October 2006

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GENERAL FISHERIES COMMISSION
FOR THE MEDITERRANEAN
COMMISSION GÉNÉRALE DES PÊCHES
POUR LA MÉDITERRANÉE

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

SCIENTIFIC ADVISORY COMMITTEE

Ninth Session

Rome, 24-27 October 2006

REPORT OF THE SCSI/SCSA/SCESS TRANSVERSAL WORKSHOP ON MEASUREMENT AND STANDARDISATION OF FISHING EFFORT*
Fuengirola (Malaga), Spain, 30–31 May 2006

***Available only in English**

I. OPENING AND ARRANGEMENT OF THE MEETING

1. The transversal workshop on measurement and standardisation of fishing effort was held in Fuengirola (Malaga), Spain, from 30 to 31 May 2006. The agenda of the meeting is given in annex A. Seventeen participants attended the meeting (Annex B).

2. Mr Juan Antonio Camiñas, Director of the "Centro Oceanográfico de Malaga" opened the meeting and welcomed the participants, followed by welcomes from Mr Abdellah Srour, Deputy executive secretary of GFCM and Mr Matthew Camilleri, coordinator of SCSI.

3. The meeting was organised by sessions which were chaired by Mr Juan Antonio Camiñas, Ms Constantina Karlou-Riga, Mr Matthew Camilleri and Mr Malouli Idrissi Mohamed.

II. DEFINITION, MEASUREMENT AND STANDARDISATION OF FISHING EFFORT AND CAPACITY AND IMPLEMENTING A FISHING EFFORT DATA COLLECTION SCHEME

Abstracts of the presentations made at the meeting

4. *Recalling the GFCM approach to fisheries management through effort control: its current status (Abdellah Srour).*

The GFCM approach to fisheries management through fleet capacity and fishing effort control is in agreement with the Code of Conduct for Responsible Fisheries which provides that states should take measures to prevent or eliminate excess fishing capacity and ensure that levels of fishing effort are commensurate with the sustainable use of fishery resources. In this respect, several measures have been adopted by Mediterranean coastal States. Among these measures, it is widely recognized that TAC and quotas management system is not a viable option in the Mediterranean Sea because of the wide variety of species characterizing Mediterranean fisheries (except for tuna and tuna-like species).

In this sense, the GFCM at the tenth Session of its Committee on Fisheries Management (*Rome, Italy, June 1997*) endorsed a step-by-step approach to establish effort control mechanisms and the establishment of a scientific advisory committee (SAC) in order to ensure an efficient follow up for the Mediterranean fisheries management. Since 1998 (Twenty-third Session), GFCM was engaged to set up a harmonised process to take decisions according to fisheries management through the fleet capacity and fishing effort control. In order to reach this goal, it was necessary to define fishing effort parameters by establishing an *ad hoc* Working Group and to identify specific tools such as (i) the concept of the Management Unit (further referred to Geographical Sub-regional Area (GSA)) and (ii) the concept of the Operational Units. The FAO sub-regional project (CopeMed; AdriaMed; MedsudMed and MedFisis) played an important role in the development and implementation of OU concept to the Mediterranean fisheries through the pilot studies, meetings and projects coordinated since 1999.

The main decisions taken to implement fishing effort control for the Mediterranean fisheries management concerns: **a)** the adoption of the Resolution 95/4 which request the Members to make a comprehensive inventory of their national fleets (>15 meters) considering a standard categorization of this fleet and the integration of several factors the control of fishing capacity; **b**) the establishment of a Working Group on Capacity and Fishing Effort Parameters who stress that information on fleet capacity and distribution should be available to serve as the basis for defining fishing effort parameters; **c**) the adoption of Resolution 2002/1 which encourage the Members to adopt measures aimed at adjusting fishing effort and at rationalising their exploitation in order to maintain the small pelagic recruitment stock at a level compatible with sustainable resources exploitation; **d)** the adoption of the Recommendation GFCM/2005/2 concerning the establishment of a GFCM record of vessels over 15 metres authorized to operate in the GFCM (Specific tables was adopted for the data collection) and; **e**) the adoption of the Recommendation GFCM/2006/1 aimed to management of fishing effort for certain demersal and pelagic fisheries in some GSAs.

5. *The SAC/Sub-Committee on Stock Assessment view (Jordi Lleonart).*

The definitions of fishing mortality, fishing effort, catchability and fishing capacity were presented and discussed from the point of view and work of the SCSA.

