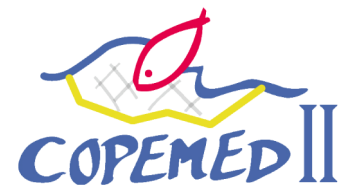




FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS



OCCASIONAL PAPER

14

**ADVANCES IN PREPARING A JOINT ASSESSMENT
OF EUROPEAN HAKE, *Merluccius merluccius*, STOCK
FOR GSAs 01, 02, 03 AND 04 OF THE GFCM (ALGERIA,
MOROCCO AND SPAIN)**

A CopeMed II contribution to:

GFCM-SAC Sub-Committee on Stock Assessment (SCSA)

Working Group on Stock Assessment of Demersal Species

Split, Croatia, 5-9 November 2012

Málaga (Spain), October 2012

CopeMed II Occasional Paper N° 14 **(GCP/INT/028/SPA – GCP/INT/006/EC)**

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



GFCM-SAC Sub-Committee on Stock Assessment (SCSA)

Working Group on Stock Assessment of Demersal Species

Split, Croatia, 5-9 November 2012

**ADVANCES IN PREPARING A JOINT ASSESSMENT
OF EUROPEAN HAKE, *Merluccius merluccius*, STOCK
FOR GSAs 01, 02, 03 AND 04 OF THE GFCM (ALGERIA,
MOROCCO AND SPAIN)**

(CARRIED OUT IN THE FRAMEWORK OF THE CopeMed II STUDY
GROUP ON *M. merluccius*. Málaga, Spain. 26-28 September 2012)

Advances in preparing a joint assessment of European hake, *Merluccius merluccius*, stock for GSAs 01, 02, 03 and 04 of the GFCM (Algeria, Morocco and Spain)¹

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Abstract

Demersal species represent an important fishery activity for the countries bordering the Alboran Sea. Among the demersal species with great importance in terms of both total landings and economic value is the European hake (*Merluccius merluccius*). The species was identified by the experts participating at the CopeMed II meeting on the definition of priority topics related to shared resources as priority for the Alboran Sea region. Algeria, Morocco and Spain were identified as the countries sharing this stock. The 5th meeting of the Coordination Committee of CopeMed II (Málaga, 3-4 May 2012) agreed that the project should “*hold the first meeting of the WG for stock assessment of Merluccius merluccius of the Alboran Sea among Algeria, Morocco and Spain*”.

This document prepared in the frame of the FAO-CopeMed II project aims at contributing to reinforce the subregional collaboration for the identification of the most relevant characteristics of *M. merluccius* stock and the national fleets involved in its fishery in Algeria, Morocco and Spain. As a first result of this cooperation among different research institutions, experts prepared data forms according to formats agreed in the framework of the SAC-SCSA, to identify if there is a single *M. merluccius* stock in GSAs 01, 02, 03 and 04 and to define the most appropriate approach and methodology to carry out a preliminary joint assessment of the *M. merluccius* stock among Algeria, Spain and Morocco. This work aims to improve the decision process for the joint management of the *M. merluccius* stock in the Alboran Sea. Compilation of socioeconomic information of *M. merluccius* fishery through the indicators provided by the GFCM and the socioeconomic impact of the recommendations and the subsequent implemented measures were stressed by the three countries.

Key words: *Merluccius merluccius*, CopeMed II, Alboran Sea, stock assessment, SCSA.

1. Background information

The General Fisheries Commission for the Mediterranean (GFCM) stressed the importance of making common assessments of shared stocks of priority species. Fisheries experts of some southern Mediterranean countries have demanded the exchange of information on fisheries data with the neighboring northern countries in order to improve knowledge on the status of

¹ This paper should be cited as follows: Benchoucha S., Pérez Gil J.L., Ainouche N., Jarbui O., Baro J., Elouamari, N., Ben Merien S., Hamida C., García T., Bernardon M., Camiñas J.A., Fernández I.L., Meléndez M.J. Advances in preparing a joint assessment of European hake, *Merluccius merluccius*, stock for GSAs 01, 02, 03 and 04 of the GFCM (Algeria, Morocco and Spain). Paper presented at the Working Group on Stock Assessment of Demersal Species (SCSA-SAC, GFCM), (Split, Croatia, 5-9 November 2012). GCP/INT/028/SPA-GCP/INT/006/EC. CopeMed II *Occasional Papers* n° 14: 19 pp.

fisheries resources and to propose new management measures for the sustainability of the fishery resources and its exploitation. The joint stock assessment of the main shared stocks in the Mediterranean Sea is considered as an important step to promote agreed management recommendations for fisheries in the GFCM area.

One of the main roles of the FAO subregional projects is to support the scientific communities in the projects areas to gather all available information on the fisheries to assess the stocks, particularly those shared by two or more countries and at least by two fishing fleets. CopeMed II emphasis is the reduction of the differences currently existing in the national capacity of the participating countries and to promote subregional approach to fisheries research and management. The subregional working groups (WGs) on Mediterranean shared stocks organized by CopeMed II are of major importance for the reorientation of approaches to stock assessments (moving from single country analysis to joint subregional analysis) and the possibility of the implementation of scientifically based up-dated management plans for the fisheries targeting these shared stocks both in each specific country and at subregional level.

Due to its market value, production and its wide distribution in several Mediterranean countries, the European hake (*Merluccius merluccius*) is a major shared resource in the Alboran Sea (GSAs 01, 02, 03 and 04). The species was identified by CopeMed II meeting on the definition of priority topics related to shared resources (demersal and pelagic) in the subregion² as priority for the Strait of Gibraltar and Alboran Sea regions. Algeria, Morocco and Spain were identified as countries sharing this possible stock. Moreover, the 5th meeting of the Coordination Committee of CopeMed II (Málaga, 3-4 May 2012) agreed that the project should “*hold the second meeting of the WG for the assessment on *Parapenaeus longirostris* of the Alboran Sea among Algeria, Morocco and Spain and the first meeting of the WG for stock assessment of *Merluccius merluccius* of the Alboran Sea among Algeria, Morocco and Spain, back to back with the previous WG meeting*”. The importance of the *M. merluccius* stock at regional level was also discussed in the SRDWG (Subregional Demersal Working Group) last meeting³ and a joint stock assessment of this species was recommended.

To answer the needs expressed by the CopeMed II countries, following the recommendations of the 5th meeting of the CopeMed II Coordination Committee, the SRDWG and the SAC-SCSA requirements, a first meeting of the CopeMed II Study Group on *Merluccius merluccius* of the Alboran Sea was organized, involving experts from Algeria, Morocco, Spain and FAO-CopeMed. The meeting aimed to compile and discuss the available data on distribution and abundance patterns, biological parameters, exploitation patterns, socio-economic indicators and current situation of the *M. merluccius* fisheries in the Alboran Sea.

