Report of 11th meeting for MEDiterranean International Acoustic Surveys (MEDIAS)

in the framework of European Data Collection Framework (DCF)

Ancona, Italy, 17-19 April 2018

Steering Committee Report

Contents

Introduction

The MEDIAS (MEDiterranean International Acoustic Surveys) Steering Committee met in Ancona, Italy, on 17-19 April 2018, hosted by CNR-ISMAR and chaired by Andrea De Felice from CNR-ISMAR. Meeting participants were representatives from the European Union countries involved in acoustic surveys in the Mediterranean Sea (i.e. Spain, Croatia, Italy, Greece and France) and in the Black Sea (i.e. Romania). A representative for Italian DCF Coordination was invited to participate following his request (see list of participants in Annexes I and II).

The main aims of the meeting were:

a) to present the results from the MEDiterranean International Acoustic Surveys (MEDIAS) carried out in 2017;
b) to coordinate the MEDIAS surveys to be performed in 2018;
c) to improve and update the common Protocol for the MEDIAS that is incorporated in the DCF framework and reflected in the MEDIAS Handbook;
d) to revise the ToRs from 2018 and to establish the ToRs for 2019.

The agenda of the 11th MEDIAS Coordination Meeting (see ANNEX III) was adopted by the participants. Following the agenda, during the first day results from the 2017 MEDIAS acoustic surveys, carried out by the MEDIAS partners (Fig. 1), were presented, as well as results from the survey carried out by Romania in the Black Sea.

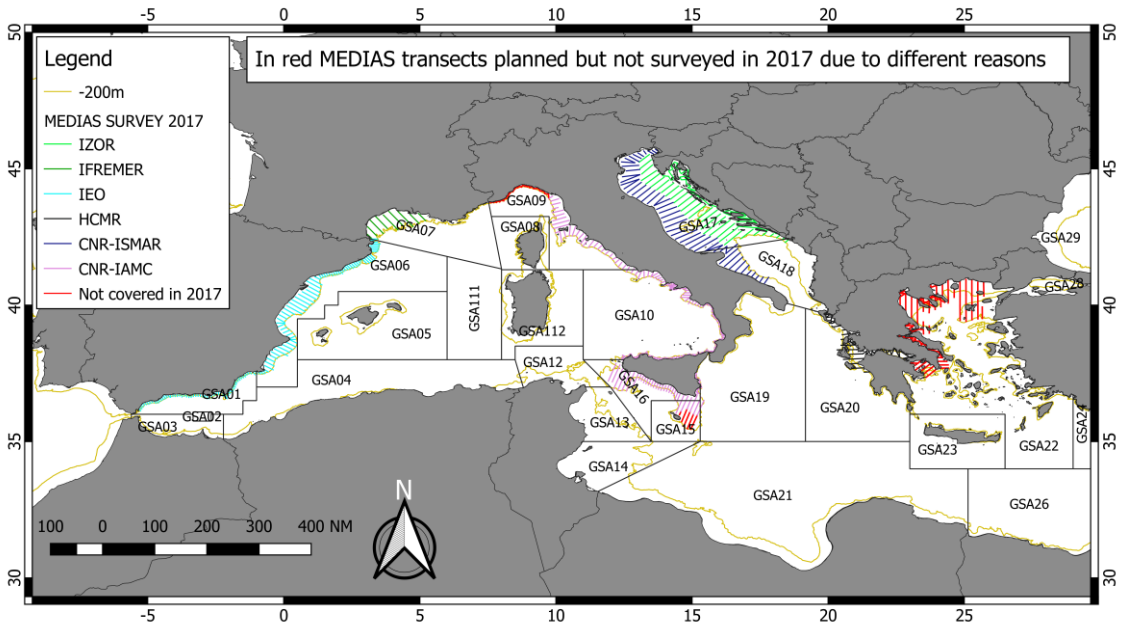


Figure 1: Acoustic surveys in MEDIAS framework in 2017

There was also the presentation of GFCM mid-term strategy 2017-19 by Angelo Bonanno and the discussion on otolith reading criteria and maturity scale in use in the MEDIAS group. Other matters of discussion were related to the establishment of a

procedure to deal with MEDIAS website registration requests and the scientific echosounder calibration procedures used by each group. During the second day of the meeting each MEDIAS group held a presentation of their workflow followed from raw data to biomass estimation in order to define a possible script for acoustic data elaboration in EchoR. Moreover, an example of CV estimation using the last version of the script written by Marco Barra (CNR-IAMC) on CV estimation was presented followed by a discussion on the official adoption of the script by the MEDIAS group. Next, there was a discussion on the eventual preparation of a basic protocol for plankton monitoring survey design. Last, there was a discussion on a Special Issue dedicated to MEDIAS work on a selected Journal and the proposals of preliminary titles of contributions by each group.

During the third day, the revision of the common MEDIAS protocol and an update of the MEDIAS handbook were carried out. Finally, the Terms of Reference (ToRs) for the next year (2019) were defined together with dates and venue for 2019 MEDIAS Coordination Meeting.

Results of the surveys carried out in 2017 in the framework of the Mediterranean International Acoustic Surveys (MEDIAS)

a) Italian Acoustic survey in Adriatic Sea - MEDIAS in the western GSA 17 and GSA 18 (Iole Leonori, Andrea De Felice, Ilaria Biagiotti, Giovanni Canduci, Ilaria Costantini, Sara Malavolti, Nicola Canduci)

The 2017 acoustic survey was carried out in June-July in western GSA 17 and GSA 18 including territorial waters of Slovenia (Dr. Tomaz Modic took part in the cruise in Slovenian waters). Acoustic data were logged over a grid of systematic parallel transects perpendicular to coastline/bathymetry. Inter-transect distance was 8-10 nmi. Acoustic monitoring was done during daytime (6:00 am – 7:00 pm). Scientific echosounder: Simrad EK60 equipped with 38, 120, 200 kHz and EK80 with 70 kHz split beam transducers hull-mounted. The research vessel was "G. Dallaporta" (built 2001, 35.30 m, 285 GT, 1100 CV). Vessel speed during acoustic survey was 9.5 knots. The acoustic system was calibrated in July 2017 using the standard sphere method (Foote et al., 1987; Demer et al., 2015). Elementary Sampling Distance Unit (EDSU) was 1 nmi, minimum bottom depth 10 m, pulse duration 1 ms for all frequencies and ping rate was set to maximum.

Table A1. Calibration results in 2017

Frequency	Beam Angles (deg)	Athw. Beam Angles (deg)	Athw. Offset Beam Angles (deg)	Along. Beam Angles (deg)	Along. Offset Beam Angles (deg)	Trasducer Gain (dB)	Sa Correction (dB)	RMS (dB)
38 kHz	7	7.10	0.03	6.96	0.00	25.36	-0.58	0.06
70 kHz	7	6.68	0.00	6.57	-0.04	27.02	-0.0008	0.07
120 kHz	7	6.42	0.08	6.45	-0.11	25.67	-0.30	0.19
200 kHz	7	6.19	0.00	6.60	-0.05	25.66	-0.29	0.31

In western GSA 17 total nautical miles effectively used for acoustic analysis (minus pelagic trawls tracks and linking transects) were 1067 for a total area of 10636 nmi^2, in western GSA 18 total nautical miles effectively used for acoustic data elaboration were 262 for a total area of 2510 nmi^2. Total area extension was about 13200 square nautical miles in the western part of Adriatic Sea, that rise up to 15700 square nautical miles including the Montenegro and Albania survey, thus ensuring a strong synopticity to the monitoring of such a large area.

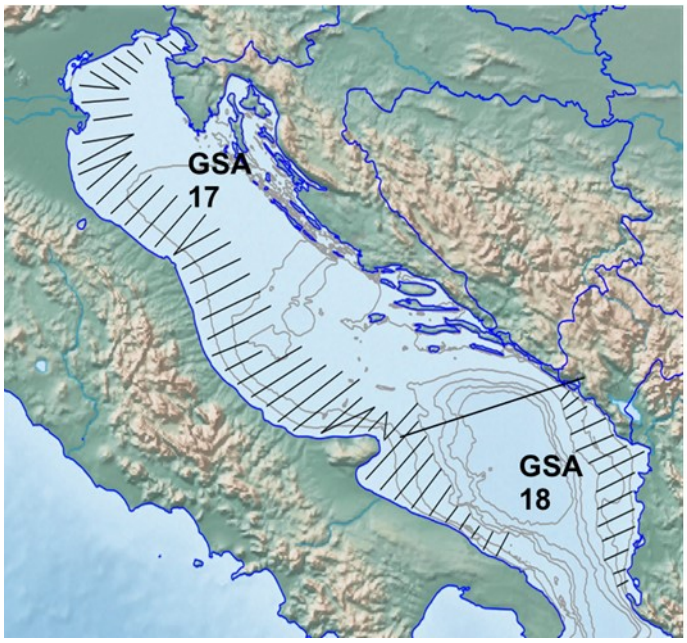


Figure A1. Acoustic survey route plan in western GSA 17 and GSA 18

In detail, the MEDIAS acoustic survey in western GSA 17 was conducted in June 2017; the coverage of the area was 100%, 36 pelagic trawls were conducted, 80 CTD stations were made and in 45 stations out of them plankton sampling by means of WP2 net (mesh size 200 µm) was carried out.

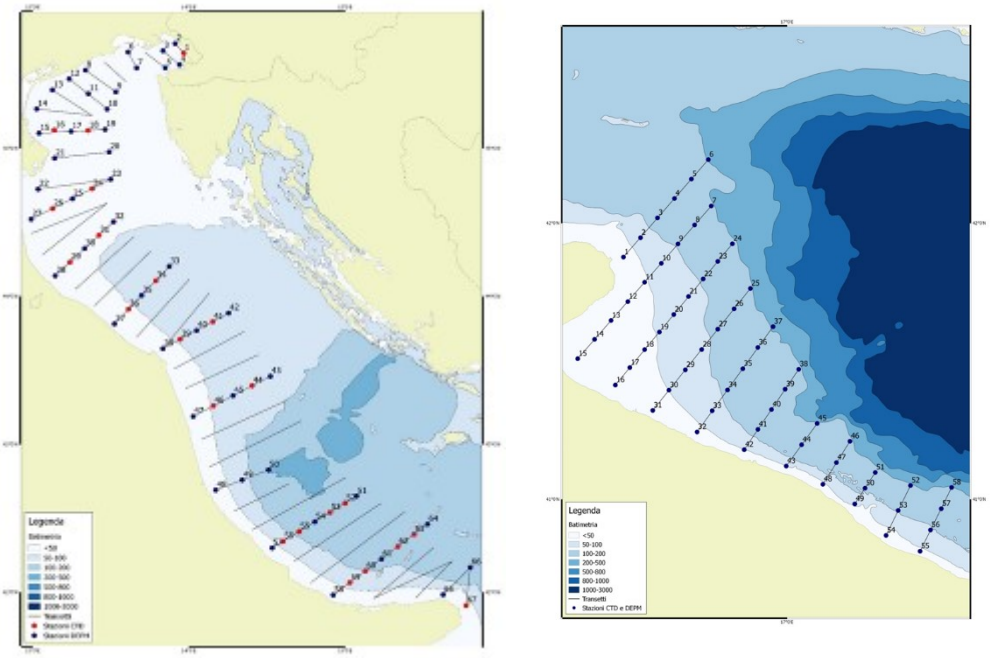


Figure A2. Acoustic survey route plan in western GSA 17 and western GSA 18. The positions of prefixed stations of CTD & plankton sampling are shown (in blue CTD&plankton stations, in red only CTD stations)

The MEDIAS acoustic survey in western GSA 18 was carried out in July 2017; area coverage was 100%, 10 pelagic trawls were conducted and 58 ichthyoplankton stations to apply Daily Egg Production Method were made, combining CTD and plankton net sampling. MEDIAS extension in eastern GSA 18 could not be entirely covered in July 2017 for the small amount of days of ship availability last year; only Montenegro area was covered, nothing could be done in Albania.

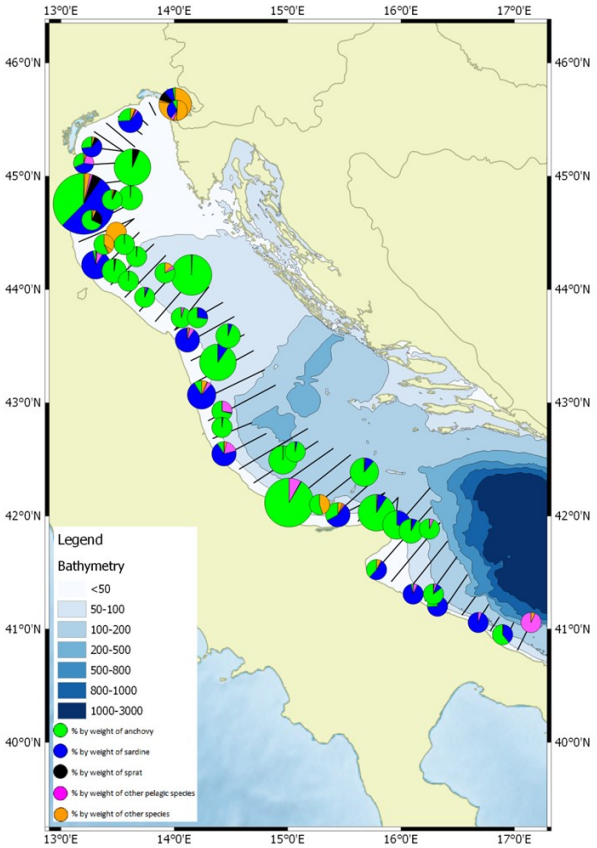


Figure A3. Acoustic survey route plan in western GSA 17 and western GSA 18. The catch composition of net samplings carried out in 2016 are reported

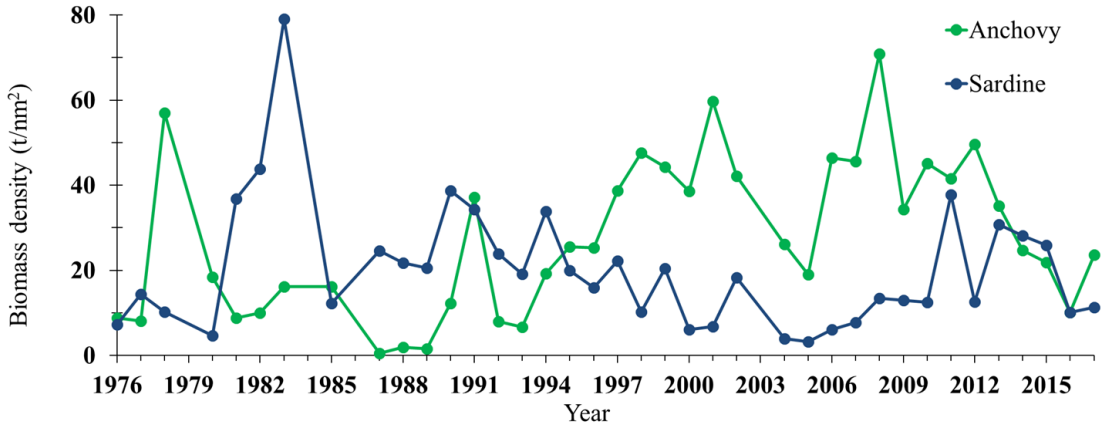


Figure A4. Trends of anchovy and sardine in western GSA 17

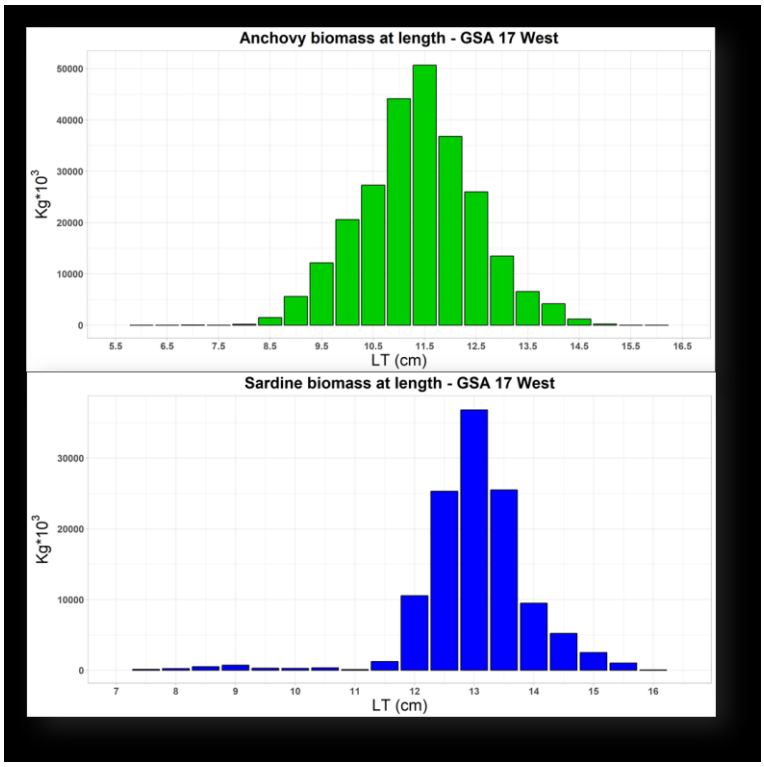


Figure A5. Anchovy and sardine biomass per length class in GSA 17 in 2017

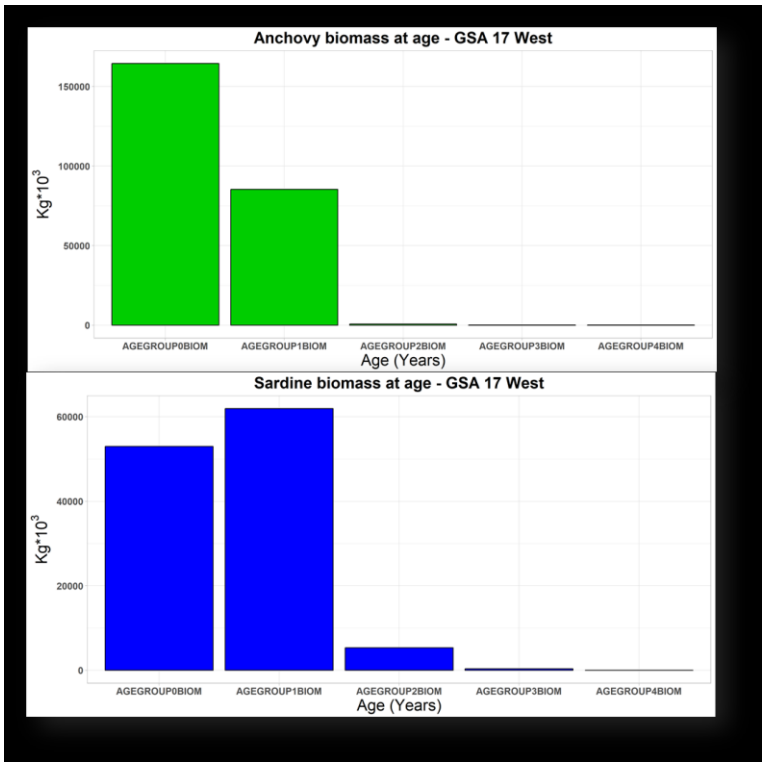


Figure A6. Anchovy and sardine biomass per age group in GSA 17 in 2017

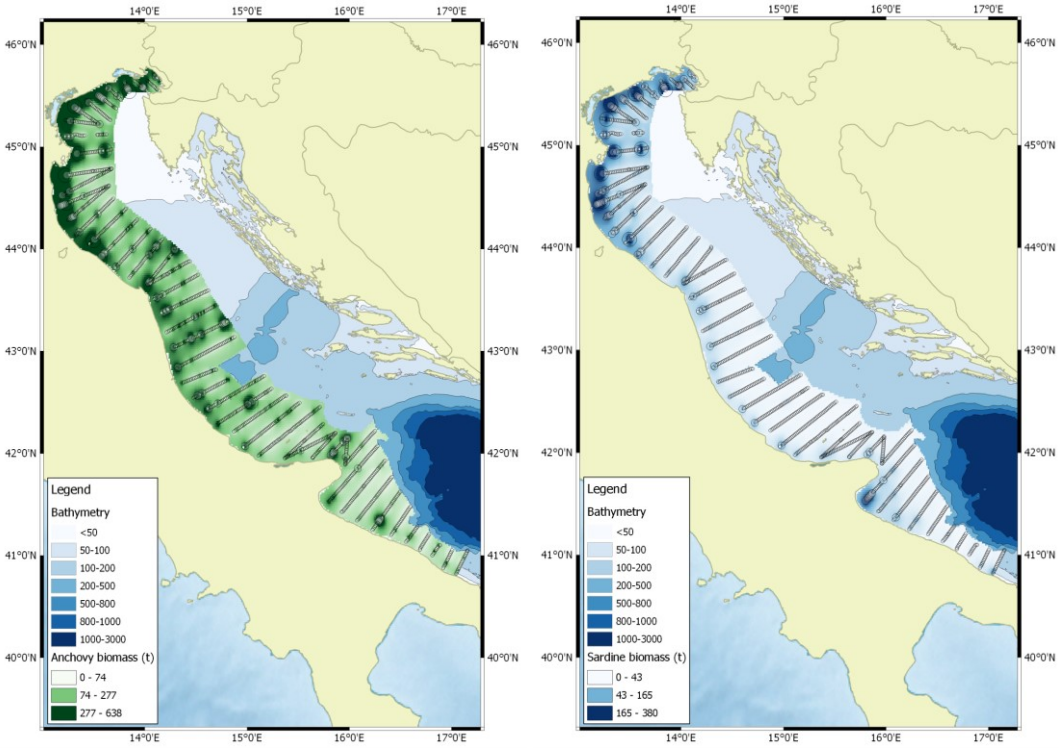


Figure A7. Anchovy and sardine spatial distribution in western Adriatic Sea in 2017

