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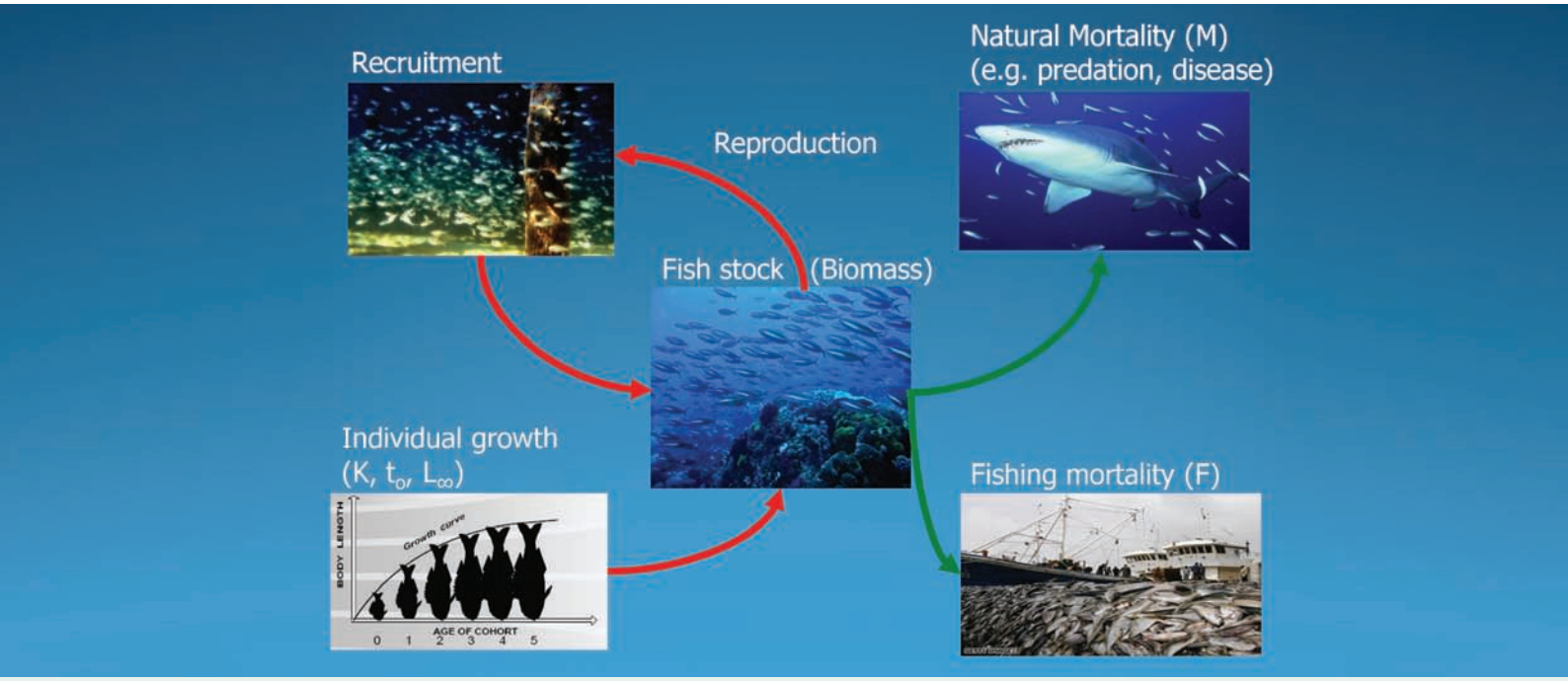

REPORT OF THE TRAINING COURSE ON SINGLE-SPECIES LENGTH BASED STOCK ASSESSMENT METHODS

KAVALA, GREECE 21 – 25 FEBRUARY 2011

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ITALIAN MINISTRY OF AGRICULTURE, FOOD AND FORESTRY POLICIES

Hellenic Ministry of Foreign Affairs

Hellenic Ministry of Rural Development and Food

GCP/INT/041/EC – GRE – ITA **Athens (Greece), 21-25 February 2011**

The conclusions and recommendations given in this and in other documents in the *Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean* series are those considered appropriate at the time of preparation. They may be modified in the light of further knowledge gained in subsequent stages of the Project. The designations employed and the presentation of material in this publication do not imply the expression of any opinion on the part of FAO or donors concerning the legal status of any country, territory, city or area, or concerning the determination of its frontiers or boundaries.