2. Introduction

The Alboran Sea (GSAs 01, 02, 03 and 04) is bordered by 3 countries (Algeria, Morocco and Spain). European hake (*Merluccius merluccius*) is considered among the most valuable exploited demersal stocks in the Alboran Sea. It is included in the list of priority shared stocks for the CopeMed II region and the GFCM.

² CopeMed II. 2011. Report of the CopeMed II meeting on the definition of priority topics related to shared resources (demersal and pelagic) in the subregion. CopeMed II – ArtFiMed Technical Documents N°22 (GCP/INT/028/SPA-GCP/INT/006/EC). Málaga, 2011. 14pp.

³ First meeting of the Working Group on *Parapenaeus longirostris* shared stock for Algeria, Morocco and Spain (GSA 04, 03 and 01). 18-19 July 2011. Fuengirola (Spain).

M. merluccius is a demersal species characterized by a wide depth distribution, being found at depths ranging from between 50 and 370 m depth (Cohen et al., 1990), highly appreciated by fishermen and consumers in all the Mediterranean countries. It is a key species in the trophic chain occupying a high position among the predators of the demersal community.

The main objective of the CopeMed SG meeting was to compile available data and information to try to perform for the first time a joint exercise on the assessment of European hake stock in the Alboran Sea, by using different approaches and models. Conclusions and recommendations provided by the SG from the results of the joint assessment intend to facilitate the decision process for the joint management of the *M. Merluccius* stock in the Alboran Sea.

The SG provided to the meeting national data and documents and analyzed all available information and data on the *Merluccius merluccius* fishery in this area: biological parameters (growth parameters, reproduction, mortality, demographic structure of the catches, etc.); distribution and abundance patterns; national fleets targeting *M. merluccius* (number, length, GT, power, age, number of fishermen, etc.); fishery aspects in each country (fishing gears, landing, seasonality, fishing effort, demographic structure of the catches, etc.); socio-economic indicators; list of studies and surveys on *M. merluccius* at national and/or international level and main results of these surveys for assessment purposes; identification of the appropriate approaches to be used for analyzing the available data.

3. National information on *Merluccius merluccius* stock

National information of the *Merluccius merluccius* fishery and the available data in Algeria, Spain and Morocco were presented. Relevant issues discussed were data availability in terms of fisheries characteristics, catch, effort, biological length at maturity and demographic parameters as length frequency structure, biomass and abundance (from trawl surveys). Trends in landings, availability and frequency of national statistics, studies conducted on the species in each country, importance of the by-catch, socioeconomic information of *M. Merluccius* fishery and stocks assessment methodologies were debated.

3.1. Algeria (GSA 04)

The Algerian demersal fishery consists of about 4000 vessels (between 2.5 and 19.2 m length overall and 39 – 430 CV engine power) including all categories: trawlers, purse seiners, and the “small scale” vessels⁴.

In 2010, the total number of trawlers in GSA 04 was 502. The Algerian demersal fishery is multispecific, targeting *Merluccius merluccius* and other demersal species with an average engine power of 449 HP and a mean GRT of 49 Tx.

| GSA | Fleet segment | Fishing Gear Class | Group of Target Species | Species |
|-----|--------------------------|--------------------|-----------------------------|------------------------------|
| 04 | E - Trawl (12-24 metres) | 03 - Trawls | 33 - Demersal shelf species | <i>Merluccius merluccius</i> |

Table 1. Demersal fleet description in Algerian GSA 04 (2011).

The greater part of the European hake production is provided by trawlers. In 2010, the *M. Merluccius* production by trawl was 269.639 tons, which represents 93% compared to 18.537 tons landed by artisanal fleet.

⁴ Ainouche N. CNRDPA, Algeria. “General characteristics of the Algerian demersal fishery (GSA 04)”. Meeting Memorandum of the Demersal SRWG on shared stocks in the MedSudMed and CopeMed II area. Mazara del Vallo (Italy), 16-17 September 2010.

M. merluccius is found from 20 to 800 m in GSA 04 showing the maximum abundance in the stratum 51-100. The length frequency distributions from the ALDEM trawl survey of demersal resources of the Algerian coast (CNRDPA / MPRH) in 2012 and the *M. merluccius* production (2006-2010) in GSA 04 are shown in Figures 1 and 2. Catch and effort data are provided from the Algerian ministry of fishing and fisheries resources (MPRH).

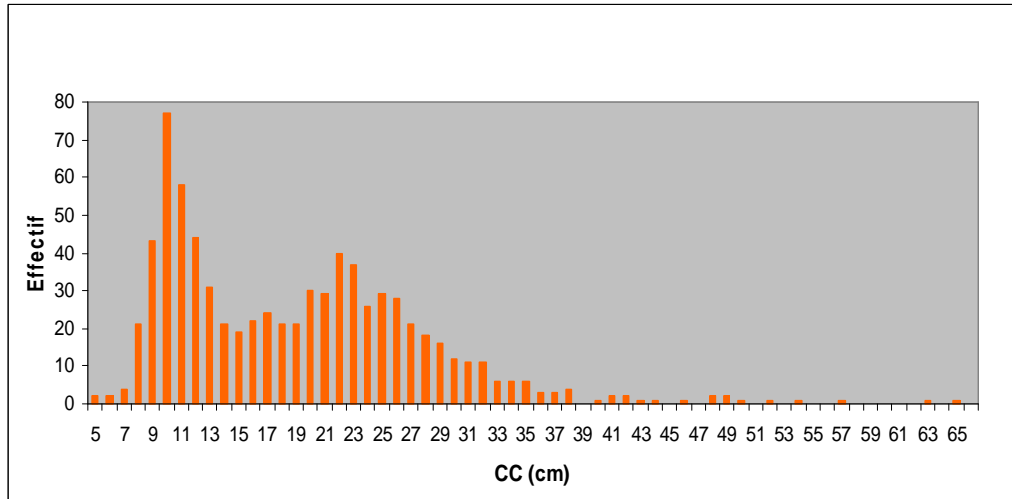
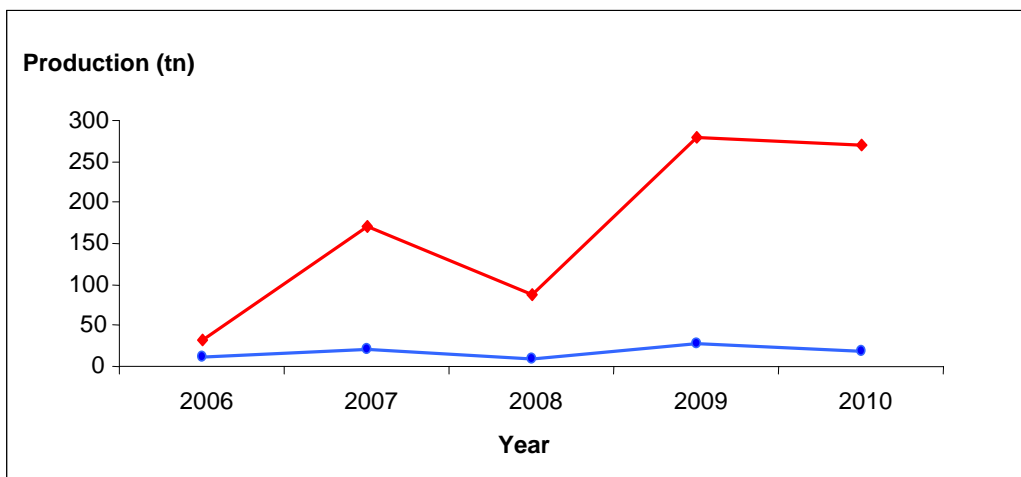


Figure 1. *M. Merluccius* mean length in GSA 04 (ALDEM 2012).



