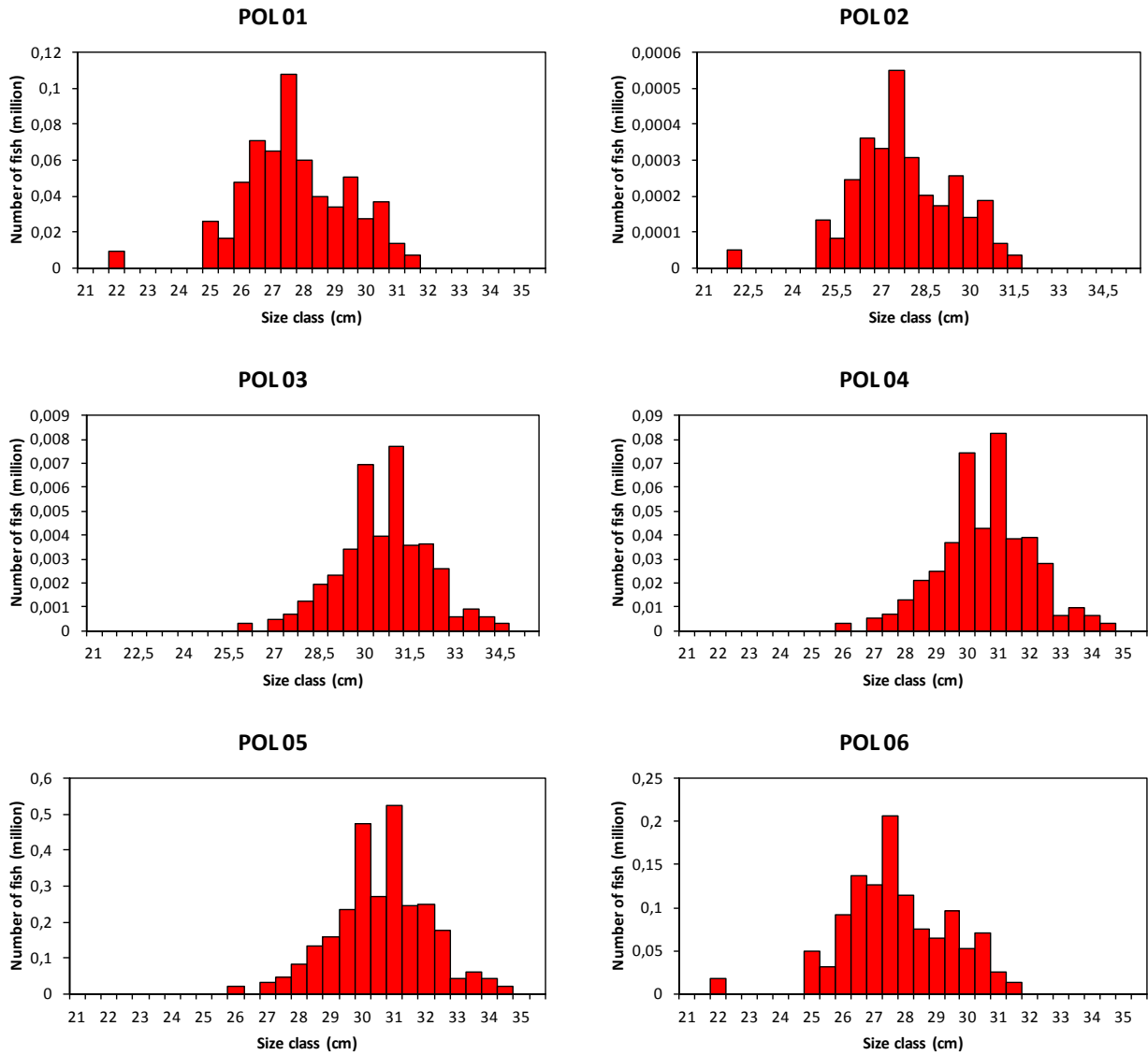
Figure 25. *ECOCADIZ 2018-07* survey. Mackerel (*Scomber scombrus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 24**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Mackerel (*S. scombrus*)

9a S (PT)

9a S (ES)

9a S (TOTAL ABUNDANCE)

9a S (TOTAL BIOMASS)
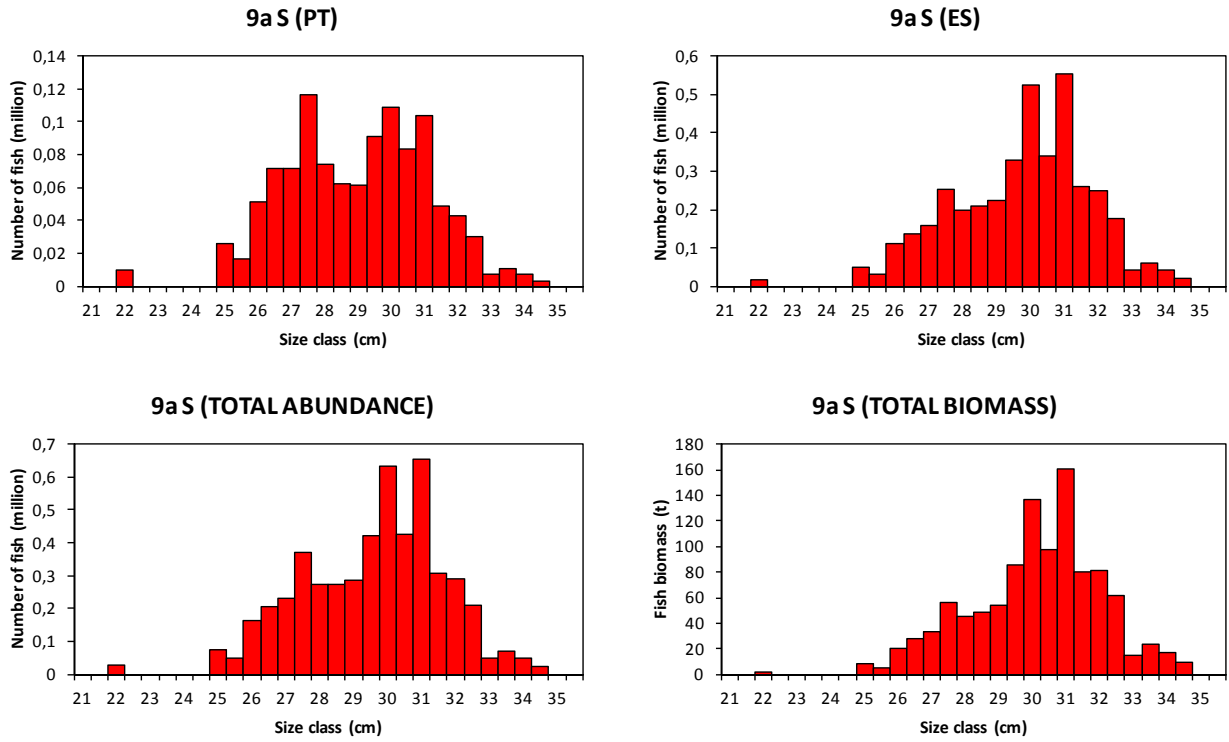
Figure 25. *ECOCADIZ 2018-07* survey. Mackerel (*Scomber scombrus*). Cont'd.

Figure 26. *ECOCADIZ 2018-07* survey. Chub mackerel (*Scomber colias*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.
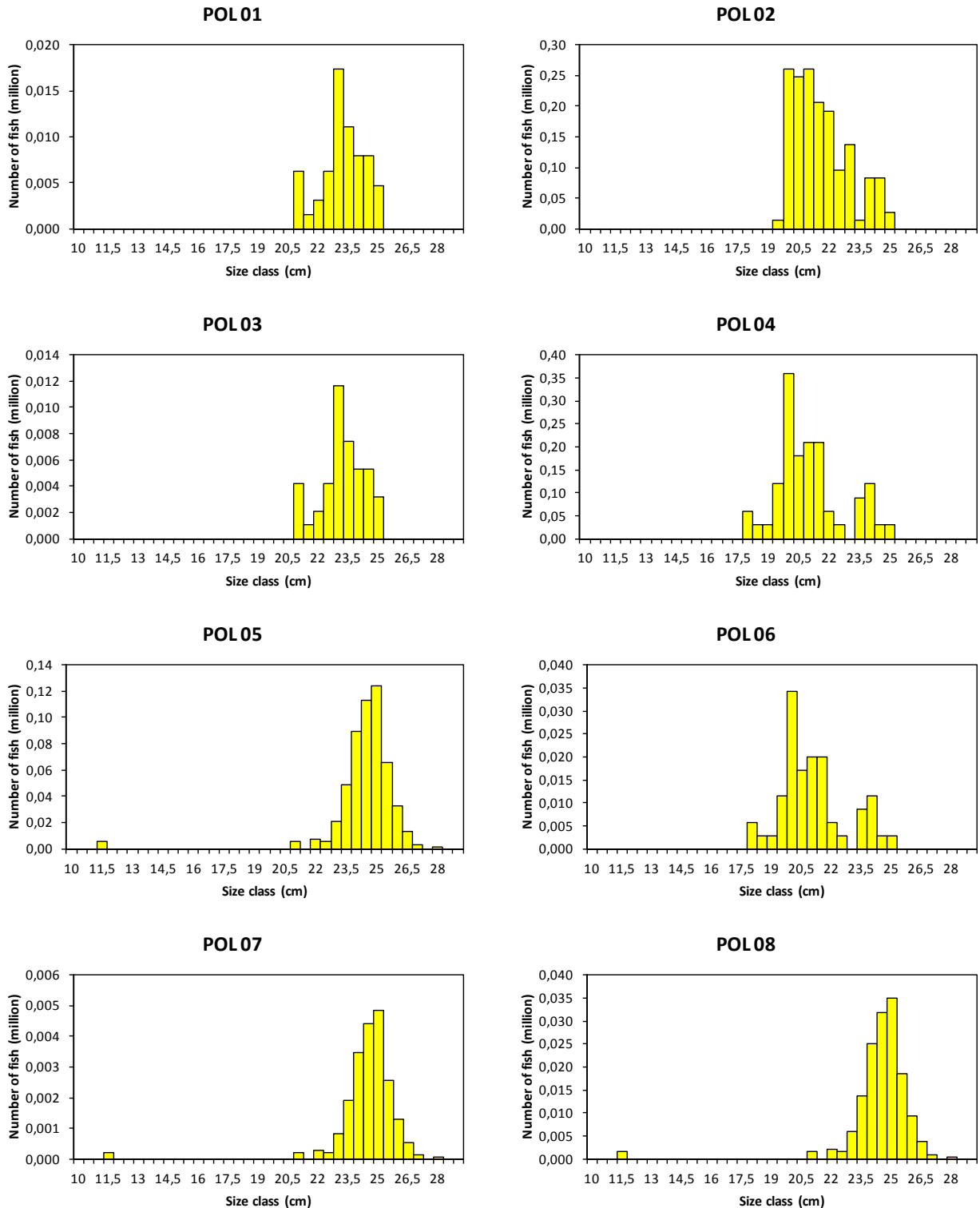
ECOCADIZ 2018-07: Chub mackerel (*S. colias*)