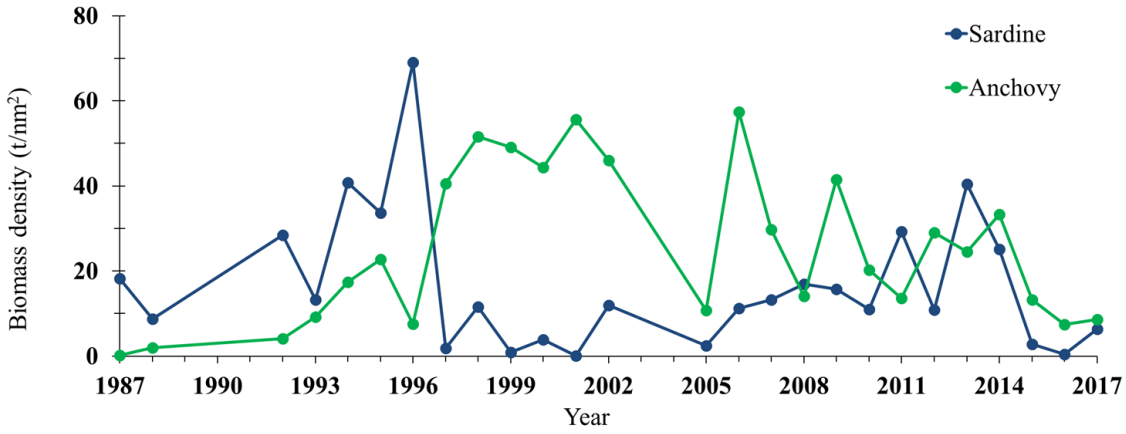


Figure A8. Trends of anchovy and sardine in western GSA 18

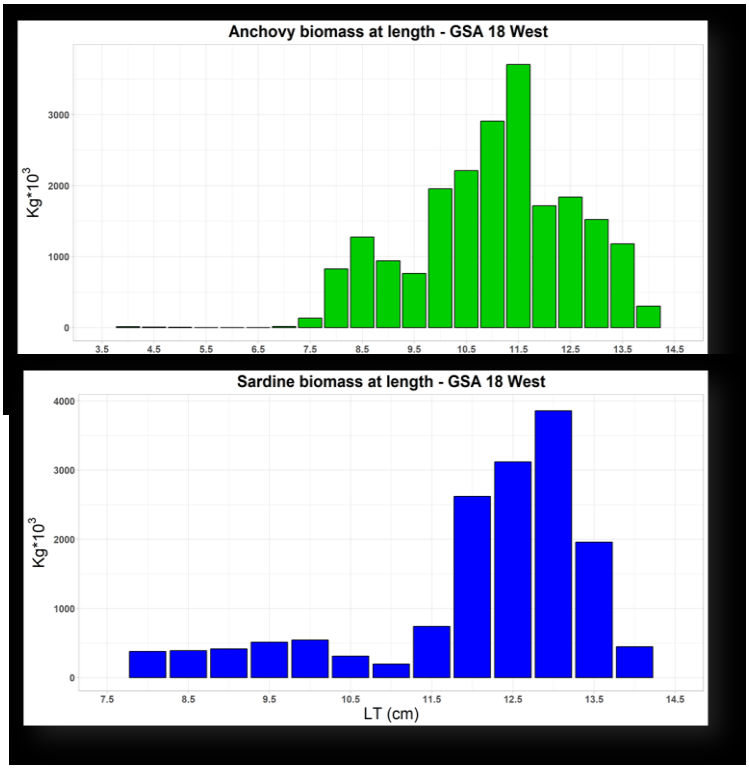


Figure A9. Anchovy and sardine biomass per length class in GSA 18 in 2017

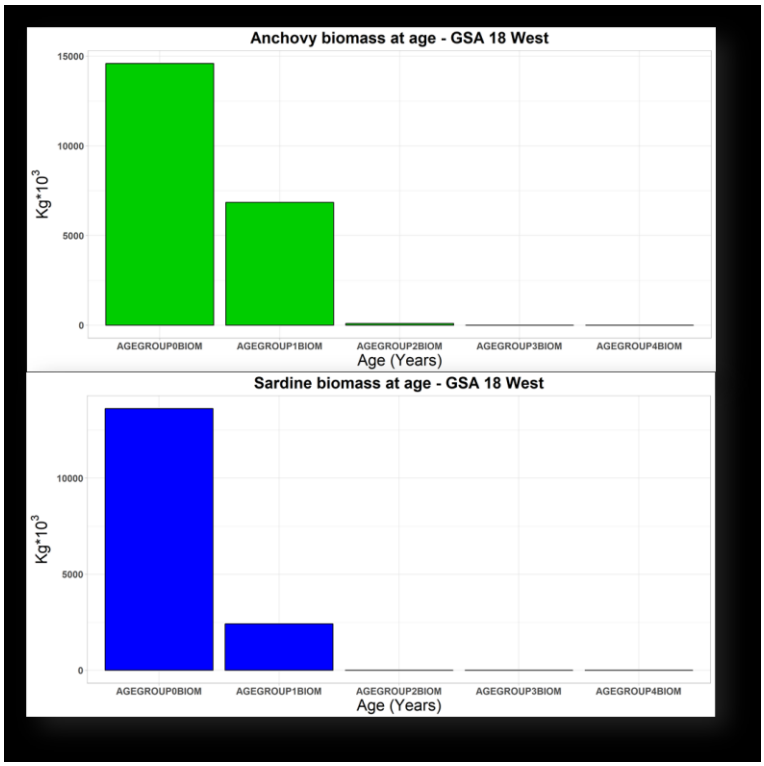


Figure A10. Anchovy and sardine biomass per age group in GSA 18 in 2017

In the last period biomass estimations of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) stocks in western Adriatic Sea saw severe decreases both in GSA 17 in 2016 and in GSA 18 in 2015. While anchovy in west GSA 17 in 2017 present an increase up to 2015 levels, sardine remains at rather low biomass values as in 2016 and in the years before 2011. In west GSA 18 anchovy and sardine biomass remain low since 2015 even if a slight increase is recorded in 2017.

Spatial distribution of anchovy and sardine in western Adriatic Sea in 2017 was mainly coastal, especially for sardine, with higher values in the northern area for both species.

b) Acoustic survey in the eastern part of the GSA 17 (Adriatic Sea – Croatia)
(Tičina V., Grbec B., Dadić V., Pallaoro A., Bogner D., Pikelj K., Matić F., Muslim S., Gašparević D., Juretić T., Ivanković D., Jelavić D. and Vučić I.)

After accession of Croatia in EU, 5th acoustic survey in eastern part of the Adriatic Sea (GSA 17) have been carried out within Data Collection Framework (DCF), as a part of international Pan European Mediterranean acoustic surveys (MEDIAS). Acoustic survey carried out in the period 30. Aug. – 30. Sept. 2017 successfully

covered 100% of total area of eastern part of GSA 17 that need to be covered within Croatian DCF (>13,500 nm^2); in total, 32 days of R/V "BIOS DVA" were used for this purpose. Since 2017, no single person has been formally nominated as national responsible scientist for MEDIAS in Croatia, as it was before. Different problems in MEDIAS related to logistic constraints (personnel, technical and financial) and administrative barriers have been highlighted.

Acoustic sampling have been carried out along transects in Croatian territorial waters, as well as within Croatian protected ecological-fishery zone (Fig. B1.). In total, acoustic data were collected in 1440 EDSU. Fish sampling has been attempted 59 times, obtaining 51 hauls with fish sampled (Fig B2.). Oceanographic properties of survey area during survey period were described based on 89 CTD stations. Data collection during acoustic survey has been done in accordance with MEDIAS Handbook (March, 2015).

Based on survey data collected, spatial distributions (GIS analyses) of anchovy and sardine stock within study area were presented (Fig. B3 and B4). According to given results, biomass indices for anchovy indicate slight decrease in biomass in September 2017 compared to September 2016 in eastern part of GSA17, with very low recruitment index noticed (Fig. B5). Spatial distribution indicated very low abundance of anchovy in the area along western Istrian coast where unusual occurence of ctenophora *Mnemiopsis leidy* has been observed. Anchovy from age group 1 showed the highest portion in biomass distribution by age, with no older ages noticed.

In the same time, according to results obtained, biomass and abundance indices for sardine indicate slight increase in September 2017 compared to September 2016 in eastern part of GSA17. Sardines from age group 0 showed the highest portion in biomass distribution by age, indicating a good recruitment in 2017, but unfortunately spawning stock biomass - SSB (i.e. older age groups) is very low. Size structured abundances of anchovy and sardine populations on eastern part of GSA17 in September are shown in Fig. B6.

It seems that overall biomass of target species (anchovy & sardine) observed by acoustic survey in eastern part of GSA 17 was slightly higher in 2017 than in 2016.

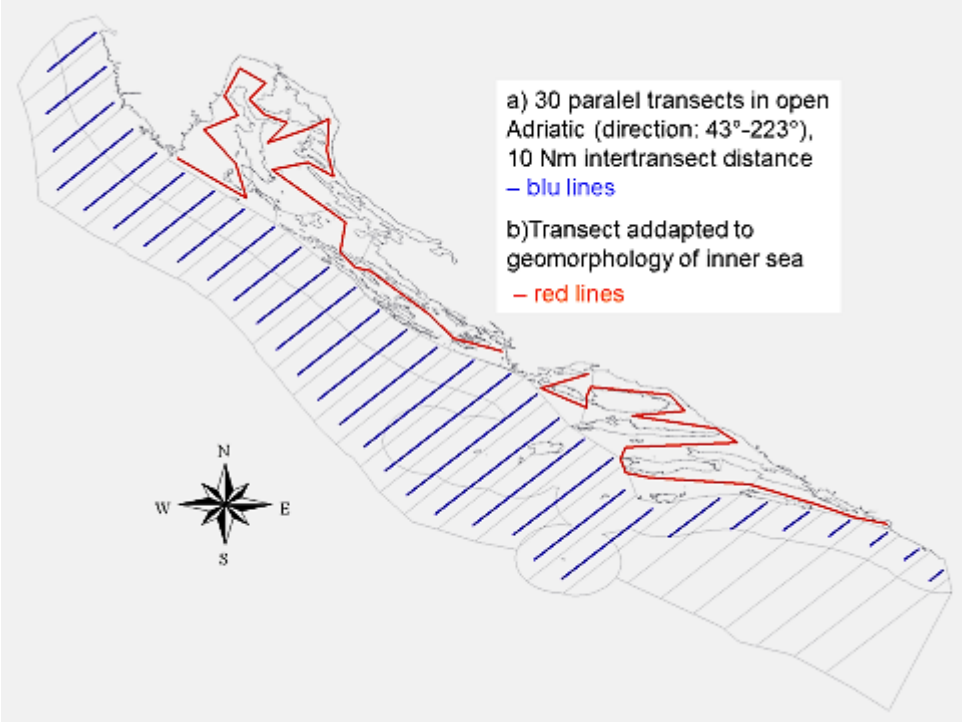


Figure B1. Survey design of acoustic transects in the eastern part of GSA 17.

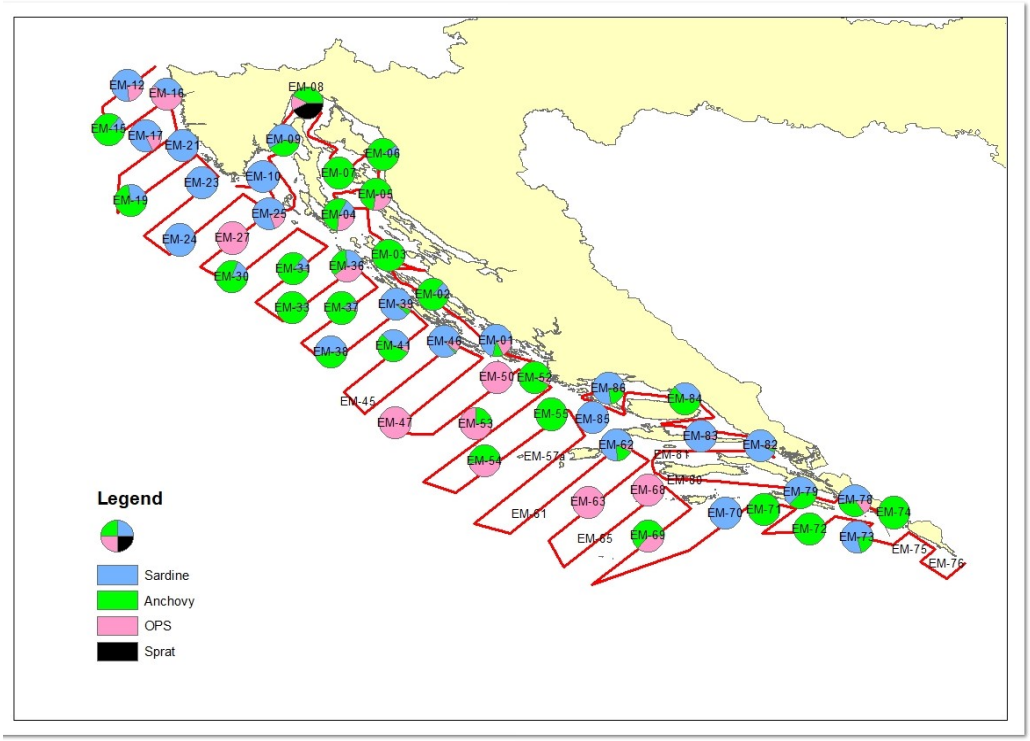


Figure B2. Compositions of pelagic fish assemblages in the eastern part of GSA 17 in September 2017.

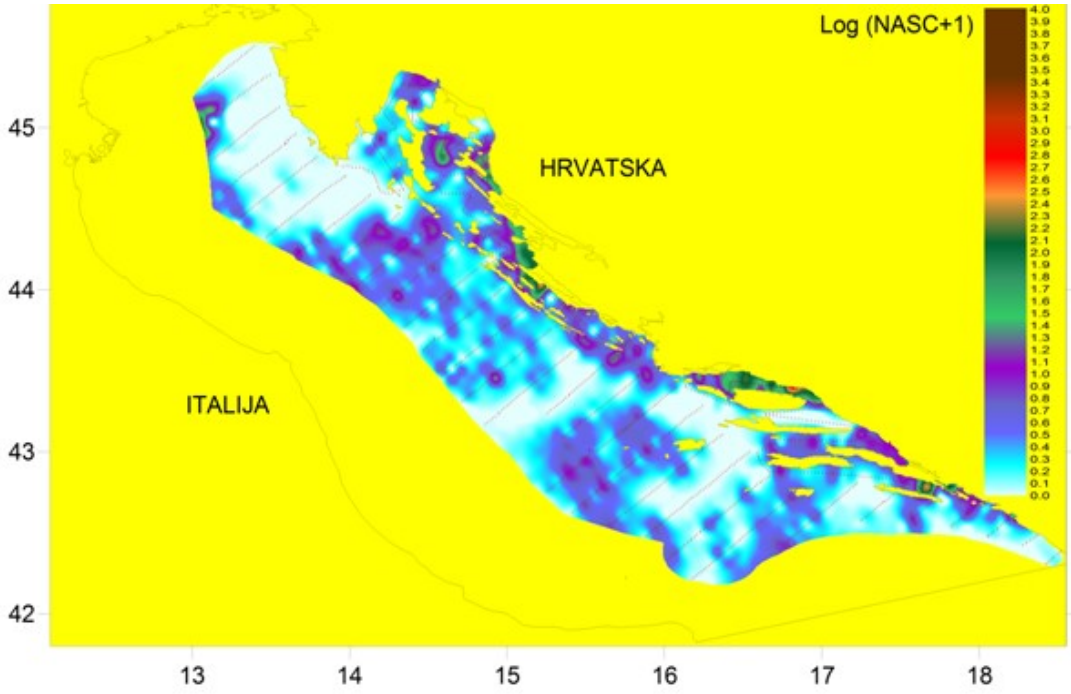


Figure B3. Spatial distribution (GIS analyses) of anchovy within survey area (September, 2017).

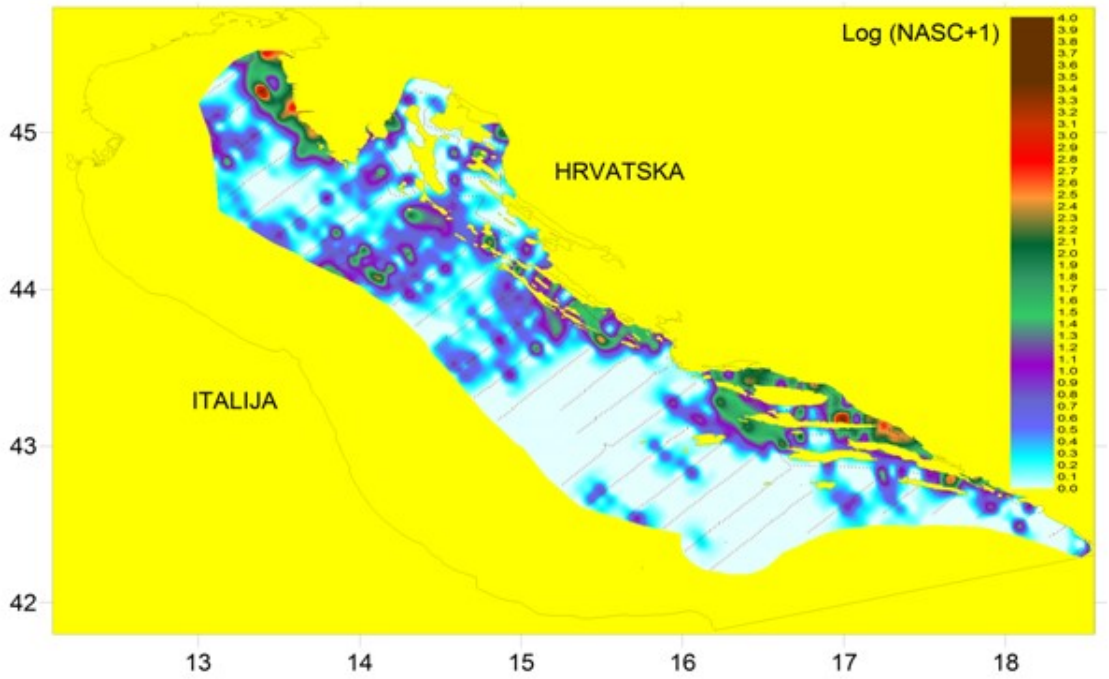


Figure B4. Spatial distribution (GIS analyses) of sardine within survey area (September, 2017).

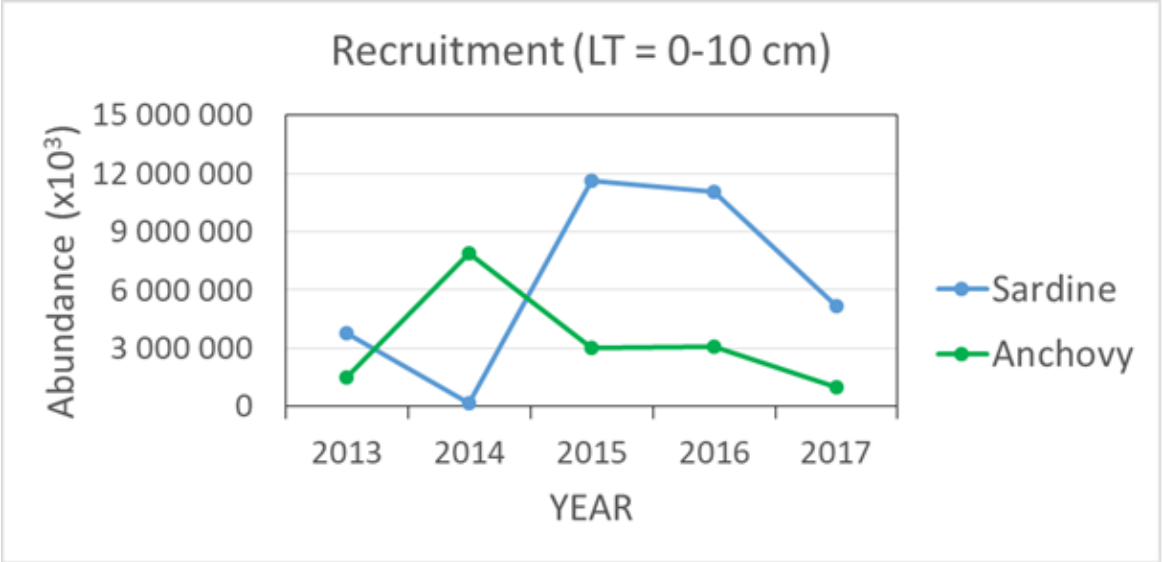


Figure B5. Recruitment indices as obtained by acoustic surveys from the eastern part of GSA17 (survey period: September).

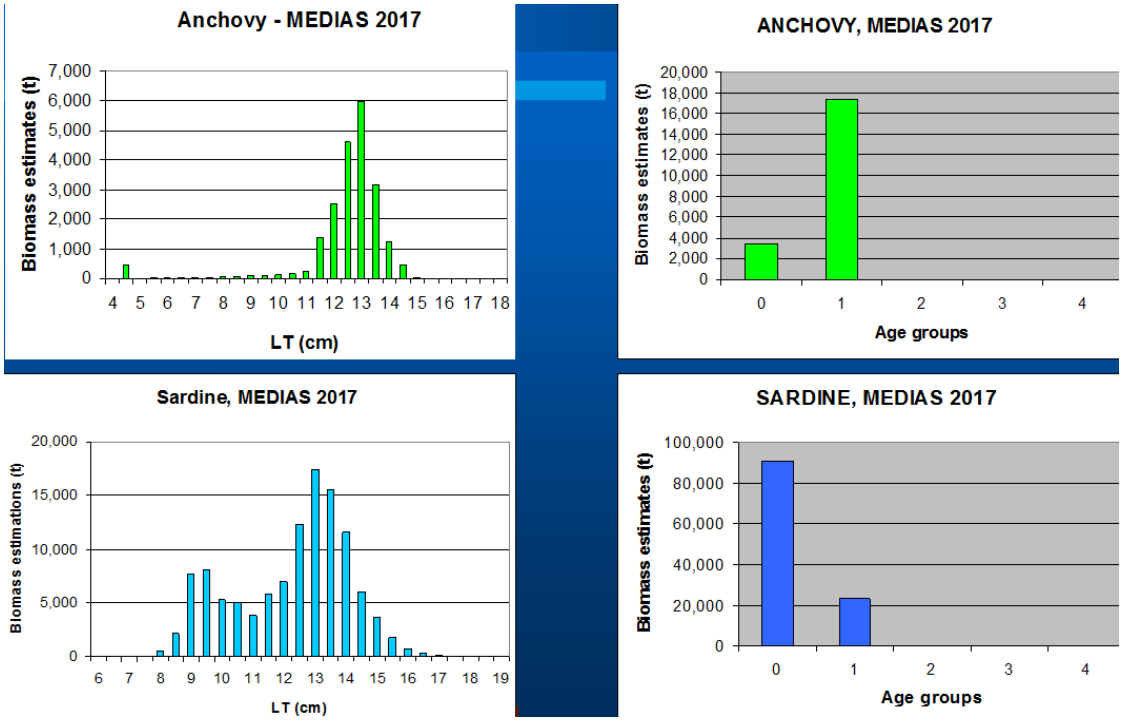


Figure B6. Size and age structured biomass estimates of anchovy and sardine in September 2017 (GSA17-eastern part).

c) Acoustic survey in the GSA 16 (Angelo Bonanno, Gualtiero Basilone, Simona Genovese, Rosalia Ferreri, Marco Barra)

The acoustic survey was carried out in the period 23 July – 02 August 2017 on board the R/V "G. Dallaporta" in the GFCM Geographical Sub-Area 16 (GSA 16 – South of Sicily). Acoustic biomass estimates and spatial distribution of sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) for the year 2017 are presented. In order to obtain a more complete picture on the spatial distribution of the two species in the Sicilian waters, the survey covered also of the continental shelf in the western part of GSA 19 and part of the continental shelf in the GSA 15.

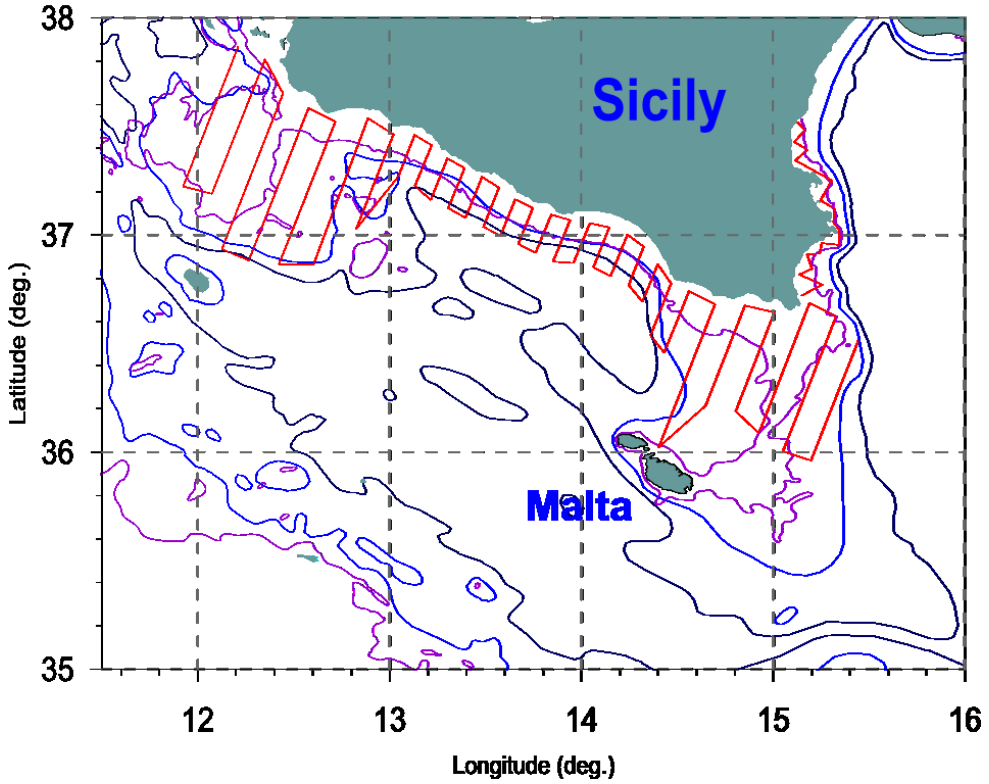


Figure C1. Acoustic survey design in summer 2017.

