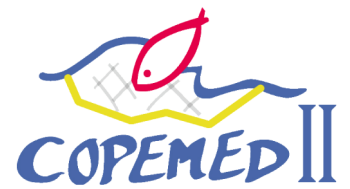




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OCCASIONAL PAPER

13

PRELIMINARY 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

Split, Croatia, 5-9 November 2012

Málaga (Spain), October 2012

CopeMed II Occasional Paper N° 13 **(GCP/INT/028/SPA – GCP/INT/006/EC)**

CopeMed II (*Co-ordination to Support Fisheries Management in the Western and Central Mediterranean*) is a project under the responsibility of the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO), executed by the Marine and Inland Fisheries Service and Coordinated from the Office of the Project in Málaga (Spain).

CopeMed II is financed by the DG Mare of the European Commission and the Government of Spain.

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For reference, this document 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. Preliminary joint assessment of *Parapenaeus longirostris* stock 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), (Split, Croatia, 5-9 November 2012). GCP/INT/028/SPA-GCP/INT/006/EC. CopeMed II *Occasional Papers* n° 13: 14 pp.



**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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Split, Croatia, 5-9 November 2012

PRELIMINARY 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 II STUDY GROUP ON *P. longirostris*, Málaga, Spain. 24-26 September 2012, IN SUPPORTING THE GFCM ASSESSMENT FORM)

Preliminary joint assessment of *Parapenaeus longirostris* stock for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04 of the GFCM)¹

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FAO-CopeMed II

Abstract

The deep-water pink shrimp (*Parapenaeus longirostris*) is of great importance in terms of total landings and economic value for the countries bordering the Alboran Sea (Algeria, Morocco and Spain). This assessment prepared in the frame of the FAO-CopeMed II project demersal study group (Málaga, 24-26 September 2012) aims to improve *P. longirostris* joint stock assessment in GSAs 01, 02, 03 and 04, in order to formulate recommendations on fishery management, by using a standard methodology and analyzing the results. For the first time a compilation of socioeconomic information of *P. longirostris* fishery through the indicators provided by the GFCM was pursued by the three countries. The experts prepared data sets according to formats agreed in the framework of the SAC-SCSA and two joint assessments analyses of the stock, by using different models (analytical and production models), were carried out. According to the results of both analyses a 50% reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris* would lead to the recovery of the stock in the Alboran Sea; so this level was recommended. The improvement of the Algerian and Moroccan database on length-frequency distribution used in the different analyses was also raised.

Key words: *Parapenaeus longirostris*, Alboran Sea, stock assessments, GSA 01, 02, 03 04, Algeria, Morocco, Spain, CopeMed.

1. Background information

The First meeting of the study group on *Parapenaeus longirostris* shared stock for Algeria, Morocco and Spain (Fuengirola, July 2011) aimed to the strengthening of regional scientific cooperation, by identifying the most relevant characteristics of *P. longirostris* stock, setting a joint research study group for the *P. longirostris* stock assessment and consequently formulating specific recommendations to be implemented within the cooperative framework of the CopeMed II Project. As a result of this meeting, a paper² with the first conclusions was

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. Preliminary joint assessment of *Parapenaeus longirostris* stock 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), (Split, Croatia, 5-9 November 2012). GCP/INT/028/SPA-GCP/INT/006/EC. CopeMed II *Occasional Papers* n° 13: 14 pp.

² Elouamari, N., Perez Gil J.L., Benchoucha S., Garcia T., Ainouche N., Jarbou O., Fernandez I.L, Bernardon M. and Caminas J.A. 2011. Advances in the joint assessment of *Parapenaeus longirostris* stock for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04 of the GFCM). Paper presented at the Working Group on Stock Assessment of

presented at the GFCM-SAC Working Group on Stock Assessment of Demersal Species (Chania, October 2011).

The outcomes of the meeting held in Fuengirola and the recommendations of the GFCM-SAC Demersal Working Group on the joint stock assessment suggested completing and updating the database already used during the first meeting of the CopeMed II study group and carrying out a new joint stock assessment to cover all the study area. In order to accomplish this assignment, CopeMed II organized the Second meeting of the study group on *Parapenaeus longirostris* stock for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04 of the GFCM) in Málaga, (24-26 September 2012). The meeting was attended by experts from the Centre National de Recherche et de Développement de la Pêche et l'Aquaculture (CNRDPA, Algeria), the National Institute of Fisheries Research (INRH, Morocco), the Spanish Institute of Oceanography (IEO), the Institut National de Sciences et Technologies de la Mer (INSTM, Tunisia), and the CopeMed II Project's staff.

