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Acoustic assessment and distribution of the main pelagic fish species in the ICES Subdivision IXa South during the *ECOCÁDIZ-RECLUTAS 1112* Spanish survey (November 2012).

By

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ABSTRACT

ECOCÁDIZ-RECLUTAS 1112 survey is the second survey by the IEO of acoustically assessing the abundance of anchovy and sardine juveniles in their main recruitment areas off the Gulf of Cádiz. The survey was conducted between 10th and 27th November 2012 onboard the Spanish R/V *Emma Bardán* and its sampled area was restricted only to the Spanish waters of the Gulf of Cádiz between 10 and 200 m depth.

Acoustic estimates from the surveyed area were as follows:

Estimate	Anchovy	Sardine	Chub mack.	Mackerel	Horse-mack.	Medit. h-mack.	Blue jack-mack.	Bogue	Total spp.
Biomass (t)	13680	22119	11155	1136	15873	3375	976	346	68660
Abundance (millions)	2649	603	157	11	1049	148	37	7	4661

The abundance and biomass of age 0 anchovies in the surveyed area were estimated at 15 187 t and 2 619 million fish, respectively, *i.e.* 97% and 99% of the total estimated anchovy biomass and abundance. Sardine estimates were not age-structured but the abundance and biomass of juveniles smaller than 17 cm were estimated at 9 675 t and 377 millions, 44% and 62% of the total estimated species' biomass and abundance. The resulting yields and location of positive fishing stations with anchovy from a groundfish survey carried out shortly before the present survey are also shown and provide a complementary picture of the anchovy juvenile distribution during the survey season.

INTRODUCTION

During the 2007 and 2008 meetings of ICES *Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES areas VIII and IX* (WGACEGG) was advanced the possibility of carrying out, since 2009 on, internationally coordinated yearly surveys aimed at the direct estimation of the anchovy and sardine recruitment in the Division IXa (ICES, 2007, 2008). Conduction of such surveys would require, at least in the Gulf of Cadiz, of an appropiate acoustic sampling of the shallowest waters of its central part, an area which the conventional surveys (either Spanish or Portuguese) do not sample but, however, used to form a great part of the recruitment areas of these species.

The general objective of these surveys should initially be focused in the acoustic assessment by vertical echo-integration and mapping of the abundance and biomass of recruits of small pelagic species (especially anchovy and secondarily sardine), as well as the mapping of both the oceanographic and biological conditions featuring the recruitment areas of these species in the Division IXa. The long term objective of the surveys would be to be able to assess the strength of the incoming recruitment to the fishery the next year.

ECOCÁDIZ-RECLUTAS 1009 survey was the first attempt by the IEO of acoustically assessing the abundance of anchovy and sardine juveniles in their main recruitment areas off the Gulf of Cádiz. In order to achieve a better sampling coverage of juveniles, the acoustic sampling grid in that survey was more intensive (4 nm-spaced transects) than the adopted one in conventional surveys (8 nm-spaced transects). Unfortunately, the initially planned survey area (17 transects over waters shallower than 50 m depth between Tavira and Chipiona) and the ship-time available (11 days) showed both insufficient due to a deeper bathymetric distribution of anchovy juveniles than expected, and the succession of a series of unforeseen problems which led to drastically reduce the foreseen sampling area to only 6 transects from the easternmost zone.

The continuation of this survey series was not guaranteed for next years and in fact no survey of these characteristics was carried out in 2010 and 2011. In 2012, the *ECOCÁDIZ-RECLUTAS 1112* survey was financed by the Spanish Fisheries Secretariat and planned and conducted by the IEO with the aim of obtaining an autumn estimate of anchovy biomass and abundance in the Spanish waters of the Gulf of Cádiz. Actually, this survey sought to comply with the commitment acquired in the summer of 2012 by the Spanish Ministry with the Fisheries Sector as for the conduction of a (direct) study on anchovy in the National fishing ground of the Gulf of Cádiz. Recall that in the summer of that year IEO was unable to conduct its *ECOCÁDIZ* standard acoustic survey due to budgetary problems and IPIMAR neither conducted its *PELAGO* Spring survey.

The present Working Document summarises the main results from this survey.

MATERIAL AND METHODS

The *ECOCÁDIZ-RECLUTAS 1112* survey was carried out between 11th and 29th November 2012 onboard the Spanish R/V *Emma Bardán*. The sampled area was restricted to the Spanish waters only (11 transects, 8 nm-spaced), between 10 and 200 m depth, with the acoustic transects being the same ones that in the *ECOCÁDIZ* standard survey although extended inshore from the 20 to the 10 m depth isobaths (**Figure 1**).

Echo-integration was carried out with a *Simrad™ EK60* echo sounder working in the multi-frequency fashion (38, 120, 200 kHz). Average survey speed during the acoustic sampling was approximately 10 knots, according to the results of the vessel's self-noise tests carried out during the first day. Such a speed (corresponding to 1500 rpm) showed as the less noisy for the 38 kHz working frequency (the one used for the assessment purposes). The acoustic signals were integrated over 1-nm intervals (ESDU). Raw acoustic data were stored for further post-processing using *Myriax Software Echoview™* software package (by *Myriax Software Pty. Ltd.,* ex *SonarData Pty. Ltd.*). Acoustic equipment was previously calibrated during the *JUVENA 2012* acoustic survey, a survey conducted in the Bay of Biscay waters just before the present survey, following the standard procedures (Foote *et al*., 1987).

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

Fishing stations were opportunistic, according to the echogram information, and they were carried out using the 10-12 m-vertical opening pelagic trawl *Gloria HOD 352* at an average speed of 4 knots. Gear performance and geometry during the effective fishing was monitored with a set of *SCANMAR™ Trawl Eye-Vertical Opening-Depth* sensors which were operated by a combination of *SCANMAR™* portable hydrophone and *ScanBas* desk unit.

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

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). For the purpose of the acoustic assessment it was only considered those size distributions based on a minimum of 30 individuals.

Due to the shortage of the scientific staff onboard the Individual biological sampling (length, weight, sex, maturity stage, stomach fullness, mesenteric fat content, otolith extraction) was performed in each haul only for anchovy.

No egg sampling by CUFES was carried out during the survey.

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

Species	b_{20}
Sardine (*Sardina pilchardus*)	-72.6
Round sardinella (*Sardinella aurita*)	-72.6
Anchovy (*Engraulis encrasicolus*)	-72.6
Chub mackerel (*Scomber colias*)	-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

Unfortunately, the abovementioned shortage of scientific staff also prevented from the conduction of vertical profiles of hydrographical variables. Nevertheless, oceanographic data recorded during a previous ground-fish survey carried out in the same are shortly before (ARSA survey, 2nd-16th November) were considered as representative of the oceanographic conditions occurring during the acoustic survey. Yields from bottom-trawl fishing stations performed in that ground-fish survey were also mapped and compared with those ones from the acoustic survey in order to analyse the spatial distribution of anchovy recruits in the area.

RESULTS

Acoustic sampling

The acoustic sampling was restricted to the Spanish waters of the Gulf of Cádiz continental shelf, between 10 and 200 m depth, limited by the landmarks of Ayamonte-Isla Cristina to the west and El

Palmar-Cabo Trafalgar to the East. The acoustic sampling was carried out during the periods of 12 – 14, 21 – 23 and 25 – 26 November (**Table 1**). The successive interruptions of the acoustic sampling were caused by the occurrence of periods of bad weather and the time invested in the searching for the "Trawl Eye" net sensor (19 and 20 November). The acoustic transect R03 was repeated the 26 November for contrasting data. This transect was previously sampled the 12 November, but then showed an unusual absence of echo-traces, probably attributable to the bad sea state in previous days.

Fishing stations

Ten (10) fishing operations, all of them valid ones according to a correct gear performance and resulting catches, were carried out (**Table 2**, **Figure 2**). The fishing station P03 was carried out the 19 November over the transect R05, starting the effective trawling in 25 m depth towards deeper depths. After 21 minutes of trawling the gear had to be recovered because of a hawking with the bottom (probably with an artificial reef module), the gear showing damages along its entire body (but the cod-end) and in the opening and with the additional loss of net sensors. Despite such damages, the cod-end could be recovered intact and the haul considered as valid.

Because of the 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 very close to the bottom. According to the above, the sampled depth range in the valid hauls oscillated between 23-120 m.

During the survey were captured 4 species of Chondrichthyans, 40 species of Osteichthyes and 8 species of Cephalopods. The percentage of occurrence of the more frequent species in the valid hauls is shown in the enclosed text table below (see also **Figure 2**). Anchovy, horse-mackerel and chub mackerel (present in all the hauls) stood especially out from the set of small and mid-sized pelagic fish species. They were followed by Mediterranean horse-mackerel and sardine (8 hauls), and mackerel and blue jack mackerel (7 hauls).

Species	# of fishing stations	Occurrence (%)
Engraulis encrasicolus	10	100
Scomber colias	10	100
Trachurus trachurus	10	100
Merluccius merluccius	9	90
Sardina pilchardus	8	80
Trachurus mediterraneus	8	80
Scomber scombrus	7	70
Trachurus picturatus	7	70
Sepia officinalis	7	70
Loligo vulgaris	6	60
Loligo subulata	6	60
Boops boops	5	50
Alosa fallax	5	50

For the purposes of the acoustic assessment, anchovy, sardine, mackerels, horse & jack mackerels, and bogue 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 these premises, during the survey was captured a total of 3 568kg and 186 thousand fish. 56**%** of the total fished biomass corresponded to chub mackerel, 19**%** to anchovy, 12**%** to sardine and

8% to horse-mackerel (**Table 3**). The most abundant species was anchovy (66%) followed by a long distance by chub mackerel (15%), horse-mackerel (11%), and sardine (6%). Mackerel, Mediterranean horse-mackerel, blue jack mackerel and bogue recorded total catches and yields almost incidental.

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

A total of 246 nmi (ESDU) from 11 transects has been acoustically sampled by echo-integration for assessment purposes. 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".

$S_{A\,(m^2\,nmi^{-2})}$	Anchovy	Sardine	Chub mack.	Mackerel	Horse-mack.	Medit. h-mack.	Blue jack-mack.	Bogue	Total spp.
Total Area (%)	24473 (22.98)	15487 (14.54)	16985 (15.95)	42 (0.04)	40428 (37.96)	6009 (5.64)	2423 (2.28)	654 (0.61)	106521 (100.0)

For this "pelagic fish assemblage" has been estimated a total of 106 521 m^2 nmi^{-2}. The highest NASC values have been recorded in the inner-middle shelf, mainly in front of the sector of Mazagón-Matalascañas. The mapping of the total back-scattering energy is shown in **Figure 3**. By species, horse mackerel accounted for 38% of this total back-scattered energy, followed by anchovy (23%), chub mackerel (16%), sardine (15%), Mediterranean horse mackerel (6%), blue jack-mackerel (only 2%) and bogue and mackerel (<1%). These especies have been those ones finally assessed.

The biomass (in t) and abundance (in million fish) estimates of all the assessed species are shown in the text table below. For the whole assessed "pelagic fish assemblage" has been estimated a total of 68 660 t, which correspond to an estimated abundance of 4 661 millions of fish. Sardine was the species yielding more biomass (22 119 t), followed by horse-mackerel (15873 t), anchovy (13 680 t) and chub mackerel (11 155 t). Regarding abundance, the most abundant species was anchovy, with 2 649 millions of fish, as a direct consequence of the detection of the recruitment resulting from the spawning events occurring the last summer. The following more abundant species were horse-mackerel (1 049 millions) and sardine (603 millions).

Estimate	Anchovy	Sardine	Chub mack.	Mackerel	Horse-mack.	Medit. h-mack.	Blue jack-mack.	Bogue	Total spp.
Biomass (t)	13680	22119	11155	1136	15873	3375	976	346	68660
Abundance (millions)	2649	603	157	11	1049	148	37	7	4661

Spatial distribution and abundance/biomass estimates

Anchovy

Parameters of the survey's length-weight relationship for anchovy are given in **Figure 4**. The mapping of the backscattering energy (nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species, the positive valid fishing stations with anchovy and the coherent strata considered for the acoustic estimation are shown in **Figure 5**. The estimated abundance and biomass by size and age class are given in **Tables 4** and **5** and **Figures 6** and **7**.

The highest acoustic integrations attributed to anchovy were recorded in the central part of the study area, between Chipiona and Mazagón, mainly in the outer shelf waters in front of Doñana. Anchovy occurred in all the fishing stations but only in 7 of them the catch was representative. The estimated biomass was of 13 680 t and the abundance of 2 649 million fish (**Table 4**). According to the abovementioned distribution of the backscattering energy, the resource concentrated the bulk of its

effectives in the central part of the sampled area, showing a nucleus of high density in the waters of the outer shelf in front of the coasts of Chipiona-Doñana (**Figure 5**).

The size range recorded for the species oscillated between 4.5 and 15.5 cm, with two modes, both for the abundance and the biomass estimates, at 7.5 and 10 cm (**Figure 6**). The smallest anchovies belonging to the first modal component (probably recruits from summer spawning events) were mainly recorded in the shallowest waters of the sector Cádiz Bay-Mazagón, where they were the dominant population fraction. A second nuclei of recruits with a larger size (around the second modal class at 10 cm), the most important in terms of abundance, was concentrated in the abovementioned high density area of the outer shelf waters in front Chipiona-Doñana, here sharing the space with one-year-old adult anchovies. Although 0, 1 and 2 years old fish were recorded, the bulk of the population was composed by age 0 fish (recruits; **Table 5**, **Figure 7**), with a mean size and weight for the whole sampled area of 9.47 cm and 5.79 g respectively (**Table 6**). The abundance and biomass of age 0 anchovies in the surveyed area were estimated at 15 187 t and 2 619 million fish, respectively, *i.e.* 97% and 99% of the total estimated anchovy biomass and abundance. Taking into account the estimated population age structure and the mean sizes by age class, the two modal classes observed in the population size composition evidence the co-occurrence of two pseudo-cohorts of recruits which are the result of the two main spawning events in the year (in spring and summer). These two fractions of the contingent of recruits seem to exhibit some bathymetric segregation (or, alternatively, a gradient or cline variation in the mean size) related to their ontogeny.

The biological sampling of the captured anchovies showed that 91% of the sampled females were sexually inactive (stages I and II). However, during the survey season is still possible to record males and females showing some reproductive activity (stages III, IV and V).

Sardine

Parameters of the survey's size-weight relationship for sardine are shown in **Figure 4**. The positive valid fishing stations with sardine and the coherent strata considered for the acoustic estimation are shown in **Figure 8**. Estimated abundance and biomass by size class are given in **Table 7** and **Figure 9**.

Sardine was the species that showed the highest levels of estimated biomass from all the assessed species in the area, with 22 119 t and an abundance of 603 million fish. The mapping of the backscattering energy attributed to the species evidences that sardine was mainly distributed in the western waters, close to the Portuguese border (**Figure 8**). Five positive fishing hauls were obtained that showed different size distributions, with the more coastal and easternmost sardines (PE 05, PE 06 and PE 08) being somewhat smaller in mean size (15 cm) than the ones occurring offshore and in westernmost waters (PE 07 and PE 10) with a mean size at 16.5 and 17 cm, respectively. The spatial mapping of acoustic densities and the own estimates of population abundance and biomass by coherent post-stratum indicate that the fraction of the sardine stock inhabiting the Spanish waters of the Gulf of Cádiz was concentrated during the survey in the westernmost waters (**Table 7** and **Figure 9**), with the species being almost absent in the Cádiz province waters.

The size frequency distribution of this species showed a range comprised between the 12.5 and 23 cm size classes, with two modes, both for the biomass and abundance at 14.5 and 18.5 cm (**Figure 9**). Although no age structure is available for the population estimate, the size composition of the estimated population seems to suggest that during the survey season sardine recruitment is occurring as evidenced by the first modal component at 14.5 cm. So, the abundance and biomass of juveniles smaller than 17 cm were estimated at 9 675 t and 377 millions, 44% and 62% of the total estimated species' biomass and abundance.

Chub mackerel

Parameters of the survey's length-weight relationship are shown in **Figure 4**. The positive valid fishing stations with chub mackerel and the coherent strata considered for the acoustic estimation are shown in **Figure 10**. Estimated abundance and biomass by size class are given in **Table 8** and **Figure 11**.

Chub mackerel was the fourth species most important in the area in terms of estimated biomass with 11 155 t, corresponding to 157 million fish (**Table 8**). The detected NASC for the species were concentrated over the western zone, sharing the space with sardine, and with chub mackerel being very scarce in the southeastern zone. The species was present in 6 fishing stations. The highest acoustic densities attributed to the species (and the highest abundance and biomass estimates as well) were concentrated in the central post-stratum (sector Chipiona-Mazagón) (**Figure 10**).

The size frequency distribution showed a range comprising the 15 and 26.5 cm size classes, with no clearly defined modes (**Figure 11**).

Mackerel

Parameters of the survey's length-weight relationship are shown in **Figure 4**. The positive valid fishing stations with mackerel and the coherent strata considered for the acoustic estimation are shown in **Figure 12**. Estimated abundance and biomass by size class are given in **Table 9** and **Figure 13**.

The mackerel population in Spanish waters of the Gulf of Cádiz shelf was assessed in 1 136 t and 11 million fish (**Table 9**). In contrast with its congeneric relative, mackerel showed a very feeble acoustic integration because of its absence of swim bladder and the lower occurrence in the area. The species was captured in 3 fishing stations. The spatial mapping of acoustic densities by coherent post-stratum indicates that the assessed population was only distributed in the central-western part of the sampled area, in outer shelf waters (**Figure 12**).

The size frequency distribution of the estimated population ranged between 20 and 30.5 cm, with a mode at 25 cm (**Figure 13**).

Horse-mackerel

The survey's length-weight relationship for this species is shown in **Figure 4**. Positive fishing stations and coherent strata are represented in **Figure 14**. Estimated abundance and biomass by size class are given in **Table 10** and **Figure 15**.

Horse-mackerel was a very abundant species in this survey as compared with previous estimates from standard (summer) *ECOCÁDIZ* acoustic surveys. The species ranked in the third place in terms of estimated biomass with 15 873 t and an abundance of 1 049 million fish (**Table 10**). The species was recorded all over the sampled area, standing out the acoustic integrations recorded in the central and western sectors. As indicated above, the presence index of this species in the fishing hauls was amongst the highest ones, with the species being present in 9 of the 10 valid fishing hauls. The mapping of acoustic densities by coherent post-stratum (**Figure 14**) and their respective acoustic estimates (**Table 10**) confirm to the westernmost sector of the study area as the main concentration zone of this species, dominated, moreover, by recruits.

The size frequency distribution shows a size range comprised between 10 and 24 cm, with two modes at 11.5 and 14.5 cm, both for the abundance and biomass (**Figure 15**).

Mediterranean horse-mackerel

The survey's length-weight relationship for this species is shown in **Figure 4**. Positive fishing stations and coherent strata are represented in **Figure 16**. Estimated abundance and biomass by size class are given in **Table 11** and **Figure 17**.

The species yielded an estimated biomass of 3 375 t and an abundance of 148 million fish (**Table 11**). The highest values of acoustic integration per nmi were recorded in the central and southeastern zones, with the species being absent further to the west of Mazagón. The species only occurred in 3 fishing stations. The sampled population was mainly located in the shelf waters in front of Matalascañas (**Figure 16**).