The total biomass of anchovy stock was 10500.3 t in the GSA 16 (surveyed area of 5260 nm^2) and 3319.2 t in the western Ionian waters (surveyed area of 132 nm^2). The spatial distribution showed that anchovy was mainly concentrated in the central and eastern parts of the study area in the Strait of Sicily and in the western Ionian Sea. The age structure, while confirming the typical presence of age classes 1 and 2, for the first time in summer surveys highlighted a high percentage of age 0 specimens.

In the case of sardine population, the biomass in 2017 was 14435.8 t in GSA 16 and 901 t in the western Ionian Sea. Differently from the previous year, the distribution of biomass among age classes shows a breakdown of the population in three age classes (0, 1 and 2) with higher percentage of age 0 specimens.

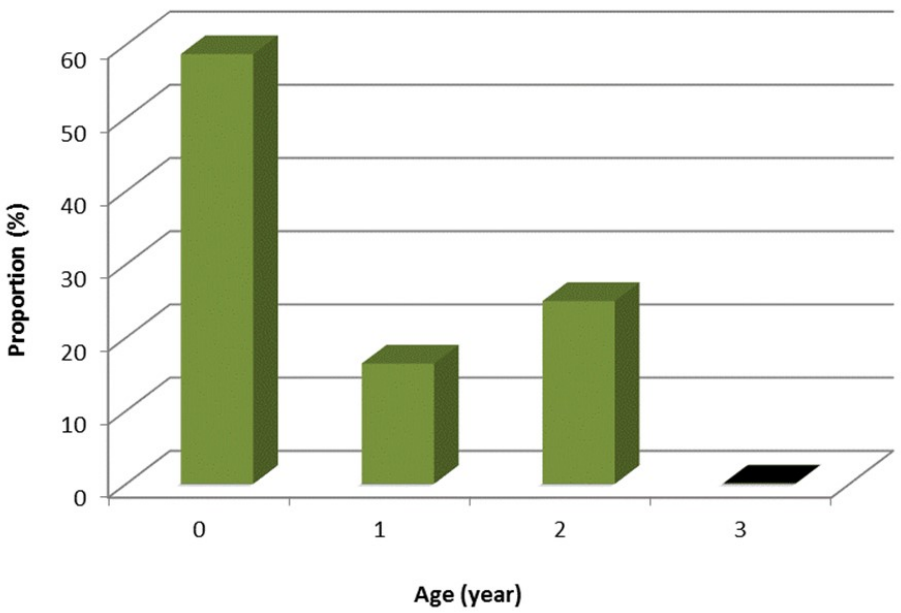


Figure C2. Anchovy age classes distribution (%) – Echosurvey 2017.

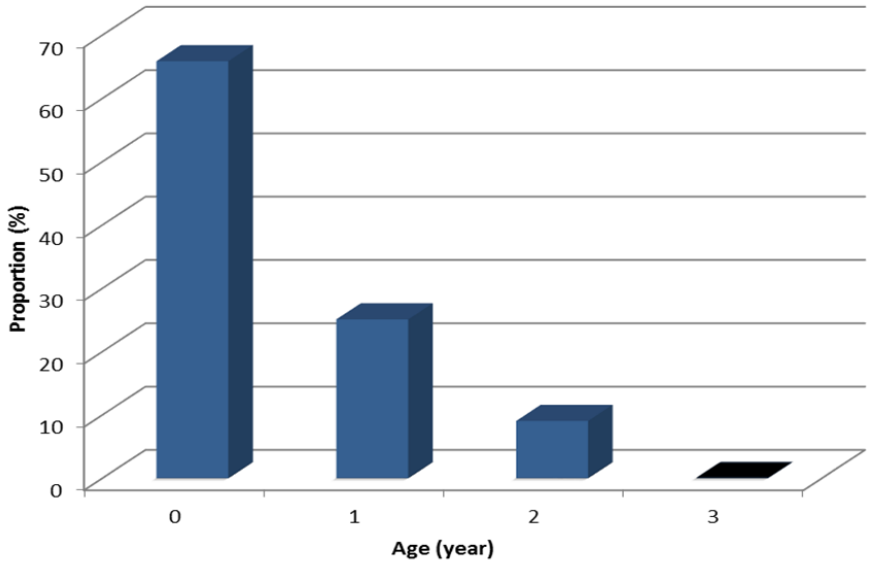


Figure C3. Sardine (*S. pilchardus*) age classes distribution (%) – Echosurvey 2017.

d) **Acoustic survey on small pelagics in the GSAs 9 and 10 in summer 2017**
(Angelo Bonanno, Gualtiero Basilone, Simona Genovese, Rosalia Ferreri, Marco Barra)

The echosurvey on small pelagics in the GSAs 9 and 10 in summer 2017 was carried out in the framework of the Italian National Program (Commission Decision C(2016) 8906

of December 19, 2016). The survey was carried out in the period 03 - 31 August 2017. The track length was 1784 nm for a surveyed area of about 6228 nm^2. During the survey, 40 trawl hauls were completed and 246 CTD casts were collected with a SBE 911 plus multiparametric probe.

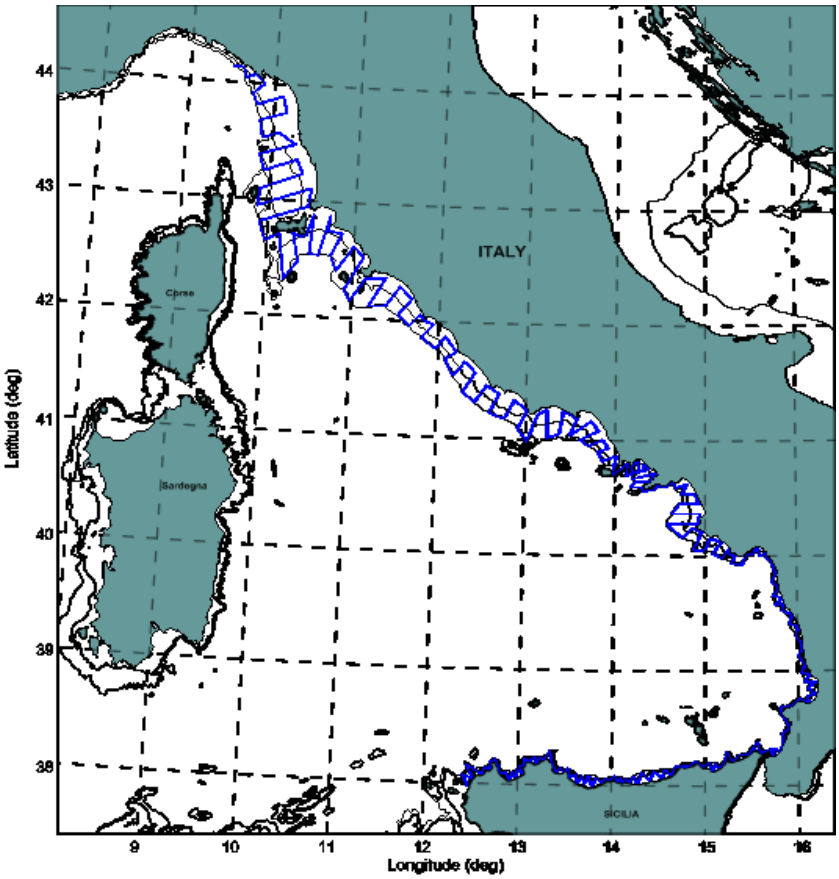


Figure D1. Map of the survey design in GSAs 9 and 10 adopted during the survey in summer 2017.

The spatial distribution of both anchovy and sardine confirmed the previously observed patterns for the two species.

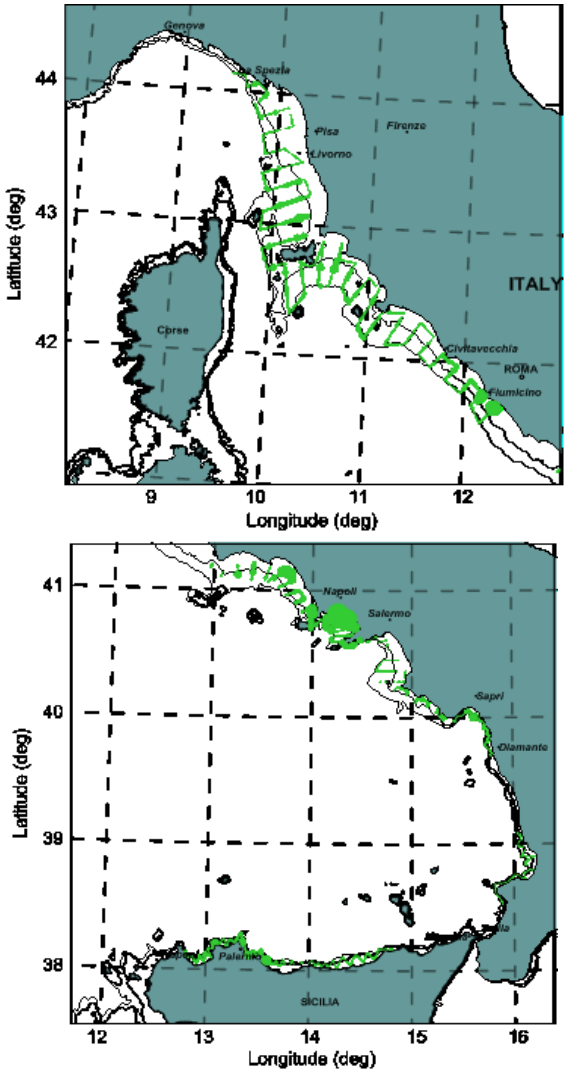


Figure D2. Spatial distribution of anchovy during the survey in 2017.

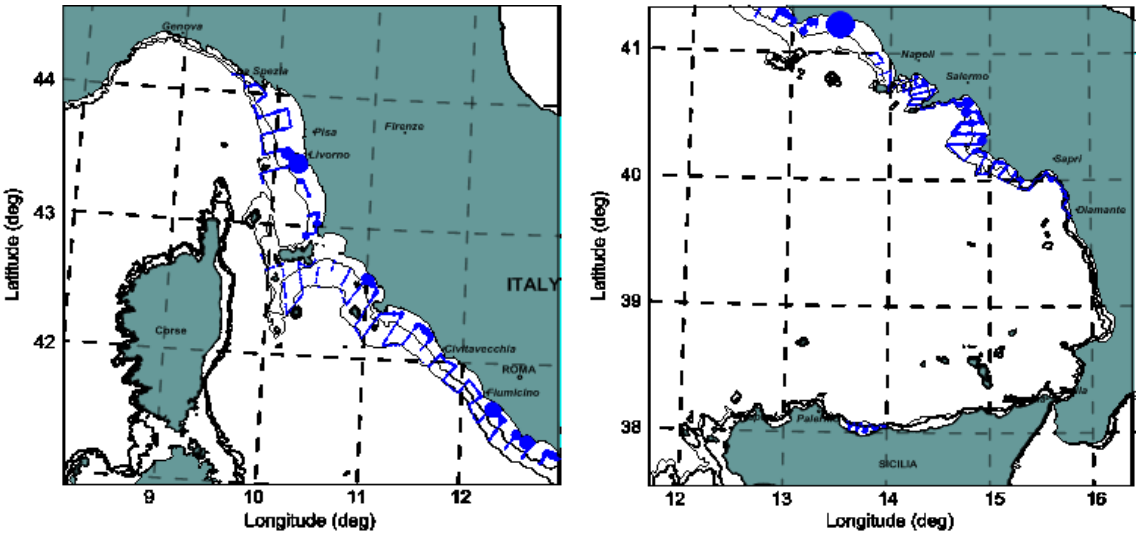


Figure D3. Spatial distribution of sardine during the survey in 2017.

During the survey both species were more abundant in GSA 9 than in GSA 10. In particular, the biomass of *Engraulis encrasicolus* was estimated to be 44593.1 t in GSA 10, while in GSA 9 it was 102036.1 t. The *Sardina pilchardus* biomass was 20116.2 t in GSA 9 and 16552.2 t in GSA 10.

The age structure revealed similar patterns in both GSAs, highlighting also a high percentage of age 1 specimens for both species.

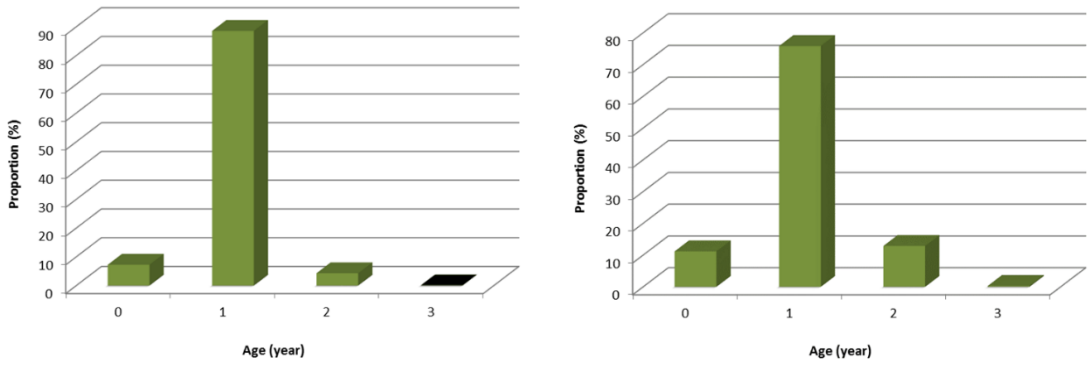


Figure D4. Anchovy age classes distribution in GSA 9 (left) and GSA 10 (right) – Echosurvey 2017.

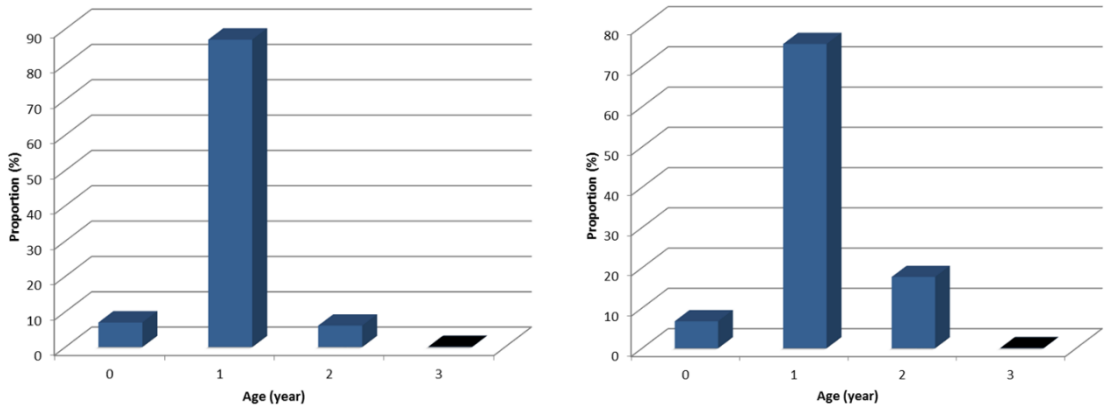


Figure D5. Sardine age classes distribution in GSA 9 (left) and GSA 10 (right) – Echosurvey 2017.

e) Greek acoustic survey in GSA 20 (Marianna Giannoulaki, Athanassios Machias, Konstantinos Tsagkarakis, Maria Myrto Pyrounaki, Zacharias Kapelonis, Spyros Stamatas, Stylianos Somarakis)

The echosurvey in the Greek waters covered only the eastern Ionian Sea (GSA 20) on board the RV "PHILIA". No survey took place in Aegean Sea in 2017. The survey design is made of parallel transects perpendicular to the isobath from 10 m to 200 m depths. The inter-transect distance is 10 nm. The EDSU is 1 nm. The average surveying acoustic vessel speed is 8 knots. Echotraces were collected with a Simrad EK80 split beam echosounder (ES38-7, ES120-7C, ES200-7C, ES333-7C) and echotraces identified based on the catch composition of the pelagic haul. Acoustic recording was performed by day time. The survey covered the eastern part of Ionian Sea including Patraikos and Amvrakikos gulfs. The survey track involved 44 acoustic transects that covered an area of 4267 NM2 in Ionian Sea (Fig. E1). In addition 101 CTD Stations and 59 plankton stations were completed during the survey.

The anchovy biomass was estimated to be 20466 t and 7999 t in eastern Ionian Sea. The biomass distribution of each species is shown (Fig. E2). The length composition for anchovy and sardine are shown in Figs. E3 and E4.

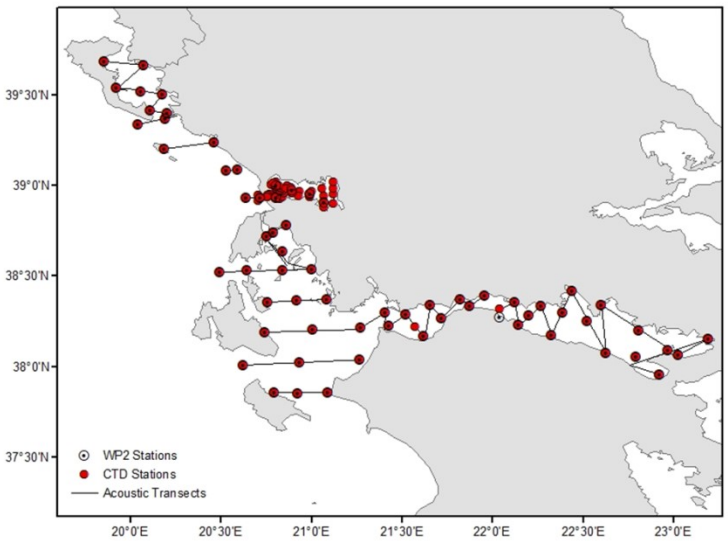


Figure E1. Map of the survey area and the survey design in GSA 20 at the Greek acoustic survey in 2017.

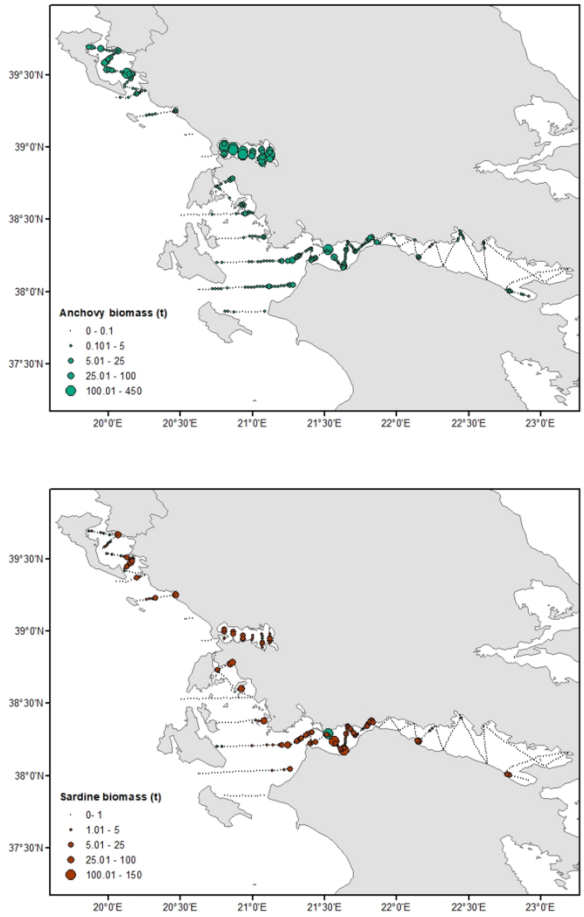


Figure E2. The distribution of anchovy biomass (t) and sardine biomass (t) per EDSU in eastern Ionian Sea during October 2017, respectively.

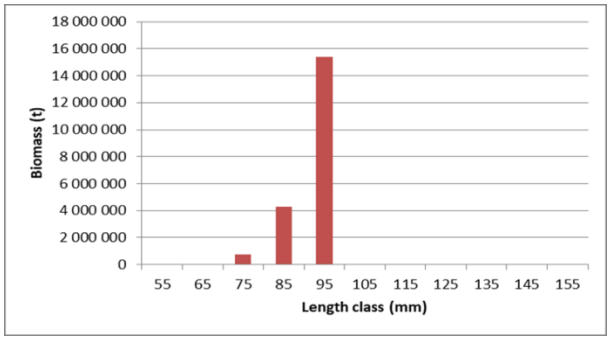


Figure E3. Length frequency distributions of anchovy catch during the acoustic survey in eastern Ionian Sea in October 2017.

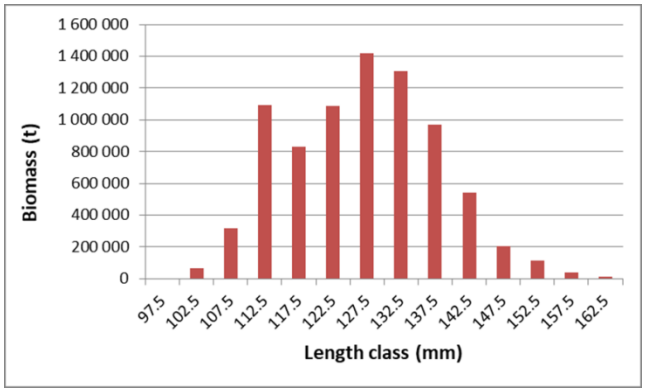


Figure E4. Length frequency distributions of sardine catch during the acoustic survey in eastern Ionian Sea in October 2017.

f) **Results from Iberian survey MEDIAS 2017** (Magdalena Iglesias, Ana Ventero, Dolores Oñate, Pilar Córdoba)

MEDIAS 2016 acoustic survey was carried out in the Mediterranean Spanish waters from 24 June to 28th July 2017 (35 days) on board the R/V "Miguel Oliver" (70 m long). Acoustic data were collected over 1067 nautical miles (nmi), corresponding 842 nmi to GSA06 and 2225 nmi to GSA01 GFCM geographical sub-areas. Twenty nine (36) pelagic hauls were carried out in GSA06 and nineteen (12) in GSA01 to be used for the scrutinizing of the echograms (Fig. 1). 92 CTD stations were performed in GSA06 and 36 in GSA01.

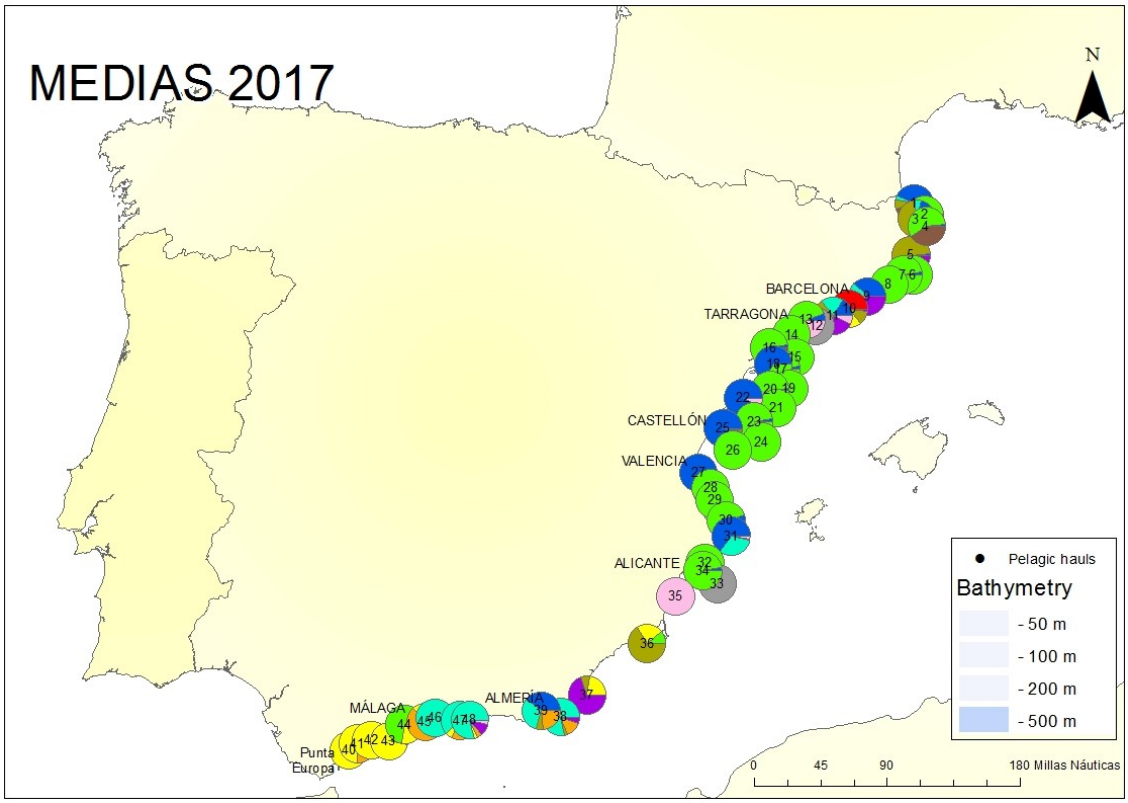


Figure F1. Survey area and pelagic hauls carried out during the Spanish acoustic MEDIAS survey carried out in June - July 2017.

