

4 Anchovy in Division 9.a

4.1 ACOM Advice Applicable to the management period July 2021–June 2022

The stock was benchmarked in February 2018 (WKPELA 2018; ICES, 2018a). WKPELA 2018 supported the proposal of considering two different components of the stock (western and southern component) due to the different dynamics of their fisheries and populations. However, until the stock structure along the division is properly identified, the provision of advice will still be given for the whole stock, but with separate catch advice for each stock component.

ICES could not give catch advice for 2018 under a management calendar based on calendar years. This is due to the lack of available data on year classes that constitute the bulk of the biomass and catches (no survey indices for such year classes are available at the time of the formulation of the advice). ICES notes, however, that the historical fisheries along the division seem to have been sustainable.

Given the high natural mortality experienced by this stock, its high dependence upon recruitment (the fishery depends largely on the incoming year class, the abundance of which cannot be properly estimated before it has entered the fishery), and the large interannual fluctuations observed in the spawning stock, ICES is aware that the state of this resource can change quickly. Therefore, an in-year monitoring and management, or alternative management measures should be considered. However, such measures should take into account the data limitation of the stock and the need for a reliable index of recruitment strength.

From the above reasons, the management calendar for the application of the advice has been agreed to be the one from 1st July of year y to 30th June of year $y+1$ since 2018 onwards.

ICES advised for the period 1st July 2021 to 30th June 2022 that when the precautionary approach is applied, catches from the western component should be no more than 7824 t and catches from the southern component should be no more than 7181 t (no more than 15 005 t for the whole stock). The TAC for this same management period was initially agreed in 15 005 t (Portugal: 7829 t; Spain: 7176 t). After the application of interannual flexibility criteria the national quotas were finally adjusted to 8571 t for Portugal and 8023 t for Spain.

Official anchovy landings in the division in 2021 were of 17 758 t. Estimated total catches were 17 837 t. Provisional estimated catches for the current management calendar are 17 056 t (western component: 11 217 t; southern component: 5839 t).

4.2 Population structure and stock identity

A review of the anchovy substock structure in the Iberian Atlantic waters (Ramos, 2015) was submitted in 2015 to the ICES Stock Identification Methods Working Group SIMWG; ICES, 2015). At that time, SIMWG considered that there was evidence to support a self-sustained population of anchovy located in the Gulf of Cadiz (GoC, ICES Subdivision 9a South), but there was a lack of information regarding the origin of European anchovy in the western subdivisions (comprising subdivisions 9a North, 9a Central-North and 9a Central-South; **Figure 4.2.1**).

This stock was benchmarked at WKPELA in 2018 by ICES (ICES, 2018a) and an updated review of this issue was provided to this workshop, which included new available information of the potential connectivity of anchovy population of the 9a West subdivisions with the south Iberian population

(Garrido *et al.*, 2018a). Evidence shown at that time led to the decision of considering the anchovy populations inhabiting the southern and western Iberian regions as separate stock components for management purposes. The western component comprises the subdivisions 9a North, 9a Central-North and 9a Central-South. The southern component includes the Portuguese and Spanish waters of the Subdivision 9a South.

A Working Document was submitted and presented during WGHANSA-1 2022 with updated information on anchovy stock structure in the 9a area (Garrido *et al.*, 2022). Anchovy spatial distribution in Division 9a provided by surveys shows a persistent discontinuity between the western and southern components of the stock for several life stages (eggs, juveniles and adults) and during different seasons of the year. Landings also show this discontinuity, with more than 90% of Portuguese landings occurring in Subdivision 9a C-N since 2017. No correlation was found between anchovy catches between the two areas, suggesting independent dynamics. The hypothesis that the western stock might come from migration from the southern component was not supported by the current data, since there was no correlation between anchovy abundance and landings in the western Iberia with anchovy abundance in the southern Iberia in the following year. The spatial discontinuity and the independent dynamics between the western and southern anchovy populations point to the presence of a self-sustained anchovy population in the western Iberia, independent of the southern component. A review of studies conducted in Portuguese estuaries have also shown the persistent presence of recruits in numerous estuaries, mainly in the Subdivision 9a C-N, which, agreeing with the concentration of eggs in this subdivision, points to the presence of a self-sustained population in this area. Morphometric and genetic studies seem to indicate a differentiation of the western and Cantabrian populations, as well as a separation with those from the Gulf of Cadiz, but additional analyses are needed as these conclusions might be affected by the presence of two ecotypes (marine and coastal), which are often not considered in these studies. From the evidence presented in the working document, WGHANSA supports the separation of the western and southern components of the anchovy 27.9.a into two stock units: the population in Subdivision 9a South and the populations from subdivisions in the western coast (9a North, Central-North and Central-South), and therefore submits it to the ICES Stock Identification Methods Working Group (SIMWG) for consideration.

4.3 The fishery in 2021

4.3.1 Fishing fleets

Anchovy harvesting throughout the Division 9.a was carried out in 2021 by the following fleets in each stock component:

Western component

- Portuguese purse-seine fleet (PS_SPF_0_0_0).
- Portuguese multipurpose fleet (although fishing with artisanal purse-seines) (MIS_MIS_0_0_0_HC).
- Portuguese trawl fleet for demersal fish species (OTB_DEF_>=55_0_0).
- Spanish purse-seine fleet (PS_SPF_0_0_0).
- Spanish miscellaneous fleet (artisanal métiers accidentally fishing anchovy) (MIS_MIS_0_0_0_HC).

Southern component

- Portuguese purse-seine fleet (PS_SPF_0_0_0).
- Portuguese multipurpose fleet (although fishing with artisanal purse-seines) (MIS_MIS_0_0_0_HC).

- Portuguese trawl fleet for demersal fish species (OTB_DEF_>=55_0_0).
- Spanish purse-seine fleet (PS_SPF_0_0_0).
- Spanish bottom otter trawl directed to demersal fish in 9.a South (OTB_MCD_>=55_0_0 anchovy discards).

The Spanish fleet fishing anchovy in the Western component was composed in 2021 by a total of 99 vessels (two vessels with unknown technical characteristics are not included in the **Table 4.3.1.1**). From this total, 94 vessels (95%) were purse-seiners (**Table 4.3.1.1**). No information on the number of Portuguese vessels fishing anchovy in 2021 was available to the working group, but it may be assumed that the fleet operating in 2021 should not be very different from the one in 2020. The Portuguese fleet targeting anchovy and operating in the Western component in 2020 was composed by a total of 113 vessels in the Subdivision 9.a Central North and 52 vessels in the Subdivision 9.a Central South (ICES, 2021a).

Number and technical characteristics of the purse-seine vessels operated by Spain targeting anchovy in their national waters off GoC (Southern component) are also summarised in **Table 4.3.1.1**. In 2021, GoC anchovy fishing was practised by 61 purse-seiners, five vessels less targeting anchovy than in 2020, and still lower than in previous years (74–78 vessels for the period 2016–2018). Details of the dynamics of this fleet in terms of number of operative vessels over time in recent years are given in ICES (2008a; WGANCA 2008 report) and subsequent WGHANSA reports. The Portuguese fleet targeting anchovy and operating in the Southern component in 2020 was composed of a total of 22 vessels (ICES, 2021a).

4.3.2 Catches by stock component and division

4.3.2.1 Catches in Division 9.a

Anchovy total catch in 2021 was estimated at 17 837 t, which represented a 38% increase on the catches landed in the previous year (12 956 t), it becomes in the historical maxima recorded through the time-series (since 1989) and culminates a recent period of consecutive high catch levels which started in 2016 (**Table 4.3.2.1.1**, **Figure 4.3.2.1.1**). The above estimate is the result from adding up 17 758 t of official landings and 80 t of discards (see **Section 4.3.3**).

As usual, the anchovy fishery in 2021 was almost exclusively harvested by purse-seine fleets (99.6% of the total catch). However, unlike the Spanish fleet fishing in the GoC, the remaining purse-seine fleets in the division (historically targeting sardine and fishing anchovy as a commercial bycatch) only have targeted anchovy when its abundance was high, as occurred in 2011 and in 2014–2021.

Provisional official landings during the first semester in 2022 amounted to 3502 t (updated until 31st March for the Portuguese fishery and until 17th May for the Spanish one). Preliminary, 39% of the official landings from the Spanish fishery in 9a S in January–May (mean 2009–2021) were added to account for catches in June 2022 not yet reported. After such computations, the official landings in the Spanish fishery in 9a S during the first semester in 2022 were estimated in 2465 t.

Provisional catches during the current management period (July 2021–June 2022), as the result of summing up total catches from the second semester in 2021 and provisional official (estimated) landings from the first semester in 2022, amounted to 17 056 t for the whole division.

The contribution of each stock component to this total catch is described in the following sections.

4.3.2.2 Catches by stock component

The updated historical series of anchovy catches by subdivision are shown in **Table 4.3.2.1.1** (see also **Figure 4.3.2.1.1**). **Table 4.3.2.2.1** shows the contribution of each fleet in the total annual catches by subdivision. The seasonal distribution of 2021 catches by subdivision is shown in **Table 4.3.2.2.2**.

Western component

The total catch in 2021 for this stock component was estimated at 10 276 t, which accounted for 82% increase on the 2020 catch (5639 t) and accounted for 58% of the total catch in the division. This 2021 estimate is the historical maximum within its time-series. The fractions composing this total catch in 2021 were: 10 276 t of official landings and 0 t of discards.

Provisional official landings during the first semester in 2022 amounted to 1037 t.

Provisional catches during the current management period (July 2021–June 2022) amounted to 11 217 t.

The distribution of these catches by subdivision is as follows:

Subdivision 9a North

In this Spanish subdivision a total of 747 t was caught in 2021, which accounted for 12% increase in relation to the 2020 catches (309 t), 55% of the total catch estimated for the Western component and 4% for the whole division. Purse seiners were the main responsible for the fishery (99.9% of the total catch in the subdivision). The fishery was concentrated in the third and fourth quarters.

Provisional official landings during the first semester in 2022 amounted to 12 t (up to 17th May 2021). Those ones corresponding to the current management calendar amounted to 705 t.

Subdivision 9a Central-North

This subdivision concentrated a great part of the anchovy fishery in 2021, both in relation to the whole division (53%) and to the Western component (94%): a total catch of 9521 t was estimated (with all of these catches corresponding to official landings; neither unallocated nor discarded catches were reported). These catches represented a 79% increase on the catches estimated the previous year (5327 t), and they become in the historical maximum within its recent time-series. Purse-seiners practically harvested the whole fishery, mainly during the third and fourth quarters in the year.

Provisional official landings during the first semester in 2022 amounted to 1024 t (up to end of April). Official landings for the current management calendar were 10 505 t.

Subdivision 9a Central-South

Anchovy catches from this subdivision were only 8 t (all of them official landings), accounting for a 213% increase in relation to the catches in 2020 (2 t) but still staying this value close to its historical minima. Such catches accounted only for 0.04% both of the total catch in the Western component and on the total catch in the division. The fishery was mainly harvested by purse-seiners, mostly during the third quarter.

No provisional official landings were recorded during the first semester in 2022 (up to end of April) in this subdivision. Official landings during 2021 for the current management calendar were ca. 7 t.

Southern component***Subdivision 9a South***

The total catch in 2021 of this stock component was estimated at 7562 t, which accounted for a 3% increase with respect to the 2020 catch (7317 t) and represented 42% of the total catch in the division. The fractions composing this total catch in 2021 were: 7482 t of official landings (Portugal: 109 t, Spain: 7373 t) and 80 t of (Spanish) discards.

Almost the whole of the total catch (99%) was captured by the purse-seine fleet.

The fishery was concentrated during the second and third quarters in the year, mainly in the second one.

Provisional official landings during the first semester in 2022 amounted to 2465 t, all of them fished by the Spanish fishery. Preliminary; 692 t, corresponding to 39% of the Spanish official landings in January–May (mean 2009–2021), were added to the Spanish data to account for landings in June 2022 not yet reported. Official landings and total catches during 2021 in the subdivision for the current management calendar were 3311 t and 3374 t, respectively. Preliminary estimates for catches for the current management calendar (July 2021–June 2022) amounted to 5839 t (official landings: 5775 t; discards: 64 t).

4.3.3 Discards

See the stock annex for previous available information on discards in the division.

General guidelines on appropriate discard sampling strategies and methodologies were established during the ICES Workshop on Discard Sampling Methodology and Raising Procedures (ICES, 2003).

Covid-19 disruption and the interruption of the IEO's on-shore and at-sea sampling programmes during the first semester in 2020 because administrative and budgetary reasons prevented from estimating discards during that semester in the Spanish fisheries in subdivision 9a N and 9a S. Sampling programmes performed as planned in 2021.

Average discard estimates (in t) in subdivision 9a N for the available time-series (2014–2021) show that quarterly discards could be considered, for the time being, as negligible, almost null. The same considerations have also been applied to the discards in the Spanish fishery in 9a S.

Western component

Subdivision 9a North

No discards have been recorded during 2021 in the Subdivision 9a N. The overall annual discard ratio for the Spanish fishery in this stock component in 2019 was 0.0006 (0.06%) and may be also considered in 2021 as negligible as described above.

Subdivisions 9a Central-North and Central-south

Regarding the Portuguese anchovy fishery in this stock component, the official information provided to the WG states that there are no anchovy discards in the fishery.

Southern component

Subdivision 9a South

No anchovy discards have been reported from the Portuguese fishery.

Discards in the Spanish fishery were recorded in the purse-seine (14 t) and the bottom-trawl fishery (66 t) mainly during the third quarter. The estimated discards (80 t) represented an annual discard ratio of 0.01 (1.1%) and may be considered as a very low ratio.

4.3.4 Effort and landings per unit of effort

Western component

CPUE indices are not considered for this stock component.

Southern component

Annual standardised LPUE series for the whole Spanish purse-seine fleet fishing GoC anchovy (Subdivision 9.a-South) are routinely provided to this WG. An update of the available series (1988–2021) has been provided this year to this WG (**Figure 4.3.4.1**). Details of data availability and the standardisation process are commented in the stock annex. At present, the series of commercial lpue indices

is only used for interpreting the Spanish purse-seine fleets' dynamics in Subdivision 9a S. The recent dynamics of fishing effort and LPUE for this fleet has been described in previous WG reports. Fishing effort experienced a strong decrease since 2017, which was coupled to a parallel decrease in catches. A relatively stable trend in effort (with some increase in 2020 and 2021) has been recorded during the 2018–2021 period, which was coupled with steeply increasing catches which resulted in an increasing trend in lpue in the very recent years (from less than 1 t to at around 1.2–1.9 t/fishing day). However, a probable overestimation of the annual estimates computed so far was suggested in previous WG reports because of a probable underestimation of the true exerted fishing effort on anchovy, since fishing trips targeting anchovy with zero anchovy catches are not considered in the effort measure.

4.3.5 Catches by length and catches-at-age by stock component

Length–frequency distribution (LFD) of catches and catch-at-age data from the whole Division 9.a are routinely provided to this WG from the Spanish fishery operating in the GoC (Subdivision 9.a S), since the anchovy fishery in the division is traditionally concentrated there. Data from the Spanish fishery in Subdivision 9.a N were usually not available since commercial landings used to be almost negligible. The same reason is also valid for the Portuguese subdivisions (included the Portuguese part of the 9.a S (Algarve)), although in this case anchovy was also a group three species in its national sampling program for DCF. Nevertheless, the local increases of anchovy abundance in subdivisions 9.a N and C-N recorded since 2014 have led to a circumstantial exploitation of the species by the fleets operating in those areas. The respective national sampling programmes accounted for this event those years but in an accidental way. A higher sampling effort has been made in the port of Matosinhos (9.a C-N) since 2018 to have monthly biological data of anchovy in that area that represents the bulk of catches in the western component.

Quarterly LFDs and ALKs in 2021 have been provided for the Spanish fishery in Subdivision 9.a N. No LFD was available for the second quarter landings; hence these landings were raised to the first quarter LFD. Quarterly ALKs were based on half-yearly ALKs made by combining March commercial and *PELACUS* survey samples (for the first and second quarters), and *IBERAS* survey samples/ALK (for the third and fourth quarters).

Quarterly LFDs and ALKs from the Spanish fishery in subdivision 9.a S were also available and showed a good coverage.

LFDs from the Portuguese fishery provided to this WG are the ones from the anchovy purse-seine fishery in Subdivision 9.a Central-North, given that only 0.1% and 1% of the Portuguese catches occurred in the 9.a Central-South and 9.a South (Algarve) subdivisions, respectively. Data were only available for the 3rd and 4th Quarters.

Catch-at-age data in 2021 have only been provided for the Portuguese fishery from Subdivision 9.a C-N for the 3rd and 4th Quarters. No age structure is available for 2021 Portuguese anchovy catches in subdivisions 9.a C-S and 9 a. S (Algarve), related to the low catches observed in those areas.

4.3.5.1 Length distributions

Western component

Subdivision 9.a North

Quarterly and annual size composition of anchovy catches for the whole fishery in the Subdivision 9.a North in 2021 are shown in **Table 4.3.5.1.1**. Size range in catches from the whole fishery varied between 11.5 and 18.5 cm size classes (mode at 13.5 cm size class), with an annual mean size and weight in catches being estimated at 15.1 cm and 25.6 g, respectively.

Subdivision 9.a Central-North

The size composition of 2021 anchovy catches from the Subdivision 9.a Central-North is shown in **Table 4.3.5.1.2**. These length–frequency distributions (LFDs) correspond to catches landed by purse-seiners and polyvalent fleets throughout the second semester and incidental bottom-trawl catches in the fourth quarter, hence the raising and further pooling processes applied in order to obtain overall LFDs by quarters for the whole fishery were done using the data from purse-seine fishery, that accounts for >95% of all catches. Anchovy size composition in catches from the whole fishery in the second semester 2021 ranged between 12.5 and 19.5 cm size classes (mode at 15.5 cm size class), with a mean size and weight in catches from that semester being estimated at 16.2 cm and 30.4 g, respectively.

Subdivision 9.a Central-South

No length composition is available from the Portuguese fishery in this subdivision since the catches were very scarce.

Southern component*Subdivision 9.a South*

Quarterly LFDs from the Spanish catches in 2021 for the whole fishery is shown in **Table 4.3.5.1.3**. Size range of the exploited stock (landings plus discards) in the whole fishery varied between 5.5 and 17.5 cm size classes, with the modal class located at the 10.5 cm size class. Anchovy mean length and weight in the Spanish 2021 annual catch (11.5 cm and 12.1 g) were quite similar to those values recorded in previous years but they used to be the smallest anchovies in the division.

No length composition is available from the Portuguese fishery in this subdivision since the catches were very scarce.

4.3.5.2 Catch numbers-at-age**Western component***Subdivision 9.a North*

Estimates from the fishery in this subdivision in 2021 are shown in **Table 4.3.5.2.1**. These estimates are shown together with the age structure of catches in previous years with available data in **Table 4.3.5.2.2** and **Figure 4.3.5.2.1**. The estimated total catch in numbers in 2021 was of 29.2 million fish, composed by ages 0, 1, 2 and 3 anchovies, with ages 0 and 1 accounting for 43% and 42% of the total catch, respectively.

Subdivision 9.a Central-North

Estimates from the fishery in this subdivision in 2021 have been provided to the WG (**Table 4.3.5.2.3**, **Figure 4.3.5.2.2**).

The estimated total catch in numbers in 2021 second semester was of 297 million fish, composed by 1, 2 and 3 year old anchovies, which accounted for 58%, 39%, and 3% of the total catch in that semester, respectively.

Subdivision 9.a Central-South

No estimate from this subdivision in 2021 has been provided to this WG since the catches were very scarce.

Southern component

Subdivision 9.a South

Table 4.3.5.2.4 shows the quarterly and annual anchovy catches-at-age in the Spanish fishery in 2021. Total catches in the Spanish fishery in 2021 were estimated at 618 million fish, which accounted for a 3% increase in relation to the 599 million caught during the previous year. Such a small increase was mainly caused by 19% and 2% increases of ages 1 and 2, respectively, but also by a 26% decrease in Age 0 anchovies. Age 1 group is the dominant age group (72% of the total catch in numbers). Age group 3 anchovies were absent in the fishery.

The recent historical series of annual landings-at-age in the Spanish fishery in 9.a South is shown in **Table 4.3.5.2.5** and **Figure 4.3.5.2.3**. Description of annual trends of landings-at-age data from the Spanish fishery through the available data series is given in previous WG reports.

No data are available from the Portuguese fishery in this subdivision since the catches were very low.

4.3.6 Mean length and mean weight-at-age in the catch

Western component

Subdivision 9.a North

The resulting estimates for the fishery in 2021 are shown in **Tables 4.3.6.1** and **4.3.6.2**. Anchovy mean length and weight in the catches were 15.1 cm and 25.6 g. The available series of estimates are shown in **Figure 4.3.6.1** and indicate that anchovies by age group from this subdivision are usually larger and heavier than those harvested in the southernmost areas. In 2021, all the age groups experienced a small increase in the mean length and weight in catches, a trend which was not coupled to the exhibited one by the overall mean estimates for the whole exploited population because the relative importance of the Age-0 anchovies.

Subdivision 9.a Central-North

The available estimates for the fishery in 2021 are shown in **Tables 4.3.6.3** and **4.3.6.4**. A series of regular estimates is only available since 2017 in this subdivision. Anchovy mean length and weight in the catches of the second semester 2021 from north-western Portugal were 16.2 cm and 30.4 g (**Figure 4.3.6.2**).

Subdivision 9.a Central-South

No estimate from this subdivision is available.

Southern component

Subdivision 9.a South

The 2021 estimates of the mean length and weight-at-age of Gulf of Cadiz anchovy Spanish catches are shown in **Tables 4.3.6.5** and **4.3.6.6**. **Figure 4.3.6.3** shows the recent history of the evolution of such estimates. Anchovy mean length and weight in the Spanish 2021 annual catches were estimated at 11.5 cm and 12.1 g respectively, a slightly lower mean size and higher mean weight than those ones recorded in the previous year. Age-0 and Age-2 anchovies showed lower mean size and weight than in 2020, whereas the reverse trend was recorded in Age-1 anchovies.

4.4 Fishery-independent Information

Table 4.4.1 shows the list of acoustic and DEPM surveys providing direct estimates for anchovy in Division 9.a. The WG considers each of these survey series as an essential tool for the direct

assessment of the population in their respective survey areas (subdivisions) and recommends their continuity in time, mainly in those series that are suffering from interruptions through its recent history.

4.4.1 DEPM-based SSB estimates

BOCADEVA series

Anchovy DEPM surveys in the division are only conducted by IEO for the SSB estimation of Gulf of Cadiz anchovy (Subdivision 9.a-South, *BOCADEVA* survey series). The methods adopted for both the conduction of these surveys and the estimation of parameters are described in the stock annex and in ICES (2009) and Massé *et al.* (2018).

The series started in 2005 and their surveys are conducted with a triennial periodicity. Since 2014, this series has been financed by DCF. The last *BOCADEVA* survey was conducted in summer 2020. The next survey will be conducted in July 2023. The time-series of mean estimates and their associated variances for the egg and adult parameters, and the SSB are shown in **Table 4.4.1.1** and **Figures 4.4.1.1** and **4.4.1.2**.

4.4.2 Spring/summer acoustic surveys

General

A description of the available acoustic surveys providing estimates for anchovy in Division 9.a is given in the stock annex. Survey methodologies deployed by the respective national Institutes (IPMA and IEO) are also thoroughly described in Massé *et al.* (2018) and Doray *et al.* (2021).

A summary list of the available acoustic and DEPM surveys providing direct estimates for anchovy in Division 9.a is given in **Table 4.4.1**. Detailed information in the present section will be provided for those surveys carried out during the elapsed time between 2021 and 2022 WGHANSA meetings.

PELACUS series

PELACUS 0322

The Spanish *PELACUS* acoustic-trawl time-series started in 1984. Since 1998, survey strategies and methodologies, together with the Portuguese *PELAGO*, are standardized with the French one *PELGAS*. Moreover, since 2000 the three time-series are using CUFES to collect subsurface sardine and anchovy eggs. *PELACUS* was carried out on board R/V *Thalassa* from 1997 to 2012 and since then is routinely conducted on board the Spanish R/V *Miguel Oliver*. An intercalibration survey was done in April 2014 off Garonne mouth (*i.e.* at the spawning season and area of both sardine and anchovy). No significant changes in both fish availability (acoustic) or in fish accessibility, catchability or selectivity (trawl) were detected, and therefore similar performance for both vessels was assumed.

PELACUS 0422 was conducted between 1st and 26th April 2022 on board the R/V *Vizconde de Eza* instead of on board the vessel routinely used, the R/V *Miguel Oliver*, because the occurrence of electric issues affecting the echosounder in the latter. The start of the survey suffered a one-week delay. Covid-19 issues also occurred at the end of the first leg (13rd April) entailing an interruption of the survey until the 24th April. All these contingencies resulted on a reduction of the available ship time for surveying the Cantabrian Sea to only 5.5 days and a reduced number of fishing stations (27 fishing hauls). Rough weather conditions occurred during the first leg of the survey. Sampling grid this year was based on acoustic transects separated 10 nm, between 20 and 1000 m depth, and with random start in each of the geographical strata, which correspond to the ICES subareas. Anchovy schools were almost exclusively recorded in the inner part of the Bay of Biscay (zone 8cEe), accounting for

99.9% of the total abundance and biomass estimated for the whole surveyed area. The occurrence of the species in the Subdivision 9a N was incidental. **Figure 4.4.2.1** shows the species contribution (% in number) in each of the valid hauls performed during the survey. A total of 0.3 t anchovies were caught in the whole surveyed area, corresponding to 24 505 specimens, 104 of those were measured (2 kg of fish). Sardine, with a presence in 61% of the fishing hauls accounted for the 38% of the total catch in number (**Table 4.4.2.1**). Anchovy was caught in 19% of the trawl hauls, and represented 9.2% of total catch number. Overall mean length in the catch was 13.59 cm. **Figure 4.4.2.2** shows the distribution area and density derived from the NASC values attributed to this fish species in the surveyed area.

A total of only 2 t, corresponding to 0.1 million fish were estimated in the Subdivision 9.a N, corresponding to one the lowest values of the *PELACUS* time-series (**Table 4.4.2.2**). The population was structured by the age groups 1, 2 and 3, with the bulk of the biomass belonging to age group 1 (75% in biomass, 82% in number). **Figure 4.4.2.3** shows the estimated abundance and biomass by length class, while in **Figure 4.4.2.4** the estimates are shown by age group. **Figure 4.4.2.5** shows the time-series (1996–2022) of anchovy biomass estimates from *PELACUS* in area 9.a N.

PELAGO series

PELAGO 21

The *PELAGO* 22 survey was conducted this year in two legs making use of two different research vessels (first leg: between 1st and 9th March on board R/V *Miguel Oliver* (MO); second leg: between 16th and 30th March on board R/V *Vizconde de Eza* (VE)), after the breakdown suffered by the former because electric issues. Seventy-one (71) transects were acoustically sampled between Caminha and Cape Trafalgar (30–200 m depth). Five (5) transects in 9a. S (ALG) surveyed with MO were repeated with VE at the beginning of leg 2. A total of 39 pelagic trawl hauls were carried out by the research vessel, 28 additional hauls were done by one purse-seiner. The distribution and species composition of all of these hauls are shown in **Figure 4.4.2.6**.

Regarding the mapping of acoustic energy, anchovy was mainly concentrated in 9.a CN and, showing lower densities, in the 9.a S (CAD). A large increase in the distribution along the 9.a CN extended further south, in the northern 9.a CS area. The distribution extended further south on the west coast than in previous years (**Figure 4.4.2.7**).

Anchovy acoustic estimates for the whole surveyed area were 5637 million fish and 120 934 t.

In 9.a Central-North were estimated a total of 4589 million fish and 108 571 t, estimates which represent the second highest peak of abundance and the first of biomass of the time-series (50% and 103% increases in abundance and biomass in relation to the 2021 estimates). The estimated population in this subdivision ranged between 11.5 and 19.0 cm size classes, with a mode at 16.0 cm size class (**Figure 4.4.2.8**). The assessed population abundance from this subdivision was structured by Age-1, Age-2, Age-3 and Age-4 fish, with the Age-2 being the dominant age (46%), followed by Age-1 fish (27%), Age-3 (26%) and Age-4 (0.7%) fish (**Figure 4.4.2.9**).

Anchovy population in 9a Central-South was supported by 198 million fish and 3391 t, entailing 62% and 44% decreases of abundance and biomass in relation to the 2021 estimates. The population showed a size range between 11.5 and 18.5 size classes, with a 13.0 cm modal size, and with a predominance of Age 2 individuals (62%), followed by Age 1 (36%) and Age 3 (1%) (**Figures 4.4.2.8 and 4.4.2.9**).

In the Subdivision 9.a South, with values of 849 million fish and 8972 t (**Table 4.4.2.3**), the Spanish waters concentrated most of the population (77% and 61% of abundance and biomass, respectively). The above 2022 estimates accounted for 43% and 36% decreases in relation to those estimated in the 2021 survey. In 9a South-Algarve a total of 196 million fish and 3535 t were estimated, representing very increased population levels in relation to the last years (**Figure 4.4.2.8**). The estimated population

in Subdivision 9.a South-Algarve ranged between 10.0 and 17.5 cm size classes, with two clearly differentiated modes at 11.5 cm (the dominant one) and 15.5 cm size class, and a dominance of Age 1 (52.8%) followed by Age 2 (25.1%) and lastly Age 3 (22.1%) individuals (**Figure 4.4.2.9**).

