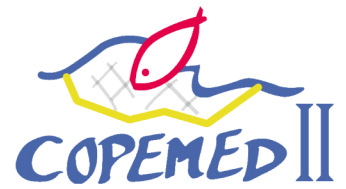




FOOD AND AGRICULTURE ORGANIZATION  
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OCCASIONAL PAPER

12

**ADVANCES IN THE JOINT ASSESSMENT OF  
*Parapenaeus longirostris* STOCK FOR ALGERIA,  
MOROCCO AND SPAIN (GSAs 01, 02, 03 AND 04 OF  
THE GFCM)**

**A CopeMed II contribution to:**

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

**Working Group on Stock Assessment of Demersal Species**

**Chania, Crete (Greece), 24-29 October 2011**

**Málaga (Spain), October 2011**

## **CopeMed II Occasional Paper N° 12** **(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)**

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Chania, Crete (Greece), 24-29 October 2011

**ADVANCES IN THE JOINT ASSESSMENT OF  
*Parapenaeus longirostris* STOCK FOR ALGERIA,  
MOROCCO AND SPAIN (GSAs 01, 02, 03 AND 04 OF  
THE GFCM)**

(CARRIED OUT IN THE FRAMEWORK OF THE CopeMed I STUDY GROUP ON *P. longirostris*, Fuengirola, Spain. 18-19 July 2011, IN SUPPORTING THE GFCM ASSESSMENT FORM)

# Advances in the joint assessment of *Parapenaeus longirostris* stock for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04 of the GFCM)<sup>1</sup>

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## FAO-CopeMed II

## 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 deep-water pink shrimp (*Parapenaeus longirostris*). This paper prepared in the frame of the FAO project CopeMed II aims at contributing to reinforce the subregional collaboration for the identification of the most relevant characteristics of *P. longirostris* stock and the national fleets involved in its fishery in each country. As a first result of this cooperation between different research institutions, experts prepared data sets according formats agreed in the framework of the SAC-SCSA, to identify if there is a single *P. longirostris* stock for GSAs 01, 02, 03 and 04 and to the election of the most appropriate approach and methodology that permitted for the first time to conduct a preliminary joint assessment of *P. longirostris* stock among Algeria, Spain and Morocco.

**Key words:** *Parapenaeus longirostris*; stock assessments; western Mediterranean; cooperation; CopeMed; Alboran Sea, Morocco; Spain; Algeria; Tunisia.

## 1. Background

The subregional working groups (WGs) on Mediterranean shared stocks, organized by CopeMed II project are of major importance for the reorientation of approaches (moving from single country analysis to joint subregional analysis) to stock assessments and the possibility of the implementation of management plans for the fisheries targeting these shared stocks in the project area. Due to its high market value, production and its wide distribution in several Mediterranean countries, the deep-water pink shrimp (*Parapenaeus longirostris*) is a major shared resource in the western Mediterranean, mainly in Algeria, Spain and Morocco (GSAs 01, 02, 03 and 04 of the GFCM).

During a first meeting in 2009 (Mazara del Vallo, Italy, 5-7 October 2009), MedSudMed and CopeMed II projects started to conduct joint activities on *P. longirostris* in the Strait of Sicily region. In 2010, a workshop was jointly organized to assess the stock of *P. longirostris* in the Sicily Strait area (Mazara del Vallo, Italy, 13-15 September 2010), with the participation of experts from Italy, Malta, Libya, Tunisia and Algeria. The assessment was presented to the SAC-SCSA in November 2010.

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<sup>1</sup> This paper should be cited as follows: Elouamari, N., Pérez Gil J.L., García T., Benchoucha S., Ainouche N., Fernández I.L., Bernardon M. and Camiñas J.A. 2011. Advances in the joint assessment of *Parapenaeus longirostris* stocks for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04 of the GFCM). Paper presented at the Working Group on Stock Assessment of Demersal Species (SCSA-SAC, GFCM), (Chania, Crete. Greece, 24-29 October 2011). GCP/INT/028/SPA-GCP/INT/006/EC. CopeMed II *Occasional Papers* n° 12: 13 pp.

