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Scientific, Technical and Economic Committee for Fisheries (STECF)

Report of the SGMED-08-04 Working Group on the Mediterranean Part IV

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COMMITTEE FOR FISHERIES (STECF)

STECF COMMENTS ON THE REPORT OF THE SGMED-08-04
WORKING GROUP ON THE MEDITERRANEAN PART IV
Ponza 6-10th October 2008

STECF UNDERTOOK THE REVIEW DURING THE PLENARY MEETING

HELD IN BRUSSELS 3-7 NOVEMBER 2008

1. BACKGROUND

The European Community is expected to establish long-term management plans (LTMP) for relevant Mediterranean demersal and small pelagic fisheries based on precautionary approach and adaptive management in taking measures designed to protect and conserve living aquatic resources, to provide for their sustainable exploitation and to minimise the impact of fishing activities on marine eco-systems.

The plans shall include conservation reference points such as targets against which measuring the recovery to or the maintenance of stocks within safe biological limits for fisheries exploiting stocks at/or within safe biological limits (e.g. population size and/or long-term yields and/or fishing mortality rate and/or stability of catches). The management plans shall be drawn up on the basis of the precautionary approach to fisheries management and take account of limit reference points as identified by scientists. The quantitative scientific assessment should provide sufficiently precise and accurate biological and economic indicators and reference points to allow also for an adaptive management of fisheries.

Stating clearly how stocks and fisheries will be assessed and how decision will be taken is fundamental for proper and effective implementation of management plans as well as for transparency and consultations with stakeholders.

Demersal and small pelagic stocks and fisheries in the Mediterranean are evaluated both at national and GFCM level; however these evaluations are often not recurring, are spatially restricted to only some GFCM geographical sub-areas (see attached reference map), covering only partially the overall spatial range where Community fishing fleets and stocks are distributed, and address only few stocks out of several that may be exploited in the same fisheries. Limited attention is also given to technical interactions between different fishing gears exploiting the same stocks.

A limited, although fundamental, scientific contribution of EU fishery scientists to the GFCM assessment process is increasingly affecting the capacity of this regional fisheries management organization to identify harvesting strategies and control rules and to adopt precautionary and adaptive fisheries management measures based on scientific advice.

Anyhow, GFCM and most of the riparian countries consider that management measures to control the exploitation rate and fishing effort, complemented by technical measures, are the most adequate approach for multi-species and multiple-gears Mediterranean fisheries.

Nevertheless, provided that scientific advice underlines to do so, also output measures may be conceivable to manage fisheries particularly for both small pelagic and benthic fish stocks.

Coherence and certain level of harmonization between Community and multilateral framework measures are advisable for effective conservation measures and to enhance responsible management supported by all concerned Parties and stakeholders in the Mediterranean.

STECF can play an important role in focusing greater contributions of European scientists towards stocks and fisheries assessment, in identifying a common scientific framework regarding specific analyses to advise on Community plans and to be then channelled into or completed by the GFCM working groups.

STECF was requested at its November plenary session to set up an operational workprogramme for 2008, beginning in the 1st quarter of 2008, with a view to update the status of the main demersal stocks and evaluate the exploitation levels with respect to their biological and economic production potentials and the sustainability of the stock by using both trawl surveys and commercial catch/landing data as collected through the Community Data Collection regulation N° 1543/2000 as well as other scientific information collected at national level.

Within this work-programme STECF is also requested to provide its advice on the status of the main small pelagic stocks and to evaluate the exploitation levels with respect to their biological and economic production potentials and the sustainability of the stock by using both echo and/or DEPM surveys and commercial catch/landing data as collected through the Community Data Collection regulation N° 1543/2000 as well as other scientific information collected at national level.

STECF should take into consideration the data that Member States have been collecting on a regular basis both via monitoring fishing activities and carrying out direct surveys. STECF, in replying at the following terms of reference, should also take into consideration chapter 7 of the 26th STECF Plenary session of 5-9 November 2007, as well as the report of the STECF working group on balance between fishing capacity and fishing opportunities.

STECF shall contribute to identify and setup a advisory framework regarding low risk adaptive management by identifying and using appropriate risk assessment methods in order to understand where we stand with respect to sustainable exploitation of ecologically and economically important stocks and what additional management actions need to be taken.

On the basis of the STECF advice derived at the April 2008 plenary the Commission launched an official data calls to EU Member States requesting submission of data collected under the Community Data Collection regulation N° 1543/2000.

STECF is requested in particular:

✓ to advice whether the data availability may allow the development of a precautionary conceptual framework within which develop specific harvesting strategies and decision control rules for an adaptive management of demersal and small pelagic fisheries in the Mediterranean;

✓ to set up a conceptual, methodological and operational assessment framework which will allow STECF to carry out in a standardized way both stocks assessment analyses and detailed reviews of assessments done by other scientific bodies in the Mediterranean. The selected assessment methods shall allow estimating indicators for measuring the current status of demersal and small pelagic fisheries and stocks, the sustainability of the exploitation and to measure progress towards higher fishing productivity (MSY or other proxy) with respect to precautionary technical/biological reference points relating to MSY or other yield-based reference points, to low risk of stock collapse and to maintaining the reproductive capacity of the stocks;

✓ to set up a conceptual, methodological and operational assessment framework which will allow STECF to identify economic indicators and reference points compatible with economic profitability of the main fisheries while ensuring sustainable exploitation of the stocks in the Mediterranean;

✓ to indicate whether age/length-based VPA or statistical catch-at –age/length methods are adequate modelling tools to estimate precautionary indicators and reference points measuring the current status and future development of multispecies/multigears Mediterranean fisheries. STECF shall also provide a conceptual and operational framework to use, if advisable, these methods for demersal and small pelagic Mediterranean fisheries;

✓ to identify adequate empirical modelling approaches that are adequate to estimate precautionary indicators and reference points measuring the current status and future development of multispecies/multigears Mediterranean fisheries. STECF shall also provide a conceptual and operational framework to use, if advisable, these methods for demersal and small pelagic Mediterranean fisheries;

- ✓ to identify the decision-making support modelling tools that are adequate for the Mediterranean fisheries and that will produce outputs that support sustainable use of fishery resources recognizing the need for a precautionary framework in the face of uncertainty and that may allow to provide projections of alternative scenarios for short-medium and long term management guidance;
- ✓ to provide either a qualitative or quantitative understanding of the level of precision and accuracy attached to the estimation of indicators and reference points through the different modelling tools;
- ✓ to identify which decision-making support modelling tools may help in setting up stock-size dependent harvesting strategies and respective decision control rules;
- ✓ to provide information on the data and standardised format needed for each of the decision-making support modelling tool which will be used to launch official data calls under the DCR n° 1543/2000. STECF should also indicate criteria to ensure quality cross- checks of the data received upon the calls.

2. TERMS OF REFERENCE

Terms of reference for the STECF plenary meeting 3-7 November were as follows:

a) assess the status and trends of the stocks of **sardine** (*Sardina pilchardus*) by all relevant GSAs, or, if the case, by bigger areas merging adjacent GSAs, in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible. Advise on the status of the exploited stocks with respect to high yields harvesting strategies and to maintain their reproductive capacity and ensure a low risk of stock collapse.

b) assess the status and trends of the stocks of **anchovy** (*Engraulis encrasicolus*) by all relevant GSAs or, if the case, by bigger areas merging adjacent GSAs, in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible. Advise on the status of the exploited stocks with respect to high yields harvesting strategies and to maintain their reproductive capacity and ensure a low risk of stock collapse.

c) assess the status and trends of the stocks of **hake** (*Merluccius merluccius*) by all relevant GSAs or, if the case, by bigger areas merging adjacent GSAs, in the Mediterranean Sea and provide the status together with short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible. Advise on the status of the exploited stocks with respect to high yields harvesting strategies and to maintain their reproductive capacity and ensure a low risk of stock collapse.

d) assess the status and trends of the stocks of **red mullet** (*Mullus barbatus*) by all relevant GSAs or, if the case, by bigger areas merging adjacent GSAs, in the Mediterranean Sea and provide the status together with short term, medium term and long term forecasts of stock biomass and yield under different management options by fisheries if possible. Advise on the status of the exploited stocks with respect to high yields harvesting strategies and to maintain their reproductive capacity and ensure a low risk of stock collapse.

e) assess the status and trends of the stocks of deep-sea rose shrimp (*Parapenaeus longirostris*) by all relevant GSAs or, if the case, by bigger areas merging adjacent GSAs, in the Mediterranean Sea and provide the status together with short term, medium term and long term forecasts of stock biomass and yield under different management options by fisheries if possible. Advise on the status of the exploited stocks with respect to high yields harvesting strategies and to maintain their reproductive capacity and ensure a low risk of stock collapse.

f) assess historic and recent trends (capacity, technological creep, nominal fishing effort) in the major fisheries by GSAs or, if the case, by bigger areas merging adjacent GSAs exploiting the stocks assessed. The trends should be interpreted in light of management regulations applicable to them.

g) review and propose biological reference points related to high yields and low risk of stock collapse in long term of each of the stocks assessed. Set up stock-size dependent harvesting strategies and slope-based approaches decision control rules to avoid risk situations for the stocks while ensuring higher fisheries productivity

h) identify any needs for management measures required to safeguard the stocks assessed.

i) review the applicability and fully document all applied methodologies for the assessments, projections and determination of the proposed biological reference points.

j) fully document the data used and their origin for the assessments, projections and determination of the proposed biological reference points.

k) review social and economic reference points. Advice on possible short-term economic consequences of the selected long-term harvesting strategies. Evaluate whether the proposed long-term harvesting strategies are compatible with long-term economic profitability (MEY) of the main fisheries exploiting the assessed stocks.

l) provide and review population and community indicators.

m) propose a detailed SGMED working plan for 2009 including data, meetings and facilities needed regarding methodology standardization and continuation of the assessments of small pelagic and demersal stocks in the Mediterranean Sea and of the provision of scientific advice for the fisheries exploiting such resources. In particular, such plan should consider availability of recent survey data to provide short term projections. The timing should also allow EU scientists to deliver a higher number of stocks assessments into the GFCM-SAC advisory mechanism as well as, if the case, to prepare the basic data and analysis for possible joint assessments therein.

n) suggest adjustments and provide guidance on data needs and quality, on methods and on interpretations so that SGMED work can further progress in 2009 towards the goals of the overall mandate given to STECF focusing its attention, in particular, on the various stocks of the following species: European hake, red mullet, blue whiting, common Pandora, red sea bream, axillary seabream, common sole, horse mackerel, greater forkbeard, poor-cod, sargo breams, picarels, bogue, Sea bass, Anglerfishes, gilthead sea bream, tub gurnard, mackerel, common dolphinfish, sardine, anchovy, sprat, deepwater rose shrimp, Norway lobster, red-shrimp, blue-and-red shrimp, Atlantic bonito, stripe-bellied bonito, bullet tuna.

3. STECF OBSERVATIONS

No specific observations were formulated.

4. STECF COMMENTS AND CONCLUSIONS

1. STECF acknowledges the extensive number of assessments (43) performed and/or finalised following analyses conducted during SGMED meetings in 2008 and presented in the report of SGMED-08-04. In addition, for the first time, summary sheets including management advice for 25 stocks of European hake, red mullet, deepwater pink shrimp, anchovy and sardine were provided. Some inconsistencies between different stocks in the estimation and definition of several biological parameters were noted by the Working Group. To resolve that incongruence, STECF recommends that a specific workshop in the beginning of 2009 should be held with the aim to:

   i. To derive and agree on appropriate values for M and growth parameters for stocks of demersal and small pelagic species.;
   ii. To explore alternative stock units and to investigate the possibility of combining stock-specific data from adjacent GSAs based on ecological,biological and fishery features.;
   iii. To standardise the MEDITS and GRUND surveys time series to account for unbalanced sampling design and appropriate data distribution. Specific work has been initiated to allow for estimation of standardized MEDITS and GRUND surveys.
   iv. To define a DCF call for biological and economic data to support the work of SGMED in 2009.
   v. To define Terms of Reference for two subsequent assessment working groups proposed for 2009 (see below).

2. STECF agrees with the SGMED recommendation that to support the GFCM, assessments for stocks in the Mediterranean be continued in 2009 within two meetings; the first meeting to focus on the estimation of historic and recent stock parameters should b held in June 2009 and the second on predictions of catch and biomass under different management scenarios in short and medium term should be held in October ahead of the STECF winter plenary meeting. The second meeting should

also aim to and derive reference points for economic sustainability and provide economic advice of the various management scenarios simulated.

3. STECF notes that for several stocks, F reference points were estimated for the first time. Thus, for those stocks where estimates of current F were available, stock status was evaluated against the proposed reference points. Despite the fact that the F estimated reference points represent a first attempt to define potential targets and limits, STECF agrees that they represent the best estimates currently available and can therefore be used as basis for evaluating the status of the exploitation.

4. STECF notes that for most of the stocks assessed (80%), current exploitation rates are higher or much higher than any level of fishing mortality that is associated with long term sustainable targets and should be reduced. The stocks concerned are listed in the SGMED summary sheets and the STECF Review of advice for 2009.

5. STECF notes that the time series used by the SGMED are often shorter than 10 years. A lack of trend in stock biomass in the short term does not automatically imply that the stock is not overexploited. Thus, STECF recommended that efforts should be made to collate historical information on biological descriptors of the stock or standardized CPUE from surveys or other sources that can be compared with current CPUE estimates.

6. STECF recommends that multi-annual plans for the management of demersal and pelagic fisheries in the Mediterranean be established. The development of such plans needs to consider catches of other species in a mixed fishery context and should be socio-economically evaluated.

7. STECF concludes that overall the SGMED framework has so far represented an excellent forum to support stock assessment and advice within the region and built the foundations upon which assessment work can be successfully undertaken. It has also allowed the standardisation of procedures for data collection and analysis within the region. In order to ensure further developthe work, the STECF suggests that inter-sessional workshops or training courses be pursued to expand the number of scientists fully able to undertake assessments within the Mediterranean region including scientists from non-EU Member States.

SGMED-08-04 WORKING GROUP REPORT
THE MEDITERRANEAN PART IV
Ponza, 6-10 October 2008

This report is the opinion of the Working Group on the Mediterranean (SGMED-08-04) and not of the Scientific, Technical and Economic Committee for Fisheries (STECF)

This report does not necessarily reflect the view of the European Commission and in no way anticipates the Commission's future policy in this area

1. EXECUTIVE SUMMARY AND RECOMMENDATIONS

With the aim of establishing the scientific evidence required to support development of long-term management plans for selected fisheries in the Mediterranean, consistent with the objectives of the Common Fisheries Policy, and to strengthen the Community's scientific input to the work of GFCM, the Commission made a number of requests to STECF. The Terms of Reference for SGMED-08-04 were extensive and are listed in section 2.1.

During the meeting, data and assessments for 43 demersal and small pelagic species/GSA combinations were approached (ToR a-e), namely European hake, red mullet, deepwater pink shrimp, anchovy and sardine. These assessments were supported by two DCR data calls as defined during the second meeting of SGMED (Athens, 21-25 April 2008). The layout of the assessments was designed to allow scientists and managers to review the data underlying the assessments presented, the specific issues encountered during the assessment and the assumptions made, the assessment outputs and subsequent management advice, in a consistent way. The report includes summary sheets for those stocks of European hake (8), red mullet (5), deepwater shrimp (3), anchovy (5) and sardine (4) for which SGMED-08-04 concluded on definitive assessments and some adviceThe major findings of the group were:

- For several stocks, reference point levels were proposed for the first time and, whenever possible, the stock status was evaluated in respect to those. However, those must be considered as the first attempt to define possible targets for long term sustainable management of Mediterranean stocks.
- For most of the stocks assessed, current exploitation rates are larger or much larger than any level of fishing mortality that is associated with long term sustainable targets.
- The working group considers that management plans should be developed and established aiming for effort reductions until the stocks are proved to be exploited consistently with the sustainability goals. The development of management plans needs to consider catches of other species in a mixed fishery context and should be socio-economically evaluated.
- Some inconsistencies between different stocks in the estimation and definition of several biological parameters were noted during the Working Group. To solve those incongruence, the working group recommends that a specific workshop should be held with the aim to develop and decide upon values of M and growth parameters for stocks of demersal and small pelagic species to be assessed. Also, definition of alternative stock units and possibilities to merge GSAs based on ecological and biological features of the stocks should be explored. Futhermore, SGMED-08-04 recommends the stock assessments to be continued in 2009 within two meetings, the first focussed on the estimation of historic and recent stock parameters and the second on predictions of catch and biomass under different management scenarios in short and medium term.
- MEDITS and GRUND surveys time series should be standardised to account for unbalanced sampling design and appropriate distribution of the data. Specific work has been initiated to allow for estimation of standardized MEDITS and GRUND surveys.
- Overall the SGMED framework has so far represented an excellent forum to support stock assessment and advice within the region and built the foundations upon which assessment work can be successfully undertaken. The meeting also allowed the standardisation of procedures for data collection and analysis within the region. In order to ensure that this is continued, the Working Group suggests that inter-sessional workshops or training courses be pursued to expand the number of scientists fully able to undertake assessments within the Mediterranean region.

2. INTRODUCTION

The European Community is expected to establish long-term management plans (LTMP) for relevant Mediterranean demersal and small pelagic fisheries, based on the precautionary approach and adaptive management in taking measures designed to protect and conserve living aquatic resources, to provide for their sustainable exploitation and to minimise the impact of fishing activities on marine ecosystems.

STECF can play an important role in focusing greater contributions for European scientists towards stocks and fisheries assessment, in identifying a common scientific framework regarding specific analyses to advise on Community plans, to be then channeled into or completed by the GFCM working groups.

STECF was requested at its November plenary session to set up an operational work programme for 2008, beginning in the 1st quarter of 2008, with a view to update the status of the main demersal stocks and evaluate the exploitation levels with respect to their biological and economic production potentials and the sustainability of the stock by using both trawl surveys and commercial catch/landing data as collected through the Community Data Collection regulation N° 1543/2000 as well as other scientific information collected at national level.

For the year 2008, the European Community adopted catch limitations and associated technical measures for sprat and turbot in the Black Sea. With a view to update the assessments of the concerned stocks and fisheries in the area, an ad-hoc STECF working group on the Black Sea is convened; a data preparatory meeting was embedded into the STECF plenary session of April 2008.

With the aim of establishing the scientific evidence that will be required to support the development of such plans and to strengthen the Community's scientific input to the work of GFCM, the Commission requested STECF to:

- Evaluate whether available data allow for stock assessments to be conducted and scientific management advice to be formulated.
- Set up operational frameworks for stock assessment and edification of economic indicators.
- Evaluate if age-based assessment methods (VPA type models) are adequate assessment tools for Mediterranean stocks.
- Identify adequate empirical modelling approaches.
- Identify decision-making support modelling.
- Consider the precision and accuracy of estimated parameters.
- Provide information on data requirements.

To address the request, the STECF Subgroup on the Mediterranean (SGMED-08-04) for demersal and small pelagic stocks met in Ponza from 6-10th October 2008. The meeting was opened at 09:00 on the 6th, and closed at 14:00 on the 10th. The meeting built upon the work performed during SGMED-08-01 (10 – 14th March 2008), SGMED-08-02 (21-25th April 2008) and SGMED-08-03 (9 - 13th June) to pursue the Commission's requests.

2.1. Terms of Reference for SGMED-08-04

The overall terms of reference for the SGMED meetings are listed in Appendix 1. The specific terms of reference for SGMED-08-04 were:

STECF SGMED-08-04 Subgroup for Mediterranean is requested to:

a) assess the status of the stocks of **sardine** by all relevant GSAs in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible.

b) assess the status of the stocks of **anchovy** by all relevant GSAs in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible.

c) assess the status of the stocks of **hake** by all relevant GSAs (15 and 16, 22 and 23 combined) in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options, by fisheries if possible. Those assessments begun during SGMED-08-03 should be improved and finalised in accordance with this request.

d) assess the status of the stocks of **red mullet** by all relevant GSAs (22 and 23 combined) in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options by fisheries if possible. Those assessments begun during SGMED-08-03 should be improved and finalised in accordance with this request.

e) assess the status of the stocks of ***Parapenaeus longirostris*** by all relevant GSAs (15 and 16, 22 and 23 combined) in the Mediterranean Sea and provide short term, medium term and long term forecasts of stock biomass and yield under different management options by fisheries if possible. Those assessments begun during SGMED-08-03 should be improved and finalised in accordance with this request.

f) assess historic and recent trends (capacity, technological creep, nominal fishing effort) in the major fisheries by GSAs (22 and 23 combined) exploiting the stocks assessed. The trends should be interpreted in light of management regulations applicable to them.

g) review and propose biological reference points related to high yields and low risk in long term of each of the stocks assessed.

f) identify any needs for management measures required to safeguard the stocks assessed.

h) review the applicability and fully document all applied methodologies for the assessments, projections and determination of the proposed biological reference points.

i) fully document the data used and their origin for the assessments, projections and determination of the proposed biological reference points.

j) review social economic reference points.

k) provide and review population and community indicators.

l) propose a detailed SGMED working plan for 2009 including data, meetings and facilities needed regarding continuation of the assessments of small pelagic and demersal stocks in the Mediterranean Sea and of the provision of scientific advice for the fisheries exploiting such resources. In particular, such plan should consider availability of recent survey data.

2.2. Participants

The full list of participants at SGMED-08-04 is presented in Appendix 2.

3. SUMMARY OF DATA PROVIDED FOR THE MEDITERRANEAN THROUGH THE DCR CALL

Data underpins all assessments. Hence SGMED-08-02 developed two official data calls designed to obtain consistent and necessary information to underpin the assessments proposed for SGMED-08-03 and SGMED-08-04. A summary of the data provided to both SGMED-08-03 and SGMED-08-04 meetings by country is presented in Table 3.1.and 3.2, respectively

Details of the total landing, discards and effort data by species, GSA, fishing technique and years successfully obtained through the DCR call is presented in Appendix 3 (section 11) and in the various assessessment sections.

Overall, the DCR calls were considered successful in obtaining required information prior to, or early during the SGMED-08-04 meeting. However, some delays were experienced, and this had knock-on effects for the ability of SGMED-08-04 assessment scientists completing the detailed Terms of Reference.

Table 3.1. Overview of data provided by country from the first DCR call for SGMED-08-03 (demersal stocks).

REQUESTED FILES	FILENAME	DESCRIPTION	CYPRUS	FRANCE	GREECE	ITALY	MALTA	SLOVANIA	SPAIN
Fisheries Data									
FILE_1	M01_MED_LAN	LANDINGS	2005-2007, 5, MUT HKE only	2002-2007 HKE 2006-2007 MUT, 5	2003-2006, 5	2002-2007, FT level 2	2005-2007, 5		2002-2007, 5
FILE_2	M02_MED_EFF	EFFORT	2005-2007, 5	2004-2006, 5	2003-2006, 5	2002-2007, FT level 2	2005-2007, 5		
FILE_3	M03_MED_LAN_LEN	LENGTH_DISTRIBUTION_LANDINGS	2005-2007, 5, MUT only	2002-2007 HKE 2006-2007 MUT, 5		2002-2007			2002-2007, 5
FILE_4	M04_MED_LAN_AGE	AGE_DISTRIBUTION_LANDINGS	2005-2007, 5, MUT only	2006-2007 MUT, 5		2002-2007			2002-2007, 5
FILE_5	M05_MED_MAT	MATURITY_AT_LENGTH	2005-2007, MUT only	2006-2007	2003-2005, MUT HKE only, F only	2002-2007	2002-2007		2002-2007
FILE_6	M06_MED_GRO	GROWTH_PARAMETERS	2005-2007, MUT only	2005-2007 MUT only	2003-2005, MUT HKE only	2002-2007			2002-2007
FILE_7	M07_MED_SEX	SEX_RATIO	2005-2007, MUT only	2006-2007		2002-2007	2002-2007		2002-2007
FILE_8	M08_MED_DIS	DISCARDS	2006, 5	2003-2007 HKE 2006-2007 MUT, 5	2003-2005, MUT HKE only, F only	2005-2006, FT level 2			2002-2007, 5
FILE_9	M09_MED_DIS_LEN	LENGTH_DISTRIBUTION_DISCARDS		2003-2007 HKE 2007 MUT, 5		2006, HKE and MUT only			2002-2005, 5, HKE only
Survey Data		**DEMERSAL**							
FILE_10	M10_MED_TA	MEDITS_TA	2005-2007	1994-2007	1994-2006	1994-2007	2002-2007		1994-2007
FILE_11	M11_MED_TB	MEDITS_TB	2005-2007	1994-2007	1994-2006	1994-2007	2002-2007		1994-2007
FILE_12	M12_MED_TC	MEDITS_TC	2005-2007	1994-2007	1994-2006	1994-2007	2002-2007		1994-2007

Table 3.2. Overview of data provided by country from the first DCR call for SGMED-08-04 (stocks of small pelagics).

REQUESTED FILES	FILENAME	DESCRIPTION	CYPRUS	FRANCE	GREECE	ITALY	MALTA	SLOVENIA	SPAIN
Fisheries Data									
FILE_1	M01_MED_LAN	LANDINGS		2003-2007, 5	2003-2006, 5	2002-2007	2006-2007, 5		2002-2007, 5
FILE_2	M02_MED_EFF	EFFORT		2004-2006, 5	2003-2006, 5	2002-2007, 2	2002-2007, 5		2002-2007, 5
FILE_3	M03_MED_LAN_LEN	LENGTH_DISTRIBUTION_LANDINGS		2002-2007, 5	2003-2006, 5	2006-2007			2002-2007, 5
FILE_4	M04_MED_LAN_AGE	AGE_DISTRIBUTION_LANDINGS		2002-2007, 5	2003-2006, 5	2006-2007			2002-2007, 5
FILE_5	M05_MED_MAT	MATURITY_AT_LENGTH		2005-2007 ANE only	2003-2005	2002-2005 ANE only			2002-2007
FILE_6	M06_MED_GRO	GROWTH_PARAMETERS		2002-2007	2003-2005	1994-2007			2002-2007
FILE_7	M07_MED_SEX	SEX_RATIO		2002-2007		2007			2002-2007
FILE_8	M08_MED_DIS	DISCARDS		2006-2007					2004-2006, 5
FILE_9	M09_MED_DIS_LEN	LENGTH_DISTRIBUTION_DISCARDS		2007					
Survey Data									
FILE_11	M11_MED_TB	MEDITS_TB	2005-2007	1994-2007		1994-2007			1994-2007
FILE_12	M12_MED_TC	MEDITS_TC	2005-2007	1994-2007 no length classes		1994-2007			
FILE_13	M13_MED_SP_LEN			1998-2007	2003-2006				2003-2007
FILE_14	M13_MED_SP_AGE			2002-2007 ANE only	2003-2006				2003-2007
FILE_15	M13_MED_SP_MAT			2005-2007 ANE only					2003-2007

4. DATA PROVISION POLICY

Working Group members were reminded that data collected under the DCR call and supplied to SGMED-08-03 and SGMED-08-04 for all GSAs could not be used outside the meeting. Requests will be made to relevant country contacts to allow the data to be stored by the EU to enable future assessments under the auspices of SGMED or related groups to be performed without the need to produce further DCR calls.

5. WORKING DOCUMENTS AND PROPOSED FUTURE WORKING PROCEDURES OF SGMED IN 2009

5.1. Working document 1: Standardization of MEDITS groundfish survey data through generalized additive models: hake in the GSA9 as a case study

By Valerio Bartolino

Data from groundfish surveys are commonly used to calculate indices of the abundance by haul that could be used as proxy of the stock abundance. The risk associated with building stock assessments on "raw" catch rates have been known for many years and various methods to standardise catch and effort data have been developed. Fishery data are well known to be highly variable and noisy data, thus a wide range of methodologies are applied to improve experimental design and data analysis. A set of approaches to data standardization that found increased interest in the last then years rely on the use of models, mainly generalized linear models and generalized additive models (GAM) that can explicitly consider the underlying spatial distribution related to the data. Although this group of methods were revealed successful respect the need to provide unbiased indices of abundance, one of their major difficulties were related to high occurrence of low values or even zeros. This kind of data represented a real challenge for scientists and statisticians mining some of the main assumptions on which Gaussian models rely. These data are generally referred as zero-inflated distributed and an array of different approaches has been developed in the last years for working with them. We presented a standardization of hake CPUE from MEDITS survey in the GSA9 for the period 1994-2005 applying GAMs: The model was build such as:

1) presence/absence (1,0) was firstly modeled as a binary process using the binomial distribution. Model predictions Pij (where i and j are geographical coordinates) indicate the probability of finding hake of a certain age class at a particular location
2) fish density (n km-2) was modeled using a negative binomial distribution (or any other appropriate distribution for the data) to obtain th model predictions Dij.
3) Final overall predictions Yij are obtained by multiplying the results of the previous two model fit: Yij = Pij * Dij

Standardized indices of abundance per age-class calculated combining the prediction from the presence/absence and the density model over a 7290 cell grid (2km x 2km) that cover the whole GSA9. Furthermore, maps of the distribution of hake by age-class were produced (fig. 2) to evaluate the accordance of the predicted spatial structure of the stock during different phases of its life cycle with our current scientific knowledge. If properly corrected for catchability for each age-class, the current method here presented could be applied to develop absolute estimations of fish numbers and biomass in any area, providing an independent assessment of the stock respect the commercial catch based estimations (i.e. VPA).

5.2. Working document 2: Modelling Adriatic demersal resources abundance with GLM's and Italian Historical landings and fishing effort

by Giacomo Chato Osio and Francesco Ferretti

The data for the Adriatic Sea (GSA17) Medits survey has been analyzed with generalized linear models (GLM) to estimate the true mean, confidence intervals and trend based on different predictors. For *Merluccius merluccius*, *Mullus barbatus* and *Parapeneus longirostris* the best model was selected using a step function of the Akaike Information Criterion (AIC) and looking at the residuals and QQplots. Mediterranean hake, according to a GLM with a LogNormal family distribution and a log link function, has been declining since 1995 till 2000 and then started recovering but till 2005 it has not reached the initial levels. *Mullus barbatus* modeled in the same way as hake performs well in terms of residuals and AIC but not perfectly with the QQplots. The resulting trend in the means shows a spike in abundance in 1999 and an overall slight increasing trend in abundance over the period 1994-2005. Several models (GLM with Normal, LogNormal and quasi family distributions) have been fit to the biomass of Pink shrimp but none was performing well as the data is over-dispersed. More advanced GLM's will include as predictors bottom type and if available water temperature.

For the sake of comparison and to put the recent survey in a historical context, we compared the Medits with the Hvar survey carried out by Yugoslav researchers in 1948-49. The spatial distribution of the cpue's is plotted for every year of the surveys. Granted some uncertainty in the swept area estimate for the Hvar survey and selecting overlapping areas between the surveys (only the Central Adriatic area), the trends are presented for the above species and *Zeus faber*. In addition the cpue for hake has been built also using the swept volume which is considered more appropriate for this specie (assuming vertical opening of 0.8m for the Hvar and the estimated value for the Medits net that ranges between 2-3m). The results show that hake might have undergone a very large decline in the past 50 years in the Central Adriatic.

A second presentation has showed the Italian landings and fleet statistics collected by ISTAT for the period 1950-2000. *Merluccius merluccius*, *Mullus barbatus*, sardines and anchovies have been plotted by region and aggregated by Adriatic, Tyrrhenian and Sicily and South. The trends in landings for hake and red mullet seemed consistent for the period 1994-2000 with the Medits data. The fleet statistics are showed for Italy and consist of number of trawlers, GRT and HP. Further steps will be of building CPUE's with landings, fleet and effort to better understand the socioeconomic drivers of the landings.

5.3. Working document 3: On the precision of fish stock parameters derived from the pseudo-cohort analysis VIT

by Hans-Joachim Rätz and Anna Cheilari

The comparative analyses of the VIT model results with those of a scientifically agreed VPA assessment of the cod stock in the Skagerrak, North Sea and Eastern Channel reveal that overall trends in fishing mortality and stock size are well captured over a period of three decades (1963-1992). However, the implications of the equilibrium assumption (steady state) by the VIT model are huge as it forces strong inter-annual variations in the estimated fishing mortality, especially in those years when the age composition shows strong year class effects. In such cases, VIT stock size estimations are significantly underestimated. The VIT estimates of the virgin stock biomass appeared extremely variable, unreasonably high and rather dependent of annual stock size estimates. Their use as biological references must be assessed as critical. The VIT estimates of $F_{0.1}$ and F_{max} are found in line with the ICES estimates.

The VIT model should allow rather qualitative conclusions regarding the recent status of marine living resources in relation to precautionary reference of stock biomass or target reference of exploitation rate. Quantitative assessments of the relevant stock parameters are only recommended when the model is applied to short time series of more than a single year and the resulting variation of the parameters appears reasonably low. As such, the model results may form the basis for scientifically sound fisheries management advice in relation to medium term periods.

5.4. Working document 4: Coincidence between trends in MEDITS biomass indices and landings of selected demersal Mediterranean stocks and its potential use for data validation and short term predictions

by Anna Cheilari and Hans-Joachim Rätz

Inconsistencies between the data series of survey biomass indices and landings usually form the basis of conflicting stock status perceptions of fishermen and scientists. Annual landings and survey biomass indices are found positively correlated for 8 Mediterranean hake stocks (by GSAs) out of 15 provisionally assessed. Also 6 out of 13 pink shrimp stocks showed significant positive correlations between annual landings and survey indices. However, only survey indices and landings of 5 red mullet stocks out of 14 are characterised by similar trends. Lacking coincidence indicate either that the survey results don't reflect the changes in stock abundance or that the fisheries data are doubtful. The inconsistencies between the data series of survey biomass indices and landings should be explored in detail.

The significant regressions between the survey biomass indices of hake, red mullet and pink shrimp in certain GSAs and the annual landings of the following year should be used to provide some quantitative guidance to the fisheries managers about likely developments of landings in the present and the future years. The need of in-season information about MEDITS biomass indices in order to provide short term outlook regarding the likely range of landing possibilities under the option of status quo fishing effort is underlined and the consequence for the optimum timing of future SGMED sub-group meetings is discussed.

5.5. Proposed future working procedures of SGMED in 2009

Workshop Meeting: SGMED 01-09 (February 2009, venue to be decided)

TORs: Establishment of M, growth parameters, stock unit and survey standardisation procedures for the assessment of pelagic and demersal Mediterranean stocks

Rationale: The working group should develop and decide upon values of M and growth parameters for demersal and pelagic stocks to be assessed during SGMED. Also, defintion of alternative stock unit and possibilities to merge GSA based on ecological and biological features of the stocks should be explored. MEDITS and GRUND surveys time series should be standardised to account for unbalanced sampling design and appropriate distribution of the data.

First Assessment Meeting: SGMED 02-09 (June 2009, venue to be decided)

TORs: Assessment of Demersal and small Pelagic stocks

Rationale: The working group should perform assesssment incorporating results obtained during SGMED 01-09.

Second Assessment Meeting: SGMED 03-09 (November 2009, venue to be decided)

TORs: Short term forecasts of catch and stock size of small Pelagic and Demersal stocks

Rationale: The working group should perform short-term projections for demersal and pelagic stocks assessed by SGMED using latest information of recruitment derived from MEDITS, GRUND and acoustic surveys.

Data call in support of SGMED

Landings, discard, MEDITS and GRUND survey data. Landings and discard data update to 2008 should be delivered in May 2009 and data from survey conducted in 2009 should be delivered at the latest in October 2009.

6. STOCK SUMMARY SHEETS

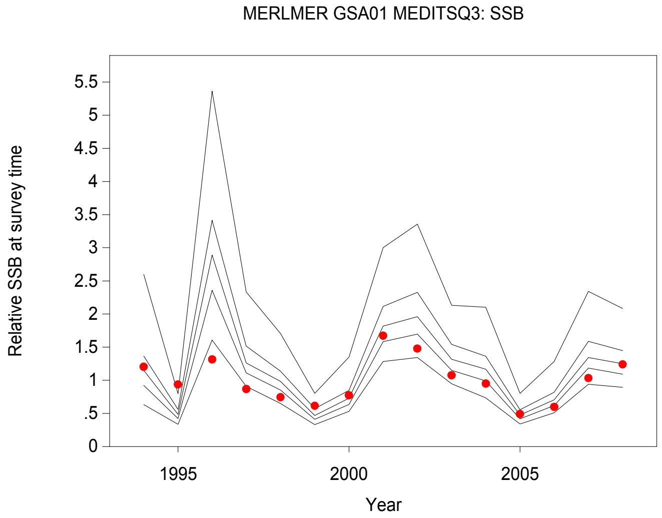
6.1. Hake in GSA 01

Species common name:	European hake
Species scientific name:	*Merluccius merluccius* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 01

Most recent state of the stock

- State of the adult abundance and biomass:

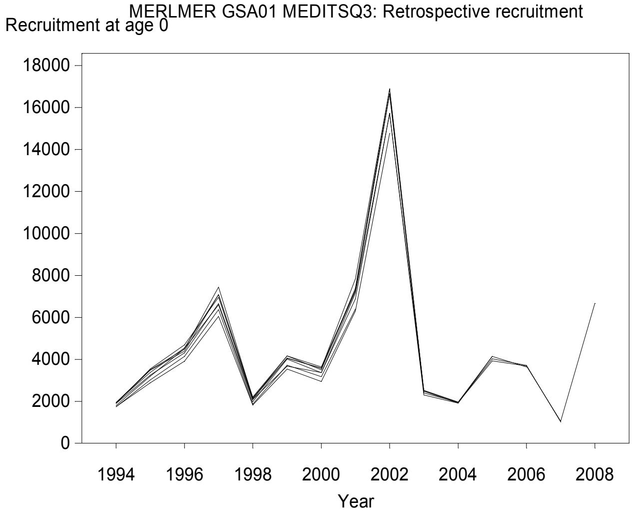
SGMED could not estimate the absolute levels of stock abundance. Survey indices indicate the stock to vary without an overall trend, and in 2008 the stock SSB appears to be at an average level compared with the last 13 years.



SSB in kg/km^2 (MEDITS survey) in GSA 01 from SURBA

- State of the juvenile (recruits):

SGMED could not estimate the absolute levels of recruitment. Survey indices in 2008 indicate the recruitment level to be above the average of the available time series.



Recruits kg/km^2 (MEDITS survey) in GSA 01 from SURBA analysis.

- State of exploitation:

SGMED cannot estimate recent or historic exploitation rates. No proposed or agreed reference points were available to SGMED to identify stock status.

The continued lack of older fish in the surveyed population indicates exploitation rates far beyond those considered consistent with high yields and low risk of fisheries collapse. However, SGMED note that the survey gear is not specifically designed to sample larger older fish.

- Source of data and methods:

The SURBA software program was used to analyse the MEDITS time series. Biological parameters used were: K=0.127; Linf = 72 cm; t_0 = -0.2. M-at-age vector (PROBIOM sheet): 0.90; 0.50; 0.40; 0.30; 0.30; 0.25; 0.25; 0.20. q vector = from VIT (trawl): q(Age1+)=0.8; q(Age2+)=1.0; q(Age3+)=0.7.

Outlook and management advice

- Short, medium and long term scenarios:

Given information available, SGMED could not provide projections of future stock status and catch possibilities. There are no proposed or agreed reference points, and hence no basis to provide management advice at this time.

- Source of data and methods:

None

Fisheries

Brief description of trends:

Hake is exploited in all trawlable areas from Gibraltar straight to Cape of Gata, including the deep-bottom fishing grounds about GSA 2 (Alborán Island). Commonly small hakes are caught from shallow waters about 50 m to 300 m depth, whereas adults reach the maximum depths exploited, 800 m, associated with the *Nephrops norvegicus* fishery. Hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries in GSA 01.

Landings (t) by year and major gear types, 2002-2007 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	1	ESP	OTB	353	201	374	208	212	220

Precautionary and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.2. Hake in GSA 05

Species common name:	European hake
Species scientific name:	*Merluccius merluccius*
Geographical Sub-area(s) GSA(s):	GSA 05

Most recent state of the stock

Hake in GSA 05 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.gfcm.org/ for GSA05 open Doc05-HKE0508Gui.xls

SGMED-08-04 reviewed the assessment results, and considered them incompatible with true population dynamics.

SGMED-08-04 therefore noted that the hake 'population' of GSA 05 is unlikely to be independent from that of the adjacent GSA 06. SGMED therefore recommends exploring the alternative of merging data from GSA 05 and GSA 06 and perfoming a single assessment for both GSAs together.

6.3. Hake in GSA 06

Species common name:	European hake
Species scientific name:	*Merluccius merluccius*
Geographical Sub-area(s) GSA(s):	GSA 06

Most recent state of the stock

It is noted that hake in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.gfcm.org/ for GSA06 open Doc06-HKE0608Gui.xls

- State of the adult abundance and biomass:

SSB has increased from historical lows in 1999 towards in 2007 half the peak level seen towards the beginning of the time series (in 1993).

- State of the juvenile (recruits):

Recruitment has varied without trend across the time series, but the 2007 estimate is the second lowest of the time series.

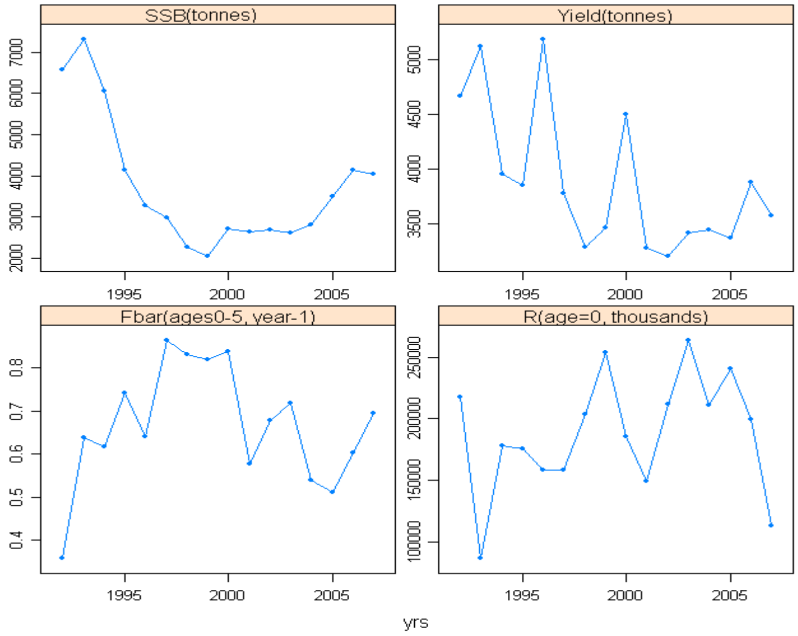
- State of exploitation:

Exploitation has fluctuated without trend in the range of 0.5-0.7. The most recent fishing mortality (F_{0-5}) is 0.7. However, SGMED notes that the F range chosen appears inappropriate.

The continued low abundance of adult fish in the surveyed population and catches indicate a very high exploitation pattern far in excess of those achieving high yields and low risk of fisheries collapse.

With $F_{0.1}$=0.19 and FMSY =0.28, it can be concluded that the resource is over-exploited (growth over-fishing), with a risk of recruitment over-exploitation.

Summary plot for hake GSA 6 assessment



- Source of data and methods:

The state of exploitation was assessed for the period 1992-2007 by means of a VPA Separable, tuned with standardised CPUE from commercial fleet and abundance indices from two trawl surveys. Analysis was carried out applying the Extended Survivor Analysis (XSA) method (Lowestoft suite; Darby and Flatman, 1994; Fisheries Library in R) over the period 1992-2007. In addition, a yield-per-recruit (Y/R) analysis (VIT program; Lleonart and Salat, 1992) was applied on the mean pseudo-cohorts 1992-2007 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). Transition analysis was also made to simulate different management strategies for the improvement of the state of this resource. A combined VPA analysis was carried out, considering an 80 % contribution of trawl, and a 20 % contribution of gillnets, for the whole GSA 06 Sub-area.

Outlook and management advice

- Short, medium and long term scenarios:

A deterministic medium term forecast of catch and biomass was performed assuming status quo effort. This predicts an immediate decline of SSB and yield. If we consider a 10% year-on-year reduction in F, some recovery of SSB is likely to be achieved.

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is in the range of $F_{0.1}$-F_{MSY}, in order to avoid future low stock productivity and landings.

- Source of data and methods:

Growth parameters used were those from INBIO (Sampedro et al. 2005) over otolith readings (2003-2006; n=1000) from National data collection program (Pérez Gil et al, 2006) and length-weight relationship and maturity ogive from García Rodriguez and Esteban (1995). The size composition of commercial landings were obtained by monthly length samplings carried out in one of the sampling ports used for the present assessment (Santa Pola) during the 1992-2007 period. Landings and effort data were obtained combining different sources, such as Official Landings provided by Autonomous Community, and from the Information and Sampling Network of the Spanish Oceanographic Institute (IEO). In this assessment, a new set of parameters (fast growth hypothesis) were considered and a natural mortality vector (PROBIOM, Caddy and Abella, 1999) was applied. SGMED-08-04 notes that the set of growth parameters used in the assessment were different to those used the year before, recommending the use of a set more agreed with the “fast growth hypothesis”. SGMED-08-04 also recommends the standardization of abundance indices provided by trawl surveys.

Fisheries

Brief description of trends:

Exploitation is based on very young age classes, mainly 0 and 1 year old individuals, with immature fraction dominating the landings.

In last years, the annual landings of this species were around 3800 tons in the whole GSA. From official data, the total trawl fleet of the whole geographical sub-area 06 (Northern Spain) is made up by 647 boats: on average, 47 TRB, 58 GT and 297 HP. Some of these units (smaller vessels) operate almost exclusively on the continental shelf (targeted at red mullet, octopus, hake and sea breams), others (bigger vessels) operate almost exclusively on the continental slope (targeted at decapod crustaceans) and the rest can operate indistinctly on the continental shelf and slope fishing grounds, depending on the season, the weather conditions and also economic factors (e.g. landings price). The percentage of these trawl fleet segments have been estimated around 30, 40 and 30% of the boats, respectively.

Year	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
GSA 6 Landings (t)	4664	5122	3953	3850	5187	3770	3286	3462
Effort (days)	114991	105137	136183	127167	106778	124183	113978	84966

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
GSA 6 Landings (t)	4497	3269	3195	3411	3441	3363	3876	3572
Effort (days)	67922	50553	92026	120049	104004	123302	106015	108879

Precautionary and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (Y/R, sexes combined)=	0.192
F_{msy} (Y/R, sexes combined)=	0.276
Z_{msy} (Y/R, sexes combined)=	0.781
Z_{mean} (0-5, sexes combined)=	1.41

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment

SGMED-08-04 notes that forecasts were performed based on the F and recruitment value of the last year. SGMED-08-04 recommended the use of the average of the last three years recruitments, and the final year F scaled to the average F-at-age over the last 3 years.

6.4. Hake in GSA 07

Species common name:	European hake
Species scientific name:	*Merluccius merluccius*
Geographical Sub-area(s) GSA(s):	GSA 07

Most recent state of the stock

Hake in GSA 07 was assessed in 2008 and the assessment was presented to the GFCM/SAC/SCSA/Demersals WG. The assessment sheets are accessible at the GFCM website: http://www.gfcm.org
Information below has been taken from these assessment forms.

- State of the adult abundance and biomass:

Since 1998 spawning stock biomass has varied without a trend and is estimated to amount 2300 tons in 2007. In the absence of proposed or agreed references SGMED is unable to fully evaluate the state of the stock.

- State of the juvenile (recruits):

Since 2003 the estimated recruitment is below average.

- State of exploitation:

Fishing mortality of ages 0-2 has decreased in 2004 and has been stable around 0.7 since then. This level of fishing mortality exceeds proposed references of $F_{0.1}$ and F_{MSY}, and thus SGMED considers the stock being subject to overfishing.

- Source of data and methods:

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 by Aldebert and Recasens (1996). The growth coefficient (k) comes from first results of tagging experiments developed by IFREMER in the area (Mellon-Duval et al, in prep.). 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 (1998-2007), 2 methodologies were applied. The first one is a tuned virtual population analysis (VPA), applying the Extended Survivor Analysis (XSA) method considering, as tuning fleets, catch per unit effort (CPUE) of commercial fisheries (French trawl, Spanish trawl and Spanish long-line) and French MEDITS campaign indices. The software used was Lowestoft VPA program (Darby and Flatman, 1994). The second method is a length cohort analysis (LCA) and yield per recruit (Y/R) analysis on a mean pseudo-cohort from the period of study, using the VIT program (Lleonart and Salat, 1992).

Outlook and management advice

SGMED recommends fishing mortality being reduced to the range of $F_{0.1}$ and F_{MSY}, through consistent effort reductions. This requires the mixed fisheries nature of the relevant fleets to be considered.

- Short, medium and long term scenarios

SGMED does not provide any short or medium term scenarios.

- Source of data and methods

Fisheries

French landings (t) by year and major gear types, 2002-2004 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	7	FRA	GNS	177	248	99	255	299	168
HKE	7	FRA	LLS	5					
HKE	7	FRA	OTB	2163	2029	1018	995	1011	1277
Sum				2345	2277	1117	1250	1310	1445

Trend in fishing effort (days, GT*days, kW*days) for France by major gear types, 2004-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006
DAYS	7	FRA	GNS	81460	76785	93193
DAYS	7	FRA	LLS	6459	6593	5028
DAYS	7	FRA	OTB	20561	19327	17991
GT*DAYS	7	FRA	GNS	329230	305685	315704
GT*DAYS	7	FRA	LLS	23742	23436	17232
GT*DAYS	7	FRA	OTB	1610963	1480834	1322919
KW*DAYS	7	FRA	GNS	7007171	5908142	88698170
KW*DAYS	7	FRA	LLS	669338	716765	385004
KW*DAYS	7	FRA	OTB	6361248	5923541	6127438

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range) =	0.22
F_{max} (age range) =	n.a.
F_{msy} (age range)=	0.3
F_{pa} (F_{lim}) (age range)=	n.a.
B_{msy} (spawning stock)=	n.a.
B_{pa} (B_{lim}, spawning stock)=	n.a.

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment

SGMED-08-04 notes that the M value (0.22) appears to be low for the growth parameters used in the analyses, which correspond to the "fast growth" scenario.

6.5. Hake in GSA 09

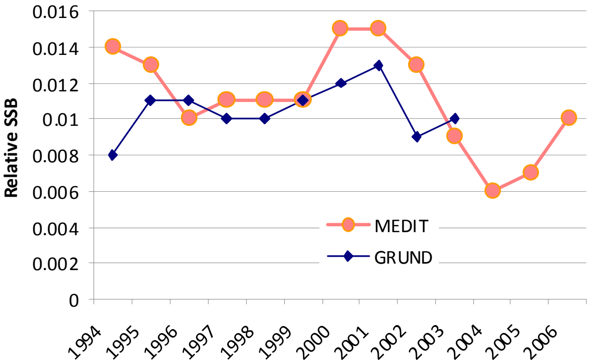
Species common name:	European hake
Species scientific name:	*Merluccius merluccius* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- State of the adult abundance and biomass:

SGMED could not estimate the absolute levels of stock abundance. SSB may be between 5 and 10% of the SSB at F_{msy}. Relative indices derived from scientific MEDITS survey for the period 1994-2006 indicated for the spawning stock biomass (SSB) a slightly decreasing trend, while the GRUND survey data series (1994-2004) shows fluctuations without a clear temporal trend.

An increase in SSB occurs in 2007 with respect the minimum observed in 2005 (MEDITS survey).



No biomass reference points have been proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock with respect to biomass.

- State of the juveniles (recruits):

Relative indices derived from MEDITS and GRUND surveys indicated high fluctuations of recruitment in the period 1994-2006, without a clear temporal trend.

- State of exploitation:

Trends in the average fishing mortality over ages 1 to 5 derived from surveys ranged from 1.2 to 1.7, with the highest values observed in the last five years.

The results of LCA applied on the DCR data for 2006 (trawl + gillnet fisheries, landing + discards) highlight an exploitation focused on young age classes, mainly age 0 and age 1. A fishing mortality (ages 1 to 5) of 1.6 was estimated.

The reference points ($F_{0.1}$ and F_{max}) estimated for this species using the Yield software were 0.22 and 0.35, respectively. The current value of F (F_{1-5}=1.6) indicates this stock is subject to overfishing. This result matches previous assessments in GSA 09.

- Source of data and methods:

Data coming from MEDITS (1994-2007) and GRUND (1994-2004) trawl surveys were used to estimate relative SSB and F with Surba. Data coming from DCR (size distribution of landings for trawl and gillnet, data on trawl discards for 2006) for the period 2005-2007 were used. LCA analysis was carried out using VIT on the 2006 landing data.

According to the scientist's knowledge DCR landing data for GSA 09 have been adjusted concerning to the contribution of artisanal fishery to the total catch (fixed to 10%).

The following parameters were used both for SURBA and VIT analyses:

Growth parameters (Von Bertalanffy)
L∞ = 104 (cm, total length); k = 0.2; $t_{0=}$ - 0.03
L*W: a = 0.006657; b=3.028
M vector Age_1=1.3, Age_2=0.8, Age_3=0.4, Age_4=0.3, Age_5=0.2; Age_6=0.2
q(age 1+) = 0.8, q(age 2+) = 1.0, q(age 3+)=0.7, q(age 4+)=0.7, q(age 5+)=0.7
Length at maturity (L_{50}) = 30 cm total length (sex combined)

Outlook and management advice

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is in the range of $F_{0.1}$-F_{MAX}, in order to avoid future low stock productivity and landings.
Considering the high productivity of the stock in terms of incoming year classes, it seems that hake could have the potential to recover quickly if F is reduced towards the reference levels.

- Short, medium and long term scenarios:

At present SGMED-08-04 is not in a position to determine future catch possibilities or stock status in relation them.

- Source of data and methods:

None.

Fisheries

Hake is the demersal species providing the highest landings and incomes in the GSA 0 9. About 90% of landings of hake are due to bottom trawl vessels; the remaining fraction is catch by artisanal vessels using set nets, in particular gillnets.

Hake trawl fishery exploits a highly diversified species assemblage: horned octopus (*Eledone cirrhosa*), poor cod (*Trisopterus minutus capelanus*), squids (*Illex coindetii*), are among the most important species in the by catch.

The trawl fleet of GSA 09 at the end of 2006 accounted for 361 vessels. The main trawl fleets of GSA 09 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium).

The fishing capacity of the GSA 09 has shown in these last 20 years a progressive decrease; from 1996 to 2006 the number of bottom trawlers of GSA9 decreased of about 30%. Consequently also fishing effort decreased, even though in a lesser extent, in this period.

In the last five years the total landings of hake of GSA 09 fluctuated between 1,000 to about 2,300 tons.

Landings (t) by year and major gear types, 2002-2007 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	9	ITA	DTS	508	1148	540	1040	1180	1026
HKE	9	ITA	HOK			1	2	38	
HKE	9	ITA	PGP	154	659	626	858	1112	727
HKE	9	ITA	PMP	236	258	16	19		
HKE	9	ITA	PTS	7	15	12			
SUM				905	2080	1195	1919	2330	1753

Trend in fishing effort (days, GT*days, kW*days, TSL*days) by major gear types, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728	4739	5242	5160
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS			143490	162480	200226	194754
KW*DAYS	9	ITA	DRB	187147	335521	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166	1013627	1174295	1151346
TSLDAYS	9	ITA	DRB	15733	28362				
TSLDAYS	9	ITA	DTS	2154256	2147750				
TSLDAYS	9	ITA	PGP	624182	650560				
TSLDAYS	9	ITA	PMP	382454	382992				
TSLDAYS	9	ITA	PTS	193726	181590				

Due to huge concentration of hake juveniles in GSA 09, trawl landings were traditionally dominated by small sized specimens; they are basically composed by age 0 and age 1 individuals. Gillnet fishery lands mostly age 2 and age 3 fish.

High quantities of small size hake are routinely discarded, especially in summer and on fishing grounds located near the main nursery areas of the species. About 450 tons of hake discards were estimated in 2006 for the trawl fishery in GSA 09. Due to the introduction of the EU Regulations on MLS, a progressive increase of the size at which 50% of the specimens caught was discarded has been observed in the last ten years

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age1-5)=	0.22
F_{max} (age 1-5)=	0.35
F_{msy} (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment

GRUND data prior to 1994 should be standardised and used within this assessment.

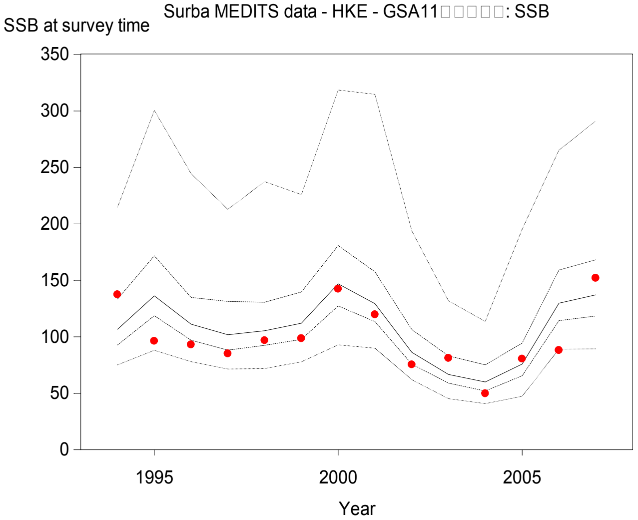
6.6. Hake in GSA 11

Species common name:	European hake
Species scientific name:	*Merluccius merluccius* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 11

Most recent state of the stock

- State of the adult abundance and biomass:

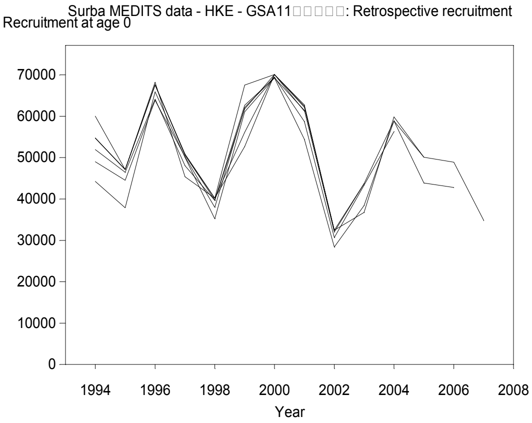
SGMED could not estimate the absolute levels of stock abundance. Survey indices indicate the stock to be stable. The stock SSB is more variable after 1999, showing and increasing trend in the last 3 years.



No biomass reference points have been proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock with respect to biomass.

- State of the juvenile (recruits):

SGMED could not estimate the absolute levels of recruitment. Relative survey indices indicated very high fluctuations of recruitment in the period 1994-2007, without a clear temporal pattern.



Recruits kg/km^2 (MEDITS survey) in GSA 11 from SURBA analysis.

- State of exploitation:

SGMED cannot estimate recent or historic exploitation rates.

Trends in the average fishing mortality over ages 1 to 3 derived from Medits surveys ranged from 1 to 2.3, with the lowest value observed in the last year.

The lack of agreed reference points does not allow SGMED to properly identify stock status. However, SGMED notes that considering the biology of the stock and reference points developed for neighbouring stocks in the Mediterranean, current estimated levels of fishing mortality are not likely to result in optimal long term yields.

- Source of data and methods:

The SURBA software program was used to analyse the MEDITS time series. Growth parameters were the same used in the neighborhood GSA 09: K=0.212; Linf = 104 cm; t_0 = -0.03. The following M-at-age vector was used: 1.17; 0.675; 0.51; 0.4275; 0.378; 0.345. Catchability q vector were used taking in to account that the survey gear is not specifically designed to sample larger older fish: q(Age 0)=0.7; q(Age 1-3)=1.0; q(Age 4)0.75; q(Age 5)0.4. Length at maturity (L_{50}) was of 30 cm total length (sex combined).

Due to inconsistent calculated age compositions of DCR landings data it was not possible to perform a VPA.

Outlook and management advice

SGMED recommends the relevant fleet efforts to be reduced as a first step to obtain high long term sustainable yields.

- Short, medium and long term scenarios:

Given information available, SGMED could not provide projections of future stock status and catch possibilities. There are no proposed or agreed reference points.

- Source of data and methods:

None

Fisheries

Brief description of trends:
Hake is exploited in all trawlable areas around Sardinia and is one of the most important target species showing the highest landings.

According to the scientist's knowledge of the GSA11 landings of hake comes almost fully from bottom trawl vessels whereas catches from trammel nets or longlines are negligible.

Commonly small hakes are caught from shallow waters about 50 m to 300 m depth, whereas adults reach the maximum depths exploited (800 m). Both small and adults catches coming from a mixed fishery, then in the GSA there is not a specific Hake fishery. The most important by catch species are horned octopus (*Eledone cirrhosa*), squids (*Illex coindetii*), poor cod (*Trisopterus minutus capelanus*) at depths less than 350 m and (*Chlorophtalmus agassizii*), greater forkbeard (*Phycis blennoides*) and deep-water pink shrimp at greater depth (*Parapenaeus longirostris*).

At the end of 2006 the trawl fleet of GSA11 accounted for 157 vessels (11.7% of the overall Sardinian fishery fleet). The main trawl fleets of GSA11 are present in the following harbors: Cagliari, Alghero, Porto Torres, La Caletta, Sant'antioco, Oristano, Alghero and Arbatax.

The fishing capacity of the GSA trawl fleet has shown in these last 15 years remarkable changes. From 1994 to 2004 a general increase in the number of vessels and by the replacement of the old, low tonnage wooden boats by larger steel boats. In the latest years the effort show a peak in 2005.

In the last five years the total landings of hake of GSA 11 fluctuated between 592 to about 768 tons, with a consistent drop (-25% of the mean) in the last year.

Italian landings (t) by year and major gear types, 2002-2007 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	11	ITA	DTS	167	592	597	768	595	447
HKE	11	ITA	PGP	4	26	114	160	229	103
HKE	11	ITA	PMP	190	279				
Sum			Total	361	897	711	928	824	550

Trend in fishing effort (days, GT*days, kW*days) for Italy by major gear types, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	11	ITA	DTS	28840	31993	26532	27374
DAYS	11	ITA	PGP	165945	151720	156269	155243
DAYS	11	ITA	PMP				
GT*DAYS	11	ITA	DTS	1598912	1881952	1437559	1486500
GT*DAYS	11	ITA	PGP	501550	484820	493411	495670
KW*DAYS	11	ITA	DTS	6711626	7736040	6017232	6340429
KW*DAYS	11	ITA	PGP	7105771	6996350	7234881	7398923

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

GRUND data should be standardised and used within this assessment.

6.7. Hake in GSA 15 and 16

Species common name:	European hake
Species scientific name:	*Merluccius merluccius* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 15 & 16

Most recent state of the stock

- State of the adult abundance and biomass:

Relative indices derived from scientific surveys indicate a recent decrease in the stock size in both GSAs since 2005. In 2007, the stock spawning stock size in weight (only GSA 16) amounted to 136% as compared to the long term average (1994-2006). However analytical assessments (Aladym Model) evaluated the spawning stock to be very low when compared with estimated virgin biomass, implying negative effects on stock productivity.

- State of the juvenile (recruits):

Medits results indicate the level of recent recruitment to be increased significantly.

- State of exploitation:

The average fishing mortality of hake in GSA 15 and 16 over ages older than 4 could not be precisely assessed. Trends in the average fishing mortality over ages 1 to 4 derived from scientific surveys indicate a recent increase in the exploitation rate since 2003. No relevant differences in F between GSA 15 and 16 are evident. The continued low abundance of adult fish in the surveyed population and catches indicate a very high exploitation pattern far in excess of any fishing mortality consistent with high yields and low risk of fisheries collapse. Considering more in detail the GSA 16, for which both commercial and trawl surveys data are available, all the stock assessments performed during the SGMED suggest quite similar diagnosis of overfishing.

- Source of data and methods:

Data derived both from indirect (fisheries monitoring) and direct (scientific surveys) sources. Stock status was assessed by using both analytic and surplus production models approaches. The stock parameters were: L_{inf}= 81.5 (F) and 53.6 (M); K= 0.15 (F) and =0.22 (M); t_0= -0.08 (F) and -0.13 (M); a=0.0043 (F) and 0.0049 (M); b= 3.1525 (F) and 3.1028 (M); $M_{(scalar)}$= 0.34 (F) and 0.43 (M); $M_{(vector)}$=0.9 (age 0), 0.5, 0.4, 0.3, 0.3, 0.25; 0.25; Minimum length at fully recruitment (L')=18; F terminal=M; Maturity at age (F) = 0 (age0), 0, 0, 0.17, 0.62, 0.91, 1.00; q=0.9 (age 0), 1, 1, 1, 0.75, 0.5, 0.4.

Outlook and management advice

SGMED recommends developing and implementing a management plan to continuously reduce current F through consistent effort reductions and catch estimations.

SGMED-08-04 was informed that medium term management plan for 2008-2013 has been agreed for Italian trawlers catching hake in GSA 15 and 16.

The effect of 5 different management scenarios considered by the Italian Management Fishery Plans (IMFP) were assessed by Aladym model. These scenarios which are:

- a fleet reduction of 25% of the current capacity obtained in two steps. The first (12.5%) from 2008 to 2010, and the second (12.5%) from 2011 to 2013;
- trawling ban of 45 days per year between January and March (targeted to deep water pink shrimp fishery which is the main commercial species in the GSA 15 and 16);
- changing the mesh opening in the cod-end from the 40 mm to 50 mm (diamond) from 2010;
- the above three measures combined; and
- maintaining the status quo.

The expected improvements of the stock indicators adopting the management measures of the IFMP versus the status quo improve the stock status. The main gains in terms of Yield, Biomass, SSB and ratio

ESSB/USSB were higher when the combination of measures were adopted. Maintaining the “status quo” is expected not produce significant changes in the stock status in long terms.

- Source of data and methods:

The availability of a time series of total mortality rates from trawl surveys, biological information and selectivity parameters allows to reconstruct the stock dynamics in the last years and to simulate the effects of management measures such as the reduction of fishing mortalities, increase of size at capture, seasonal closures and all the measures considered combined.

Fisheries

Although hake is not a target of a specific fishery, such as deep water pink shrimp and striped mullet, it is the third species in terms of biomass of Italian yield in the area. Hake is caught by trawlers in a wide depth range (50-500m) together with other important species such as *Nephrops norvegicus*, *Parapenaeus longirostris*, *Eledone* spp., *Illex coindetii, Todaropsis eblanae*, *Lophius* spp., *Mullus* spp., *Pagellus* spp., *Zeus faber, Raja* spp among others. Italian trawling, based in the harbors along the southern coasts of Sicily, operate both in GSA 16 and 15 with exclusion of Maltese Fishing Management Zone (MFMZ). Italian trawlers exert the most of fishing effort and yield more than 99% of hake catches in the entire area.

In the late nineties Sicilian trawlers fishing off-shore (15–25 days of trip) had higher discard rates of hake (86% in number and 31% in weight) than the inshore trawlers (1-2 days trips) (32% in number and 9% in weight). More recent data showed that discarded fraction of undersized hakes by Sicilian trawlers decrease (13% in number and 3% in weight in 2006), amounting to about 54 tons in 2006. The trends in fishing effort of otter trawl fleet increased from 2004 to 2007 by 12%.

Landings (t) of hake by fishing technique by the Sicilian (ITA) and Maltese (MLT) fleets (DTS = demersal trawl; HOK = gears using hooks; PGP = polyvalent passive gears; PMP = combining mobile and passive gears; PTS = pelagic trawl.) (IREPA source).

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	15	MLT	[LHP] [LHM]				0		
HKE	15	MLT	[SB] [SV]						0
HKE	15	MLT	GNS				0		
HKE	15	MLT	GTR				0	0	0
HKE	15	MLT	LA						1
HKE	15	MLT	LLD				0		0
HKE	15	MLT	LLS				2	1	2
HKE	15	MLT	LTL				0		
HKE	15	MLT	OTB				4	5	6
HKE	15	MLT	Other gear				0		
HKE	15 & 16	ITA	DTS	1716	1960	1927	1713	1597	1599
HKE	15 & 16	ITA	HOK			22	9	2	9
HKE	15 & 16	ITA	PGP	92	12		67	27	111
HKE	15 & 16	ITA	PMP	52	23				
HKE	15 & 16	ITA	PTS	13	18	0	1		0

Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSAs 15 and 16, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	15	MLT	[LHP] [LHM]		28		
DAYS	15	MLT	[SB] [SV]			73	59
DAYS	15	MLT	GNS		51		
DAYS	15	MLT	GTR		200	152	320
DAYS	15	MLT	LA			1116	1096
DAYS	15	MLT	LLD		3164	3159	2827

DAYS	15	MLT	LLS		1197	1466	1624
DAYS	15	MLT	LTL		263		
DAYS	15	MLT	OTB		421	404	688
DAYS	15	MLT	Other gear		64		
DAYS	15 & 16	ITA	DTS	81853	82557	89319	89164
DAYS	15 & 16	ITA	HOK	14856	11450	10272	9284
DAYS	15 & 16	ITA	PGP	118425	97285	85556	85298
DAYS	15 & 16	ITA	PMP	6939			
DAYS	15 & 16	ITA	PTS	4899	5476	7926	7032
GT*DAYS	15	MLT	[LHP] [LHM]		170		
GT*DAYS	15	MLT	[SB] [SV]			192	139
GT*DAYS	15	MLT	GNS		135		
GT*DAYS	15	MLT	GTR		1174	477	1023
GT*DAYS	15	MLT	LA			23999	29596
GT*DAYS	15	MLT	LLD		82011	72364	60606
GT*DAYS	15	MLT	LLS		16866	18866	18072
GT*DAYS	15	MLT	LTL		2539		
GT*DAYS	15	MLT	OTB		24878	34527	69268
GT*DAYS	15	MLT	Other gear		226		
GT*DAYS	15 & 16	ITA	DTS	6673029	6864030	7429483	7322198
GT*DAYS	15 & 16	ITA	HOK	764595	403669	507862	370612
GT*DAYS	15 & 16	ITA	PGP	249032	206056	192811	212519
GT*DAYS	15 & 16	ITA	PMP	20134			
GT*DAYS	15 & 16	ITA	PTS	224188	236435	352518	346405
KW*DAYS	15	MLT	[LHP] [LHM]		1880		
KW*DAYS	15	MLT	[SB] [SV]			3805	2507
KW*DAYS	15	MLT	GNS		2121		
KW*DAYS	15	MLT	GTR		13889	8391	20724
KW*DAYS	15	MLT	LA			203361	208456
KW*DAYS	15	MLT	LLD		554562	483437	449900
KW*DAYS	15	MLT	LLS		140846	159692	160914
KW*DAYS	15	MLT	LTL		26318		
KW*DAYS	15	MLT	OTB		129838	143909	240858
KW*DAYS	15	MLT	Other gear		3394		
KW*DAYS	15 & 16	ITA	DTS	21381964	21772464	23699835	23644626
KW*DAYS	15 & 16	ITA	HOK	3153486	1758722	2076446	1695903
KW*DAYS	15 & 16	ITA	PGP	2691324	2302777	2207660	2378933
KW*DAYS	15 & 16	ITA	PMP	223470			
KW*DAYS	15 & 16	ITA	PTS	962786	1063031	1592930	1431085

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (1-4)= 0.16	Females;(TRP)
F_{max} (1-4)= 0.25	Females; (LRP)
Fmsy (age range)= not available	
Fpa (Flim) (age range)= not available	
Bmsy (spawning stock)= not available	
F_{mbp} (1-4)=0.39	Sex combined; (LRP)
Z_{mbp} (1-4)= 0.87	Sex combined; (LRP)

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	

F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.8. Hake in GSA 17

Species common name:	European hake
Species scientific name:	*Merluccius merluccius* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 17

Most recent state of the stock

- State of the adult abundance and biomass:

The average stock biomass estimated by LCA in 2006-2007 was around 4,000 tonnes. Without any biomass reference proposed or agreed, SGMED-08-04 is unable to fully evalute the state of the stock size.

- State of the juvenile (recruits):

Not available.

- State of exploitation:

The recent average F not weighted on abundance was 1.22 while the weighted average F was 0.50. Given the values of F and F/Z (the latter one higher than 0.50), the stock of hake can be considered to be at least fully exploited. According to Mertz and Myers (1998), F/Z = 0.80 represents the maximum value which a demersal stock may endure, and the highest estimated value of F/Z (that based on unweighted F) was just slightly lower than 0.80. According to Rochet and Trenkel (2003), it would be safe to avoid F/Z higher than 0.50: the estimated value of F/Z based on weighted F was slightly lower than 0.60. Thus, a risk of overexploitation is real for hake in the GSA 17. Finally, a meaningful percentage of caught hake has a length below the values of sexual maturity: this is a further reason for caution in managing this stock.

- Source of data and methods:

The present assessment of this stock was carried out by means of Length Cohort Analysis (LCA), using Italian length frequency and catch data collected for the years 2006 and 2007. The annual natural mortality rate M = 0.36 was employed for LCA calculations.

Outlook and management advice

In order to avoid the indicated risk of overexploitation for hake in GSA 17 SGMED recommends effort reductions of the relevant fleets to be considered. Effort reductions would require mixed fisheries considerations.
A significant percentage of caught hake has a length below the values of sexual maturity: this is a further reason for caution in managing this stock.

- Short, medium and long term scenarios:

SGMED did not undertake any short, medium or long term projections of catch and biomass under different management scenarios.

- Source of data and methods:

Not applicable.

Fisheries

The Italian landings are mainly caught by demersal otter trawlers.

Total and bottom otter trawl hake landings in GSA 17, 2002-2007.

Year	Total fleet landings (t)	Bottom otter trawler catch (t)
2002	2637	2339
2003	2606	2387
2004	3045	2884

2005	3609	3403
2006	4395	4212
2007	3764	3586

Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSA 17, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	17	ITA	DRB	58297	69126	64120	54047	59099	70261
DAYS	17	ITA	DTS	124529	125106	134776	126013	114903	102270
DAYS	17	ITA	HOK			641	595	610	487
DAYS	17	ITA	PGP	335599	272040	287886	260459	233846	217661
DAYS	17	ITA	PMP	96386	98110	15512	12743		
DAYS	17	ITA	PTS	23522	25649	23387	22453	23104	22981
DAYS	17	ITA	TBB			12395	13166	12440	10901
GT*DAYS	17	ITA	DRB			858864	697091	792375	959807
GT*DAYS	17	ITA	DTS			5624744	5429766	4656664	4283788
GT*DAYS	17	ITA	HOK			9492	10510	10983	9150
GT*DAYS	17	ITA	PGP			518165	429665	444329	427962
GT*DAYS	17	ITA	PMP			73495	66778		
GT*DAYS	17	ITA	PTS			1516671	1472075	1557168	1646419
GT*DAYS	17	ITA	TBB			673656	701874	812298	747714
KW*DAYS	17	ITA	DRB	6381241	7517860	6982982	5884599	6421392	7575921
KW*DAYS	17	ITA	DTS	27568094	27486393	26771813	25026709	22118619	20619962
KW*DAYS	17	ITA	HOK			153794	148821	150195	121827
KW*DAYS	17	ITA	PGP	9297244	7646003	9120053	8011107	8568762	8638666
KW*DAYS	17	ITA	PMP	7989134	7039902	1072033	1032751		
KW*DAYS	17	ITA	PTS	7841347	7636049	6955633	6778783	6978292	7156333
KW*DAYS	17	ITA	TBB			3419642	3622199	3943318	3463256

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ = 0.22	Average for the time interval 2006-2007, calculated using F not weighted on abundance for the length interval 9-39+ cm (age from 0 to 4+).
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.9. Red mullet in GSA 06

Species common name:	Red mullet
Species scientific name:	*Mullus barbatus*
Geographical Sub-area(s) GSA(s):	GSA 06

Most recent state of the stock

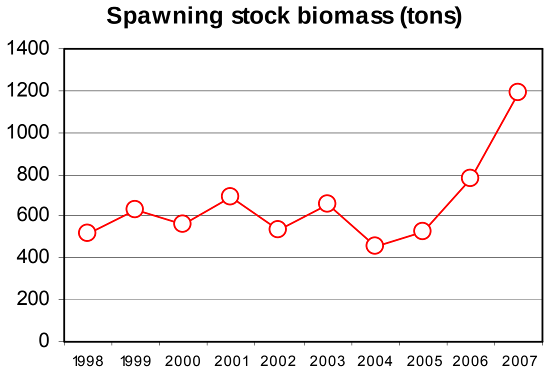
SGMED note that red mullet in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.gfcm.org/ for GSA06 open Doc04-MUT0608Gui.xls

SGMED-08-04 reviewed the assessment, and came to the following conclusions.

- State of the adult abundance and biomass:

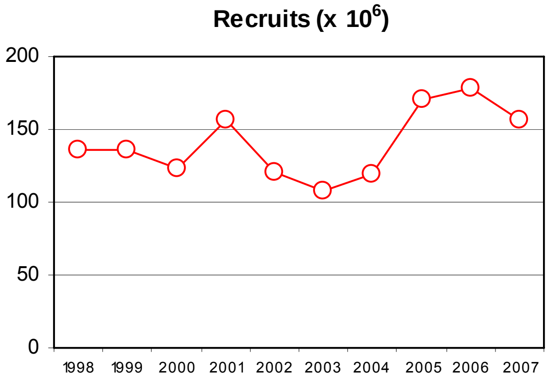
Since 1998 spawning stock biomass has been estimated to fluctuate around 600 tons. However, there is an estimated increase observed since 2006 with the highest value of 1200 tons in 2007.

Only relative biomass reference points have been estimated and proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock.



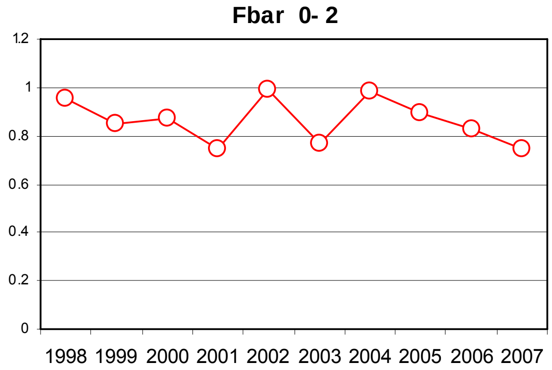
- State of the juvenile (recruits):

Recruitments in the last three years are just above the mean recruitment for the period 1998-2004.



- State of exploitation:

The fishing mortality for ages 0-2 has fluctuated without any obvious trend since 1998, around 0.9.



Fishing mortality reference points have been proposed for this stock ($F_{0.1}$=0.16, F_{max}=0.24).

On the basis of these reference points, SGMED considers the stock to be subject to overfishing.

- Source of data and methods:

The stock of *Mullus barbatus* of the GFCM-GSA06 has been assessed using data from the trawl fishery on a time series covering ten years (1998-2007). The assessment has been carried out applying tuned VPA (Extended Survivor Analysis, XSA) and Y/R analysis on the pseudo-cohort 1998-2007. These approaches were performed using monthly size composition of catches, official landings and the growth parameters accorded in the SGMED-08-03 meeting. The VPA was tuned with CPUE data from MEDITS and LEDER bottom trawl surveys and standardised fleet CPUE by applying GLM model. Several XSA runs were carried out using different values for the terminal fishing mortality, retaining for the final analysis the value that minimised the SSQ. Software used were the Lowestoft VPA program for the XSA (Darby and Flatman, 1994) and the VIT program (Lleonart and Salat, 1997) for the Y/R analysis from a mean pseudo-cohort.

Outlook and management advice

- Short, medium and long term scenarios:

Short term projections have not been carried out for this stock.

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is in the range of $F_{0.1}$-F_{MAX}, in order to obtain high long term sustainable yields.

Transition analysis on technical measures indicates that a 24% increase in Y/R is expected with a change to 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.

- Source of data and methods:

The size composition of commercial landings was obtained by monthly length samplings carried out in one of the sampling ports used for the present assessment (Santa Pola) during the 1998-2007 period. Landings and effort data were obtained combining different sources, such as Official Landings provided by Autonomous Community, and from the Information and Sampling Network of the Spanish Oceanographic Institute (IEO). Growth parameters adopted in the SGMED-08-03 meeting. Length-weight relationships and oogive of maturity were obtained within the framework of the Spanish Data Collection Programme. The vector of natural mortality-at age was obtained from Caddy´s (1991) formula using the PROBIOM Excel spreadsheet (Abella et al., 1997).

Fisheries

Red mullet (*Mullus barbatus*) is one of the target species of the trawl fishery in the GFCM geographical sub-area 6 (Northern Spain). The trawl fleet operating in this area is composed by 647 boats averaging 47 TRB, 58 GT and 297 HP. Some of these units (smaller vessels) operate almost exclusively on the continental shelf, targeting red mullet, octopus, hake and different species of sea breams. According to official data, landings increased considerably between 1973 and 1982 and from this year until now a decreasing trend has been observed. In the period 1998-2004 landings of this species averaged 1315 t per year. Both species of red mullet, *Mullus surmuletus* and *M. barbatus*, are exploited by trawl and artisanal fisheries fleets in GSA 06, although small gears (trammel nets and gillnets) account only for 5% of the total landings of these species (Demestre et al., 1997). Trawl fisheries developed along the continental shelf and upper slope are multi-specific. Small vessels operate almost exclusively on the continental shelf targeting on red mullets, octopus, cuttlefish and sea breams. Medium and large vessels usually operate on the slope areas targeting on hake and decapod crustaceans, but some of these units can also operate on the continental shelf depending on the season (e.g. red mullet is more intensively exploited from September to November; Martín et al., 1999), the weather conditions or market prices. Landings of *M. barbatus* increased continuously from the earliest 1970's until 1998. From this year until 2006 a general decreasing trend with some fluctuations is observed. Estimated landings for the year 2007 are the highest in the data series. An important fraction (30% of individuals) of *M. barbatus* are under the minimum legal size.

Annual landings (t) by fishing technique (otter trawlers only) in GSA 06.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	6	ESP	OTB	1159	1004	958	1027	1437	1232

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

F_{max} (Ages 1-3)=	0.24
$F_{0.1}$ (Ages 1-3)=	0.16

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.10. Red mullet in GSA 09

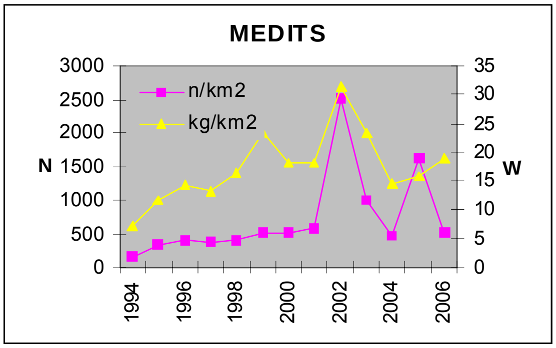
Species common name:	Red mullet
Species scientific name:	*Mullus barbatus*
Geographical Sub-area(s) GSA(s):	GSA 09

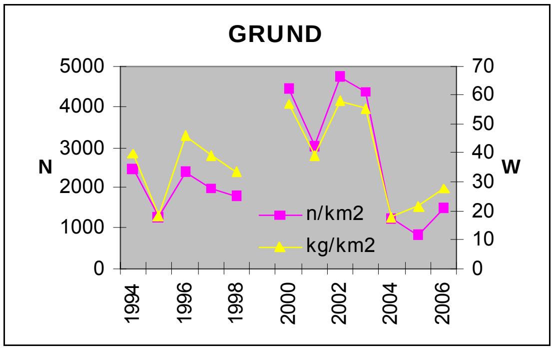
Most recent state of the stock

- State of the adult abundance and biomass:

SGMED is unable to estimate absolute stock size. In the absence of proposed or agreed references SGMED is unable to fully evaluate the status of the stock.

The index of stock abundance from GRUND survey shows high variability throughout the time series, but no trend is observed. The index of abundance from MEDITS surveys, that approximates a spawning stock biomass index (mostly represented by mature fish), suggests a positive trend from 1994 to 2006. Wide fluctuations are observed from 2002 to 2006.





- State of the juvenile (recruits):

Index of abundance of juveniles shows a high variability, with highest values in 2000-2003 and with recent levels similar to those of 1994-95.

- State of exploitation:

The stock status as regards the proposed reference points $F_{0.1}$ (0.42) and F_{msy} (0.59) can be defined as overfished (Fcurr=0.86).

- Source of data and methods:

Data used derive from trawl surveys on size composition and abundance indices and on landings and direct fishing effort from commercial catch assessement surveys (in the framework of DCR and from other programs).
LCA with data from 2007 was used for the estimation of the F vector, using catches from trawlers and small scale fisheries. Yield per recruit analysis was used for the definition of F_{max} and $F_{0.1}$. A dynamic Biomass Production model (ASPIC) using both catch and effort commercial data and an abundance index derived from trawl surveys allowed to estimate F_{msy}, q for each fishery, B_{msy}, and a value of F for each year along the time series. Finally, time series of Z and abundance (kg/km^2) from trawl surveys were used for the construction of a non-equilibrium production model and for the definition of the Z_{MBP} (the level of Z corresponding to the Maximum Biological Production: yields + biomass removed by natural mortality).

- The main parameters used are:
  Linf=29, K=0.6, to=-0.1
  L/W relationship a=0.00053 b=3.12
  M vector (age1=1.30, age2 0.79, age3 0.62, age4= 0.54)
  weighted mean value of M=0.8

Outlook and management advice

SGMED-08-04 concludes that the red mullet stock in GSA 09 has no significant recovery potential under the current fishing strategy. SGMED recommends fishing mortality to be reduced to the range between $F_{0.1}$ and F_{MSY} through effort reductions of the relevant fleets. This requires consideration of the mixed fisheries nature of such fleets.

- Short, medium and long term scenarios:

The species is mostly exploited by trawlers, being the catches derived from artisanal fisheries negligible. A status quo projection made with ASPIC for 2007-2012 indicates a low increase in biomass.

Fisheries

The species is caught by a multi-species fishery of trawlers operating on the continental shelf. Among the main species targeted with *M. barbatus* there are *Squilla mantis, Sepia officinalis, Trigla lucerna, Merluccius merluccius* and *Gobius niger.* The species is mainly caught in late summer and the beginning of autumn, when juveniles are highly concentrated near shore. Age of first capture is about 7 cm. Catch is mainly composed by age 0 individuals while the older age classes are poorly represented in the catch.

Total landings ranged between 583 tons in 2004 to the maximum of 1097 tons observed in 2007. Discards reported in 2006 represented approximately 15% of the landing (158 tons over 1050 tons). CPUE increased along the analysed period. The total trawl fleet of GSA 09 at the end of 2006 accounted for 361 vessels. The main trawl fleets of GSA9 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium). The fishing capacity of the GSA 09 has shown in these last 20 years a progressive decrease. From 1996 to 2006 the number of bottom trawlers of GSA9 decreased of about 30%. Consequently also fishing effort decreased, even though in a lesser extent, in this period.

Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	9	ITA	DTS	454	839	514	682	1033	1075
MUT	9	ITA	HOK				2		
MUT	9	ITA	PGP	14	44	49	28	17	22
MUT	9	ITA	PMP	150	174	16	3		
MUT	9	ITA	PTS	3	7	4			
SUM				621	1064	583	715	1050	1097

Effort trends by fishing technique in GSA 09. (Data regards the whole fleets by fishing typology without any distinction regarding targets, season nor operations depth interval).

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728	4739	5242	5160
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS			143490	162480	200226	194754
KW*DAYS	9	ITA	DRB	187147	335520	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166	1013627	1174295	1151346

Precautionary and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age 1-3) = 0.42	From Y/R
F_{max} (age 1-3) = 0.63	From Y/R
F_{msy} (all exploited ages) = 0.59	From catch and effort with ASPIC
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	n.a.
B_{pa} (B_{lim}, spawning stock)=	
Z_{MBP} (all exploited ages) = 0.59	From trawl surveys series of Z and Kg/km^2

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

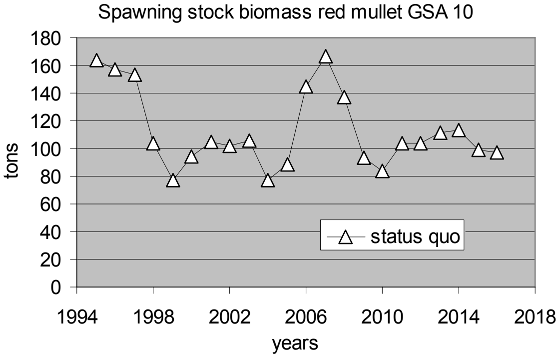
6.11. Red mullet in GSA 10

Species common name:	Red mullet
Species scientific name:	*Mullus barbatus* (L., 1758)
Geographical Sub-area(s) GSA(s):	GSA 10

Most recent state of the stock

- State of the adult abundance and biomass:

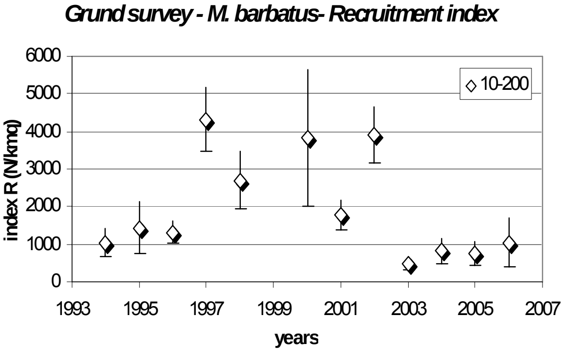
In the absence of proposed or agreed references SGMED is unable to fully evaluate the state of the stock. Survey indices indicate a decreasing pattern of biomass from 1999 onwards. In the recent years (especially in 2007) a rising of stock number and biomass was observed but subject to high variation (uncertainty). The Aladym model shows that, except in the last two years, the SSB was at lower level compared to the beginning of the time series. A similar pattern shows also the spawning potential ratio that was varying around 10% between 1998 and 2005. Long-term scenario was also simulated.



SSB in tons from Aladym simulations. Red mullet, GSA 10. Prediction of the consequences of the fishing pressure exerted in the last 4 years up to 2016.

- State of the juvenile (recruits):

The recruitment of recent years since 2003 is indicated to be below average.



Recruits N/km^2 (Grund survey) in GSA 10.

- State of exploitation:

Considering the level of F in 2006 i.e. 0.7, a reduction of 47% would be necessary to reach F0.1 (0.37). In 2007 the situation seems changed. Despite the value of status quo F (0.65) is close to that of 2007, the exploitation pattern was different and thus a reduction of about 10% would be needed to reach F0.1 (0.59).

2006	Factor	F	Y/R	B/R	SSB
F(0.1)	0.53	0.37	7.761	17.873	10.911
F(Max)	0.94		8.304	12.162	5.944
F(Current)	1.01		8.295	11.514	5.414
F(Double)	2		7.503	6.524	1.779
2007	Factor		Y/R	B/R	SSB
F(0.1)	0.91	0.59	11.709	21.51	18.001
F(Max)	1.75		12.671	13.082	9.666
F(Current)	1.01		11.971	20.078	16.58
F(Double)	2		12.635	11.752	8.364

Given the results of the present analysis, the stock appears to be subject to overfishing, that might be mitigated if the estimates related to the fishing mortality in 2007 will be confirmed in the successive years. Other signals, from survey indices and Aladym model predictions, show that the condition of the stock could be at risk of being harvested unsustainably if the mortality levels observed in the past years (mean of 2004-2007 fishing pressure) will occur in the future.

- Source of data and methods:

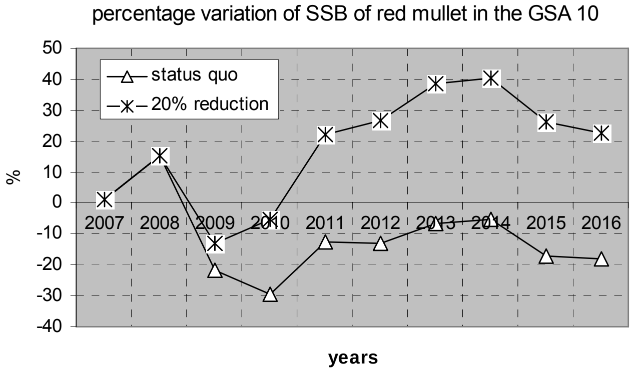
The data used in the analyses were from trawl surveys (time series of Medits and Grund surveys from 1994 to 2007 and 2006 respectively) and from the data collection of landings and effort (DCR), including the landing length structure. Two models were used in the analyses: Aladym and VIT models.

Outlook and management advice

SGMED recommends fishing mortality to be reduced to the range between $F_{0.1}$ and F_{MSY} through effort reductions of the relevant fleets. This requires consideration of the mixed fisheries nature of such fleets.

- Short, medium and long term scenarios:

Basically information from trawl survey were used and simulation performed using Aladym model. To this purpose a total mortality based on an average value (1.65 from 2004 to 2007) was used to project forwards the population up to 2016.



Results from Aladym simultions. Percentage variations of the SSB of red mullet under the status quo scenario and the 20% fishing pressure reduction scenario, the benchmarks represented by the average value from 2004 to 2007.

- Source of data and methods:

A hindcasting analysis was performed using historical Z estimates from 1995. Then, a preliminary forecast analysis was conducted using Aladym model. By this way short and long term scenarios (2010-2013) could be simulated. Also a scenario accounting for a 20% reduction of fishing pressure was simulated.

Fisheries

Brief description of trends:

Available landing data are from DCR regulations and range from 839 tons of 2002 to 501 tons in 2007, being the lowest value of 393 tons registered in 2006.

Annual landings (t) by fishing technique, 2002-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	10	ITA	DTS	446	265	370	249	289	265
MUT	10	ITA	HOK			2		0	
MUT	10	ITA	PGP	195	83	110	116	104	237
MUT	10	ITA	PMP	189	71	41	56		0
MUT	10	ITA	PTS	10		1			
SUM				840	419	524	421	393	502

Table of fishing effort by country and fleet for longest time series available.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	10	ITA	DRB	658	205	830	1776	1984	1040
DAYS	10	ITA	DTS	37949	38134	44087	46547	43848	40724
DAYS	10	ITA	HOK			20929	20418	8064	7043
DAYS	10	ITA	PGP	357895	311474	325523	268441	346849	311693
DAYS	10	ITA	PMP	105705	143062	62225	64177	10532	7261
DAYS	10	ITA	PTS	8258	9780	11792	11206	9332	9367
GT*DAYS	10	ITA	DRB			7968	17128	19136	9939
GT*DAYS	10	ITA	DTS			1337882	1622062	1331071	1266460
GT*DAYS	10	ITA	HOK			157882	143835	103111	82342
GT*DAYS	10	ITA	PGP			661958	534880	800036	693057
GT*DAYS	10	ITA	PMP			336053	333845	152717	110850
GT*DAYS	10	ITA	PTS			390096	468145	367417	280190
KW*DAYS	10	ITA	DRB	94663	29540	110899	244013	272628	142455
KW*DAYS	10	ITA	DTS	7344089	7231486	7883881	8467144	7596783	7105075
KW*DAYS	10	ITA	HOK			1654352	1413547	925244	794816
KW*DAYS	10	ITA	PGP	6440217	7222145	7056306	6018600	9486681	8397010
KW*DAYS	10	ITA	PMP	12686947	8003452	3588004	3728376	1404642	1003285
KW*DAYS	10	ITA	PTS	2631242	2930380	2308589	2434470	2016508	1680295

The whole fishing effort (kwdays) of trawlers in the GSA shows an increasing trend from 2002 to 2005, and a decreasing in 2006, while the effort of the small scale fishery (PGP) shows a slight decrease up to 2005 and an increase in 2006.

Precautionary and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (0-3 years)=	0.37-0.59
F_{max} (age range)=	Not well defined dome shaped curves
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.12. Red mullet in GSA 17

Species common name:	Red mullet
Species scientific name:	*Mullus barbatus*
Geographical Sub-area(s) GSA(s):	GSA 17

Most recent state of the stock

- State of the adult abundance and biomass:

Without any biomass reference proposed or agreed, SGMED-08-04 is unable to fully evalute the state of the stock size.

The average stock biomass estimated by LCA in 2006-2007 was around 4000 tonnes.

- State of the juvenile (recruits):

Not available.

- State of exploitation:

The average F not weighted on abundance was 1.08 while the weighted average F was 0.62. The corresponding exploitation rates were 0.63 and 0.50, respectively. Given the values of F and F/Z (the latter one equal to or higher than 0.50) the stock can be considered to be sustainably exploited with some risk of overexploitation. According to Rochet and Trenkel (2003), it would be safe to avoid F/Z higher than 0.50. Also, the seasonality fishing mortality of red mullet (from September to November) has to be taken into account.

- Source of data and methods:

The present assessment of this stock was carried out by means of Length Cohort Analysis (LCA), using Italian length frequency and catch data collected for the years 2006 and 2007. The annual natural mortality rate M = 0.64 was employed for LCA calculations.

Outlook and management advice

In order to reduce the risk of overfishing, SGMED recommends fishing mortality to be reduced through effort reductions of the relevant fleets. This requires consideration of the mixed fisheries nature of such fleets.

- Short, medium and long term scenarios:

- Source of data and methods:

Fisheries

The Italian landings are mainly caught by demersal otter trawlers.

Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	17	ITA	DRB	29					
MUT	17	ITA	DTS	2475	2394	3620	3553	3180	3357
MUT	17	ITA	PGP	209	214	153	45	12	7
MUT	17	ITA	PMP	374	487	27	14		
MUT	17	ITA	PTS	11	16	4	5	1	
MUT	17	ITA	TBB			80	79	33	61
SUM				3098	3111	3884	3696	3226	3425

Effort trends by fishing technique in GSA 17.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	17	ITA	DRB	58297	69126	64120	54047	59099	70261
DAYS	17	ITA	DTS	124529	125106	134776	126013	114903	102270
DAYS	17	ITA	HOK			641	595	610	487
DAYS	17	ITA	PGP	335599	272040	287886	260459	233846	217661
DAYS	17	ITA	PMP	96386	98110	15512	12743		
DAYS	17	ITA	PTS	23522	25649	23387	22453	23104	22981
DAYS	17	ITA	TBB			12395	13166	12440	10901
GT*DAYS	17	ITA	DRB			858864	697091	792375	959807
GT*DAYS	17	ITA	DTS			5624744	5429766	4656664	4283788
GT*DAYS	17	ITA	HOK			9492	10510	10983	9150
GT*DAYS	17	ITA	PGP			518165	429665	444329	427962
GT*DAYS	17	ITA	PMP			73495	66778		
GT*DAYS	17	ITA	PTS			1516671	1472075	1557168	1646419
GT*DAYS	17	ITA	TBB			673656	701874	812298	747714
KW*DAYS	17	ITA	DRB	6381241	7517860	6982982	5884599	6421392	7575921
KW*DAYS	17	ITA	DTS	27568094	27486393	26771813	25026709	22118619	20619962
KW*DAYS	17	ITA	HOK			153794	148821	150195	121827
KW*DAYS	17	ITA	PGP	9297244	7646003	9120053	8011107	8568762	8638666
KW*DAYS	17	ITA	PMP	7989134	7039902	1072033	1032751		
KW*DAYS	17	ITA	PTS	7841347	7636049	6955633	6778783	6978292	7156333
KW*DAYS	17	ITA	TBB			3419642	3622199	3943318	3463256

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ = 0.50	Average for the time interval 2006-2007, calculated using F not weighted on abundance for the length interval 9-20+ cm (age from 0 to 3+).
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.13. Red mullet in GSA 25

Species common name:	Red mullet
Species scientific name:	*Mullus barbatus*
Geographical Sub-area(s) GSA(s):	GSA 25

Most recent state of the stock

- State of the adult abundance and biomass:

Unknown.

- State of the juvenile (recruits):

Unknown.

- State of exploitation:

Unknown.

- Source of data and methods:

A preliminary assessment of stock status was performed using LCA and YPR techniques, within the VIT software (Lleonart and Salat, 1992). This was applied to catch-at-length data averaged for the period 2005-2007, from the two main fishing fleets. Alternative biological growth parameters for *M. barbatus* ('fast', 'slow' and estimated using otoliths collected within Cyprus waters) were used to convert length data into age. Natural mortality rate was estimated using the equations of Djabali and Pauly (for the latter using fast growth parameters only). Results of these preliminary assessments were not considered to provide sufficiently robust estimates of stock status or provide a basis for management advice. Biomass estimates from the preliminary VIT analysis with 'fast' growth parameters was estimated to be 12-15% of virgin levels.

Outlook and management advice

- Short, medium and long term scenarios

Preliminary nature of assessment means no advice has been provided.

- Source of data and methods

Preliminary nature of assessment meant no projections were performed.

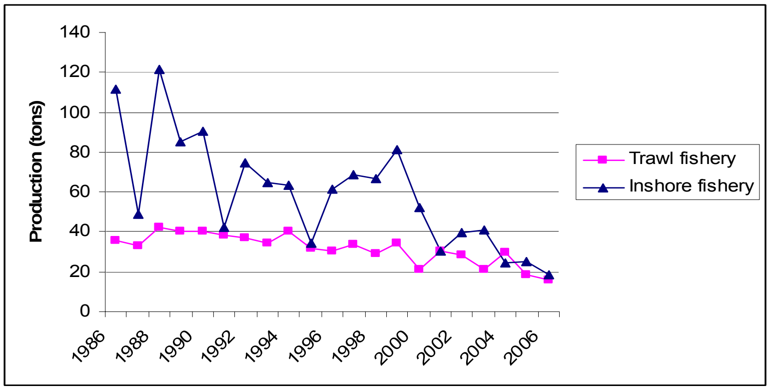
Fisheries

Brief description of trends

The red mullet stock in GSA 25 is only fished by Cypriot vessels. Landings are from the Cyprus bottom trawl fishery, and the inshore fishery. Annual landings (t) by fishing technique as reported to SGMED-08-03 through the DCR data call, 2003-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	25	CYP	GTR				25	18	25
MUT	25	CYP	OTB				18	16	23
SUM							43	34	48

Production data available for the period 1986-2006 indicate a declining trend in production for both fleets, from ~80 tons to 20 tons in the inshore fleet, and ~ 40 tons to 20 tons in the trawl fishery (see figure).



Studies suggested that of *M. barbatus* within the fishery to be negligible.

Important bycatch species include *Spicara* spp., *Boops boops*, *Mullus barbatus*, *M. surmuletus*, *Pagellus erythrinus* and cephalopods (*Octopus vulgaris*, *Eledone moschata*, *Loligo vulgaris* and *Sepia officinalis*) for the bottom trawl fishery, and *Diplodus* spp, *Sparisoma cretense* and *Siganus* spp. for the inshore fishery.

Effort trends by fishing technique in GSA 25, 2005-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	25	CYP	GTR				84706	89375	100103
DAYS	25	CYP	LLS				306	378	407
DAYS	25	CYP	OTB				1018	726	752
GT*DAYS	25	CYP	GTR				256436	275468	301864
GT*DAYS	25	CYP	LLS				2022	5245	6421
GT*DAYS	25	CYP	OTB				94561	72422	75036
KW*DAYS	25	CYP	GTR				3305514	3526850	3896835
KW*DAYS	25	CYP	LLS				21790	51626	57561
KW*DAYS	25	CYP	OTB				327616	231816	240182

Limit and target management reference points or levels

Preliminary nature of assessment meant no reference points were derived.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment and proposed future work

'Slow' growth parameters were clearly inconsistent with the available growth data and resulted in inappropriate stock assessment results. These should not be used in the future.

Cyprus-specific growth parameters estimated based upon otolith readings showed a highly negative t_0, and hence were likely to underestimate K. The feasibility of re-estimating these parameters with $t_0=0$ should be examined. The impact of this on age-slicing results should be examined.

F_{bar} estimates by age, in relation to corresponding estimates of $F_{0.1}$, should be provided in future assessments.

6.14. Pink shrimp in GSA 06

Species common name:	Deepwater pink shrimp
Species scientific name:	*Parapenaeus longirostris*
Geographical Sub-area(s) GSA(s):	GSA06

Most recent state of the stock

It is noted that pink shrimp in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.gfcm.org/ for GSA06 open Doc20-DPS0608Gui.xls

SGMED-08-04 reviewed the assessment, and came to the following conclusions.

- State of the adult abundance and biomass:

Since 2001 SSB declined rapidly and continuously to the lowest value observed in 2007, which represents only 10% of that observed in 2001.

SGMED notes that the MEDITS survey abundance index shows a very high peak in abundance in the 1999-2001 period, which represents the start of the assessment period. Prior to 1999, abundance levels were comparable to those seen in the 2002-2007 period.

SGMED cannot evaluate the state of the spawning stock relative to reference points, as these have not been proposed or defined. Given the short-term decline by 90% from 2001 values, SGMED considers the stock status to be far below any sustainable levels.

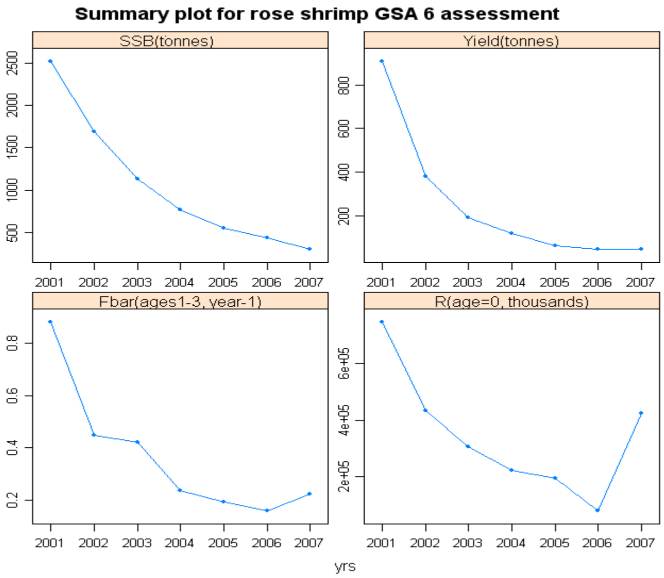
- State of the juvenile (recruits):

Recruits were estimated to have declined from 2001 to 2006 in the same pattern as SSB (90% to 2006). However, the most recent recruitment estimate in 2007 appears to be at the 50% level of the initial 2001 value.

- State of exploitation:

Fishing mortality over ages 1-3, was estimated to have declined from 2001 to 2005, from 0.9 to 0.2, and remained low since then.

The estimated level of exploitation should be considered to be sustainable under normal conditions, although no reference points have been estimated.



- Source of data and methods:

A VPA tuned with standardised CPUE from commercial fleet and abundance indices from two 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 2001-2007. Both methods were performed from size composition of trawl and official landings, transforming length data to age data by slicing (L2AGE). Available standardised CPUE data series, both of commercial fisheries from Santa Pola fleet, and scientific surveys (MEDITS – LEDER) were used.

Outlook and management advice

F and effort should be kept at a low level to allow any strong future recruitments to rebuild the stock. SGMED recommends a recovery plan to be established for this stock that takes into account the mixed species nature of the fishery.

- Short, medium and long term scenarios:

Forecast at status quo predicts no changes on SSB and yields, being affected only by the strength of recruitments. A reduction of 10% of F shows no changes on SSB and yields.

- Source of data and methods:

A forecast analysis was carried out maintaining the present level of F during each of the following 5 years and simulating a reduction of 10% of F for the same period of time, considering a constant recruitment obtained as an average of the data series (FLR software).

The parameters of the size-weight relationship used in this assessment (García Rodriguez et al., 2008) are similar to those calculated by other authors, (Ribeiro-Cascalho & Arrobas, 1987; Sobrino, 1998; Tosunoglu et al., 2007). The estimates made for the VBGF parameters (García Rodriguez et al., 2008) show that, although the Linf values were similar, the values for the growth rate (K) calculated in this study are lower than those presented by other authors both for the Mediterranean (Ardizzone et al., 1990; D'Ongia et al., 1998) and for the Atlantic (Ribeiro-Cascalho, 1988; Sobrino, 1998), The size composition of commercial landings were obtained by monthly length samplings carried out both in one of the ports (Santa Pola) as well as on board samplings, during the 2001-2007 period. Landings and effort data were obtained combining different sources, such as Official Landings provided by Autonomous Community, and from the Information and Sampling Network of the Spanish Oceanographic Institute (IEO).

Fisheries

Deep-water pink shrimp (*Parapenaeus longirostris*) is one of the most important crustacean 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 target species of the trawl fleet, composed by around 600 vessels, and especially by 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 decreasing trend during the period 2001-2007. In 2007 the annual landings of this species amounts 43 tons in the whole area, which it has been the lowest value of the historical series.

Fishing effort has reduced from 50,000 days in 2000 to 13,000 in 2006, with a slight increase in 2007 to 18,000. SGMED notes that the fishing effort below only includes vessels that have landed pink shrimp in the given years.

Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
GSA 6 landings (t)	160	731	1098	910	380	190	117	59	43	43
Effort (days)	30278	45279	49990	45010	38466	27519	23052	16133	12942	18812

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment

SGMED-08-04 suggests the use of seasonal VPA models for assessment of short lived crustaceans.

6.15. Pink shrimp in GSA 09

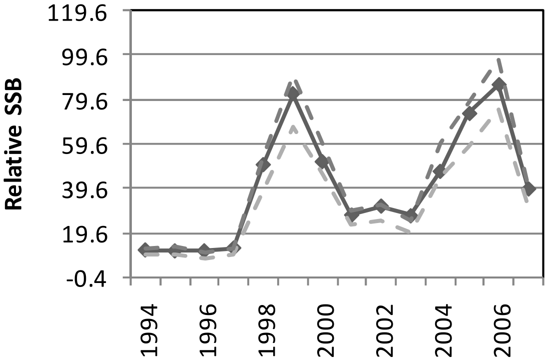
Species common name:	Deepwater pink shrimp
Species scientific name:	*Parapenaeus longirostris*
Geographical Sub-area(s) GSA(s):	GSA 09

Most recent state of the stock

- State of the adult abundance and biomass:

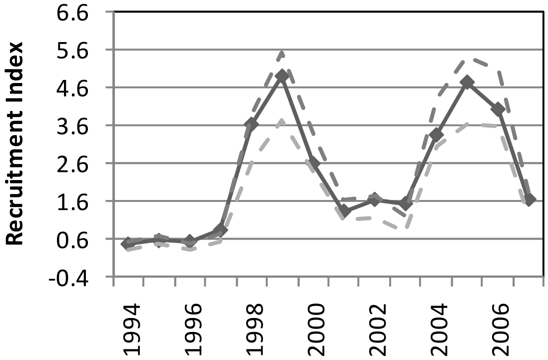
SGMED was unable to estimate the absolute stock size. Relative indices derived from scientific MEDITS survey for the period 1994-2006 indicated an increasing trend of the spawning stock biomass with two very high peaks in 1999 and 2006. In 2007 the SSB was 53% of the short term average (2004-2006), but however well above the lowest values observed in 1994-97.

As no precautionary level for the stock of deep-sea pink shrimp in GSA 09 is proposed or agreed, SGMED cannot evaluate the stock status in relation the precautionary approach.



- State of the juveniles (recruits):

Young of the year (0+) are poorly sampled by the MEDIT survey. Relative indices for age 1+ indicated a general increasing trend since 1994 with two main recruitment peaks in 1999 and 2005. In 2007 recruitment index was 40% of the short term average (2004-2006).



- State of exploitation:

Average mortality (F_{2-4}) estimated from SURBA needs to be refined giving both the high uncertainty and variability in the annual estimates. F_{2-4} estimated through LCA and the survivor rate of annual cohorts were, respectively 0.37-0.41 (LCA) and 0.19-0.39 (survival rate) in the last two years (2006-07).

According to the estimated reference value of $F_{0.1}$=1.3 this stock could be considered underexploited, even though a better assessment of both F_{curr} and F_{01} would be required.

- Source of data and methods:

Time series of survey data were used (MEDITS: 1994-2007; GRUND: 1996-2007) to investigate trends in abundance and F with SURBA. Length cohort analysis was used on 2006 and 2007 DCR data.
The following parameters were used both for SURBA and VIT analyses:

• **Growth**
L∞ = 43.5 mm carapace length
K = 0.6
to = 0
• **Length-Weight relationhips**
a = 0.00686
b = 2.24
• **Natural mortality**
M = 1.2 (Samed project, Beverton & Holt)
• **Length-at-maturity (L50)**
L50 = 24 mm
Lc100 = 20 mm

Outlook and management advice

Any management measure should consider the mixed nature of the fisheries exploiting the stock.

- Short, medium and long term scenarios:

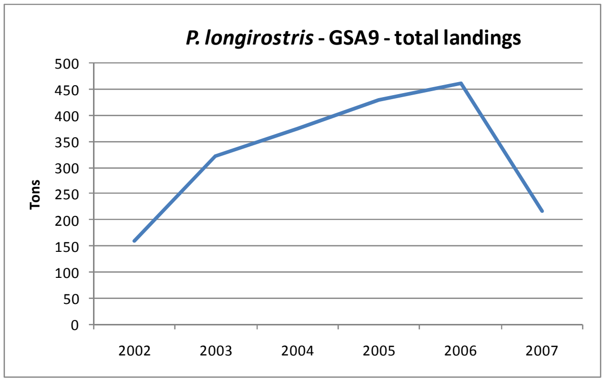
At present SGMED-08-04 is not in a position to determine future catch possibilities or stock status in relation to them

- Source of data and methods:

None.

Fisheries

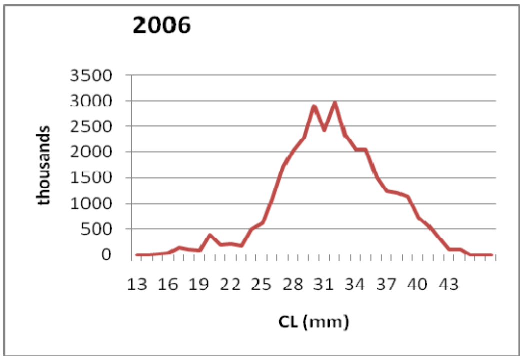
The species is exploited by trawl fleet mostly on muddy bottoms from 150 to 500 m depth. Annual trawl landings increased from 160 tons in 2002 to 450 tons in 2006, decreasing to 220 tons in 2007.

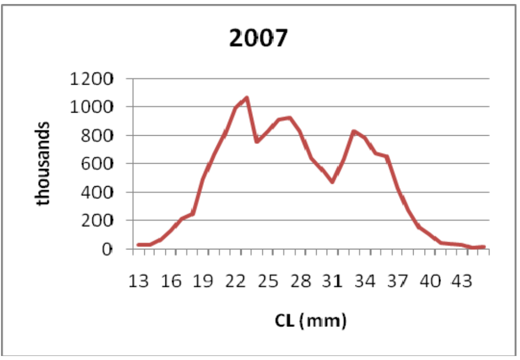


Annual landings (t) by fishing technique in GSA 09.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	9	ITA	DTS	133	308	367	430	462	215
DPS	9	ITA	PGP		3	8	1		2
DPS	9	ITA	PMP	19	12	0			
DPS	9	ITA	PTS	9	0	1			
SUM				161	323	376	431	462	217

A total of 9 tons of discards, composed by individuals smaller than 20 mm carapace length, was estimated in 2006 (approx. 2% landing). Trawl landings showed a marked difference in the length composition between 2006 and 2007. Proportion of juveniles (0+) increased in 2007 landing.





The total trawl fleet of GSA 09 at the end of 2006 accounted for 361 vessels. The main trawl fleets of GSA 09 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium). The fishing capacity of the GSA 09 has shown in the last 20 years a progressive decrease. From 1996 to 2006 the number of bottom trawlers of GSA 09 decreased of about 30%. Also fishing effort decreased, even though in a lesser extent, in this period.

Trends in annual fishing effort by fishing technique deployed in GSA 09, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728	4739	5242	5160
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS			143490	162480	200226	194754
KW*DAYS	9	ITA	DRB	187147	335520	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166	1013627	1174295	1151346

Precautionary and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)= 1.3	Uncertainty in Yield model parameters produced considerable variations in $F_{0.1}$ with an increased probability for values between 1.1 and 1.5
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.16. Pink shrimp in GSA 15 and 16

Species common name:	Deep water pink shrimp
Species scientific name:	*Parapenaeus longirostris* (Lucas, 1846)
Geographical Sub-area(s) GSA(s):	GSA 15 & 16

Most recent state of the stock

- State of the adult abundance and biomass:

SGMED is unable to estimate the absolute stock size. Relative indices derived from scientific surveys indicate a recent decrease in the stock size in both GSAs since 2005. In the absence of proposed or agreed references SGMED is unable to fully evaluate the state of the stock.

- State of the juvenile (recruits):

No recent information on recruit abundance was available to the SGMED-04.

- State of exploitation:

Current values of F (age 1-3) are lower than F_{max} and higher than $F_{0.1}$, suggesting an overexploitation state for this stock. To reach $F_{0.1}$=0.83 a reduction of at least 30% of the current F would be needed.

- Source of data and methods:

Data derived both from indirect (fisheries monitoring) and direct (scientific surveys) sources. Stock status was assessed by using Y and SSB per recruit analysis with package VIT and Yield on females, which reach larger size and represents more than 60% of the landing in weight. Current F was assessed with steady state VPA with VIT by length and by age on LFD of 2006 and 2007 landings. Further estimations of F derived from Z estimator of Beverton & Holt on average LFD form MEDITS (2005, 2006 and 2007) and GRUND (2005 and 2006) subtracting M. The stock parameters were: L_{inf}= 43; K= 0.68; t_0= -0.2; a=0.0036; b= 2.4423; M $_{(scalar)}$= 1.04; Minimum length at fully recruitment (L')=20; F terminal=M; Maturity ogive at length: $L_{50\%}$=21.5 and g=0.45

Outlook and management advice

In order to achieve the required reductions of fishing mortality, SGMED recommends reduction of fishing effort of the relevant fleet considering the mixed nature of the fisheries.

SGMED-08-04 was informed that medium term management plan for 2008-2013 has been agreed for Italian trawlers catching hake in GSA 15 and 16.
The effect of 5 different management scenarios considered by the Italian Management Fishery Plans were assessed by Aladym model. These scenarios which are:

- a fleet reduction of 25% of the current capacity obtained in two steps. The first (12.5%) from 2008 to 2010, and the second (12.5%) from 2011 to 2013;
- trawling ban of 45 days per year between January and March (targeted to deep water pink shrimp fishery which is the main commercial species in the GSA 15 and 16);
- changing the mesh opening in the cod-end from the 40 mm to 50 mm (diamond) from 2010;
- the above three measures combined; and
- maintaining the status quo.

The expected improvements of the stock indicators adopting the management measures of the IFMP versus the status quo improve the stock status. The main gains in terms of Yield, Biomass, SSB and ratio ESSB/USSB were higher when the combination of measures were adopted. Maintaining status quo is expected to worse the stock status in long terms.

- Source of data and methods:

The availability of a time series of total mortality rates from trawl surveys, biological information and selectivity parameters allows to reconstruct the stock dynamics in the last years and to simulate the effects of management measures such as the reduction of fishing mortalities, increase of size at capture, seasonal closures and all the measures considered combined.

Fisheries

The deep water pink shrimp is main target species of the Sicilian trawlers and is caught both on shelf and upper slope during all year round, but landing peaks are observed from March to July. Yield of the Italian trawlers in 2006 was about 8500 t decreasing to 6000 t in 2007. The Maltese trawlers landed 11 t in 2006 and 8 t in 2007.

P. longirostris is fished exclusively by otter trawl, together with other species (*Nephrops norvegicus, Merluccius merluccius, Eledone sp., Illex coindetii, Todaropsis eblanae, Lophius sp., Mullus sp., Pagellus sp., Zeus faber* and *Raja sp.*).

The Sicilian trawlers between 12 and 24 LOA, are based in seven harbours along the southern coasts of Sicily. They operate mainly on a short-distance trawl fishery with trips from 1 to 2 days at sea, fishing on outer shelf and upper slope. The distant trawlers of Mazara del Vallo represents the main commercial fleet of trawlers of the area and one of the most important of the Mediterranean. Differently from the other Sicilian fleets, the large trawlers of Mazara fleet (LOA>24m) are employed on long fishing trips (3 – 4 weeks) in offshore waters, both national and international, of the Strait of Sicily. After the recent increase of the fuel costs a critical phase for the deep water pink shrimp fishery started, affecting mainly the distant fleet, which needs about 1 ton of fuel per day during the fishing trip. Fishing effort of Italian otter trawl fleet increased from 2004 to 2007 by 12%. Discarded fraction of undersized shrimps by Sicilian trawlers amount to about 25 tons in 2006.

Annual landings (t) by fishing technique in GSAs 15 and 16.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	15	MLT	LA						1
DPS	15	MLT	OTB				1	11	7
DPS	15 & 16	ITA	DTS	7463	7388	6606	8355	8455	5966
DPS	15 & 16	ITA	HOK			57	224		0
DPS	15 & 16	ITA	PGP	1	23	2		1	
DPS	15 & 16	ITA	PMP	101					
DPS	15 & 16	ITA	PTS	20	55		5		

Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSAs 15 and 16, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	15	MLT	[LHP] [LHM]		28		
DAYS	15	MLT	[SB] [SV]			73	59
DAYS	15	MLT	GNS		51		
DAYS	15	MLT	GTR		200	152	320
DAYS	15	MLT	LA			1116	1096
DAYS	15	MLT	LLD		3164	3159	2827
DAYS	15	MLT	LLS		1197	1466	1624
DAYS	15	MLT	LTL		263		
DAYS	15	MLT	OTB		421	404	688
DAYS	15	MLT	Other gear		64		
DAYS	15 & 16	ITA	DTS	81853	82557	89319	89164
DAYS	15 & 16	ITA	HOK	14856	11450	10272	9284
DAYS	15 & 16	ITA	PGP	118425	97285	85556	85298
DAYS	15 & 16	ITA	PMP	6939			
DAYS	15 & 16	ITA	PTS	4899	5476	7926	7032
GT*DAYS	15	MLT	[LHP] [LHM]		170		
GT*DAYS	15	MLT	[SB] [SV]			192	139
GT*DAYS	15	MLT	GNS		135		
GT*DAYS	15	MLT	GTR		1174	477	1023
GT*DAYS	15	MLT	LA			23999	29596
GT*DAYS	15	MLT	LLD		82011	72364	60606
GT*DAYS	15	MLT	LLS		16866	18866	18072
GT*DAYS	15	MLT	LTL		2539		
GT*DAYS	15	MLT	OTB		24878	34527	69268
GT*DAYS	15	MLT	Other gear		226		
GT*DAYS	15 & 16	ITA	DTS	6673029	6864030	7429483	7322198
GT*DAYS	15 & 16	ITA	HOK	764595	403669	507862	370612
GT*DAYS	15 & 16	ITA	PGP	249032	206056	192811	212519
GT*DAYS	15 & 16	ITA	PMP	20134			
GT*DAYS	15 & 16	ITA	PTS	224188	236435	352518	346405
KW*DAYS	15	MLT	[LHP] [LHM]		1880		
KW*DAYS	15	MLT	[SB] [SV]			3805	2507
KW*DAYS	15	MLT	GNS		2121		
KW*DAYS	15	MLT	GTR		13889	8391	20724
KW*DAYS	15	MLT	LA			203361	208456
KW*DAYS	15	MLT	LLD		554562	483437	449900
KW*DAYS	15	MLT	LLS		140846	159692	160914
KW*DAYS	15	MLT	LTL		26318		
KW*DAYS	15	MLT	OTB		129838	143909	240858
KW*DAYS	15	MLT	Other gear		3394		
KW*DAYS	15 & 16	ITA	DTS	21381964	21772464	23699835	23644626
KW*DAYS	15 & 16	ITA	HOK	3153486	1758722	2076446	1695903
KW*DAYS	15 & 16	ITA	PGP	2691324	2302777	2207660	2378933
KW*DAYS	15 & 16	ITA	PMP	223470			
KW*DAYS	15 & 16	ITA	PTS	962786	1063031	1592930	1431085
TSLDAYS	15 & 16	ITA	DTS				
TSLDAYS	15 & 16	ITA	PGP				
TSLDAYS	15 & 16	ITA	PMP				
TSLDAYS	15 & 16	ITA	PTS				

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (1-3)= 0.83	Females;(TRP)
F_{max} (1-3)= 1.27	Females; (LRP)
F_{msy} (age range)= not available	
F_{pa} (F_{lim}) (age range)= not available	
B_{msy} (spawning stock)= not available	

Table of limit and target management reference points or levels **agreed by fisheries managers.**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

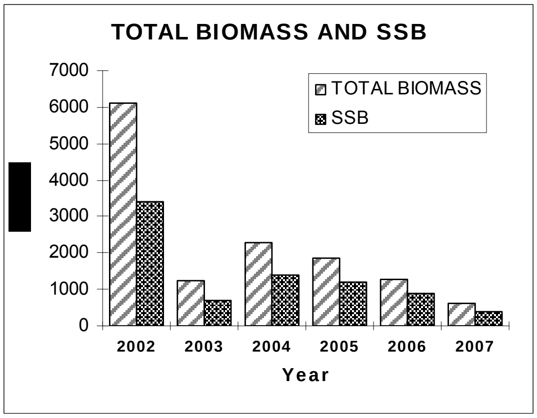
6.17. Anchovy in GSA 01

Species common name:	Anchovy
Species scientific name:	*Engraulis encrasicolus*
Geographical Sub-area(s) GSA(s):	GSA 01 – Northern Alboran Sea

Most recent state of the stock

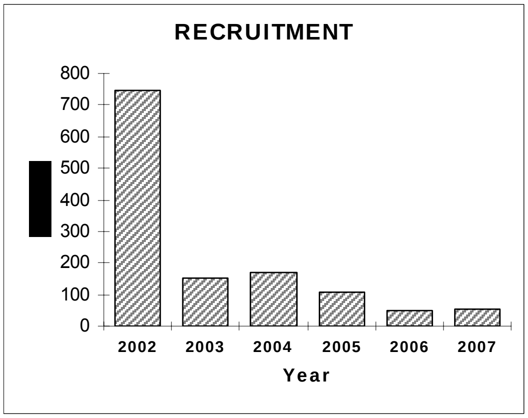
- State of the adult abundance and biomass:

Both total biomass in 2007 (TB=633 t) and Spawning Stock Biomass in 2007 (SSB=378 t) are the lowest of the series 2002-2007, continuing with the decreasing trend observed since 2004.
No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.



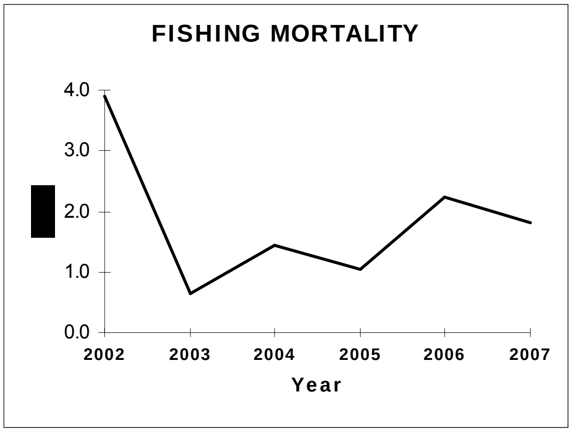
- State of the juvenile (recruits):

Recruitment levels in 2006 and 2007 are the lowest of the time series (R_{06}=48 millions and R_{07}=54 millions).



- State of exploitation:

Since 2002 fishing mortality (F_{0-2}) has varied between 3.9 and 0.6. The maximum was observed in 2002, then falling down to the minimum in 2003. Since then, F shows an increasing trend (F_{07}=1.82).
No reference points were proposed for fishing mortality levels, and hence SGMED cannot comment on the state of the stock with this respect.



- Source of data and methods:

This assessment is based on VPA (XSA) methods. VPA Lowestoft software suite (Darby and Flatman 1994) was used and XSA was the assessment method. A separable VPA (Pope and Sheperd, 1982) was also run as exploratory analysis for this stock. Deterministic short term projections were also produced.

Data used for XSA:

- Landings from 2002-2007 from all Fishery ports from GSA01.
- Combined ALK (2003-2007) for all the years.
- Length Distributions 2003-2007. 2003 Length Distribution was applied for 2002.
- Biological sampling 2003-2007 for Maturity at age and Weight-Length relationships.
- Tuning data from acoustic survey ECOMED and Commercial Fleet off Málaga for years 2003 to 2006.

The stock is also assessed by acoustic methods. ECOMED abundance data from 2003 to 2006 were also used for tuning the XSA model. The ECOMED survey did not cover the whole area in 2003 and 2006, sampling only the two most representative bays of GSA01. For 2004 and 2005 the whole GSA01 area was acoustically sampled. No data for 2007 was available from ECOMED survey, as weather conditions and lack of available time did not allow the area to be sampled.

Both XSA and acoustics methods have the same perception of the state of the stock.

Outlook and management advice

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

It should be noted that small pelagic fishery in GSA01 is multispecies and effort on sardine and anchovy should be considered together.

- Short Terms Deterministic Projections for three years (2008 to 2010).

Landings, total biomass and SSB is predicted to remain at the same levels under this management scenario.

Assuming status quo F ($Fbar_{05\text{-}07}$=1.70) and the recruitment is the percentile 10% of the recruitment time series (Rlow=54 millions) as suggested by the GFCM WG on Joint Stock Assessment at Izmir. We realise this option is more conservative but the most realistic and robust as recruitment is continuously decreasing in last years.

- Landings are predicted to be 271 t in 2008 and 284 t in 2009.
- Total biomass are predicted to be 738 t in 2008 and 759 t in 2010.
- SSB will remain stable from 427 t in 2008 to 446 t in 2010.

2008				
Biomass	SSB	FMult	FBar	Landings
738	427	1	1.6981	271

2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
756	443	0	0	0	992	667
.	443	0.1	0.1698	42	954	630
.	443	0.2	0.3396	80	920	598
.	443	0.3	0.5094	115	891	570
.	443	0.4	0.6792	146	865	546
.	443	0.5	0.8491	174	842	524
.	443	0.6	1.0189	200	822	505
.	443	0.7	1.1887	223	803	488
.	443	0.8	1.3585	245	787	472
.	443	0.9	1.5283	265	772	459
.	443	1	1.6981	284	759	446
.	443	1.1	1.8679	301	747	435
.	443	1.2	2.0377	317	736	425
.	443	1.3	2.2076	332	726	416
.	443	1.4	2.3774	347	717	407
.	443	1.5	2.5472	360	708	399
.	443	1.6	2.717	372	700	392
.	443	1.7	2.8868	384	693	386
.	443	1.8	3.0566	395	687	380
.	443	1.9	3.2264	406	681	374
.	443	2	3.3962	416	675	369

- Source of data and methods.

Deterministic short-term forecast was performed using MFDP software (Multi-Fleet Deterministic Projections).

Fisheries

The current fleet in GSA01 Northern Alborán Sea is composed by 136 units, characterised by small vessels. 22% of them are smaller than 12 m, 78% between 12 and 24 m. The purse seine fleet has been continuously decreasing in the last two decades, from more than 230 vessels in 1980 to 136 in 2007.

Anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) and are the main target species of the purse seine fleet in Northern Alboran GSA01, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus spp.*), mackerel (*Scomber spp.*) and gilt sardine (*Sardinella aurita*).

Brief description of trends:

The annual landings of anchovy in the Northern Alborán Sea show a strong annual fluctuation for the last six years ranged between 3268 and 245 tons. Landings decreased in 2007, reaching up 245 t (the same value found in 2003) that are the lowest of the time series.

Discards are negligible.

Table of landings (Spanish purse seiners in GSA01).

YEAR	LANDINGS (tonnes)
2002	3268
2003	245
2004	746
2005	518
2006	637
2007	245

Table of fishing effort (Spanish purse seiners by segment in GSA01).

	VL0012			VL1224			VL2440		
	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	373	3697	33352	3662	96196	480075			
2003	548	5124	40364	3949	99069	500302			
2004	445	3780	29149	3217	74599	389661			
2005	448	3656	28795	3506	89424	445675			
2006	419	3481	27732	4145	111485	552119	4	312	1295
2007	362	3422	22471	3704	103083	509196	5	390	1619

Limit and target management reference points or levels

Some work was done in SGMED-08-04 and some preliminary reference points were estimated were based on yield-per-recruit analysis. However the use of yield-per-recruit targets for long-term management of pelagic fisheries has been specifically discouraged (Patterson, 1992) and no reference points can be proposed at this time. Further research is aimed to produce effective Reference Points in this small pelagic fishery as well as Harvest Control Rules.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range) =	
F_{max} (age range) =	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of precautionary and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

Monitoring of the stock should be continued. It is also recommended a complete sampling of ECOMED acoustic survey for the whole GSA01 area.

The WG considered the M vector as a good approach since it has more biological sense. WG encourages the use of such approach for natural mortality input data into the assessments.

6.18. Anchovy in GSA 06

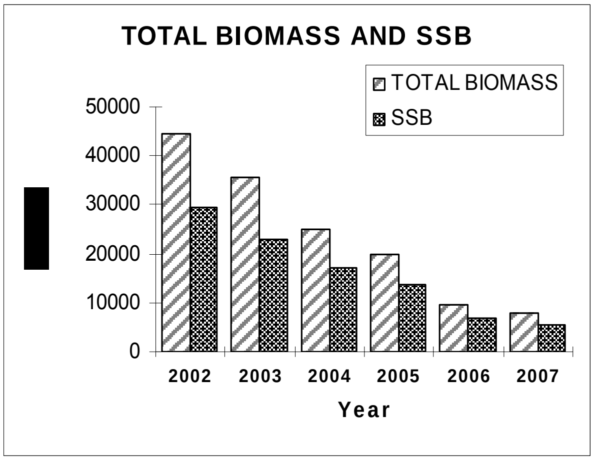
Species common name:	Anchovy
Species scientific name:	*Engraulis encrasicolus*
Geographical Sub-area(s) GSA(s):	GSA06 – Northern Spain

Most recent state of the stock

- State of the adult abundance and biomass:

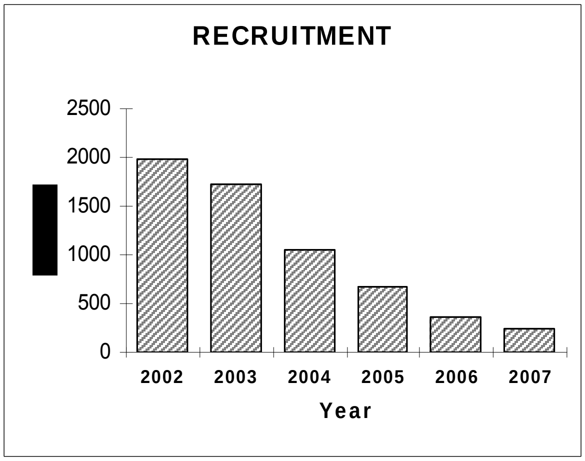
Both total biomass (TB=7,860 t) and Spawning Stock Biomass in 2007 (SSB=5,480 t) continues the sharp decrease, apparent from the beginning of the time series. The lowest observed SSB is the most recent estimate from 2007 (Bloss=5,480 t).

No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.



- State of the juvenile (recruits):

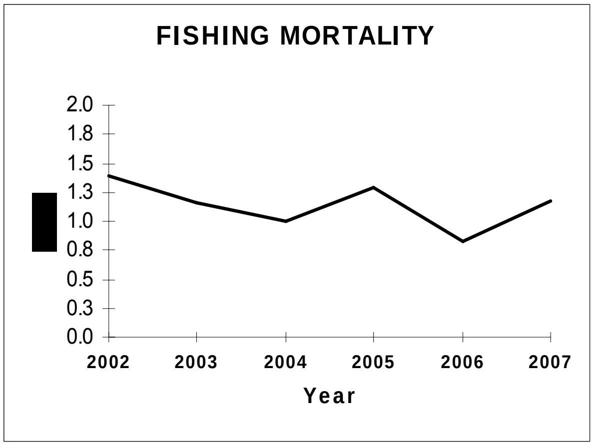
Recruitment in 2007 (R=244 millions) decreases from that of 2006 (361 millions). WG highlighted that the fishery is highly dependent of the recruitment strength.



- State of exploitation:

Fishing mortality has been fluctuating around 1.15, without a clear trend. F_{0-2} in 2007 =1.17.

No reference points were proposed for fishing mortality levels, and hence SGMED cannot comment on the state of the stock with this respect.



- Source of data and methods:

This assessment is based on VPA (XSA) methods.

Fishery assessment by VPA methods of the anchovy sardine stock GSA 06 is shown for the very first time. VPA Lowestoft software suite was used and XSA was the assessment method. A separable VPA was also run as exploratory analysis for both stocks. Deterministic short term projections were also produced.

Data used for XSA:

- Landings from 2002-2007 from GSA06, available to experts in SGMED-08-04.
- Combined ALK (2003-2007) for all the years. Length Distributions 2003-2007, Length distrib 2003 was applied to 2002 landings.
- Biological sampling 2003-2007 for Maturity at age and Weight-Length relationships.
- Tuning data from acoustic survey ECOMED.

Outlook and management advice

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

It should be noted that small pelagic fishery in GSA06 is multispecies and effort on anchovy and sardine should be considered together.

Short Terms Deterministic Projections for three years (2008 to 2010).
MFDP software (Multi-Fleet Deterministic Projections).

Catch prognosis was produced assuming status quo F ($F_{0\text{-}2}$=1.10) and recruitment is the percentile 10% of the recruitment time series (R_{low}=302 millions). We realise this option is more conservative but the most realistic and robust as recruitment is continuously decreasing in last years.

- landings are predicted to be 1,680 t in 2008 and 1,740 t in 2009.
- Total biomass will be 6,780 t in 2008, 6,920 t in 2009 and 6,970 t in 2010, what account for a decrease in 2008 with respect to 2007 and a small increase on stock numbers in subsequent years.
- SSB will decrease in 2008 to 4,170 t, with a rather small increase in following years till reach 4340 t in 2010.

2008				
Biomass	SSB	FMult	FBar	Landings
6778	4168	1	1.0951	1678

2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
6919	4287	0	0	0	8446	5771
.	4287	0.1	0.1095	249	8221	5550
.	4287	0.2	0.219	475	8020	5354
.	4287	0.3	0.3285	681	7840	5179
.	4287	0.4	0.438	869	7678	5022
.	4287	0.5	0.5475	1042	7532	4880
.	4287	0.6	0.657	1203	7400	4751
.	4287	0.7	0.7665	1351	7279	4634
.	4287	0.8	0.8761	1489	7168	4528
.	4287	0.9	0.9856	1619	7066	4430
.	4287	1	1.0951	1740	6973	4340
.	4287	1.1	1.2046	1854	6886	4257
.	4287	1.2	1.3141	1961	6806	4181
.	4287	1.3	1.4236	2062	6731	4109
.	4287	1.4	1.5331	2159	6661	4043
.	4287	1.5	1.6426	2250	6596	3982
.	4287	1.6	1.7521	2337	6535	3924
.	4287	1.7	1.8616	2420	6478	3870
.	4287	1.8	1.9711	2499	6424	3819
.	4287	1.9	2.0806	2575	6373	3772
.	4287	2	2.1901	2648	6325	3727

- Source of data and methods applied with short hints regarding data quality, quantity and underlying assumptions.

A short term projection was carried out using the MFDP software (Multi-Fleet Deterministic Projections).

Fisheries

The purse seine fleet operate in GSA 06 Northern Spain is composed by 132 units: 4% are smaller than12 m in length, 87% between 12 and 24 m and 9% bigger than 24 m. The fleet continuously decreased in the last decade, from more than 222 vessels in 1995 to 132 in 2007. This stronger reduction (59%) is possibly linked to a decreasing in anchovy catches.

Anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) are the main target species of the purse seine fleet in Northern Spain GSA06, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus* spp.), mackerel (*Scomber* spp.), and gilt sardine (*Sardinella aurita*).

The annual landings of anchovy (*Engraulis encrasicolus*) in the Northern Spain for the last six years ranged between 14340 and 2570 tons. This species is the most valuable one in pelagic fisheries off GSA 06.

Landings in 2007 were 2,570 t, showing a decrease from that of 2006 (3,100 t). The time series shows a very sharp decrease from the beginning of the times series in 2002. The lowest landings of the assessed time series is 2007.

Discards are negligible.

Year	LANDINGS (t)
2002	14338
2003	8538
2004	8097
2005	6216
2006	3096
2007	2570

Table of fishing effort (Spanish purse seiners) by vessel segments in GSA06

	VL0012			VL1224			VL2440		
YEAR	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	28	197	1896	12408	534217	2736656	178	12383	46380
2003	77	459	4337	10926	475782	2396483	196	14426	59043
2004	53	363	3514	14072	626307	3130943	1176	84527	319364
2005	44	304	2920	11403	513362	2548942	1512	108709	417447
2006	59	403	3818	11645	543460	2646176	2017	146803	558870
2007	48	344	3272	10305	466123	2242095	1895	138195	541494

Precautionary and target management reference points or levels

Some work was done in SGMED-08-04 and some preliminary reference points were estimated based on yield-per-recruit analysis. However the use of yield-per-recruit targets for long-term management of pelagic fisheries has been specifically discouraged (Patterson, 1992) and no reference points can be proposed at this time. Further research is aimed to produce effective Reference Points in this small pelagic fishery as well as Harvest Control Rules.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The WG consider the M vector is a good approach as it has more biological sense. WG encourages the use of such approach for natural mortality input data into the assessments.

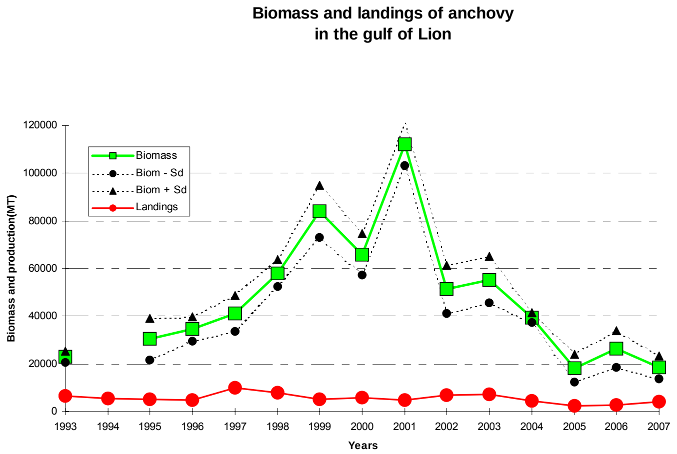
6.19. Anchovy in GSA 07

Species common name:	Anchovy
Species scientific name:	*Engraulis encrasicolus*
Geographical Sub-area(s) GSA(s):	GSA 07

Most recent state of the stock

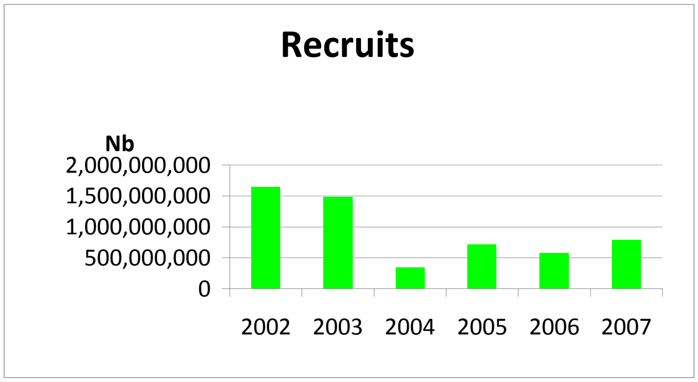
- State of the adult abundance and biomass:

SGMED is unable to precisely estimate the absolute levels of stock abundance and biomass. Survey indices indicate that recent stock biomass (2005-2007) remains at the lowest level observed since 1993. The acoustic method applied results in an estimate of 18,473 t of total biomass in 2007.



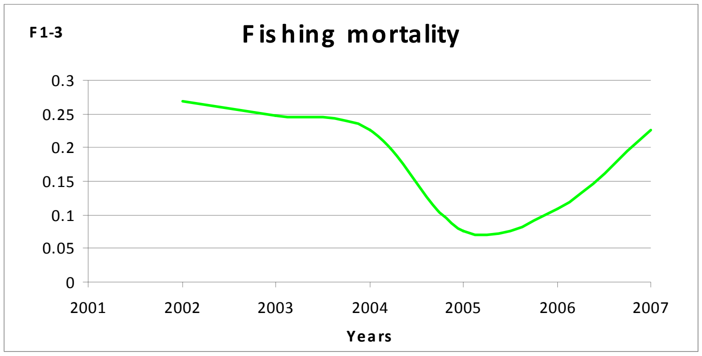
- State of the juvenile (recruits):

Recruitment since 2004 is estimated to be low in relation to the time series available.



- State of exploitation:

Fishing mortality (F_{1-3}) in 2007 is estimated to be near the maximum observed since 2002 (F_{07}~0.23). Reference points have not been proposed and hence SGMED cannot evaluate the state of the stock.



- <u>Source of data and methods:</u>

Both VPA/XSA (SCA) and acoustic methods were used. Specific methodological and data descriptions are given in the SGMED-08-04 report. Natural mortality was set at 0.5. The VPA was calibrated by means of acoustic biomass estimates.

Discards are considered to be negligible.

Outlook and management advice

SGMED recommends the fishing mortality to be reduced in order to allow future recruitment contributing to stock recovery.

It should be noted that small pelagic fishery in GSA 07 is multispecies and effort on sardine and anchovy should be considered together.

- <u>Short, medium and long term scenarios</u>

Not applicable.

- <u>Source of data and methods</u>

None.

Fisheries

The current fleet in GSA07 is composed by 50 units (all gear types included), characterised by vessels bigger than 24 m. The purse seine fleet has been continuously decreasing in the last decades, now there are only 12 units in 2007 and they catch only a small quantity of anchovy.

The annual landings of anchovy in the Gulf of Lions show strong annual fluctuation, ranging between 2,000 and 7,000 tons. Discards are occasional and negligible.

Table of landings

YEAR	LANDINGS (tonnes)
2002	6941
2003	7073
2004	4497
2005	2249
2006	2125
2007	4108

Table of fishing effort

Official data	DAYS	GTDAYS	KWDAYS
2002			
2003			
2004	7559	1045791	2835543
2005	9112	1303832	3118789
2006	14040	1628954	4983160
2007			

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range) =	
F_{max} (age range) =	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.20. Anchovy in GSA 17

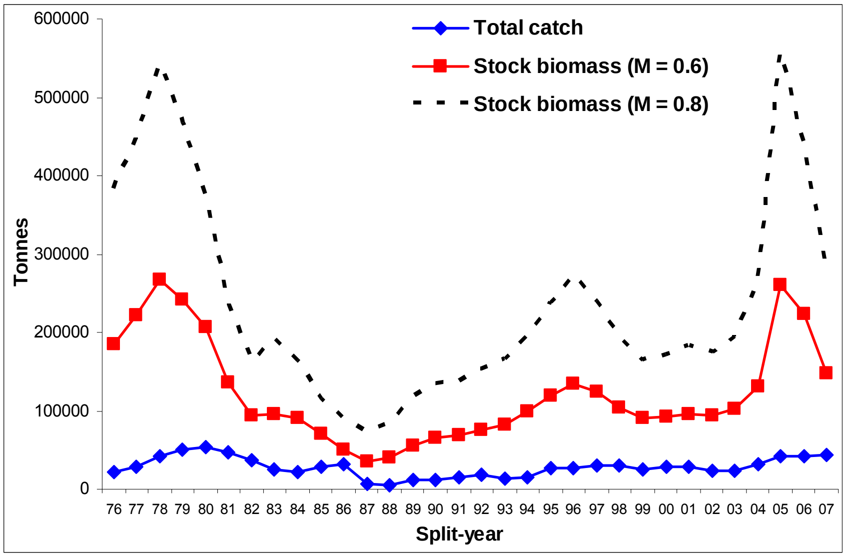
Species common name:	Anchovy
Species scientific name:	*Engraulis encrasicolus*
Geographical Sub-area(s) GSA(s):	GSA 17

Most recent state of the stock

SGMED has reviewed this assessment, which was originally conducted under the framework of GFCM.

- State of the adult abundance and biomass:

The average stock biomass estimated by VPA was 120,000 tonnes in 1976-2007 and 210,000 tonnes in 2005-2007.



In September 2004 there was a point estimate of abundance in the eastern part of GSA17: 84,369 tons. SGMED did not have the opportunity to verify this point estimate.

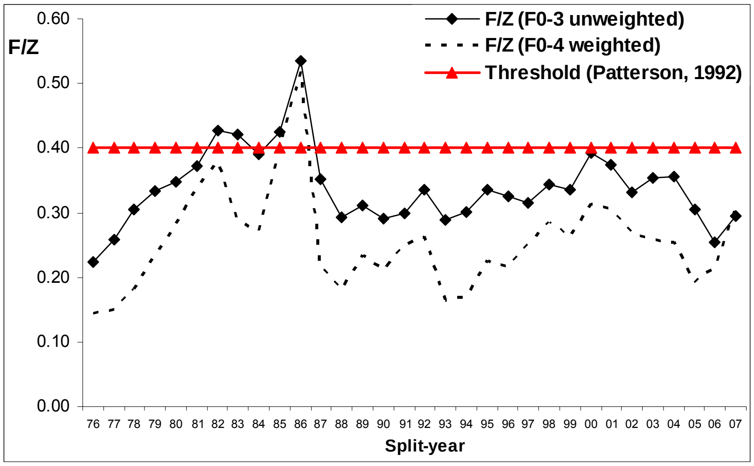
No biomass reference points have been proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock with respect to biomass.

- State of the juvenile (recruits):

Average recruitment during the period 2005-2007 was 1.6 times the average over the period 1976-2007.

- State of exploitation:

The mean ratio between total catch and stock biomass was 0.2 in 2005-2007; also, in the same period, the average exploitation rate F/Z was 0.28 and thus, lower than the threshold value 0.4 suggested as a reference point for small pelagics by Patterson (1992).



SGMED notes the fishing mortality level corresponding to F/Z=0.4 is F=0.4. F corresponding to the estimated current exploitation rate (0.28) is F=0.23.

Using the exploitation rate as a reference point for sustainable exploitation, SGMED considers this stock as being exploited sustainably.

- <u>Source of data and methods:</u>

The assessment of this stock was carried out by means of Virtual Population Analysis (VPA), using catch data collected for Italy, Slovenia and Croatia, from 1975 to 2007. Split-year data were used assuming the first of June as the birth date of anchovy. The annual natural mortality rates M = 0.6 and M = 0.8 were employed for VPA calculations; however, according to a precautionary approach, much more emphasis was given to the results obtained with M = 0.6, i.e. all the results mentioned in this document were obtained with M = 0.6. The Laurec-Shepherd tuning of VPA was performed using an abundance index series derived from echo-surveys carried out in the western part of the GSA17. Additional trials with Integrated Catch Analysis (ICA) were also done during the last SCSA-SAC-GFCM meeting (Izmir, 22-26 September 2008), but the results were not mentioned in this document.

Outlook and management advice

- <u>Short, medium and long term scenarios:</u>

Projections of stock status were not performed.

SGMED recommends the relevant fleet efforts to be kept at fishing mortality levels (F/Z<0.4) appropriate to maintain high long term sustainable yields.

It should be noted that small pelagic fishery in the GSA17 is multispecies and effort on sardine and anchovy should be considered together. Management of anchovy should therefore take into account the status of sardine, due to these mixed fishery considerations.

- <u>Source of data and methods:</u>

Not applicable.

Fisheries

Mid-water trawlers and purse seiners. In 2007, the Italian fleet was composed of about 130 (65 pairs) pelagic trawlers (*volante*) mainly operating from Trieste to Ancona (average GRT 43, average engine power 290 kW) and about 45 purse seiners attracting fish with light (*lampara*), operating in the Gulf of Trieste (24 small *lampara*, average GRT 9, average engine power 110 kW) and in the Central Adriatic (21 big *lampara*, average GRT 97, average engine power 390 kW). In 2007, the Slovenian fleet was composed of 1 pelagic trawler pair and 7 purse seiners; no updated data are available for the Croatian fleet.

The main fraction of the total catch has been usually taken by the Italian fleet but, in recent years, the fraction relative to the fleets of the eastern part of the GSA17 has increased.

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	
E_{lim} (F/Z, F age range 0-3)	0.4

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

SGMED notes that there was no information presented during the meeting regarding the fry fishery within GSA17. The catches of fry fishery are believed to be negligible in this GSA by CNR-ISMAR-SPM Fish Population Dynamics Unit. Fry fishery may be more important in GSA18 and an ongoing EU funded project (SARDONE) will allow to evaluate if this fishery has an impact also on the stock in GSA17.

The natural mortality rate was taken as fixed over ages and years. Trials with a vector of natural mortality rates at age could be done in the future. ICA could be applied more extensively in the future.

Inclusion of all catch data for anchovy in GSA17 should be ensured.

Explore the possibility to include acoustic survey data carried out in the eastern part of GSA17 as a tuning fleet within the assessment.

6.21. Anchovy in GSA 22

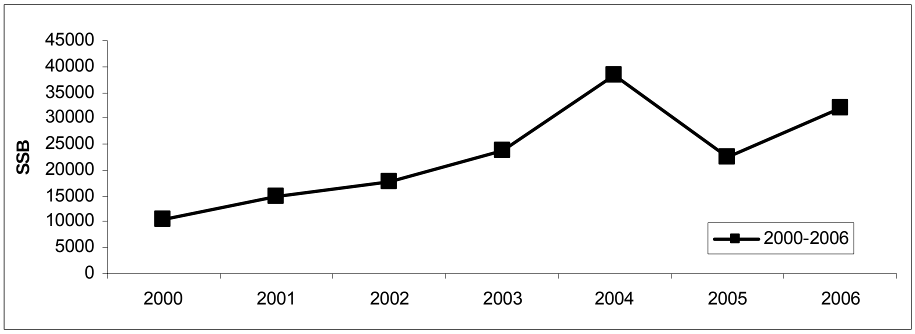
Species common name:	Anchovy
Species scientific name:	*Engraulis encrasicolus*
Geographical Sub-area(s) GSA(s):	GSA 22

Most recent state of the stock

- State of the adult abundance and biomass:

Given the short length of the time series, SGMED is unable to precisely estimate the absolute levels of stock abundance and biomass. Survey indices and VPA analyses indicate that average total biomass and SSB has increased in 2006. SSB in 2006 estimated from the ICA model is around 30,000 t.

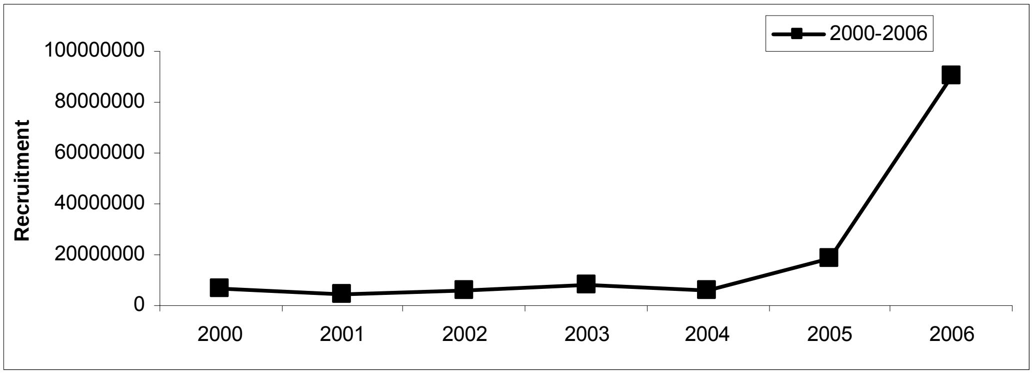
Limit reference points have not been estimated for this stock, and hence advice relative to these cannot be provided by SGMED.



SSB estimates of ICA model for anchovy stock in GSA 22.

- State of the juvenile (recruits):

ICA model estimates suggest an exceptionally high recruitment in 2006.

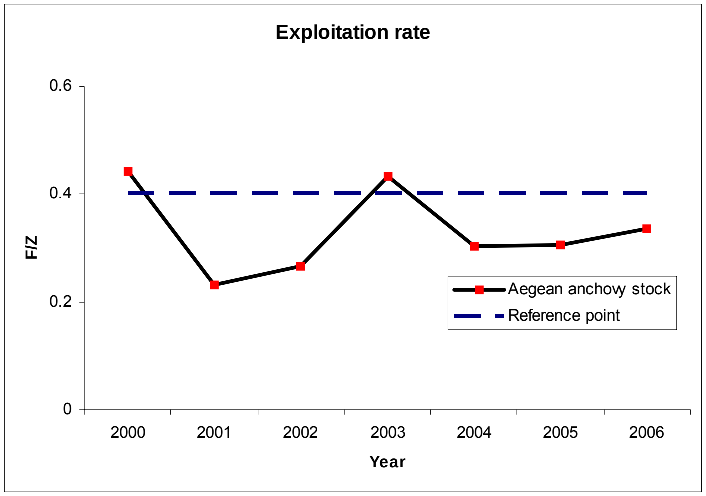


Recruitment estimates of ICA model for anchovy stock in GSA 22.

- State of exploitation:

Based on ICA results, the mean F/Z (F averaged over ages 1 to 3) has fluctuated around 0.32 and has been below the empirical level of sustainability (E<0.4, Patterson 1992) for small pelagics since 2004.

Taking the empirical level as a reference point for sustainable exploitation, the stock is considered to be exploited sustainably.



Exploitation rate based on F for ages 1 to 3 estimates of ICA results for anchovy stock in GSA 22.

- Source of data and methods:

This assessment is based on fishery independent surveys information as well as on Integrated Catch at Age (ICA) analysis model. Specifically, acoustic surveys estimations were used for Total Biomass estimates and DEPM surveys for the estimation of SSB. ICA assessment method uses separable virtual population analysis (VPA) with weighted tuning indices. The application of ICA was based on commercial catch data (2000-2006) and as tuning indices were used the biomass estimates from acoustic surveys and the Daily Egg Production Method (DEPM) estimates over the period 2003-2006. Anchovy data were comprised of annual anchovy landings, annual anchovy catch at age data (2000-2006), mean weights at age, maturity at age at age and the results of acoustic and DEPM surveys. Since, acoustics and DEPM are being applied at the same time and with the same research vessel acoustic estimates were used as an index for the numbers at age of the population and DEPM estimates as stock spawning biomass estimates. Natural mortality was set constant for all ages and years at value of 0.7. Reference age for the fishery was age group 2, as fully exploited and fully recruited. The age groups 0, 4 and 5 were underweighted in the analysis based on their percentage in the catch. Age 1 was also underweighted in the acoustic surveys (0.5). Catchability for the DEPM index is assumed as absolute indicator of biomass and linear catchability relationship is assumed for the acoustic surveys.

The shortage of the time series restricts the acceptance of model results as absolute.

Discards are not included within this assessment, although they are expected as a result of the minimum landing size.

Outlook and management advice

Increased fishing is not expected to result in increased landings in the long term.

The absence of 2007 data prevents SGMED from providing any short or medium term projections of biomass.

Y/R analyses were performed but were not considered reliable due to its flat-topped shape. Therefore the use of $F_{0.1}$ (1.0) and F_{max} (1.9) as a reference point requires further analysis before acceptance.

For precautionary reasons the possibility of changing the closed period should be examined. Since the purse seine fishery is a multispecies fishery targeting both anchovy and sardine, a shift of the closed period (present: mid December to end of February) towards the recruitment period of anchovy (e.g. October to December) / or the recruitment period of sardine (e.g. February to April) could be suggested. This approach has the potential to improve the selectivity of the fishery, and thus provide higher potential catch in the long term.

Fisheries

In GSA 22 (Greek part) anchovy is almost exclusively exploited by the purse seine fleet. Pelagic trawls are banned and benthic trawls are allowed to fish small pelagics in percentages less than 5% of their total catch. Regarding the regulations enforced they concern a closed period from the mid December till the end of February and technical measures such as minimum distance from shore, gear and mesh size, engine, GR. There is a minimum landing size at 9 cm.

Anchovy landings showed an increasing trend towards 2006. Anchovy reported landings have showed an increasing trend since 2000, comprising 22,311 tons in 2006. Information regarding the age and length distribution of sardine landings prior to 2003 is based on the Hellenic Centre of Marine Research data collection system.

Data of the fishing effort (Days at Sea) and the landings per vessel class indicate that small vessels (12-24 m) (Tables below) are mainly responsible for anchovy catches (>70% of anchovy catches).

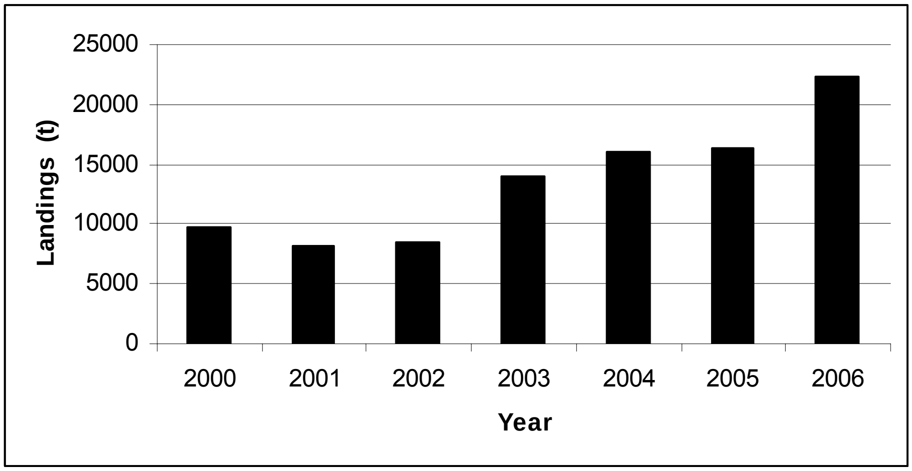
Table of anchovy landings (in t) in GSA 22 per vessel size for 2003 to 2006 concerning the purse seine fleet in Greek waters.

Year	PS 12-24 m	PS 24-40 m
2003	12507	1495
2004	12222	3877
2005	11073	5274
2006	16121	6190

No discards data were available for GSA 22.

Table of fishing effort in GSA 22 per vessel size for 2003 to 2006 concerning the purse seine fleet in Greek waters. GRT=Gross tonnage, KW=engine horsepower.

Year	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m
	Days at Sea	**Days at Sea**	**Days at Sea x GRT**	**Days at Sea x GRT**	**Days at Sea x KW**	**Days at Sea x KW**
2003	41539	2942	1767398	230726	8709727	679624
2004	39783	3989	1620847	366709	8111571	1029410
2005	42520	5690	1753346	542120	8123673	1532790
2006	37255	5619	1568893	539146	7386042	1606608



Anchovy landings for GSA 22 (2000-2006).

Limit and target management reference points or levels

No reference points concerning biomass can be suggested at this point due to the small time series of data available. Further research is aimed to produce Reference Points. F_{max} and $F_{0.1}$ are overestimated so precautionary the F_{pa} might be set as the fishing mortality that assures exploitation rate below the empirical level for stock decline (E<0.4, Patterson 1992) for small pelagic.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)= ages 1-3	n.a.
F_{max} (age range)= ages 1-3	n.a.
F_{msy} (age range)=	
E_{lim} (F/Z, age range 1-3)	0.4
B_{msy} (spawning stock)=	
B_{lim} (spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)= ages 1-3	
F_{max} (age range)= ages 1-3	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

6.22. Sardine in GSA 01

Species common name:	Sardine
Species scientific name:	*Sardina pilchardus*
Geographical Sub-area(s) GSA(s):	GSA 01 – Northern Alboran Sea

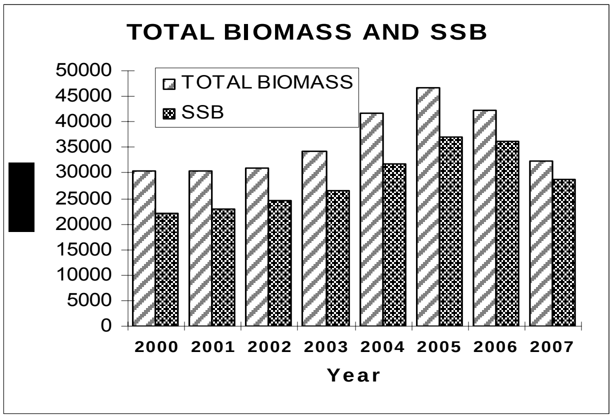
Most recent state of the stock

It is noted that sardine in GSA 01 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at http://www.gfcm.org

- State of the adult abundance and biomass:

Both Total biomass in 2007 (TB=32,300 t) and Spawning Stock Biomass in 2007 (SSB=28,800 t) decreased since 2005, although the levels are still over the lowest SSB in the time series (in 2000).

No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.



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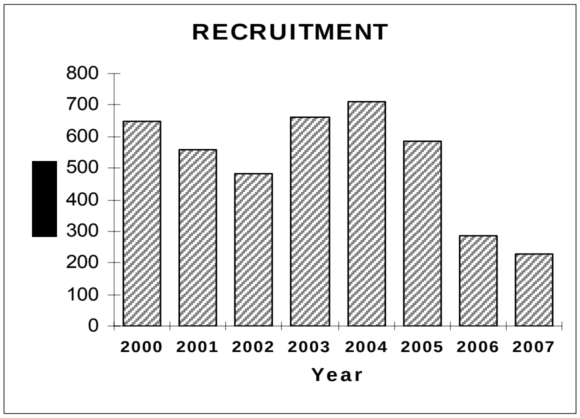
- State of the juvenile (recruits):

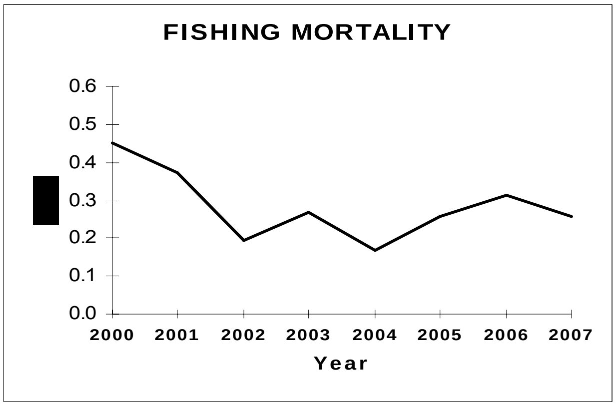
Recruitment levels in 2006 and 2007 are low relative to the rest of the time series (R=228 millions).



[redacted]

- State of exploitation:

Since 2000 fishing mortality (F_{1-3}) has varied between 0.2 and 0.4, without any consistent trend (F=0.26). No reference points were proposed for fishing mortality levels, and hence SGMED cannot comment on the state of the stock with this respect.



- Source of data and methods:

This assessment is based on VPA (XSA) methods. VPA Lowestoft software suite (Darby and Flatman 1994) was used and XSA was the assessment method. A separable VPA (Pope and Sheperd, 1982) was also run as exploratory analysis for this stock. Deterministic short term projections were also produced.

Data used for XSA:

- Landings from 2000-2007 from all Fishery ports from GSA01.
- ALK 2003-2007, combined ALK for 2000-2002. Length Distributions 2003-2007, combined for 2000-2002.
- Biological sampling 2003-2007 for Maturity at age and Weight-Length relationships.
- Tuning data from acoustic survey ECOMED and Commercial Fleet off Estepona, Málaga and Adra for years 2003 to 2007.

The stock is also assessed by acoustic methods. ECOMED abundance data from 2003 to 2006 were also used for tuning the XSA model. The ECOMED survey did not cover the whole area in 2003 and 2006, sampling only the two most representative bays of GSA01. For 2004 and 2005 the whole GSA01 area was acoustically sampling. No data for 2007 was available from ECOMED survey, as weather conditions and lack of available time did not allow the area to be sampled.

Both XSA and acoustics methods have the same perception of the state of the stock.

Outlook and management advice

It should be noted that small pelagic fishery in GSA01 is multispecies and effort on sardine and anchovy should be considered together.

- Short Terms Deterministic Projections for three years (2008 to 2010).

SGMED notes that status quo fishing should be sustainable in the short term, and result in landings of 6000 t in 2008 and 5,300 t in 2009. However, SSB is predicted to decrease around 20% by 2010 under this management scenario.

Assuming status quo F ($Fbar_{05-07}$=0.28) and the recruitment is the percentile 10% of the recruitment time series (Rlow=268 millions) as suggested by the GFCM WG on Joint Stock Assessment at Izmir, We realise this option is more conservative but the most realistic and robust as recruitment is continuously decreasing in last years.

- landings are predicted to be 6000 t in 2008 and 5300 t in 2009.
- Total biomass will decrease from 28200 t in 2008 to 23800 t in 2010.
- SSB will also decrease from 24000 t in 2008 to 19500 t in 2010.

2008				
Biomass	SSB	FMult	FBar	Landings
28236	24003	1	0.2761	5985

2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
25532	21270	0	0	0	29529	25086
.	21270	0.1	0.0276	598	28878	24456
.	21270	0.2	0.0552	1180	28246	23842
.	21270	0.3	0.0828	1746	27630	23246
.	21270	0.4	0.1104	2298	27032	22666
.	21270	0.5	0.1381	2835	26450	22102
.	21270	0.6	0.1657	3359	25884	21554
.	21270	0.7	0.1933	3868	25334	21021
.	21270	0.8	0.2209	4364	24798	20502
.	21270	0.9	0.2485	4847	24278	19998
.	21270	1	0.2761	5318	23771	19507
.	21270	1.1	0.3037	5776	23279	19030
.	21270	1.2	0.3313	6223	22800	18566
.	21270	1.3	0.359	6657	22334	18115
.	21270	1.4	0.3866	7081	21881	17676
.	21270	1.5	0.4142	7493	21440	17250
.	21270	1.6	0.4418	7895	21011	16834
.	21270	1.7	0.4694	8287	20594	16431
.	21270	1.8	0.497	8668	20189	16038
.	21270	1.9	0.5246	9039	19794	15656
.	21270	2	0.5522	9401	19410	15285

- Source of data and methods:

A deterministic short-term forecast was performed using MFDP software (Multi-Fleet Deterministic Projections).

Fisheries

The current fleet in GSA01 Northern Alborán Sea is composed by 136 units, characterised by small vessels. 22% of them are smaller than 12 m, 78% between 12 and 24 m. The purse seine fleet has been continuously decreasing in the last two decades, from more than 230 vessels in 1980 to 136 in 2007.

Sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) are the main target species of the purse seine fleet in Northern Alboran GSA01, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus spp.*), mackerel (*Scomber spp.*) and gilt sardine (*Sardinella aurita*).

Brief description of trends:

The annual landings of sardine (*Sardina pilchardus*) in the Northern Alborán Sea show a strong annual fluctuation for the last eight years ranged between 4000 and 10000 tons. Landings decreased in 2007, reaching up 6770 t.

Discards are negligible.

Table of landings (Spanish purse seiners in GSA01).

YEAR	LANDINGS (tonnes)
2000	9325
2001	7457
2002	5348
2003	8244
2004	3964
2005	7208
2006	10002
2007	6766

Table of fishing effort (Spanish purse seiners by segment in GSA01).

	VL0012			VL1224			VL2440		
	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	373	3697	33352	3662	96196	480075			
2003	548	5124	40364	3949	99069	500302			
2004	445	3780	29149	3217	74599	389661			
2005	448	3656	28795	3506	89424	445675			
2006	419	3481	27732	4145	111485	552119	4	312	1295
2007	362	3422	22471	3704	103083	509196	5	390	1619

Limit and target management reference points or levels

Some work was done in SGMED-08-04 and some preliminary reference points were estimated based on yield-per-recruit analysis. However the use of yield-per-recruit targets for long-term management of pelagic fisheries has been specifically discouraged (Patterson, 1992) and no reference points can be proposed at this time. Further research is aimed to produce effective Reference Points in this small pelagic fishery as well as Harvest Control Rules.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (1-3) =	
F_{max} (1-3) =	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on assessment

Monitoring of the stock should be continued. It is also recommended a complete sampling of ECOMED acoustic survey for the whole GSA01 area.

The WG considered the M vector as a good approach since it has more biological sense. However it needs further checking to have a complete explanation on the effects of this new M's on the assessment. It was also highlighted both the total values and that the trend of the stock does not change with respect to assessment of M=0.33, so the perception on the health of the stock and how it evolves are practically the same.

6.23. Sardine in GSA 06

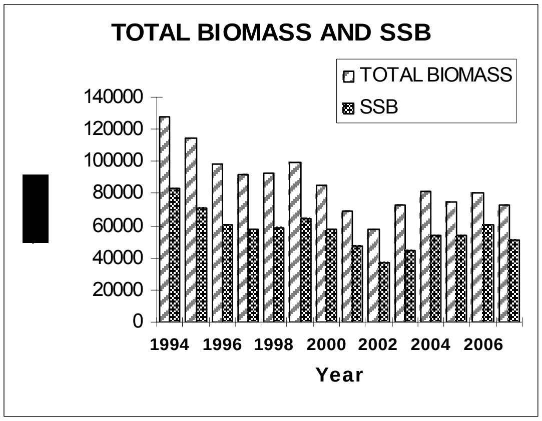
Species common name:	Sardine
Species scientific name:	*Sardina pilchardus*
Geographical Sub-area(s) GSA(s):	GSA06 – Northern Spain

Most recent state of the stock

It is noted that sardine in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at http://www.gfcm.org

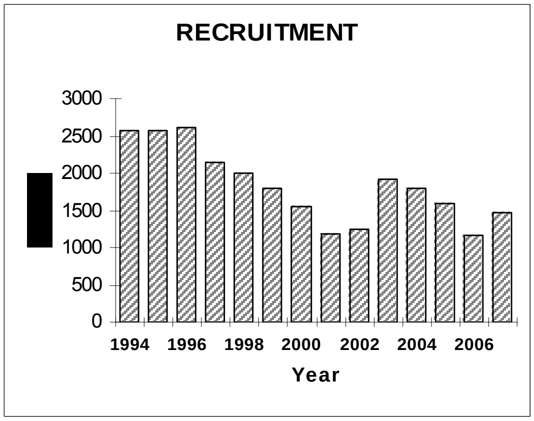
- State of the adult abundance and biomass:

SSB has decreased from 1994 to 2002 from about 80,000 t to about 40,000 t, and has subsequently increased to around 50,000 t in 2007.
No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.



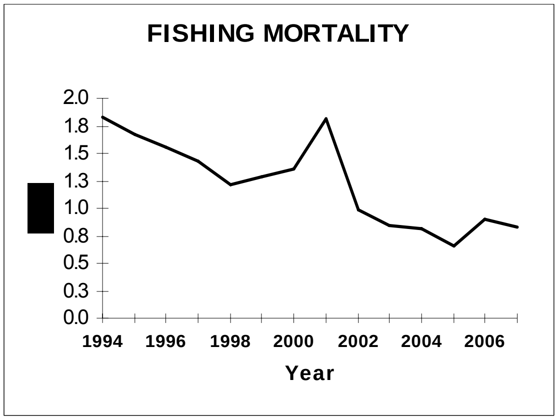
- State of the juvenile (recruits):

Recent recruitment in 2006 and 2007 has been estimated to be below average.



- State of exploitation:

Fishing mortality has declined from a high level in 1994 and 2001, to 2003, and has subsequently fluctuated around the 2003 level. F_{1-3} in 2007 =0.83.
No reference points were proposed for fishing mortality levels, and hence SGMED cannot comment on the state of the stock with this respect.



- Source of data and methods:

This assessment is based on both on VPA (XSA) methods and acoustic methods. Both XSA and acoustics methods have the same perception of the state of the stock.

Fishery assessment by VPA methods of the Spanish sardine stock GSA06 is shown. VPA Lowestoft software suite was used and XSA was the assessment method. A separable VPA was also run as exploratory analysis for both stocks. Deterministic short term projections were also produced.

Data used for XSA:

- Landings from 2000-2007 from all Fishery ports from GSA01.
- ALK 2004-2007, combined ALK for 1994-2003. Length Distributions 1994-2007.
- Biological sampling 2004-2007 for Maturity at age and Weight-Length relationships.
- Tuning data from acoustic survey ECOMED and Commercial Fleet off Barcelona, Tarragona, Castellon and Torrevieja for years 1994 to 2007.

The stock is also assessed by acoustic methods. The ECOMED survey provided data from 1990 onwards, although the abundance time series used for XSA tuning goes from 2003 onwards. The sampling coverage is completed for all years in GSA06. Both XSA and acoustics methods have the same perception of the state of the stock.

Outlook and management advice

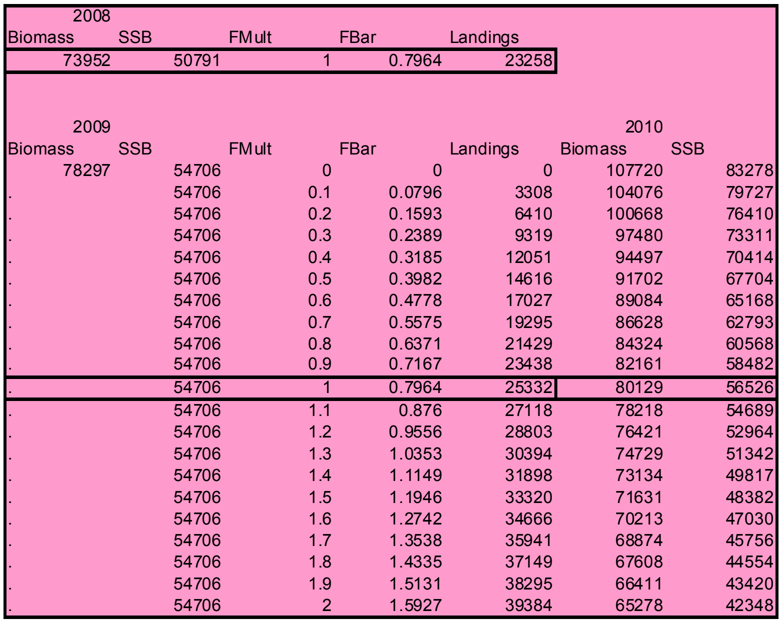
It should be noted that small pelagic fishery in GSA06 is multispecies and effort on sardine and anchovy should be considered together.

- Short, medium and long term scenarios:

SSB and catches are projected to remain at a low level relative to historical levels. The exact results are presented below.

Table 1 shows the management options from the short term catch prediction. Assuming status quo F (Fbar=0.80) and a geometric mean recruitment (RGM97-06=1603 millions),

- landings are predicted to be close to 23,200 t in 2008 and 25,300 t in 2009.
- Total biomass will be 74,000 t in 2008, 78,300 t in 2009 and 80,100 t in 2010, what account for an increase on stock numbers.
- SSB will also increase from 50,800 t to 56,500 t from 2008 to 2010.



2008				
Biomass	SSB	FMult	FBar	Landings
73952	50791	1	0.7964	23258

2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
78297	54706	0	0	0	107720	83278
.	54706	0.1	0.0796	3308	104076	79727
.	54706	0.2	0.1593	6410	100668	76410
.	54706	0.3	0.2389	9319	97480	73311
.	54706	0.4	0.3185	12051	94497	70414
.	54706	0.5	0.3982	14616	91702	67704
.	54706	0.6	0.4778	17027	89084	65168
.	54706	0.7	0.5575	19295	86628	62793
.	54706	0.8	0.6371	21429	84324	60568
.	54706	0.9	0.7167	23438	82161	58482
.	54706	1	0.7964	25332	80129	56526
.	54706	1.1	0.876	27118	78218	54689
.	54706	1.2	0.9556	28803	76421	52964
.	54706	1.3	1.0353	30394	74729	51342
.	54706	1.4	1.1149	31898	73134	49817
.	54706	1.5	1.1946	33320	71631	48382
.	54706	1.6	1.2742	34666	70213	47030
.	54706	1.7	1.3538	35941	68874	45756
.	54706	1.8	1.4335	37149	67608	44554
.	54706	1.9	1.5131	38295	66411	43420
.	54706	2	1.5927	39384	65278	42348

- <u>Source of data and methods applied:</u>

A short term projection was carried out using the MFDP software (Multi-Fleet Deterministic Projections).

Fisheries

The purse seine fleet operate in GSA 06 Northern Spain is composed by 132 units: 4% are smaller than 12 m in length, 87% between 12 and 24 m and 9% bigger than 24 m. The fleet continuously decreased in the last decade, from more than 222 vessels in 1995 to 132 in 2007.

Sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) are the main target species of the purse seine fleet in Northern Spain GSA06, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus* spp.), mackerel (*Scomber* spp.), and gilt sardine (*Sardinella aurita*).

The annual landings of sardine (*Sardina pilchardus*) in the Northern Spain for the last seventeen years ranged between 19000 and 53000 tons. This species is the most fished one in GSA 06, both for pelagic and demersal species. Although its economical value is lower than anchovy the high volume of catches makes it a valuable fishery.

Landings in 2007 were 23,980 t, showing a decrease from that of 2006 (29,350 t). The time series shows a stable pattern, although it is at low level. The lowest landings of the assessed time series are in 2002.

Discards are negligible.

Landings from 1994 to 2007 from all fishery ports in GSA 06.

Year	LANDINGS (tonnes)
1994	52439
1995	48525
1996	44387
1997	35618
1998	32274
1999	36142
2000	36972
2001	30275
2002	18762

2003	20817
2004	24874
2005	22081
2006	29381
2007	23984

Table of fishing effort (Spanish purse seiners by vessel segments in GSA06).

	VL0012			VL1224			VL2440		
YEAR	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	28	197	1896	12408	534217	2736656	178	12383	46380
2003	77	459	4337	10926	475782	2396483	196	14426	59043
2004	53	363	3514	14072	626307	3130943	1176	84527	319364
2005	44	304	2920	11403	513362	2548942	1512	108709	417447
2006	59	403	3818	11645	543460	2646176	2017	146803	558870
2007	48	344	3272	10305	466123	2242095	1895	138195	541494

Limit and target management reference points or levels

Some work was done in SGMED-08-04 and some preliminary reference points were estimated based on yield-per-recruit analysis. However the use of yield-per-recruit targets for long-term management of pelagic fisheries has been specifically discouraged (Patterson, 1992) and no reference points can be proposed at this time. Further research is aimed to produce effective Reference Points in this small pelagic fishery as well as Harvest Control Rules.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

The WG consider the M vector is a good approach as it has more biological sense. However it needs further checking to have a complete explanation on the effects of these new Ms on the assessment. It was also highlighted that the trend of the stock does not change, so the perception on the health of the stock and how it evolves it is practically the same.

