Report of 9th meeting for MEDiterranean International Acoustic Surveys (MEDIAS)

in the framework of European Data Collection Framework (DCF)

Split, Croatia, 5-7 April 2016

Steering Committee Report

Contents

Introduction

The MEDIAS (MEDiterranean International Acoustic Surveys) Steering Committee met in Split, Croatia, on 5-7 April 2016, hosted by IOF and chaired by Angelo Bonanno from IAMC-CNR. Participants in the meeting were representatives from the European Union countries involved in acoustic surveys in the Mediterranean Sea (i.e. Greece, Spain, Croatia, France, Slovenia and Italy) and in the Black Sea (Romania). One scientist from Tunisia, one scientist from Morocco, both working on fisheries acoustics in the Mediterranean Sea, and one scientist from the European Commission – Joint Research Centre, Maritime Affairs Unit (Ispra, Italy) were invited to participate (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 2015;
b) to coordinate the MEDIAS to be performed in 2016;
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 2016 and to establish the ToRs for 2017.

The agenda of the 9th MEDIAS Meeting (see ANNEX III) was adopted by the participants. Following the agenda, during the first day results from the 2015 MEDIAS acoustic surveys, carried out by the MEDIAS partners (Figure 1), were presented, as well as results from the survey carried out by Romania in the Black Sea and by Morocco in Mediterranean waters.

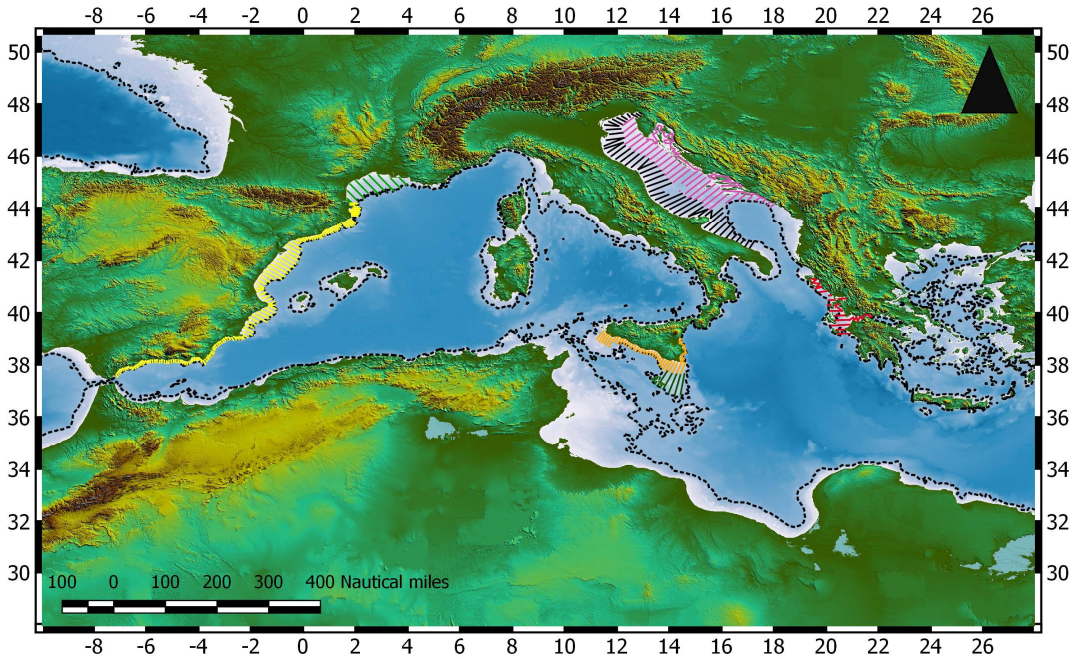


Figure 1: Acoustic surveys in the framework of MEDIAS in 2015.

In the second day of the meeting a workshop on “common scripts to be adopted for the estimation of CV in a standardized way and the allocation of trawl catches on acoustic data” and a workshop on the “workflow for the analysis of the echograms and, in particular, the aspects concerning the multifrequency analysis” were carried out.

During the third day, the revision of the common MEDIAS protocol and an update of the MEDIAS handbook were carried out. Part of the day was dedicated to define the Terms of Reference (ToRs) for the next year (2017), and to discuss and propose common studies in the framework of MEDIAS.

Results of the surveys carried out in 2015 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, Andrea Miccoli, Gianluca Gabrielli).

The 2015 acoustic survey was carried out in June in the whole GSA 18 and in western GSA 17 including territorial waters of Slovenia (Dr. Tomaz Modic took part in the cruise in Slovenia waters). Acoustic data were logged over a grid of systematic parallel transects perpendicular to coastline/ bathymetry. In WEST GSA 17 total nautical miles were 1502 for a total area of 10636 nm^2, in WEST GSA 18 total nautical miles were 395 for a total area of 2510 nm^2 and in EAST GSA 18 378 nautical miles for a total area of 2597 nm^2 (survey conducted with the same MEDIAS methodology but under FAO AdriaMed and CNR fundings). All this account for a total of 2275 nautical miles, identifying an area of about 13200 square nautical miles in the western part of Adriatic Sea, that rise up to 15700 nautical miles including the Montenegro and Albania survey. The entire survey in WEST 17 and 18 plus EAST 18 took place from 25 May to 1st July, thus ensuring a strong synopticity to the monitoring of such a large area. In particular GSA 18 EAST took place from 24 May to 3 June; GSA 18 WEST from 4 to 10 June and GSA 17 WEST from 11 June to 1st July.

In detail, the MEDIAS acoustic survey in western GSA 18 was carried out from 4 to 10 June 2015; area coverage was 100%, 395 nautical miles were monitored and 14 pelagic trawls were conducted. 58 ichthyoplankton stations to apply Daily Egg Production Method were made, combining CTD and plankton net sampling.

Acoustic survey in western GSA 17 was conducted from 11 June to 1 July 2015; the coverage of the area was 100%, 1502 nautical miles were monitored and 33 pelagic trawls were conducted. 76 CTD stations were made and in 45 stations out of 76 mesozooplankton sampling by means of WP2 net (mesh size 200 µm) was made in collaboration with the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS) of Trieste (Italy).

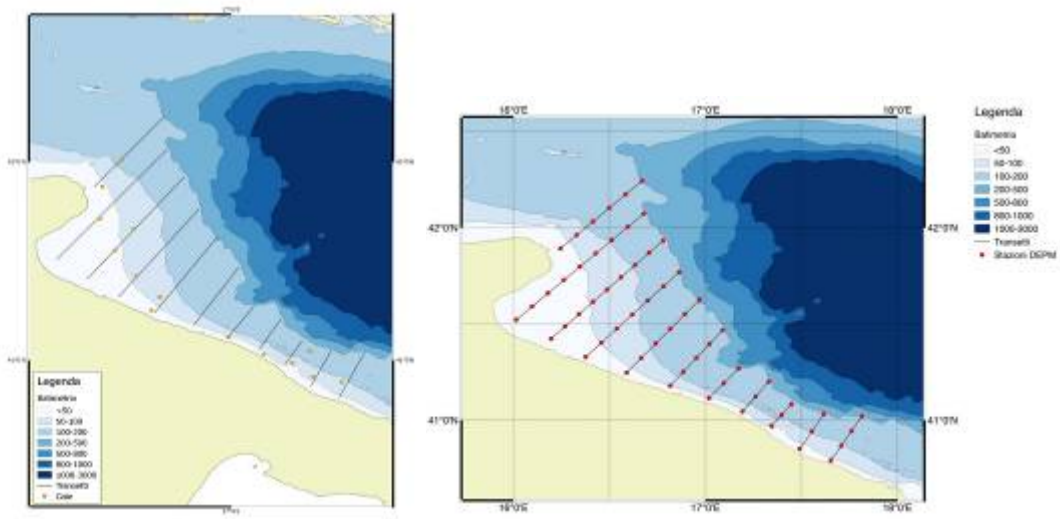


Figure A1. Acoustic survey route plan in western GSA 18. On the left the positions of net samplings are reported; on the right positions of prefixed stations of CTD & plankton sampling are shown.

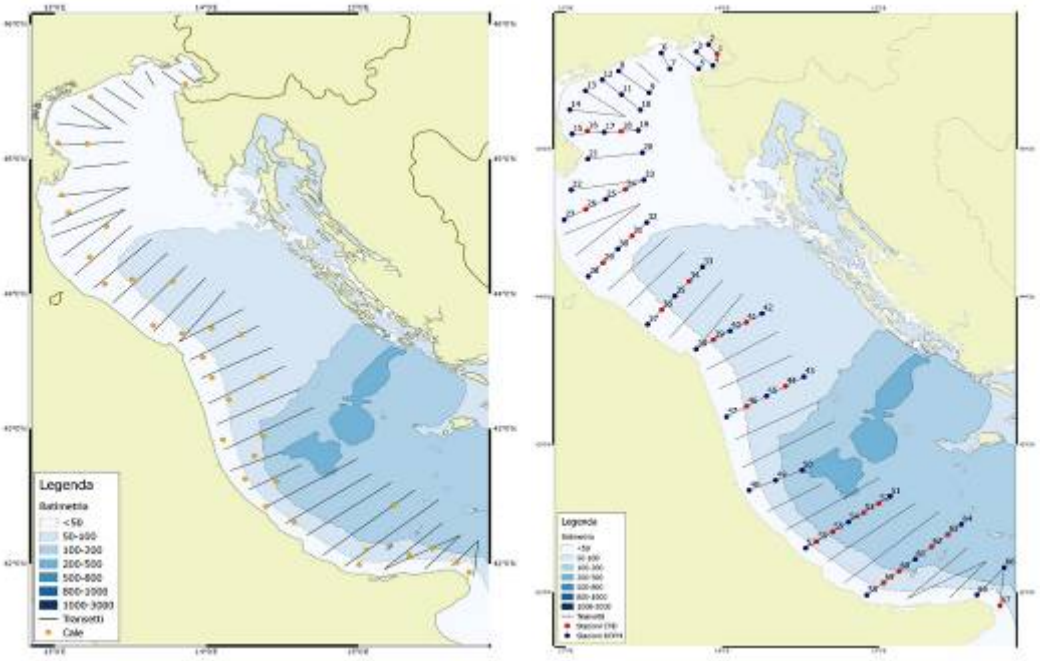


Figure A2. Acoustic survey route plan in western GSA 17. On the left the positions of net samplings are reported; on the right positions of prefixed stations of CTD & plankton sampling are shown (in blue CTD&plankton stations, in red CTD stations).

Biomass estimations of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) stocks in western Adriatic Sea show a slight decrease in the biomass in the northern part, a weak increase in the central Adriatic and a severe decrease in the southern Adriatic Sea (GSA 18) especially for sardine, that comes back to very low levels.

Due to the change in the survey time in GSA 17, a statistical analysis was performed in order to identify if there are significant differences on the length frequency distributions between 2015 and the previous years, but also among all the years to verify if these differences are only between June and September or are present among the September surveys too. Anchovy mean lengths from the surveys 2004-2015 show alternate values over the years with 2015 mean being the highest, even if the gap with the previous years is little. Sardine mean lengths present a quite evident decreasing trend over the years. Comparing the means in pairs performing pairwise t-tests with Bonferroni correction methodology the results show that not only 2015 means are different in most of the cases with the other years means, but also most of the "September" means are significantly different between them, stating that there is a substantial variability of LFD between years even keeping the month of the survey constant.

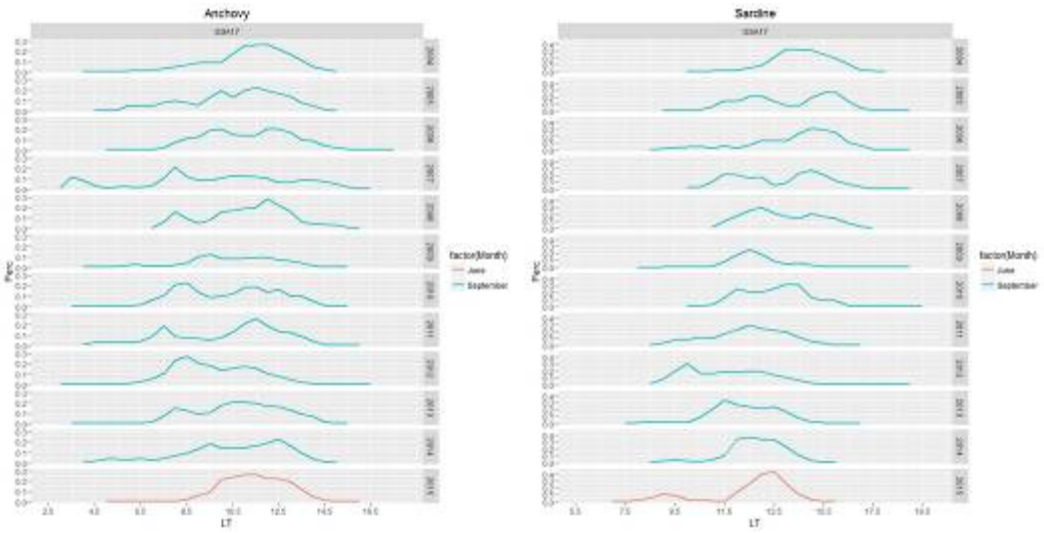


Figure A3. Anchovy and sardine LFD in western GSA 17 from 2004 to 2015.

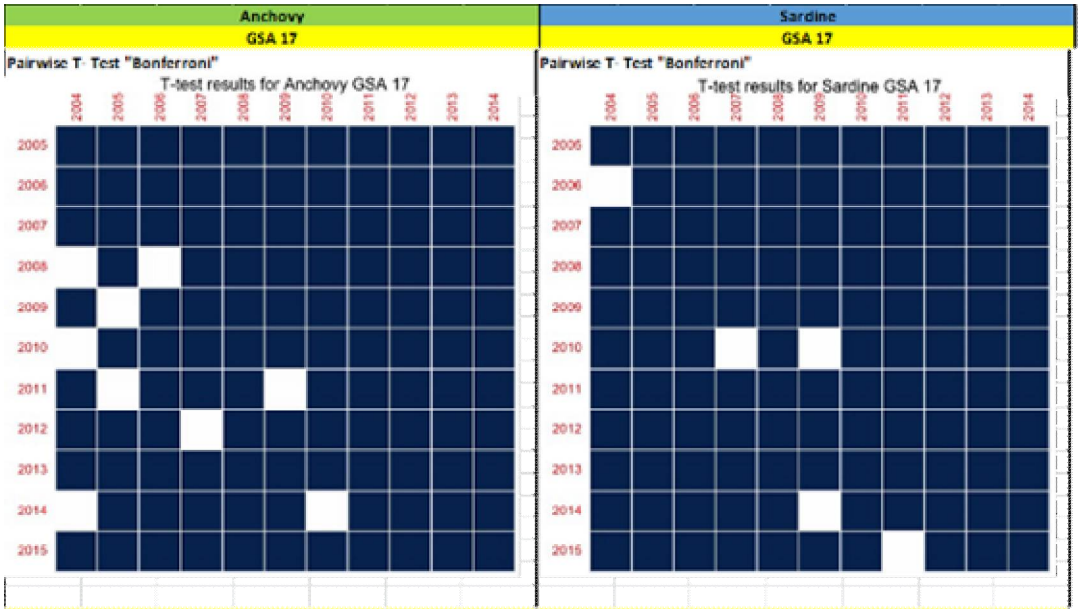


Figure A4. Results of pairwise T- test "Bonferroni" showing in dark the significant differences between couples of mean size values, in white the non-significant differences.

b) **MEDIAS in the eastern part of GSA 17 - Croatian survey** (Vjekoslav Ticina)

The third acoustic survey in eastern part of GSA 17, carried out after accession of Croatia to EU in accordance with DCF-MEDIAS protocol, has been presented. The survey was performed in September 2015 in the eastern part of GSA 17. During this survey, acoustic data has been collected within 1447 EDSU, covering entire survey area of 13.578 nmi^2 as planned (Fig. B1). In total, 32 vessel days were used.

Fish sampling by mid-water trawl have been performed 61 times, obtaining 59 hauls with catch. Qualitative analyses of collected fish samples were presented (Fig. B2). Oceanographic properties of the survey area was described on the basis of 88 CTD vertical profiles. Laboratory analyses on detailed biologic information on both target species (age, maturity, sex) were done, and some preliminary results were presented.

Based on survey data collected, spatial distributions (GIS analyses) of anchovy and sardine stock within study area were presented (Figs. B3 and B4). With aim to estimate abundance of target species, TS equations based on 20 log has been used in accordance with MEDIAS agreements.

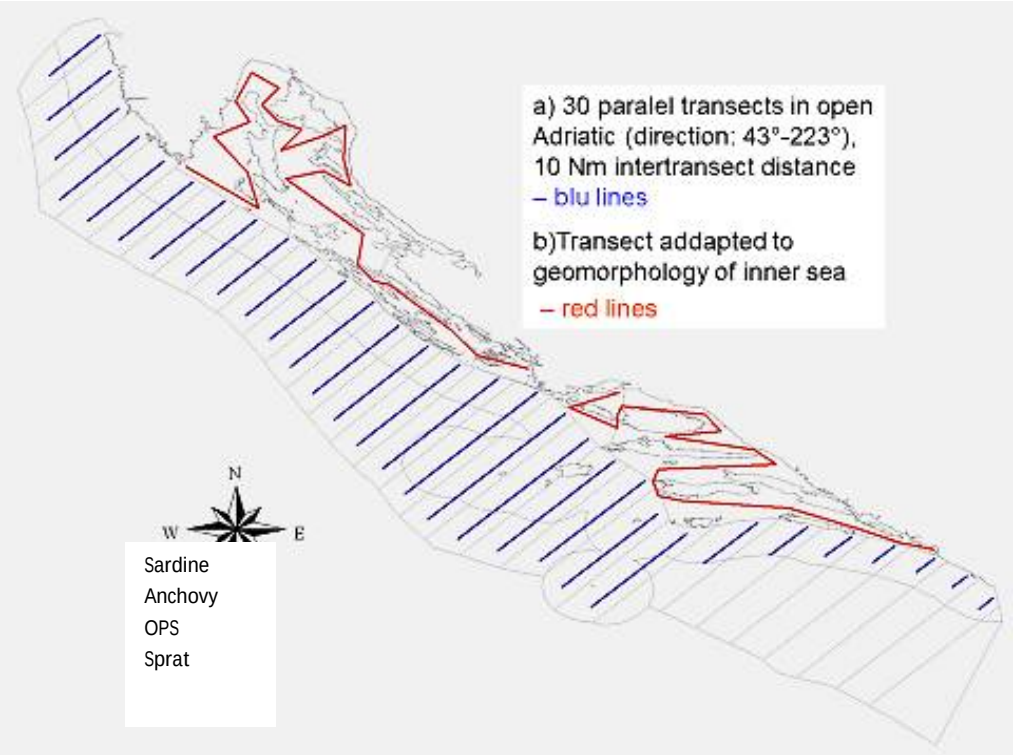


Figure B1. Survey design of acoustic transects in the eastern part of GSA 17.

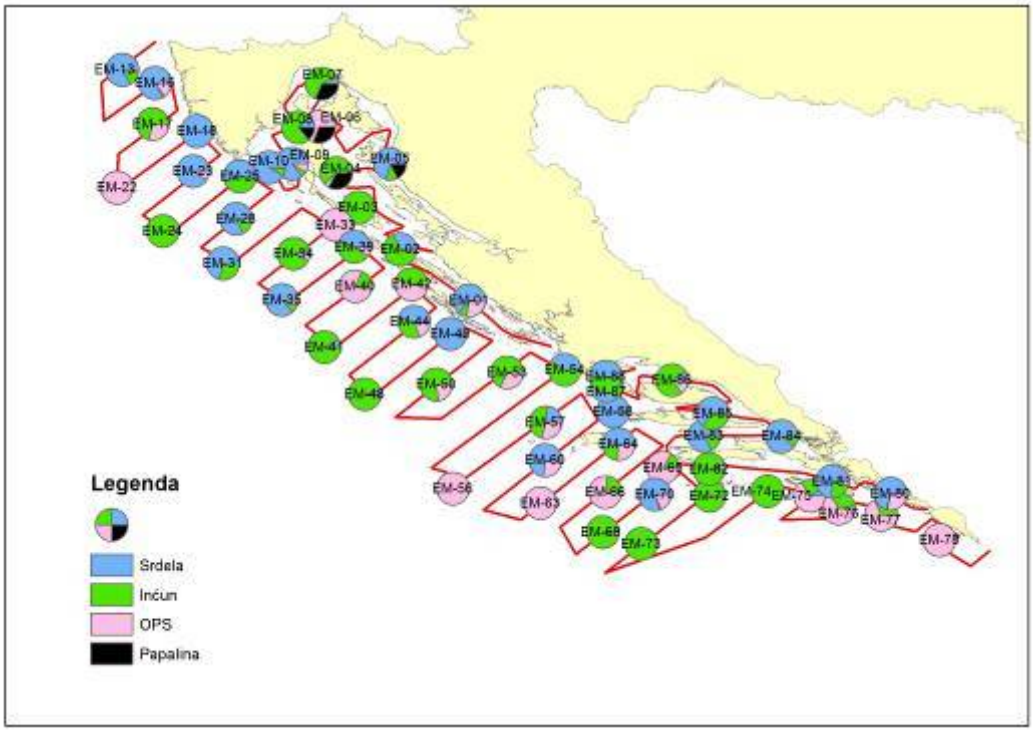


Figure B2. Compositions of pelagic fish assemblages in the eastern part of GSA 17 in September 2015.

