Report of 4th meeting for MEDIterranean Acoustic Surveys (MEDIAS)

in the framework of European Data Collection Framework

Ancona, Italy, 28-30 March 2011

Steering Committee Report

CONTENTS

Introduction

The current meeting took place in Ancona (Italy) between 28th and 30th March 2011. The aim of the meeting was

a) To improve the common Protocol (as adapted in the previous MEDIAS meetings that were held in Athens-2008, Palma-2009 and Sicily-2010) for the Pan-Mediterranean Pelagic survey (MEDIAS) which is incorporated in the DCF framework.
b) To coordinate the third MEDIAS survey of 2011.
c) To improve the optimization of the surveys in the different regions through a workshop on the survey design and
d) To improve the harmonization of the surveys in the different regions through a workshop on sardine and anchovy target strength estimation.

Participants in the meeting were representatives from all European Union countries involved in acoustic surveys in the Mediterranean (i.g. Greece, Italy, Slovenia, Malta, France and Spain) as well as representatives from the EU countries operating in the Black Sea (i.g. Bulgaria and Romania). In addition, participation of a scientist from Croatia as an EU candidate country (that covers by acoustic survey the eastern part of the GSA17) participated as an observer was supported by FAO AdriaMed Project.

Additionally, in this 4th MEDIAS meeting scientists from North African Mediterranean countries (i.g. Morocco, Algeria and Tunisia) working on fisheries acoustics in Mediterranean Sea were invited to participate, as well as a scientist from Turkey, working in acoustic surveys both in Mediterranean and Black Sea (see list of participants in ANNEX I). The participation of the scientists from Morocco, Algeria and Tunisia was financed by the FAO Copemed II project (Co-ordination to Support Fisheries Management in the Western and Central Mediterranean).

During the first day the participants adopted the agenda of the 4th MEDIAS Meeting (see ANNEX II). Following the agenda, the first day was devoted to discuss the results of the 2010 MEDIAS acoustic surveys carried out by the MEDIAS partners and the non EU countries

(Figure 1) as well as to discuss and improve the MEDIAS common protocol. The summary of the common protocol adopted in the previous meeting is reported in ANNEX III.

During the second day a workshop took place regarding the geostatistical analysis of past acoustic surveys in order to improve the harmonization of the acoustic survey design. Dr. Pierre Petitgas from IFREMER, expert on this subject, assisted the workshop by correspondence. The aim of the workshop was to examine and recommend possible improvements of the survey design of each region. Results from this workshop are available in ANNEX IV.

Dr. Enrico Arneri (FAO, Coordinator Project AdriaMed and MedSudMed) welcomed the participants, congratulated the team and the organizers for the effort of standardization of the Mediterranean acoustic surveys and encouraged the group to produce overall analysis with the overall picture of the Mediterranean Sea.

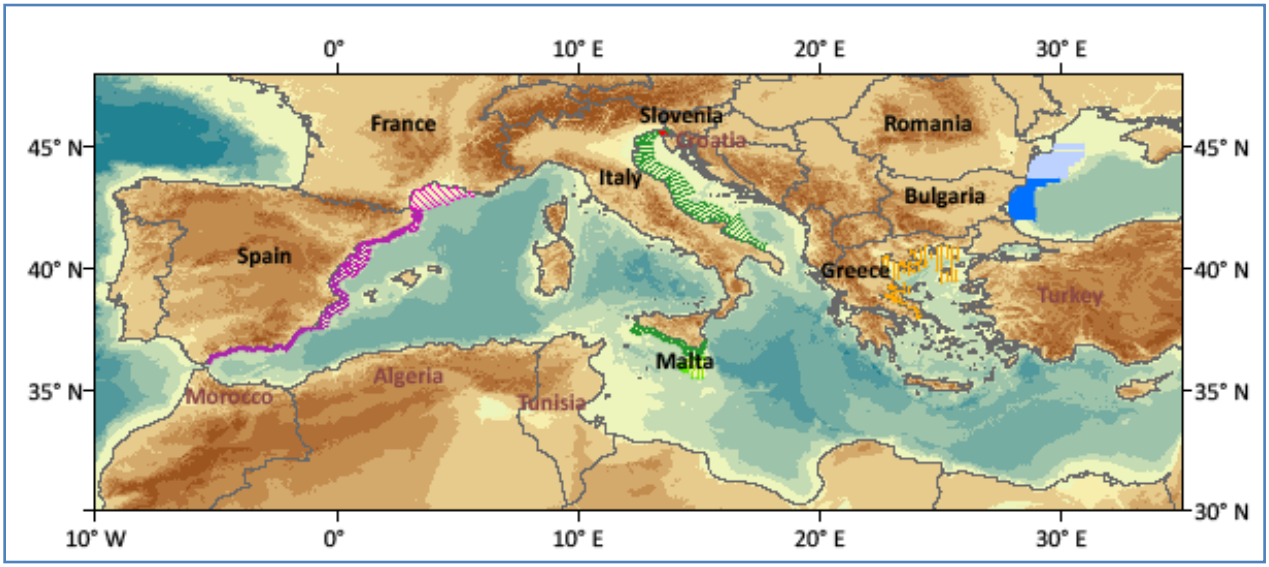

Figure 1.- MEDIAS acoustic surveys design.

A) Surveys held in 2010 in the framework of the Mediterranean Acoustic Survey and acoustic surveys from non EU Mediterranean countries

During 2010 five acoustic surveys were carried out under the umbrella of the MEDIAS project: the west Adriatic survey (including Slovenian waters), the Gulf of Lions survey, the

Sicilian survey (including Maltese waters), the Black Sea acoustic survey (Bulgaria and Romania) and the Iberian acoustic survey. In the first day of the meeting, a presentation of the 2010 acoustic surveys in each area was shown in relation to the common protocol in order to define the progress done so far as well as to define the points needed further harmonization.

It is important to note once more this year the impact of the absence of Greek coverage in the MEDIAS surveys since the DCF was not applied by Greece during 2010. Due to this fact, Dr. A. Machias presented the results from the acoustic surveys carried out in the Thracian Sea during 2010 within the framework of the REPRODUCE project (MARIFISH Eranet) (Figure 2). The REPRODUCE surveys cover 1/3 of total MEDIAS survey area. The Thracian Sea (GSA 22) has a high interest because it is directly affected by Black Sea waters. REPRODUCE surveys were performed twice during the year 2010, in May and July, being the first time that this kind of surveys were performed two times in the beginning and the peak of the reproduction period of anchovy . Anchovy and sardine abundances were presented, and differences between the two sampling periods were explained principally by migration of the species.

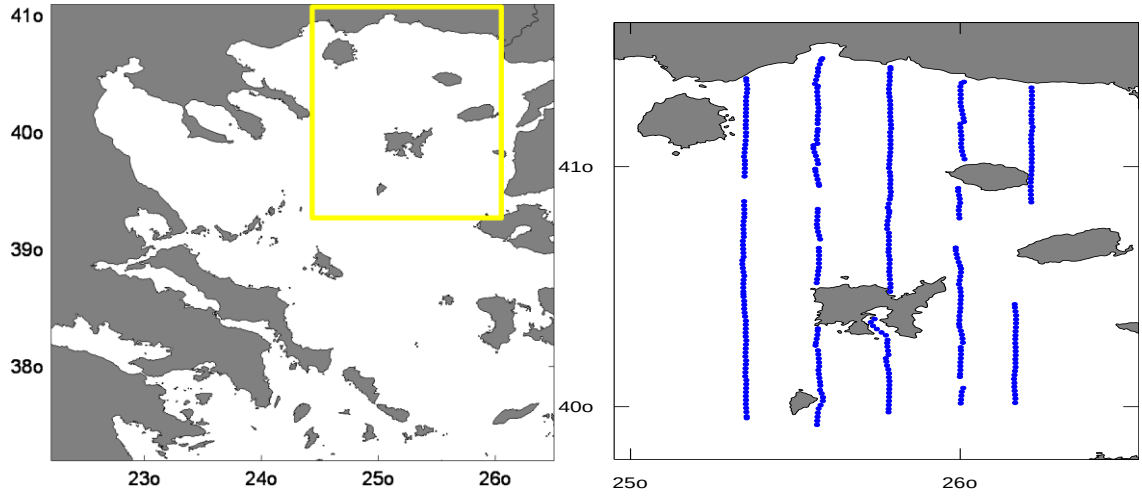

Figure 2. - Thracian acoustic survey coverage in Greece.

Dr. I. Leonori presented the acoustic surveys carried out in West North and Central Adriatic (GSA 17) in September 2010 (including territorial waters of Slovenia) and in Southern Adriatic

(GSA 18) in July 2010. Due to very bad weather conditions only 90% of the GSA 17 area was covered. Results from the 2010 acoustic surveys were still under elaboration.

No results were presented from the Croatian acoustic survey carried out during 2010 in the East Adriatic Sea (GSA 17 and one transect in GSA18). Dr. Ticina's presentation was aimed to explain the acoustic methodology applied during the survey and suggested some improvements for the MEDIAS protocol such as to include information on data deviation from the beam model (RMS value) in the calibration report and the collection of additional ecosystem related biological parameters (i.g. chlorophyll a, oxygen, phytoplankton, zooplankton, fish nutrition...) as optional. Dr. A. De Felice suggested also adding the sA correction in the calibration MEDIAS protocol table.

Dr. G. Basilone presented the results from the Sicilian channel acoustic survey that covered the GSA 16 (Sicily) during the 1st and 2nd week of July and the GSA 15 (Malta) during the 3rd and 4th week of July. He reported the use of a new research vessel "Maria Grazia", a multi-disciplinary vessel, 42 m long, equipped with two frequencies (38 and 120 kHz), and the technical problems they had in order to adapt the pelagic trawl from the R/V "Dallaporta". Results from the survey showed a bimodal anchovy frequency distribution length, and an early spawning was detected. Also for sardine a bimodal frequency distribution length was found unexpectedly. The Tyrrhenian Sea area was not covered in 2010.