Biomass (tons) (Fig. 2 & 3) and abundance (nº individuals) of sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) were estimated by GSA. Sardine and anchovy were the most abundant species in the GSA06 area. The fish pelagic community detected and estimated includes sardinella (*Sardinella aurita*), sprat (*Sprattus sprattus*), horse mackerel (*Trachurus trachurus*, *T. mediterraneus* and *T. picturatus*)), bogue (*Boops boops*) and Spanish mackerel (*Scomber colias*). Horse mackerel was the most abundant species en GSA01.

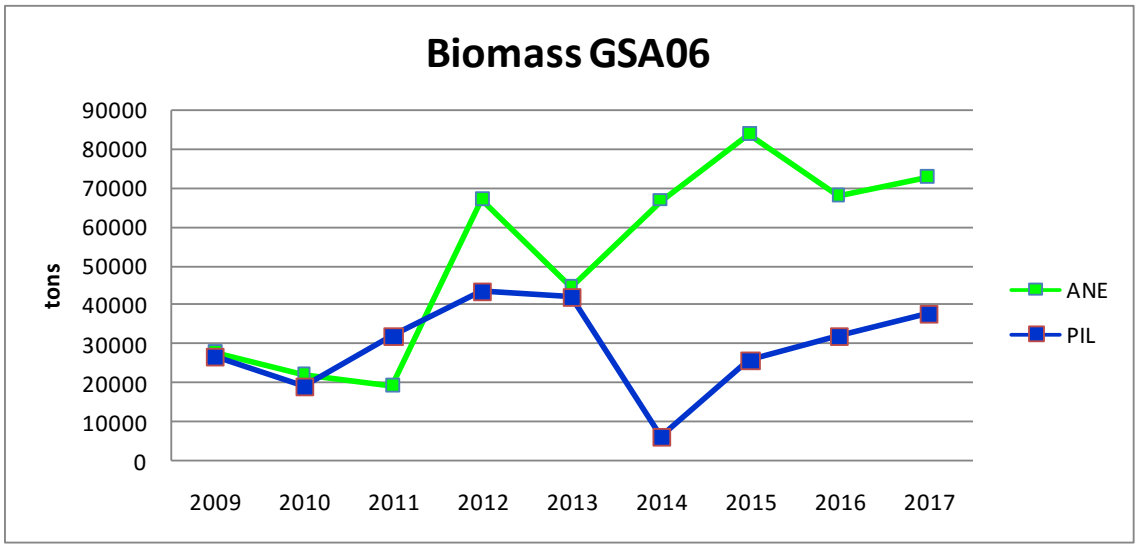


Figure F2. Anchovy (ANE) and sardine (PIL) biomass (tons) in GSA 06 in the period 2009-2017.

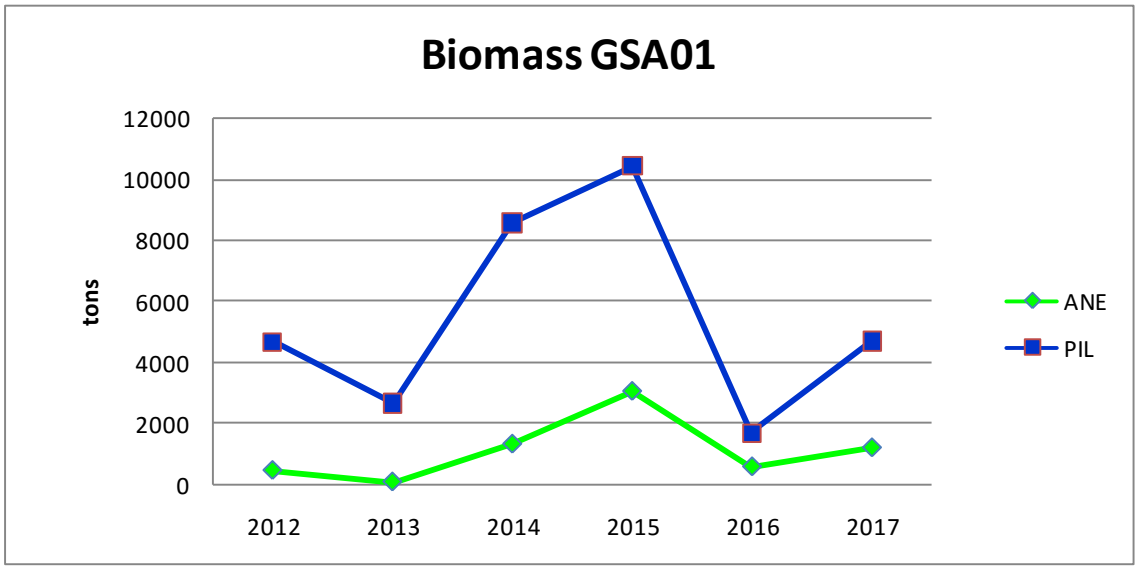
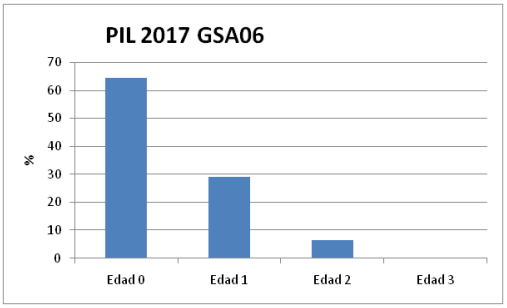


Figure F3. Anchovy (ANE) and sardine (PIL) biomass (tons) in GSA 01 in the period 2012-2017.

Age was estimated for sardine and anchovy by counting growth rings on the otoliths and age-length key calculated (Fig. 4 & 5).



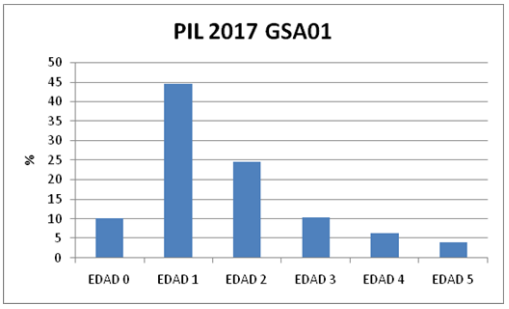
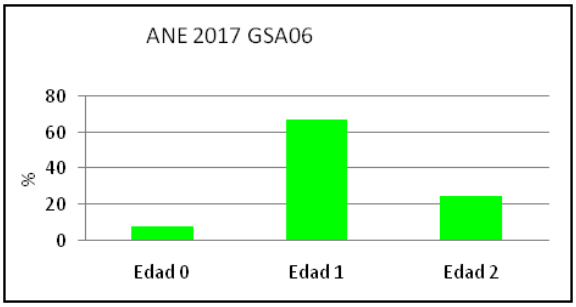


Figure F4. Sardine age-length key in MEDIAS 2017 in GSA06 and 01.



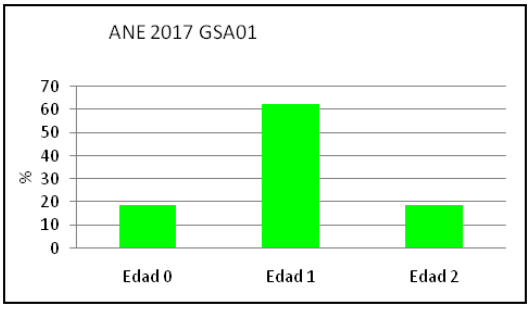


Figure F5. Anchovy age-length key in MEDIAS 2017 in GSA06 and 01.

g) Pelagic Surveys at the Romanian Black Sea Coast (GSA 29)

(Valodia Maximov, Alexandru Nicolaev, Gheorghe Radu)

Description of the Fisheries

The Romanian fishing fleet is operating in the area of competence of the Regional Fisheries Management Organisations - G.F.C.M., Area 37 - Mediterranean and Black Sea, Sub-area 37.4., Division 37.4.2, GSA 29. The Romanian fishing area is comprised between Sulina and Vama Veche; coastline extends for over 240 km, which can be divided into two main geographical and geomorphologic sectors:

♦ the northern sector (about 158 km in length) lies between the secondary delta of the Chilia branch and Constantza, constituted of alluvial sediments;

♦ the southern sector (about 85 km in length) lies between Constantza and Vama Veche characterised by promontories with active, high cliffs, separated by large zones with accumulative beaches often protecting littoral lakes.

The distance from the sea shore to the shelf limits (200 m depth) varies from 100 to 200 km in the northern sector and to 50 km in the southern one. The submarine slope of the shelf is very gentle in the north, while in the southern sector the slope increase very quickly (Fig. 1 and 2).

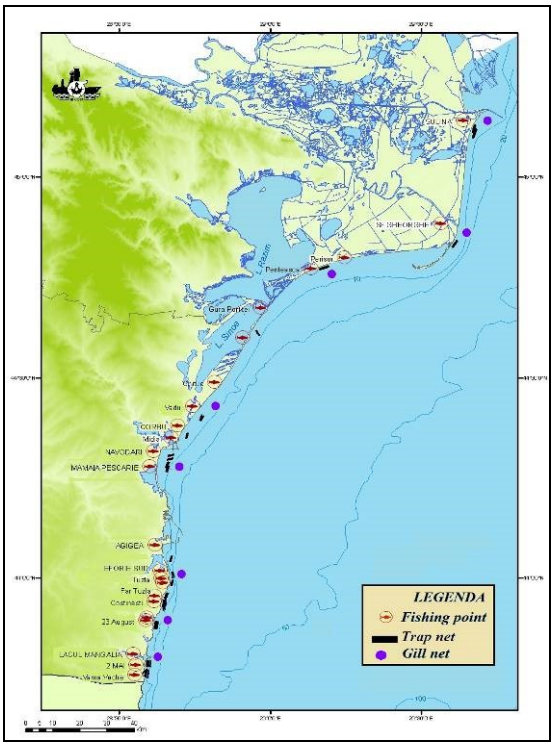


Figure G1. Fishery ports and distribution area for stationary fishing gears.

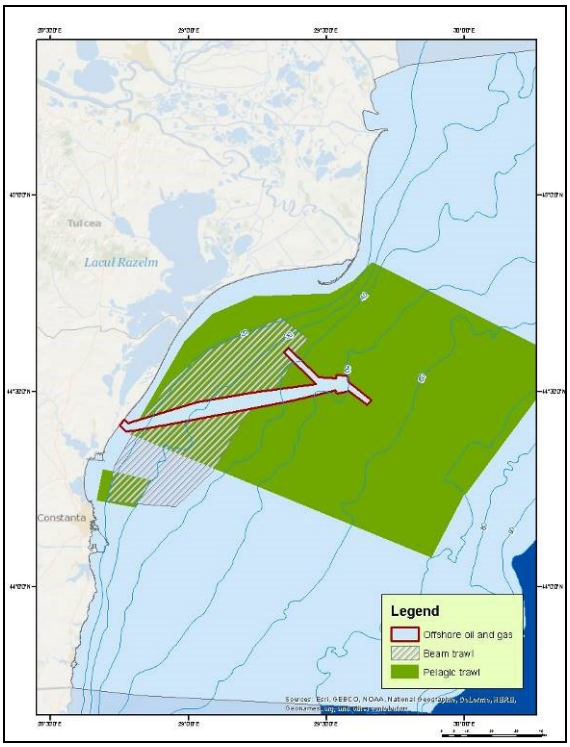


Figure G2. Distribution of trawling zones for active fishing gears.

In the coastal zone of the Romanian marine sector with small depth, fishing with fixed gear is characterized by the concentration of activity mainly in the first six-seven months of the season (March-September), when usually the species migrates to the coastal area for reproduction and other species migrate for feeding. In generally, total fishing season being of about eight months. The capture level and the level of fishing productivity differs from one year to another, depending on the fishing effort (number of pound nets and effective fishing days), and also depends on the evolution of hydro climatic conditions and at last but not least, the state of fish stocks. The structure on species in the catches mirrored only partly the composition of Black Sea ichtyofauna from the Romanian sector, because the type of gear conditions the ratio between the different fish species. As a general rule, the pelagic species, small-sized and short life cycle keep continue to be dominant in catches.

In **2017**, when only **155 vessels** were registered, of which **135** were active. Even though compared to the previous years the total number of registered vessels slightly dropped (abou 5%), the number of active vessels increase, by the activation of 12 - 18 m and 18 - 24 m LOA vessels, specialized for rapa whelk fishing. The passive fishing gears include the equipment for catching in general the fish migrating for spawning and feeding in shallow waters, namely: long lines and bottom lines; gillnets for turbot, Danube shad, gray mullet, gobies and horse mackerel; trap nets for gobies; sea pound nets. Another category of fishing equipment used in the Romanian coastal zone includes the active fishing gear like beach seine, pelagic trawl and, since 2013, beam trawl.

Qualitative and quantitative structure of catches

After a decreasing trend during 2002-2010, when it dropped from more than 2,000 t, in 2002, to 1,390-1,940 t, during 2003-2006, and below 500 t during 2007 - 2009, reaching a minimum value in 2010/258 t, in the past years the total catch has had an increasing trend, namely 568 t, in 2011, 835 t, in 2012, 1,711 t in 2013, 2,231 t in 2014 (more than 23.31% higher than the previous year), 4,847 in 2015 (more than 105.5 % higher than the previous year), 6,839.5 tons in 2016, and 9,553 in 2017 official registered (Fig. 3). In period 2011 – 2017, the total catches increased compared to the previous period due to the rapa whelk catches. The main species in the 2017, catches have been: rapa whelk (9,244.3 tons / 98.4 % of total catches); anchovy (27.275 tons); sprat (28.738 tons); turbot (42,616 tons); horse mackerel (34.569 tons); shad (9.208 tons) and gobies about 12.630 tons (Fig. 4).

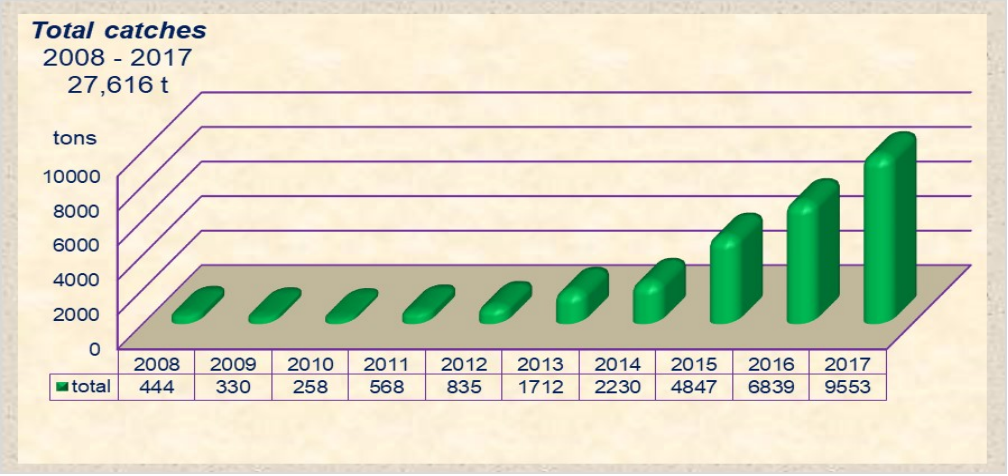


Figure G3. Total catches at the Romanian littoral.

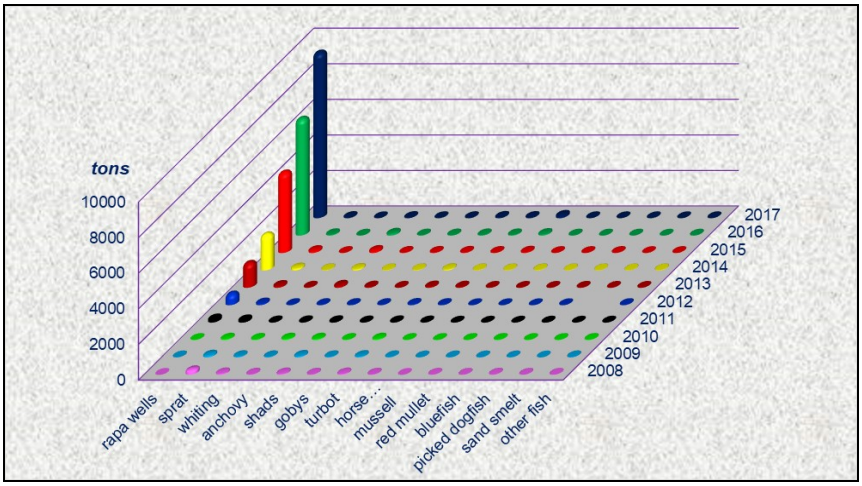


Figure G4. Structure on species at the Romanian littoral, during 2008 – 2017.

Survey 2017:

♦ period: 06 – 13 June and 10 - 19 October 2017

♦ type of fishing vessel: B-410 (***STEAUA DE MARE 1***);

♦ characteristics: pelagic trawls: 36/26-59 m; horizontal trawl opening - 20 m; vertical trawl opening 11-12 m; no. trawls: 42 + 30; drepth 20.1 - 66.4 m; trawl speed 3.2 knots; time trawling 30 min; catch 50 – 1,650 kg.

Estimated total biomass:

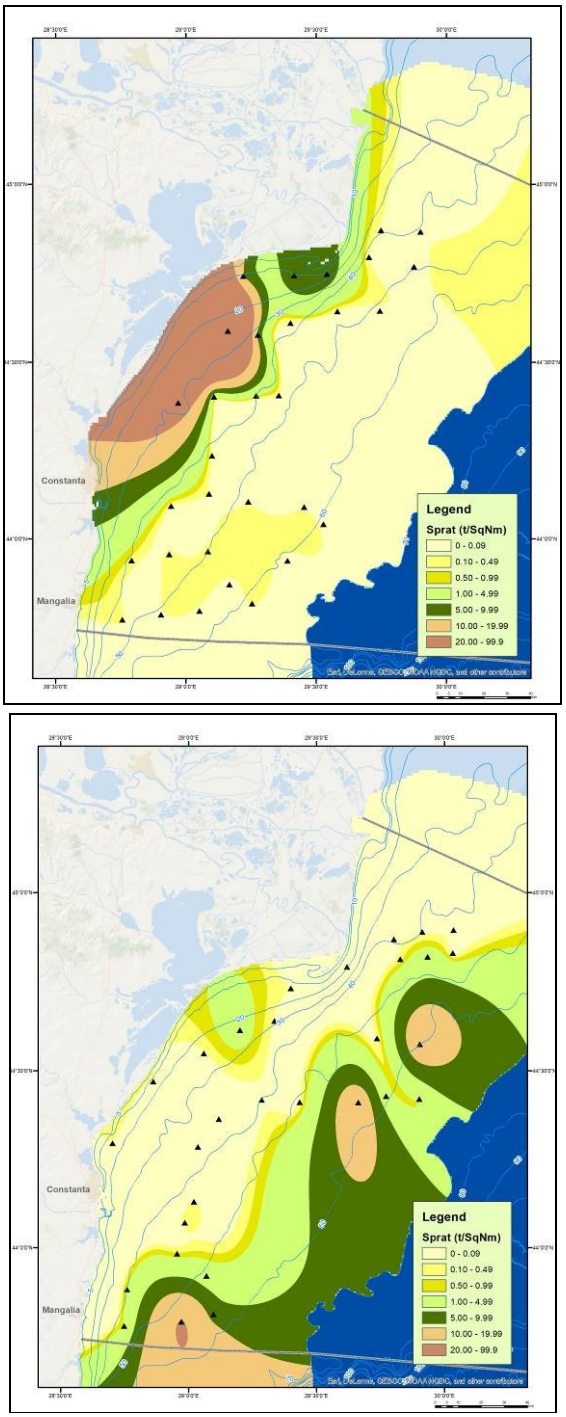
a. ***Sprattus sprattus*** (european sprat):

Spring - in the **31** sample trawlings made with the pelagic trawl, on a surface of **1,800** Nm², the average values of the catches were of about **0.02 - 30.97** t/Nm². The maximum value was recorded in the Sf. Gheorghe -Constanta sectors (0 - 50 m)(Fig. 5 a). The estimated biomass for sprat crowds, in the research a area, was of about **23,268 to**.

Table G1. Assessment of sprat agglomerations (tons), in June 2017.

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	325	1050	425	**1800**
Variation of the catches (t/ Nm^2)	6.60 - 78.37	0 - 31.67	0 - 0.04	**0 - 78.37**
Average catch (t/ Nm^2)	30.971	3.002	0.0244	**4.653**
Biomass of the fishing agglomerations (t)	10070.817	3152.23	10.376	**8376.73**
Biomass extrapolated the Romanian shelf (t)				**23268.7**

a.



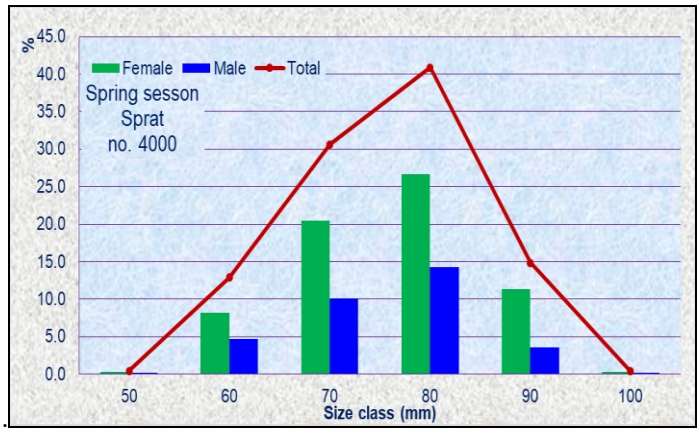
b.

Figure G5. The distribution of the whiting agglomerations in spring (a) and autumn period (b), pelagic trawl survey, in Romanian area.

The analysis of structure by lengths and mass cards of sprat during survey, has highlighted the presence of mature specimens and a high homogeneity of cards. The length of sprat individuals are within the limits of classes of length 55.0-105.0 mm / 1.05 – 6.43 g. The dominant classes are those of 65.0 - 90.0 mm / 1.7 – 4.72 g (Fig. 6a). The dominant females 67.18 %, males (32.83 %). The average body length was 80.83 mm and the average mass of 3.177 g. Age composition of sprat catches indicates the presence of individuals from 1 to 3 years. Most of the individuals caught are 1 years

old (72.0 % of all specimens analyzed), followed closely by those of 2 years (25.5 %) and 3 years (2.6 %)(Fig. 6b).

a.



b.

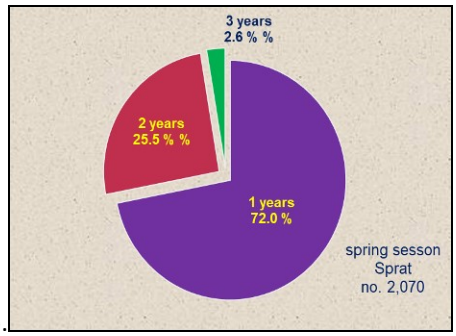


Figure G6. Structure by lengths (a) and age (b) of sprat during spring survey.