Regarding the size composition of the estimated population the species showed a size range between 9 and 36 cm, with two modal classes at 11 (the main one, composed by recruits) and 27 cm (**Figure 17**).

Blue jack mackerel

Parameters of the survey's length-weight relationship are shown in **Figure 4**. The positive valid fishing stations with mackerel and the coherent strata considered for the acoustic estimation are shown in **Figure 18**. Estimated abundance and biomass by size class are given in **Table 12** and **Figure 19**.

Blue jack mackerel yielded a biomass estimate of only 976 t and an abundance of 37 million fish (**Table 12**). The species showed an oceanic distribution, in outer shelf waters, although restricted to the westernmost sector of the sampled area. The species was captured in 5 fishing hauls (**Figure 18**).

The size frequency distribution showed a range of size classes between 11.5 and 19.5 cm, with a mode at the 15 cm size class (**Figure 19**).

Bogue

Parameters of the survey's length-weight relationship are shown in **Figure 4**. The positive valid fishing stations with mackerel and the coherent strata considered for the acoustic estimation are shown in **Figure 20**. Estimated abundance and biomass by size class are given in **Table 13** and **Figure 21**.

The acoustic estimates of both biomass and abundance of bogue (346 t and 7 million fish) evidence the incidental nature of its occurrence in the sampled area during the survey season (**Table 13**). Bogue showed a scarce acoustic integration, with only one positive fishing haul and a spatial distribution restricted to the central and eastern sectors of the surveyed area (**Figure 20**).

The size composition of the estimated population showed a size class range between 10 and 24 cm, although with a very irregular distribution (**Figure 21**). The above facts lead us to consider that the species has not been properly assessed.

DISCUSSION

The anchovy biomass has been acoustically estimated in the surveyed area at 13 680 t and its population abundance at 2 649 million fish. Age 0 anchovies (recruits) accounted for 98.9% (2 619 million fish) of the estimated total population of anchovy. Mean size and weight of these recruits were estimated at 9.47 cm and 5.79 g, respectively. The highest densities of anchovy were recorded in the central part of the surveyed area, between Chipiona and Mazagón, and more precisely in the outer shelf waters in front of Doñana coasts. The size composition and spatial distribution of anchovy recruits evidence the co-

occurrence of two pseudo-cohorts within the recruits' population fraction (probably the offspring of the two main spawning events in the year in spring and summer) which seem to exhibit some bathymetric segregation (or, alternatively, a bathymetric gradient or cline variation in the mean size) related to small-scale ontogenetic inshore-offshore migrations. Thus, the smallest anchovies (around the first modal size class at 7.5 cm) were mainly recorded in the shallowest waters of the sector Cádiz Bay-Mazagón, where they were the dominant population fraction. This sector could be well identified as the core of the recruitment area and under the influence of the Guadalquivir river mouth and estuary. Larger recruits (second modal class at 10 cm), the most important in terms of abundance and biomass, co-occurred with anchovy adults (mainly age 1 fish) in the outer shelf waters in front of Doñana conforming a second recruits "wave". Such data evidence that the Gulf of Cádiz anchovy recruitment area may be well extend to deeper waters than expected (*i.e.* the coastal waters), spreading by almost the whole shelf, at least in the central part of the Gulf of Cádiz.

Figure 22 illustrates a comparative analysis of the extension of the anchovy spatial distribution as sampled by the pelagic hauls carried out in the present survey and by those bottom-trawl hauls carried out during the *ARSA 1112* ground-fish survey. *ARSA* survey dates (2^{nd} – 16^{th} November) were partially overlapped to the ones of the acoustic survey. The good spatial sampling coverage of the ground-fish survey yields valid information for comparative purposes, although the conduction of the fishing stations in each survey is based on different sampling schemes (opportunistic in the acoustic survey, a stratified random scheme in the ground-fish survey). Moreover, *ARSA*'s data are the only ancillary information available to the acoustic survey, since the fishery (the other source of information possible) stopped in those dates. Although the bottom-trawl gear used in the ground-fish survey (2 m vertical opening) may not be the most suitable gear to sample anchovy, the distribution pattern of the species in this last survey might give us an approximate picture of the probable general distribution of the species in the area complementary to the one given by the acoustic survey. In any case, the quasi-demersal behaviour of anchovy during the day-light hours (when both surveys are conducted) leads us to consider the bottom-trawl data as a valuable source of information. Thus, the anchovy size and age composition from bottom trawl hauls corroborates and even completes the distribution pattern of anchovy recruits in the surveyed area provided by the acoustic survey and indicate that smaller (age 0) anchovies are mainly concentrated in the same waters abovementioned described as the main core of the recruitment area. *ARSA* survey, however, seems to sample larger anchovies in the outer shelf waters than the acoustic survey, but this fact does not refute the spatial pattern described above. The potential of the *ARSA* survey series (with 2 surveys in the year, one in March and the other one in November) as an additional abundance/biomass index should be tested for its further use in the stock assessment as an alternative calibration (or recruitment) index.

The present acoustic anchovy estimates as well as those from the remaining assessed species should be considered as partial estimates for the Gulf of Cádiz since they do not include the whole of their stocks and the magnitude of these populations in the Portuguese Algarve shelf is unknown. Therefore, such estimates only will be valid when they are exclusively referred to the contingents of each stock resident in the Spanish waters. On the other hand, it is risky to issue any judgment about the magnitudes estimated as we do not have any recent estimates in similar dates. It should be remembered that the only survey with similar dates and objectives was carried out in 2009 (*ECOCÁDIZ-RECLUTAS 1109*), but problems of ship time available and sampling coverage only allowed to provide acoustic estimates for only a small part of the study area.

The same recruitment events described for anchovy were also detected for sardine and the 3 species of horse-mackerels, standing especially out amongst the carangid species the recruitment of *T. trachurus*.

During the survey occurred a high and persistent turbidity event (HPTE, see González Ortegón *et al*., 2010) in the Guadalquivir river mouth as a consequence of strong and sudden freshwater discharges

(**Figure 23**). The above authors corroborated the hypothesis that HPTEs may negatively impact the nursery function of the Guadalquivir estuary either by decreasing prey availability or by decreasing survival/arrival of marine recruits. Regarding anchovy, these authors evidenced that anchovy recruits were less abundant in the estuary during HPTEs due to significant decreases in the abundance of *Mesopodopsis slabberi*, the commonest mysid in the estuary and a key species in the estuarine food web, which is also one of the main preys of anchovy in this stage of its life cycle. This event is just being analysed by IEO oceanographers, but the probable impact of such event in the survival of the coastal biota should also be properly investigated.

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Table 1. *ECOCÁDIZ-RECLUTAS 1112* survey. Descriptive characteristics of the acoustic tracks.

Acoustic track	Location	Date	Start				End			
			Latitude	Longitude	GMT time	Mean depth (m)	Latitude	Longitude	GMT time	Mean depth (m)
R01	Trafalgar	13/11/12	36º 01.9999 N	6º 28.9999 W	10:32	121	36º 13.6710 N	6º 07.5370 W	12:29	27
R02	Sancti-Petri	14/11/12	36º 09.0000 N	6º 34.0000 W	10:01	176	36º 19.3650 N	6º 14.5219 W	15:18	15
R03	Cádiz	12/11/12	36º 27.1830 N	6º 19.1190 W	08:45	17	36º 16.5000 N	6º 37.9999 W	10:46	214
R03 bis	Cádiz	26/11/12	36º 16.5000 N	6º 37.9999 W	11:48	200	36º 27.1830 N	6º 19.1190 W	13:58	17
R04	Rota	12/11/12	36º 23.5000 N	6º 42.4999 W	11:56	189	36º 34.5120 N	6º 23.1220 W	17:32	12
R05	Chipiona	21/11/12	36º 40.1359 N	6º 29.8800 W	07:19	14	36º 31.0000 N	6º 46.5000 W	11:06	207
R06	Doñana	21/11/12	36º 37.0000 N	6º 53.1000 W	12:03	176	36º 46.4040 N	6º 35.9920 W	15:53	10
R07	Matalascañas	22/11/12	36º 44.6500 N	6º 57.0000 W	10:39	136	36º 53.5240 N	6º 40.9630 W	16:04	10
R08	Mazagón	23/11/12	37º 01.0579 N	6º 44.5849 W	08:06	14	36º 49.0999 N	7º 06.7999 W	12:14	219
R09	Punta Umbría	23/11/12	36º 49.0999 N	7º 06.7999 W	12:15	219	37º 05.0719 N	6º 55.5439 W	14:30	10
R10	El Rompido	25/11/12	37º 06.8539 N	7º 06.9030 W	08:02	12	36º 49.0999 N	7º 06.7999 W	11:56	219
R11	Isla Cristina	25/11/12	36º 52.2499 N	7º 16.6999 W	12:45	162	37º 07.7419 N	7º 16.9600 W	14:28	11

Table 2. *ECOCÁDIZ-RECLUTAS 1112* survey. Descriptive characteristics of the fishing stations.

Fishing station	Date	Acoustic track	Start		End		Depth (m)		GMT Time		Effective Trawling (min)	Total Maneuver (min)	Trawled distance (nm)
			Latitude	Longitude	Latitude	Longitude	Start	End	Start	End			
PE01	11/12/2012	R04	36º 30.8139 N	6º 29.5834 W	36º 29.6476 N	6º 31.7133 W	53,96	65,05	14:34	15:06	00:32	00:55	2,075
PE02	14/11/2012	R02	36º 12.2230 N	6º 31.4449 W	36º 09.8365 N	6º 31.3671 W	118,82	119,96	11:35	12:17	00:42	01:23	2,384
PE03	19/11/2012	R05	36º 40.0392 N	6º 30.0408 W	36º 39.3070 N	6º 31.3635 W	24,92	28,20	08:51	09:12	00:21	00:47	1,291
PE04	20/11/2012	R04	36º 31.6458 N	6º 27.0270 W	36º 30.0661 N	6º 25.5898 W	43,17	41,62	15:45	16:15	00:30	00:44	1,957
PE05	21/11/2012	R05	36º 35.3479 N	6º 38.5719 W	36º 34.0452 N	6º 40.9852 W	74,11	91,91	09:31	10:06	00:35	01:08	2,339
PE06	21/11/2012	R06	36º 43.3185 N	6º 41.6145 W	36º 42.4051 N	6º 43.2744 W	46,60	61,20	13:45	14:10	00:25	00:50	1,617
PE07	22/11/2012	R07	36º 48.3599 N	6º 50.3059 W	36º 47.1870 N	6º 52.4799 W	74,85	94,70	11:47	12:19	00:32	01:04	2,103
PE08	22/11/2012	R07	36º 52.9371 N	6º 42.0519 W	36º 51.7699 N	6º 44.2029 W	23,26	28,56	14:17	14:47	00:30	00:50	2,083
PE09	23/11/2012	R08	36º 53.3160 N	6º 59.0109 W	36º 52.3099 N	7º 00.9240 W	92,80	104,10	10:51	11:21	00:30	01:06	1,834
PE10	25/11/2012	R10	37º 02.2740 N	7º 05.9389 W	37º 02.8239 N	7º 08.3769 W	46,00	46,28	09:44	10:14	00:30	00:54	2,028

Table 3. *ECOCÁDIZ-RECLUTAS 1112* survey. Catches by species in number (upper panel) and weight (in kg, lower panel) from valid fishing stations.

Fishing station	ABUNDANCE (nº)										
	Anchovy	*Sardine*	*Chub Mack*	*Mackerel*	*Horse Mack*	*Blue Jack-Mackerel*	*Medit. Horse-Mackerel*	*Bogue*	*Longspine snipefish*	Others spp.	TOTAL
PE01	13	10	3		587	23	2	11		2	**651**
PE02	14		113	1	569	78	3		1506	7	**2291**
PE03	33		2		1		76	2		100	**214**
PE04	7033	22	23		4281	1	878	45		184	**12467**
PE05	104115	915	228	152	765	81	5			5	**106266**
PE06	4	1753	72	3	108	94	3	13		19	**2069**
PE07	2611	1057	26599	78	39	156	26	26		3	**30595**
PE08	658	99	40	1	226		109			91	**1224**
PE09	7440	8	11	52	1608	377				13	**9509**
PE10	442	7509	1041	25	11369					7	**20393**
TOTAL	**122363**	**11373**	**28132**	**312**	**19553**	**810**	**1102**	**97**	**1506**	**431**	**185679**

Fishing station	BIOMASS (kg)										
	Anchovy	*Sardine*	*Chub Mack*	*Mackerel*	*Horse Mack*	*Blue Jack-Mackerel*	*Medit. Horse-Mackerel*	*Bogue*	*Longspine snipefish*	Others spp.	TOTAL
PE01	0,069	0,456	0,645		9,73	0,527	0,021	0,142		0,167	**11,757**
PE02	0,191		4,981	0,074	7,145	1,845	1,855		7,585	1,241	**24,917**
PE03	0,076		0,34		0,03		15,02	0,316		17,867	**33,649**
PE04	17,375	0,77	1,62		64,394	0,049	19,921	2,234		23,482	**129,845**
PE05	596,803	23,1	11,978	15,4	13,784	2,448	2,101			1,117	**666,731**
PE06	0,011	57,835	5,24	0,369	2,207	2,525	0,177	0,693		3,015	**72,072**
PE07	20,921	42,821	1951,038	6,635	0,652	14,339	3,611	3,233		0,785	**2044,035**
PE08	2,62	2,61	4,34	0,188	3,76		1,7			6,174	**21,392**
PE09	68,26	0,212	0,66	6,1	28,31	7,495				1,29	**112,327**
PE10	3,682	304,92	70,023	5,374	155,793					1,671	**541,463**
TOTAL	**710,008**	**432,724**	**2050,865**	**34,14**	**285,805**	**29,228**	**44,406**	**6,618**	**7,585**	**56,809**	**3658,188**

Table 4. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*E. encrasicolus*). Estimated abundance (in numbers and millions) and biomass (t) by size class, homogeneous post-stratum (Polygons, POL06 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: ANCHOVY (*E. encrasicolus*). ABUNDANCE (nº of individuals)**							
Size class (cm)	**I. Cristina-Matalascañas (offshore)**	**I. Cristina- Pta. Umbría (coastal)**	**Matalascañas (coastal)**	**Chipiona (coastal)**	**Chipiona (offshore)**	**Rota-Trafalgar**	**TOTAL**
	POL06	**POL05**	**POL04**	**POL02**	**POL03**	**POL01**	
4	0	0	0	0	0	0	0
4,5	0	0	0	7156893	0	0	7156893
5	0	0	0	14313786	0	0	14313786
5,5	0	0	0	21470679	0	0	21470679
6	0	0	11633669	57255134	0	0	68888803
6,5	0	0	0	50098248	0	12018090	62116338
7	0	0	59063211	28627567	0	62616276	150307054
7,5	0	0	118126482	14313786	0	113173747	245614015
8	0	0	70696916	7156893	33331134	60171925	171356868
8,5	0	0	70696916	14313786	50005666	28884156	163900524
9	0	0	59063211	14313786	116667935	7210855	197255787
9,5	22508252	201072	70696916	7156893	266675969	2403618	369642720
10	165501880	970986	70696916	0	241673136	0	478842918
10,5	188010121	3400097	11633669	0	150008034	0	353051921
11	76792852	5060454	23267339	0	50005666	0	155126311
11,5	22508252	4917673	11633669	0	16665567	0	55725161
12	22508252	914361	11633669	0	0	0	35056282
12,5	33100370	739351	0	0	0	0	33839721
13	10592118	221649	0	0	8337266	0	19151033
13,5	22508252	263825	0	0	0	0	22772077
14	22508252	62753	0	0	0	0	22571005
14,5	0	201072	0	0	0	0	201072
15	0	184957	0	0	0	0	184957
15,5	0	122204	0	0	0	0	122204
TOTAL	586538601	17260454	588842583	236177451	933370373	286478667	**2648668129**
Millions	**587**	**17**	**589**	**236**	**933**	**286**	**2649**

Table 4 (cont'd)**.**

ECOCÁDIZ-RECLUTAS 1112: ANCHOVY (*E. encrasicolus*). BIOMASS (t)							
Size class (cm)	**I. Cristina-Matalascañas (offshore)**	**I. Cristina- Pta. Umbría (coastal)**	**Matalascañas (coastal)**	**Chipiona (coastal)**	**Chipiona (offshore)**	**Rota-Trafalgar**	**TOTAL**
	POL 06	**POL 05**	**POL 04**	**POL 02**	**POL 03**	**POL 01**	
4	0	0	0	0	0	0	0
4,5	0	0	0	3,826	0	0	3,826
5	0	0	0	10,464	0	0	10,464
5,5	0	0	0	20,858	0	0	20,858
6	0	0	14,667	72,184	0	0	86,851
6,5	0	0	0	80,339	0	19,273	99,612
7	0	0	118,422	57,398	0	125,546	301,366
7,5	0	0	291,742	35,351	0	279,51	606,603
8	0	0	212,289	21,491	100,087	180,685	514,552
8,5	0	0	255,157	51,661	180,479	104,248	591,545
9	0	0	253,608	61,461	500,954	30,962	846,985
9,5	113,934	1,018	357,861	36,227	1349,887	12,167	1871,094
10	979,509	5,747	418,414	0	1430,322	0	2833,992
10,5	1291,352	23,354	79,906	0	1030,334	0	2424,946
11	607,998	40,066	184,216	0	395,914	0	1228,194
11,5	204,154	44,604	105,519	0	151,159	0	505,436
12	232,557	9,447	120,2	0	0	0	362,204
12,5	387,553	8,657	0	0	0	0	396,21
13	139,862	2,927	0	0	110,089	0	252,878
13,5	333,692	3,911	0	0	0	0	337,603
14	373,109	1,04	0	0	0	0	374,149
14,5	0	3,712	0	0	0	0	3,712
15	0	3,79	0	0	0	0	3,79
15,5	0	2,77	0	0	0	0	2,77
TOTAL	**4663,720**	**151,043**	**2412,001**	**451,260**	**5249,225**	**752,391**	**13679,640**

Table 5. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*E. encrasicolus*). Estimated abundance (millions) and biomass (t) by age group and homogeneous post-stratum (Polygons, POL06 to POL01, ordered from west to east).

Age class	POL06	POL05	POL04	POL02	POL03	POL01	TOTAL
	N	N	N	N	N	N	N
0	558	17	589	236	932	286	2619
I	25	1	0	0	1	0	27
II	3	0,01	0	0	0	0	3
III	0	0	0	0	0	0	0
IV	0	0	0	0	0	0	0
TOTAL	586	18	589	236	933	286	2649

Age class	POL06	POL05	POL04	POL02	POL03	POL01	TOTAL
	B	B	B	B	B	B	B
0	4914,240	162,539	2708,676	495,973	5964,677	830,788	15187,309
I	450,139	14,140	0	0	21,816	0	486,745
II	56,271	0,157	0	0	0	0	56,428
III	0	0	0	0	0	0	0
IV	0	0	0	0	0	0	0
TOTAL	5420,649	176,836	2708,676	495,973	5986,493	830,788	15730,481

Table 6. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*E. encrasicolus*). Mean (±SD) size (cm) and weight (g) by age class and homogeneous post-stratum (Polygons, POL06 to POL01, ordered from west to east).

