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

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
SCIENTIFIC ADVISORY COMMITTEE (SAC)
Meeting of the Sub-Committee on Stock Assessment (SCSA) **Malaga, Spain, 30 November – 3 December 2009**
REPORT OF THE WORKING GROUP ON STOCK ASSESSMENT OF DEMERSAL SPECIES* **Ancona, Italy, 19-23 October 2009**

* Only available in English

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1. Introduction

The meeting of the SCSA Working Group on Demersal species (WG) was held in Ancona, Italy, from 19 to 23 October 2009 at CNR-ISMAR. It was attended by 25 participants from France, Italy, Croatia, Montenegro, Slovenia, Albany, Greece, Turkey, Egypt and Algeria as well as representatives of FAO and the GFCM Secretariat (see list of participants in Annex I).

Mr. Abdellah Srour, Executive Secretary *ad interim* of the General Fisheries Commission for the Mediterranean (GFCM), welcomed the participants and thanked the CNR-ISMAR representative for their kindness in hosting and arranging the meeting. He called for a more active participation of national scientists to the working group meetings and stressed the importance to feed the WG's work by the required data and information.

Ms. Constantina Karlou_Riga, FAO SCSA coordinator, introduced the meeting and objectives.

Mr. Graham Pilling chaired the meeting and acted as Rapporteur.

The Terms of Reference for the Moderator are presented in Annex II. This report represents the culmination of those Terms of Reference.

The aim of the meeting was to perform 'joint' stock assessments, where "joint" refers to the participation of scientists from different countries providing their data and sharing them with their colleagues, using a standard method and analyzing together the results and options for fisheries management. A number of assessments across species and GSAs were performed during the meeting (see Annex II) and the methods and results discussed by the participants. Scientific advice was developed using these results, relative to reference points.

2. Overview of assessments performed and stock status

An overview of the stock assessments performed during the demersal working group meeting, and a summary of the resulting scientific advice is provided in Table 1. Further summary details of the assessments performed are subsequently provided, including the methodologies used, the general results, reference points and stock status observations. This is not a detailed description; readers should see the separate stock assessment forms for more information. These are published on the GFCM website.

Tunisian scientists submitted additional assessments for *Diplodus annularis* in GSAs 12 and 14. Unfortunately, these scientists could not attend the meeting. Given the 'content and objectives' of the group (see Annex II), these assessments could not reasonably be considered within the demersal working group, since "The outcome of the assessments already undertaken by national experts including with the support of FAO Regional projects and/or other international initiatives would be presented directly to the Sub- Committee on Stock Assessment (SCSA) meeting for review."

Table 1. Overview of the assessments performed and resulting scientific advice to managers, by GSA and species.

GSA	Species	Data type	Yrs data	Methodology used	Stock status advice
GSA 3	*M. merluccius*	Lfreq	2008	VIT	Over-exploited
	Pagellus bogaraveo	CPUE	2005-2007	VIT/YPR	Moderately exploited
	P. longirostris	Catch Length CPUE	Oct 2007-Sept 2008 2000-08	VIT Schaeffer Surplus production	Over-exploited
	B. boops	Lfreq Catch	2000-2008	VIT	Over-exploited
	M. barbatus	Lfreq Catch	2005-08	VIT	Over-exploited
GSA 6 (local region)	*M. merluccius*	Lfreq	2008	VIT/YPR	Over-exploited
GSA 15	*M. barbatus*	Lfreq MEDITS	2002-2008	B&H Z and SURBA	Over-exploited
	M. surmuletus	Lfreq MEDITS	(2002) 2006-2008 Lfreq	B&H Z and SURBA	Fully exploited
GSA 17	*N. norvegicus*	Lfreq (Catch at length) survey	2006-2008	VIT and LCA	Over-exploited
	S. solea	Catch at age	2000-2008	LCCC SCAA VIT	Over-exploited
GSA 26	*M. merluccius*	Lfreq	2006-2007	VIT/YPR	Over-exploited
	M. barbatus	Lfreq	July 07 – Apr 08	LCCC/YPR	Over-exploited
	M. surmuletus	Lfreq	July 07 – Apr 08	LCCC/YPR	Over-exploited

2.1. GSA03 *Merluccius merluccius*

(By Sadia Belcaid)

Fishery

The fishing activity in Morocco plays an important social and economical role. The landings are made in 7 ports and 86 artisanal fishery sites. The fishing boats are composed by trawlers, longliners, seiners and artisanal small scale boats. The number of the trawlers is 114. 51% of the trawlers are based in Nador port, 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 of the power of the trawlers is about 325 and the mean tonnage is about 50 TJB. The annual catch of the coastal fishery is around 8500 tonnes, for an average of 117 millions dirham in value. The hake (*Merluccius merluccius*) trawlers catch in 2008 is about 210 tonnes, the CPUE is about 31 kg/nb trips for the same year. The catch, effort and CPUE trend show a decline from 2002 to 2008. The most species targeted with the *Merluccius merluccius* are the deep water pink shrimp, *Pagellus acarne*, *Mullus spp.*, *Boops boops*, *Gadus poutassou*, *Octopus vulgaris* and *Sepia* spp.

