Joint meeting

General Fisheries Commission for the Mediterranean (GFCM)
Scientific Advisory Committee (SAC)
Subcommittee on Stock Assessment (SCSA)

And

Black Sea Commission (BSC)
The Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources (AG FOMLR)
Commission on the Protection of the Black Sea Against Pollution (BSC)

Istanbul, 8-10 March 2006

Permanent Working Group on Stock Assessment Methodology (PWGAM)
And
Workshop on Black Sea Assessment of Pelagic and Demersal Fish Stocks.

1. Opening of the Meeting

The Joint meeting on Stock Assessment Methodology and Workshop on Black Sea Assessments of Pelagic and Demersal Fish Stocks was held in Istanbul, Turkey, from 8 to 10 March 2006.

Forty four participants attended the meeting (ANNEX I).

The Director of F.R.I., Dr. Argyris Kalianiotis opened the meeting, followed by welcomes from Dr. Oksana Tarasova, Dr. Abdellah Srour, Pr. Corrado Piccinetti, Dr. Jordi Lleonart, Dr. Constantina Karlou-Riga, and Dr. Simion Nicolaev.

Dr. Argyris Kalianiotis and Dr. Constantina Karlou-Riga were assigned to chair the 1st Session regarding the Joint meeting on Stock Assessment Methodology and Dr. Oksana Tarasova assigned to chair the 2st Session regarding the Workshop on Black Sea Assessments of Pelagic and Demersal Fish Stocks. Mr. Anastasios Papadopoulos and Mr. Vincent Gennotte acted as rapporteurs.

2. Adoption of the agenda and arrangements of the session.

The agenda was adopted (ANNEX II). A set of documents related to Stock Assessment Methods were available before the meeting in the SCSA ftp sites: ftp://cucafera.icm.csic.es/pub/scsa/assessment_methodology/
ftp://cucafera.icm.csic.es/pub/scsa/Methodology%20and%20Black%20Sea/
Some of them were also distributed as hard copy during the meeting.

A) Joint meeting of Permanent Working Group on Stock Assessment Methodology (PWGAM).

The aim of the meeting was to discuss about the existing possibilities for stock assessment in the Mediterranean, to evaluate the use of available data, to identify gaps and to compare methodologies. The meeting was considered to be a brain storming not a conference. The meeting commenced with the presentations of the two invited speakers namely Dr. Sc., Henrik Sparholt and Dr. John Caddy.

Henrik Sparholt provided a presentation "The Ecosystem Approach in fisheries management: ICES strategies for implementation".

> The ICES strategies for implementing the Ecosystem Approach for the North East Atlantic were described. The multi-species/mixed-fisheries approaches within ICES in an advisory context seen as part of the ecosystem approach and as part of the wider scope of adding environmental issues to the fish stock assessment were presented. A section on prediction of yields in a multi-fisheries context was also included. Information on environment impacts on fisheries and fisheries impacts on the ecosystem is taken on board incrementally. Since 2005 ICES advice increasingly integrates fisheries and ecosystem issues. Internally in ICES it is debated whether a holistic approach can be a useful supplement to the incremental approach while ICES Regional Ecosystem Study Group for the North Sea (REGNS) is examining this issue.

Following the presentation, the group discussed the meaning of short and long term. Short term generally means within 1-2 years and long term more than 10 years. Mr Sparholt clarified, that ICES gives advice on issues that ICES clients have asked for, either via Memoranda of Understanding (MoUs) or as special and fast track requests for issues, which are only a one-off thing or where a special issue needs urgent reply.
The link between environmental science and assessments was discussed by initially presenting the methods that are being used by ICES in the Baltic Sea. It was also mentioned that in ICES the link between environmental science and fish stock assessment is not strong and there are considerations to improving the situation. Part of the explanation is that fish stocks assessment needs environmental drivers to be realistic and not just parameters which although have shown to be significant over the past – they also need to be valid in the future. Identified drivers have often failed the test of "time". The ICES representative presented the fishery control system in the ICES area pointing out pros and cons in the system. Regarding the overall stock situation in the ICES area, the ICES representative presented the relation between some fishing stocks and their trends over the years and compared these trends with the ICES advice on fishing mortality.

The meeting proceeded with a presentation provided by J. Caddy ¨Some Key issues when advising on the status of resources in the Mediterranean and Black Sea¨.

Mr Caddy stressed out that the assessment approach must be based on reliable data and biological realities.

An overall problem that restricts considerably the methodologies and analyses used is a general lack of time series on catch sizes/ages, and in some areas a lack of continuity in trawl surveys. Recent work in the Black Sea and Mediterranean has focussed on empirical indicators and reference points as a practical approach, and assessment work should build on these initiatives. Some time series of survey biomass exist (e.g. MEDITS), but corresponding catch sampling for size and age is not always available. This restricts the types of analyses and models that can be applied. A key question is what useful advice can we extract from survey data alone?

Single-species approaches have limited utility for multi-species fisheries, and FAO is promoting multi-species methods. It is not clear what these should be.

Some problems in setting up a GFCM assessment framework are the multispecific-multigear characteristics of most demersal fisheries and the dispersed landing sites. The small fraction of catches passing through fish markets makes systematic collection of data difficult. In some countries samples must be purchased, which is expensive given the high price of species of commercial importance. There is also generally poor coverage of vital fleet, catch and effort statistics.

Exploitation rates in the Mediterranean/Black Sea must be close to MSY levels, or over-exploited, judging from a traffic light analysis reported. This will make fitting yield models to new data problematical, given that a narrow range of rather high mortalities is likely the case. For some species, recovery plans need to be considered – especially, but not exclusively in the Black Sea.

There has been controversy within GFCM/SAC over what should be the standard stock assessment procedures. A review by Oliver (2002) suggested that given the lack of time series, the only approach applicable throughout the Mediterranean is size-based VPA. This view was contested by Lembo and 11 co-authors from the central and eastern Mediterranean, who pointed to a number of other approaches, and to errors in assuming constant parameter approaches when assessing juvenile fisheries.

- Oliver is correct in stating that we have few options.
- At the same time, assessments should be firmly based on the biology and available data, and not simply apply standard procedures from other areas!
- Comparing results using different approaches is the normal approach in science, but original thinking is also called for given the particularities of the Mediterranean situation.