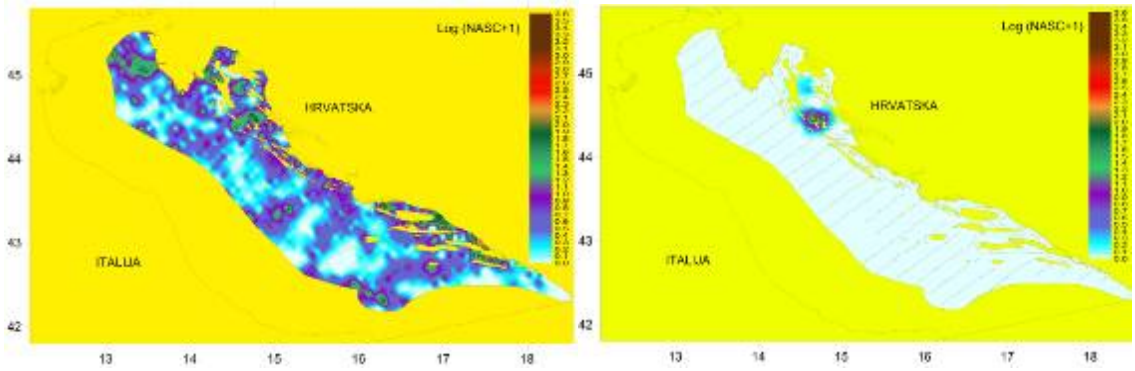


Figure B3. Spatial distribution (GIS analyses) of anchovy (left: LT>6cm; right: LT<6cm) within survey area (September, 2015).

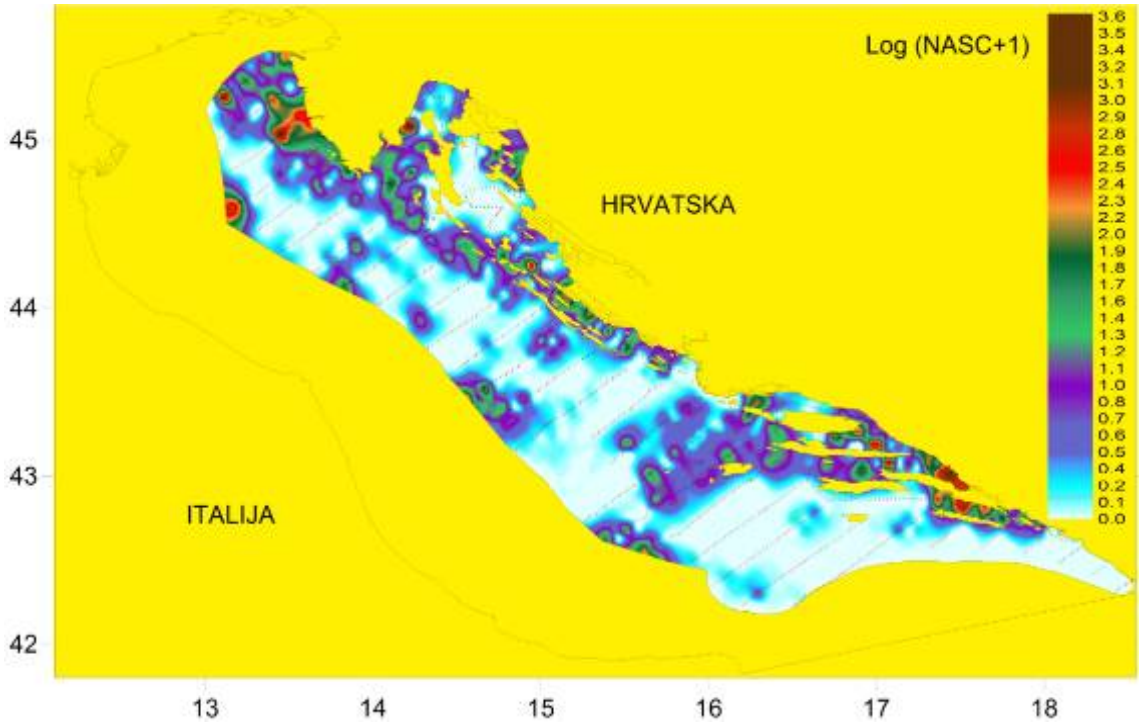


Figure B4. Spatial distribution (GIS analyses) of sardine stock within survey area (September, 2015).

Acoustic data for abundance analyses have been collected during daytime only.

According to preliminary results, it seems that abundance indices indicate slight decrease in anchovy biomass in September 2015 in comparison to September 2014 in eastern part of GSA17. Fish from age class 2 showed the highest portion in biomass distribution by age.

In contrary, preliminary results on abundance indices for sardine indicate slight increase of sardine biomass in September 2015 in comparison to September 2014. in

eastern part of the Adriatic Sea. Fish from Age class 0 showed the highest portion in biomass distribution by age, indicating a good sardine recruitment in 2015.

Considering biomass of both target species combined (anchovy + sardine), it seems that overall biomass of in this area did not changed significantly from 2014 to 2015.

c) Gulf of Lion survey (Claire Saraux).

Pelmed surveys cover the Gulf of Lions (3300 nm²) 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 EDSU is 1 nm. The surveying acoustic vessel speed is 8 knots. Echotraces are identified with a pelagic haul. Acoustic recording and trawl hauls are performed during day time and the survey lasts approximately 26 days. The split beam echo sounder used is SIMRAD ER60, with the 38, 70, 120, 200 and 333 kHz frequencies. The pulse duration is 1024 ms. The echo sounder is calibrated at each survey. Acoustic data are saved both in HAC and RAW format. The threshold for acquisition is –80 dB and that for processing for the assessment (38 KHz) is –60 dB. Additionally, the use of a multi-beam echo sounder SIMRAD ME70 enables us to visualize 3D echos and helps in species allocation.

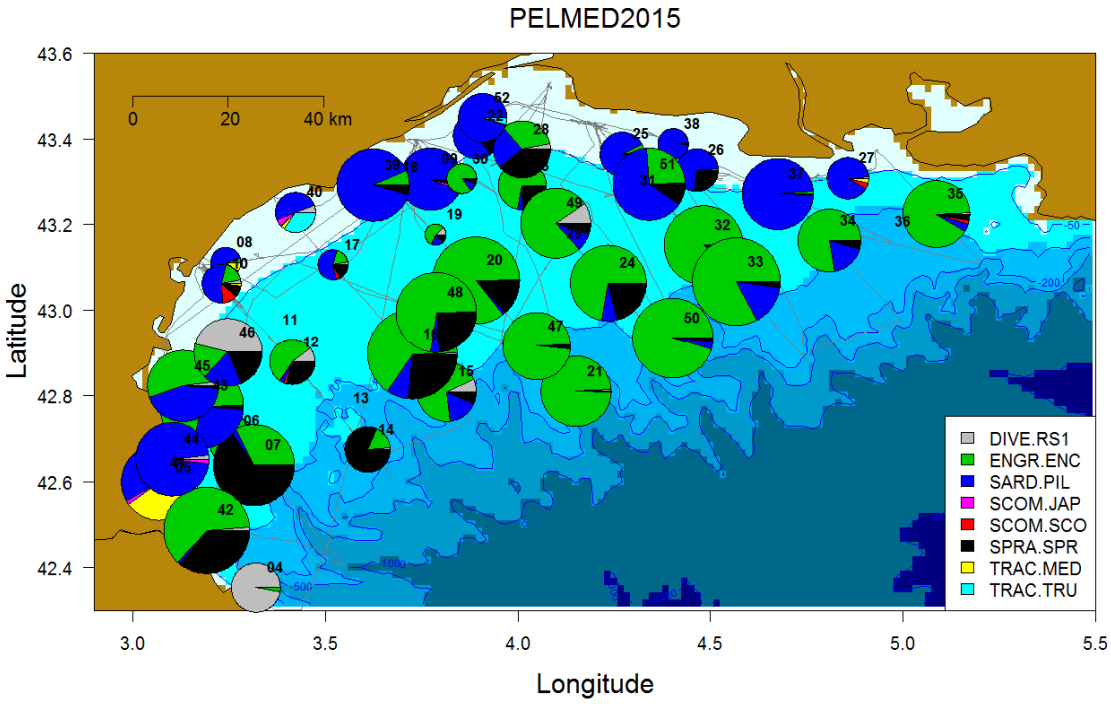


Figure C1. Map of the assessed area and sampling design. 2015 survey is used as an example to show the trawl positions and species composition.

Regarding anchovy, the stock is judged of low biomass (B/Bpa=0.91). The exploitation level is low and the declining trend in biomass and landings is supposed to be driven mainly by exogenous environmental factors. Further, biological parameters showed slight improvement: anchovies maintained their slightly larger size as last year, and their condition increased after the dramatic drop of last year, though it is still very low. If the stock shows slight encouraging improvement, it still hasn't totally recovered from poor exogenous environmental factors.

Regarding sardine, the current situation shows small individuals, as a result of a lower growth and the disappearance of old individuals. Individuals are also still in a poor body condition (i.e. low reserves). As a consequence, the stock is still judged unbalanced due to its lack of old individuals and problems of growth and body condition. The exploitation level is almost null, while the biomass is intermediate.

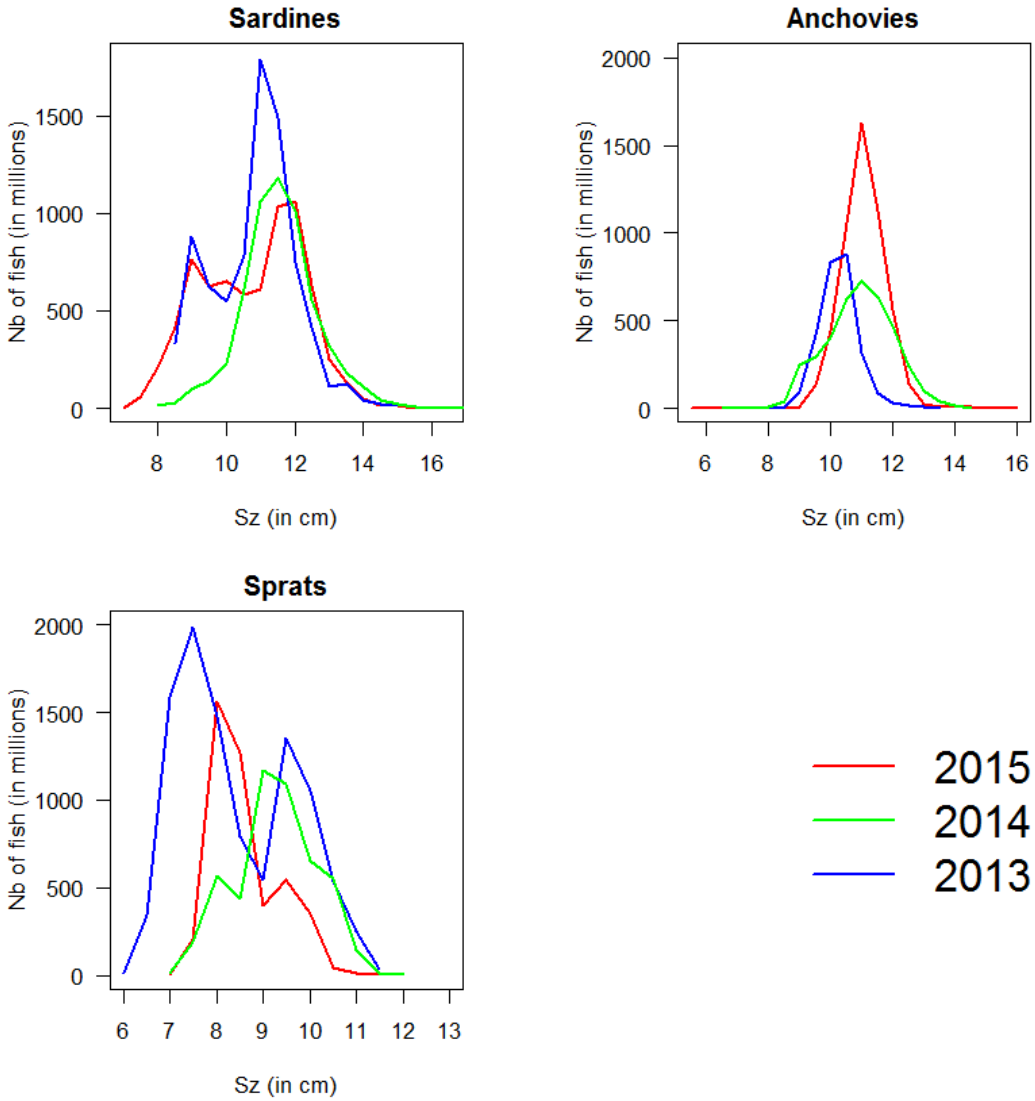


Figure C2. Size distribution of anchovies, sardines and sprats from 2015 (in red), 2014 (in green) and 2013 (in blue) surveys.

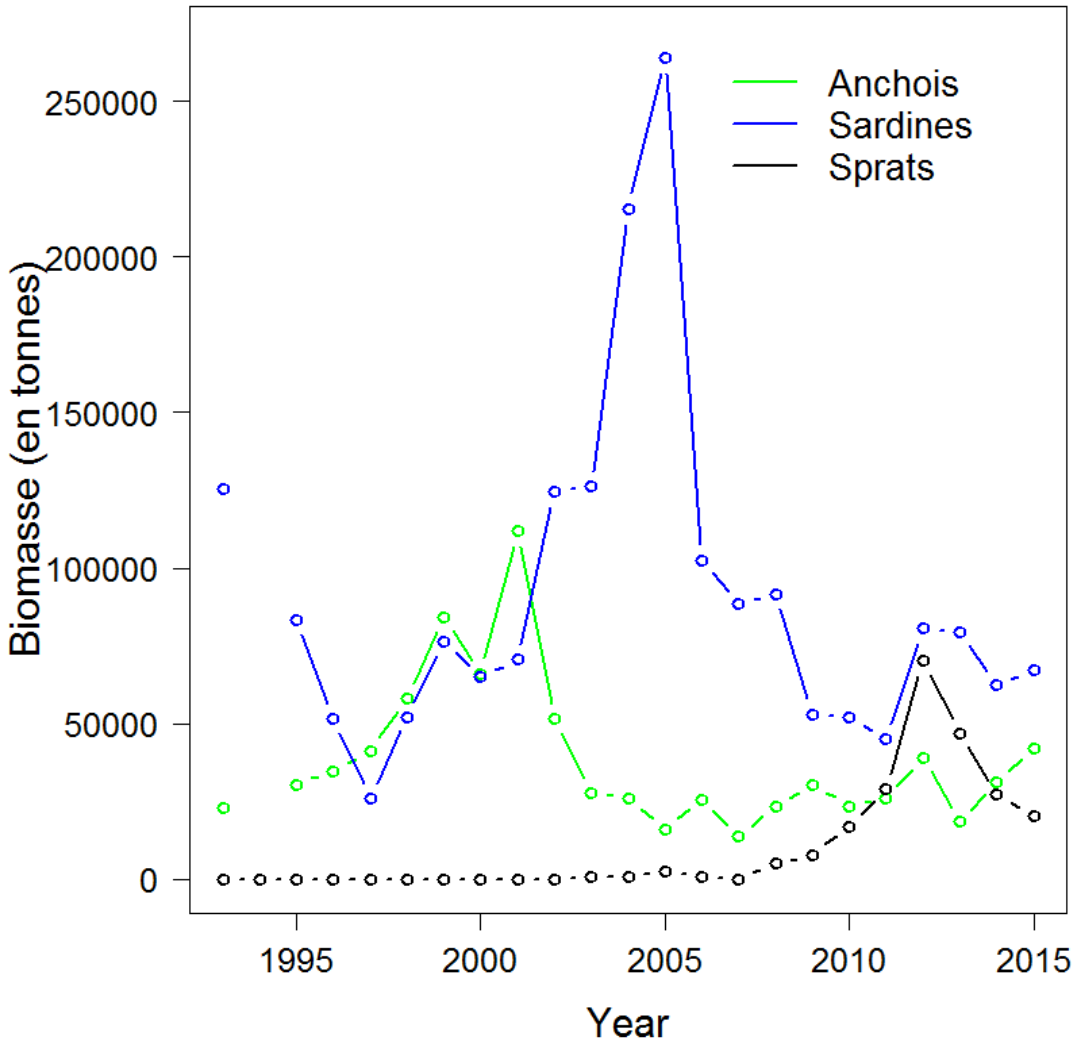


Figure C3. Direct assessment of biomass since the start of the PELMED acoustic survey.

Finally, on top of fish parameters, several hydrological stations have been conducted. Zoopkankton was sampled through WP2 vertical nets, while phytoplankton was sampled through Niskin bottles.

d) Acoustic survey in the Strait of Sicily - GSA 16 (Angelo Bonanno, Gualtiero Basilone, Simona Genovese, Rosalia Ferreri, Marco Barra)

Acoustic data were collected during the echosurvey carried out in the period 11-22 July 2015 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 2015 are presented.

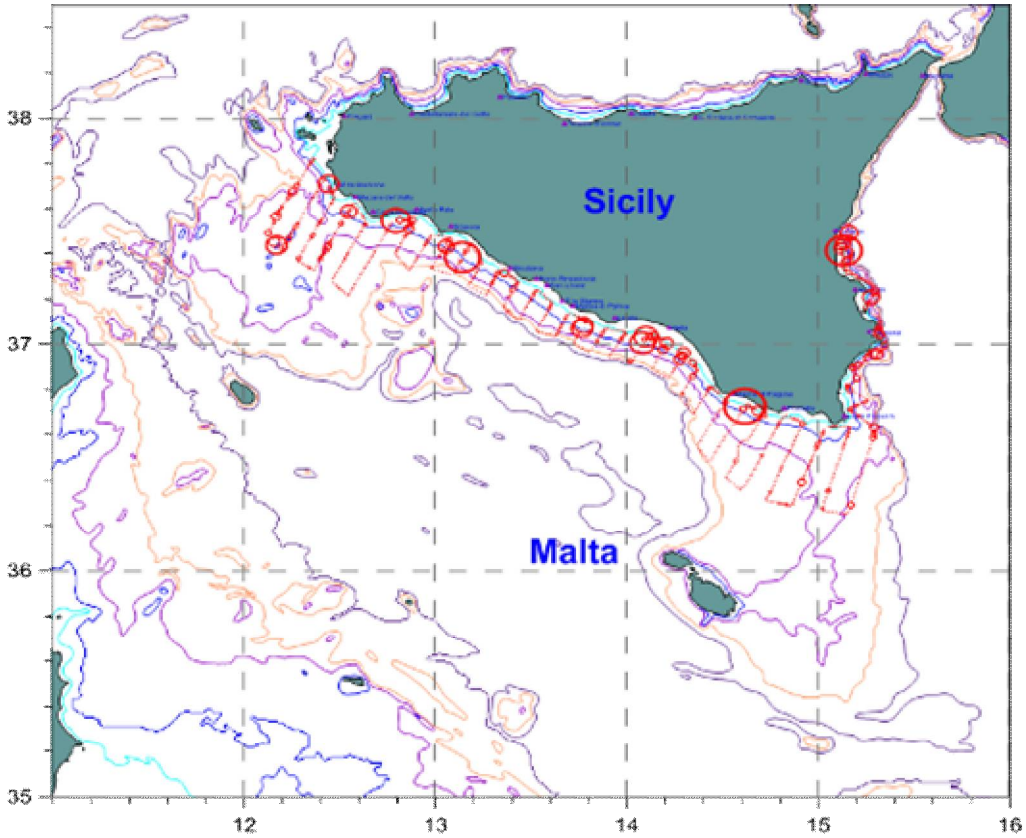


Figure D1. Fish NASC estimated in the GSA16.