The Sub-regional Demersal Working Group (SRDWG)<sup>2</sup> following the recommendation coming from the 4<sup>th</sup> CopeMed II Coordination Committee meeting (CopeMed II, 2011a) decided to organize a meeting in Spain on *Parapenaeus longirostris* that was held in Fuengirola, Spain, from 18 to 19 July 2011 (CopeMed II, 2011b), kindly hosted by the Instituto Español de Oceanografía, Centro Oceanográfico de Málaga (IEO). The WG was attended by experts from the Institut National de Sciences et Technologies de la Mer (INSTM) of Sfax (Tunisia), the National Research Centre for the Development of Fisheries and Aquaculture (CNRDPA) of Algeria; the National Institute of Fisheries Research (INRH) of Morocco, the **Spanish Institute of Oceanography** (IEO) and the CopeMed II Project's staff.

## 2. Introduction

*P. longirostris* is a demersal species characterised by a wide depth distribution, being found at depths ranging from 20 to 700 m. Juveniles and adults of this species have different depth distributions, with the former more abundant on the outer shelf (50-200m) and the latter mainly distributed along the upper slope up to 500 m depth. *P. longirostris* is caught mainly by trawlers on sandy-muddy bottoms, and peaks of abundance have been recorded between 70 and 400 m depth (Fischer et al., 1987). In the central and western Mediterranean, *P. longirostris* has been of great importance in terms of both total landing and economic value. The Alboran Sea is a transition zone between the Atlantic and the western Mediterranean generates a highly peculiar and complex environment. The influence of the Atlantic waters in the Alboran sea is related with the high crustacean species richness that is considered (Abelló, Carbonell and Torres, 2002) a possible independent management area for demersal fisheries. Also *P. longirostris* in the northern Alboran sea is a member of the group of species typifying the slope muddy bottoms (Abad et al., 2007) dispersed following the bathymetric axis.

The WG meeting (Fuengirola, Spain, 18 - 19 July 2011) aimed to the identification of the most relevant characteristics of the exploited resource and the fleets involved in this fishery in each country and the preparation of data sets according to needs and formats agreed in the framework of the GFCM-SAC Sub-Committee on Stock Assessment (SCSA) as well as the reinforcement of the sub-regional scientific synergies and coordination on *P. longirostris* stock assessment within the cooperative framework of the CopeMed II Project and in close collaboration with the twin WG on *P. longirostris* in the Sicily channel.

The main questions during the meeting of the WG to bear the problems aiming to strengthening regional scientific cooperation, joint research and sub-regional management on *P. Longirostris*, are: Compile and review all information available on the biological and ecological characteristics of the *P. longirostris* stock. Compile and review the information available on the dynamic of this fishery, including defining the relevant Operational Units. Assess the *P. longirostris* stock to identify if it can be considered a shared stock (e.g. movement across the region, fleets exploring common grounds, distribution of eggs and larvae, etc.) and decide if it should be assessed as a shared stock. Define data and information required for the *P. longirostris* stock assessment and decide the units and format to be submitted, according to the SAC-GFCM standards. Identify the gaps of the scientific knowledge necessary for carrying out joint assessments of this stock. Prepare a scientific programme to address these gaps, in such a way that joint assessments of the *P. longirostris* stock can be carried out in a reasonable time-frame. Identify the methods that can be used for the *P. longirostris* stock assessment, given the types of information currently available or to become

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<sup>2</sup> The meeting was the result of CopeMed II cooperation with the FAO Regional Project MedSudMed in the framework of the joint SRDWG created in 2010 by the two projects.