A list of common errors that have been reported in the past originate from extrapolating conclusions from areas where mature fish are targeted, to the Mediterranean demersal trawl fishery which is basically a fishery for juveniles. Some examples of these types of errors were mentioned, which if not corrected project into providing erroneous advice, e.g., by VPA or yield/recruit.

Multispecies methods must be tackled, and it was suggested to tackle an analysis of the MEDITS data first by statistical techniques (e.g. cluster analysis) to identify biological assemblages which react in a common way to fishing effort, and then compare the summed assemblage biomass determined by

MEDITS with the fishing effort data series for the same area. This was done in an experimental way for GRUND data provided by ARPAT, and strongly suggested that fishing effort was significantly higher than at MSY conditions. An alternative use of the dynamic formulation for production modelling using overall mortality in place of fishing effort was shown to be a useful way of analysing survey data, if the overall mortality Z for a species in each year can be determined from size composition or age composition of survey samples. It is suggested to begin with a descriptive/statistical approach, and work towards a classification of species with similar behaviour, availability, and distributional range. Only when this has been done will it be possible to define an overall ecosystem strategy!

Some other conclusions were:

- An approach that seems suited to the Operational Unit approach would be to use composite production modelling for sub-areas that are biologically comparable. Here the suggestion was to attempt to estimate fishing intensity (effort measured in days, or tonnage of vessels x days fished?) /square kilometre of fishing grounds. These estimates may be compared with the survey catch rate for the same area and year.
- Assessment methods should ideally take into account spatial factors such as the probable existence of refugia, nursery areas, and critical habitats. Using GIS for mapping fishing grounds is recommended to further refine the fishing intensity estimates.
- In the absence of time series, perhaps the first option is to compare recent and historical analyses using short-term data?

Although management should ideally provide the objectives, the two main objectives of management that emerged from the recent report of experts on the performance of SAC, are to provide a continuity of supply and the precautionary objective of preserving ecosystem integrity and preventing stock collapses. Finally, it may be desirable for the Commission to consider formulating a management control law based in part on indicator series and on the reference points agreed to.

Problems of protecting juveniles as well as large size mature fish and hence fecundity were discussed. The importance of presenting data in a way that can be understood by managers was pointed out. In addition causes of increases in the landings and the importance of controlling the fleet were examined. There was an overall consent that both spatial measures and careful monitoring of the fishing power is probably the best way to efficiently manage fisheries. Aspects of the methodologies (LCA, VPA) and problems identified regarding the discontinuity of data collection in some countries were discussed.

Mr Jordi Lleonart, FAO, Rome-Italy, presented a paper "Stock assessment in the SCSA State of the art".

Since its inception, in 1999, until 2005, the Subcommittee on Stock Assessment (SCSA) has identified 41 priority species (15 of them actually evaluated) and 38 shared stocks, involving 28 species in 7 sub areas (plus the whole Mediterranean for large pelagics), 10 of these stocks have been actually assessed.

Since 2001 to 2005 the trends of the number of assessed stocks, species and GSA, are flat or decreasing.

	2001	2002	2003	2004	2005	2001-05
species	13	7	7	9	8	18
small pelagics	4	2	3	2	2	6
demersals	9	5	4	7	5	12
GSAs	12	10	9	7	7	16
assessments	31	19	15	21	22	110
stocks	29	19	15	22	20	53
shared stocks	3	4	2	2	6	6

The most assessed species are: sardine, anchovy, hake, red shrimp and red mullet. Almost all GSAs in Western Mediterranean have been covered by assessment. In central Mediterranean stocks in Adriatic, off Tunisia and Greek waters of Ionian Sea have been assessed. In eastern Mediterranean, only stocks in Aegean Sea have been assessed.

Length cohort analysis is the method used for most of the assessments. Some VPAs have been recently presented. Statistical methods (time series analysis and GLM) have been applied to Mediterranean stocks and published in scientific journals, but never presented to the SCSA. Bio-economic and ecological modelling are currently being developed and their progress results presented to the SCSA.

Since the beginning of the SCSA activities, a set of "assessment forms" were made available to the participants. The aim of these sheets was to standardize as much as possible the presentation of the assessments. These forms were adapted to single species assessments by direct or indirect methods, and consist of sheets to cover the following aspects: biology, fisheries, direct methods (swept area, acoustics, and egg production) and indirect methods (production models, VPA and similar, yield per recruit), including an accurate description of the procedure, software, parameters, data and results. There are two final forms on diagnosis and recommendations.

No proposals for amendment of these sheets have been received ever since. However not always the sheets are used properly, or even used at all, to present assessments. The forms can be downloaded from: ftp://cucafera.icm.csic.es/pub/scsa/stock_assessment_forms.zip

The group encourages all the countries to fill the assessment forms year after year with the most valuable data in order to compose a portable library in which data can be compared. Regarding proposals on MEDITS extension it was pointed out that MEDITS is not covering all the Mediterranean; it is concentrated in some areas only and is not representative of all the depth zones.

1. Use of different methods (e.g. Biomass dynamic models) to produce assessments using the data obtained in the trawl surveys carried out in the Mediterranean.

Mr. Alvaro J. Abella Research Senior – ARPAT, Italy provided a presentation "Use of some approaches for stock assessment in conditions of data shortage (with special attention to surplus production models)".

The utilisation of surplus production models for the assessment of stocks in the Mediterranean became very popular in the seventies and eighties. These approaches however, generally did not furnish reliable results. Failures can be mainly related to wrong estimates of total catches, to the use of unsuitable effort units, to the unfeasibility of total effort partitioning, to the lack of contrasting a

sufficient amount of data regarding effort and correspondent abundance levels, to the assumption of equilibrium.

Three approaches based on surplus production models, that avoid most of the problems listed above, and usable within a limited amount of data available, are presented. These approaches were utilised for an assessment of the status of some demersal stocks in the Ligurian-Northern Tyrrhenian seas. The first two approaches use data proceeding exclusively from trawl surveys. The third method needs time series of catch and directed effort, but no information is necessary regarding size or age structure of the catch.