Pescas	Lmed±SD		
	edad 0	edad 1	edad 2
POL 06	11.01±0.94	13.47±0.58	14.00±0.00
POL 05	11.41±0.74	14.18±1.07	14.00±0.00
POL 04	8.91±1.29		
POL 02	6.92±1.18		
POL 03	10.01±0.82	13.00±0.00	
POL 01	7.86±0.56		
Total	9.47±1.60	13.46±0.67	14.00±0.00

Pescas	Wmed±SD		
	edad 0	edad 1	edad 2
POL 06	8.84±2.94	17.77±2.41	19.99±0.00
POL 05	9.80±2.31	21.25±4.86	19.99±0.00
POL 04	4.64±2.32		
POL 02	2.09±1.27		
POL 03	6.43±1.70	15.75±0.00	
POL 01	2.90±0.72		
Total	5.79±2.99	17.75±2.56	19.99±0.00

Table 7. *ECOCÁDIZ-RECLUTAS 1112* survey. Sardine (*S. pilchardus*). Estimated abundance (in numbers and millions) and biomass (t) by size class, homogeneous post-stratum (Polygons, POL04 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: SARDINE (*S. pilchardus*). ABUNDANCE (nº of individuals)**					
Size class (cm)	**I. Cristina- Pta. Umbría**	**Matalascañas-Doñana (offshore)**	**Matalascañas-Doñana (coastal)**	**Chipiona-Cádiz**	**TOTAL**
	POL04	**POL03**	**POL02**	**POL01**	
12	0	0	0	0	0
12,5	0	0	721485	39916	761401
13	0	0	3678060	0	3678060
13,5	28122939	0	11380628	115312	39618879
14	25323568	1067943	29020854	492294	55904659
14,5	45005306	5339715	45505689	1024503	96875213
15	22481125	3203829	32374325	873711	58932990
15,5	25323568	9687772	29461482	1064419	65537241
16	11240562	9687772	10395103	341501	31664938
16,5	8441188	10755712	4663585	115312	23975797
17	11240562	7551884	3496428	0	22288874
17,5	22481125	7551884	3094481	0	33127490
18	28122939	12891601	2108956	0	43123496
18,5	33764740	7551884	6051056	0	47367680
19	39363501	3203829	0	0	42567330
19,5	16882377	0	3094481	0	19976858
20	2799374	1067943	1387472	0	5254789
20,5	2799374	0	4162414	0	6961788
21	0	0	1707010	0	1707010
21,5	0	0	721485	0	721485
22	0	0	1387472	0	1387472
22,5	0	0	721485	0	721485
23	0	1067943	0	0	1067943
TOTAL	323392248	80629711	195133951	4066968	**603222878**
Millions	**323**	**81**	**195**	**4**	**603**

Table 7 (cont'd)**.**

ECOCÁDIZ-RECLUTAS 1112: SARDINE (*S. pilchardus*). BIOMASS (t)					
Size class (cm)	**I. Cristina- Pta. Umbría**	**Matalascañas-Doñana (offshore)**	**Matalascañas-Doñana (coastal)**	**Chipiona-Cádiz**	**TOTAL**
	POL04	**POL03**	**POL02**	**POL01**	
12	0	0	0	0	0
12,5	0	0	10,197	0,564	10,761
13	0	0	59,48	0	59,48
13,5	517,786	0	209,535	2,123	729,444
14	528,37	22,282	605,513	10,272	1166,437
14,5	1059,563	125,713	1071,344	24,12	2280,74
15	594,816	84,768	856,575	23,117	1559,276
15,5	750,162	286,982	872,74	31,531	1941,415
16	371,493	320,174	343,551	11,286	1046,504
16,5	310,211	395,269	171,385	4,238	881,103
17	457,907	307,641	142,434	0	907,982
17,5	1012,195	340,018	139,327	0	1491,54
18	1395,587	639,739	104,656	0	2139,982
18,5	1841,906	411,964	330,092	0	2583,962
19	2354,636	191,646	0	0	2546,282
19,5	1104,748	0	202,496	0	1307,244
20	199,947	76,278	99,101	0	375,326
20,5	217,777	0	323,815	0	541,592
21	0	0	144,345	0	144,345
21,5	0	0	66,186	0	66,186
22	0	0	137,825	0	137,825
22,5	0	0	77,469	0	77,469
23	0	123,741	0	0	123,741
TOTAL	**12717,104**	**3326,215**	**5968,066**	**107,251**	**22118,636**

Table 8. *ECOCÁDIZ-RECLUTAS 1112* survey. Chub mackerel (*S. colias*). Estimated abundance (in numbers and millions) and biomass (t) by size class, homogeneous post-stratum (Polygons, POL04 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: CHUB MACKEREL (*S. colias*). ABUNDANCE (nº of individuals)**					
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Doñana**	**Chipiona-Cádiz**	**Trafalgar (offshore)**	**TOTAL**
	POL04	**POL03**	**POL02**	**POL01**	
14	0	0	0	0	0
14,5	0	0	0	0	0
15	0	507519	0	0	507519
15,5	0	0	0	32563	32563
16	0	0	0	0	0
16,5	322123	0	42362	0	364485
17	322123	507519	203338	293070	1326050
17,5	2697777	1745867	203338	455887	5102869
18	6361923	2700003	160976	1139717	10362619
18,5	3704410	3938351	406676	814084	8863521
19	2013266	5765420	245700	455887	8480273
19,5	2335389	4851886	321952	227943	7737170
20	2335389	7105272	279590	65127	9785378
20,5	1691144	10170689	42362	65127	11969322
21	4026533	10109788	0	65127	14201448
21,5	4711045	14718063	0	0	19429108
22	4026533	8262415	0	32563	12321511
22,5	3704410	9480463	0	32563	13217436
23	1328756	6516549	0	0	7845305
23,5	1691144	12139864	42362	0	13873370
24	684511	5440608	0	0	6125119
24,5	0	1827070	0	0	1827070
25	0	1278949	0	0	1278949
25,5	0	1278949	0	0	1278949
26	0	0	0	0	0
26,5	0	1278949	0	0	1278949
TOTAL	41956476	109624193	1948656	3679658	**157208983**
Millions	**42**	**110**	**2**	**4**	**157**

Table 8 (cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: CHUB MACKEREL (*S. colias*). BIOMASS (t)**					
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Doñana**	**Chipiona-Cádiz**	**Trafalgar (offshore)**	**TOTAL**
	POL04	**POL03**	**POL02**	**POL01**	
14	0	0	0	0	0
14,5	0	0	0	0	0
15	0	11,146	0	0	11,146
15,5	0	0	0	0,798	0,798
16	0	0	0	0	0
16,5	9,73	0	1,28	0	11,01
17	10,752	16,94	6,787	9,782	44,261
17,5	99,226	64,214	7,479	16,768	187,687
18	257,153	109,136	6,507	46,068	418,864
18,5	164,133	174,498	18,019	36,07	392,72
19	97,545	279,34	11,904	22,088	410,877
19,5	123,45	256,473	17,019	12,049	408,991
20	134,392	408,879	16,089	3,748	563,108
20,5	105,725	635,841	2,648	4,072	748,286
21	272,933	685,278	0	4,415	962,626
21,5	345,583	1079,656	0	0	1425,239
22	319,077	654,744	0	2,58	976,401
22,5	316,569	810,175	0	2,783	1129,527
23	122,255	599,569	0	0	721,824
23,5	167,26	1200,673	4,19	0	1372,123
24	72,665	577,556	0	0	650,221
24,5	0	207,879	0	0	207,879
25	0	155,745	0	0	155,745
25,5	0	166,472	0	0	166,472
26	0	0	0	0	0
26,5	0	189,474	0	0	189,474
TOTAL	**2618,448**	**8283,688**	**91,922**	**161,221**	**11155,279**

Table 9. *ECOCÁDIZ-RECLUTAS 1112* survey. Mackerel (*S. scombrus*). Estimated abundance (in numbers and millions) and biomass (t) by size class, homogeneous post-stratum (Polygons, POL02 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: MACKEREL (*S. scombrus*). ABUNDANCE (nº of individuals)**			
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Rota (offshore)**	**TOTAL**
	POL02	**POL01**	
19	0	0	0
19,5	0	0	0
20	0	641261	641261
20,5	0	0	0
21	0	0	0
21,5	0	0	0
22	0	125737	125737
22,5	139989	125737	265726
23	69994	352065	422059
23,5	279978	766999	1046977
24	629949	352065	982014
24,5	419966	829868	1249834
25	139989	2275849	2415838
25,5	419966	251475	671441
26	69994	892736	962730
26,5	279978	603540	883518
27	139989	352065	492054
27,5	139989	125737	265726
28	209983	0	209983
28,5	209983	0	209983
29	209983	0	209983
29,5	69994	0	69994
30	139989	0	139989
30,5	69994	0	69994
TOTAL	3639707	7695134	**11334841**
Millions	**4**	**8**	**11**

Table 9 (cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: MACKEREL (*S. scombrus*). BIOMASS (t)**			
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Rota (offshore)**	**TOTAL**
	POL02	**POL01**	
19	0	0	0
19,5	0	0	0
20	0	26,191	26,191
20,5	0	0	0
21	0	0	0
21,5	0	0	0
22	0	7,436	7,436
22,5	9,034	8,114	17,148
23	4,920	24,746	29,666
23,5	21,396	58,614	80,010
24	52,248	29,200	81,448
24,5	37,740	74,576	112,316
25	13,609	221,244	234,853
25,5	44,097	26,405	70,502
26	7,926	101,097	109,023
26,5	34,146	73,608	107,754
27	18,362	46,179	64,541
27,5	19,722	17,714	37,436
28	31,734	0	31,734
28,5	33,999	0	33,999
29	36,382	0	36,382
29,5	12,963	0	12,963
30	27,680	0	27,68
30,5	14,761	0	14,761
TOTAL	**420,719**	**715,124**	**1135,843**

Table 10. *ECOCÁDIZ-RECLUTAS 1112* survey. Horse-mackerel (*T. trachurus*). Estimated abundance (in numbers and millions) and biomass (t) by size class. homogeneous post-stratum (Polygons, POL04 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: HORSE-MACKEREL (*T. trachurus*). ABUNDANCE (nº of individuals)**						
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Doñana (offshore)**	**Matalascañas-Doñana (coastal)**	**Rota-Trafalgar (offshore)**	**Chipiona-Trafalgar (coastal)**	**TOTAL**
	POL05	**POL04**	**POL03**	**POL02**	**POL01**	
9	0	0	0	0	0	0
9,5	0	0	0	0	0	0
10	0	0	1965899	0	571581	2537480
10,5	6568783	0	6389172	775548	8570368	22303871
11	65875524	201264	17338138	7755481	36513946	127684353
11,5	197579635	1189828	21269932	7561595	51203193	278804183
12	125135312	1687070	32537453	2714418	37850480	199924733
12,5	79013068	4569889	28787675	1163322	19619036	133152990
13	39506534	1485805	19131109	387774	15402102	75913324
13,5	6568783	7648052	11130993	193887	14154084	39695799
14	6568783	793219	21370044	387774	17367358	46487178
14,5	6568783	597874	21370044	0	15309820	43846521
15	0	497242	18193671	581661	11228049	30500623
15,5	0	201264	12068435	0	7886070	20155769
16	0	100632	5542743	387774	5780833	11811982
16,5	0	0	491475	193887	7713084	8398446
17	0	100632	2011406	0	1143162	3255200
17,5	0	0	1519931	0	571581	2091512
18	0	0	0	0	571581	571581
18,5	0	0	0	0	0	0
19	0	0	0	0	571581	571581
19,5	0	0	1028456	0	0	1028456
20	0	0	0	0	0	0
20,5	0	0	0	0	0	0
21	0	0	0	0	0	0
21,5	0	0	0	0	0	0
22	0	0	0	0	0	0
22,5	0	0	0	0	0	0
23	0	0	0	0	0	0
23,5	0	0	0	0	19627	19627
24	0	0	0	0	19627	19627
TOTAL	533385205	19072771	222146576	22103121	252067163	**1048774836**
Millions	**533**	**19**	**222**	**22**	**252**	**1049**

Table 10 (cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: HORSE-MACKEREL (*T. trachurus*). BIOMASS (t)**						
Size class (cm)	**I. Cristina-Pta. Umbría**	**Matalascañas-Doñana (offshore)**	**Matalascañas-Doñana (coastal)**	**Rota-Trafalgar (offshore)**	**Chipiona-Trafalgar (coastal)**	**TOTAL**
	POL05	**POL04**	**POL03**	**POL02**	**POL01**	
9	0	0	0	0	0	0
9,5	0	0	0	0	0	0
10	0	0	15,349	0	4,463	19,812
10,5	59,19	0	57,572	6,988	77,226	200,976
11	680,613	2,079	179,134	80,128	377,255	1319,209
11,5	2326,722	14,012	250,477	89,046	602,975	3283,232
12	1670,474	22,521	434,354	36,236	505,279	2668,864
12,5	1189,7	68,809	433,456	17,516	295,404	2004,885
13	667,844	25,117	323,405	6,555	260,367	1283,288
13,5	124,136	144,531	210,351	3,664	267,481	750,163
14	138,22	16,691	449,669	8,160	365,444	978,184
14,5	153,334	13,956	498,837	0	357,375	1023,502
15	0	12,832	469,502	15,01	289,749	787,093
15,5	0	5,723	343,184	0	224,252	573,159
16	0	3,144	173,157	12,114	180,595	369,01
16,5	0	0	16,820	6,635	263,965	287,42
17	0	3,763	75,207	0	42,743	121,713
17,5	0	0	61,933	0	23,290	85,223
18	0	0	0	0	25,321	25,321
18,5	0	0	0	0	0	0
19	0	0	0	0	29,73	29,730
19,5	0	0	57,784	0	0	57,784
20	0	0	0	0	0	0
20,5	0	0	0	0	0	0
21	0	0	0	0	0	0
21,5	0	0	0	0	0	0
22	0	0	0	0	0	0
22,5	0	0	0	0	0	0
23	0	0	0	0	0	0
23,5	0	0	0	0	1,921	1,921
24	0	0	0	0	2,045	2,045
TOTAL	**7010,233**	**333,178**	**4050,191**	**282,052**	**4196,880**	**15872,534**

Table 11. *ECOCÁDIZ-RECLUTAS 1112* survey. Mediterranean horse-mackerel (*T. mediterraneus*). Estimated abundance (in numbers and millions) and biomass (t) by size class. homogeneous post-stratum (Polygons, POL03 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: MEDITERRANEAN HORSE-MACKEREL (*T. mediterraneus*). ABUNDANCE (nº of individuals)**				
Size class (cm)	**Matalascañas**	**Doñana**	**Rota-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
8	0	0	0	0
8,5	0	0	0	0
9	991954	0	1966553	2958507
9,5	2975864	0	4719697	7695561
10	8927590	63008	5899621	14890219
10,5	21823002	0	4719697	26542699
11	26782768	63008	6686250	33532026
11,5	24798861	0	5112991	29911852
12	10911496	63008	786629	11761133
12,5	4959772	0	786629	5746401
13	991954	0	393295	1385249
13,5	2975864	0	0	2975864
14	0	0	0	0
14,5	0	0	0	0
15	0	0	393295	393295
15,5	0	0	393295	393295
…	…	…	…	…

Table 11 (Abundance. Cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: MEDITERRANEAN HORSE-MACKEREL (*T. mediterraneus*). ABUNDANCE (nº of individuals)**				
Size class (cm)	**Matalascañas**	**Doñana**	**Rota-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
…	…	…	…	…
22	0	0	39831	39831
22,5	0	0	79663	79663
23	0	0	0	0
23,5	0	0	0	0
24	0	0	0	0
24,5	0	0	0	0
25	0	0	0	0
25,5	0	0	39831	39831
26	0	0	398314	398314
26,5	0	0	278819	278819
27	991954	0	517808	1509762
27,5	0	0	557639	557639
28	0	126015	557639	683654
28,5	0	630077	238988	869065
29	0	693084	278819	971903
29,5	0	1134138	79663	1213801
30	0	441054	0	441054
30,5	0	567069	0	567069
31	0	252031	0	252031
31,5	0	252031	0	252031
32	0	189023	0	189023
32,5	0	126015	39831	165846
33	0	0	0	0
33,5	0	0	0	0
34	0	63008	0	63008
34,5	0	63008	0	63008
35	0	0	0	0
35,5	0	63008	0	63008
36	991954	0	0	991954
TOTAL	108123033	4788585	34964797	**147876415**
Millions	**108**	**5**	**35**	**148**

Table 11 (Biomass. Cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: MEDITERRANEAN HORSE-MACKEREL (*T. mediterraneus*). BIOMASS (t)**				
Size class (cm)	**Matalascañas**	**Doñana**	**Rota-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
8	0	0	0	0
8,5	0	0	0	0
9	5,596	0	11,093	16,689
9,5	19,688	0	31,225	50,913
10	68,719	0,485	45,412	114,616
10,5	194,038	0	41,965	236,003
11	273,281	0,643	68,224	342,148
11,5	288,647	0	59,513	348,160
12	144,085	0,832	10,387	155,304
12,5	73,927	0	11,725	85,652
13	16,612	0	6,586	23,198
13,5	55,749	0	0	55,749
14	0	0	0	0
14,5	0	0	0	0
15	0	0	10,081	10,081
15,5	0	0	11,115	11,115
…	…	…	…	…

Table 11 (Biomass. Cont'd)**.**

ECOCÁDIZ-RECLUTAS 1112: MEDITERRANEAN HORSE-MACKEREL (*T. mediterraneus*). BIOMASS (t)				
Size class (cm)	**Matalascañas**	**Doñana**	**Rota-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
…	…	…	…	…
22	0	0	3,204	3
22,5	0	0	6,855	7
23	0	0	0	0
23,5	0	0	0	0
24	0	0	0	0
24,5	0	0	0	0
25	0	0	0	0
25,5	0	0	4,987	4,987
26	0	0	52,862	52,862
26,5	0	0	39,179	39,179
27	147,424	0	76,957	224,381
27,5	0	0	87,567	87,567
28	0	20,888	92,432	113,320
28,5	0	110,137	41,775	151,912
29	0	127,643	51,349	178,992
29,5	0	219,869	15,444	235,313
30	0	89,930	0	89,930
30,5	0	121,509	0	121,509
31	0	56,707	0	56,707
31,5	0	59,499	0	59,499
32	0	46,786	0	46,786
32,5	0	32,678	10,329	43,007
33	0	0	0	0
33,5	0	0	0	0
34	0	18,712	0	18,712
34,5	0	19,551	0	19,551
35	0	0	0	0
35,5	0	21,305	0	21,305
36	349,816	0	0	349,816
TOTAL	**1637,582**	**947,174**	**790,266**	**3375,022**

Table 12. *ECOCÁDIZ-RECLUTAS 1112* survey. Blue jack mackerel (*T. picturatus*). Estimated abundance (in numbers and millions) and biomass (t) by size class. homogeneous post-stratum (Polygons, POL03 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: BLUE JACK MACKEREL (*T. picturatus*). ABUNDANCE (nº of individuals)**				
Size class (cm)	**I. Cristina-Mazagón**	**Matalascañas-Cádiz**	**Sancti-Petri-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
11	0	0	0	0
11,5	0	0	32754	32754
12	212203	53060	98264	363527
12,5	212203	0	229282	441485
13	689660	300458	589581	1579699
13,5	689660	0	393054	1082714
14	2281183	318358	196527	2796068
14,5	3872705	2353268	262036	6488009
15	6790497	2705826	65509	9561832
15,5	3183047	2962068	229282	6374397
16	1114066	3546895	0	4660961
16,5	689660	1503142	0	2192802
17	212203	459637	131018	802858
17,5	0	353517	65509	419026
18	0	353517	32754	386271
18,5	0	53060	98264	151324
19	0	0	65509	65509
19,5	0	0	65509	65509
TOTAL	19947087	14962806	2554852	**37464745**
Millions	**20**	**15**	**3**	**37**

Table 12 (cont'd)**.**

***ECOCÁDIZ-RECLUTAS 1112*: BLUE JACK MACKEREL (*T. picturatus*). BIOMASS (t)**				
Size class (cm)	**I. Cristina-Mazagón**	**Matalascañas-Cádiz**	**Sancti-Petri-Trafalgar**	**TOTAL**
	POL03	**POL02**	**POL01**	
11	0	0	0	0
11,5	0	0	0,367	0,367
12	2,706	0,677	1,253	4,636
12,5	3,066	0	3,312	6,378
13	11,232	4,893	9,602	25,727
13,5	12,606	0	7,184	19,790
14	46,603	6,504	4,015	57,122
14,5	88,089	53,528	5,960	147,577
15	171,36	68,282	1,653	241,295
15,5	88,817	82,651	6,398	177,866
16	34,264	109,089	0	143,353
16,5	23,311	50,808	0	74,119
17	7,861	17,027	4,854	29,742
17,5	0	14,315	2,653	16,968
18	0	15,609	1,446	17,055
18,5	0	2,549	4,720	7,269
19	0	0	3,415	3,415
19,5	0	0	3,699	3,699
TOTAL	**489,915**	**425,932**	**60,531**	**976,378**

Table 13. *ECOCÁDIZ-RECLUTAS 1112* survey. Bogue (*B. boops*). Estimated abundance (in numbers and millions) and biomass (t) by size class. homogeneous post-stratum (Polygons, POL02 to POL01, ordered from west to east), and total area.

