MEDIAS HANDBOOK

(last version Palma de Mallorca, Spain, April 2017)

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

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	CNR-ISMAR/FRIS	Adriatic Sea (Slovenia)	117 NM^2	1*
Italy	CNR-ISMAR	Adriatic Sea (Italy)	13200 NM^2	40
Italy	CNR-IAMC	Sicily Channel	4300 NM^2	16**
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

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

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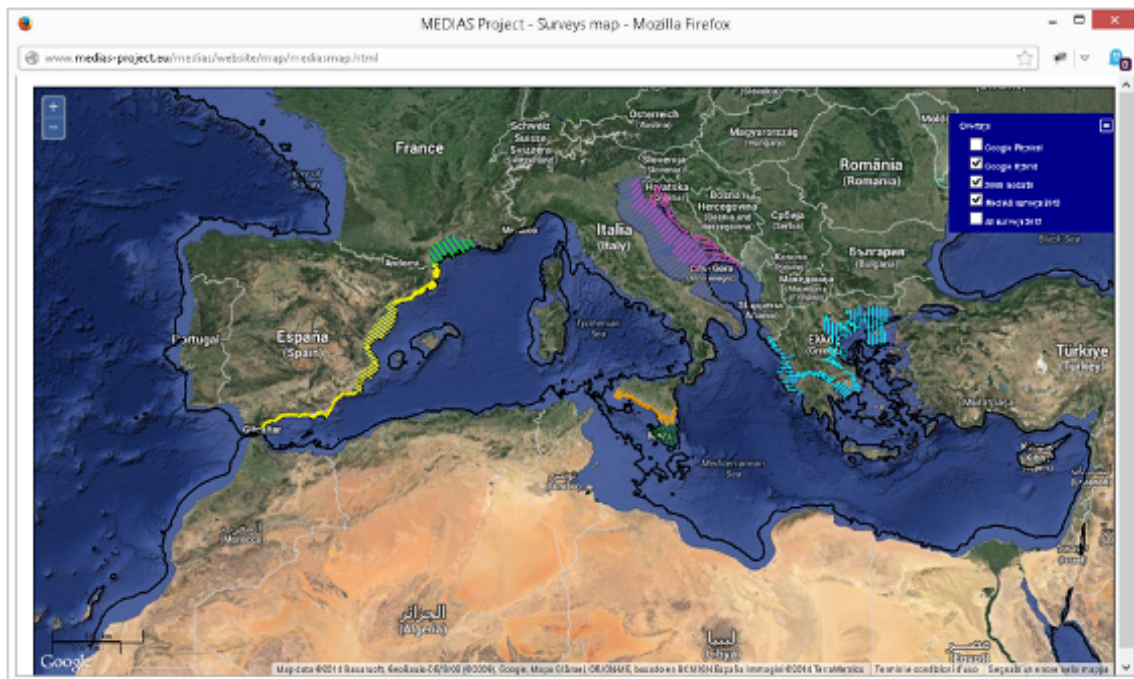

Figure 1: Surveys design in the MEDIAS.

1. Survey Identity

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

2. Echo sounder parameters

A variety of equipments with specific characteristics could be considered as adequate for the assessment of small pelagics. A split beam echo–sounder should be used for the echo–sampling. The angle beam, Athwart Beam Angle (in degrees), Along Beam Angle, and Ping rate of the echo–sounder should be reported. The frequency for assessment should be the 38 kHz, while the 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	

Calibration report	
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:

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

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.

<table>
<tr><td rowspan="25">Good Environmental Status indicators</td><td rowspan="3">Spatial/temporal strata</td><td rowspan="2">Spatial strata</td><td colspan="5">GSA</td></tr>
<tr><td colspan="5">Acoustic survey</td></tr>
<tr><td>Time periods</td><td colspan="5">Season (Summer/Autumn depending on the area)</td></tr>
<tr><td rowspan="4">Taxonomic levels</td><td>Community</td><td colspan="5">Pelagic fish (Species composition, occurrence in pelagic hauls)</td></tr>
<tr><td rowspan="3">Target Species</td><td rowspan="3">Adult</td><td colspan="4">Anchovy</td></tr>
<tr><td colspan="4">Sardine (for Mediterranean)</td></tr>
<tr><td colspan="4">Sprat (for Black Sea)</td></tr>
<tr><td rowspan="18">Indicators</td><td rowspan="18">Biodiversity</td><td rowspan="12">Species</td><td rowspan="2">Population size</td><td rowspan="2">Acoustic estimates</td><td colspan="2">Total biomass & abundance estimates for target species</td></tr>
<tr><td colspan="2">Estimation error (CV) (i.e. as agreed based on a common estimation procedure, see ToRs)</td></tr>
<tr><td rowspan="2">Population condition</td><td>Biomass & abundance estimate per size/age</td><td colspan="2">Anchovy, Sardine, Sprat (Black Sea)</td></tr>
<tr><td>Recruitment index</td><td colspan="2">Sardine (i.e. Number at Age 0 of the population based on summer surveys)</td></tr>
<tr><td rowspan="2">Habitats</td><td rowspan="2">Habitat condition</td><td rowspan="2">Hydrological condition</td><td>Temperature (i.e. SST: average at 10m, estimated as the interpolated mean value for the whole area)</td></tr>
<tr><td>Salinity (i.e. SSS: average at 10m, estimated as the interpolated mean value for the whole area))</td></tr>
<tr><td rowspan="2">Community</td><td rowspan="2">Fish Community condition</td><td>Community Synthesis</td><td colspan="2">Total pelagic fish NASC</td></tr>
<tr><td colspan="3">Species composition (i.e. percentage in terms of weight of pelagic trawls per hour)*</td></tr>
<tr><td rowspan="2">Age and size distribution</td><td colspan="4">95% percentile of the population length distribution for the target species</td></tr>
<tr><td colspan="4">Proportion of fish larger than L50 (length at first maturity estimated based on collected data or defined based on literature)</td></tr>
</table>