The total biomass of anchovy stock (8185 t) increased reaching a level similar to the value estimated in 2013. The spatial distribution showed that anchovy was mainly concentrated in the more coastal part of the study area in the Strait of Sicily. The age structure highlighted the presence of juveniles and two main age classes (1 and 2).
In the case of sardine population the biomass in 2015 (26593 t) further increased in comparison to that estimated in previous years; only in the period 1999-2000 higher sardine biomasses were evaluated. However, the distribution of biomass among age classes shows a breakdown of the population mainly in two age classes (0 and 1). Although the increase in biomass levels over the previous years constitutes a positive signal, one cannot certify that the state of the stock is improving. In fact, the risk of collapse of sardines in the Strait of Sicily could be referable not only to the age structure, but also to a decline in the total biomass of the stock shown by the estimates obtained in recent years.

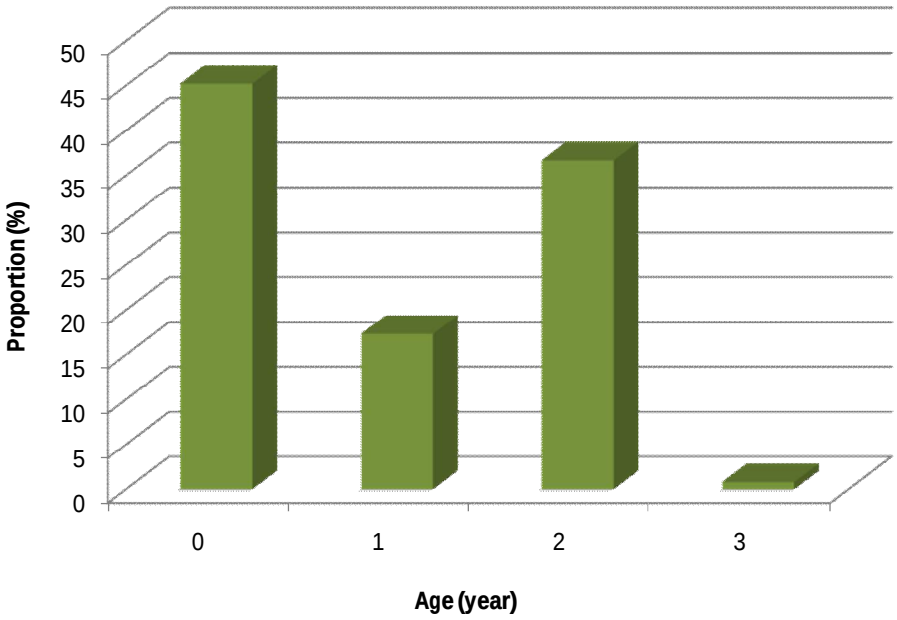


Figure D2. Anchovy age classes distribution (%).

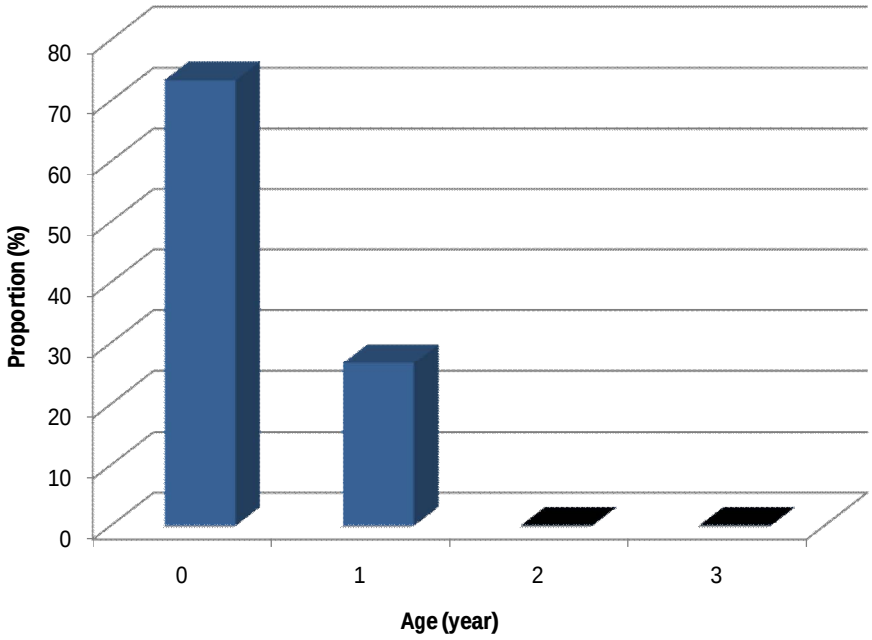


Figure D3. Sardine (*S. pilchardus*) age classes distribution (%).

e) Maltese waters survey in GSA 15 (Roberta Mifsud, Angelo Bonanno, Reno Micallef, Gualtiero Basilone, Simona Genovese, Rosalia Ferreri, Marco Barra)

The echosurvey in the Maltese waters was carried out in summer 2015 on board the RV "G. Dallaporta" in collaboration with the Italian colleagues of CNR-IAMC. The survey track was 304 nm long and covered an area of about 2026 nm^2; 10 pelagic hauls were completed during such survey. No sardine specimen was collected during the survey and, consequently, the sardine biomass was 0.0 t, while anchovy abundance was 2834

t. The Anchovy NASC distribution shown in the previous figure E1 evidences the presence of anchovies in the eastern part of the Maltese shelf.

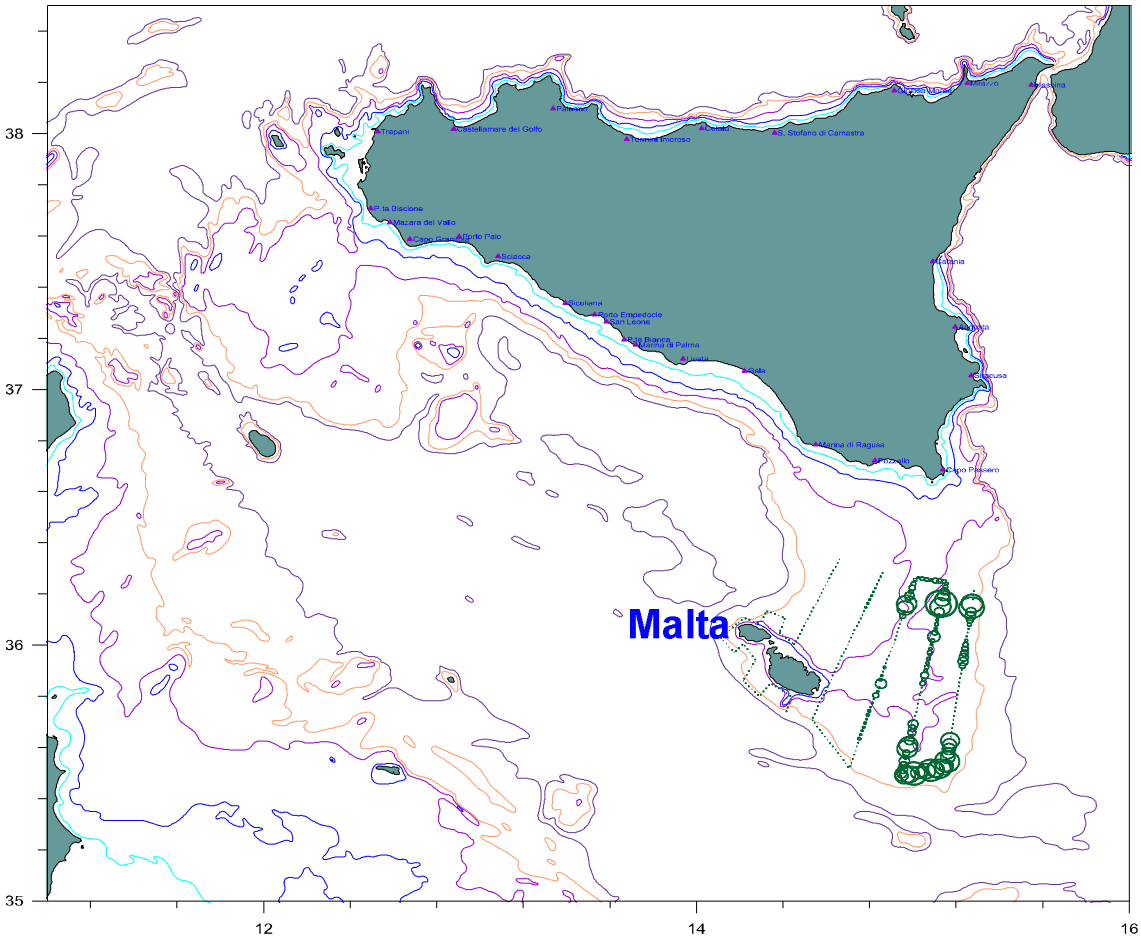


Figure E1. Anchovy NASC spatial distribution estimated in the GSA 15.

f) Greek acoustic survey in the GSA 20 (Athanassios Machias, Marianna Giannoulaki, Konstantinos Tsagarakis, Maria Myrto Pyrounaki, Stylianos Somarakis, Eudoxia Schismenou)

The lack of the Greek acoustic survey in GSA 22 was due to the delayed adoption of the NP for 2015 by the Greek Government in September 2015. This along with the limited availability of the R/V Philia during September - October imposed the need to skip the Aegean Sea and focus on Ionian Sea. The echosurvey in the Greek waters was carried out in October 2015 in GSA 20 on board the RV "PHILIA". The survey design is made of parallel transects perpendicular to the isobath from 10 m to 200 m depths. The intertransect distance is 10 nm. The EDSU is 1 nm. The average surveying acoustic vessel speed is 7.5 knots. Echotraces were 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 30 acoustic transects, that covered an area of 2535 nm2 (Fig. F1).

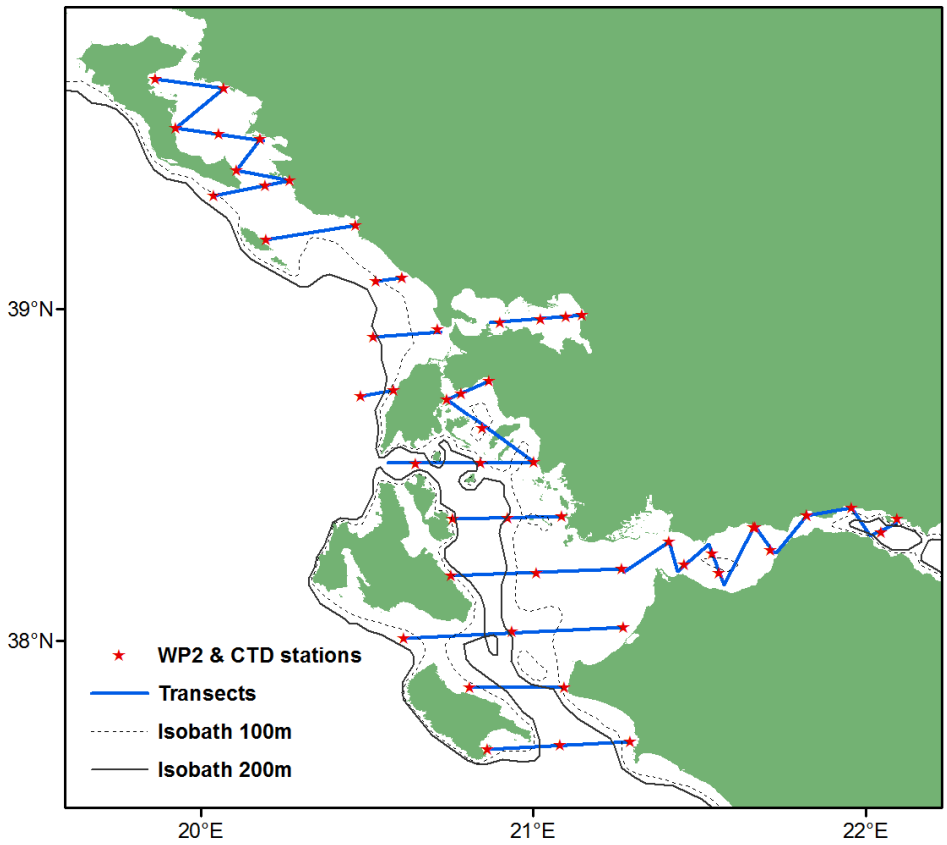


Figure F1. Map of the survey area and the survey design in GSA 20 at the Greek acoustic survey in 2015.

In addition, CTD measurements and zooplankton sampling were completed in 56 stations during the survey. The anchovy and sardine biomass were estimated to be 12055 t and 3456 t, respectively. The biomass distribution of each species is shown in Figs. F2 and F3. The length composition for anchovy and sardine are shown in Figs. F4 and F5.

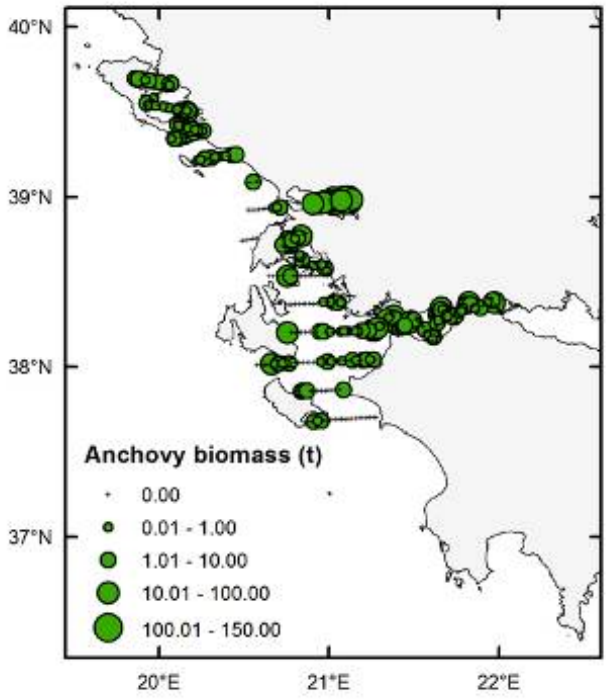


Figure F2. The distribution of anchovy biomass as estimated in the Greek Survey in 2015.

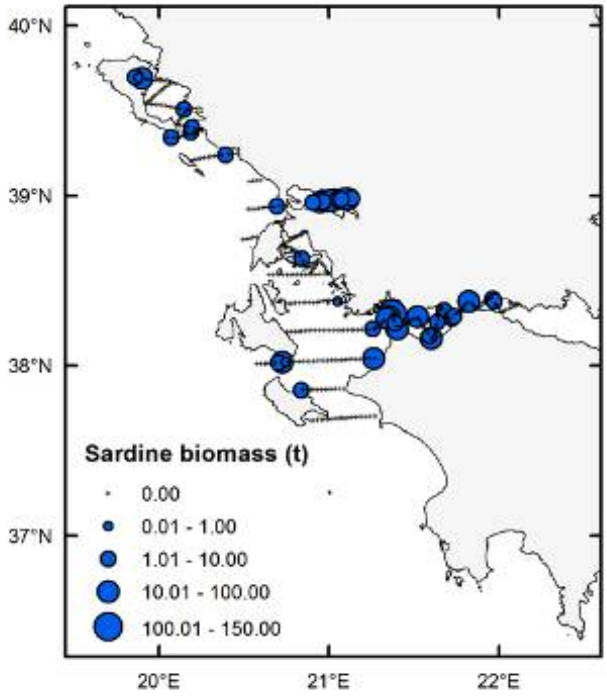


Figure F3. The distribution of sardine biomass as estimated in the Greek Survey in 2015.

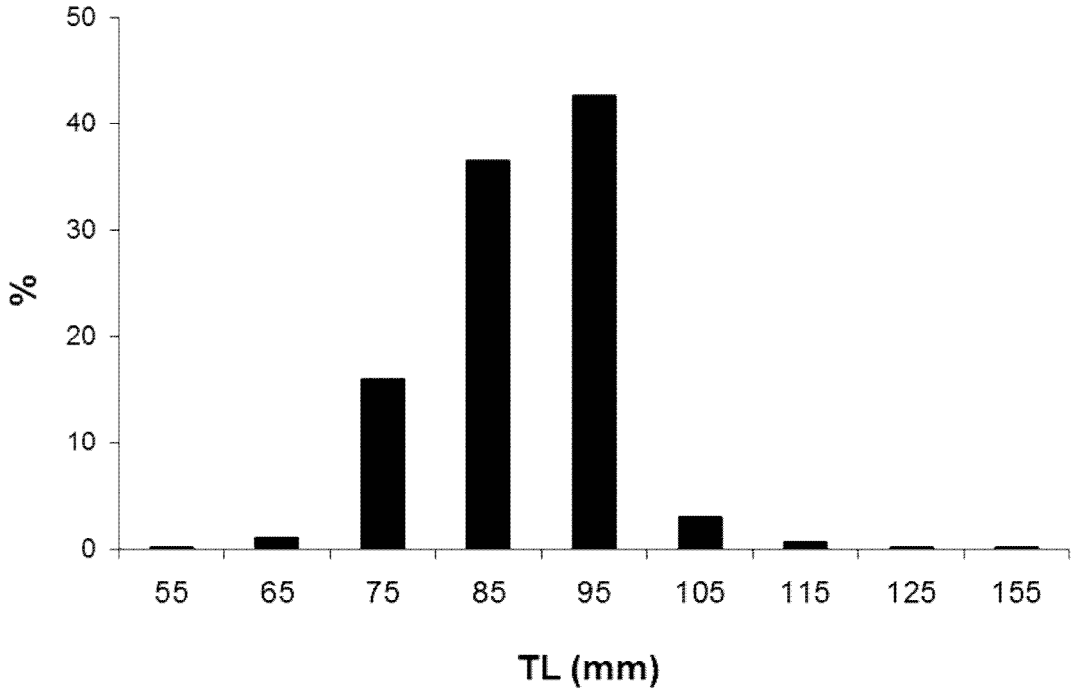


Figure F4. Length frequency distribution of anchovy catches during the survey in Greek Waters in 2015.

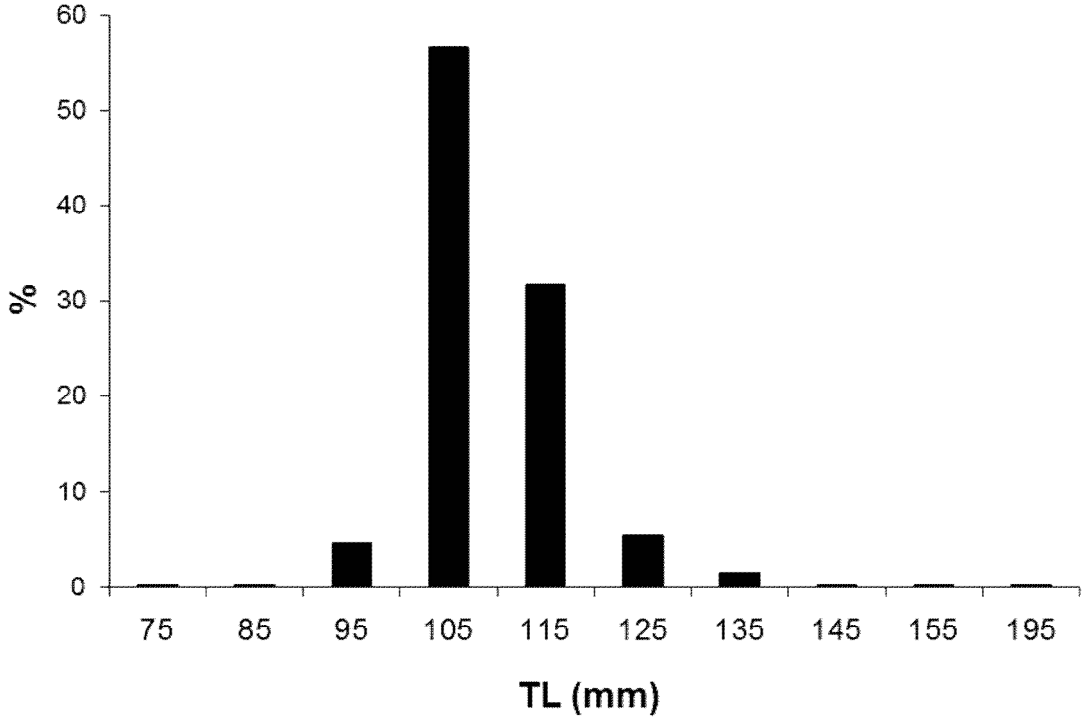


Figure F5. Length frequency distribution of sardine catches during the survey in Greek Waters in 2015.

g) Iberian acoustic survey in the GSAs 01 and 06 (Magdalena Iglesias, Ana Ventero, Joan Miquel, Dolores Oñate, Pilar Córdoba)

The MEDIAS 2015 acoustic survey was carried out in the Mediterranean Spanish waters from 23 June to 22th July 2015 on board the R/V "Miguel Oliver" (70 m long). Acoustic data were collected over 1316 nautical miles (nmi), corresponding to 1014 nmi to the GSA06 and 302nmi to the GSA01 GFCM geographical sub-areas. Forty (40) pelagic hauls were carried out in GSA06 and 15 in GSA01 to scrutinize the echograms (Fig. G1) and 88 CTD stations were performed in GSA06 and 30 in GSA01.