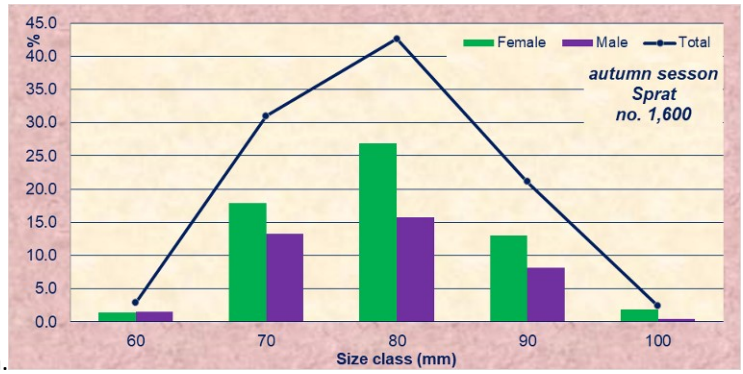
Autumn - in the **30** sample trawlings made with the pelagic trawl, on a surface of **2,050** Nm², the average values of the catches were of about **2.39-8.051** t/Nm². The maximum value was recorded in the Sf. Gheorghe - Cap Tuzla (50 - 70 m) sectors (Fig. 5 b). The estimated biomass of about **11,960 t**.

Table G2. Assessment of sprat agglomerations (tons) in October 2017.

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	450	1150	450	**2050**
Variation of the catches (t/ Nm^2)	0 - 1.55	0 - 2.14	0 - 15.54	**0 - 15.54**
Average catch (t/ Nm^2)	0.222	0.371	7.223	**2.392**
Biomass of the fishing agglomerations (t)	100.027	426.5	3250.776	**4903.925**
Biomass extrapolated the Romanian shelf (t)				**11,960**

The length of sprat individuals are within the limits of classes of length 65.0-110.0 mm / 1.8 – 7.35 g. The dominant classes are those of 75.0 - 95.0 mm / 2.2 – 4.92 g (Fig. 7a). The dominant females 60.94 %, males (39.06 %). The average body length was 83.82 mm and the average mass of 3.667 g. Age composition of sprat catches indicates the presence of individuals from 1 to 3 years. Most of the individuals caught are 1 years old (56.8 % of all specimens analyzed), followed closely by those of 2 years (36.3 %) and 3
years (6.9 %)(Fig. 7b).

a.



b.

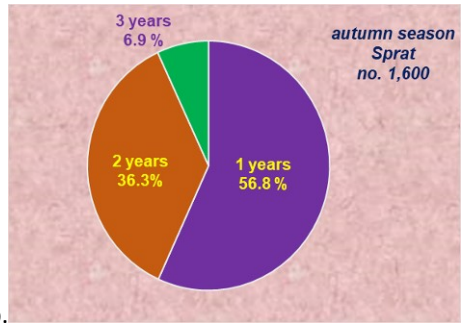


Figure G7. Structure by lengths (a) and age composition (b) of sprat during autumn survey.

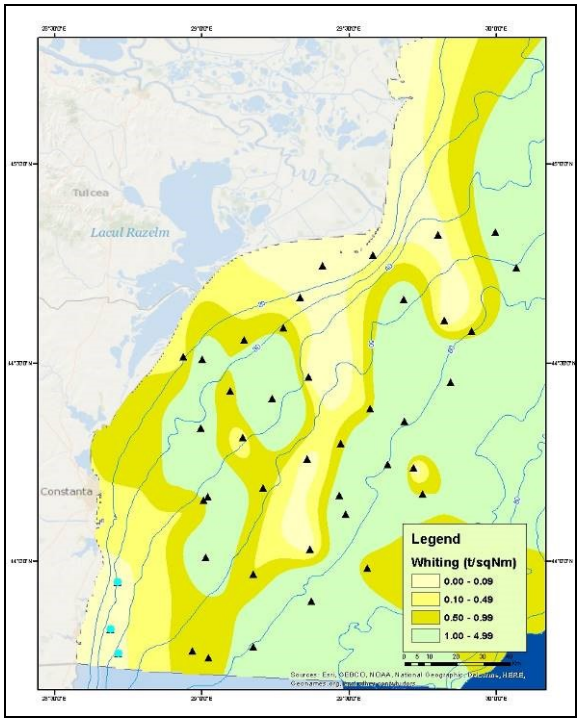
b. ***Merlangius merlangus*** (whiting):

Spring - sweeping area procedures were conducted on an surface of **1,800** Nm^2. The average values of whiting catches, were situated in the limits between 0.009 -1.058 **t**/Nm^2. Revealed that whiting had a flat distribution in large area between Constanta–Vama Veche sectors (**0.71-1.06** t/Nm^2/depth 30-70 m and Sf. Gheorghe Portita sectors (**0.0–3.27** t/Nm^2/depth 30-50 m (Fig. 8 a). Estimated biomass for the Romanian platform about 4,167.77 t.

Table G3. Assessment of whiting agglomerations (tons), in June 2016, Romanian area.

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	325	1050	425	**1800**
Variation of the catches (t/ Nm^2)	0.029	0 - 4.532	0 - 2.315	**0 - 4.532**
Average catch (t/ Nm^2)	0.009	1.0586	0.71	**0.833**
Biomass of the fishing agglomerations (t)	3.23	1111.55	301.891	**1500.398**
Biomass extrapolated the Romanian shelf (t)				**4,167.77**

a.



b.

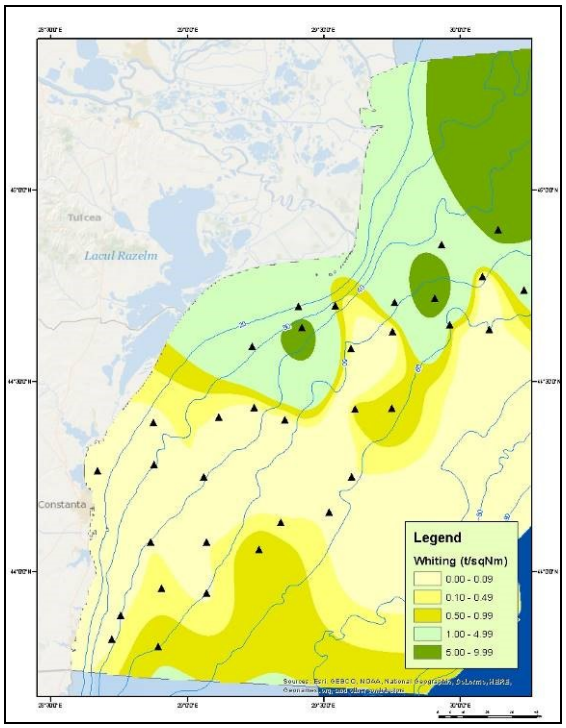
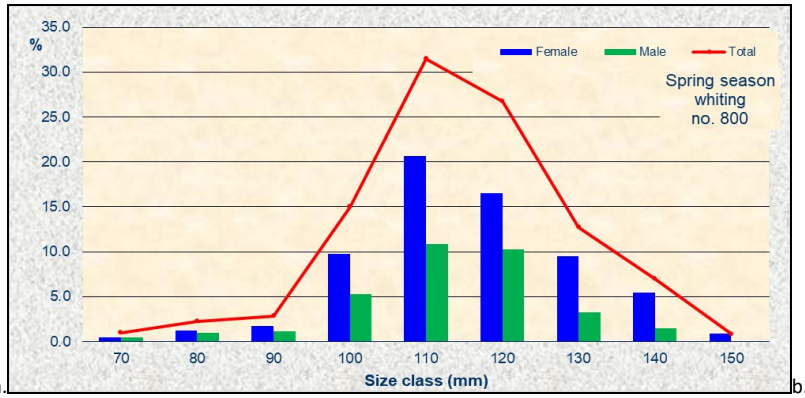


Figure G8. The distribution of the whiting agglomerations in the spring (a) and autumn (b) period, pelagic trawl survey, in Romanian area.

The analysis of structure by lengths and mass cards of whiting during survey, show length of whiting individuals are within the limits of classes of length 75.0-155.0 mm / 2.65 – 27.6 g. The dominant classes are those of 105.0 - 145.0 mm / 9.46 – 21.18 g (Fig. 9a). The dominant females 66.25 %, males (33.75 %). The average body length was 119.29 mm and the average mass of 13.34 g. Age composition of sprat catches indicates the presence of individuals from 1 to 4 years. Most of the individuals caught are 1 years old (52 % of all specimens analyzed), followed closely by those of 2 years (24 %) and 3 years (17 %)(Fig. 9b).

a. 

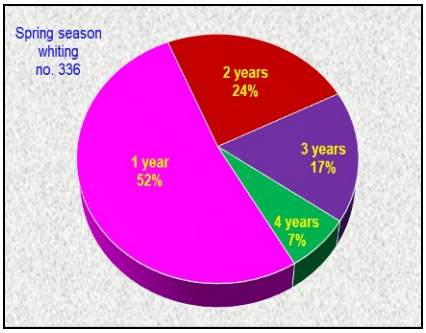
b.


Figure G9. Structure by lengths (a) and age composition (b) of whiting, during spring survey.

Autumn - in the 30 sample trawlings made with the pelagic trawl, on a surface of **2,050** Nm², the average values of the catches were of about 0.56 – 5.56 t/Nm². The maximum value was recorded in the Sf. Gheorghe – Managalia sectors (50 - 70 m)(Fig. 8b). The estimated biomass for the whiting crowds, in the research area, was of about 20,911 tones.

Table G4. Assessment of whiting agglomerations (tons), in Octomber 2017, in Romanian area

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	450	1150	450	2050
Variation of the catches (t/ Nm^2)	0-3.978	0-23.904	0-14.181	0-23.904
Average catch (t/ Nm^2)	0.568	5.097	5.569	4.182
Biomass of the fishing agglomerations (t)	255.785	5861.89	2506.3	8573.595
Biomass extrapolated the Romanian shelf (t)				**20,911**

The analysis of structure by lengths and mass cards of whiting during survey, show length of whiting individuals are within the limits of classes of length 70.0-185.0 mm / 2.50 – 42.1 g. The dominant classes are those of 100.0 - 140.0 mm / 8.05 – 21.50 g (Fig. 10.a). The dominant females 63.17 %, males (36.83 %). The average body length was 114.84 mm and the average mass of 12.59 g. Age composition of sprat catches indicates the presence of individuals from 1 to 5 years. Most of the individuals caught are 2 years (42.0 % of all specimens analyzed) and 1 years old (39.0 %), followed closely by those of 3 years (11.0 %)(Fig. 10b).

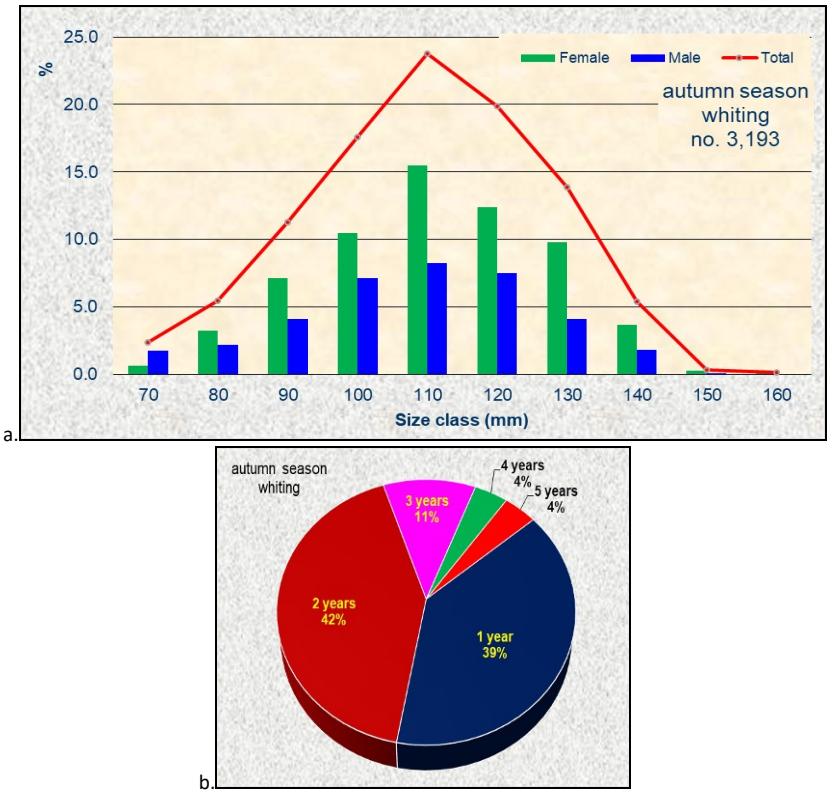


Figure G10. Structure by lengths and age composition, of whiting during autumn survey.

c. *Squalus achanthias* (dogfish)

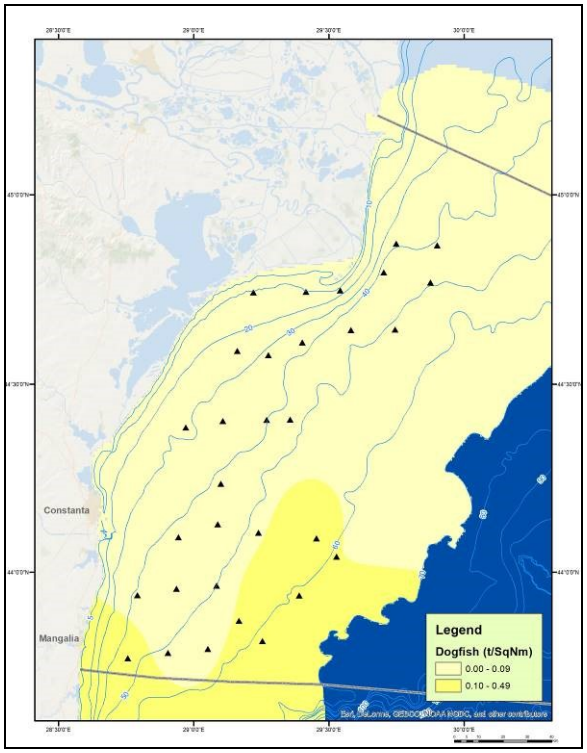
Spring - in the 31 sample trawlings made with the pelagic trawl, on a surface of **1,800** Nm², the average values of the catches were of about **0.011 – 0.111 t**/Nm². The maximum value was recorded in the Constanta ap Tuzla (30–70 m) sectors (Fig. 11a). The estimated biomass in the research area, was of about **229.06 to**.

Table G5. Assessment of dog fish agglomerations (tons), in June 2017, Romanian area.

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	325	1050	425	1800
Variation of the catches (t/ Nm^2)	0	0-0.197	0-0.436	0-0.436
Average catch (t/ Nm^2)	0	0.011	0.111	0.0458
Biomass of the fishing agglomerations (t)	0	12.203	47.235	82.460
Biomass extrapolated the Romanian shelf (t)				**229.06**

Autumn **-** in the 30 sample trawlings made with the pelagic trawl, on a surface of **2.050** Nm², the average values of the catches were of about **0.05 - 0.366** t / Nm². The maximum value was recorded in the Cape Tuzla – Mangalia and Sf. Gheorghe sectors (30 - 70 m)(Fig.11b). The estimated biomass for the dogfish crowds, in the research area, was of about **936.384 to**.

a.



b.

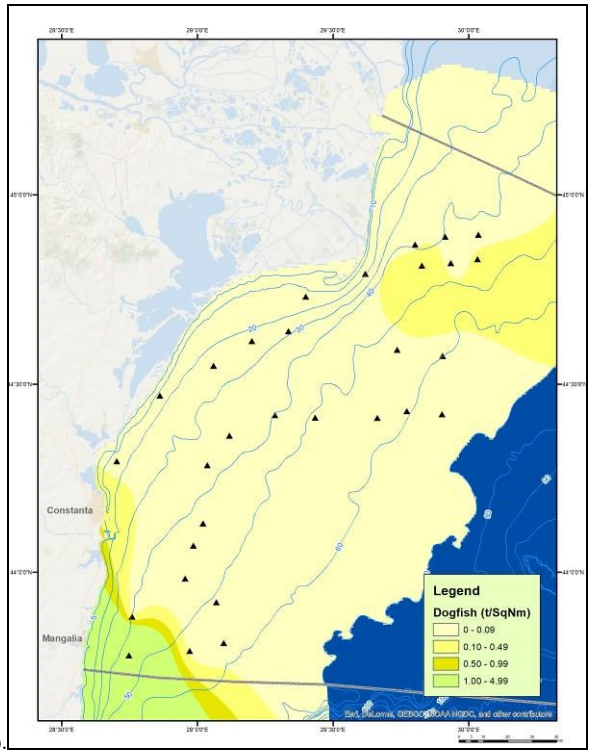


Figure G11. The distribution of the dog fish agglomerations in the spring (a) and autumn (b) period, pelagic trawl survey, in Romanian area.

Table G6. Assessment of dogfish agglomerations (tons), in Octomber 2017, in Romanian area

Depth range (m)	*0 – 30 m*	*30 – 50 m*	*50 - 70 m*	*Total*
Investigated area (Nm^2)	450	1150	450	**2050**
Variation of the catches (t/ Nm^2)	0-0.055	0-4.987	0-0.434	**0-4.987**
Average catch (t/ Nm^2)	0.007	0.366	0.048	**0.1872**
Biomass of the fishing agglomerations (t)	3.586	421.22	21.729	**383.917**
Biomass extrapolated the Romanian shelf (t)				**936.384**

The length of dogfish individuals are within the limits of classes of length 90.0-141.0 mm / 2,500 – 15,800 g. The dominant classes are those of 105.0 - 135.0 cm / 4,150 – 11,833 g (Fig. 12a). The dominant males (80.0 %). The average body length was 116.98 cm and the average mass of 6,592 g. Age composition of sprat catches indicates the presence of individuals from 13 to 17 years. Most of the individuals caught are 14 years (34.9 % of all specimens analyzed) and 13 years old (25.6 %), followed closely by those of 15 years (20.9. %), 16 years (11.6 %) 17 years (4.7 %) and 12 years (2.3 %)(Fig. 12b).

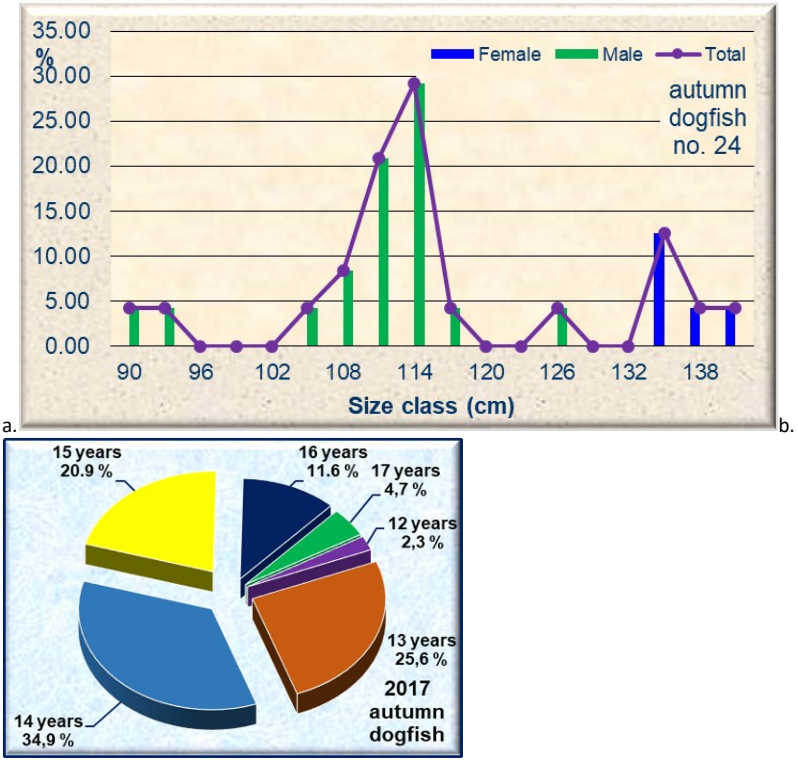


Figure G12. Structure by lengths (a) and age composition (b), of dogfish, during spring survey.

The agglomeration biomass of the main species from Romanian littoral

The swept area method is used for assessment of the biomass of fishing agglomerations of sprat, whiting and picked dogfish based on the statistic processing of productivity data obtained in sampling trawling and industrial trawling. The calculated biomasses by swept area for main species at the Romanian littoral ranged between: sprat (30,917 tons and 68,887 tons); whiting (6,565 t and 26,171 t) and dogfish (967 t and 5,635 t)(Fig. 13).

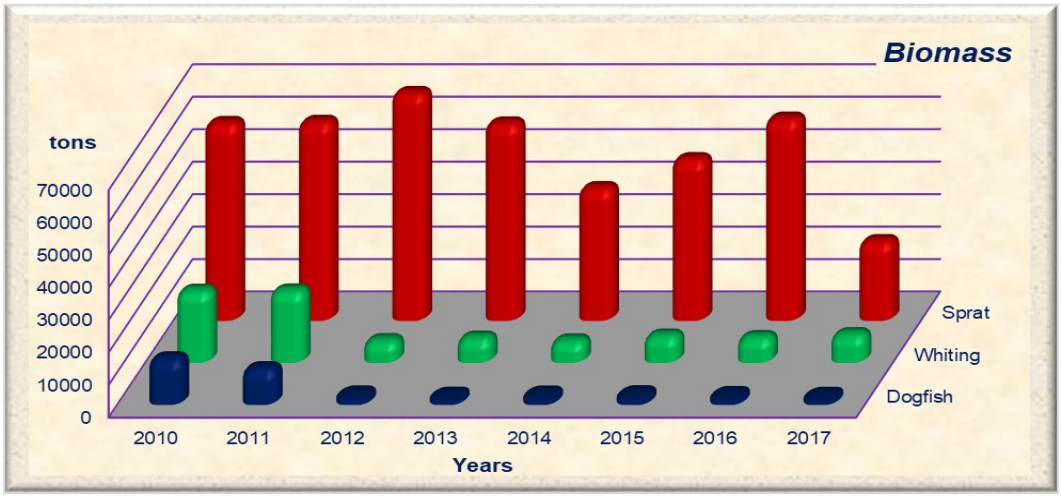


Figure G13. The agglomeration biomass of the main species from Romanian littoral.

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h) Gulf of Lion survey (Tarek Hattab, Claire Saraux, Jean Hervé Bourdeix).

Pelmed surveys cover the Gulf of Lions (3300 nm^2) and have been performed annually in July since 1995 with R/V L'Europe to estimate the spatial distribution and abundance of all small pelagic fish, including anchovy and sardine which are the target species. The survey design is made of 9 parallel transects perpendicular to the coastline and 12 nm apart, from the 20 m isobath to the 200 m one. The surveying acoustic vessel speed is 8 knots. Echotraces are identified with a pelagic haul. A total of 51 trawls were conducted in 2017. Acoustic recording and trawl hauls are performed during day time and the survey lasts approximately 27 days. The split beam echo sounder used is SIMRAD ER60, 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. Additionally, the use of a multi-beam echo sounder SIMRAD ME70 enables us to visualize 3D echos and helps in species allocation.

On top of fish parameters, 46 hydrological stations have been conducted. Zooplankton was sampled through WP2 vertical nets and bongo diagonal nets, while phytoplankton was sampled through Niskin bottles in subsurface and at the maximum of chlorophyll depth. Seabirds and marine mammals are also observed all along the survey.