Data and parameters

Length frequencies for the year 2008 from trawlers landing within the port of M'diq were used as the basis of the assessment. Following discussion on the patterns of growth shown by hake in the Mediterranean, the 'fast' growth parameters developed for Spanish waters (GSA 1; Garcia Rodriguez et al., 2002) were used in place of those developed using more local data. This was due to a limited length range available from local sampling due to the fact that samples came from trawls that fished in near shore waters (and hence focused on smaller size groups).

Assessment approach and results

The length cohort analysis approach within VIT (Lleonart and Salat, 1992) was used. Final results were:

F= 1.2 (global F) – 1.9 (mean F);
$F_{0.1}$=0.74, F_{max}=0.93

Stock status

Overexploited

Management advice and recommendation

Decrease fishing mortality. To achieve $F_{0.1}$, a reduction of 38-62% would be required. It should be noted that this does not imply that this reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments

Both the mean and global F estimates from VIT were higher than both $F_{0.1}$ and F_{max}. The group comment upon the very variable pattern in fishing mortality at length, which was notably affected by the sampled length structure analysed. The selectivity of the trawl gear for generally smaller individuals was also noted, which may bias the F estimates.

2.2. GSA03 *Pagelus bogaraveo*

(by Sadia Belcaid)

Fishery

The longliners fishery on Moroccan coast is the major activity in the Strait of Gibraltar. This fleet is mainly based in Tangier port which has 200 boats in this fleet. This number represents 85% of the total longliners in the whole Mediterranean. Units belonging to this fishery have an average GRT about 20 tons, a power average about 160 cv and an average age of 7 years. Longliners target primarily swordfish, small tunas, red seabream, the grouper fish, *Helecolenius dactylopterus* and *Lepidopus caudatus*.

Data and parameters

Length frequencies for the years 2000-2008 from trawlers landing within the ports of Nador and Al hoceima (averaged to approximate equilibrium conditions for the pseudocohort analysis) were used as the basis of this analysis. Growth parameters were based upon those of Krug (1989) from Spain.

Assessment approach and results

The length cohort analysis approach within VIT (Lleonart and Salat, 1992) was used. Final results were:

F= 0.12 (global F) – 0.20 (mean F);
$F_{0.1}$=0.20, F_{max}=NA.

Stock status

Moderately exploited.

Management advice and recommendations

Maintain fishing mortality at the current level.

Comments

The fact that longliners tend to exploit larger individuals within the population, and that individuals close to the assumed maximum size (taken from Fishbase for Spain, and hence open to some uncertainty), supports the general opinion on stock status. This is further supported by the general trends in CPUE, although the shortness of the time series (2001-2007) was noted. Patterns in the CPUE around 2004 may result from improved data collection.

The yield per recruit curve is quite flat-topped, and hence F_{max} is not well defined. The value of $F_{0.1}$ is more robust to this, but may also be positively biased.

2.3. GSA03 *Parapenaeus longirostris*

(by Said Benchoucha and Najib el Ouamari)

Fishery

The fishing activity in Morocco plays an important social and economical role. The landings are made into 7 ports and 86 artisanal fishery sites. The fishing boats are composed of trawlers, longliners, senners and artisanal small scale boats. The number of the trawlers is 114. 51% of the trawlers are based in Nador port, 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 of the power of the trawlers is about 325 and the mean tonnage is about 50 TJB. The annual catch of the coastal fishery turn around 8500 tonnes, for an average of 117 millions dirham in value. The *Parapenaeus longirostris* trawlers catch in 2008 is about 337 tonnes, the fishing effort is 11345 (nb of trips) which correspond to 34035 fishing days, and the CPUE is about 30 kg/nb trips for the same year. The catch, effort and CPUE trend show a decline from 2002 to 2008. 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. This species represent more than 84% of the total demersal species landed by the trawl fishery.

Data and parameters

Two alternative assessment approaches were used for *P. longirostris* within this GSA: a dynamic Schaeffer production model (based upon CPUE data), and VIT (based upon trawler length frequency data).

Length frequencies (cephalothoracic length, mm) for the period Oct 2007-Sept 2008 from trawlers landing at the port of Nador, which represents ~70% of catches, were used as the basis of the VIT assessment. Biological sampling was carried out on a 4kg to 6 kg sub-sample of landed catch, subsequently analyzed at the laboratory for the frequency of sizes by sex, stages of sexual maturity and weight. CPUE data from the National Office for Fishing for the period 2000-2008 from the trawl fishery were used within the Schaeffer model analysis.

Assessment approach and results

Two separate assessment approaches were used:

Length cohort analysis within VIT (Lleonart and Salat, 1992);

Schaeffer production model (1954).

Results from both are presented. Final results were:

VIT:F= 0.80 (mean F);

$F_{0.1}$=0.58, F_{max}=0.64.