Figure 27. *ECOCADIZ 2018-07* survey. Chub mackerel (*Scomber colias*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 26**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.
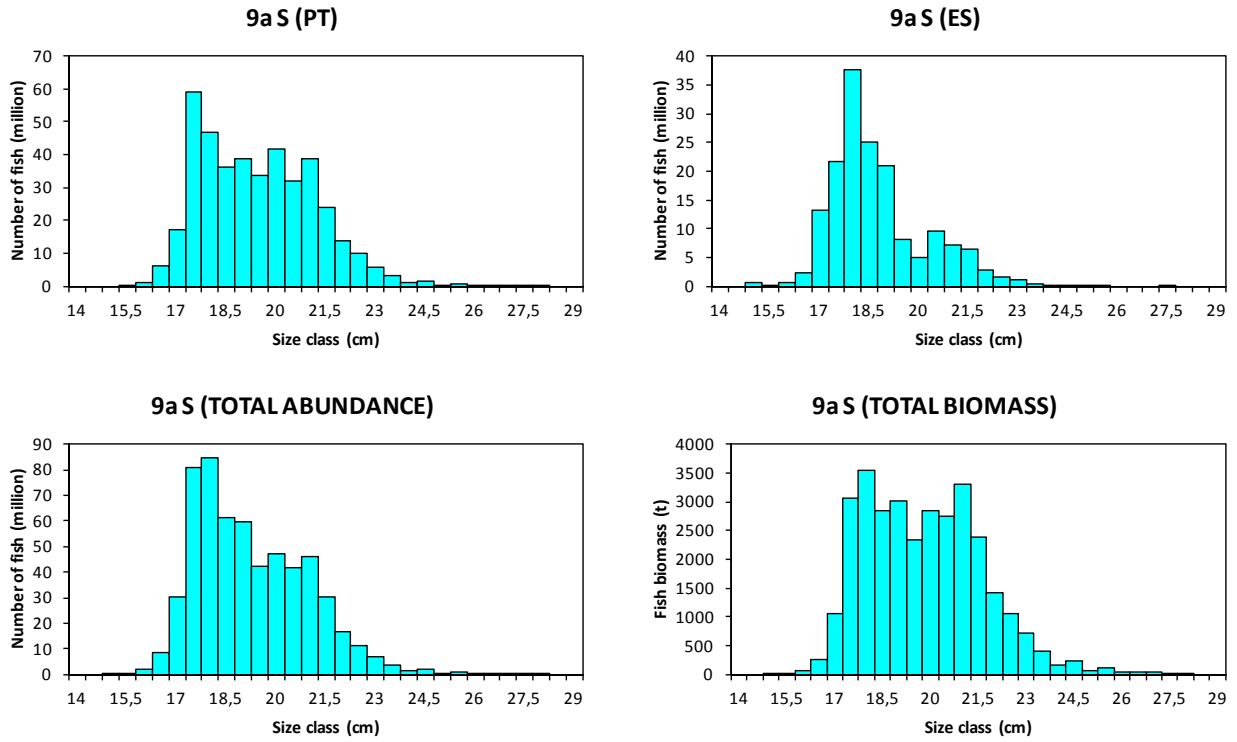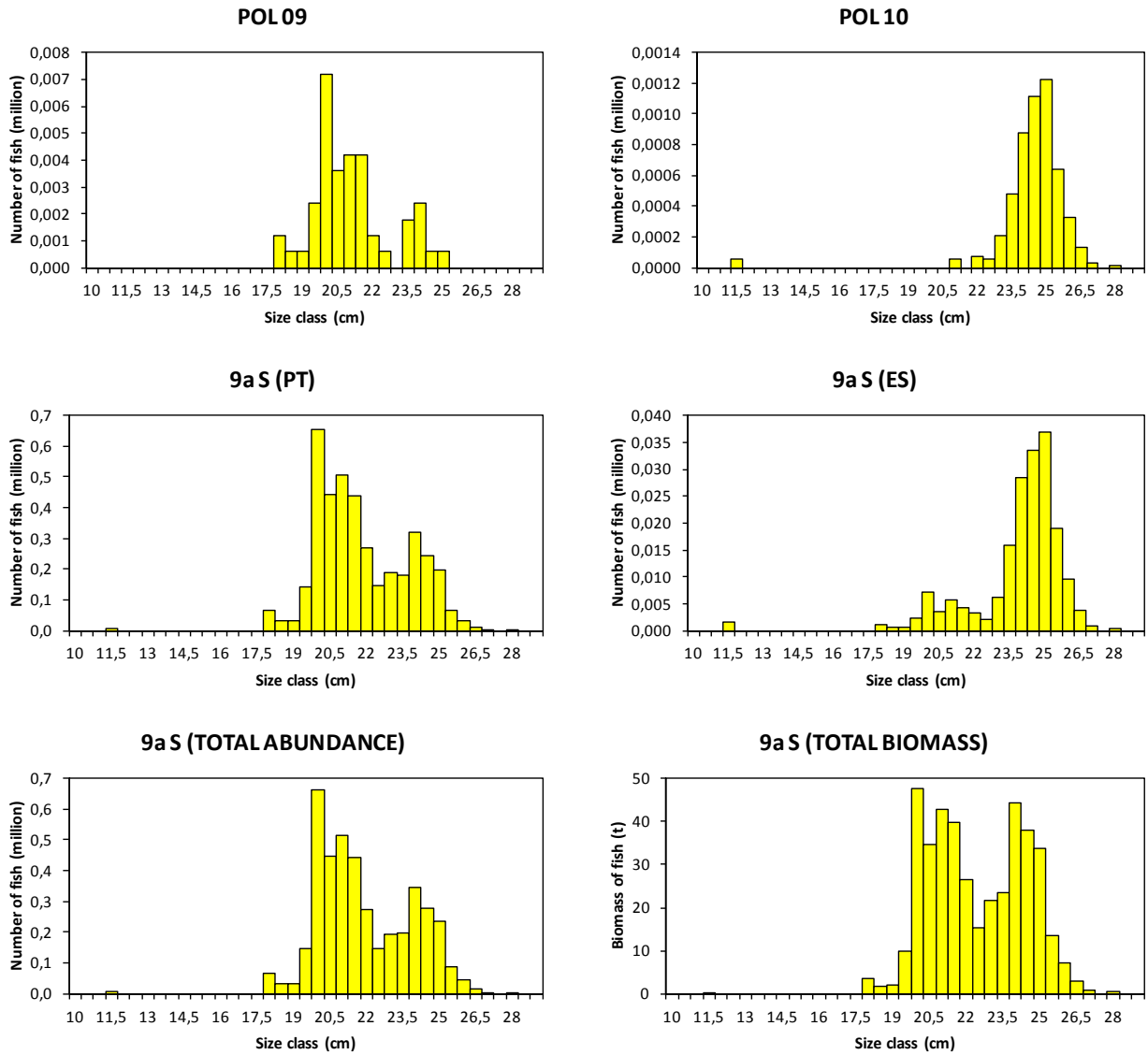
Figure 27. *ECOCADIZ 2018-07* survey. Chub mackerel (*Scomber colias*). Cont'd.
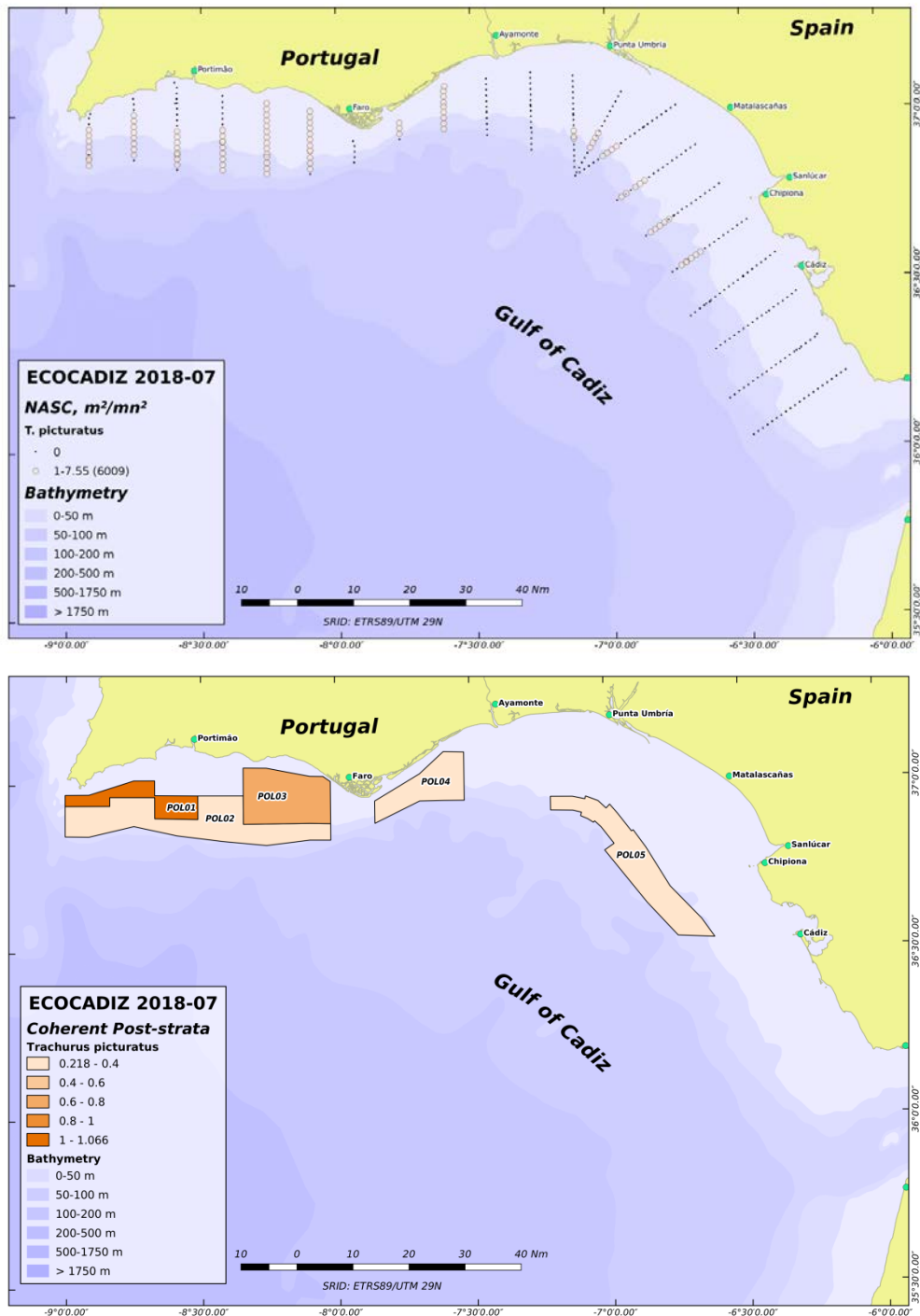
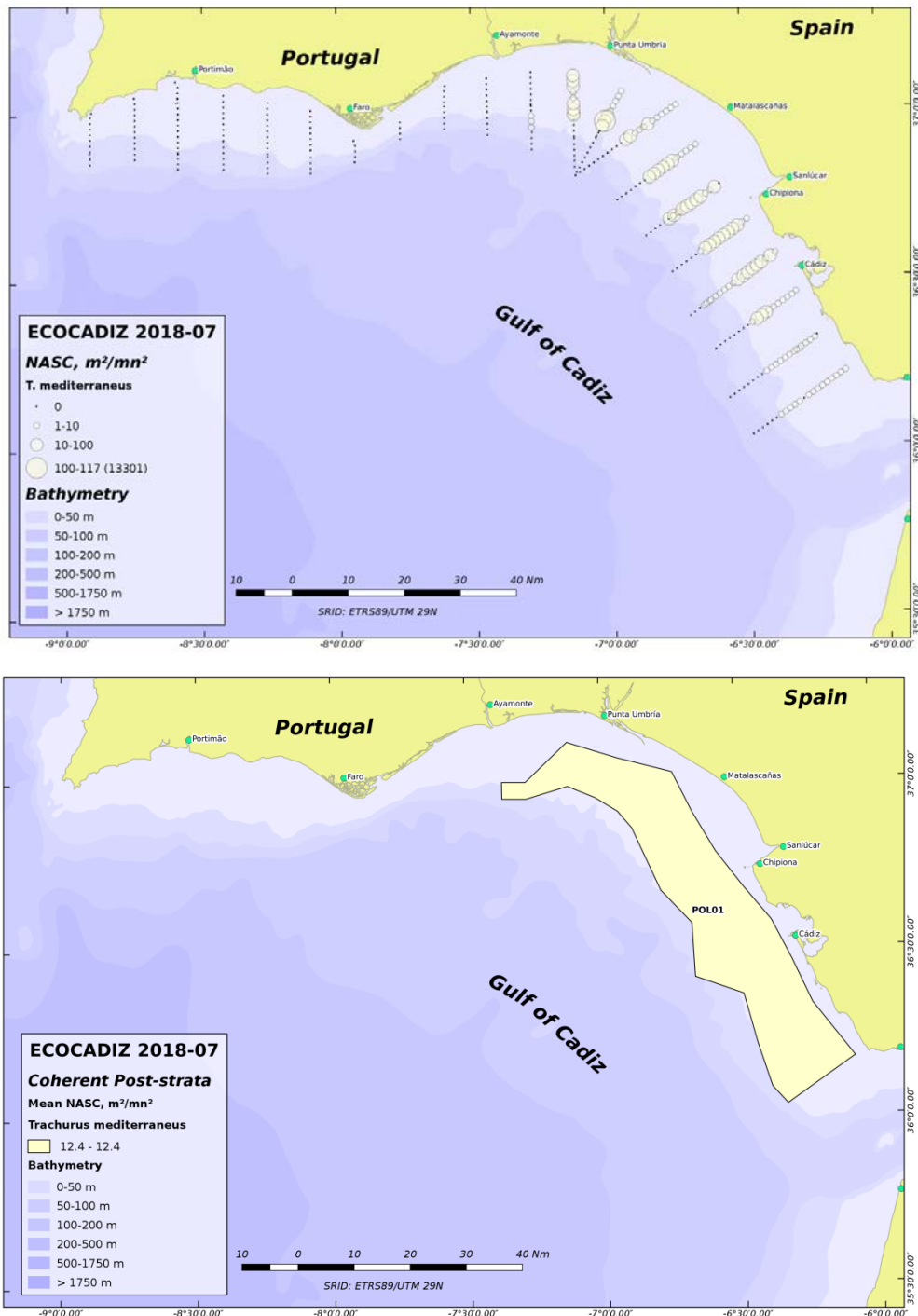**Figure 28.** *ECOCADIZ 2018-07* survey. Blue jack mackerel (*Trachurus picturatus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.
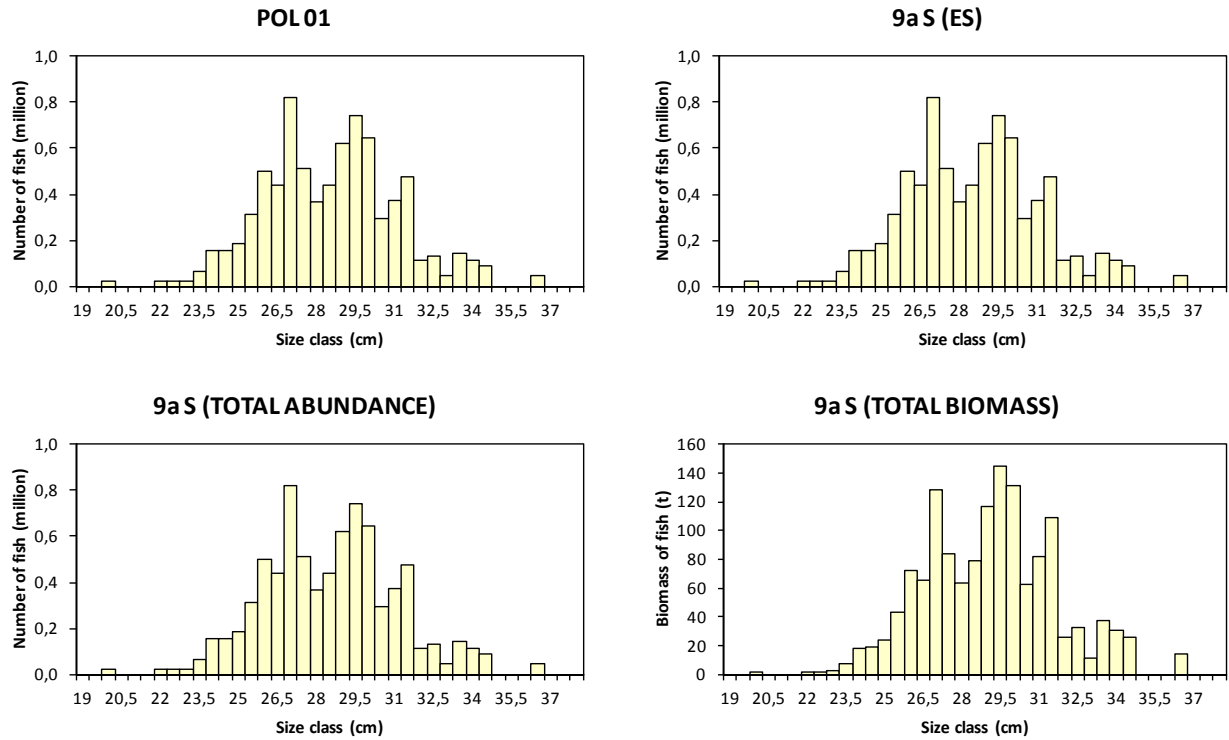
ECOCADIZ 2018-07: Blue jack mackerel (*T. picturatus*)