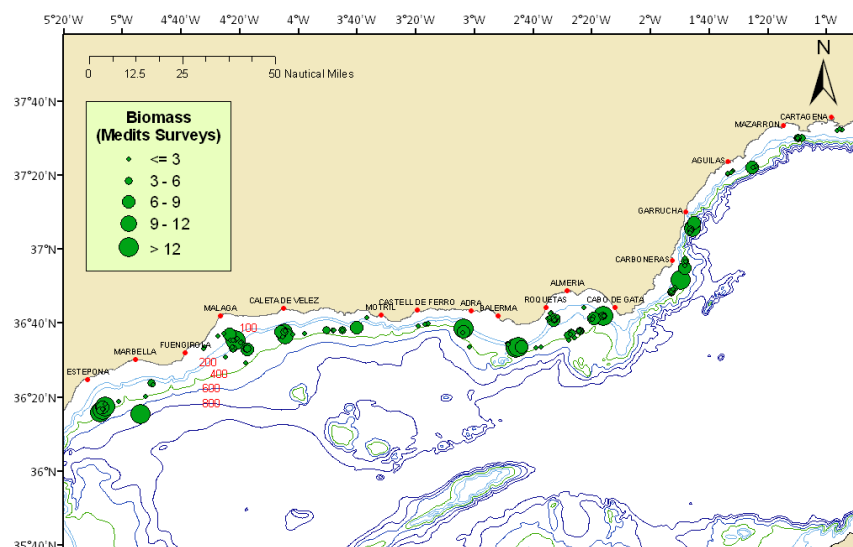
available in the sequence of the planned scientific programme. Identify possible activities to conduct on this shared stock, based on their relative socio-economic importance and total landings in the countries involved, so as to develop a feasible work programme.

### 3. National information on *Parapenaeus longirostris* stock

To address the most appropriate methodology to conduct a joint assessment of *P. longirostris* stock among Algeria, Spain and Morocco, it is important firstly to gather data on *P. longirostris* landings and fishing effort. For the standardization of fishing effort of vessels targeting deep-water pink shrimp the classification of vessels adopted by GFCM was considered.

Fisheries related issues at the sub-regional level, considering the GFCM Geographical Sub Areas, the Operational Units and other elements of the GFCM scientific framework were deeply analyzed by the WG. Information and data currently available on *P. longirostris* biology, spatial distribution and abundance in the CopeMed II project area was presented by the experts from Algeria, Morocco and Spain (Fig. 1).

Relevant issues discussed were trends in landings and data quality, availability and frequency of national landings statistics, the importance of species accompanying the targeted resource, fleets characteristics targeting *P. longirostris* and the most appropriate approach and methodology to conduct a joint assessment of this stock among Algeria, Spain and Morocco.



**Figure 1.** *P. longirostris* abundance (Biomass) in GSA01 (northern Alboran Sea) based in MEDITS surveys.

#### 3.1. Algeria

Data of total catch and fishing effort in 2000-2010 of the Algerian trawling fleet in GSA04 were presented. Abundance based on survey data, biological parameters, landings and samplings in 2010 were presented confirming that with a similar fishing effort there was a great decrease in *P. longirostris* landings from 2002 to 2010 (Table 1 and 2).

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total catch (tonnes)	2696'4	2107'4	1653'6	1383'9	1134	1151'7	849'54	638'49	760	1204	719

**Table 1.** *P. longirostris* catches (tonnes) in GSA04.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fishing effort (fishing days)			23	151	154	133	113	97	130	130	120

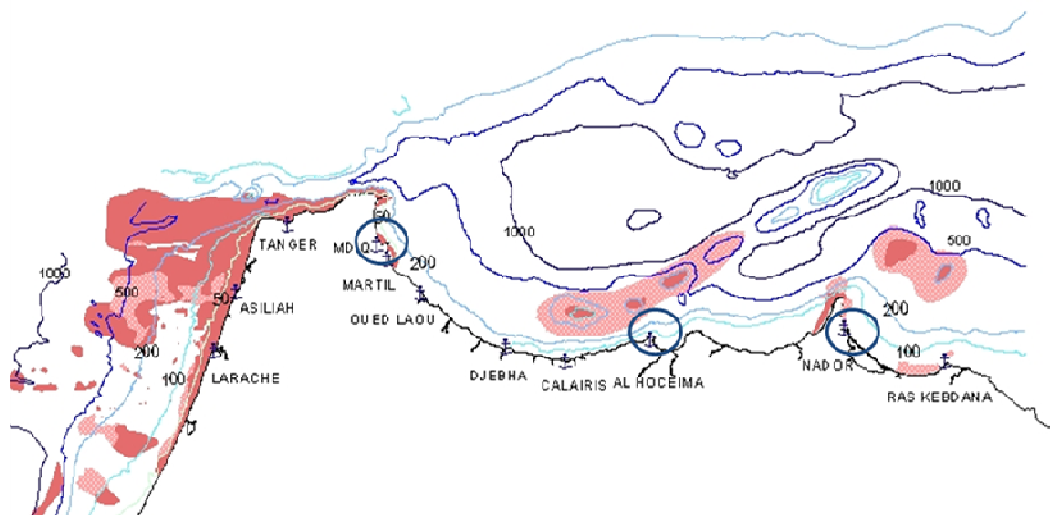
**Table 2.** *P. longirostris* fishing effort in GSA04.