In 9a South-Cadiz a total of 654 million fish and 5438 t were estimated, entailing strong 56% and 61% decreases in abundance and biomass in relation to the previous year's estimates, respectively (**Figure 4.4.2.8**). The estimated population in this Subdivision 9.a South-Cadiz ranged between 8.5 and 14.5 cm size classes, with a main mode at 10.0 cm size class. The population was dominated by Age 1 individuals (80.0%), followed by Age 2 (15.0%) and Age 3 (0.6%) (**Figure 4.4.2.9**).

Table 4.4.2.3 and **Figure 4.4.2.10** track the historical series of anchovy acoustic estimates from *PELAGO* surveys in the Division 9.a. Anchovy experienced a huge outburst in 9.a Central-North in 2018, after the decreased biomass recorded in 2017, and reaching population levels even higher than the previous historical peaks recorded in the 2011 and 2016 outbursts. After a strong drop in 2019 the population has experienced consecutive increases in abundance and biomass which culminate in the historical maximum recorded in 2022. Anchovy in 9.a Central-South had low abundances in the past and had a 3 order of magnitude increased in number and biomass. Biomass levels in the Subdivision 9.a South, after experiencing an increasing trend started in 2018 which peaked in 2020 have shown consecutive drops in the last two years down to levels well below the historical average (**Figure 4.4.2.10**).

Figure 4.4.2.11 shows the age structure of the population estimates in the western component. Age 2 anchovies constitute the bulk of the population in spring 2022 (47%), followed by age 1 (28%) and 3 (25%). Age 4 was present in very low numbers in spring 2022. Strong incoming recruitments seem to be inferred in the period 2019–2021, in particular in 2020.

Size composition and age structure of the population estimated in the southern component through the time-series was described in previous reports. In **Table 4.4.2.5** and **Figure 4.4.2.12** we revisit the trends observed in the age structure of the population as estimated by the *PELAGO* and *ECOCADIZ* survey series. As described in previous reports, Portuguese acoustic estimates for anchovy until 2013 did not provide age-structured data to the WG. As an alternative, this age structure was estimated by applying the Spanish Gulf of Cadiz commercial age-length keys for the second quarter in the year. It should also be taken into consideration that such keys are based on commercial samples from purse-seine catches and therefore they may result in a biased picture of the population structure because of a different catchability.

Regarding the last years in the series, the Southern component population age structure in 2010, as estimated by the Portuguese survey, evidenced a strong decrease in 1-year-old anchovies, but especially in two-year-old fish, suggesting a weak population structure sustaining a very low biomass level.

The population age structure in previous years suggests strong 2000, (exceptionally) 2001, and 2006 year classes, with the last one still being present in 2009 (as age 3 anchovies). The strength of the 2007, 2008 and 2009 year classes decreased in relation to that observed for the 2006 year class: population numbers of age 1 anchovies in 2008, 2009 and 2010 showed 49.7%, 43.3% and 68.9% decreases in relation those ones estimated in 2007. Notwithstanding the above, the extreme situation that the population reached in spring 2011, when no anchovy was detected in the *PELAGO* acoustic survey, seems uncertain because the observation of high egg densities during the survey is not consistent with the null detection of biomass with acoustics and with the estimates provided by the *BOCADEVA* DEPM survey (32.7 kt) some months later. These reasons led to the WG to consider the 2011 acoustic estimate with caution. The population age structure in 2013 suggests a failed recruitment, which, however, seems to show clear signs of progressive recovery in the three following years, especially in 2016. The decreased population levels in 2017 pointed again to a failed incoming recruitment. The situation in 2018 and 2019 seems to be quite similar to the one occurring in 2015–2016. Conversely, the 2020 and 2021 year classes show again a low strength.

*ECOCADIZ series**ECOCADIZ 2021-07*

The *ECOCADIZ 2021-07* survey was planned to be conducted by IEO between 31st July and 13rd August 2021 in the Portuguese and Spanish shelf waters (20–200 m isobaths) off the Gulf of Cadiz on board the Spanish R/V *Miguel Oliver*. However, a malfunctioning of the echo-sounder, probably caused by RV's electric problems, during the previous acoustic survey (*MEDIAS*) caused the interruption of that survey. Failed attempts of solving such problems also led to the definitive suspension of the *ECOCADIZ* survey.

The R/V *Miguel Oliver*'s EK60 echo-sounder was replaced by the EK80 this winter, including the corresponding further checks (calibration, self-noises, acoustic recording, etc.).

Time-series of available estimates so far are shown in **Table 4.4.2.4** and **Figure 4.4.2.13**.

Table 4.4.2.5 shows the time-series of population estimates at age in the southern component estimated by *PELAGO* and *ECOCADIZ* surveys (see also **Figure 4.4.2.12**).

4.4.3 Recruitment surveys

SAR, JUVESAR and IBERAS autumn survey series

The last survey in the *SAR* series (aimed to cover the sardine early spawning and recruitment season in the Division 9.a, but also covering the anchovy recruitment season) which provided anchovy estimates was carried out in 2007 (see **Table 4.4.1**). **Table 4.4.3.1** shows the historical series of anchovy acoustic estimates derived from this survey series in the Division 9.a available so far. The *JUVESAR* autumn survey series, an acoustic survey restricted to the Subdivision 9.a Central-North, the main recruitment area of sardine in Portuguese waters, started in 2013. The scarce presence and abundance of anchovy in the 2013 and 2014 surveys prevented the provision of acoustic estimates for the species. The last survey in this series was conducted in 2017 (*JUVESAR 17*), because in 2018 the *JUVESAR* acoustic sampling area was incorporated into the new *IBERAS* survey series, described below. Point estimates of anchovy abundance of the *JUVESAR/IBERAS* series are at present scarce but the trend is so far not consistent with spring survey series.

IBERAS is a new acoustic-trawl time-series aiming to get a synoptic coverage of the Atlantic waters of the Iberian Peninsula and the Bay of Biscay targeting on Young of the Year (YoY) of sardine and anchovy. Since 2017, both the Bay of Biscay (*JUVENA*) and the Gulf of Cadiz (*ECOCADIZ-RECLUTAS*) were routinely prospected by R/V *Ramón Margalef* and the Northwest coast of Portugal (*JUVESAR*) by R/V *Noruega* since 2013. The idea is to fill the gap between both *JUVENA* and *ECOCADIZ-RECLUTAS* surveys and incorporate the *JUVESAR* series, following the same radials in Subdivision 9.a Central-North. This new time-series is being conducted either in the vessel R/V *Ángeles Alvariño* or in R/V *Ramón Margalef*, twin of the former. Both vessels have similar shape, with slight changes in the main engine but using the same equipment (acoustic and trawling devices). Together with this synoptic coverage, using similar vessel equipment will limit both the vessel and trawling effects on the overall precision and accuracy of the estimates. In 2018, due to the lack of available vessel time in September, the survey was delayed until November, but in 2019 the survey was planned in September, at the same time of *JUVENA* and previous to *ECOCADIZ-RECLUTAS* one (see **Table 4.4.3.2**).

The rationale of this new time-series is to track and assess early juveniles for predicting the strength of the recruitment previously to the incoming fishing season (e.g. next year) as this will heavily depend on the incoming year class. This strategy is of special interest to manage the fisheries for short-lived species because of the short time between spawning and the exploitation of subsequent emerging recruits. Due to the recent situation of the sardine stock, with the biomass at the lowest productivity ever recorded and with a continuous period since 2004 of bad recruitment as compared with

previous periods, any recovery of the biomass will likely be triggered by the strength of the recruitment.

IBERAS 0921

The monitoring of the *Cumbre Vieja* volcano eruption caused drastic changes in the planning of the IBERAS 0921 survey on board R/V *Ramón Margalef*. The survey was finally conducted during two legs: 18th - 20th September (subdivision 9a N) and 9th - 18th October (subdivisions 9a CN and 9a CS). The survey area (from 20 to 100 m isobath) was planned to be covered using an adaptive grid with 73 tracks with random start and evenly distributed each 8 nmi on those areas out of the main expected recruitment areas and each 4 nmi on the main ones. However, the acoustic sampling of the survey area was incomplete (67 transects from the 73 initially planned ones) and restricted to the waters to the north of Sines, the northern area of the 9.a CS. Additionally, zig-zag transects were also conducted inside the Rías (**Figure 4.4.3.1**). The vessel's acoustic equipment consisted of a Simrad EK-80 scientific echosounder, operating at 18, 38, 70, 120 and 200 kHz, working in CW mode. All frequencies were calibrated according to the standard procedures (Demer *et al.*, 2015) at the start of the survey. The backscattering acoustic energy from marine organisms was measured continuously during daylight.

A total of 23 pelagic hauls and 9 purse-seine shots were done as shown in **Figure 4.4.3.1**. Sardine accounted 61% of the total catch in weight, and was present in 74% of the hauls. Anchovy occurred in 35% of the hauls, with a 25% contribution in the total catch.

Anchovy was absent in 9a N (**Figure 4.4.3.2**), while in 2020 it was found in the outer part of the surveyed area (e.g. close to the slope), occurring in rather dense epi-pelagic schools. Given the short duration of the 2021 survey, the outer shelf waters deeper than 100 m depth were not sampled and no information is available on if this same pattern was repeated in 2021. The bulk of the estimated population was concentrated in the subdivision 9a CN, with the centre of gravity of its distribution being located in the coastal waters (c.a. 20 m depth), as it was also recorded in previous years (except 2020).

The estimated biomass in 2019 and 2020 ($4 \cdot 10^3$ t and $5 \cdot 10^3$ t, respectively) showed an important decrease in relation to 2018 ($182 \cdot 10^3$ t). Anchovy biomass in autumn 2021 experienced a relative increase up to $31.2 \cdot 10^3$ t (1431 million fish). Anchovy recruits accounted for 47% of the total number of individuals estimated in the survey (**Table 4.4.3.2**; **Figures 4.4.3.3** and **4.4.3.4**).

ECOCADIZ-RECLUTAS survey series

ECOCADIZ-RECLUTAS 2021-10

ECOCADIZ-RECLUTAS 2021-10 survey was conducted by IEO between 25th October and 6th November 2021 in the Portuguese and Spanish shelf waters (20–200 m isobaths) off the Gulf of Cadiz on board the R/V *Ramón Margalef*. Subsurface sea temperature, salinity and *in vivo* fluorescence were continuously collected with a thermosalinograph-fluorometer. Vertical profiles of hydrographical variables were also recorded by night from 168 CTDO₂ casts. Neither CUFES sampling nor census of top predators were carried out during the survey. Results from this survey have been reported to this WG by Ramos *et al.* (WD 2022).

The 21 foreseen acoustic transects were sampled. A total of 18 valid fishing hauls were carried out for echotrace ground-truthing purposes. From the pelagic fish species set, chub mackerel, anchovy and sardine were the most frequent captured species in the fishing hauls, followed by horse mackerel, bogue, Atlantic mackerel, Mediterranean horse mackerel and blue jack mackerel. Boarfish, longspine snipefish and pearlside showed an incidental occurrence in the hauls performed in the surveyed area. Sardine and chub mackerel showed the highest yields in these hauls, followed by anchovy and Mediterranean horse mackerel (**Figure 4.4.3.5**).

Total and Spanish estimates of total NASC allocated to the “pelagic fish species assemblage” in this survey showed lower values than those recorded last year, whereas the Portuguese estimates showed an increasing trend. By species, sardine accounted for 55% of the total back-scattered energy, followed by anchovy (16%) and chub mackerel (9%), and the remaining species with relative contributions of acoustic energies lower than 6%.

GoC anchovy was widely distributed in the surveyed area, although avoided the easternmost waters. Higher densities were mainly recorded in two areas: between Alanzina and west of Cape Santa Maria, in the Algarve, and between Isla Cristina and Bay of Cadiz, in Spanish waters (**Figure 4.4.3.5**)

GoC anchovy acoustic estimates in autumn 2021 were of 1973 million fish and 17 512 tones (**Table 4.4.3.3; Figure 4.4.3.6**), entailing 38% and 51% decreases in abundance and biomass, respectively, in relation to the last year’s estimates (3197 million, 36 070 t). The current overall estimates are lower than the time-series average (i.e. 3258 million; 25 627 t). By geographical strata, the Spanish waters yielded 89% (1763 million) and 76% (13 370 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 211 million and 4143 t (**Table 4.4.3.3; Figure 4.4.3.6**).

The size class range of the assessed anchovy population in autumn 2021 varied between the 2.0 and 18.5 cm size classes. The size distribution showed a mixed composition, with several modal classes, the main mode at 10.0 cm, a secondary mode at 14.0 cm, and less important modes at 8.0 and 3.0 cm size class. It is noticeable the occurrence of this last modal size, as a consequence of the record of very tiny juveniles (size class range: 2.0 – 4.5 cm) in the coastal waters located between Mazagón and Punta Umbría. The size composition of anchovy throughout the surveyed area confirms the usual pattern exhibited by the species during the survey season, with the largest (and oldest) fish being distributed in the westernmost waters and the smallest (and youngest) ones concentrated in the surroundings of the Guadalquivir river mouth and adjacent shallow waters (**Table 4.4.3.3; Figure 4.4.3.6**).

The population was composed by fishes not older than 2 years. Age 0 fish accounted for 83% (1629 million) and 69% (12 063 t) of the total estimated abundance and biomass, respectively (**Table 4.4.3.3; Figure 4.4.3.7**). Spanish waters concentrated the bulk (97%) of this juvenile fraction. The estimates of age-0 fish experienced a similar decreasing trend than the one showed by the whole population in relation to the historical peak recorded in 2019 and the values recorded in 2020, but with values close to the time-series average (**Table 4.4.3.3**). Age 1 fish represented 16% and 28% of the total abundance and biomass (**Figure 4.4.3.7**).

The time-series of survey estimates is shown in **Figure 4.4.3.8**. **Figure 4.4.3.9** shows the correspondence between acoustic estimates of abundance of age-0 anchovies from *ECOCADIZ-RECLUTAS* surveys in the autumn of the year y against the abundance of age-1 anchovies estimated in spring of the following year ($y+1$) by the *PELAGO* survey and in summer by the *ECOCADIZ* survey. Some positive relationship seems to be suggested when the most recent *ECOCADIZ-RECLUTAS* and *PELAGO* surveys estimates are compared.

4.5 Biological data

4.5.1 Weight-at-age in the stock

Western component

First estimates of mean weight-at-age for this stock component from *PELACUS* and *PELAGO* spring acoustic surveys were presented to WKPELA 2018. Given the assessment and provision of advice for this stock component is survey trend-based, no weight-at-age estimates have been provided to the present WG, although the collections of otoliths of the Portuguese surveys are being analysed by IPMA to be able to reconstruct a time-series of weights-at-age for this stock component to present.

Southern component

Weight-at-age in the stock are shown in **Table 4.5.1.1**. See the stock annex for comments on their computation.

4.5.2 Maturity-at-Age

Maturity stage assignment criteria were agreed between national institutes involved in the biological study of the species during the Workshop on Small Pelagics (*Sardina pilchardus*, *Engraulis encrasicolus*) maturity stages (WKSPMAT; ICES, 2008 c).

See the stock annex for comments on computation of the maturity ogives in both stock components.

Due to some inconsistencies in the maturity ogives of anchovy in the southern component, not noticed during WKPELA 2018, we assume that all individuals with age 1 or higher (B1+), are mature for assessment purposes.

The macroscopic maturity scale used by IPMA (Soares *et al.*, 2009) has been validated with histology (microscopic identification of macroscopic maturity stages). Results show that only histology allows the correct identification of mature and immature individuals macroscopically identified as stage 1 (Immature or Resting); therefore, the maturity ogive of this species must be obtained during the spawning season with histology.

4.5.3 Natural mortality

Western component

Natural mortality, M , is unknown for this stock component. It has been suggested in WKPELA 2018 to follow the M pattern at-age used for the anchovy in the Bay of Biscay, which is 1.2 for age 0, 0.8 for age 1 and 1.2 for older ages, for further modelling exercises.

Southern component

M is also unknown for this stock component. The following estimates for M at-age were finally adopted in WKPELA 2018: $M_0=2.21$; $M_1=1.30$; $M_2+=1.30$ (similar at any older age; see ICES, 2018a). A description of the rationale and whole process for deriving the above estimates is shown in the stock annex.

4.6 Stock Assessment

Both components of the stock are assessed using an interim trend-based procedure according to ICES data-limited stock approaches (by analogy with the current method 3.2, DLS: ICES CM 2012/ACOM 68) and following the guidelines presented on ICES (2021), as follows:

$$C_y = \begin{cases} 0.2C_{y-1} & \text{if } \frac{I_y}{(I_{y-1} + I_{y-2})/2} < 0.2 \\ C_{y-1} \frac{I_y}{(I_{y-1} + I_{y-2})/2} & \text{if } 0.2 \leq \frac{I_y}{(I_{y-1} + I_{y-2})/2} \leq 1.8, \\ 1.8C_{y-1} & \text{if } \frac{I_y}{(I_{y-1} + I_{y-2})/2} > 1.8 \end{cases}$$

where C_y and C_{y-1} represent the catch advice corresponding to the current (y) and previous ($y-1$) years, respectively, and I_y , I_{y-1} and I_{y-2} represent the biomass indicators corresponding to the current (y) and two previous years ($y-1$ and $y-2$), respectively. Note that the first and third cases correspond to the application of an uncertainty cap of 0.2 and 1.8, respectively. For the Western component the biomass

indicator input has been taken from the results of the acoustic spring surveys covering this area (by adding *PELAGO* and *PELACUS* estimates), while for the Southern component the biomass indicator input has been obtained from the results of SSB estimates from the Gadget assessment model, using those as a relative index. The basis of this procedure for both components was approved in the last benchmark for this stock (WKPELA 2018; ICES, 2018a), when it was also decided that instead of providing advice for calendar years, advice would be given in-year for the period from 1st July to 30th June next year, after obtaining the results of the spring acoustic surveys. The uncertainty cap for this year is different to the one used in 2018 as a consequence of the conclusions obtained in ICES WKLIFE 10 (ICES, 2021b).

4.6.1 Western component

The stock assessment procedure for this component is described in the stock annex.

4.6.1.1 Biomass survey trend as base of the advice

The anchovy biomass indicator for the Western component is computed as the sum of *PELACUS* (9a N) and *PELAGO* (9a C-N and 9a C-S) acoustic estimates of biomass.

4.6.2 Southern component

4.6.2.1 Model used as basis of the advice

The model used to provide the estimates of the SSB indicator is a Gadget model. Gadget is an age-length-structured model that integrates different sources of information in order to produce a diagnosis of the stock dynamics. It works making forward simulations and minimizing an objective (negative log-likelihood) function that measures the difference between the model and data. General model specifications are described in the Stock Annex while details on data input, implementation and results up to 2021 are described in Rincón *et al.* (WD 2022).

A model issue for this year regarding last year implementation was found. It was noticed that the length distribution data for *ECOCADIZ* in year 2020 was not included. It was included in the model of this year. A comparison between both models was performed and no significant differences were found.

4.6.2.1.1 Data input

Data input for optimization routines is summarized in **Table 4.6.2.1.1.1**. It corresponds to all the information of the fishery available until the end of June of 2022, together with data from *ECOCADIZ* and *PELAGO* survey series up to 2020 (no *ECOCADIZ* survey in 2021) and 2022, respectively.

Catches (landings + discards, discards from 2014 onwards) from Spain and Portugal are assumed to be removed from the population by only one fleet from 1989 to the second quarter of 2022. For the first two quarters of year 2022, provisional catches estimations of Spanish (until May 17th) purse-seine fleet were used and catches for June were estimated as the 39% of January to May catches based on historical records from 2009 to 2021.

4.6.2.1.2 Model fit

A summary of the goodness of fit of model estimations compared with data is shown in **Figures 4.6.2.1.2.1, 4.6.2.1.2.2, 4.6.2.1.2.3** (length distributions), **4.6.2.1.2.5, 4.6.2.1.2.6** and **4.6.2.1.2.7** (age distributions). These figures show that length and age frequency distributions of catches and surveys match reasonably well with available data. Goodness of fit for length distribution of catches (**Figure 4.6.2.1.2.1**) is better in the last 20 years compared to the first years, in coherence with the assumption of two different selectivity periods. The model seems to not capture well enough the fluctuating or

sharp patterns of year 2013 for the *ECOCADIZ* survey (**Figure 4.6.2.1.2.2**) and for most of the years for *PELAGO* survey; in this survey series the length distribution fit is better for years 2000, 2005, 2008, 2017-2020 and 2022 (**Figure 4.6.2.1.2.3**). Age distributions present a very good fit in almost all the cases (**Figures 4.6.2.1.2.5, 4.6.2.1.2.6 and 4.6.2.1.2.7**), except for some mismatch in years 2014, 2020, 2021 and 2022 for *PELAGO* survey (**Figure 4.6.2.1.2.7**). There are no remarkable differences compared with the fit of the 2018 model implementation.

Figure 4.6.2.1.2.4 shows the model residuals from the fit to the catch-at-length composition and the acoustic survey length composition, while **Figure 4.6.2.1.2.8** shows the model residuals from the fit to the catch-at-age composition and the acoustic survey age composition. In both cases the residuals from the present assessment are very similar to those in the benchmark model implementation.

Figure 4.6.2.1.2.9 presents the comparison between observed and estimated survey indices. It can be observed that the model assimilates the trend of survey indices in most of the years but in particular, it does not assimilate the first four years of the *PELAGO* series.

4.6.2.1.3 Model estimates

Parameter estimates after optimization are presented in **Table 4.6.2.1.3.1**, while **Figure 4.6.2.1.3.1** presents model annual estimates for abundance (removing Age-0 individuals to be accurate with the time of the assessment), recruitment, fishing mortality and catches at the end of the second quarter of each year. **Figure 4.6.2.1.3.2** shows annual estimates for biomass of individuals of Age-1+ at the end of the second quarter of each year. Due to some inconsistencies in the maturity ogives not noticed during WKPELA 2018, we assume that all individuals with Age 1 or older (B_{1+}) are mature, *i.e.* these biomass estimates result equivalent to spawning stock biomass estimates. The SSB estimates used for 2022 advice are those corresponding to years 2020, 2021 and 2022, with values of 3987, 2502 and 953 t, respectively (**Figure 4.6.2.1.3.2**). Detailed model outputs are available at https://github.com/ices-iaf/2022_south_assessment/tree/main/results, where each file corresponds to the following description:

- sidat: model fit to the survey indices.
- suitability: model estimated fleet suitability.
- stock.recruitment: model estimated recruitment.
- res.by.year: results by year.
- catchdist.fleets: data compared with model output for the length and age-length distributions.
- stock.full: modelled abundance and mean weight by year, step, length and stock.
- stock.std: modelled abundance, mean weight, number by age consumed by the fleet, stock and year.
- stock.prey: consumption of the fleet by length, year and step.
- fleet.info: information on catches, harvest rate and harvestable biomass by fleet, year and step.
- params: parameter values used for the fit.

4.7 Reference points

4.7.1 Western component

Reference points were not calculated for this area.

4.7.2 Southern component

A B_{lim} of 1186.34 t (corresponding to a relative B_{lim} equal to 0.325) and a B_{pa} of 1946 t were calculated with updated values of SSB following the procedure agreed at the most recent benchmark (**Figure 4.7.2.1**). B_{pa} is defined as the upper 95% of the distribution of the estimated SSB if the true SSB equals B_{lim} based on a terminal SSB coefficient of variation assumed as 0.3 as recommended by ICES (ICES, 2017b) for short-lived species.

4.8 State of the Stock

4.8.1 Western component

The stock size indicator (a combined index from *PELAGO* and *PELACUS* estimates) was obtained this year.

4.8.2 Southern component

The SSB has been fluctuating without a trend over the time-series showing a decrease in the last two years which is consistent with the trend on recruitment and survey biomass estimates, and with an increase of F . Time series for recruitment and F are fluctuating with no clear trend (**Figures 4.6.2.1.3.1 and 4.6.2.1.3.2**).

4.9 Catch scenarios

4.9.1 Western component

The ICES framework for category 3 stocks was applied (ICES, 2012). The advice is based on the ratio between the last index value corresponding to 2022 (111 963 t) and the average of the two preceding values of 2020 and 2021 (61 104 327 t), and the Advised Catch (July 2020 to June 2021, 4 347 t). The index is estimated to have increased by 83% and thus the 80% uncertainty cap was applied.

4.9.2 Southern component

The ICES framework for category 3 stocks was applied (ICES, 2021b). The SSB estimated by the assessment model relative to the average of the time-series (1989-2021) was used as the index of stock size development. The advice is based on the ratio between the last index value (0.261) and the average of the two preceding values (0.89), multiplied by the recent advised catches for 2021 (July 2021 to June 2022, 7181 t). The index ratio is estimated to have decreased 71%, i.e. less than 80% and thus the 80% uncertainty cap was not applied. Given that the estimated abundance is below a biomass trigger, which in this case is B_{lim} , the ratio is also multiplied by a biomass safe guard defined as the quotient between the last index value and the biomass trigger. The advice rule with an 80% uncertainty cap and a biomass safe guard is considered precautionary and as such the precautionary buffer was not considered (ICES 2021b). Fishing mortality was not used to consider the application of this buffer because fishing mortality reference points are not considered relevant for short lived species.

4.10 Short-term projections

Short-term projections were not calculated in the two components.

4.11 Quality of the assessment

4.11.1 Western Component

In the last benchmark it was decided that this stock component would be assessed using a biomass survey trend as the basis of the advice. This decision was made taking into account that there is no time-series of regular information of the composition by length and age of the catches available. This data gap corresponds to a very low abundance index and low catches in the first half of the time-series.

Advised catches were calculated according to the Guidance on the applications of the advisory rules for category 3 short lived stocks drafted by WK LIFE 10 (ICES, 2021b), whereby the 1-over-2 rule is constrained by an uncertainty cap of $\pm 80\%$ of the former catch advice.

The expert group considers that the current advice procedure for short-lived species category 3 stocks, based on the 1-over-2 ratio with uncertainty cap of 80%, is still not flexible enough to adapt to the highly fluctuating nature of this stock. For this reason, work is being carried out in the framework of WKDLSSLS/WK LIFE guidelines to evaluate a new method to provide advice for this stock.

4.11.2 Southern Component

The biomass estimates provided by the Gadget model are assumed as relative because during the last benchmark it was observed that although the model provided a good model fit, it presented some instability (as shown by the occurrence of a certain retrospective pattern) and also the estimated catchability for both surveys was very high. These issues need to be further investigated.

A comparison with last year estimated time series and also a sensitivity analysis regarding including the 2020 length distribution for the *ECOCADIZ* survey (missing in the last year model) was performed and it is presented in **Figure 4.11.2.1**. This figure shows the annual model estimates for relative SSB of individuals with more than one year of age, relative fishing mortality, recruitment and catches (in tons). The pink line represents last year estimated time series, the green line the estimated by the same model but including the *ECOCADIZ* length distribution in 2020 and the blue line the estimated by the model used this year. It was observed that the estimated biomass for some of the last years is smaller when including the length distribution missing (green line) but population trend remains very similar. It is also important to remark that the number of iterations for the optimization process in the model corresponding to the pink line was 2 000 000, while in the others was just 1 000 000. In a previous meeting the group acknowledged that the rule assumes the past advice was unbiased, but as far as our new assessment updates the past series estimates of the indicator SSB, it is saying at the same time that the trend-based indicator for providing advice in 2021 was partially biased (as far as those biomass estimates SSB have now been changed). Therefore, the new application of the rule is incorporating a catch advice for the previous year which is now known to be not consistent with what would have been advised in case of perceiving the population as in the current (most recent) assessment. This is probably a general problem which may affect others stock in category 3 with an indicator linked to an analytical assessment.

This situation was not considered when putting forward the guidelines for category 3 short lived species. Certainly, the stability/variability of the assessment producing the stock trend indicators is something has to be incorporated when assessing the performance of these HCRs for category 3 stocks and it requires further investigation.

4.12 Management considerations

ICES has agreed with the clients that the catch advice will be framed in a management calendar set from 1st July (y) to the following 30th June ($y+1$), instead of calendar years.

Other management considerations and the current management situation are described in the stock annex.

4.13 Ecosystem considerations

Ecosystem considerations are described in the stock annex and there have not been remarkable changes in the last year.

4.14 Deviations from stock annex caused by missing information from Covid-19 disruption (and other reasons)

For this year assessment, there were some deviations for the southern component of the stock, but they were not related to the Covid-19 disruption. For the western component there were only deviations that were previously considered in the 2020 assessment. Those deviations in 2020 were related to missing survey data associated to *PELACUS* survey, details which were provided at ICES (2020b; WGHANSA 2020 report).