Figure 29. *ECOCADIZ 2018-07* survey. Blue jack mackerel (*T. picturatus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 28**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Blue jack mackerel (*T. picturatus*)
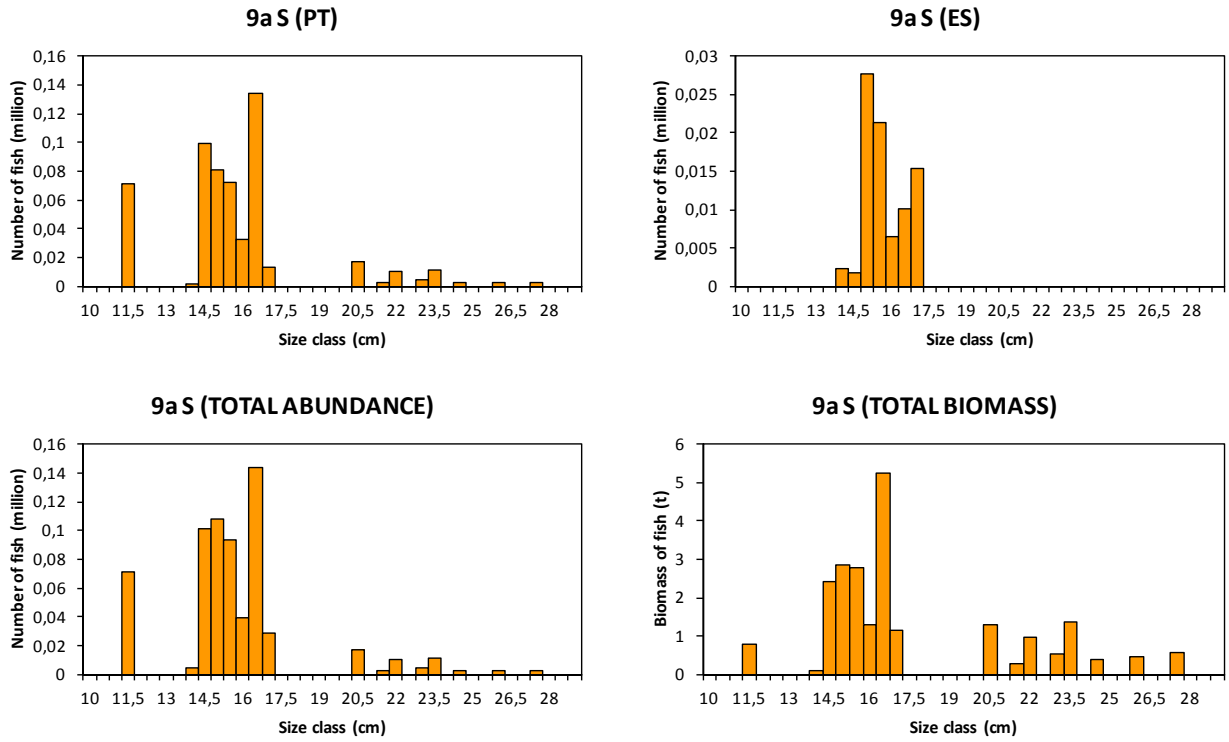
Figure 29. *ECOCADIZ 2018-07* survey. Blue jack mackerel (*T. picturatus*). Cont'd.
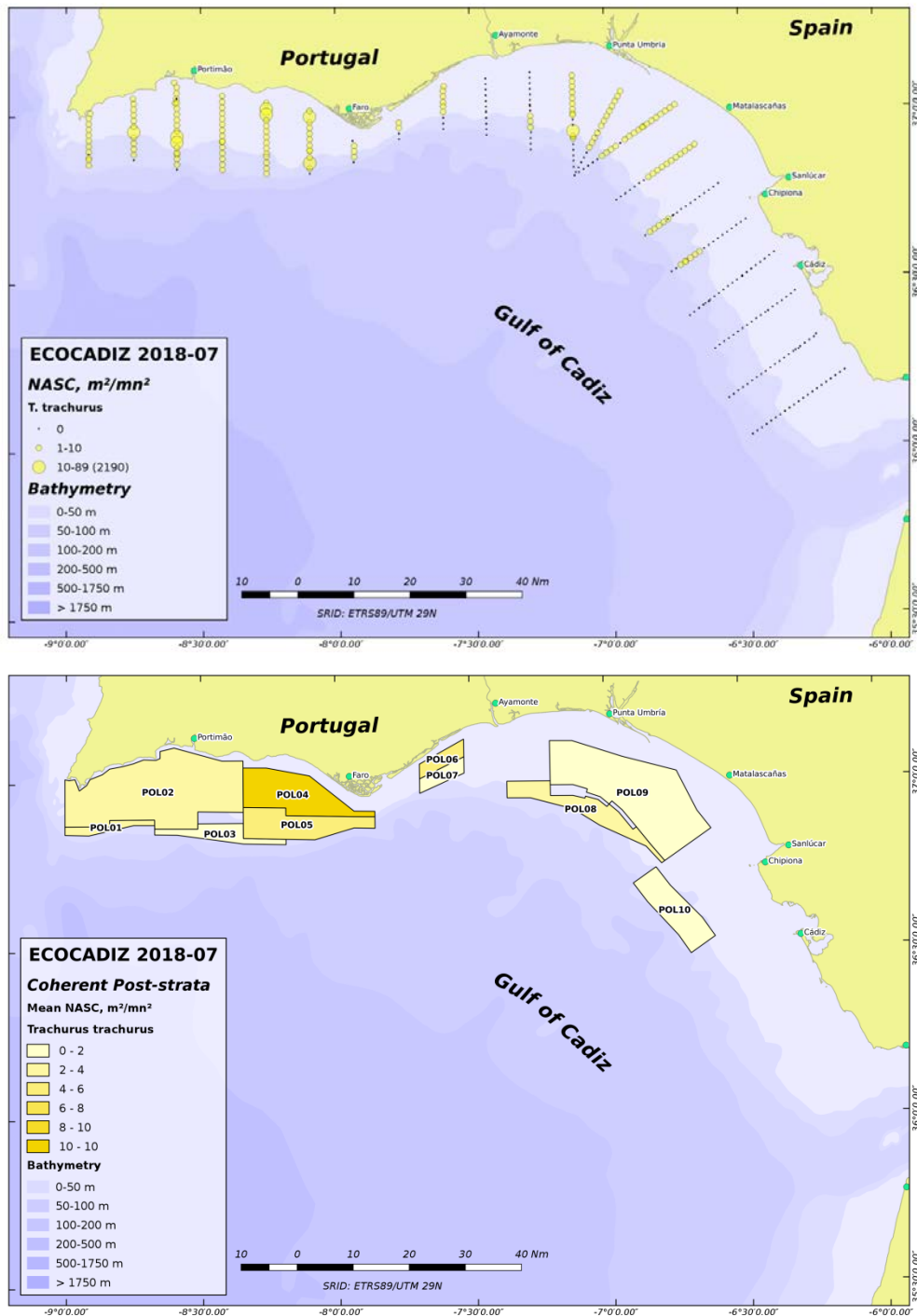
Figure 30. *ECOCADIZ 2018-07* survey. Horse mackerel (*Trachurus trachurus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.