Schaeffer model: $F_{curr}/F_{0.1}$=295%; $B/B_{0.1}$=19%

Stock status

Over-exploited (high fishing mortality and low abundance).

Management advice and recommendations

Decrease fishing mortality. To achieve $F_{0.1}$, a reduction of between 30% and ~66% would be required (based on the VIT and Schaeffer production model results, respectively). It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended, for example; it was recommended that a decrease in fishing mortality of 10% each year be attempted.

Comments

The VIT analysis was run with a number of alternative terminal-F values. The results from the run where $F_{terminal}$=0.3 were selected for the final advice. There were potential issues with the sampling of larger size classes, which will affect estimates of fishing mortality.

The Schaeffer production model appeared to fit the available data well, despite that data showing an overall one-way decline in CPUE.

2.4. GSA03 *Boops boops*

(by Mostafa Layachi)

Fishery

Exploitation of the stocks of *Boops boops* is carried out by trawlers from Moroccan Mediterranean ports. Fishing is focussed between the coastal region of Tangier from the port of Saidia in the east. 70% of landings occur within the ports of Nador and Al hoceima.

Data and parameters

Length frequencies for the years 2005-2007 from trawlers landing within the ports of Nador and Al hoceima (averaged to approximate equilibrium conditions for the pseudocohort analysis) were used as the basis of this analysis.

Assessment approach and results

The length cohort analysis approach within VIT (Lleonart and Salat, 1992) was used. Final results were:

F= 0.36 (mean F);
$F_{0.1}$=0.13, F_{max}=0.22.

Stock status

Over-exploited.

Management advice and recommendations

Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 64% would be required (based on the VIT results). It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments

It was noted that this analysis was based upon trawl gear catch sampling, whose selectivity pattern may affect the results of the length-based assessment.

2.5. GSA03 *Mullus barbatus*

(by Mostafa Layachi)

Fishery

Exploitation of the stocks of red mullet is carried out by trawlers from Moroccan Mediterranean ports. Fishing is focussed between the coastal region of Tangier from the port of Saidia in the east. 70% of landings occur within the ports of Nador and Al hoceima.

Data and parameters

Length frequencies for the years 2005-2008 from trawlers landing within the ports of Nador and Al hoceima (averaged to approximate equilibrium conditions for the pseudocohort analysis) were used as the basis of this assessment.

Assessment approach and results
The length cohort analysis approach within VIT (Lleonart and Salat, 1992) was used. Final results were:

F= 0.80 (mean F);
$F_{0.1}$=0.19, F_{max}=0.24.

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 76% would be required (based on the VIT results). It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
It was noted that this analysis was based upon trawl gear catch samples, whose selectivity pattern may affect the results of the length-based assessment.

2.6. GSA06 *Merluccius merluccius*

(by Paloma Martín, Laura Recasens, Jordi Lleonart)

Fishery
Hake is exploited by bottom trawl, gillnet and longline, each fishing gear targeting a given length range. Highest landings, both in weight and in numbers, correspond to bottom trawling. Fishing is carried out five days a week.
Recruits are the main component of the overall landings. The catch mean age is around 1 year.
Annual hake landings along the Catalan Coast since late nineties were around 2000 tonnes and were produced by a total effort of between 55000-65000 fishing days (number of days with hake landings, all fishing gears combined).
Landings in 2008 were highest for the period 2000-2008, and correspond to the increase in bottom trawl landings; landings by the artisanal vessels and longliners in 2008 decreased regarding the previous year. In 2007 hake annual landings were the lowest for the period 1988-2008.

Data and parameters
Length frequency distribution for the year 2008 from trawlers, longliners and other gears (gillnets), landing within ports in the northern part of Spain. The analysis was therefore based on data from only part of the assumed stock.

Assessment approach and results
The program VIT (Lleonart and Salat, 1992) is designed for the analysis of marine populations, exploited by one or several gears, based on single species catch data (structured by age or size). The main assumption underlying the model is that of steady state, because the program works with pseudo-cohorts and it is therefore not suitable for historical data series. The program uses the catch data and ancillary parameters for rebuilding the population of the species and the mortality vectors affecting it by means of Virtual Population Analysis (VPA).

Once the virtual population has been rebuilt, an analysis of the fishery can be carried out with the aid of several tools: Comprehensive VPA results, Yield-per-Recruit analysis based on the fishing mortality vector, analysis of sensitivity to parameter values and transition analysis. The latter permits a non-equilibrium analysis of how a shift in exploitation regime is reflected in the fisheries. All these tools can be applied to specific studies of competition among fishing gears.
A natural mortality at age vector was used within the assessment, based upon the PROBIOM Excel spreadsheet (Abella et al. 1997, 1998).
The growth parameters used within the VIT analysis were those representing the 'fast' growth assumption for hake. By combining data from different gears, a more 'complete' length frequency was developed.

Final results were:

F= 0.60 (global F), 0.88 (mean F);
$F_{0.1}$, F_{max}=0.27.