Trawlers (-)
 Artisanal fleet (-)

Figure 2. *M. Merluccius* production (tons) in GSA 04 (2006-2010).

M. merluccius growth parameters (Von Bertalanffy) obtained in GSA 04 are shown in Table 2.

| Author | Sex | L_{∞} | k | t_0 |
|-------------------------------------|--------------|--------------|-------|---------|
| ALDEM (2012) | Combined sex | 72.78 | 0.2 | -0.5 |
| Bouaziz et al., (1998) ⁵ | Male | 48.72 | 0.32 | -0.0479 |
| | Female | 80.64 | 0.139 | -0.442 |

Table 2. *M. merluccius* growth parameters (Von Bertalanffy) obtained in GSA 04.

The fishing regulations in Algeria are stated below:

- The minimum catch size of European hake is 20 cm.
- A biological rest period from May 1st to September 1st, during which trawl fishing is prohibited under 3 miles.
- Interdiction of fishing under 50 m.
- The mesh size is 40 mm.

3.1. Morocco (GSA 03)

The current knowledge on *Merluccius merluccius* fishery in Moroccan GSA 03 was presented. The trawl fishing fleet in this region is heterogeneous. The number of trawlers operating in GSA 03 is 115. The catch and effort data used were the official data collected in the period 2003-2011, provided by the Office National des Pêches (ONP) that has established the MAIA system since 2003.

Landings are made at 4 fishing ports: Beni Nsar (Nador), Al Hoceima, M'diq and Tangier. The port of Nador is the most important in terms of *M. merluccius* production (84%) and with regard to the fishing effort (59%). In 2011, the number of trawlers targeting *M. merluccius* in GSA 03 was 115 with an average engine power of 230 HP and a mean GRT of 50 Tx (Table 3). Longliners are not found in Moroccan GSA 03.

| Ports | Number of trawlers | Mean HP | Mean GRT |
|--------------|--------------------|---------|----------|
| Nador | 73 | 357 | 55 |
| Al Hoceima | 25 | 307 | 51 |
| M'diq | 17 | 200 | 28 |
| Total | 115 | - | - |

Table 3. Segment fleet characteristics in Moroccan GSA 03.

| GSA | Fleet segment | Fishing Gear Class | Group of Target Species | Species |
|-----|--------------------------|--------------------|-----------------------------|------------------------------|
| 03 | E - Trawl (12-24 metres) | 03 - Trawls | 33 - Demersal shelf species | <i>Merluccius merluccius</i> |

| Operational Units | Fleet (n° of boats) | Kilos or Tons | Catch(species assessed) | Effort units |
|-----------------------------|---------------------|---------------|-------------------------|--------------|
| MAR 03 E 03 33 - HKE | 115 | Tons | 248 | Fishing trip |

Table 4. Segment fleet description in Moroccan GSA 03 (2010).

M. merluccius is found at depths ranging from 50 to 510 m. In the period 2003-2011, the mean

⁵ Bouaziz, A., Bennoui, A., Djabali, F., & Maurin, C., 1998. Reproduction du merlu, *Merluccius merluccius* (Linnaeus, 1758) dans la région de Bou-Ismaïl. Cahiers Options Méditerranéennes, 35, 109-117.

annual *M. merluccius* production was 218 tons (Figure 3). Two peaks in 2000 and 2006 with productions of 464 and 547 tons. In 2009, the hake production represented 1'61 % (198 tons) of the total production of the demersal fishery. However, the contribution was around 5 millions of dirhams (equivalent to 584.000 \$).

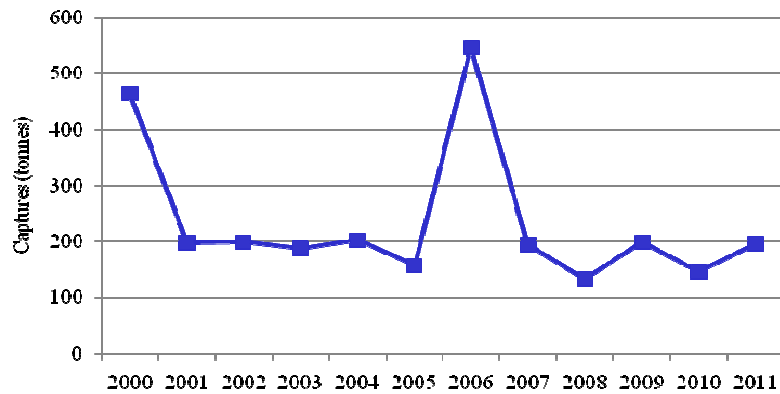


Figure 3. *Merluccius merluccius* (tons) in the period 2000-2011 (GSA 03).

The fishing effort evolution of the *M. merluccius* fishery in GSA 03 is showed in Figure 4.

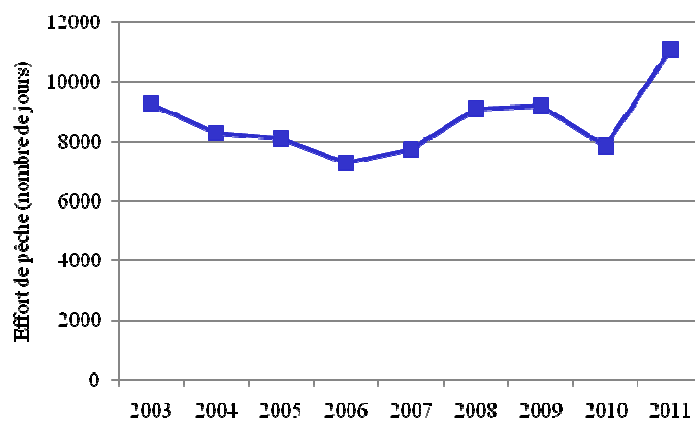


Figure 4. Fishing effort (number of days) of the fishery targeting *M. merluccius* (2003-2011) in GSA 03.

The index of abundance trend in the period 2000-2009 (Figure 5) shows two peaks in 2000 and 2006 (abundance indices of 49 and 60 kg/tide), which could be explained by a strong recruitment.