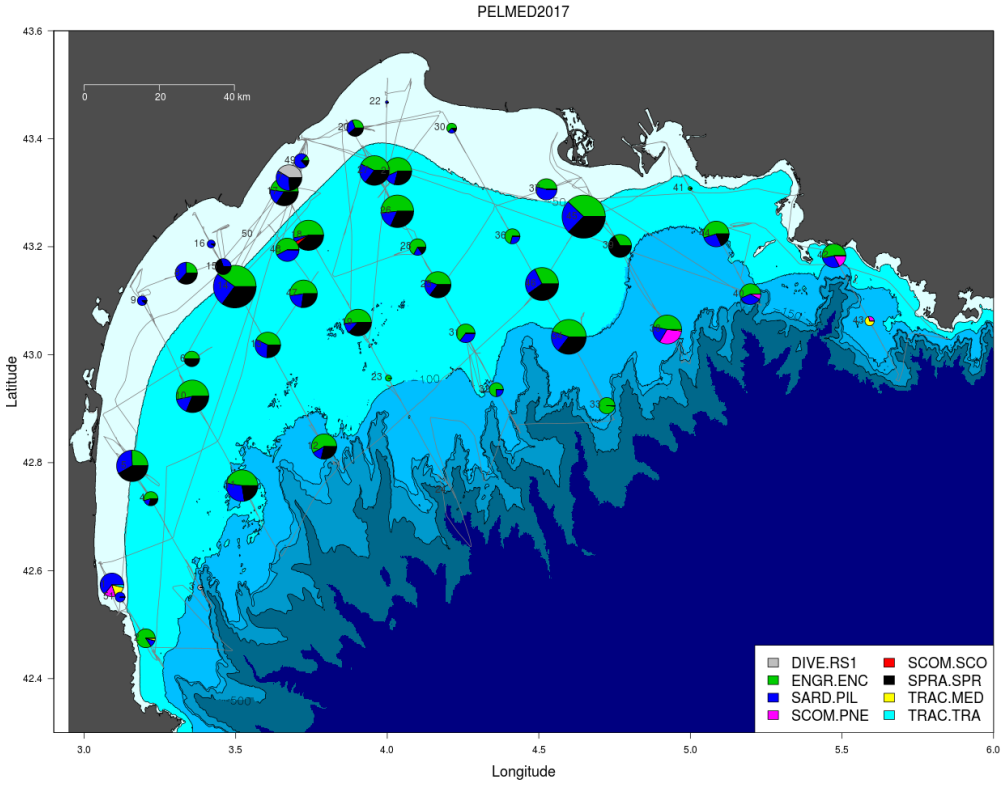

Figure H1. Map of the assessed area and sampling design. 2017 survey is used as an example to show the trawl positions and species composition.

The sardine and anchovy biomasses were estimated to be respectively 43828 t and 60631 t in 2017. The biomass distribution of each species is shown (Fig. 2).

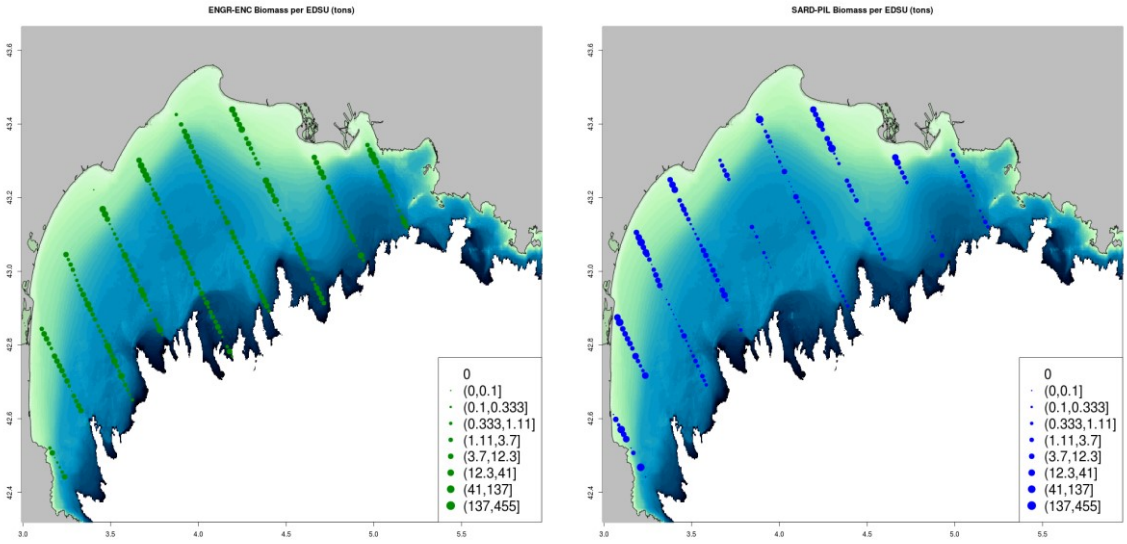

Figure H2. Sardine and anchovy biomasses distribution in 2017 observed all along the survey.

The Mid-term (2017-2020) strategy and the implementation of pelagic surveys
(Angelo Bonanno)

The mid-term strategy (2017–2020) towards the sustainability of Mediterranean and Black Sea fisheries is the fruit of the commitment of GFCM contracting parties, cooperating non-contracting parties and partner organizations to improve, by 2020, the sustainability of Mediterranean and Black Sea fisheries and ensure that the alarming trend in the status of commercially exploited stocks is reversed.

It is based on five targets which include selected outputs and proposed actions: (1) Reverse the declining trend of fish stocks through strengthened scientific advice in support of management; (2) Support livelihoods for coastal communities through sustainable small-scale fisheries; (3) Curb illegal unreported and unregulated (IUU) fishing, through a regional plan of action; (4) Minimize and mitigate unwanted interactions between fisheries and marine ecosystems and environment, and (5) Enhance capacity-building and cooperation.

This strategy stems from existing international and regional legal instruments, it does not create any new obligations on GFCM Contracting Parties and Cooperating non-Contracting Parties (CPCs). On the other hand, it purports to define a course of instrumental action to further progress in the development of sustainable fisheries at

the regional level. The collection, analysis and dissemination of information on the status and trends of fisheries, ecosystems and marine environment, as well as information on IUU fishing, should account for all relevant participants (which may include, inter alia, representatives of CPCs and other riparian states, relevant international, non-governmental and civil society organizations), in the preparation, analysis and presentation of scientific advice and conclusions.

In particular, the Output 1.1 of the mentioned strategy "*Enhanced knowledge and expertise on Mediterranean and Black Sea fisheries*" will require the compilation of data and information on different fisheries-related issues. This will be achieved through the implementation of the new GFCM Data Collection Framework (GFCM_DCRF, 2016), as well as the execution of a number of actions including the realization of regional surveys at sea (e.g. acoustic surveys for pelagic species and trawl surveys for demersal fisheries). It is expected that the collection and analysis of appropriate surveys data (demersal trawling and pelagic acoustic surveys) will allow the possibility to formulate scientifically based advice for improved conservation of the stocks. From this general goal, the implementation of regional surveys at sea would aims:

(i) to contribute to the characterization of demersal and pelagic fisheries resources in the Mediterranean & Black Sea in term of population distribution (relative abundance indices) as well as demographic structures (length distributions);

(ii) to provide data for more accurate estimates of life history parameters such as mortality and growth.

(iii) to better assess the spatial occupation of the different components of the stocks (e.g. seasonal distribution, spatial segregation and community structure, reproduction and recruitment areas).

The gain in accuracy would, in turn, make also more robust the evaluation of changes in the population indicators and of the input parameters for population and community modelling.

Rationale:

More specifically, the aim of an acoustic survey is to determine species and size composition of the pelagic biomass and *in situ* oceanographic data. At present, acoustic surveys are conducted only in few GSAs of the Mediterranean waters, focusing on the small pelagic fish anchovies (*Engraulis encrasicolus*) and sardines (*Sardina pilchardus*). There is the urgent need to join and to harmonize the ongoing acoustic surveys in the rest of the Mediterranean Sea and Black Sea, in order to gain

knowledge of biomass levels and spatial distribution of the major stocks of small pelagic fishes over the region, and for further comparisons of the results issued from different areas.

Methodology:

The implementation of acoustic survey(s) should be associated with a multidisciplinary approach, acquiring both acoustic data and net samplings on small pelagic fish, by means of pelagic trawl. Standard methodologies and homogeneous operational protocols will be applied among participants and covering: the design of the survey, the information collected, the management of the data as far as the production of common standardized analysis of the data (existing survey protocol already used by some GFCM Countries i.e. MEDIAS, could be used as reference). The design for the acoustic sampling survey should take into account the characteristics of the spatial structures of small pelagic fish in the different GFCM sub-regions as well as the peculiarities in the topography of each area.

To carry out these surveys and depending on the area, different fishing vessels (e.g. research vessels and/or chartered fishing vessels), working during the same period, will be used. In each GFCM sub-regions, these vessels, duly equipped, should work at sea for about one month per year (i.e. summer.).

During acoustic surveys, both the biological parameters (e.g. length frequency distribution of all the caught fish species), and CTD oceanographic data (e.g. temperature, salinity, fluorescence and dissolved oxygen) should be recorded.

Discussion on calibration procedure

Each MEDIAS group presented briefly the echosounders they use, frequencies and calibration procedure applied. The outcome of the discussion was that at the moment all groups are using SIMRAD echosounders even if there is some variability with the ancillary frequencies available. All the groups have at least 38 and 120 kHz available. The calibration procedures are all in agreement with Demer et al. (2015).

Discussion on otolith reading criteria in MEDIAS group

An extensive examination on age otolith criteria of anchovy took place during last meeting, also recalling the past discussions of the previous years on this issue.

The criteria agreed during last ICES "Workshop on Age estimation of European anchovy (*Engraulis encrasicolus*)" on this topic, WKARA2 2016, Pasaia (Guipuzcoa, Spain) are now adopted by all MEDIAS groups. In particular, for the case of the Adriatic Sea, criteria were recently revised after several ad hoc meetings (2016-2018) within the framework of FAO-AdriaMed Project to reach an agreement among the different countries (Italy, Croatia, Slovenia, Montenegro and Albania).

For what concerns the conventional birthdate, during ICES WKARA2 meeting, it was strongly suggested to use the 1st of January as birthdate for both anchovy and sardine, only for stock assessment purposes. Biologically speaking, this choice can be rational for sardine, because it is a winter spawner, but not for anchovy, a spring-summer spawner. The opinion on this, group by group, was asked to understand who use "stock assessment" or "biological" birthdate: CNR-ISMAR, IFREMER, IEO and IOF are applying the 1st of January as birthday for both anchovy and sardine, HCMR and CNR-IAMC are using 1st of July for anchovy, but they are ready to change to 1st of January, given the importance of MEDIAS data in stock assessment of anchovy and sardine and in order to achieve a general standardization within the MEDIAS group. A change in birthday has no effect on anchovy age estimations for those MEDIAS surveys carried out on the 2nd semester.

Changing otolith reading criteria, imply an update of historical data. For this aim it was suggested to re-read otoliths from past years, even if the new readings could be limited to a subset of samples; this should ensure the reduction of errors respect to simply applying the age-length key of the last year with the new criteria backwards. Some tests made by CNR-IAMC confirm the fact that is better to re-read past years otoliths with the new criteria.

Otolith reading criteria are standardized between survey and commercial data in all the areas covered by MEDIAS surveys.

Discussion on registration requests to MEDIAS website from external researchers

Due to the fact that some requests for registration and access to the MEDIAS website have been made in 2017 for the first time, a discussion on this issue took place during the meeting. It was decided to put certain information regarding the MEDIAS surveys freely available on the MEDIAS website without any need for registration. In particular this information would include the MEDIAS Coordination Meeting reports, maps

showing the survey design followed per GSA, the MEDIAS Handbook, latest maps with the spatial distribution of the target species per area and a link to the scientific publications of the group. The general intent of the website is to provide a GIS oriented tool for an easier and faster consultation of the survey results in a geographical context. Maps with transect plans and the planned CTD stations per GSA will be added together with a table giving information of data availability per area. Maps showing non-EU surveys tracks will also be available in the website after receiving proper authorization. The possibility to add echogram pictures associated to certain target species in a dedicated open access section of the website, was also discussed.

Discussion on the reference scale to be used for maturity stages determination

The group had a discussion on maturity scales to be used for anchovy and sardine.

Since the first MEDIAS Coordination Meetings it was decided to follow the outcome of ICES "Workshop on Small Pelagics (*Sardina pilchardus, Engraulis encrasicolus*) maturity stages", WKSPMAT 2008, Mazara del Vallo, (Italy) for what concerns maturity stages determination in anchovy and sardine. The discussion was opened again due to the fact that in 2017, GFCM asked, in the ambit of "Data Collection Reference Framework (DCRF)", to submit maturity data in accordance to the MEDITS scale. The possibility of inter-conversion between the two kinds of scale was discussed and Table 1 was added below reporting the possible correspondence between the stages of each scale.

Table 1. Maturity scales conversion table: MEDITS scale – ICES WKSPMAT scale.

MATURITY	MEDITS scale		ICES WKSPMAT (2008) scale		
Immature	1	IMMATURE VIRGIN	1	IMMATURE OR RESTING	F: Invisible or very small ovaries (cord shaped), translucent or slightly coloured (when resting). M: Very small testes, translucid. Sex is very difficult to identify; Small testis, colour orange–red (when rest).
	2a	VIRGIN DEVELOPING			
Mature	2b	RECOVERING	2	DEVELOPING	F: Wider ovaries occupying 1/4 to 1/3 of body cavity; pinkish or yellow colour. Visible oocytes are not present. M: The testes occupy approximately 1/3 of the abdominal cavity. White–greyish colour.
	2c	MATURING	3	IMMINENT SPAWNING	F: Ovaries occupying 3/4 to almost fitting body cavity; opaque with yellow or orange colour. Opaque oocytes are visible. M: Whitish to creamy testis long about 2/3 of the body cavity. Under light pressure, sperm is not expelled.
	3	MATURE/SPAWNER	4	SPAWNING	F: Large ovaries occupying the full body cavity; fully or partially translucent with gelatinous aspect. Hyaline oocytes are visible. M: Whitish–creamy soft testes occupy the full body cavity. Under light pressure, sperm is expelled freely.
	4a	SPENT	5	PARTIAL POST SPAWNING	F: Size from 1/2 to 3/4 of abdominal cavity; not-turgid ovaries with haemorrhagic zones. Blood coloured. M: Deflated testicles occupy up to 2/3 of the body cavity, brownish/reddish colour.
	4b	RESTING	6	SPENT	F: Reddish ovary shrunken; Size less than 2/3 of abdominal cavity Flaccid ovary. Some small opaque oocytes. M: Flaccid and thin testicles with haemorrhagic aspect.

The present conversion scale represents the results of a strong effort from different labs, which generally applied the 6-phase scale drew up for anchovy and sardine during the focused workshop, ICES WKSPMAT (2008). Such workshop is a keystone in the standardization process of the reproductive phase assignment for small pelagics, producing a wide agreement among different European labs, which study the small pelagics.

However, in order to meet the request from GFCM (GFCM DCRF, version 2017.1) to adopt a unique scale for all the bony fishes, experts from the involved labs compared the scale proposed from MEDITS with the scale from the ICES WKSPMAT. Despite the effort done to find an agreement, the scale adopted in WKSPMAT is specific for partial spawner species and sometimes is hard to combine with a generic scale like the MEDITS one. However the main results of this comparison are listed as follows:

1. According to the description proposed by ICES, the macroscopic characteristics of phases "1" and "2a" of MEDITS scale appear both almost equivalent to phase "1" and partially similar to stage "2 as described in ICES (WKSPMAT)". Therefore within the ICES working group it was adopted a criterion more focused on the colour than on the gonad size respect to the body cavity, as the latter is very difficult to evaluate at the beginning of gonad development. In such cases, the colour of the gonad seems a more valuable tool to define if a gonad belongs to phase 1 or not, that is to discriminate if an individual is mature or immature. Accordingly, the conversions of ICES WKSPMAT stage "1" into the MEDITS stage "1" or "2a" appears to be not relevant since both these MEDITS phases are immature, thus belonging to the same category when estimating the size at first maturity (L_{50}), which is the most important application of maturity data for stock assessment purposes.

2. One of the most critical aspects of the application of the MEDITS scale is represented by the stage 3 which combines together mature and spawning individuals avoiding to identify the hydrated phase 4 (ICES scale). Such phase is particularly relevant in several kinds of applications (spawner biomass estimation, spawning ground, migration, etc.).

3. Although the macroscopic characteristics of phase 4 of the MEDITS scale are very similar to those from the phase 5 in the ICES scale, the individuals 4 in the MEDITS scale are "spent" since they already laid down all the mature eggs within the spawning season, while according to partial spawner biology the fishes classified as stage 5 (ICES scale) are still in the spawning period with one or more egg batches to be spawned in the season.

In conclusion, these first observations, even though do not exclude the opportunity to build up common scales for all the bony fishes as proposed by MEDITS, show that several aspects have to be addressed more deeply and shared among the labs and scientist involved in maturity data collection (i. e. new international WORKSHOP on such topic).

It would be strongly recommended the use of WKSPMAT 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 L_{50} estimation. This scale allows reaching a higher accuracy since it has been developed specifically for small pelagics (indeterminate spawners). Following this approach, the data conversion on MEDITS stages would be adopted only if no other choices are available.

Presentations of the workflow used to process raw data to biomass estimation by each MEDIAS group

Aspiring to the standardization of the workflow within the Medias groups and in a second step to incorporate common steps into R routines workflow in use from acoustic/biologic raw data to biomass estimation by each institution was briefly presented. A description of the workflows presented by each group is shown below.

IOF:

Data analyses performed at IOF, from raw data to biomass estimation, are in line with procedures described by Simmonds and MacLennan (2005). Windows-based hydroacoustic data processing software (Echoview Essentials module) is used for this specific purpose.

The starting point is geo-referenced acoustic data. At the beginning, raw data are loaded in Echoview, grouped and eventually EV files are created. Based on calibration results, a supplement calibration file (.esc) is created and applied on appropriate EV files. Within all EV files, EDSU are defined in accordance with MEDIAS protocol. Surface and bottom exclusion layers are defined. Unwanted signals (i.e. noise and reverberation) are removed by appropriate regions and using data threshold to remove plankton reverberation. Then, the first visual check of acoustic data (echograms) is performed and necessary corrections are made (i.e. bottom line editing, unwanted data exclusion, etc.). If necessary, raw data are re-loaded and previous steps are repeated. Different region classes are then created within selected EV files for eventual analyses, and classes' properties are defined by taking into account information from trawl samples compositions and data from biological analyses. Pie-charts (biomass/classes) are made based on trawl data. After this, acoustic data

analyses begin by detailed visual inspection/scrutinization of echograms – EDSU by EDSU; echogram scrutinization is made by drawing regions around individual fish schools and/or a group of fish schools and assigning their backscattered acoustic energy to appropriate region class within each particular EDSU. Eventually, analyses by cell as well as analyses by regions by cell are made, and first draft data outputs are exported. Results obtained from these analyses are then combined in excel sheets and 0-data values are added in empty cells, if necessary. Outputs of cell data analyses are visualized by mapping each EDSU and quick visual inspection is made. Next step includes detailed data checking (i.e. data values against acoustic data in Echoview in particular EDSUs) and filtering (by location - excluding data points outside transects). Eventually, necessary corrections are made in scrutinization process, acoustic data are re-analyzed and new exports are made and re-checked. Now, data are used to create GIS-maps by results spatial interpolation. Maps obtained are checked against input excel data and acoustic (echograms) data. Errors noticed are corrected by going back and checking/correcting data in excel and/or in echogram scrutinization. All necessary previous steps are repeated one more time, and finally data outputs are validated and used in estimation of abundance and biomass indices by target species within each survey's sub-area. Results from different sub-areas are than combined to produce estimates (according to MEDIAS Handbook) for entire area surveyed. At the end, DCF templates are used and appropriate csv files are produced and sent to national DCF correspondent for uploading in JRC database.

Reference:

Simmonds J., MacLennan D. 2005. Fisheries Acoustics: Theory and Practice. (2nd Edition) Blackwell Publishing Ltd., 437 p.

HCMR:

Acoustic data are collected during daytime using a SIMRAD EK80 split beam echosounder following the calibration of all transducers (ES38-7, ES120-7C, ES200-7C, ES333-7C) according to SIMRAD's instructions and adhering to standard protocols (Demer *et al*., 2015).

Acoustic data processing is being held in the lab after completion of the survey (the limited research crew of 6 people does not allow any processing on board) and involves the following steps:

- Calibration files are produced and applied based on CTD profiles (synchronous to the acoustic survey) per sub-area.
- Echogram scrutinization:
  - application of -70 db threshold
  - exclusion of bad data (false bottom echoes, gas plume echo traces, etc.)
  - bottom detection

- removal of surface (~5m) and bottom acoustic deadzones.
- School detection and identification.

Echo traces are identified either based on school characteristics or based on the mesopelagic haul catch. The first approach mainly concerns anchovy and sardine schools (Tsagarakis et al., 2012a; Tsagarakis et al., 2012b; Tsagarakis et al., 2015) and to a lesser degree round sardinella, horse mackerels and bogue schools. At this point expert judgment is crucial.

In cases where direct identification is not possible (too many or unclear schools), echo traces are assigned depending on the mesopelagic haul catch within Echoview. Two distinct categories are identified "mixed schools" that include anchovy and / or sardine along with other species and "Other" where echo assignment involves all other species schools besides anchovy or sardine.

Subsequently, a csv file is obtained using "Echoview export" with information on the NASC values per EDSU and per species, along with geographic coordinates, depth, sampling time and sampling date. Since the Echoview software exports only EDSUs with non-zero NASC, info regarding the geographic coordinates, depth, sampling time and sampling date for EDSUs where zero NASC values were recorded are manually appended to the export file.

As a next step, transects are assigned to sub-areas, which are defined based on:

- the "homogeneous" distribution of echo-traces
- the catch of the hauls,
- bathymetry,
- area peculiarities

Examples for Aegean Sea and eastern Ionian Sea are shown in Figure 1.

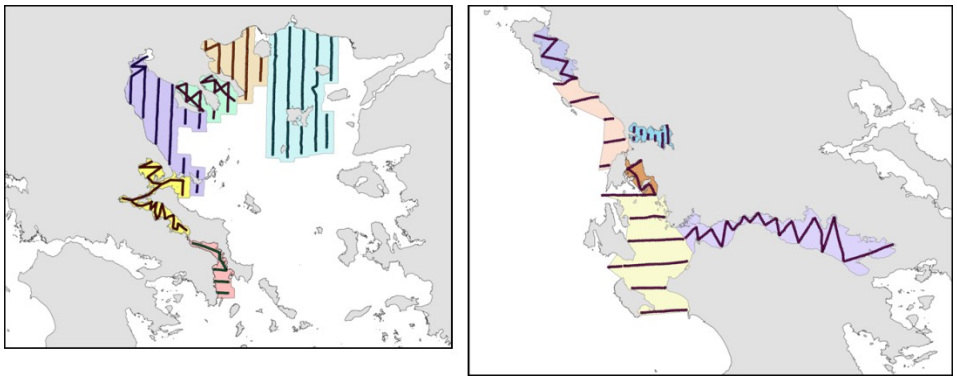

Figure 1. Sub-areas division in Aegean Sea (left) and eastern Ionian Sea (right).

Hauls catch is used to obtain:

- Biological data

- Length frequencies distribution (processed on board)
- Length – Weight relationship; estimated at the lab, removal of otoliths for age reading

Finally, the biological info obtained per haul is entered into a database to obtain per sub-area estimates of:

- Length Frequency
- mean length
- mean weight

Next, the Number of individuals per species and per EDSU is estimated based on the equation:

$N_s = NASC_s/(4*pi*10\text{^}TS_s)$

where $NASC_s$ the NASC attributed to species *s*, TS_s the Target strength for species *s*, as calculated by equation $TS = 20 \log L_m - b_{20s}$, and L_m the mean length estimate for species *s* in the sub-area corresponding to the current EDSU (Simmonds and MacLennan, 2005).

The Biomass per species and EDSU is estimated as:

$B_s = N_s * W_s$

where W_s the mean weight estimate for species *s* in the sub-area corresponding to the current EDSU, as calculated by the Length-Weight relationship and the mean length of species *s* for the same sub-area.

With species biomass estimates for all EDSUs, we calculate (for each species):

-The average biomass per sub-area based on the transects assigned to each sub-area.

-The total biomass per sub-area by multiplying the average biomass per sub-area with the sub-area surface.

-The overall biomass estimate for the entire Aegean or eastern Ionian Sea by summing up the total biomass of all sub-areas for each of the two surveys.

-The coefficient of variation is calculated based on the R script (implementing a geostatistical simulation method by Walline, 2007) provided by Marco Barra (CNR-IAMC).