Composite methods with Z as a direct index of effort

Composite models (Munro, 1980) that use spatial information proceeding from ecologically similar sub-areas exploited at different rates can be used even in the case long data series on catch and effort are not available. An assessment of the state of the fisheries of *Merluccius merluccius* and *Mullus barbatus* that covered the whole western Italian coast and the eastern coasts of Corsica was performed by using trawl surveys data from the MEDITS European research program (Abella et al, 1999). The assessment was done combining a Composite Model with the Caddy and Csirke (1983) variant of Surplus Production Modelling. This variant uses the instantaneous total mortality rate Z as a direct index of effort, and catch per hour towing as an abundance index. This approach allows comparing the total mortality rate of each single sub-area to the Z at Maximum Biological Production (Z_{MBP}). As noted by Die and Caddy (1997) this reference point can be considered precautionary. It corresponds to a lower exploitation rate than the Z at Maximum Sustainable Yield, and is relatively stable and easy to calculate..

Biomass dynamic approach using Z and Biomass proceeding from trawl surveys

Biomass and total mortality estimates time series derived from trawl surveys were used in order to fit a non-equilibrium production model approach and for the estimation of the parameters of the logistic population growth model. The definition of these parameters allows the estimation of the value of fishing mortality rate that produces the Maximum Sustainable Yield (Fmsy). However, being the biomass estimates only indexes of the real biomass at sea; the approach does not allow estimating the absolute value for MSY but only the level of F in the curve that produces the MSY.

If series of data of estimates of Biomass and Total Mortality rates proceeding from trawl surveys are available, it is possible to fit a version of the logistic Schaefer model. The problem we have to solve is the lacking of information on catch per year included in the equation. A rough estimate of catch was obtained by substituting C by the well known Baranov catch equation. In this case we only need of an estimate of natural mortality obtained in some way (i.e. some empirical equation).

Data from the Italian trawl surveys project GRUND was used here. The fitting was performed with the MS Excel solver by minimizing the sum of the squared deviations between observed and estimated values of Biomass by changing seed values of r and K. More statistically robust approaches are currently in development aimed at a dynamic fitting that takes into consideration observation and process errors.

Biomass Dynamic models using fisheries dependent information

It may occur in the Mediterranean that some information on commercial fleet is available (total catches and directed effort), but no on demographic structure of the catch. In such situations, it could be possible to fit a traditional equilibrium production model (i.e. Schaefer, Fox, Pella & Tomlinson). However, these approaches seldom furnish reliable results considering that the equilibrium is difficult to assume in evolving fisheries. It was decided as an alternative approach to explore the use of a biomass dynamic approach (Prager, 1994, 2004) and the ASPIC software. Data used proceed from GRUND Italian trawl surveys performed each year since 1985.

ASPIC 5.0 fits Schaefer, Fox and the generalised version of Pella and Tomlinson model. It also incorporates different extensions to classical production models as the ability to fit up to 10 data series that may include trawl surveys abundance indexes, a bootstrapping procedure for bias

correction and the construction of non-parametric confidence intervals. A special routine REPAST incorporated in the last version of ASPIC 5.0 considers uncertainty and allows the definition of a target reference point linked to the Limit Reference Point MSY. This new TRP defines a more precautionary level of effort that is positioned at the left side of MSY taking under consideration a defined probability of not exceeding the LRP and the variability of the estimates.

In conclusion, we consider the above briefly described procedures as useful approaches aiming at an assessment of the resources in conditions of data shortage similar to the Mediterranean fisheries.
While age or size structured models are used for the management of many resources when there is access to time series of catch at age data, biomass dynamic models are still in use in many areas where this information is not available. Biomass dynamic models, in some circumstances, may provide more precise assessments and furnishes parameters more easily understandable for management purposes (Prager, 2004; Punt & Hilborn, 1996).

The group pointed out the difficulties of applying this approach in a multi-gear and multi-species system. It also stressed out that sets of data and their analysis must be divided by area since similar communities can be characterized by different biomasses, mortalities and be subjected to different fishing efforts. Finally there was a proposal for a training workshop regarding the application of these approaches in Mediterranean.

Dr. Eduardo Ferrandis, Dto. CC del Mar - University of Alicante Spain, "Direct Survival Analysis as a possible method to apply in Marine Population Dynamics".

Dr. Ferrandis pointed out that the starting point is the correspondence between the concepts of Mortality, Survival and Lifetime Distribution. He believes that this is the corner stone of the possibilities that Survival Analysis Techniques open to Marine Population Dynamics.

Some well established models for lifetime distribution that generalize the usual simple exponential distribution may be used with their corresponding survivals and mortalities.

Among them, an original model was proposed in the way opened by J. Caddy and H. Sparholt, considering that natural mortality is continuously decreasing.

Some models for the evolution of the Stock such as Markovian Processes are presented, as well as the necessary "Catch Equation" as an integral equation with respect to the aforementioned markovian process of the stock. This catch equation leads to consider the use of the "Proportional Hazards" technique established by Cox.

As a case study, the application of trawl survey data analysis was presented. The data must be structured in a "cohort and catch per unit effort concept". The considered models allow:

- The likelihood estimation of the survival parameters (hence of mortality)
- The analysis of the evolution of the stock in the period
- The use of reference parameters used in management adapted to the proposed models.

- The use of robust parameters of general application in population dynamics such as the "Life Expectancy", as an integral of the survival.
- The comparison among different geographical areas (mainly neighbours) and cohorts along a period through their corresponding specific survivals.
- The integration of commercial landing data as well as selectivity studies in order to improve the considered models and their applications.

The originality and the interest of the approach presented were emphasized. It is conceivable to consider survival instead of mortality in stock assessment analysis but the mortality rate must be evaluated with precaution in order to represent as much as possible the whole life history of fish. A constant rate gives indeed a biased picture of the reality.

The applicability of this approach to demersal resources (i.e. Medits data) was emphasized. Afterwards, gear and selectivity control (e.g. increase the mesh size) as a major issue in the Mediterranean fisheries management was debated.

Mr. Corrado Piccinetti, University of Bologna, Lab. of Marine Biology, FANO-ITALY, provided a presentation "Stock assessment of some demersal species in the Adriatic Sea (GSA 17)".