1. Stock: ane.27.9a. Anchovy 9.a southern and western components.
2. Missing or deteriorated survey data: YES. *ECOCADIZ 2021-07* acoustic-trawl survey was the Gulf of Cadiz pelagic ecosystem survey (20-200 m depth) to be conducted by IEO onboard RV *Miguel Oliver* (SGP) last year. The survey was planned to be conducted from 31/07 – 13/08/2021. A malfunctioning of the echo-sounder (probably caused by RV's electric problems affecting to the echo-sounder) during the previous acoustic survey (*MEDIAS_ES*) caused the interruption of that survey. Further failed attempts of solving such problems also led to the definitive suspension of the *ECOCADIZ 2021-07* survey.
3. Missing or deteriorated catch data: NO.
4. Missing or deteriorated commercial *LPUE/CPUE* data: NO
5. Missing or deteriorated biological data: For the western component: missing length distribution (LFD) and age-length key (ALK) for Spanish commercial catches in the second quarter (Q2) in 2021 in 9a N; missing ALK for Q4 also for the same year and subdivision. Missing LFDs and ALKs in Q1 and Q2 2021 for the Portuguese fishery in 9a CN. No data from the Portuguese fishery in 9a CS in 2021, but catches were very scarce in that subdivision. For the southern component: no missing data for the Spanish fishery. Missing LFDs and ALKs for commercial catches from the Portuguese fishery, but landings are comparatively very scarce (1.4% of total catches from this component in 2021).
6. Brief description of methods explored to remedy the challenge: For the western component: 2021 Q1 LFD from 9a N was propagated to the 2021 Q2 catches in 9a N (without LFD). Quarterly

ALKs for Spanish commercial catches in 9a N were based in a combination of samples from commercial and research (*PELACUS 0321*) samples (the same ALK for Q1 and Q2) and research (*IBERAS 0921*) samples only (the same ALK for Q3 and Q4). Methods to remedy gaps of biological information in the Portuguese fishery have not been explored because the very low catches recorded in those quarters without biological data. For the southern component: quarterly LFDs and ALKs from the Spanish fishery were propagated to the very low quarterly catches from the Portuguese fishery. The assessment model for this year did not include the missing data corresponding to 2021 in the *ECOCADIZ* time series. No further analysis was performed to understand the effect of this missing data but considering that *PELAGO* survey estimates were available and that estimated biomass was consistent with the last year estimates, it was assumed that *PELAGO* and fishery information was enough to provide an accurate biomass index for this year.

7. Suggested solution to the challenge, including reason for this selecting this solution: For the western component: 2021 Q1 LFD from 9a N was propagated to the 2021 Q2 catches in 9a N (without LFD). Quarterly ALKs for Spanish commercial catches in 9a N were based in a combination of samples from commercial (one sample in March) and research (*PELACUS 0321*) samples (the same ALK for Q1 and Q2) and research (*IBERAS 0921*) samples only (the same ALK for Q3 and Q4). Methods to remedy gaps of biological information in the Portuguese fishery have not been explored because the very low catches recorded in those quarters without biological data. For the southern component: quarterly LFDs and ALKs from the Spanish fishery were propagated to the very low quarterly catches from the Portuguese fishery. The model for this year did not include the missing data corresponding to 2021 in the *ECOCADIZ* time series. No further analysis was performed to understand the effect of this missing data but considering that *PELAGO* survey estimates were available and that estimated biomass was consistent with the last year estimates, it was assumed that *PELAGO* and fishery information was enough to provide an accurate biomass index for this year.
8. Was there an evaluation of the loss of certainty caused by the solution that was carried out? For the southern component: A comparison with last year model implementation was performed where it can be observed that estimated biomass without this survey was consistent with the previous estimated biomass time series.

4.15 References

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Table 4.3.1.1. Anchovy in Division 9.a. Composition of the Spanish fleets operating in Southern Galician waters (Western component, subdivision 9.a North) and in the Gulf of Cadiz (Southern component, Subdivision 9.a-South) targeting anchovy in 2021. The categories include both single purpose purse-seiners, artisanal and trawl and artisanal vessels fishing with purse-seine in some periods through the year (multi-purpose vessels). Storage: catches are dry hold with ice (one fishing trip equals one fishing day). Similar tables for yearly data since 1999 are shown for the Gulf of Cadiz Spanish fleet in previous WG reports.

Subdivision 9.a North						
2021	Vessels targeting anchovy					
	Engine (HP)					
Length (m)	0–50	51–100	101–200	201–500	>500	Total
≤10	2					2
11–15	5	15	13			33
16–20		1	11	12		24
>20			6	29	3	38
Total	7	16	30	41	3	97
Subdivision 9.a South						
2021	Vessels targeting anchovy					
	Engine (HP)					
Length (m)	0–50	51–100	101–200	201–500	>500	Total
≤10						
11–15	1	4	1	1		7
16–20		6	23	10		39
>20			3	11	1	15
Total	1	10	27	22	1	61

Table 4.3.2.1.1. Anchovy in Division 9.a. Recent historical series of annual catches (t) by subdivision, stock component and total division since 1989 on (the period with available data for all the subdivisions). Catches in Subdivision 9.a South are also differentiated between Portuguese (PT) and Spanish (ES) waters. (-) not available data; (0) less than 1 tonne (from Pestana, 1989, 1996 and WGMHSA, WGANCA, WGANSA and WGHANSA members). The rest of the historical series of catches is shown in the stock annex. Discards are considered negligible in both the Portuguese (9.a C-N to 9.a S (PT)) and Spanish (9.a N, 9.a S (ES)) fisheries. Notwithstanding the above, the estimates for the Spanish fishery include estimates of discarded (and unallocated) catches since 2014 on. Discards estimates for the Spanish fishery are not available for the first semester 2020 because Covid-19 disruption and interruption of the IEO's observers at-sea sampling program. (*) Provisional official landings data for the 2022 first semester updated until 31st March (9a.CN, 9a.CS, 9a.S-ALG) –17th May (9a.N, 9a.S-CAD).

Year	9.a N	9.a C-N	9.a C-S	West. Comp.	9.a S (PT)	9.a S (ES)	South. Comp.	Total Division
1989	118	646	141	905	36	5330	5365	6270
1990	220	431	4	655	110	5726	5836	6491
1991	15	187	3	205	22	5697	5718	5924
1992	33	136	1	170	2	2995	2997	3167
1993	1	22	1	24	0	1960	1960	1984
1994	117	236	8	361	0	3035	3035	3397
1995	5329	2521	9	7859	0	571	571	8430
1996	44	2711	13	2768	51	1780	1831	4599
1997	63	610	8	682	14	4600	4614	5296
1998	371	894	153	1419	610	8977	9587	11006
1999	413	957	96	1466	355	5587	5942	7409
2000	10	71	61	142	178	2182	2360	2502
2001	27	397	19	444	439	8216	8655	9098
2002	21	433	90	543	393	7870	8262	8806
2003	23	211	67	301	200	4768	4968	5269
2004	4	83	139	226	434	5183	5617	5844
2005	4	82	6	92	38	4385	4423	4515
2006	15	79	15	110	14	4368	4381	4491
2007	4	833	7	844	34	5576	5610	6454
2008	5	211	87	303	37	3168	3204	3508
2009	19	35	5	59	32	2922	2954	3013
2010	179	100	2	281	28	2901	2929	3210
2011	541	3239	1	3782	78	6216	6294	10076
2012	39	521	220	779	56	4754	4810	5589

Year	9.a N	9.a C-N	9.a C-S	West. Comp.	9.a S (PT)	9.a S (ES)	South. Comp.	Total Division
2013	69	192	131	392	67	5172	5240	5632
2014	581	678	21	1281	118	8933	9051	10332
2015	173	2533	10	2717	2	6878	6880	9597
2016	222	6908	10	7140	19	6581	6599	13740
2017	1069	8854	170	10094	26	4585	4611	14705
2018	992	7871	370	9233	65	4433	4499	13732
2019	991	5205	4	6200	113	4701	4814	11014
2020	309	5327	2	5639	155	7163	7317	12956
2021	747	9521	8	10276	109	7452	7562	17837
2022*	12	1024	0	1037	0	1425	1425	2462

Table 4.3.2.2.1. Anchovy in Division 9.a. Catches (t) by gear and subdivision in 1989–2021. Discards are considered negligible in both the Portuguese (9.a C-N to 9.a S (PT)) and Spanish (9.a N, 9.a S (ES)) fisheries. Notwithstanding the above, the estimates for the Spanish fishery include estimates of discarded catches by gear since 2014 on. Discards estimates for the Spanish fishery are not available for the first semester 2020 because Covid-19 disruption and interruption of the IEO's observers at-sea sampling program. Landings by gear in subdivisions 9.a C-N to S (PT) are not available by subdivision until 2009.

Subarea	Gear	1989	1990	1991	1992	1993	1994	1995*	1996	1997	1998	1999	2000
9.a N	Artisanal	0	0	0	0	0	0	0	0	0	0	0	0
	Purse-seine	118	220	15	33	1	117	5329	44	63	371	413	10
9.a C-N to 9.a S (PT)	Demersal Trawl	-	-	-	4	9	1	-	56	46	37	43	6
	P. seine polyvalent	-	-	-	1	1	3	-	94	7	35	20	7
	Purse-seine	-	-	-	270	14	233	-	2621	579	1541	1346	297
	Not different. By gear	496	541	210	-	-	-	7056	-	-	-	-	-
9.a S (ES)	Demersal Trawl	0	0	0	0	330	152	75	224	190	1148	993	104
	Purse-seine	5336	5911	5696	2995	1630	2884	496	1556	4410	7830	4594	2078
Subarea	Gear				2001	2002	2003	2004	2005	2006	2007	2008	2009
9.a N	Artisanal				0	0	4	1	0	0	0	1	0.1
	Purse-seine				27	21	19	2	4	15	4	4	18
9.a C-N to 9.a S (PT)	Demersal Trawl				16	13	7	5	7	27	14	9	4

Subarea	Gear	2001	2002	2003	2004	2005	2006	2007	2008	2009			
	P. seine polyvalent	32	13	184	197	57	24	376	141	38			
	Purse-seine	806	888	287	455	62	57	484	185	30			
	Not different. By gear	-	-	-	-	-	-	-	-	-			
9.a S (ES)	Demersal Trawl	36	23	14	6	0.2	0.4	0.3	0.1	0.02			
	Purse-seine	8180	7847	4754	5177	4385	4367	5575	3168	2922			
Subarea	Gear	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
9.a N	Demersal trawl	0	0	0	0	0	0.2	0	7	0.6	0.6	0	0
	Artisanal	4	0	1	6	0	21	6	6	0.4	0.1	0.1	0.1
	Purse-seine	175	541	37	63	581	152	217	1057	991	990	309	747
9.a C-N	Demersal Trawl	5	4	1	0.5	2	3	2	2	0,3	0.2	2	2
	P. seine poly-valent	45	1116	177	17	9	150	294	332	403	34	122	400
	Purse-seine	50	2119	342	175	668	2381	6613	8521	7468	5170	5203	9119
9.a C-S	Demersal Trawl	1	1	0.4	1	3	2	1	0.2	1	0.02	0.02	0.01
	P. seine poly-valent	0	0.1	17	4	1	0.4	4	13	14	1	2	2
	Purse-seine	1	0.4	202	127	18	8	5	157	355	4	0	5
9.a S (PT)	Demersal Trawl	8	13	16	2	5	1	3	6	1	0	0.1	0.1
	P. seine poly-valent	4	33	0.1	2	0.04	0.02	0.04	0	0	0	1	2
	Purse-seine	17	33	41	63	113	1	16	20	65	113	153	107
9.a S (ES)	Demersal Trawl	0	0	2	0	99	33	118	204	90	209	105	66
	Artisanal	0	0	0	0	0	0.1	0.1	0.01	0	0	0	0
	Purse-seine	2901	6216	4752	5172	8835	6845	6463	4381	4343	4492	7058	7387

Table 4.3.2.2.2. Anchovy in Division 9.a. Quarterly anchovy catches (t) by subdivision in 2021.

SUBDIVISION/ COMPONENT	QUARTER 1		QUARTER 2		QUARTER 3		QUARTER 4		ANNUAL (2020)	
	C(t)	%	C(t)	%	C(t)	%	C(t)	%	C (t)	%
9.a North	47	6,3	7	0,9	433	57,9	260	34,8	747	4,2
9.a Central North	2	0,02	39	0,4	6688	70,2	2792	29,3	9521	53,4
9.a Central South	0,01	0,1	1	12,7	5	66,8	2	20,4	8	0,04
Western Comp.	49	0,5	47	0,5	7126	69,3	3054	29,7	10276	57,6
9.a South (PT)	2	1,5	1	1,1	106	97,3	0,1	0,1	109	0,6
9.a South (ES)	643	8,6	3542	47,5	2659	35,7	609	8,2	7452	41,8
Southern Comp.	644	8,5	3543	46,9	2765	36,6	609	8,1	7562	42,4
TOTAL	694	3,9	3590	20,1	9890	55,4	3664	20,5	17837	100,0

Table 4.3.5.1.1. Anchovy in Division 9.a. Western Component. Subdivision 9.a North. Spanish fishery (all fleets). Seasonal and annual length distributions ('000) of anchovy catches in 2021. Discards were sampled but they were null, hence landings equals to catches.

2021	Q1	Q2	Q3	Q4	TOTAL
Length (cm)	9.a N	9.a N	9.a N	9.a N	9.a N
6	0	0	0	0	0
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
9.5	0	0	0	0	0
10	0	0	0	0	0
10.5	0	0	0	0	0
11	0	0	0	0	0
11.5	0	0	254	0	254
12	1	0	507	144	653
12.5	21	3	888	289	1201
13	63	9	2157	796	3025
13.5	68	10	2537	1432	4047
14	109	15	1269	2287	3680
14.5	143	20	381	2698	3242
15	277	39	127	1592	2034
15.5	334	47	90	1626	2096
16	234	33	362	578	1207
16.5	214	30	1538	0	1783
17	117	16	2443	289	2866
17.5	58	8	1900	0	1967
18	58	8	814	0	881
18.5	0	0	271	0	271

2021	Q1	Q2	Q3	Q4	TOTAL
19	0	0	0	0	0
19.5	0	0	0	0	0
20	0	0	0	0	0
20.5	0	0	0	0	0
21	0	0	0	0	0
21.5	0	0	0	0	0
Total N	1698	238	15539	11731	29206
Catch (T)	47	7	421	273	747
L avg (cm)	15,7	15,7	15,3	14,7	15,1
W avg (g)	28,1	28,1	27,1	23,2	25,6

Table 4.3.5.1.2. Anchovy in Division 9.a. Western Component. Subdivision 9.a Central North. Portuguese fishery (all fleets). Seasonal and annual length distributions ('000) of anchovy catches in 2021. Discards are null, hence landings correspond to catches. Length frequency distributions were not available for other métiers. They have been estimated by raising total catches to the respective quarterly LFDs from the métier PS_SPF_0_0_0, that represents >95% of catches from all quarters. In this case, TOTAL corresponds to data from the second semester.

2021	Q1	Q2	Q3	Q4	TOTAL
Length (cm)	9.a CN	9.a CN	9.a CN	9.a CN	9.a CN
6	-	-	0	0	0
6.5	-	-	0	0	0
7	-	-	0	0	0
7.5	-	-	0	0	0
8	-	-	0	0	0
8.5	-	-	0	0	0
9	-	-	0	0	0
9.5	-	-	0	0	0
10	-	-	0	0	0
10.5	-	-	0	0	0
11	-	-	0	0	0
11.5	-	-	0	0	0
12	-	-	0	0	0
12.5	-	-	0	2608	2608

2021	Q1	Q2	Q3	Q4	TOTAL
13	-	-	0	2608	2608
13.5	-	-	1251	4334	5584
14	-	-	6157	5317	11474
14.5	-	-	13915	11710	25625
15	-	-	23468	11710	35177
15.5	-	-	26824	12998	39822
16	-	-	26824	10390	37213
16.5	-	-	26824	10390	37213
17	-	-	25573	10390	35963
17.5	-	-	20672	7681	28353
18	-	-	15710	5956	21666
18.5	-	-	7934	1288	9222
19	-	-	3012	0	3012
19.5	-	-	1740	0	1740
20	-	-	0	0	0
20.5	-	-	0	0	0
21	-	-	0	0	0
21.5	-	-	0	0	0
Total N	-	-	0	0	0
Catch (T)	2	39	6688	2792	9480
L avg (cm)	-	-	16.6	15.9	16.2
W avg (g)	-	-	32.8	28.0	30.4

Table 4.3.5.1.3. Anchovy in Division 9.a. Southern component. Subdivision 9.a South (ES). Spanish fishery (all fleets). Seasonal and annual length distributions ('000) of anchovy catches in 2021. Discards were sampled and estimated.

2021	Q1	Q2	Q3	Q4	TOTAL
Length (cm)	9.a S (ES)	9.a S (ES)	9.a S (ES)	9.a S (ES)	9.a S (ES)
4	0	0	0	0	0
4.5	0	0	0	0	0
5	0	0	0	0	0
5,5	0	0	19	0	19
6	0	0	10	0	10
6.5	3	0	12	81	96
7	12	0	106	164	281
7.5	9	9	171	278	467
8	9	38	247	357	651
8.5	20	179	2600	179	2977
9	14	709	16074	1551	18348
9.5	23	4743	31246	1561	37573
10	54	18399	33022	3897	55372
10.5	790	48696	26594	8331	84411
11	1113	46728	16464	5760	70065
11.5	5346	40229	25804	6500	77879
12	5830	22845	16352	8706	53733
12.5	11100	25801	25256	7953	70111
13	7355	23840	13732	7702	52629
13.5	5938	21403	16805	2416	46562
14	3916	11103	5988	2259	23266
14.5	1648	7613	5371	782	15415
15	325	3457	1131	121	5034
15.5	155	1188	759	111	2213
16	7	0	535	9	551

2021	Q1	Q2	Q3	Q4	TOTAL
16.5	7	264	129	9	409
17	16	0	1	0	17
17.5	0	0	5	0	5
18	0	0	0	0	0
18.5	0	0	0	0	0
19	0	0	0	0	0
19.5	0	0	0	0	0
20	0	0	0	0	0
20.5	0	0	0	0	0
Total N	43690	277244	238433	58727	618094
Catch (T)	643	3499	2688	623	7452
L avg (cm)	12,9	12,0	11,5	11,9	11,9
W avg (g)	14,7	12,6	11,3	10,6	12,1

Table 4.3.5.2.1. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Spanish catches (all fleets) in numbers-('000) at-age of Galician anchovy in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	7400	5297	0	12697	12697
	1	782	110	5275	5982	891	11257	12148
	2	890	125	2864	452	1015	3316	4331
	3	26	4	0	0	30	0	30
	Total (n)	1698	238	15539	11731	1936	27270	29206
	Catch (t)	47	7	433	260	54	693	747
	SOP	48	7	420	273	54	693	748
	VAR.%	0,99	0,99	1,03	0,95	0,99	1,00	1,00

Table 4.3.5.2.2. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Spanish annual catches of anchovy in numbers ('000) at-age (only data for 2011–2012 and 2015–2021).

Year	Age 0	Age 1	Age 2	Age 3
2011	2725	23903	380	0
2012	0	668	599	7
2013	n.a	n.a	n.a	n.a
2014	n.a	n.a	n.a	n.a
2015	0	1667	6667	66
2016	4677	9206	881	1
2017	14116	21150	10310	184
2018	0	33336	8551	354
2019	0	3274	5942	196
2020	0	4091	4170	1526
2021	12697	12148	4331	30

Table 4.3.5.2.3. Anchovy in Division 9.a. Western component. Subdivision 9.a Central-North. Portuguese catches (all fleets) of anchovy in numbers ('000) at-age in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	0	0	-	0	-
	1	-	-	130889	51953	-	171925	-
	2	-	-	62636	42299	-	115535	-
	3	-	-	6376	3127	-	9821	-
	Total (n)	-	-	199901	97379	-	297281	-
	Catch (t)	2	39	6688	2792	41	9480	9521
	SOP	-	-	6544	2729	-	9031	-
	VAR. %	-	-	0,98	0.97	-	0.71	-

Table 4.3.5.2.4. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Spanish catches (all fleets) in numbers ('000) at-age of Gulf of Cadiz anchovy in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	0	0	101943	42984	0	144927	144927
	1	28574	266558	133670	15619	295132	149290	444421
	2	15116	10686	2819	123	25802	2943	28745
	3	0	0	0	0	0	0	0
	Total (n)	43690	277244	238433	58727	320934	297160	618094
	Catch (t)	643	3542	2659	609	4184	3268	7452
	SOP	643	3499	2697	622	4142	3319	7462
	VAR.%	1,00	1,01	0,99	0,98	1,01	0,98	1,00

Table 4.3.5.2.5. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Spanish annual catches (all fleets) in numbers ('000) at-age of Gulf of Cadiz anchovy (1995–2021).

Year	Age 0	Age 1	Age 2	Age 3
1995	34497	33961	189	0
1996	484540	162483	2053	0
1997	333758	279641	44823	0
1998	436307	1015535	13260	0
1999	124784	472348	32279	0
2000	118808	197497	3844	0
2001	158126	541331	23342	0
2002	74399	708070	17515	0
2003	71847	381407	13109	0
2004	105958	398862	2590	0
2005	37906	482256	3495	0
2006	11303	491307	5261	0
2007	61692	559217	7342	0
2008	57477	138295	30970	394
2009	9695	184941	20051	2673
2010	34462	210384	11118	257

Year	Age 0	Age 1	Age 2	Age 3
2011	199191	406217	16117	0
2012	25265	335487	8348	0
2013	176169	300781	5950	0
2014	73210	808350	6155	0
2015	196337	460887	13667	0
2016	87979	460201	19758	0
2017	118554	402410	4339	8
2018	39467	316336	6450	0
2019	163216	265091	17311	0
2020	196225	373573	28237	1357
2021	144927	444421	28745	0

Table 4.3.6.1. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Mean length (TL, in cm) at-age in the Spanish catches of Galician anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	13,4	13,9	-	13,6	13,6
	1	15,0	15,0	16,9	15,3	15,0	16,1	16,0
	2	16,3	16,3	17,4	16,1	16,3	17,2	17,0
	3	17,3	17,3	-	-	17,3	-	17,3
	Total	15,7	15,7	15,3	14,7	15,7	15,1	15,1

Table 4.3.6.2. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Mean weight (in kg) at-age in the Spanish catches of Galician anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	0,018	0,020	-	0,019	0,019
	1	0,025	0,025	0,034	0,026	0,025	0,030	0,029
	2	0,031	0,031	0,037	0,030	0,031	0,036	0,035
	3	0,036	0,036	-	-	0,036	-	0,036
	Total	0,028	0,028	0,027	0,023	0,028	0,025	0,026

Table 4.3.6.3. Anchovy in Division 9.a. Western component. Subdivision 9.a Central-North. Mean length (TL, in cm) at-age in the Portuguese catches of Northwestern anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	0	0	-	0	-
	1	-	-	15,0	15,0	-	15,8	-
	2	-	-	16,8	16,8	-	17,0	-
	3	-	-	18,0	18,0	-	15,2	-
	Total	-	-	15,9	15,9	-	16,2	-

Table 4.3.6.4. Anchovy in Division 9.a. Western component. Subdivision 9.a Central-North. Mean weight (in kg) at-age in the Portuguese catches of Northwestern anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	0	0	-	0	-
	1	-	-	0,030	0,023	-	0,027	-
	2	-	-	0,037	0,033	-	0,034	-
	3	-	-	0,050	0,041	-	0,045	-
	Total	-	-	0,033	0,028	-	0,030	-

Table 4.3.6.5. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Mean length (TL, in cm) at-age in the Spanish catches of Gulf of Cadiz anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	10,2	11,5	-	10,6	10,6
	1	12,6	11,9	12,4	13,0	12,0	12,5	12,2
	2	13,5	14,6	12,3	15,0	14,0	12,4	13,8
	3	-	-	-	-	-	-	-
	Total	12,9	12,0	11,5	11,9	12,1	11,6	11,9

Table 4.3.6.6. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Mean weight (in kg) at-age in the Spanish catches of Gulf of Cadiz anchovy (all fleets) in 2021 on a quarterly (Q), half-year (HY) and annual basis.

2021	AGE	Q1	Q2	Q3	Q4	HY1	HY2	ANNUAL
	0	-	-	0,007	0,009	-	0,008	0,008
	1	0,014	0,012	0,014	0,014	0,012	0,014	0,013
	2	0,017	0,023	0,015	0,021	0,019	0,016	0,019
	3	-	-	-	-			-
	Total	0,015	0,013	0,011	0,011	0,013	0,011	0,012

Table 4.4.1. Acoustic and DEPM surveys providing direct estimates for anchovy in Division 9.a. (1): *ECOCADIZ-COSTA 0709*, (pilot) Spanish survey surveying shallow waters <20 m depth and complementary to the standard survey; ((Month)): surveys that were carried out but did not provide any anchovy acoustic estimate because of its very low presence and/or for an incomplete geographical coverage (some areas were not covered: either the Spanish or the Portuguese part of the Gulf of Cadiz).

Method	Acoustics								DEPM		
Survey	PELACUS 04	PELAGO	SAR	JUVESAR	IBERAS	ECOCADIZ	ECO-CADIZ-RE-CLUTAS	BOCADEVA			
Institute (Country)	IEO (ES)	IPMA (PT)	IPMA (PT)	IPMA (PT)	IPMA-IEO (PT-ES)	IEO (ES)	IEO (ES)	IEO (ES)			
Subareas	9.a N	9.a CN-9.a S	9.a CN-9.a S	9.a CN	9.a N-9.a CS	9.a S	9.a S	9.a S			
Year/Quarter	Q2	Q1 Q2	Q4	Q4	Q3 Q4	Q2 Q3	Q4	Q2 Q3			
1998			Nov								
1999		Mar									
2000			Nov								
2001		Mar	Nov								
2002		Mar									
2003		Feb	(Nov)								
2004		(Jun)				Jun					
2005		Apr	(Nov)					Jun			
2006		Apr	(Nov)			Jun					
2007		Apr	Nov			Jul					
2008	Apr	Apr	(Nov)					Jun			
2009	Apr	Apr				Jun (Jul)(1)	(Oct)				
2010	Apr	Apr				(Jul)					
2011	Apr	Apr						Jul			
2012	Apr						Nov				
2013	Mar	Apr		(Nov)		Aug					
2014	Mar	Apr		(Nov)		Jul	Oct	Jul			
2015	Mar	Apr		Dec		Jul	Oct				
2016	Mar	Apr		Dec		Jul	Oct				

Method	Acoustics					DEPM	
2017	Mar	Apr	Dec		Jul	Oct	Jul
2018	Mar	Apr		Nov	Jul	Oct	
2019	Mar	Apr		Sep	Jul	Oct	
2020	No survey (Covid-19 disruption)	Mar		Sep	Aug	Oct	Jul
2021	Apr	Mar		Sep	No survey	Oct	
2022	Apr	Mar					

Table 4.4.1.1. Anchovy in Division 9.a. BOCADEVA survey series (summer Spanish anchovy DEPM survey in Subdivision 9.a South). Historical series of eggs, adult and SSB estimates in Subdivision 9.a South. (1): time-series average

Year	2005	2008	2011	2014	2017	2020
P0 (eggs/m ² /day)	50.8 / 224.5	184 / 348	276	314	146	523
Z (day ⁻¹) (CV)	-0.039	-1,43	-0.29	-0.33	-0,16	-1.11
Ptotal (eggs/day) (x10 ¹²)	1,13	2,11	1,87	1,95	0,74	5,26
Surveyed area (km ²)	11982	13029	13107	14595	15556	16223
Positive area (km ²)	6139	6863	6770	6214	5080	10058
Female Weight (g)	25.2 / 16.7	23,7	15,2	18,2	16,2	16,6
Batch Fecundity	13820/ 11160	13778	7486	7502	7507	8212
Sex Ratio	0.53 / 0.54	0,53	0,53	0,54	0,53	0,54
Spawning Fraction	0.26 / 0.21	0,218	0,276	0,276	0,243	0,241 (1)
Spawning Biomass (tons)	14673	31527	32757	31569	12392	81466

Table 4.4.2.1. Anchovy in Division 9.a. *PELACUS* survey series (spring Spanish acoustic survey in Subdivision 9.a North and Subarea 8.c). Summary of the fishing stations performed during *PELACUS 0422*.

	TOTAL CAP (Kg)	No ind.	No Fishing st	Sample weight (kg)	Measured fish	Mean length	%PRES	% Catch_W	% Catch_No
ANE	323	24505	5	2	144	13.59	19.23	1.70	9.19
BOC	52	1243	3	16	371	13.10	11.54	0.27	0.47
BOG	1252	10866	13	159	1355	22.99	50.00	6.60	4.08
HKE	58	673	18	52	595	21.81	69.23	0.31	0.25
HOM	391	4428	9	80	373	24.33	34.62	2.06	1.66
HOM_S	752	31518	9	59	1332	15.61	34.62	3.97	11.82
HMM	1	2	1	1	2	35	3.85	0.00	0.00
JAA	0	2	1	0	2	22.00	3.85	0.00	0.00
MAC	5634	17295	19	266	1003	33.31	73.08	29.72	6.49
PIL	6532	102069	16	116	1958	19.70	61.54	34.46	38.28
SBR	125	336	10	119	284	28.76	38.46	0.66	0.13
VMA	709	6583	11	96	640	25.21	42.31	3.74	2.47
WHB	3451	91625	11	34	821	19.11	42.31	18.21	34.36
Total	18957	266640	26	998	8736				

Table 4.4.2.2. Anchovy in Division 9.a. *PELACUS* survey series (spring Spanish acoustic survey in Subdivision 9.a North and Subarea 8.c). Historical series of acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes) in Subdivision 9.a North.

