# Report of 15th meeting for MEDiterranean International Acoustic Surveys (MEDIAS)

in the framework of European Data Collection Framework (DCF)

Zoom, 05-07 April 2022

Steering Committee Report

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# 1. Introduction

Due to difficulties caused by COVID-19 that prevented organization of physical 15th annual meeting from being organized in Ljubljana, Slovenia, in April 2022, the host country decided to organize a virtual meeting. The meeting was held from 05 to 07 April 2022, virtually hosted by Tomaž Modic (FRIS) on Zoom platform and chaired by Vjekoslav Tičina (IOR).

Meeting participants were experts from 8 European Union member states involved in acoustic survey's related activities in the Mediterranean Sea (i.e., Croatia, France, Greece, Italy, Slovenia and Spain) and in the pelagic trawl surveys performed in the Black Sea (i.e. Romania and Bulgaria). In total, 28 participants attended the meeting (see list of participants in Annex I and Institute's acronims in Annex II).

The agenda of the 15th virtual MEDIAS Coordination Meeting (see Annex III) was adopted by all participants.

In accordance to the Agenda adopted, the main aims of the 15th MEDIAS Coordination Meeting were:

- to present the outcomes related to the MEDiterranean International Acoustic Surveys (MEDIAS) activities carried out in 2021;
- to review and discuss information provided by EC representative;
- to review issues from other meetings related to MEDIAS;
- to discuss information for management decisions and inputs for stock assessments;
- to discuss information for Good Environmental Status in the MSFD;
- to review information about MEDIAS papers;
- to review and agree on next steps in production of standardized NASC maps at the Mediterranean scale;
- work on standardization of biological analyses (e.g. age and maturity estimates);
- to review and propose updates of MEDIAS Website and common working protocol (MEDIAS Handbook);
- election of new Chair for the next 3-year period (2023-2025);
- to establish the ToRs and plan 16th MEDIAS meeting in 2023.

Following the agenda, during the first day activities and outcomes related to the 2021 MEDIAS acoustic surveys, carried out by the MEDIAS teams (Fig. 1.1), were presented, as well as results from the pelagic trawl surveys carried out by Romania and Bulgaria in the Black Sea.

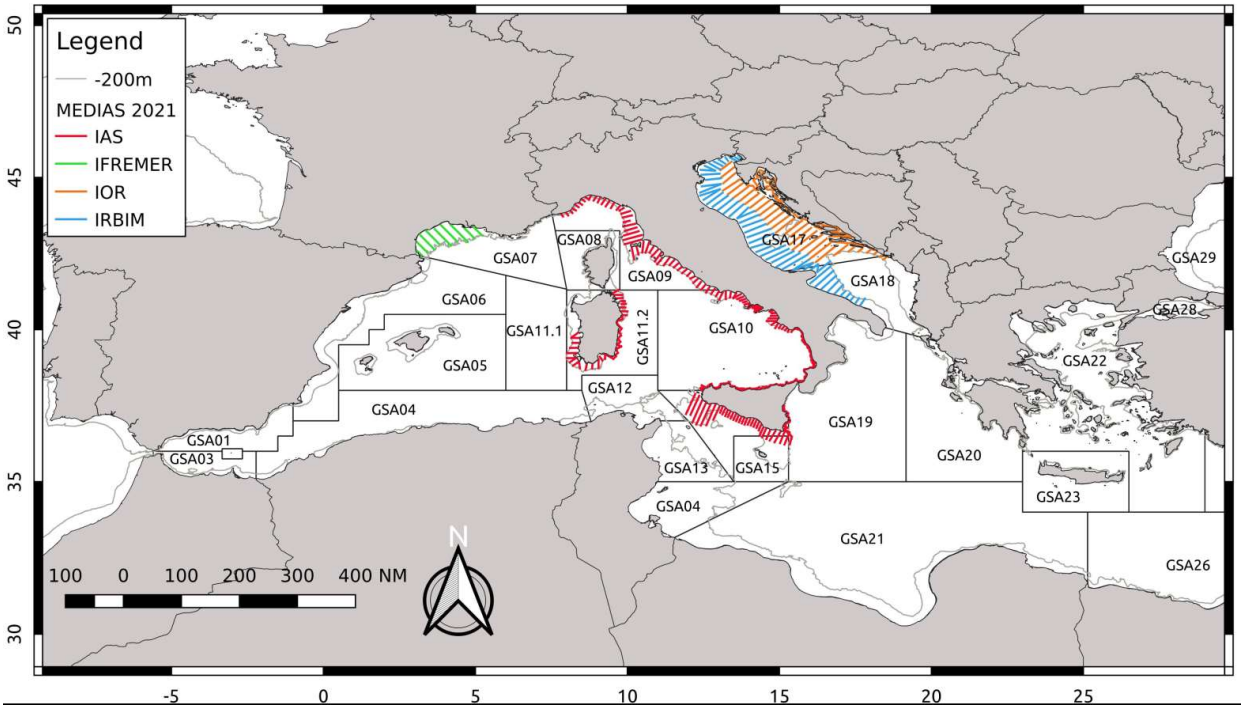



**Figure 1.1** Acoustic surveys performed in the MEDIAS framework during 2021.

# 2. Results of the surveys carried out in 2021 in the framework of the Mediterranean International Acoustic Surveys (MEDIAS)

## 2.1 MEDIAS 2021 in Iberian coast (ESP): GSA 1 - Northern Alboran Sea and GSA 6 - Northern Spain (Magdalena Iglesias, CNIEO/CSIC.)

a) General information on the survey

The MEDIAS_2021 survey was planned to be carried out from June 27 to July 29 covering GSA06 (Northern Spain) and 01 (Northern Alboran Sea), unfortunately electrical problems of the research vessel (R/V Miguel Oliver) prevented the achievement of the objectives.

During the calibration of the scientific echosounder, an anomalous behavior of the echosounder was identified, which was confirmed during the acoustic prospection of the first transect. The GPTs lost communication with the CPU, which led to a decrease in the ping rate, following by a total disconnection of the acoustic system. SIMRAD technical support came on board and worked for a week to find the source of the problem and fix it, unsuccessfully. Finally, after 15 days at sea, the survey was suspended and the R/V Miguel Oliver went to the shipyard to try to solve the

problem. It is newsworthy to point out that the problems not only affected the scientific echosounder but also other R/V electronic equipment, between other the automatic navigation system or the propulsion during fishing tasks.

Different technical operations have been carried out on the R/V Miguel Oliver since then, although to this day certain anomalies continue to occur in the R/V. The CN/IEO is optimistic about the improvements made to the R/V Miguel Oliver and it seems that it will be operational for the MEDIAS 2022 survey.

## 2.2 MEDIAS 2021 in GSA 07 (Gulf of Lions, FRA) - (Tarek Hattab & Jean Hervé Bourdeix, IFREMER)

a) General information on the survey

The surveys took place from June 25 to July 28, 2021, (lasts 33 days at sea) and covered the Gulf of Lions (3300 nm2) with the fishery Research Vessel L'Europe (29.60 m length, 469 × 2 HP).

b) Type of echosounders and frequencies in use

The equipment was composed by SIMRAD ER60 split beam echo sounder, with the 38, 70, 120, 200 and 333 kHz frequencies. The threshold for acquisition is –80 dB and that for processing for the assessment (38 kHz) is –60 dB. The pulse duration is 1024 ms. The surveying acoustic vessel speed is 8 knots. Additionally, the multi-beam echo sounder SIMRAD ME70 was used in order to visualize 3D echos and improve species allocation. The MOVIES 3D software was used to visualize and analyze acoustic data.

c) Calibration results

The acoustic system was calibrated on May 17, 2021. Calibration results are shown in Table 2.2.1.

Table 2.2.1. Calibration results in MEDIAS 2021.

| **Frequency (kHz)** | **38kHz** | **70kHz** | **120kHz** | **200kHz** | **333kHz** |
|---|---|---|---|---|---|
| Echo-sounder type | ES38B | ES70_7C | ES120_7 | ES200_7C | ES333_7C |
| Transducer serial no. | 31288 | 127 | 29497 | 288 | 159 |
| Vessel | RV l'Europe | RV l'Europe | RV l'Europe | RV l'Europe | RV l'Europe |
| Date | 19/05/21 | 19/05/21 | 19/05/21 | 19/05/21 | 19/05/21 |
| Place | Marseille | Marseille | Marseille | Marseille | Marseille |
| Bottom depth (m) | 16 | 16.14 | 16.14 | 16.14 | 15.81 |
| Temperature (°C) at sphere depth | 19.6 | 19.6 | 19.6 | 19.6 | 19.6 |
| Salinity (psu) at sphere depth | 37 | 37 | 37 | 37 | 37 |
| TS of sphere (dB) | -42.4 | -41.5 | -39.6 | -39 | -44 |
| Pulse duration (ms) | 1.024 | 1.024 | 1.024 | 1.024 | 1.024 |
| Ping rate | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Rms beam | 0.08 | 0.09 | 0.09 | 0.13 | 0.29 |
| Resulting gain (dB) | 26.73 | 26.71 | 25.35 | 25.90 | 27. |
| Sa corr (dB) | -0.60 | -0.36 | -0.37 | -0.39 | -0.30 |
| Beam width atwarth | 6.67 | 6.55 | 7.17 | 6.60 | 6.97 |
| Beam width along | 6.71 | 6.64 | 7.36 | 6.63 | 7.14 |
| Atwarth offset | -0.03 | -0.07 | -0.02 | -0.05 | 0.10 |
| Along offset | 0.03 | 0.01 | 0.08 | -0.12 | 0.05 |

d) Survey design

The survey design is made of 9 parallel transects (min and max lengths are 13 and 42 nautical miles) perpendicular to the coastline and 12 nm apart, from the 15 m isobath to the 200 m one (Fig. 2.2.1). In 2021 total nautical miles effectively used for acoustic analysis (minus pelagic trawls tracks and linking transects) were 265.

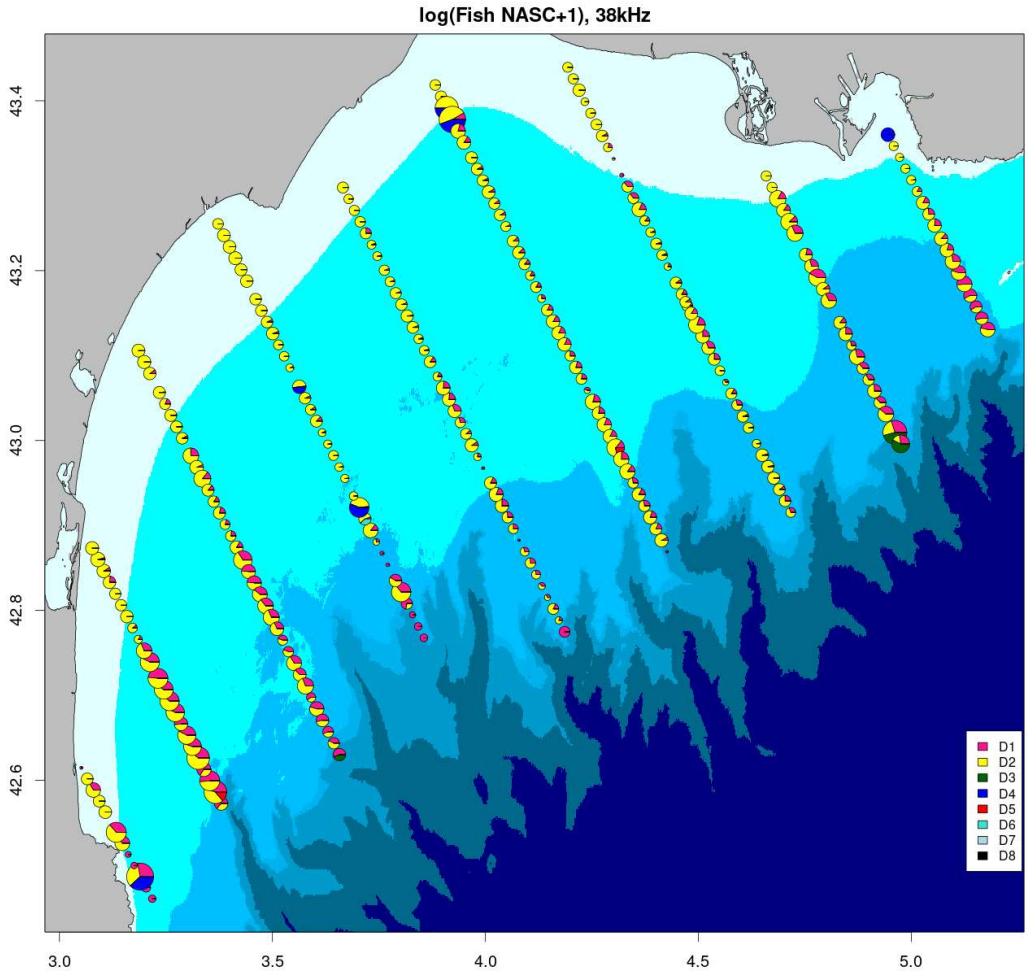



Figure 2.2.1. The survey design in GSA 7 (MEDIAS, 2021). The size of the pie charts is propotional to the log(Fish NASC+1) while the color shows the echotyping result.

e) Fish sampling

Echotraces are identified with a pelagic haul. Thirty six (36) pelagic hauls were then carried out in GSA07 to be used for the scrutinizing of the echograms (Figure 2.2.2). Each time a fish trace was observed for at least 2 nm on the echogram, the boat turned around to conduct a 30 min-trawl at 4 nm.h-1 in order to evaluate the proportion of each species (by randomly sampling and sorting of the catch before counting and weighing each individual species). Acoustic recording and trawl hauls are performed during day time. The pelagic net used has headline length of 83.2m, a sideline dimension of 65.20 m and a codend mesh size of 18mm.

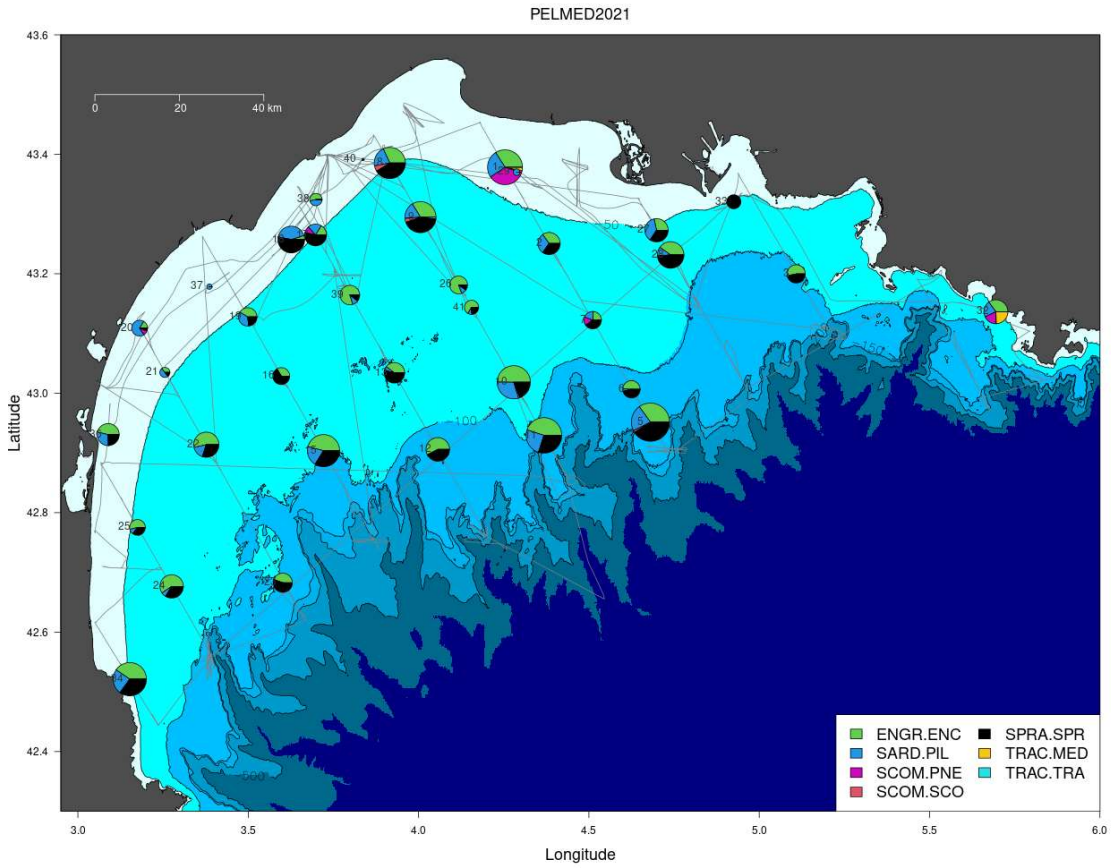



Figure 2.2.2. Catch compositions of pelagic hauls (36) carried out in GSA07 during the French acoustic survey MEDIAS 2021.

f) Oceanographic parameters

Thirty seven (37) hydrological stations have been sampled using a SBE 19plus V2 CTD which measures conductivity, temperature, pressure, fluorescence, PAR (Photosynthetically active radiation), pH, oxygen and turbidity (Figure 2.2.3). Zooplankton was sampled through WP2 vertical nets, while phytoplankton was sampled through Niskin bottles in subsurface and at the maximum of chlorophyll depth.

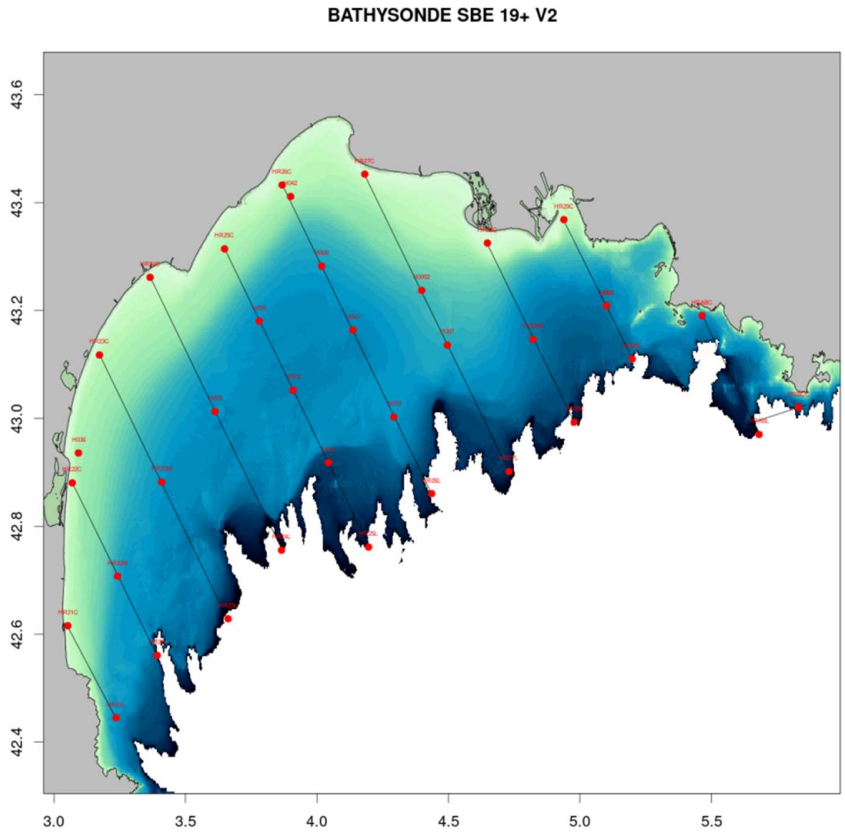



Figure 2.2.3. CTD stations (37) carried out during the French acoustic survey MEDIAS 2021.

g) Biomass estimations of target species

Acoustic data analyses (stock estimation, length-weight relationships, etc.) were performed using R scripts (EchoR package). The sardine and anchovy biomasses (Fig. 2.2.4 and 2.2.5) were estimated to be respectively 35676 t and 42712 t in 2021. The CVs of geostatistical simulations were 17.3 and 9.5 % while the CV associated to Hauls / ESDUs associations were 15 % and 9 % for respectively for sardine and anchovy.

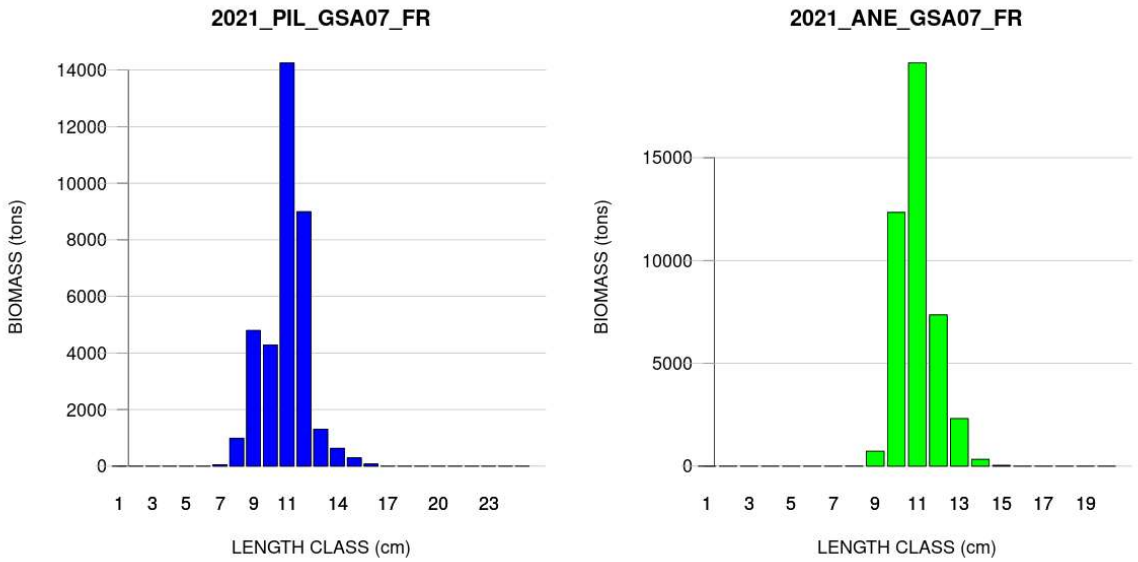



Figure 2.2.4. Biomass estimates per length classes (MEDIAS 2021).

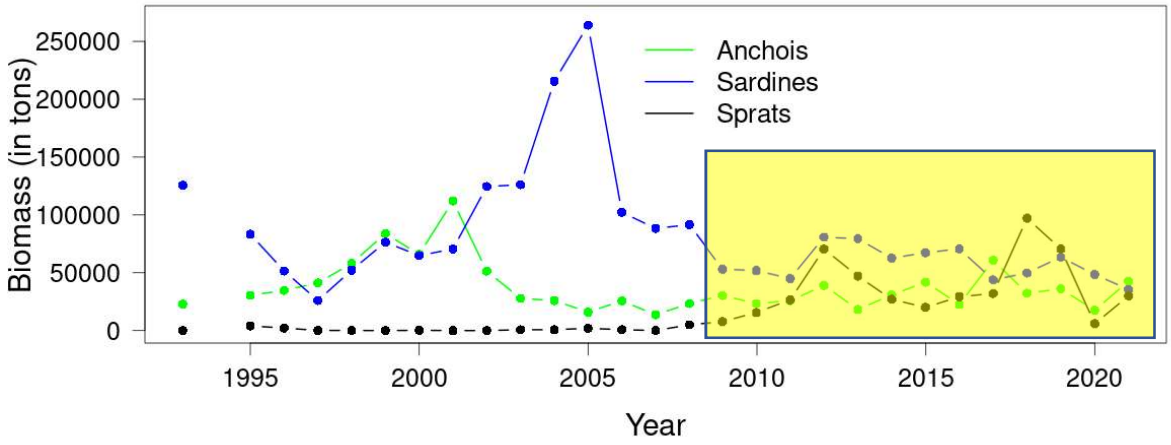



Figure 2.2.5. Long-term biomass estimates in GSA 7 for anchovy, sardine and sprat (in yellow frame: DCF-MEDIAS estimates have started in 2009).

Biomass per age was estimated for sardine and anchovy using otoliths reading and survey specific age-length keys (Figure 2.2.6). The number otoliths readings for sardine and anchovy were respectively 566 and 628.

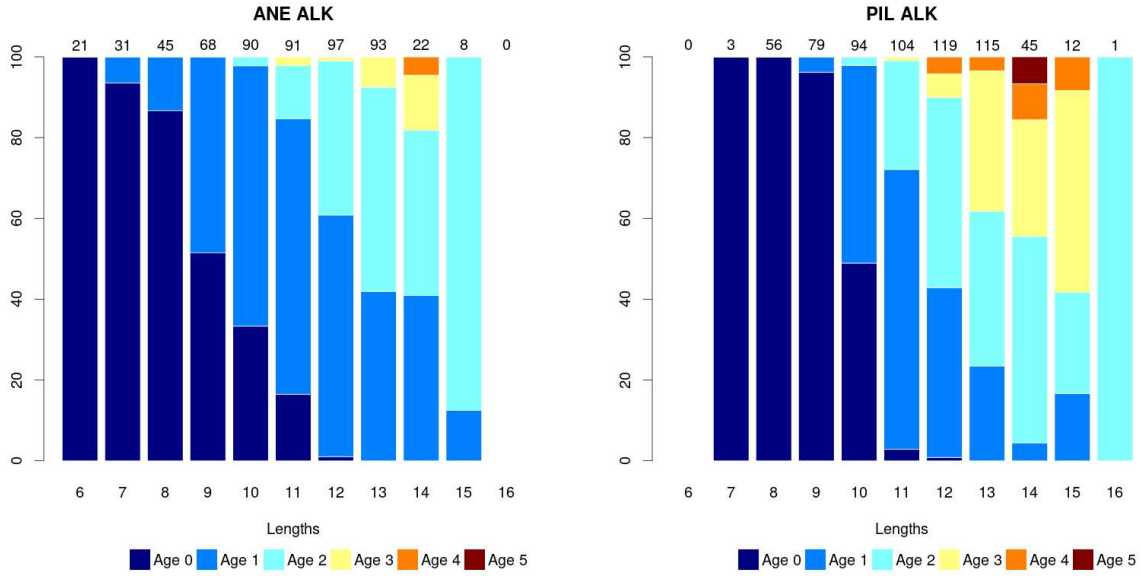



Figure 2.2.6. Age-length keys for sardine and anchovy in GSA 7 (MEDAIS 2021). The number of observations per size class are shown at the top of each bar in the barplot.

Sardine and anchovy population's age structures, estimated as biomass at age, are shown in Figure 2.2.7.

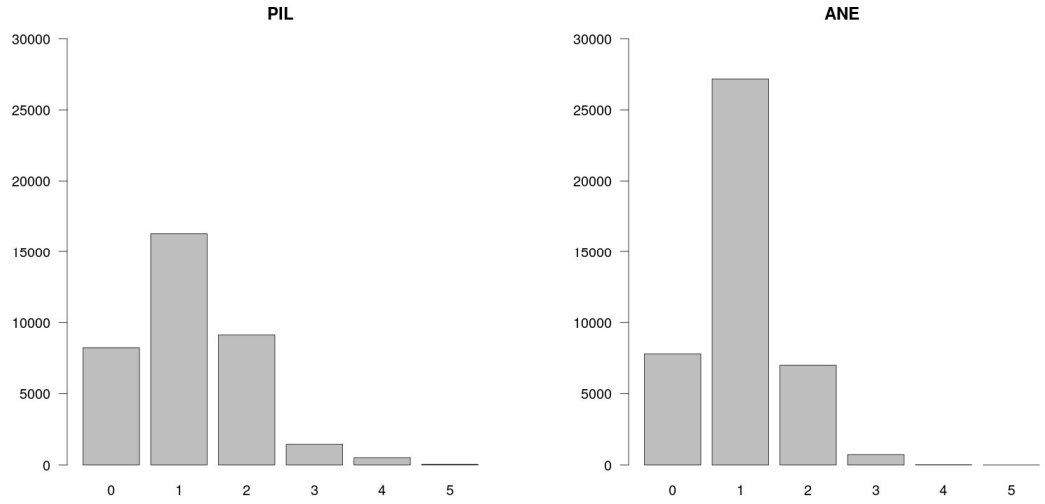



Figure 2.2.7. Biomass at age (in tons) estimates in MEDIAS 2021.

h) Abundance indices of target species

Spatial distributions of abundance indices of sardine and anchovy in GSA 7 during MEDIAS 2021 are shown in Figure 2.2.8.

Abundance at length estimates for sardines and anchovy are shown in Figure 2.2.9. Long-term abundance estimates are shown in Figure 2.2.10 and Figure 2.2.11.

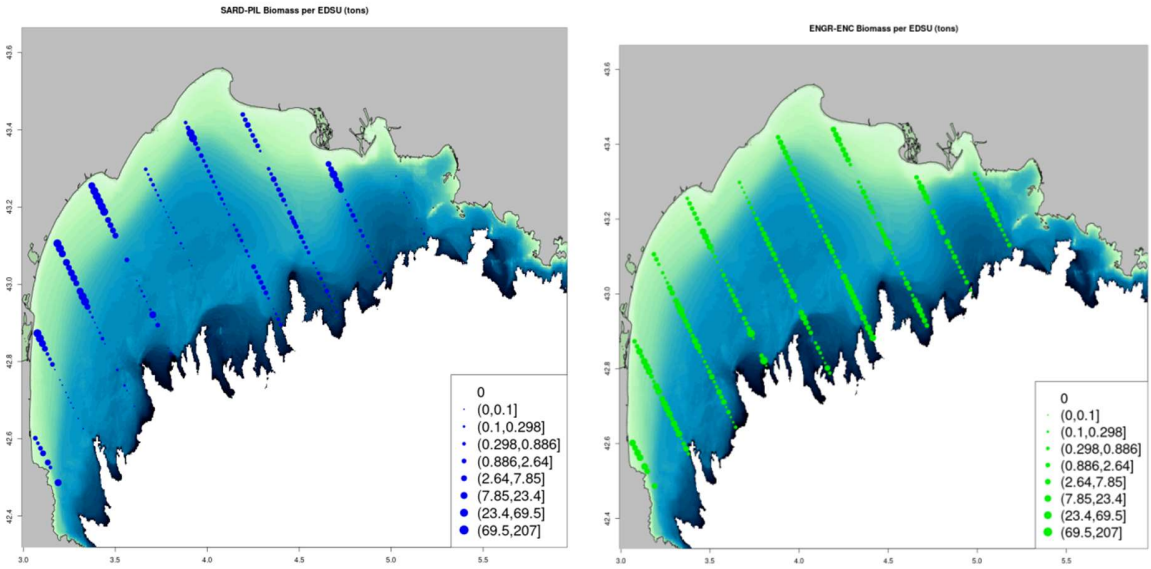



Figure 2.2.8. Spatial distributions of abundance indices of sardine (left) and anchovy (right) in GSA 7 during MEDIAS 2021.

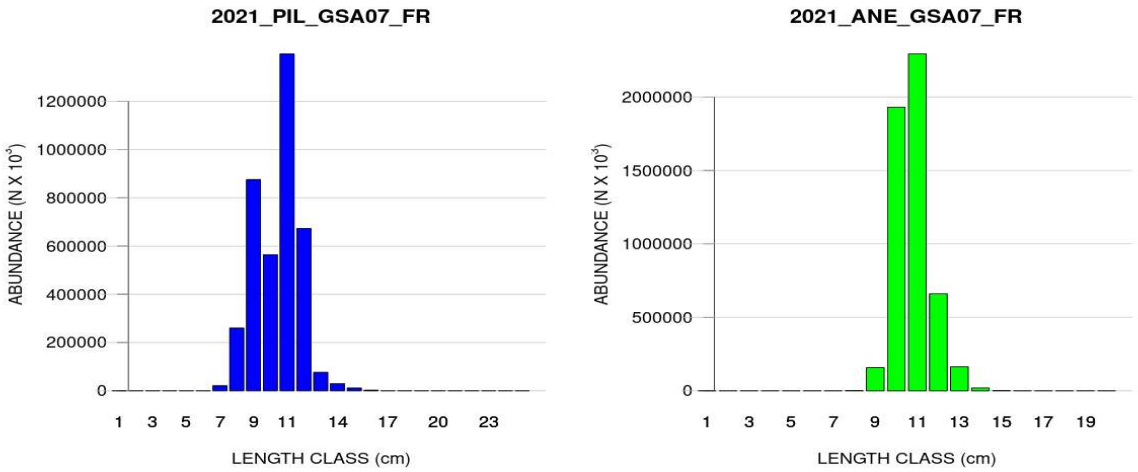


Figure 2.12.9. Abundance estimates per length classes (MEDIAS, 2021).

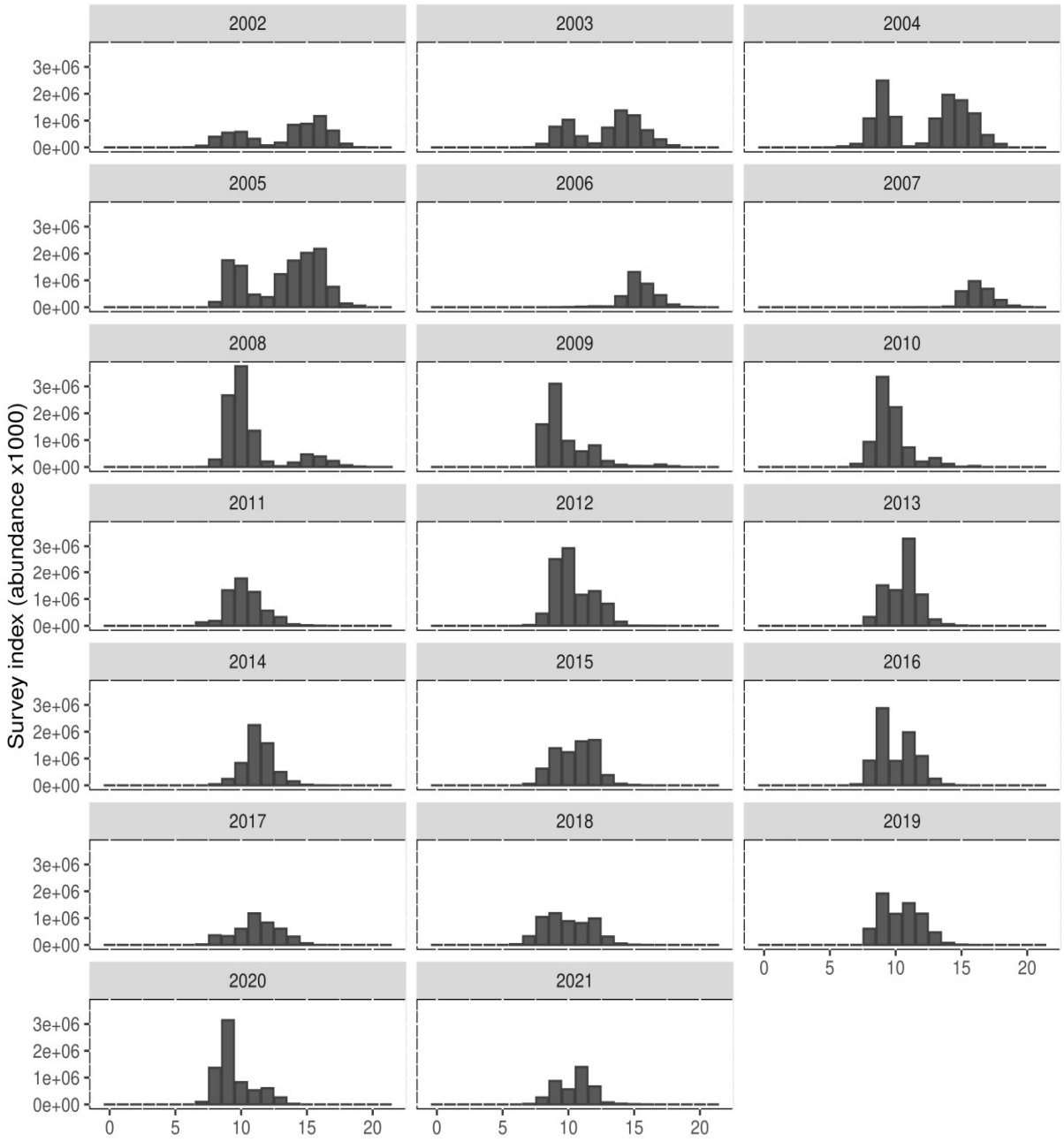



Figure 2.2.10. Length structured abundance estimates for sardine in GSA 07.

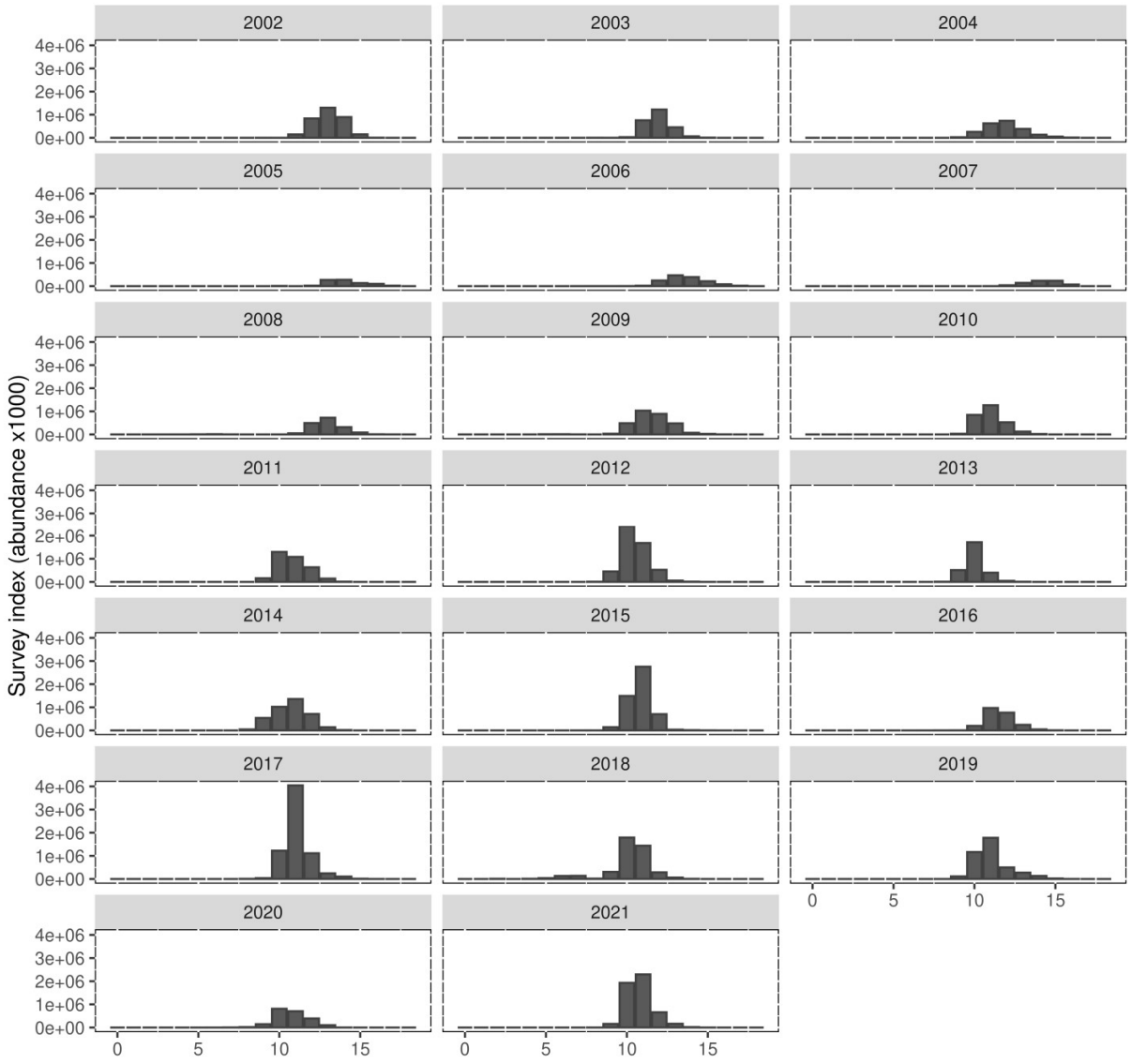



Figure 2.2.11. Length structured abundance estimates for anchovy in GSA 07.

Age-structured estimates from acoustic surveys, related to sardine and anchovy populations, are shown in Figure 2.2.12 and Figure 2.2.13.

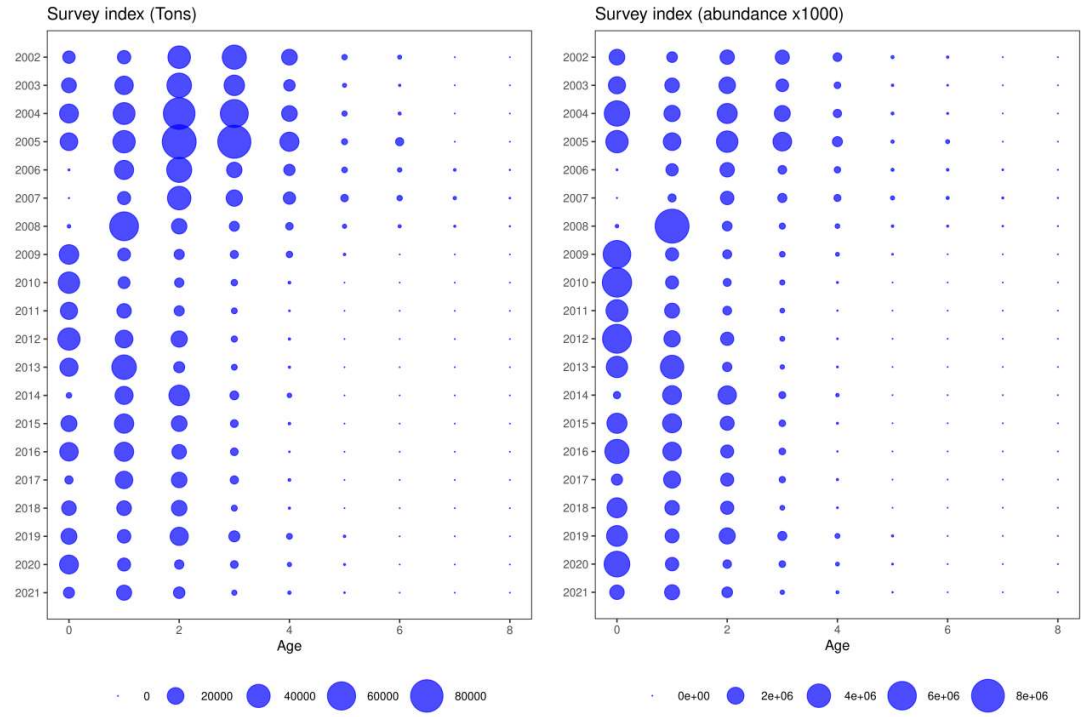



Figure 2.2.12. Age-structured estimates from acoustic surveys for sardine's population in GSA 7.

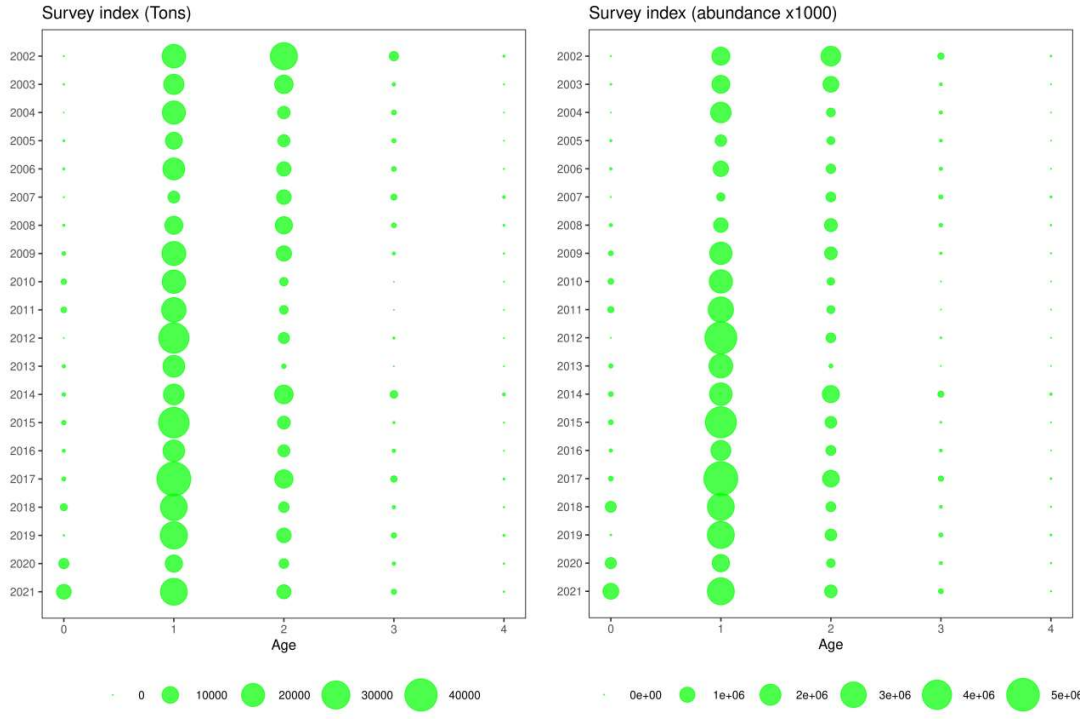



Figure 2.2.13. Age-structured estimates from acoustic surveys for anchovy's population in GSA7.

