GENERAL FISHERIES COMMISSION
FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES
POUR LA MÉDITERRANÉE

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GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

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WORKING GROUP ON STOCK ASSESSMENT OF DEMERSAL SPECIES

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

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Abella A., Colloca F., Sbrana M., Ligas A. and Mannini A.

Stock assessments were made using different approaches (XSA, LCA, Y/R, Production models, life tables. Data proceed from European data collection plans and souces rae commercial fisheries (catch, effort, age structure of the catch, etc) and trawl surveys. The involved species are *Mullus barbatus*, *Mullus surmulletus*, *Pagellus erythrinus*, *Papapenaeus longirostris*, *Merluccius merluccius*, *Nephrops norvegicus*, *Squilla mantis*, *Aristaeus antennatus*, *Aristaeomorpha foliacea*, *Galeus melastomus*.

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Assessment of red shrimp (*Aristeus antennatus*) exploited by the Spanish trawl fishery (1992–2010): GFCM geographical sub-areas 05 (Balearic Islands).

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The assessment of the red shrimp (*Aristeus antennatus*) using data from trawl fishery in the GSA-5 was carried out by length cohort analysis (LCA, VPA and Y/R) for short time series covering the last five years 2006-2010, and by age cohort analysis by a Separable VPA and Extended Survivor Analysis (XSA) performed for the whole time series (1992-2010). The VPA was tuned with CPUE from commercial trawl fleet (1992-2010) and bottom trawl surveys (2001–2010). These approaches were performed from monthly size composition of catches, official landings, effort in trips (days at sea) and the biological parameters estimated from the set of data obtained for the fishery (1992 to 2003). The assessment shows decreasing trend of spawning and total biomass. Recruitment shows a sinusoidal pattern. Yield per recruit analysis and Fishing mortality reference points are close to the maximum yields. Following the recommendations of the 2010 SAC committee the present analysis explore the assessment of the two sexes afterward combine results, and the VPA combining sex age matrix afterward perform the VPA. The fishery is considered fully exploited.

Stock assessment of red mullet (*Mullus barbatus*) and striped red mullet (*Mullus surmuletus*) in GSA 25

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Catch-at-age data, survey (Medits) data, official landings and biological parameters for the years 2005-2010 for *Mullus barbatus* and *M. surmuletus* in GSA 25. (The assessments will be performed during the meeting).

Fisheries biology and management of *Pagellus erythrinus* (Linnaeus, 1758) in the Egyptian Mediterranean coast

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The present study deals with the fisheries of *Pagellus erythrinus* (Common pandora) in the Egyptian Mediterranean coast from Port Said in the east to El-Sallum in the west. Fish samples collected from both trawl survey and the commercial catch during two years. Data were used to estimate; length weight relationship, catch length structure, total length by the end of each year of life, growth in weight, Von Bertalanffy parameters, coefficients of total (Z), natural (M) and fishing (F) mortalities, survival rates, length and age at first capture, length and age at recruit, yield per recruit, biomass per recruit, determination of the biological reference points and the effect of age at first capture on Y/R. The fisheries status of this important species in the Egyptian Mediterranean coast was assessed and recommendations for its fisheries management were presented.

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

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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.

Assessment of red shrimp *Aristeus antennatus*, exploited by the Spanish trawling fishery (1996-2010): GSA 6 (Northern Spain)

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The state of exploitation was assessed for the period 1996-2010 by means of a VPA Separable and XSA analysis. In addiction, a yield-per-recruit (Y/R) analysis (VIT program; Lleonart and Salat, 1992) vas applied on the mean pseudo-cohort 1996-2010 for the GFCM geographical sub-area Northern Spain (GSA-06). Both methods were performed from size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings , transforming length data to age data by slicing (L2AGE program). Exploitation is based on very young age classes, mainly 0 and 1 year old individuals, with immature fraction dominating the landings , dominating thereafter mature fraction. The resource was considered over exploited, with some indications of growth overexploitation.