6.24. Sardine in GSA 17

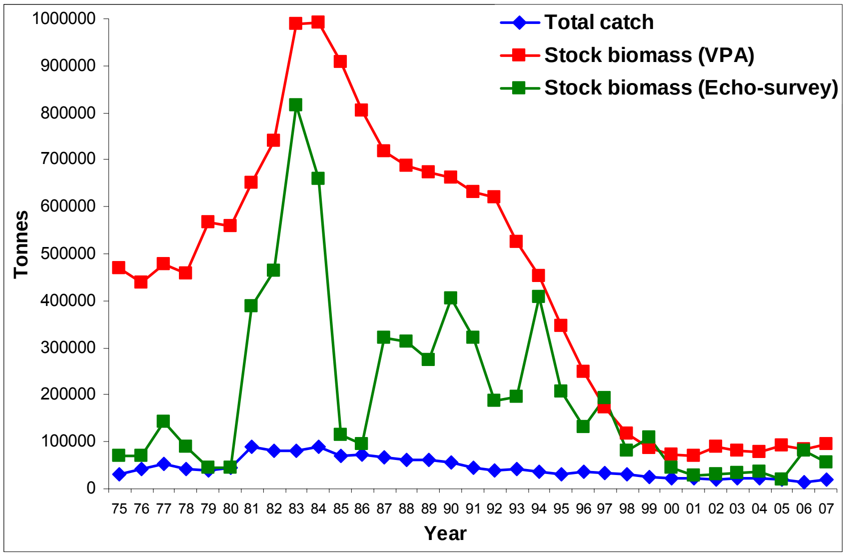
Species common name:	Sardine
Species scientific name:	*Sardina pilchardus*
Geographical Sub-area(s) GSA(s):	GSA 17

Most recent state of the stock

SGMED has reviewed this assessment, which was originally conducted under the framework of GFCM.

- State of the adult abundance and biomass:

The average stock biomass estimated by VPA was 440,000 tonnes in 1975-2007 and 90,000 tonnes in 2005-2007. Spawning stock biomass showed the lowest levels just in recent years.



GSA 17 sardine: total catch and stock biomass estimated by VPA (entire GSA 17) and echo-surveys (western part of GSA 17) over years.

In September 2004 there was a point estimate of abundance in the eastern part of GSA17: 213,332 tons. SGMED did not have the opportunity to verify this point estimate.

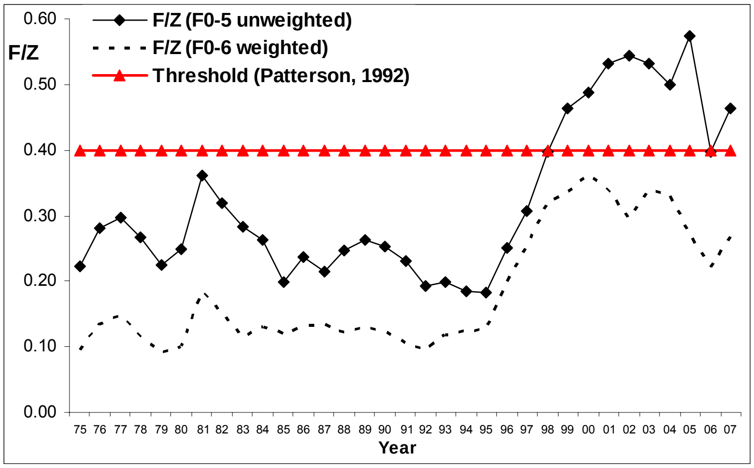
No biomass reference points have been proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock with respect to biomass.

- State of the juvenile (recruits):

The average number of recruits between 2005-2007 was 30% of the average recruits between 1975-2007. Recruitment showed the lowest levels just in recent years.

- State of exploitation:

The mean ratio between total catch and stock biomass was 0.2 in 2005-2007; however, in the same period, the average exploitation rate F/Z was 0.48. This value is higher than the threshold value 0.4 suggested as reference point for small pelagics by Patterson (1992).



SGMED notes the fishing mortality level corresponding to F/Z=0.4 is F=0.33. F corresponding to the estimated current exploitation rate (0.48) is F=0.46.

Using the exploitation rate as a reference point for sustainable exploitation, SGMED considers this stock as being exploited unsustainably.

- Source of data and methods:

The assessment of this stock was carried out by means of Virtual Population Analysis (VPA), using catch data collected for Italy, Slovenia and Croatia, from 1975 to 2007. The annual natural mortality rate M = 0.5 was employed for VPA calculations. The Laurec-Shepherd tuning of VPA was performed using an abundance index series derived from echo-surveys carried out in the western part of the GSA17.

Outlook and management advice

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

- Short, medium and long term scenarios:

Projections of stock status were not performed.

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is below F/Z=0.4, in order to obtain high long term sustainable yields. It must be noted that small pelagic fishery in the GSA17 is multispecies and effort on sardine and anchovy (the latter is not overexploited) should be considered together.

- Source of data and methods:

Not applicable.

Fisheries

In 2007, the Italian fleet was composed of about 130 (65 pairs) pelagic trawlers (*volante*) mainly operating from Trieste to Ancona (average GRT 43, average engine power 290 kW) and about 45 purse seiners attracting fish with light (*lampara*), operating in the Gulf of Trieste (24 small *lampara*, average GRT 9, average engine power 110 kW) and in the Central Adriatic (21 big *lampara*, average GRT 97, average engine power 390 kW). In 2007, the Slovenian fleet was composed of 1 pelagic trawler pair and 7 purse seiners; no updated data are available for the Croatian fleet.

The fractions of the total catch due to the fleets of the Italy and Slovenia-Croatia were quite similar, but the latter one accounted for higher fraction in recent years.

Limit and target management reference points or levels

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	
E_{lim} (F/Z, F age range 0-5)	0.4

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)=	
F_{max} (age range)=	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

Comments on the assessment

Inclusion of all catch data for sardine in GSA17 should be ensured.

Explore the possibility to include acoustic survey data carried out in the eastern part of GSA17 as a tuning fleet within the assessment.

SGMED notes that there was no information presented during the meeting regarding the fry fishery within GSA17. The catches of fry fishery are believed to be negligible in this GSA by CNR-ISMAR-SPM Fish Population Dynamics Unit. Fry fishery may be more important in GSA18 and an ongoing EU funded project (SARDONE) will allow to evaluate if this fishery has an impact also on the stock in GSA17.

The natural mortality rate was taken as fixed over ages and years. Trials with a vector of natural mortality rates at age could be done in the future. Abundance data from echo-surveys carried out also in the eastern part of the GSA17 could be useful.

6.25. Sardine in GSA 22

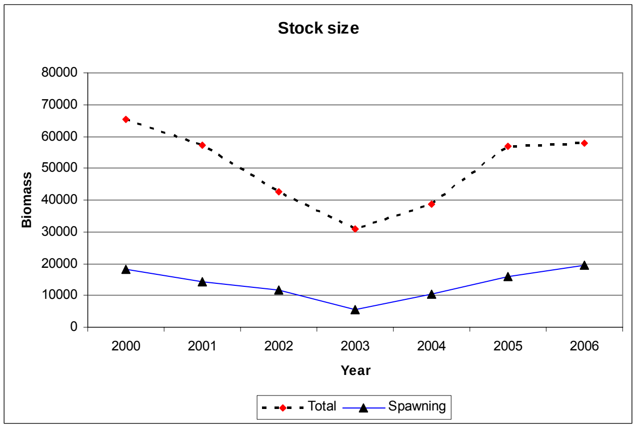
Species common name:	Sardine
Species scientific name:	*Sardina pilchardus*
Geographical Sub-area(s) GSA(s):	GSA 22

Most recent state of the stock

- State of the adult abundance and biomass:

Given the short length of the time series, SGMED is unable to precisely estimate the absolute levels of stock abundance and biomass. Survey indices and VPA analyses indicate that average total biomass and SSB has increased in 2006. SSB in 2006 estimated from the ICA model is just below 20,000 t.

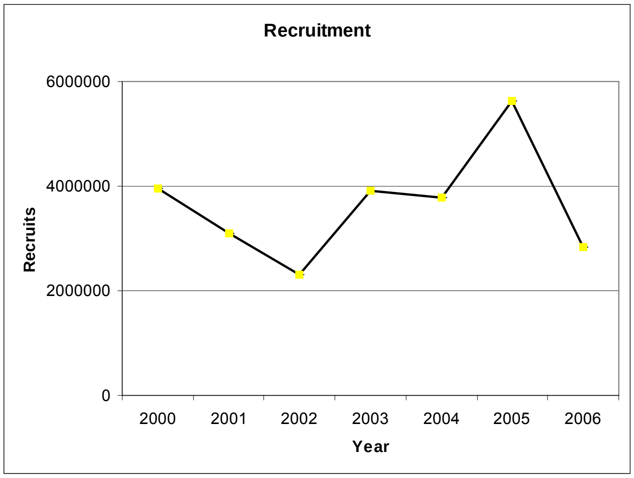
Limit reference points have not been estimated for this stock, and hence advice relative to these cannot be provided by SGMED.



TB and SSB estimates of ICA model for sardine stock in GSA 22.

- State of the juvenile (recruits):

ICA model estimates suggest recruitments are low in 2006.

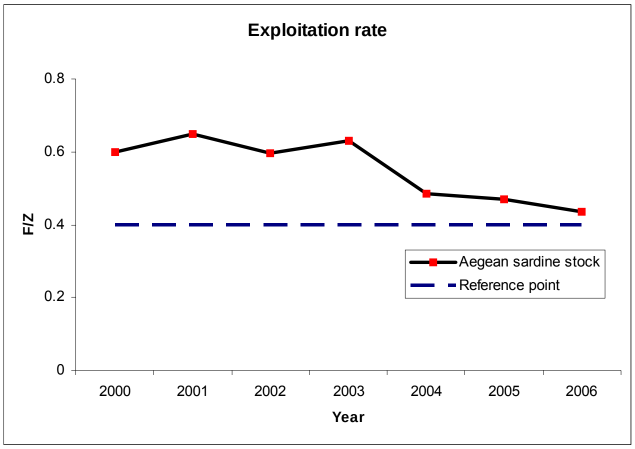


Recruitment estimates of the ICA model for sardine stock in GSA 22.

- State of exploitation:

Based on ICA results, the mean fishing mortality (averaged over ages 1 to 3) showed a clear decreasing trend, and has remained below 0.75 since 2004. The mean F/Z has declined from 2003 but remains above the empirical level of sustainability (E<0.4, Patterson 1992) for small pelagics.

Taking the empirical level as a reference point for sustainable exploitation, overfishing is occurring.



Exploitation rate based on F for ages 1 to 3 estimates of ICA results for sardine stock in GSA 22.

- <u>Source of data and methods:</u>

This assessment is based on fishery independent surveys information as well as on Integrated Catch at Age (ICA) analysis model. Acoustic surveys estimations were used for Total Biomass estimates. ICA assessment method uses separable virtual population analysis (VPA) with weighted tuning indices. The application of ICA was based on commercial catch data (2000-2006) and as tuning indices were used the biomass estimates from acoustic surveys estimates over the period 2003-2006. Sardine data were comprised of annual sardine landings, annual sardine catch at age data (2000-2006), mean weights at age, maturity at age at age and the results of acoustic surveys. Natural mortality was set constant for all ages and years at value of 0.8. Reference age for the fishery was age group 2, as fully exploited and fully recruited. The age groups 0, 4 and 5 were underweighted in the analysis based on their percentage in the catch. Age 1 was also underweighted in the acoustic surveys (0.5). Linear catchability relationship assumed for the acoustic surveys.

The shortage of the time series restricts the acceptance of model results as absolute.

Discards are not included within this assessment, although they are expected as a result of the minimum landing size (11cm).

Outlook and management advice

The absence of 2007 data prevents SGMED from providing any short or medium term projections of biomass.

Y/R analyses were performed but were not considered reliable due to its flat-topped shape. Therefore the use of $F_{0.1}$ (0.8) and F_{max} (2.8) as reference points requires further analysis before acceptance.

Given current estimated fishing mortality is above the exploitation rate 0.4, effort should be decreased so that the exploitation rate falls below this level. This requires consideration of the mixed fisheries nature of the fleets.

For precautionary reasons the possibility of changing the closed period should be examined. Since the purse seine fishery is a multispecies fishery targeting both anchovy and sardine, a shift of the closed period (present: mid December to end of February) towards the recruitment period of anchovy (e.g. October to December) / or the recruitment period of sardine (e.g. February to April) could be suggested. This approach has the potential to improve the selectivity of the fishery, and thus provide higher potential catch in the long term.

Fisheries

In GSA 22 (Greek part) sardine is almost exclusively exploited by the purse seine fleet. Pelagic trawls are banned and benthic trawls are allowed to fish small pelagics in percentages less than 5% of their total catch. Regarding the regulations enforced they concern a closed period from the mid December till the end of February and technical measures such as minimum distance from shore, gear and mesh size, engine, GR. There is a minimum landing size at 11 cm.

Sardine landings showed a decreasing trend towards 2006, comprising 12,784 tons in 2006. Information regarding the age and length distribution of sardine landings prior to 2003 is based on the Hellenic Centre of Marine Research data collection system.

Data of the fishing effort (Days at Sea) and the landings per vessel class indicate that small vessels (12-24 m) (Tables below) are mainly responsible for sardine catches (> 88% of the total catches). The purse seine fishery is considered a mixed fishery, where sardine, anchovy and other species are caught.

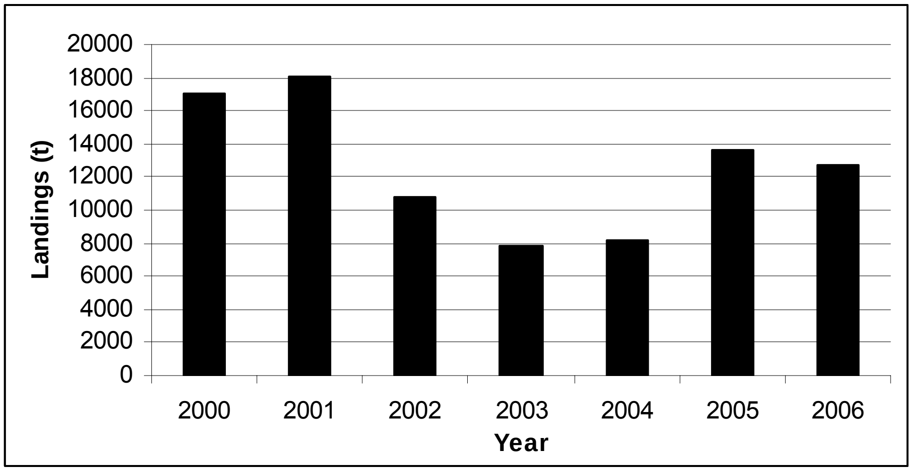
Table of sardine landings (in t) in GSA 22 per vessel size for 2003 to 2006 concerning the purse seine fleet in Greek waters derived from data provided to DCR call.

Year	PS 12-24 m	PS 24-40 m
2003	7158	634
2004	7267	902
2005	12159	1468
2006	11618	1166

No discards data were available for GSA 22.

Table of fishing effort in GSA 22 per vessel size for 2003 to 2006 concerning the purse seine fleet in Greek waters. GRT=Gross tonnage, KW=engine horse power.

Year	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m
	Days at Sea	**Days at Sea**	**Days at Sea x GRT**	**Days at Sea x GRT**	**Days at Sea x KW**	**Days at Sea x KW**
2003	41539	2942	1767398	230726	8709727	679624
2004	39783	3989	1620847	366709	8111571	1029410
2005	42520	5690	1753346	542120	8123673	1532790
2006	37255	5619	1568893	539146	7386042	1606608



Sardine landings for GSA 22 (2000-2006).

Limit and target management reference points or levels

No reference points concerning biomass can be suggested at this point. Further research is aimed to produce Reference Points. Reference Points. F_{max} and $F_{0.1}$ are overestimated so precautionary the F_{pa} might be set as the fishing mortality that assures exploitation rate below the empirical level for stock decline (E<0.4, Patterson 1992) for small pelagic.

Table of limit and target management reference points or levels **proposed by SGMED**

$F_{0.1}$ (age range)=	n.a.
F_{max} (age range)=	n.a.
F_{msy} (age range)=	
E_{lim} (F/Z, age range 1-3)	0.4
B_{msy} (spawning stock)=	
$B_{lim\,(}$spawning stock)=	

Table of limit and target management reference points or levels **agreed by fisheries managers**

$F_{0.1}$ (age range)= ages 1-3	
F_{max} (age range)= ages 1-3	
F_{msy} (age range)=	
F_{pa} (F_{lim}) (age range)=	
B_{msy} (spawning stock)=	
B_{pa} (B_{lim}, spawning stock)=	

7. STOCK ASSESSMENTS REVIEWED OR CONDUCTED

7.1. Introductory notes

SGMED-08-04 presents the following stock assessment approaches in an agreed and consistent format in order to allow scientists and fisheries managers a quick review of all information provided, the methods used and the assessment results.

Constrained by data availability and the fact, that the framework of SGMED has just been created in 2008, not all the assessments presented are considered final. SGMED will continue to improve and update the assessments in the future, especially where data or scientific advice with respect to target and limit references of stock size and exploitaiton is lacking.

The assessments are largely based on data obtained through the DCR and two official calls issued in 2008 for fisheries and scientific survey data, also covering data collected during national programmes or projects co-funded by the EU-Commission. SGMED was often unable to verify the origin or quality of the data used in the assessment but will continue its effort to validate the data through expert knowledge and transparent presentation of the data.

In some assessments, SGMED apllied a number of different approaches in order to verify the assessment results. The assessment tools applied are CPUE analyses from surveys, hydro-acoustic surveys, daily egg productions, virtual population analyses (XSA or ICA) calibrated with survey or commercial data on stock abundance, pseudo-cohort analyses (VIT), deterministic short and medium term forecasts, and various dynamic production models under equilibrium (YpR) or non-equilibrium conditions (ALADYM, ASPIC).

7.2. Stock assessment of hake in GSA 01

7.2.1. Stock identification and biological features

7.2.1.1. Stock Identification

The delimitation of the hake stock in GSA01 is considered largerly unknown. Likely connections with hake in GSA06 may exist, because of the continuity of shelf. Large exchanges with the south Alborán Sea (GSA03) are believed insignificant.

7.2.1.2. Growth

Two growth parameter sets were considered: fast and slow. Also different values were used for males and females.They are shown in Table 7.2.1.2.1.

Table 7.2.1.2.1. Two sets of growth parameters (v. Bertalanffy) by sex for hake in GSA 01.

	Fast growth Females	Fast growth Males	Slow growth Females	Slow growth Males	Units
Linf	100.7	72.8	100.7	72.8	cm
K	0.248	0.298	0.124	0.149	$year^{-1}$
t0	-0.35	-0.383	-0.35	-0.383	year
a	0.0069	0.0069	0.0069	0.0069	gr
b	3.03	3.03	3.03	3.03	
M	0.18	0.22	0.18	0.22	$year^{-1}$

7.2.1.3. Maturity

The following maturity at length ogive was used for assessments in GSAs 01, 05 and 06. The more recent years indicate signifianct reduction in size at maturation.

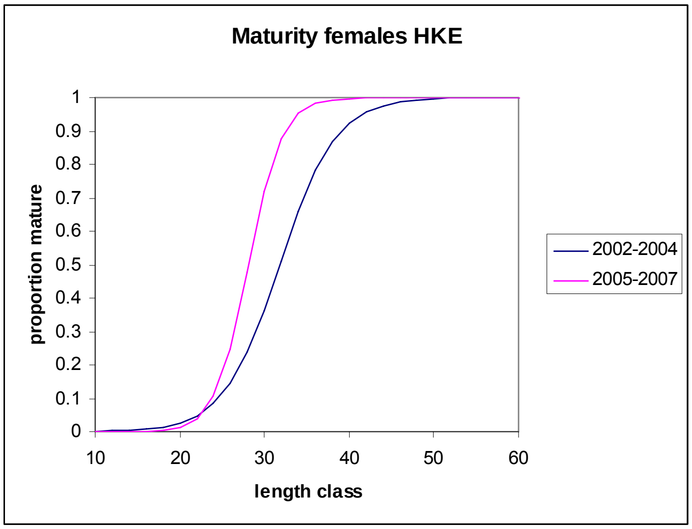
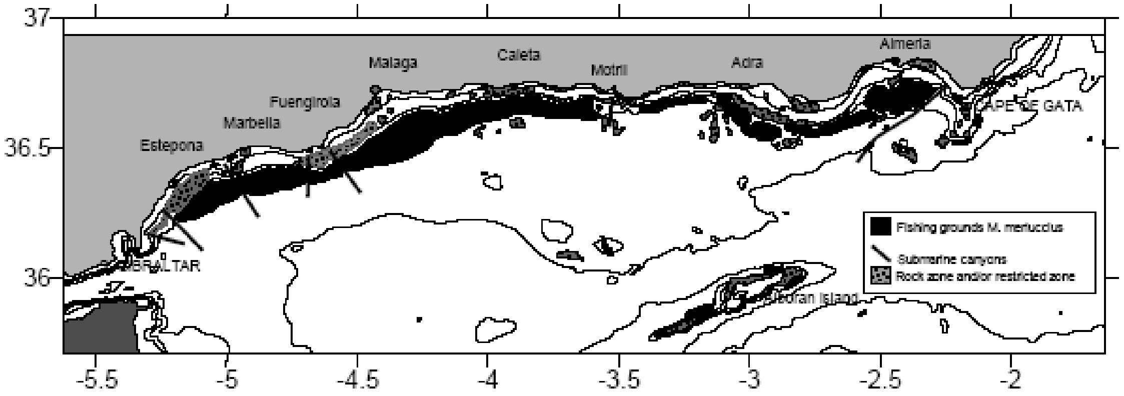


Fig. 7.2.1.3.1 Maturity ogives for female hake in GSAs 01, 05 and 06.

7.2.2. Fisheries

7.2.2.1. General description of fisheries

Hake is exploited in all trawlable areas from Gibraltar straight to Cape of Gata, including the deep-bottom fishing grounds about GSA 2. Commonly small hakes are caught from shallow waters about 50 m to 300 m depth, whereas adults reach the maximum depths exploited, 800 m, associated with the red shrimp (*Aristeus antennatus*) fishery. Hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries in GSA 01.



Fishing grounds M. Merluccius in GSA 1 (Source: I.E.O.)

Fig. 7.2.2.1.1 Fishing grounds of hake in GSA 01. Countries: only Spain

7.2.2.2. Management regulations applicable in 2007 and 2008

No information was provided to SGMED-08-04.

7.2.2.3. Catches

7.2.2.3.1. Landings

Fig. 7.2.2.3.1.1 shows the trend in reported landings taken by trawlers (Spain only). The data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.1 of Appendix 3.

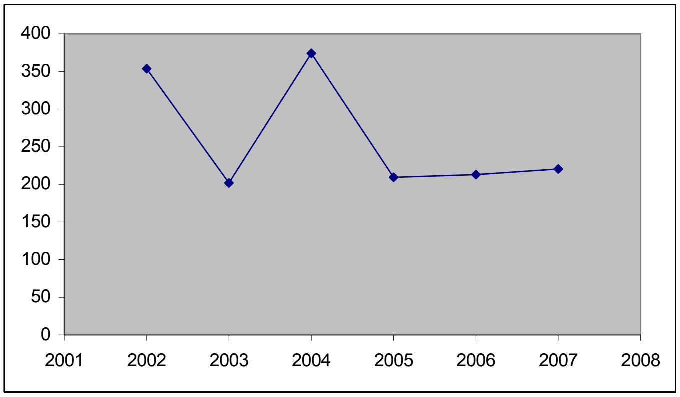


Fig. 7.2.2.3.1.1 Annual hake landings (t) by Spanish trawlers.

Annual lengths of landings were reported to SGMED-08-04 only for 2005-2007 and are shown in Fig. 7.2.2.3.1.2.

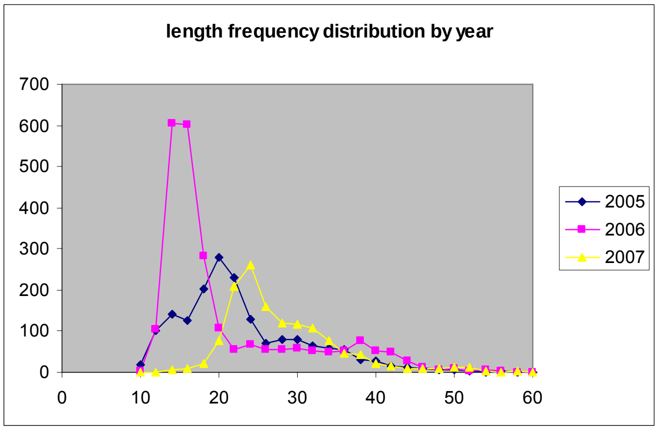


Fig. 7.2.2.3.1.2 Annual size composition of hake landings (t) by Spanish trawlers, 2005-2007.

7.2.2.3.2. Discards

SGMED-08-04 received discard data only for 2005. A total of 5.7 tons discarded in 2005 (2.7% of the landings). The data were compiled and reported through the Data collection regulation and are listed in Table A3.6 of Appendix 3.

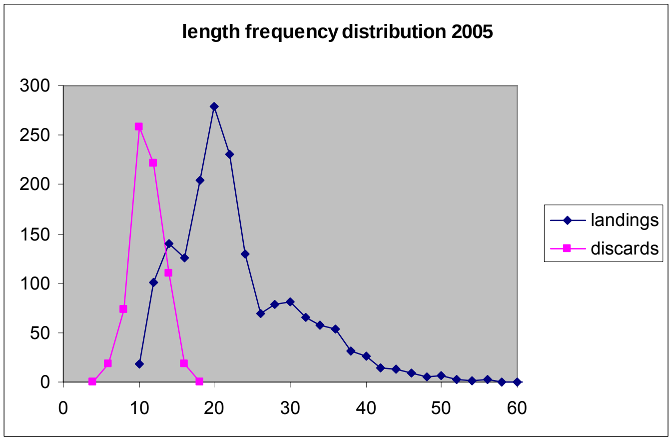


Fig. 7.2.2.3.2.1 Annual size composition of hake landings and discards (t) by Spanish trawlers, in 2005.

7.2.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9. STECF (stock review part II in 2007) noted that in the GSA 01 there are 140 trawlers landing around 400 tonnes by year.

7.2.3.Scientific surveys

7.2.3.1. Medits

7.2.3.1.1. Methods

SGMED was provided with evaluations of abundance and length composition for joint GSAs 1 and 6. Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 1 the following number of hauls were reported per depth stratum (s. Tab. 7.2.3.1.1.1)

Tab. 7.2.3.1.1.1. Number of hauls per year and depth stratum in GSA 01, 1994-2007

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.2.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.2.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 01 was derived from the international survey Medits. Figure 7.2.3.1.3.1 displays the estimated trend in hake abundance for the joint GSAs 01 and 06. The re-estimated trends based on the DCR data call are illustrated in section 11 of this report.

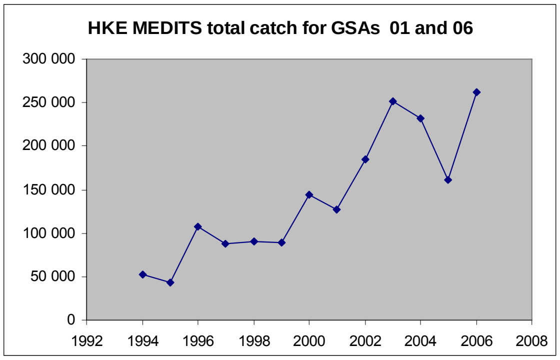


Fig. 7.2.3.1.3.1 Estimated trend in abundance indices for joint GSAs 01 and 06, 1994-2007.

However, it can be seen in the following figures, that the Medits indices for hake in GSA 01 do not follow the general increasing trend but appear to having recently increased from a very low to an average level estimated since 1994 (Fig. 7.2.3.1.3.2). The analyses of Medits indices are considered preliminary.

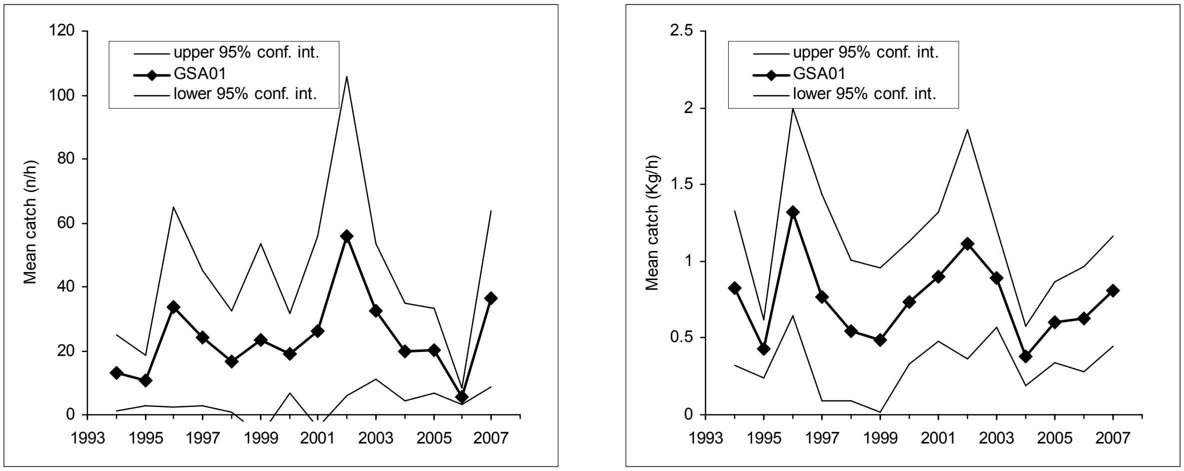


Fig. 7.2.3.1.3.2. Abundance and biomass indices of hake in GSA 01.

7.2.3.1.4. Trends in abundance by length or age

Fig. 7.2.3.1.4.1 displays the length composition of the hake stock as derived from the Medits survey for joint GSAs 01 and 06.

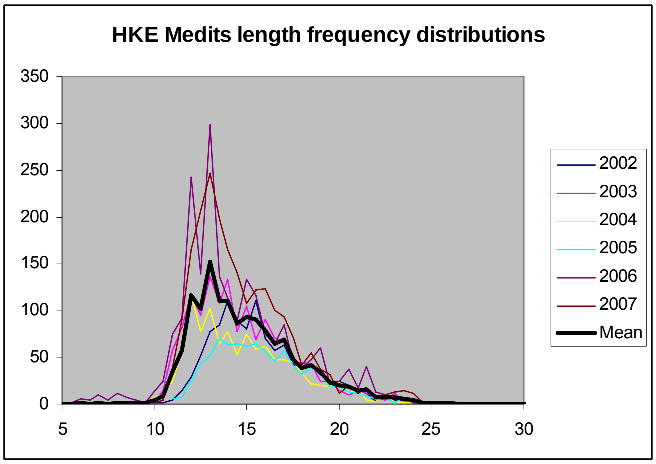


Fig. 7.2.3.1.4.1 Estimated changes in size compositions for GSAs 01 and 06, 2002-2007.

The following Fig. 7.2.3.1.4.2 and 3 display the stratified abundance indices of GSA 01 in 1994-1999 and 2000-2007. These size compositions are considered preliminary.

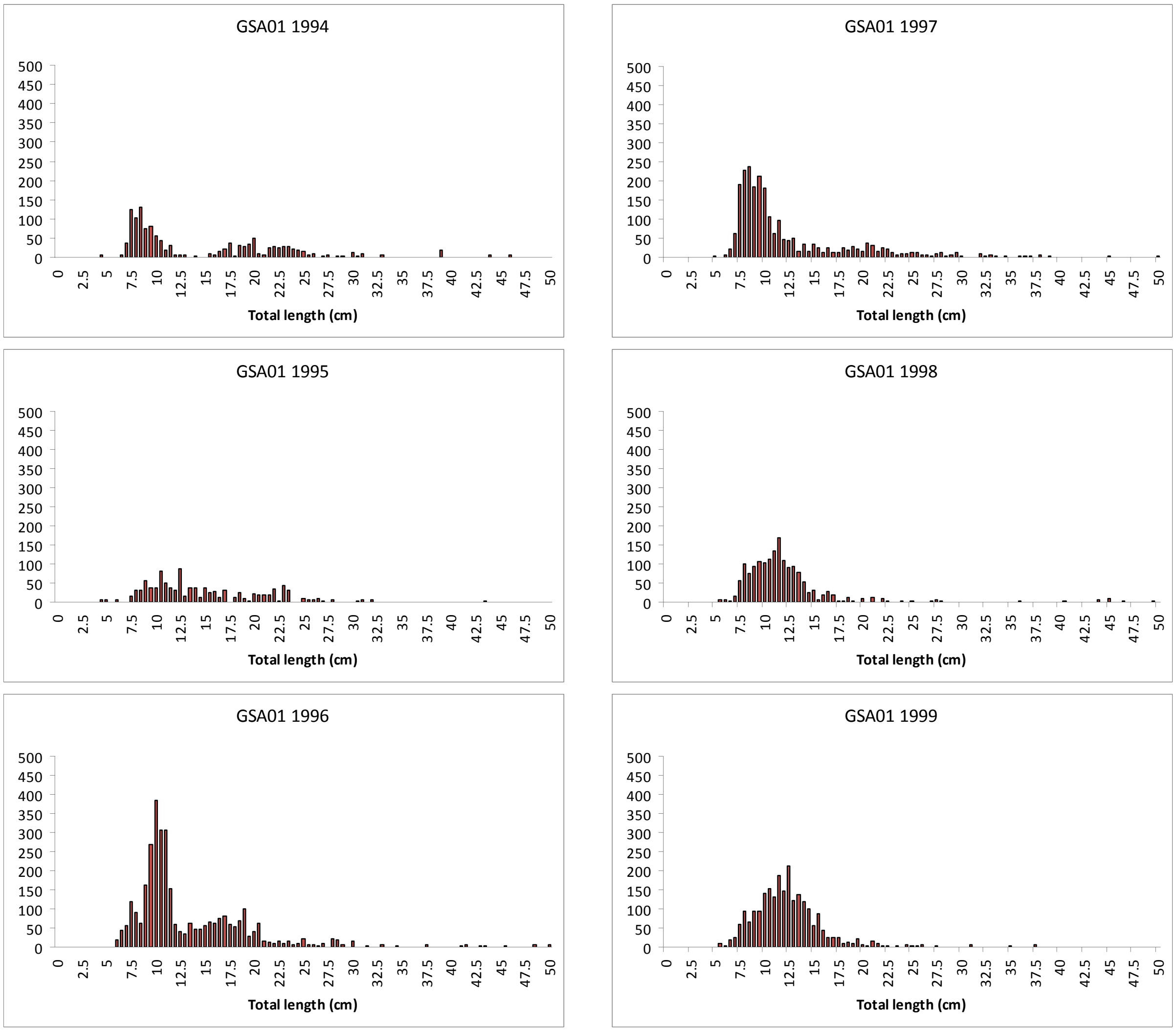


Fig. 7.2.3.1.4.2 Stratified abundance indices by size, 1994-1999.

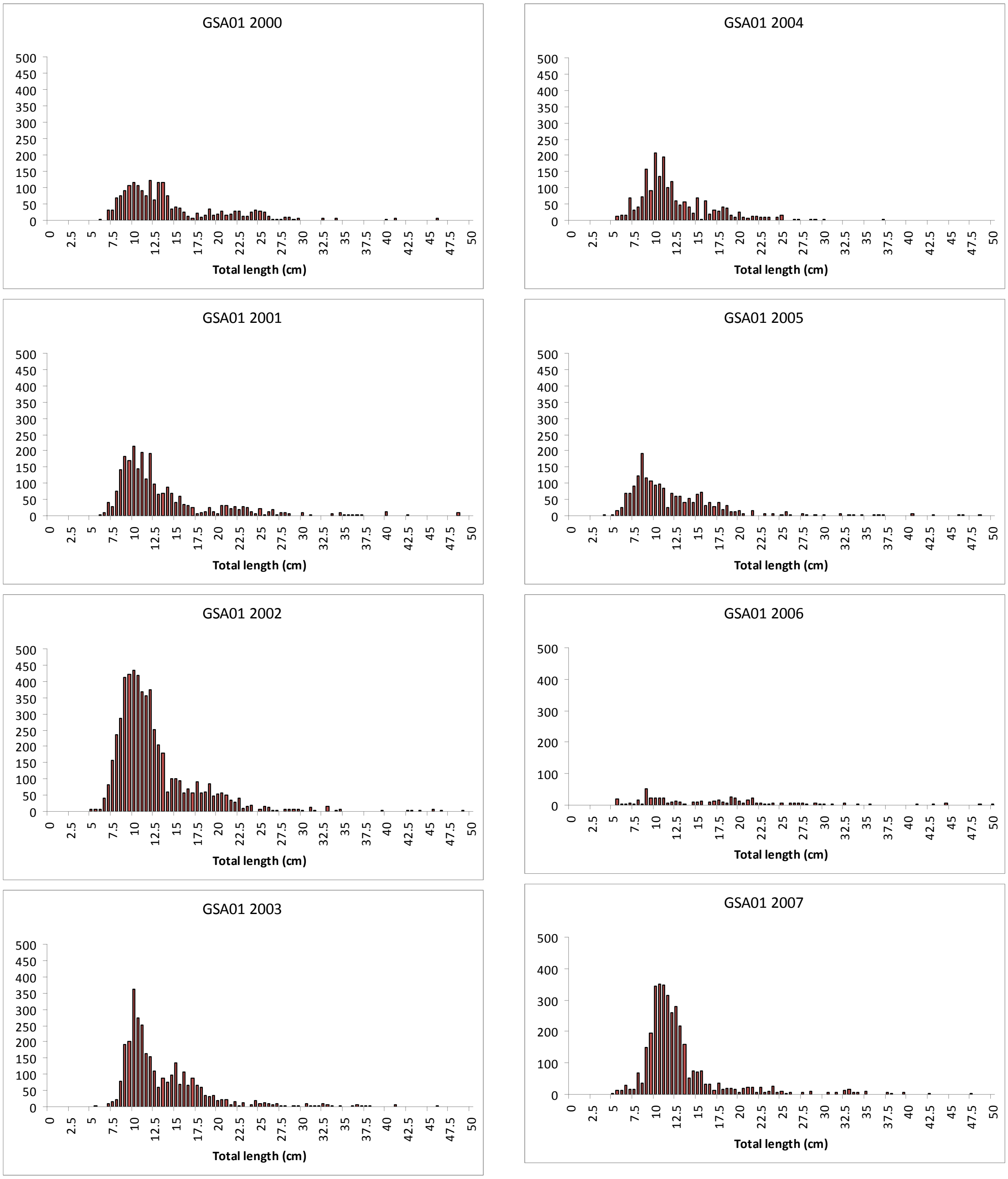


Fig. 7.2.3.1.4.3 Stratified abundance indices by size, 2000-2007.

7.2.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.2.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.2.4.Assessment of historic stock parameters

7.2.4.1. Method 1: SURBA

7.2.4.1.1. Justification

The availability of a long time series of data from MEDITS surveys provides the use of the SURBA assessment tool.

7.2.4.1.2. Input parameters

MEDITS survey over the period 1994-2008.
BVT Growth parameters: Linf= 72 cm TL; k=0.127; to= -0.02
length- weight relationship: a=0.0064; b=3.02
Maturity Length (L50) = 30 cm TL
Length of first capture= Lc= 12 cm TL
M vector, estimated using PROBIOM.

Table 7.2.1.2 M and q at age as used as input to SURBA.

age class	1	2	3	4	5	6	7	8
M	0.9	0.5	0.4	0.3	0.3	0.25	0.25	0.20
q	0.8	1.0	0.7	0.7	0.7	0.7	0.7	0.7

7.2.4.1.3. Results including sensitivity analyses

SGMED could not estimate the absolute levels of stock abundance. Survey indices indicate the stock to vary without an overall trend, and in 2008 the stock SSB appears to be at an average level compared with the last 13 years.

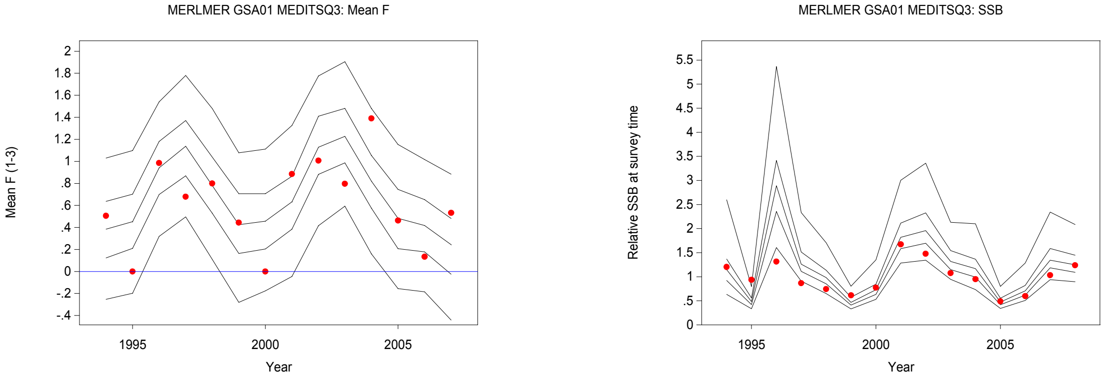


Fig. 7.2.4.1.3.1 Trends in SSB in kg/km^2 (MEDITS survey) in GSA 01 from SURBA.

SGMED could not estimate the absolute levels of recruitment. Survey indices in 2008 indicate the recruitment level to be above the average of the available time series.

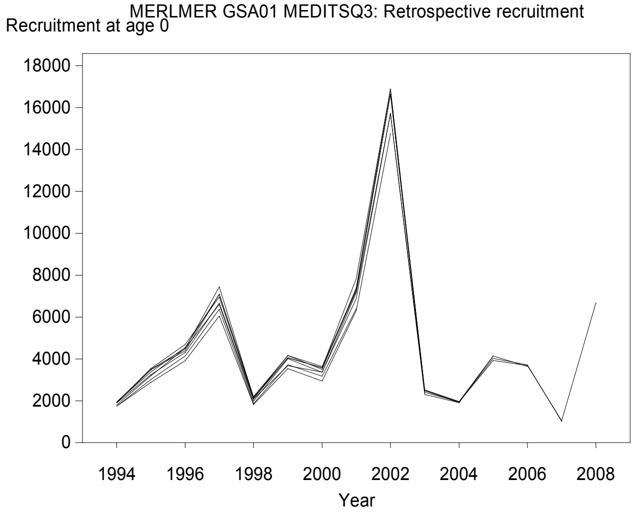


Fig. 7.2.4.1.3.2 Trends in SSB in recruitment (MEDITS survey) in GSA 01 from SURBA.

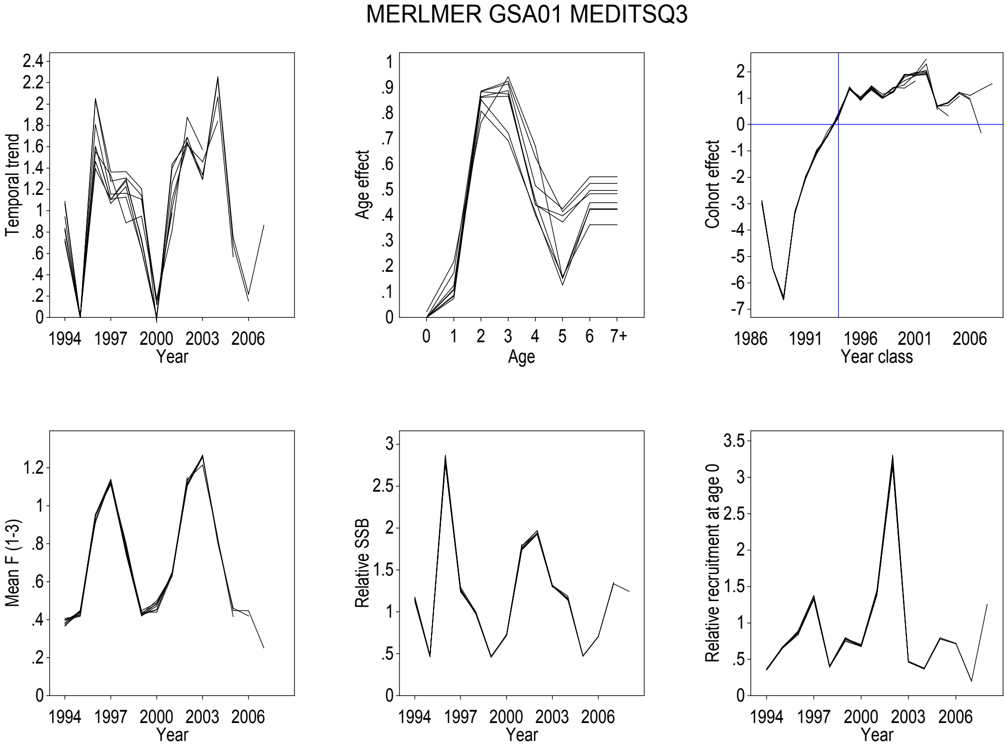


Fig. 7.2.4.1.3.3 Trends in stock parameters (MEDITS survey) in GSA 01 from SURBA.

SGMED cannot estimate recent or historic exploitation rates. No proposed or agreed reference points were available to SGMED to identify stock status. These results are to be considered to be preliminary.

The continued lack of older fish in the surveyed population indicates exploitation rates far beyond those considered consistent with high yields and low risk of fisheries collapse. However, SGMED notes that the survey gear is not specifically designed to sample larger older fish.

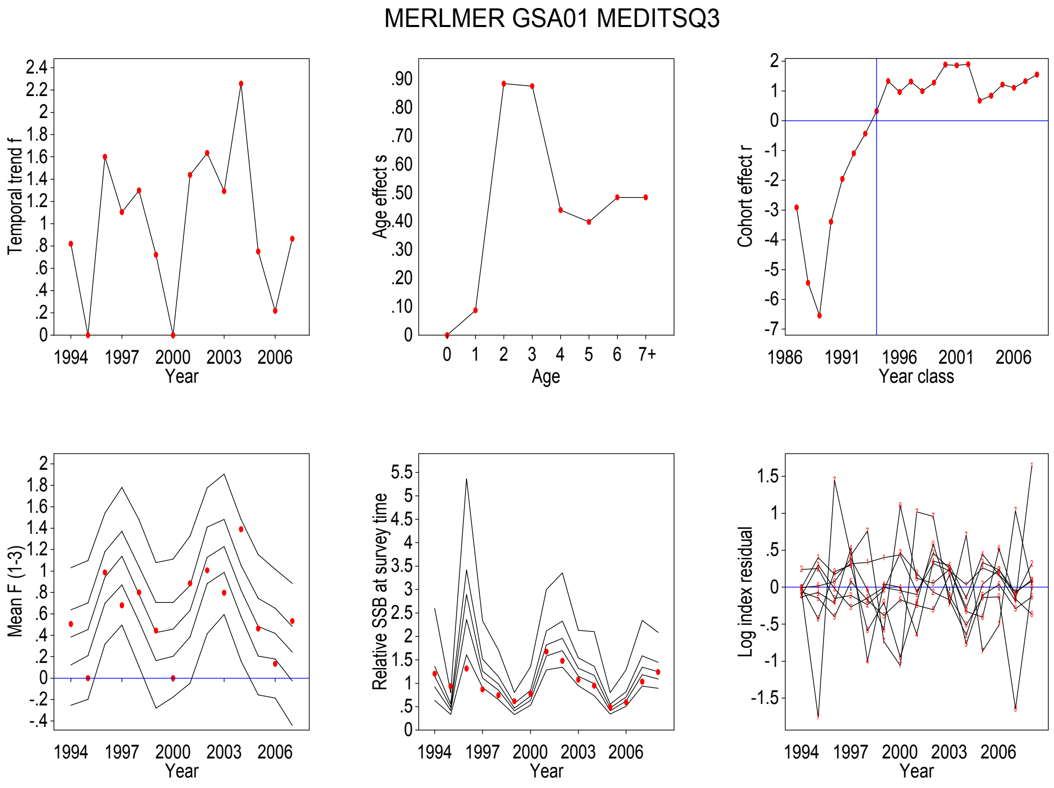


Fig. 7.2.4.1.3.5 Trends in stock parameters (MEDITS survey) in GSA 01 from SURBA.

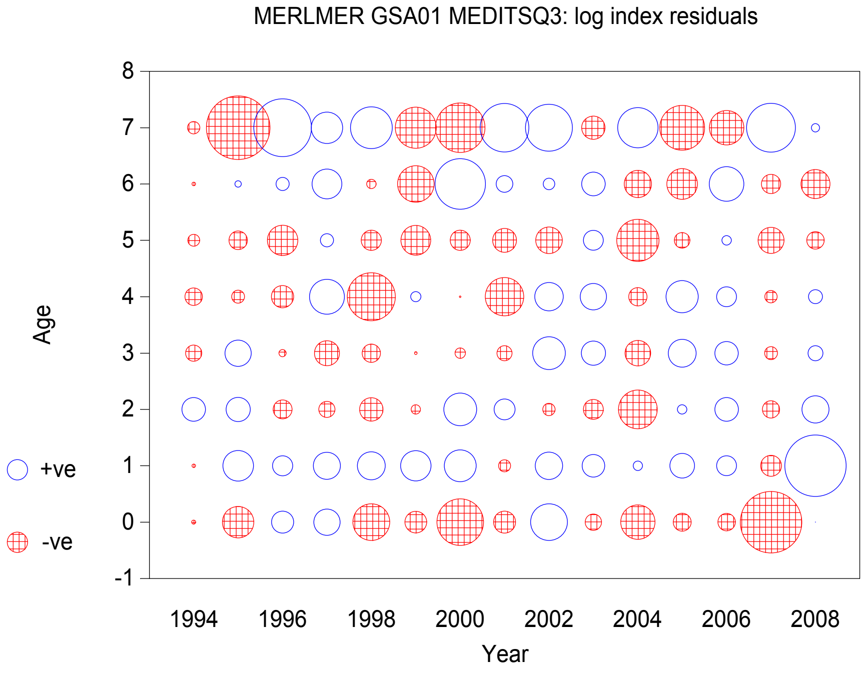


Fig. 7.2.4.1.3.6 Trends in log index residuals (MEDITS survey) in GSA 01 from SURBA.

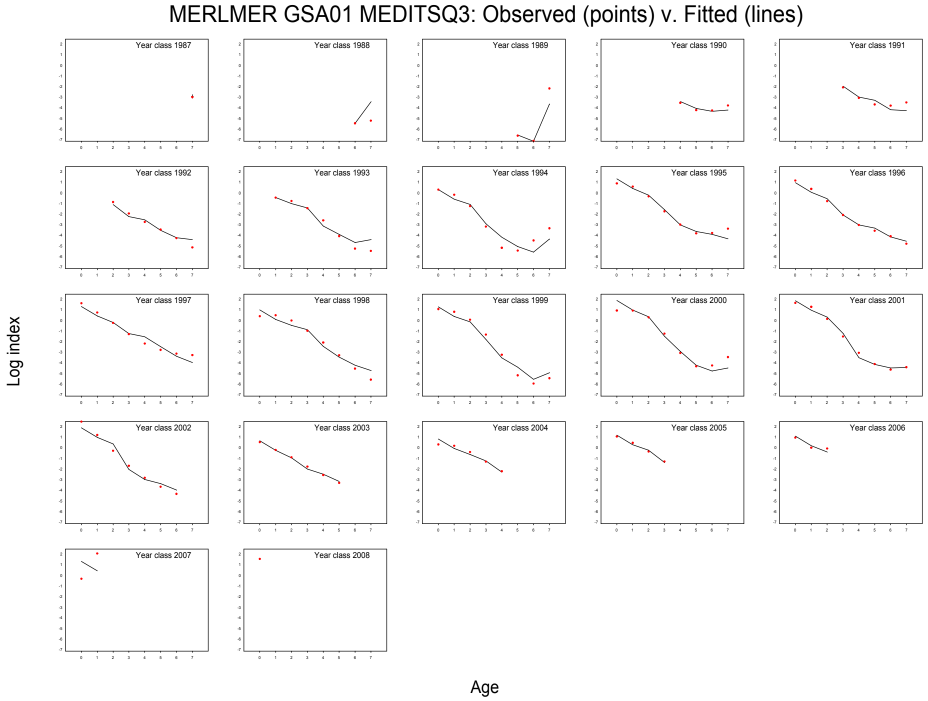


Fig. 7.2.4.1.3.7 Trends in assessment parameters (MEDITS survey) in GSA 01 from SURBA.

7.2.4.2. Method 2: VIT

7.2.4.2.1. Justification

This is the first assessment of the hake stock in GSA01. There are only three years with data on length compositions so an XSA does not seem applicable. Survey data could not be disaggregated between GSAs within the time available. For these reasons we applied VIT (pseudocohort analysis, Y/R and simulation under two different management scenarios) using the commercial data series from the DCR. Furthermore, since females and males growth is different and bottom trawl exploitation is based in the smaller sizes, the analyses are presented for each sex separately, so as to highlight the also different fishing mortality exerted over males and females by this type of fishing.

7.2.4.2.2. Input parameters

As presented above, two sets of growth parameters (slow and fast growth) were used, and a separate analysis performed by sex. No discards were included. There were no data on CPUE used.

Input data are presented in Table 7.2.1.2.1, Fig. 7.2.2.3.1.1 and in the Tables 7.2.4.2.2.1 and 7.2.4.2.2.2. Data on the annual length distributions and maturity taken from the DCR data were submitted to the meeting.

Tab. 7.2.4.2.2.1 Landings in 2007 by sex.

Landings	(tonnes)	
Wfemales	196,5	72,86%
Wmales	73,2	27,14%
Wtotal	269,7	

Tab. 7.2.4.2.2.2 Size compositions of the landings in 2007 by sex.

Length class TL(cm)	Females Annual size freq.distribution	Females Maturity ogive	Males Annual size freq.distribution	Males Maturity ogive
10	19,04	0,00	19,04	0,00
12	54,39	0,00	54,39	0,00
14	71,29	0,00	116,73	0,00
16	93,21	0,01	128,23	0,01
18	66,02	0,01	123,48	0,01
20	65,40	0,03	97,38	0,03
22	54,56	0,05	102,70	0,05
24	51,23	0,08	86,39	0,08
26	47,50	0,14	63,58	0,14
28	38,96	0,24	49,84	0,24
30	44,64	0,36	37,34	0,36
32	46,63	0,51	27,29	0,51
34	49,10	0,66	13,20	0,66
36	49,08	0,78	5,07	0,78
38	44,36	0,87	0,45	0,87
40	36,85	0,92		
42	25,40	0,96		
44	17,56	0,98		
46	10,87	0,99		
48	8,40	0,99		
50	7,08	1,00		
52	5,79	1,00		
54	3,53	1,00		
56	2,00	1,00		
58	1,16	1,00		
60	0,85	1,00		
62	0,50	1,00		
64	0,72	1,00		
66	0,54	1,00		
68	0,58	1,00		
70	0,22	1,00		
72	0,12	1,00		
74	0,09	1,00		
76	0,13	1,00		

7.2.4.2.3. Results including sensitivity analyses

All the results refer to the observable range of length/ages. Since the analysis is based on pseudocohort analysis, it is not possible to present trends. The sensitivity analysis has been done only for comparison of fast and slow growth. The estimated stock parameters are listed in Table 7.2.4.1.3.1.

Table 7.2.4.1.3.1 Estimated stock parameters of hake in GSA 01 as derived from the VIT model.

	FAST GROWTH		SLOW GROWTH	
	Females	Males	Females	Males
Biomass (Bmean)	1730		3758	
SSB	826		1762	
Fmean	1,138	2,329	0,568	1,267
Catch mean age	0,746	0,566	2,28	1,971

As it was to be expected, highest F correspond to the fast growth scenario, and also, it is worth mentioning the highest F for males, which can be explained by relative higher abundance of males among the smaller sizes.

Resulting stock size composition, mean weights and fishing mortalities over fish size for both fast and slow growth assumptions are shown in Fig. 7.2.4.1.3.1.

FAST GROWTH SLOW GROWTH

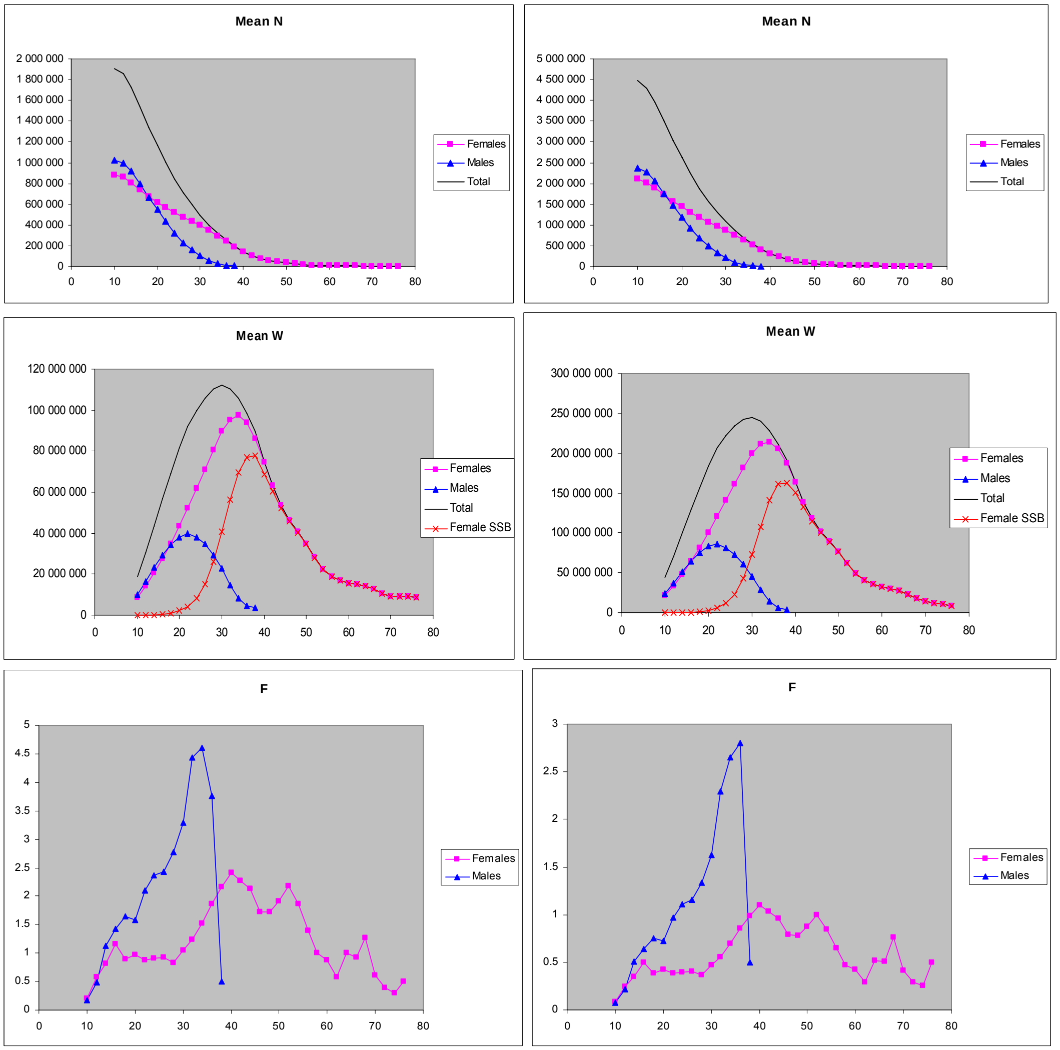


Fig. 7.2.4.1.3.1 Resulting stock size composition, mean weights and fishing mortalities over fish size for both fast and slow growth assumptions.

7.2.5.Short term prediction for 2008 and 2009

7.2.5.1. Justification

No forecast analyses were conducted.

7.2.5.2. Input parameters

No forecast analyses were conducted.

7.2.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 01.

7.2.6. Medium term prediction

7.2.6.1. Justification

No forecast analyses were conducted.

7.2.6.2. Input parameters

No forecast analyses were conducted.

7.2.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 01.

7.2.7. Long term prediction

7.2.7.1. Justification

Yield per recruit analyses were conducted assuming equilibrium conditions.

7.2.7.2. Input parameters

Based on the exploitation pattern resulting from the VIT model and its population parameters, yield per recruit analyses were formulated.

7.2.7.3. Results

Assuming equilibrium conditions, current Y/R appears to be much lower than the maximum, in the fast and growth scenarios, and in the case of females and males. Y/R max would be obtained at much lower effort than currently exerted. Thus, a fishing effort of around 0.3-0.4 that currently applied would correspond to the highest Y/R (Table 7.2.7.3.1 below and Fig. 7.2.7.3.1).

Tab. 7.2.7.3.1 Results of the Y/R analysis.

	FAST GROWTH		SLOW GROWTH	
	Females	Males	Females	Males
current Y/R	196,631	76,116	163,772	76,116
F(current)	1	1	1	1
Y/R max	380,2	103,9	256,8	103,877
Fmax in relation F(current)	0,28	0,39	0,33	0,39

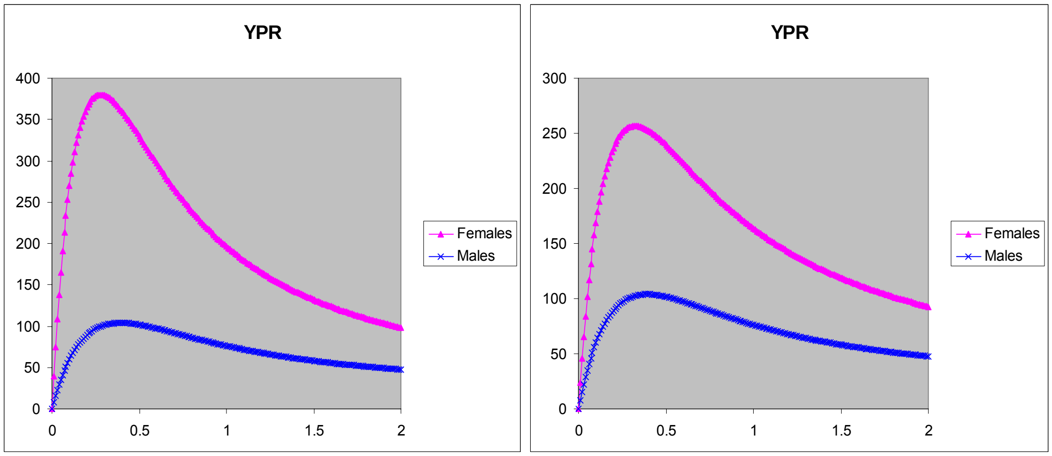
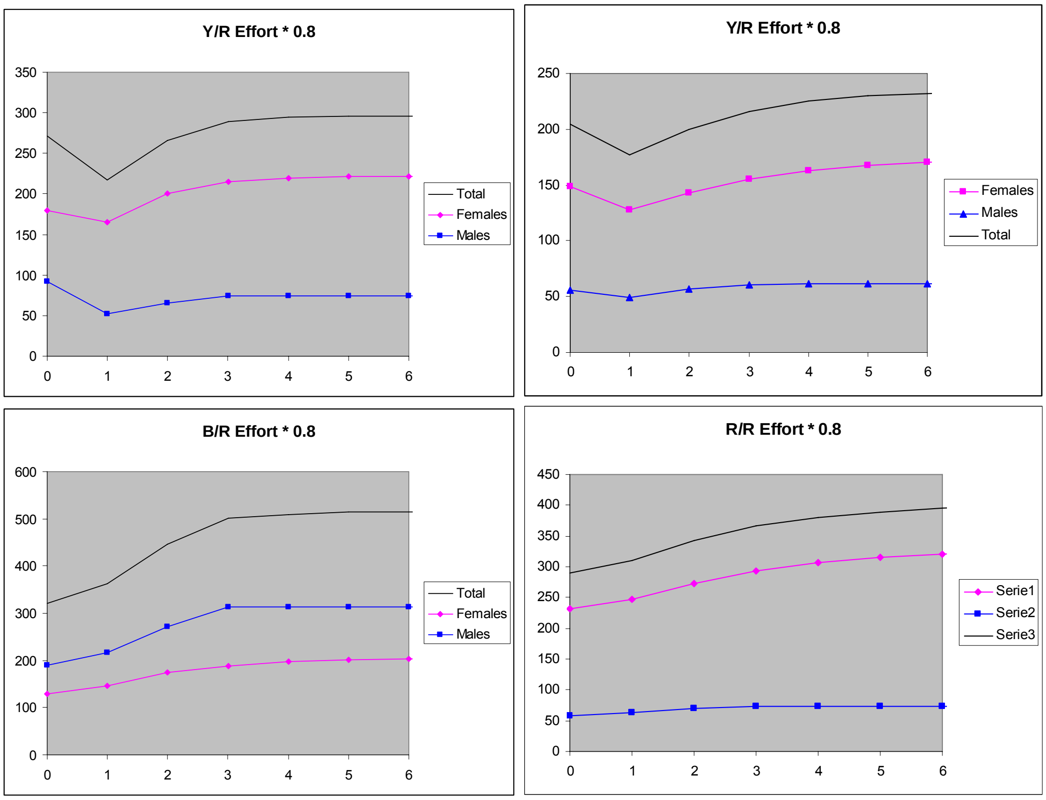
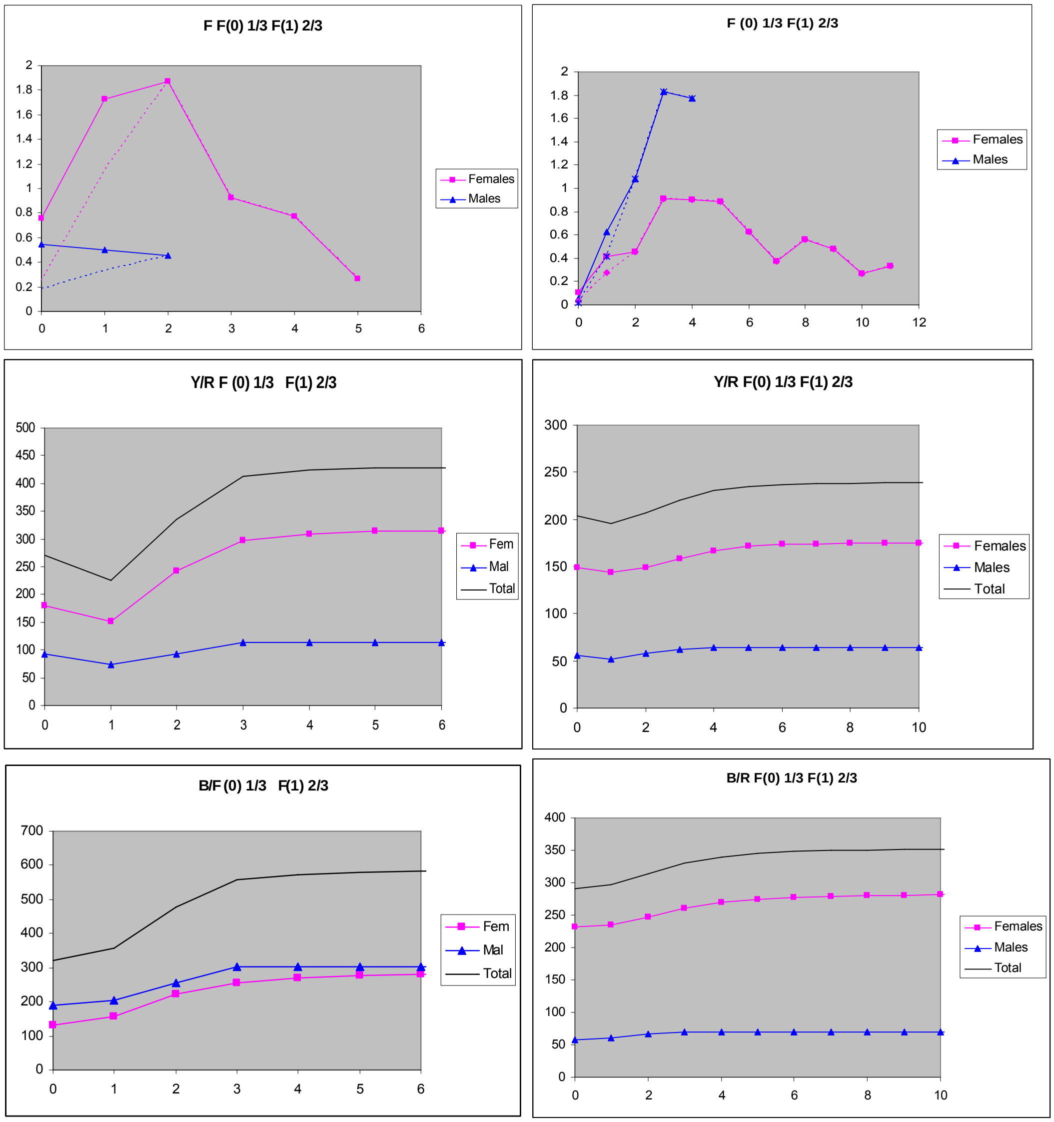


Fig. 7.2.7.3.1 Yield per recruit for the hake stock in GSA 01.

VIT software was used to forecast the behavior of the exploited population under changes in the pattern of exploitation, using as input age-structure of the population in equilibrium (taken from VPA results) and taking into account that the bulk of landings correspond to classes 0 and 1. Simulations of two management measures were performed: removal of 20% of effort (equivalent to remove one day of fishing, from 5 to 4 per week), and modification of selectivity: the F on class 0 reduced to 1/3 of its value, the F on class 1 reduced to 2/3 of its value, keeping the rest unchanged (Fig. 7.2.7.3.2).





F F(0) 1/3 F(1) 2/3

F (0) 1/3 F(1) 2/3

Y/R F (0) 1/3 F(1) 2/3

Y/R F(0) 1/3 F(1) 2/3

B/F (0) 1/3 F(1) 2/3

B/R F(0) 1/3 F(1) 2/3

Fig. 7.2.7.3.2 Various stock parameters under the assumption of an effort reduction by 20% and modification of selectivity.

The reduction of the current effort by 20% would lead to a decrease of Y/R the first year of implementation of the measure and higher values in the next two years, reaching a plateau, both in the fast and growth scenarios, while biomass would increase already in the first year of implementation. The modification of selectivity seems to be the most effective management measure in the fast growth scenario, given that after a decrease of the Y/R in the first year, Y/R values in the next years would be much higher than the current values (year 0). The modification of selectivity in the slow growth scenario would result in small changes in Y/R and biomass.

Results suggest that management measures addressed to a modification of the selectivity would lead to higher Y/R and B than those resulting from a reduction of effort, in the fast growth scenario, which seems to be the growth pattern that best fits the species biology.

7.2.8. Scientific advice

7.2.8.1. Short term considerations

7.2.8.1.1. State of the spawning stock size

SGMED could not estimate the absolute levels of stock abundance. Survey indices indicate the stock to vary without an overall trend, and in 2008 the stock SSB appears to be at an average level compared with the last 13 years. SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.2.8.1.2. State of recruitment

SGMED could not estimate the absolute levels of recruitment. Survey indices in 2008 indicate the recruitment level to be above the average of the available time series. SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.2.8.1.3. State of exploitation

SGMED cannot estimate recent or historic exploitation rates. No proposed or agreed reference points were available to SGMED to identify stock status.

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.2.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.3. Stock assessment of hake in GSA 05

7.3.1. Stock identification and biological features

7.3.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.3.1.2. Growth

No information was documented during SGMED-08-04.

7.3.1.3. Maturity

No information was documented during SGMED-08-04.

7.3.2. Fisheries

7.3.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that the trawl fishery off Mallorca is developed by around 40 vessels, corresponding to about 72% of the total trawl fleet of the Balearic Islands (GFCM GSA 05). The total annual landings are approximately 1,400 tonnes, representing around 90% of the total catch of GSA 05. 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 t during the last decades.

7.3.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.3.2.3. Catches

7.3.2.3.1. Landings

Fig. 7.3.2.3.1.1 shows the trend in reported landings taken by trawlers (Spain only). The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.1 of Appendix 3. Since 2002 the annual landings varied between 40 and 100 t.

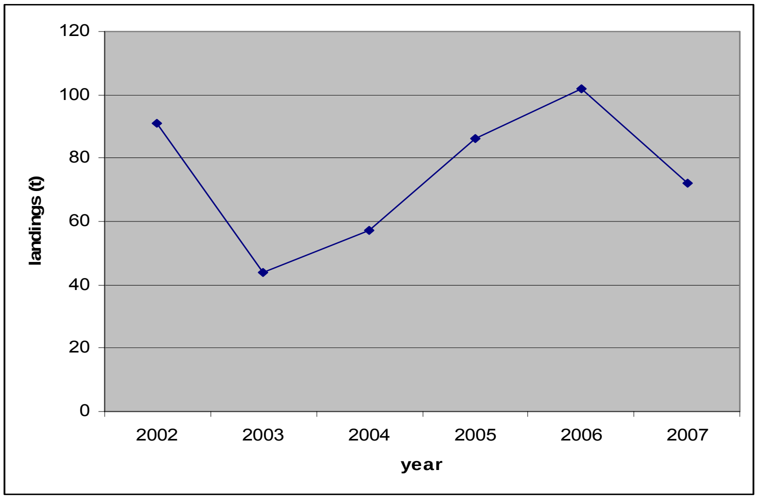


Fig. 7.3.2.3.1.1 Annual hake landings (t) by Spanish trawlers.

7.3.2.3.2. Discards

Reported discards through the DCR data call to SGMED-08-04 varied among 5 and 10 t annually during 2002 to 2007. The data are listed in Table A3.6 of Appendix 3.

7.3.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9. STECF (stock review part II in 2007) noted that the trawl fishery off Mallorca is developed by around 40 vessels, corresponding to about 72% of the total trawl fleet of the Balearic Islands (GFCM GSA 05).

7.3.3.Scientific surveys

7.3.3.1. Medits

7.3.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 05 the following number of hauls were reported per depth stratum (s. Tab. 7.3.3.1.1.1)

Tab. 7.3.3.1.1.1. Number of hauls per year and depth stratum in GSA 05, 1994-2007

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA05_100-200		1				1		1			1		1	1
GSA05_200-500		4	2	2	2	1		5	2		2	2	4	3
GSA05_500-800	1	5	3	2	2	3	1	2	2		2	2	2	2

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.3.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.3.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 05 was derived from the international survey Medits. Figure 7.3.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 05.

The few hauls may indicate a general increasing trend in both abundance and biomass since 1994. The analyses of Medits indices are considered preliminary.

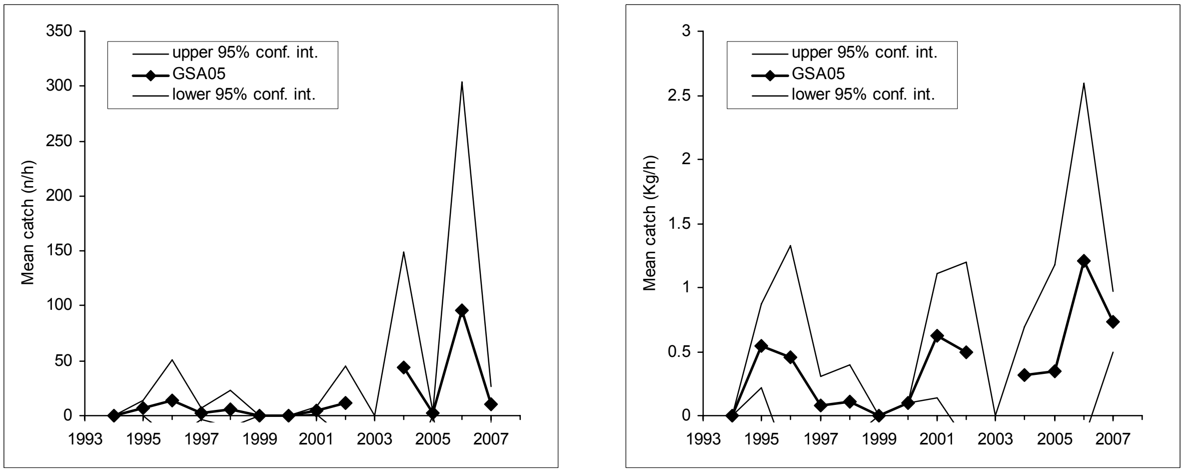
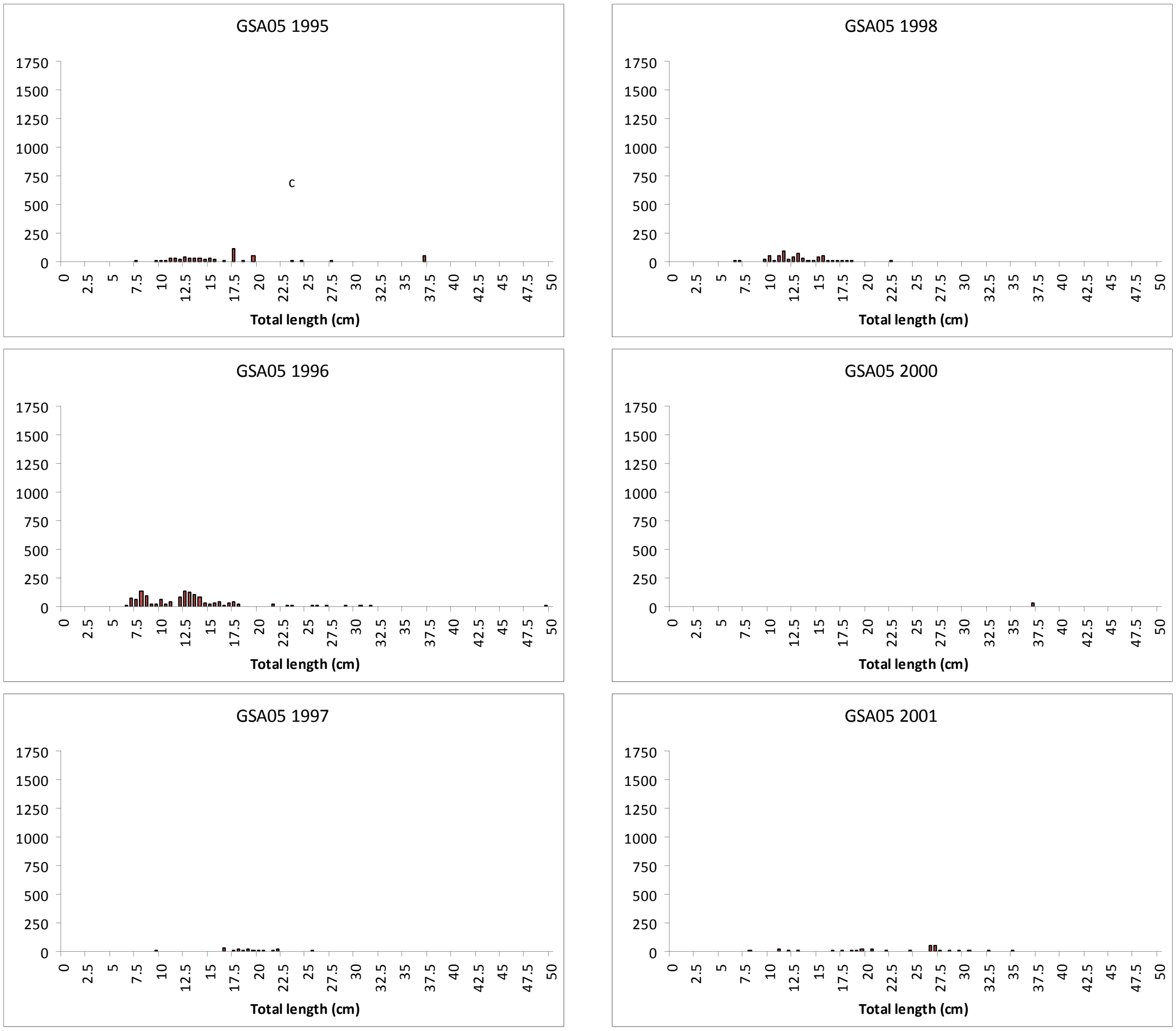


Fig. 7.3.3.1.3.1 Abundance and biomass indices of hake in GSA 05.

7.3.3.1.4. Trends in abundance by length or age

The following Fig. 7.3.3.1.4.1 and 2 display the stratified abundance indices of GSA 05 in 1995-2004 and 2005-2007. These size compositions are considered preliminary.



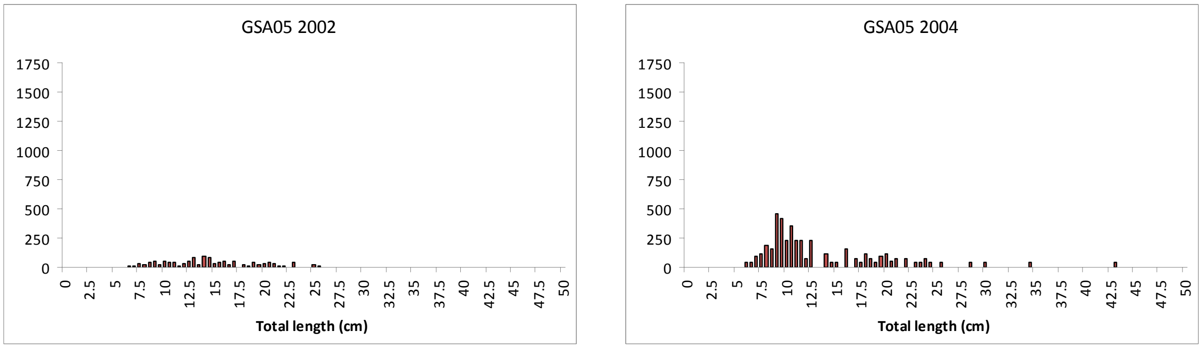


Fig. 7.3.3.1.4.1 Stratified abundance indices by size, 1995-2004.

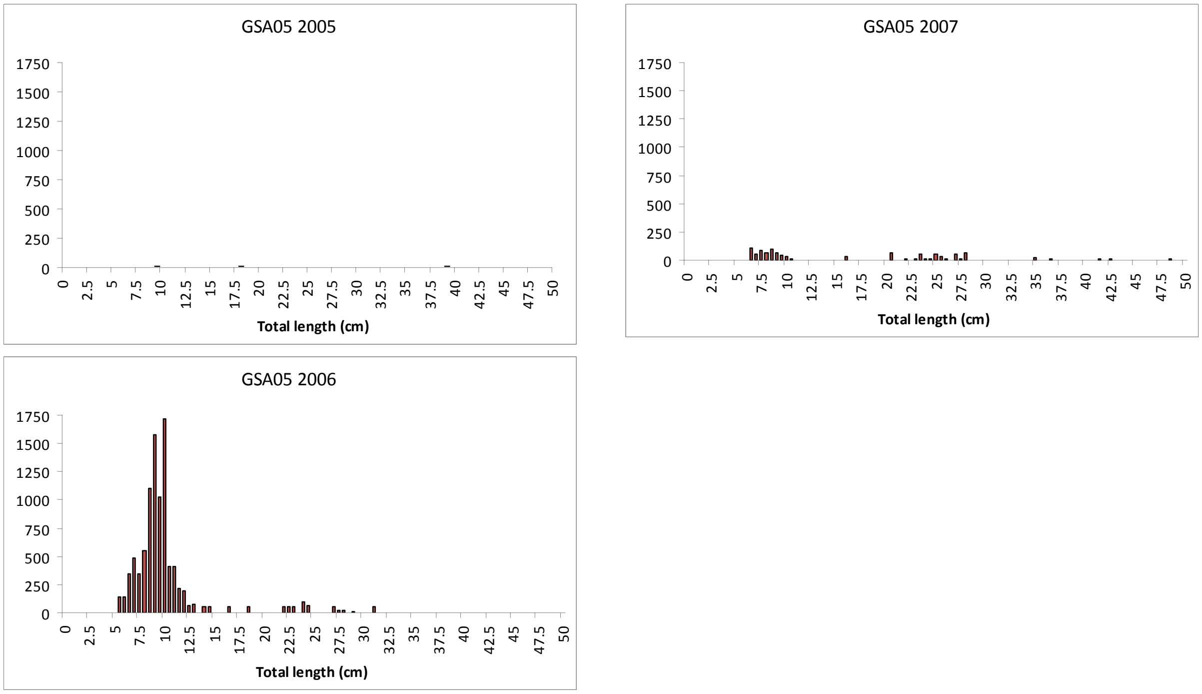


Fig. 7.3.3.1.4.2 Stratified abundance indices by size, 2005-2007.

7.3.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.3.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.3.4.Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment. It was noted that hake in GSA 05 was assessed in 2007 and presented to SCSA/SAC/GFCM. This assessment can be viewed at:

: http://www.gfcm.org/ for GSA05 open Doc05-HKE0508Gui.xls

SGMED-08-04 reviewed the assessment results, and considered them incompatible with true population dynamics.

7.3.5. Short term prediction for 2008 and 2009

7.3.5.1. Justification

No forecast analyses were conducted.

7.3.5.2. Input parameters

No forecast analyses were conducted.

7.3.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 05.

7.3.6. Medium term prediction

7.3.6.1. Justification

No forecast analyses were conducted.

7.3.6.2. Input parameters

No forecast analyses were conducted.

7.3.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 05.

7.3.7. Long term prediction

7.3.7.1. Justification

No forecast analyses were conducted.

7.3.7.2. Input parameters

No forecast analyses were conducted.

7.3.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 05.

7.3.8. Scientific advice

7.3.8.1. Short term considerations

7.3.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

SGMED-08-04 noted that the hake 'population' of GSA 05 is unlikely to be independent from that of the adjacent GSA 06. SGMED therefore recommends exploring the alternative of merging data from GSA 05 and GSA 06 and perfoming a single assessment for both GSAs together.

7.3.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.3.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.3.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.4. Stock assessment of hake in GSA 06

7.4.1.Stock identification and biological features

7.4.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.4.1.2. Growth

No information was documented during SGMED-08-04.

7.4.1.3. Maturity

No information was documented during SGMED-08-04.

7.4.2.Fisheries

7.4.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that hake (*Merluccius merluccius*) is one of the most important target species for the trawl fisheries carried out by around 647 vessels in the Northern Spain (GSA 6). In the last years, the annual landings of this species, which are mainly composed by juveniles living on the continental shelf, were situated around 3,800 tonnes in the whole area.

7.4.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.4.2.3. Catches

7.4.2.3.1. Landings

Fig. 7.4.2.3.1.1 shows the trend in reported landings taken by trawlers (Spain only). The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.1 of Appendix 3. The annual landings increased from 3,400 t in 2005 to 3,700 t in 2007.

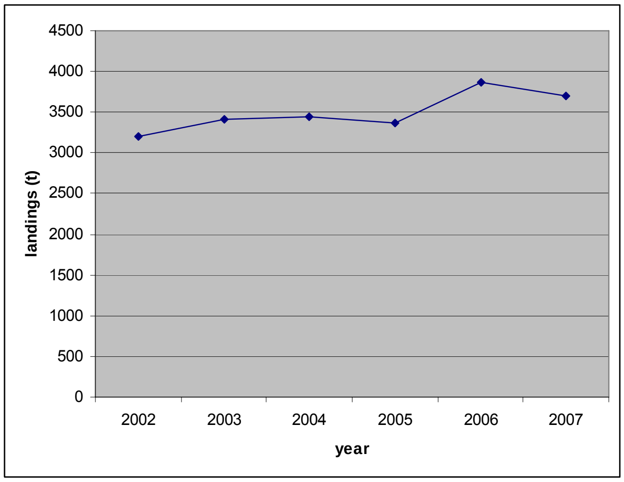


Fig. 7.4.2.3.1.1 Annual hake landings (t) by Spanish trawlers.

7.4.2.3.2. Discards

Reported discards through the DCR data call to SGMED-08-04 amount 80 t in 2005. The data are listed in Table A3.6 of Appendix 3.

7.4.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9. STECF (stock review part II in 2007) noted that the trawl fishery off northern Spain (GSA 06) is carried out by around 647 vessels.

7.4.3. Scientific surveys

7.4.3.1. Medits

7.4.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 06 the following number of hauls were reported per depth stratum (s. Tab. 7.4.3.1.1.1).

Tab. 7.4.3.1.1.1. Number of hauls per year and depth stratum in GSA 06, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA06_010-050	7	8	7	7	7	8	9	8	11	9	9	11	11	6
GSA06_050-100	19	26	26	26	28	29	29	31	36	38	31	32	34	27
GSA06_100-200	11	17	17	15	13	17	18	20	20	21	17	18	19	15
GSA06_200-500	10	12	10	12	7	13	12	16	17	18	16	15	18	11
GSA06_500-800	6	8	9	7	4	9	6	8	7	11	11	8	10	8

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes

hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.4.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.4.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 06 was derived from the international survey Medits. Figure 7.4.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 06.

The hauls indicate a general increasing trend in both abundance and biomass since 1996, except for the most recent year 2007, when the indices suddenly decreased to the lowest level obsered. The analyses of Medits indices are considered preliminary.

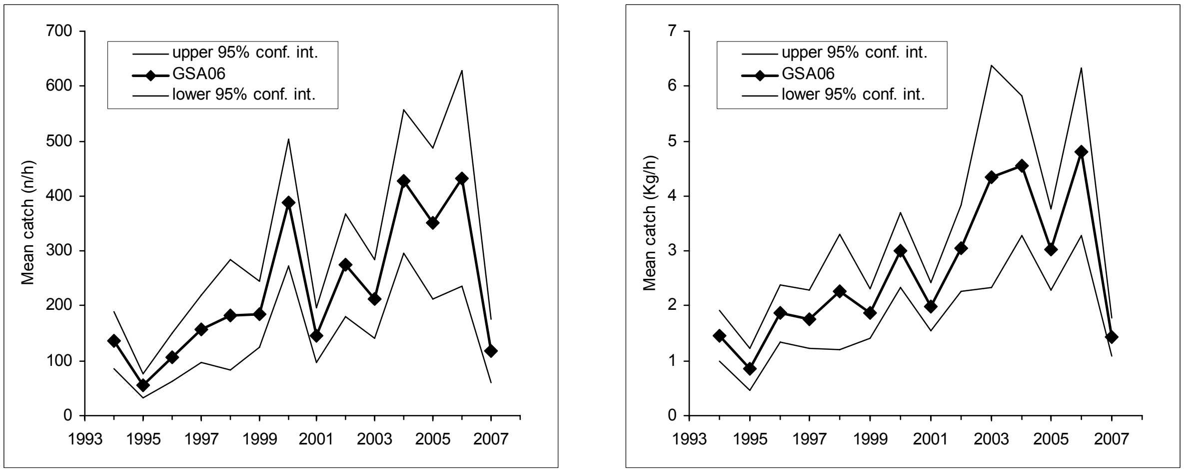


Fig. 7.4.3.1.3.1 Abundance and biomass indices of hake in GSA 06.

7.4.3.1.4. Trends in abundance by length or age

The following Fig. 7.4.3.1.4.1 and 2 display the stratified abundance indices of GSA 06 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

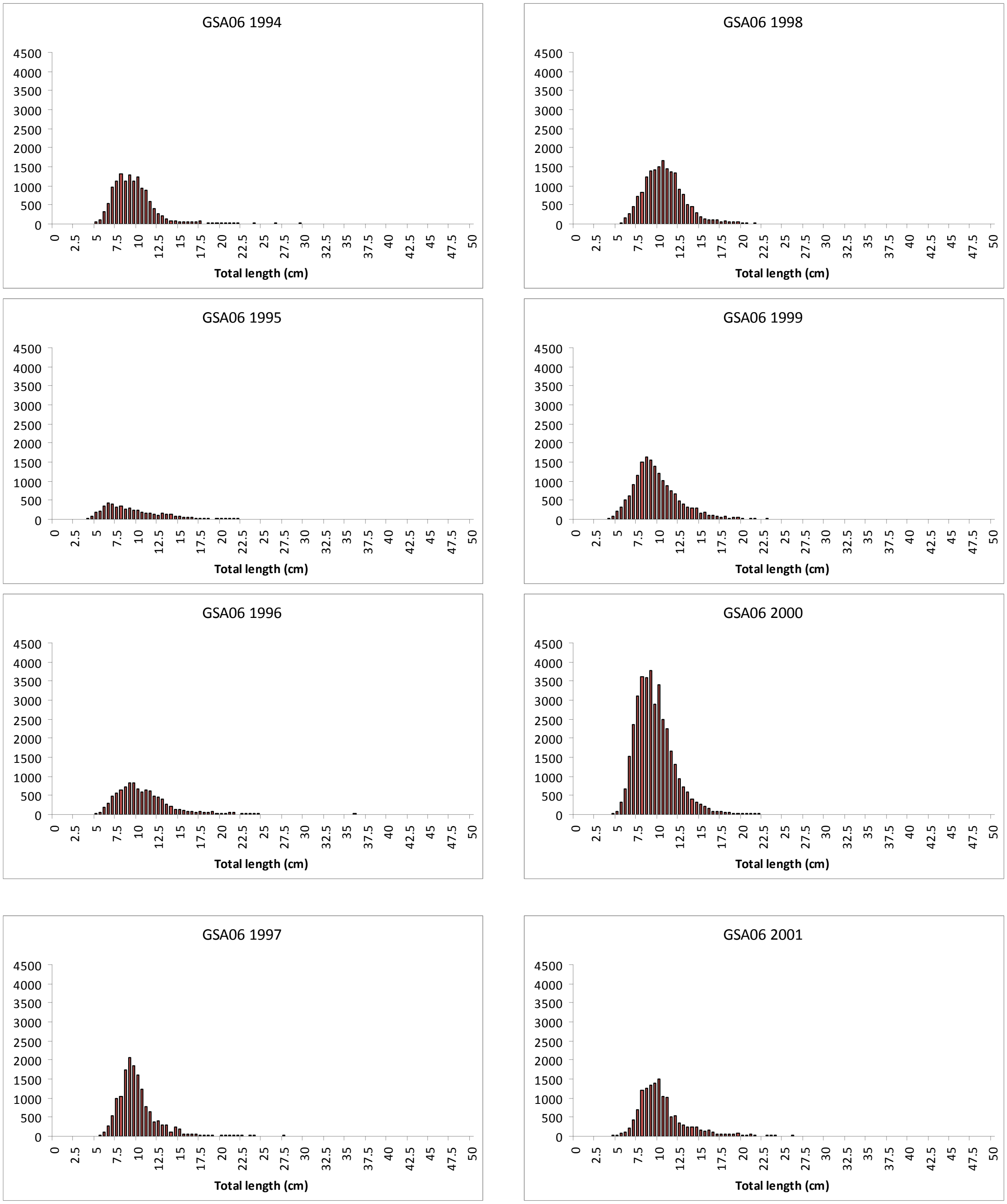


Fig. 7.4.3.1.4.1 Stratified abundance indices by size, 1994-2001.

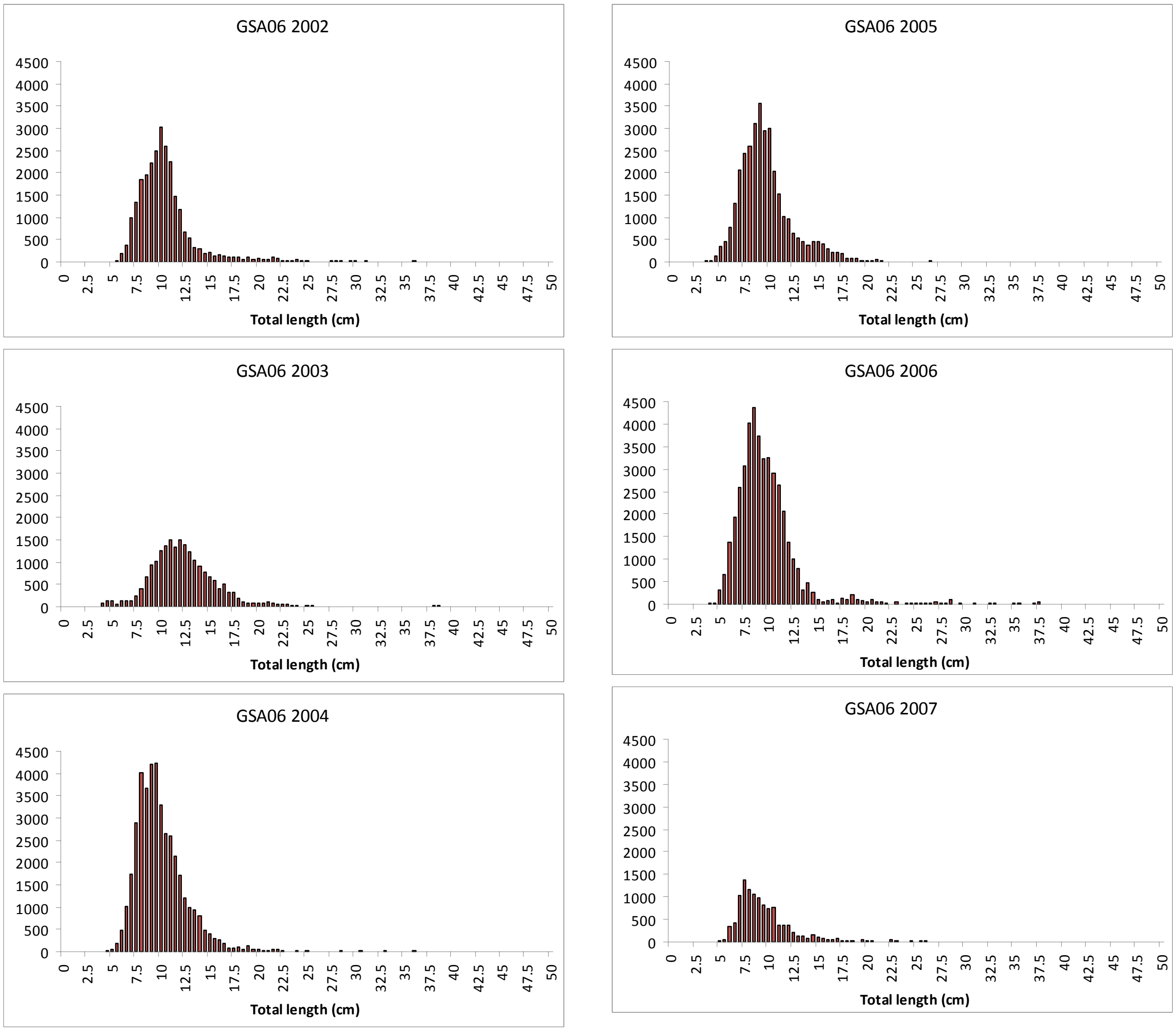


Fig. 7.4.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.4.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04.

7.4.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04.

7.4.4. Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment. It was noted that hake in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at:

http://www.gfcm.org/ for GSA06 open Doc06-HKE0608Gui.xls

7.4.5.Short term prediction for 2008 and 2009

7.4.5.1. Justification

No forecast analyses were conducted.

7.4.5.2. Input parameters

No forecast analyses were conducted.

7.4.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 06.

7.4.6. Medium term prediction

7.4.6.1. Justification

No forecast analyses were conducted.

7.4.6.2. Input parameters

No forecast analyses were conducted.

7.4.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 06.

7.4.7. Long term prediction

7.4.7.1. Justification

No forecast analyses were conducted.

7.4.7.2. Input parameters

No forecast analyses were conducted.

7.4.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 06.

7.4.8. Scientific advice

7.4.8.1. Short term considerations

7.4.8.1.1. State of the spawning stock size

SSB has increased from historical lows in 1999 towards in 2007 half the peak level seen towards the beginning of the time series (in 1993).

7.4.8.1.2. State of recruitment

Recruitment has varied without trend across the time series, but the 2007 estimate is the second lowest of the time series.

7.4.8.1.3. State of exploitation

Exploitation has fluctuated without trend in the range of 0.5-0.7. The most recent fishing mortality (F_{0-5}) is 0.7. However, SGMED notes that the F range chosen appears to be inappropriate and F_{1-4} is suggested as alternative.

The continued low abundance of adult fish in the surveyed population and catches indicate a very high exploitation pattern far in excess of those achieving high yields and low risk of fisheries collapse.

With $F_{0.1}$=0.19 and FMSY =0.28, it can be concluded that the resource is over-exploited with a larger risk for recruitment over-exploitation.

7.4.8.2. Medium term considerations

A deterministic medium term forecast of catch and biomass was performed assuming status quo effort. This predicts an immediate decline of SSB and yield. If we consider a 10% year-on-year reduction in F, some recovery of SSB is likely to be achieved.

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is in the range of $F_{0.1}$-F_{MSY}, in order to avoid future low stock productivity and landings.

7.5. Stock assessment of hake in GSA 07

7.5.1.Stock identification and biological features

7.5.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.5.1.2. Growth

No information was documented during SGMED-08-04.

7.5.1.3. Maturity

No information was documented during SGMED-08-04.

7.5.2.Fisheries

7.5.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that hake (*Merluccius merluccius*) is one of the most important demersal target species of commercial fisheries in the Gulf of Lions (GFCM GSA 7). In this area, hake is exploited by French trawl, French gillnet, Spanish trawl and Spanish long-line. Around 250 boats are involved in the fishery. According to the official statistics the total annual landings decreased from 2,751 tonnes in 2003 to 1,341 t in 2004 (this was mainly due to the decrease of the French trawlers landings (from 2,024 t to 1,023 t) and of the Spanish trawlers landings (from 207 t to 101 t).

7.5.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.5.2.3. Catches

7.5.2.3.1. Landings

SGMED-08-04 received French landings data for GSA 07 which are listed in Tab. 7.5.2.3.1.1. Otter trawls dominate the landings which have stabilized around 1,100 t and 1,400 t since 2004 after a major decrease by about one third. The trend in landings is shown in Fig. 7.5.2.3.1.1. The data are listed in Table A3.1 of Appendix 3.

No Spanish data for GSA 07 were provided.

Table 7.5.2.3.1.1 French landings (t) by year and major gear types, 2002-2004 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	7	FRA	GNS	177	248	99	255	299	168
HKE	7	FRA	LLS	5					
HKE	7	FRA	OTB	2163	2029	1018	995	1011	1277
Sum				2345	2277	1117	1250	1310	1445

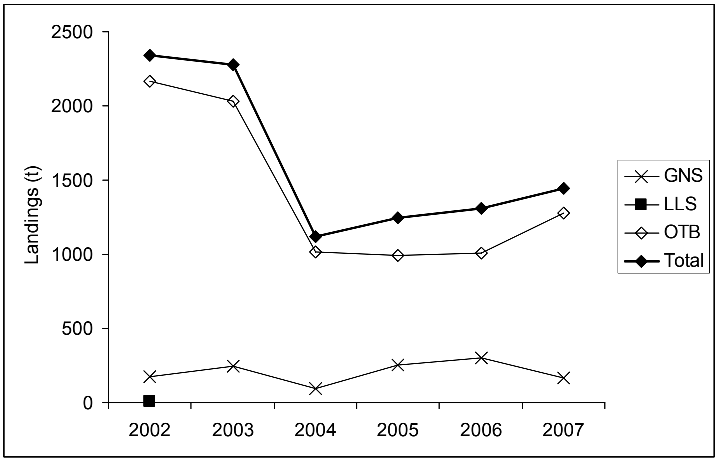


Fig. 7.5.2.3.1.1 Annual hake landings (t) by French fisheries.

7.5.2.3.2. Discards

Reported discards through the DCR data call to SGMED-08-04 vary among 16-56 t in 2003-2007. The data are listed in Table A3.6 of Appendix 3.

7.5.2.3.3. Fishing effort

STECF (stock review part II in 2007) noted that about 250 boats from France and Spain are engaged in the fishery. The trends in fishing effort by year and major gear type is listed in Tab. 7.5.2.3.3.1 and shown in Fig. 7.5.2.3.3.1 for trawls only in terms of kW*days, as the gill net figures appear inconsistent. The fishing effort in kW*days appear quite stable during 2004-2006.

No Spanish effort data for GSA 07 were provided.

Tab. 7.5.2.3.3.1 Trend in fishing effort (days, GT*days, kW*days) for France by major gear types, 2004-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006
DAYS	7	FRA	GNS	81460	76785	93193
DAYS	7	FRA	LLS	6459	6593	5028
DAYS	7	FRA	OTB	20561	19327	17991
GT*DAYS	7	FRA	GNS	329230	305685	315704
GT*DAYS	7	FRA	LLS	23742	23436	17232
GT*DAYS	7	FRA	OTB	1610963	1480834	1322919
KW*DAYS	7	FRA	GNS	7007171	5908142	88698170
KW*DAYS	7	FRA	LLS	669338	716765	385004
KW*DAYS	7	FRA	OTB	6361248	5923541	6127438

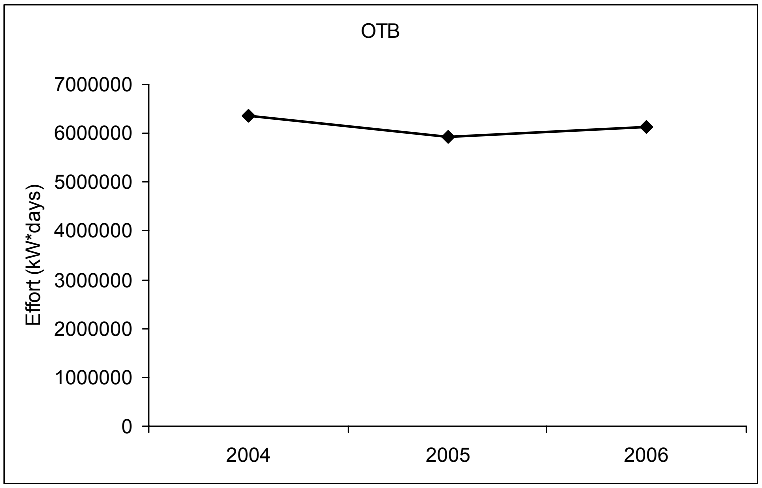


Fig. 7.5.2.3.3.1 Trend in fishing effort (kW*days) for France trawlers, 2004-2006.

7.5.3.Scientific surveys

7.5.3.1. Medits

7.5.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 07 the following number of hauls were reported per depth stratum (s. Tab. 7.5.3.1.1.1).

Tab. 7.5.3.1.1.1. Number of hauls per year and depth stratum in GSA 06, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA07_010-050	12	12	12	14	12	12	12	12	12	13	12	12	12	14
GSA07_050-100	32	32	32	35	39	32	32	32	31	38	31	30	33	31
GSA07_100-200	10	9	9	9	9	9	10	9	9	10	13	11	10	10
GSA07_200-500	6	6	5	5	5	5	5	6	4	5	5	5	5	5
GSA07_500-800	8	7	4	5	4	4	6	5	4	5	5	5	5	5

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area

Ai=area of the i-th stratum

si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.5.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.5.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 07 was derived from the international survey Medits. Figure 7.5.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 07.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance indices since 2005 appear low. The analyses of Medits indices are considered preliminary.

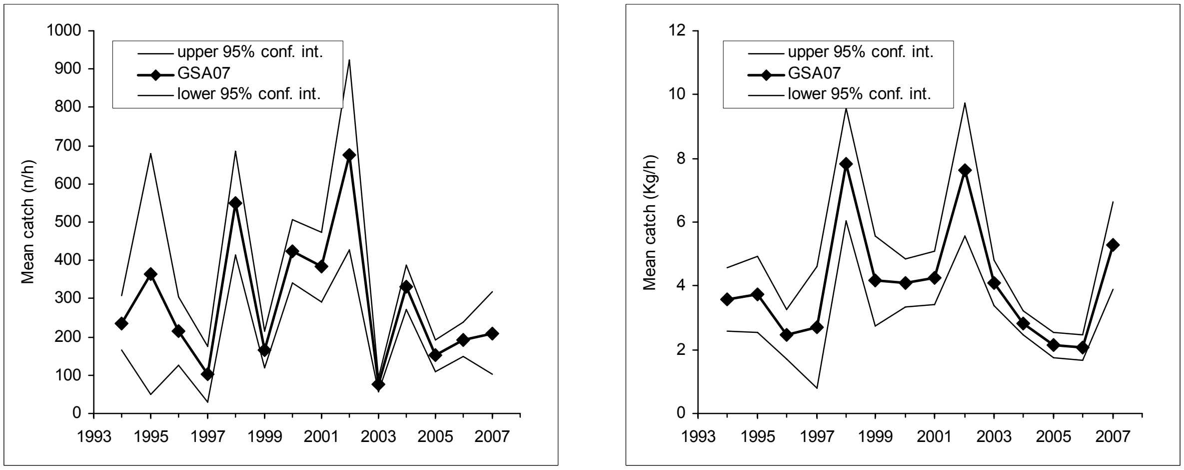


Fig. 7.5.3.1.3.1 Abundance and biomass indices of hake in GSA 07.

7.5.3.1.4. Trends in abundance by length or age

The following Fig. 7.5.3.1.4.1 and 2 display the stratified abundance indices of GSA 07 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

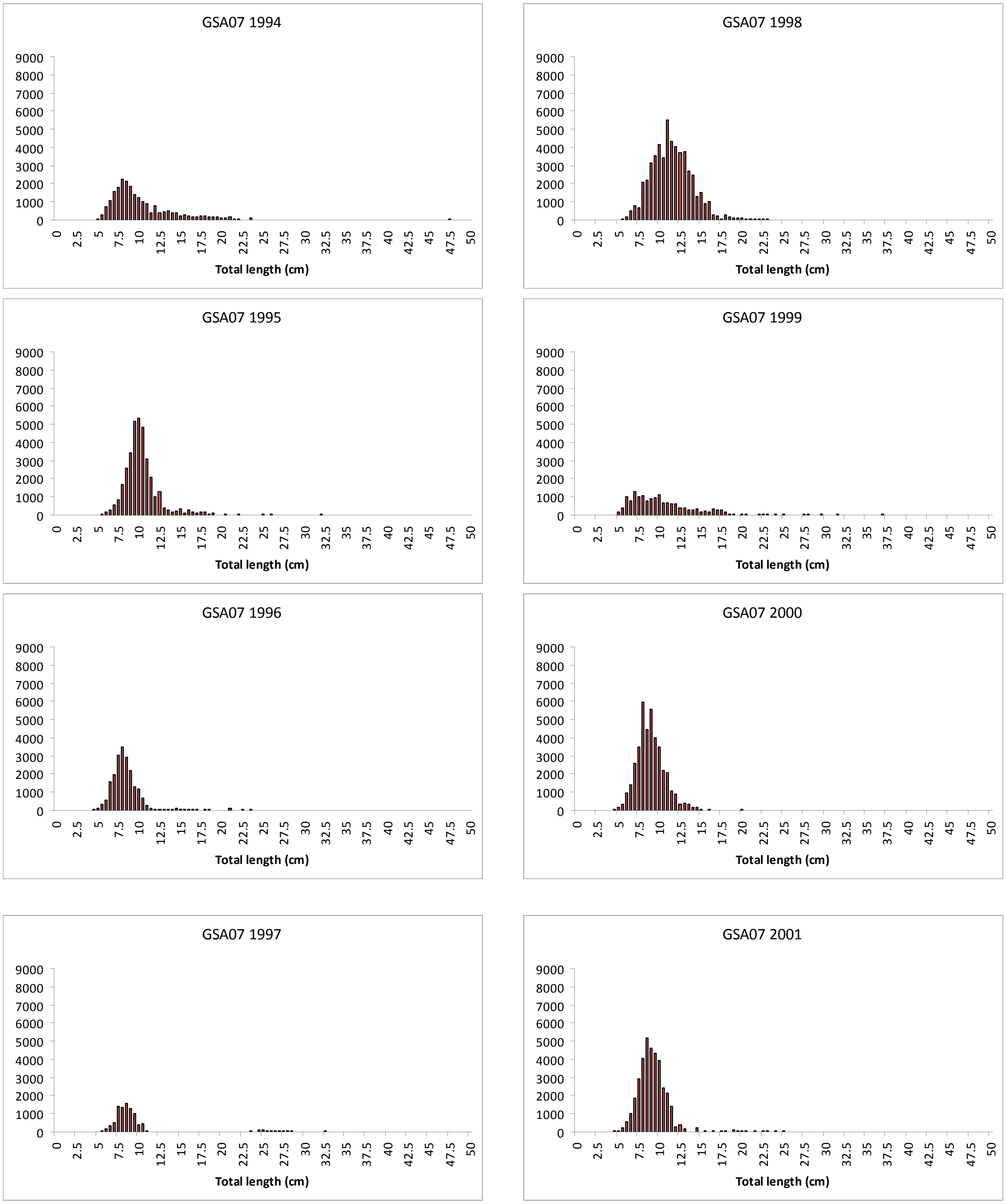
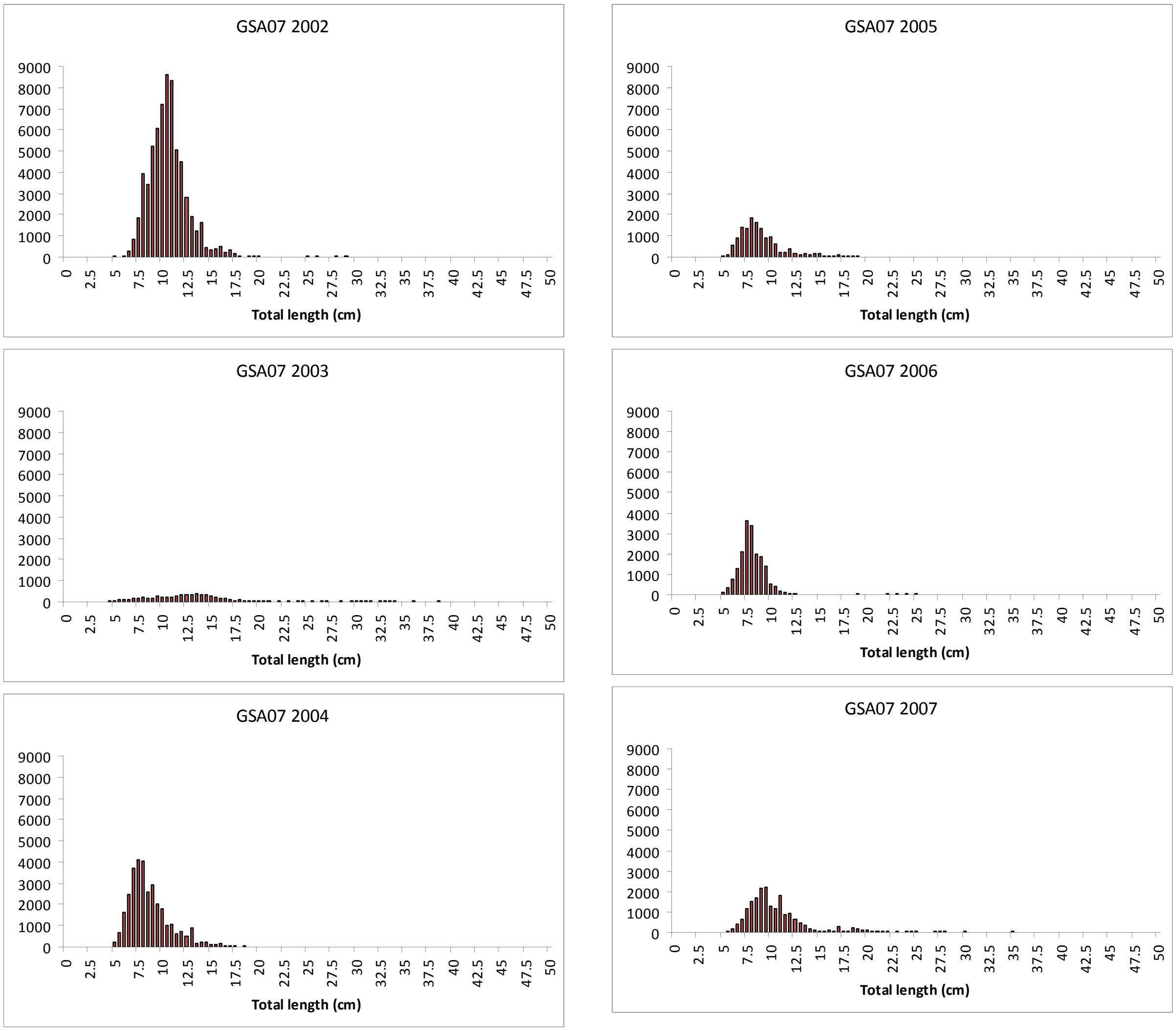


Fig. 7.5.3.1.4.1 Stratified abundance indices by size, 1994-2001.


GSA07 2002

GSA07 2003

GSA07 2004

GSA07 2005

GSA07 2006

GSA07 2007

Fig. 7.5.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.5.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.5.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.5.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.5.5. Short term prediction for 2008 and 2009

7.5.5.1. Justification

No forecast analyses were conducted.

7.5.5.2. Input parameters

No forecast analyses were conducted.

7.5.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 07.

7.5.6. Medium term prediction

7.5.6.1. Justification

No forecast analyses were conducted.

7.5.6.2. Input parameters

No forecast analyses were conducted.

7.5.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 07.

7.5.7. Long term prediction

7.5.7.1. Justification

No forecast analyses were conducted.

7.5.7.2. Input parameters

No forecast analyses were conducted.

7.5.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 07.

7.5.8. Scientific advice

7.5.8.1. Short term considerations

7.5.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.5.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.5.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.5.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.6. Stock assessment of hake in GSA 08

7.6.1. Stock identification and biological features

7.6.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.6.1.2. Growth

No information was documented during SGMED-08-04.

7.6.1.3. Maturity

No information was documented during SGMED-08-04.

7.6.2. Fisheries

7.6.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.6.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.6.2.3. Catches

7.6.2.3.1. Landings

No information was documented during SGMED-08-04.

7.6.2.3.2. Discards

No information was documented during SGMED-08-04.

7.6.2.3.3. Fishing effort

No information was documented during SGMED-08-04.

7.6.3. Scientific surveys

7.6.3.1. Medits

7.6.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

SGMED-08-04 notes that the reported Medits data in GSA 08 only cover the eastern coast of Corsica. In GSA 08 the following number of hauls were reported per depth stratum (s. Tab. 7.6.3.1.1.1).

Tab. 7.6.3.1.1.1. Number of hauls per year and depth stratum in GSA 08, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA08_010-050	3													
GSA08_050-100	5	5	7	3	7	6	5	5		6	6	7	7	5
GSA08_100-200	3	5	4	2	5	5	5	5	1	5	5	5	5	3
GSA08_200-500	9	11	12	8	12	10	11	10		10	10	10	11	8
GSA08_500-800	5	5	4	4	4	5	4	5		4	5	5	4	5

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.6.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.6.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 08 was derived from the international survey Medits. SGMED-08-04 notes that the reported Medits data in GSA 08 only cover the eastern coast of Corsica. Figure 7.6.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 08.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2006 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

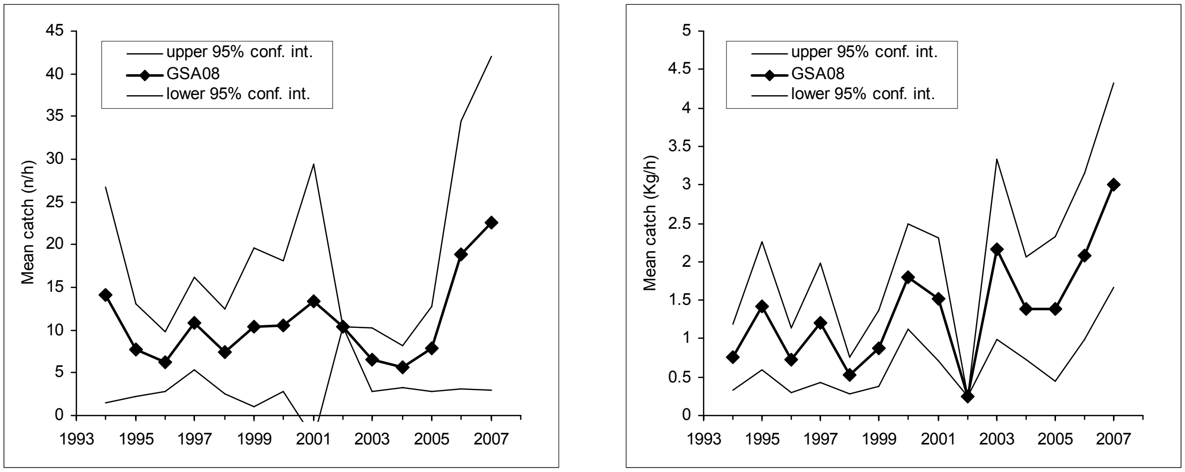


Fig. 7.6.3.1.3.1 Abundance and biomass indices of hake in GSA 08.

7.6.3.1.4. Trends in abundance by length or age

The following Fig. 7.6.3.1.4.1 and 2 display the stratified abundance indices of GSA 08 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

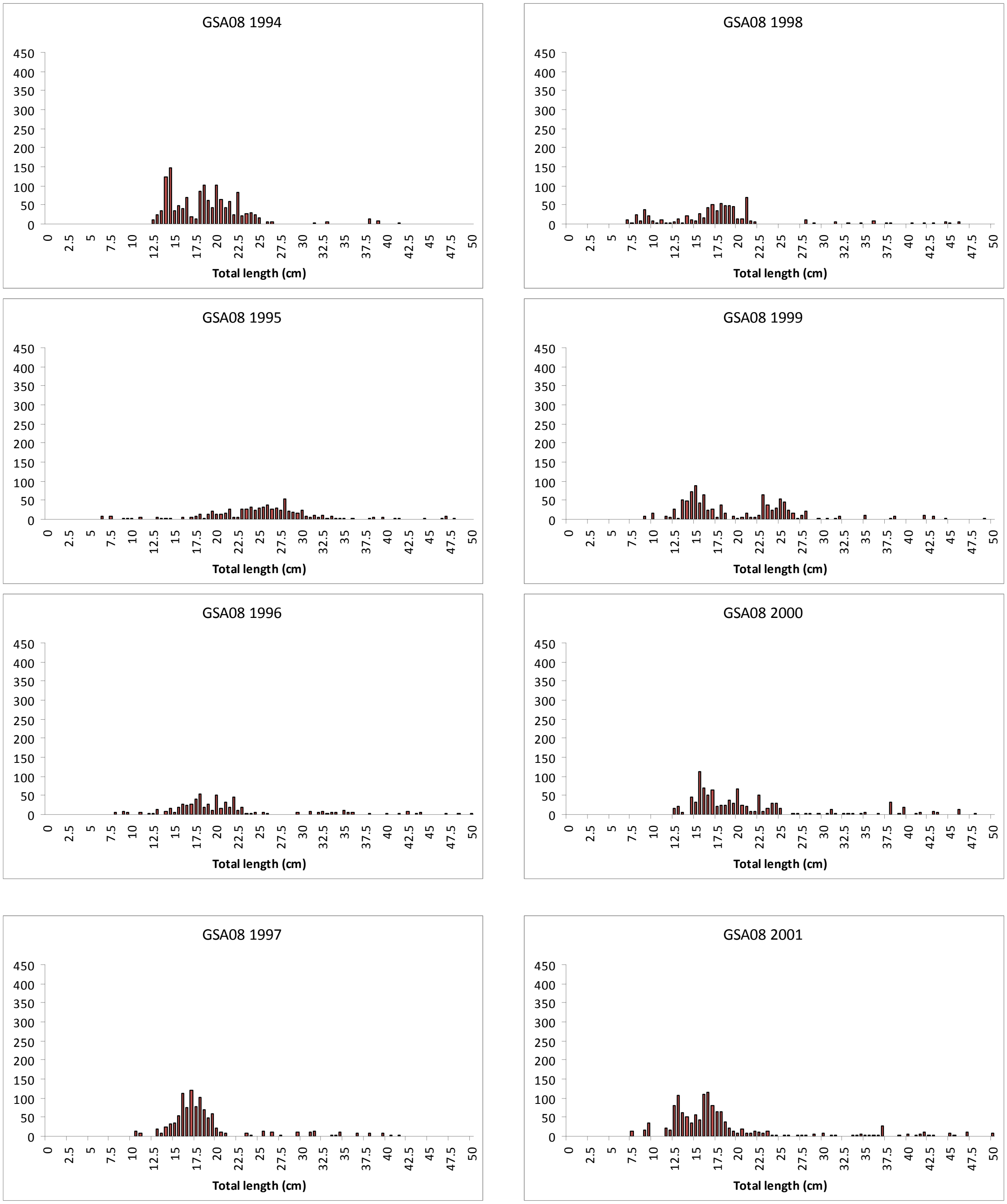


Fig. 7.6.3.1.4.1 Stratified abundance indices by size, 1994-2001.

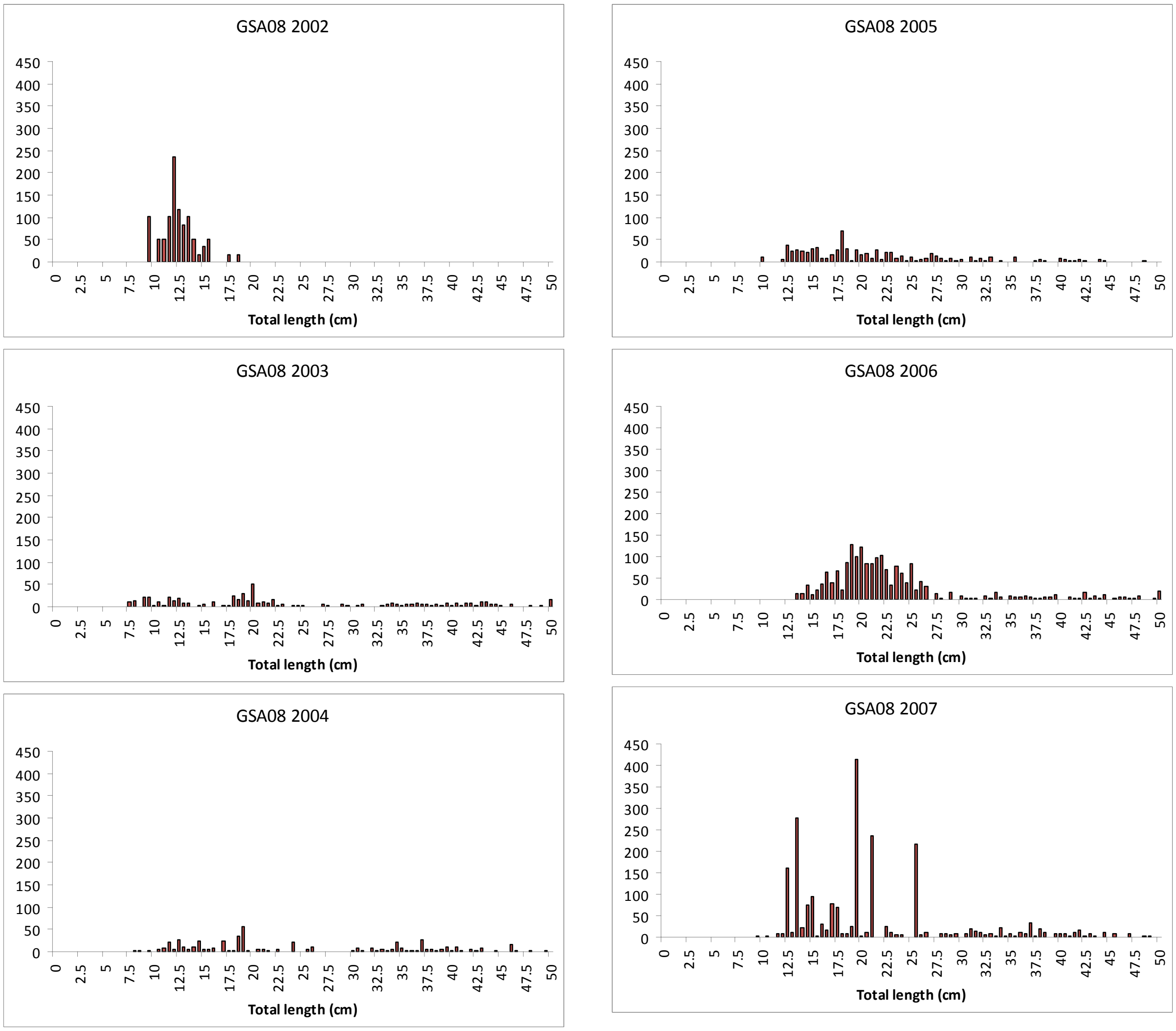


Fig. 7.6.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.6.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.6.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.6.4. Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment.

7.6.5. Short term prediction for 2008 and 2009

7.6.5.1. Justification

No forecast analyses were conducted.

7.6.5.2. Input parameters

No forecast analyses were conducted.

7.6.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 08.

7.6.6. Medium term prediction

7.6.6.1. Justification

No forecast analyses were conducted.

7.6.6.2. Input parameters

No forecast analyses were conducted.

7.6.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 08.

7.6.7. Long term prediction

7.6.7.1. Justification

No forecast analyses were conducted.

7.6.7.2. Input parameters

No forecast analyses were conducted.

7.6.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 08.

7.6.8. Scientific advice

7.6.8.1. Short term considerations

7.6.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.6.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.6.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.6.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.7. Stock assessment of hake in GSA 09

7.7.1.Stock identification and biological features

7.7.1.1. Stock Identification

Due to a lack of information about the structure of hake population in the western Mediterranean, this stock was assumed to be confined within the GSA 9 boundaries. Hake is distributed in the whole area between 10 and 800 m depth (Biagi et al., 2002; Colloca et al., 2003). Recruits peak in abundance between 150 and 250 m depth over the continental shelf-break and appear to move slightly deeper when they reach 10-cm total length. Crinoid (*Leptometra palangium*) bottoms over the shelf-break are the main settlement habitat for hake in the area (Colloca et al., 2004, 2006; Reale et al., 2005). Migration from nurseries takes place when juveniles attained a critical size between 13 and 15.5 cm TL (Bartolino et al., 2008a). Maturing hakes (15-35 cm TL) persist on the continental shelf with a preference for water of 70–100 m depth, while larger hakes can be found in a larger depth range from the shelf to the upper slope. Juveniles show a patchy distribution with some main density hot spots (nurseries) showing a high spatio-temporal persistence (Abella et al., 2005; Colloca et al., 2006, Jona Lasinio et al., 2007) (Fig. 7.7.1.1.1) in areas with frontal terms and other oceanographic structures that can enhance larval retention (Abella et al., 2008).

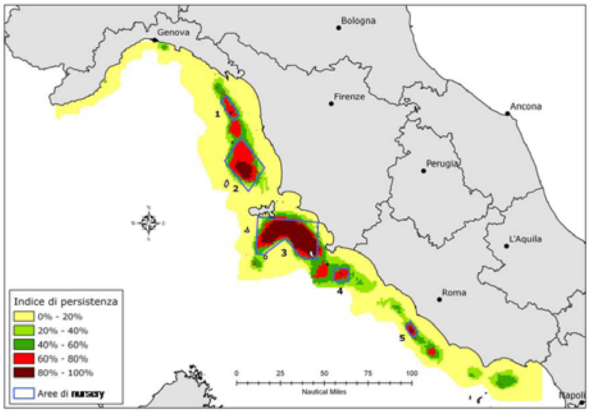
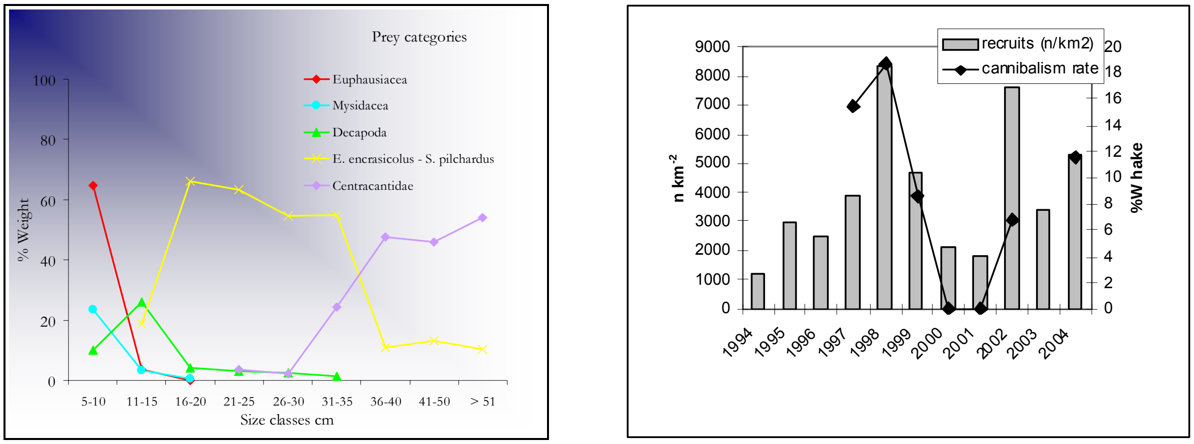


Fig 7.7.1.1.1 Temporal persistence of hake nurseries calculated from Medits and Grund time-series density maps (1994-2005) of juveniles.

Although hakes are demersal fish, they feed typically upon prey that are fast-moving pelagics, ambushed in the water column (Alheit and Pitcher, 1995). There is evidence that hakes feed in mid-water or at the surface during night-time, undertaking daily vertical migrations (Orsi-Relini et al., 1989, Carpentieri et al., 2008) which are more intense for juveniles. In GSA 9 many different studies are available on hake diet. Results from stomach data collected in the 1996-2001 period can be found in Sartor et al. (2003a) and Carpentieri et al. (2005). Hake diet shifts from euphausids and mysiids, consumed by smaller hake (<16 cm TL), to fishes consumed by larger hake.

Before the transition to the complete icthyophagous phase (TL> 36 cm) hake shows more generalized feeding habits where decapods, benthic (Gobiidae, *Callionymus* spp.,) and necktonic fish (*S. pilchardus, E. encrasicolus*) dominated the diet, whereas cephalopods had a lower incidence (Fig. 7.7.1.1.2).



A) B)

Fig. 7.7.1.1.2 A) Hake diet composition in GSA 9 by size class (from Carpentieri et al., 2005). B) Relationships between recruitment and cannibalism rate (proportion by weight, %W, of hake in hake stomachs).

Estimation of cannibalism rate has been provided for the southern part of the GSA (Latium, EU Because project). Cannibalism increased with size and can be considered significant for hakes between 30 and 40 cm TL (up to 20% by weight in diet) and seems to relate closely to hake recruitment density and level of spatial overlapping.

Consumption rate has been estimated for juveniles and piscivorous hakes. Daily consumption of juveniles, calculated in proportion of body weight (%BW), varied between 5 (July) and 5.9 % BW (Carpentieri et al., 2008). The estimated relative daily consumption for hake between 14 and 40 cm, estimated using a bioenergetic approach (EU Because project) TL was between 2.9 and 2.3 BW%.

7.7.1.2. Growth

Juvenile growth rate was estimated to be about 1.5 cm.month^{-1} using daily growth increments on otoliths (Belcari et al., 2006). According to this growth rate, hake reaches an average length of about 18 cm TL at the end of the first year. According to these observations, the growth of hake in the GSA 9 seems to follow the pattern estimated in the NW Mediterranean (Garcia-Rodriguez and Esteban, 2002) adopting the hypothesis that two rings are laid down within otoliths each year. This new interpretation of otolith ring patterns returns a growth rate (L∞ = 103.9, K/year = 0.212, to =0.031) double than that assumed in the past.

As showed in the Fig. 7.7.1.2.1, cohorts obtained through age slicing of LFDS MEDITS data according to fast growth parameters, can be consistently followed during time, while an unreliable pattern was obtained according to the slow growth parameters.

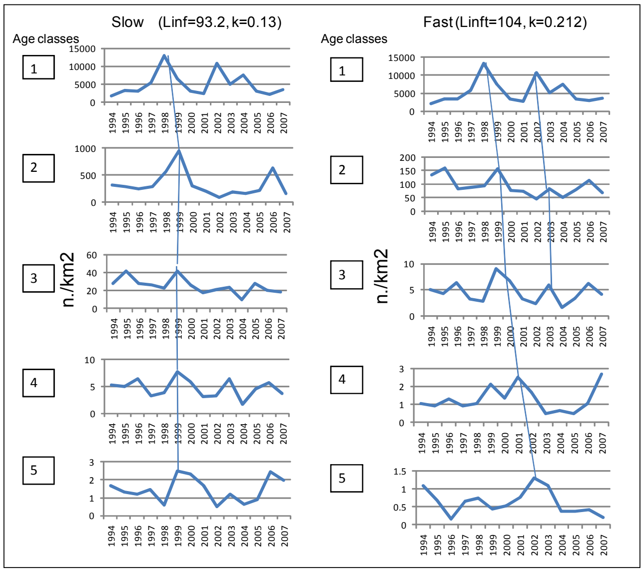


Fig. 7.7.1.2.1 Trends in abundance of age classes obtained using age slicing according to two different sets of growth parameters on Medits data.

7.7.1.3. Maturity

The catchability of hake spawners to the Mediterranean trawl nets is rather limited. Either the distribution of adults is in deeper and untrawable areas, or the ability of larger fish to avoid capture have been claimed as causes of the observed reduced catch of adult hake by trawlers in the Mediterranean (Abella et al., 1997). Also during trawl surveys (MEDITS and GRUND) the catch rate of mature specimens was very low, reducing the possibility of use trawl survey data to explore pattern in gonad development as well as the relationships between growth rate and maturation processes.

Large size hake are targets of a specifically targeted gillnet fishery carried out by several vessels working in the southern part (northern and central Tyrrhenian Sea) of the GSA9 (Sartor et al., 2001a).

Reproductive biology and fecundity of hake have been studied in northern Tyrrhenian Sea (Biagi et al., 1995; Nannini et al., 2001; Recasens et al., in press) by monthly samplings of adults caught by trawling and gillnets.

Females in advanced maturity stages, spawning and partial post-spawning are present all year round, but reproductive activity is concentrated from January to May, with two peaks of spawning in February and May. The presence of hake spawners seems to be more concentrated in the southern part of GSA9, in particular in northern Tyrrhenian Sea.

Female length at first maturity was estimated at 35.1 cm TL in northern Tyrrhenian Sea (Recasens et al., in press.). This value is consistent with the observations obtained from trawl surveys over the Latium (Colloca, pers. comm.) reporting first maturity from 31 to 37 for females and from 21 to 25 cm TL for males.

Batch fecundity was about 200 eggs per gonad-free female gram, with asynchronous oocyte development (Recasens et al., in press).

7.7.2.Fisheries

7.7.2.1. General description of fisheries

Hake is the most important component of bottom trawlers targeting a species complex and is the demersal species providing the highest landings and incomes for the GSA 09. The analysis of available information suggests that about 90% of landings of hake is due to bottom trawl vessels; the remaining fraction is provided by artisanal vessels using set nets, in particular gillnets.

The trawl fleet of GSA9 at the end of 2006 accounted for 361 vessels (Tab. 7.7.2.1.1).

The main trawl fleets of GSA9 are present in the following continental harbours: Viareggio, Livorno, Porto Santo Stefano (Tuscany), Fiumicino, Terracina, Gaeta (Latium).

Tab. 7.7.2.1.1 Technical characteristics of the trawl fleet of GSA 09 (year 2006, DCR official data)

N. of boats	361
GT	13.191
kW	75.514
Mean GT	36.5
Mean kW	209.2

As concerns fishing activity, the majority of bottom trawlers of GSA 09 performs daily fishing trips; only some vessels can stay out of the port for two-three days, especially in summer.

Hake fishing grounds comprise all the soft bottoms of continental shelfs and the upper part of continental slope. Fishing pressure shows some geographical differences inside the GSA9 according to the consistency of the fleets and the characteristics of the bottoms.

The artisanal fleets, according to the last official data (end of 2006), accounted for 1,309 vessels; widespread in many harbours along the continental and insular coasts. Of these, about 50 vessels, located in some harbors of the GSA 09 (e.g. Marina di Campo, Ponza, Porto Santo Stefano), especially from winter to summer, utilize gillnets and target medium and large sized hakes (greather than 25 cm TL).

7.7.2.2. Management regulations applicable in 2007 and 2008

- Fishing closure for trawling: 45 days in late summer (not every year have been enforced)
- Minimum landing sizes: EC regulation 1967/2006: 20 cm TL for hake.
- Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
- Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.
- Two small No Take Zones (“Zone di Tutela Biologica”, ZTB) are present inside the GSA 09; one off the Giglio Island (50 km^2, northern Tyrrhenian Sea) another off Gaeta, (125 km^2, central Tyrrhenian Sea). In both areas fishing gears operating on the bottom are not allowed.

7.7.2.3. Catches

7.7.2.3.1. Landings

In the last five years the total landings of hake of GSA 09 fluctuated between 1,000 to about 2,300 tons, and even though the time series is short the general shape suggests an increasing trend (Fig. 7.7.2.3.1.1).

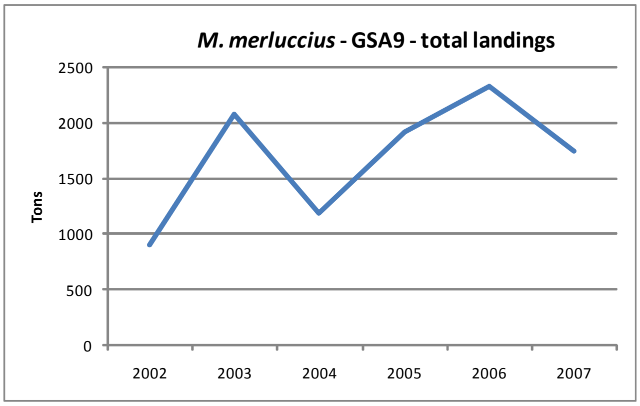


Fig. 7.7.2.3.1.1 Landings of hake (all gears) in the GSA 09, from 2002 to 2007 (DCR official data).

Due to huge concentration of hake juveniles in GSA 09, trawl landings were traditionally dominated by small sized specimens; they are basically composed by 0 and 1 year old individuals. Gillnet fishery lands mostly 2 and 3 years old fish, as shown by the two following histograms (Fig. 7.7.2.3.1.2).

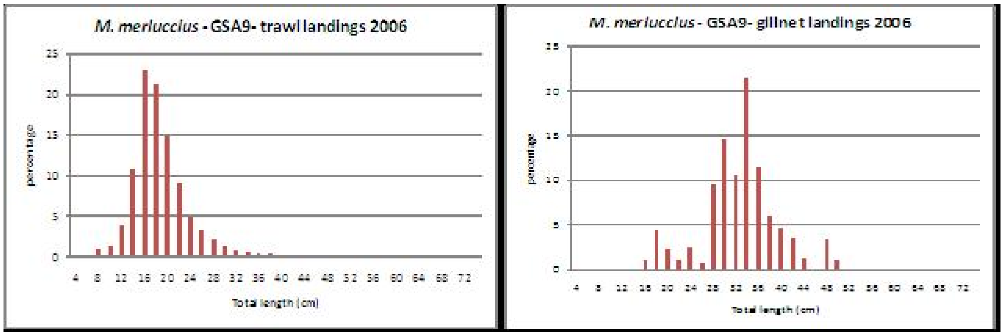


Fig. 7.7.2.3.1.2 Size structure of the landings of hake provided in 2006 by otter trawling and by set nets in the GSA 09 (DCR official data).

The landings data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.1 of Appendix 3 by major gear types.

7.7.2.3.2. Discards

Several EU and national projects carried out in GSA 09 highlighted the problem of discard of hake by trawl fisheries. High quantities of small sized hakes are routinely discarded, especially in summer and on the fishing grounds located near the main nursery areas of the species (Fig. 7.7.2.3.2.1).

Due to the introduction of the EU Regulations on MLS a progressive increase of the size at which 50% of the specimens caught was discarded has been observed in these last years: from about 11 cm TL in 1995 (Sartor et al., 2001b), to about 17 cm TL in 2006 (De Ranieri 2007).

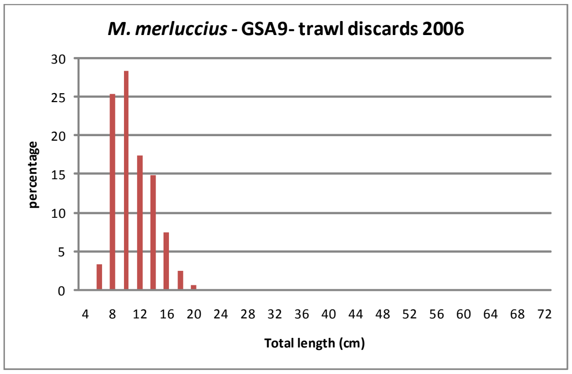


Fig. 7.7.2.3.2.1 Size structure of the hake discarded by the trawl fleets operating in the GSA9 in 2006 (DCR official data).

Reported discards through the DCR data call to SGMED-08-04 amount 467 t in 2006 for trawlers. The data are listed in Table A3.6 of Appendix 3.

7.7.2.3.3. Fishing effort

The fishing capacity of the GSA 09 has shown in these last 20 years a progressive decrease; from 1996 to 2006 the number of bottom trawlers of GSA9 decreased of about 30%.

The total fishing days carried out by all the GSA 09 trawlers varied from about 65,000 in 2004 to about 63,000 in 2006 (Fig. 7.7.2.3.3.1), a little decrease of the mean number of fishing days/year per vessel was observed in this period, from 187 to 177.

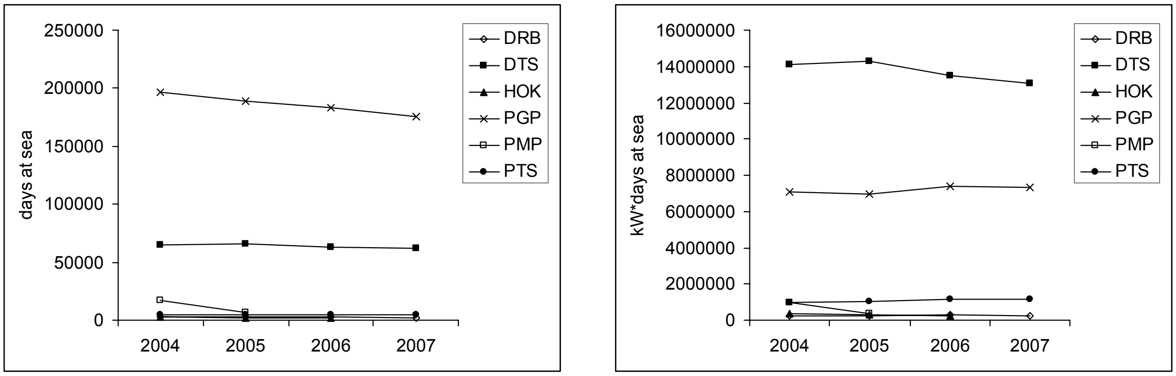


Fig. 7.7.2.3.3.1 Effort trends (days and kW*days) by major fleets, 2004-2007. The data are listed in Tables A3.7 and A3.9 of Appendix 3.

7.7.3.Scientific surveys

7.7.3.1. Medits

7.7.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 09 the following number of hauls were reported per depth stratum (s. Tab. 7.7.3.1.1.1).

Tab. 7.7.3.1.1.1. Number of hauls per year and depth stratum in GSA 09, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13
GSA09_050-100	19	19	18	19	18	19	20	20	15	15	15	14	16	16
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33
GSA09_500-800	31	30	31	28	30	28	27	29	24	22	21	20	20	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.7.3.1.2. Geographical distribution patterns

According to recent studies (Orsi Relini et al., 2002), the density of hake recruits concentrations in nursery areas in GSA9 is by far higher than that of the other GSAs of the western Mediterranean and, probably, also of the other Mediterranean GSAs (Fig. 7.7.3.1.2.1).

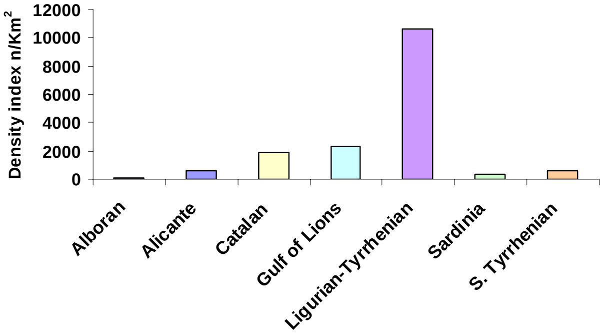


Fig. 7.7.3.1.2.1 MEDITS density indices of the hake recruits (<12 cm TL) obtained in different Mediterranean GSAs (from Orsi-Relini et al., 2002, modified).

Generalized additive models were developed to investigate hake recruitment dynamics in the Tyrrhenian Sea in relation to spawner abundance and selected key oceanographic variables. Thermal anomalies in summer, characterised by high peaks in water temperature, revealed a negative effect on the abundance of recruits in autumn, probably due to a reduction in hake egg and larval survival rate. Recruitment was reduced when elevated sea-surface temperatures were coupled with lower levels of water circulation. Enhanced spring primary production, related to late winter low temperatures could affect water mass productivity in the following months, thus influencing spring recruitment. In the central Tyrrhenian a dome-shaped relationship between wind mixing in early spring and recruitment could be interpreted as an "optimal environmental window" in which intermediate water mixing level played a positive role in phytoplankton displacement, larval feeding rate and appropriate larval drift (Bartolino et al., 2008b) (Fig. 7.7.3.1.2.2).

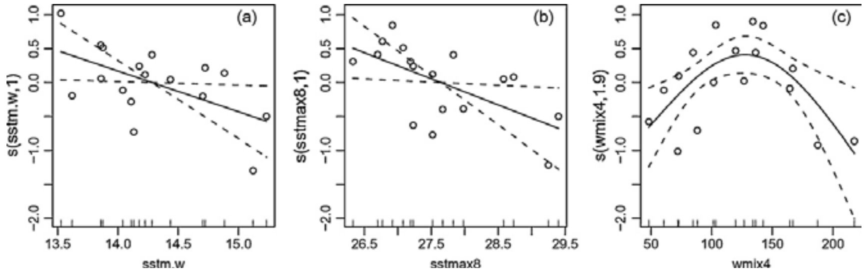


Fig. 7.7.3.1.2.2 Effects of: (a) sstm.w, (b) sstmax8 and (c) wmix4 on hake recruitment in the central Tyrrhenian (from Bartolino et al., 2007).

The temporal trend in spatial distribution of hake > 26 cm TL showed a clear reduction of distribution area, particularly in the Tyrrhenian part of the GSA (Grund data, Fig. 7.7.3.1.2.3).

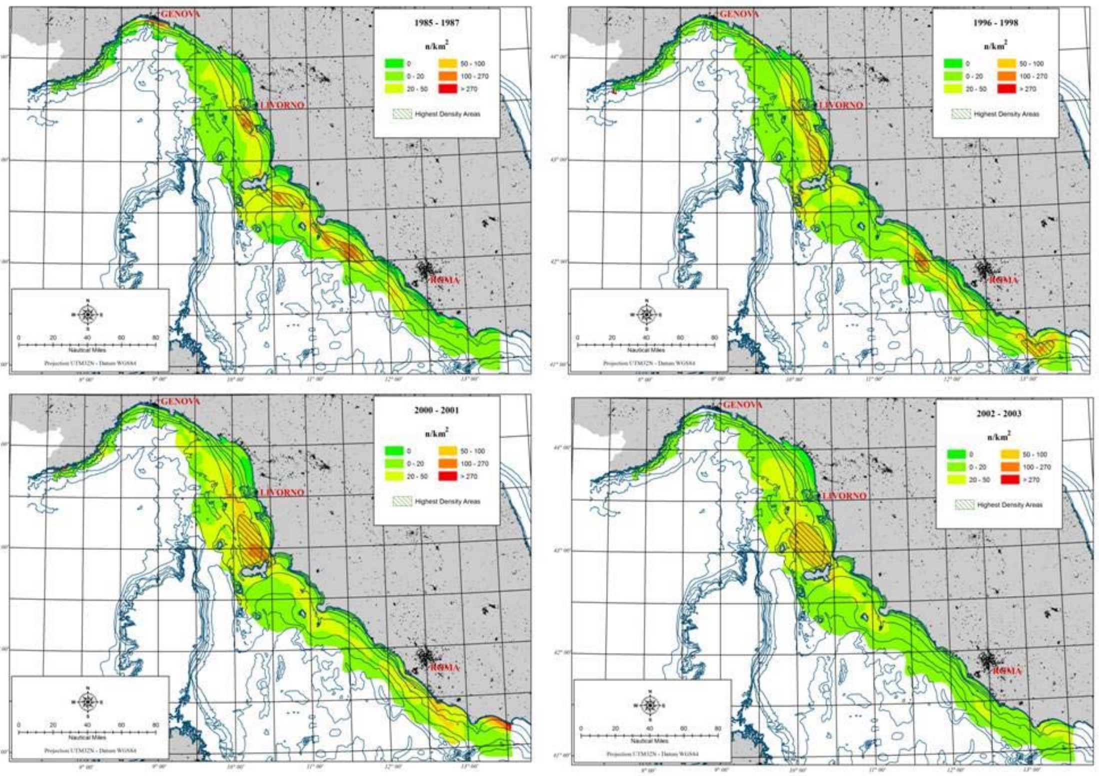


Fig. 7.7.3.1.2.3 Distribution of hakes larger than 26 cm TL in 1985-87, 1996-98, 2000-01, 2002-03.

7.7.3.1.3. Trends in abundance and biomass

The national GRUND trawl survey (Relini, 1998) is regularly carried out along the Italian coasts in addition to MEDITS. It has been carried out since 1985, with some years lacking (1988, 1989 and 1999). Sampling is random stratified, except in the period 1990-93 where a different sampling design, based on transects, was applied. Locations of stations were selected randomly within each stratum in the period 1985-87, while starting from 1996, the same stations were sampled the following years. Therefore from 1994 in Italy two trawl surveys are regularly carried out each year: MEDITS, in spring, and GRUND, in autumn. The two surveys provide integrate pictures on different seasons, allowing to monitor the most important biological events (recruitment, spawning) for the majority of the demersal species.

Fig. 7.7.3.1.3.1 shows the density and biomass indices of hake obtained from 1994 to 2006; no evident trends are present.

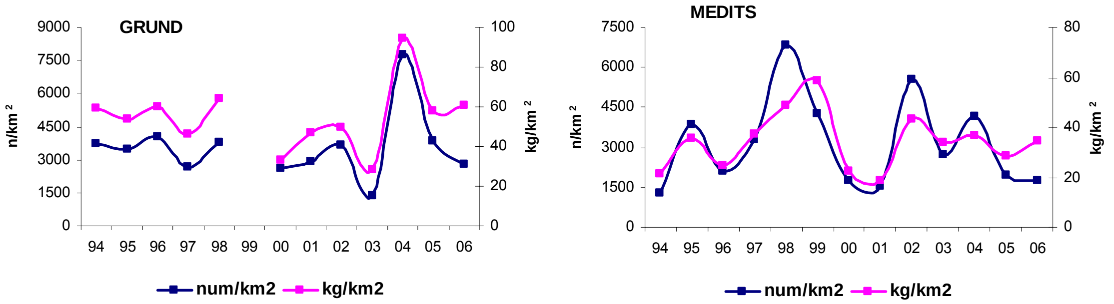


Fig. 7.7.3.1.3.1 Density and abundance indices of hake according to the GRUND (left) and MEDITS (RIGHT) surveys.

Fishery independent information regarding the state of the hake in GSA 09 was derived from the international survey Medits. Figure 7.7.3.1.3.2 displays the re-estimated trend in hake abundance and biomass in GSA 09 based on the DCR data call. Both Medits trends presented are similar without any long term trend. Hovever, abundance and biomass appear low since 2005.

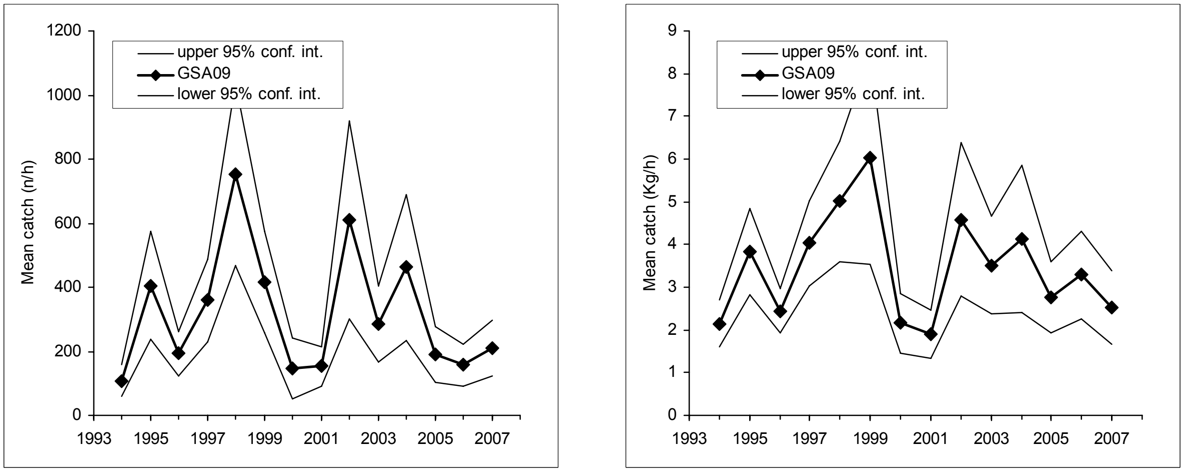


Fig. 7.7.3.1.3.2 Abundance and biomass indices of hake in GSA 09.

7.7.3.1.4. Trends in abundance by length or age

The following Fig. 7.7.3.1.4.1 and 2 display the stratified abundance indices of GSA 09 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

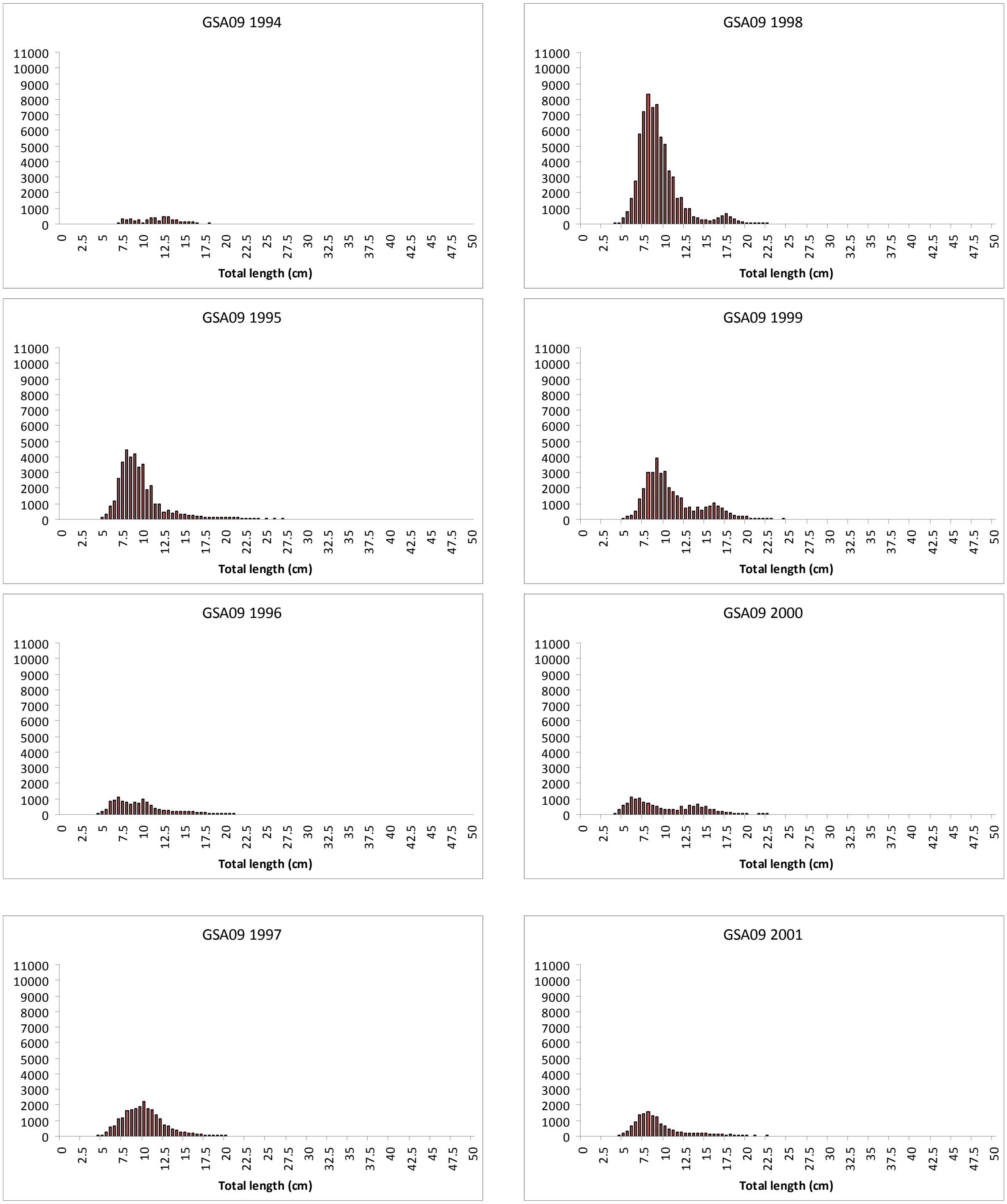


Fig. 7.7.3.1.4.1 Stratified abundance indices by size, 1994-2001.

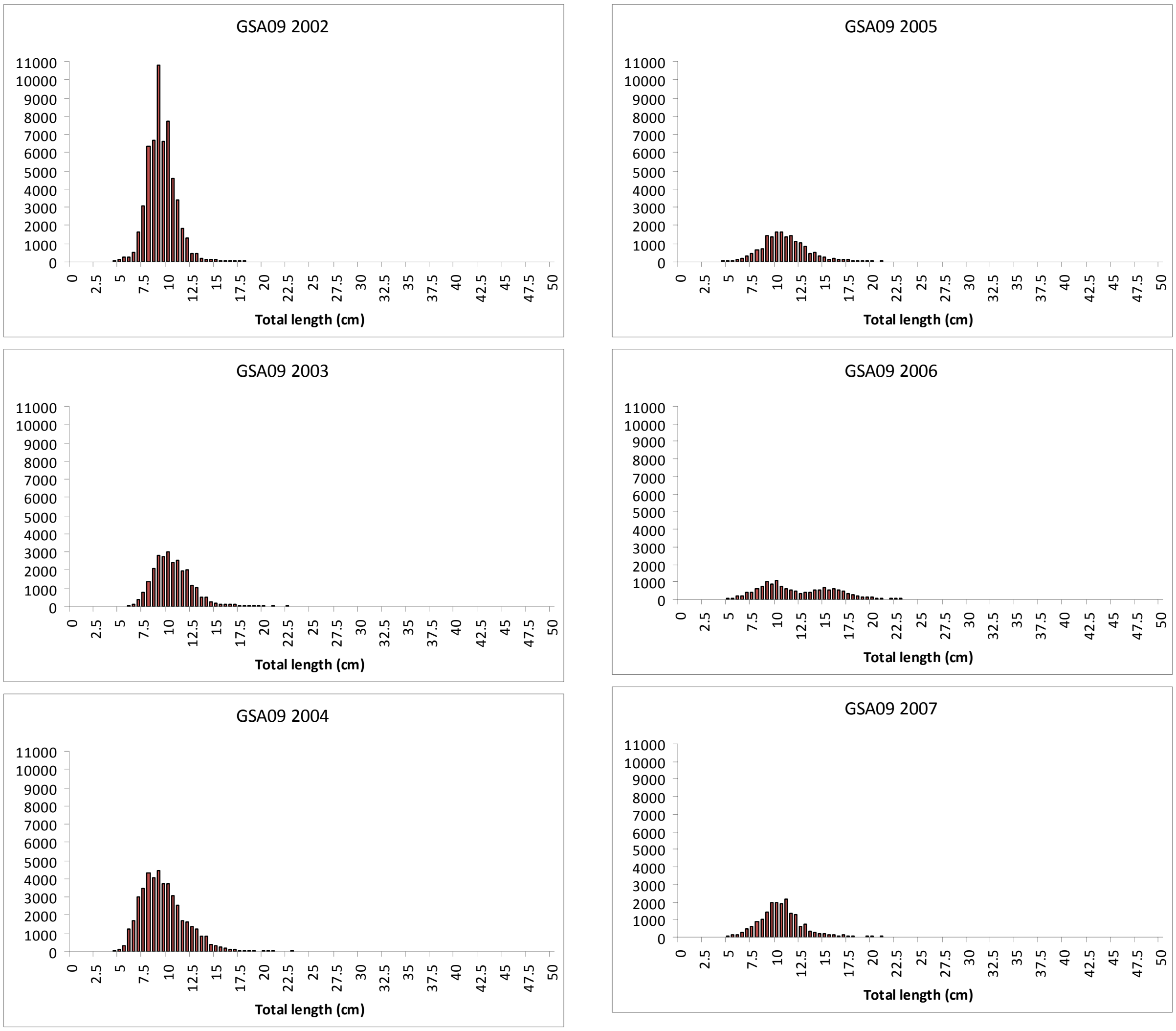


Fig. 7.7.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.7.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.7.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.7.4.Assessment of historic stock parameters

Due to its importance as demersal resource, hake has been object of several assessments in the GSA9 (Reale et al., 1995; Fiorentino et al., 1996; Ardizzone et al., 1998; Abella et al., 1999; 2007; Colloca et al., 2000). These results are published and regularly updated in the GFCM SAC sheets. The assessments, often performed with different approaches in different periods or in different subareas of the GSA9, showed substantially convergent results.

The hake in the GSA9 seems to be in a “chronic” overexploitation, as shown by the results of the analytical models (reference points as F_{max}, $F_{0.1}$ and ESSB/USSB). Also the production models provided total mortality estimates greater than the mortality corresponding to the maximum biological production (ZMBP).

A growth overfishing situation was detected, with excessive fishing mortality on 0+ and 1+ age classes. The values of the ESSB/USSB ratio are always lower than 0.1.

As concern the STECF-SGMED-08-04, two new assessments were produced. The main results are presented below.

7.7.4.1. Method 1: Trends in LPUE

As concerns the Landings per Unit of Effort, quite long time series are available for some important fleets operating in this GSA 09.

7.7.4.1.1. Justification

Trends in LPUE may provide insight into trends in stock size. SGMED-08-04 recommends that technological creep should be considered when trends in LPUE are interpreted.

7.7.4.1.2. Input parameters

These data come from independent monitoring activities performed by the research institutes working in the GSA.

7.7.4.1.3. Results

As an example, the LPUE evolution in the period 1991-2006 is reported in Fig. 7.7.4.1.3.1. LPUE showed a continuous decreasing trend till 2004, then a little increase was observed in the last two years. The decrease in LPUE is mainly due to a change in fishing pattern experienced by the local fleets: the progressive disappearance of the smallest specimens from the landings is the effect of the introduction of the EU Regulations (1626/94 and 1967/06) concerning MLS (20 cm TL for hake).

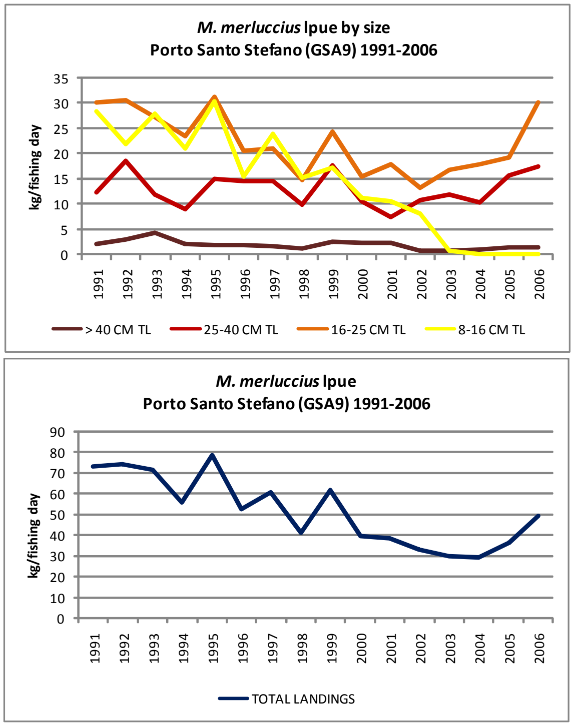


Fig. 7.7.4.1.3.1 Hake LPUE of the Porto Santo Stefano trawl fleet (1991-2006); above: LPUE by size class; below: total LPUE

7.7.4.2. Method 2: SURBA

7.7.4.2.1. Justification

The relatively long time series of data available from the GRUND and MEDITS surveys provided the most promising data sets for analysis. The survey-based stock assessment approach SURBA (Needle, 2003) was used both on MEDITS (1994-2007) and GRUND (1994-2004) data of the hake of GSA 09.

7.7.4.2.2. Input parameters

The following set of parameters was adopted:

Growth parameters (Von Bertalanffy)
L∞ = 104 (mm, length)
K = 0.2
to = - 0.03
L*W
a = 0.006657
b = 3.028
Natural mortality
M vector Age$_1$=1.3 , Age$_2$=0.8, Age$_3$=0.4, Age$_4$=0.3, Age$_5$=0.2; Age$_6$=0.2
Catchability (q)
q(age 1+) = 0.8, q(age 2+) = 1.0, q(age 3+)=0.7, q(age 4+)=0.7, q(age 5+)=0.7
Length at maturity (L50)
L50 = 30 cm
Length of first capture (Lc)
Lc = 12 cm

Tab. 7.7.42.2.2 Input parameters used used for the SURBA model.

MEDITS						GRUND				
Abundance indices										
	Age					Age				
Year	0	1	2	3	4+	0	1	2	3	4+
1994	2062.6	132.4	5	1.1	1.1	4079.4	111.5	6.5	0.1	0.3
1995	3446.2	159.5	4.3	0.9	0.7	3586.1	132.0	3.2	0.6	0.3
1996	3366.3	80.9	6.3	1.3	0.2	3930.0	157.9	4.5	1.1	0.6
1997	5753.5	86.4	3.3	0.9	0.7	2729.1	119.9	4.0	0.9	0.7
1998	13371	94.8	2.9	1	0.7	3894.3	122.9	4.4	0.7	0.3
1999	7441.3	156.7	9	2.2	0.4	3265.3	103.9	5.0	0.6	0.5
2000	3371	75.3	6.8	1.4	0.5	2636.3	84.9	5.6	0.6	0.7
2001	2663.1	73.8	3.3	2.5	0.7	3254.5	126.2	4.0	0.8	0.4
2002	10864	44.7	2.3	1.7	1.3	3901.0	107.8	3.9	0.8	0.5
2003	5153	82	6	0.5	1.1	1243.5	102.7	4.4	0.7	0.7
2004	7590.5	51.1	1.6	0.6	0.4	7859.5	110.5	3.3	0.9	0.6
2005	3278.9	79.3	3.4	0.5	0.4					
2006	2865	114	6.2	1.1	0.4					
2007	3559.8	69.1	4.2	2.7	0.2					
Proportion of matures										
	Age									
Year	0	1	2	3	4+	0	1	2	3	4+
1994	0	0.012	0.96	1	1	0	0	0.012	0.96	1
1995	0	0.012	0.92	1	1	0	0.012	0.92	1	1
1996	0	0.029	0.9	1	1	0	0.029	0.9	1	1
1997	0	0.02	0.94	1	1	0	0.02	0.94	1	1
1998	0	0.017	0.89	1	1	0	0.017	0.89	1	1
1999	0	0.015	0.92	1	1	0	0.015	0.92	1	1
2000	0	0.026	0.92	1	1	0	0.026	0.92	1	1
2001	0	0.018	0.96	1	1	0	0.018	0.96	1	1
2002	0	0.028	0.97	1	1	0	0.028	0.97	1	1
2003	0	0.025	0.93	1	1	0	0.025	0.93	1	1
2004	0	0.012	0.9	1	1	0	0.012	0.9	1	1
2005	0	0.027	0.92	1	1					
2006	0	0.021	0.93	1	1					
2007	0	0.019	0.96	1	1					
Mean weights										
	Age									
Year	0	1	2	3	4+	0	1	2	3	4+
1994	0.008	0.086	0.498	1.244	3.261	0.013	0.113	0.461	0.875	1.794
1995	0.006	0.091	0.491	1.205	3.031	0.013	0.112	0.488	0.912	2.885
1996	0.006	0.103	0.452	1.455	2.122	0.012	0.108	0.454	1.051	1.834
1997	0.007	0.097	0.519	1.340	2.918	0.013	0.114	0.420	1.095	1.954
1998	0.005	0.091	0.489	1.509	2.630	0.015	0.105	0.438	1.021	1.952
1999	0.009	0.090	0.451	1.292	2.036	0.012	0.110	0.449	1.026	1.919
2000	0.008	0.105	0.475	1.153	2.136	0.009	0.116	0.458	1.032	1.904
2001	0.006	0.094	0.580	1.180	2.839	0.012	0.112	0.438	1.108	2.359
2002	0.005	0.114	0.513	1.335	2.522	0.011	0.111	0.445	1.060	2.118
2003	0.007	0.100	0.509	1.269	2.509	0.015	0.117	0.420	0.986	1.596
2004	0.006	0.087	0.491	1.345	2.233	0.011	0.112	0.447	1.113	2.245
2005	0.009	0.101	0.448	1.052	3.447					
2006	0.013	0.088	0.505	1.286	3.307					
2007	0.007	0.096	0.559	1.225	1.811					

7.7.4.2.3. Results

The two surveys gave a similar picture for F(1-5) and SSB. F shows a clear increasing trend (Medits, $p<0.01$) from 1.2 (1994) to 1.8 (2007). Relative SSB decreased significantly ($p<0.01$) in the same period. Recruitment fluctuated from year to year without a clear temporal pattern. (Fig. 7.7.4.2.3.1).

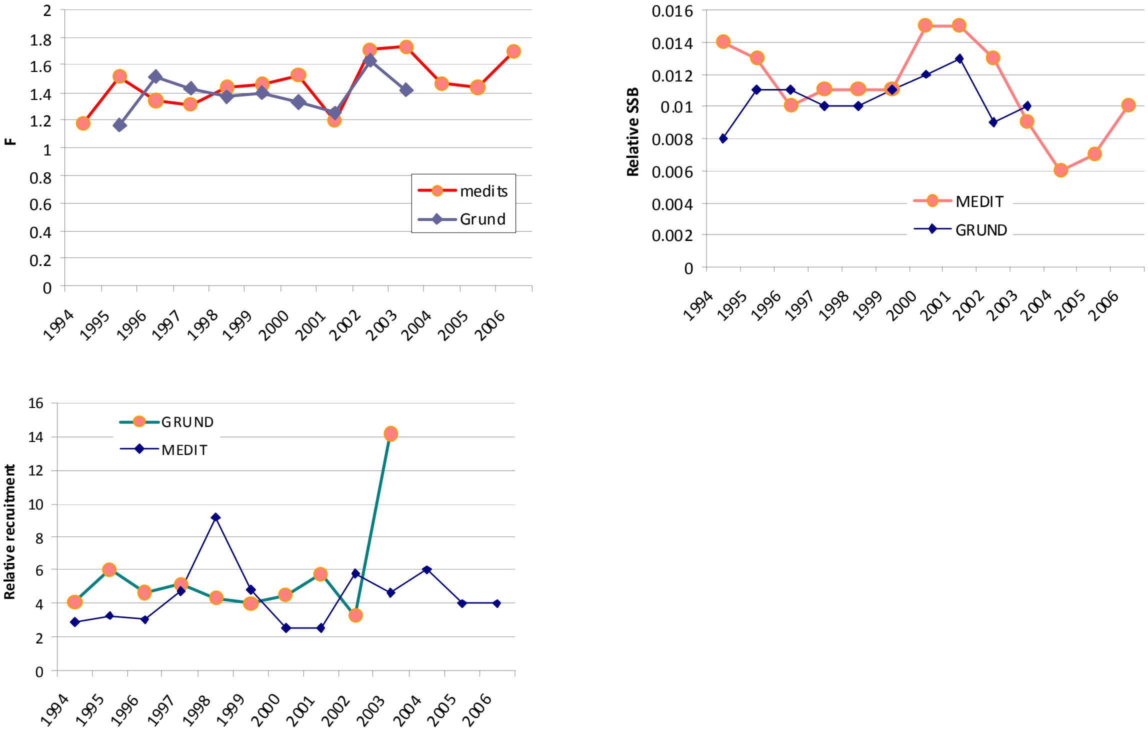


Fig. 7.7.4.2.3.1 Medits and Grund surveys. Estimated trend in F, relative SSB and recruitment using SURBA.

Model diagnostics are shown in the folloing Fig. 7.7.4.2.3.2 and Fig. 7.7.4.2.3.3.

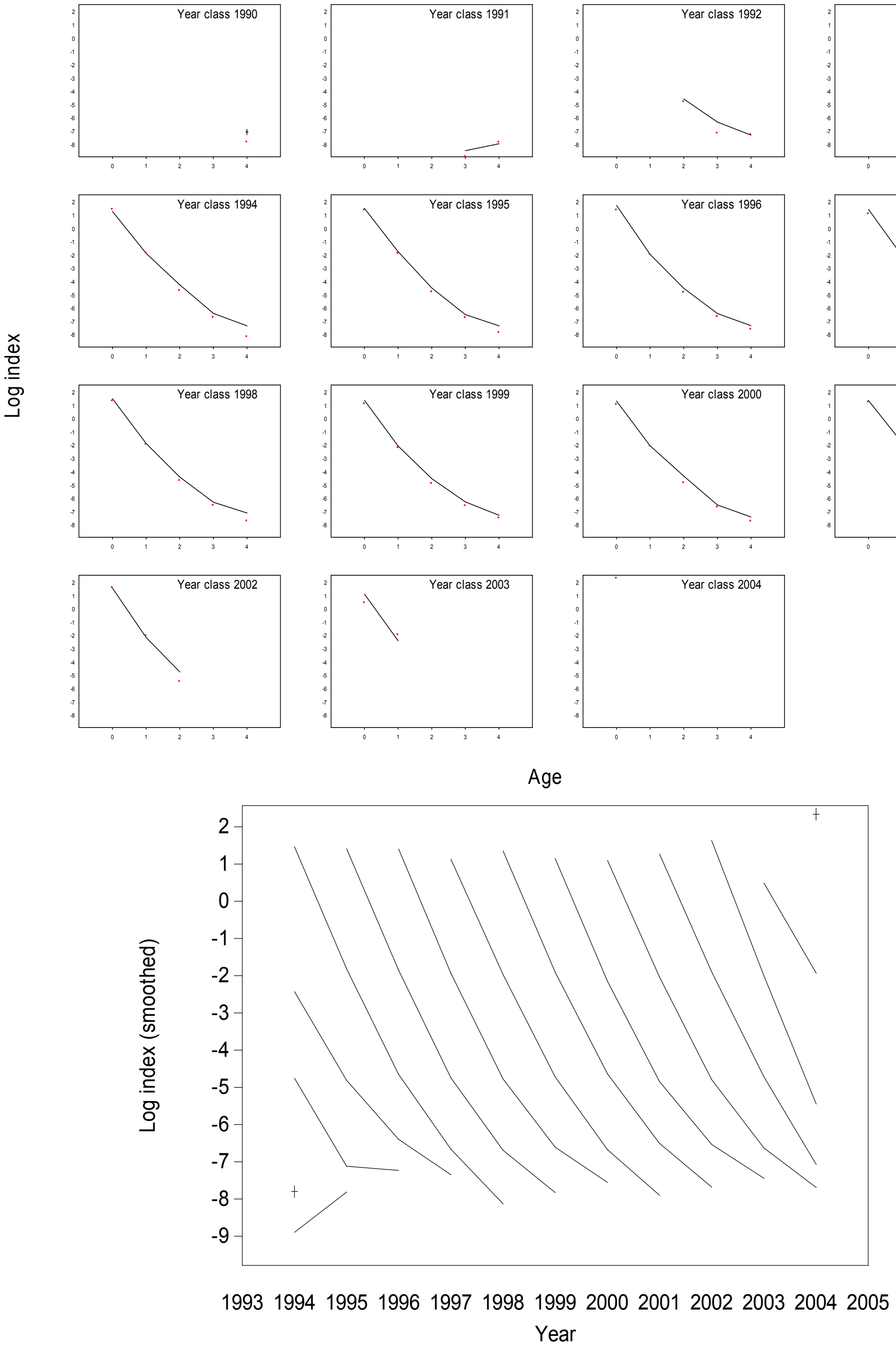


Fig. 7.7.4.2.3.2. Model diagnostic for Surba model in the GSA 9. A) Comparison between observed (points) and fitted (lines) of Medits survey abundance indices, for each year. B) Log survey abundance indices by cohort. Each line represents the log index abundance of a particular cohort throughout its life.

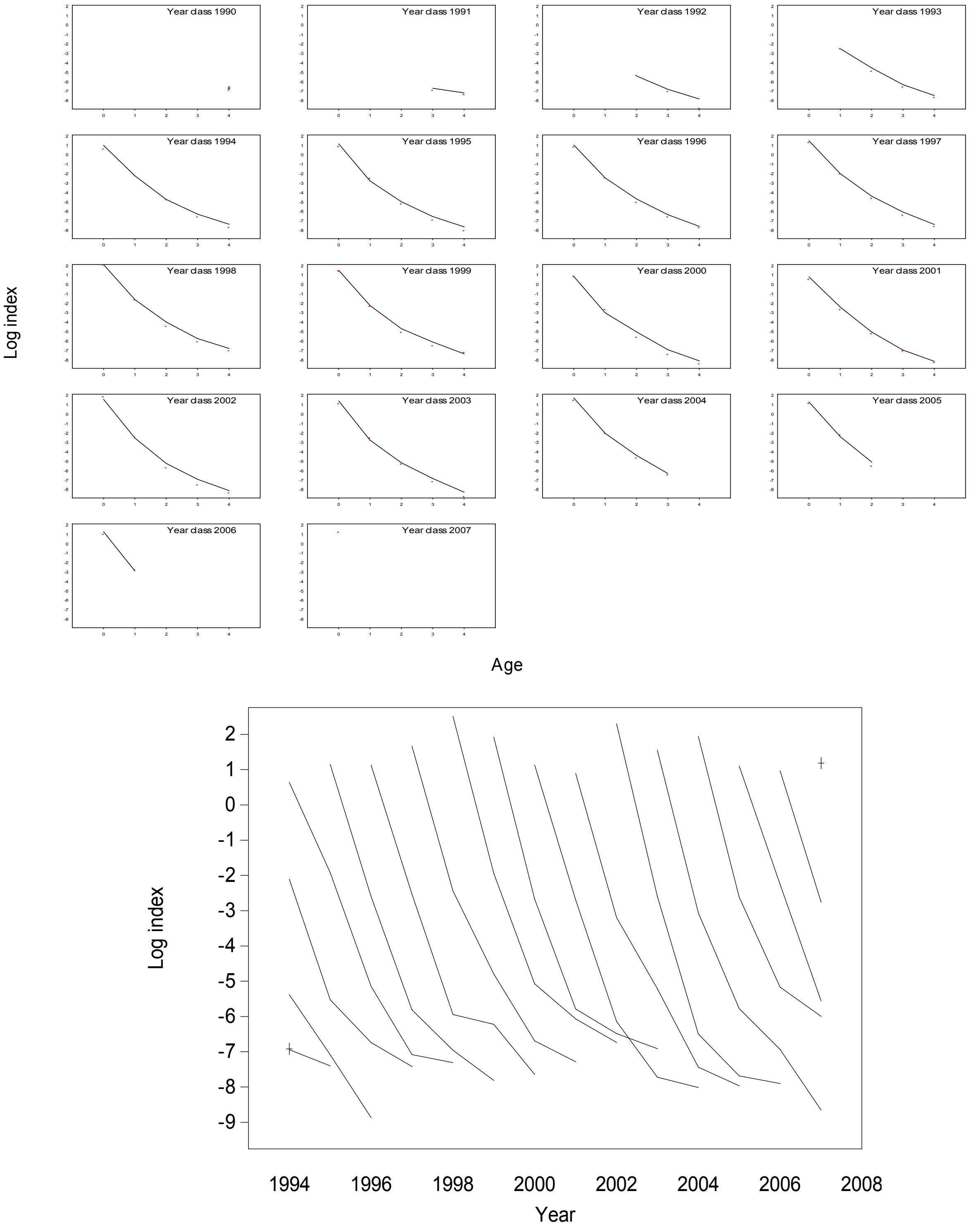


Fig. 7.7.4.2.3.3. Model diagnostic for Surba model in the GSA 9. A) Comparison between observed (points) and fitted (lines) of Grund survey abundance indices, for each year. B) Log survey abundance indices by cohort. Each line represents the log index abundance of a particular cohort throughout its life.