10. Tables

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. Common format for presentations at MEDIAS Coordination Meetings

• GSA number and general information on the GSA; map and general information on the acoustic survey

• Type of echosounder and frequencies in use

• Calibration results

• Survey design

• Number of nautical miles effectively processed for biomass estimation

• Biomass estimation results in tons by GSA and graphs in terms of biomass density

• Headline length of the pelagic net, sidelines dimensions, mesh size

• CTD stations map

• Biomass per length classes (0.5 cm) and per age classes in tons

• Graphs of Age Length Keys

• Maps of anchovy and sardine spatial distribution

• Map with pie charts reporting percentages in weight of anchovy, sardine and other species

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

12. References

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.

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

MEDIAS group proposals: 1) MEDIAS database

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

The Common Database structure for 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)
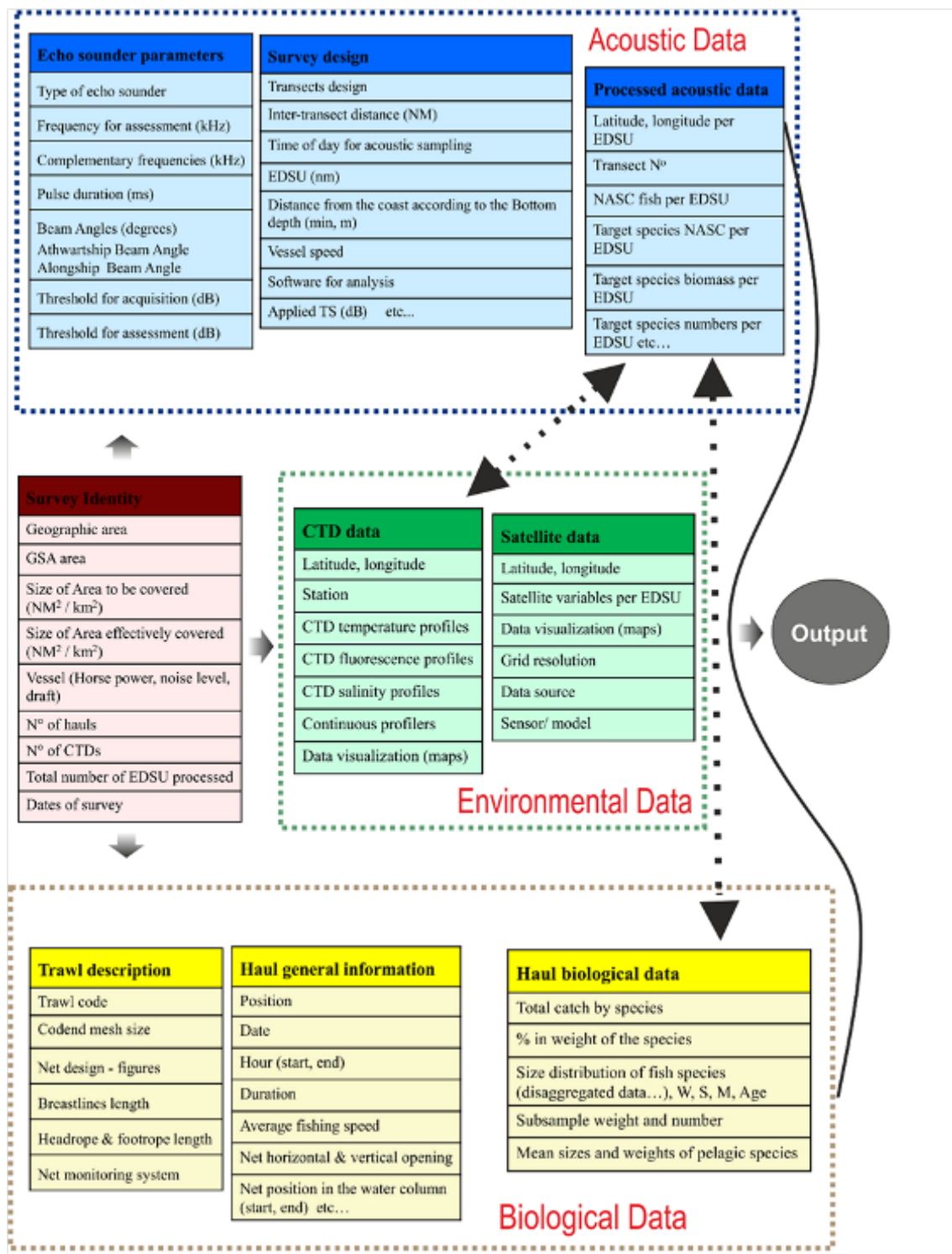
Figure B1. General outline of a database for acoustic surveys.