2. Preliminary joint stock assessment using VIT Program

Selection of biological data and parameters

Catch data, length distributions, age distributions, mean weights, maturity ogive and natural mortality used in the assessment are included in the GFCM form.

The study group decided updating the LCA-VPA assessment with the Moroccan and the Spanish total length frequencies from 2009 till 2011 to make a pseudo-cohort analysis.

The study group agreed on using the low growth hypothesis parameters set (García et al, 2009), from GSA 01.

For the length weight relationship and the von Bertalanffy growth function, the parameters values used are presented in **Table 1**:

Length weight relationship		von Bertalanffy	
a	0.0019	K	0.3903 year ⁻¹
b	2.6113	Linf	45 mm
		t0	0.1019

Table 1. Length weight relationship and von Bertalanffy growth function parameters values used in the assessment.

Female L₅₀ maturity was assumed = 25.65 mm CL (García et al, 2009). This value comes from fitting the observed values to a logistic function:

Parameter	Value
a	-5.77
b	0.22

Table 2. Parameters of the logistic function.

Natural mortality (M) vector used was from the literature (Abella et al, 2002).

The study group decided to update the LCA assessment with the available data from Moroccan and Spanish length frequencies (2009-2011) using the VIT software. The study group run a Yield Per Recruit analyses (YPR) (Beverton and Hold, 1957) and Spawning Stock Biomass per Recruit (SSB/R) (Gabriel et al, 1989) to calculate the biological reference points F_{max} and $F_{0.1}$ with the output results of the VIT, by using the VIT software and an ad-hoc Excel sheet.

The input values used in the YPR and SSB/R analysis for the exploitation pattern were obtained from the VIT results. Exploitation patterns, weights and maturities by age are presented in **Table 3** (weights are Kg):

Age	F	M	Stock Weight	Catch Weight	Maturity
0	0.008	0.82	0.502	0.502	0.01030013
1	0.395	0.388	4.427	4.427	0.1981609
2	1.429	0.227	10.533	10.533	0.5896139
3	0.994	0.2	17.605	17.605	0.8313475
4	0.984	0.2	23.483	23.483	0.941375
5+	0.3	0.2	28.29	28.29	1

Table 3. Input values by age used in the YPR and SPR analysis. F and M selectivity, stock and catch weights in kilograms and maturity proportion.

Assessment exercise

With the available data, the study group tried different assessment models. The first one was an update of the assessment made in 2010 with the VIT program. The analytical assessment exercise was carried out using pseudo-cohorts (2009-2011) with the VIT software. Moroccan (GSA 03) and Spanish (GSA 01) length-size composition (LC, mm) data were used to make the pseudo-cohort analysis. Biological input data for relative and absolute growth, natural mortality (M) and maturity at age were also endorsed by the group.

Considering that exclusively length-size composition data from 2010 in Algeria were available, the group agreed to perform a length cohort analysis (LCA) exercise only for 2010, by using the length-size composition data from Algeria, Morocco and Spain.

After this first step, the group used four different F terminal values ($F=0.3, 0.5, 1$ and 1.5) and pointed out that ages are relative to the first length of the analyses. Figure 1 shows the results for F by length classes and by age for the four different values of terminal F.

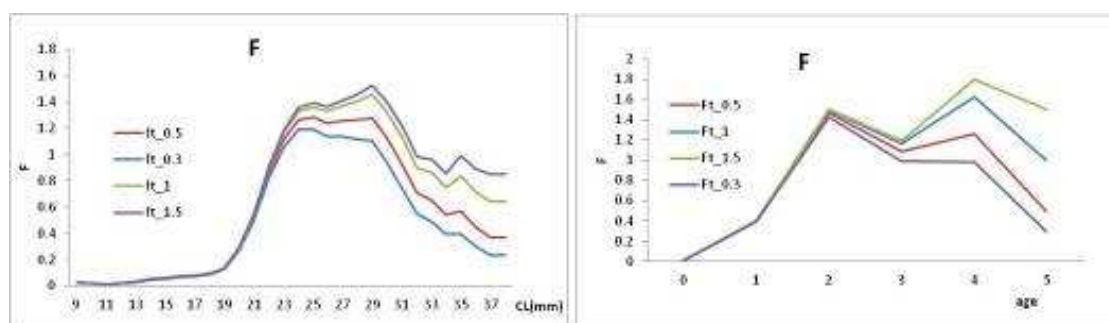


Figure 1. VIT results for F by length classes and by age for the four different values of F terminal.

class age	Ft_0.3	Ft_0.5	Ft_1	FT_1.5
1	0.008	0.008	0.008	0.008
2	0.395	0.399	0.402	0.403
3	1.429	1.467	1.497	1.507
4	0.994	1.084	1.163	1.191
5	0.984	1.264	1.628	1.801
	Fbar2-4			
	1.1356	1.271	1.1350	1.4293

Table 4. VIT estimates of fishing mortality (F) by age and the average fishing mortalities for class ages 2-6 (Fbar) for the four different levels of terminal F (0.3, 0.5, 1,1.5).