***ECOCÁDIZ-RECLUTAS 1112*: BOGUE (*B. boops*) ABUNDANCE (nº of individuals)**			
Size class (cm)	**Mazagón-Doñana**	**Chipiona-Trafalgar**	**TOTAL**
	POL02	**POL01**	
9	0	0	0
9,5	0	0	0
10	100567	47490	148057
10,5	100567	47490	148057
11	301701	142469	444170
11,5	402268	189958	592226
12	502835	237448	740283
12,5	402268	189958	592226
13	0	0	0
13,5	0	0	0
14	0	0	0
14,5	0	0	0
15	201134	94979	296113
15,5	100567	47490	148057
16	0	0	0
16,5	100567	47490	148057
17	0	0	0
17,5	402268	189958	592226
18	100567	47490	148057
18,5	0	0	0
19	502835	237448	740283
19,5	0	0	0
20	100567	47490	148057
20,5	100567	47490	148057
21	502835	237448	740283
21,5	100567	47490	148057
22	100567	47490	148057
22,5	201134	94979	296113
23	100567	47490	148057
23,5	0	0	0
24	100567	47490	148057
24,5	0	0	0
TOTAL	4525515	2137035	**6662550**
Millions	**5**	**2**	**7**

Table 13 (cont'd).

ECOCÁDIZ-RECLUTAS 1112: BOGUE (*B. boops*) BIOMASS (t)			
Size class (cm)	**Mazagón-Doñana**	**Chipiona-Trafalgar**	**TOTAL**
	POL02	**POL01**	
9	0	0	0
9,5	0	0	0
10	0,838	0,396	1,234
10,5	0,981	0,463	1,444
11	3,422	1,616	5,038
11,5	5,270	2,489	7,759
12	7,564	3,572	11,136
12,5	6,910	3,263	10,173
13	0	0	0
13,5	0	0	0
14	0	0	0
14,5	0	0	0
15	6,257	2,955	9,212
15,5	3,482	1,644	5,126
16	0	0	0
16,5	4,270	2,017	6,287
17	0	0	0
17,5	20,704	9,777	30,481
18	5,676	2,680	8,356
18,5	0	0	0
19	33,871	15,994	49,865
19,5	0	0	0
20	8,013	3,784	11,797
20,5	8,688	4,103	12,791
21	47,012	22,20	69,212
21,5	10,156	4,796	14,952
22	10,952	5,172	16,124
22,5	23,579	11,134	34,713
23	12,671	5,983	18,654
23,5	0	0	0
24	14,570	6,880	21,450
24,5	0	0	0
TOTAL	**110,918**	**234,886**	**345,804**

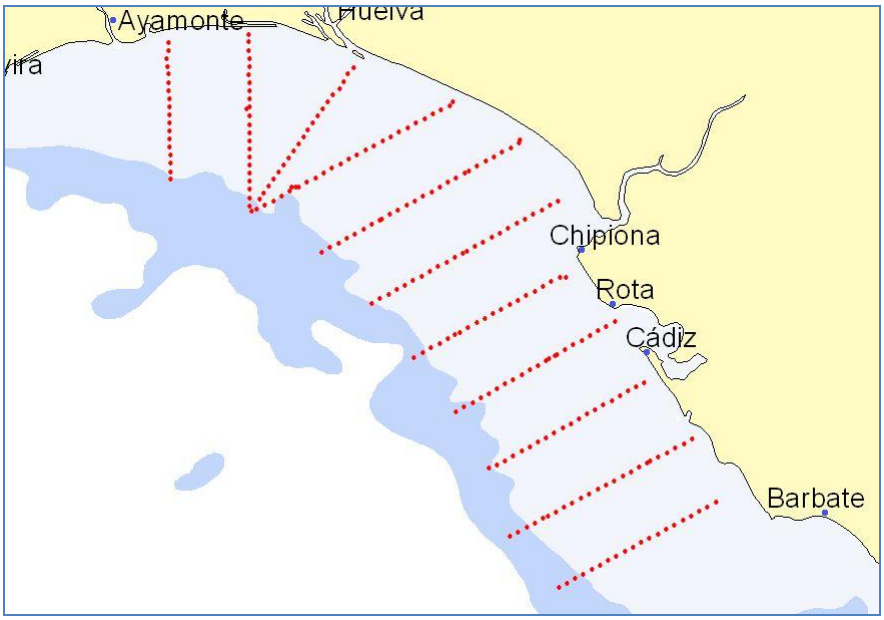

Figure 1. *ECOCÁDIZ-RECLUTAS 1112* survey. The grid of 11 transects for acoustic sampling. This set of transects corresponds to the same one sampled in the summer standard survey (ECOCÁDIZ series) but with the shallower limit extended to the 10 m depth isobaths. The sampled area in this survey only included the Spanish shelf of the Gulf of Cádiz.

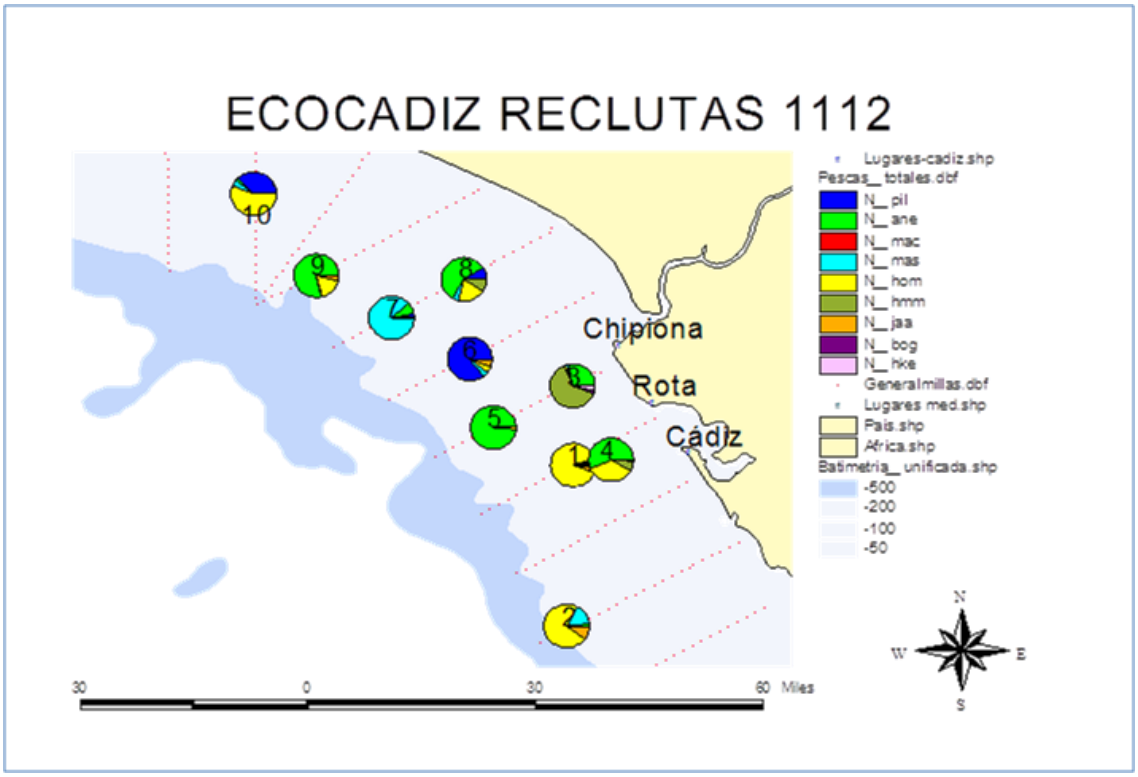

Figure 2. *ECOCÁDIZ-RECLUTAS 1112* survey. Location of valid fishing stations with indication of their species composition (percentages in number).

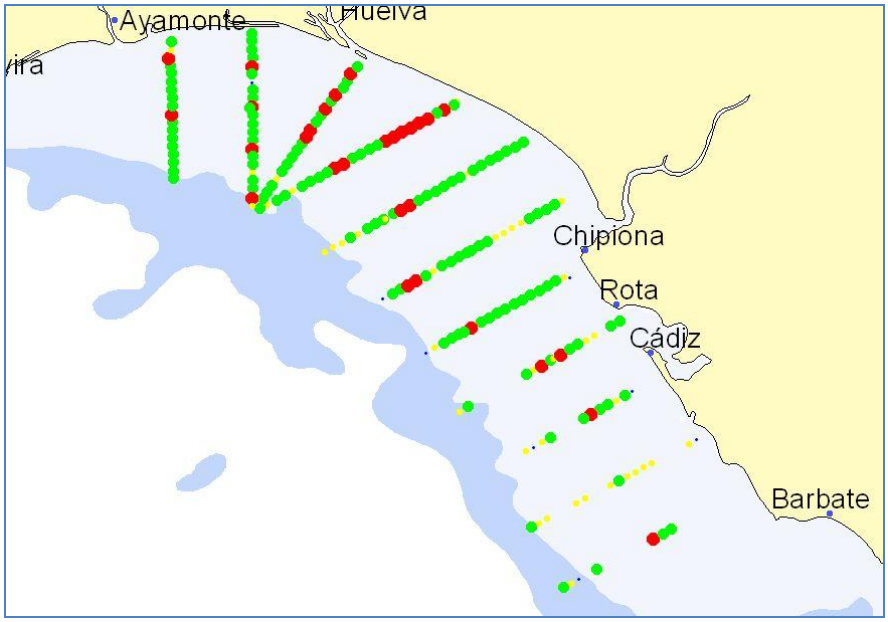

Figure 3. *ECOCÁDIZ-RECLUTAS 1112* survey. Distribution of the total backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the pelagic fish species assemblage.

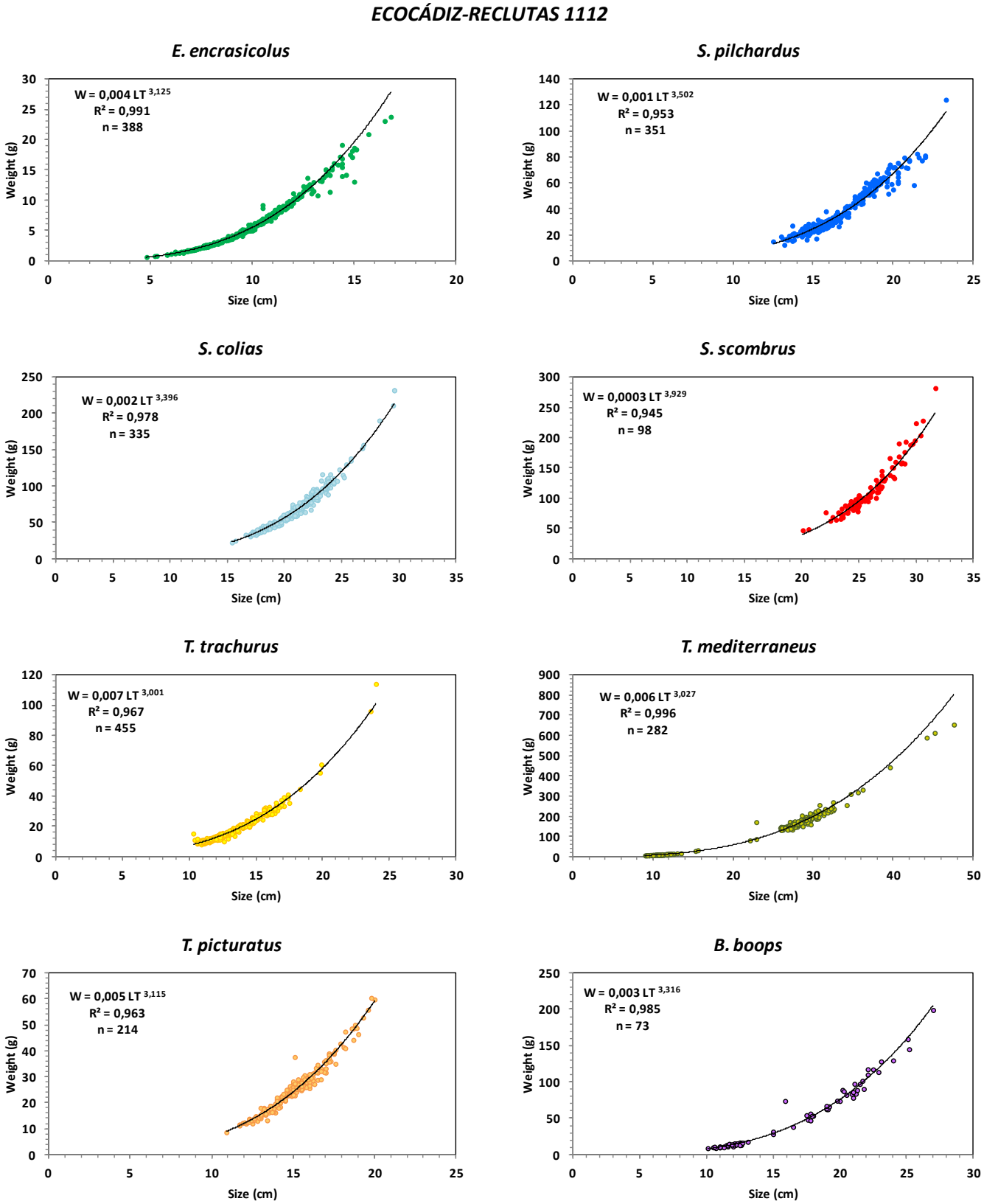

Figure 4. *ECOCÁDIZ-RECLUTAS 1112* survey. Size-weight relationships of the assessed species.

***ECOCÁDIZ-RECLUTAS 1112*: Anchovy (*E. encrasicolus*)**

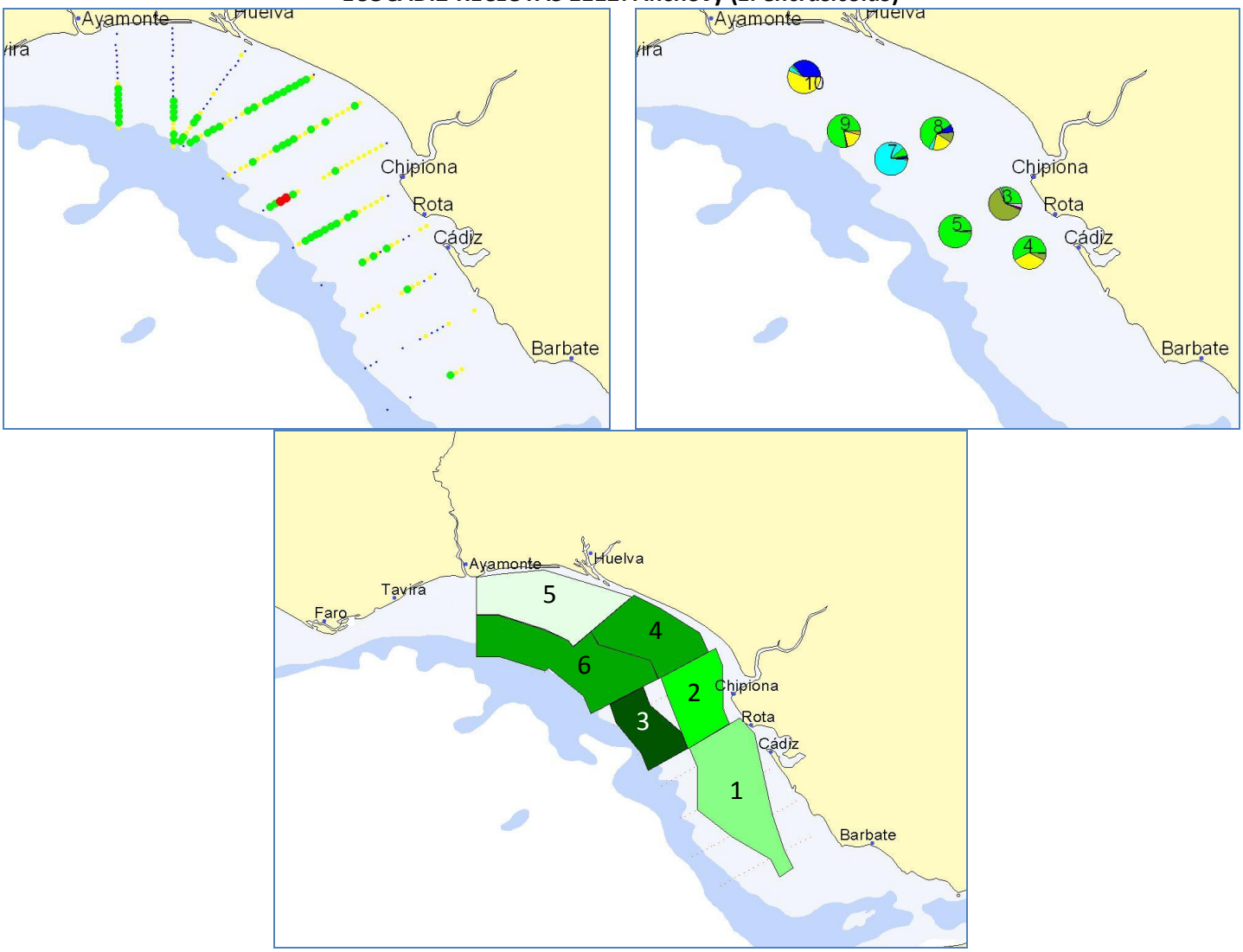

Figure 5. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*Engraulis encrasicolus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