Stock Assessment of *Octopus vulgaris* from the Tunisian Southern waters (Central Mediterranean)

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Among four exploited common species (cuttlefish, common octopus, musky octopus and European squid), Octopus vulgaris is the most required species in the Tunisian Southern area (35°N-33°10N) thanks to its economical value. This area provides 83% of the octopus national production of which 95% are supplied from small-scale fishery especially by means of the pots. In spite of the establishment of a regulation elaborated for the octopus fishing in 1987 and amended twice, the southern production knew numerous fluctuations between 1975 and 2007 with a tendency to the significant diminution beyond 1990. Since twenty years, we have been noted the regression of small-scale octopus fishery in the profit of the trawlers capture (95% in 80 years; 85% in 2000 years) and the increasing of the cuttlefish landings in the detriment of octopus fishing. Indeed, the cuttlefishes produce more than 65% (in 2005) of the national cephalopod whereas during the eighties years, the common octopus obviously dominated. In order to preserve stock, southern octopus has been evaluated for two periods: in 1996-1998 and in 2003-2005 in using the Virtual Population Analysis method (VPA). The stock was respectively overfished and in optimum exploitation state. The present paper compiles the results on the assessment stock of octopus exploited in southern area in the period between 2006 and 2009. In total, 3579 individuals were sampled composed by 2537 provided from the artisan landings and 1042 from the trawlers fishing. The size classes were between 6cm and 26cm. According to the number distribution in term of size class; the artisan fishing effort affects the adults whereas the trawl effort hits the juveniles. The yield by recruit corresponding to 2006-2009 period is below the maximum level and then the southern stock of Octopus vulgaris seems underexploited. To attain optimal situation, the actual fishing effort might be doubled. The results are interpreted and recommendations are proposed.

Stock assessment of *Mullus barbatus* from the GSA 06 (Northern Spain)

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The stock of *Mullus barbatus* in the GFCM-GSA06 has been assessed using the trawl fishery data from 1995 until 2010. The assessment has been carried out applying tuned VPA (Extended Survivor Analysis, XSA) and Y/R analysis. Software used was the Lowestoft VPA program for the XSA (Darby and Flatman, 1994). Cath in number of individuals are based on younger ages (0 and 1). Average fishing mortality for ages 0-2 shows a general decreasing trend over the studied period reflecting the continuous reduction observed in the fleet. Recruitment shows a slight decreasing trend, being under the average of the whole period in the last two years. There isn't any trend in the total biomass whereas SSB shows a slight increasing trend. Transition analysis indicates that a 24% increase in Y/R is expected with the square mesh in the cod-end. A 32% increase in Y/R is expected with both the square mesh and a 20% decrease in fishing effort and a 44% increase in Y/R is expected with a 40% decrease in fishing effort and the use of the square mesh. The stock status is overexploited. To improve the trawl exploitation pattern and a substantial reduction in fishing effort are recommended.

Stock assessment of red mullet (*Mullus barbatus*, L., 1758) in the GSA 15 and 16