Preface

The Project "Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean- EastMed is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by Greece, Italy and EC.

The Eastern Mediterranean countries have for long lacked a cooperation framework as created for other areas of the Mediterranean, namely the FAO sub-regional projects AdriaMed, MedSudMed, CopeMed II and ArtFiMed. This made it more difficult for some countries in the region to participate fully in international and regional initiatives for cooperation on fishery research and management. Following the very encouraging experience of technical and institutional assistance provided to countries by the other FAO sub-regional Projects,

EastMed

was born to support the development of regional cooperation and the further development of multidisciplinary expertise necessary to formulate appropriate management measures under the FAO Code of Conduct for Responsible Fisheries and the principles of the Ecosystem Approach to Fisheries (EAF) to ensure rational, responsible and participative fisheries management

The project's **longer-term objective** aims at contributing to the sustainable management of marine fisheries in the Eastern Mediterranean, and thereby at supporting national economies and protecting the livelihoods of those involved in the fisheries sector.

The project's **immediate objective** is to support and improve the capacity of national fishery departments in the sub-region to increase their scientific and technical information base for fisheries management and to develop coordinated and participative fisheries management plans in the Eastern Mediterranean sub-region.

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Publications

EastMed publications are issued as series of Technical Documents (GCP/INT/041/EC – GRE – ITA/TD-00) and Occasional Papers (GCP/INT/041/EC – GRE – ITA/OP-00) related to meetings, missions and research organized by or conducted within the framework of the Project.

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Preparation of this document

This document is the final version of the Report of the Training Course on Single-species Length based Stock Assessment, organized by the FAO-EastMed Project (Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean) in Kavala (Greece), 21-25 February 2011.

Acknowledgements

The Fisheries Research Institute (FRI) in Kavala, Greece, that provided hospitality and technical assistance in the organization of meeting are gratefully acknowledged.

EastMed, 2011. Report of the Training Course on Single-species Length based Stock Assessment. Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean. GCP/INT/041/EC – GRE – ITA/TD-05. Athens 2011: 18 pp.

ABSTRACT

The training course on length-based stock assessment methods was held in Kavala, Greece between the 21st to 25th of February 2011. Twenty three scientists from Algeria, Cyprus, Egypt, Gaza Strip and West Bank, Greece, Lebanon and Turkey attended the course. The course was designed for fisheries biologists working in fisheries centres or other research institutions involved in fisheries monitoring, research and management in the Eastern Mediterranean. The course covered a five day period and provided instruction, demonstration, and exercises in estimating biological parameters and application of stock assessment models from length based methods. The last day was designed as an exercise session requiring the conduction of a complete stock assessment, starting from the estimation of biological parameters (growth, maturity, natural mortality), and including the calculation of total and fishing mortality using both the catch curve approach and the LCA. The exercise was completed with the estimation of fishing reference points ($F_{0.1}$) and the evaluation of the stock status. Formal procedures through which stock assessments are presented to the General Fisheries Commission for the Mediterranean (GFCM) were also described. Overall the participants were highly satisfied with the quality of the training, that scored a high mean evaluation (very good), from a feedback questionnaire that was distributed after the course. Following the feedback received from the participants and the experience of the instructors recommendations have been proposed for a follow up of this training course.

Table of Contents

REPORT OF THE TRAINING COURSE ON SINGLE-SPECIES LENGTH BASED STOCK ASSESSMENT METHODS

KAVALA, GREECE
21 – 25 FEBRUARY 2011

Introduction and Objectives

The general objective of the course was to enhance the skills required of the fisheries scientists in the Eastern Mediterranean region to be able evaluate the status of fish stocks and provide sound scientific advice to fisheries managers. The specific objectives were to develop skills in the analysis and interpretation of length based data to obtain estimates of key population parameters such as growth and natural mortality, calculating fishing mortality, population abundance and appropriate reference points to determine the status of the stocks and fisheries.