7.7.4.3. Method 3: LCA on DCR data

7.7.4.3.1. Justification

Assessment was performed using an LCA (VIT software, Lleonart and Salat 1997) on an annual pseudocohort (year 2006).

7.7.4.3.2. Input parameters

Data coming from DCR provided at SGMED 08-03 contained, for GSA9, information on hake landings and the respective size/age structure for 2005-2007; discard size structure was also available but only for 2006. Such data were available for the two main fishing gears exploiting hake in GSA9: trawling and set nets (gillnets). Anyway, the short data time series did not allow to apply a VPA.

LCA was performed using VIT software on data of the year 2006. Landing data were “corrected” including the information on discard (Fig. 7.7.4.3.2.1).

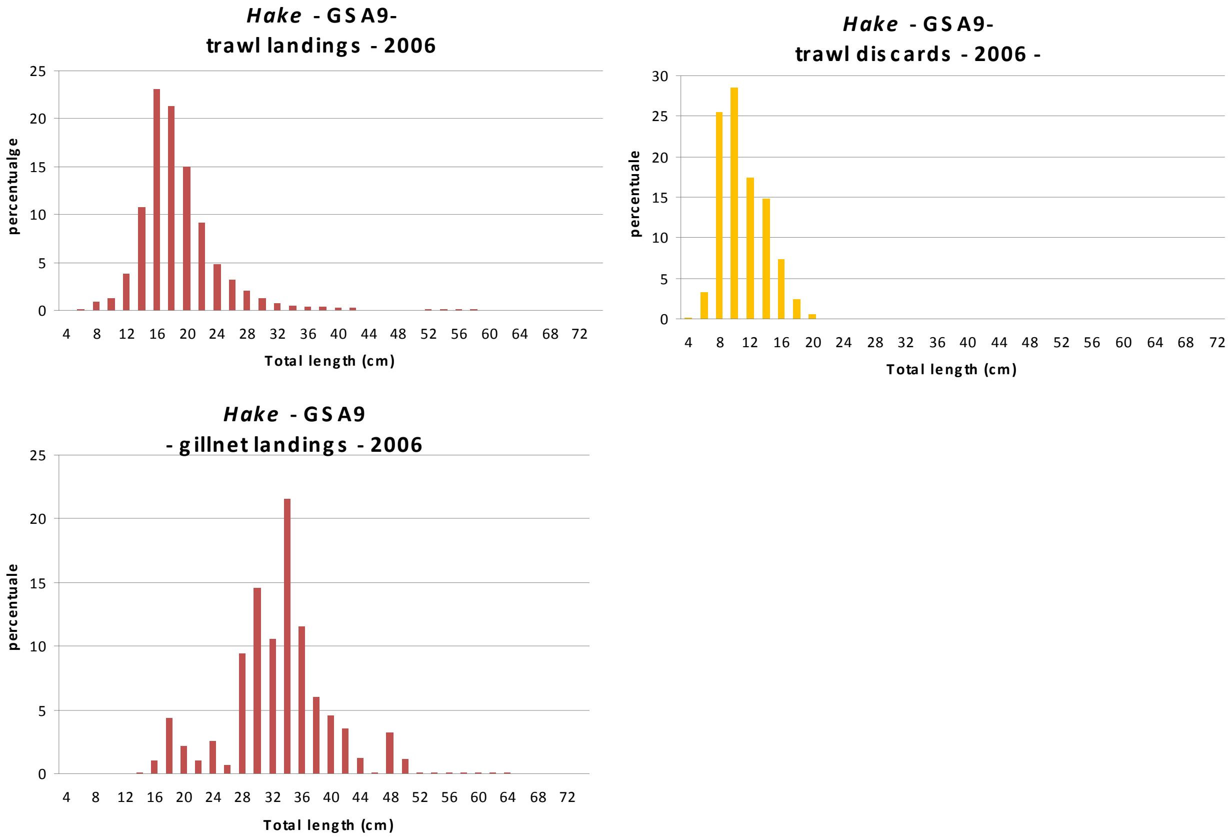


Fig. 7.7.4.3.2.1. Length frequency distributions of the *M. merluccius* landings and discards in 2006 in the GSA 9.

Tab. 7.7.4.3.2.1 shows the imput data. The used parameters were the same of the SURBA analysis, including the same M-vector and the same maturity ogive.

	Data are in percentage	
Total length (CM)	BOTTOM TRAWL Landings + discards	GILLNETS Landings
4	0.0595	0.0000
6	2.6588	0.0000
8	20.4007	0.0000
10	22.8540	0.0000
12	14.5735	0.0000
14	14.0674	0.0638
16	10.6385	1.0094
18	6.2978	4.3835
20	3.5836	2.2102
22	1.8927	1.0732
24	0.9992	2.5426
26	0.6632	0.7016
28	0.4215	9.4687
30	0.2611	14.6433
32	0.1472	10.6057
34	0.1039	21.5582
36	0.0793	11.5010
38	0.0712	5.9670
40	0.0535	4.5749
42	0.0467	3.4882
44	0.0101	1.2645
46	0.0053	0.0638
48	0.0045	3.2331
50	0.0017	1.1370
52	0.0369	0.0638
54	0.0164	0.1276
56	0.0164	0.1276
58	0.0164	0.0638
60	0.0113	0.1276
62	0.0078	0.0801
64	0.0078	0.0801
66	0.0078	0.0401
68	0.0037	0.0010
70	0.0078	0.0000
72	0.0036	0.0000

	BOTTOM TRAWL	GILLNETS
LANDINGS (tons)	1180	131
	BOTTOM TRAWL	
DISCARDS	465	

Tab. 7.7.4.3.2.1. Input data for LCA of the European hake in GSA 9

According to the STECF-SGMED-08-04 scientist's knowledge, DCR landing data for GSA9 have been adjusted concerning to the contribution of artisanal fishery to the total catch. DCR data gave a proportion of about about 60% for trawling and about 40% for set nets. An overestimation of the set nets was detected, so the percentage contribution of set nets was reduced to 10%, a more reliable value taking account the expert's knowledge of the GSA 09 fisheries. These aspect underlines both the need of some improvements of the data collection, paying particular attention to the sampling design and the importance of a routinely check of the official data.

7.7.4.3.3. Results

The general results of LCA (Fig. 7.7.4.3.3.1).highlight an exploitation focused on young age classes, mainly 0+ and 1+, reflecting a growth overfishing state. A value of F(1-4) of 1.24 was estimated, even though the global F estimasted by the model was 1.6.

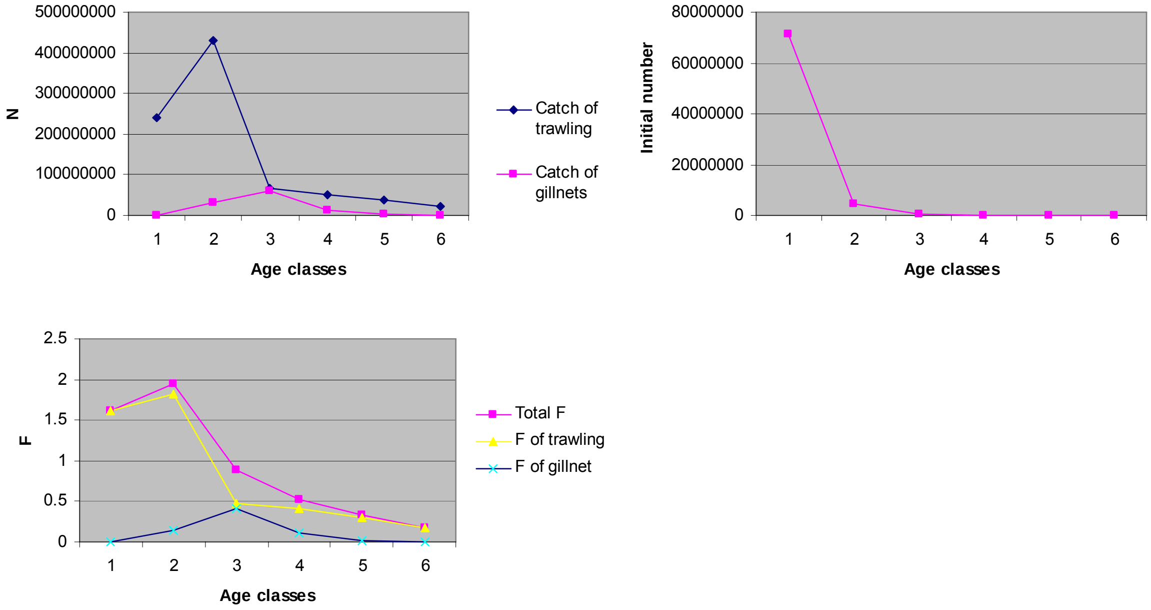


Fig. 7.7.4.3.3.1. LCA outputs: catch numbers, numbers-at-age and fishing mortality at age of *M. merluccius* in the GSA 9.

7.7.5. Short term prediction for 2008 and 2009

7.7.5.1. Justification

No forecast analyses were conducted.

7.7.5.2. Input parameters

No forecast analyses were conducted.

7.7.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 09.

7.7.6. Medium term prediction

7.7.6.1. Justification

A simulation of an example of Harvest Control Rule (HCR) for the GSA9 hake stock was performed during SGMED-08-04. This exercise does not represent an official recommendation for this rule by SGMED, but was a theoretical exercise to demonstrate the potential impacts of such a rule (combined with example target and limit reference levels as per ICES) on future population status.

7.7.6.2. Input parameters

The HCR examined aimed to achieve a target fishing mortality F[A], from a point at which the stock was above a trigger SSB [C], using TAC limits (not usually applied in the Mediterranean). The HCR included a maximum inter annual variation in TAC[B], expressed as interannual variation (%IAV). When the SSB was lower than [C] a linear decrease in F was applied according to the following relationship:

$$F = (F_A - F_{low}) \times (SSB_{TAC} - SSB_L)/(SSB_C - SSB_L) + F_{low}$$

F is estimated by iteration of TAC levels and subsequent SSB to the TAC; SSBL is a limit spawning stock level below which a Flow= 0.1 is expected. The HCR simulation tool was used to explore the effect of harvest rule parameters and model conditions. In each of several scenario runs a range of levels of target F[A] and trigger SSB [C] and levels of maximum TAC variation %IAV [B] were explored. Initial numbers at age, weight at age in the catch, weight at age in the stock, natural mortality, maturity at age, selection patterns and proportions of F and M taken before spawning were taken from VIT analysis (Table 7.7.6.3.1). Reference F was set at ages from 1 to 5. CV was set at 0.25 for all age classes. Catch in the starting year and first year of the analysis (2006 and 2007) was set equal to observed catches in 2006. For details see WKHMP report in 2008 (ICES 2008).

Stock and recruitment data were derived from rescaling SURBA relative estimates of SSB and R developed above, using 2006 estimates from VIT for this stock. Stock recruitment was assumed to follow a lognormal distribution around a hockey stick model with a SSB break point (SSBL). Geometric mean recruitments (77 millions, VIT scenario) and CVs (0.36) were estimated. SSBL was set at 470 t, equal to the lowest observed SSB in the time series 1994-2007.
Current (2006) F (age 1-5) varies between 1 and 1.2.

The yield per recruit curve levels approached a plateau at fishing mortalities around 0.20 (Fig. 7.7.6.2.1), with $F_{0.1}$ around 0.14. As with yield per recruit from the other scenarios the recruitment level only affects the level of the plateau not the curvature with F (and the corresponding F levels). The current SSB is likely to be less than 5% of the SSB at F_{msy}.

Table 7.7.6.3.1. Parameters used in the HCR analysis. M is the natural mortality, SEL is the selectivity pattern, WECA and WEST are weight at age in the catch and in the stock MAT is the proportion of matures, NAA is the number at age. GEO_{recr} is the geometrical mean recruitment and SSB_L is the limit biomass. Parameters are from VIT estimated for 2006.

Age	M	SEL	WECA	WEST	MAT	NAA (millions)
0	1.09	0.78	0.01	0.01	0.00	71.24
1	0.54	1.00	0.14	0.14	0.40	4.73
2	0.26	0.73	0.61	0.61	0.95	0.39
3	0.14	0.53	1.37	1.37	1.00	0.12
4	0.10	0.37	2.30	2.30	1.00	0.07
5	0.10	0.21	3.31	3.31	1.00	0.04
GEO_{recr}	77 millions					
SSB_L	470 tonnes					

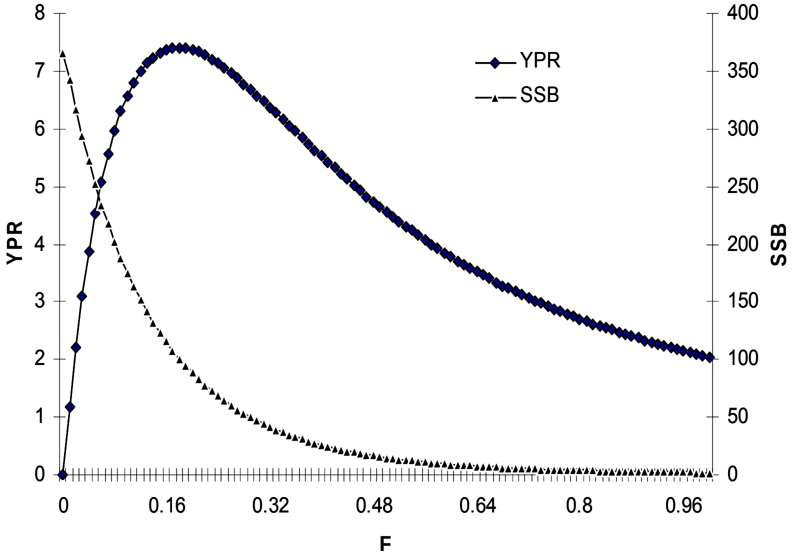
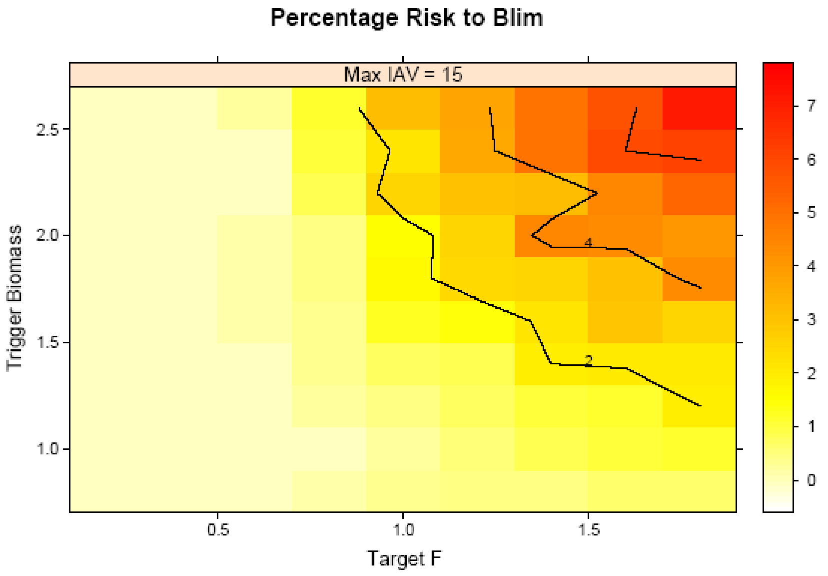


Fig. 7.7.6.2.1 Yield per recruit analysis estimated by HCR software.

7.7.6.3. Results

F values above which the risk to Blim increases are quite different depending on the imposed maximum TAC variation (%IAV: 15-20%). When IAV% is 50%, F above 0.8 increase the risk to Blim (>5%) while with smaller IAV% risks are much smaller (around 2%) at the same F (Fig. 7.7.6.3.1). However, it is important to stress that B_{lim} is set as B_{loss} in that stock and thus, it might be largely underestimated.

Catches approach a maximum level at target fishing mortality F[A] of 0.4. Also the catches decrease at higher target fishing mortality (Fig. 7.7.6.3.2).



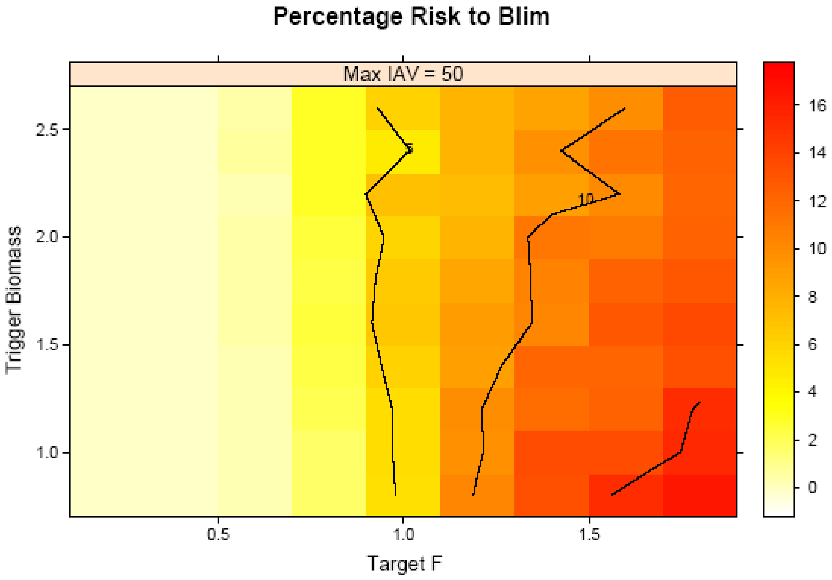


Fig. 7.7.6.3.1 Risk to B_{lim} with different values of trigger biomass, IAV% (15 and 50%) and different values of target F.

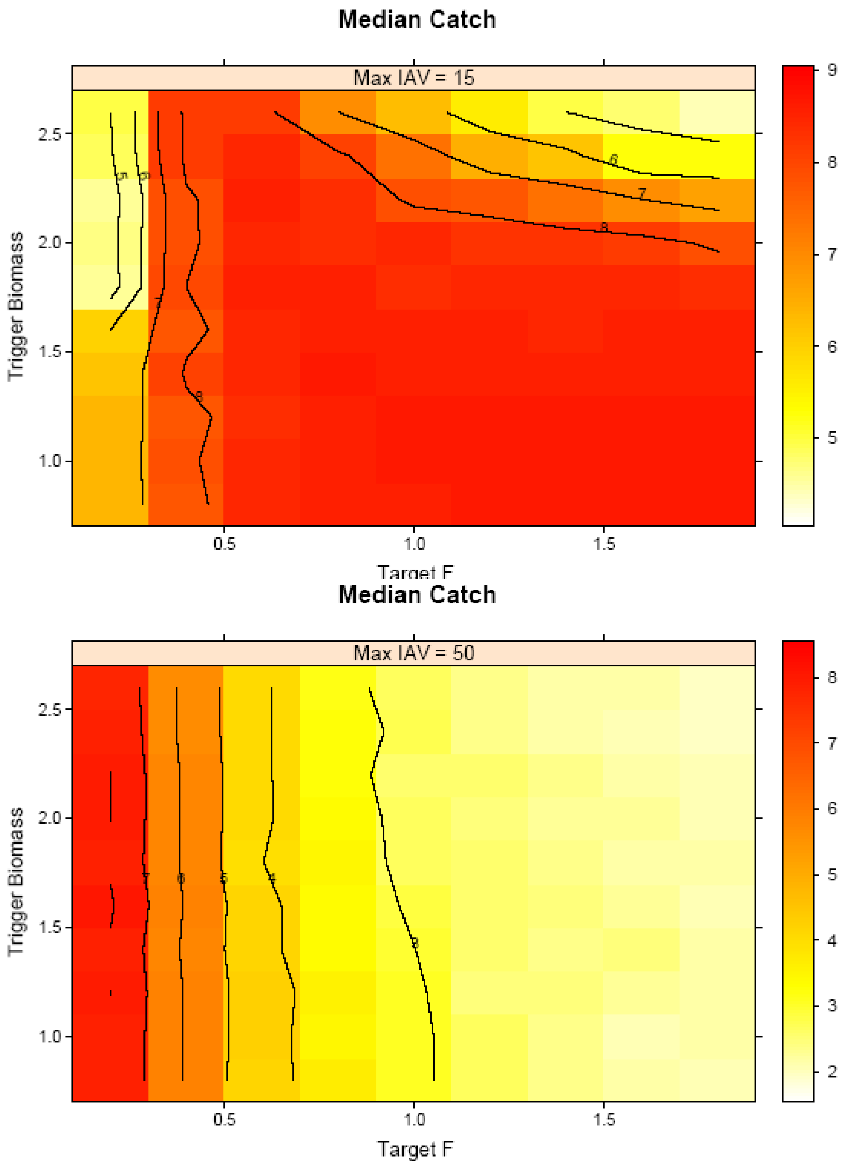


Fig. 7.7.6.3.2 Median yearly catches during 20 years with different values of trigger biomass, IAV% (15 and 50%) and different values of target F using adjusted catches.

7.7.7. Long term prediction

7.7.7.1. Justification

Equilibrium YPR reference points for the stock estimated through the Yield software (Hoggarth et al., 2006) were assessed.

Further YPR analyses were conducted based on the VIT (pseudocohort) results.

7.7.7.2. Input parameters

Equilibrium YPR reference points for the stock were estimated through the Yield software (Hoggarth et al., 2006) assuming recruitment fluctuating randomly around a constant value and 20% uncertainty in input parameters.
The second YPR analyses used the results of VIT (pseudocohort) as inputs.

The used parameters were the same of the SURBA and LCA analyses previously showed.

7.7.7.3. Results

Yield software quantified uncertainty by repeatedly selecting a set of biological and fishery parameters by sampling from the probability distributions for uncertain parameters set by the user, and then calculating the quantities of interest. In this sampling, it is assumed that each of the uncertain parameters are independently distributed, even though for some biological parameters, this assumption is almost certainly incorrect (Hoggarth et al., 2006). F_{max} and F_{ref} , this latter corresponding to F at SSB/initial SSB = 0.30, were assumed as limiting reference points. $F_{0.1}$ was assumed as target reference point. The probability distributions of the three RPs showed a considerable variations (Fig. 7.7.7.3.1). The following mean values were obtained: F_{max} = 0.35; $F_{0.1}$= 0.22 and F_{ref} = 0.28. The maximum predicted values were respectively 0.59 (F_{max}), 0.36 (F_{01}) and 0.41 (F_{ref}). Interesting to note that $F_{0.1}$ and F_{ref} showed a similar distribution in the estimated values.
RPs suggest an overfishing situation for the stock considering F curr about six times higher than the limit and target RPs F.

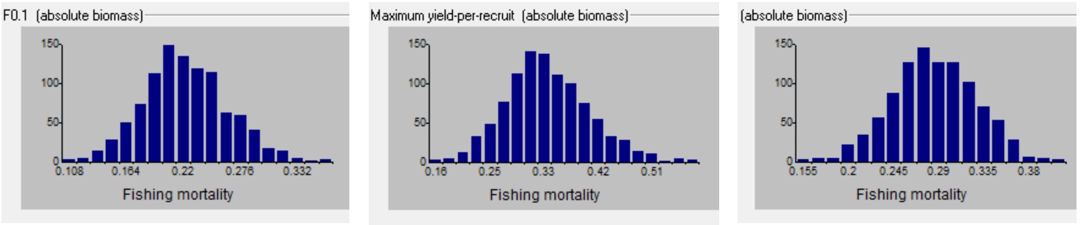


Fig. 7.7.7.3.1 Probability distribution of hake RPs in the GSA9 obtained using the Yield software (age groups 1-5).

Fig. 7.7.7.3.2. shows the YPR analysis performed with VIT software.

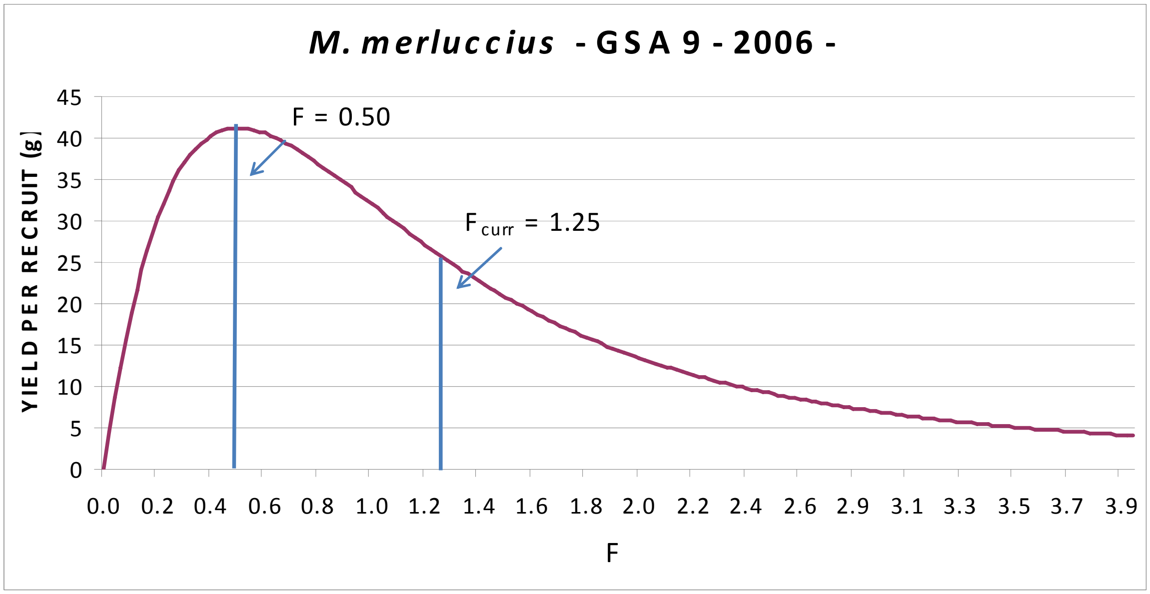


Fig. 7.7.7.3.2 Y/R curves from VIT analyses. F values (age groups 1-5) are also shown.

7.7.8. Scientific advice

7.7.8.1. Short term considerations

7.7.8.1.1. State of the spawning stock size

From the above reported analyses, SSB is likely to between 5 and 10% of the SSB at F_{msy}. STECF-SGMED-08-04 underlines that this conclusion could be influenced by the observed exploitation patterns in the surveys and fisheries, which almost exclusively represent the juvenile part of the stock.

7.7.8.1.2. State of recruitment

In recent years recruitment has varied without a clear trend.

7.7.8.1.3. State of exploitation

The stock appears to be highly overexploited and F needs a consistent reduction considering candidate reference point for long term sustainability F between 0.2-0.4 and current F from 1.2 to 1.7 (SURBA estimates). However, considering the high productivity in terms of incoming year classes, this stock has the potential to recover quickly if F is reduced towards F_{msy}.
The continued lack of older fish in the surveyed population indicates exploitation rates far beyond those considered consistent with high yields and low risk of fisheries collapse.
An improvement of the catchability estimates of adults is needed to better estimate the impact of fishing activity on this stock
The stock appears to be highly overexploited and F needs to be reduced in the order of 75-85% considering candidate reference point for long term sustainability F between 0.2-0.4 and current F around 1.6 (SURBA estimates). However, considering the high productivity in terms of incoming year classes, this stock has the potential to recover quickly if F is reduced towards F_{msy}.

7.7.8.2. Medium term considerations

SGMED-08-04 recommends a management plan to countinously reduce F through consistent effort reductions.

7.8. Stock assessment of hake in GSA 10

7.8.1.Stock identification and biological features

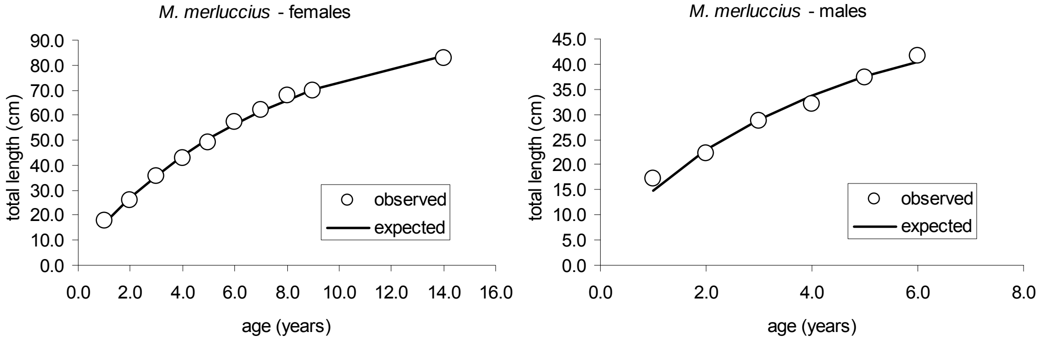
7.8.1.1. Stock Identification

The stock of European hake was assumed in the boundaries of the whole GSA10, lacking specific information on stock identification. *M. merluccius* is with red mullet and deep-water rose shrimp a key species of fishing assemblages in the central-southern Tyrrhenian sea (GSA 10). It is generally also ranked among species with higher abundance indices in the trawl surveys (e.g. Spedicato et al. 2003). It is a long lived fish mainly exploited by trawlers, especially on the continental shelves of the Gulfs (e.g. Gaeta, Salerno, Palermo) but also by artisanal fishers using fixed gears (gillnets, bottom long-line). The mesh size of the traditional Italian trawl net defines a very low age/size at first capture (8-13 cm; Lembo et al., 2002; Sala et al., 2008).

Trawl-survey data have evidenced highest biomass indices on the continental shelf of the GSA (100-200 m; Spedicato et al., 2003), where juveniles (less than 12 cm total length) are mainly concentrated. During autumn trawl surveys, one of the main recruitment pulses of this species is observed. Two main recruitment pulses (in spring and autumn; Spedicato et al. 2003) are reported in GSA10 as for other Mediterranean areas (Orsi Relini *et al*., 2002). European hake is considered fully recruited to grounds at 10 cm TL (SAMED, 2002). The length structures from trawl surveys are generally dominated by juveniles, while large size individuals are rare, this might be due to the different vulnerability of older fish (Abella and Serena, 1998). The few large European hake caught during trawl surveys are generally females and inhabit deeper waters. The overall sex ratio (~0.42-0.47) estimated from trawl survey data is slightly skewed towards males.

7.8.1.2. Growth

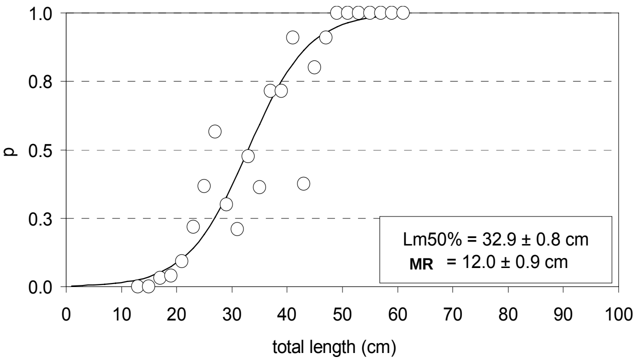
Estimates of growth parameters were achieved during the Samed project (SAMED, 2002). The approach was based on the analysis of length frequency distributions and the following von Bertalanffy parameters were estimated by sex: females: L_∞=74.2 cm; K=0.178; t_0= -0.20; males: L_∞=46.3cm; K=0.285; t_0= -0.20. In the DCR framework the growth has been studied aging fish by otolith readings using the whole sagitta and thin sections for older individuals. Length frequency distributions were also analyzed using techniques as Batthacharya for separation of modal components. The observed maximum lengths of European hake was 83 cm for females and 45.5 for males both registered during the biological samplings (bottom long-lines) of DCR (years: 2003-2005). The aging was 14 and 6 years respectively. The following estimates of von Bertalanffy growth parameters for each sex were obtained from average length at age using an iterative non-liner procedure that minimises the sum of the square differences between observed and expected values (excel): females: L_∞=97.9 cm, K=0.134, t_0= -0.39; males: L_∞=50.8 cm, K=0.25, t_0= -0.39. Parameters of the length-weight relationship estimated from the DCR data sets (2003-2005) were: females: a=0.00350, b=3.21; males a=0.0086, b=3.215 for length expressed in cm.



7.8.1.2.1 V. Bertalanffy growth functions for female and male of hake in the GSA10

7.8.1.3. Maturity

A proxy of size at first maturity as estimated in the Samed project (SAMED, 2002) using the average length at stage 2 (females with gonads at developing stage) indicates an average length of about 30 cm. According to the data obtained in the DCR framework (2003-2005), the proportion of mature females (fish belonging to the maturity stage 2 onwards) by length class is reported in the table below together with the estimated maturity ogive which indicates a $L_{m50\%}$ of about 33 cm (±0.8 cm).



TL (cm)	Proportion of mature	TL (cm)	Proportion of mature
15	0.000	33	0.476
17	0.032	35	0.364
19	0.041	37	0.714
21	0.092	39	0.714
23	0.217	41	0.909
25	0.367	43	0.375
27	0.565	45	0.800
29	0.300	47	0.909
31	0.211	49	1.000

7.8.1.3.1 – Maturity ogive and proportions of mature female of hake in the GSA10 (MR indicates the difference $Lm_{75\%}$-$Lm_{25\%}$).

7.8.2.Fisheries

7.8.2.1. General description of fisheries

European hake is mostly targeted by trawlers, but also by small scale fisheries using nets and bottom long-lines. Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth or 3 miles from the coast. Catches from trawlers are from a depth range between 50-60 and 500 m and hake occurs with other important commercial species as *Illex coindetii*, *M. barbatus*, *P. longirostris*, *Eledone* spp., *Todaropsis eblanae*, *Lophius* spp., *Pagellus* spp., *P. blennoides*, *N. norvegicus*.

7.8.2.2. Management regulations applicable in 2007 and 2008

Management regulations are based on technical measures and do not differ from those applied in the previous years: closed number of fishing licenses for the fleet and area limitation (fishing forbidden within 50 m depth or 3 miles from the shore, depending on the zone). In order to limit the over-capacity of fishing fleet, the Italian fishing licenses have been fixed since the late eighties. After 2000, in agreement with the European Common Policy of Fisheries, a gradual decreasing of the fleet capacity is occurring. Along northern Sicily coasts two main Gulfs (Patti and Castellammare) have been closed to the trawl fishery up 200 m depth, since 1990. Two closed areas were also established since 2004 along the mainland, in front of Sorrento peninsula (Napoli Gulf) and Amantea (Calabrian coasts), although these protected area mainly cover the distribution of coastal species. Other measures on which the management regulations are based regards technical measures (mesh size) and minimum landing sizes (EC 1967/06). In the GSA 10 the fishing ban has not been mandatory along the time, and from one year to the other it was adopted on a voluntary basis by fishers.

7.8.2.3. Catches

7.8.2.3.1. Landings

Available landing data are from DCR regulations. SGMED-08-03 received Italian landings data for GSA 10 by major fishing gears which are listed in Tab. 7.8.2.3.1.1. The fishing segments DTS, HOK, PGP, PMP and PTS indicate respectively trawler, long-lines, small scale fishery (nets), polyvalent, pair trawl and purse-seine. Since 2002, landings of hake increased from 1,013 t to 1,544 t in 2006 and decreased to 1,269 t in 2007 (Fig. 7.8.2.3.1.1). The data are listed in Table A3.1 of Appendix 3. Most part of the landings of hake are from trawlers and nets.

Table 7.8.2.3.1.1 Landings (t) by year and major gear types, 2002-2007 as reported through DCR in the GSA10.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	10	ITA	DTS	515	425	446	595	758	638
HKE	10	ITA	HOK			58	96	111	41
HKE	10	ITA	PGP	225	329	694	484	663	578
HKE	10	ITA	PMP	246	322	123	303	12	12
HKE	10	ITA	PTS	27	21	17	7		
			Sum	1013	1097	1338	1485	1544	1269

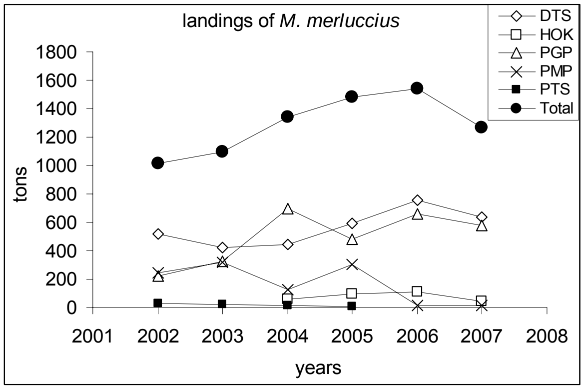


Fig. 7.8.2.3.1.1 Landings (t) by year and major gear types, 2002-2007 as reported through DCR in the GSA10.

The length distribution of landings in 2006 and 2007 is reported in Fig. 7.8.2.3.1.2, besides the total, the landings of the following fishing segments are shown: bottom trawls, longlines, nets, and polivalents. Both number of individuals and weight by length class are reported.

The number of individuals was raised to the total landings of the fleet segment using the proportion of the number of individuals by size class observed in the sample. The total weight corresponding to each length class was calculated using the obtained number of individuals and the average weight at each central value of the length class, as calculated from the length-weight relationship.

The LFDs of the two years in numbers are characterized by a peak around 16 cm total length, whilst the LFDs in weight are characterized by two peaks, around 16 and 30 cm. The landings of trawlers are much more relevant in terms of number of individuals.

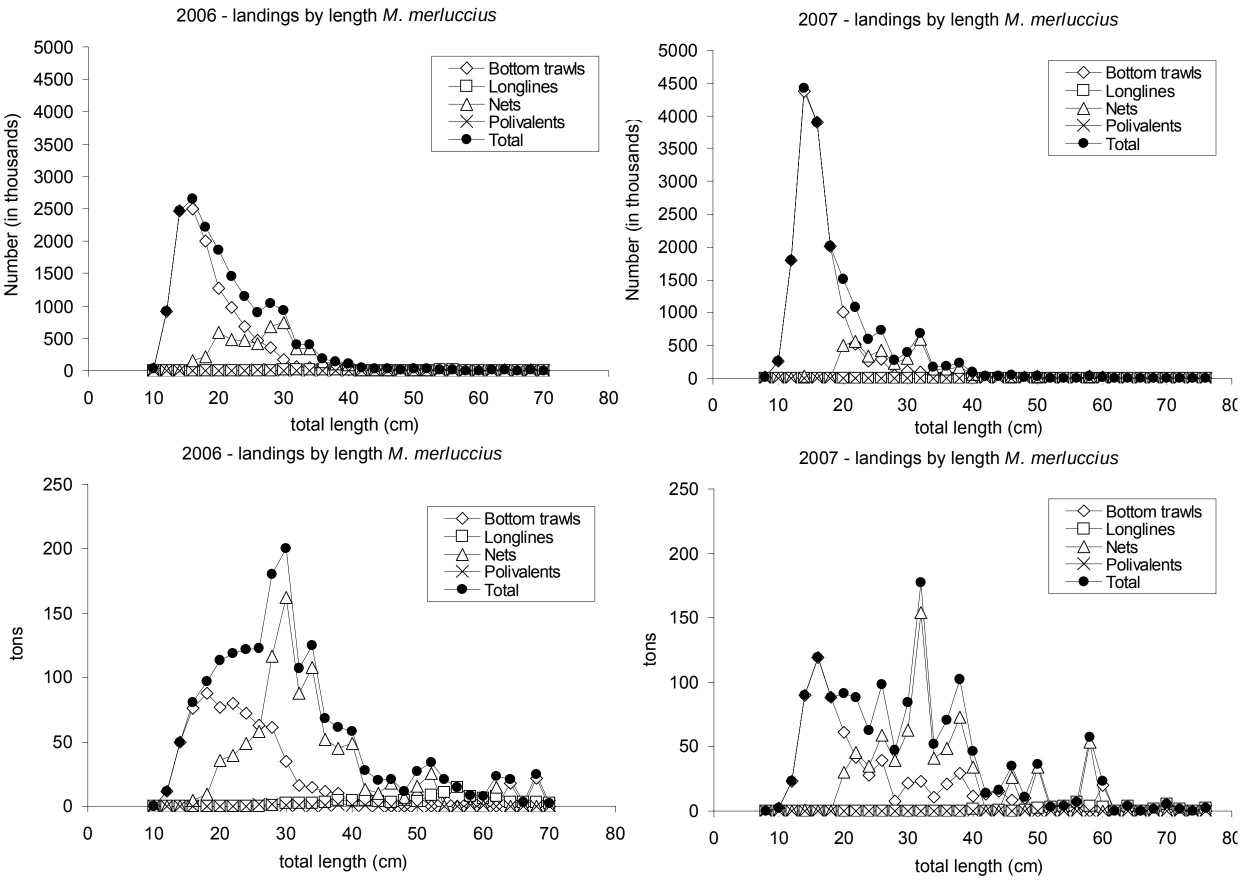


Fig. 7.8.2.3.1.2 Landings by length in thousands and tons in 2006 and 2007 for bottom trawls, longlines, nets, polivalents fishing segments and total in the GSA10.

7.8.2.3.2. Discards

The discards of hake in the GSA 10 was about 1% of the landings. Despite this value was lower than the prescription of reg UE 1639/2001 (10% in weight or 20% in number) the composition in length and age was estimated, that highlights the prevailing of the age 0 group; the average length was 9.7 cm (Fig. 7.8.2.3.2.1).

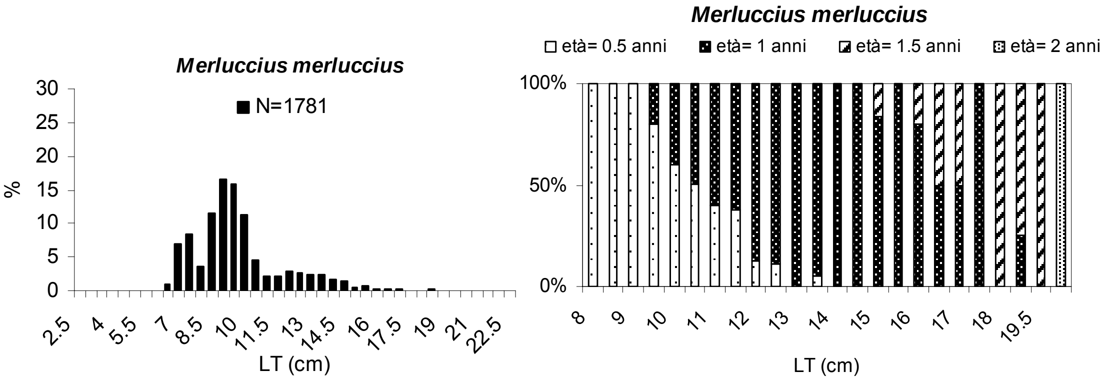


Fig. 7.8.2.3.2.1 Size and age composition of discards.

About 6 tons of discards in 2006 were reported to SGMED-08-03 (Tab. A3.6 of Appendix 3).

7.8.2.3.3. Fishing effort

The trends in fishing effort by year and major gear type is listed in Tab. 7.8.2.3.3.1 and shown in Fig. 7.8.2.3.3.1 in terms of kW*days. The fishing segments DRB, DTS, HOK, PGP, PMP and PTS indicate respectively dredges, trawlers, long-lines, small scale fishery (nets), polyvalent, pair trawl and purse-seine. The fishing effort in kW*days appear quite stable during 2004-2007 for most gear types.

Tab. 7.8.2.3.3.1 Trend in fishing effort (days, GT*days, kW*days) for Italy by major gear types, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	10	ITA	DRB	830	1776	1984	1040
DAYS	10	ITA	DTS	44087	46547	43848	40724
DAYS	10	ITA	HOK	20929	20418	8064	7043
DAYS	10	ITA	PGP	325523	268441	346849	311693
DAYS	10	ITA	PMP	62225	64177	10532	7261
DAYS	10	ITA	PTS	11792	11206	9332	9367
GT*DAYS	10	ITA	DRB	7968	17128	19136	9939
GT*DAYS	10	ITA	DTS	1337882	1622062	1331071	1266460
GT*DAYS	10	ITA	HOK	157882	143835	103111	82342
GT*DAYS	10	ITA	PGP	661958	534880	800036	693057
GT*DAYS	10	ITA	PMP	336053	333845	152717	110850
GT*DAYS	10	ITA	PTS	390096	468145	367417	280190
KW*DAYS	10	ITA	DRB	110899	244013	272628	142455
KW*DAYS	10	ITA	DTS	7883881	8467144	7596783	7105075
KW*DAYS	10	ITA	HOK	1654352	1413547	925244	794816
KW*DAYS	10	ITA	PGP	7056306	6018600	9486681	8397010
KW*DAYS	10	ITA	PMP	3588004	3728376	1404642	1003285
KW*DAYS	10	ITA	PTS	2308589	2434470	2016508	1680295

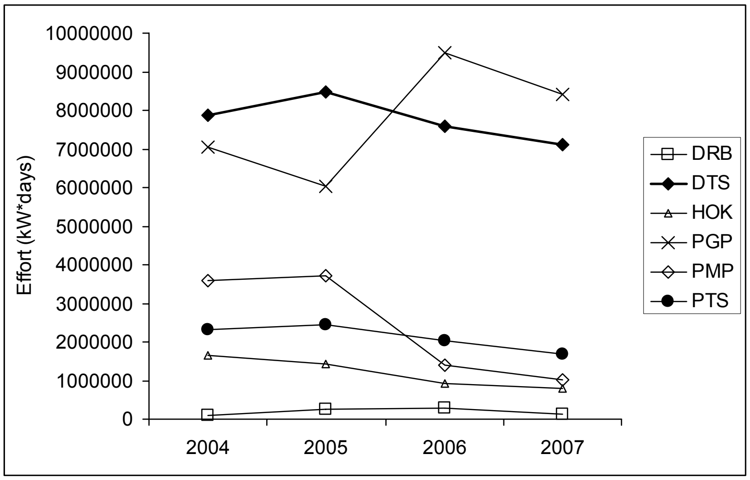


Fig. 7.8.2.3.3.1 Trend in fishing effort (kW*days) for GSA 10 by major gear types, 2004-2007.

7.8.3.Scientific surveys

7.8.3.1. Medits

7.8.3.1.1. Methods

According to the MEDITS protocol (Bertrand et al., 2002), trawl surveys were yearly (May-July) carried out, applying a random stratified sampling by depth (5 strata with depth limits at: 50, 100, 200, 500 and 800 m; each haul position randomly selected in small sub-areas and maintained fixed throughout the time). Haul allocation was proportional to the stratum area. The same gear (GOC 73, by P.Y. Dremière, IFREMER-Sète), with a 20 mm stretched mesh size in the cod-end, was employed throughout the years. Detailed data on the gear characteristics, operational parameters and performance are reported in Dremière and Fiorentini (1996). Considering the small mesh size a complete retention was assumed. All the abundance data (number of fish per surface unit) were standardised to square kilometre, using the swept area method.

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 10 the following number of hauls were reported per depth stratum (s. Tab. 7.8.3.1.1.1).

Tab. 7.8.3.1.1.1. Number of hauls per year and depth stratum in GSA 10, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA10_010-050	9	10	10	10	10	10	10	10	9	9	9	9	9	9
GSA10_050-100	12	12	12	12	12	12	12	12	10	10	10	10	10	10
GSA10_100-200	20	20	20	20	20	20	20	20	17	17	17	17	17	17
GSA10_200-500	26	27	26	26	27	26	26	28	22	22	22	22	22	22
GSA10_500-800	31	30	31	31	31	30	31	29	26	26	26	26	26	26

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.8.3.1.2. Geographical distribution patterns

The geographical distribution pattern of European hake has been studied in the area using trawl-survey data and the geostatistical methods. In these studies both the total abundance indices (Lembo et al., 1998a) and the abundance indices of recruits were analysed (Lembo et al., 1998b, 2000). The higher concentration of recruits in the GSA10 were localised in the northen side (Gulfs of Napoli and Gaeta).

More recent analyses performed in an ongoing national project (some results are represented in Fig. 7.8.3.1.2.1 and 7.8.3.2.2.1) confirmed the presence of important zone for recruits in the northernmost part of the GSA, although sites with a high probability of locating a nursery appeared also in the southern part of the mainland and along the coasts of North Sicily. From Grund data (autumn survey) (Fig. 7.8.3.2.2.1) the higher abundance of recruits were instead localised in the central part of the GSA, along the mainland coasts.

As an example two maps referring to Medits and Grund data are reported. Fig. 7.8.3.1.2.1 shows a map of the hake recruits obtained from Medits data and applying the indicator kriging technique. The contours represent the probability (in percentage) of estimating an abundance of recruits higher than 638 individuals per square kilometer. The map is referred to the Medits survey of 2001. The recruits were estimated each year using the length frequency distribution and separating the first mode applying the Battacharya method. On average, considering the analyzed distributions (years 1994-2005), the recruits are individual smaller than 12.3 cm (±1.41). These individual are belonging to the age 0 group.

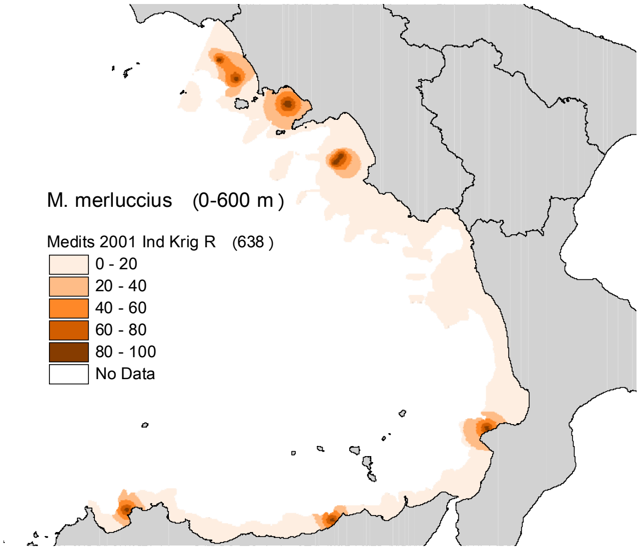


Fig. 7.8.3.1.2.1 Medits 2001. Indicator kriging map of the hake recruits, contours represent the probability (in percentage) of estimating an abundance higher than 638 N/km^2.

7.8.3.2. GRUND

7.8.3.2.1. Methods

Since 2003 Grund surveys (Relini, 2000) was conducted using the same sampler (vessel and gear) in the whole GSA. Sampling scheme, stratification and protocols were similar as in Medits. All the abundance data (number of fish and weight per surface unit) were standardised to square kilometre, using the swept area method.

7.8.3.2.2. Geographical distribution patterns

Fig. 7.8.3.2.2.1 shows a mapping of the hake recruits obtained applying the indicator kriging technique. The contours represent the probability (in percentage) of estimating an abundance of recruits higher than 4752 individuals per square kilometer. The map is referred to the Grund survey of 2002. The recruits were estimated each year using the length frequency distribution and separating the first mode applying the Battacharya method. On average, considering the analyzed distributions (years 1994-2005), the recruits are individual smaller than 14.1 cm (±1.01). These individual are mostly belonging to the age 0 group.

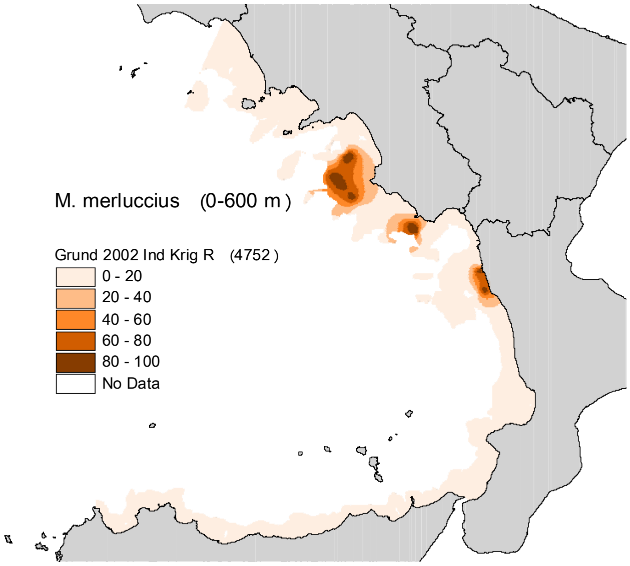


Fig. 7.8.3.2.2.1 Grund 2002. Indicator kriging map of the hake recruits, contours represent the probability (in percentage) of estimating an abundance higher than 4752 N/km^2.

7.8.3.2.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 10 was derived from the international survey Medits. Additional information were provided by Grund surveys. Figure 7.8.3.2.3.1 displays the estimated trend of hake abundance and biomass in GSA 10. Indices from Medits trawl-surveys show an increasing pattern (not significant $p<0.05$ on ln-transformed data of both indices) in the last years, although variability is higher (Fig. 7.8.3.2.3.1).

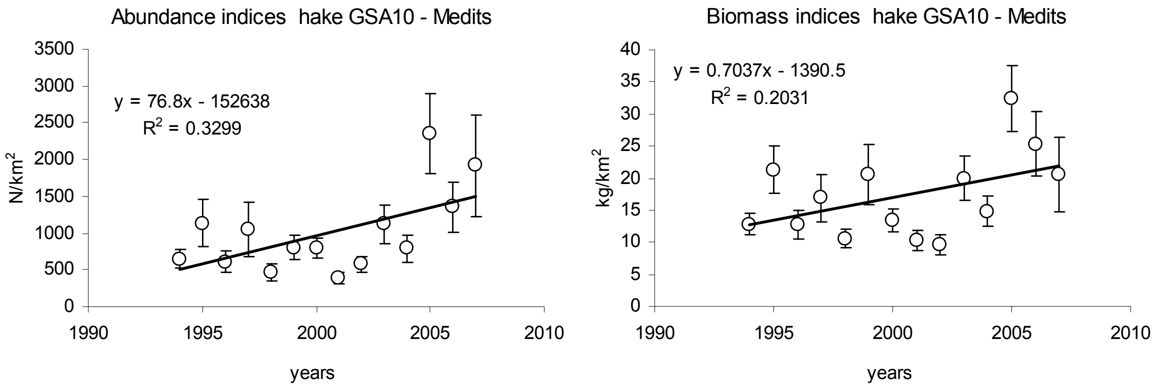


Fig. 7.8.3.2.3.1 Trends in survey abundance and biomass derived from Medits.

The re-estimated abundance and biomass indices (Figure 7.8.3.2.3.2) also reveal increasing trends since 2002. However, the recent high abundance and biomass indices are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

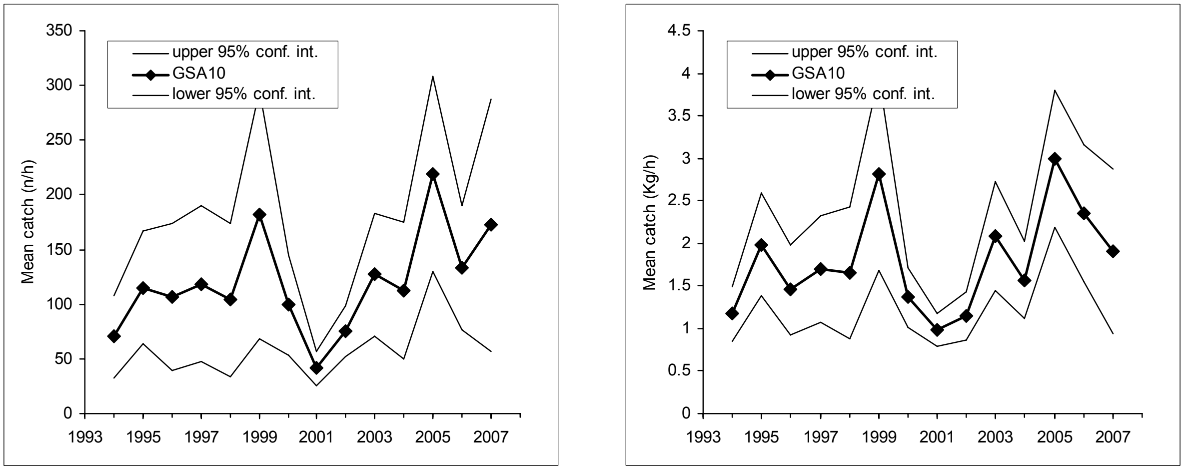
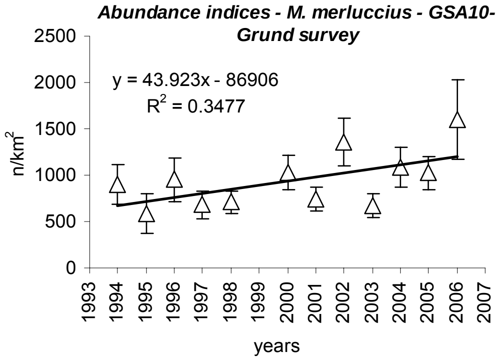
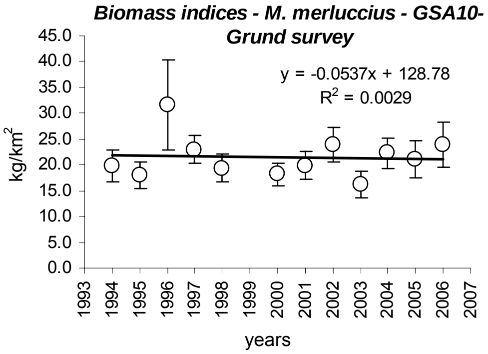


Fig. 7.8.3.2.3.2 Abundance and biomass indices of hake in GSA 10.

Trends derived from the GRUND surveys are shown in Fig. 7.8.3.2.3.3. Abundance indices were significantly increasing (p<0.05 on ln-transformed data), as well as recruitment indices (Fig. 7.8.3.2.3.3) while biomass indices were almost stationary. The analyses of Grund indices are considered preliminary.





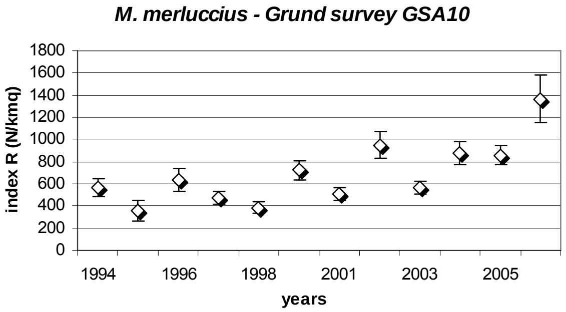


Fig. 7.8.3.2.3.3. Abundance and biomass indices of hake in GSA 10 derived from Grund surveys. Recruitment indices (N/km^2) with standard deviation are also reported.

7.8.3.2.4. Trends in abundance by length or age

No trend in the mean length was observed in Medits survey (Fig. 7.8.3.2.4.1), nor at the third quantile lengths, as obtained from the length structures of Grund time series from 1994 to 2006 (Fig. 7.8.3.2.4.2).

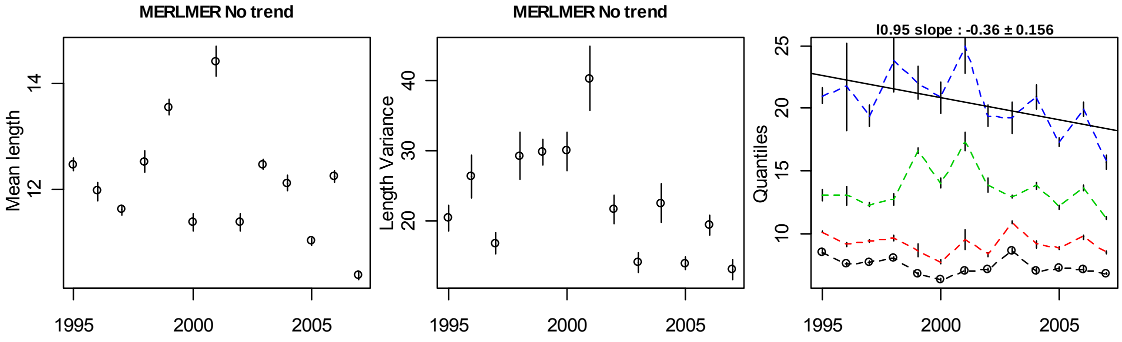


Fig. 7.8.3.2.4.1 Mean length, variance and quantiles derived from the Medits length compositions in 1995-2007.

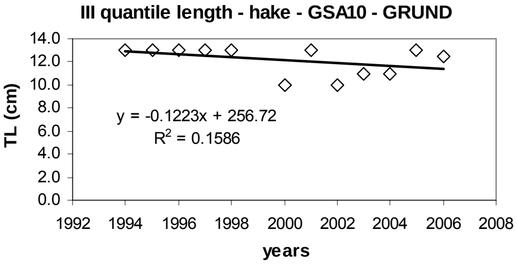


Fig. 7.8.3.2.4.2 III Quantile derived from the GRUND length structures in 1994-2006.

The following Fig. 7.8.3.2.4.3 and 4 display the stratified abundance indices of GSA 10 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

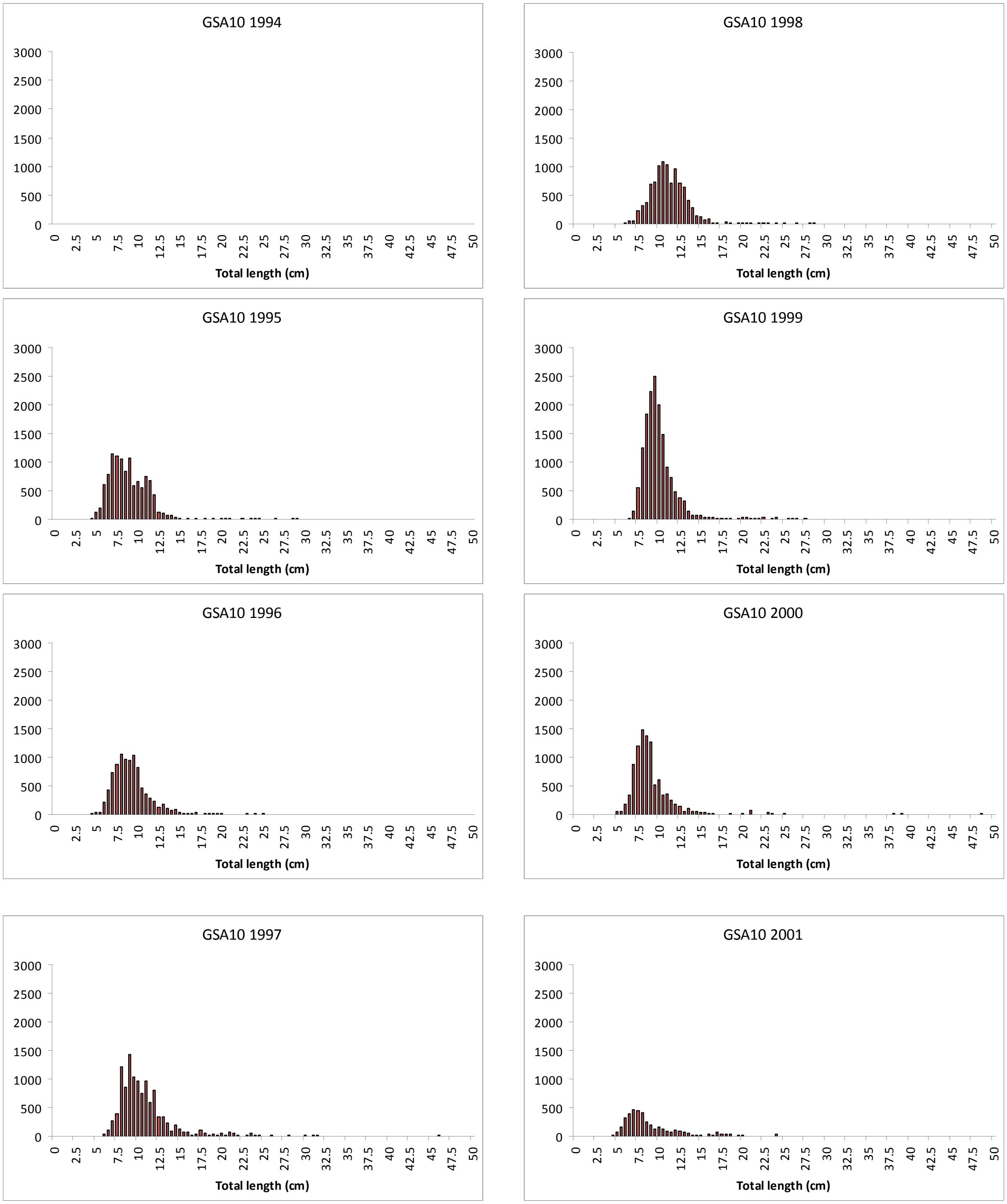


Fig. 7.8.3.2.4.3 Stratified abundance indices by size, 1994-2001.

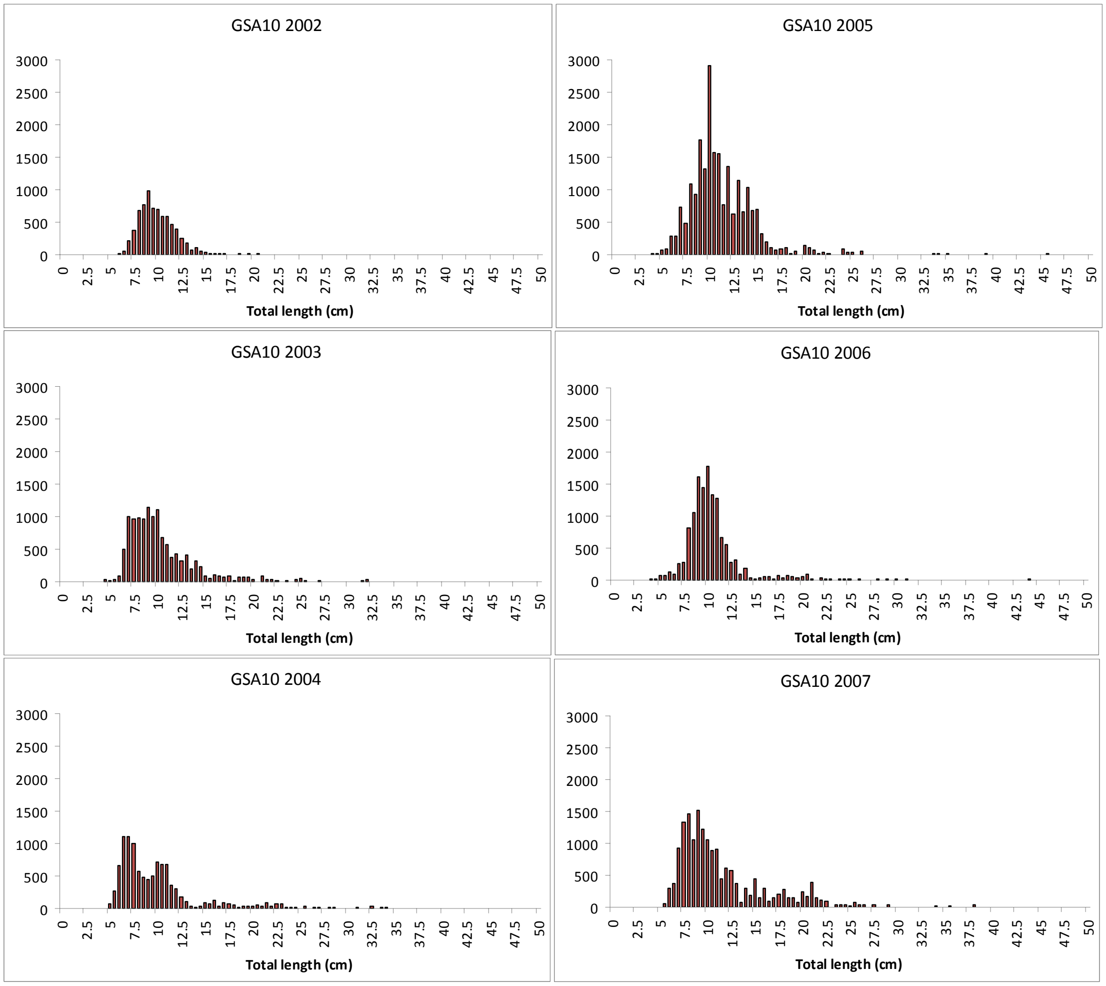


Fig. 7.8.3.2.4.4 Stratified abundance indices by size, 2002-2007.

7.8.3.2.5. Trends in growth

No analyses were conducted during SGMED-08-03.

7.8.3.2.6. Trends in maturity

No analyses were conducted during SGMED-08-03.

7.8.4. Assessment of historic stock parameters

SGMED-08-03 did not undertake any analytical assessment.

7.8.5. Short term prediction for 2008 and 2009

7.8.5.1. Justification

No forecast analyses were conducted.

7.8.5.2. Input parameters

No forecast analyses were conducted.

7.8.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-03 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 10.

7.8.6. Medium term prediction

7.8.6.1. Justification

No forecast analyses were conducted.

7.8.6.2. Input parameters

No forecast analyses were conducted.

7.8.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-03 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 10.

7.8.7. Long term prediction

7.8.7.1. Justification

No forecast analyses were conducted.

7.8.7.2. Input parameters

No forecast analyses were conducted.

7.8.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-03 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 10.

7.8.8. Scientific advice

7.8.8.1. Short term considerations

7.8.8.1.1. State of the spawning stock size

SGMED-08-03 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.8.8.1.2. State of recruitment

SGMED-08-03 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.8.8.1.3. State of exploitation

SGMED-08-03 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.8.8.2. Medium term considerations

SGMED-08-03 is unable to provide any scientific advice given the preliminary state of the data and analyses.

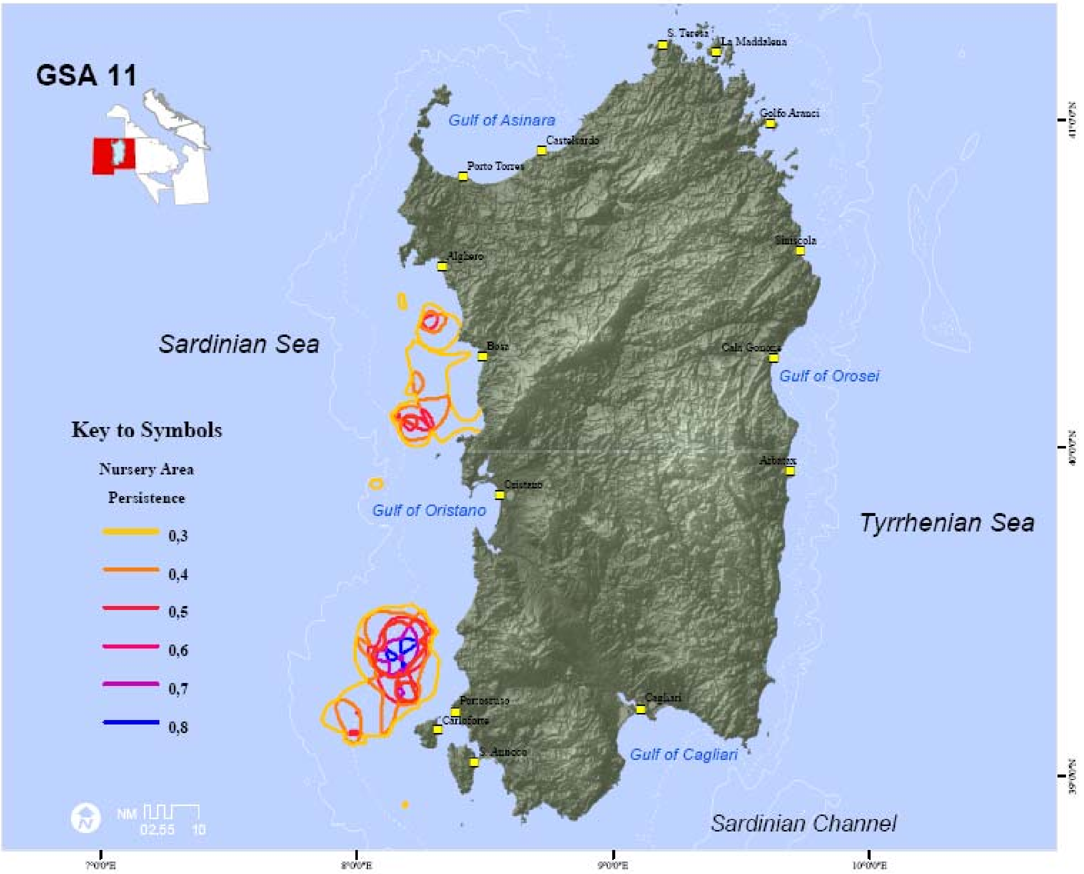
7.9. Stock assessment of hake in GSA 11

7.9.1. Stock identification and biological features

7.9.1.1. Stock Identification

Within the GSA 11 boundaries Hake is distributed between 30 and 650 m of depth, with a peak in abundance (due to high number of recruits) over the continental shelf-break (depth between 150 and 250 m). The stock is mainly exploited by the local fishing fleet, although seasonally and occasionally some other Italian fleet use to fish in some areas.
Spawning is taking place almost all year around, with a peak during winter –spring.

Juveniles showed a patchy distribution with some main density hot spots (nurseries) showing a high spatio-temporal persistence (Murenu et al., 2007) in western areas.



Temporal persistence of hake nurseries calculated from data survey time-series density maps (1994-2006) of juveniles.

7.9.1.2. Growth

Data coming from LFDA hake showed a slow growth pattern both in male and female (Samed, 2002). A slower growth pattern for the GSA11 hake population comes from recent otolith readings (DCR, 2008).
The Von Bertalanffy Growth Function parameters by sex available for GSA11 are reported in Table 7.9.1.2.1.

Table 7.9.1.2.1Von Bertalanffy growth function parameters for hake in the GSA11.

Reference	Period	Sex	L∞	K	t_0	Remarks
SAMED, 2002	1994-1999	F	84.0	0.165	-0.13	LFD analysis
SAMED, 2002	1994-1999	M	60.4	0.213	-0.24	LFD analysis
DCR, 2008	2006	C	89.5	0.1	-0.25	Otolith readings
DCR, 2008	2007	C	89.7	0.09	-0.64	Otolith readings
DCR, 2008	2003-2005	C	84.6	0.12	-0.23	Otolith readings

These growth estimations contrast with recent evidences that support a fast growing pattern hypotesis for hake either in the W Mediterranean (Garcia-Rodriguez and Esteban, 2002; Jadaud et al., 2006; Piñeiro et al., 2007) or in the Bay of Biscay (De Pontual *et al*., 2003).

7.9.1.3. Maturity

Due to the well-known limited trawl nets catchability of hake spawners, the catch rate of mature specimens during the MEDITS survey was very low thus influencing the analysis to identify the pattern in gonad development as well as the growth rate and maturation processes relationship.
The logistic model detect Female length at first maturity at 30.6 cm.
Although Spawning off Sardinian coast (GSA 11) occurs nearly all over the year (Jan to Sept) the maturity peak occours place in winter (Feb-May).

7.9.2.Fisheries

7.9.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that hake is one of the most important commercial species in the Sardinian seas where the biology and population dynamics have been studied intensively in the past fifteen years.
Although hake is not a target of a specific fishery, such as deep red shrimp, it is the third species in terms of biomass which is landed in GSA 11 (Murenu M., pers. com.). In the GSA 11 hake is caught exclusively by a mixed bottom trawl fishery at depth between 50 and 600 m. No gillnet or longline fleets targeting on this species. Although different nets are used in shallow, mid and depth water (“terra” mainly targeted to mullus spp.,. “mezzo fondo” targeting on fish and “fondale” net targeting on deep shrimp) the main characteristics belong to an “Italian trawl net” type with a low vertical opening (max up to 1.5 m). The dimensions change in relation to the trawlers engine power.
Important by catch species are horned octopus, squids, poor cod, shortnose greeneye, greater forkbeard and deep-water pink shrimp.

Detailed maps of the trawlers fishing-grounds are reported in Murenu *et al*. (2006). Most of the GSA effort of is concentrated within a relative short radius around the major fishing ports (Cagliari, Alghero, Porto Torres, La Caletta, Sant’antioco, Oristano, Alghero). However some big trawlers seasonally move in different fishing ground far from the customary Port.

From 1994 to 2004, in GSA 11, the trawl fleet remarkably changed. The change mostly consisted of a general increase in the number of vessels and by the replacement of the old, low tonnage wooden boats by larger steel boats. For the entire GSA an increase of 85% for boats >70 Tons class occurred. A decrease of 20% for the smaller boats (<30 GRT) was also observed.

7.9.2.2. Management regulations applicable in 2007 and 2008

As in other areas of the Mediterranean, the stock management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area closures), and minimum landing sizes (EC 1967/06).

7.9.2.3. Catches

7.9.2.3.1. Landings

SGMED-08-04 received Italian landings data for GSA 11 by major fishing gears which are listed in Tab. 7.9.2.3.1.1. Since 2002, landings increased form 360 t to 930 t in 2005 and decreased to 550 t in 2007 (Fig.. 7.9.2.3.1.1). Landings are dominated by demersal trawl fisheries. The data are listed in Table A3.1 of Appendix 3.

Table 7.9.2.3.1.1 Italian landings (t) by year and major gear types, 2002-2007 as reported through DCR.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	11	ITA	DTS	167	592	597	768	595	447
HKE	11	ITA	PGP	4	26	114	160	229	103
HKE	11	ITA	PMP	190	279				
Sum			Total	361	897	711	928	824	550

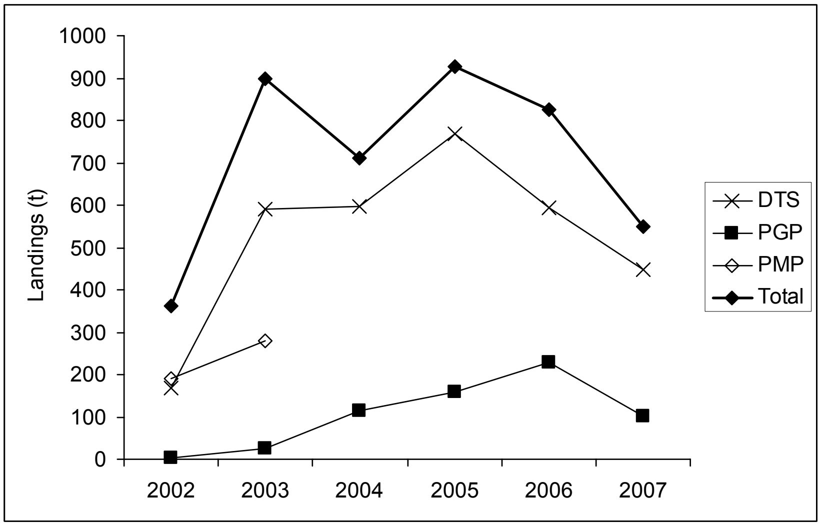


Fig. 7.9.2.3.1.1 Italian landings (t) by year and major gear types, 2002-2007 as reported through DCR.

7.9.2.3.2. Discards

SGMED-08-04 noted 15 and 63 t of discard reported for 2005 and 2006 through the DCR data call, respectively. The data are listed in Table A3.6 of Appendix 3.

7.9.2.3.3. Fishing effort

The trends in fishing effort by year and major gear type is listed in Tab. 7.9.2.3.3.1 and shown in Fig. 7.9.2.3.3.1 in terms of kW*days.

Tab. 7.9.2.3.3.1 Trend in fishing effort (days, GT*days, kW*days) for Italy by major gear types, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	11	ITA	DTS	28840	31993	26532	27374
DAYS	11	ITA	PGP	165945	151720	156269	155243
DAYS	11	ITA	PMP				
GT*DAYS	11	ITA	DTS	1598912	1881952	1437559	1486500
GT*DAYS	11	ITA	PGP	501550	484820	493411	495670
KW*DAYS	11	ITA	DTS	6711626	7736040	6017232	6340429
KW*DAYS	11	ITA	PGP	7105771	6996350	7234881	7398923

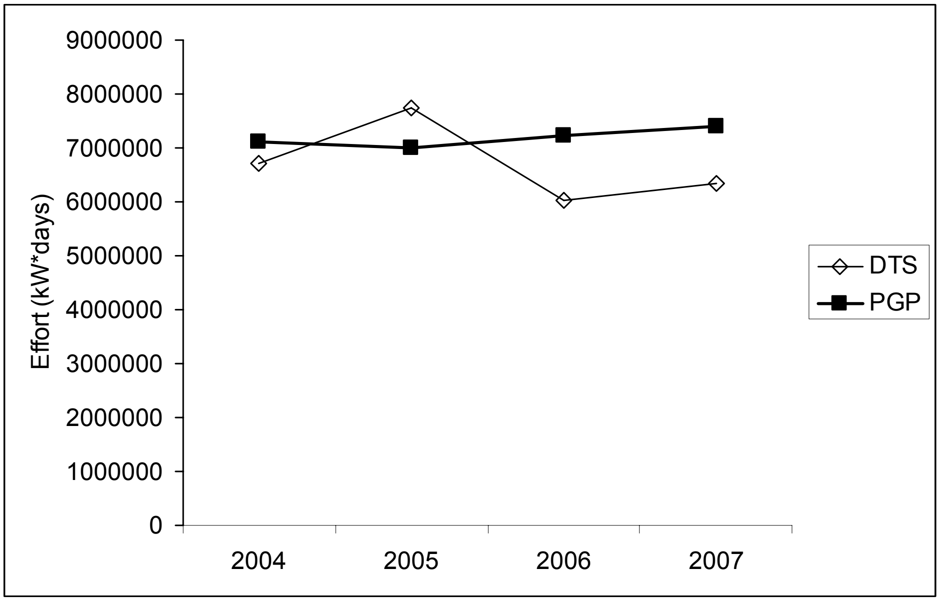


Fig. 7.9.2.3.3.1 Trend in fishing effort (kW*days) for Italy by major gear types, 2004-2007.

7.9.3. Scientific surveys

7.9.3.1. Medits

7.9.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 11 the following number of hauls were reported per depth stratum (s. Tab. 7.9.3.1.1.1).

Tab. 7.9.3.1.1.1. Number of hauls per year and depth stratum in GSA 11, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA11_010-050	16	18	21	21	21	20	19	17	28	18	17	17	19	19
GSA11_050-100	25	21	22	22	20	22	22	24	25	19	18	21	18	20
GSA11_100-200	20	23	30	31	31	30	29	30	32	24	24	24	24	24
GSA11_200-500	33	29	29	26	25	27	24	25	32	24	21	20	20	20
GSA11_500-800	23	16	21	25	25	24	27	26	27	14	15	14	16	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

- A=total survey area
- Ai=area of the i-th stratum
- si=standard deviation of the i-th stratum
- ni=number of valid hauls of the i-th stratum
- n=number of hauls in the GSA
- Yi=mean of the i-th stratum
- Yst=stratified mean abundance
- V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.9.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.9.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 11 was derived from the international survey Medits. Figure 7.9.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 11.

The estimated abundance and biomass indices reveal increasing trends since 1999 but appear highly variable. However, the recent abundance and biomass indices in 2007 dropped significantly to the lowest level observed since 1994. The analyses of Medits indices are considered preliminary.

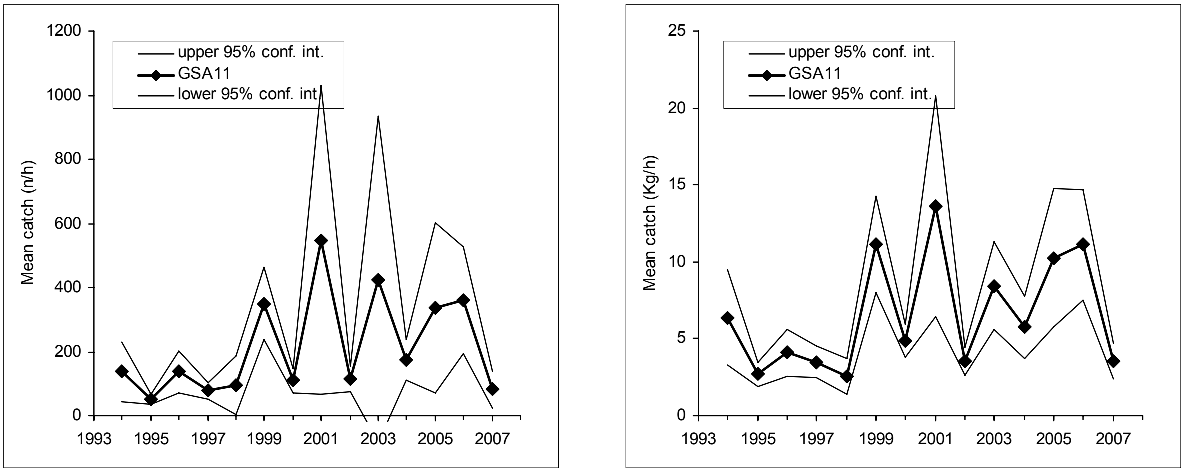


Fig. 7.9.3.1.3.1 Abundance and biomass indices of hake in GSA 11.

7.9.3.1.4. Trends in abundance by length or age

The following Fig. 7.9.3.1.4.1 and 2 display the stratified abundance indices of GSA 11 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

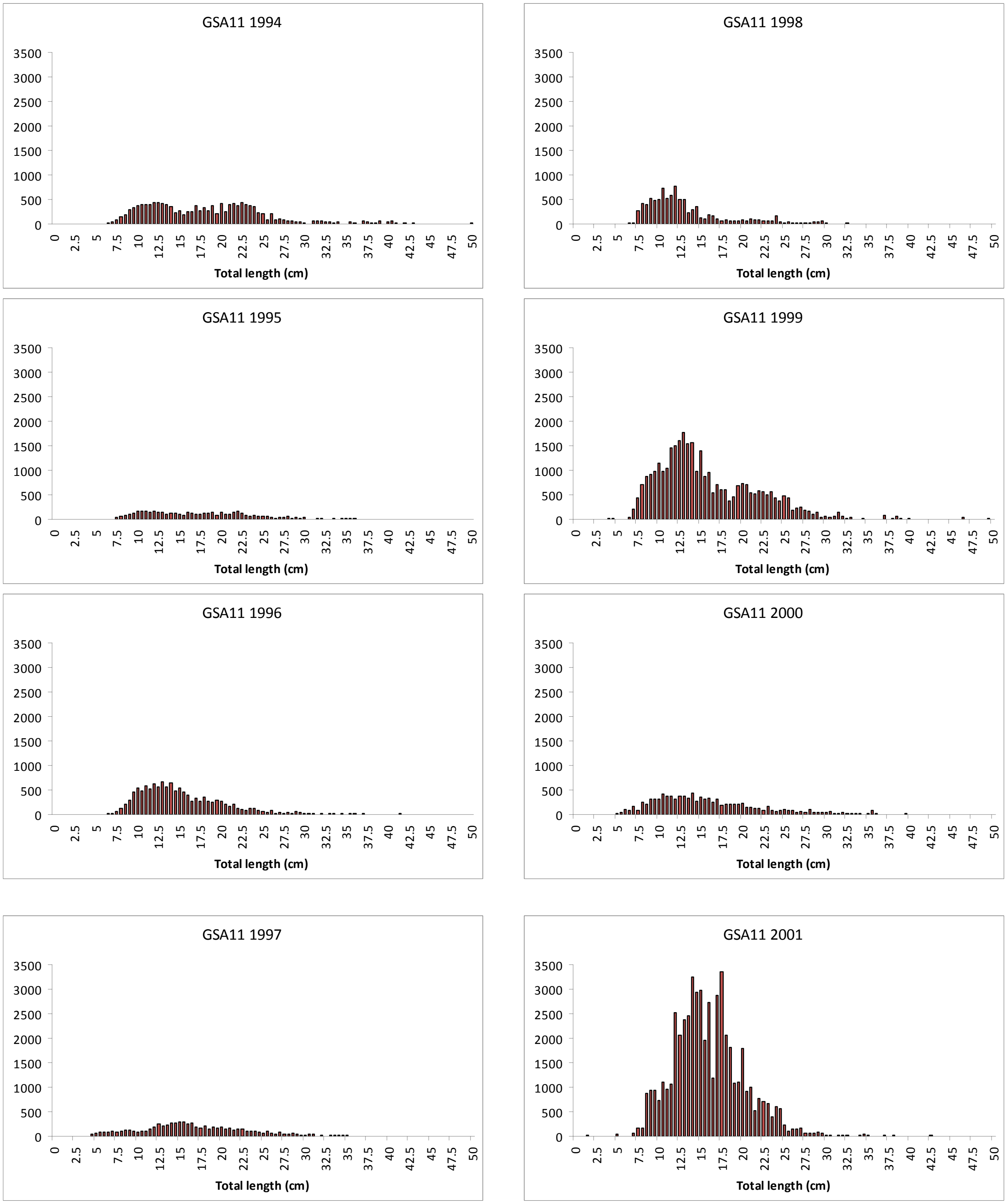


Fig. 7.9.3.1.4.1 Stratified abundance indices by size, 1994-2001.

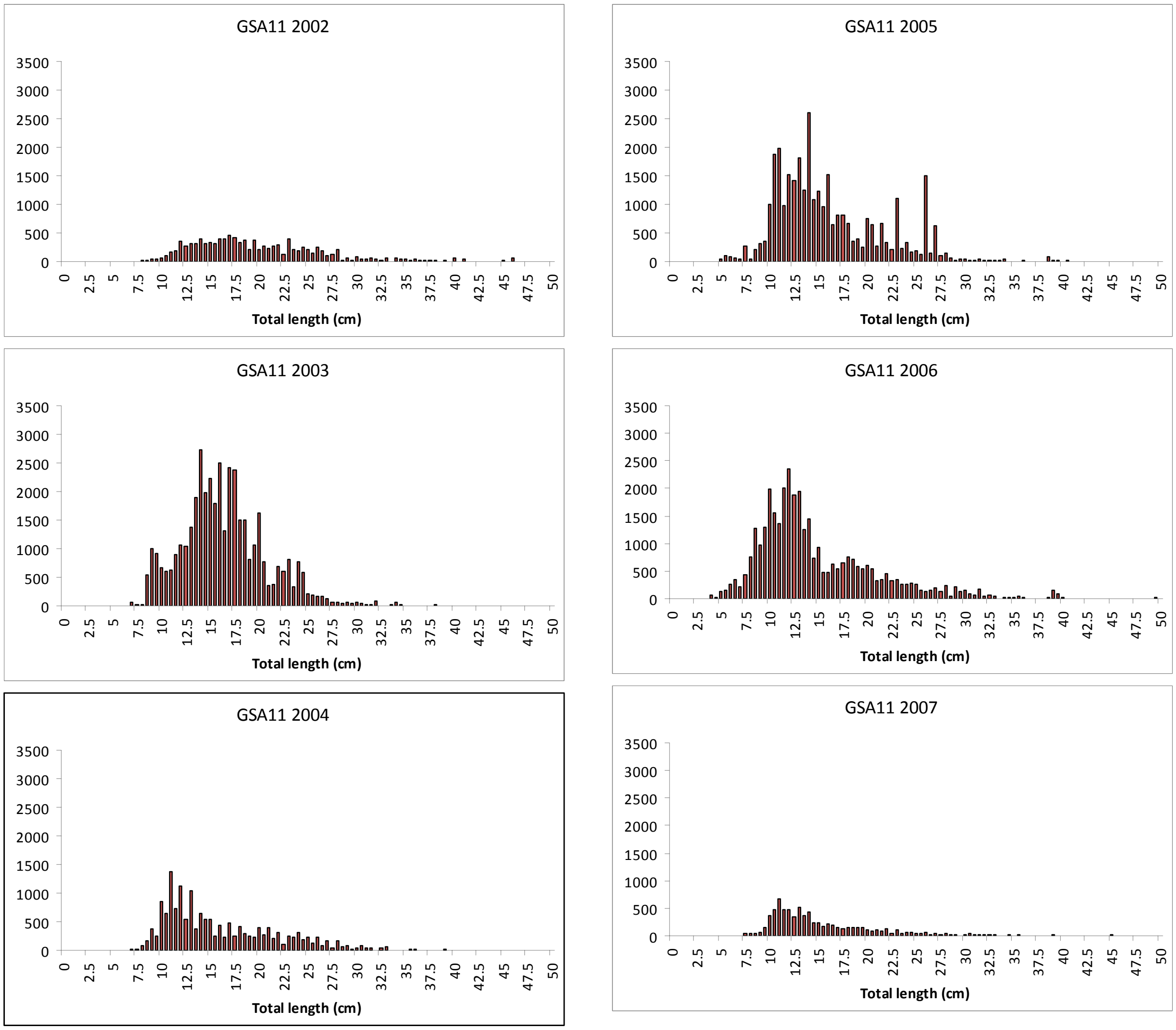


Fig. 7.9.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.9.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.9.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.9.4. Assessment of historic stock parameters

7.9.4.1. Method 1: Trends in LPUE

7.9.4.1.1. Justification

Trends in LPUE may provide insight into trends in stock size. SGMED-08-04 recommends that technological creep should be considered when trends in LPUE are interpreted.

7.9.4.1.2. Input parameters

Landings and effort for the trawler (DTS) fleet operating in GSA11 were used. Data come from DCR.

7.9.4.1.3. Results

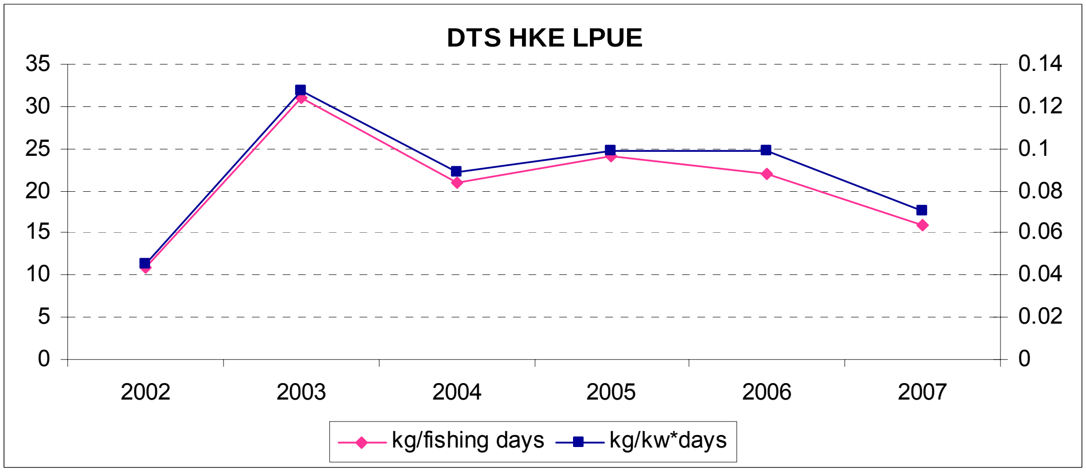


Figure 7.9.4.1.3.1 Landing per unit effort of commercial trawling by the Sardinian fleet (GSA 11).

According to commercial data (DCR, 2008), a light decrease of hake landings per unit effort is occurring since 2003 (Fig. 7.9.4.1.3.1).

7.9.4.2. Method 2: SURBA

7.9.4.2.1. Justification

The SURBA software package (Needle, 2003) lets to take advantage of the long trawl surveys data time series (1994-2007) available from the Medits research program. Using the software the evolution of fishing mortality rates of hake in the GSA 11 was reconstruct starting from the analysis of the length frequency distribution (LFD).

7.9.4.2.2. Input parameters

The main input parameters to run the SURBA-survey based stock analysis are abundances, natural mortality rates and catchability.

The LFDs were converted in numbers by age group using the subroutine "age slicing" as implemented in the software package LFDA (Kirkwood *et al*., 2001). The VBGF parameters used for age slicing of LFD the same used in the neighborhood GSA9 (Tab. 7.9.4.2.2.1).

According to the approach of Caddy and Abella (1999), a vectorial natural mortality at age was computed for the analysis (Tab. 7.9.4.2.2.1).

Guess estimates of catchability by age are given in Tab. 7.9.4.2.2.1.

Tab. 7.9.4.2.2.1 Input parameters use in the SURBA analysis (sex combined) in the (GSA11).

Growth parameters (Von Bertalanffy)
L∞ = 104 (mm, total length)
K = 0.2
to = - 0.03
Natural mortality
M vector Age$_1$=1.17 , Age$_2$=0.675, Age$_3$=0.51, Age$_4$=0.4275, Age$_5$=0.378; Age$_6$=0.345
Catchability (q)
q_0 = 0.7, q_{1-3} = 1.0, q_4=0.75, q_5=0.4
Length at maturity (L50)
L50 = 30 cm (sex combined)

7.9.4.2.3. Results

Trends in estimated fishing mortalities are plotted in Fig. 7.9.4.2.3.1-2.

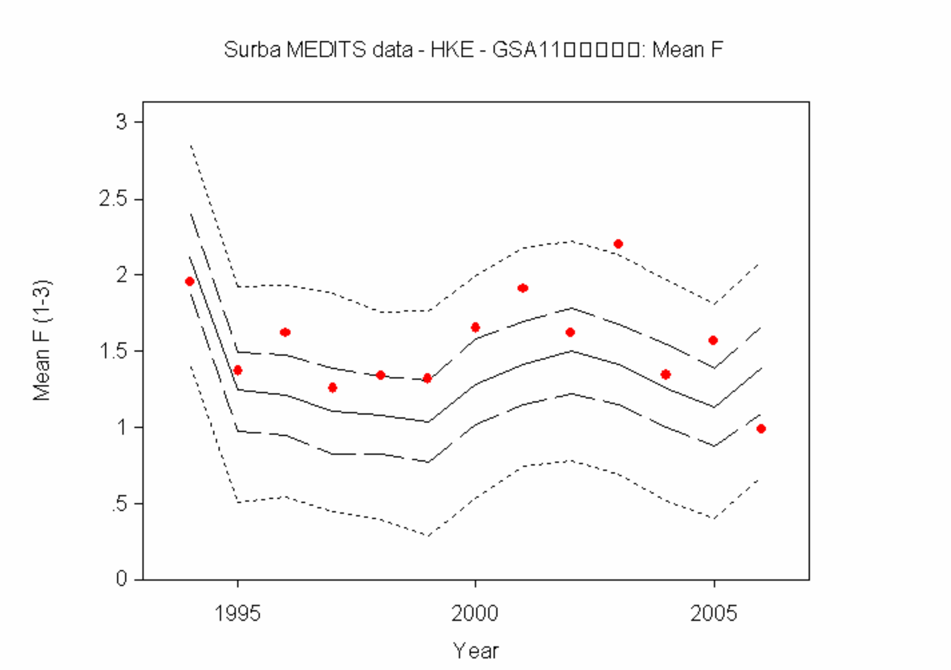


Figure 7.9.4.2.3.1 Fishing mortalities estimated by SURBA using trawl surveys age composition (MEDITS).

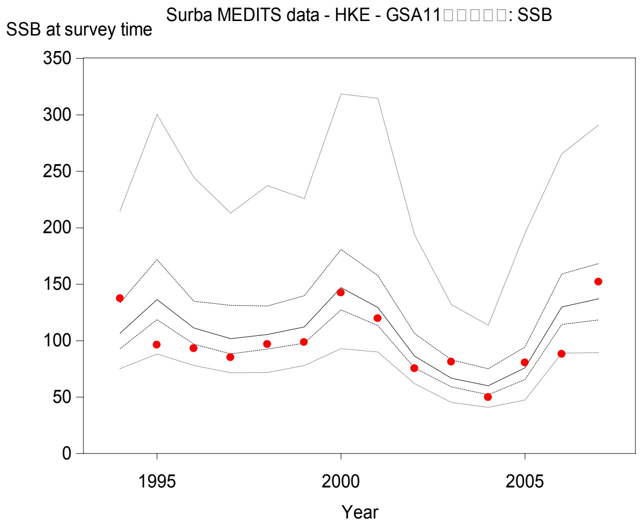


Figure 7.9.4.2.3.2 SSB trend estimated by SURBA using trawl surveys age composition (MEDITS).

7.9.5.Short term prediction for 2008 and 2009

7.9.5.1. Justification

No forecast analyses were conducted.

7.9.5.2. Input parameters

No forecast analyses were conducted.

7.9.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 11.

7.9.6. Medium term prediction

7.9.6.1. Justification

No forecast analyses were conducted.

7.9.6.2. Input parameters

No forecast analyses were conducted.

7.9.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 11.

7.9.7. Long term prediction

7.9.7.1. Justification

No forecast analyses were conducted.

7.9.7.2. Input parameters

No forecast analyses were conducted.

7.9.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 11.

7.9.8. Scientific advice

7.9.8.1. Short term considerations

7.9.8.1.1. State of the spawning stock size

SGMED-08-04 could not estimate the absolute levels of stock abundance. Survey indices indicate the stock to be stable in time. The stock SSB is more variable after 1999, showing and increasing trend in the last 3 years. No biomass reference points have been proposed for this stock. As a result, SGMED is unable to evaluate the status of the stock with respect to biomass.

7.9.8.1.2. State of recruitment

SGMED-08-04 could not estimate the absolute levels of recruitment. Relative survey indices indicated very high fluctuations of recruitment in the period 1994-2007, without a clear temporal pattern.

7.9.8.1.3. State of exploitation

SGMED-08-04 cannot estimate recent or historic exploitation rates. Trends in the average fishing mortality over ages 1 to 3 derived from Medits surveys ranged from 1 to 2.3, with the lowest value observed in the last year. The lack of agreed reference points do not allow SGMED to properly identify stock status. However, SGMED notes that considering the biology of the stock and reference points developed for neighbouring stocks in the Mediterranean, current estimated levels of fishing mortality are not likely to result in optimal long term yields.

7.9.8.2. Medium term considerations

SGMED-08-04 recommends the relevant fleet efforts to be reduced as a first step to obtain high long term sustainable yields.

7.10. Stock assessment of hake in GSAs 15 and 16

7.10.1. *Stock identification and biological features*

7.10.1.1. Stock Identification

The stock structure of hake in the Strait of Sicily is not well known. Levi *et al*. (1994) compared the growth of *M. merluccius* in Mediterranean and found quite a similar pattern in individuals from the Northern side of the Strait of Sicily (GSAs 15 and 16) and those caught in the Gulf of Gabes (GSA 14). Lo Brutto *et al*. (1998) have also found no evident of genetic subdivisions or significant differences in allelic frequencies, between samples near Sicily and those from the mid-line. More recently Levi *et al*. (2004) applied electrophoretic, morphometric and growth analyses to test the hypothesis of the existence of a unique stock of hake in the Sicily channel, which includes part of the North African continental shelf off the Tunisian coast and the shelf off the southern Sicilian coast. Although the level of genetic variation detected at five selected sampling sites was very low, morphometric analyses and otolith readings revealed some significant differences at phenotypic level, mainly in females. On the basis of the spatial distribution of spawning and nursery areas compared with the current patterns in the Strait of Sicily, Camilleri *et al*., (in press) believed the existence of genetic exchange between hake sub-populations inhabiting GSAs 15 and 16. In consequence it was decided to perform a common assessment for hake in GSA 15 and 16.

Despite very small specimens of 3.5 cm TL (Sinacori G., pers. com.) were caught during fine mesh trawl surveys, hake is considered fully recruited to grounds at 10 cm TL (SAMED, 2002). Differently to other areas of the Mediterranean, where two main recruitment pulses are known (Orsi Relini *et al*., 2002), the analysis of the length frequency distribution through year suggest that in GSA 15 and 16 recruits reach grounds all year round (SAMED, 2002).

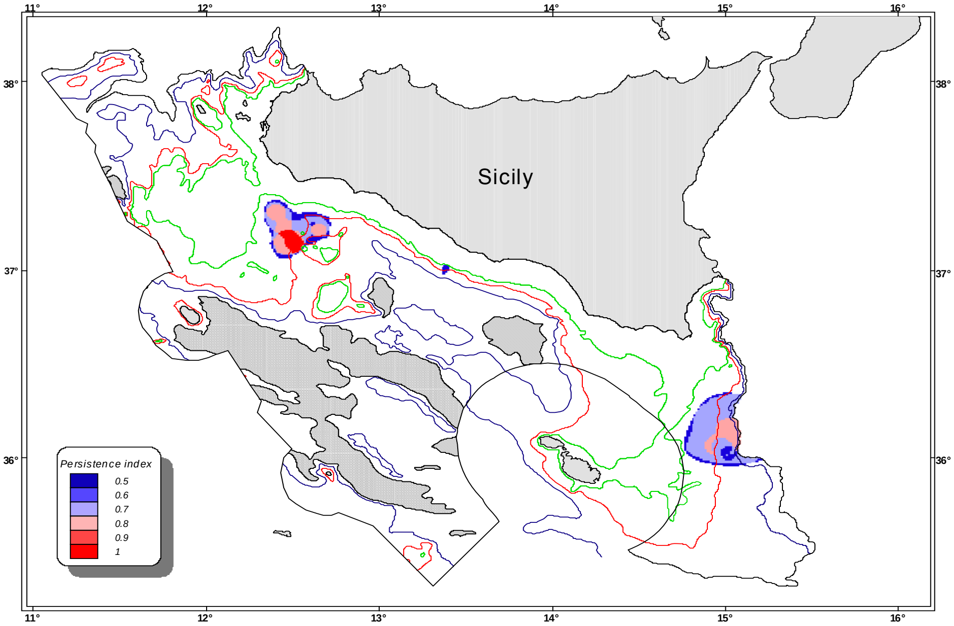


Figure 7.10.1.1.1 Areas showing stable presence of recruits of *M. merluccius* between 1994 and 1999 in GSA 15 and 16, excluding the Maltese Fisheries Management Zone (FMZ). The index of persistence ranges between 0 and 1, where 1 indicates stable nursery and 0 absence of nursery (modified from Fiorentino *et al*., 2003b).

In the northern sector of the Strait of Sicily (GSA 15 and 16), although some inter-annual variability in the nurseries distribution was evident, two stable areas for hake were identified, which are related with the presence of meso-scale oceanographical processes. These nurseries were located on the eastern side of the Adventure and Malta banks, between 100 and 200 m depth (Fig. 7.10.1.1.1).

On the basis of trawl surveys carried out in the northern side of the Strait (GSA 15 & 16) sex ratio is around 0.5 between 12 and 24 cm TL, while females prevail on males mainly at larger sizes (SR≥0.90 after 36 cm TL) (SAMED, 2002). In GSA 16 sex ratio shows a significant decrease (r_s=-0.673) with time, showing a reduction of females in the population since 1994 (Fiorentino *et al*., 2005).

A study by Andaloro *et al*., (1985) in the Strait of Sicily found that hake's diet varied according to size. Smallest fish of 4.5-12 cm TL feed mainly on Euphausiacea. Decapods are the main preys of hake between 13 and 24 cm TL, while fish is the preferred food of individuals larger than 25 cm TL. Similar feeding behaviour that varied with size has also been observed for other areas in the Mediterranean (see Colloca, 1999).

7.10.1.2.Growth

Considering the northern sector of the Strait of Sicily (GSA 15 and 16) the observed maximum length is 88 cm TL in females (Fiorentino *et al*., 2003a) and 53 cm TL in males (Sinacori G., pers. com.). According to Fiorentino *et al*. (2003a), the maximum estimated age in years in the exploited standing stock, resulted to be 15 years. This was established by thin section otolith lectures of largest females collected in trawl surveys for over 15 years. On the basis of comparison of results produced by different methods to estimate natural mortality (Chen & Watanabe; Beverton & Holt Invariants, Alagaraya), M=0.34 in females and M=0.43 in males were proposed as reference values for stock assessment purposes (SAMED, 2002).

With the exception of Andaloro *et al*. (1985), hake showed similar growth patterns in populations inhabiting the Strait of Sicily and the adjacent seas. Excluding the values given by Andaloro *et al*. (1985), the mean growth rates per month during the first two years range between 0.92 and 1.1 cm in females and 0.86 and 1.0 cm in males. These rates are compatible with those reported for juvenile hake in the Mediterranean by Fiorentino *et al*. (2000). The growth parameters were reported in Table 7.10.1.2.1.

Table 7.10.1.2.1 Von Bertalanffy growth function (cm;y) and length-weight relationship (cm;g) parameters in GSA 16.

	Sex	Linf	K	t_0	a	b
CNR_IAMC; 2007	Females	81.54	0.15	-0.08	0.0043	3.1525
	Males	53.58	0.22	-0.13	0.0049	3.1028

7.10.1.3.Maturity

Although spawning off Tunisia (GSA 12) occurs all over the year, Bouhlel (1973) reported three maturity peaks, in summer, winter and spring depending to the size of females. The largest females (LT> 40 cm) spawn mainly in spring, while the smallest (29<TL<39 cm) have two main spawning peaks one in summer and another one in winter. Bouaziz *et al*. (1998), studied samples from Bou-Ismail (GSA 4), reported that the spawning season runs throughout the whole year, even if a peak in summer is evident. According to Levi (1991), in GSA 15 and 16 mature specimens were collected both in autumn (November) and winter (February). Information on the northern sector of the Strait of Sicily (GSA 16) show that outer shelf on the western side of Adventure Bank might be a relevant spawning area (Fiorentino *et al*., 2006). According to literature spawning should occur in the outer shelf-upper slope. Aggregation of mature adults was reported between 100 and 200 m in the Gulf of Tunis (Bouhlel, 1973).
The parameters of maturity ogive were: L50% of 35.6 cm TL and 0.29 the corresponding slope in females, L50% of 24.6 cm TL and 0.23the corresponding slope in males (CNR_IAMC, 2007).

7.10.2. Fisheries

7.10.2.1. General description of fisheries

Although hake is not a target of a specific fishery, such as deep water pink shrimp and striped mullet, it is the third species in terms of biomass which is landed in GSA 16 (Fiorentino *et al*., 2005). Hake is caught by trawling in a wide depth range (50-500 m) together with other important species such as *Nephrops norvegicus*, *Parapenaeus longirostris*, *Eledone* spp., *Illex coindetii, Todaropsis eblanae*, *Lophius* spp., *Mullus* spp., *Pagellus* spp., *Zeus faber, Raja* spp. among others. In the northern sector of the Strait of Sicily (GSA 15 and 16) although hake is fished by long lines and gill-net (Gangitano *et al*., 2007) more than 95% of the catches are obtained by bottom trawling.

A rough delimitation of the most important commercial macro-areas for a large part of the Strait of Sicily is reported in Andaloro (1996). Main fishing-grounds, species caught, fishing periods and other relevant information of the Mazara distant trawl fleet fishing for hake in the Strait of Sicily are reported in Fiorentino *et al*. (2007). Very detailed maps of the trawling grounds for Maltese Fisheries Management Zone (FMZ), including a wide part of GSA 15 are available (Camilleri *et al*., in press). Most of the Maltese effort of bottom longlining and trammel netting is concentrated within a short radius around the major fishing ports with large areas being slightly exploited (Camilleri *et al*., in press).

The Italian and Maltese trawlers operating in the Strait of Sicily use the same typology of trawl net called “Italian trawl net”. Although some differences in material between the net used in shallow waters (“banco” net, mainly targeted to shelf fish and cephalopods) and that employed in deeper ones (“fondale “ net, mainly targeted to deep water crustaceans) exist, the Italian trawl net is characterized by a low vertical opening (up to 1.5 m) with dimensions changing with engine power (Fiorentino *et al*., 2003a).

7.10.2.2. Management regulations applicable in 2007 and 2008

At present there are no formal management objectives for hake fisheries in the Strait of Sicily. As in other areas of the Mediterranean, the stock management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area closures), and minimum landing sizes (EC 1967/06).

In order to limit the over-capacity of fishing fleet, the Italian fishing licenses have been fixed since the late eighties. After 2000, in agreement with the European Common Policy of Fisheries, a gradual decreasing of the fleet capacity is occurring. Furthermore from 1987 to 2005 a 30-45 days stopping of fishing activities was enforced each year, although in different ways, in order to reduce fishing effort. However this measure is considered less effective in order to protect hake juveniles. In Malta the trawling fleet has been stable since the early 2000 with 16 trawlers having a license to fish. Unfortunately in 2008 due to a reduction in capacity of other fleets 8 new trawl licenses will be issued that will increase the trawl capacity for Malta by 50%.

The new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). The mesh has to be modified in square 40 mm or diamond 50 mm after July 2008, however derogations are possible up to 2010.

A further and more effective improvement in the exploitation pattern of hake might be obtained through an integrative technical measure having a similar effect to the increasing of mesh size, i.e. the protection of hake nurseries. Differently from red mullet, whose nurseries are in the already protected bottoms within three nautical miles from the coast, the location of hake nurseries are on discrete off-shore areas on the outer shelf (100-200 m) and in international waters making the possibility of protecting the nursery areas a difficult task especially with respect to enforcement (see Fig. 7.10.1.1.1).

It must be outlined the existence in the Strait of Sicily of the Maltese FMZ which extends up to 25 nautical miles from baselines around the Maltese islands, where fisheries are specifically managed on the basis of capacity control (EC 813/04; EC 1967/06).

The access of Community vessels to the waters and resources in the FMZ is regulated as follows:
(a) fishing within the management zone is limited to fishing vessels smaller than 12 metres overall length using other than towed gears and;
(b) the total fishing effort of those vessels, expressed in terms of the overall fishing capacity, does not exceed the average level observed in 2000-2001 that corresponds to 1 950 vessels with an overall engine power and tonnage of 83 000 kW and 4 035 GT respectively.

Trawlers not exceeding an overall length of 24 metres are authorised to fish in certain areas within the management zone. The overall fishing capacity of the trawlers allowed to operate in the management zone must not exceed the ceiling of 4 800 kW and the fishing capacity of any trawler authorised to operate at a depth of less than 200 metres must not exceed 185 kW. Trawlers fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1627/94 and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned.

7.10.2.3.Catches

7.10.2.3.1. Landings

The most recent Italian and Maltese data were collected within the framework of the DCR. Available information is considered feasible by the experts attending the working group. Andreoli *et al*. (1995) estimated yield of hake landed by trawling with 1-2 day trip of commercial fisheries of southern coasts of Sicily (GSA 15 and 16) in the middle eighties. Between April 1985 and March 1986 landing was about 1440 tons; the next year it amounted to 1,238 tons.

Table 7.10.2.3.1.1 Landings (t) of hake by fishing technique by the Sicilian (ITA) and Maltese (MLT) fleets (DTS = demersal trawl; HOK = gears using hooks; PGP = polyvalent passive gears; PMP = combining mobile and passive gears; PTS = pelagic trawl.) (IREPA source).

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	15	MLT	[LHP] [LHM]				0		
HKE	15	MLT	[SB] [SV]						0
HKE	15	MLT	GNS				0		
HKE	15	MLT	GTR				0	0	0
HKE	15	MLT	LA						1
HKE	15	MLT	LLD				0		0
HKE	15	MLT	LLS				2	1	2
HKE	15	MLT	LTL				0		
HKE	15	MLT	OTB				4	5	6
HKE	15	MLT	Other gear				0		
HKE	15 & 16	ITA	DTS	1716	1960	1927	1713	1597	1599
HKE	15 & 16	ITA	HOK			22	9	2	9
HKE	15 & 16	ITA	PGP	92	12		67	27	111
HKE	15 & 16	ITA	PMP	52	23				
HKE	15 & 16	ITA	PTS	13	18	0	1		0

Considering that overall yield of trawling was about 9,666 tons in 2006 and 8,052 tons in 2007, hake landings representing about 14-15% of total yield in the area. On the basis of 2007 data, more than 93% of Sicilian landings are due to trawling (Table 7.10.2.3.1.1). Furthermore, hake yield corresponded to less than 10% of the whole demersal landing of Sicilian fisheries in the Strait of Sicily. To note that landings of hake in the Sicilian ports do not derive solely from GSA 16 but from GSA 15 and 16 with some catches also from other GSAs in the Strait of Sicily.

The Maltese hake yield decreased from 10 t in 1985 to about 1 t in 1992; the following years it fluctuated around 5 t. This reduction could be partially explained by the reduction in the amount of trawlers during the 1980s and a change in target species of the remaining trawlers, which fished mainly for red shrimps from the mid nineties onwards.

Total annual landings are shown in Fig. 7.10.2.3.1.1 as reported to SGMED-08-03 through the DCR. The data are listed in Table A3.1 of Appendix 3.

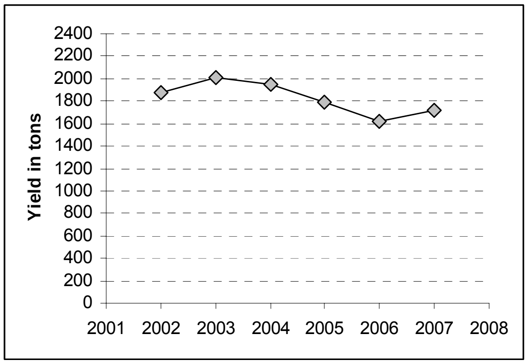


Figure 7.10.2.3.1.1 The Italian hake yield in GSA 15 and 16 (IREPA source).

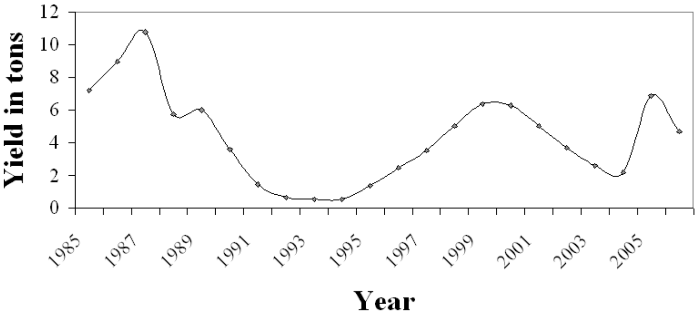


Figure 7.10.2.3.1.2 The Maltese hake yield (GSA 15; all gears combined).

As the length compositions of landing concerns, information is available only for the Sicilian vessels. Data were considered representative since the 3rd quarter of 2005, when a sampling scheme allowing a realistic raising of the sampled catches to the total ones was adopted (SIBM, 2005).

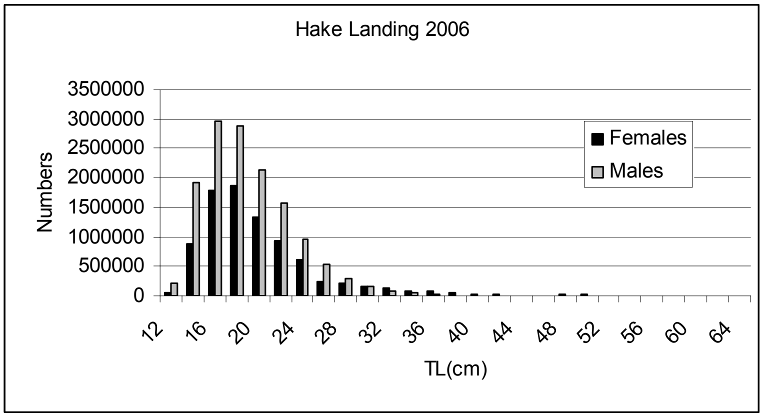


Figure 7.10.2.3.1.3 Yearly length structure of hake landings by sex in absolute numbers of Sicilian trawlers in 2006 (GSA 15 and 16).

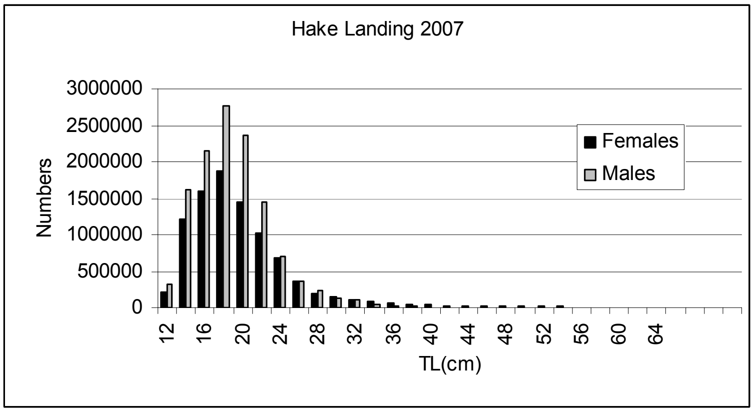


Figure 7.10.2.3.1.4 Yearly length structure of hake landings by sex in absolute numbers of Sicilian trawlers in 2007 (GSA 15 and 16).

7.10.2.3.2. Discards

In the late nineties Sicilian trawlers fishing off-shore (15 – 25 days of trip) had higher discard rates of hake (86% in number and 31% in weight) than the inshore trawlers (1-2 days trips) (32% in number and 9% in weight) (Anon., 2000). For distant fisheries the first modal group (10-12 cm) in the catches was totally discarded. This is due to the intensive use of the working time and the space in the cold cellar for high prised crustaceans. Conversely trawlers operating in coastal waters tend to reduce the discarded fraction to the smallest specimens of the first age group present in the catches.

More recent data, collected within the framework of DCR, showed that discarded fraction of undersized hakes by Sicilian trawlers seems to decrease (13% in number and 3% in weight in 2006), amounting to about 54 tons in 2006. The mean size of the discarded hakes varies according to the season. During 2006 the length at 50% discard of the Sicilian trawlers ranged between 12.9 (summer and autumn) and 15.0 (spring) cm TL, being 13.5 cm TL the yearly value (Gancitano V., pers. comm.).

Annual discards are listed in Table A3.6 of Appendix 3.

7.10.2.3.3. Fishing effort

The trends in fishing effort by year and major gear type is listed in Tab. 7.10.2.3.3.1 and shown in Fig. 7.10.2.3.3.1 in terms of kW*days for the otter trawls. However, the effort of the main otter trawl fleet increased from 2004 to 2007 by 12%. The data are listed in Tables A3.7-A3.9 of Appendix 3.

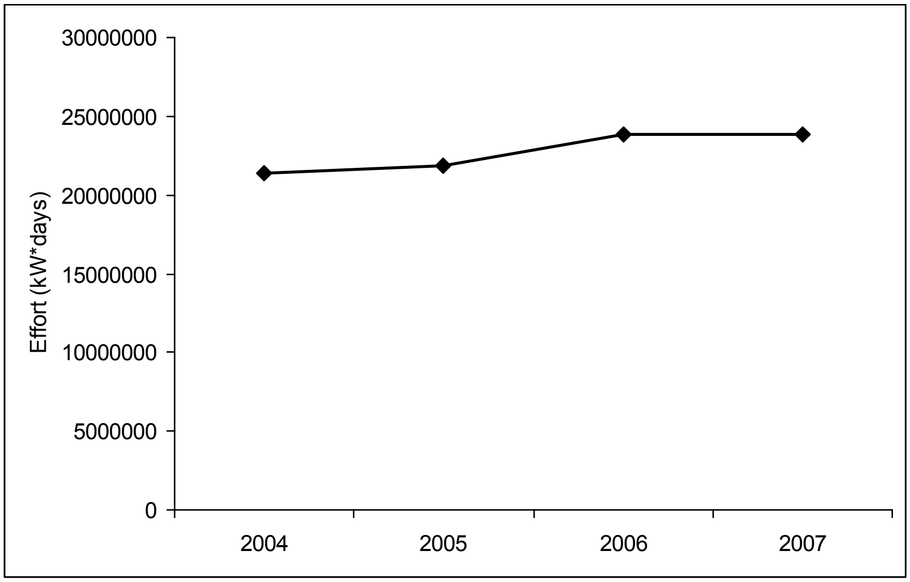


Fig. 7.10.2.3.3.1 Trend in annual effort (kW*days) of the Italian otter trawlers operating in GSAs 15 and 16, 2004-2007.

Tab. 7.10.2.3.3.1 Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSAs 15 and 16, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	15	MLT	[LHP] [LHM]		28		
DAYS	15	MLT	[SB] [SV]			73	59
DAYS	15	MLT	GNS		51		
DAYS	15	MLT	GTR		200	152	320
DAYS	15	MLT	LA			1116	1096
DAYS	15	MLT	LLD		3164	3159	2827
DAYS	15	MLT	LLS		1197	1466	1624
DAYS	15	MLT	LTL		263		
DAYS	15	MLT	OTB		421	404	688
DAYS	15	MLT	Other gear		64		
DAYS	15 & 16	ITA	DTS	81853	82557	89319	89164
DAYS	15 & 16	ITA	HOK	14856	11450	10272	9284
DAYS	15 & 16	ITA	PGP	118425	97285	85556	85298
DAYS	15 & 16	ITA	PMP	6939			
DAYS	15 & 16	ITA	PTS	4899	5476	7926	7032
GT*DAYS	15	MLT	[LHP] [LHM]		170		
GT*DAYS	15	MLT	[SB] [SV]			192	139
GT*DAYS	15	MLT	GNS		135		
GT*DAYS	15	MLT	GTR		1174	477	1023
GT*DAYS	15	MLT	LA			23999	29596
GT*DAYS	15	MLT	LLD		82011	72364	60606
GT*DAYS	15	MLT	LLS		16866	18866	18072
GT*DAYS	15	MLT	LTL		2539		
GT*DAYS	15	MLT	OTB		24878	34527	69268
GT*DAYS	15	MLT	Other gear		226		
GT*DAYS	15 & 16	ITA	DTS	6673029	6864030	7429483	7322198
GT*DAYS	15 & 16	ITA	HOK	764595	403669	507862	370612
GT*DAYS	15 & 16	ITA	PGP	249032	206056	192811	212519
GT*DAYS	15 & 16	ITA	PMP	20134			
GT*DAYS	15 & 16	ITA	PTS	224188	236435	352518	346405
KW*DAYS	15	MLT	[LHP] [LHM]		1880		
KW*DAYS	15	MLT	[SB] [SV]			3805	2507
KW*DAYS	15	MLT	GNS		2121		
KW*DAYS	15	MLT	GTR		13889	8391	20724
KW*DAYS	15	MLT	LA			203361	208456
KW*DAYS	15	MLT	LLD		554562	483437	449900
KW*DAYS	15	MLT	LLS		140846	159692	160914
KW*DAYS	15	MLT	LTL		26318		
KW*DAYS	15	MLT	OTB		129838	143909	240858
KW*DAYS	15	MLT	Other gear		3394		
KW*DAYS	15 & 16	ITA	DTS	21381964	21772464	23699835	23644626
KW*DAYS	15 & 16	ITA	HOK	3153486	1758722	2076446	1695903
KW*DAYS	15 & 16	ITA	PGP	2691324	2302777	2207660	2378933
KW*DAYS	15 & 16	ITA	PMP	223470			
KW*DAYS	15 & 16	ITA	PTS	962786	1063031	1592930	1431085

7.10.3. Scientific surveys

7.10.3.1.Medits

7.10.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 15 and 16 the following number of hauls were reported per depth stratum (s. Tab. 7.10.3.1.1.1).

Tab. 7.10.3.1.1.1. Number of hauls per year and depth stratum in GSAs 15 and 16, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA15_010-050									1	1	2	1	1	
GSA15_050-100									6	5	4	5	5	12
GSA15_100-200									12	13	13	13	13	12
GSA15_200-500									9	10	9	9	9	4
GSA15_500-800									17	16	15	17	16	17
GSA16_010-050	4	4	4	4	4	4	4	4	7	7	7	10	10	11
GSA16_050-100	8	8	8	8	8	8	7	8	11	12	12	20	22	23
GSA16_100-200	4	4	4	4	5	5	6	5	10	8	9	18	19	21
GSA16_200-500	10	11	11	12	11	11	11	11	19	18	19	28	31	27
GSA16_500-800	10	14	14	13	14	14	14	14	19	20	19	32	33	38

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma\,(Yi*Ai) / A$$

$$V(Yst) = \Sigma\,(Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = $Yst \pm t(\text{student distribution}) * V(Yst) / n$

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.10.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.10.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSAs 15 and 16 was derived from the international surveys Medits. Figure 7.10.3.1.3.1 display the estimated trend in hake abundance and biomass in GSAs 15 and 16, respectively.

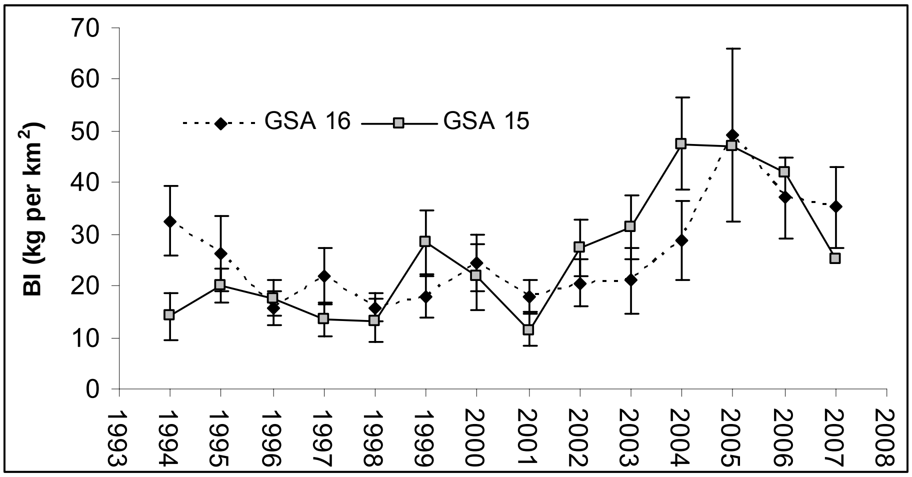


Fig. 7.10.3.1.3.1 Biomass indices (BI as kg per km^2) obtained during the MEDITS survey in GSA 15 and 16.

In the last years the biomass indices for both GSAs 15 and 16 show a similar pattern with an increasing trend since 2002 till 2005-2006 and decrease in 2006-2007.

The recruitment indices obtained during MEDITS surveys (Fig 7.10.3.1.3.3) ranged between 85 and 577 Recruits per km^2. After a period of low recruit abundance from 1995 to 2002, a phase of increasing recruitment is occurring.

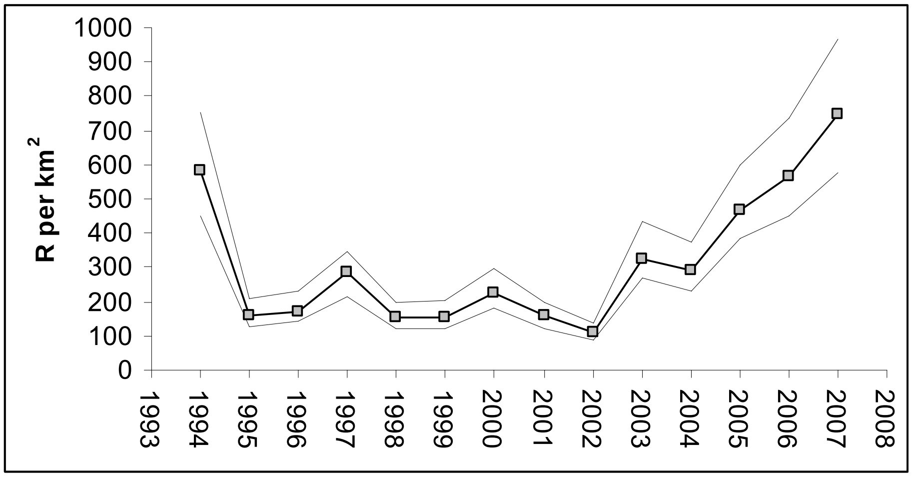


Fig. 7.10.3.1.3.3 Recruits per km^2 (MEDITS surveys) in GSA 16 from Surba. 25th, 50th and 75th percentile of bootstrapped runs are reported.

The trend in abundance and biomass as reestimated by SGMED-08-03 are shown in Figures 7.10.3.1.3.4 and 7.10.3.1.3.5 for GSAs 15 and 16. While the trend in GSA 15 is quite short, recent abundance and biomass indices (2005-2007) in GSA 16 appear at the highest level observed since 1994. Such analyses of Medits indices are considered preliminary.

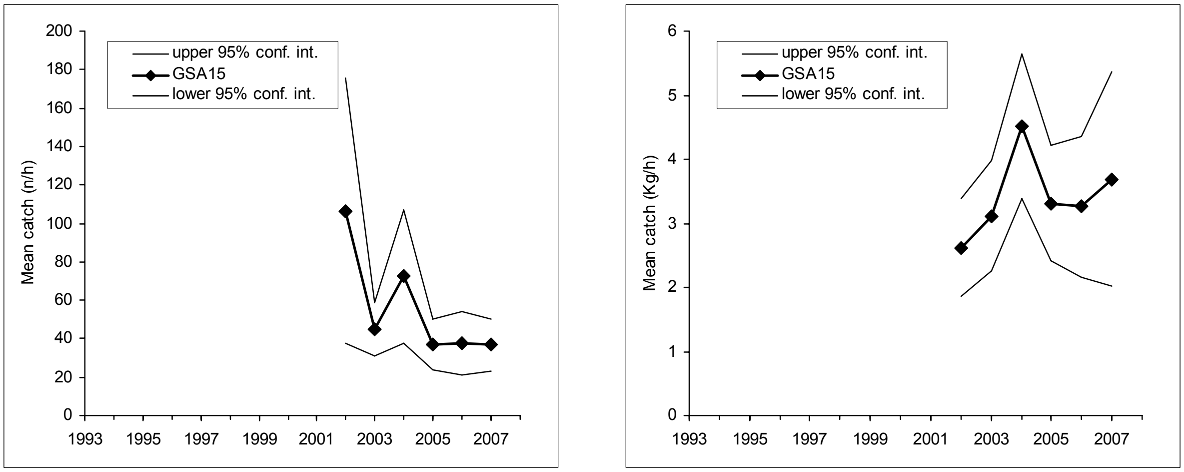


Fig. 7.10.3.1.3.4 Abundance and biomass indices of hake in GSA 15.

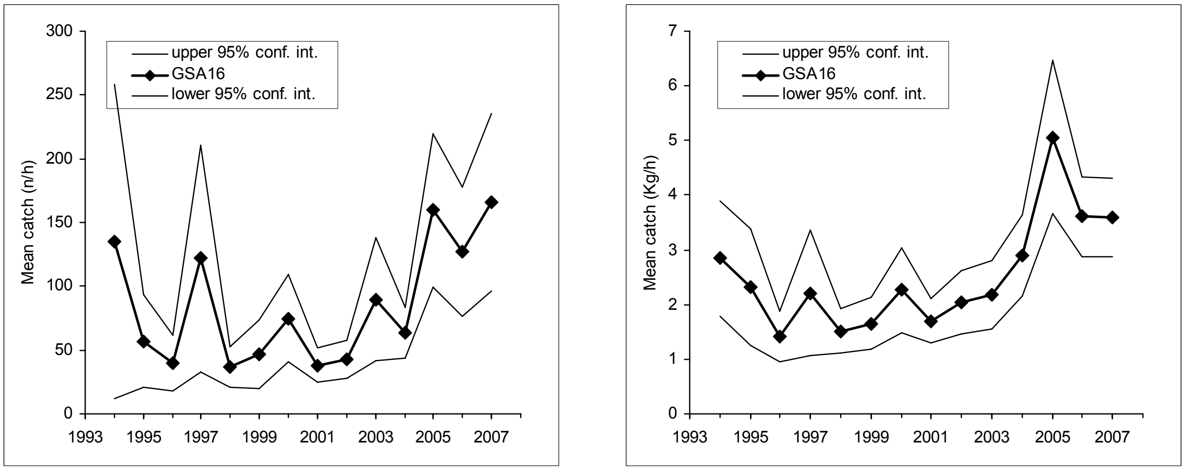


Fig. 7.10.3.1.3.5 Abundance and biomass indices of hake in GSA 16.

7.10.3.1.4. Trends in abundance by length or age

The following Fig. 7.10.3.1.4.1 displays the stratified abundance indices of GSA 15 in 2002-2007. These size compositions are considered preliminary.

The Figures 7.10.3.1.4.2 and 7.10.3.1.4.3 display the stratified abundance indices of GSA 16 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

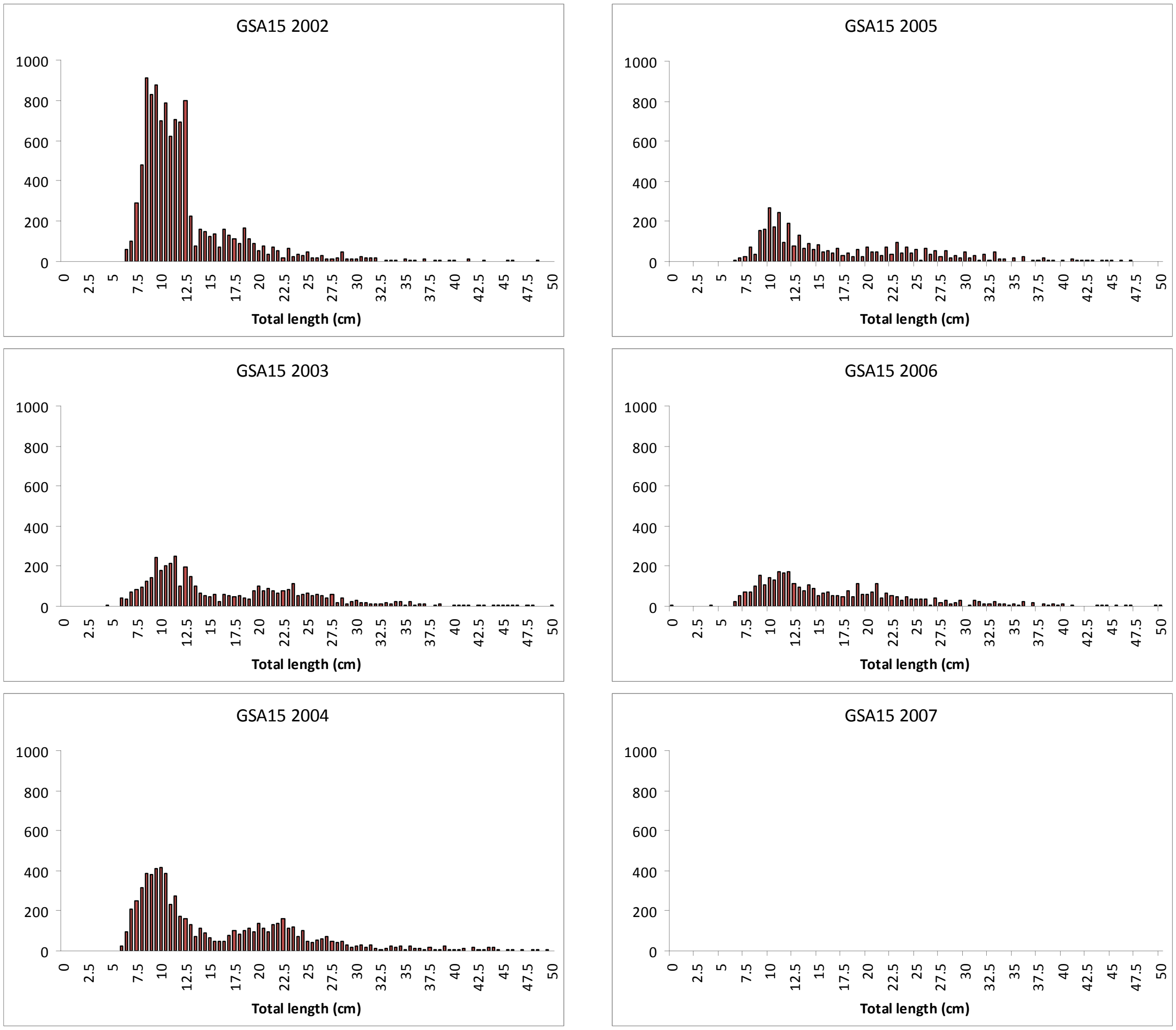


Fig. 7.10.3.1.4.1 Stratified abundance indices by size in GSA 15, 2002-2007.

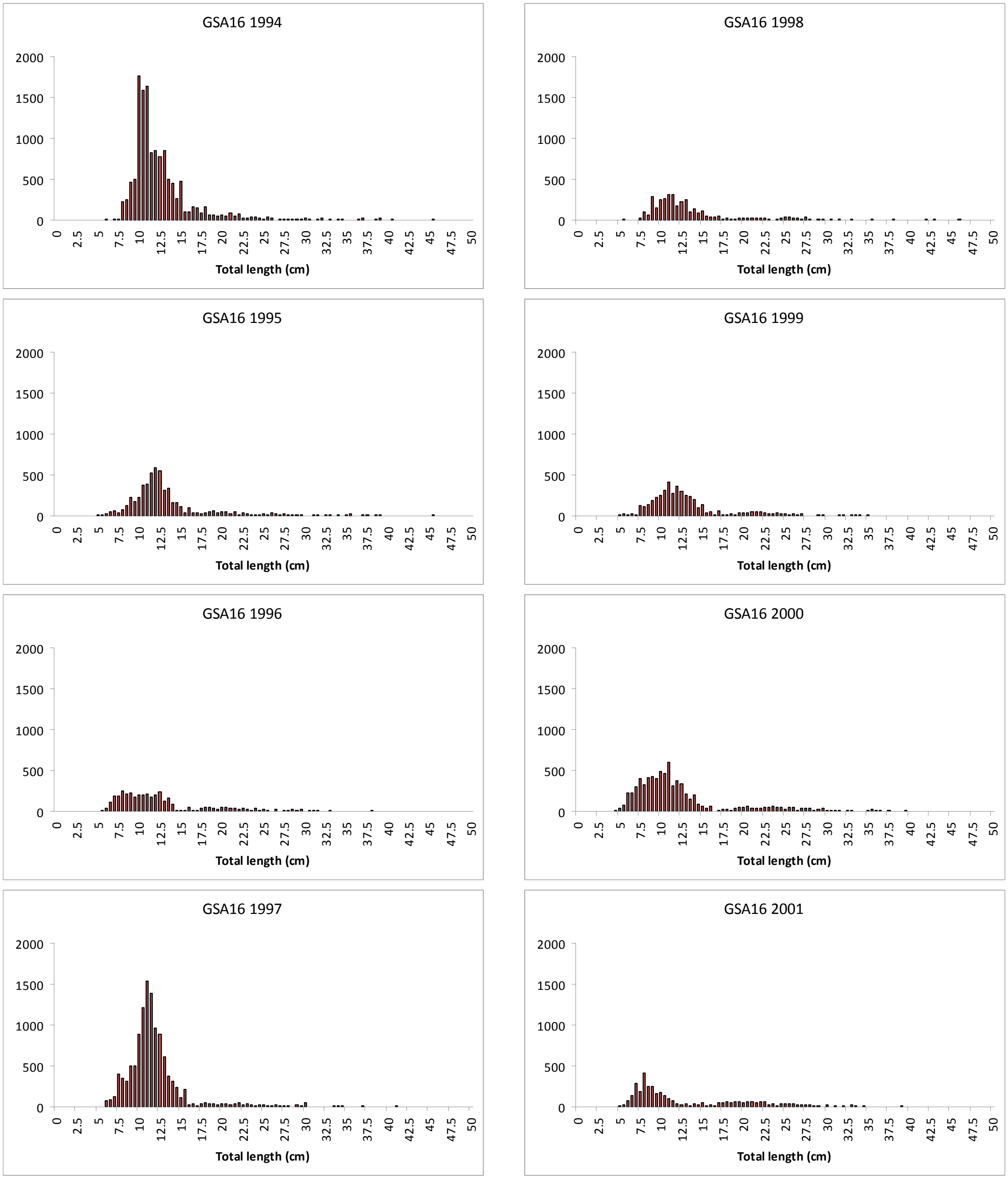


Fig. 7.10.3.1.4.2 Stratified abundance indices by size in GSA 16, 1994-2001.

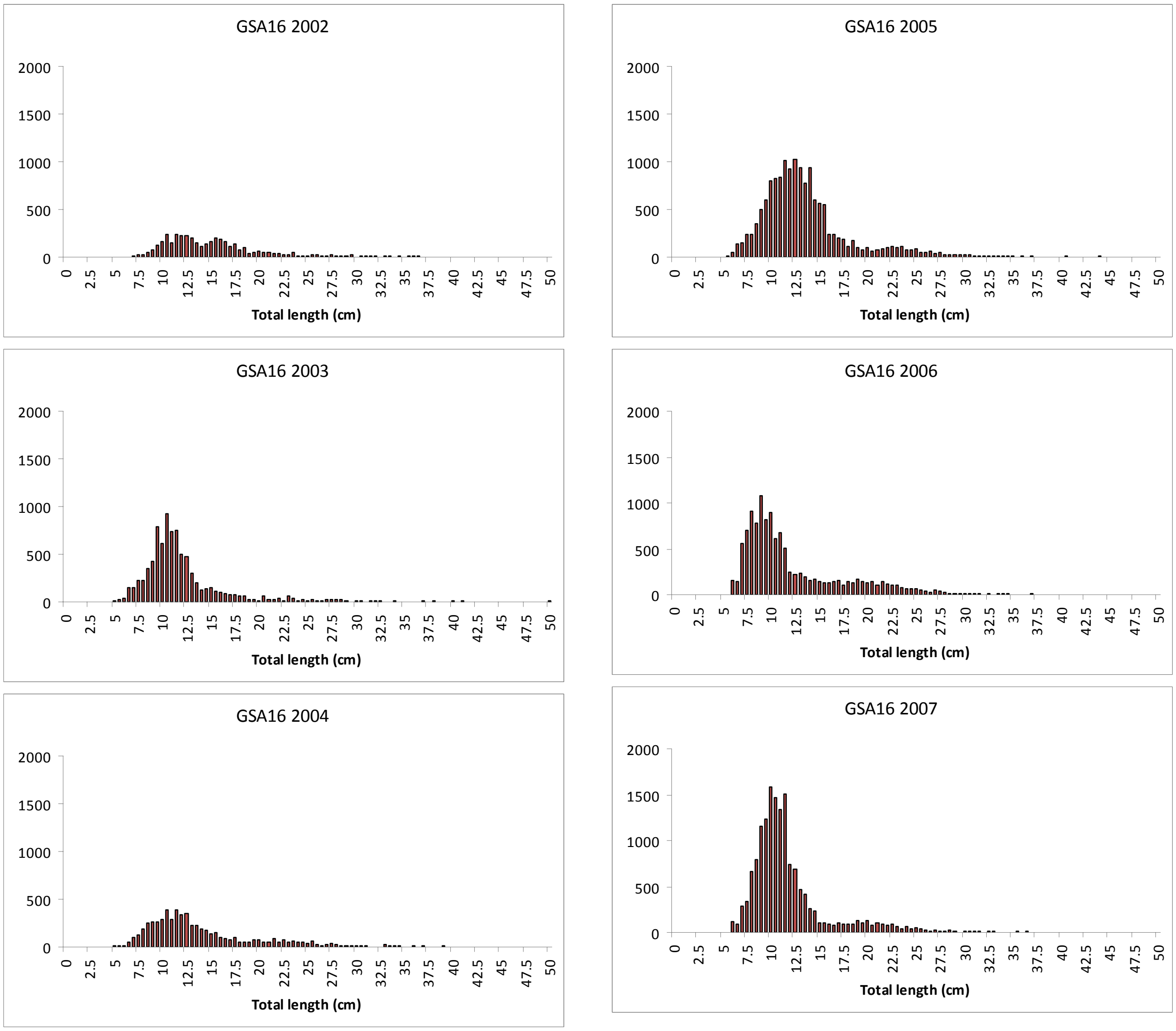


Fig. 7.10.3.1.4.3 Stratified abundance indices by size in GSA 16, 2002-2007.

7.10.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.10.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.10.4. Assessment of historic stock parameters

7.10.4.1. Method 1: Trends in LPUE

7.10.4.1.1. Justification

Trends in LPUE may provide insight into trends in stock size. SGMED-08-04 recommends that technological creep should be considered when trends in LPUE are interpreted.

7.10.4.1.2. Input parameters

Landings and effort for the Sicilian trawler fleet operating in GSAs 15 and 16 were used.

7.10.4.1.3. Results

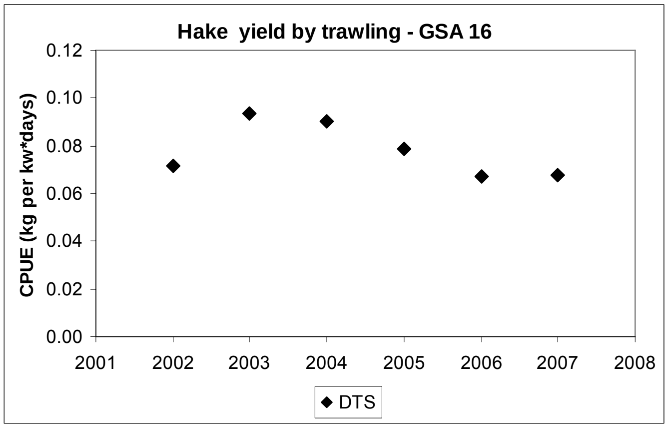


Figure 7.10.4.1.3.1 Landing per unit effort of commercial trawling by the Sicilian fleet (GSAs 16)..

According to commercial data, a light decrease of hake landings per unit effort is occurring since 2003 (Fig. 7.10.4.1.3.1).

7.10.4.2.Method 2: SURBA

7.10.4.2.1. Justification

The availability of a long time series (1994-2007) of length frequency distribution (LFD) from trawl surveys data allows to reconstruct the evolution of fishing mortality rates of hake in the GSA 15 and 16 by using the SURBA software package. Firstly the LFD by sex from the MEDITS trawl surveys was corrected by including the data for the individuals with unidentified sexes. This was based on the sex ratio per size class. The corrected LFDs by sex for each GSA were then converted in numbers by age group using the subroutine "age slicing" as implemented in the software package LFDA (Kirkwood *et al*., 2001). Secondly we estimated the mean weight at age using VBGF and a vectorial natural mortality at age (Caddy and Abella, 1999) for the SURBA software to run the analysis. Then the numbers at age were used to estimate time series of fishing mortality rates. This was done due to the difficulties in obtaining feasible information from commercial fisheries data especially from GSA 15 were length frequencies distributions do not exist from landings. Still for GSA 16 data from commercial fisheries were only available since 2002 with the start of the DCR regulation (EC 1639/01; EC 1581/04).

7.10.4.2.2. Input parameters

The VBGF parameters used for age slicing of LFD in both GSAs were obtained from CNR_IAMC (2007) for GSA 16 (Tab. 7.10.4.2.2.1). Natural mortality rates by age were calculated according to the approach of

Caddy and Abella (1999), minimizing the difference of proportion by size of numbers between LCA and surveys for full vulnerable range (Tab. 7.10.4.2.2.1).
The parameters used in the analysis are given in Tab. 7.10.4.2.2.1.

Tab. 7.10.4.2.2.1 Biological parameters used for Surba analyses for hake (females) in the Strait of Sicily (GSAs 15 and 16).

Age	0	1	2	3	4	5	6	7+
Natural mortality at age	0.9	0.5	0.4	0.3	0.3	0.25	0.25	0.2
Maturità at age	0.00	0.00	0.02	0.17	0.62	0.91	0.98	1.00
Weight at age	0.005	0.011	0.072	0.198	0.388	0.628	0.903	1.300
Catchability coefficient	0.9	1	1	0.75	0.5	0.5	0.4	0.3

7.10.4.2.3. Results

State of the adult abundance and biomass: Relative indices derived from scientific surveys indicate a recent decrease in the stock size in both GSAs since 2005. In 2007, the stock spawning stock size in weight (only GSA 16) amounted to 136% as compared to the long term average (1994-2006) (Fig. 7.10.4.2.3.1). However analytical assessment evaluated that the spawning stock is assessed to be about 3-5% of the virgin one, implying negative effects on stock productivity.

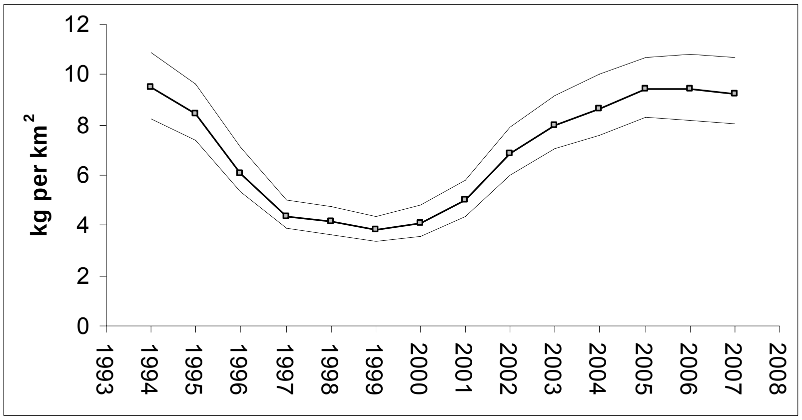


Fig. 7.10.4.2.3.1 SSB in kg per km^2 (MEDITS surveys) in GSA 16 from Surba. 25th, 50th and 75th percentile of bootstrapped runs are reported.

- State of the juvenile (recruits): Feasible estimation of the absolute size of the recruitment at age 0 of hake in GSA 15 and 16 to the fisheries are not available. Relative indices derived from scientific surveys (only GSA 16) indicate the recruitment in 2007 to be high, being about the 266% as compared to the long term average (1994-2006) (Fig. 7.10.4.2.3.2).

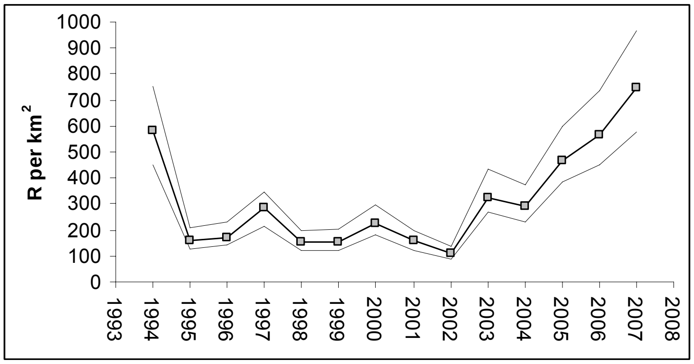


Fig. 7.10.4.2.3.2 Recruits per km^2 (MEDITS surveys) in GSA 16 from Surba. 25th, 50th and 75th percentile of bootstrapped runs are reported.

7.10.4.3. Method 3: VIT

7.10.4.3.1. Justification

Since only two complete years (2007-2008) of length frequency distribution of landing were available, an approach under steady state (pseudocohort) was used. Since there were no evident differences between the two examined years (Fig. 7.10.2.3.1.1, Fig. 7.10.2.3.1.3 and Fig. 7.10.2.3.1.4), the analysis was performed on the mean landings. Cohort (VPA equation) and Y/R analysis as implemented in the package VIT4win were used (Lleonart and Salat, 2000). Data were derived from DCR call for GSA.

7.10.4.3.2. Input parameters

The parameters used in the analysis are reported in table… No discard data were included.

Table 7.10.4.3.2.1 Parameters used for stock assessment trough VIT approach.

Parameter	Females	Males
L∞	81.54	53.58
K	0.15	0.22
t0	-0.08	-0.13
a	0.0043	0.0049
b	3.1525	3.1028
L50%	35.6	24.6
g	0.29	0.23
M	0.34	0.43
Ft	0.34	0.43

Table 7.10.4.3.2.2 Absolute number by length class (mean TL) of landings (average 2006 and 2007).

TL (cm)	Females	Males	TL (cm)	Females	Males
13	131290	265159	**45**	16683	724
15	1039796	1767333	**47**	15158	1335
17	1696340	2565263	**49**	17063	860
19	1868371	2824879	**51**	17463	724
21	1383435	2250268	**53**	15860	
23	977447	1513738	**55**	7780	
25	637451	823667	**57**	8342	
27	302091	450670	**59**	4776	
29	198150	262721	**61**	3979	
31	153292	149256	**63**	1186	
33	120189	96687	**65**	5708	
35	76475	50994	**67**	460	
37	69514	20622	**69**	460	
39	48449	10360	**71**	746	
41	40714	2830	**73**	746	
43	28248	976			

7.10.4.3.3. Results

Mortality rates (Z and F) by sex and size of hake in GSA 16 are shown in Fig. 7.10.4.3.3.1.

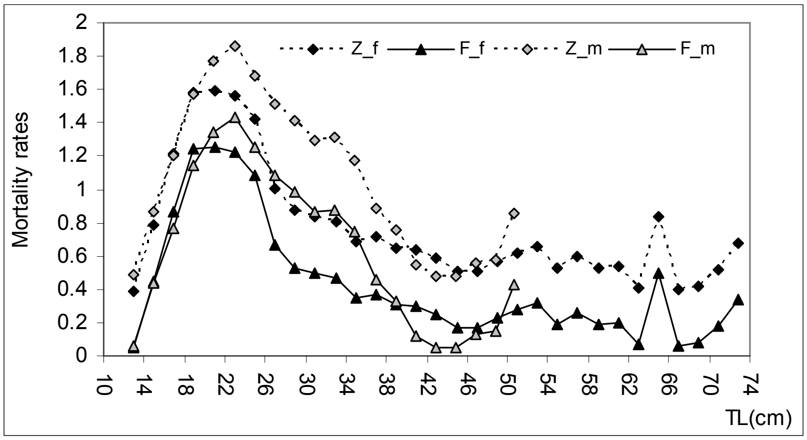


Fig. 7.10.4.3.3.1 Total (Z) and Fishing (F) mortalities rates by size and sex of Hake in GSA 16.

The reconstructed yield obtained by the VIT package (1,597 t) is virtually equal to the observed one (1,598 t). Absolute recruitment estimation and other main results of VIT, including the current mortality rates, are listed in table 7.10.4.3.3.1.

The wg noted that high differences in values between the scalar F estimated by VIT as mean F and global F can produce ambiguity in assessing current exploitation of a stock.

Since the latter is not related to the survival of the cohort, the wg recommend to avoid its use as synthetic descriptor for evaluating the current F when a stock is assessed with any analytic approach.

Table 7.10.4.3.3.1 The main results of VIT analysis.

Variables	Females	Males	Total
Observed Yield (tons)	……	……..	1598
Reconstructed Yield (tons)	796	802	1597
Recruits at 12 cm TL (millions)	13.5	21.2	34.7
Mean Z (ages 1-4)	1.04	1.31	
Mean F (ages 1-4)	0.70	0.88	
Catch mean length (cm)	21.1	19.9	
Stock mean length (cm)	21.1	17.7	

7.10.5. Short term prediction for 2008 and 2009

7.10.5.1. Justification

No forecast analyses were conducted.

7.10.5.2. Input parameters

No forecast analyses were conducted.

7.10.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSAs 15 and 16.

7.10.6. Medium term prediction

7.10.6.1. Justification

The availability of a time series of total mortality rates and main relevant parameters allows to reconstruct the stock dynamics in the last years and to simulate the effects of management measures such as the reduction of fishing mortalities, increase of size at capture, seasonal closures and all the measures considered combined. Hence the Aladym simulation model (Lembo et al., 2007) is a very useful tool to give practical management advice in order to improve the status of the stock. Since the indices from the trawl surveys of GSA 15 and 16 are complimentary and follow the same trend we have utilized only the data from GSA 16 to make the simulation since there is a longer time series and a more complete data set. This implies that any advice on management measures resulting from the Aladym simulation to improve the status of the hake stock would apply to both GSAs 15 and 16.

7.10.6.2. Input parameters

The input parameters used in the Aladym simulation for hake stock in the Strait of Sicily are reported in Tab. 7.10.6.2.1.

Tab. 7.10.6.2.1 Stock parameters used in Aladym model.

GSA 15 + 16	***M. merluccius***	
Parameters	**Females**	**males**
K (y)	0.16±0.01	0.27±0.01
L_∞ (mm)	760 ±14	450 ±14
t_0	-0.4 ±0.1	-0.4 ±0.1
a	0.000003248	0.00002118
b	3.1416	2.8684
Life span (y)	20	11
M	0.34	0.43
L_{mat} (mm)	320±20	270±20
Maturity range (L75-L25) (mm)	30	20
Sex ratio (F/F+M)	0.5	
L_{50} (mm); SR (mm)	95; 36 up to 2009	
	190; 86 from 2010	
D_{50} (mm)	500	
Activity coefficient/intensity	Tuned by month with commercial catches	
	From 2008 onward trawling ban between January and February	
Pre-recruits (initial number) and *ln*-normal distribution parameters	$59 \cdot 10^6$ (mean ln(R)=17.74; ds ln(R)=0.74)	
Spawning period (spawning peak)	January-September (February-May)	
Years of simulation	30	
proxy of Z (y) 1994-2006	1.65 (M) and 1.04 (F)	

Analysis aims to evaluate the effect of 5 different management scenarios on the hake stock in the Strait of Sicily. These scenarios are:

- a fleet reduction of 25% of the current capacity obtained in two steps. The first (12.5%) from 2008 to 2010, and the second (12.5%) from 2011 to 2013;
- trawling ban of 45 days per year between January and March (targeted to deep water pink shrimp fishery which is the main commercial species in the GSA 15 and 16);
- changing the mesh opening in the cod-end from the 40 mm to 50 mm (diamond) from 2010;
- the above three measures combined; and
- maintaining the status quo.

7.10.6.3.Results

The expected improvements of the stock indicators adopting the management measures of the IFMP versus the status quo are reported in Tab. 7.10.6.3.1.

Table 7.10.6.3.1 Aladym simulations. Main indicators of the stock status in 2008 (start point) and percentage variations in 2010 and 2013 from the start point are reported. **B** is total biomass, **SSB** the spawning stock biomass, **ESSB/USSB** the ratio between the exploited and the unexploited SSB and **Y** is yield.

Measures	**indicators**	**Current values**	**% variation**	
		2008	2010	2013
Fleet reduction	B	1689.97	27.31	36.34
	SSB	708.78	6.13	39.37
	Y	915.44	17.38	25.92
	ESSB/USSB	0.05	11.67	42.65
Trawling ban	B	1698.83	30.85	38.79
	SSB	711.17	11.14	43.95
	Y	828.26	31.23	40.96
	ESSB/USSB	0.05	16.93	47.32
Mesh increase	B	1651.08	26.14	74.92
	SSB	691.04	-7.64	65.40
	Y	968.19	-8.67	47.80
	ESSB/USSB	0.05	-2.82	69.30
Combined	B	1735.99	49.27	127.10
	SSB	728.34	23.33	161.90
	Y	779.45	12.54	81.61
	ESSB/USSB	0.05	29.77	168.05
Status quo	B	1651.08	13.75	11.35
	SSB	691.04	-9.99	0.78
	Y	968.19	12.68	11.98
	ESSB/USSB	0.05	-5.30	3.16

Considering the single measures, the increase of mesh size or the 25% decrease of fishing capacity would produce an important mean increase in biomass after 2013 ranging from 65 to 78% of the 2008 value. The trawling ban would produce a minor rise, corresponding to about 10%.

The three measures combined would cause in the long period (2013-2023) a mean increase in biomass of about 160% of the 2008 value, while maintaining the *status quo* would produce a mean decrease of about 9% in 2013-2023 period.

Under the scenario 4 (combined measures), the ratio ESSB/USSB in 2013-2023 period would increase in mean of about 260% the 2008 value, with an expected value of the ESSB being about the 15% of the USSB. A slight decrease of yield for the first two years after the change in mesh size is implemented is expected, but then it is followed by a mean increase in 2013-2023 of 40% (adoption of 50 mm mesh) and 18% (reduction of fleet capacity) of the 2008 value. The trawling ban would produce a negligible change, while '*status quo*' would produce in long time a mean reduction of total catches of about the 4%. It is worth noting that under the combined measures scenario yield is expected to increase in mean of about 60% of current value between 2013 and 2023.

7.10.7. Long term prediction

7.10.7.1. Method 1: Y, B and SSB per recruit according to the VIT package

7.10.7.1.1. Justification

The VIT approach to Biomass and Yield per recruit analysis has been applied in order to analyse the stock production with increasing exploitation under equilibrium conditions.

7.10.7.1.2. Input parameters

The input parameters have been already reported at section dealing with the VIT assessment above.

7.10.7.1.3. Results

Estimation of Biomass and Yield per recruit varying current fishing mortality (Fc) by a multiplicative factor is reported in Fig. 7.10.7.1.3.1.

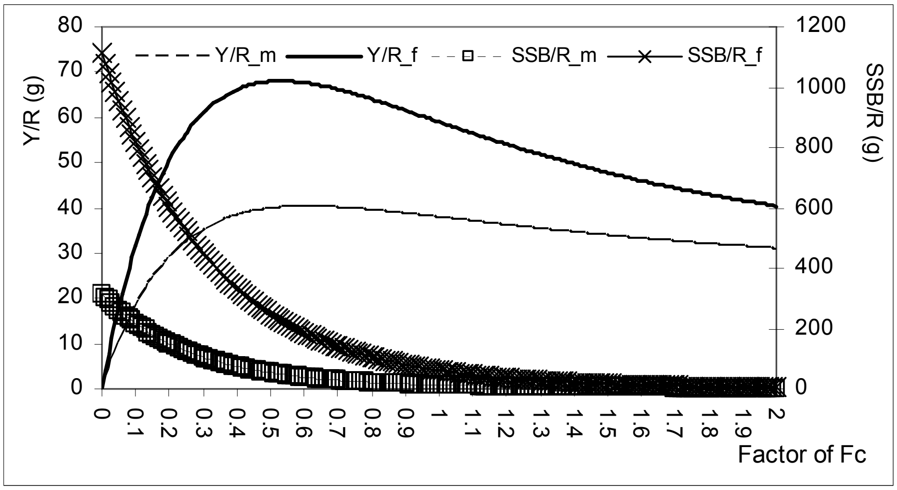


Fig. 7.10.7.1.3.1 Spawning Stock Biomass and Yield per recruit varying current fishing mortality (Fc) by a multiplicative factor according to the VIT package.

Assuming no variation in the exploitation pattern, the main result of Y/R analysis are reported in Tab. 7.10.7.1.3.1

Tab. 7.10.7.1.3.1 Estimation of yield (Y in g), biomass (B in g) and spawning stock biomass (SSB in g) per recruit (R) varying current fishing mortality (F=0.70 in females and F=0.88 in males, mean F over 1-4 age groups) by a multiplicative factor.

Sex	**Status**	**Factor**	**Y/R**	**B/R**	**SSB**
Females	**F(Virgin)**	0	0	1390.59	1112.60
	F(0.1)	0.38	65.42	502.74	353.43
	F(Max)	0.54	67.99	346.98	228.03
	F(Current)	1.01	58.96	123.60	60.64
	F(Double)	2	40.40	29.03	4.48
Males	**F(Virgin)**	0	0	424.55	315.64
	F(0.1)	0.40	38.29	130.87	73.99
	F(Max)	0.62	40.20	80.88	37.02
	F(Current)	1.01	37.82	42.41	12.12
	F(Double)	2	30.88	19.52	2.10

According to the VIT steady state VPA, a overfishing state is detected. Maintaining the current fishing pattern, a reduction of current effort of 60-62% and 38-46% is advisable to reach $F_{0.1}$ and F_{max} respectively.

7.10.7.2. Method 2: Y, B and SSB per recruit according to the Yield package

7.10.7.2.1. Justification

Availability of biological parameter with their uncertainty and length at first capture allows to quantify by simulation the likely changes in Y, B and SSB per recruit in function of fishing mortality (F) with the Yield package. It is also possible to estimate the probability distribution of main Biological Reference Point (F_{max}, $F_{0.1}$ and $F_{spr=0.3}$ and the corresponding Yield per Recruit) to assess the stock status.

7.10.7.2.2. Input parameters

Growth, length-weight relationship, natural mortality and maturity ogive the same used in the previous paragraph VIT (point 1.1.4.3.2). Length at 50% capture was 14 cm TL (about 1 year old).

A guess estimate of uncertainty in terms of coefficient of variation (CV=0.2) was added to each parameter.

Spawning stock-recruitment relationship was not used. Variables were estimated for 1 million young fish nominal recruitment. The recruitment variability among years was estimated as CV=0.45 from recruit indices obtained in trawl surveys.

7.10.7.2.3. Results

Estimation of Y and SSB per recruit are shown in Fig 7.10.7.2.3.1 (females) and 7.10.7.2.3.2 (males).

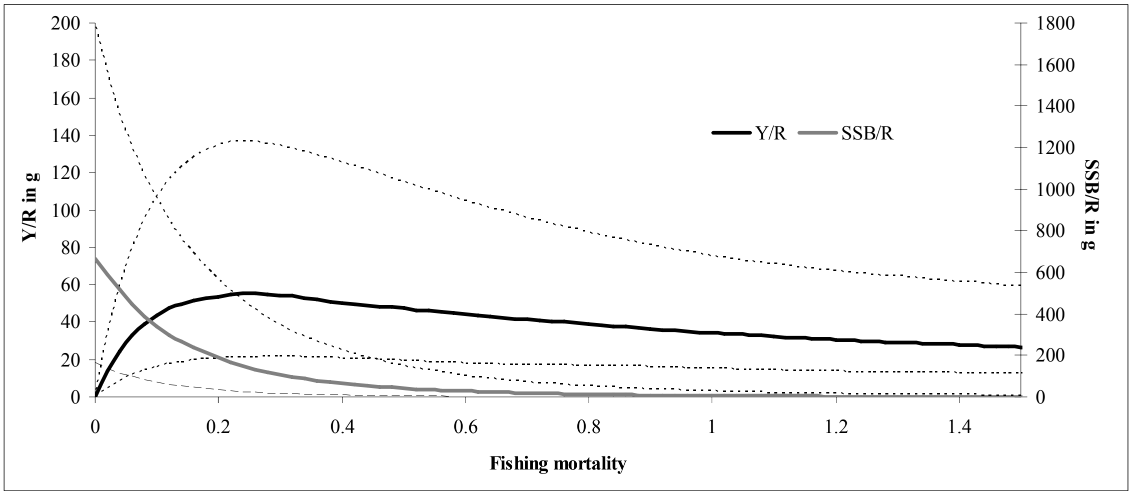


Fig. 7.10.7.2.3.1 Yield and spawning stock biomass per recruit and corresponding uncertainty of female hake in the GSA 15 and 16 according to the Yield Package.

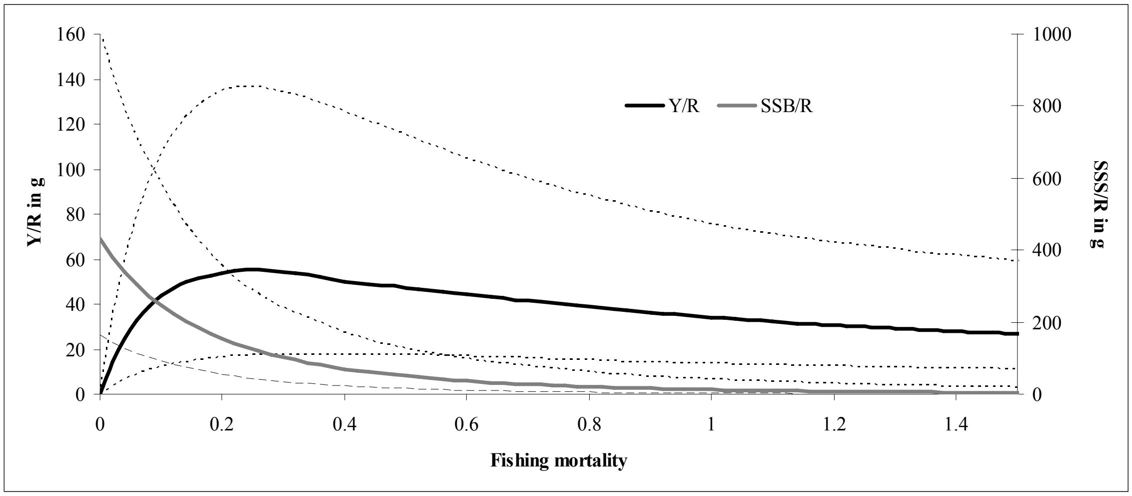


Fig. 7.10.7.2.3.2 Yield and spawning stock biomass per recruit and corresponding uncertainty of male hake in the GSA 15 and 16 according to the Yield Package.

Searching for biological reference points (BRP) through 1000 simulation produced the median values reported in table 7.10.7.2.3.1 Y/R_{max} and F_{max} should be considered as Limit Reference Points (LRP) whereas Y/R 0.1, F0.1, $Y/R_{SPR\_0.35}$ and $F_{SPR\_0.35}$ should be considered as Target reference points (TRP).

Tab. 7.10.7.2.3.1 Yield (g) per recruit and fishing mortality based BRP of hake by sex for GSA 15 and 16 according to the Yield package.

Yield based RP	**female**	**male**	**F based RP**	**female**	**male**
Y/R_{max}	59.6	39.8	F_{max}	0.244	0.315
$Y/R_{F0.1}$	57.4	37.4	$F_{0.1}$	0.157	0.194
$Y/R_{SPR\_0.35}$	59.5	37.8	$F_{SPR\_0.35}$	0.154	0.202

7.10.7.3. Method 3: Non equilibrium Surplus Production model

7.10.7.3.1. Justification

When commercial information is limited but long time series of Z and U proceeding from trawl surveys are available a variant of non-equilibrium surplus production model can be fitted (Abella, 2005).

The classical model requiring time series of index of abundance and effort is:

$$B_{t+1} = B_t + rB_t(1-(B_t / k)) - qfB_t$$

Since $qfBt =Y$, catch in weight (Yt) can be substituted by the classic Baranov catch equation:

$$Y=(F/Z)\ B(1-exp(-Z_t)$$

and the model can be written as:

$$B_{t+1} = B_t + rB_t(1-(B_t / k)) – (F/Z)\ B_t(1-exp(-Z_t)\ )$$

Z can be estimated by analysing the size structure of the surveys catches and F computed by subtraction if an estimate of M is available.

7.10.7.3.2. Input parameters

Data input is time series of biomass indices on slope (kg per km^2 as overall mean) and total mortality rates (SURBA estimates) derived from MEDITS trawl surveys in GSA 16 (1994-2007) (Tab.) . A scalar value of M=0.48 (mean of figures reported earlier) was used to estimate Z_{MBP} from F_{MBP}.

Tab. 7.10.7.3.2.1 Total mortality rates (Z) from Surba (ages 1-4) and biomass indices (BI as kg per km^2) by area and year used to estimated the surplus production model.

Area	**Year**	**Z**	**BI**	**Area**	**Year**	**Z**	**BI**
GSA 16	1994	1.21	23.35	GSA 16	2000	1.01	13.26
GSA 16	1995	1.73	19.02	GSA 16	2001	1.17	16.07
GSA 16	1996	1.26	10.57	GSA 16	2002	1.05	20.79
GSA 16	1997	1.16	12.85	GSA 16	2003	0.88	32.40
GSA 16	1994	1.21	9.55	GSA 16	2004	0.9	47.36
GSA 16	1998	1.29	16.34	GSA 16	2005	1.07	23.34
GSA 16	1999	1.02	13.42	GSA 16	2006	1.29	13.26

7.10.7.3.3. Results

Main model parameters are reported in Table 7.10.7.3.3.1.

Tab. 7.10.7.3.3.1 Main parameters of the surplus production model of hake in GSA 16.

Population growth rate (r)	0.790	F_{MBP} (r/2)	0.395
Maximum BI (k)	39.36	Z_{MBP} (F_{MBP}+M)	0.875

Observed and predicted values of biomass indices (kg per km^2) showed a good agreement (Fig. 7.10.7.3.3.1) and the distribution of the residuals is quite satisfying.

The surplus production model in terms of Biological production is shown in Fig. 7.10.7.3.3.2.

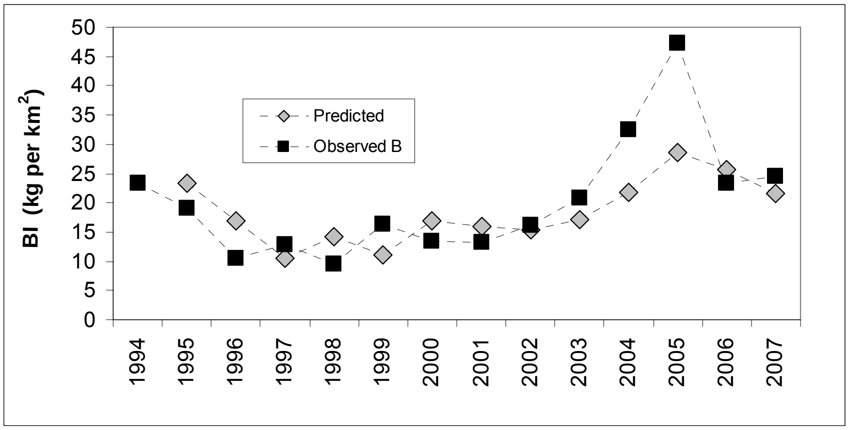


Fig. 7.10.7.3.3.1 Observed and predicted values of biomass indices (kg per km^2) according to the Surplus production model based on trawl surveys data (GSA 16).

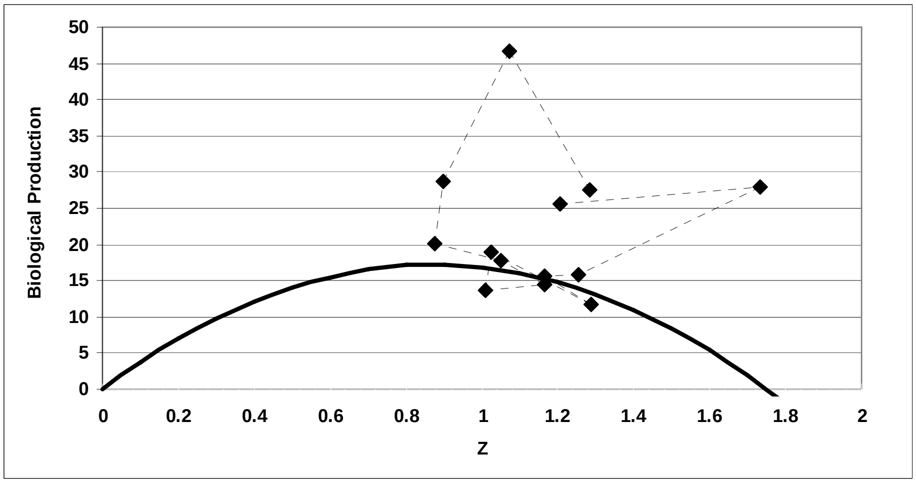


Fig. 7.10.7.3.3.2 Biological production (BP) vs. total mortality rates (Z) under the non-equilibrium state assumption of Hake in GSA 16.

The ratio of the mean Z of 2005 and 2006 obtained by SURBA (Z= 1.18) and the optimal one (Z_{MBP}= 0.875) suggested an overfishing state ($Z_{curr.}/Z_{opt.}$=1.34). If an estimation of current F is obtained as Z-M, with M=0.48, the ratio between current F (0.70) and the optimal one (F_{MBP}=0.395) suggested a reduction of fishing mortality of 44% to improve the status of the stock.

If there are precautionary or target levels proposed or agreed, quantify the actual status of the stock to it (use term overfished when F>Fmsy or its proxy range from F0.1 to Fmax). Considering more in detail the GSA 16, for which both commercial and trawl surveys data are available, all the stock assessments performed during the SGMED suggest quite similar diagnosis in terms of exploitation state in long term. Nevertheless some differences are evident on the level of overexploitation detected according to the used approaches. Considering the analytic assessments, the overfishing condition resulted more severe when uncertainty in long term production curves (Yield package) is considered and F values (Surba and B_H estimator) were estimated by trawl surveys data than in the case of those derived from commercial data and deterministic models. On the other hand overexploitation is more severe using Surplus production model out equilibrium hypothesis than with Surplus Production Composite approach.

7.10.8. Scientific advice

7.10.8.1. Short term considerations

7.10.8.1.1. State of the spawning stock size

Relative indices derived from scientific surveys indicate a recent decrease in the stock size in both GSAs since 2005. In 2007, the stock spawning stock size in weight (only GSA 16) amounted to 136% as compared to the long term average (1994-2006). However analytical assessments (Aladym Model) evaluated that the spawning stock is assessed to be very low (about 3-5% of the virgin one), implying negative effects on stock productivity.

7.10.8.1.2. State of recruitment

Medits results indicate the level of recent recruitment have increased compared to the rest of the time series.

7.10.8.1.3. State of exploitation

The average fishing mortality of hake in GSA over ages older than 4 could not be precisely assessed. Trends in the average fishing mortality over ages 1 to 4 derived from scientific surveys indicate a recent increase in the exploitation rate since 2003. No relevant differences in F between GSA15 and 16 are evident. The continued low abundance of adult fish in the surveyed population and catches indicate a very high exploitation pattern far in excess of any fishing mortality consistent with high yields and low risk of fisheries collapse.

Table 7.10.8.1.3.1 Synopsis of hake assessments carried out during the SGMED 03 and 04 in terms of current mortalities vs. mortality based Reference Points in the GSA 16. Limit Reference Points (F_{max}) and Target Reference Points (Z_{MBP}; F_{MBP}, $F_{0.1}$ and $F_{SPR=0,3}$) were considered.