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. To achieve F_{max}, a reduction of 70% would be required (based on the VIT results), and to achieve $F_{0.1}$ a greater decrease would be required. It should be noted that this does not imply that this reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
It was noted that landings in 2008 were higher than in previous years, suggesting higher recruitment. This will invalidate the equilibrium assumptions of the pseudocohort model, and results may be biased.
An example of the impact of reductions in fishing mortality on future stock status was developed using the VIT software, based upon a 20% reduction in trawl effort. This suggested that increases in yield-per-recruit could be seen within 2-3 years. These results are presented within the stock assessment form.

2.7. GSA15 *Mullus barbatus*

(by Mark Dimech and Leyla Knittweis)

Fishery
The fisheries resources in GSA 15 are shared by three main member countries, namely Malta, Italy and Cyprus. 21 Maltese trawlers operate within this GSA. Only 12 of them are allowed to fish inside the Maltese 25 nautical mile Fisheries Management Zone. Five of these target red mullet on the continental shelf throughout the year, while the rest target pink and red shrimps on the continental slope. Apart from the Maltese trawling fleet a number of Sicilian trawlers fish outside the 25 nautical mile zone targeting red mullet, red shrimp and pink shrimp. 3 Cypriot vessels also fish outside the 25 nautical mile zone which target exclusively red mullet on the continental shelf.

Data and parameters
Three different groups of data were used in separate analyses:
The stock of *Mullus barbatus* was assessed using length frequency distributions for the years 2005-2008 from trawlers operating within the area (from Malta, Cyprus and Italy). The biological parameters used were those reported by SAMED (2002), except for the length weight relationship that was estimated using the MEDITS data. A value of 0.43 of natural mortality was used as reported by Andaloro et al. (1985). These data were used to estimate trends in total mortality over time using the approach of Beverton and Holt.
Another approach using the SURvey Based Assessment (SURBA; Needle, 2003) VPA was also tested to estimate the trend in F, using data from the MEDITS Trawl survey on a time series covering 7 years from 2002-2008. The annual length frequency distribution was converted to age by the age slicing procedure in the LFDA 5 software (Hoggarth et al., 2006). A vector of natural mortality by age was calculated from Caddy´s (1991) formula, using the PROBIOM Excel spreadsheet (Abella et al., 1996; 1997). SURBA was then used to estimate mean fishing mortality by year.

Assessment approach and results
Two assessment approaches were used:
Trends in fishing mortality by year were obtained by the Beverton and Holt method using the LFDA 5 software;
Mean annual fishing mortality was estimated through SURBA (Needle, 2003) from MEDITS trawl data.
Yield per recruit analysis was conducted using the YIELD package (Hoggarth et al., 2006) which also allowed the estimation of the biological reference points F_{max} and $F_{0.1}$.

The results from the Beverton and Holt Z estimation approach are presented as the final results (see comments):

F= 0.51(B&H Z for 2008);
$F_{0.1}$=0.35, F_{max}=0.63.

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. Current F is between $F_{0.1}$ and F_{max}. To achieve $F_{0.1}$, a reduction of 30% would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
SURBA outputs were uncertain, giving variable and high mean F estimates. SURBA model diagnostics showed that the model did not fit the data properly. This is probably due to the relatively short time series of data available (7 years) and the short lifespan of the species. As a result, the Beverton and Holt Z estimates were used to develop advice for managers.

2.8. GSA15 *Mullus surmuletus*

(by Leyla Knittweis and Mark Dimech)

Fishery
The fisheries resources in GSA 15 are shared by three main member countries, namely Malta, Italy and Cyprus. 21 Maltese trawlers operate within this GSA. Only 12 of them are allowed to fish inside the Maltese 25 nautical mile Fisheries Management Zone, 5 of which target red mullet on the continental shelf throughout the year, while the rest target pink and red shrimps on the continental slope. Apart from the Maltese trawling fleet a number of Sicilian trawlers fish outside the 25 nautical mile zone targeting red mullet, red shrimp and pink shrimp. 3 Cypriot vessels also fish outside the 25 nautical mile zone which target exclusively red mullet on the continental shelf.

Data and parameters
Three different groups of data were used in separate analyses:
The stock of *Mullus surmuletus* was assessed using length frequency distributions for the years 2005-2008 from trawlers operating within the area (from Malta, Cyprus and Italy). The biological parameters used were those reported by Ragonese et al. (2004), except for the length weight relationship that was estimated using the MEDITS Trawl survey on a time series covering 7 years from 2002-2008. A value of 0.43 of natural mortality was used as reported by Andaloro et al. (1985). Using these parameters the trend in fishing mortality by year was obtained by the Beverton and Holt method using the LFDA 5 software (Hoggarth et al., 2006).
The second approach used the SURvey Based Assessment (SURBA; Needle, 2003) VPA was also tested to estimate the trend in F. The length frequency distribution was converted to age by the age splicing procedure in the LFDA software. A vector of natural mortality by age was calculated from Caddy´s (1991) formula, using the PROBIOM Excel spreadsheet (Abella et al., 1996; 1997). Mean F per year was then estimated using the software SURBA.
Yield per recruit analysis was conducted using the YIELD package (Hoggarth et al., 2006), which also allowed the estimation of the biological reference points F_{max} and $F_{0.1}$.