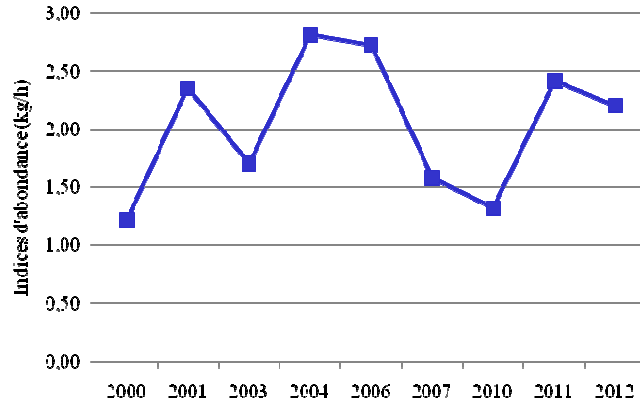


Figure 5. Index of abundance of *Merluccius merluccius* (yield in Kg/h) in Moroccan GSA 03 in the period 2000-2012.

In the same way, the average index of abundance (Figure 6) recorded during surveys campaigns (CAI_MD) fluctuates between 1 and 10.44 Kg/h.

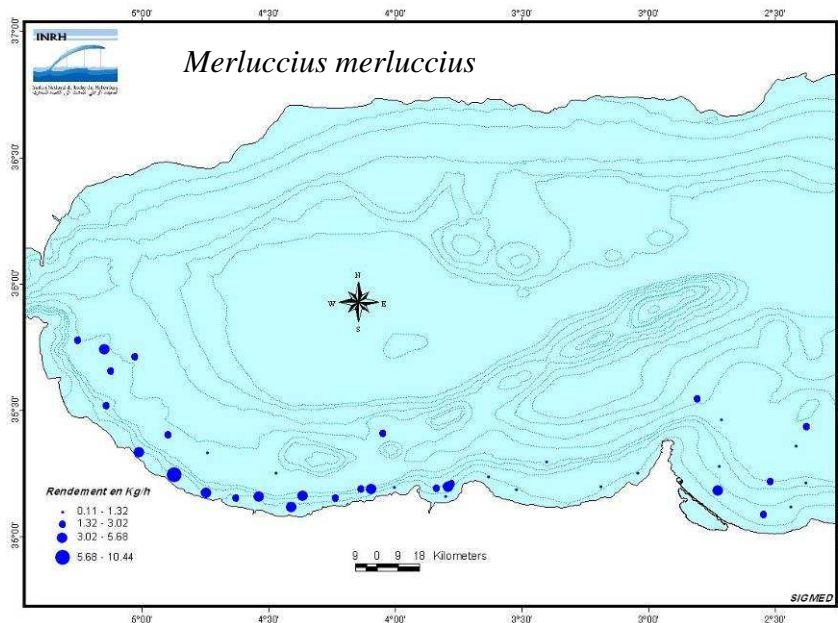


Figure 6. Index of abundance of *Merluccius merluccius* (yield in Kg/h) in Moroccan GSA 03.

M. Merluccius average length (cm) in GSA 03 for the period 2000-2012 (data from surveys at sea) is shown in Figure 7.

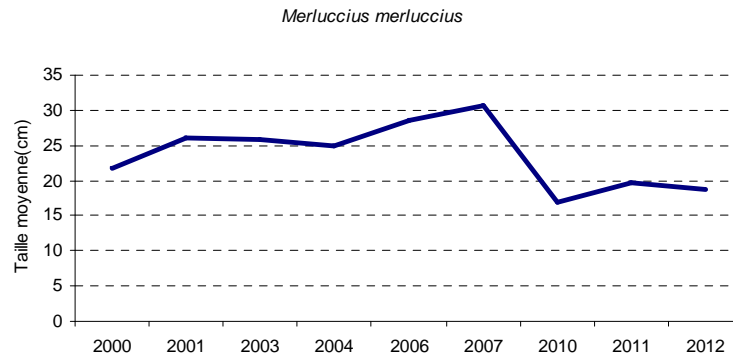


Figure 7. *M. Merluccius* average length (cm) for the period 2000-2012 in GSA 03.

The Regulations in force and degree of observance of regulations in GSA 03 are listed below:

- Fishing licence: Fully observed.
- Trawl mesh size : ≥ 50 mm (mesh stretched).
- Minimum landing size = 20 cm.
- Interdiction of fishing under 80 m deep in the area between Tangier and Al Hoceima.
- Interdiction of fishing under 3 miles in the area between Al Hoceima and Saidia.

M. merluccius growth parameters in GSA 03 are:

| | a | b | L_{∞} | K | to | Source |
|------|--------|------|--------------|-------|--------|--|
| Hake | 0.0059 | 3.02 | 96.8 | 0.081 | -1.146 | Zoubi, A., 2001. Etude de la biologie de croissance des principaux stocks demersaux de la mediterranee marocaine. Rapp. Comm. int. Mer Médit., 36 :341 |

3.1. Spain (GSAs 01 and 02)

Merluccius merluccius is one of the target demersal species of the Mediterranean fishing fleets, largely exploited in GSA 01 (Northern Alboran Sea) essentially by trawl (88% landings) on the shelf and slope. *M. merluccius* average landings of the small-scale using gillnets and longliners represented respectively 6% and 3% of the total landings (Figure 8).

There is not a fishery targeting *M. merluccius* in GSA 02. Annual landings from GSA 02 represented about 1% of the total landings (all species). Mean anual value for the period 2009-2011 was 1.6 tons.

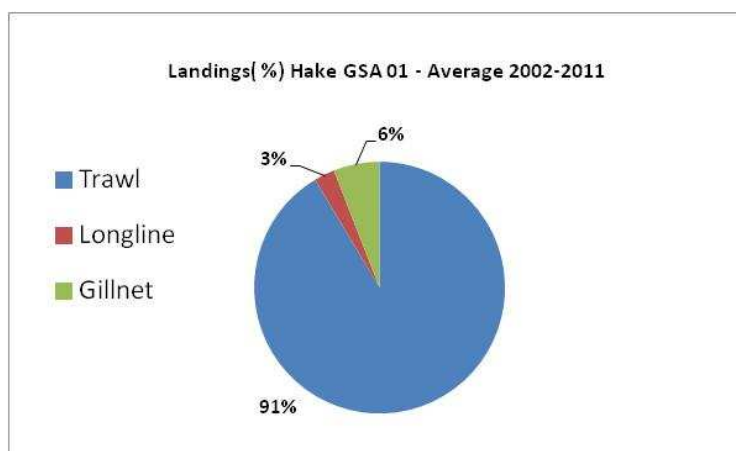


Figure 8. *M. merluccius* average landings (%) in GSA 01 in the period 2002-2011.

The trawling fleet in the GSA 01 consists of 183 boats, averaging 34.9 GRT and 175.8 HP. In 2011, the number of trawlers targeting *M. merluccius* in GSA 01 was 134 with an average engine power of 170 HP and a mean GRT of 37 Tx (Table 3). In the period 2002-2011 the average annual landings of this species was 448 tons in (Figure 9).