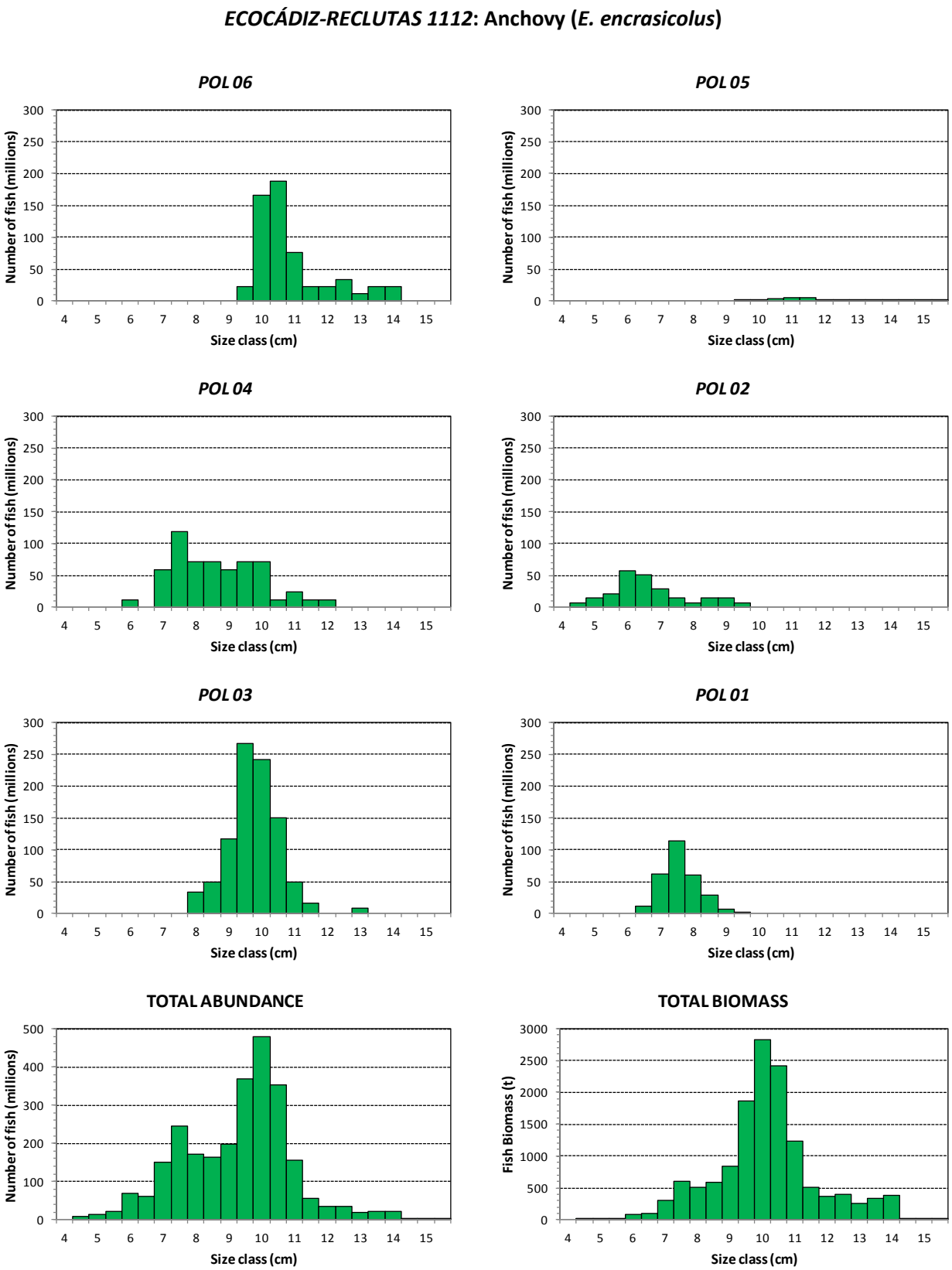

Figure 6. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*E. encrasicolus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 5) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

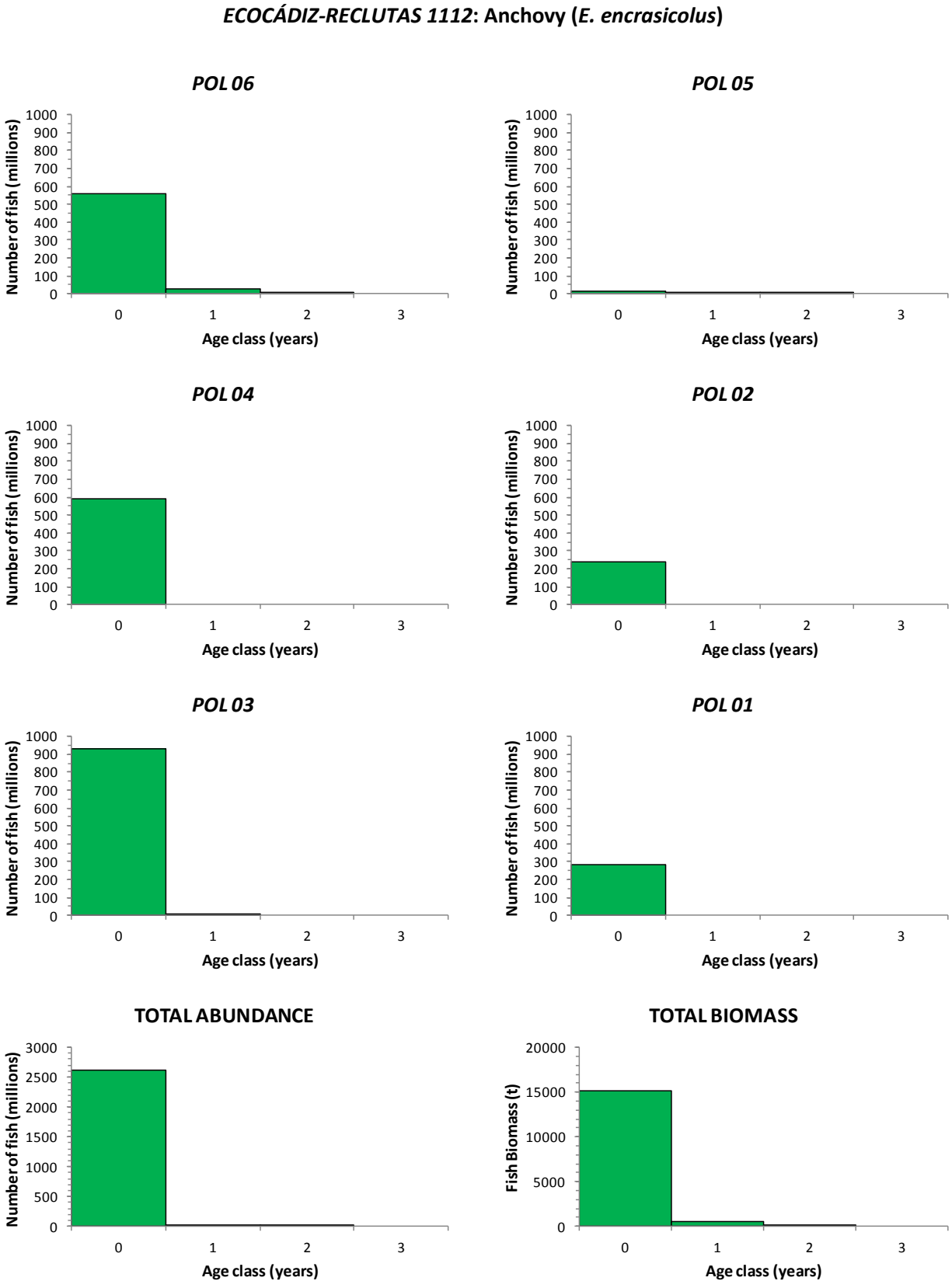

Figure 7. *ECOCÁDIZ-RECLUTAS 1112* survey. Anchovy (*E. encrasicolus*). Estimated abundance (number of fish in millions) by age group by homogeneous stratum (POL01-POLn, numeration as in Figure 5) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by age class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Sardine (*S. pilchardus*)**

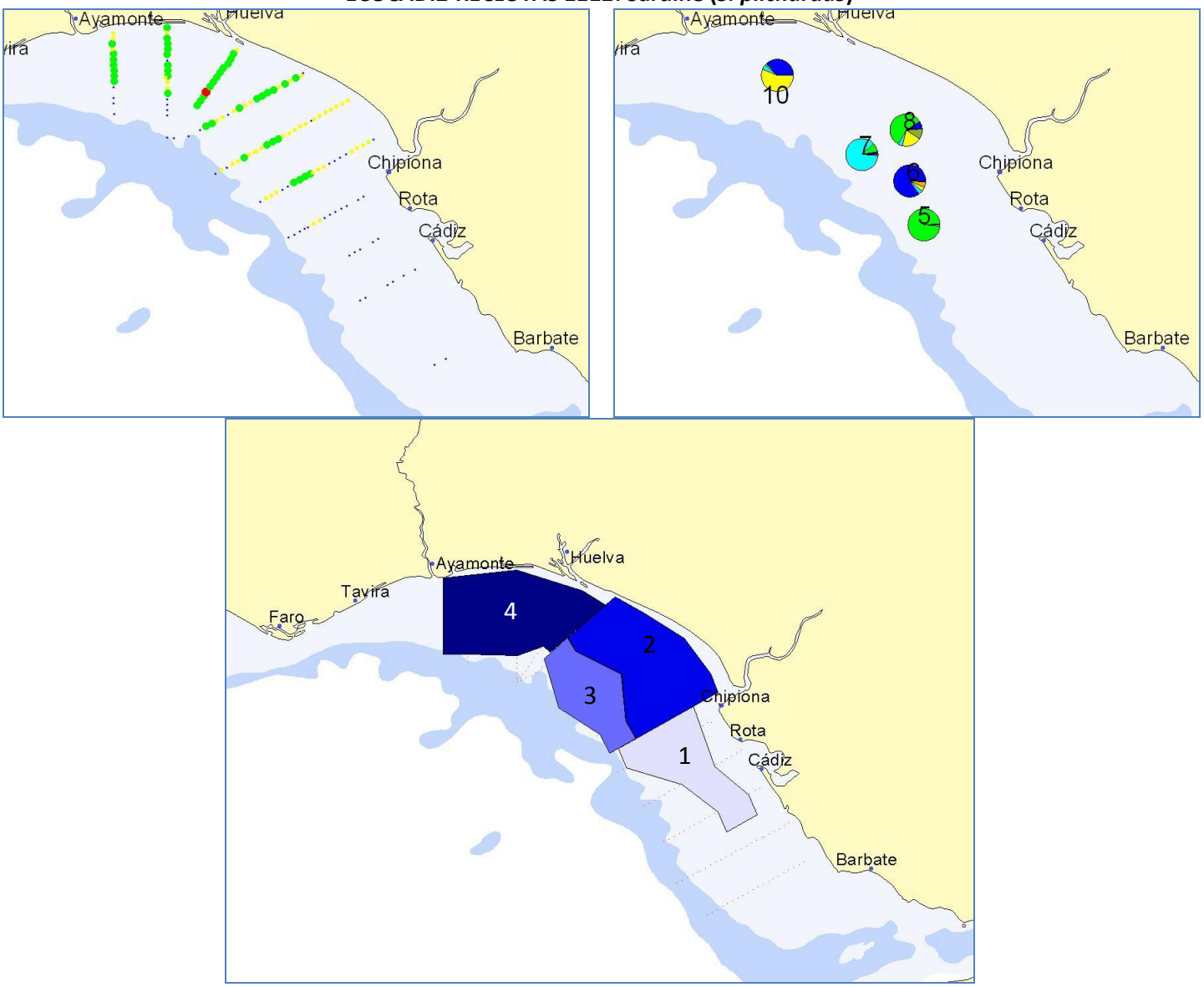

Figure 8. *ECOCÁDIZ-RECLUTAS 1112* survey. Sardine (*Sardina pilchardus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

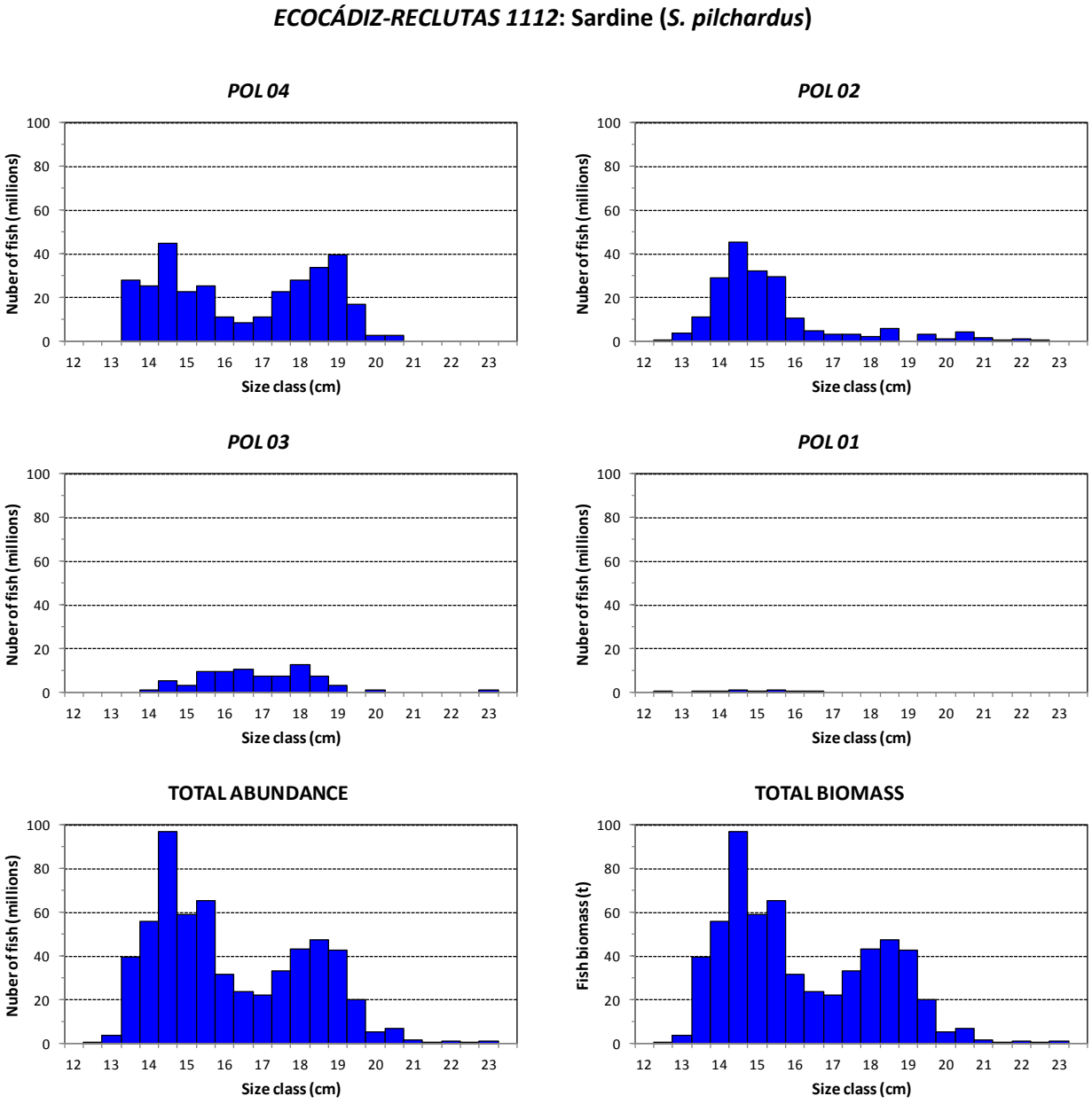

Figure 9. *ECOCÁDIZ-RECLUTAS 1112* survey. Sardine (*S. pilchardus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 8) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Chub mackerel (*S. colias*)**

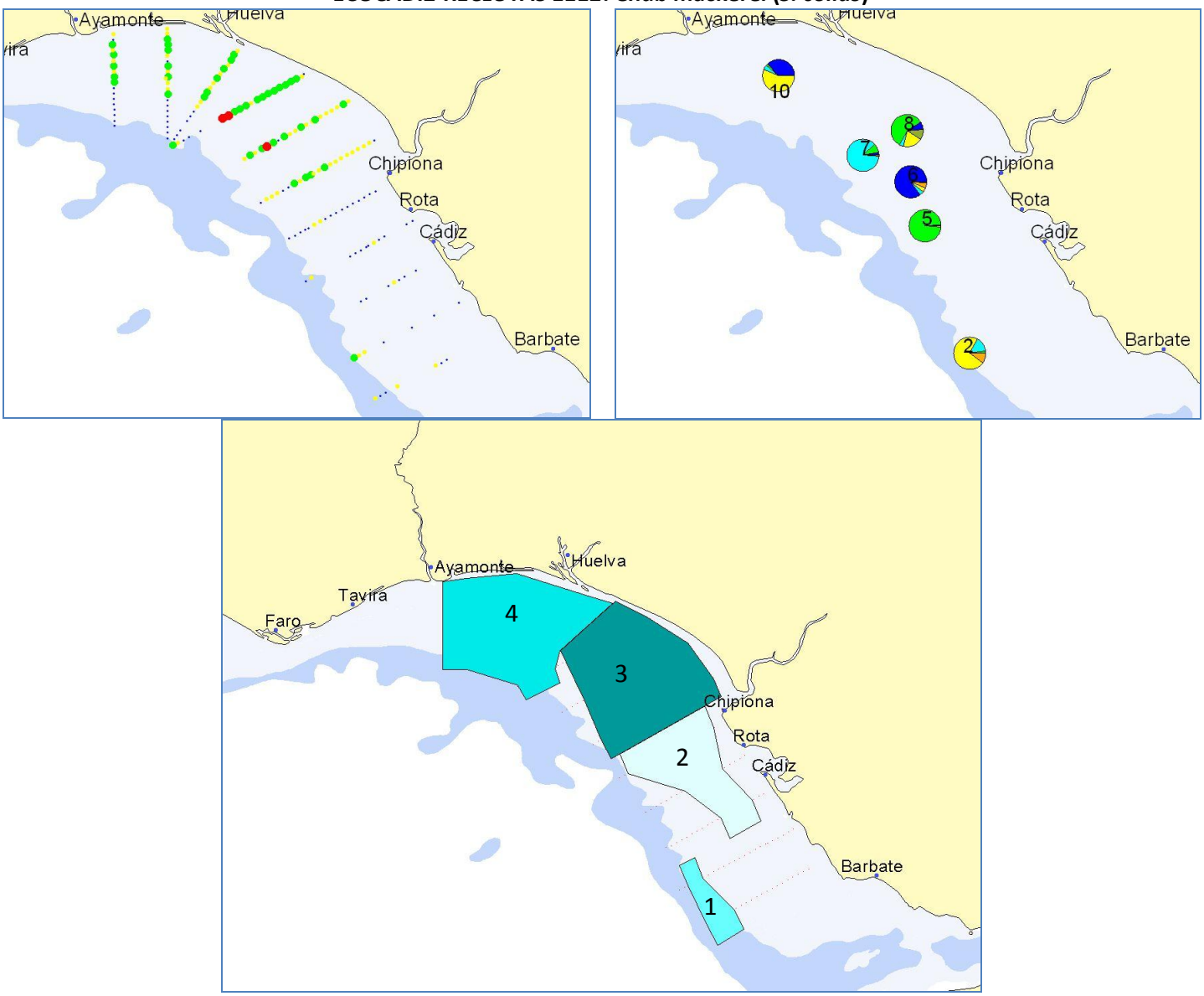

Figure 10. *ECOCÁDIZ-RECLUTAS 1112* survey. Chub mackerel (*Scomber colias*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