- Fishing mortality (F) is well defined by species, age, fleet, OU or vessel. It is very useful for assessment, and fully employed by SCSA to provide indicators. Several recommendations are based on it, i.e. decrease E (assuming E~F) or improving selectivity (changes on F as age-vector). However F is a tool for assessment tool but not for management (as the effort is).
- Effort (E) is seldom used in SCSA, only in surplus production models (composite) in the northern Tyrrhenian and as fishing days/surface unit. The definition of E is not fixed, depends on catchability, is not defined by species but by OU or vessel. The effort (E) It is a management tool.

- Fishing capacity. Not well defined, SCSA does not use it. It is a management tool.

As conclusion the following issues have to be developed:

- a precise definition of E for different gears, fleets or OUs;
- relationships between multispecies E and the related specific F's (based on VPA or empiric analysis);
- a precise definition of fishing capacity for different gears, fleets or OUs as a mean to establish upper limits to E;
- estimators of q, by gear, fleet or OU, and time.

6. *Determination of Effective Fishing Effort on Hake Merluccius merluccius in a Mediterranean Trawl Fishery (F. Alemany, F. Alvarez).*

The direct control of fishing effort as a management tool is of special interest in the Mediterranean where the lack of effective international management systems and the high diversity of the catches increases significantly the complexity of the implementation of TAC's as indirect control of fishing effort. However, its enforcement should be based on the precise knowledge of the relationship between the fishing effort and its correspondent fishing mortality. In this sense, our goal was to develop an approach that could allow us to analyse this relationship, considering as a case study the hake fisheries south of Mallorca island (western Mediterranean). Fishing mortalities were available from VPA, whereas a relational data base including daily landings by vessel and species 1983-1991, based on information obtained from the bills of daily sales in the Palma de Mallorca auction wharf, provided detailed data on fishing activity, which combined with data from fleet census permitted to obtain estimations of fishing effort, defined as fishing capacity (GT) multiplied by fishing activity (fishing days). Such relational database allowed also to identify, through cluster analysis, at least three sub-fleets or "metiers" characterised by different fishing strategies: one operating almost exclusively on slope fishing grounds targeting red shrimp, other working mainly on shelf fishing grounds targeting hake or red mullet and a third sub-fleet which combined both strategies. Moreover, considering the species composition of the daily landings of each vessel and previous knowledge about the composition and bathymetric distribution of biocoenosis, the spatial distribution of fishing effort could be roughly estimated. The most relevant result was that when considered as a measure of fishing effort, the total annual effort of the trawl fleet (GT*fishing days) did not show a direct, but an inverse and significant relationship with hake annual fishing mortalities. On the contrary, when estimates of effective fishing effort on the fishing grounds where hake is mainly distributed were considered, obtained from the aforementioned database, direct and close relationships between fishing mortalities and "effective" fishing effort were obtained. On the other hand, no clear trends in catchability by métier were found during the analysed period. The main conclusion is that for a proper management of fish stocks through fishing effort control it is necessary not only to quantify fishing activity but also to get spatial information which allow to estimate the effective fishing effort exerted over a given biocoenosis and hence a specific stock.

7. *New improvements in predicting Fishing Tactics (J. Moranta).*

Multispecies fisheries in the Mediterranean are versatile in the sense that the same vessel are able to use more than one fishing strategy even during the same fishing trip, which typically comprises a single day. In the case of the Mallorcan fleet, up to 38% of the fishing trips used more than one tactic. Here, a new method that uses the information gathered in the daily sale bill is proposed to predict the fishing tactics used in a single fishing trip. Four a priori categories were defined depending in the main target species. Daily sales bill and fishing tactics (determined by an on board observed) were available for 224 fishing trips. The raw data (abundances) were submitted to a preliminary Principal Component Analysis and/or Correspondence Analysis with filtering purpose (only the first

few axes were retained for defining the daily catches). A Generalized Regression neural network (GRNN) was parameterized using 200 of the trips, and prediction capability was tested using the remaining 24 trips. The new approach has proved to be accurate and precise. The percentage of correct classifications of 500 runs (i.e., randomly changing the training and testing data sets) rise up to 93-94% of correct predictions. Trips for which a fully corrected set of prediction were made (i.e., four correct predictions) rise to 80%. This kind of accurate prediction will improve CPUE estimates, and will contribute to understand the complex relationships between the fleet and the resources, which is potentially mediated by either local abundance of the resources or market preferences.