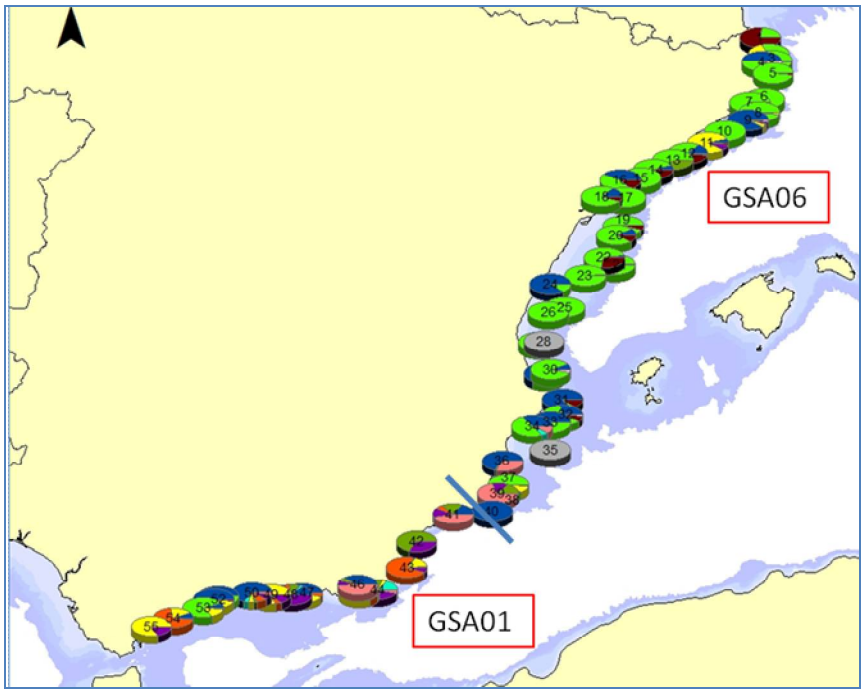


Figure G1. Map of the survey area and situation of the pelagic hauls carried out during the Spanish acoustic MEDIAS survey in june-july 2015.

Biomass (tons) (Figs. G2 & G3) and abundance (nº individuals) of sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) were estimated by GSA, being the most abundant species in the covered area. The fish pelagic community detected includes sardinella (*Sardinella aurita*), sprat (*Sprattus sprattus*), horse mackerel (*Trachurus trachurus*, *T. mediterraneus* and *T. picturatus*), bogue (*Boops boops*) and spanish mackerel (*Scomber colias*).

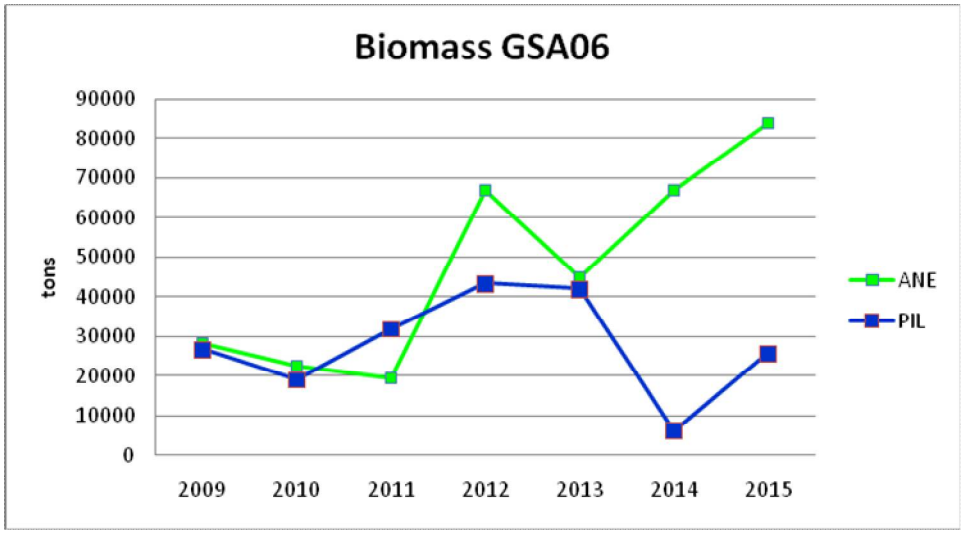


Figure G2. Anchovy (ANE) and sardine (PIL) biomass (tons) in GSA 06 in the period 2009-2015.

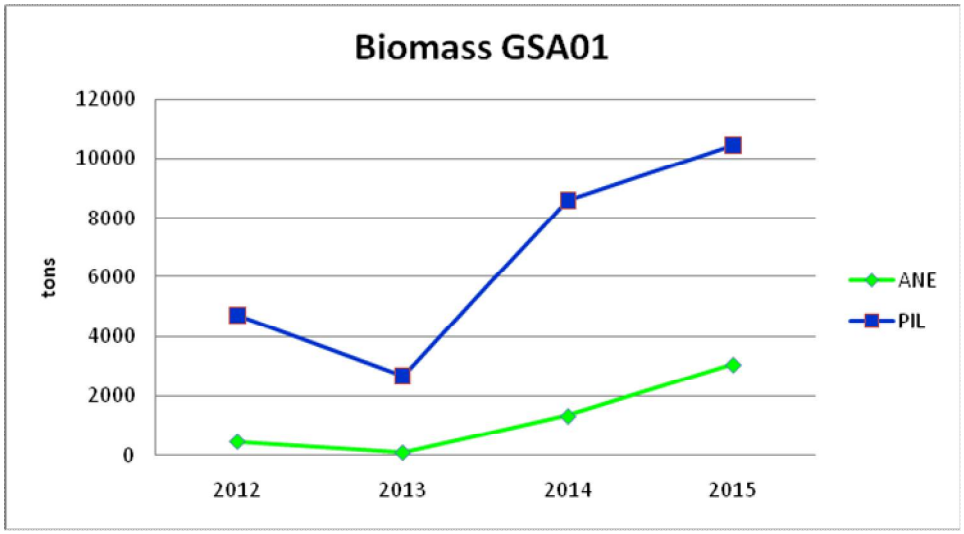


Figure G3. Anchovy (ANE) and sardine (PIL) biomass (tons) in GSA 01 in the period 2012-2015.

Age was estimated for sardine and anchovy by counting growth rings on the otoliths and age-length key calculated (Fig. G4 & G5).

Sardine recruitment detected in GSA06 in 2015 was higher than sardine recruitment detected in 2014, being similar to the recruitment detected in the 2010 acoustic survey (Fig. G6).

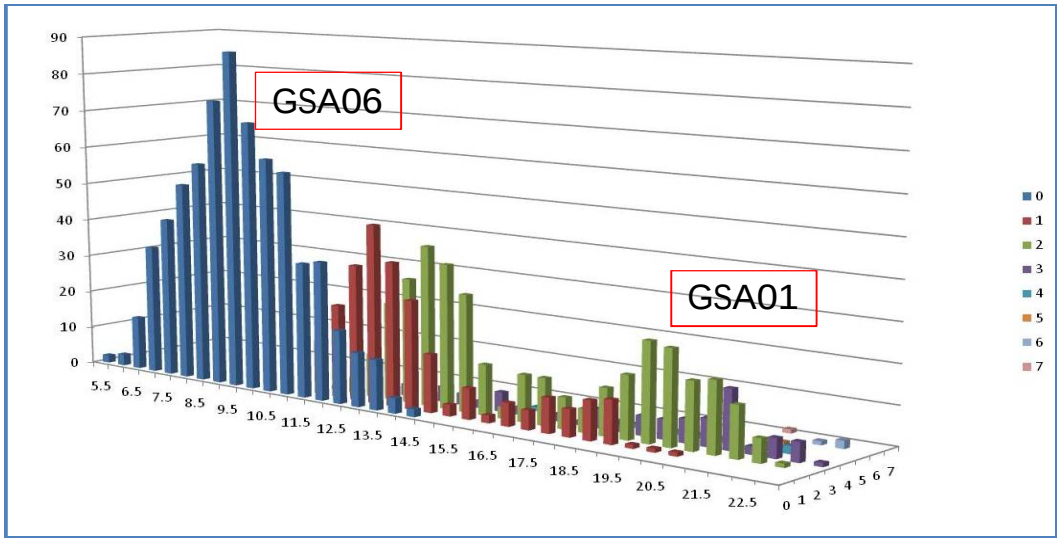


Figure G4. Sardine age-length key in MEDIAS 2015 in GSA06 and 01.

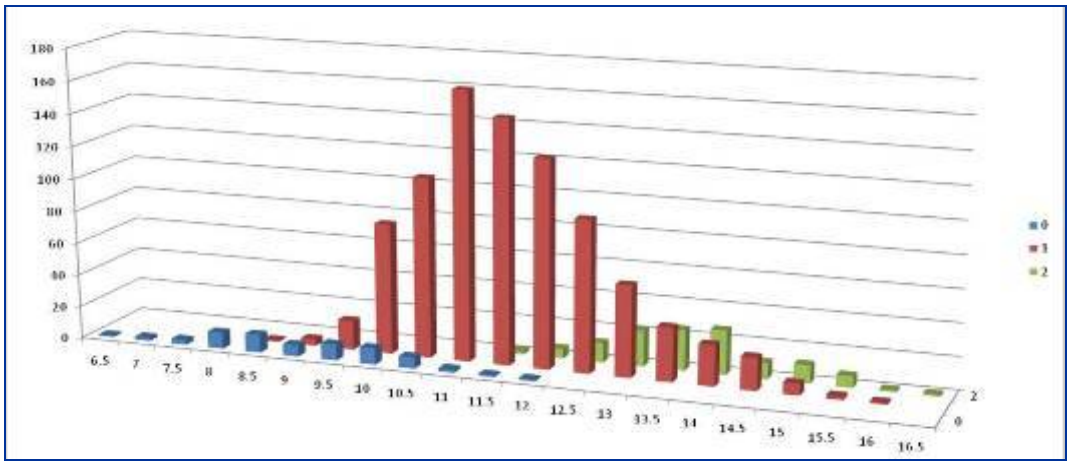


Figure G5. Anchovy age-length key in MEDIAS 2015 in GSA06 and 01.

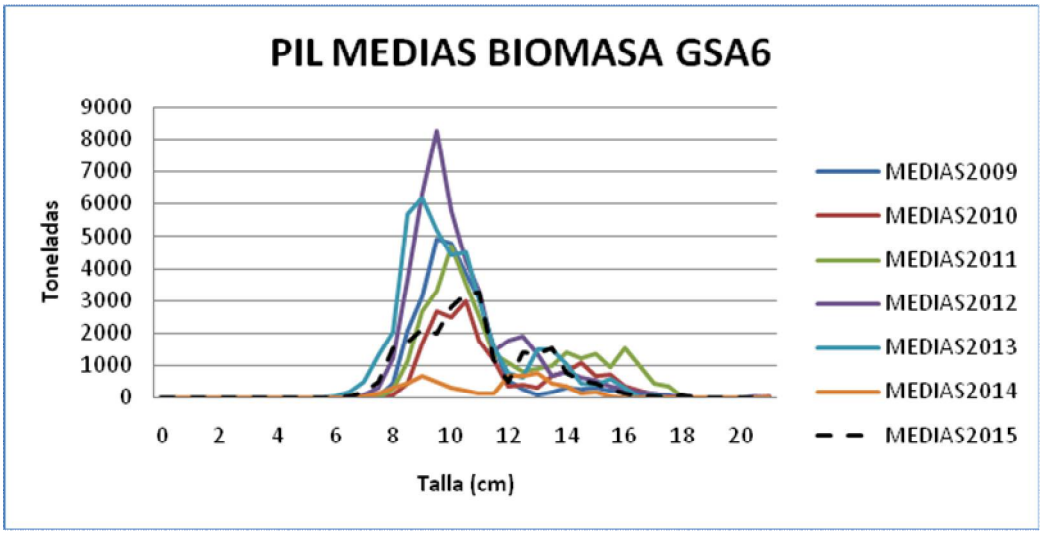


Figure G6. Sardine (PIL) abundance in GSA06 detected during the MEDIAS 2015 acoustic survey in summer in the period 2009-2015. 2015 sardine recruitment (black dash line).

h) **Pelagic Surveys at the Romanian Black Sea Littoral** (Valodia Maximov, George Tiganov Tiganov)

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. Taken into account the evolution of the marine fisheries in the last 25 years, the structure of the vessels in the fleet in the last 4 - 5 years (with small size - more than 90% and low technological investment per fishers), generally using traditional fishing techniques, for subsistence or local, small markets, limited infrastructure for landing and keeping of catches, research, management, and monitoring, we can considered as being small-scale/artisanal fisheries. 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.

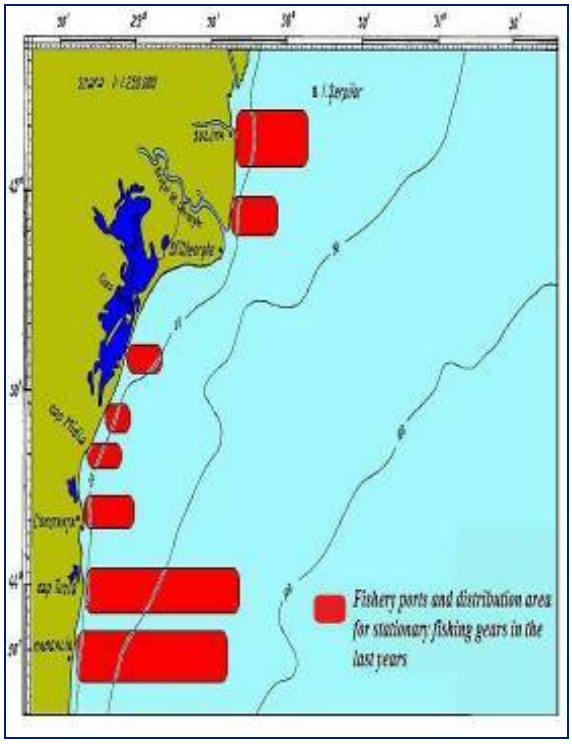


Fig. I1 Fishery ports and distribution area for stationary fishing gears

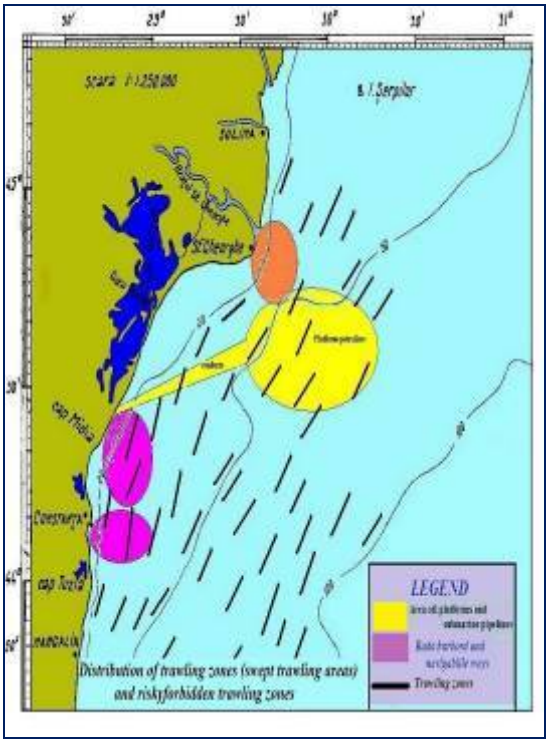


Fig. I2 Distribution of trawling zones

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 (Figs. I1 and I2).

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.

Qualitative and quantitative structure of catches

During 2000-2013 periods, the level of total catch declining from 2476 tons to 444 tons (2008), 330 tons (2009), 258 tons (2010), 568 tons (2011), 835 (2012) 1,712 tons (2013), 2.231 tons (2014) and 4.825 tons (2015), official registered (Fig. I3). In period 2011 – 2015, the total catches increased compared to the previous period due to the rapa whelk catches. The main species in the 2015, catches have been: rapa whelk (4,460 tons / 92.02 %, of total catches); anchovy (112 tons); sprat (110 tons); turbot (31 tons); horse mackerel (14 tons); shad (22 tons) and gobies about 24 tons (Fig. I4).

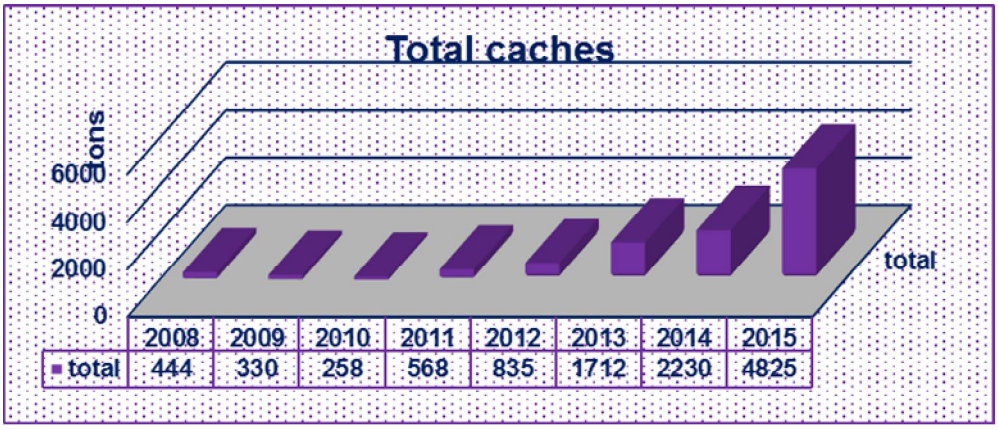


Fig. I3 Total catches and structure on species at the Romanian littoral

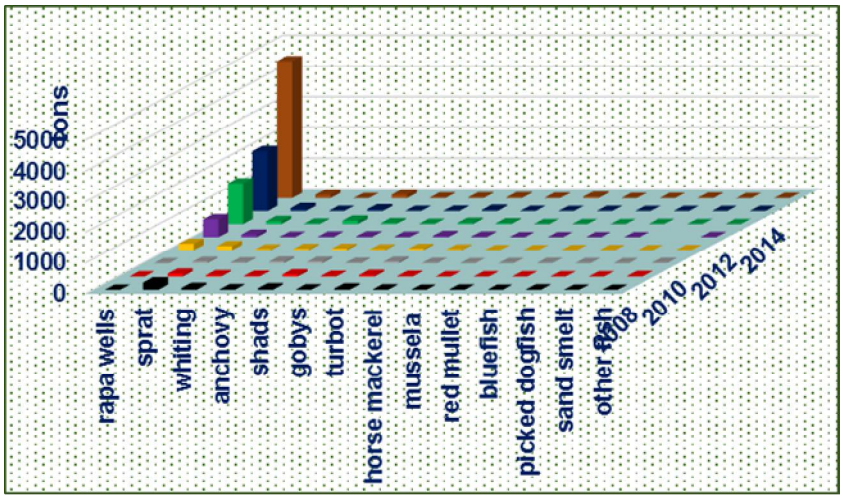


Fig. I4 Total catches and structure on species at the Romanian littoral, during 2008 - 2015

Survey 2015:

- ♦ period: 07 – 14 June and 11 - 21 November 2015
- ♦ 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 32 ÷ 30; drepth 30.3 - 62.1 m; trawl speed 3.2 knots; time trawling 30 min; catch 50 – 2,000 kg.

Estimated total biomass:

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

Spring - in the **31** sample trawlings made with the pelagic trawl, on a surface of **2,725** Nm², the average values of the catches were of about **4.75 - 24.21** t/Nm². The maximum value was recorded in the Chituc -Constanta (0-30 m), Sf. Gheorghe (0 - 70 m) and Cap Tuzla (30-50 m) sectors (Fig. I5 a). The estimated biomass for sprat crowds, in the research a area, was of about **48,903 to**.