Dr. J.L. Bigot presented the results from the 2010 Gulf of Lions acoustic survey, focusing on the very low biomass of the large sardine found for the two last years. Surprisingly, *Sprattus sprattus* appeared in all the hauls.

Dr. M. Iglesias presented the results from Iberian acoustic survey and notified the performance of an intercalibration exercise between the French R/V "L'Europe" and the Spanish R/V "Cornide de Saavedra" in Spanish waters. *Sprattus sprattus* was also found in the most northern part of the area, in accordance with French reports.

Dr. M. Panayotova presented the results from the first Black Sea acoustic survey performed by Rumania and Bulgaria in December 2010. Acoustic survey was carried out during the

period 6-13 December 2010 in GSA 29 including partially territorial waters and EEZ of Bulgaria and Romania. Target species were sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangus*).The acoustic survey had planned to cover a bigger area of GSA 29 during May and September, but due to bureaucratic problems a unique survey was conducted during 8 days at the end of 2010. Due to the short time between the survey and the MEDIAS meeting, acoustic and biological data were processed partially. They presented preliminary results of total fish and do not include yet abundance and biomass by species. Problems with the calibration exercise were reported due to the scarcity of sheltered zones in the area and the very bad weather.

Mr. S. Sakinan from the Middle East Technical University, Institute of Marine Sciences (METU, IMS) in Mersin, Turkey, presented the results from the North Eastern Levantine Sea acoustic surveys (East Mediterranean) carried out in June and October of 2009 and 2010 (4 surveys) and the methodology employed. As there is a multi-specific area, they apply data mining to classify schools:

- Unsupervised clustering with Echoview extracted data (morphometry, energy and position).
- Supervised classification using Artificial Neural Networks (ANN).

For the near future they are going to start a new project in the Southern Black Sea area (4 years) aimed at anchovy. Surveys design and equipment will be harmonized with MEDIAS protocol. Dr. Machias pointed the possibility of including 3 more transects to cover the Marmara Sea (GSA 24).

Mr. L. Ben Abdallah from the National Institute of Sciences and Technologies of the Sea (INSTM) in Tunisia presented an overview of the acoustic surveys carried out in the Tunisian continental shelf (GSA 12, 13 and 14) during the last 14 years. They detect and estimate abundances of 9 pelagic species: sardine, round sardinella (*Sardinella aurita*), anchovy, Mediterranean horse mackerel (*Trachurus mediterraneus*), Atlantic horse mackerel (*Trachurus trachurus*), blue jack (*Trachurus picturatus*), Atlantic mackerel (*Scomber scombrus*), Spanish mackerel (*Scomber colias*) and bogue (*Boops boops*). Acoustics are

carried out only during the day by means of an EK-500 scientific echosounder working at 38 kHz. Movies software is used for scrutinizing acoustic data, PESMA software (J. Miquel, IEO, Spain) for estimating pelagic fish abundances and Surfer software for mapping. Total pelagic NASC was presented, not split by species. The most abundant species, for the last survey in 2009, is sardine (27.9 %) followed by *Trachurus mediterraneus* (11.0%).

Mr. A. Bennoui from the "Centre de Rechercheé et de Développement de la Pêche et l'Aquaculture" (CNRDPA) in Algeria presented the future plans for acoustic surveys in this country (GSA 04) where 85% of the catches are small pelagic, the most abundant being the sardine. According to the landings, the most important species is *Sardina pilchardus* and the second, *Sardinella aurita*, but they also have bogue, mackerel, *Trachurus* spp, etc. Mr. Bennoui explained the availability of a new R/V "Belkacem Grine", 40 m long, and equipped with a SIMRAD EK60 (3 frequencies), an ITI to control the trawl, a thermosalinometer and a CTD to carry out the surveys. They are planning to carry out the first acoustic survey at the end of 2011 in autumn. Mr. Bennoui explains the survey design and methodology they are going to apply, in accordance with MEDIAS protocol.

Mr. J. Settih from the "Institut National de Rechercheé Halieutique" (INRH) in Morocco presented the acoustic survey carried out in their Mediterranean waters in April 2008. He presented the study area (GSA 03), the survey's goal, the survey design (zig-zag survey design, 5 nm inter-transect), and the results in abundance (nº individuals) and biomass (tons) by pelagic species.

MEDIAS handbook

The Table summarizing the MEDIAS protocol was presented by Dr. Machias and changes were proposed to update the protocol. It was proposed to use this table to design the first MEDIAS handbook required by the Regional Coordination Meeting Committee last year (2010). A draft was presented by Dr. Machias and distributed to all the participants in order to propose improvements and to agree on a common format (ANNEX V). It was agreed to

have a workshop about survey planning to be sure the same principles are used to design the survey.

Ecosystem indicators

Dr. I. Leonori introduced the Ecosystem indicators topic from the acoustic MEDIAS survey. The Marine Strategy Framework Directive (MSFD) adopted in July 2008 aims at achieving or maintaining a good environmental status by 2020 at the latest. The Commission Decision on criteria and methodological standards on good environmental status (GES) of marine waters in the framework of Article 9 (3) of the MSFD contains a number of criteria and associated indicators for assessing good environmental status, in relation to the 11 descriptors of good environmental status laid down in Annex I of the Directive. The National Programs require the estimation of the environmental indicators listed in appendix XIII of the DCR. The following table reports the surveys data sources that will be used for each indicator that can be acquired during surveys:

Indicator	Definition	Source
1)	Conservation status of fish species - Indicator of biodiversity to be used for synthesizing, assessing and reporting trends in the biodiversity of vulnerable fish species	MEDITs/ MEDIAS
2)	Proportion of large fish - Indicator for the proportion of large fish by weight in the assemblage, reflecting the size structure and life history composition of the fish community	MEDITs/ MEDIAS
3)	Mean maximum length of fishes - Indicator for the life history composition of the fish community	MEDITs/ MEDIAS
4)	Size at maturation of exploited fish species - Indicator of the potential “genetic effects” on a population	MEDITs/ Biological sampling of catches

The MEDITS survey results have been used to estimate ecosystem indicators 1 to 4 listed in appendix XIII of the DCR. MEDIAS survey partners have to record data necessary to assess

indicators n°1, 2 and 3 of appendix XIII of the DCR in the ambit of the pelagic ecosystem. The TOR was inserted into all surveys groups in response to the MSFD requirements of GES (Good environmental status) descriptor 3.3. It is particularly important for the pelagic survey groups, as is the MEDIAS group, because most of the existing work on these indicators comes from demersal and trawl survey research. There is a clear need in the future to identify a priority list of ecosystem indicators derived from acoustic surveys that can be used for Ecosystem Approach to Fisheries Management (EAFM) and for the MSFD. Ideally this should also describe how such data should be collected and how to assure their quality.

After discussion of the subject participants proposed to carry out a common workshop with ICES scientists involved in acoustic surveys to provide advice on the prioritisation of potential ecosystem indicators that either are or could potentially be collected or estimated.

Inter-calibration exercise by the MEDIAS research vessels

The MEDIAS project aims to join and harmonize the five ongoing acoustic surveys in the Mediterranean Sea and should give information for management decisions and provide input to assessment for stocks which are managed internationally.

The MEDIAS survey is a multi-vessel survey that target mainly sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus)* Mediterranean stocks and each research vessel covers 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 target species abundance it is necessary to inspect and calibrate any possible differences in the respective research vessels measurement capabilities.

An important step towards the progress of the harmonization of the MEDIAS survey is to carry out an inter-calibration between the research vessels used by the different Institutes in order to test the overall performance of the acoustic and hauling equipment of the vessels in the field.

It was agreed by the Steering Committee to present again to the RCM the proposal for a study intercallibration exercise by the R/V involved in the MEDIAS acoustic surveys and to investigate the possibility to include in this study Croatian research vessel as well, that probably in near future will be a vessel involved in the MEDIAS.

B) Workshop on Survey design: geostatistics

During the second day of the meeting Dr Marianna Gianoulaki presented a summary of the work performed during the Joint AcousMed project/ICES WGACEGG (ICES Working Group on Acoustic and Egg Surveys for Sardine and Anchovy in ICES areas VIII and IX) Workshop on Geostatistics (WKACUGEO) in November 2010 in Palma de Mallorca.

First of all, the geostatistical work carried out in each area was presented. ECOMED acoustic surveys were presented by M. P. Tugores, who made an overview of the methodology applied in this area (transitive and intrinsic) and the different approaches (raw data, log transformation, removing high values…) applied, as well as the results from all the approaches.

Gulf of Lions acoustic surveys were presented by J.L. Bigot, focusing on the CVgeo estimated for anchovy and sardine and the absence of spatial structure across the area.

Sicily Strait acoustic survey was presented by M. Barra, for the 2002-2008 period using EVA2. High nugget and short range were observed and, generally, non-centered covariance showed clearer picture of the spatial structure in the directional variograms. When the non-centered covariance did not show the spatial structure, semivariance was used. For some years, when the spatial structure was not seen with the raw data, high values were removed. M. Barra encourages the use of RGeoS software to optimize and standardize protocol and suggested the use of a script written by him.

West Adriatic acoustic surveys was presented by Dr. C. Vasapollo for 2008-2009 surveys when transects where established as parallel. Software's used were RGeoS and EVA2 and applied to anchovy, both for raw data and log transformed data.

East Adriatic survey (i.e. eastern part of GSA 17) was presented by Dr**.** V. Ticina on data from 2008, 2009 and 2010, log transformed. Only omnidirectional variograms were presented. Sill represented between 90 and 95% of the model value applying a linear model. Dr. Giannoulaki suggested the fit of nugget effect along with a spherical/exponential model when it is possible in order to be able to try different spatial models and underlined the problem of using degrees to plot variograms in a big area like the whole Croatian. Moreover certain cases presented unbounded behavior so a detrending approach was suggested.