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Red mullet (*M. barbatus*) is one of the main demersal resources of the coastal areas in the Mediterranean, fished by otter trawl and trammel and gill-net, together with other several species (Voliani, 1999). Red Mullet is caught together with other important species such as *Mullus surmuletus, Merluccius merluccius, Pagellus sp., Uranoscopus scaber, Raja sp., Trachinus sp., Octopus vulgaris, Sepia officinalis, Eledone sp.* and *Lophius sp*. In GSA 15 and 16 red mullet is caught almost exclusively by inshore trawlers operating on shelf fishing-groundsof GSA 16 and 15. The Italian landing represents more than 95% of total yield, which decreased from 1409 t in 2005 to 770 t in 2010. The artisanal catch are about 1-2% of the total catch in Italian vessels and 3-7% in the maltese ones. Five complete years (2006-2010) of length frequency distributions from GSA 16 commercial landings data (fished in GSA 15 as well as GSA 16) were available, so an approach under steady state (pseudocohort) assumptions was used. Cohort (VPA equation) and Y/R analysis as implemented in the package VIT4win were thus used. Data were derived from the DCF data call for GSA 15 (total landings data only) 16 (LFDs as well as total landings data). In addition, fishery independent information regarding the state of the red mullet in GSA 16 was derived from the international survey MEDITS and the Italian survey GRUND. Trends in abundance and biomass indices as well as length frequency distributions were plotted. According to VIT analysis, absolute estimations of SSB (combined sex) in the 2006-2010 was 1070 t in 2006, 1307 t in 2007, 1046 t in 2008, 905t in 2009 and 1072 t in 2010. Biomass indices derived from scientific surveys in spring-summer (MEDITS), which is representative of SSB, show a clear increasing trend of spawners' abundance since early 1990s. The estimates of absolute recruitment in millions of individuals (age class 0) from VIT analysis in 2006-2010 were 39.3 in 2006, 57.7 in 2007, 48.0 in 2008, 31.6 in 2009, and 40.2 in 2010. The time series of recruitment indices from trawl surveys in autumn (GRUND surveys) carried out in GSA 16 (individuals smaller than 11 mm CL) showed high values in 2003-2004 and in 2007-2008. Considering the overall time series

an increasing trend of recruitment seems to occur, with peaks in 2003 and 2007 that were years affected by strong positive anomalies of the seawater surface temperature.

The stock of red mullet in the Northern sector of the Strait of Sicily is in overfishing since the current fishing mortality is higher than $F_{0.1}$ and lower than F_{max}. However a decrease of fishing mortality from the 2006-2008 (0.67-0.69) to 2009-2010 (0.58-0.59) was detected suggesting an improvement of the fishery pattern. Considering the Sicilian fleet operating in GSAs 15-16, a reduction of about 40% of the fishing mortality needs to reach the technical target Reference points $F_{0.1}$=0.45 (median value of the 2006-2010 assessment). However stock size show an increasing trend of SSB and recruitment indices from trawl surveys. This could be correlated with the reduction of illegal trawling in the coastal areas within the 50 m depth where the recruitment of the species occur in late summer-early autumn, to the reduction of fishing effort since 2008 and to the positive effect of warming of the surface seawater on the recruitment success

Stock assessment of Common Pandora (*Pagellus erythrinus*) in the GSA 15 and 16

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Common Pandora is an important demersal fishery resource through the Mediterranean, including in the Strait of Sicily. Trawling is carried out on the continental shelf of the Central Mediterranean throughout the year, and catches include common Pandora (*Pagellus erythrinus*), pink shrimp (*Parapenaeus longirostris*), Norway lobster (*Nephrops norvegicus*), giant red shrimp (*Aristaeomorpha foliacea*), violet shrimp hake (*Merluccius merluccius*), violet shrimp (*Aristeus antennatus*), scorpionfish (*Helicolenus dactylopterus*), grater forkbeard (*Phicys blennioides*), red Pandora (*Pagellus bogaraveo)* and monkfish (*Lophius piscatorius*). In addition to trawling, common Pandora is targeted by several artisanal gears, including set gillnets, trammel nets, pots and traps and set longlines. The mean yield in last years (2006-2010) was 486 t per year, ranging from 917 in 2006 to 295 in 2009. Most of the catch is due to Sicilian fisherman (94-99%). Sicilian catch is due almost exclusively to trawlers while in Maltese islands the amount of fish catch by artisanal fishery may be more important than the trawlers' ones. Five complete years (2006, 2007, 2008, 2009 and 2010) of length frequency distributions from GSA 16 commercial landings data (fished in GSA 15 as well as GSA 16) were available, so an approach under steady state (pseudocohort) ssumptions was used. Cohort (VPA equation) and Y/R analysis as implemented in the package VIT4win were thus used . Age structure of landings were derived from the European DCF data call for GSA 16. Total landing included the yield of both the Italian and Maltese fleet.
According to VIT analysis, absolute estimations of SSB (combined sex) in the 2006-2009 was 1070 t in 2006, 1307 t in 2007, 1046 t in 2008, 905t in 2009 and 1072 t in 2010. Estimate of 2009 was considered not reliable. The estimates of absolute recruitment in millions of individuals (age class 1) from VIT analysis in 2006-2009 were 15.2 in 2006, 8.1 in 2007, 7.1 in 2008, 5.1 in 2009, and 3.9 in 2010. Considering that the estimate of 2009 was considered not reliable, the strength of recruits remained quite stable along the time series.. During the MEDITS survey higher numbers of recruits were found in GSA 15 in 2006-2010 than in GSA 16. On the basis of the VIT