The demersal species with great commercial interest in Algeria are *Aristeus antennatus* and *Parapenaeus longirostris*, moreover *P. longirostris* is the main commercial species in 19 Algerian fishing ports. *Parapenaeus longirostris* is present throughout the Algerian coast from east to west. Sizes range from 13 to 41 mm in cephalothorax length, with an average catch of 25.27mm. The minimum size of the deep-water pink shrimp is set to 20 mm cephalothorax length. Sex ratio is slightly in favor of females (54.06%). Landings are made in 32 fishing ports. In terms of regulation, namely in Algeria trawling is prohibited from 0-50 meters deep.

In 2009, the deep-water pink shrimp catches are estimated at around 1204 tons while the following year the production decreased (719 tons). CPUE showed a slight decline between 2009 and 2010 when the catch per unit effort decreased from near 3 kg/vessel to 2kg/vessel. In 2010, 358 trawlers worked in total with the following average characteristics: 19 meters length, 449 hp boat power and tonnage of 45 GRT.

### 3.2. Morocco

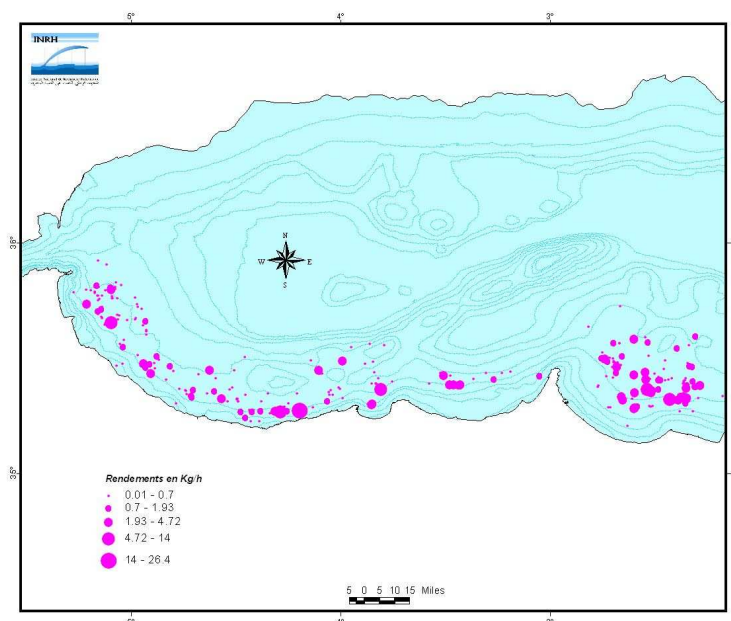
The fishing activity in Morocco plays important social and economical roles. Landings are made in 7 ports and 86 artisanal fishery sites. *Parapenaeus longirostris* main landings ports in GSA03 are Nador, Al Hoceima and M'diq (Fig. 2).



**Figure 2.** Map of spatial distribution of *P. longirostris* and main landings ports in GSA03 (Moroccan Alboran Sea).

Moroccan multispecific trawling fleet operates in the whole GSA 03. *P. longirostris* represents 9 % of the total catch and the main ports in terms of landings are Nador, Al Hoceima and

M'diq. The distribution map of *P. longirostris* show a homogenous distribution with high concentrations eastern Nador and around M'diq (Fig. 3).



**Figure 3.** *Parapenaeus longirostris* yield (Kg/h) in GSA 03.

*P. longirostris* is targeted by 114 trawlers, 51% based in Nador, 19% in Al Hoceima, 17% in Tangier, 12% in M'diq and 1% in Rass Kebdana, however, the Tangier trawlers are mostly operating in Atlantic side. The average power of the Moroccan trawlers is about 325 HP and the mean tonnage about 50 TJB. Annual catch of *P. longirostris* turn around 600 tons for an average of 117 million dirhams in value. The catch in 2010 is about 358 tones, the fishing effort is 12636 (nb of trips = fishing days) and the CPUE is about 28 kg/nb trips for the same year.