## 2.3 MEDIAS 2021 in GSA 9 and GSA 10 (ITA) – Tyrrhenian Sea and Ligurian Sea (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese & Rosalia Ferreri, CNR-IAS)

### a) General information on the survey

MEDIAS 2021 in GSA 9 and GSA 10 took place from July 30 to August 26 (lasts 28 days at sea) and covered the continental shelf in the Ligurian and Tyrrhenian seas (6238 $nm^2$) with the fishery Research Vessel "G. Dallaporta" (35.7 m length, 1086 HP).

### b) Type of echosounders and frequencies in use

The split beam echo sounder used was SIMRAD EK60, with the 38, 70, 120 and 200 kHz frequencies. The threshold for acquisition was –80 dB and that for processing for the assessment (38 KHz) was -60 dB. The pulse duration was 1024 ms. The mean surveying acoustic vessel speed was 9 knots. The Echoview software was used to visualize and analyse acoustic data.

### c) Calibration results

The acoustic system was calibrated in the Bay of Syracuse on 19-20 July 2021. Results are shown in Table 2.3.1.

Table 2.3.1 Calibration results in MEDIAS 2021

| Transducer Frequency | 38 kHz | 70 kHz | 120 kHz | 200 kHz |
|---|---|---|---|---|
| Transducer model | ES38B | ES70-7C | ES120-7C | ES200-7C |
| Transducer serial no. | 30789 | 271 | 480 | 365 |
| Bottom depth (m) | 15 | 15 | 15 | 15 |
| Temperature at sphere depth | 24.2°C | 24.2°C | 24.2°C | 24.2°C |
| Salinity (PSU) at sphere depth | 38.6 | 38.6 | 38.6 | 38.6 |
| TS of sphere (dB) | -33.6 | -39.1 | -40.4 | -45.0 |
| Pulse duration (ms) | 1.024 | 1.024 | 1.024 | 1.024 |
| Ping interval (s) | 1 | 1 | 1 | 1 |

| Transducer Frequency | 38 kHz | 70 kHz | 120 kHz | 200 kHz |
|---|---|---|---|---|
| RMS | 0.10 | 0.38 | 0.40 | 0.85 |
| Transducer gain (dB) | 25.01 | 25.74 | 23.71 | 22.36 |
| Sa corr. (dB) | -0.56 | -0.34 | -0.34 | -0.51 |
| Athw. Beam angle (deg) | 7.12 | 6.40 | 6.52 | 8.14 |
| Along Beam angle (deg) | 6.99 | 6.46 | 6.24 | 6.63 |
| Athw. Offset Beam angle (deg) | 0.10 | -0.01 | 0.24 | 0.44 |
| Along Offset Beam angles (deg) | 0.00 | 0.00 | 0.20 | 0.12 |

d) Survey design

Most of the survey design is made of parallel transects perpendicular to the coastline (Fig. 2.3.1), from the 10-20 m isobath to the 200 m one. Due to the narrow continental shelf along the northern coast of Sicily and the western coast of Calabria, a zig-zag transects design was adopted. The total number of nautical miles effectively used for acoustic analysis (minus pelagic trawls tracks and linking transects) was 1403.

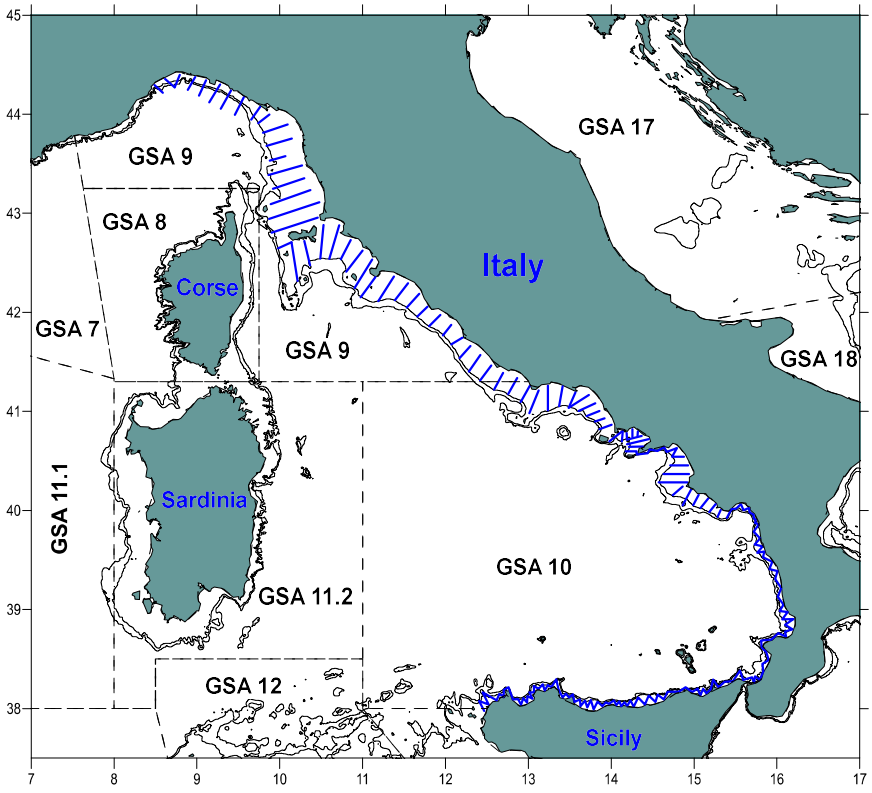



Figure 2.3.1 Survey design in GSA 9 and GSA 10 (MEDIAS 2021).

e) Fish sampling

Pelagic fishes are identified with a pelagic haul. In summer 2021, sixteen (16) and twenty-two (22) pelagic hauls were carried out respectively in GSA 9 and GSA 10 to be used for echograms scrutinizing (Fig. 2.3.2). Trawl hauls were performed during day time.
The pelagic net used has a total length of 78 m (Cod end length 22 m), Cod end mesh size of 18 mm, Vertical opening of 7 m, Horizontal opening 13 m, Initial mesh size 182x800 mm and Lateral mesh size 400 mm.

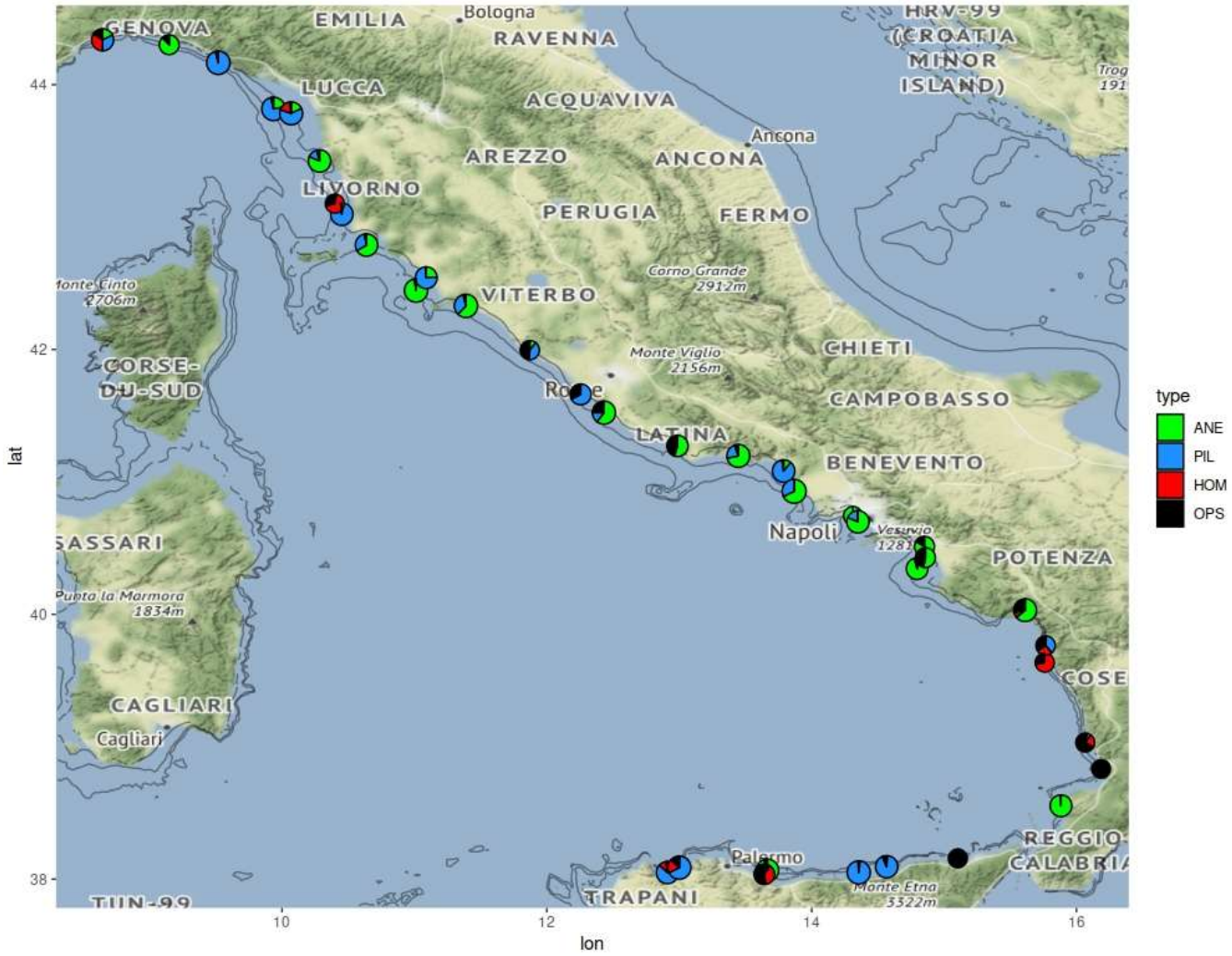



Figure 2.3.2.- Map with pie charts reporting percentages in weight of anchovy, sardine and other species for hauls carried out during the acoustic survey in GSAs 9 and 10. MEDIAS 2021.

f) Oceanographic parameters

During the survey in summer 2021, 58 and 154 hydrological stations have been conducted in GSAs 9 and 10 respectively using a SBE 9/11plus CTD which measures conductivity, temperature, pressure, fluorescence, PAR (Photosynthetically active radiation), pH, oxygen and turbidity. (Fig. 2.3.3).

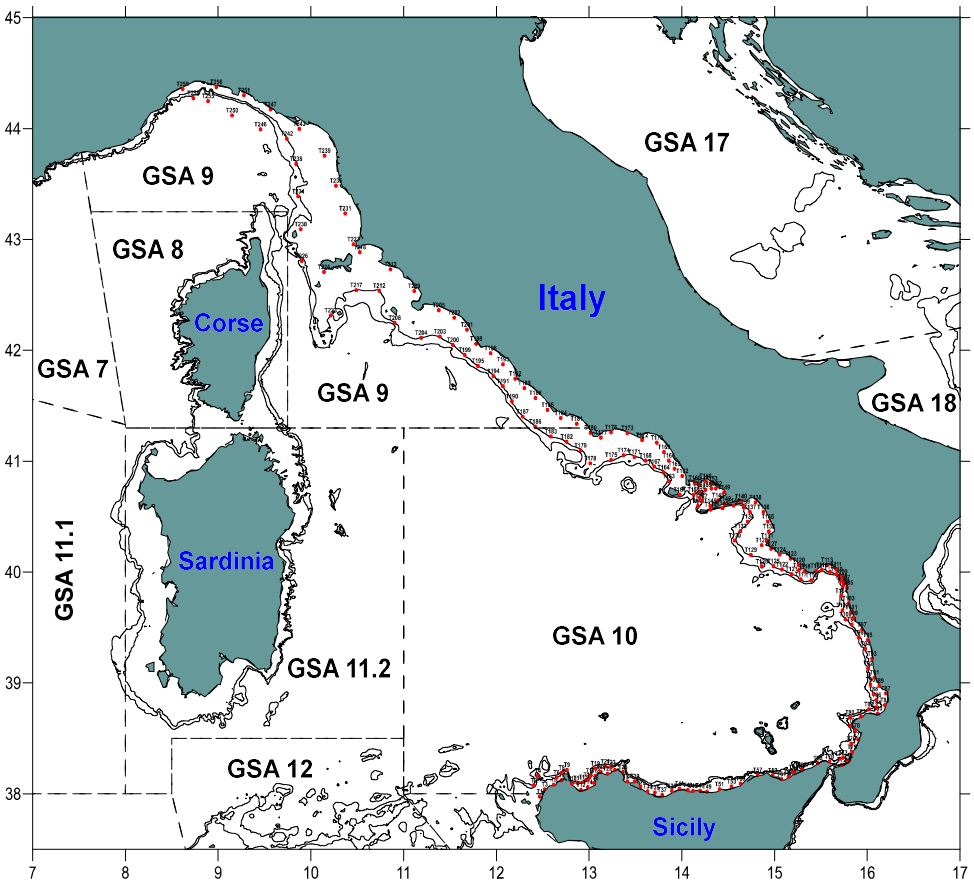



Figure 2.3.3 CTD stations performed during the echosurvey in GSAs 9 and 10. MEDIAS 2021.

g) Biomass estimations of target species

The biomass estimation of sardine and anchovy in GSAs 9 and 10, as well as the associated CVs of geostatistical simulations, are reported in the table 2.3.2.

Table 2.3.2 The biomass estimation of sardine and anchovy in GSAs 9 and 10.

| | GSA 9 | | GSA 10 | |
|---|---|---|---|---|
| | Biomass (t) | CV | Biomass (t) | CV |
| Anchovy | 19085.2 | 11 | 22747.7 | 13.1 |
| Sardine | 21127.7 | 14 | 8416.9 | 14.3 |

Biomass estimates by lengths for sardine and anchovy for MEDIAS 2021 are shown in Figure 2.3.4 and Figure 2.3.5.

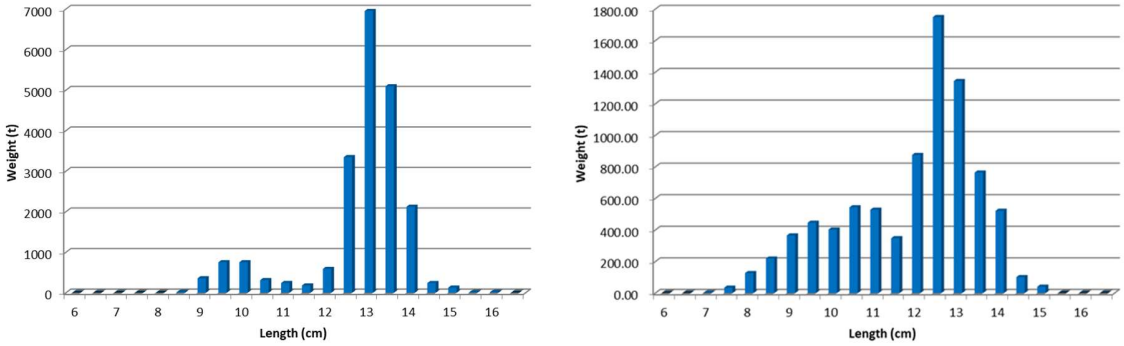



Figure 2.3.4. Sardine (PIL) biomass in tons by length (LFD) in GSAs 9 (left panel) and 10 (right panel). MEDIAS 2021.

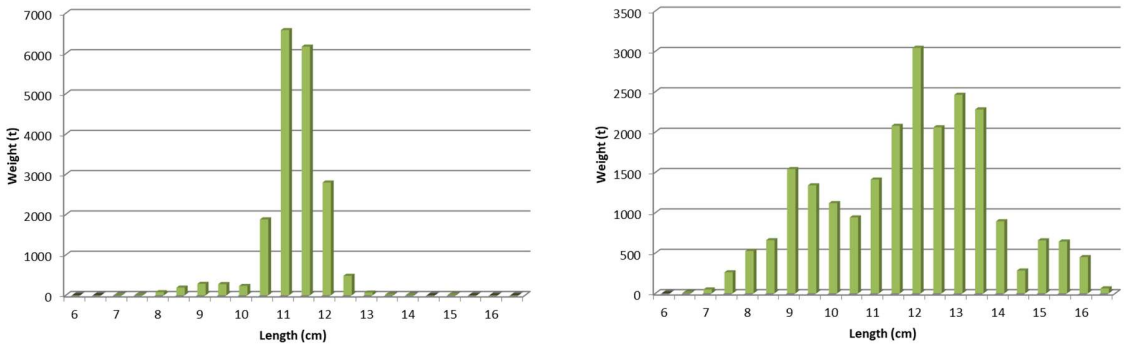



Figure 2.3.5. Anchovy (ANE) biomass in tons by length (LFD) in GSAs 9 (left panel) and 10 (right panel). MEDIAS 2021.

Age length key (ALK) for sardine in GSA 9, MEDIAS 2021, was composed by four year classes. The number of otoliths readings was 701 (no. individuals) (Fig. 2.3.6). In GSA 10, ALK was composed by three year classes; the number of otoliths readings was 667 (no. individuals).

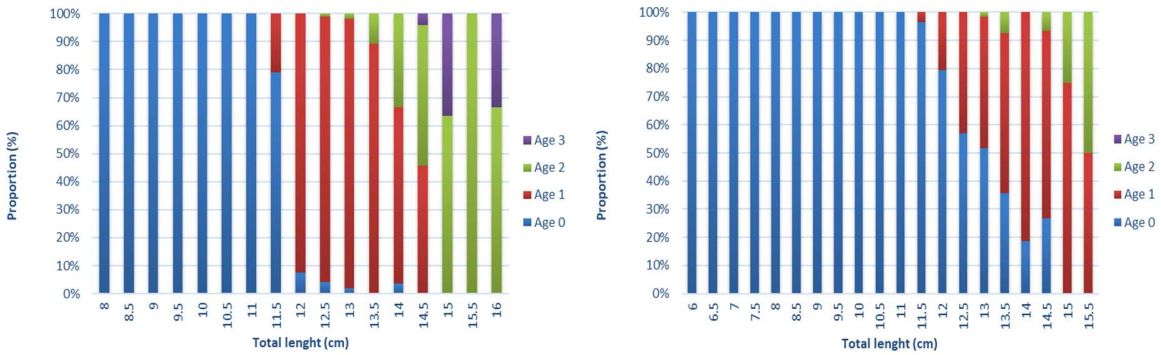



Figure 2.3.6. Sardine ALK in GSAs 9 (left panel) and 10 (right panel), MEDIAS 2021.

Anchovy ALK in GSA 9, MEDIAS 2021, was represented by three year classes. The number of otoliths readings was 687 (no. individuals) (Fig. 2.3.7). In GSA 10, ALK was composed by four year classes; the number of otoliths readings was 628 (no. individuals).

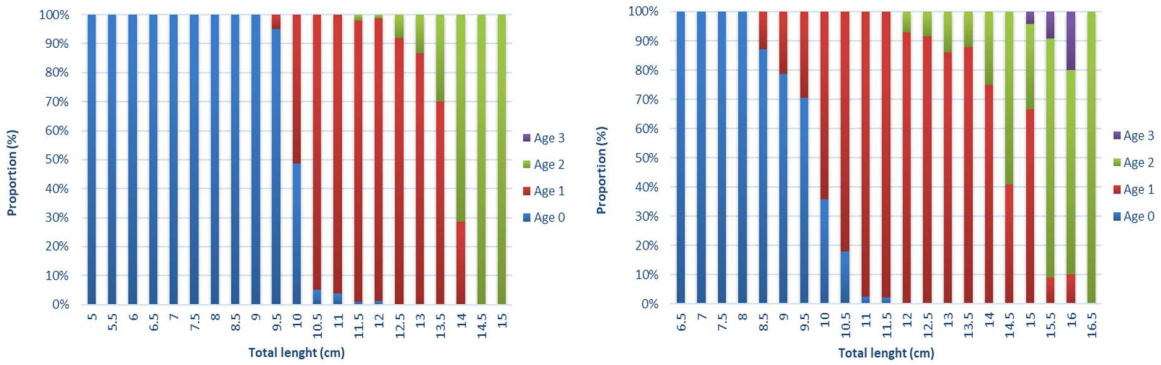



Figure 2.3.7.- Anchovy ALK in GSAs 9 (left panel) and 10 (right panel), MEDIAS 2021.

h) Abundance indices of target species in 2019

Spatial distribution of sardine and anchovy in GSAs 9 and 10 in summer 2021 is shown in Figures 2.3.8 and 2.3.9.

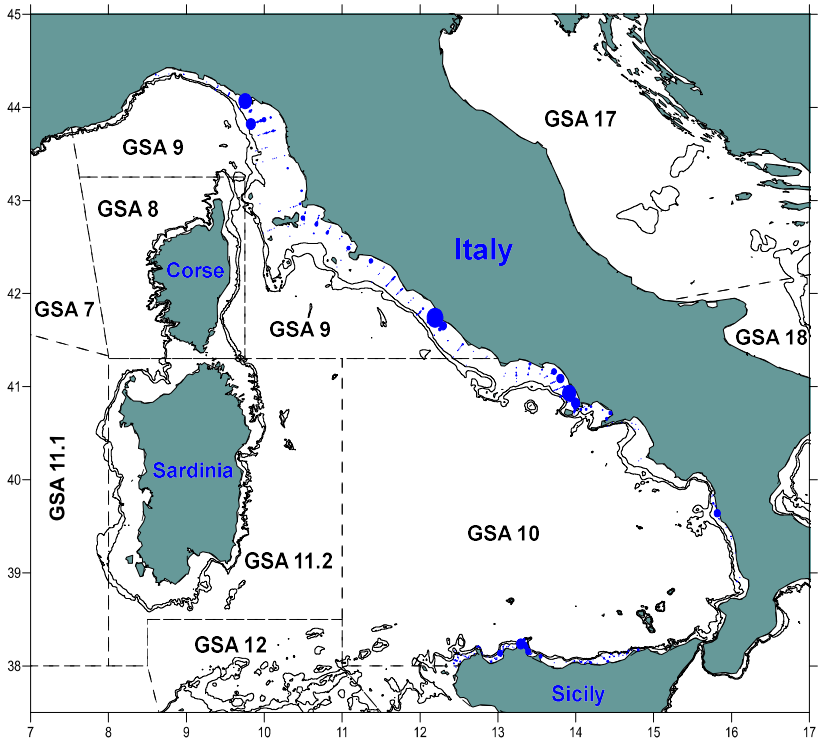


Figure 2.3.8. Sardine (PIL) spatial distribution in GSAs 9 and 10. MEDIAS 2021.

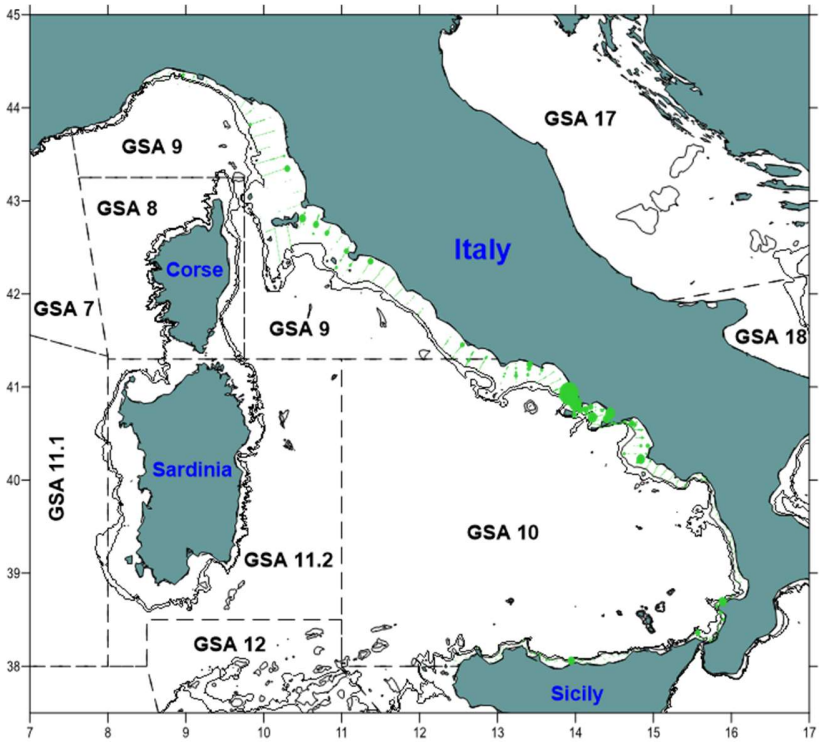


Figure 2.3.9. Anchovy (ANE) spatial distribution in GSAs 9 and 10. MEDIAS 2021.

Abundance of sardine (*Sardina pilchardus*) in GSAs 9 and 10 is reported in Fig. 2.3.10. Also during this survey, the main difference between the LFD in the two GSAs is the presence also of smaller specimens GSA 10.

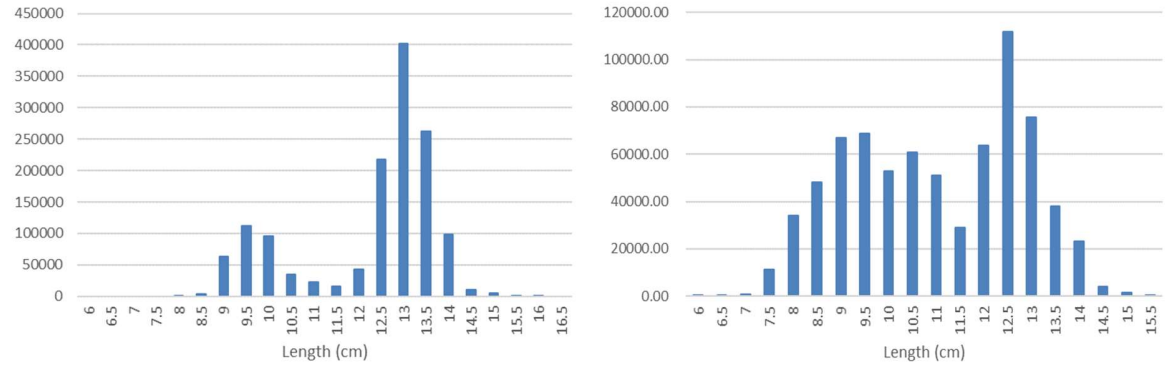



Figure 2.3.10. Sardine (PIL) abundance in numbers by length (LFD) in GSAs 9 (left panel) and 10 (right panel), MEDIAS 2021.

Abundance of anchovy (*Engraulis encrasicolus*) estimated in GSA 10 revealed a more complex LFD in comparison with GSA 9 with the presence of smaller and bigger specimens (Fig. 2.3.11).

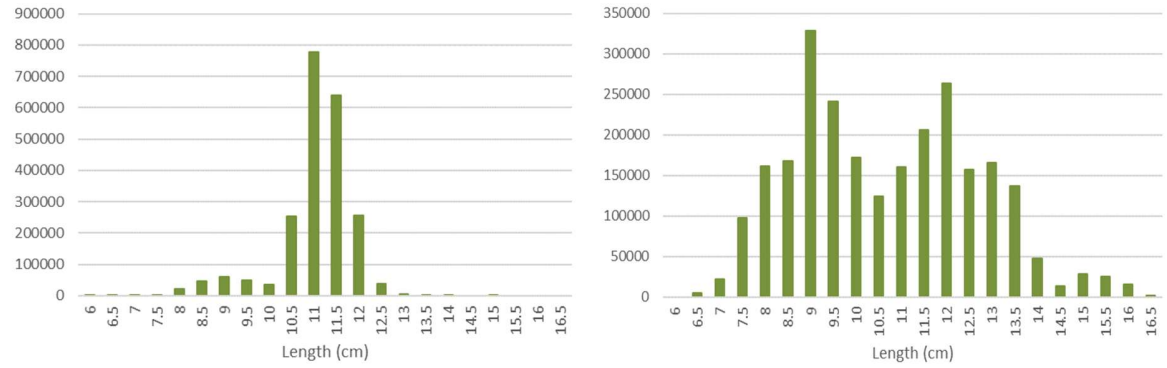



Figure 2.3.11. Anchovy (ANE) abundance in numbers by length (LFD) in GSAs 9 (left panel) and 10 (right panel), MEDIAS 2021.

## 2.4 MEDIAS 2021 in GSA 16 (ITA) – South of Sicily (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese & Rosalia Ferreri, CNR-IAS)

a) General information on the survey

MEDIAS 2021 in GSA 16 took place in the period 19-29 July (lasts 11 days at sea) and covered the continental shelf along the southern coast of Sicily (3998 $nm^2$) with the fishery Research Vessel "G. Dallaporta" (35.7 m length, 1086 HP).

b) Type of echosounders and frequencies in use

The split beam echo sounder used was SIMRAD EK60, with the 38, 70, 120 and 200 kHz frequencies. The threshold for acquisition was –80 dB and that for processing for the assessment (38 KHz) was -60 dB. The pulse duration was 1024 ms. The mean surveying acoustic vessel speed was 9 knots. The Echoview software was used to visualize and analyse acoustic data.

c) Calibration results

The acoustic system was calibrated in the Bay of Syracuse on 19-20 July 2021. The calibration results are reported in the section belonging to the MEDIAS in GSAs 9 and 10 (see Table 2.3.1).

d) Survey design

The survey design is made of 29 parallel transects (min and max lengths are 7 and 43 nautical miles) perpendicular to the coastline, from the 10-20 m isobath to the 200 m one; a small part of the survey, located in the easternmost area, adopted a zig-zag design due to the very narrow extension of the continental shelf (Fig. 2.4.1). In summer 2021, total nautical miles effectively used for acoustic analysis (minus pelagic trawls tracks and linking transects) were 706.

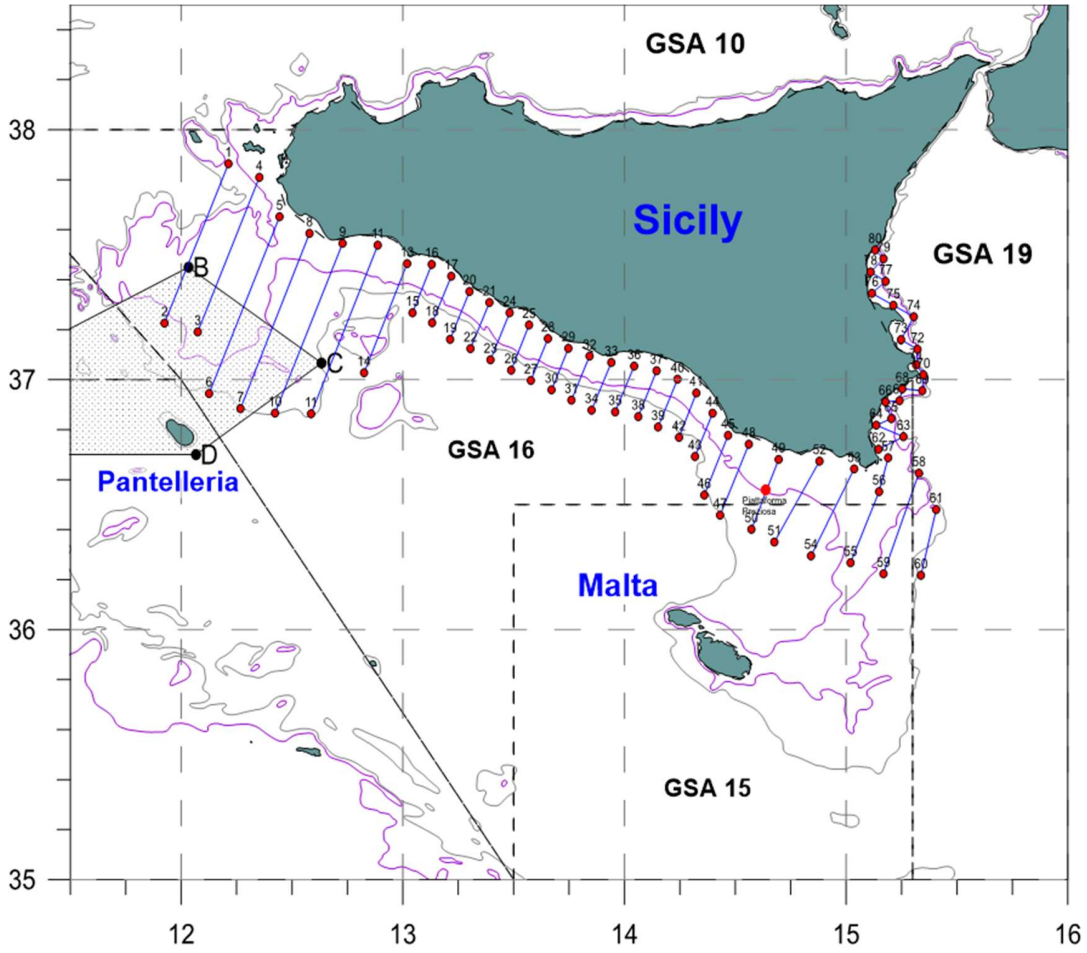


Figure 2.4.1. Acoustic survey design in GSA 16. MEDIAS 2021.

e) Fish sampling

Pelagic fishes are identified with a pelagic haul. In summer 2021, twenty-one (21) pelagic hauls were carried out in GSA 16 to be used for echograms scrutinizing (Fig. 2.4.2). Trawl hauls were performed during day time.

The pelagic net used has a total length of 78 m (Cod end length 22 m), Cod end mesh size of 18 mm, Vertical opening of 7 m, Horizontal opening 13 m, Initial mesh size 182x800 mm and Lateral mesh size 400 mm.


Figure 2.4.2.- Map with pie charts reporting percentages in weight of anchovy, sardine and other species for hauls carried out during the acoustic survey in GSA 16, MEDIAS 2021.

f) Oceanographic parameters

During the survey in summer 2021, 124 hydrological stations have been conducted in GSA 16 using a SBE 9/11plus CTD which measures conductivity, temperature, pressure, fluorescence, PAR (Photosynthetically active radiation), pH, oxygen and turbidity. (Fig. 2.4.3).

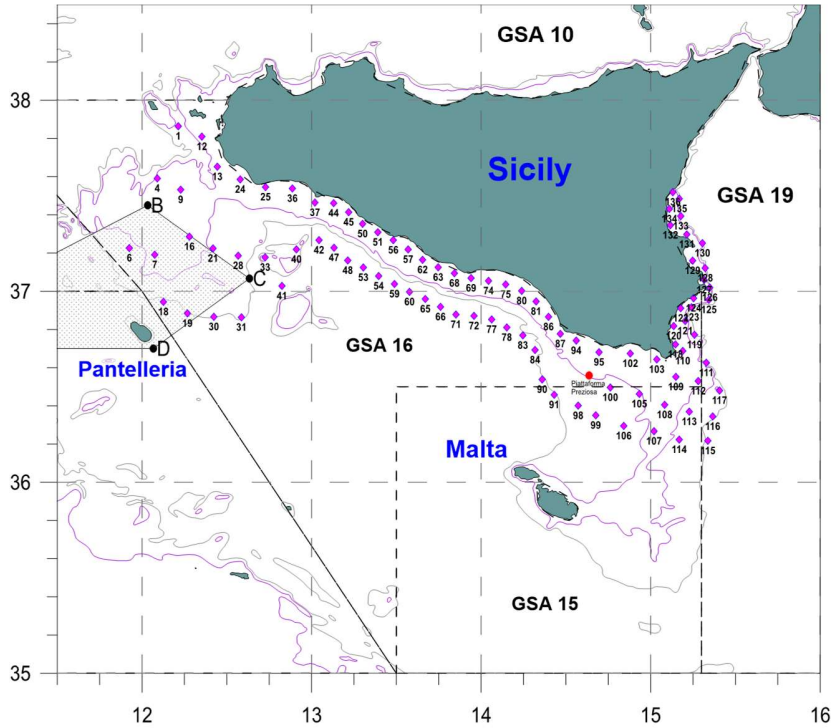


Figure 2.4.3.- CTD stations performed during the echosurvey in GSA16. MEDIAS 2021.

g) Biomass estimations of target species

The biomass estimations of sardine and anchovy in GSA 16, as well as the associated CVs of geostatistical simulations, are reported in the table 2.4.1.

Table 2.4.1. Biomass and CV estimates for anchovy and sardine in MEDIAS 2021.

| | GSA 16 | |
|---|---|---|
| | Biomass (t) | CV |
| Anchovy | 7739.4 | 18 |
| Sardine | 5218.6 | 17 |

Biomass estimates by lengths for sardine and anchovy for MEDIAS 2021 are shown in Figures 2.4.4 and Figure 2.4.5.

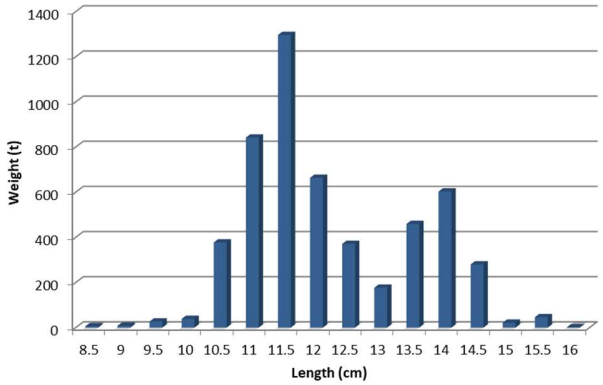



Figure 2.4.4. Sardine (PIL) biomass in tons by length (LFD) in GSA 16. MEDIAS 2021.

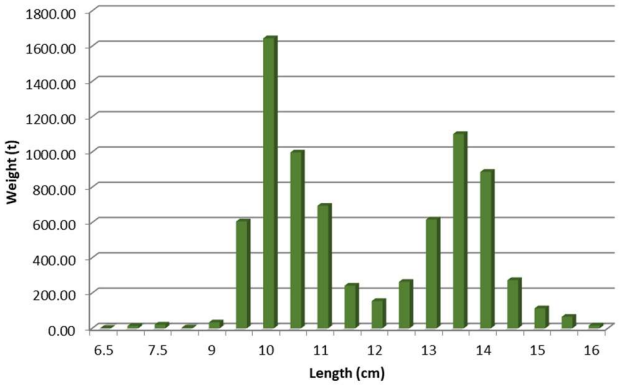



Figure 2.4.5. Anchovy (ANE) biomass in tons by length (LFD) in GSA 16. MEDIAS 2021.

Age length key (ALK) for sardine in GSA 16, MEDIAS 2021, was composed by three year classes. The number of otoliths readings was 413 (no. individuals) (Fig. 2.4.6).

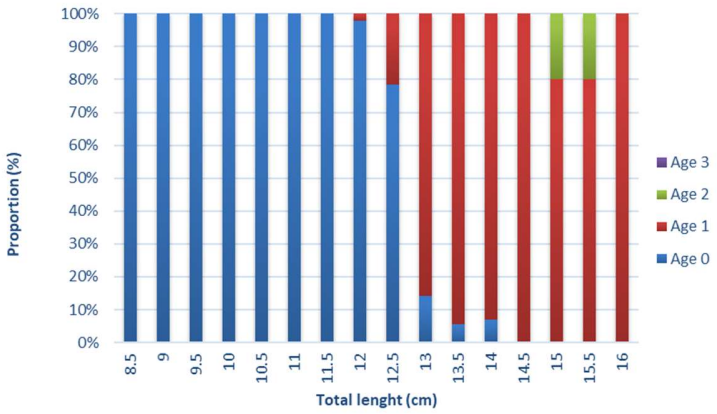



Figure 2.4.6. Sardine ALK in GSA 16. MEDIAS 2021.

Anchovy ALK in GSA 16, MEDIAS 2021, was represented by four year classes; the number of otoliths readings was 403 (no. individuals) (Fig. 2.4.7).

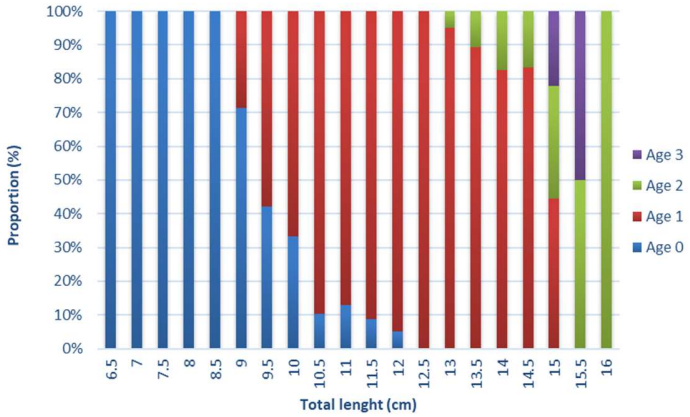



Figure 2.4.7.- Anchovy ALK in GSA 16. MEDIAS 2021.

h) Abundance indices of target species

Spatial distribution of sardine and anchovy in GSA 16 in summer 2021 is shown in Figures 2.4.8 and 2.4.9.

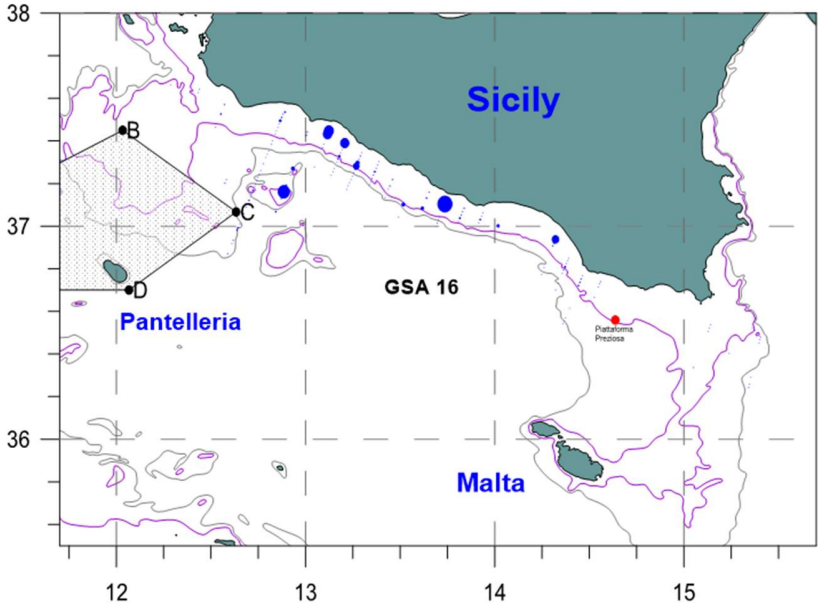



Figure 2.4.8. Sardine (PIL) spatial distribution in GSA 16. MEDIAS 2021.

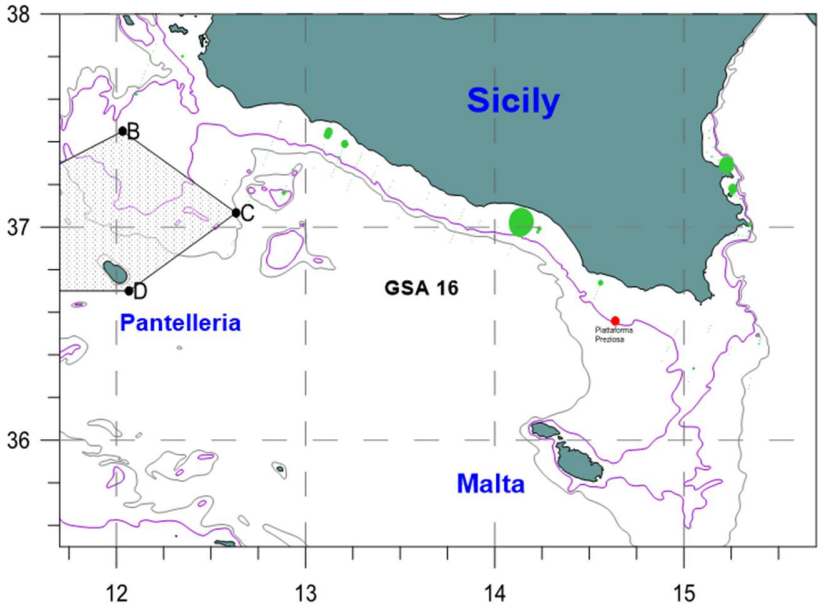



Figure 2.4.9. Anchovy (ANE) spatial distribution in GSA 16. MEDIAS 2021.

Abundance of sardine (*Sardina pilchardus*) in GSA 16 reported in Fig. 2.4.10. Also during this survey, the LFD is mainly characterized by bimodal structure with modes at 11.5 cm and 14 cm.

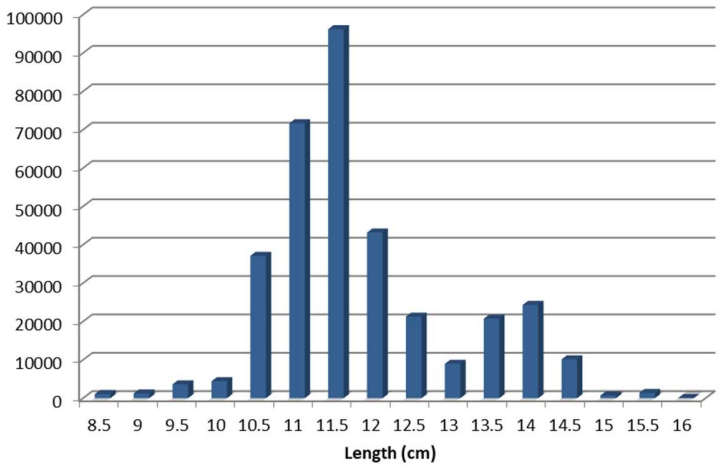



Figure 2.4.10. Sardine (PIL) abundance in numbers by length (LFD) in GSA 16, MEDIAS 2021.