Finally, regarding the DCF requirements we estimate per sub-area the biomass / numbers per Length and Age class. This is based on the ALK and LF and the algorithms described in the ICES Working Groups “on the raising and estimating the properties of

statistical estimates in fisheries data" (ICES, 2007; Vigneau, 2009). Total area estimates are subsequently calculated as the sum of all sub-areas.

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CNR-ISMAR:

After data logging during acoustic survey, data are imported in Echoview and the calibration file is applied. Moreover, the outcome of oceanographic sampling (CTD) per sub-area is applied through the calibration file. Acoustic data that are not useful for official biomass estimation, such as trawl tracks, intertransect link tracks, etc., are excluded from the analysis by means of bad data regions. Other bad data regions, smaller in extension, are generated in concomitance with surface noise from bubbles,

gas emissions from the bottom, clearly identifiable non-target species aggregations (as pearlside), etc.

Data go through a specific workflow that performs in succession the following operations with acoustic data:

- Resampling (mean, vert. resolution 20 cm)
- Matching Ping times (allowed slope 600 sec)
- Cleaning all above and below the exclusion lines (surface line fixed at 7 m, bottom line 0.5 m above bottom, edited if needed)
- Removing background noise (default settings)
- Applying different thresholds: -60 dB threshold for layers with significant plankton presence; -70 dB threshold for the rest (mainly fish schools)
- Subdivision in two groups: one group is composed by all the regions defined by the operator: layer regions (one region for each nautical mile), school regions. The other group is composed by sparse organisms. Each group of backscattered signals will proceed on separated paths through the following multifrequency comparison
- Resampling (mean, num. of pings in interval 4, vert. resolution 1 m)
- Multifrequency comparison 120/38 kHz (rule A) and 200/38 kHz (rule B)
- Joining of Rule A and Rule B
- Resampling (mean, vert. Resolution 20 cm)
- Matching ping times (allowed slope 600 sec)
- Linear plus between regions' data and sparse targets' data

Since the introduction of a secondary frequency, with the aim to discriminate target species as a group, a specific ΔdB difference interval was tested. Specific literature on multifrequency comparison was also consulted. The group of target species is composed by small pelagic and semi-pelagic species with the swimbladder as anchovy, sardine, sprat, horse mackerel, chub mackerel, bogue, gilt sardine, picarel. A discrimination interval ΔdB 120/38 kHz was adopted: -12 dB --- +3 dB. After some years with the introduction of 200 kHz and the availability of more data and results on multifrequency analyses on pelagic species a second discrimination interval was added based mainly on the results from the SIMFAMI Project. Main ΔdB difference intervals from the SIMFAMI Project Report (2005) were taken into account to develop a ΔdB

200/38 kHz and check the ΔdB 120/38 kHz already in use. Considering the species *ensemble* from SIMFAMI Project, our «traditional» ΔdB 120/38 kHz interval didn't differ significantly, so we kept it constant. ΔdB 200/38 kHz was identified in -10.5 dB --- +3 dB.

The study area is subdivided in homogeneous sub-areas on the base of topography of the basin and species composition in the catches and sizes (cluster analysis). The data concerning a group of hauls in a sub-area is used for species allocation for the transects (or part of them) inside the sub-area. The splitting of acoustic densities of fish into species biomass is made on the base of pelagic trawl data.

Merging of information from hauls concerning length measurements and species proportions are made as described in Simmonds and Mac Lennan (2005) and biomass per species is calculated through the formula for mixed species by Nakken and Dommasnes (1975). Lengths from hauls presenting less than 20 individuals for the target species are not taken into account.

Abundance in number estimated per GSA is calculated by length classes on the base of specific LFD obtained from pelagic trawls. Biomass is then calculated on the base of length-weight relationships obtained from samples. In the case of GSA 17 calculation is made by sub-areas and then results are summed. Similarly the calculation of abundance and biomass per age is made applying the age-length keys currently in use.

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SIMFAMI Project Report, 2005. 488 pp.

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IFREMER:

The acoustic data acquired by echosounder during the survey are loaded in MOVIES 3D software environment for visual exploration in terms of echograms and maps. 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. 271

nautical miles of acoustic measurement were effectively processed for biomass estimation. Before analysing the acoustic data, ambient noise present in the underwater were filtered. Echograms are then scrutinized and bottom detection errors are manually corrected. Daytime 38 kHz volume backscattering coefficients higher than -60 dB and recorded from 10 m depth to 200 m depth along acoustic transects are then echo-integrated in each beam over standard depth channel of 10 m thickness and averaged over 1 NM long Elementary Sampling Distance Units (ESDUs). Expert echogram scrutinizing is then performed to allocate echo-integrals (SA) thought to correspond to fish targets to several echotrace categories in each ESDU, based on echotraces shape, density and position. To associate acoustic and fishing data A 'reference haul' is manually allocated to each ESDU. Catches and size composition distributions derived from reference haul catches are then used to derive stock abundance estimates. Fish abundances per species and size class are computed for each echotype category and each ESDU using the EchoR routine.

CNR-IAMC:

The acoustic data, acquired by the Simrad EK60 scientific echosounder during each of the surveys in GSAs 9, 10 and 16, are post-processed in the Capo Granitola laboratory through the Echoview software package. The following steps are part of the workflow:

- visual exploration in terms of echograms and maps in the Echoview environment;
- raw acoustic data are converted into absolute backscattering measurements by installing the calibration results, obtained on board the vessel, and the correct settings of transducers position referred to GPS antenna;
- the algorithm proposed by De Robertis and Higginbottom (2007) is adopted for removing noise present in the underwater environment;
- regions and mathematical operators are used for excluding from the collected acoustic data any backscattering signal not linked to the presence of fish and/or plankton. For surface and seafloor exclusions two lines are set (3.5 m below the transducers and 0.5 m above the sea bottom). A further visual inspection is adopted for evaluating and removing other noise sources or possible interferences in the echograms or artefacts (e.g. presence of fluid vents);
- for plankton removal, we use the data acquired with frequencies 38, 120 and 200 kHz for creating a mask, as suggested by Schwartzman et al. (1999);
- total NASC and fish NASC are exported for each nautical mile.

The biological samples processing is carried out in the wet laboratory in Capo Granitola. Size frequency distribution per species (0.5 cm), length-weight relationships per species, age-length keys, sex and maturity stages are evaluated.

The ‘‘Nearest Haul’’ method (see Petitgas et al., 2003) is adopted for allocating biological information to the acoustic data per EDSU, thus obtaining NASC per species and density per species per EDSU.

Due to the presence of two different survey designs, the fish biomass is obtained as follows:

- for strictly regular sampling design (parallel transects), total biomass is obtained by multiplying mean density and total area;
- for zig-zag sampling design in complex area (narrow continental shelf and high coastline complexity), total biomass is obtained by considering for each EDSU the area of influence computed by means of the Voronoi polygons.

References

De Robertis, A., and Higginbottom, I. 2007. A post-processing technique to estimate the signal-to-noise ratio and remove echosounder background noise. – ICES Journal of Marine Science, 64: 1282–1291.

Petitgas, P., J. Massè, P. Beillois, E. Lebarbier, A. Le Cann, 2003. Sampling variance of species identification in fisheries-acoustic surveys based on automated procedures associating acoustic images and trawl hauls. ICES Journal of Marine Science 60:437-445.

Swartzman, G.L., Brodeur, R., Napp, J., Walsh, D., Hewitt, R., Demer, D., Hunt, G. and E. Logerwell (1999). Relating fish and plankton acoustically sampled at different frequencies: Data viewing, image analysis and spatial proximity. Canadian Journal for Fish and Aquatic Science, 56 (1): 188-198.

IEO:

Acoustic data are acquired by a scientific echosounder EK60 (Simrad) operating at 5 frequencies, logged during the survey and processed using the Echoview software. Fish echotraces are verified using a pelagic trawl. The calibration output is used to convert the raw data in absolute measures of backscatter, data are correctly positioned in space and time, and bottom detection errors are manually corrected. The background noise is removed and a virtual echogram is used to isolate fish echotraces. The scrutinize process is carried out by an expert that associates the acoustic energy with a reference haul.

Taking into account the biological information from the reference hauls (pelagic species composition in % and LFD of each species) and the specific TS, the total acoustic energy are split into species (Simmonds and Maclennan, 2005_9.42_mixed

species). Then, the acoustic energy per species is spread to each nautical mile recorded. Homogeneous regions (Simmonds and Maclennan, 2005_9.3.4) are delimited using the Arc GIS 10.4 software and finally acoustic data are transformed into abundance and biomass per size, sex and age according to the biological data.

Taking into account the above presented workflows it was decided to have a parallel session to the MEDIAS Coordination Meeting next year in order to identify ways to translate these procedures into an R environment.

Translating some of the procedures of workflows described in R environment is considered by all MEDIAS groups as an additional option, and not as mandatory substitution of procedures currently used.

Discussion on CV estimation

Total Biomass CV computation by means of geostatistical simulations (Marco Barra)

An updated version of the R script for the computation of CV related to total biomass estimates was presented. The adopted approach is based on the procedure proposed by Walline (2007) and was developed by using the "gstat" package (Pebesma, 2004). In particular, during the previous meeting it was asked to provide specific examples to fit the variograms taking into account the presence of spatial anisotropy and nested structures. The code was then modified according to the above-mentioned request. In particular three examples were provided: a first one related to the use of omni-directional variograms and automatic variogram fitting, a second one showing how to fit a directional variogram by explicitly specifying all model parameters and a third one showing how to add a second structure (i.e. nested structure) to a previously defined variogram. The script was also modified in order to provide a more suitable way to define and modify the required input parameters (input data, projection etc.).

References

Pebesma, E. J., 2004. Multivariable geostatistics in S: the gstat package. Computers & Geosciences, 30: 683-691.

Walline, P. D., 2007. Geostatistical simulations of eastern Bering Sea walleye pollock spatial distributions, to estimate sampling precision. ICES Journal of Marine Science, 64: 559–569.

General discussion on CV estimation

The group had a discussion focused on the last version of R script for CV estimation related to biomass estimation from acoustic survey. Due to the fact that the script was available only a few days before the meeting, not all the groups managed to try it with their own data. So, it was decided to postpone after the meeting the decision to adopt the script officially in the MEDIAS.
The adoption of the script, for the moment, it is not mandatory for the MEDIAS as a whole, but all the groups that applied it successfully are going to use it officially from now on, in order to calculate CV associated to their biomass estimations due to the fact that this issue is very important and urgent.

Plankton monitoring synoptic with acoustic survey

A general discussion on the recent proposal to include a zooplankton monitoring along with the acoustic survey funded by DCF, took place. The conclusions were that although most of the groups already collect plankton samples within the acoustic survey aiming to improve our knowledge on the:

- Spawning and nursery areas for anchovy and possibly gilt sardine
- Zooplankton spatial distribution as derived from acoustic data
- Population dynamics of small pelagics in terms of zooplankton distribution and abundance

In order to analyze the collected data, obtain results and provide them in a systematic way to DCF, additional funding is required as these analyses need more manpower, more days at sea, specific sampling material etc..

Special Issue

The group continued the discussion started the previous years about the production of papers from the MEDIAS to contribute to a Special Issue of a Scientific Journal. First of all there was an update in the foreseen Guest Editors that now are: Magdalena Iglesias, Andrea De Felice, Vjekoslav Ticina and Marianna Giannoulaki.
Initially, certain topics were proposed for the Special Issue; these topics are of general interest or were started in past projects as AcousMed and need to be finalized.
Moreover, individual papers (per research group) are expected. The group also agreed to address other acoustics groups working in the Mediterranean to contribute.

MEDIAS Handbook updates

The group discussed some improvements to be introduced to MEDIAS Handbook.
These updates will be directly put in the last version of the Handbook in appendix to this report.

Terms of Reference for the “MEDIAS 2019”

General:

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

Specific:

- Update MEDIAS handbook;
- Update the MEDIAS Website;
- Conduct a parallel session on the adaptation of the MEDIAS groups workflows to R procedures
- To work on Marine Strategy Framework Directive for ecosystem descriptors and to evaluate the contribution of MEDIAS;
- To update the common work on the tentative Special Issue of a Journal.

Conclusions and decisions of the MEDIAS Steering Committee

In the 11th MEDIAS meeting the results of the acoustic surveys carried out in 2017 were presented by participants of all the countries working in MEDIAS: Spain, Greece, Italy, France, Slovenia and Croatia. Moreover, results from the surveys carried out in 2017 by Romania in the Black Sea were also presented.

EchoR

After the presentation of the workflows in use by the MEDIAS groups from raw data to biomass estimation, it was decided to try to translate those aspects of the workflows not contemplated in EchoR through the organization of a specific session, in parallel with next MEDIAS Coordination Meeting, with the experts from each group that already worked with this software.

CV estimation

The adoption of the script developed by Marco Barra, for the moment, is not to be considered mandatory for the MEDIAS as a whole, but all the groups that applied it successfully with their data are going to use it officially from now on, in order to calculate CV associated to their biomass estimations due to the fact that this issue is very important and urgent.

MEDIAS proposals

MEDIAS group agrees to continue submitting its proposals at RCG meetings, but evaluate also the possibility to look for other ways to proceed with the proposals with specific projects at various levels or under the umbrella of GFCM activities.

MEDIAS group is proposing the building of a **common database** through a specific project, based on the past decisions concerning the common format of the database during AcousMed project and during some of the previous MEDIAS Coordination Meetings. Another proposal is the **intercalibration exercise** among the MEDIAS groups to be conducted at a unique location with all the research vessels and equipment in use during MEDIAS surveys. MEDIAS group proposes also the introduction of a **plankton monitoring** activity synoptically with MEDIAS acoustic surveys to be added to the DCF to improve the knowledge useful for acoustic signals discrimination (mainly fish from plankton) and to improve ecosystem knowledge by adding information on small pelagic fish preys in an ecosystem approach perspective. See Annex B for further details.

Anchovy and sardine age determination

The MEDIAS group agrees to use otolith reading criteria for anchovy and sardine in accordance with ICES WKARA2 report (2016) and to follow the recommendation of that meeting to consider as birthdate for anchovy the 1st of January from an assessment point of view in relation to time-steps in the assessment.

Maturity scale

For MEDIAS group it is strongly recommended the use of WKSPMAT 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 L_{50} estimation. This scale allows reaching a higher accuracy since it has been developed specifically for small pelagics (indeterminate spawners). Data conversion to MEDITS stages has to be adopted only if no other choices are available.

Journal Special Issue

The group decided 6 main themes to develop through specific papers for a dedicated Special Issue of a journal and updated the foreseen Guest Editors.

MEDIAS website

It was decided to make some documents and maps freely available to public. In particular: MEDIAS Coordination Meeting reports, survey designs, MEDIAS Handbook, maps with spatial distribution of target species per area and a link to the principal publications from the group. The website in the future will have a more GIS oriented aspect for an easier and faster consultation of the survey results in a geographical context.

MEDIAS handbook

Some aspects of MEDIAS Handbook were updated in the last version of the Handbook in appendix to the report on the base of the discussion during the meeting.

Possible future expansions of the MEDIAS project

CNR-ISMAR and CNR-IAMC have referred their interest to cover respectively GSA 19 (western Ionian Sea) and GSA 11 (Sardinia) by acoustic survey. The Steering Committee agreed to ask for the inclusion in the MEDIAS of these new areas in order to fill the existing knowledge gaps in Italian seas; in the meanwhile possibilities to carry out these surveys within the framework of specific projects, until the inclusion in the MEDIAS, will be explored.

Other studies

The possibility to gather data concerning vulnerable species, marine litter and jellyfish has been discussed. The group is available to build up proposals in case there is interest in this sense by EU or GFCM.

The MEDIAS Steering Committee approved the Terms of Reference for "MEDIAS 2019".

Finally, the Steering Committee concluded for the 12th MEDIAS meeting to take place in Athens, Greece, in the period 9-11 April 2019.

Annex I: List of participants

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Zakarias Kapelonis	zkapelonis@hcmr.gr	Greece	HCMR

Annex II: Institutions Acronyms

FRIS: Fisheries Research Institute of Slovenia. Ljubljana, Slovenia

HCMR: Hellenic Center of Marine Research, Greece

CNR-IAMC: Consiglio Nazionale delle Ricerche. Istituto per l'Ambiente Marino Costiero. Capo Granitola, Italy

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

IEO: Instituto Español de Oceanografía. Spain

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

IOF: Institute of Oceanography and Fisheries. Split, Croatia

INRH: Institut National de recherche halieutique. Morocco

INSTM: Institut National des Sciences et Technologies de la Mer. Tunisia

CNR-ISMAR: Consiglio Nazionale delle Ricerche. Istituto di Scienze Marine. Ancona, Italy

METU, IMS: Middle East Technical University, Institute of Marine Sciences. Turkey

MSDEC-DFA: Ministry for Sustainable Development, the Environment and Climate Change - Department of Fisheries and Aquaculture. Marsa, Malta

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

Annex III: Agenda of the 11th MEDIAS Coordination Meeting (Mediterranean International Acoustic surveys)

Ancona, Italy, 17-19 April 2018

Draft Agenda

Tuesday 17/04/2018

09.00-09.30: Opening of the meeting & welcome. Adoption of the agenda

09.30-09.50: Presentation of the Adriatic acoustic survey in the eastern part of GSA 17 (Vjekoslav Tičina et al.)

09.50-10.10: Presentation of the Adriatic acoustic surveys in the western part of GSA17 and GSA 18 (Iole Leonori, Andrea De Felice, Giovanni Canduci, Ilaria Biagiotti, Ilaria Costantini, Sara Malavolti, Nicola Canduci)

10.10-10.30: Presentation of the Iberian acoustic survey (Magdalena Iglesias, Ana Ventero)

10.30-10.50: Presentation of Eastern Ionian acoustic survey (Athanassios Machias, Marianna Giannoulaki, Maria-Myrto Pyrounaki)

10.50-11.10: Presentation of the acoustic surveys in the GSA 16 (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri, Roberta Mifsud, Reno Micallef)

11.10-11.40: *Coffee break*

11.40-12.00: Presentation of the acoustic surveys in GSAs 9 and 10 (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri)

12.00-12.20: Presentation of the acoustic survey in the Gulf of Lion (Tarek Hattab, Jean Herve Bourdeix)

12.20-12.40: Presentation of Romania survey in the Black Sea (Valodia Maximov, Gheorghe Radu, Simion Nicolaev)

12.40-13.00: Discussion on otolith reading criteria in the MEDIAS group: Presentation of otolith reading criteria in each GSA, Standardization among MEDIAS group

13.00-14.30: *Lunch break*

14.30-15.50: Discussion on otolith reading criteria in the MEDIAS group: Presentation of otolith reading criteria in each GSA, Standardization among MEDIAS group (continues)

15.50-16.00: Presentation on GFCM Mid Term Strategy – non EU surveys (Angelo Bonanno)

16.00-16.30: *Coffee break*

16.30-17.30: Discussion on the establishment of a procedure to deal with registration requests to MEDIAS website from researchers/Institutions outside MEDIAS group

17.30-18.30: Discussion on calibration procedure: brief presentations from each group concerning echosounder in use and calibration procedure

Wednesday 18/04/2018

09.00-11.00: Presentation of workflows from raw data to biomass estimation from each MEDIAS group in order to define a possible script for acoustic data elaboration in EchoR

11.00-11.30: *Coffee break*

11.30-13.00: Presentation of workflows from raw data to biomass estimation from each MEDIAS group in order to define a possible script for acoustic data elaboration in EchoR (continues)

13.00-14.30: *Lunch break*

14.30-16.00: Presentation of the last tests on CV estimation routine in R and discussion on a possible official adoption for MEDIAS surveys

16.00-16.30: *Coffee break*

16.30-17.30: Discussion on plankton monitoring survey design

17.30-18.30: Proposals of preliminary titles of contributions from each group for the Special Issue of a Journal

Thursday 19/04/2018

09.00-10.00: General discussion and revision of the common MEDIAS protocol

10.00-11.00: Update of MEDIAS Handbook and discussion on the eventual constitution of a group to improve its text and figures. Inclusion of ICES maturity scale in MEDIAS Handbook.

11.00-11.30: *Coffee break*

11.30-13.00: Terms of reference for the next meeting (2019); dates and venue of next meeting

13.00-14.30: *Lunch break*

14.30-16.00: Draft report and adoption of the report

Annex IV: MEDIAS HANDBOOK

Common protocol for the Pan-MEDIterranean Acoustic Survey (MEDIAS)

The geographical areas that will be 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 also be found on MEDIAS website:

http://www.medias-project.eu/medias/website/

Table 1. The size of the geographical area that is covered by each Institute in the Mediterranean Sea and in the Black Sea. (Note that it should be updated on an annual basis). 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	30
Slovenia	CNR-ISMAR/FRIS	Adriatic Sea (Slovenia)	117 NM^2	1*
Italy	CNR-ISMAR	Adriatic Sea (Italy)	13200 NM^2	40
Italy	CNR-IAMC	Sicily Channel	4300 NM^2	16**
Italy	CNR-IAMC	Tyrrhenian Sea	6644 NM^2	30
Spain	IEO	Iberian coast	8829 NM^2	33
Croatia	IOF	Adriatic Sea (Croatia)	13578 NM^2	30
Bulgaria	IO – BAS	Black Sea	3400 NM^2	20

* There is an agreement between Italy and Slovenia to extend the Italian acoustic survey in Slovenian waters

** This area includes both Sicily Channel and Maltese waters (GSA 15) due to an agreement between Italy and Malta

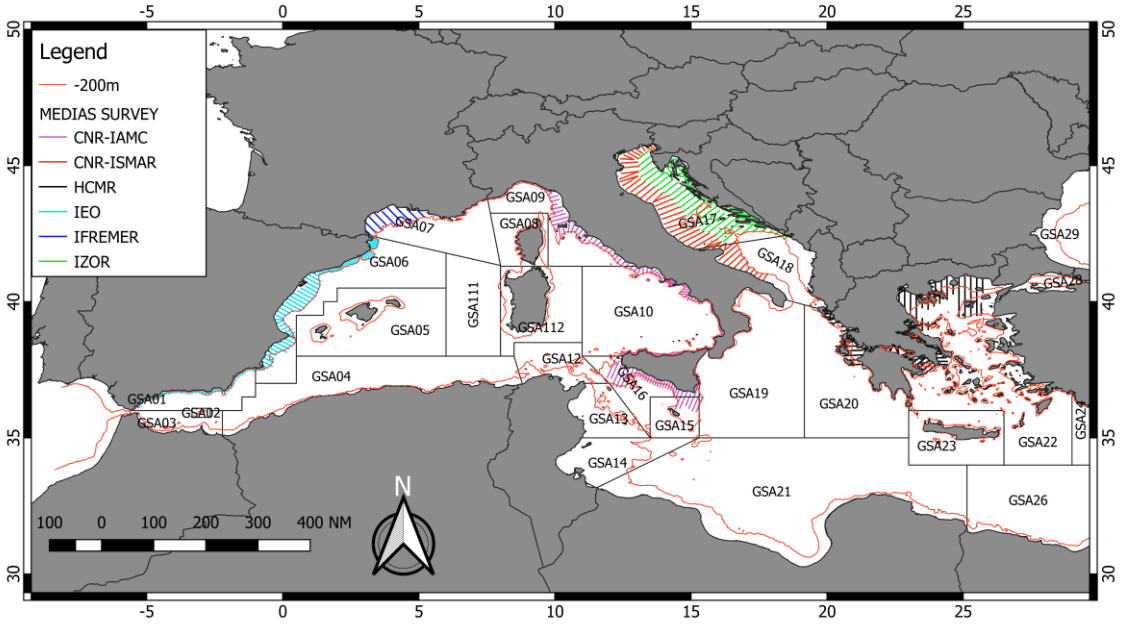

Figure 1: Surveys design in the MEDIAS.

1. 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.

2. 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.

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	

Calibration report	
Range to sphere (m)	
Ping rate	
Calibrated TS transducer gain	
Time (GMT)	
RMS	
sA correction	

3. Survey Design

The survey design for the acoustic sampling should take into account 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, taking into account 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 5th MEDIAS coordination meeting. However, in order to achieve the optimization of the survey design in each area, a workshop with this specific Terms of Reference should be regularly held 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 cavitations.