The catch and CPUE trends show a decline from 2000 to 2010 (Tables 3, 4 and 5). The most species targeted with the deep water pink shrimp are *Pagellus acarne*, *Mullus spp*, *Merluccius merluccius*, *Boops boops*, *Gadus poutassou*, *Octopus vulgaris* and *Sepia spp*.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Trawling fleet total catches (tonnes)	1051	965	767	686	515	468	201	185	336	596	358

**Table 3.** *P. longirostris* catches (tonnes) in GSA03.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Trawlers fishing effort (fishing days)	9472	10773	11739	11569	10331	10111	9070	9647	11345	12705	12636

**Table 4.** *P. longirostris* fishing effort in GSA03.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CPUE	111	90	65	59	50	46	22	19	30	47	28

**Table 5.** *P. longirostris* CPUE in GSA03.



The length distribution of *P. longirostris* in 2009 and 2010 show a large wide distribution starting from 13 to 42 mm of the carapace length. The mean carapace size is about 24mm in 2009 and about 28mm in 2010. The regulation in Morocco prohibits fishing under 80m depth from Tangier to Al Hoceima and under 3 nautical miles from Al Hoceima to Saidia. The trawlers stretched diamond mesh size is 50mm and the minimal landing size (carapace length) is 25mm. The fisheries regulation include a gel of investment since 1992, a marine protected area in Al Hoceima and 2 antitrawling artificial reefs in Cala Iris and in Martil areas.



**Figure 4.** Regulation map in Moroccan GSA03.

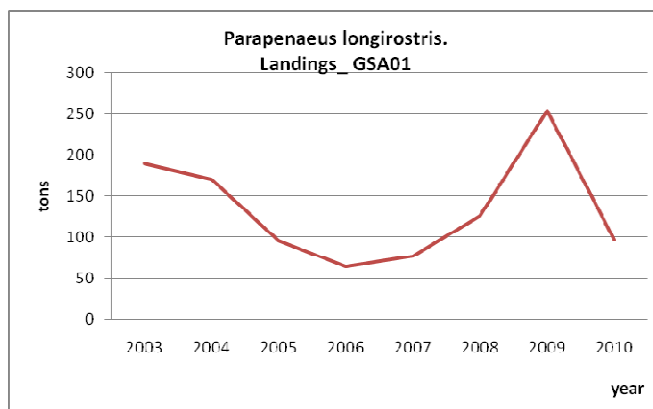
### 3.3 Spain

Deep-water pink shrimp is a target species for around 170 trawling vessels (2010) which operate on the upper slope and one of the most important crustaceans species for the trawl fisheries deployed in GSA01 (northern Alboran Sea).

The North Alboran Sea corresponds to FAO area 37 and to Management Unit 1 (GSA01) of the General Fisheries Commission for the Mediterranean. It constitutes a living resources exploitation area characterized by a great diversity of fishes, crustaceans and molluscs of commercial interest. There are a total of 15 landing ports in the GSA.

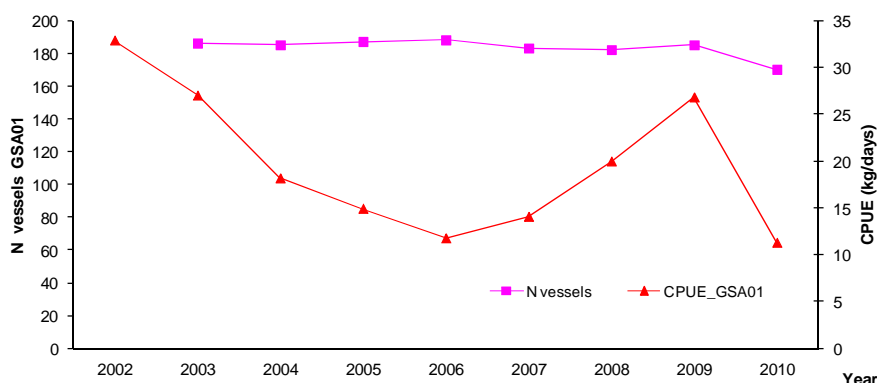
The fleet with the largest GRT corresponded to the ports of Garrucha (55.3 t), Motril (44.7 t) and Almeria (43.1 t). Engine power was correlated to the size of the fishing vessel. Highest engine power was associated with those vessels based in the ports of Garrucha (289.8 HP), Almeria (205.7 HP) and Motril (190.7 HP). The HP of fishing vessels is directly related to the distance to the fishing grounds where they normally operate.