analyses a provisional reference point was given, corresponding to F0.1= 0.30. Since the current fishing mortality is higher than $F_{0.1,}$ the stock of common Pandora in the Northern sector of the Strait of Sicily is assessed in overfishing. Considering the current fishing mortality (Fc) in 2010, to reach the proposed TRP a reduction of Fc of about 50% is advisable.

Stock assessment of hake (*Merluccius merluccius*) from GSA 05 (Balearic Islands)

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The trawl fishery off Mallorca (Balearic Islands; GFCM-GSA05) is developed by around 40 vessels, which total annual landings are approximately 1400 tons. The European hake (*Merluccius merluccius*) is a target species for this fishery, mainly exploited on the deep shelf and upper slope, with annual landings oscillating between 50 and 190 tons during the last decades. The information used for the assessment of the stock consisted in annual size composition of catches (estimated from monthly sampling), official landings and the biological parameters estimated from the Data Collection Programme (2003-2007). The vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet. The methodology applied was: (i) a tuned virtual population analysis (VPA), applying the Extended Survivor Analysis (XSA) method on the period 1980-2010 and considering catch per unit effort (CPUE) from commercial trawl fleet (2000-2010) and bottom trawl surveys (2001-2010) as tuning fleets; and, (ii) a yield per recruit (Y/R) analysis based on the exploitation pattern resulting from the XSA model and population parameters for the period 2008-2010. The software used was FLR in R and Excel.

Hake - GSA 7

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Hake (*Merluccius merluccius*) is one of the most important demersal target species of the commercial fisheries in the Gulf of Lions (GFCM-GSA07). In this area, hake is exploited by French trawlers, French gillnetters, Spanish trawlers and Spanish long-liners. Around 220 boats are involved in this fishery and, according to official statistics, total annual landings for the period 1998-2010 have oscillated around a mean value of 2250 tons (1980 tons in 2009). The fishing capacity of the GSA 07 has shown in these last 10 years a progressive decrease considering the French trawlers. The number of these trawlers decreased of about 30% on the period. Most fleets and catches correspond to French trawlers (44 and 72%, respectively). Trawlers catches range between 3 and 92 cm total length (TL), with an average size of 20 cm TL, followed by French gillnetters (~39 and 14% respectively, ranging 13-86 cm TL and average size 39 cm TL), Spanish trawlers (~11 and 8%, respectively, ranging 5-87 cm TL, and average size 25 cm TL), and Spanish long-liners (~6 and 6%, respectively, ranging 23-96 cm TL and average size 54 cm TL). Hake trawlers fishery exploits a highly diversified species assemblage: Striped mullet (*Mullus barbatus*), Red mullet (*Mullus surmuletus*), Angler (*Lophius piscatorius*), Black-bellied angler (*Lophius budegassa*), European conger (*Conger conger*), Poor-cod (*Trisopterus minutus capelanus*), Fourspotted megrim (*Lepidorhombus boscii*), Soles (*Solea* spp.), horned octopus (*Eledone* sp.). The information used for the assessment of the stock consisted in annual size composition of catches (estimated from monthly or quarterly sampling in the main landing ports), official landings and biological parameters estimated from data collected in the GSA 7 (2003-2010) by IFREMER for the DCF. These parameters were length-weight relationship, sex-ratio and maturity ogive and were computed using inbio (R scripts developed by IEO).The growth coefficient (k) comes from tagging experiments developed by IFREMER in the area (Mellon-Duval et al, 2010). The vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997). For the period of the study (1998-2010), the