The course had five general goals:

i) to provide a sound foundation in the fundamentals of data required for stock assessment purposes;

ii) to increase the understanding of participants in the basics principles of population dynamics followed by a development of their skills in practical stock assessment procedures;

iii) to introduce participants to the use of single-species length-based stock assessment models, with special emphasis on the methodologies currently used in Mediterranean, together with the estimation of biological reference points and the development of projections according to different management strategies

iv) to prepare the participants to take the next steps in stock assessment methods, by applying age based stock assessment methods

v) to describe the formal procedures through which stock assessments are presented to the General Fisheries Commission for the Mediterranean (GFCM)

Course Content and Evaluation

A five days training course on length-based stock assessment methods was organized by the FAO-EastMed project at the Fisheries Research Institute (FRI) of Nea Peramos, Kavala, Greece, between 21 and 25 February 2011.

The course was designed for fisheries biologists working in fisheries centres or other research institutions involved in fisheries monitoring, research and management in the Eastern Mediterranean. Scientists from areas covered by other FAO regional projects (AdriaMed, MedSudMed, CopeMed) were also invited.

Twenty-three researchers from seven countries (Algeria, Cyprus, Egypt, Gaza Strip and West Bank, Greece, Lebanon, Turkey) participated in the course, and all attended lectures and exercise sessions, generally completing the assignments. Their background in population dynamics and stock assessment was heterogeneous including both skilled researchers able to develop models using spreadsheets and young scientists with a very limited experience in data analysis.

The training included theoretical classes, generally during the morning, and practical afternoon exercise sessions using the computer. The exercises focused on the application of different methods to analyse length frequency data. The participants were supplied with lectures, software and data. Topics covered included the estimation of stock parameters (growth, maturity, natural mortality and fishing mortality-Z and F), using several methods including length cohort analysis (LCA), the estimation of biological reference points using e.g. the Thompson and Bell Yield per Recruit model (Y/R), and the provision of scientific advice for fisheries management. During the course participants were introduced in the use of some of the most commonly used software for the analysis of length frequency distributions data and application of Y/R, such as Fisat II, LFDA, Yield, VITM. The forecast routines of VITM was also taught through the use of case study examples.

One of the exercise sessions was focused on the use of the solver routine in excel to fit simple models, such as the maturity ogives, through the minimization of the squared differences between observed and theoretical values. Excel spreadsheets were also used to introduce participants in the modelling of cohort biomass under different assumptions about fishing and natural mortality by applying the exponential decay model and the catch equation.

The last day was designed as an exercise session requiring the participants to undertake a complete stock assessment, starting from the estimation of biological parameters (growth, maturity, natural mortality) and the calculation of total and fishing mortality using both the catch curve and the LCA. The exercise was completed with the estimation of fishing reference points ($F_{0.1}$) and the evaluation of the stock status. Excel spreadsheets with time series of survey and landing data for a case study stock (Sole in the Adriatic Sea) were supplied to participants. About one third of the participants opted to use their own data for the last day's exercise by applying the approaches learned during the previous days. Feedback from students was solicited using a course evaluation questionnaire using a seven point Likert scale from insufficient to excellent.

In terms of acquired knowledge, the group assimilated the basic concepts of population dynamics, however for most of the participants their capability of independently developing stock assessments is limited by a reduced familiarity in working with fisheries data, using database, spreadsheets and ad hoc software. In the opinion of the instructors at least fifteen (the most computer skilled people) out of the twenty three participants will be able to develop their own analysis after the course. For the others further study will be required.

The participants were generally highly satisfied with the quality of the training, that scored a high mean evaluation (very good). Some participants however remarked, that the time for the training was too short considering the number of training subjects covered and that more training should be necessary to better improve their skills in the application of the stock assessment methods through the use of software and spreadsheets.