Geostatistics in the Aegean was presented by Dr. M. Giannoulaki on data from 2003-2006 and 2008 and anchovy and sardine NASC values. The area was divided in subareas due to topography. The results show the Thracian Sea as an area of non pronounced anisotropy, the Thrermaikos gulf has shorter ranges of correlation for sardine than for anchovy and in the North Evoikos Sea very small scales spatial structures were found.

After that, Dr. M. Giannoulaki introduced the approach of indicator variogram that Dr. Pierre Petitgas suggested to apply during this workshop. The work was based on the analyses and the fill of a table that was decided in the previous meeting. The rest of the day was dedicated to work on indicator variograms. It was decided to choose one year of average abundance of anchovy to work with. EVA2 software, as well as the documentation related was given to the new participants in the meeting.

It was agreed by the group that the indicator approach could be a good option for homogenizing the work from the different areas in order to write a common publication.

It was also agreed by the group the use of the script from M. Barra for applying indicator variograms following a common approach and thus will allow having the same outputs for the different areas.

Results from this workshop can be found in ANNEX IV as well as planning for future work.

C) TS estimation: anchovy & sardine

The third day of the meeting was dedicated to work on TS estimation of anchovy and sardine and to other issues. An overview of the common protocol agreed in past meetings to work on TS determination was presented by Dr. M. Iglesias as well as a brief presentation of preliminary TS results obtained by the different Institutes.

A table comparing the TS used in the different areas, both Atlantic and Mediterranean, was presented. It was pointed the fact that, although it was decided in the protocol to collect data on TS "in situ" at 0.5 ms, when working on past data the normal was to have gathered the acoustic data at 1 ms. It was also noted that it is easier to find monospecific anchovy trawls (especially at night) than for sardine, thus it has been common than more trawls are available for anchovy than for sardine to work on TS determination. Results were discussed by the group.

Some demonstration of the methodology for extracting in situ TS measurements by means of the Fishtrack module was shown by M. Pyrounaki and some suggestions were made by the participants relative to the number of pings used for determining a fish track as an only individual.

Regarding the work on TS and having in mind all the problems encountered when computing in situ TS measurements and the instability that has been found so far to the results from the different partners, it was proposed by the group to continue working and harmonizing the TS protocol, with single targets and not using fish tracks.

It is advisable to conduct more TS measurements of European anchovy and sardine, in various environmental conditions, to further investigate the range of variations of their TS. Assessing the range of TS variability is in fact crucial to the accurate computation of the estimation error around the fish biomass estimates. New targeted TS experiments should ideally be conducted in more controlled experimental conditions such as in cages. It was agreed by the Steering Committee to present a study proposal on TS in cages ("ex situ") to the next RCM Med & BS.

Bearing in mind the high amount of variables that can introduce variations in the experiment (bad weather, finding fish or not, etc.), Dr. Basilone proposed that the length of the experiment should be long enough to ensure good results.

Connection of ITI with the scientific echosounder

Mr. G. Canduci made a presentation about the connection of ITI with the scientific echosounder designed during the acoustic surveys carried out in the Adriatic Sea by the R/V "Dallaporta". Based on NMEA code which is common to all vessels nowadays, the connection between the EK60, the ITI and the GPS allows a more accurate fishing operation during the acoustic surveys for echotrace identification. A correction for the distance of the hauls between the boat and the net is applied. With this system, the position of the net respective to the boat can also be seen. All the data is stored in an excel format.

Dr. A. Bonanno presented the Official data call of the Commission (May 2009) were there was a request for small pelagic surveys to provide the percentage of mature individuals per age class. It was discussed by the group that this was not included in the MEDIAS protocol. A discussion was open that in order to fill the table in a consistent way it is necessary to standardize a maturity scale between the different areas. Dr. A. Machias pointed that maybe an assignment mature/immature could be adequate without needing to establish a standardized scale. It was decided by the group to ask the Commission to clarify mature/immature or active/inactive as the definition of maturity/immaturity is not clear. As there was not a clear definition the group concluded that inactive will be immature and active will be mature and to add this to the MEDIAS protocol.

Regarding the **location of the next 5th MEDIAS meeting**, Malta was proposed. It was agreed by the group that next meeting is going to be held in Malta in March 2012.

D) Conclusions of the MEDIAS Steering Committee

1.- The Steering Committee underlines the importance of the fact that annual meeting MEDIAS (Ancona, March 2011) was attended for the first time by experts from Algeria, Morocco, Tunisia and Turkey. The MEDIAS group underlines the interest of the participation of southern and eastern countries in order to harmonise methodologies and reinforce the scientific cooperation.

2.- The Steering committee informed that the MEDIAS survey was not performed in Aegean and Ionian Sea, because Greece did not apply the Data Collection Program in 2010. The Steering committee assesed one more year the impact of the absence of Greek coverage in the MEDIAS survey 2010.

3.- The MEDIAS group proposed a draft MEDIAS handbook based on the MEDIAS table protocol. This handbook was required by the Regional Coordination Meeting Committee last year (2010). A draft was presented by Dr. Machias and distributed to all the participants in order to propose improvements and to agree on a common format (ANNEX V).

4.- The Steering Committee agreed to do a workshop about survey planning to be sure the same principles are used to design the survey.

5.- The Steering Committee proposed to carry out a common workshop with ICES experts involved in acoustic surveys to provide advice on the prioritisation of potential ecosystem indicators that either are or could potentially be collected during acoustic surveys.

6.- It was agreed by the Steering Committee to present again to the RCM the proposal for a study intercallibration exercise by the R/V involved in the MEDIAS acoustic surveys.

7.- The Steering Committee thanks to Dr. Pierre Petitgas his participation as assesor in the workshop on survey design carried out during the 4th Medias meeting.

8.- It was agreed by the group that the indicator variogram approach could be a good option for homogenizing the work from the different areas in order to write a common publication.

9.- It was also agreed by the group the use of the script from M. Barra for applying indicator variograms following a common approach and thus will allow having the same outputs for the different areas.

10.- It was agreed by the Steering Committee to present a study proposal on TS in cages ("ex situ") to the next RCM Med & BS.

11.- It was decided by the group ask the Commission to clarify mature/immature or active/inactive as the definition of maturity/immaturity is not clear. As there was not a clear definition the group concluded that inactive will be immature and active will be mature and to add this to the MEDIAS protocol.

12.- The MEDIAS participants reviewed and improved the existing common callibration protocol. The reviewed common acoustic protocol is presented in table X.

13.- The Steering Committee agreed on asking a Letter of Commitment by Echoview (Myriax Ltd) in order to obtain a better service as a group.

14.- The Steering Committee concluded for the next MEDIAS meeting to take place in Malta by the end of March 2012.

ANNEX I
List of participants

Name	e-mail	Country	Institute
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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

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

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

CFS-MRRA: Capture Fisheries Section, Ministry for Resources and Rural Affairs, Fisheries Research Unit, 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

INRH: Institut National de rechercheé halieutique, Morocco

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

CNRDPA: centre de rechercheé et de deveéloppement de la Pêeche et l'Aquaculture, Algeriae

METU, IMS: Middle East Technical University, Institute of Marine Sciences, Mersin TURKEY

ANNEX II

4th MEDIAS Coordination Meeting

Ancona, Italy 28-30 /03/2011

Agenda

MONDAY 28/03/2011

9:00 - 9:30: Opening of the meeting & welcome.

9:30 - 9:45: Presentation of the MEDIAS acoustic surveys: Aegean Sea survey (2010).

9:45 - 10:00: Presentation of the Adriatic survey.

10:00 - 10:15: Presentation of Croatian survey.

10:15 - 10:30: Presentation of the Sicilian channel survey.

10:30 -10:45: Presentation of the Gulf of Lions survey.

10:45 - 11:00: Presentation of the Iberian survey.

11:00 - 11:30: Coffee break

11:30 - 11:45: Presentation of Black Sea surveys: Rumania-Bulgaria.

11:45 - 12:00: Presentation of Black Sea Turkish survey.

12:00 - 12:15: Presentation of Tunisian survey.

12:15 - 12:30: Presentation of Algeria acoustic project.

12:30 - 12:45: Presentation of Morocco acoustic survey.

12:45 - 13:00: General discussion

13:00 - 14:00 Lunch

14:00 - 15:00: Revision of the common MEDIAS protocol.

15:00 - 15:30: MEDIAS handbook: design proposal

15:30 - 16:00: Ecosystem indicators from the acoustic MEDIAS survey.

16:00 - 16:30: Discussion on the RCM Med & BS presented studies & new surveys: intercallibration exercise proposed by the R/V involved in the MEDIAS acoustic surveys.

16:30 – 17:00: TS study to present to the RCM Med & BS: discussion of the project.

17:00 – 18:00: Other issues.

TUESDAY 29/03/2011

Working group on Survey design: geostatistics.

[The work will be based on the analyses and the fill of the table that we have decided in our previous meeting]

9:00 – 10:30: Presentations of the work applied in each area (10 min presentation from each participant)

Briefing of WKACUGEO results and presentation of the protocol for standardized work based on the input of P. Petitgas (M. Giannoulaki)

10:30 – 13:00: Working on the data, applying indicator variograms.

11:30 – 13:00: Working on the data, applying indicator variograms.

13:00 – 14:00 Lunch

14:00 – 17:00: Working on the data, applying indicator variograms.

17:00-18:00 Briefing of the workshop results per area.

Coffee break at 11:00-11:30, 16:00-16:30

WEDNESDAY 30/03/2011

Working group on TS estimation: anchovy & sardine.

9:00 - 10:30: Overview of the common protocol for work on TS, brief presentation of initial TS results.

10:30 - 11:00: Working on sardine and anchovy data based on a common xls template (integrating data from all areas)

11:30 - 14:00: Working on anchovy and sardine data (continued)

13:00 – 14:00 Lunch

14:00 – 15.00: Working on anchovy and sardine data (continued)

16.00 – 17.00: Brief discussion of results– adoption of the report.