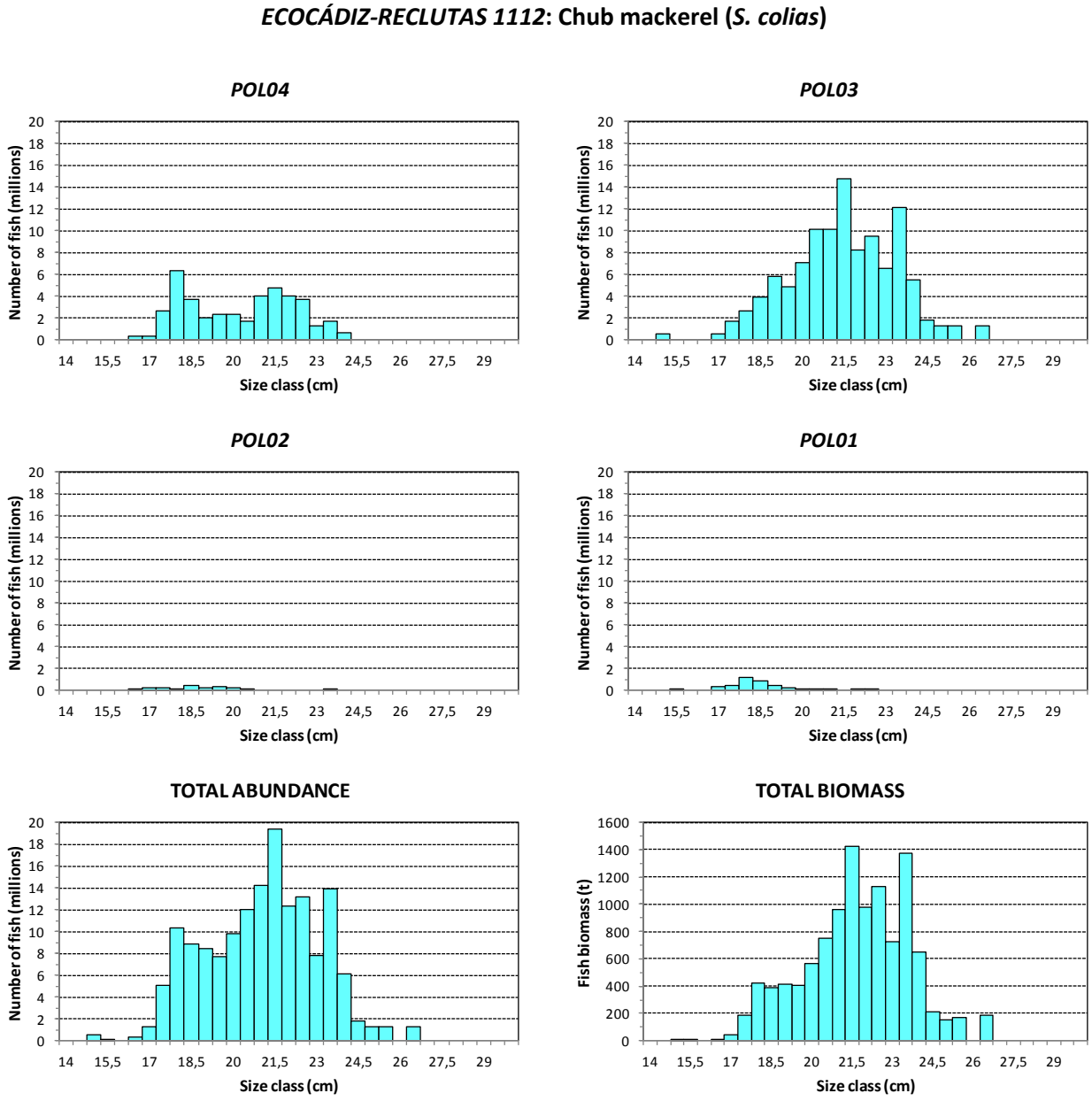

Figure 11. *ECOCÁDIZ-RECLUTAS 1112* survey. Chub mackerel (*S. colias*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 10) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Mackerel (*S. scombrus*)**

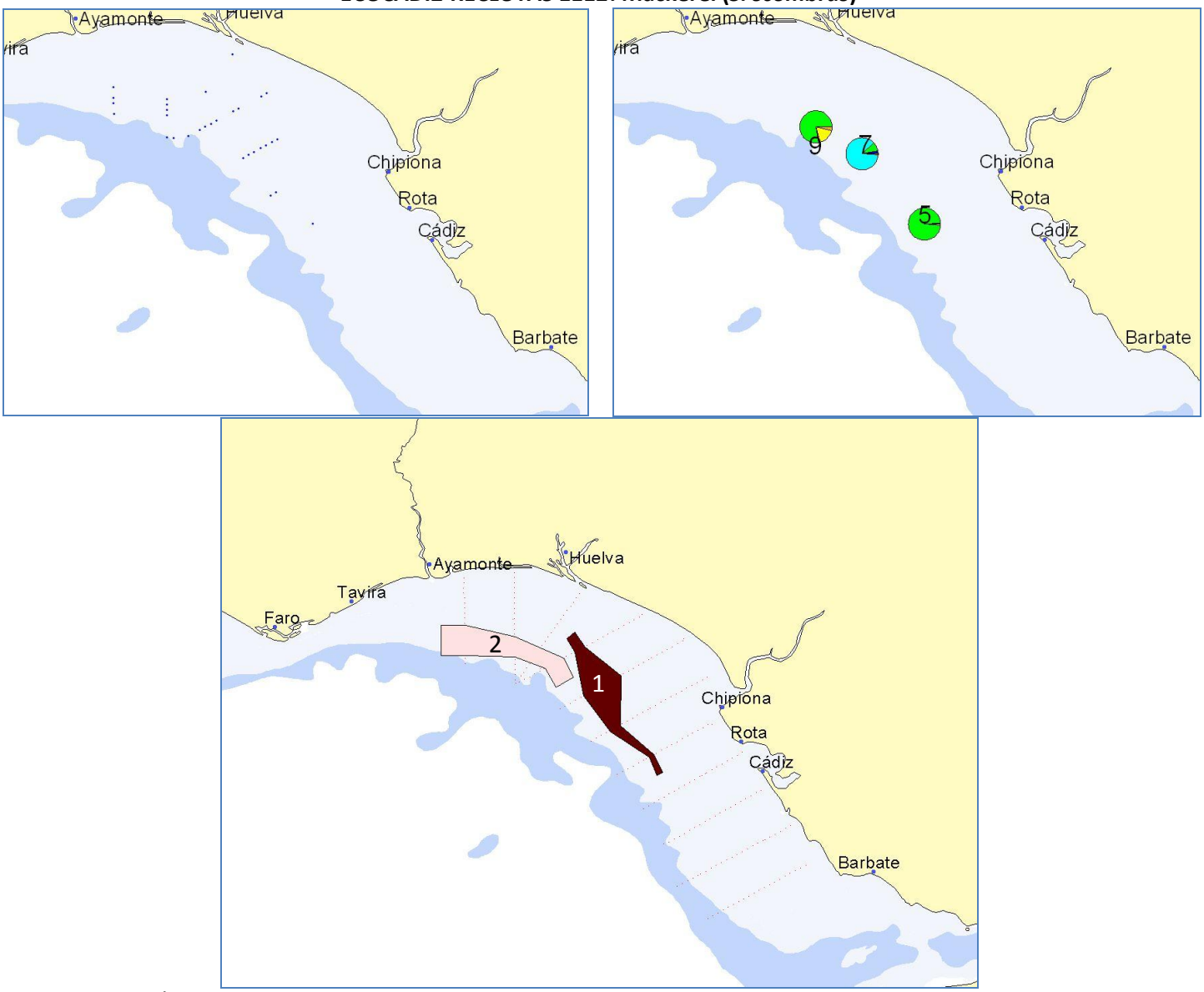

Figure 12. *ECOCÁDIZ-RECLUTAS 1112* survey. Mackerel (*Scomber scombrus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

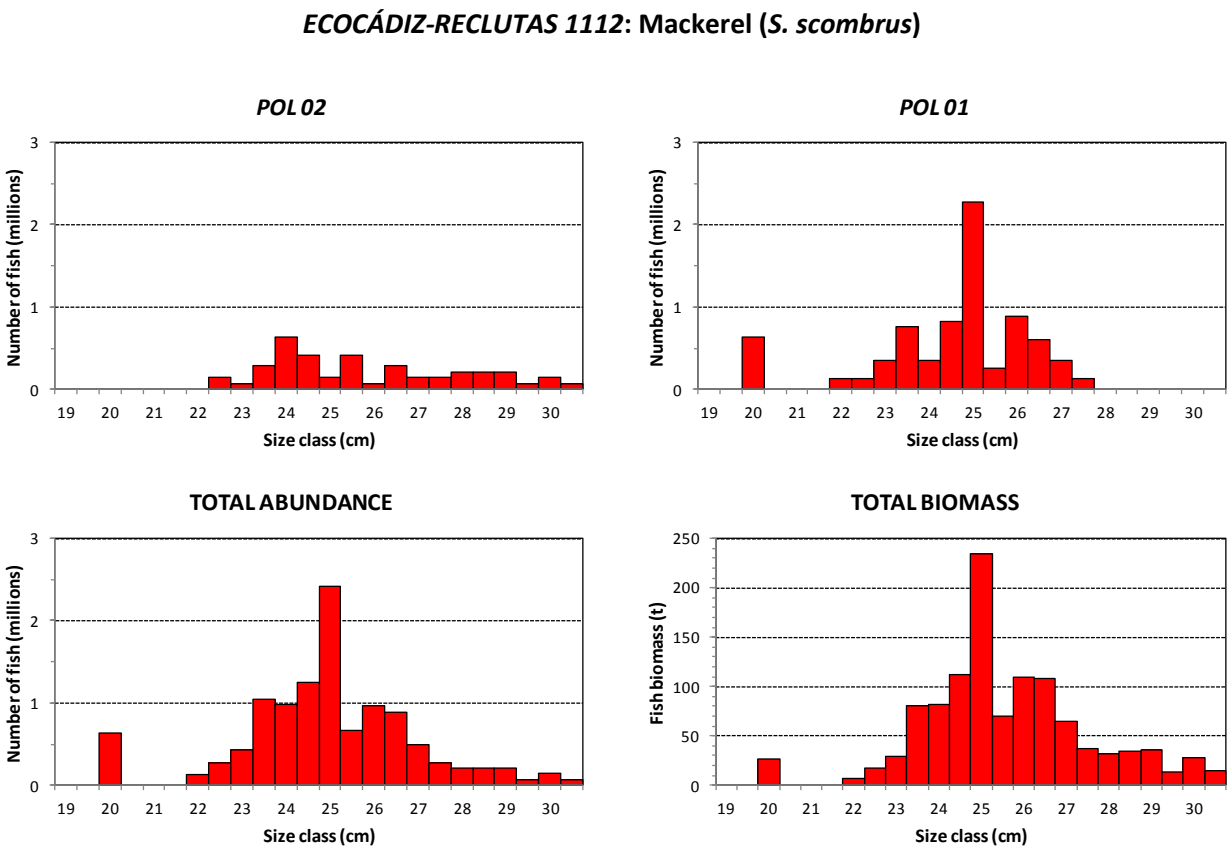

Figure 13. *ECOCÁDIZ-RECLUTAS 1112* survey. Mackerel (*Scomber scombrus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 12) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Horse mackerel (*T. trachurus*)**

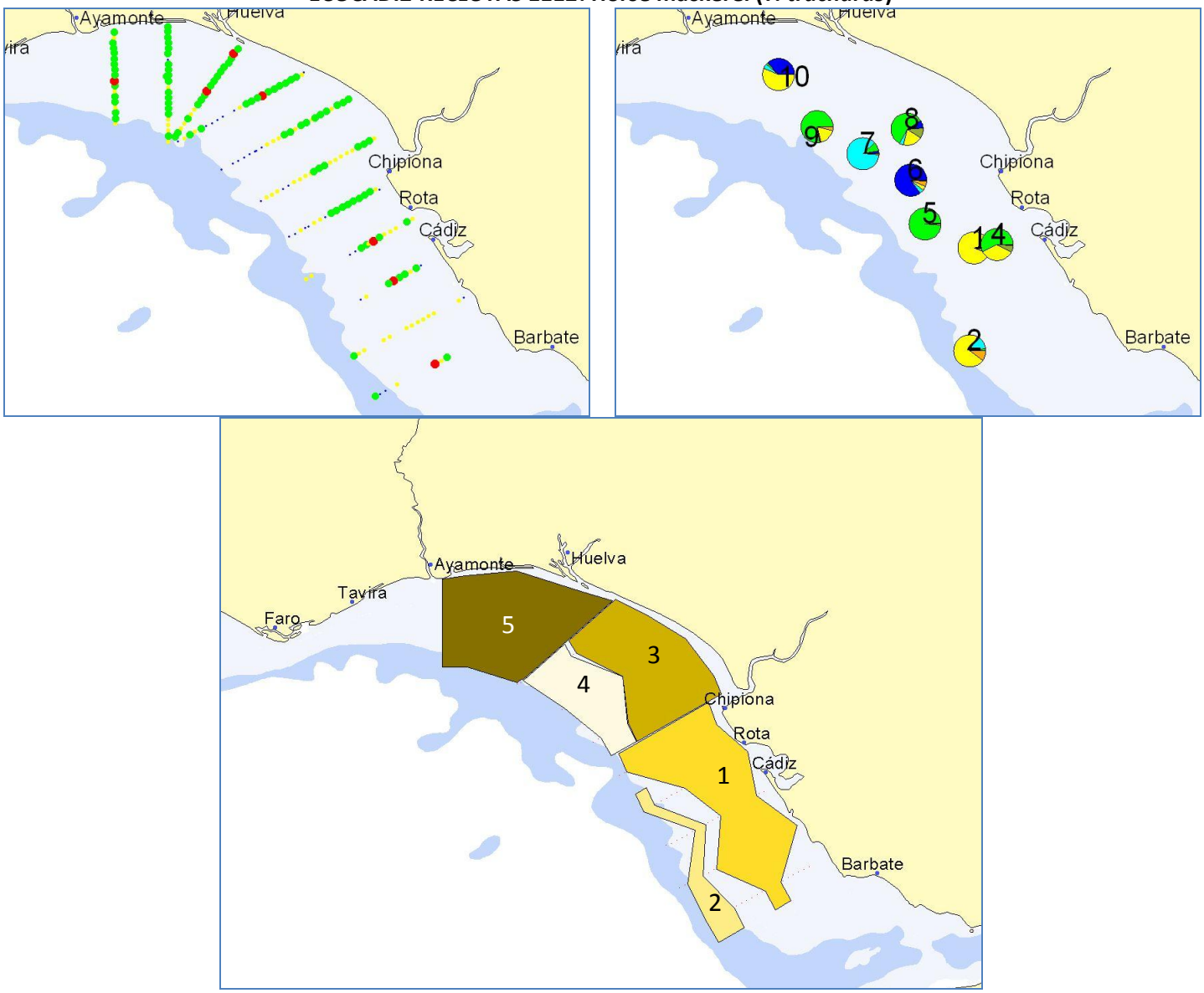

Figure 14. *ECOCÁDIZ-RECLUTAS 1112* survey. Horse-mackerel (*Trachurus trachurus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

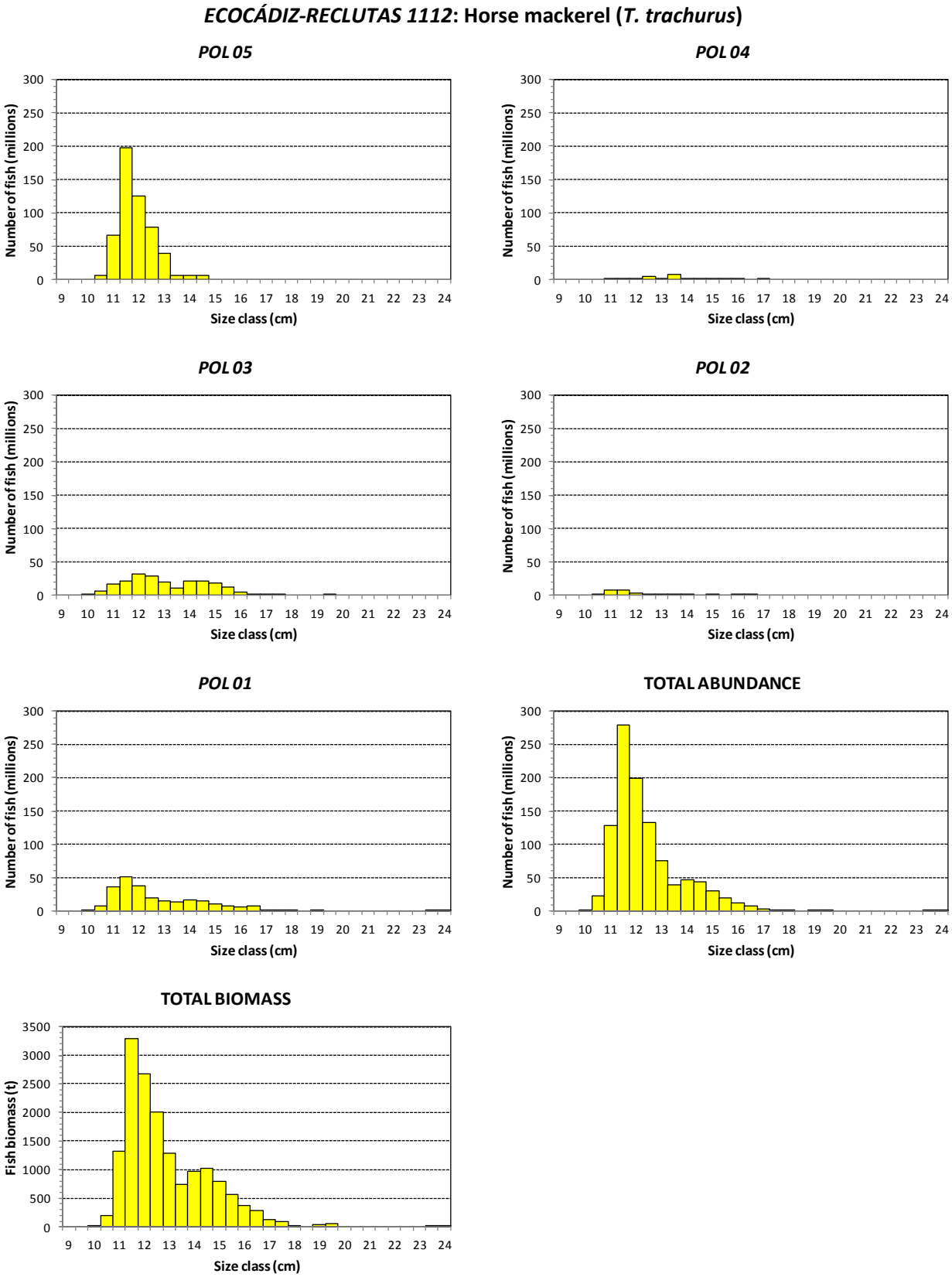

Figure 15. *ECOCÁDIZ-RECLUTAS 1112* survey. Horse-mackerel (*Trachurus trachurus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 14) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Mediterranean horse mackerel (*T. mediterraneus*)**