Survey	Estimate	9.a North
April 2008	N	10
	B	306
April 2009	N	0.7
	B	26
April 2010	N	0.03
	B	90
April 2011	N	73
	B	1650
April 2012	N	1
	B	45
March 2013	N	-
	B	-
March 2014	N	-
	B	-
March 2015	N	-

Survey	Estimate	9.a North
	B	-
March 2016	N	8
	B	205
March 2017	N	124
	B	3566
March 2018	N	771
	B	10660
March 2019	N	7
	B	192
March 2020	N	No survey
	B	(Covid-19 disruption)
April 2021	N	358
	B	6075
April 2022	N	0.1
	B	2

Table 4.4.2.3. Anchovy in Division 9.a. *PELAGO* survey series (spring Portuguese acoustic survey in Subdivisions 9.a Central-North to 9.a South). Historical series of overall and regional acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes).

Survey	Estimate	Portugal				Spain	S(Total)	TOTAL
		C-N	C-S	S(A)	Total	S(C)		
Mar. 99	N	22	15	*	37	2079	2079	2116
	B	190	406	*	596	24763	24763	25359
Mar. 00	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Mar. 01	N	25	13	285	324	2415	2700	2738
	B	281	87	2561	2929	22352	24913	25281
Mar. 02	N	22	156	92	270	3731 **	3823 **	4001 **
	B	472	1070	1706	3248	19629 **	21335 **	22877 **
Feb. 03	N	0	14	*	14	2314	2314	2328
	B	0	112	*	112	24565	24565	24677
Mar. 04	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Apr. 05	N	-	59	-	59	1306	1306	1364
	B	-	1062	-	1062	14041	14041	15103
Apr. 06	N	-	-	319	319	1928	2246	2246
	B	-	-	4490	4490	19592	24082	24082
Apr. 07	N	0	103	284	387	2860	3144	3247
	B	0	1945	4607	6552	33413	38020	39965
Apr.08	N	69	252	213	534	1819	2032	2353
	B	3000	2505	4661	10166	29501	34162	39667
Apr.09	N	127	0****	159	286	1910	2069	2196
	B	2089	0****	3759	5848	20986	24745	26834
Apr. 10	N	0	62	0	62	963	963	1026
	B	0	1188	0	1188	7395	7395	8583
Apr. 11	N	1558	0	0	1558	0	0	1558
	B	27050	0	0	27050	0	0	27050

Survey	Estimate	Portugal				Spain	S(Total)	TOTAL
		C-N	C-S	S(A)	Total	S(C)		
Apr. 12	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-

*Due to the distribution observed during the survey, the last transect (near the border with Spain) that normally belongs to the Algarve subarea was included in Cadiz.

**Corrected estimates after detection of errors in the sA values attributed to the Cadiz area (Marques and Morais, 2003).

****Possible underestimation: although no echo-traces attributable to the species were detected in this area, however, the loss of pelagic gear samplers prevented from confirming directly this.

Table 4.4.2.3. Anchovy in Division 9.a. *PELAGO* survey series (spring Portuguese acoustic survey in Subdivisions 9.a Central-North to 9.a South). Cont'd.

Survey	Estimate	Portugal				Spain	S(Total)	TOTAL
		C-N	C-S	S(A)	Total	S(C)		
Apr. 13	N	251	0	263	514	634	897	1148
	B	3955	0	5044	8999	7656	12700	16655
Apr. 14	N	130	0	26	156	2216	2241	2371
	B	1947	0	509	2456	28408	28917	30864
Apr. 15	N	645	0	158	802	3531	3689	4334
	B	8237	0	2156	10393	30944	33100	41337
Apr. 16	N	3198	0	0	3198	9811	9811	13009
	B	38302	0	0	38302	65345	65345	103647
May 17	N	1015	0	137	1152	1718	1855	2870
	B	15481	0	1208	16689	12589	13797	29278
Apr. 18	N	4845	0	300	5145	1857	2157	7001
	B	54437	0	4328	58765	19145	23473	77910
Apr. 19	N	229	7	0	236	3398	3398	3634
	B	3814	123	0	3937	29876	29876	33813
Apr. 20	N	3152	0.3	89	3242	5550	5639	8791
	B	50282	9	1789	52080	47998	49787	100078
Mar. 21	N	3069	519	9	3597	1485	1485	5082
	B	53513	6095	107	59715	13958	13958	73673
Apr. 22	N	4589	198	196	4983	654	849	5637

Survey	Estimate	Portugal				Spain	S(Total)	TOTAL
		C-N	C-S	S(A)	Total	S(C)		
	B	108571	3391	3535	115496	5438	8972	120934

Table 4.4.2.4. Anchovy in Division 9.a. *ECOCADIZ* survey series (summer Spanish acoustic survey in Subdivision 9.a South). Historical series of overall and regional acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes).

Survey	Estimate	Portugal	Spain	TOTAL
		S(A)	S(C)	S(Total)
Jun. 04***	N	125	1109	1235
	B	2474	15703	18177
Jun. 05	N	-	-	-
	B	-	-	-
Jun. 06	N	363	2801	3163
	B	6477	30043	36521
Jul. 07	N	558	1232	1790
	B	11639	17243	28882
Jul. 08	N	-	-	-
	B	-	-	-
Jul. 09	N	35	1102	1137
	B	1075	20506	21580
Jul. 10	N	?	954+	954 +
	B	?	12339 +	12339 +
Jul. 11	N	-	-	-
	B	-	-	-
Jul. 12	N	-	-	-
	B	-	-	-
Aug. 13	N	50	558	609
	B	1315	7172	8487
Jul. 14	N	184	1778	1962
	B	4440	24779	29219
Jul. 15	N	168	2506	2674
	B	2137	19168	21305
Jul. 16	N	346	3341	3686
	B	5250	29051	34301

Survey	Estimate	Portugal S(A)	Spain S(C)	TOTAL S(Total)
Jul. 17	N	151	1354	1504
	B	2666	9563	12229
Jul. 18	N	224	2839	3063
	B	4224	30683	34908
Jul. 19	N	80	5405	5485
	B	1561	56139	57670
Aug. 20	N	439	4714	5153
	B	7773	37114	44887
Aug. 21	N	-	-	-
	B	-	-	-

***Possible underestimation: shallow waters between 20 and 30 m depth were not acoustically sampled. + Partial estimate due to an incomplete coverage of the subdivision (only the Spanish part).

Table 4.4.2.5. Anchovy in Division 9.a. Southern component. Historical series of overall acoustic estimates of anchovy abundance (N, millions) by age group estimated by *PELAGO* and *ECOCADIZ* acoustic surveys.

PELAGO	N (million)	N (million)	N (million)	N (million)	N (million)	N (million)
Year	Age 0	Age 1	Age 2	Age 3	Age 4	TOTAL
1999	0	2025	54	0	0	2079
2000	-	-	-	-	-	-
2001	0	2635	65	0	0	2700
2002	0	3774	49	0	0	3823
2003	0	2077	237	0	0	2314
2004	-	-	-	-	-	-
2005	0	1245	61	0	0	1306
2006	0	2197	48	2	0	2246
2007	0	3060	85	0	0	3144
2008	0	1540	485	7	0	2032
2009	0	1735	295	38	0	2069
2010	0	951	12	0	0	963

PELAGO	N (million)	N (million)	N (million)	N (million)	N (million)	N (million)
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	0	157	900	201	6	1264
2014	0	1501	1327	63	0	2890
2015	0	2999	311	0	0	3310
2016	0	6403	127	4	0	6535
2017	0	1142	117	0	0	1259
2018	0	2115	39	3	0	2157
2019	0	3105	289	0	0	3393
2020	0	5237	392	9	0	5639
2021	0	9449	3902	715	0	14065
2022	0	677	127	43	0	847

PELAGO	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Year	Age 0	Age 1	Age 2	Age 3	Age 4	TOTAL
1999	0	97.4	2.6	0	0	100
2000	-	-	-	-	-	-
2001	0	97.6	2.4	0	0	100
2002	0	98.7	1.3	0	0	100
2003	0	89.7	10.3	0	0	100
2004	-	-	-	-	-	-
2005	0	95.3	4.7	0	0	100
2006	0	97.8	2.1	0.1	0	100
2007	0	97.3	2.7	0	0	100
2008	0	75.8	23.9	0.3	0	100
2009	0	83.9	14.3	1.9	0	100
2010	0	98.7	1.3	0	0	100
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	0	12.4	71.2	15.9	0.5	100

PELAGO	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
2014	0	51.9	45.9	2.2	0	100
2015	0	90.6	9.4	0	0	100
2016	0	98.0	1.9	0.1	0	100
2017	0	90.7	9.3	0	0	100
2018	0	98.1	1.8	0.1	0	100
2019	0	91.5	8.5	0	0	100
2020	0	92.9	7.0	0.2	0	100
2021	0	67,2	27,7	5,1	0	100
2022	0	80,0	15,0	5,1	0	100

Table 4.4.2.5. Anchovy in Division 9.a. Southern component. Cont'd.

ECOCADIZ	N (million)	N (million)	N (million)	N (million)	N (million)	N (million)
Year	Age 0	Age 1	Age 2	Age 3	Age 4	TOTAL
2004	0	1215	19	0	0	1235
2005	-	-	-	-	-	-
2006	0	3170	42	0.1	0	3211
2007	0	1619	167	5	0	1790
2008	-	-	-	-	-	-
2009	0	879	218	39	0	1137
2010	185	686	80	4	0	954
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	169	394	33	0	0	596
2014	51	1873	36	0	0	1960
2015	1607	1053	13	0	0	2673
2016	1666	1665	354	0	0	3686
2017	892	447	149	0	0	1488
2018	1408	1609	46	0	0	3063
2019	2320	3031	134	0	0	5485

ECOCADIZ	N (million)	N (million)	N (million)	N (million)	N (million)	N (million)
2020	3792	1326	35	0	0	5153
2021	-	-	-	-	-	-

ECOCADIZ	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Year	Age 0	Age 1	Age 2	Age 3	Age 4	TOTAL
2004	0	98.5	1.5	0	0	100
2005	-	-	-	-	-	-
2006	0	98.7	1.3	0.004	0	100
2007	0	90.4	9.3	0.3	0	100
2008	-	-	-	-	-	-
2009	0	77.3	19.2	3.4	0.02	100
2010	19.4	71.8	8.4	0.4	0	100
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	28.4	66.1	5.5	0	0	100
2014	2.6	95.6	1.8	0	0	100
2015	60.1	39.4	0.5	0	0	100
2016	45.2	45.2	9.6	0	0	100
2017	60.0	30.0	10.0	0	0	100
2018	46.0	52.5	1.5	0	0	100
2019	42.3	55.3	2.4	0	0	100
2020	73,6	25,7	0,7	0	0	100
2021	-	-	-	-	-	-

Table 4.4.3.1. Anchovy in Division 9.a. SAR/JUVESAR autumn survey series (autumn Portuguese acoustic survey in subdivisions 9.a Central–North to 9.a South - SAR - or Subdivision 9.a Central-North and Central-South - JUVESAR -). Historical series of overall and regional acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes). Juvenile fish (< 10.0 cm) estimates between parentheses.

Survey	Estimate	Portugal				Spain	S (Total)	TOTAL
		C-N	C-S	S (PT)	Total	S (ES)		
Nov. 98	N	30	122	50	203	2346	2396	2549
	B	313	1951	603	2867	30092	30695	32959
Nov. 99	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 00	N	4	20	*	23	4970	4970	4994
	B	98	241	*	339	33909	33909	34248
Nov. 01	N	35	94	-	129	3322	3322	3451
	B	1028	2276	-	3304	25578	25578	28882
Nov. 02	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 03	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 04	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 05	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 06	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 07	N	0	59	475	534	1386	1862	1921
	B	0	1120	7632	8752	16091	23723	24843
Nov. 13	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Nov. 14	N	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-
Dec. 15	N	3870 (3835)	-	-	-	-	-	-

Survey	Estimate	Portugal				Spain	S (Total)	TOTAL
		C-N	C-S	S (PT)	Total	S (ES)		
	B	30000 (29000)	-	-	-	-	-	-
Dec. 16	N	2836 (2835)	-	-	-	-	-	-
	B	14397 (14367)	-	-	-	-	-	-
Dec 17	N	2145 (570)		-	-	-	-	-
	B	38000 (4700)		-	-	-	-	-

* Due to the distribution observed during the survey, the last transect (near the border with Spain) that normally belongs to the Algarve subarea was included in Cadiz.

Table 4.4.3.2. Anchovy in Division 9.a. IBERAS survey series (autumn Spanish-Portuguese acoustic survey in subdivisions 9.a North to Central-South). Historical series of overall and regional acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes). Age 0 fish estimates between parentheses.

Survey	Estimate	Spain	Portugal			TOTAL
		N	C-N	C-S	Total	
Nov. 18	N	0.04 (0.03)	8836 (592)	0.02 (0.001)	8836 (592)	8836 (592)
	B	0.4 (0)	181576 (5894)	0.4 (0)	181577 (5894)	181577 (5894)
Sep. 19	N	0 (0)	122 (0.3)	42 (0)	164 (0.3)	164 (0.3)
	B	0 (0)	2981 (3)	1232 (0)	4212 (3)	4212 (3)
Sep. 20	N	0 (570)	12 (1)	0 (0.7)	583 (560)	583 (572)
	B	0 (4879)	289 (20)	0 (8)	5176 (4669)	5176 (4907)
Sep. 21	N	0 (0)	1429 (664)	2 (2)	1431 (666)	1431 (666)
	B	0 (0)	31206 (10591)	29 (26)	31236 (10617)	31236 (10617)

Table 4.4.3.3. Anchovy in Division 9.a. *ECOCADIZ-RECLUTAS* survey series (autumn Spanish acoustic survey in Subdivision 9.a South). Historical series of overall and regional acoustic estimates of anchovy abundance (N, millions) and biomass (B, tonnes). Age 0 fish estimates between parentheses.

Survey	Estimate	Portugal	Spain	TOTAL
		S (PT)	S (ES)	S (Total)
Nov. 12*	N	-	2649 (2619)	-
	B	-	13680 (13354)	-
Oct. 14	N	111 (3)	875 (811)	986 (814)
	B	2168 (25)	5945 (5107)	8113 (5131)
Oct. 15	N	115 (75)	5113 (5042)	5227 (5117)
	B	1335 (430)	29491 (28789)	30827 (29219)
Oct. 16	N	177 (42)	3490 (3404)	3667 (3445)
	B	3054 (463)	16807 (15506)	19861 (15969)
Oct. 17**	N	-	1492 (1433)	-
	B	-	7641 (7290)	-
Oct. 18	N	405 (96)	548 (447)	952 (543)
	B	6259 (1005)	4234 (2830)	10493 (3834)
Oct. 19	N	1217 (763)	4301 (4082)	5518 (4845)
	B	16089 (6613)	32309 (29792)	48398 (36405)
Oct. 20	N	145 (30)	3051 (2355)	3197 (2385)
	B	3290 (512)	32779 (20547)	36070 (21060)
Oct. 21	N	211 (53)	1763 (1575)	1973 (1629)
	B	4143 (923)	13370 (11140)	17512 (12063)

* Partial estimate: only the Spanish waters were acoustically surveyed. ** Partial estimate only 70% of the Spanish waters was acoustically surveyed.

Table 4.5.1.1. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Mean weight-at-age in the stock (in g).

Year	Age 0	Age 1	Age 2	Age 3
1995	7,0	10,7	22,6	
1996	1,1	6,3	20,0	
1997	2,6	11,1	20,9	
1998	2,6	7,4	20,4	
1999	3,2	12,8	20,0	
2000	3,1	10,0	23,8	
2001	6,2	13,3	31,8	
2002	3,3	10,5	26,3	
2003	6,0	10,6	26,8	
2004	6,6	12,0	21,9	
2005	4,9	9,2	22,6	
2006	3,6	8,2	21,0	
2007	5,4	9,4	20,4	
2008	7,2	14,9	21,8	23,1
2009	4,1	12,2	20,3	24,2
2010	6,9	11,3	19,1	23,0
2011	8,2	10,3	22,7	
2012	8,3	14,3	22,5	
2013	6,4	11,9	21,8	
2014	6,6	10,9	19,0	
2015	7,7	10,5	20,7	
2016	8,7	12,9	18,2	
2017	6,7	9,1	19,9	
2018	10,2	12,4	18,6	
2019	10,0	11,9	20,0	
2020	9,6	12,3	17,4	26,6
2021	7,4	12,9	21,8	

Table 4.6.2.1.1.1. Anchovy in Division 9.a. Southern component. Overview of the data used in the assessment model for optimization routines (maximization of likelihood function). Due to lack of information of length distributions and Age-length keys for commercial catches in the first and second quarter of 2020, the length distribution was approximated using the joint distribution of 2018 and 2019 and the Age-length key used was the one for the PELAGO 2020 survey.

Data source	Type	Time span
Commercial landings	Length distribution	All quarters, 1989–2021
	Age-length key	All quarters, 1989–2021
ECOCADIZ acoustic survey	Biomass survey indexes	Second quarter 2004, 2006 third quarter 2007, 2009, 2010, 2013–2020
	Length distribution	Second quarter 2004, 2006 third quarter 2007, 2009, 2010, 2013–2020
	Age-length key	Second quarter 2004, 2006 third quarter 2007, 2009, 2010, 2013–2020
PELAGO acoustic survey	Biomass survey indexes	First quarter 1999, 2001–2003 second quarter 2005–2010 and 2013–2022
	Length distribution	First quarter 1999, 2001–2003 second quarter 2005–2010, 2013–2022
	Age-length key	second quarter 2014–2022

Table 4.6.2.1.3.1. Anchovy in Division 9.a. Southern component. Summary of parameters estimated by the assessment model.

Symbol	Meaning and estimated value
l_{∞}	Asymptotic length, $l_{\infty}=28.4296$ cm
k	Annual growth rate, $k=0.0772549$
β	Beta-binomial parameter, $\beta = 5000$
v_a	Age factor, $v_0=120000$, $v_1=116000$, $v_2=0.0607$, $v_3=9.2e-07$
μ	Recruitment mean length, $\mu = 10.313$ cm
σ_t	Recruitment length standard deviation by quarter, $\sigma_2 = 2.60238$, $\sigma_3 = 2.59163$, $\sigma_4 = 1.79378$
$l_{50,T}$	Length with a 50% probability of predation during period T, seine: $l_{50,1}=12.6$ cm, $l_{50,2}=10.8$ cm, ECOCADIZ survey: $l_{50}=13$ cm, PELAGO survey: $l_{50}=14.3$ cm
α_T	Shape of selectivity function, purse-seine: $\alpha_1 = 0.193$, $\alpha_2 = 0.764$, ECOCADIZ survey: $\alpha_3 = 1.31$, PELAGO survey: $\alpha_3 = 0.406$



Figure 4.2.1. Anchovy in Division 9.a. Map showing the split of Division 9a into the stock components 9a South and 9a West. Note that, in turn, the stock component 9a South is divided into Portuguese and Spanish waters, whereas stock component 9a West is divided into the subdivisions 9a North, 9a Central–North, and 9a Central–South.

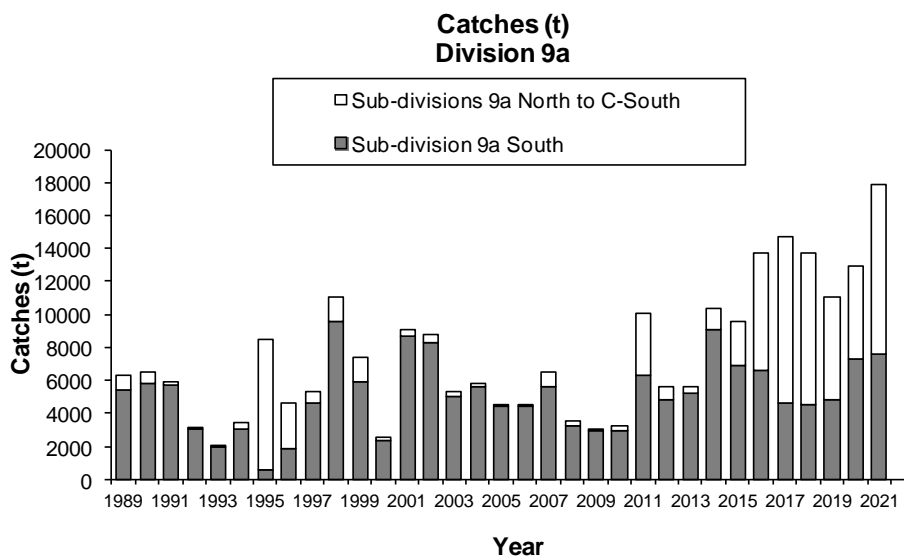


Figure 4.3.2.1.1. Anchovy in Division 9.a. Recent series of anchovy catches in Division 9.a (ICES estimates for 1989–2021, the period with data for all the subdivisions, all metiers are considered). Subdivisions are pooled in order to differentiate the anchovy fishery harvested throughout the Atlantic façade of the Iberian Peninsula (Western component: ICES subdivisions 9.a North, Central–North and Central–South) from the fishery in the Gulf of Cadiz (Southern component: Subdivision 9.a South), where both the stock and the fishery were mainly located during a great part of the time-series. Discards are considered as negligible all over the division, but since 2014 on estimates include the available discarded catches (see Section 4.3.3).

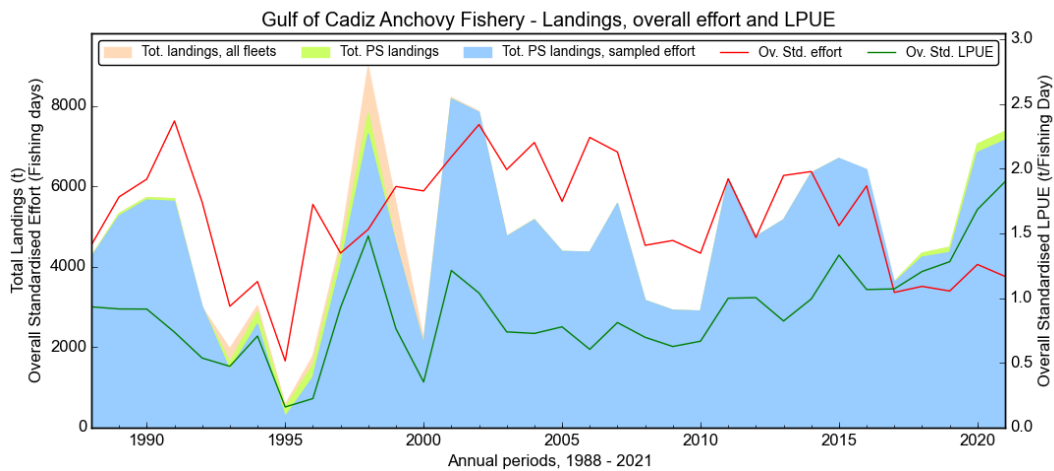


Figure 4.3.4.1. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Spanish purse-seine fishery (métier PS_SPF_0_0_0). Trends in Gulf of Cadiz anchovy annual landings, and purse-seine fleets’ stand-ardised overall effort and lpue (1988–2021).

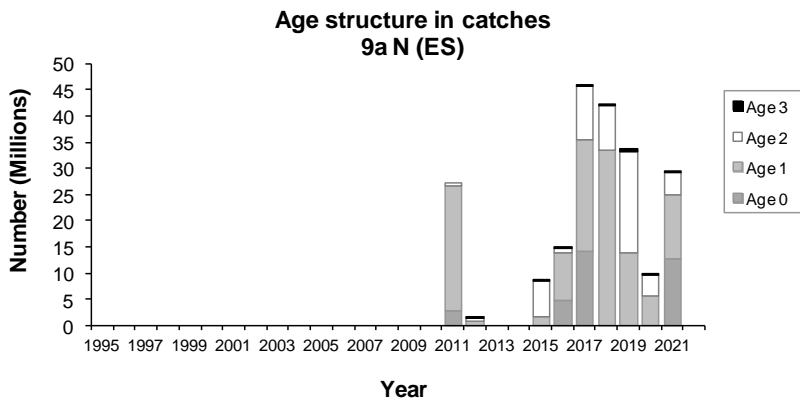


Figure 4.3.5.2.1. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Spanish fishery (all mé-tiers). Age composition in Spanish catches of SW Galician anchovy (available data provided to the WG). Alt-hough discards are still considered as negligible (hence landings are assumed as equal to catches), data since 2014 include discards estimates (see Section 4.3.3).

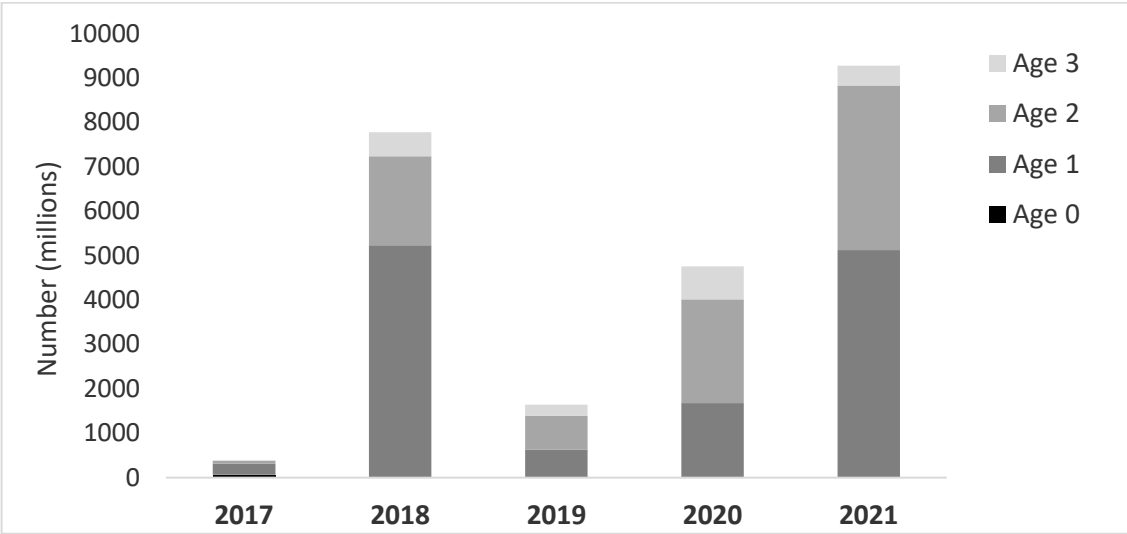


Figure 4.3.5.2.2. Anchovy in Division 9.a. Western component. Subdivision 9.a Central-North. Portuguese fishery (all métiers). Age composition in Portuguese anchovy catches (available data provided to the WG). Discards are negligible (hence landings are assumed as equal to catches). Data for 2021 are only available for the 3rd and 4th Quarters (99.5% catches).

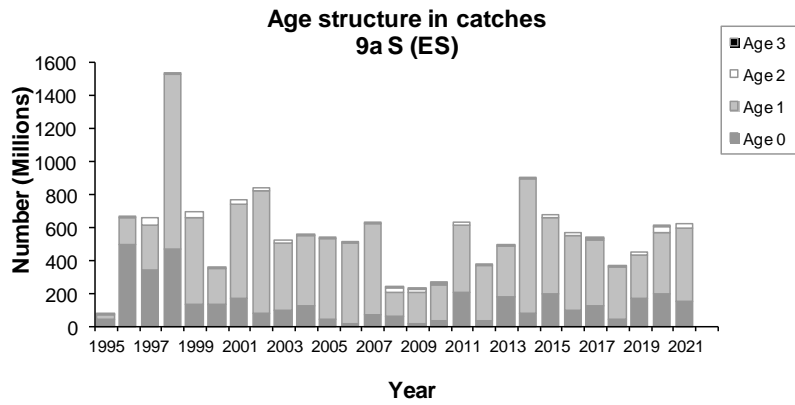


Figure 4.3.5.2.3. Anchovy in Division 9.a. Southern component. Subdivision 9.a-South. Spanish fishery (all métiers). Age composition in Spanish catches of Gulf of Cadiz anchovy (1995–2021). Discards are considered either very low or even negligible in this fishery, but since 2014 on estimates include the available discarded catches (see Section 4.3.3).

