Report of 5th meeting for MEDIterranean Acoustic Surveys (MEDIAS)

in the framework of European Data Collection Framework (DCF)

Sliema, Malta, 20-22 March 2012

Steering Committee Report

Contents

Introduction……5

Results of surveys held in 2011 in the framework of the Mediterranean Acoustic Surveys (MEDIAS)……8

Adriatic Survey……8

Gulf of Lions survey……9

Strait of Sicily Survey……11

Iberian Acoustic survey……12

Black Sea surveys: Romania-Bulgaria……13

Results of Acoustic surveys from non EU countries ……15

Croatian survey……15

Tunisian survey……16

Acoustic surveys in Morocco……17

ACOUSMED project: summary results ……18

ICES Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC): short summary ……22

Anchovy and sardine come back to North & Baltic Sea……22

Inversion of the Ionian gyre……23

Sardinella aurita moves northwards……24

Preliminary work with this data……26

Future work on this subject……28

Workshop on Ecosystem Indicators related to acoustic surveys……29

Recommendations addressed by the last Regional Coordination Meeting for the Mediterranean and Black Sea (RCMMed&BS) region in 2011……32

Terms of Reference for the MEDIAS 2012 ……32

Terms of Reference for MEDIAS 2013 ……..34

Studies and Workshops proposed to the RCMMed&BS……..38

Studies……38

Workshops……..39

Scientific work carried by the MEDIAS group during the last year.……

ANNEX I: List of participants ……

ANNEX II: Acronyms of the Institutions……

ANNEX III: 5th MEDIAS Coordination Meeting agenda ……..

ANNEX IV: MEDIAS handbook: Common protocol for Mediterranean acoustic surveys: updated

Introduction

The MEDIAS (MEDIterranean Acoustic Surveys) Steering Committee met in Sliema, Malta, 20- 22 March 2012, hosted by Roberta Mifsud of FCD-MRRA (Fisheries Control Directorate - Ministry for Resources and Rural Affairs) and chaired by Magdalena Iglesias (Instituto Español de Oceanografía, Spain). Participants in the meeting were representatives from all European Union countries involved in acoustic surveys in the Mediterranean Sea (i.e. Greece, Italy, Slovenia, Malta, France and Spain) as well as representatives from the EU countries operating in the Black Sea (i.e. Bulgaria and Romania). A scientist from Croatia, as an EU candidate country, participated as an observer and was supported by FAO AdriaMed Project. Additionally, two scientists from North African Mediterranean countries (i.e. Morocco and Tunisia) working on fisheries acoustics in Mediterranean and Atlantic Sea were invited to participate and their participation was financed by the FAO Copemed II project (Co-ordination to Support Fisheries Management in the Western and Central Mediterranean) (see list of participants in ANNEX I).

The aim of the meeting was:

a) To present the results from the Pan-Mediterranean Pelagic survey (MEDIAS) carried out in 2011.

b) To coordinate the MEDIAS surveys those are going to be performed in 2012.

c) To improve and update the common Protocol for the MEDIAS acoustic surveys that is incorporated in the DCF framework and reflected in the MEDIAS Handbook.

d) To present the results from the ACOUSMED project “Harmonization of the past acoustic surveys in the Mediterranean 2002-2006” granted by the DGMARE.

e) To carry out a Workshop on “Ecosystem Indicators available from acoustic surveys”.

f) To present a summary of the last ICES Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC), Fuengirola, Spain, 27 February - 02 March 2012.

g) To revise the ToR’s from 2012 and to establish the ToR’s for 2013.

First of all, the agenda of the 5th MEDIAS Meeting (see ANNEX III) was adopted by the participants. Following the agenda, the morning of the first day was devoted to present a summary of the MEDIAS project, the work carried out by the group during the last four years, as well as the outcomes arising from this work. In addition, recommendations from the Regional Coordination Meeting for the Mediterranean and Black Sea (2011) were presented and the Terms of Reference (TOR's) for the MEDIAS 2012 were discussed. Last, a general discussion on the revision of the common MEDIAS protocol and an update of the MEDIAS handbook was carried out. In the afternoon, results from the 2011 MEDIAS acoustic surveys carried out by the MEDIAS partners (Figure 1) were presented, as well as results from acoustic surveys carried out by Croatia in the Adriatic Sea, Tunisia in the Mediterranean Sea and Morocco in the Atlantic and Mediterranean Sea.

At this point, it is important to note the impact of the absence of Greek coverage in the MEDIAS surveys for the third consecutive year, since the DCF was not applied by Greece during 2011.

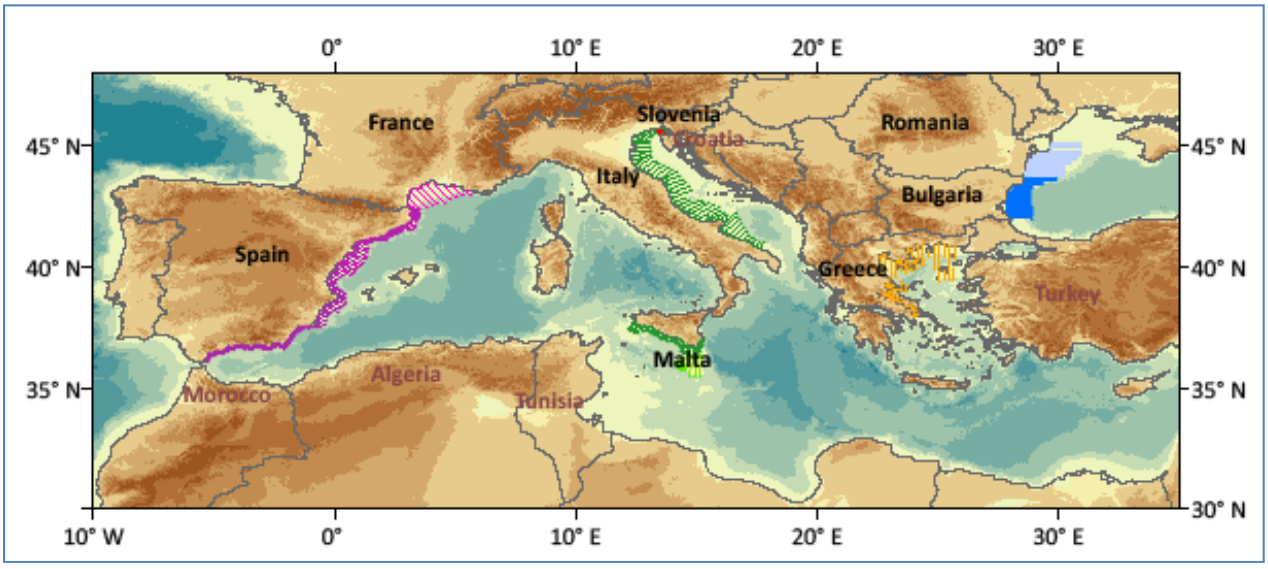


Figure 1: MEDIAS acoustic surveys design.

During the second day, the ACOUSMED project granted by the DGMARE ("Harmonization of the past acoustic surveys in the Mediterranean 2002-2006") results

were presented by the coordinator of the project Dr. Marianna Giannoulaki (HCMR). Dr. Giannoulaki presented the principal outcomes corresponding to the main Work packages of the project:

- Optimization of Survey design: Geostatistical analysis.
- Harmonization and the optimization of the acoustic methodology**:**
    - Target strength equations for anchovy and sardine.
    - Day-night acoustic sampling.
    - Day-night biological sampling.
    - Common format on acoustic data.

The second part of the day was devoted to discuss and plan a tentative Intercalibration study that is supposed to be carried out in the Mediterranean Sea in a near future, financed by the DGMARE. Moreover, a brief summary of the ICES "Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact" WGSPEC, carried out last February in Fuengirola, Spain (27 February – 2 Mars 2012), was presented by Dr. Andrea De Felice (CNR-ISMAR).

In the course of the third day, a Workshop on Ecosystem indicators related to acoustic surveys was carried out, conducted by Dr. Marianna Giannoulaki (HCMR). The afternoon was dedicated to decide the Terms of Reference for the next year (2013), to propose the studies and workshops necessaries to improve the MEDIAS surveys that have to be presented to the RCMMed&BS in 2012 and to prepare and adopt the draft report.

Results of surveys held in 2011 in the framework of the Mediterranean Acoustic Surveys (MEDIAS).

a) **Adriatic survey** (Iole Leonori, Andrea De Felice).

The 2011 acoustic survey was carried out, aboard R/V Dallaporta, in July in GSA 18 and in September in 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 for a total of about 2100 nautical miles in the western part of the Adriatic Sea (MEDIAS 2011). The main acoustic sampling characteristics were: Split Beam Simrad Scientific Echosounder EK 60 at 38 – 120 – 200 kHz; No TS and Sv thresholds set for data logging; -70 dB for data processing or -60 dB in case of strong scattering from plankton. 8 - 10 nm inter-transect distance; ESDU 1 nm; Min Bottom Depth 10 m; Vessel speed: 9.5 knots. Myriax Echoview software was used for echogram analysis. The acoustic system was calibrated before the survey using the standard sphere method (Foote et al., 1987).

The biological sampling characteristics were: Midwater sampling trawl "Volante" (18 mm codend mesh size, 8-10 m vertical opening, 11-13 m horizontal opening); biological samplings were conducted along the survey routes for biomass allocation into species and to know mean lengths and weights of the pelagic fish; fishing operations were performed at different light conditions and bathymetry; Pelagic trawls were monitored by means of Simrad ITI trawl eye and temp-depth net sondes (information concerning depth of the net, vertical opening, local temperature and the visualization of fish entering the net is obtained by means of these instruments); samples were collected to determine age by means of otholith readings following DCF standards, sex ratio and maturity stages.

Acoustic survey in western GSA 18 was conducted in the period 14 - 28 July 2011. The area coverage was 100% with a total survey extent of 433 nautical miles. 12 pelagic trawls and 33 CTD stations (temperature, salinity, oxygen, fluorescence, turbidity and density of sea water) were made in the study area; 33 ichtyoplankton stations were

carried out for the Assessment of anchovy Spawning Stock Biomass by means of Daily Egg Production Method (DEPM). The DEPM was not financed by MEDIAS project.

Acoustic survey in western GSA 17 was conducted in the period 6 – 27 September 2011. Area coverage was 100% with a total survey extent of 1613 nautical miles. 47 pelagic hauls with "volante" trawl and 111 CTD stations were conducted; 37 mesozooplankton stations (200 µm) were carried out in collaboration with OGS of Trieste (Italy), this activity was not financed by MEDIAS project.

b) Gulf of Lions survey (Jean-Louis Bigot).

Pelmed surveys (Figure 2) cover the Gulf of Lion (3300 nm^2) and are performed annually in July since 1995 with R/V L'Europe to estimate the spatial distribution and abundance of all pelagic fish, including anchovy and sardine which are the target species. Since 2008 the survey covers also the north Catalan Sea as foreseen in the MEDIAS protocol.

The survey design is made of parallel transects perpendicular to the isobath from 10 m to 200 m depths. The inter-transect distance is 12 nm. 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 by day time. The survey lasts approximately 26 days.

The split beam echo sounder used is SIMRAD ER60. Frequencies used are 38, 70, 120 and 200 kHz. The pulse duration is 1024 ms. The echo sounder is calibrated at each survey. Data are saved in HAC format. The threshold for acquisition is –80 dB and that for processing for the assessment (38 KHz) is –60 dB.