Landings trend in GSA01 (Fig. 5) have two picks, one around 190 tons (corresponding to 2003) decreasing to a minimum of 64 t in 2006, increasing from 2007 to a new maximum of 250 tons in 2009 to decrease again to 96 t in 2010.



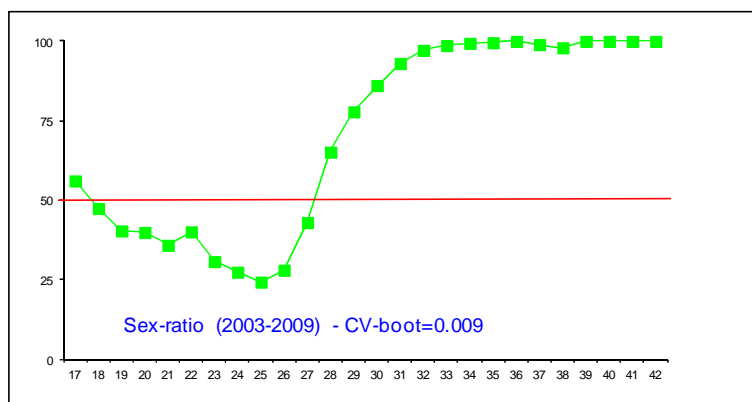
**Figure 5.** *P. longirostris* landings in the period 2003-2010 (GSA01).

Operational Units main characteristics (number boats/year, CPUE, mean length of boats, mean HP, type of gear, fishing days, etc.) targeting *P. longirostris* and management regulation in force in GSA 01 are presented in Figure 6. Information on landings (2003-2010), fishing effort (2002-2010), samplings (abundance indices from surveys and landings 2002-2010), biological parameters (sex ratio by size class, size dimorphism, etc.) and assessments of deep-water pink shrimp from the trawl fishery (2001-2009) of GSAs 05 and 06 was also shown.



**Figure 6.** Number of trawlers targeting *P. longirostris* and Fishing effort (Kg/day) in the period 2002-2010.

Sex ratio by size class for the period 2003-2009 shows that the females start to prevail above 28 mm CL, and from there in all sizes (Figure 7).



**Figure 7.** *P. longirostris* sex ratio by size class for the period 2003-2009.

The presentation made clear that in the GSA 01 and 02, *P. longirostris* is caught almost exclusively by trawl as a by-catch in the deep continental shelf and the upper slope (100 – 400 m). There was a progressive reduction in the number of trawlers during the period 2002-2010 but the fishing effort increased from 2006 to 2008 because of the increase in vessel mean power. No artisanal boats targeting *P. longirostris* are found in Spain. In GSA 02 (Alboran Island) there is a fleet of 30 boats targeting almost exclusively *Aristeus antennatus* and *P. longirostris* as by-catch. In GSA 01 abundance indices from surveys and landings show similar trends from 2002-2010.

#### **4. *Parapenaeus longirostris* joint stock assessment**

According to the Mazara del Vallo report (September 2010 meeting), the experience earned and lessons learnt during the 2-year joint analysis of data on *P. longirostris* were highlighted as an example of joint stock assessment befitting for Algeria, Morocco and Spain. All the steps which led to the final joint data analysis were summarised: investigation on the spatial distribution of species' nurseries and spawning grounds; discussion on the national fishing fleet characteristics and fishing grounds; description of data available; identification of the assessment methods and biological parameters; joint analysis and discussion on the results. The WG also stressed the importance of the compromise of the national experts on the use of the results and on the technical management advice based on them to be provided during the appropriate FAO-GFCM related meetings.

After analyzing all information and data provided by experts, the WG pointed out that trends in Morocco and Spain are similar in terms of catch and fishing effort, with a strong decrease from 2002-2010. In Morocco there is only one "métier" targeting *P. longirostris* in GSA 03 and in Spain (GSAs 01 and 02) as well. Morocco has data on the sampling of landings since 2008 while Spain has data on samplings and landings since 2002. Deliberations on how to analyze data for the stock assessment stressed the importance of taking only the GSAs areas with information of the 3 countries.