Abundance of anchovy (*Engraulis encrasicolus*) estimated in GSA 16 revealed a LFD similar to the one observed for sardine with two modes centered at 10 cm and 13.5 cm (Fig. 2.4.11).

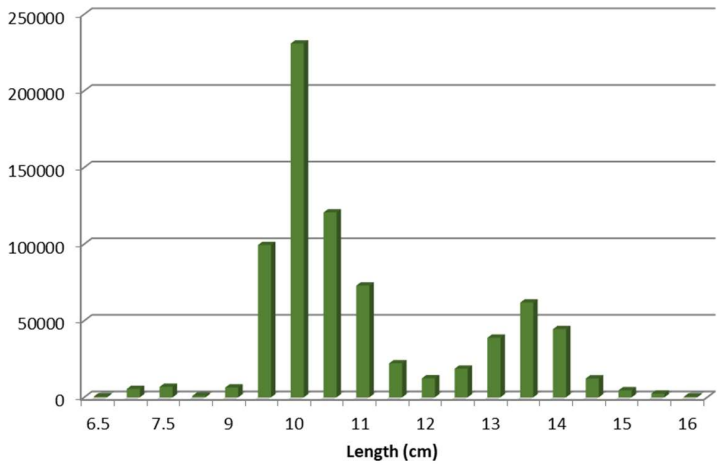



Figure 2.4.11. Anchovy (ANE) abundance in numbers by length (LFD) in GSAs 16, MEDIAS 2021.

## 2.5 Acoustic surveys on small pelagics in GSA 11 - Sardinia (ITA): three surveys carried out in a new area (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese & Rosalia Ferreri, CNR-IAS)

a) General information on the survey

In the framework of the IDMAR Project (funded by the European Regional Development Fund - ERDF), three acoustic surveys were carried out in GSA 11 according to the MEDIAS protocol. In summer 2019 the survey took place in the period 06-18 July (lasts 13 days at sea) and completely covered the continental shelf around Sardinia (3207 $nm^2$). In summer 2020 and in summer 2021, due to bad weather conditions not all the area was surveyed. In particular, in 2020, the survey covered an area of 1479 $nm^2$ while, in summer 2021, the covered area was 1952 $nm^2$. The fishery Research Vessel "G. Dallaporta" (35.7 m length, 1086 HP) was used for the three surveys.

b) Type of echosounders and frequencies in use

The split beam echo sounder used was SIMRAD EK60, with the 38, 70, 120 and 200 kHz frequencies. The threshold for acquisition was –80 dB and that for processing for the assessment (38 KHz) was -60 dB. The pulse duration was 1024 ms. The mean surveying acoustic vessel speed was 9 knots. The Echoview software was used to visualize and analyse acoustic data.

c) Calibration results

In summer 2021, the acoustic system was calibrated in the Bay of Syracuse on 19-20 July 2021. The calibration results are reported in the section belonging to the MEDIAS in GSAs 9 and 10 (see Table 2.3.1). See the 14th MEDIAS meeting report in 2021 for the calibration results of the surveys carried out in summer 2019 and in summer 2020.

d) Survey design

In summer 2019, the survey design was made of 29 parallel transects perpendicular to the coastline, from the 10-20 m isobath to the 200 m one; part of the survey, mainly located in the eastern area and in the north-western area, adopted a zig-zag design due to the very narrow extension of the continental shelf. In summer 2019, the total number of nautical miles were 873 (Figure 2.5.1); the number of nautical miles effectively processed for biomass estimation was 666.
The survey design was also adopted in summer 2020 and 2021. Unfortunately, due to very bad weather conditions, associated to north-westerly winds, only 377 nm and 518 nm were surveyed in summer 2020 and in summer 2021, respectively.

e) Fish sampling

Pelagic fishes are identified with a pelagic haul. In summer 2019, seventeen (17) pelagic hauls were carried out in GSA 11 to be used for echograms scrutinizing (Fig. 2.5.2). Trawl hauls were performed during day time. Only 7 and 9 trawl hauls were performed in summer 2020 and in summer 2021, respectively (Fig. 2.5.2).
The pelagic net used has a total length of 78 m (Cod end length 22 m), Cod end mesh size of 18 mm, Vertical opening of 7 m, Horizontal opening 13 m, Initial mesh size 182x800 mm and Lateral mesh size 400 mm.

f) Oceanographic parameters

During the survey in summer 2019, 79 hydrological stations have been conducted in GSA 11 using a SBE 9/11plus CTD which measures conductivity, temperature, pressure, fluorescence, PAR (Photosynthetically active radiation), pH, oxygen and turbidity. (Fig. 2.5.3).
33 and 53 CTD stations were performed in summer 2020 and in summer 2021, respectively.

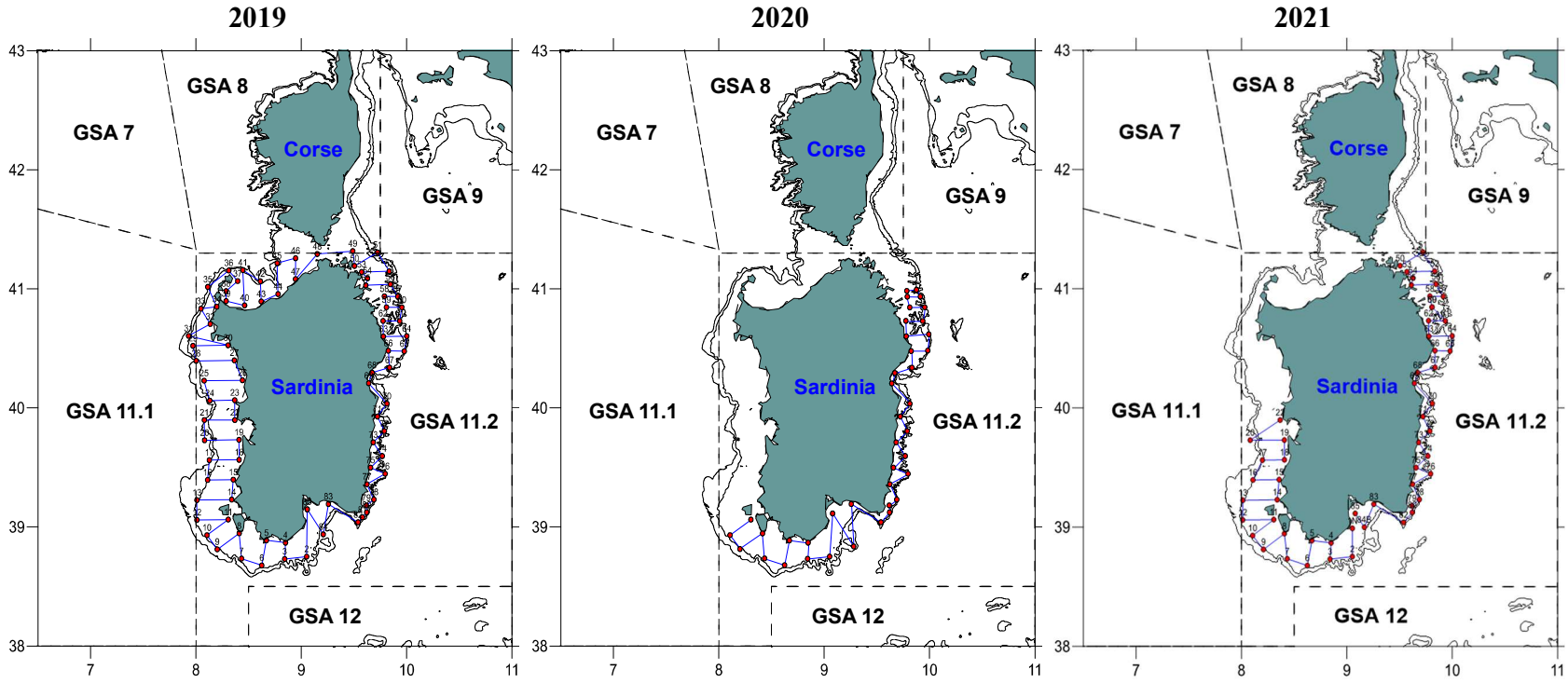



Figure 2.5.1. Acoustic survey design in GSA 11. IDMAR Project.

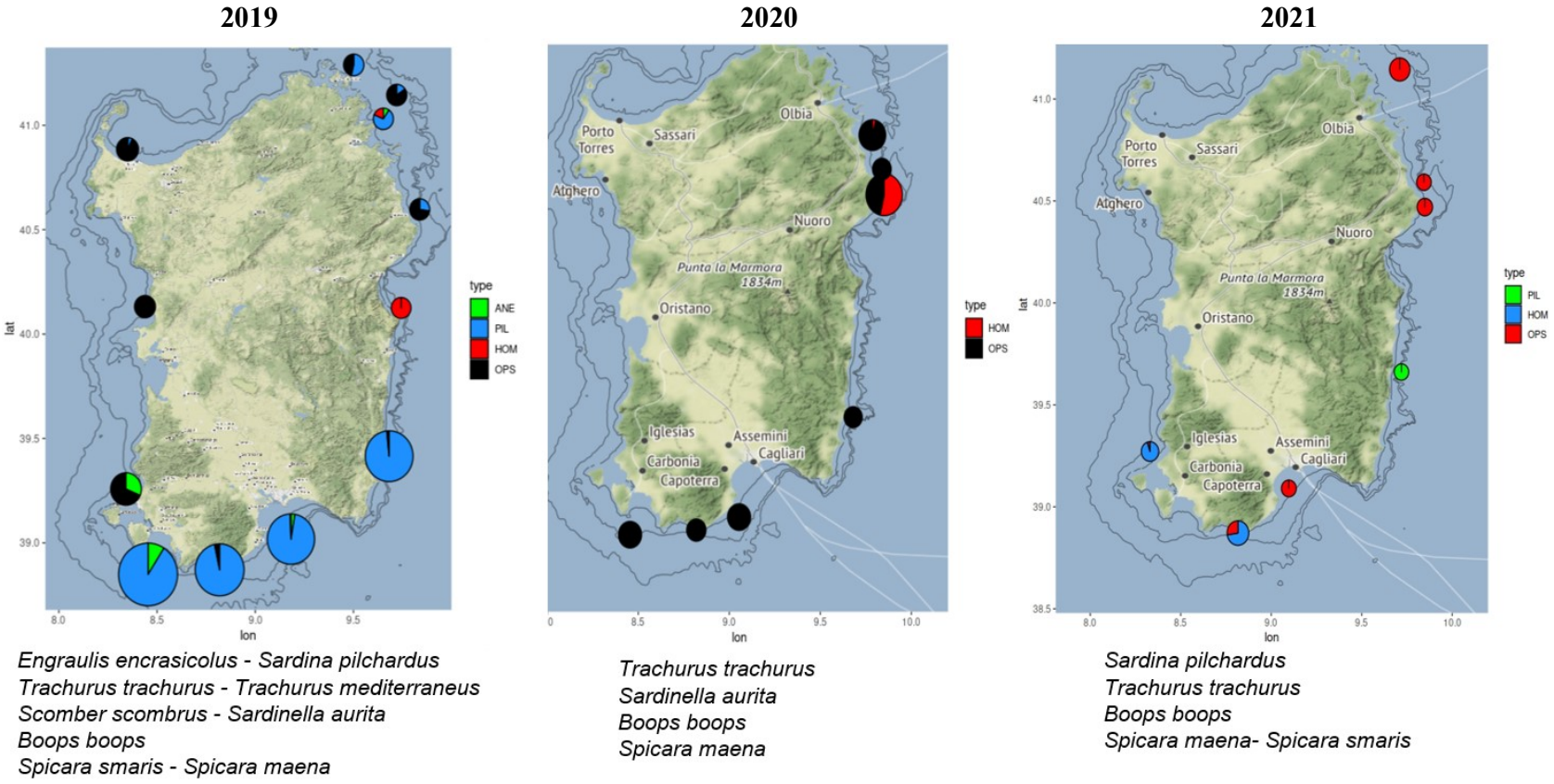



Figure 2.5.2.- Map with pie charts reporting percentages in weight of anchovy, sardine and other pelagic species (OPS) for hauls carried out during the three acoustic surveys in GSA 11. IDMAR Project.

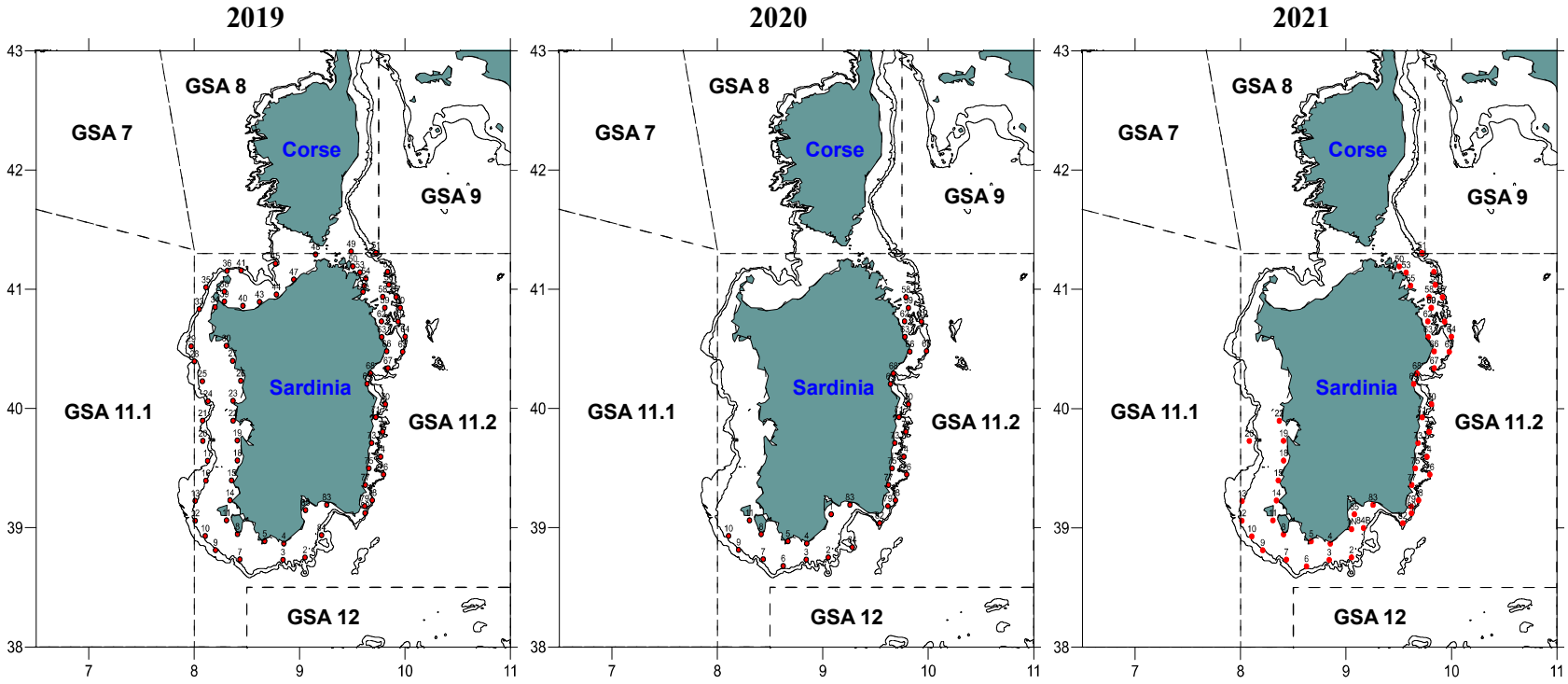



Figure 2.5.3.- CTD stations performed during the three echosurveys in GSA11. IDMAR Project.

g) Biomass estimations of target species

Sardine and anchovy biomasses in GSA 11 were estimated only in summer 2019. Biomass estimates and the associated CVs of geostatistical simulations, are reported in the table 2.5.1.

Table 2.5.1. Estimates of biomass and CV for sardine and anchovy in GSA11 in 2019.

| | GSA 11 | |
|---|---|---|
| | Biomass (t) | CV |
| Anchovy | 2155.9 | 13 |
| Sardine | 13309.6 | 11 |

Biomass estimates by lengths for sardine and anchovy for acoustic survey in GSA11 during 2019 are shown in Figure 2.5.4 and Figure 2.5.5.

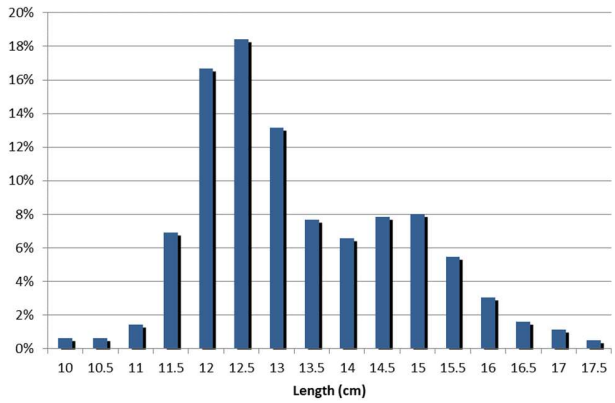



Figure 2.5.4. Sardine (PIL) biomass in percentages by length (LFD) in GSA 11. IDMAR 2019.

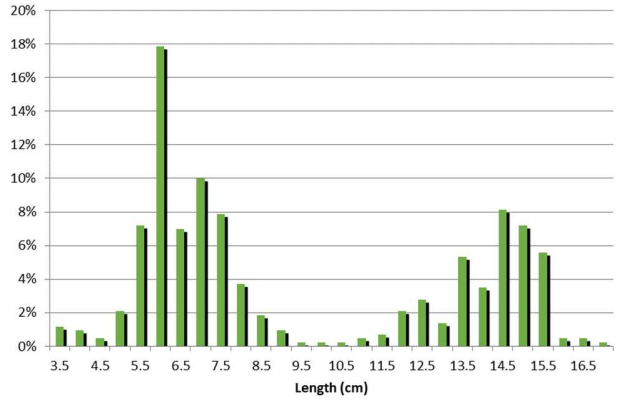



Figure 2.5.5. Anchovy (ANE) biomass in percentages by length (LFD) in GSA 11. IDMAR 2019.

h) Abundance indices of target species

Spatial distribution of sardine and anchovy in GSA 11 in summer 2019 is shown in Figures 2.5.6 and 2.5.7.

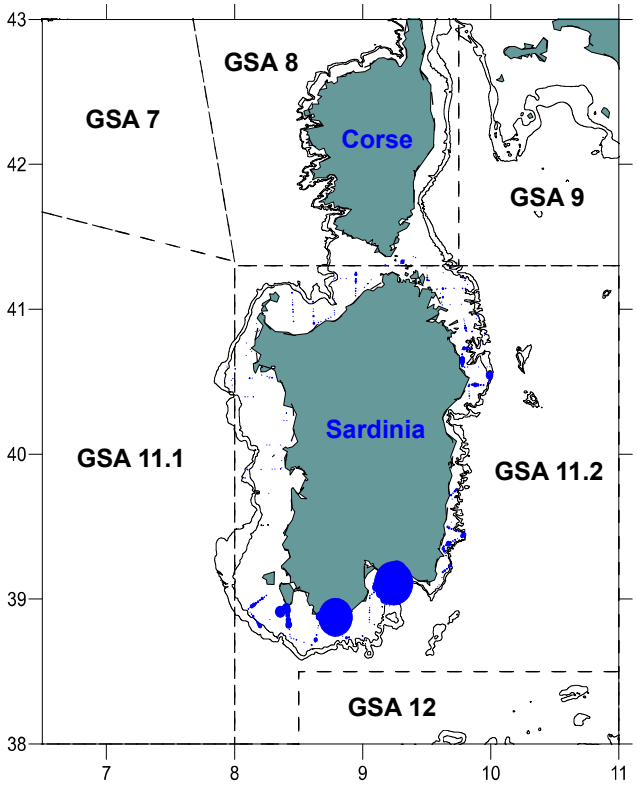



Figure 2.5.6. Sardine (PIL) spatial distribution in GSA 11. IDMAR 2019.

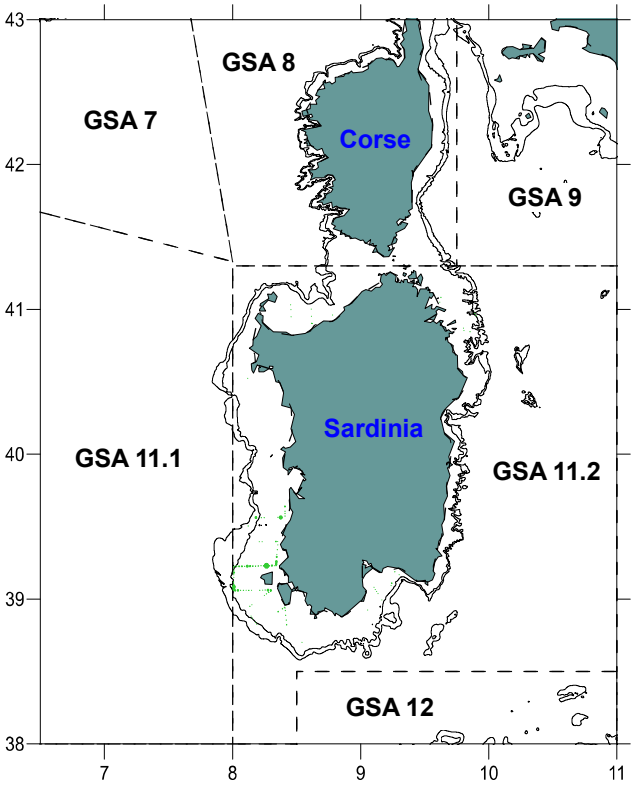
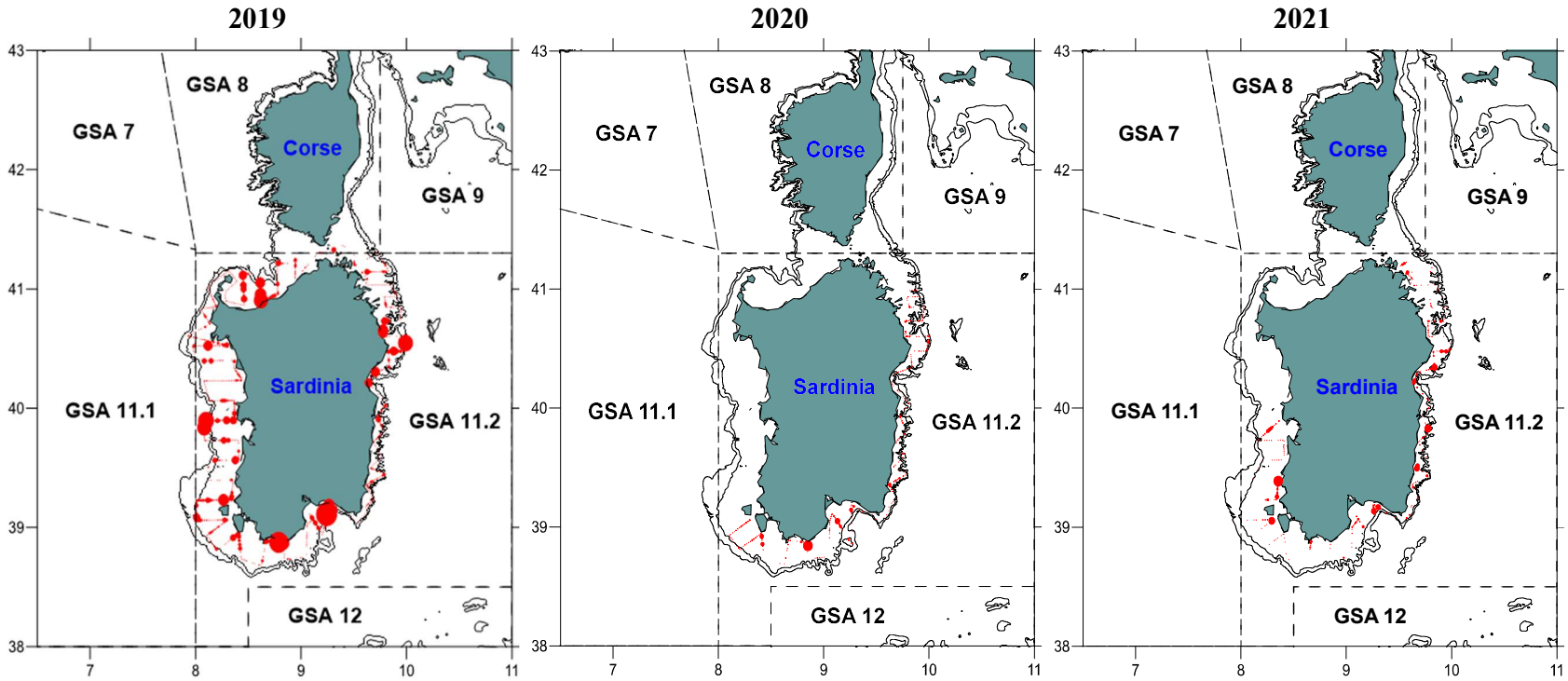


Figure 2.5.7. Anchovy (ANE) spatial distribution in GSA 11. IDMAR 2019.

i) Spatial distribution of NASC for all pelagic species



j) Conclusions

The acquired experience in performing the three acoustic surveys in GSA 11 allowed us to put in evidence some aspects related to such peculiar area of the Mediterranean Sea:

1. Limited available time interval for the survey.
   The available vessel time (i.e. 11 days for each survey) permitted to cover the entire area only during the 2019 survey. Bad weather conditions prevented the completion of the surveys in the other two years. The western part of the area is often affected by strong north-west winds which do not allow the survey to be carried out safely. For this reason, a longer time interval is required to complete the acoustic survey in GSA 11.

2. Complex sea water circulation.
   The survey area is located in the central part of the western Mediterranean basin and its water circulation is characterized by permanent and semi-permanent oceanographic features. Furthermore, during the three surveys, many specimens of krill were collected by the pelagic net. This area is to be considered a very peculiar one both from the oceanographic and ecological points of view. This highlights the importance to plan a more accurate survey in order to monitor different aspects of this ecosystem (small pelagics, planktonic organisms, sea water circulation, ecc.).

3. Rocky and/or sandy bottom
   One of the difficulties encountered during the surveys was the position of the trawl hauls due to rocky and/or sandy bottom around Sardinia. Only the southern part of the area is characterized by a slightly soft bottom. This makes trawling operations complex and, contemporary, increases the likelihood of breaking fishing gear and acoustic devices.
   For this reason, it will be necessary to study an opportune procedure that allows to obtain the biological sample necessary to complete the small pelagics biomass estimation procedures.

## 2.6 MEDIAS 2021 in the eastern part of the Adriatic Sea (HRV) – GSA17 - Northern Adriatic Sea (V. Tičina, T. Juretić, D. Gašparević, et al., IOR)

a) General information on the survey

Acoustic survey on the eastern part of GSA 17 was performed in the period from 01.09.2021. to 30.09.2021. For this purpose, R/V BIOS DVA (length: 36m, engine power: 1200HP) was used for 30 day, in order to survey the area of 13.578 $NM^2$.

b) Type of echosounders and frequencies in use

R/V BIOS DVA is equipped with SIMRAD scientific echosounder system (EK80), including GPT (38kHz) and WBT (120kHz) transceivers connected to hull-mounted transducers (ES38B and ES120-7). In line with MEDIAS Handbook, the principal frequency for the survey was 38 kHz, while 120 kHz acoustic equipment was used as complementary with aim to improve categorization of different acoustic targets. The system was operating with SIMRAD EK80 software. In order to improve the quality of acoustic data collected in the rough sea conditions, echosounder system is connected to the vessel's motion reference unit (MRU3).

c) Calibration results

The acoustic system on R/V BIOS DVA was calibrated at the 1st day of the survey using the standard WC-sphere (38.1 mm) and EK80 software. Calibration results are shown in Table 2.6.1.

Table 2.6.1 Calibration of 38 kHz scientific sounder system at R/V BIOS DVA (MEDIAS, 2021).

| Calibration report | | |
|---|---|---|
| Transducer frequency | 38 kHz | 120 kHz |
| Echosounder type | SIMRAD, EK80 | SIMRAD, EK80 |
| Transducer serial no. | ES38B (30825) | ES 120-7 |
| Vessel | BIOS DVA | BIOS DVA |
| Date | 01.09.2021. | 01.09.2021. |
| Place | Kašjuni | Kašjuni |
| Latitude | 43°30.371' N | 43°30.371' N |
| Longitude | 16°23.488' E | 16°23.488' E |
| Bottom depth (m) | 35 | 35 |
| Temperature (°C) at sphere depth | 20.6 | 20.6 |
| Salinity (psu) at sphere depth | 38.0 | 38.0 |
| Speed of sound (ms-1) | 1527.20 | 1527.20 |
| TS of WC 38.1mm sphere (dB) | -42.04 | -39.83 |
| Pulse duration (ms) | 1.024 | 0.256 |

| Calibration report (cont.) | | |
|---|---|---|
| Equivalent 2-way beam angle (dB) | -20.7 | -20.7 |
| Default TS transducer gain | 22.81 dB | 27.47 |
| Iteration no. | 889 | 1333 |
| Time | 11:15 – 11:30 | 11:15 – 11:30 |
| Range to sphere (m) | 11-12 | 11-12 |
| Ping rate | Max | Max |
| Calibrated TS transducer gain | 22.47 dB | 27.11 |
| Time (GMT) | 09:15-09:30 | 09:15-09:30 |
| RMS | 0.3271 | 0.1423 |
| $S_A$ correction | -0.4628 | -0.1292 |

Acoustic data calibration and processing has been done with EchoView softvare (Ver. 12), considering Elementary Sampling Distance Unit (EDSU) of 1 NM and data integration depth range from 7 to 200 m.

d) Survey design

Survey design in eastern part of GSA 17 (Fig. 2.6.1) is made of two long transects adapted to geomorphology of inner sea area (channel areas between small islands), and 30 parallel transects (direction: 43°-223°) in the open Adriatic (i.e. within Croatian territorial waters and EEZ). Inter-transect distance between parallel transects is 10 NM. Parallel transect lengths are in the range from 6 to 55 NM. Number of nautical miles effectively processed for biomass estimation in 2021 was 1451.

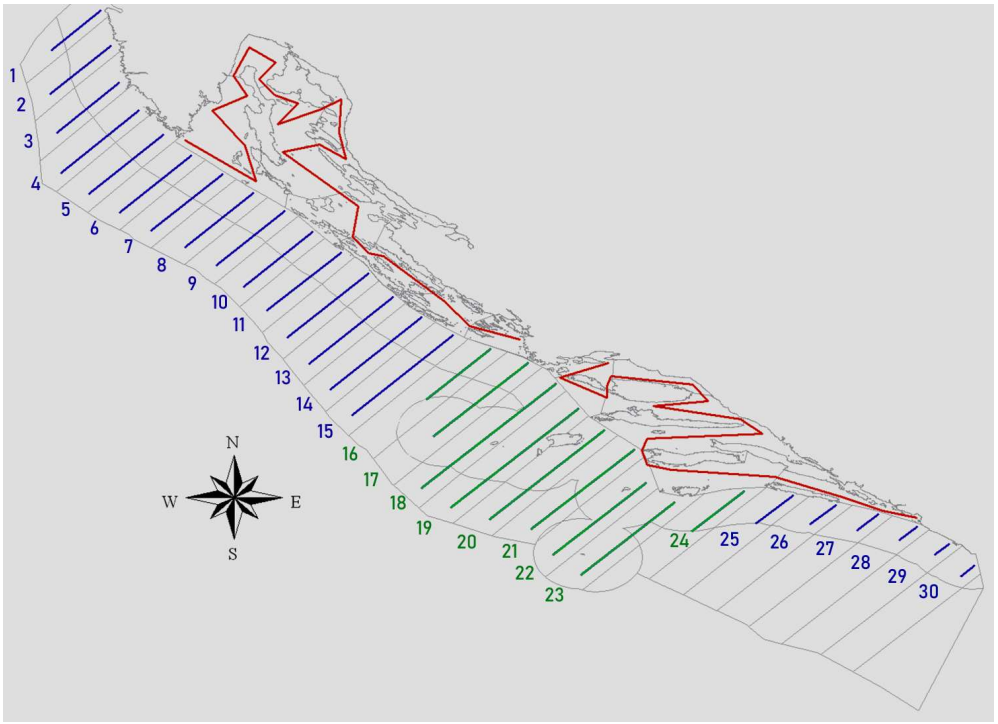



Figure 2.6.1 Acoustic survey design in the eastern part of GSA 17 (red transects in inner sea, green and blue transects in open sea).

e) Fish sampling

In order to identify echo traces recorded by echosounder, 55 sampling has been made by pelagic trawl with otter boards. Pelagic trawl sampling net has headline length 29.40m and side-line lengths 24.80m, with 18 mm mesh size in the cod-end. In addition, fine mesh cod-end cover has been used in order to identify small acoustic targets (not used in fish LFDs). Trawling speed was around 4 knots (i.e. 3.5 – 4.5 knots), and haul's duration was 30 min or more. During sampling operations, trawl was monitored by Simrad ITI System, mostly indicating vertical opening 10-13 m in most cases. Locations and species composition of samples obtained are shown in Figure 2.6.2.

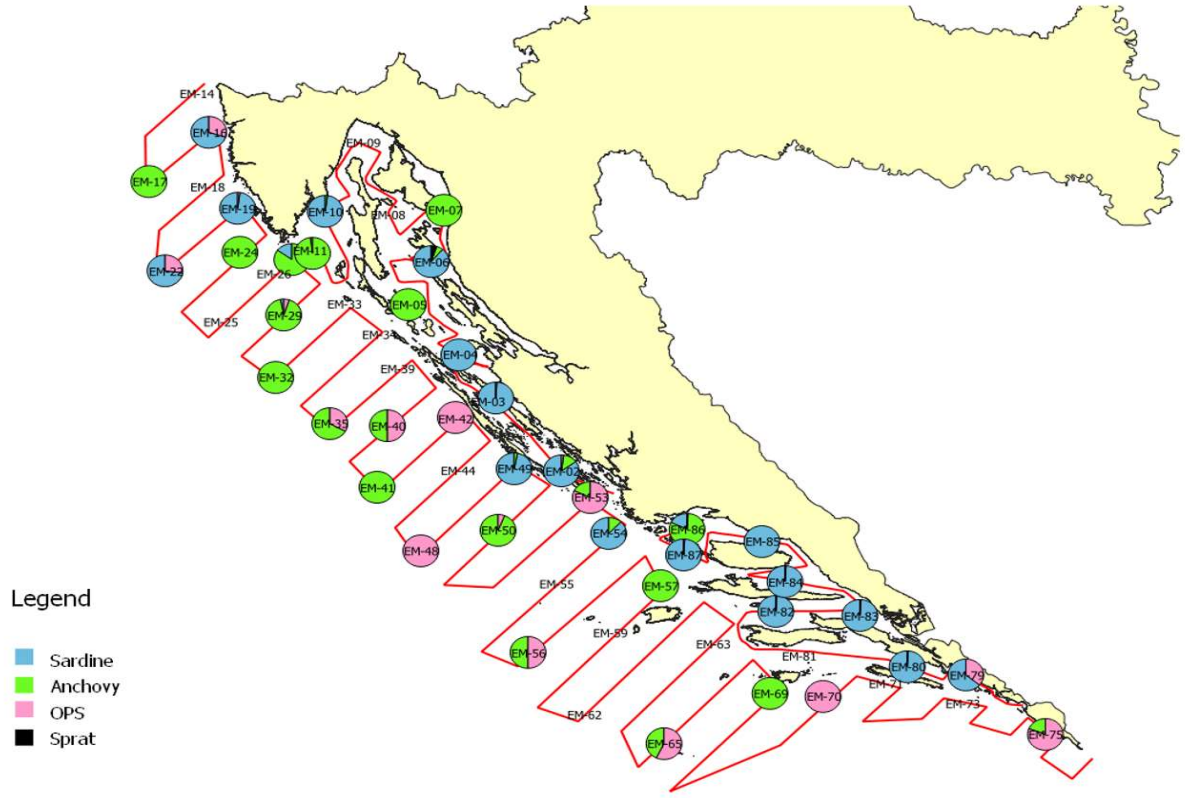



Figure 2.6.2 Locations and species composition of fish samples (W%) obtained by pelagic trawl (MEDIAS, 2021).

f) Oceanographic parameters

Oceanographic parameters were measured by CTD probe (temperature and salinity) at 89 different locations (Fig. 2.6.3). Based on measurements made, sound speeds were calculated and used to update echosounder during survey, as well as for surveyed area oceanographic description.


Figure 2.6.3 Locations of oceanographic measurement (CTD) made during survey (MEDIAS, 2021).

g) Biomass estimations of target species

The anchovy and sardine biomasses present in the eastern part of GAS 17, were estimated to be 35556 tons (CV=10) and 154458 tons (CV=52) respectively in September 2021. Biomass estimates per length classes are shown in the Figure 2.6.4, and time series of biomass density estimates for anchovy and sardine are shown in Figure 2.6.5.

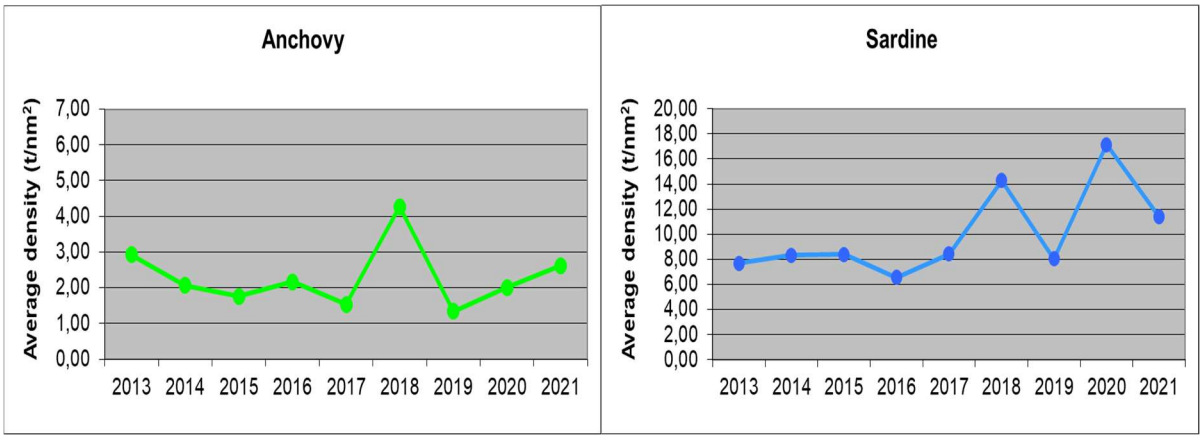



Figure 2.6.4 Biomass densities for anchovy and sardine in September 2021 in eastern part of GSA17.

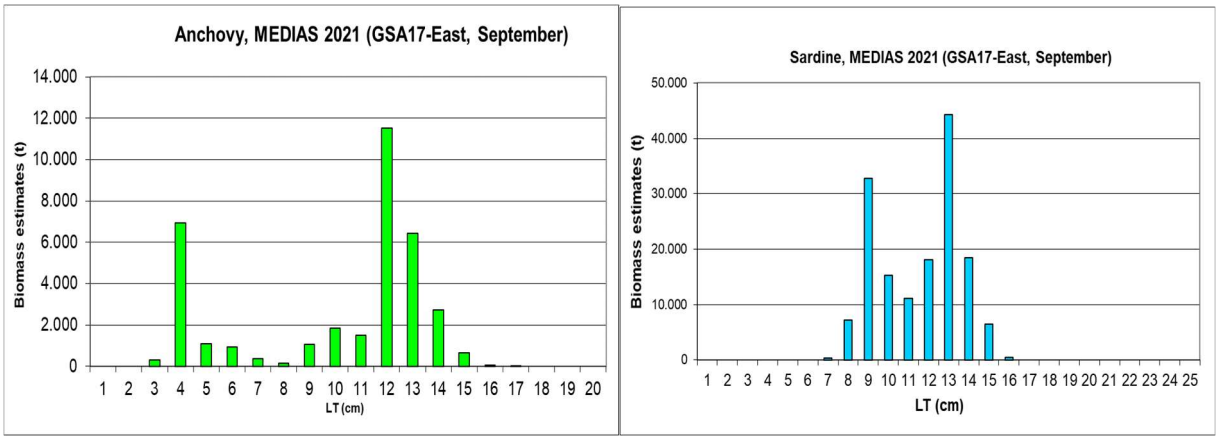



Figure 2.6.5. Biomass estimates per length classes (MEDIAS, 2020).

Age analyses, made in line with ICES WKARA2 report (2017) recommendations, resulted in survey specific ALKs for anchovy and sardine (Figure 2.6.6). Results of analyses indicated that anchovy's population consisted of three age groups (0, 1 and 2), while two age groups only (0 and 1) have been found in sardine's population. During September 2021, in terms of biomass, fish from age group 1 were slightly dominant in anchovy's population, while fish from age group 0 strongly dominated in sardine's population biomass (Fig. 2.6.7).

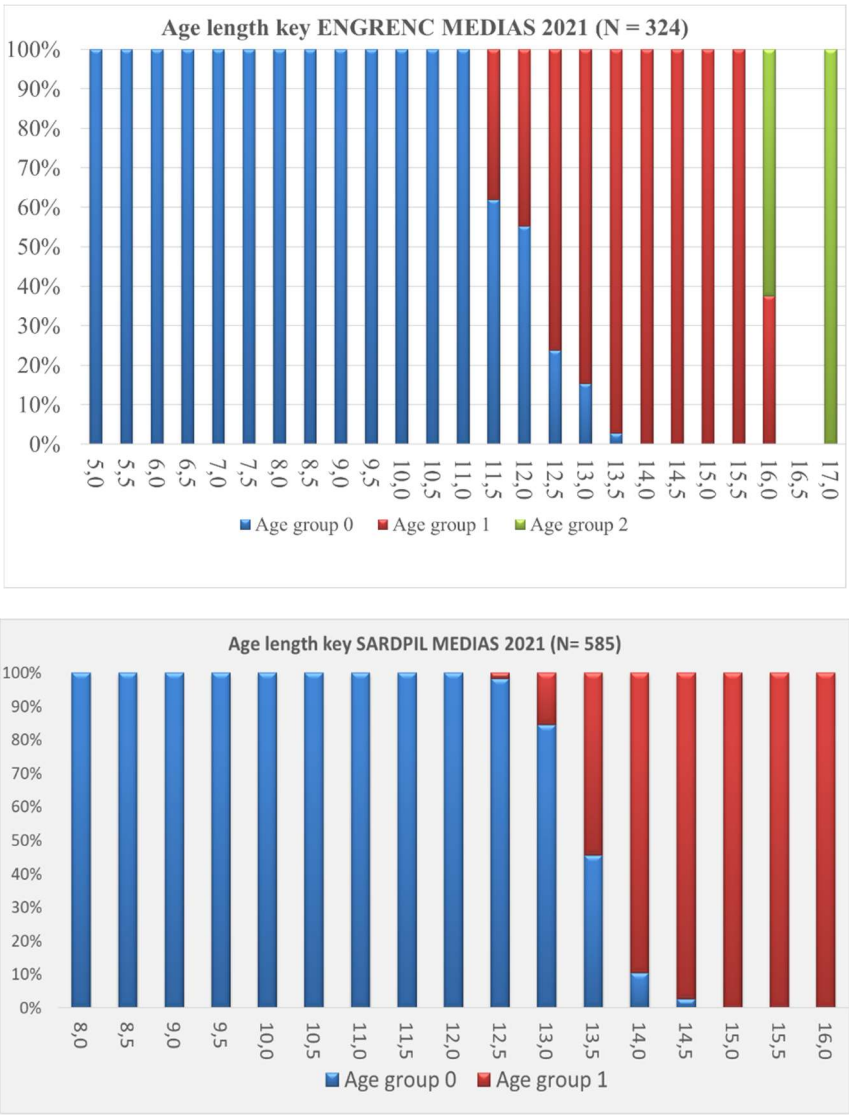



Figure 2.6.6 ALKs for anchovy (above) and sardine (below) for MEDIAS 2021 (GSA17-East).