The study group agreed to take the VIT results for the terminal F = 0.3 as the best round to try an YPR analysis with the NOAA software. The inputs for YPR analysis were presented.

A length cohort analysis (LCA) and a virtual population analysis (VPA) were performed in a first step for all length-size composition. Figure 2 presents the VIT results for F by length classes.

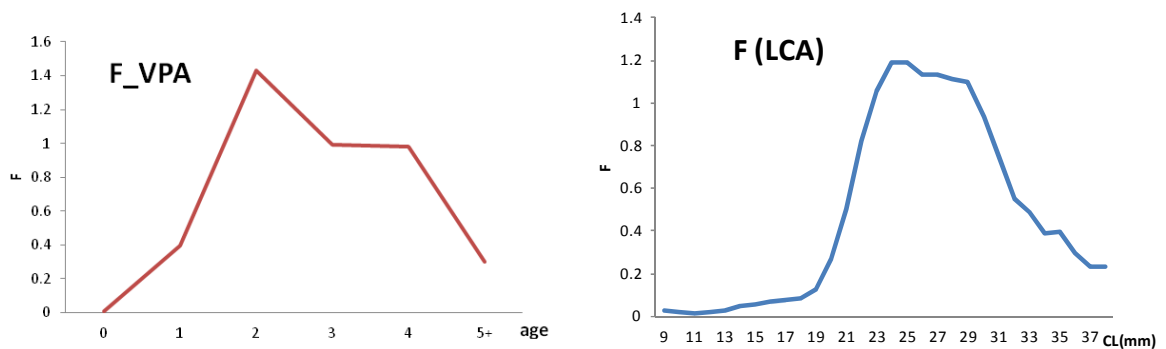


Figure 2. VIT results for Fishing mortality by length (LCA) and age (VPA) classes.

In the SSB/R analyses, the group decided to use F 0.1 as the biological reference point. This reference point appeared to be precautionary and sustainable and can be used as F_{msy} proxy for most of the demersal species analyzed.

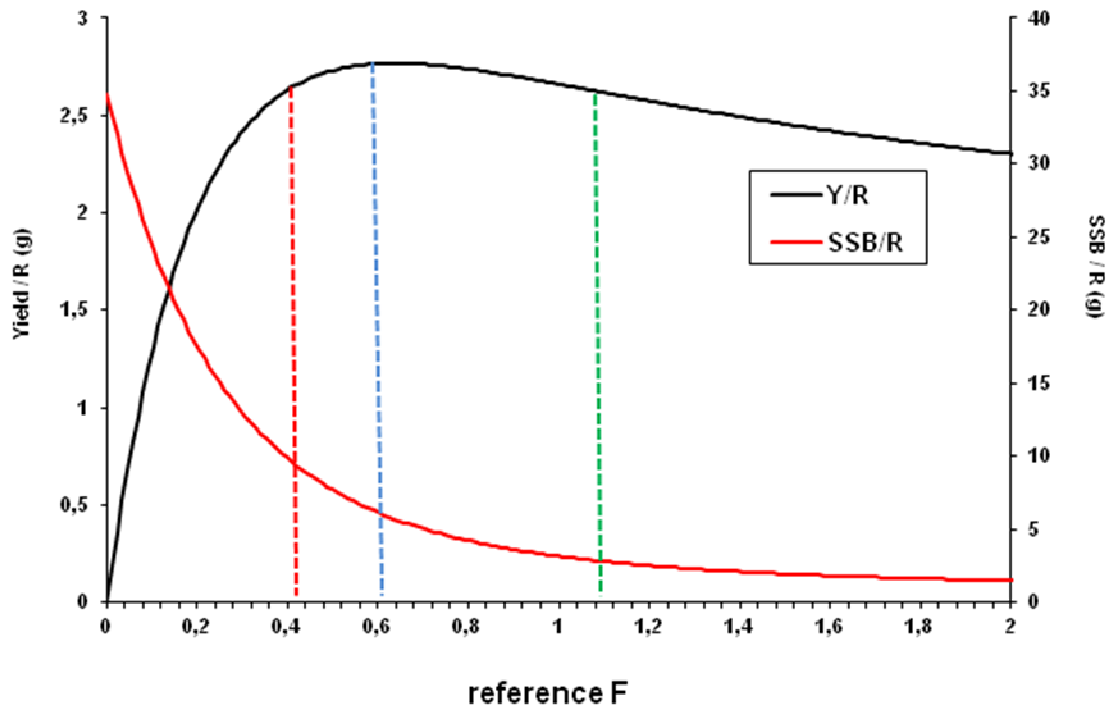


Figure 3. Yield Per Recruit (YPR) and Spawning Stock Biomass per Recruit (SSB/R) by F. The F values are referring to F at age 5.