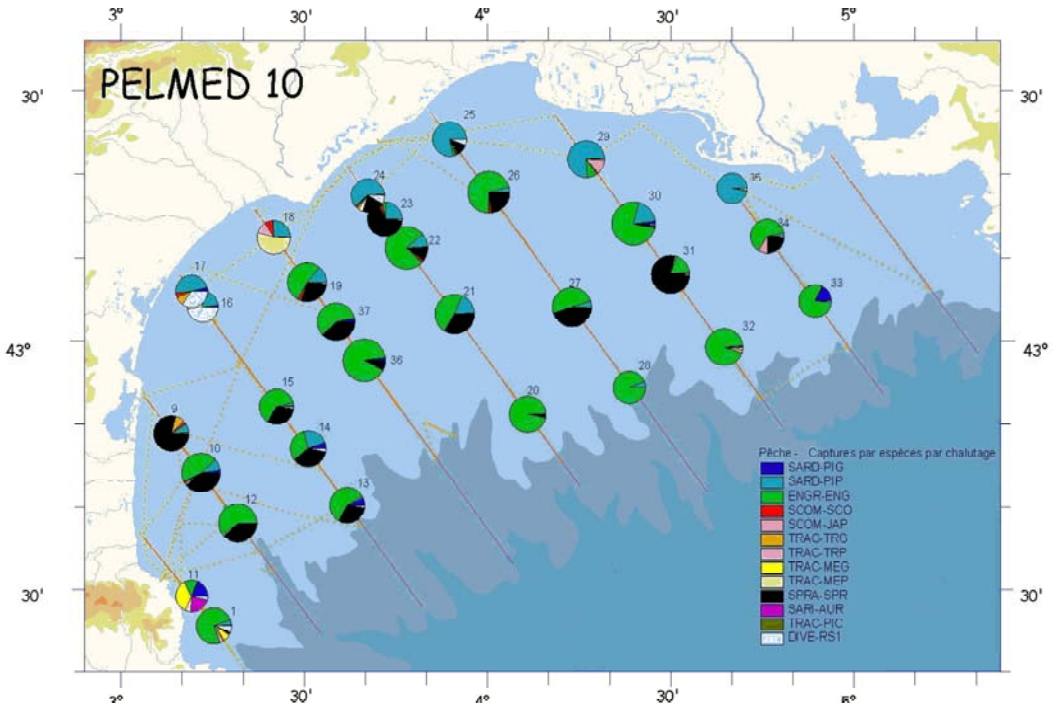


Figure 2: Gulf of Lions: Map of the study area and sampling design, 2010 survey as example showing the proportion of species in the trawl hauls.

In the Gulf of Lion, ecosystem seems perturbed since 2008. *Sprattus sprattus* begins to appear and species biomass increased rapidly from 5 000 tons (T) in 2008 to 25 000 T in 2011.

During the same period, biomass of sardine decreases from 96 000 T to 27 000 T. In spite of the high recruitment observed in 2008, the adult biomass decreased dramatically since then stabilizing into less than 5 000 T for the two last years.

For anchovy the lowest biomass was 18 000 T in 2005 but a positive trend was observed since 2005 with 36 000 T in 2011.

Another peculiarity is that the maximum length of anchovy and sardine catch during the survey decreases since 2008.

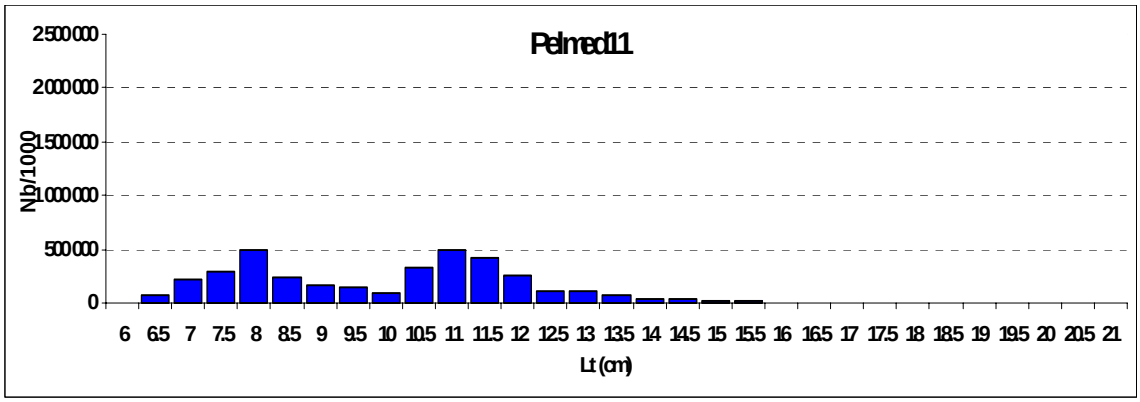


Figure 3: Length of sardine catch during the survey PELMED 2011.

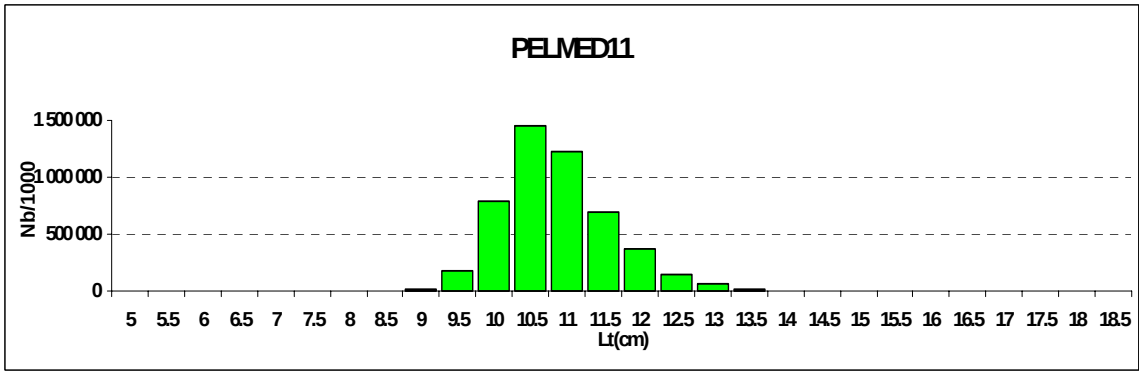


Figure 4: Length of anchovy catch during the survey PELMED 2011.

c) Strait of Sicily survey (Angelo Bonanno, Gualtiero Basilone).

Acoustic biomass estimates and spatial distribution of sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) for the year 2011 are presented. Acoustic data were collected during an echosurvey carried out from 20 June to 12 July 2011 on board the R/V "G. Dallaporta" in the GFCM Geographical Sub-Area 16 (GSA 16 – South of Sicily). The time series of acoustic biomass estimates for anchovy and sardine for the period 1998 – 2011 in the Strait of Sicily are also presented. The sardine biomass time series shows a sharply decreasing trend in the period 1999 – 2002 followed by increasing biomass values from 6000 t in 2002 to 14977 t in 2011; the maximum biomass level (21219 t) was estimated in 2005. Anchovy biomass in the period 1998 – 2011 oscillated between a minimum level of 3130 t in 2009 to a maximum value of 22950 t in 2001. In the last year anchovy biomass decreased reaching a level of 5070 t.

The last two echosurveys, carried out in summer 2011 in Maltese waters (GSA 15) and in the Thyrrenian sea (GSAs 9 and 10), are presented. For such echosurveys the analysis of data collected is still in progress and no biomass estimate is presented.

d) **Iberian acoustic survey** (Magdalena Iglesias)

The MEDIAS 2011 acoustic survey was carried out in the Mediterranean Spanish waters from 22th June to 21th July 2011. Acoustic data were collected over 1164 nautical miles, corresponding to 94 tracks and 54 pelagic trawls were used to scrutinize the echograms. Moreover, 141 CTD stations were performed and 365 CUFES (Continous Underway Fish Egg Sampler) stations were analyzed. The most abundant species in the pelagic trawls were sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*), but other important pelagic species were *Trachurus mediterraneus, Trachurus trachurs, Boops boops* and *Sprattus sprattus*. Biomass and abundance from 10 pelagic species were estimated, being the more abundant sardine and anchovy. It was detected a good recruitment for sardine, similar to the recruitment detected in 2009. The anchovy stock has suffered a decline since 2008. *Sprattus sprattus* has extended its distribution to the south and the abundance of this species in Spanish waters has increased from last year 2010.

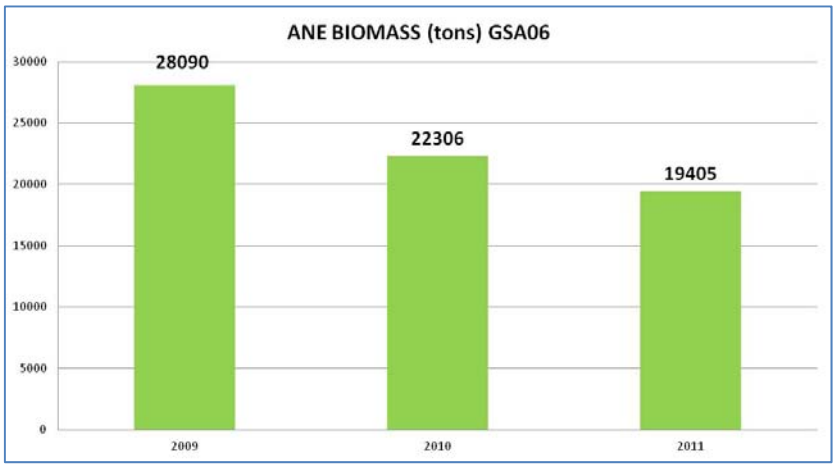


Figure 5.- Anchovy biomass estimated during the MEDIAS acoustic surveys in Mediterranean Spanish waters.

e) Black Sea surveys: Rumania-Bulgaria (Marina Panayotova, Valodia Maximov).

Two acoustic surveys were carried out in the Bulgarian and Romanian Black Sea areas in 2010 and 2011. The studies have been accomplished under the Data Collection Programs of Bulgaria and Romania and were executed by a joint team of the IO-BAS (Bulgaria) and NIMRD (Romania). Surveys were carried out on board of RV"Akademik" and acoustic data were collected by scientific echosounder SIMRAD EK60 at frequencies 38, 120 and 200 kHz. The post processing was carried out by LSSS (MAREC, Norway).

Acoustic survey in 2010 was carried out in December 2010 in GSA 29 including partially territorial waters and EEZ of Bulgaria and Romania. Target species were European sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangius*). Study area was covered by parallel transects design perpendicular to the bathymetry. Inter-transect distance was set at 5 nm. Sampling takes place during the day and the night. Total investigated area – 1525 Nm^2, total length of transects - 415 Nm. The target species (sprat and whiting) are usually distributed in mixed layers with other species, so it is difficult to allocate the integrator readings to a single species. Therefore the species composition was based on the trawl catch results. According to data, dense sprat agglomerations were observed in the cross border area between Shabla (BG) and Mangalia (RO) and also in the area in front of Obzor – Kamchia (BG) with NASC values range of 12 – 31 ($m^2.nm^{-2}$). Estimated sprat biomass amounts at 445 t in the surveyed area in 2010. Due to inappropriate season and small scale of the pilot survey, the results could not be considered as representative for sprat distribution in the whole Bulgarian and Romanian areas. The schools of the second target species – whiting, were rare and acoustically were registered only in front of Varna Bay, Bulgarian area. In the rest areas whiting was presented in small quantities. Together with acoustic and biological sampling, the environmental parameters as temperature, salinity, dissolved oxygen and zooplankton biomass were studied. Indicator variogram was applied in order to assess the ability of the current survey design to capture the spatial structure of the area of patches and compare that precision for different survey designs. Results of the

analysis confirmed the adequacy of the chosen sampling grid design to the spatial structures of pelagic fish in the Black sea and no need for survey design optimization.