Approach	**Data**	**Period**	**Current point**	**Reference point**	**Diagnosis**
VIT (steady state VPA)	Biological samplings of landings	2006-2007	F=0.70 (Females; Ages 1-4)	F_{max} =F*× 0.54=0.37 $F_{0.1}$ =F*×0.38=0.20	O; -47% O; -71%
Yield & Surba (YPR)	Trawl surveys	2005-2006	F=0.49 (females; Ages 1-3)	F_{max}= 0.24 $F_{0.1}$= 0.16 $F_{SPR=0.3}$= 0.15	O; -51% O; -68%
Yield & B_H estimator (YPR)	Trawl surveys	2005-2007	F=0.76 (Females with LC=18 cm TL)	F_{max}= 0.24 $F_{0.1}$= 0.16 $F_{SPR=0.3}$= 0.15	O; -65% O; -78%
Non–equilibrium Surplus production (Z from surba)	Trawl surveys	2005-2006	Z=1.18 (combined sex; ages 1-4)	Z_{mbp} = 0.87 F_{MBP} = 0.39	O O; -44%

7.10.8.2. Medium term considerations

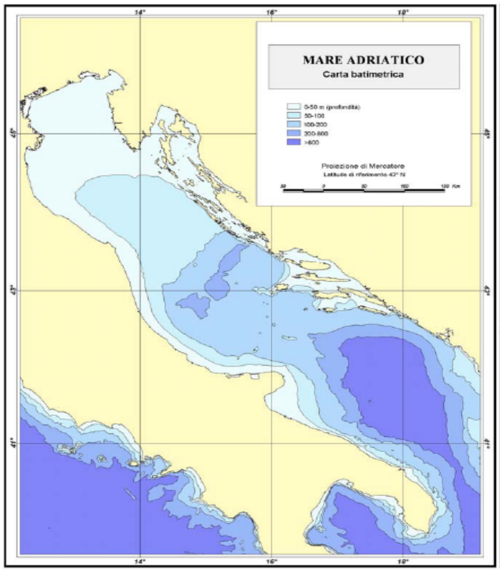
SGMED recommends to develop and implement a management plan to continuously reduce current F towards F_{01}-F_{max} through consistent effort reductions and catch estimations.

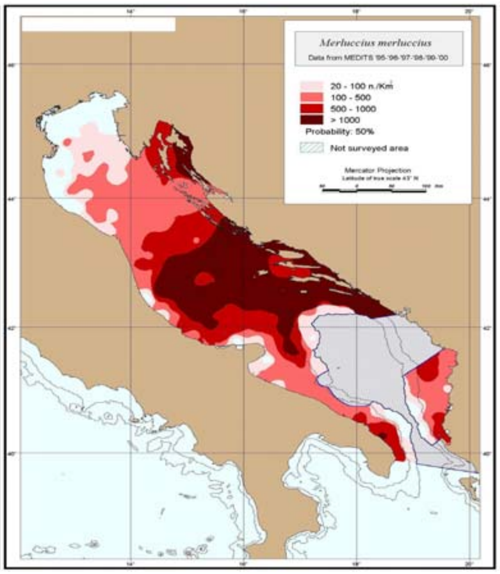
7.11. Stock assessment of hake in GSA 17

7.11.1. Stock identification and biological features

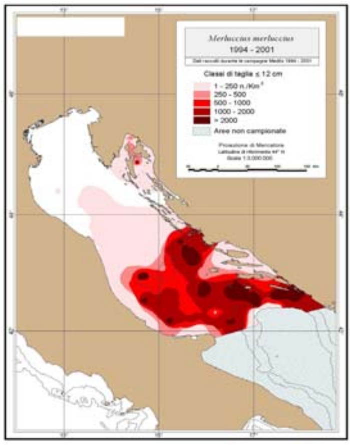
7.11.1.1. Stock Identification

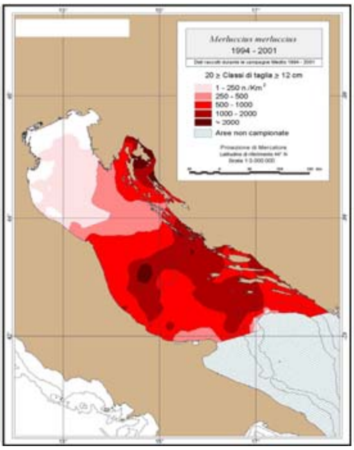
The distribution of hake (*Merluccius merluccius*) in GSA 17, in spring-summer, is shown in the maps below, imported from Sabatella and Piccinetti (2004). The picture on the left provides details on the depth, increasing with darker colour (0-50, 50-100, 100-200, 200-800, > 800 m). The picture on the right displays the hake densities at sea from MEDITS trawl survey in the second half of the 1990s, expressed as number of individuals per square kilometre. In the GSA 17, higher densities are observed in the southern part and at depths between 100 and 200 m.

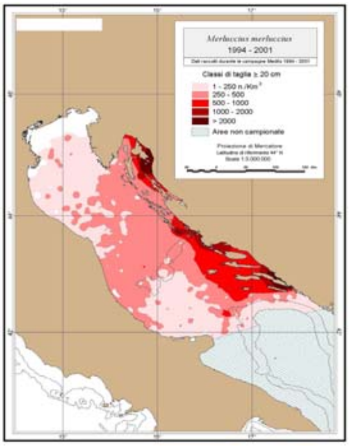




In the subsequent three maps, again imported from Sabatella and Piccinetti (2004), densities at sea are plotted taking into account different length ranges (increasing in the maps from left to right). In particular, individuals with length lower than 12 cm are concentrated in the southern part of the GSA 17. The individuals with length between 12 and 20 cm display the same pattern but are more diffuse; the same holds true for the individuals with length higher than 20 cm, but they are more abundant on the eastern side of Adriatic.







Spawning of hake occurs throughout the year with two peaks in winter and summer. Earliest spawning occurs in winter in deeper waters, up to 200 m, in the Pomo/Jabuka Pit (where the greatest depths in GSA 17 are observed). In the summer period, spawning occurs in shallower waters. Nursery areas are located close just to the Pomo/Jabuka Pit (Vrgoc *et al*., 2004).

7.11.1.2.Growth

No information was documented during SGMED-08-04.

7.11.1.3.Maturity

A reasonable value of length at the first sexual maturity for hake, in the GSA 17, is between 23 and 33 cm for females and between 20 and 28 cm for males, as reported by Zupanovic and Jardas (1986) (mentioned in Vrgoc *et al.*, 2004).

The summary of the values of length at the first sexual maturity estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004), as follows.

Author	Sex	L_m (cm)
Zei, 1949	M	22-30
Županović, 1968;	M	20-28
	F	26-33
Županović and Jardas, 1986	M	20-28
	F	23-33
Ungaro *et al*., 1993	M+F	25-30
Cetinić *et al*., 1999	M+F (Velebit Channel)	24

On the basis of the maturity at length (and age) data collected through DCR in the year 2007, the proportion of females with mature stages (macroscopically measured) higher than 2 was equal to 0 in the length classes of 17 and 19 cm and fluctuated around 0.50 in the higher classes. The proportion of males was equal to 0.11 in the length class of 19 cm and fluctuated around 0.50 in the higher classes. These values seem to be consistent with those form Zupanovic and Jardas (1986) mentioned above.

In conclusion, a meaningful percentage of caught hake has a length below the values of sexual maturity. This is a further reason for caution in managing this stock.

7.11.2. Fisheries

7.11.2.1.General description of fisheries

The fisheries for hake are one of the most important in the GSA 17. Fishing grounds mostly correspond to the distribution of the stock (SEC (2002) 1374).

7.11.2.2.Management regulations applicable in 2007 and 2008

According to Regulation (EC) 1967/2006 the minimum legal length for fishery is, for hake, equal to 20 cm.

7.11.2.3.Catches

7.11.2.3.1. Landings

On the basis of data collected for Italy through DCR from 2002 to 2007 (see the table below), landings are due, mainly, to bottom otter trawlers, which account for over 90% of the total. Longline catches are not observed in this data set (Tab. 7.11.2.3.1.1). The data are listed in Table A3.1 of Appendix 3.

Tab. 7.11.2.3.1.1. Total and bottom otter trawl hake landings in GSA 17, 2002-2007.

Year	Total fleet landings (t)	Bottom otter trawler catch (t)
2002	2637	2339
2003	2606	2387
2004	3045	2884
2005	3609	3403
2006	4395	4212
2007	3764	3586

Moreover, according to the FAO statistics (ftp://ftp.fao.org/fi/stat/windows/fishplus/gfcm.zip), in the northern and central Adriatic Sea, the annual landings of hake (see the figure below) in the 1980s and 1990s were estimated at around 2,000-4,000 t, with some peaks over 5,000 tonnes. A decreasing trend occurred from 1993 to 2000.

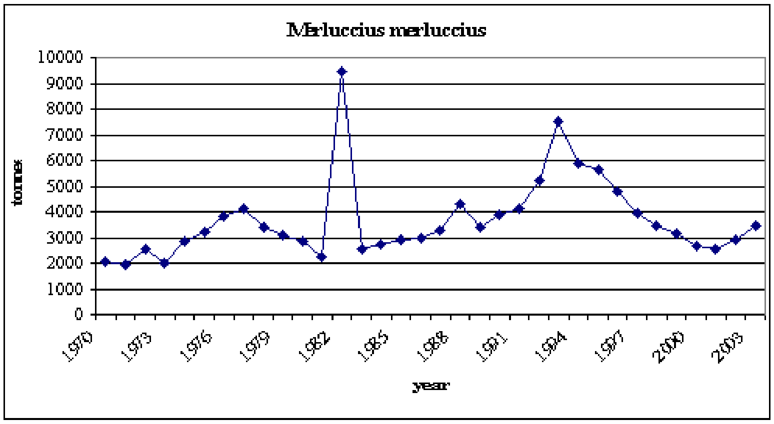


Fig. 7.11.2.3.1.1 FAO landing statistics 1970-2003.

7.11.2.3.2. Discards

Discards reported to SGMED-08-04 amount to 70 t in 2006, estimated for demersal otter trawls only. Discards as obtained through the DCR data call are listed in Table A3.6 of Appendix 3.

7.11.2.3.3. Fishing effort

Table 7.11.2.3.3.1 reveals an overall decreasing trend in effort of the major bottom otter trawl fleet.

Tab. 7.11.2.3.3.1. Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSA 17, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	17	ITA	DRB	58297	69126	64120	54047	59099	70261
DAYS	17	ITA	DTS	124529	125106	134776	126013	114903	102270
DAYS	17	ITA	HOK			641	595	610	487
DAYS	17	ITA	PGP	335599	272040	287886	260459	233846	217661
DAYS	17	ITA	PMP	96386	98110	15512	12743		
DAYS	17	ITA	PTS	23522	25649	23387	22453	23104	22981
DAYS	17	ITA	TBB			12395	13166	12440	10901
GT*DAYS	17	ITA	DRB			858864	697091	792375	959807
GT*DAYS	17	ITA	DTS			5624744	5429766	4656664	4283788
GT*DAYS	17	ITA	HOK			9492	10510	10983	9150
GT*DAYS	17	ITA	PGP			518165	429665	444329	427962
GT*DAYS	17	ITA	PMP			73495	66778		
GT*DAYS	17	ITA	PTS			1516671	1472075	1557168	1646419
GT*DAYS	17	ITA	TBB			673656	701874	812298	747714
KW*DAYS	17	ITA	DRB	6381241	7517860	6982982	5884599	6421392	7575921
KW*DAYS	17	ITA	DTS	27568094	27486393	26771813	25026709	22118619	20619962
KW*DAYS	17	ITA	HOK			153794	148821	150195	121827
KW*DAYS	17	ITA	PGP	9297244	7646003	9120053	8011107	8568762	8638666
KW*DAYS	17	ITA	PMP	7989134	7039902	1072033	1032751		
KW*DAYS	17	ITA	PTS	7841347	7636049	6955633	6778783	6978292	7156333
KW*DAYS	17	ITA	TBB			3419642	3622199	3943318	3463256

7.11.3. Scientific surveys

7.11.3.1.Medits

7.11.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 17 the following number of hauls were reported per depth stratum (s. Tab. 7.11.3.1.1.1).

Tab. 7.11.3.1.1.1. Number of hauls per year and depth stratum in GSA 17, 2002-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA17_010-050									59	45	47	63	49	
GSA17_050-100									54	37	37	62	38	
GSA17_100-200									50	26	22	43	21	
GSA17_200-500									9	7	5	7	5	
GSA17_500-800									1	1				

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.11.3.1.2. Geographical distribution patterns

See section 7.11.1.1.

7.11.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 17 was derived from the international survey Medits. Figure 7.11.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 17.

The analyses of Medits indices are considered preliminary.

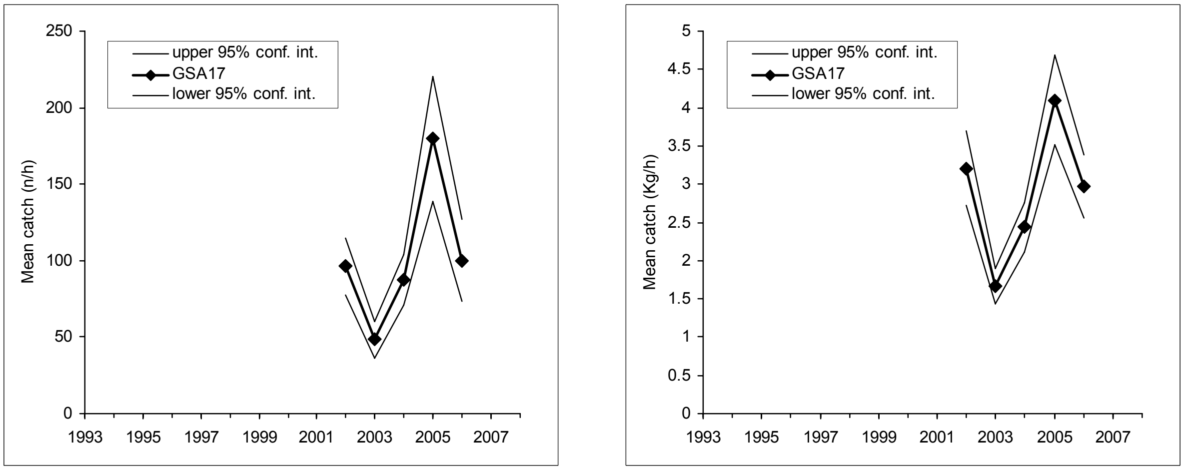


Fig. 7.11.3.1.3.1 Abundance and biomass indices of hake in GSA 17.

7.11.3.1.4. Trends in abundance by length or age

The following Fig. 7.11.3.1.4.1 displays the stratified abundance indices of GSA 17 in 2002-2006. These size compositions are considered preliminary.

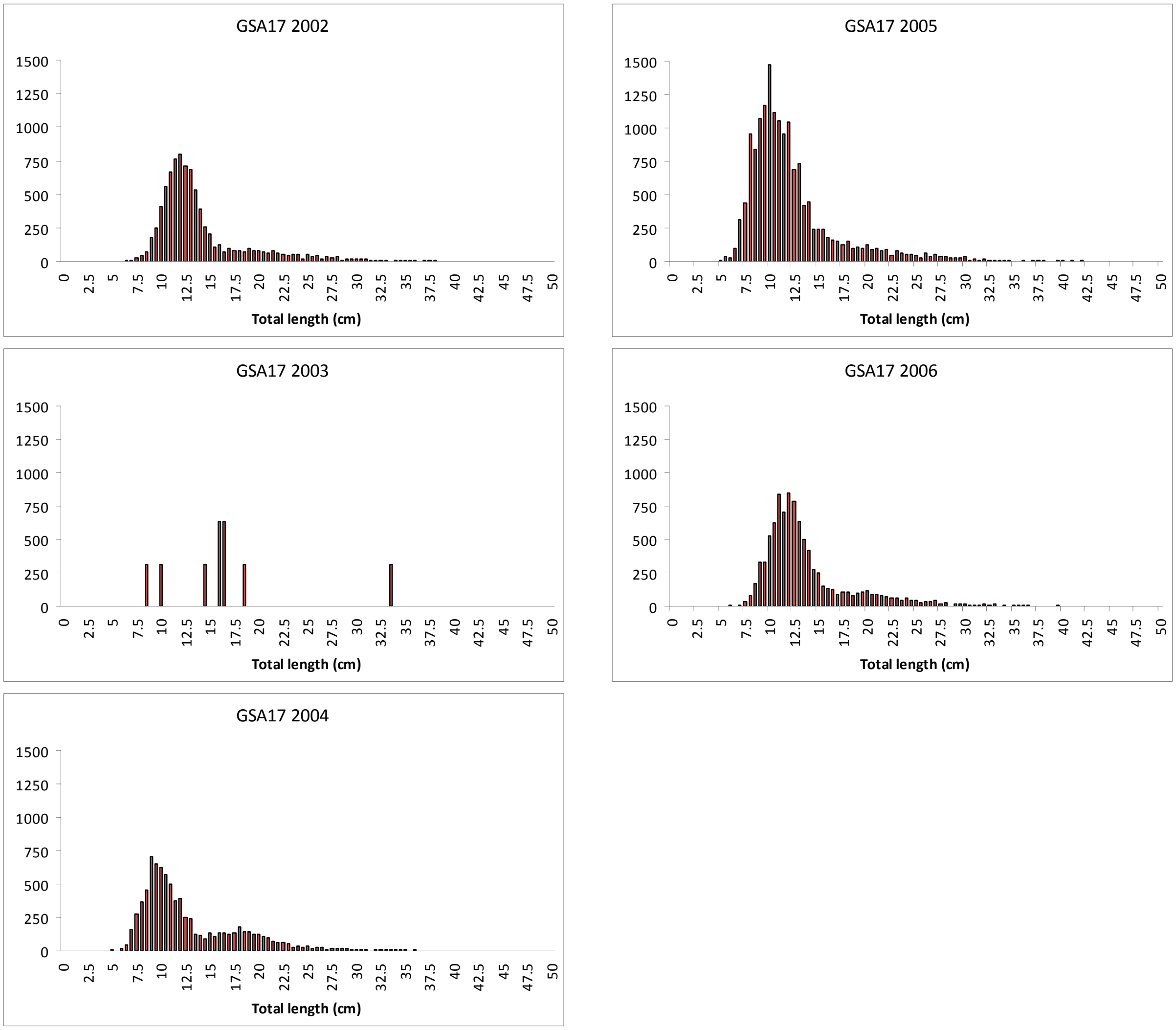


Fig. 7.11.3.1.4.1 Stratified abundance indices by size, 2002-2006.

7.11.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.11.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.11.4. Assessment of historic stock parameters

7.11.4.1. Method 1: LCA

7.11.4.1.1. Justification

Stock assessment was carried out by means of population dynamics methods, using data obtained through the DCR call. Due to the short time series of available data, Length Cohort Analysis (LCA) was selected.

The software packages used were VIT and VITM (Lleonart and Salat, 1997). The latter allowed the use of a different natural mortality rate, M, as a function of length.

7.11.4.1.2. Input parameters

The catch data used represented the Italian mean calculated for the years 2006 and 2007, 4,395 and 3,764 tonnes, respectively, as in the table above (column for the total fleet). The mean for the 2006-2007 period was 4,080 tonnes, thus slightly higher than the mean for the whole period 2002-2007, i.e. 3,343 tonnes.

The length frequency distributions obtained for Italy through DCR in 2006 and 2007 were used. They were relative to bottom otter trawlers and was thus assumed that these distributions were also representative for the other gears. As noted above, these other gears accounted for a small fraction of the total catch.

A longer times series (i.e. five - six years) of length frequency data would have been better for the stock assessment method being used.

The total number of caught individuals was distributed in the length classes 9, 11, 13,…, 39+ cm.

Females and males were used as combined.

The catch (landing in the figure below, on the left) was corrected to take into account discards at sea, using an estimate obtained through DCR for the year 2006. The amount of discards was relative to small sized fish and equal to 99 tonnes per year. Thus, the amount of catch used to obtain the number of caught individuals at length for LCA (s. Fig. 7.11.4.1.2.1) increased from 4,080 to 4,179 t.

This estimate of discards should be treated with caution. For example, in some estimates (Coll *et al*., 2007) based on information from a previous investigation (Wieczorek *et al*., 1999), the ratio between amounts of discarded and landed were higher than in the present evaluation, i.e. 0.02 (= 99 /4,080 tonnes) (it becomes higher when calculated for numbers of individuals). Data available from a previous EU report suggested the estimates from the DCR for hake could be taken like a minimum estimate and used to correct landings at length for LCA. Estimates of 48 and 22 t for the third and fourth quarter, respectively, on the basis of the same trip numbers.

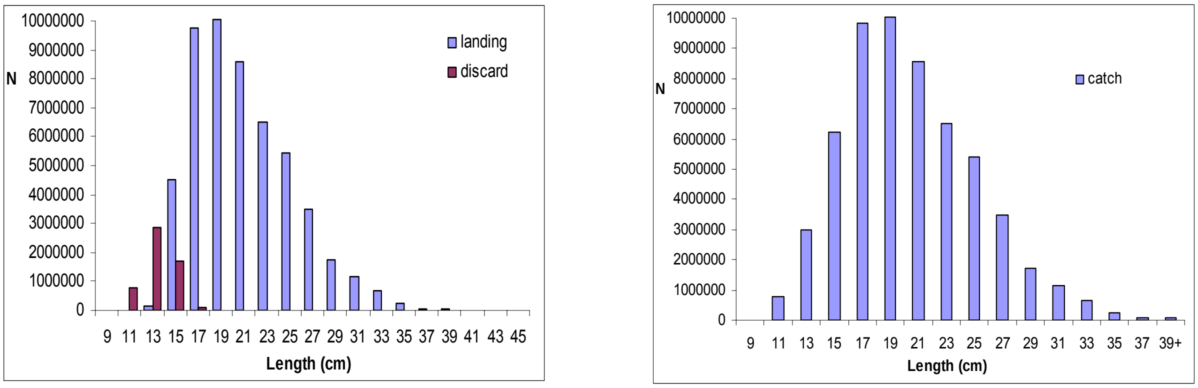


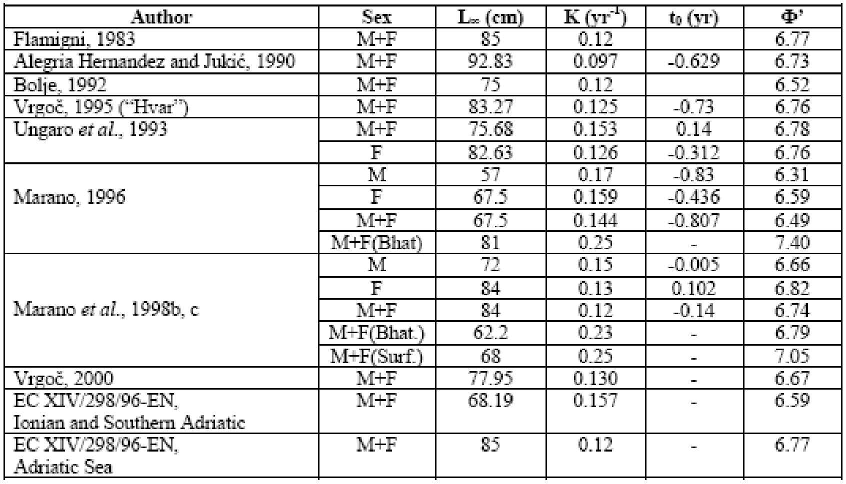
Fig. 7.11.4.1.2.1 Average size composition of hake catches in 2006 and 2007.

In order to calculate some parameters, the sex ratio Females/Total = 0.54 was used. It was calculated using the values of F/T at length obtained through DCR in the year 2007, which were weighted on the corresponding numbers of caught individuals at length. It is worth noting that the value of F/T obtained from the SAMED project (SAMED, 2002) for the GSA 17 was equal to 0.50.

The von Bertalanffy growth parameters used were: Linf = 78.5 (cm), k = 0.14 (year^{-1}), t_0 = 0.05 (year). These values were calculated as weighted means of the values for females and males, by using the mentioned sex ratio. The original values for females (Linf = 84.0, k = 0.13, t_0 = 0.102) and males (Linf = 72.0, k = 0.15, t_0 = -0.005) were estimated for the southern Adriatic Sea by Marano *et al.* (1998b,c) (mentioned in Vrgoc al., 2004).

The summary of the von Bertalanffy parameter values estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004) (see Tab. 7.11.4.1.2.1.). Here, the index Phi' is also shown.

Tab. 7.11.4.1.2.1. Summary of v. Bertalanffy parameters.



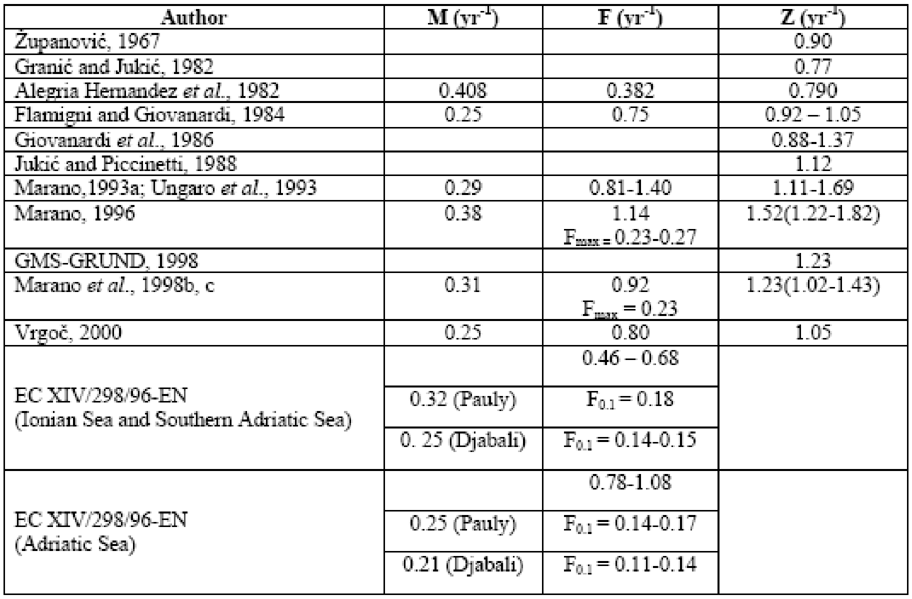
Author	Sex	L_∞ (cm)	K (yr^{-1})	t_0 (yr)	Φ'
Flamigni, 1983	M+F	85	0.12		6.77
Alegria Hernandez and Jukić, 1990	M+F	92.83	0.097	-0.629	6.73
Bolje, 1992	M+F	75	0.12		6.52
Vrgoč, 1995 ("Hvar")	M+F	83.27	0.125	-0.73	6.76
Ungaro *et al.*, 1993	M+F	75.68	0.153	0.14	6.78
	F	82.63	0.126	-0.312	6.76
Marano, 1996	M	57	0.17	-0.83	6.31
	F	67.5	0.159	-0.436	6.59
	M+F	67.5	0.144	-0.807	6.49
	M+F(Bhat)	81	0.25	-	7.40
Marano *et al.*, 1998b, c	M	72	0.15	-0.005	6.66
	F	84	0.13	0.102	6.82
	M+F	84	0.12	-0.14	6.74
	M+F(Bhat.)	62.2	0.23	-	6.79
	M+F(Surf.)	68	0.25	-	7.05
Vrgoč, 2000	M+F	77.95	0.130	-	6.67
EC XIV/298/96-EN, Ionian and Southern Adriatic	M+F	68.19	0.157	-	6.59
EC XIV/298/96-EN, Adriatic Sea	M+F	85	0.12	-	6.77

Most values of k - a parameter with relatively high influence on LCA results - are between 0.12 and 0.16, thus slightly below or above 0.14, which is the value employed in the present assessment.

The annual mortality rate M = 0.36 (year^{-1}) was used. This value was calculated as a weighted mean of the values for females and males, using the mentioned sex ratio. The original values of M for females (M = 0.34) and males (M = 0.38) were obtained from the SAMED project (SAMED, 2002) for the GSA 17. The corresponding Z was 1.73 (year^{-1}) and, thus, F (= Z – M) was 1.37 (year^{-1}).

The summary of the M values estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004), see Tab. 7.11.4.1.2.2.

Tab. 7.11.4.1.2.2. Summary of mortality parameters estimated.



Author	M (yr^{-1})	F (yr^{-1})	Z (yr^{-1})
Županović, 1967			0.90
Granić and Jukić, 1982			0.77
Alegria Hernandez *et al.*, 1982	0.408	0.382	0.790
Flamigni and Giovanardi, 1984	0.25	0.75	0.92 – 1.05
Giovanardi *et al.*, 1986			0.88-1.37
Jukić and Piccinetti, 1988			1.12
Marano,1993a; Ungaro *et al.*, 1993	0.29	0.81-1.40	1.11-1.69
Marano, 1996	0.38	1.14 F_{max} = 0.23-0.27	1.52(1.22-1.82)
GMS-GRUND, 1998			1.23
Marano *et al.*, 1998b, c	0.31	0.92 F_{max} = 0.23	1.23(1.02-1.43)
Vrgoč, 2000	0.25	0.80	1.05
EC XIV/298/96-EN (Ionian Sea and Southern Adriatic Sea)		0.46 – 0.68	
	0.32 (Pauly)	$F_{0.1}$ = 0.18	
	0. 25 (Djabali)	$F_{0.1}$ = 0.14-0.15	
EC XIV/298/96-EN (Adriatic Sea)		0.78-1.08	
	0.25 (Pauly)	$F_{0.1}$ = 0.14-0.17	
	0.21 (Djabali)	$F_{0.1}$ = 0.11-0.14	

It is worth noting that M = 0.36 is higher than the value M = 0.21 obtained using the relationship suggested by Jensen (1996, 2001), i.e. M = 1.5 k (with k = 0.14). Moreover, in the table from Vrgoc et al. (2004), most values are lower than 0.36. Thus, the most conservative M (i.e. lower M implies lower estimated biomass), among the possible values shown here, was not used in the present stock assessment.

A run of LCA was also carried out using a vector of M at length values. On the basis of the values derived from the SAMED project (SAMED, 2002) for the GSA 17 (estimated by means of the method of Chen and Watanabe), M was assumed to be equal to 0.62 for the length classes from 9 to 21 cm and equal to 0.35 for all the classes from 23 cm onwards.

Different values of the fishing mortality rate, F, for the last length class, 39+, were evaluated.

7.11.4.1.3. Results

The mean biomass at sea estimated by LCA was equal to 4,092 tonnes, when the scalar M = 0.36 was used. This estimate slightly increased when the M at length vector was used, i.e. 4,460 tonnes. Thus, the level of mean biomass calculated was similar to the catch value used for the analysis (i.e. year 2006-2007).

On the basis of the run with the scalar M value, the unweighted mean of F (calculated taking all the length classes) was equal to 1.22. When the mean F was weighted on the estimated mean numbers of fish at sea, the obtained value was 0.50.

The corresponding values of F/Z were 0.77 and 0.58, with unweighted and weighted F, respectively.

The values of both F and F/Z estimated for each length class are shown in the figure below, on the left. High values of F (around 1.0 and also higher than 1.5) are observed for some length classes. In Fig. 7.11.4.1.3.1 on the right, both F and F/Z are displayed as a function of age (transformation from length into age class was based on the same von Bertalanffy parameters used for LCA).

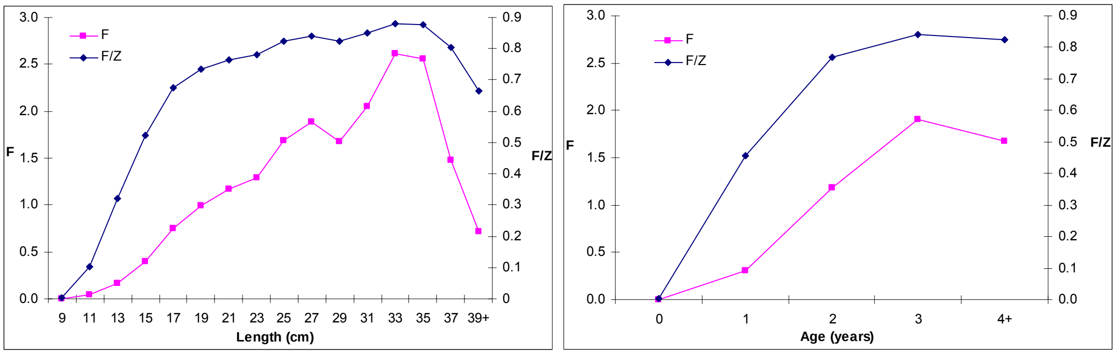


Fig. 7.11.4.1.3.1 Selection patterns (mean F and ration F/Z over length and age).

7.11.5. Short term prediction for 2008 and 2009

7.11.5.1. Justification

No forecast analyses were conducted.

7.11.5.2. Input parameters

No forecast analyses were conducted.

7.11.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 17.

7.11.6. Medium term prediction

7.11.6.1. Justification

No forecast analyses were conducted.

7.11.6.2. Input parameters

No forecast analyses were conducted.

7.11.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 17.

7.11.7. Long term prediction

7.11.7.1. Justification

No forecast analyses were conducted.

7.11.7.2. Input parameters

No forecast analyses were conducted.

7.11.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 17.

7.11.8. Scientific advice

7.11.8.1. Short term considerations

7.11.8.1.1. State of the spawning stock size

The average stock biomass estimated by LCA in 2006-2007 was around 4,000 tonnes. Without any biomass reference proposed or agreed, SGMED-08-04 is unable to fully evalute the state of the stock size.

7.11.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.11.8.1.3. State of exploitation

The recent average F not weighted on abundance was 1.22 while the weighted average F was 0.50. Given the values of F and F/Z (the latter one higher than 0.50), the stock of hake can be considered to be at least fully exploited. According to Mertz and Myers (1998), F/Z = 0.80 represents the maximum value which a demersal stock may endure, and the highest estimated value of F/Z (that based on unweighted F) was just slightly lower than 0.80. According to Rochet and Trenkel (2003), it would be safe to avoid F/Z higher than 0.50: the estimated value of F/Z based on weighted F was slightly lower than 0.60. Thus, a risk of overexploitation is real for hake in the GSA 17. Finally, a meaningful percentage of caught hake has a length below the values of sexual maturity: this is a further reason for caution in managing this stock. Without any biomass reference proposed or agreed, SGMED-08-04 is unable to fully evaluate the state of the exploitation.

7.11.8.2. Medium term considerations

A risk of overexploitation is real for hake in the GSA 17. A significant percentage of caught hake has a length below the values of sexual maturity: this is a further reason for caution in managing this stock.

7.12. Stock assessment of hake in GSA 18

7.12.1. Stock identification and biological features

7.12.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.12.1.2. Growth

No information was documented during SGMED-08-04.

7.12.1.3. Maturity

No information was documented during SGMED-08-04.

7.12.2. Fisheries

7.12.2.1. General description of fisheries

STECF (stock review part II in 2007) noted that *Merluccius merluccius* is one of the most important species in the Geographical Sub Area 18 representing more than 20% of landings from trawlers. Trawling represents the most important fishery activity in the southern Adriatic Sea and a yearly catch of around 30,000 tonnes could be estimated for the last decades. Demersal species catches are landed on the western side (Italian coast) and the eastern side (Albanian coast), with an approximate percentage of 97% and 3%, respectively. Trawling is the most important fishery activity on the whole area (about n° 900 boats, 60% of total number of fishing vessels; 85% of gross tonnage). The Mediterranean hake is also caught by off-shore bottom long-lines, but these gears are utilised by a low number of boats (less than 5% of the whole South-western Adriatic fleet).

7.12.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.12.2.3. Catches

7.12.2.3.1. Landings

SGMED-08-04 received the following information about hake landings in GSA 18 through the official DCR data call (Tab. 7.12.2.3.1.1). The landings increased from 2,300 t in 2002 to 5,500 t in 2006 and decreased to 4,200 t in 2007. The landings are listed in Tab. A3.1 of Appendix 3. Landings by demersal trawlers dominate by far.

Tab. 7.12.2.3.1.1 Hake landings in GSA 18 by fishing technique, 2002-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	18	ITA	DTS	2006	2899	2798	3275	4613	3497
HKE	18	ITA	HOK			140	439	721	607
HKE	18	ITA	PGP	26	199	175	70	172	51
HKE	18	ITA	PMP	277	1353	84			
HKE	18	ITA	PTS			7			
SUM				2309	4451	3204	3784	5506	4155

7.12.2.3.2. Discards

No information was documented during SGMED-08-04.

7.12.2.3.3. Fishing effort

Tab. 7.12.2.3.3.1 lists the fishing effort reported to SGMED-08-04 through the DCR data call. The overview is given in Tab. A3.7-A3.9 of Appendix 3 to this report. The dominant demersal otter trawl fleet decreased in effort since 2002.

Tab. 7.12.2.3.3.1 Fishing effort in different units by fishing technique deployed in GSA 18, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	18	ITA	DRB	11081	5890	3865	5776	7562	8132
DAYS	18	ITA	DTS	85424	71203	80259	84207	88418	73637
DAYS	18	ITA	HOK			1799	3053	4397	3190
DAYS	18	ITA	PGP	110621	63332	67232	80648	88583	68253
DAYS	18	ITA	PMP	53475	35980	3667			
DAYS	18	ITA	PTS	4140	4526	4679	4428	5291	6186
GT*DAYS	18	ITA	DRB			41347	62244	81590	87740
GT*DAYS	18	ITA	DTS			2568868	2592741	2632767	2275442
GT*DAYS	18	ITA	HOK			27800	58254	79940	58026
GT*DAYS	18	ITA	PGP			120701	146182	147150	115612
GT*DAYS	18	ITA	PMP			40920			
GT*DAYS	18	ITA	PTS			369876	360279	446754	516692
KW*DAYS	18	ITA	DRB	1100225	584801	381968	570792	746921	807073
KW*DAYS	18	ITA	DTS	17112022	14530793	14369490	14621928	14929696	12904532
KW*DAYS	18	ITA	HOK			284535	514377	778355	567996
KW*DAYS	18	ITA	PGP	1722336	1002933	1180371	1442219	1394671	1311109
KW*DAYS	18	ITA	PMP	7277279	4416994	351689			
KW*DAYS	18	ITA	PTS	1480945	1464793	1842716	1785787	2221605	2613654

7.12.3. Scientific surveys

7.12.3.1.Medits

7.12.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 18 the following number of hauls were reported per depth stratum (s. Tab. 7.12.3.1.1.1).

Tab. 7.12.3.1.1.1. Number of hauls per year and depth stratum in GSA 18, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA18_010-050	14	15	15	14	14	14	14	15	11	11	10	9	10	9
GSA18_050-100	14	14	14	15	15	15	15	14	13	13	15	15	14	14
GSA18_100-200	24	23	23	23	23	23	23	23	26	23	24	25	25	22
GSA18_200-500	10	10	10	10	10	10	10	10	8	8	8	9	9	6
GSA18_500-800	10	10	10	10	10	10	10	10	7	7	8	7	7	7

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.12.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.12.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 18 was derived from the international survey Medits. Figure 7.12.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 08.

The estimated abundance and biomass indices do not reveal any significant trends since 1995 until 2003, increased to the highest values in 2005 and dropped sharply to the lowest level of the time series in 2007. The analyses of Medits indices are considered preliminary.

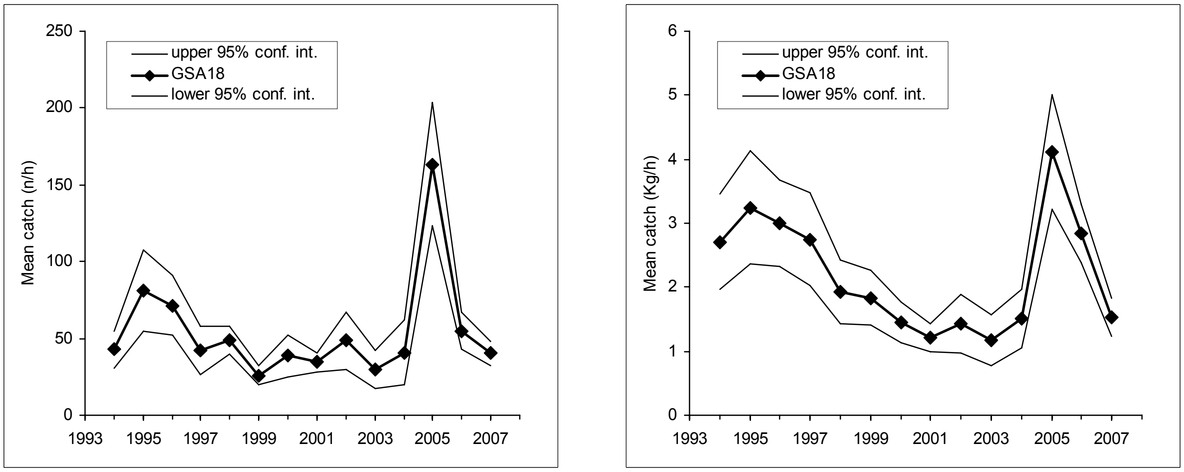


Fig. 7.12.3.1.3.1 Abundance and biomass indices of hake in GSA 18.

7.12.3.1.4. Trends in abundance by length or age

The following Fig. 7.12.3.1.4.1 and 2 display the stratified abundance indices of GSA 18 in 1995-2002 and 2003-2007. These size compositions are considered preliminary.

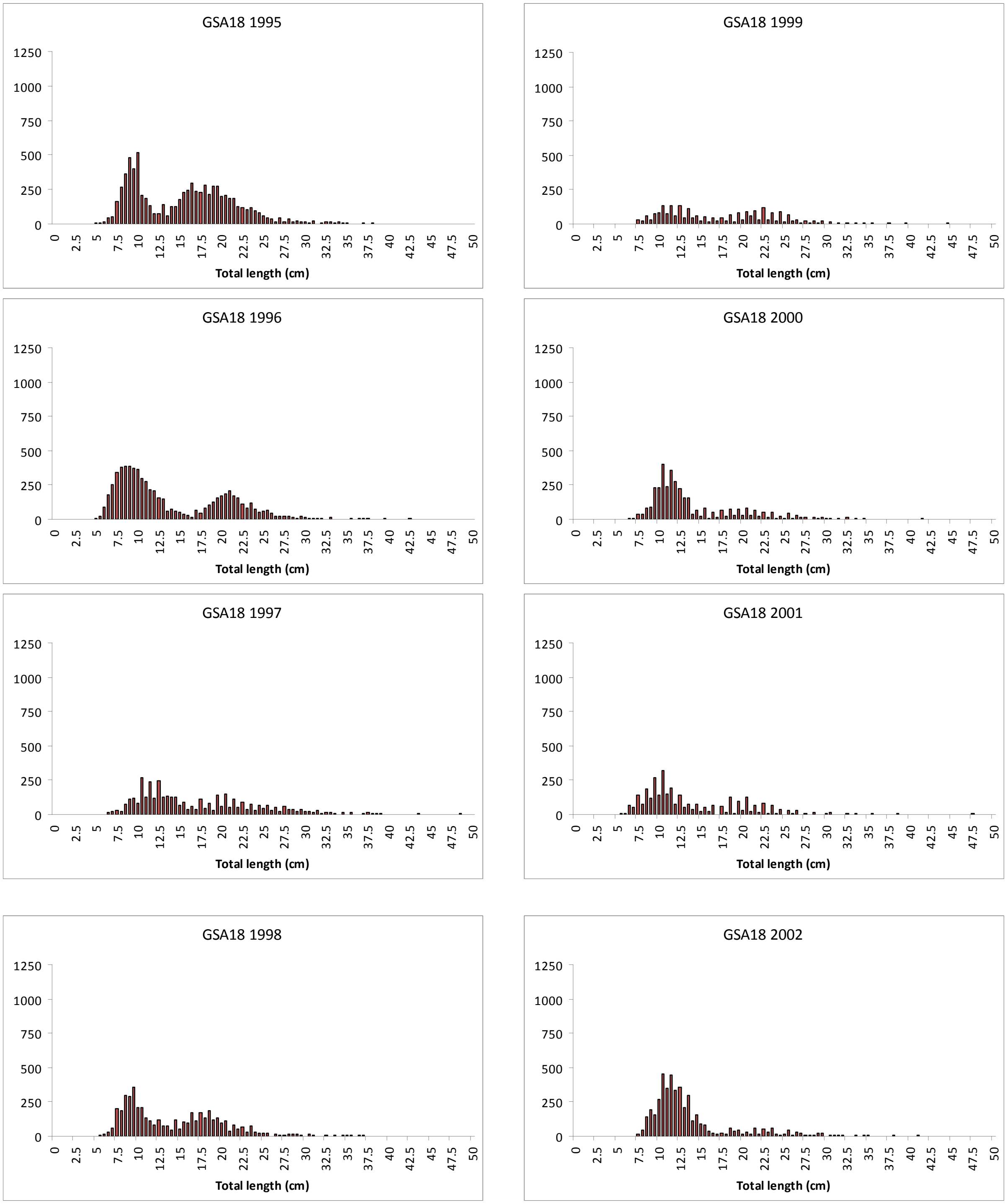


Fig. 7.12.3.1.4.1 Stratified abundance indices by size, 1995-2002.

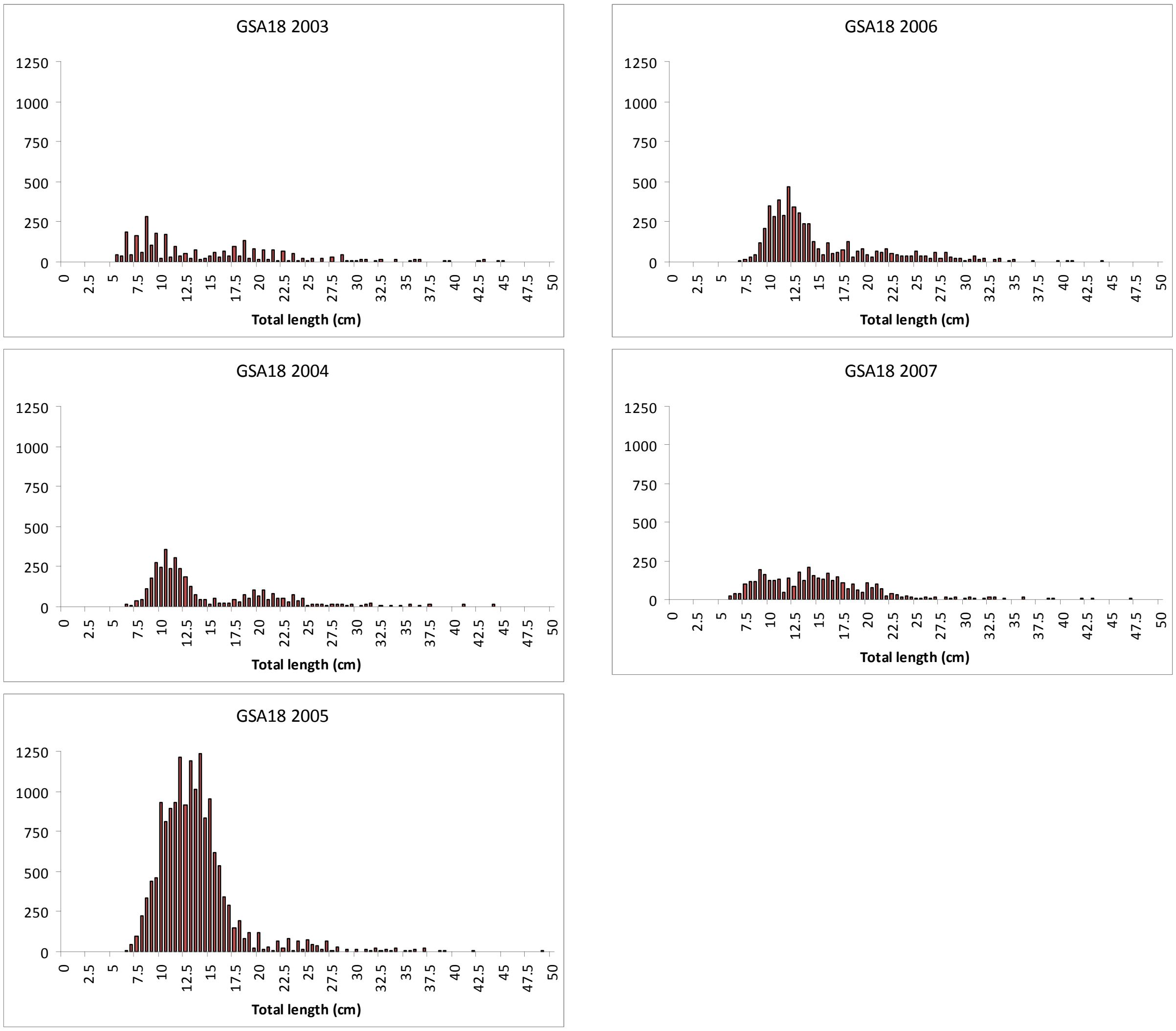


Fig. 7.12.3.1.4.2 Stratified abundance indices by size, 2003-2007.

7.12.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.12.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.12.4. Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment.

7.12.5. Short term prediction for 2008 and 2009

7.12.5.1. Justification

No forecast analyses were conducted.

7.12.5.2. Input parameters

No forecast analyses were conducted.

7.12.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 18.

7.12.6. Medium term prediction

7.12.6.1. Justification

No forecast analyses were conducted.

7.12.6.2. Input parameters

No forecast analyses were conducted.

7.12.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 18.

7.12.7. Long term prediction

7.12.7.1. Justification

No forecast analyses were conducted.

7.12.7.2. Input parameters

No forecast analyses were conducted.

7.12.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 18.

7.12.8. Scientific advice

7.12.8.1. Short term considerations

7.12.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.12.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.12.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.12.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.13. Stock assessment of hake in GSA 19

7.13.1. Stock identification and biological features

7.13.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.13.1.2. Growth

No information was documented during SGMED-08-04.

7.13.1.3. Maturity

No information was documented during SGMED-08-04.

7.13.2. Fisheries

7.13.2.1. General description of fisheries

STECF (stock review part II in 2007) noted that *Merluccius merluccius* is one of the most important species in the GSA 19, considering both the amount of catch and the commercial value. It is fished with different strategies and gears (bottom trawling and long-line). In the year 2004 the landings in the Ionian area were detected around 850 tonnes (IREPA data). The main fisheries operating in GSA 19 are Gallipoli, Taranto, Schiavonea and Crotone. The fishing pressure varies between fisheries and fishing grounds.

7.13.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.13.2.3. Catches

7.13.2.3.1. Landings

Since 2002 until 2006, landings as provided to SGMED-08-04 through the DCR data call varied among 1,300 and 1,600 t. In 2007, landings dropped significantly by about 50% to 883 t (Tab. 7.13.2.3.1.1). The data are listed in Tab. A3.1 of Appendix 3. Demersal otter trawls appear the major fishing gear.

Tab. 7.13.2.3.1.1 Hake landings in GSA 19 by fishing technique, 2002-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	19	ITA	DTS	688	668	852	1077	1330	572
HKE	19	ITA	HOK			139	72	81	54
HKE	19	ITA	PGP	263	367	145	122	218	257
HKE	19	ITA	PMP	390	478	163	1		
HKE	19	ITA	PTS	16	1				
SUM				1357	1514	1299	1272	1629	883

7.13.2.3.2. Discards

Discards reported to SGMED-08-04 amount to 10 t in 2006, estimated for demersal otter trawls only. Discards as obtained through the DCR data call are listed in Table A3.6 of Appendix 3.

7.13.2.3.3. Fishing effort

Tab. 7.13.2.3.3.1 lists the fishing effort reported to SGMED-08-04 through the DCR data call. The overview is given in Tab. A3.7-3.9 of Appendix 3 to this report. The dominant demersal otter trawl fleet increased in effort since 2002.

Tab. 7.13.2.3.3.1 Fishing effort in different units by fishing technique deployed in GSA 19, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	19	ITA	DTS	31381	31586	37234	42413	42976	40423
DAYS	19	ITA	HOK			39190	43898	25644	17695
DAYS	19	ITA	PGP	233718	254881	225109	193806	217447	168411
DAYS	19	ITA	PMP	100208	122225	20325	6905		
DAYS	19	ITA	PTS	3458	7302	6605	5554	5507	4441
GT*DAYS	19	ITA	DTS			782163	884513	835267	800971
GT*DAYS	19	ITA	HOK			1015534	1091913	850691	710177
GT*DAYS	19	ITA	PGP			473727	438792	555916	483882
GT*DAYS	19	ITA	PMP			111129	34967		
GT*DAYS	19	ITA	PTS			195882	238105	188866	114537
KW*DAYS	19	ITA	DTS	5125805	5002396	5802023	6562337	6460683	6063817
KW*DAYS	19	ITA	HOK			6809150	7299195	5575566	4053202
KW*DAYS	19	ITA	PGP	4669873	9192254	4881153	4698292	6141378	5333724
KW*DAYS	19	ITA	PMP	13116917	9143878	1188078	341008		
KW*DAYS	19	ITA	PTS	978457	1629677	1105203	1026897	1008813	691704

7.13.3. Scientific surveys

7.13.3.1.Medits

7.13.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 19 the following number of hauls were reported per depth stratum (s. Tab. 7.13.3.1.1.1).

Tab. 7.13.3.1.1.1. Number of hauls per year and depth stratum in GSA 19, 2002-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA19_010-050									9	9	9	9	9	8
GSA19_050-100									8	8	8	8	8	9
GSA19_100-200									10	10	10	10	10	10
GSA19_200-500									14	14	14	15	14	14
GSA19_500-800									29	29	29	28	29	29

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.13.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.13.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 19 was derived from the international survey Medits. Figure 7.13.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 19.

The short time series of estimated abundance and biomass indices does not reveal any significant trends since 2002. The analyses of Medits indices are considered preliminary.

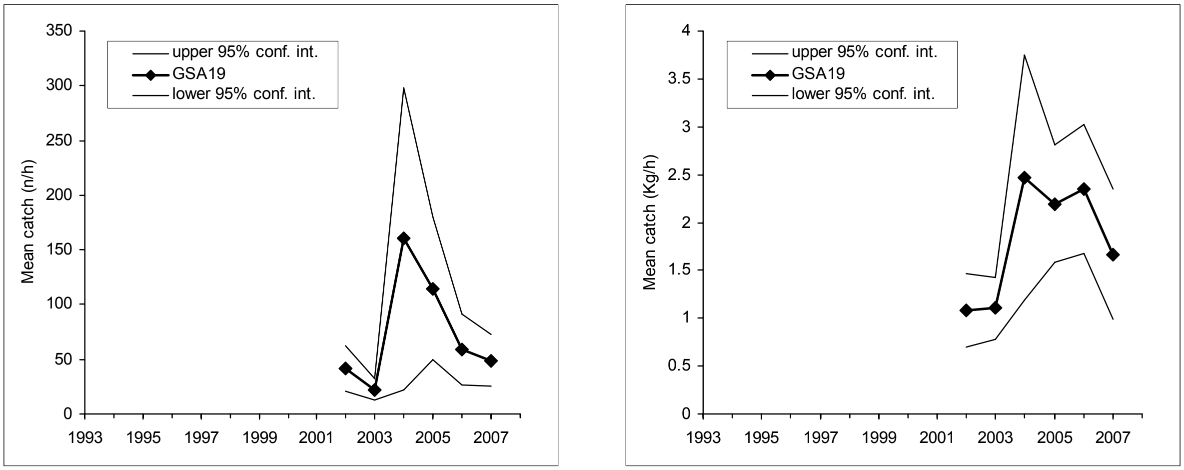


Fig. 7.13.3.1.3.1 Abundance and biomass indices of hake in GSA 19.

7.13.3.1.4. Trends in abundance by length or age

The following Fig. 7.13.3.1.4.1 displays the stratified abundance indices of GSA 19 in 2002-2007. These size compositions are considered preliminary.

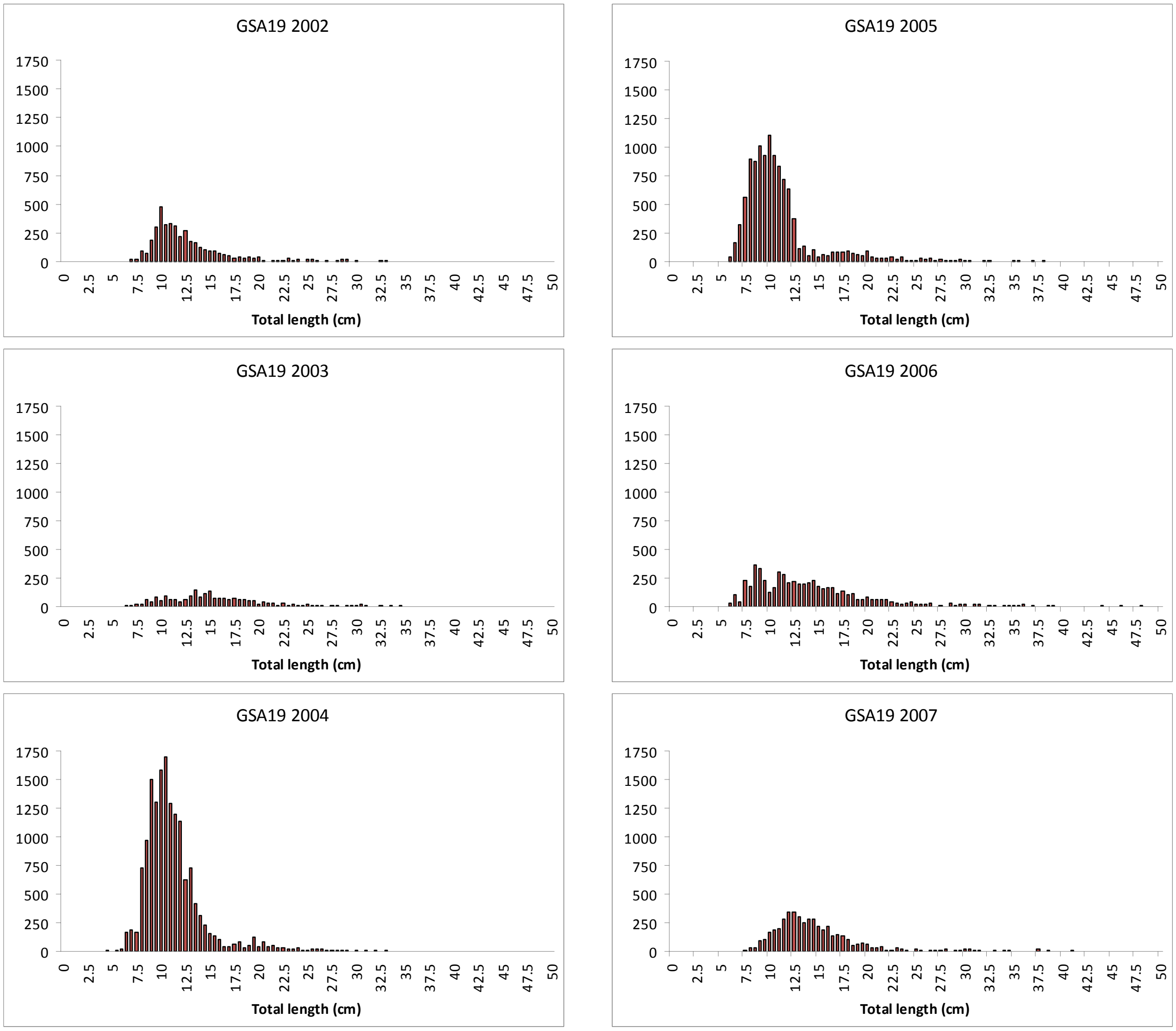


Fig. 7.13.3.1.4.1 Stratified abundance indices by size, 2002-2007.

7.13.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.13.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.13.4. Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment.

7.13.5. Short term prediction for 2008 and 2009

7.13.5.1. Justification

No forecast analyses were conducted.

7.13.5.2. Input parameters

No forecast analyses were conducted.

7.13.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 19.

7.13.6. Medium term prediction

7.13.6.1. Justification

No forecast analyses were conducted.

7.13.6.2. Input parameters

No forecast analyses were conducted.

7.13.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for hake in GSA 19.

7.13.7. Long term prediction

7.13.7.1. Justification

No forecast analyses were conducted.

7.13.7.2. Input parameters

No forecast analyses were conducted.

7.13.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 19.

7.13.8. Scientific advice

7.13.8.1. Short term considerations

7.13.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.13.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.13.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.13.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.14. Stock assessment of hake in GSA 20

7.14.1. Stock identification and biological features

7.14.1.1. Stock Identification

Hake is one of the most important fish stocks in GSA 20 for bottom trawlers, nets (mainly gill nets) and longlines. The stock is distributed in depth between 50-600 m, with a peak in abundance in depths between 200 and 300 m. The stock is exploited almost exclusively by the Greek fishing fleet. Spawning takes place all year around, with a peak during winter –spring.

7.14.1.2. Growth

Biological sampling was conducted in 4 fishing ports, which are the main landing ports of GSA 20. Landings from trawlers, nets and hooks were included in biological sampling. Sampling was conducted during different seasons, depending on the species life cycle, the size of local production and the temporal or spatial restrictions on the use of fishing gears.

The growth parameters for hake for each sex are given for GSA 20 in Figure 7.14.1.2.1. The age interpretation was done by otoliths reading. Sampling was conducted from 2003 to 2005.

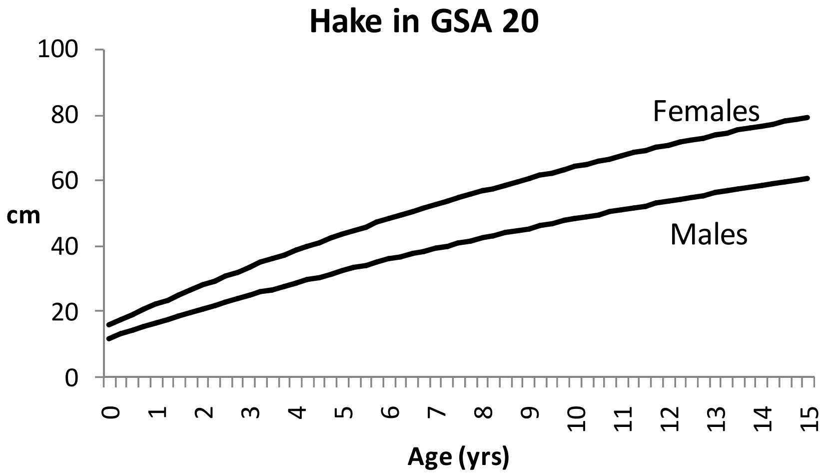


Fig. 7.14.1.2.1 Growth curves of male and female hake in GSA 20.

After studying the growth equations from each GSA, it was noticed that there is a big variability in growth parameters. The reason for this was more likely the uncertainty of hake age readings which has been documented by various researchers so far (Piñeiro and Saínza, 2002, 2003). Recent results from a tagging experiment in France have strongly suggested that those criteria may not be accurate and that they may lead to overestimation of ages (De Pontual et al., 2003). It was mentioned that a faster growth is expected for hake in the Mediterranean, as suggested by the tagging experiment conducted in France (Gulf of Lions), which validated hake age. Therefore the SGMED decided to perform hake assessments using the growth parameters according to the French tagging experiments. These parameters are given in the Tab. 7.14.1.2.1.

Tab. 7.14.1.2.1. Growth parameters of hake according to the French tagging experiments.

HAKE	**L_∞ (cm)**	**k**	**t_0**
Females	72.8	0.298	-0.383
Males	100.7	0.248	-0.35

7.14.1.3. Maturity

Biological sampling in order to define the maturity ogives and the reproduction cycle of the species was conducted as for sampling for growth parameters. Maturity was defined based on Nikolsky scale. All individuals with a maturity stage >3 were considered as mature (only reproductive months were taken into account). The percentage of mature individuals per length class was estimated. Data were provided only for females. However, it was pointed out that in other GSAs hake are considered mature at maturity stages >2 (on the Nikolsky scale). Thus, the estimated Lm_{50} was greater than that estimated in other GSAs that used the '>2' criterion. The estimated Lm_{50} might be an overestimation and the issue needs further consideration; standardisation among GSAs is needed.

The maturity curve was estimated by logistic regression (with non-linear least-squares) based on the official data provided. The estimated parameters of the curve are given in the Tab. 7.14.1.3.1 below.

Tab. 7.14.1.3.1 Parameters desribing the maturity at length.

	Estimations	**SE**	**95% LL**	**95% UL**
L_{50}	52.7	1.4	49.8	55.6
L_{75}-L_{25}	11.7	0.4	10.8	12.6

7.14.2. Fisheries

7.14.2.1. General description of fisheries

Hake mainly lives on muddy substrates in depths between 50-600 m. The main landing port in the area is the port of Patra. Other important landing ports are in Igoumenitsa, Kerkyra, Preveza, Killini and Kalamata.

The bottom trawl fishery in Greece is a mixed fishery, operating 24hr per day. Bottom trawl fishing targeting hake, is taking place mainly during the day in muddy bottoms in depths 80-400 m (approximately). The mesh size of the cod end of bottom trawls is 40 mm. Apart from hake, important target species are shrimps, anglerfish, blue whiting, megrims, picarel and red mullet.

The gill nets are setting in the morning and are hauling the next day in depth from 80-300 m. The mesh size used is about 48 to 64 mm. The fishery is carried out mainly during summer when bottom trawl fishery is closed. Long line fishery for hake is taking place in deeper waters down to 500 m mainly during summer. Fishing is taking place during the day. The size of the hook is No 6-8. Gillnet and especially longline fisheries have a relatively greater species and size selectivity. The main by catch species in the gill net fishery is horse mackerel.

Due to the selectivity of each gear the length composition differs significantly. The catch from bottom trawls consists mainly of small individuals (hake with lengths between 6-18 cm are ~75% of the catch by number). The catch of gill nets comprises mainly of specimens with lengths between 20 and 40 cm, while longliners catch relatively large fish.

There was a general declining trend in the number of vessels in recent years in all fleet segments. Capacity generally declined, except in trawlers that had a peak of capacity in 1997, which then declined to approximately the same levels as in 1991. The average length slightly increased in all fleet segments, except boat seiners. Average age substantially declined in all fleet segments except boat seiners where average age remained stable and was the highest among all fishing fleets.

There was a general declining trend in the number of vessels in recent years in all fleet segments. Capacity generally declined, except in trawlers that had a peak of capacity in 1997, which then declined to approximately the same levels as in 1991. The average length slightly increased in all fleet segments, except boat seiners. Average age substantially declined in all fleet segments except boat seiners where average age remained stable and was the highest among all fishing fleets.

7.14.2.2. Management regulations applicable in 2007 and 2008

RD 917/1966 is the principal law regulating the operation of trawlers. Although this law is still in effect, it has been superseded by EC Regulation 1626/1994, and its replacement Regulation 1967/2006. The main restrictions established by Greek and European legislation are:

(1) establishment of a total exclusion zone one and a half mile from the coastline of the mainland and the islands,
(2) a total fishing ban from the 1st of June till the end of September,
(3) establishment of a total exclusion zone which is: either a zone three miles from the coastal line or a zone shallower than 50 m,
(4) minimum cod-end mesh size is 40 mm (EC regulation 1967/2006); from 1 July 2008, the net shall be replaced by a square-meshed net of 40 mm at the cod-end or, at the duly justified request of the shipowner, by a diamond meshed net of 50 mm.

Additional restrictions exist for bottom trawling in specific areas: in Amvrakikos Gulf and some parts of the Korinthiakos Gulf and the Ionian Sea, trawling is prohibited all year around, while in Patraikos Gulf trawling is prohibited from the 1st of March till the end of November.

The operation of the bottom set nets is subject to the following main restrictions:
(1) the maximum total length of the trammel net is 6000 m.
(2) the minimum mesh size opening is 16 mm.
(3) monofilament or twine diameter of the net should not exceed 0.5 mm.
(4) the maximum drop of a combined trammel and gill net should not exceed 10 m and the length of combined nets should not exceed 2,500 m.

7.14.2.3. Catches

7.14.2.3.1. Landings

Estimation of landings was based on random sampling in 66 sampling stations (ports) in GSA 20. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type was randomly selected and landings by species recorded. Based on these data, average landings per fishing day, by species and for each fishing gear were estimated. Based on total effort estimations, sampled data were raised to the whole fleet to estimate total landings by species, fleet segment, fishing gear, and GSA.

The estimated landings of hake in GSA 20 are presented in Fig. 7.14.2.3.1.1 and Tab. 7.14.1.3.1. According to official data, the annual bottom trawl landings ranged from 310 to 750 t, the landings of the gill nets ranged from 1,370 to 3,200 t, whereas the landings of the long lines ranged from 70 to 300 t. The annual landings of the bottom trawl segment 12-24 m increased from 190 to 560 t.

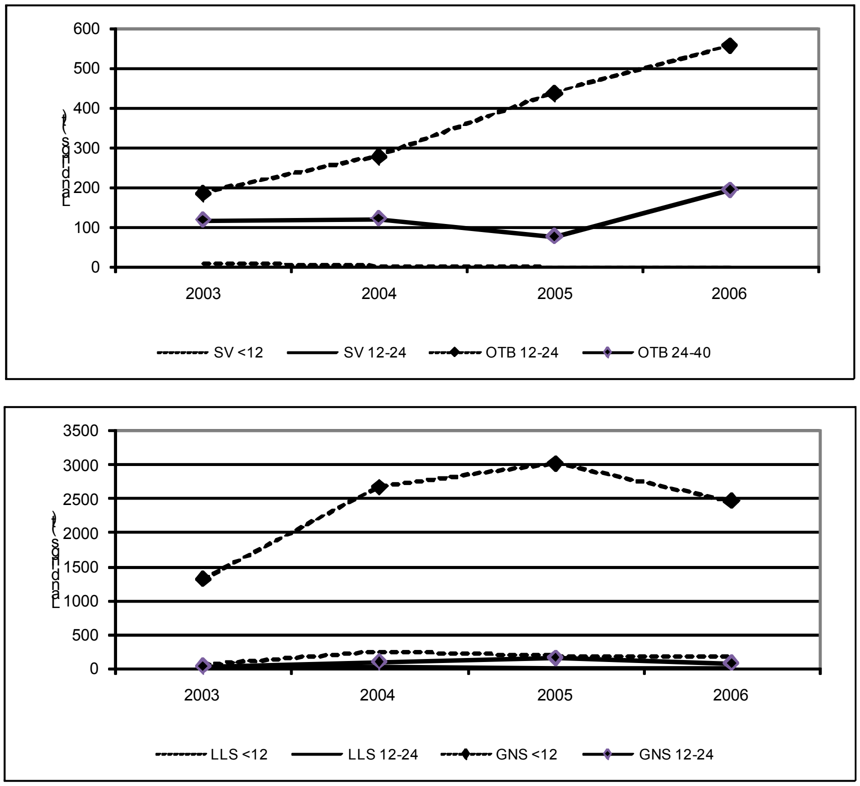


Fig. 7.14.2.3.1.1 Landings of hake in GSA 20 from 2003-2006.

Tab. 7.14.1.3.1Hake catches per gear and per year in GSA 20.

Year\Gear	SV	OTB	LLS	GNS	**Total**
2003	11	307	73	1370	**1761**
2004	3	403	295	2796	**3497**
2005	0	515	207	3195	**3917**
2006	0	753	199	2568	**3520**
Total	**14**	**1978**	**774**	**9929**	**12695**

Overall, for the period 2003-2006, 78% of the hake landings are attributed to gill nets, 15% to bottom trawls, and 6% to long lines.

The landings of hake and the fishing effort (kW*days at sea) of gill nets, long lines and bottom trawl are presented in Fig. 7.14.2.3.1.2. The high value of the fishing effort of the gill nets is expected because of the large number of vessels. From 2003 to 2005 the landings of nets were increased and the effort was decreased.

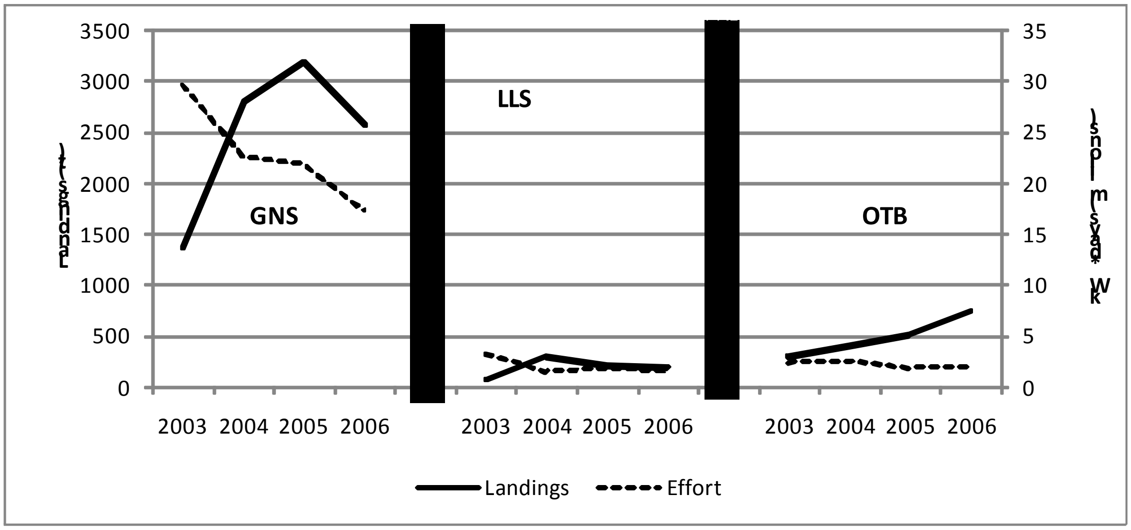


Fig. 7.14.2.3.1.2 Landings of hake and fishing effort per gear category in GSA 20.

The length frequency distribution of hake bottom trawl landings in GSA 20 is presented in Fig. 7.14.2.3.1.3 The modal length in 2004 was 15-19 cm in 2005 13 cm and in 2006 19 cm. The proportion of the undersized landed specimens (<20 cm, according to 1967/2006 Regulation) was 61%, 71%, and 37%, for the years 2004, 2005 and 2006, respectively whereas the proportion of specimens with lengths >29 cm was 5%, 4% and 6% for the years 2004, 2005 and 2006, respectively.

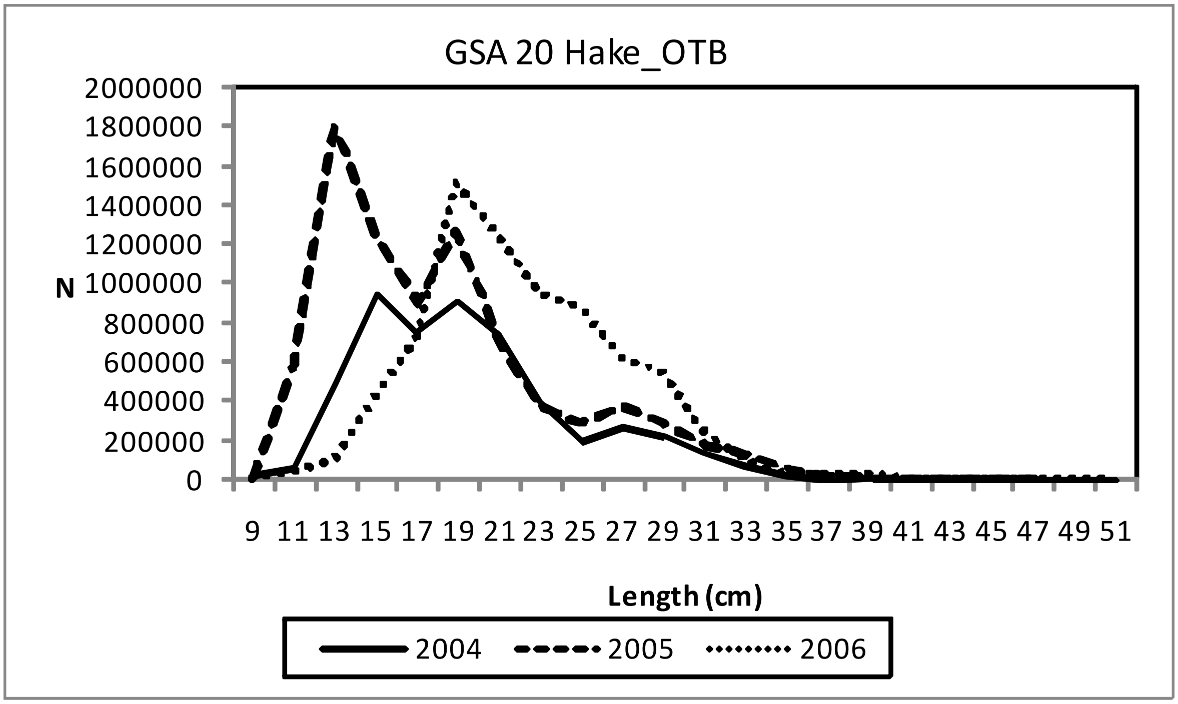


Fig. 7.14.2.3.1.3. Length distribution of hake bottom trawl landings in GSA 20 from 2004-2006.

Length data for long liners landings were provided for the years 2005 and 2006 and for netters for the years 2004 and 2005 (Fig 7.14.2.3.1.4. and 7.14.2.3.1.5) . The lengths of long line landings ranged from 23 cm to 69 cm. No undersized species were landed by long liners during these years whereas the proportion of the specimens larger than 29 cm was 97% and 95% in 2005 and 2006, respectively. The lengths of the nets landings ranged from 17 cm to 37 cm. A very small proportion of the landings was consisted of undersized specimens.

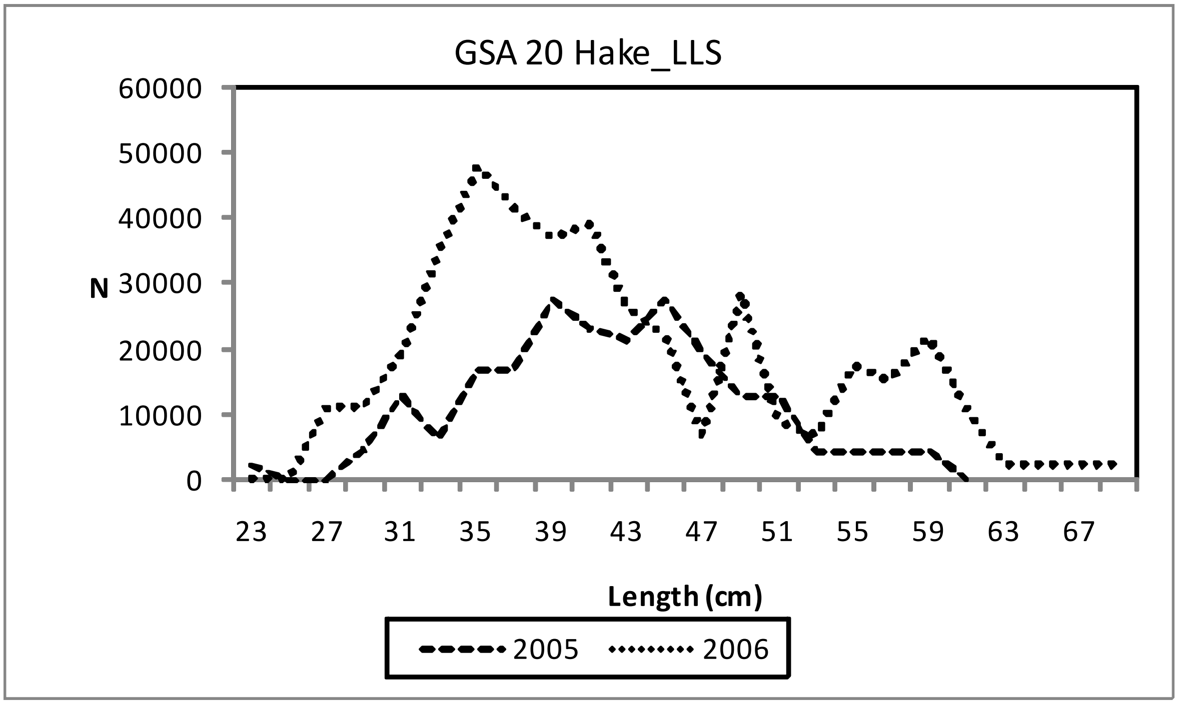


Fig. 7.14.2.3.1.4. Length distribution of hake long liners landings in GSA 20.

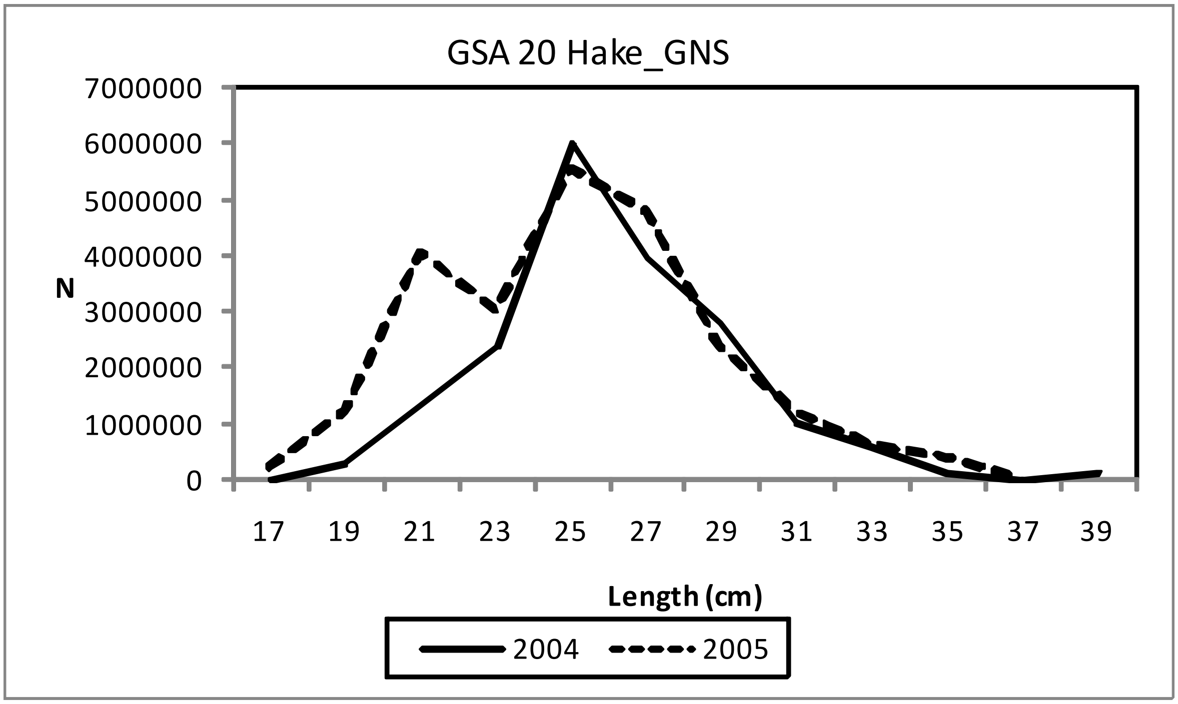


Fig. 7.14.2.3.1.5. Length distribution of hake netters landings in GSA 20.

The landings composition by length classes in weight of bottom trawl, long lines and gill nets are presented in Figs 7.14.2.3.1.6 i7.14.2.3.1.7 s7.14.2.3.1.8. The bottom trawl landings by weight were mainly consisted of specimens with lengths from 17 cm to 33 cm, the landings of the nets with lengths from 23 cm to 33 cm and the landings of the long lines with lengths from 33 cm to 60 cm.

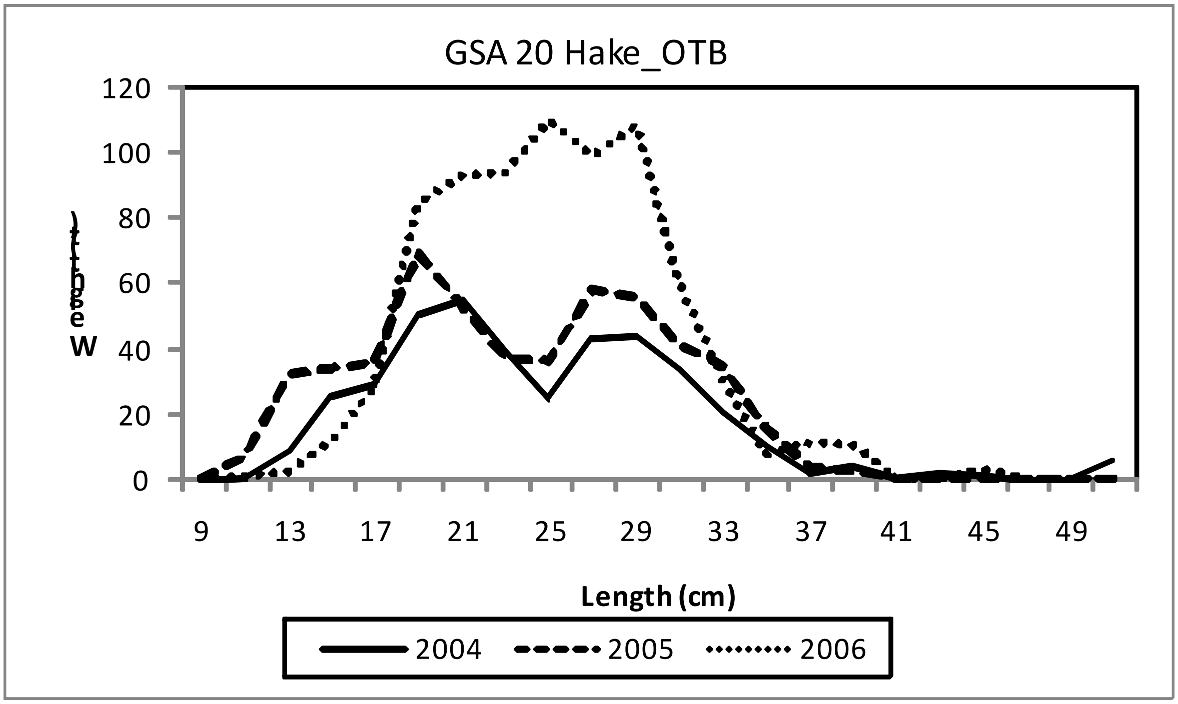


Fig. 7.14.2.3.1.6. Bottom trawl landings composition by length classes in weight.

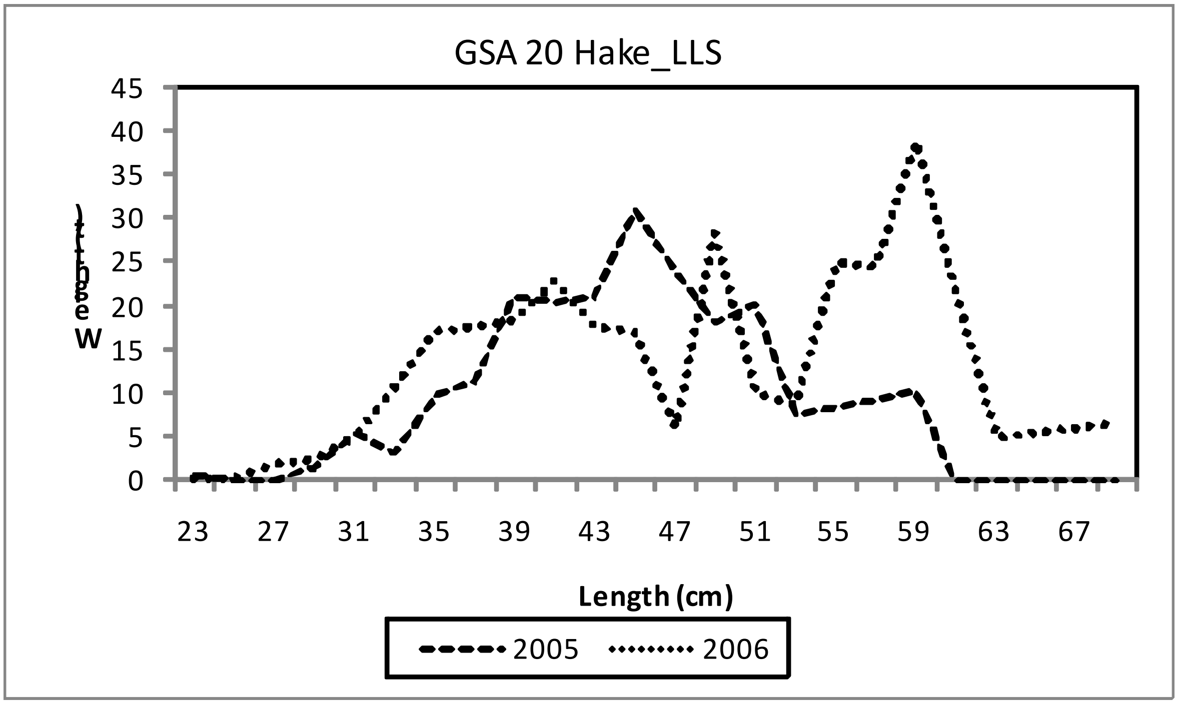


Fig. 7.14.2.3.1.7. Long line landings composition by length classes in weight.

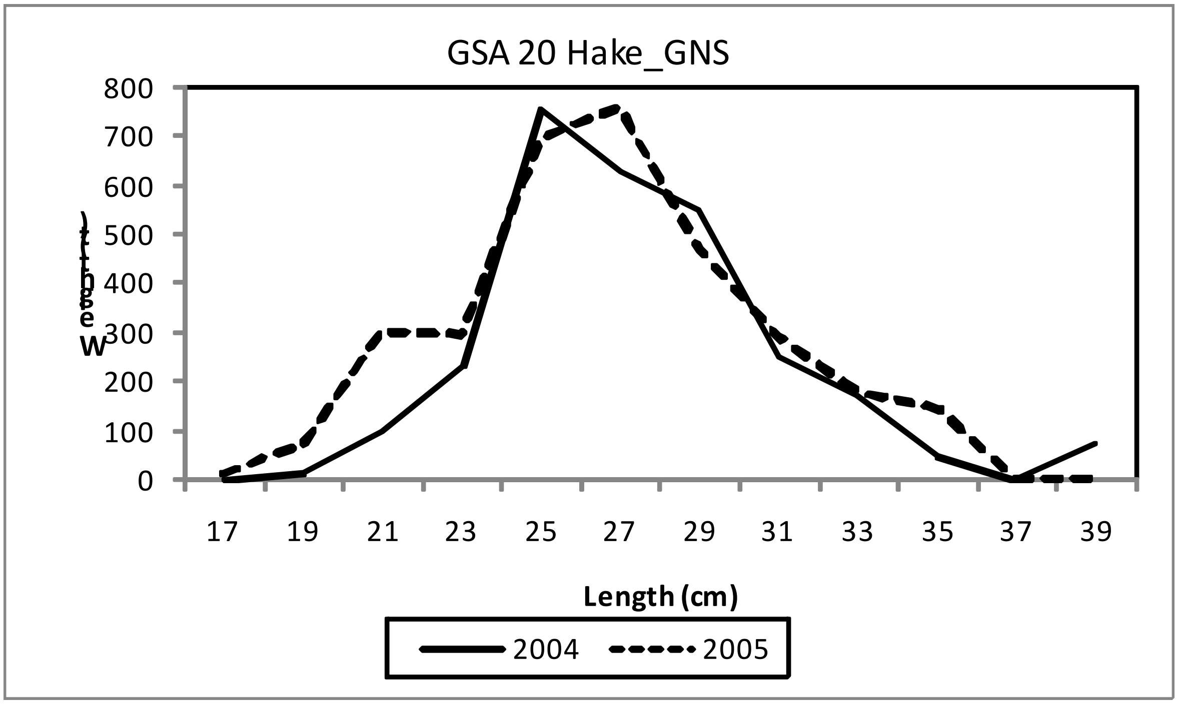


Fig. 7.14.2.3.1.8. Nets landings composition by length classes in weight.

In order to see the impact of each gear in each length class, the proportion of each gear in each length class by number and by weight was estimated for the year 2005 (Fig 7.14.2.3.1.9). The small fish are caught exclusively by bottom trawls whereas the large ones by long lines.

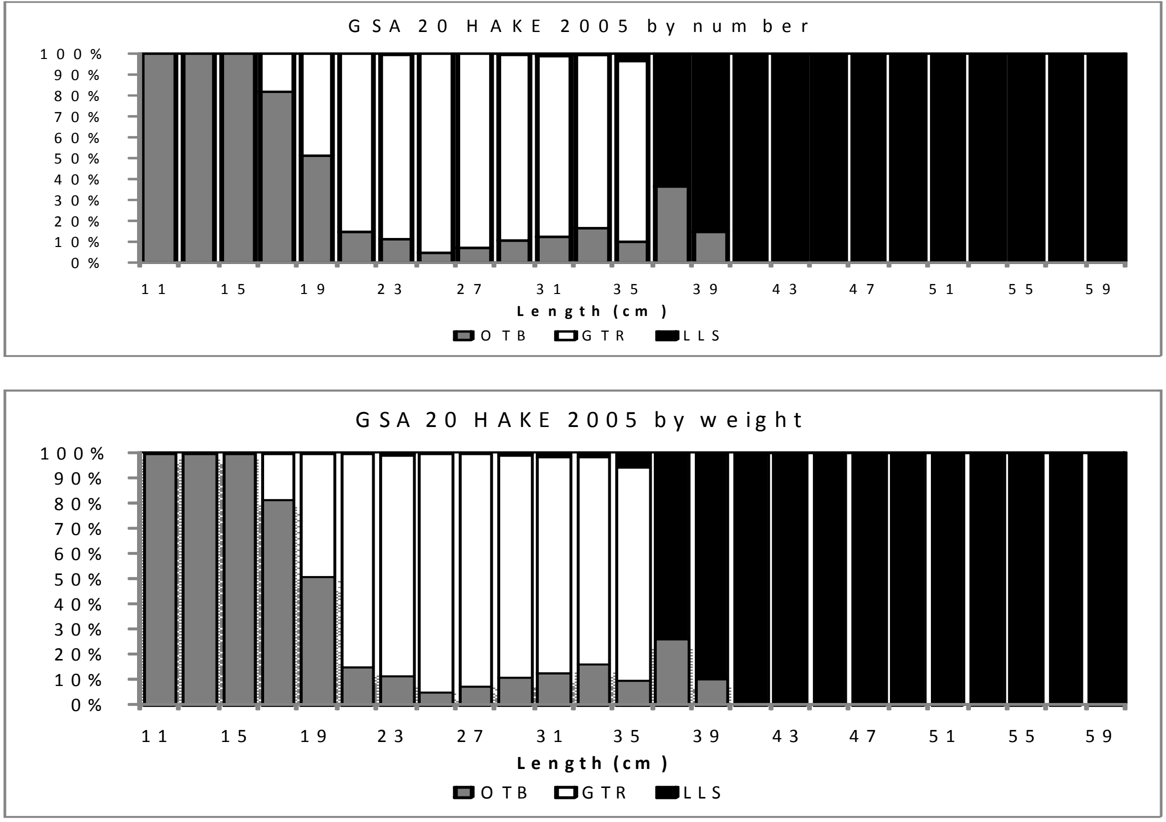


Fig. 7.14.2.3.1.9. Proportion of each gear landings per length class of hake in GSA 20 for 2005.

7.14.2.3.2. Discards

In Greece, the discards and landings of trawlers, purse-seiners, coastal vessels, and drifting longliners were estimated based on onboard sampling. Three times every year, sampling was conducted in GSA 20. Each time, catch, discards, and landings were recorded for each gear type and fleet segment. Based on this sampling, total discards were estimated by species, gear type, and GSA (Fig. 7.14.2.3.2.1).

Discards of hake in bottom trawl fishery in GSA 20 were < 30 t in all years for both fleet segments. The proportion of discards to catch ranged from 0.05 to 0.8. An extremely high value for hake discards from gill nets was reported in 2005 (679 t discards). This value can't be considered as a real one and is probably due to misreporting or typing errors in data entry. Discards reported to SGMED-08-03 through the DCR data call are listed in Table A3.6 of Appendix 3.

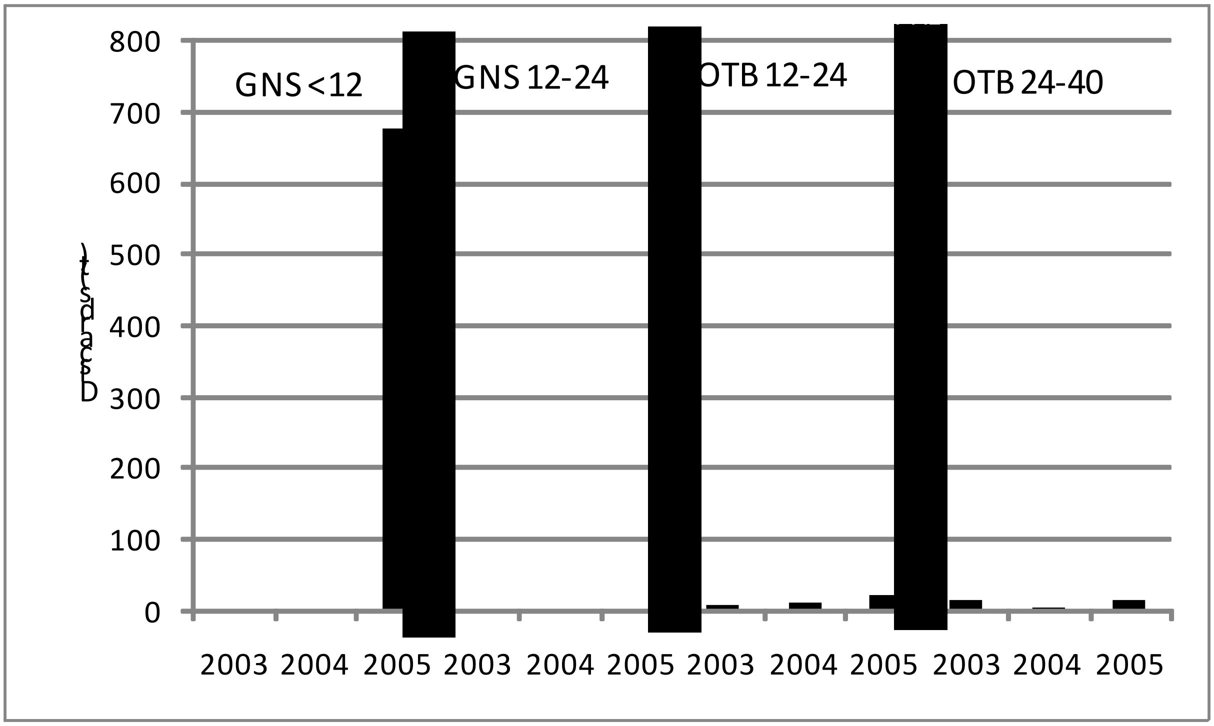


Fig. 7.14.2.3.2.1 Discards of hake in GSA 20 per fleet segment.

No length distribution of discards was available for Greece at the meeting.

7.14.2.3.3. Fishing effort

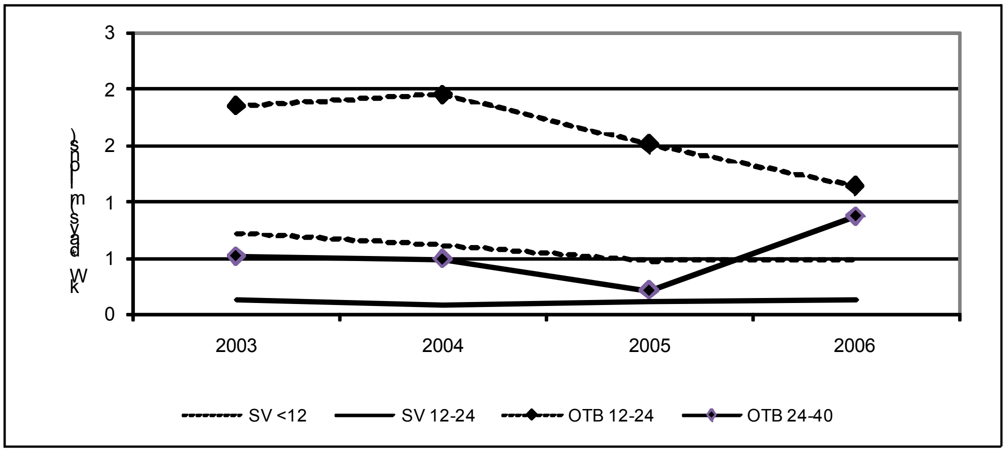
Estimation of effort was based on interviews conducted with random sampling in 30 sampling stations (ports) in GSA 20. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type were randomly selected and effort was recorded. In addition, all fishing vessels present in the sampling stations were categorized as full-time, part-time, occasionally fishing, or inactive and the proportion of the year when they were active was estimated. Based on this information, sampled data were raised to the whole fleet to estimate total effort per fleet segment, fishing gear, and GSA. Should be noted that the estimated effort do not refer to the effective effort targeting to hake but to the entire effort of each fleet segment. This is very important for the long lines and gill nets because the effort targeting hake is much smaller than the effort of the fleets.

The fishing effort of the gill nets <12 m and of the bottom trawls 12-24 m showed a significant reduction in GSA 20 from 2003 to 2006 (Fig. 7.14.2.3.3.1, Tab. 7.14.2.3.3.1).

Tab. 7.14.2.1.3.3.1 Trends in relative (to 2003) fishing effort (kW*days at sea) in GSA 20.

Year\Gear type	OTB 12-14m	OTB 24-40 m	GNS <12 m
2003	100	100	100
2004	105	95	75
2005	82	42	73
2006	62	168	58

The evaluation of the fishing effort of the main fishing gears in Ionian Sea is difficult to be interpreted. For example, the effort of the nets decreased by 42% in 2006 in relations with the effort in 2003. Such a reduction is unlikely to happen in the number of vessels or in the kW.



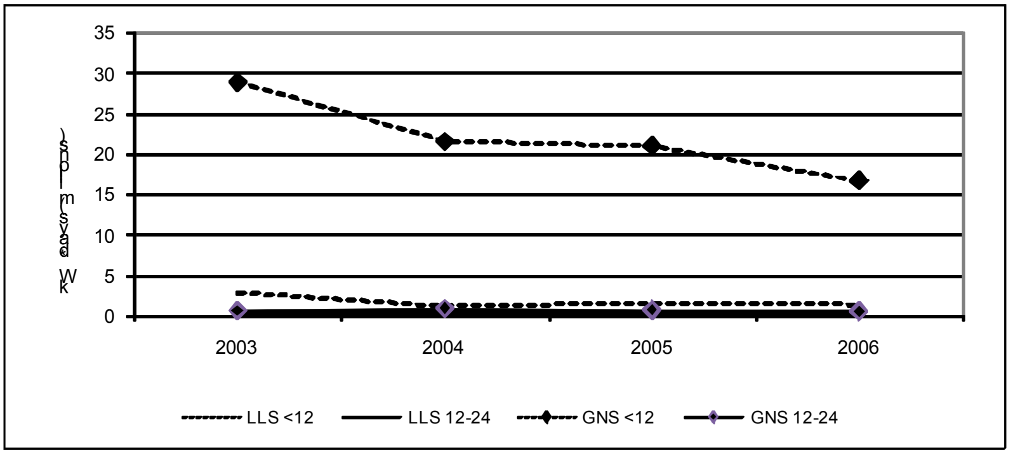


Fig. 7.14.2.3.3.1 Fishing effort per fleet segment in GSA 20.

The fishing effort of the gill nets <12 m and of the bottom trawls 12-24 m showed a significant reduction in GSA 20 from 2003 to 2006 (Fig. 7.14.2.3.3.1).

Tab. 7.14.2.3.3.2 lists the fishing effort reported to SGMED-08-04 through the DCR data call. The overview is given in Tab. A3.7-3.9 of Appendix 3 to this report.

Tab. 7.14.2.3.3.2 Fishing effort in different units by fishing technique deployed in GSA 20, 2003-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	20	GRE	GNS		717773	634540	655783	588850	
DAYS	20	GRE	LLS		114160	79657	84159	73790	
DAYS	20	GRE	OTB		7810	7284	6279	6682	
DAYS	20	GRE	SV		13429	10902	10883	11363	
GT*DAYS	20	GRE	GNS		2885125	2548709	2611649	2210227	
GT*DAYS	20	GRE	LLS		436107	268489	203140	228351	
GT*DAYS	20	GRE	OTB		574443	580909	435054	565011	
GT*DAYS	20	GRE	SV		83099	62465	58441	57058	
KW*DAYS	20	GRE	GNS		29609039	22529478	21758835	17272519	
KW*DAYS	20	GRE	LLS		3247285	1435103	1823114	1448109	
KW*DAYS	20	GRE	OTB		2374841	2447515	1729664	2024955	
KW*DAYS	20	GRE	SV		863066	709465	604098	623628	

7.14.3. Scientific surveys

7.14.3.1.Medits

7.14.3.1.1. Methods

Tables TA, TB, TC were provided according to the MEDITS protocol. The MEDITS survey was carried out in GSA 20 every summer from 1994 to 2006, except in 2002 because of administrative problems. For similar reasons, no MEDITS survey was conducted in Greece in 2007. During 1994 and 1995 the survey in GSA 20 was carried out in a small number of stations (12 and 15). The number of stations kept increasing and in 1998 was more than doubled (32 stations). The survey vessel changed in 1998. Due to these changes in the survey design, caution is needed when investigating the trends of relevant indicators in the MEDITS time series. More details on methodology and trends on selected indicators may be found in MEDITS (2007).

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 20 the following number of hauls were reported per depth stratum (s. Tab. 7.14.3.1.1.1).

Tab. 7.14.3.1.1.1. Number of hauls per year and depth stratum in GSA 20, 1994-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA20_010-050	2	2	2	2	4	3	3	3		3	3	3	3	
GSA20_050-100	3	4	8	7	11	10	11	9		10	10	10	9	
GSA20_100-200	1	3	4	2	5	6	5	6		6	6	5	6	
GSA20_200-500	2	3	4	4	7	7	7	8		8	9	8	8	
GSA20_500-800	3	2	4	3	5	5	5	5		5	3	5	4	

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.14.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.14.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSA 20 was derived from the international survey Medits. Figure 7.14.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSA 20.

The estimated abundance and biomass indices reveal a significantly increased level of stock size since 2003. However, the recent abundance and biomass indices are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

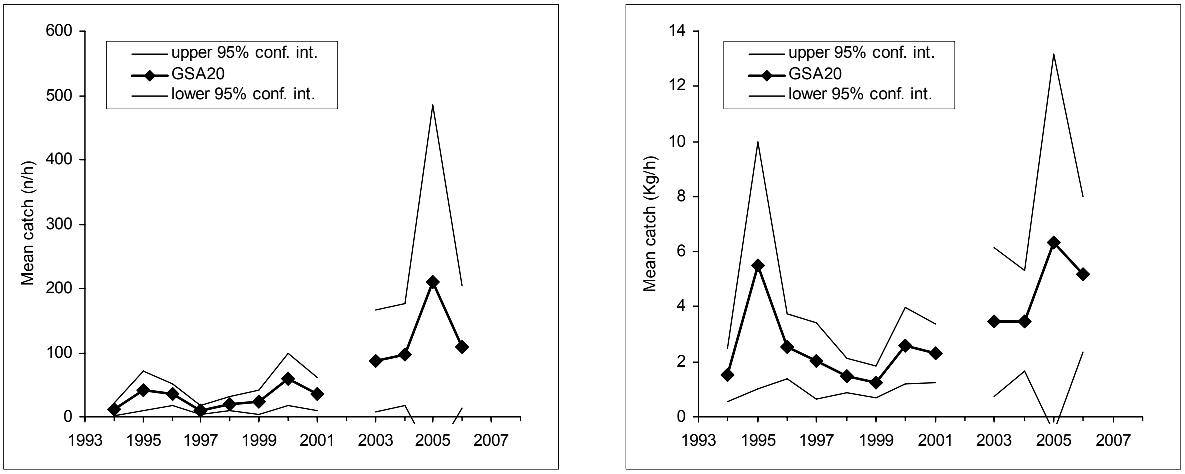


Fig. 7.14.3.1.3.1 Abundance and biomass indices of hake in GSA 20.

7.14.3.1.4. Trends in abundance by length or age

The following Fig. 7.14.3.1.4.1 and 2 display the stratified abundance indices of GSA 20 in 1994-2001 and 2003-2006. These size compositions are considered preliminary.

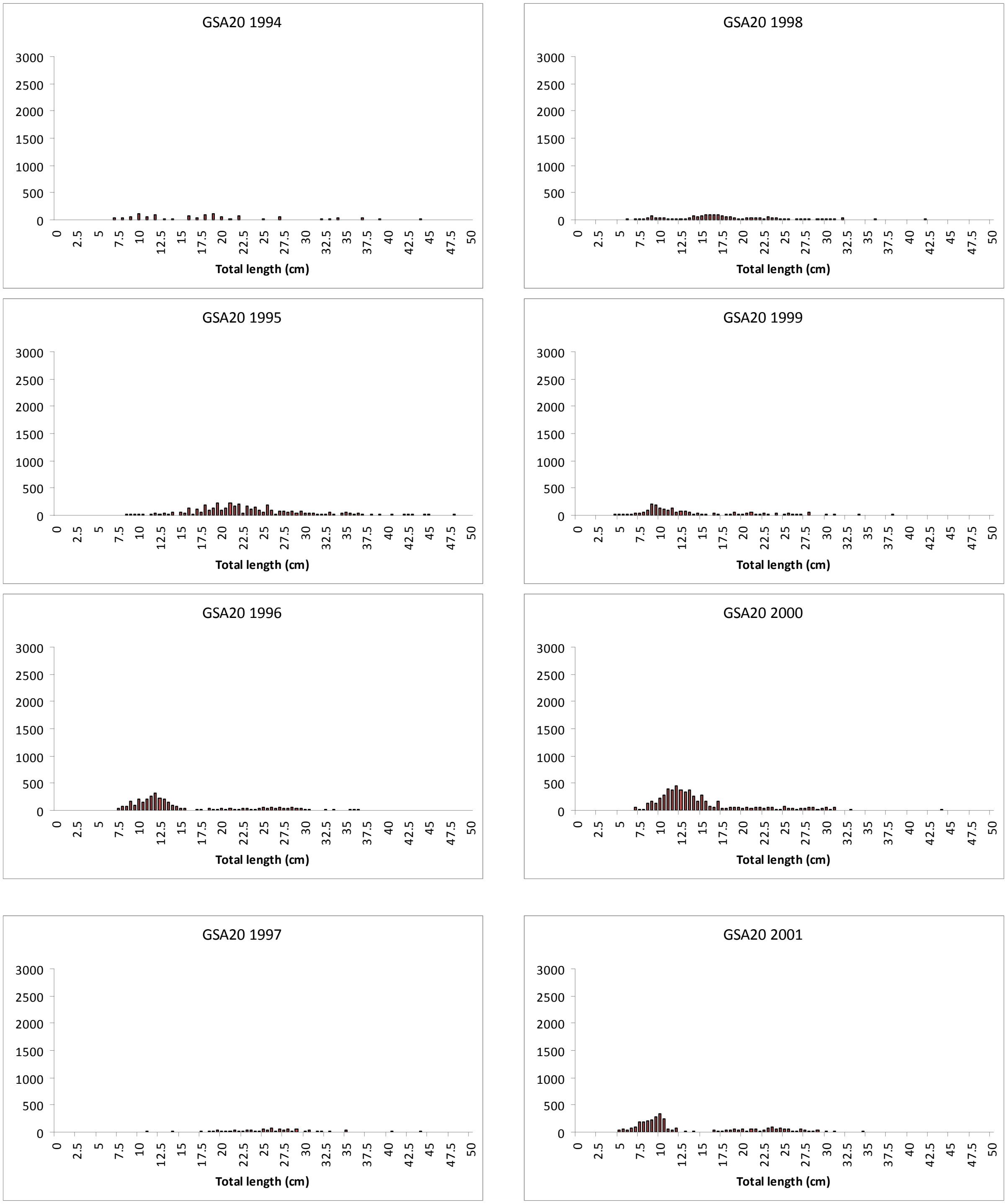


Fig. 7.14.3.1.4.1 Stratified abundance indices by size, 1994-2001.

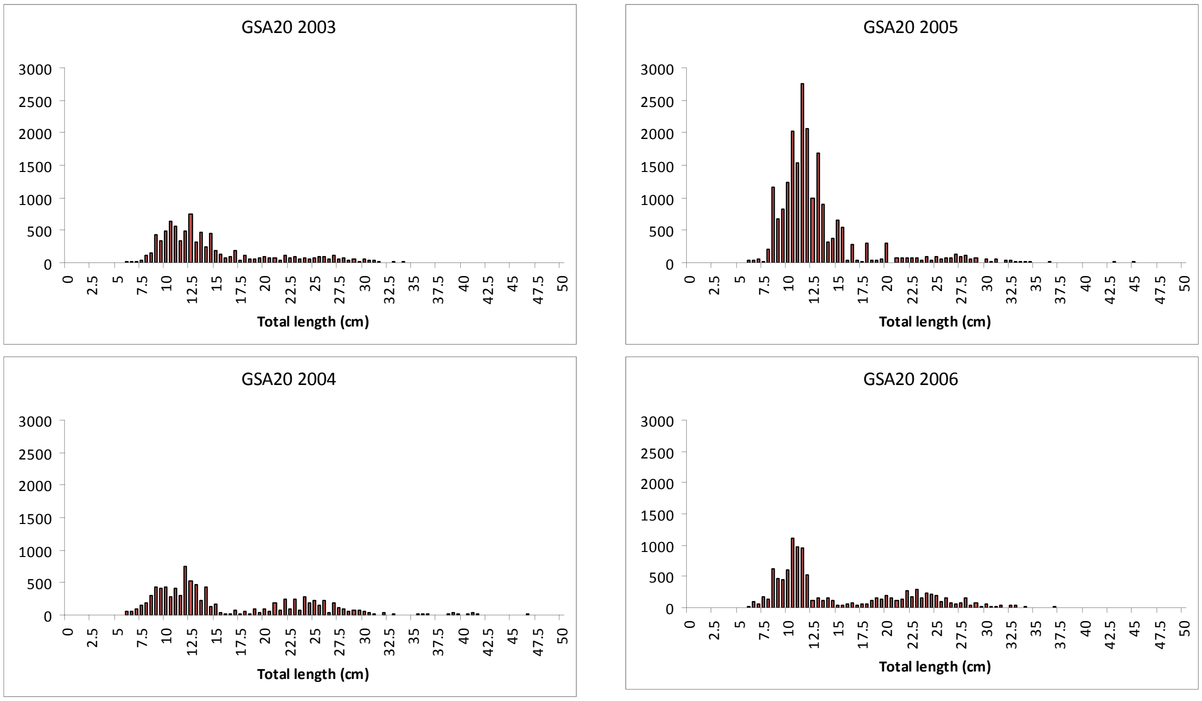


Fig. 7.14.3.1.4.2 Stratified abundance indices by size, 2003-2006.

7.14.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04.

7.14.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04.

7.14.4. Assessment of historic stock parameters

7.14.4.1.Method 1: SURBA (Survey Based Assessment)

7.14.4.1.1. *Justification*

Some of the requested data in the official data call were not provided by Greece in time for the meeting. No data on length distribution of the landings, age distribution of the landings, maturity ogive for males, sex ratio at length, and discards length distribution were available. Due to this lack of available data, many of the methods for stock assessment proposed in the previous meetings of SGMED could not be applied. Therefore, the MEDITS data (1994-2004) were surveyed with the use of the software SURBA.

SURBA 2.0 is a simple survey-based separable model of mortality. The package calculates relative indices regarding the stock status and not the actual number of individuals in the population or actual biomass. SURBA models include a simple, deterministic forecasting capability. This is done by rolling the survey-estimated population forward through time, assuming fixed geometric mean recruitment and the fitted year and age effects.

7.14.4.1.2. Input parameters

The data needed for SURBA are estimates of natural mortality at age, proportion mature at age, and stock weights at age. MEDITS survey data (1997-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters

L∞	100.7
k	0.248
to	-0.35

Weight-Length parameters

a (W-L)	0.0000019
b (W-L)	3.24

Length at age

1	28.65
2	44.48
3	56.82
4	66.46
5+	73.98

Mortality at age

	1	**2**	**3**	**4**	**5**
For all years	1.3	0.66	0.48	0.40	0.35

Mature at age

	1	**2**	**3**	**4**	**5**
For all years	0.06	0.3	0.5	0.7	1

7.14.4.1.3. Results

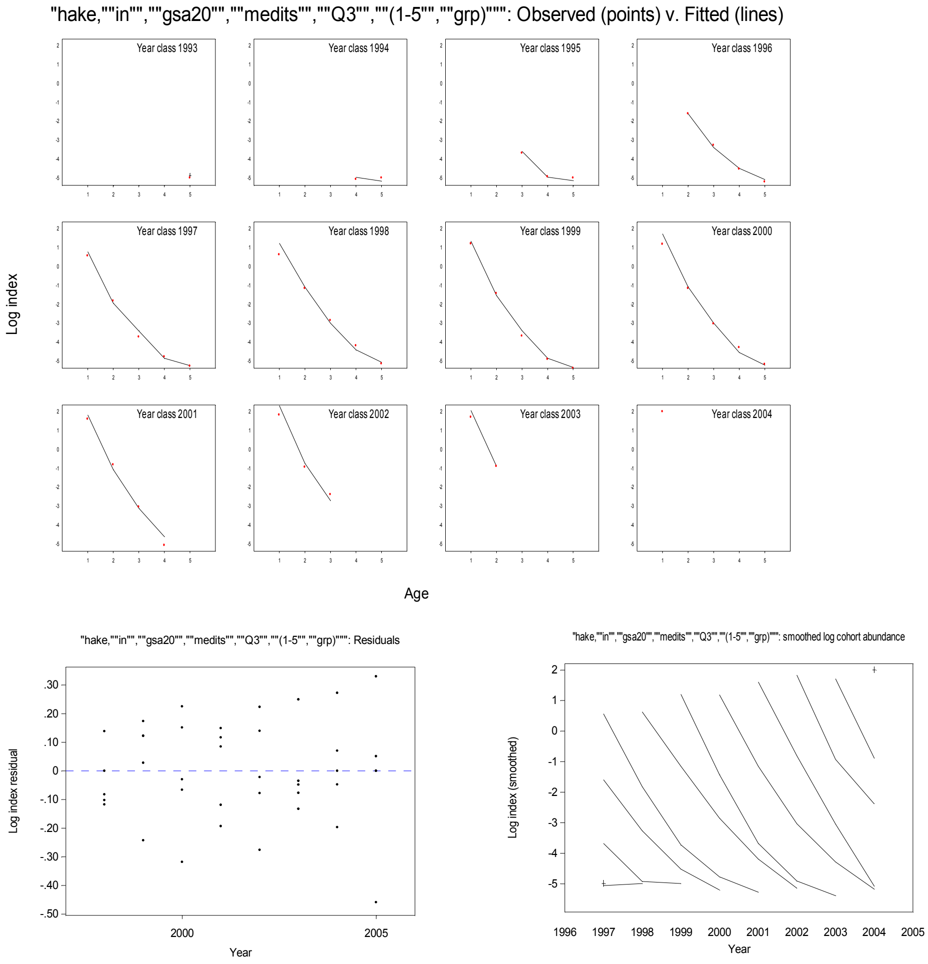


Fig. 7.14.4.1.3.1 Model diagnostics of the model fitted on hake in GSA 20.

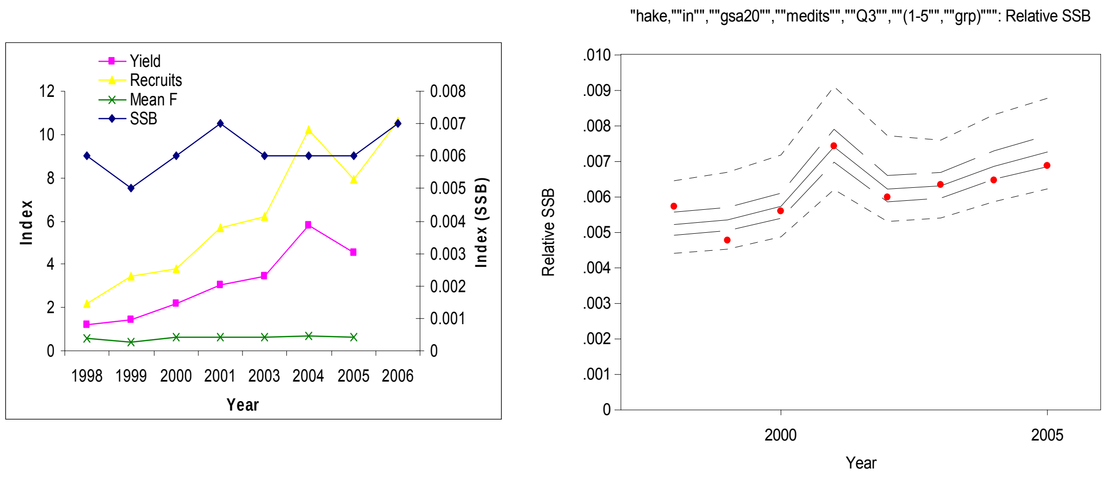


Fig. 7.14.4.1.3.2 Stock summary of the model fitted on hake in GSA 20.

Results obtained with SURBA 2.0 (Figures 7.14.4.1.3.1 and 7.14.4.1.3.2) showed an adequate fitting of the model in hake data in GSA 20.

Relative SSB index decreased until 1999 and then slightly increased. High values were recorded in 2001. An increase over time was evidenced in recruits and yield. Mean F decreased the first 2 years and then increased over the remaining study period.

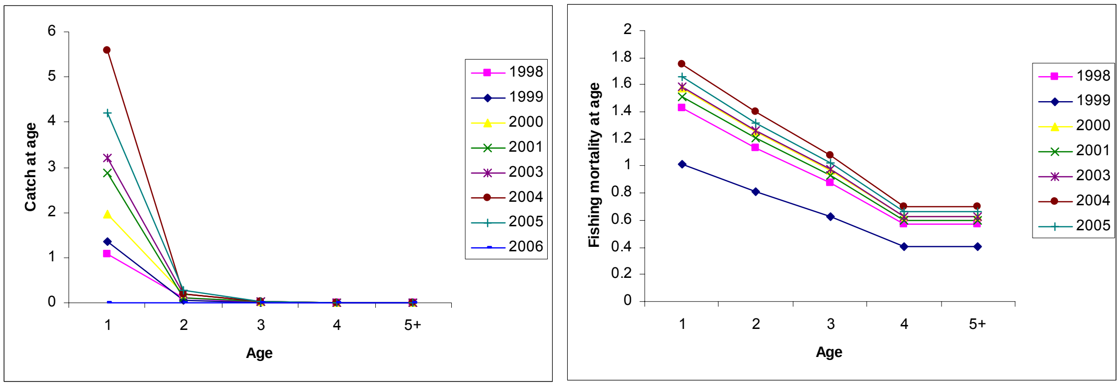


Fig. 7.14.4.1.3.3 Catch at age and fishing mortality at age of hake in GSA 20.

Most of hake was caught in the 1st age class when the fish were generally small and immature (Fig. 7.14.4.1.3.3). Fishing mortality decreased with age.

The data provided in the WG for the GSA 20, were not sufficient to carry assessment for the stocks of hake. For the hake stock, in GSA 20, the 78% of the landings are coming from net fishery. Length data on this fishery were provided for the years 2004 and 2005. Length data from long line fishery (which targets to the spawning stock) were provided for the years 2005 and 2006. The application of VIT for the data on 2005, when length data were available for all the gears, resulted in a non reasonable estimation of F, due to high fish mortality in the length classes 20-30 cm, which are the specimens coming from the net fisheries. To carry on assessment without taking into account the gear which, according to the landing data, is the gear that produces the higher fishing mortality is not reasonable. Additionally, the lack of length distribution of discards is another source of bias and miss estimation. Length and age data on discards and age data on landings should be available for the next meetings.

The landings data should be recalculated and the rising factor for the nets and the long line fisheries should be corrected to the effective fishing effort (the effort targeting hake) and not the total effort of the small scale fisheries vessels of the area.

The discards for GNS in year 2005 for the vessels <12 m should be re-estimated. The reported value of 700 tones is not reasonable taking into account that for the other years for both segments of net vessel, the quantities were negligible.

The fishing effort for the bottom trawlers and for the nets <12 m showed a fluctuation which is not in accordance with changes in the number of the vessels.

Assessment based only on scientific survey is rather difficult to be the basis for scientific advice for fisheries management. There are many factors affecting the performance of the sampling gear which are difficult to be measured, calibrated and regulated. Still there is an open discussion about the distribution of the data coming from scientific surveys and how they should be treated statistically.

In each model there are underlining assumptions. The length frequency used is assumed to be representative of the sampled population. But this is not the case for hake, as is common opinion between the Mediterranean scientists and fishermen that the mature individuals males and females are raising from the bottom and big part of the population is out of the capture range of bottom trawl. Additionally, the distribution of the sampled population could vary from year to year (is depended on many factors, like abundance, environmental parameters, time of fishing etc) and there is a concern if the indices are always a precise estimation of the abundance.

Growth parameters are needed in order to translate the length to age and for hake there is not agreement between the scientists. The survey, in the GSA 20, 22-23, didn't take place the same time. Two months difference could lead in different conclusions, depending on the recruitment time of the species. In the case of hake in GSA 20, according to SURBA model, the yield and the recruits have been increased 4-5 times, but in the time the fishing mortality for the age 1,2 and 3 is higher than 1.

7.14.5. Short term prediction for 2008 and 2009

7.14.5.1. Justification

No forecast analyses were conducted.

7.14.5.2. Input parameters

No forecast analyses were conducted.

7.14.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSA 20.

7.14.6. Medium term prediction - Method 1: ALADYM

7.14.6.1. Justification

ALADYM (Age-Length Based Dynamic Model) is a simulation model, belonging to the group of dynamic pool models. The model simulates population dynamics of a single species following the simultaneous evolution of several cohorts at monthly intervals and accounting for sex differences in growth, maturity and mortality. It is a non-equilibrium approach capable of working also in the absence of fishery-dependent information in order to explore alternative management strategies and predict their consequences in the medium and long term. A summary of requirements, strengths, weaknesses, outputs, and several examples are provided in SGMED-08-01 and SGMED-08-02 reports.

7.14.6.2. Input parameters

The data needed for ALADYM are growth parameters, length-weight relationships, an initial estimate of total mortality, natural mortality, recruitment and spawning season and peak, stock recruitment relationship or a recruitment vector, selectivity parameters of the gears used by the fleet, a fishing activity coefficient by month.

The following input parameters were used:

	Females	Males	Comments
Linf	1007	728	French growth data
k	0.25	0.3	
to	min: -0.47 max: -0.34	min: -0.47 max: -0.34	
Lifespan	12	10	
a (W-L)	0.000001988	0.000002166	
b (W-L)	3.231	3.215	
M	Chen-Watanabe equation		
vector of offspring/month	.18 .19 .12 .05 .07 .09 .03 .03 .03 .03 .04 .15		based on GSI temporal variation
sex ratio	0.5		
gear selectivity	L50 = 123 mm L75 - L25 = 49 mm		selectivity experiment

Quarterly fishing coefficients (based on official catch data)				
year	**1st**	**2nd**	**3rd**	**4th**
2003	1.16	0.79	1.02	1.03
2004	0.87	1.36	0.96	0.80
2005	0.87	1.06	0.98	1.09
2006	1.11	1.16	0.82	0.91
average	1.00	1.09	0.95	0.96

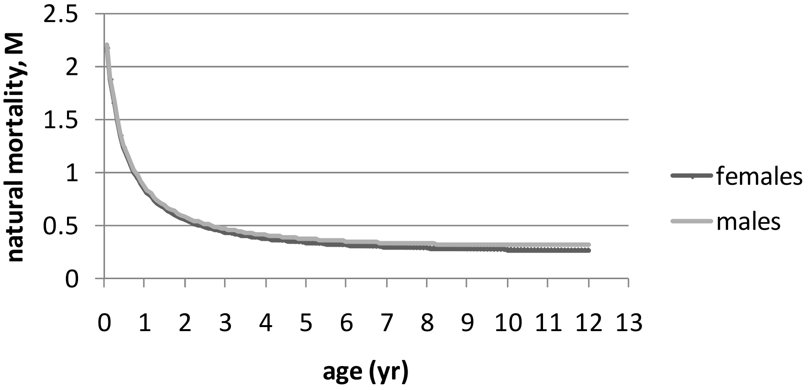


Fig. 7.14.6.2.1 Assumed natural mortality, based on the Chen-Watanabe equation

A constant recruitment was assumed, independent of stock size, i.e. the stock-recruitment relationship was assumed to be a horizontal line.

Simulations were based on 5 scenarios. In the ‘present status’ scenario all parameters were kept constant at current levels. In the other scenarios, a management action has been put forward, starting from year 2007. The quarterly fishing coefficients were taken as the average of the coefficients for the years 2003 to 2006. In the ‘20% pressure reduction scenario’ it was assumed that fishing pressure was reduced by 20% (the fishing coefficients were reduced by 20%). In the ‘increased mesh size’ scenario, the selectivity pattern of the fishing gears was changed assuming an increase of Lc_{50} to a value of 200 mm, which is the minimum legal size of hake landings according to current legislation. In the ‘summer closure’ scenario, the fishery was completely closed during the 3rd quarter (July to September). In the ‘all measures’ scenario, all the above measures were implemented simultaneously.

7.14.6.3. Results

The results of the Aladym model in terms of change/impact of main model-based indicators and reference points (biomass, yield, ESSB/USSB, Zfemale, mean age of the spawning stock) in the long-term are synthesised at annual time scale and reported in the following figures.

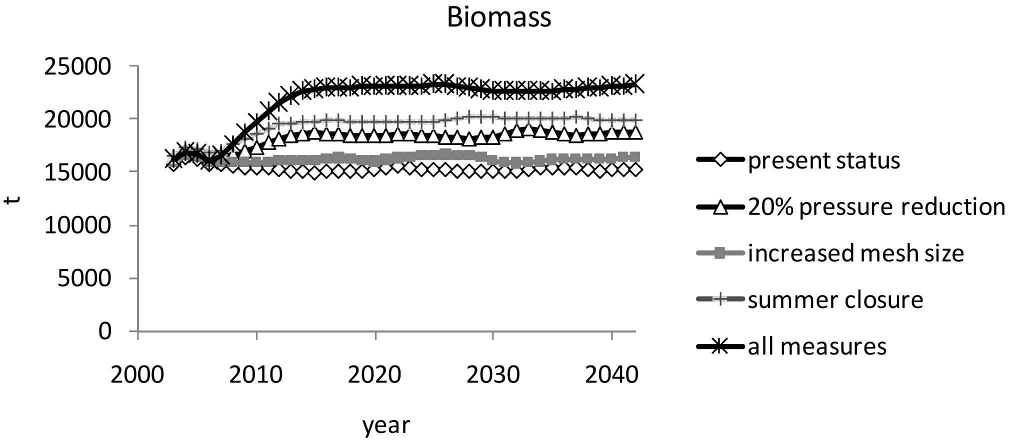


Fig. 7.14.6.3.1 Simulated time series of biomass by ALADYM, based on 5 scenarios.

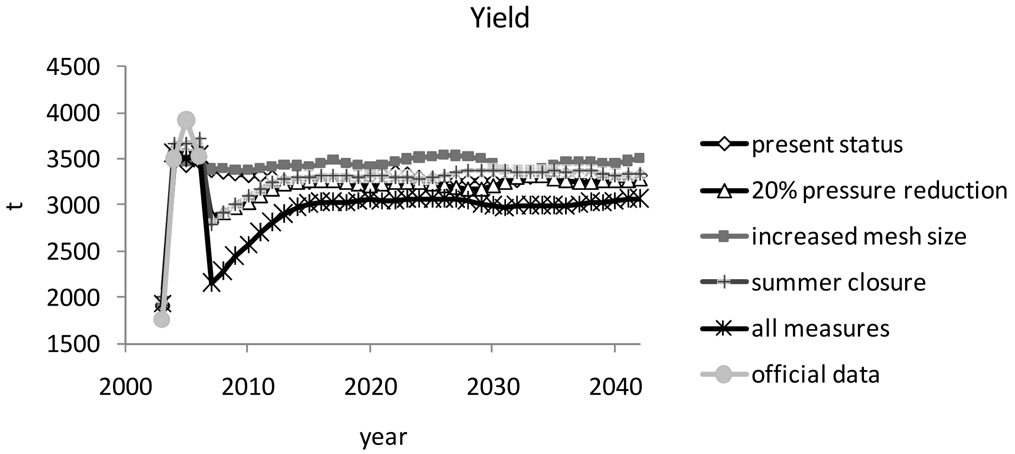


Fig. 7.14.6.3.2 Simulated time series of yield by ALADYM, based on 5 scenarios.

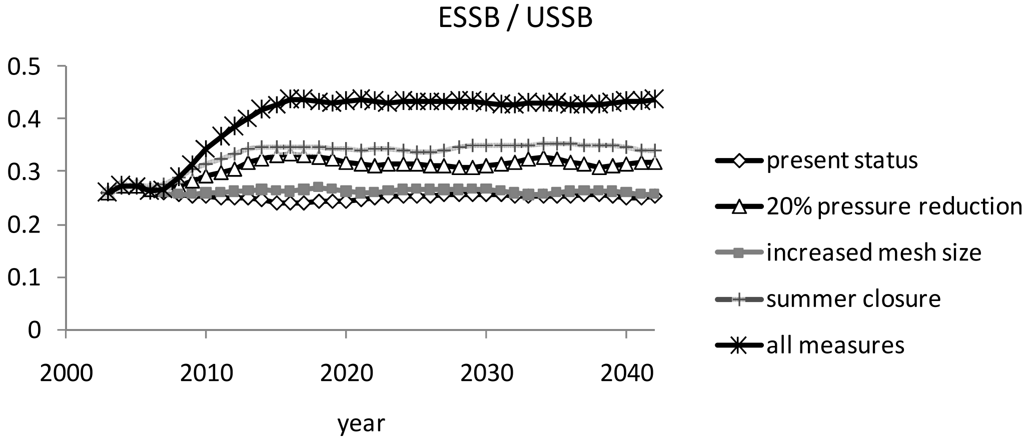


Fig. 7.14.6.3.3 Simulated time series of the ratio of exploited spawning stock biomass to unexploited spawning stock biomass by ALADYM, based on 5 scenarios.

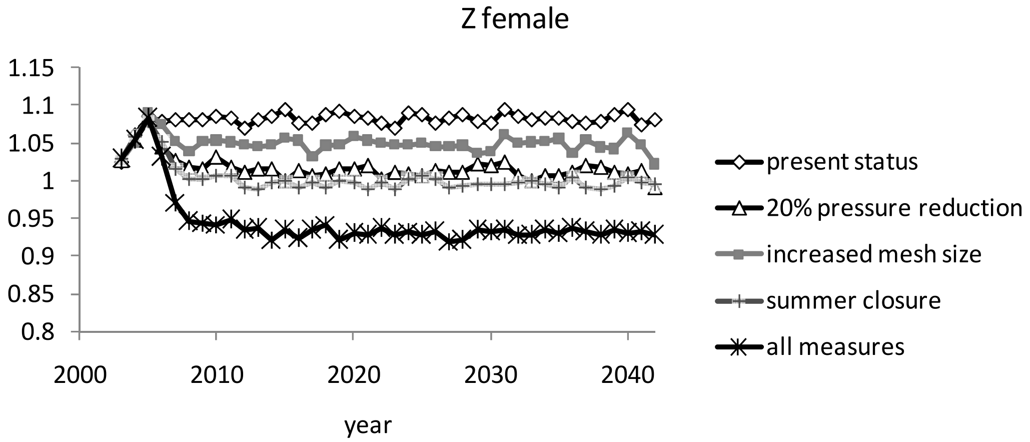


Fig. 7.14.6.3.4 Simulated time series of female mortality by ALADYM, based on 5 scenarios.

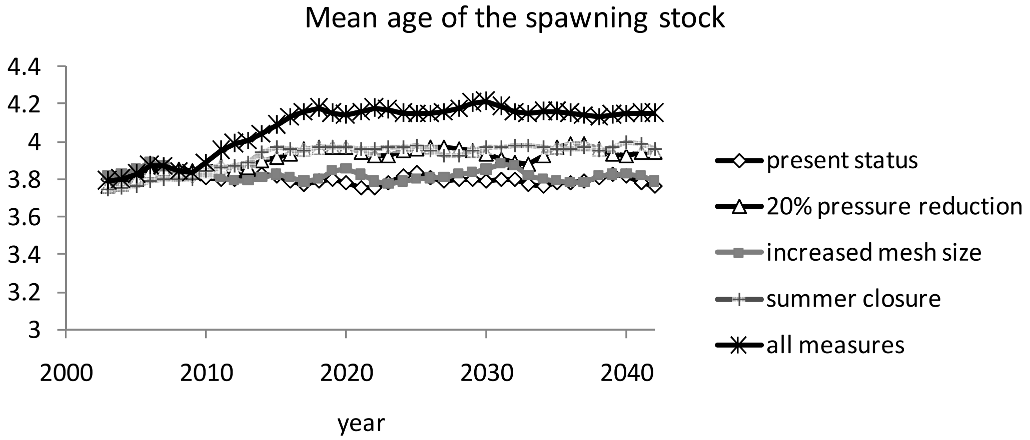


Fig. 7.14.6.3.5 Simulated time series of the mean age of the spawning stock by ALADYM, based on 5 scenarios.

Results highlighted that the current situation of hake stock exploitation would substantially be improved under some of the management scenarios tested. Biomass of the hake stock would increase with any of the three management measures; the highest increase would occur after a decision for a summer closure of the hake fishery and the lowest increase after a decision for a mesh size increase. The 'all measures scenario' would cause an increase of the stock biomass by more than 50% in the long term. Total mortality of the females would decrease under all scenarios; the highest decrease would occur with a summer closure of the fishery and the lowest decrease by increasing mesh size. Mean age of the spawning stock would not be substantially affected by increasing mesh size but would increase with all the other measures. Yield would decrease in the short term with all management scenarios in relation to the present status and this decrease would be more pronounced with the '20% pressure reduction' and the 'summer closure' scenarios. In the long term, yield would not substantially change with the '20% pressure reduction' or the 'summer closure' scenarios but it would slightly increase with the 'increased mesh size' scenario. However, the mixed scenario would cause a very large short-term reduction of yield as well as a long term reduction by 7.5%. The sustainability reference point ESSB/USSB would substantially rise in the long-term with all management scenarios, except for the 'increased mesh size' scenario.

7.14.7. Long term prediction

7.14.7.1. Justification

No forecast analyses were conducted.

7.14.7.2. Input parameters

No forecast analyses were conducted.

7.14.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSA 20.

7.14.8. Scientific advice

The assessment results should be considered as preliminary (based on assumptions that need verification and uncertain data) and insufficient to form the basis for sound scientific advice.

Based on MEDITS data, spawning stock biomass appeared stable, while yield and recruits had an increasing trend. Based on the official DCR data, landings had an overall increasing trend (but a slight decrease in 2006). Simulations in ALADYM, showed that with a decrease of effort or an increase in mesh size, the stock would improve but yield would either decrease or slightly increase, depending on the scenario. Thus, based on the data available on the conducted analyses, the stock of hake in GSA 20 appears to be stable and no signs of decline are visible.

However, incomplete data was provided to the WG. Only for one year (2005), landings length data was provided for all the fishing gears catching hake in the area. Length data on discards was not available. The fit of VIT model for the year 2005 resulted to an estimation of F>6, probably due to inaccurate data, especially related to the nets landings and length distribution of the landings.

7.14.8.1. Short term considerations

7.14.8.1.1. State of the spawning stock size

According to the SURBA analysis the SSB with an exception in 1999 was at the same level or higher than in 1998 (first year included in the model). Without proposed or agreed reference point, SGMED-08-04 is unable to fully evaluate the stock status

7.14.8.1.2. State of recruitment

According to the SURBA analysis the recruitment of hake in GSA 20 showed a continuously and significant increase since 1998 despite the fact that the SSB remained quite constant this period.

7.14.8.1.3. State of exploitation

Based on SURBA estimates, fishing mortality appears to have been stable during 2000-2005. Without proposed or agreed reference point, SGMED-08-04 is unable to fully evaluate the stock status.

7.14.8.2. Medium term considerations

Simulations in ALADYM, showed that with a decrease of effort or an increase in mesh size, the stock would improve but yield would either decrease or slightly increase, depending on the scenario.

7.15. Stock assessment of hake in GSAs 22 and 23 combined

7.15.1. Stock identification and biological features

7.15.1.1. Stock Identification

Hake is one of the most important fish stocks in GSAs 22-23 for bottom trawlers, nets (mainly gillnets) and longlines. The stock is distributed in depth between 50-600 m, with a peak in abundance in depths between 200 and 300 m. The stock is exploited by the Greek fishing fleet in the National Greek waters and by the Greek and Turkish fleet in the international waters. Spawning is taking place all year around, with a peak during winter –spring.

7.15.1.2. Growth

Biological sampling was conducted in 16 fishing ports, which are the main landing ports of the GSAs 22-23. Landings from trawlers, nets and hooks were included in biological sampling. Sampling was conducted during different seasons for each species depending on the life cycle of the species, the size of local production, and the temporal or spatial restrictions on the use of fishing gears.

The growth parameters for hake and for each sex are given for GSAs 22-23 in the following figure. The age interpretation was done by otolith reading. Sampling was conducted from 2003 to 2005. The growth curves are as shown in the Fig. 7.15.1.2.1.

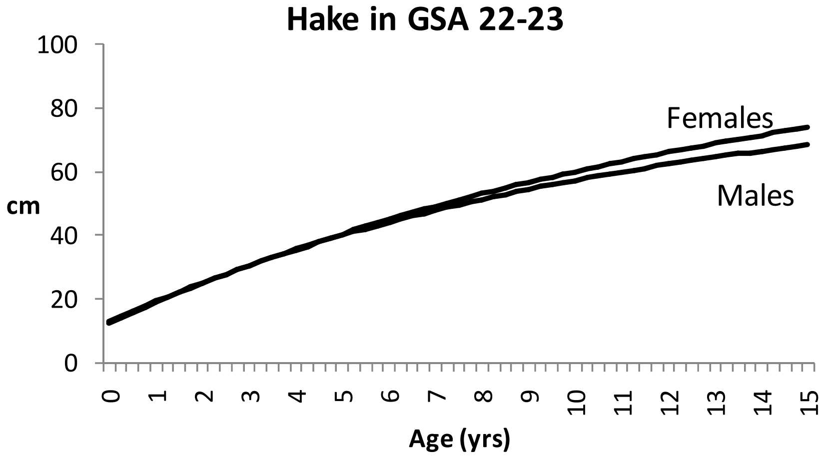


Fig. 7.15.1.2.1. Growth functions of hake in GSAs 22-23.

After studying the growth equations from each GSA, it was noticed that there is a big variability in growth parameters. The reason for this was likely the uncertainty of hake age readings, which has been documented by various researchers (Piñeiro and Saínza, 2002, 2003). Recent results from a tagging experiment in France have strongly suggested that those criteria may not be accurate and that they may lead to overestimation of ages (De Pontual et al., 2003). It was mentioned that faster growth is expected for hake in the Mediterranean, as suggested by the tagging experiment conducted in France (Gulf of Lions), which validated hake age. Therefore the SGMED decided to perform hake assessments using the growth parameters according to the French tagging experiments. These parameters are given in the table below.

Growth parameters of hake according to the French tagging experiments are listed in Table 7.15.1.2.1.

Tab. 7.15.1.2.1 Growth parameters of hke according to the French tagging experiments.

HAKE	L_∞ (cm)	k	t_0
Females	72.8	0.298	-0.383
Males	100.7	0.248	-0.35

7.15.1.3.Maturity

Biological sampling in order to define the maturity ogives and reproduction cycle of species was conducted as for the growth parameter sampling. Maturity was defined based on Nikolsky scale. All individuals with a maturity stage >3 were considered as mature (only reproductive months were taken into account). For each species, the percentage of mature individuals per length class was estimated. Data were only provided for females. However, it was pointed out that in other GSAs hake are considered mature at maturity stages >2 (on the Nikolsky scale). Thus, the estimated Lm_{50} was greater than that estimated in other GSAs that used the '>2' criterion. The estimated Lm_{50} might be an overestimation and the issue needs further consideration; standardisation among GSAs is needed.

The maturity curve was estimated by logistic regression (with non-linear least-squares) based on the official data provided. The estimated parameters of the curve are given in the table below.

Tab. 7.15.1.2.1 Parameters of maturity at length.

	Estimations	SE	95% LL	95% UL
L_{50}	43.7	1.9	39.9	47.4
L_{75}-L_{25}	12.8	0.8	11.3	14.4

7.15.2. Fisheries

7.15.2.1.General description of fisheries

Hake mainly lives on muddy substrates in depths between 50-600 m. The main landing ports in the GSAs 22-23 are the port of Pireus, Thessaloniki, Kavala, Alexandroupolis, Volos, Chalkida and Chios.

The bottom trawl fishery in Greece is a mixed fishery, operating 24hr per day. Bottom trawl fishing targeting hake, is taking place mainly during the day in muddy bottoms in depths 80-400 m (approximately). Especially for the offshore fisheries in the international waters, the duration of the trip could be up to 3 days. The mesh size of the cod end of bottom trawls is 40 mm. Important bycatch species are shrimps, anglerfish, blue whiting, Norway lobster, megrims, pickarel and red mullet.

The gill nets are setting in the morning and are hauling the next day in depth from 80-300 m. The mesh size used is about 48 to 64 mm. The fishery is carried out mainly during summer when bottom trawl fishery is closed. Long line fishery for hake is taking place in deeper waters down to 500 m mainly during summer. Fishing is taking place during the day. The size of the hook is No 6-8. Gillnet and especially longline fisheries have a relatively greater species and size selectivity. The main by catch species in the gill net fishery is horse mackerel.

Due to the selectivity of each gear the length composition differs significantly. The catch from bottom trawls consists mainly of small individuals (hake with lengths between 6-18 cm are ~75% of the catch). The catch of gillnets comprises mainly of specimens with lengths between 20 and 40 cm, while longliners catch relatively larger fish.

There was a general declining trend in the number of vessels in recent years in all fleet segments. Capacity generally declined, except in trawlers where it increased. The average length slightly increased in all fleet

segments, except boat seiners. Average age substantially declined in all fleet segments except boat seiners where average age remained stable and the highest among all fishing fleets.

There was a general declining trend in the number of vessels in recent years in all fleet segments. Capacity generally declined, except in trawlers where it increased. The average length slightly increased in all fleet segments, except boat seiners. Average age substantially declined in all fleet segments except boat seiners where average age remained stable and the highest among all fishing fleets.

7.15.2.2.Management regulations applicable in 2007 and 2008

RD 917/1966 is the principal law regulating the operation of trawlers. Although this law is still in effect, it has been superseded by EC Regulation 1626/1994, and its replacement Regulation 1967/2006. The main restrictions established by Greek and European legislation are:

(1) establishment of a total exclusion zone one mile from the coastline of the mainland and the islands,
(2) a total fishing ban from the 1st of June till the end of September,
(3) establishment of a total exclusion zone which is: either a zone three miles from the coastal line or a zone shallower than 50 m,
(4) minimum cod-end mesh size is 40 mm (EU EC regulation 1967/2006); from 1 July 2008, the net shall be replaced by a square-meshed net of 40 mm at the cod-end or, at the duly justified request of the shipowner, by a diamond meshed net of 50 mm.

Additional restrictions exist for bottom trawling in specific areas: in Pagassitikos, S. Euboikos, Porto Lagos, Thessaloniki, part of the Saronicos Gulf, Oreon Channel trawling is prohibited all year around, while in the Gulf of Kavala, Thermaikos Gulf, Strimonikos Gulf trawling is prohibited from 1st of April till the end of October.

The operation of the bottom set nets is subject to the following main restrictions:
(1) the maximum total length of the trammel length is 6000 m.
(2) the minimum mesh size opening is 16 mm.
(3) monofilament or twine diameter of the net should not exceed 0.5 mm.
(4) the maximum drop of a combined trammel and gill net should not exceed 10 m and the length of combined nets should not exceed 2,500 m.

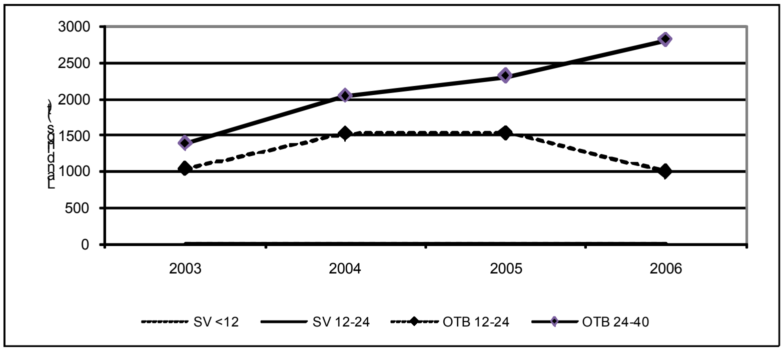
7.15.2.3.Catches

7.15.2.3.1. Landings

Estimation of landings was based on random sampling in 127 sampling stations (ports) in GSA 22-23. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type was randomly selected and landings by species recorded. Based on these data, average landings per fishing day, by species and for each fishing gear were estimated. Based on total effort estimations, sampled data were raised to the whole fleet to estimate total landings by species, fleet segment, fishing gear, and GSA

The landings of hake in GSA 22-23 are presented in Fig. 7.15.2.3.1.1.and in Tab. 7.15.1.3.1.1. According to official data, the bottom trawl catch ranged from 2,440 to 3,850 t, catches of gillnets ranged from 1,790 to 3,770 t, whereas the catches of the long lines ranged from 710 to 1,470 t.

The landings of all gears increased in comparison with the landings in 2003 (Fig. 7.15.2.3.1.2). In particular, gillnets landings increased from 1,790 to 3,770 t. At the same time effort of gillnets and bottom trawls remained quite constant while effort of longlines decreased. The landings of bottom trawlers in this area is less than 50% of the total.



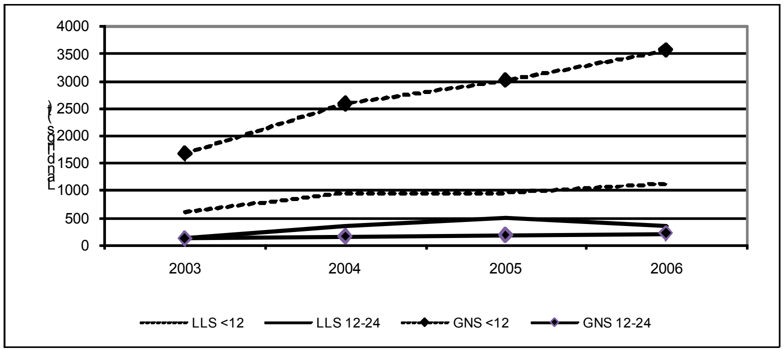


Fig. 7.15.2.3.1.1 Landings of hake in GSA 22-23s from 2003-2006.

Tab. 7.15.1.3.1.1 Hake catches per gear and per year in GSA 22-23.

Year\Gear	SV	OTB	LLS	GNS	**Total**
2003	13	2443	712	1793	**4961**
2004	4	3572	1305	2732	**7613**
2005	7	3856	1460	3187	**8510**
2006	15	3821	1469	3771	**9076**
Total	**39**	**13692**	**4946**	**11483**	**30160**

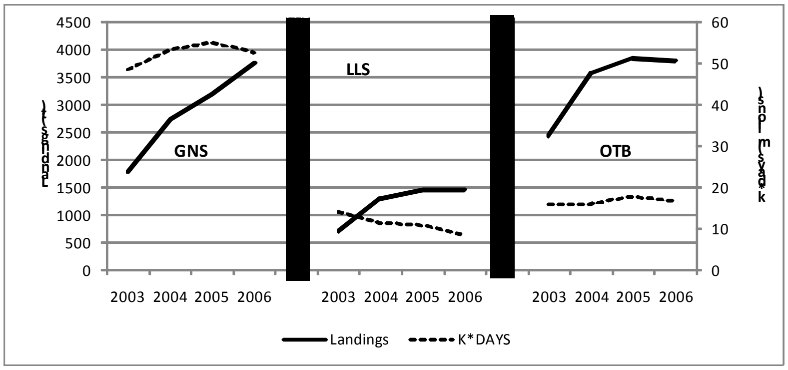


Fig. 7.15.2.3.1.2 Landings of hake and fishing effort per gear category in GSAs 22-23.

The landings of all gears increased in comparison with the landings in 2003 (Fig. 7.15.2.3.1.2). In particular, gillnets landings increased from 1,790 to 3,770 t. At the same time effort of gillnets and bottom trawls remained quite constant while effort of longlines decreased. The landings of bottom trawlers in this area is less than 50% of the total.

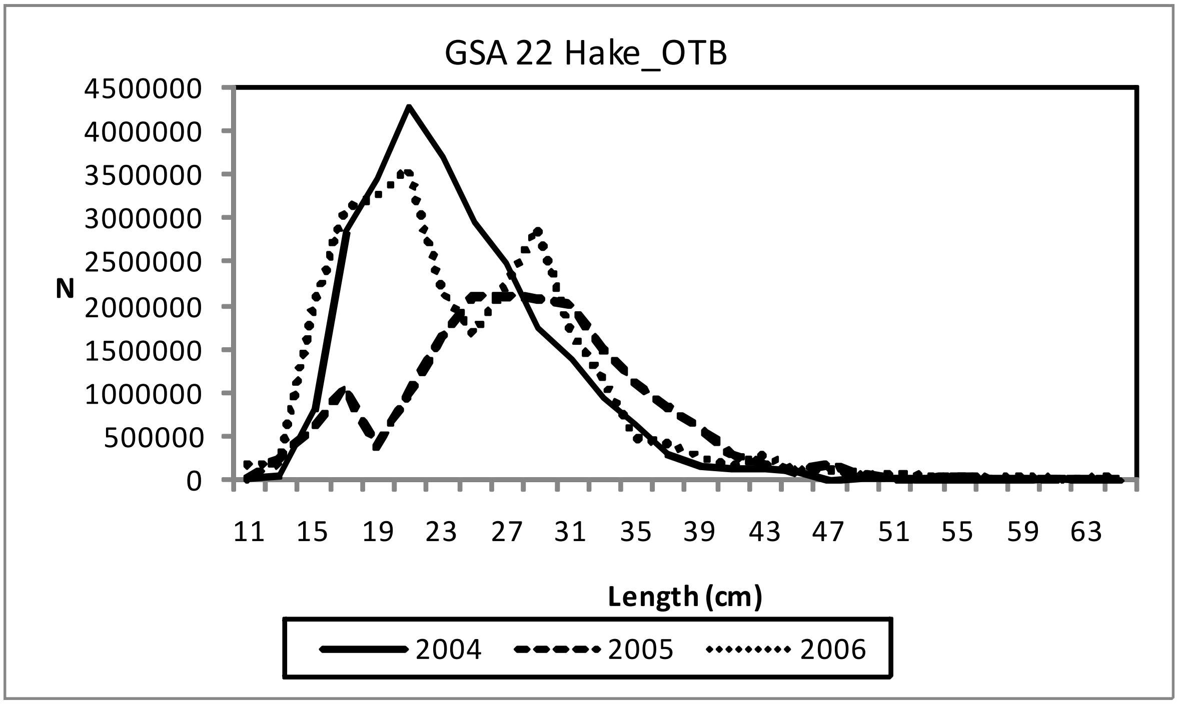


Fig. 7.15.2.3.1.3. Length distribution of hake bottom trawl landings in GSA 22-23 from 2004-2006.

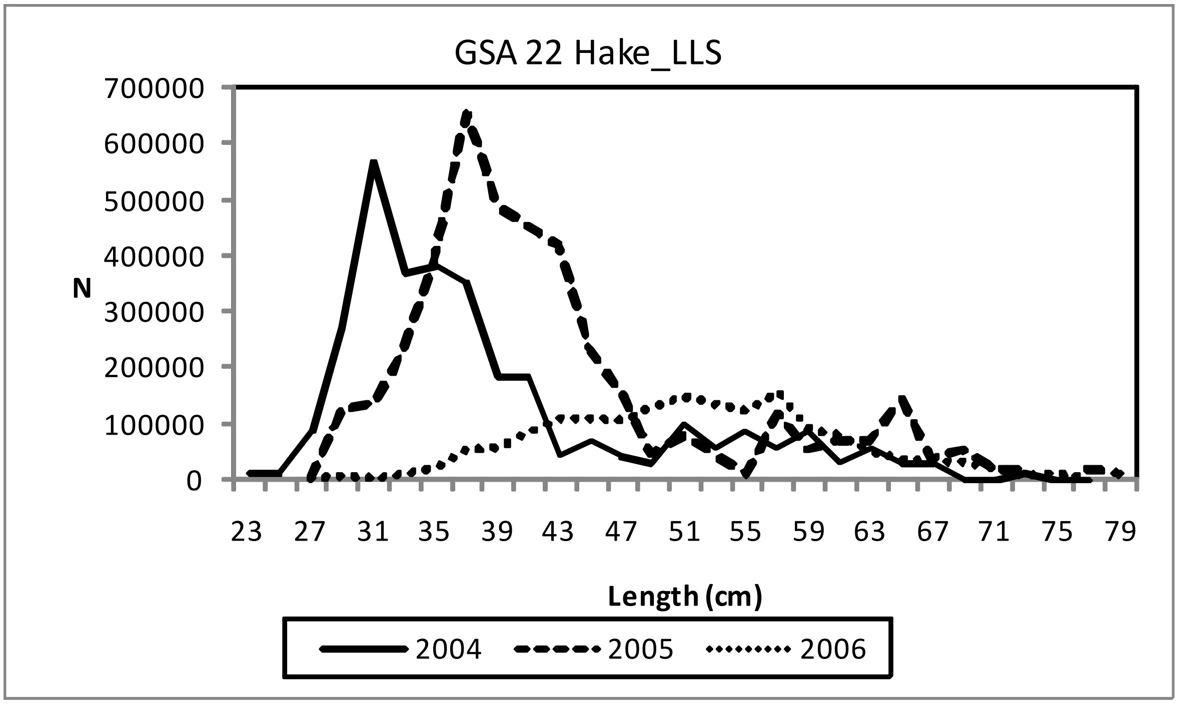


Fig. 7.15.2.3.1.4. Length distribution of hake long lines landings in GSA 22-23 from 2004-2006.

The modal length it was 21 cm in 2004 and 2006 and 25-31 cm in 2005 (Fig. 7.15.2.3.1.3). The proportion of the undersized specimens of hake in bottom trawl landings in GSA 22-23 was much lower than in GSA 20. It was 27%, 12% and 33% in 2004, 2005 and 2006, respectively whereas the proportion of specimens with lengths >29 cm was 15%, 38% and 18%, in 2004, 2005, 2006, respectively.

The lengths of hake in the long line landings in GSA 22-23 ranged from 21 cm to 79 cm (Fig. 7.15.2.3.1.4). No undersized specimens were caught in the long lines. In 2004, the modal length was at 31 cm.

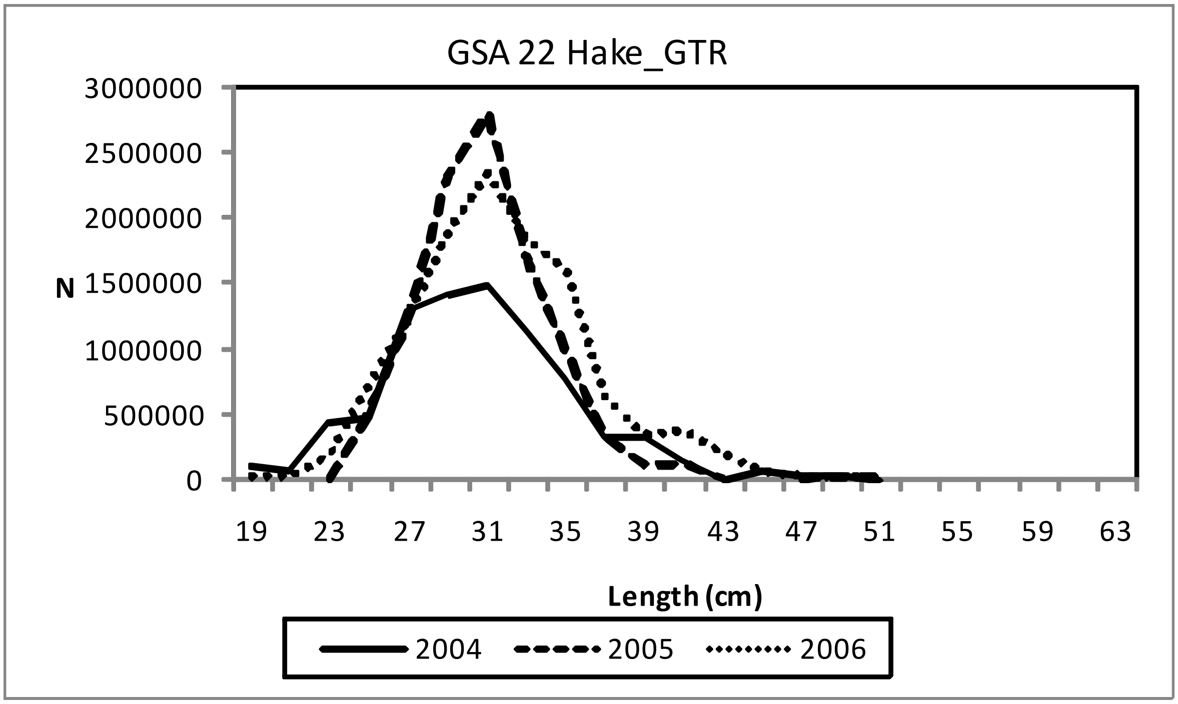


Fig. 7.15.2.3.1.5. Length distribution of hake nets landings in GSA 22-23 from 2004-2006.

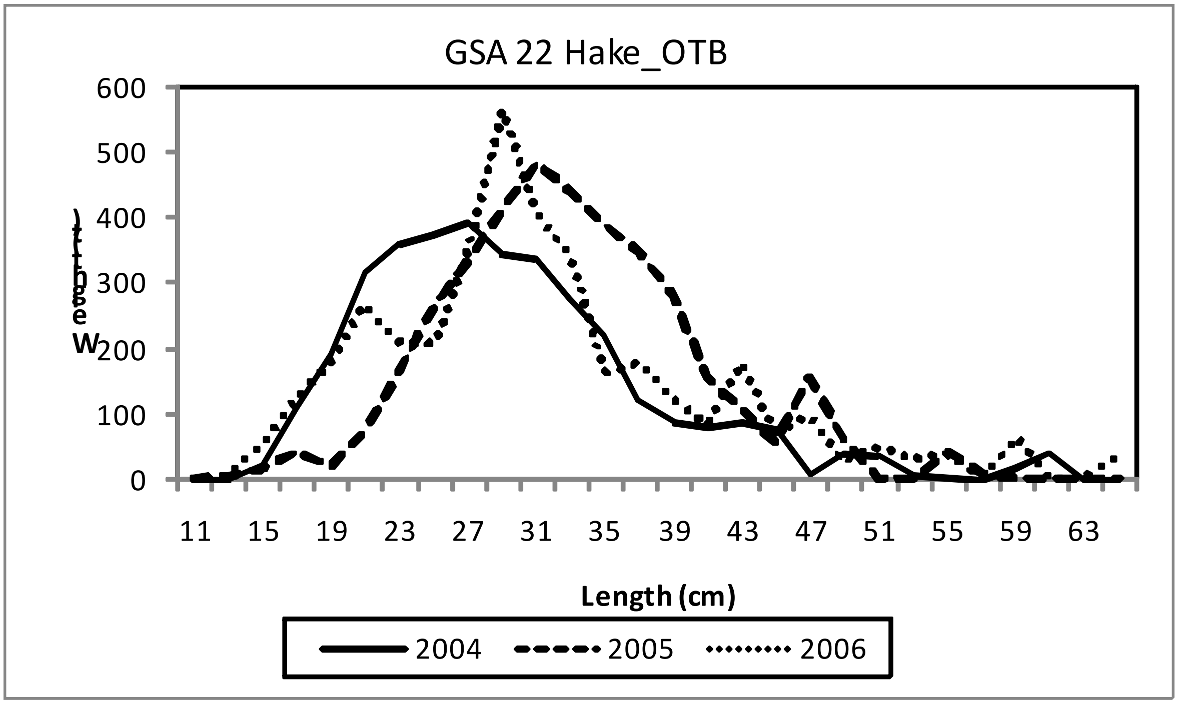


Fig. 7.14.2.3.1.6. Bottom trawl landings composition by length classes in weight in GSA 22-23.

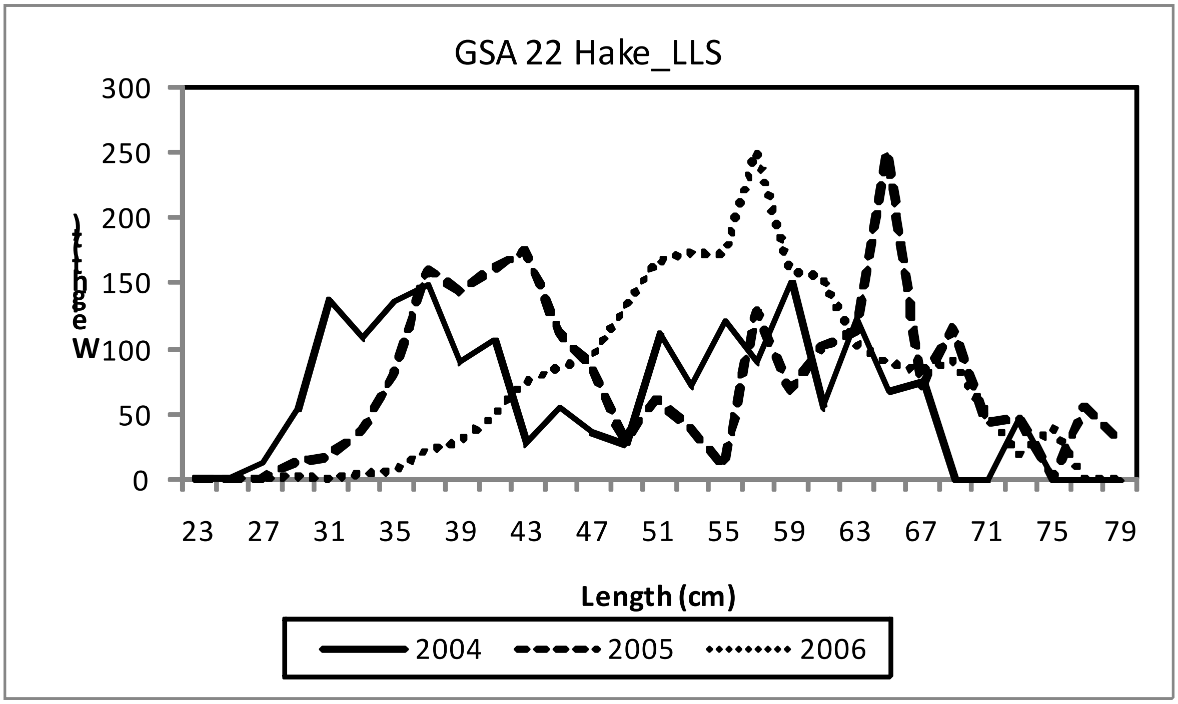


Fig. 7.14.2.3.1.7. Long lines landings composition by length classes in weight in GSA 22-23.

During all the years, the modal length of the hake landings of the nets was 31 cm (Fig. 7.15.2.3.1.5). The lengths of the specimens ranged from 19 cm to 45 cm.

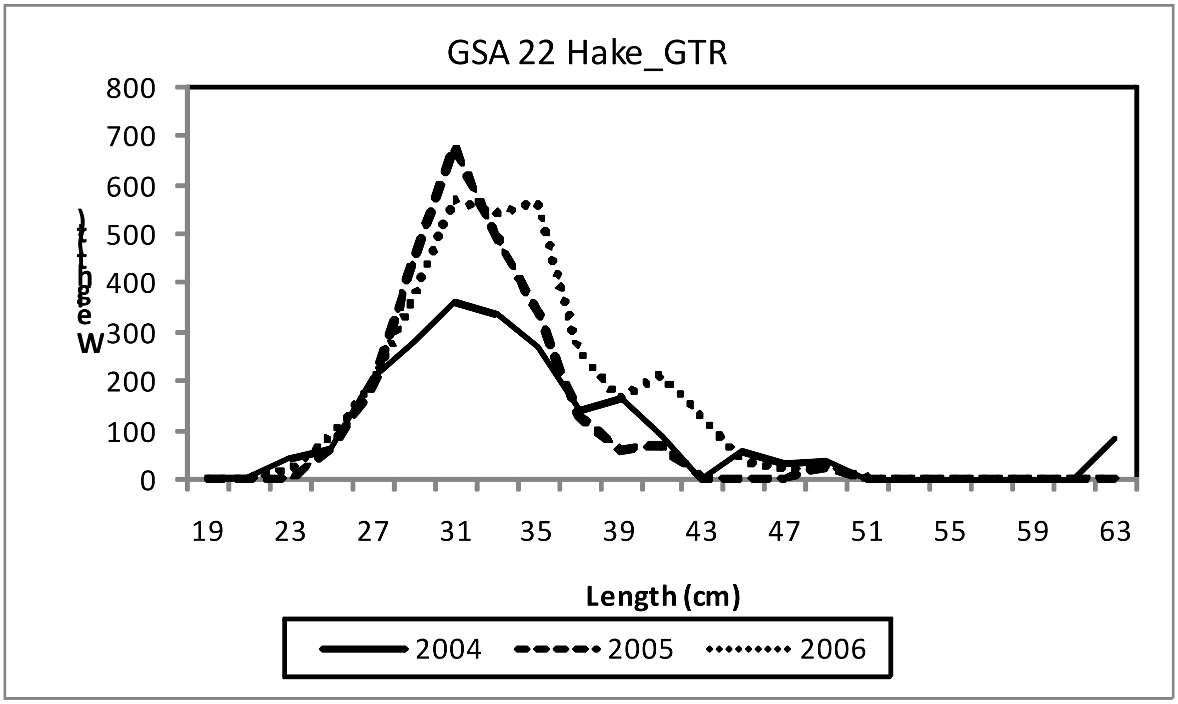


Fig. 7.14.2.3.1.8. Nets landings composition by length classes in weight in GSA 22-23.

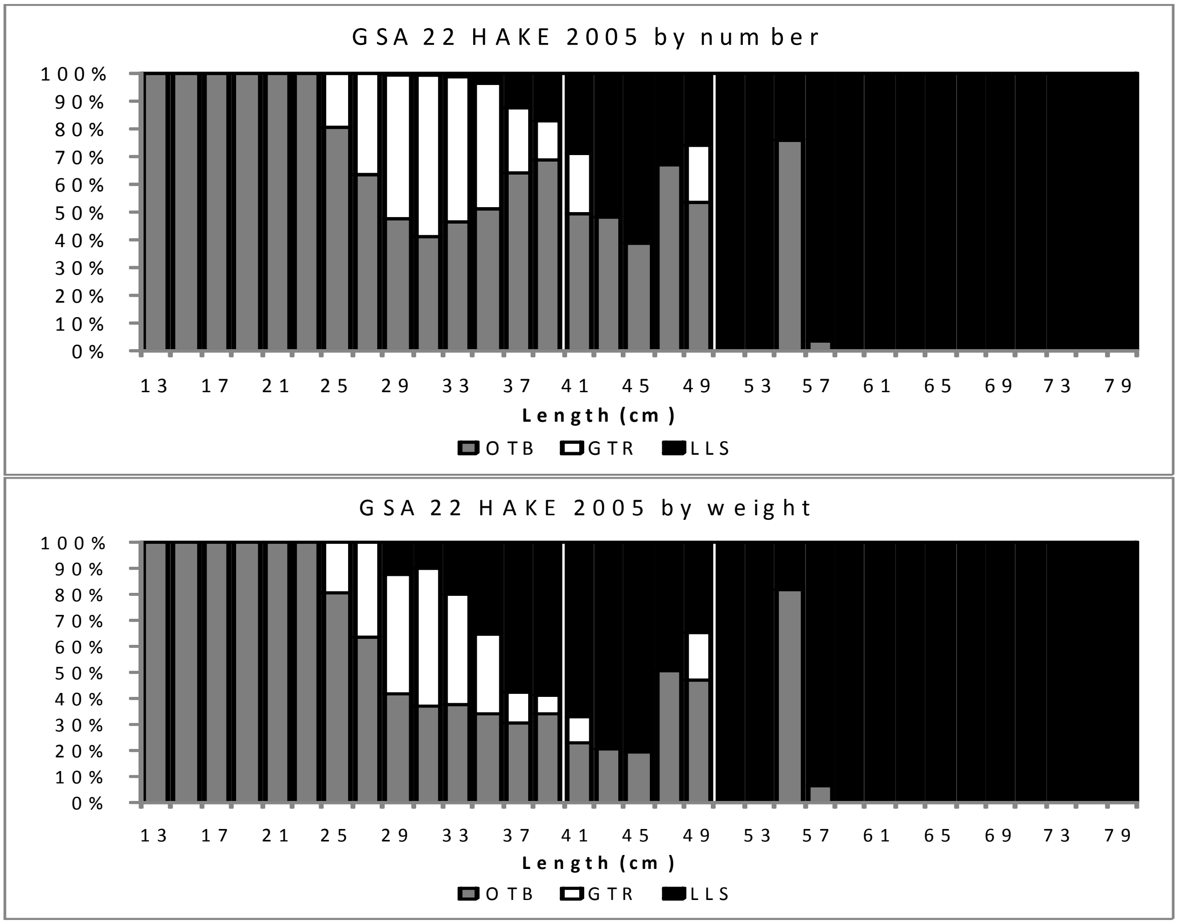


Fig. 7.14.2.3.1.9. Proportion of each gear landings per length class of hake in GSA 22-23 for 2005.

Tab. 7.15.2.3.1.2 Landings (t) as reported to SGMED-08-04 through the DCR data call, 2003-2006. The data are listed in Tab. A3.1 of Appendix 3.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	22+23	GRE	SV		13	4	7	15	
HKE	22+23	GRE	OTB		2443	3572	3856	3821	
HKE	22+23	GRE	LLS		712	1305	1460	1469	
HKE	22+23	GRE	GNS		1793	2732	3187	3771	
SUM					4961	7613	8510	9076	

7.15.2.3.2. Discards

In Greece, the discards and landings of trawlers, purse-seiners, coastal vessels, and drifting longliners were estimated based on onboard sampling. Three times every year, sampling was conducted in the northern and southern parts of GSA 22. Each time, catch, discards, and landings were recorded for each gear type and fleet segment. Based on this sampling, total discards were estimated by species, gear type, and GSA. No length distribution of discards was provided for GSAs 22-23.

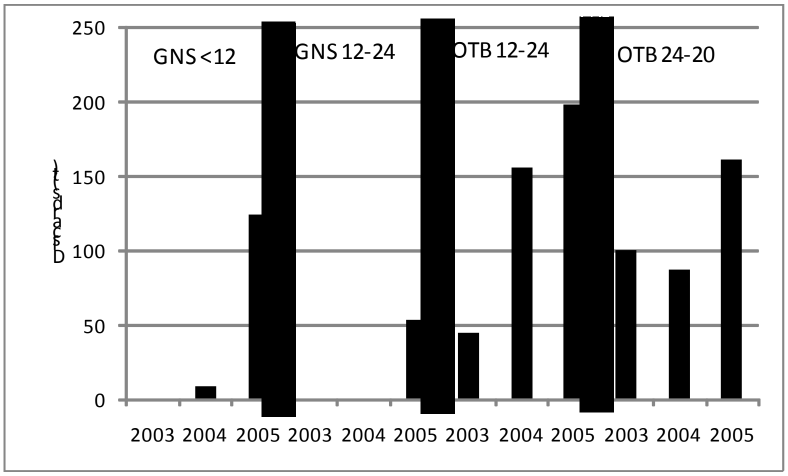


Fig. 7.15.2.3.2.1. Discards of hake in GSA 22-23 per fleet segment.

Discards of hake in bottom trawl fishery in GSAs 22-23 were estimated 147, 244 and 360 t for the years 2003, 2004 and 2005, respectively (Fig. 7.15.2.3.2.1). Discards for the gillnet fishery were reported in 2004 (9 t) for the segment <12 m and for 2005 (179 t) for both segments. The ratio of discards to total catch was less than 0.05 for the gill nets and ranged from 0.06 to 0.09 for bottom trawl. No discards from the longline fishery were reported.

7.15.2.3.3. Fishing effort

Estimation of effort was based on interviews conducted with random sampling in 127 sampling stations (ports) in GSA 22-23. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type were randomly selected and effort was recorded. In addition, all fishing vessels present in the sampling stations were categorized as full-time, part-time, occasionally fishing, or inactive, and the proportion of the year they were active was estimated. Based on this information, sampled data were raised to the whole fleet to estimate total effort per fleet segment, fishing gear, and GSA. Should be noted that the estimated effort do not refer to the effective effort targeting to hake but to the entire effort of each fleet segment. This is very important for the long lines and gill nets because the effort targeting hake is much smaller than the effort of the fleets.

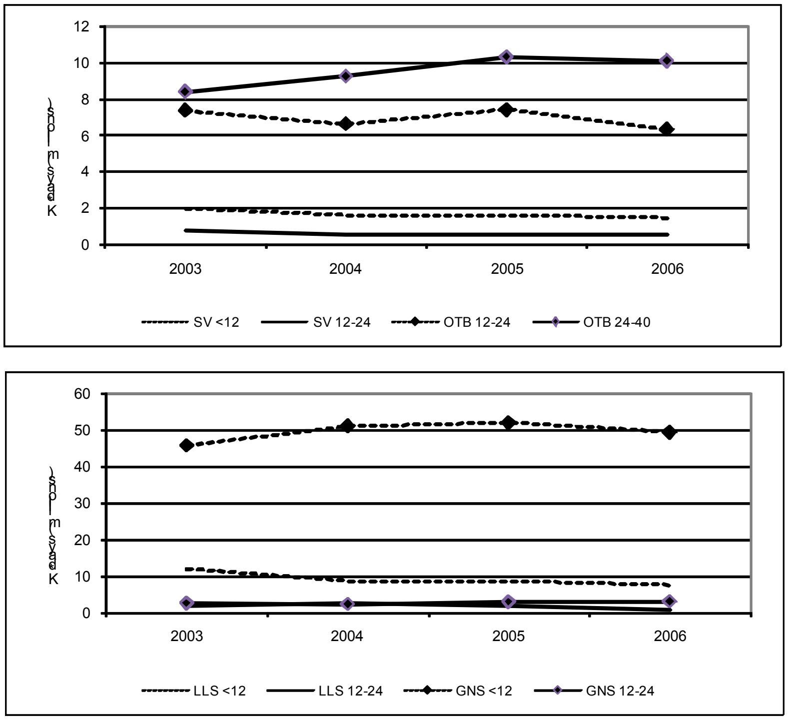


Fig. 7.15.2.3.3.1 Fishing effort per fleet segment in GSAs 22-23.

The fishing effort of the small bottom trawlers (12-24 m), of small gill netters (<12 m) and of the longliners decreased whereas the effort of the big bottom trawlers and gill netters increased (figure 7.15.2.3.3.1).

Tab. 7.15.2.3.3.1 lists the fishing effort reported to SGMED-08-04 through the DCR data call. The overview is given in Tab. A3.7-3.9 of Appendix 3 to this report.

Tab. 7.15.2.3.3.1 Fishing effort in different units by fishing technique deployed in GSAs 22 and 23, 2003-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	22+23	GRE	GNS		1499507	1445880	1529002	1479134	
DAYS	22+23	GRE	LLS		381095	295005	315854	253335	
DAYS	22+23	GRE	OTB		52536	53389	56580	52831	
DAYS	22+23	GRE	SV		36266	31987	33200	30098	
GT*DAYS	22+23	GRE	GNS		5837915	5675508	5782002	5610405	
GT*DAYS	22+23	GRE	LLS		1762101	1660263	1602486	1323112	
GT*DAYS	22+23	GRE	OTB		4927349	4971783	5553804	5554194	
GT*DAYS	22+23	GRE	SV		294896	269645	276265	257271	
KW*DAYS	22+23	GRE	GNS		48227268	53304432	54981971	52423637	
KW*DAYS	22+23	GRE	LLS		14158502	11416302	10631705	8283337	
KW*DAYS	22+23	GRE	OTB		15792715	15877180	17730748	16402915	
KW*DAYS	22+23	GRE	SV		2775797	2206815	2193550	2022231	

7.15.3. Scientific surveys

7.15.3.1.Medits

7.15.3.1.1. Methods

Tables TA, TB, TC were provided according to the MEDITS protocol. The MEDITS survey was carried out in GSAs 22-23 every summer from 1994 to 2006, except in 2002 because of administrative problems. For similar reasons, no MEDITS survey was conducted in Greece in 2007. In GSA 22 and 23, the number of stations was 98 in 1994 and gradually increased to 146 in 1996 and onwards. During the first two years (1994, 1995) the survey was conducted by two scientific teams from two institutes but with the same vessel. From 1996 three scientific teams were involved. During 1996 and 1997 two commercial vessels were used, and three vessels from 1998. Due to these changes in the survey design, caution is needed when investigating the trends of relevant indicators in the MEDITS time series. More details on methodology and trends on selected indicators may be found in MEDITS (2007).

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSAs 22 and 23 the following number of hauls were reported per depth stratum (s. Tab. 7.15.3.1.1.1).