Assessment of sprat agglomerations (tons), in June 2015, Romanian area

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	625	1125	975	2725
Variation of the catches (t/ Nm^2)	24.2	0.25-28.37	0.074-24.46	0.074-28.37
Average catch (t/ Nm^2)	24.2	12.33	4.75	9.78
Biomass of the fishing agglomerations (t)	15125	13871.25	4631.25	26650.5
Biomass extrapolated the Romanian shelf (t)				**48,903**

Autumn - in the **30** sample trawlings made with the pelagic trawl, on a surface of **1,775** Nm², the average values of the catches were of about **0.40-16.24** t/Nm² (Fig. I5 b). The maximum value was recorded in the Sf. Gheorghe - Cap Tuzla (50 - 70 m) sectors. The estimated biomass of about **24,832 t**.

Assessment of sprat agglomerations (tons) in November 2015, Romanian area

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	625	900	250	1775
Variation of the catches (t/ Nm^2)	0.0-1.67	0.0-22.04	3.21-46.31	0.0-46.31
Average catch (t/ Nm^2)	0.402	3.395	16.24	4.97
Biomass of the fishing agglomerations (t)	251.25	3055.5	4060	8821.75
Biomass extrapolated the Romanian shelf (t)				**24,832**

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

Spring - sweeping area procedures were conducted on an surface of 2**,725** Nm². The average values of whiting catches, were situated in the limits between **0.646 - 0.841** t/Nm². It revealed that whiting had a flat distribution in large area between Constanta – Vama Veche (**0.0-1.08** t/Nm² / depth 30 - 50 m, respectively **0.0–3.27** t/Nm² / depth 50 - 70 m (Fig. I6 a). Estimated biomass for the Romanian platform about **3,505** t.

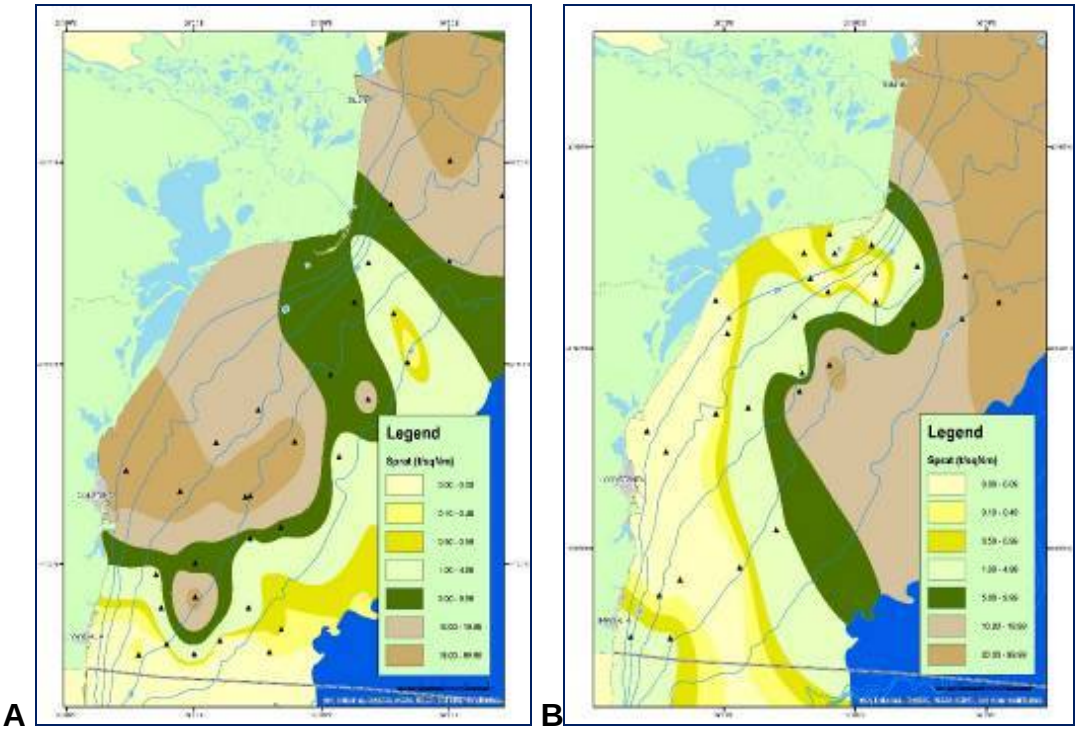


Fig. I5 The distribution of the sprat agglomerations in the spring (A) and autumn (B) period, pelagic trawl survey, Romanian area

Assessment of whiting agglomerations (tons), in June 2015, Romanian area

Depth range (m)	*0 – 30 m*	*30 – 50 m*	*50 - 70 m*	*Total*
Investigated area (Nm^2)	625	1125	975	2725
Variation of the catches (t/ Nm^2)	0	0.0-3.86	0.0-3.54	0.0-3.86
Average catch (t/ Nm^2)	0	0.646	0.841	0.701
Biomass of the fishing agglomerations (t)	0	726.75	819.975	1910.225
Biomass extrapolated the Romanian shelf (t)				**3,505**

Autumn - in the **30** sample trawlings made with the pelagic trawl, on a surface of **1,775** Nm^2, the average values of the catches were of about **0.04-1.31** t/Nm^2. The maximum value was recorded in the Cape Midia – Managalia sectors (50 - 70 m)(Fig I6 b). The estimated biomass for the whiting crowds, in the research area, was of about **1,328 tones**.

Assessment of whiting agglomerations (tons), in November 2015, Romanian area

Depth range (m)	*0 – 30 m*	*30 – 50 m*	*50 - 70 m*	*Total*
Investigated area (Nm^2)	625	900	250	1,775
Variation of the catches (t/ Nm^2)	0.0	0.0-0.06	0.0-2.47	0.0-2.47
Average catch (t/ Nm^2)	0.0	0.004	1.31	0.27
Biomass of the fishing agglomerations (t)	0.0	3.6	327.5	479.25
Biomass extrapolated the Romanian shelf (t)				**1,328**

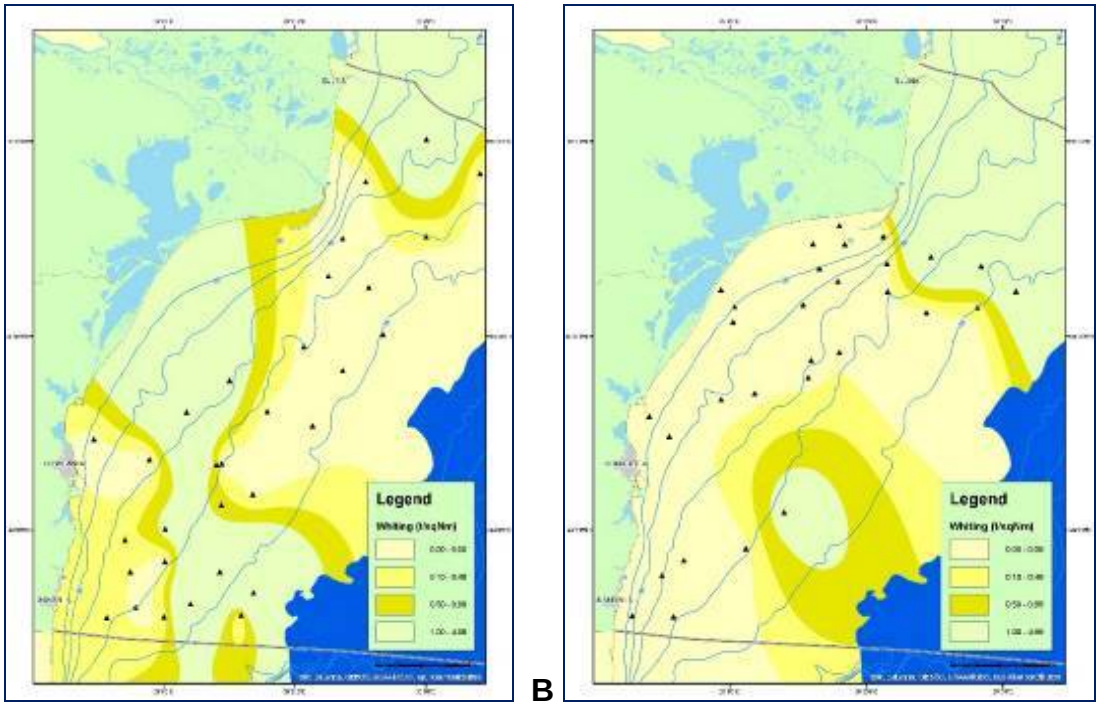


Fig. I6 The distribution of the whiting agglomerations in the spring (a) and autumn (b) period, pelagic trawl survey, Romanian area

c. *Squalus achanthias* (dogfish)

Spring - in the 31 sample trawlings made with the pelagic trawl, on a surface of **2,725** Nm², the average values of the catches were of about **0.331 – 1.161 t**/Nm². The maximum value was recorded in the Gura Portita-Cap Midia (30-50 m) and Constanta–Cap Tuzla (0–50 m) sectors (Fig. I7). The estimated biomass in the research area, was of about **1,657 to**.

Assessment of dog fish agglomerations (tons), in June 2015, Romanian area

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	625	1125	975	2725
Variation of the catches (t/ Nm^2)	0.0	0.0-2.33	0.0-1.16	0.0-2.33
Average catch (t/ Nm^2)	0.0	0.41	1.161	0.331
Biomass of the fishing agglomerations (t)	0.0	461.25	1131.975	901.975
Biomass extrapolated the Romanian shelf (t)				**1,657**

Autumn - in the 30 sample trawlings made with the pelagic trawl, on a surface of **1,775** Nm², the average values of the catches were of about **0.05 - 0.105** t / Nm². The maximum value was recorded in the Perisor – Cap Midia (50-70 m) sectors. The estimated biomass for the dogfish crowds, in the research area, was of about **244 t**.

Assessment of dog fish agglomerations (tons), in November 2015, Romanian area

Depth range (m)	***0 – 30 m***	***30 – 50 m***	***50 - 70 m***	***Total***
Investigated area (Nm^2)	625	900	250	1,775
Variation of the catches (t/ Nm^2)	0.0	0.0-0.77	0.0	0.0-0.77
Average catch (t/ Nm^2)	0.0	0.105	0.0	0.05
Biomass of the fishing agglomerations (t)	0.0	94.5	0.0	88.75
Biomass extrapolated the Romanian shelf (t)				**244**

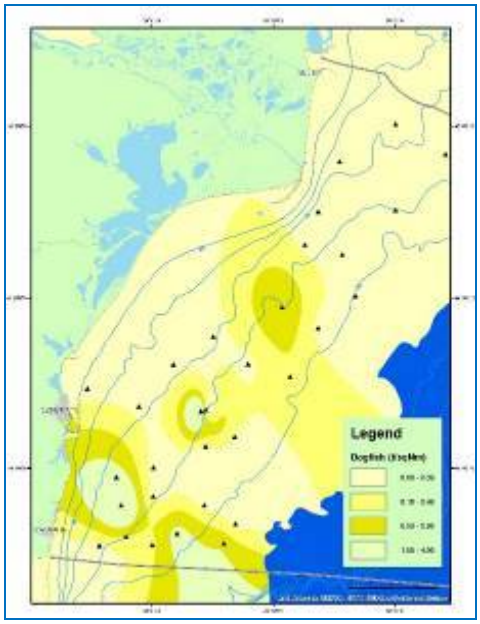


Fig. I7 The distribution of the dog fish agglomerations in the spring period.

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.

Qualitative and quantitative structure of catches

During 2000-2013 periods, the level of total catch declining from 2476 tons to 444 tons (2008), 330 tons (2009), 258 tons (2010), 568 tons (2011), 835 (2012) 1,712 tons (2013), 2.231 tons (2014) and 4.825 tons (2015), official registered (Fig. I3). In period 2011 – 2015, the total catches increased compared to the previous period due to the rapa whelk catches. The main species in the 2015, catches have been: rapa whelk (4,460 tons / 92.02 %, of total catches); anchovy (112 tons); sprat (110 tons); turbot (31 tons); horse mackerel (14 tons); shad (22 tons) and gobies about 24 tons (Fig. I4).

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, 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. I8).

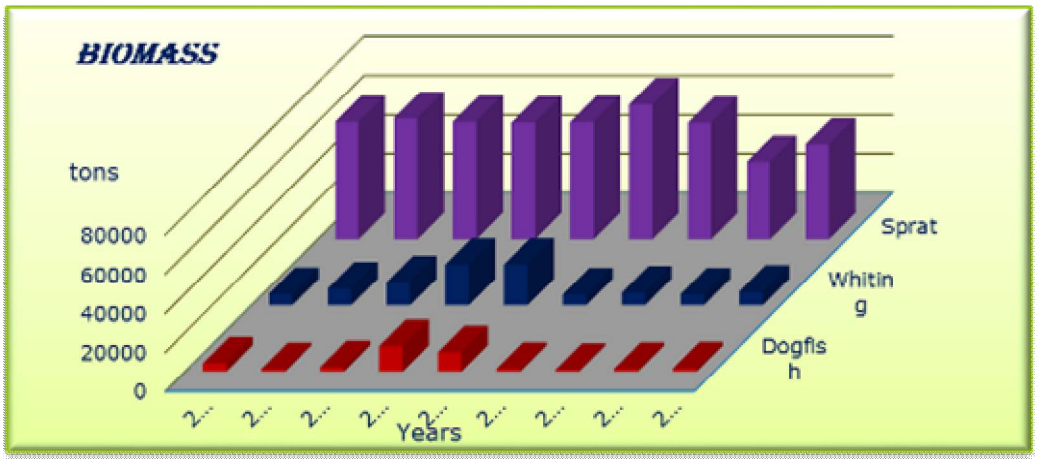


Fig. I8 The agglomeration biomass of the main species from Romanian littoral

i) **Echosurveys on small pelagics in GSAs 9 and 10** (Angelo Bonanno, Gualtiero Basilone, Simona Genovese, Rosalia Ferreri, Marco Barra)

In the Italian waters, echosurveys on small pelagics are regularly carried out only in the northern sector of the Sicily Channel (GSA 16) and the western part of the Adriatic Sea (GSAs 17 and 18) since 2009 as part of the National Data Collection Program on Fisheries (EU Reg. 199 / 2008). For the year 2015, the echosurvey in the GSAs 9 and 10 was funded by the Italian Ministry of Agriculture, Food and Forestry in the framework of the European Maritime and Fisheries Fund (EMFF) Reg. (UE) n. 508/2014, through a specific contract entitled "Estensione della Campagna acustica Medias (Mediterranean International Acoustic Survey) nelle sub aree geografiche 9 (Mar Ligure e Mar Tirreno settentrionale) e 10 (Mar Tirreno centrale e meridionale) per l'annualità 2015".

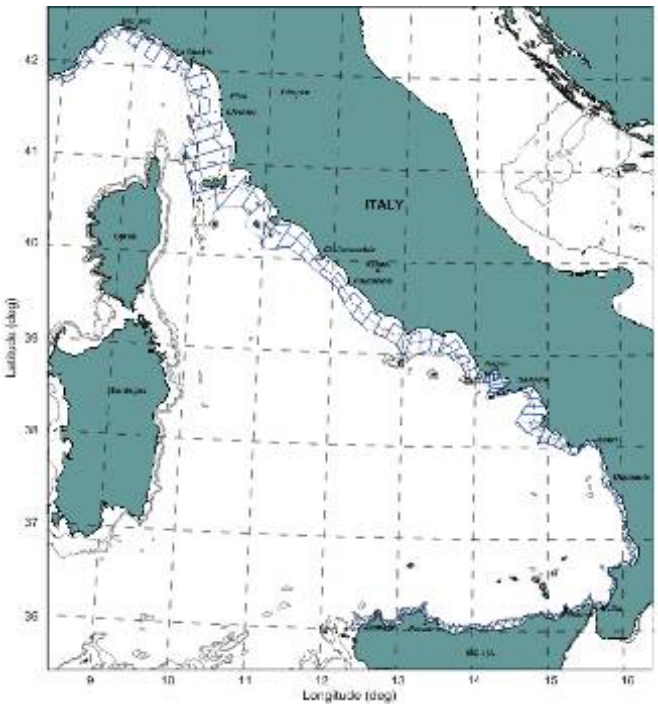


Figure J1. Map of the survey design in GSAs 9 and 10 adopted during the survey in 2015.

The survey was carried out in the period 1 – 27 August 2015. The track length was 1900 NM for a surveyed area of about 6600 NM^2. During the survey, 47 trawl hauls were performed and 270 CTD casts were collected with a SBE 911 plus multiparametric probe.

The spatial distribution of both anchovy and sardine confirmed the previously observed different patterns for the two species with anchovy more abundant in the GSA 10, while bigger sardine biomass was observed in the GSA 9.

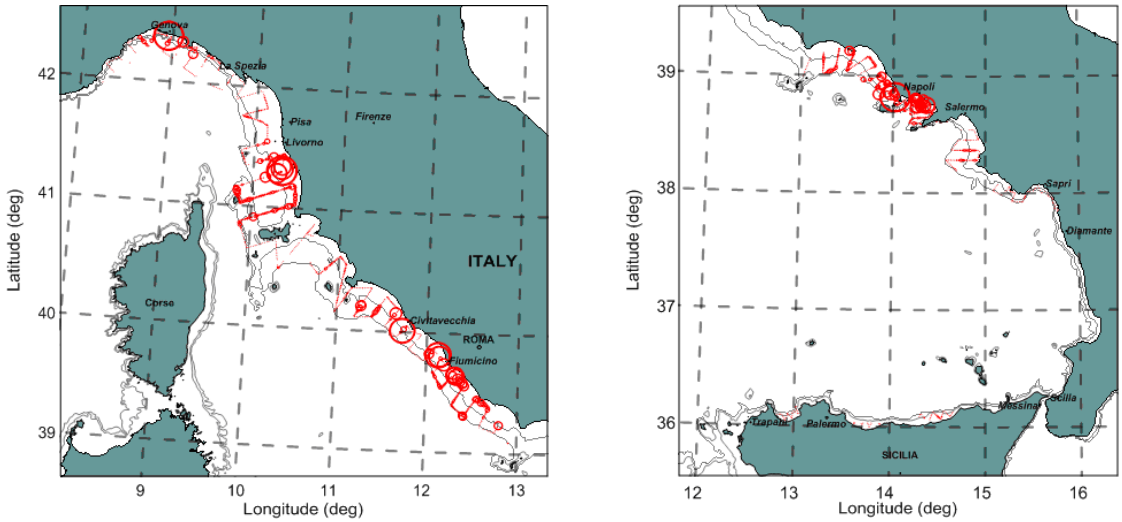


Figure J2. Spatial distribution of anchovy during the survey in 2015.

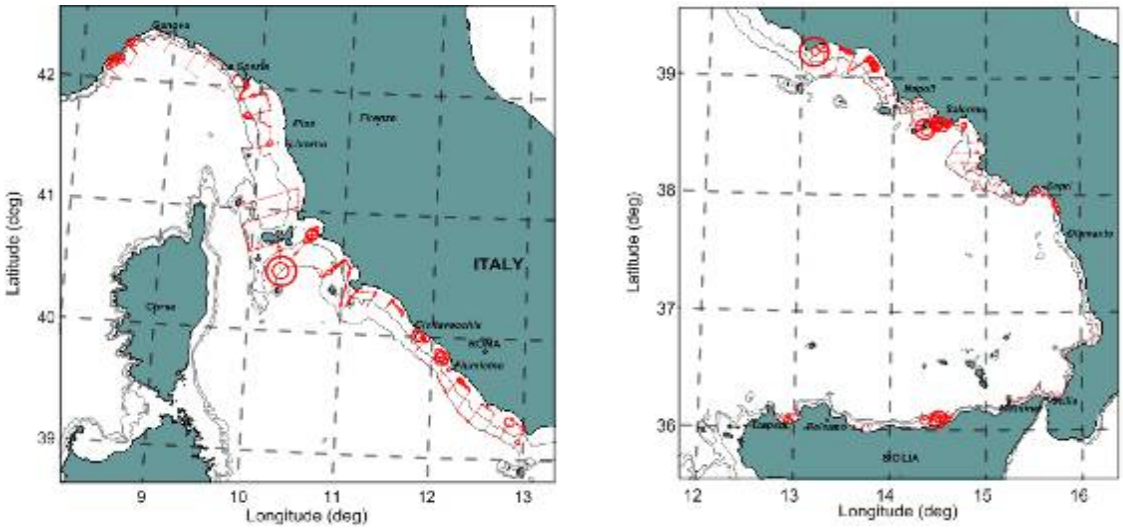


Figure J3. Spatial distribution of sardine during the survey in 2015.