Assessment approach and results
Two assessment approaches were used, as noted above:
Beverton and Holt Z estimation (LFDA, Hoggarth et al., 2006);
SURBA (Needle, 2003).

Only the results from the Beverton and Holt analysis are presented as the final results (see comments).

F= 0.31(B&H Z mean F for 2006-2008);
$F_{0.1}$=0.33, F_{max}=0.60.

Stock status
Fully exploited.

Management advice and recommendations
Maintain fishing mortality at the current level (~$F_{0.1}$).

Comments
SURBA outputs were uncertain, giving variable and high mean F estimates. SURBA model diagnostics showed that the model did not fit the data properly. This is probably due to the

relatively short time series of data available (7 years) and the short lifespan of the species. As a result, the Beverton and Holt Z estimates were used to develop advice for managers.
Current status estimates appear consistent with the more inshore distribution of the species, within the Maltese Islands Fisheries Management Zone (25nm), in areas where it is harder to fish with trawl gear. The impact of fishing is therefore potentially reduced. A spatial separation of effort management may therefore be feasible.

2.9. GSA17 *Nephrops norvegicus*

(by A. Santokanni, A. Belardinelli, P. Carpi, N. Congolani, S. Colella and M. Panfili)

Fishery

N. norvegicus in the Adriatic Sea is caught primarily with two types of gear: the majority of the catch is by bottom trawl nets and the rest with traps (mainly in channel areas of the northern Adriatic).
The catch fluctuates significantly in different times of day and night, and during the year. Generally, the catch is highest at sunrise and sunset, and different parts of the population are accessible to fishing gear at different times of day. The catch is biggest in spring while in winter the catch is at a minimum.

Data and parameters

Length frequency distributions for the years 2006-2008 from Italian trawler catches (averaged to approximate equilibrium conditions for the pseudocohort analysis) formed the basis of the analysis. The assessment incorporated the sexual dimorphism of *N. norvegicus*, males being treated separately from females with different parameters used. Trial assessments were undertaken with alternative natural mortality values for males and females. These were based upon a mean value for each sex (SAMED, 2002), or a natural mortality at age vector, based upon the PROBIOM Excel spreadsheet (Abella et al. 1997, 1998). The results appeared robust to the values assumed for natural mortality.

Assessment approach and results

The length cohort analysis approach within VIT (Lleonart and Salat, 1992) and FLR (Kell et al., 2007) were used. Final results from VIT were:

F= 0.69-0.77 (females), 0.87-0.96 (males);
$F_{0.1}$=0.25 (females) and 0.20 (males),
F_{max}= 0.40 (females) and 0.30 (males).

Stock status

Over-exploited.

Management advice and recommendations

Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 64-68% (females) and 77-79% (males) would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
Data were only available for the western side of the Adriatic, and hence did not incorporate the whole stock. The results must therefore be viewed with caution.
It was noted that while the Lc_{50} was 14.6cm, the smallest size in the length frequency was 20cm, which suggests issues with sampling. Results may therefore be biased.

2.10. GSA17 *Solea solea*

(by G. Scarcella, O. Giovanardi, F. Grati, P. Polidori, S. Raicevich, N. Vrgoč and G. Fabi)

Fishery
Sole (*Solea solea*) is one of most important target species of rapido trawl and set net fleets in GSA 17. The stock is shared between the Adriatic countries (Italy, Croatia and Slovenia). The Italian fleets exploit this resource with rapido trawl and set nets (gill nets and trammel nets), while only trammel net is used in the countries of the eastern coast. More than 90% of catches come from the Italian side. Landings fluctuated between 1,000 and 2,300 t in the period 1996-2006 (data source: FAO-FishStat, IREPA-SISTAN time series, ISMEA). The fishing effort applied by the Italian rapido trawlers gradually increased from 1996 to 2005, and slightly decreased in the last years.

Data and parameters
Abundance and biomass indexes from rapido trawl surveys were computed using ATrIS software (Gramolini et al., 2005) which also allowed GIS maps of the spatial distribution of the stock, of spawning females and of juveniles, to be drawn. Underestimation of small specimens in catches due to the gear selectivity was corrected using the selectivity parameters given by Ferretti and Froglia (1975). Several projects carried out in of GSA17 highlighted that the discard of sole both by rapido trawl and set net fisheries is negligible as the damaged specimens are also commercialized.
Numbers at age were obtained from commercial catch data (2000-2008) sampled from trawlers and gillnets, and catch rate data from fishery-independent surveys (2005-2008). Abundance-at-age data was obtained from survey data.
Length frequency distributions were obtained from surveys for the years 2005-2006 (catches; averaged to approximate equilibrium conditions for the pseudocohort analysis) and 2008 (survey).
Length converted catch curve was also used on length frequency distributions from survey data (2008), and catch data (2005-2006).
Growth parameters were obtained through the Solemon project (2004-2008). A natural mortality vector (M_a) was estimated using Caddy's method (1991) (PROBIOM Excel spreadsheet; Caddy and Abella, 1999; Abella et al. 1997, 1998).
At present, data on sole are not available from the eastern side of Adriatic Sea; within the statistics sole is inside a "mixed flatfish" category. Landings of around 200 tons of *Solea solea* have been suggested for the eastern part, mainly from set-netters.