Tab. 7.15.3.1.1.1. Number of hauls per year and depth stratum in GSAs 22 and 23, 1994-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA22+23_010-050	10	10	11	10	13	12	13	13		13	13	14	14	
GSA22+23_050-100	17	21	22	28	24	26	21	25		25	23	24	24	
GSA22+23_100-200	19	25	37	36	36	33	37	35		36	43	41	41	
GSA22+23_200-500	28	35	44	50	51	51	50	48		51	52	52	52	
GSA22+23_500-800	18	12	19	21	22	21	20	17		17	16	17	16	

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.15.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.15.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSAs 22 and 23 was derived from the international survey Medits. Fig. 7.15.3.1.3.1 displays the estimated trend in hake abundance and biomass in GSAs 22 and 23.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices in 2006 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

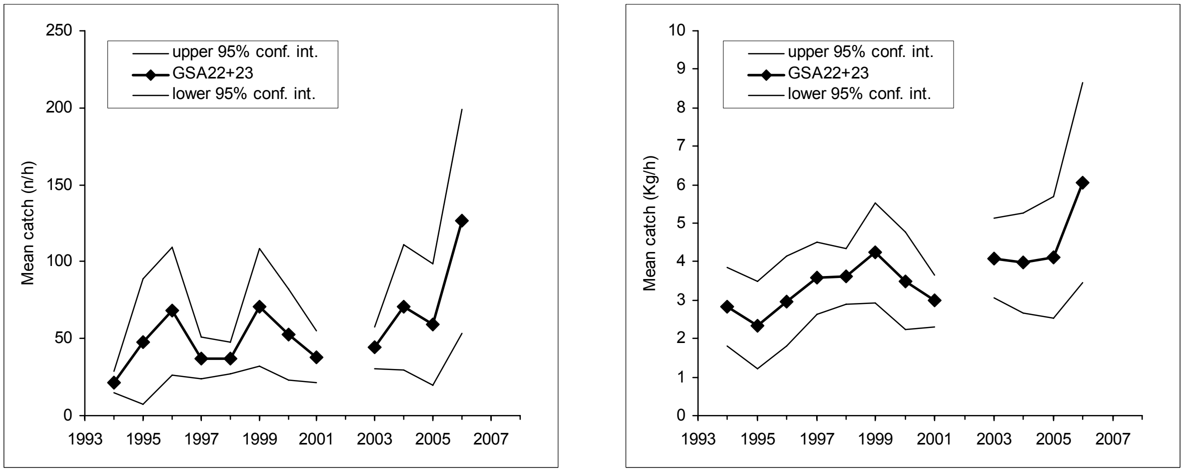


Fig. 7.15.3.1.3.1 Abundance and biomass indices of hake in GSAs 22 and 23.

7.15.3.1.4. Trends in abundance by length or age

The following Fig. 7.15.3.1.4.1 and 2 display the stratified abundance indices of GSAs 22and 23 combined in 1994-2001 and 2003-2006. These size compositions are considered preliminary.

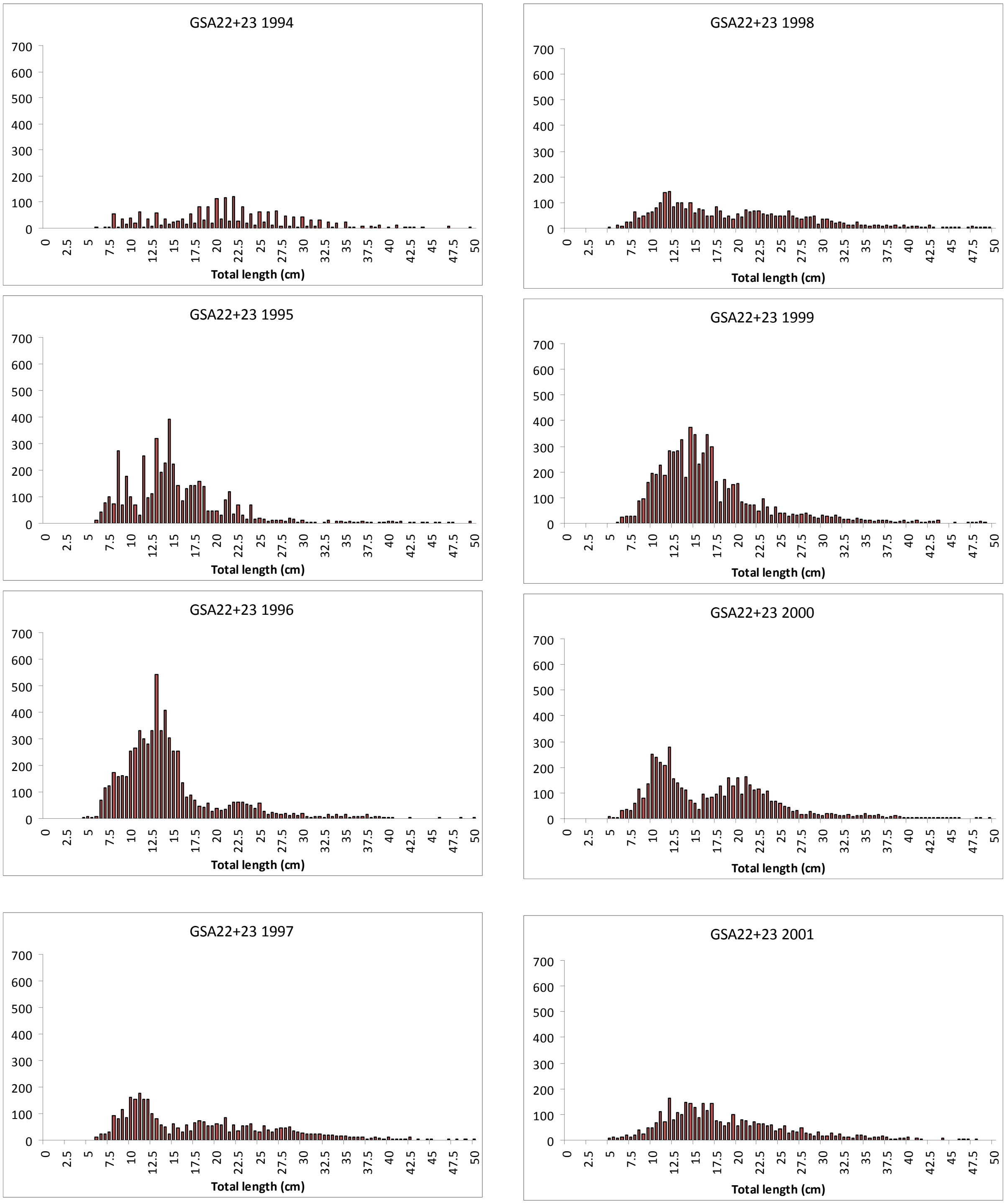


Fig. 7.15.3.1.4.1 Stratified abundance indices by size, 1994-2001.

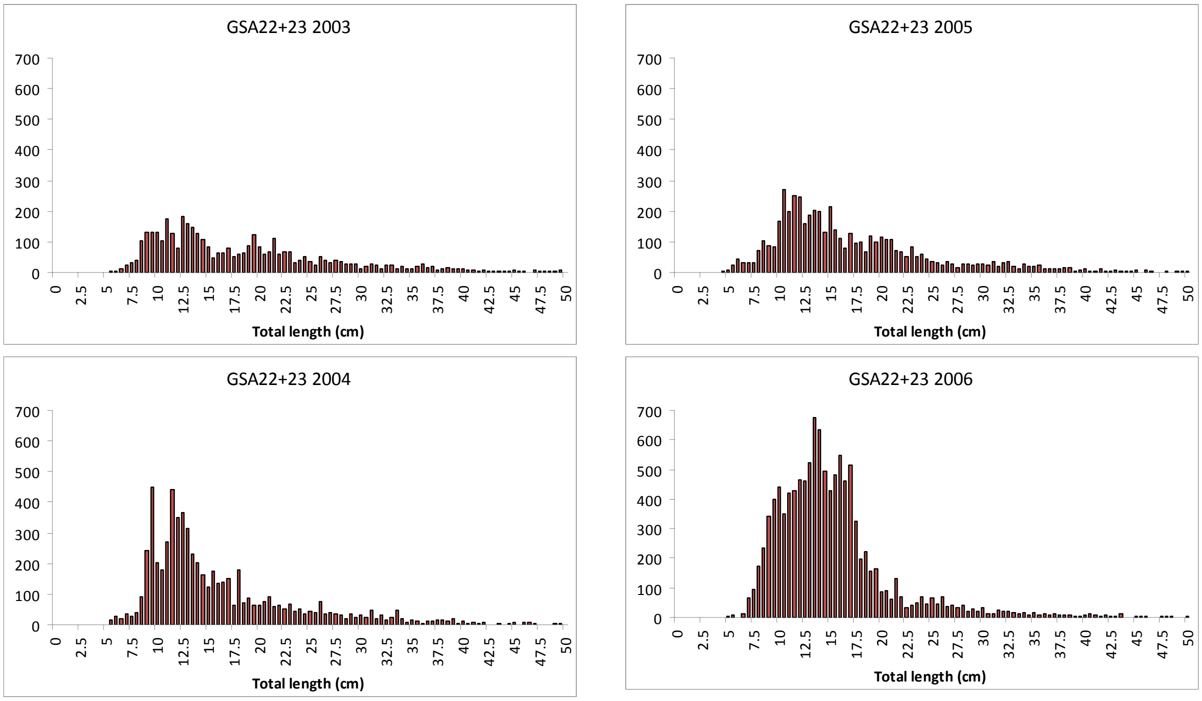


Fig. 7.15.3.1.4.2 Stratified abundance indices by size, 2003-2006.

7.15.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04.

7.15.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04.

7.15.4. *Assessment of historic stock parameters*

7.15.4.1.Method 1: SURBA (Survey Based Assessment)

7.15.4.1.1. *Justification*

Some of the requested data in the official data call were not available from Greece at the meeting. No data on length distribution of the landings, age distribution of the landings, maturity ogive for males, sex ratio at length, and discards length distribution were provided. Due to the lack of available data, many of the methods for stock assessment proposed in the previous meetings of SGMED were impossible to apply. The MEDITS data (1994-2004) were surveyed with the use of the software SURBA. ALADYM was also used to make simulations based on different management scenarios.

SURBA 2.0 is a simple survey-based separable model of mortality. The package calculates relative indices regarding the stock status and not the actual number of individuals in the population or actual biomass. SURBA models include a simple, deterministic forecasting capability. This is done by rolling the survey-estimated population forward through time, assuming fixed geometric mean recruitment and the fitted year and age effects.

7.15.4.1.2. Input parameters

The data needed for SURBA are estimates of natural morality at age, proportion mature at age and stock weights at age. MEDITS survey data (1994-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters (hake females)

Linf	100.7
k	0.248
to	-0.35

Weight-length relationship

a (W-L)	0.0000035
b (W-L)	3.196

Length at age

1	28.65
2	44.48
3	56.82
4	66.46
5	73.98
6+	79.85

Mortality at age

	1	**2**	**3**	**4**	**5**	**6+**
For all years	1.3	0.66	0.48	0.40	0.35	0.32

Mature at age

	1	**2**	**3**	**4**	**5**	**6+**
For all years	0.1	0.4	0.8	0.9	1	1

7.15.4.1.3. Results

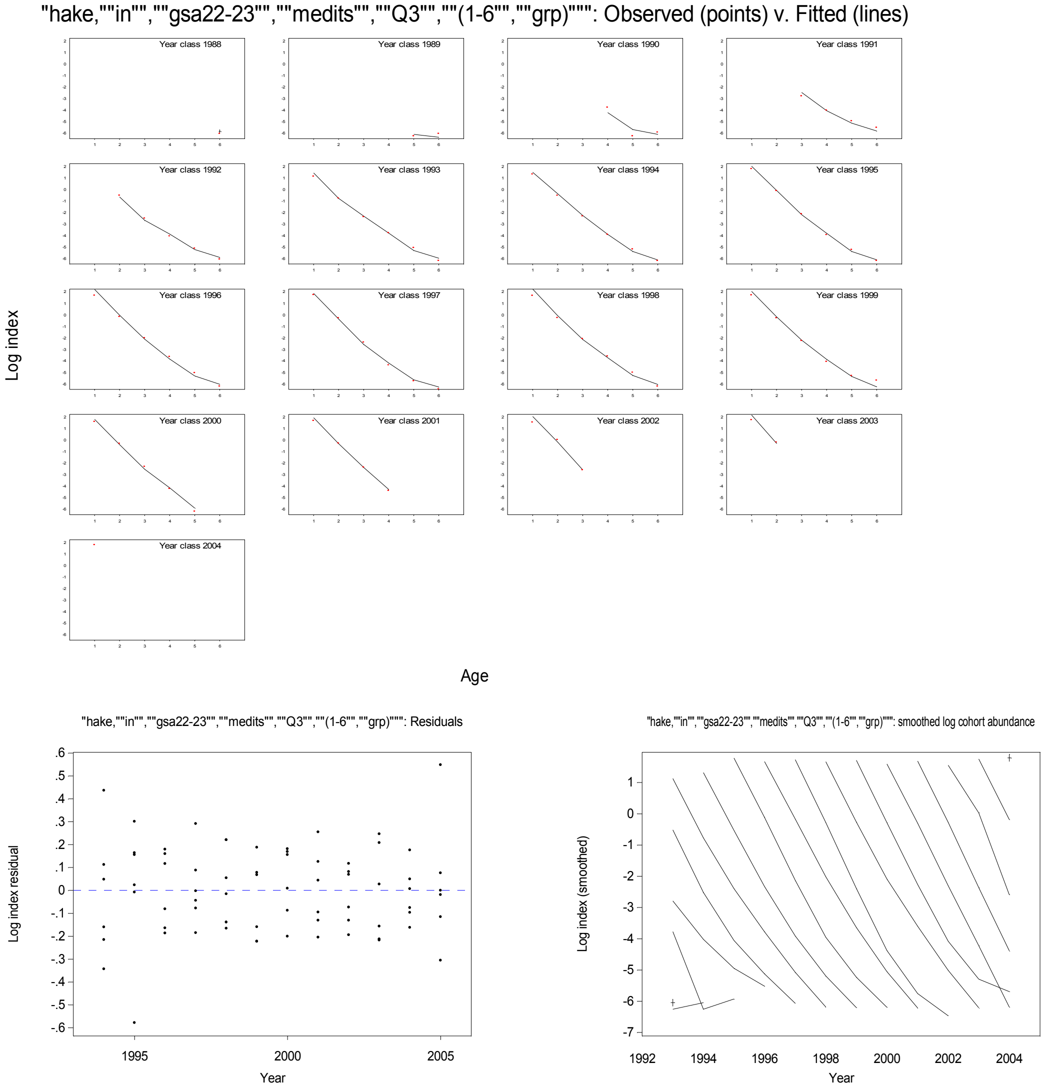


Fig. 7.15.4.1.3.1 Model diagnostics of the model fitted on hake (females) in GSAs 22 and 23.

Results obtained with SURBA 2.0 showed an adequate fitting of the model in hake (females) data in GSAs 22 and 23 (Fig. 7.15.4.1.3.1 and Fig. 7.15.4.1.3.2).

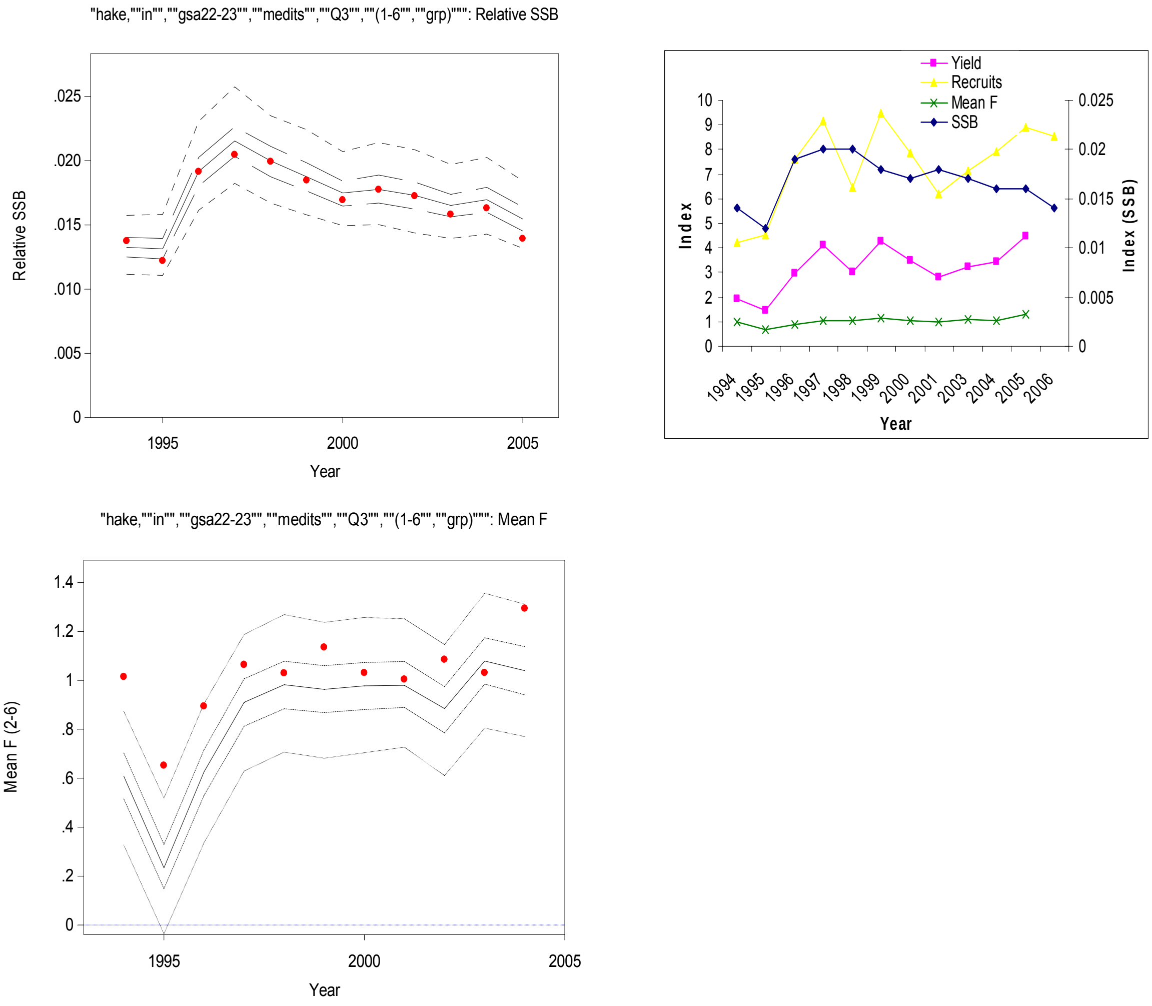


Fig. 7.15.4.1.3.2 Stock summary of the model fitted on hake (females) in GSAs 22 and 23.

An increase until 1998 and a decrease afterwards was recorded on relative SSB of hake. Recruits, yield and mean F showed an increase over time.

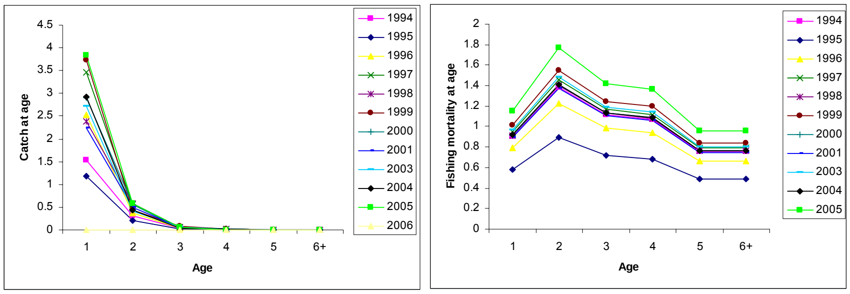


Fig. 7.15.4.1.3.3 Catch at age and fishing mortality at age of hake (females) in GSA 22, 23.

Most of hake was caught in the 1st age class when the fish were generally small and immature (Fig. 7.15.4.1.3.3).

For the hake stock, in GSA 22-23, the proportion of the nets and long line landings were constantly higher than 50%. Length data were provided for the main gears for the years 2004, 2005 and 2006. However, the quality of the nets and long lines length data was not adequate and the attempt to run VIT was not successful. The sampling effort on the landings of nets and long lines should be increased in the future in order to provide an accurate length distribution.

Additionally, the lack of length distribution of discards is another source of bias and misestimating. Length and age data on discards and age data on landings should be available for the next meetings.

The landings data should be recalculated and the rising factor for the nets and the long line fisheries should be corrected to the effective fishing effort (the effort targeting hake) and not the total effort of the small scale fisheries vessels of the area.

The discards for GNS in year 2005 for the vessels <12 m maybe should be re-estimated. The reported value of 125 tones maybe is not reasonable taking into account that for this segment during 2003 and 2004 the the quantities were negligible.

Assessment based only on scientific survey is rather difficult to be the basis for scientific advice for fisheries management. There are many factors affecting the performance of the sampling gear which are difficult to be measured, calibrated and regulated. Still there is an open discussion about the distribution of the data coming from scientific surveys and how they should be treated statistically.

In each model there are underlining assumptions. The length frequency used is assumed to be representative of the sampled population. But this is not the case for hake, as is common opinion between the Mediterranean scientists and fishermen that the mature individuals males and females are raising from the bottom and big part of the population is out of the capture range of bottom trawl. Additionally, the distribution of the sampled population could vary from year to year (is depended on many factors, like abundance, environmental parameters, time of fishing etc) and there is a concern if the indices are always a precise estimation of the abundance.

Growth parameters are needed in order to translate the length to age and for hake there is not agreement between the scientists. The survey, in the GSA 20, 22-23, didn't take place the same time. Two months difference could lead in different conclusions, depending on the recruitment time of the species.

7.15.5. Short term prediction for 2008 and 2009

7.15.5.1. Justification

No forecast analyses were conducted.

7.15.5.2. Input parameters

No forecast analyses were conducted.

7.15.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for hake in GSAs 22 and 23.

7.15.6. Medium term prediction Method 1: ALADYM

7.15.6.1.Justification

ALADYM is a simulation model, belonging to the group of dynamic pool models. The model simulates population dynamics of a single species following the simultaneous evolution of several cohorts at monthly intervals and accounting for sex differences in growth, maturity and mortality. It is a non-equilibrium approach capable of working also in the absence of fishery-dependent information in order to explore alternative management strategies and predict their consequences in the medium and long term. A summary of requirements, strengths, weaknesses, outputs, and several examples are provided in SGMED-08-01 and SGMED-08-02 reports.

7.15.6.2.Input parameters

The data needed for ALADYM are growth parameters, length-weight relationships, an initial estimate of total mortality, natural mortality, recruitment and spawning season and peak, stock recruitment relationship or a recruitment vector, selectivity parameters of the gears used by the fleet, and a fishing activity coefficient by month.

The following input parameters were used:

	Females	**Males**	**Comments**
Linf	1007	728	French growth data
k	0.25	0.3	
to	min: -0.47 max: -0.34	min: -0.47 max: -0.34	
Lifespan	12	10	
a (W-L)	0.000002377	0.000003489	
b (W-L)	3.196	3.122	
M	Chen-Watanabe equation		
vector of offspring/month	.18 .19 .12 .05 .07 .09 .03 .03 .03 .03 .04 .15		based on GSI temporal variation
sex ratio	0.5		
gear selectivity	L50 = 123 mm L75 - L25 = 49 mm		selectivity experiment

Quarterly fishing coefficients (based on official catch data)

year	**1st**	**2nd**	**3rd**	**4th**
2003	1.01	1.14	0.69	1.15
2004	0.83	0.90	0.79	1.48
2005	1.05	1.08	0.62	1.25
2006	1.08	0.97	0.65	1.30
average	0.99	1.02	0.69	1.30

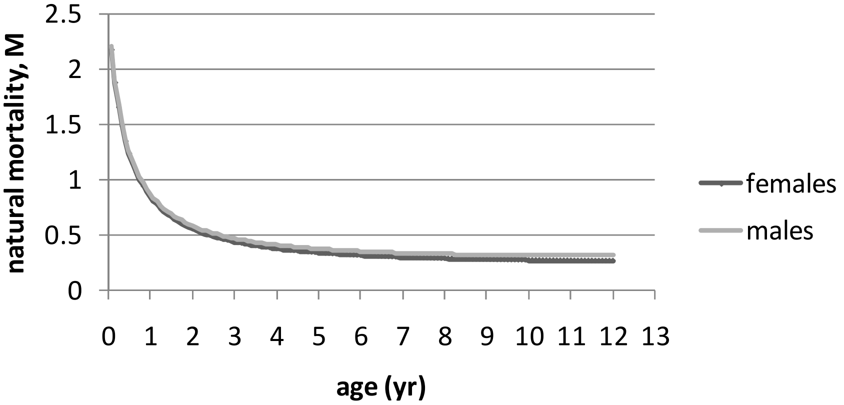


Fig. 7.15.6.2.1 Assumed natural mortality, based on the Chen-Watanabe equation

A constant recruitment was assumed, independent of stock size, i.e. the stock-recruitment relationship was assumed to be a horizontal line.

Simulations were based on 5 scenarios. In the 'present status' scenario all parameters were kept constant at current levels. In the other scenarios, a management action has been put forward, starting from year 2007. The quarterly fishing coefficients were taken as the average of the coefficients for the years 2003 to 2006. In the '20% pressure reduction scenario' it was assumed that fishing pressure was reduced by 20% (the fishing coefficients were reduced by 20%). In the 'increased mesh size' scenario, the selectivity pattern of the fishing gears was changed assuming an increase of Lc_{50} to a value of 200 mm, which is the minimum legal size of hake landings according to current legislation. In the 'summer closure' scenario, the fishery was completely closed during the 3rd quarter (July to September). In the 'all measures' scenario, all the above measures were implemented simultaneously.

7.15.6.3.Results

The results of the Aladym model in terms of change/impact of main model-based indicators and reference points (biomass, yield, ESSB/USSB, Zfemale, mean age of the spawning stock) in the long-term are synthesised at annual time scale and reported in the following figures.

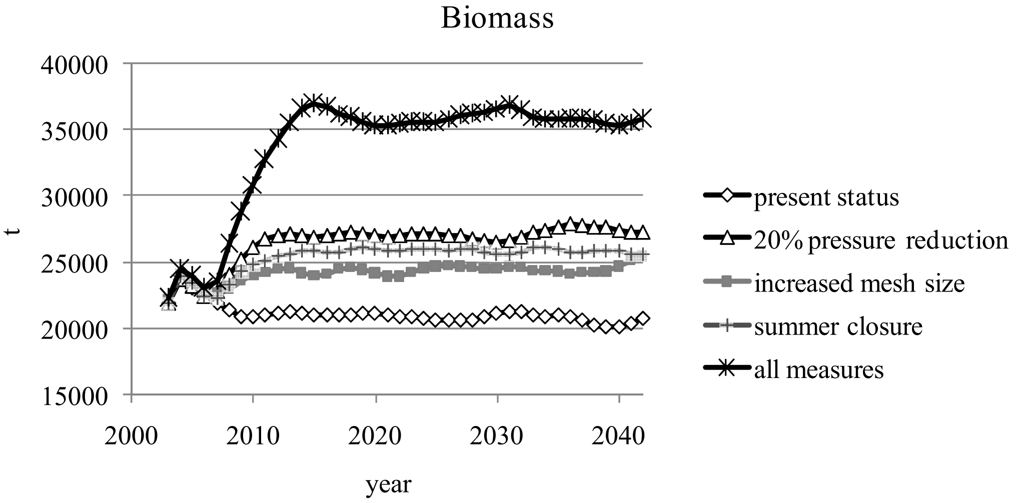


Fig. 7.15.6.3.1 Simulated time series of biomass by ALADYM, based on 5 scenarios

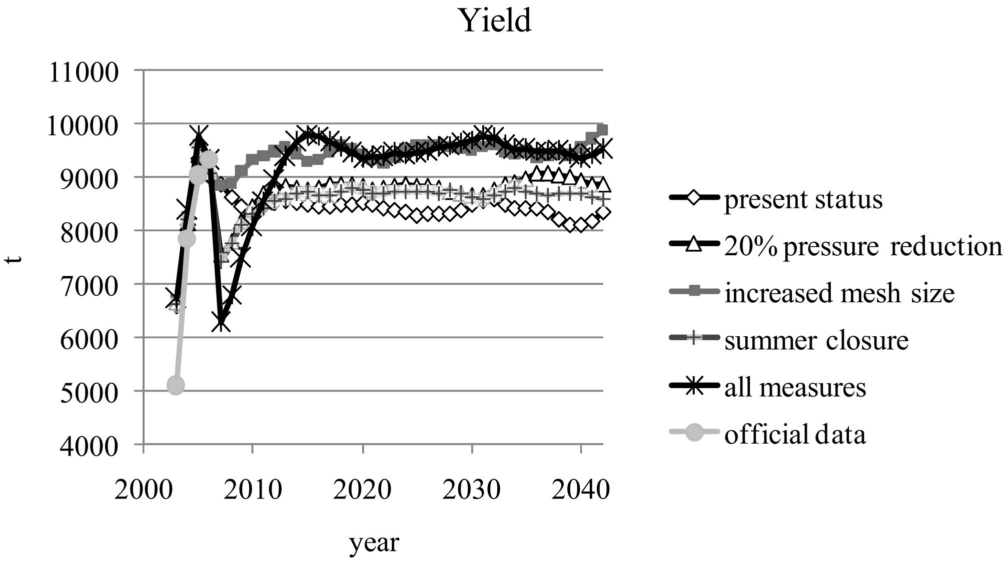


Fig. 7.15.6.3.2 Simulated time series of yield by ALADYM, based on 5 scenarios

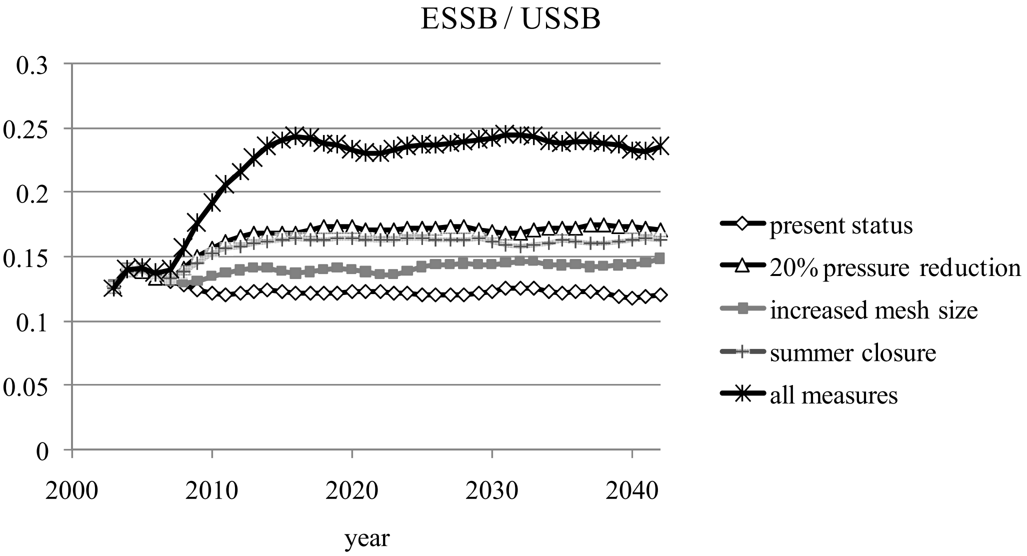


Fig. 7.15.6.3.3 Simulated time series of the ratio of exploited spawning stock biomass to unexploited spawning stock biomass by ALADYM, based on 5 scenarios

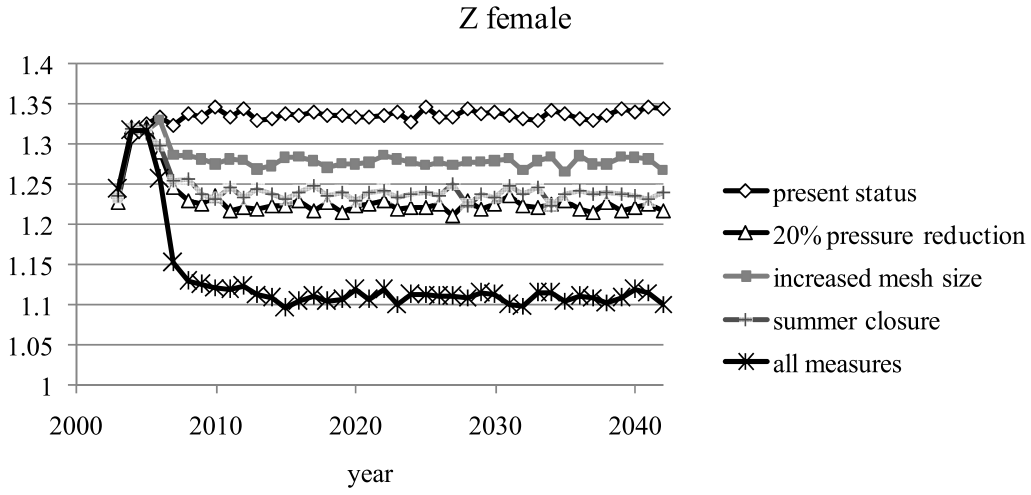


Fig. 7.15.6.3.4 Simulated time series of female mortality by ALADYM, based on 5 scenarios

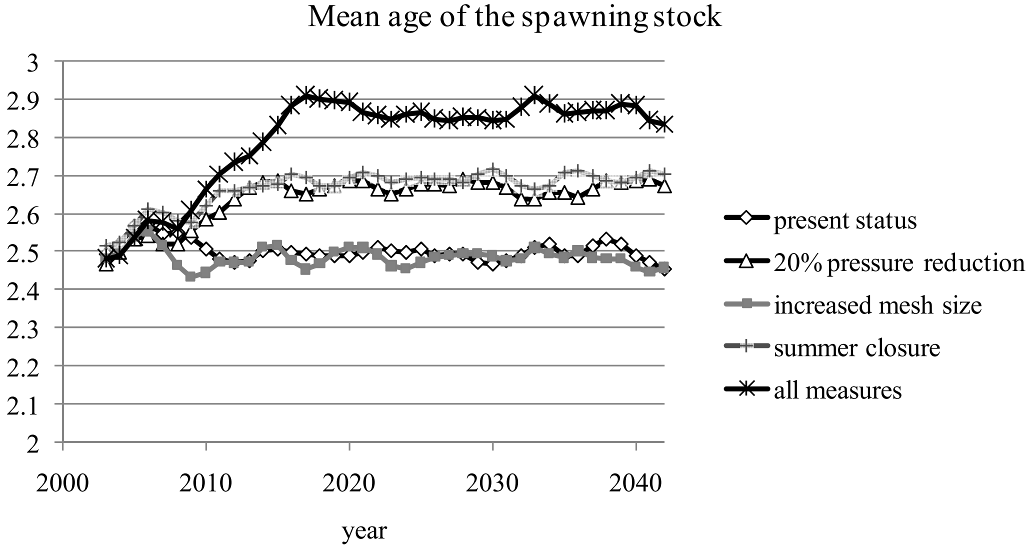


Fig. 7.15.6.3.5 Simulated time series of the mean age of the spawning stock by ALADYM, based on 5 scenarios

Results highlighted that the current situation of hake stock exploitation would substantially be improved under some of the management scenarios tested. The three basic scenarios (‘20 % pressure reduction’, ‘increased mesh size, ‘summer closure’) are compared hereafter. Biomass of the hake stock would increase with any of the three management measures; the highest increase would occur after a decision for a 20% pressure reduction in the hake fishery and the lowest increase after a decision for a mesh size increase. The ‘all measures scenario’ would cause an increase of the stock biomass by more than 70% in the long term. Total mortality of the females would decrease under all scenarios; the highest decrease would occur with a 20% pressure reduction in the hake fishery and the lowest decrease by increasing mesh size. Mean age of the spawning stock would not be substantially affected by increasing mesh size but would increase with all the other measures. Yield would decrease in the short term with all management scenarios in relation to the present status and this decrease would be quite pronounced with the ‘all measures’ scenario. In the long term, yield would increase with all four management scenarios with a more pronounce increase with the ‘increased mesh size’ scenario. The sustainability reference point ESSB/USSB would substantially rise in the long-term under all management scenarios.

7.15.7. Long term prediction

7.15.7.1. Justification

No forecast analyses were conducted.

7.15.7.2. Input parameters

No forecast analyses were conducted.

7.15.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for hake in GSAs 22 and 23.

7.15.8. Scientific advice

SGMED-08-04 considers all analyses presented to assess the status of hake in GSAs 22-23 as preliminary and not suitable to provide sound scientific advice.

7.15.8.1. Short term considerations

7.15.8.1.1. State of the spawning stock size

SGMED-08-03 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.15.8.1.2. State of recruitment

SGMED-08-03 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.15.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.15.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.16. Stock assessment of red mullet in GSA 01

7.16.1. Stock identification and biological features

7.16.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.16.1.2. Growth

No information was documented during SGMED-08-04.

7.16.1.3. Maturity

No information was documented during SGMED-08-04.

7.16.2. Fisheries

7.16.2.1. General description of fisheries

STECF (second stock review in 2007) notes that this species mainly appears in the mixed catches of bottom trawlers operating in sandy areas, being also caught with set gears, in particular trammel-nets and gillnets. Catch data are incomplete. Red mullets (*Mullus barbatus* and *Mullus surmuletus*) are one of the most important target species for the trawl fisheries. In the GSA 1 there are 142 trawlers that land over 150 t by year.

7.16.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.16.2.3. Catches

7.16.2.3.1. Landings

Landings data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.2 of Appendix 3. Only landings by otter trawlers are considered, which increased from 68 t in 2002 to 138 t in 2007.

Table 7.16.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	1	ESP	OTB	68	81	109	94	109	138

7.16.2.3.2. Discards

No information was documented during SGMED-08-04.

7.16.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9.

7.16.3. Scientific surveys

7.16.3.1.Medits

7.16.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 01 the following number of hauls were reported per depth stratum (s. Tab. 7.16.3.1.1.1).

Tab. 7.6.3.1.1.1. Number of hauls per year and depth stratum in GSA 01, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.16.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.16.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 01 was derived from the international survey Medits. Figure 7.16.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 01.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2006 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

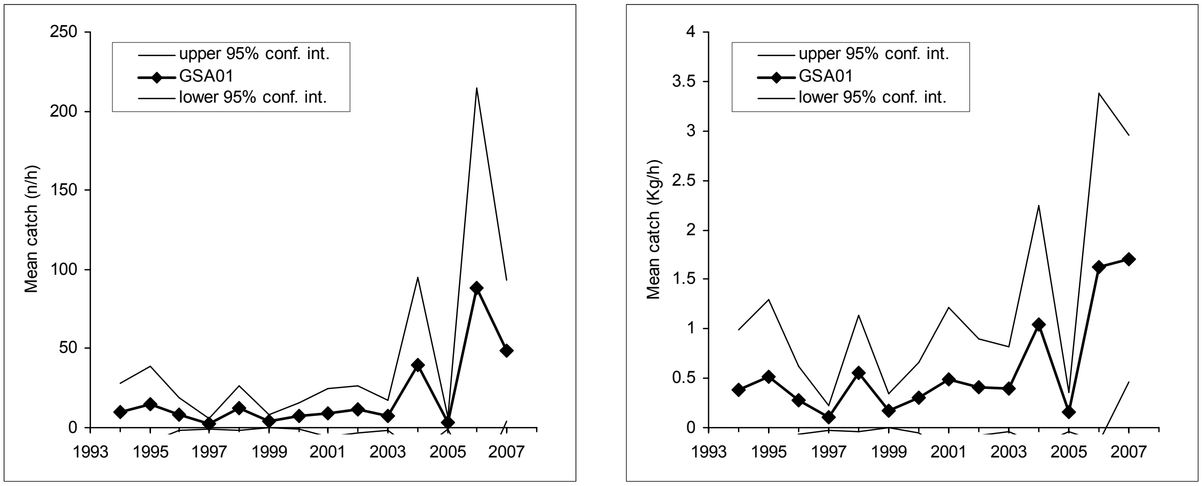


Fig. 7.16.3.1.3.1 Abundance and biomass indices of red mullet in GSA 01.

7.16.3.1.4. Trends in abundance by length or age

The following Fig. 7.6.3.1.4.1 and 2 display the stratified abundance indices of GSA 01 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

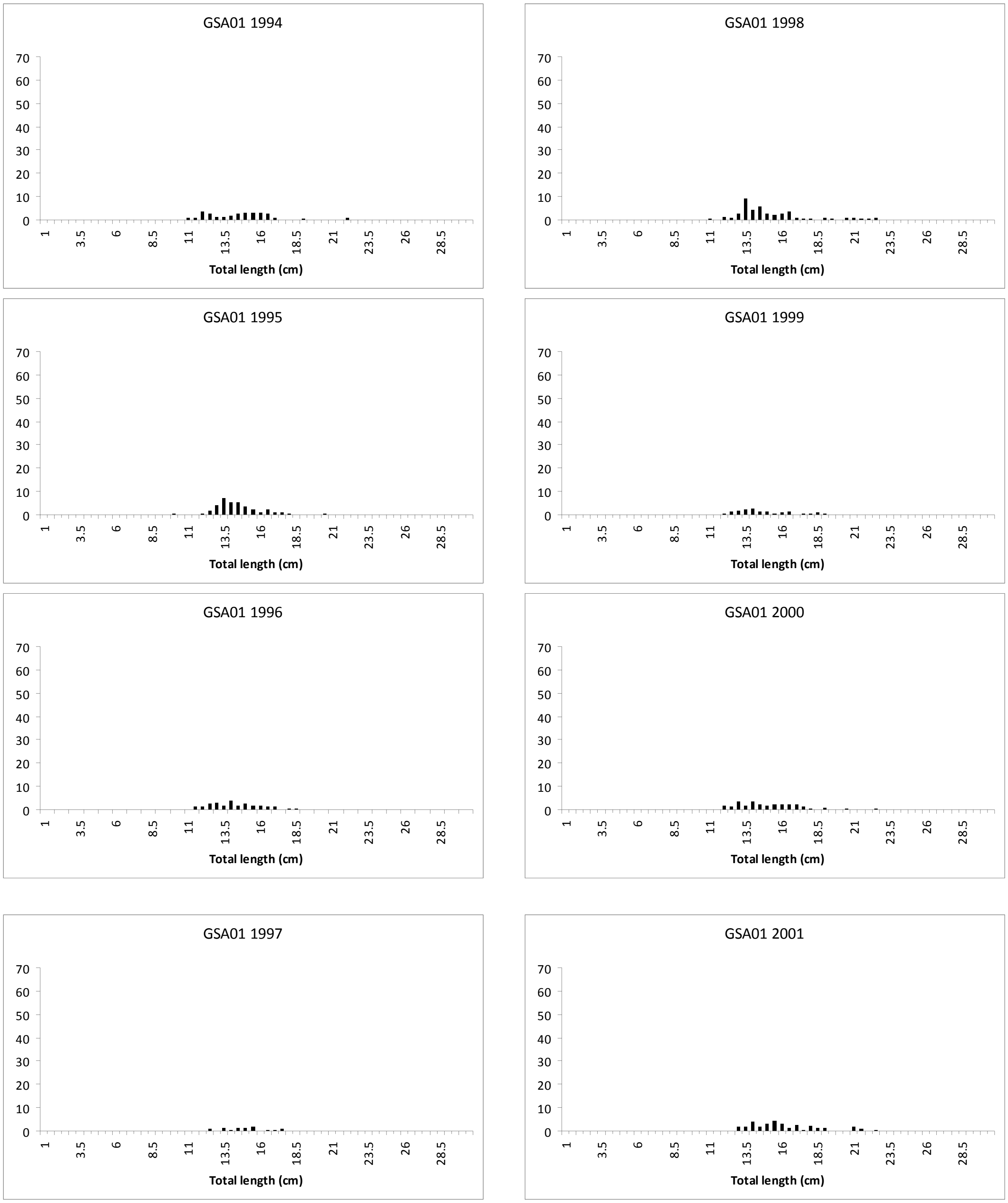


Fig. 7.16.3.1.4.1 Stratified abundance indices by size, 1994-2001.

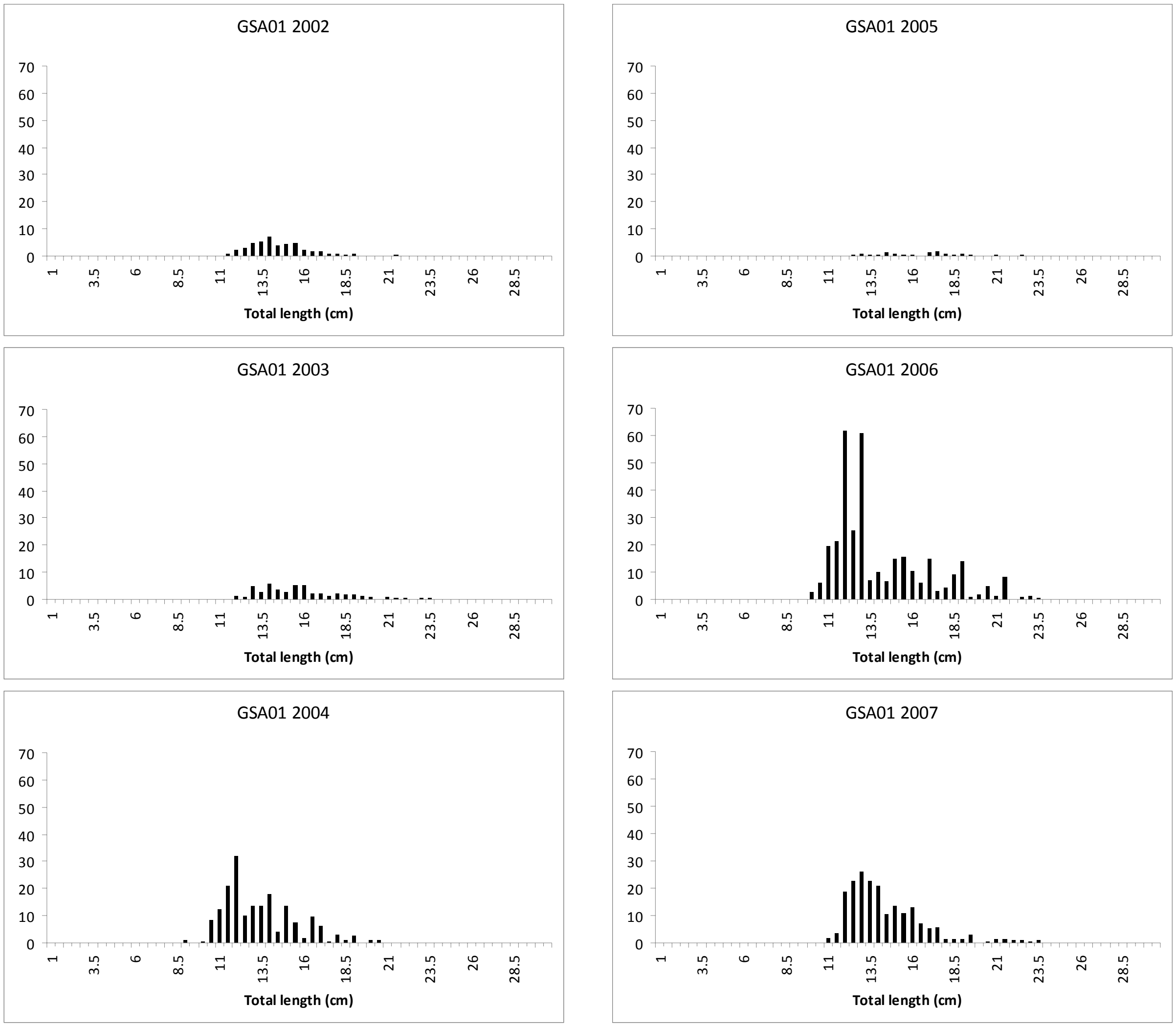


Fig. 7.16.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.16.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.16.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.16.4. Assessment of historic stock parameters

7.16.4.1.Method 1: VIT

7.16.4.1.1. Justification

The last assessment of this stock was presented in 2004 to the GFCM by Quetglas et al. It was performed a pseudocohort analysis using a single year (2003). Both a VPA and a yield per recruit (Y/R) analysis were carried out using the VIT software (Lleonart and Salat 1992). The result of this assessment was that *Mullus barbatus* in GSA01 was overexploited. This does not agree with the results of the present assessment, but it must be taken into account that the size distributions used in both cases are very different. In Quetglas et al (2004) the modal size was 10 cm, while in the new data set this modal size increased up to 14-15 cm.

Since there are not data on length-frequency distributions for *M. barbatus* in GSA01 before 2005, this assessment using pseudocohort analysis may be considered as near definitive. Although the main work is done (pseudocohort and Y/R analyses), other procedures such as sensitivity analyses should be carried out.

Since only three years of data were available (2005–2007), a pseudocohort analysis was carried out. This pseudocohort is the mean number of individuals by age and mean catch from 2005–2007. Furthermore, a yield per recruit (Y/R) analysis was also performed. For both analyses, the VIT software (Lleonart and Salat 1992) was used.

7.16.4.1.2. Input parameters

The length frequency distributions used showed the same size range throughout the three years and seems appropriate for pseudocohort analysis, which assumes steady state.

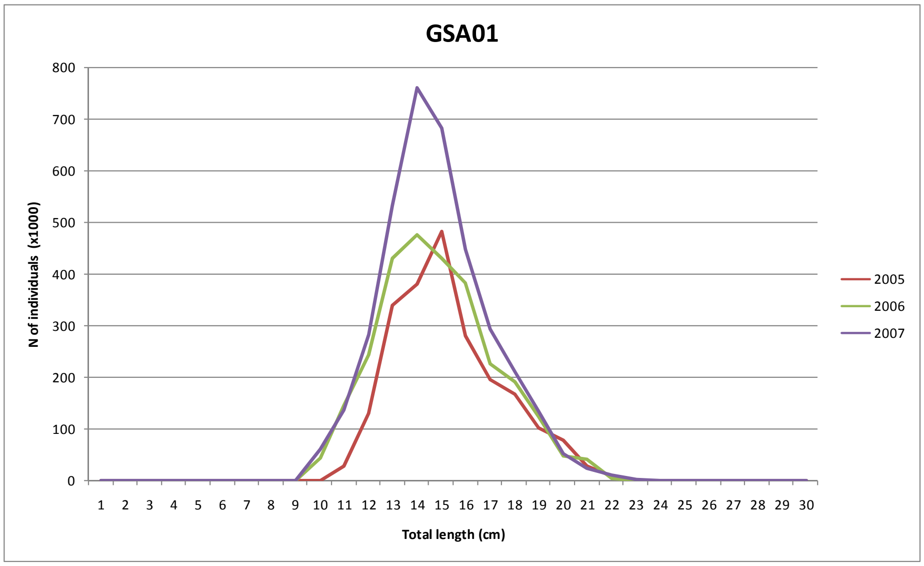


Fig. 7.16.4.1.2.1 Total landings at length showing an increasing trend from 2005 to 2007.

The biological parameters used were the following:

One of the sets of growth parameters accorded during the present meeting was used: Linf=26.0, K=0.41, t_0=-0.40.

Length-weight relationships: a=0.0062, b=3.1597; these data come from the Spanish National Data Collection.

Natural mortality by age was calculated using the PROBIOM spreadsheet (Abella et al. 1997), obtaining the following vector:

Age	0	1	2	3	4	5	Mean
M	0.8	0.5	0.3	0.3	0.3	0.2	0.4

Since the data series is too short (3 years) to calculate the terminal fishing mortality (F_t) from the catch curve, the same as the obtained in GSA06 was considered (F_t=1.42) because both areas have a similar exploitation pattern.

The maturity ogive used were obtained from the Spanish National Data Collection in GSA01.

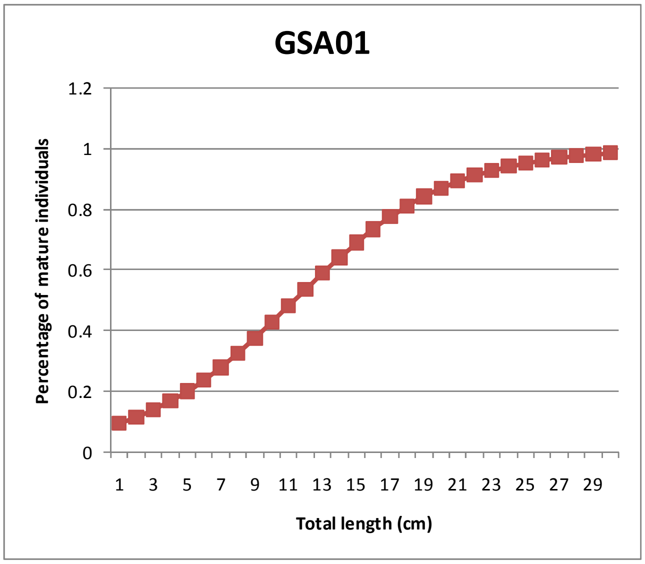


Fig. 7.16.4.1.2.2 Maturity ogive used were obtained from the Spanish National Data Collection in GSA01.

7.16.4.1.3. Results

The following Table 7.16.4.1.3.1 shows the summary results from the pseudocohort analysis. These results show that the actual level of exploitation is moderate and may be sustainable whenever the fishing effort is not increased. Both mean age and mean length are clearly higher in the catch (1.7 yr and 14.8 cm) than in the current stock (0.8 yr and 9.5 cm). Furthermore, the current stock biomass represents 21% of the virgin stock biomass. The figure below shows the vector of fishing mortality by age resulting from the pseudocohort analysis.

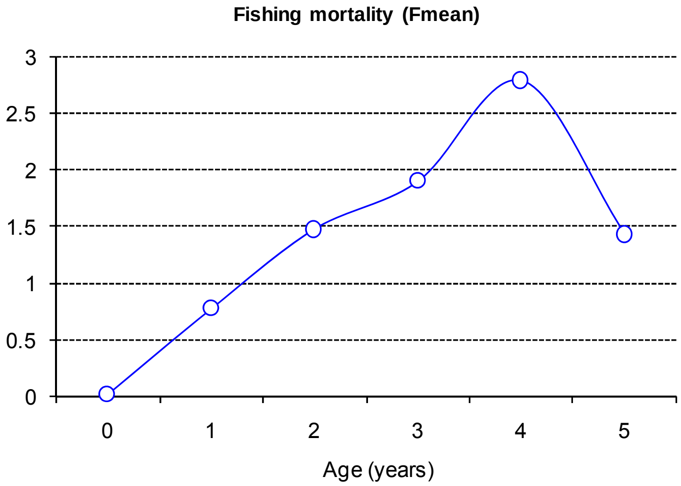


Table 7.16.4.1.3.1 Estimated exploitation pattern over age as derived from the VIT model.

Table 7.16.4.1.3.1 Summary results of stock parameters derived from the VIT model.

---	Total
Catch mean age	1.73
Catch mean length	14.75
Mean F	1.39
Global F	0.29
Total catch (tons)	113.61
Catch/D%	57.69
Catch/B%	80.28
Current Stock Mean Age	0.791
Current Stock Critical Age	1
Virgin Stock Critical Age	4
Current Stock Mean Length	9.51
Current Stock Critical Length	11.36
Virgin Stock Critical Length	21.72
Number of recruits, R ($x10^3$)	11626.97
Mean Biomass, B_{mean} (tons)	141.51
Spawning Stock Biomass, SSB (tons)	86.17
Biomass Balance, D (tons)	196.92
Natural death/D	42.31
B_{max}/B_{mean}	48.93
Turnover, D/B_{mean}	139.16
B_{now}/B_{virgin} (%)	20.7

7.16.5. Short term prediction for 2008 and 2009

7.16.5.1. Justification

No forecast analyses were conducted.

7.16.5.2. Input parameters

No forecast analyses were conducted.

7.16.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 01.

7.16.6. Medium term prediction

7.16.6.1. Justification

No forecast analyses were conducted.

7.16.6.2. Input parameters

No forecast analyses were conducted.

7.16.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 01.

7.16.7. Long term prediction

7.16.7.1. Justification

A Y/R analysis was conducted.

It was also simulated the evolution of the Y/R in the next ten years in case that the effort were reduced by 20%, i.e. reduction from 5 to 4 working days per week.

7.16.7.2. Input parameters

No input data were presented to SGMED-08-04.

7.16.7.3. Results

In the following Table 7.16.7.3.1 lists the results from the Y/R analysis, whereas in the Fig. 7.16.7.3.1 below shows the evolution of Y/R when the actual level of exploitation (factor=1) is doubled (factor=2). The figure indicates signs of overexploitation but it must be taken into account the minimal difference existing between the maximum Y/R (10.6 g) and the current Y/R (9.8 g). Owing to this, the status of this stock would be defined as fully exploited.

Tab. 7.16.7.3.1 Results of the Y/R analysis.

Phi	Factor	Y/R	B/R	SSB
Absence of fishing	0	0	58.85	51.11
$F_{0.1}$	0.26	9.99	28.63	22.24
Y/R_{max}	0.46	10.62	20.63	14.84
Current	1.01	9.77	12.17	7.41
Max factor	2	8.59	7.83	3.99

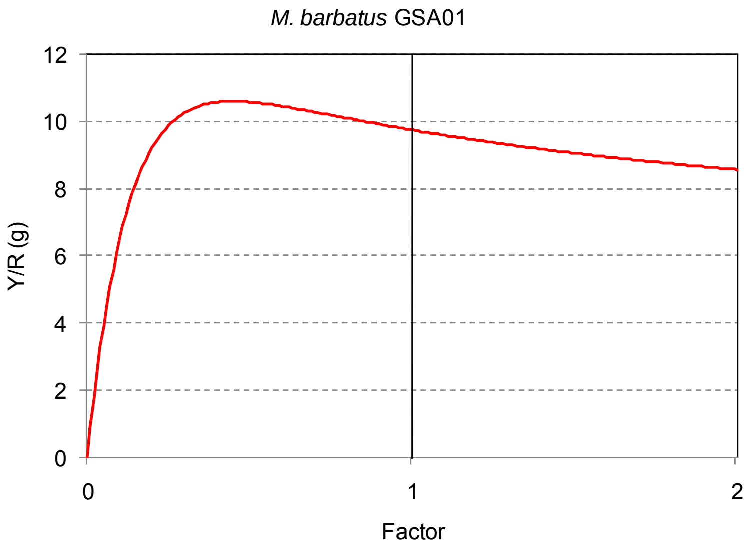
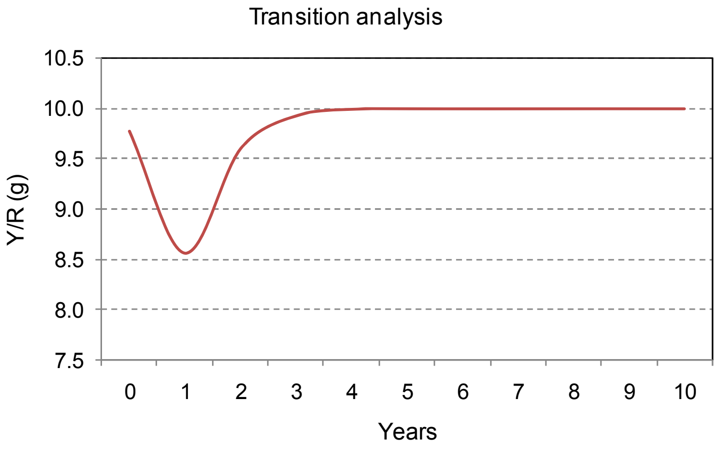


Fig. 7.16.7.3.1 Results of the Y/R analysis.

The analysis of a 20 percent reduction in effort showed a decrease in the first year and a recovery afterwards, but the Y/R maintains constant near the 10 g per recruit during the following years. However, the improvement in Y/R is very low, since it goes from about 9.7 g in the actual fishing level to 10.0 g when the measure in practice obtained their best results.



7.16.8. Scientific advice

7.16.8.1. Short term considerations

7.16.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.16.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.16.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.16.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.17. Stock assessment of red mullet in GSA 06

7.17.1. Stock identification and biological features

7.17.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.17.1.2. Growth

No information was documented during SGMED-08-04.

7.17.1.3. Maturity

No information was documented during SGMED-08-04.

7.17.2. Fisheries

7.17.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that Red mullet (*Mullus barbatus*) is one of the target species of the trawl fishery in the GFCM geographical sub-area 6 (Northern Spain). The trawl fleet operating in this area is composed by 647 boats averaging 47 TRB, 58 GT and 297 HP. Some of these units (smaller vessels) operate almost exclusively on the continental shelf, targeting red mullet, octopus, hake and different species of sea breams. According to official data, landings increased considerably between 1973 and 1982 and from this year until now a decreasing trend has been observed. In the period 1998-2004 landings of this species averaged 1315 t per year.

7.17.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.17.2.3. Catches

7.17.2.3.1. Landings

Tab. 7.17.2.3.1.1 lists the trend in reported landings taken by trawlers (Spain only). The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.2 of Appendix 3. Since 2002 the annual landings varied between 960 and 1,230 t.

Tab. 7.17.2.3.1.1 Annual landings (t) by fishing technique (otter trawlers only) in GSA 06.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	6	ESP	OTB	1159	1004	958	1027	1437	1232

7.17.2.3.2. Discards

No information was documented during SGMED-08-04.

7.17.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9.

7.17.3. Scientific surveys

7.17.3.1. Medits

7.17.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 06 the following number of hauls were reported per depth stratum (s. Tab. 7.17.3.1.1.1).

Tab. 7.17.3.1.1.1. Number of hauls per year and depth stratum in GSA 06, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA06_010-050	7	8	7	7	7	8	9	8	11	9	9	11	11	6
GSA06_050-100	19	26	26	26	28	29	29	31	36	38	31	32	34	27
GSA06_100-200	11	17	17	15	13	17	18	20	20	21	17	18	19	15
GSA06_200-500	10	12	10	12	7	13	12	16	17	18	16	15	18	11
GSA06_500-800	6	8	9	7	4	9	6	8	7	11	11	8	10	8

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.17.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.17.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 06 was derived from the international survey Medits. Figure 7.17.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 06.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices in 2007 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

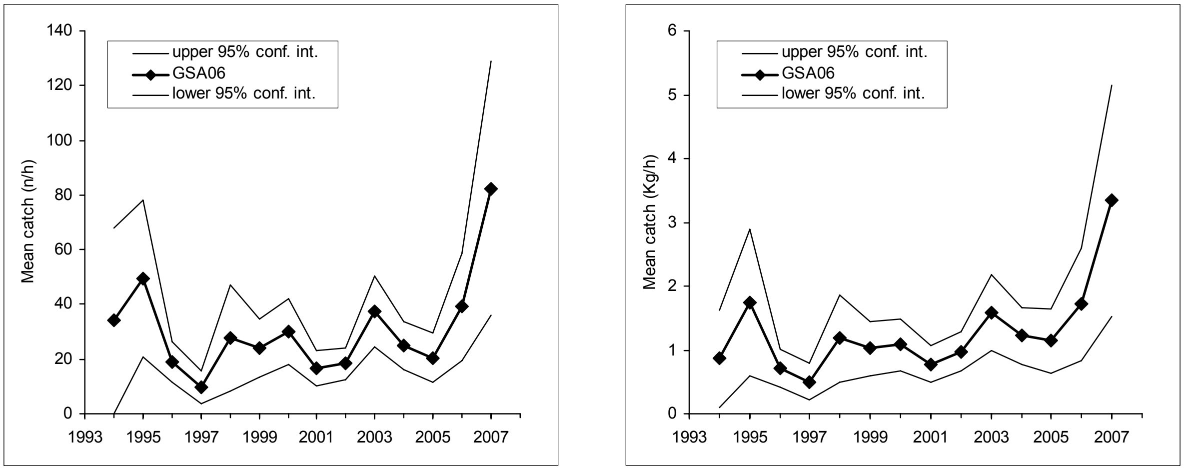


Fig. 7.6.3.1.3.1 Abundance and biomass indices of red mullet in GSA 06.

7.17.3.1.4. Trends in abundance by length or age

The following Fig. 7.17.3.1.4.1 and 2 display the stratified abundance indices of GSA 06 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

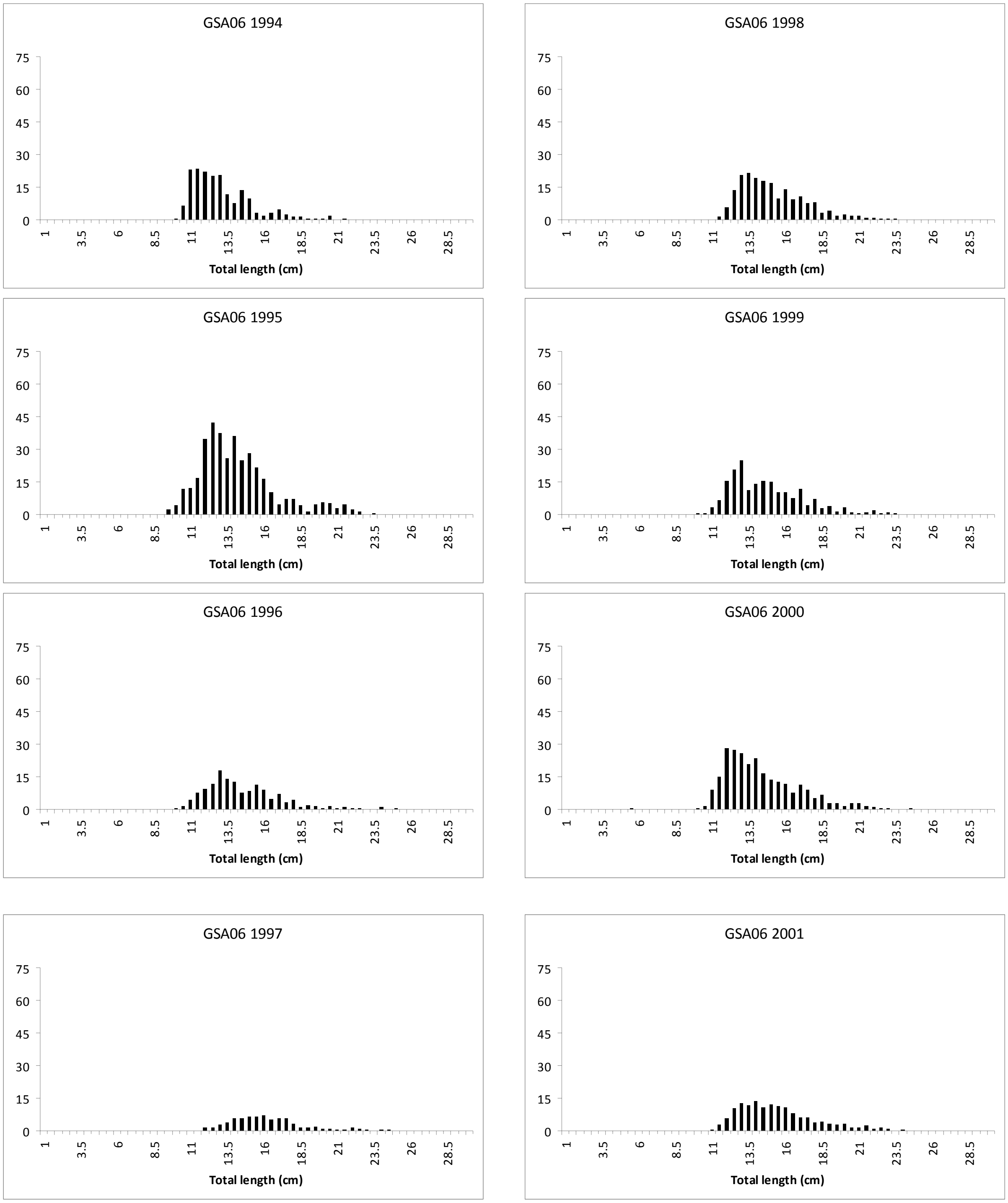
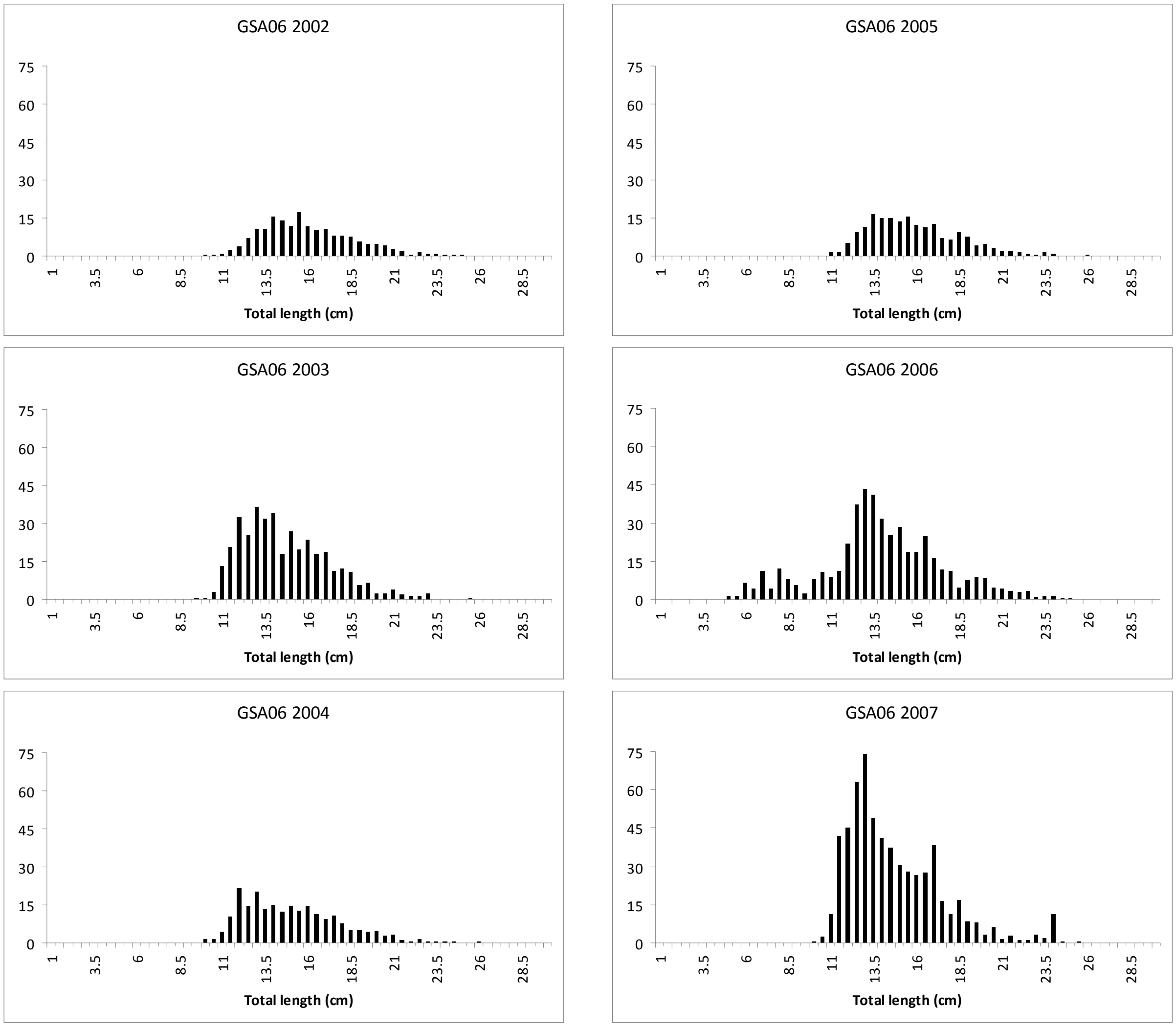


Fig. 7.17.3.1.4.1 Stratified abundance indices by size, 1994-2001.


GSA06 2002

GSA06 2005

GSA06 2003

GSA06 2006

GSA06 2004

GSA06 2007

Fig. 7.17.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.17.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.17.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.17.4. Assessment of historic stock parameters

SGMED-08-04 did not undertake any analytical assessment. SGMED noted that red mullet in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.gfcm.org/ for GSA06 open Doc04-MUT0608Gui.xls

7.17.5. Short term prediction for 2008 and 2009

7.17.5.1. Justification

No forecast analyses were conducted.

7.17.5.2. Input parameters

No forecast analyses were conducted.

7.17.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 06.

7.17.6. Medium term prediction

7.17.6.1. Justification

No forecast analyses were conducted.

7.17.6.2. Input parameters

No forecast analyses were conducted.

7.17.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 06.

7.17.7. Long term prediction

7.17.7.1. Justification

No forecast analyses were conducted.

7.17.7.2. Input parameters

No forecast analyses were conducted.

7.17.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 06.

7.17.8. Scientific advice

SGMED-08-04 reviewed the assessment conducted by GFCM, and came to the following conclusions.

7.17.8.1. Short term considerations

7.17.8.1.1. State of the spawning stock size

Since 1998 spawning stock biomass has been estimated to fluctuate around 600 tons. However, there is an estimated increase observed since 2006 with the highest value of 1200 tons in 2007. In the absence of any biomass references proposed or agreed, SGMED-08-04 is unable to fully evaluate the stock status.

7.17.8.1.2. State of recruitment

Recruitments in the last three years are just above the mean recruitment for the period 1998-2004.

7.17.8.1.3. State of exploitation

Fishing mortality reference points have been proposed for this stock (F0.1=0.16, Fmax=0.24). On the basis of these reference points, SGMED considers the stock to be subject to overfishing.

7.17.8.2. Medium term considerations

Short or medium term projections have not been carried out for this stock.

SGMED recommends the relevant fleet efforts to be reduced until fishing mortality is in the range of $F_{0.1}$-F_{MAX}, in order to obtain high long term sustainable yields.

Transition analysis on technical measures indicates that a 24% increase in Y/R is expected with a change to 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.

7.18. Stock assessment of red mullet in GSA 07

7.18.1. Stock identification and biological features

7.18.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.18.1.2. Growth

No information was documented during SGMED-08-04.

7.18.1.3. Maturity

No information was documented during SGMED-08-04.

7.18.2. Fisheries

7.18.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.18.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.18.2.3. Catches

7.18.2.3.1. Landings

Tab. 7.18.2.3.1.1 lists the trend in reported landings taken by trawlers (France only). The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.2 of Appendix 3. Since 2006 the annual landings varied between 170 and 180 t.

Tab. 7.18.2.3.1.1 Annual landings (t) by fishing technique (otter trawlers only) in GSA 07.

No information was documented during SGMED-08-04.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	7	FRA	OTB					183	172

7.18.2.3.2. Discards

8 t of discards were reported to SGMED-08-04 and are listed in Table A.3.6 of Appendix 3.

7.18.2.3.3. Fishing effort

Tab. 7.18.2.3.2.1 lists the trends in fishing effort by fishing technique deployed in GSA 07, 2004 to 2006 (Tab. A3.7-3.9 in Appendix 3). The data were reported to SGMED-08-04 trough the DCR data call.

Tab. 7.18.2.3.2.1 Trends in fishing effort by fishing technique deployed in GSA 07, 2004 to 2006.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	7	FRA	GNS			81460	76785	93193	
DAYS	7	FRA	LLS			6459	6593	5028	
DAYS	7	FRA	OTB			20561	19327	17991	
GT*DAYS	7	FRA	GNS			329230	305685	315704	
GT*DAYS	7	FRA	LLS			23742	23436	17232	
GT*DAYS	7	FRA	OTB			1610963	1480834	1322919	
KW*DAYS	7	FRA	GNS			7007171	5908142	88698170	
KW*DAYS	7	FRA	LLS			669338	716765	385004	
KW*DAYS	7	FRA	OTB			6361248	5923541	6127438	

7.18.3. Scientific surveys

7.18.3.1.Medits

7.18.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 07 the following number of hauls were reported per depth stratum (s. Tab. 7.18.3.1.1.1).

Tab. 7.18.3.1.1.1. Number of hauls per year and depth stratum in GSA 07, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA07_010-050	12	12	12	14	12	12	12	12	12	13	12	12	12	14
GSA07_050-100	32	32	32	35	39	32	32	32	31	38	31	30	33	31
GSA07_100-200	10	9	9	9	9	9	10	9	9	10	13	11	10	10
GSA07_200-500	6	6	5	5	5	5	5	6	4	5	5	5	5	5
GSA07_500-800	8	7	4	5	4	4	6	5	4	5	5	5	5	5

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area

Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.18.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.18.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 07 was derived from the international survey Medits. Figure 7.18.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 07.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices in 2007 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

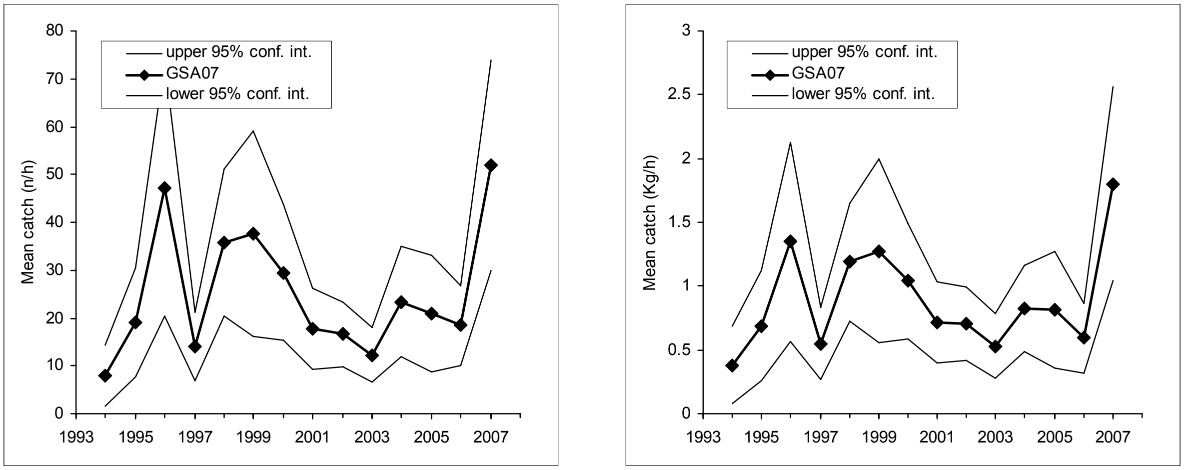


Fig. 7.6.3.1.3.1 Abundance and biomass indices of red mullet in GSA 07.

7.18.3.1.4. Trends in abundance by length or age

The following Fig. 7.18.3.1.4.1 and 2 display the stratified abundance indices of GSA 07 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

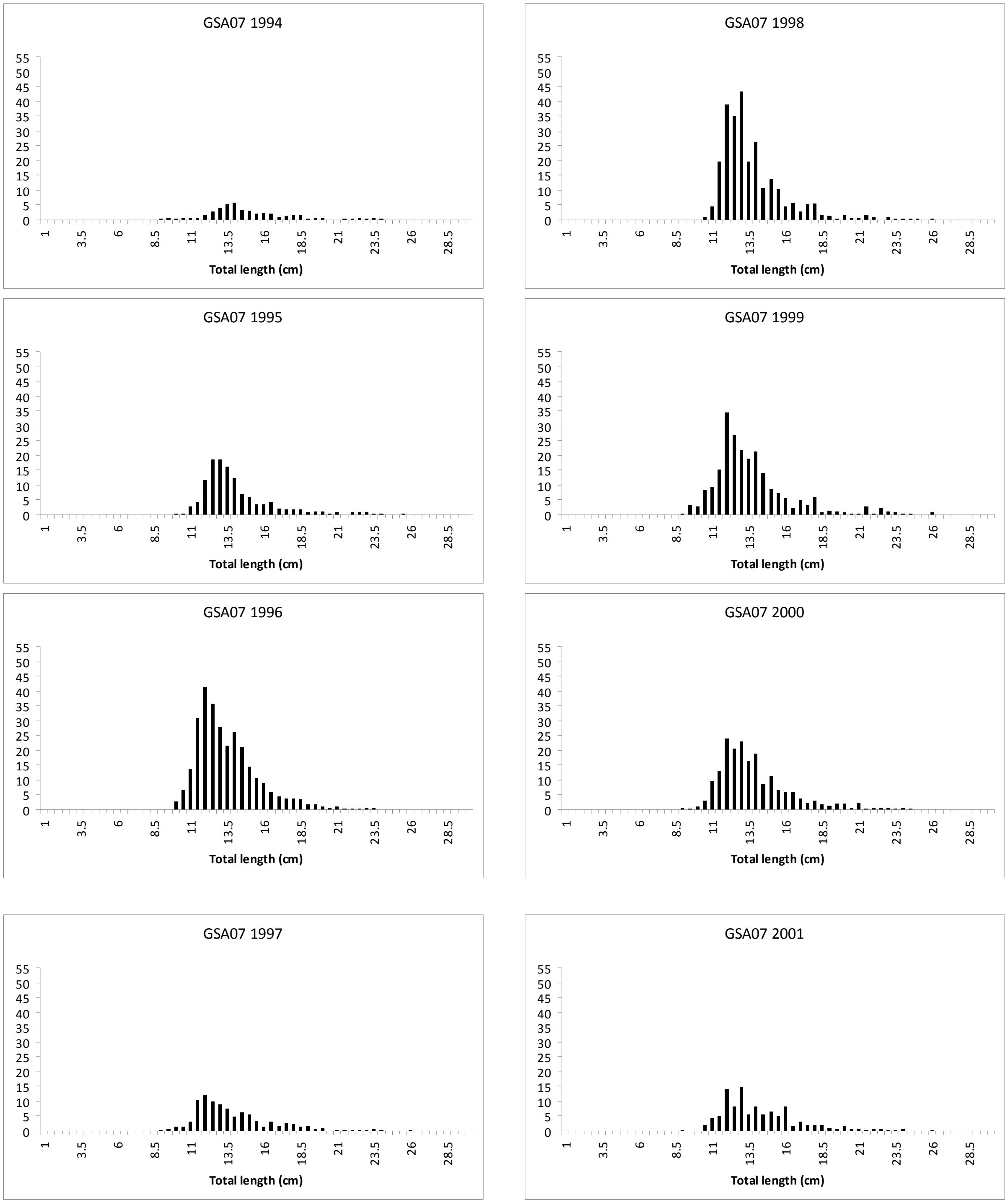


Fig. 7.18.3.1.4.1 Stratified abundance indices by size, 1994-2001.

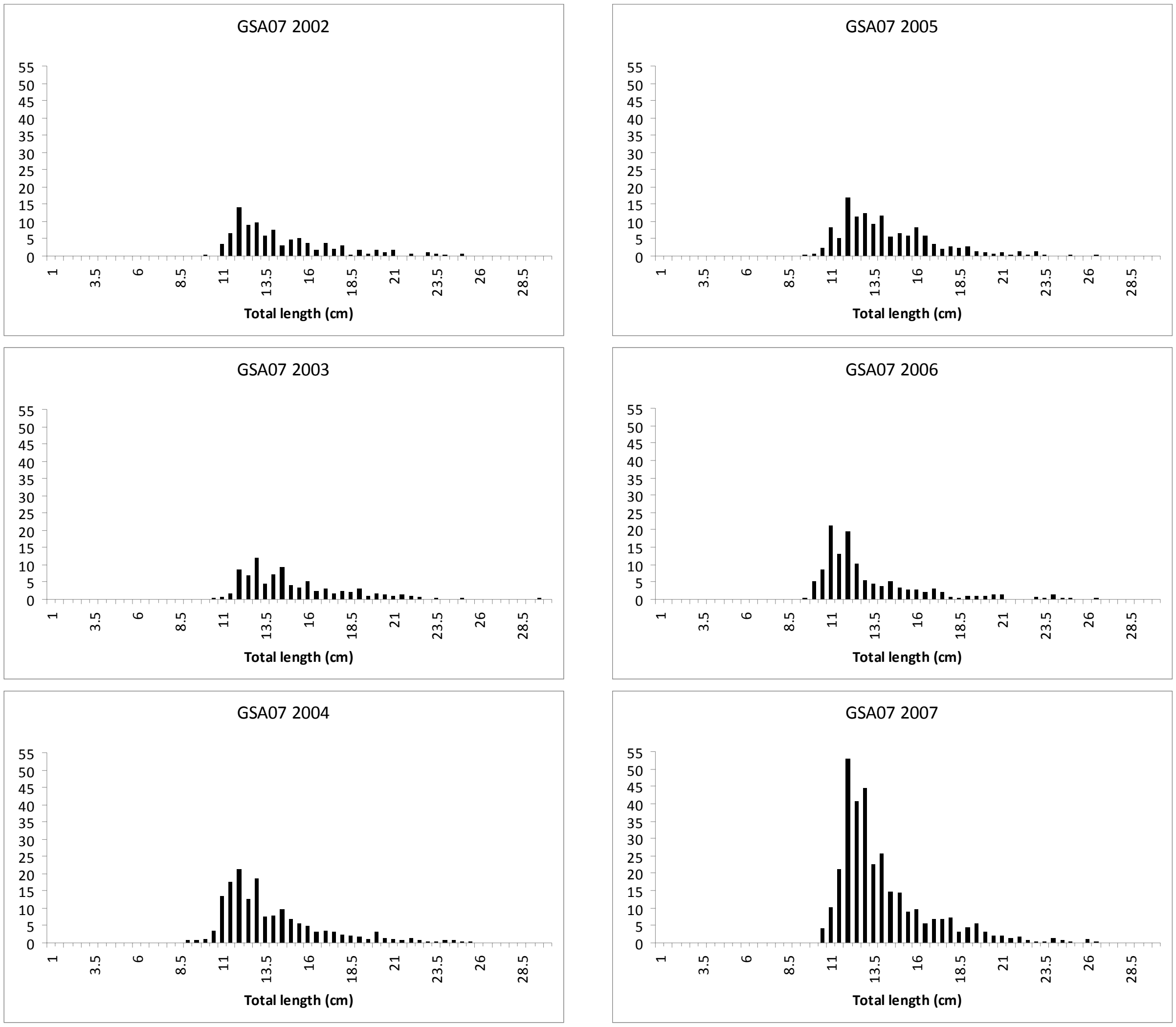


Fig. 7.18.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.18.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.18.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.18.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.18.5. Short term prediction for 2008 and 2009

7.18.5.1.Justification

No forecast analyses were conducted.

7.18.5.2. Input parameters

No forecast analyses were conducted.

7.18.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 07.

7.18.6. Medium term prediction

7.18.6.1. Justification

No forecast analyses were conducted.

7.18.6.2. Input parameters

No forecast analyses were conducted.

7.18.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 07.

7.18.7. Long term prediction

7.18.7.1. Justification

No forecast analyses were conducted.

7.18.7.2. Input parameters

No forecast analyses were conducted.

7.18.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 07.

7.18.8. Scientific advice

7.18.8.1. Short term considerations

7.18.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.18.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.18.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.18.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.19. Stock assessment of red mullet in GSA 08

7.19.1. Stock identification and biological features

7.19.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.19.1.2. Growth

No information was documented during SGMED-08-04.

7.19.1.3. Maturity

No information was documented during SGMED-08-04.

7.19.2. Fisheries

7.19.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.19.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.19.2.3. Catches

7.19.2.3.1. Landings

No information was documented during SGMED-08-04.

7.19.2.3.2. Discards

No information was documented during SGMED-08-04.

7.19.2.3.3. Fishing effort

No information was documented during SGMED-08-04.

7.19.3. Scientific surveys

7.19.3.1. Medits

7.19.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

SGMED-08-04 notes that the reported Medits data in GSA 08 only cover the eastern coast of Corsica. In GSA 08 the following number of hauls were reported per depth stratum (s. Tab. 7.6.3.1.1.1).

Tab. 7.6.3.1.1.1. Number of hauls per year and depth stratum in GSA 08, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA08_010-050	3													
GSA08_050-100	6	5	8	4	8	6	5	5		6	6	8	8	5
GSA08_100-200	3	5	4	2	5	5	5	5	1	5	5	5	5	3
GSA08_200-500	9	11	12	8	12	10	11	10		10	10	10	11	8
GSA08_500-800	5	5	4	4	4	5	4	5		4	5	5	4	5

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.19.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.19.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 08 was derived from the international survey Medits. SGMED-08-04 notes that the reported Medits data in GSA 08 only cover the eastern coast of Corsica. Figure 7.19.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 08.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices in 2007 appear very low. The analyses of Medits indices are considered preliminary.

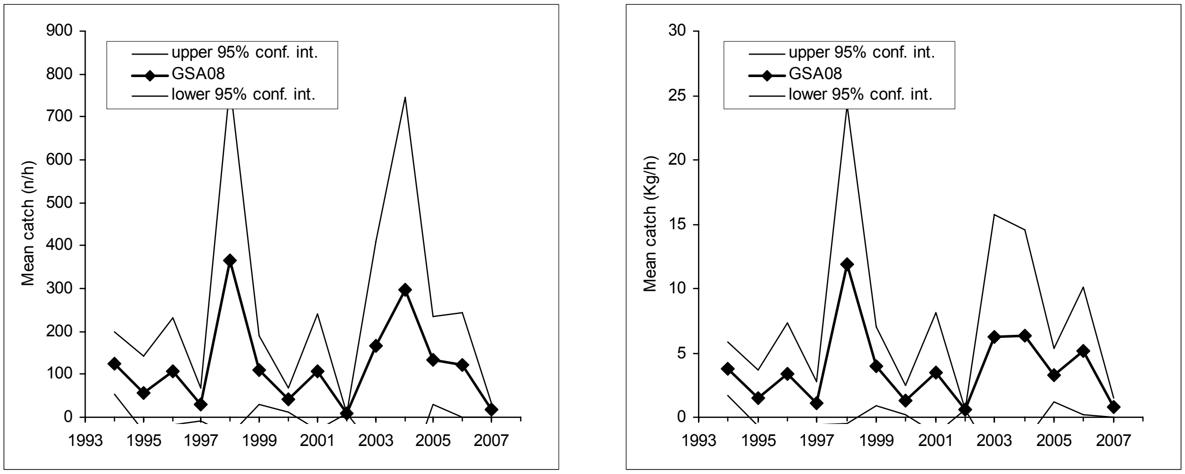
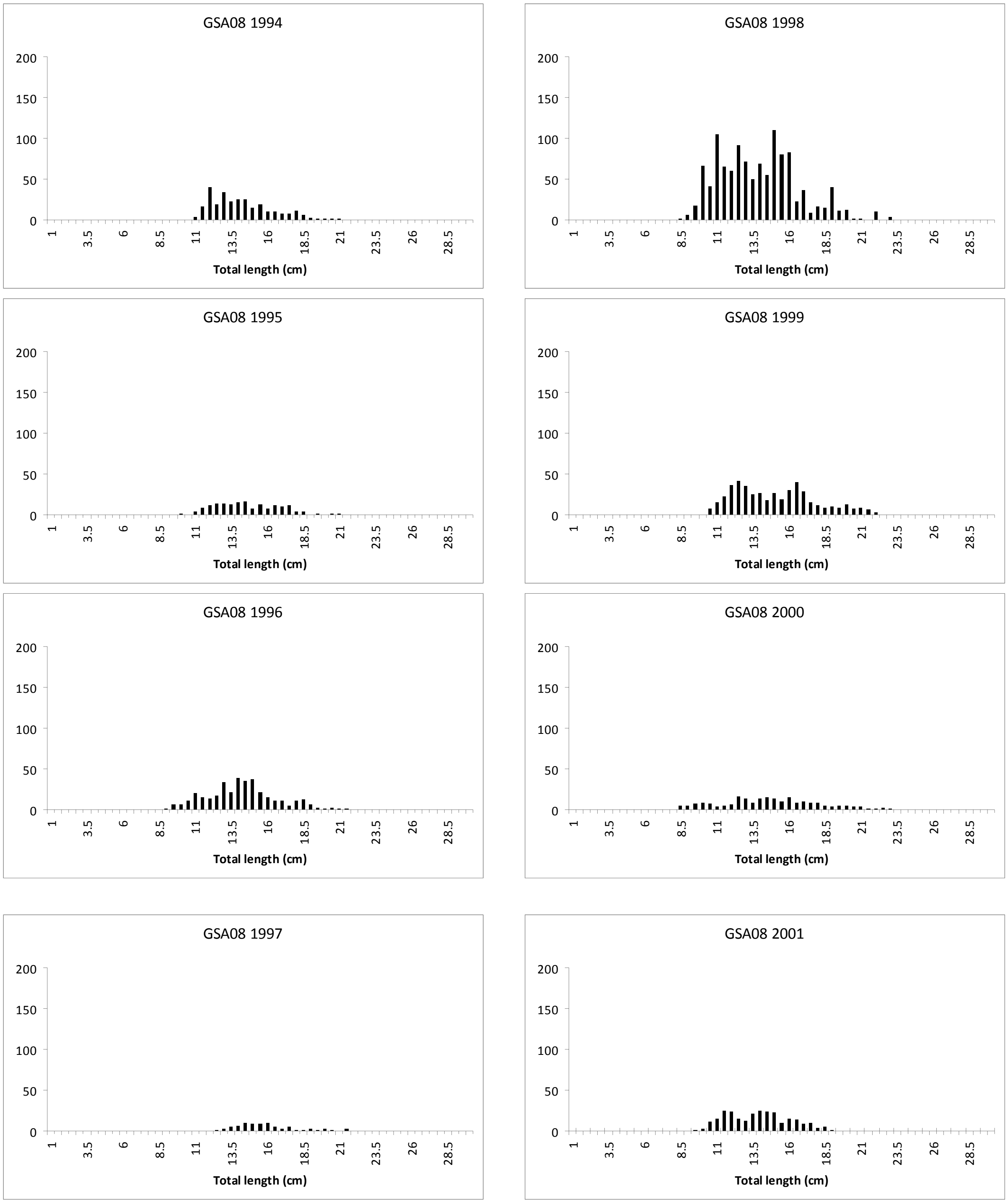


Fig. 7.19.3.1.3.1 Abundance and biomass indices of red mullet in GSA 08.

7.19.3.1.4. Trends in abundance by length or age

The following Fig. 7.19.3.1.4.1 and 2 display the stratified abundance indices of GSA 08 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.


GSA08 1994

GSA08 1998

GSA08 1995

GSA08 1999

GSA08 1996

GSA08 2000

GSA08 1997

GSA08 2001

Fig. 7.19.3.1.4.1 Stratified abundance indices by size, 1994-2001.

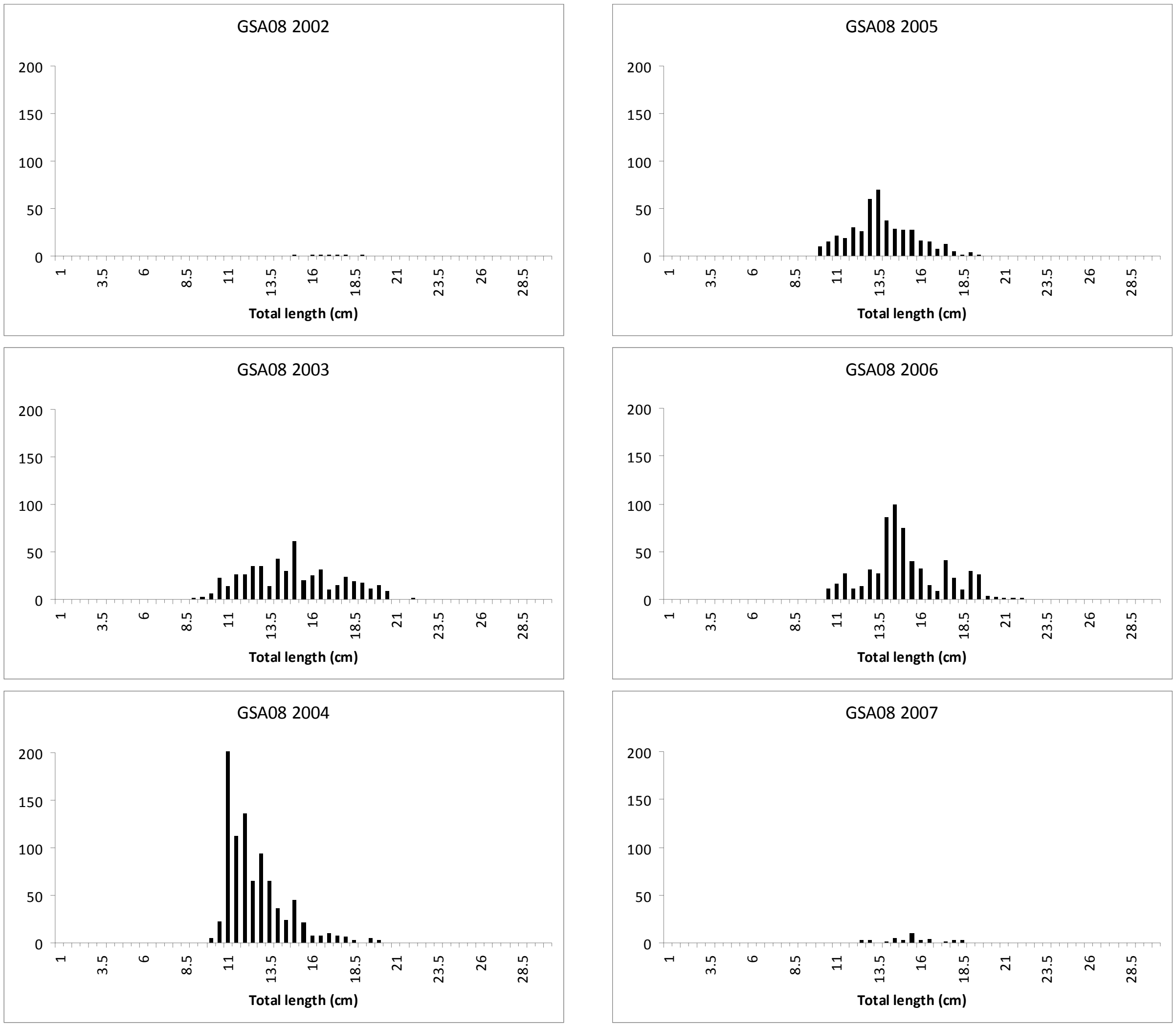


Fig. 7.19.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.19.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.19.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.19.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.19.5. Short term prediction for 2008 and 2009

7.19.5.1.Justification

No forecast analyses were conducted.

7.19.5.2. Input parameters

No forecast analyses were conducted.

7.19.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 08.

7.19.6. Medium term prediction

7.19.6.1. Justification

No forecast analyses were conducted.

7.19.6.2. Input parameters

No forecast analyses were conducted.

7.19.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 08.

7.19.7. Long term prediction

7.19.7.1. Justification

No forecast analyses were conducted.

7.19.7.2. Input parameters

No forecast analyses were conducted.

7.19.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 08.

7.19.8. Scientific advice

7.19.8.1. Short term considerations

7.19.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.19.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.19.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.19.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.20. Stock assessment of red mullet in GSA 09

7.20.1. Stock identification and biological features

7.20.1.1. Stock Identification

The red mullet is a species that is distributed all along the shelf of all the Mediterranean countries and mainly concentrated in the depth range 0-100m. All the year classes and nursery and spawning areas are well distributed along the narrow Mediterranean shelves.

No definition of has been presented neither based on genetics, bio-chemistry nor on any alternative method based on somatic features of stocks. Under a management point of view, it has been decided that inside each one of the GSAs boundaries inhabits a single, homogeneous red mullet stock that behaves as a single well-mixed population. The GSA boundaries are however arbitrary and do not take under consideration neither the existence of any local biological features nor any differences in the spatial allocation in fishing pressure. The inability to account for spatial structure may reduce flexibility and can lead to uncertainty in the definition of the status of the stocks, to local depletions and to a worse utilization of the potential productivity of the resources.

7.20.1.2. Growth

The species is fast growing. Some light differences in growth speed has been observed within different zones of the GSA9. In zones where the species is less exploited and individuals more densely concentrated, the mean size of 6 months old individuals is from 1 to 1.5 cm lower than in other areas were the species is more highly exploited and hence less abundant. In any case, the parameters reported as follows may be considered suitable for the description of an average growth performance along the whole GSA9.

Table 1. Common growth parameters considered representative for M. barbatus in the GSA9 utilized in the successive analyses.

Parameter	Value	Source
L_{inf}	29.2 cm TL (females) 22 cm TL (males)	Voliani *et al*., 1998
k	0.68/year 0.74/year	Voliani *et al*., 1998

7.20.1.3. Maturity

The species reaches massively the sexual maturity at one year old. Experiments of proportion of mature by size have produced the following sizes at age maturity by sex. The classical method was utilised and as expected it produced a light underestimation of the size at which the bulk of the females spawn, that corresponds to a size of about 14 cm.

L_m	12.5 cm TL (females) 10 cm TL (males	Sanchez *et al*. 1995

There have been performed some studies on fecundity. The following relationship of fecundity at size was defined in the area: Fec= 0.7599*TL^3.336

7.20.2. Fisheries

7.20.2.1. General description of fisheries

STECF (second stock review in 2007) notes that Mullus barbatus is among the most commercially valuable species in the area and is an important component of a species assemblage that is the target of the bottom trawling fleets operating near shore. It becomes a specific target of part of the fleet in some particular periods when the species is densely concentrated near the coast. The species is mainly caught with three different variants of the Italian bottom trawl net (tartana, volantina and francese). The small mesh size of the cod end in all cases defines a very precocious age of first capture.

L_c 7.4 cm TL (males + females) De Ranieri *et al.* , 2000

The exerted fishing pressure on this species on different zones of sub-area 09 is quite variable because conditioned by the structural composition of the fractions of the fleets that operate close to their respective ports and also to likely differences in the fisheries' target among fleets and sub-areas. Mullus barbatus catch rates are higher during the post-recruitment period (from September to November). More than 200 of the 350 trawlers and a small number of artisanal vessels exploit the species. Annual landings are from 700 to 1000 tons, mostly proceeding from trawling. Discarding of undersized individuals is in general limited, mainly due to the fact that immediately after recruitment, small sized individuals concentrated inside the 3 miles where trawling practices are excluded. Illegal catches of juveniles within this stripe, even though limited, do occur.

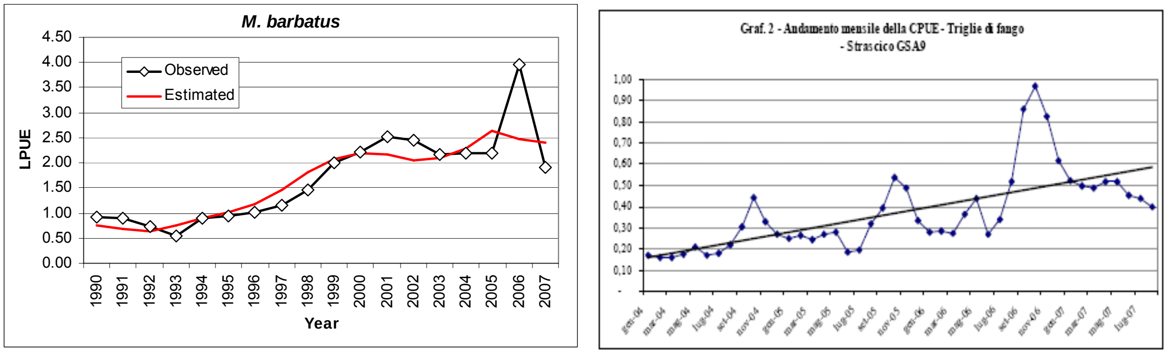


Fig. 7.20.2.1 Landings per unit of effort by year and month.

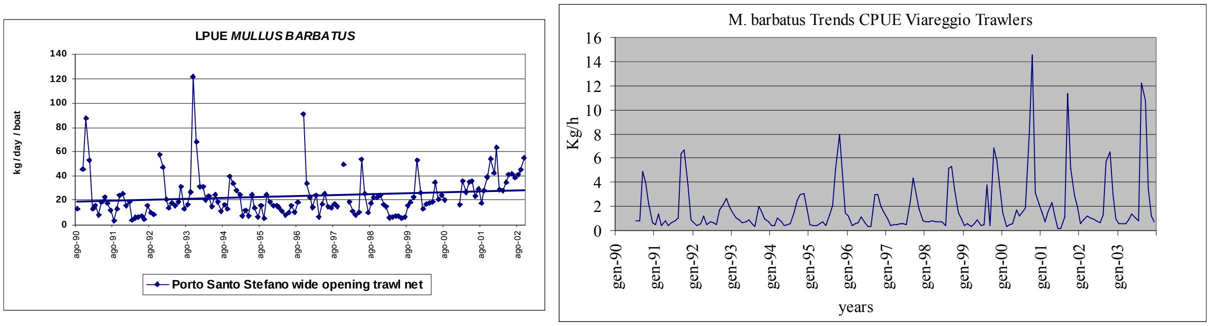
7.20.2.2. Management regulations applicable in 2007 and 2008

Fishing closure for trawling: 45 days in late summer
Minimum landing sizes: EC regulation 1967/2006: 12 cm TL for red mullet.
Cod end mesh size of trawl nets: 40 mm (stretched, diamond meshes) till 30/05/2010. From 1/6/2010 the existing nets will be replaced with a cod end with 40 mm (stretched) square meshes or a cod end with 50 mm (stretched) diamond meshes.
Towed gears are not allowed within three nautical miles from the coast or at depths less than 50 m when this depth is reached at a distance less than 3 miles from the coast.

7.20.2.3. Catches

7.20.2.3.1. Landings

Landings data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.2 of Appendix 3. Since 2002 annual landings varied between 620 and 1,100 (Tab. 7.20.2.3.1.1). Demersal otter trawlers dominate the landings by far. Landings size show a very high seasonal variability.



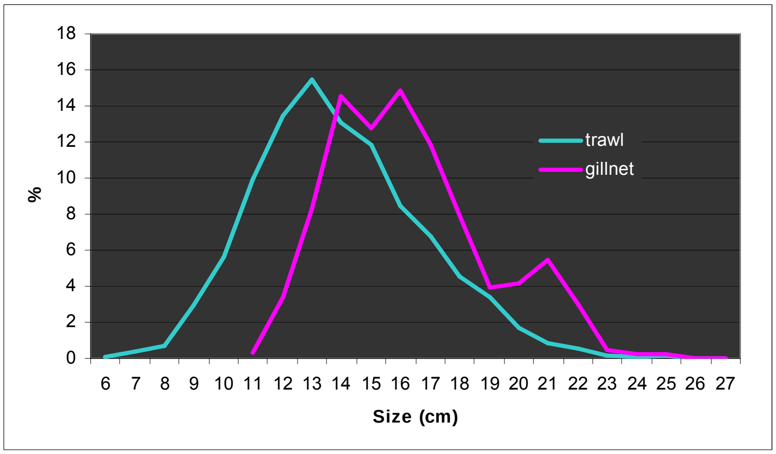
Regular seasonal fluctuations in red mullet landings size in two of the main ports of GSA9

Table 7.20.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	9	ITA	DTS	454	839	514	682	1033	1075
MUT	9	ITA	HOK				2		
MUT	9	ITA	PGP	14	44	49	28	17	22
MUT	9	ITA	PMP	150	174	16	3		
MUT	9	ITA	PTS	3	7	4			
SUM				621	1064	583	715	1050	1097

Fig. 7.20.2.3.1.2 Composition of the commercial catches.

Size	trawl	trammel nets
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0.0	0.0
7	6.5	0.0
8	32.8	0.0
9	377.6	0.0
10	1903.9	0.0
11	2592.8	0.0
12	3291.5	0.0
13	4030.4	5.4
14	4115.8	18.0
15	3665.2	26.0
16	2907.8	21.7
17	2321.2	24.3
18	1758.4	18.5
19	1527.6	8.8
20	778.4	3.3
21	454.5	4.9
22	301.9	6.5
23	83.6	1.6
24	49.6	1.1
25	62.7	0.0
26	6.5	0.0
27	7.4	0.0
28	0.0	0.0



7.20.2.3.2. Discards

158 t of discards in 2006 were reported to SGMED-08-04 and are listed in Tab. A3.6 of Appendix 3.

7.20.2.3.3. Fishing effort

Tab. 7.20.2.3.3.1 lists the effort by fishing technique deployed in GSA 09 as reported to SGMED-08-03 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3. A minor decrease is observed for the main gear demersal otter trawl. It is however difficult to extract from these figures the real number of vessels that target red mullet.

In the last 15 years, a general decrease in the size of the fishing fleets operating in the GSA9 targeting demersal species was observed. This decrease has been particularly important in Porto Santo Stefano fleet (about 50% of reduction of the number of vessels) in the South and in that of Viareggio (about 30%) in the North. It is likely that this general reduction in numbers of vessels also apply for the fraction of the fleet that exert its fishing effort on M. barbatus over all the GSA9. The number of vessels targeting the species in question and the changes (reduction) in number along the time interval 1990-2007 is only known for some ports of the GSA.

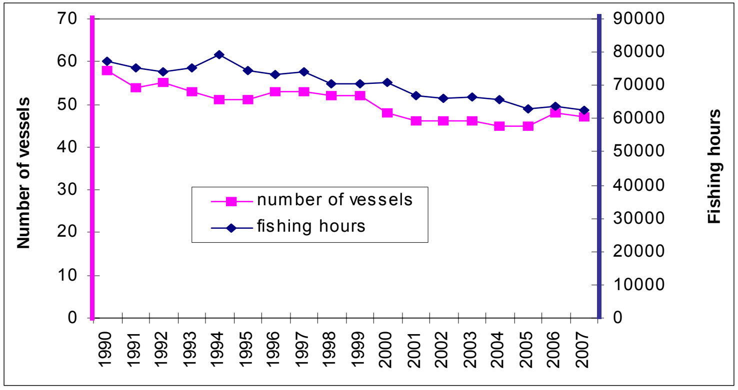


Fig. 7.20.2.3.3.1 Number of vessels and fishing activity in the port of Viareggio (1990-2007)

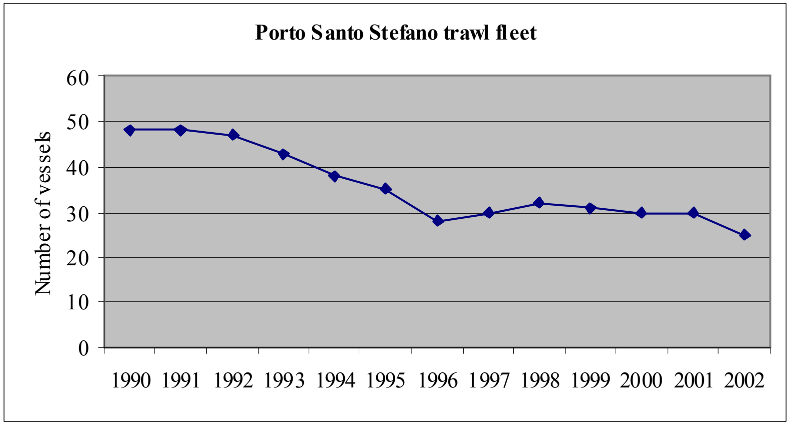


Fig. 7.20.2.3.3.2 Number of vessels in the port of Porto Santo Stefano (1990-2002).

Tab. 7.20.2.3.3.1 Effort trends by fishing technique in GSA 09. Data regards the whole fleets by fishing typology without any distinction regarding targets, season nor operations depth interval).

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728	4739	5242	5160
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS			143490	162480	200226	194754
KW*DAYS	9	ITA	DRB	187147	335520	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166	1013627	1174295	1151346

7.20.3. Scientific surveys

7.20.3.1.Medits

7.20.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 09 the following number of hauls were reported per depth stratum (s. Tab. 7.20.3.1.1.1).

Tab. 7.20.3.1.1.1. Number of hauls per year and depth stratum in GSA 09, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13
GSA09_050-100	19	19	18	19	18	19	20	20	15	15	15	14	16	16
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33
GSA09_500-800	31	30	32	28	30	28	27	29	24	22	21	20	20	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.20.3.1.2. Geographical distribution patterns

The species is distributed all along the continental shelf of the GSA9, with major abundance in the depth range 0-100m. The species is highly concentarted along the coastal stripe 0-30m when in late summer-beginnings of autumn juveniles massively settle to the bottom. The major nursery areas are allocated in the northern portion of the GSA , Northwards the Elba Island (yellow areas in Fig. 7.20.3.1.2.1).

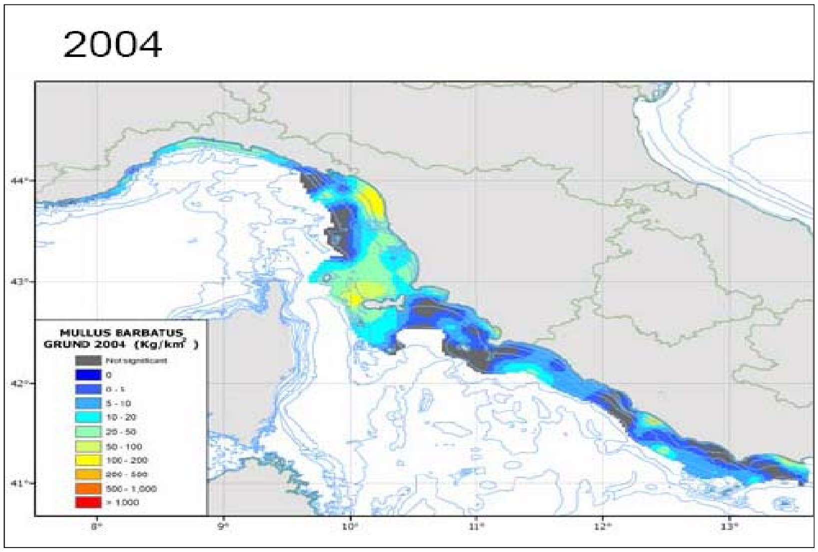


Fig. 7.20.3.1.2.1 Distribution of juveniles of red mullet in autumn 2004 (GRUND survey) in kg/km2

Also mature individuals are more abundant in the Southern portion of the GSA9.

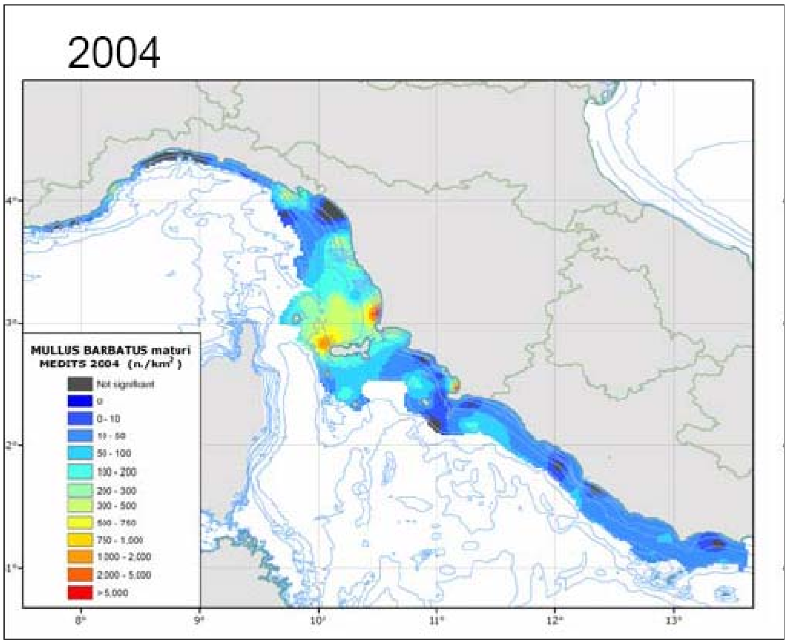


Fig. 7.20.3.1.2.2 Distribution of mature adults of red mullet in spring 2004 (MEDITS survey) in numbers/km2

7.20.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 09 was derived from the international survey Medits. Figure 7.20.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 09.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2002 appear increased but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

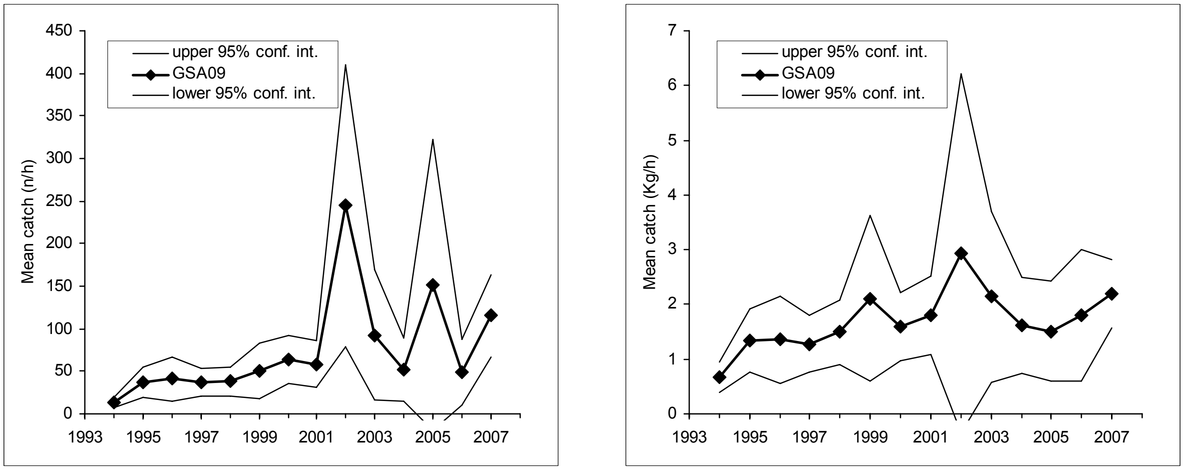


Fig. 7.20.3.1.3.1 Abundance and biomass indices of red mullet in GSA 09.

7.20.3.1.4. Trends in abundance by length or age

The following Fig. 7.20.3.1.4.1 and 2 display the stratified abundance indices of GSA 09 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

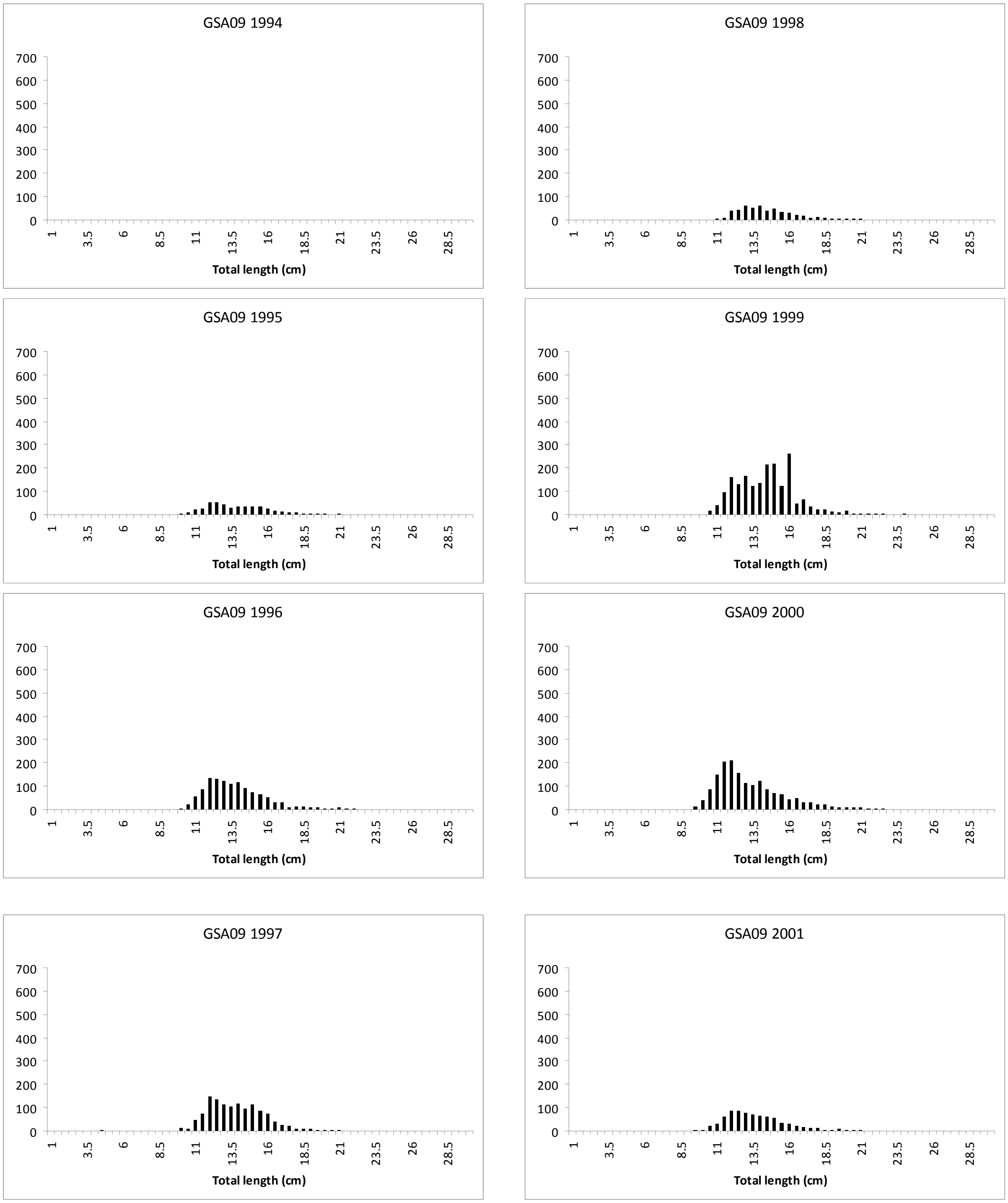


Fig. 7.20.3.1.4.1 Stratified abundance indices by size, 1994-2001.

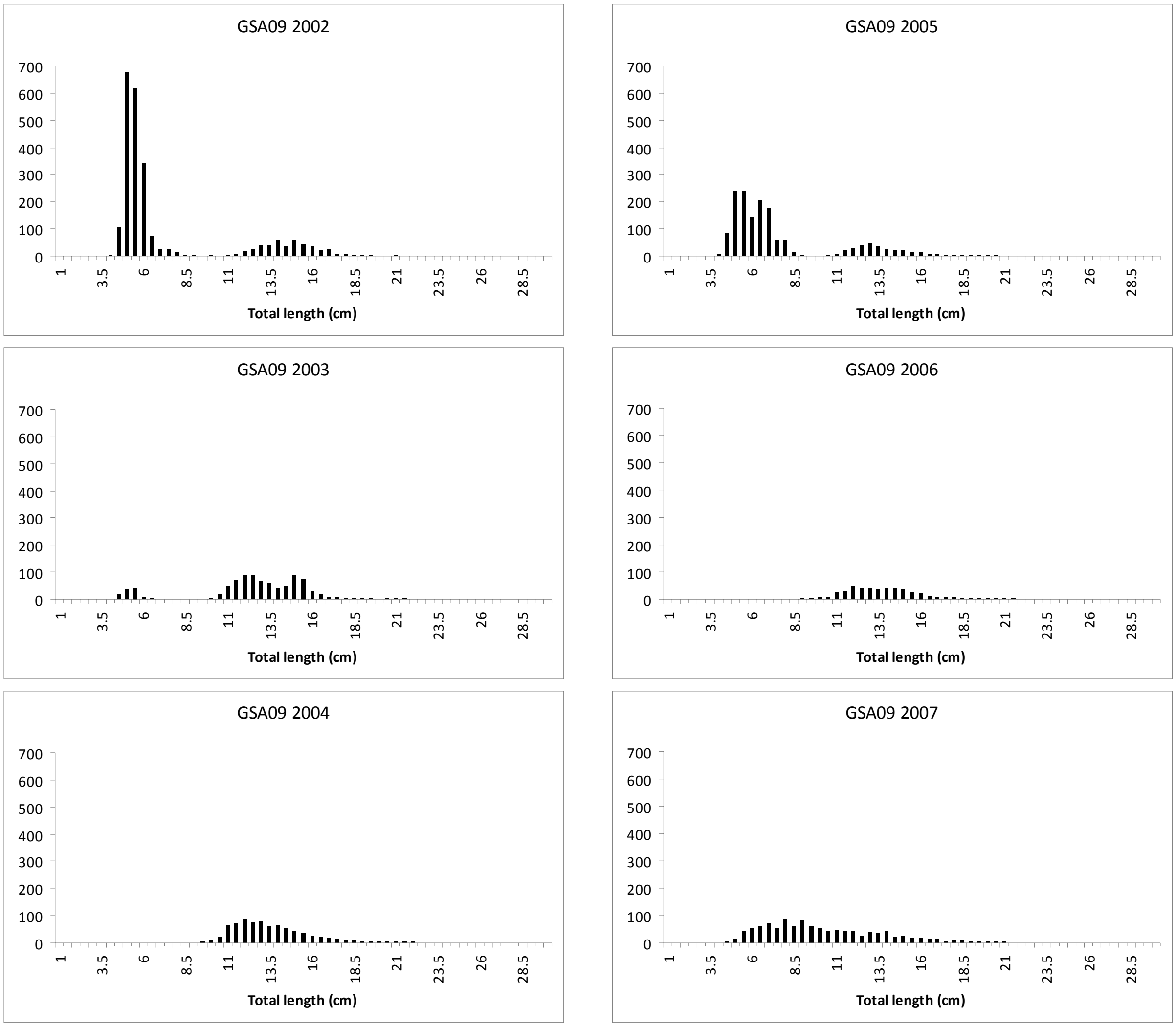


Fig. 7.20.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.20.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.20.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.20.4. Assessment of historic stock parameters

7.20.4.1. Method 1: Length cohort analysis LCA

7.20.4.1.1. Justification

A LCA was performed using data on total annual catches by size including discard.

7.20.4.1.2. Input parameters

Catch of red mullet proceeds from two fisheries (bottom trawlers targeting a coastal demersl assemblage and artisanal fisheries using trammel nets for year 2006). The catch of trammel nets is quite modest (<2% in numbers). A reasonable hypothesis of a declining rate of M with age was used in the computations (age 0 =1.30, age 1 = 0.79, age 2 = 0.62, age 3= 0.54).

7.20.4.1.3. Results

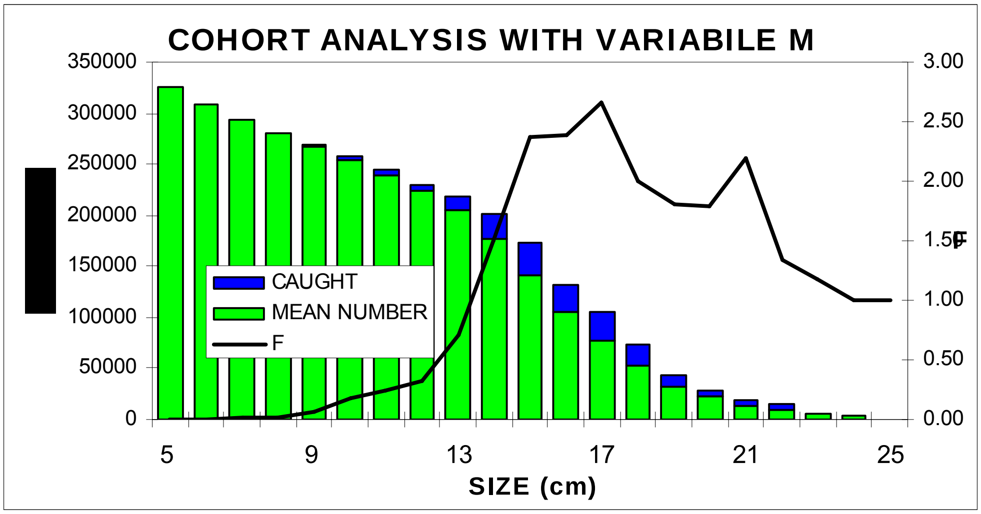


Fig 7.20.4.1.3.Size composition of the stock, the catch and fishing mortality at length.

7.20.4.2.Method 2: ASPIC

7.20.4.2.1. Justification

The analysis was performed using the ASPIC.5 software (A Stock-Production model Incorporating Covariates) (Prager, 1994, 2005) assuming a Schaefer (1954) model. This program implements a non-equilibrium, continuous-time, observation-error estimator for the dynamic production model (Schnute, 1977; Prager, 1994). The model was used to estimate r (the intrinsic rate of population growth), MSY, the ratios of both current biomass or F to the biomass or F at which MSY can be attained, and q (the catchability coefficient, the proportion of total stock removed by one unit of fishing effort).

7.20.4.2.2. Input parameters

Input data consist in 2 sets of time series of total landings (in kg) and fishing effort (effective hours fishing) for two of the main ports of the GSA9 (Viareggio and Porto Santo Stefano) and a time series of an index of abundance (kg/km2) for the whole GSA9 derived from MEDITS surveys. This is a new extension incorporated in ASPIC new versions.

Table 7.20.4.2.1 Aspic input parameters.

```
BOT                ## Run type (FIT, BOT, or IRF)
"Enter your model description here"
LOGISTIC YLD SSE        ## See notes at end of this file
```

```
2                    ## Verbosity on screen (0-3); add 10 for SUM & PRN files
1000                   ## Number of bootstrap trials, <= 1000
0 20000                 ## 0=no MC search, 1=search, 2=repeated srch; N trials
1d-8                  ## Convergence crit. for simplex
3d-8    5              ## Convergence crit. for restarts, N restarts
1d-4    24              ## Conv. crit. for F; N steps/yr for gen. model
6d0                   ## Maximum F when cond. on yield
0d0                   ## Stat weight for B1>K as residual (usually 0 or 1)
3                    ## Number of fisheries (data series)
1d0  1d0  1d0          ## Statistical weights for data series
0.3d0                 ## B1/K (starting guess, usually 0 to 1)
80000                  ## MSY (starting guess)
750000                 ## K (carrying capacity) (starting guess)
1.00d-5 1.00d-5  1.00d-5  ## q (starting guesses -- 1 per data series)
1 1 1 1 1 1             ## Estimate flags (0 or 1) (B1/K,MSY,K,q1...qn)
50000   1000000             ## Min and max constraints -- MSY
100000  10000000            ## Min and max constraints -- K
3941285                ## Random number seed (large integer)
13                    ## Number of years of data in each series
"Porto Santo Stefano"            ## Title for 1st series (<=40 chars)
CE                              ## Series type (CC = CPUE, catch)
1994        74130       57571.659    ## year_effort_catch
1995        73410       54995.024
1996        74690       49141.538
1997        76020       50870.093
1998        76690       50102.399
1999        76390       50354.808
2000        72310       55589.8145
2001        68730       65035.8385
2002        67440       69941.2965
2003        64870       70928.6185
2004        63520       69277.1115
2005        61420       72878.3715
2006        60050       76338.2895


"Viareggio"        ## Title for 2nd series
CE                          ## Series type (I1 = midyear index)
1994        78375       69650     ## year_effort_catch
1995        75240       71326
1996        74195       74663
1997        73150       85110
1998        71060       104051
1999        71060       141873
2000        70015       154654
2001        67925       170953
2002        66880       163647
2003        65835       143018
2004        64790       142679
2005        63745       140381
2006        63556       150826
"survey medits"
I1
1994        7.35059604    ## index of biomass  kg/km2
1995        11.01081423
1996        12.99169252
1997        14.5988436
1998        17.63350113
1999        19.29349602
2000        19.84710355
2001        22.51280819
2002        24.2151148
2003        23.040515
2004        17.93906946
2005        16.41705452
2006        18.81409063
```

7.20.4.2.3. Results

Tab. 7.20.4.2.3.1 Apspic output results.

Main output ASPIC

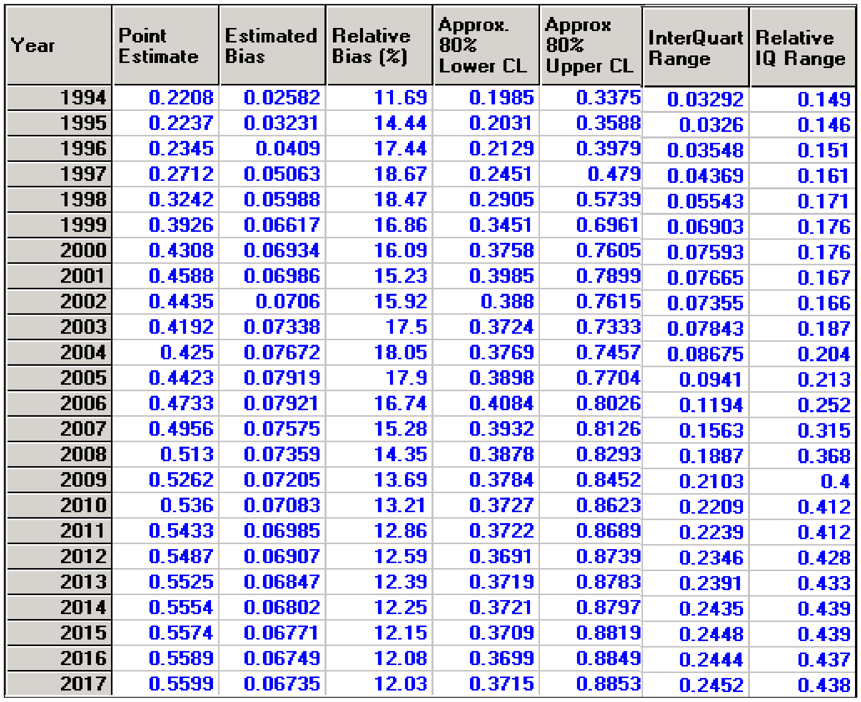
```
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 5.16)
                                                          BOT program mode
Author:    Michael H. Prager; NOAA Center for Coastal Fisheries and Habitat Research            LOGISTIC model mode
           101 Pivers Island Road; Beaufort, North Carolina  28516  USA                         YLD conditioning
           Mike.Prager@noaa.gov                                                SSE optimization

Reference:  Prager, M. H. 1994. A suite of extensions to a nonequilibrium           ASPIC User's Manual is available
           surplus-production model.  Fishery Bulletin 92: 374-389.                 gratis from the author.

CONTROL PARAMETERS (FROM INPUT FILE)                                  Input file: d:\mbagsa9newaspic500.inp
----------------------------------------------------------------------------------------------------------------------
Operation of ASPIC:  Fit logistic (Schaefer) model by direct optimization with bootstrap.
Number of years analyzed:                  13          Number of bootstrap trials:                 500
Number of data series:                      3       Bounds on MSY (min, max):      5.000E+04    1.000E+06
Objective function:              Least squares       Bounds on K (min, max):       1.000E+05    1.000E+07
Relative conv. criterion (simplex):      1.000E-08       Monte Carlo search mode, trials:      0        50000
Relative conv. criterion (restart):     3.000E-08        Random number seed:                  333344453
Relative conv. criterion (effort):      1.000E-04        Identical convergences required in fitting:       6
Maximum F allowed in fitting:                5.000


PROGRAM STATUS INFORMATION (NON-BOOTSTRAPPED ANALYSIS)                                               error code   0
----------------------------------------------------------------------------------------------------------------------
Normal convergence


CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)
----------------------------------------------------------------------------------------------------------------------
                                   |
 1  MEDITS trawl survey            |  1.000
                                   |    13
                                   |
 2  Viareggio fleet                |  0.879    1.000
                                   |    13       13
                                   |
 3  Porto Santo Stefano fleet      |  0.434   0.698    1.000
                                   |    13       13       13
                              ---------------------------------------------------
                                        1        2        3


GOODNESS-OF-FIT AND WEIGHTING (NON-BOOTSTRAPPED ANALYSIS)
----------------------------------------------------------------------------------------------------------------------
                                     Weighted        Weighted      Current    Inv. var.   R-squared
Loss component number and title                        SSE     N        MSE       weight        weight      in CPUE

Loss(-1)  SSE in yield                        0.000E+00
Loss(0)   Penalty for B1 > K                     0.000E+00     1        N/A    0.000E+00         N/A
Loss(1)   MEDITS trawl survey                       3.108E-01     13    2.825E-02    1.000E+00    1.007E+00        0.697
Loss(2)   Viareggio fleet                       2.089E-01    13    1.899E-02    1.000E+00    1.499E+00       0.865
Loss(3)   Porto Santo Stefano fleet               6.338E-01    13    5.761E-02    1.000E+00    4.939E-01       0.358
..............................................................................................
TOTAL OBJECTIVE FUNCTION, MSE, RMSE:          1.15342404E+00         3.495E-02    1.870E-01
Estimated contrast index (ideal = 1.0):             0.1374          C* = (Bmax-Bmin)/K
Estimated nearness index (ideal = 1.0):             0.7478          N* = 1 - |min(B-Bmsy)|/K

MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
----------------------------------------------------------------------------------------------------------------------
Parameter                                Estimate    User/pgm guess    2nd guess    Estimated          User guess

B1/K      Starting relative biomass (in 1994)       1.104E-01          3.000E-01       4.125E-01              1            1
MSY       Maximum sustainable yield                3.259E+05          8.000E+04       1.573E+05              1            1
K         Maximum population size               1.098E+06         4.500E+05         9.438E+05              1            1
phi       Shape of production curve (Bmsy/K)         0.5000             0.5000              ----              0            1

--------- Catchability Coefficients by Data Series ---------------
q(1)      MEDITS trawl survey                    8.300E-05          1.000E-05          9.500E-04                  1            1
```

```
q(2)    Viareggio fleet                   8.515E-06     1.000E-05     9.500E-04          1        1
q(3)    Porto Santo Stefano fleet         4.325E-06     1.000E-05     9.500E-04          1        1


MANAGEMENT and DERIVED PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------
Parameter                               Estimate          Logistic formula       General formula

MSY      Maximum sustainable yield              3.259E+05                ----              ----
Bmsy     Stock biomass giving MSY               5.491E+05                 K/2       K*n**(1/(1-n))
Fmsy     Fishing mortality rate at MSY          5.935E-01            MSY/Bmsy              MSY/Bmsy

n        Exponent in production function        2.0000                  ----              ----
g        Fletcher's gamma                       4.000E+00               ----     [n**(n/(n-1))]/[n-1]

B./Bmsy   Ratio: B(2007)/Bmsy                   4.956E-01               ----              ----
F./Fmsy   Ratio: F(2006)/Fmsy                   1.437E+00               ----              ----
Fmsy/F.   Ratio: Fmsy/F(2006)                   6.957E-01               ----              ----

Y.(Fmsy)  Approx. yield available at Fmsy in 2007   1.615E+05        MSY*B./Bmsy          MSY*B./Bmsy
          ...as proportion of MSY               4.956E-01               ----              ----
Ye.       Equilibrium yield available in 2007   2.430E+05     4*MSY*(B/K-(B/K)**2)    g*MSY*(B/K-(B/K)**n)
          ...as proportion of MSY               7.456E-01               ----              ----

--------- Fishing effort rate at MSY in units of each CE or CC series ---------
fmsy(2)   Viareggio fleet                       6.971E+04          Fmsy/q( 2)          Fmsy/q( 2)
fmsy(3)   Porto Santo Stefano fleet             1.372E+05          Fmsy/q( 3)          Fmsy/q( 3)


ESTIMATED POPULATION TRAJECTORY (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------

          Estimated  Estimated  Estimated   Observed     Model   Estimated   Ratio of   Ratio of
    Year    total    starting    average     total       total    surplus     F mort     biomass
Obs or ID   F mort    biomass    biomass     yield       yield  production   to Fmsy     to Bmsy

  1  1994    1.042  1.213E+05  1.221E+05  1.272E+05  1.272E+05  1.288E+05  1.756E+00  2.208E-01
  2  1995    1.004  1.228E+05  1.258E+05  1.263E+05  1.263E+05  1.323E+05  1.691E+00  2.237E-01
  3  1996    0.892  1.288E+05  1.389E+05  1.238E+05  1.238E+05  1.440E+05  1.502E+00  2.345E-01
  4  1997    0.832  1.489E+05  1.635E+05  1.360E+05  1.360E+05  1.651E+05  1.401E+00  2.712E-01
  5  1998    0.783  1.780E+05  1.969E+05  1.542E+05  1.542E+05  1.917E+05  1.319E+00  3.242E-01
  6  1999    0.849  2.155E+05  2.263E+05  1.922E+05  1.922E+05  2.132E+05  1.431E+00  3.926E-01
  7  2000    0.860  2.366E+05  2.445E+05  2.102E+05  2.102E+05  2.256E+05  1.449E+00  4.308E-01
  8  2001    0.953  2.519E+05  2.475E+05  2.360E+05  2.360E+05  2.276E+05  1.606E+00  4.588E-01
  9  2002    0.988  2.435E+05  2.365E+05  2.336E+05  2.336E+05  2.203E+05  1.664E+00  4.435E-01
 10  2003    0.923  2.302E+05  2.318E+05  2.139E+05  2.139E+05  2.171E+05  1.555E+00  4.192E-01
 11  2004    0.889  2.333E+05  2.383E+05  2.120E+05  2.120E+05  2.215E+05  1.499E+00  4.250E-01
 12  2005    0.847  2.429E+05  2.517E+05  2.133E+05  2.133E+05  2.303E+05  1.428E+00  4.423E-01
 13  2006    0.853  2.599E+05  2.663E+05  2.272E+05  2.272E+05  2.394E+05  1.437E+00  4.733E-01
 14  2007           2.721E+05                                      4.956E-01
```

```
ESTIMATES FROM BOOTSTRAPPED ANALYSIS
---------------------------------------------------------------------------------------------------------------
                  Estimated  Estimated     Bias-corrected approximate confidence limits        Inter-
Param         Point   bias in pt   relative    -----------------------------------------------   quartile   Relative
name       estimate     estimate        bias    80% lower    80% upper    50% lower    50% upper       range   IQ range

B1/K     1.104E-01   1.291E-02    11.69%   8.554E-02   1.414E-01   1.035E-01   1.139E-01   1.031E-02     0.093
K       1.098E+06   1.566E+05    14.26%   9.344E+05   1.840E+06   1.021E+06   1.232E+06   2.115E+05     0.193

q(1)     8.300E-05  -8.030E-06    -9.67%   5.889E-05   9.461E-05   7.773E-05   8.987E-05   1.214E-05     0.146
q(2)     8.515E-06  -8.177E-07    -9.60%   6.572E-06   9.886E-06   8.089E-06   9.370E-06   1.281E-06     0.150
q(3)     4.325E-06  -4.218E-07    -9.75%   3.164E-06   4.931E-06   4.066E-06   4.725E-06   6.592E-07     0.152

MSY      3.259E+05  -1.052E+03    -0.32%   2.726E+05   4.071E+05   3.165E+05   3.445E+05   2.800E+04     0.086
Ye(2007)  2.430E+05  -5.174E+02    -0.21%   2.191E+05   2.751E+05   2.311E+05   2.614E+05   3.034E+04     0.125
Y.@Fmsy  1.615E+05   1.719E+04    10.64%   1.284E+05   1.896E+05   1.404E+05   1.720E+05   3.168E+04     0.196

Bmsy     5.491E+05   7.831E+04    14.26%   4.672E+05   9.199E+05   5.105E+05   6.162E+05   1.058E+05     0.193
Fmsy     5.935E-01  -3.514E-02    -5.92%   4.203E-01   6.640E-01   5.488E-01   6.276E-01   7.880E-02     0.133

fmsy(1)  7.151E+03   8.573E+02    11.99%   6.404E+03   7.854E+03   6.682E+03   7.372E+03   6.899E+02     0.096
fmsy(2)  6.971E+04   8.453E+03    12.13%   6.267E+04   7.656E+04   6.557E+04   7.244E+04   6.871E+03     0.099
fmsy(3)  1.372E+05   1.670E+04    12.17%   1.204E+05   1.475E+05   1.276E+05   1.403E+05   1.262E+04     0.092

B./Bmsy  4.956E-01   7.575E-02    15.28%   3.548E-01   6.801E-01   4.123E-01   5.475E-01   1.352E-01     0.273
F./Fmsy  1.437E+00  -6.689E-02    -4.65%   1.256E+00   1.727E+00   1.366E+00   1.604E+00   2.382E-01     0.166
Ye./MSY  7.456E-01   2.290E-02     3.07%   5.761E-01   8.955E-01   6.552E-01   7.982E-01   1.430E-01     0.192

q2/q1    1.026E-01   2.622E-04     0.26%   9.446E-02   1.140E-01   9.812E-02   1.086E-01   1.051E-02     0.102
q3/q1    5.210E-02   9.112E-05     0.17%   4.692E-02   5.738E-02   4.915E-02   5.447E-02   5.313E-03     0.102


INFORMATION FOR REPAST (Prager, Porch, Shertzer, & Caddy. 2003. NAJFM 23: 349-361)
---------------------------------------------------------------------------------------------------------------
Unitless limit reference point in F (Fmsy/F.):            0.6957
CV of above (from bootstrap distribution):                0.4559


NOTES ON BOOTSTRAPPED ESTIMATES:
---------------------------------------------------------------------------------------------------------------
- Bootstrap results were computed from 500 trials.
- Results are conditional on bounds set on MSY and K in the input file.
- All bootstrapped intervals are approximate. The statistical literature recommends using at least 1000 trials
  for accurate 95% intervals. The default 80% intervals used by ASPIC should require fewer trials for equivalent
  accuracy. Using at least 500 trials is recommended.
- Bias estimates are typically of high variance and therefore may be misleading.

Trials replaced for lack of convergence:     0          Trials replaced for MSY out of bounds:             7
Trials replaced for q out-of-bounds:         0
Trials replaced for K out-of-bounds:         8          Residual-adjustment factor:               1.0871

Elapsed time: 0 hours, 19 minutes, 25 seconds.
```

The results of the Biomass Dynamic Model suggest that the species in the GSA9 is on average overexploited. Data of abundance index of Porto Santo Stefano have shown a lower correlation with surveys data, probably due to the fact that in this port, the fleet has a light different spatial behaviour (they operate at a higher mean depth) because the species is not a prioritary commercial species. A value of FMSY of 0.59 was estimated while the model estimated for the more recent years values of F of about 0.85. A lower F value of 0.431 was defined with the routine Repast (Ratio Extended Probability Approach to Setting Targets) (Prager et al., 2003). This routine allows to derive a more precautionary target reference point facing the intrinsic uncertainty of the observation errors. It is important to highlight, as shown in Fig. 7.20.4.1.3.1, that the level of biomass shows a general increasing trend while F decreases along the analysed period. Projections suggest that a light increase in biomass should occur in a medium term (up to 2015) if F is kept at the current rate. The new equilibrium biomass that is assumed to be obtained at medium term keeping F unchanged is however quite lower than the maximum potential one.

Tab. 7.20.4.2.3.2 Aspic output results.



Year	Point Estimate	Estimated Bias	Relative Bias (%)	Approx. 80% Lower CL	Approx 80% Upper CL	InterQuart Range	Relative IQ Range
1994	0.2208	0.02582	11.69	0.1985	0.3375	0.03292	0.149
1995	0.2237	0.03231	14.44	0.2031	0.3588	0.0326	0.146
1996	0.2345	0.0409	17.44	0.2129	0.3979	0.03548	0.151
1997	0.2712	0.05063	18.67	0.2451	0.479	0.04369	0.161
1998	0.3242	0.05988	18.47	0.2905	0.5739	0.05543	0.171
1999	0.3926	0.06617	16.86	0.3451	0.6961	0.06903	0.176
2000	0.4308	0.06934	16.09	0.3758	0.7605	0.07593	0.176
2001	0.4588	0.06986	15.23	0.3985	0.7899	0.07665	0.167
2002	0.4435	0.0706	15.92	0.388	0.7615	0.07355	0.166
2003	0.4192	0.07338	17.5	0.3724	0.7333	0.07843	0.187
2004	0.425	0.07672	18.05	0.3769	0.7457	0.08675	0.204
2005	0.4423	0.07919	17.9	0.3898	0.7704	0.0941	0.213
2006	0.4733	0.07921	16.74	0.4084	0.8026	0.1194	0.252
2007	0.4956	0.07575	15.28	0.3932	0.8126	0.1563	0.315
2008	0.513	0.07359	14.35	0.3878	0.8293	0.1887	0.368
2009	0.5262	0.07205	13.69	0.3784	0.8452	0.2103	0.4
2010	0.536	0.07083	13.21	0.3727	0.8623	0.2209	0.412
2011	0.5433	0.06985	12.86	0.3722	0.8689	0.2239	0.412
2012	0.5487	0.06907	12.59	0.3691	0.8739	0.2346	0.428
2013	0.5525	0.06847	12.39	0.3719	0.8783	0.2391	0.433
2014	0.5554	0.06802	12.25	0.3721	0.8797	0.2435	0.439
2015	0.5574	0.06771	12.15	0.3709	0.8819	0.2448	0.439
2016	0.5589	0.06749	12.08	0.3699	0.8849	0.2444	0.437
2017	0.5599	0.06735	12.03	0.3715	0.8853	0.2452	0.438

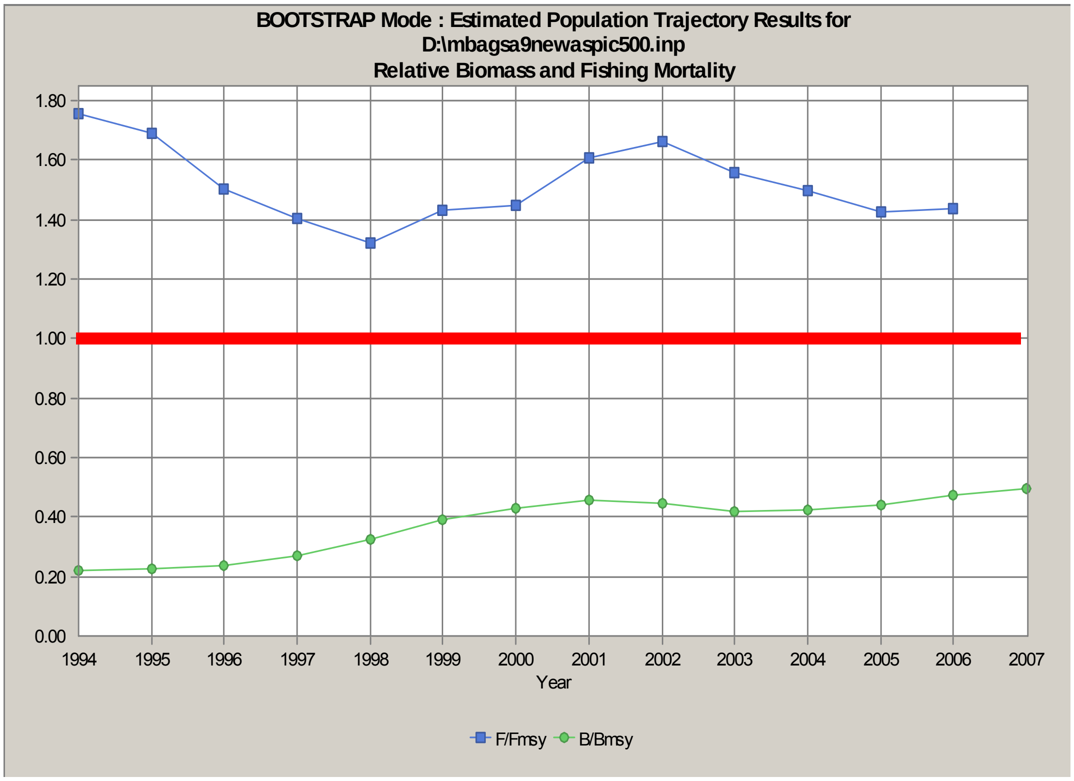


Fig 7.20.4.2.3.1 Historic trend in estimated fishing mortality as F/F$_{MSY}$ ratio (upper panel) and biomass as B/B$_{MSY}$ ratio (lower panel).

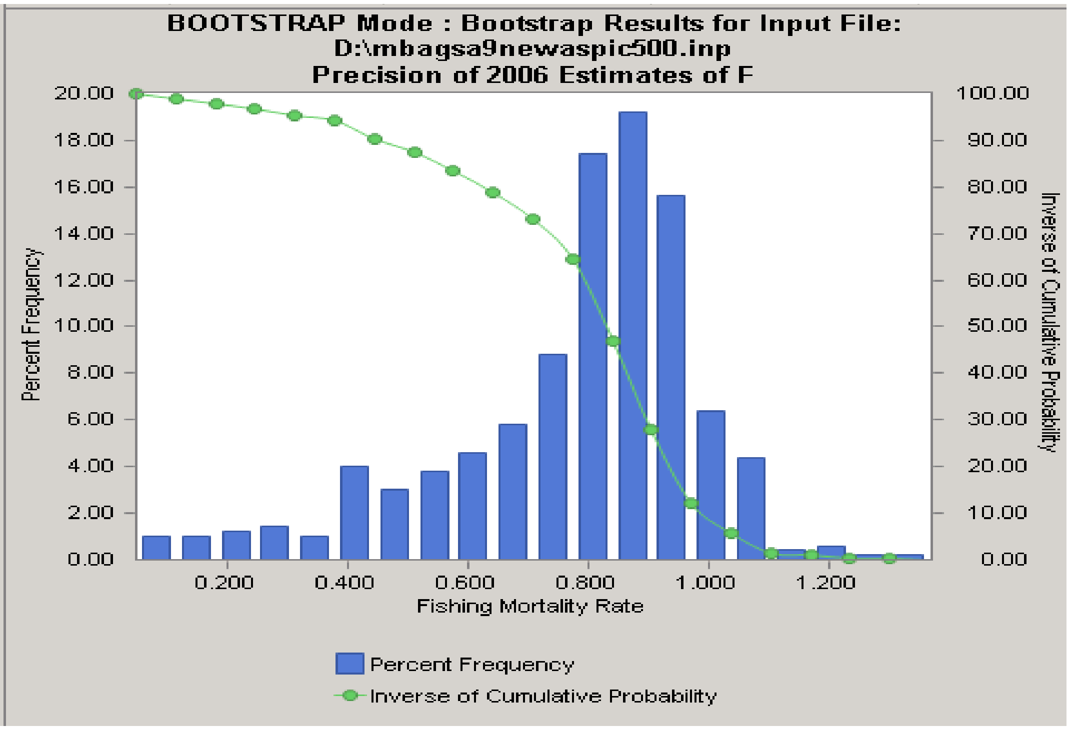


Fig 7.20.4.2.3.2 Fishing mortality as estimated by Aspic..

7.20.4.3.Method 3: Non equilibrium dynamic model

7.20.4.3.1. Justification

The model allows estimating the parameters r and K of the logistic population growth model and the definition of Z and F at the Maximum Biological Production (MBP) level. MBP represents the comprehensive maximum production derived from the harvesting and from the biomass losses due to natural mortality. Considering that we are not using total biomass but an index U, derived from the survey and espressed as kg/km2, the approach will not allow calculating the absolute value of MBP but an index of it. In any case, the Biological Production curve will have the same shape, although with proportional lower values, and its maximum will be localized at the same value of mortality rate obtained when absolute biomass values are used.

The constructed production model is based on the Caddy and Csirke (1983) variant of Surplus Production models that uses the instantaneous total mortality rate Z as a direct index of effort, and a catch rate as abundance index. The use of Z is justified by the lacking of reliable information on fishing effort for the whole area, but its use avoids passing through several problems, as the correct quantification of the overall fishing effort of the trawlers fleet directed to the species..

MEDITS trawl surveys were every year performed in spring with the same stratified random sampling scheme, same towing speed, vessel characteristics and fishing gear. The measurement of the wing spread with hydroacustic devices allowed the standardization of the data of the different tows. Swept area was calculated for each tow and abundance indexes expressed in kg/km2. The survival rate along the cohorts was used for the estimation of Z, after the reconstruction of the demographic structure of the stock.

The used model is based on the modified Schaefer logistic equation (Walters and Hilborn,1976):

$$Bt+1 = Bt + rBt(1-(Bt / k)) - qEtBt$$

With the exclusive use of trawl surveys data, information on q and fishing effort E is not available, but this problem was resolved by using the Baranov (1918) catch equation and modifying the above equation as follows:

Bt+1 = Bt + rBt(1-(Bt / k)) – (F/Z) Bt(1-exp(-Zt))

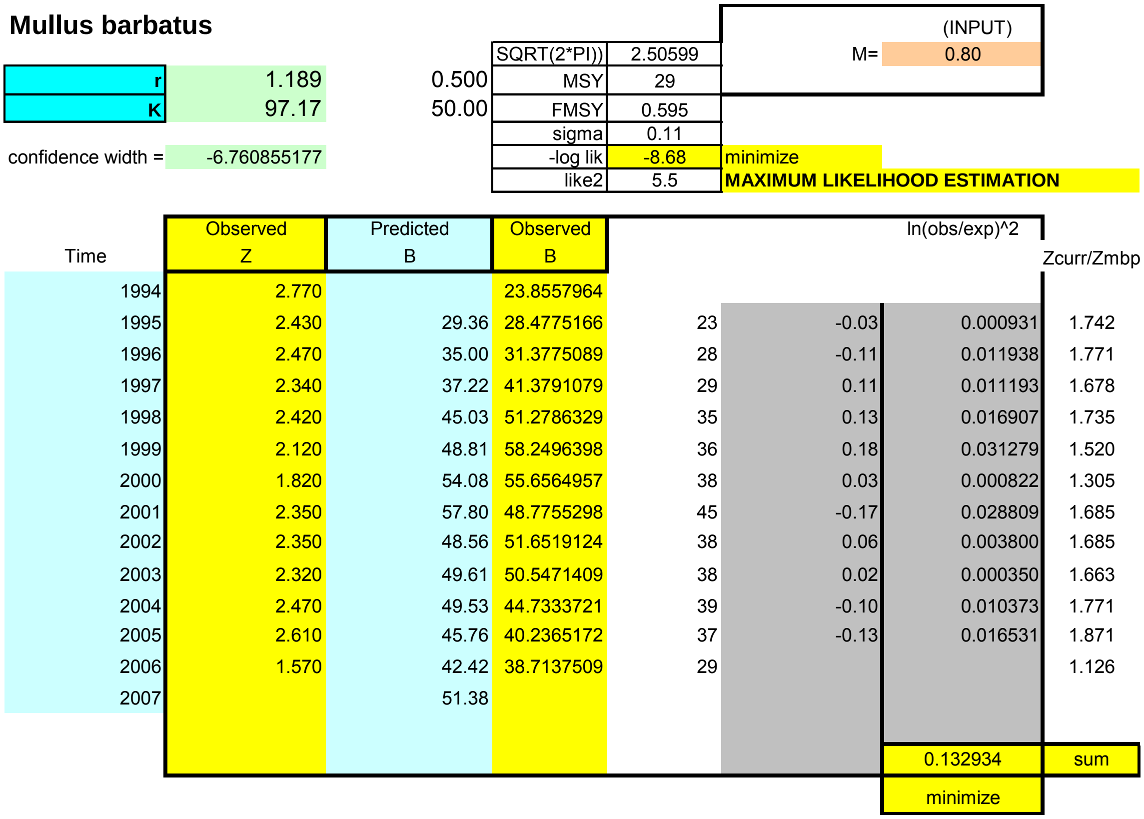
A computationally simple fitting procedure was utilized using an Excel spreadsheet. The log likelihood value was minimized by changing the seed values of r and K.
With this variant of the Schaefer model, only K and r have to be estimated. With the estimated values of K and r it is possible to define F and Z corresponding to the Maximum Biological Production (FMBP and ZMBP). The routine also allows comparisons between the Biological Production at Zcurr with the BP at ZMBP.

7.20.4.3.2. *Input parameters*

A value of M=0.8 derived from the estimated vector of M at age was used considering that Z is highly conditioned by the high levels of both natural and fishing mortality rates exerted on juveniles. The use value of M represents the weighted average value considering numbers by age class.

7.20.4.3.3. *Results*

Tab. 7.20.4.3.3.1 Spreadsheet used for the fitting of the non-equilibrium production model using time series of data of Z and an index of abundance (kg/km2) from trawl surveys.



Mullus barbatus

			SQRT(2*PI))	2.50599	M=	0.80 (INPUT)
r	1.189	0.500	MSY	29		
K	97.17	50.00	FMSY	0.595		
			sigma	0.11		
confidence width =	-6.760855177		-log lik	-8.68	minimize	
			like2	5.5	MAXIMUM LIKELIHOOD ESTIMATION	

Time	Observed Z	Predicted B	Observed B			ln(obs/exp)^2	Zcurr/Zmbp
1994	2.770		23.8557964				
1995	2.430	29.36	28.4775166	23	-0.03	0.000931	1.742
1996	2.470	35.00	31.3775089	28	-0.11	0.011938	1.771
1997	2.340	37.22	41.3791079	29	0.11	0.011193	1.678
1998	2.420	45.03	51.2786329	35	0.13	0.016907	1.735
1999	2.120	48.81	58.2496398	36	0.18	0.031279	1.520
2000	1.820	54.08	55.6564957	38	0.03	0.000822	1.305
2001	2.350	57.80	48.7755298	45	-0.17	0.028809	1.685
2002	2.350	48.56	51.6519124	38	0.06	0.003800	1.685
2003	2.320	49.61	50.5471409	38	0.02	0.000350	1.663
2004	2.470	49.53	44.7333721	39	-0.10	0.010373	1.771
2005	2.610	45.76	40.2365172	37	-0.13	0.016531	1.871
2006	1.570	42.42	38.7137509	29			1.126
2007		51.38					
						0.132934	sum
						minimize	

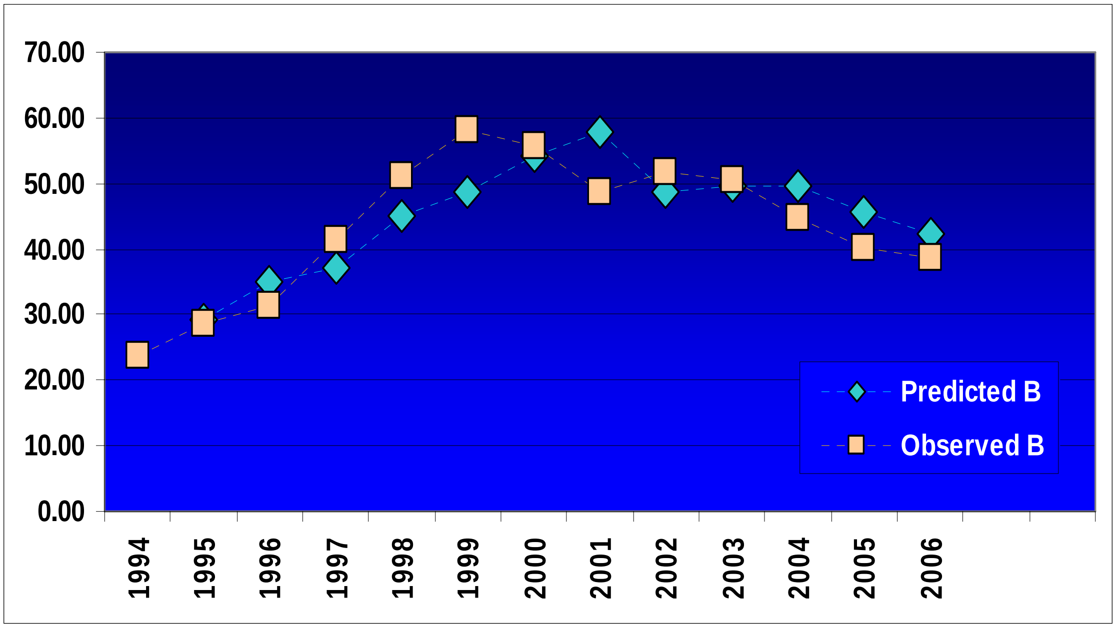


Fig. 7.20.4.3.3.1 Fitting of predicted values to observed values of the abundance index for each year with 80% confidence intervals.

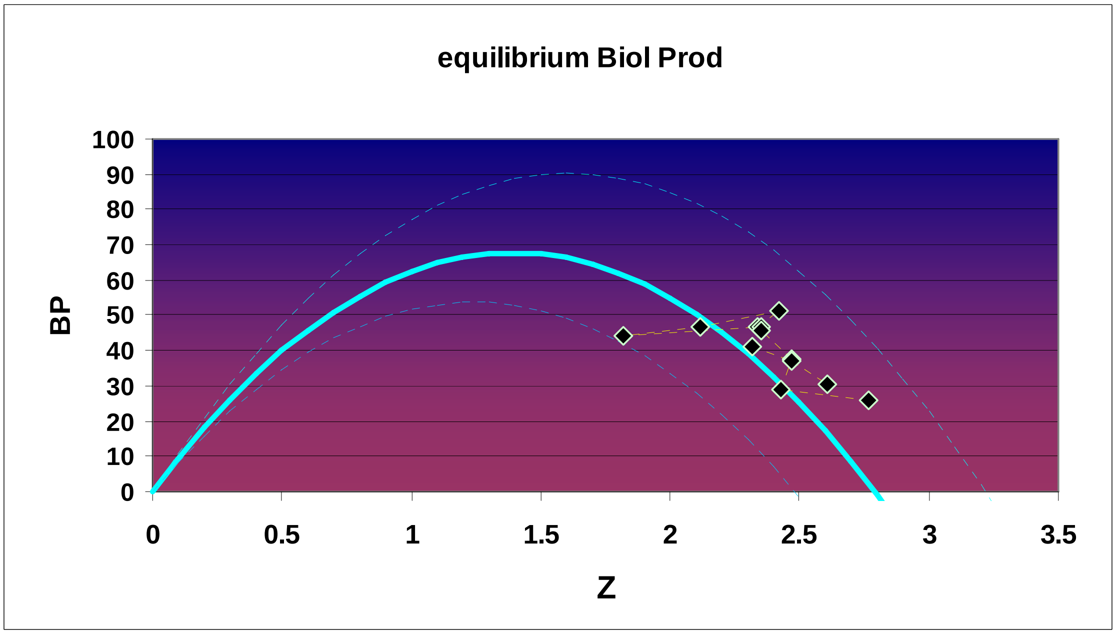


Fig. 7.20.4.3.3.2 Equilibrium Surplus Production Model and observed values of biological production (UZ).

7.20.5. Short term prediction for 2008 and 2009

7.20.5.1. Justification

No forecast analyses were conducted.

7.20.5.2. Input parameters

No forecast analyses were conducted.

7.20.5.3.Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 09.

7.20.6. Medium term prediction

7.20.6.1.Justification

An Aspic model was run to estimate future 10 years stock parameters under status quo fishing mortality.

7.20.6.2.Input parameters

See section 7.20.4.2.

7.20.6.3.Results

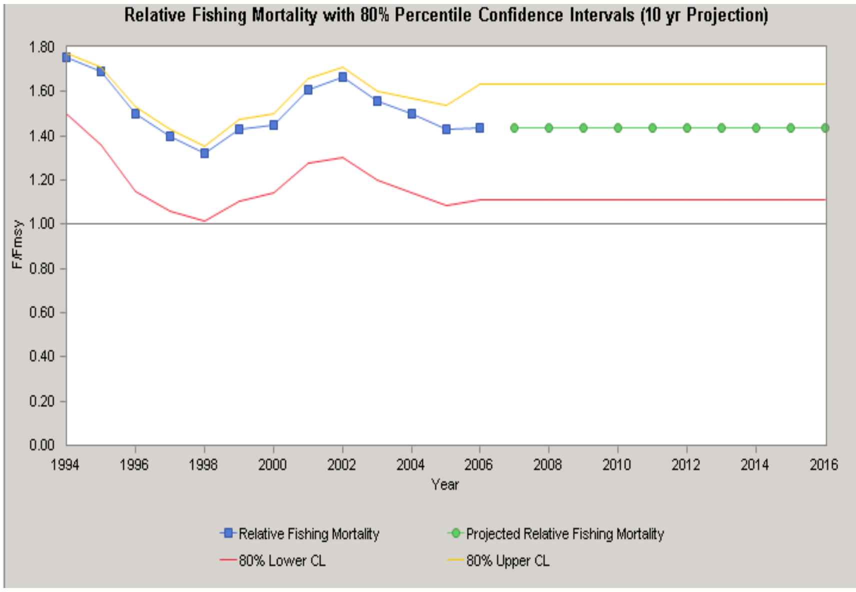


Fig 7.20.6.3.1 Historic and future trend (10 years) in estimated fishing mortality.d

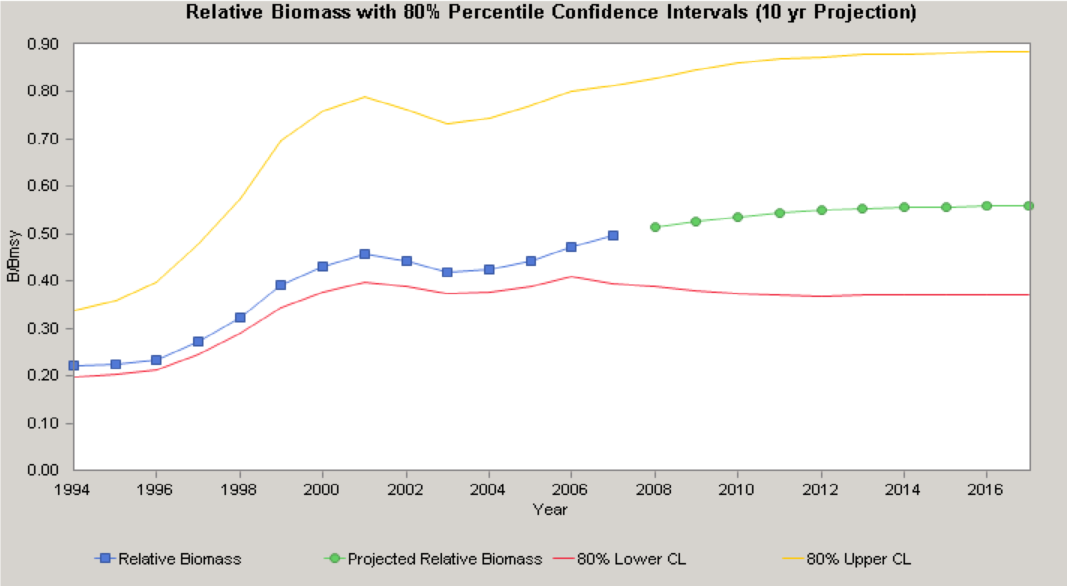


Fig 7.20.6.3.1 Historic and future (10 years) trend in estimated stock biomass.

7.20.7. Long term prediction

7.20.7.1. Justification

A traditional Beverton & Holt Y/R analysis was performed with the “Yield” software.

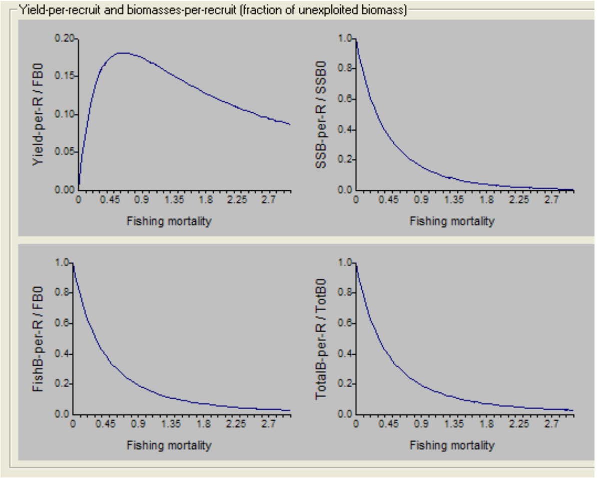
7.20.7.2. Input parameters

A weighted mean value of M of 0.8 was used.

7.20.7.3. Results

A value of 0.63 was estimated for Fmax and of 0.42 for F0.1 while the F rate at which the Spawning Biomass is expected to be reduced to 30% of the pristine Biomass (F30%SSB) was estimated as 0.24.

Relative per recruit (left) and absolute (righ) estimated values of Y, SSB, Fished B and Total B are shown in Fig 7.20.7.3.1.



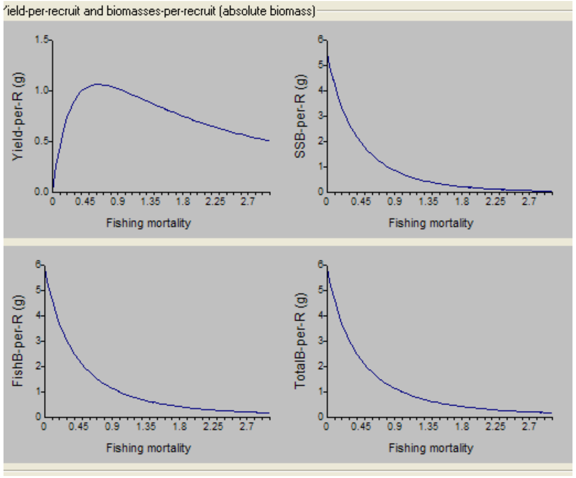


Fig 7.20.7.3.1. Results of the Y/R analysis.

7.20.8. Scientific advice

7.20.8.1. Short term considerations

7.20.8.1.1. State of the spawning stock size

The index of stock abundance from GRUND survey shows high variability throughout the time series, but no trend is observed.

The index of abundance from MEDITS surveys, that approximates a spawning stock biomass index (mostly represented by mature fish), suggests a positive trend from 1994 to 2006. Wide fluctuations are observed from 2002 to 2006.

7.20.8.1.2. State of recruitment

Recruitment shows a slight increasing trend, especially in the most recent years.

7.20.8.1.3. State of exploitation

The species is considered overexploited, with a current fishing mortality (F = 0.85 ASPIC, and 1.04 LCA) decisely higher to the values considered limit reference points ($F_{0.1}$ and F_{MBP}). The size of first capture is too low and an increase in yield can be expected in the case more selective gears are used and a reduction of fishing effort do occur. It is advisable to avoid the illegal fishing within the 3 miles stripe as well as the landing of undersized individuals.

7.20.8.2. Medium term considerations

SGMED-08-04 concludes that the red mullet stock in GSA 09 has no significant recovery potential under the current fishing strategy.

7.21. Stock assessment of red mullet in GSA 10

7.21.1. Stock identification and biological features

7.21.1.1. Stock Identification

Red mullet stock was assumed in the boundaries of the whole GSA10, lacking specific information on stock identification. *M. barbatus* is with European hake and deep-water rose shrimp a key species of fishing assemblages in the central-southern Tyrrhenian sea (GSA 10). The species is almost exclusively distributed on the continental shelf and is a rather small-sized, fast-growing and characterized by a relatively short lifespan. It spawns in late spring-early summer with a peak in June-July. In late summer, recently settled juveniles are highly concentrated nearshore and this concentration is still present up to October. Aggregation of juveniles and subsequent movements towards more offshore grounds have been reported and indicated as a source of increased vulnerability of this population component to the harvest strategy (Voliani et al., 1998). During late summer-early autumn (September-October), the species is intensely caught and often represent an important fraction of the landings of the coastal bottom trawlers. About three-four months after settlement, red mullet has spread up to depths of about 100 m.

7.21.1.2. Growth

The growth of red mullet has been studied in the GSA using two different approaches that also allowed validation of the aging: 1) whole otolith readings and 2) the analysis of length-frequency distributions using techniques as Batthacharya for separation of modal components. The estimates of von Bertalanffy growth parameters for sex combined obtained using DCR data sets were the following: L_∞=26 cm k=0.42 t_0= -0.4.
Parameters of the length-weight relationship estimated from the DCR data sets and related to the sex combined were a=0.0086; b=3.05 for length expressed in cm.

7.21.1.3. Maturity

Estimates of size at first maturity of females were conducted using Medits trawl survey data and the method developed within the Fisboat project (Rochet and Trenkel, 2005; Fisboat web-site: http://www.ifremer.fr/drvecohal/fisboat/). In the following table the size at first maturity (in cm) of females and the associated errors are reported.

Year	L50.maturity	SdL50.maturity
1994	13.7	0.0544
1995	13.2	0.09
1996	13.3	0.0964
1997	13.4	0.0808
1998	12.9	0.0258
1999	13.7	0.0309
2000	13.2	0.0386
2001	13.1	0.041

Size at first maturity of females was ranging from about 13.0 to about 14 cm that is when fish are aged 1 year. This range of length at first maturity was successively used in the assessment.

7.21.2. Fisheries

7.21.2.1. General description of fisheries

Red mullet is mostly targeted by trawlers, but also by small scale fisheries using trammel nets. Fishing grounds are located along the coasts of the whole GSA offshore 50 m depth or 3 miles from the coast.

7.21.2.2. Management regulations applicable in 2007 and 2008

Management regulations are based on technical measures and do not differ from those applied in the previous years: closed number of fishing licenses for the fleet and area limitation (fishing forbidden within 50 m depth or 3 miles from the shore, depending on the zone). Along northern Sicily coasts two main Gulfs (Patti and Castellammare) have been closed to the trawl fishery up 200 m depth, since 1990. Effects of protection have been also evaluated (Fiorentino et al., in press). Two closed areas were also established since 2004 along the mainland, in front of Sorrento peninsula (Napoli Gulf) and Amantea (Calabrian coasts), the latter including one of the areas where red mullet is more concentrated. In the GSA 10 the fishing ban has not been mandatory along the time, and from one year to the other it was adopted on a voluntary basis by fishers.

7.21.2.3. Catches

7.21.2.3.1. Landings

Available landing data are from DCR regulations and range from 839 tons of 2002 to 501 tons in 2007, being the lowest value of 393 tons registered in 2006. Most part of the landings of red mullet are from trawlers and shows a pattern similar to the total landing of red mullet, except for the last two years. In 2006 landings of trawlers were increasing compared to 2005, while in 2007 they were decreasing. Opposite directions were observed from all the fishing segments (Fig. 7.21.2.3.1.1). This is more evident if the respective contribute of DTS and PGP segments along the years are considered (Fig. 7.21.2.3.1.1).

Tab. 7.21.2.3.1.1 lists the annual landings by major fishing techniques. Data are listed in Tab. A3.2 of Appendix 3.

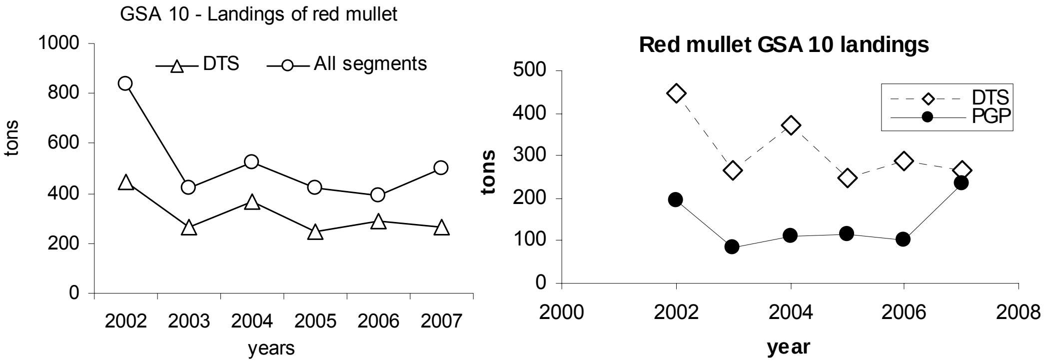


Fig. 7.21.2.3.1.1 Annual landings of red mullet in tons (DTS and total)

Tab. 7.21.2.3.1.1 Annual landings (t) by fishing technique, 2002-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	10	ITA	DTS	446	265	370	249	289	265
MUT	10	ITA	HOK			2		0	
MUT	10	ITA	PGP	195	83	110	116	104	237
MUT	10	ITA	PMP	189	71	41	56		0
MUT	10	ITA	PTS	10		1			
SUM				840	419	524	421	393	502

The length distribution of landings is reported in Fig. 7.21.2.3.1.2 for 2006 and 2007 and for the DTS and Nets segments. Both number of individuals and weight are reported. The number of individuals was raised to the total landings of the fleet segment using the proportion of the number of individuals by size class observed in the sample. The total weight corresponding to each length class was calculated using the obtained number of individuals and the average weight, from the length-weight relationship, at each central value of the length class.

The LFDs of the two years present a different pattern between the two fishing segments as showed in the Fig. 7.21.2.3.1.2. The contribute in term of number of individuals is more relevant for the nets segments in 2007, although the contribute in weight of trawlers (DTS) is more conspicuous. Analogously also the distribution by age and fleet segment shows a different pattern in the two years (Fig. 7.21.2.3.1.3).

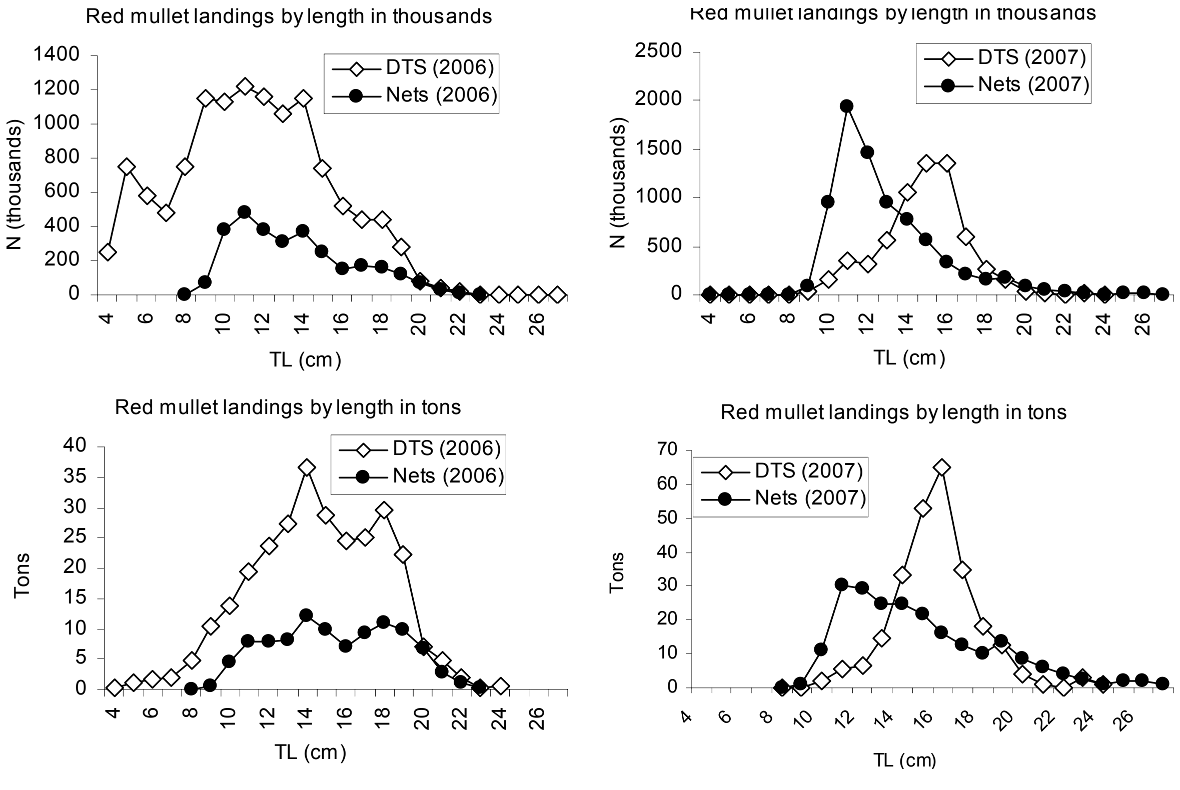


Fig. 7.21.2.3.1.2 Landings by length in thousands and tons in 2006 and 2007 for DTS and nets segments.