In particular, in the GSA 10 the biomass of *Engraulis encrasicolus* was estimated to be 64951 t, while in the GSA 9 it was 41394 t. The *Sardina pilchardus* biomass was 60112 t in the GSA 9 and 25256 t in the GSA 10.

j) **Summary of the acoustic surveys conducted in Mediterranean Sea of Morocco** (Salaheddine El Ayoubi)

During the years 2014 and 2015, acoustic surveys for small pelagic assessment doubly covered the entire Moroccan coast: the Mediterranean stock, the northern Atlantic stock, the central Atlantic stock and the southern Atlantic stock. The first acoustic coverage was in prientemps and the second in autumn. Other acoustic surveys were conducted by foreign research vessel (Norwegian R/V Dr. Fridtjof Nansen and Russian R/V Atlantida), mainly on the small pelagic stock of the Southern Atlantic.

Concerning acoustic surveys in the Mediterranean sea in 2014 and 2015, they were carried out according to the same standardized 725 nautical miles track, consisting of transects perpendicular to the coast and spaced by 5 nautical miles. The indicators of the Mediterranean acoustic survey are summarized in the following table:

Table K1. Summary of the acoustic surveys in Mediterranean sea in 2014 and 2015

Survey	Date	Trawl stations	Hydro stations	Fish length	Biology
Spring 2014	17 may - 28 may	37	58	4 658	985
Autumn 2014	10 sep - 20 sep	27	54	2 960	616
Spring 2015	22 apr - 03 may	27	55	4 661	788
Autumn 2015	25 aug - 07 sep	29	45	5265	1 038

The acoustic prospection covered the small pelagic fish distribution area from 20 m to 300 m depth. The echograms were collected only during the day, by two Simrad split beam echosounders operating at 38 and 120 kHz frequencies. The echosounders were calibrated before the start of the surveys, in addition to the transducers, propeller and water intakes were thoroughly cleaned. The acoustic data were analyzed and processed using Echoview software and the post-processor BI500.

Fishing operations were carried out regularly to serve the identification of echo traces and collect biological data needed to study the conditions of reproduction, growth and feeding. Studies of the physico-chemical and biological oceanography were performed in parallel according to a specific sampling plan.

On the other hand, samples of small pelagic fish were collected and transfered to the various laboratories of the INRH for further studies in acoustics, bio- ecology and ecotoxicology.

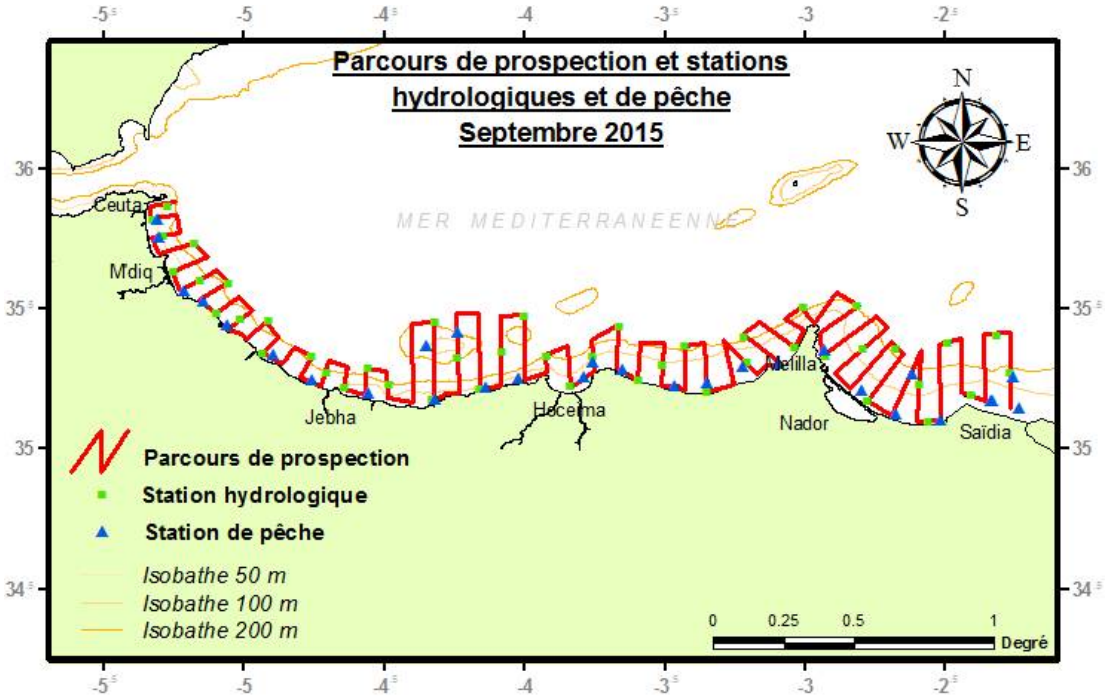


Figure K1. Acoustic track with trawl and hydrological stations of the autumnal Mediterranean survey

During the MEDIAS meeting, were presented maps the spatial distribution of small pelagics and the results of biology and indices of biomass and abundance. Main results of last mediterranean survey show a decrease in sardine biomass against an increase of horse mackerel resources and a high occurence of jellyfish, likely caused by the high SST.

Workshop on CV estimation

Following the discussions held during the last two meetings about a common procedure for CV estimation, during the 2016 meeting the procedure based on geostatistical simulations (GS) was applied on different dataset in order to evaluate the CV in different areas. In particular, the procedure was applied on anchovy densities (t/NM^2) running an R script based on gstat package in the following areas: Strait of Sicily (2006 year, GSA16), Patraikos-Corinthiakos subarea (2015 year, GSA20), South-western Adriatic Sea (2013 year, GSA 18), Spanish waters (2009 year, GSA06). In all considered areas the survey design was characterized by regularly spaced transects perpendicular to the line coast, except for Greek waters where a zigzag survey design

was adopted based on the coastline morphology. In the following table, the obtained results for each considered area are reported.

Results obtained in different areas using geostatistical simulation for CV estimation.

Country	GSA	year	Subarea	Sampling design	Intertransect distance (NM)	Total investigated area (NM2)	Total biomass from GS (tons)	CV (%)
Greek	20	2015	Patraikos-Corinthiakos	Zig-zag		301	1045	23
Spain	6	2009		Parallel transects	4 - 8	4598	25318	11
Italy	16	2006		Parallel transects	5	2113	6172	10
Italy	18	2013	South-western Adriatic sea	Parallel transects	8 - 10	2510	80620	14

Obtained results were finally discussed. All participants agreed that proposed procedure could be adopted to obtain a CV estimates explicitly accounting for spatial autocorrelation, but some of them (not familiar with R) indicated possible problems due to lack of skill in using a R script based on gstat package for that purpose.

Furthermore, the procedure provided a set of auxiliary information that could be reported highlighting specific aspects about the spatial aggregations of investigated species such as distribution maps and variogram ranges and sill.

Workshop on the workflow by CNR-ISMAR powered up by multifrequency approach

The workflow implemented by CNR-ISMAR of Ancona for acoustic survey data analysis is composed by several blocks performing different operations on the above mentioned data. The first block averages the data with the resolution of 1 ping x 20 cm (horizontal x vertical) and cleans the data that are above the surface exclusion line and below the bottom exclusion line. In this way further calculations and region automatic identification can be much quicker. The second block removes the background noise (default settings) and applies a threshold of -60 dB to layers with highly probable plankton presence, while other aggregations (mostly fish schools) are treated at -70 dB, in order to avoid school erosion. The third block separates the sparse targets by the aggregated targets (schools and layers). The first group will undergo a resampling

at a resolution of 4 pings x 1 m and the following frequency comparison will be done at this resolution. The second group is made up of many regions (schools and layers detected by the operator and partly automatically) and the following frequency comparison will be made on the mean value at the different frequencies for each region.

Two frequency comparisons are made in the workflow: 120/38 kHz (Rule A) and 200/38 kHz (Rule B). Both rules have to be satisfied to keep the density relative to a region or non-aggregated target. The dB difference interval relative to Rule A in case of pelagic fish with swim bladder is -12 --- +3 dB; this interval was obtained in the '90s through specific experiments, consulting also literature on this subject. The more recent introduction of the 200 kHz frequency and the availability of new results on multifrequency analysis allowed the definition of a dB interval for Rule B (200/38 kHz) as -10.5 --- +3 dB. In particular the results of SIMFAMI Project (SIMFAMI report, 2005) relative to *Engraulis encrasicolus*, *Sardina pilchardus* and *Trachurus trachurus* were combined to derive a more general interval relative to small pelagics with the swim bladder. The dB difference interval already in use by CNR-ISMAR for 120/38 kHz was found to be quite similar to what reported in the SIMFAMI report. The introduction of the comparison 200/38 kHz slightly improved the multifrequency filtering of ISMAR workflow, without modifying significantly fish density estimation.

Essential habitat of small pelagic fish: first results of the Ecological Niche Modelling and lessons learnt from the tuna and hake habitat analysis (Druon J.N.)

European Commission – Joint Research Centre, Maritime Affairs Unit, Ispra (VA), Italy
Contact email: jean-noel.druon@jrc.ec.europa.eu

NASC data in the Adriatic sea: Vjekoslav Ticina and Iole Leonori.

The stocks of small pelagic fish species (anchovy, sardine) show high and unexplained variability likely related to the major influence of environmental covariates on the recruitment and growth. Understanding the dynamics and spatial distribution of these species are therefore crucial for management, and also because spatial variability governs the definition of management units and stocks. An ecological niche modelling (ENM) approach was developed to model the suitable habitat for top predators (tuna species, fin whale) and recruits (hake) and is now adapted to the small pelagic species. The ENM was built linking knowledge on the species ecological traits (e.g. temperature tolerance, mobility, feeding and spawning strategy) with patterns of selected environmental variables (e.g. chlorophyll-a fronts and concentration, sea surface current and temperature, sea surface height anomaly) to highlight favourable feeding and spawning habitats. The environmental variables are derived from daily remote

sensors (Modis-Aqua and SeaWiFS for surface chlorophyll-a content) and from observation-assimilated ocean models (EU Copernicus - MyOcean for physical variables).

The presentation described the methodology on how the environmental envelope is derived and a very preliminary analysis using NASC data from the Adriatic. The limited seasonal coverage (September only) prevented from deriving the envelope for that region although anchovy and sardines were shown to be attracted by productive frontal features of similar characteristics than one of their main predator, the Atlantic bluefin tuna. The major findings of the recent work done on the habitat of Atlantic bluefin tuna and European hake were also presented notably as regards to the methodology.

The two main recommendations gathered during the meeting on the use of acoustic data were:

- use of daily data only so that the near bottom school echograms do not substantially mix with zooplankton further up in the water column and the school energy is more comparable in space and time;
- define a minimum relative abundance level (to work on core habitat) using regional thresholds (by GSA or group of GSAs, to be defined) to take into account regional specificity (geomorphology, fish behaviour and expert analysis). The 95th percentile NASC by area may be used to normalize.

Seen the vicinity of school to the sea bed, bottom current velocity and bottom temperature will be tested as potential covariates that affect the distribution of sardine and anchovy.

The habitat modelling outputs were highlighted as key information to infer robust environmentally-driven stock-recruitment relationships, increase predictability of the stock assessments and improve Management Strategy Evaluations. Besides a growth (feeding) and recruitment (spawning) index for stock assessment by stock unit, habitat outputs may also serve as information for dynamic management (e.g. incentive to protect nurseries in real time or to locally adapt the fishing effort to a recently detected environmental anomaly).

Data templates for collecting data on NASC abundance for anchovy and sardine as well as on eggs presence/abundance (for the characterization of spawning habitat) were sent to the MEDIAS conveners.

Research activities in the framework of MEDIAS and proposals for common studies and manuscripts.

Fish and plankton interactions at 38 kHz in Alborán Sea (Ana Ventero)

The interactions between fish and plankton echotraces at 38 kHz have been analyzed applying an experimental co-existence index in order to determinate the influence of

the plankton community in the echograms scrutinizing process and, as extension, in the small pelagic stock assessment.

The main ecological groups that compose the pelagic ecosystem are the pelagic fish community and the plankton community, and both coexist in the water column. This ecological behavior can affect negatively the echogram scrutinizing process as long as plankton hinder the properly detection of fish schools.

The study area, located in the southeastern part of the Spanish Mediterranean Sea, included the Gulf of Vera and the Alborán Sea continental shelf, from 25 to 200 m depth. Acoustic data were collected during the MEDIAS Spanish surveys following the common MEDIAS protocol. To detect the schools affected by the plankton layer, an experimental co-existence index based on the schools and plankton depth was applied by depth intervals as follow: **If the $Min\_depth_{school} > Max\_depth_{plankton\ layer}$,** the school was considered affected by the plankton layer.

In the study area the interaction between fish and plankton was depth dependent and most of the fish schools found between 50 and 75 meters were affected by the plankton layer (**Figure 1**), so it was necessary generate a virtual echogram in order to separate fish and plankton to improve the scrutinizing process.

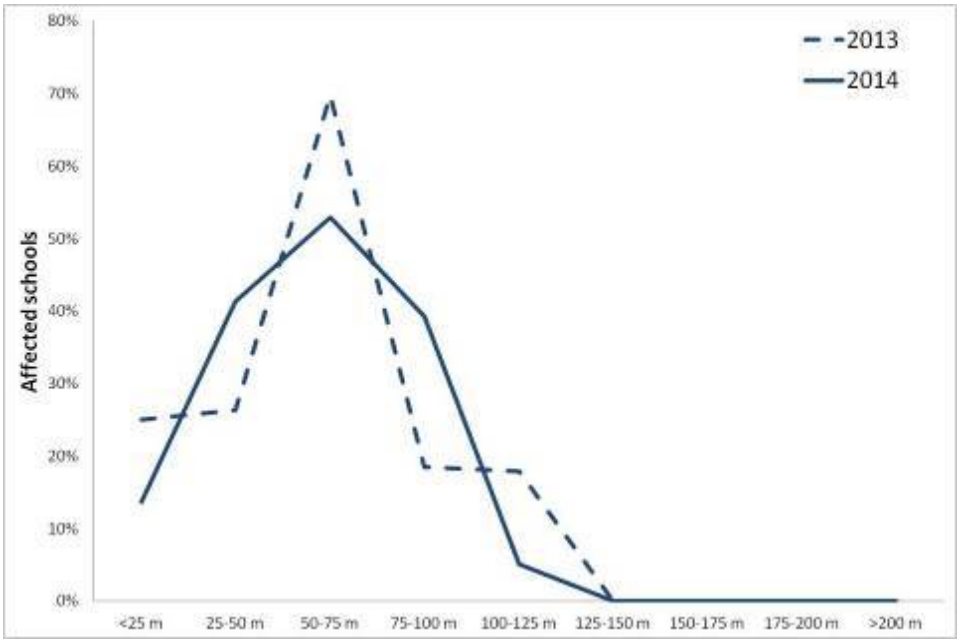


Figure 1: Percentage of affected schools by the presence of the plankton layer.

Bottom editing and schools close to the bottom: ideas for a common protocol of analysis (Iole Leonori, Andrea De Felice, Giovanni Canduci)

Bottom editing is a routine pre-processing analysis performed in order to define the boundary near the bottom of the integration region in an echogram; this is a time consuming process that need expert scrutinizers.
In some areas dense schools close to the bottom with a strong Sv threshold could be confused with rocks, or the contrary.
The "White Line" is a tool within ER60 & EK80 software intended as a support to discriminate between fish and rocks close to the bottom, the algorithm works bleaching pings under the sounder detected bottom line (Figure 1).

"*While seabed-following algorithms are reasonably reliable, even the best of them fail sometimes. If there are fish close to the seabed, the user may wish to minimize the safety margin (or back step) needed to exclude the seabed echo. This increases the risk of some seabed returns being wrongly identified as fish. A casual inspection of the echogram may not be sufficient to detect this problem.*
One method of finding occasional near-surface or seabed values that are invalid (i.e. not fish) is to integrate narrow layers at these boundaries, ***using high thresholds*** *that exclude most (but not all) of the fish traces.*"
(pag. 337 *in* ***Simmonds E.J. and MacLennan D.N. 2005. Fisheries Acoustics (Blackwell Publishing, Oxford). 437 pp.,***)

The right way to deal with school of fish is well summarized in Reid D. G. 2000 Report on Echo Trace Classification, ICES cooperative research report N° 238, where authors suggest to put -60 dB threshold for school classification.
In our experience white line algorithm fails quite easily as the sounder detected bottom fails with fish close to the seabed; manual bottom editing is the right way to deal in such situations. A right way to proceed following literature is to analyse data with a processing software (Figure 2) and proceed as follow:

- **Put a severe threshold:** fish disappear or is visualized in a different colour respect to the bottom increasing threshold (Figure 3);
- **Increase the range to visualize second bottom echo:** second bottom echo is a good check for the quality of your signal to noise ratio, only very strong echo are present here i.e. the bottom, if it appears as a continuous flat line, no rocks are there on the bottom (Figure 4);
- **Changing colour palette:** Simrad EK80 have a 140 dB dynamic range, this means that you are able to receive very weak and very strong echoes, each colour represent a 3 dB (12 colours) or 0.5 dB strength (64 colours) so that you can easily find the colour palette much suitable to separate targets in your area (Figure 4).

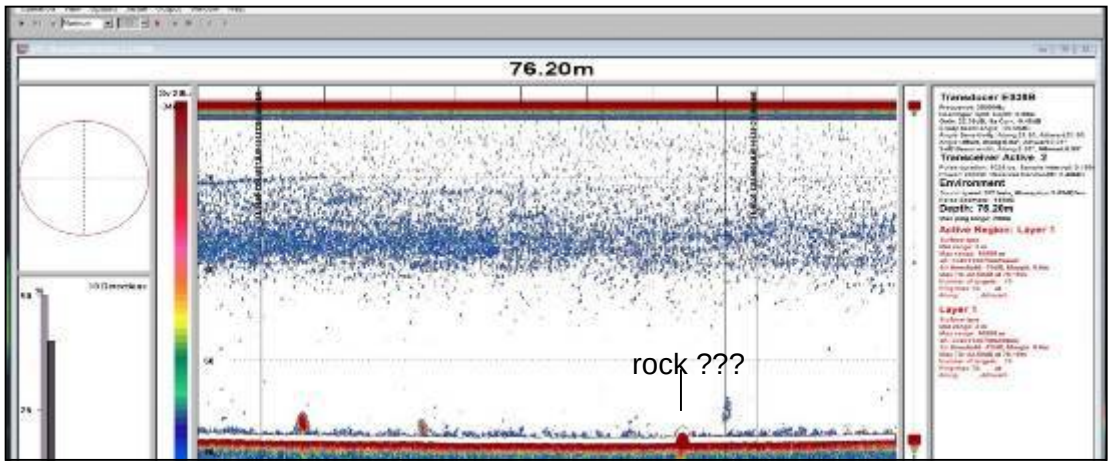
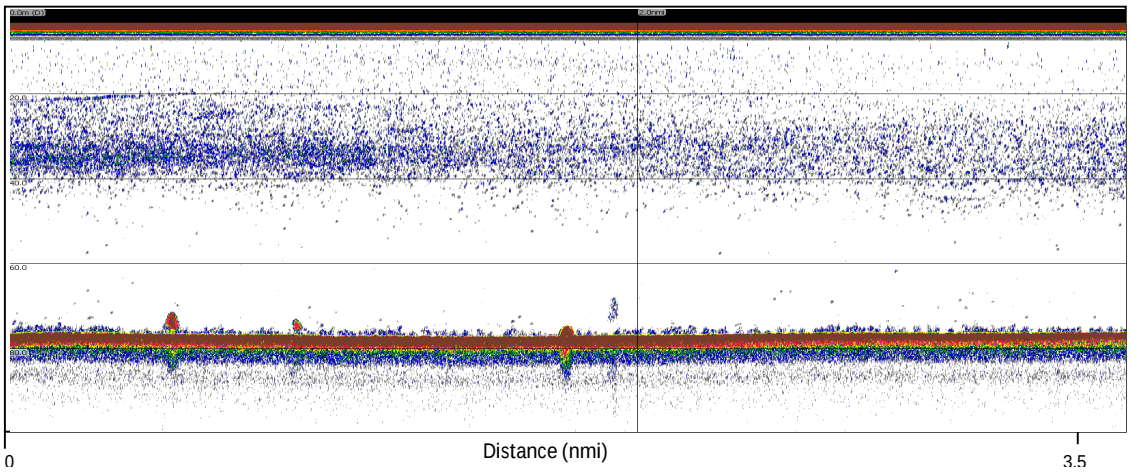
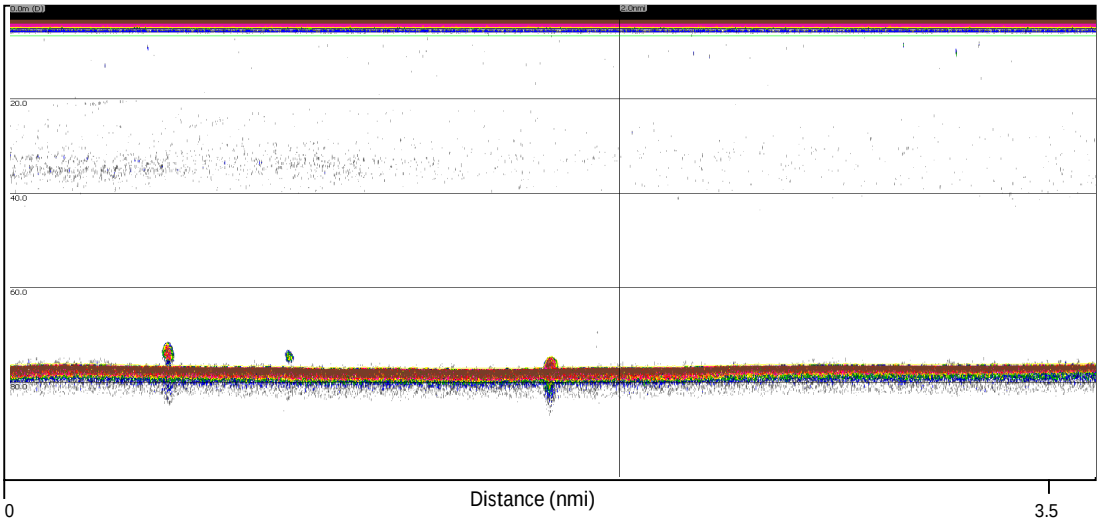