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 indicated that night estimates can be higher or lower compared to daytime estimates largely depending on the area characteristics 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 always cover the 20 m isobath or less, reaching the 10 m isobath whenever this is possible. 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”. The acoustic energy in the inter-transect tracks will not be taken into account 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 scrutinisation. 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 specific 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 5th MEDIAS coordination meeting agreed to apply for sardine the following TS-TL equation this point forward:

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

where TS=Target Strength, TL=Total Length. The coordination meeting also agreed that IFREMER should continue to use a b_{20}=-71.2 dB in the Gulf of Lions, for compatibility reasons to the long time-series available, as well as because the available data analyzed from the area of Gulf of Lion were very limited.

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 b_{20} 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 CV associated with biomass estimates from acoustic survey, based on Walline et al. (2007), has been created by Marco Barra (IAMC-CNR) and tested by all MEDIAS groups. This script will be considered mandatory when all groups will manage to get successful results with it; given the fact that most groups have already managed to get satisfying results to calculate CV, these groups are adopting the script officially for this aim since 2018.

4. Workflow for acoustic data processing

During the 6th 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
   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.

b. Calibrate
   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.

c. Remove background noise

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

d. 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. Specific aspects are:

   Intermittent noise removal

   Evaluate possible interferences that may produce artefacts in the echograms, and adopt a procedure for removing them.

   Surface and seafloor exclusions

   Use lines for correctly separating the backscattering signals from surface and bottom.

   Single targets estimation

   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.

   Schools estimation

   Use regions and/or mathematical operators for estimating backscattering signal due to fish aggregations.

5. 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.

6. 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 analysed 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.

Taking into account 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.
- 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 regarding length frequency distribution and Length-Weight relationships should also be acquired.

7. 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 two 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 (2016) 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.

It is strongly recommended the use of WKSPMAT 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 L_{50} estimation. This scale allows reaching a higher accuracy since it has been developed specifically for small pelagics (indeterminate spawners). Data conversion to MEDITS stages is possible, but reduces the maturity classification accuracy and has to be adopted only if no other choices are available.

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.

8. 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 ANNEX B). The 6th 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.

9. Ecosystem Indicators 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 the ecosystem indicators that can derive from acoustic surveys (based on data regularly collected and analyzed) are reported.

<table>
<tr><td rowspan="12">Good Environmental Status indicators</td><td rowspan="3">Spatial/temporal strata</td><td>Spatial strata</td><td colspan="5">GSA</td></tr>
<tr><td colspan="5">Acoustic survey</td></tr>
<tr><td>Time periods</td><td colspan="5">Season (Summer/Autumn depending on the area)</td></tr>
<tr><td rowspan="4">Taxonomic levels</td><td>Community</td><td colspan="5">Pelagic fish (Species composition, occurrence in pelagic hauls)</td></tr>
<tr><td rowspan="3">Target Species</td><td rowspan="3">Adult</td><td colspan="4">Anchovy</td></tr>
<tr><td colspan="4">Sardine (for Mediterranean)</td></tr>
<tr><td colspan="4">Sprat (for Black Sea)</td></tr>
<tr><td rowspan="7">Indicators</td><td rowspan="7">Biodiversity</td><td rowspan="6">Species</td><td rowspan="2">Population size</td><td rowspan="2">Acoustic estimates</td><td colspan="2">Total biomass & abundance estimates for target species</td></tr>
<tr><td colspan="2">Estimation error (CV) (i.e. as agreed based on a common estimation procedure, see ToRs)</td></tr>
<tr><td rowspan="2">Population condition</td><td>Biomass & abundance estimate per size/age</td><td colspan="2">Anchovy, Sardine, Sprat (Black Sea)</td></tr>
<tr><td>Recruitment index</td><td colspan="2">Sardine (i.e. Number at Age 0 of the population based on summer surveys)</td></tr>
<tr><td rowspan="2">Habitats</td><td rowspan="2">Habitat condition</td><td rowspan="2">Hydrological condition</td><td>Temperature (i.e. SST: average at 10m, estimated as the interpolated mean value for the whole area)</td></tr>
<tr><td>Salinity (i.e. SSS: average at 10m, estimated as the interpolated mean value for the whole area))</td></tr>
<tr><td rowspan="2">Community</td><td rowspan="2">Fish Community condition</td><td>Community Synthesis</td><td colspan="2">Total pelagic fish NASC</td></tr>
<tr><td colspan="3">Species composition (i.e. percentage in terms of weight of pelagic trawls per hour)*</td></tr>
<tr><td rowspan="2">Age and size distribution</td><td colspan="4">95% percentile of the population length distribution for the target species</td></tr>
<tr><td colspan="4">Proportion of fish larger than L50 (length at first maturity estimated based on collected data or defined based on literature)</td></tr>
</table>

10. Tables for DCF Data Call

The data and the common format of the Tables for MEDIAS Data Call (e. g. year 2015), regularly provided to the DCF, are the following:

TABLE 1 - BIOMASS medbs.xlsx – biomass per species per sex and length class

COUNTRY	YEAR	START_DAY	END_DAY	START_MONTH	END_MONTH	AREA	NAME_OF_SURVEY	SPECIES	SEX	UNIT	LENGTHCLASS0	LENGTHCLASS1	LENGTHCLASS2	LENGTHCLASS3	LENGTHCLASS4	LENGTHCLASS5	LENGTHCLASS6	LENGTHCLASS7	...
		1<= INTEGER <=31	1<= INTEGER <=31	1<= INTEGER <=12	1<= INTEGER <=12			2015 Data Call. ANNEX 1- Appendix 1.7											
ESP	2014					SA 1, 6	any text of max 10 characters		F	mm									
FRA	2014					SA 7			M	cm									
GRC	2014					SA 19, 22			U										
HRV	2014					SA 17			C										
ITA	2014					SA 16, 17, 18													
MLT	2014					SA 15													
SVN	2014					SA 17													
BUL	2014					SA 29													
ROM	2014					SA 29													

TABLE 2 - ABUNDANCE medbs.xlsx – abundance (in number) per species per sex and length class

COUNTRY	YEAR	START_DAY	END_DAY	START_MONTH	END_MONTH	AREA	NAME_OF_SURVEY	SPECIES	SEX	UNIT	LENGTHCLASS0	LENGTHCLASS1	LENGTHCLASS2	LENGTHCLASS3	LENGTHCLASS4	LENGTHCLASS5	LENGTHCLASS6	LENGTHCLASS7	...
		1<= INTEGER <=31	1<= INTEGER <=31	1<= INTEGER <=12	1<= INTEGER <=12			2015 Data Call. ANNEX 1- Appendix 1.7											
ESP	2014					SA 1, 6	any text of max 10 characters		F	mm									
FRA	2014					SA 7			M	cm									
GRC	2014					SA 19, 22			U										
HRV	2014					SA 17			C										
ITA	2014					SA 16, 17, 18													
MLT	2014					SA 15													
SVN	2014					SA 17													
BUL	2014					SA 29													
ROM	2014					SA 29													

TABLE 3 - ABUND_BIO medbs.xlsx – abundance and biomass per species per sex and age class

COUNTRY	YEAR	START_DAY	END_DAY	START_MONTH	END_MONTH	AREA	NAME_OF_SURVEY	SPECIES	SEX	AGEGROUP0ABUND	AGEGROUP0BIOM	AGEGROUP1ABUND	AGEGROUP1BIOM	AGEGROUP2ABUND	AGEGROUP2BIOM	AGEGROUP3ABUND	AGEGROUP3BIOM	...
		1<= INTEGER <=31	1<= INTEGER <=31	1<= INTEGER <=12	1<= INTEGER <=12			2015 Data Call. ANNEX 1- Appendix 1.7										
ESP	2014					SA 1, 6	any text of max 10 characters		F									
FRA	2014					SA 7			M									
GRC	2014					SA 19, 22			U									
HRV	2014					SA 17			C									
ITA	2014					SA 16, 17, 18												
MLT	2014					SA 15												
SVN	2014					SA 17												
BUL	2014					SA 29												
ROM	2014					SA 29												

11. 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
- 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
- Maps of anchovy and sardine spatial distribution
- Map with pie charts reporting percentages in weight of anchovy, sardine and other species

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

12. References

Anonymous 2012. "AcousMed: Harmonization of the Acoustic Data in the Mediterranean 2002-2006". Final Report. MARE/2009/09, 212 pp.

Demer, D.A., Berger, L., Bernasconi, M., Bethke, E., Boswell, K., Chu, D., Domokos, R., et al. 2015. Calibration of acoustic instruments. ICES Cooperative Research Report No. 326. 133 pp.

Machias A., Pyrounaki M.M., Leonori I., Basilone G., Iglesias M., De Felice A., Bonanno A., Giannoulaki M. 2013. Catch of pelagic hauls in Mediterranean acoustic surveys: Is it the same between day and night ? Scientia Marina, 77(1): 69-79.

Walline, P. D. 2007. Geostatistical simulations of eastern Bering Sea walleye pollock spatial distributions, to estimate sampling precision. ICES Journal of Marine Science, 64: 559–569.

ANNEX A

Summary of the common protocol for the Pan-MEDIterranean 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 depending on availability
Pulse duration (ms)	1 ms, 0.5 ms in case of TS experiments
Beam Angles (degrees) Athw. Beam Angle, Alog. Beam Angle	Should be reported
Ping rate	Maximum depending on depth
Calibration (No per survey)	A calibration report should be given 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 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. 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
Distance from the coast according to the Bottom depth (min, m)	At least 20 m bottom depth, minimum 10 m of echo-sampling.
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 Other species: keep historical TS equations.
Echo partitioning into species	Echo trace classification based on echogram visual scrutinisation • Direct allocation and • allocation on account of representative fishing station
Abundance estimates	
Abundance indices estimated	ν Total fish NASC per EDSU ν Anchovy, Sardine NASC per EDSU ν Anchovy, Sardine Biomass per EDSU ν Anchovy, Sardine Numbers per EDSU ν Anchovy, Sardine Number/age and per length class ν Anchovy, Sardine Biomass/age and per length class
Maps and charts	ν Point maps of total fish NASC ν Point maps of target species in NASC/mile; biomass / mile. ν Catch compositions of the hauls, pie-charts indicating percentage by weight 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
Net-sounder 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 • ensure identification of echo traces • obtain length structure of the population • obtain species composition • 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 Sample sizes according to the new DCR.
Length – Weight relationships	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. Minimum variables: T, S

ANNEX B

MEDIAS group proposals:

1) 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.

2) MEDIAS database

MEDIAS group planned 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 was 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 Acoustics adopted in the 5th MEDIAS meeting.

The major fields agreed were associated to:

1. input information related to export data from acoustic software (Figs. B2 & B3),
2. input information related to biological sampling and environmental data sampling (Figs. B4 & B5)
3. queries-calculations to fulfill DCF requirements (Fig. B6)
4. queries-calculations to facilitate abundance/biomass estimates (Fig. B6)
5. echo-sounder calibration report (Fig. B7)
6. data input validation and control checks
7. up to date demands related to surveys and the Ecosystem Approach to Fisheries (Figs. B5 & B6)

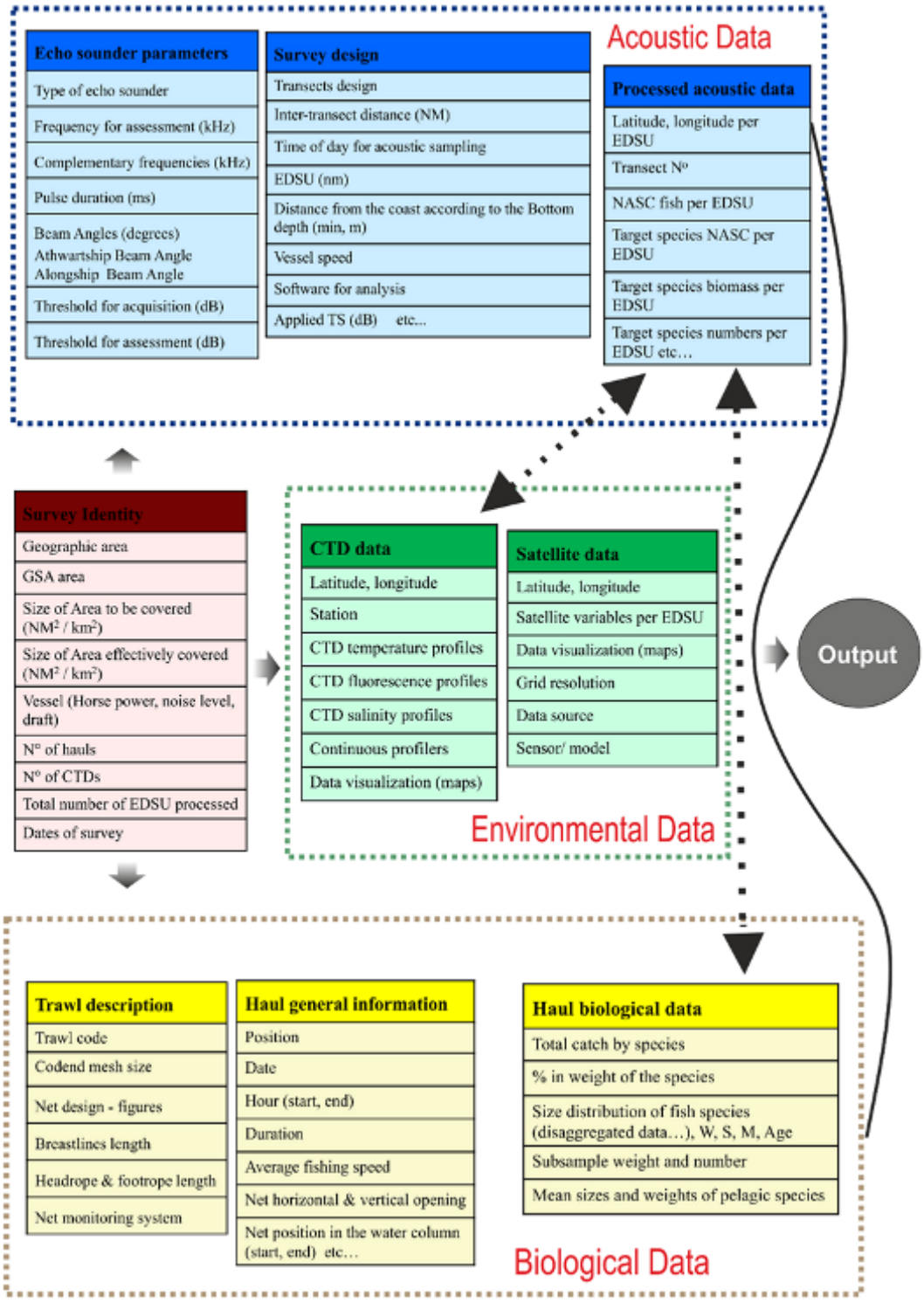

Figure B1. General outline of a database for acoustic surveys

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 B2. Fields associated with the typical input info about the survey

Echo sounder parameters
Type of echo sounder
Frequency for assessment (kHz)
Complementary frequencies (kHz)
Pulse duration (ms)
Beam Angles (degrees) Athwartship Beam Angle Alongship Beam Angle
Threshold for acquisition (dB)
Threshold for assessment (dB)

Survey design
Transects design
Inter-transect distance (NM)
Time of day for acoustic sampling
EDSU (nm)
Distance from the coast according to the Bottom depth (min, m)
Echo sounding depth (min, m)
Echo sounding depth (max, m) recording.
Vessel speed
Software for analysis
File format
Applied TS (dB)

Acoustic Data

Processed acoustic data
Latitude, longitude per EDSU
Transect Nº
NASC fish per EDSU
Target species (i.e. anchovy, sardine) NASC per EDSU
Target species biomass per EDSU
Target species numbers per EDSU
Echogram figures especially related to hauls

Figure B3. 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.

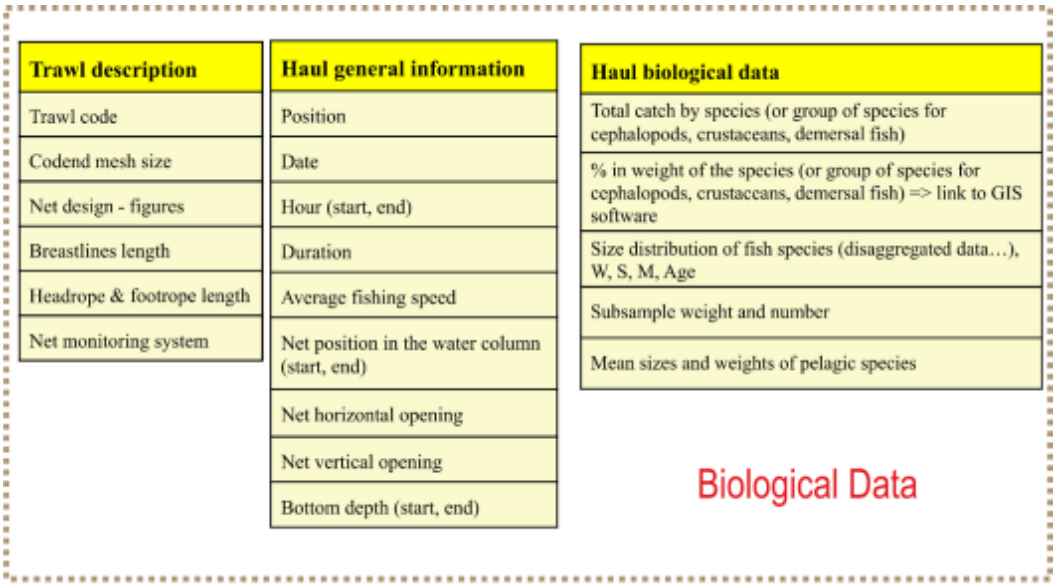

Figure B4. Fields associated with input info on Biological Data related to acoustic surveys

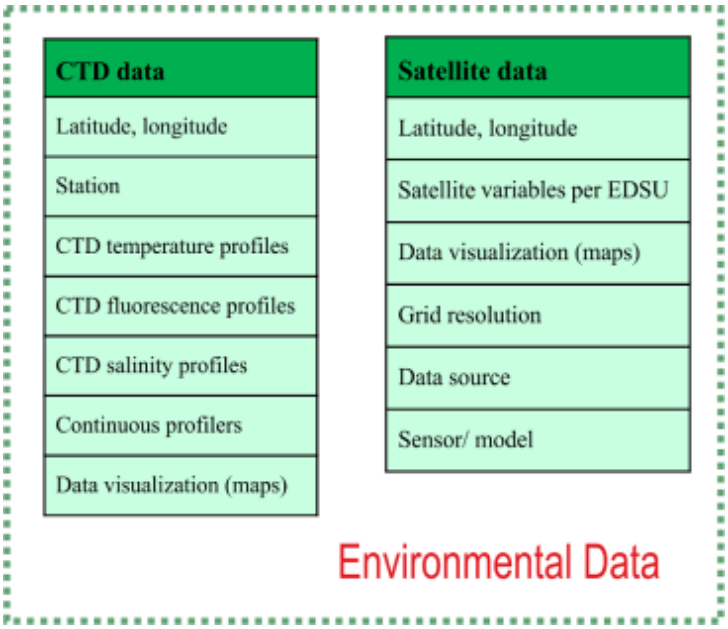

Figure B5. Fields associated with input info on Environmental Data related to acoustic surveys

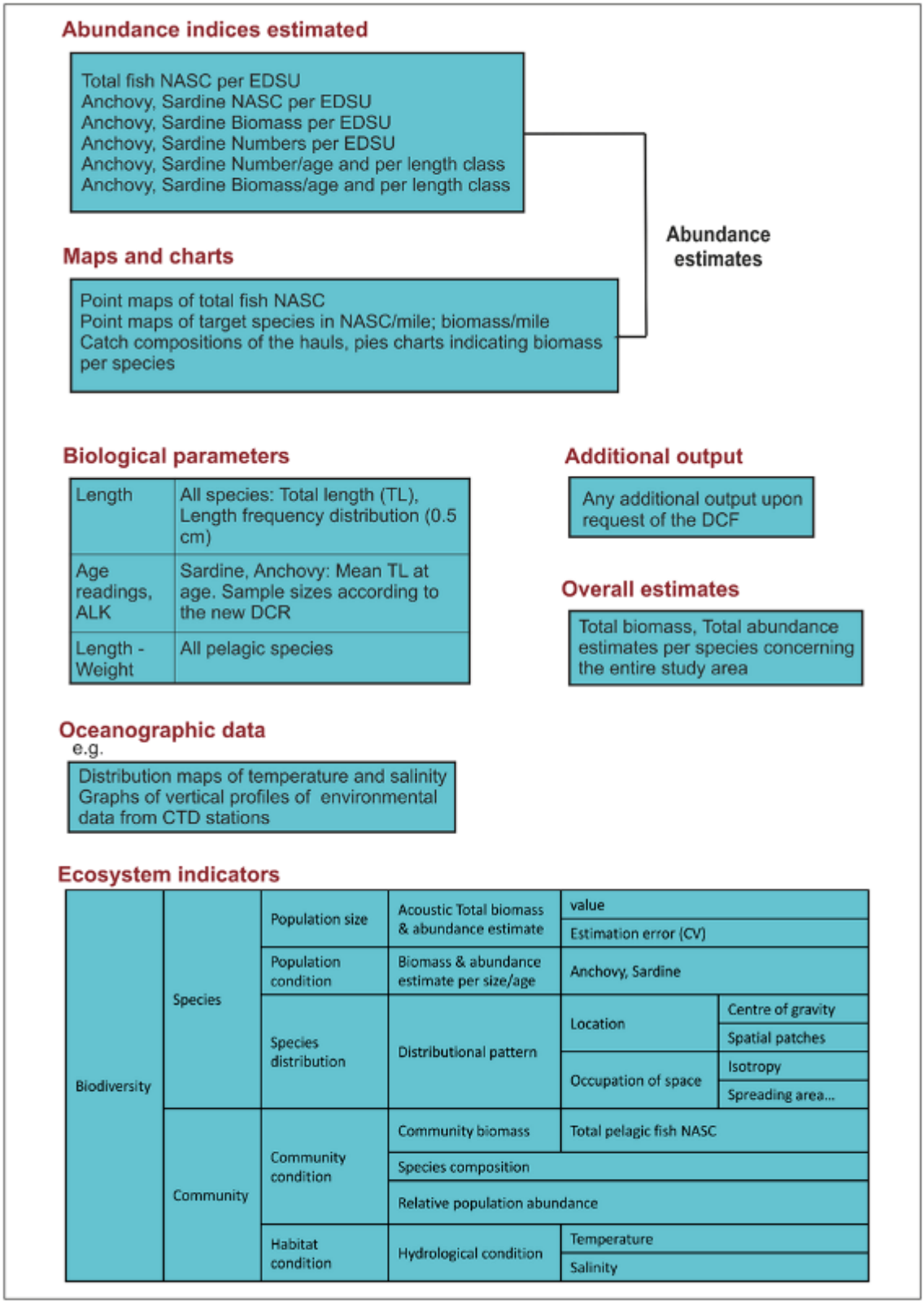

Figure B6. Fields associated with potential acoustic database output

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 B7. Database Fields related to electro-acoustic calibration report.

3) 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) and Tyrrhenian Sea (GSA 9 and 10) by CNR-IAMC (Italy), western Adriatic Sea (GSA 17 and 18) by CNR-ISMAR (Italy), eastern Adriatic Sea (GSA 17) by IOF (Croatia) and eastern Ionian Sea and Aegean Sea (GSA 20 and 22) by HCMR (Greece). 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.

Most of the MEDIAS groups are already collecting plankton samples, but lack money to produce advanced analyses that could bring to the production of information such as:

- Spawning and nursery areas for anchovy and possibly gilt sardine
- Plankton spatial distribution from acoustic data
- Ecosystem approach, adding information on preys to that of biomass of small pelagic fish

These results could only be achieved with a proper financial support because this analyses need more manpower, more days at sea, specific sampling material etc.