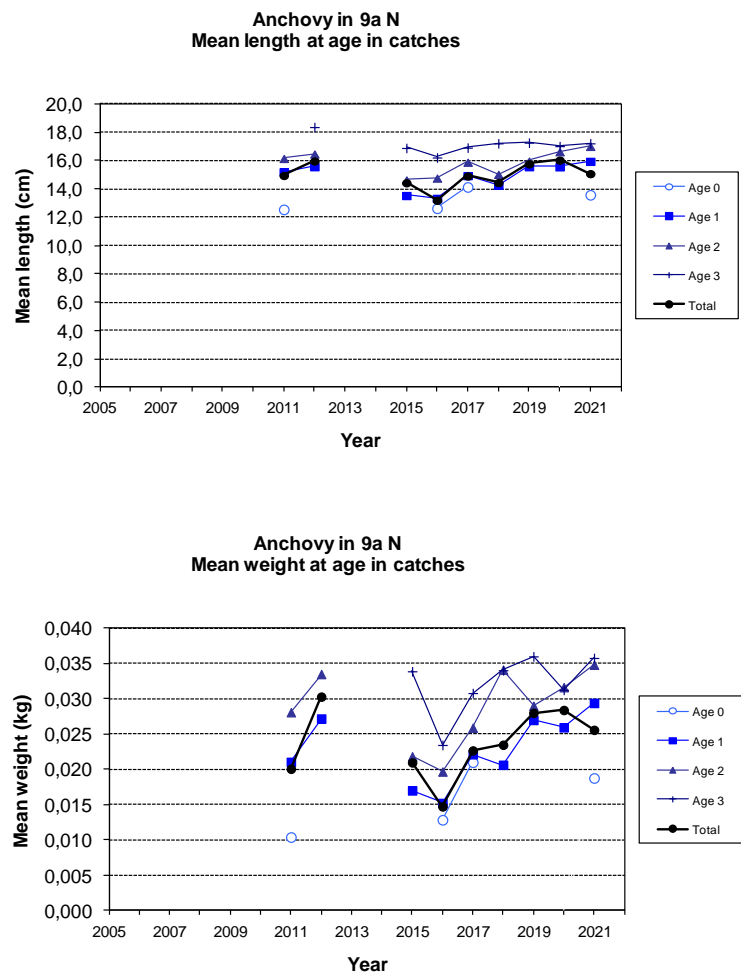


Figure 4.3.6.1. Anchovy in Division 9.a. Western component. Subdivision 9.a North. Spanish fishery (all méti-ers). Annual mean length (TL, in cm) and weight (kg) at-age in the Spanish catches of Western Galicia anchovy (2011–2021).

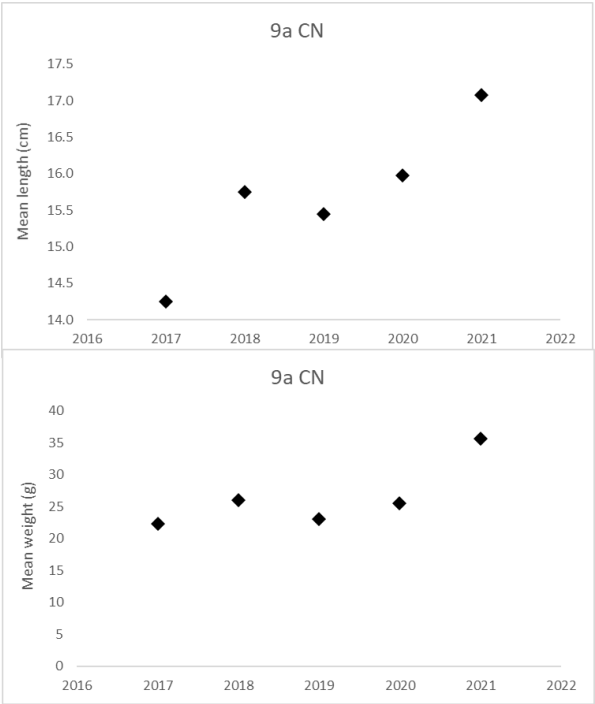


Figure 4.3.6.2. Anchovy in Division 9.a. Western component. Subdivision 9.a Central North. Portuguese fishery (all metiers). Annual mean length (TL, in cm) and weight (kg)e in the Portuguese catches of Western anchovy (2017–2021).

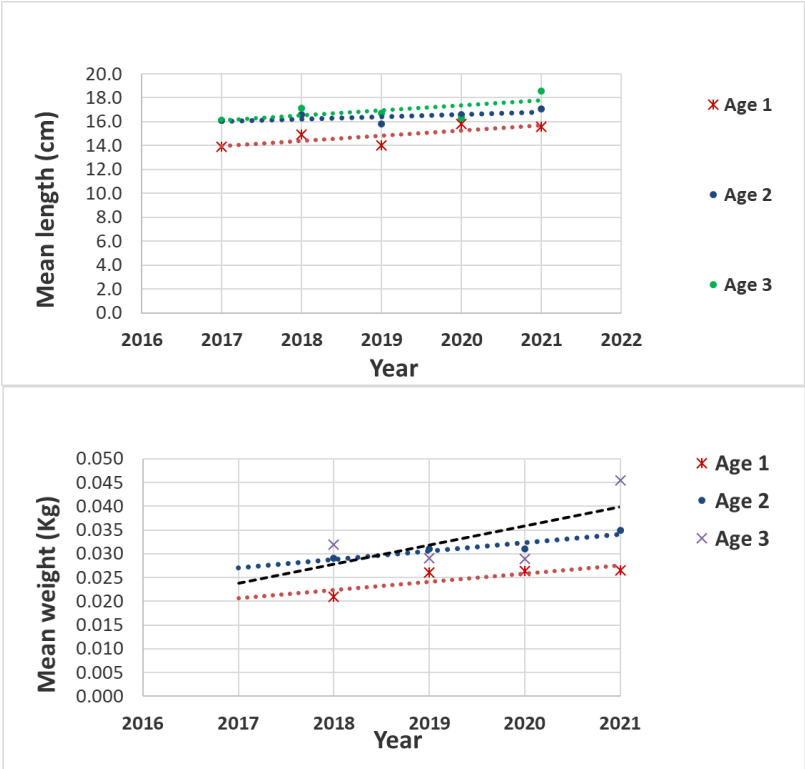


Figure 4.3.6.2. Anchovy in Division 9.a. Western component. Subdivision 9.a Central North. Portuguese fishery (all métiers). Cont'd. Annual mean length (TL, in cm) and weight (kg) at-age in the Portuguese catches of Western anchovy (2017 to 2021).

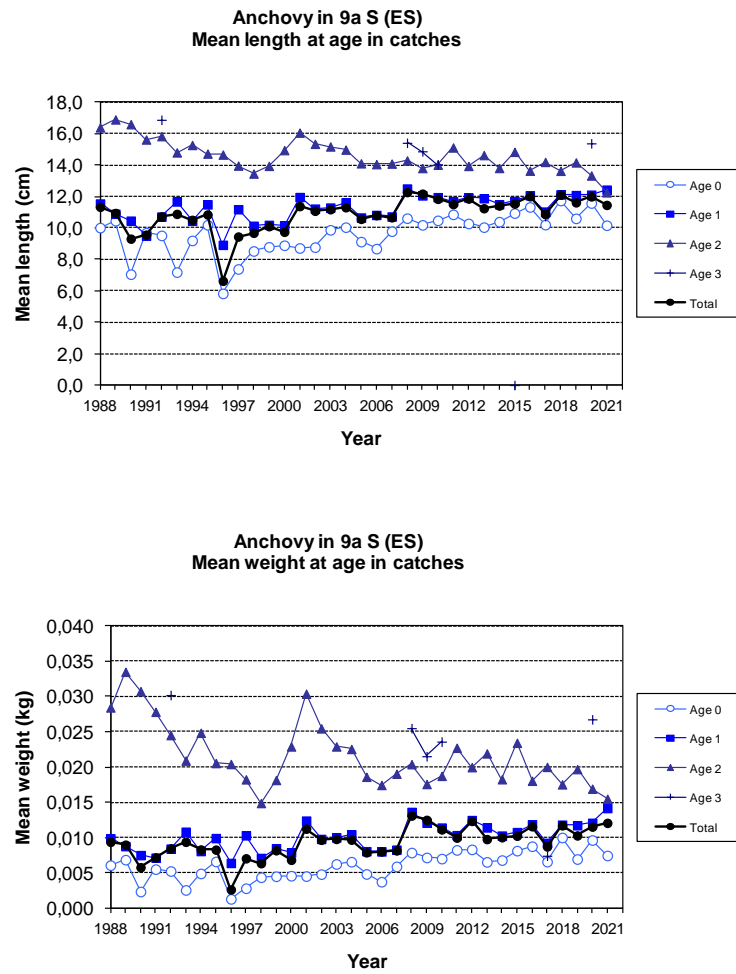


Figure 4.3.6.3. Anchovy in Division 9.a. Southern component. Subdivision 9.a-South. Spanish fishery (all métiers). Annual mean length (TL, in cm) and weight (kg) at-age in the Spanish catches of Gulf of Cadiz anchovy (1988–2021).

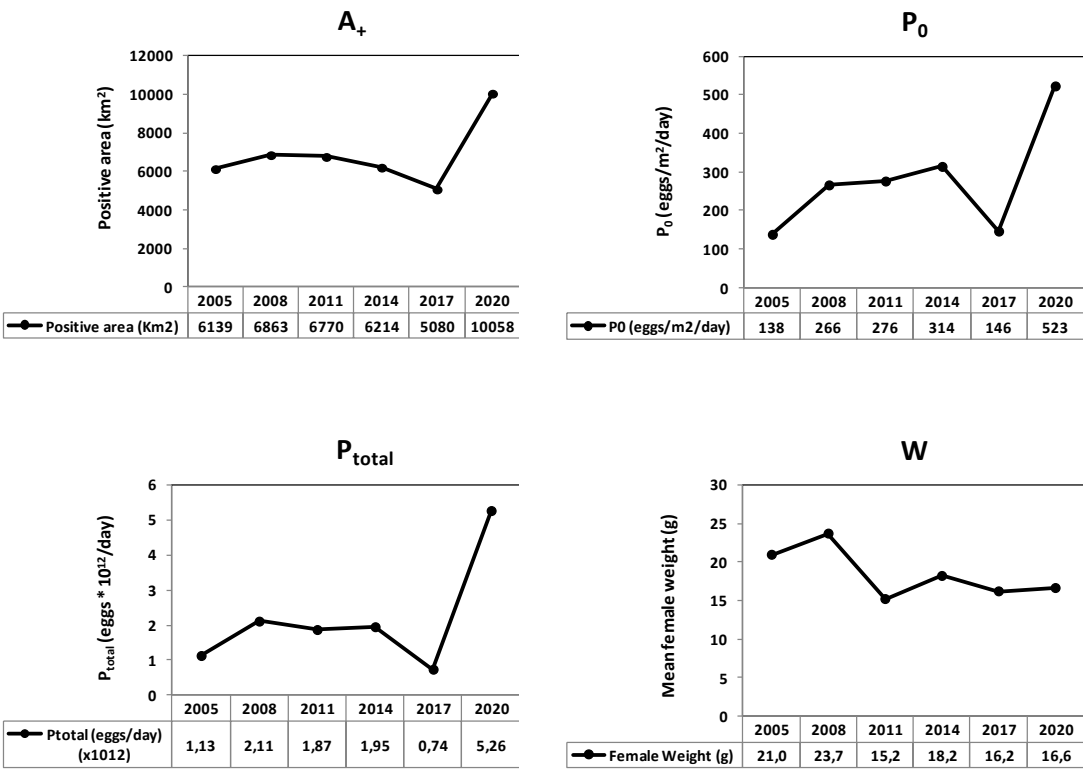


Figure 4.4.1.1. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *BOCADEVA* survey series (summer Spanish DEPM survey in Subdivision 9.a South). Time-series of eggs and adult parameters estimates. A+ (positive area, in km²), P₀ (daily egg production, in eggs/m²/day), P_{total} (total egg production, in eggs 10¹²/day), W (mean female weight, in g).

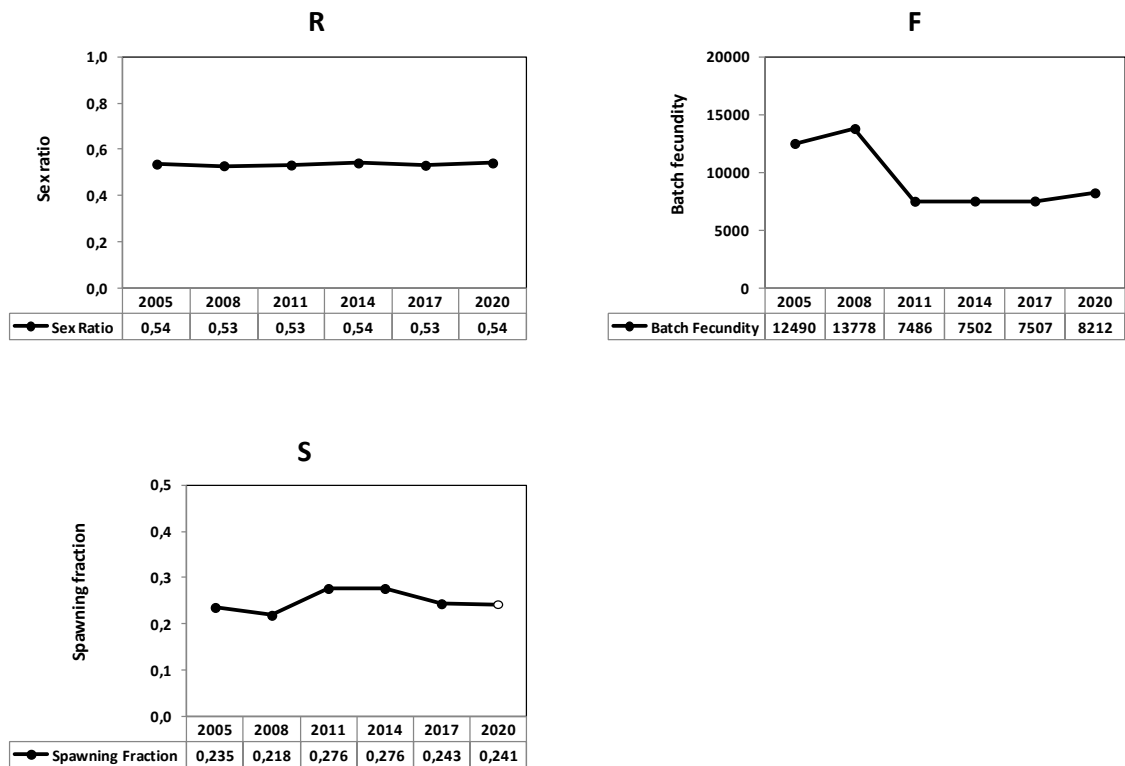


Figure 4.4.1.1. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *BOCADEVA* survey series (summer Spanish DEPM survey in Subdivision 9.a South). Time-series of eggs and adult parameters estimates. Cont’d. R (sex ratio), F (individual batch fecundity), S (spawning fraction; the 2020 estimate is provisionally computed as the time-series average value).

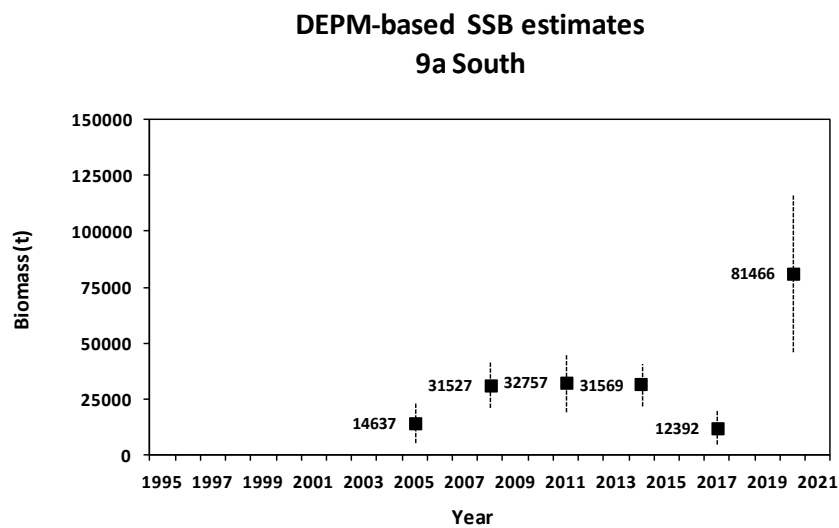


Figure 4.4.1.2. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *BOCADEVA* survey series (summer Spanish DEPM survey in Subdivision 9.a South). Series of SSB estimates (\pm SD) obtained from the survey series.

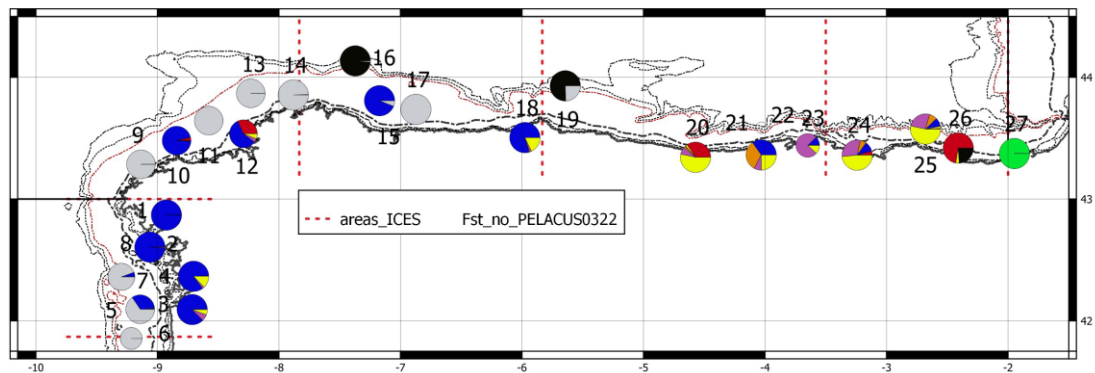


Figure 4.4.2.1. Anchovy in Division 9.a. Western component. Subdivision 9.a North. *PELACUS* 0322 survey (spring Spanish acoustic survey in Sub-division 9.a North and Sub-area 8c in 2022). Distribution of pelagic hauls for echo-traces identification, with indication of the species composition.

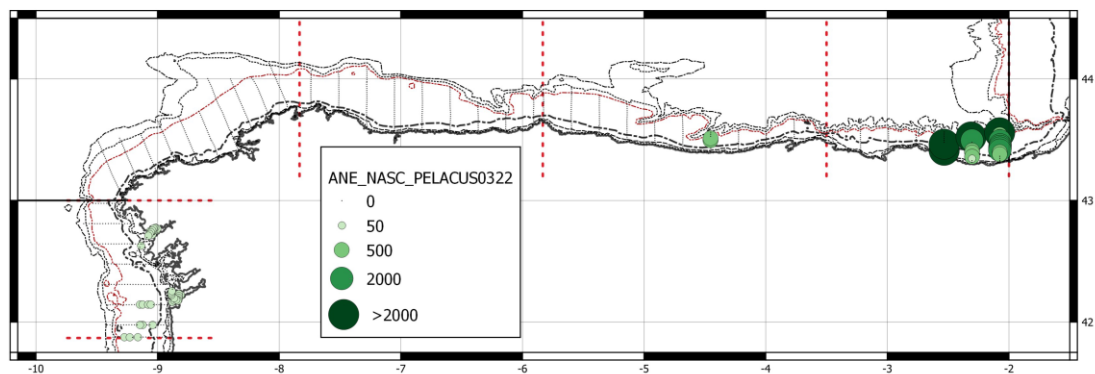


Figure 4.4.2.2. Anchovy in Division 9.a. Western component. Subdivision 9.a North. *PELACUS* 0322 survey (spring Spanish acoustic survey in Sub-division 9.a North and Sub-area 8c in 2022). Spatial distribution of energy allocated to anchovy (NASC coefficients in m^2/mn^2).

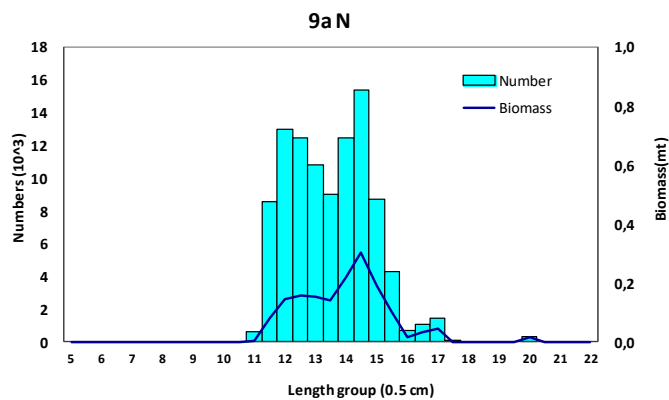


Figure 4.4.2.3. Anchovy in Division 9.a. Western component. Subdivision 9.a North. *PELACUS* 0322 survey (spring Spanish acoustic survey in Subdivision 9.a North and Subarea 8c in 2022). Estimated abundance and biomass (number of fish in thousands and tonnes, respectively) in Subdivision 9.a North by size class.

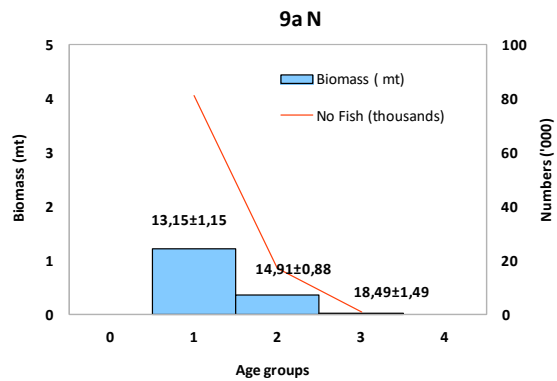


Figure 4.4.2.4. Anchovy in Division 9.a. Western component. Subdivision 9.a North. *PELACUS* 0322 survey (spring Spanish acoustic survey in Subdivision 9.a North and Subarea 8c in 2022). Estimated abundance and biomass (number of fish in thousands and tonnes, respectively) in Subdivision 9.a North by age group, with indication of the mean size by age

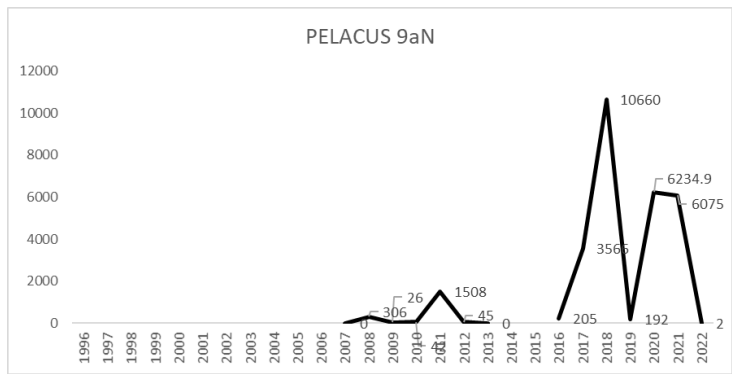


Figure 4.4.2.5. Anchovy in Division 9.a. Western component. Subdivision 9.a North. *PELACUS* survey series (spring Spanish acoustic survey in Subdivision 9.a North and Subarea 8c). Historical series of acoustic estimates of anchovy biomass (t) for the Subdivision 9.a North.

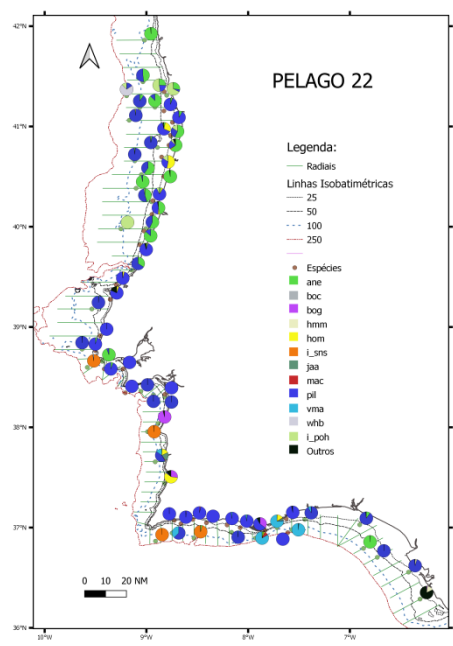


Figure 4.4.2.6. Anchovy in Division 9.a. Western and Southern components. Subdivisions 9.a Central-North to 9.a South. *PELAGO* survey series (spring Portuguese acoustic survey in Subdivisions 9.a Central-North to 9.a South). *PELAGO* 22 survey. Location of valid fishing stations with indication of their species composition (percentages in number).

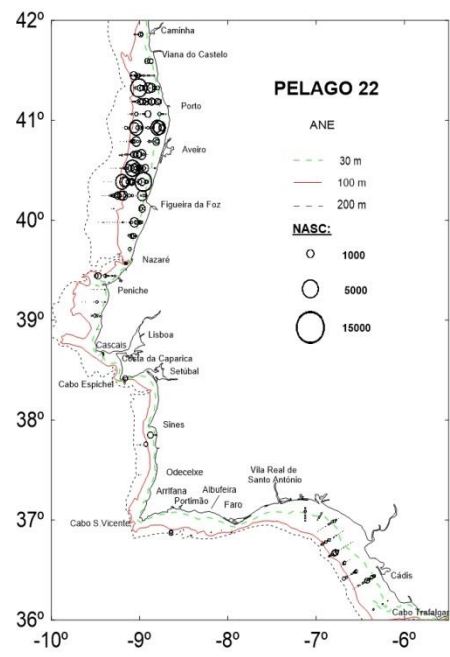


Figure 4.4.2.7. Anchovy in Division 9.a. Western and Southern components. Subdivisions 9.a Central-North to 9.a South. *PELAGO* survey series (spring Portuguese acoustic survey in Sub-divisions 9.a Central-North to 9.a South). *PELAGO* 22 survey. Distribution of the NASC coefficients (m^2/mn^2) attributed to anchovy.

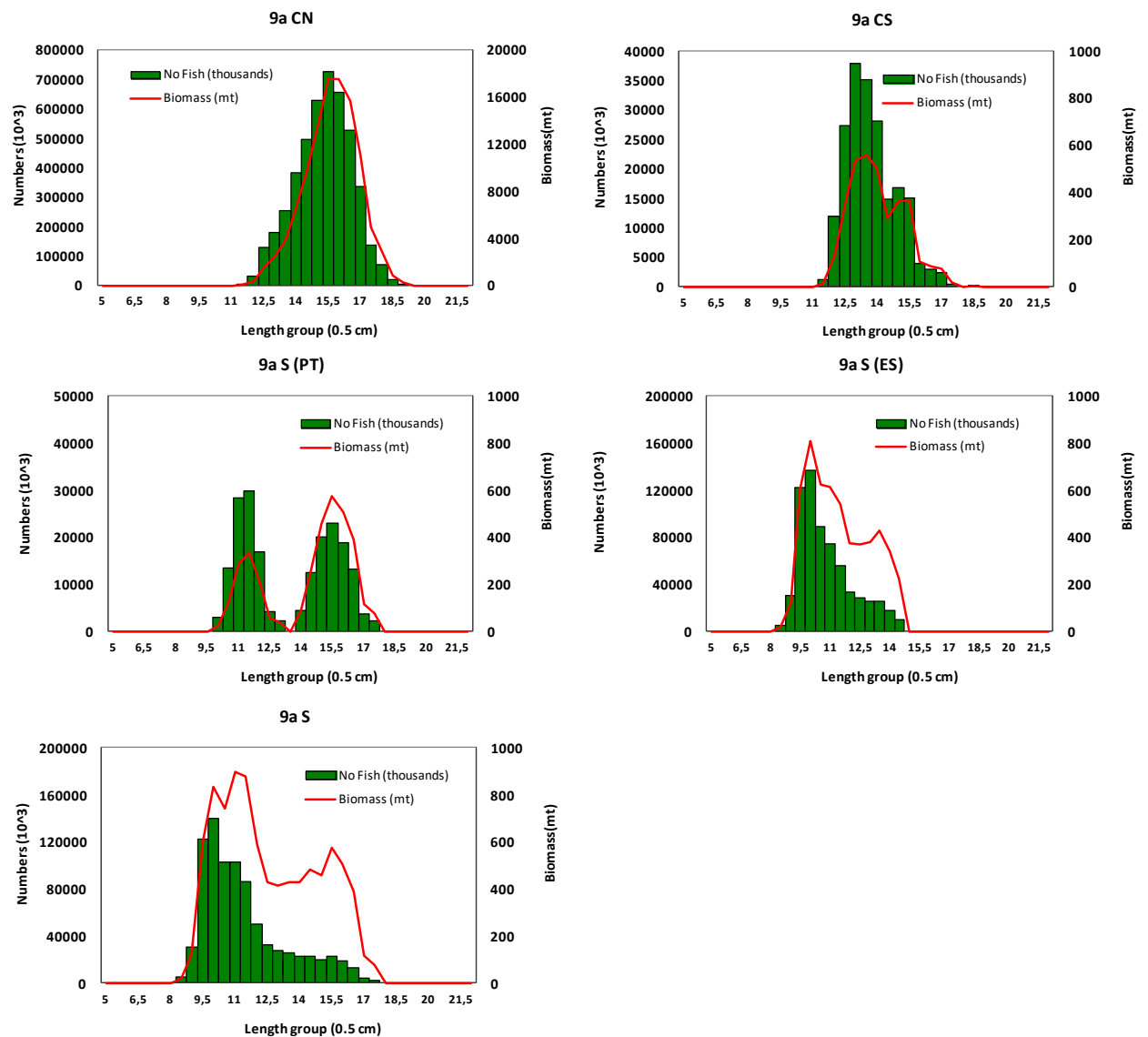


Figure 4.4.2.8. Anchovy in Division 9.a. Western and Southern components. Sub-divisions 9.a Central-North to 9.a South. *PELAGO* survey series (spring Portuguese acoustic survey in Sub-divisions 9.a Central-North to 9.a South). *PELAGO* 22 survey. Estimated abundances and biomasses (number of fish in thousands and tonnes, respectively) for the surveyed area by length class (cm). Note the different scales in the y axis.