Acoustic survey in November - December 2011 covered Bulgarian and Romanian territorial waters and EEZ zones (total 7663 nm^2), applying parallel transect design with intertransect distance of 5nm. Target species were sprat and whiting. At total, 33 hauls, 33 CTD and 19 zooplankton stations were realized. The acoustic and biological data are still not fully processed for both areas. The preliminary results for the distribution of total fish NASC in the Bulgarian area show that there were scattered in the whole studied area with the highest abundance of fish agglomerations in the central Bulgarian areas up to 50 m depth. Echo-integration of acoustic data was carried out for the layer 20 – 100 m for the whole area. Geostatistical analysis of raw total fish NASC values presents a spatial distribution, characterized with steady increase in data values along the whole length of the stratum and the variogram was fitted to a linear model.

Preliminary results for the Romanian area in 2011 showed that hauls were dominated by sprat. In the size structure prevailed individuals with total lengths between 8 – 10 cm and ages of 2-3 years old fish.

Results of acoustic surveys from non EU countries

a) **Croatian survey** (Vjekoslav Ticina)**.**

During 2011, a pilot-study PELMON-MEDIAS 2011 was carried out during 15 days, covering approximately 50% of total area that need to be surveyed in the eastern part of Adriatic Sea. Aim of the study was to estimate necessary resources needed for harmonization of Croatian national pelagic monitoring project PELMON (2003-2010) with future activities that should be performed in accordance with common MEDIAS Protocol within EU Data Collection Framework (DCF). To cover entire area, 30 vessel days and substantial increase in available resources is needed to perform complete data collection and analyses required.

Study revealed unusual oceanographic conditions in the northern part of the Adriatic Sea (due to lack of rains and high summer temperatures) during 2011. Spatial distribution indicated high abundance of sardine along the mid-line of the Adriatic Sea, suggesting that spawning migration from feeding ground (west) to spawning ground (east) was probably delayed. Consequently, abundance estimate of sardine at that time within study area was lower than in previous year. Abundance of anchovy decreased a lot in comparison with 2010 year.

This was the first time that acoustic data in the eastern Adriatic have been collected during daytime only. Taking into account the advantages and disadvantages of such practice, it is still not clear how future work will be organized. It is likely that key factors for that decision will be availability of vessel and personnel time.

Due to limited resources, fish ageing has not been done in 2011. Since Croatian and Italian surveys in the Adriatic Sea have been assessing the common and shared stock of anchovy and sardine, it has been proposed that Croatian survey would use the same age-length keys as Italian survey team, to provide population age structured data. Considering the need to continue with further harmonization (in overall data processing and reporting) of Croatian survey with survey conducted by the team from ISMAR-Ancona, the role of FAO AdriaMed Project in future Adriatic acoustic surveys' coordination & harmonization will be very important.

Figure 7.- Study area indicated (red)

b) **Tunisian survey** (Lotfi Ben Abdallah).

In order to estimate the biomass of small pelagic species (PIL, ANE, SAA, MAS, MAC, BOG, HOM, HMM), and their geographical distribution along the Tunisian coast, INSTM organizes, regularly since 1998, acoustic surveys and experimental fishing in a well-defined protocol. Related to the morphology of the Tunisian coasts we distinguished five sectors: North sector, Sector of Gulf of Tunis, Sector of Gulf of Hammamet, Sector of Sahel (from Sousse to Sfax) and South sector: Gulf of Gabes.

For each sector a sampling design was adapted to be perpendicular to the bathymetry and the shore line. Transects start at the depth of 20 m and end at 200 m depth. Prospecting and biological sampling are done only at day time. The prospecting is done with the echosounder Simrad EK 500 within the frequency 38 kHz while the speed of the vessel is around 9 Knots. The biological sampling is done with a midwater trawl (4FF) with 7 m vertical opening.

For the survey OASIS14 the total distance on transects is 1077 Nmi and we performed 42 hauls.

Although sardine is still the most important species, its biomass is still decreasing since 2007.

Compared to the survey OASIS13 in 2009, all the biomasses decreased except for HMM and MAS where their biomasses increased.

	PIL	ANE	SAA	BOG	HOM	HMM	MAS
%	24	5	6	10	9	24	22

PIL: *Sardina pilchardus*
ANE: *Engraulis encrasicolus*
SAA: *Sardinella aurita*
BOG: *Boops boops*
HOM: *Trachurus trachurus*
HMM: *Trachurus mediterraneus*
MAS: *Scomber japonicus/colias*

c) **Acoustic surveys in Morocco** (Salaheddine EL AYOUBI)

In Morocco, 9 acoustic surveys were carried out in 2011 for small pelagic stocks assessment. Two surveys were conducted in the Moroccan Mediterranean Sea, the first in July-August and the second in November. Those surveys are conducted on board the research vessel "Al Amir Moulay Abdallah" (38.5 m LOA and 1000 HP) which is equipped by the EK60 system with 2 frequencies 38 and 120 kHz, regularly calibrated and used with pulse duration of 1 msec. The prospecting track in Mediterranean Sea covers a distance of approximately 600 nm from 20 m to 500 m depth, EDSU is 1 NM. Fishing operations are conducted with a pelagic trawl having a vertical opening of 20 m, the trawling speed is around 4 knots.

The surveys allow the collection and processing of three types of data: the acoustic data from two frequencies echograms, the biological data derived from the trawl catches and the oceanographic and environmental data obtained from different sensors on board, CTD, rosette and bongo net.

The acoustic surveys in the Moroccan Mediterranean Sea began in 1973 but were not regular. These surveys are being planned to provide two covers of the entire national coast per year in the Atlantic Ocean and Mediterranean Sea in spring and autumn with a total annual days at sea of 156 days.

ACOUSMED project: summary results (Marianna Giannoulaki, HCMR).

During the 5th MEDIAS meeting the results of an EU funded study called AcousMed were presented by the project scientific coordinator Dr Marianna Giannoulaki (HCMR). AcousMed is a DG MARE Negotiated Procedure that aimed at the "Harmonization of the acoustic data in the Mediterranean 2002-2006". In this study IEO, Ifremer, CNR-IAMC, CNR-ISMAR and HCMR were the partners involved. The duration of the study was 24 months starting March 2010 and ended at the beginning of March 2012. Among the study objectives were the optimization of the survey design of these acoustic surveys held in Spanish Mediterranean waters, Gulf of Lions, western Adriatic Sea, Strait of Sicily and North Aegean Sea, promote the compatibility of the acoustic estimations among these areas as well as the compatibility of old and new acoustic data within each area.

Specifically, geostatistical analysis was applied in order to estimate survey accuracy (i.e. variance) and examine alternative survey designs. In addition, the harmonization and the optimization of the acoustic methodology used in each survey was promoted towards three major issues i.e. (a) the Target Strength equation used for the target species in each area, (b) the effect of the time of day on the acoustic and biological sampling as well as (c) the standardization of a common format for acoustic data, the estimated parameters in terms of DCF requirements.

Concerning the evaluation and optimization of existing surveys design in the study areas the approach followed was presented. Specifically, a two way approach based on geostatistics was followed: First in order to analyze the spatial structure of the target species in the study areas variogram modeling on raw data was applied but adapted to the peculiarities of the local populations in each study area. In a second step, enhanced spatial analysis was applied following the indicator function that allowed standardization of the analysis among the different areas impairing a geometric perspective to the analysis of survey design and estimating the probability to

encounter patches of high values representing a given percentage of total biomass. Results showed that:

- Variography on raw data generally showed that existing survey designs seem well adapted to the underlying spatial correlation range since the shorter correlation range was often close in value to the inter-transect distance.
- Furthermore, the indicator approach revealed that space for improvement exists in the acoustic survey of North Aegean Sea where local small pelagic fish aggregations are highly aggregative.
- In the Spanish Mediterranean waters, the Strait of Sicily, the western part of the Adriatic and the Gulf of Lions, the current survey design seems to provide quite precise survey estimates.
- In the western part of the Adriatic and the Gulf of Lions the existing survey design seems to resolve moderately well the structural component of fish aggregations, indicating that there is potentially some room for improvement.

Concerning the issues related to the "Harmonization and optimization of acoustic surveys" the work achieved and the respective results were presented. Specifically, regarding the *in situ* Target strength equations, day night comparisons in acoustic sampling and day night comparisons in biological sampling the protocols followed for the analysis were presented along with the following results:

- The effect of different TS-length equations parameters on biomass acoustic estimates for anchovy and sardine were assessed at the different study areas. Results highlighted that even small differences in the b_{20} values can lead to a significant underestimation or overestimation of the fish stock biomass.

- Acoustic data from acoustic surveys (2003-2011) derived from the Iberian coast, the western part of the Adriatic Sea, the Strait of Sicily and the Aegean Sea were analyzed towards the *in situ* TS estimation for anchovy and sardine. Different TS-TL equations were estimated per study area upon data adequacy based on single target estimations for both anchovy and sardine. However the large variation in the TS

equations from the different areas impaired the need to integrate all available data towards the estimation of a global equation. A relationship was found significant only concerning the central and eastern Mediterranean for anchovy. These results clearly indicate that a re-evaluation for the currently applied b_{20} values especially for anchovy is required. Differences were less pronounced concerning sardine TS. Moreover the series of problems encountered during the TS analysis that need to be overcome towards the adaption of a new TS equation for anchovy and sardine were presented.

- The effect of day – night sampling in acoustic estimates was studied based on data from past surveys as well as targeted minisurveys in the Strait of Sicily and the western Adriatic Sea. Results indicated differences largely dependent on area characteristics in terms of plankton and fish density. In most cases no large deviations between day-time and night-time estimations were observed especially when night-time data were analyzed at -70 dB threshold. In the Strait of Sicily and the western Adriatic Sea higher NASC values were estimated on average during night-time compared to day-time, although these differences were not always found significant. Moreover some initial results were presented towards an approach to anticipate the error in acoustic estimates between day-time and night-time acoustic sampling.

- The effect of day – night biological sampling was studied based on data from past surveys in the Spanish Mediterranean waters, the Gulf of Lions and the North Aegean Sea as well as targeted minisurveys in the Strait of Sicily and the western Adriatic Sea. Results showed that fishing during night seems to be more random (less selective), less biased and more representative of the local populations at sea recognizing though that day-time sampling is essential and practically obligatory in order to identify acoustic targets, species associations and schools. These results suggest that a more flexible strategy can be adapted, depending on the needs of each acoustic survey and day-time sampling can be combined with night-time sampling reducing the survey time.

- Concerning the fields of a common database related to acoustics were defined and presented. These fields were based on the revision of existing databases, DCF data requirements and abundance assessments. Moreover, fields and input data associated to acoustic surveys but connecting their output to the ecosystem approach to fisheries were defined.

ICES Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact (WGSPEC): short summary. (Andrea De Felice, CNR-ISMAR).

a) Anchovy and sardine come back to North & Baltic Sea

One of the most relevant events occurred in these last years concerning small pelagics in the North and Baltic Sea is the change in the distribution and community composition of fish and plankton species; in particular anchovies and sardines came back to these areas after about 30 years of absence starting from the end of '80.