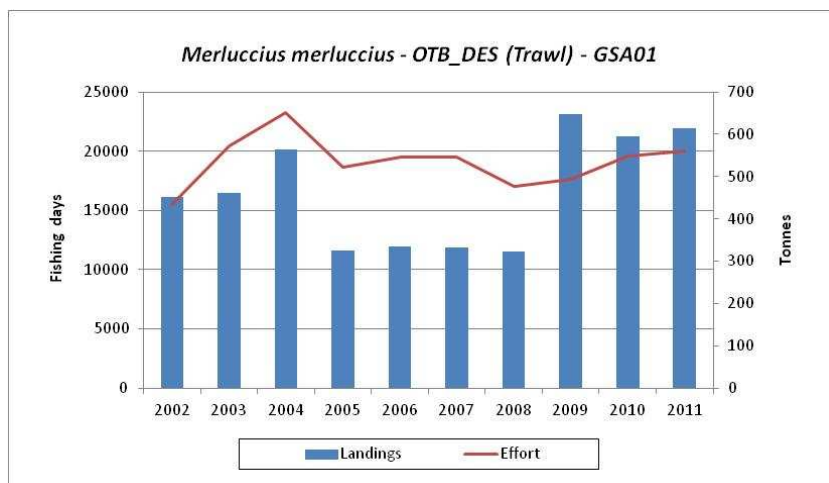


Figure 9. *M. merluccius* average annual landings and fishing effort in the period 2002-2011.

The port of Almería had the largest number of boats with an average of 40 units. The fleet with the largest GRT corresponded to the port of Garrucha (55.3 t), followed by the port of Motril (44.7 t) by that of Almeria (43.1 t). Engine power was correlated to the size of the fishing vessel. Highest engine power was associated with those vessels based in the port of Garrucha (289.8 HP), Almeria port (205.7 HP) and Motril port (190.7 HP). The HP of fishing vessels is directly related to the distance to the fishing grounds where they normally operate (Mendoza et al, 2010).

| GSA | Fleet segment | Fishing Gear Class | Group of Target Species | Species |
|-----|--------------------------|--------------------|-----------------------------|------------------------------|
| 01 | E - Trawl (12-24 metres) | 03 - Trawls | 33 - Demersal shelf species | <i>Merluccius merluccius</i> |

| Operational Units | Fleet (n° of boats) | Kilos or Tons | Catch(species assessed) | Effort units |
|-----------------------------|---------------------|---------------|-------------------------|--------------|
| ESP 01 E 03 33 - HKE | 134 | Tons | 448 | Fishing day |

Table 5. Fleet description in Spanish GSA 01 (2011).

The plot emphasized the decrease of the catch proportion at age 0 after 2007, indicating ages 1 as fully recruited to the fishery and suggested a change in the exploitation pattern. In the period 2009-2011, it a different exploitation pattern for trawlers targeting *M. Merluccius* in GSA 01 was observed (Figure 10). This was due to an improvement in control (EC regulation 1967/2006) of the minimum landing size (20 cm).

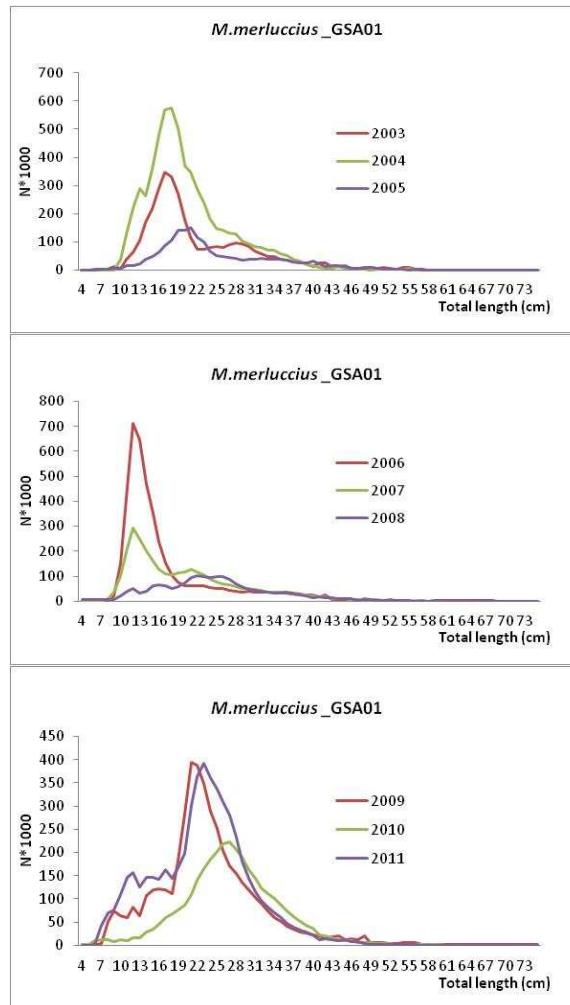


Figure 10. *M. merluccius* production in the period 2003-2011 (GSA 01).

Traditional otoliths reading based on slow growth have proved that the estimation of age in *M. Merluccius* is not accurate. Experts are still not at a stage where they are able to validate the age of Mediterranean European hake from otoliths reading, although the application of new ageing criteria based in landed analysis and tagging showed that this species grows at higher rates and matures earlier than previously considered (Alemany and Oliver, 1995; García-Rodríguez and Esteban, 2002; Mellon-Duval et al, 2010). Particular attention is due to growth rate variation with size and sex. Results showed that the estimated growth parameter (von Bertalanffy k) was two times the previously published values based on size frequency distribution in the area (Mellon-Duval et al. 2010). However, the research on the effects of environmental factors on otoliths formation, in combination with daily growth and tagging experiments, will lead to the overall understanding of the otoliths structure and interpretation, as already done for the Atlantic European hake (Piñeiro Álvarez, 2011). At present, it can be assumed that the hake growth is fast ($K=0.21$) and in the past it was believed a slow growth.

| Growth_1 * (Tagging) | |
|---|-------|
| L inf | 110 |
| K | 0.178 |
| T ₀ | 0.0 |
| Growth_2** progression_Elefan | |
| L inf | 108 |
| K | 0.21 |
| T ₀ | 0.115 |
| * Mellon-Duval et al. 2009. Gulf of Lions. ** García-Rodríguez and Esteban 2002. Gulf of Alicante. | |

Table 6. *Merluccius merluccius* growth parameters.

M. Merluccius abundance (N°/Km²) data of the total annual landings in the period 2007-2011 (index of abundance from MEDITS surveys, GSA 01) is shown in Figure 11. Abundance (Biomass) from sampling on board commercial fishing vessels (2003-2008) in GSA 01 is in Figure 12. *M. Merluccius* samplings in the period 2003-2008 were concentrated in three fishing ports (Fuengirola, Caleta de Vélez and Almería).