methodology applied was a tuned virtual population analysis (VPA), applying the Extended Survivor Analysis (XSA) method considering, as tuning fleet French MEDITS campaign indices. The software used was FLR. For 2010, a yield per recruit (Y/R) analysis was performed.

Red mullet - GSA 7

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In the Gulf of Lions (GFCM-GSA07), red mullet (*Mullus barbatus*) is exploited by both French and Spanish trawlers. Around 120 boats are involved in this fishery. According to official statistics, total annual landings for the period 2004-2010 have oscillated around a mean value of 157 tons. Most boats and catches correspond to the French trawling fleet (80% and 85% respectively). In French and Spanish landings, modal length is 14 cm. In GSA 7, the trawl fishery is a multi-specific fishery. In addition to *M. barbatus*, the following species can be considered important by-catches: *Merluccius merluccius*, *Lophius* sp., *Pagellus* sp., *Trachurus* sp., *Mullus surmuletus*, *Octopus vulgaris*, *Eledone* sp., *Scyliorhinus canicula*, *Trachinus* sp., *Triglidae*, *Scorpaena* sp. Length at first capture is about 7 cm. Catch is mainly composed by individuals of age 0 and 1, while the oldest age class (5+ group) is poorly represented. Catch rates showed oscillations, with an increase in the last year (2010). The assessment of this stock has been carried out by means of Extended Survivor Analysis (XSA) for the period 2004-2010, and yield-per-recruit (Y/R) for the period 2008-2010, considering French and Spanish trawl. The information used for the assessment of the stock consisted in annual size composition of French and Spanish trawler landings and biological parameters obtained from the French National Data Collection Programme. A vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997).

Stock assessment of Bogue (*Boops boops*) from GSA 25; Stock assessment of Picarel (*Spicara smaris*) from GSA 25

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Both assessments were performed by means of VPA analysis, using a mean pseudo-cohort from catch at age data for two three-year periods (2005-2007 and 2008-2010). For both periods, Yield per recruit (Y/R) analysis was also performed. The VIT software (Lleonart and Salat, 1997) was used for both analyses. The estimated reference points (Fmax and F0.1) for bogue stock in the first period, suggest an overexploitation state and an intermediate abundance of the stock (21.7% of mean stock biomass in relation to the virgin biomass). At the second period, the stock of bogue turned to fully-exploited with a higher percentage of the abundance (27.5%). In the case of picarel, the reference points suggest a fully exploitation state for both periods with higher percentages of the mean stock biomass in relation to the virgin, with 46.5% for the first period and 31% for the second period. For both species, according to the results and transition analysis a reduction of 15% of the fishing pressure could lead the current F-value close to F0.1 assuming a constant recruitment. This could be achieved with the reduction of licensed fishing boats (OAL:6-12m) and trawlers (OAL:12-24m). Additionally, other management measures are mentioned.