8. *Definition and Measurement of fishing capacity and its potential use in the assessment and management of resources in the OU context (John Caddy).*

This background document presented a summary and historical perspective on fishing effort control and the use of effort data in assessment. Existing concepts relevant to the assessment and management of fisheries by effort control are reviewed and the advantages and disadvantages of analytical and effort-based assessments are reviewed. In addition, the use of effort time series in analysing resource time series was supported.

Emphasis was placed on the need to establish categories of vessels within OUs that are relatively homogenous, or to calibrate the fishing power of individual vessels. Considerable variation in fishing power in a fleet arises due to factors that are not only related to vessel size or horse power - in particular, skipper skills and the introduction of electronic equipment have been responsible for a 'technological creep' whereby vessels in any category have shown increases in fishing power of between 1 and 4% / year over recent decades. Standardisation of nominal effort measures to an effective effort unit that reflects fishing mortality is important for use of effort data in assessment or for shared resource management. The importance of a complete vessel register for each port, OU and GSA was emphasized: the register can be used in determining the capacity factor by which to multiply fishing days in order to obtain an overall estimate of fishing effort exerted in nominal units. From the perspective of stock assessment, fishing capacity is defined in terms of the vessel's engine horse power or physical dimensions, but it is suggested that over-capacity be defined in terms of the excess of effort units fishing within a GSA over that level corresponding to f (MSY) for a resource. While effort control may be achieved by setting the number of days fished, problems of overcapacity and technological creep will need to be addressed by specific criteria applied at the time of vessel replacement. In management, the proportion of effort spent by each OU within different GSAs must be determined. A traffic light approach to effort control monitoring was suggested.

While the biological sampling needs (ages and sizes) under effort control are less than for quota control, the analysis of regular trawl survey data to provide independent estimates of biomass and mortality offers a means of checking for undiscovered trends in fishing mortality. It is supposed that the management approach will focus on the keystone species agreed to by GFCM, while at the same time monitoring changes in overall catch rate of all commercial species in the catch. For the demersal fishery, it is recommended to convert effort units to fishing intensity; requiring estimates of the area fished which is unlikely to be uniform throughout the GSA for bottom gear such as trawls. This opens the possibility of using composite production models to compare estimates of yield/area against fishing intensity between GSAs. The difference between catchability and availability was emphasized: the existence of refugia in rough ground is of importance to stock continuity and the avoidance of trawling in these areas was recommended. The extent of bioecoenosis and bottom types can be entered onto maps produced and upgraded by GIS and will be useful in partitioning the effort data by biocoenosis. The information available from surveys such as MEDITS 1 can also usefully supplement the spatial data on availability.

9. Data collection in Malta (Matthew Camilleri).

In Malta, the fleet register contains information on the activity of each vessel throughout the previous year with details on fishing gear used per month, gear dimensions and number of outgoings. This information is updated annually and has been useful in identifying OUs and obtaining estimates of fishing effort. The combination of this information with landings data by vessel and species from sales vouchers at the central fish market has been used in Malta to obtain various results including CPUE by gear and species.

10. The integration of the environment in the Mediterranean fishing effort system (Juan A. Camiñas).

A GFCM system on effort control should integrate other relevant aspects related to the fisheries environment in agreement with the FAO ecosystem approach to fisheries management recommendations. The fishing effort is generally considered as an important parameter in the context of the mathematical models used for fisheries management purpose. Actually a management system based on the fishing effort control must take into consideration the environmental effects of such fishing effort on the discarded and non target species and not only on target or commercial species.

Due to the marine ecosystem dynamics, the natural changes in the species composition and in its relative species abundance and biomass are a general aspect to be considered when establishing a control system for management purposes. To integrate the biological data and information related to the changes in the ecosystem as consequence of the effects of the fishing effort on target and non target species and on the ecosystem, an on board observer system should be implemented at national level as part of the Mediterranean Fishing Effort Control System in order to evaluate the relation between the fishing effort and the fishing ecosystem changes.

The national on board observer systems for fishing effort control should be complemented with data and information obtained during scientific trawl surveys as currently some international ones are doing. Nevertheless and due to the above mentioned ecosystem dynamics the effort effects on the ecosystem control scheme should not be based exclusively on this seasonal data.

11. Economics Aspects (Mohamed Idrissi Malouli).

The effort based fishing management follows economic logics, because by limiting the fishing effort (i.e. decreasing the number of fishing days), the cost of the activity is also decreased, which is considered one of the principal strategies of the theory of economics. The main effort data needed for economic analysis are found in table 3 (report of the 30th Session of the GFCM, appendix D). Regarding economics, the fishing effort could be envisaged under the following points of view.