Considering 12 cruises carried out in the Adriatic Sea in the framework of Medits projects, we present few results and the line for a new approach in fishery management.

For a list of more than 50 species, the distribution map of the species, the distribution map of juveniles, the trend of abundance index for the whole population, for spawners, and for juveniles exist. These indices derive directly from survey results and not from models.

Data for *Mullus barbatus*, *Merluccius merluccius*, *Pagellus erythrinus*, *Nephrops norvegicus*, *Loligo vulgaris*, *Eledone moschata* and *Eledone cirrhosa* are reported.

Each species extends on a different distribution area so the effects of fisheries on each population are different.

Each species shows different trend in abundance; it is evident the decrease of the abundance index for *Nephrops norvegicus* and the increase of the abundance indices for *Pagellus erythrinus* and *Loligo vulgaris*.

In order to improve the management of fisheries a study of a different approach started in the framework of AdriaMed project.

The fishing fleet of Adriatic is grouped in operational units identified as group of vessel using the same gear, in the same area, for the catch of the same group of species and under the same economical conditions. The species existing in the fishing area are determined and research institute controls the trend of an entire group of species using both biological and economical indicators.

For each indicator one or two reference points will be fixed. If the values of indicators exceed the alarm reference points, a gradual number of management rules will be enforced.

The new rules are discussed before with fishermen's professional organisation and will be strictly applied only for the gears area and time necessary.

The fisherman organisations are involved in the entire process for the immediate adoption of the new rules.

The definition of target species was discussed. Targets are defined on an economic basis. In each area and for each operational unit, biologists and economists should work together to identify the target species. Depending on population distribution, targets are different for different areas and countries. Moreover, not only the distribution but also the growth performance varies from one region of the Mediterranean to another. Consequently, attention has to be paid in the evaluation of growth parameters used in stock assessment, especially for the early life stages of species.

2. Compare the VPA, echo surveys and DEPM applied to the small pelagics and analyse their reliability and usefulness to assess these resources.

Mr Alberto Santojanni, Italian Research National Council (CNR), Ancona, Italy, offered a presentation "Comparison of the results obtained from VPA, echo-survey and DEPM applied to the stocks of small pelagics in the Adriatic Sea".

Mr Santojanni reviewed the situation regarding stock assessment in the Adriatic Sea. Since 1975, ISMAR-CNR has been conducting research on the biology and stock assessment of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) in the northern and central Adriatic Sea (GFCM sub area 17) by means of population dynamics methods. In the recent years, the collaboration with scientists of Croatia and Slovenia was improved thanks to the Adriamed project (FAO-MIPAF) and, for both species, joint stock assessments were presented at the SCSA-SAC meetings.

The two stocks are defined as those fractions of populations exploited by mid-water pair trawlers and purse-seiners attracting fish by light and, therefore, they are formed by individuals with length from around 10 cm onwards. For both species, the stock assessment is usually based on the application of Virtual Population Analysis (VPA) on catch data of Italy, Slovenia, Croatia and former Yugoslavia.

The trends of biomass derived from VPA for the period 1975-2004 were discussed at the last SCSA-SAC meeting (Rome, 26-30 September 2005) and, here, are compared with the corresponding trends of density derived from echo-surveys by ISMAR-CNR (Azzali et al. 2005 - personal communication) in a very similar time interval, i.e. 1976-2004. The trends are not very different, but those based on acoustics show more pronounced fluctuations on a relatively shorter time scale, especially in the case of sardine. For anchovy, higher abundance in the second half of seventies, subsequent decline till to the minimum values in the period 1986-1988 (corresponding to a strong crisis of the anchovy fishery) and partial recovery are perceived by both methods. For sardine, increasing abundance in the first half of the 1980's is observed in both series, but a sharp decrease displayed by the echo-survey trend is not present in the VPA one.

However, an important pattern for management purposes is common to both methods: this is represented from the declining abundance since the second half till the lowest values of most recent years. It is worth noting that these low levels of abundance have been associated with some difficulties in obtaining economically satisfactory catches of sardine by both Italian and Croatian fishermen.

In order to compare the two series in terms of absolute values, the VPA biomass has been converted into density. For anchovy, in the period 1976-2004, the average density from echo-survey is 6 times higher than that from VPA. For sardine, densities from echo-survey are also higher than VPA ones but in a less pronounced way and, in 2004, the two methods give quite similar values: 4.6 and 6 tonnes per square nautical mile for echo-survey and VPA, respectively (this VPA value becomes lower under a different hypothesis on catchability at age pattern over time).

The difference between the two methods observed for anchovy could be due, at least partially, to the fact that the area covered by the echo-survey is different from that of VPA, as the former one is relative to only the western side of the Adriatic and, moreover, its southern limit is over the southern limit of the GFCM sub area 17 relative to VPA: the north-western area of the Adriatic covered by echo-survey is likely more positive for anchovy because of more suitable environmental conditions for this species.

A density value for the year 2004, obtained by means of acoustics for both species, was presented at the last SCSA-SAC meeting by Croatian scientists (Ticina et al.). The area covered by this survey was relative to the eastern side of the Adriatic, with a southern limit comparable to that of VPA. The estimated density of anchovy is relatively similar to that yielded by VPA, but the estimate for sardine is higher than densities from VPA and Italian echo-survey, as it is around 13 tonnes per square nautical mile. It cannot be excluded that a different distribution of sardine between western and eastern side of the Adriatic contribute to such differences: the Croatian echo-survey would give higher abundance just because it could be relative to a more positive area for this species.

The echo-survey carried by the Italian scientists (Azzali et al. 2002 - MIPAF report) also gave estimates of the density of sprat (*Sprattus sprattus*) since 1976 onwards. A decline is observed over time and, in the most recent years (with 2001 being the final year presented at this meeting); the values of density are between 0.3 and 1.9 tonnes per square nautical mile. In 2004, the echo-survey value presented by Ticina et al. at the SCSA-SAC meeting of 2005 is even lower. Such a difference could have been influenced by the fact that the latter value is relative to an area including relatively southern waters representing a not optimal environment for sprat.