17:00 – 18:00: Planning for the future work.

Coffee break at 11:00-11:30 and 16:00-16:30

ANNEX III

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 (nm2 / km2)	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)	1 ms
Beam Angles (degrees) Athw. Beam Angle, Alog. Beam Angle	Should be reported
Ping rate	Máximum depending on depth
Calibration (No per survey)	A calibration report should be given (Annex III) 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 should be reported.
Inter-transect distance (NM)	Max <=12 NM.
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)	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
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 area. Minimum variables: T, S

Table. Calibration report

Calibration report
Frequency (kHz)
Echosounder type
Transducer serial nº
Vessel
Date
Place
Latitude
Longitude
Bottom depth (m)
Temperature (ºC) 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 Sv transducer gain
Iteration nº
Time
Range to sphere (m)
Ping rate
Calibrated Sv transducer gain
Time (GMT)
RMS value
sA correction

ANNEX IV

Workshop on Survey Design for Acoustic Surveys by means of indicator variograms

4rth MEDIAS Meeting

Ancona 29/3/11

The workshop allowed the gathering of most of the acoustic surveys on small pelagic fish that are regularly being held in the Mediterranean waters. The objectives of the workshop were to standardise data analysis methods for the evaluation and optimisation of survey design and in particular answer the following problem: is the survey design adapted to the spatial distribution of the patches of high or medium values? For that it was proposed to estimate the spatial error of a survey when estimating the area (geometry of patches) containing values larger than a given threshold.

Dr P. Petitgas was supporting the workshop by correspondence. The framework of linear geostatistics and indicator variograms was flexible and robust enough to allow analyse all case studies, extract the underlying spatial correlation structure, estimate survey precision for the current survey design and evaluate other designs. A common protocol was proposed that is described below in order to standardise the analysis of data.

1. Files to Prepare

Data : text format with separators '\t' or ';' (the decimal symbol is '.')
Col.1=year or survey code
Col.2=longitude (decimal degrees)
Col.3=latitude (decimal degrees)
Col.4=variable to be analysed (sA value or biomass of target species)
Col.5,…n = any other variable (for another species or environment)

Polygon : text format with separators '\t' or ';' (the decimal symbol is '.')
Col.1=longitude (decimal degrees)
Col.2=latitude (decimal degrees)
Columns contain the coordinates along long and lat of the polygon vertices. The polygon is closed : first and last lines are the same.
Polygon for selecting the data to be analysed may differ from that for mapping.

Survey design : EVA2 format. See section 4.3.1 in document ICES CM 1997/Y:21 (eva2_doc.zip). An empty formatted file can be created using EVA2 (file/create Eva data file).
Line.1 : comments or nothing
Line.2 : comments or nothing
Line.3 : header
Line.4,…n : data
You only need to fill Cols.1,2 (x,y : 2D analysis for regular parallel transects) or Col.4 (lg tr. : 1D analysis for regular parallel transects : transect lengths) or Cols.15,16 (rtex,rtey : zig-zag survey)

depending on which case you are in. Also you may fill Cols. 5-6, …, 13-14 (px1 py1, … px5, py5 : closed polygon vertices) if you are considering polygons. If problems with EVA in selecting survey points inside polygon, add a dummy variable in Col.3.
This survey design file (data locations only) will serve to estimate the precision of the survey mean estimate, given a variogram model. Different survey designs (i.e., files) can be constructed and their precision compared. The file eva_survey_1.txt is one of such files.
The file 'eva_survey_data.txt' is a test data file in eva. The file 'eva_survey_1.txt' is a file for an alternative survey design to be tested with EVA2.

2. Files and software

EVA2 : EVA2 was used to estimate the precision of the estimate of the area of patches and compare that precision for different survey designs. The input data will be survey design files (see above) and the parameters of the variogram, which will be inputted manually using the interface.

3. Steps of the study with EVA

Windows Data and Design. Import the data in EVA and chose the appropriate sampling design.

In order to apply indicator variography the following steps should be taken in EVA software:
In the window Variable, choose a threshold s and define the indicator Is(x). Is(x)=1 if Z(x)>s; Is(x) =0 otherwise. P(Z>s) is the mean of the indicator and is an estimate of the area occupied by values greater than s. %Q and %V are the respective contributions to the data mean and variance of the values greater than s. Different indicators can be considered based on e.g., P=0.10, 0.20, ..etc or %Q. Values of P and %Q are helpful in choosing a suite of meaningful thresholds. Note that if P is the mean of the indicator, its variance is P(1-P).

- Window Structure. Compute the variogram of the indicator
- Window Model. Model the variogram of the indicator.
- Window Variance. Compute the global estimation variance of the indicator. This gives the spatial error when estimating the area occupied by values greater than s, given the sample locations.
- The calculations are repeated for a suite of thresholds. The variogram is expected to be less structured with increasing thresholds (25%, 50%, 75% percentiles for consistency).

All previous calculations will be repeated for another survey design to compare its performance relative to the current one. Three survey designs were tested: the one currently applied, half the inter-transect distance, double the inter-transect.

The following common protocol for reporting was proposed and agreed.

4. Reporting

- A map showing the survey design
- The table of the suite of thresholds considered: s, P, P(1-P), %Q, %V and a graph of the Q(s) curve.
- The variogram for each indicator: experimental and model superposed.
- The graph of the estimation variance as a function of (increasing) s. As s relates to P (area occupied by values greater than s) and %Q (percent abundance), it is straightforward to deduce which patches can be well sampled by the survey design considered.
- The graphs of the estimation variance as a function of s can be produced for different survey designs (i.e., different inter-transect distance).

Due to time limitation one year of data was analyzed per case study for the examination of different survey designs, target variable was Anchovy NASC values in all cases and Four cases studies were analyzed and included in the report: Thracian Sea (North Aegean Sea, Eastern Mediterranean), South Western part of the Adriatic Sea (Central Mediterranean), Sicily Strait (Central Mediterranean) and the Spanish Mediterranean waters (Western Mediterranean). For the selection of the threshold the percentage of biomass/echo abundance was plotted as a function of threshold: curve P(z); and the threshold z was chosen depending on the percent biomass carried by the values above the threshold. o2<-order(Z,decreasing=T); Z2<-Z[o2]; P<-cunsum(Z2)/sum(Z). In all cases a threshold that included about 80% of the total echo abundance was selected.

In addition participants from Croatia (eastern Adriatic) agreed to work according to the proposed protocol using data from the same year as the one used in the western part of the Adriatic. Participants from Turkey (Mersin Bay), Tunisia and Morocco were practicing in importing data to EVA and the application of geostatistical analysis. The analysis was completed only in a small part of Tunisian waters, where omnidirectional variogram was estimated in a certain year and it was used for testing 3 different survey designs. Participants from Bulgaria have not completed the analysis of the survey data in 2010 therefore they were not able to apply geostatistical analysis. However they were supported with software and related papers to enable them the application of geostatistical analysis upon the completion of the analysis of acoustic data.

Results are presented below:

Case Study 1. Thracian Sea, June 2004 (Marianna Giannoulaki)

- Anchovy NASC (m^2 nm^2) was the variable examined
- Year: 2004
- Season: early summer (May - June)
- Different NASC thresholds were examined in terms of the echo abundance retained.

Threshold corresponding on 80% of abundance 50 NASC was selected

Table 1. 1. Threshold (s) in relation to P (area occupied by values greater than s) and %Q (percent abundance). %Q and %V are the respective contributions to the data mean and variance of the values greater than s.

s	P(z>=s)	%Q (z>=s)	%Var (z>=s)	P(1-P)
499	0.0275	0.62	0.75	0.02674375
450	0.0275	0.622	0.7536	0.02674375
350	0.0345	0.738	0.855	0.03330975
300	0.034	0.738	0.855	0.032844
200	0.041	0.816	0.898	0.039319
150	0.048	0.878	0.924	0.045696
100	0.062	0.959	0.944	0.058156
50	0.0689	0.984	0.946	0.06415279
20	0.0758	0.991	0.946	0.07005436
15	0.0827	0.996	0.946	0.07586071
5	0.089	0.998	0.946	0.081079
1	0.11	0.999	0.947	0.0979
0	1	1	1	0

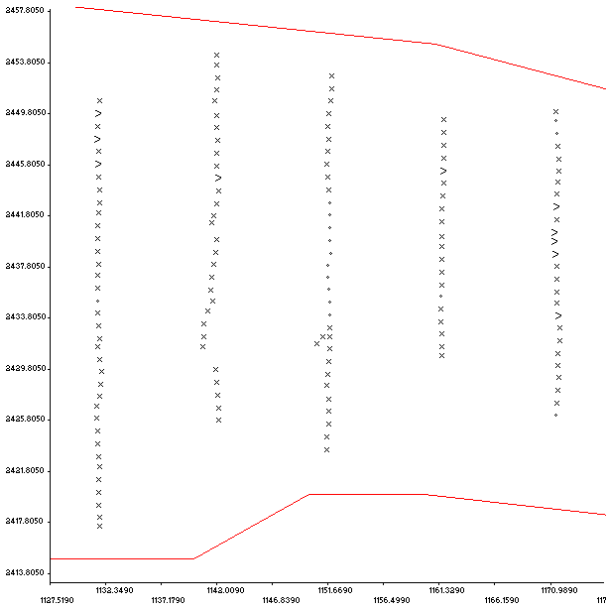


Fig. 1.1. Map of the study area

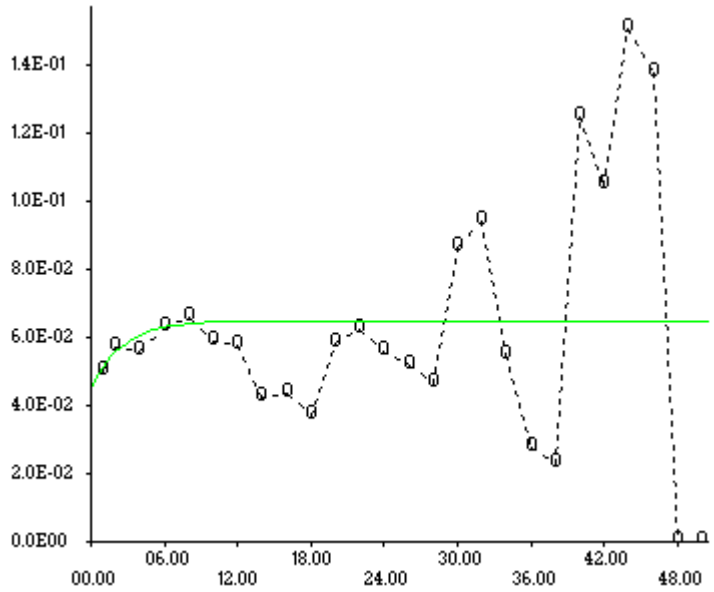


Fig. 1.2. Omnidirectional variogram on data defined upon this threshold revealed a spatial structure of 7.8 nm autocorrelation range (Nugget=0.045, sill=0.02, r=7.8 nm, Lag =2, No Lag=25)

Table 1.2. Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision.