Reference Point	F	YPR	SSBR
F Zero	0	0	34.86
F-0.1	0.3746	2.5913	10.55
F-Max	0.6356	2.768	5.72
F-Reference	1.135	2.602	2.69

Table 5. Fishing mortality (F) biological references points and their Yield Per Recruit (YPR) and Spawning Stock Biomass per Recruit (SSB/R) values.

The actual level of fishing mortality ($F_{bar} = 1.135$) is higher than the values calculated for the F_{msy} proxi ($F_{0.1} = 0.3746$) showing that the stock status is currently overfished. Based on these results:

Transition analysis

A transition analysis was carried out decreasing the current trawl effort by 20% of the current value (from 5 to 4 days/week).

The simulation conditions were the following:

- LCA, developed on a mean pseudocohort (year 2003).
- Prediction of 20 years.
- Recruitment independent from the stock (non stock–recruitment relationship).

The change of the current trawl effort would produce an increment only in the B/R and SSB/R. After the application of this management measure, in the third year, a recovery of the stock can be observed.

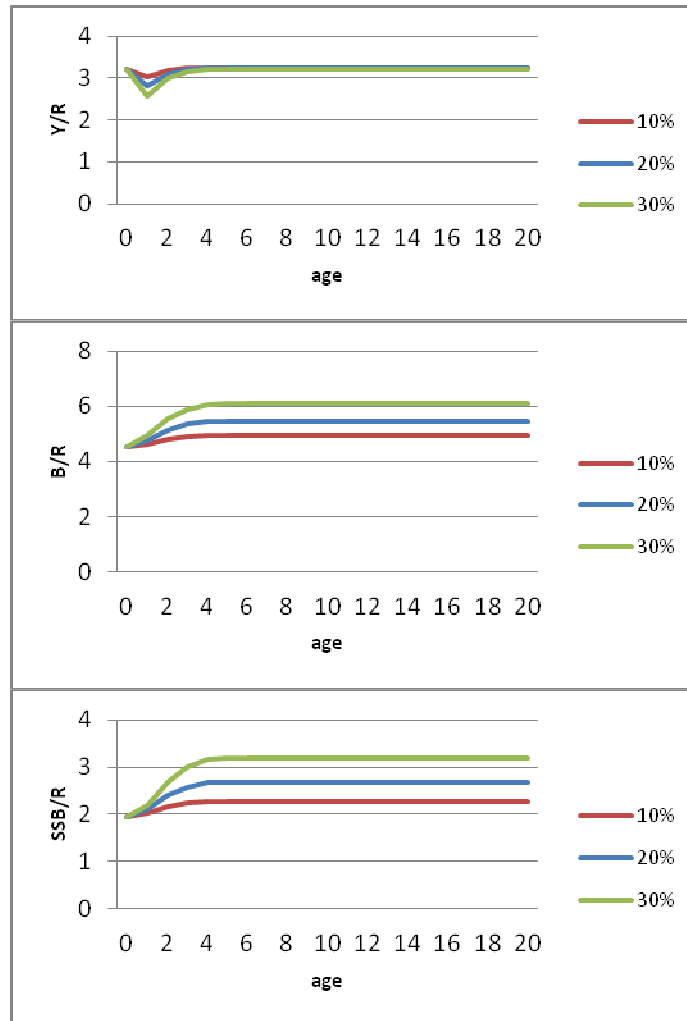


Figure 4. Results of the transition analysis.

Recommendations

- The SG recommended a 50% reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris*.
- According to this recommendation, the SG stressed that the actual effort level in the trawl fisheries should be reduced to adjust the current fishing mortality to levels more in agreement with the sustainability values, with F0.1 as reference point (VPA analysis).
- The SG agreed that a sensitive analysis of the most representative parameters used in the joint assessment (L_{∞} , K, F, a, b, t_0 ...) should be carried out after the joint assessment.