Stock assessment of red giant shrimp (*Aristaeomorpha foliacea*, Risso 1827) in the GSA 15 and 16

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The giant red shrimps is a relevant target species of the Sicilian and Maltese trawlers and is caught on the slope ground during all year round, but landing peaks are observed in summer. *A.foliacea* is fished exclusively by otter trawl, mainly in the central–eastern side of the Strait of Sicily, whereas in the western side it is substituted by the violet shrimp, *Aristeus antennatus.* Giant red shrimps are frequently caught together with Norway lobster (*Nephrops norvegicus*), large sized deep water pink shrimp (*Parapenaeus longirostris*), the more rare violet shrimp (*Aristeus antennatus*) as well as large hake (*Merluccius merluccius*). In the last years (2005-2010) mean total Yield was 1428 t, ranging from 1287 in 2008 to 1951 in 2009. The Sicilian landing are about 98-99% of the total Yield. Five complete years (2006, 2007, 2008, 2009 and 2010) of length frequency distributions from GSA 16 commercial landings data (fished in GSA 15 as well as GSA 16) were available, as well as two years (2009 and 2010) from GSA 15, so an approach under steady state (pseudocohort) assumptions was used. Cohort (VPA equation) and Y/R analysis as implemented in the package VIT4win were thus used. Data were derived from European DCF data call for GSA 15 and 16. Based on VIT analysis, there were 1070 t of spawning stock biomass in 2006, 1370 in 2007, 1300 in 2008, 1580 in 2009 and 1260 in 2010. SURBA analysis of GSA 16 data estimated highly fluctuating SSB indices from 1994 to 2001; from 2002 to 2010 spawning stock biomass remained stable at low levels. The estimates of absolute recruitment in millions of individuals (age class 1) from VIT analysis in 2006-2010 were 98.1 in 2006, 114 in 2007, 83 in 2008, 118 in 2009 and 123 in 2010. SURBA analysis of GSA 16 data showed that from 1994 to 2001 recruitment biomass indices fluctuate highly, with the lowest number of recruits recorded in 2001. From 2002 to 2010 recruitment abundance remained at low levels. The giant red shrimp stock in the Strait of Sicily is considered overfished since the current fishing mortality is higher than both F_{max} and $F_{0.1}$. Considering the high consistency of results with different methods, F_{max} = 0.70 were proposed as Limit Reference Points (LRP), and $F_{0.1}$=0.40 as the Target reference points

(TRP). Considering $F_{0.1}$ as target reference points, a reduction ranging between 50 and 60 % of the current F in 2009 and 2010 is needed to reach a more sustainable fishery exploitation. To reach an exploitation below F_{max} a reduction of current F in the same years ranging between 20 and 40% should be pursued.

Assessment of Deep-water pink shrimp *Parapenaeus longirostris* from the trawl fishery (2001-2006) off the geographical sub-area Northen Spain GSA 6

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Deep-water pink shrimp (*Parapenaeus longirostris*) is one of the most important crustaceans species for the trawl fisheries developed along the GFCM geographical sub-area Northern SPAIN (GSA-06). This resource is an important component of commercial landings in some ports of the Mediterranean Northern Spain and occasionally a target specie of the trawl fleet, around 260 vessels, which operate on the upper slope. During the last years, a sharp increase in landings was observed, starting in 1998 and reaching the maximum value in 2000, followed by a decreased trend during the period 2001-2004. During de period 2005-2010 stabilization in catches is observed whit an average of 138 t for this period. In 2010 the annual landings of this species amounts 141 tons in the whole area. The state of exploitation was assessed for the period 2001-2010 for the GFCM geographical sub-area Northern Spain (GSA-06). A VPA tunned with CPUE from commercial fleet and abundance indices from MEDITS trawl surveys, was carried out applying the Extended Survivor Analysis (XSA) method (Lowestoft program; Darby and Flatman, 1994) and FLR (Fisheries Libraries in R) over the period 2001-2010. This methods were performed from size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings transforming length data to age data by slicing. A yield per recruit (Y/R) analysis based on the exploitation pattern resulting from the XSA model and population parameters for the entire period was carried out. The results show a decreasing trend both in landings and total biomass of the stock from 2001 to 2004 and 2003 respectively. Landings, biomass and SSB values remain stabilized for the last 7 years whit light fluctuations. Although these values are low compared with 2001 values (the highest in the series).