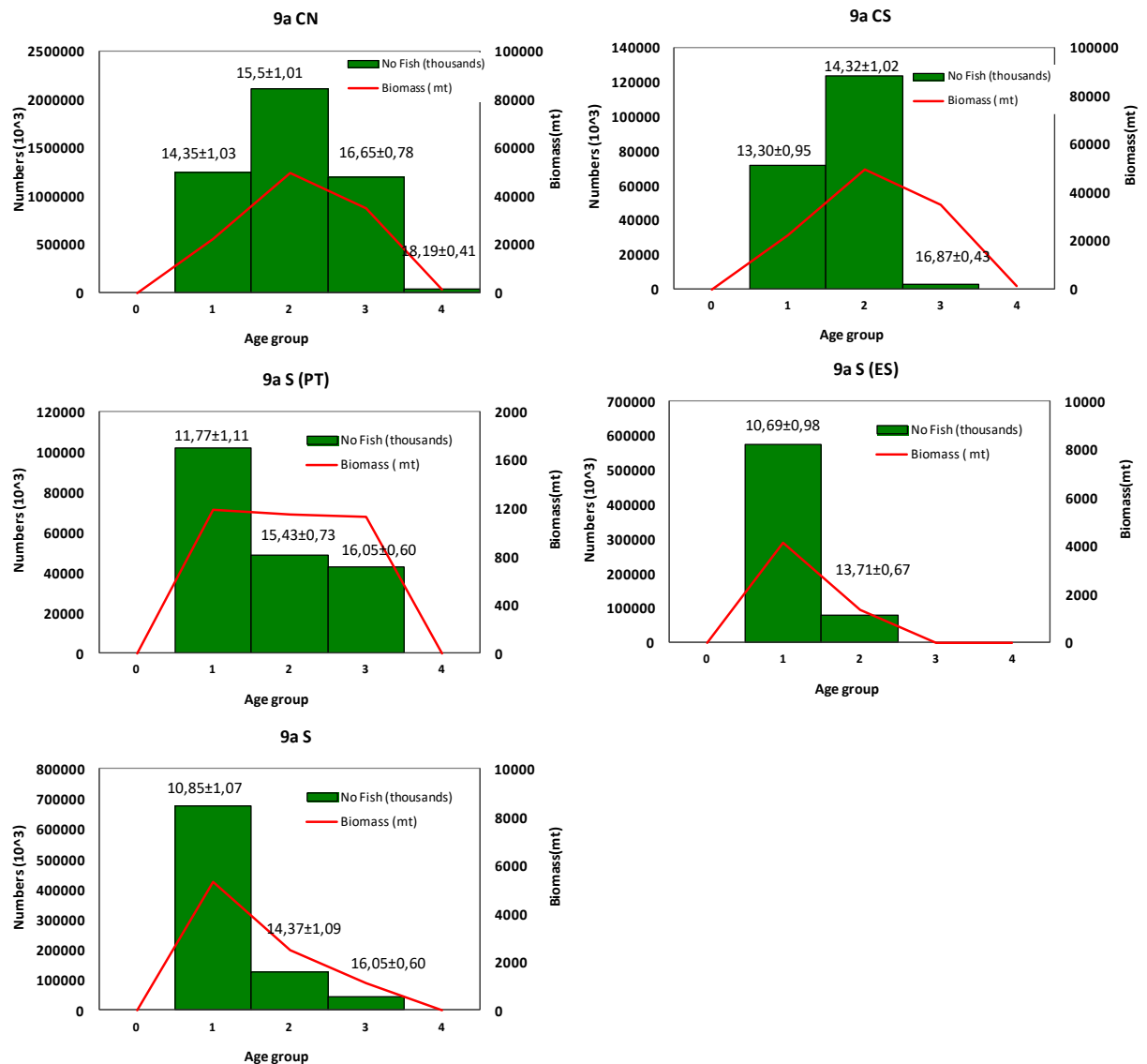


Figure 4.4.2.9. Anchovy in Division 9.a. Western and Southern components. Sub-divisions 9.a Central-North to 9.a South. *PELAGO* survey series (spring Portuguese acoustic survey in Sub-divisions 9.a Central-North to 9.a South). *PELAGO* 22 survey. Estimated abundances and biomasses (number of fish in thousands and tonnes, respectively) for the surveyed area by age group, with indication of the mean size by age. Note the different scales in the y axis.

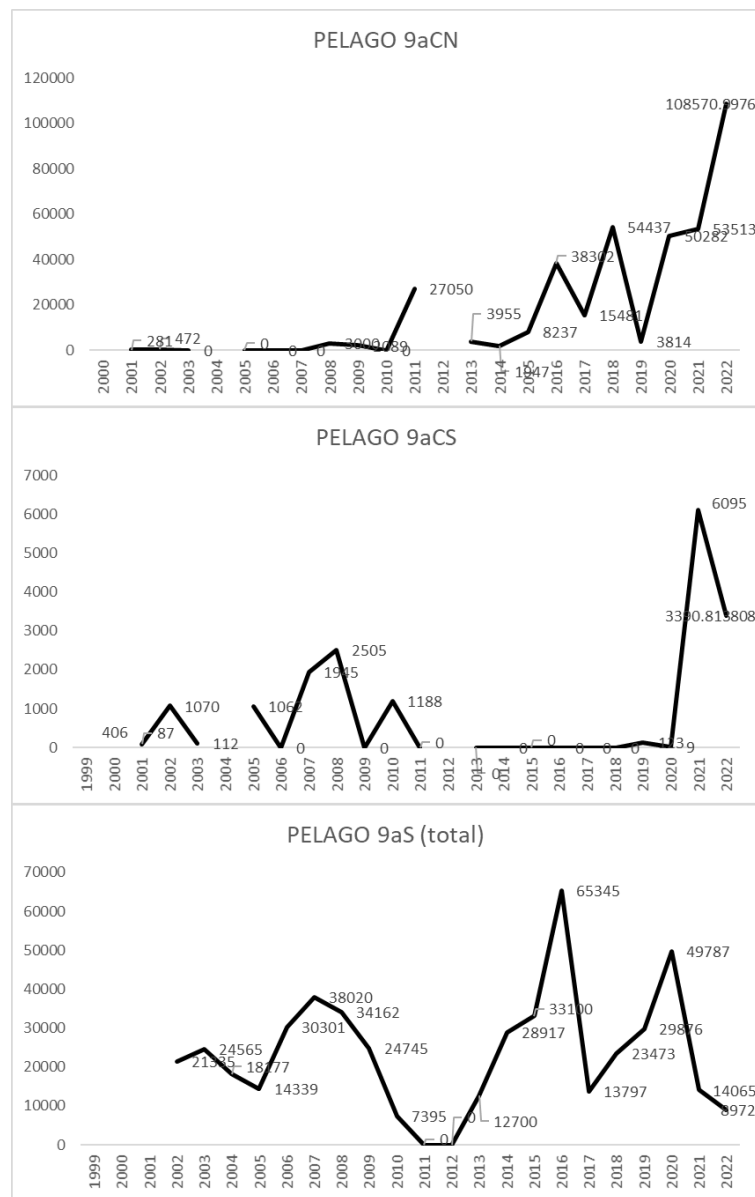


Figure 4.4.2.10. Anchovy in Division 9.a. Western and Southern components. Subdivisions 9.a Central-North to 9.a South. *PELAGO* survey series (spring Portuguese acoustic survey in Subdivisions 9.a Central-North to 9.a South). Historical series of regional acoustic estimates of anchovy biomass (t). Note the different scale of the y-axis.

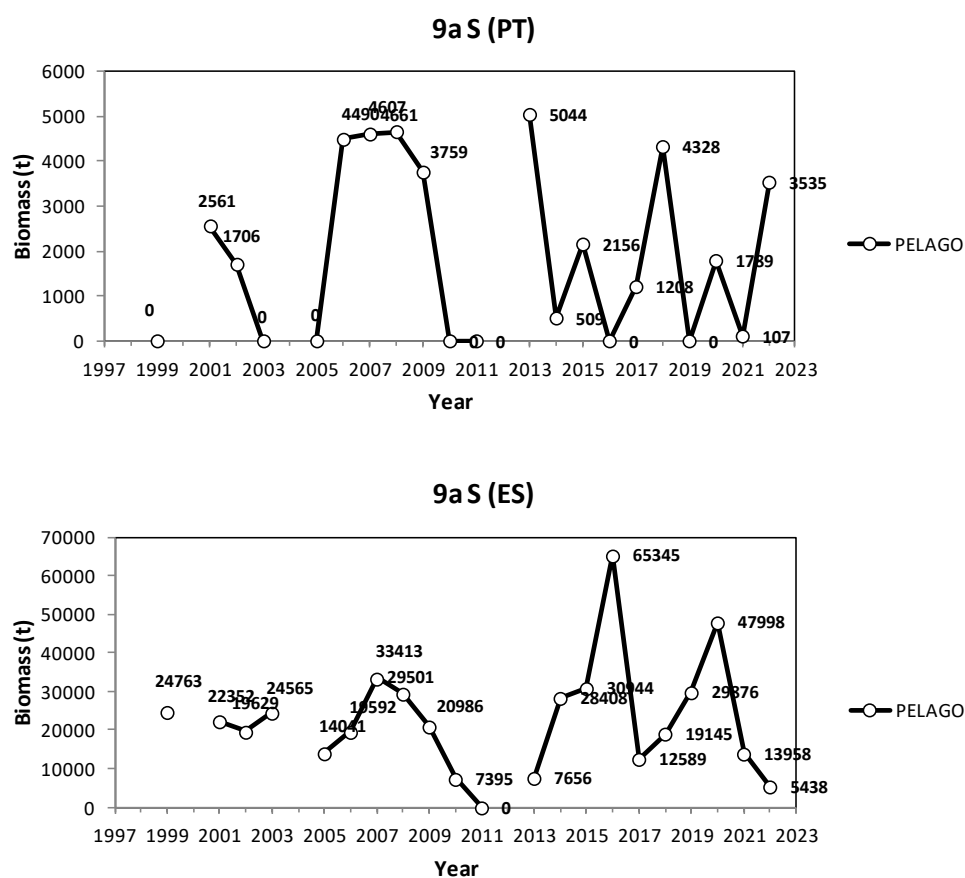


Figure 4.4.2.10. Continued. Acoustic estimates in the 9.a South differentiated by Portuguese (PT) and Spanish waters of the Gulf of Cadiz (ES). Note the different scale of the y-axis. Although estimates from Subdivision 9.a South in 2010 and 2014 were not separately provided for Algarve and Cadiz to this WG, the total estimated for the subdivision was assigned to the Cadiz area (by assuming some overestimation) according to the observed acoustic energy distribution in the area.

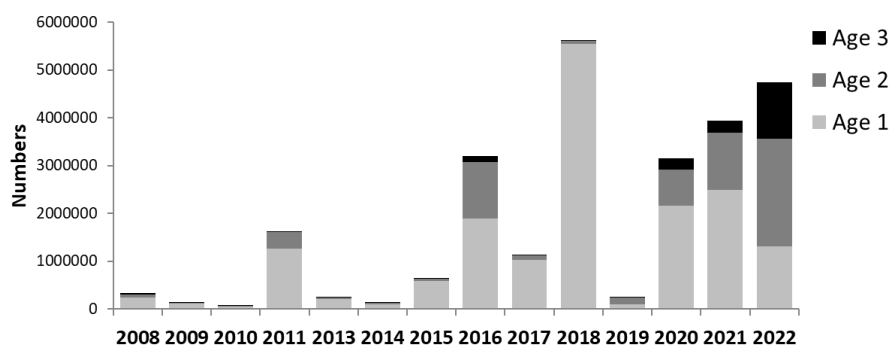


Figure 4.4.2.11. Anchovy in Division 9.a. Western component. Subdivisions 9.a North to Central-South. Annual trends of the estimated population by age class from the *PELACUS* (9a North)+*PELAGO* (9a Central-North and Central-South) Spring acoustic surveys. Age composition for 2020 only derived from the *PELAGO* survey given the *PELACUS* was not carried out.

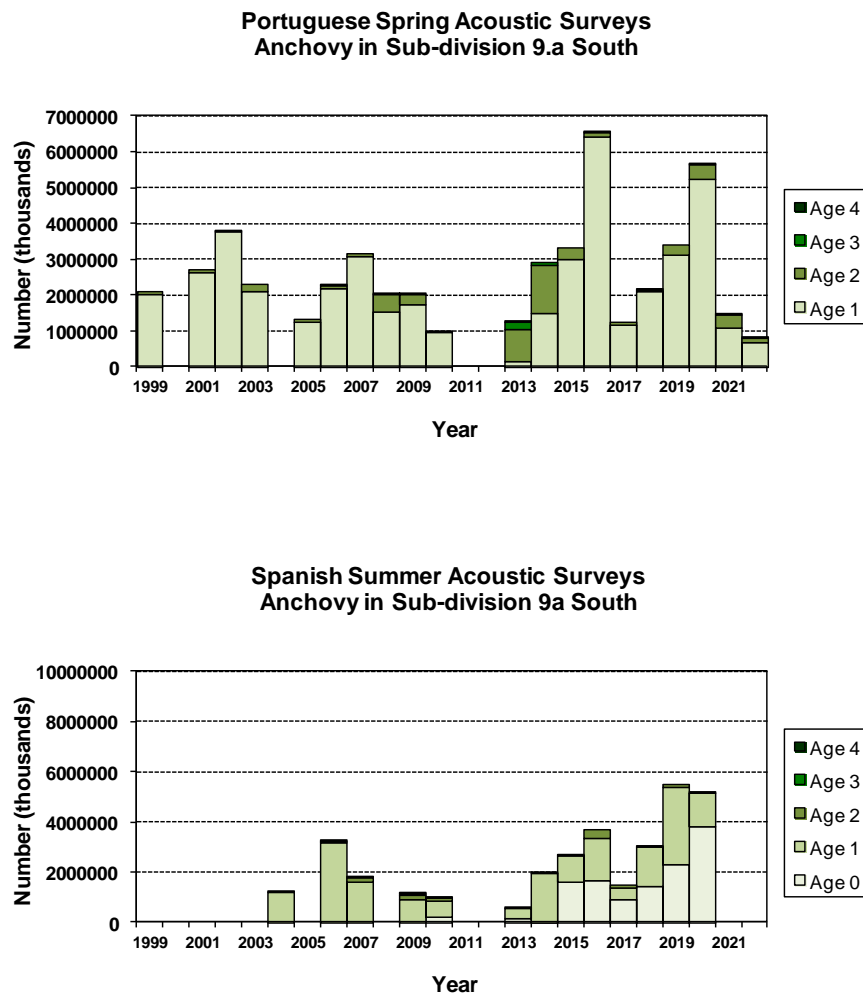


Figure 4.4.2.12. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. Annual trends of the estimated population by age class from the Algarve + Gulf of Cadiz areas by the *PELAGO* Portuguese Spring (upper plot) and *ECOCADIZ* Spanish summer (lower plot) acoustic surveys (*ECOCADIZ* 2021-07 was not finally conducted). Portuguese estimates until 2012 have been age-structured using Spanish ALKs from the commercial fishery in the second quarter in the year.

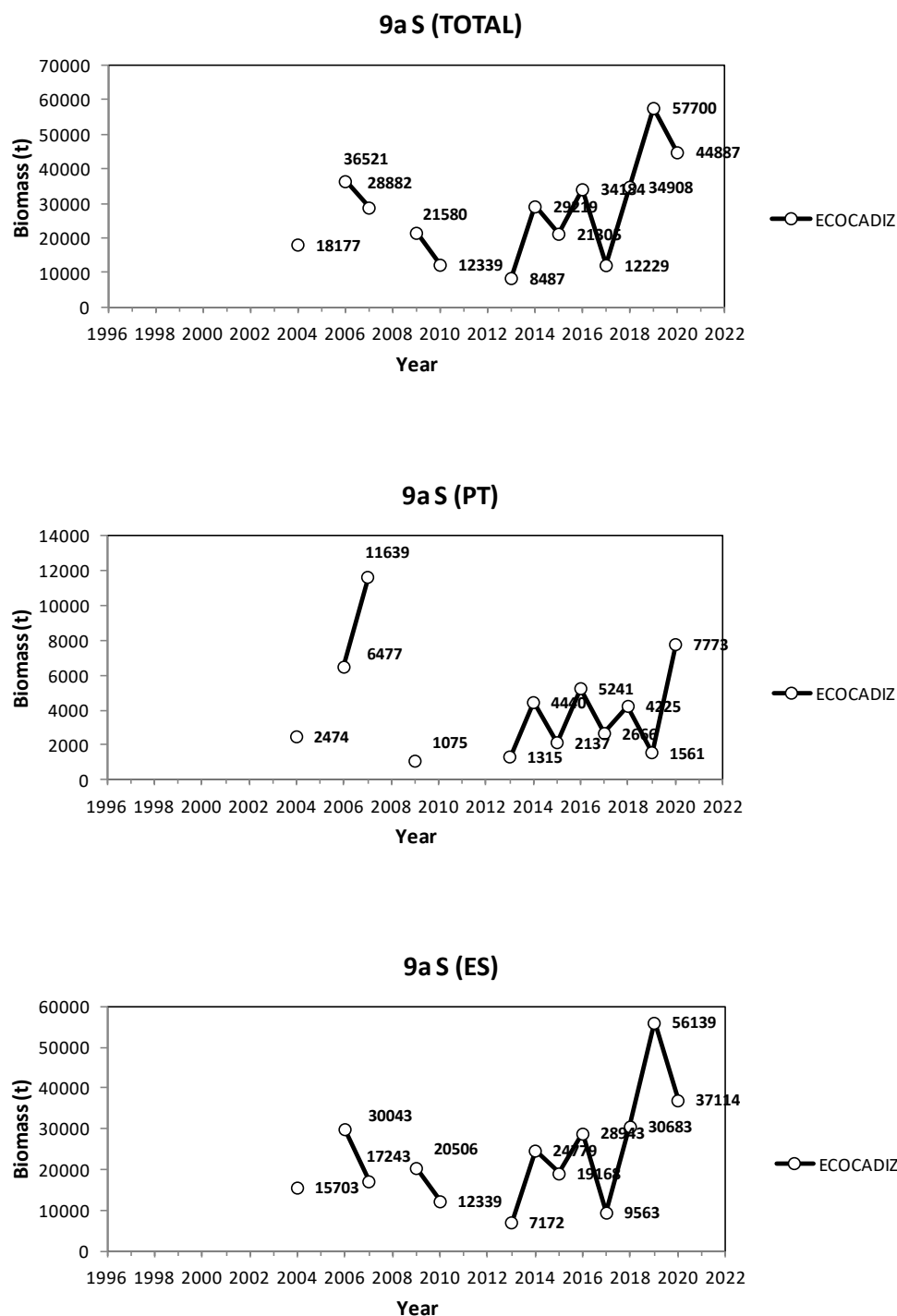


Figure 4.4.2.13. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ* survey series (summer Spanish acoustic survey in Subdivision 9.a South). Historical series of overall and regional (Portuguese, PT, and Spanish waters of the Gulf of Cadiz, ES) acoustic estimates of anchovy biomass (t). Note the different scale of the y-axis. *ECOCADIZ* 2021-07 was not finally conducted.

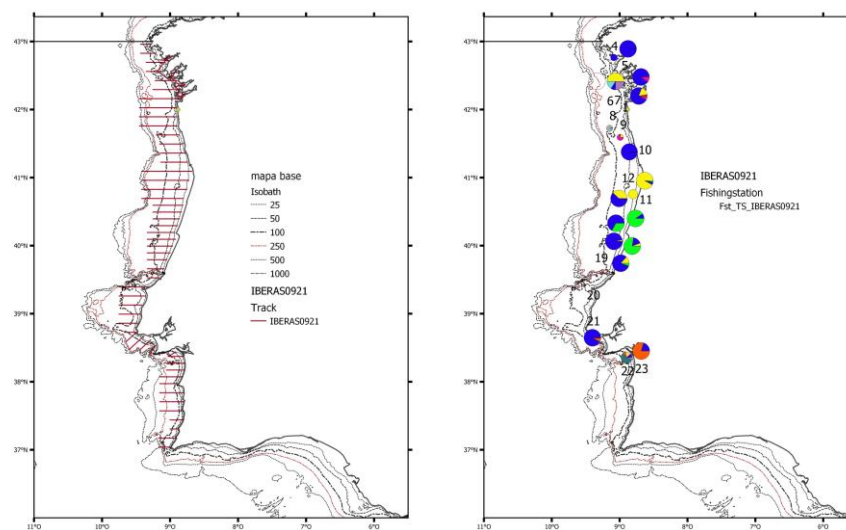


Figure 4.4.3.1. Anchovy in Division 9.a. Western component. Subdivisions 9.a North, 9.a Central-North and 9.a Central-South. *IBERAS 0921* survey (autumn Spanish-Portuguese acoustic survey in Subdivisions 9.a North to Central-South). Left: sampling grid. Right: location of valid fishing stations with indication of their species composition (percentages in number).

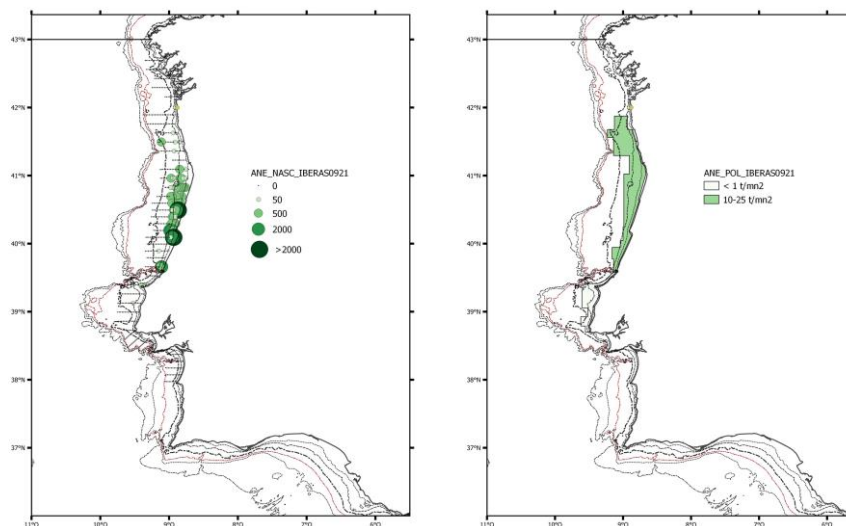


Figure 4.4.3.2. Anchovy in Division 9.a. Western component. Subdivisions 9.a North, 9.a Central-North and 9.a Central-South. *IBERAS 0921* survey (autumn Spanish-Portuguese acoustic survey in Subdivisions 9.a North to Central-South). Left: distribution of the backscattering energy (Nautical area scattering coefficient, NASC, in $\text{m}^2 \text{nmi}^{-2}$) attributed to the species. Right: distribution of the homogeneous size-based post-strata used in the biomass/abundance estimates. Colour scale according to the mean value of fish density (in t nmi^{-2}) in each post-stratum.

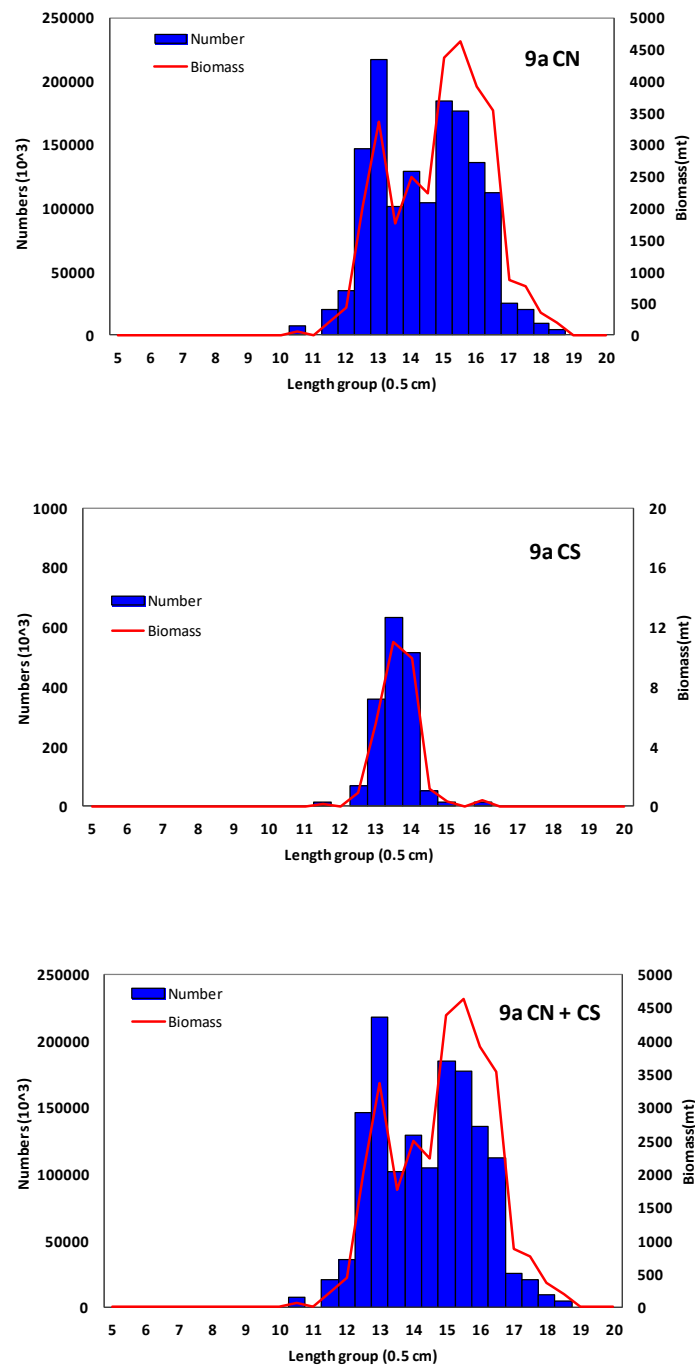


Figure 4.4.3.3. Anchovy in Division 9.a. Western component. Subdivisions 9.aNorth, 9.a Central-North and 9.a Central-South. *IBERAS 0921* survey (autumn Spanish-Portuguese acoustic survey in Subdivisions 9.a North to Central-South). Estimated abundances and biomasses (number of fish in thousands and tonnes, respectively) for the surveyed area by length class (cm). Note the different scales in the y-axis.

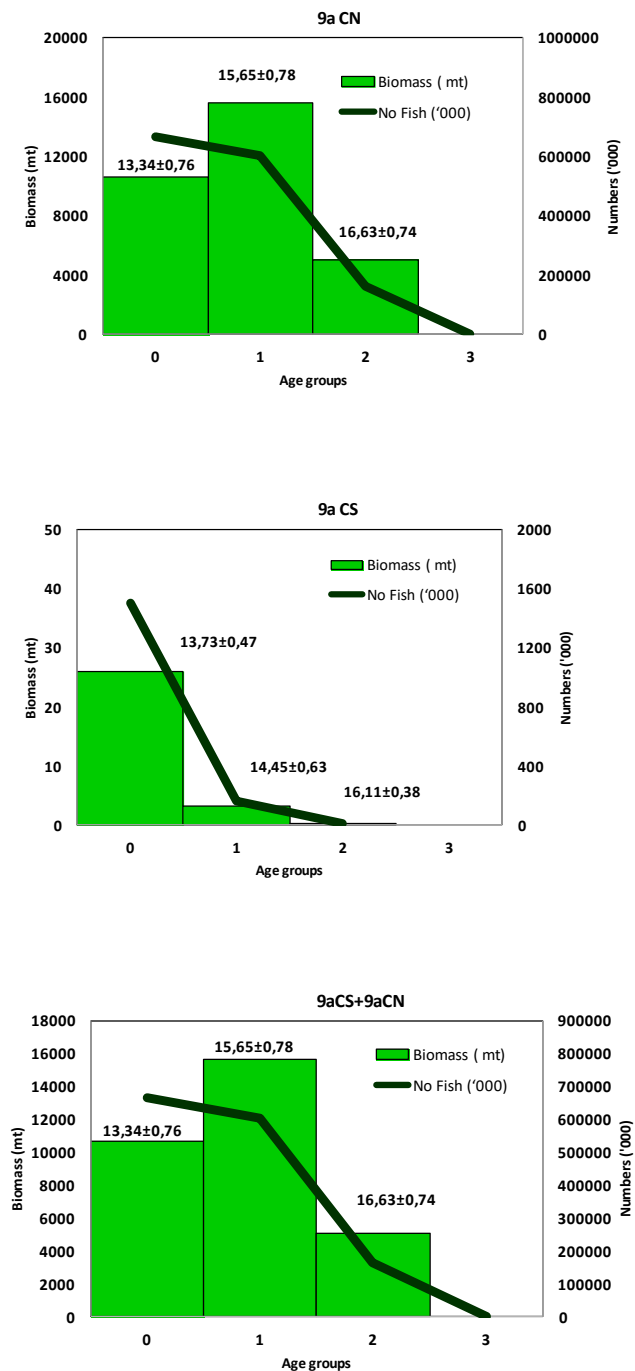


Figure 4.4.3.4. Anchovy in Division 9.a. Western component. Subdivisions 9.a North, 9.a Central-North and 9.a Central-South. *IBERAS 0921* survey (autumn Spanish-Portuguese acoustic survey in Subdivisions 9.a North to Central-South). Estimated abundances and biomasses (number of fish in thousands and tonnes, respectively) for the surveyed area by age group, with indication of the mean size by age. Note the different scales in the y-axis.