Few estimates of the spawning stock biomass of anchovy and sardine by means of DEPM are available for the Adriatic. The values obtained for the southern Adriatic (GFCM sub area 18) found in literature are compared with those obtained from the Italian echo-survey (Azzali et al. 2002 - MIPAF report) for a partially overlapping area, placed between sub area 17 and 18: the densities based on acoustics are higher.

Finally, for the sub area 17, Regner (1996 - Scientia Marina) corrected its original AEPM estimates trying to take into account batch fecundity and spawning frequency: the spawning stock biomass estimated for anchovy shows the same decline along the first half of seventies and eighties observed in the time series of abundance yielded by VPA and Italian echo-survey.

The discussion begun with a background given on developments in the past two years within the Subcommittee of Stock Assessment, regarding assessment of pelagic stocks performed with different methods (VPA, eco-surveys) by Italy and Croatia in Adriatic (GSA 17) (cf 2004 and 2005 reports of SAC/SCSA).

Stock assessment of small pelagic species is a major issue. Agreement was not achieved regarding the interpretation of the assessment concerned. The reason was that two different positions for the management measures were presented: 1) No increase in the fishing effort because of an unhealthy stock; 2) Moderate increase in effort due to a healthy stock. The discussion is still open.

Following up, aspects of the precision and the limits of the two methodologies (VPA and Echo-survey) were discussed. It was acknowledged that VPA and echo-surveys give different results but all methodologies have to be considered and evaluated. This considered the starting point of standardization and collaboration between the different

countries. The group pointed out that the methodologies that will be used should be affordable by all countries

3. Explore the reliability and applicability of ecological and bioeconomic models, in particular those that have already been applied in Mediterranean fisheries.

Mr Jordi Lleonart, FAO Rome-Italy, presented "MEFISTO: MEditerranean FIsheries Simulation Tool, A bio-economic model for Mediterranean fisheries".

Mr Lleonart stressed out that MEFISTO is a bioeconomic model for the Mediterranean fisheries.

The objective is to reproduce the bio-economic conditions in which the fisheries occur and to simulate alternative management strategies. The model is, perforce, multispecies and multigear. The control variables (user's decisions) include different management measures: (i) technical: effort (time at sea, number of boats, closures), selectivity and (ii) economic (subsidies, taxes, penalties). The associated software allows performing stochastic simulations.

The output includes the following: (i) biological indicators (by species and age): biomass, number, catches, (ii) fleet indicators (by fleet or boat): number of boats, catches by boat, (iii) economic indicators (by fleet or boat): revenues, costs, benefits and (iv) stochastics: statistics of location (means or medians) and statistics of dispersion (user specified CI)

The model also incorporates the fishermen strategy of increasing efficiency, in order to increase fishing mortality, while maintaining the nominal effort. This is modeled by means of a function relating the efficiency with the capital invested in the fishery, and time (technical creeping).

The final users of the product are three: the scientist, the decision-maker, and the fisherman. For the scientist the present model constitutes a research tool that should lead to an improved understanding of the mechanisms by which the fisheries system operates. It can also be an advisory tool, as the model acts as a test bench for analysing different management options, decision risks, sensibility of the parameters, etc. For the administrators and decision-makers, the model offers a way to assess the economic and biological effects of particular management measures (technical, economic or both) in the short and mid term. This could be very useful in the design of policies for mid-term objectives and for exploring the different ways to attain them. It is also important that the administrators realize the extent to which the fishery depends on the dynamics of a biological resource and not only on economic decisions.

The model offers fishermen a new perspective on the behavior of the system, including its temporal scale. The model should contribute to increased comprehension of the usefulness or uselessness of certain management measures, and establish the difference between short and mid term regarding earnings and losses

The availability, the collection and the needs of biological and economic data required to run the model were discussed. The weakness of data availability and reliability highlighted for some countries and the difficulties encountered to gather them were

discussed. However, even though the model is sensitive to economic parameters, its successful application in a small gulf in Greece has proven its robustness with limited sets of data.

This model provides projections and trends for the future and allows setting up economic and biological reference points in order to assure the sustainability of the fisheries. However, one of its shortcomings is that it doesn't take into account biological interactions between species.

4. Study the possibility of fixing the stock assessment parameters for the main species in the same area.

Dr. Constantina Karlou-Riga, Ministry of Rural Development and Food, Fisheries Laboratory Piraeus, Hellas, presented "Growth parameters of *Merluccius merluccius*, *Mullus barbatus, Nephrops norvegucus, Aristeus antennatus* and *Sardina pilchardus* used in stock assessments (2001-2005)".

Growth parameters (L_{inf}, k, t_0) of *Merluccius merluccius*, *Mullus barbatus, Nephrops norvegucus, Aristeus antennatus* and *Sardina pilchardus* as used in stock assessments and presented in the Sub-Committee of Stock Assessment during the period from 2001-2005 were elaborated. A first approach was to group the parameters for close GSAs and relevant tables were given for Western Mediterranean (GSAs: 01, 02, 03, 05, 06 07), North Central Mediterranean (GSAs: 08, 09, 10, 11), South Central Mediterranean (GSAs: 15, 16), Adriatic Sea (GSAs: 17, 18), Ionian Sea (GSAs: 19, 20) and Eastern Mediterranean (GSAs: 22, 23). Apart of the different values observed between the different parts of the Mediterranean, different values were also noticed for the same GSA and species even for the same year. For the most of the species studied the length frequency was used for the estimation of the growth parameters probably due to issues of cost/benefit and no update of those parameters was shown to be performed during the years. The Phi-prime ($\Phi' = Lnk + 2LnLinf$) expressing the growth performance was calculated for each species, while the plot of this quantity for each GSA showed a high variation among the different GSAs and also inside the same GSA. However, by fitting the log relationship of L_{inf} on k, a close correlation was shown for the majority of species in the whole Mediterranean.

Differences in growth performance for given species were once more underlined. These variations can derive from different productivity characterizing each area assessed or from the different methods used to evaluate growth parameters (length frequency analysis, otolith reading etc.) as well as the statistical analysis used to treat the data. More specifically, the estimation of k and L_∞ was discussed. The evaluation of growth parameters requires a lot of data particularly covering early life stages. The comparison of survey and landing data will be of great assistance towards this purpose.