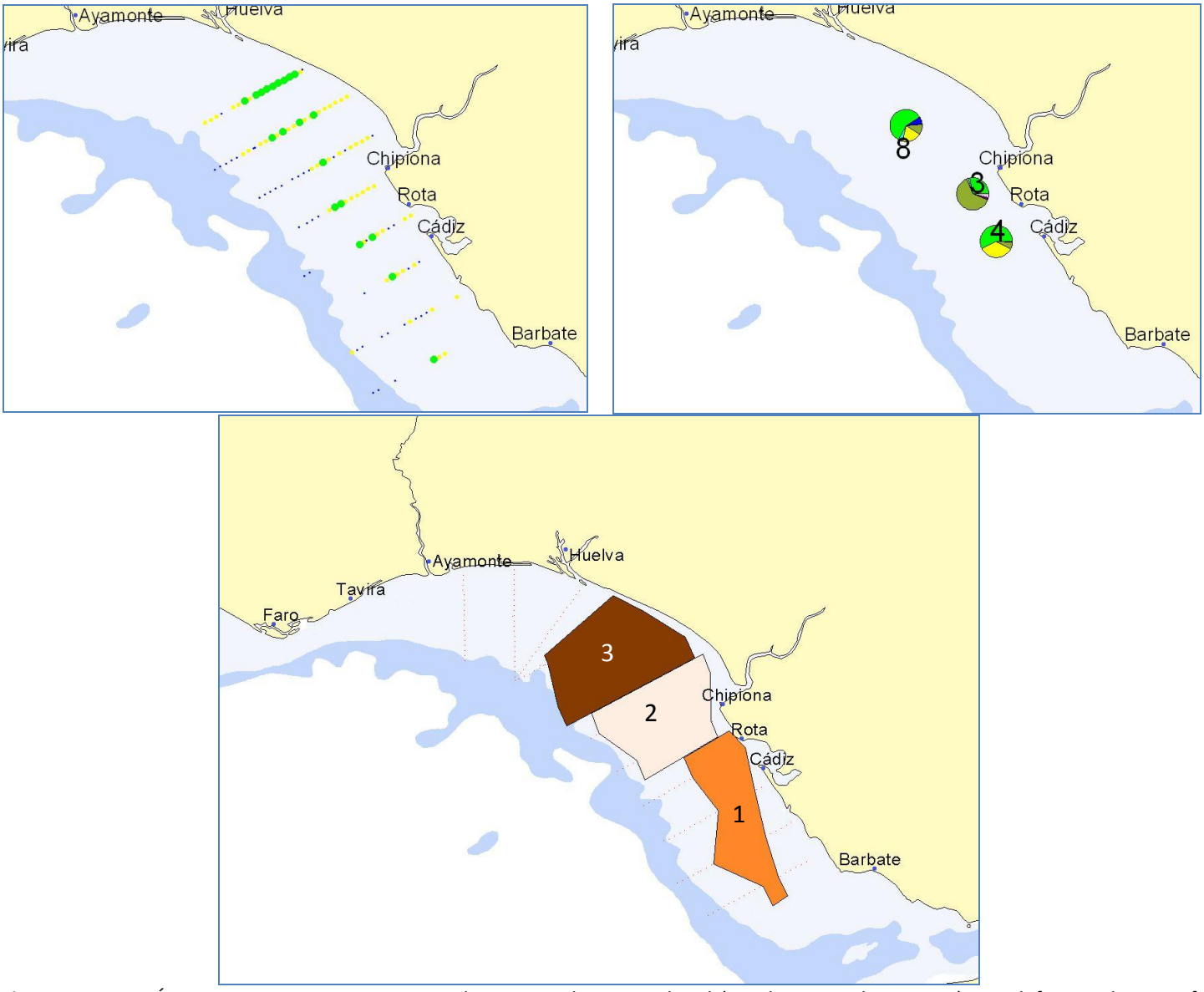

Figure 16. *ECOCÁDIZ-RECLUTAS 1112* survey. Mediterranean horse-mackerel (*Trachurus mediterraneus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

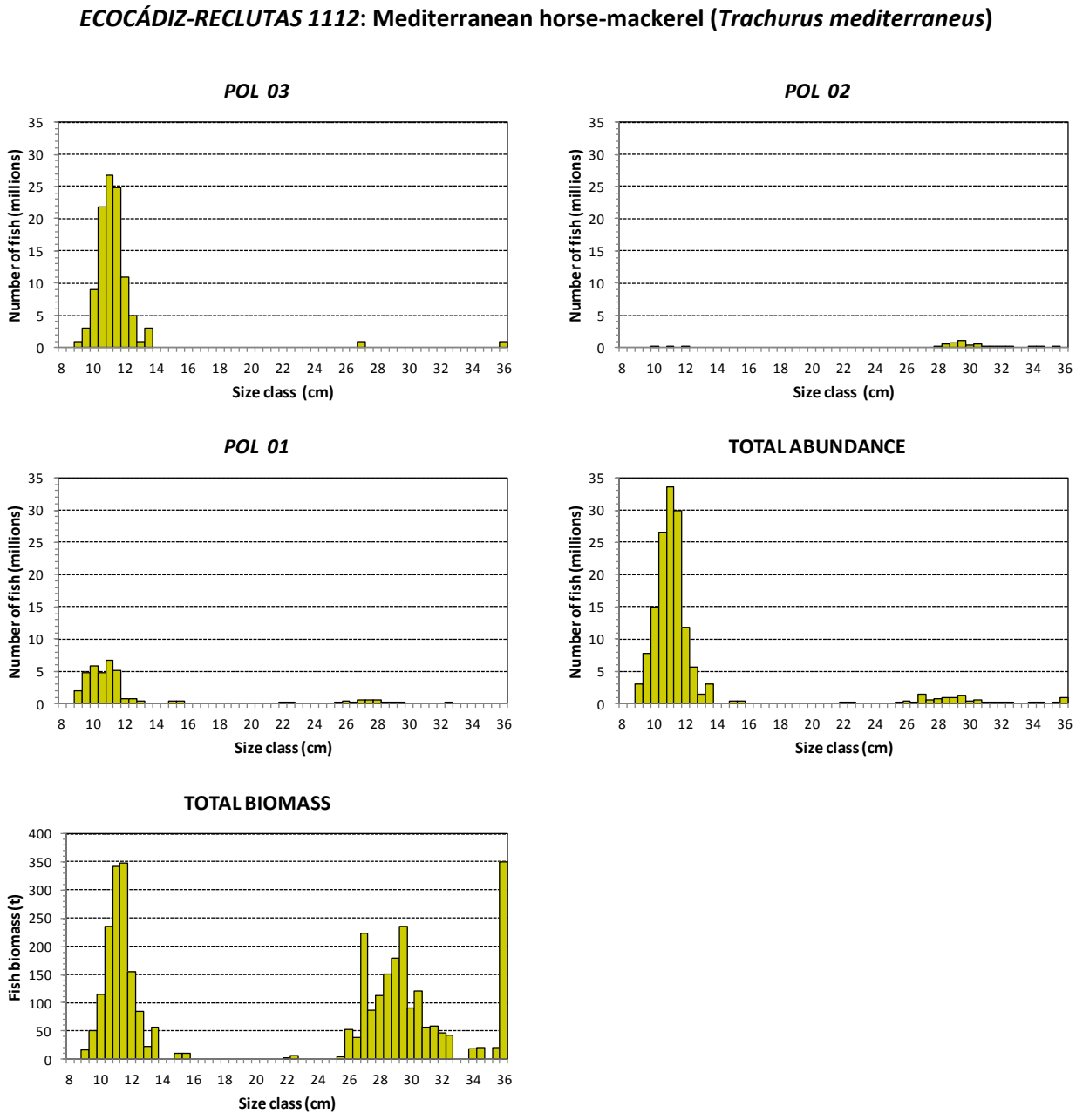

Figure 17. *ECOCÁDIZ-RECLUTAS 1112* survey. Mediterranean horse-mackerel (*Trachurus mediterraneus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 16) and total sampled area. Post-strata ordered in the W-E direction. 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.

***ECOCÁDIZ-RECLUTAS 1112*: Blue jack mackerel (*T. picturatus*)**

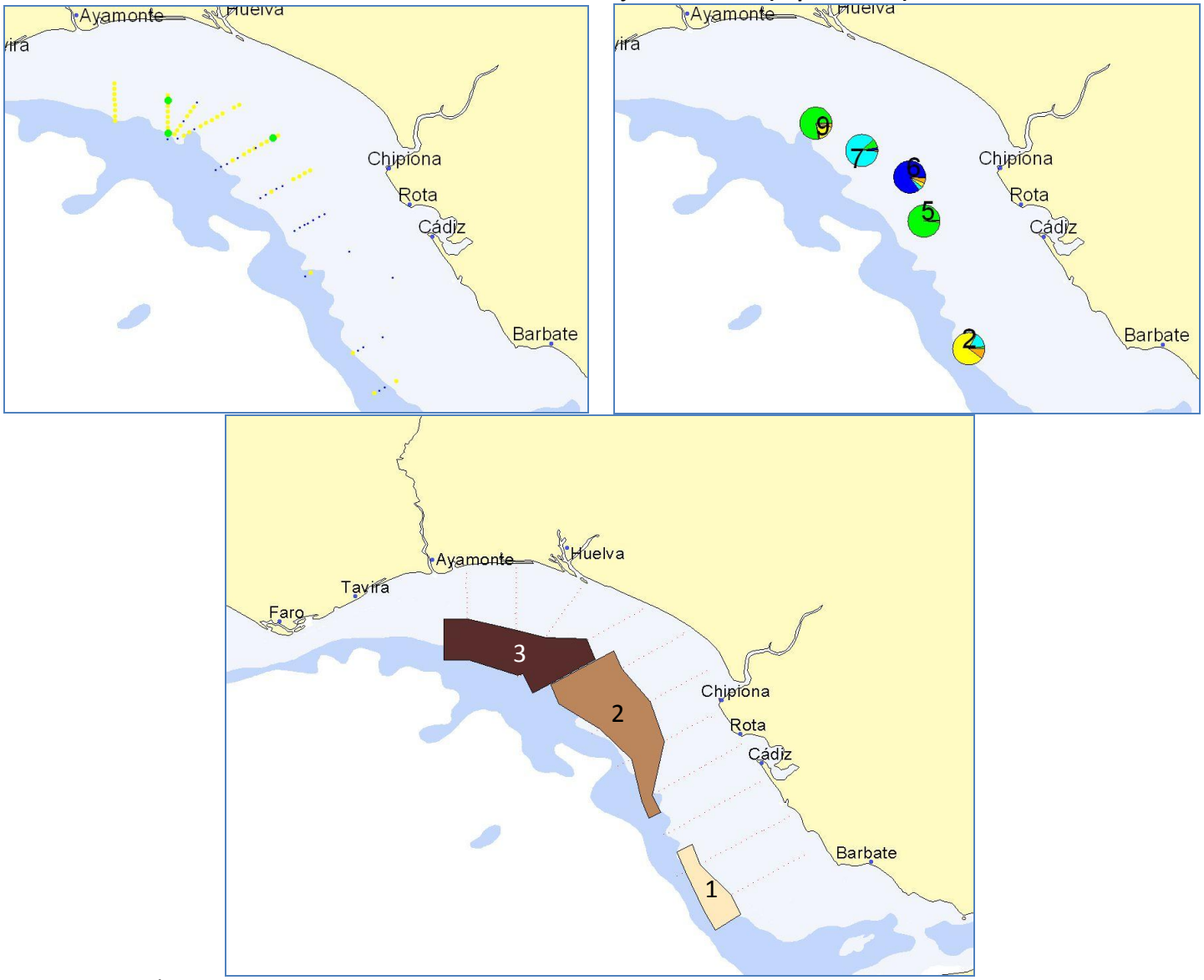

Figure 18. *ECOCÁDIZ-RECLUTAS 1112* survey. Blue jack mackerel (*Trachurus picturatus*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

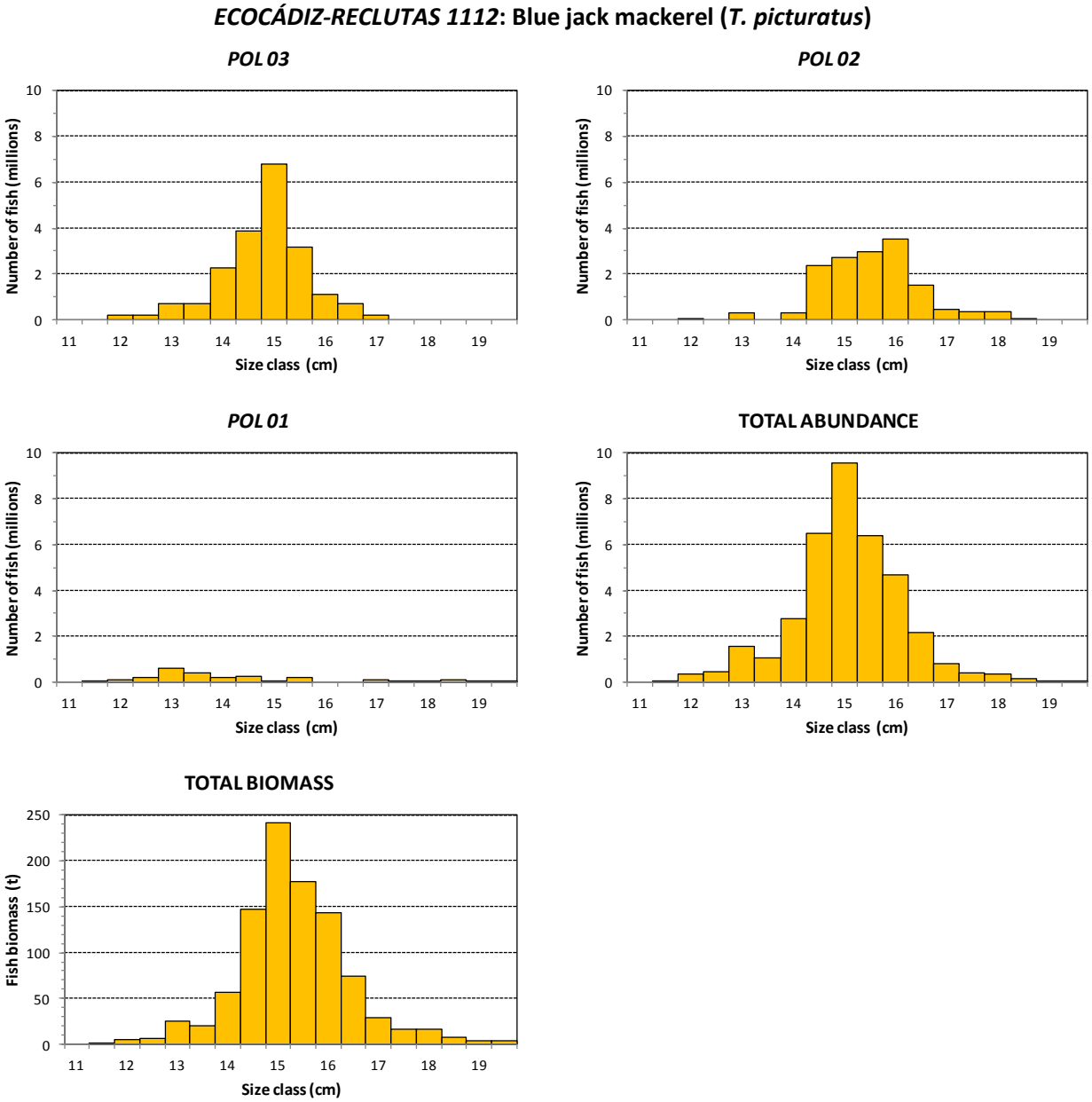

Figure 19. *ECOCÁDIZ-RECLUTAS 1112* survey. Blue jack mackerel (*Trachurus picturatus*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 18) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

***ECOCÁDIZ-RECLUTAS 1112*: Bogue (*B. boops*)**

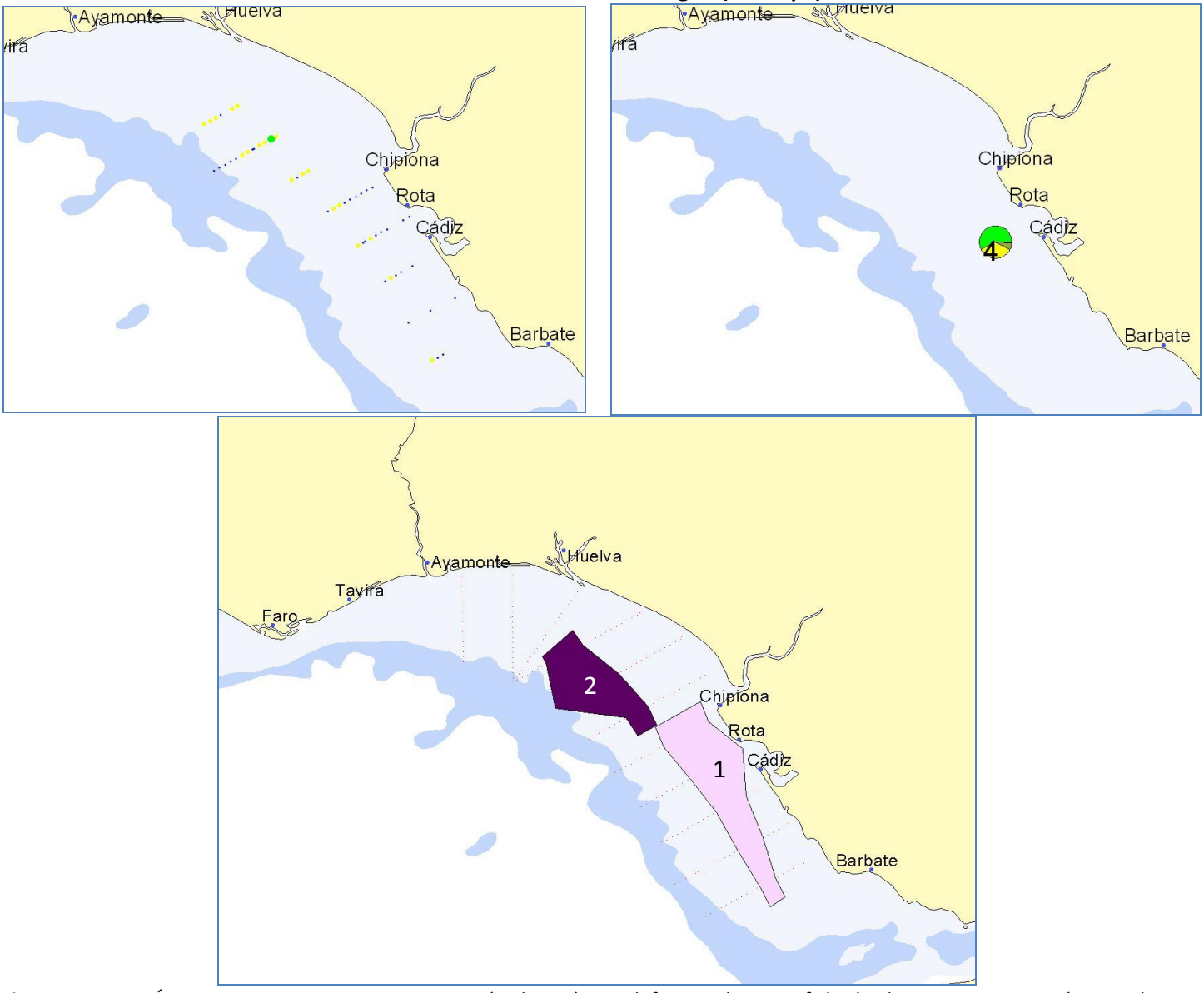

Figure 20. *ECOCÁDIZ-RECLUTAS 1112* survey. Bogue (*B. boops*). Top left: Distribution of the backscattering energy (Nautical area scattering coefficient, *NASC*, in m^2 nmi^{-2}) attributed to the species. Top right: valid fishing hauls for the species (more than 30 individuals showing a normal distribution). 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.