A single common shared stock for Algeria, Morocco and Spain can be likely identified although more studies are needed to correctly identify this shared stock. The WG discussed on how to identify if there is a single *P. longirostris* stock or not for GSAs 01, 02, 03 and 04. A common stock could be assumed as *P. longirostris* is an offshore species and due to reproduction pattern and larvae characteristics, but it has to be verified particularly with joint genetic analysis.

To accomplish the CopeMed II objective of supporting the establishment and implementation of scientific management plans for relevant specific fisheries, both in each specific country and at sub-regional level, the WG proposed a multidisciplinary analysis and started a joint evaluation of *P. longirostris* stock.

After analyzing all available data, the WG decided to start the assessment with data series from Morocco and Spain (2009-2010), as Algeria had no record data in 2009. The stock assessment was carried out with the "combined sexes" assumption.

In Algeria, a virtual population analysis of *P. longirostris* was carried out by separated sexes based on the length (VPA) and conducted by the VIT program (Leonart and Salat, 1992), that permitted an assessment of the level of exploitation of the stock to an optimal level.

The available information on growth parameters was chosen with two assumptions: separated sexes and/or combined sexes parameters. The WG worked considering both options to analyze data from Morocco and Spain separately; and also varying the “F terminal” (FT), considering two values (0’5 and 1’0). A matrix with information of the 3 countries was prepared, starting with the biological parameters.

#### 4.1. Biological parameters.

Growth parameters from GSAs 01 and 03 were presented. As data from Morocco was not published it was strongly recommended to publish it to strengthen the assessment. Spanish experts also presented data from GSAs 05 (Balearic Islands) and 06 (northern Spain), contiguous to GSA01 and north of the limit of the area defined by the WG (see biological parameters in Table 6). Differences in growth parameters values among Algeria, Morocco and Spain opened a discussion on how to present data to the SAC-SCSA. Size class fishing mortality was also analyzed for the Spanish and Moroccan fleet.

GSAs	GSA03	GSA04	GSA05	GSA06
Country	Morocco	Algeria	Spain1	Spain 2
$L_{\infty}$ (mm)	40,01	38,1325	40	45
<b>K</b>	0,497	0,7	0,89	0,3903
<b>t0</b>	-0,31	-0,169	-0,49	0,1019
<b>a</b>	0,0027	0,003175	0,0022	0,0019
<b>b</b>	2,5187	2,4457	2,6113	2,5682

**Table 6.** Biological parameters used in the *P. longirostris* joint stock assessment ( $L_{\infty}$ : asymptotic length. K: instant growth tax. t0: age corresponding  $L=0$ . a,b: length-weight relationship parameters).

#### 4.2. Length sampling distribution (LSD), growth and natural mortality (M).

Data from Spain and Morocco were presented (GSAs 01 and 03) and the WG agreed to include the Algerian length sampling distribution in the final report. LSD (LC (mm)) and growth parameters were selected. Length beyond 38 was considered 38+. An Excel tool for M calculations (Probiom, Abella et al, 1997) was explained and used to calculate the vector M. The results of the analysis confirmed that in a small interval of age (between 0 and 1) the natural mortality decreased.

#### 4.3. Data analysis

The state of exploitation was assessed applying a length cohort (LCA), VPA by slicing and yield per recruit (Y/R) analysis on a mean pseudo-cohort (2009-2010) for Spain and Morocco in GSA01 and GSA03, based on size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings, using VIT program (Lleonart and Salat, 1992).

M vector, calculated by Abella Excel tool, and F terminal value (0.5) were adopted. The exercise includes a yield per recruit Y/R model from the assessment estimates. Analysis by size (LCA) and age (VPA) showed the same trend with FT=0’5 and 1.

The results of this evaluation are shown in the figure and the matrix showed below.