"Whereas global warming probably played a role in these northward migrations, the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation (AMO) and the contraction of the sub polar gyre were important influences. Sardine re-invaded the North Sea around 1990, probably mainly as a response to warmer temperatures associated with the strengthening of the NAO in the late 1980s. However, increasing numbers of anchovy eggs, larvae, juveniles and adults have been recorded only since the mid-1990s, when, particularly, summer temperatures started to increase. This is probably a result of the complex dynamics of ocean–atmosphere coupling involving changes in North Atlantic current structures, such as the contraction of the sub polar gyre, and dynamics of AMO. Apparently, climate variability drives anchovies and sardines into the North and Baltic Seas".

Adapted from Alheit, J., et al. Climate variability drives anchovies and sardines into the North and Baltic Seas. Prog. Oceanogr. (2011), doi:10.1016/j.pocean.2011.11.015

In summary the changes in fish/plankton spatial distribution and communities composition in the North Sea & Baltic Sea seem to be due to:

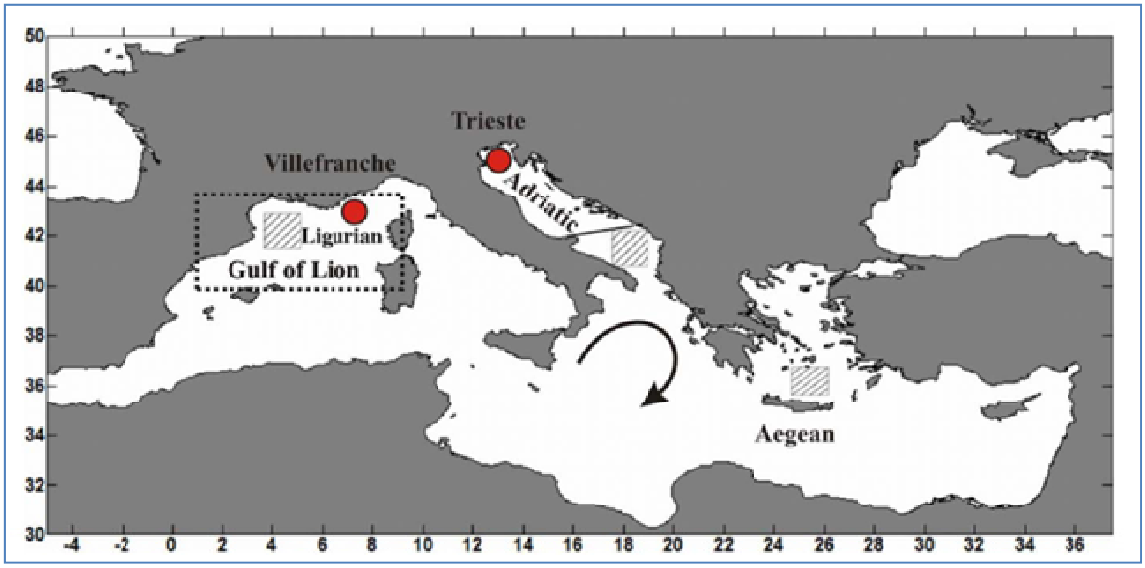
- Global warming
- NAO index => The NAO refers to a redistribution of atmospheric mass between the Arctic and the subtropical Atlantic. It produces large changes in mean wind speed and direction over the North Atlantic, heat and moisture transport, and intensity and number of storms, their paths, and associated weather patterns (centers of pressure cells in Iceland and Azores Islands at the beginning but these centers moved)
- AMO index => AMO is a multidecadal index of detrended SST anomalies averaged over the North Atlantic from 0° to 70° North and has been identified as an important mode of climate variability
- Sub polar gyre contraction

b) Inversion of the Ionian gyre

In the Mediterranean Sea another important change was the inversion of the Ionian gyre that occurred in the 1987 and changed again in 1997 (reported in the figure below from Conversi et al., 2010). “The Ionian gyre reversal of 1987 and consequent augmented input of surface waters of North Atlantic origin in the Adriatic Sea was

hypothesized, together with the general warming of the area, as possible explanations for the alteration in the copepod community".

In the Adriatic Sea we assist to anchovy stock collapse in 1987 and to a change in the dominant species from sardine to anchovy around 1997. Are these phenomena related to the Ionian gyre inversion?



(from Conversi et al., 2010)

c) *Sardinella aurita* moves northwards

Another interesting change in the distribution observed in these last years is the shift northwards of *S. aurita* that seems to be in accordance with the increase in the mean temperatures since the '90. This can be seen in NW Mediterranean Sea, in the Aegean Sea and in the Atlantic Ocean particularly in NW Africa.

"In the western Mediterranean basin (1950–2003), a significant positive relationship was found between round sardinella landings and temperature anomalies. Along a latitudinal gradient off the Mediterranean Iberian coast (1989–2004), a gradual increase in species abundance was observed from south to north, with a certain time lag going northwards, associated with the increase in sea water temperature. The abundance of round sardinella in the two warmest and southernmost areas was

positively and significantly correlated with sea surface temperature registered during the start of gonad maturation the previous year. In addition, the positive relationship established between water temperature and abundance of round sardinella in the coldest and northernmost study area demonstrates that there is a temperature limit for the distribution of this species in the western Mediterranean.

Results show a marked increase in larval abundance during the last decades and the present appearance of larvae in the northernmost study areas, where they did not occur 20 years ago. This indicates the successful reproduction of round sardinella in the northern part of the Mediterranean, where the species has expanded, confirming its establishment in the area." (From Sabatés et al., 2006)

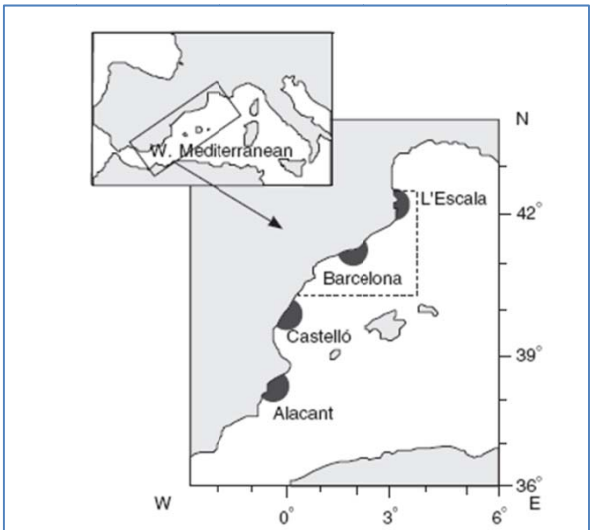


Fig. 1 Map of the western Mediterranean showing the location of the study areas (Alacant, Castelló, Barcelona and L'Escala). The rectangle corresponds to the area covered in the ichthyoplankton surveys.

"The northward expansion is directly related to the sea warming observed in the northern Aegean Sea. Besides its distribution extension, the population of round sardinella in the northern Aegean Sea exhibited a 30-fold increase since the early 1990s and showed a positive correlation to sea surface temperature" (From Tsikliras, 2008).

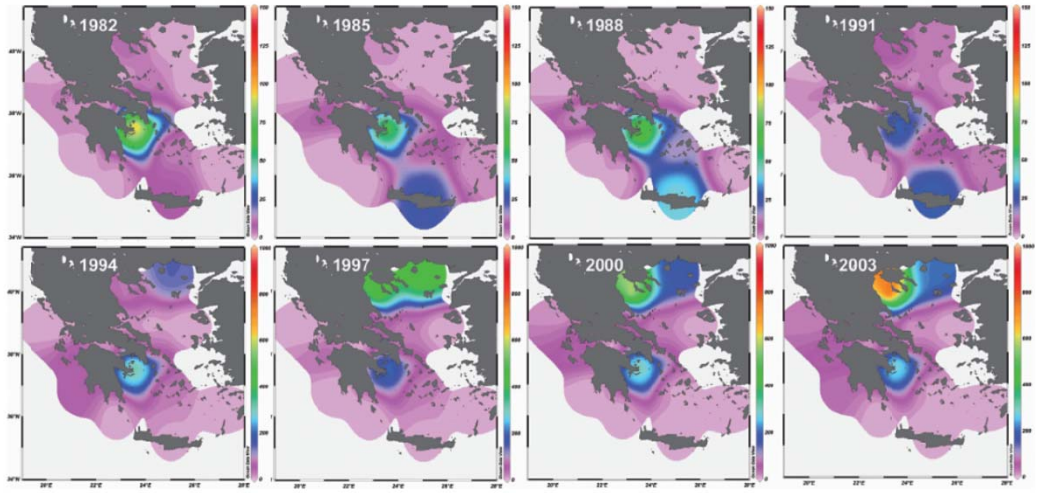
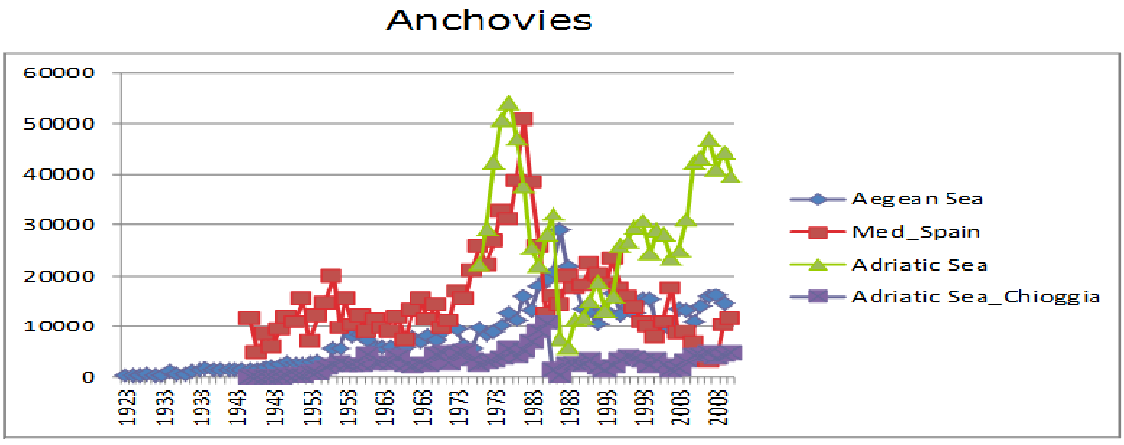


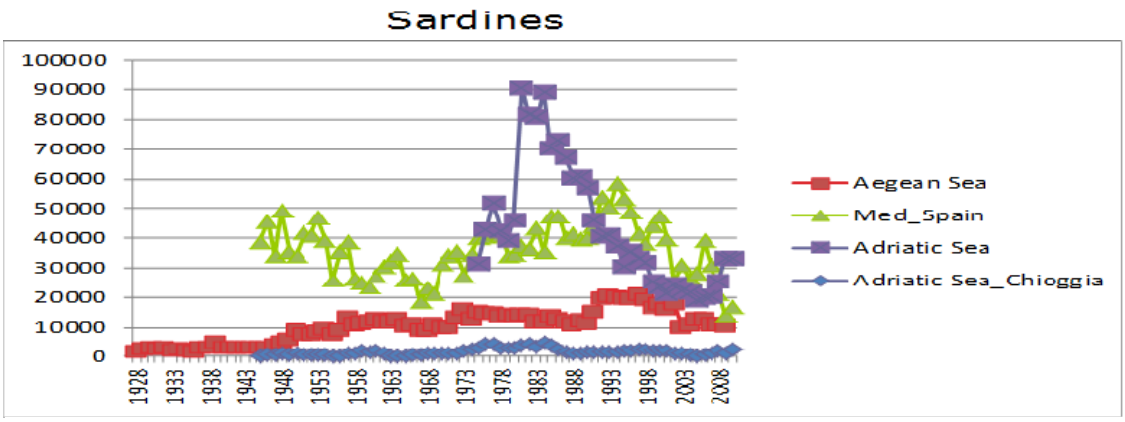
Figure 2. Spatial distribution of round sardinella (*Sardinella aurita*) landings (in metric tons; data from the National Statistical Service of Greece) for the Greek seas for selected years (3-year intervals) covering the period 1982–2003. Note the scale difference between top and bottom panels.

d) Preliminary work with the data.