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

Echo sounder parameters	Survey design	Acoustic Data
Type of echo sounder	Transects design	
Frequency for assessment (kHz)	Inter-transect distance (NM)	**Processed acoustic data**
Complementary frequencies (kHz)	Time of day for acoustic sampling	Latitude, longitude per EDSU
Pulse duration (ms)	EDSU (nm)	Transect N°
Beam Angles (degrees) Athwartship Beam Angle Alongship Beam Angle	Distance from the coast according to the Bottom depth (min, m)	NASC fish per EDSU
	Echo sounding depth (min, m)	Target species (i.e. anchovy, sardine) NASC per EDSU
Threshold for acquisition (dB)	Echo sounding depth (max, m) recording.	Target species biomass per EDSU
Threshold for assessment (dB)	Vessel speed	Target species numbers per EDSU
	Software for analysis	Echogram figures especially related to hauls
	File format	
	Applied TS (dB)	

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

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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.

Trawl description	Haul general information	Haul biological data
Trawl code	Position	Total catch by species (or group of species for cephalopods, crustaceans, demersal fish)
Codend mesh size	Date	% in weight of the species (or group of species for cephalopods, crustaceans, demersal fish) => link to GIS software
Net design - figures	Hour (start, end)	Size distribution of fish species (disaggregated data…), W, S, M, Age
Breastlines length	Duration	
Headrope & footrope length	Average fishing speed	Subsample weight and number
Net monitoring system	Net position in the water column (start, end)	Mean sizes and weights of pelagic species
	Net horizontal opening	
	Net vertical opening	**Biological Data**
	Bottom depth (start, end)	

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

CTD data	Satellite data
Latitude, longitude	Latitude, longitude
Station	Satellite variables per EDSU
CTD temperature profiles	Data visualization (maps)
CTD fluorescence profiles	Grid resolution
CTD salinity profiles	Data source
Continuous profilers	Sensor/ model
Data visualization (maps)	

Environmental Data

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

Abundance indices estimated

Total fish NASC per EDSU
Anchovy, Sardine NASC per EDSU
Anchovy, Sardine Biomass per EDSU
Anchovy, Sardine Numbers per EDSU
Anchovy, Sardine Number/age and per length class
Anchovy, Sardine Biomass/age and per length class

Abundance estimates

Maps and charts

Point maps of total fish NASC
Point maps of target species in NASC/mile; biomass/mile
Catch compositions of the hauls, pies charts indicating biomass per species

Biological 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

Additional output

Any additional output upon request of the DCF

Overall estimates

Total biomass, Total abundance estimates per species concerning the entire study area

Oceanographic data
e.g.

Distribution maps of temperature and salinity
Graphs of vertical profiles of environmental data from CTD stations

Ecosystem indicators

Biodiversity	Species	Population size	Acoustic Total biomass & abundance estimate	value	
				Estimation error (CV)	
		Population condition	Biomass & abundance estimate per size/age	Anchovy, Sardine	
		Species distribution	Distributional pattern	Location	Centre of gravity
					Spatial patches
				Occupation of space	Isotropy
					Spreading area...
	Community	Community condition	Community biomass	Total pelagic fish NASC	
			Species composition		
			Relative population abundance		
		Habitat condition	Hydrological condition	Temperature	
				Salinity	

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.

2) Mesozooplankton sampling synoptic with acoustic survey

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

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

The analysis on plankton can also give information on the ichthyoplankton fraction; in this way a deeper knowledge on spawning (from collected eggs) and nursery areas (from collected larvae), at least for anchovy (*Engraulis encrasicolus*), given the survey period, could be gained.

This fact would potentially allow the possibility to explore new management scenarios in the Mediterranean Sea, eventually based on local closures in correspondence of spawning and nursery areas.

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

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

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

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