Class	Mean Age	Lower Length	Mean Length	Mean Weight	Maturity ratio	Total F	Z
0	0.346	14.138	20.491	5.583	0.313286	1.144	1.964
1	1.378	29.38	32.195	16.496	0.8088861	1.133	1.523
2	2.415	35.639	36.893	23.281	0.9275836	0.757	1.037
3	3.439	38.209	38.75	26.392	1	0.5	0.74

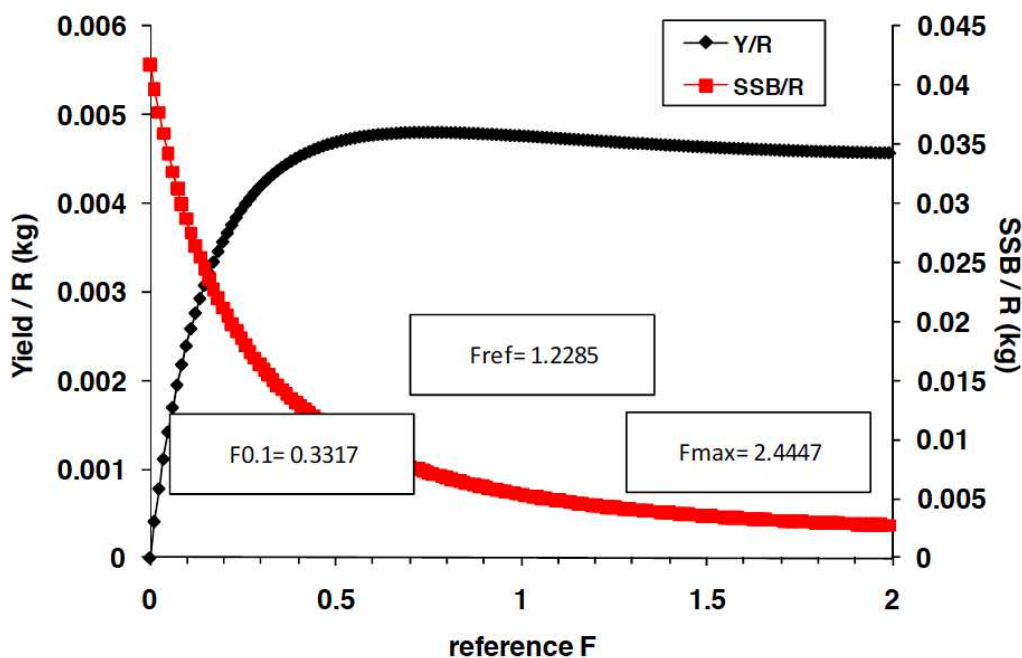
**Table 7.** Joint assessment exercise of the *Parapenaeus longirostris* fishery in GSA01 and GSA03. Length classes considered in the analysis with their mortality rates estimates.

	Critical age	Critical length
Current stock	0	14.138
Virgin stock	2	35.639
Total Biomass balance (D): 1027452594.94		
	Biomass	Percentage
Recruitment	281907648.9	27.44
Growth	745544946.1	72.56
Natural death	375765154.9	36.57

**Table 8.** VPA summary results.

<b>F current</b>	1.2281
<b>F 0.1</b>	0.3317
<b>F max</b>	2.4447

**Table 9.** F estimation as reference.



**Figure 8.** Y/R curve.

The results of the Y/R analysis (Figure 8) showed a pattern not close to the overexploitation, as in other short-living species, such as it occurs with the deep-water shrimp *Aristeus antennatus*.

Yield reach asymptotic values at an effort level double than the current one. Nevertheless, SSB values decrease quickly above actual effort level and the Frefs (1.22) exceeds the Y/R F0.1 reference point (0.33).

## 5. Results and conclusions

Once analyzing *Parapenaeus longirostris* data compilation from Morocco and Spain and based on the joint stock assessment carried out, the WG recommended:

- To perform joint genetic analysis and research on *Parapenaeus longirostris* in Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04) to identify if there is a single common *P. longirostris* shared stock.
- To perform research and experimental surveys on *P. longirostris* in the Strait of Gibraltar area to find out if it is part of the GSAs 01-03 stock.
- To complete information on *P. longirostris* stock in Algeria (GSA04) in 2011 to join Algerian data to the current stock assessment to cover all the study area.
- To finalize the *P. longirostris* joint stock assessment to present the conclusions to the Working Group of Demersal Species when ready and if possible next year.
- According the preliminary results the WG recommend to control the fishing effort in the study area and not increasing the fishing mortality.
- To continue with the CopeMed II support in order to produce a scientific paper with all the information related to *P. longirostris* and finish the first joint stock assessment among Algeria, Morocco and Spain.

## 6. References

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