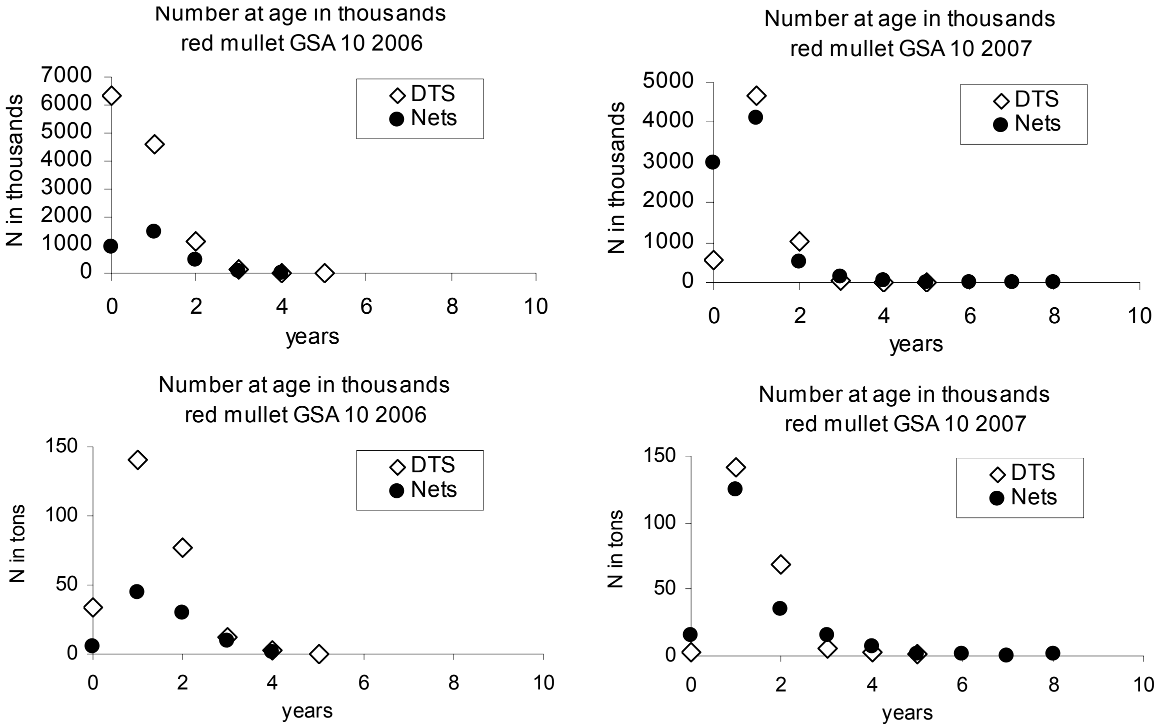


Fig. 7.21.2.3.1.3 Landings by age in thousands and tons in 2006 and 2007 for DTS and Nets segments.

7.21.2.3.2. Discards

The proportion of the discards of red mullet in the GSA 10 was generally low and concentrated in the third and fourth quarter, when recruitment is occurring. In 2006 the estimate of discard proportion compared to the total landings in the GSA was 3%. Despite this value was lower than the prescription of reg UE 1639/2001 (10% in weight or 20% in number) the composition in length and age was estimated, that highlights the prevailing of the age 0 group; the average length was 8.7 cm (Fig. 7.21.2.3.2.1).

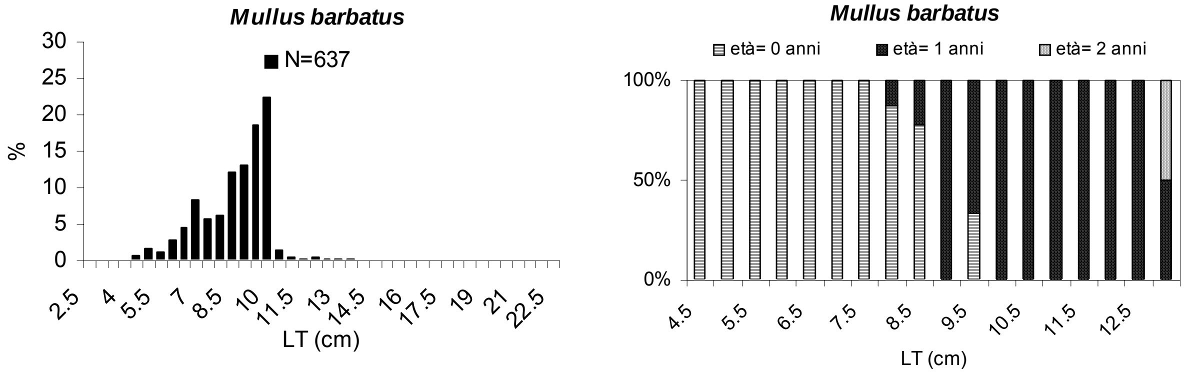


Fig. 7.21.2.3.2.1 Size and age composition of discards.

Only 3 t of discards in 2006 were reported to SGMED-08-04 (Tab. A3.6 of Appendix 3).

7.21.2.3.3. Fishing effort

In the area, the total fishing effort of the trawlers (OTB or DTS) and small scale fishery (PGP or Nets), the two main fishing segments targeting also red mullet, is shown in Fig.7.21.2.3.3.1. The whole fishing effort (kwdays) of trawlers in the GSA shows an increasing from 2002 to 2005, and a decreasing in 2006, while the effort of the small scale fishery (PGP) shows a slight decrease up to 2005 and an increase in 2006.

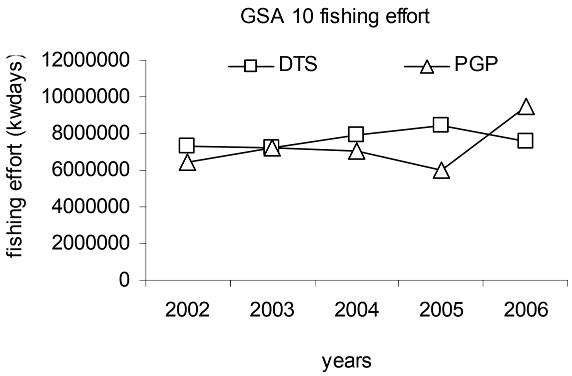


Fig.7.21.2.3.3.1 Trend in trawl and small scale fishery fishing effort (in kwdays) along 2002-2006.

Tab. 7.21.2.3.3.1 lists the effort by fishing technique deployed in GSA 10 as reported to SGMED-08-04 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.21.2.3.3.1 Effort trends by fishing technique in GSA 09.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	10	ITA	DRB	658	205	830	1776	1984	1040
DAYS	10	ITA	DTS	37949	38134	44087	46547	43848	40724
DAYS	10	ITA	HOK			20929	20418	8064	7043
DAYS	10	ITA	PGP	357895	311474	325523	268441	346849	311693
DAYS	10	ITA	PMP	105705	143062	62225	64177	10532	7261
DAYS	10	ITA	PTS	8258	9780	11792	11206	9332	9367
GT*DAYS	10	ITA	DRB			7968	17128	19136	9939
GT*DAYS	10	ITA	DTS			1337882	1622062	1331071	1266460
GT*DAYS	10	ITA	HOK			157882	143835	103111	82342
GT*DAYS	10	ITA	PGP			661958	534880	800036	693057
GT*DAYS	10	ITA	PMP			336053	333845	152717	110850
GT*DAYS	10	ITA	PTS			390096	468145	367417	280190
KW*DAYS	10	ITA	DRB	94663	29540	110899	244013	272628	142455
KW*DAYS	10	ITA	DTS	7344089	7231486	7883881	8467144	7596783	7105075
KW*DAYS	10	ITA	HOK			1654352	1413547	925244	794816
KW*DAYS	10	ITA	PGP	6440217	7222145	7056306	6018600	9486681	8397010
KW*DAYS	10	ITA	PMP	12686947	8003452	3588004	3728376	1404642	1003285
KW*DAYS	10	ITA	PTS	2631242	2930380	2308589	2434470	2016508	1680295

7.21.3. Scientific surveys

7.21.3.1.Medits

7.21.3.1.1. Methods

According to the MEDITS protocol (Bertrand et al., 2002), trawl surveys were yearly (May-July) carried out, applying a random stratified sampling by depth (5 strata with depth limits at: 50, 100, 200, 500 and 800 m;

each haul position randomly selected in small sub-areas and maintained fixed throughout the time). Haul allocation was proportional to the stratum area. The same gear (GOC 73, by P.Y. Dremière, IFREMER-Sète), with a 20 mm stretched mesh size in the cod-end, was employed throughout the years. Detailed data on the gear characteristics, operational parameters and performance are reported in Dremière and Fiorentini (1996). Considering the small mesh size a complete retention was assumed.All the abundance data (number of fish per surface unit) were standardised to square kilometre, using the swept area method.

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 10 the following number of hauls were reported per depth stratum (s. Tab. 7.21.3.1.1.1).

Tab. 7.21.3.1.1.1. Number of hauls per year and depth stratum in GSA 10, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA10_010-050	9	10	10	10	10	10	10	10	9	9	9	9	9	9
GSA10_050-100	12	12	12	12	12	12	12	12	10	10	10	10	10	10
GSA10_100-200	20	20	20	20	20	20	20	20	17	17	17	17	17	17
GSA10_200-500	26	27	26	26	27	26	26	28	22	22	22	22	22	22
GSA10_500-800	31	30	31	31	31	30	31	29	26	26	26	26	26	26

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

GRUND survey was conducted in the area using a commercial gear and different vessels until 2003, when a unique sampler (combination of vessel and gear) was adopted in the whole GSA. Sampling scheme, stratification and protocols were as in Medits.

7.21.3.1.2. *Geographical distribution patterns*

Map of the bubble plot of the survey indices indicates a higher abundance of the population in the southernmost part of the area, along the mainland and the north Sicily coasts. The approach based on spatial indicators (Woillez et al., 2007) to characterise the spatial dynamics of red mullet life stages has been applied to the GSA 10 (Spedicato et al., 2007), with the objectives of identifying areas where red mullet recruits are more concentrated, establishing relationships with the adult distribution and detecting the ability of spatial indicators to capture the stability of the spatial occupation of preferential sites across the years. The spatial indices mainly studied were the centre of gravity (CG), the inertia (I) and the global index of collocation (GIC). Gravity centres (xcg-longitude; ycg-latitude; graph below) by age groups across years and life-stages highlighted a less changing spatial location of the younger age (A1) compared to the older ones (A2 and A3) that were more dispersed. The approach of the spatial indicators enabled the location of the geographical zone (along the Calabrian coast, southwards in the study area) where recruits (age 0 fish) of red mullet are mainly distributed and to verify that these locations are rather stable across years. Furthermore a first absolute estimate of juvenile abundance was performed.

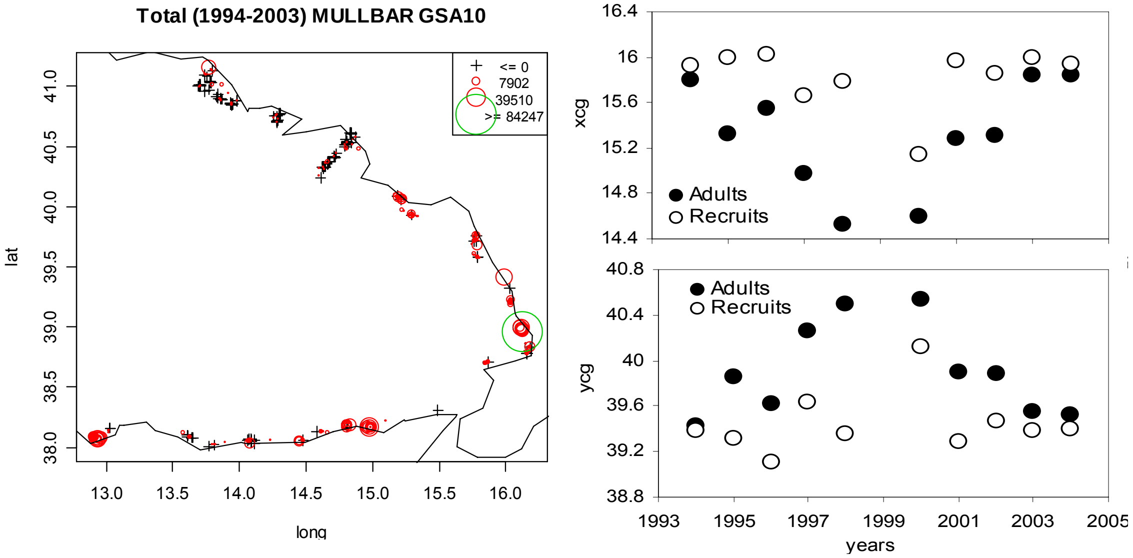


Fig. 7.21.3.1.2.1 Scaled survey catches of red mullet in GSA 10 and centre of gravity (CG) of recruits and adults.

7.21.3.1.3. *Trends in abundance and biomass*

Indices from Medits trawl-survey show a decreasing pattern from 1999 onwards (significant for the biomass index). In the last year 2007, a rising of both indices was observed (Fig. 7.21.3.1.3.1).

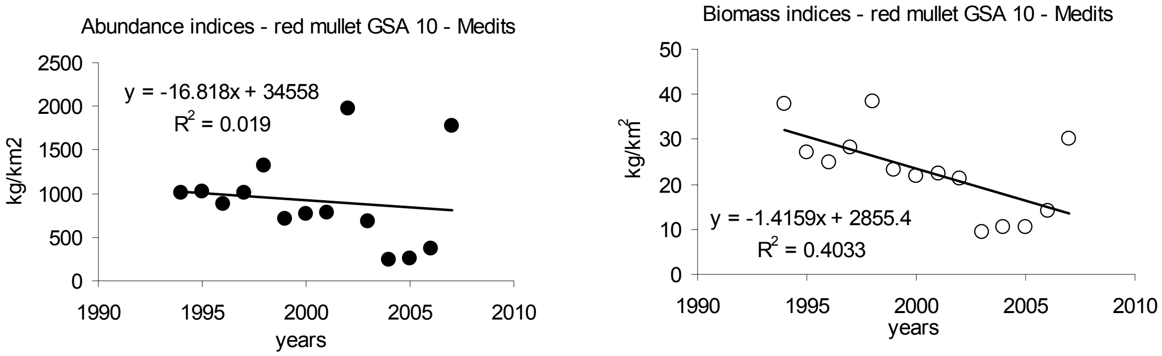


Fig. 7.21.3.1.3.1 Trends in survey abundance and biomass derived from Medits.

Fishery independent information regarding the state of the red mullet in GSA 10 was derived from the international survey Medits. Figure 7.21.3.1.3.2 displays the estimated trend in red mullet abundance and biomass in GSA 10.

The re-estimated abundance and biomass indices do reveal identical trends to those shown above. However, the recent abundance and biomass indices in 2007 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

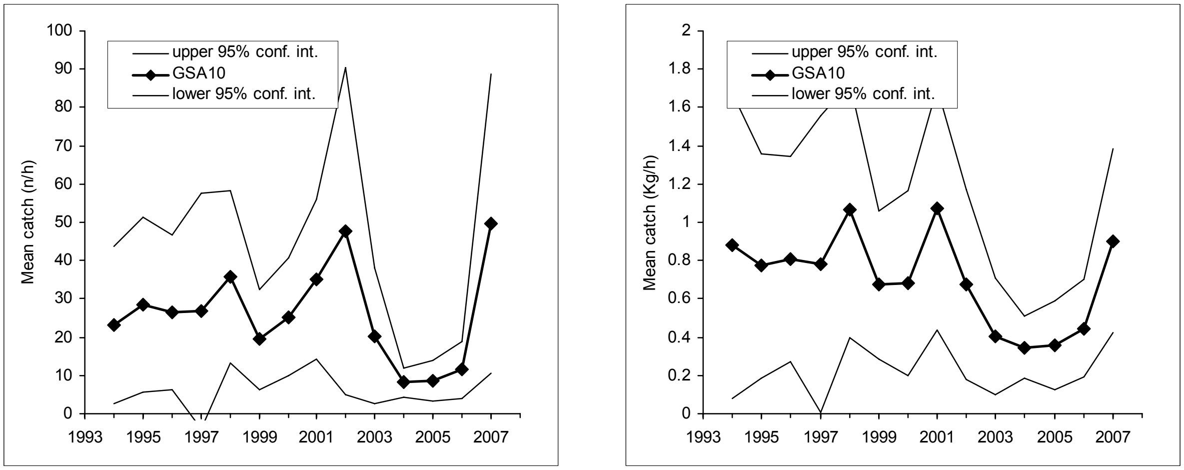


Fig. 7.21.3.1.3.2 Abundance and biomass indices of red mullet in GSA 10 derived from Medits.

7.21.3.1.4. Trends in abundance by length or age

No trend in the mean length was observed in Medits survey.

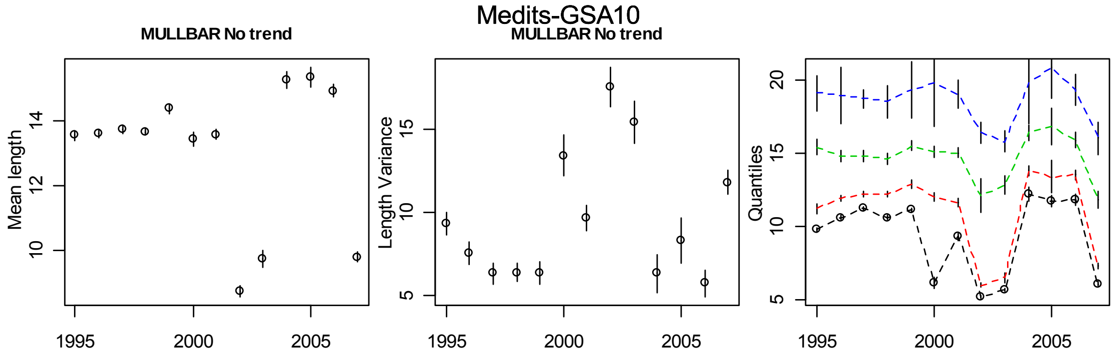


Fig. 7.21.3.1.4.1 Mean length, variance and quantiles derived from the Medits length compositions in 1995-2007.

The following Fig. 7.21.3.1.4.2 and 3 display the stratified abundance indices of GSA 08 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

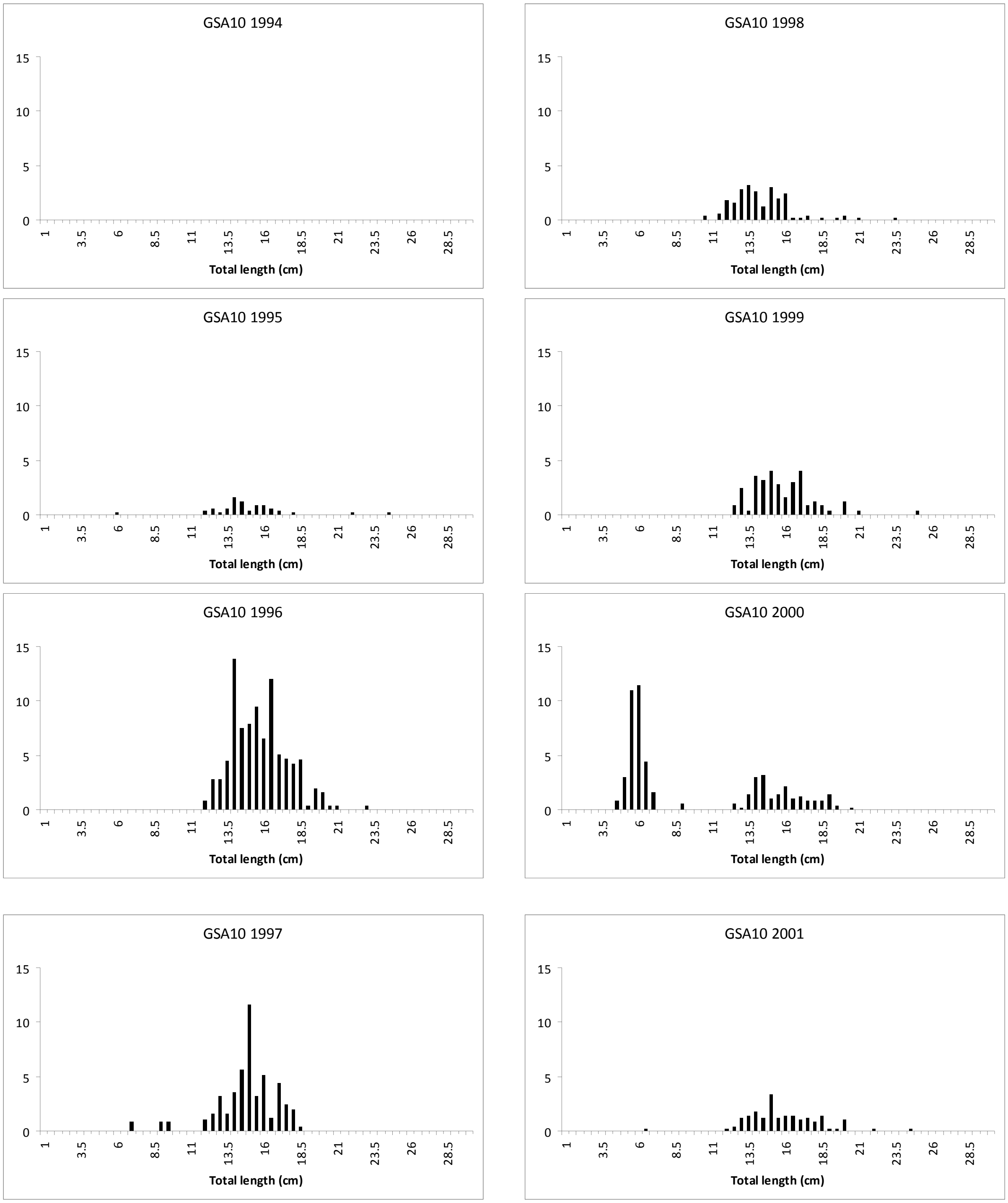


Fig. 7.21.3.1.4.2 Stratified abundance indices by size, 1994-2001.

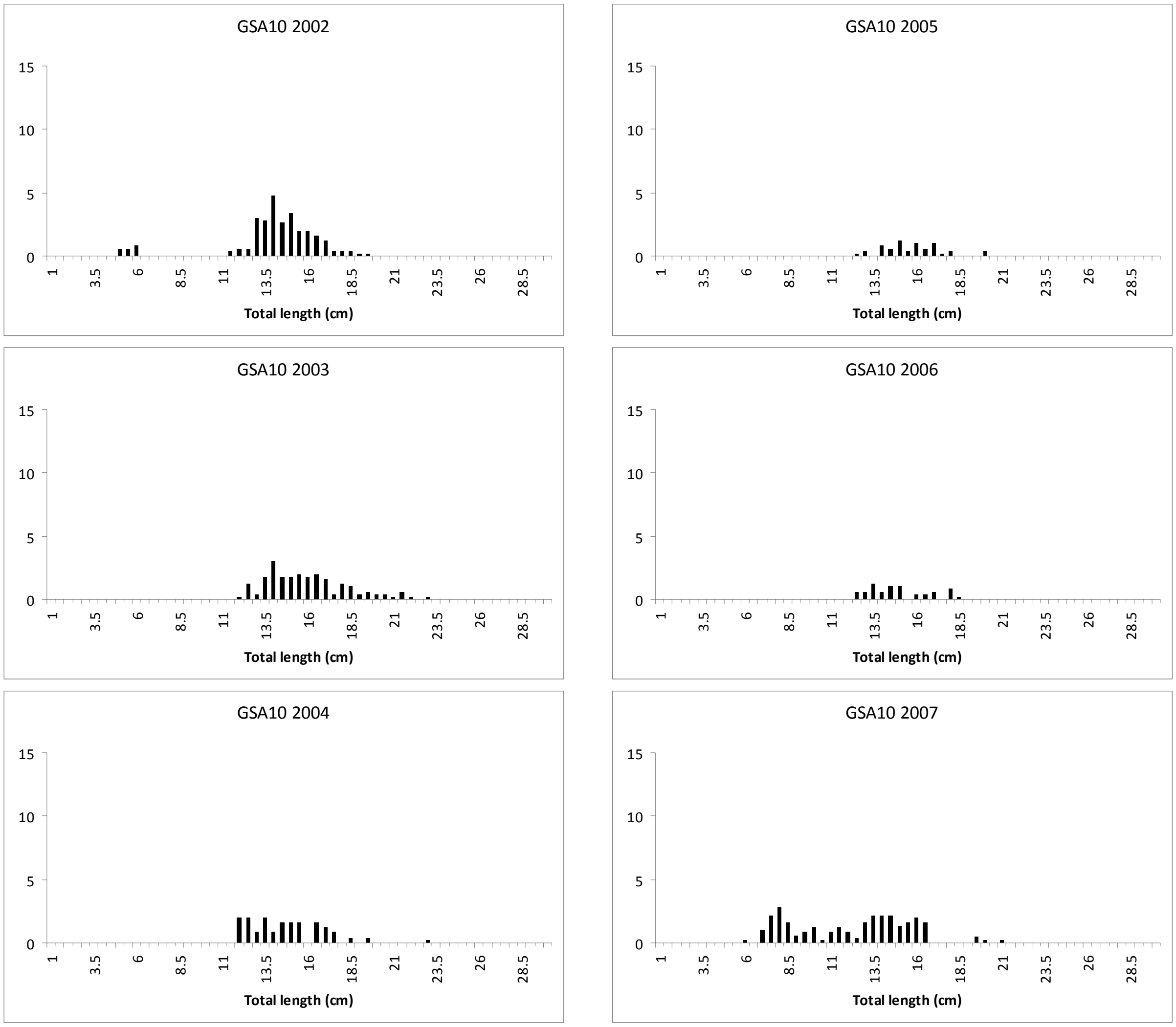


Fig. 7.21.3.1.4.3 Stratified abundance indices by size, 2002-2007.

7.21.3.2. GRUND

7.21.3.2.1. Methods

Since 2003 Grund surveys (Relini, 2000) was conducted using the same sampler (vessel and gear) in the whole GSA. Sampling scheme, stratification and protocols were similar as in Medits. All the abundance data (number of fish and weight per surface unit) were standardised to square kilometre, using the swept area method.

7.21.3.2.2. Geographical distribution patterns

Map of abundance of recruits (N/km^2) as estimated using Grund data and the ordinary kriging shows that the sub-zones where the recruits are mainly concentrated along the nearshore grounds of the southernmost part of the GSA, except a nucleus located in the northernmost side (Fig. 7.21.3.1.2.2). The higher values were around 25000 recruits/km^2.

Fig. 7.21.3.1.2.2 shows a map of abundance of recruits (N/km^2) as estimated using Grund data and the ordinary kriging. The recruits were estimated each year using the length frequency distribution and separating the first mode applying the Battacharya method. On average, considering the analyzed distributions (years 1994-2005), the recruits are individual smaller than 11.5 cm (±1.08). These individual are mostly belonging to the age 0 group.

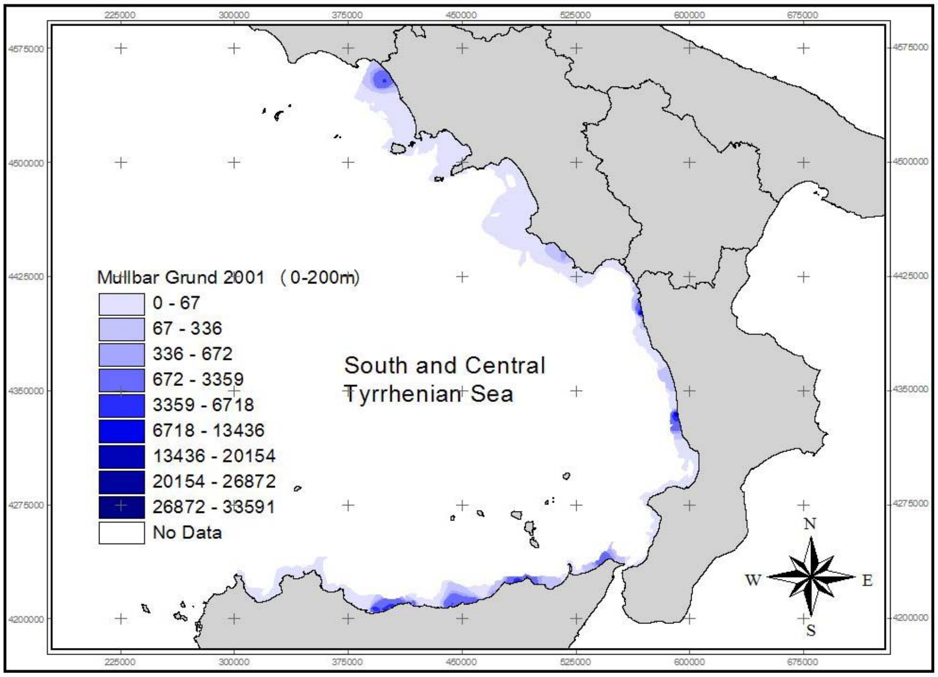


Fig. 7.21.3.1.2.2 Map of abundance of recruits (N/km^2) as estimated using Grund data and the ordinary kriging.

7.21.3.2.3. Trends in abundance and biomass

Similar trends are derived from the GRUND survey and shown in Fig. 7.21.3.2.3.1. Biomass and abundance indices were both significantly decreasing ($p<0.05$ on ln-transformed data), while the recruitment indices were highly variable but without any significant trend. Low levels were however observed in the periods 1994-1996 and 2003-2006. The analyses of Grund indices are considered preliminary.

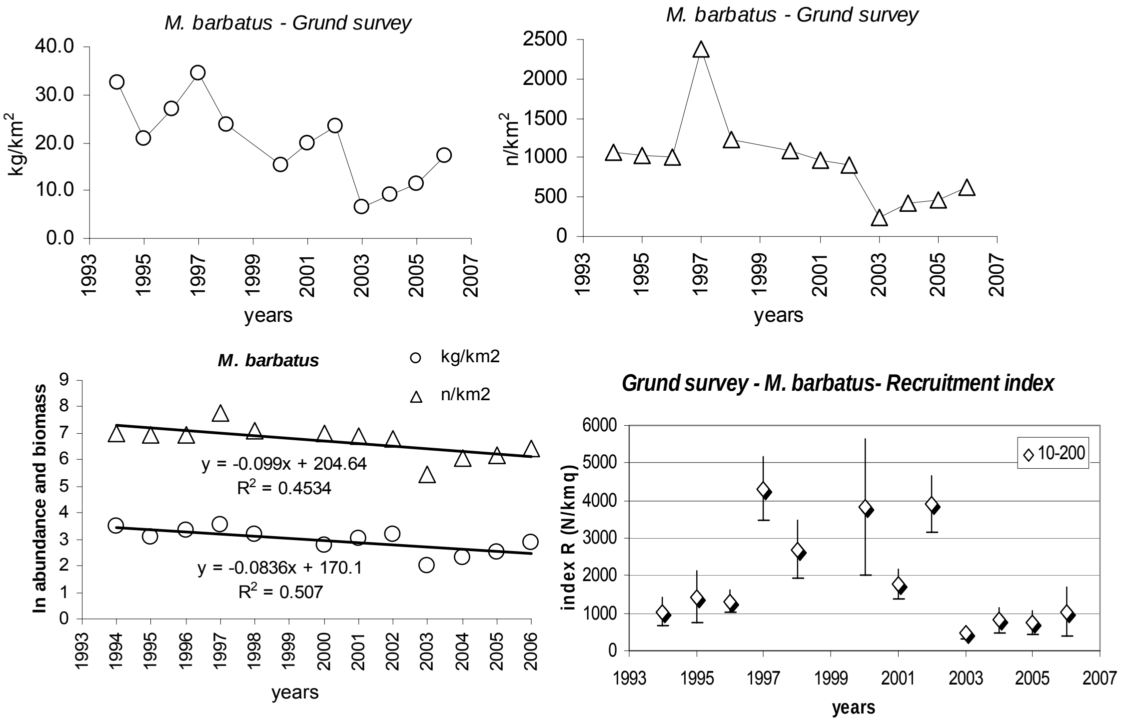


Fig. 7.21.3.1.3.3. Abundance and biomass indices of red mullet in GSA 10 derived from Grund survey. Ln transformed values and linear regression results are also presented and the recruitment indices (N/km^2) with standard deviation are reported.

7.21.3.2.4. Trends in abundance by length or age

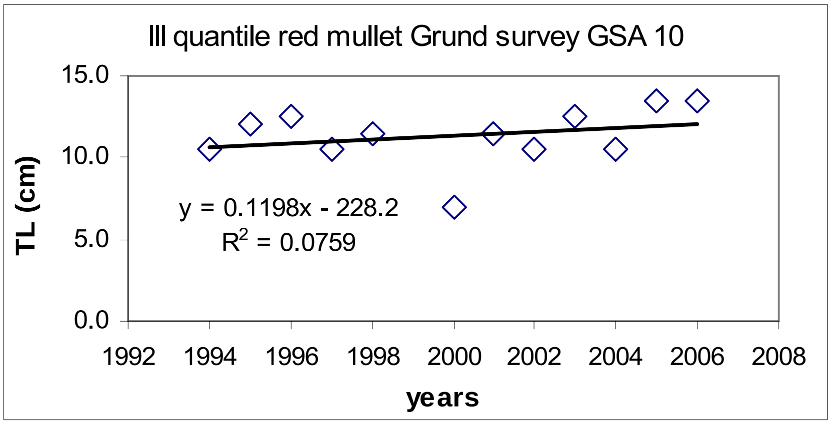


Fig. 7.21.3.1.4.4 III Quantile derived from the GRUND length compositions in 1994-2006.

7.21.3.2.5. Trends in growth

The occurrence of growth change along time was not fully explored during SGMED-08-04.

7.21.3.2.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.21.4. Assessment of historic stock parameters

7.21.4.1.Method 1: Aladym

7.21.4.1.1. Justification

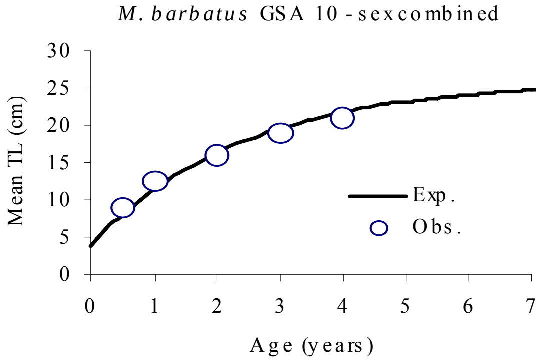
Aladym model (Lembo et al., 2007) was used for hindcasting, and for short-term and long-term prediction, including the effects of two different management scenarios.

ALADYM (Age-Length Based Dynamic Model) is an age-length based simulation model designed to predict the consequences of management scenarios on a single population, in terms of different metrics and indicators. Removals are simulated through total mortality modulated using a selectivity pattern and a fishing activity coefficient. ALADYM uses the classical equations of population dynamics to create a tool that uses fishery-independent information (e.g. from trawl surveys) as the primary data source. The formulation of population dynamics at a fine time scale (month) allows to model the effects of harvest controls that evolve through the year, which is particularly useful for fast growing species. The possibility of specifying a vector of natural mortality by age/length makes the model more suitable for non-equilibrium situations and when stocks are exploited at an early life stage such as Mediterranean fisheries. Stochastic effects can be added to some key life-history traits to incorporate uncertainty in input data and in their relationships. ALADYM can be used for a range of applications such as comparing management strategies, evaluating indicator changes or searching for reference points.

A summary of requirements, strengths, weaknesses, outputs, and several examples are provided in SGMED-08-01 and SGMED-08-02 reports.

7.21.4.1.2. Input parameters

The parameters of the growth function used in the assessment are shown in Fig. 7.21.4.1.2.1. The figure also reports the table that contains the age and length mean at age, with the standard deviation of the length at each age class. The total length mean expected from the model and the squared differences between observed and expected results are also shown. The sum of the squared differences between observed and expected values (3.356) is also reported in bold. In the fitting of the model if L∞, k and t0 were all left to vary, the resulting value of L∞ tended to be underestimated compared to the observed length in the samples. Thus L∞ was fixed to take into account the larger individuals in the samples.



age	mean TL	sd	TL mean.exp	$(\text{TLobs.-TLexp.})^2$
0.50	8.8	1.10	8.02	0.642
1.00	12.5	2.08	11.35	1.424
2.00	16.0	1.95	16.27	0.070
3.00	18.9	1.88	19.54	0.447
4.00	20.8	0.62	21.71	0.772
				3.356

Fig. 7.21.4.1.2.1 V. Bertalanffy growth function and parameters

Maturity data used to parameterize the model have been already showed in paragraph 7.21.1.1.3. An average length at first maturity of 13.5 cm was used, with a maturity range of 1 cm. The function is shown in the figure 7.21.4.1.2.2 that is reporting also the logistic function of selection ogive used in the model. This function was derived during selectivity experiments conducted in the area (Lembo et al., 2002) using a commercial net with a stretched mesh size in the cod-end of 40 mm.
In the figure the selection ogive parameters are also reported (L_{50} and selection range SR with respective standard errors, the selection factors is also reported).

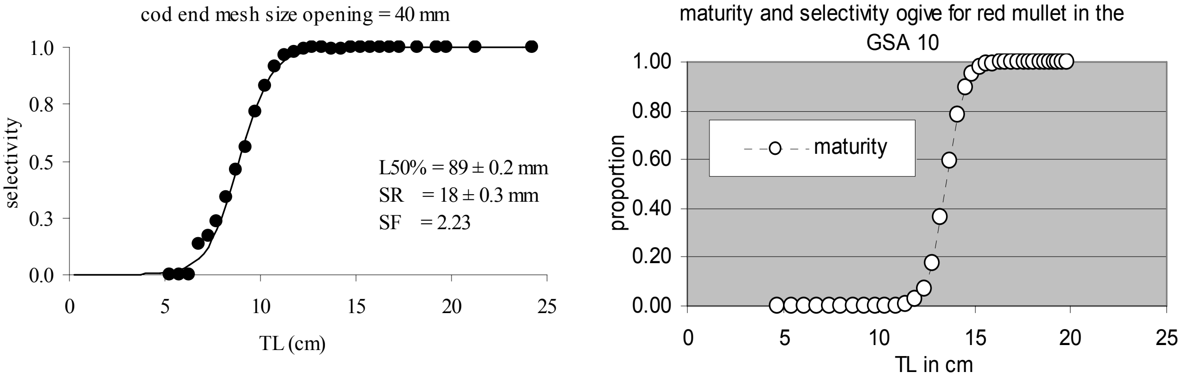


Fig. 7.21.4.1.2.2 Logistic function of selection and maturation (selectivity parameters are reported in mm).

A preliminary estimate of total mortality was estimated in each year using the method reported by Sinclair (2001):

$$Z_t = \frac{1}{\Delta t} \ln \left(\frac{\sum_{j=1}^{\infty} N_{t,j}}{\sum_{j=2}^{\infty} N_{t+\Delta t,j}} \right)$$

The length frequency distributions (Medits from 1995 to 2007 and Grund from 1995 to 2005, except 1999) of each haul were standardized to the square km and summed up. Then the distribution were split into age groups using the von Bertalanffy parameters and the procedure of slicing in LFDA package. By this way number at age per year were obtained for each survey. To these data the Sinclair method was applied year by year using the age group from 1 to 4 in each year. The estimates of total mortality are reported in the table Table 7.21.4.1.2.1 and shown in Fig. 7.21.4.1.3.1.

Tab. 7.21.4.1.2.1 Estimates of total mortality by year and survey. The average value between the two survey is also reported.

year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
grund 1-4 year	1.486	1.714	1.835	1.641	1.953	1.805	1.657	1.615	2.084	1.994	1.428	1.829	
medits 1-4 year		1.263	1.701	1.866	1.812	1.451	1.596	1.54	1.476	2.254	1.241	1.099	1.355
average	1.486	1.488	1.768	1.754	1.883	1.628	1.626	1.578	1.78	2.124	1.335	1.464	1.355

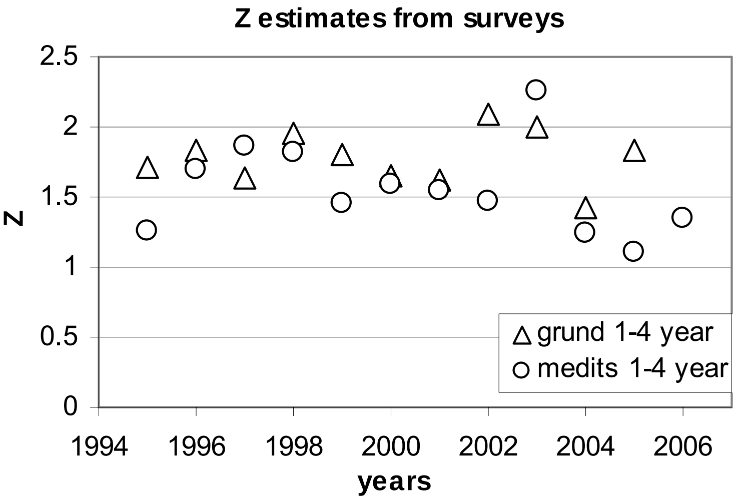


Fig. 7.21.4.1.3.1 Estimates of total mortality Z based on MEDITS and GRUND data, 1995-2006.

Aladym model was applied also for the short and long-term predictions. An hypothesis of a total mortality based on an average value (1.65) estimated using the last four years was formulated to project forwards the population.

The relationship between spawners and recruits was investigated (Fig. 7.21.4.1.3.2) and a Ricker type seemed plausible. However, considering that this analysis is very preliminary further insights have been postponed to successive investigations.

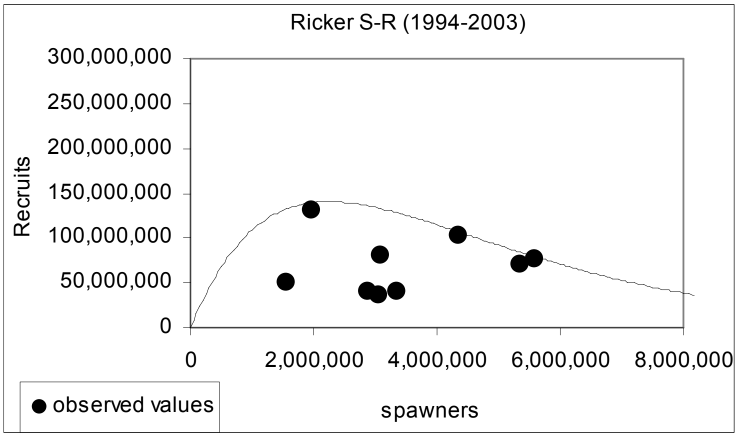


Fig. 7.21.4.1.3.2 Ricker function and observed values of estimated spawning stock and recruitment.

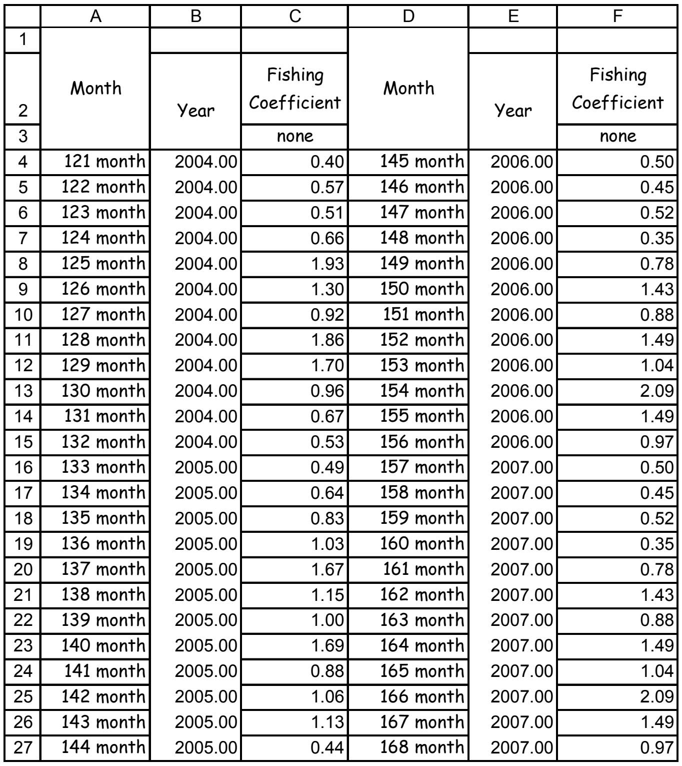
A random recruitment was thus assumed to parameterized Aladym model. The level of recruits was estimated from the number of individuals at age 1 in the whole GSA as obtained from the spatial indicators approach developed in the Fisboat project. The total number of recruits estimated in each year of the time series were projected backward using the observed level of mortality to get the offspring numbers at starting point of the simulation. The same estimates were used to calculate the mean and standard deviation, in order to both derive the parameters of a log-normal distribution (minimum, the maximum, the mean and standard deviation of log-transformed data) and generate a vector of offspring. The fishing activity coefficient was

parameterised using the ratio of the catch of the month to the catch of the year. These estimates were based on the data by month provided by IREPA for 2004-2007. The same pattern was assumed for the hindcasting and forecasting analysis.
The input parameters of the Aladym model are summarised in the Tables 7.21.4.1.2.1 and 2.

Tab. 7.21.4.1.2.1 Inputs parameters for Aladym model. Red mullet in the GSA 10.

GSA10	***M. barbatus***
Inputs	
K (anno)	0.41±0.03
L_{∞} (mm)	260 ±10
t_0	-0.4 ±0.05
a	0.00001037264
b	3.0053
Life span (years)	7
M (Chen and Watanabe, 1989)	Variable at age/length
L_{mat} (mm)	135±5
Maturità range (L75-L25) (mm)	10
Sex ratio (F/F+M)	0.5
L_{50} (mm); SR (mm) of the fleet	89; (18)
	110 (30) dal 2010
Fishing activity coefficient	Tuned by month on the basis of the real catches
	From 2009 onwards reduced of 20%
Average number, minimum, maximum and parameters of the *ln*-normal distribution	$\sim 100 \cdot 10^6$ Min $\sim 50 \cdot 10^6$ Max $\sim 170 \cdot 10^6$ (mean ln(R)=18.3; ds ln(R)=0.43)
Spawning time and peak	May-September (June-July))
Number of years of the simulation	22

Tab. 7.21.4.1.2.2 Inputs parameters regarding the fishing activity coefficient by month in 2004-2007.



	A	B	C	D	E	F
1	Month			Month		
2		Year	Fishing Coefficient		Year	Fishing Coefficient
3			none			none
4	121 month	2004.00	0.40	145 month	2006.00	0.50
5	122 month	2004.00	0.57	146 month	2006.00	0.45
6	123 month	2004.00	0.51	147 month	2006.00	0.52
7	124 month	2004.00	0.66	148 month	2006.00	0.35
8	125 month	2004.00	1.93	149 month	2006.00	0.78
9	126 month	2004.00	1.30	150 month	2006.00	1.43
10	127 month	2004.00	0.92	151 month	2006.00	0.88
11	128 month	2004.00	1.86	152 month	2006.00	1.49
12	129 month	2004.00	1.70	153 month	2006.00	1.04
13	130 month	2004.00	0.96	154 month	2006.00	2.09
14	131 month	2004.00	0.67	155 month	2006.00	1.49
15	132 month	2004.00	0.53	156 month	2006.00	0.97
16	133 month	2005.00	0.49	157 month	2007.00	0.50
17	134 month	2005.00	0.64	158 month	2007.00	0.45
18	135 month	2005.00	0.83	159 month	2007.00	0.52
19	136 month	2005.00	1.03	160 month	2007.00	0.35
20	137 month	2005.00	1.67	161 month	2007.00	0.78
21	138 month	2005.00	1.15	162 month	2007.00	1.43
22	139 month	2005.00	1.00	163 month	2007.00	0.88
23	140 month	2005.00	1.69	164 month	2007.00	1.49
24	141 month	2005.00	0.88	165 month	2007.00	1.04
25	142 month	2005.00	1.06	166 month	2007.00	2.09
26	143 month	2005.00	1.13	167 month	2007.00	1.49
27	144 month	2005.00	0.44	168 month	2007.00	0.97

7.21.4.1.3. Results

The Figure 7.21.4.1.3.2 shows the monthly trends in observed and predicted landings by Aladym, using a stock recruitment relationship (SR) and a random vector of recruits. The observed landings are those of IREPA. The period from January 2004 to September 2007 is considered. The parameters of the Ricker-type stock recruitment relationship were: a=170 and b= 0.000000445. This output is reported to show the consistency between predicted and observed estimates of catches.

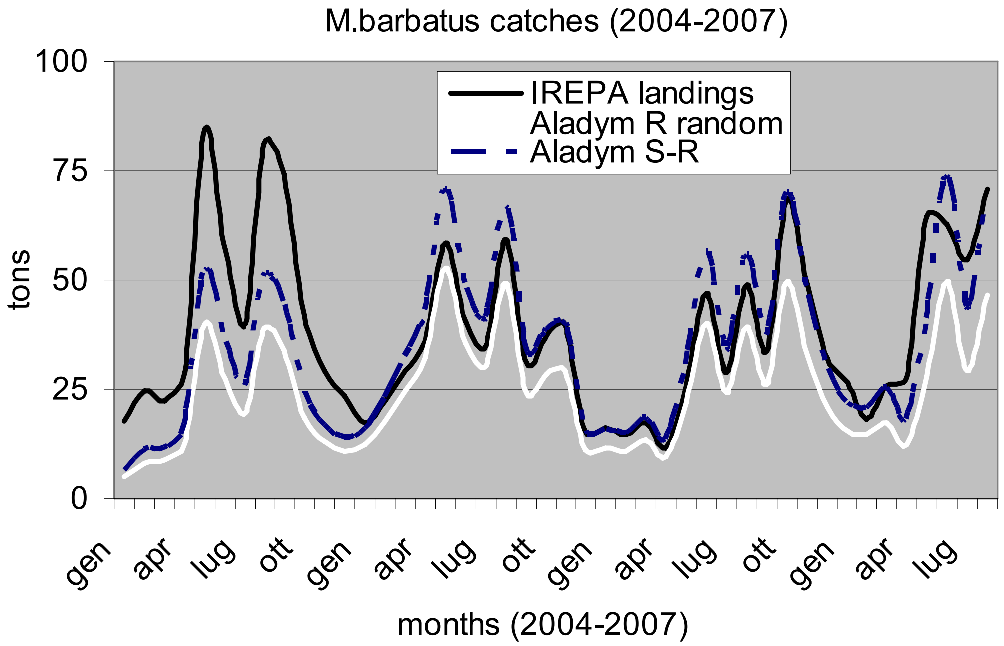


Fig. 7.21.4.1.3.2 Monthly trends in observed and predicted landings by Aladym, using (SR) or not (NO) a stock recruitment relationship. The observed landings are those of IREPA. The period from January 2004 to September 2007 is considered..

In both cases a fairly good approximation of the real catches was obtained.

7.21.4.2.Method 2: VIT

7.21.4.2.1. Justification

Two complete years (2006-2007) of length frequency distributions of landing were available, thus only an approach under steady state (pseudocohort) assumption was applied. Cohort (VPA equation) and Y/R analyses as implemented in the package VIT4win were used (Lleonart and Salat, 1997). Data were derived from DCR in the GSA 10.

7.21.4.2.2. Input parameters

LFDs of landing for sex combined were converted in number by age using the growth parameters L_{∞}=26 cm k=0.42 t_0= -0.4 reported in the paragraph 7.21.1.2 and presented in the Figure 7.21.4.1.2.1. LFDs split by fishing gears (DTS and Nets) were used as inputs. The length-weight relationships and the maturity ogive parameters are reported in the table 7.21.4.1.2.1.

Terminal F was fixed as equal to M. A value of 0.7 was adopted as derived from estimates from a very slightly exploited area in Castellammare Gulf. This estimate was derived from the Hoenig approach using a longevity of 7 years. No discard data were included. A plus group has been used for the distribution of 2007.

7.21.4.2.3. Results

Fishing mortality rates (F) by fishing segments (DTS and Nets), total fishing mortality and total mortality rate Z by length estimated by LCA using VIT separately for 2006 and 2007 are reported in Figure 7.21.4.2.3.1 For sake of comparison the VIT estimates of total F for 2006 and 2007 are also compared with Aladym prediction of F. In VIT these point estimates are averages of the age groups 0-3.

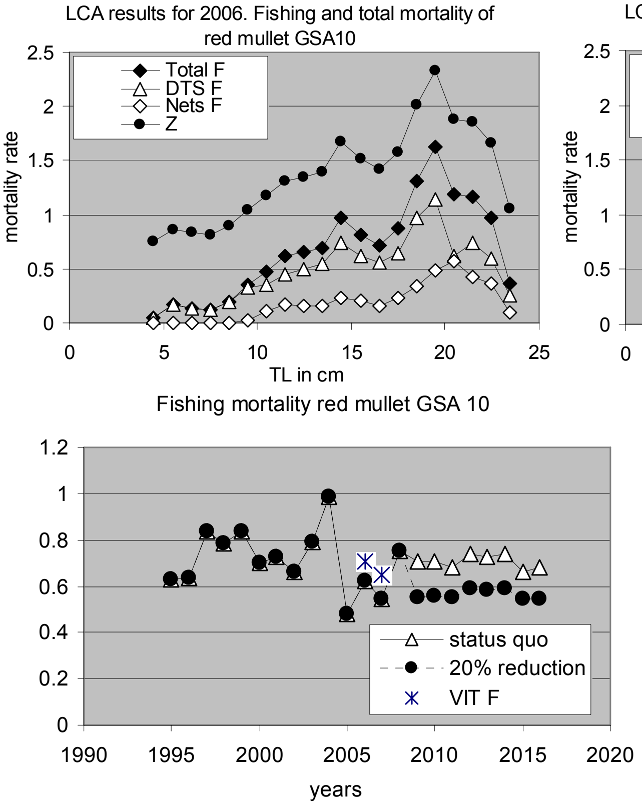


Figure 7.21.4.2.3.1 Fishing (F) and total mortality (Z) rates by size fishing segment and year. A comparison of the VIT estimates of total F for 2006 and 2007 are also compared with Aladym prediction of F.

The reconstructed yields obtained by the VIT package in 2006 and 2007 are very close to the observed ones, both for the total landings and landings by gear. Estimates of absolute recruitment and other main results of VIT, including the current mortality rates, are reported in the table 7.21.7.4.3.1. Mean F was calculated in the age range 0-3 and 0-4 years in 2006 and 2007 respectively.

Compared to 2006, a slight decrease of fishing and total mortality is observed in 2007.

The estimate of the recruit numbers at 4 cm and 9 cm in 2006 and 2007 show a level comparable to the average estimates of offspring (at initial time) derived using trawl-survey data and the spatial indicators approach (see Tab. 7.21.4.1.2.1).

Table 7.21.7.4.3.1 The main results of VIT analysis for 2006 and 2007 by year.

Variables	2006	2006	2006	2007	2007	2007
	DTS	Nets	Total	DTS	Nets	Total
Observed Yield (tons)	289.4	103.5	393.0	264.9	236.6	501.9
Reconstructed Yield (tons)	288.4	96.1	384.5	252.4	223.9	476.3
Recruits at 4 (2006) and 8 (2007) cm TL (millions)			46,352,565			39,791,296
Mean Z			1.34			1.29
Mean F	0.47	0.24	0.71	0.37	0.28	0.65
Catch mean length (cm)	11.9	14.0	12.3	15.3	13.3	14.2
Stock mean length (cm)			9			12.3

7.21.5. Short term prediction for 2008 and 2009

7.21.5.1. Justification

No forecast analyses were conducted.

7.21.5.2. Input parameters

No forecast analyses were conducted.

7.21.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 10.

7.21.6. Medium term prediction

7.21.6.1. Justification

A hindcasting analysis was performed using Z estimates since 1995. A preliminary forecast analysis was also conducted using Aladym model. To this purpose a total mortality based on an average value (1.65), estimated using the total mortality rate of the last four years, was used to project forwards the population up to 2016. By this way also the short term scenarios (2008-2009) could be simulated.

7.21.6.2. Input parameters

Inputs parameters of Aladym model are those reported in Tab. 7.21.4.1.2.1. for red mullet in the GSA 10.

7.21.6.3. Results

In the Figure 7.21.6.3.1. some of the main outputs of Aladym model are reported. These are related to the level of the spawning stock biomass in tons, to the spawning potential ratio, calculated as the ratio between the exploited spawning biomass and the spawning biomass when F=0. Also the yield and fishing mortality outputs are reported. The results are related to two considered scenarios: a status quo scenario and a scenario in which a reduction of about 20% of the fishing pressure is simulated from year 2009 onwards. In the status quo scenario the spawning biomass and spawning potential ratio would decrease in 2009 compared to the previous years, whilst the yield would increase as result of the applied fishing pressure.

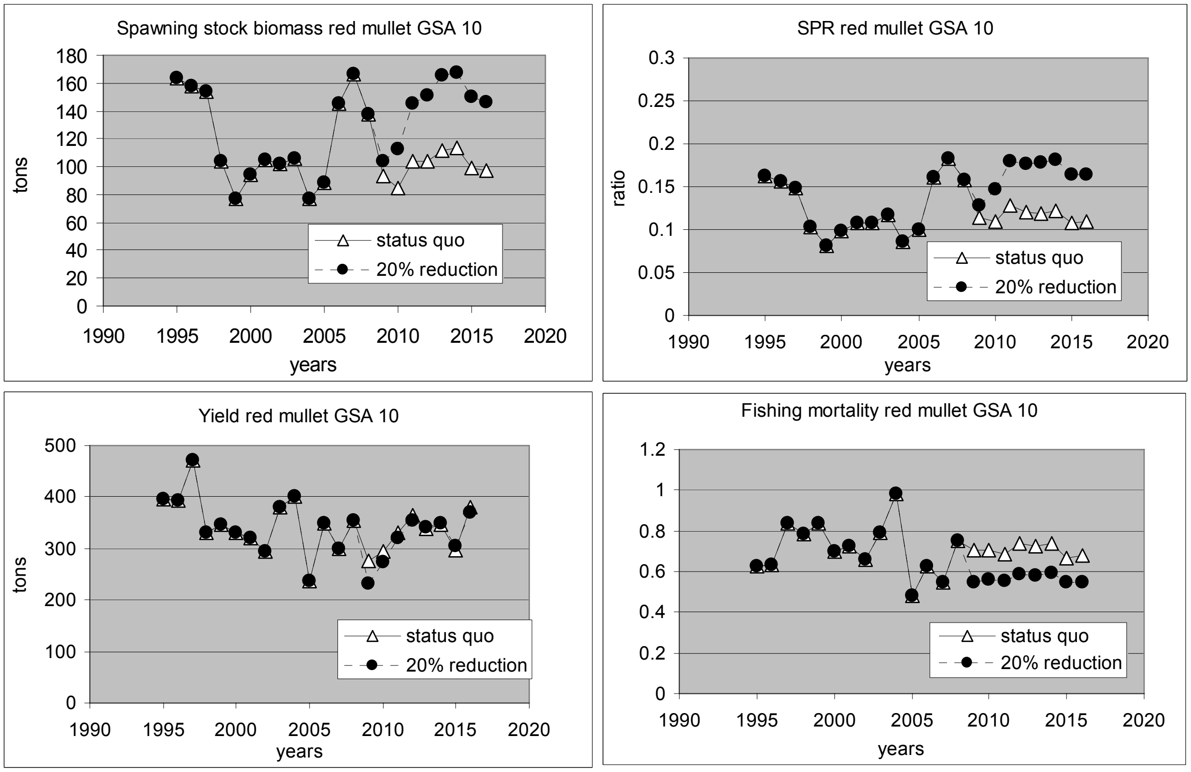


Fig. 7.21.6.3.1. Main outputs of Aladym model, related to the level of the spawning stock biomass in tons, the spawning potential ratio, the yield and fishing mortality. Two scenarios are considered, the status quo scenario and the scenario in which a reduction of about 20% of the fishing pressure is simulated. Red mullet in the GSA 10.

7.21.7. Long term prediction

7.21.7.1. Justification

Yield per recruit analysis has been conducted.

7.21.7.2. Input parameters

7.21.7.3. Results

Figures 7.21.7.3.1 and 7.21.7..3.2 show the per recruit predictions. Changes of the stock indicators: Biomass, Spawning Stock Biomass and Yield per recruit at increasing levels of fishing mortality, as derived multiplying the current value (F status quo) by the F factor are represented.

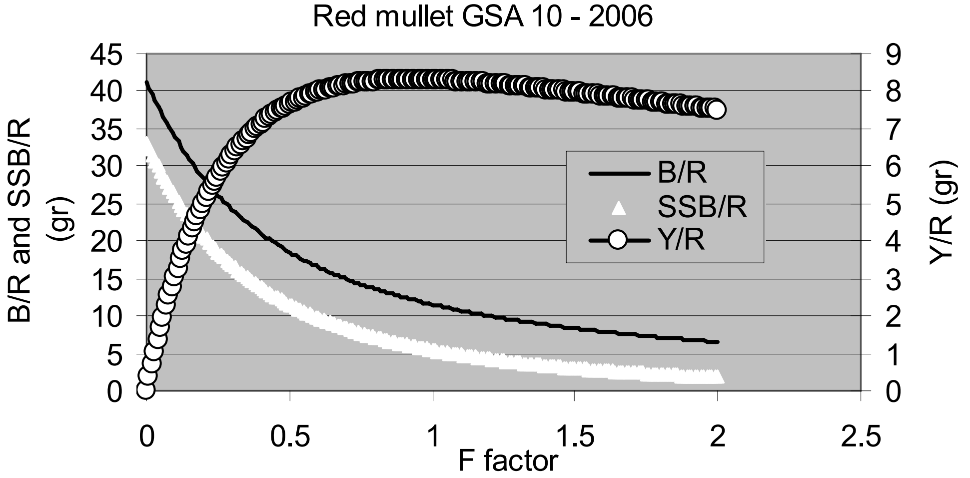


Figure 7.21.7.3.2.1 Biomass, Spawning Stock Biomass and Yield per recruit at increasing levels of fishing mortality, as derived multiplying the current value (F status quo) by the F factor according to the VIT package. 2006 analysis.

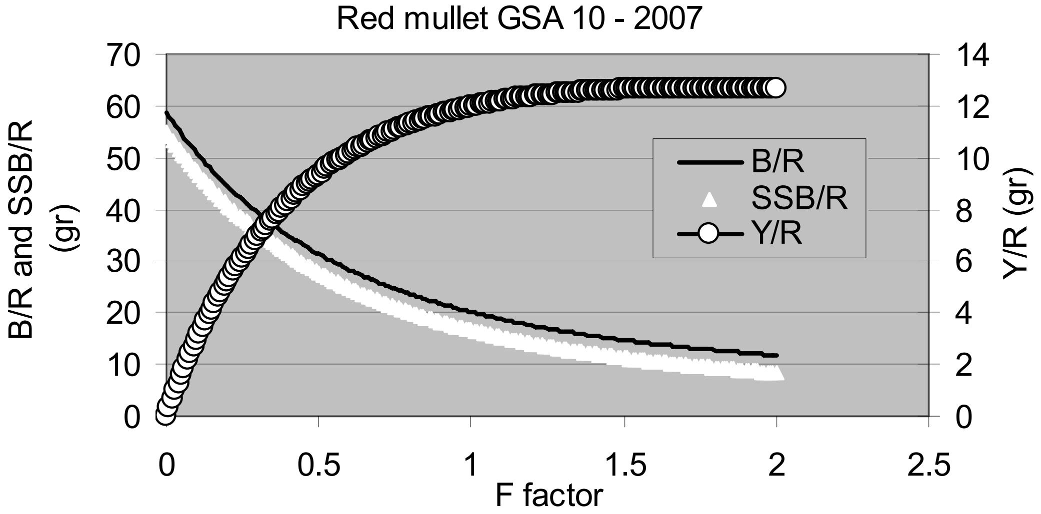


Figure 7.21.7.3.2 Biomass, Spawning Stock Biomass and Yield per recruit at increasing levels of fishing mortality, as derived multiplying the current value (F status quo) by the F factor according to the VIT package. 2007 analysis.

Assuming no variation of the exploitation pattern, the main result of Y/R analysis are reported in the table 7.21.7.3.1 for 2006 and 2007.

Table 7.21.7.3.1 Estimation of yield (Y), biomass (B) and spawning stock biomass (SSB) per recruit (R) varying current fishing mortality (F) by a multiplier F factor.

2006	Factor	F	Y/R	B/R	SSB
F(0.1)	0.53	0.37	7.761	17.873	10.911
F(Max)	0.94		8.304	12.162	5.944
F(Current)	1.01		8.295	11.514	5.414
F(Double)	2		7.503	6.524	1.779
2007	Factor		Y/R	B/R	SSB
F(0.1)	0.91	0.59	11.709	21.51	18.001
F(Max)	1.75		12.671	13.082	9.666
F(Current)	1.01		11.971	20.078	16.58
F(Double)	2		12.635	11.752	8.364

Considering the level of F in 2006 i.e. 0.7 (Table 7.21.7.3.1), a reduction of 47% would be necessary to reach F0.1 (0.37; Table 7.21.7..3.1.). In 2007 the situation seems changed. Despite the value of status quo F (0.65; Table 7.21.7..3.1) is close to that of 2007, the exploitation pattern was different and thus a reduction of about 10% would be needed to reach F0.1 (0.59; Table 7.21.7. 3.1).

7.21.8. Scientific advice

7.21.8.1. Short term considerations

7.21.8.1.1. State of the spawning stock size

SGMED-8-04 cannot provide any scientific advice of the state of the spawning stock in relation to proposed target level, given the preliminary state of the data and analyses, and the non availability of agreed reference points. However, the results of Aladym model suggest that the continuation of the level of pressure exerted in the recent past will contribute to reduce the spawning stock, bringing it around the lower level of the past.

7.21.8.1.2. State of recruitment

The recruitment observed from Grund survey data is in the recent years show low levels of abundance.

7.21.8.1.3. State of exploitation

Given the results of the present analysis, the stock appears to be subject to overfishing. The overfishing might be lower if the estimates related to the fishing mortality in 2007 will be confirmed in the successive years. Other signals, from survey indices and Aladym model predictions, show that the condition of the stock could be at risk of being harvested unsustainably if the mortality levels observed in the past years (except 2007) will occur in the future.

7.21.8.2. Medium term considerations

The low level of observed recruitment, the decreasing tendency of the abundance indices estimated from trawl surveys in the recent years, the level of F estimated in 2006 by VIT, and the hindcasting analysis performed using Aladym suggest to reduce the level of fishing pressure. Simulations showed that a reduction of 20% would contribute to restore the reproductive capacity of SSB. In the long term the production (landings) seems not substantially penalized by the fishing pressure reduction.

7.22. Stock assessment of red mullet in GSA 11

7.22.1. Stock identification and biological features

7.22.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.22.1.2. Growth

No information was documented during SGMED-08-04.

7.22.1.3. Maturity

No information was documented during SGMED-08-04.

7.22.2. Fisheries

7.22.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that red mullet *Mullus barbatus is* among the most commercially important species in the area and forms part of an assemblage that is the target of the bottom trawling fleets, which operate near shore. From 1994 to 2004, in GSA 11, the trawling-fleet has remarkably changed. The change has mostly consisted of a general increase of the number of vessels and by the replacement of the old, low tonnage wooden boats by larger steel boats. For the entire GSA a decrease of 20% for the smaller boats (<30 GRT), which principally exploit this species, was also observed.

7.22.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.22.2.3. Catches

7.22.2.3.1. Landings

Tab. 7.22.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.2 of Appendix 3. Since 2002 the annual landings varied between 115 and 354 t. The landings were mainly taken by demersal otter trawls.

Tab. 7.22.2.3.1.1 Annual landings (t) by fishing technique in GSA 11.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	11	ITA	DTS	38	253	333	264	244	345
MUT	11	ITA	PGP	0		14	1	18	9
MUT	11	ITA	PMP	77	68				
SUM				115	321	347	265	262	354

7.22.2.3.2. Discards

7 t of discards in 2006 were reported to SGMED-08-04 through the DCR data call and are listed in Tab. A3.6 of Appendix 3.

7.22.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.22.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3. The effort of the major trawler fleet has doubled during 2003-2004 and stayed at the high level thereafter.

Tab. 7.22.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 11, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	11	ITA	DTS	14539	18957	28840	31993	26532	27374
DAYS	11	ITA	PGP	102826	126272	165945	151720	156269	155243
DAYS	11	ITA	PMP	57543	30879				
GT*DAYS	11	ITA	DTS			1598912	1881952	1437559	1486500
GT*DAYS	11	ITA	PGP			501550	484820	493411	495670
KW*DAYS	11	ITA	DTS	3679604	4652647	6711626	7736040	6017232	6340429
KW*DAYS	11	ITA	PGP	2865738	5099814	7105771	6996350	7234881	7398923

7.22.3. Scientific surveys

7.22.3.1. Medits

7.22.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 08 the following number of hauls were reported per depth stratum (s. Tab. 7.22.3.1.1.1).

Tab. 7.22.3.1.1.1. Number of hauls per year and depth stratum in GSA 11, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA11_010-050	16	18	21	21	21	20	19	17	20	18	17	17	19	19
GSA11_050-100	25	21	22	22	20	22	22	24	19	19	18	21	18	20
GSA11_100-200	20	23	30	31	31	30	29	30	24	24	24	24	24	24
GSA11_200-500	33	29	29	26	25	27	24	25	20	24	21	20	20	20
GSA11_500-800	23	16	21	25	25	24	27	26	16	14	15	14	16	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.22.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.22.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 11 was derived from the international survey Medits. Figure 7.22.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 11.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2005 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

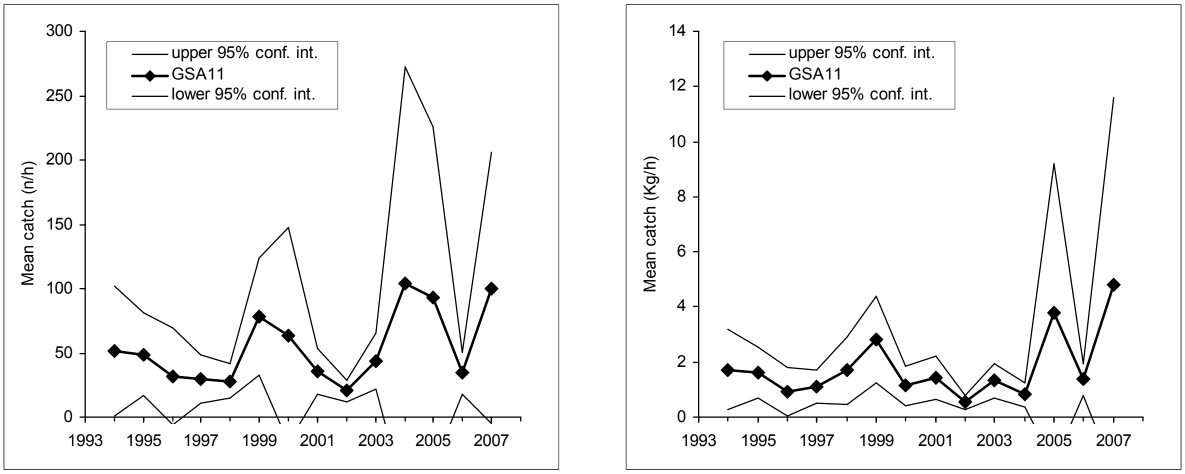


Fig. 7.6.3.1.3.1 Abundance and biomass indices of red mullet in GSA 11.

7.22.3.1.4. Trends in abundance by length or age

The following Fig. 7.22.3.1.4.1 and 2 display the stratified abundance indices of GSA 11 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

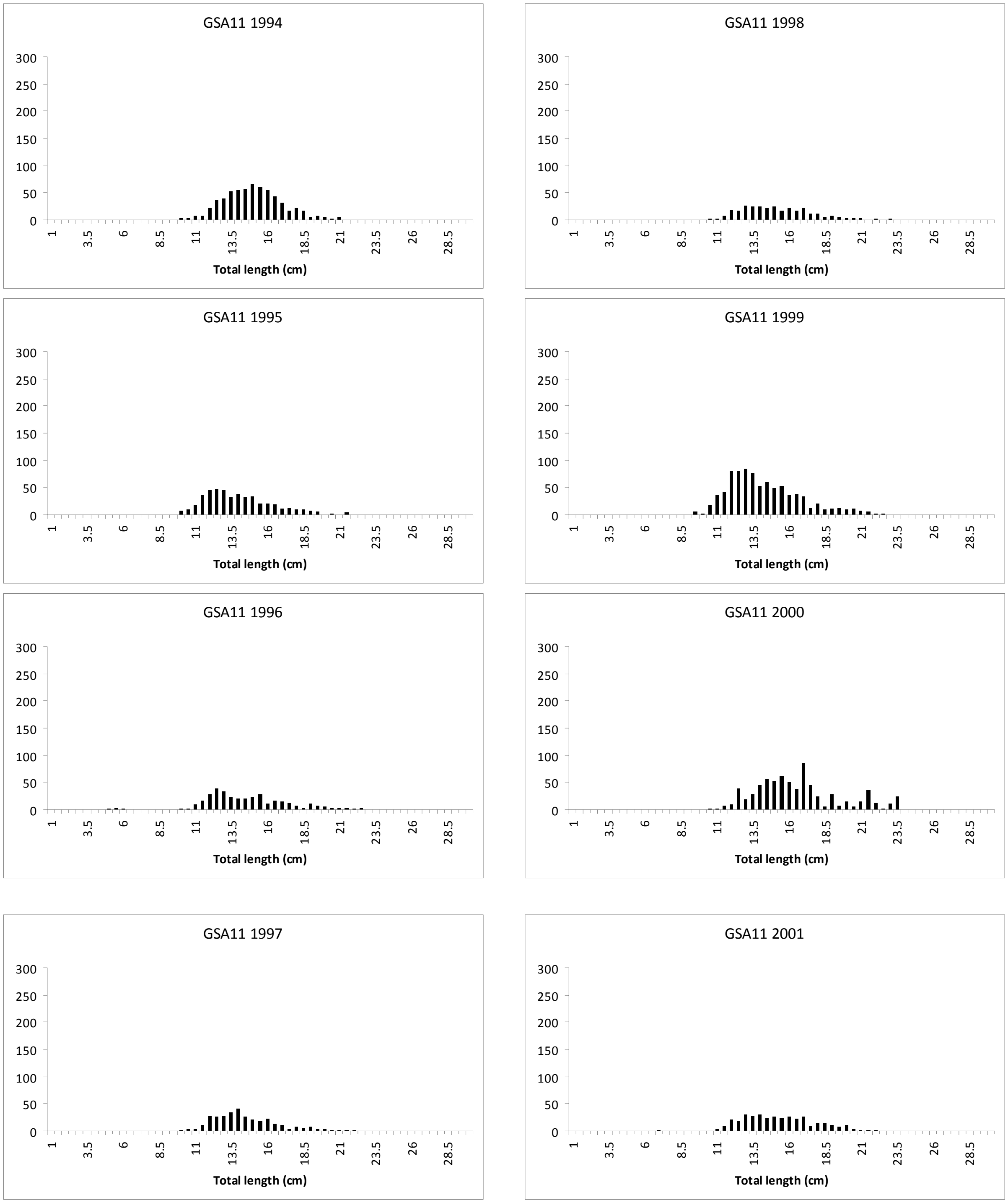


Fig. 7.22.3.1.4.1 Stratified abundance indices by size, 1994-2001.

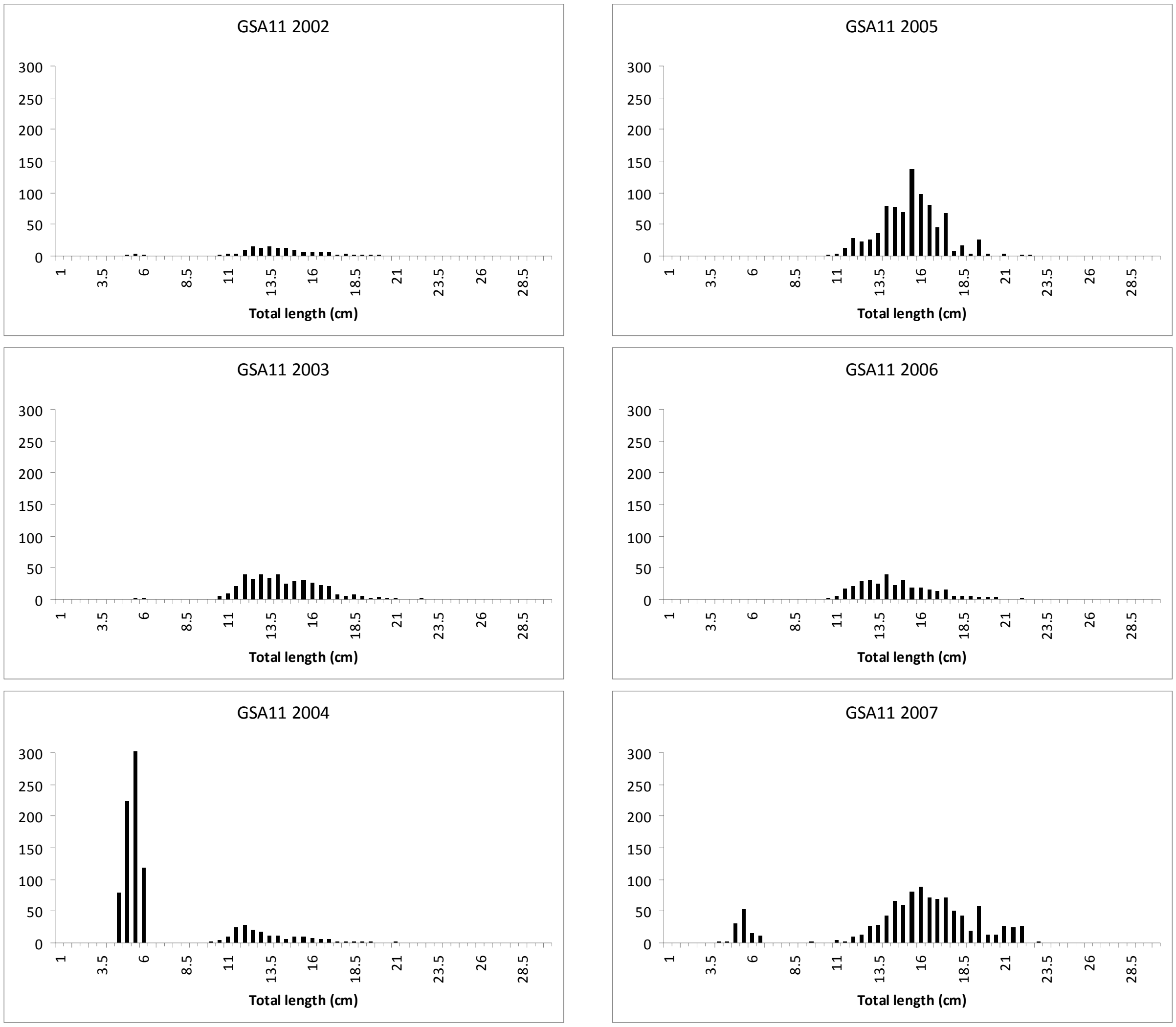


Fig. 7.22.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.22.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.22.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.22.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.22.5. Short term prediction for 2008 and 2009

7.22.5.1.Justification

No forecast analyses were conducted.

7.22.5.2. Input parameters

No forecast analyses were conducted.

7.22.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 11.

7.22.6. Medium term prediction

7.22.6.1. Justification

No forecast analyses were conducted.

7.22.6.2. Input parameters

No forecast analyses were conducted.

7.22.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 11.

7.22.7. Long term prediction

7.22.7.1. Justification

No forecast analyses were conducted.

7.22.7.2. Input parameters

No forecast analyses were conducted.

7.22.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 11.

7.22.8. Scientific advice

7.22.8.1. Short term considerations

7.22.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.22.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.22.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.22.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.23. Stock assessment of red mullet in GSA 16

7.23.1. Stock identification and biological features

7.23.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.23.1.2. Growth

No information was documented during SGMED-08-04.

7.23.1.3. Maturity

No information was documented during SGMED-08-04.

7.23.2. Fisheries

7.23.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.23.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.23.2.3. Catches

7.23.2.3.1. Landings

Landings data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.2 of Appendix 3. Annual landings decreased from 3,380 t in 2003 to only 1,120 t in 2006 and increased to 1.320 in 2007 (Tab. 7.23.2.3.1.1). Demersal otter trawlers dominate the landings by far.

Table 7.23.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	16	ITA	DTS	1924	3306	1541	1340	1086	1343
MUT	16	ITA	HOK			27	37	1	
MUT	16	ITA	PGP	169	27	58	29	37	37
MUT	16	ITA	PMP	52	47	0			
MUT	16	ITA	PTS	4	4				0
SUM				2149	3384	1626	1406	1124	1380

7.23.2.3.2. Discards

94 t of discards in 2006 were reported to SGMED-08-04 and are listed in Tab. A3.6 of Appendix 3.

7.23.2.3.3. Fishing effort

Tab. 7.23.2.3.3.1 lists the effort by fishing technique deployed in GSA 16 as reported to SGMED-08-04 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3. The main gear demersal otter trawl does not reveal any significant trend in effort deployed.

Tab. 7.23.2.3.3.1 Effort trends by fishing technique in GSA 16.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	16	ITA	DTS	87300	76233	81853	82557	89319	89164
DAYS	16	ITA	HOK			14856	11450	10272	9284
DAYS	16	ITA	PGP	146019	118660	118425	97285	85556	85298
DAYS	16	ITA	PMP	26655	34956	6939			
DAYS	16	ITA	PTS	8778	8568	4899	5476	7926	7032
GT*DAYS	16	ITA	DTS			6673029	6864030	7429483	7322198
GT*DAYS	16	ITA	HOK			764595	403669	507862	370612
GT*DAYS	16	ITA	PGP			249032	206056	192811	212519
GT*DAYS	16	ITA	PMP			20134			
GT*DAYS	16	ITA	PTS			224188	236435	352518	346405
KW*DAYS	16	ITA	DTS	23952310	20951845	21381964	21772464	23699835	23644626
KW*DAYS	16	ITA	HOK			3153486	1758722	2076446	1695903
KW*DAYS	16	ITA	PGP	3133993	4603457	2691324	2302777	2207660	2378933
KW*DAYS	16	ITA	PMP	2792612	2761842	223470			
KW*DAYS	16	ITA	PTS	2510582	1750128	962786	1063031	1592930	1431085

7.23.3. Scientific surveys

7.23.3.1.Medits

7.23.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 16 the following number of hauls were reported per depth stratum (s. Tab. 7.6.3.1.1.1).

Tab. 7.6.3.1.1.1. Number of hauls per year and depth stratum in GSA 16, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA16_010-050	4	4	4	4	4	4	4	4	7	7	7	10	10	11
GSA16_050-100	8	8	8	8	8	8	7	8	11	12	12	20	22	23
GSA16_100-200	4	4	4	4	5	5	6	5	10	8	9	18	19	21
GSA16_200-500	10	11	11	12	11	11	11	11	19	18	19	28	31	27
GSA16_500-800	10	14	14	13	14	14	14	14	19	20	19	32	33	38

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.23.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.23.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 16 was derived from the international survey Medits. Figure 7.23.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 16.

The estimated abundance and biomass indices reveal a significant increasing trend since 1999. However, the highest abundance in 2003 conincides with the high landings recorded. The analyses of Medits indices are considered preliminary.

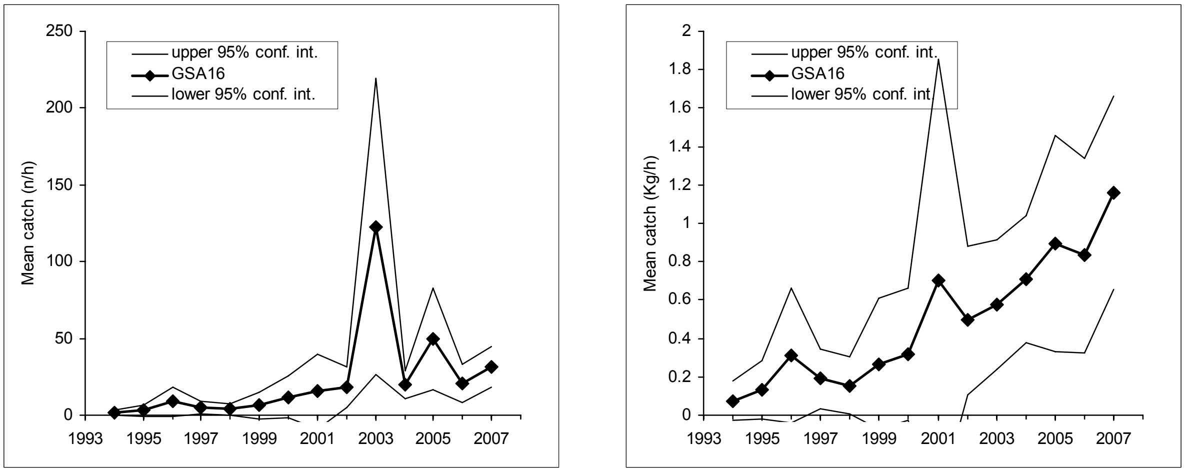


Fig. 7.23.3.1.3.1 Abundance and biomass indices of red mullet in GSA 16.

7.23.3.1.4. Trends in abundance by length or age

The following Fig. 7.23.3.1.4.1 and 2 display the stratified abundance indices of GSA 16 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

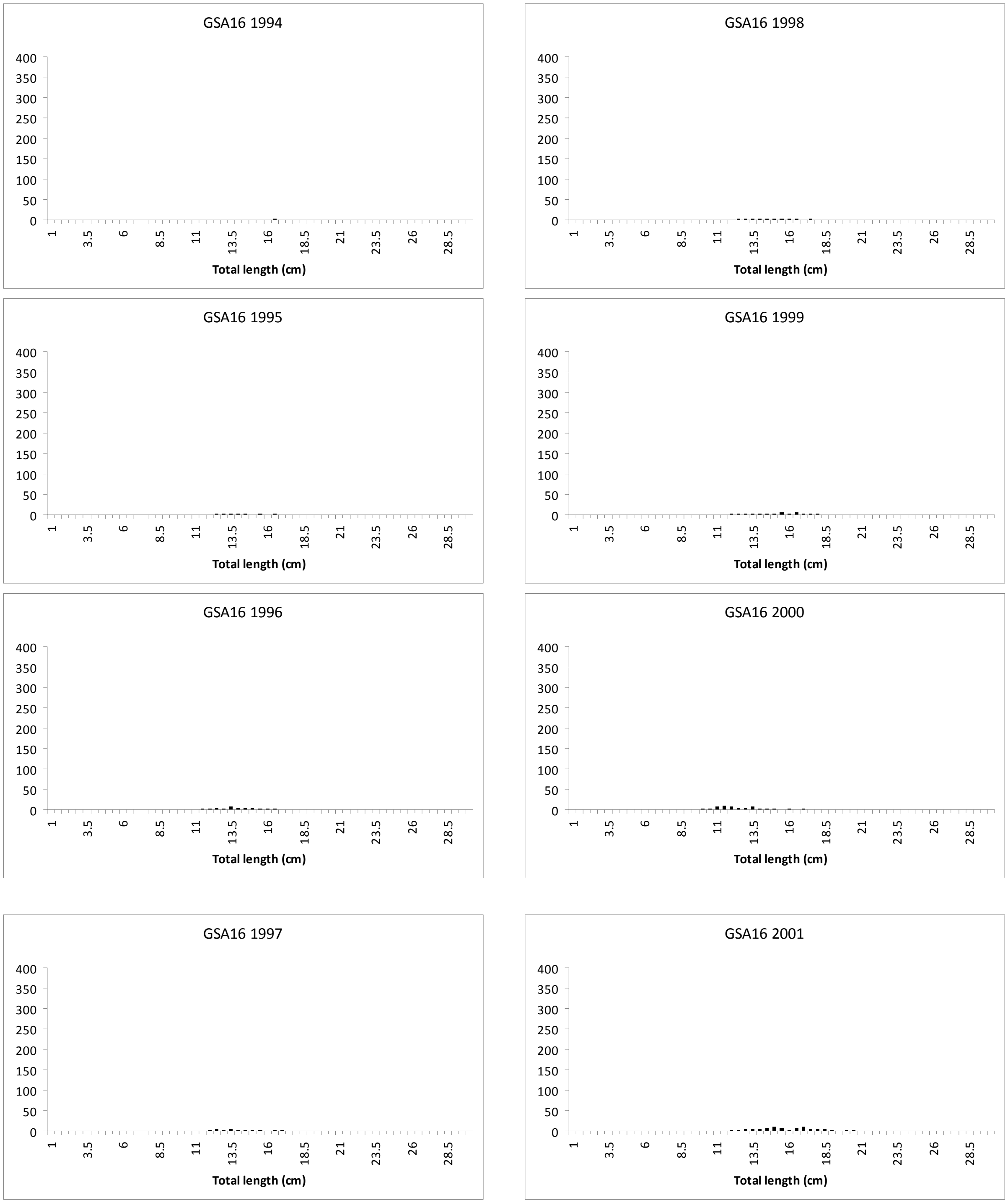
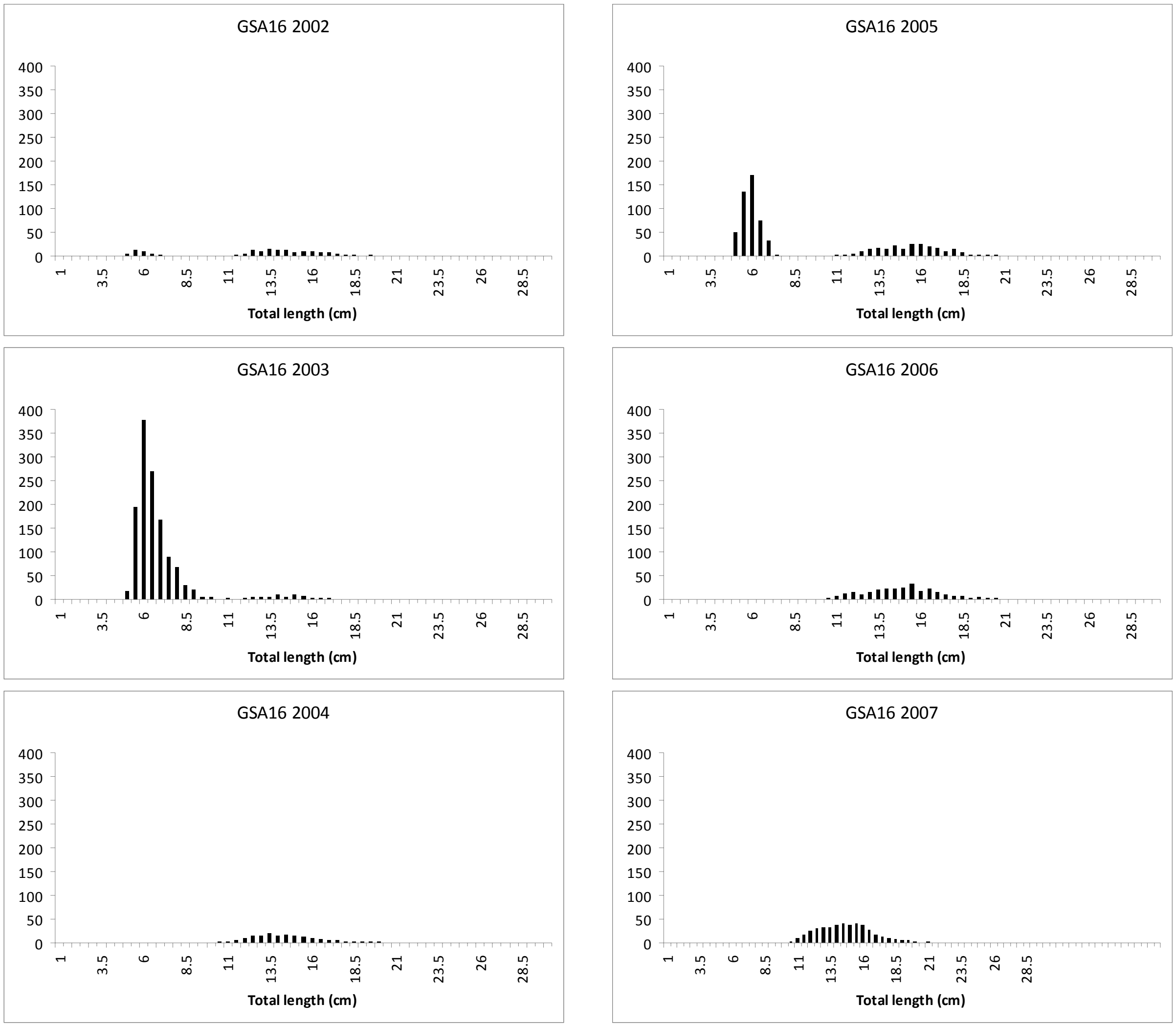


Fig. 7.6.3.1.4.1 Stratified abundance indices by size, 1994-2001.


GSA16 2002

GSA16 2005

GSA16 2003

GSA16 2006

GSA16 2004

GSA16 2007

Fig. 7.6.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.23.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.23.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.23.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.23.5. Short term prediction for 2008 and 2009

7.23.5.1. Justification

No forecast analyses were conducted.

7.23.5.2. Input parameters

No forecast analyses were conducted.

7.23.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 16.

7.23.6. Medium term prediction

7.23.6.1. Justification

No forecast analyses were conducted.

7.23.6.2. Input parameters

No forecast analyses were conducted.

7.23.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 16.

7.23.7. Long term prediction

7.23.7.1. Justification

No forecast analyses were conducted.

7.23.7.2. Input parameters

No forecast analyses were conducted.

7.23.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 16.

7.23.8. Scientific advice

7.23.8.1. Short term considerations

7.23.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.23.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.23.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.23.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.24. Stock assessment of red mullet in GSA 17

7.24.1. Stock identification and biological features

7.24.1.1. Stock Identification

Red mullet is found across the whole of GSA 17. However, patterns of abundance are observed over seasons and space. Along the eastern side of Adriatic, abundance seems to be relatively constant over the year. Along the western side, in late summer and autumn, large concentrations of individuals are observed in the shallow waters along the coast, whereas, in the subsequent months, a migration towards deeper waters occurs (Arneri and Jukic, 1986; SEC (2002) 1374; see also below).

The distribution of red mullet (*Mullus barbatus*) in the GSA 17, in spring-summer, is shown in the maps below (Fig. 7.24.1.1.1), imported from Sabatella and Piccinetti (2004). The picture on the left shows the depth contours, increasing with darker colour (0-50, 50-100, 100-200, > 200 m). The picture on the right displays mullet densities at sea from the MEDITS trawl survey in the second half of the 1990s, expressed as number of individuals per square kilometre.

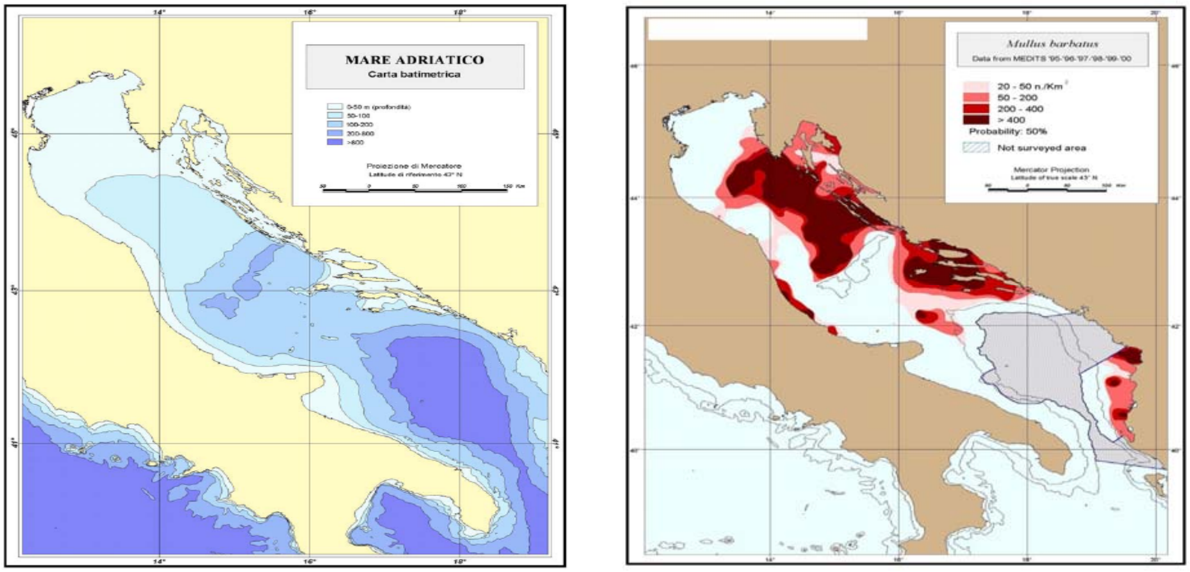


Fig. 7.24.1.1.1 Topography and geographical distribution patterns of red mullet in GSA 17.

Spawning of red mullet occurs in late spring and summer (Vrgoc *et al.*, 2004). In particular, the life cycle is characterized by the occurrence of juveniles in shallow coastal waters in late summer and autumn, and subsequent occurrence of adult individuals offshore in deeper waters during winter and spring months ((SEC (2002) 1374).

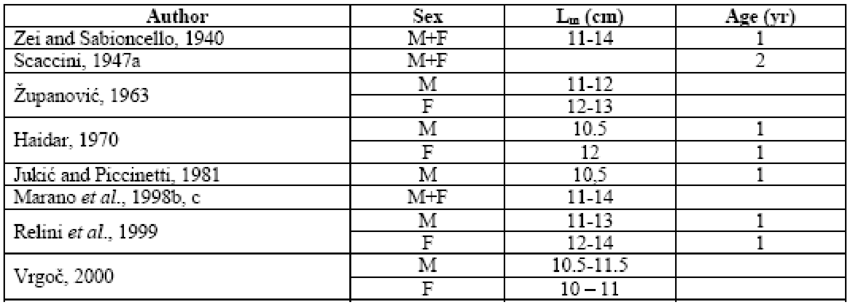
7.24.1.2. Growth

No information was documented during SGMED-08-04.

7.24.1.3. Maturity

The summary of the values of length at the first sexual maturity estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004) and listed in Table 7.24.1.3.1.

Tab. 7.24.1.3.1 Length and age at maturity and literature references.



Author	Sex	L_m (cm)	Age (yr)
Zei and Sabioncello, 1940	M+F	11-14	1
Scaccini, 1947a	M+F		2
Županović, 1963	M	11-12	
	F	12-13	
Haidar, 1970	M	10.5	1
	F	12	1
Jukić and Piccinetti, 1981	M	10.5	1
Marano *et al.*, 1998b, c	M+F	11-14	
Relini *et al.*, 1999	M	11-13	1
	F	12-14	1
Vrgoč, 2000	M	10.5-11.5	
	F	10 – 11	

7.24.2. Fisheries

7.24.2.1. General description of fisheries

The fishery for red mullet is one of the most important in the GSA 17. Fishing grounds correspond to the distribution of the stock particularly within 100 m depth. The allocation of fishing effort depends on the features of the life cycle as described above (SEC (2002) 1374).

7.24.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.24.2.3. Catches

7.24.2.3.1. Landings

Landings data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.2 of Appendix 3. Annual landings increased to 3,880 t in 2004 and decreased to 3.425 t in 2007 (Tab. 7.24.2.3.1.1). Demersal otter trawlers dominate the landings by far.

Table 7.24.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	17	ITA	DRB	29					
MUT	17	ITA	DTS	2475	2394	3620	3553	3180	3357
MUT	17	ITA	PGP	209	214	153	45	12	7
MUT	17	ITA	PMP	374	487	27	14		
MUT	17	ITA	PTS	11	16	4	5	1	
MUT	17	ITA	TBB			80	79	33	61
SUM				3098	3111	3884	3696	3226	3425

According to FAO statistics (ftp://ftp.fao.org/fi/stat/windows/fishplus/gfcm.zip), in the northern and central Adriatic Sea, the annual landings of *Mullus* spp. (Fig. 7.24.2.3.1.1) were estimated to be over 2,000 tonnes in many years of the 1980s and 1990s. An increasing trend occurred over the 1990s.

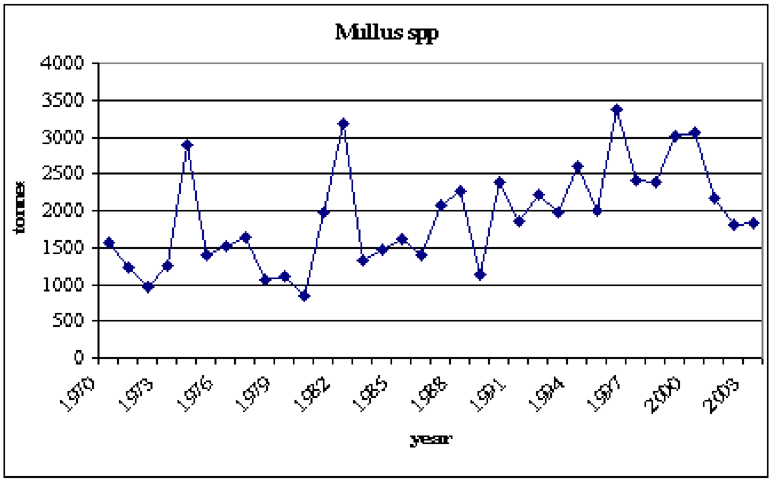


Fig. 7.24.2.3.1.1 Annual landings of red mullet in the northern and central Adriatic Sea according to FAO.

7.24.2.3.2. Discards

147 t of discards in 2006 were reported to SGMED-08-04 and are listed in Tab. A3.6 of Appendix 3.

7.24.2.3.3. Fishing effort

Tab. 7.24.2.3.3.1 lists the effort by fishing technique deployed in GSA 17 as reported to SGMED-08-04 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3. The main gear demersal otter trawl reveals a significant decreasing trend in effort deployed.

Tab. 7.24.2.3.3.1 Effort trends by fishing technique in GSA 17.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	17	ITA	DRB	58297	69126	64120	54047	59099	70261
DAYS	17	ITA	DTS	124529	125106	134776	126013	114903	102270
DAYS	17	ITA	HOK			641	595	610	487
DAYS	17	ITA	PGP	335599	272040	287886	260459	233846	217661
DAYS	17	ITA	PMP	96386	98110	15512	12743		
DAYS	17	ITA	PTS	23522	25649	23387	22453	23104	22981
DAYS	17	ITA	TBB			12395	13166	12440	10901
GT*DAYS	17	ITA	DRB			858864	697091	792375	959807
GT*DAYS	17	ITA	DTS			5624744	5429766	4656664	4283788
GT*DAYS	17	ITA	HOK			9492	10510	10983	9150
GT*DAYS	17	ITA	PGP			518165	429665	444329	427962
GT*DAYS	17	ITA	PMP			73495	66778		
GT*DAYS	17	ITA	PTS			1516671	1472075	1557168	1646419
GT*DAYS	17	ITA	TBB			673656	701874	812298	747714
KW*DAYS	17	ITA	DRB	6381241	7517860	6982982	5884599	6421392	7575921
KW*DAYS	17	ITA	DTS	27568094	27486393	26771813	25026709	22118619	20619962
KW*DAYS	17	ITA	HOK			153794	148821	150195	121827
KW*DAYS	17	ITA	PGP	9297244	7646003	9120053	8011107	8568762	8638666
KW*DAYS	17	ITA	PMP	7989134	7039902	1072033	1032751		
KW*DAYS	17	ITA	PTS	7841347	7636049	6955633	6778783	6978292	7156333
KW*DAYS	17	ITA	TBB			3419642	3622199	3943318	3463256

7.24.3. Scientific surveys

7.24.3.1.Medits

7.24.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 17 the following number of hauls were reported per depth stratum (s. Tab. 7.24.3.1.1.1).

Tab. 7.24.3.1.1.1. Number of hauls per year and depth stratum in GSA 17, 2002-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA17_010-050									59	45	47	63	49	
GSA17_050-100									54	36	37	62	38	
GSA17_100-200									50	27	22	43	21	
GSA17_200-500									9	7	5	7	5	
GSA17_500-800									1	1				

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma\ (Yi*Ai)\ /\ A$$

$$V(Yst) = \Sigma\ (Ai^2 * si^2 / ni)\ /\ A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = $Yst \pm t(\text{student distribution}) * V(Yst) / n$

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.24.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.24.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 17 was derived from the international survey Medits. Figure 7.24.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 17.

The analyses of Medits indices are considered preliminary.

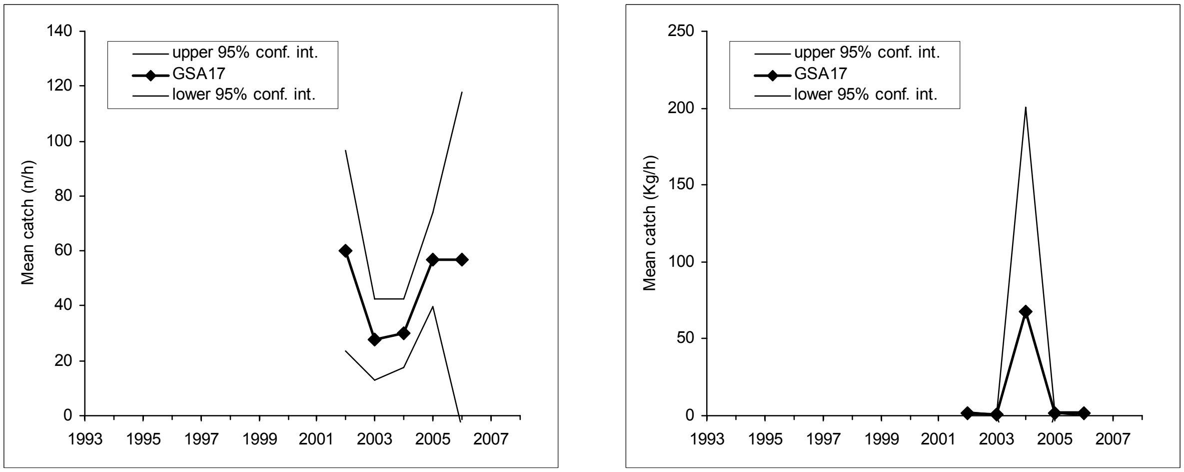


Fig. 7.24.3.1.3.1 Abundance and biomass indices of red mullet in GSA 17.

7.24.3.1.4. Trends in abundance by length or age

The following Fig. 7.24.3.1.4.1 displays the stratified abundance indices of GSA 17 in 2002-2007. These size compositions are considered preliminary.

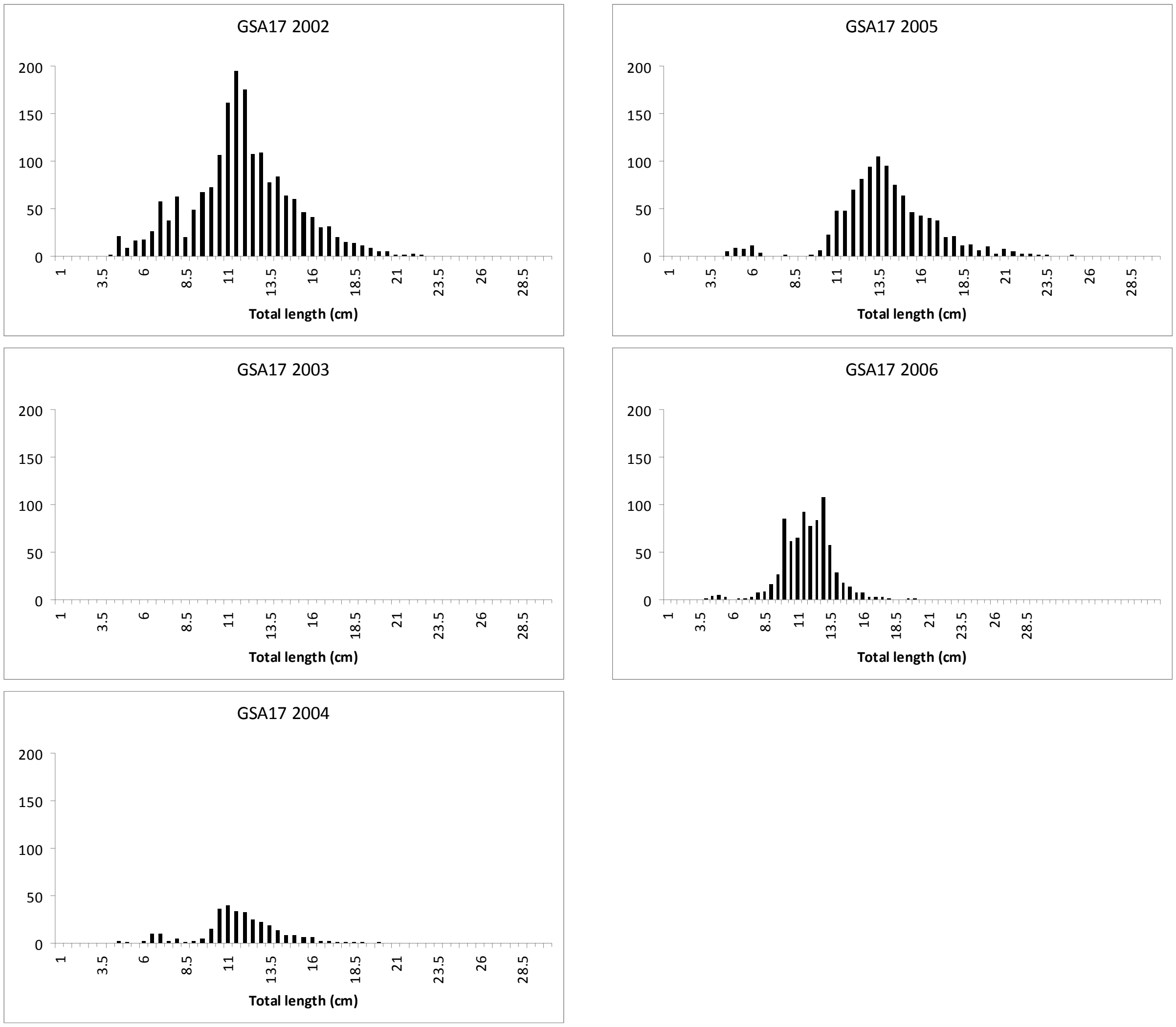


Fig. 7.24.3.1.4.1 Stratified abundance indices by size, 2002-2006.

7.24.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.24.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.24.4. Assessment of historic stock parameters

7.24.4.1.Method 1: LCA

7.24.4.1.1. Justification

Stock assessment was carried out by means of population dynamics methods. Due to the short time series of available data, Length Cohort Analysis (LCA) was selected. The software packages used were VIT and VITM (Lleonart and Salat, 1997). The latter allowed the use of a different natural mortality rate, M, as a function of length.

7.24.4.1.2. Input parameters

The landings used represented the Italian mean calculated for the years 2006 and 2007, 3,226 and 3,424 tonnes, respectively. These values are similar to those observed in the previous years from 2002 to 2005.

The length frequency distributions obtained for Italy through DCR in 2006 and 2007 were used. They were relative to bottom otter trawlers and was thus assumed that these distributions were also representative for the other gears. As noted above, these gears accounted for a small fraction of the catch.

A longer times series (i.e. five - six years) of length frequency data would have been better for the stock assessment method being used.

The total number of caught individuals was distributed in the length classes 9, 10, 11,…, 20+ cm.

Females and males were used as combined.

Though the DCR investigation carried out in 2006 indicated that discarding at sea of smaller size specimens (mostly between 9 and 13 cm) might occur, these estimated data were not used to correct landings, as there were concerns regarding their reliability. A strong fluctuation between estimated discards in the third and fourth quarter of 2006 was seen: 147 tonnes (with 19 trips on board) and 0 tonnes (with 92 trips) (0 and 2 trips were carried for the first and second quarter), although the large third quarter discards could be the result of young red mullet being caught in September. These data need further investigation.

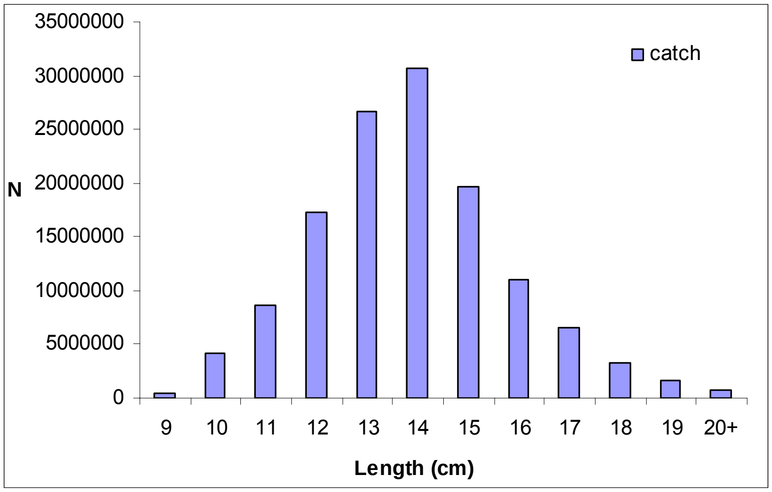


Fig. 7.24.4.1.2.1 Size composition of the landings in 2006 and 2007.

In order to calculate some parameters, the sex ratio Females/Total was assumed to be equal to 0.50. A quite similar value of F/T, 0.43, was estimated using the values of F/T at length obtained through DCR in the year 2007, which were weighted on the corresponding numbers of caught individuals at length.

The von Bertalanffy growth parameters used were L_∞ = 25.0 (cm), k = 0.42 (year^{-1}), t0 = -0.790 (year). They were calculated as weighted means of the values for females and males, by using the mentioned sex ratio.

The original values for females (L_∞ = 27.0, k = 0.40, t_0 = -0.780) and males (L_∞ = 23.0, k = 0.43, t_0 = -0.800) were obtained from the SAMED project (SAMED, 2002) for the GSA 17.

The summary of the von Bertalanffy parameter values estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004), as follows. Here, the index Phi' is also shown.

Tab. 7.24.4.1.2.1 Overview of v. Bertalanffy growth parameters.

Author	Sex	L_∞ (cm)	K (yr^{-1})	t_0 (yr)	Φ'
Scaccini (in Levi *et al.*, 1994)	M+F	27.49	0.5	-0.25	5.93
Jukić and Piccinetti, 1988	M+F	27.0	1.8		7.18
Marano, 1994; Ungaro *et al.*, 1994	M+F	19.70	0.360	-1.18	4.94
Vrgoč, 1995 ("Hvar")	M+F	27.75	0.274	-0.616	5.35
Marano, 1996; Marano *et al.*, 1998b, c	M	27	0.184	-1.92	4.90
	F	34.5	0.156	-1.53	5.22
	M+F	31.5	0.182	-1.45	5.19
	M+F (Bhatt)	26.3	0.45		5.74
Ardizzone, 1998	M+F	27.50	0.50		5.93
Marano, 1998b, c	M	22.5	0.24	-1.29	4.80
	F	26.2	0.23	-1.41	5.06
	M+F	22.5	0.38	-0.63	5.26
	M+F (Bhatt)	25.4	0.25		5.08
	M+F (Surf.)	23	0.52		5.62
Vrgoč, 2000	M+F	26.86	0.295		5.36
EC XIV/298/96-EN, Ionian and Southern Adriatic	M+F	21.72	0.31		4.99
EC XIV/298/96-EN, Adriatic Sea	M+F	27.5	0.50		5.94

The annual mortality rate M = 0.64 ($year^{-1}$) was used. It was calculated as weighted mean of the values for females and males, by using the mentioned sex ratio. The original values for females (M = 0.61) and males (M = 0.66) were obtained from the SAMED project (SAMED, 2002) for the GSA 17.

The summary of the M values estimated for the Adriatic Sea was imported from Vrgoc *et al.* (2004), as follows.

Tab. 7.24.4.1.2.2 Overview of values of natural mortality M and fishing mortaliy and total mortality Z.

Author	M (yr^{-1})	F(yr^{-1})	Z (yr^{-1})
Arneri and Jukić, 1986			2.47 –4.37 (age 0 – 1)
			1.64
Haidar, 1970	-	-	0.64
Jukić and Piccinetti, 1988			1.64
Piccinetti and Jukic, 1988			1.45-1.63
Marano *et al.*, 1994	0.43	0.10 – 0.64	0.53-1.07
Ungaro *et al.*, 1994	0.43		1.13 – 1.28
Marano, 1996	0.77	1.11 F_{max}=0.6-0.85	1.88(1.61-2.15)
Ardizzone, 1998	0.91 (Pauly) 0.51 (Djabali)	$F_{(obs)}$=2.60 $F_{(0.1)}$=1.00	
GMS-GRUND, 1998			2.99
Marano *et al.*, 1998b	0.31	0.92	1.23(1.02-1.43)
Marano *et al.*, 1998c	0.43-0.77		1.2-1.9
Vrgoč, 2000	0.58	0.90	0.61
EC XIV/298/96-EN (Ionian Sea and Southern Adriatic Sea)		$F_{(obs)}$=0.65-1.28	
	0.69 (Pauly)	$F_{(0.1)}$=0.6-1.63	
	0.41 (Djabali)	$F_{(0.1)}$=0.36-0.65	
EC XIV/298/96-EN (Adriatic Sea)		$F_{(obs)}$=0.91-4.09 (obs)	
	0.91 (Pauly)	$F_{(0.1)}$= 0.95-1.85	
	0.51 (Djabali)	$F_{(0.1)}$=0.52-0.79	

It is worth noting that M = 0.64 is slightly higher than the value (0.62) obtained by means of the relationship suggested by Jensen (1996, 2001), i.e. M = 1.5 k (with k = 0.42). Moreover, the value M = 0.64 is placed about in the middle of the range of values in the table from Vrgoc *et al.* (2004). Thus, the most conservative

M (i.e. lower M implies lower estimated biomass), among the possible values shown here, was not used in the present stock assessment.

Different input (start) values of the fishing mortality rate, F, for the last length class, 20+, were evaluated.

7.24.4.1.3. Results

The mean biomass at sea estimated by LCA was equal to 4,169 tonnes and, thus, slightly higher than the catch value.

The unweighted mean F was equal to 1.08. When the mean F was weighted on the estimated mean numbers of fish at sea, the obtained value was 0.62.

The corresponding values of F/Z were 0.63 and 0.50, with unweighted and weighted F, respectively.

The values of both F and F/Z estimated for each length class are shown in the Fig. 7.24.4.1.3.1. High values of F (higher than 1.0) are observed for some length classes. In the figure on the right, both F and F/Z are displayed as a function of age (transformation from length into age class was based on the same von Bertalanffy parameters used for LCA).

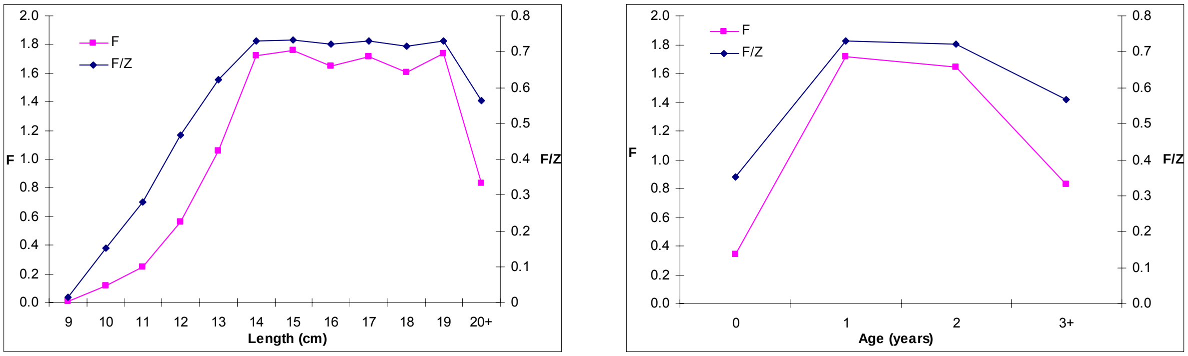


Fig. 7.24.4.1.3.1 Estimated exploitation patterns over length and ages.

7.24.5. Short term prediction for 2008 and 2009

7.24.5.1.Justification

No forecast analyses were conducted.

7.24.5.2.Input parameters

No forecast analyses were conducted.

7.24.5.3.Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 17.

7.24.6. Medium term prediction

7.24.6.1. Justification

No forecast analyses were conducted.

7.24.6.2. Input parameters

No forecast analyses were conducted.

7.24.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 17.

7.24.7. Long term prediction

7.24.7.1. Justification

No forecast analyses were conducted.

7.24.7.2. Input parameters

No forecast analyses were conducted.

7.24.7.3. Results

Given the values of F and F/Z calculated as relative to all the length classes used in the analysis (F/Z between 0.50 and 0.63), the stock can be considered to be fully exploited. As said for the stock of hake, according to Rochet and Trenkel (2003), it would be safe to avoid F/Z higher than 0.50. Also, a high seasonal (from September to November) fishing mortality of red mullet has to be taken into account. Thus, there is some degree of risk of overexploitation for red mullet in the GSA 17.

According to R(CE) 1967/2006 the minimum legal length for fishery is, for red mullet, equal to 11 cm.

A reasonable value of length at the first sexual maturity for red mullet, in the GSA 17, is 12 cm for females and 10.5 cm for males, as reported by Haidar (1970) mentioned in Vrgoc *et al.* (2004).

In conclusion, a meaningful percentage of caught red mullet may have a length around the values of sexual maturity. This is a further reason for caution in managing this stock.

7.24.8. Scientific advice

7.24.8.1. Short term considerations

7.24.8.1.1. State of the spawning stock size

The average stock biomass estimated by LCA in 2006-2007 was around 4000 tonnes. In the absence of any proposed or agreed target referendes, SGMED cannot fully evaluate the state of the stock.

7.24.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.24.8.1.3. State of exploitation

The average F not weighted on abundance isestimated to aoumt to 1.08 while the weighted average F amounts to 0.62. According to Rochet and Trenkel (2003), it would be safe to avoid F/Z higher than 0.50. Also, the seasonality fishing mortality of red mullet (from September to November) has to be taken into account. Thus, there is some risk of overexploitation for red mullet in the GSA 17. However, in the absence of any proposed or agreed target referendes, SGMED cannot fully evaluate the state of the stock.

7.24.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.25. Stock assessment of red mullet in GSA 18

7.25.1. Stock identification and biological features

7.25.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.25.1.2. Growth

No information was documented during SGMED-08-04.

7.25.1.3. Maturity

No information was documented during SGMED-08-04.

7.25.2. Fisheries

7.25.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.25.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.25.2.3. Catches

7.25.2.3.1. Landings

Tab. 7.25.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.2 of Appendix 3. Since 2002 the annual landings decreased from 4,910 t to only 1,800 t in 2007. The landings were mainly taken by demersal otter trawls.

Tab. 7.25.2.3.1.1 Annual landings (t) by fishing technique in GSA 18.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	18	ITA	DTS	3114	1750	1817	1350	1804	1680
MUT	18	ITA	HOK				0		
MUT	18	ITA	PGP	90	312	205	99	130	123
MUT	18	ITA	PMP	1707	308	40			
MUT	18	ITA	PTS			2			
SUM				4911	2370	2064	1449	1934	1803

7.25.2.3.2. Discards

No information was documented during SGMED-08-04.

7.25.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.25.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3. The effort of the major trawler fleet decrased form 2002 to 2007..

Tab. 7.25.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 18, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	18	ITA	DRB	11081	5890	3865	5776	7562	8132
DAYS	18	ITA	DTS	85424	71203	80259	84207	88418	73637
DAYS	18	ITA	HOK			1799	3053	4397	3190
DAYS	18	ITA	PGP	110621	63332	67232	80648	88583	68253
DAYS	18	ITA	PMP	53475	35980	3667			
DAYS	18	ITA	PTS	4140	4526	4679	4428	5291	6186
GT*DAYS	18	ITA	DRB			41347	62244	81590	87740
GT*DAYS	18	ITA	DTS			2568868	2592741	2632767	2275442
GT*DAYS	18	ITA	HOK			27800	58254	79940	58026
GT*DAYS	18	ITA	PGP			120701	146182	147150	115612
GT*DAYS	18	ITA	PMP			40920			
GT*DAYS	18	ITA	PTS			369876	360279	446754	516692
KW*DAYS	18	ITA	DRB	1100225	584801	381968	570792	746921	807073
KW*DAYS	18	ITA	DTS	17112022	14530793	14369490	14621928	14929696	12904532
KW*DAYS	18	ITA	HOK			284535	514377	778355	567996
KW*DAYS	18	ITA	PGP	1722336	1002933	1180371	1442219	1394671	1311109
KW*DAYS	18	ITA	PMP	7277279	4416994	351689			
KW*DAYS	18	ITA	PTS	1480945	1464793	1842716	1785787	2221605	2613654

7.25.3. Scientific surveys

7.25.3.1.Medits

7.25.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 18 the following number of hauls were reported per depth stratum (s. Tab. 7.25.3.1.1.1).

Tab. 7.25.3.1.1.1. Number of hauls per year and depth stratum in GSA 18, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA18_010-050	14	15	15	14	14	14	14	15	11	11	10	9	10	9
GSA18_050-100	14	14	14	15	15	15	15	14	13	13	15	15	14	14
GSA18_100-200	24	23	23	23	23	23	23	23	26	23	24	25	25	22
GSA18_200-500	10	10	10	10	10	10	10	10	8	8	8	9	9	6
GSA18_500-800	10	10	10	10	10	10	10	10	7	7	8	7	7	7

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.25.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.25.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 18 was derived from the international survey Medits. Figure 7.25.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 18.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices since 2005 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

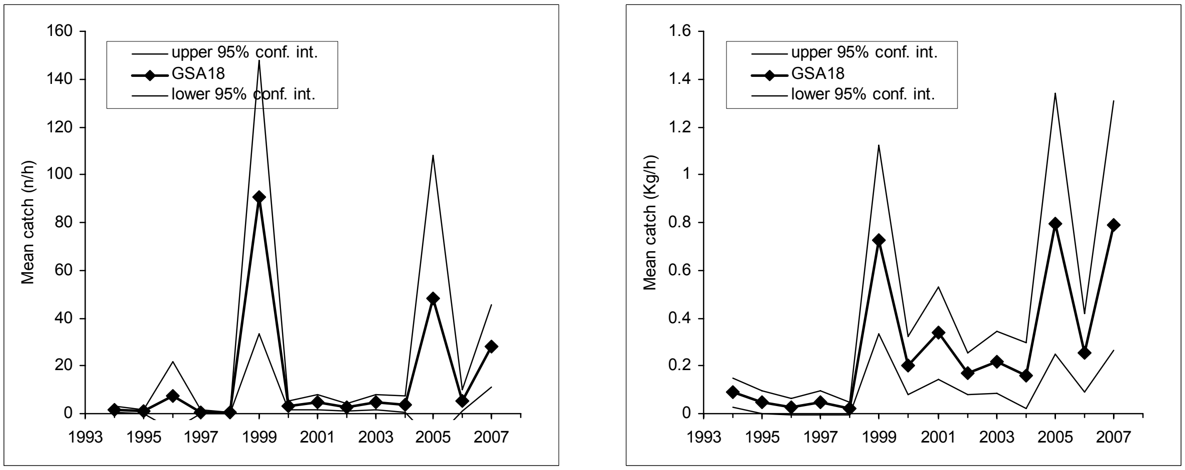


Fig. 7.25.3.1.3.1 Abundance and biomass indices of red mullet in GSA 18.

7.25.3.1.4. Trends in abundance by length or age

The following Fig. 7.25.3.1.4.1 and 2 display the stratified abundance indices of GSA 18 in 1995-2002 and 2003-2007. These size compositions are considered preliminary.

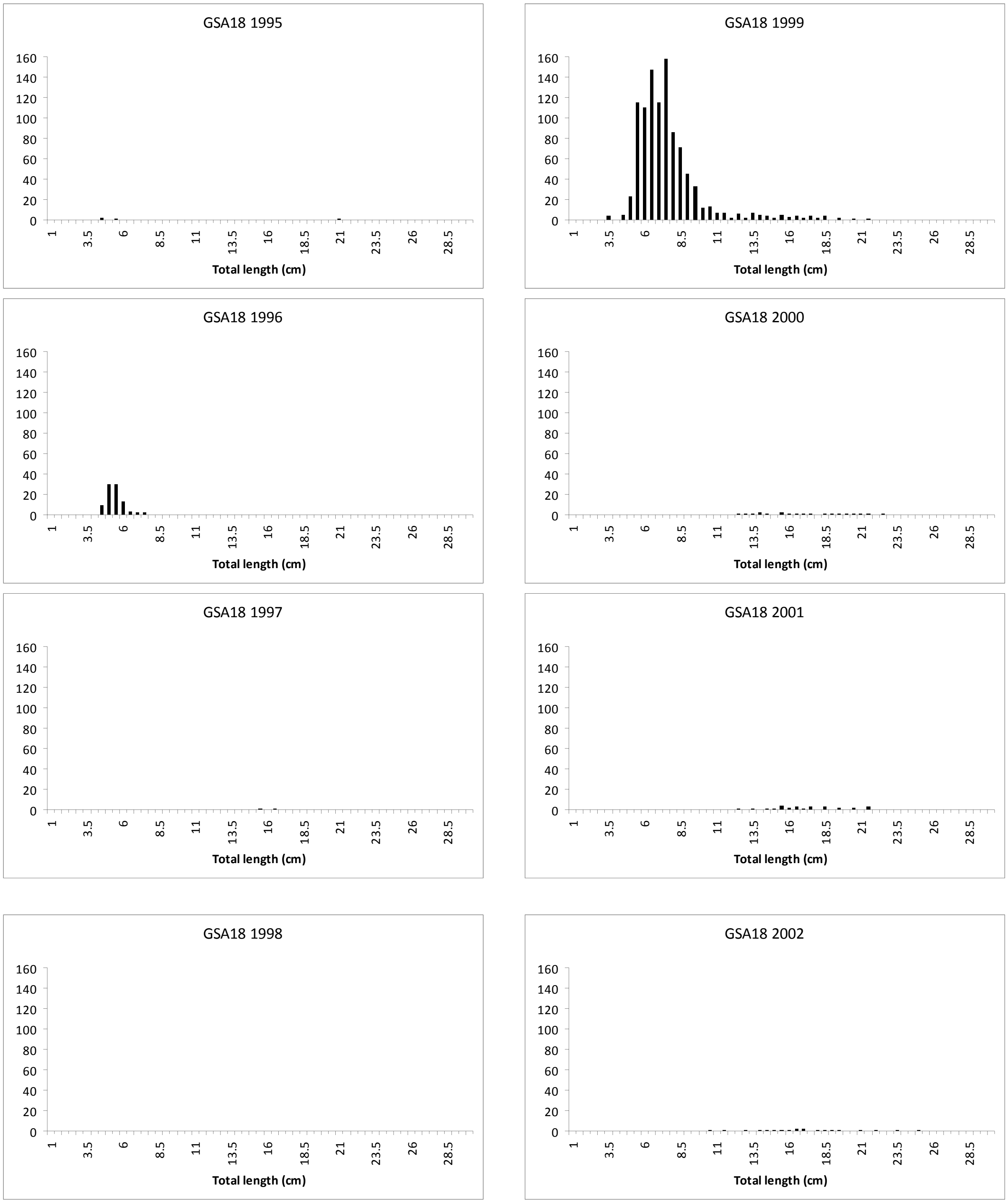


Fig. 7.25.3.1.4.1 Stratified abundance indices by size, 1995-2002.

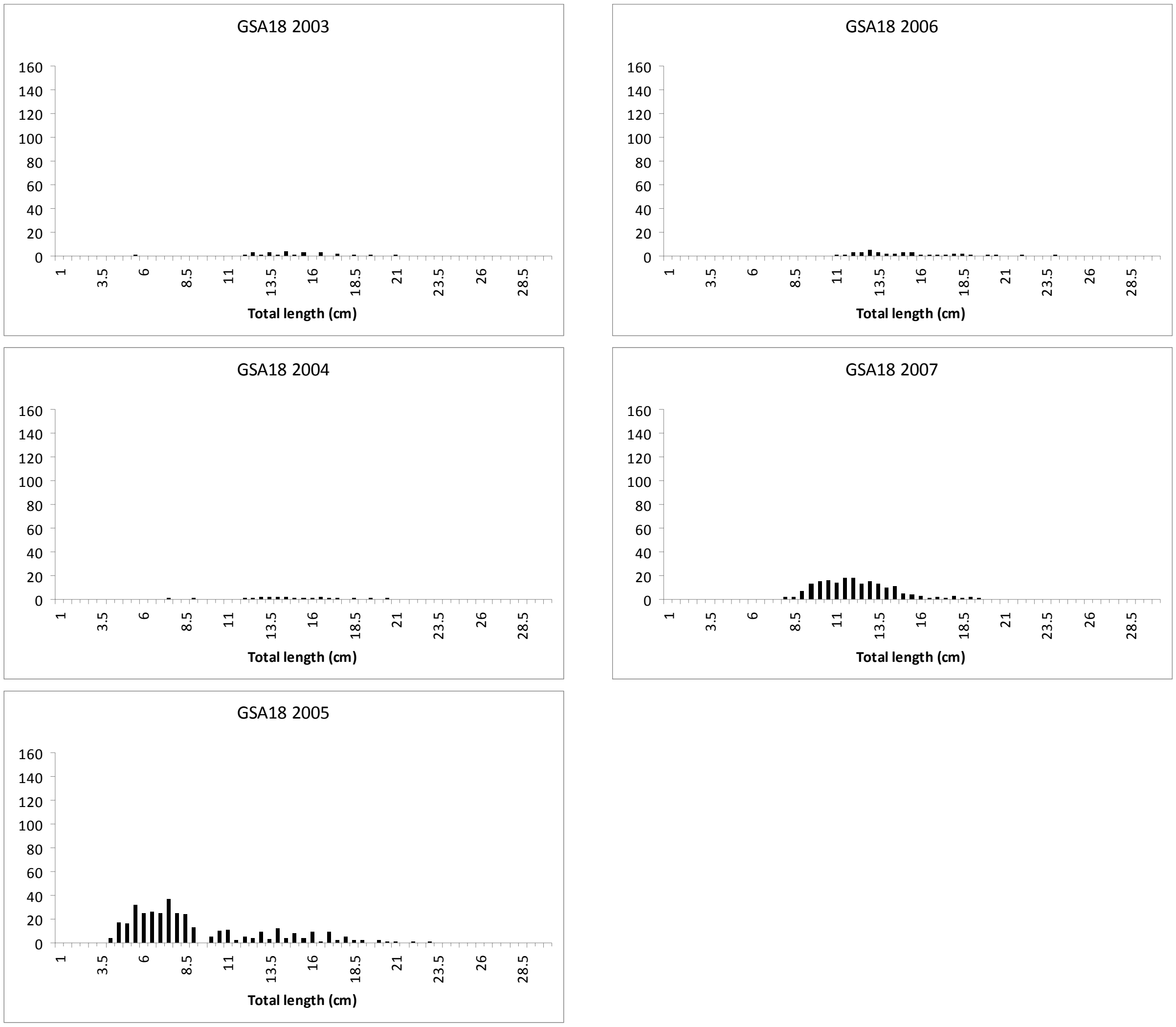


Fig. 7.25.3.1.4.2 Stratified abundance indices by size, 2003-2007.

7.25.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.25.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.25.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.25.5. Short term prediction for 2008 and 2009

7.25.5.1. Justification

No forecast analyses were conducted.

7.25.5.2. Input parameters

No forecast analyses were conducted.

7.25.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 18.

7.25.6. Medium term prediction

7.25.6.1. Justification

No forecast analyses were conducted.

7.25.6.2. Input parameters

No forecast analyses were conducted.

7.25.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 18.

7.25.7. Long term prediction

7.25.7.1. Justification

No forecast analyses were conducted.

7.25.7.2. Input parameters

No forecast analyses were conducted.

7.25.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 18.

7.25.8. Scientific advice

7.25.8.1. Short term considerations

7.25.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.25.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.25.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.25.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.26. Stock assessment of red mullet in GSA 19

7.26.1. Stock identification and biological features

7.26.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.26.1.2. Growth

No information was documented during SGMED-08-04.

7.26.1.3. Maturity

No information was documented during SGMED-08-04.

7.26.2. Fisheries

7.26.2.1. General description of fisheries

STECF in 2007 (stock review part II) noted that red mullet *Mullus barbatus* is among the species with high commercial value. The highest trawl fishing pressure occurs along the Calabrian coast while the presence of rocky bottoms on the shelf along the Apulian coast prevents the fishing by trawling in this sector. The landings in the 2004 in the whole GSA 19 were detected around 321 t coming mainly from bottom trawling and small-scale boats.

7.26.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.26.2.3. Catches

7.26.2.3.1. Landings

Tab. 7.26.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.2 of Appendix 3. Since 2003 the annual landings decreased from 2,450 t to only 540 t in 2007. Many geras contributed to the reported landings.

Tab. 7.26.2.3.1.1 Annual landings (t) by fishing technique in GSA 19.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	19	ITA	DTS	782	427	321	294	566	288
MUT	19	ITA	HOK			69	70		
MUT	19	ITA	PGP	243	1152	508	747	321	253
MUT	19	ITA	PMP	1242	870	53	2		
MUT	19	ITA	PTS	6	2				
SUM				2273	2451	951	1113	887	541

7.26.2.3.2. Discards

7 t of discards in 2005 were reported to SGMED-08-04 through the DCR data call and are listed in Tab. A3.6 of Appendix 3.

7.26.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.26.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.26.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 19, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	19	ITA	DTS	31381	31586	37234	42413	42976	40423
DAYS	19	ITA	HOK			39190	43898	25644	17695
DAYS	19	ITA	PGP	233718	254881	225109	193806	217447	168411
DAYS	19	ITA	PMP	100208	122225	20325	6905		
DAYS	19	ITA	PTS	3458	7302	6605	5554	5507	4441
GT*DAYS	19	ITA	DTS			782163	884513	835267	800971
GT*DAYS	19	ITA	HOK			1015534	1091913	850691	710177
GT*DAYS	19	ITA	PGP			473727	438792	555916	483882
GT*DAYS	19	ITA	PMP			111129	34967		
GT*DAYS	19	ITA	PTS			195882	238105	188866	114537
KW*DAYS	19	ITA	DTS	5125805	5002396	5802023	6562337	6460683	6063817
KW*DAYS	19	ITA	HOK			6809150	7299195	5575566	4053202
KW*DAYS	19	ITA	PGP	4669873	9192254	4881153	4698292	6141378	5333724
KW*DAYS	19	ITA	PMP	13116917	9143878	1188078	341008		
KW*DAYS	19	ITA	PTS	978457	1629677	1105203	1026897	1008813	691704

7.26.3. Scientific surveys

7.26.3.1.Medits

7.26.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 19 the following number of hauls were reported per depth stratum (s. Tab. 7.26.3.1.1.1).

Tab. 7.26.3.1.1.1. Number of hauls per year and depth stratum in GSA 19, 2002-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA19_010-050									9	9	9	9	9	8
GSA19_050-100									8	8	8	8	8	9
GSA19_100-200									10	10	10	10	10	10
GSA19_200-500									14	14	14	15	14	14
GSA19_500-800									29	29	29	28	29	29

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:
- A=total survey area
- Ai=area of the i-th stratum
- si=standard deviation of the i-th stratum
- ni=number of valid hauls of the i-th stratum
- n=number of hauls in the GSA
- Yi=mean of the i-th stratum
- Yst=stratified mean abundance
- V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.26.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.26.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 19 was derived from the international survey Medits. Figure 7.26.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 19.

The estimated abundance and biomass indices do not reveal any significant trends since 1994. However, the recent abundance and biomass indices in 2007 appear high but are subject to high variation (uncertainty). The analyses of Medits indices are considered preliminary.

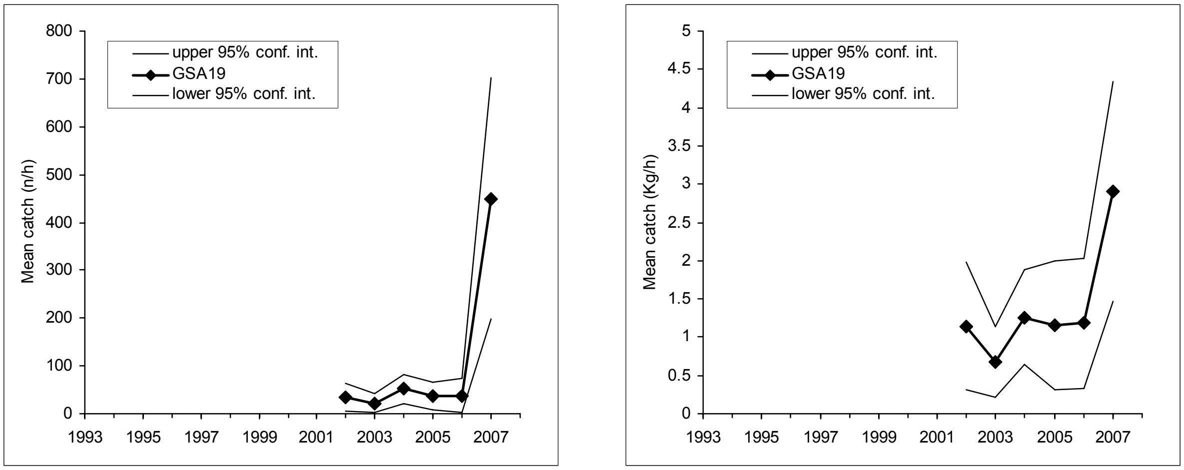
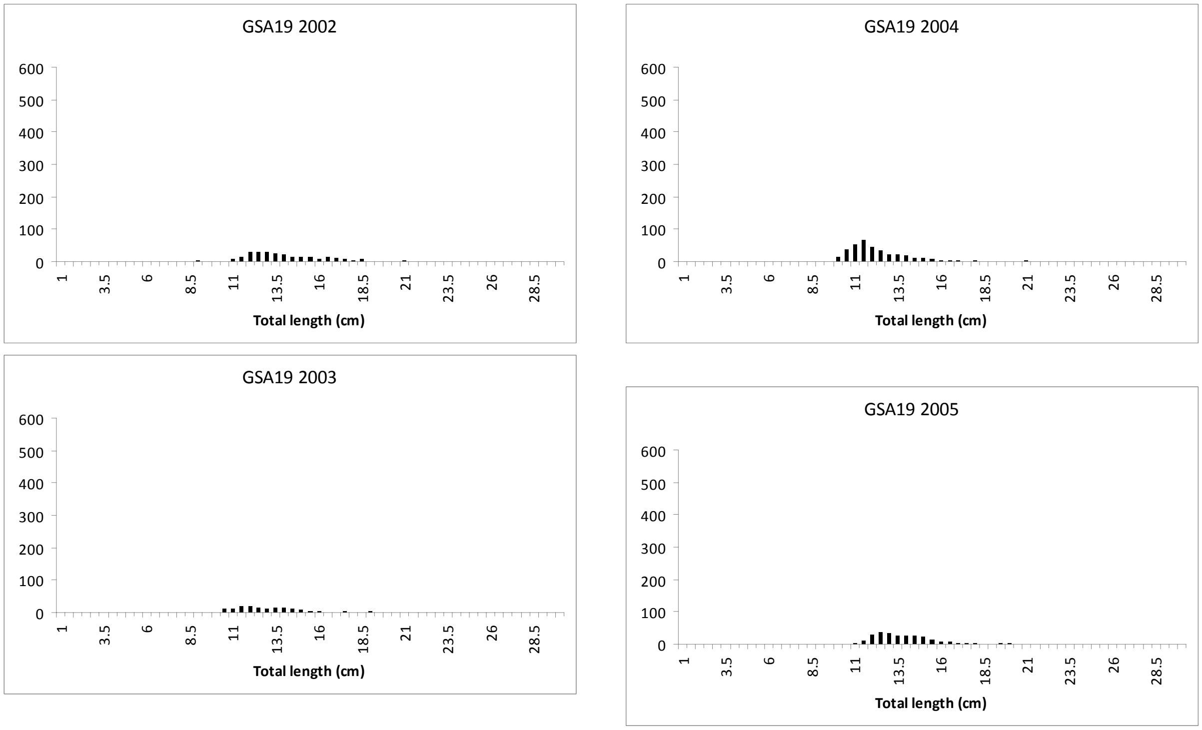


Fig. 7.26.3.1.3.1 Abundance and biomass indices of red mullet in GSA 19.

7.26.3.1.4. Trends in abundance by length or age

The following Fig. 7.26.3.1.4.1 display the stratified abundance indices of GSA 19 in 2002-2007. These size compositions are considered preliminary.



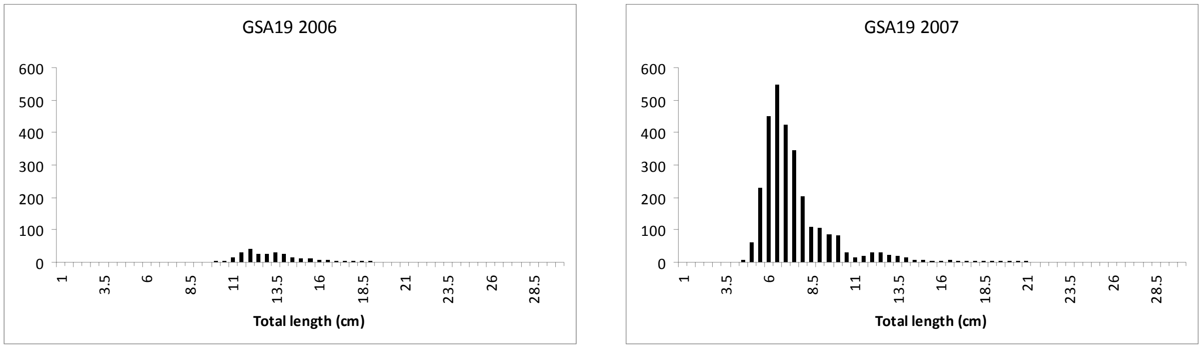


Fig. 7.26.3.1.4.1 Stratified abundance indices by size, 2002-2007.

7.26.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.26.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.26.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.26.5. Short term prediction for 2008 and 2009

7.26.5.1. Justification

No forecast analyses were conducted.

7.26.5.2. Input parameters

No forecast analyses were conducted.

7.26.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 19.

7.26.6. Medium term prediction

7.26.6.1. Justification

No forecast analyses were conducted.

7.26.6.2. Input parameters

No forecast analyses were conducted.

7.26.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 19.

7.26.7. Long term prediction

7.26.7.1. Justification

No forecast analyses were conducted.

7.26.7.2. Input parameters

No forecast analyses were conducted.

7.26.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 19.

7.26.8. Scientific advice

7.26.8.1. Short term considerations

7.26.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.26.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.26.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.26.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.27. Stock assessment of red mullet in GSA 20

7.27.1. Stock identification and biological features

7.27.1.1. Stock Identification

Red mullet is one of the most common and most valuable fish species in Greek Seas. The species is fished by bottom trawl and nets (mainly gill nets) in shallow-mid waters along the Greek coast. The stock is distributed mainly on muddy bottoms along the coast. Its depth distribution is limited in depths less than 200 m. However, is not abundant in water deeper than 150 m. Spawning takes place during spring-early summer. The juveniles of the species are concentrated in shallow waters (10-50 m). Nursery grounds in GSA 20 have been defined along the Western Coast of Peloponnese and Epirus. The stock in GSA 20 is exploited exclusively by the Greek fleet.

7.27.1.2. Growth

The growth parameters for red mullet for the sexes is shown in Fig 2.27.1.2.1 The age interpretation was done by otoliths reading. Sampling was conducted from 2003 to 2005.

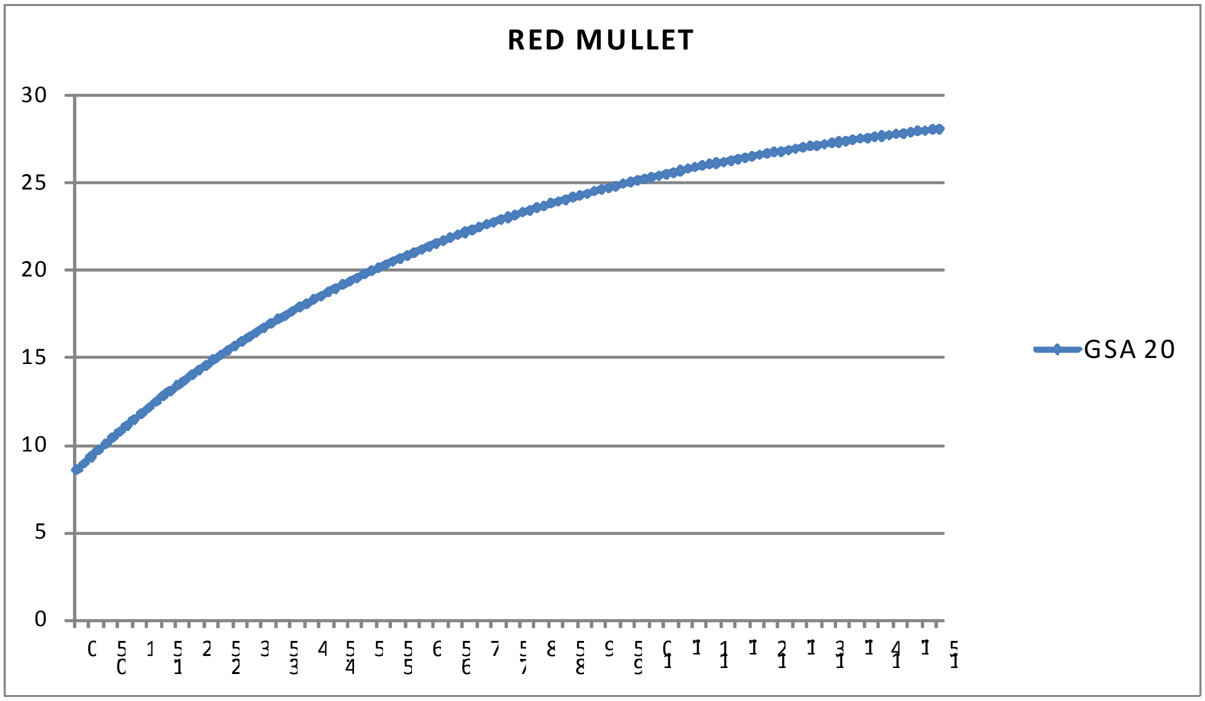


Fig.2.27.1.2.1 V. Bertalanffy growth function of length (cm) over age (years).

During the discussion developed in the plenary, a big variability was noticed in the growth parameters even for the same GSA. In order those discrepancies to be solved, a Workshop regarding the validation of growth parameters of red mullet is expected to be convened very shortly. For the purposes of the present assessments it was decided to use parameters representing slow and fast growth in the whole Mediterranean. These parameters are given in table 2.27.1.2.1.

Table 2.27.1.2.1. Growth parameters of red mullet representing slow and fast growth

RED MULLET	**L_{inf} (cm)**	**k**	**t_0**
Slow growth	26,00	0,412	-0,4
Fast growth	34,50	0,336	-0,143

7.27.1.3. Maturity

The species achieves sexual maturity in the first year of life, having a length of 10-11 cm.

7.27.2. Fisheries

7.27.2.1. General description of fisheries

The main fishing gears targeting red mullet in GSA 20 are bottom trawls and gill nets. In some cases, trammel nets are used as well. According to the European and Greek Legislation, bottom trawls operate in waters deeper than 50 m or in a distance 3 miles from the coasts. Thus the gear is targeting the species in waters from the limit (as defined by the legislation) down to 150 m (or deeper but the abundance is not high so red mullet is not the target or one of the target species). Illegal fishing by bottom trawls was very common in the past (in waters less than 50 m or in a distance less than 3 miles) and could be considered as harmful for the species. Large quantities of 0 age specimens, with length 5-9 cm, were caught during Autumn. Nowadays, with the use of VMS the situation has been improved significantly but the problem still exists.

There is no depth limit or restriction related to distance from shore for the nets in Greece. However, nets from October to May usually fish at depths <50 m or in a distance <3 miles from the coasts. During summer, when bottom trawl fishery is closed, nets may be used in deeper waters. The mesh size is usually 36-44 mm but there are cases where smaller mesh size (32 or 34 mm) is used. Mesh sizes >36 mm have no important impact on the juveniles. The optimum selection lengths were at 13.5 cm, 15 cm, 16.5 cm and 17 cm for the 34 mm, 38 mm, 42 mm and 44 mm nets respectively (Petrakis, 1998, SELMED Selectivity of fixed nets in Mediterranean EEC contract: 95/C/76/15,). There is a clear seasonal pattern of the red mullet net metier, which varies between different areas depending on the abundance of the species and on the availability of other more profitable resources.

7.27.2.2. Management regulations applicable in 2007 and 2008

No specific regulation to manage the species is enforced.

The MLS is 11 cm (according to EE 1967/2006 regulation). The most important measures for managing bottom trawl or net fisheries in Greece has been described in the section 7.14.2.2.

7.27.2.3. Catches

7.27.2.3.1. Landings

Estimation of landings was based on random sampling in 66 sampling stations (ports) in GSA 20. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type was randomly selected and landings by species recorded. Based on these data, average landings per fishing day, by species and for each fishing gear were estimated. Based on total effort estimations, sampled data were raised to the whole fleet to estimate total landings by species, fleet segment, fishing gear, and GSA.

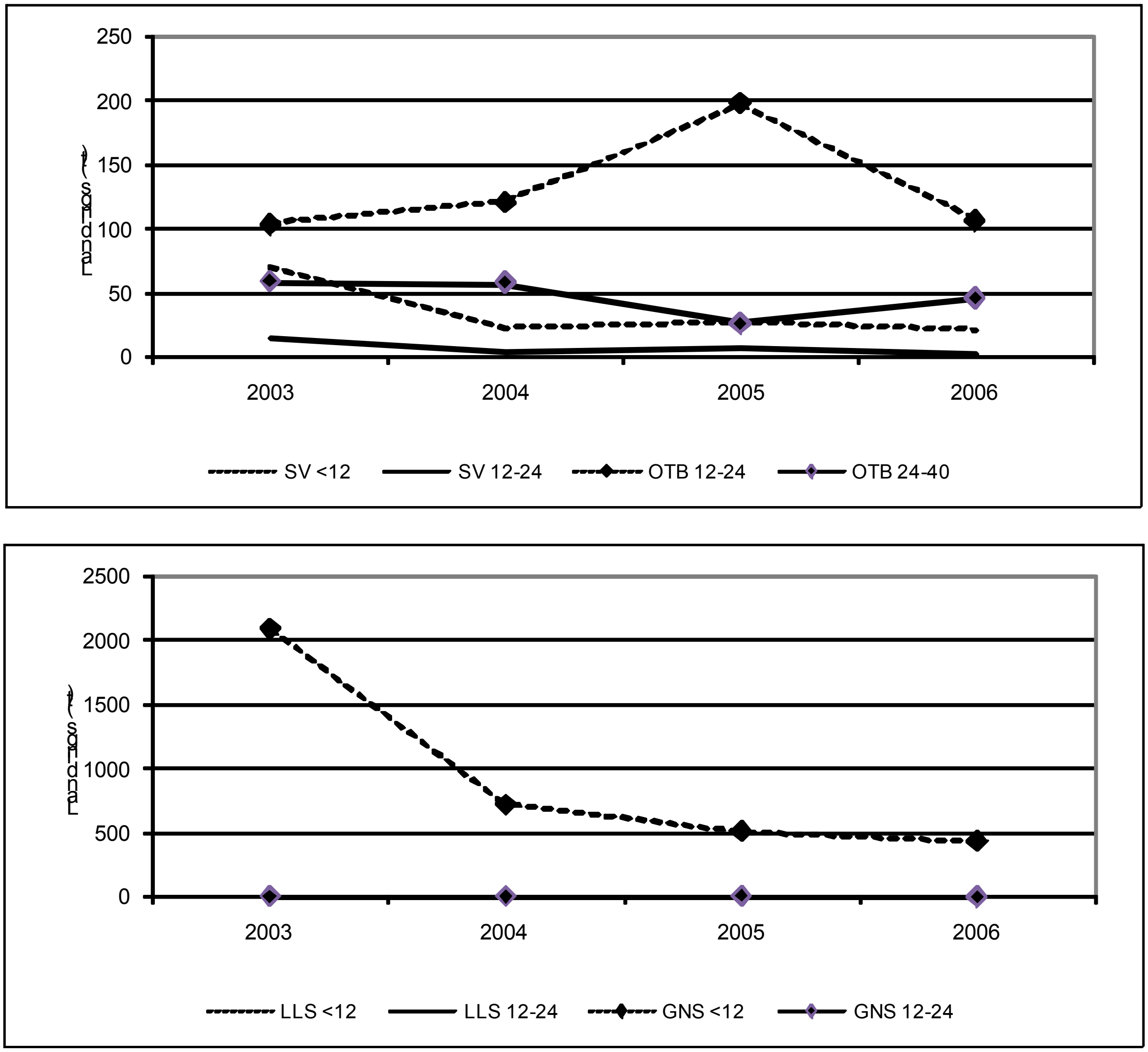


Fig. 7.27.2.3.1.1 Landings of red mullet in GSA 20 from 2003-2006.

Landings of red mullet in GSA 20 for the years 2003-2006 are presented in Fig. 7.27.2.3.1.1-2 and Tab. 7.27.2.3.1.1. The bottom trawl and boat seine landings were quite constant and ranged between 153 and 225 tones. The nets landings, in 2003 were 2103 tones. A decrease was observed in the following years and in 2006 were 432 tones. The proportion taken by nets was 89% in 2003 (higher value) and 66% in 2005 (lower value).

Table 7.27.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call, 2003-2006.

Gear	SV		OTB		GNS	
Year	Weight (t)	% of Total	Weight (t)	% of Total	Weight (t)	% of Total
2003	86	3.66	163	6.93	2103	89.41
2004	26	2.80	179	19.31	722	77.89
2005	36	4.65	225	29.07	513	66.28
2006	24	3.94	153	25.12	432	70.94

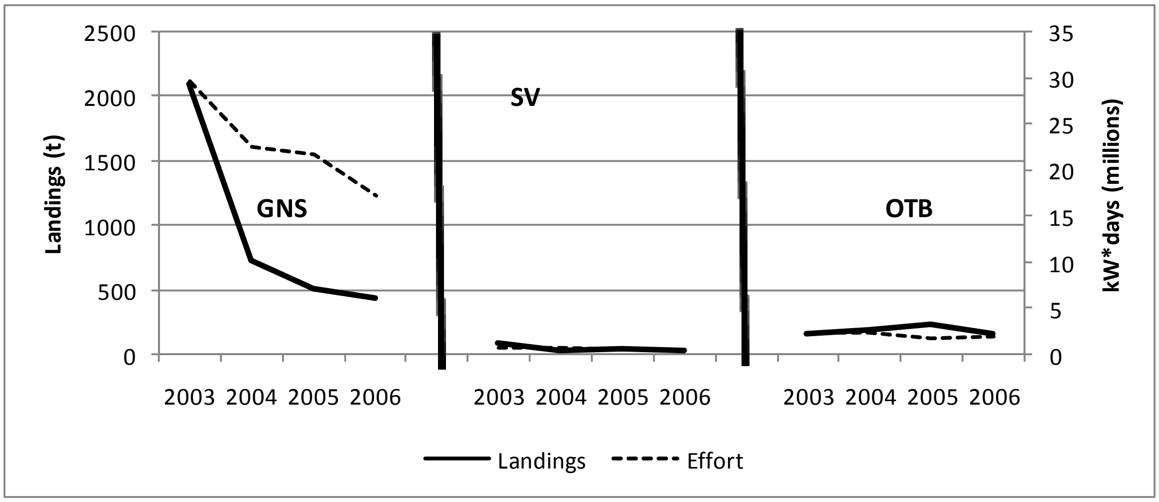


Fig. 7.27.2.3.1.2 Landings of red mullet and fishing effort per gear category in GSA 20.

The length frequency distribution of bottom trawl red mullet landings in GSA 20, by number and by weight, is presented in Fig. 7.27.2.3.1.3. and Fig. 7.27.2.3.1.4. The proportion of the undersized specimens varied between the years and it was by number 21%, 41% and 1% and by weight 7%, 14% and 0% for the years 2004, 2005 and 2006, respectively.

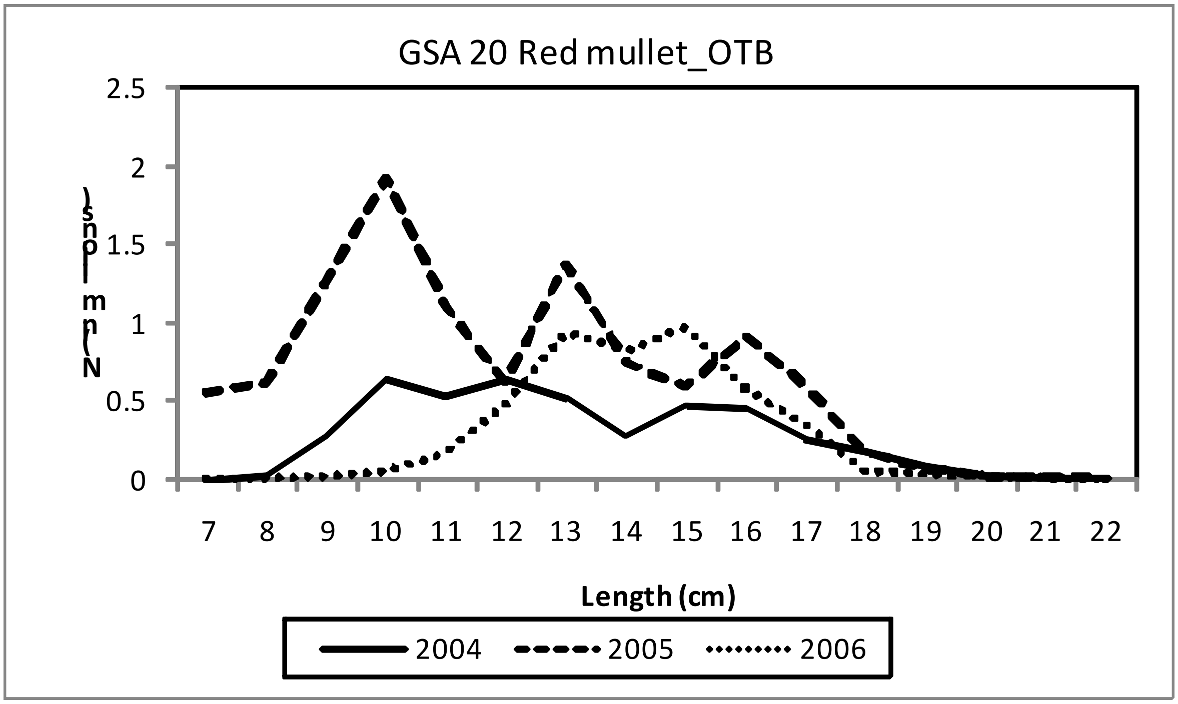


Fig. 7.27.2.3.1.3 OTB length composition of landings in numbers, 2004-2006.

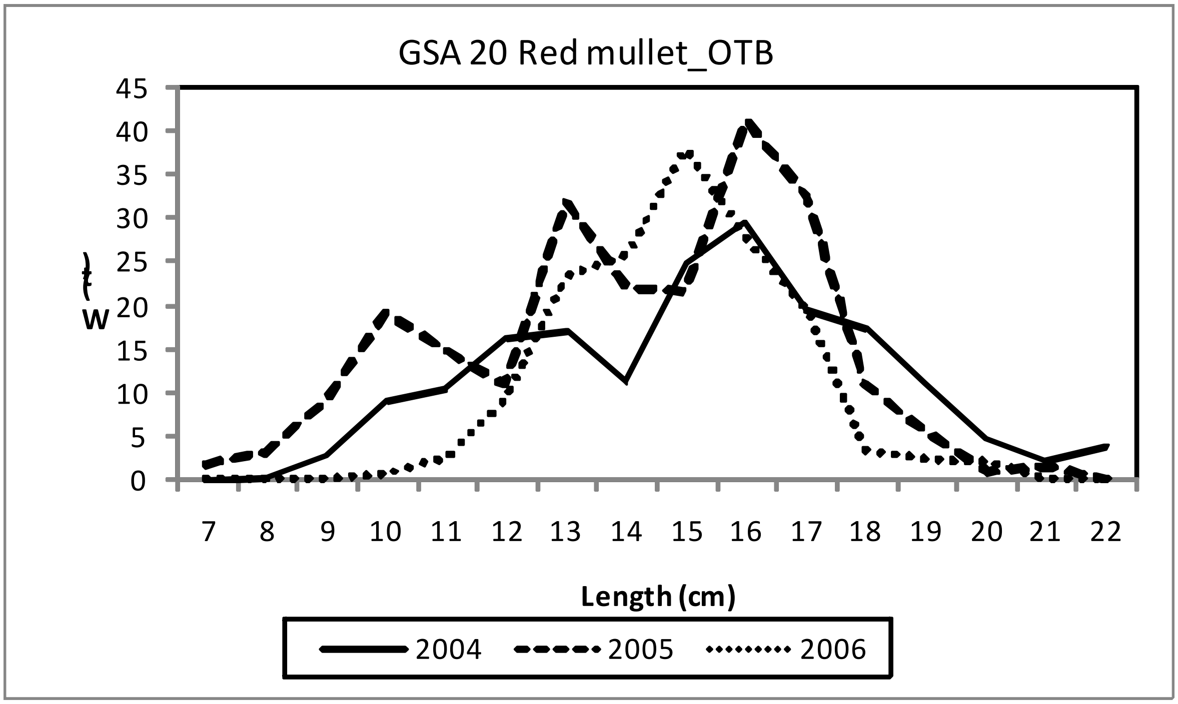


Fig. 7.27.2.3.1.3 OTB length composition of landings in weight, 2004-2006.

No length data were provided on the length distribution of nets and boat seines.

7.27.2.3.2. Discards

In Greece, the discards and landings of trawlers, purse-seiners, coastal vessels, and drifting longliners were estimated based on onboard sampling. Three times every year, sampling was conducted in GSA 20. Each time, catch, discards, and landings were recorded for each gear type and fleet segment. Based on this sampling, total discards were estimated by species, gear type (Fig. 2.27.2.3.2.1).

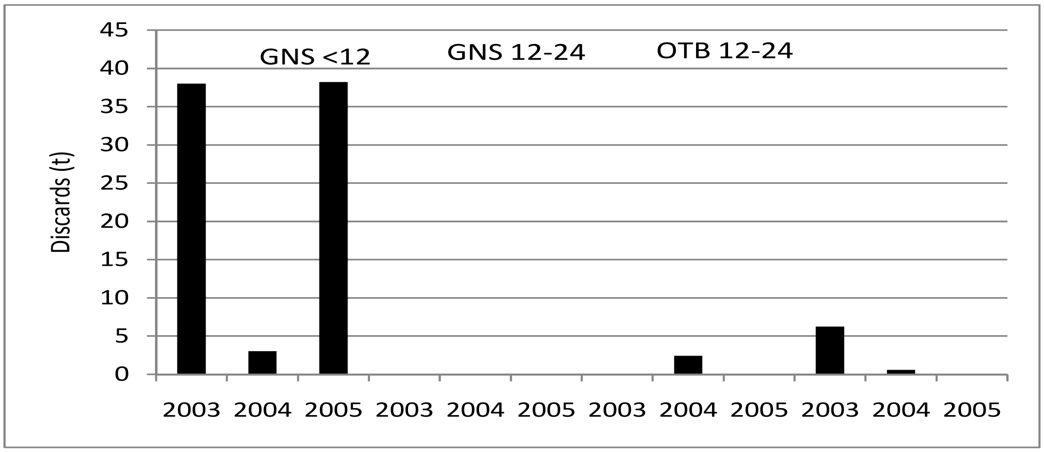


Fig. 2.27.2.3.2.1 Discards of red mullet in GSA 20 per fleet segment.

In 2003 and in 2005 38 tones of red mullet have been reported as discarded in the netters <12 m fleet segment. These values are considered very high taking into account that the reported discards for the other fleet segments were less than 6 tones. No discards of boat seines were reported.

Reported discards from 2003 to 2005 were reported to SGMED-08-03 and are listed in Tab. A3.6 of Appendix 3. During this period, annual discards varied among 6 and 44 t (Tab. 7.27.2.3.2.1).

Table 7.27.2.3.2.1 Annual discards (t) by fishing technique as reported to SGMED-08-03 through the DCR data call, 2003-2005.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	20	GRE	GNS		38	3	38		
MUT	20	GRE	OTB		6	3	0		
SUM					44	6	38		

No length distribution of discards was available for Greece during SGMED-08-04.

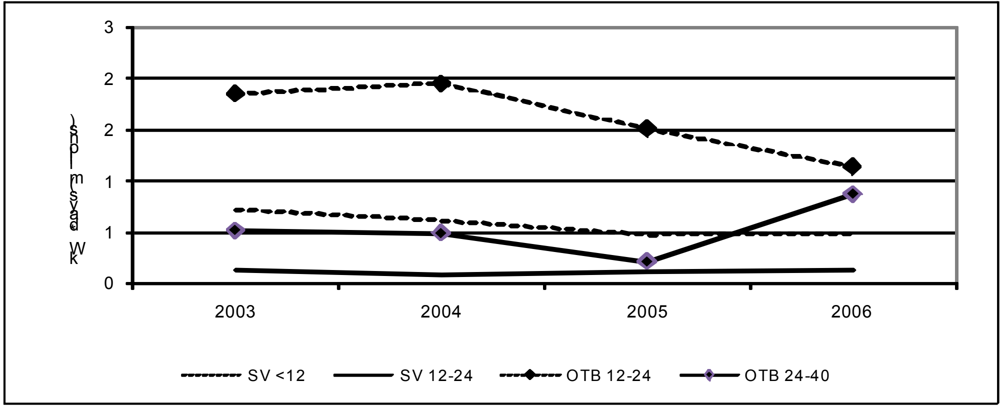
7.27.2.3.3. Fishing effort

The fishing effort of the gill nets <12 m and of the bottom trawls 12-24 m showed a significant reduction in GSA 20 from 2003 to 2006 (Fig. 27.2.3.3.1, Tab. 27.2.3.3.1).

Tab. 27.2.3.3.1 Relative fiishing effort (relative to 2003) in kW*days at sea in GSA 20.

Year\Gear type	OTB 12-14m	OTB 24-40 m	GNS <12 m
2003	100	100	100
2004	105	95	75
2005	82	42	73
2006	62	168	58

The evaluation of the fishing effort of the main fishing gears in Ionian Sea is difficult to be interpreted. For example, the effort of the nets decreased by 42% in 2006 in relation to the effort in 2003. Such a reduction is unlikely to happen in the number of vessels or in the kW.



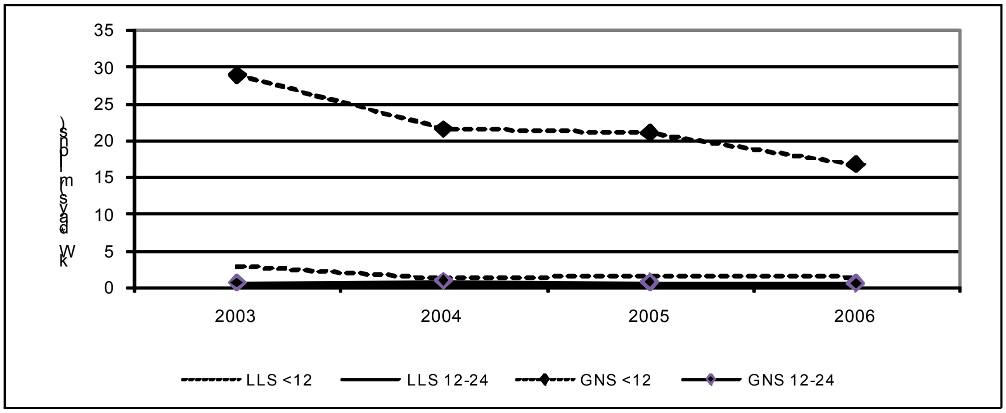


Fig. 7.27.2.3.3.1 Fishing effort per fleet segment in GSA 20.

Tab. 7.27.2.3.3.2 lists the effort by fishing technique deployed in GSA 20 as reported to SGMED-08-03 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3. A decrease is observed for the main fleet using gill nets.

Tab. 7.27.2.3.3.1 Effort trends by fishing technique in GSA 20.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	20	GRE	GNS		717773	634540	655783	588850	
DAYS	20	GRE	LLS		114160	79657	84159	73790	
DAYS	20	GRE	OTB		7810	7284	6279	6682	
DAYS	20	GRE	SV		13429	10902	10883	11363	
GT*DAYS	20	GRE	GNS		2885125	2548709	2611649	2210227	
GT*DAYS	20	GRE	LLS		436107	268489	203140	228351	
GT*DAYS	20	GRE	OTB		574443	580909	435054	565011	
GT*DAYS	20	GRE	SV		83099	62465	58441	57058	
KW*DAYS	20	GRE	GNS		29609039	22529478	21758835	17272519	
KW*DAYS	20	GRE	LLS		3247285	1435103	1823114	1448109	
KW*DAYS	20	GRE	OTB		2374841	2447515	1729664	2024955	
KW*DAYS	20	GRE	SV		863066	709465	604098	623628	

7.27.3. Scientific surveys

7.27.3.1.Medits

7.27.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 20 the following number of hauls were reported per depth stratum (s. Tab. 7.27.3.1.1.1).

Tab. 7.27.3.1.1.1. Number of hauls per year and depth stratum in GSA 20, 1994-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA20_010-050	2	2	2	2	4	3	3	3		3	3	3	3	
GSA20_050-100	3	4	8	7	11	10	11	9		10	10	10	9	
GSA20_100-200	1	3	4	2	5	6	5	6		6	6	5	6	
GSA20_200-500	2	3	4	4	7	7	7	8		8	9	8	8	
GSA20_500-800	3	2	4	3	5	5	5	5		5	3	5	4	

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:
A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.27.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.27.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 09 was derived from the international survey Medits. Figure 7.27.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 20.

The estimated abundance and biomass indices do not reveal any significant trends since 1997 when the indices increased from a lower level. The analyses of Medits indices are considered preliminary.

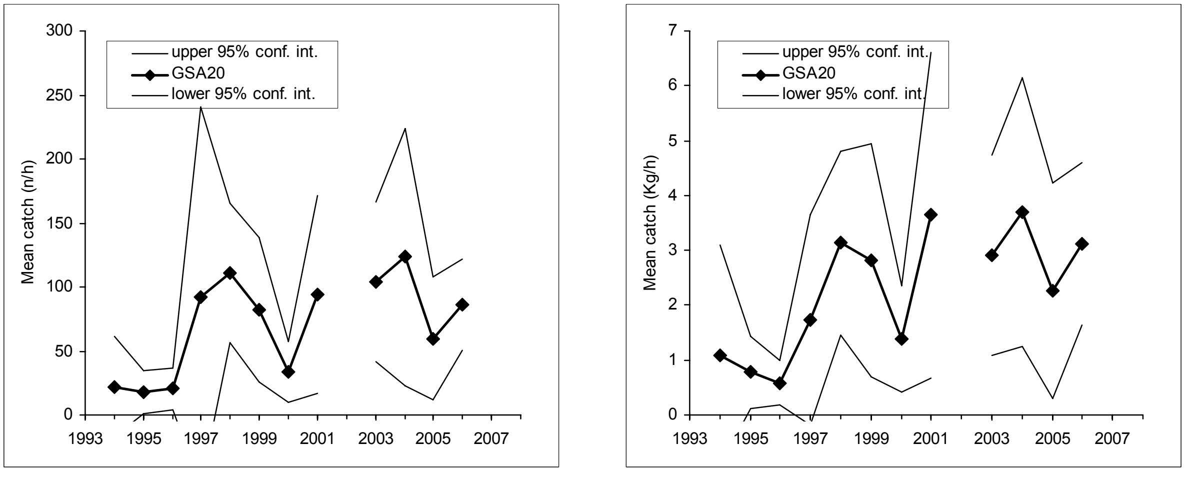


Fig. 7.27.3.1.3.1 Abundance and biomass indices of red mullet in GSA 20.

7.27.3.1.4. Trends in abundance by length or age

The following Fig. 7.27.3.1.4.1 and 2 display the stratified abundance indices of GSA 20 in 1994-2001 and 2003-2006. These size compositions are considered preliminary.

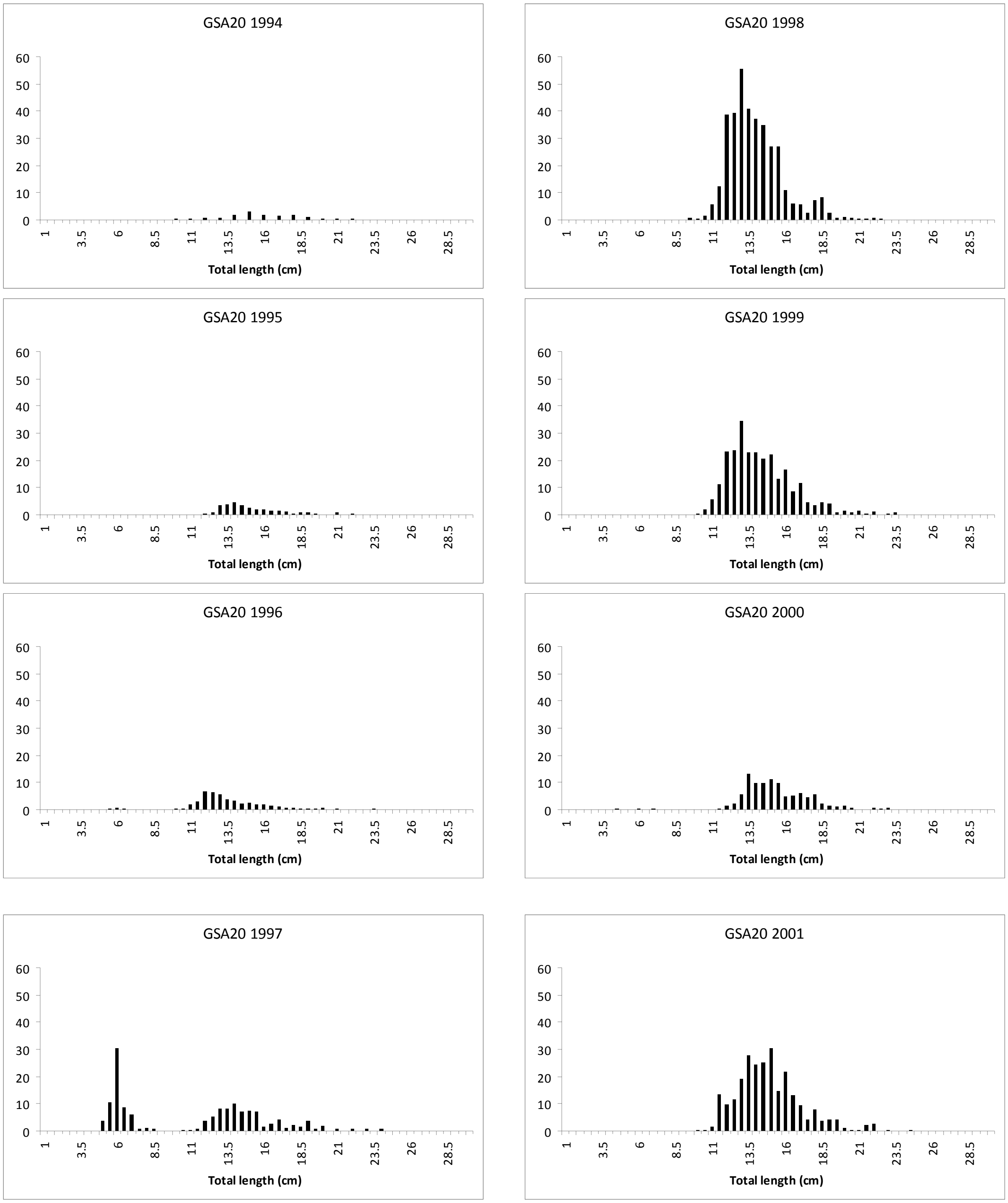


Fig. 7.27.3.1.4.1 Stratified abundance indices by size, 1994-2001.

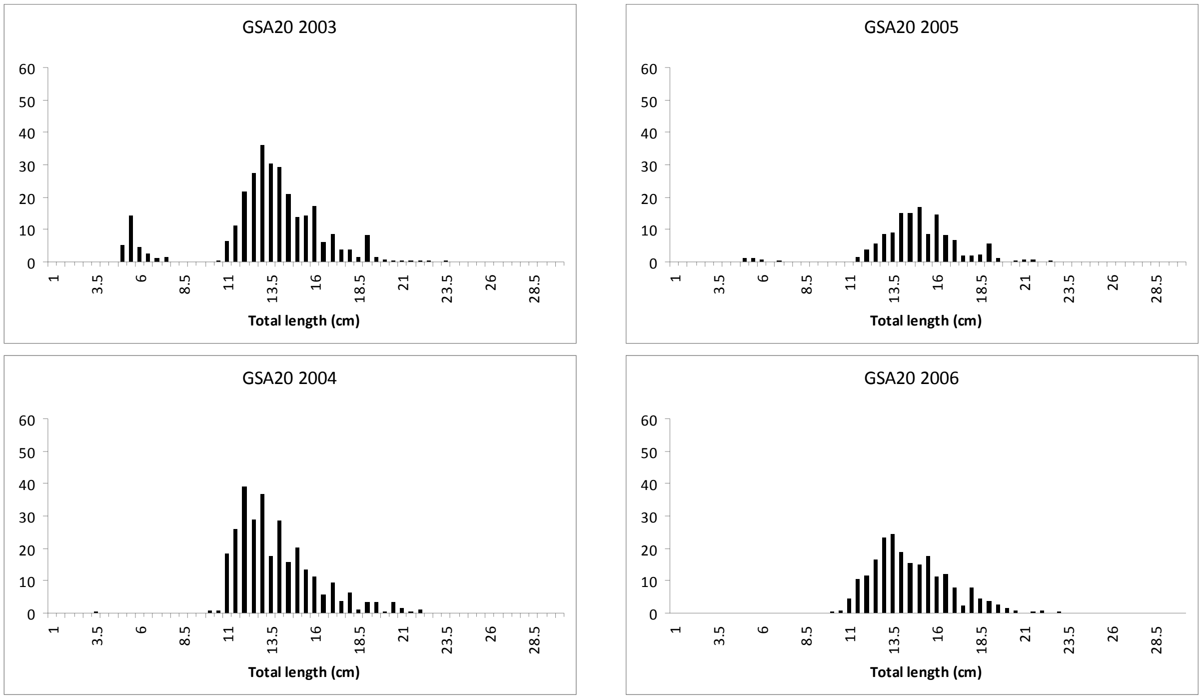


Fig. 7.27.3.1.4.2 Stratified abundance indices by size, 2003-2006.

7.27.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.27.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.27.4. Assessment of historic stock parameters

7.27.4.1. Method 1: SURBA (Survey Based Assessment)

7.27.4.1.1. Justification

Some of the requested data in the official data call were not provided by Greece in time for the SGMED 08-03 meeting. No data on length distribution of the landings, age distribution of the landings, maturity ogive for males, sex ratio at length, and discards length distribution were available. Due to this lack of available data, many of the methods for stock assessment proposed in the previous meetings of SGMED could not be applied. Therefore, the MEDITS data (1994-2004) were surveyed with the use of the software SURBA.