- The number of vessels/year, by fleet segment, could inform us about the invested capital and the action undertaken by fishermen to renew the vessels and improve the work conditions.
- Number of trips/year (number of hours/trip) informs about variable costs which should be estimated in the most appropriate way. It is the most important parameter for the cost-benefit approach. In this sense, it is also important to have fuel consumption and price, per vessel and trip as a separate input.
- The vessel characteristics (engine power, GT, length, etc.). The profits are calculated in general as a function of those characteristics, because it is important to know profits by power unit or profit by capacity unit.

For some countries those data are not available; for this reason it is advisable to propose data collection systems and methods to collect the data needed with respect to the working conditions of the different countries.

Should effort reduction on a stock in a GSA be proportional across all Operational Units?

12. While the workshop felt that this is an issue to be decided by management, it will inevitably arise, and the opinion of biologists on this issue will be requested. What seems to have already been decided is that under effort control, the number of key species actively managed will be small - but representative species from each major biocoenosis/depth zone should be chosen for particular attention. Methods were proposed for dividing the trip data for demersal resources in Majorcan trawl fishery by species composition or target species, and this approach is to be recommended. If two types of gear catch the same species, as long as the number of key species is limited, cross calibration is in theory possible, but further attention to this problem in practice will be required, and should not exclude special sampling for size and age if this is needed to reconcile the relative impacts of two or more gear types at different stages in the life history. Effort regulation should be regarded within the context of biological knowledge of the life history: thus if one gear is targeting vulnerable nursery areas, its effort (at least in these areas) will need to be curtailed: a similar comment applies if the gear is targeting spawning concentrations.

Calibration/allocation of effort units

13. The use of analytical methods to parallel collection of effort data and convert it to fishing mortality estimates may on occasions be possible by VPA, although this particular approach requires a significant research for data collection and age reading. Another approach that permits effort calibration would be the use of trawl survey samples to calculate overall mortality rate.

III. CONCLUSIONS OF THE WORKSHOP

- Any system of effort control should be integrated within the complex of technical measures in place within a GSA, so as to avoid changes in fishing methodology counteracting the intention of the control on number of days fished by an increase in fishing power.
- Particularly for shared stocks, inter-calibration of OUs from different countries will be necessary to determine relative fishing power, prior to deciding on a possible effort share from a Total Allocation of Effort (TAE).
- Trawl surveys, including MEDITS, or other biological sampling scheme should provide estimates of biomass and mortality. These annual values should be used to ensure that the overall measure of fishing effort exerted is not subject to hidden changes in fishing power.
- Fishing effort on demersal fishery resources should be specified where possible, in terms of depth, area fished and/or biocoenosis exploited.
- These areas/resources should be identified in any effort data collection system and effort divided where possible between target resources. When possible, a GIS system should document the distribution of biocoenosis and fishing grounds, in cooperation with the system of effort collection in place.
- When available, disaggregated data on catch composition by fishing effort unit (e.g. daily sale bills) could be used to estimate the effective fishing effort exerted on a given stock.
- The workshop noted that the term “capacity” as used here, for stock assessment purposes, is often substituted for by “fishing power” - the fishing mortality rate exerted by one unit of fishing effort by a vessel/gear of a given fishing capacity.

- The fishing effort measure used for assessment purposes is supposed to be proportional to the resulting fishing mortality.
  - To make fishing effort units additive between OUs, it will be necessary to calibrate their relative fishing power of OUs in terms of the catch rate or CPUE taken per unit of effort.
  - To ensure that the effort measure closely reflects fishing mortality, it would be ideal for demersal resources to express effort in terms of fishing intensity = fishing effort/unit area of grounds.

14. The table below shows some parameters to measure fishing effort[1] both in terms of fishing capacity, fishing activity and, if relevant, number and dimension of fishing gears. This table refers to a single vessel. The effort measure is calculated adding the effort of all single vessels.