The results from the feedback questionnaire indicate that the course content and material covered was good to very good, course design was very good, helpfulness of teaching staff and clarity of presentation were high and course environment and results were good to very good. Individual comments by the participants included:

- Practicing all the software available on the same dataset was very useful since most of us had used only one or two programs before.
- More time for each software package with more examples
- Better organization in IT facilities in order to distribute software programs, lectures and exercises
- I would recommend many courses such as this one to build the scientific expertise in stock assessment
- We met new people from different countries who work in the same field as ours and we could exchange experiences and knowledge, also including the trainers
- A follow up of this course with specific training on one software would be good
- We could discuss with the expert trainers on specific cases and possibilities for assessment

One student thought that the course was too intensive and much more time was required to undertake the exercises and familiarize himself with the data and the software. He did not manage to draw any conclusions from the course.

The course was intended for fisheries biologists who had familiarity with fisheries data and the description explicitly included population modeling and quantitative exercises. Recommended text for reading were also given to the students before the course to familiarize themselves with population dynamics and stock assessment models.

In the future to better prepare the students for such a course, required skills could be added to the course description filtering participants who are not familiar with basic fisheries data. One problem encountered during the course was the different operating systems and versions of the software, which led to some time being lost to make the software packages work properly. Prior to the course the students and the instructors should be sure that the software to be used during the course works perfectly on the various operating systems. Students should have a considerable knowledge of excel since a lot of time was used up to explain basic excel functions such as working with formulas and the pivot table.

The students were energetic and worked hard. The partnership of instructors was effective, with complementary skills for helping students to understand difficult topics and debugging various software and computer problems. The project organization staff as well as the personnel of the FRI were always available for solving any technical or logistic problem. The room (noise isolation, space for accommodating attendants and for placing laptops) and the available hardware (screen, projector) as well as internet facilities were adequate and compatible with the course needs.

Recommendations

This course provided a general overview of length-based methods for population dynamics and stock assessment. The high number of subjects compared with the days available for the training made the course highly intensive requiring therefore a continuous attention from the participants.

To allow the participants to assimilate the methods taught and increase their skills in data manipulation and analyses the instructors recommend to provide new training opportunities in the next months to the same group of participants. It would be advisable to organize such training on population dynamics and stock assessment in the form of a working group (WG) where participants can work on their own data if possible with the support and feedback of experts. Working groups are an excellent opportunity for more hands-on and interactive activities and can be used to deal with specific issues also of cross-sectoral concern involving participants with different levels of experience in the subject.

The advisable approach for the definition of TOR for next training is to focus on the approaches and models that can be used in the current data situation of the Eastern Mediterranean countries, avoiding lecturing on models and approaches that cannot be applied to most of the stocks in the region.

Relevant topics to be considered for future training include the following:

i) basic data management and programming using databases and excel spreadsheet;

ii) fisheries sampling design and basic statistics;

iii) use of data for the calculation of stock biological parameters identifying the most suitable methods according to the data available.

iv) estimation of fishing mortality, stock biomass and recruitment, using the more appropriate methods according to the data available;

v) Pre-processing and analyses of fisheries data (e.g. CPUE) to produce indicators of fisheries and stock status;

vi) delivering of scientific advice for fisheries management including the evaluation of the likely effect of different fishing scenarios (predictions)

Apart from possible training courses it would also be advisable to set up a permanent working group on stock assessments in the eastern Mediterranean region within the framework of the EastMed project. Terms of reference for the first meeting of such a working group are presented in Annex IV.

ANNEXES

Annex I List of participants

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Annex II Terms of Reference

FAO EastMed Training Course on Single-species Length based Stock Assessment Methods

Terms of Reference

The general objective of the course is to train the students in data requirements for stock assessment, population dynamics and stock assessment models. The course is intended not only to present the theoretical elements but also to guide participants in putting theory into practice through case studies and hands-on exercises on the computer. Specific objectives are:

1) Understand the data requirements for stock assessment purposes

2) Understand the role of stock assessment in fishery science;

3) Conduct length based stock assessments using Length Cohort Analysis (LCA) and Yield-per-Recruit models (Y/R).