Two growth patterns were assumed in order to apply the SURBA method, either slow or fast growth.

7.27.4.1.2. Input parameters

Slow growth:

The data needed for SURBA are estimates of natural morality at age, proportion of mature individuals at age and stock weights at age. MEDITS survey data (1994-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters (slow growth)

Linf	26
k	0.412
to	-0.4

Weight-length relationship

a (W-L)	0.0000043
b (W-L)	3.18

Length at age

1	11.40
2	16.33
3	19.59
4	21.76
5+	23.19

Mortality at age

	2	**3**	**4**	**5+**
1994	0.66	0.55	0.49	0.46
1995	0.66	0.55	0.49	0.46
1996	0.66	0.55	0.49	0.46
1997	0.66	0.55	0.49	0.46
1998	0.66	0.55	0.49	0.46
1999	0.66	0.55	0.49	0.46
2000	0.66	0.55	0.49	0.46
2001	0.66	0.55	0.49	0.46
2003	0.66	0.55	0.49	0.46
2004	0.66	0.55	0.49	0.46
2005	0.66	0.55	0.49	0.46
2006	0.66	0.55	0.49	0.46

Mature at age

	2	**3**	**4**	**5+**
1994	0.70	1	1	1
1995	0.70	1	1	1
1996	0.70	1	1	1
1997	0.70	1	1	1

1998	0.70	1	1	1
1999	0.70	1	1	1
2000	0.70	1	1	1
2001	0.70	1	1	1
2003	0.70	1	1	1
2004	0.70	1	1	1
2005	0.70	1	1	1
2006	0.70	1	1	1

Fast growth

The data needed for SURBA are estimates of natural morality at age, proportion mature at age and stock weights at age. MEDITS survey data (1994-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters (fast growth)

Linf	34.5
k	0.336
to	-0.143

Weight-length relationship

a (W-L)	0.0000043
b (W-L)	3.18

Length at age

1	11.00
2	17.71
3	22.50
4+	25.92

Mortality at age

	2	**3**	**4+**
1994	0.65	0.52	0.45
1995	0.65	0.52	0.45
1996	0.65	0.52	0.45
1997	0.65	0.52	0.45
1998	0.65	0.52	0.45
1999	0.65	0.52	0.45
2000	0.65	0.52	0.45
2001	0.65	0.52	0.45
2003	0.65	0.52	0.45
2004	0.65	0.52	0.45
2005	0.65	0.52	0.45
2006	0.65	0.52	0.45

Mature at age

	2	3	4+
1994	0.80	1	1
1995	0.80	1	1
1996	0.80	1	1
1997	0.80	1	1
1998	0.80	1	1
1999	0.80	1	1
2000	0.80	1	1
2001	0.80	1	1
2003	0.80	1	1
2004	0.80	1	1
2005	0.80	1	1
2006	0.80	1	1

7.27.4.1.3. Results

Slow growth

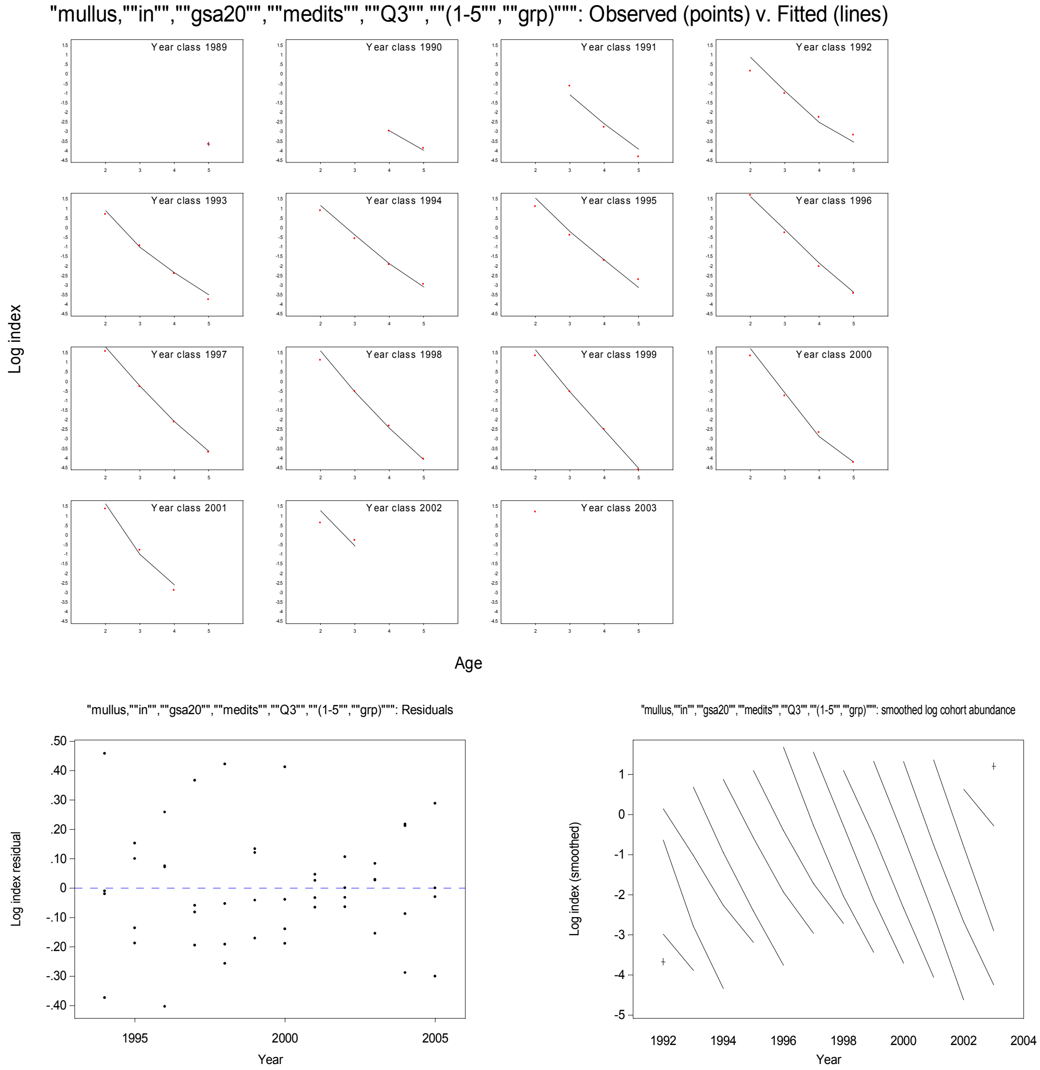
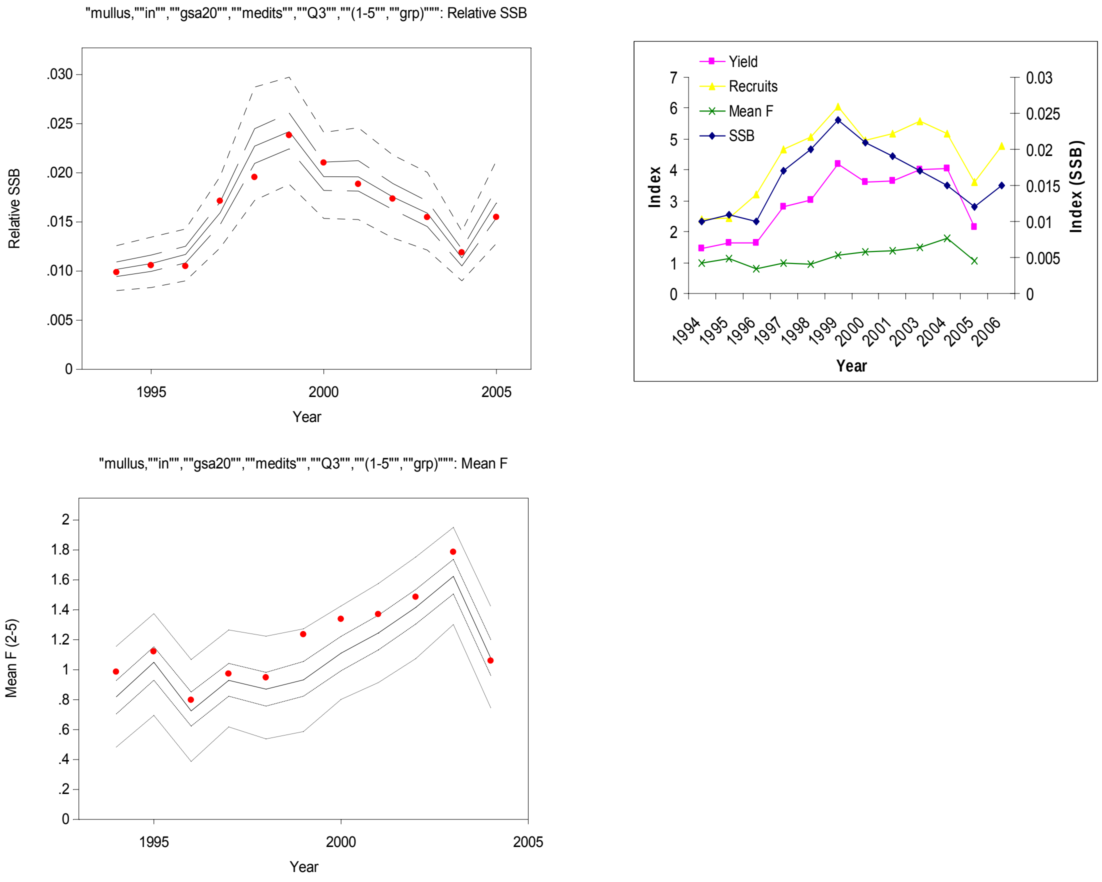


Fig. 7.27.4.1.3.1 Model diagnostics of the model fitted on red mullet (slow growth) in GSA 20.

Results obtained with SURBA 2.0 showed an adequate fitting of the model in red mullet data (slow growth) in GSA 20.


"mullus,""in"",""gsa20"",""medits"",""Q3"",""(1-5"",""grp)""": Relative SSB

"mullus,""in"",""gsa20"",""medits"",""Q3"",""(1-5"",""grp)""": Mean F

Fig. 7.27.4.1.3.2 Stock summary of the model fitted on red mullet (slow growth) in GSA 20.

An increase until 1999 and a decrease afterwards was observed in relative SSB, recruits and yield of red mullet (slow growth), with the exception of the year 2006 (for the recruits and SSB) where an increase was found. Mean F increased over the study period, with the exception of the last year where a decrease was recorded.

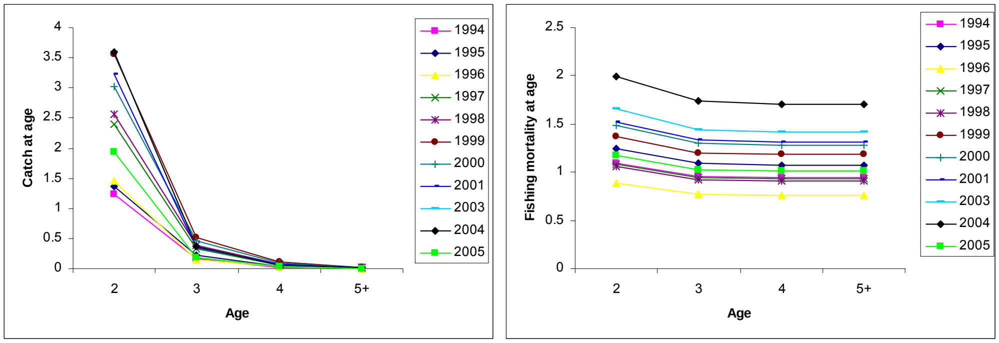


Fig. 7.27.4.1.3.3 Catch at age and fishing mortality at age of red mullet (slow) in GSA 20.

Most of red mullet was caught in the 2nd and 3rd age classes. Fishing mortality was rather stable with age.

Fast growth

7.27.4.1.4. *Results including sensitivity analyses (fast growth)*

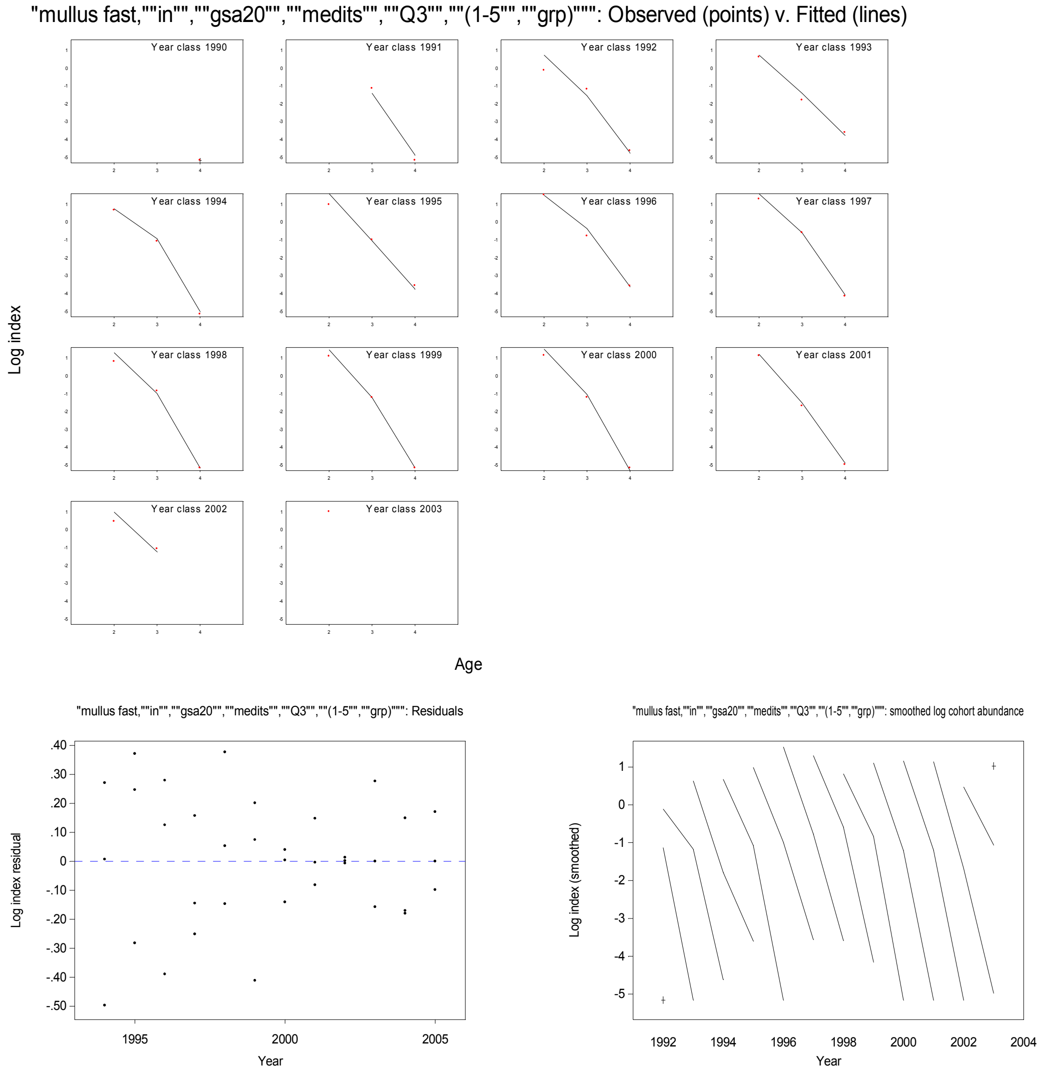


Fig. 7.27.4.1.3.4 Model diagnostics of the model fitted on red mullet (fast growth) in GSA 20.

Results obtained with SURBA 2.0 showed an adequate fitting of the model in red mullet data (fast growth) in GSA 20.

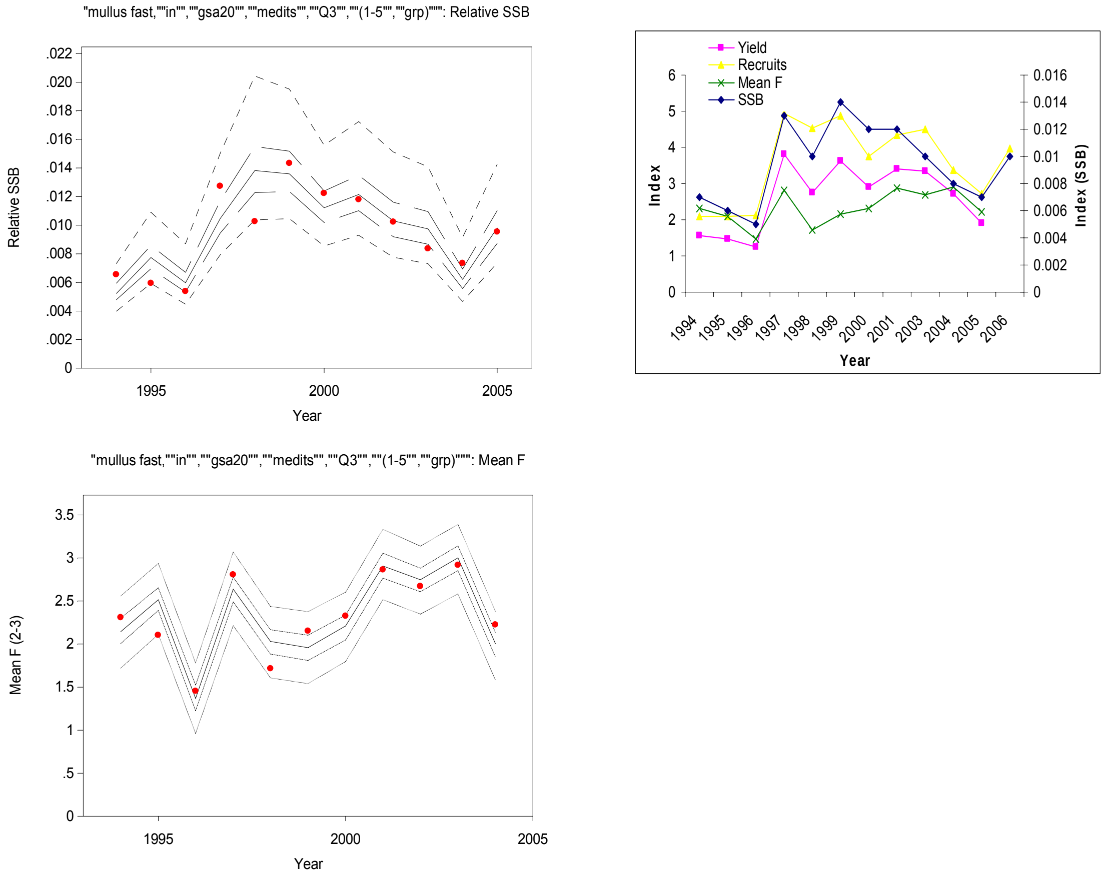


Fig. 7.27.4.1.3.5 Stock summary of the model fitted on red mullet (fast growth) in GSA 20.

An increase in 1994-1999 study period was recorded in relative SSB, recruits and yield and a decrease afterwards (with the exception of 1996 and 1998 where a decrease was observed). A decrease in 2000-2005 and an increase the last year where the characteristic of relative SSB, recruits and yield (except for yield which didn't existed the last year). Mean F increased in the periods 1994-1995, 1997 and 1999-2001. Higher values of mean F were recorded in 1997, 2000 and 2004.

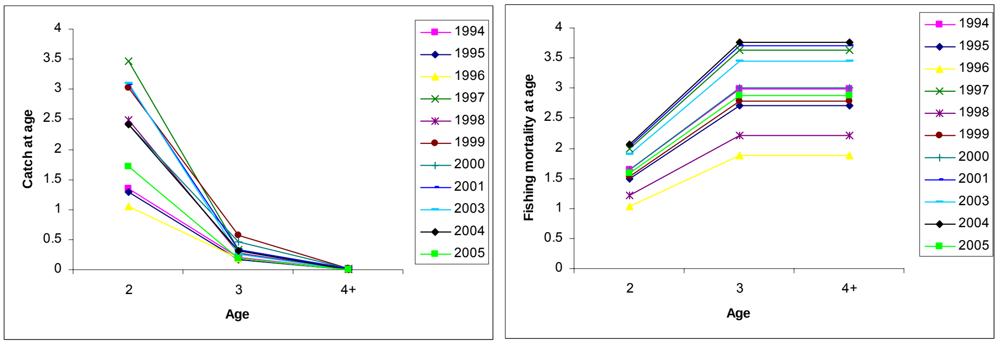


Fig. 7.27.4.1.3.6 Catch at age and fishing mortality at age of red mullet (fast) in GSA 20.

Most of red mullet was caught in the 2nd and 3rd age classes. Fishing mortality increased with age.

The data provided in the WG for the red mullet stock in GSA 20, were not sufficient to carry analytical assessment. For the red mullet stock, in GSA 20, the proportion of the nets was 89.4% in 2003 (higher value) and 66.3 in 2005 (lower value). Length data were not provided for the nets which is the main gear catching the species. The sampling effort on the landings of nets should be increased in the future in order to provide an accurate length distribution.

Length distribution of discards was not provided. However, the discards of the species are negligible, since only the damaged fish caught by nets are discarded. The discards for GNS in year 2003 and 2005 for the vessels <12 m should be re-estimated. The reported values are not reasonable taking into account that for this segment during 2004 no discards were reported and for the segment 12-24 there were negligible quantities for all the years.

The landings data should be recalculated and the rising factor for the nets fisheries should be corrected to the effective fishing effort (the effort targeting red mullet) and not the total effort of the small scale fisheries vessels of the area.

Assessment based only on scientific survey is rather difficult to be the basis for scientific advice for fisheries management. There are many factors affecting the performance of the sampling gear which are difficult to be measured, calibrated and regulated. Still there is an open discussion about the distribution of the data coming from scientific surveys and how they should be treated statistically.

In each model there are underlining assumptions. The length frequency used is assumed to be representative of the sampled population. Additionally, the distribution of the sampled population could vary from year to year (is depended on many factors, like abundance, environmental parameters, time of fishing etc) and there is a concern if the indices are always a precise estimation of the abundance.

Growth parameters are needed in order to translate the length to age and for red mullet there is no agreement between the scientists. The application of SURBA in GSA 20 using the fast and slow growth parameters resulted in considerable differences in the estimated fishing mortality but in both cases was rather high.

7.27.5. Short term prediction for 2008 and 2009

7.27.5.1. Justification

No forecast analyses were conducted.

7.27.5.2. Input parameters

No forecast analyses were conducted.

7.27.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 20.

7.27.6. Medium term prediction

7.27.6.1. Justification

No forecast analyses were conducted.

7.27.6.2. Input parameters

No forecast analyses were conducted.

7.27.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 20.

7.27.7. Long term prediction

7.27.7.1. Justification

No forecast analyses were conducted.

7.27.7.2. Input parameters

No forecast analyses were conducted.

7.27.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 09.

7.27.8. Scientific advice

7.27.8.1. Short term considerations

7.27.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.27.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.27.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.27.8.2. Medium term considerations

The juveniles are aggregated along the coasts in shallow waters. The enforcement of the regulations related to trawling restrictions near the coast and in shallow waters, as well as the MLS will be beneficial for the stock.

7.28. Stock assessment of red mullet in GSAs 22 and 23

7.28.1. Stock identification and biological features

7.28.1.1. Stock Identification

Red mullet is one of the most common and most valuable fish species in Greek Seas. The species is fished by bottom trawl and nets (mainly gill nets) in shallow-mid waters along the Greek coast. The stock is distributed mainly on muddy bottoms along the coast. Its depth distribution is limited in depths less than 200 m. However, is not abundant in water deeper than 150 m. Spawning occurs during spring-early summer. The juveniles of the species are concentrated in shallow waters (10-50 m). Part of the stock in GSA 22 (in the coasts of eastern Aegean) is exploited by the Turkish fleet..

7.28.1.2. Growth

The growth parameters for red mullet (combined sexes) were estimated for the GSAs 22-23 combined. The age interpretation was done by otoliths reading. Sampling was conducted from 2003 to 2005. The growth curve is as shown in Fig. 7.281.2.1.

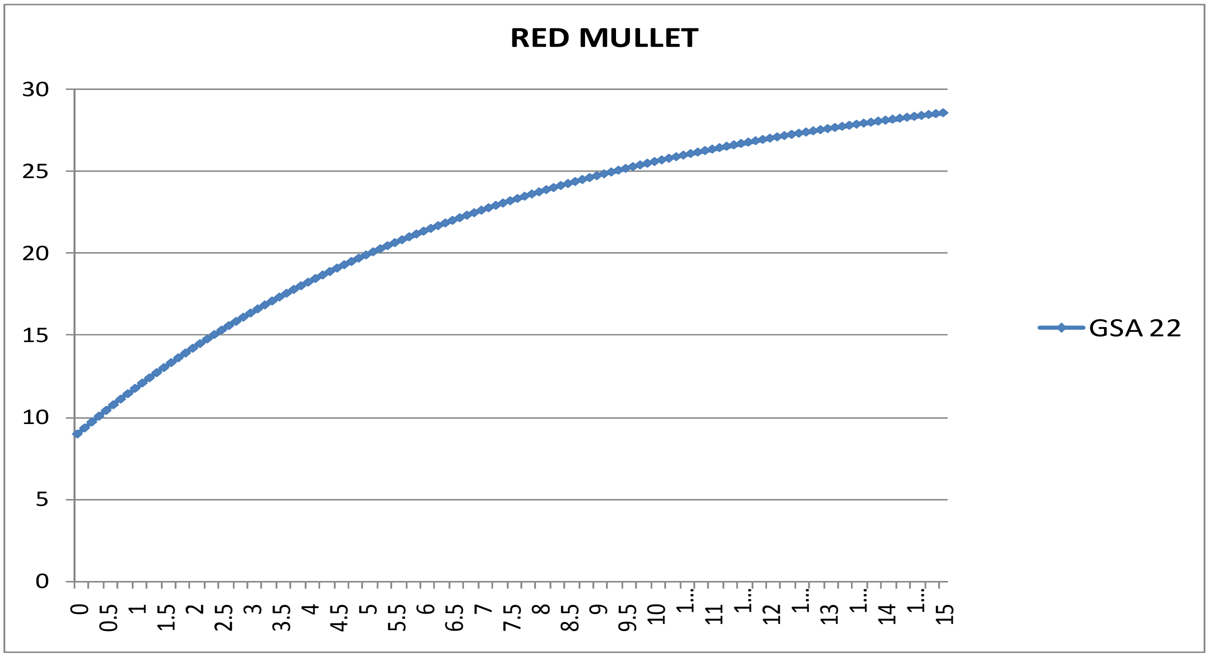


Fig. 7.281.2.1 V. Bertalanffy growth function of length (cm over ages.

During the discussion developed in the plenary, it was noticed that there is a large variability in the growth parameters even for the same GSA. In order for those discrepancies to be solved, a Workshop regarding the validation of growth parameters of red mullet is expected to be convened very shortly. For the purposes of the present assessments it was decided that parameters representing slow and fast growth in the whole Mediterranean will be used. These parameters are given in Table . 7.281.2.1.

Table 7.281.2.1. Growth parameters of red mullet representing slow and fast growth.

RED MULLET	**L_{inf} (cm)**	**k**	**t_0**
Slow growth	26,00	0,412	-0,4
Fast growth	34,50	0,336	-0,143

7.28.1.3. Maturity

The species achieves sexual maturity in the first year of life, having a length of 10-11 cm.

7.28.2. Fisheries

7.28.2.1. General description of fisheries

The main fishing gears targeting red mullet in GSA 22-23 are bottom trawls and gill nets. In some cases, trammel nets are used as well. According to the European and Greek Legislation, bottom trawls operate in waters deeper than 50 m or in a distance >3 miles from the coasts. Thus the gear is targeting the species in waters from the limit (as defined by the legislation) down to 150 m (or deeper but the abundance is not high so red mullet is not the target or one of the target species). Illegal fishing by bottom trawls was very common in the past (in waters < 50 m or in a distance less than 3 miles) and could be considered as harmful for the species. Nowadays, with the use of VMS the situation has been improved significantly but the problem still exists.

There is not depth limit or distance from the coasts restriction for the nets in Greece. However, the nets from October to May are mainly used in waters <50 m or in a distance <3 miles from the coasts. During summer, when bottom trawl fishery is closed, nets could be used in deeper waters. The mesh size is usually 36-44 mm but there are cases where smaller mesh size (32 or 34 mm) is used. Mesh sizes larger than 36 mm have no important impact on the juveniles. The optimum selection lengths were at 13.5 cm, 15 cm, 16.5 cm and 17 cm for the 34 mm, 38 mm, 42 mm and 44 mm nets respectively (Petrakis, 1998, SELMED Selectivity of fixed nets in Mediterranean EEC contract: 95/C/76/15,). There is a seasonal pattern of the red mullet net metier, which varies between different areas depending on the behaviour of the species and on the availability of other more profitable resources.

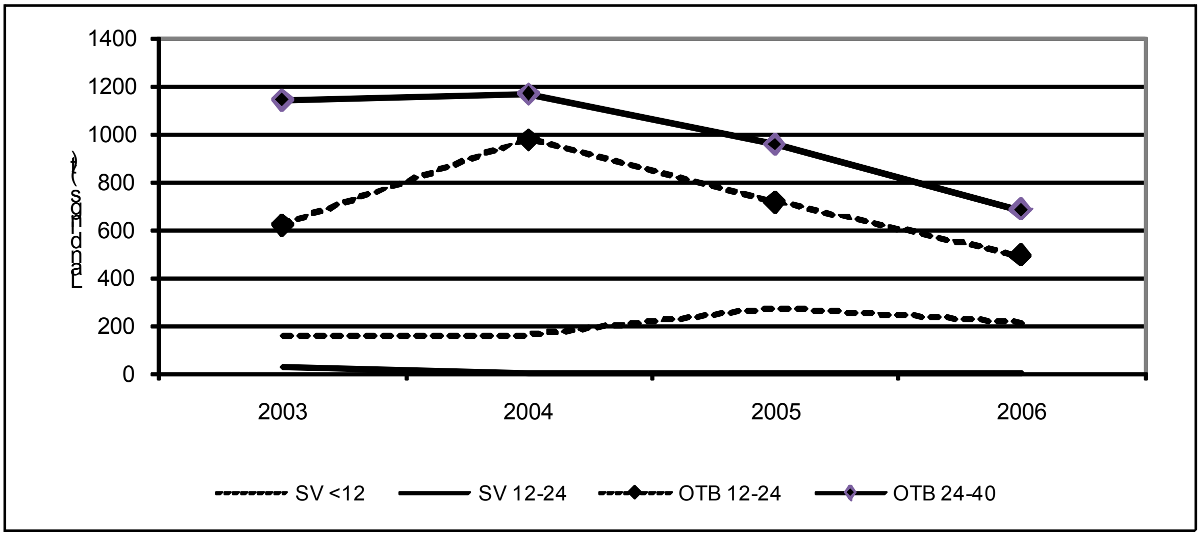
7.28.2.2. Management regulations applicable in 2007 and 2008

The MLS is 11 cm (according to EE 1967/2006 regulation). The most important measures for managing bottom trawl or net fisheries in Greece has been described in the section 7.14.2.2.

7.28.2.3. Catches

7.28.2.3.1. Landings

Estimation of landings was based on random sampling in 127 sampling stations (ports) in GSA 22-23. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type was randomly selected and landings by species recorded. Based on these data, average landings per fishing day, by species and for each fishing gear were estimated. Based on total effort estimations, sampled data were raised to the whole fleet to estimate total landings by species, fleet segment, fishing gear, and GSA.



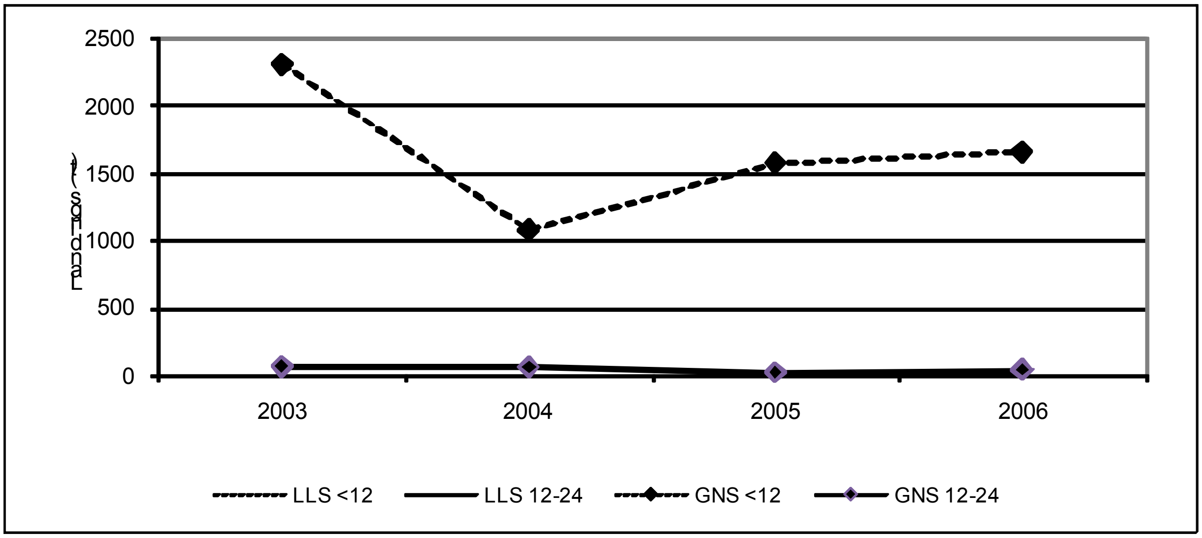


Fig. 7.28.2.3.1.1 Landings of red mullet in GSA 22-23.

Landings of red mullet in GSA 22-23 for the years 2003-2006 are presented in Fig. 7.28.2.3.1.1-2 and Tab. 7.28.2.3.1.1. The boat seine landings were quite constant and ranged between 166 to 285 tones. The nets landings, in 2003 were 2364 tones, the next year decreased to 1125 tones (52% reduction) the next year increased by 41% and in 2006 by 6%. The bottom trawl landings in 2004 increased by 22%, the next year decreased 22% and in the following year decreased by 29%. Significant fluctuations were observed in the proportion of each gear in the landings. These fluctuations are difficult to be explained taking into account that there were no similar fluctuations in the fishing effort (Fig. 7.28.2.3.1.2.2).

Tab. 7.28.2.3.1.1 Landings of red mullet by fishing technique, 2003-2006.

Gear	SV		OTB		GNS	
Year	Weight (t)	% of Total	Weight (t)	% of Total	Weight (t)	% of Total
2003	184	4.26	1769	40.98	2364	54.76
2004	166	4.82	2152	62.50	1125	32.67
2005	285	8.03	1679	47.28	1587	44.69
2006	218	7.07	1179	38.22	1688	54.72

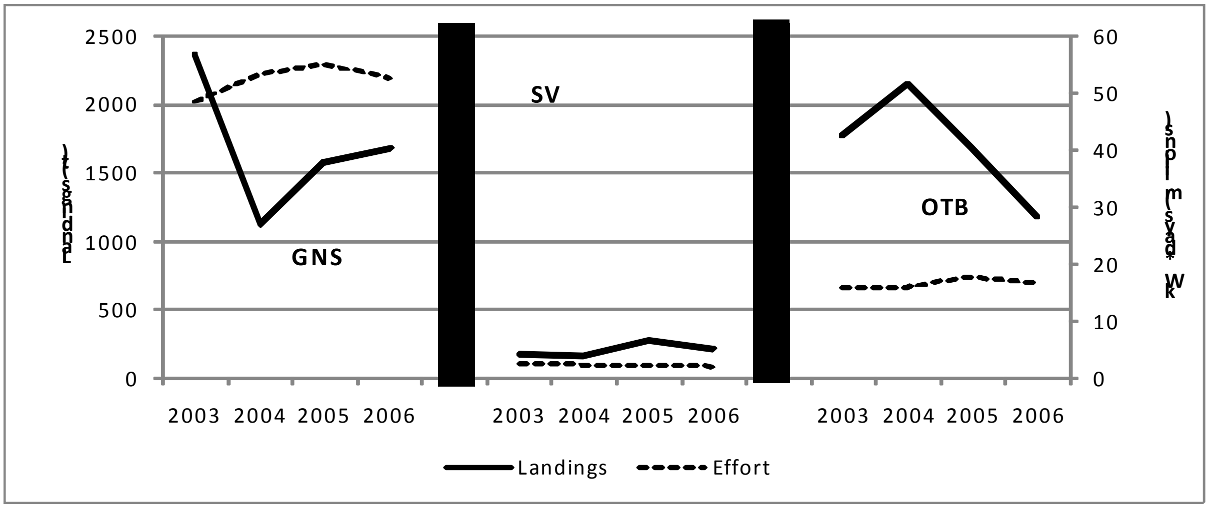


Fig. . 7.28.2.3.1.2.2 Landings and effort of red mullet by fishing technique, 2003-2006.

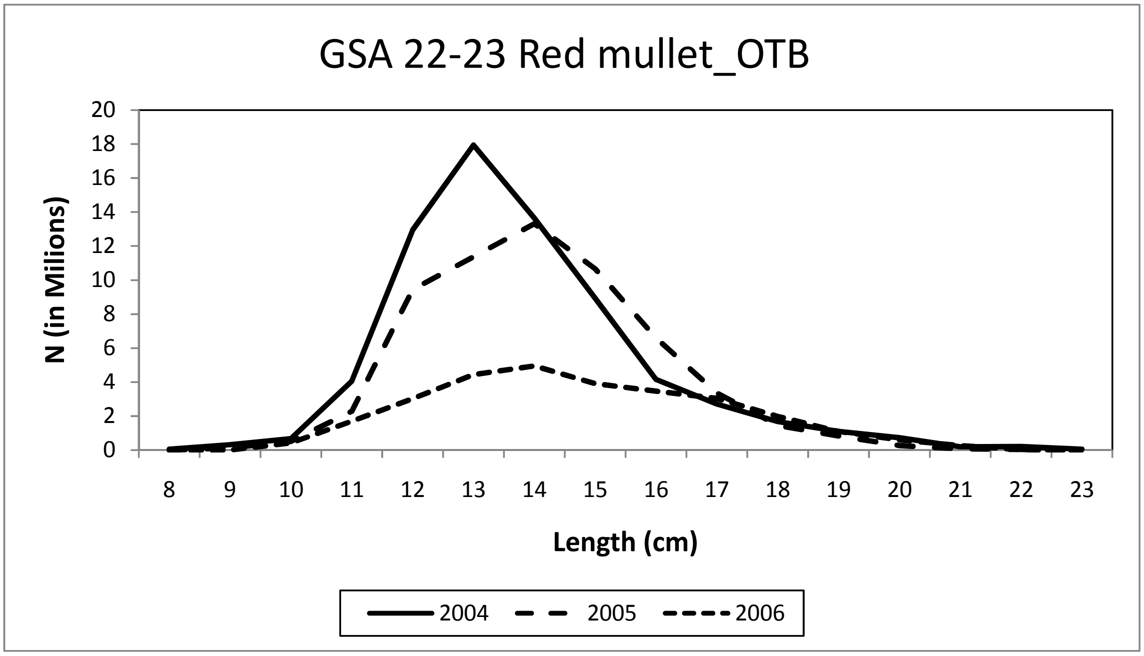


Fig. 7.28.2.3.1.2.3 Length frequency of the bottom trawl red mullet landings in GSA 22-23.

The length frequency distribution of the bottom trawl landings is presented in Fig. 7.28.2.3.1.2. Only a very small proportion of undersized specimens was reported (less than 0.5%).

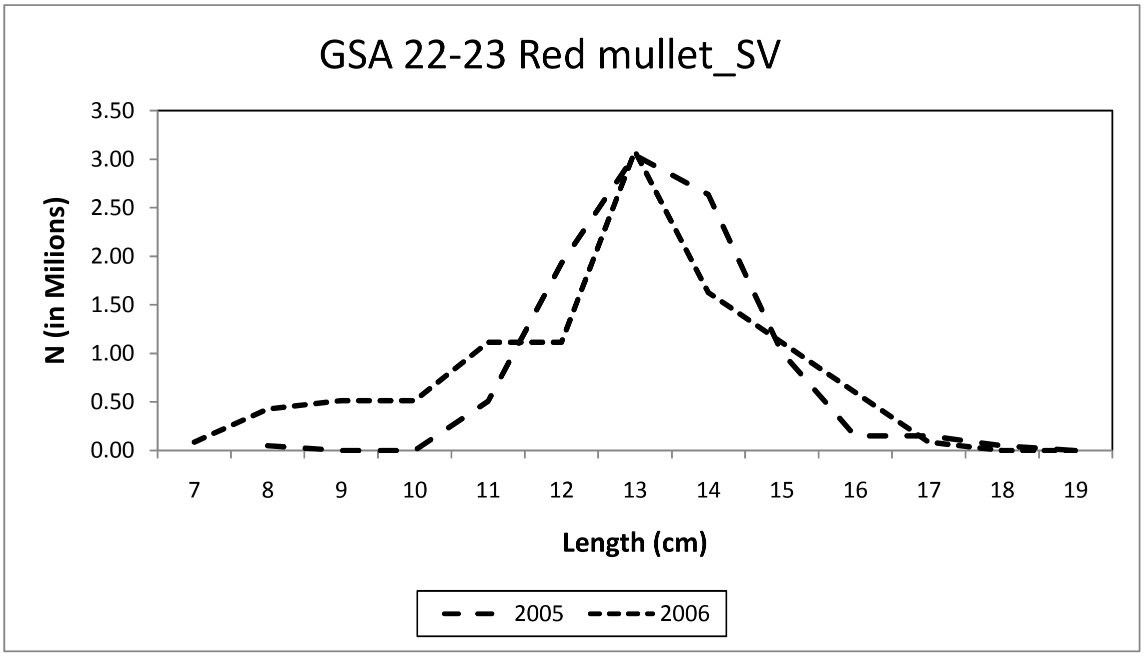


Fig. . 7.28.2.3.1.4 Length frequency of the boat seine red mullet landings in GSA 22-23.

The length frequency distribution of the boat seine landings is presented in Fig. . 7.28.2.3.1.4. The proportion of the undersized specimens was 0.5% in 2005 and 10% in 2006.

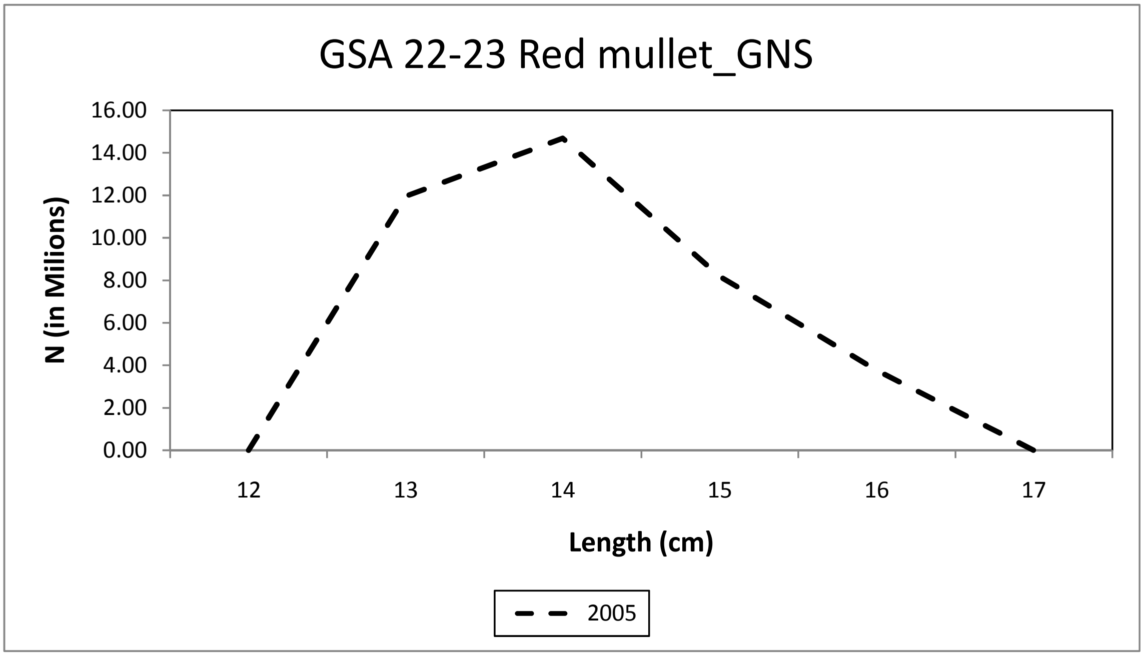


Fig. . 7.28.2.3.1.5. Length frequency of the nets red mullet landings in GSA 22-23.

The length frequency distribution of the nets landings is presented in Fig. . 7.28.2.3.1.5. All the specimens were above the MLS.

7.28.2.3.2. Discards

In Greece, the discards and landings of trawlers, purse-seiners, coastal vessels, and drifting longliners were estimated based on onboard sampling. Three times every year, sampling was conducted in GSA 22-23. Each time, catch, discards, and landings were recorded for each gear type and fleet segment. Based on this sampling, total discards were estimated by species, gear type, and GSA (Fig. 7.28.2.3.2.1).

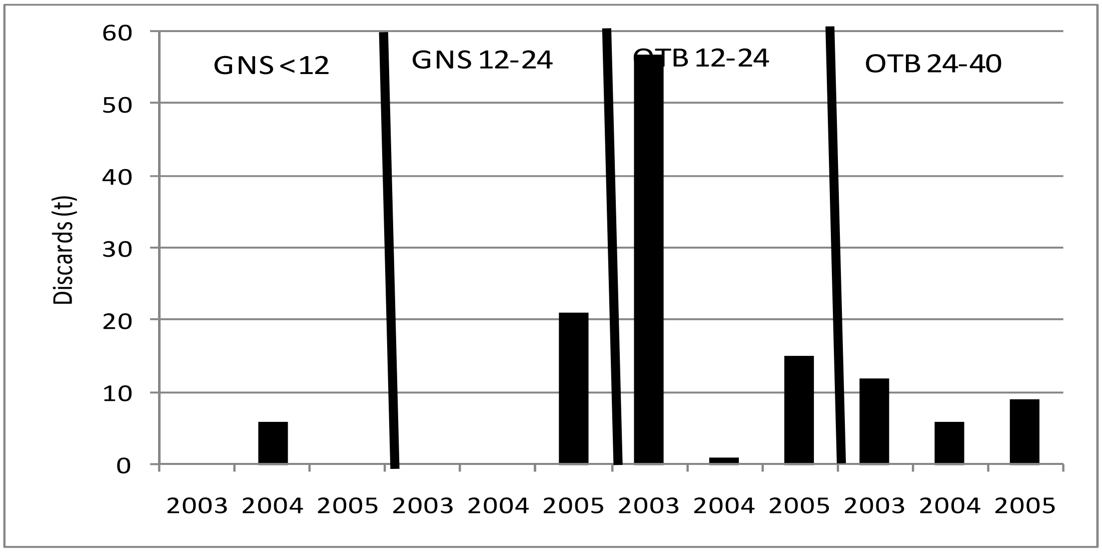


Fig. 7.28.2.3.2.1. Discards estimated for the years 2003-2005.

The ratio discards/landings was very high for the species in 2003 for the bottom trawl 12-24 m whereas in 2005 discards of nets (12-24 m fleet segment) were reported to be more than the landings (21 tones discards and 14 tones landings).

No length distribution of discards was available for Greece at the meeting SGMED-08-04.

Annual discards during 2003-2005 were reported to SGMED-08-03 and are listed in Tab. A3.6 of Appendix 3. Discards varied among 12 and 70 t per year (Tab.).

Table 7.28.2.3.2.1 Annual discards (t) by fishing technique in GSAs 22 and 23 as reported to SGMED-08-03 through the DCR data call, 2003-2005.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	22-23	GRE	GNS		0	6	21		
MUT	22-23	GRE	OTB		70	6	20		
SUM					70	12	41		

7.28.2.3.3. Fishing effort

Estimation of effort was based on interviews conducted with random sampling in 127 sampling stations (ports) in GSA 22-23. Sampling was conducted on a monthly basis at each sampling station, where a sufficient number of vessels from each fleet segment and gear type were randomly selected and effort was recorded. In addition, all fishing vessels present in the sampling stations were categorized as full-time, part-time, occasionally fishing, or inactive, and the proportion of the year they were active was estimated. Based on this information, sampled data were raised to the whole fleet to estimate total effort per fleet segment, fishing gear, and GSA.

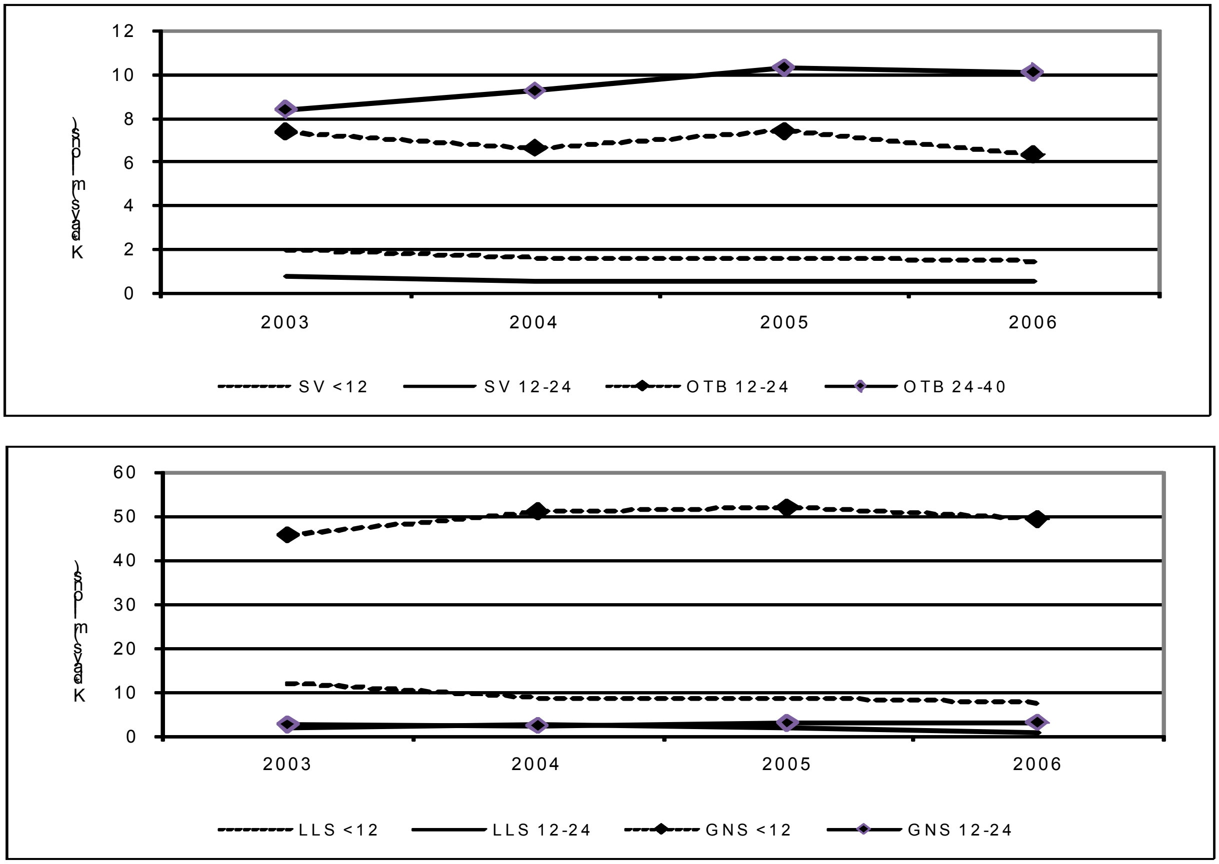


Fig. 7.28.2.3.3.1 Fishing effort per fleet segment in GSA 22-23.

The fishing effort of the small bottom trawlers (12-24 m), of small gill netters (<12 m) and of the longliners decreased whereas the effort of the big bottom trawlers and gill netters increased (Fig. 7.28.2.3.3.1).

Tab. 7.28.2.3.3.1 lists the effort by fishing technique deployed in GSAs 22 and 23 as reported to SGMED-08-03 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3. During 2003-2006, the dominating gill nets and demersal otter trawls do not display a significant trend.

Tab. 7.20.2.3.3.1 Effort trends by fishing technique in GSAs 22-23, 2003-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	22-23	GRE	GNS		1499507	1445880	1529002	1479134	
DAYS	22-23	GRE	LLS		381095	295005	315854	253335	
DAYS	22-23	GRE	OTB		52536	53389	56580	52831	
DAYS	22-23	GRE	SV		36266	31987	33200	30098	
GT*DAYS	22-23	GRE	GNS		5837915	5675508	5782002	5610405	
GT*DAYS	22-23	GRE	LLS		1762101	1660263	1602486	1323112	
GT*DAYS	22-23	GRE	OTB		4927349	4971783	5553804	5554194	
GT*DAYS	22-23	GRE	SV		294896	269645	276265	257271	
KW*DAYS	22-23	GRE	GNS		48227268	53304432	54981971	52423637	
KW*DAYS	22-23	GRE	LLS		14158502	11416302	10631705	8283337	
KW*DAYS	22-23	GRE	OTB		15792715	15877180	17730748	16402915	
KW*DAYS	22-23	GRE	SV		2775797	2206815	2193550	2022231	

7.28.3. Scientific surveys

7.28.3.1.Medits

7.28.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSAs 22 and 23 the following number of hauls were reported per depth stratum (s. Tab. 7.28.3.1.1.1).

Tab. 7.20.3.1.1.1. Number of hauls per year and depth stratum in GSAs 22 and 23, 1994-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA22+23_010-050	10	10	11	10	13	12	13	13		13	13	14	14	
GSA22+23_050-100	17	21	22	28	24	26	21	25		25	23	24	24	
GSA22+23_100-200	19	25	37	36	36	33	37	35		36	43	41	41	
GSA22+23_200-500	28	35	44	50	51	51	50	48		51	52	52	52	
GSA22+23_500-800	18	12	19	21	22	21	20	17		17	16	17	16	

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma\ (Yi*Ai)\ /\ A$$

$$V(Yst) = \Sigma\ (Ai^2 * si^2\ /\ ni)\ /\ A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.28.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.28.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSAs 22 and 23 was derived from the international survey Medits. Figure 7.28.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSAs 22 and 23.

After a significant increase in abundance until 1999 and in Biomass until 2001, the estimated indices decreased again to a low level in 2005-2006. The analyses of Medits indices are considered preliminary.

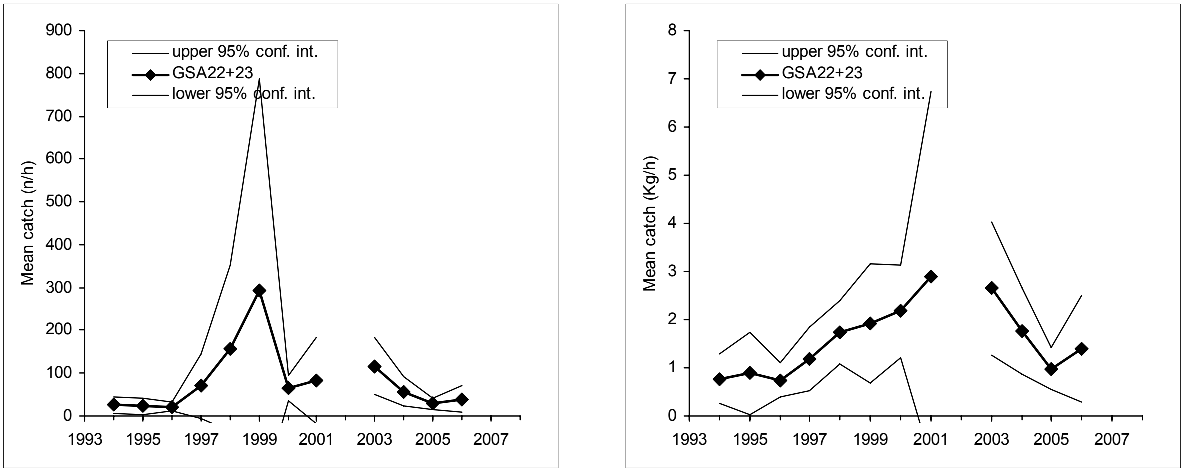


Fig. 7.20.3.1.3.1 Abundance and biomass indices of red mullet in GSAs 22 and 23.

7.28.3.1.4. Trends in abundance by length or age

The following Fig. 7.28.3.1.4.1 and 2 display the stratified abundance indices of GSAs 22 and 23 in 1994-2001 and 2002-2006. These size compositions are considered preliminary.

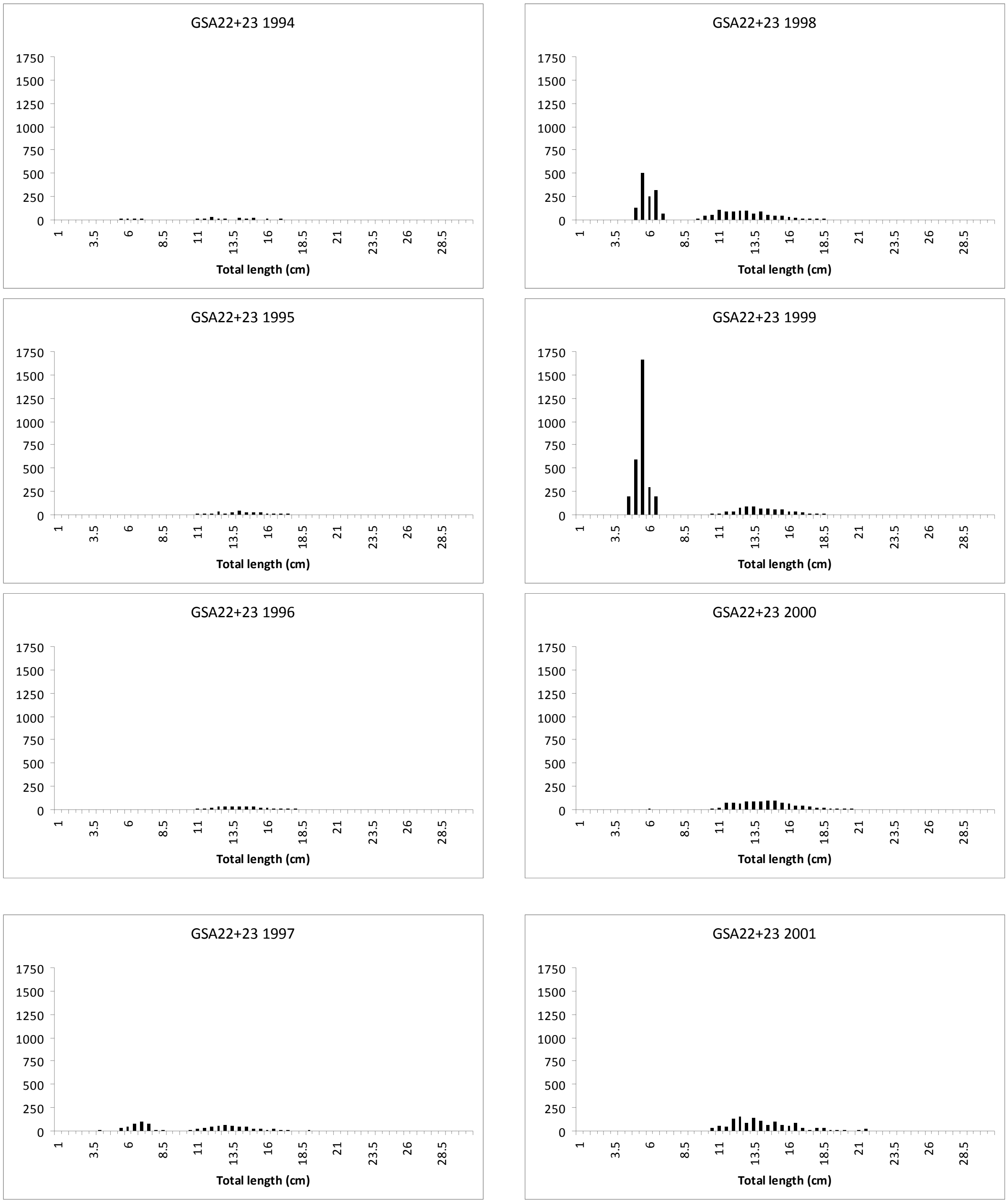


Fig. 7.28.3.1.4.1 Stratified abundance indices by size, 1994-2001.

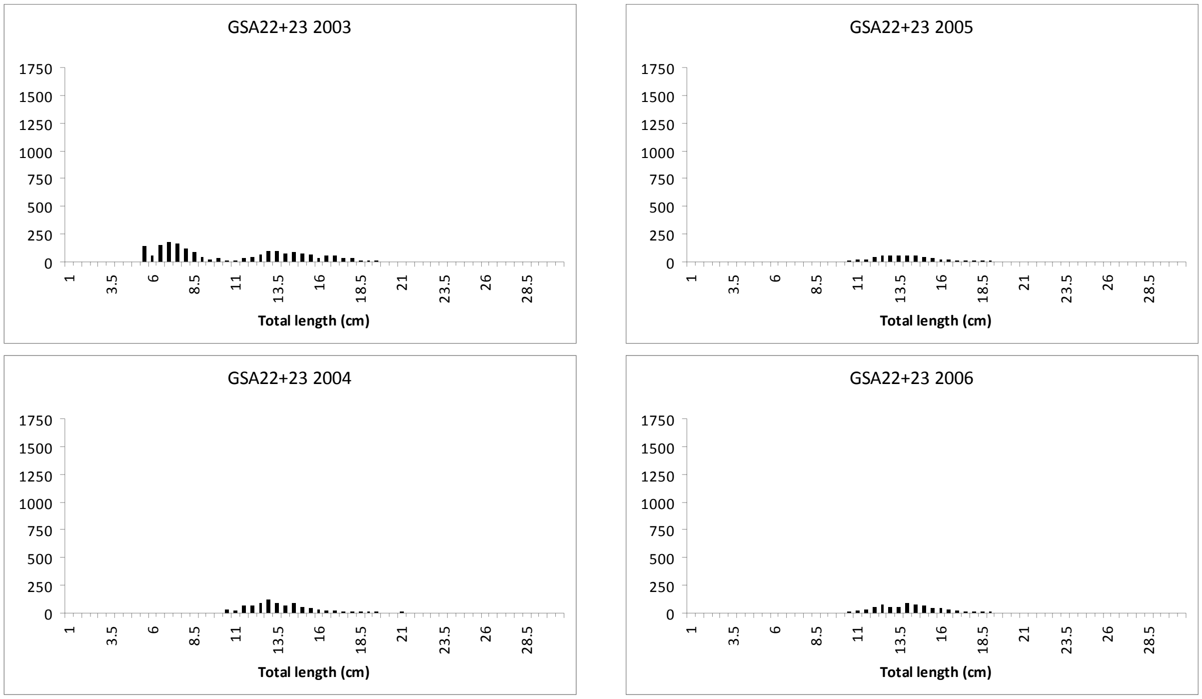


Fig. 7.28.3.1.4.2 Stratified abundance indices by size, 2003-2007.

7.28.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.28.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.28.4. Assessment of historic stock parameters

7.28.4.1. Method 1: SURBA (Survey Based Assessment)

7.28.4.1.1. Justification

Some of the requested data in the official data call were not provided by Greece in time for the SGMED 08-03 meeting. No data on length distribution of the landings, age distribution of the landings, maturity ogive for males, sex ratio at length, and discards length distribution were available. Due to this lack of available data, many of the methods for stock assessment proposed in the previous meetings of SGMED could not be applied. Therefore, the MEDITS data (1994-2004) were surveyed with the use of the software SURBA.

Two growth patterns were assumed in order to apply the SURBA method the slow and the fast growth.

7.28.4.1.2. Input parameters

Slow growth:

The data needed for SURBA are estimates of natural morality at age, proportion mature at age and stock weights at age. MEDITS survey data (1994-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters (slow growth)

Linf	26
k	0.412
to	-0.4

Weight-length relationship

a (W-L)	0.0000043
b (W-L)	3.18

Length at age

1	11.40
2	16.33
3	19.59
4	21.76
5+	23.19

Mortality at age

	2	3	4	5+
1994	0.66	0.55	0.49	0.46
1995	0.66	0.55	0.49	0.46
1996	0.66	0.55	0.49	0.46
1997	0.66	0.55	0.49	0.46
1998	0.66	0.55	0.49	0.46
1999	0.66	0.55	0.49	0.46
2000	0.66	0.55	0.49	0.46
2001	0.66	0.55	0.49	0.46
2003	0.66	0.55	0.49	0.46
2004	0.66	0.55	0.49	0.46
2005	0.66	0.55	0.49	0.46
2006	0.66	0.55	0.49	0.46

Mature at age

	2	3	4	5+
1994	0.70	1	1	1
1995	0.70	1	1	1
1996	0.70	1	1	1
1997	0.70	1	1	1

1998	0.70	1	1	1
1999	0.70	1	1	1
2000	0.70	1	1	1
2001	0.70	1	1	1
2003	0.70	1	1	1
2004	0.70	1	1	1
2005	0.70	1	1	1
2006	0.70	1	1	1

Fast growth:

The data needed for SURBA are estimates of natural morality at age, proportion mature at age and stock weights at age. MEDITS survey data (1995-2006) were used to estimate F and relative SSB and abundance at age using SURBA 2.0 software. The variables used in the analysis were:

Growth parameters (fast growth)

Linf	34.5
k	0.336
to	-0.143

Weight-length relationship

a (W-L)	0.0000037
b (W-L)	3.22

Length at age

1	11.00
2	17.71
3	22.50
4	25.92
5+	28.37

Mortality at age

	2	**3**	**4**	**5+**
1995	0.66	0.55	0.49	0.46
1996	0.66	0.55	0.49	0.46
1997	0.66	0.55	0.49	0.46
1998	0.66	0.55	0.49	0.46
1999	0.66	0.55	0.49	0.46
2000	0.66	0.55	0.49	0.46
2001	0.66	0.55	0.49	0.46
2003	0.66	0.55	0.49	0.46
2004	0.66	0.55	0.49	0.46
2005	0.66	0.55	0.49	0.46
2006	0.66	0.55	0.49	0.46

Mature at age

	2	3	4	5+
1995	0.7	1	1	1
1996	0.7	1	1	1
1997	0.7	1	1	1
1998	0.7	1	1	1
1999	0.7	1	1	1
2000	0.7	1	1	1
2001	0.7	1	1	1
2003	0.7	1	1	1
2004	0.7	1	1	1
2005	0.7	1	1	1
2006	0.7	1	1	1

7.28.4.1.3. Results

Slow growth:

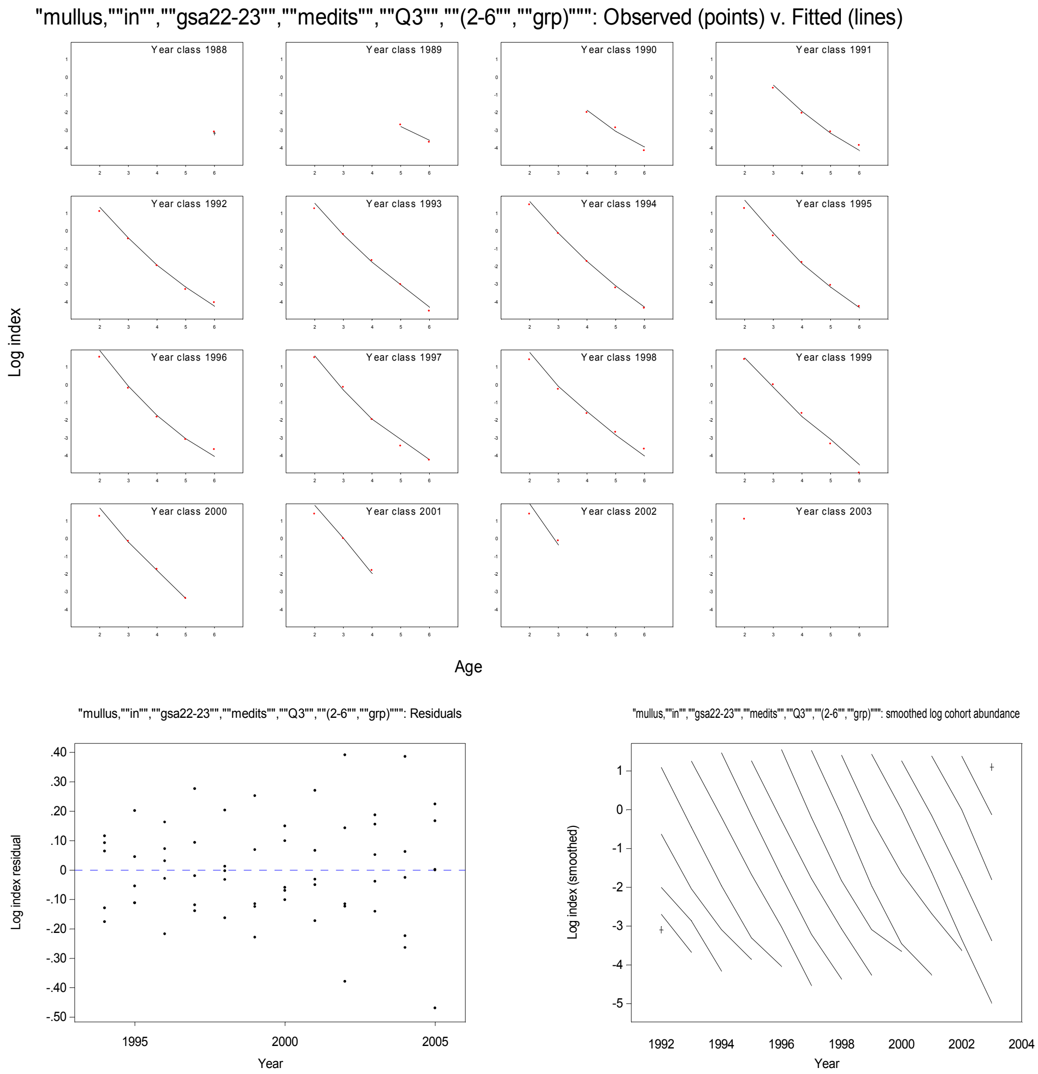


Fig. 7.28.4.1.3.1 Model diagnostics of the model fitted on red mullet (slow growth) in GSAs 22, 23.

Results obtained with SURBA 2.0 showed an adequate fitting of the model in red mullet (slow growth) data in GSAs 22, 23.

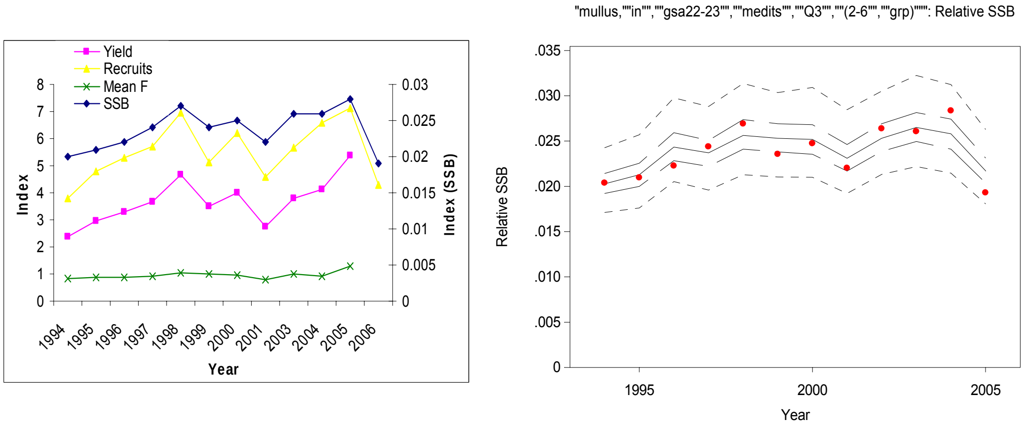


Fig. 7.28.4.1.3.2 Stock summary of the model fitted on red mullet (slow growth) in GSAs 22, 23.

An increase on yield, recruits, mean F and relative SSB was observed for red mullet (slow), with the exception of the last year (in recruits and relative SSB) where a decrease was recorded.

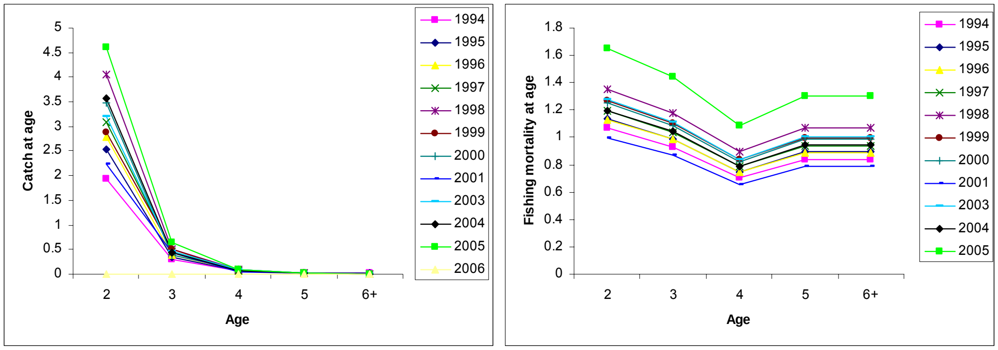


Fig. 7.28.4.1.3.3 Catch at age and fishing mortality at age of red mullet (slow growth) in GSAs 22, 23.

Most of red mullet was caught in the 2nd and 3rd age classes. Fishing mortality decreased until the forth class and then increased.

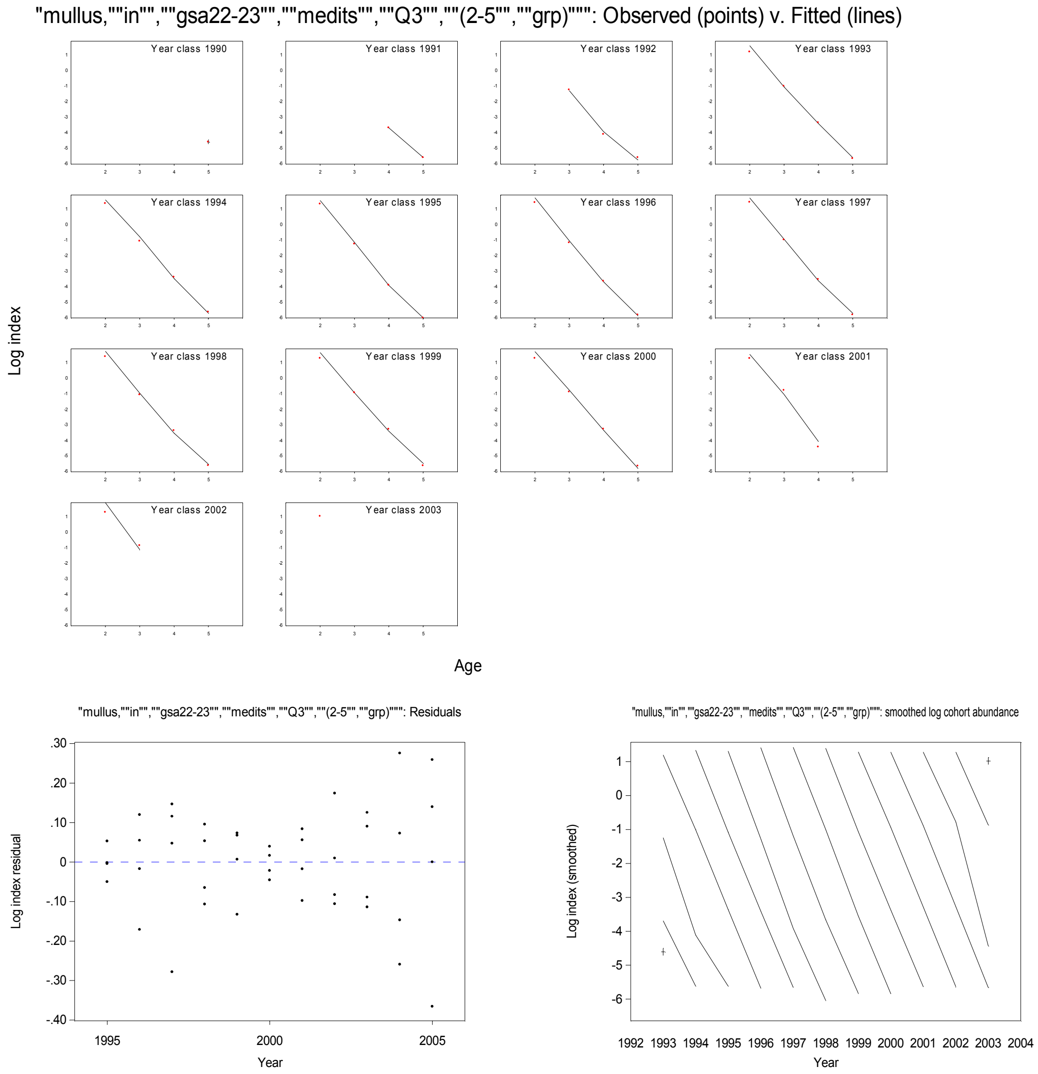


Fig. 7.28.4.1.3.4 Model diagnostics of the model fitted on red mullet (fast growth) in GSAs 22, 23.

Results obtained with SURBA 2.0 showed an adequate fitting of the model in red mullet (fast growth) data in GSAs 22, 23.

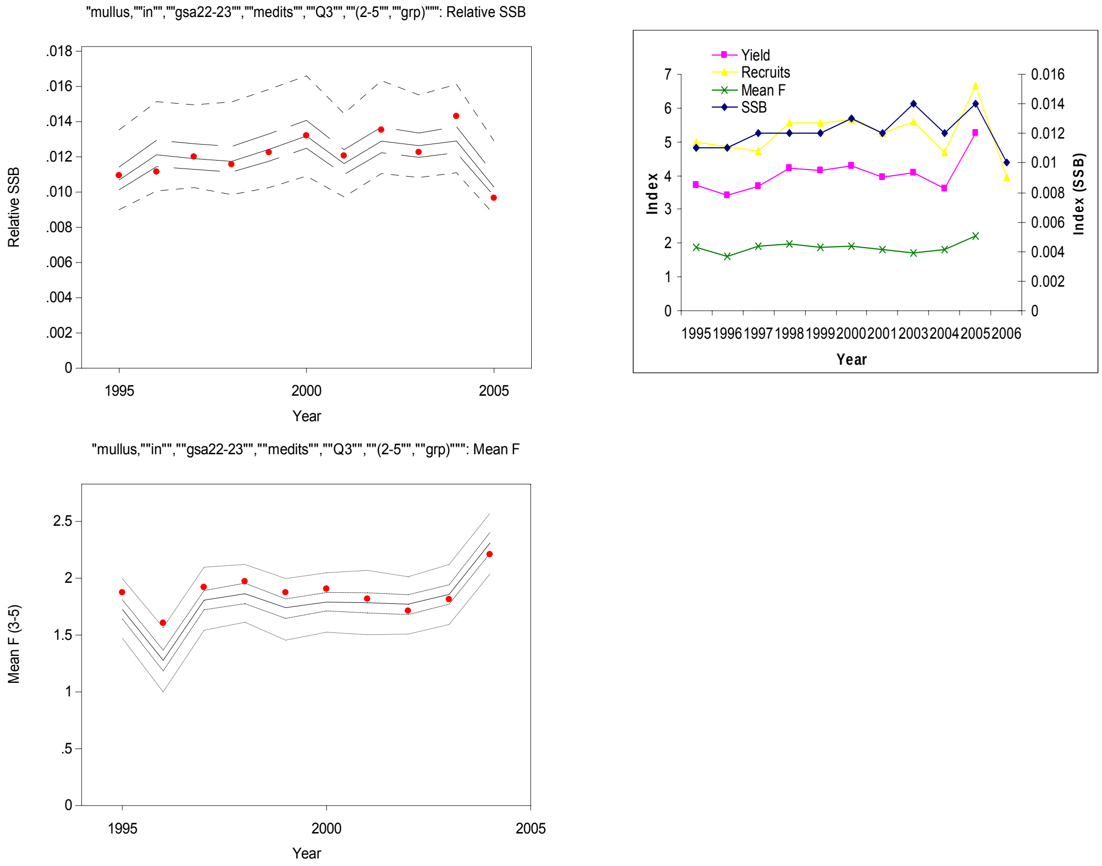


Fig. 7.28.4.1.3.5 Stock summary of the model fitted on red mullet (fast growth) in GSAs 22, 23.

Relative SSB, yield, recruits and mean F of red mullet (fast growth) were slightly increased through the study period, except for relative SSB and recruits which decreased in 2006.

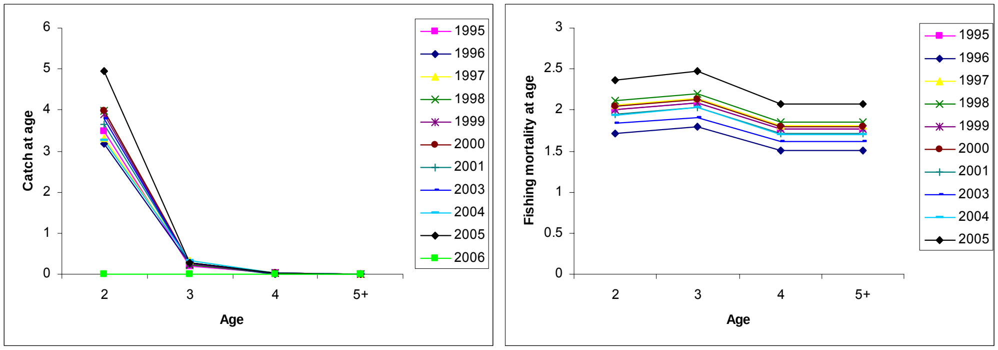


Fig. 7.28.4.1.3.5 Catch at age and fishing mortality at age of red mullet (fast growth) in GSAs 22, 23.

Most of red mullet was caught in the 2nd age class. Fishing mortality showed a small decrease with age.

The data provided in the WG for the red mullet stock in GSA 22-23, were not sufficient to carry analytical assessment. Length data were not provided for the nets which is the main gear catching the species. The sampling effort on the landings of nets should be increased in the future in order to provide an accurate length distribution.

Length distribution of discards was not provided. However, the discards of the species are negligible, since only the damaged fish caught by nets are discarded. For the year 2005 the discards of the 12-24 m fleet segment were reported to be more than the landings.

The landings data should be recalculated and the rising factor for the nets fisheries should be corrected to the effective fishing effort (the effort targeting red mullet) and not the total effort of the small scale fisheries vessels of the area.

Assessment based only on scientific survey is rather difficult to be the basis for scientific advice for fisheries management. There are many factors affecting the performance of the sampling gear which are difficult to be measured, calibrated and regulated. Still there is an open discussion about the distribution of the data coming from scientific surveys and how they should be treated statistically.

In each model there are underlining assumptions. The length frequency used is assumed to be representative of the sampled population. Additionally, the distribution of the sampled population could vary from year to year (is depended on many factors, like abundance, environmental parameters, time of fishing etc) and there is a concern if the indices are always a precise estimation of the abundance.

Growth parameters are needed in order to translate the length to age and for red mullet there is no agreement between the scientists. The application of SURBA in GSA 22-23 using the fast and slow growth parameters resulted in considerable differences in the estimated fishing mortality but in both cases was rather high.

7.28.5. Short term prediction for 2008 and 2009

7.28.5.1. Justification

No forecast analyses were conducted.

7.28.5.2. Input parameters

No forecast analyses were conducted.

7.28.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSAs 22 and 23.

7.28.6. Medium term prediction

7.28.6.1. Justification

No forecast analyses were conducted.

7.28.6.2. Input parameters

No forecast analyses were conducted.

7.28.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSAs 22 and 23.

7.28.7. Long term prediction

7.28.7.1. Justification

No forecast analyses were conducted.

7.28.7.2. Input parameters

No forecast analyses were conducted.

7.28.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSAs 22 and 23.

7.28.8. Scientific advice

7.28.8.1. Short term considerations

7.28.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.28.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.28.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.28.8.2. Medium term considerations

Red mullet spawns in small size and in the first year of life. The juveniles are aggregated along the coasts in shallow waters. The enforcement of the regulations related to trawling restrictions near the coast and in shallow waters, as well as the MLS will be beneficial for the stock.

7.29. Stock assessment of red mullet in GSA 25

7.29.1. Stock identification and biological features

7.29.1.1. Stock Identification

The red mullet is a common demersal fish in the Mediterranean Sea found in depths ranging from 10-200 meters. Inhabits sandy and muddy bottoms.

The fishing grounds of GSA 25 are characterized by a limited coastal shelf and a deep slope existing around most of the coast of Cyprus[1]. The substrate is characterized by various types of sediment; hard bottom predominates in the southwestern and eastern part of the island, while in the south-eastern part muddy and sandy bottoms are equally extensive. The salinity around Cyprus waters, as in the whole Levantine Sea, is about 39‰, the highest value in the Mediterranean and among the highest in the world.

Close to the surface, a seasonal pattern occurs with temperature reaching a maximum value of 29-30°C, during summer, and a minimum value of 16°C, during winter. The surface temperature remains stable around the island, except for an area at the south-western side, where waters during summer have an average temperature of 23-24 °C, possibly due to the existence of a local upwelling. In most areas a seasonal thermocline is formed during summer at a depth ranging from 20 to 30m. The temperature below the thermocline is around 18 °C.

The spawning season of red mullet in GSA 25 ranges from April to August with spawning peak in the months May-June[2].

7.29.1.2. Growth

The growth parameters of red mullet were provided by the Cyprus authorities, according to the data call[3]. It was decided during SGMED-08-04 that the biological parameters in regard to the different GSAs should be discussed. The growth parameters to be used in the assessment of red mullet were set during the meeting (see Tab. 7.29.1.2.1).

Table 7.29.1.2.1 V. Bertalanffy growth, length-weight relation parameters and coefficients of natural mortlity rates.

Species	**Param. set**	**L_{inf} (cm)**	**K**	**T_0**	**a**	**b**	**M Djabali**
M. barbatus	Upper	34.5	0.34	-0.143	0.0081	3.113	0,40644
	Lower	26.01	0.41	-0.4			0,22530
	Cyprus	26,01	0,2025	-1.688			0,48874

7.29.1.3. Maturity

The maturity of red mullet was provided[4] (see Fig. 7.29.1.3.1, Tab. 7.16.2). The method used was the Nikolski scale, (Individuals >stage 2 are considered mature, only reproductive months were taken into account. 2005 data derive only from Medits survey).

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[1] Assessment of indicator trends related to exploited demersal fish populations and communities in the Mediterranean p.148, http://www.ifremer.fr/docelec/doc/2007/rapport-2198.pdf

[2] Data call 2008, Cyprus data (06_MED_GRO)

[3] Brussels, 15 May 2008,DGMARE (2008) n° 5332, Official call for data on landings, catches, length and age compositions, effort and trawl surveys in the Mediterranean

[4] Data Request Call (FILE 5-M05_MED_MAT, MATURITY_AT_LENGTH)

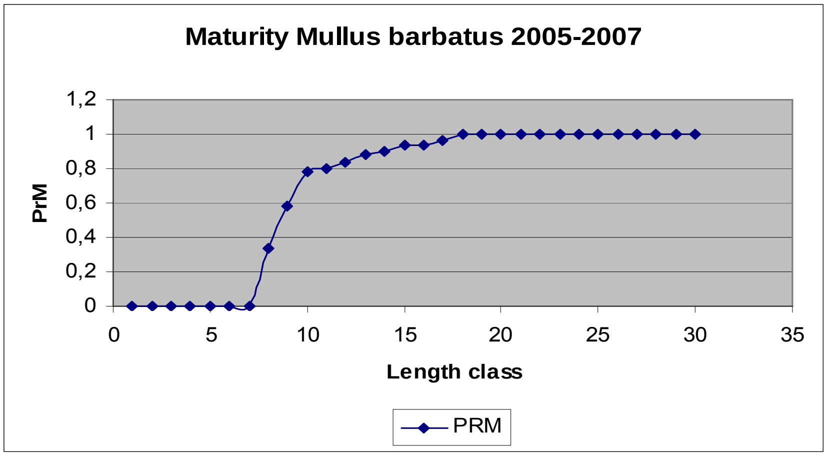

Fig. 7.29.1.3.1 Maturity at length of *Mullus barbartus*.

7.29.2. Fisheries

7.29.2.1.General description of fisheries

GSA 25 covers the area around the island of Cyprus (*official data available from areas under the control of the Cyprus Government*). It is noted that since 1974 important fishing grounds became inaccessible to the Government of the Cyprus Republic. The available fishing grounds were reduced from 846 to 507 square miles[5], leading to a dramatic increase of fishing intensity (fishing effort per square mile) in the remaining accessible fishing grounds.

The landing ports of Cyprus are categorized into ports and fishing shelters. The two main ports were catches of trawlers are landed are the ports of Larnaca and Limassol. Artisanal vessels (small scale inshore vessels) land their catch in fishing shelters.

The Cyprus fishing fleet operating in GSA 25 is categorized into the following segments:

- the small scale inshore boats,
- the polyvalent vessels,
- bottom trawlers,
- recreational vessels.

The small scale inshore boats, with an overall length between 6 - 12m, operate with passive polyvalent gears, mainly with bottom set nets and bottom longlines, targeting demersal species.

The polyvalent vessels have an overall length between 12 - 24 m and operate with passive polyvalent gears. The term “polyvalent vessels” is used because these vessels are engaged in two fisheries; mainly in the large pelagic fishery using drifting longlines and operating around Cyprus waters and the eastern Mediterranean (*targeting swordfish, bluefin tuna and albacore*), but also in the inshore demersal fishery using mostly bottom set nets and bottom longlines.

The bottom trawlers have an overall length between 21-27 m and are categorized, based on their type of license, in those fishing in the territorial waters of Cyprus and those fishing in international waters (eastern and central Mediterranean).

Recreational fishing vessels are not authorized to used various gear such as surface longlines, nets according to Article 17 “Leisure fisheries” of Council Regulation 1967/2006.

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[5] **CYPRUS Management Plan for Bottom Trawling**

7.29.2.2. Management regulations applicable in 2007 and 2008

From November 2004, following the accession of Cyprus in the EU and the implementation of Community Law, the new fishing season included the requirements of the Mediterranean Regulation (EC) 1626/1994:

- minimum landing sizes,
- increase of cod-end mesh size from 34 mm (diamond shape) to 40 mm (diamond shape)

There is a closed trawling period applied for the territorial waters of Cyprus, from 1st of June to the 7th of November, set in the National Legislation. The closed period has been put into force since the mid `80s. All the minimum landing sizes provided by Annex III of the Mediterranean Regulation (EC) No 1967/2006 are applied. Furthermore, trawlers are not allowed to operate in waters that are shallower than 50 meters, as it was provided by the Mediterranean Regulation, 1626/1994. The fishing effort adjustment management plan is included during the Operational Program for Fisheries 2007 – 2013 having as a priority the withdrawal of all bottom trawlers that are active in the territorial waters of Cyprus.

There are no closed fishing periods for the artisanal vessels operating in the territorial waters of Cyprus.

7.29.2.3. Catches

7.29.2.3.1. Landings

The Cyprus bottom trawl, polyvalent and artisanal fishery target a mix of demersal species, as it is the case in all Mediterranean demersal fisheries. The exploited stocks are not shared with other counties' fleets. Landings[6] are mainly composed of *Spicara* spp., *Boops boops*, *Mullus barbatus*, *M. surmuletus*, *Pagellus erythrinus* and cephalopods (*Octopus vulgaris*, *Eledone moschata*, *Loligo vulgaris* and *Sepia officinalis*). The inshore fishery catches also catch quantities of *Diplodus* spp, *Sparisoma cretense* and *Siganus* spp.

The composition of the landings of the two fisheries during the last 5 years (2002-2006) is provided in Figure 7.29.2.3.1.1.

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[6] **CYPRUS Management Plan for Bottom Trawling**

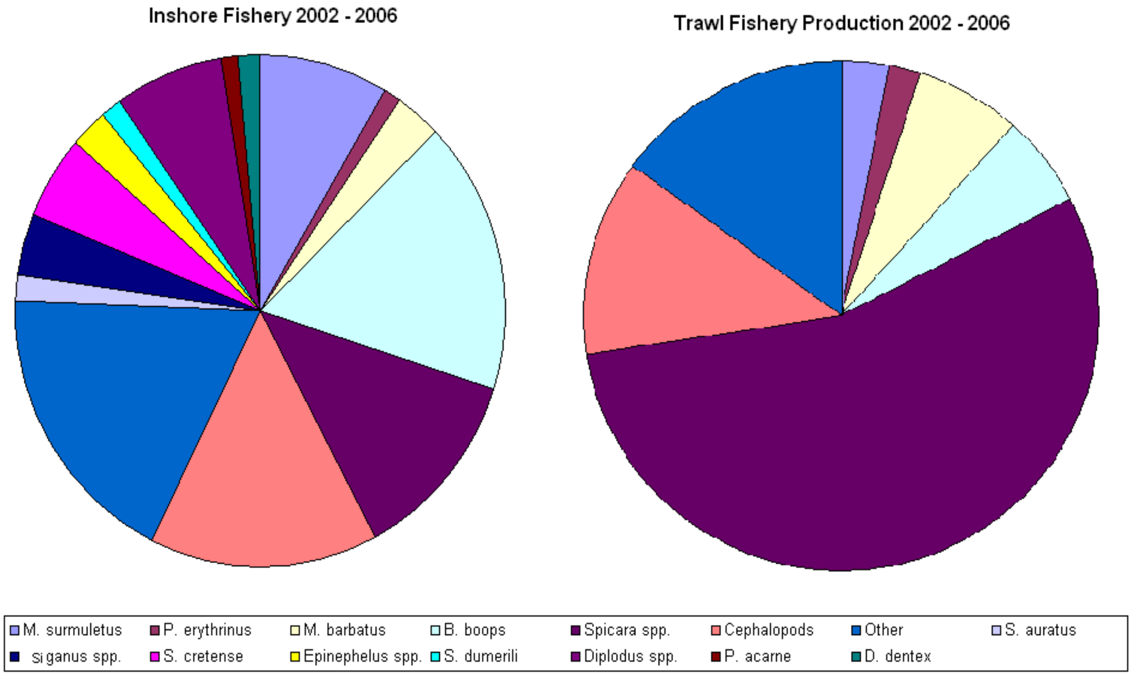

Figure 7.29.2.3.1.1 Composition of landings for the period 2002-2006.

The trends of the landings of red mullet by trawlers and artisanal vessels are illustrated in Fig. 7.29.2.3.1.2 below covering the period 1986-2006.

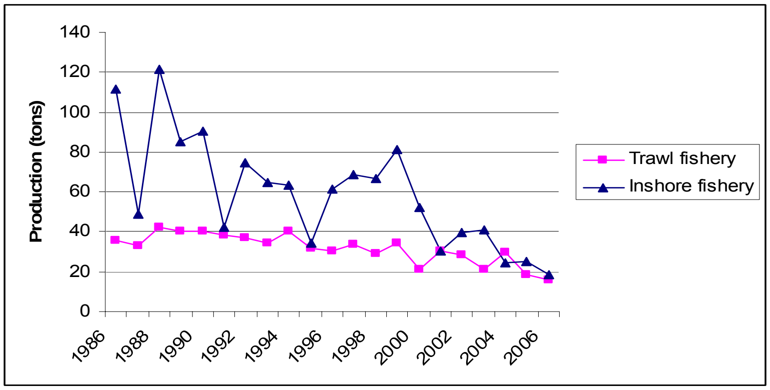

Figure 7.29.2.3.1.2 Landings of *Mullus barbatus* in GSA 25.

The evaluation of the species from the 1980s to 2004[7] (implementation of the 40mm diamond mesh size of trawl nets) from stock assessment studies performed by the Department of Fisheries and Marine Research suggested an over-exploitation of the red mullet stock. The Exploitation Rate (E) from the data analysis indicates a fluctuating E over the value of 0.5, and a high value of F of the older age groups (especially 3+ and 4+). Also, in some years a relatively significant F of the smallest age group (0+) is suggested (Data from the Department of Fisheries and Marine Research, DFMR).

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[7] **CYPRUS Management Plan for Bottom Trawling**

The evaluation of the stock in 2005, the first year of implementation of the 40mm diamond mesh size of trawl net (fishing season staring in November 2004), indicated that the stock continued to be over-exploited, with an E value lower than the 2004 level (DFMR).

The data origin on catches of red mullet is based on the methodology for collecting data on catches and landings by the DFMR based on the following Data Collection Practices:

- Direct Reports given by the various segments of the Fishery
- Legislative procedures
- Interviews

Landings data were reported to SGMED-08-04 through the Data collection regulation and are listed in Table A3.2 of Appendix 3 (Tab. 7.29.2.3.1.1).

Table 7.29.2.3.1.1 Annual landings (t) by fishing technique as reported to SGMED-08-04 through the DCR data call, 2003-2007.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	25	CYP	GTR				25	18	25
MUT	25	CYP	OTB				18	16	23
SUM							43	34	48

7.29.2.3.2. Discards

Data on discard[8] (weight and numbers) were provided based on the results of the 2006 pilot study conducted[9] as part of the 2006 Cyprus National Fisheries Data Collection Programme under the EC Data Collection Regulation on-board bottom trawl vessels. The study suggests that total quantities discarded, including non-commercial species, represent 13% of the total catch[10]. Discards were raised by trip. The study also suggested that discard quantities are negligible for *Mullus barbatus*,.

- No data on length at age were provided.
- No data on length or age composition of discards.

7.29.2.3.3. Fishing effort

Fishing effort data on GSA 25 were provided according to the Official call for data on landings, catches, length and age compositions, effort and trawl surveys in the Mediterranean (FILE_2, M02_MED_EFF, EFFORT).

Tab. 7.27.2.3.3.1 lists the effort by fishing technique deployed in GSA 25 as reported to SGMED-08-04 throught the DCR data call and listed in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.27.2.3.3.1 Effort trends by fishing technique in GSA 25, 2005-2007.

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[8] Data call , File 08_MED_DIS

[9] Council Regulation 1543/2000, Commission Regulation 1639/2001, and Commission Regulation 1581/2004.

[10] CYPRUS Management Plan for Bottom Trawling

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	25	CYP	GTR				84706	89375	100103
DAYS	25	CYP	LLS				306	378	407
DAYS	25	CYP	OTB				1018	726	752
GT*DAYS	25	CYP	GTR				256436	275468	301864
GT*DAYS	25	CYP	LLS				2022	5245	6421
GT*DAYS	25	CYP	OTB				94561	72422	75036
KW*DAYS	25	CYP	GTR				3305514	3526850	3896835
KW*DAYS	25	CYP	LLS				21790	51626	57561
KW*DAYS	25	CYP	OTB				327616	231816	240182

7.29.3. Scientific surveys

7.29.3.1.Medits

7.29.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 20 the following number of hauls were reported per depth stratum (s. Tab. 7.29.3.1.1.1).

Tab. 7.29.3.1.1.1. Number of hauls per year and depth stratum in GSA 25, 2005-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA25_010-050												5	5	5
GSA25_050-100												8	8	8
GSA25_100-200												5	5	5
GSA25_200-500												3	3	3
GSA25_500-800												4	4	4

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma\ (Yi*Ai)\ /\ A$$

$$V(Yst) = \Sigma\ (Ai^2 * si^2 / ni)\ /\ A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

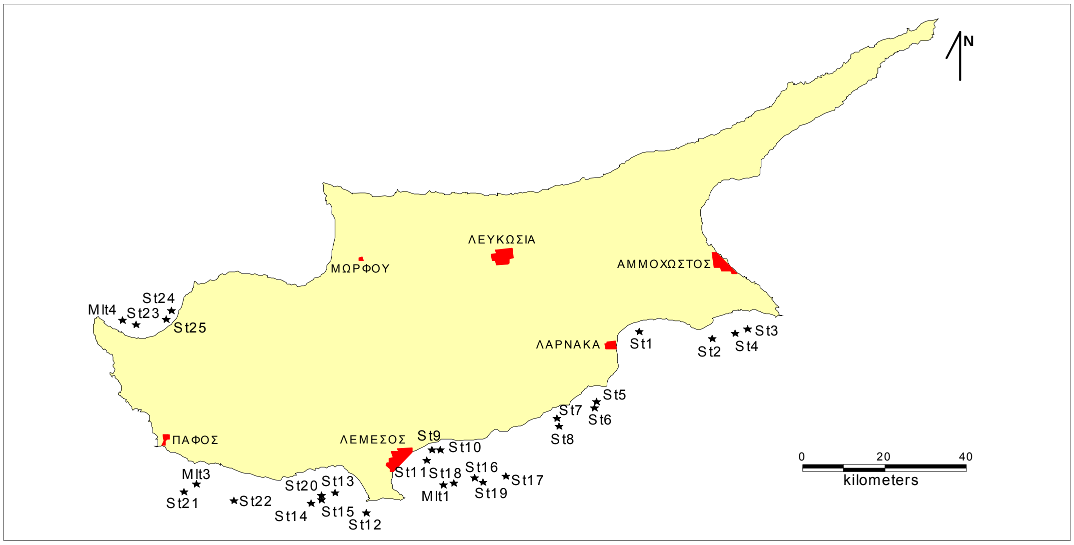
The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.29.3.1.2. Geographical distribution patterns

The geographical distribution pattern of the Medits survey in area GSA 25 is illustrated below (Fig. 7.29.3.1.2.1, Medits stations Cyprus).



7.29.3.1.2.1 Medits stations Cyprus

7.29.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the red mullet in GSA 25 was derived from the international survey Medits. SGMED-08-04 notes that the MEDITS survey does only cover the southern and north-western slopes off Cyprus. Figure 7.29.3.1.3.1 displays the estimated trend in red mullet abundance and biomass in GSA 25.

The estimated abundance and biomass indices do not reveal any significant trends since 2005 and are subject to high variability (uncertainty). The analyses of Medits indices are considered preliminary.

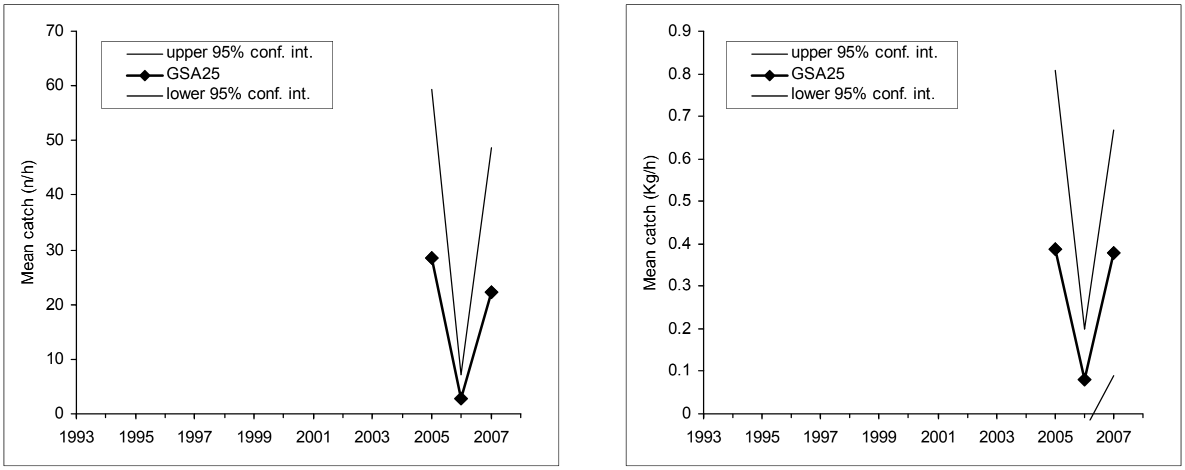


Fig. 7.27.3.1.3.1 Abundance and biomass indices of red mullet in GSA 25.

7.29.3.1.4. Trends in abundance by length or age

The following Fig. 7.29.3.1.4.1 displayS the stratified abundance indices of GSA 25 in 2005-2007. These size compositions are considered preliminary.

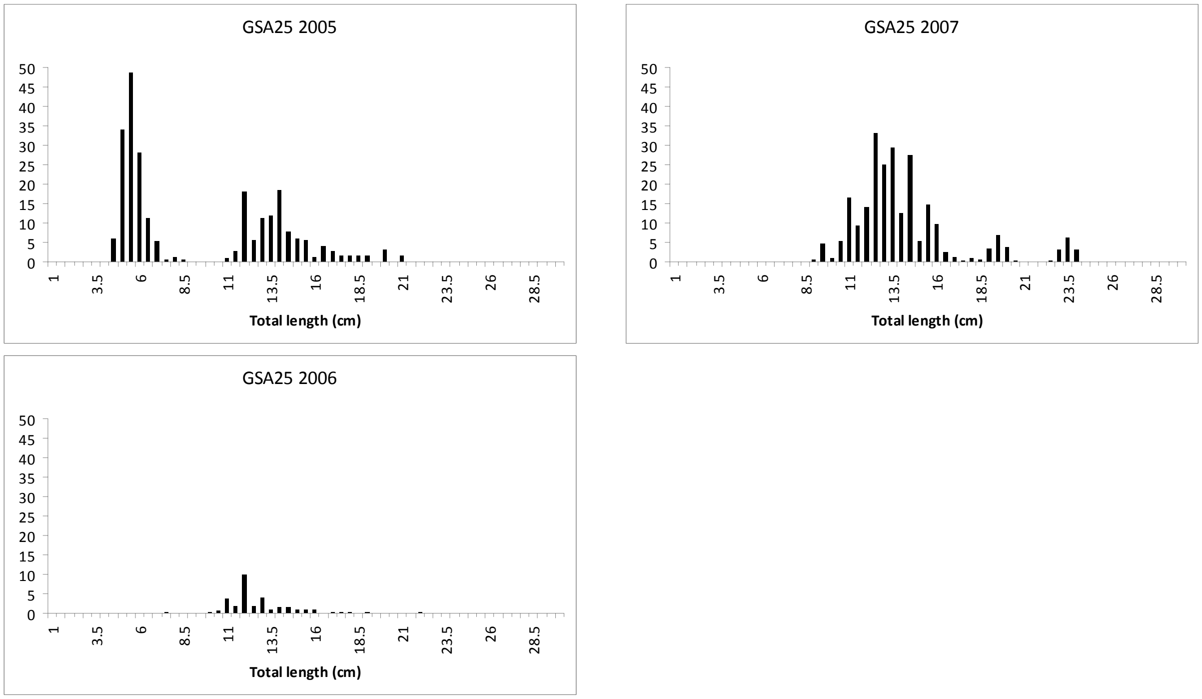


Fig. 7.29.3.1.4.1 Stratified abundance indices by size, 2005-2007.

7.29.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.29.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.29.4. Assessment of historic stock parameters

The assessment was performed using the VIT software[11]. The software was conceived for the analysis of fisheries where the time series of the information available is limited and where the technical interaction among fishing gears is an important factor to be accounted for. This program is often used to analyse Mediterranean fisheries. The program VIT was first published in Spanish (Lleonart and Salat 1992) and later in English as volume 11 of the FAO Computerized Information Series (FAO, 1997).

- Data used 2005-2007 catches in GSA 25 (limited information time series)
- Medits Survey 2005-2007

The program VIT[12] 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 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.

7.29.4.1.Method 1: VIT

7.29.4.1.1. Justification

The stock assessment method used was the Length Cohort and Yield per Recruit Analysis (LCA & Y/R, VIT). Length frequency distributions of the catch by gear were available from the data submitted by Cyprus under the DCR call. Growth parameters were set by the SGMED plenary (see Table 7.29.4.1.2.1). The growth parameters provided by Cyprus were not used.

The VIT assessment method was used for the analysis due to the limited time depth information available and because the technical interaction among the fishing gears was an important factor to account for.

The Medits data provided by Cyprus were not adequate (short time series) for the use of the SUBRA assessment method.

7.29.4.1.2. Input parameters

The input parameters used were set at the plenary of the SGMED. The parameters that were used in the assessment were the 'Upper' parameters:

L_{inf} = 34.5, K= 0.34 and t0= - 0.143.

Table 7.29.4.1.2.1 Growth parameters set by the plenary

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[11] http://www.faocopemed.org/es/activ/infodif/vit.htm
[12] http://www.faocopemed.org/es/activ/infodif/vit.htm

Species	**Param. set**	**L_{inf} (cm)**	**K**	**T_0**	**Source**
M. barbatus	Fast	34.5	0.34	-0.143	Length
	Slow	26.0	0.41	-0.4	Otoliths[13]
*M. merluccius**	Female	100.7	0.25	-0.35	Tagging
	Male	72.8	0.30	-0.38	Tagging
*P. longirostris***	High	4.2	0.62	-0.08	Length
	Low	4.5	0.34	-0.06	Length

* suggest generating size at length using sex ratio at length data
** Spanish figures – suggest using those figures most relevant to your GSA (e.g. Italian, Spanish)
NOTE: ensure related parameters (e.g. natural mortality) are consistent with growth parameters used

Natural mortality was calculated using the approach of Djabali:

$$\mathbf{logM = 0{,}0278 - 0{,}1172 * log(linf) + 0{,}5092 * log(K)}$$

Table 7.29.4.1.2.2 Growth parameters set by the plenary, length-weight regression and estimated M.

Species	**Param. set**	**L_{inf} (cm)**	**K**	**T_0**	**a**	**b**	**M**
M. barbatus	Upper	34.5	0.34	-0.143	0,0081	3,113	0,40644
	Lower	26.01	0.41	-0.4			0,22530
	Cyprus	26,01	0,2025	-1.688			0,48874

The mean length composition of catch landings of red mullet for the period 2005-2007 was used:

- two gears Trawl (OTB) & Nets (GTR)
- Mean annual catch (tons)

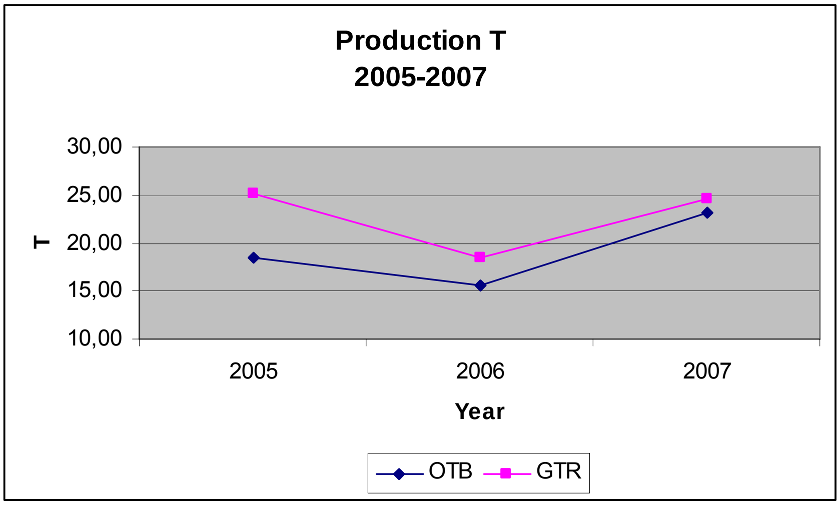

Fig. 7.29.4.1.2.1 Annual landings (t) by fishing techniques, 2005-2007.

Tab. 7.29.4.1.2.2 Estimated mean landings (g), 2005-2007.

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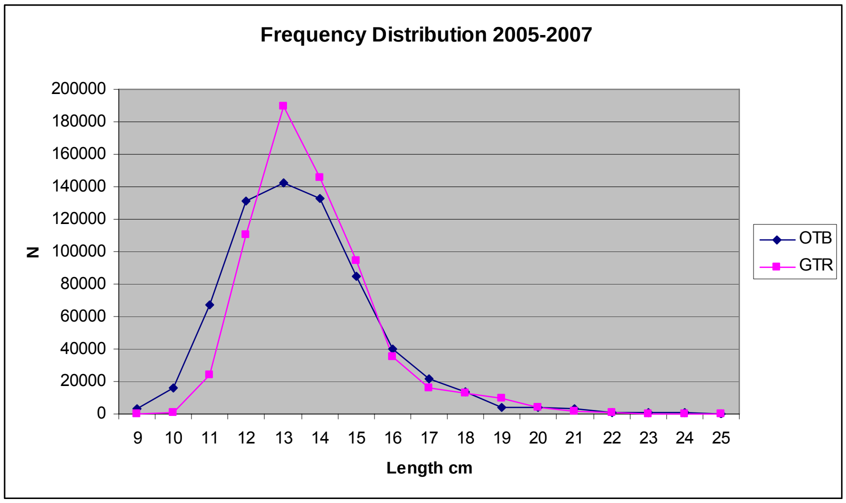
[13] GSA 9 and 10 combined, from otoliths

AVERAGE 2005-2007		
Trawl W	19064000	45,60%
Nets W	22743333	54,40%
Total	41807333	



7.29.4.1.2.2 Estimated size compositions of average landings by fishing technique, 2005-2007.

7.29.4.1.3. Results

Tab. 7.29.4.1.3.1 Estimated population parmaters, weights are in kg.

Parameters	**Upper (Growth)**	**Upper Growth (M- Pauly)**	**Lower Growth**	**Cyprus**
Spawning Stock Biomass, (SSB)	**26880**	**21571**	**34745542**	**1053217**
Biomass, (B)	**31176**	**28824**	**37684296**	**1115847**
Virgin biomass (V)	**248313**	**188924**	**846644**	**1438309**
B/V	**12,55%**	**15,25%**	**44,51**	**77,58**
Number of classes	**4**	**4**	**76**	**38**

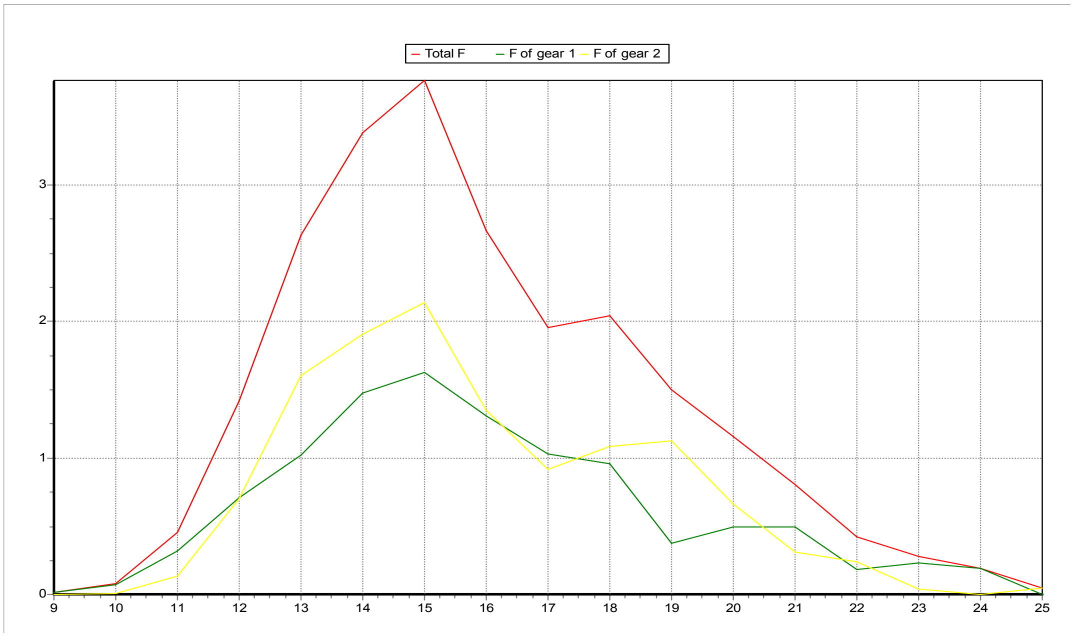


Fig. 7.29.4.1.3.1 Total fishing mortality and by gear at length estimated using VIT (SLOW GROWTH) parameters.

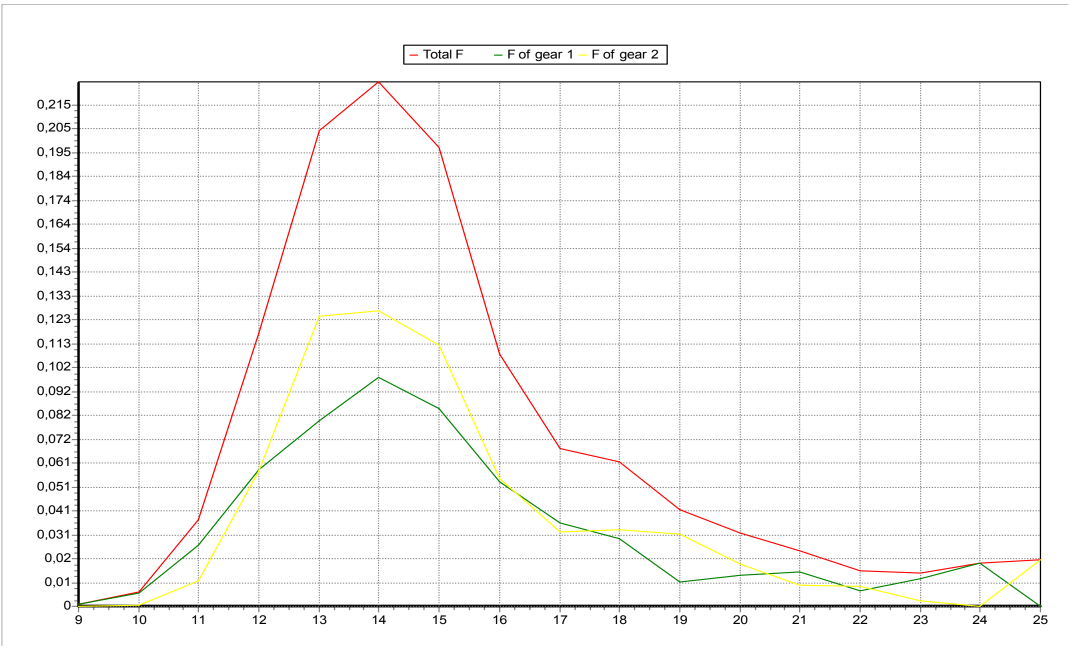


Fig. 7.29.4.1.3.2 Total fishing mortality and by gear at length estimated using VIT (SLOW GROWTH) parameters.

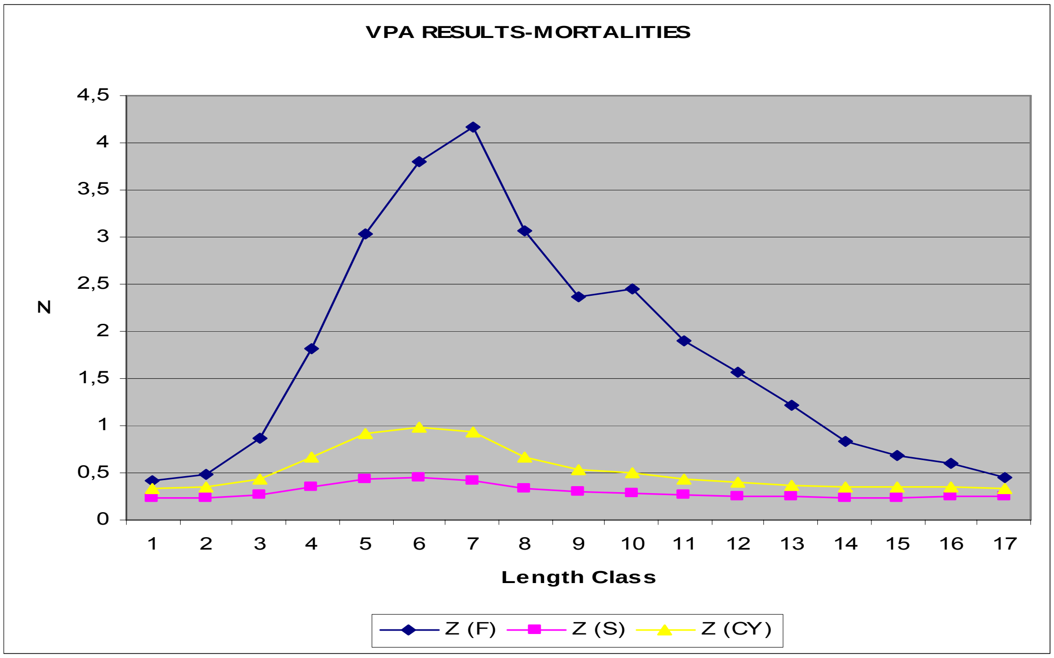


Fig. 7.29.4.1.3.3 VPA mortalities at length.

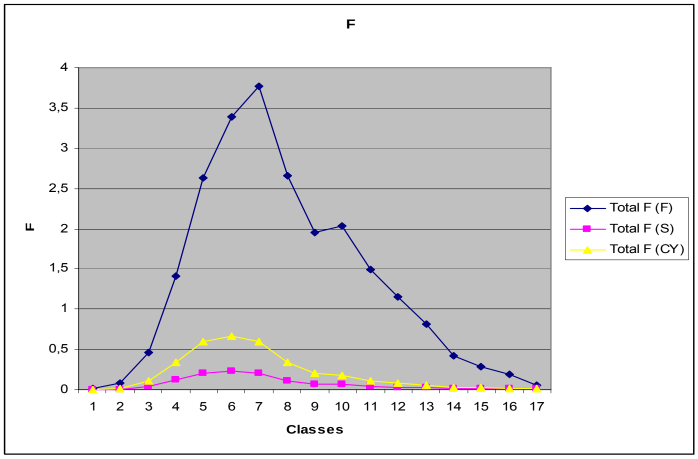


Fig. 7.29.4.1.3.4 VPA mortalities at length.

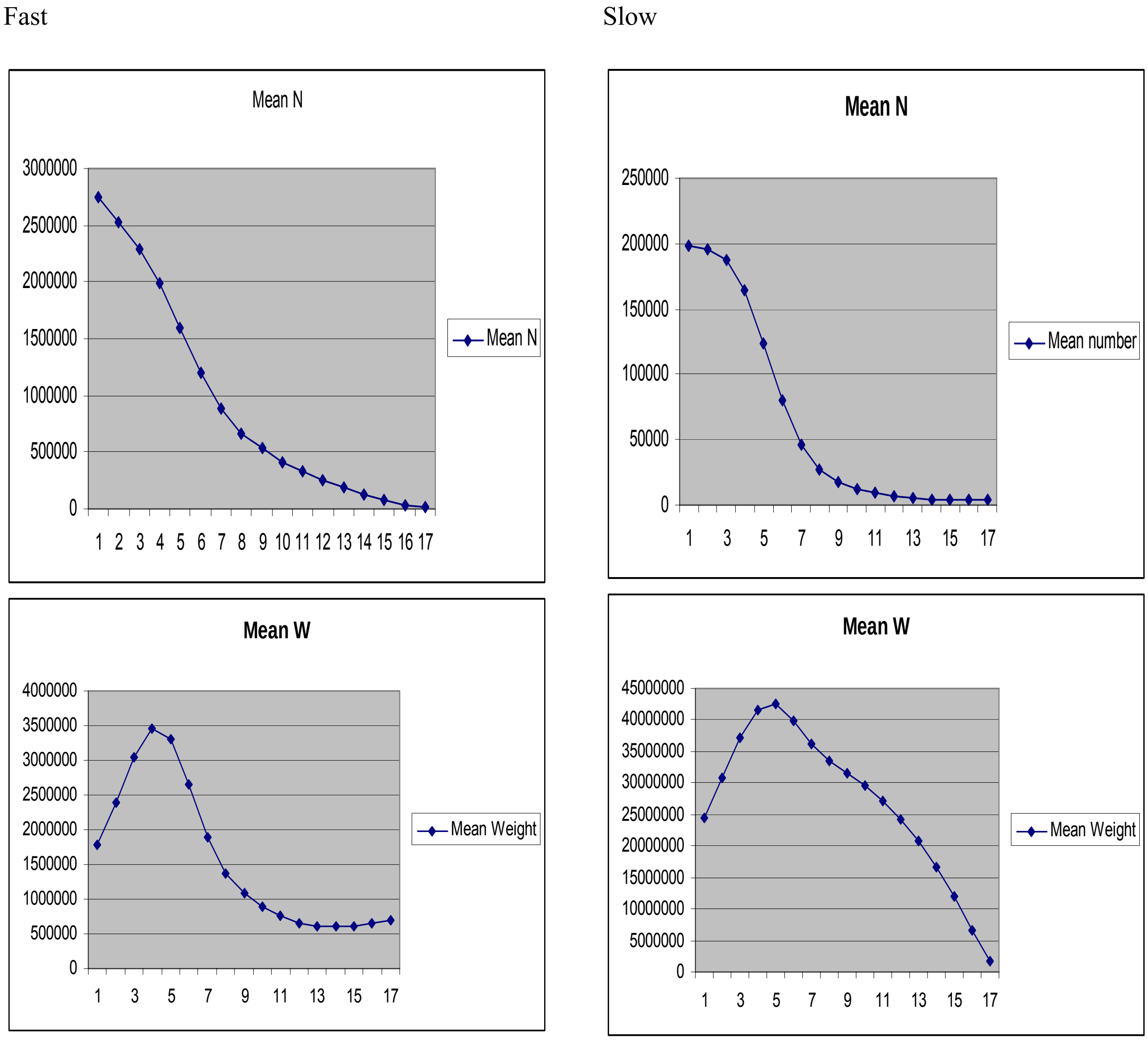


Fig. 7.29.4.1.3.5 Estimated length structure of the landings in terms of numbers and weight.

7.29.5. Short term prediction for 2008 and 2009

7.29.5.1. Justification

No forecast analyses were conducted.

7.29.5.2. Input parameters

No forecast analyses were conducted.

7.29.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for red mullet in GSA 25.

7.29.6. Medium term prediction

7.29.6.1.Justification

No forecast analyses were conducted.

7.29.6.2.Input parameters

No forecast analyses were conducted.

7.29.6.3.Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for red mullet in GSA 25.

7.29.7. Long term prediction

7.29.7.1.Justification

VIT model was used to estimate yield per recruit.

7.29.7.2.Input parameters

Y/R was estimated using VIT parameters (FAST GROWTH).

7.29.7.3.Results

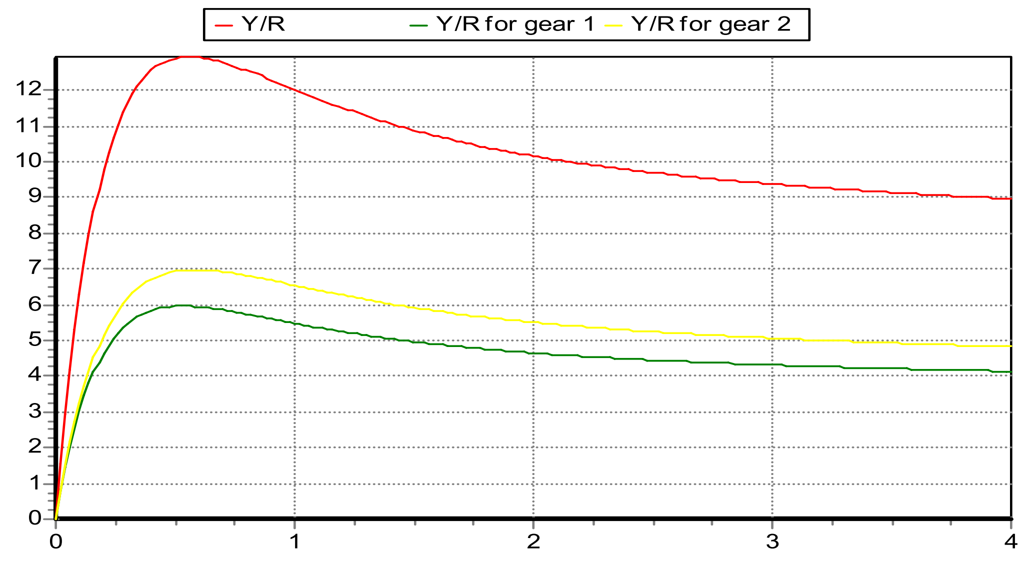


Fig. 7.29.7.3.1 Total yield per recruit (g.) and yield per recruit by fishing gear.

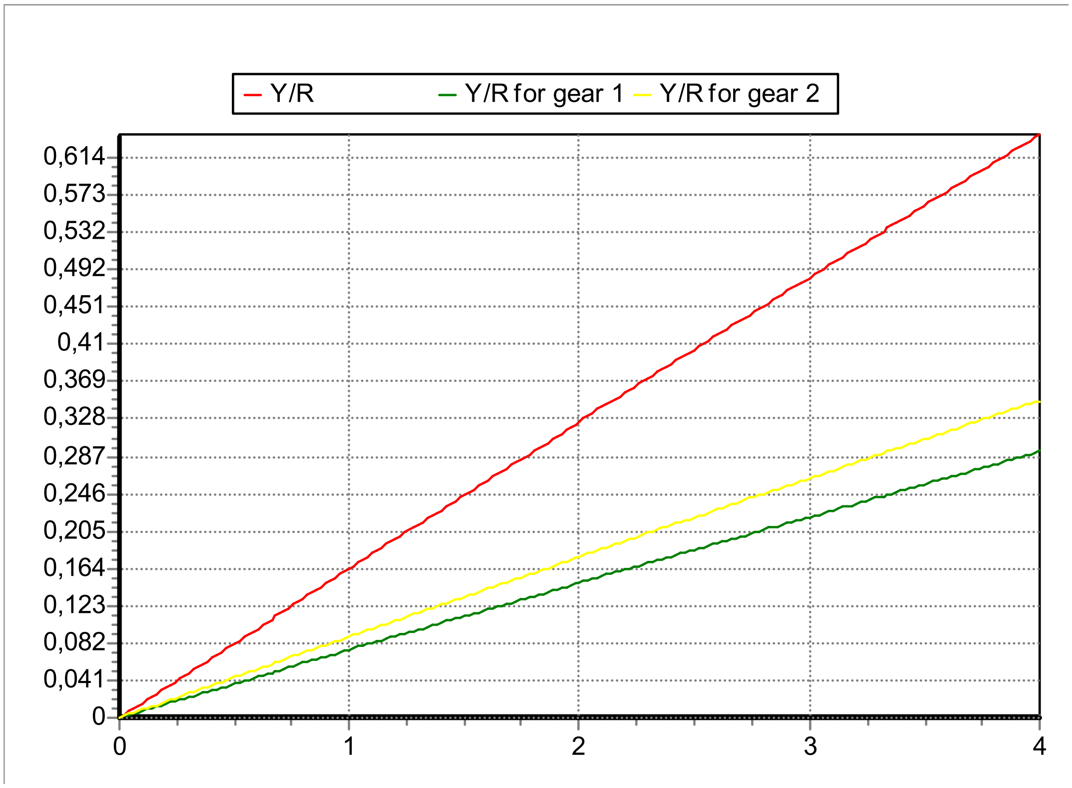


Fig. 7.29.7.3.2 Y/R estimated using VIT (SLOW GROWTH).

SGMED-08-04 explored and discussed technical changes and 20% reduction of fishing mortality but did so far not come to any final conclusions due to uncertainties in the data used.

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for red mullet in GSA 25.

7.29.8. Scientific advice

7.29.8.1. Short term considerations

7.29.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.29.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.29.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.29.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.30. Stock assessment of pink shrimp in GSA 01

7.30.1. Stock identification and biological features

7.30.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.30.1.2. Growth

Two sets of parameters were submitted to the meeting, obtained within the frame of the DCR call. These were for males and females combined, and GSA01, GSA05 and GSA06 also combined. Growth parameters were estimated through length frequency analysis, "Slow" for the period 2002-2004 and "Fast" parameters were estimated for the period 2005-2007.

Tab. 7.30.1.2.1 Bertalanffy growth parameters for the two options considered, fast and slow growth (data source: DCR).

	L_{inf} (cm)	K	T_0	Source
Fast	4.2	0.62	-0.08	Length
Slow	4.5	0.34	-0.06	Length

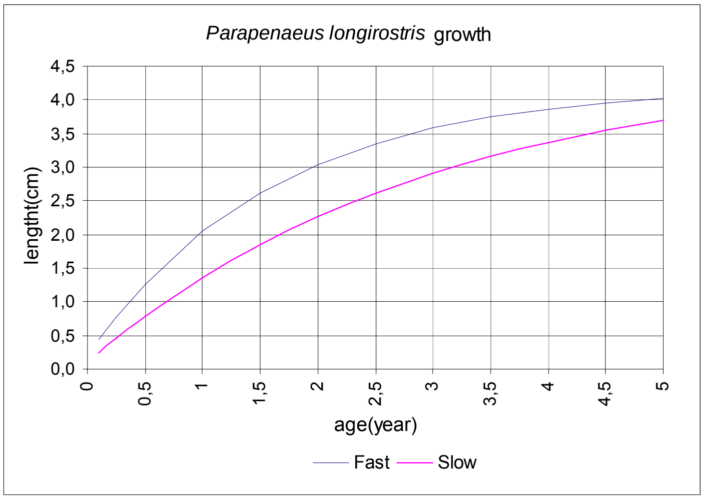


Fig. 7.30.1.2.2 Growth functions for the two fast and slow growth options.

Tab. 7.30.1.2.2 Length- weight relationship parameters, males and females combined

a	b	
0,8142	2,6013	fast growth set
0,8148	2,61	slow growth set

7.30.1.3. Maturity

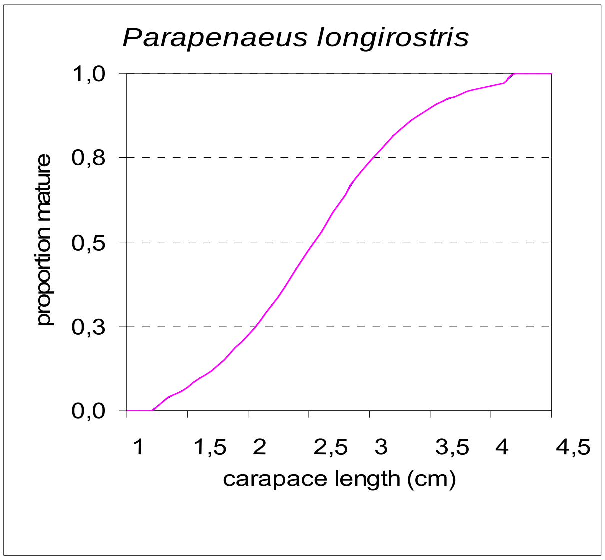


Fig. 7.30.1.3.1 Maturity ogive for males and females combined in GSA01. Maturity stage determined macroscopically during the reproduction period (data source:DCR)..

7.30.2. Fisheries

7.30.2.1. General description of fisheries

The bottom trawl fishery in GSA 01 is multispecific, targeting fish, cephalopods and crustaceans. Main target species are *Merluccius merluccius, Pagellus acarne, Octopus vulgaris and Parapenaeus longirostris.* Crustaceans get the highest values in the market representing 24% in the total catch, although *Nephrops norvegicus* and *Parapenaeus longirostris* contribute 6% to the total catch in weight. Fishing grounds are characterized by a narrow continental shelf, between 3 and 11 nautical miles wide (SEC(2004)772).

The species is found mainly at depths of between 140 and 400 m, i.e. on the continental shelf and in the upper slope on muddy or sandy muddy bottoms (Sbrana *et al.* 2006).

7.30.2.2. Management regulations applicable in 2007 and 2008

Unknown, assumed to be the same regulations in force within the Spanish Mediterranean (5 fishing days a week; to be practiced at >50 depth; 12 hours at sea per day). In the last years a two-month closure has been implemented in the first half of the year.

7.30.2.3. Catches

7.30.2.3.1. Landings

Landings underwent a sharp decrease in the most recent years; current landings along the Spanish Mediterranean Coast are very low (Catalan Coast is the "northern" northern Spain, from the French border to the Delta of the Ebre River). Likewise, landings in other Mediterranean areas have shown notable interannual fluctuations, assumed to be due to the life cycle of the species (Sbrana *et al.* 2006). Data source: DCR and Fisheries Statistics by the Catalan Government; landings in tones are shown in Fig. 7.30.2.3.1.1.

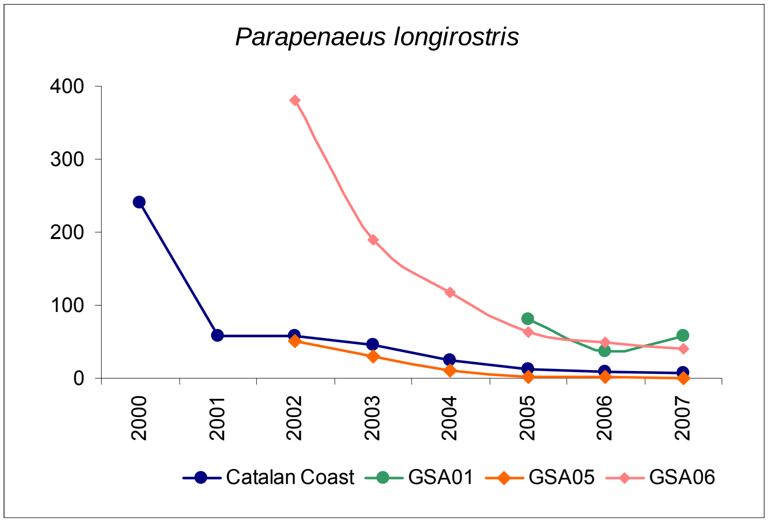


Fig. 7.30.2.3.1.1 *Parapenaeus longirostris* annual landings, in tonnes. Data source: DCR and Fisheries Statistics by the Catalan Government.

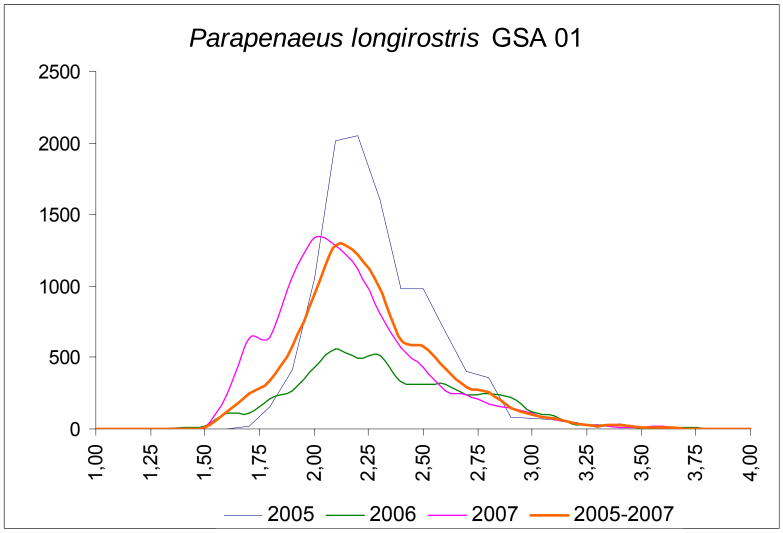


Fig. 7.30.2.3.1.2 *Parapenaeus longirostris* annual size distributions, CL in cm. In bold orange the "mean" size distribution over 2005-2007, which was used in the performance of length cohort analysis (pseudocohort) with VIT software.

The bulk of the landings ranged within 1.5 and 3.0 cm CL (Fig. 7.30.2.3.1.2). According to the "fast" growth scenario, this size range corresponds to an age of between 0.5 and 2 years and according to the "slow" growth scenario, this size range would correspond to an age of between 1-3 years.

Tab. 7.30.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings decreased from 173 t to only 37 t in 2006 and remained low in 2007. The landings were only taken by demersal otter trawls.

Tab. 7.30.2.3.1.1 Annual landings (t) by fishing technique in GSA 01.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	1	ESP	OTB	173	123	117	81	37	58

7.30.2.3.2. Discards

Parapenaeus longirostris is not discarded.

7.30.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9.

7.30.3. Scientific surveys

7.30.3.1.Medits

7.30.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 01 the following number of hauls were reported per depth stratum (s. Tab. 7.30.3.1.1.1).

Tab. 7.30.3.1.1.1. Number of hauls per year and depth stratum in GSA 01, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA01_010-050	2	1	2	2	2	2	2	3	3	3	3	2	3	3
GSA01_050-100	5	4	5	5	5	7	6	4	6	10	7	7	6	6
GSA01_100-200	3	3	3	5	5	5	5	4	8	6	5	6	5	6
GSA01_200-500	7	9	11	10	7	11	12	10	11	11	13	11	11	11
GSA01_500-800	6	9	12	10	12	12	9	13	13	14	13	11	15	10

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area

Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.30.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.30.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 01 was derived from the international survey Medits. Figure 7.30.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 01.

The estimated abundance and biomass indices peaked in 1998 and decreased significantly until 2003. Since then, the indices varied at a low level. The analyses of Medits indices are considered preliminary.

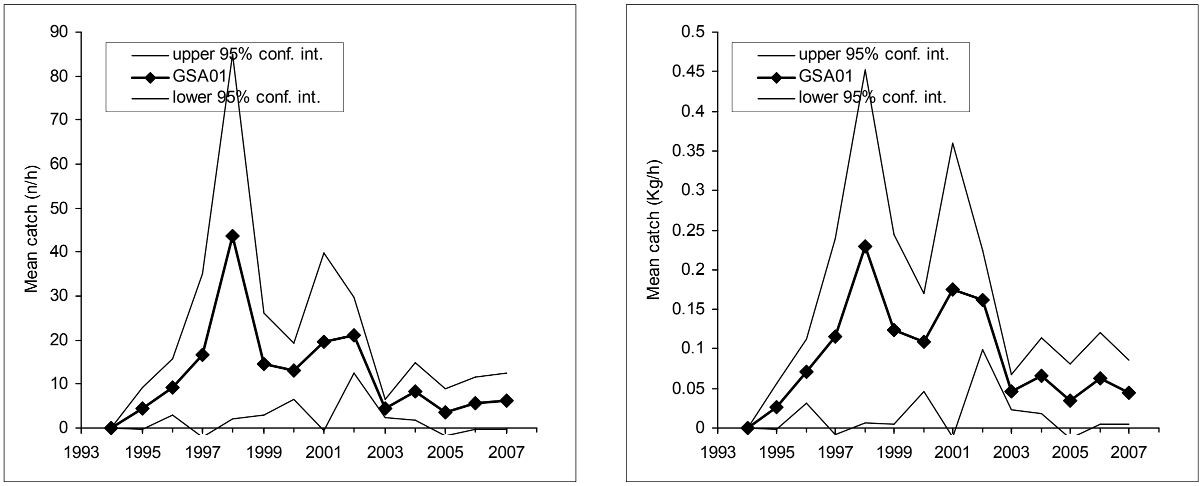


Fig. 7.25.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 01.

7.30.3.1.4. Trends in abundance by length or age

The following Fig. 7.25.3.1.4.1 and 2 display the stratified abundance indices of GSA 01 in 1995-2002 and 2003-2007. These size compositions are considered preliminary.

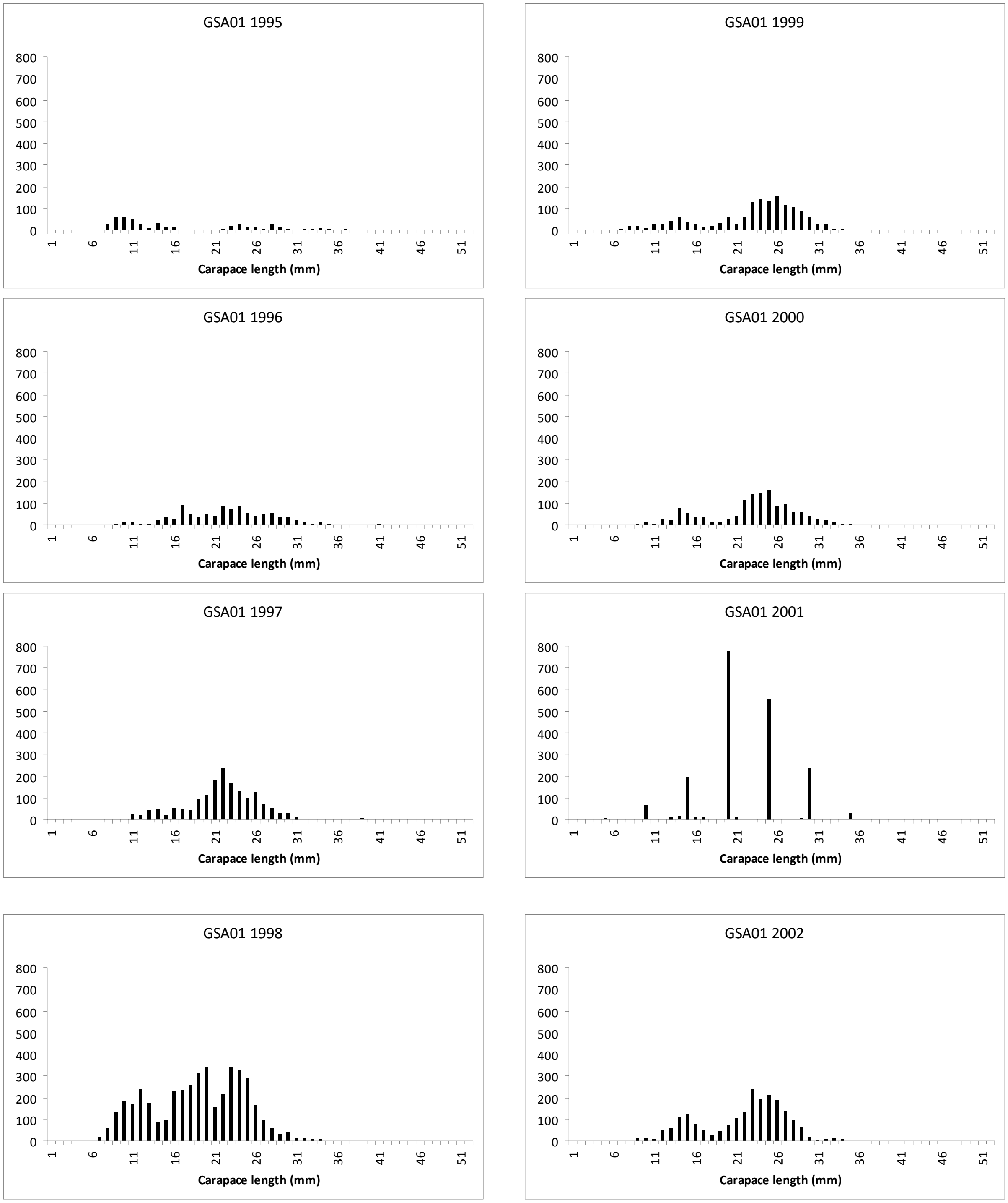


Fig. 7.25.3.1.4.1 Stratified abundance indices by size, 1995-2002.

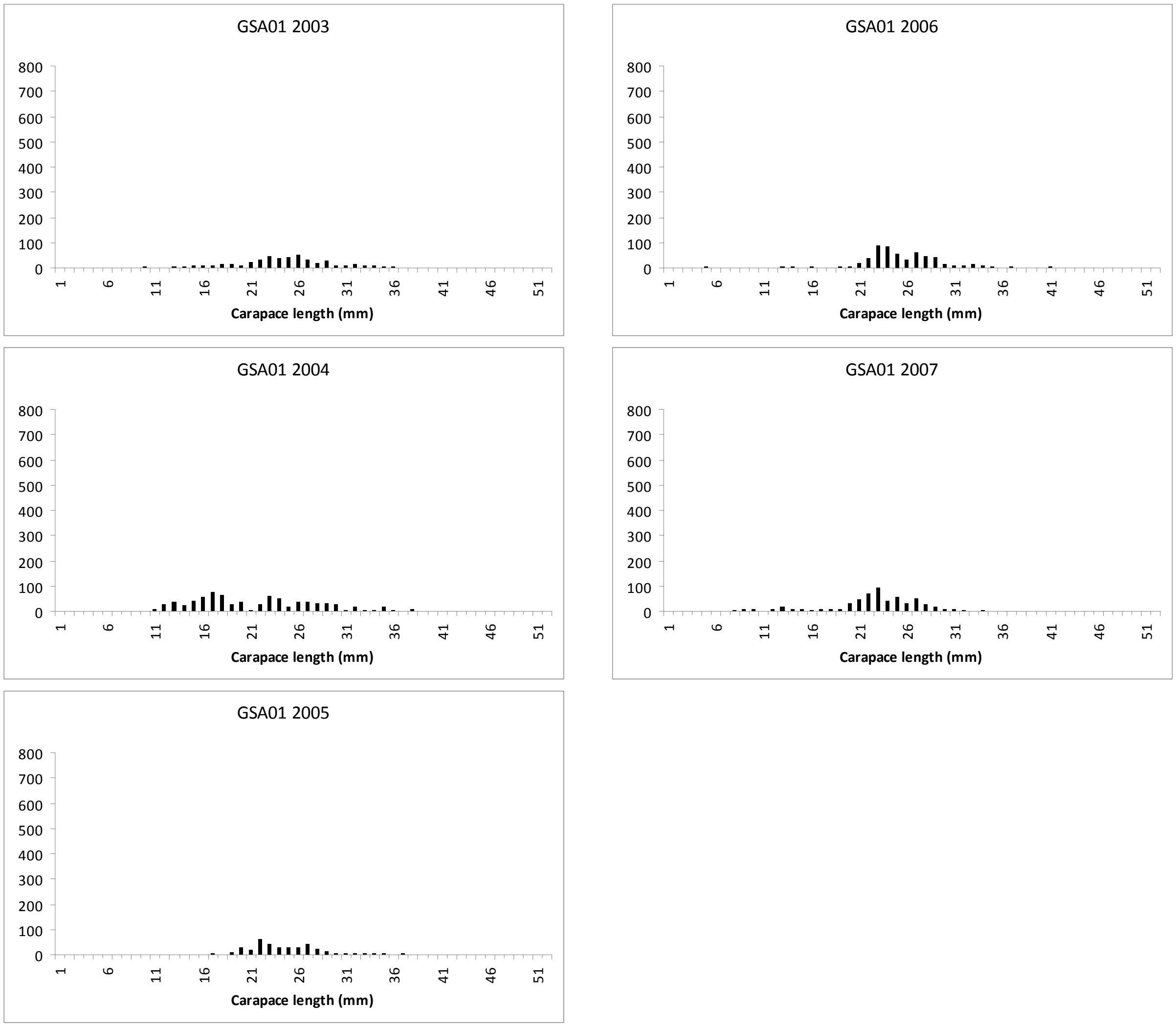


Fig. 7.25.3.1.4.2 Stratified abundance indices by size, 2003-2007.

7.30.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.30.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.30.4. Assessment of historic stock parameters

7.30.4.1.Method 1: SURBA

7.30.4.1.1. Justification

The availability of a long time series of data from MEDITS surveys.

7.30.4.1.2. Input parameters

MEDITS survey over the period 1994-2008.
BVT Growth parameters: Linf= 43 mm carapace length (cl); k=0.6; to= -0.97
length- weight relationship: a=0.00686; b=2.24
Maturity Length (L50) = 23 mm cl
Length of first capture= Lc= 20 mm cl
M vector, estimated using PROBIOM.

7.30.4.1.3. Results

<u>State of the adult abundance and biomass:</u>

SGMED cannot evaluate the state of the spawning stock because the number of samples in the analysis is not sufficient.

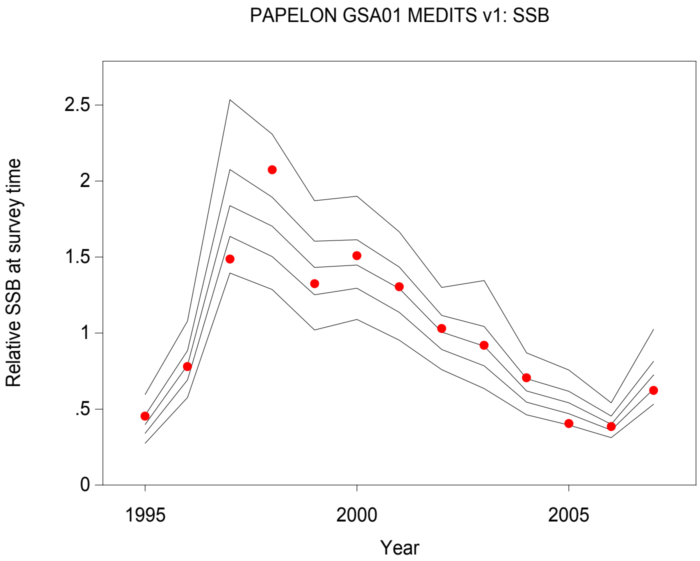


Fig. 7.30.4.1.3.1 Trends in SSB as estimated by SURBA.

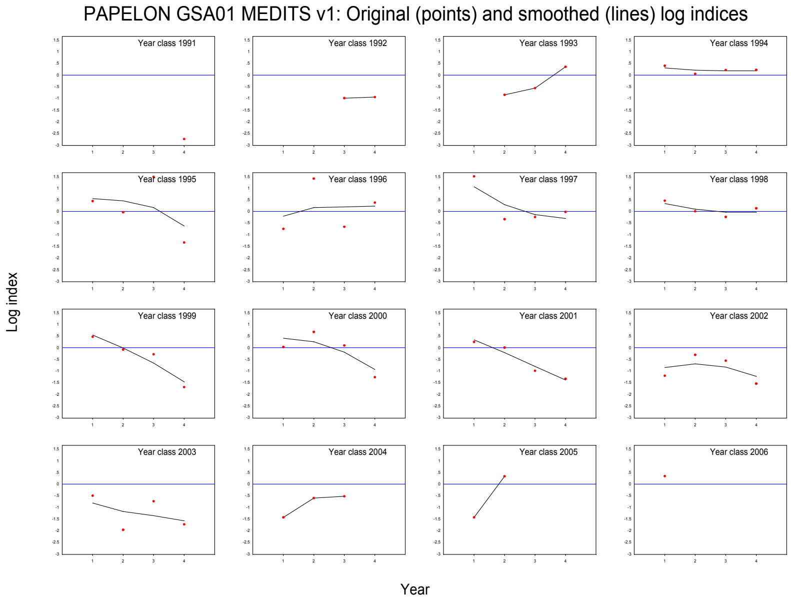


Fig. 7.30.4.1.3.2 Diagnostigs as estimated by SURBA.

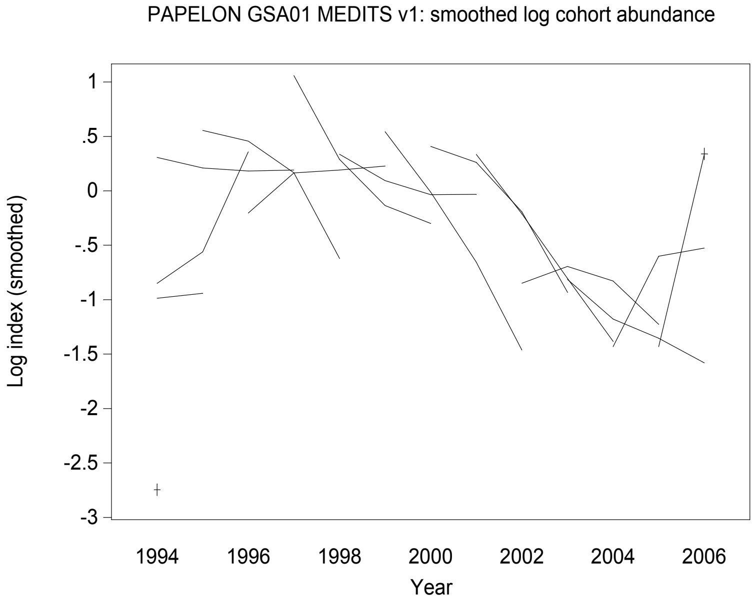


Fig. 7.30.4.1.3.3 Diagnostics as estimated by SURBA.

Recruits

Class 0 was not sampled in MEDITS surveys, as recruitment of pink shrimp takes place in autumn.

State of exploitation

Due to the very low abundance, almost absent from the traditional fishing grounds, the resulting trends from SURBA point to "quasi" disappearance of the species in the area.

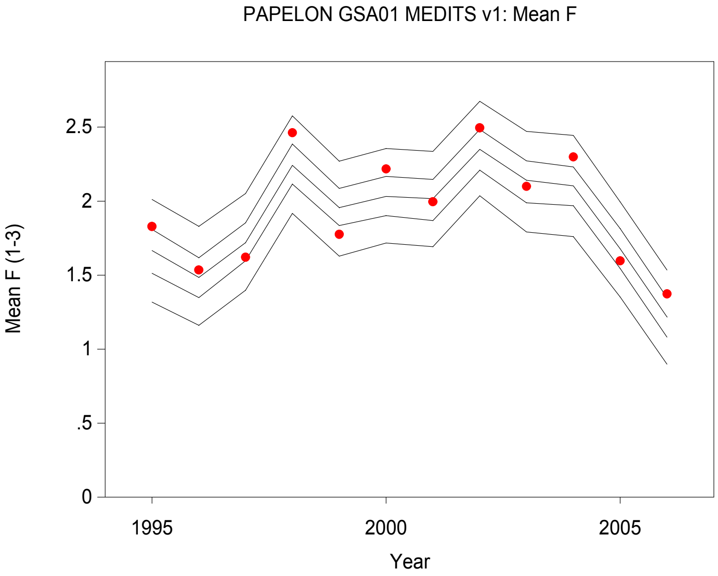


Fig. 7.30.4.1.3.4 Trend in fishing mortality as estimated by SURBA.

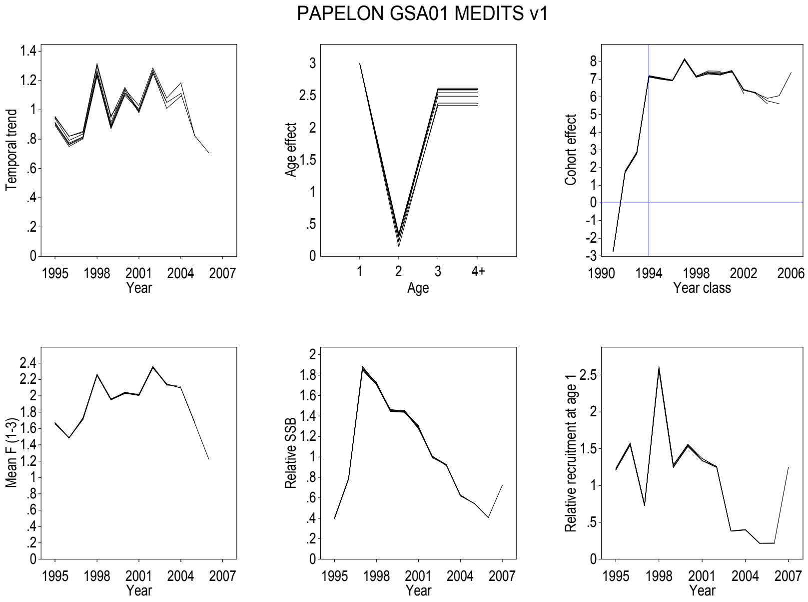


Fig. 7.30.4.1.3.5 Dynamics in various stock parameters as estimated by SURBA

7.30.4.2.Method 2: VIT

7.30.4.2.1. Justification

Size distribution data were available only for 2005-2007. Since landings in GSA01 during 2005-2007 were at similar and low level, equilibrium was assumed and cohort analysis was performed using VIT. Considering data available, and the very low landings during this period, results are presented for the "mean" pseudocohort for the period 2005-2007.

7.30.4.2.2. Input parameters

Length composition of landings, pseudocohort, is shown in Fig. 7.30.2.3.1.2. The species is not discarded. No effort data were available. Weight at length and maturity at length in the stock as input; these data were transformed into ages during the analysis.

number of classes, by length	25
number of fishing gears	1
lower limit of the first class	1.4
class interval	0.1
plus group	no
M*	1.25
F term*	0.5

* M constant; M and Fterm taken from Pérez *et al*. 2007. This value of M is similar to that used in other Mediterranean areas.

class number	Length class	Annual landings Length distriibution	Fast growth Mean Age	Fast growth Mean Length	Fast growth Mean weight	Slow growth Mean Age	Slow growth Mean Length	Slow growth Mean weight	Maturity ogive
1	1,4	0.024	0,61	1,45	2,14	1,07	1,4	2,15	0,05
2	1,5	0.128	0,67	1,55	2,55	1,17	1,5	2,56	0,07
3	1,6	1.385	0,73	1,65	3,00	1,27	1,6	3,01	0,10
4	1,7	3.031	0,79	1,75	3,49	1,37	1,7	3,51	0,12
5	1,8	4.051	0,86	1,85	4,03	1,48	1,8	4,06	0,15
6	1,9	6.958	0,93	1,95	4,62	1,59	1,9	4,65	0,19
7	2	11.329	1,00	2,05	5,26	1,71	2,0	5,30	0,23
8	2,1	15.454	1,08	2,15	5,95	1,83	2,1	6,00	0,27
9	2,2	14.674	1,16	2,25	6,70	1,96	2,2	6,75	0,31
10	2,3	11.741	1,25	2,35	7,50	2,09	2,3	7,56	0,37
11	2,4	7.512	1,34	2,45	8,36	2,23	2,4	8,43	0,42
12	2,5	6.908	1,43	2,55	9,28	2,37	2,5	9,36	0,48
13	2,6	5.039	1,53	2,65	10,25	2,52	2,6	10,35	0,53
14	2,7	3.507	1,64	2,75	11,29	2,69	2,7	11,40	0,59
15	2,8	3.138	1,75	2,85	12,38	2,86	2,8	12,51	0,64
16	2,9	1.806	1,88	2,95	13,55	3,04	2,9	13,69	0,69
17	3	1.236	2,01	3,05	14,78	3,23	3,0	14,93	0,74
18	3,1	0.922	2,16	3,15	16,07	3,44	3,1	16,24	0,78
19	3,2	0.443	2,32	3,25	17,44	3,66	3,2	17,62	0,82
20	3,3	0.231	2,50	3,35	18,87	3,90	3,3	19,07	0,85
21	3,4	0.296	2,70	3,45	20,35	4,16	3,4	20,57	0,87
22	3,5	0.074	2,93	3,55	21,94	4,46	3,5	22,19	0,90
23	3,6	0.082	3,20	3,65	23,56	4,77	3,6	23,83	0,92
24	3,7	0.022	3,53	3,75	25,30	5,14	3,7	25,59	0,93
25	3,8	0.007	3,93	3,85	27,09	5,55	3,8	27,41	0,95

7.30.4.2.3. Results

This is the first assessment of *P. longirostris* in GSA01. We applied VIT, pseudocohort analysis and Y/R, under two different management scenarios, fast and slow growth. All the results refer to the observable range of length/ages. Since the analysis is based on pseudocohort analysis, it is not possible to present trends.

Tab. 7.30.4.2.3.1 Results and stock parameters estimated by VIT.

	FAST GROWTH	SLOW GROWTH
Total catch	58544,01	58544.01
Mean Biomass, Bmean	47609,23	109225,22
SSB	14379,37	30053,34
Mean F	1,372	0,855
F0,1	0,96	1.20
Global F	0,820	0,332
Catch mean age	1,229	2,055
Catch mean length	2,296	2,296
Y/R	2.932	1.569

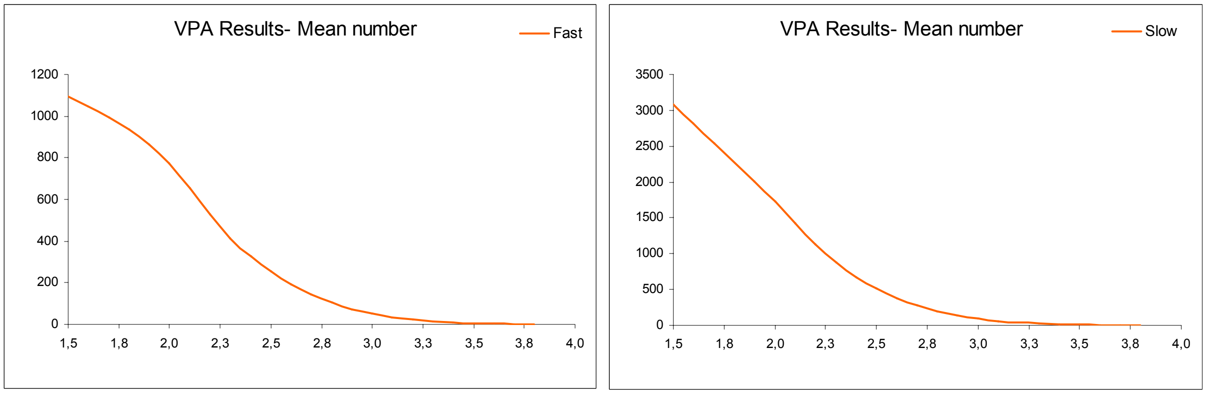


Fig. 7.30.4.2.3.1 Stock mean numbers over size (carapace length), as estimated by VIT for the the fast (left) and slow growth (right) scenarios.

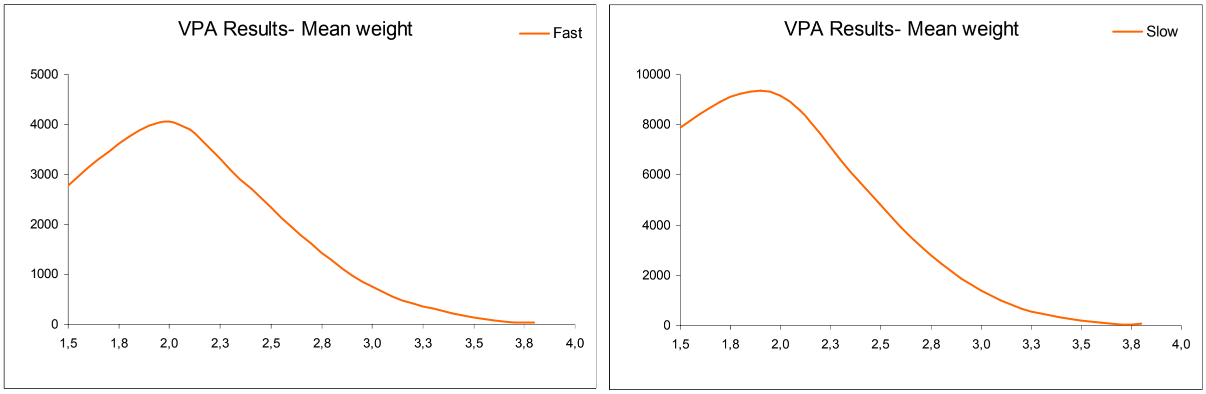


Fig. 7.30.4.2.3.2 Stock mean weights over size (carapace length), as estimated by VIT for the the fast (left) and slow growth (right) scenarios.

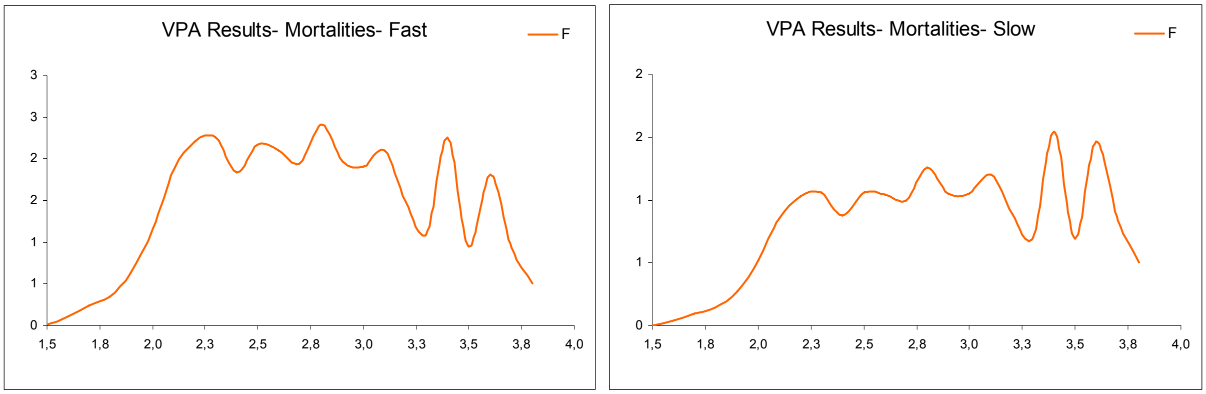


Fig. 7.30.4.2.3.3 Fishing mortalities over size (carapace length), as estimated by VIT for the the fast (left) and slow growth (right) scenarios.

VIT was also run for each annual pseudocohort separately, as suggested. The overall results of VPA (VIT software) using as input data the "mean pseudocohort 2005-2007" (results above presented) and the 2005 annual pseudocohort, for the fast growth scenario, are presented below, to allow comparison. Input parameters values are the same as presented in section 1.1.4.1.2 and the shape of each annual pseudocohort is shown in Fig. 7.30.2.3.1.2. The 2005 pseudocohort was chosen because is the one that differs more from the "mean pseudocochort" in shape and amount of landings. Anyway, results are very similar in both cases since the only input values that change are the length distributions, which show a single mode at similar sizes, and the total catch.

7.30.5. Short term prediction for 2008 and 2009

7.30.5.1. Justification

No forecast analyses were conducted.

7.30.5.2. Input parameters

No forecast analyses were conducted.

7.30.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 01.

7.30.6. Medium term prediction

7.30.6.1. Justification

No forecast analyses were conducted.

7.30.6.2. Input parameters

No forecast analyses were conducted.

7.30.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 01.

7.30.7. Long term prediction

7.30.7.1. Justification

Yield per recruit analyses were conducted assuming equilibrium conditions.

7.30.7.2. Input parameters

Based on the exploitation pattern resulting from the VPA (VIT) and its population parameters, yield per recruit analyses were formulated.

7.30.7.3. Results

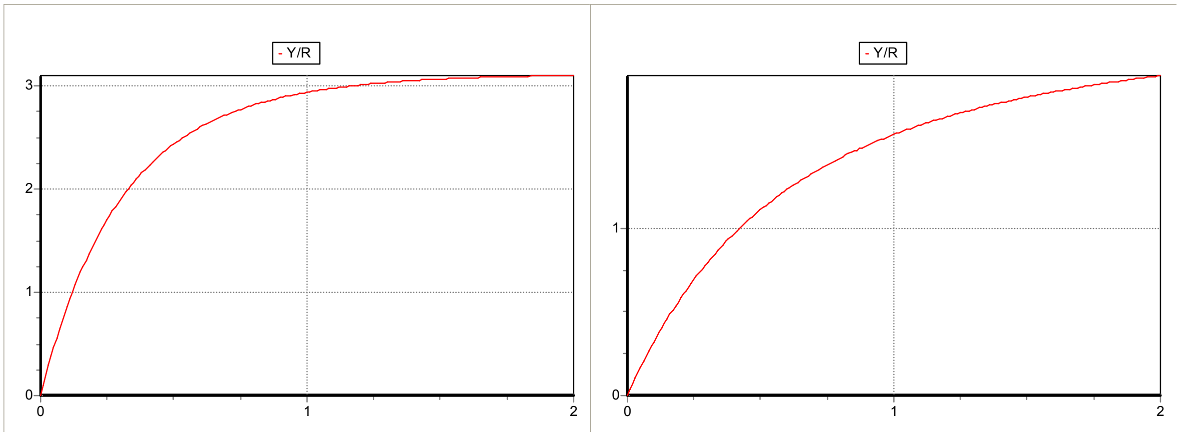


Fig. 7.30.7.3.1 Yield per recruit for fast (left) and slow growing scenarios (right) for the pink shrimp stock in GSA 01 (current effort).

Assuming equilibrium conditions, Fmax (F corresponding to the highest Y/R) seems to be in the region near the current F (F=1) in the fast growth scenario, or below it, in the slow growth scenario. Results suggest the stock would be in a situation near full exploitation in the fast growth scenario, where an increase in F would not result in an increase in Y/R, or underexploited in the case of slow growth scenario, where increasing F would lead to higher Y/R (see F0.1 for the fast and slow growth scenarios in Table 7.30.4.1.3.1).

Because of the differences in growth, and under constant M, higher mean biomass and spawning stock biomass are needed in the case of slow growth scenario than in the fast growth, to sustain a given amount of landings. Also, current Fmean would be higher in the fast growth scenario.

SURBA results show decreasing F in the last years, when landings are at their lowest, and abundance and biomass indices from MEDITS are also low.

7.30.8. Scientific advice

7.30.8.1. Short term considerations

7.30.8.1.1. State of the spawning stock size

In the absence of proposed or agreed references SGMED-08-04 is unable to fully evaluate the state of the stock and provide any scientific advice in relation to them. However, the stock size is estimated to be at a very low level with potentially negative effects on future recruitment.

7.30.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.30.8.1.3. State of exploitation

In the absence of proposed or agreed references SGMED-08-04 is unable to fully evaluate the state of the stock and provide any scientific advice in relation to them.

7.30.8.2. Medium term considerations

SGMED-08-04 recommends fishing effort to be reduced in order to allow future recruitment contributing to stock recovery.

7.31. Stock assessment of pink shrimp in GSA 06

7.31.1. Stock identification and biological features

7.31.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.31.1.2. Growth

No information was documented during SGMED-08-04.

7.31.1.3. Maturity

No information was documented during SGMED-08-04.

7.31.2. Fisheries

7.31.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.31.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.31.2.3. Catches

7.31.2.3.1. Landings

The Working Group members reviewed the assessment of *Parapenaeus longirostris* presented in GSA 06 at the 2007 GFCM meeting[14]. The steep decline in catches from 2000 was noted (Figure 7.31.1.2.3.1.1), which was matched by downward trends in survey abundance estimates.

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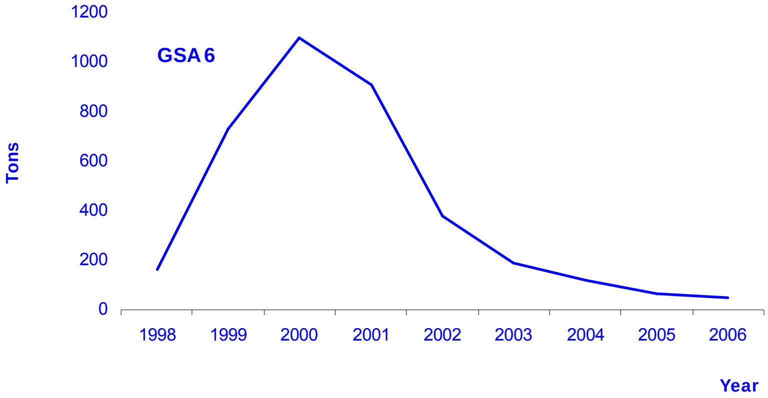
[14] SCSA/SAC/GFCM: http://www.icm.csic.es/rec/projectes/scsa/Demersals_2007/open documents.zip
for GSA06 open Doc01-DPS0607Pér.xls



Fig, 7.31.1.2.3.1.1 Landings as used by GFCM SAC in 2007.

Tab. 7.31.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings decreased from 380 t to only 41 t in 2007. The landings were only taken by demersal otter trawls.

Tab. 7.25.2.3.1.1 Annual landings (t) by fishing technique in GSA 06.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	6	ESP	OTB	380	190	117	63	49	41

7.31.2.3.2. Discards

No information was documented during SGMED-08-04.

7.31.2.3.3. Fishing effort

Fishing effort data are listed in Appendix 3, Tables 3.7-3.9.

7.31.3. Scientific surveys

7.31.3.1.Medits

7.31.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 01the following number of hauls were reported per depth stratum (s. Tab. 7.31.3.1.1.1).

Tab. 7.31.3.1.1.1. Number of hauls per year and depth stratum in GSA 06, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA06_010-050	7	8	7	7	7	8	9	8	11	9	9	11	11	6
GSA06_050-100	19	26	26	26	28	29	29	31	36	38	31	32	34	27
GSA06_100-200	11	17	17	15	13	17	18	20	20	21	17	18	19	15
GSA06_200-500	10	12	10	12	7	13	12	16	17	18	16	15	18	11
GSA06_500-800	6	8	9	7	4	9	6	8	7	11	11	8	10	8

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.31.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.31.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 06 was derived from the international survey Medits. Figure 7.31.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 06.

The estimated abundance and biomass indices were high in 2000 and 2001 but varied at a low level since then. The analyses of Medits indices are considered preliminary.

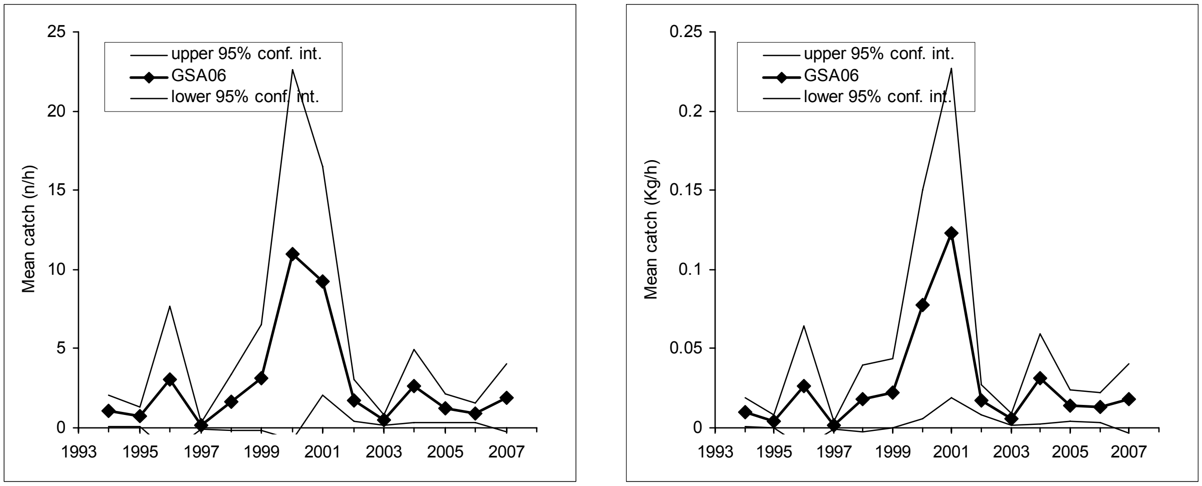
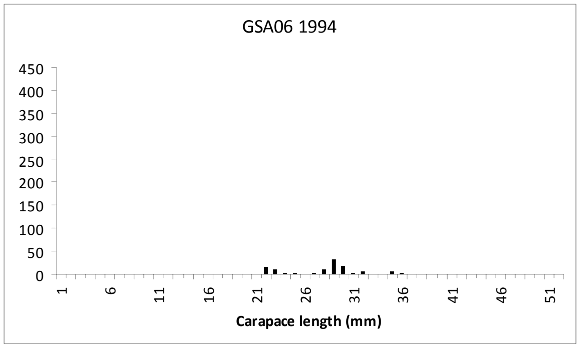
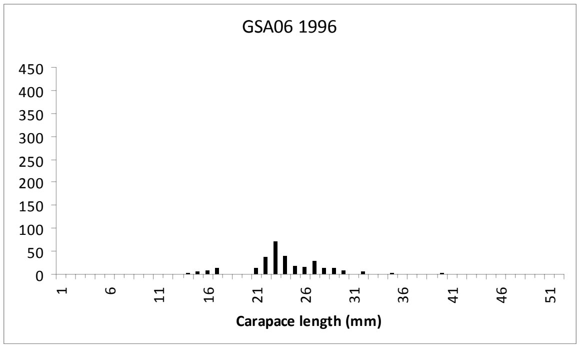


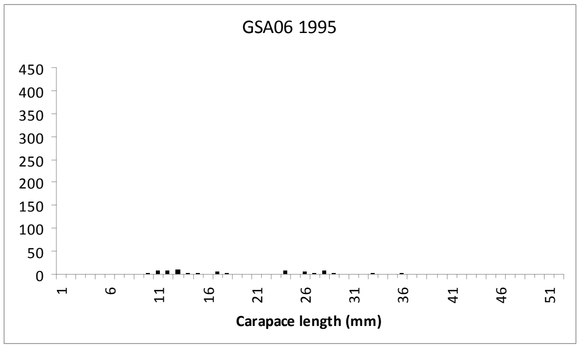
Fig. 7.25.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 06.

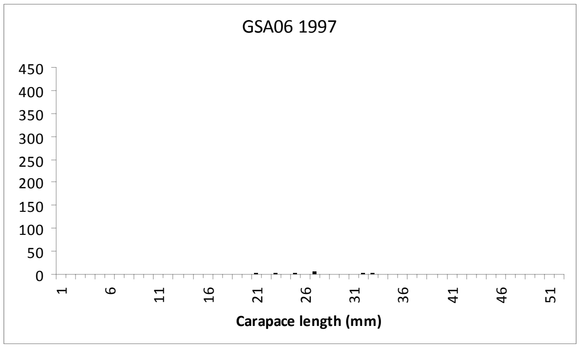
7.31.3.1.4. Trends in abundance by length or age

The following Fig. 7.31.3.1.4.1 and 2 display the stratified abundance indices of GSA 06 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.