What's going on with anchovy and sardine in the Mediterranean Sea?

At the meeting, an experiment was started on landings data (the most available among the present scientists). Time series from different areas of the Atlantic Ocean and the Mediterranean were put together to see if similarities could be noticed and possibly associated to NAO index, AMO index etc. Similar trends seem to occur in different areas even if landings data have to be treated with caution; in particular the focal periods are the end of the '80 (NAO influence) and the mid '90 (AMO, global warming influence).





In our common area (MEDIAS) for example it can be seen a peak in anchovy landings in the second half of the '70 in the Adriatic Sea followed shortly by NW Mediterranean Sea, while in the Aegean Sea this peak has a time lag. In these last years also the increase in anchovy landings in the Adriatic Sea coincides with decreasing trend in the NW Mediterranean Sea, while in the Aegean Sea we assist to periodical fluctuations in accordance with the Adriatic Sea but of minor extent.

As for sardine the peak in the early '80 in the Adriatic Sea is followed with a certain time lag by NW Mediterranean Sea and Aegean Sea. Also the declining trend for this species starts earlier in the Adriatic and later in the Aegean and NW Mediterranean Sea; moreover the recovery of sardine in these last years is present only in the Adriatic but could be followed by the other areas in the near future.

e) Future work on this subject?

During the ICES WGSPEC it was suggested that after discussion among MEDIAS partners a decision would have been taken whether to contribute to this analysis with our fishery independent data or not. Results with acoustic survey data could confirm or refute those obtained through landings helping in the understanding of the processes that are going on.

The report of ICES WGSPEC meeting will be available for further details in two months time approximately. Moreover many presentations and papers are available in the

ICES WGSPEC Sharepoint and could be consulted by all MEDIAS partners that are interested in this subject.

Workshop on Ecosystem Indicators related to acoustic surveys

(Marianna Giannoulaki, HCMR).

Ecosystem-based management requires more extensive information than single-species stock assessment. Active under-water acoustic methods provide a means of collecting a wealth of ecosystem information with high space-time resolution. Mediterranean fisheries institutes and agencies are carrying out regular acoustic surveys mainly for stock assessment purposes. The abilities of currently applied MEDIAS surveys to contribute towards an ecosystem based management approach were presented. Specifically, a brief introduction to acoustics and complementary data collection methods, a review of the current and potential contributions to monitoring population abundance and biomass, spatial distributions and predator–prey relationships was made. Acoustics have the potential to make a strong contribution to ecosystem-based management, but only if a clear understanding of the targets of acoustic measurements can be achieved. Certain ecosystem indicators that can derive from acoustic surveys were discussed and proposed. Moreover ecosystem indicators that can be provided, either on a regular basis (based on data regularly collected and analyzed) or on a potential basis (depending on survey peculiarities and available funding), were reviewed and proposed.

Table 1. Proposed standard ecosystem indicators associated to the MEDIAS acoustic surveys.

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			
				Sprat (for Black Sea)			
	Indicators	Biodiversity	Species	Population size	Acoustic estimates	Total biomass & abundance estimates for target species	
						Estimation error (CV) (Agree on a common estimation procedure)	
				Population condition	Biomass & abundance estimate per size/age	Anchovy, Sardine, Sprat (Black Sea)	
					Recruitment index	Sardine	
				Habitats	Habitat condition	Hydrological condition	Temperature (SST)
							Salinity (SSS)
			Community	Fish Community condition	Community biomass	Total pelagic fish NASC	
					Species composition		
			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)			

Table 2. Proposed potential ecosystem indicators associated to the MEDIAS acoustic surveys. These indicators can be potentially available depending on:
a) the season of the standard survey e.g. an additional targeted survey in the case of juveniles for certain species is needed, **b)** if parallel actions take place during the survey e.g. net sampling in the case of zooplankton, marine mammals and bird monitoring and **c)** the available personnel and funds for data analysis.

Good Environmental Status indicators	Taxonomic levels	Community	Zooplankton (no species separation, Total zooplankton S_A)				
		Species	Adult	Mammals (Survey-dependent)			
				Birds (Survey-dependent)			
			Juvenile	Anchovy (Survey-dependent)			
				Sardine (Survey-dependent)			
			Larvae	Anchovy (Survey-dependent)			
			Egg	Anchovy (Survey-dependent)			
	Indicators	Biodiversity	Species	Population size	DEPM estimates	Stock Spawning biomass estimates for anchovy	
						Estimation error (CV)	
					Distributional pattern	Location	Centre of gravity
							Spatial patches
						Occupation of space	Inertia
							Isotropy
							Positive area
							Spreading area
							Equivalent area
						Statistical dispersion	Gini index
							Coefficient of variation of strictly positive densities
						Microstructure	
						Global index of collocation	
						Mean biomass	
						Percentage of total area occupied	
				Species distribution			
			Community	Fish Community condition	Relative population abundance		
			Ecosystem structure	Ecosystem processes and functions	Intra and Inter specific interactions concerning small pelagic species		
					Interactions between the structural components of the ecosystems		
					Services provided by biological diversities within ecosystems		
		Commercial fish	Reproductive capacity	Spawning Stock biomass (SSB)	DEPM SSB estimate (mainly addressing anchovy given the season of MEDIAS survey)		
					Acoustic SSB estimate		
				DEPM reproductive parameters[1]	Fecundity (mainly addressing anchovy given the season of MEDIAS survey)		
					Spawning frequency (mainly addressing anchovy given the season of MEDIAS survey)		

Recommendations addressed by the last Regional Coordination Meeting for the Mediterranean and Black Sea (RCMMed&BS) region in 2011:

The last RCMMed&BS carried out in Ljubljana (Slovenia) in May 2011 recommended to the MEDIAS group:

- to emphasize the current estate of development of the Regional Database for MEDIAS surveys and report it to the RCMMed&BS.

- to address their worries in relation to the maturity scales or any other methodological issues to the suitable groups (e.g. PGMed) and not to the Commission.

- to clearly follow the Terms of References defined and to inform about the resulting discussion in their annual reports.

Moreover, the RCMMed&BS recognizes the effort made by the Member States in order to increase the coverage of the MEDIAS survey to new areas which are not covered outside the DCF but stresses the importance to clearly reflect them in their report (for instance, in the case of the Tyrrhenian and Ionian Sea in 2011).

The RCMMed&BS 2011 following the evaluation and the results presented regarding the MEDIAS Steering Committee report 2011, drew up the Terms of Reference for the MEDIAS 2012 as follows:

Terms of Reference for the "MEDIAS 2012"

- To finalize the MEDIAS handbook.
- Development of a Regional Database.
- Development of a website.
- Use of data for stock assessment purposes.
- Propose workshop and studies to be evaluated by the RCMMed&BS 2012.

During the 5th MEDIAS coordination meeting, the MEDIAS group focused on the recommendations addressed by the RCMMed&BS, as well as on the TOR's drawn up for MEDIAS 2012 and discussed how to answer to these requirements.

- Concerning the MEDIAS handbook, the MEDIAS group has been working on it, updating some subjects according to the results from the studies carried out in the last years (i.e. Acousmed project). An updated copy has been included in this report (Annex III). It was agreed that this handbook will be updated and improved according to the outcomes and changes developed by the MEDIAS partners in an annual basis.

- The MEDIAS group made big progress towards the Development of a Regional Database within the framework of the Acousmed project. The fields of a common database related to acoustics were defined and presented. These fields were based on the revision of existing databases, DCF data requirements and abundance assessments. Moreover, fields and input data associated to acoustic surveys but connecting their output to the ecosystem approach to fisheries were defined. In the summary of the Acousmed project presented in this report, appears all the info concerning the DataBase framework proposed by the group although, it was agreed that additional funding is needed for the completion of the DataBase.

- Concerning the doubts that were raised concerning the clarification of mature/immature or active/inactive as the definition of maturity/immaturity was not clear, the group concluded that inactive will be immature and active will be mature and that this should be added to the MEDIAS protocol. This decision needs to be confirmed and accepted by the Mediterranean Planning Group for the Methodological Development (PGMED).

- The Development of a website has been considered and discussed by the MEDIAS group. The MEDIAS website will be a dynamic website, revised and updated every year. The work is going to be performed this year and

presented during the next MEDIAS Steering Committee meeting in 2013. Marco Barra, from CNR-IAMC, has offered to plan the design of this MEDIAS website with a List of possible contents:

- General info about the project
- Topics of the project
- Participants: Involved institutes and persons
- Map of study areas
- News
- Useful links
- Download section (Handbook, reports etc etc)
- Contacts: a list of mail address (one point of contact for each involved institute)

- the MEDIAS group agreed on the Terms of Reference for "MEDIAS 2013":

TERMS OF REFERENCE FOR 2013:

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.

Specific:

- Update MEDIAS handbook
- Develop the MEDIAS Website
- To Agree on a code list for the common database
- To work on common procedures to estimate a coefficient variation for acoustic estimates
- To Work on procedures to filter echograms to improve acoustic estimates.

- and, to finalize, the MEDIAS group discussed and agreed on the studies and workshops to be proposed the RCMMed&BS, that are described below.

Studies and Workshops

The MEDIAS group, considering their needs, proposes the next studies and workshops to be evaluated by the RCMMed&BS 2012:

A) Studies:

- Concerning the "Intercallibration study" proposed to the RCMMed&BS in 2010 and 2011, the MEDIAS group is still waiting for news from the Liaison meeting.

- TS « ex situ » study (Gualtiero Basilone ; Iole Leonori)

STUDY: STANDARDIZATION OF THE TARGET STRENGTH VS. LENGTH EQUATIONS FOR SARDINE AND ANCHOVY IN THE MEDITERRANEAN SEA BY THE MEDIAS (2012 PROPOSAL).

The MEDIAS project aims are to standardize and harmonize among countries the acoustic biomass evaluation in the Mediterranean Sea and should give information for management decisions and provide input to assessment for stocks which are managed internationally.

One of the most important sources of variability among different research groups working on acoustic biomass evaluation is the target strength vs length relationship for sardine and anchovy

The MEDIAS surveys target mainly sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus)* Mediterranean stocks and cover most part of the distribution area of sardine and anchovy. In order to obtain comparable results and be able to produce one single estimate of the target species abundance it is necessary to use the same target strength vs. length equation for each species. Unfortunately not enough data are present in literature to select the best value for all surveyed areas, and every group use an equation based on literature or in situ measurement (or both).

An important step towards the progress of the harmonization of the MEDIAS survey is to carry out a joint TS measurement experiment, by the different Institutes (Ifremer, France; IEO, Spain; CNR, Italy; HCMR, Greece) in order to test all the possible hypothesis about the variability of TS estimation and eventually adopt one common equation for each target species.