Gear	**Number and dimension**	**Capacity**	**Activity**	**Nominal Effort**[2]
Dredge	Open mouth			Dredged bottom surface[3]
Trawl	Type of trawl (pelagic, bottom) GT and/or GRT Engine power Mesh size Size of the net (opening) speed	GT	Time fishing	GT*days GT*hours
Purse seine	Length of the net GT Light power Number of small boats	GT Length of the net	Search time Set	GT * Fishing sets[2] Length of the net * fishing sets
Nets	Type of net (trammel net, driftnet, bottom) Net length (used in regulations) GT Net surface Mesh size	Net length	Time fishing	Net length * days
Long lines	Number of hooks GT Number of longline units Characteristics of hooks Bait	Number of hooks Number of longline units	Time fishing	Number of hooks * hours Number of hooks * days Number of longline units * days/hours
Traps	GT	Number of traps	Time fishing	Number of traps * days
Purse seine/FADs	Number of FADs	Number of FADs	Number of trips	Number of FADs * Number of trips

[1] It refers to nominal effort
[2] Should be referred to a particular area (indicating the surface) to estimate fishing intensity (effort · km^{-2}) and to relate the effort to exploited communities
[3] The effort measures that do not include a time activity should be referred to a period of time (i.e. by year)

Proposal to hold a Workshop on methodology to analyze disaggregated fishery data with the following Terms of Reference

15. There exist, for some Mediterranean areas, data series on landings and prices/revenues, disaggregated by day, vessel and species. The purpose of the workshop is to develop a common methodology to analyze and compare results from these different series.

16. Taking into account the progress made on operational units characterization and effort by SAC/GFCM, in the framework of the existing Permanent Working Group on Stock Assessment Methodology, the Workshop will develop standard methods to:

- filter data and detect errors and biases;
- analyze variability of landings at different time scales;
- identify clusters of vessels (potential OUs);
- identify target species;
- identify species composition;
- identify and describe seasonality;
- identify and describe trends, both in fishing activity and in stock abundance;
- identify fishing strategy and tactics[4] (métiers);
- define nominal effort and propose a method to obtain effective effort for each vessel/OU;
- analyze prices; and
- explore methods to calibrate official landing statistics from sampling on board and field surveys.

17. A description of each data series, including: years covered, vessels and species, number of registers (vessel-day-species-catch-price/revenue) will be provided before the workshop.

18. The workshop will consist of a practical work of analysis of data series (several years) on landings and prices/revenues, disaggregated by day, vessel and species. It will take place on the condition that at least two relevant sets of data will be guaranteed before the workshop.

IV. ADOPTION OF THE REPORT

19. The Workshop convened on the further adoption of the report by e-mail. The report was adopted on June 15, 2006.

[4] A **strategy** is a general plan or set of plans intended to achieve something, especially over a long period. **Tactics** are the methods that you choose to use in order to achieve what you want in a particular situation. [(c) HarperCollins Publishers].

ANNEX A

Agenda

1- Opening and arrangement of the meeting.

2- Definition, Measurement and standardisation of fishing effort and capacity and implementing a fishing effort data collection scheme

3- Conclusions and recommendations

4- Adoption of the report

ANNEX B

List of participants

Francisco ALEMANY
Instituto Español de Oceanografía
Biologist, Centro Oceanográfico
de Baleares.
Ministerio de Educación y Ciencia
Moll de ponent s.n.
Palma de Mallorca. Spain
Tel.: +34 971 401561/ 401877
Fax: +34 971 404945
E-mail: francisco.alemany@ba.ieo.es

Jorge BARO
Instituto Español de Oceanografia
Biologist, Centro Oceanográfíco
de Málaga
Ministerio de Educacon y Ciencia
Apto. 285, Puerto Pesquero
29640 Fuengirola
Tel: (+34 95) 247 81 48
Fax: (+34 952) 246 38 08
Email: jorgebaro@ma.ieo.es

Casto López BENÍTEZ
Management of fleets
Conservation policy
DG Fisheries and Maritime Affairs
European Commission
Rue Joseph II, 99
B-1040 Brussels
Tel.: +32 2 2996077
Fax: +32 2 2955621
E-mail: Casto.Lopez-Benitez@cec.eu.int

John CADDY
GFCM Consultant
E-mail: jfcaddy@yahoo.co.uk

Leonardo CANNIZZARO
Consiglio Nazionale delle Ricerche
Instituto per l'Ambiente Marino Costiero
Mazara del Vallo
Mobile: +39 3331133165
E-mail: leonardo.cannizzaro@iamc.cnr.it

Matthew CAMILLERI
Head
Malta Centre for Fisheries Sciences
Ministry for Rural Affairs and
the Environment
FORT San Lucian, M'Xlokk
Tel.: +356 21 650933
Fax: +356 21 659380
E-mail: matthew.camilleri@gov.mt