Figure 31. *ECOCADIZ 2018-07* survey. Horse mackerel (*Trachurus trachurus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 30**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

ECOCADIZ 2018-07: Horse mackerel (*T. trachurus*)

Figure 29. *ECOCADIZ 2018-07* survey. Horse mackerel (*Trachurus trachurus*). Cont'd.

Figure 32. *ECOCADIZ 2018-07* survey. Mediterranean horse mackerel (*Trachurus mediterraneus*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.

ECOCADIZ 2018-07: Mediterranean horse mackerel (*T. mediterraneus*)

Figure 33. *ECOCADIZ 2018-07* survey. Mediterranean horse mackerel (*Trachurus mediterraneus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 32**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.
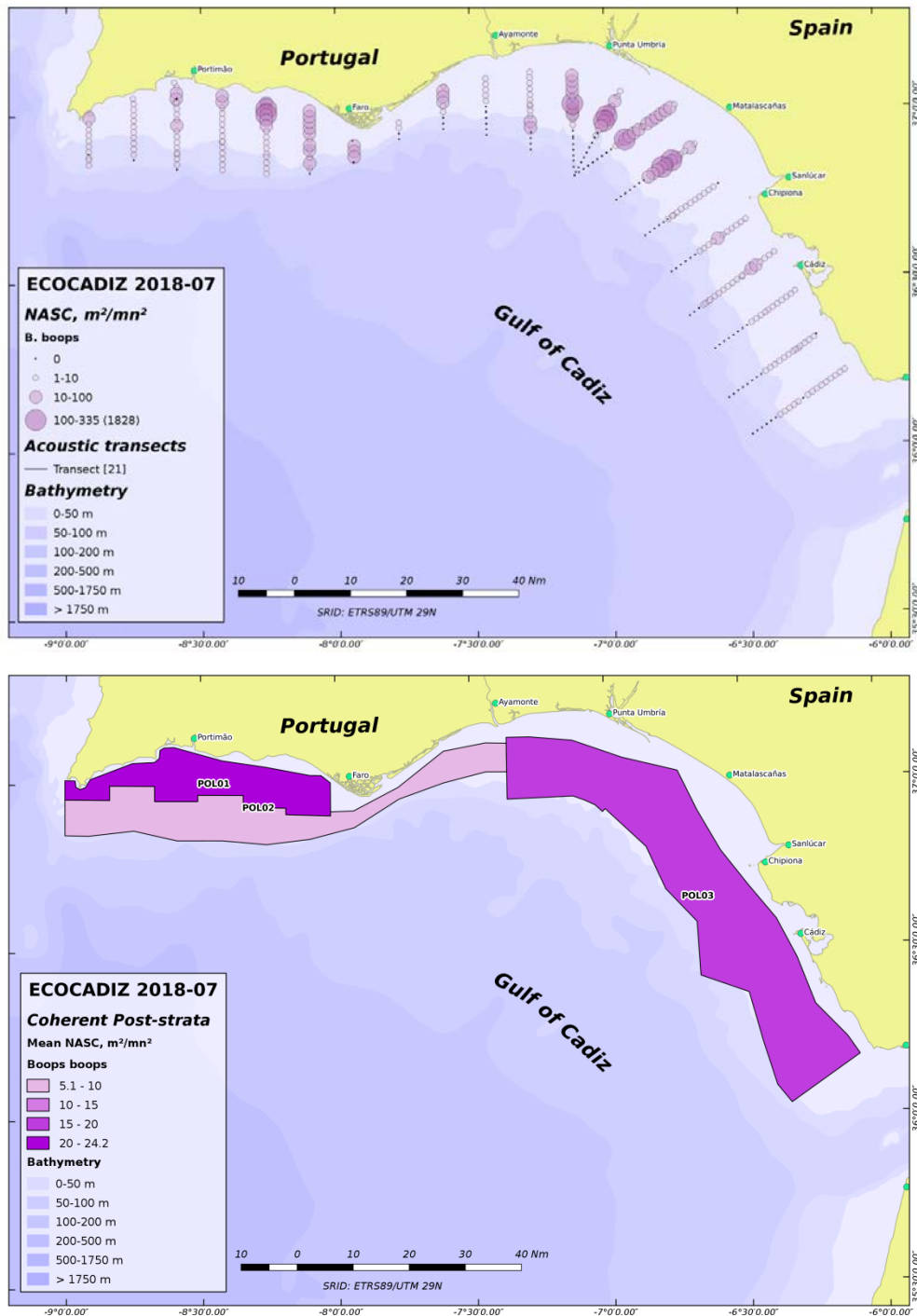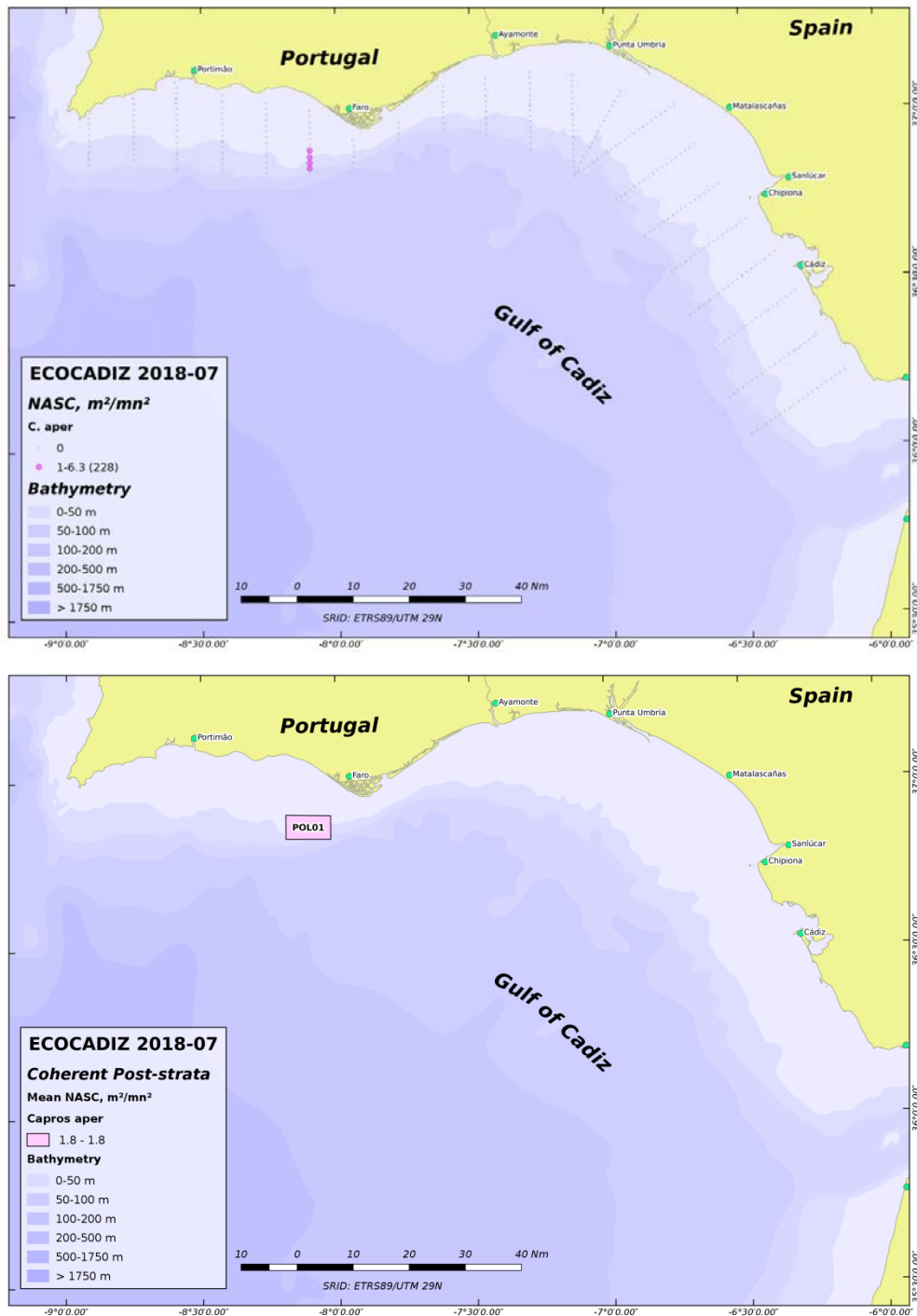
Figure 34. *ECOCADIZ 2018-07* survey. Bogue (*Boops boops*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.
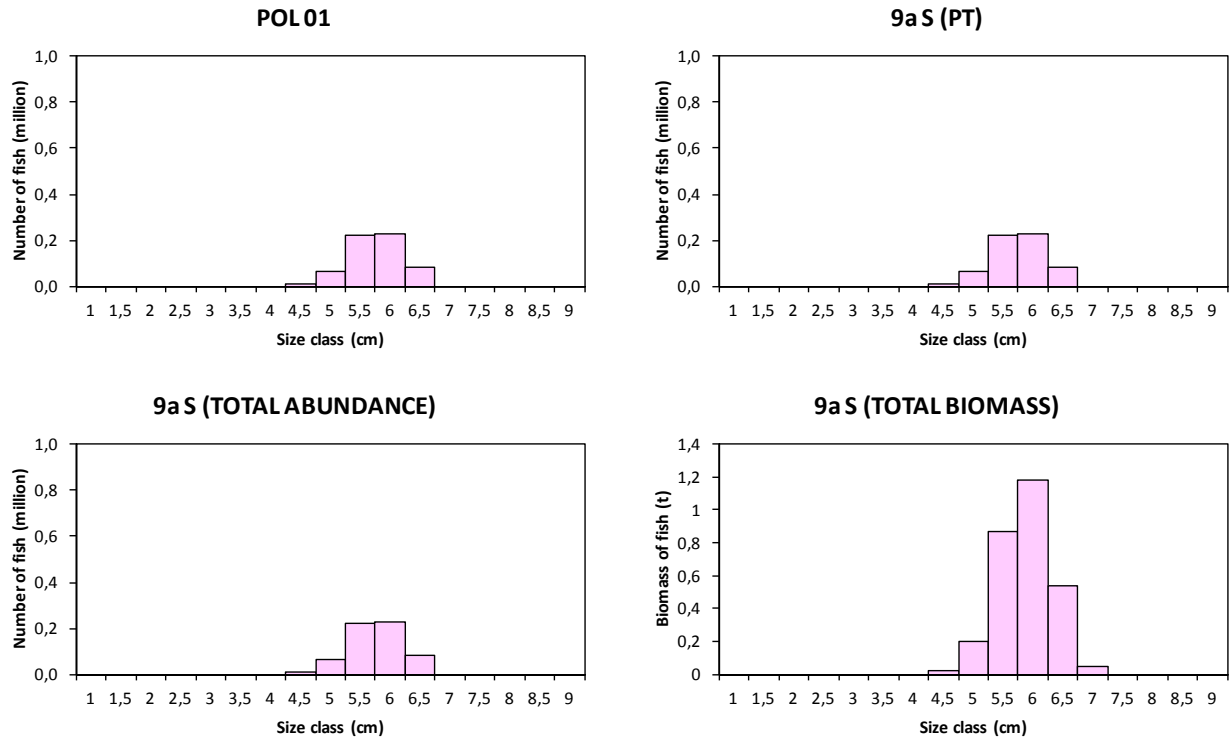
ECOCADIZ 2018-07: Bogue (*B. boops*)
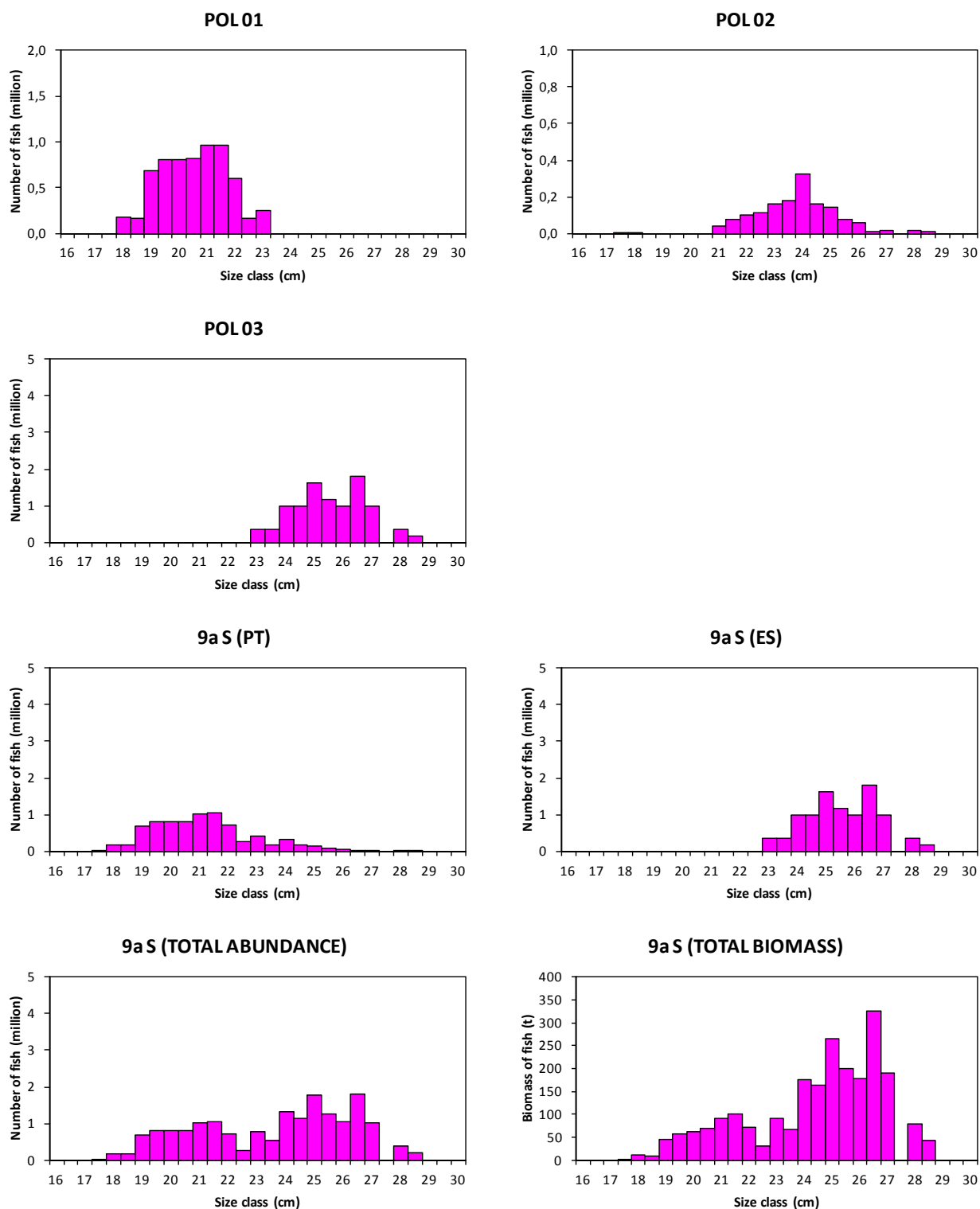
Figure 35. *ECOCADIZ 2018-07* survey. Bogue (*Boops boops*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 34**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.
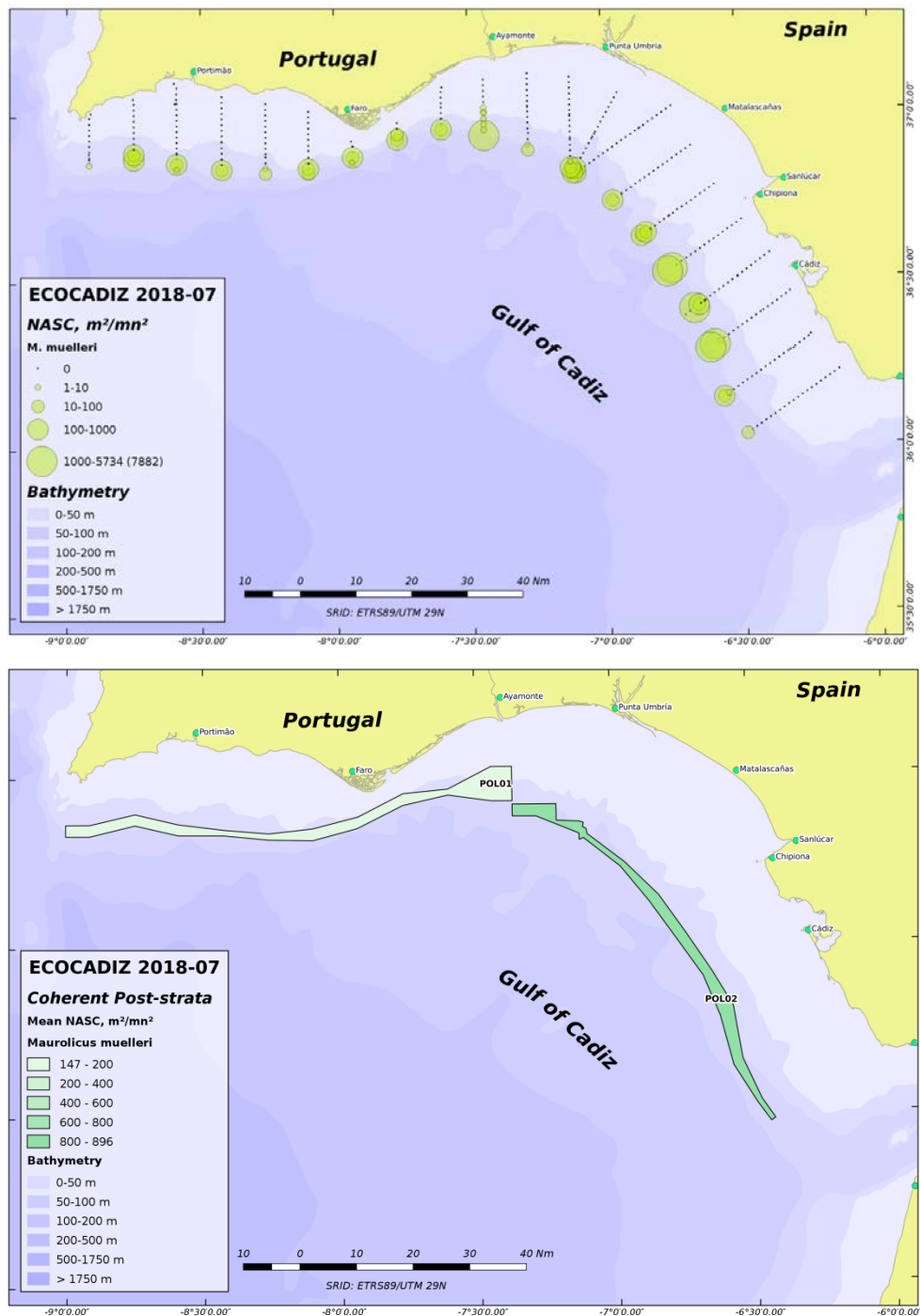
Figure 36. *ECOCADIZ 2018-07* survey. Boarfish (*Capros aper*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.