Assessment approach and results
Two alternative assessment approaches were used:
statistical catch at age (SCAA; Doubleday's method, in Excel);
length-converted catch curve (LFDA; Kirkwood et al., 2001).

A yield-per-recruit (Y/R) analysis (Yield version 1.0, see Hoggarth et al., 2006) was applied to estimate the reference points, based upon alternative potential values of steepness within the Beverton and Holt stock recruitment relationship (being 0.75 and 0.9).
The results from the statistical catch at age analysis are presented. Final results were:

F= 1.48 (2008, from SCAA);
$F_{0.1}$=0.26 (steepness=0.9) and 0.20 (steepness=0.75),
F_{max}= 0.46 (steepness=0.9) and 0.40 (steepness=0.75).

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 82-86% would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended. In turn, a two–months closure for rapido trawling inside 11 km off-shore along the Italian coast, after the biological fishing ban (August), would be advisable to reduce the portion of juvenile specimens in the catches.

Comments
Spatial distribution information by age indicated that sole move east across the Adriatic Sea with increasing age. Fisheries local to the Italian coast will therefore be biased towards younger individuals compared to the true population. The selectivity of the gear was therefore modelled within the analysis as being dome-shaped, to account for this change in availability with age. Bias may remain due to the incomplete picture of the stock (although 90% of the catch is likely to come from the Italian side).
The SCAA model suggests fishing mortality is high, if declining slightly over the period, with some increase in SSB. Catch curves estimated a similarly high fishing mortality level (>1) for the years 2005-2006 (commercial), and 2008 (survey).

2.11. GSA26 *Merluccius merluccius*

(by Sahar Mehanna)

Fishery
The number of licensed trawl vessels ranged between 1100 and 1500 during the period from 1991 to 2007. This fleet targets many species such as red mullet *Mullus surmuletus* and *M. barbatus*; the sparids *Sparus aurata*, *Pagellus* spp., *Boops boops*, *Lithognathus mormyrus*, *Diplodus* spp.; the soles *Solea* spp.; the European hake *Merluccius merluccius*; the picarels *Spicara* spp.; the lizardfishes *Synodus saurus*; the cephalopods *Sepia* spp., *Loligo* spp. and *Octopus* spp.; crabs *Portunus pelagicus* and shrimp (about 10 species). European hake contributed about 3% of the total trawl landings in the Egyptian Mediterranean waters.
The vessel length varied between 18 and 22 m and its width varied from 4 to 6 m. Each vessel is powered by main engine of 150 to 600 hp but the majority of 250 hp engine. The fishing trip is about 7 to 10 days and the number of crew is about 6 to 15 persons.
The mean annual landing of trawl fishery is around 16 thousand tons accounting for approximately 33% of total catches in Egyptian Mediterranean.

Data and parameters
Length frequency distribution from trawl catches for the years 2006-2007 sampled from the Egyptian ports Alexandria and Rashid (averaged to approximate equilibrium conditions for the pseudocohort analysis) were used as the basis of the analysis. Data for June 2007 - April 2008 were also analysed, but results were poor (see comments). Growth parameters were obtained from Mehanna (in press). The natural mortality coefficient was estimated as the geometric mean of estimated from two methods: Taylor (1960) and Djabali et al. (1993). The length at first capture (Lc) was estimated from the catch curve analysis. The length at first sexual maturity (Lm) was estimated by fitting the maturation curve between the observed points of mid-class interval and the percentage maturity of fish corresponding to each length interval.

Assessment approach and results
Two alternative assessment approaches were used:
Length cohort analysis within VIT (Lleonart and Salat, 1992);
Length-converted catch curve (FiSAT; Gayanillo et al., 1994).
The results from the VIT analysis are presented. Final results were:

Position of reference points relative to current F (2006-2007):
$F_{0.1}$=0.49; F_{max}=0.78.

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 51% would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
The VIT model did not fit well to data from 2008. Therefore the analysis was re-done with data from 2006-2007; results presented therefore reflect the status over that period.
The length converted catch curve analysis estimated a fishing mortality of ~0.66.