Exploitation is based on very young age classes, mainly 1 and 2 year old individuals, indicating a dependence on recruitments. Fishing mortality shows a decreasing trend from 2001 to 2004 but increasing in the 2005-2010 period. The fisheries of *Parapenaeus longirostris* in the study area show important inter-annual variations in landings, biomass and SSB. Currents indicators represent a 43%, 62% and 71%

respectively of the values observed nine years ago, (the highest in the serie).The Y/R analysis shows that the F_{ref} (1.11) exceeds the Y/R $F_{0.1}$ reference point (0.3009). It can be conclude that pink shrimp in GSA06 is overexploited. The oscillation found for this species is in agreement with other areas of the Mediterranean. Is assumed that environmental conditions can affect the stock in addition the fishing mortality. A reduction of the fishing effort in trawl is recommended.

Assessment of hake *Merluccius merluccius* from the trawl fishery (2003-2010) off the geographical sub-area Northen Alboran Sea GSA 1

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European hake (*Merluccius merluccius* (Linnaeus, 1758)) is one of the target demersal species of the Mediterranean fishing fleets, largely exploited in GSA01 almost exclusively by trawl (88% landings) on the shelf and slope and by small-scale using gillnets (9%) and long lines (3%). The trawling fleet in the GSA01 area comprised an average of 183 boats, averaging 35 GRT and 176 HP. In 2003–2010 period the annual landings of this species averaged 448 tons in the whole area. The state of exploitation was assessed for the period 2003-2010 for the GFCM geographical sub-area Northern Alboran Sea (GSA-01). A VPA tunned with CPUE from commercial fleet and abundance indices from MEDITS trawl surveys, was carried out applying the Extended Survivor Analysis (XSA) method (Lowestoft program; Darby and Flatman, 1994) over the all period. This methods were performed from size composition of trawl catches (obtained from on board and on port monthly sampling) and official landings transforming length data to age data by slicing. A retrospective analysis and a yield per recruit (Y/R) analysis based on the exploitation pattern resulting from the XSA model and population parameters for the entire period was carried out. The results show a decreasing trend in the last year both in biomass and spawning stock biomass of the stock. Current Recruitment in numbers represent a 26% of the value observed two years ago (the highest in the series). Fishing mortality increasing from 2008 to 2009, decreasing slightly in the last year. The Y/R analysis shows that the F_{ref} (1.33) exceeds the Y/R $F_{0.1}$ reference point (0.32 absolute value). It can be conclude that the stock status is overexploited. A not increase of the fishing effort and especial surveillance in the use of 40 mm square or 50mm diamond mesh size in the bottom trawl cod-end is recommended.

Stock assessment of *Mullus surmuletus* from GSA05 (Balearic Islands)

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Striped red mullet (*Mullus surmuletus*) is one of the most important target species in the trawl fishery developed by around 40 vessels off Mallorca (Balearic Islands, GFCM-GSA05). A fraction of the small-scale fleet (~100 boats) also directs to this species during the second semester of the year, using both trammel nets and gillnets. During the last decade, the annual landings of this species have oscillated between 73-117 and 17-29 tons in the trawl and small-scale fishery, respectively. The stock of *Mullus surmuletus* of the GFCM-GSA05 has been assessed using data from both the trawl and the small-scale fishery on a time series covering 11 years (2000-2010). The assessment has been carried out applying tuned VPA (Extended Survivor Analysis, XSA) on the cohorts present during 2000-2010 and both VPA and Y/R analysis on a mean pseudo-cohort from that period. These approaches were performed using monthly size composition of catches, official landings and the biological parameters estimated within the framework of the Data Collection Programme. The VPA was tuned with CPUE from commercial trawl fleet (2000-2010) and bottom trawl surveys (2001–2010). The vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet. The softwares used were the Lowestoft VPA program for the XSA and the VIT program for the VPA and Y/R analysis from a mean pseudo-cohort. The current Fref was found to be above the Y/R F0.1 reference point, which indicates that red mullet in GSA055 is subject to overfishing.