The first part of the meeting regarding stock assessment concluded at this point. The second part of the meeting dedicated to Black Sea Assessment of Pelagic and Demersal Fish Stocks commenced immediately afterwards.

B) Workshop on Black Sea Assessment of Pelagic and Demersal Fish Stocks.

1. Fisheries and Mariculture related Activities under the commission on the Protection of the Black Sea Against Pollution. Dr. Oksana Tarasova, PMA Officer, Black Sea Commission Permanent Secretariat,

Dr. Tarasova offered a presentation "Convention on the protection of the Black Sea against pollution", regarding mainly facts and figures governing fisheries in the Black Sea.

The purpose of the Convention on the Protection of the Black Sea Against Pollution is to preserve, protect and manage in the sustainable way the environment of the Black Sea.

The Contracting Parties to the Convention namely Bulgaria, Georgia, Romania, Turkey, Russian Federation, Ukraine were presented.

Dr. Tarasova described the unique topographic features of the Black Sea and gave an indication of the Hydrogen Sulfide Zone distribution in relation to the bathymetry in the Black Sea stating that the retention time lasts over 1000 years. Frequently Used Names (Convention on the Protection of the Black Sea Against Pollution, Bucharest Convention, Black Sea Convention) and Protocols to the Convention were presented.

Dr. Tarasova elaborated the BSC Organization Structure which consists of the Black Sea Commission and its Permanent Secretariat based in Istanbul, Turkey, the Advisory Groups, the Activity Centers and the Focal Points. Then the Major Environmental Problems of the Black Sea and the Actions Plans and Strategies were presented:

- Eutrophication to which the Danube contributes in a significant way
- Oil Pollution – threats arise from increasing intensity of oil transport
- Exotic species – the invasion of Mnemiopsis leydyi had a devastating effect on the fish resources especially for the Sea of Azov
- Overexploitation of marine living resources
- Climate change and its effects on the Black Sea ecosystem

The Actions Plans and Strategies are:

- Strategic Action Plan for Rehabilitation and Protection of the Black Sea, 1996, amended 2002
- the Black Sea Contingency Plan to the Protocol on Co-operation in Combating Pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations (Emergency Protocol), Volume I, Response to Oil Spills, 2003 –signed by Romania, Bulgaria and Turkey

Further on the main Policy Measures, the Main accomplishments and the Expected Activities in 2005-2006 were presented.

Main Policy Measures:

a) Pollution reduction

b) Conservation of biodiversity and marine living resources

c) Sustainable development of coastal zone

Main accomplishments:

A) establishment of regional cooperation

b) Development and improvement of national environmental legislation

c) Better knowledge of the environmental, economic, and societal issues of coastal population

d) Establishment of dialog with public and stakeholders

Expected Activities in 2005-2006

- Black Sea Assessment of Distribution and Abundance of Cetaceans
- Black Sea Assessments of Stocks of Anchovies and Turbot
- Black Sea Oil Spill Response Exercise
- Satellite Monitoring and Assessment of Sea-based Oil Pollution in the Black Sea (Training course + Workshop, 15 June, Istanbul)
- The 1st Biannual Scientific Conference of the Black Sea Commission

Dr. Tarasova presented, a List of Species whose Exploitation should be regulated and provided details regarding matters such as Mariculture in the Black Sea, Landing and Stock Assessment in Romania (Profile of Fishing Fleet of the Black Sea in 2002-2004), Fish Landings in the Black Sea, Fisheries Regulatory Tools in the Black Sea States, European Anchovy sizes in the Black Sea.

The group examined matters relevant to the major environmental problems that the Black Sea is coming across with and discussed the proposed actions, plans, strategies and policy measures needed for encountering the aforementioned environmental issues. In addition the group discussed matters regarding landings and stock assessment in relation to the Black Sea Countries. Funding possibilities for future actions were also examined.

2. Analysis of stock assessment methodologies for pelagic stocks including proposal on standard report forms for assessment components". Dr.. Vladislav Shliakhov, Black Sea laboratory, YUGNIRO Institute, Ukraine.

The regional methodology for the assessment of anchovy stocks should consist of three components: "Hydro acoustics", "Ichthyoplanton" and "VPA".

Anchovy hydro acoustic surveys should be carried out in the major area of wintering and active fisheries, that is, the waters of Georgia and Turkey. He proposed December and January as the best period for the survey. "Hydro acoustics" enables to obtain the current characteristics of the available for fisheries part of stock immediately during the fishing season. Assessments of anchovy schools biomass may be ready by late January.

Ichthyoplankton and fingerling surveys should be carried out in the major reproductive areas, that is, the waters of Bulgaria, Romania and Ukraine. By late August is possible to collect samples of "Ichthyoplankton" and therefore to assess anchovy spawning stocks and recruitment for the on-coming fishing season. After samples processing, such assessments may be produced by November.

The database for the VPA analysis for anchovy regarding the period of 1967 – 1994 in terms of biological years (from April until March) already exists and it may be supplemented with data up to 2005. It would be desirable to retain the same software package for VPA analysis introduced by Dr. Prodanov's group.

Applying historical biological and fishing data, as well as data of the most recent fishing season, "VPA" allow assessing the dynamics of the stock as far as possible to the later fishing season. Such assessments may be produced in April.

In order to implement the standard regional methodology for anchovy, it is proposed that the especially established scientific group for anchovy (or pelagic species) would be authorized to make standardization of the national data and regional stock assessment.

Blank forms for all of the three components are proposed to be filed in by every Black Sea country with available data.

The BSC pointed that EU intends to help Romania and Bulgaria to perform echo-surveys. Concerning the VPA, the committee stated that Ukraine has to take into account the influence of predators in small pelagic stock assessment.

The GFCM encouraged once more all the participants to report data using the stock assessment standard forms. However, the problem of the collection of data and their reliability (particularly due to unreported illegal fishing) in the Black Sea was mentioned. Consequently, the starting point for these countries is to set up a data collection system and gather consistent data on landings, fishing gears, vessels, efforts, etc.