2.12. GSA26 *Mullus barbatus*
(by Sahar Mehanna)

Fishery
Red mullets are among the most valuable and highly priced fish species in Egypt. Though widely distributed along the entire Egyptian Mediterranean coast, their major fisheries are located on the area from Alexandria to Port Said. Red mullet are mainly exploited by the trawl fishery and contributed about 10% of the total trawl landings in Mediterranean waters. The catch is composed mainly of two species; *Mullus surmuletus* and *M. barbatus*, while some species of Red Sea origin have been recorded in the eastern Mediterranean. The mean annual catch of red mullet was about 2000 tons in the period 1991-2008 (GAFRD annual reports).
The trawl fleet operating in the Egyptian Mediterranean is composed by 1170 boats (mean number for period 1991-2008), varying between 18 and 22 m length and from 4 to 6 m width.

Each vessel is powered by a main engine of 100 to 600 hp, but the majority are of 250 hp. Some of these vessels are equipped with echo-sounders.

Data and parameters

Analyses were based upon monthly length frequency distributions sampled from trawl catches for the year June 2007 - April 2008 landed in the Egyptian ports Alexandria, Demietta and Port Said (except for May and the first half of June 2007, the period when all fishing operations are prohibited). These data (raised to the landings and combined to approximate equilibrium conditions for the pseudocohort analysis) formed the basis of the assessment.

Sagittal otoliths were used for age determination (see Mehanna, 2009). Back-calculated lengths-at-age were applied to the Ford – Walford plot to estimate $L\infty$ and K, while to was estimated from the equation: $-\ln [(L\infty - Lt) / L\infty] = -Kt_0 + Kt$.

The total length at which 50% of the specimens were mature was estimated by a method based on a logistic non-linear least-squares regression. The size at first capture (Lc) was estimated by the catch curve analysis.

The natural mortality coefficient (M) was estimated using the method of Djabali et al., 1993 as follows: $\text{Log}M = -0.0278 - 0.1172 \text{ Log } L\infty + 0.5092 \text{ Log } K$.

Assessment approach and results

Two alternative assessment approaches were used:

Length cohort analysis within VIT (Lleonart and Salat, 1992);

Cumulated length-based catch curve (Jones and van Zalinge, 1981).

Results from both approaches are presented. Final results were:

Current F=0.85 (Jones and van Zalinge estimate).

Position of reference points relative to current F: $F_{0.1}$=0.39; F_{max}=0.64 (VIT)

Stock status

Over-exploited.

Management advice and recommendations

Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 61% would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments

Smoothing of the length frequency distribution was suggested.

2.13. GSA26 *Mullus surmuletus*

(by Sahar Mehanna)

Fishery

The Egyptian Mediterranean coast is about 1100 km extending from El-Salloum in the West to Taba city in the East. The mean annual fish production from this area is about 50 thousand ton (GAFRD; 1991 - 2007). The main fishing gears operated in this region are trawling, purse-seining and lining, especially long and hand lining.

The fishing grounds along the Egyptian Mediterranean coast are divided into four regions, namely: Western region (Alexandria and El-Mex, Abu-Qir, Rashid, El-Maadya and Mersa Matrouh); Eastern region (Port Said and El-Arish); Demietta region; and Nile Delta region.
Red mullets are among the most valuable and highly priced fish species in Egypt, though widely distributed along the entire coast of Mediterranean, their major fisheries are located on the area from Alexandria to Port Said. Red mullet are mainly exploited by the trawl fishery and contributed about 10% of the total trawl landings in the Egyptian Mediterranean (GAFRD annual reports). The catch of Red mullet is composed mainly of two species: *Mullus surmuletus* and *M. barbatus*, while some species of Red Sea origin have been recorded in the eastern Mediterranean. The striped red mullet, *Mullus surmuletus* is the most common species in the catch and constituted about 65% of red mullet landings.
The number of trawl vessels which operated in the Egyptian Mediterranean ranged between 1100 and 1500 during 1991-2007. The vessel length varies between 18 and 22 m and width from 4 to 6 m.

Data and parameters
Analyses were based upon monthly length frequency distributions from trawl catches for the year June 2007 - April 2008 sampled from the Egyptian ports Alexandria, Demietta and Port Said (except for May and the first half of June 2007, the period when all fishing operations are prohibited). These data (raised to the landings and combined to approximate equilibrium conditions for the pseudocohort analysis) formed the basis of the assessment.
Sagittal otoliths were used for age determination. Growth parameters were estimated using the von Bertalanffy equation (see Mehanna, 2009).
The natural mortality coefficient (M) was estimated using the method of Djabali et al. (1993) as follows: $\text{LogM} = -0.0278 - 0.1172\ \text{Log}L\infty + 0.5092\ \text{LogK}$.
The size at first capture (L_c) was estimated through the catch curve analysis. The length at first sexual maturity Lm_{50} was estimated by fitting the maturation curve between the observed points of mid-class interval and the percentage maturity of fish corresponding to each length interval.

Assessment approach and results
The length cohort analysis approach within VIT (Lleonart and Salat, 1992) was used. The final results were:

Current F=0.73.
Position of reference points relative to current F: $F_{0.1}$=0.37; F_{max}=0.53.

Stock status
Over-exploited.