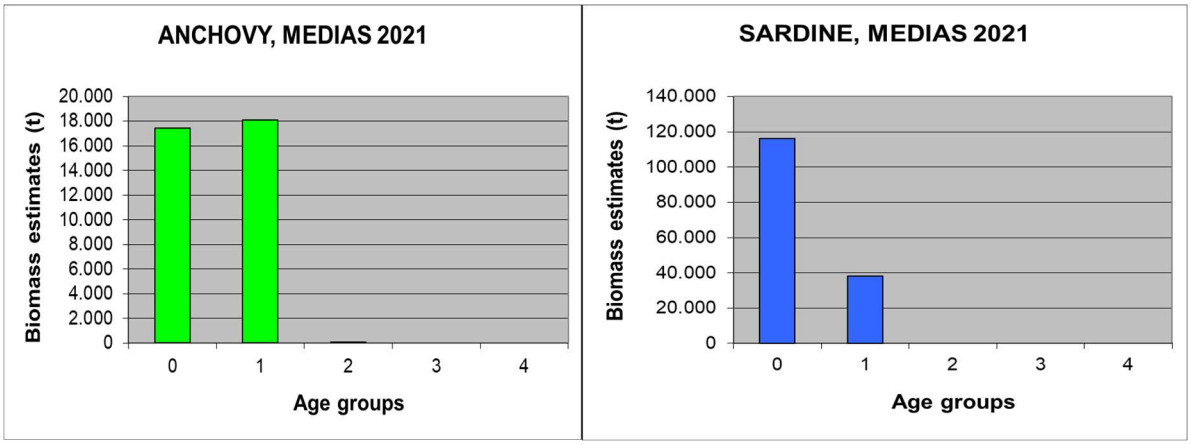



Figure 2.6.7 Biomass estimates per age groups (GSA 17-East).

h) Abundance indices of target species

Time series of sardine and anchovy abundance indices by age groups during September in the eastern part of GSA 17 is shown in Figure 2.6.8.

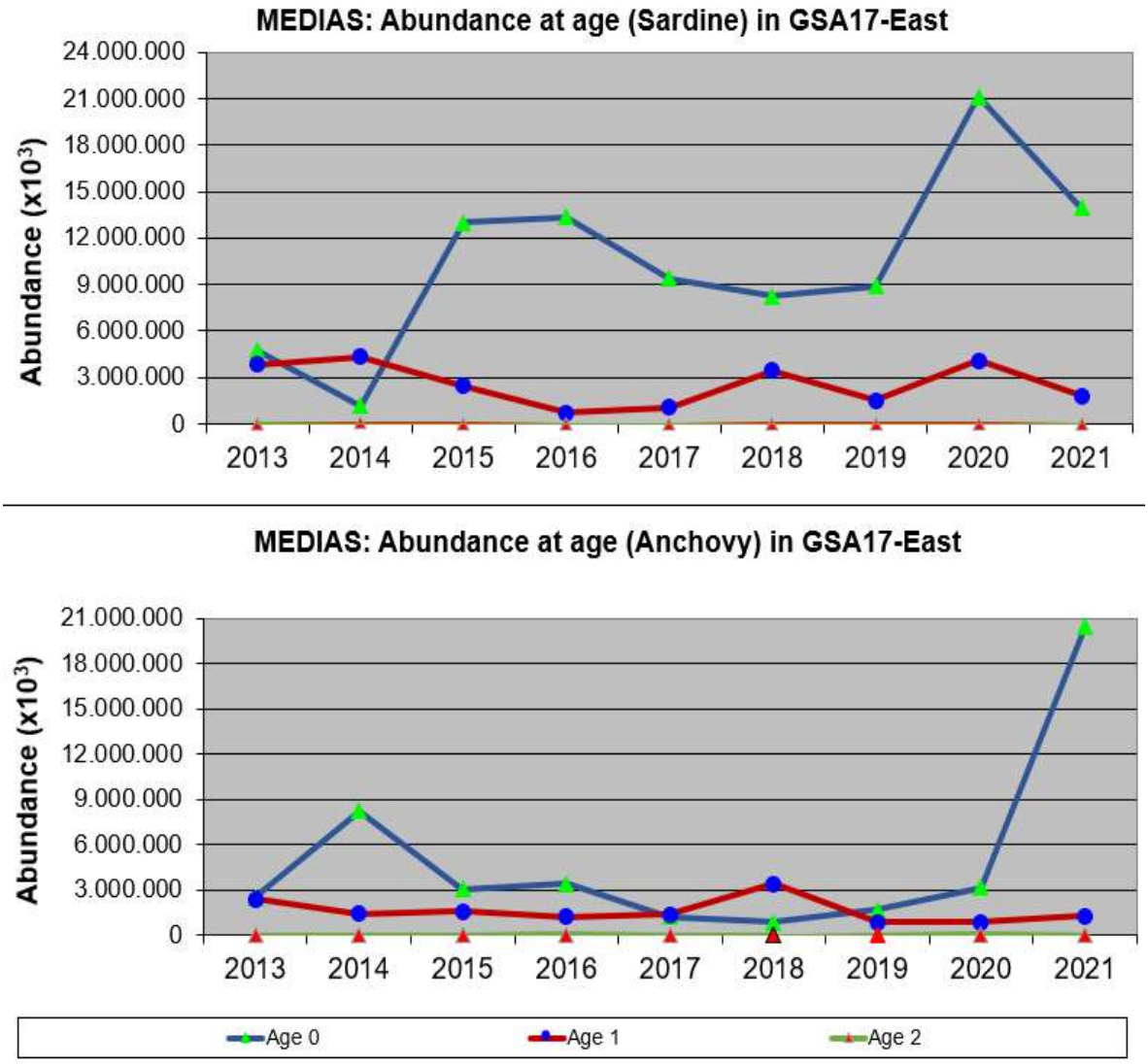



Figure 2.6.8. Abundance indices of sardine (above) and anchovy (below) by age groups during September in the eastern part of GSA 17.

Abundance of sardine and anchovy, for all age groups combined, is shown in Figure 2.6.9. Abundances of small specimens (LT up to 10 cm), as a proxy to recruitment, are shown in Figure 2.6.10.

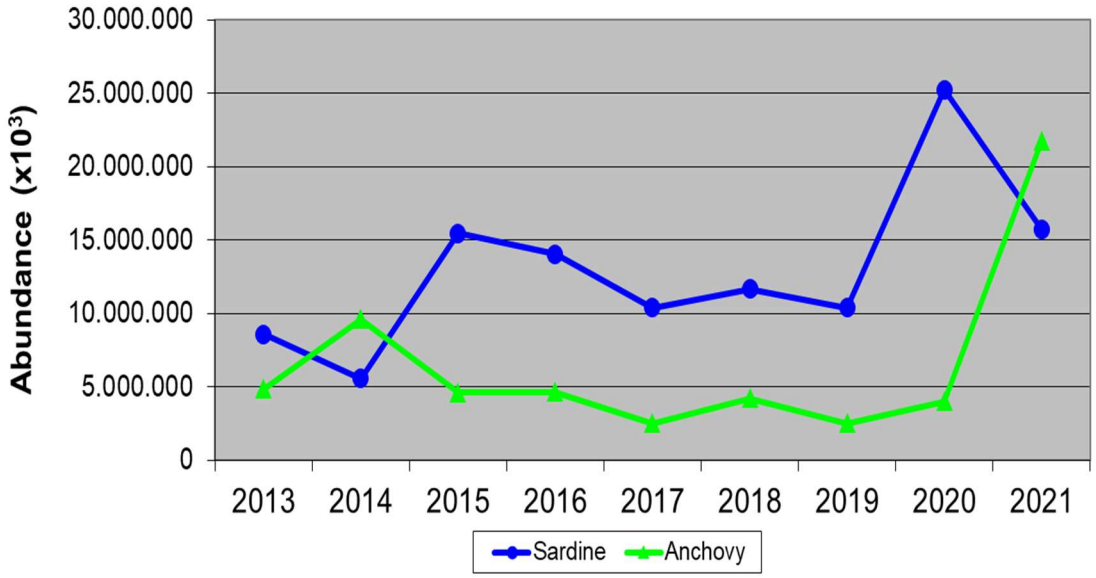



Figure 2.6.9 Abundance of sardine and anchovy, for all age groups combined (GSA 17-East).

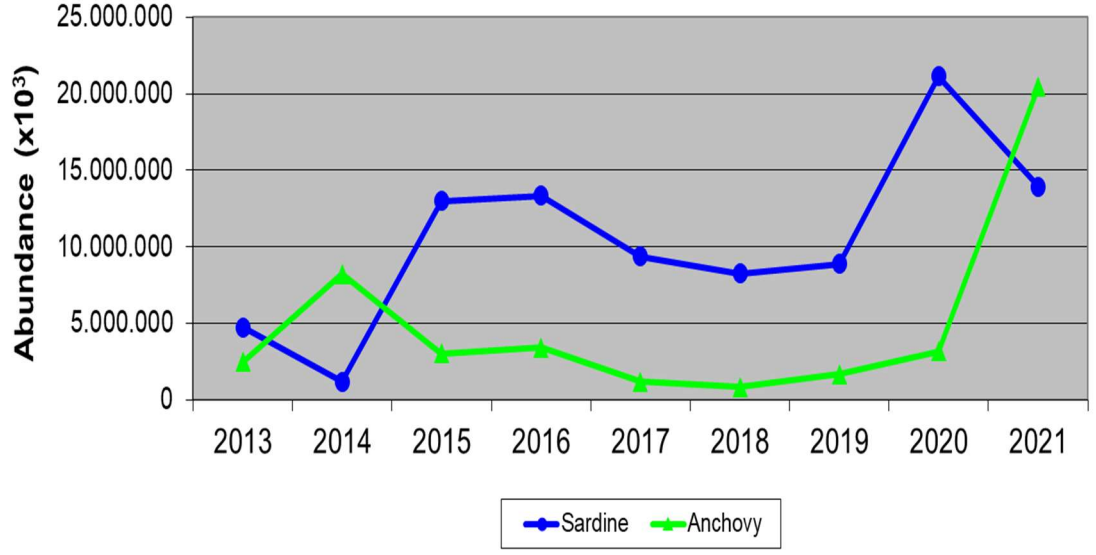



Figure 2.6.10 Abundances of small specimens (LT up to 10 cm), as a proxy to recruitment.

Spatial distributions of anchovy in September 2021 are shown in Figures 2.6.11. (a, b) and sardine in Figure 2.6.12. In case of both target species, exceptionally high abundances of juvenile specimens were recorded in the northern part of inner sea area.

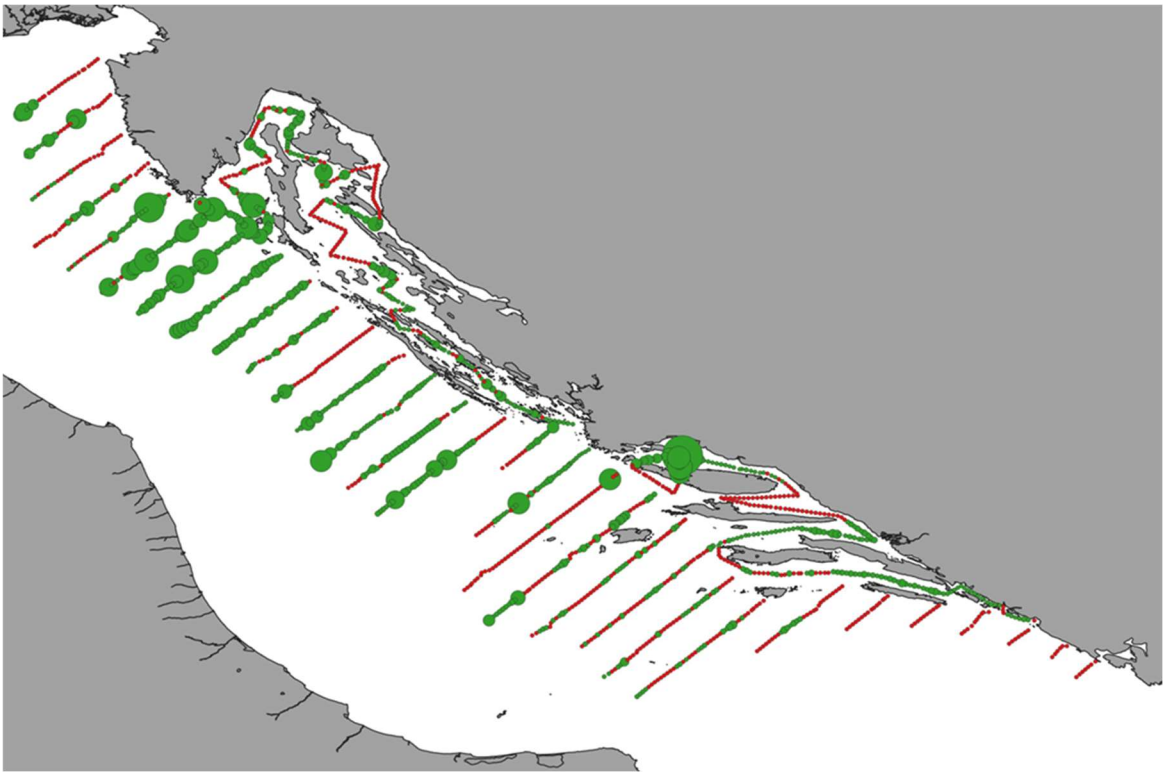


Figure 2.6.11 (a) Spatial distributions of adult anchovy during September 2021 in the eastern part of GSA 17.

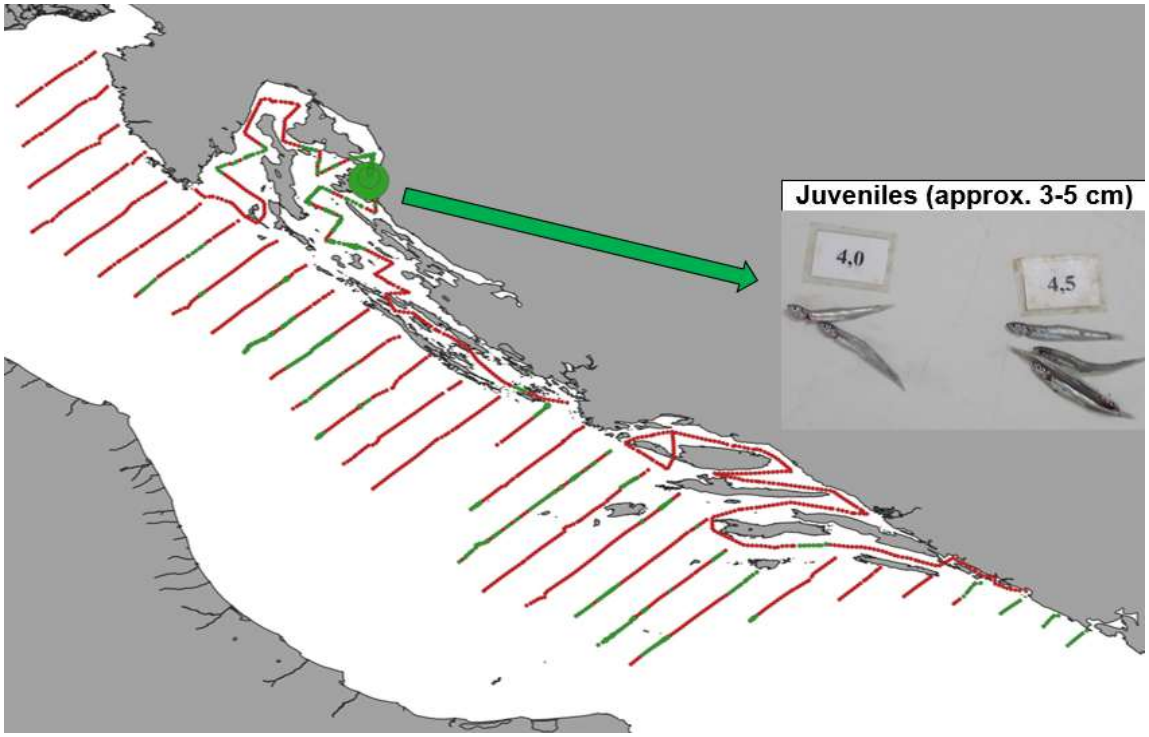



Figure 2.6.11 (b) Spatial distributions of anchovy juveniles during September 2021 in the eastern part of GSA 17.

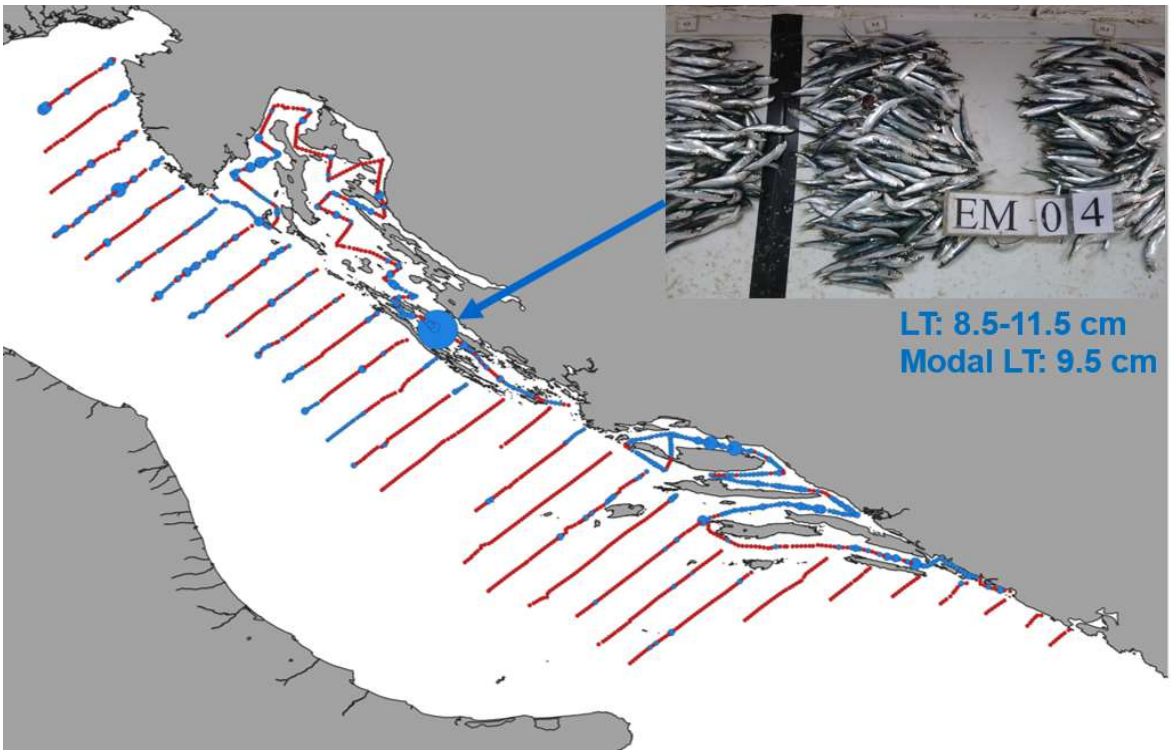



Figure 2.6.12 Spatial distributions of sardine during September 2021 in the eastern part of GSA 17.

## 2.7 MEDIAS 2021 in western GSA 17 and GSA 18 (western Adriatic Sea). (Iole Leonori, Andrea De Felice, Ilaria Biagiotti, Giovanni Canduci, Ilaria Costantini, Michele Centurelli, Antonio Palermino. CNR-IRBIM Ancona, ITALY)

a) General information on the survey

The 2021 acoustic surveys were carried out in in the period 01/06/2021 – 06/07/2021. They were conducted in the western GSA 17, including territorial waters of Slovenia, and western GSA 18, following MEDIAS protocol (MEDIAS Handbook, 2021), in the planned area of ~ 13,300 nmi$^2$ in western Adriatic Sea. The cruises were conducted on board the research vessel "G. Dallaporta" (built in 2001, 35.30 m, 285 GT, 1100 CV). Dr Modic didn't take part in the cruise in Slovenia waters in 2021, since it was not possible due to restrictions on board for COVID-19 pandemic: maximum 5 scientists (instead of 11) could be present on board R/V "G. Dallaporta".

b) Type of echosounders and frequencies in use

Acoustic System was SIMRAD EK80 scientific echosounder operating at 38, 70, 120 and 200 kHz connected with hull-mounted split beam transducers. No TS and Sv thresholds were set for data logging. The threshold for data processing was -70 dB or -60 dB in case of strong scattering from plankton. The pulse duration was 1.024 ms for all frequencies. The surveying acoustic vessel speed was generally 9.5 knots. Echoview software was used to analyse acoustic data.

c) Calibration results

Acoustic System was calibrated at 38, 70 and 120 kHz, using the standard sphere method.

**Table 2.7.1.** Calibration results in 2021

| Vessel | Date | Place | Latitude | Longitude | Bottom depth (m) | Temp. At sphere depth (°C) | Salinity at sphere depth (°C) | Speed of sound (m sec$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| R/V Dallaporta | 16/05/2021 | Ancona | 43° 38.0' | 13° 42.9' | 30.0 | 13.2 | 38.0 | 1505.29 |

| Freq. (kHz) | Echosounder type | Transducer ser. N° | Tungsten (Wc-Co) 38.1 mm TS (dB) | Pulse duration (msec) | Ψ (dB) | Default TS gain | Iter. N° | Time | Range to sphere (m) | Ping rate (s) | Calibrated TS gain | Time (GMT) | RMS | Sa corr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | SIMRAD EK60 | 30789 | -42.4 | 1.024 | -20.7 | 25.27 | 5000 | 09:32 – 10:00 | 20.5 | Max | 25.28 | 07:32 – 08:00 | 0.069 | -0.5603 |
| 70 | SIMRAD EK80 | 271 | -41.6 | 1.024 | -20.7 | 27.19 | 1784 | 10:01 – 10:25 | 20.5 | Max | 27.33 | 08:01 – 08:25 | 0.089 | -0.0577 |
| 120 | SIMRAD EK80 | 924 | -39.6 | 1.024 | -20.7 | 26.87 | 3047 | 10:26 - 10:43 | 20.5 | Max | 26.98 | 08:26 – 08:43 | 0.098 | -0.0039 |

d) Survey design

Acoustic data were logged over a grid of systematic parallel transects perpendicular to coastline/bathymetry (inter-transect distance 8-10 nmi, minimum transect length: 5 nmi, maximum transect length: 40 nmi). Number of transects is 39 in GSA 17 and 11 in GSA 18 for a total of ~ 2,000 nmi in western Adriatic Sea.

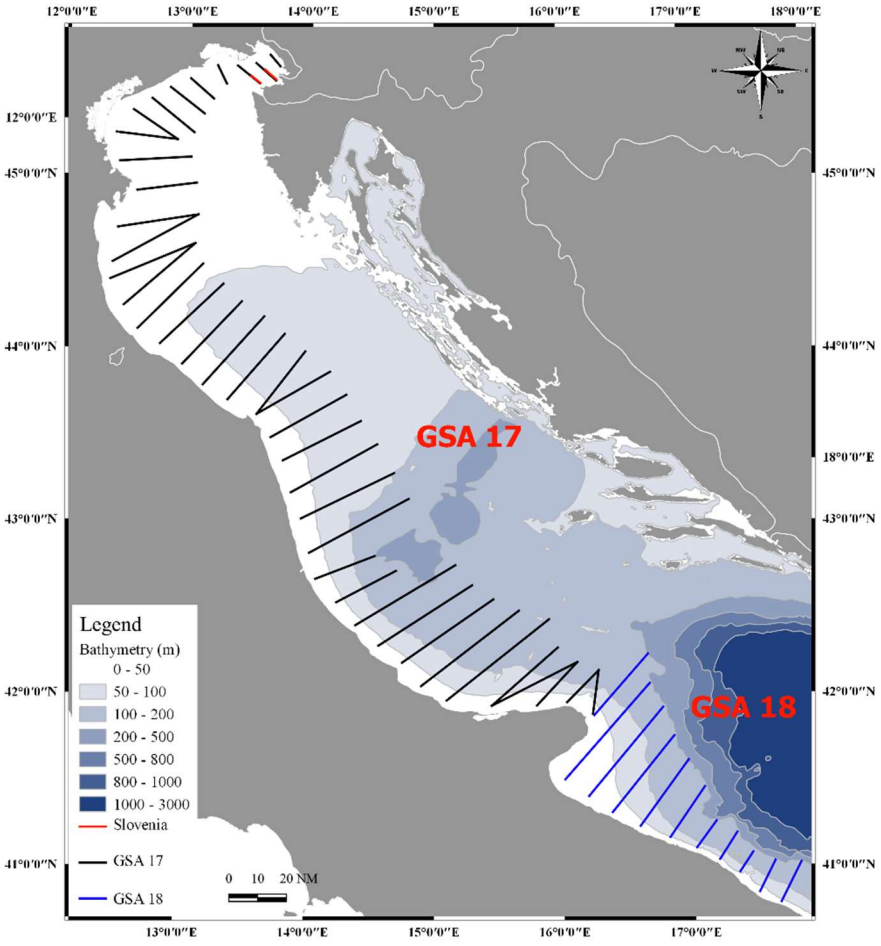



**Figure 2.7.1.** Acoustic survey route plan in western part of GSA 17 and GSA 18, in 2021

Survey period of the 2021 acoustic survey in western GSA 17 was 01/06/2021 – 23/06/2021; area coverage was 100% over a total area of 10,636 nmi² and 39 transects. The number of nautical miles effectively processed for biomass estimation was 1063.

2021 acoustic survey in western GSA 18 was done in the period of the 23/06/2021 – 06/07/2021; area coverage was 100% over a total area of 2,510 nmi² and 11 transects. The number of nautical miles effectively processed for biomass estimation was 267.

e) Fish sampling

A midwater sampling trawl "Volante" with the following characteristics was used during the surveys: 18 mm codend, about 10 m vertical opening and 12 m horizontal opening, headline/ft rope = 35 m; sidelines length = 27 m. Vessel speed was 3.5 – 4.5 knots during fishing. Haul's duration was about 30 min. Trawls were monitored by means of SIMRAD FX80 Trawl Sonar. Fishing operations were performed at different light conditions and bathymetry. Biological samplings were conducted along the survey routes for biomass allocation into species and to know mean lengths and weights of the pelagic fish (Species, Size Composition, length-weight

relationship). The entire catch was considered to determine the proportion in species by weight; in case the catch was huge (more than 50 kg) an adequate subsample was considered for this operation. Length frequency distributions on board were obtained measuring a subsample of 100 individuals per species when available. Subsamples of target species specimens of up to 5 individuals per 0.5 cm length class were collected to determine age, by means of otoliths readings, following DCR standards, and maturity stages and frozen for successive measurements in the laboratory.

In western Adriatic Sea in 2021, 32 pelagic hauls were done in GSA 17 and 10 pelagic haul in GSA 18. Catch composition, resumed from pelagic hauls, showed among the most abundant species *Engraulis encrasicolus*, *Sardina pilchardus* and *Sprattus sprattus.* Other pelagic fish species minor for occurrence were: *Trachurus mediterraneus, Trachurus trachurus, Spicara maena, Scomber scombrus, Scomber colias, Sardinella aurita, Boops boops, Aphia minuta, Alosa fallax, Spicara smaris.* Other species found in some catches were: *Loligo volgaris, Illex coindetii and Alloteuthis media.*

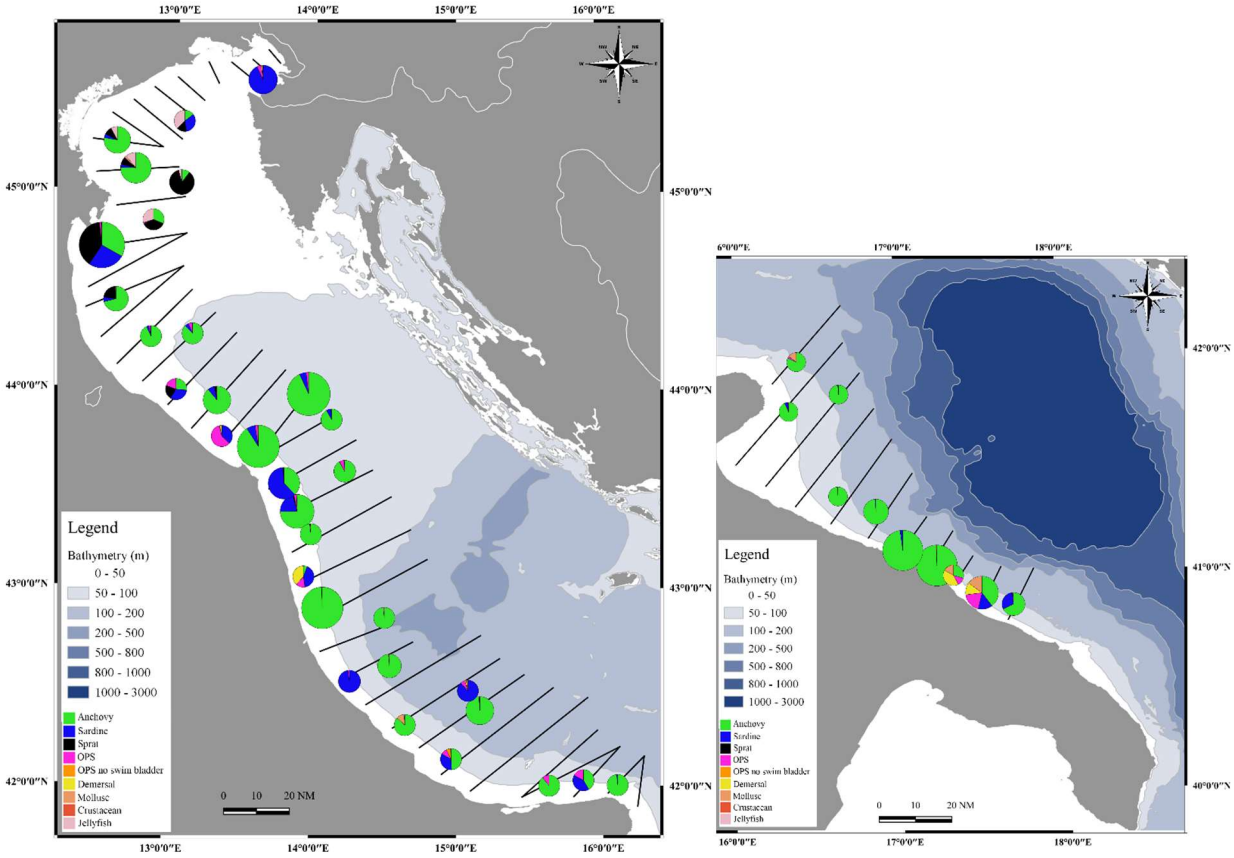



**Figure 2.7.2.** Catch composition from pelagic hauls in 2021 in GSA17 (left) and GSA18 (right).

f) <u>Oceanographic parameters</u>

In western Adriatic Sea in 2021, 62 CTD stations were performed in GSA 17 and 19 CTD stations in GSA 18; mesozooplancton and ichthyoplankton sampling was not possible due to COVID-19 restrictions on board.

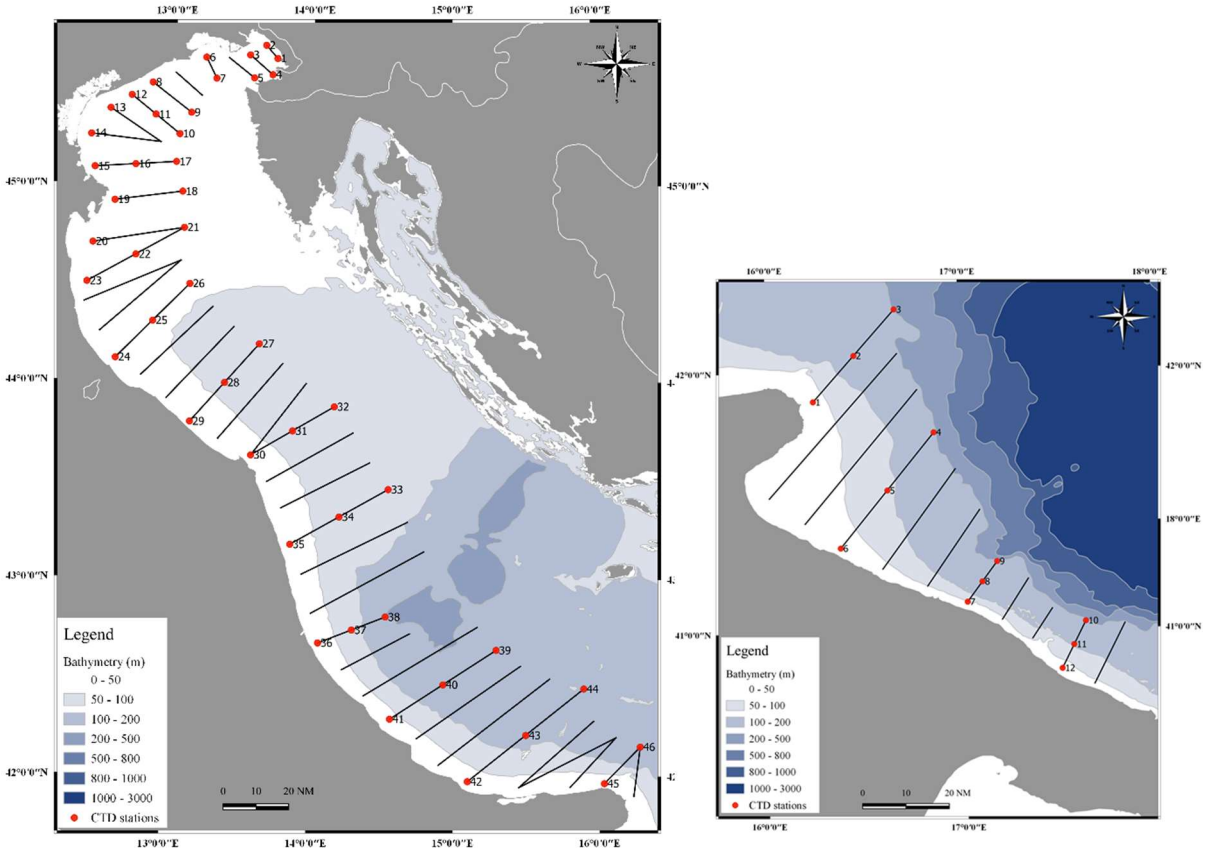



**Figure 2.7.3.** Acoustic survey route plan in western part of GSA 17 (left) and GSA18 (right) with grid of planned CTD stations in 2021.

g) Biomass estimations of target species

Estimates of anchovy and sardine biomass and related CV in June 2021 in western GSA 17 are given in Table 2.7.2.

Table 2.7.2 Anchovy and sardine biomass and related CV in MEDIAS 2021 in western GSA17.

| Year | Anchovy | CV | Sardine | CV | Sampled Area |
|---|---|---|---|---|---|
| **2021** | 274,415 t | 11% | 84,706 t | 13% | 10,636 $nmi^2$ |

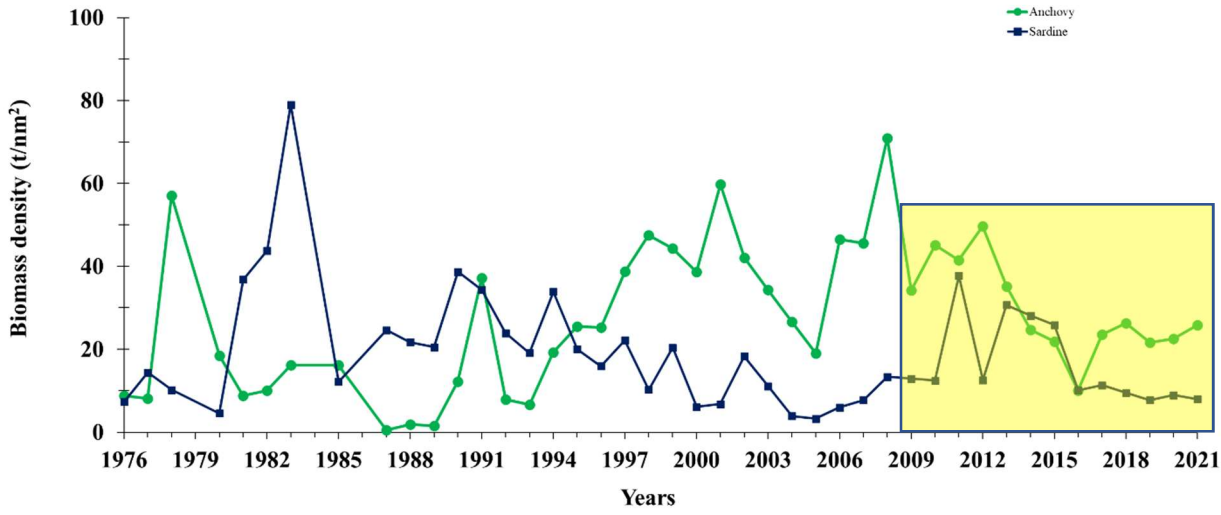



**Figure 2.7.4.** Historical trends in GSA17-West (North-Western Adriatic Sea) in 1976-2021. EU-MEDIAS estimates are shown in yellow frame.

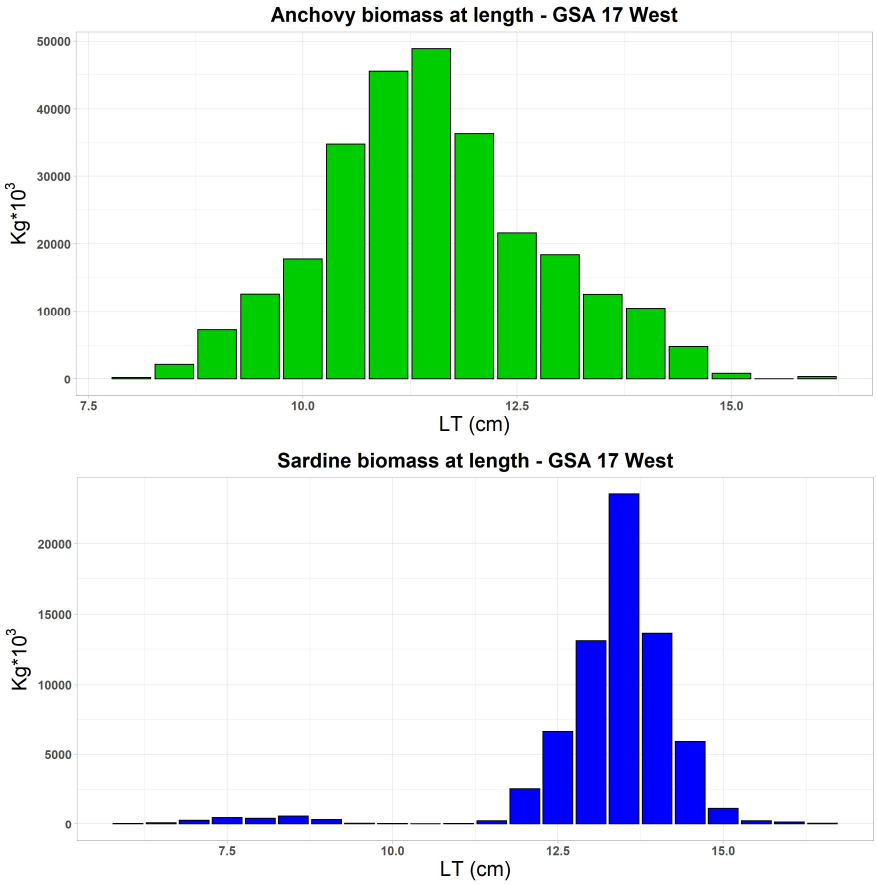



**Figure 2.7.5.** Anchovy (above) and sardine (below) biomass at length in western GSA 17 in June 2021.

Recruitment of anchovy was almost absent and low for sardine. Anchovy length frequency distribution was unimodal.

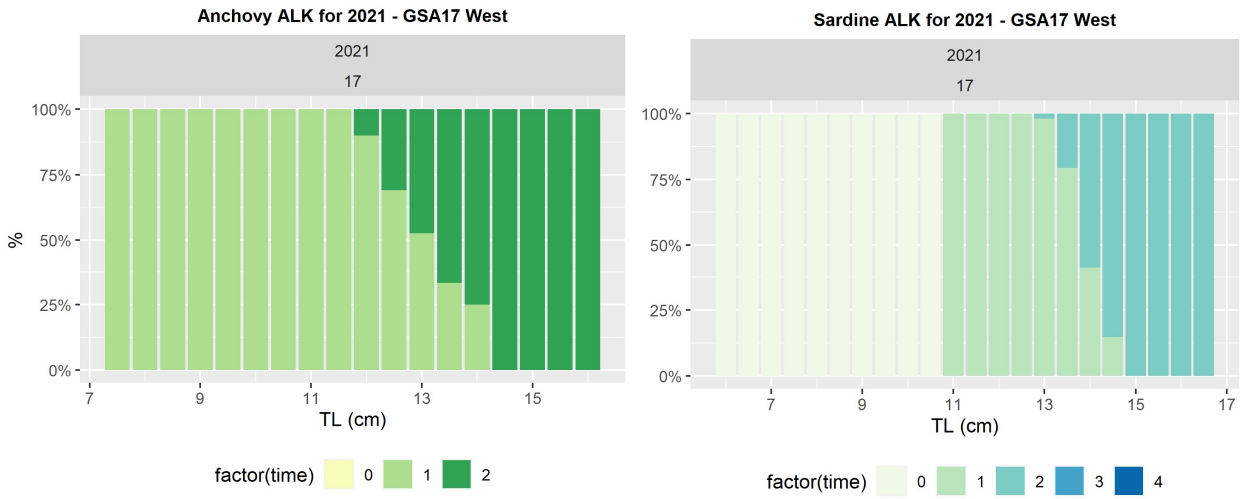



**Figure 2.7.6.** ALK in 2021 in western GSA 17 for anchovy (N=851) and sardine (N=551).

Age length key (ALK) for anchovy was composed by 2 year classes: 1, 2 in GSA 17 (no recruits), ALK for sardine was composed by 3 year classes: 0, 1, 2 in GSA 17. The number of otoliths readings was 851 for anchovy and 551 for sardine. Estimates of anchovy and sardine biomass at age in western part of GSA 17 during survey period in 2021 are shown in Figures 2.7.7 and 2.7.8.

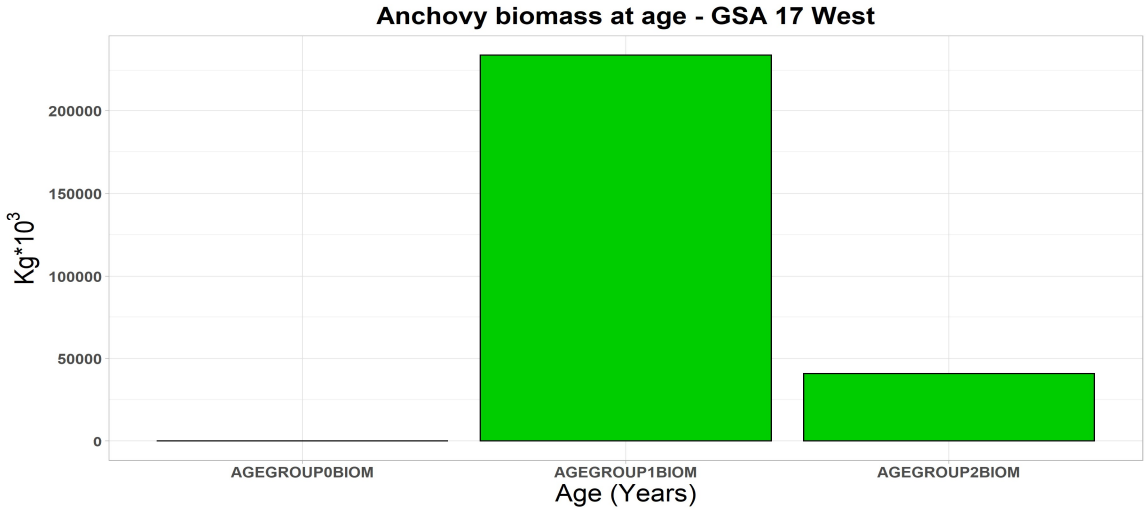



**Figure 2.7.7.** Anchovy biomass at age in western part of GSA 17 in 2021.

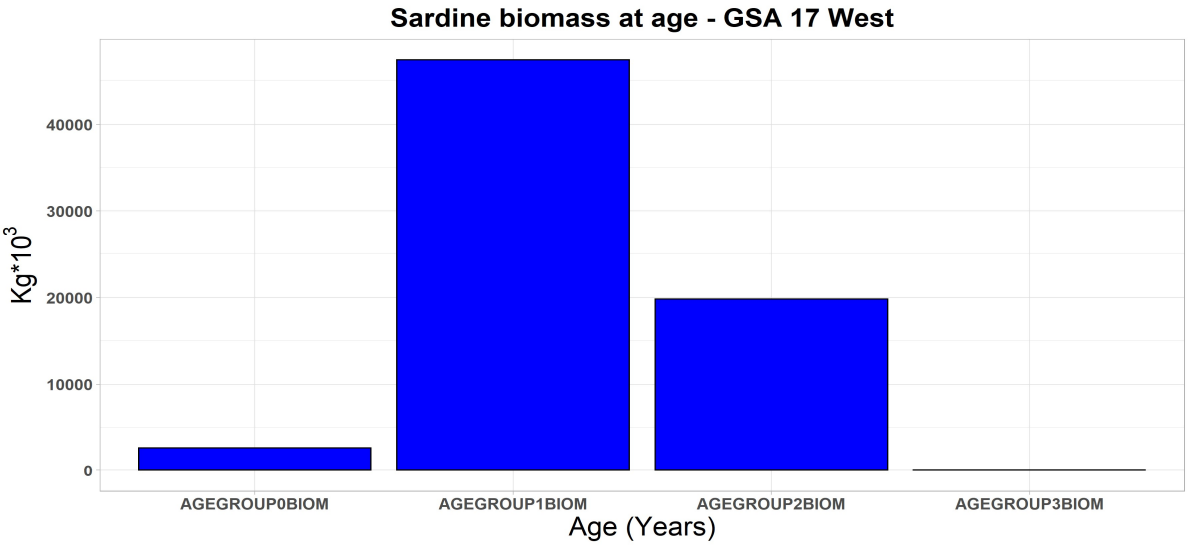



**Figure 2.7.8.** Sardine biomass at age in western part of GSA 17 in June 2021.

Estimates of anchovy and sardine biomass and related CV in June-July 2021 in Western part of GSA 18 are shown in Table 2.7.3.