ECOCADIZ 2018-07: Boarfish (*C. aper*).

Figure 37. *ECOCADIZ 2018-07* survey. Boarfish (*Capros aper*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 36**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

Figure 38. *ECOCADIZ 2018-07* survey. Pearlside (*Maurolicus muelleri*). Top: distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species Bottom: distribution of homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of the backscattering energy attributed to the species in each stratum.
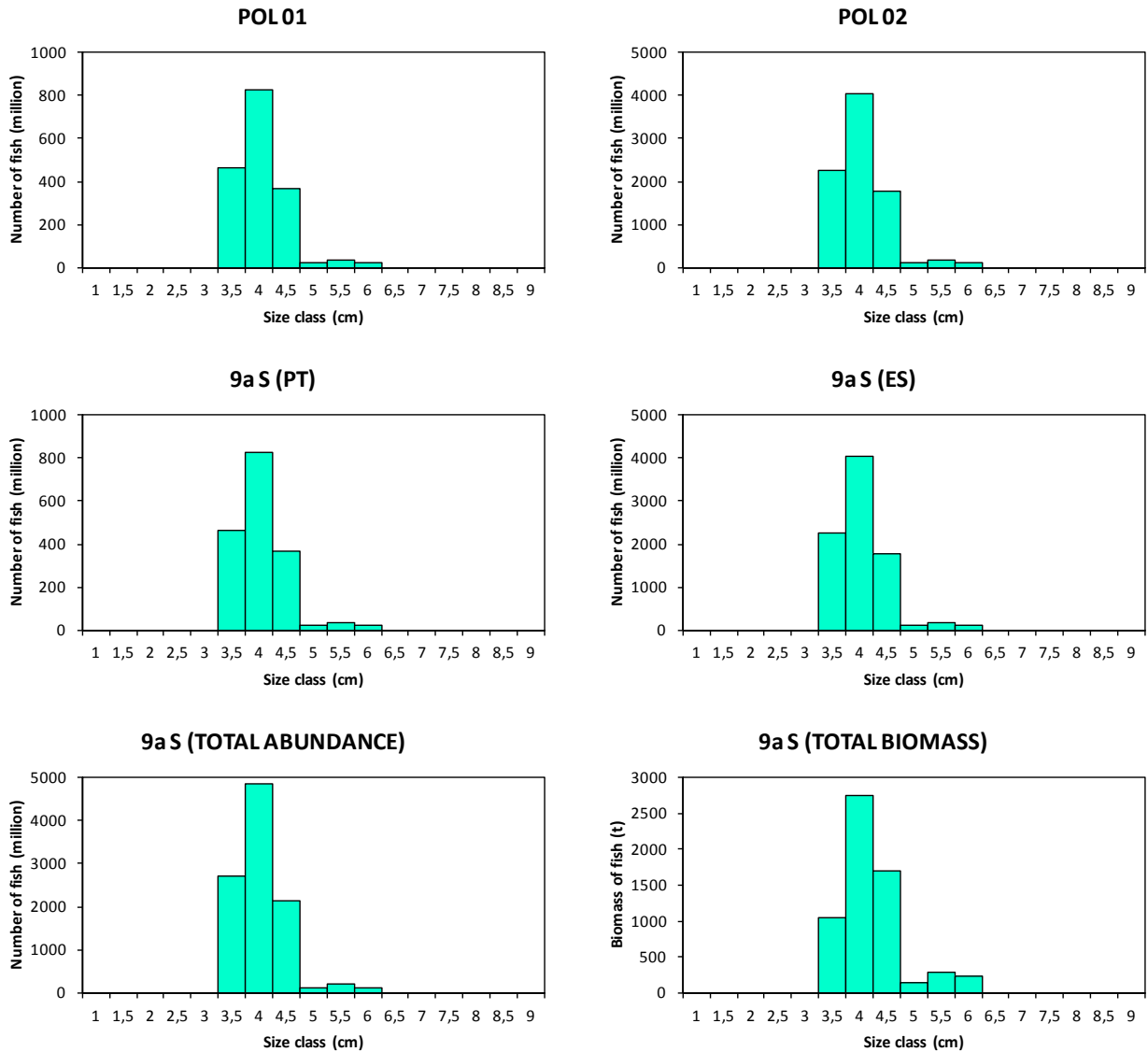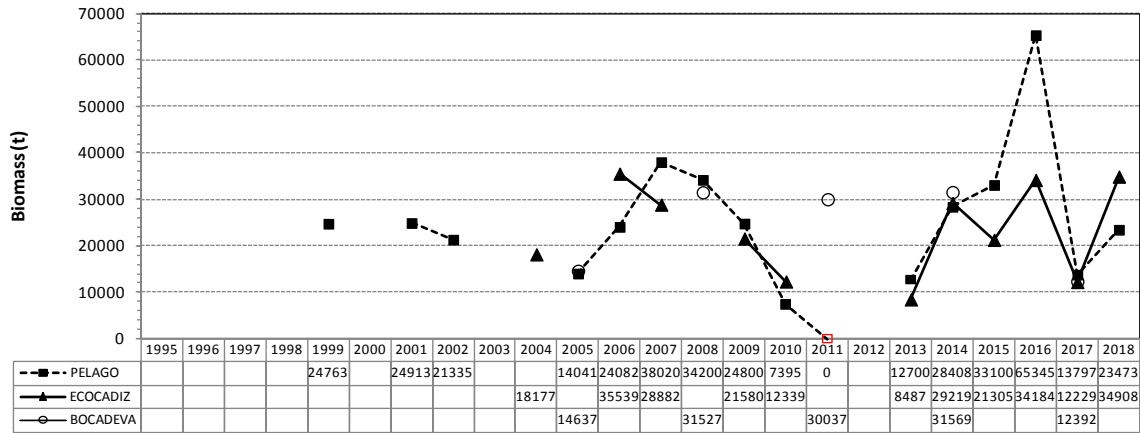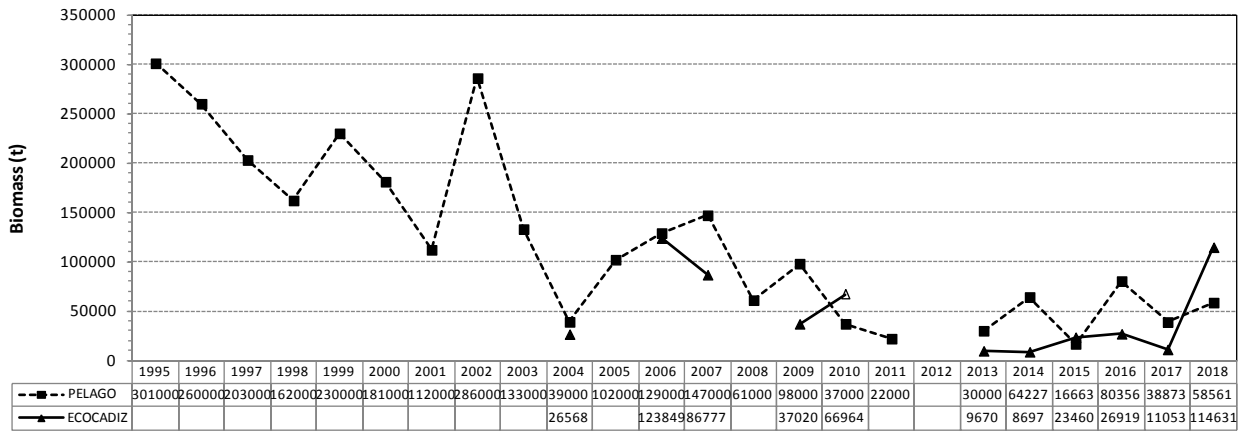
Figure 39. *ECOCADIZ 2018-07* survey. Pearlside (*Maurolicus muelleri*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in **Figure 38**) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