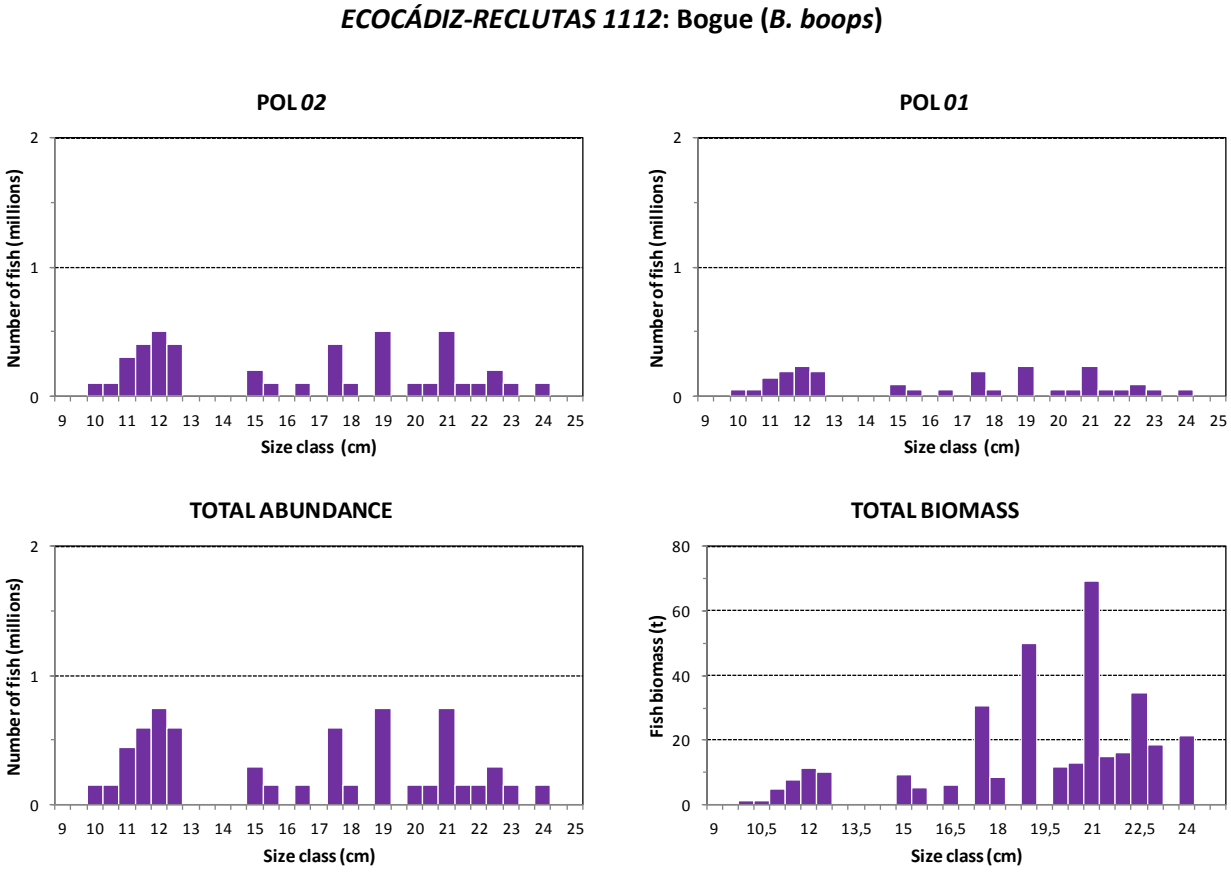

Figure 21. *ECOCÁDIZ-RECLUTAS 1112* survey. Bogue (*B. boops*). Estimated abundances (number of fish in millions) by length class (cm) by homogeneous stratum (POL01-POLn, numeration as in Figure 20) and total sampled area. Post-strata ordered in the W-E direction. The estimated biomass (t) by size class for the whole sampled area is also shown for comparison. Note the different scales in the y axis.

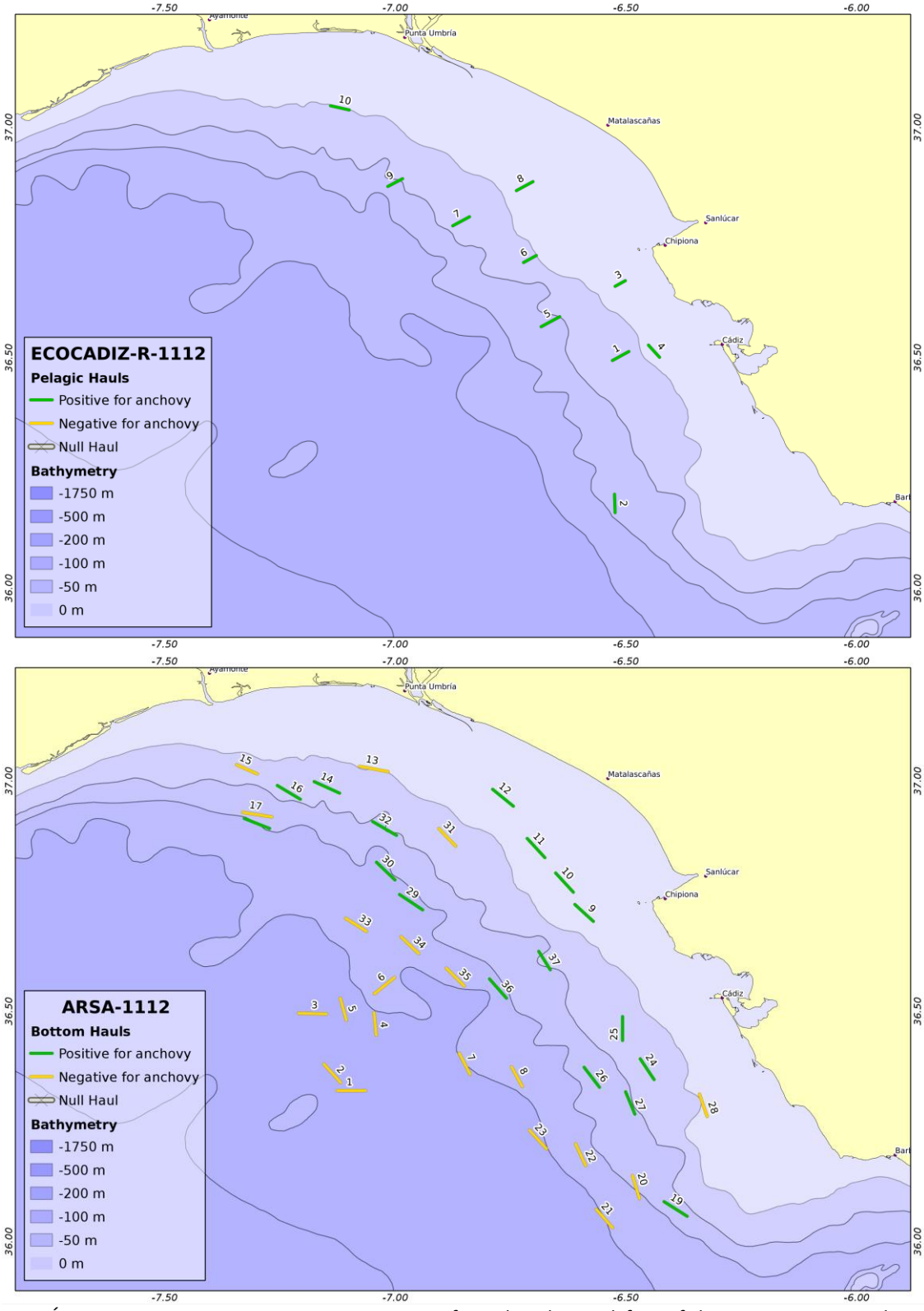

Figure 22. *ECOCÁDIZ-RECLUTAS 1112* survey. Comparison of results obtained from fishing stations carried out during the present survey (11th - 29th November, top) with those ones carried out during the *ARSA 1112* ground-fish survey (02nd – 23rd November, below). Sampling grids with indication of the location of the trawl hauls differentiated between positive and negative for anchovy.

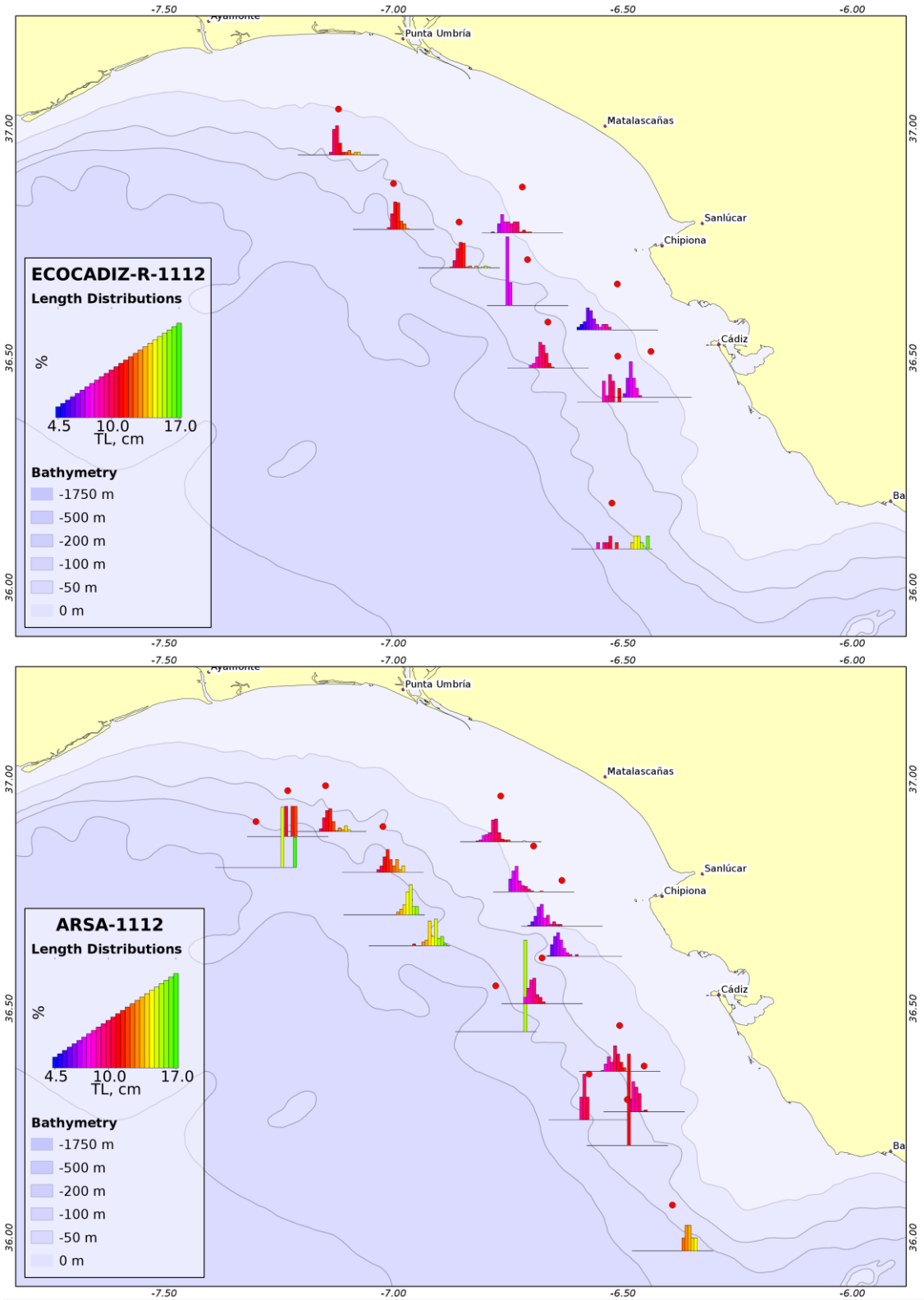

Figure 22. *ECOCÁDIZ-RECLUTAS 1112* survey (cont'd.). Anchovy length frequency distributions by fishing station.

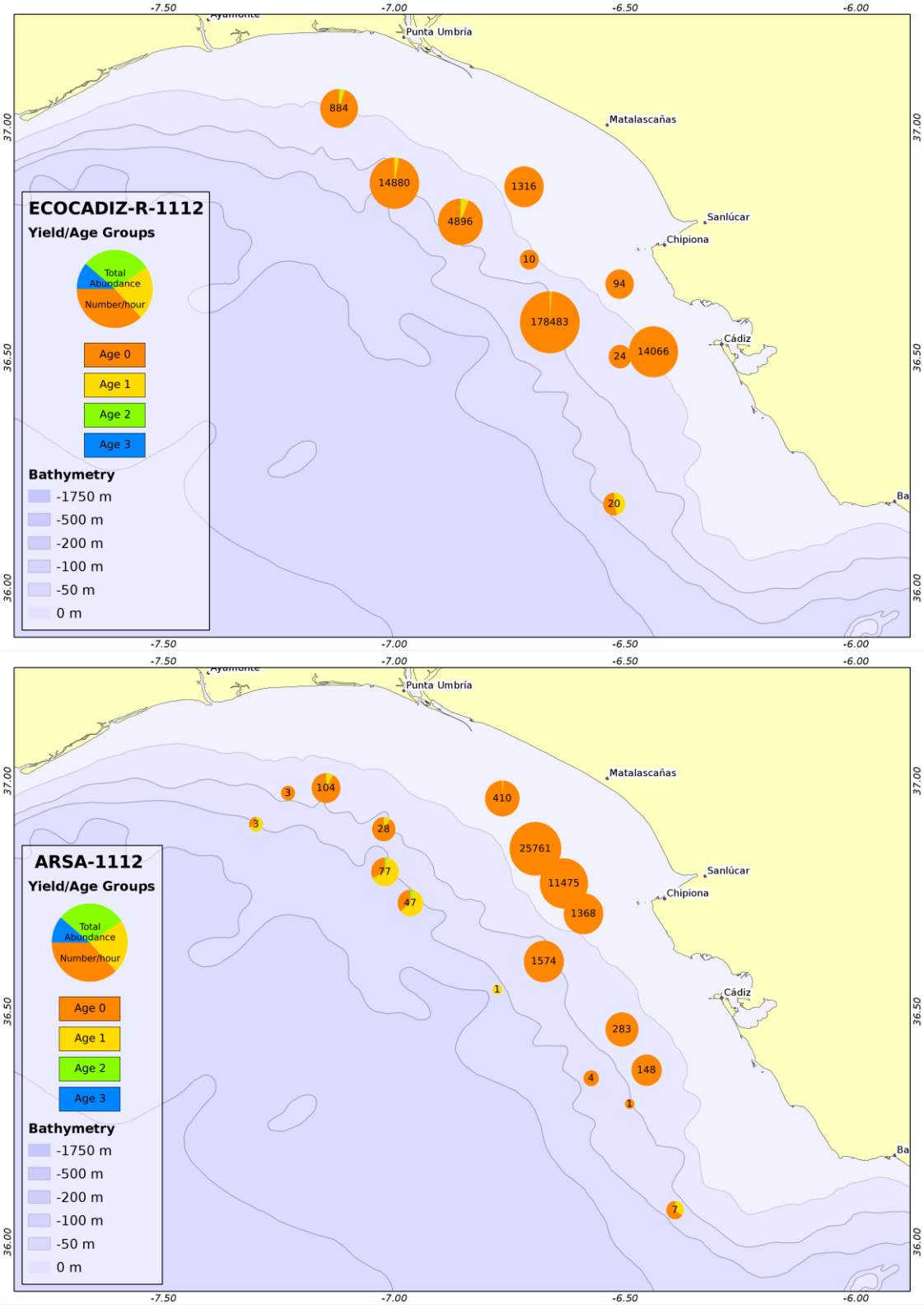

Figure 22. *ECOCÁDIZ-RECLUTAS 1112* survey (cont'd.). Anchovy age composition (% in numbers by trawling hour) by fishing station. Circle size proportional to the yield in numbers. Inserted numbers indicate estimated total numbers by trawling hour.

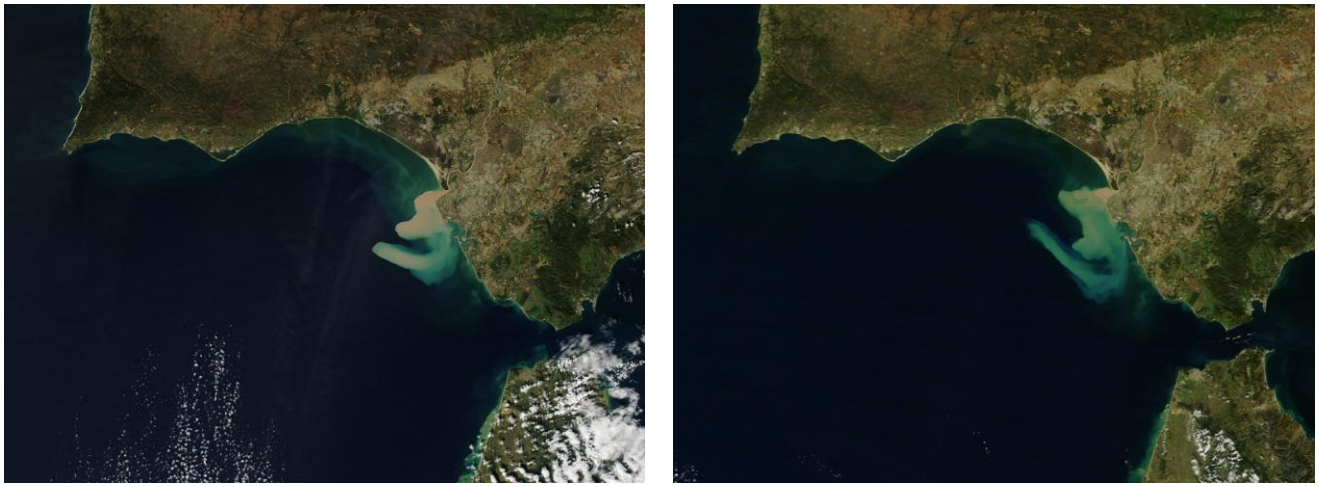

Figure 23. *ECOCÁDIZ-RECLUTAS 1112* survey. Spatial distribution of the plume of continental runoffs from the Guadalquivir River recorded by the MODIS spectroradiometer from the *Aqua* and *Terra* NASA's satellites during the 12nd (left) and 13rd November (right) (natural color).