Black Sea countries have to find a way to collaborate on stock assessment. Particularly due to the seasonal distribution of small pelagics it was suggested echo-surveys have to be performed at an international level. The lack of continuity regarding surveys in the Black Sea area was pointed out. The group was informed that a Turkish stock assessment program is commencing at the beginning of next year focused on the black sea mainly using all three methods followed by suggestions for cooperation.

3. Analysis of stock assessment methodologies for demersal stocks including proposal on standard report forms for assessment components". Dr. Mustafa Zengin, Central Fisheries Research Institute, Trabzon, Turkey.

Turbot is a benthic species that has limited migratory behaviour. Migrations are local and seasonal in character. Migrations are related to spawning and feeding habits. Seasonal distributions are generally from spring to early summer (In April-May-June) during reproduction periods. Population migrates and concentrates in depths 30-40 m where spawning areas are located.

After the spawning, turbot moves downwards to the depth 50-90 m in June-August. Late autumn it leads a low-activity life, feeding is poor and growth is limited. Scientists have some different ideas about the definition of the Black Sea turbot stock units. In generally turbot fishery area is located in the continental shelf of the Black Sea coasts. It is more common in the western part of the Black Sea (Romania, Bulgaria and Ukraine), North (Odessa and Crimean). North-east Black Sea (Caucasian coast) and South Black Sea- along the Turkish coast -has a very narrow shelf.

Proposals for the Standardized Methodology: in general, swept area methods are used most frequently for monitoring demersal stocks when only an index of abundance is required. These experimental methods have some drawbacks and more time is needed, i.e. more financial effort and

equipment. We can choose swept area method for the Turkish coast or the entire Black Sea (Other countries sides). It is widely accepted that the turbot stocks are overexploited.

It is reported that all the Black Sea national assessments and research papers have increased fishing rates and pressures on the turbot populations since the beginning of the 80s. The main question is how research management and cooperation can be arranged for reliable collaboration of all Black Sea Countries in the future.

The first step should be the establishment of a common "National Stock Research Committee" for all countries. They should also constitute common fishing indicators at this frame.

The second step should be a common online system to supply flow and sharing of all data (e.g. a common database with detailed and true estimates of total fishing effort for the most important fisheries. Collect and store historical data for stock assessments and provide support to the new data collection systems and their regulation).

Rearrangement of data:

1. VPA analysis of commercial catch. All of the Black Sea countries have their own definitions of basic parameters for the Black Sea turbot, but some countries haven't a long time series catch and biological data. Age structures and landing catch/length compositions should use these methods. In order to avoid great discrepancies in age reading of turbot otolith samples, it would be reasonable at the regional level to arrange a special training course. The correction of the catch statistics is necessary, taking into account unreported catch (on the basis of its annual special assessments in every country). Common reporting procedures should be established among all countries to enable intercalibration of the methods for sampling at the regional level, for processing and interpretation of data.

2. Swept area method: This method could be used for the determination of potential yields. There is also an opportunity to assess full species composition in the catches (in commercial catches low value species are usually discarded), biological information about migration, food composition and other important parameters. Trawl surveys should be carried out mainly in autumn to include both juvenile and adult stocks inshore and offshore. The best periods of the trawl surveys are between end of the summer and middle of the autumn. This period is also the main feeding period after the post-intensive spawning season. Swept area method is described by Gulland (1975), Pauly (1980) and Sparre et al. (1989). Preliminary specifications for stock units are desirable to obtain absolute stock value and real mortality (F or M) coefficients. But before application, intercalibration is needed at regional level regarding the methods for sampling and processing in the sea during the surveys. These are operation time, vessel speed, sampling area, survey season/month, and survey number, number of the sub survey stations, sub sample size/number; trawl design/model, codend mesh size and material, biometric measurement, sex, otolith.

The way of reporting data using GFCM stock assessment form was discussed and compared with the ICES data reporting system. Then, the question of the collaboration on stock assessment between Black Sea countries was approached, regarding the great disparity of stock distribution and catches between these countries. It was noted that catch data are not necessarily representative of resources distribution since some stocks are not exploited in the Black Sea, thus underlining the need of an international collaboration for stock assessment in the Black Sea.

4. Indicators Recommended for assessment of the black Sea Fisheries by Black Sea Commission Advisory Group. Dr. Simion Nicolaev, National Institute for Marine Research and Development, Romania.

Dr. Nicolaev presented "Specific indicators for Black Sea marine living resources"

The process for elaboration of the indicators follow the logical scheme, general accepted, respectively:
- Specific objectives for marine Living Resources (MLR);
- Specific indicators;
- Data and informational needs for evaluation of indicators;
- monitoring program for providing above data and information.

In the case of the Black Sea, the starting point represents the objectives provided by Black Sea Strategic Action Plan and those selected in special seminar organised in Sile (Turkey) in 2003 by BSC and GFCM.

Selection procedures of specific indicators for marine living resources took place in the frame AG FOMLR taking into consideration the following elements:

- keeping the parameters used traditionally in the Black Sea area for assuring the historical data sets;
- introduction of new modern approaches for MLR indicators recommended by specialised European institutions and EU strategies;
- Assessment of MLR will be initially focused only on six species considered key species for the Black Sea: sprat, anchovy, horse mackerel, turbot, whiting and spiny dogfish.

The AG FOMLR considers process of elaboration of the MLR indicators only at beginning and we need to validate him at concrete activities.

For these reasons AG FOMLR decide to test initial designed indicators in annual national and regional reporting to the Commission.

The list of indicators contain 20 basic proposals structured on four groups: pressure, impact, state and response indicators

The group pointed out that the use of the indicators presented is a long term approach with regard to the amount of data needed. The discussion aroused the question of how to merge and use all these indicators, while the collection of those data relevant was stressed.

5. A general discussion was followed regarding the opportunity to set up a working group on stock assessment in the frame of AG FOMLR and the need of strengthening the cooperation between GFCM/SAC/SCSA and the BSC/AG FOMLR. It was also suggested to draft a work plan for implementation of the Black Sea stock assessment.