Figure 1: The white line tool considers the third school as a rock



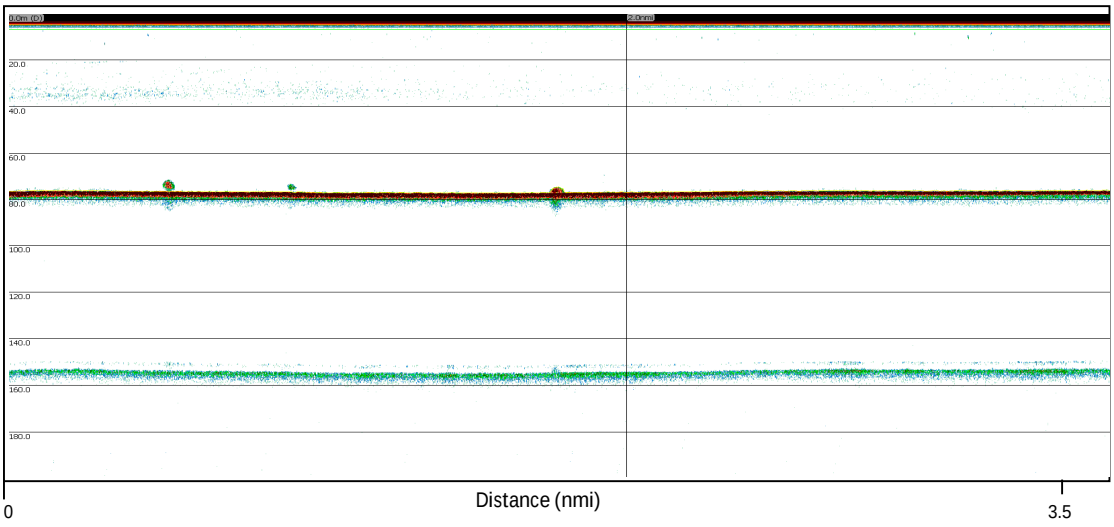
Area	Date	Time	Speed (kn)	Scientific name	%kg	lenght (cm)	dB
Adriatic Sea			9.5	*Rock???*			-70

Figure 2: The same raw data as above in the postprocessing software Echoview



Area	Date	Time	Speed (kn)	Scientific name	%kg	lenght (cm)	dB

Figure 3: Increasing threshold level to **-**60 dB puts in evidence a difference between the bottom signal and the fish school



Area	Date	Time	Speed (kn)	Scientific name	%kg	lenght (cm)	dB
Adriatic Sea			9.5	*Rock???*			-60

Figure 4: Visualization of the second bottom echo and change of colour palette shows a strong constant echo from the bottom, while the dense fish school signal is much weaker

In figure 5 it is reported an example of the subtraction of energy from school near the bottom from the white line tool that were object of pelagic trawling with 100 % pelagic catch and no damage to the net, as to say no rocks on track.

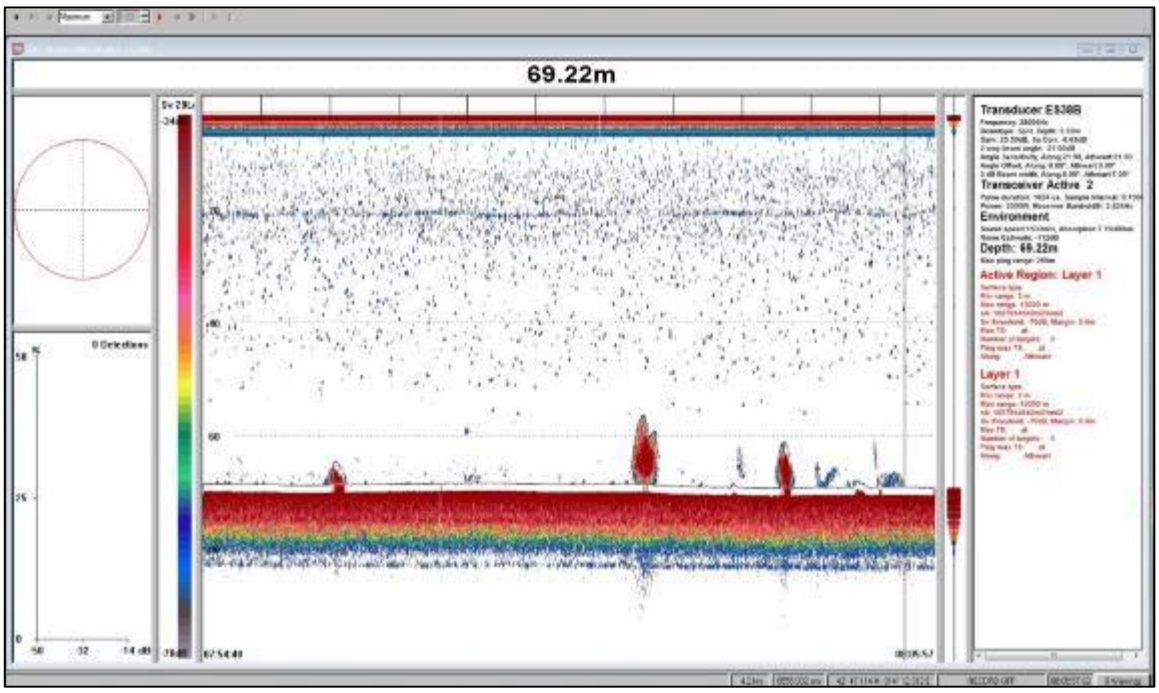


Figure 5: White line tool subtraction of energy from school near the bottom (the red colour in the white strip) that were object of pelagic trawling with 100 % pelagic catch and no damage to the net

In conclusion, according to us the white line or similar automatic bottom detection tools have not to be used as the only instrument to separate/identify schools and the bottom.

In case of dense echo-traces on the bottom, -60 dB threshold should be applied, also looking at the secondary echo in the most problematic cases.

Terms of Reference for the "MEDIAS 2017"

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;
- To carry out a specific workshop on plankton removal using the multifrequency analysis;
- To complete the EchoR workflow (in the joint meeting with WGACEGG);
- To update the progress of work on the estimation of CV in a standardized way;
- 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;
- To define a common format for the presentation of survey results.

Discussion, conclusions and decisions of the MEDIAS Steering Committee

In the 9th MEDIAS meeting the results of the acoustic surveys carried out in 2015 were presented by participants of the seven countries working in MEDIAS: Spain, Greece, Italy, Malta, France, Slovenia and Croatia. Moreover, results from the surveys carried out in 2015 by Romania in the Black Sea, by Morocco in the Mediterranean sea in 2014 and 2015, and by CNR-IAMC in the GSAs 9 and 10 (Ligurian and Tyrrhenian seas) were also presented.

For what concerns the standardization of the acoustic surveys in the Mediterranean sea, it is well known how important is to be able to harmonize the periods of the surveys. During the first MEDIAS coordination meeting it was agreed that the acoustic surveys will cover the major anchovy stocks during the spawning period (June to September, 2nd -3rd quarter).
In this context, and taking into account this agreement, Andrea De Felice explained that the decision of CNR-ISMAR to anticipate the GSA 17 WEST survey is based on the following considerations:

- In 2014, after extensive discussions, the General Fisheries Commission for the Mediterranean (GFCM) adopted the Recommendation GFCM/38/2014/1, amending Recommendation GFCM/37/2013/1, and on precautionary and emergency measures for 2015 on small pelagic stocks in the GFCM GSA 17. In line with such Recommendation, the Commission suggested that technical elements for the management of small pelagic fisheries in the Adriatic Sea be addressed during the next intersessional period, with the aim to (among others):
  - Identify gaps and evaluate ways to strengthen the working methodology when performing acoustic surveys. Thus, propose alternatives to reduce the amount of time between the acoustic survey and the availability of data for stock assessment;
  - Identify gaps and needs on scientific data and evaluate the way forward to obtain a complete stock assessment of sardine and anchovy for the whole Adriatic Sea (i.e. including GSA 18).
- In 2015 the General Fisheries Commission for the Mediterranean (GFCM) adopted the Recommendation GFCM/39/2015/1 establishing further precautionary and emergency measures in 2016 for small pelagic stocks in the Adriatic Sea (GSA 17 and GSA 18):
  - RECALLING that the SAC has considered that the stocks of anchovy and sardine are distributed in GSA 17 and GSA 18;
  - NOTING that hydroacoustic surveys have the potential of providing latest biomass estimates and their results can support management decisions;

- ADOPTS in conformity with the applicable relevant provisions of the GFCM Agreement that (among others).
- The SAC shall propose alternatives to make the results of the hydroacoustic surveys of the previous year available during the first month of the year.

Keeping in mind the above mentioned recommendations, the best way to fulfil these requests was to concentrate the period of the surveys, given the fact that for management purposes one stock of anchovy and one stock of sardine are in GSAs 17 and 18. In order to fulfil this advice, in a large area as Adriatic Sea (15700 mni^2) there are not many alternatives to anticipate the GSA 17 acoustic survey and to conduct in the same period of GSA 18 acoustic survey that was already done in June-July.

Moreover in the last report of the GFCM Working Group on Stock Assessment of Small Pelagic species (WGSASP 2015 point 56d pag. 37, 2015 available on the GFCM Website) there is the clear indication that information from the acoustic surveys of the current year are welcome and should pass necessarily through this WG in order to be of use and could be utilized for short term forecasting. Again, there is no other way to present results by end of November than to perform the survey in June-July.

In the past, GSA 18 (WEST or EAST+WEST depending of the year) was covered mainly in June while GSA 17 WEST was covered in September. The new scheme adopted by CNR-ISMAR thus increases a lot the overall timing of coverage of a wide area avoiding limiting as much as possible bias caused by north south migration. Moreover, in June and July weather conditions are much better on average than in September when autumn storms are rather frequent in the Adriatic, this is not irrelevant given the fact that the large and completely unsheltered area that needs to be covered by the surveys.

In line with earlier acoustic surveys in GSA 17 WEST, IOF has been conducting the surveys always in September, not covering the entire GSA 17 EAST in the period 2011-2012 (due to financial constraints).

Although there cannot be a decision of imposing a change in the survey period to a member state, there are enough suggestions that this should be done, now that from a period where GSA 17 EAST and WEST were done in September and GSA 18 East and West in June-July, so with a 2-3 month gap, we have passed to a system where most of the surveys are anticipated to June-July.

IOF scientists explained that, after the period 2003-2014 in which Croatian and Italian surveys in the GSA 17 were harmonised (i.e. both surveys in September), since 2015 the colleagues from CNR-ISMAR have changed their survey period to June. Furthermore, it has been pointed out that because of very limited capacities (vessel and personnel availability) IOF cannot change the survey period from September to June-July. In case of IOF, both Croatian DCF surveys (i.e. MEDITS and MEDIAS) are carried out using the same research vessel (r/v BIOS DVA), while Italian r/v Dallaporta is used in MEDIAS and not for MEDITS.

An exhaustive discussion on the advantages and disadvantages of the standardization of the periods in the MEDIAS group took place. The Steering Committee proposed to have an exhaustive discussion on survey period during the next MEDIAS meeting.

During the Workshop on CV estimation some datasets were analysed. Obtained results were finally discussed. All participants agreed that proposed procedure could be adopted to obtain CV estimates explicitly accounting for spatial autocorrelation. However, some participants were facing with problems in using R script for that purpose.

The MEDIAS group made some steps in the development of the workflow for the analysis of the echograms. In particular, a procedure for the analysis of echograms with a multifrequency approach was presented and discussed. It was decided to continue the work on a common workflow for acoustic data processing and to discuss during the next MEDIAS meeting further aspects concerning the multifrequency analysis for plankton filtering.

As far as the use of the EchoR scripts is concerned, the Steering committee agreed on the opportunity to complete the EchoR workflow during the next joint meeting with WGACEGG and the next MEDIAS meeting.

After a general discussion on MEDIAS contributions for ecosystem descriptors for Marine Strategy Framework Directive, the participants decided to discuss such argument also in the next MEDIAS meeting and to evaluate the already proposed contributions.
The Steering Committee decided to submit to the next RCMMed&BS 2016 the proposal for a zooplankton sampling program to be carried out during MEDIAS surveys taking into account the importance of such study for the entire MEDIAS group not only for ecosystem indicators in the MSFD but also for increasing the accuracy and precision of biomass evaluation by avoiding zooplankton noise.

During the third day of the meeting the Acta Adriatica Journal was presented by Anita Marušić, which highlighted the aims and topics of the journal.

The colleagues from HCMR informed that the Simrad EK60 was operating during the surveys in Aegean and Ionian seas. The colleagues from CNR-ISMAR informed that the new system Simrad EK80 was working (together with the Simrad EK60) during the surveys in the Adriatic Sea.

For the calibration of acoustic instruments used during the MEDIAS, it was proposed to consider as reference the following new report:
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.
All the MEDIAS participants agreed on the use of such document.

The chairman pointed out that the next WGACEGG-MEDIAS joint meeting is scheduled for the period 14-18 November 2016 in Capo Granitola. In particular, the MEDIAS participants will take part to the first three days of the meeting (from Monday 14th to Wednesday 16th November) while the colleagues from WGACEGG will continue their work also on Thursday 17th and Friday 18th.

Some research activities were proposed and discussed during the meeting. Moreover, the MEDIAS participants worked on a proposal for a special issue to be submitted to a scientific journal, and that may collect scientific contributions from all the countries in the Mediterranean and in the Black Sea. As first hypothesis, it was proposed the following theme for the Hydrobiologia Journal: "Environmental and biological factors influencing pelagic communities in different areas of the Mediterranean and Black sea". The following "*Rationale for choosing the theme sessions / focus topics"* was discussed*:*

A. Advances in basic knowledge of small pelagics populations through the Mediterranean acoustic surveys

- Behavior of Small Pelagic Fish

Fish school structure and school morphology depending on the species, ontogenetic changes in schooling and possible area or seasonal differences. Also, diel vertical migration by means of acoustics, vertical and temporal distribution of small pelagics.

- Life history traits of small pelagic fish species

MEDIAS Project protocol include systematic, biological sampling by means of pelagic trawls, allowing to build an extended dataset on biological features (i.e., age and growth, spatial distribution, reproductive status, body conditions, etc.). This huge amount of data, available in several areas of the Mediterranean and Black Sea, permits to improve our knowledge on several aspects linked to ecology and biology of fish species. Studies carried out on the life history of the most important pelagic fish species showed the high variability of these populations. Strong environmental gradients and habitat variability appeared determinant not only on stock distribution and abundance, but also on reproductive potential as well as on survival of early life

stages (eggs and larvae) and recruitment. The effort on standardizing sampling and analysis, carried out from MEDIAS members, allows more accurate comparative studies both on life history traits and ecological aspects, providing the tools to evaluate different stock behavior in response to local environmental variability.

B. Environmental relationships driving small pelagic fish populations as derived by the Mediterranean acoustic surveys.

- Spatial structure and distribution of small pelagic fish in relation to environmental and oceanographic regimes in the Mediterranean Sea

Taking into account the ecosystem heterogeneity characterizing the Mediterranean Sea, the link between the spatial distribution of pelagic fish communities and environmental processes will be discussed under different points of view. Diverse environments may lead to different kind of fish assemblages in terms of both species composition and relative abundance. In the highly diverse Mediterranean Sea in terms of productivity environmental enrichment processes are known to affect the food resources concentration, strongly influencing the density level of some species and determining their availability for human consumption. Fishing is known to affect the abundance of the Mediterranean stocks, yet several studies show that other factors such as food compositions and climate variability also affect Mediterranean small pelagics fisheries production. For example, food "composition" can also favor the abundance and growth of certain species rather than others depending on their feeding preferences and strategy. At the same time the temperature increase in the Mediterranean Sea may favor species preferring warmer waters for their spawning (such as anchovy and round sardinella) compared to those preferring colder waters (such as sardine and sprat).
All these information can lead to a holistic view of the different environmental and biological components acting in this area, providing a good basis for the ecosystem approach to fisheries for small pelagics and the adoption of more effective management of the pelagic resources.

- The role of zooplankton in the pelagic environment: Spatial and temporal dynamics observed within the Mediterranean acoustic surveys

This session will give participants the opportunity to present the interaction between the spatial distribution of zooplankton aggregations and the aggregations of the pelagic fish community, observed during surveys, as well as to analyze zooplankton relationship with physical features of the aquatic environment. Attributes of the physical environment that are relevant to zooplankton dynamics include issues such as ecosystem productivity, salinity and temperature gradients as well as water masses dynamics and circulation processes.

A brief discussion was made about possible upgrade of the MEDIAS website (http://www.medias-project.eu) functionality. In particular, it was proposed to switch the website content management system (CMS) towards a more GIS oriented platform in order to share and publish spatially explicit information. As first step, it was proposed the publication of NASC fish maps, according to the data policy of each country.

Concerning the MEDIAS HANDBOOK, the MEDIAS group has been working on it, updating some subjects according to what was agreed during the meeting. An updated copy has been included in this report (Annex IV). It was confirmed that this handbook, as well as the MEDIAS website, will be updated and improved according to the outcomes and changes developed by the MEDIAS partners on an annual basis.

The Steering Committee elected as new chairman of the MEDIAS action Dr. Andrea De Felice from CNR-ISMAR.

The MEDIAS Steering Committee approved the Terms of Reference for "MEDIAS 2017".

Finally, the Steering Committee concluded for the 10th MEDIAS meeting to take place in Palma de Mallorca, Spain, in the period 4-6 April 2017.

Annex I: List of participants

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Vjekoslav Tičina	ticina@izor.hr	Croatia	IOF

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 9th MEDIAS Coordination Meeting (Mediterranean International Acoustic surveys)

Split, Croatia, 5-7 April 2016

Agenda

Tuesday 05/04/2016

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

09.30-09.50: Presentation of Croatian survey (Vjekoslav Tičina).

09.50-10.10: Presentation of the Adriatic survey (Iole Leonori, Andrea De Felice).

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

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

10.50-11.10: Presentation of the Gulf of Lion survey (Claire Saraux).

11.10-11.40: Coffee break

11.40-12.00: Presentation of Romania survey in the Black Sea (Valodia Maximov, George Tiganov).

12.00-12.20: Presentation of the echosurveys 2015 in the GSAs 15 and 16 (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri, Roberta Mifsud, Reno Micallef).

12.20-12.40: Presentation of the echosurveys on small pelagics biomass estimation in GSAs 9 and 10 (Angelo Bonanno, Gualtiero Basilone, Marco Barra, Simona Genovese, Rosalia Ferreri).