4) Estimate Biological reference points (e.g. $F_{0.1}$, F_{Max}, F_{MSY})

5) Build experience with stock assessment software such as FiSAT II, VIT and Yield package.

Outcome

By the end of the course, the participants will

- understand the data collection needs required for different stock assessment methods
- be familiar with the most common stock assessments methods used in the Mediterranean
- be able to conduct single-species length based stock assessments
- be familiar with indicators and reference points, both biological and economic, as tools in fishery management; be able to give management advice from the results of the stock assessments
- develop basic knowledge on age based stock assessments methods and fisheries projections using simulation models to improve scientific advice for managers.

Annex III Agenda

FAO EastMed Training Course on Single-species Length based Stock Assessment Methods

21–25 February 2011.

Fisheries Research Institute (FRI)
Nea Peramos
640 07 Kavala, Greece

Coffee Breaks will be from 10.30 - 11.00 & Lunch breaks will be from 12.30 to 14.00 every day

Day 1 Introduction to stock assessment and length based methods

9.00-9.30 Introduction of the instructors and participants

9.30-10.30 Introduction to stock assessment and population dynamics (Lecture I; M Dimech).

- Objectives of stock assessment
- the stock concept and methods for stock identification
- population structure and definition of cohort
- recruitment and spawning stock biomass concepts
- population growth and the MSY concept,
- input data for stock assessment,
- stock sampling (length, weight, age, maturity), impact of errors bias and precision

11.00-12.30 Stock parameters (Lecture II; F Colloca).

- Sex and reproduction (Length-at-maturity, Sex-ratio, Fecundity, Spawning period);
- Length-weight relationship;
- Growth (length based approaches for the calculation of growth parameters).

14.00-17.00 Practical session. Calculation of growth parameters using length based approaches part I

- Batthacharia and Modal Progression Analysis, seasonal growth, Gulland and Holt plot using Fisat

Day 2 Calculation of population parameters

9.00 -10.30 Practical session. Calculation of growth parameters using length based approaches part II

- Elefan and seasonal growth with LFDA5;

11.00 - 12.30 Mortality: natural mortality, fishing mortality, total mortality (Lecture III; F Colloca)

14.00 - 17.00 Practical section. Calculation of natural mortality, total and fishing mortality of total mortality using Fisat (length converted catch curve, other approaches)

Day 3 Yield per recruit and reference points

9.00-10.30 Yield per recruit and reference points (Lecture IV; F Colloca)

- Concepts, cohort decline, basic equations, gear selectivity curves, reference points (Fmax, F01, Fmsy)

11.00 - 12.30 Practical session. Exercises on cohort dynamics.

- Evolution of a cohort under different fishing pattern (e.g: Fcurr, F01, change in selectivity)

14.00-17.00 Practical session. Exercises on yield per recruit

- Calculation of Y/R curves assuming different age of first capture
- Calculation of reference points and projections using the Yield software

Day 4 Length cohort analysis (LCA)

- Comparison of length and age based stock assessment methods.

9.30-10.30 Introduction to LCA (Lecture V; F Colloca)

- LCA basic equations, assumptions and limits, F term, calculation of F and Y/R curves, projections

11.00-12.30 Exercise on LCA using Fisat

14.00-16.30 Exercise on LCA using VIT

Day 5 Case study exercise (conduct a trial full stock assessment on a case study stock)

9.00-9.30 Stock assessment in the GFCM (Lecture VII; M Dimech).
9.30-10.009.00-9.30 Problems associated with length based methods (Lecture VI, G. Scarcella)

10.00 - 11.00 Exercise explanation (sets of data of a case study stock will be provided to students. They will carry out a complete assessment starting from the calculation of the stock parameters, to the estimation of current F and F_{01} and the formulation of a scientific advice based on the status of the stock.)