The TS experiment has to be done in a suitable area with known features and where past experience of TS measurements were carried out successfully for small pelagic fishes.

In the Sicilian proposed site during 2003 it was carried out one of these experiments which gave good results. However these results are considered as preliminary because of the low number of observations and the frequency used (200 KHz).

Another possible site is in the Adriatic Sea where ex situ experiments have been conducted in the past and results (at 38 and 120 kHz) are currently applied to produce biomass estimates for this area. In particular, for the case of ISMAR-CNR of Ancona a possible place to conduct such experiments would be the Muggia Bay next to Trieste in the North Adriatic Sea where these kind of trials were already done in the past (Azzali et al., 1997); this solution provides a good protection to bad weather conditions. There is the need to rent a research vessel to reach the place and for the adaptation and use of the structure for *ex situ* measurements. One week would be enough for this purpose. It is necessary to have a proper calibration floating net and cages to keep the fish alive and move it from fishery vessels to the calibration net. ISMAR-CNR already has these structures but both net and cages to transport and stabilize the fish have to be restored. Simrad EK60 with three split-beam transducers (38, 120 and 200 kHz) and a suitable platform for the adaptation of the transducers over the calibration net are already available. Purse seiners operating in the Trieste Gulf could be contacted to obtain alive fish

Duration: 18 months.

B) **Workshops**:

During the MEDIAS meeting, the needs of the MEDIAS acoustic surveys were discussed and the opportunity for the MEDIAS group of sharing knowledge with other Atlantic acoustic teams (France, Portugal, England…) was considered. For that, it was agreed by the group to propose a Joint Workshop with the WGACEGG acoustic scientists, next November in Fuengirola, Spain, for two days duration, working on 3 different subjects:

- ecosystem indicators from acoustic surveys (half a day).

- the use of R scripts developed for the estimation of spatial indicators using acoustic surveys data: A practical session and potential application for metadata analysis (Half a day).

- the use of R scripts developed for acoustic estimation by Ifremer (M. Doray): a practical session (One day)

On the other hand, it was discussed by the MEDIAS partners the necessity to improve TS detection and plankton filtering working with different frequencies and virtual echograms, to be able to obtain clean echograms and facilitate scrutinizing. For that reason, it was also proposed the possibility to carry out a Workshop in the next MEDIAS meeting (2013) dealing with the use of Echoview (Myriax, LTD) software tools, considering the participation of some expert from Myriax. This would require extra funding.

Specifically:
2 days workshop, 10-15 people: AUD $14,000 for up to 15 attendees. (requested budget from Myriax)

Scientific work carried by the MEDIAS group during the last year.

The scientific work carried out by the MEDIAS group last year is presented below:

a) Participation in EU projects:

1) Acousmed Project: Contract MARE/2009/09 SI2.557652.

"Harmonisation of the acoustic data in the Mediterranean 2002-2006".

Leader of the Project: Marianna Giannoulaki (HCMR)

MEDIAS partners involved:

1. Hellenic Center for Marine Research, Iraklion, Greece
2. Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine, CNR-ISMAR (Italia)
3. Consiglio Nazionale delle Ricerche, Istituto per l'Ambiente Marino Costiero, CNR-IAMC (Italia)

4. Institut Français de Recherche pour l'Exploitation de la Mer, IFREMER (Francia)
5. Instituto Español de Oceanografía, IEO (España).

Duration: 24 months, from 5/03/2010 to 4/03/2012.

2) MAREA/MEDISEH project: Contract number MARE/2009/05-/Lot 1 SI2.600741.

Leader of the MEDISEH Project: Marianna Giannoulaki (HCMR)

MEDIAS partners involved:

1. Hellenic Center for Marine Research, Iraklion, Greece
2. Consiglio Nazionale delle Ricerche, Istituto di Scienze Marine, CNR-ISMAR (Italia)
3. Consiglio Nazionale delle Ricerche, Istituto per l'Ambiente Marino Costiero, CNR-IAMC (Italia)
4. Institut Français de Recherche pourl'Exploitation de la Mer, IFREMER (Francia)
5. Instituto Español de Oceanografia, IEO (España).
6. Fisheries Control Directorate. Ministry for Resources and Rural Affairs (FCD-MRRA), Malta.

……..

Duration: 18 months, from 01/09/2011 to 28/02/2013

b) Papers published:

Habitat suitability modelling for sardine *Sardina pilchardus* in a highly diverse ecosystem: the Mediterranean Sea.

Maria Pilar Tugores[1], Marianna Giannoulaki[2],*, Magdalena Iglesias[1], Angelo Bonanno[3], Vjekoslav Ticina[4], Iole Leonori[5], Athanassios Machias[2], Konstantinos Tsagarakis[2], Núria Díaz[1], Ana Giráldez[6], Bernando Patti[3], Andrea De Felice[5], Gualtiero Basilone[3], Vasilis Valavanis[2]
Mar Ecol Prog Ser, Vol. 443: 181–205, 2011. doi: 10.3354/meps09366

*Corresponding author. Email: marianna@her.hcmr.gr

1 Centro Oceanográfico de Baleares, Instituto Español de Oceanografía, Muelle de Poniente s/n, 07015 Palma de Mallorca, Baleares, España

2 Institute of Marine Biological Resources, Hellenic Centre of Marine Research, PO Box 2214, 71003, Iraklion, Greece

3 Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Capo Granitola, 91021, Campobello di Mazara (TP), Italy

4 Institute of Oceanography and Fisheries, Šetalište I. Meštrovi a 63, 21000 Split, Croatia

5 Istituto di Scienze Marine, Consiglio Nazionale delle Ricerche, Largo Fiera della Pesca, 60125 Ancona, Italy

6 Centro Oceanográfico de Málaga, Instituto Español de Oceanografía, Puerto Pesquero s/n, 29640 Fuengirola, Málaga, España.

c) Papers submitted:

Paper submitted to Fisheries Oceanography:

Identifying the potential habitat of anchovy Engraulis encrasicolus at different life stages in the Mediterranean Sea.

M. GIANNOULAKI[1], M. IGLESIAS[2], M. P. TUGORES[2], A. BONANNO[3], B. PATTI[3], A. DE FELICE[4], I. LEONORI[4], J. L. BIGOT[5], V. TIČINA[6], M. M. PYROUNAKI[1], K. TSAGARAKIS[1], A. MACHIAS[1], S. SOMARAKIS[1], E. SCHISMENOU[1], E. QUINCI[3], G. BASILONE[3], A. CUTTITTA[3], J. MIQUEL[2], D. OÑATE[2], D. ROOS[5], V. VALAVANIS[1]

1Hellenic Centre for Marine Research, Institute of Marine Biological Resources,

PO Box 2214, GR 71003, Iraklion, Greece

2 Instituto Español de Oceanografia, Centro Oceanográfico de Baleares, Muelle de Poniente s/n, 07015 Palma de Mallorca, Baleares, España

3 Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Capo Granitola, 91021, Campobello di Mazara (TP), Italy

4 Istituto di Scienze Marine, Consiglio Nazionale delle Ricerche, Largo Fiera della Pesca, 60125 Ancona, Italy

5 IFREMER, Boulevard Jean Monnet, B.P. 171 34203, Sète Cedex, France

6 Institute of Oceanography and Fisheries, Šet. I. Meštrovića 63 21000, Split, Croatia

Corresponding author: Marianna Giannoulaki, e mail: marianna@hcmr.gr

Conclusions of the MEDIAS Steering Committee

In the 5th MEDIAS meeting results from the Acousmed project were presented and, according to that, the MEDIAS Steering Committee agreed and concluded that:

1.- The inter-transect distance in the acoustic surveys should be adjusted to achieve the minimization of the coefficient of variation of the acoustic estimates for the target species in each area, taking also into account survey duration.

2.- In order to achieve the optimization of the survey design in each area, a workshop should be regularly held within the framework of the MEDIAS annual meetings.

3.- to continue to use acoustic data from nighttime, when night sampling is inevitable (i.e. lack of time to cover the sampling area), during the MEDIAS acoustic surveys. Further analysis of the day-time and night –time acoustic sampling data are needed to verify the Acousmed initial results in terms of biomass and introduce possible corrections.

4.- 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 Lions were very limited.

5.- Concerning anchovy the coordination meeting 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 the anchovy TS should continue within the framework of specific MEDIAS workshops, using available data from additional areas, such as Croatia.

6.- The coordination meeting based on the Acousmed results concluded that biological samples collected during both day and night in the same survey could be merged and used for the necessary estimations.

7.- In the framework of the AcousMed project as well as a MEDIAS workshop, a common data base design has been concluded for all MEDIAS surveys (See ANNEX II, MEDIAS Handbook). The 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.

8.- The need for collaboration with respective surveys in the Atlantic (Bay of Biscay) has also been discussed and agreed by the Steering Committee and a Joint Workshop has been proposed for the next November in Fuengirola. In the framework of this collaboration, information and experience will be exchanged.

9.- The Steering Committee discussed and proposed ecosystem indicators that can be derived and provided from acoustic surveys, either on a regular basis (based on data regularly collected and analyzed) or on a potential basis (depending on survey peculiarities and available funding).

10.- Finally, the Steering Committee concluded for the next MEDIAS meeting to take place in Capo Granítola, Sicily, Italy. Dates proposed: 8-12 April 2013.

ANNEX I

List of participants

Name	e-mail	Country	Institute
Magdalena Iglesias Marroig	magdalena.iglesias@ba.ieo.es	Spain	IEO
Ana Ventero Martín	ana.ventero@ba.ieo.es	Spain	IEO
Athanassios Machias	amachias@ath.hcmr.gr	Greece	HCMR
Marianna Giannoulaki	marianna@her.hcmr.gr	Greece	HCMR
Angelo Bonanno	angelo.bonanno@iamc.cnr.it	Italy	IAMC-CNR
Gualtiero Basilone	gualtiero.basilone@iamc.cnr.it	Italy	IAMC-CNR
Marco Barra	marco.barra@iamc.cnr.it	Italy	IAMC-CNR
Simona Genovese	simona.genovese@iamc.cnr.it	Italy	IAMC-CNR
Jean-Louis Bigot	jean.louis.bigot@ifremer.fr	France	IFREMER
Iole Leonori	i.leonori@ismar.cnr.it	Italy	ISMAR-CNR
Andrea De Felice	a.defelice@ismar.cnr.it	Italy	ISMAR-CNR
Tomaz Modic	tomaz.modic@zzrs.si	Slovenia	FRIS
Roberta Mifsud	roberta.mifsud@gov.mt	Malta	FCD-MRRA
Valodia Maximov	vmaximov@alpha.rmri.ro	Romania	NIMRD
George Tiganov	gtiganov@alpha.rmri.ro	Romania	NIMRD
Marina Panayotova	mpanayotova@io-bas.bg	Bulgaria	IO-BAS
Vjekoslav Tičina	ticina@izor.hr	Croatia	IOF
Lotfi Ben Abdallah	lotfi.benabdallah@instm.rnrt.tn	Tunisia	INSTM
Salaheddine El Ayoubi	s_elayoubi@yahoo.com	Moroco	INRH

Annex II

Institutions Acronyms

IEO: Instituto Español de Oceanografía, Spain

HCMR : Hellenic Center of Marine Research, Greece

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

IAMC-CNR : Istituto per l'ambiente marino costiero. Consiglio Nazionale delle Ricerche. Sicily, Italy

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

FCD-MRRA: Fisheries Control Directorate. Ministry for Resources and Rural Affairs. Malta.