Table 2.7.3 Estimates of anchovy and sardine biomass and related CV in 2021 in Western GSA 18.

| Year | Anchovy | CV | Sardine | CV | Sampled Area |
|---|---|---|---|---|---|
| **2021** | 50,437 t | 15% | 2,282 t | 25% | 2,510 nmi$^2$ |

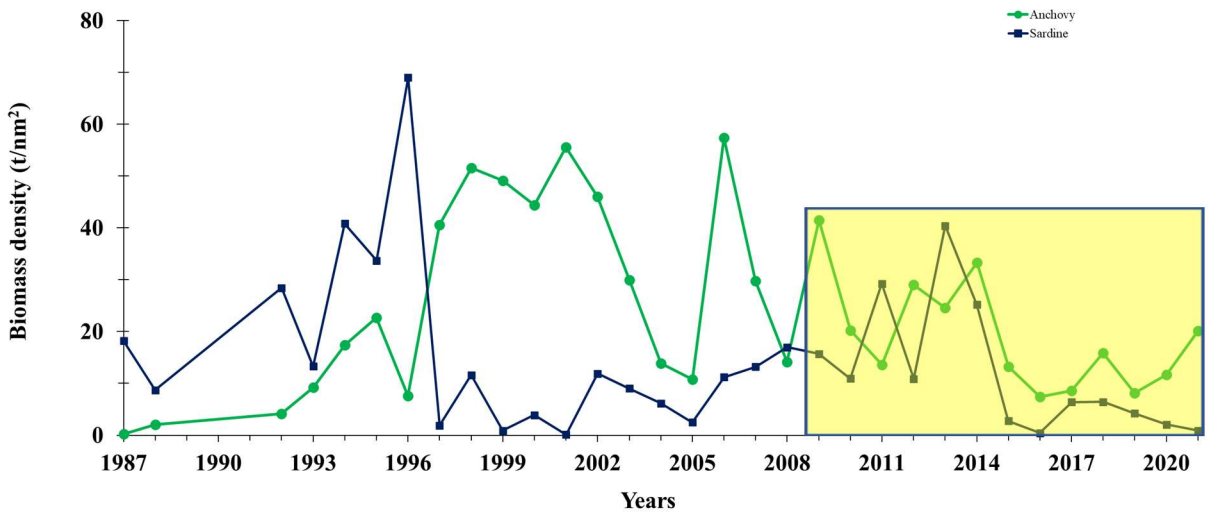



**Figure 2.7.9** Historical trends in GSA18-West (South-Western Adriatic Sea) in 1976-2021. EU-MEDIAS estimates are shown in yellow frame.

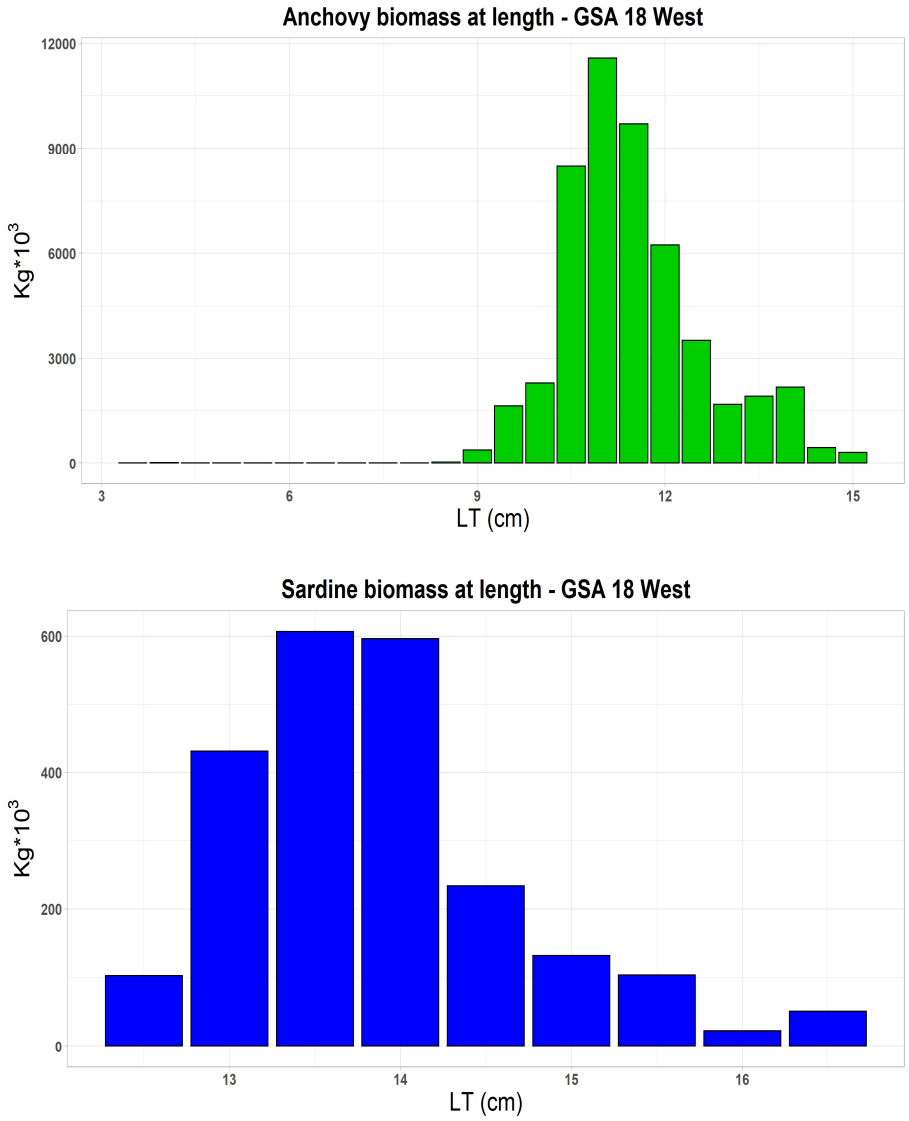



**Figure 2.7.10** Anchovy (above) and sardine (below) biomass per length class in western GSA 18 in 2021.

Recruitment of anchovy was almost absent and absent for sardine. Anchovy length frequency distribution was unimodal.

Age length key (ALK) for anchovy was composed by 3 year classes: 0, 1, 2 in GSA 18. ALK for sardine was composed by 3 year classes: 1, 2, 3 in GSA 18 (no recruits). The number of otoliths readings was 244 (individuals) for anchovy and 105 for sardine.

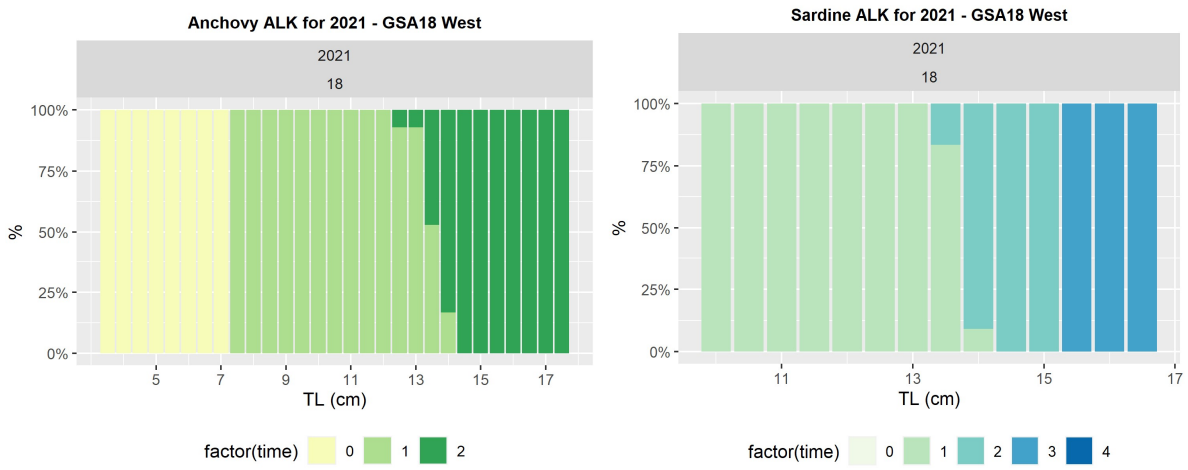



**Figure 2.7.11.** Anchovy (N=244) and sardine (N=105) ALKs in western GSA 18 in 2021.

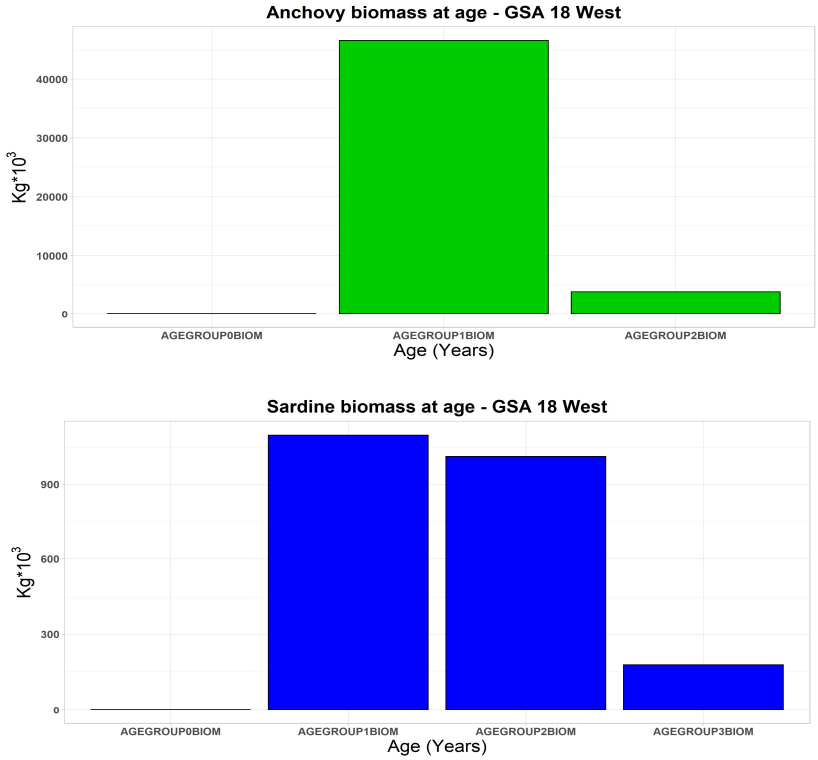



**Figure 2.7.12.** Estimates of anchovy (above) and sardine (below) biomass at age in western GSA 18 in June-July 2021.

h) Abundance indices of target species

Spatial distribution of anchovy and sardine in western part of GSA 17 and GSA 18 in June-July 2021, are shown in Figures 2.7.13 and 2.7.14.

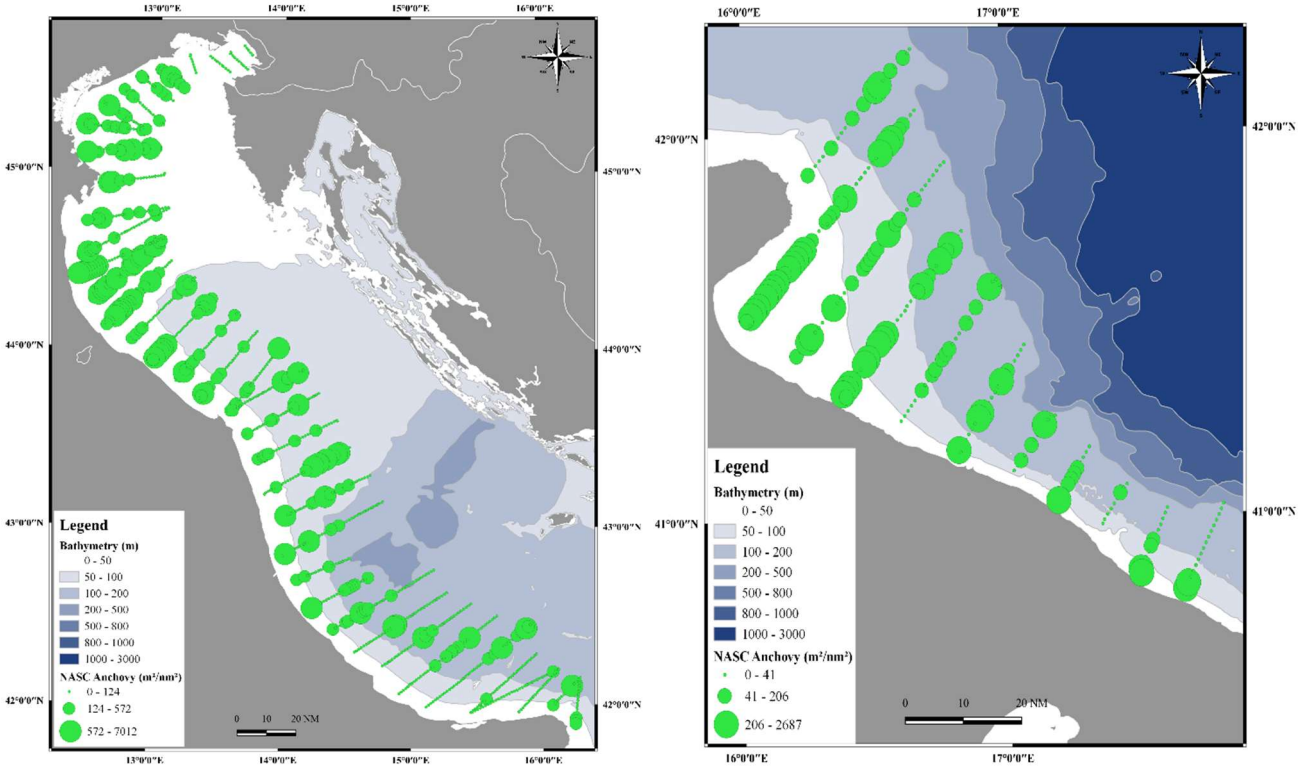



Figure 2.7.13 Anchovy spatial distribution in western GSAs 17 and 18 in June-July 2021.

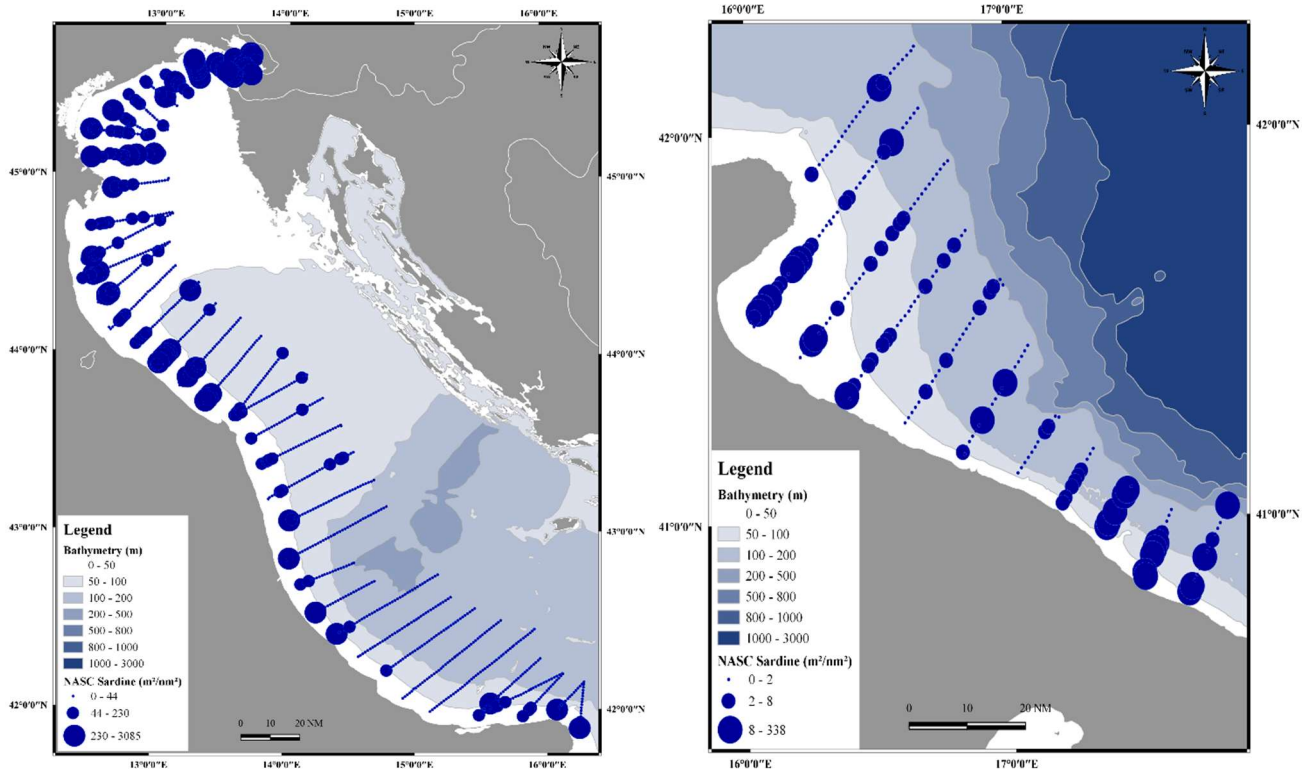



Figure 2.7.14 Sardine spatial distribution in western GSAs 17 and 18 in June-July 2021.

Spatial distribution of anchovy covers all the continental shelf. The same distribution was found for sardine in the northern part of survey area, while this species was concentrated near the coast in the central and south Adriatic Sea.

## 2.8 Information on acoustic surveys in GSAs 20 & 22 (Eastern Ionian and Aegean Seas, GRC) in 2021 and re-evaluation of acoustic survey in GSA 22 (Northern Aegean Sea, GR) in 2019 and 2020 - (A. Machias, K. Tsagarakis, Z. Kapelonis, M.M. Pyrounaki, S. Tsoukali, S. Somarakis, E. Schismenou, K. Markakis & M. Giannoulaki, HCMR)

a) General information on the surveys in 2021

No acoustic survey took place in 2021 in GSA22 or GSA20, due to the reconstruction of the RV PHILIA and the lack of a suitable commercial vessel. Details on the reconstruction of the RV PHLIA can be found in https://rephil.eu/en/. The renovated RV PHILIA can now ensure its security and functionality and offer improved accommodation facilities to researchers, hosts a bigger number of scientists onboard, expand its research activities by contributing to research and innovation through the use of new advanced technological tools, facilitates fishing operations with the use of the A-frame, has a reduced carbon footprint with less fuel consumption per nautical mile and eventually contribute to the realization of new doctoral theses and create jobs for young researchers.

Therefore, during 2021 MEDIAS activities in Greece, an extended re-evaluation of the acoustic estimates for anchovy abundance in GSA22 for 2019 and 2020 took place. The re-evaluation was considered necessary following a) the results of a simultaneous ichthyoplankton survey that took place in 2019, at the same time with acoustics on board the RV PHILIA in North Aegean Sea and b) the estimates of the Daily Egg Production Method applied outside of the DCF. Specifically, the ichthyoplankton survey outcome clearly demonstrated the presence of high abundance of day-0 anchovy eggs within the gulfs of North Aegean Sea evidencing the presence of dense aggregations of anchovy schools. Based on this, the Daily Egg Production Method was applied, although outside the DCF. The "Stock Spawning Biomass" estimates were twice the values of the "Total Biomass" acoustics estimates.

As this was considered scientifically inconsistent, it was deemed necessary to proceed on the re-analysis of the acoustic data. This re-analysis took place during the second half of 2021. In detail, the echograms and the re-allocation of fish schools echotypes took place taking into account the knowledge of the spatial distribution of anchovy day-0 eggs. The revised estimates evidenced higher biomass and abundance estimates for anchovy in 2019 and 2020. Small changes for sardine stock, due to the re-allocation of schools initially assigned to sardine, also occurred. Based on these updated biomass estimates, a re-estimation of the length and the age structure of the stocks was also held and presented below.

In brief, the surveys covered 9066 $nm^2$ and 8241 $nm^2$ in northern Aegean Sea in June - July, 2019 and 2020 respectively, with the fishery Research Vessel PHILIA (26 m length, 2× 340 HP).

b) Type of echosounders and frequencies in use

The split beam echo sounder used is SIMRAD EK80, with the 38 kHz frequency. The rest of the transducers (120, 200 and 333 kHz) have not been used, because they exhibited high acoustic measurement and sector impedance value offsets during the calibration. There is no threshold limit applied in the raw data. The threshold for processing for the assessment (38 KHz) is –70 dB. The pulse duration is 1024 ms. The surveying acoustic vessel speed is 8 knots. The Echoview software was used to visualize and analyze acoustic data.

c) Calibration results

Table 2.8.1 Latest calibration settings used for the MEDIAS of northern Aegean Sea (GSA 22) in 2020.

| | **38 kHZ (ES38-7)** |
|---|---|
| **Target** | **Copper (Cu) 60 mm** |
| Beam Angle | 7 deg |
| Gain (adj. ,final) | (0.62, 26.12) dB |
| Sa correction | -0.04 dB |
| Offset Alongship | -0.05 deg |
| Offset Athwart ship | -0.03 deg |
| Beamwidth along ship | 7.50 deg |
| Beamwidth Athwart ship | 7.53 deg |
| Depth | 9 m |
| RMS TS error | 0.07 dB |

d) Survey design

The survey design is made of 70 transects in 2019 and 58 transects in 2020, either parallel, perpendicular to the coastline and 10 nm apart from the 10m isobath to 200m isobaths (reaching the 1500m isobath in certain areas like the Thracian Sea plateau) or zigzag inside gulfs (Fig. 2.8.1 and 2.8.2). Total nautical miles effectively used for acoustic analysis were 1206 and 1103 for 2019 and 2020, respectively.

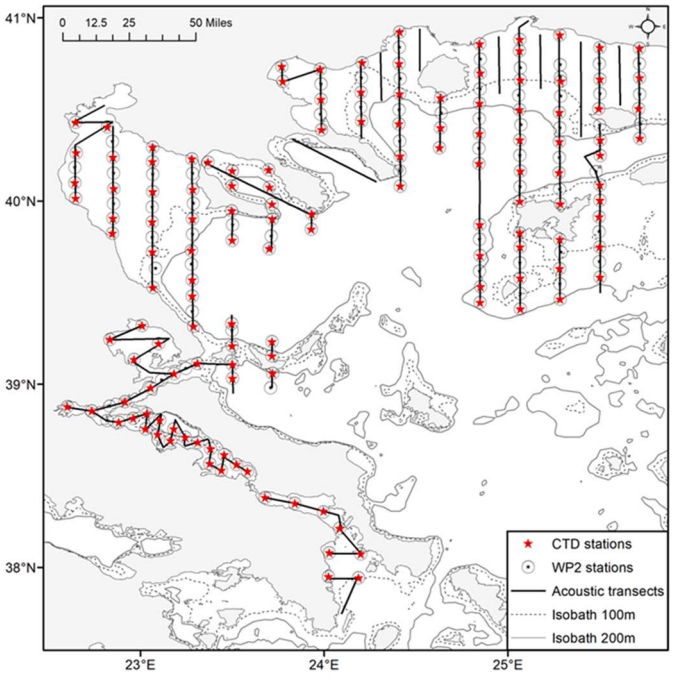



Figure 2.8.1. Acoustic transects sampled in the MEDIAS of the Hellenic part of northern Aegean Sea (GSA 22) in June-July 2019. The position of CTD stations and WP2 stations sampled are also shown.

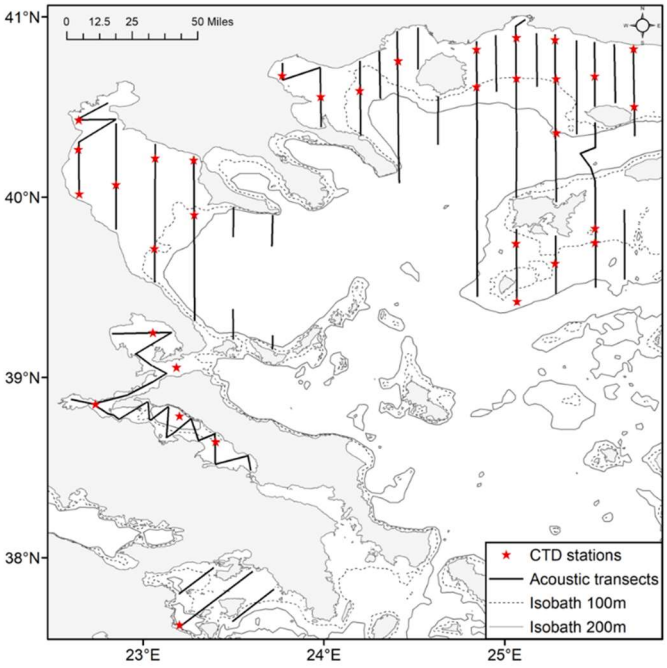



Figure 2.8.2. Acoustic transects sampled in the MEDIAS of the Hellenic part of northern Aegean Sea (GSA 22) in June-July 2020. The position of CTD stations sampled are also shown.

e) Fish sampling

Echotraces are identified with pelagic hauls. Seventeen (17) and fifteen (15) pelagic hauls were carried out in GSA22 to be used for the scrutinizing of the echograms in 2019 and 2020, respectively (Fig. 2.8.3 and 2.8.4). Acoustic recording was conducted during daytime and trawl hauls during daytime/ night time. The pelagic net used has headline length of 28m, a sideline dimension of 55m and codend mesh size of 8mm.

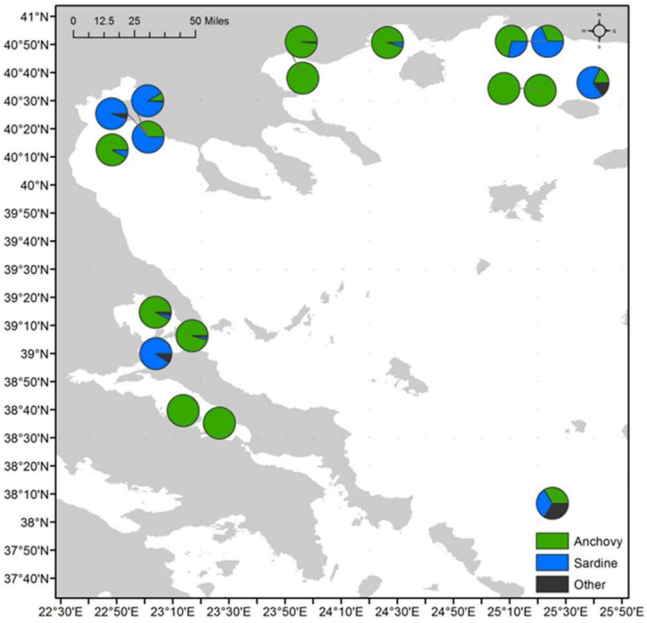



Figure 2.8.3. The catch compositions of the hauls (species kg/haul) weighted per hauling hour in northern Aegean Sea (GSA 22) during June-July 2019.

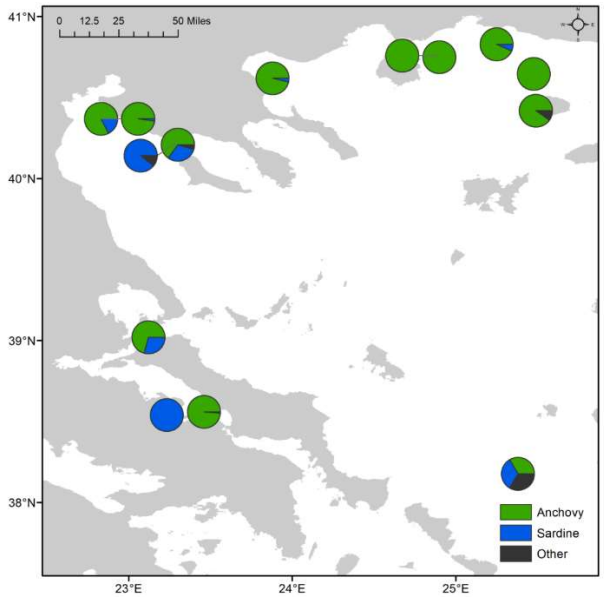



Figure 2.8.4. The catch compositions of the hauls (species kg/haul) weighted per hauling hour in northern Aegean Sea (GSA 22) during June-July 2020.

f) Oceanographic parameters

136 and 33 hydrological stations have been conducted in 2019 and 2020, respectively, using a SBE 19plus CTD, which measures conductivity, temperature, pressure, fluorescence, PAR (Photosynthetically active radiation), oxygen and turbidity (Fig.2.8.1 and 2.8.2).

g) Biomass estimations of target species

Based on the re-evaluation of the acoustic surveys in 2019 and 2020, the anchovy biomass was estimated to be 64650 t (CV=9%) and 50460 t (CV=8%) in 2019 and 2020, respectively. Similarly, sardine biomass was estimated at 36535 t (CV =16%) and 24593 t (CV=16%) in 2019 and 2020.

Biomass per length class for the two species is shown in figure 2.8.5 and 2.8.6 for 2019 and 2020, respectively. Biomass per age class was estimated for anchovy and sardine using otoliths reading and age-length key was assessed (Fig. 2.8.7 and 2.8.8). Subsequently, biomass per age class is shown in figure 2.8.9 and 2.8.10.

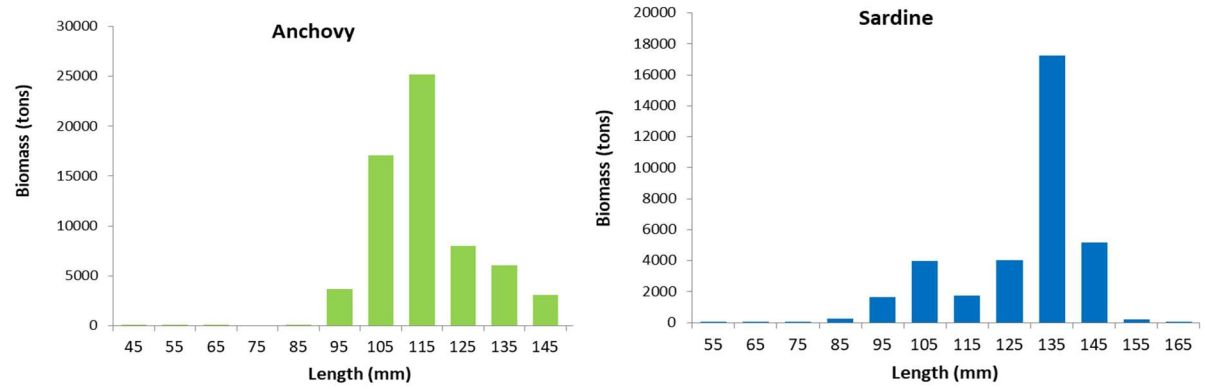



Figure 2.8.5. The anchovy and sardine biomasses (in tons) per length class in northern Aegean Sea (GSA 22) during June-July 2019.

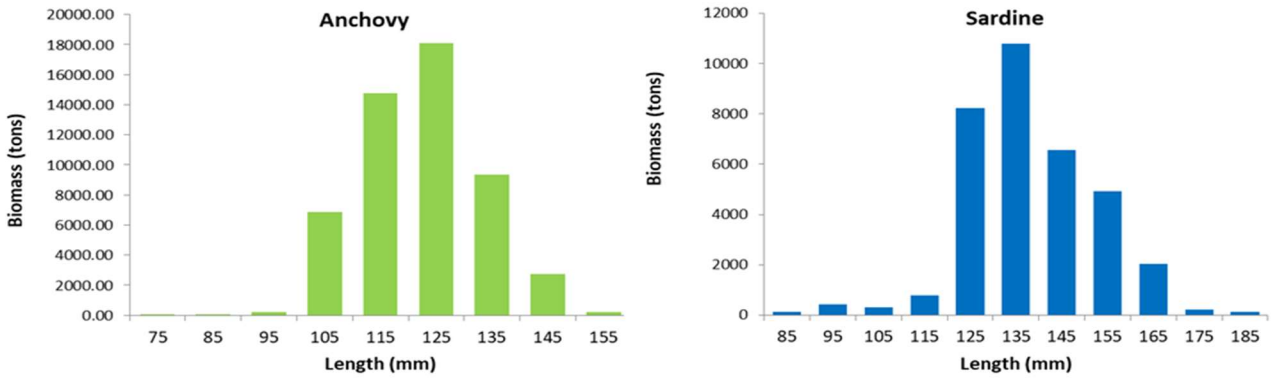



Figure 2.8.6. The anchovy and sardine biomasses (in tons) per length class in northern Aegean Sea (GSA 22) during June-July 2020.

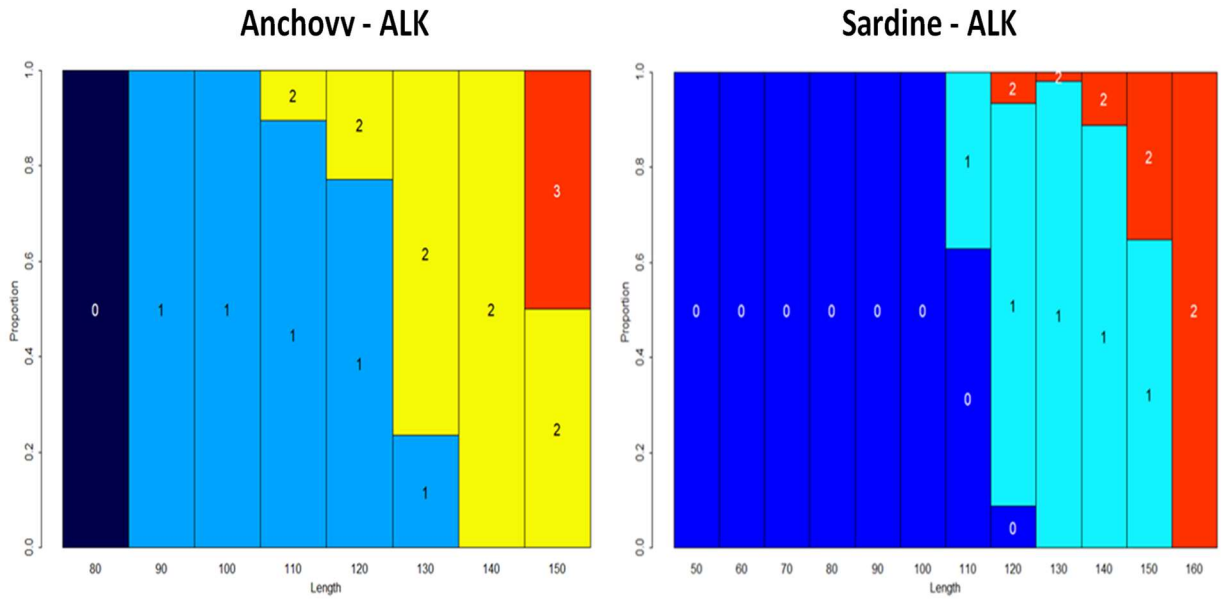



Figure 2.8.7. Age-length key assessed for anchovy and sardine in 2019.

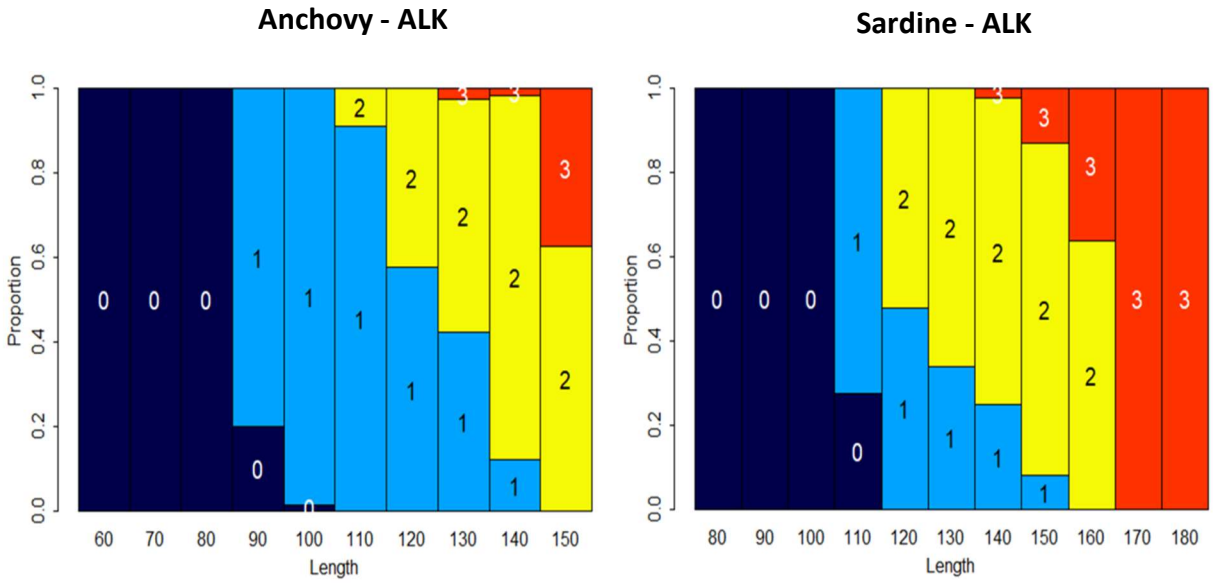



Figure 2.8.8. Age-length key assessed for anchovy and sardine in 2020.

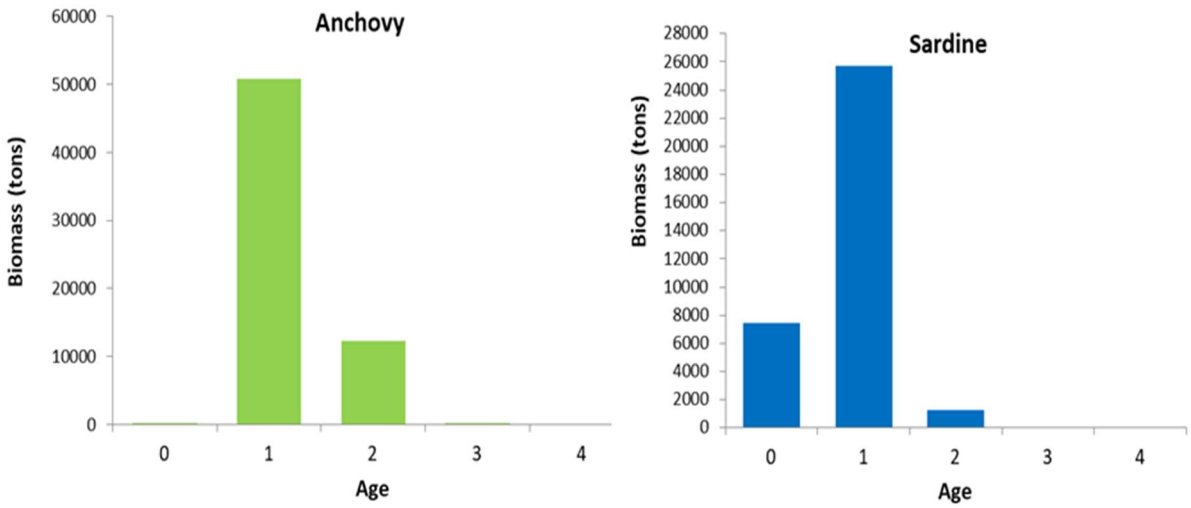



Figure 2.8.9. Anchovy and sardine biomasses (in tons) per age class in northern Aegean Sea (GSA 22) during June-July 2019.

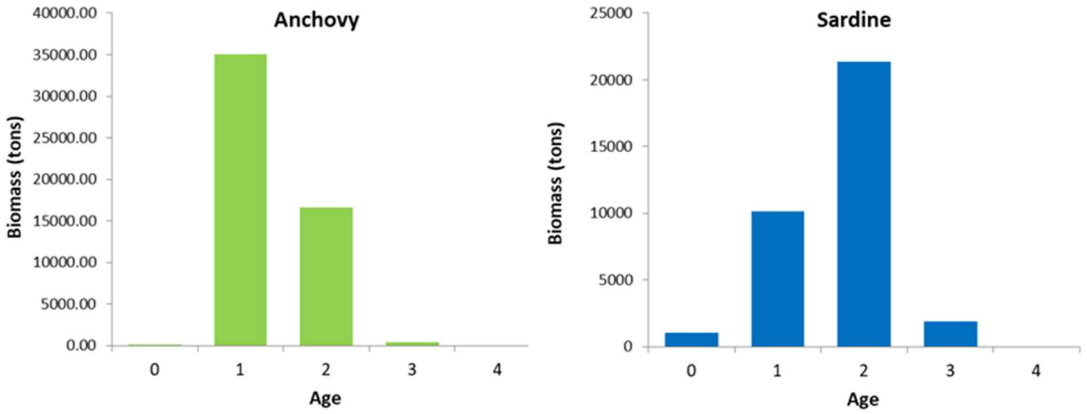



Figure 2.8.10. Anchovy and sardine biomasses (in tons) per age class in northern Aegean Sea (GSA 22) during June-July 2020.

h) Abundance indices of target species

Spatial distributions of anchovy and sardine abundance indices, in terms of NASC ($m^2/nm^2$) and biomass (tons/EDSU), are given in figures 2.8.11 – 2.8.18.

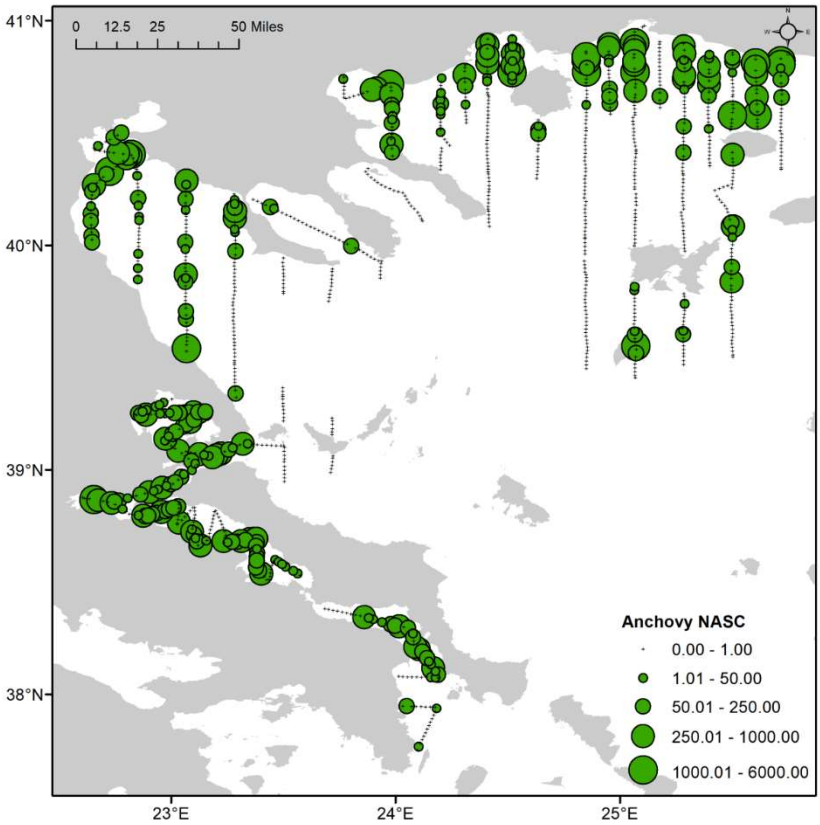



Figure 2.8.11. The distribution of the anchovy NASC ($m^2/nm^2$) per EDSU in northern Aegean Sea (GSA 22) during June-July 2019.

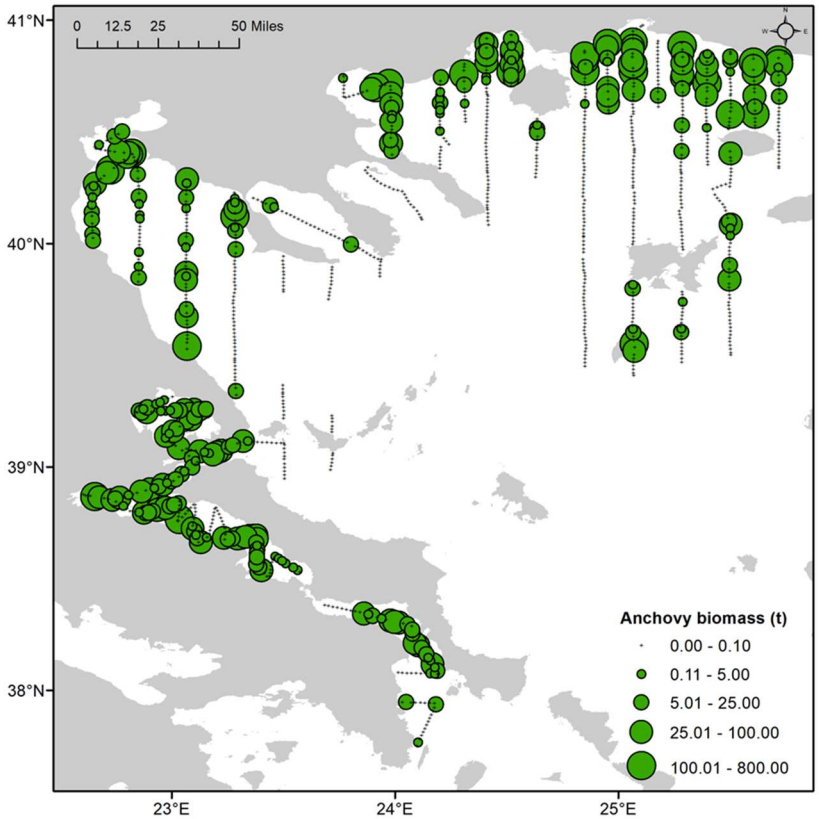



Figure 2.8.12. The distribution of the anchovy biomass (t) per EDSU in northern Aegean Sea (GSA 22) during June-July 2019.