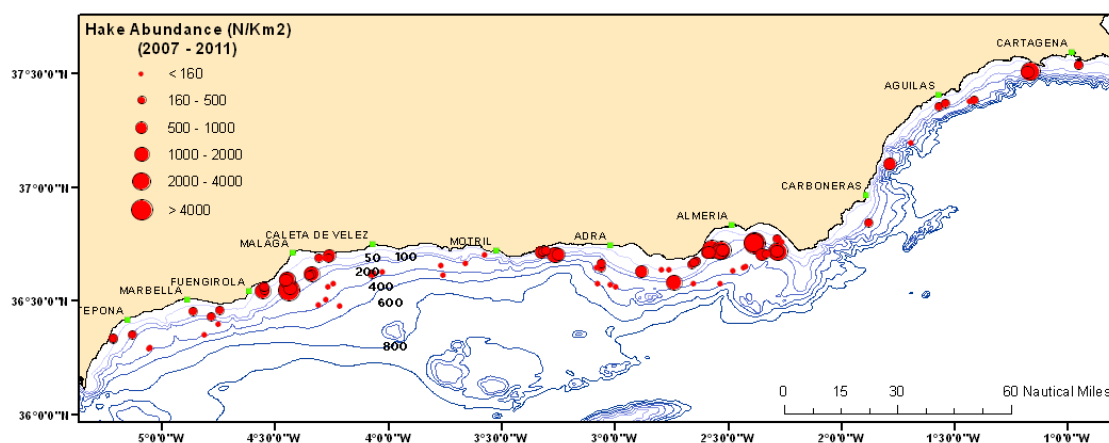


Figure 11. *M. Merluccius* abundance (N/Km²) in the period 2007-2011 (GSA 01).

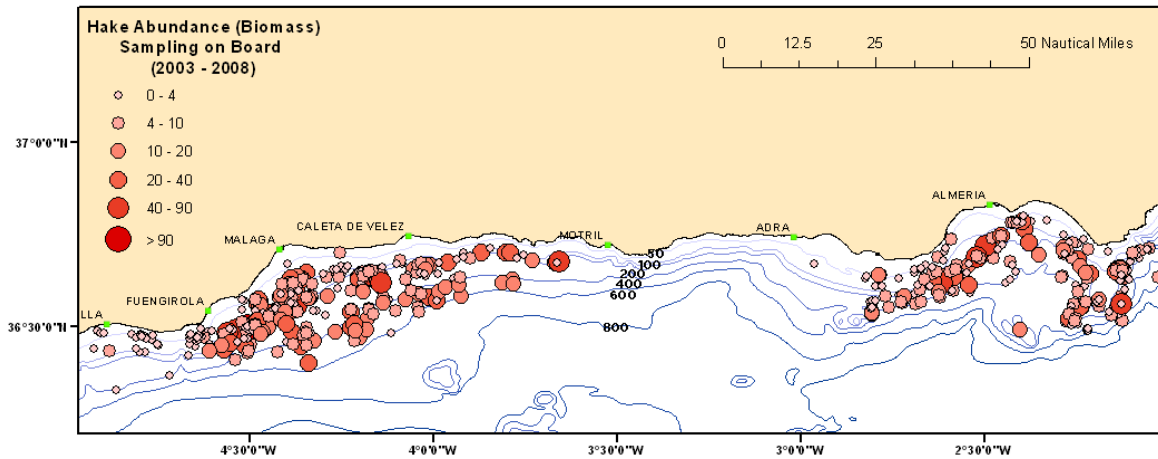


Figure 12. *M. Merluccius* abundance (Biomass) with sampling on board commercial fishing vessels (2003-2008) in GSA 01.

Data from the MEDITS surveys shows a *M. Merluccius* abundance (CPUE and Biomass) decrease in the period 2009-2010, however landings (CPUE) have slightly increased in 2011 (Figure 13).

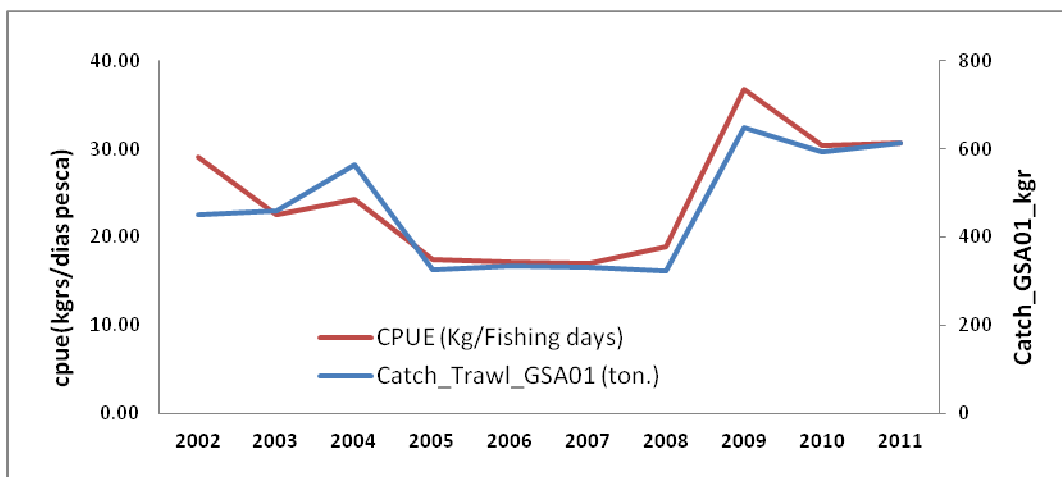


Figure 13. *M. Merluccius* abundance (CPUE and Biomass) with the MEDITS surveys in the period 2002-2011 (GSA 01).

The Regulations in force and degree of observance of regulations in GSA 01 are listed below:

- Fishing license: fully observed.
- Engine power limited to 316 KW or 500 HP: not fully observed.
- Mesh size in the cod-end (40 mm square or 50 mm rhomboidal): fully observed.
- Fishing forbidden within upper 50 m depth: not fully observed.
- Time at sea (12 hours per day and 5 days per week): fully observed.
- Minimum legal size (20 cm): observed.

4. Preliminary joint assessment of *Merluccius merluccius* in GSAs 01, 03 and 04

After analyzing all information and data provided by experts, two groups were created for the *M. merluccius* stock assessment exercise: one group to review the biological parameters and

methodology to be used in the assessment and a second group to prepare the demographic structure data for the joint stock assessment.

The biological parameters to be used in the joint stock assessment were presented (Table 7):

| <i>Merluccius merluccius</i> | | Algeria | Spain | Morocco |
|------------------------------|-------------------|--|--|---|
| Biological Parameters | | ALDEM, 2012 Bouaziz et al, 1998 | Mellou et al, 2009-GSA 07 DCF, 2010 Spain, Pauly-FISAT, 2010 | Zoubai, 2001 INRH-in process, 2012 |
| GP | L_{∞} (mm) | 72,78 | 110 | 96,8 |
| | k | 0,2 | 0,178 | 0,081 |
| | t_0 | -0,5 | 0,001 (Mellou et al, 2009-GSA 07) | -1,146 |
| Lenght-weight | a | 0,007 | 0,0048 | 0,0059 |
| | b | 2,9995 | 3,12 (DCF, 2010) | 3,02 |
| Maturity | Lt mat (mm) | 21,5 (cm) (Male), 30,6cm (Female), Bouaziz et al, 1992 | 28,2 (DCF, 2010) | |
| | aMat | | -14,3031 | |
| | bMat | | 0,5074 | |
| Selectivity | Lc 50 (cm) | | | |
| | aSel | | | |
| | bSel | | | |
| Sex ratio | (F/F+M) | 0,53 | 0,53 (DCF, 2010) | 0,49 (INRH-en cours, 2012) |
| Nat. Mortality | M | 0,48 | 0,2 (Spain, Pauly-FISAT, 2010) | |

Table 7. Synthesis of biological parameters of European hake in the CopeMed region (Algeria, Morocco and Spain).