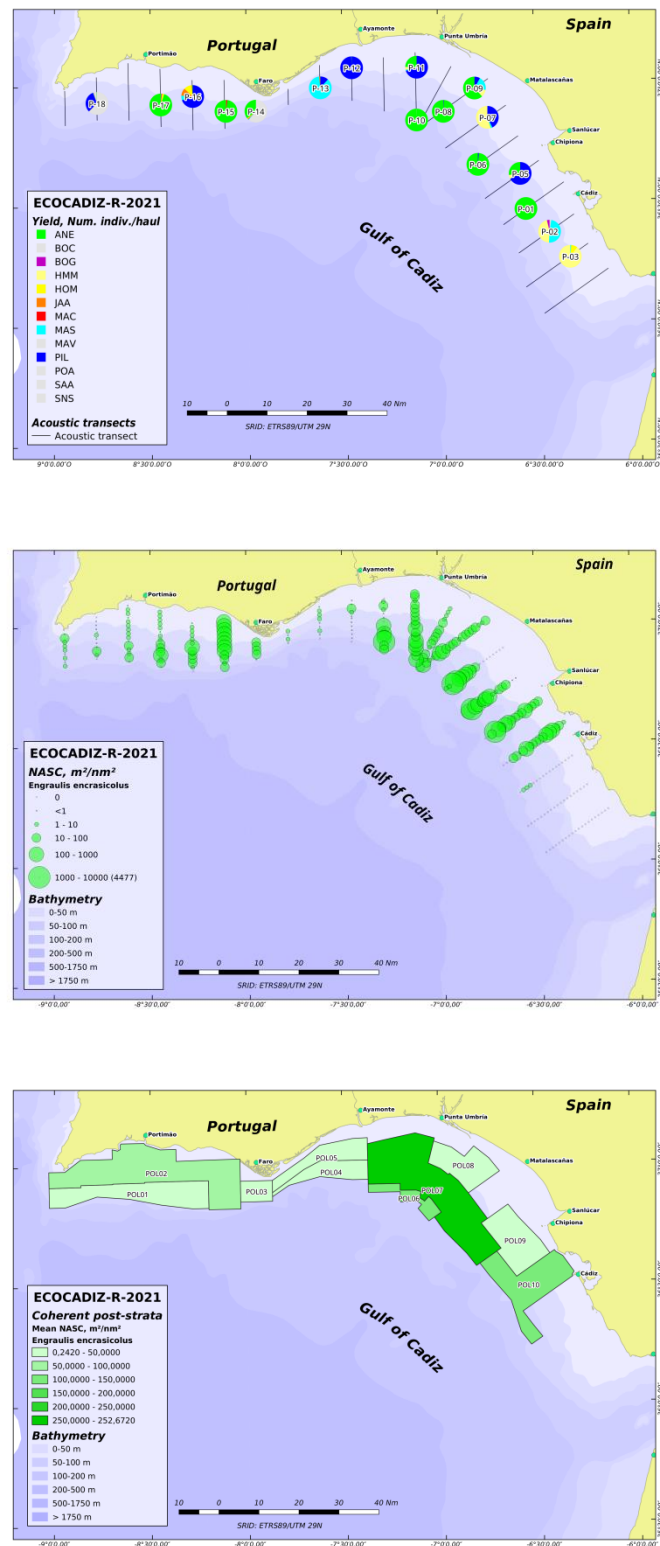


Figure 4.4.3.5. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ-RECLUTAS 2021-10* survey (autumn Spanish acoustic survey in Subdivision 9.a South). Top: Location of valid fishing stations with indication of their species composition (percentages in number). Middle: Distribution of the 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.

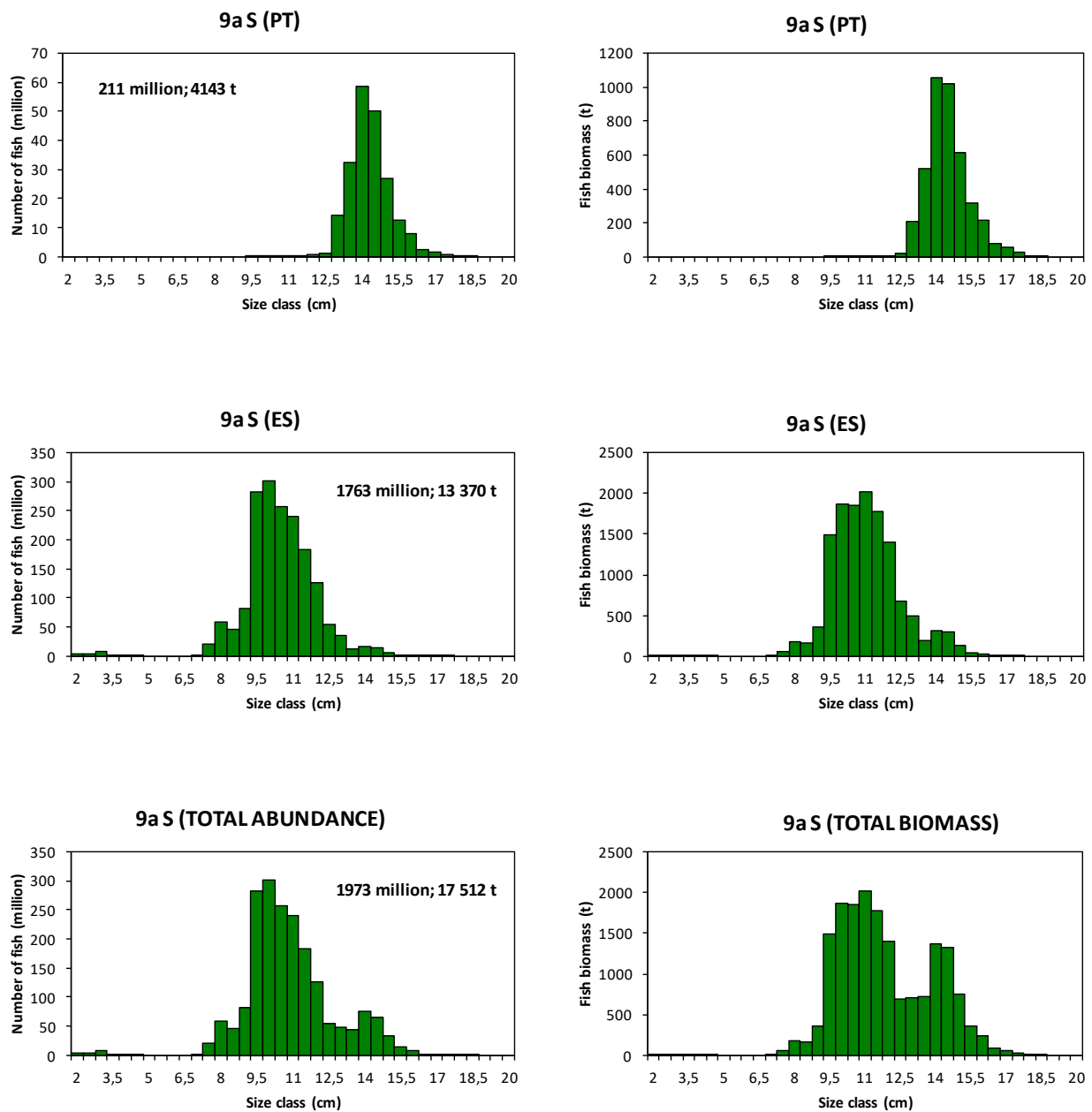


Figure 4.4.3.6. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ-RECLUTAS 2021-10* survey (autumn Spanish acoustic survey in Subdivision 9.a South). Estimated abundances and bio-masses (number of fish in millions and tonnes, respectively) for the surveyed area by length class (cm). Note the different scales in the y-axis.

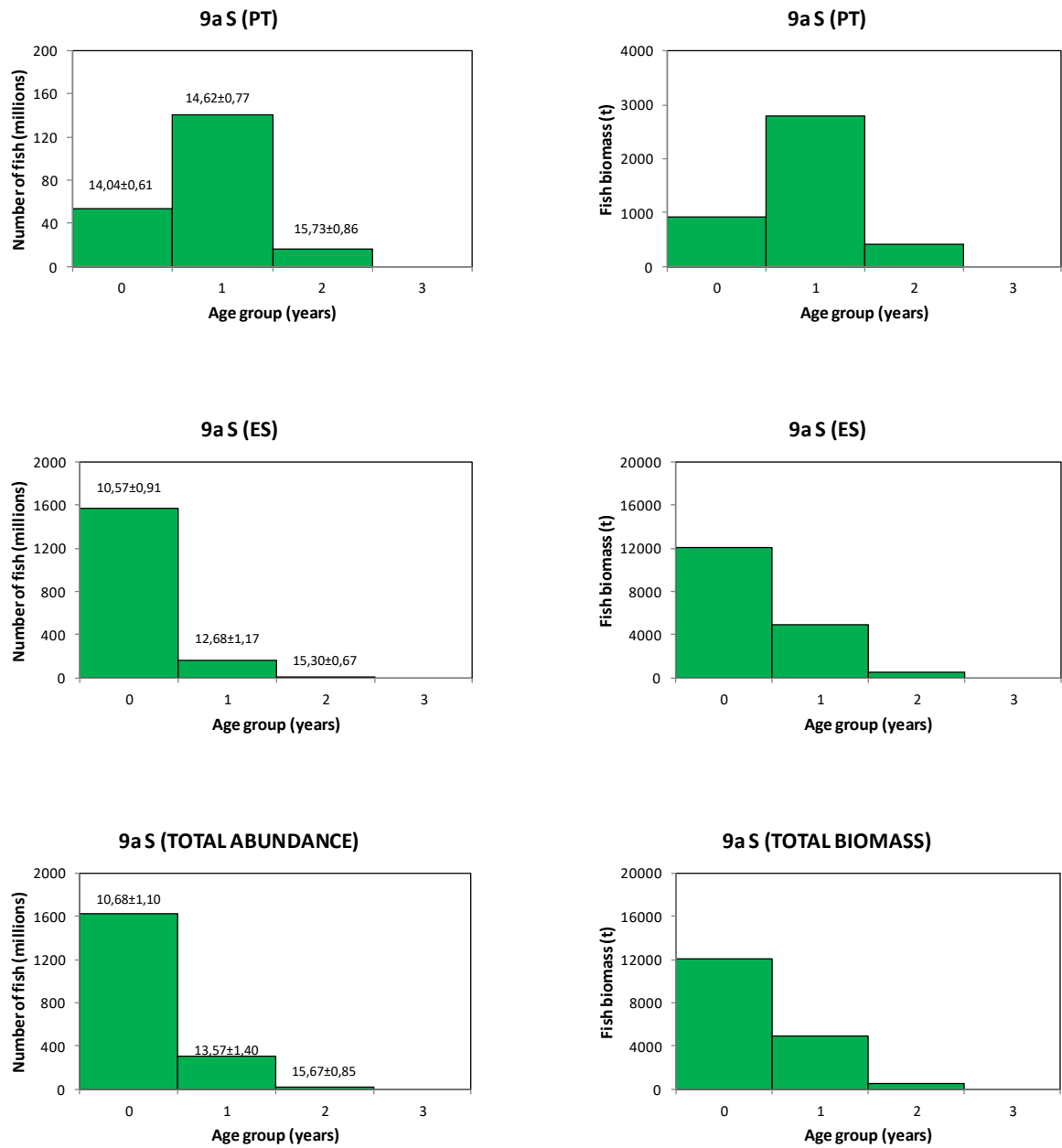


Figure 4.4.3.7. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ-RECLUTAS 2021-10* survey (autumn Spanish acoustic survey in Subdivision 9.a South). Estimated abundances and biomasses (number of fish in millions and tonnes, respectively) for the surveyed area by age group, with indication of the mean size by age. Note the different scales in the y-axis.

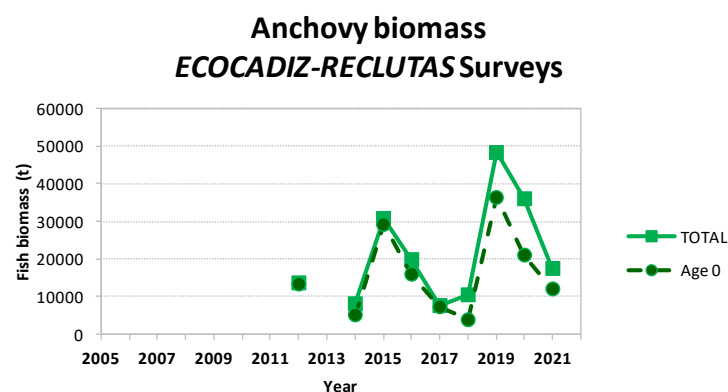
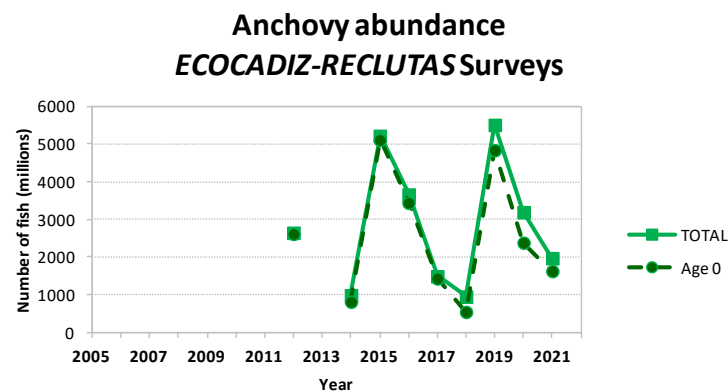
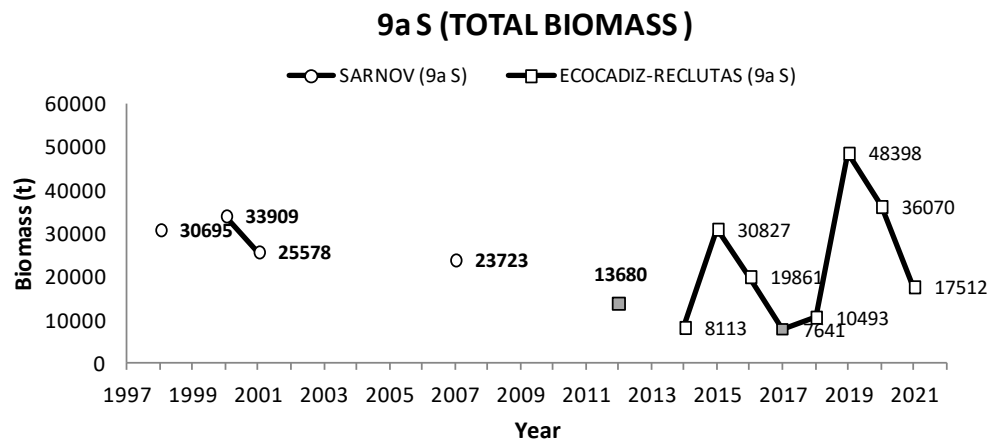


Figure 4.4.3.8. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ-RECLUTAS* survey series (autumn Spanish acoustic survey in Subdivision 9.a South). Top: historical series of overall acoustic estimates of anchovy biomass (t), (squares). The estimates from the older Portuguese *SARNOV* survey series are also included for comparison of trends (circles). The 2012 and 2017 estimates (in dark grey) are partial ones, since the surveys either covered the Spanish waters (2012) or the seven easternmost transects (2017). Middle and bottom: time-series estimates of abundance and biomass of the total population and Age 0 fish. In this case, the 2017 has not been included. The 2012 estimate is retained because the recruitment area was almost covered.

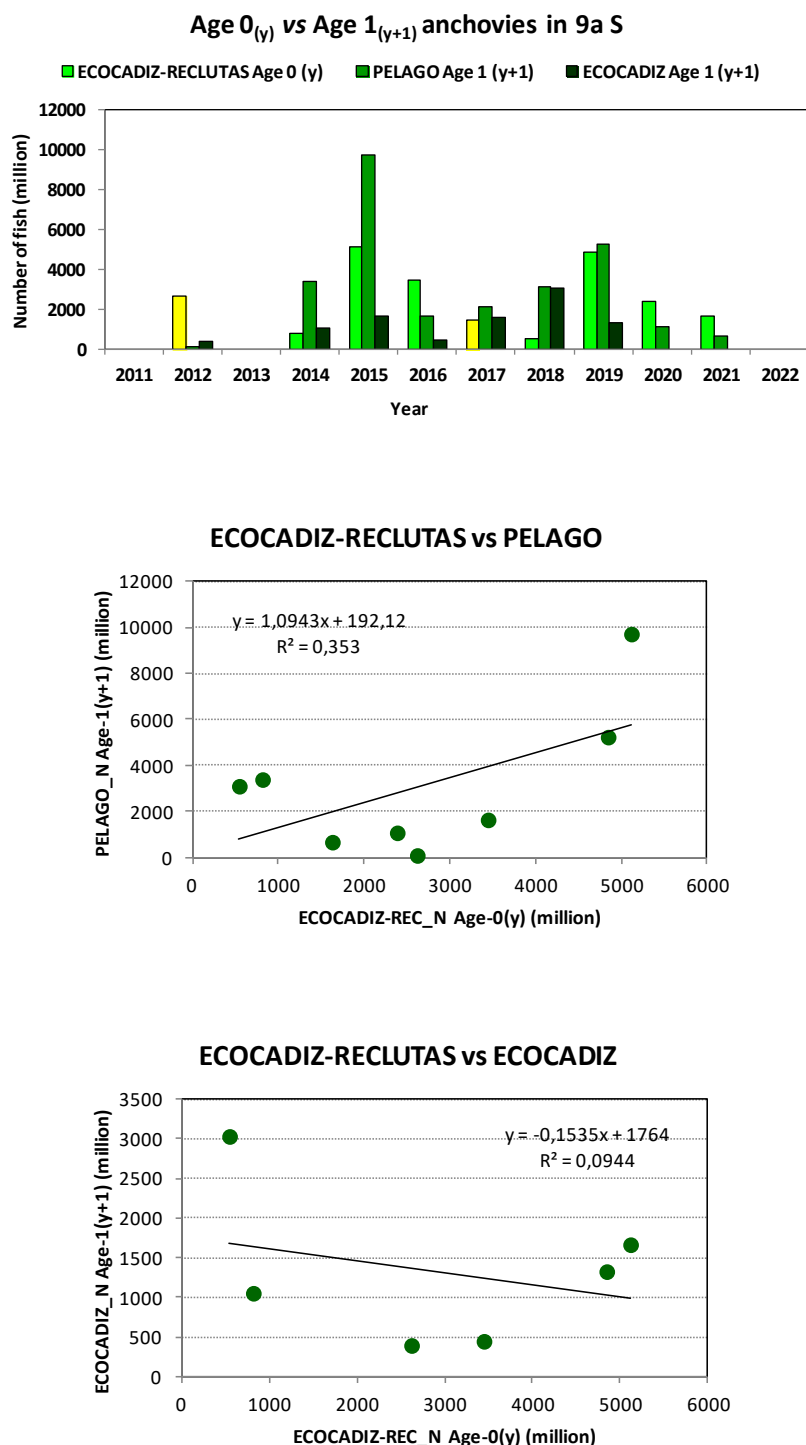


Figure 4.4.3.9. Anchovy in Division 9.a. Southern component. Subdivision 9.a South. *ECOCADIZ-RECLUTAS* survey series (autumn Spanish acoustic survey in Subdivision 9.a South). Correspondence between acoustic estimates of abundance of Age 0 anchovies from *ECOCADIZ-RECLUTAS* surveys in the autumn of the year y against the abundance of Age 1 anchovies estimated in spring of the following year ($y+1$) by the *PELAGO* survey and in summer by the *ECOCADIZ* survey. The *ECOCADIZ-RECLUTAS* 2012 and 2017 estimates are partial ones since the 2012 survey only covered the Spanish waters and the 2017 survey the seven easternmost transects (this last data point was removed from the regression fittings). *ECOCADIZ* 2021-07 was not finally conducted.



Figure 4.6.2.1.2.1. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated catches length distribution by quarters from 1989 to 2021. Black lines represent estimated data while gray lines represent observed data.

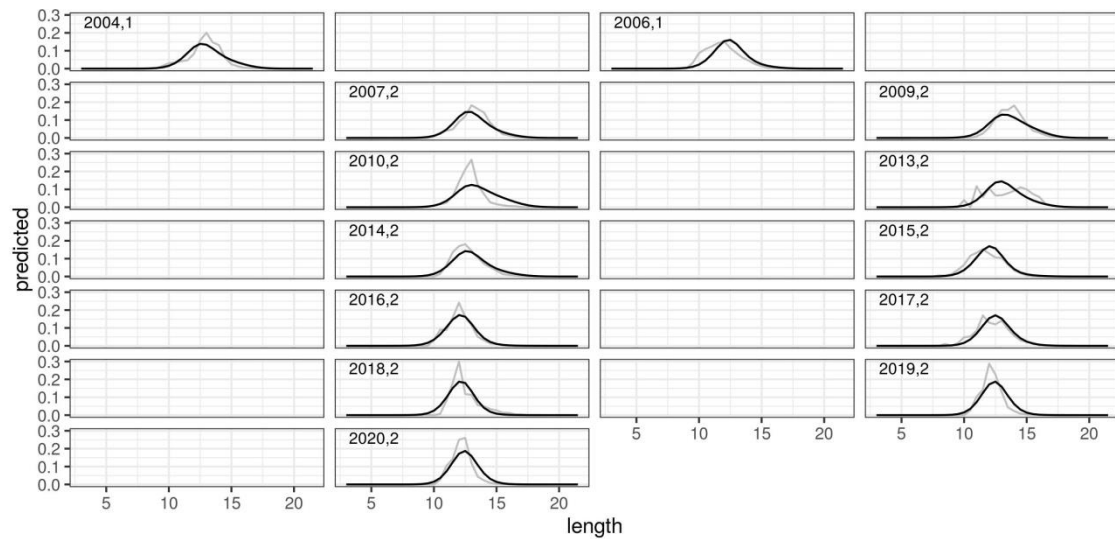


Figure 4.6.2.1.2.2. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated catches length distribution for *ECOCADIZ* survey from 2004 to 2020. Black lines represent estimated data while gray lines represent observed data. The number next to the year indicates the quarter. Note that the time of the survey in the model is assumed to be one quarter before it really happens; this assumption follows from the order of calculations in the model.

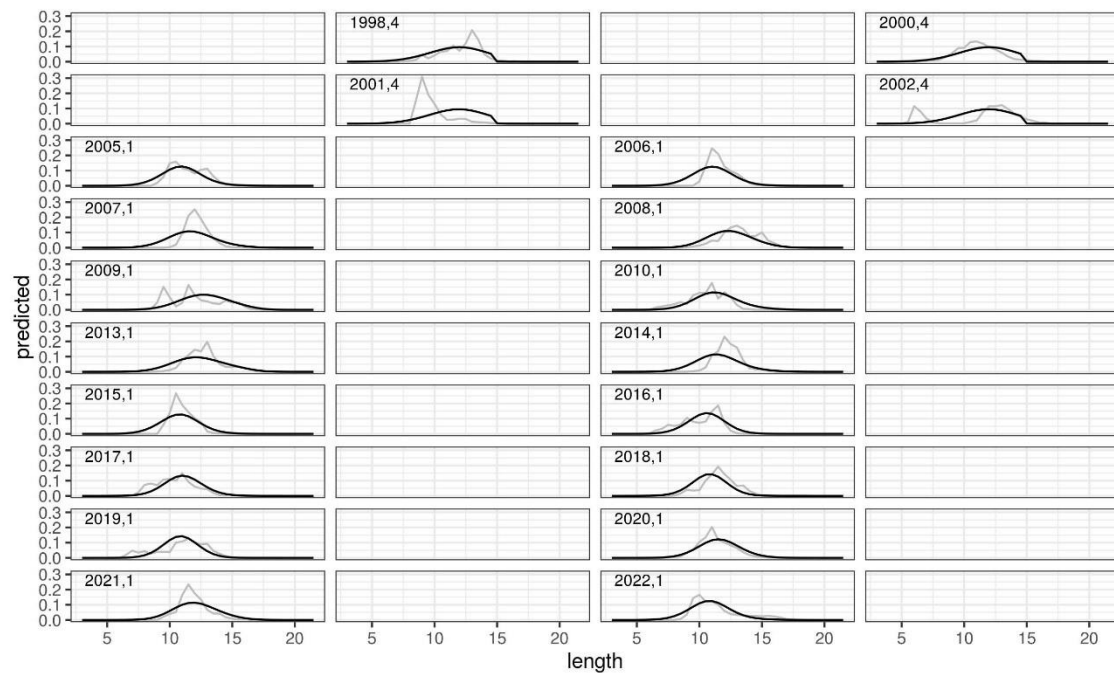


Figure 4.6.2.1.2.3. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated catches length distribution for *PELAGO* survey from 1998 to 2022. Black lines represent estimated data while gray lines represent observed data. The number next to the year indicates the quarter. Note that the time of the survey in the model is assumed to be one quarter before it really happens; this assumption follows from the order of calculations in the model.

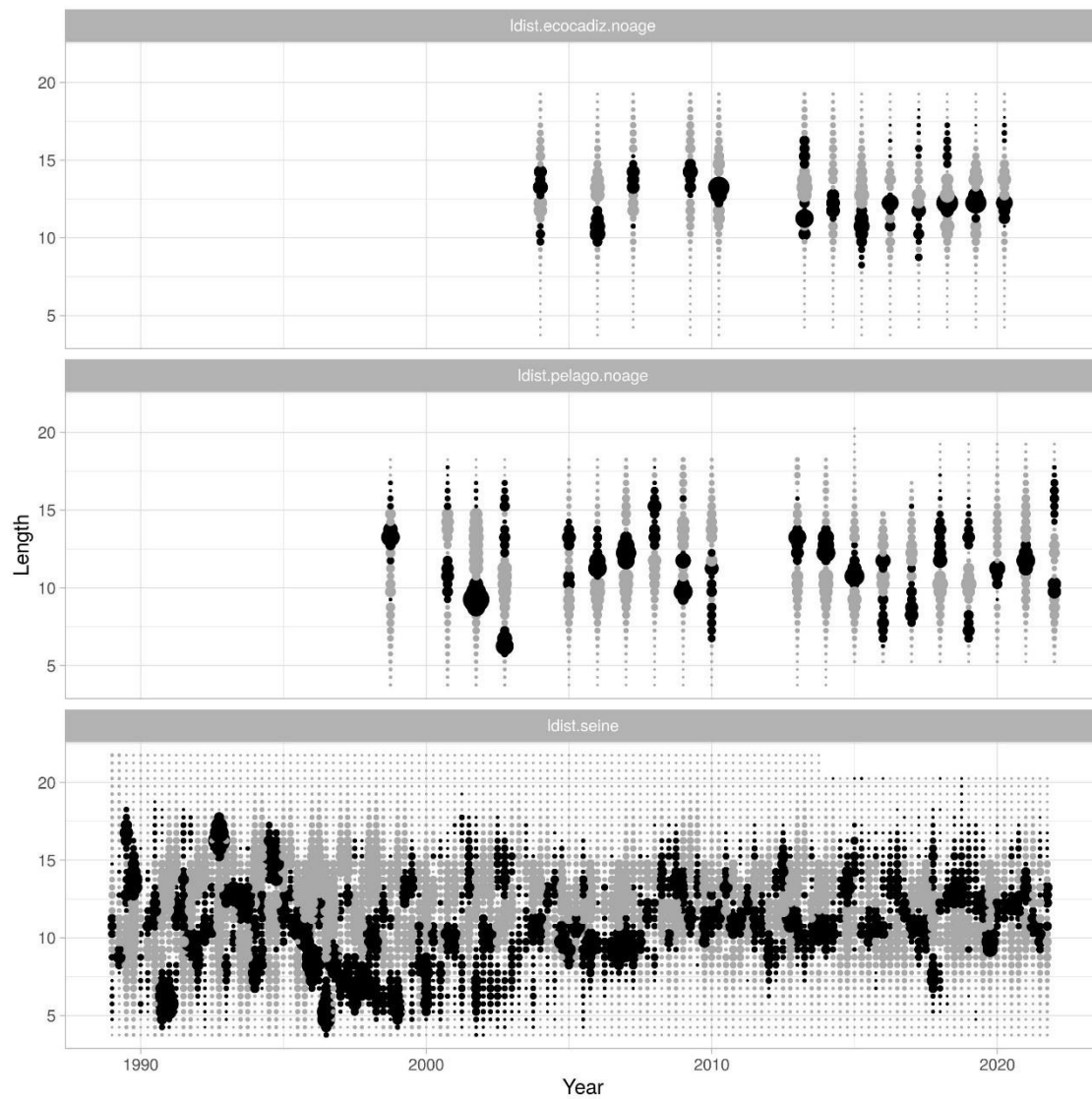


Figure 4.6.2.1.2.4. Anchovy in Division 9.a. Southern component. Standardised residual plots for the fitted length distribution from the *ECOCADIZ* survey, *PELAGO* survey and commercial fleet. Black points denote a model underestimate and gray points an overestimate. The size of the points denotes the scale of the standardised residual.