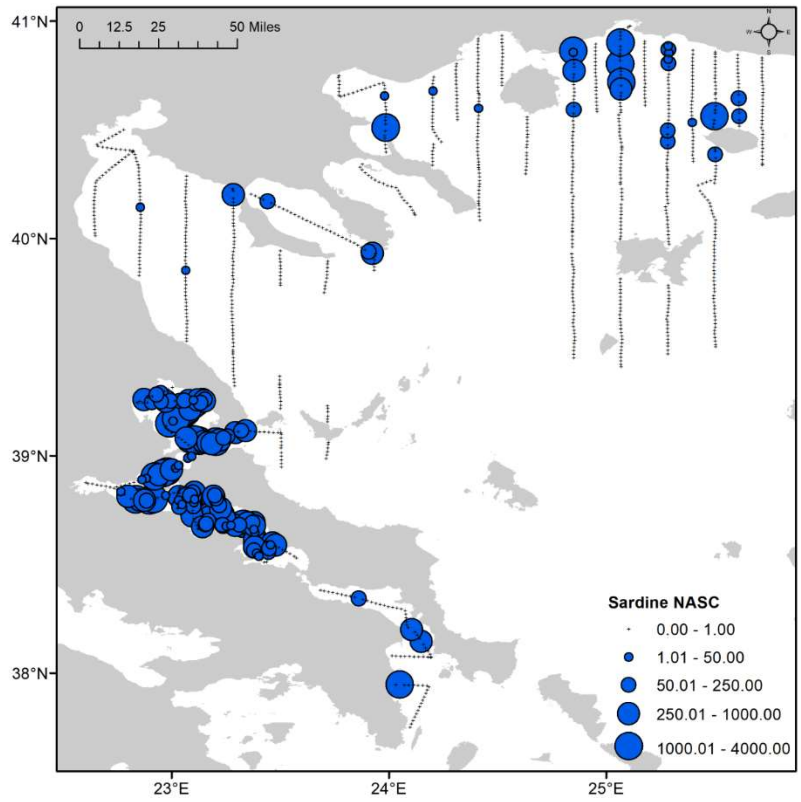



Figure 2.8.13. The distribution of the sardine NASC ($m^2/nm^2$) per EDSU in northern Aegean Sea (GSA 22) during June-July 2019.

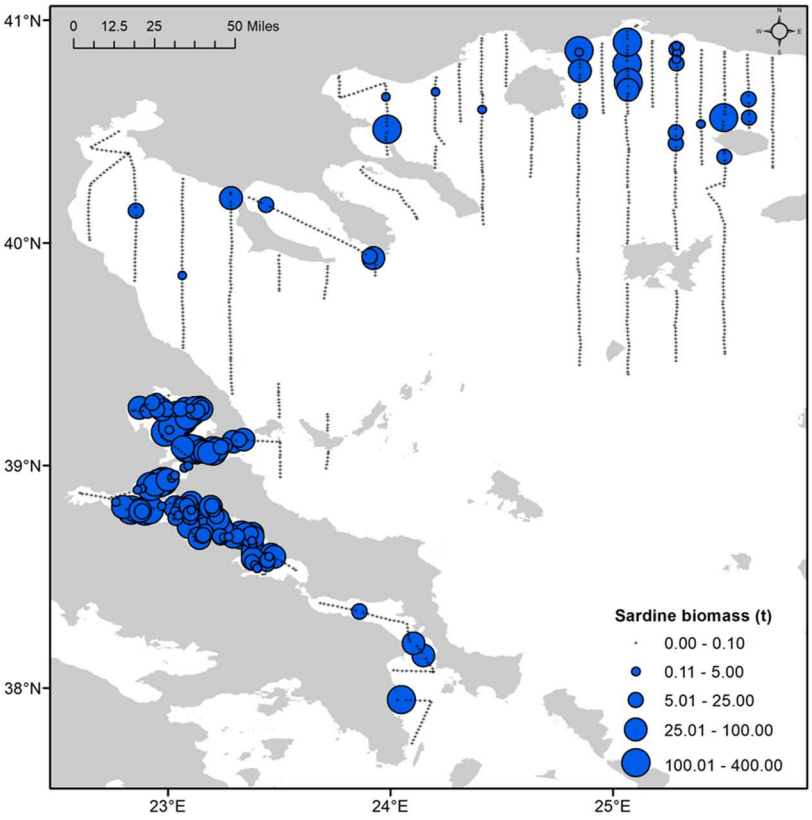



Figure 2.8.14. The distribution of the sardine biomass (t) per EDSU in northern Aegean Sea (GSA 22) during June-July 2019.

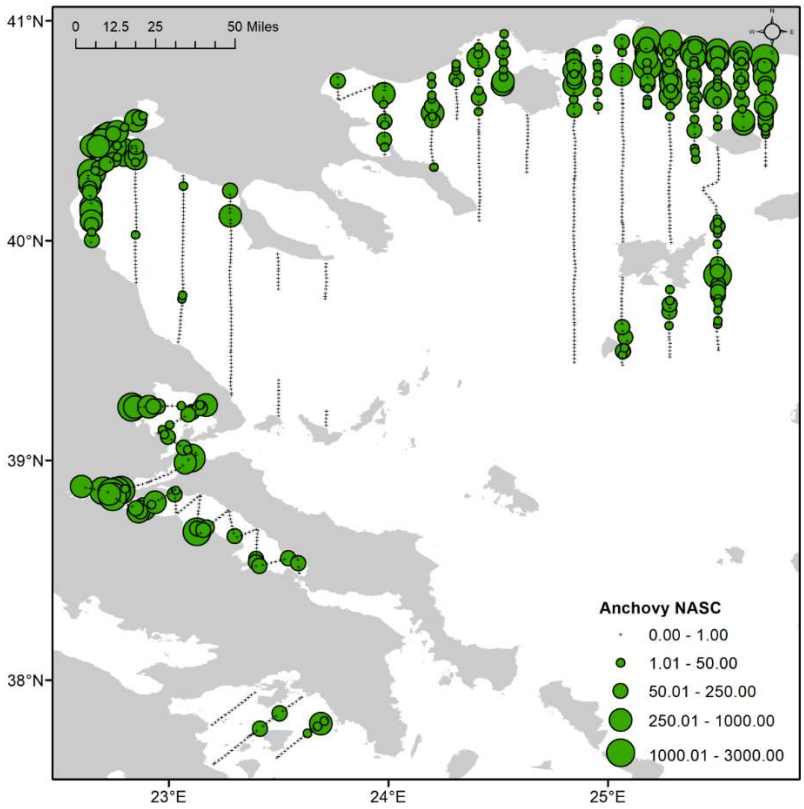



Figure 2.8.15. The distribution of the anchovy NASC ($m^2/nm^2$) per EDSU in northern Aegean Sea (GSA 22) during June-July 2020.

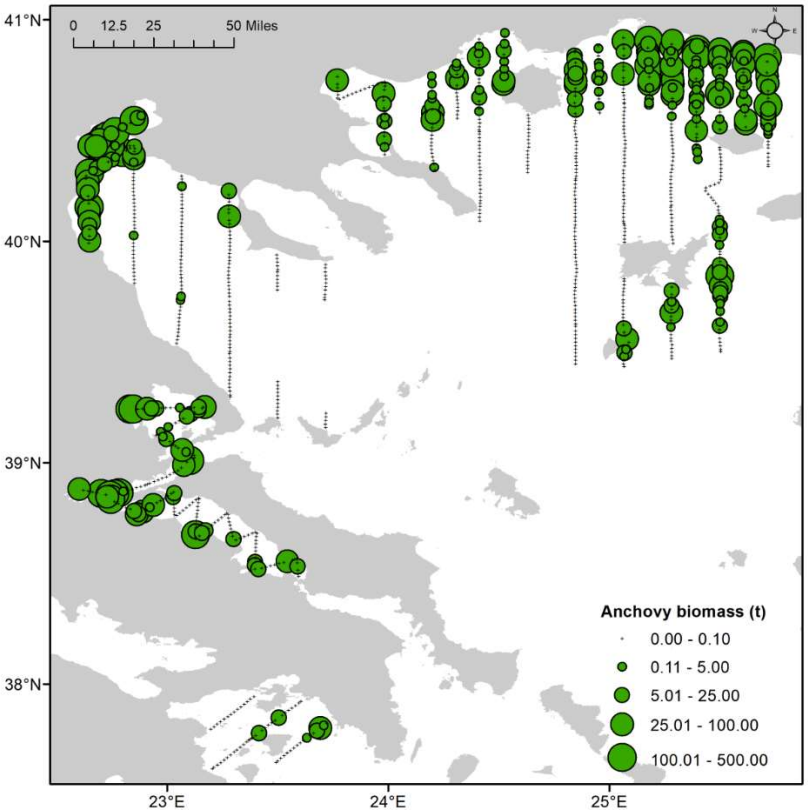



Figure 2.8.16. The distribution of the anchovy biomass (t) per EDSU in northern Aegean Sea (GSA 22) during June-July 2020.

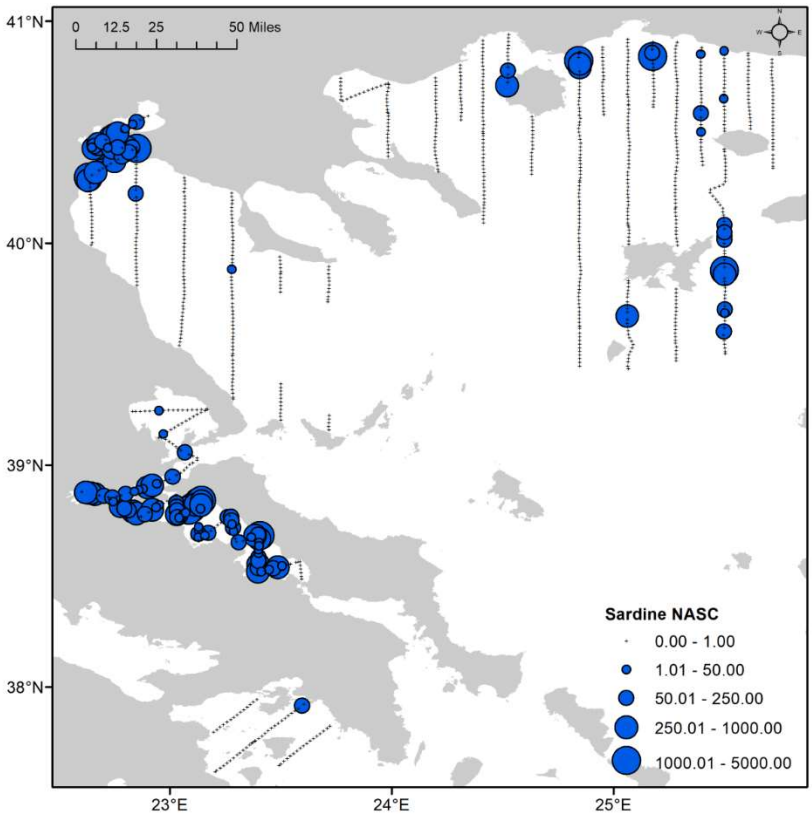



Figure 2.8.17. The distribution of the sardine NASC ($m^2/nm^2$) per EDSU in northern Aegean Sea (GSA 22) during June-July 2020.

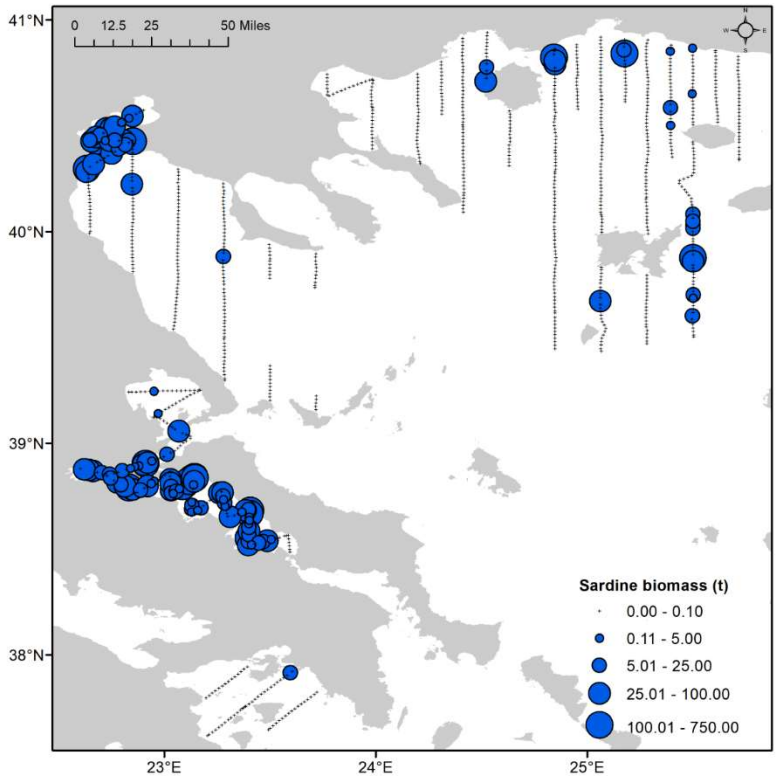



Figure 2.8.18. The distribution of the sardine biomass (t) per EDSU in northern Aegean Sea (GSA 22) during June-July 2020.

# 3. Results of pelagic trawl surveys in the Black Sea (GSA 29) in 2021

## 3.1 Results of the 2019-2020 surveys in the GSA 29 - Black Sea: Bulgarian survey (Raykov and Dimitrov)

Results of pelagic trawl surveys during 2021 in the Bulgarian waters of GSA 29 (Black Sea), carried out by IO-BAS, were presented in the meeting. MEDIAS Steering Committee acknowledged efforts of Bulgarian experts in conducting pelagic trawl surveys in Bulgarian area of GSA29.

## 3.2 Pelagic Surveys at the Romanian Black Sea Coast (GSA 29), in 2019 and 2020 (Madalina Galatchi and Valodia Maximov)

Results of spring and autumn pelagic trawl surveys during 2021 in the Romanian waters of GSA 29 (Black Sea), carried out by NIMRD, were presented in the meeting (http://www.medias-project.eu/medias/website/meetingrep/meet_pres_/2022-meeting-presentations/Pelagic-Surveys-in-2021-at-the-Romanian-Black-Sea-(GSA29)/). MEDIAS Steering Committee acknowledged efforts of Romanian experts in conducting pelagic trawl surveys in Romanian area of GSA29.

# 4. Results of other acoustic surveys in GFCM area (outside EU waters)

## 4.1 MarE acoustic survey in Albania (Eastern part of GSA 18 – Southern Adriatic Sea) in 2021 (Andrea De Felice, Iole Leonori, Ilaria Biagiotti, Giovanni Canduci, Ilaria Costantini, Antonio Palermino, Michele Centurelli, CNR-IRBIM)

a) General information on the survey

Continental shelf in front of Albania was monitored through acoustic survey together with the area in front of Montenegro since 2008 until 2016 thanks to financing from FAO AdriaMed Projects and CNR. In 2017 and 2018 due to prolonged bad weather conditions and ship availability limitations it was not possible to investigate this area.

In 2019 in the framework of the new project "Institutional assistance for the development of Albanian maritime economy", acronym MarE, an acoustic survey following MEDIAS protocol as for the previous years and covering the Albanian area was carried out. MarE project is financed by "Cooperazione Italiana allo sviluppo"/AICS Tirana and executed by CIHEAM of Bari. This project was thought to give a help to Albania in the Fishery and Tourism fields and particularly for Fishery to help with the management of fish stocks through the formation of local technicians on stock assessment topics and through the acquisition of data on small pelagic fish collected at sea. In 2020 another acoustic survey was scheduled, but due to Covid19 restrictions it was canceled. In 2021 acoustic survey in Albania was carried out, even if it was not possible to cover 100% of the area due to very prolonged bad weather conditions.

b) Type of echosounders and frequencies in use

Simrad EK80 scientific echosounder operating at 38 kHz, 70 and 120 kHz was used. Hull-mounted split beam transducers were connected to the transceivers. Due to a technical issue 200 kHz frequency could not be used during the survey.

c) Calibration results

Acoustic system was calibrated at 38, 70 and 120, using the standard sphere method.

Table 4.1.1. Calibration results in 2021.

| Vessel | | Date | Place | Latitude | | Longitude | Bottom depth (m) | | Temp. At sphere | | Salinity at sphere depth | | Speed of sound (m sec$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (kHz) | Echosounder type | Transducer ser. N° | Tungsten (Wc-Co) 38.1 mm TS (dB) | Pulse duration (msec) | Ψ (dB) | Default TS gain | Iter. N° | Time | Range to sphere (m) | Ping rate (s) | Calibrated TS gain | Time (GMT) | RMS | Sa corr. |
| 38 | SIMRAD EK60 | 30789 | -42.4 | 1.024 | -20.7 | 25.27 | 5000 | 09:32 – 10:00 | 20.5 | Max | 25.28 | 07:32 – 08:00 | 0.069 | -0.5603 |
| 70 | SIMRAD EK80 | 271 | -41.6 | 1.024 | -20.7 | 27.19 | 1784 | 10:01 – 10:25 | 20.5 | Max | 27.33 | 08:01 – 08:25 | 0.089 | -0.0577 |
| 120 | SIMRAD EK80 | 924 | -39.6 | 1.024 | -20.7 | 26.87 | 3047 | 10:26 - 10:43 | 20.5 | Max | 26.98 | 08:26 – 08:43 | 0.098 | -0.0039 |

d) Survey design

Acoustic data were logged over a grid of systematic parallel transects perpendicular to coastline/bathymetry (inter-transect distance 8-10 nmi). Bad weather conditions impacted heavily on the survey execution; anyway, around 70% of the total area was covered. A total of 123 nautical miles were processed for biomass estimation of target species.

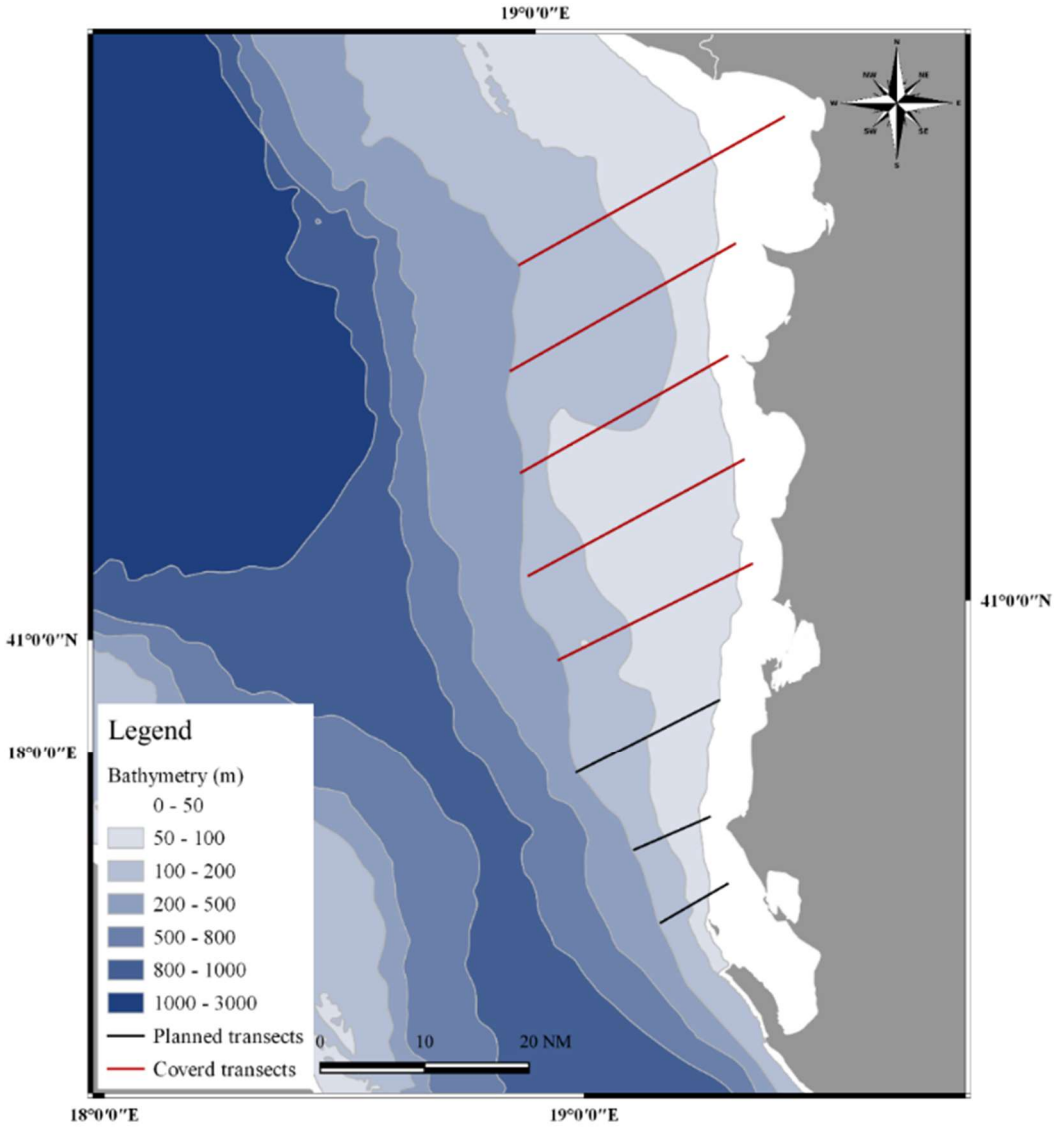



Figure 4.1.1. Acoustic survey plan in Albania. The transects effectively covered are evidenced in red.

e) Fish sampling

A midwater sampling trawl "Volante" was used. It has the following characteristics: 18 mm codend, about 10 m vertical opening and 12 m horizontal opening, headline/footrope = 35 m; sidelines length = 27 m.

Biological samplings were conducted along the survey routes for biomass allocation into species and to know mean lengths and weights of the pelagic fish (Species, Size Composition, length-weight relationship). Samples were also collected to determine age, by means of otoliths readings, following DCR standards, and maturity stages. Fishing operations were performed at different light conditions and bathymetry. Trawls during fishing operations were monitored by means of trawl sonar Simrad FX80. 5 pelagic hauls were performed in the study area.

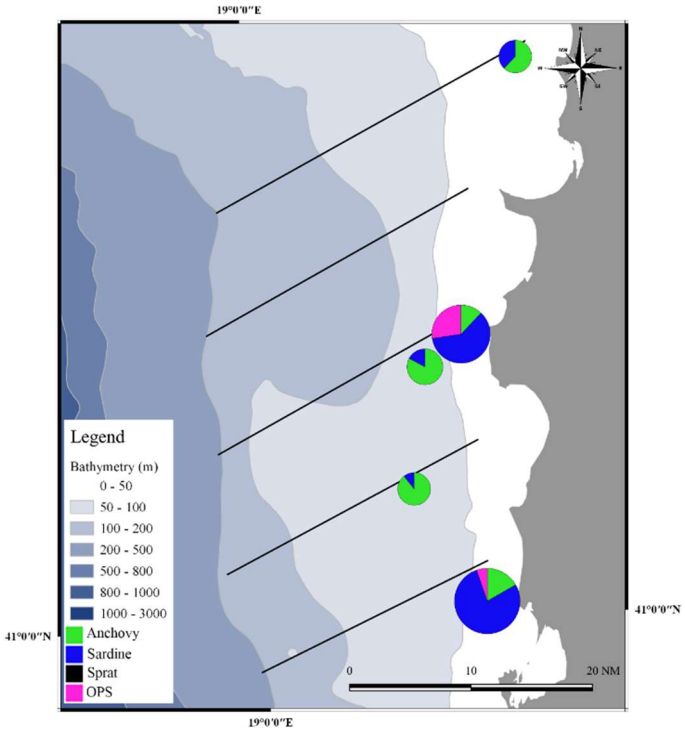



Figure 4.1.2. Pelagic hauls composition carried out during the acoustic survey in Albania (GSA 18 east).

f) Oceanographic parameters

Ten (10) CTD stations could be performed since environmental sampling effort was reduced due to the limited number of personnel on board.

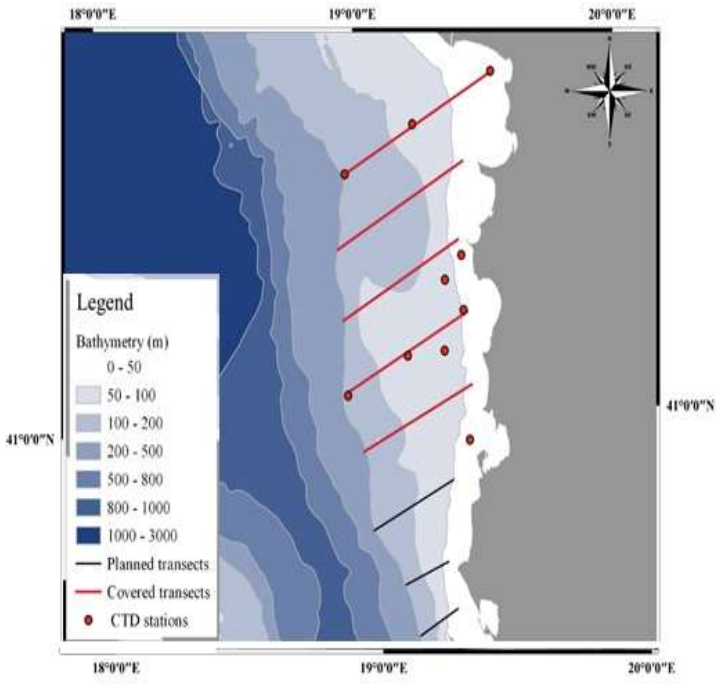



Figure 4.1.3. CTD stations carried out during the acoustic survey in Albania (GSA 18 east).

g) Biomass estimations of target species

Biomass of anchovy and sardine in tons in Albanian continental shelf (study area of 1569 $nm^2$) in 2021 resulted composed as the following:

- *Engraulis encrasicolus* 10,760.3 t (6.9 t/$nm^2$),
- *Sardina pilchardus* 9,930.2 t (6.3 t/$nm^2$).

Anchovy length frequency distribution in 2021 in terms of biomass was trimodal with peaks at 10.5, 14 and 16.5 cm (Fig. 4.1.4). Respect to past years, there was a remarkable presence of very big anchovy individuals (the third mode in the graph) reaching the rare maximum size of 17.5 cm. Sardine distribution resulted unimodal with a maximum at 11.5 cm (Fig. 4.1.5).

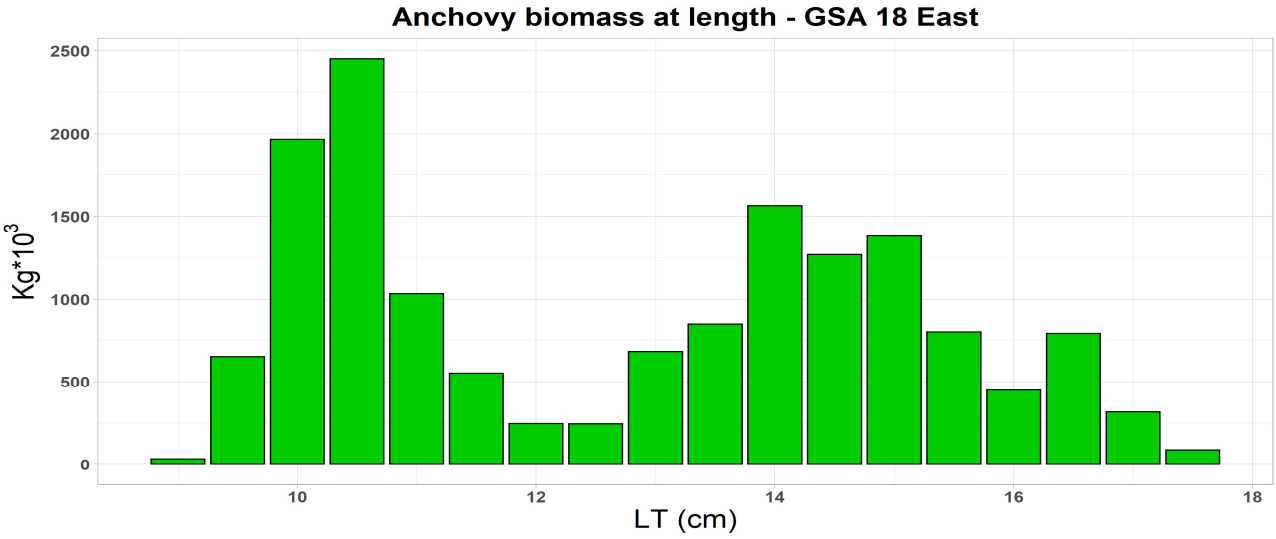



Figure 4.1.4. Anchovy (ANE) biomass in tons per length (LFD) in 2021 - GSA18 east (Albania).

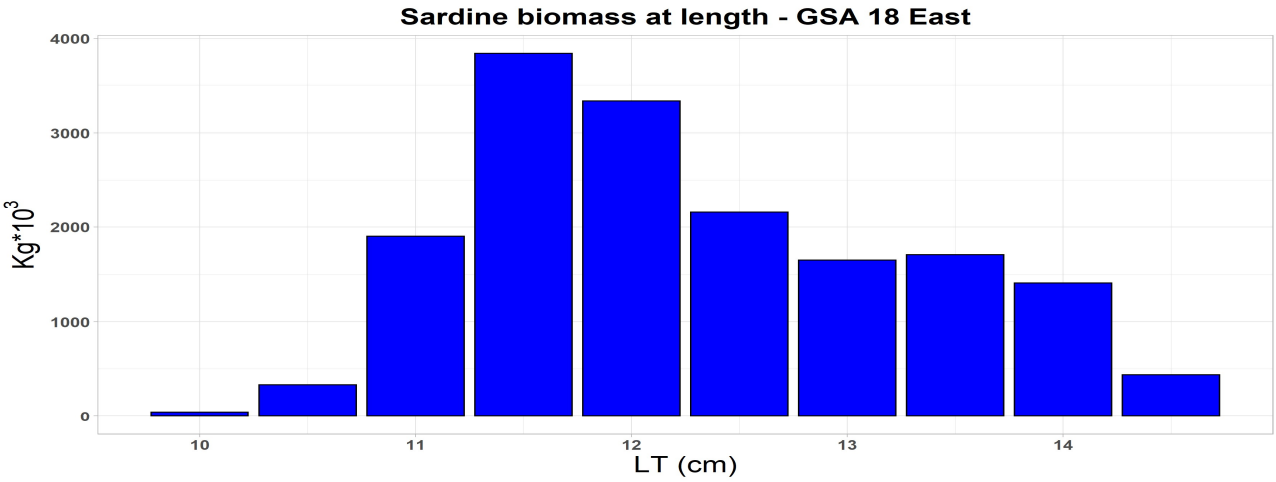



Figure 4.1.5. Sardine (PIL) biomass in tons per length (LFD) in 2021 - GSA18 east (Albania).

No specific age-length keys for anchovy and sardine were produced in this survey. In order to estimate age of anchovy and sardine populations in Albania, ALKs applied in western GSA 18 were used. These ALKs (Figs. 4.1.6 and 4.1.7) were based on 244 otoliths read for anchovy and 105 for sardine sampled in western part of GSA 18.

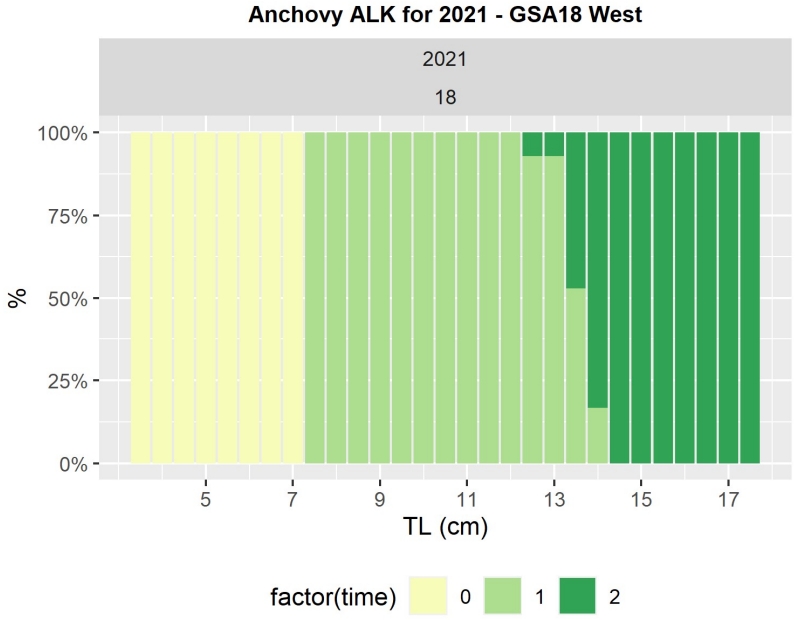



Figure 4.1.6. Anchovy ALK in western GSA 18 applied also in eastern GSA 18.

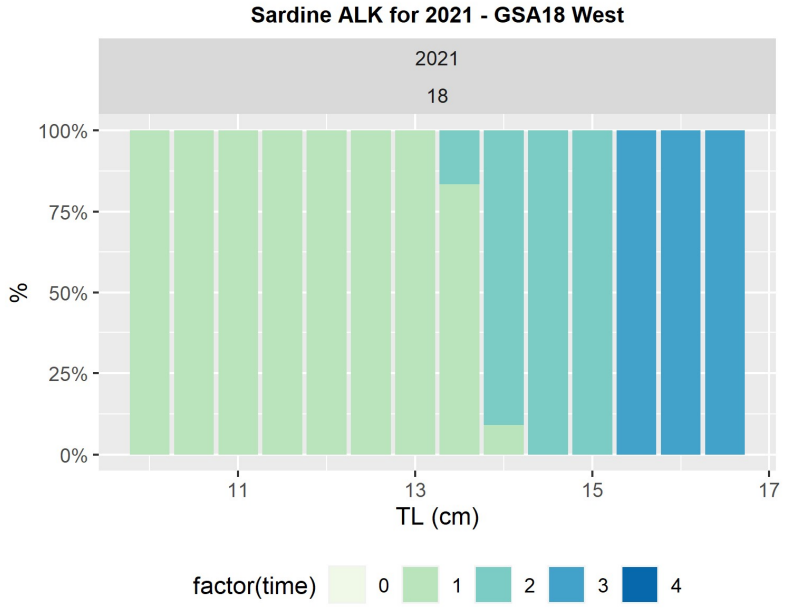



Figure 4.1.7. Sardine ALK in western GSA 18 applied also in eastern GSA 18.

Anchovy biomass presented two age classes, 1 and 2, with similar levels (Fig. 4.1.8). Sardine presented age classes 1 and 2 as anchovy, with age 1 being by far the most abundant in this case (Fig. 4.1.9).

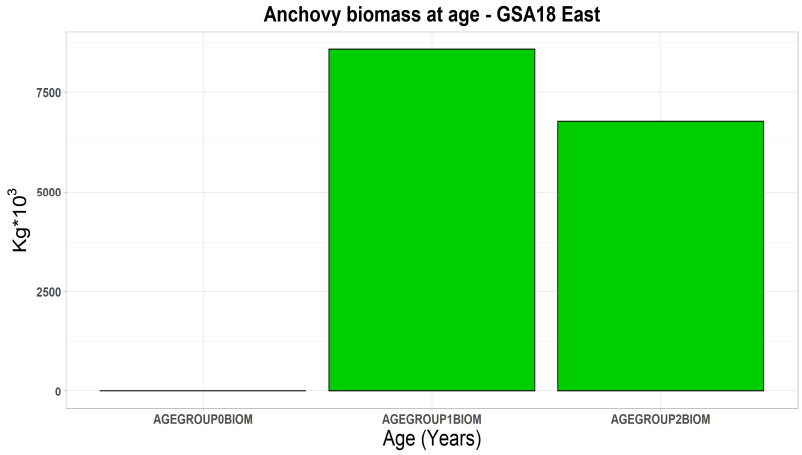



Figure 4.1.8. Anchovy biomass per age class in eastern GSA 18.

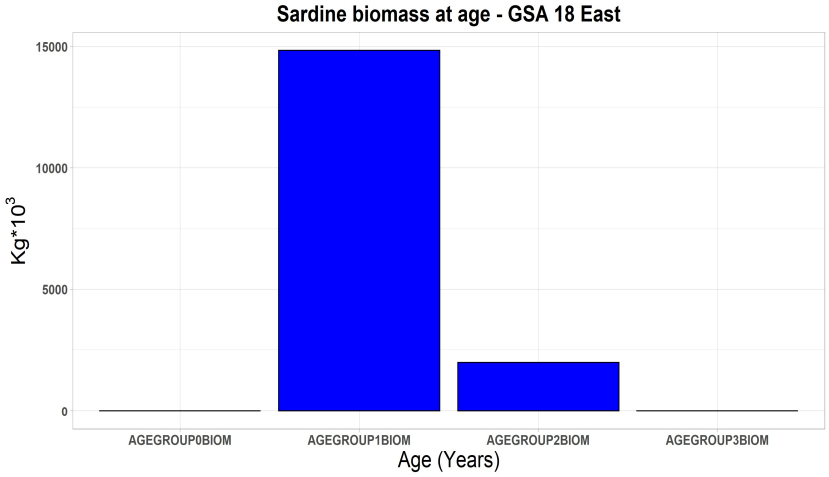



Figure 4.1.9. Sardine biomass per age class in eastern GSA 18.

h) Spatial distribution

Anchovy spatial distribution in Albania in 2021 was concentrated in the Drin Gulf for what concerns coastal areas, but for the rest, this species was found mainly in offshore areas from the bathymetry of 50 m to around 150 m. Sardine was mainly concentrated from the coast until the bathymetry of 50 m.

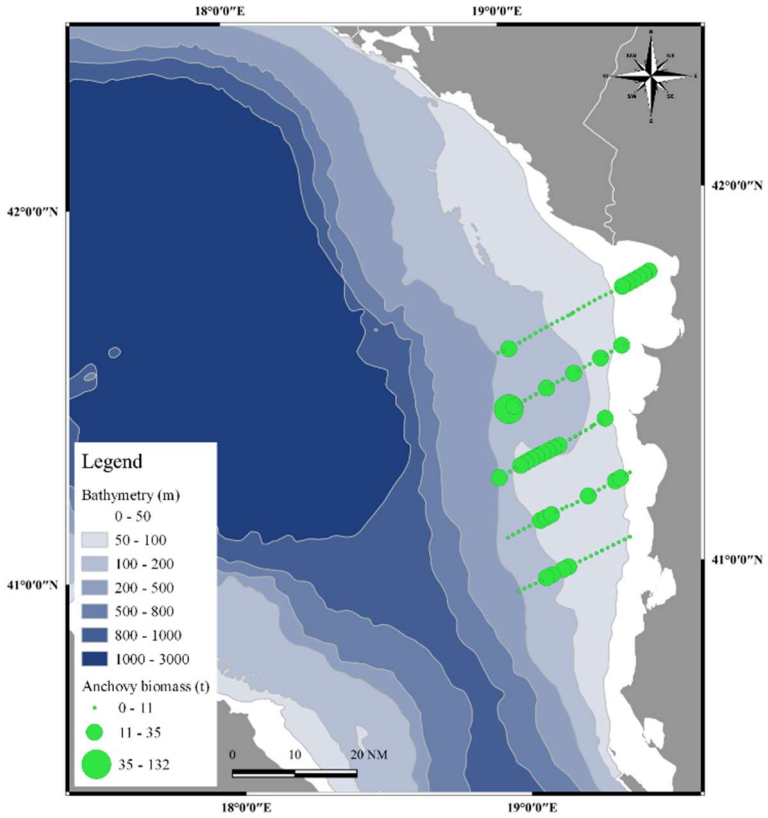



Figure 4.1.10. Spatial distribution of anchovy biomass in Albania in 2021.

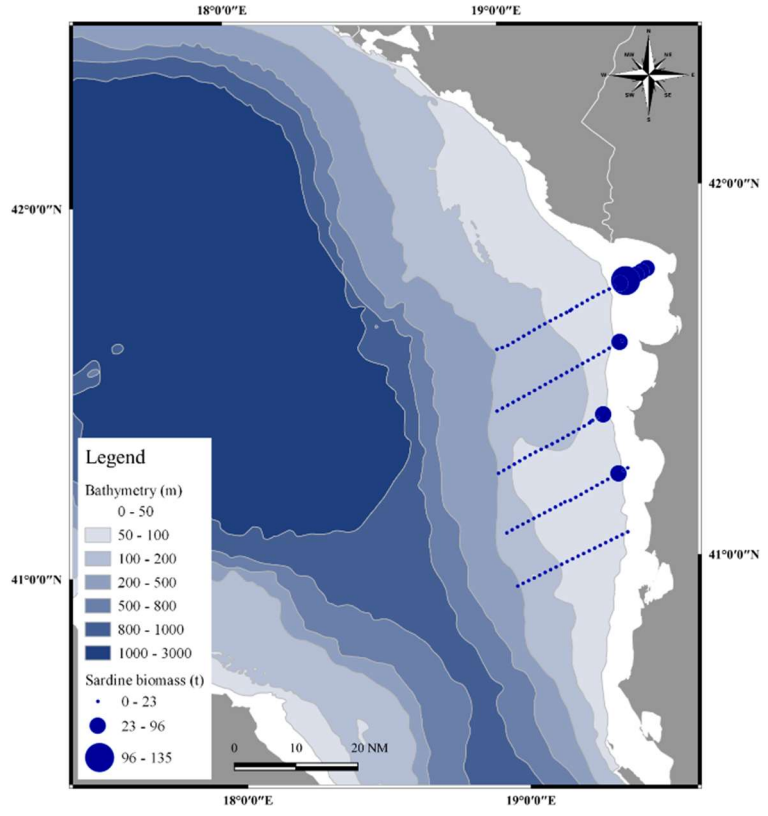



Figure 4.1.11. Spatial distribution of sardine biomass in Albania in 2021.

# 5. Communication with DG-MARE

In communication with the representative of EC, Venetia Kostopoulou from DG - MARE Unit C3, before the meeting, the chair of MEDIAS suggested that it could be a good practice for the future work of the MEDIAS Steering Committee (SC) to foresee regular participation of representatives from DG-MARE. According to the representative of EC, such a proposal for a 'standing' COM participation in MEDIAS SC meetings is very good, as regular communication of DG-MARE with the MEDIAS group will add value to these meetings. Unfortunately, the representative of DG-MARE could not attend the meeting of MEDIAS SC this year.

However, DG-MARE expressed its interest in the opinion of the MEDIAS group on the following topics if they are discussed at the meeting:

1) Possible integration of MEDIAS data in the future regional database of the Med & BS and next steps;

2) Possible issues in need of harmonisation of MEDIAS across GSAs/MS (e.g. on fishing gear);

3) Possible agreement on harmonised MEDIAS-related input for Annual Reports and Work Plans (Tables and Text boxes), if relevant;

4) Overview of how MEDIAS data have been used in stock assessment;

5) Any age reading issues or updates.

In the discussion that followed, MEDIAS SC focused on issues that need harmonization among GSA/ MS. It was clarified that information obtained from fishing gear used in MEDIAS (e.g., pelagic trawls) is considered qualitative, and not quantitative information. MEDIAS Handbook indicates that "the trawling gear used is of no importance as long as it is suitable to catch a representative sample of the target- school or layer". Fishing gears with different characteristics are used because they are adapted to the characteristics of the different research vessels, and the need to harmonize the different research vessels should be the focus in the future harmonization. It was recalled that MEDIAS SC has already proposed intercalibration between research vessels as a necessary step, but no resources have been available for this purpose.

The Chair also reminded that various harmonization issues were discussed at the last 14th MEDIAS meeting and reported to RCG Med& BS (see 14th MEDIAS report, Table 6.2). In addition, it was pointed out that not all of these issues can be resolved within framework of MEDIAS SC, but that in some cases (e.g., research vessels intercalibration) the harmonization process depends directly on the availability of resources (e.g., funds, vessel time, etc.) and coordinated support from the respective MS and DG-MARE is needed.

MEDIAS SC emphasized the need to push for research vessel intercalibration. In addition, it became clear at the meeting that acoustic surveys are highly dependent on the availability and operational capability of the existing research vessel due to the lack of alternative research

vessels or suitable commercial vessels. Consistent with the need for further harmonization, MEDIAS SC agreed to consider vessel intercalibration as a first priority.