Biomass trends (in tons)

Anchovy biomass estimates

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PELAGO					24763		24913	21335			14041	24082	38020	34200	24800	7395	0		12700	28408	33100	65345	13797	23473
ECOCADIZ										18177		35539	28882		21580	12339			8487	29219	21305	34184	12229	34908
BOCADEVA											14637			31527			30037			31569			12392	

Sardine biomass estimates

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PELAGO	301000	260000	203000	162000	230000	181000	112000	286000	133000	39000	102000	129000	147000	61000	98000	37000	22000		30000	64227	16663	80356	38873	58561
ECOCADIZ										26568		12384	86777		37020	66964			9670	8697	23460	26919	11053	114631

Chub mackerel biomass estimates

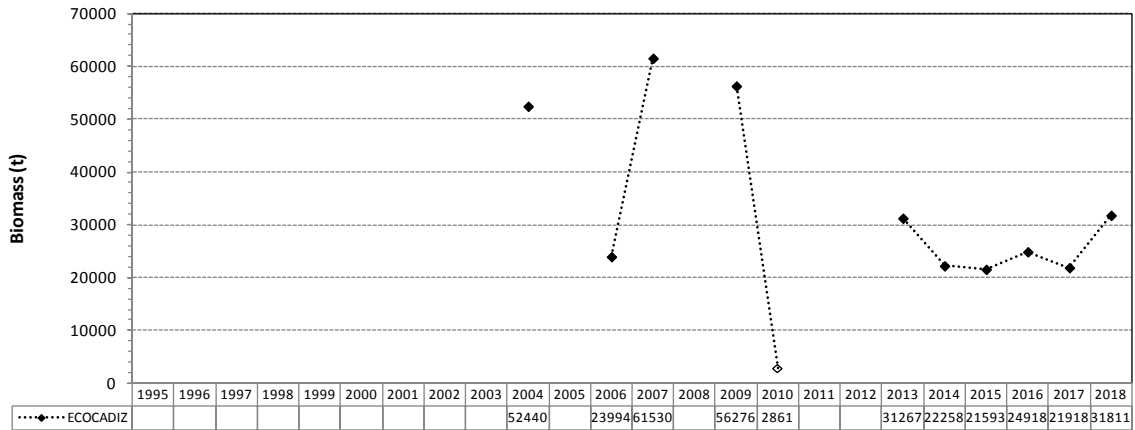|	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ECOCADIZ										52440		23994	61530		56276	2861			31267	22258	21593	24918	21918	31811

Figure 40. Trends in biomass estimates (in tons) for the main assessed species in Portuguese (*PELAGO*) and Spanish (*ECOCADIZ* and *BOCADEVA*) survey series. Note that the *ECOCADIZ* survey in 2010 partially covered the whole study area. The anchovy null estimate in 2011 from the *PELAGO* survey should be considered with caution.

ANNEX
(Figures of echograms showing dense sardine schools in shallow waters. EK60 echo-sounder. 38 kHz).
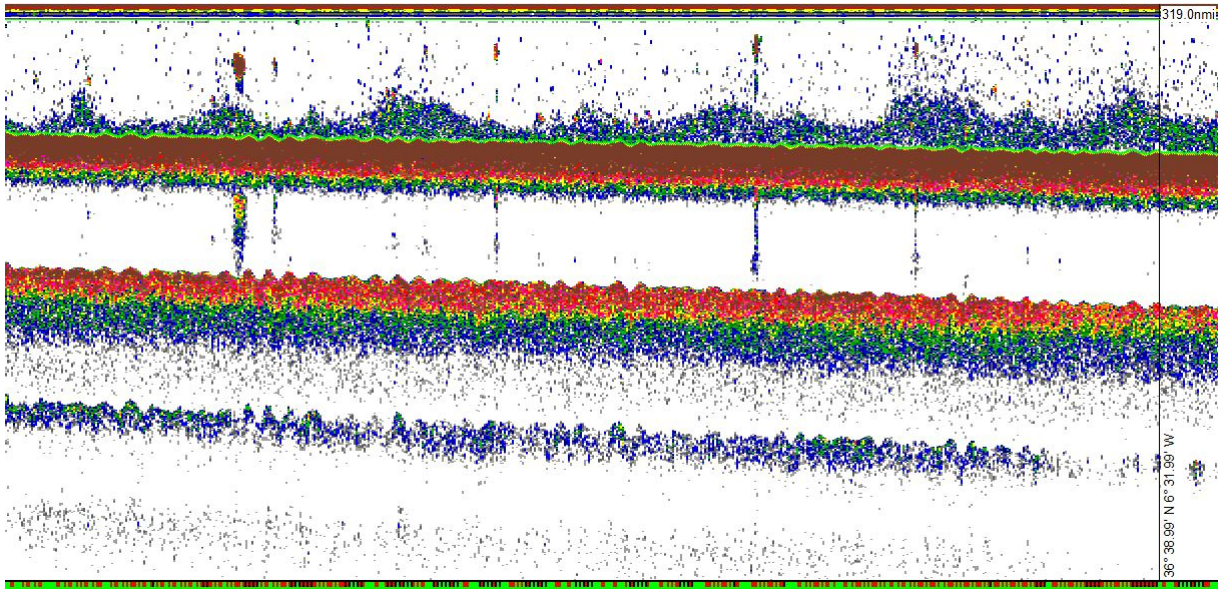

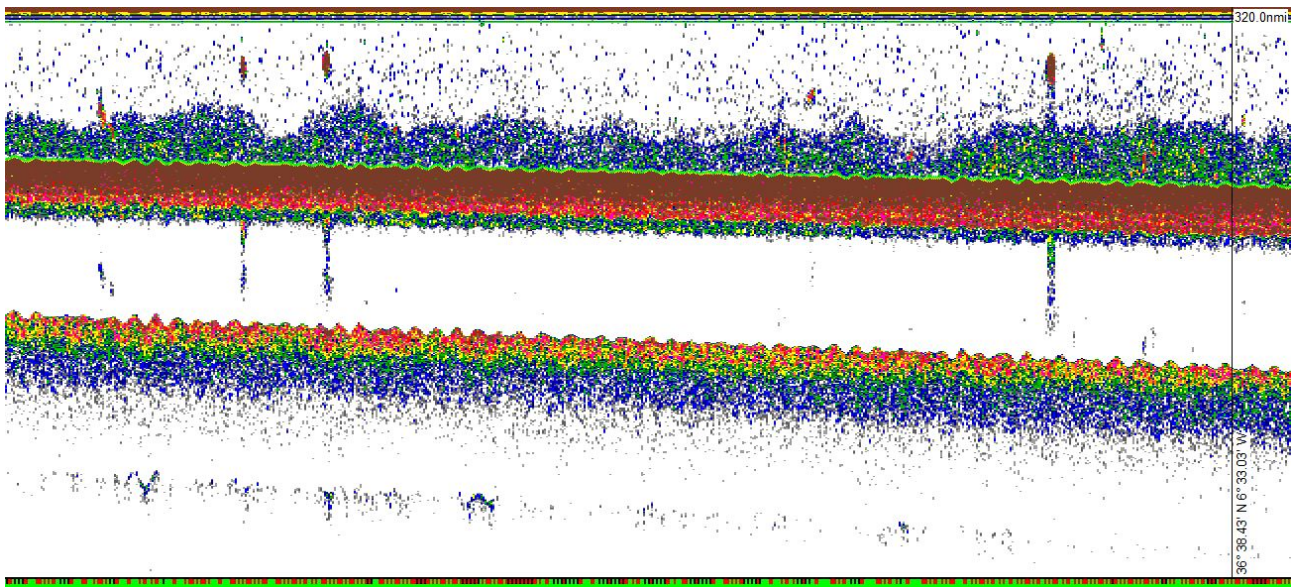**Figure A1**. Transect RA05 (Chipiona), 23-25 m depth.