The SG agreed on using available data from Morocco and Spain (2007-2011) for the *M. merluccius* stock assessment exercise. The SG finally decided not to include Algerian data in the analysis as only information from 2012 was available.

The SG stressed that the length-frequency distribution in GSAs 01 and 03 (2011) presented significant differences related to the exploitation pattern and also to the different source of data (commercial catch in GSA 01 and surveys in GSA 03). Moreover and for the whole series (2007-2009), the sampling intensity in GSA 03 was very low (2-3 samples/year in some years), although the sampling was done on commercial captures/vessels. Considering the previous reasons the SG decided to carry out an assessment exercise using the length-size composition from the analysis of the combined GSA 01+GSA 03 data and the average for the period 2007-2010.

The SG carried out a length cohort (LCA) and a yield per recruit (Y/R) analysis using a mean pseudo-cohort (2007-2011, GSAs 01 and 03), based on the size composition of the trawl catches (obtained from on board and on port monthly sampling) and the official landings.

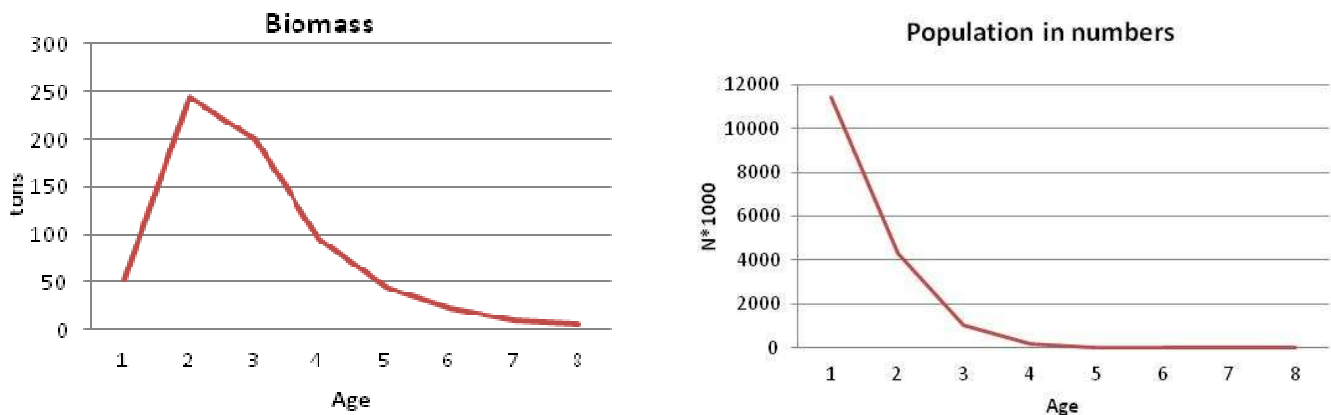


Figure 14. LCA-VPA results. Biomass and Population. Pseudocohort 2007-2010 in GSAs 01 and 03.

Once the length cohort analysis was conducted, after carrying out a slicing, a distribution with 7 age classes (8+) was obtained (Figure 14 shows the population structure with the VPA).

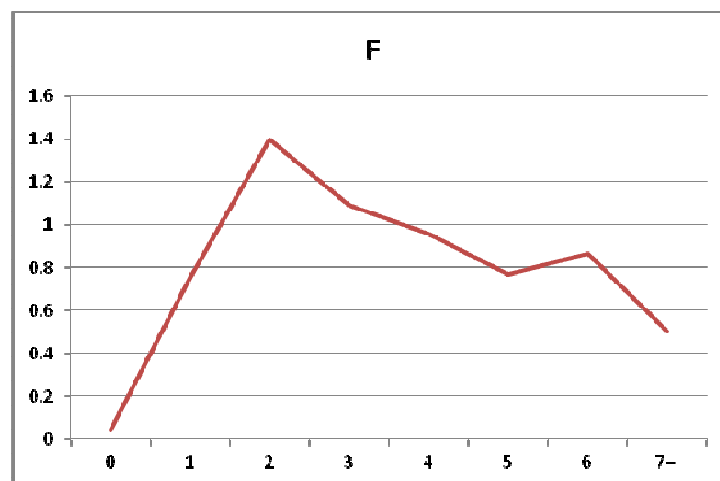


Figure 15. LCA-VPA results. Fishing mortality vector. Pseudocohort 2007-2010 in GSAs 01 and 03.

For the fishing mortality vector (F) a terminal mortality of 0.5 was used. It was stressed that exploitation is mainly based on age classes 2-4 (Figure 15). For the Yield per Recruit (Y/R) analysis $F_{reference}=1.148$ value from F_{bar2-4} was used.

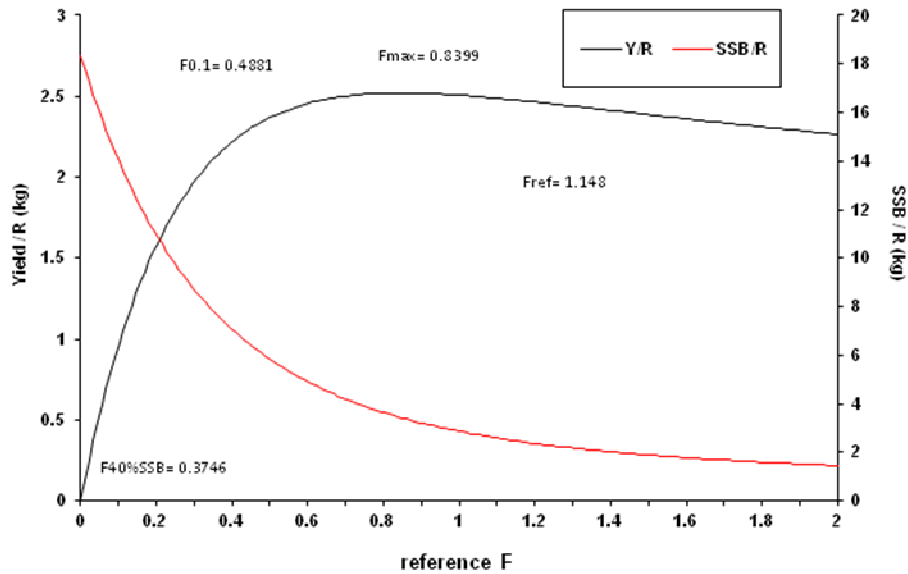


Figure 16. LCA-VPA results. Yield per Recruit analysis and Reference Points. Pseudocohort 2007-2010 for GSAs 01 and 03.

| Reference Point | F | YPR | SSBR |
|-----------------|--------|--------|---------|
| F Zero | 0 | 0 | 18.3633 |
| F-0.1 | 0.4881 | 2.35 | 5.9798 |
| F-Max | 0.8399 | 2.5201 | 3.4602 |
| F-40%SSB | 0.3746 | 2.1657 | 7.4604 |
| F-Reference | 1.148 | 2.4798 | 2.5 |

Table 8. Fishing mortality Biological References Points values and corresponding Yield Per Recruit (YPR) and Spawning Stock Biomass (SSB) per Recruit.