Survey Design	CVgeo	%Nugget	Inter-Transect Distance (nm)
Current Survey Design	0.349	0.62	10
Half inter-transect distance	0.220	0.81	5
Double inter-transect distance	0.517	0.19	20

Case study 2. Spanish Mediterranean waters (Pilar Tugores)

Indicator variogram approach

- Survey: ECOMED
- Year: 2004
- Season: late autumn (mid November-mid December)
- Variable: Anchovy sA (m^2 nm^{-2})
- Year of average abundance, Southern area

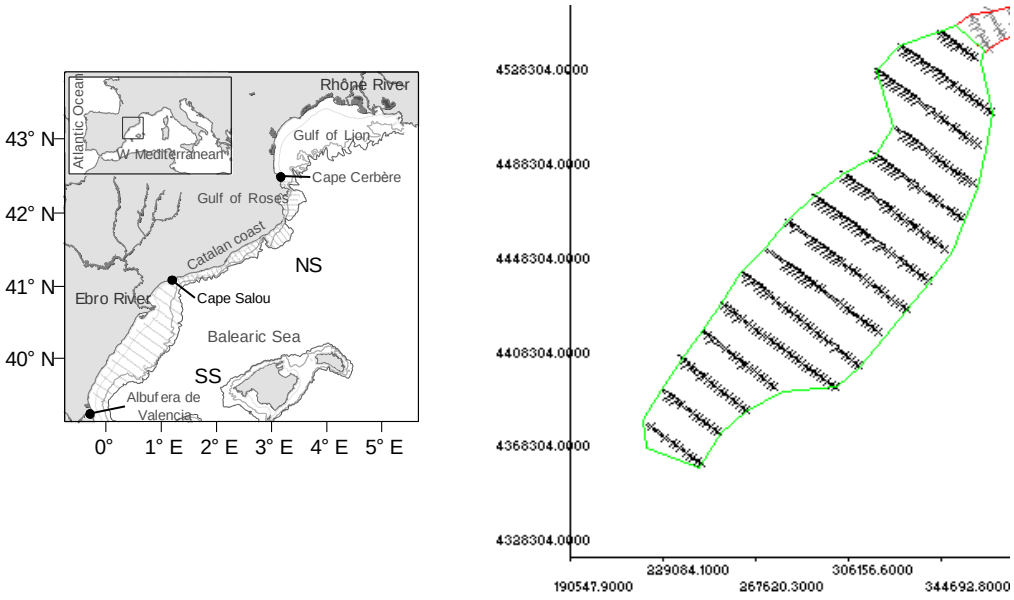
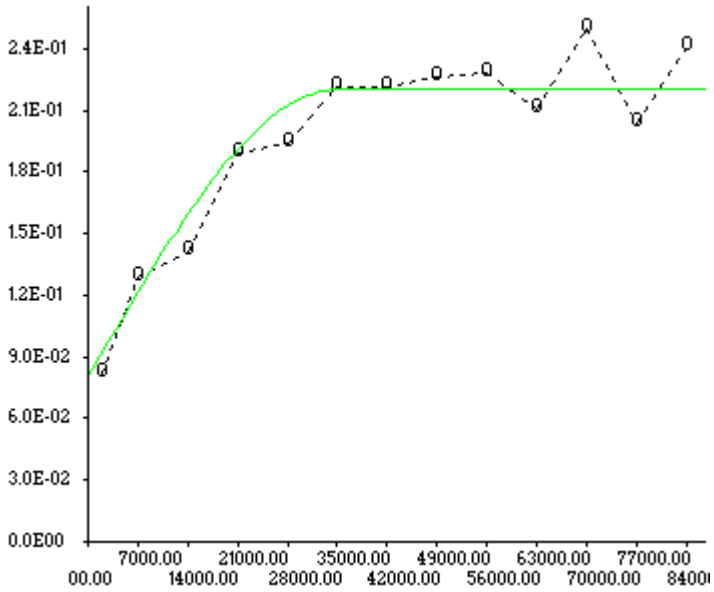


Fig. 2.1. Study area and subareas in NW Spanish Mediterranean waters: NS, 4 nm inter-transect, SS: 8 nm inter-transect. The southern area was used for modelling as indicated in the right side.

Table 2.1. Threshold (s) in relation to P (area occupied by values greater than s) and %Q (percent abundance). %Q and %V are the respective contributions to the data mean and variance of the values greater than s.

s	P(z>=s)	%Q (z>=s)	%Var (z>=s)	P(1-P)
748	2.65E-03	5.89E-02	0.1471	0.0026385
600	5.29E-03	0.1132	0.2706	0.00526301
500	1.32E-02	0.2356	0.474	0.01305302
400	2.38E-02	0.3792	0.6796	0.02324308
300	3.17E-02	0.4613	0.7654	0.03073819
200	5.56E-02	0.6264	0.8695	0.05246953
100	8.47E-02	0.7407	0.9028	0.07748936
50	0.1429	0.8677	0.9142	0.12247959
20	0.2249	0.9514	0.9149	0.17431999
10	0.2937	0.979	0.918	0.20744031
5	0.3624	0.9932	0.9233	0.23106624
2	0.4312	0.9987	0.9305	0.24526656
1	0.4735	1	0.9354	0.24929775
0	1	1	1	0

Design A (s=100)

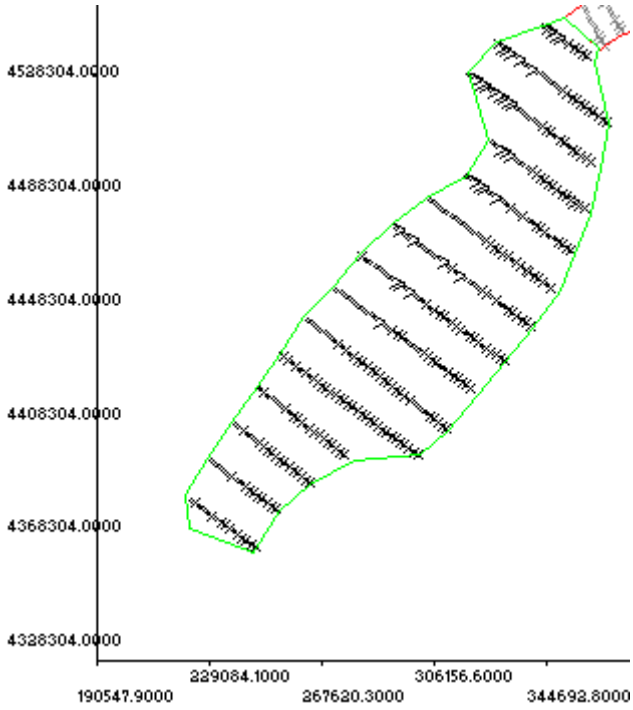


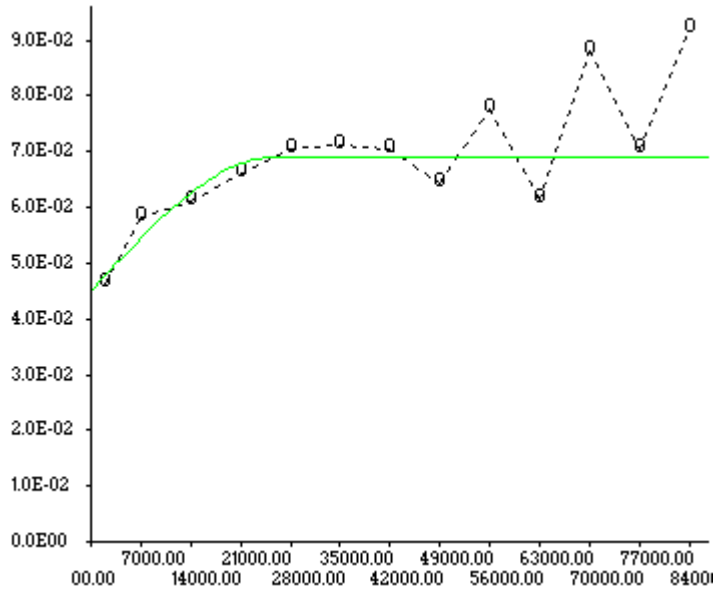
Selected model: Nugget: 0.08; Spherical: sill 0.14; range 35000

Table 2.2. Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design:

Inter-transect (m)	Variance estimation	Model %	Nugget %	CVgeo
7,408	0.0003	17.6%	82.4%	0.0590
14,816	**0.0003**	**37.1%**	**62.9%**	**0.0590**
29,632	0.0007	70.9%	29.1%	0.0901

Design A (s=10)





Selected model: Nugget: 0.045; Spherical: sill 0.024; range 26000

Table 2.3. Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design.