3. Global approach of the deepwater pink shrimp stock evaluation for Algeria, Morocco and Spain (GSAs 01, 02, 03 and 04)

Description of the model used

The deepwater pink shrimp (*Parapenaeus longirostris*) stock in the Algeria + Morocco + Spain region was evaluated with the "Biodyn" production model based on the Schaeffer model, updated and performed by Mr. Pedro Barros (FAO).

The model uses four essential parameters: carrying capacity biomass (K), intrinsic growth rate of the population (r), initial depletion (D) (initial biomass relative to K) and catchability coefficient (q). All other parameters estimates derived from these four parameters.

After giving the best estimates of these parameters, the model calculates the reference points MSY, B_{MSY} and F_{MSY} . It calculates the reference points Bratios = B_{Cur}/B_{MSY} et $B_{Cur}/B_{M0,1}$ (ratio between the estimated biomass for the last year of data series and B_{MSY} or $B_{0,1}$) and Fratios = F_{Cur}/F_{MSY} and $F_{Cur}/F_{0,1}$ (ratio between the fishing mortality of the stock in the last year of data series and the optimal fishing mortality F_{MSY} or the target fishing mortality $F_{0,1}$). It also calculates the Fratio = F_{Cur}/F_{SYCur} (Ratio between the coefficient of fishing mortality observed the last year of the data series and the coefficient that would give a sustainable capture at current biomass levels).

The absolute values of F_{MSY} , B_{MSY} and K should not be taken into consideration, given that the model provides a more accurate estimate for Fratios and Bratios.

Trends of these ratios and whether they are above or below 1.0 (100%) provide useful information to management.

Bratios: B_{Cur}/B_{MSY} et $B_{Cur}/B_{0,1}$ indicate the current status of the stock compared to the biomass that would be produced by MSY. Values below 100% indicate an abundance of the stock below B_{MSY} or $B_{0,1}$ while values above 100% indicate an abundance higher than B_{MSY} or $B_{0,1}$.

Fratios : F_{Cur}/F_{SYCur} , F_{Cur}/F_{MSY} et $F_{Cur}/F_{0,1}$ measure the level of exploitation in the last year with available data, as a proportion of the necessary level of exploitation to extract the sustainable capture, the optimal production or the production related to the estimated biomass levels in the same year. Values below 100% indicate a situation of potential growth of the stock, while values higher than 100% suggest that the stock will decline the next year. The indices B_{Cur}/B_{MSY} and F_{Cur}/F_{MSY} have been used as Limit Reference Points (LRP) while the indices $B_{Cur}/B_{0,1}$ and $F_{Cur}/F_{0,1}$ were chosen as Target Reference Points (TRP).

This model and its adjustments were recorded on Excel with an observation error model (Haddon, 2001). The model was fitted to the data by using the Excel's nonlinear optimization function: the solver function.

Used data

The source data used for the *P. longirostris* stock were the total annual catch of this species in Algeria, Morocco and Spain for the period 2003-2011 and 5 analyses with annual abundance indices (indices of abundance of scientific surveys in Morocco, indices of abundance from scientific surveys in Spain, CPUE of the coastal trawl commercial fishery targeting this species in Spain, CPUE of the coastal trawl commercial fishery targeting this species in Morocco and the overall CPUE of the commercial trawl fishery in Algeria) for the same period.

Assessment Results

The five series of abundance indices used are fitted with the model. Indices of abundance of the scientific surveys in Morocco and the CPUE of the commercial trawl fishery targeting this species in Spain were, however, the indices of abundance that showed the best fit with the model.

Index of abundance	F_{cur}/FSY_{cur}	$F_{cur}/F_{0.1}$	F_{cur}/F_{MSY}	$B_{cur}/B_{0.1}$	B_{cur}/B_{MSY}	R
First analysis : Indices of abundance of scientific surveys in Morocco (kg/h)	26%	41%	37%	52%	57%	0,921
Second analysis : Indices of abundance of scientific surveys in Spain (kg/km ²)	40%	32%	29%	118%	129%	0,589
Third analysis : CPUE of the commercial trawl fishery targeting this species in Morocco (kg/fd)	113%	17%	15%	170%	187%	0,625
Fourth analysis : CPUE of the commercial trawl fishery targeting this species in Algeria (kg/fd)	120%	15%	13%	172%	189%	0,871
Fifth analysis : CPUE of the commercial trawl fishery targeting this species in Spain (kg/fd)	125%	263%	236%	10%	11%	0,767

Table 6. Results of the evaluations of the state of exploitation of the *Parapenaeus longirostris* stock obtained by 5 series of the indices of abundance with the total catch of the stock in the CopeMed subregion: Algeria+Spain+Morocco (GSA 04+01+03).