CONCLUSIONS OF THE MEETING

1. RECOMMENDATIONS OF THE PERMANENT WORKING GROUP

Ecosystem Approach

The PWGAM recommends:

An expert group under SCMEE/SCSA has to be set up for defining ecosystems within the GFCM Area. For each ecosystem a general text has to be prepared including the known impacts of fisheries and other human activities. The group should be consisted of a balanced blend of experts in the various related fields, in order to produce an interdisciplinary text across the Mediterranean ecosystems. In addition a set of Ecosystem Quality Objectives should be proposed (for later discussion with managers and stakeholders) for those elements of the ecosystem which have been recognised above.

Use of different Methods for demersal resources assessment

The PWGAM recommends:

- The use of composite models and direct survival analysis are encouraged. These methods allow the use of independent data from trawl surveys. For this purpose the organization of training courses/workshops dealing with both theoretical background and case studies to be presented to the SCSA are recommended.
- The indicators and their trends by the use of trawl surveys (i.e. MEDITS) were acknowledged for their importance in stock assessment methodology. Thus, the elaboration of these indicators to other areas and probably the identification and application of additional ones was recommended, and suggested to be presented in the next SCSA.

Comparison of methods for small pelagic stock assessment

The PWGAM recommends:

- The use of VPA, echosurveys and DEPM.
- Occasional disagreements between VPA and echosurveys estimates due to either the fluctuations of small pelagics, sampling seasons or sampling methods are not

reason to dismiss one of those methods. The reasons of these occasional disagreements must be identified and be presented at the SCSA.

Explore and Apply Ecological and Bioeconomic Models

Ecological and bioeconomic modeling are being developed in Mediterranean. PWGAM considers these approaches useful and reliable. However there is a need for further improvements. In particular PWGAM recommends the application of ecosystem indicators and multispecies analysis (trends, assemblages) and continuation of the use of the on-going activities regarding ECOPATH model and MEFISTO.

Growth parameters in the Mediterranean

Taken into consideration the variation of the growth parameters for the same GSA/species the PWGAM acknowledges first the necessity of performing statistical analysis of fitting procedures and also sensitivity analysis mainly on their impact on assessment of the stocks, and second it realizes that the values of those parameters can not be fixed for the same GSA and need to be updated.

Revision of the Terms of reference for the PWGAM

The meeting agreed on the necessity to revise the mandate and the "Terms of Reference" for the PWGAM. The coordinator of the SCSA, the facilitator of PWGAM, the Deputy Secretary of GFCM and the FAO backstopping, will prepare these documents. Both documents will be submitted to the next SCSA meeting.

2. ADVICE of the Workshop on the Black Sea Stock Assessment Methodologies.

1. The assessment methods used in the black sea countries are practically the same as those used in the GFCM area. However in the Black Sea data collection have some differences between the countries and approaches used in GFCM and ICES. Therefore one of the objectives of cooperation shall be the development of common methodologies for collecting, processing and analyzing data of both pelagic and demersal species using experience and advice from GFCM and ICES experts.
2. Scientists in the Black Sea area are encouraged to actively participate in the subcommittees of GFCM especially in stock assessments of small pelagic migratory species.

3. The group has discussed the possibility to prepare and implement a regional project in the Black Sea area (i.e. BLACK MED). Through this project the improvement of the cooperation between Black Sea experts will be achieved.

4. Funding and organization of a number of joint training courses in assessment methodologies that will be selected for the regional purposes by Black Sea scientists shall be sought.

ANNEX I: LIST OF PARTICIPANTS

The Joint Workshop of the General Fisheries Commission for the Mediterranean (GFCM) and Advisory Group on Fisheries and Other Marine Living Resources (AG FOMLR)

March 8-10, 2006, Kalyon Hotel, Istanbul-TURKEY

List of Participants

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ANNEX II: AGENDA

General Fisheries Commission for the Mediterranean (GFCM)

Scientific Advisory Committee (SAC)

Subcommittee on Stock Assessment (SCSA)

Permanent Working Group on Stock Assessment Methodology (PWGAM)

and

Black Sea Commission (BSC)

The Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources (AG FOMLR)

Commission on the Protection of the Black Sea Against Pollution (BSC)

Joint Meeting

On STOCK ASSESSMENT METHODOLOGY

And WORKSHOP ON BLACK SEA ASSESSMENTS OF PELAGIC AND DEMERSAL FISH STOCKS

Istanbul, 8-10 March, 2006

Hotel Kalyon

Kennedy Caddesi34, Sahilyolu, Sultanahmet, Istanbul

Provisional annotated agenda

1) Opening of the meeting
2) Adoption of the agenda and arrangements of the session
3) Evaluation of the stock assessment methodology in the Mediterranean

- Use of different methods (e.g. biomass dynamic models) to produce assessments using the data obtained in the trawl surveys carried out in the Mediterranean.
- Compare the VPA, echo surveys and DEPM applied to the small pelagics and analyse their reliab;ility and usefulness to assess these resources.
- Explore the reliability and applicability of ecological and bioeconomic models, in particular those that have already been applied in Mediterranean fisheries.
- Study the possibility of fixing the stock assessment parameters for the main species in the same area.

Invited Keynote speakers

- Henrik Sparholt: The ecosystem Approach – ICES Strategies for implementation.
- John Caddy: Stock assessment indicators and reference points.

4. Workshop on Stock Assessment Methodology in the Black Sea

- Fisheries and Mariculture Related Activities under the Commission on the Protection of the Black Sea Against Pollution. Dr. Oksana Tarasova, Pollution Monitoring and Assessment Officer.
- Analysis of stock assessment methodologiew for demersal stocks including proposal on standard report forms for assessment components. Dr. Mustafa Zengin, Trabzon Central Fisheries Institute, Turkey.
- Indicators recommended for assessment of the Black Sea fisheries by Black Sea Commission Advisory Group. Dr. Simion Nicolaev, Chair of BSC AG FOMLR, Director NIMRD, Contanta, Romania.
- Discussion on the opportunity to set up a working group on stock assessment in the frame of AG FOMLR.
- Future cooperation between GFCM/SAC/SCSA and BSC/AG FOMLR.
- Draft the work plan for implementation of Black Sea stock assessment.

5. Other Matters

6. Conclusions of the Meeting.