Inter-transect (m)	Variance estimation	Model %	Nugget %	CVgeo
7,408	0.0001	6.5%	93.5%	0.1181
14,816	**0.0001**	**21.5%**	**78.5%**	**0.1181**
29,632	0.0002	51.6%	48.4%	0.1671

Case study 3. Western Adriatic Sea (Claudio Vasapollo)

- Anchovy sA (m^2 nm^{-2})
- North western part of the Adriatic,
- **September 2009**

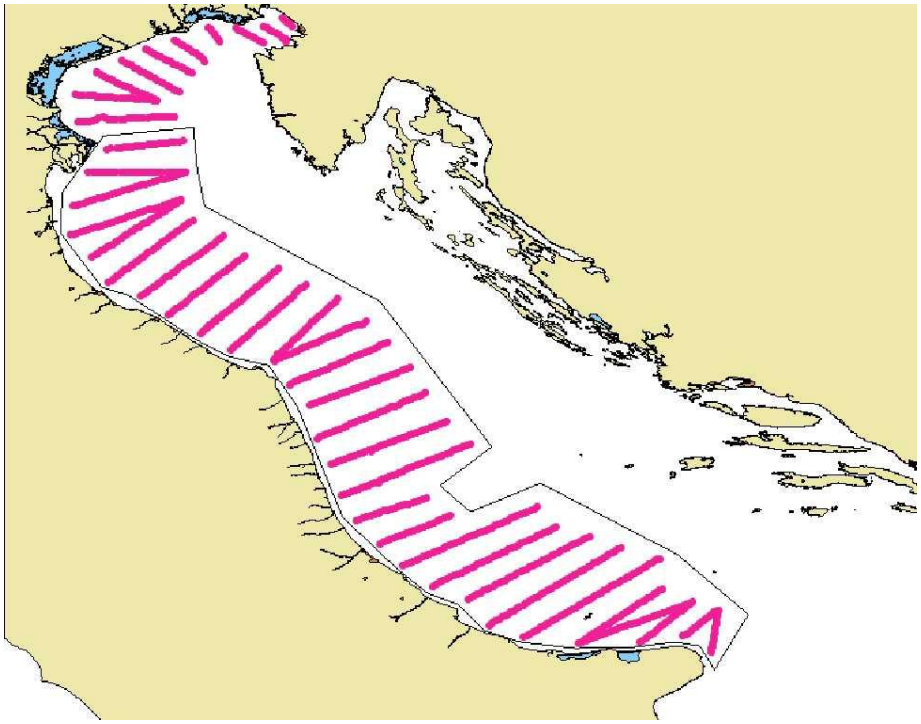


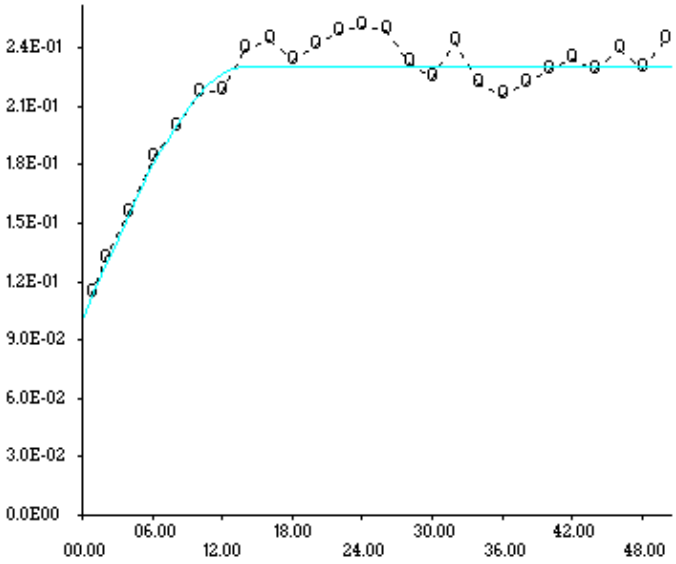
Fig. 3.3 Map of the study area indicating the polygon used for variance estimate.

Table 3.1. Threshold (s) in relation to P (area occupied by values greater than s) and %Q (percent abundance). %Q and %V are the respective contributions to the data mean and variance of the values greater than s.

s	P(z>=s)	%Q	%V	P(1-P)
6000	0.00095	0.01544	0.1248	0.00094
5000	0.00095	0.01544	0.1248	0.00094
4000	0.00189	0.0266	0.1273	0.00189
3000	0.00473	0.05264	0.294	0.0047
2000	0.01512	0.1231	0.04927	0.01489
1000	0.07844	0.3497	0.7437	0.07229
700	0.14744	0.5056	0.8077	0.1257
500	0.2296	0.6375	0.8257	0.17688
400	0.2835	0.7019	0.827	0.20313
300	0.3809	0.7936	0.8275	0.23582

200	0.5132	0.8812	0.8365	0.24983
100	0.7372	0.9705	0.8828	0.19374
50	0.8383	0.9901	0.9197	0.13555
10	0.964	0.9996	0.9801	0.0347
1	0.9905	1	0.9946	0.00941
0	1	1	1	0

Threshold selected was 300 Sa Anchovy that contained 79% of the total echo abundance.



Fitted variogram: Nugget = 0.10, Sill = 0.16, Range = 14, Angle of transects = 130° (along transects), No lags=25, lag=2

Table 3.2. Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design.

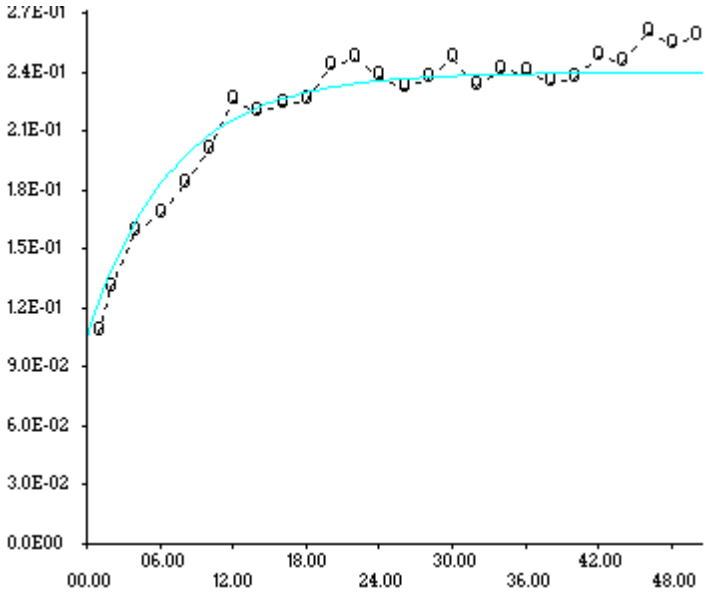
Survey Design	Est Var	CVgeo	%Nugget	Inter-Transect Distance (nm)
Current Survey Design	0.0002	0.0371	49.5	10
Half inter-transect distance	0.0001	0.0262	78.6	5
Double inter-transect distance	0.0011	0.087	20.4	20

September 2008

Table 3.3. Threshold (s) in relation to P (area occupied by values greater than s) and %Q (percent abundance). %Q and %V are the respective contributions to the data mean and variance of the values greater than s.

s	P(z>=s)	%Q	%V	P(1-P)
9000	0.000969	0.01704	0.1618	0.000968
8000	0.000969	0.01704	0.1618	0.000968
6000	0.001939	0.02877	0.2344	0.001935
4000	0.005819	0.06292	0.378	0.005785
3000	0.009699	0.08844	0.4524	0.009605
2000	0.02715	0.17038	0.5993	0.026413
1000	0.13579	0.45724	0.798	0.117351
800	0.1901	0.55065	0.81553	0.153962
700	0.22599	0.60226	0.81979	0.174919
600	0.27255	0.66049	0.82165	0.198266
500	0.34529	0.73816	0.822	0.226065
400	0.44034	0.82113	0.82313	0.246441
300	0.55092	0.89641	0.83017	0.247407
200	0.65761	0.94776	0.84781	0.225159
100	0.77885	0.98234	0.88568	0.172243
50	0.87584	0.99586	0.9294	0.108744
25	0.92046	0.99918	0.95263	0.073213
10	0.93986	0.9998	0.9636	0.056523

Threshold selected was 400 Sa Anchovy that contained 82% of the total echo abundance.



Fitted variogram: Nugget = 0.105, Sill = 0.135, Range = 21, Angle of transects = 130° (along transects), No lags=25, lag=2

Table 3.4. Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design.

Survey Design	Est Var	CVgeo	%Nugget	Inter-Transect Distance (nm)
Current Survey Design	0.0002	0.0321	49	10
Half inter-transect distance	0.0001	0.0227	79.4	5
Double inter-transect distance	0.0009	0.0681	25.1	20

Case Study 4. Sicily Strait (M. Barra)

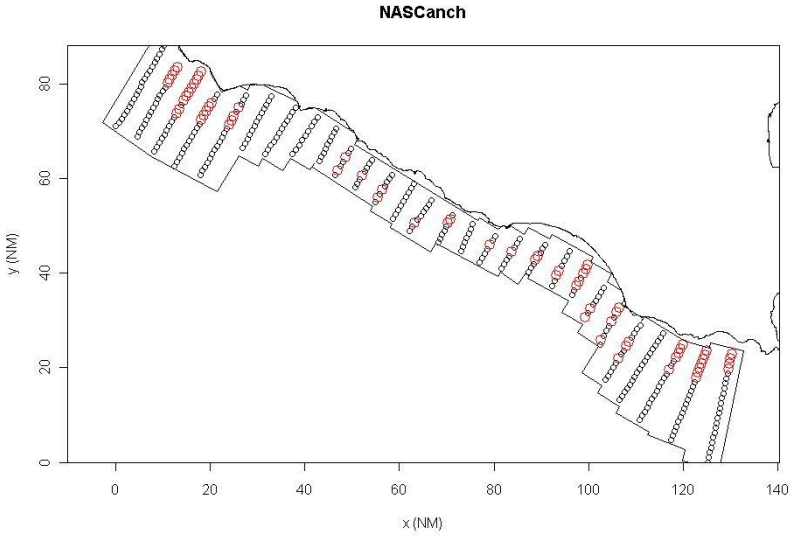
Analysis specifications

Indicator variography was applied in order to assess the ability of the current survey design to capture the spatial structure of high-density patches. Data threshold was set at 20 representing the 90% of the total biomass (P(z>=s)=0.198).