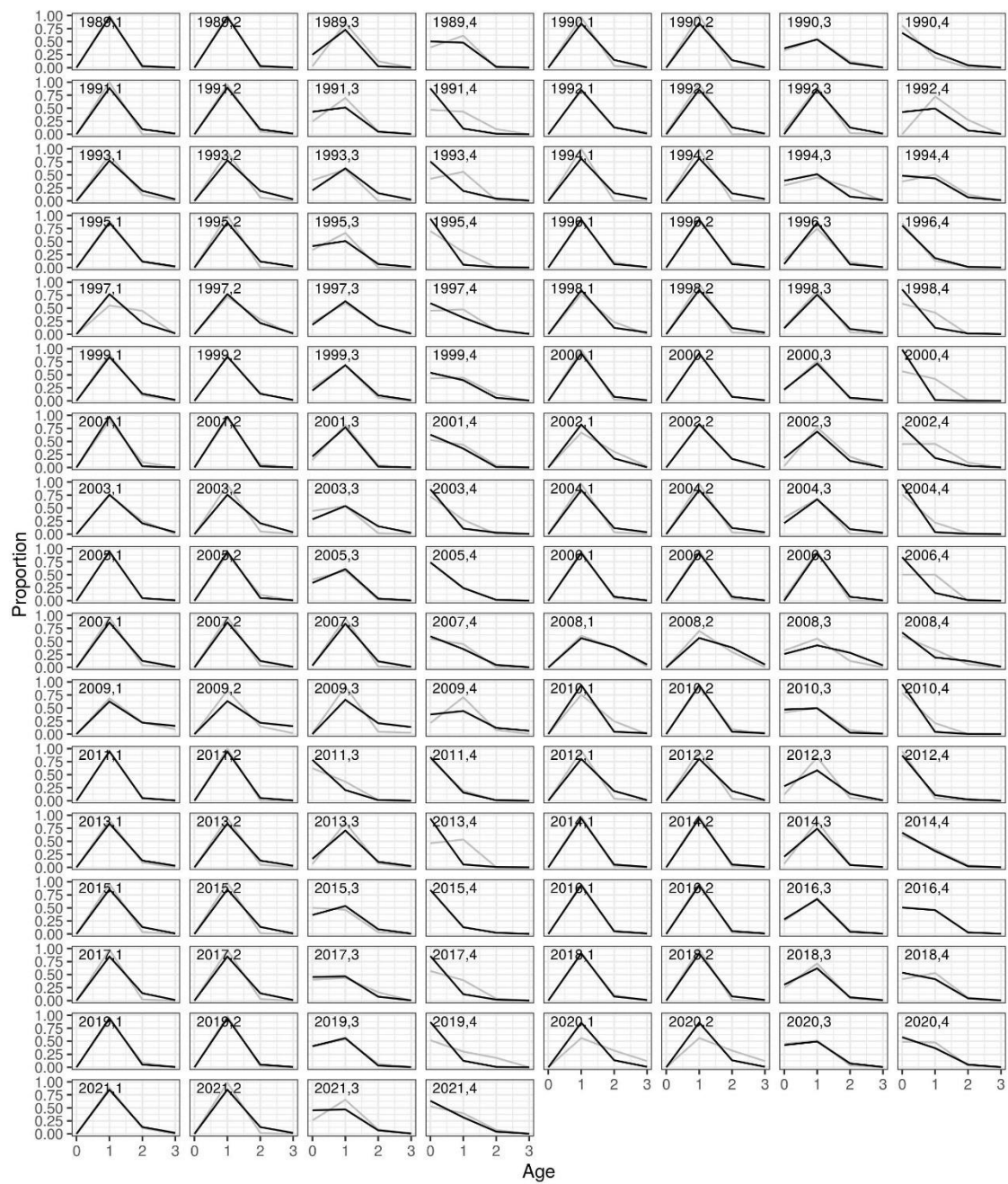


Figure 4.6.2.1.2.5. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated quarterly catches age distribution from 1989 to 2021. Black lines represent estimated data while gray lines represent observed data. The number next to the year indicates the quarter.

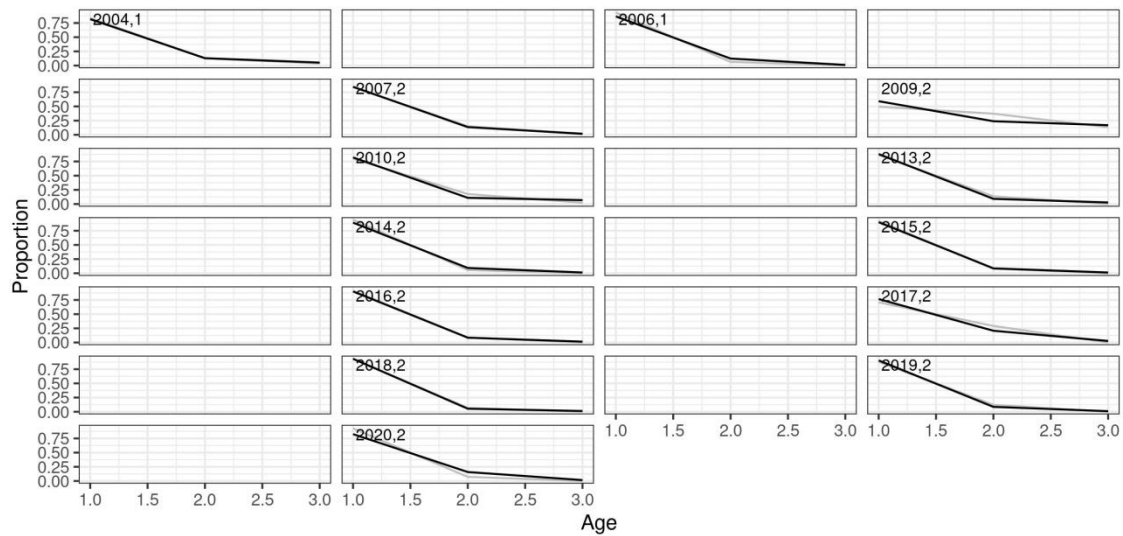


Figure 4.6.2.1.2.6. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated *ECOCADIZ* survey age distribution from 2004 to 2020. Black lines represent estimated data while gray lines represent observed data. The number next to the year indicates the quarter. Note that the time of the survey in the model is assumed to be one quarter before it really happens; this assumption follows from the order of calculations in the model.

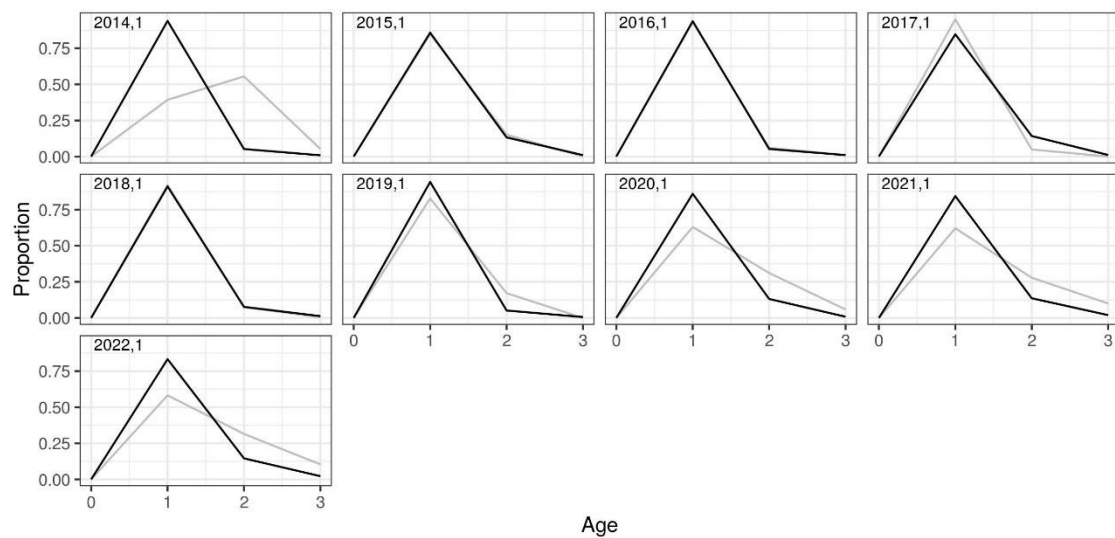


Figure 4.6.2.1.2.7. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated *PELAGO* survey age distribution from 2014 to 2022. Black lines represent estimated data while gray lines represent observed data. The number next to the year indicates the quarter. Note that the time of the survey in the model is assumed to be one quarter before it really happens; this assumption follows from the order of calculations in the model.

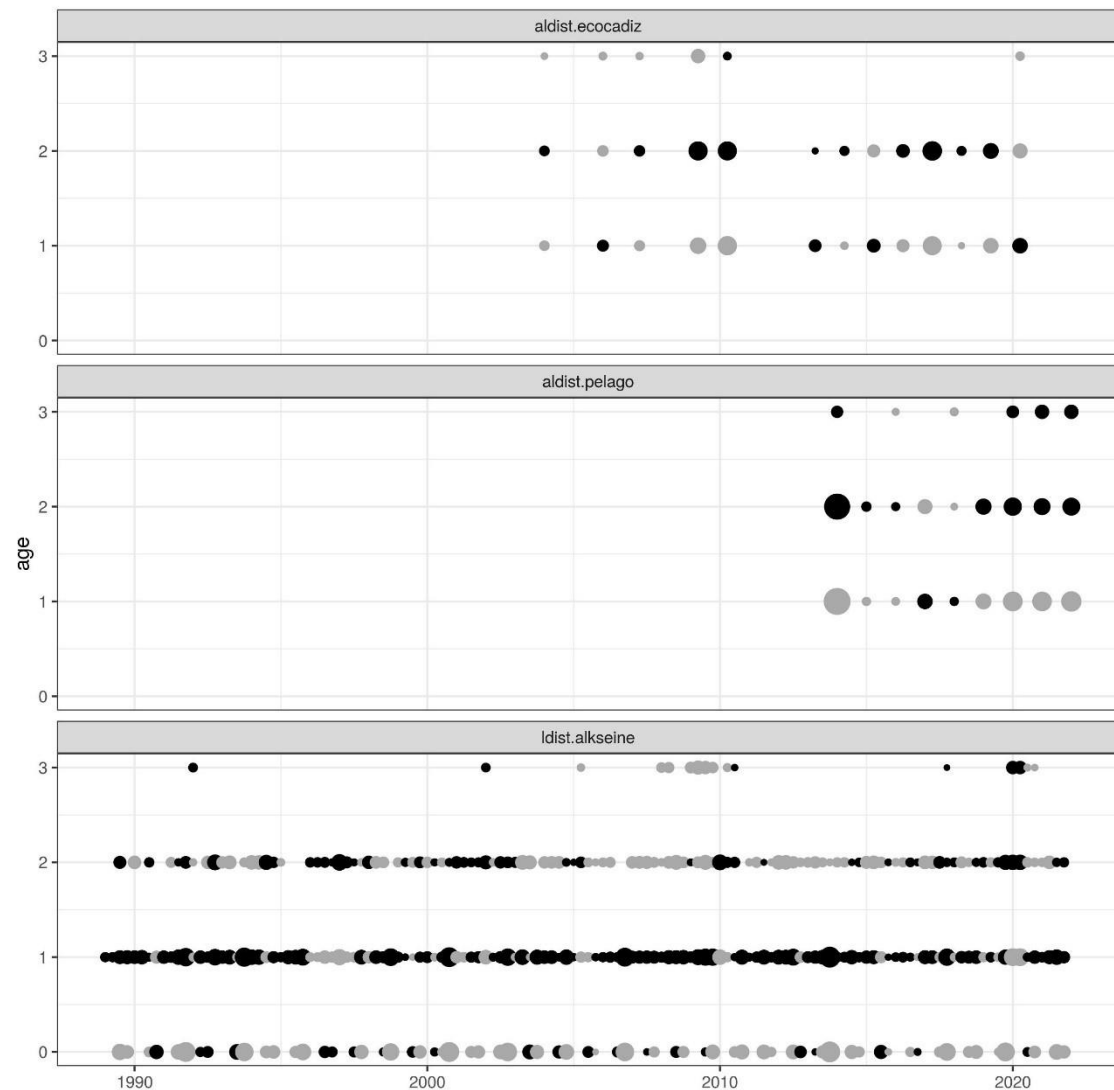


Figure 4.6.2.1.2.8. Anchovy in Division 9.a. Southern component. Standardised residual plots for the fitted age distribution from the *ECOCADIZ* survey, *PELAGO* survey and commercial fleet. Black points denote a model underestimate and gray points an overestimate. The size of the points denotes the scale of the standardised residual.

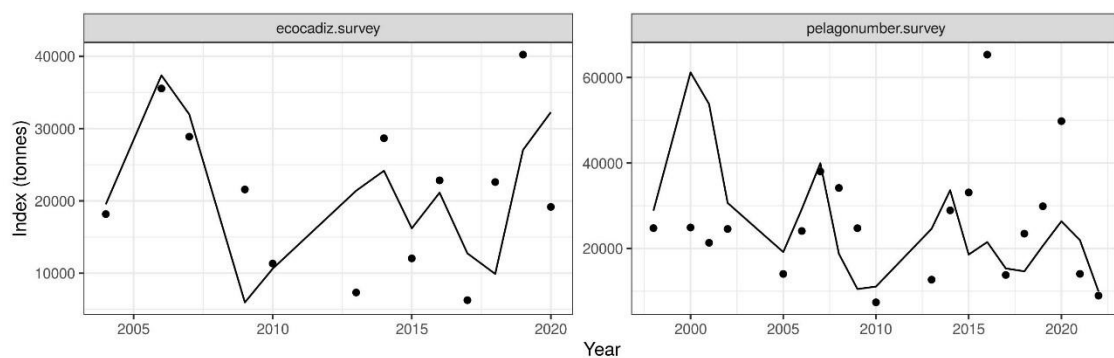


Figure 4.6.2.1.2.9. Anchovy in Division 9.a. Southern component. Comparison between observed and estimated survey biomass indices. Black points represent observed data while black line represents estimated data.

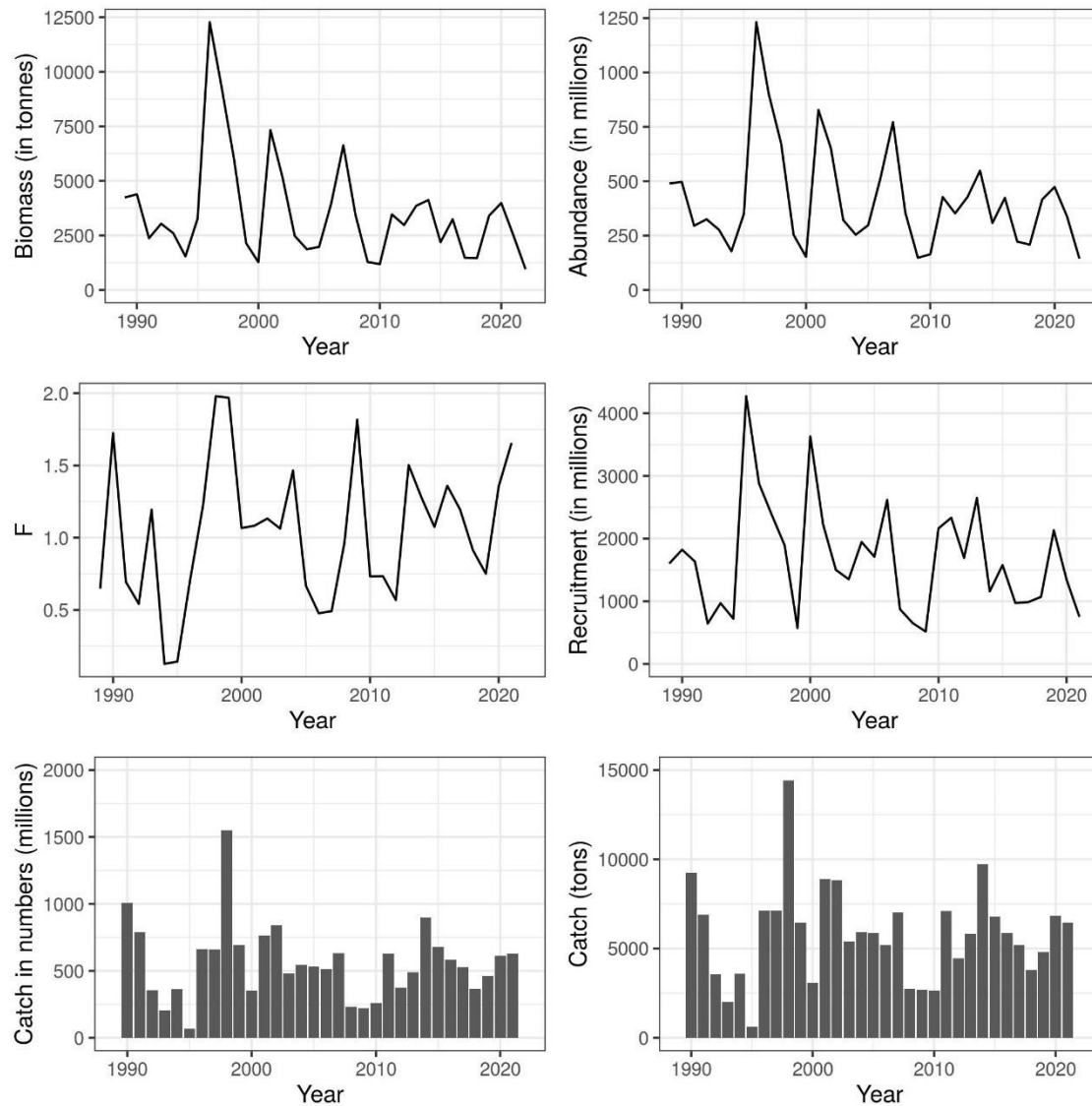


Figure 4.6.2.1.3.1. Anchovy in Division 9.a. Southern component. Annual model estimates for abundance with more than one year of age (in numbers and biomass), recruitment and fishing mortality compared with annual catch time-series (in numbers and biomass). Measures were summarised at the end of June each year, assuming that a year starts in July and ends in June of the next year.

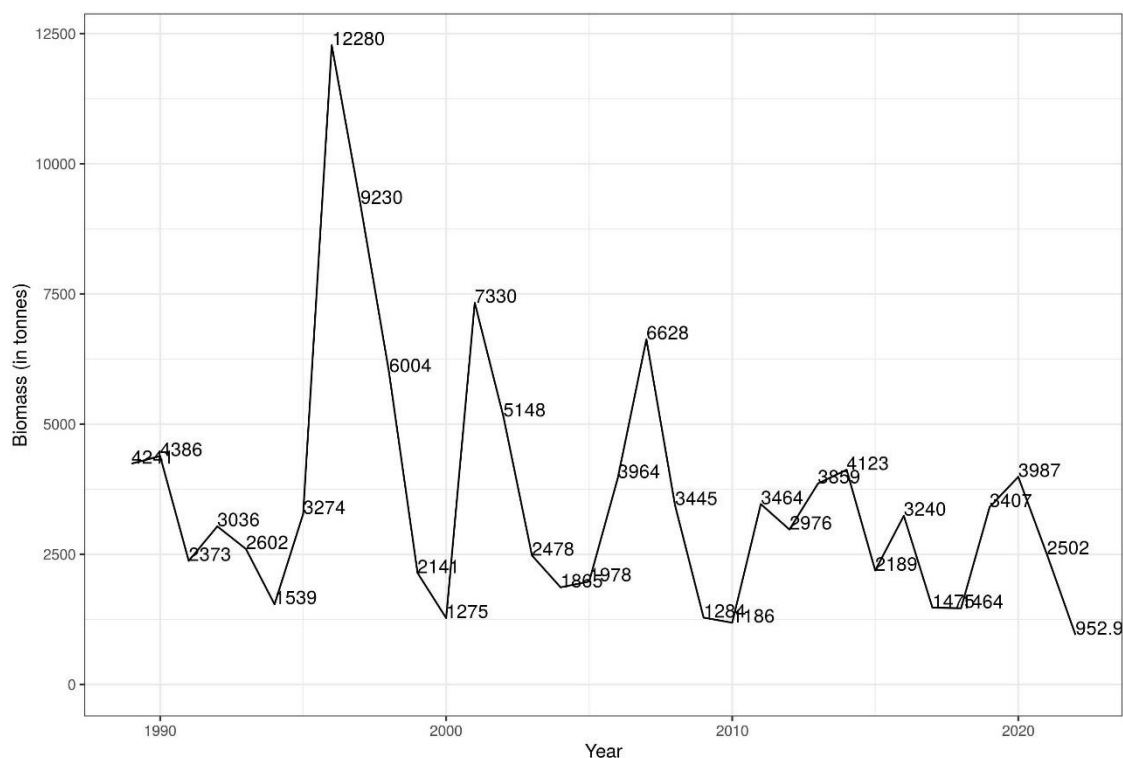


Figure 4.6.2.1.3.2. Anchovy in Division 9.a. Southern component. Time-series of estimated biomass at the end of June each year, assuming that a year starts in July and ends in June of the next year. For this stock, it is assumed that there are no individuals of age 0 at that time of the year, then this abundance estimates corresponds to individuals of age 1+. These biomass estimates are equivalent to spawning-stock biomass estimates since it is assumed that all individuals with age 1 or higher are mature.

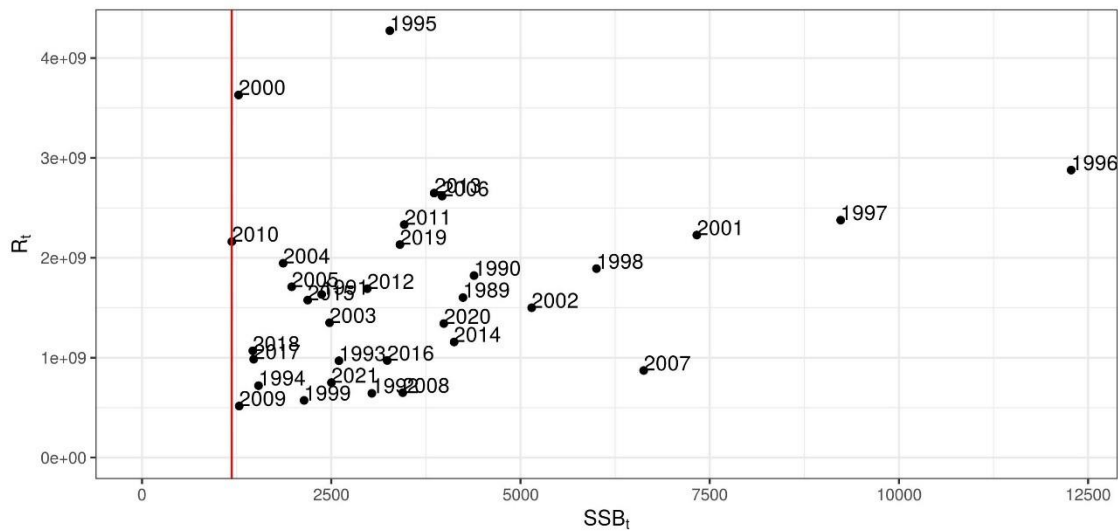


Figure 4.7.2.1. Anchovy in Division 9.a. Southern component. Estimated Stock Spawning biomass vs. Recruitment plot. Red line indicates the $Blim$ value ($Blim=Bloss=SSB_{2017}=1483.48$ t).

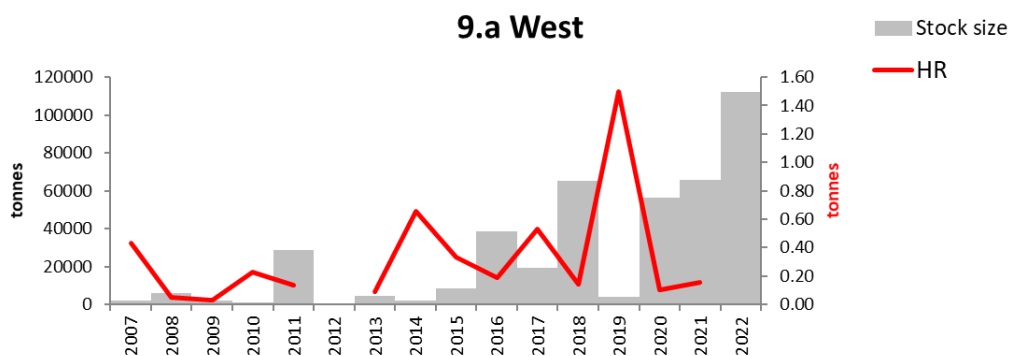


Figure 4.8.1.1. Anchovy in Division 9.a. Western Component. Stock biomass survey index and harvest rates. Harvest rates were estimated with the biomass of the surveys of a given year and the catches of the management period, i.e. 2007 corresponds to the period 07/2007 to 06/2008.

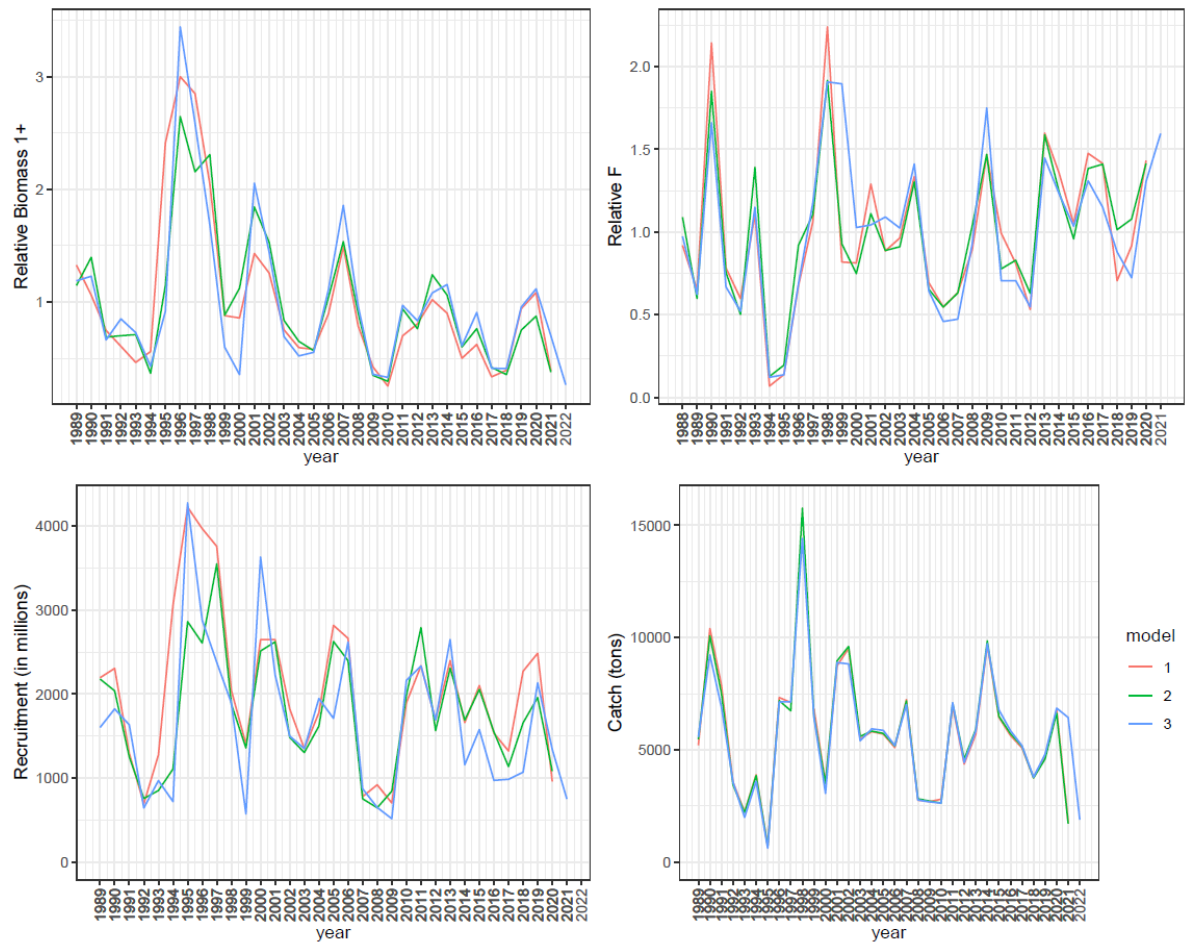


Figure 4.11.2.1: Anchovy in Division 9.a. Southern component. Comparison of estimates from different model implementations. 1. Model used last year (pink), 2. Model used last year but including the ECOCADIZ length distribution in 2020 (green), 3. Model described in this document which is the reference for the advice provided in 2022 (blue): Annual model estimates for relative abundance of individuals with more than one year of age, relative fishing mortality, recruitment and catches (in numbers). Measures were summarized at the end of June each year, assuming that a year starts in July and ends in June of the next year. It is also important to remark that the number of iterations for the optimization process in the first model was 2000000, while in the others was just 1000000.