F_{cur} / FSY_{cur} : Ratio between the coefficient of fishing mortality observed the last year of the data series and the coefficient that would give a sustainable capture at current biomass levels.

$F_{cur}/F_{0.1}$: Ratio between the coefficient of fishing mortality observed the last year of the data series and the target mortality coefficient $F_{0.1}$.

$F_{cur} / FMSY$: Ratio between the coefficient of fishing mortality observed the last year of the data series and the mortality coefficient that would give a long term maximum sustainable capture.

$B_{cur}/B_{0.1}$: Ratio between the estimated biomass observed the last year of the data series and the biomass corresponding to $F_{0.1}$.

$B_{cur} / BMSY$: Ratio between the estimated biomass observed the last year of the data series and the coefficient of biomass corresponding to $FMSY$.

Discussion of the results

The Study Group decided to adopt, however, the results obtained with the CPUE of the commercial trawl fishery targeting this species in Spain and the series of total captures of this stock considering that CPUE series was the only data that lead to the same conclusions obtained by analytical models.

The adopted abundance indices series fits well with the model used. The obtained results give a MSY of 6059 tons, $B_{cur}/B_{0.1}$ and $B_{cur} / BMSY$ of 10% and 11% respectively and F_{cur} / FSY_{cur} , $F_{cur}/F_{0.1}$ and $F_{cur} / FMSY$ of 125%, 263% and 236% respectively.

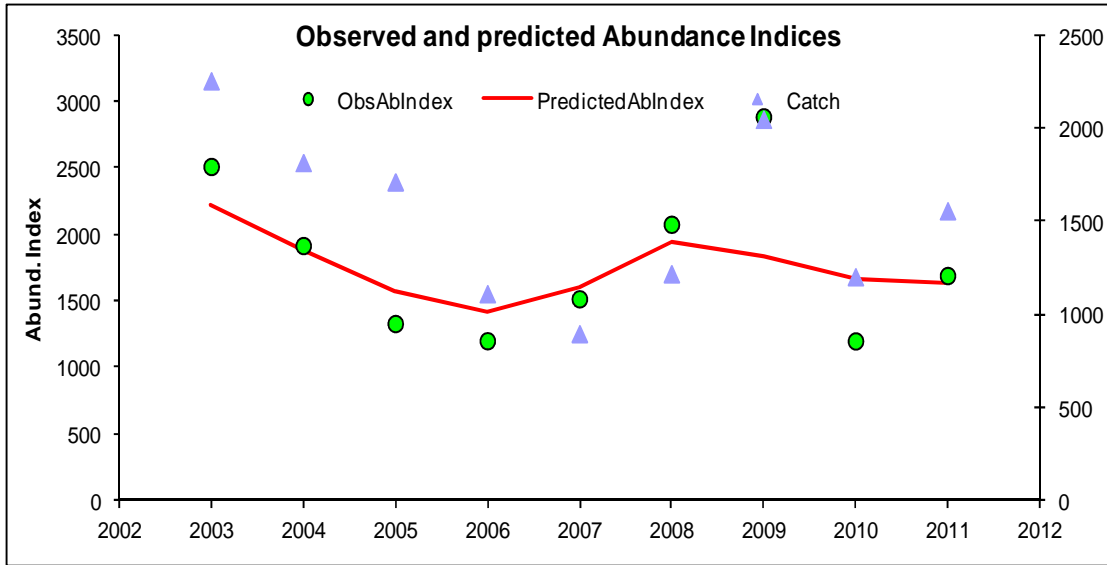


Figure 5. Adjustment of the Biodyn model with the CPUE of the Spanish commercial trawl fishery targeting the deepwater pink shrimp and the total catch of this species in the CopeMed subregion: Algeria+Spain+Morocco.