Analyzed dataset: NASC Anchovy 2003

Survey design: parallel transects

Software used: RGeoS



s	P(z>=s)	%Q (z>=s)	%Var (z>=s)	P(1-P)
397	0.00280	0.0677	0.23	0.00279
300	0.00570	0.12	0.39	0.00567
200	0.00860	0.16	0.47	0.00853
150	0.01700	0.24	0.56	0.01671
100	0.04600	0.45	0.75	0.04388
70	0.09200	0.67	0.85	0.08354
50	0.11000	0.75	0.88	0.09790
20	0.20000	0.91	0.89	0.16000
10	0.23000	0.94	0.89	0.17710
5	0.31000	0.97	0.89	0.21390
1	0.42000	0.99	0.91	0.24360
0	1	1	1	0.00000

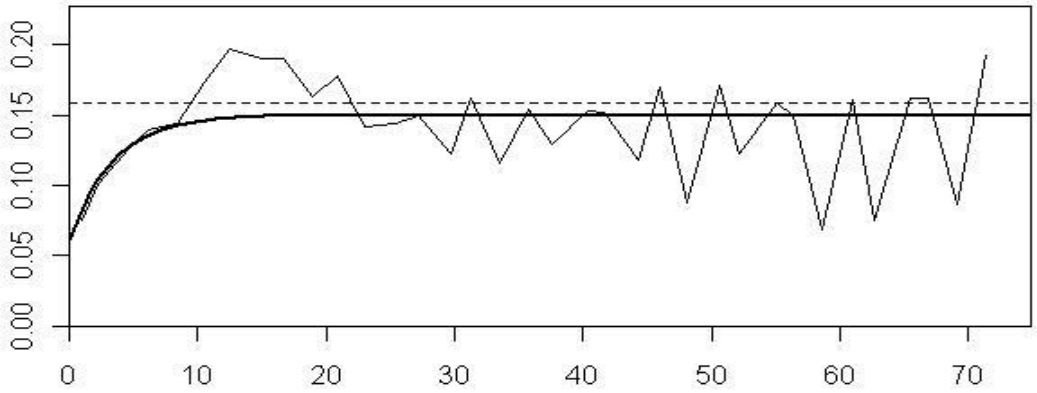


Table 4.2 Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design.

Tr. Dist	Est. Var	Nug%	Model%	Cvgeo
2.5	0.0001	84.4	15.6	0.05000
5	**0.0003**	**61.9**	**38.1**	**0.08660**
10	0.001	35	64.2	0.15811

Case study 5. Tunisia (Lotfi Ben Abdallah)

Due to lack of data availability for Anchovy Nasc, Total Nasc was used instead. Part of the sampling area where parallel transects are applied was used for testing different survey designs.

- Total NASC (m^2 nm^2)
- November 2006
- Inter-transect distance under the current survey design is 10 nm

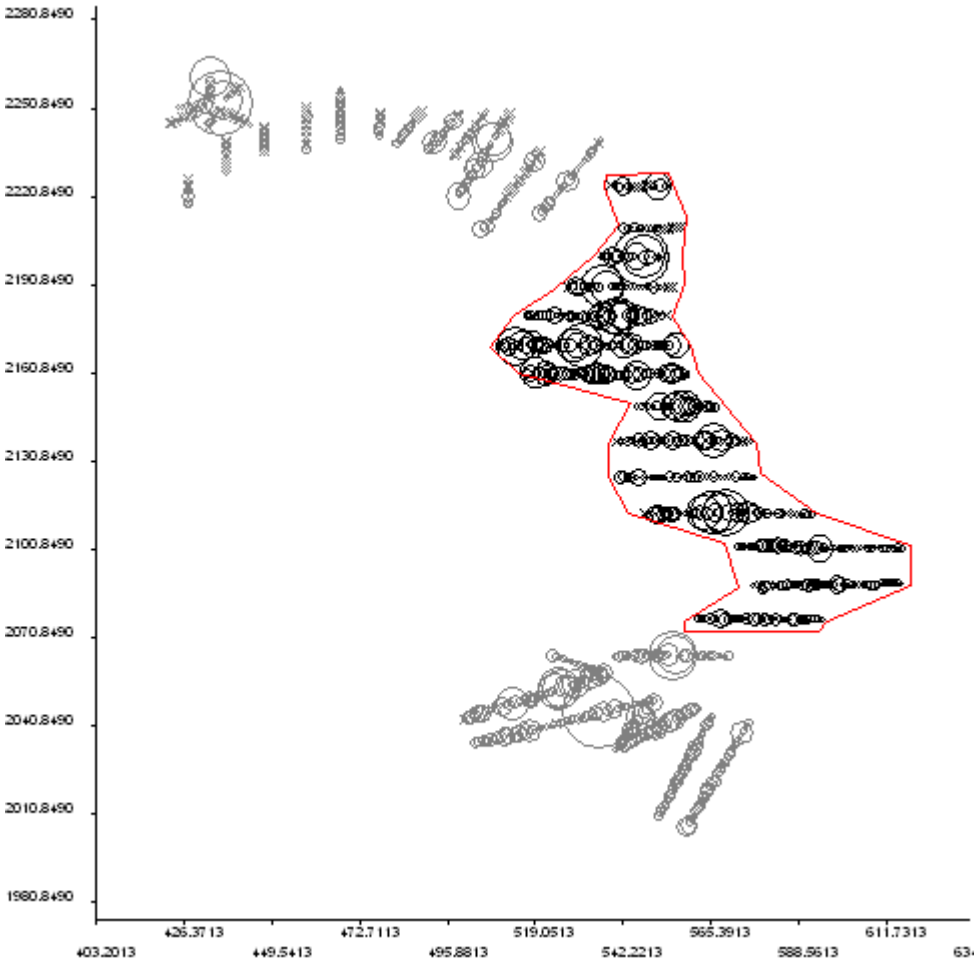


Fig. 5.1. Survey area with polygon used for variance estimate

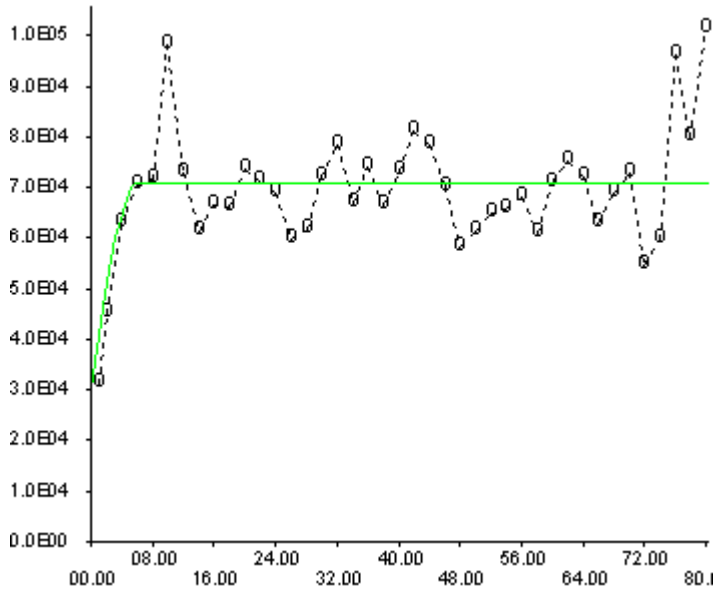


Fig. 5.2. Omnidirectional variogram in raw data: range 12nm, nugget 30000, sill 40000, variance 69139

Table 5.1 Results of different survey designs in terms of the geostatistical coefficient of variation and the contribution of the nugget to the survey precision. In bold, the results for the actual sampling design.

Tr. Dist	Est. Var	Nug%	Cvgeo
5	55.07	60.3	0.0012
10	**226.11**	**28.9**	**0.0035**
20	654.9	19.5	0.0081

Case study 6: Eastern Adriatic Sea (Croatian waters).

No geostatistical analysis was done concerning the eastern part of the Adriatic Sea during the workshop. However a short presentation on geostatistical analysis results already available was given. A map of the study area is presented below along with suggestions of the working group for future analysis in relation to the evaluation of survey design.

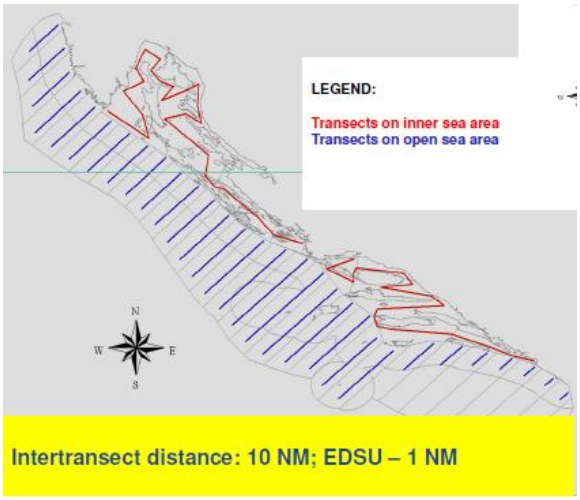


Fig. 6.1 Map of the study area indicating survey design.