Juan A. CAMIÑAS
Instituto Español de Oceanografia
Director, Centro Oceanográfíco
de Málaga
Ministerio de Educacon y Ciencia
Apto. 285, Puerto Pesquero
29640 Fuengirola
Tel: (+34 95) 247 81 48
Fax: (+34 952) 246 38 08
Email: jacaminas@ma.ieo.es

Ester ESTEBAN RODRIGO
Ministerio de Agricultura, Pesca y
Alimentacion
Spain
Tel.: +34 91 3476161
Fax: +34 91 3476046
E-mail. eesteban@mapya.es

Omar KADA
Biologiste des pêches et chef du
Laboratoire des Ressources Halieutiques
INRH - Centre Régional à Nador
Tel.: +212 36 33 12 51
Fax: +212 36 60 3828
E-mail: inrhomarkada@yahoo.fr

Alberto GARCIA
Instituto Español de Oceanografia
Biologist, Centro Oceanográfíco
de Málaga
Ministerio de Educacon y Ciencia
Apto. 285, Puerto Pesquero
29640 Fuengirola
Tel: (+34 95) 247 81 48
Fax: (+34 952) 246 38 08
Email: agarcia@ma.ieo.es

Constantina KARLOU-RIGA (Ms)
Fisheries Laboratory
Directorate General for Fisheries
Ministry of Agriculture
15 Karaoli & Demetriou
18531 Piraeus
11143 Athens
Email: fishres@otenet.gr

Jordi LLEONART
Senior Fishery Resources Officer
Marine Resources Service
FAO
Viale delle Terme di Caracalla
00100 Roma, Italy
Tel.: +39 0657056354
E-mail: jordi.lleonart@fao.org

Idrissi MALOULI
Economiste des pêches
INRH - Centre Régional à Tanger
B.P. 5268 Dradeb Tanger 90 000
Tel: +212 3932 5134
Fax:+212 39325139
E-mail: malouliinrh@yahoo.fr

Piero MANNINI
Project Coordinator
Viale delle Terme di Caracalla
00100 Roma, Italy
Tel. : +39 0657055402
Fax : +39 0657053020
E-mail : piero.mannini@fao.org

Joan MORANTA MESQUIDA
Instituto Español de Oceanografía
Biologist, Centro Oceanográfico
de Baleares.
Ministerio de Educación y Ciencia
Moll de ponent s.n.
Palma de Mallorca. Spain
Tel.: +34 971 401561/ 401877
Fax: +34 971 404945
E-mail: joan.moranta@ba.ieo.es

Corrado PICCINETTI
Director
Laboratorio di Biologia Marina Pesca
Viale Adriatico 1/N
61032 Fano
E-mail: cpiccinetti@mobilia.it
Corrado.piccinetti@unibo.it

Abdellah SROUR
GFCM Deputy Executive Secretary
FAO
Viale delle Terme di Caracalla
00100 Roma, Italy
Tel.: +39 0657055730
Fax: +39 0657056500
E-mail: abdellah.srour@fao.org

ANNEX C

List of documents

Working Documents:

- ✓ Some common definitions of fishing effort and its potential use in assessment and management of GFCM resources in the OU context. (J.F. Caddy)
- ✓ New Method to Detect Fishing Tactics (J. Moranta)
- ✓ Modelling the Relationship Between Fishing Effort and Effective Fishing Mortality in Western Mediterranean Trawl Fleets: the Case of Hake and Striped Red Mullet Fisheries in Balearic Islands (F. Alvarez, F. Alemany, E. Ferrandis)
- ✓ Determination of Effective Fishing Effort on Hake Merluccios merluccius in a Mediterranean Trawl Fishery (F. Alemany, F. Alvarez)

Information Documents:

- ✓ Report of the Permanent Working Group on Stock Assessment Methodology (PWGAM) and Workshop on Black Sea Assessment of Pelagic and Demersal Fish Stocks, Istanbul, 8-10 March 2006
- ✓ Operational Units in Mediterranean Sea (P. Accadia, R. Franquesa)
- ✓ Sustainable Use of Flatfish Resources: Solving the Credibility Crisis in Mixed Fisheries Management (A.D. Rijnsdorp, N. Daan, W. Dekker, J.J. Poos, W.L.T. Van Densen)
- ✓ Fishing effort control: could it work under the common fisheries policy (J.G. Shepherd)

Presentations:

- ✓ Recalling the GFCM Approach to Fisheries Management Through Effort Control: Its Current Status (A. Srour)
- ✓ Fishing Mortality, Fishing Effort, Catchability and Fishing Capacity: The SCSA View (J. Lleonart)