Management advice and recommendations
Reduce fishing mortality. To achieve $F_{0.1}$, a reduction of 63% would be required. It should be noted that this does not imply that the reduction be achieved in one year. A management plan to achieve this reduction over time would be recommended.

Comments
Issues arising from using one year of data were noted (e.g. invalidation of the equilibrium assumption). Smoothing of the length frequency distribution was also suggested.

3. Recommendations arising from the Working Group

The working group raised the following comments and suggestions.

Comments

- There is a need to be consistent and clear when presenting stock assessment results, particularly from VIT, whether values given represent the absolute estimated value of reference points, or the 'F factor' values – i.e. their position relative to the estimated current effort (e.g. where the F-factor $F_{0.1}$=0.5, the position of $F_{0.1}$ is half the value of $F_{current}$). Discussions suggested there was merit in using the relative values (e.g. $F_{0.1}/F_{current}$).

- The range of ages or lengths over which the average fishing mortality is estimated needs to be clearly stated. Furthermore, when estimated through length-based methodologies, this range should encompass only those lengths that are fully selected by the gear, to avoid under-estimation of fishing mortality.

- A presentation provided on the abundance of *Pecten jacobeus* in the Adriatic Sea, based upon results from the Solemon survey, showed that observed catches were very low in recent years, potentially as a consequence of a lack of management advice, and also environmental deterioration. Consideration of the inclusion of *Pecten* on the priority species table and GFCM shared stocks list was suggested to the SAC.

Suggestions for the future

- During the meeting, it was noted that a range of growth and other biological parameters were being used in different geographical regions. Some of these were potentially biased due to sampling limitations, or the methods used to prepare samples. As a result, the first recommendation was for the Secretariat to collate information on biological parameters, building on those activities performed in the past, for the Working Group to validate in the future.

- For the previously proposed workshop on otolith preparation and age reading to go ahead, combined with future otolith exchange programmes, to improve the standardisation of methodologies and ageing protocols and to increase consistency between institutes and regions.

- For regional co-operation on the biology and assessment of demersal species to be improved. This, and the support of research needs, may best be facilitated through regional projects.

- That the increasing use of survey-based assessment approaches such as SURBA (Needle, 2003) may require modification of the GFCM stock assessment forms in Excel to develop a specific sheet for the methodology. This process should be linked to the practical manual being developed for this software.

- Working Group attendees found the meeting useful for the exchange of ideas, development of skills, and peer review of assessments and advice to managers.

- There was a relatively limited number of attendees at the Working Group. In part, this may have resulted from the decision for assessments completed prior to the meeting to bypass the Working Group and be presented directly to the SCSA (Annex II). While the reduced Group size made the collation of activities easier, and allowed the Terms of Reference to be delivered within the available time, it prevented the original plan of developing four thematic sub-groups on crustaceans, hake, mullets and 'other' demersal species. In turn, where scientists from key countries were absent, the process of performing joint stock assessments on shared stocks was also hindered.

- The development of regional assessment groups (as for bodies within ICES, e.g. the 'North Sea demersal working group') is a potential way forward. This would support the exchange of information and skills within regions, while being consistent with the ecology of the different regions of the Mediterranean, with the ultimate aim of developing scientific advice on a multispecies, rather than single species, basis.

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Annex I

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Annex II

Draft terms of reference for Moderator

These draft terms of reference are an excerpt from the SAC 11 report, Appendix J.

Draft Terms of Reference for selected activities
(i) Moderator of the practical stock assessments of the SCSA Working Groups

One of the objectives of SCSA, is to progress in the enhancement of joint practical stock assessment. "Joint" refers to the participation of scientists from different countries providing their data and sharing them with their colleagues, using a standard method and analyzing together the results and options for fisheries management.

During the SCSA Working Group on demersal and small pelagic species (September 2008) a joint practical session to assess, in particular the stocks of hake (*Merluccius merluccius*) and associated species, as well as those of sardine and anchovy were performed. The practical sessions referred to the Terms of Reference as agreed in the GFCM 31st session.

Under the supervision of the GFCM Secretariat and in cooperation with the SCSA Coordinator, the Moderator will:

1. Define the methods to be followed and provide the theoretical background (papers) as well as the software to be used. This information must be communicated to the GFCM Secretariat well in advance of the meeting.
2. Prepare the agenda for the practical session.
3. Determine the data and information needs, including the standard format to be used, and prepare all material and tools to be used by the participants before the meeting.
4. Moderate the session, providing adequate assistance to the participants.
5. Write a report describing the methods and data used together with the results of the assessment. A section of the report must include recommendations for the next joint practical stock assessment session. The GFCM standard assessment forms should also be included as an appendix.

The consultant will take into account some specific items such as:

- VPA tuning (using trawl survey results when possible).
- LCA.
- SURBA.
- Determine main indicators and their corresponding reference points.
- Produce a diagnosis of the state of the stock.
- Supervise the process concerning the formulation of management advice, considering different alternatives.