FRIS: Fisheries Research Institute of Slovenia. Ljubljana, Slovenia

IOF: Institute of oceanography and fisheries. Split, Croatia.

NIMRD: National Institute for Marine research and development "Grigore Antipa". Constantza, Romania.

IO-BAS: Institute of Oceanology, Bulgarian Academy of Sciences, Varna, Bulgaria

INSTM: National Institute of Sciences and technologies of the sea. Tunisia.

INRH: Institut National de rechercheé halieutique. Morocco.

Annex III

5th MEDIAS Coordination Meeting

(Mediterranean Acoustic surveys)

Sliema, Malta 20-22 /03/2012

Agenda

Tuesday 20/03/2012

09:00 - 09:30: Opening of the meeting & welcome. Adoption of the agenda.

09:30 – 10:15: Presentation of the MEDIAS acoustic surveys: brief summary (M. Iglesias).

10:15 – 11:00: RCMMed&BS recommendations.

11:00 - 11:30: Coffee break

11:30 – 12:30: Terms of Reference for the "MEDIAS 2012":

- Improvements in the MEDIAS handbook
- Development of a Regional Database.
- Development of a website

12:30 – 13:00: General discussion and Revision of the common MEDIAS protocol.

13:00 - 14:00 Lunch break

14:00 - 14:30: Presentation of the Adriatic survey (Iole Leonori, Andrea De Felice).

14:30 – 15:00: Presentation of the Gulf of Lions survey (Jean-Louis Bigot).

15:00 – 15:30: Presentation of the Strait of Sicily survey (Angelo Bonanno, Gualtiero Basilone).

15:30 – 16:00: Presentation of the Iberian survey (Magdalena Iglesias)

16:00 - 16:30: Coffee break

16:30 – 17:00: Presentation of Black Sea surveys: Rumania-Bulgaria (Marina Panayotova, Valodia Maximov).

17:00 – 17:30: Presentation of Croatian survey (Vjekoslav Ticina).

17:30 – 18:00: Presentation of Tunisian survey (Lotfi Ben Abdallah).

18:00 – 18:30: Presentation of Morocco survey (Salaheddine EL AYOUBI)

18:30 – 19:00: General discussion

Wednesday 21/03/2012

09:00 – 11:00: Presentation of the results of the AcousMed project: "Harmonization of the acoustic data in the Mediterranean 2002-2006" (Marianna Giannoulaki).

11:00 - 11:30: Coffee break

11:30 – 13:00: Presentation of the results of the AcousMed project: "Harmonization of the acoustic data in the Mediterranean 2002-2006" (Marianna Giannoulaki).

13:00 – 14:00 Lunch break

14:00 – 16:00: Discussion on the RCM Med & BS presented and approved (???) study: intercallibration exercise by the R/V involved in the five MEDIAS acoustic surveys.

16:00 - 16:30: Coffee break

16:30 – 17:30: Forms and formulas to merge the information of different hauls in a sub-area (in terms of sizes and percentages in number/weight). (Andrea De Felice)

17:30 – 18:30: Brief report of the ICES WGSPEC: “Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact”, carried out in Fuengirola, Spain, last 27 February – 2 Mars 2012. (Andrea De Felice).

Thursday 22/03/2012

09:00 – 11:00 Workshop on Ecosystem indicators from the acoustic MEDIAS survey (Marianna Giannoulaki)

11:00 - 11:30: Coffee break

11:30 – 13.00: MEDIAS ToR’s:

- Use of data for stock assessment purposes.
    - Propose workshop and studies to be evaluated by the RCMMed&BS 2012:
        - Workshop on mutual interest subjects with the WGACEGG in 2012 like ecosystem indicators or TS, …
        - TS study “ex situ”, …

13:00 – 14:00 Lunch break.

14:00 – 15.00: Discussion of results.

15:00 – 16:00: Terms of reference for next meeting (2013).

16:00 – 16:30: *Coffee break*

16.30 – 18.00: Adoption of the report.

Annex IV

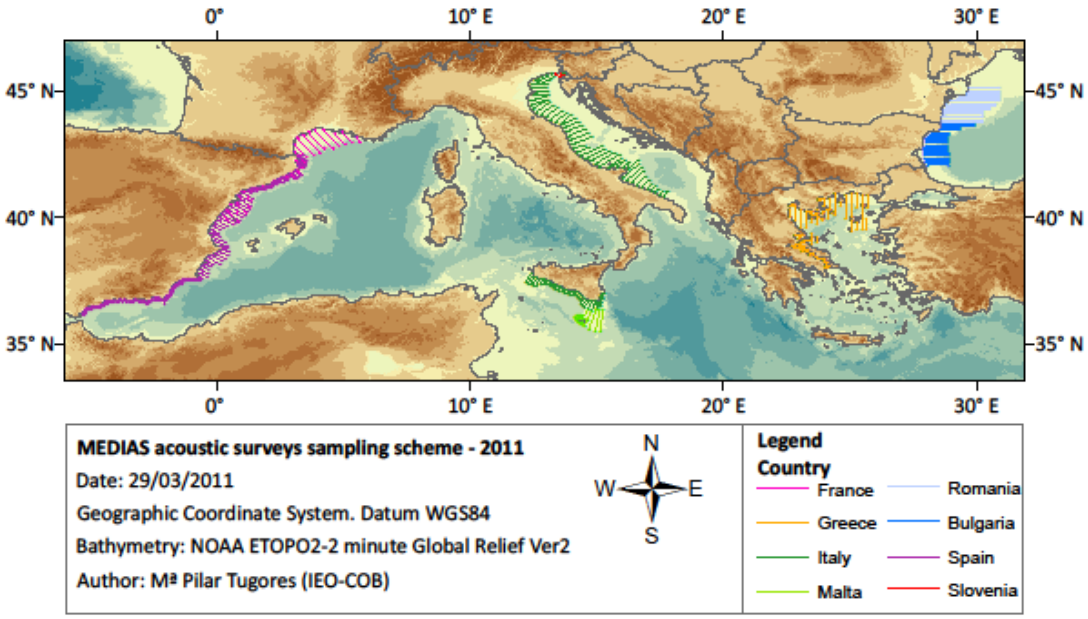
MEDIAS HANDBOOK (Athanassios Machias)

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 *. (Note that it should be updated in an annual basis). **Day night sampling.

Country	**Institute**	**Geographical area**	**Size of area**	**Duration of survey (days)**
Greece	HCMR	Aegean Sea	9 000 NM^2	40
France	IFREMER	Gulf of Lions	3 300 NM^2	30
Slovenia	FRIS	Adriatic Sea (Slovenia)	117 NM^2	1**
Italy	CNR-ISMAR	Adriatic Sea (Italy)	13 100 NM^2	40**
Italy - Malta	CNR- IAMC/FCD-MRRA	Sicily channel	2 700 NM^2	16
Spain	IEO	Iberian coast	8 829 NM^2	33
Bulgaria Romania	Institute of Oceanology - BAS NIMRD “Grigore Antipa”	Black Sea	7700 NM^2, (Romania 4300 NM^2 Bulgaria 3400 NM^2)	40 (2 surveys 20 days each)



(*) In Table 1 and Figure 1 the Croatia (EU candidate country) is not presented as it is yet not incorporated into the DCF. The Croatian part of Adriatic Sea (surveyed area: 13,580 NM2) is covered by a survey carried out by the Institute of Oceanography and Fisheries (IOF). EC should foresee the inclusion of the survey covering the eastern part of GSA 17 (30 days) in the MEDIAS in the near future.

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 follow vessel characteristics should be reported: Name of vessel, vessel length and vessel HP.

Echo sounder parameters

A variety of equipment with specific characteristics could be considered as adequate for the assessment of small pelagic. 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 120 and/or 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 data acquisition will be at -80 dB for compatibility reasons, while the threshold for assessment should be -70 to -60 depending on the survey and should be reported. As the main objective is the optimum discrimination between fish and plankton, 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 perpendicular to 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 it is not advisable to 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 in 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 from 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 encounter 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 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. Further analysis of the day-time and night-time acoustic sampling data are needed to verify the Acousmed initial results in terms of biomass and introduce possible corrections.

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). 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. Base 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 Lions were very limited.

Analysis results concerning anchovy indicated large differences between areas. For this purpose the coordination meeting 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 the 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.

5) Abundance indices

The follow 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. Specifically, for the two target species the abundance estimates that should be 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.

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. 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 the occurrence of different echo traces in the sounder 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 period 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 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.

- In an acoustic survey a standard total number of hauls could not be set because it depends on the distribution and abundance found in each survey. In any case the haul 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.

Biological and oceanographic parameters.

The follow biological parameters should be estimated in each survey.

The Length frequency distribution (0.5 cm) should be estimated from a representative sample for each species per haul. Total length will be measured for all species. The Length– Weight relationship for all 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 hydrographical 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 respective surveys in the Atlantic (Bay of Biscay) has also been discussed and agreed. In the framework of this collaboration, information and experience will be exchanged.

Data Base

In the framework of the AcousMed project as well as a MEDIAS workshop, a common data base design has been concluded for all MEDIAS surveys (See ANNEX II). The 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.

Tables

The data and the common format of the Tables that will regularly be provided to the DCF are the following

TABLE 1.

COUNTRY	AREA	YEAR	NAME_OF_SURVEY	SPECIES	SEX	LENGTH_CLASS	NUMBER	BIOMASS(Kg)
				ANE				
				ANE				
				PIL				
				PIL				
				PIL				

TABLE 2.

COUNTRY	AREA	YEAR	NAME_OF_SURVEY	SPECIES	SEX	AGE_CLASS	NUMBER	BIOMASS (Kg)
				ANE		0		
				ANE		1		
				ANE		2		
				ANE		3		
				ANE		4		
				PIL		0		
				PIL		1		
				PIL		2		
				PIL		3		
				PIL		4		

ANNEX I

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)	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 II

The Common Database for Acoustics (Figs. 1 to 7) adopted in the 5th MEDIAS meeting.