The actual level of fishing mortality ($F_{bar} = 1.148$) is higher than the values calculated for the F_{msy} proxi ($F_{0.1} = 0.48$) which indicates that the stock is in overfishing status. Considering the results of the assessment exercise, the SG recommended a 50 % reduction of the fishing mortality in the current trawl fishery.

5. Results and conclusions

Based on the available data compilation from Morocco and Spain on *Merluccius merluccius* and on the preliminary joint stock assessment carried out, the SG recommended:

- To perform joint genetic analysis and research on *M. merluccius* in Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04) to identify if there is a single common *M. merluccius* shared stock.
- To complete the information on *M. merluccius* stock in Algerian GSA 04 to join Algerian data to the GSAs 01 and 03 to cover all the study area.
- To improve the database it was stressed that monthly biological data from Algeria and Morocco on length-frequency distribution at landing are necessary and should be provided for the next meeting of the SG. If necessary, partial support of CopeMed II could be provide to complete some series.

- The organization of a meeting with the Sicily Strait area SG to analyse the possibility in comparing the biological and fisheries data and performing a joint evaluation on the *M. Merluccius* stock if possible.
- The SG agreed that biological and fisheries data in each country used for the assessment (biological parameters, demographic structure, etc.) should be uploaded to the CopeMed web (Regional Networks and databases).
- That the next assessment should be based on VPA (not in equilibrium) tuned by effort data from commercial fleets and independent indices from surveys.
- That the data of trawl surveys should be used to estimate the level and the variability of recruitment.
- It was agreed to reinforce the SG stock assessment results by incorporating socioeconomic data and information and facilitating the participation of experts on this field to the SG. The SG recommended CopeMed II to prepare the TORs for this matter.
- To continue working in improving the data to carry out a *M. merluccius* joint stock assessment before the 2013 meeting of the WG of Demersal Species of the SCSA.
- According to the preliminary results, the SG recommended not increasing the fishing mortality in the study area.
- To request the CopeMed II support to the SG in order to produce a scientific paper with all the information related to *M. merluccius* stock in the Alboran Sea.

6. References

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Annex I. VPA results (VIT).

| Class | Lower Age | Mean Age | Lower Length | Mean Length | Lower Weight | Mean Weight | Maturity ratio |
|-------|-----------|----------|--------------|-------------|--------------|-------------|----------------|
| 0 | 0 | 0.42 | 0 | 7.804 | 0 | 7.329 | 4.49E-05 |
| 1 | 1 | 1.385 | 17.936 | 23.927 | 39.164 | 106.121 | 0.0539656 |
| 2 | 2 | 2.362 | 32.948 | 37.679 | 261.137 | 407.837 | 0.836781 |
| 3 | 3 | 3.39 | 45.512 | 49.762 | 715.471 | 956.162 | 0.9994315 |
| 4 | 4 | 4.402 | 56.027 | 59.692 | 1368.503 | 1677.121 | 0.9999968 |
| 5 | 5 | 5.418 | 64.828 | 68.018 | 2157.436 | 2514.112 | 1 |
| 6 | 6 | 6.413 | 72.194 | 74.828 | 3018.254 | 3381.458 | 1 |
| 7 | 7 | 7.442 | 78.358 | 80.715 | 3897.481 | 4279.826 | 1 |

| Class | Catch in Numbers | Catch in Weight(g) |
|-------------|------------------|--------------------|
| 0 | 286747.43 | 2101629.36 |
| 1 | 1729249.43 | 183510038 |
| 2 | 685723.41 | 279663228.8 |
| 3 | 108511.13 | 103754224.8 |
| 4 | 26020.92 | 43640223.8 |
| 5 | 6811.63 | 17125193.59 |
| 6 | 2750.38 | 9300290.47 |
| 7 | 641.19 | 2744171.17 |
| Total | 2846455.51 | 641839000 |
| Mean Age | 1.643 | |
| Mean Length | 27.095 | |

| VPA Results--Numbers | | | VPA Results--Weight | | |
|----------------------|----------------|-------------|---------------------|----------------|-------------|
| age | Initial number | Mean number | Class | Initial Weight | Mean Weight |
| 0 | 11393843.9 | 7295567.47 | 0 | 0 | 53470676.47 |
| 1 | 4322218.74 | 2298369.66 | 1 | 169276637.7 | 243905764.6 |
| 2 | 1033360.63 | 490952.15 | 2 | 269848676.3 | 200228344.9 |
| 3 | 182714.79 | 99715.39 | 3 | 130727060.2 | 95344074.75 |
| 4 | 46713.38 | 27143.94 | 4 | 63927384.38 | 45523661.39 |
| 5 | 13993.97 | 8867.98 | 5 | 30191097.87 | 22295093.88 |
| 6 | 5178.9 | 3184.87 | 6 | 15631242.62 | 10769518.57 |
| 7 | 1783.15 | 1282.38 | 7 | 6949782.78 | 5488342.34 |
| Total | --- | 10225083.84 | Total | | 677025476.9 |
| Stock Mean Age | --- | 0.777 | SSB | | 360078543.3 |
| Stock Mean Length | --- | 13.492 | | | |

| VPA Results--Mortalities | Z | Ft_0.5 | Ft_1 | Ft_1.5 | M |
|--------------------------|-------|--------------|--------------|--------------|-------|
| 0 | 0.969 | 0.039 | 0.039 | 0.039 | 0.93 |
| 1 | 1.431 | 0.752 | 0.754 | 0.754 | 0.679 |
| 2 | 1.733 | 1.397 | 1.404 | 1.407 | 0.336 |
| 3 | 1.364 | 1.088 | 1.108 | 1.115 | 0.276 |
| 4 | 1.205 | 0.959 | 1.008 | 1.025 | 0.246 |
| 5 | 0.994 | 0.768 | 0.867 | 0.904 | 0.226 |
| 6 | 1.066 | 0.864 | 1.166 | 1.317 | 0.202 |
| 7+ | 0.7 | 0.5 | 1 | 1.5 | 0.2 |
| Fbar_2-4 | | 1.148 | 1.173 | 1.182 | |