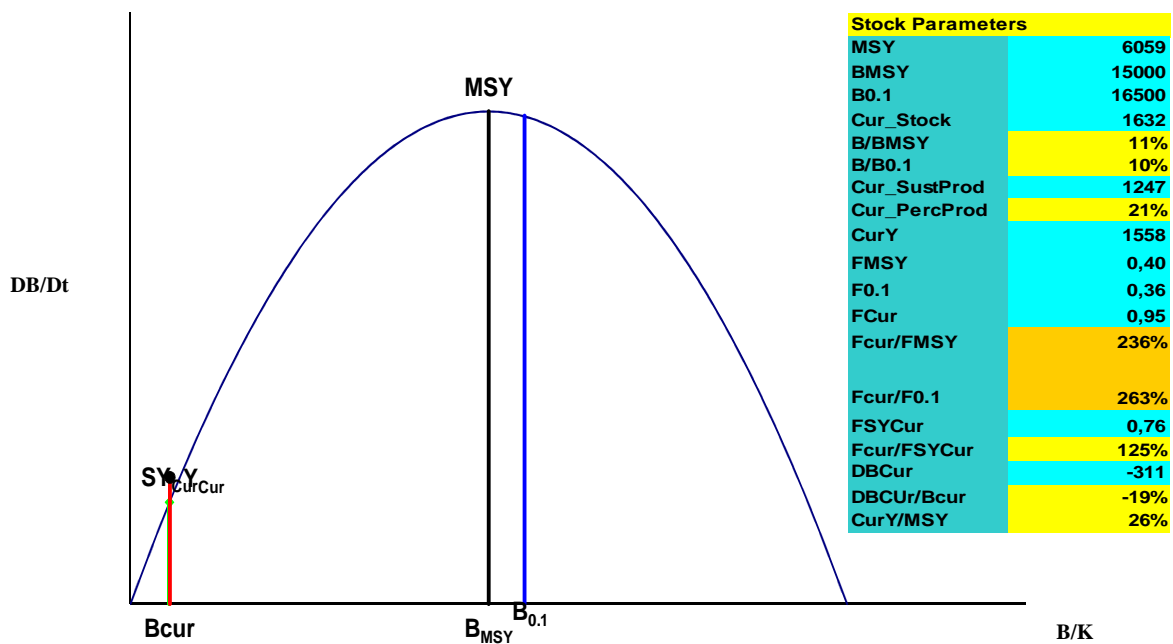


Figure 6. Summary of the results on the state of the *Parapenaeus longirostris* stock in the CopeMed subregion: Algeria+Spain+Morocco.

The obtained results indicate that the deepwater pink shrimp stock is overexploited, with captures that exceed the natural production of the stock. Current biomass represents only 10% of the target biomass and the fishing mortality exceeds 2.6 times the target mortality.

The results obtained for the Fratio are higher than 100% (Table 5, Figure 2), showing that the fishing mortality exceeds the target mortality and the mortality producing an optimal yield. The ratio F_{cur} / F_{SYcur} is 125%, showed a decreasing trend of the exploitable stock for the next year. The ratios $(B_{cur}/B_{0,1}$ and $B_{cur} / B_{MSY})$ are respectively 10% and 11%. Current biomass represents only 10% of the target biomass and 11% of the optimal biomass. These results show

that the stock of deepwater pink shrimp in the CopeMed region (GSAs 01, 03 and 04) is overexploited with a fishing mortality rate that exceeds 2.6 times the target fishing mortality (F0.1).

The predictive model shows that only a reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris* in the subregion: Algeria+Spain+Morocco can allow the recovery of the stock nearly to its optimal level (figures 7 and 8).

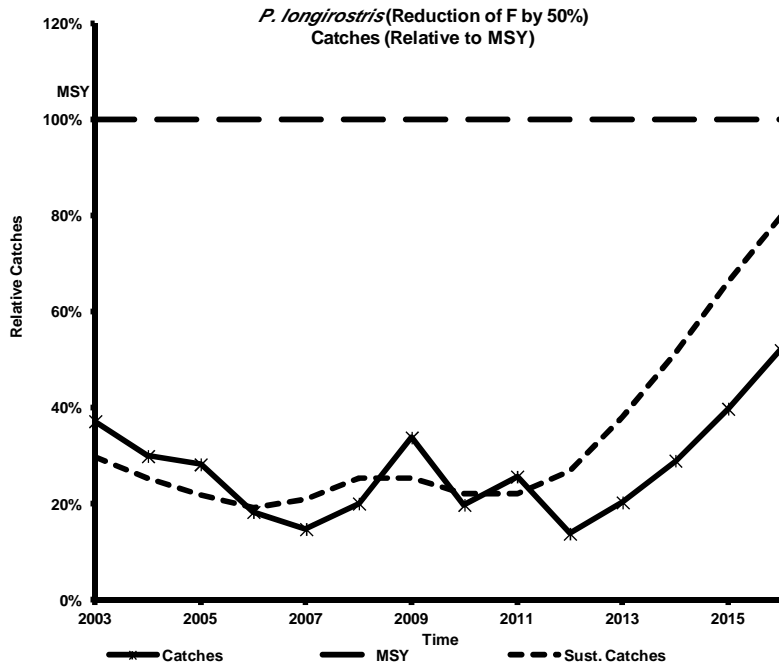


Figure 7. Results of the prediction analysis on catches by a 50% reduction of the fishing effort in the subregion: Algeria+Spain+Morocco.