Stock assessment of common sole (*Solea solea*) in GSA 17

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The common sole *Solea solea* (Linnaeus, 1758) is one of the most important valuable species in the FAO GFCM area, which provides for 13% of the word overall catches of this species. Around 22% of the GFCM area landings comes from the Adriatic Sea, especially the northern and central basins (GSA 17) representing an important spawning and aggregation area for sole. Taking into consideration the importance of sole in GSA 17 and the lack of scientific data for sustainable managing the stock, the SoleMon project was initiated in 2005. The aims of the project are to provide a stock assessment of *S. solea* through surveys at sea, carried out by the *rapido* trawl, and analysis of landings of the fleets catching the common sole either as target species (*rapido* trawl and set nets) or as a portion of a multi-species catch (otter trawl). The assessment is based on VPA (XSA) methods, survey based methods (SURBA) and steady state cohort analyses (VIT software).

Stock assessment of *M. merluccius* in GSA 18

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For the evaluation of hake stock status in GSA 18 different methods and different sources of data (fishery dependent and fishery independent) have been used. Regarding the methods, SURBA software (Needle, 2003), the ALADYM model (Lembo et al., 2009) and VIT software (Lleonart and Salat, 1997) were used. Every method provides information, focusing on a specific aspect: SURBA provides estimates of total mortality and indirectly (via natural mortality) of fishing mortality from the scientific surveys. In addition, some guess estimates of the recruitment at age 0 and at the beginning of the year can be obtained. In ALADYM mortality levels and harvesting strategies are used to forecast the effects on the population metrics (accounting for cohort structure) and simulated catches, thus even different harvesting strategies from those actually assessed can be evaluated. The current level of the spawning stock vs. the level at F = 0 can be also estimated. The LCA (or pseudocohort analysis age-based) as implemented in VIT allows to perform a length cohort analysis under the steady state assumption and thus the fishing mortality vector is estimated. In addition, the Y/R analysis implemented in the software allows the calculation of the Biological Reference Points $F_{0.1}$ and F_{max}. A transition analysis with VIT was performed, in order to evaluate the impact of different exploitation scenarios. Finally, all the methods for the evaluation are discussed and used in a complementary and integrated way, in order to exploit the advantage of a multi-methods and multi-data approach. To account for uncertainty in life history profile of European hake a sensitivity analysis was performed using two scenarios of growth: slow and fast growth. For both scenarios the analyses are conducted for sex combined. Natural mortality vector for the two scenarios were obtained applying the Prodbiom method (Abella et al., 1997). The results highlight that it is necessary a considerable reduction of the fishing mortality to allow the achievement of both the limit and target reference points, $F_{0.1}$ and F_{max}, regardless of the growth pattern of the species. These BRPs can be gradually achieved by a multiannual management plans that will require a more sharp reduction in the short term than in the medium term. However, it should also

be taken into account that a more gradual reduction will very likely imply lower social and economic costs, without hampering the sustainability objectives. Simulations also show that the objectives of a more sustainable harvest strategy could be achieved with a multiannual plan with a reduction of fishing mortality through fishing activity limitations and possibly fishing capacity decreasing. It is however necessary to consider in the eventual implementation of a multiannual management plans that most of the fishing mortality is derived from the Italian bottom trawlers that represent about 85% of the total F in the GSA and that of the Italian longlines accounting for about 7-8%, with an overall percentage of about 92-93%, while Montenegrin trawlers account for about 1% of the F exerted on the GSA and Albanian trawlers of about 6.5% (Tab. 2.3.3). Moreover, the production of hake in GSA 18 is split in 14% caught by Italian longlines, 79% by Italian trawlers (total about 93%), about 1% by Montenegrin trawlers and about 6% by Albania trawlers.