Harmonization of some on-board sampling procedures (e.g., meso-zooplankton sampling) was also discussed. MEDIAS SC emphasized the importance of zooplankton sampling in acoustic surveys (e.g., vertical tows, CUFES, etc.) and the need to standardize it among all acoustic teams as much as possible, including consideration of available ship time relative to coverage of the various sizes of survey areas concerned. The importance of sampling zooplankton in the context of MFSD in GSA7 was mentioned, suggesting that zooplankton data could also be important for stock assessments of small pelagic fishes. In addition, sampling of plankton scattering layers using plankton nets could facilitate echogram interpretation and thus improve the accuracy of stock assessments for anchovy and sardine. Potential relationships between acoustic surveys and anchovy stock assessments based on the daily egg production method were also discussed.

The group stressed the need to obtain funding from the DCF for plankton sampling and analyses because of the importance of these data for the interpretation of acoustic observations, and for their relevance to the monitoring of the pelagic ecosystem. This additional funding is intended to be used primarily for the integration of meso-zooplankton sampling in existing MEDIAS surveys. Nevertheless, for some MS for which additional sampling effort is not feasible due to research vessel and/or scientific crew constraints, the new funding could also allow the initiation of new specialized plankton survey in close collaboration with the acoustic surveys.

MEDIAS SC is aware of its limitations and the fact that some harmonization processes (e.g. intercalibration of research vessels, workload/vessel day) require the participation and synergy of the administrations of the respective EU Member States, RCG Med& BS and/or DG-MARE.

In line with the adopted agenda of the meeting, MEDIAS SC also discussed other topics mentioned by DG-MARE. Outcomes of these discussions on other topics are included in other parts of this report.

# 6. Review of issues discussed in other meetings held in relation to MEDIAS

MEDIAS Chair presented to Steering Committee an overview of some outcomes of past international meetings related to the activities of EU-MEDIAS as follows:

a) Recommendation #12 of the RCM Med& BS meeting in 2016, dealing with the availability of MEDIAS data for MS and end users. It was noted that RCM Med& BS agreed in 2016 that MEDIAS data need to be available after March 31 of the next year (e.g., N+1 March 31, where N is the year of the survey), and MS and end users are recommended to respect this date;

b) Recommendation #10 of the RCM Med&BS meeting in 2017, which addressed the implementation of new surveys at-sea in EU MAP (e.g., SOLEMON in GSA17, acoustic surveys in additional GSAs 11 and 19), clearly indicated that newly proposed surveys should not affect in any way the implementation of existing surveys in terms of available resources for ongoing surveys at-sea, MEDITS and MEDIAS (Annex IV);

c) Recommendation #3 - Documents for end-users from the report of the Meeting with End-users of Scientific data (GFCM Headquarters, Rome, Italy, 12-14. March) in 2019, addressing data transmission to GFCM, clearly states that only GFCM members (CPCs) should provide data for use in GFCM working groups, while national scientists (e.g., MEDIAS experts) should not be asked by GFCM to provide and work on its own datasets during working groups.

d) Recommendation GFCM/44/2021/20, which addresses the multi-year management plan for the sustainable exploitation of small pelagic stocks in the Adriatic Sea (GSAs 17-18), calls on GFCM members (CPCs) to ensure that all scientific data, including echo survey data, are made available by 1st of April of the following year (year N+1). With regard to the previous RCM Med& BS Recommendation #12 from 2016, it can be noted that MEDIAS data from GSA 17-18 need to be provided to the GFCM by respected CPSs on the first day of their availability, and therefore no time is foreseen for the administrations of EU MS's for data handling and verification, which may have a negative impact on the quality of the data submitted.

The Chair also informed MEDIAS SC that there was no joint meeting with ICES WGACEEG in 2021 due to problems caused by COVID -19.

In addition, the Chair informed MEDIAS SC about the outcomes of the 2021 RCG Med & BS virtual meeting (September 7-9). As foreseen in the MEDIAS SC conclusions of the 14th MEDIAS meeting in 2021, the Chair made initial contacts with the experts responsible for regional database (i.e. Stefanos Kavadas, coordinator of the MARE /2020/08 regional grant) and the coordinator of the STREAMLINE project (Alessandro Ligas) on behalf of MEDIAS SC. The Chair also informed MEDIAS SC about the presentations from that meeting related to the Regional Database (RDB) and the STREAMLINE project, pointing out that the RDB is still under development and currently contains 7 data tables related to MEDIAS, but there are no plans to include a MEDIAS expert as a member of the RDB Steering Committee. With respect to the STREAMLINE project, it was emphasized that this project focuses primarily on commercial and recreational fisheries.

In following discussion on RDB, it became clear that, on one hand key role in decision making and responsibility for data provision is given to MS's administrations, but on the other hand, it was also noted that administrative staff may not be familiar with the information requested in the RDB data tables associated with MEDIAS. It was pointed out that RDB is developing in the context of a specific project in which the experts of MEDIAS are not involved. SC members also expressed some doubts about the general scope of RDB, noting that the purpose and utility of RDB for MEDIAS SC is not entirely clear. The group expressed the desire that RDB would be developed as a useful tool for the experts of MEDIAS and not only for administrative

purposes. Due to the high complexity of the data from MEDIAS, from a formal point of view, it might be necessary to include a representative of the MEDIAS group in the RDB Steering Committee.

# 7. Information for management decisions

Regarding information used for management decisions, the MEDIAS Steering Committee noted that management decisions are not directly based on MEDIAS fishery-independent stock evaluations, but in all cases MEDIAS stock evaluations contribute in tuning of stock assessment models based on commercial fisheries data. The results of these fishery-based stock assessment models, tuned with MEDIAS data, are ultimately used to formulate scientific advice for management decisions.

## 7.1 Input for stock assessment purposes concerning stocks which are managed internationally

MEDIAS Steering Committee noted that stocks of small pelagic fish, anchovies, and sardines in the Mediterranean Sea (i.e., MEDIAS target species) are managed internationally by the General Fisheries Commission for the Mediterranean (GFCM). To support fisheries management, EU-MEDIAS provides annual fishery-independent, age-structured estimates of abundance and biomass of anchovy and sardine stocks within the survey area and relative to the survey period.

The MEDIAS Steering Committee was informed that 18 small pelagic stocks were assessed by the GFCM (GFCM WGSASP) this year, all of which were tuned based on acoustics. Four stock assessments were based on the surplus model, while 14 assessments were based on age-structured models. Since last year, information from acoustics has been improved.

The MEDIAS evaluations of anchovy and sardine stocks are provided (by the respective EU Member States) to the end-user expert working groups (STECF and GFCM) as input for analytical stock assessments in the form of length-, age-, and sex-structured abundance and biomass estimates (e.g., number/age and per length class; biomass/age and per length class and sex). Estimates from EU-MEDIAS are uploaded to the JRC database annually, using three specific templates (Abundance, Biomass and Abundance biomass) available at https://datacollection.jrc.ec.europa.eu/dc/medbs/templates.

## 7.2 Information for Good Environmental Status in the MSFD

MEDIAS SC was informed that EC has produced a set of detailed criteria and methodological standards to help Member States implement the Marine Strategy Framework Directive (MSFD). These were revised in 2017 and resulted in the new Commission Decision on Good Environmental Status. The descriptors related to MEDIAS are:

- D3: "Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock."

- D4: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

As mentioned in the previous meeting, important criteria related to Descriptor 3 (D3 (Commission Decision (EU) 2017/848 of 17 May 2017)) are:

**D3C1 – Primary**: The Fishing mortality rate of populations of commercially exploited species is at or below levels which can produce the maximum sustainable yield (MSY).

**D3C2 – Primary**: The Spawning Stock Biomass of populations of commercially exploited species are above biomass levels capable of producing maximum sustainable yield.

**D3C3 – Primary**: The age and size distribution of individuals in the populations of commercially-exploited species is indicative of a healthy population. This shall include a high proportion of old/large individuals and limited adverse effects of exploitation on genetic diversity. Member States shall establish threshold values through regional or sub-regional cooperation for each population of species in accordance with scientific advice obtained pursuant to Article 26 of Regulation (EU) No 1380/2013.

MEDIAS Steering Committee was reminded of the similarity between the MSFD and the Common Fisheries Policy (CFP). Both the MSFD and CFP require estimates of fishing mortality (F) and spawning stock biomass (SSB), but at different time periods: the MSFD requires estimates over a six-year period, while the CFP requires annual estimates.

During surveys-at-sea, additional environmental data could be collected such as marine mammal data, mesopelagic fish data, mesozooplankton data, etc.

It was mentioned that EU Member States are responsible for fulfilling data requests for MSFD that come from DG-ENVIRONMENT and not from DG-MARE. Therefore, another agency within MS (e.g., the Ministry of Environment), rather than the Ministry of Agriculture, is usually responsible for providing MSFD-related information.

The Steering Committee noted that MEDIAS experts may be able to contribute to the description of biodiversity indices (i.e., population size per species: total biomass and

abundance estimates for target species (+ CV estimate)) and in the description of population status of target species (i.e., biomass/abundance estimate per size/age) in certain GSAs, at the request of their respective MS. Potentially, MEDIAS can also provide recruitment indices and fish community synthesis information (i.e., species composition and total fish NASC ).

# 8. Review on MEDIAS papers published in Special Issues of MMS journal and status of other papers

The guest editor of the MMS special issue, Andrea De Felice, informed SC that eight (8) MEDIAS papers have been successfully published (available at: https://ejournals.epublishing.ekt.gr/index.php/hcmr-med-mar-sc/issue/view/1696 ), including an introduction to the "MEDiterrannean International Acoustic Survey" by Giannoulaki et al. 2021 (https://ejournals.epublishing.ekt.gr/index.php/hcmr-med-mar-sc/article/view/29068) and a review paper describing the history of acoustic surveys in the European Mediterranean Sea written by Leonori et al. (https://ejournals.epublishing.ekt.gr/index.php/hcmr-med-mar-sc/article/view/26001 ).

Other MEDIAS paper published in Special Issues of MMS journal (2021) were:

- Effects of sampling intensity and biomass levels on the precision of acoustic surveys in the Mediterranean Sea, written by Barra et al. (https://doi.org/10.12681/mms.26100);
- Acoustic correction factor estimate for compensating vertical diel migration of small pelagics, written by Bonanno et al. (https://doi.org/10.12681/mms.25120);
- Distribution, diet and relationships of the invasive ctenophore *Mnemiopsis leidyi* with anchovies and zooplankton, in the northeastern Adriatic Sea, written by Budiša et al. (https://doi.org/10.12681/mms.23305);
- Environmental drivers influencing the abundance of round sardinella (*Sardinella aurita*) and European sprat (*Sprattus sprattus*) in different areas of the Mediterranean Sea, written by De Felice et al. (https://doi.org/10.12681/mms.25933);
- Variability in size at maturity of European anchovy (*Engraulis encrasicolus*) within the Mediterranean Sea, written by Ferreri et al. (https://doi.org/10.12681/mms.25995);
- Temperature strongly correlates with regional patterns of body size variation in Mediterranean small pelagic fish species, written by Hattab et al. (https://doi.org/10.12681/mms.26525) and
- Temporal and spatial genetic variation of *Engraulis encrasicolus* in the Adriatic Sea, written by Malavolti et al. (https://doi.org/10.12681/mms.25990).

Ana Ventero reminded SC that the paper on zooplankton was rejected by the MMS journal and not published in the special issue. The authors plan to continue working on this topic and eventually submit the improved manuscript to the journal Marine Biology.

The target strength (TS) related issues encountered in the manuscript about anchovy TS, that prevented publication in the MMS special issue were explained by leading author Zacharias

Kapelonis. The authors will continue to work on this manuscript later this year with aim to improve it and make it suitable for publication hopefully in 2023.

Regarding the planned paper on Trachurus, Gualtiero Basilone explained that the spatial distribution of data was not as expected, as only data from CNR-IAS (GSAs 9, 10, and 16) were available. The authors are waiting for possible improvements in the available datasets, so this paper is on "stand-by" at the moment.

Regarding the planned paper on spatial indicators, Marianna Giannoulaki (HCMR) informed SC that this paper is very advanced so far. The biggest difficulties were encountered in the Adriatic region, as the data from the eastern and western parts of the Adriatic are very different. It is foreseen that the authors will continue to work on this paper by e-mail correspondence.

The bureaucratic problems and misunderstandings related to the payment of publication costs were also raised, and it was explained to SC that the whole amount was paid by CNR-IAS.

## 8.1 Review of the paper on "New evidences on acoustic backscatter of *Trachurus mediterraneus*, *Scomber colias* and *Sprattus sprattus*" (Antonio Palermino , Andrea De Felice , Giovanni Canduci , Ilaria Biagiotti , Ilaria Costantini , Michele Centurelli , Iole Leonori *)

Knowing the species-specific target strength (TS) allows converting volume backscattering strength, provided by the survey into absolute biomass estimates. Nevertheless, the stochastic nature of TS makes it one of the main sources of uncertainty in biomass estimates. TS measurement approaches can be grouped into three main categories: *ex situ,* where the fish are measured in controlled experiments, backscattering modelling, and *in situ,* where fish are measured in their natural environment. The latter is currently considered the best available method, even though the scarcity of monospecific hauls and gear selectivity still involve limitations for the data analysis. Despite its importance, in the Mediterranean Sea, there were no available studies on the TS of non-target species like *Scomber colias* and *Trachurus mediterraneus* and only Azzali in 1994 investigated the TS of *Sprattus sprattus*. Nowadays, the conversion factor values in use in the Mediterranean Sea for these species are heterogeneous and the $b_{20}$ applied for *S. colias* and *T. mediterraneus* rely on studies conducted on other species of the same genus carried out in other areas. In the presentation, Palermino et al. (2021) reported the results of the application of the aforementioned techniques in order to increase the knowledge of species-specific acoustic reflectivity of the three species.

Firstly, the results of a novel ex-situ experiment on tethered fish carried out in 2013 and 2014 based on the calibration sphere method using a fish instead of a sphere were presented. A small scrap of synthetic rope was used instead of a hook so as to reduce the stress on the fish and the strength of the unwanted echoes. In Figure 8.1.1 it is depicted the experimental

design. TS was measured at three frequencies, 38,120 and 200 kHz using a EK60 echosounder. The analysis of TS histograms revealed a Gaussian distribution feature by one or two modes that suggest a wide range of tilt angles and movements performed by specimens during TS measurements. Successively, the mean TS to TL regression was calculated using the standard model: $TS = m\,log\,L + b$ and the model proposed by Foote (1987)[1]: $TS = 20\,log\,L + b_{20}$. The results of the fitted linear models reported in Table 1 show values significantly different compared to the one now in use in the Mediterranean Sea; more details can be found in Palermino et al. 2021 (https://doi.org/10.1016/j.fishres.2021.105973 ).

Secondly, some preliminary results on the application of backscattering models were presented in order to validate the ex-situ experiment results. The latter, suggest a good agreement between empirical and theoretical model considering a fish mean tilt angle of -11° SD=12° in Kirchhoff Ray Approximation model computations.

Table 8.1.1. Results of the linear regression models. The slope represents the parameter *m* in the standard equation. To compute the $b_{20}$ values displayed below the slope was forced to 20.

| **Frequencies** | ***T. mediterraneus*** | | ***S. colias*** | |
|---|---|---|---|---|
| **38 kHz** | Slope= 15.1<br>Intercept *b*= -64.9 | $b_{20}$= -71.4 | Slope= 15<br>Intercept *b*= -63.8 | $b_{20}$= -71.6 |
| **120 kHz** | Slope= 11.6<br>Intercept *b*= -61.4 | $b_{20}$= -72.7 | Slope= 10.9<br>Intercept *b*= -60.7 | $b_{20}$= -74.8 |
| **200 kHz** | Slope= 11.8<br>Intercept *b*= -61 | $b_{20}$= -72.2 | Slope= 12.4<br>Intercept *b*= -62.7 | $b_{20}$= -74.5 |

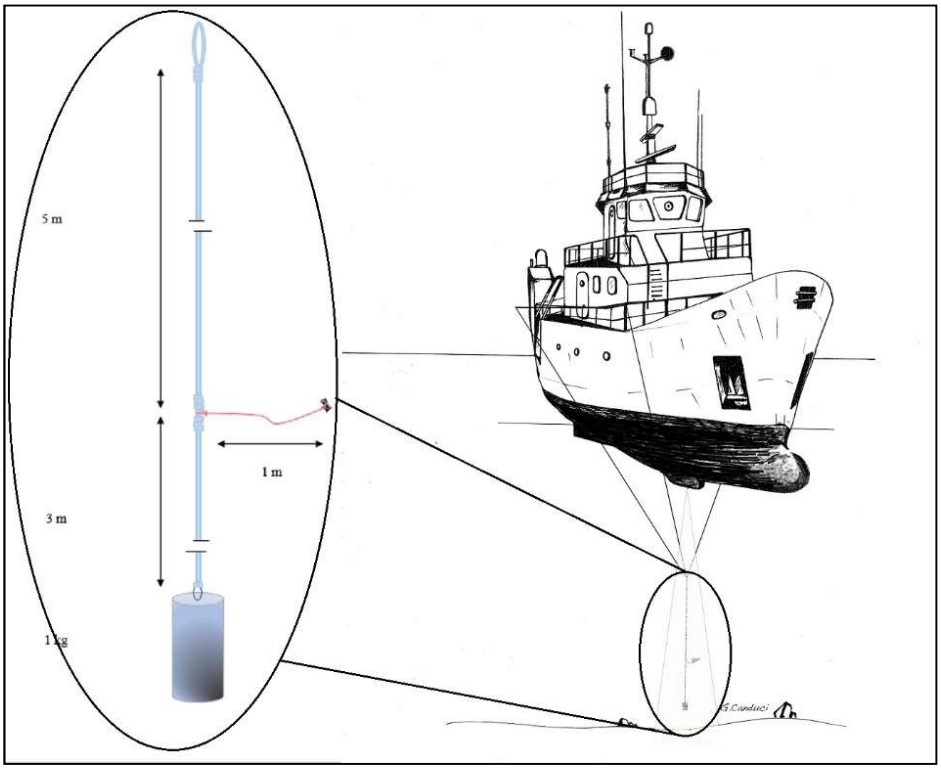


Figure 8.1.1. Experimental design

Thirdly, the analysis conducted on two sprat monospecific hauls collected during MEDIAS 2014 and 2020, was shown. A density filter algorithm and a multifrequency algorithm were performed to reduce the inclusion of unwanted targets. Successively, due to the poor dataset, two theoretical approaches were applied in order to match the length-frequency distribution with the TS distribution following the formulae published by MacLennan and Menz (1996) and an improvement of the method proposed by Kasatkina (2005). Finally, a Ten thousand Monte Carlo simulation was computed on the new $b_{20}$ values to assess the influence of TS uncertainty on biomass estimates of sprat in 2014 and 2020. All the methods resulted in higher $b_{20}$ values compared to that one now in use in the Mediterranean and the Black Sea, affecting the biomass estimates up to 20%.

Summarizing, we found different conversion factor values for *T. mediterraneus* and *S. colias* compared to the available literature on other species of the genus *Trachurus* and *Scomber*. Due to the absence of data in the entire Mediterranean Sea we opened a discussion about the possibility to adopt the -71.4 and -71.6 dB found in this study (Table 8.1.1) as new $b_{20}$ reference values for *T. mediterraneus* and *S. colias* respectively. Additionally, the analysis of sprat TS revealed higher $b_{20}$ values compared to the ones now in use in the Mediterranean Sea. Despite the small dataset, these results may be considered as a proxy for sprat-specific TS estimation in the light of the consequently influence on biomass estimates. We underlined the necessity to implement the acoustic data collection on this species to validate our results and standardize the $b_{20}$ values currently in use.

# 9. Progress review on production of standardized NASC maps at the Mediterranean scale

MEDIAS SC noted that the main expert working on the production of standardized NASC maps at the Mediterranean scale, Marco Barra, was unable to attend the meeting. It was mentioned that last year the IFREMER team agreed to use a common TS for anchovies and sardines this is a step in the right direction to facilitate the standardization of maps to be produced on the Mediterranean scale.

In addition, the development of RDB may also potentially benefit the production of common maps, but standardization of datasets from different acoustic teams is a necessary prerequisite for this.

Tarek Hattab mentioned the possibility of using EchoR for creating common maps and suggested to do some tests. For this purpose, data from all areas must be available in one place.

MEDIAS SC noted that it will not be possible to create common maps this year. The discussion that followed focused on the need to collect data from all acoustic teams and it was decided to send them to Marco Barra at least one month before the meeting so that they are ready for the next SC meeting. To facilitate this first step, it was suggested to start working on common maps with only one year to set up the system. Over time, additional years can be added.

In the discussion that followed, SC agreed that the first datasets for this purpose will be those related to the 2019 anchovy NASC, and that these datasets must be submitted by each acoustic team to Marco Barra by February 2023.

MEDIAS SC agreed to include this item in the Terms of Reference for 2023.

# 10. Work on standardization of age reading and maturity estimates

In a short presentation, the Chair of MEDIAS SC recalled the conclusion #7 of the 14th meeting of MEDIAS from last year and what is written in the MEDIAS protocol/Handbook about biological analysis. He also informed SC about the request to organise thematic workshops on biological analyses in the Mediterranean Sea that was made at the RCG meeting in September 2021. However, this request was not adopted as a specific RCG recommendation at this meeting.

Currently, the MEDIAS Handbook foreseen the use of common criteria for maturity stage analyses (e.g., WKSPMAT, 2008) and common criteria for age determination (e.g., WKARA2, 2016).

In the discussion that followed, Ilaria Constantini (CNR-IRBIM) pointed out that the GFCM requests maturity data based on a general maturity scale for bony fish that differs from that in the MEDIAS Handbook. Gualtiero Basilone (CNR-IAS) explained that the maturity scale used by GFCM is adapted to demersal fish (e.g., MEDITS survey) and not for pelagic fish that are partial spawners. The Chair suggested that this issue be addressed at the RCG meeting where GFCM representatives are also present.

Based on email communications prior to the meeting, and consistent with Conclusion #7 of the 14th MEDIAS meeting, SC organised two subgroups composed of MEDIAS experts working on biological analyses on age and maturity as shown in Table 10.1.

Table 10.1 Two subgroups of MEDIAS experts on biological analyses (age & maturity). Subgroup coordinators are written in bold.

| **Institute** | **Subgroup 1: Age analyses** | **Subgroup 2: Maturity analyses** |
|---|---|---|
| COB-IEO/CSIC | Ana Ventero | **Nuria Zaragoza** |
| IFREMER | Geoffrey Bled Defruit | Jean-Hervé Bourdeix |
| HCMR | Kostas Markakis | Stelios Somarakis and Evis Scismenou |
| IOR | Denis Gašparević | Denis Gašparević |
| CNR-IRBIM | **Ilaria Costantini** | Ilaria Biagiotti |
| CNR-IAS | Walter Basilone | Rosalia Ferreri |
| FRIS | Tomaž Modic & Petra Bratina | Tomaž Modic & Petra Bratina |

In the discussion that followed, Gualtiero Basilone (CNR-IAS) pointed out that there is already an expert group on age analysis at the EU level and that, in his opinion, there is no need to set up a subgroup for the standardization of ages at MEDIAS level. However, it was stated that the organization of these two subgroups within MEDIAS framework is in line with the 2021 conclusions of MEDIAS SC. These two subgroups are organized by MEDIAS SC within the only possible "MEDIAS framework", but this does not prevent the experts of MEDIAS from working also in other larger frameworks at EU or regional level. Synergy of MEDIAS subgroups with other biological analysis working groups (e.g. ICES WKARA3) is more than welcome. Denis Gašparević (IOR) mentioned that during the WKARA3 meeting it was proposed to organize a new anchovy otolith exchange to take place between November 2022 and February 2023 via Smart Dots and suggested that all MEDIAS age readers should participate and, if possible, use these readings as an "intercalibration exercise" instead of conducting an additional exchange. Other experts from MEDIAS also agreed with this suggestion.

Ilaria Constantini (CNR-IRBIM) and Nuria Zaragoza (CNIEO/CSIC) were nominated by SC as coordinators of the subgroups for age and maturity analyses respectively, and they agreed.

Ana Ventero pointed out the peculiarities of otoliths from MEDIAS, which are all collected in the same (survey) period and analyzed in large quantities by MEDIAS experts, while on the other hand otoliths from commercial fisheries are collected in much smaller quantities and distributed throughout the calendar year. Gualtiero Basilone emphasized that the results of the MEDIAS age analyses are important for providing age-structured data for eventual stock assessments, and expressed the opinion that experts from MEDIAS need to work on standardizing age determination also in the wider EU framework. Magdalena Iglesias (CNIEO/CSIC) recalled the SC on the current MEDIAS protocol, which must be followed as it stands, and suggested that these subgroups should keep the problems simple in biological analyses. In her opinion, these expert groups should be very practical and share images, knowledge and their opinions among themselves in case of doubt, without involving the whole MEDIAS community.

Finally, the Chair emphasized that the ultimate goal of standardization among experts within each biological analysis subgroup (age and maturity) would be that all experts apply the agreed ageing and maturity criteria in the same way, regardless of the origin of the fish.

## 11. Review, discussion and update of MEDIAS Website: http://www.medias-project.eu/medias/website/

MEDIAS SC reviewed the current website MEDIAS, and in the ensuing discussion some updates were suggested, as follows.

On the home page, SC suggested updating the numbers related to the new EU regulation on fisheries data collection, as well as updating the information on the "Participants" page according to recent changes in acronyms and/or logo of some institutes participating in EU-MEDIAS. It was mentioned that MSDEC-DFA Ministry of Sustainable Development, Environment and Climate Change from Malta is still shown as one of the participating institutions, but for a long time no experts from Malta are involved in the activities of MEDIAS and SC is not informed about possible changes in Malta. Therefore, it was proposed to ask the Maltese authorities during the RCG meeting for a clarification of their possible future participation in EU-MEDIAS.

Regarding the "Useful Links" page, MEDIAS SC noted that no acoustic group uses BioSonics and suggested that the link to it be removed. It was also noted that a change from Myriax to Echoview (https://echoview.com ) is needed. In addition, SC suggested updating this page by adding new links, such as:

EU Data Collection (https://datacollection.jrc.ec.europa.eu/ ),

https://www.flotteoceanographique.fr/Nos-moyens/Logiciels-de-la-flotte/Gestion-de-missions-et-des-donnees/HERMES-et-MOVIES3D

https://gitlab.ifremer.fr/md0276b/echor

https://stecf.jrc.ec.europa.eu/reports

https://www.fao.org/gfcm/publications/en/

https://www.fao.org/gfcm/statutory-meetings/en/

MEDIAS SC also pointed out that updates are also possible on other pages (e.g., News) of the website, e.g., information about the renovation of the R/V Philia, information about MMS-SI, information about new surveys (e.g. in GSA11), list of previous and current MEDIAS chairs (e.g., 2008- 2010: Athanassios Machias; 2011 - 2013: Magdalena Iglesias; 2014 - 2016: Angelo Bonanno; 2017 - 2019: Andrea De Felice; 2020 - 2022: Vjekoslav Tičina; 2023 - present: Tarek Hattab), etc. It was suggested to add a page called "Other Acoustic Projects" and include here links to other projects that use hydroacoustics (e.g., projects on mesopelagic fish, tuna larvae, etc.).

It was mentioned that the Publications page should be visible and accessible without having to log in, and it was suggested that a page with reference images of otoliths and gonads could be created.

A reorganisation of the documents on the "Meeting reports" and "Handbooks", starting with the most recent document at the top, was also suggested.

## 12. Review and updates of MEDIAS Handbook

The meeting participants went through the latest version of MEDIAS Handbook (April 2021), discussed some issues and suggested appropriate changes and updates.

As a result, Table 1 of MEDIAS Handbook, which describes the size of the geographic area covered by each institute, was updated. The members of SC also discussed various items in other sections, and agreed changes were made to the text.

The MEDIAS SC decided that Handbook is intended to be a living document and should not be updated more often than once a year. It can be viewed at http://www.medias-project.eu/medias/website/. The latest revised and updated version of the MEDIAS Handbook (April 2022) can be found in Annex VI of this report.

# 13. Terms of reference, venue and date for the next MEDIAS Steering Committee coordination meeting (2023)

MEDIAS SC discussed and accepted the Terms of References (ToR) for the next, 16th MEDIAS coordination meeting in 2023 (Annex V).

Given the progress in global vaccination, MEDIAS SC hopes to organise a physical meeting in 2023. Tomaž Modic from FRIS kindly proposed the organisation of the 16th MEDIAS SC meeting to be held in Ljubljana, Slovenia, April 18-20, 2023.

# 14. Other issues

In addition to COVID-19 related issues, the same problems as reported to RCG Med&BS (Malta, 2019) still persist in Croatia (e.g. lack of responsible national scientist). Acoustic survey in the eastern part of GSA 17 has the largest area (>13,500 nm2) need to be covered with very limited vessel's days available (in Handbook: 30 days increased to 35).

Furthermore, recent expansion of Croatian MEDITS survey area (due to declaration of Exclusive Economic Zones in the Adriatic; January, 2021) and new mandatory survey (SOLEMON) are strongly competing with MEDIAS for the same limited resources, resulting in limitations related to purchase of new hydro-acoustic equipment and decreased availability of research vessel. The same research vessel (RV BIOS DVA) has been used in MEDITS and MEDIAS, as well as in number of other projects carried out by IOR.

In relation to the new acoustic survey proposed in GSA5 (Balearic Island), insufficient vessel time was allocated by MS administration for this purpose (e.g. 3 days only).

In general, lack of robustness in EU-MEDIAS capacities has been noted also. Due to very low number of suitable research vessels able to perform acoustic surveys in the Mediterranean Sea, it was impossible to find an alternative vessel to perform planned MEDIAS activities in time. During 2021, it was proved that in case of problems related to research vessels, it was not possible to carry out acoustic surveys in some GSAs as planned.

# 15. Conclusions and decisions of the 15th MEDIAS Steering Committee (SC)

1. At the 15th MEDIAS meeting, information on the 2021 acoustic surveys was presented by participants from MEDIAS teams: Spain, Greece, Italy, France, Slovenia and Croatia. In addition, the results from the eastern part of GSA 18 (Albanian waters) and the results of the pelagic trawl surveys conducted by Romania and Bulgaria in the Black Sea (GSA 29) were presented. The presentations were uploaded to the website MEDIAS.
2. In relation to Malta participation in MEDIAS SC, it has been decided to ask MS administration, in the next RCG Med&BS meeting, to clarify future involvement in MEDIAS activities in GSA15.
3. MEDIAS SC emphasized the lack of capacity robustness in acoustic surveys, particularly with respect to the functionality and availability of appropriate research vessels. MEDIAS is highly dependent on adequately equipped research vessels for acoustic surveys, and other vessels cannot be used for these purposes. Since this problem cannot be solved quickly, the MEDIAS SC decided to address this problem to RCG Med& BS and proposed to start proper planning for the construction of a new generation of research vessels in the respective member states with the support of EU funds (e.g. EMFAF and others).
4. Regarding harmonisation of regional mapping, MEDIAS SC concluded that the IFREMER acoustic team will provide results for this purpose using the commonly agreed TS equation for sardine. SC members agreed to provide 2019 NASC data for anchovy, by February 2023 for preliminary regional map construction.
5. To improve the results of biological analyses within MEDIAS framework, MEDIAS SC has formed two subgroups of experienced experts to harmonise the application of standard criteria for age and maturity analyses. MEDIAS SC has decided that these subgroups should also collaborate with other working groups outside the framework of MEDIAS (e.g., ICES WKARA and WKSPMAT). Experts in these subgroups are encouraged to actively participate in other working groups that address these specific topics.
6. Following the discussion on possible interaction of EU-MEDIAS with other EU projects, the Chair informed SC about initial contacts made with experts responsible for regional database related to the RCG (Stefanos Kavadas, coordinator of MARE /2020/08 regional grant, and the coordinator of the STREAMLINE project Alessandro Ligas) to explore a possible future relationship with MEDIAS. MEDIAS SC pointed out that the STREAMLINE project focuses mainly on commercial (including small-scale) and recreational fisheries. Regarding RDBFIS, SC believes that experts from MEDIAS need to be involved in RDBFIS SC and participate in the further development of RDBFIS to incorporate the results of acoustic surveys.
7. The MEDIAS SC recognise the importance of meso-zooplankton sampling/analysis and emphasise the need for experts to explore the potential for plankton sampling in parallel with acoustic sampling and request funding from MS through DCF to cover additional efforts. Plankton sampling is important for evaluating acoustic observations and monitoring the pelagic ecosystem.

8. MEDIAS SC agrees to continue with interest in previous proposals, particularly the proposal on intercalibration of research vessels. It also became clear at the meeting that acoustic surveys are highly dependent on the availability and operational capability of existing research vessels, given the lack of alternative/suitable research vessels or suitable commercial vessels.

9. MEDIAS SC decided to update the website with new information and agreed that the members of SC will provide appropriate useful links to be added to the website as needed.

10. Some aspects of the MEDIAS manual/Handbook were discussed and updated in the latest version annexed to this report (Annex IV) based on the discussion held during the meeting.

11. Tarek Hattab from IFREMER was elected as the new MEDIAS Chair for the next three years.

12. The MEDIAS Steering Committee approved the Terms of Reference for the 16th MEDIAS SC meeting in 2023.

13. Finally, the MEDIAS SC decided that the 16th coordination meeting of the MEDIAS Steering Committee will be held in Ljubljana, Slovenia, if the situation related to the COVID pandemic allows the organisation of a physical meeting. If it is not possible to organise a physical meeting, it would be organised by the host country as an online meeting. The tentative date proposed for the meeting is April 18-20, 2023.

## 16. Closure of the meeting

The Chair thanked all experts for their participation in the 15th meeting of the MEDIAS Steering Committee and particularly to Tomaž Modic (FRIS, Slovenia) for the efficient organization and technical support of this virtual meeting.

The 15th MEDIAS Steering Committee was closed on 07 April 2022 at 16:00.

# ANNEXES:

## Annex I: List of participants (2022)

| Name | e-mail | Country | Institution |
|---|---|---|---|
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| Vjekoslav Tičina | <ticina@izor.hr> | Croatia | IOR |
| Zakarias Kapelonis | <zkapelonis@hcmr.gr> | Greece | HCMR |

## Annex II: Institutions Acronyms

**COB-IEO/CSIC**: Centro Oceanográfico de Illes Balears (COB-IEO), CSIC, 07015, Palma, Spain

**CNR-IAS**: Consiglio Nazionale delle Ricerche. Istituto per lo Studio degli Impatti Antropici e Sostenibilità in Ambiente Marino. Capo Granitola, Italy

**CNR-IRBIM**: Consiglio Nazionale delle Ricerche. Istituto per le Risorse Biologiche e le Biotecnologie Marine. Ancona, Italy

**FRIS**: Fisheries Research Institute of Slovenia. Ljubljana, Slovenia

**HCMR**: Hellenic Center of Marine Research, Greece

**IFREMER**: Institut Français de Recherche pour l'exploitation de la Mer, France

**IO-BAS**: Institute of Oceanology - Bulgarian Academy of Sciences. Bulgaria

**IOR**: Institute of Oceanography and Fisheries. Split, Croatia

**NIMRD**: National Institute for Marine Research and Development "GRIGORE ANTIPA". Romania

Annex III – Agenda of 15th MEDIAS Coordination meeting

# 15th MEDIAS Coordination Meeting

# ZOOM (On-line meeting)

# 5 - 7 April 2022

# Agenda

## Tuesday 05/04/2022

09:00 - 09:30 Connection testing; Opening of the meeting & participants introduction. Adoption of the agenda.

09:30 - 09:40 Presentation of the 2021 acoustic surveys in GSA 1 - Northern Alboran Sea and GSA 6 - Northern Spain (Magdalena Iglesias, IEO)

09:40 - 10:10 Presentation of the 2021 acoustic surveys in the GSA 7 - Gulf of Lion (Tarek Hattab and Jean-Hervé Bourdeix, IFREMER)

10:10 - 10:40 Presentation of the 2021 acoustic survey in GSA 9 and GSA 10 – Tyrrhenian and Ligurian Seas (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri – CNR-IAS and CNR-IRBIM)

10:40 - 11:10 Presentation of the 2021 acoustic survey in GSA 11: three surveys carried out in a new area (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri – CNR-IAS and CNR-IRBIM)

11:10 - 11:30 *Coffe break*

11:30 - 12:00 Presentation of the 2021 acoustic surveys in GSA 16 - South Sicily (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri – CNR-IAS and CNR-IRBIM)

12:00 - 12:30 Presentation of the 2021 acoustic survey in the eastern part of GSA 17 - Northern Adriatic Sea (V. Tičina et all. - IOR)

12:30 - 13:00 Presentation of the 2021 acoustic surveys in the western part of GSA 17 - Northern Adriatic and GSA 18 - Southern Adriatic (Iole Leonori, Andrea De Felice, Ilaria Biagiotti, Giovanni Canduci, Ilaria Costantini, Michele Centurelli, Antonio Palermino. CNR IRBIM)

13:00 - 14:00 *Lunch break*

14:00 - 14:30 Presentation of the R/V PHILIA reconstruction during 2021 and re-evaluation of previous survey's estimates in GSA 22 - Aegean Sea (Marianna Giannoulaki et all. HCMR)

14:30 - 15:00 Presentation of the 2021 surveys in the GSA 29 - Black Sea: Bulgarian survey (IO-BAS)

15:30 - 16:00 Presentation of the 2021 surveys in the GSA 29 - Black Sea: Romanian survey (NIMRD)

16:00 - 16:30 Presentation of other acoustic surveys from GFCM area (outside EU waters): Presentation of the 2021 acoustic survey in the Albanian part of GSA 18 – Southern Adriatic Sea (Andrea De Felice, Iole Leonori, Ilaria Biagiotti, Giovanni Canduci, Ilaria Costantini, Antonio Palermino. CNR IRBIM)

## Wednesday 06/04/2022

09:00 - 09:30 General Discussion (on surveys presented)

09:30 - 10:00 "New evidences on acoustics backscatter of Trachurus mediterraneus, Scomber colias and Sprattus sprattus" (A. Palermino et all., CNR-IRBIM, Ancona).

10:00 - 10:30 DG-MARE - Commission's views and suggestions

ToR 2022. – Discussion on General issues

10:30 - 11:10 - Review of issues discussed in other meetings held in relation to MEDIAS

11:10 - 11:30 *Coffe break*

11:30 – 12:00 Information for management decisions

12:00 – 12:30 Input for stock assessment purposes concerning stocks which are managed internationally

12:30 – 13:00 Information for Good Environmental Status in the MSFD

13:00 – 14:00 *Lunch break*

ToR 2022. – Discussion on Specific issues

14:00 – 14:40 Review on MEDIAS papers published in Special Issues of MMS journal and status of other papers

14:40 – 15:00 Progress review and agreement on production of standardized NASC maps at the Mediterranean scale

15:00 – 16.00 Work on standardization of age reading and maturity estimates

## Thursday 07/04/2022

09:00 – 09:30 Review on MEDIAS Website: http://www.medias- project.eu/medias/website/ (updates)

09.30 – 10:00 General discussion and revision of the common MEDIAS protocol and Website

10:00 – 10:30 Updating of MEDIAS Handbook

10:30 – 11:00 Drafting the meeting conclusions

11:00 – 11:15 *Coffee break*

11:15 – 11.30 Adoption of meeting conclusions

11:30 – 11:45 Election of a new MEDIAS Chair

11:45 – 12:30 Terms of reference for the next meeting (2023); dates and venue of next meeting

12:30 – 13:00 Other issues

13:00 – 14:00 *Lunch break*

14:00 – 16.00 Drafting report

16:00 - Closure of the meeting

# Annex IV – RCG Med&BS Recommendation on new surveys

| *Introduction of new research surveys at sea in the Mediterranean and Black Sea area* | |
|---|---|
| **RCM MED&BS 2017 Recommendation 10** | RCG MED&BS recommend to introduce new surveys at sea in EU MAP Table 10 Research surveys at sea.<br><br>Proposed new surveys are:<br><br>- SOLEMON survey for the GSA 17 and<br>- extension of the MEDIAS survey in GSA 11 and 19<br><br>Proposed surveys should not affect in any way the implementation of the existing surveys in terms of available resources for surveys at sea (MEDITS and MEDIAS).<br><br>STECF EWG 17-14 should take in the consideration this recommendation. |
| **Justification** | SOLEMON research survey is filling the gap left behind other surveys. Beam trawl used as sampling gear enable appropriate sampling of benthic fish, crustaceans and cephalopods. SOLEMON research survey is the only fishery independent data source for stock assessment of Solea solea and other benthic species in Adriatic Sea. The SOLEMON data are used for stock assessment purposes.<br><br>Acustic survey for the evaluation of the biomass and spatial distribution of small pelagic fish in the Mediterranean Sea started since the '70s and several research projects of this kind were undertaken at national level. Since 2009 the acoustic surveys of the UE area in the Mediterranean are coordinated by means of a common protocol under the umbrella of pan-Mediterranean Acoustic Surveys (MEDIAS). Recently, GFCM has approved and started the Mid Term Strategy aimed at improving already existent surveys in non EU countries or develop new ones where they does not yet exist, possibly with the support of MEDIAS group for what concerns acoustic surveys. The general aim is to expand research surveys at sea in the Mediterranean as much as possible in order to gather the most complete picture that is possible. Anyway, even at UE countries level some gaps in GSAs coverage exist by now. With the aim to try to strengthen coverage in UE area, scientists of CNR-ISMAR of Ancona and scientists from CNR-IAMC of Capo Granitola decided to give their availability to cover by acoustic survey respectively GSA 19 (western Ionian Sea) and GSA 11 (Sardinia), given an adequate financial support, possibly to be added to DCRF in the MEDIAS framework in the future. |
| **Follow-up actions needed** | Amendment of the Commission Implementing Decision (EU) 2016/1251, of 12 July 2016, adopting a multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019, (notified under document C(2016) 4329). |
| **Responsible persons for follow-up actions** | COM, MS, LM, STECF EWG 17-14 |
| **Time frame (Deadline)** | Report of the STECF EWG 17-14 (1st trimester of the 2018) |

# Annex V - Terms of Reference for the MEDIAS SC meeting in 2023

**General**:

- to present and harmonize the ongoing acoustic surveys in the Mediterranean Sea and Black Sea;
- to provide information for management decisions if requested;
- to provide input for stock assessment purposes concerning the stocks which are managed internationally;
- to provide information for Good Environmental Status in the MSFD, if requested.

**Specific**:

- Update MEDIAS handbook if needed;
- Update the MEDIAS Website if needed;
- Agree on the method to produce standardized maps at the Mediterranean scale;
- Work/Update on common reporting template to be used by all MEDIAS groups;
- Work on standardization of age reading and maturity estimates.
- Organize a specific session to share and discuss peculiar / common types of echograms from different areas.

Annex VI – MEDIAS HANDBOOK

(Version: April, 2022)

# Common protocol for the MEDIterranean International Acoustic Survey (MEDIAS)

The geographical areas that are covered by the MEDIAS surveys and the respective days at sea per survey are presented in the following Table 1 and Figure 1. References can be found on MEDIAS website: http://www.medias-project.eu/medias/website/. More detailed information on MEDIAS, from current and historical perspective, are given in editorial written by Giannoulaki et al., 2021 and review paper written by Leonori et al., 2021 (see: https://doi.org/10.12681/mms.29068 and https://doi.org/10.12681/mms.26001 ).