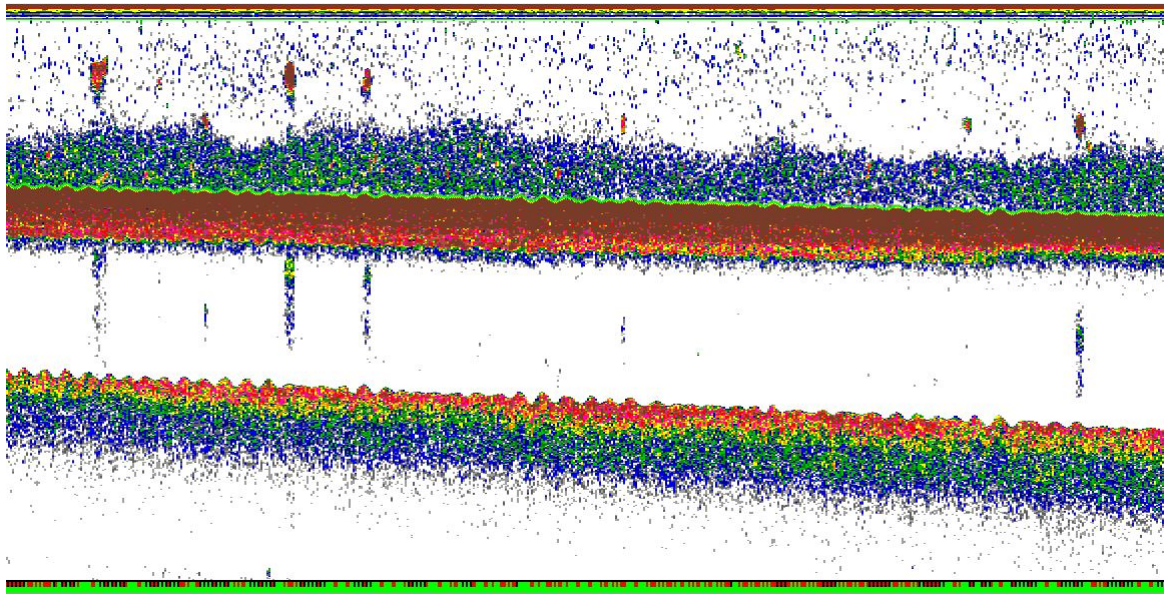**Figure A2**. Transect RA05 (Chipiona), 27-29 m depth.

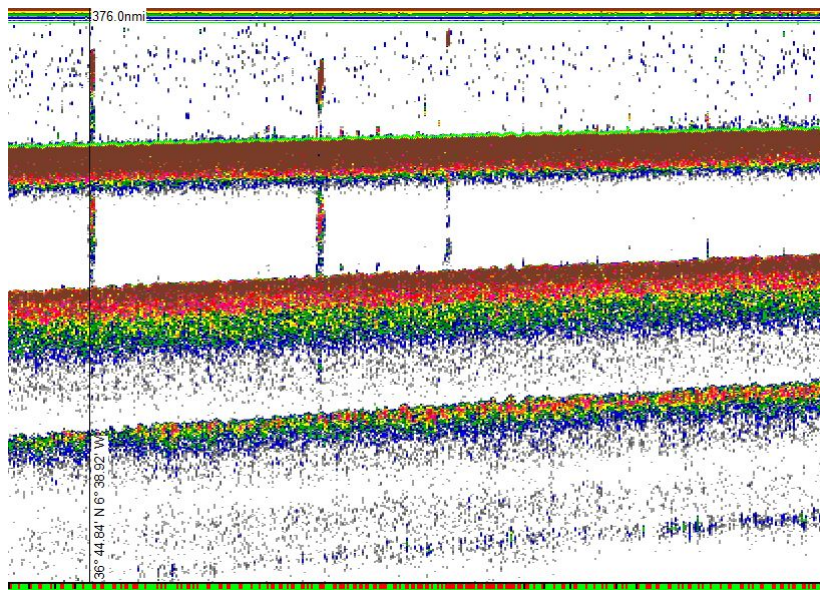**Figure A3**. Transect RA05 (Chipiona), 31-37 m depth.

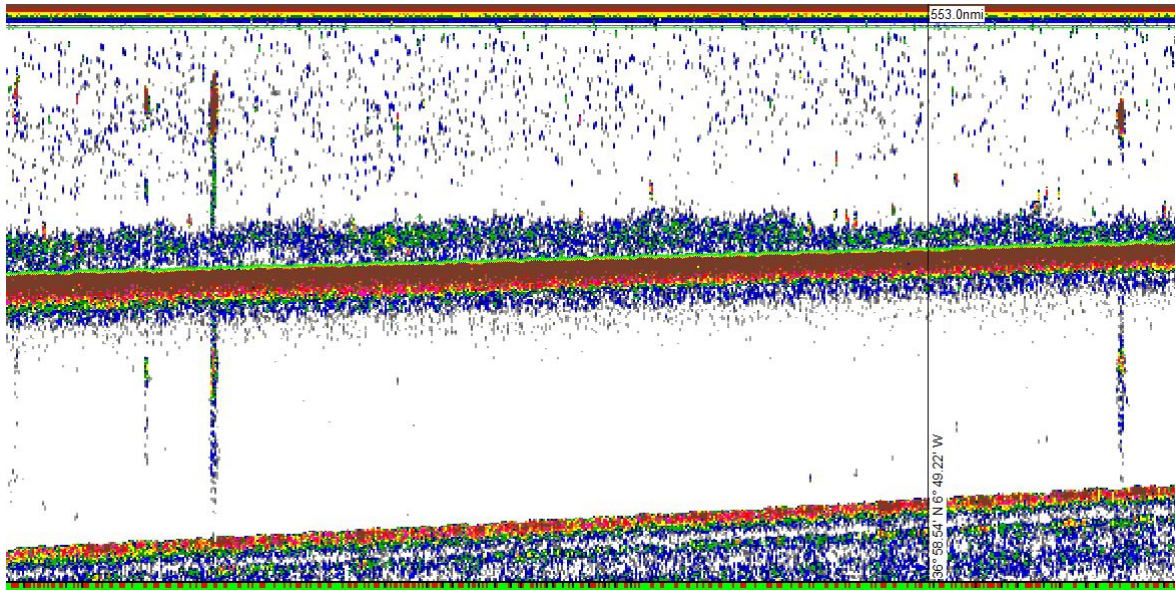**Figure A4**. Transect RA06 (Doñana), 23-24 m depth.
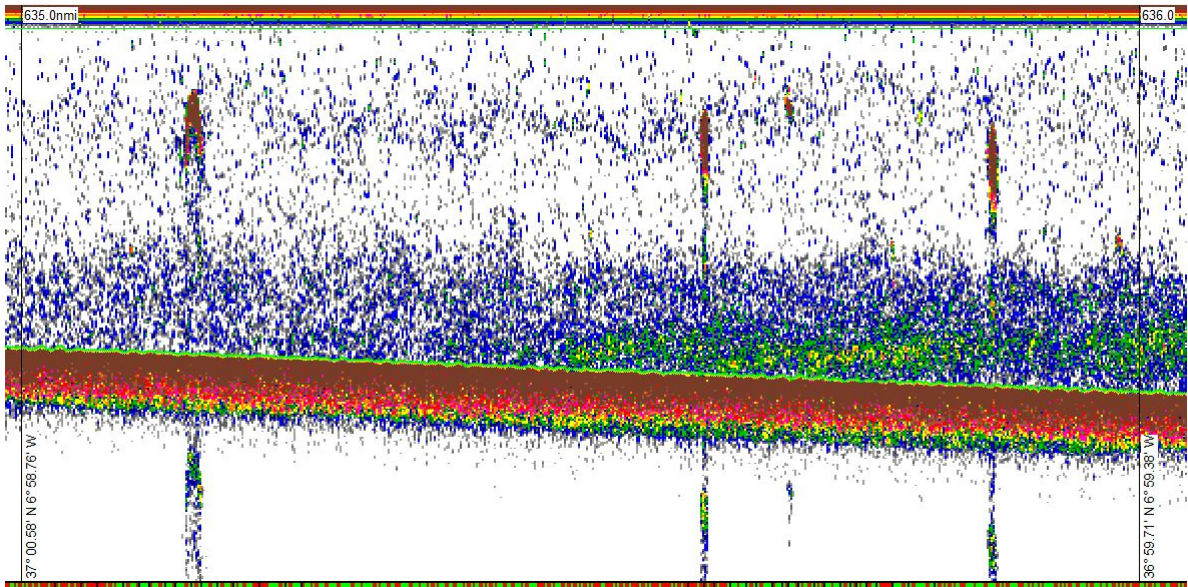
Figure A5. Transect RA08 (Mazagón), 23-24 m depth.

Figure A6. Transect RA10 (El Rompido), 40-44 m depth.