11.30-12.30. Practical section: calculation of stock parameters starting from length frequency distribution

- Length-weight, length-at-maturity, growth

14.00-15.30 Practical section: estimation of F and F_{01} using VIT

16.00-17.00 Practical section: comments and advice based on the assessment results

Annex IV Proposed Terms of Reference for the first meeting of a permanent Working Group on Stock Assessment

The terms of reference for a possible 1st meeting of a five day working group include:

i) to identify the candidate shared stocks in the Eastern Mediterranean

ii) to identify the most important stocks in the eastern Mediterranean which are in need of scientific advice from stock assessments and to prioritise these stocks at sub-regional and national level

iii) to determine the existing data in the Eastern Mediterranean which is suitable for stock assessment purposes

iv) to identify the gaps in the data required for stock assessment in each country and provide advice on how these gaps can be reduced for example by data collection, collaboration with local universities and research institutes, collaboration with neighbouring countries and data sharing

v) to agree on standardised methodologies for the collection of data for stock assessment purposes

vi) to determine the best methodologies to estimate growth parameters and suggest a way forward for data collection.

vii) to determine the most adequate stock assessment models to estimate biological indicators, reference points and future projections. The selected assessment methods should allow the estimation of indicators for measuring the current status of demersal and pelagic stocks, the sustainability of exploitation and to measure progress towards higher fishing productivity (MSY or other proxy).

Annex IV List of Software and Exercises used during the course

Software

i) Microsoft Excel

ii) FISAT II - F.C. Gayanilo F.C., Sparre P., Pauly D (2005) Food an Agricultural Organisation of the United Nations (FAO) ICLARM Fish Stock Assessment Tools (FISAT II) Ver 1.2.2, Viale delle Terme di Caracalla, 00153 Rome-Italy

iii) LFDA - Kirkwood G.P., Aukland R., Zara S.J., (2001). Length Frequency Distribution Analysis (LFDA), version 5.0. MRAG Ltd, London, U.K.

iv) VIT for Win - Maynou F. (1999) VIT (windows version): Software for fisheries analysis Food and Agriculture Organization of the United Nations (FAO) and the Institut de Ciències del Mar de Barcelona, Consejo Superior de Investigaciones Científicas (ICM-CSIC), FAO Viale delle Terme di Caracalla, 00153 Rome-Italy

v) Yield - Branch T.A., Kirkwood G.P., Nicholson S.A., Lawlor B., Zara S.J. (2000). Yield version 1.0, MRAG Ltd, London, U.K.

Exercises

i) Estimation of maturity ogive including L25, L50, L75 using the solver routine in Excel
ii) Gulland and Holt plot exercise in Fisat II to calculate L_∞ and K of the Von Bertalanffy growth equation using length-at-age data
iii) Batthacharya and modal progression analysis using Fisat II
iv) Calculation of growth parameters using the Elefan procedure in Fisat II
v) Estimation of seasonal growth using the LFDA 5 software
vi) Calculation of natural mortality, total and fishing mortality of total mortality using the length converted catch curve (static and dynamic) in Excel, Fisat II and LFDA 5
vii) Evolution of a cohort under different fishing patterns (Yield per recruit) in Excel
viii) Calculation of Y/R curves assuming different age of first capture
ix) Yield per Recruit analysis using VIT
x) Calculation of reference points and projections using the Yield software
xi) Length Cohort Analysis using Fisat II and VIT
xii) Calculation of stock parameters starting from length frequency distribution, length-weight, length-at-maturity, growth and estimation of F and $F_{0.1}$
xiii) Provision of the scientific advice based on the results of the analysis

Beneficiary countries

Countries with waters included in the GFCM
Geographical Sub-Areas (GSAs) 19-20 and 22-28

Donors

Greece

- Ministry of Foreign Affairs
- Ministry of Rural Development and Food

Italy

- Ministry of Agriculture Food and Forestry Policies

European Community

- Directorate General of Maritime Affairs and Fisheries (DG-MARE)

Hellenic Ministry of Foreign Affairs

Hellenic Ministry of Rural Development and Food

ITALIAN MINISTRY OF AGRICULTURE, FOOD AND FORESTRY POLICIES

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