**Table 1.** The size of the geographical area that is covered by each Institute in the Mediterranean Sea (acoustic surveys) and in the Black Sea (pelagic trawl surveys). NM = nautical miles.

| Country | Institute | Geographical area | Size of area | Standard number of days |
|---|---|---|---|---|
| Greece | HCMR | Aegean Sea | 9000 $NM^2$ | 40 |
| Greece | HCMR | Eastern Ionian Sea | 2800 $NM^2$ | 30 |
| France | IFREMER | Gulf of Lion | 3300 $NM^2$ | 33 |
| Slovenia | CNR-IRBIM/FRIS | Adriatic Sea (Slovenia) | 117 $NM^2$ | 1 |
| Italy | CNR-IRBIM | Adriatic Sea (Italy) | 13200 $NM^2$ | 40 |
| Italy | CNR-IAS | Sicily Channel* | 4300 $NM^2$ | 16 |
| Italy | CNR-IAS | Sardinia (east)** | 3207 $NM^2$ | ** |
| Italy | CNR-IAS | Tyrrhenian and Ligurian Sea | 6644 $NM^2$ | 30 |
| Spain | CNIEO/CSIC | Iberian coast | 8829 $NM^2$ | 33 |
| Croatia | IOR | Adriatic Sea (Croatia) | 13578 $NM^2$ | 35 |
| Bulgaria | IO-BAS | Black Sea | 3400 $NM^2$ | 20 |
| Romania | NIMRD | Black Sea | 4300 $NM^2$ | 20 |

Notes: * This area includes both GSA 16 (South of Sicily) and part of GSA 15 (Malta)
** - official inclusion of this survey in DFC is pending

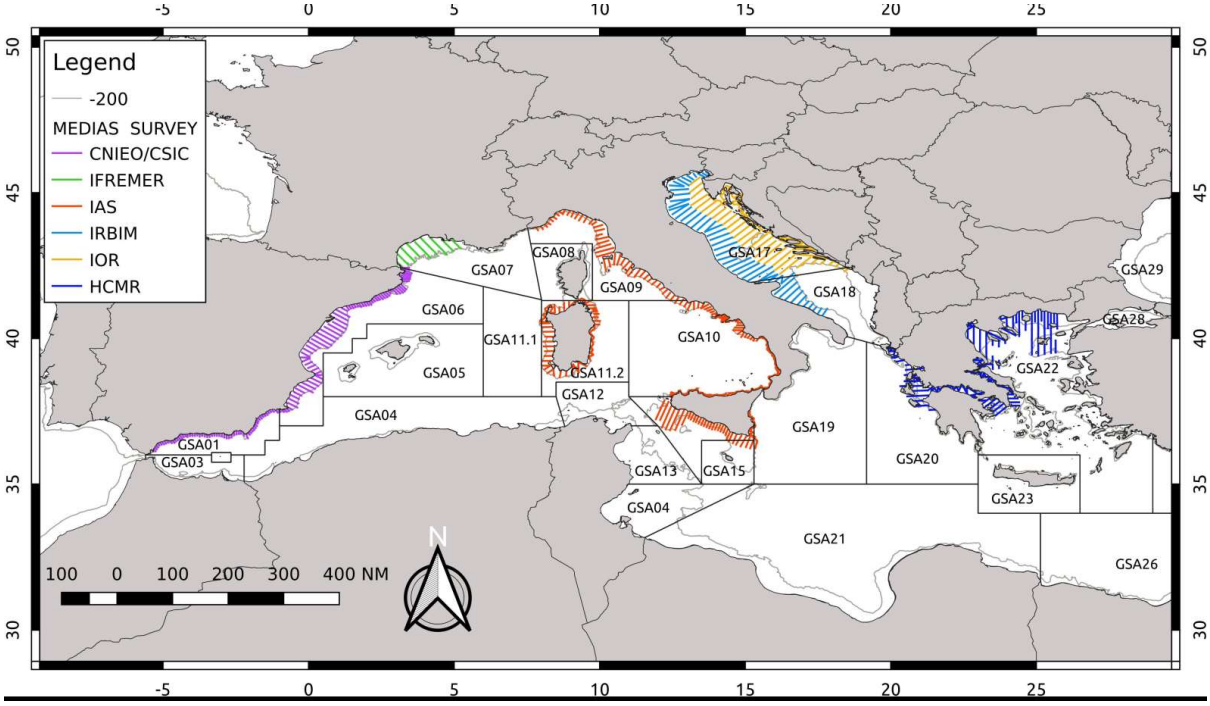


**Figure 1:** Surveys designs in the EU-MEDIAS.

### Survey Identity

In the report of the DCF each Institute should report, the geographical area, the size of the area covered, the days at sea, as well as the period and dates in which the survey took place. In addition, the following vessel characteristics should be reported: Name of vessel, vessel length and vessel HP.

### Echo sounder parameters

A variety of equipments with specific characteristics could be considered as adequate for the assessment of small pelagics. A split beam echo–sounder should be used for the echo–sampling. The angle beam, Athwart Beam Angle (in degrees), Along Beam Angle, and Ping rate of the echo–sounder should be reported. The frequency for assessment should be the 38 kHz, while the 18, 70, 120, 200 and 333 kHz can operate as complementary frequencies, depending on the research vessel used.

The pulse duration should be 1 ms; a pulse duration of 0.5 ms will be used only in case of Target Strength specific experiments. The threshold for assessment should be -70 to -60 dB depending on the survey and the ecosystem and should be reported. As the main objective is the optimum discrimination between fish and plankton, the background noise should be removed and in a next step, based on the available frequencies used in each survey, a frequency response-based

mask should be developed to split the acoustic backscattering between fish and plankton. Whenever this cannot apply, the threshold for assessment should be set at -70 to -60 dB, depending a) on noise level (-60 dB in case of high noise); b) the peculiarities of each area regarding school morphology and plankton density (-60 when plankton is dense, but -70 dB when small schools dominate the area); c) echo-sounder features; d) time of day that echo acquisition is carried out.

The ping rate should be set as fast as possible depending on depth, in order to assure good echo discrimination. At least one calibration of echo-sounder should be held per survey based on the procedure described in the manual of each echo-sounder and according to the principles described by Demer *et al.* (2015). The calibration parameters and the results of the acoustic equipment should be reported by survey according to the following Table 2. In principle, one calibration per survey is suggested.

**Table 2. Calibration report**

| **Calibration report** | |
|---|---|
| Frequency (kHz) | |
| Echo-sounder type | |
| Transducer serial no. | |
| Vessel | |
| Date | |
| Place | |
| Latitude | |
| Longitude | |
| Bottom depth (m) | |
| Temperature ($^{o}$C) at sphere depth | |
| Salinity (psu) at sphere depth | |
| Speed of sound ($ms^{-1}$) | |
| TS of sphere (dB) | |
| Pulse duration (s) | |
| Equivalent 2-way beam angle (dB) | |
| Default TS transducer gain | |
| Iteration no. | |
| Time | |
| Range to sphere (m) | |
| Ping rate | |
| Calibrated TS transducer gain | |
| Time (GMT) | |
| RMS | |
| sA correction | |

**Survey Design**

The survey design for the acoustic sampling should consider the characteristics of the spatial structures of small pelagic fish in each area as well as the peculiarities in the topography of each area. Transects should be run along the greatest gradients in fish density, which is often related to gradients in bottom topography, meaning that transects will normally run perpendicular to the coastline/bathymetry. Inter-transect distance should be adjusted to achieve the minimization of the coefficient of variation of the acoustic estimates for the target species in each area but also take into account survey duration. In cases that topography is complex like in the case of semi-closed gulfs transect design could be decided otherwise. The survey design in each area should be reported. Based on some preliminary studies of the spatial structure characteristics of small pelagics in the Mediterranean Sea (WKACUGEO 2010; MEDIAS 2011) the inter-transect distance should not exceed 12 NM.

Specifically, within certain common workshops that were held in the framework of the AcousMed project (Anonymous, 2012) and past MEDIAS meetings, the existing survey design at different areas has been reviewed along with area peculiarities (e.g. size of the area, topography, survey duration). In the framework of these workshops, geostatistical analysis was applied on historical acoustic data under a common protocol and different survey designs were evaluated towards optimization, considering the spatial characteristics of small pelagic fish aggregations. The optimum inter-transect distance in each area has been identified and proposed. The results have been adopted at the 5$^{th}$ MEDIAS coordination meeting. However, in order to evaluate the survey performances in each area, a dedicated session with this specific Terms of Reference should be held when needed within the framework of the MEDIAS annual meetings.

Vessel speed during acoustic sampling should be adjusted depending on vessel noise as set by the ICES-WGFAST (WGFAST 2006). The working group agreed that vessel speed of 8-10 knots is adequate for a split beam echo sounder of 38 kHz. At higher speeds, problems might be encountered with engine noise or propeller cavitation.

It was strongly recommended that if species identification depends on the recognition of schools based on the echograms, the survey will have to take place only during day- time, being interrupted during periods in the 24-hour cycle when the schools disperse.

Otherwise, if available survey time does not permit this, echo sampling might be extended. In this case, echo allocation into species will not be based on school shape identification and justification should be given in the report that this does not affect the accuracy of the estimations. In the framework of the AcousMed project appropriate acoustic data from daytime and nighttime have been analyzed in order to determine the degree of error. Results from recent study (Bonanno et al, 2021) indicated that night estimates can be higher or lower compared to daytime estimates largely depending on the area peculiarities and especially the local plankton and fish densities. However, results showed that correction is possible and it is advisable when night sampling is inevitable.

Transects should be extended as close to the coast as possible in order to cover adequately the spatial distribution of sardine. The minimum distance from the shore largely depends on the size of the research vessel used. In any case, the Distance of acoustic sampling from the coast in respect to the Bottom depth should whenever this is possible reach the 10 m isobath. In each case the minimum bottom depth of each survey should be reported. The maximum echo-sounding depth should be 200 m and the minimum echo-sounding depth should be reported as it depends on the draught of the research vessel.

The Elementary Distance Sampling Unit (EDSU) for echo integration should be 1 nautical mile (NM), excluding "bad data". In the case of parallel transect designs, the acoustic energy in the inter-transect tracks will not be considered for assessment purposes. The working group concluded that the target species of the survey will be anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*).

The echo partitioning into species should be based on echogram visual scrutinization. This will be done either by direct allocation based on the identification of individual schools and/or allocation on account of representative fishing stations.

Target Strength (TS) equations: in the Mediterranean Sea, different species TS equations are currently applied depending on the area. The application of common TS equations should ideally derive from *in situ* estimations of TS, preferably based on acoustic data from the Mediterranean Sea. For this purpose, specific workshops were held in the framework of AcousMed project as well as DCF and MEDIAS coordination meetings but largely based on the analysis of available historical data. Based on these results, the 5$^{th}$ MEDIAS coordination meeting agreed to apply for sardine the following TS-TL equation this point forward:

$$TS=20\log (TL)-72.6 \text{ dB}$$

where TS=Target Strength, TL=Total Length. The Steering Committee at its 14th annual meeting also agreed that in addition to use previous TS equation for sardine (with b20= -72.6 dB), IFREMER also will continue to use a b20=-71.2 dB in the Gulf of Lions, for compatibility reasons to the long time-series available, but in line with harmonization IFREMER will also provide estimates based on common TS that will be used for regional mapping purposes. Analysis results concerning anchovy indicated large differences between areas. For this purpose, MEDIAS partners concluded that further analysis using more data from all areas is needed and agreed not to propose a single TS equation and b20 value for anchovy. It was suggested that the work regarding anchovy TS should continue within the framework of specific MEDIAS workshops, using available data from additional areas, such as Croatia. Thus, it was agreed that for the time being, the historical Target Strength equations for anchovy will be maintained in each area and the applied TS equation should be reported.

Acoustic data processing for the assessment of the target species, Echoview or alternative Movies 3D software should be used for acoustic data analysis and the estimation of abundance. For compatibility reasons, raw data should be available into a common *.hac file format. Due to the large file size raw data will be stored within the responsibility of each Institute. The

common *hac format will be also available for the requirements of the Data Collection Framework (DCF) upon request.

A script in R to calculate geostatistical CV associated with biomass estimates from acoustic survey, based on Walline et al. (2007), has been created by Marco Barra (CNR) and tested by all MEDIAS groups. This procedure is considered mandatory to calculate geostatistical CV to be provided along with acoustic estimates.

**Workflow for acoustic data processing**

During the 6$^{th}$ MEDIAS meeting the Steering Committee agreed on a common workflow for acoustic data processing, which is structured in the following four steps:

a) Load and view data

b) The acoustic data acquired by echo-sounder during the survey are loaded in a software environment for visual exploration in terms of echograms and maps.

c) Calibrate

d) The results of calibration procedure, carried out on board the vessel, are installed in order to convert the raw acoustic data into absolute backscattering measurements. Such step includes also the installation of correct settings of transducers position referred to GPS antenna.

e) Remove background noise

f) Before analyzing the acoustic data any ambient noise present in the underwater environment has to be removed.

g) Detect and filter

The step includes the use of grids, lines, regions and mathematical operators for excluding from the collected acoustic data any backscattering signal not linked to the presence of fish and/or plankton.

<u>Specific aspects are:</u>

1. Intermittent noise removal;
2. Evaluate possible interferences that may produce artefacts in the echograms, and adopt a procedure for removing them;
3. Surface and seafloor exclusions;
4. Use lines for correctly separating the backscattering signals from surface and bottom;

5. Single targets estimation;
6. In case of organisms scattered in the water column, typical of night-time data acquisition, adopt the necessary procedure for separating fishes from planktonic organisms;
7. Schools estimation;
8. Use regions and/or mathematical operators for estimating backscattering signal due to fish aggregations.

**Abundance indices**

The following abundance indices should be estimated and reported in the DCF within the framework of MEDIAS:

The Total fish NASC per EDSU, as well as Point maps of total fish NASC should be available.

The target species of MEDIAS for assessment purposes will be anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*). The abundance indices estimated by all MEDIAS parties provided in the DCF report should include both NASC and Biomass estimations, for the whole area. Specifically, for the two target species abundance estimates provided in the report are: NASC/EDSU; Biomass/EDSU; Number of fish/EDSU; Number/age and per length class; Biomass/age and per length class. Point maps of anchovy and sardine in NASC/mile; Biomass/mile should also be available. In addition, abundance indices could be given for all pelagic species in the community which are important in each area.

The catch compositions of the hauls: pie-charts indicating percentage by weight per species and/or group of species should be available also.

**Fish sampling**

According to the standard methodology followed in acoustics, species allocation of the acoustic records is impossible if trawl information is not available. Fish sampling is required to collect representative samples of the fish population in order to identify echoes. The main objectives of trawling in an acoustic survey are a) to obtain a sample from the school or the layer that appears as an echo trace on the sounder for echo trace identification and allocation into species and b) to get biological information and evaluation of the size distribution of each species. Therefore, the trawling gear used is of no importance as long as it is suitable to catch a representative sample of the target-school or layer. In the framework of the AcousMed project available past data from different areas in the Mediterranean were analyzed based on a common protocol. Results showed no significant differences between day and night sampling (Machias et al., 2013). The coordination meeting based on these results concluded that samples collected

during both day and night in the same survey could be merged and used for the necessary estimations.

In addition, the sampling intensity of the hauls cannot be pre-determined because of the objectives of the acoustic survey *per se*. The sampling intensity in an acoustic survey depends on the size of the area covered, the frequency of occurrence of different echo traces on the sounder screen and the spatial characteristics of fish aggregations. In addition, the geographical coordinates or the sampling depth of the hauls cannot be pre-determined because pelagic species execute extended horizontal and vertical movements. Schools morphometry and energetic characteristics might change depending on the area, the time interval or even the fishing pressure. Therefore, the sampling strategy has to be adaptive depending on the school characteristics per area, time period and year.

Considering that, within a common protocol, the different research vessels used and the peculiarities of each area the following points have been agreed:

- A pelagic trawl will be used in all areas for biological sampling.
- Maximum codend mesh size should be equal to 24 mm (side of mesh equal to 12 mm). The codend and the trawl characteristics used in each area will be reported. If codend cover is used it should be reported and not to be used for LFD of target species.
- The vertical opening of the pelagic hauls along with the netsounder used should be reported.
- The duration of hauls should be no less than 30 min for unknown echoes and when multi-species scattered echoes are being fished.
- Vessel speed during fishing should be 3.5–4.5 knots.
- It is widely accepted that in the framework of an acoustic survey a standard total number of hauls cannot be set because this depends on the fish distribution and abundance found in each survey. However, in any case the hauls number must be adequate in order to a) ensure identification of echo traces; b) obtain a representative length structure of the population for each target species; c) obtain species composition and biological samples.
- Target species of the MEDIAS surveys are anchovy and sardine, but biological data for all species in the pelagic community (e.g. bogue, horse mackerels, sprat, etc.) regarding length frequency distribution and Length-Weight relationships should also be acquired.

**Biological and oceanographic parameters**

The following biological parameters should be estimated in each survey:

- The Length frequency distribution (0.5 cm) should be estimated from a representative sample for each fish species per haul. Total length will be measured for all species. The

Length–Weight relationship for all pelagic species will be estimated and reported. The size of each sample should be set at minimum the one described in the respective protocol of the Data Collection Framework (DCF).

- For the target species, anchovy and sardine, the mean Total Length at age should be estimated, as well as the Age-Length-Key used for the conversion of abundance indices to abundance-at-age. Data should be provided according to the DCF instructions.
- Otolith reading criteria for anchovy and sardine should be in accordance with ICES WKARA2 report (2017) and follow the recommendation of that meeting. In particular the 1st of January should be considered the birthdate for anchovy from an assessment point of view in relation to time-steps in the assessment. Mean TL at age should be reported.
- It is strongly recommended the use of ICES WKSPMAT report (2008) scale during the lab processing for classifying the reproductive phase for anchovy and sardine, particularly for identifying mature/immature which are very relevant to stock assessment purposes, in order to obtain the L50 estimation. This scale allows reaching a higher accuracy since it has been developed specifically for small pelagics (indeterminate spawners).
- Since the environmental parameters are very important for small pelagic fish, a minimum of 3 CTD stations should be held per transect or a grid of stations with density adequate to describe the oceanography of the surveyed area. Temperature and salinity are the hydrographic parameters that should be measured in the entire water column at each station.

Furthermore, the need for a common database has been concluded. The need for collaboration with the respective surveys in the Atlantic region (e.g. Bay of Biscay) has also been discussed and agreed. In the framework of this collaboration, information and experience will be exchanged.

**Database**

In the framework of the AcousMed project as well as a MEDIAS workshop, a common database design has been decided for all MEDIAS surveys (See: MEDIAS proposals in Annex VII). The 5th MEDIAS coordination meeting agreed to use this data base framework to store acoustic and biological data collected within the acoustic surveys in the Mediterranean Sea.

**Ecosystem indices related to acoustic surveys**

The abilities of currently applied MEDIAS surveys to contribute towards an ecosystem-based management approach in relation to the current and the future DCF requirements was extensively discussed by the MEDIAS partners. In the following Table 3 the ecosystem indices that can derive from acoustic surveys (based on data regularly collected and analyzed) are reported.

**Table 3.** Ecosystem indices that could be derived from acoustic surveys.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Good Environmental Status indices** | Spatial/temporal strata | Spatial strata | GSA | | | | |
| | | | Acoustic survey | | | | |
| | | Time periods | Season (Summer/Autumn depending on the area) | | | | |
| | Taxonomic levels | Community | Pelagic fish (Species composition, occurrence in pelagic hauls) | | | | |
| | | Target Species | Adult | Anchovy | | | |
| | | | | Sardine (for Mediterranean) | | | |
| | | | | Sprat (for Black Sea) | | | |
| | Indices | Biodiversity | Species | Population size | Acoustic estimates | Total biomass & abundance estimates for target species | |
| | | | | | | Estimation error (CV) (i.e. as agreed based on a common estimation procedure, see ToRs) | |
| | | | | Population condition | Biomass & abundance estimate per size/age | Anchovy, Sardine, Sprat (Black Sea) | |
| | | | | | Recruitment index | Sardine (i.e. Number at Age 0 of the population based on summer surveys) | |
| | | | | Habitats | Habitat condition | Hydrological condition | Temperature (i.e. SST: average at 10m, estimated as the interpolated mean value for the whole area) |
| | | | | | | | Salinity (i.e. SSS: average at 10m, estimated as the interpolated mean value for the whole area)) |
| | | | Community | Fish Community condition | Community Synthesis | Total pelagic fish NASC | |
| | | | | | Species composition (i.e. percentage in terms of weight of pelagic trawls per hour)* | | |
| | | | Age and size distribution | 95% percentile of the population length distribution for the target species | | | |
| | | | | Proportion of fish larger than L50 (length at first maturity estimated based on collected data or defined based on literature) | | | |

**Tables for DCF Data Call**

The common templates (e. g. https://datacollection.jrc.ec.europa.eu/dc/medbs/templates), currently used for submission of MEDIAS results to Data Calls by MS, provided by JRC, are the following:

| | |
|---|---|
| Abundance (in numbers per species per sex and length class) | xxx_Abundance |
| Biomass (biomass per species per sex and length class) | xxx_Biomass |
| Abundance biomass (abundance and biomass per species per sex and age class) | xxx_Abund_Biom |

**Common format for presentations at MEDIAS Coordination Meetings**

- GSA number and general information on the GSA; map and general information on the acoustic survey
- Type of echosounder and frequencies in use
- Calibration results
- Survey design
- Number of nautical miles effectively processed for biomass estimation
- Biomass estimation results in tons by GSA and graphs in terms of biomass density (time series of average t/nm$^2$)
- Headline, footrope length of the pelagic net, sidelines dimensions, mesh size
- CTD stations map
- Biomass per length classes (0.5 cm) and per age classes in tons
- Graphs of Age Length Keys (in %, with total No. otoliths, by length classes)
- Maps of anchovy and sardine spatial distribution (proportional maps of NASC values - bubble plots)
- Map with pie charts reporting % in weight of anchovy, sardine and other species.

Other results of interest from acoustic surveys could be also reported but they are not mandatory.

**Data accessibility**

As the MEDIAS Steering Committee acknowledges the need for MEDIAS data and output accessibility it was agreed to:

1) MEDIAS data need to be available after March 31 of the next year (e.g. N+1 March 31, where N is year of the survey), and MS and end-users are recommended to respect this date (Recommendation No. 12 from RCM Med&BS meeting in 2016);

2) MEDIAS results per survey are presented in the Annual MEDIAS report which is freely available in the MEDIAS website;

3) Overall biomass and abundance estimates are available through the DCF Data Call;

4) Include annual distribution maps of NASC per species along with the respective metadata information in a GEOportal.

Detailed data per EDSU could be available to third parties through the GEOportal. The third party should send a request and present to the Steering Committee the type of data requested, the purpose for which data are needed and exchange ideas for collaboration.

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## Summary table of the common protocol for the MEDiterranean International Acoustic Survey (MEDIAS).

| **Survey Identity** | |
|---|---|
| Geographic area | Should be reported |
| GSA area | Should be reported |
| Size of Area to be covered ($NM^2$ / $km^2$) | Should be reported |
| Days at sea | Should be reported |
| Vessel | Should be reported |
| Vessel length | Should be reported |
| Vessel HP | Should be reported |
| Period of survey | Should be reported |
| **Echo sounder parameters** | |
| Echo sounder | Split beam |
| Frequency for assessment (kHz) | 38 |
| Complementary frequencies (kHz) | 18, 70, 120, 200, 333 kHz depending on availability. |
| Pulse duration (ms) | 0.5 or 1 ms, should be reported |
| Beam Angles (degrees)<br>Athw. Beam Angle,<br>Alog. Beam Angle | Should be reported |
| Ping rate | Maximum depending on depth |
| Calibration (No per survey) | A calibration report should be given<br>One calibration per survey |
| Threshold for acquisition (dB) | -80 |
| Threshold for assessment (dB) | -70 to -60 (reported) |
| **Survey design** | |
| Transects design | Perpendicular to the coastline/bathymetry, otherwise depending on topography<br>The survey design according to the MEDIAS conclusion for each area and should be reported. |
| Inter-transect distance (NM) | Max <=12 NM. The inter-transect distance should be according to the MEDIAS conclusion for each area and should be reported |
| Time of day for acoustic sampling | Day time.<br>Otherwise, in cases of time limitation and if echo allocation into species does not depend on school shape identification (in this case justification of the accuracy of results will be presented) |

| | |
|---|---|
| EDSU (nm) | 1 NM |
| Distance from the coast according to the Bottom depth (min, m) | Bottom depth should whenever this is possible reach the 10 m isobath |
| Echo sounding depth (min, m) | Depending on the draught of RV. Should be reported |
| Echo sounding depth (max, m) recording. | 200 m |
| Vessel speed | 8-10 knots |
| Software for analysis | Movies and/or Echoview |
| File format | *.hac |
| Inter - transect | Acoustic energy in the inter-transect track will not be taken into account |
| Applied TS (dB) | Sardine: -72.6 dB, See also hand book<br>Other species: Keep historical TS equations. |
| Echo partitioning into species | Echo trace classification based on echogram visual scrutinisation<br>• Direct allocation and<br>• allocation on account of representative fishing station |
| **Abundance estimates** | |
| Abundance indices estimated | ☐ Total fish NASC per EDSU<br>☐ Anchovy, Sardine NASC per EDSU<br>☐ Anchovy, Sardine Biomass per EDSU<br>☐ Anchovy, Sardine Numbers per EDSU<br>☐ Anchovy, Sardine Number/age and per length class<br>☐ Anchovy, Sardine Biomass/age and per length class |
| Maps and charts | ☐ Point maps of total fish NASC<br>☐ Point maps of target species in NASC/mile; biomass / mile.<br>☐ Catch compositions of the hauls, pies charts indicating biomass per species |
| **Fish sampling** | |
| Target species | Anchovy, Sardine |
| Other species | Biological data for all species in the pelagic community: Length-Weight relationships; Length distribution. |

| | |
|---|---|
| Fishing gear, codend mesh size | Pelagic trawl, Codend and trawl characteristics should be reported. Max Codend mesh size = 24 mm (side of mesh = 12 mm). |
| Vertical opening of the pelagic trawl | Should be reported |
| Netsounder used | Should be reported |
| Duration of haul | Minimum 30 min for unknown echoes |
| Time of sampling | Both daytime and night time biological samples from the same survey will be used. |
| Vessel speed during fishing | 3.5 – 4.5 knots |
| Sampling intensity, no of hauls | The total number of hauls has to be adequate to:<br>• ensure identification of echo traces;<br>• obtain length structure of the population;<br>• obtain species composition;<br>• get biological samples. |
| **Biological and oceanographic parameters** | |
| Length | All species: Total length (TL), Length frequency distribution (0.5 cm) |
| Age readings, ALK | Sardine, Anchovy: Mean TL at age<br>Sample sizes according to the new DCF. |
| Length - Weight | All pelagic species |
| Oceanographic. Parameter (CTD) | Minimum 3 CTD per transect or grid of stations with density adequate to describe the oceanography of the surveyed area.<br>Minimum variables: T, S |

# Annex VII - MEDIAS group proposals:

## 1) MEDIAS database

MEDIAS group is planning the development of a common database for all the partners involved in the project, that would be highly beneficial concentrating the information on small pelagic stocks of different areas of the Mediterranean in the same structure with a standardized format. In order to proceed in this way a proper financial support is requested in order to buy hardware components and software adequate for this aim and contracts for the database technical developers.

The Common Database structure for acoustic surveys was adopted in the 5th MEDIAS meeting. General outline of a database for acoustic surveys is shown in Figure A1.

The major fields agreed are associated to:

a) input information related to export data from acoustic software (Figs. A2 & A3);

b) input information related to biological sampling and environmental data sampling (Figs. A4 & A5);

c) queries-calculations to fulfill DCF requirements (Fig. A6);

d) queries-calculations to facilitate abundance/biomass estimates (Fig. A6);

e) echosounder calibration report (Fig. A7);

f) data input validation and control checks;

g) up to date demands related to surveys and the Ecosystem Approach to Fisheries (Figs. A5 & A6).

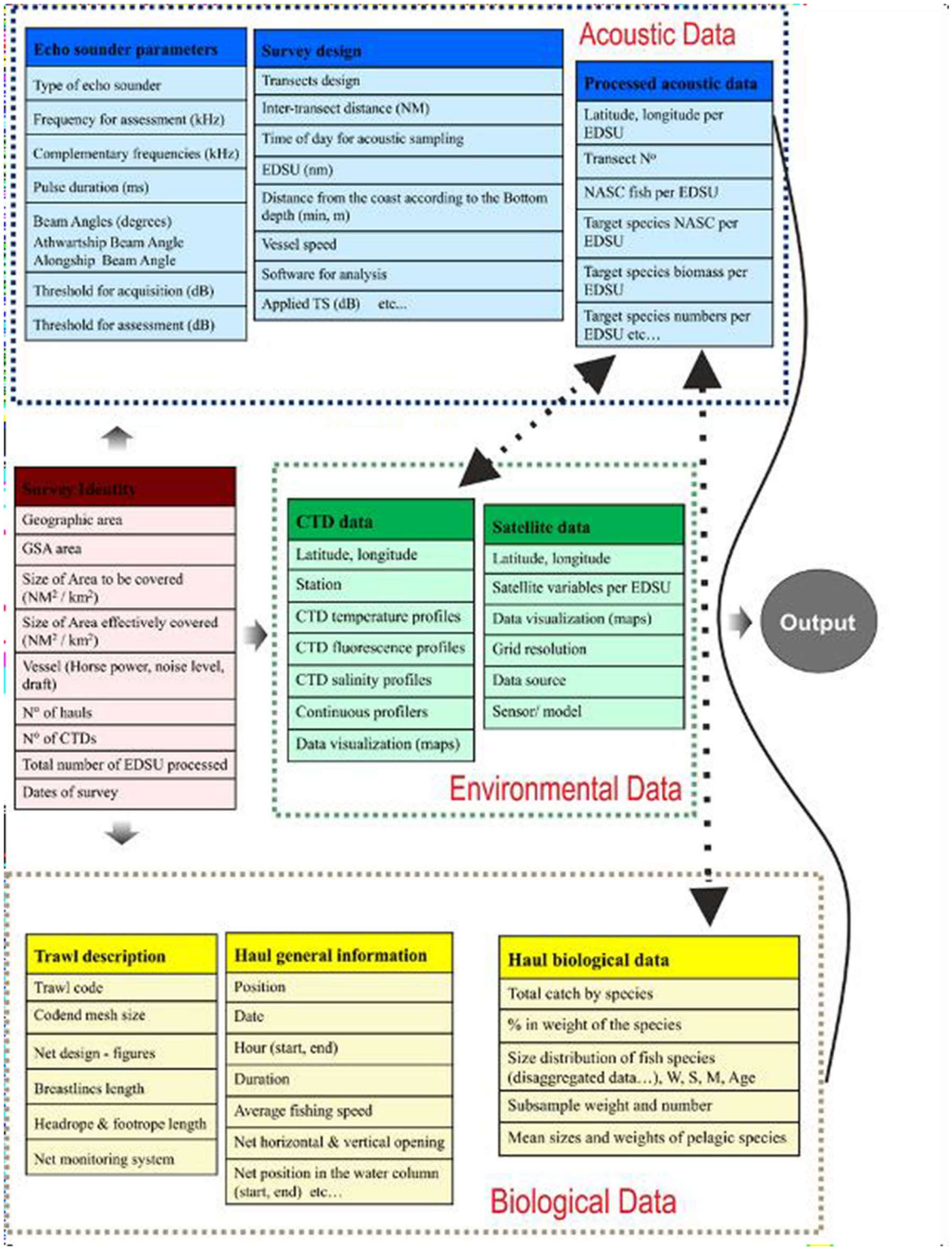


Figure A1. General outline of a database for acoustic surveys.

Analytical info per database field are presented below.

| Survey Identity |
| --- |
| Geographic area |
| GSA area |
| Size of Area to be covered ($NM^2$ / $km^2$) |
| Size of Area effectively covered ($NM^2$ / $km^2$) |
| Vessel (Horse power, noise level, draft) |
| N° of hauls |
| N° of CTDs |
| Total number of EDSU processed |
| Dates of survey |

Figure A2. Fields associated with the typical input info about the survey

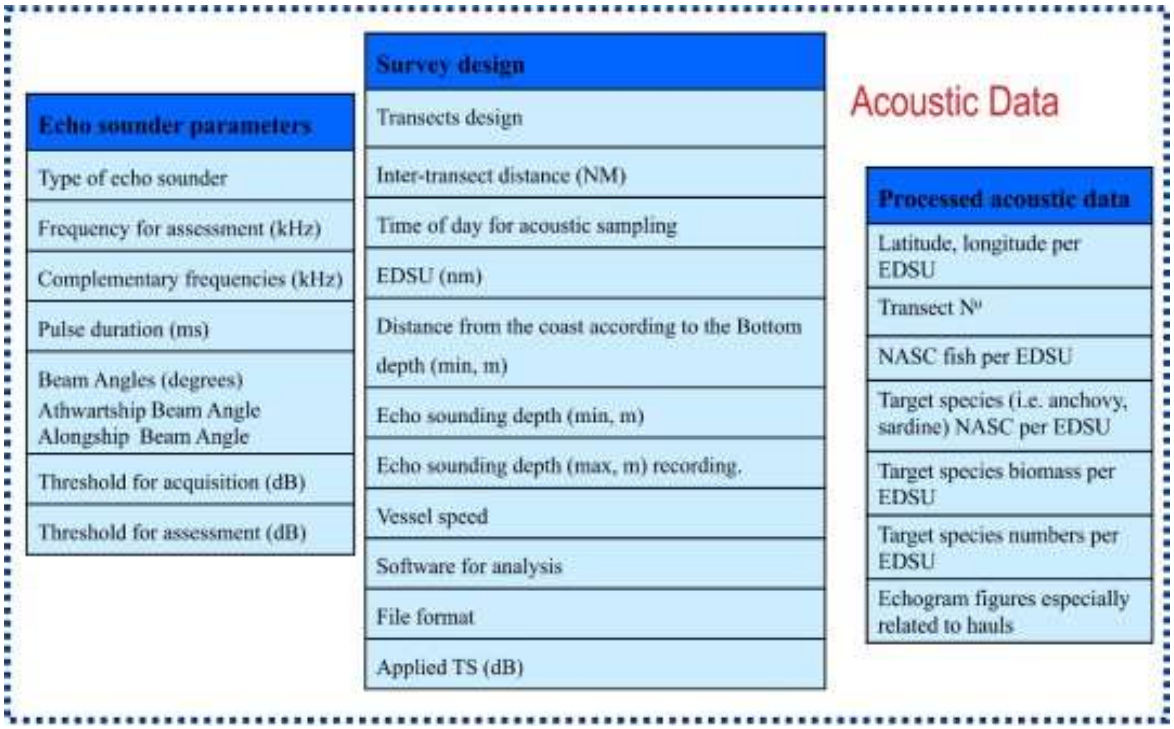


Figure A3. Fields associated with input info on Acoustic Data

Specific routines that are useful for a database dealing with acoustic survey data are outlined below:

1. Sub-area creation: query that allows the selection of a sub-area along with the underlined acoustic data (i.e. referring to whole transects or parts of transects) and the respective hauls based on certain criteria (e.g. depth, etc.), possibly through a GIS software that will be linked to the database;

2. Calculation of NASC average values and standard error in a sub-area;
3. Merge haul information in a sub-area: calculation of the mean size by species and the percentage in terms of weight and number of the species composition
4. Biomass estimation per species in a sub-area: using the average NASC value per species and composition information from hauls otherwise through direct allocation of NASC to species.

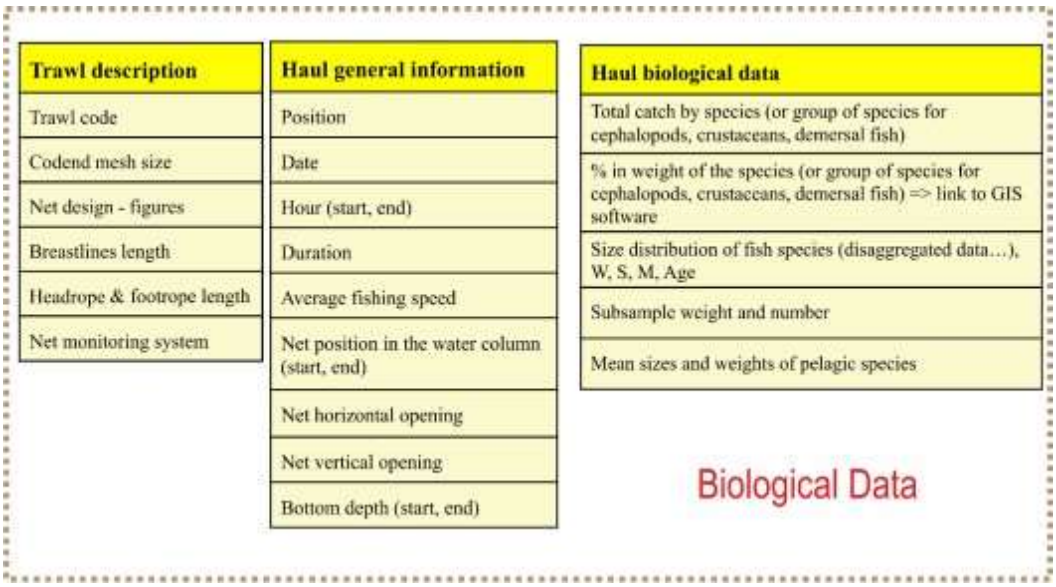


Figure A4. Fields associated with input info on Biological Data related to acoustic surveys

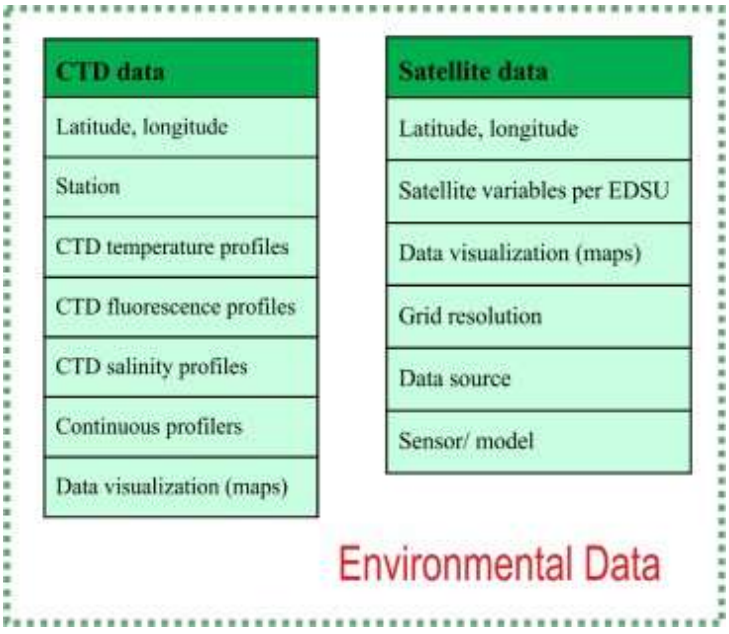


Figure A5. Fields associated with input info on Environmental Data related to acoustic surveys

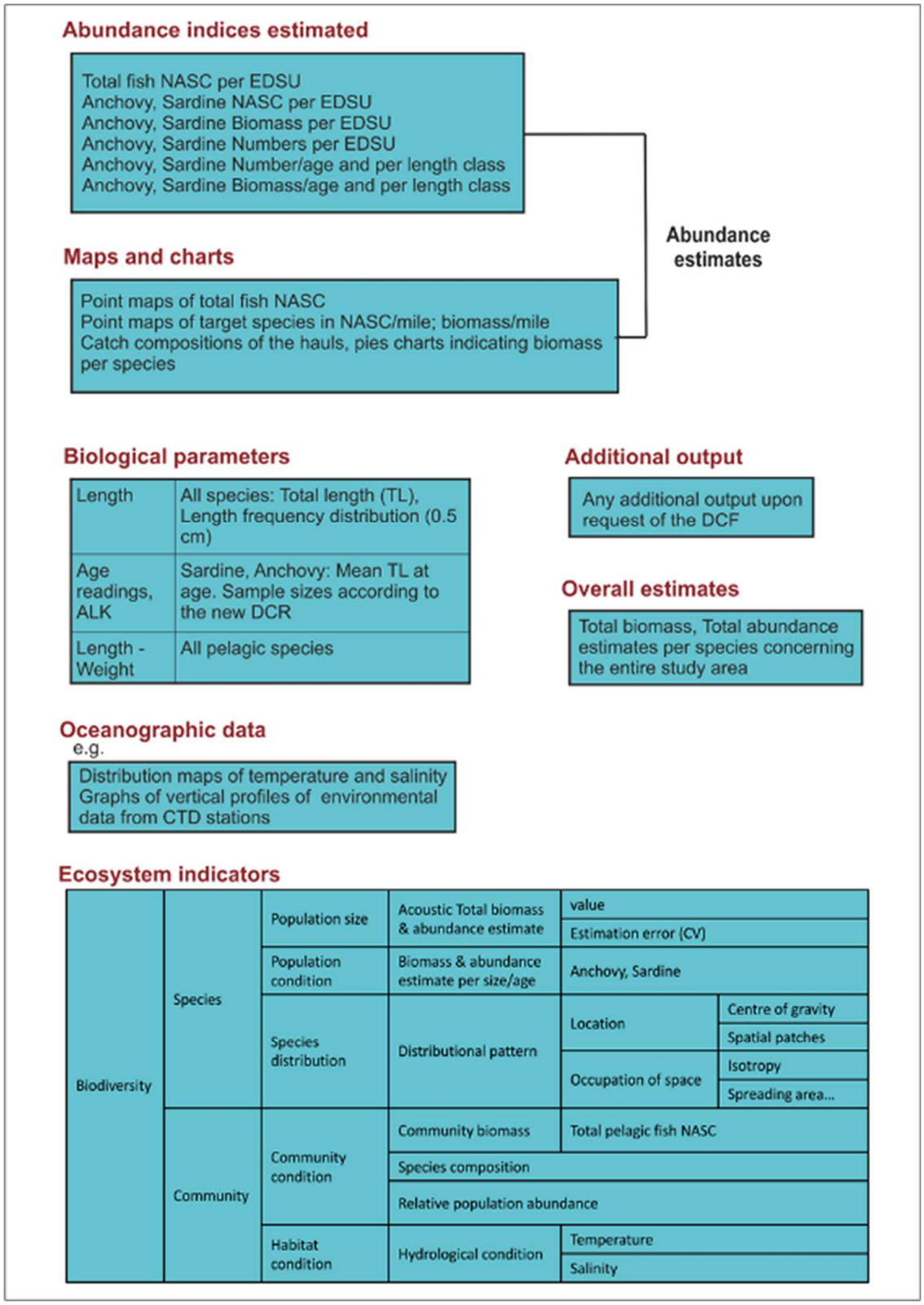


Figure A6. Fields associated with potential acoustic database output.

**Calibration report**

| | | | |
|---|---|---|---|
| **Frequency (kHz)** | * | **Speed of sound ($ms^{-1}$)** | * |
| **Echosounder type** | * | **TS of sphere (dB)** | * |
| **Transducer serial no.** | * | **Pulse duration (s)** | * |
| **Vessel** | C | **Equivalent 2-way beam angle (dB)** | * |
| **Date** | * | **Default Sv transducer gain** | * |
| **Place** | C | **Iteration no.** | C |
| **Latitude** | C | **Time** | * |
| **Longitude** | C | **Range to sphere (m)** | * |
| **Bottom depth (m)** | C | **Ping rate** | C |
| **Temperature ($^oC$) at sphere depth** | C | **Calibrated Sv transducer gain** | * |
| **Salinity (psu) at sphere depth** | C | **Time (GMT)** | * |

***.- Data you can find in the EK60 report sheet.**

Figure A7. Database Fields related to electro-acoustic calibration report.

## 2) Mesozooplankton sampling synoptic with acoustic survey

The MEDIAS Steering Committee discussed in many occasions about the importance to add a sampling on zooplankton to the already foreseen MEDIAS routine activities at sea, and finally agreed to propose that this research topic could be incorporated into the DCF for what concerns acoustic surveys. The reasons for this proposal are numerous. First of all, by knowing plankton abundance it is possible to have an index of productivity, and thus prey availability, that is important in the study of small pelagic fish abundance over the years and of their spatial distribution; this ecosystem indicator could also be important in the Marine Strategy Framework Directive.

Another important element is given by the fact that the sampling activity on plankton would produce a ground truth of some targets in the acoustic data, so that, during the acoustic processing, these targets could be discarded with a higher degree of certainty, while separating the small pelagic fish echoes from unwanted plankton echoes. The accuracy of this process could be further enhanced through the knowledge of the kind of planktonic organisms that are prevalent in a certain area, derived from sample collection by means of the plankton net, due to the fact that different planktonic organisms for anatomic and physiologic characteristics give different responses in multifrequency during the acoustic survey.

The analysis on plankton can also give information on the ichthyoplankton fraction; in this way a deeper knowledge on spawning (from collected eggs) and nursery areas (from

collected larvae), at least for anchovy (*Engraulis encrasicolus*), given the survey period, could be gained. This fact would potentially allow the possibility to explore new management scenarios in the Mediterranean Sea, eventually based on local closures in correspondence of spawning and nursery areas.

The analysis on plankton can also give additional information on the pelagic ecosystem structure and function. The knowledge on zooplankton component in pelagic ecosystem is particularly important because it represent a link between the lowest trophic level (i.e. primary production - phytoplankton) and higher trophic levels (i.e. fish) in the marine food web. Such improved knowledge on marine ecosystem can be considered as necessary precondition in applying ecosystem-based management (EBM) in the future, in line with the new CFP.

This proposal concerns the MEDIAS surveys that are held along the Iberian coast (GSA 1 and 6) carried out by IEO (Spain), Gulf of Lion (GSA 7) by IFREMER (France), Sicily Channel (GSA 16) by CNR-IAS (Italy), western Adriatic Sea (GSA 17 and 18) by CNR-IRBIM (Italy), eastern Adriatic Sea (GSA 17) by IOR (Croatia) and eastern Ionian Sea and Aegean Sea (GSA 20 and 22) by HCMR (Greece). The proposal also concerns the acoustic survey carried out by CNR-IAS (Italy) in the Tyrrhenian and Ligurian seas (GSAs 9 and 10), that are part of the MEDIAS since 2017. All these surveys are conducted in the period June-September.

A proper number of stations (depending on transect length) could be performed along dedicated transects in order to collect information on mesozooplankton with an appropriate resolution.

A proper financial support is needed in order to plan and perform this kind of activity, both in the field and in the laboratory. Moreover, there is the need to buy specific staff such as plankton nets, bottles, laboratory staff for the preservation and the analysis of the samples, etc.

**3) Intercalibration exercise**

An intercalibration exercise involving all the MEDIAS groups is proposed. One of the MEDIAS study areas could be selected to host the intercalibration and all the involved research vessels, together with personnel and equipment in use during acoustic surveys should converge there. The procedure to conduct the intercalibration could be the one described in Simmonds and Mac Lennan (2005). Due to the fact that there are more than two vessels operating in MEDIAS surveys, the calibration should proceed in pair (two vessels at a time) conducting more trials.