12.40-13.00: General discussion

13:00-14:30: Lunch break

14.30-15.00: Moroccan acoustic surveys in the Mediterranean sea (Salah El Ayoubi)

15.00-16.00: Essential habitat of small pelagic fish: first results of the Ecological Niche Modelling and lessons learnt from the tuna habitat analysis (Jean-Noel Druon)

16:00-16:30: Coffee break

16.30-17.00: Bottom editing (Andrea De Felice)

17.00-17.30: General discussion on MEDIAS contributions for ecosystem descriptors for Marine Strategy Framework Directive
MEDIAS website: comments, suggestions, approval.

Wednesday 06/04/2016

09:00-11.00: Workshop on the use of the EchoR scripts (Claire Saraux)

11.00-11.30: Coffee break

11:00-13.00: Workshop on common scripts to be adopted for the estimation of CV in a standardized way and the allocation of trawl catches on acoustic data.

13:00-14:30: Lunch break

14.30-16.00: Workshop on the workflow for the analysis of the echograms and, in particular, the aspects concerning the multifrequency analysis
Fish and plankton interaction at 38 kHz in the Alboran sea

16:00-16:30: Coffee break

16.30-17.30: General discussion and revision of the common MEDIAS protocol.

Thursday 07/04/2016

09:00-11.00: Proposal of new research activities in the framework of MEDIAS

11.00-11.30: Coffee break

11:30-11:40: Presentation of Journal Acta Adriatica

11:40-13.00: Discussion on proposals for common studies and manuscripts.
Election of a new MEDIAS chair.

13:00-14:30: Lunch break

14.30-16.00: Terms of reference for the next meeting (2017).

16:00-16:30: Coffee break

16:30-17:30: 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.

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**Day night sampling.

Country	Institute	Geographical area	Size of area	Duration of survey (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	FRIS/CNR-ISMAR	Adriatic Sea (Slovenia)	117 NM^2	1
Italy	CNR-ISMAR	Adriatic Sea (Italy)	13200 NM^2	40
Italy - Malta	CNR-IAMC/MSDEC-DFA	Sicily Channel	4300 NM^2	16
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
Romania	NIMRD "Grigore Antipa"	Black Sea	4300 NM^2	20

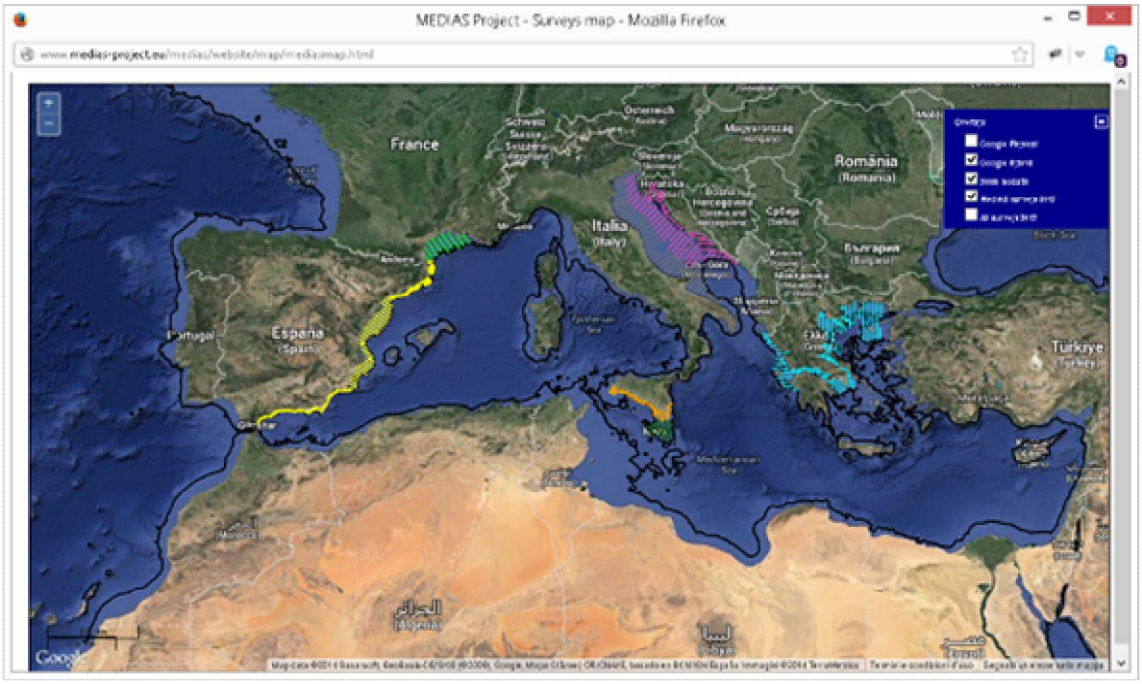

Figure 1: Surveys design in the MEDIAS.

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 70, 120 and 200 kHz can operate as complementary frequencies, depending on the research vessel used.

The pulse duration should be 0.5 or 1 ms depending on the technical specifications of each echosounder and it should be reported. 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 echosounder and according to the principles described by Foote *et al.* (1987). 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)	
Echosounder type	
Transducer serial no.	
Vessel	
Date	
Place	
Latitude	
Longitude	
Bottom depth (m)	
Temperature (^{o}C) at sphere depth	
Salinity (psu) at sphere depth	
Speed of sound (ms^{-1})	
TS of sphere (dB)	
Pulse duration (s)	
Equivalent 2-way beam angle (dB)	
Default TS transducer gain	
Iteration no.	
Time	
Range to sphere (m)	
Ping rate	
Calibrated TS transducer gain	
Time (GMT)	
RMS	
sA correction	

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 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, Myriax Echoview or alternative Movies + 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.

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 echosounder 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 biomass 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.

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 concluded 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.

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

10. Tables

The data and the common format of the Tables for 2015 Data Call, regularly provided to the DCF, are the following:

TABLE 1 - BIOMASS_medbs.xlsx

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

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

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. References

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.

Foote K.G., Knudsen H.P., Vestnes G., MacLennan D.N., Simmonds E.J. (1987). Calibration of acoustic instruments for fish density estimation: a practical guide. ICES Coop. Res. Rep. 144:82.

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)	70, 120, 200 depending on availability.
Pulse duration (ms)	0.5 or 1 ms, should be reported
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 NM
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, pies charts indicating biomass per species
Fish sampling	
Target species	Anchovy, Sardine
Other species	Biological data for all species in the pelagic

	community: Length-Weight relationships; Length distribution.
Fishing gear, codend mesh size	Pelagic trawl, Codend and trawl characteristics should be reported. Max Codend mesh size = 24 mm (side of mesh = 12 mm).
Vertical opening of the pelagic trawl	Should be reported
Netsounder used	Should be reported
Duration of haul	Minimum 30 min for unknown echoes
Time of sampling	Both daytime and night time biological samples from the same survey will be used.
Vessel speed during fishing	3.5 – 4.5 knots
Sampling intensity, no of hauls	The total number of hauls has to be adequate to • 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	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

The Common Database structure for Acoustics adopted in the 5th MEDIAS meeting.

The major fields agreed are 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. echosounder 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)

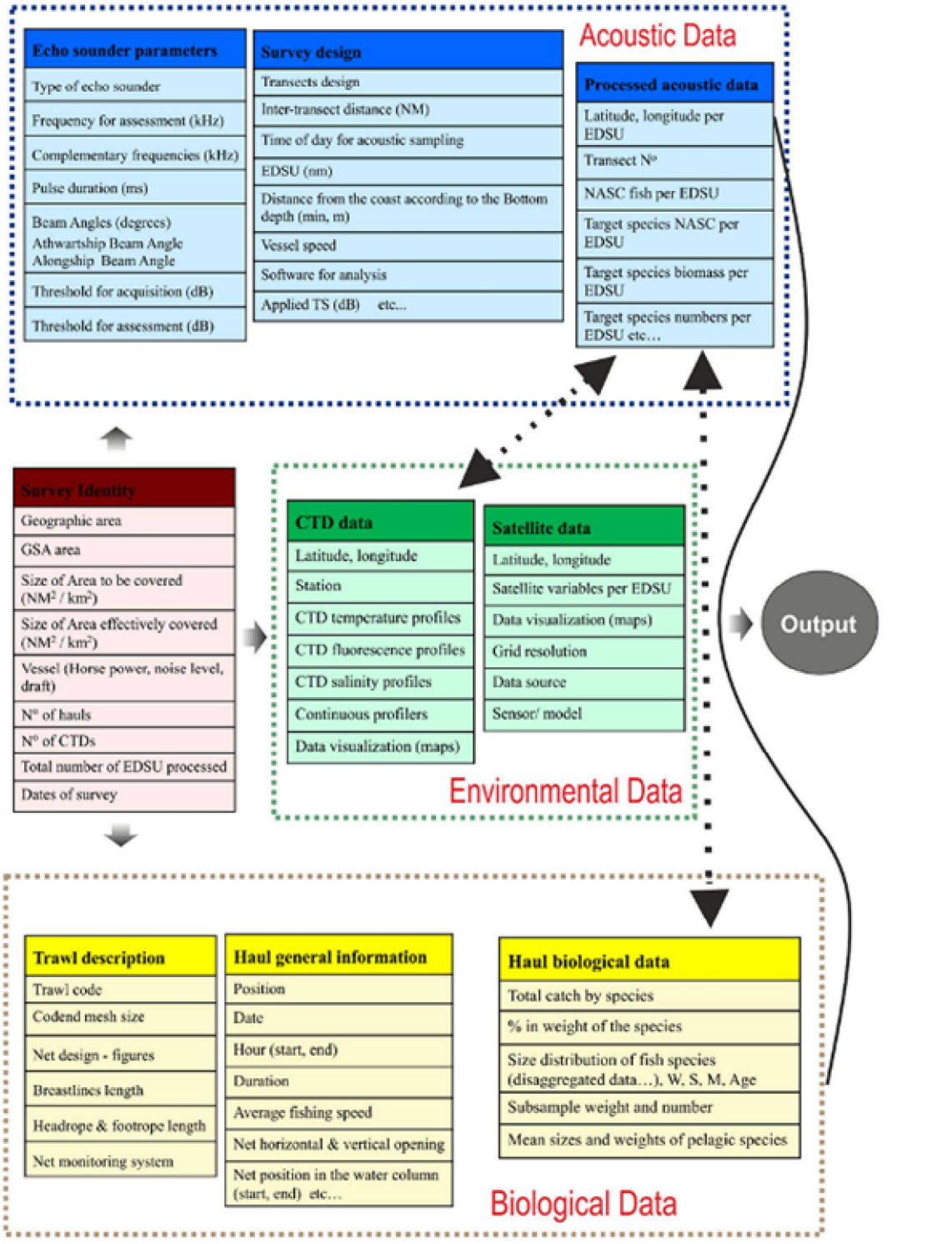

Figure B1. General outline of a database for acoustic surveys.

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

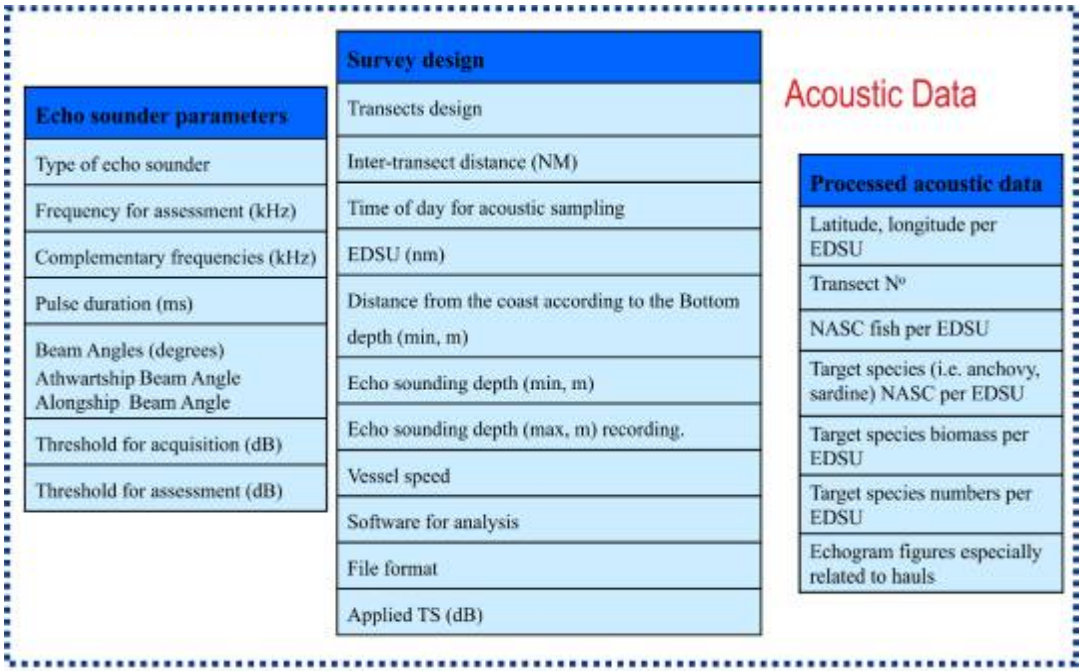

Figure B3. Fields associated with input info on Acoustic Data

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.

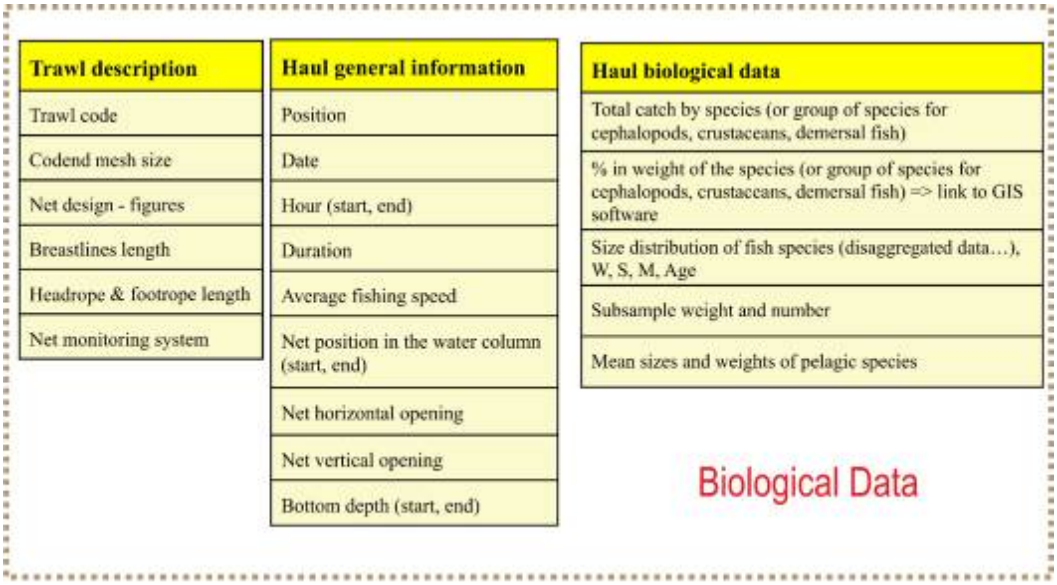

Figure B4. Fields associated with input info on Biological Data related to acoustic surveys

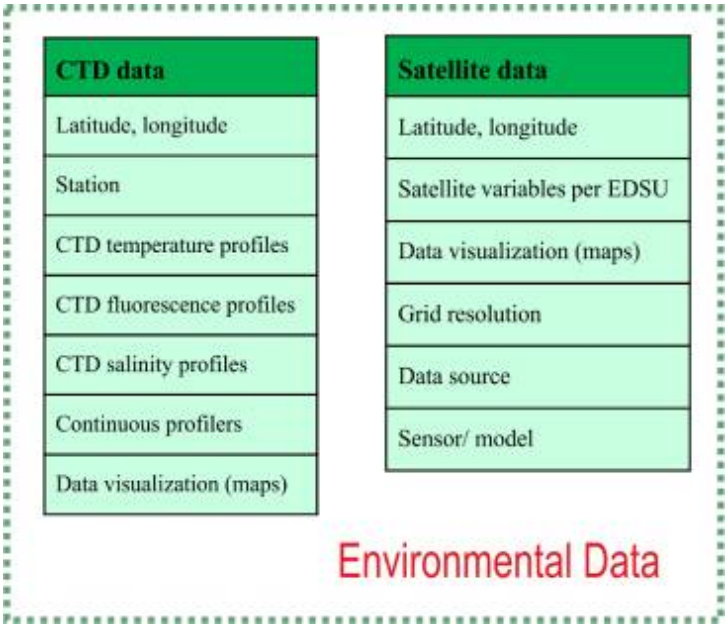

Figure B5. Fields associated with input info on Environmental Data related to acoustic surveys

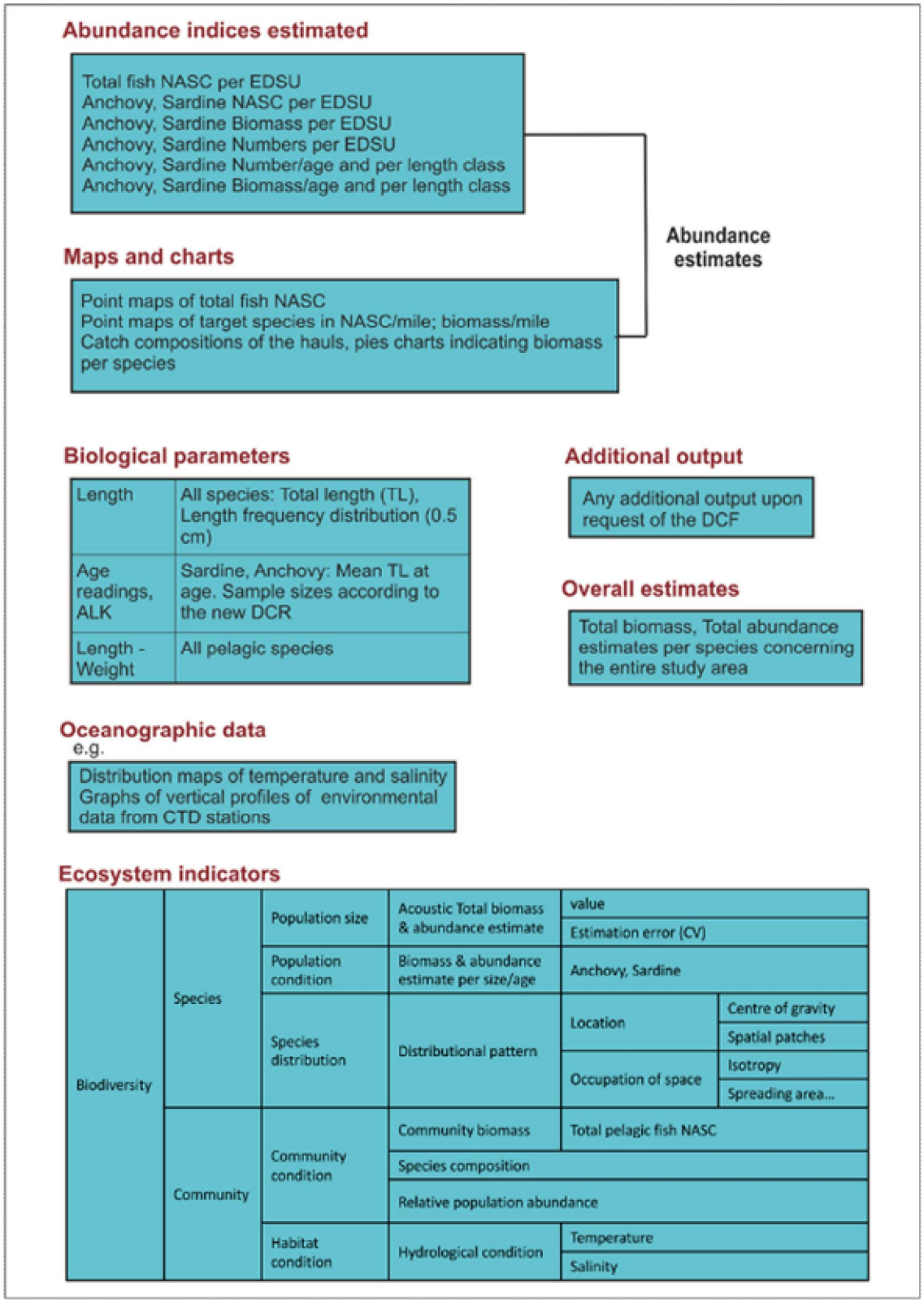

Figure B6. Fields associated with potential acoustic database output.

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.