The major fields agreed are associated to:

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

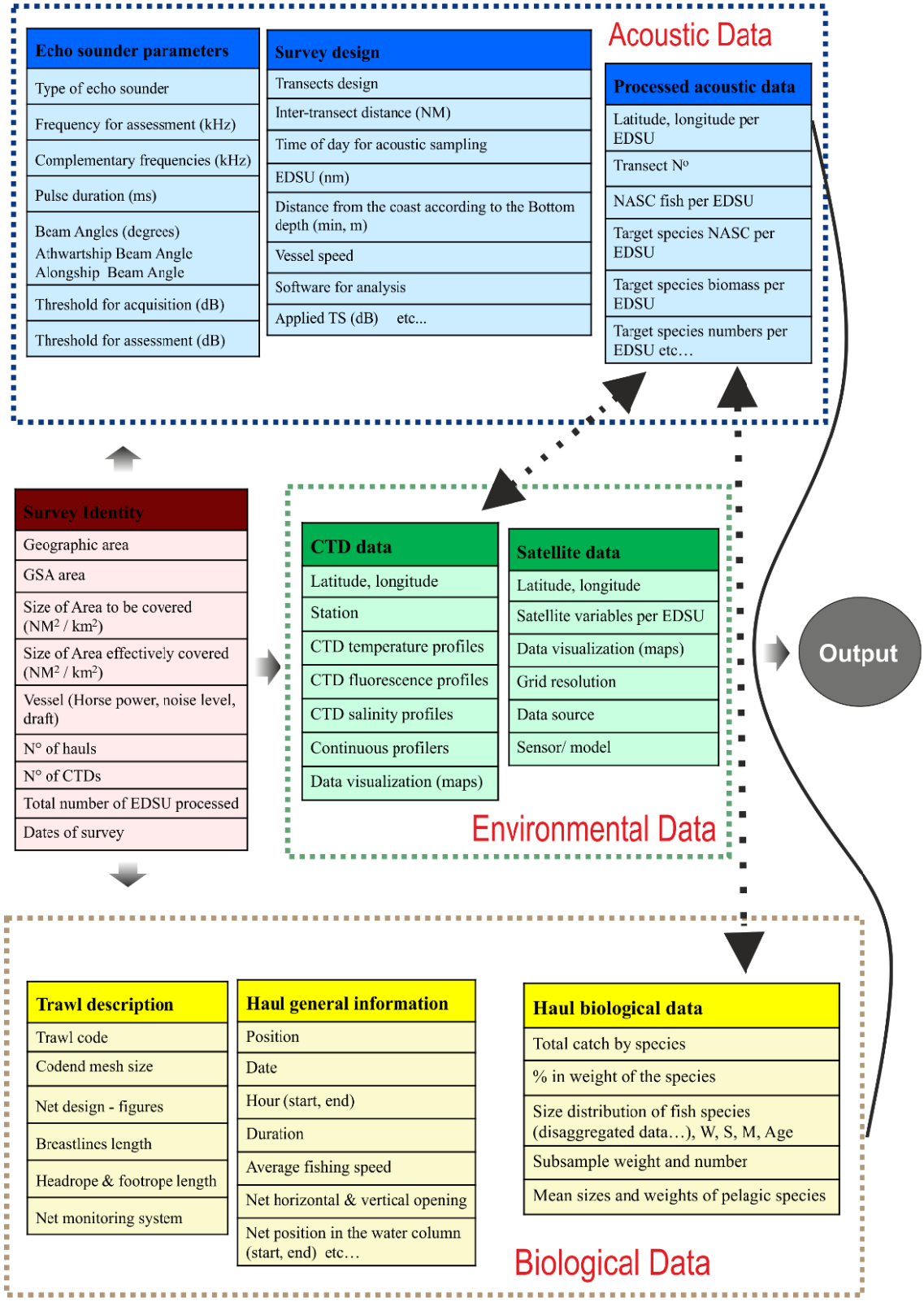


Figure 1. General outline of a database for acoustic surveys.

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

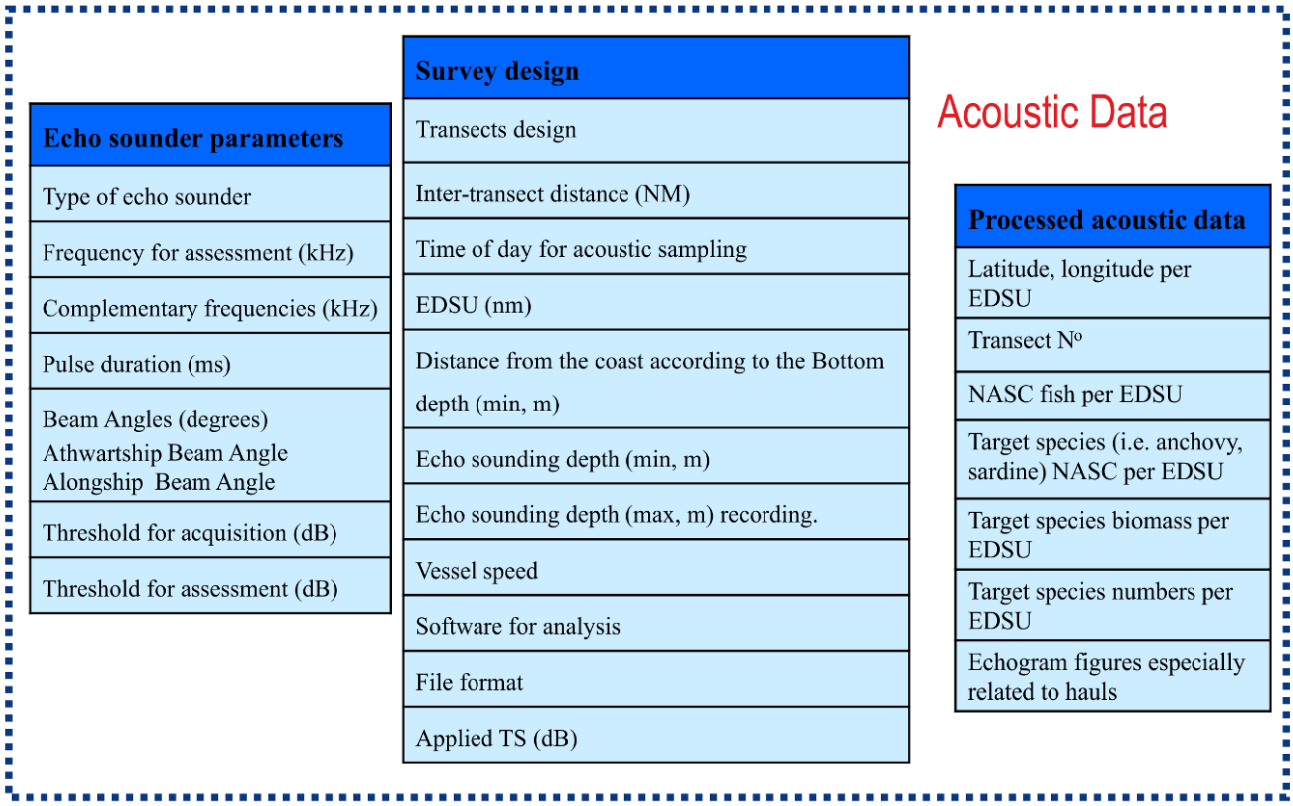


Figure 3. Fields associated with input info on Acoustic Data

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 or through direct allocation of NASC to species if otherwise

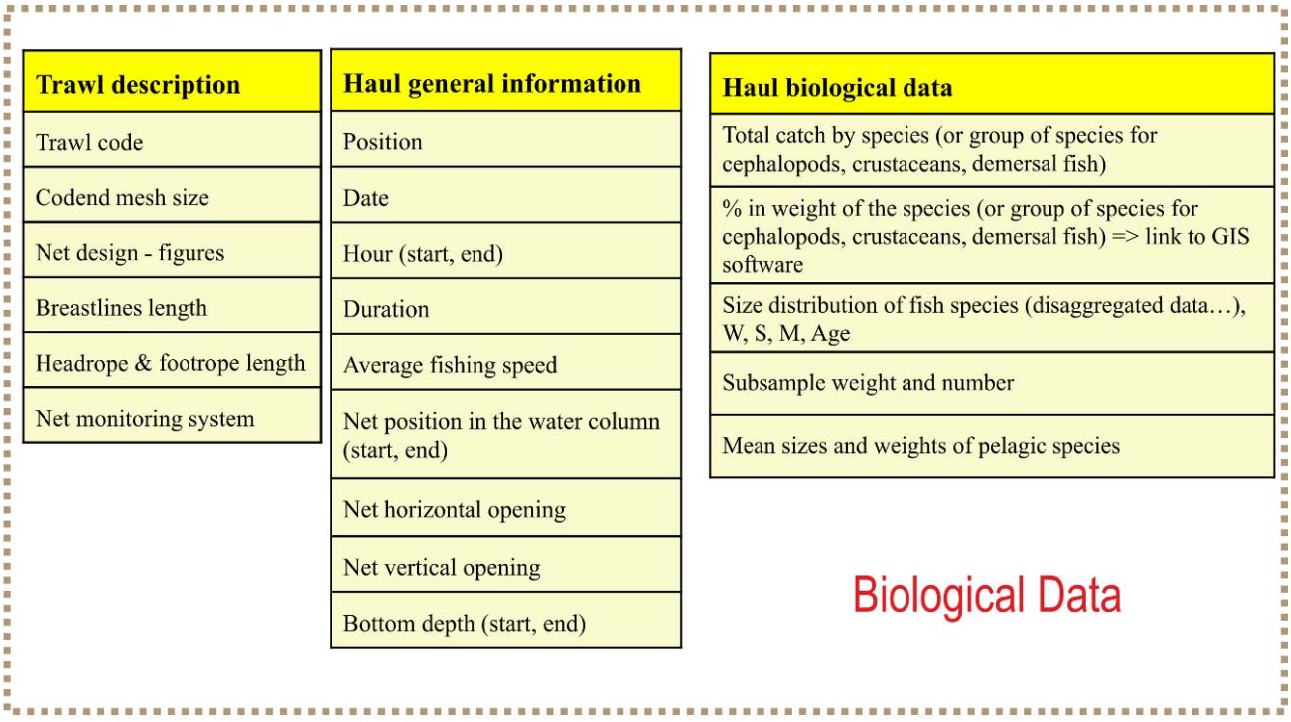


Figure 4. Fields associated with input info on Biological Data related to acoustic surveys

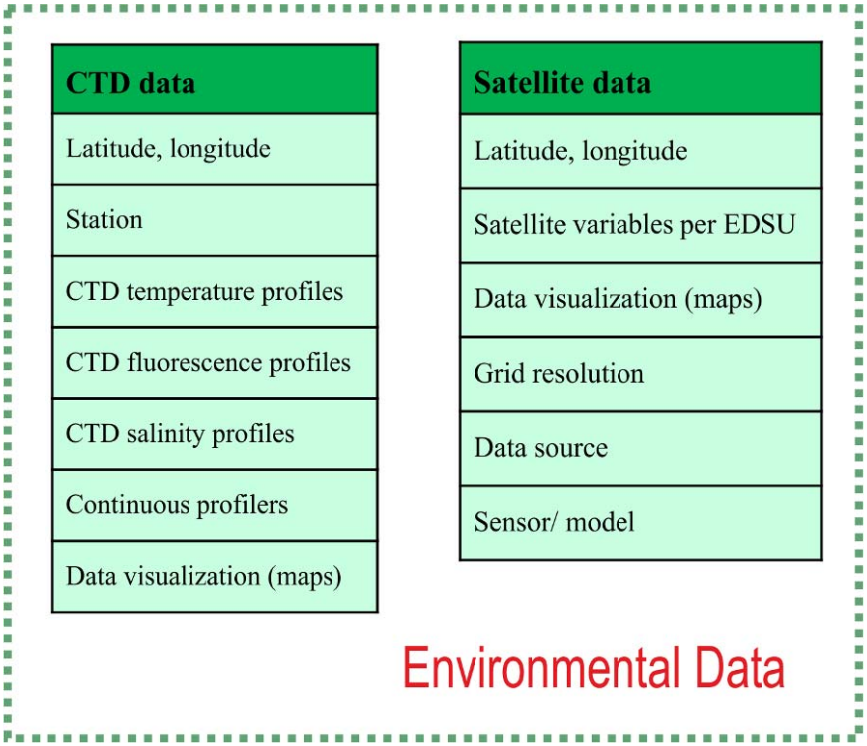


Figure 5. Fields associated with input info on Environmental Data related to acoustic surveys

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

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

Abundance estimates

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 6. 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 7. Database Fields related to electroacoustic calibration report.