Concerning the work presented for the eastern part of the Adriatic Sea (Croatia) it was commented that all fitted model variograms were linear which was not always justified but the experimental variograms. Moreover in certain cases the existence of trend was obvious. Therefore it was suggested:

1. detrending to be applied in certain years when trend was obvious,
2. fit another type of variogram model like spherical or exponential that is more appropriate to the underlying spatial structure and allows the estimation of nugget, sill and range and
3. fit indicator variograms and estimate Q(s) curves for the same years done in the western part of the Adriatic Sea. For this purpose only the outer part of the area that is consisted of parallel transects should be used that allows testing different survey design with EVA software

Future work

Within this one day workshop:

- Work was done on one year representing the average situation
- Indicator variogram was based threshold that 80% of biomass was retained

- In addition within the framework of this workshop it was agreed to work on a common R script that uses the RGeos library for geostatistical analysis and data export in a consistent way. Marco Barra (CNR-IAMC) took responsibility of developing the script, however the script needs to be finalised and validated from the rest of the working group.

Based on initial results from the study areas the working group concluded the following:

- Threshold was defined in order to characterize those patches of values that contribute most to the abundance estimate.
- So, it can be lower than 80%.
- Therefore, a procedure to define thresholds in a more consistent way is required.

For this purpose:

- the Q(s) curves and their inter-annual variation would be estimated.
- Plot Q(s) curves for all years to characterize variability in the aggregation: choose case study years on that basis.
- Anchovy NASC will be the variable for all to work with (Tunisia included)
- Croatia will work on 2009 and 2008 data, the same years used for the western part of the Adriatic Sea
- Deadline is set by the 30th of May 2011 to complete analysis on Q(s)
- P. Petitgas will support and comment in order to standardize further the work

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ANNEX V

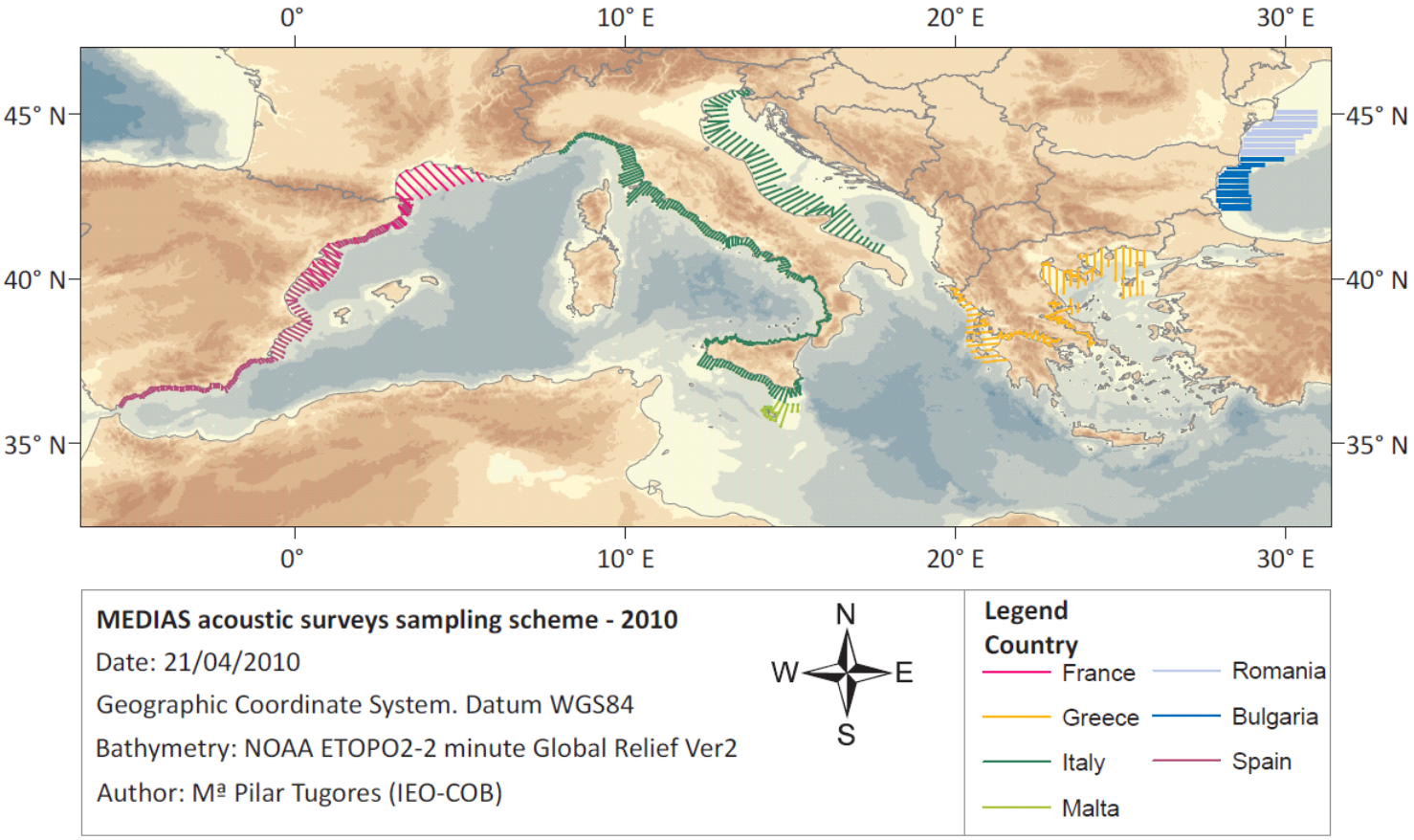
MEDIAS HANDBOOK DRAFT

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

The geographical areas that will be covered by MEDIAS and the days at sea are presented in the followed Table 1 and Figure 1.

Table 1.- The size of the geographical area that covered by each Institute *. (should be checked and reviewed)

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)	16 200 NM^2	40
Italy - Malta	CNR- IAMC	Sicily channel	2 700 NM^2	16
Spain	IEO	Iberian coast	8 829 NM^2	33
Greece (??)	HCMR	east Ionian Sea	6 200 NM^2	30
Italy (??)	CNR- IAMC	Tyrrhenian Sea	6 000 NM^2	30
Bulgaria Romania	Institute of Oceanology - BAS NIMRD “Grigore Antipa”	Black Sea	9 400 NM^2, (Romania 5500 NM^2 Bulgaria 3900 NM^2)	60 (3 surveys 20 days each)



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

Survey Identity

In the report to the DCF each Institution 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 could be used satisfactory for the assessment of small pelagic. In all areas 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 that should be used for assessment was agreed to be the 38 kHz, while complementary frequencies will be the 120 and/or 200 kHz, depending on the research vessel used.

The pulse duration should be 1 ms, the threshold for data acquisition will be at -80 dB for compatibility reasons, while the threshold for assessment should be -70 to -60 depending of 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 by Foote *et al.* (1987). The calibration parameters and results of the acoustic equipment should be reported by survey according to the follow Table.

Table 2. Calibration report

Calibration report	
Frequency (kHz)	*
Echosounder type	*
Transducer serial no.	*
Vessel	C
Date	*
Place	C
Latitude	C

Calibration report	
Longitude	C
Bottom depth (m)	C
Temperature (^{o}C) at sphere depth	C
Salinity (psu) at sphere depth	C
Speed of sound (ms^{-1})	*
TS of sphere (dB)	*
Pulse duration (s)	*
Equivalent 2-way beam angle (dB)	*
Default Sv transducer gain	*
Iteration no.	C
Time	*
Range to sphere (m)	*
Ping rate	C
Calibrated Sv transducer gain	*
Time (GMT)	*

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

3) Survey Design

The sampling design followed in each region should take into account 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. 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. The inter-transect distance should not exceed 12 NM based on preliminary studies of the spatial structure characteristics of small pelagics in the Mediterranean Sea.

In order to follow common principles for all survey a review and optimization of survey design should be held in common workshops in the framework of MEDIAS meeting. In these workshops, existing survey designs should be reviewed, area peculiarities (e.g. size of the area, topography, survey duration) will be taken into account and results from a geostatistical analysis applied to historic acoustic data from different areas in the

Mediterranean Sea will be evaluated for survey design optimization, taking into account the spatial characteristics of small pelagic fish aggregations.

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 recognition of schools on the echogram 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.

Transects should be extended as close to the coast as possible in order to obtain the best estimation for sardine. Because each survey uses research vessel of different size that sets a limit to the minimum distance from shore. In any case, the Distance of acoustic sampling from the coast according to the Bottom depth should be held at least from 20 m bottom depth, or limited to a minimum of 10 m of acoustic sampling in water column. 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. 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 school characteristics vary largely among areas and the working group concluded to maintain, for the time being, the historical Target Strength equations used in each area for the target species. In each case, the TS equation applied should be reported. The application of new TS equations in the Mediterranean, common for all areas would require the revision of the past estimates of the existing time series which would require time and effort. Such common TS equations must derive from *in situ* estimations of TS, preferably based on acoustic data from the Mediterranean Sea. For this purpose workshops should be held in the framework of DCR and

MEDIAS coordination meetings. In such a workshop issues regarding the estimations of common TS equations for each target species would be decided taken into consideration a) literature information and b) the application of different TS equations to existing raw acoustic data and the subsequent comparison of the results.

Acoustic data processing for the assessment of the target species, Echoview or alternative Movies software should be used for the analysis and estimation of abundance. For compatibility reasons, all data should be available into a common *.hac file format. Raw data will be stored within the responsibility of each country. The common *hac format will be also available for the requirements of the Data Collection Regulation (DCR).

5) Abundance indices

The follow abundance indices should be estimated and reported in the DCR 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 DCR report should include both NASC (independent from TS equations) 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 addition, the sampling intensity cannot be pre-determined because of the objectives of the acoustic survey *per se*. The sampling intensity in an acoustic survey depends on the size of the area covered, the frequency of occurrence of different echo traces 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. Characteristics of schools 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 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 is depended 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 sampling are anchovy and sardine, but also biological data for all species in the pelagic community regarding Length frequency distribution and Length-Weight relationships will 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 size of each sample should be at minimum that described in the respective protocol of the Data Collection Regulation (DCR). The Length– Weight relationship for all species will be estimated and reported.

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 hydographic parameters that should be measured in the entire water column at each station.

Furthermore, the need for a common database has been concluded. The fields of a common acoustic database will be established by the MEDIAS participants in future meetings. 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.