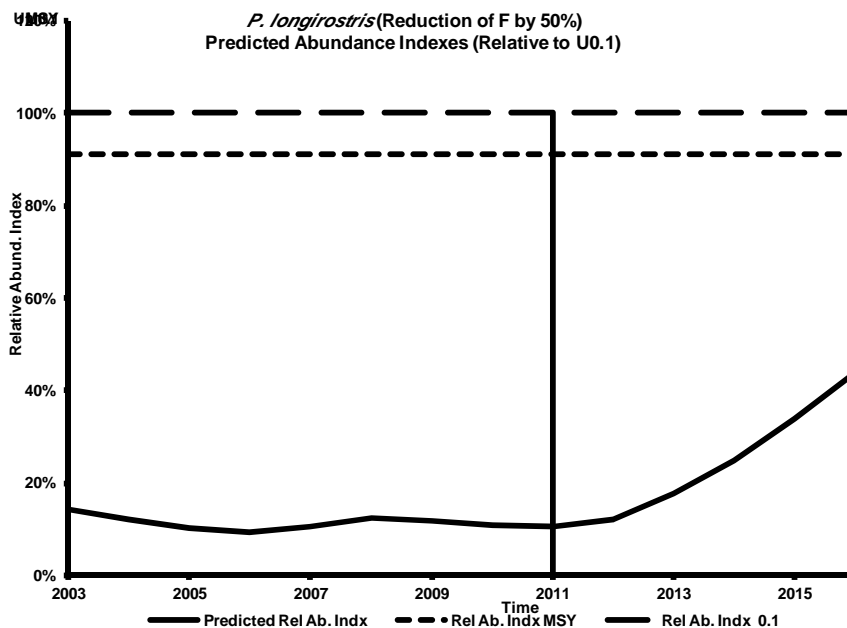


Figure 8. Results of the prediction analysis on abundance index by a 50% reduction of the fishing effort in the subregion: Algeria+Spain+Morocco.

Useful management recommendations

According to the predictive model results, the SG recommended a 50% reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris* in order to reach the stock recovery to its optimal level.

4. Recommendations and conclusions

Based on the results of the two joint assessments analyses (analytical and production models) the SG agreed to carry out a sensitive analysis of the most representative parameters used in the joint assessment (L_{∞} , K, F, a, b, t_0 ...).

General recommendations:

- Data from Algeria and Morocco on length-frequency distribution at landing are necessary and should be provided for the next meeting of the SG to improve the joint database used in the analyses carried out by the SG, with partial support of CopeMed II if necessary.
- The organization of a joint stock assessment meeting with the Sicily Strait area SG for a joint evaluation of *P. longirostris*.
- The biological and fisheries data in each country used for the assessment (biological parameters, demographic structure, etc.) will be uploaded to the CopeMed web (Regional Networks and databases).
- To carry out predictive analysis to complete the assessments.
- To reinforce the SG stock assessment results by incorporating to the SG socioeconomic information and data from experts on this field. The SG recommended CopeMed II to prepare the TORs for this matter.
- The SG agreed that Mr. Benchoucha (INRH, Morocco) should be in charge of presenting the assessment in the next meeting of the SAC-SCSA WG on Demersal Species.
- CopeMed II expressed the willingness to support this participation.

Recommendations from the results of the analytical model (GSAs 01 and 03):

- The SG recommended a 50% reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris*.
- According to this recommendation, the SG stressed that the actual effort level in the trawl fisheries should be reduced to adjust the current fishing mortality to levels more in agreement with the sustainability values, with $F_{0.1}$ as reference point (VPA analysis).

Recommendations from the production model results (GSAs 01, 03 and 04):

- The SG recommended a 50% reduction of the current fishing mortality in the trawl fisheries targeting *P. longirostris*.
- According to this recommendation, the SG stressed that the actual effort level in the trawl fisheries should be reduced to adjust the current fishing mortality to levels more in agreement with the sustainability values, with $f_{0.1}$ as reference point (Schaeffer model).
- According to the projection coming from the production model, the SG agreed that the reduction of the fishing mortality (F) at the mentioned level could permit the recovery of the *P. longirostris* stock in 4-5 years.

5. Future research

The SG recommended the realization of the following actions:

- To improve the current biological sampling of the landings of this species in Algeria, Morocco and Spain with the support and assistance of the national administrations and the regional projects, with the objective of having a regular coverage of the landings of this species at least twice per month.
- To estimate the bycatch and the discards at sea caused by *P. longirostris* fishery in Algeria, in Morocco and Spain.
- To improve the statistical information related to the fishing effort on *P. longirostris* in Algeria.

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