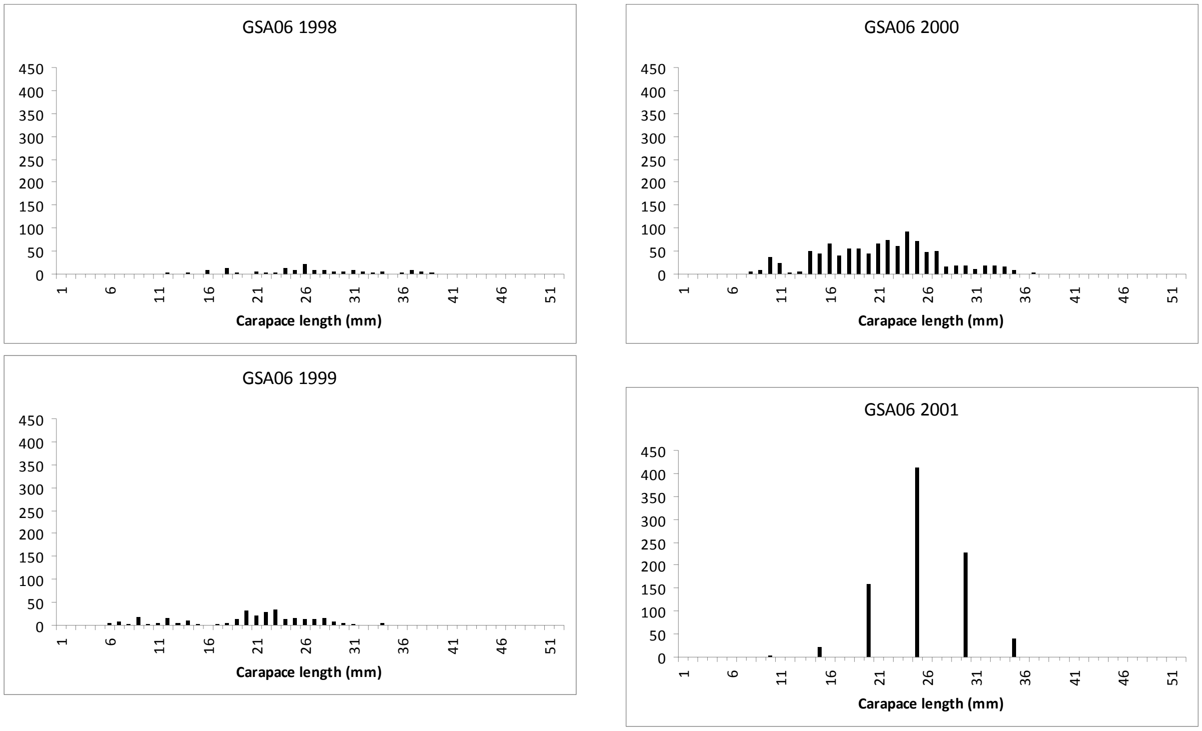
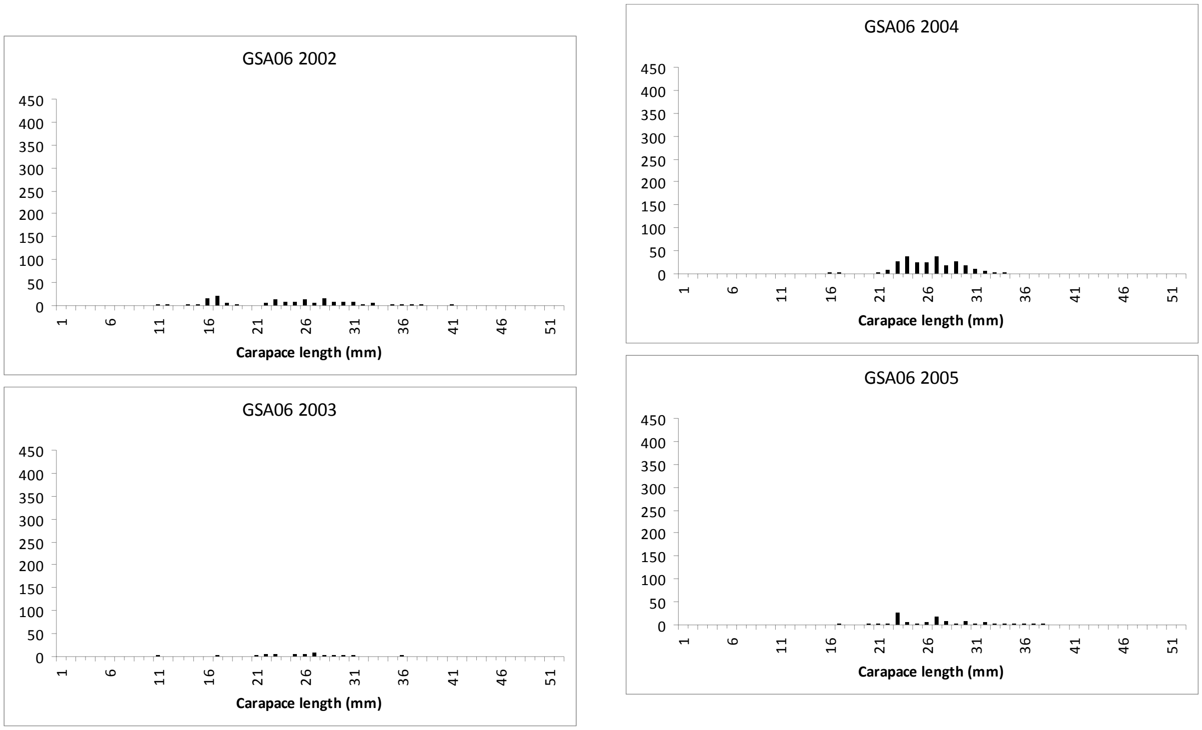


Fig. 7.31.3.1.4.1 Stratified abundance indices by size, 1994-2001.



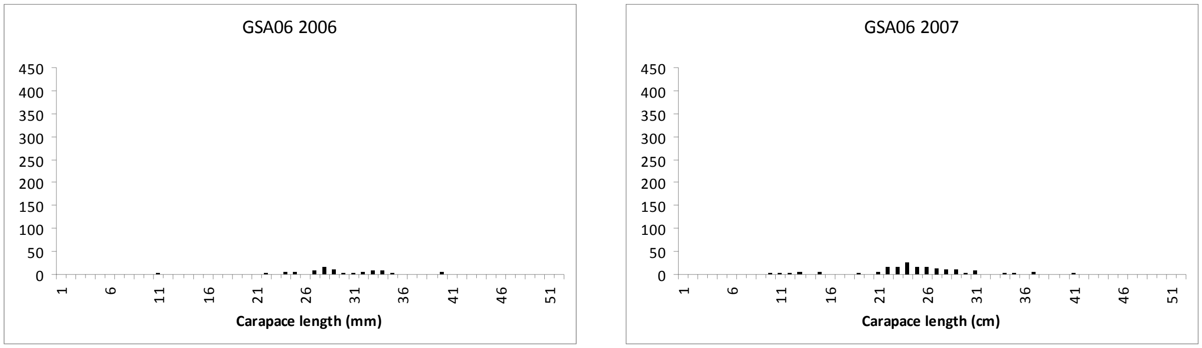


Fig. 7.31.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.31.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04.

7.31.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04.

7.31.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

It is noted that pink shrimp in GSA 06 was assessed in 2008 and presented to SCSA/SAC/GFCM. This assessment can be viewed at: http://www.icm.csic.es/rec/projectes/scsa/Demersals_2008/open documents.zip for GSA06 open Doc20-DPS0608Gui.xls
However, estimates of fishing mortality also showed a slight decline, which appeared inconsistent with the trends in biomass (Figure 7.31.3.1.6.1).

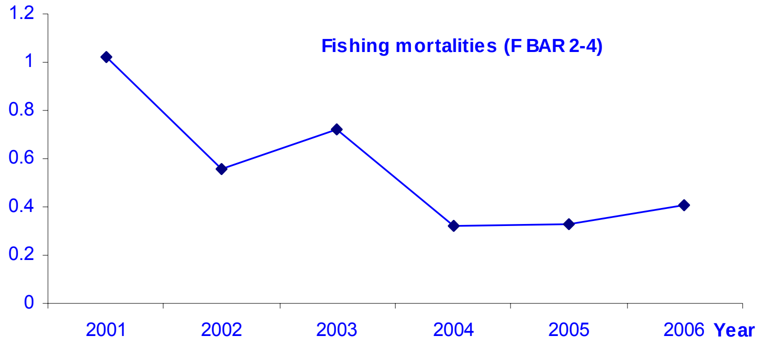


Fig. 7.31.3.1.6.1. Fishing mortality estimates from XSA assessment

The Working Group noted that is was difficult to perform a full review of the assessment, since the diagnostic information produced by XSA was not available in the GFCM report. As a result, the Group suggested that this assessment be re-analysed at SGMED-08-04, thereby allowing the Group to examine the issues further and learn from the experience. This is not a source of criticism of the original assessment, but the productive use of the SGMED framework to progress work intersessionally from GFCM meetings.

The Group noted that there appeared to be a mismatch within the biological parameters used – in particular a relatively low von Bertalanffy K value combined with a value of M of 1.25. The Group recommended that more consistent values of K be used (faster growth values of ~0.6 having been used in previous assessments).

The Group noted that the use of a constant natural mortality rate (a common assumption) which might affect the estimated pattern of fishing mortality over time. More critically, however, the Group noted that the last few years of fishing mortality estimated through XSA (and VPA in general) are the most uncertain, and hence the downward trend in fishing mortality cannot be confirmed.

7.31.5. Short term prediction for 2008 and 2009

7.31.5.1. Justification

No forecast analyses were conducted.

7.31.5.2. Input parameters

No forecast analyses were conducted.

7.31.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 06.

7.31.6. Medium term prediction

7.31.6.1. Justification

No forecast analyses were conducted.

7.31.6.2. Input parameters

No forecast analyses were conducted.

7.31.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 06.

7.31.7. Long term prediction

7.31.7.1. Justification

No forecast analyses were conducted.

7.31.7.2. Input parameters

No forecast analyses were conducted.

7.31.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSA 06.

7.31.8. Scientific advice

7.31.8.1. Short term considerations

7.31.8.1.1. State of the spawning stock size

Since 2001 SSB declined rapidly and continuously to the lowest value observed in 2007, which represents only 10% of that observed in 2001.

SGMED notes that the MEDITS survey abundance index shows a very high peak in abundance in the 1999-2001 period, which represents the start of the assessment period. Prior to 1999, abundance levels were comparable to those seen in the 2002-2007 period.

SGMED cannot evaluate the state of the spawning stock relative to reference points, as these have not been proposed or defined. Given the short-term decline by 90% from 2001 values, SGMED considers the stock status to be far below any sustainable levels.

7.31.8.1.2. State of recruitment

Recruits were estimated to have declined from 2001 to 2006 in the same pattern as SSB (90% to 2006). However, the most recent recruitment estimate in 2007 appears to be at the 50% level of the initial 2001 value.

7.31.8.1.3. State of exploitation

Fishing mortality over ages 1-3, was estimated to have declined from 2001 to 2005, from 0.9 to 0.2, and remained low since then.

The estimated level of exploitation should be considered to be sustainable under normal conditions, although no reference points have been estimated.

F and effort should be kept at a low level to allow any strong future recruitments to rebuild the stock. SGMED recommends a recovery plan to be established for this stock that takes into account the mixed species nature of the fishery.

7.31.8.2.Medium term considerations

Forecast at status quo predicts no changes on SSB and yields, being affected only by the strength of recruitments. A reduction of 10% of F shows no changes on SSB and yields.

7.32. Stock assessment of pink shrimp in GSA 09

7.32.1. Stock identification and biological features

7.32.1.1. Stock Identification

Stock delimitations are considered unknown.

The species shows a wide bathymetric distribution in the GSA9, being present from 50 to 650 m depth with greatest abundance between 150 and 400 m depth over muddy or sandy-muddy bottoms (Ardizzone and Corsi, 1997; Biagi *et al.*, 2002).

The highest abundances have been found in the Tyrrhenian part of the GSA (south Tuscany and Latium).

Recruits (CL ≤ 15 mm) occur all year round with a main peak from July to October (De Ranieri *et al.*, 1997). The main nurseries revealed a high spatio-temporal persistency (Fig. 7.20.1) between 60 and 220 m depth. The core of nursery areas overlap with crinoid beds (*Leptometra phalangium*) areas over the shelf-break (Colloca *et al*., 2004, 2006; Reale *et al*., 2005). This is a peculiar habitat in the GSA 09 which is also an essential fish habitat for other commercially important species as the European hake, *Merluccius merluccius*. A positive size-depth distribution was found with an increased abundance of larger females on deeper depths (Ardizzone *et al*., 1990).

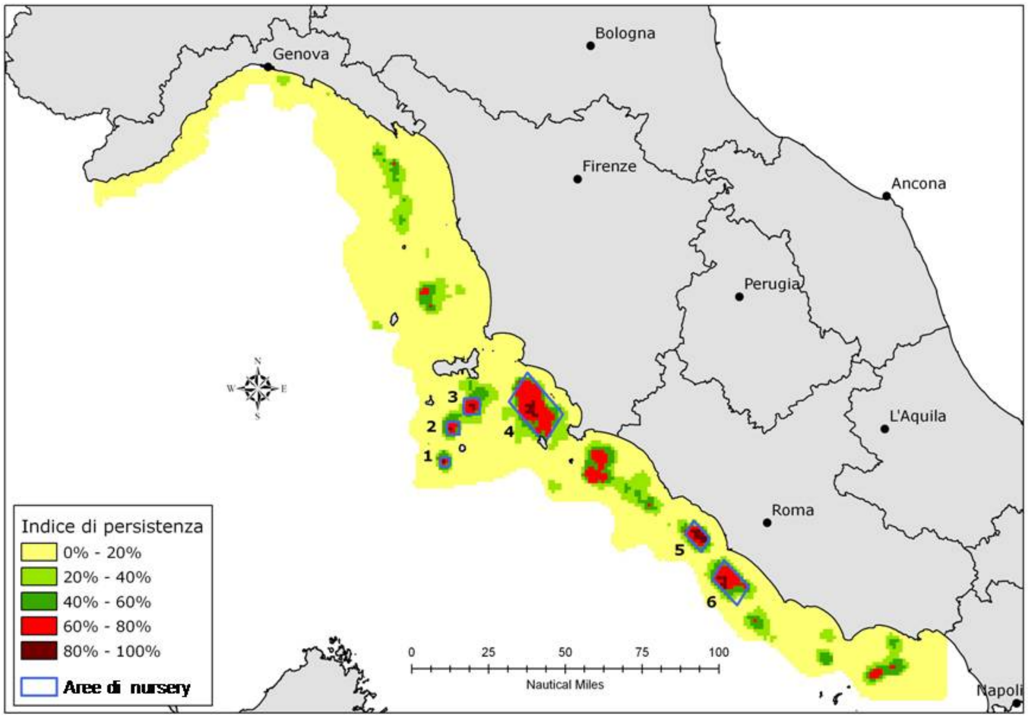


Fig. 7.32.1.1.1 Temporal persistence of *P. longirostris* nurseries in the GSA 09

7.32.1.2. Growth

The growth of *P. longirostris* has been studied in the southern part of the GSA 09 (central Tyrrhenian Sea) using modal progression analysis (Ardizzone *et al*., 1990). The following sets of Von Bertalanffy growth parameters were estimated: Females: L∞ = 43.5, K=0.74, t_o=-0.13; Males: L∞ = 33.1, K=0.93, t_o=-0.05. The life cycle is of 3-4 years. Females grow faster than males attaining lager size-at-age.

P. longirostris diet is composed of a great variety of organisms; the prey items consisted mostly of external skeletons of bottom organisms, always crushed and often in an advanced state of deterioration. Crustaceans dominated the diet both qualitatively and quantitatively; they were characterized by a high abundance of peracarids, mainly represented by mysids (*Lophogaster typicus*), and amphipods (Lysianassidae). Molluscs (juvenile bivalves and gastropods); cephalopods (Sepiolids), small echinoderms, annelids, small fishes, foraminiferans, (Globigerinidae) and organic detritus are other important food item in the diet of the species (Mori *et al.*, 2000b).

7.32.1.3.Maturity

In the northern Tyrrhenian Sea, the reproduction area of *P. longirostris* is located from 150 to 350 m; mature females are present all year round, even though the species shows two maxima of reproductive activity, one in spring and another at the beginning of autumn. (Mori *et al*., 2000a). In the central Tyrrhenian Sea, the southern part of GSA 09, a main winter spawning was hypothesized (Ardizzone *et al*., 1990). The size at onset of sexual maturity estimated for different years in northern Tyrrhenian Sea is about 24 mm CL (Mori *et al*., 2000a).

The number of oocytes in the ovary was related to the size of the females and ranged from 23,000 oocytes at 26 mm CL to 204,000 at 43 mm CL. An exponential relationship was observed between fecundity and carapace length: Fecundity = 0.0569 CL4.0177 (r = 0.829) (Mori *et al*. (2000a).

7.32.2. Fisheries

7.32.2.1.General description of fisheries

In the GSA9 the deep water pink shrimp is one of the most important target species of the fishery carried out on the shelf break and upper part of continental slope. The species is exclusively exploited with otter bottom trawling.

The fishing grounds are located in the southern part of the GSA 09, to the south of Elba Island (northern and central Tyrhhenian Seas); they are mainly exploited by several trawlers of Porto Santo Stefano, Porto Ercole, Fiumicino, Terracina and Gaeta. *P. longirostris* belongs to a fishing assemblage distributed from 150 to 350 m depth, where the main target species are hake, *Merluccius merluccius*, horned octopus, *Eledone cirrhosa* and Norway lobster, *Nephropos norvegicus*, at greater depths (Biagi *et al.*, 2002; Colloca *et al.*, 2003; Sartor *et al*., 2003; Sbrana *et al*., 2006).

As concerns fishing activity, the majority of bottom trawlers of GSA 09 performs daily fishing trips; only some vessels (especially those of Porto Santo Stefano) can stay out of the port for two-three days, mainly in summer. The mean number of fishing days/year per vessel fishing days carried out by the GSA 09 trawlers varied from 187 in 2004 to 177 in 2006. Due to the distance of the fishing grounds to the main harbours, fishing activity targeting *P. longirostris* shows some seasonal variations, with maxima from mid spring to mid autumn.

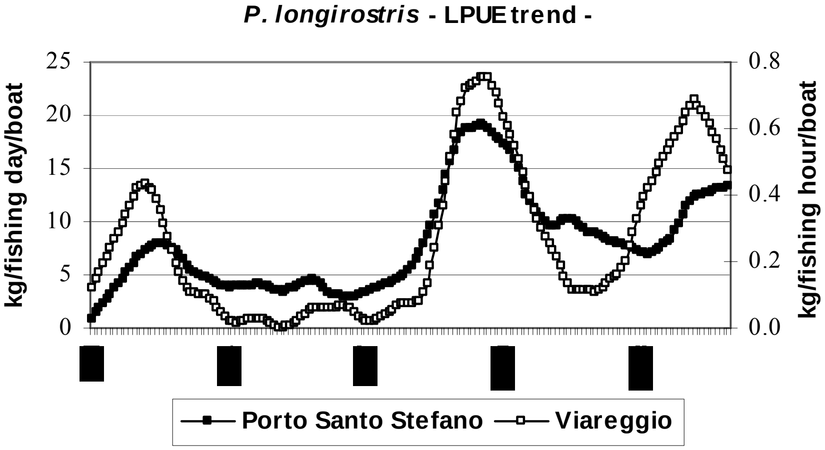


Fig. 7.32.2.1.1 *P. longirostris.* LPUE of P. S. Stefano and Viareggio trawlers since 1991 (bottom)

The size structure of the landings, according to the DCR data collected in 2006, shows that the most exploited sizes ranged from 24 and 40 mm CL (Fig. 7.32.2.1.2); the presence of specimens under the MLS (20 mm CL) is negligible. According to the growth pattern of the species, fishing exploits 1^+ - 3^+ shrimps.

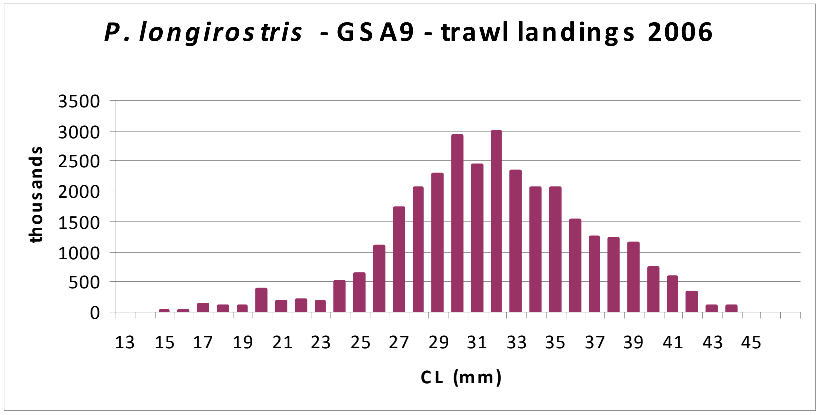


Fig. 7.32.2.1.2 Length frequency distribution of *P. longirostris* landed in the GSA 09.

7.32.2.2. Management regulations applicable in 2007 and 2008

The minimum legal landing sizes is 20 mm Carapace Length (EC regulation 1967/2006). The other management regulation are the same described for hake in the GSA 09.

7.32.2.3. Catches

7.32.2.3.1. Landings

Total landings of deep water rose shrimps fluctuated from 160 tons in 2002 to 220 tons in 2007, showing a peak in 2006 corresponding to 450 tons (Fig. 7.32.2.2.3.1). The fluctuating trend is a proper characteristic of the landings of this species, as shown by the LPUE produced by the fleets of Porto Santo Stefano and Viareggio in the period 2001-2005 (Sartor *et al.*, 2005) (Fig. 7.32.2.1.1). The values of the two fleets showed the same temporal pattern with maxima in 1992, 1999 and 2004.

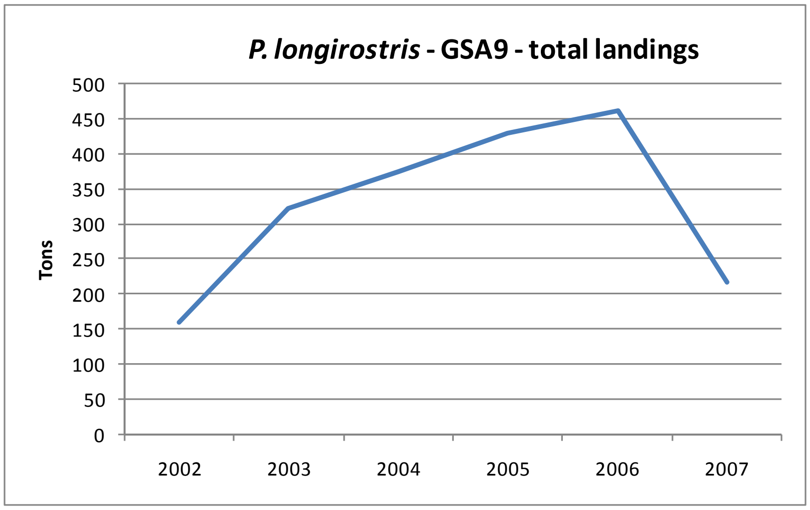


Fig. 7.32.2.2.3.1 Total landings in GSA 09.

Tab. 7.32.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 annual landings increased from 160 t to 460 t in 2006 and decreased in 2007 to 220 t. The landings were mainly taken by demersal otter trawls.

Tab. 7.32.2.3.1.1 Annual landings (t) by fishing technique in GSA 09.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	9	ITA	DTS	133	308	367	430	462	215
DPS	9	ITA	PGP		3	8	1		2
DPS	9	ITA	PMP	19	12	0			
DPS	9	ITA	PTS	9	0	1			
SUM				161	323	376	431	462	217

7.32.2.3.2. Discards

As a matter of fact, discards of *P. longirostris* are scarce; according to Sbrana *et al*. (2006) they ranged from 0.35 to 1.24% of the total catch of the species. Discards occurred mainly on the fishing grounds located at depths of less than 200 m, where juvenile specimens are more abundant.

9 t in 2006 of discards were reported to SGMED-08-04 (Tab. A3.6 of Appendix 3).

7.32.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.32.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3. After 2006, the effort of the major demersal trawler fleet decrased slightly.

Tab. 7.32.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 09, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728	4739	5242	5160
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS			143490	162480	200226	194754
KW*DAYS	9	ITA	DRB	187147	335520	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166	1013627	1174295	1151346

7.32.3. Scientific surveys

7.32.3.1.Medits

7.32.3.1.1. Methods

From 1994 two trawl surveys are regularly carried out each year: MEDITS, in spring, and GRUND, in autumn. The two surveys gave a similar temporal increasing trend in density and biomass of deep water pink shrimp showing large fluctuations from year to year (Fig. 7.32.3.1.1.1). A similar increasing trend in abundance has been observed also in other Italian geographic subareas and could be related to the warming trend in water temperature. *P. longirostris* is a thermopile species that could benefit by the ongoing climatic change in the Mediterranean region. Relationships between environmental variability and deep-sea pink shrimp population dynamic still needs to be investigated.

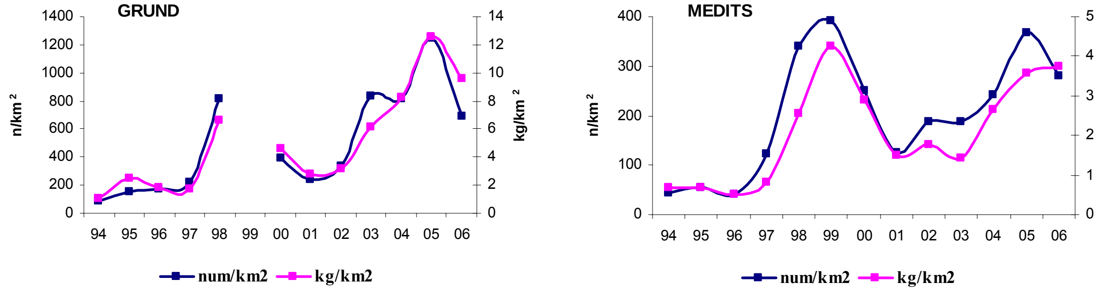


Fig. 7.32.3.1.1.1 *P. longirostris*: Grund and Medits trends in density and biomass from 1994 to 2006 in GSA 09.

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 09 the following number of hauls were reported per depth stratum (s. Tab. 7.32.3.1.1.1).

Tab. 7.32.3.1.1.1. Number of hauls per year and depth stratum in GSA 09, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA09_010-050	19	18	18	18	19	18	18	18	13	13	13	14	13	13
GSA09_050-100	19	19	18	19	18	19	20	20	15	15	15	14	16	16
GSA09_100-200	35	35	36	35	35	35	34	34	26	27	26	27	25	26
GSA09_200-500	32	33	33	36	32	36	37	35	27	27	27	28	29	33
GSA09_500-800	31	30	32	28	30	28	27	29	24	22	21	20	20	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.32.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.32.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 09 was derived from the international survey Medits. Figure 7.32.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 09.

The estimated abundance and biomass indices peaked in 1998-1999 and in 2004-2005. Recent abundance and biomass indices in 2007 appear low. The analyses of Medits indices are considered preliminary.

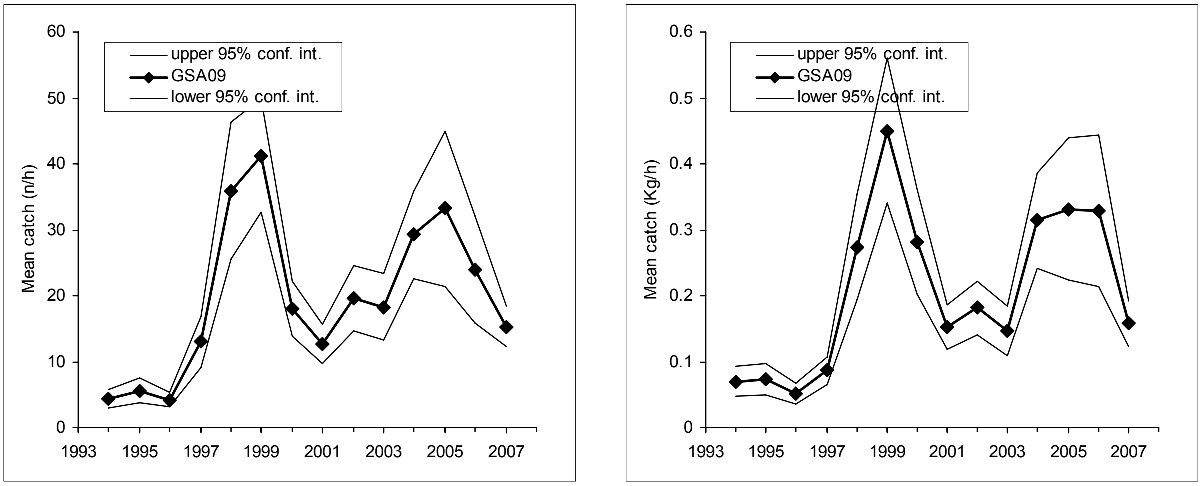
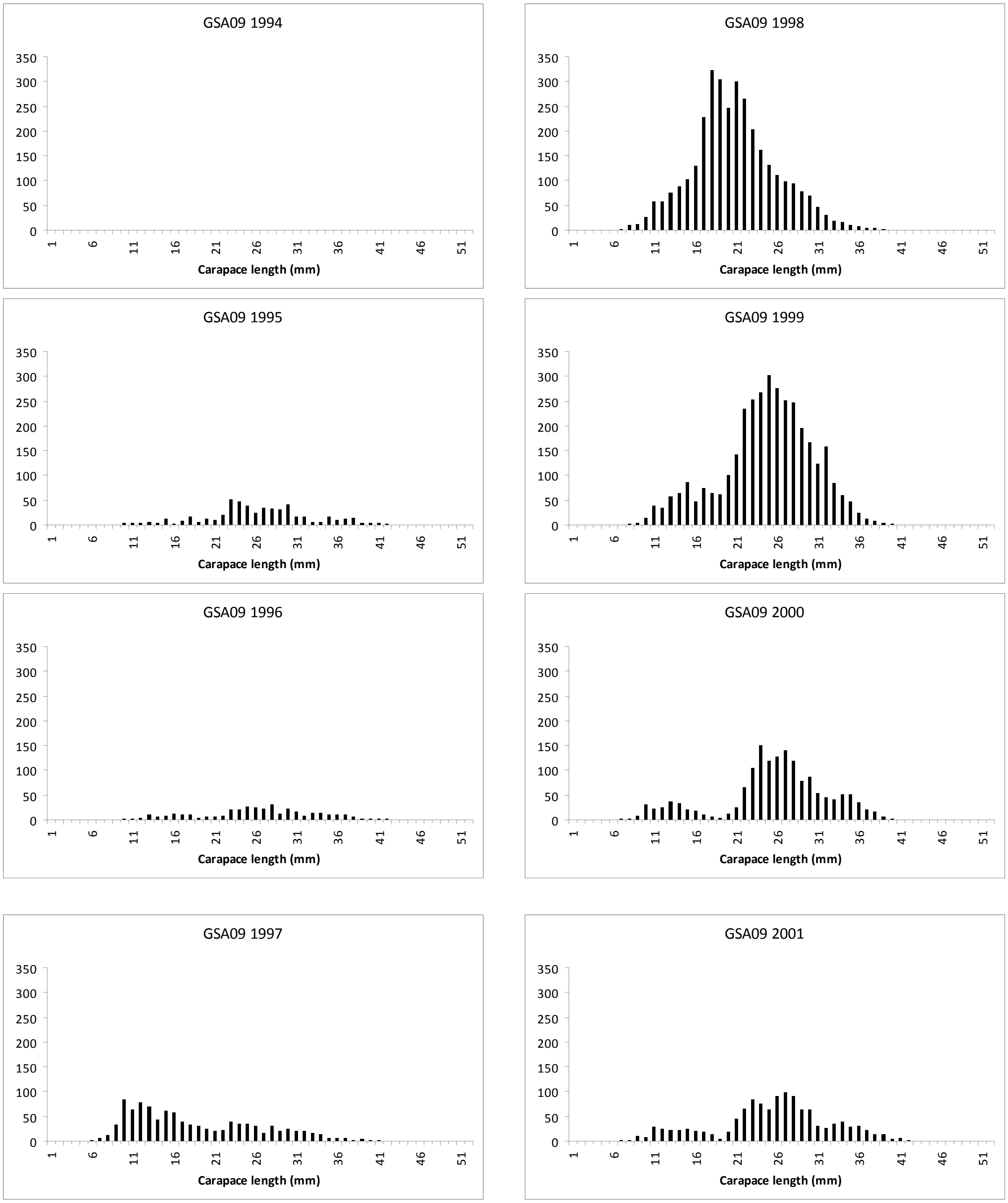


Fig. 7.32.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 09.

7.32.3.1.4. Trends in abundance by length or age

The following Fig. 7.32.3.1.4.1 and 2 display the stratified abundance indices of GSA 09 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.



GSA09 1994

GSA09 1998

GSA09 1995

GSA09 1999

GSA09 1996

GSA09 2000

GSA09 1997

GSA09 2001

Fig. 7.32.3.1.4.1 Stratified abundance indices by size, 1994-2001.

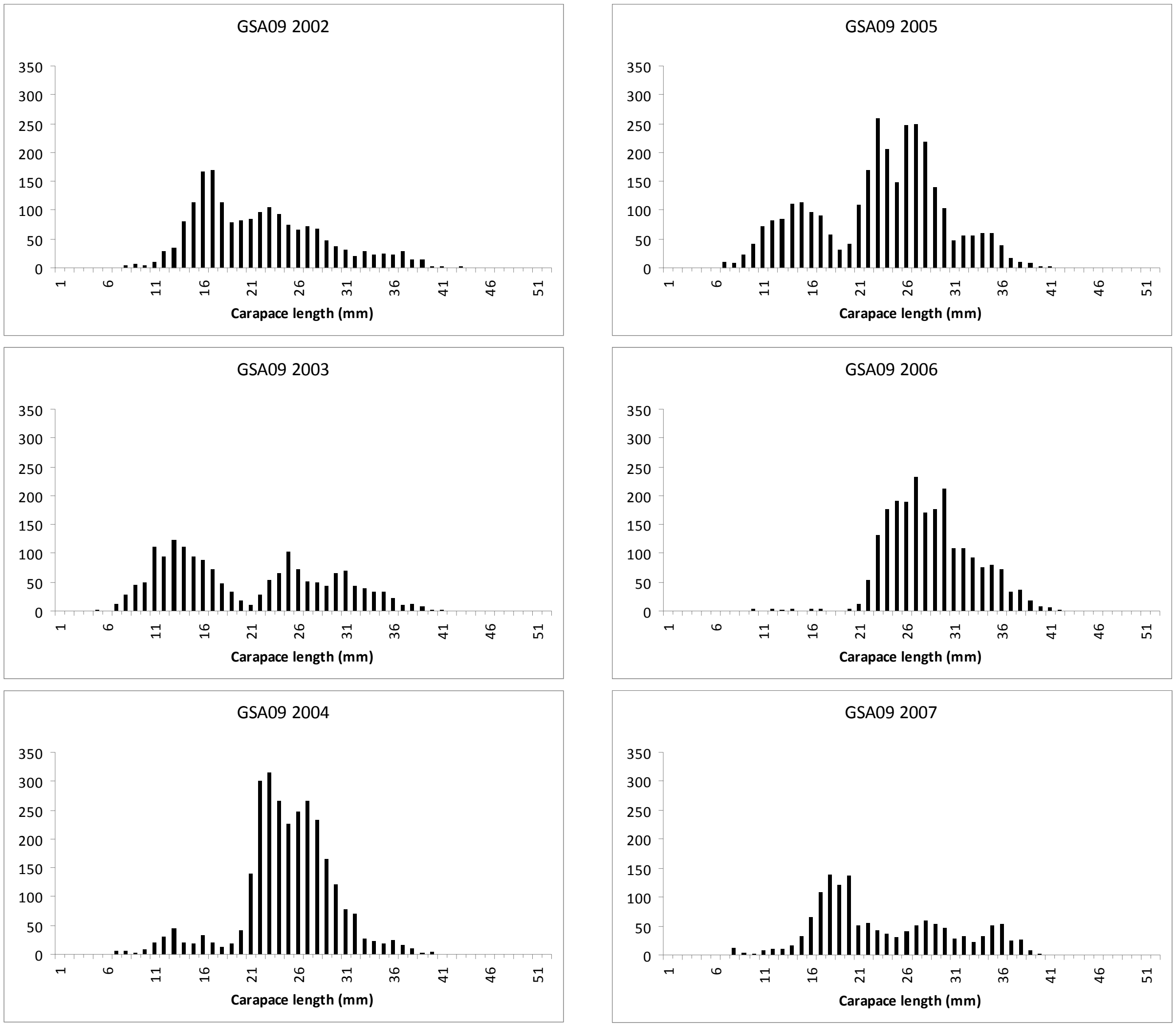


Fig. 7.32.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.32.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.32.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.32.4. Assessment of historic stock parameters

7.32.4.1.Method 1: SURBA

7.32.4.1.1. Justification

The Medits survey provided the longer standardized time-series data on abundance and population structure of *P. longirostris* in the GSA 09.

7.32.4.1.2. Input parameters

The survey-based stock assessment model SURBA (Needle, 2003) was used to reconstruct trend in population structure and fishing mortality.

The following set of input data and parameters were used (Tables 7.32.4.1.2.1, 7.32.4.1.2.2).

Tab. 7.32.4.1.2.1 Input data used in the SURBA model.

Abundance indeces by age				Proportion of mature by age				Weight at age (g) by age			
1	2	3	4	1	2	3	4	1	2	3	4
19.6	367.7	155.3	55.8	0.3	0.8	1	1	2.661	15.52	18.13	25.14
137.1	489.6	102.5	50.4	0.3	0.8	1	1	2.734	15.08	18	24.72
118.3	334.9	116.5	37.4	0.3	0.8	1	1	3.252	16.47	18.12	24.96
1010.8	513.2	136.1	23.9	0.3	0.8	1	1	2.479	13.81	17.37	24.62
1988.6	2625.9	198.7	19.7	0.3	0.8	1	1	3.752	15.79	17.08	24.91
859.6	3708.3	799.8	42.7	0.3	0.8	1	1	3.223	15.94	17.23	23.97
610.9	2274.9	661.5	98.4	0.3	0.8	1	1	2.491	14.71	18.03	23.82
331.1	1114.7	290.6	90.4	0.3	0.8	1	1	2.58	14.72	18.23	24.56
1102.1	1185.5	261.3	106.6	0.3	0.8	1	1	3.527	16.04	18.01	24.22
1427.4	822.8	343.3	59.8	0.3	0.8	1	1	2.581	14.87	17.58	24.26
307.9	2913.3	339.9	41.7	0.3	0.8	1	1	2.748	14.74	17.12	23.82
1398.5	3629.6	521.6	59.9	0.3	0.8	1	1	2.773	14.86	18.03	24.69
50.0	3416.7	1016.0	191.1	0.3	0.8	1	1	3.085	16.5	17.81	24.37
879.3	1235.9	443.4	120.3	0.3	0.8	1	1	3.977	17.23	18.53	23.75

Tab. 7.32.4.1.2.2 Input parameters used in the SURBA model.

• **Growth**
L∞ = 43.5 mm carapace length
K = 0.6
to = 0
• **Length-Weight relationhips**
a = 0.00686
b = 2.24
• **Natural mortality**
M = 1.2 (Samed project, Beverton & Holt)
• **Length-at-maturity (L50)**
L50 = 24 mm
Lc100 = 20 mm

Standardized time series of Medits length-frequency-distributions were sliced into different age-groups using the same growth parameters for the whole time series (Fig. 7.32.4.1.2.1). The resulting age structures showed a very high internal consistency, thus showing the reliability of the growth parameters used (Fig. 7.32.4.1.2.1).

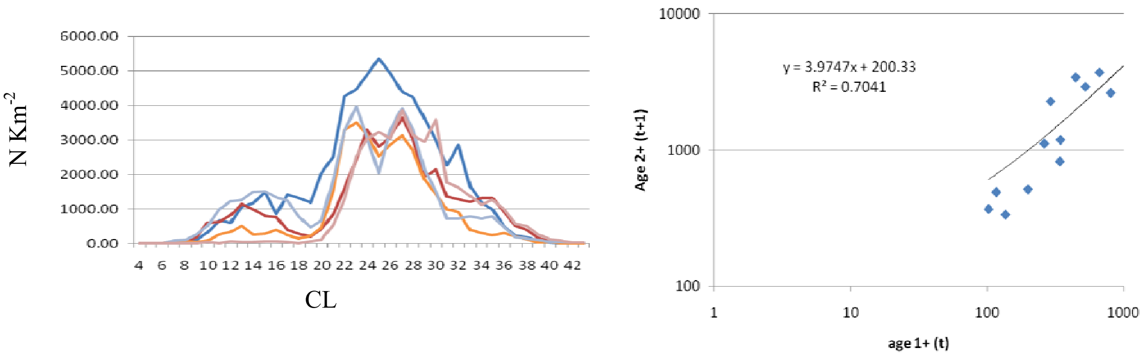


Fig. 7.32.4.1.2.1 Length frequency distributions of P. longirostris for 2000 to 2005 (left). Relationship between the estimated shrimp abundance at age 1 (time t) and age 2 (time t+1) (right).

A preliminary attempt to use Surba was made excluding 0+ (CL < 20mm) specimens from the dataset due to their low catchability with the Medits trawl net. A fixed M mortality value (M=1.0) obtained from literature was adopted .

7.32.4.1.3. Results

Temporal trend in $F_{2\text{-}4}$ showed large fluctuations between 0.2 and 1.2 (mean over the whole time period: 0.65). Two main peaks in SSB appeared in 1999 and 2005, followed by a decreasing in 2006 and 2007. SSB in 2007 was however at a higher level than in 1994-97 (Fig. 7.32.4.1.3.1).

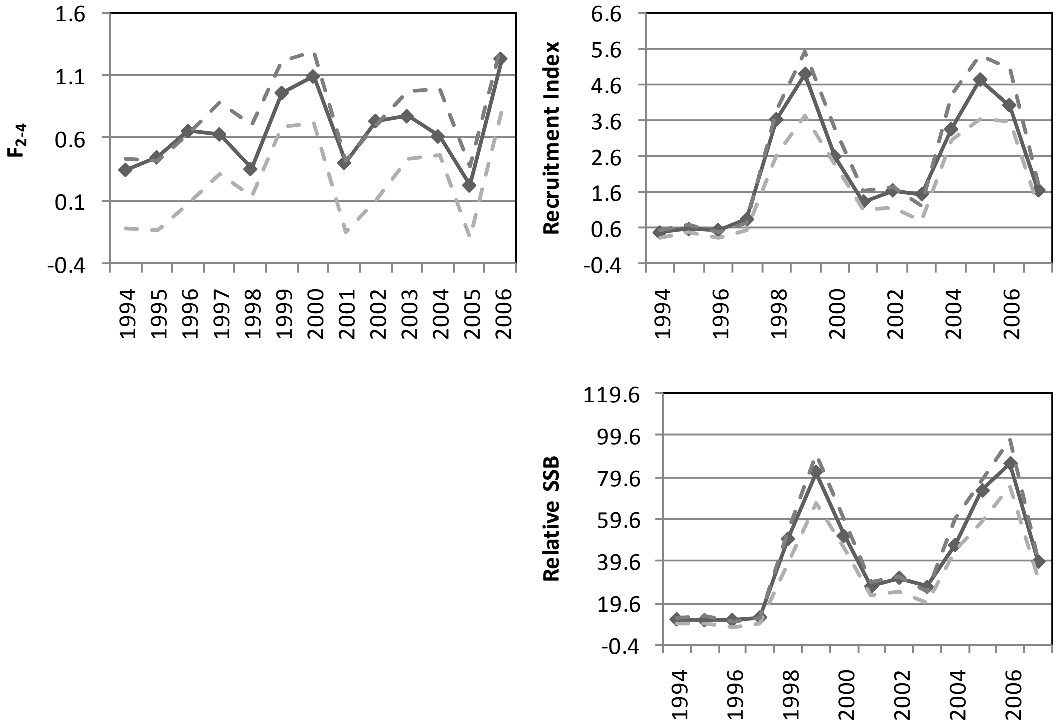
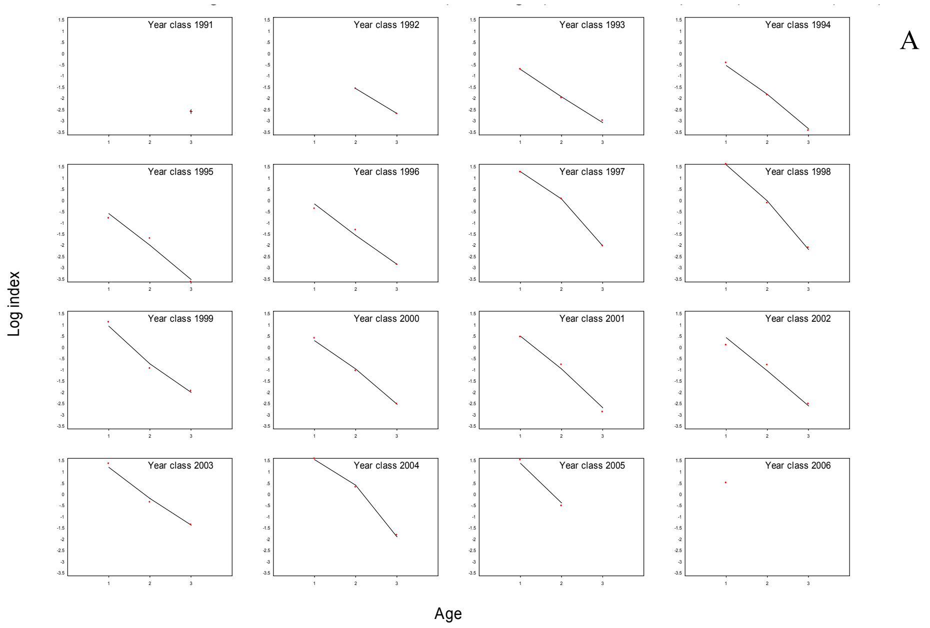


Fig. 7.32.4.1.3.1 Estimated trend in $F_{2\text{-}4}$ relative SSB and recruitment index at age 1+ of *P. longirostris* in the GSA 09, dotted lines are 2.5% and 97.5% confidence intervals.

<u>Model diagnostics</u>

The Surba model for *P. longirostris* fits very well on survey data as showed in Figs 7.32.4.1.3.2.



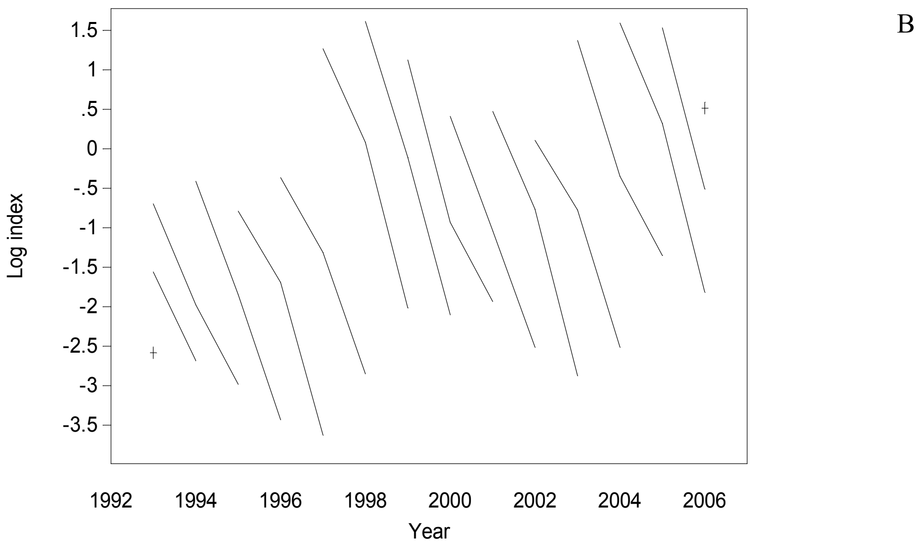


Fig. 7.32.4.1.3.2. Model diagnostic for Surba model of in the GSA 9. A) Comparison between observed (points) and fitted (lines) Medits survey abundance indices, for each year. B) Log survey abundance indices by cohort. Each line represents the log index abundance of a particular cohort throughout its life.

7.32.4.2. Method 2: Z from survival rate

7.32.4.2.1. Justification

F_{2-4} was also estimated taking the ratio of the average abundance of age classes ($Z=\ln N_0/N_1$)
Age slicing obtained from Medits LFDs returned a quite consistent estimation of survey abundance of age classes allowing the use of conventional approaches for mortality estimation.

7.32.4.2.2. Input parameters

Abundace-at-age data from surveys (Tab. 7.32.4.2.2.1) and a fixed M value (M=1) were used.

7.32.4.2.3. Results

Mean F_{2-4} ranged between 0.19 and 0.41 according to different years (Tab. 7.32.4.2.3.1).

Tab. 7.32.4.2.3.1 Estimated total instantaneous mortality coefficients (Z and F) for different pairs of year and age groups.

	Age				
year	2/3	3/4	Mean Z	M	Mean F
1994/95	1.28	1.29	1.28	1	0.28
1995/96	1.30	1.28	1.29	1	0.29
1996/97	1.18	1.50	1.34	1	0.34
1997/98	1.18	1.65	1.41	1	0.41
1998/99	1.18	1.41	1.29	1	0.29
1999/00	1.27	1.46	1.36	1	0.36
2000/01	1.36	1.44	1.40	1	0.40
2001/02	1.26	1.21	1.24	1	0.24
2002/03	1.21	1.36	1.29	1	0.29
2003/04	1.15	1.57	1.36	1	0.36
2004/05	1.27	1.42	1.35	1	0.35
2005/06	1.18	1.19	1.19	1	0.19
2006/07	1.34	1.45	1.39	1	0.39

7.32.4.3.Method 3: LCA

7.32.4.3.1. Justification

7.32.4.3.2. Input parameters

Data coming from DCR provided at SGMED 08-03 contained, for GSA9, information on deep sea pink shrimp landings and the respective size structure for 2006-2007 (Fig. 7.32.4.1.2.3.). VIT software was used to run an LCA analysis for each year separately, using data in Tab. 7.32.4.3.2.1 and biological parameters listed in Tab. 7.32.4.1.2.2. The following M-vector was adopted (age 1: 1.2; age 2: 1.0; age 3: 0.8; age 4: 0.6).

Tab. 7.32.4.3.2.1. Input data for LCA of deep sea pink shrimp in GSA 9

	Landing numbers*1000	
CL	2006	2007
11		7.06
12		
13	19.76	28.46
14	29.65	28.25
15	136.22	61.93
16	101.14	129.32
17	95.09	213.89
18	392.93	246.38
19	188.91	492.04
20	214.65	668.14
21	182.13	814.39
22	495.90	990.43
23	625.68	1066.59
24	1100.89	757.59
25	1728.21	830.91
26	2051.99	907.30
27	2287.16	926.05
28	2912.56	828.73
29	2432.77	636.88
30	2985.42	558.48
31	2344.57	465.97
32	2057.42	629.60
33	2063.54	827.58
34	1509.35	782.86
35	1244.06	671.66
36	1209.23	653.08
37	1142.83	425.16
38	726.60	273.12
39	574.89	150.91
40	324.24	102.82
41	108.11	41.56
42	98.26	31.79
43	7.95	29.64
44		7.41
45		14.82

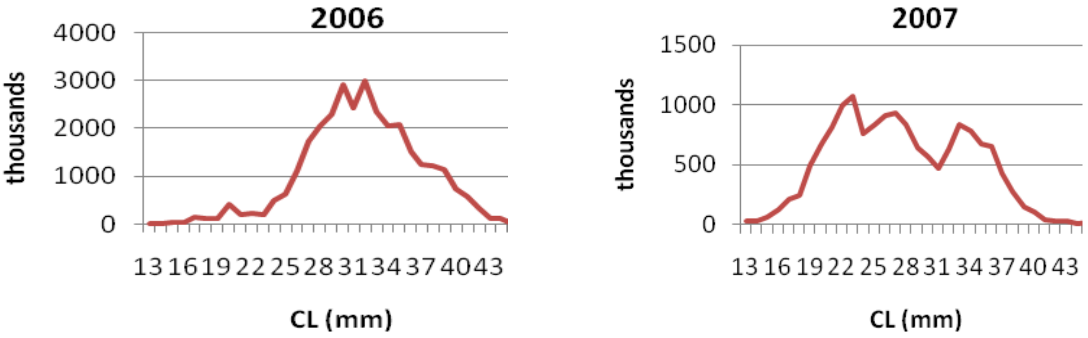


Fig. 7.32.4.3.2.1. Length frequency distributions of the *P. longirostris* catch in 2006 and 2007 in the GSA 9

7.32.4.3.3. Results

Deep-sea pink shrimp landing in 2006 and 2007 was concentrated on adults of age classes 2-4. A high landing was observed in 2007. LCA estimated very similar population numbers in the two years. Fishing mortality peaked for specimens of age classes 3-4 (Fig. 7.32.4.3.3.1). F_{2-4} (obtained averaging the estimated F values of age classes 2,3 and 4) was 0.44 and 0.51 in 2006 and 2007, respectively.

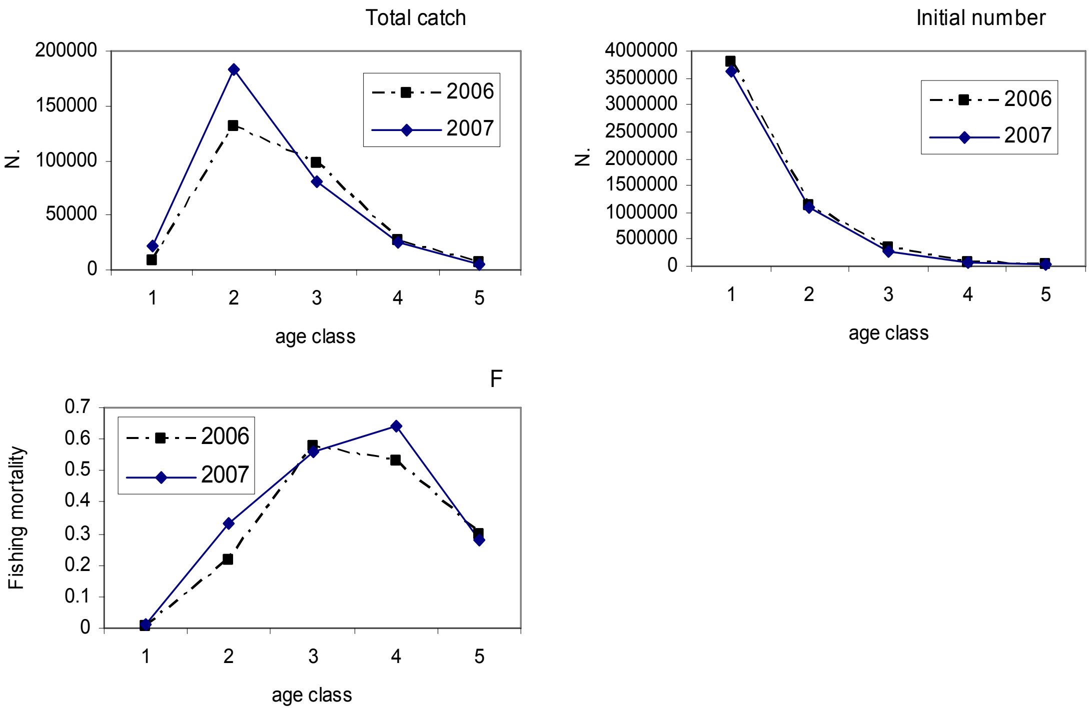


Fig. 7.32.4.3.3.1 Lca outputs: catch numbers, numbers-at-age and fishing mortality at age of *P. longirostris* in the GSA 9.

7.32.5. Short term prediction for 2008 and 2009

7.32.5.1. Justification

No forecast analyses were conducted.

7.32.5.2. Input parameters

No forecast analyses were conducted.

7.32.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 09.

7.32.6. Medium term prediction

7.32.6.1. Justification

No forecast analyses were conducted.

7.32.6.2. Input parameters

No forecast analyses were conducted.

7.32.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 09.

7.32.7. Long term prediction

7.32.7.1. Justification

The Yield software (Hoggarth et al., 2006) was used to estimate F_{01} as target equilibrium YPR reference point for the stock assuming a 20% uncertainty in parameters estimations.

7.32.7.2. Input parameters

The following parameters were used to estimate F_{01} through Yield software.

Tab. 7.32.7.2.1 Input to long term forecast.

L∞ = 43.5 mm carapace length
K = 0.6
to = 0
a = 0.00686
b = 2.24
M = 1.2 CV=0.1
L50 = 24 mm, CV=0.05
Lc100 = 20 mm, CV=0.05
Spawning season: March-August
Fishing season: January-December

7.32.7.3.Results

Fig. 7.32.7.3.1 shows the probability distribution of $F_{0.1}$ (1,000 simulations). Uncertainty in model parameters produced considerable variations in $F_{0.1}$ which ranged between 0.8 and 1.8 (mean = 1.3) with an increased probability for values between 1.1 and 1.5.

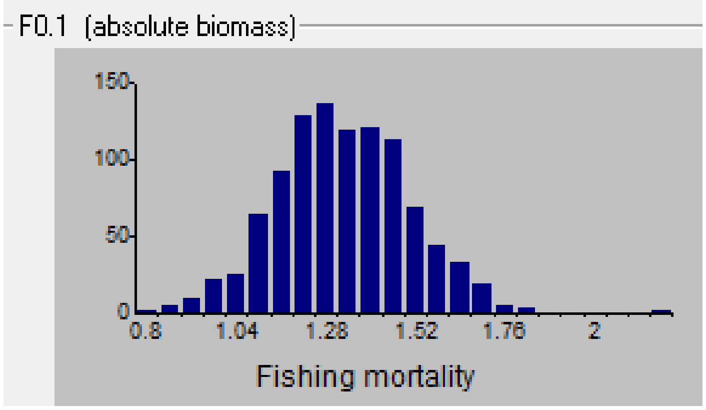


Fig. 7.20.8. Probability distribution of $F_{0.1}$ obtained using the Yield software

According to these $F_{0.1}$estimates, Fcurr was in most of the year lower than the minimum estimated $F_{0.1}$ value (0.8) and never exceeding the average $F_{0.1}$ value (1.3).

7.32.8. Scientific advice

7.32.8.1.Short term considerations

7.32.8.1.1. State of the spawning stock size

SSB showed an increasing trend during the last 13 years, even though a decreasing in 2007 was observed.

7.32.8.1.2. State of recruitment

Relative indices for age 1+ indicated a general increasing trend since 1994 with two main recruitment peaks in 1999 and 2005. In 2007 recruitment index was 40% compared to the short term average (2004-06).

7.32.8.1.3. State of exploitation

The stock appears able to face the current level of fishing effort in the GSA 09. In the period considered (1994-2007) it seemed to be in an underexploited status.
Average mortality(F_{2-4}) estimated from SURBA needs to be refined giving both the high uncertainty and variability in the annual estimates. F_{2-4} estimated through LCA and the survivor rate of annual cohorts were, respectively 0.44-0.51 (LCA) and 0.19-0.39 (survival rate) in the last two years (2006-07) well below the estimated reference value of $F_{0.1}$=1.3.
It is however important to consider that this stock could be strongly driven by environmental and ecological factors (e.g. water temperature, predatory release effect) that can make difficult to evaluate the effect of fishing on the stock.

7.32.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.33. Stock assessment of pink shrimp in GSA 10

7.33.1. Stock identification and biological features

7.33.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.33.1.2. Growth

No information was documented during SGMED-08-04.

7.33.1.3. Maturity

No information was documented during SGMED-08-04.

7.33.2. Fisheries

7.33.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.33.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.33.2.3. Catches

7.33.2.3.1. Landings

Tab. 7.33.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings varied annually among 487 t and 1,861 t. The landings were mainly taken by demersal otter trawls.

Tab. 7.33.2.3.1.1 Annual landings (t) by fishing technique in GSA 10.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	10	ITA	DTS	1452	416	488	695	1086	533
DPS	10	ITA	HOK			0		1	
DPS	10	ITA	PGP	2		0	0	1	
DPS	10	ITA	PMP	373	71	63	80	1	2
DPS	10	ITA	PTS	34		0			
SUM				1861	487	551	775	1089	535

7.33.2.3.2. Discards

1 t of discards in 2006 was reported to SGMED-08-04 through the DCR data call and is listed in Tab. A.3.6 of Appendix 3..

7.33.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.33.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.33.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 10, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	10	ITA	DRB	658	205	830	1776	1984	1040
DAYS	10	ITA	DTS	37949	38134	44087	46547	43848	40724
DAYS	10	ITA	HOK			20929	20418	8064	7043
DAYS	10	ITA	PGP	357895	311474	325523	268441	346849	311693
DAYS	10	ITA	PMP	105705	143062	62225	64177	10532	7261
DAYS	10	ITA	PTS	8258	9780	11792	11206	9332	9367
GT*DAYS	10	ITA	DRB			7968	17128	19136	9939
GT*DAYS	10	ITA	DTS			1337882	1622062	1331071	1266460
GT*DAYS	10	ITA	HOK			157882	143835	103111	82342
GT*DAYS	10	ITA	PGP			661958	534880	800036	693057
GT*DAYS	10	ITA	PMP			336053	333845	152717	110850
GT*DAYS	10	ITA	PTS			390096	468145	367417	280190
KW*DAYS	10	ITA	DRB	94663	29540	110899	244013	272628	142455
KW*DAYS	10	ITA	DTS	7344089	7231486	7883881	8467144	7596783	7105075
KW*DAYS	10	ITA	HOK			1654352	1413547	925244	794816
KW*DAYS	10	ITA	PGP	6440217	7222145	7056306	6018600	9486681	8397010
KW*DAYS	10	ITA	PMP	12686947	8003452	3588004	3728376	1404642	1003285
KW*DAYS	10	ITA	PTS	2631242	2930380	2308589	2434470	2016508	1680295

7.33.3. Scientific surveys

7.33.3.1.Medits

7.33.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 10 the following number of hauls were reported per depth stratum (s. Tab. 7.33.3.1.1.1).

Tab. 7.33.3.1.1.1. Number of hauls per year and depth stratum in GSA 10, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA10_010-050	9	10	10	10	10	10	10	10	9	9	9	9	9	9
GSA10_050-100	12	12	12	12	12	12	12	12	10	10	10	10	10	10
GSA10_100-200	20	20	20	20	20	20	20	20	17	17	17	17	17	17
GSA10_200-500	26	27	26	26	27	26	26	28	22	22	22	22	22	22
GSA10_500-800	31	30	31	31	31	30	31	29	26	26	26	26	26	26

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.33.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.33.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 10 was derived from the international survey Medits. Figure 7.33.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 10.

The estimated abundance and biomass indices peaked in 1999 and 2005-2006. However, the recent abundance and biomass indices in 2007 appear low, which appears consistent with the low landings in 2007. The analyses of Medits indices are considered preliminary.

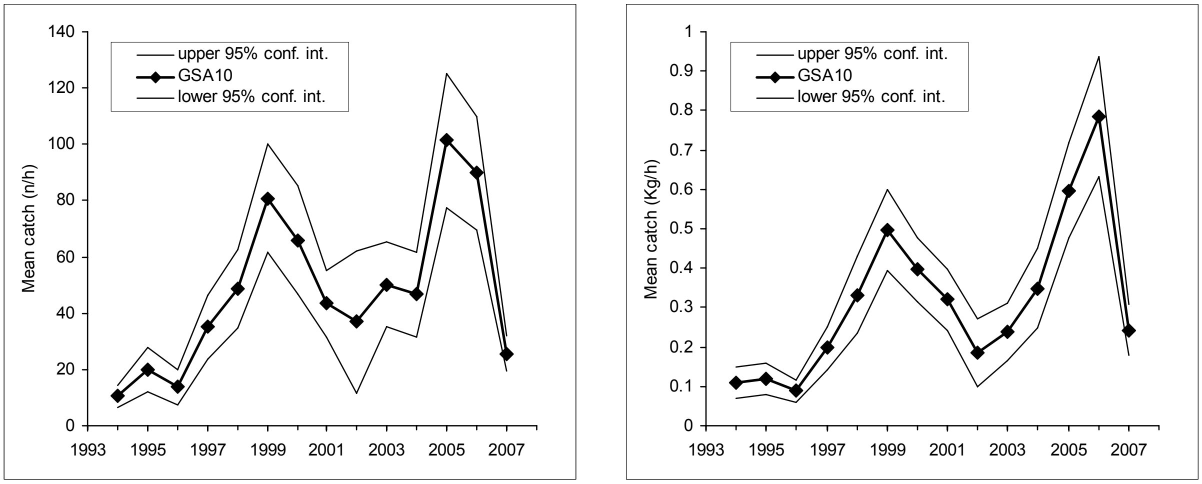


Fig. 7.33.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 10.

7.33.3.1.4. Trends in abundance by length or age

The following Fig. 7.33.3.1.4.1 and 2 display the stratified abundance indices of GSA 10 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

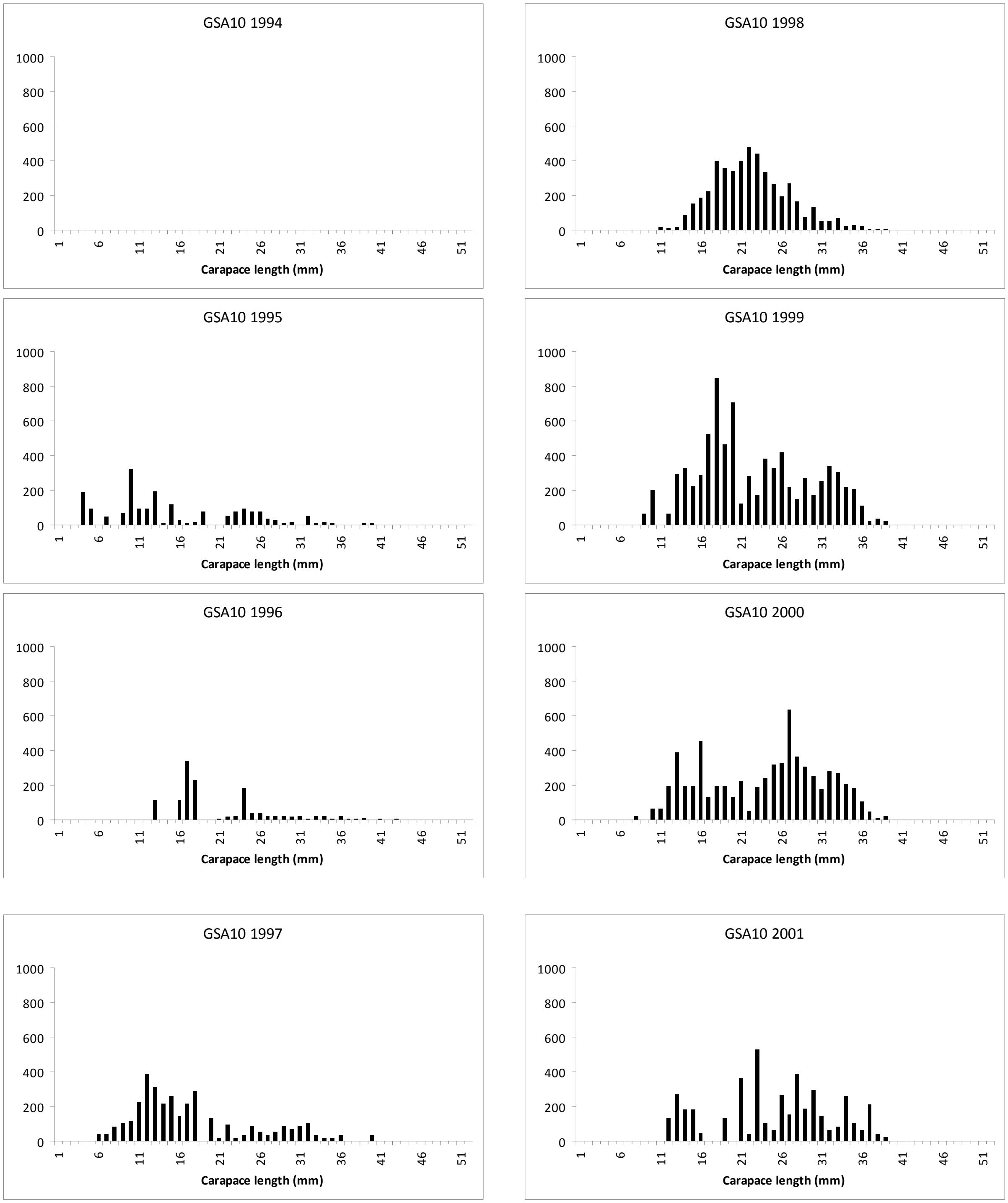


Fig. 7.33.3.1.4.1 Stratified abundance indices by size, 1994-2001.

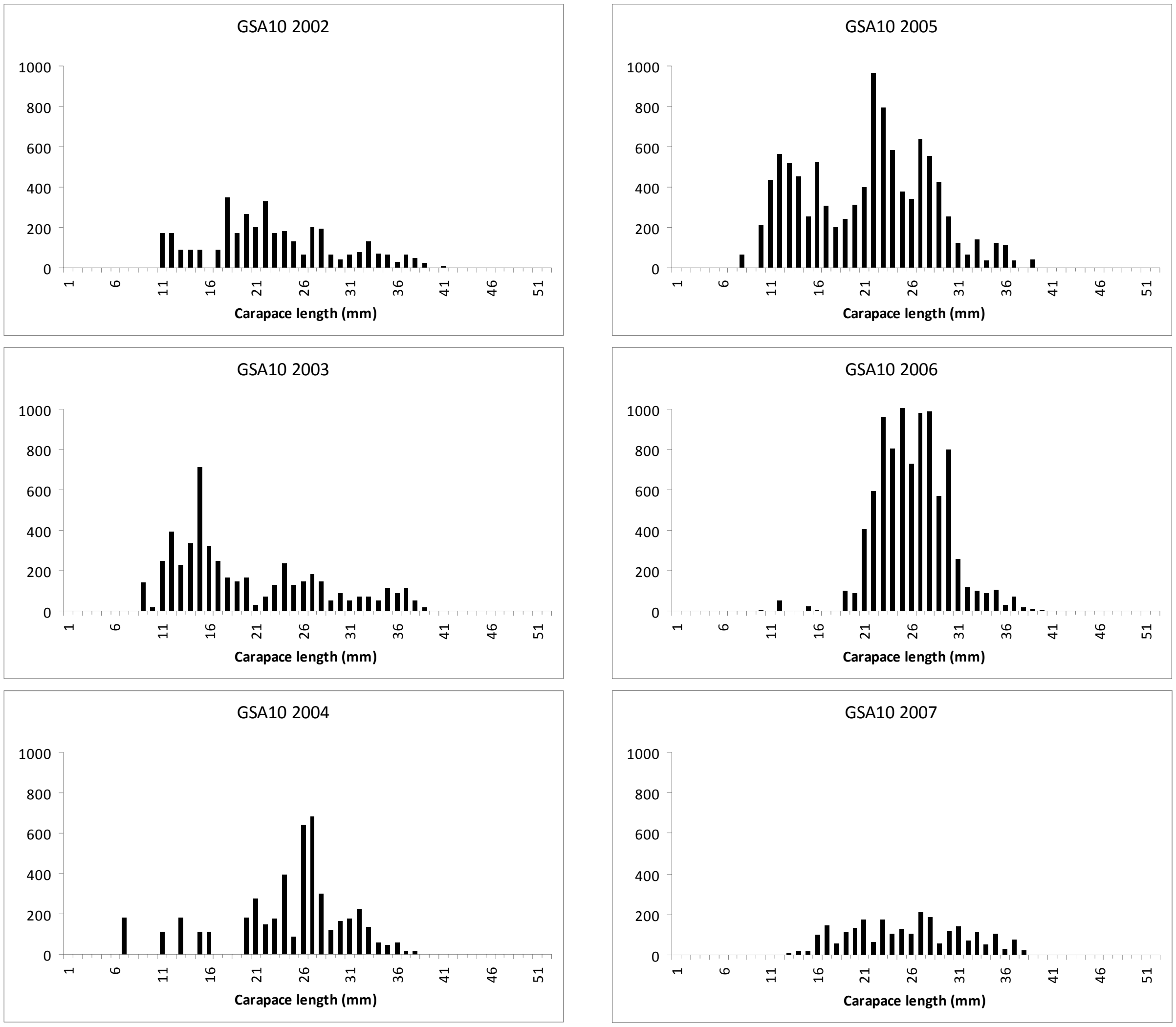


Fig. 7.33.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.33.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.33.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.33.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.33.5. Short term prediction for 2008 and 2009

7.33.5.1. Justification

No forecast analyses were conducted.

7.33.5.2. Input parameters

No forecast analyses were conducted.

7.33.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 10.

7.33.6. Medium term prediction

7.33.6.1. Justification

No forecast analyses were conducted.

7.33.6.2. Input parameters

No forecast analyses were conducted.

7.33.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 10.

7.33.7. Long term prediction

7.33.7.1. Justification

No forecast analyses were conducted.

7.33.7.2. Input parameters

No forecast analyses were conducted.

7.33.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSA 10.

7.33.8. Scientific advice

7.33.8.1. Short term considerations

7.33.8.1.1. State of the spawning stock size

SGMED-08-04 is unable to provide any scientific advice of the state of the spawning stock in relation to proposed precautionary level given the preliminary state of the data and analyses.

7.33.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.33.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.33.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.34. Stock assessment of pink shrimp in GSA 11

7.34.1. Stock identification and biological features

7.34.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.34.1.2. Growth

No information was documented during SGMED-08-04.

7.34.1.3. Maturity

No information was documented during SGMED-08-04.

7.34.2. Fisheries

7.34.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.34.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.34.2.3.Catches

7.34.2.3.1. Landings

Tab. 7.34.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings varied annually among 13 t and 552 t. The landings were mainly taken by demersal otter trawls.

Tab. 7.33.2.3.1.1 Annual landings (t) by fishing technique in GSA 11.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	11	ITA	DTS	38	13	232	551	124	79
DPS	11	ITA	PGP	1			1	6	
DPS	11	ITA	PMP	47					
SUM				86	13	232	552	130	79

7.34.2.3.2. Discards

No information was documented during SGMED-08-04.

7.34.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.34.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.34.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 11, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	11	ITA	DTS	14539	18957	28840	31993	26532	27374
DAYS	11	ITA	PGP	102826	126272	165945	151720	156269	155243
DAYS	11	ITA	PMP	57543	30879				
GT*DAYS	11	ITA	DTS			1598912	1881952	1437559	1486500
GT*DAYS	11	ITA	PGP			501550	484820	493411	495670
KW*DAYS	11	ITA	DTS	3679604	4652647	6711626	7736040	6017232	6340429
KW*DAYS	11	ITA	PGP	2865738	5099814	7105771	6996350	7234881	7398923

7.34.3. Scientific surveys

7.34.3.1.Medits

7.34.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 34 the following number of hauls were reported per depth stratum (s. Tab. 7.34.3.1.1.1).

Tab. 7.34.3.1.1.1. Number of hauls per year and depth stratum in GSA 11, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA11_010-050	16	18	21	21	21	20	19	17	20	18	17	17	19	19
GSA11_050-100	25	21	22	22	20	22	22	24	19	19	18	21	18	20
GSA11_100-200	20	23	30	31	31	30	29	30	24	24	24	24	24	24
GSA11_200-500	33	29	29	26	25	27	24	25	20	24	21	20	20	20
GSA11_500-800	23	16	21	25	25	24	27	26	16	14	15	14	16	17

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.34.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.34.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 11 was derived from the international survey Medits. Figure 7.34.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 11.

The estimated abundance and biomass indices peaked in 1998-1999 and 2003. However, the recent abundance and biomass indices since 2005 appear low. The analyses of Medits indices are considered preliminary.

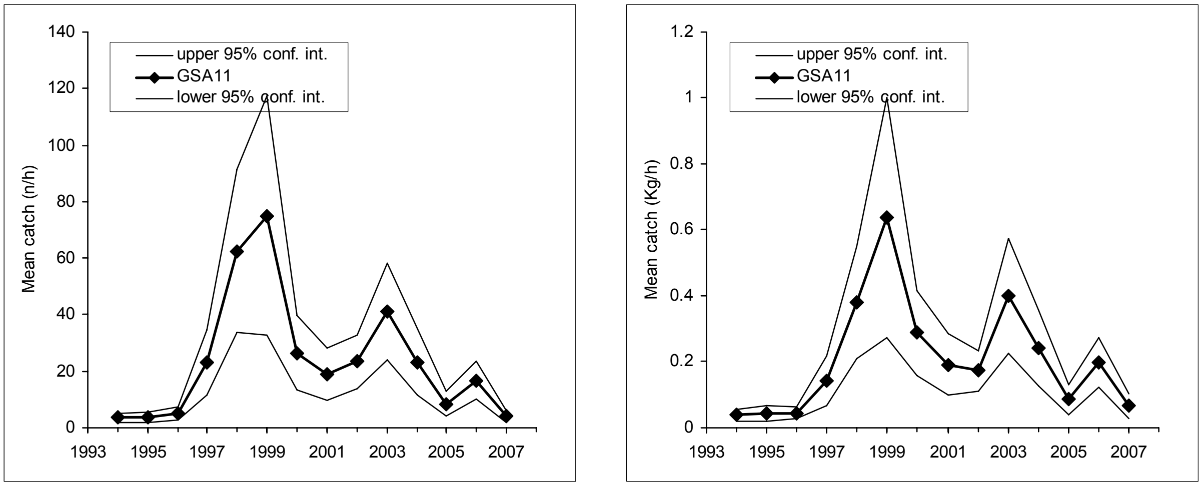


Fig. 7.34.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 11.

7.34.3.1.4. Trends in abundance by length or age

The following Fig. 7.34.3.1.4.1 and 2 display the stratified abundance indices of GSA 11 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

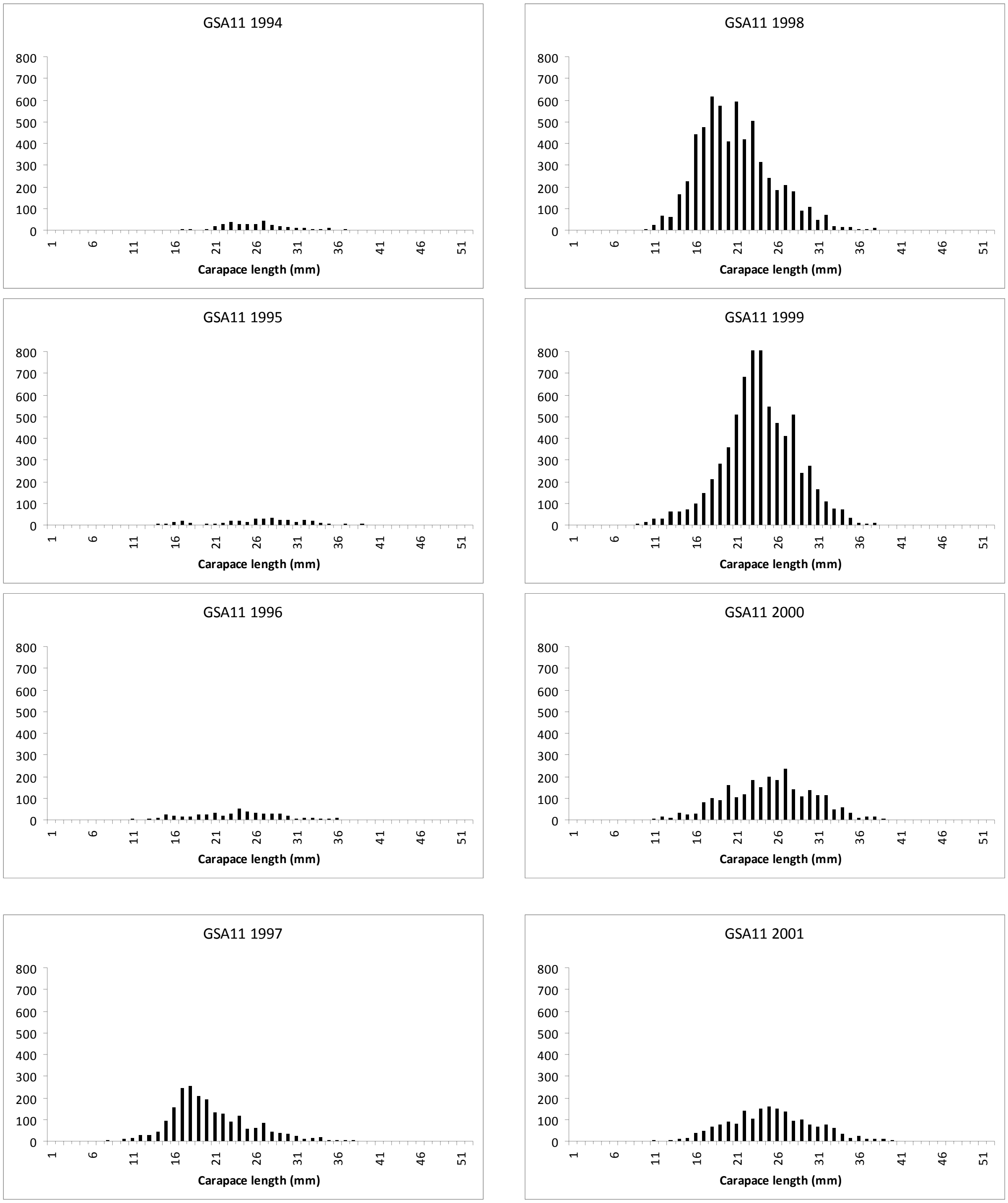


Fig. 7.343.3.1.4.1 Stratified abundance indices by size, 1994-2001.

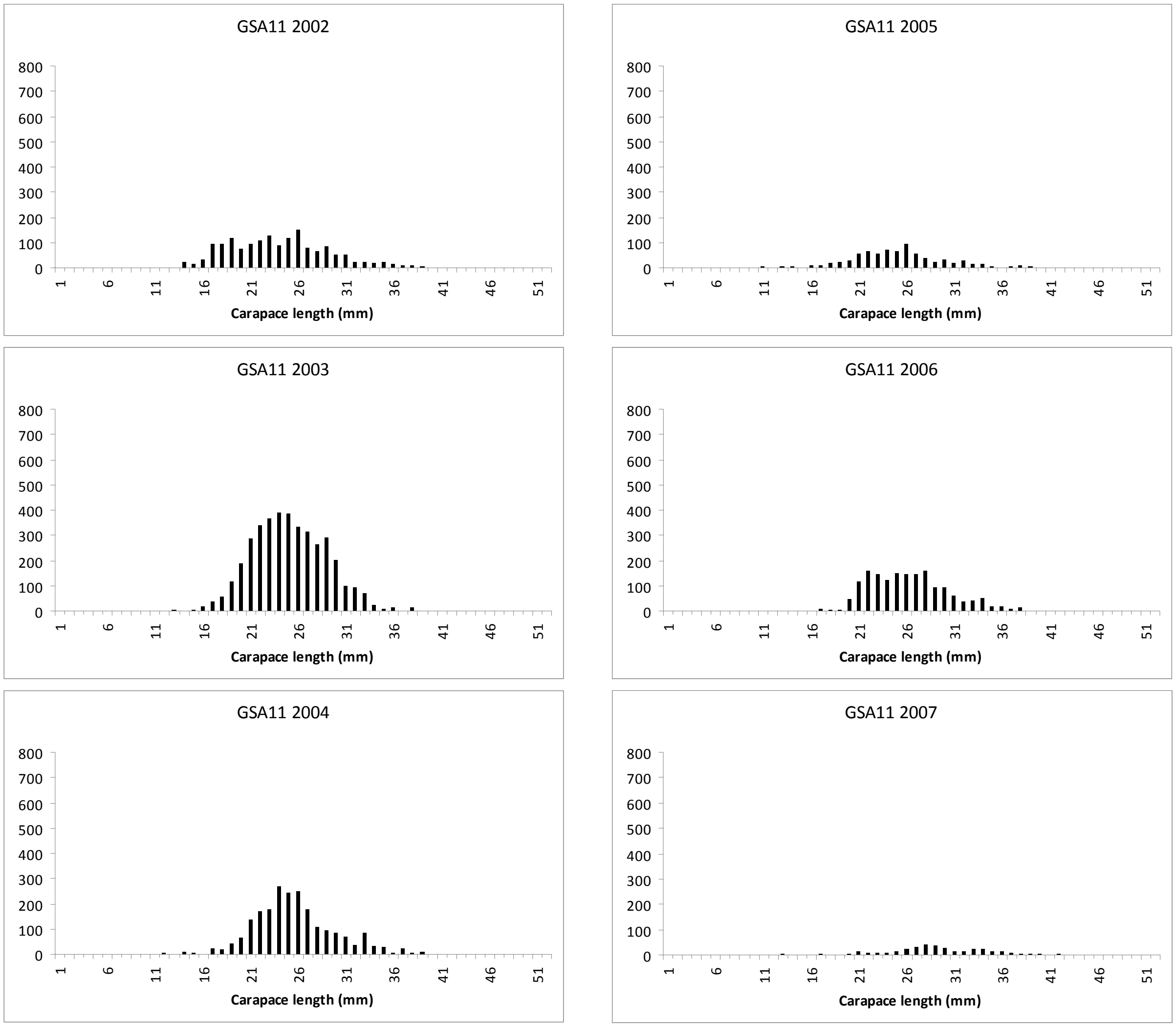


Fig. 7.33.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.34.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.34.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.34.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.34.5. Short term prediction for 2008 and 2009

7.34.5.1. Justification

No forecast analyses were conducted.

7.34.5.2. Input parameters

No forecast analyses were conducted.

7.34.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 11.

7.34.6. Medium term prediction

7.34.6.1. Justification

No forecast analyses were conducted.

7.34.6.2. Input parameters

No forecast analyses were conducted.

7.34.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 11.

7.34.7. Long term prediction

7.34.7.1. Justification

No forecast analyses were conducted.

7.34.7.2. Input parameters

No forecast analyses were conducted.

7.34.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSA 11.

7.34.8. Scientific advice

7.34.8.1. Short term considerations

7.34.8.1.1. State of the spawning stock size

In the absence of proposed or agreed reference SGMED-08-04 is unable to fully evaluate the stock and provide any scientific advice of the state of the spawning stock in relation to them.

7.34.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.34.8.1.3. State of exploitation

In the absence of proposed or agreed reference SGMED-08-04 is unable to fully evaluate the stock and provide any scientific advice of the state of the spawning stock in relation to them.

7.34.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.35. Stock assessment of pink shrimp in GSAs 15 and 16

7.35.1. Stock identification and biological features

7.35.1.1. Stock Identification

Stock structure of the species in the Strait of Sicily is not well known. Levi et al. (1995) have hypothesed a flux from east to west of eggs, larvae and juveniles of P. longirostris due to the intermediate water current. More recently the existence of at least two sub-populations in the northern side of the area (GSA 15 and 16) were advanced by Camilleri et al. (in press). This idea is based on the occurrence of local spawning and nursery areas that are connected by the Atlantic Ionian Stream flow (0-150 m depth), which are considered the current in which the development of larval and juveniles phases occurs. These local sub-populations, one on the Adventure Bank and one on the Malta Bank, are separated by a wide area where the species abundance is scanty.

The maximum observed lengths in GSA 15 and 16 recorded during trawl surveys over 14 years were 46 and 41 mm CL for females and males respectively (Sinacori G., pers. com.). Although very small specimens were caught in trawl surveys samples from a minimum size of 5 mm CL (Sinacori G., pers. com.), the size class at fully recruitment to the bottom in the GSA 15 and 16 were 17 and 18 mm for females and males, respectively (Samed, 2002).

A rough geographical mapping of nurseries in GSA 15 and 16 was reported in Fiorentino et al. (2004). The annual variability in nurseries' position was low. One important nursery was located off Capo Rossetto, in the western-central part of the area, another in the Eastern side of the Malta Bank, close to 200 m depth.

On the basis of trawl surveys carried out in the northern side of the Strait in GSA 16 sex ratio remained stable and close to 0.5 (Fiorentino et al., 2005). Sex ratio in weight from commercial landings (2006-2007) as F/(M+F) was 0.66

Tursi et al. (1999) reported that P. longirostris feed on a wide variety of preys. During the hunting phase it eats small fish, cephalopods and crustaceans while during the digging phase it searches for preys in mud, such as polichets, bivalves, echinoderms and mostly foraminifers.

7.35.1.2. Growth

According to Ardizzone et al., (1990), the life cycle of P. longirostris lasts two years with the possibility of some larger animals entering a third year, and it is characterized by high rates of growth and mortality.
On the basis of comparison of results produced by different methods to estimate natural mortality (Chen & Watanabe; Beverton & Holt Invariants, Alagaraya), values of 1.04 and 1.15 for females and males, respectively, were proposed as reference values for stock assessment purposes in GSA 15 and 16 (SAMED, 2002). These last estimates of natural mortalities are compatible with longevities ranging between 4 and 4.5 years. The growth parameters were reported in Table ……

Table 7.35.12.1 Von Bertalanffy growth function (cm;y) and length-weight relationship (cm;g) parameters in GSA 16.

Source	Sex	Linf	K	t_0	a	b
Samed, 2002	Females	43.0	0.68	-0.2	0.0035	2.4457
	Males	38.0	0.75	-0.2	0.0038	2.4090

7.35.1.3. Maturity

According to Levi et al., (1995) mature females are found in the GSA 15 and 16 all round the year, although a wide maturity peak extended from November to February and another in April. The lowest percentage of mature females appeared in June-July, but continuous spawning seems to occur. Ben Mariem et al. (2001) reported that *P. longirostris* off the Tunisian coasts (GSA 12) reproduces all year along, with a peak in June-July and a minimum in winter.

The most recent parameters of maturity ogive were: L50% of 22.1 mm CL and the corresponding slope 0.45 in females, L50% of 14.3 mm CL and the corresponding slope 1.5 in males (CNR_IAMC, 2007).

7.35.2. Fisheries

7.35.2.1. General description of fisheries

The deep water pink shrimps is main target species of the Sicilian trawlers and is caught both on shelf and upper slope during all year round, but landing peaks are observed from March to July.

The Sicilian trawlers between 12 and 24 m LOA, are based in seven harbours along the southern coasts of Sicily. They operate mainly on a short-distance trawl fishery with trips from 1 to 2 days at sea, fishing on outer shelf and upper slope.

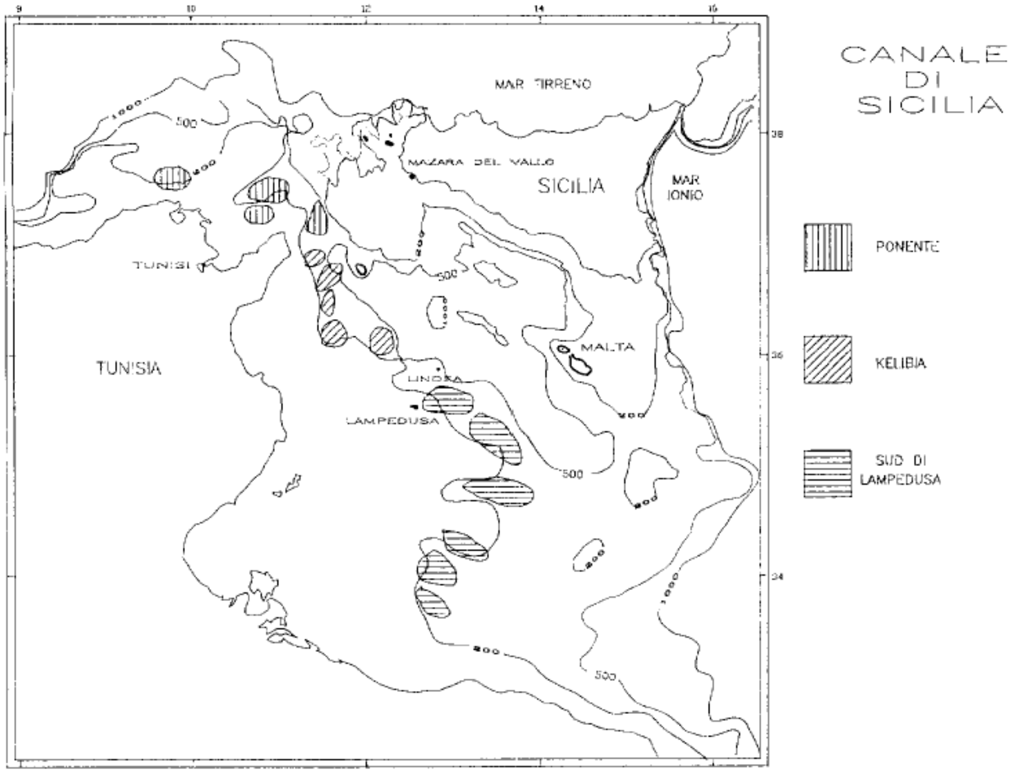


Fig. 7.35.2.1.1 The three main fishing areas for P. longirostris in the Strait of Sicily. Each fishing areas is divided into several fishing grounds (from Levi et al.,1995).

The distant trawlers of Mazara del Vallo represents the main commercial fleet of trawlers of the area and one of the most important of the Mediterranean.

Differently from the other Sicilian fleets, the large trawlers of Mazara fleet (LOA>24m) are employed on long fishing trips (3 – 4 weeks) in offshore waters, both national and international, of the Strait of Sicily. The main fishing grounds of Mazara distant trawlers in the Strait of Sicily are shown in fig…..

After the recent increase of the fuel costs a critical phase for the deep water pink shrimp fishery started, affecting mainly the distant fleet, which needs about 1 ton of fuel per day during the fishing trip.

P. longirostris is fished exclusively by otter trawl, together with other species (*Nephrops norvegicus, Merluccius merluccius, Eledone sp., Illex coindetii, Todaropsis eblanae, Lophius sp., Mullus sp., Pagellus* *sp., Zeus faber* and *Raja sp.*) (Anon., 2000).

7.35.2.2. Management regulations applicable in 2007 and 2008

At present there are no formal management objectives for deep water pink shrimp fisheries in the Strait of Sicily. As in other areas of the Mediterranean, the stock management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area closures), and minimum landing sizes of 20 mm CL (EC 1967/06).

In order to limit the over-capacity of fishing fleet, the Italian fishing licenses have been fixed since the late eighties. After 2000, in agreement with the European Common Policy of Fisheries, a gradual decreasing of the fleet capacity is occurring. Furthermore from 1987 to 2005 a 30-45 days stopping of fishing activities was enforced each year, although in different ways, in order to reduce fishing effort. However this measure is considered less effective in order to protect hake juveniles. In Malta the trawling fleet has been stable since the early 2000 with 16 trawlers having a license to fish. Unfortunately in 2008 due to a reduction in capacity of other fleets 8 new trawl licenses will be issued that will increase the trawl capacity for Malta by 50%.

The new regulation EC 1967 of 21 December 2006 fixed a minimum mesh size of 40 mm for bottom trawling of EU fishing vessels (Italian and Maltese trawlers). The mesh has to be modified in square 40 mm or diamond 50 mm after July 2008, however derogations are possible up to 2010.

A further and more effective improvement in the exploitation pattern of deep water pink shrimp might be obtained through an integrative technical measure having a similar effect to the increasing of mesh size, i.e. the protection of hake nurseries. Differently from red mullet, whose nurseries are in the already protected bottoms within three nautical miles from the coast, the location of deep water pink shrimp nurseries are on discrete off-shore areas on the outer shelf (100-200 m) and in international waters making the possibility of protecting the nursery areas a difficult task especially with respect to enforcement.

It must be outlined the existence in the Strait of Sicily of the Maltese FMZ (GSA 15) which extends up to 25 nautical miles from baselines around the Maltese islands, where fisheries are specifically managed on the basis of capacity control (EC 813/04; EC 1967/06).

The access of Community vessels to the waters and resources in the FMZ is regulated as follows:
(a) fishing within the management zone is limited to fishing vessels smaller than 12 metres overall length using other than towed gears and;
(b) the total fishing effort of those vessels, expressed in terms of the overall fishing capacity, does not exceed the average level observed in 2000-2001 that corresponds to 1 950 vessels with an overall engine power and tonnage of 83 000 kW and 4 035 GT respectively.

Trawlers not exceeding an overall length of 24 metres are authorised to fish in certain areas within the management zone. The overall fishing capacity of the trawlers allowed to operate in the management zone must not exceed the ceiling of 4 800 kW and the fishing capacity of any trawler authorised to operate at a depth of less than 200 metres must not exceed 185 kW. Trawlers fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1627/94 and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned.

7.35.2.3. Catches

7.35.2.3.1. Landings

The estimation of yearly overall yield of Sicilian trawlers with 1-2 day trips in middle eighties ranged between 1290 and 1640 tons (Andreoli et al., 1995). The estimation of yearly overall yield of the Mazara distant fleet in late eighties-early nineties ranged between 2360 and 5180 tons (Levi et al., 1995).

Table 7.35.2.3.1.1 Landings (t) of deep water pink shrimp by fishing technique by the Sicilian (ITA) and Maltese (MLT) fleets (DTS = demersal trawl; HOK = gears using hooks; PGP = polyvalent passive gears; PMP = combining mobile and passive gears; PTS = pelagic trawl.) (Official data).

Tab. 7.35.2.3.1.1 Annual landings (t) by fishing technique in GSA 15 and 16.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	15	MLT	LA						1
DPS	15	MLT	OTB				1	11	7
DPS	15 & 16	ITA	DTS	7463	7388	6606	8355	8455	5966
DPS	15 & 16	ITA	HOK			57	224		0
DPS	15 & 16	ITA	PGP	1	23	2		1	
DPS	15 & 16	ITA	PMP	101					
DPS	15 & 16	ITA	PTS	20	55		5		

Considering that overall yield of trawling was about 9,666 tons in 2006 and 8,052 tons in 2007, deep water pink shrimp landings representing about 74-87% of total yield in the area. To note that landings of deep water pink shrimp. in the Sicilian ports do not derive solely from GSA 16 but from GSA 15 and 16 with some catches also from other GSAs in the Strait of Sicily (fig….).

The Maltese shrimp yield ranged from 11 t in 2006 and 7 t in 2007, being les than 1% of yield in GSA 15 & 16.

Since 2002 onwards the yield of all the Sicilian boats fishing in the Strait of Sicily (inshore and distant fisheries) ranged from 8600 tons in 2006 and 5990 tons in 2007 (from IREPA data).

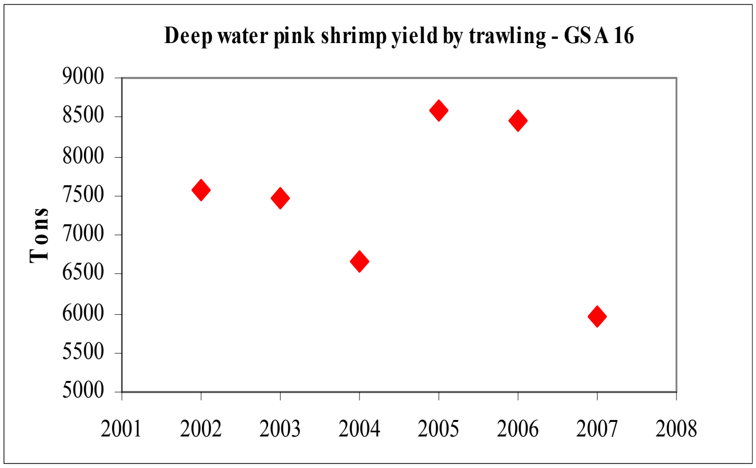


Fig. 7.35.2.3.1.1 Yield of Italian trawlers based in GSA 16 in the Strait of Sicily.

Detailed information on yield in 2006 and 2007 by trawler size is given in table… The smaller trawlers (LOA 12_24 m) operating in more inshore water are more numerous (about the 67% in number) and produce between 53% (2006) and 65% (2007) of the deep water pink shrimp yield of Sicilian trawlers in the Strait of Sicily.

Tab. 7.35.2.3.1.2 Yield by sex of Italian trawlers in the Strait of Sicily (number of boats: LOA 12_24 m = 350 in 2006 and 315 in 2007; LOA >24 m = 172 in 2006 and 151 in 2007) (IREPA source).

	LOA 12_24 m		LOA >24 m		total
2006	Yield	4535	Yield	3920	8455
	Females	3018	Females	2755	5773
	Males	1517	Males	1165	2682
2007	Yield	3880	Yield	2108	5989
	Females	2140	Females	1255	3395
	Males	1741	Males	853	2594

As the length compositions of landing concerns, information is available only for the Sicilian trawlers. Data were considered representative since the 3rd quarter of 2005, when a sampling scheme allowing a realistic raising of the sampled catches to the total ones was adopted (SIBM, 2005). Since there are differences in biological parameters by sex stock assessment based on length structure of landing was done only by females, since they represent about the 66% of landing and reach the largest size.

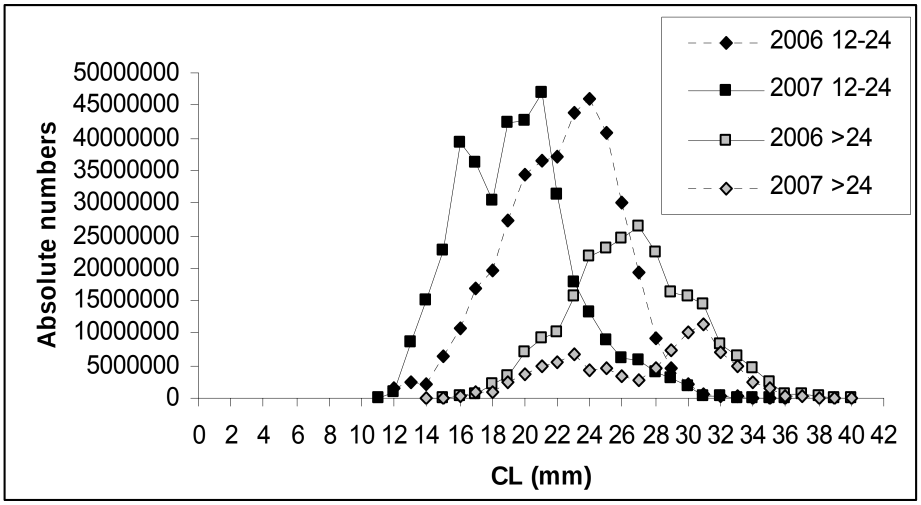


Fig. 7.35.2.3.1.2 Absolute catches in number of Italian trawlers in the Strait of Sicily, 2006-2007. Catches of the two operational units (LOA12-24 and LOA>24) are distinguished

7.35.2.3.2. Discards

According to Levi et al., (1995), the length at 50% capture of 32 mm mesh size trawling estimated by catch curve on commercial landing was 16.1 mm CL (Selection Factor=0.5).

More recently experiments of selectivity for the same mesh size gave a L50%=13.0□0.1 (mm) (Selection Range=5.2 and SF=0.42) (Ragonese & Bianchini, 2006).

The modal size of the catch and discarded fraction of P. longirostris of Sicilian trawlers is very variable according to the season and the deep range of fisheries (tab. 6). The amount of discards are also variable, being higher in autumn-winter and between 150 and 300 m (Anon., 2000).

Table 7 – Yearly modal length (LC in mm) of discarded fraction and landings of P. longirostris in typical inshore (Porto Palo- South eastern Sicily) and distant (Mazara del Vallo - South western Sicily) Sicilian trawling fisheries (from Anon., 2000).

	Modal length (mm)	
	discards	landings
Inshore fisheries	12	16 and 19
Distant fisheries	19	25-26

Recent studies on the discarded fraction of trawlers in GSA 16 during 2006 given a length at 50% discard ranging between 14.6 and 17.0 mm CL (Gancitano V., pers. comm.)

7.35.2.3.3. Fishing effort

No information on specific effort of trawling on deep water pink shrimp are available. The trends in overall fishing effort by year and major gear type is listed in Tab. 7.10.2.3.3.1 and shown in Fig. 7.10.2.3.3.1 in terms of kW*days for the otter trawls.

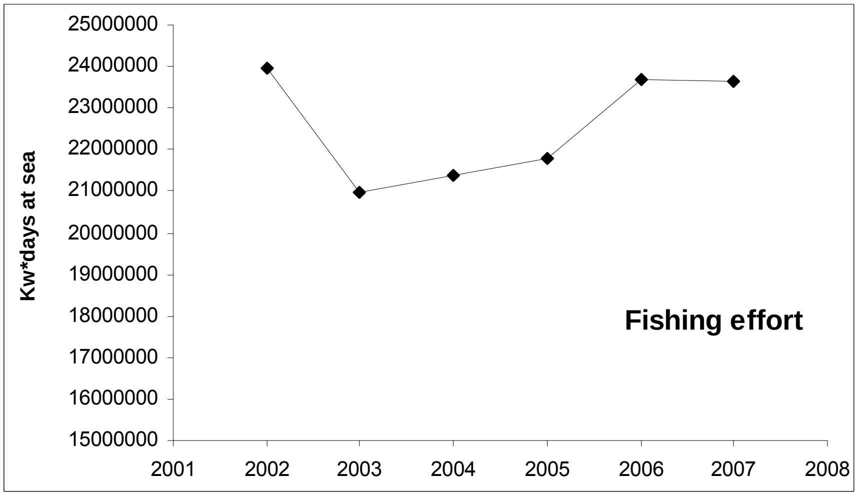


Fig. 7.35.2.3.3.1 Trend in annual effort (kW*days) of the Italian otter trawlers operating in the Strait of Sicily, 2002-2007.

Tab. 7.35.2.3.3.1 Trend in annual effort (days at sea, GT*days, kW*days) by country and gears in GSA 15 and 16, 2004-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2004	2005	2006	2007
DAYS	15	MLT	[LHP] [LHM]		28		
DAYS	15	MLT	[SB] [SV]			73	59
DAYS	15	MLT	GNS		51		
DAYS	15	MLT	GTR		200	152	320
DAYS	15	MLT	LA			1116	1096
DAYS	15	MLT	LLD		3164	3159	2827
DAYS	15	MLT	LLS		1197	1466	1624
DAYS	15	MLT	LTL		263		
DAYS	15	MLT	OTB		421	404	688
DAYS	15	MLT	Other gear		64		
DAYS	15 & 16	ITA	DTS	81853	82557	89319	89164
DAYS	15 & 16	ITA	HOK	14856	11450	10272	9284
DAYS	15 & 16	ITA	PGP	118425	97285	85556	85298
DAYS	15 & 16	ITA	PMP	6939			
DAYS	15 & 16	ITA	PTS	4899	5476	7926	7032
GT*DAYS	15	MLT	[LHP] [LHM]		170		
GT*DAYS	15	MLT	[SB] [SV]			192	139
GT*DAYS	15	MLT	GNS		135		
GT*DAYS	15	MLT	GTR		1174	477	1023
GT*DAYS	15	MLT	LA			23999	29596
GT*DAYS	15	MLT	LLD		82011	72364	60606
GT*DAYS	15	MLT	LLS		16866	18866	18072
GT*DAYS	15	MLT	LTL		2539		
GT*DAYS	15	MLT	OTB		24878	34527	69268
GT*DAYS	15	MLT	Other gear		226		
GT*DAYS	15 & 16	ITA	DTS	6673029	6864030	7429483	7322198
GT*DAYS	15 & 16	ITA	HOK	764595	403669	507862	370612
GT*DAYS	15 & 16	ITA	PGP	249032	206056	192811	212519
GT*DAYS	15 & 16	ITA	PMP	20134			
GT*DAYS	15 & 16	ITA	PTS	224188	236435	352518	346405
KW*DAYS	15	MLT	[LHP] [LHM]		1880		
KW*DAYS	15	MLT	[SB] [SV]			3805	2507
KW*DAYS	15	MLT	GNS		2121		
KW*DAYS	15	MLT	GTR		13889	8391	20724
KW*DAYS	15	MLT	LA			203361	208456
KW*DAYS	15	MLT	LLD		554562	483437	449900
KW*DAYS	15	MLT	LLS		140846	159692	160914
KW*DAYS	15	MLT	LTL		26318		
KW*DAYS	15	MLT	OTB		129838	143909	240858
KW*DAYS	15	MLT	Other gear		3394		
KW*DAYS	15 & 16	ITA	DTS	21381964	21772464	23699835	23644626
KW*DAYS	15 & 16	ITA	HOK	3153486	1758722	2076446	1695903
KW*DAYS	15 & 16	ITA	PGP	2691324	2302777	2207660	2378933
KW*DAYS	15 & 16	ITA	PMP	223470			
KW*DAYS	15 & 16	ITA	PTS	962786	1063031	1592930	1431085
TSLDAYS	15 & 16	ITA	DTS				
TSLDAYS	15 & 16	ITA	PGP				
TSLDAYS	15 & 16	ITA	PMP				
TSLDAYS	15 & 16	ITA	PTS				

7.35.3. Scientific surveys

7.35.3.1.Medits

7.35.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 16 the following number of hauls were reported per depth stratum (s. Tab. 7.35.3.1.1.1).

Tab. 7.35.3.1.1.1. Number of hauls per year and depth stratum in GSA 15 and 16, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA15_010-050									1	1	2	1	1	
GSA15_050-100									6	5	4	5	5	12
GSA15_100-200									12	13	13	13	13	12
GSA15_200-500									9	10	9	9	9	4
GSA15_500-800									17	16	15	17	16	17
GSA16_010-050	4	4	4	4	4	4	4	4	7	7	7	10	10	11
GSA16_050-100	8	8	8	8	8	8	7	8	11	12	12	20	22	23
GSA16_100-200	4	4	4	4	5	5	6	5	10	8	9	18	19	21
GSA16_200-500	10	11	11	12	11	11	11	11	19	18	19	28	31	27
GSA16_500-800	10	14	14	13	14	14	14	14	19	20	19	32	33	38

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.35.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.35.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the hake in GSAs 15 and 16 was derived from the international surveys Medits. Figure 7.10.3.1.3.1 display the estimated trend in deep water pink shrimps biomass in GSAs 15 and 16.

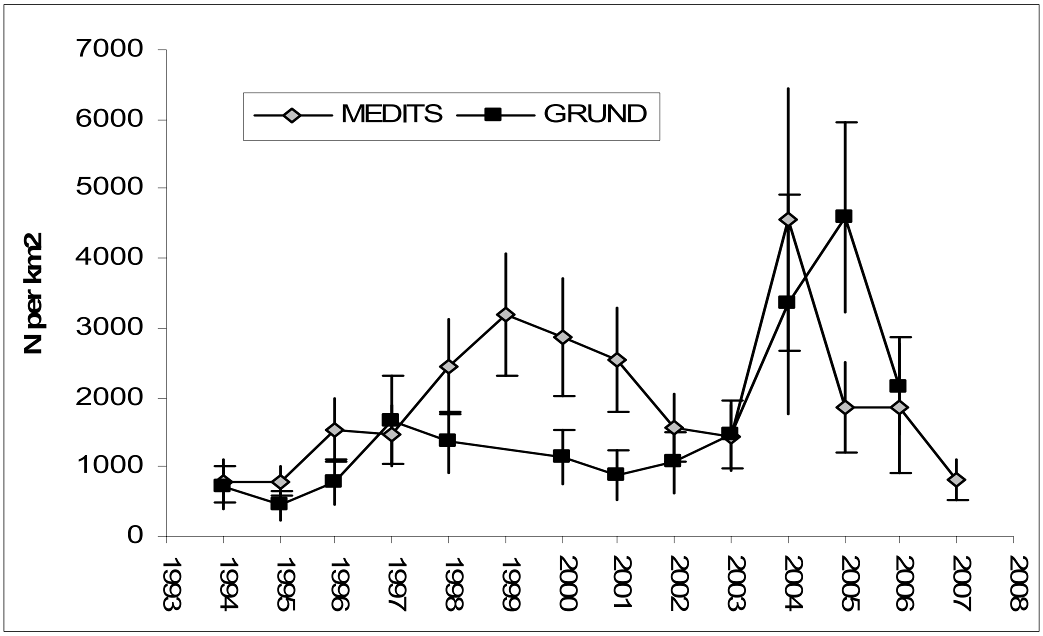


Fig. 7.35.1.3.1 Density indices (DI as N per km2) obtained during the MEDITS and GRUND survey in GSA 15 and 16.

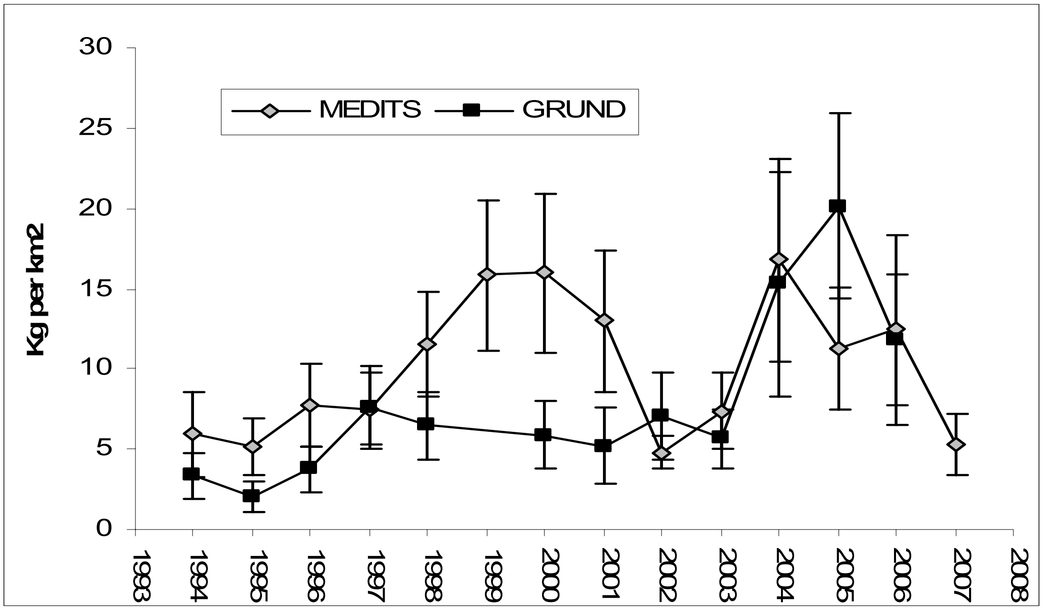


Fig. 7.35.1.3.2 Biomass indices (BI as kg per km2) obtained during the MEDITS and GRUND survey in GSA 15 and 16.

In the last years the biomass indices for both GSAs 15 and 16 show a similar pattern with an increasing trend since 2002 till 2005-2006 and decrease in 2006-2007.

Density indices (DI) of recruits (individuals less than 18 mm CL) derived from MEDITS trawl surveys were used to estimate recruitment strength in GSA 15 & 16 assuming that recruitment occurs within 50 and 200 m depth (16500 km2). The mean value (±sd) of DI and absolute number of recruits from 1994 to 2004 was 1601 ± 969 individuals per km2 and 26.376 ± 15.959 millions of individuals (Fiorentino et al., in press).

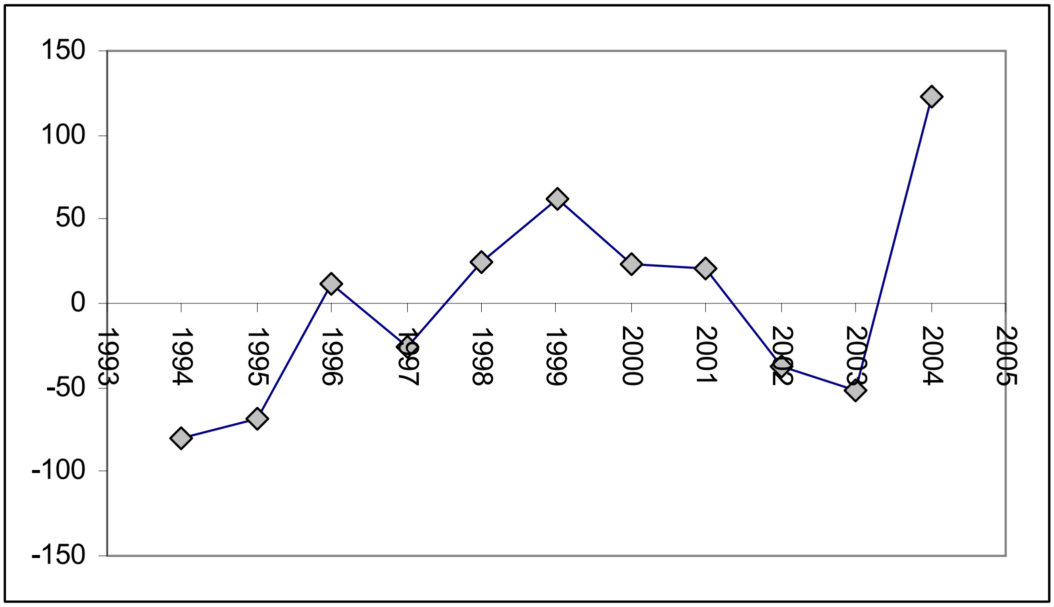


Fig 7.35.1.3.3 Percentage variation of annual values from mean recruitment of P. longirostris in the GSA 15 and 16.

The trend in abundance and biomass as re-estimated by SGMED-08-04 are shown in Figures 7.10.3.1.3.4 and 7.10.3.1.3.5 for GSAs 15 and 16. While the trend in GSA 15 is quite short, recent abundance and biomass indices (2005-2007) in GSA 16 appear at the highest level observed since 1994. Such analyses of Medits indices are considered preliminary.

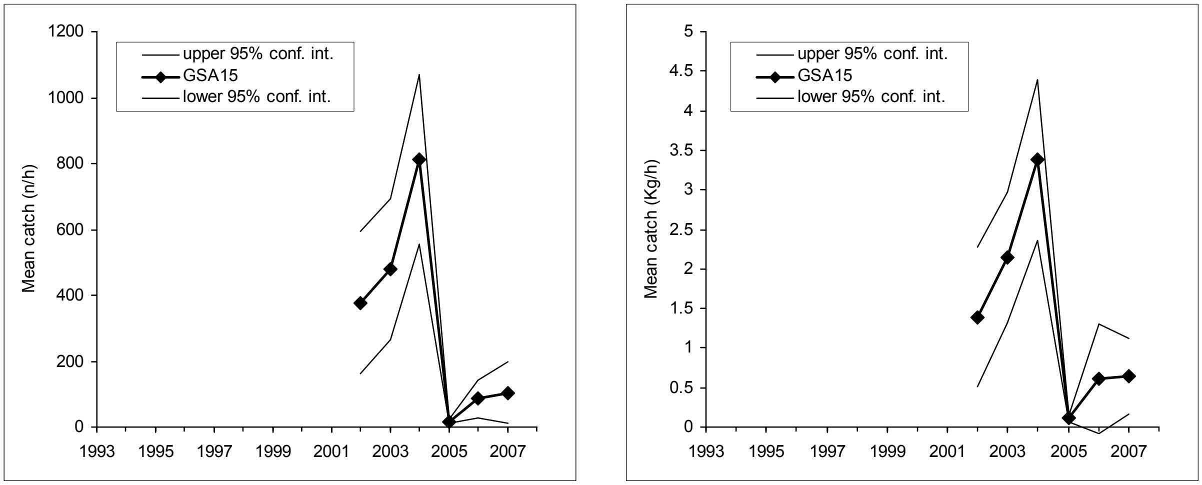


Fig. 7.35.3.1.3.4 Abundance and biomass indices of pink shrimp in GSA 15.

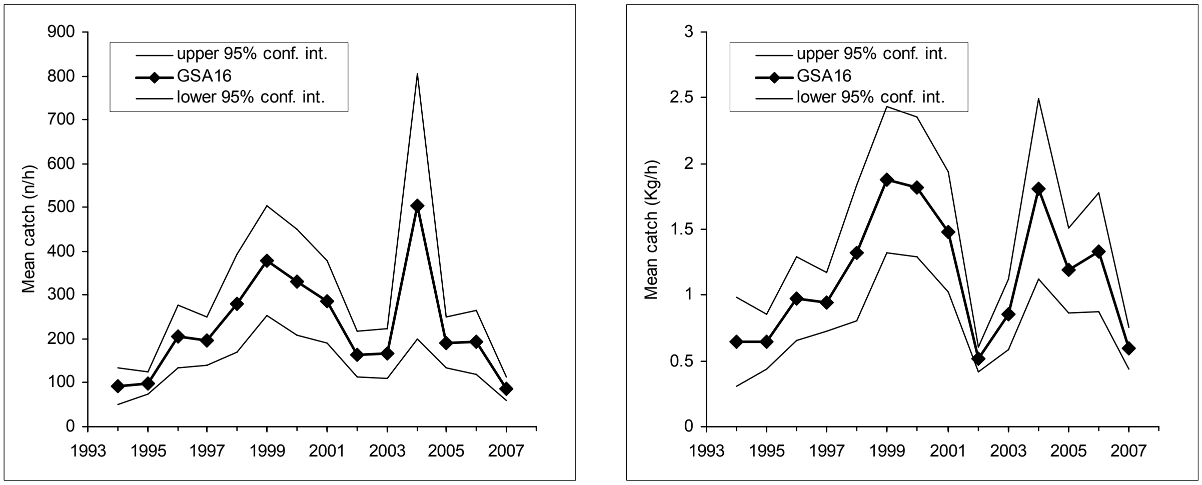


Fig. 7.35.3.1.3.5 Abundance and biomass indices of pink shrimp in GSA 16.

7.35.3.1.4. Trends in abundance by length or age

The following Fig. 7.10.3.1.4.1 displays the stratified abundance indices of GSA 15 in 2002-2007. These size compositions are considered preliminary.

The Figures 7.10.3.1.4.2 and 7.10.3.1.4.3 display the stratified abundance indices of GSA 16 in 1994-2001 and 2002-2007. These size compositions are considered preliminary.

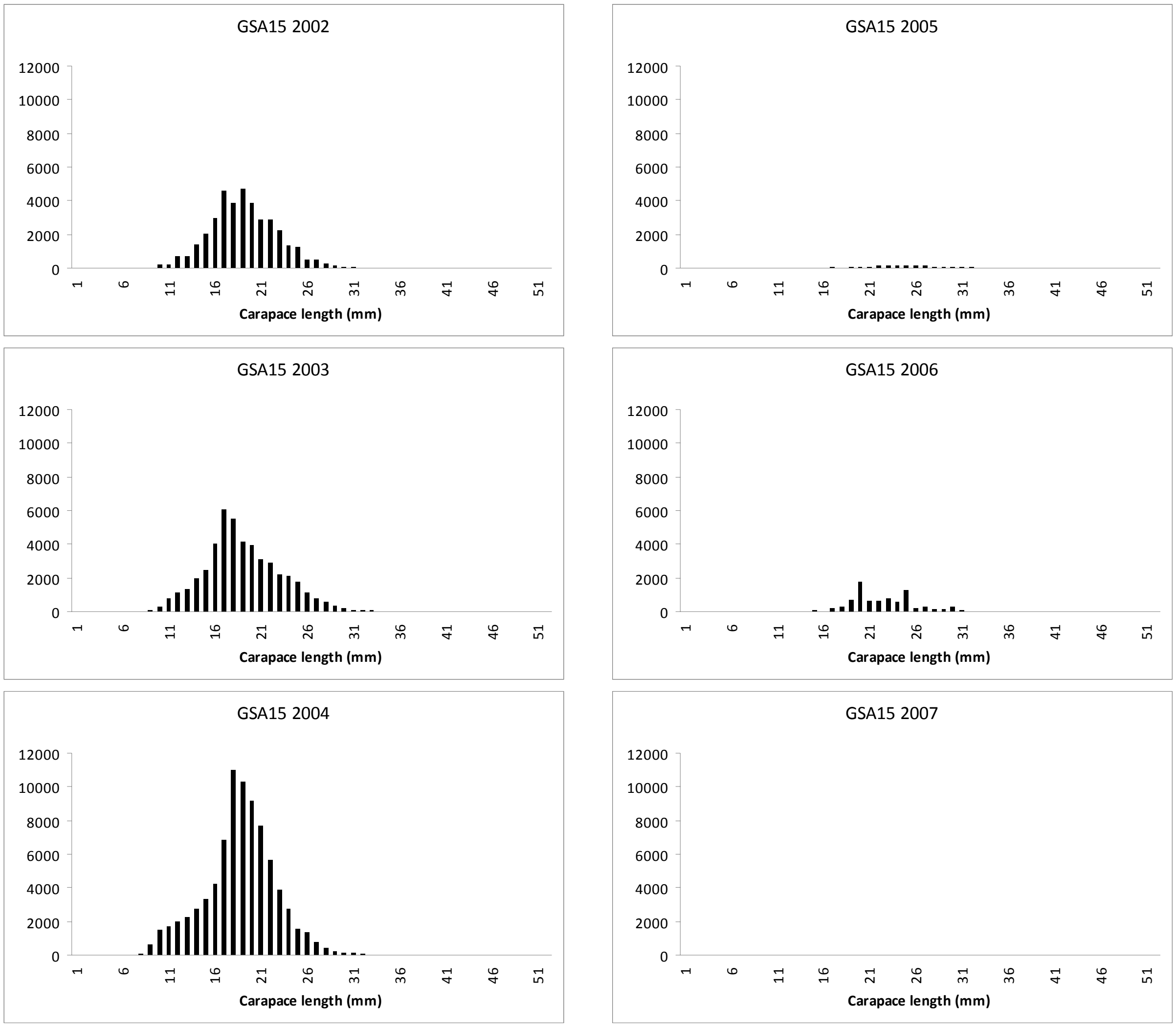


Fig. 7.10.3.1.4.1 Stratified abundance indices by size in GSA 15, 2002-2007.

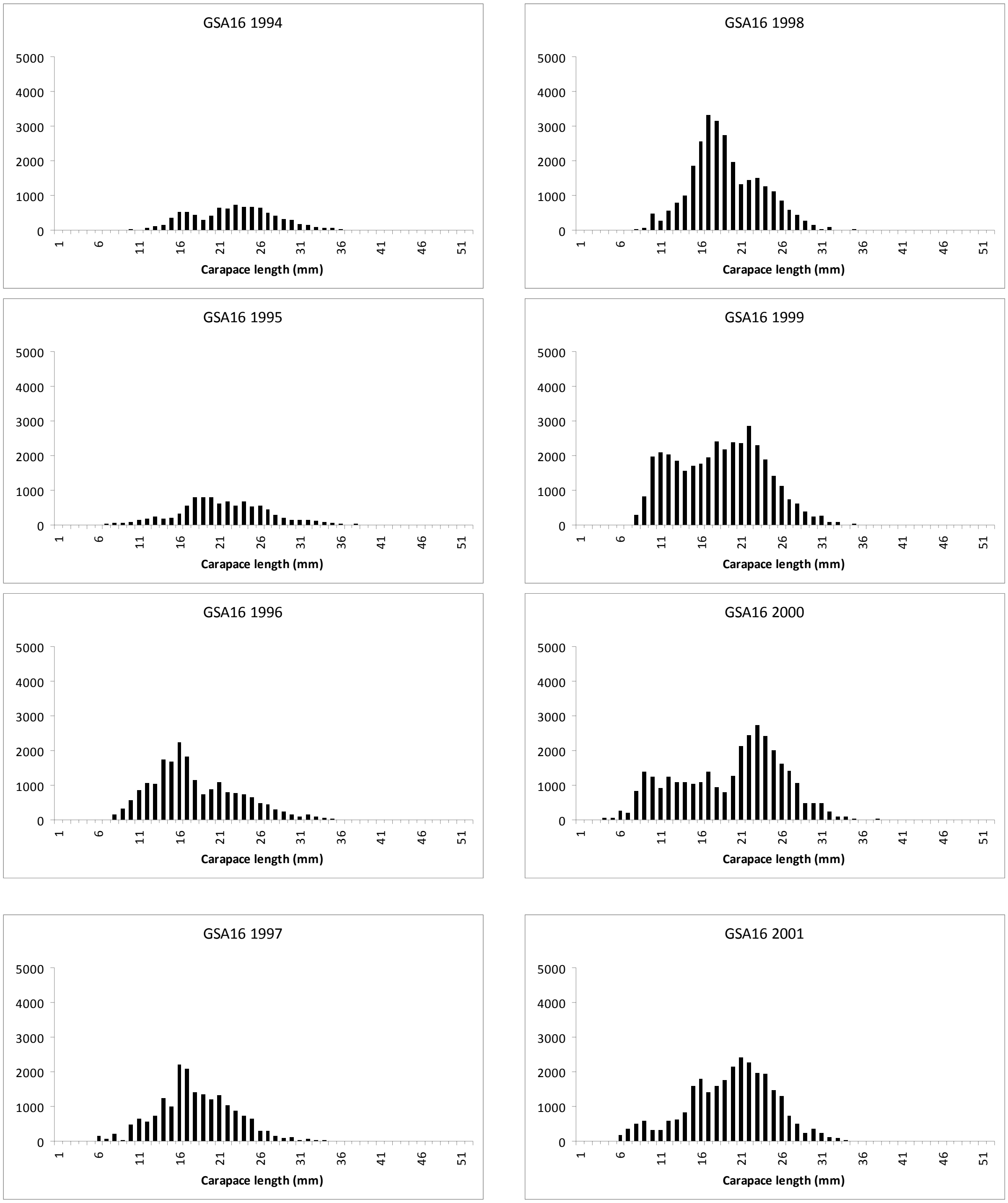


Fig. 7.35.3.1.4.1 Stratified abundance indices by size, 1994-2001.

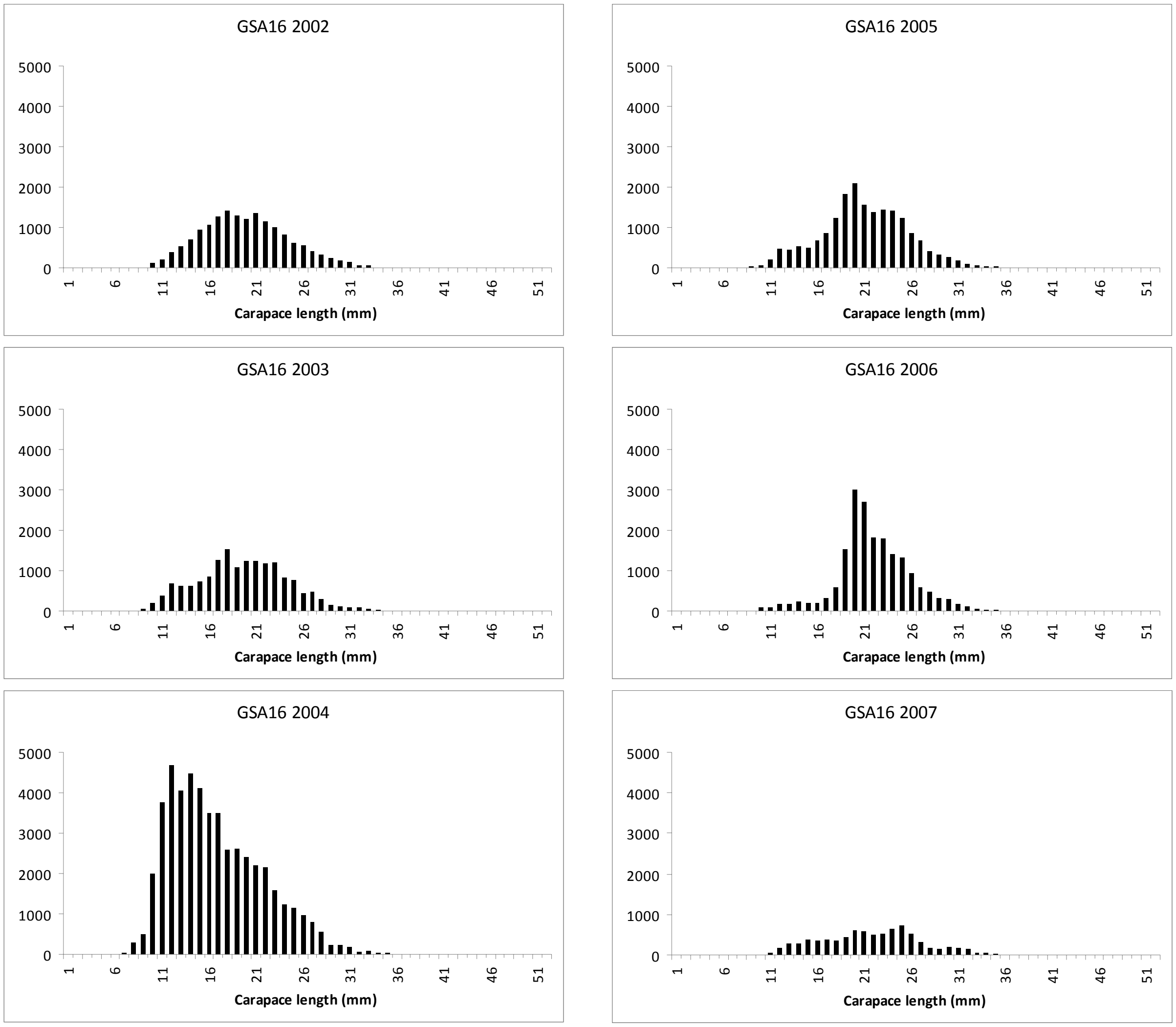


Fig. 7.35.3.1.4.2 Stratified abundance indices by size, 2002-2007.

7.35.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.35.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.35.4. Assessment of historic stock parameters

7.35.4.1. Method 1: Trends in LPUE

7.35.4.1.1. Justification

Trends in LPUE may provide insight into trends in stock size. SGMED-08-04 recommends that technological creep should be considered when trends in LPUE are interpreted.

7.35.4.1.2. Input parameters

Landings and effort for the Sicilian trawler fleet operating in GSAs 15 and 16 were used.

7.35.4.1.3. Results

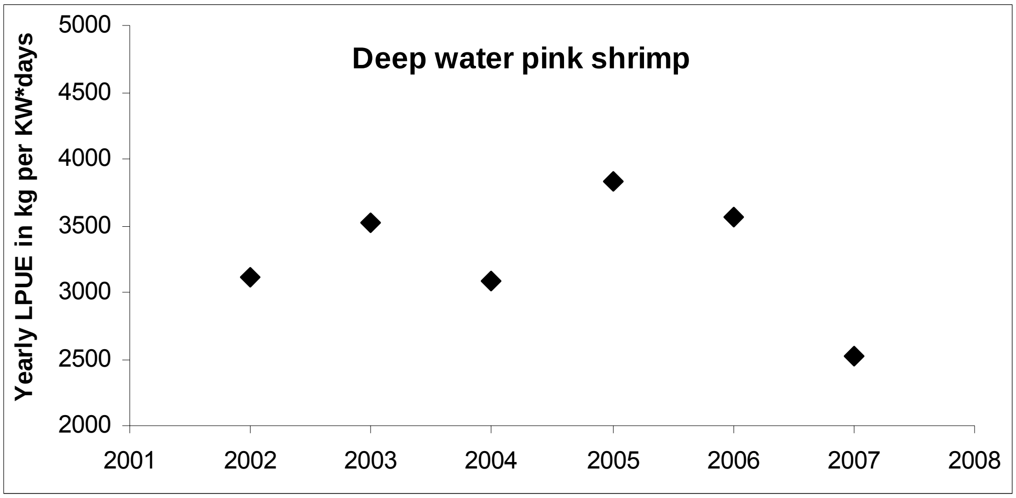


Fig. 7.35.4.1.3.1 Annual landing per unit effort of commercial trawling by the Sicilian fleet (GSAs 15 & 16).

According to commercial data, a significant decrease of shrimp landings per unit effort is occurring since 2005 (Fig. 7.35.4.1.3.1).

7.35.4.2. Method 2: VIT

7.35.4.2.1. Justification

According to the SGMED 03 suggestions an approach under steady state (pseudocohort) was used keeping separate the available years (2006 and 2007) and fleet segments (trawlers with 12<LOA<24 m and LOA>24m) (fig……). Cohort (VPA equation) and Y/R analysis as implemented in the package VIT4win were used (Lleonart and Salat, 2000). Data were derived from DCR call for GSA.

7.35.4.2.2. Input parameters

The parameters used in the analysis are reported in table… No discard data were included.

Table 7.35.4.2.2.1 Parameters used for stock assessment trough VIT approach. Only females fraction of the fished stock was assessed.

L∞	**43**	**L50%**	**21.5**
K	**0.68**	**g**	**0.45**
t0	**-0.2**	**M**	**1.04**
a	**0.0036**	**Ft**	**1.04**
b	**2.4423**	**L'**	**20.5**

Table 7.35.4.2.2.1 Absolute number by length class (mean TL) of landings by year and fleet segments.

	2006		**2007**	
CL(mm)	**12_24**	**>24**	**12_24**	**>24**
11			11268	0
12	1668303	0	926085	0
13	2485179	0	8581010	0
14	2117186	0	15122241	33404
15	6540968	82448	22981482	53316
16	10942250	274829	39609013	210846
17	17137603	768972	36712383	943954
18	19811368	2147920	30687752	897590
19	27609399	3549550	42881628	2820686
20	34881509	7186566	43234691	4125258
21	37020594	9478655	47477481	5451671
22	37776248	10148638	31793379	6095845
23	44560212	15706418	18136905	7670196
24	46584272	22108440	13210200	4926501
25	41421049	23264885	9144715	5261448
26	30405933	24727594	6221999	3745089
27	19569406	26848521	5831625	3146352
28	9420122	22763559	4109493	5257387
29	4687984	16451271	3225159	8086978
30	2135362	15946691	1997315	11211788
31	572446	14724511	376055	12618808
32	307739	8480636	291102	7903352
33	184186	6555410	125351	5527581
34	154368	4755269	125351	2562594
35	42444	2366128	69125	1805711
36	42444	760967	69125	435209
37	0	634298	0	276846
38	0	428635	0	124603
39	0	61587	0	36433
40	0	61587	0	36433
	398078571	240283987	382940667	101265879

7.35.4.2.3. Results

Mortality rates (Z and F) by size and fleet segments of female deep water pink shrimps in GSA 15 and 16 are shown in Fig. 7.35.4.2.3.1.
The reconstructed yield obtained by the VIT package (1,597 t) is virtually equal to the observed one (1,598 t). Absolute recruitment estimation and other main results of VIT, including the current mortality rates, are listed in table 7.10.4.3.3.1.

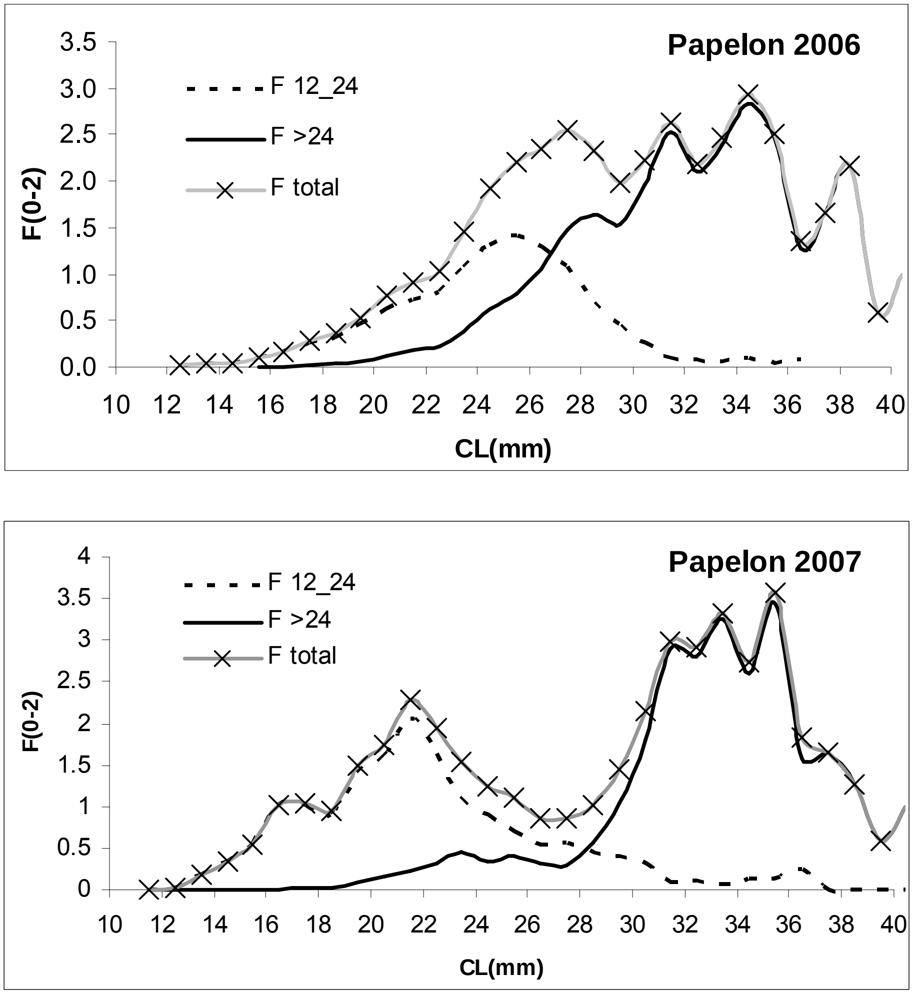


Fig. 7.35.4.2.3.1 Total (Z) and Fishing (F) mortalities rates by size and year of female deep water shrimps in GSA 15 & 16.

Table 7.35.4.2.3.1 The main results of VIT analysis.

Year	2006	2007	Mean
Recostructed yield (g)	5773	3394	4584
Recruitment (ml)	1516	1254	1385
Z	2.54	2.54	2.54
F	1.54	1.54	1.54
F 12_24	0.24	0.31	0.28
F>24	1.30	1.24	1.27
F*	0.73	0.91	0.82
F* 12_24	0.45	0.72	0.59
F*>24	0.27	0.19	0.23

The wg noted that high differences in values between the scalar F estimated by VIT as mean F and global F can produce ambiguity in assessing current exploitation of a stock.

Since the latter is not related to the survival of the cohort, the wg recommend to avoid its use as synthetic descriptor for evaluating the current F when a stock is assessed with any analytic approach.

7.35.5. Short term prediction for 2008 and 2009

7.35.5.1. Justification

No forecast analyses were conducted.

7.35.5.2. Input parameters

No forecast analyses were conducted.

7.35.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 16.

7.35.6. Medium term prediction

7.35.6.1. Justification

No forecast analyses were conducted.

7.35.6.2. Input parameters

No forecast analyses were conducted.

7.35.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 16.

7.35.7. Long term prediction

7.35.7.1. Method 1: Y, B and SSB per recruit according to the VIT package

7.35.7.1.1. Justification

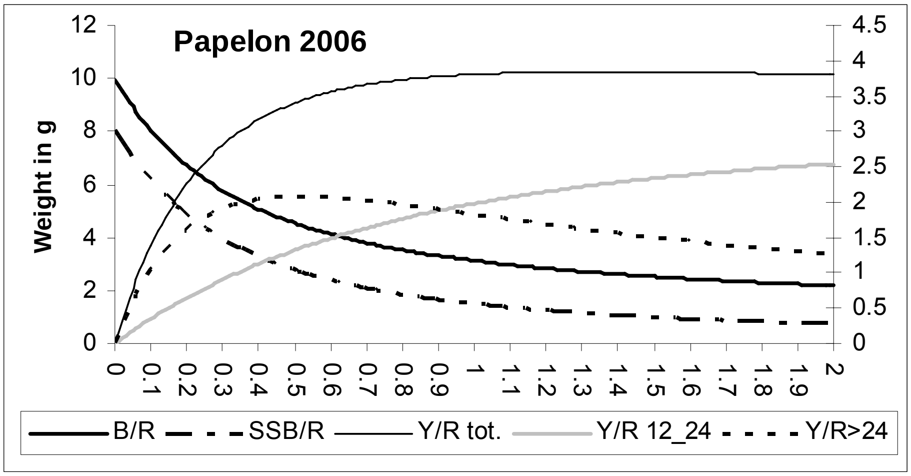
The VIT approach to Biomass and Yield per recruit analysis has been applied in order to analyse the stock production with increasing exploitation under equilibrium conditions.

7.35.7.1.2. Input parameters

The input parameters have been already reported in section XXX.

7.35.7.1.3. Results

Estimation of Biomass and Yield per recruit varying current fishing mortality (Fc) by a multiplicative factor is reported in Fig. 7.35.7.1.3.1.



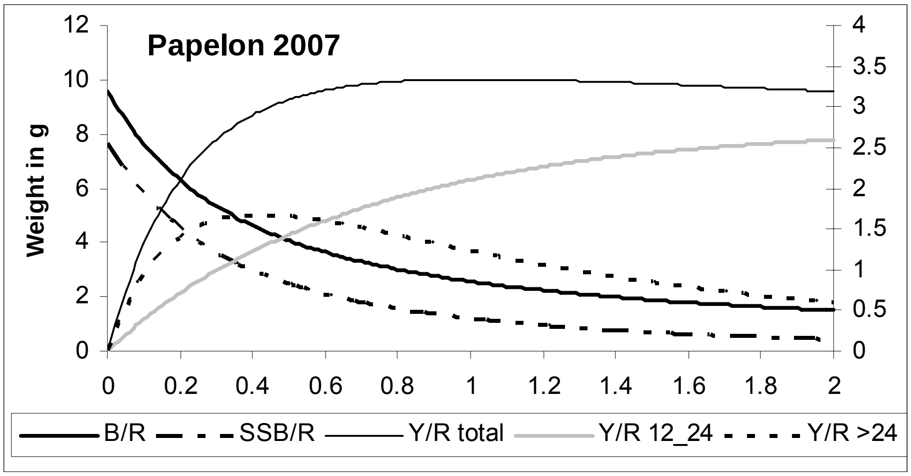


Fig. 7.35.7.1.3.1 Biomass (B), Spawning Stock Biomass (SSB) and Yield (Y) per recruit varying current fishing mortality (Fc) by a multiplicative factor according to the VIT package.

Assuming no variation in the exploitation pattern, the main result of Y/R analysis are reported in Tab. 7.35.7.1.3.1

Tab. 7.35.7.1.3.1 Estimation of yield (Y in g), biomass (B in g) and spawning stock biomass (SSB in g) per recruit (R) varying current fishing mortality by a multiplicative factor (phi).

	Year	Factor	Y/R	B/R	SSB	Y/R Gear 1	Y/R Gear 2
F(0)	2006	0	0	9.947	7.998	0	0
F(0.1)		**0.53**	**3.455**	4.401	2.651	1.372	2.083
Max Gear2		0.53	3.438	4.445	2.691	1.355	2.083
phi=1		1.01	**3.807**	3.127	1.503	1.98	1.827
Max(:)		1.38	3.842	2.645	1.1	2.263	1.579
phi=2		2	3.802	2.182	0.744	2.54	1.262
F(0)	2007	0	0	9.556	7.633	0	0
Max Gear2		0.43	2.947	4.504	2.87	1.269	1.677
F(0.1)		**0.48**	**3.059**	4.176	2.575	1.391	1.667
phi=1		1.01	**3.339**	2.568	1.209	2.104	1.236
Max(:)		1.03	3.34	2.531	1.18	2.122	1.217
phi=2		2	3.189	1.502	0.433	2.594	0.595

According to the VIT steady state VPA, a overfishing state is detected. Maintaining the current fishing pattern, a reduction of current fishing mortality of 50% is advisable to reach $F_{0.1}$. The loss in Y/R consequent to move from F_c to $F_{0.1}$ ranges between 8 and 10% of the current value.

7.35.7.2. Method 2: Y, B and SSB per recruit according to the Yield package

7.35.7.2.1. Justification

Availability of biological parameter with their uncertainty and length at fully capture (L') allows to quantify by simulation the likely changes in Y, B and SSB per recruit in function of fishing mortality (F) with the Yield package. It is also possible to estimate the probability distribution of main Biological Reference Point (F_{max}, $F_{0.1}$ and $F_{spr=0.3}$ and the corresponding Yield per Recruit) to assess the stock status. The current fishing mortality (F_c) was assessed subtracting natural mortality rate (M=1.04) from the current total mortality rate (Z). Total mortality was estimated by Beverton & Holt Z estimator on trawl surveys data on MEDITS (2005-2005 and 2007) and GRUND (2005-2006) length frequency distributions by LFDA package (Kirkwood G., P. et. Al, 2001).

7.35.7.2.2. Input parameters

Growth, length-weight relationship, natural mortality and maturity ogive the same used in the previous paragraph VIT (point 1.1.4.3.2). Minimum length at fully capture (L') was 20.5 mm CL.
All the linear parameters were expressed as TL (cm). Conversions were made by using the relationship reported by Crosnier et al.,(1970): TL(mm)= 3,646+4,436 CL(mm).
A guess estimate of uncertainty in terms of coefficient of variation (CV=0.2) was added to each parameter.

Spawning stock-recruitment relationship was not used. Variables were estimated for 1 million young fish nominal recruitment. The recruitment variability among years was estimated as CV=0.6 from recruit indices obtained in trawl surveys.
The mean length frequency distribution from trawl survey for the Beverton and Holt Z estimator are reported in Table 7.35.7.2.2.1.

Tab. 7.35.7.2.2.1 Mean length frequency distributions (LFD) of MEDITS (spring 2005-2006-2007) and GRUND (autumn 2005-2007) surveys in GSA 16. The LFD were standardized as number in 100 km^2.

LC (mm)	MEDITS	GRUND	LC (mm)	MEDITS	GRUND
8	13	0	24	6529	6151
9	85	166	25	6301	8228
10	285	682	26	4617	7508
11	747	2009	27	3396	7887
12	1535	5905	28	2511	5009
13	1484	6810	29	1901	3119
14	1656	7696	30	1825	2283
15	1568	9523	31	1367	1234
16	1278	10567	32	861	831
17	1450	9922	33	541	518
18	1276	7864	34	239	182
19	1438	7495	35	123	82
20	2504	7965	36	56	17
21	3761	7766	37	20	11
22	4741	5387	38	12	0
23	6491	5920	39	3	0

7.35.7.2.3. Results

Estimation of Y and SSB per recruit are shown in Fig. 7.35.7.2.3.1.

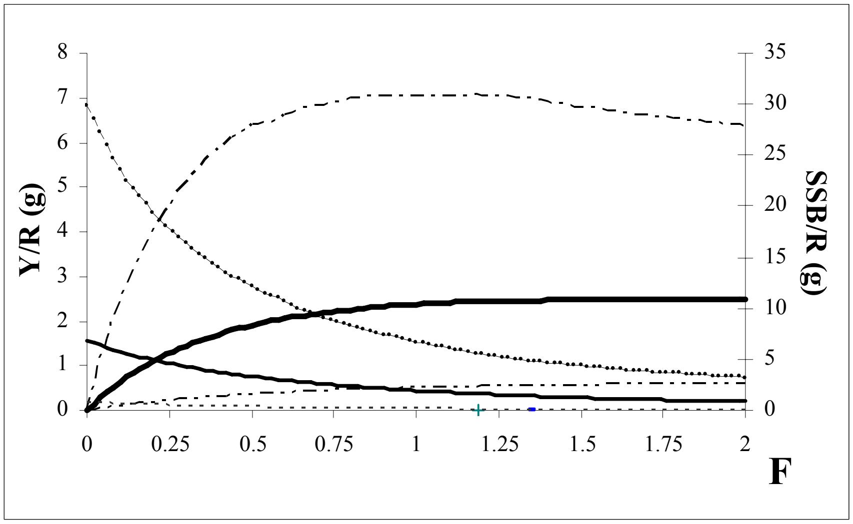


Fig. 7.35.7.2.3.1 Median of yield and spawning stock biomass per recruit and corresponding uncertainty of female deep water pink shrimps in the GSA 15 and 16 according to the Yield Package.

Searching for biological reference points (BRP) through 2000 simulation produced the median values reported in table 7.10.7.2.3.1 Y/R$_{max}$ and F$_{max}$ should be considered as Limit Reference Points (LRP) whereas Y/R 0.1, F0.1, $Y/R_{SPR\_0.30}$ and $F_{SPR\_0.30}$ should be considered as Target reference points (TRP).

Tab. 7.10.7.2.3.2 Median values of yield (g) per recruit and fishing mortality based BRP of female deep water pink shrimp for GSA 15 and 16 according to the Yield package.

Yield based RP	female	F based RP	male
Y/R_{max}	2.53	F_{max}	1.73
$Y/R_{F0.1}$	2.28	$F_{0.1}$	0.83
$Y/R_{SPR\_0.30}$	2.37	$F_{SPR\_0.30}$	0.87

7.35.8. *Scientific advice*

7.35.8.1. Short term considerations

7.35.8.1.1. State of the spawning stock size

In the absence of proposed or agreed references SGMED-08-04 is unable to fully evaluate the state of the stock. No information available to SGMED-08-04 after 2004.

7.35.8.1.2. State of recruitment

No information available to SGMED-08-04 after 2004.

7.35.8.1.3. State of exploitation

SGMED-08-04 considers the stock of deep water pink shrimp being subject to overfishing, as the estimated fishing mortalies exceed the proposed reference $F_{0.1}$.

Table 7.35.8.1.1.1 Synopsis of deep water pink shrimp assessments carried out during the SGMED 04 in the GSA 15 and 16. Percentage of reduction of current fishing mortality to reach $F_{0.1}$ were reported.

Current F	Source and remarks	F0.1 (0.74-0.83)	Status	% of reduction
1.54	**Landing 2006-07 Mean F over size**	**0.83**	**O**	**-46**
1.71	**Landing 2006-07 Mean F age (1-3)**	**0.83**	**O**	**- 51**
1.19	**Medits (2005-07) and B_H estimator**	**0.83**	**O**	**-30**
1.34	**Grund (2005-2006) and B_H estimator**	**0.83**	**O**	**-38**

7.35.8.2. Medium term considerations

Considering more in detail the GSA 16, for which both commercial and trawl surveys data are available, all the stock assessments performed during the SGMED suggest quite similar diagnosis in terms of exploitation state in long term. Considering $F_{0.1}$ as target reference points, a reduction of at least 30% of the current F is needed to reach a more sustainable fishery exploitation. The WG was informed that the Italian government is adopting a management plan in which a reduction of fishing mortality of 25% is planned within 2013. SGMED recommend to adopt a management plan to continuously reduce current F through consistent effort reductions and catch estimations.

7.36. Stock assessment of pink shrimp in GSA 18

7.36.1. Stock identification and biological features

7.36.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.36.1.2. Growth

No information was documented during SGMED-08-04.

7.36.1.3. Maturity

No information was documented during SGMED-08-04.

7.36.2. Fisheries

7.36.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.36.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.36.2.3. Catches

7.36.2.3.1. Landings

Tab. 7.36.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings varied annually among 860 t in 2007 and 1,860 t in 2004. The landings in 2007 represent the record low since 2002. The landings were mainly taken by demersal otter trawls.

Tab. 7.36.2.3.1.1 Annual landings (t) by fishing technique in GSA 18.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	18	ITA	DTS	903	1253	1742	1181	1473	863
DPS	18	ITA	PGP		67	95			
DPS	18	ITA	PMP	244	496	20			
DPS	18	ITA	PTS			0			
SUM				1147	1816	1857	1181	1473	863

7.36.2.3.2. Discards

No information was documented during SGMED-08-04.

7.36.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.36.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.36.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 18, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	18	ITA	DRB	11081	5890	3865	5776	7562	8132
DAYS	18	ITA	DTS	85424	71203	80259	84207	88418	73637
DAYS	18	ITA	HOK			1799	3053	4397	3190
DAYS	18	ITA	PGP	110621	63332	67232	80648	88583	68253
DAYS	18	ITA	PMP	53475	35980	3667			
DAYS	18	ITA	PTS	4140	4526	4679	4428	5291	6186
GT*DAYS	18	ITA	DRB			41347	62244	81590	87740
GT*DAYS	18	ITA	DTS			2568868	2592741	2632767	2275442
GT*DAYS	18	ITA	HOK			27800	58254	79940	58026
GT*DAYS	18	ITA	PGP			120701	146182	147150	115612
GT*DAYS	18	ITA	PMP			40920			
GT*DAYS	18	ITA	PTS			369876	360279	446754	516692
KW*DAYS	18	ITA	DRB	1100225	584801	381968	570792	746921	807073
KW*DAYS	18	ITA	DTS	17112022	14530793	14369490	14621928	14929696	12904532
KW*DAYS	18	ITA	HOK			284535	514377	778355	567996
KW*DAYS	18	ITA	PGP	1722336	1002933	1180371	1442219	1394671	1311109
KW*DAYS	18	ITA	PMP	7277279	4416994	351689			
KW*DAYS	18	ITA	PTS	1480945	1464793	1842716	1785787	2221605	2613654

7.36.3. Scientific surveys

7.36.3.1.Medits

7.36.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 18 the following number of hauls were reported per depth stratum (s. Tab. 7.36.3.1.1.1).

Tab. 7.36.3.1.1.1. Number of hauls per year and depth stratum in GSA 18, 1994-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA18_010-050	14	15	15	14	14	14	14	15	11	11	10	9	10	9
GSA18_050-100	14	14	14	15	15	15	15	14	13	13	15	15	14	14
GSA18_100-200	24	23	23	23	23	23	23	23	26	23	24	25	25	22
GSA18_200-500	10	10	10	10	10	10	10	10	8	8	8	9	9	6
GSA18_500-800	10	10	10	10	10	10	10	10	7	7	8	7	7	7

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes

hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.36.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.36.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 18 was derived from the international survey Medits. Figure 7.36.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 18.

The estimated abundance and biomass indices peaked in 2005 after some years of relatively high abundance. However, the recent abundance and biomass indices in 2007 appear very low, which appears consistent with the low landings in 2007. The analyses of Medits indices are considered preliminary.

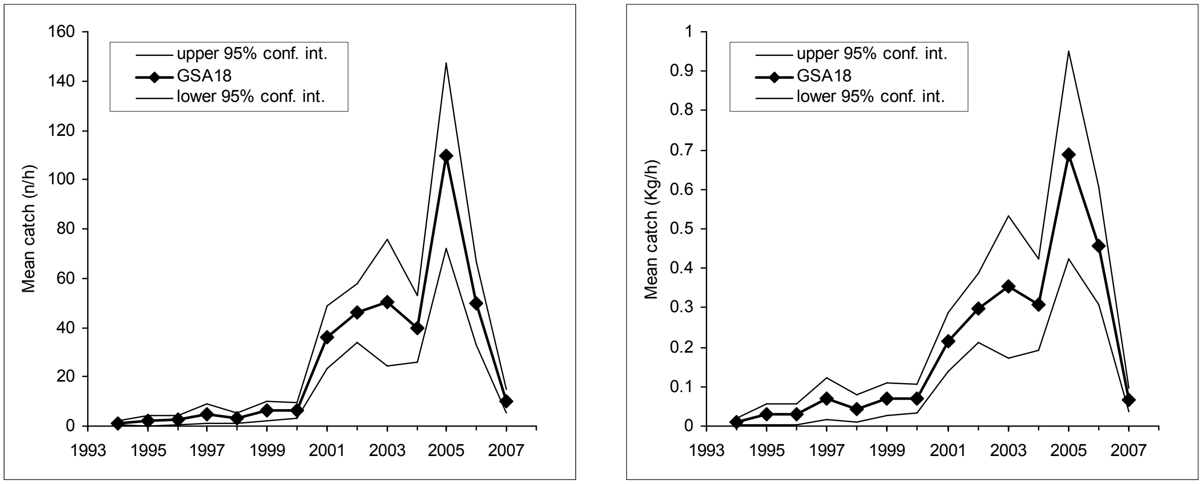


Fig. 7.36.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 18.

7.36.3.1.4. Trends in abundance by length or age

The following Fig. 7.36.3.1.4.1 and 2 display the stratified abundance indices of GSA 18 in 1995-2002 and 2003-2007. These size compositions are considered preliminary.

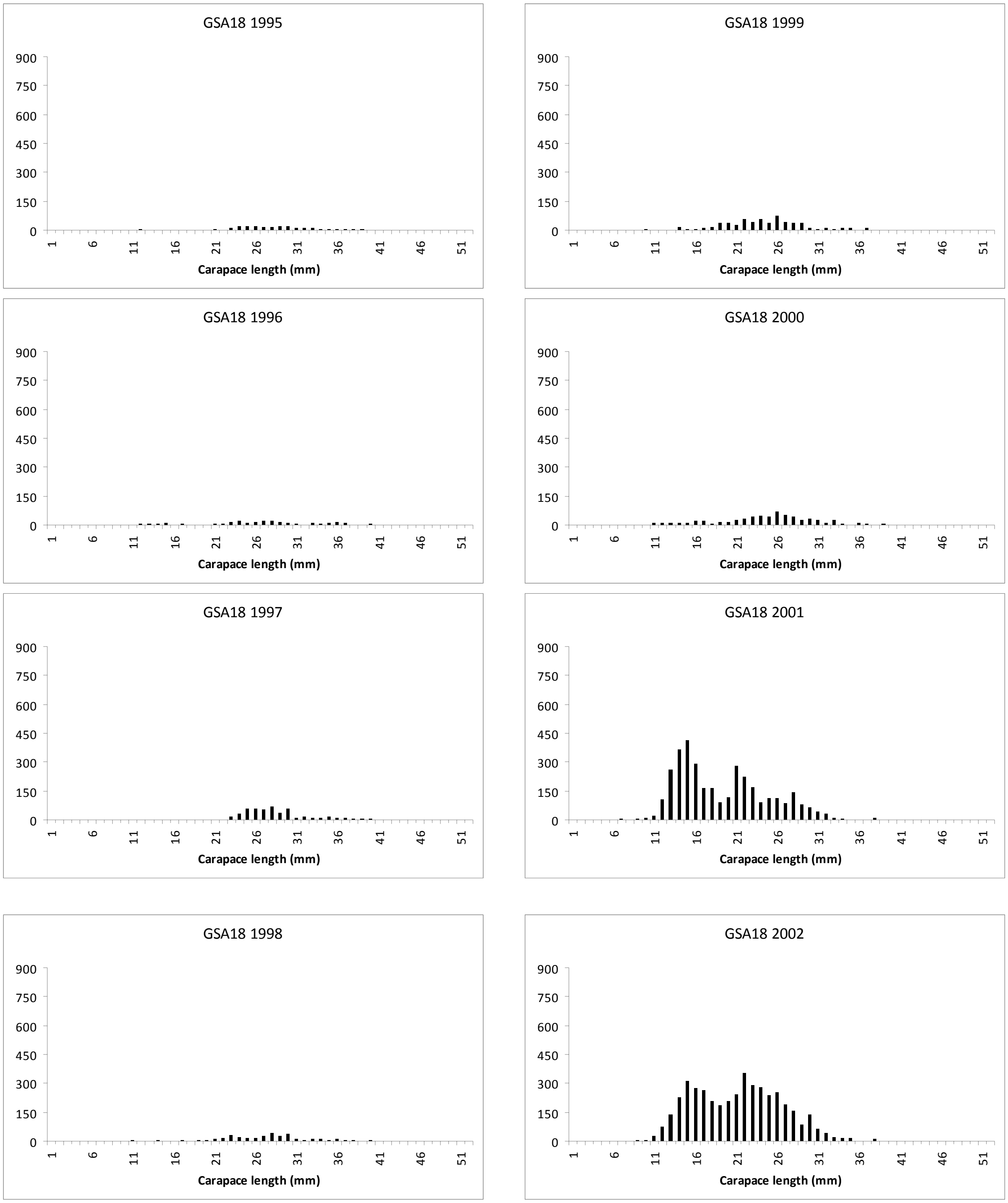


Fig. 7.36.3.1.4.1 Stratified abundance indices by size, 1995-2002.

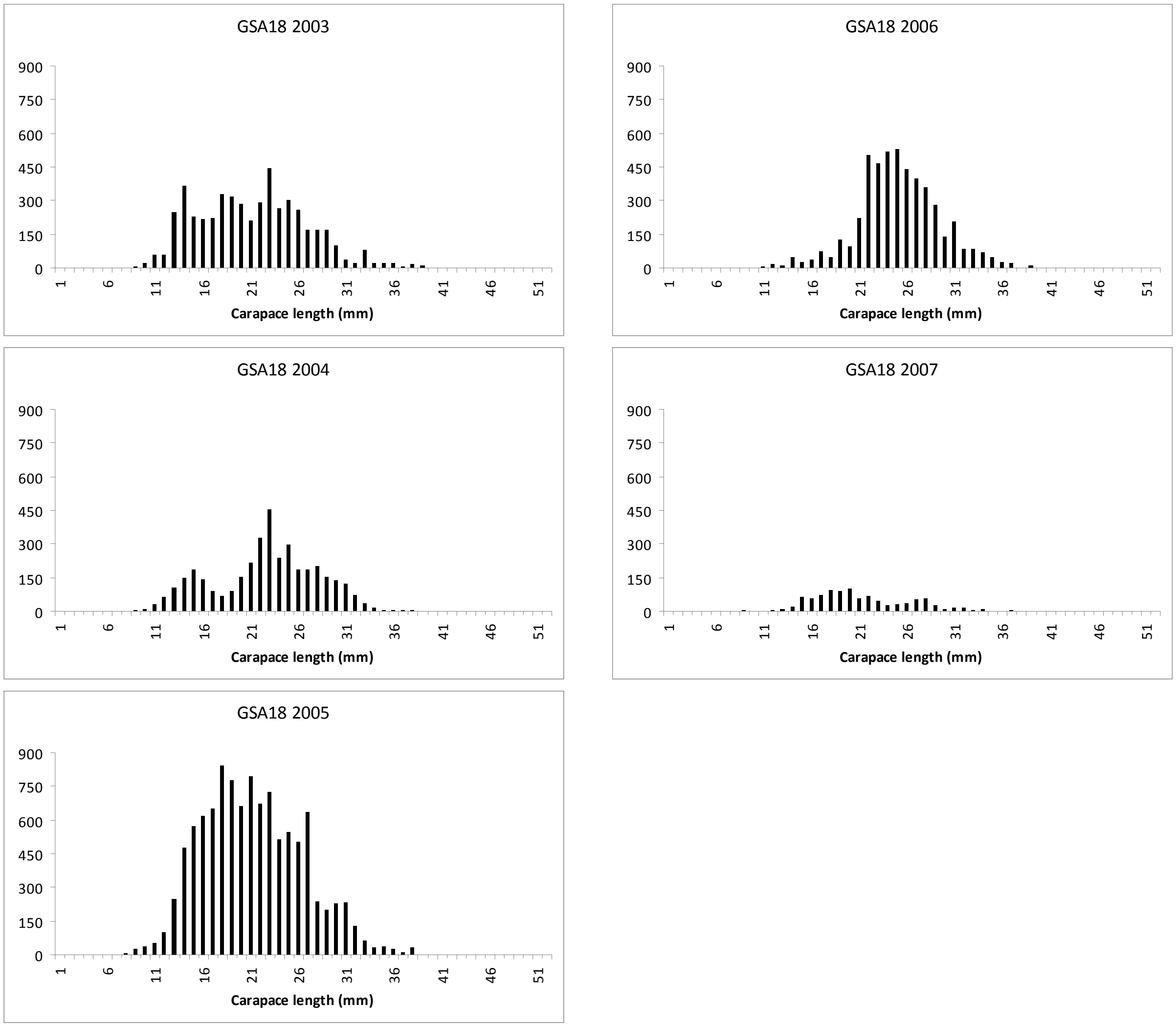


Fig. 7.36.3.1.4.2 Stratified abundance indices by size, 2003-2007.

7.36.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.36.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.36.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.36.5. Short term prediction for 2008 and 2009

7.36.5.1. Justification

No forecast analyses were conducted.

7.36.5.2. Input parameters

No forecast analyses were conducted.

7.36.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 18.

7.36.6. Medium term prediction

7.36.6.1. Justification

No forecast analyses were conducted.

7.36.6.2. Input parameters

No forecast analyses were conducted.

7.36.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 18.

7.36.7. Long term prediction

7.36.7.1. Justification

No forecast analyses were conducted.

7.36.7.2. Input parameters

No forecast analyses were conducted.

7.36.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSA 18.

7.36.8. Scientific advice

7.36.8.1. Short term considerations

7.36.8.1.1. State of the spawning stock size

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.36.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.36.8.1.3. State of exploitation

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.36.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.37. Stock assessment of pink shrimp in GSA 19

7.37.1. Stock identification and biological features

7.37.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.37.1.2. Growth

No information was documented during SGMED-08-04.

7.37.1.3. Maturity

No information was documented during SGMED-08-04.

7.37.2. Fisheries

7.37.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.37.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.37.2.3. Catches

7.37.2.3.1. Landings

Tab. 7.37.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2002 the annual landings varied annually among 608 t in 2007 and 1,390 t in 2003. The landings in 2007 represent the record low since 2002. The landings were mainly taken by demersal otter trawls.

Tab. 7.37.2.3.1.1 Annual landings (t) by fishing technique in GSA 19.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	19	ITA	DTS	738	646	1037	1242	1245	608
DPS	19	ITA	HOK			34			
DPS	19	ITA	PGP	3		77	1		
DPS	19	ITA	PMP	365	745	53	1		
DPS	19	ITA	PTS	20					
SUM				1126	1391	1201	1244	1245	608

7.37.2.3.2. Discards

4 t of discards in 2006 was reported to SGMED-08-04 through the DCR data call and is listed in Tab. A.3.6 of Appendix 3..

7.37.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.37.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.37.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSA 19, 2002-2007.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	19	ITA	DTS	31381	31586	37234	42413	42976	40423
DAYS	19	ITA	HOK			39190	43898	25644	17695
DAYS	19	ITA	PGP	233718	254881	225109	193806	217447	168411
DAYS	19	ITA	PMP	100208	122225	20325	6905		
DAYS	19	ITA	PTS	3458	7302	6605	5554	5507	4441
GT*DAYS	19	ITA	DTS			782163	884513	835267	800971
GT*DAYS	19	ITA	HOK			1015534	1091913	850691	710177
GT*DAYS	19	ITA	PGP			473727	438792	555916	483882
GT*DAYS	19	ITA	PMP			111129	34967		
GT*DAYS	19	ITA	PTS			195882	238105	188866	114537
KW*DAYS	19	ITA	DTS	5125805	5002396	5802023	6562337	6460683	6063817
KW*DAYS	19	ITA	HOK			6809150	7299195	5575566	4053202
KW*DAYS	19	ITA	PGP	4669873	9192254	4881153	4698292	6141378	5333724
KW*DAYS	19	ITA	PMP	13116917	9143878	1188078	341008		
KW*DAYS	19	ITA	PTS	978457	1629677	1105203	1026897	1008813	691704

7.37.3. Scientific surveys

7.37.3.1.Medits

7.37.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSA 19 the following number of hauls were reported per depth stratum (s. Tab. 7.37.3.1.1.1).

Tab. 7.37.3.1.1.1. Number of hauls per year and depth stratum in GSA 16, 2002-2007.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA19_010-050									9	9	9	9	9	8
GSA19_050-100									8	8	8	8	8	9
GSA19_100-200									10	10	10	10	10	10
GSA19_200-500									14	14	14	15	14	14
GSA19_500-800									29	29	29	28	29	29

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes

hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$Yst = \Sigma (Yi*Ai) / A$

$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.37.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.37.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSA 19 was derived from the international survey Medits. Figure 7.37.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSA 19.

The estimated abundance and biomass varied without a clear trend. However, the recent abundance and biomass indices in 2007 appear very low, which appears consistent with the low landings in 2007. The analyses of Medits indices are considered preliminary.

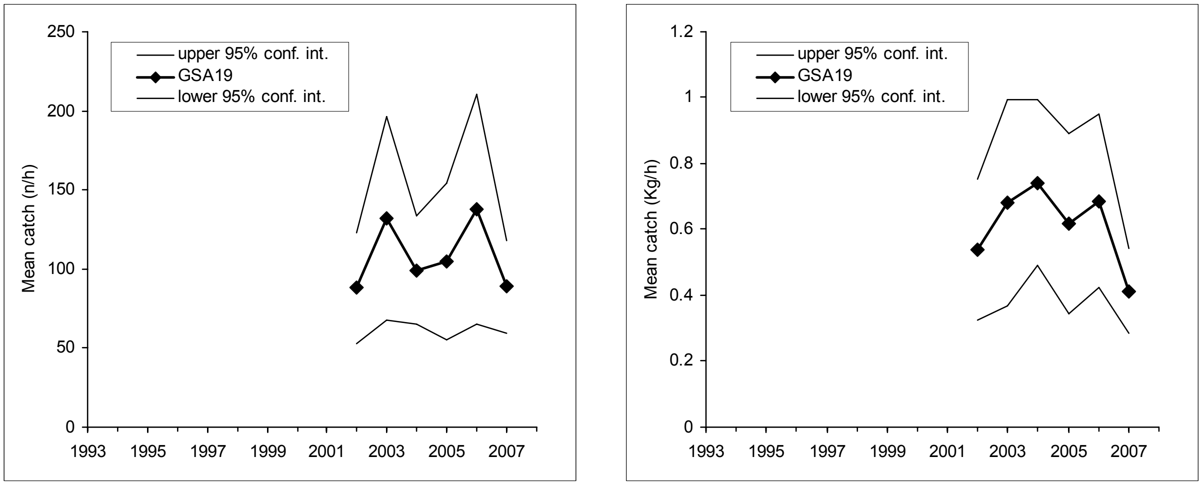


Fig. 7.37.3.1.3.1 Abundance and biomass indices of pink shrimp in GSA 19.

7.37.3.1.4. Trends in abundance by length or age

The following Fig. 7.37.3.1.4.1 and 2 display the stratified abundance indices of GSA 19 in 2003-2007. These size compositions are considered preliminary.

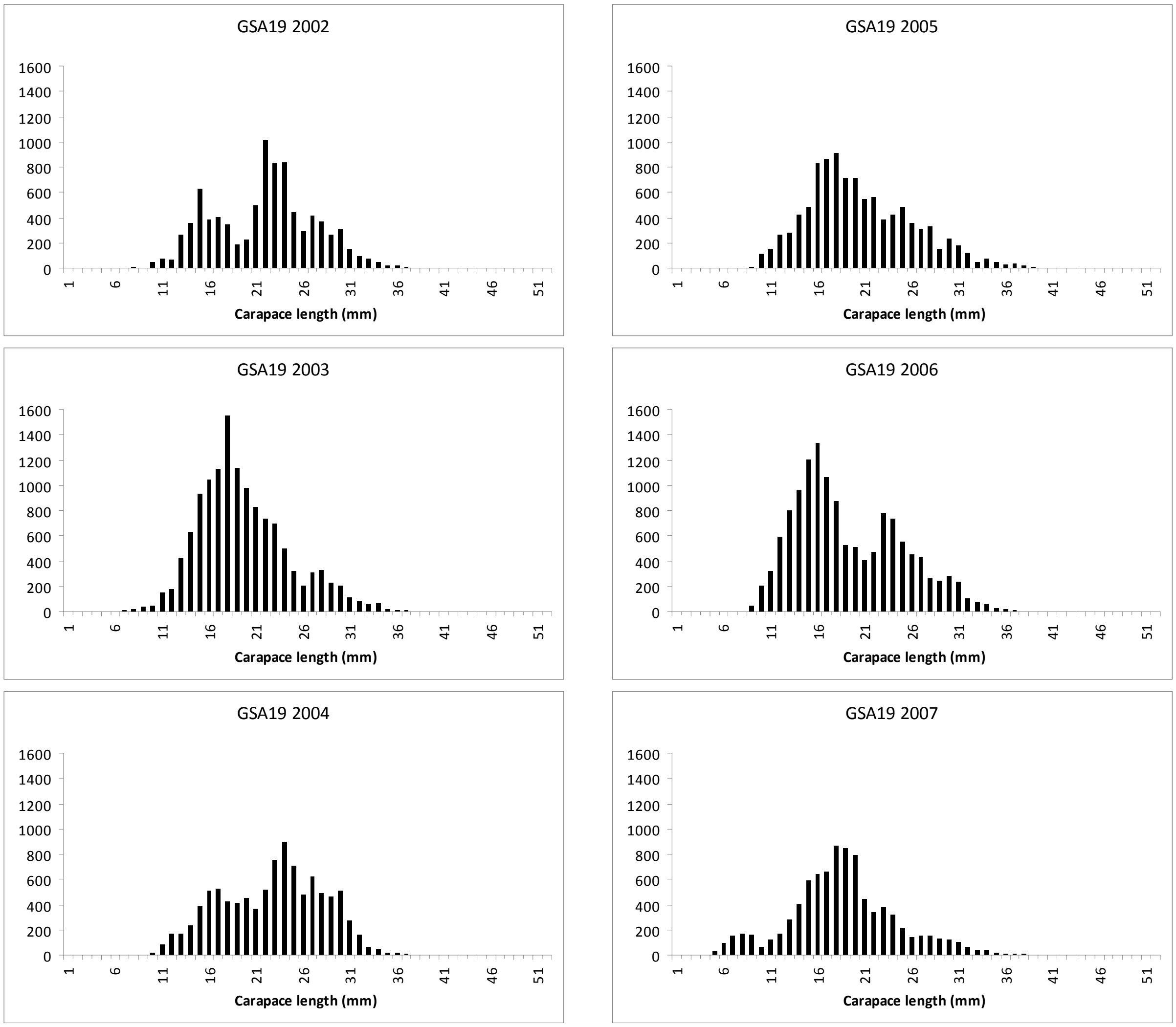


Fig. 7.37.3.1.4.1 Stratified abundance indices by size, 2002-2007.

7.37.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.37.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.37.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.37.5. Short term prediction for 2008 and 2009

7.37.5.1. Justification

No forecast analyses were conducted.

7.37.5.2. Input parameters

No forecast analyses were conducted.

7.37.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSA 19.

7.37.6. Medium term prediction

7.37.6.1. Justification

No forecast analyses were conducted.

7.37.6.2. Input parameters

No forecast analyses were conducted.

7.37.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSA 19.

7.37.7. Long term prediction

7.37.7.1. Justification

No forecast analyses were conducted.

7.37.7.2. Input parameters

No forecast analyses were conducted.

7.37.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSA 19.

7.37.8. Scientific advice

7.37.8.1. Short term considerations

7.37.8.1.1. State of the spawning stock size

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.37.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.37.8.1.3. State of exploitation

SGMED-08-04 is unable to provide any scientific advice of the state of the exploitation in relation to proposed precautionary and target levels given the preliminary state of the data and analyses.

7.37.8.2. Medium term considerations

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.38. Stock assessment of pink shrimp in GSAs 22-23

7.38.1. Stock identification and biological features

7.38.1.1. Stock Identification

No information was documented during SGMED-08-04.

7.38.1.2. Growth

No information was documented during SGMED-08-04.

7.38.1.3. Maturity

No information was documented during SGMED-08-04.

7.38.2. Fisheries

7.38.2.1. General description of fisheries

No information was documented during SGMED-08-04.

7.38.2.2. Management regulations applicable in 2007 and 2008

No information was documented during SGMED-08-04.

7.38.2.3. Catches

7.38.2.3.1. Landings

Tab. 7.38.2.3.1.1 lists the trend in reported landings by fishing technique. The data were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.3 of Appendix 3. Since 2003 the annual landings increased significantly from 1,070 t in 2003 and 4,175 t in 2006. The landings were mainly taken by demersal otter trawls.

Tab. 7.38.2.3.1.1 Annual landings (t) by fishing technique in GSAs 22 and 23.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	22-23	GRE	GNS		206	97	71	123	
DPS	22-23	GRE	OTB		865	3257	3925	4052	
SUM					1071	3354	3996	4175	

7.38.2.3.2. Discards

Annual discards were reported to SGMED-08-04 through the DCR data call and is listed in Tab. A.3.6 of Appendix 3. The annual discards varied between 83 and 455 t.

Tab. 7.38.2.3.2.1 Annual landings (t) by fishing technique in GSAs 22 and 23

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	22-23	GRE	OTB		83	455	188		

7.38.2.3.3. Fishing effort

The trends in fishing effort by fishing technique reported to SGMED-08-04 are listed in Tab. 7.38.2.3.3.1 and in Tab. A3.7-3.9 of Appendix 3.

Tab. 7.38.2.3.3.1 Trends in annual fishing effort by fishing technique deployed in GSAs 22 and 23, 2003-2006.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	22-23	GRE	GNS		1499507	1445880	1529002	1479134	
DAYS	22-23	GRE	LLS		381095	295005	315854	253335	
DAYS	22-23	GRE	OTB		52536	53389	56580	52831	
DAYS	22-23	GRE	SV		36266	31987	33200	30098	
GT*DAYS	22-23	GRE	GNS		5837915	5675508	5782002	5610405	
GT*DAYS	22-23	GRE	LLS		1762101	1660263	1602486	1323112	
GT*DAYS	22-23	GRE	OTB		4927349	4971783	5553804	5554194	
GT*DAYS	22-23	GRE	SV		294896	269645	276265	257271	
KW*DAYS	22-23	GRE	GNS		48227268	53304432	54981971	52423637	
KW*DAYS	22-23	GRE	LLS		14158502	11416302	10631705	8283337	
KW*DAYS	22-23	GRE	OTB		15792715	15877180	17730748	16402915	
KW*DAYS	22-23	GRE	SV		2775797	2206815	2193550	2022231	

7.38.3. Scientific surveys

7.38.3.1.Medits

7.38.3.1.1. Methods

Based on the DCR data call, abundance and biomass indices were recalculated and presented in section 11 of this report.

In GSAs 22 and 23 the following number of hauls were reported per depth stratum (s. Tab. 7.38.3.1.1.1).

Tab. 7.38.3.1.1.1. Number of hauls per year and depth stratum in GSAs 22 and 23, 1994-2006.

STRATUM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GSA22+23_010-050	10	10	11	10	13	12	13	13		13	13	14	14	
GSA22+23_050-100	17	21	22	28	24	26	21	25		25	23	24	24	
GSA22+23_100-200	19	25	37	36	36	33	37	35		36	43	41	41	
GSA22+23_200-500	28	35	44	50	51	51	50	48		51	52	52	52	
GSA22+23_500-800	18	12	19	21	22	21	20	17		17	16	17	16	

Data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). Few obvious data errors were corrected. Catches by haul were standardized to 60 minutes hauling duration. Hauls noted as valid were used only, including stations with no catches of hake, red mullet or pink shrimp (zero catches are included).

The abundance and biomass indices by GSA were calculated through stratified means (Cochran, 1953; Saville, 1977). This implies weighting of the average values of the individual standardized catches and the variation of each stratum by the respective stratum areas in each GSA:

$$Yst = \Sigma (Yi*Ai) / A$$

$$V(Yst) = \Sigma (Ai^2 * si^2 / ni) / A^2$$

Where:

A=total survey area
Ai=area of the i-th stratum
si=standard deviation of the i-th stratum
ni=number of valid hauls of the i-th stratum
n=number of hauls in the GSA
Yi=mean of the i-th stratum
Yst=stratified mean abundance
V(Yst)=variance of the stratified mean

The variation of the stratified mean is then expressed as the 95 % confidence interval: Confidence interval = Yst ± t(student distribution) * V(Yst) / n

It was noted that while this is a standard approach, the calculation may be biased due to the assumptions over zero catch stations, and hence assumptions over the distribution of data. A normal distribution is often assumed, whereas data may be better described by a delta-distribution, quasi-poisson. Indeed, data may be better modelled using the idea of conditionality and the negative binomial (e.g. O'Brien et al. (2004)).

Length distributions represented an aggregation (sum) of all standardized length frequencies (subsamples raised to standardized haul abundance per hour) over the stations of each stratum. Aggregated length frequencies were then raised to stratum abundance * 100 (because of low numbers in most strata) and finally aggregated (sum) over the strata to the GSA. Given the sheer number of plots generated, these distributions are not presented in this report.

7.38.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.38.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the pink shrimp in GSAs 22 and 23 was derived from the international survey Medits. Figure 7.38.3.1.3.1 displays the estimated trend in pink shrimp abundance and biomass in GSAs 22 and 23.

The estimated abundance and biomass indices increased from a very low level in 1994 to the highest value of the time series in 2006. The analyses of Medits indices are considered preliminary.

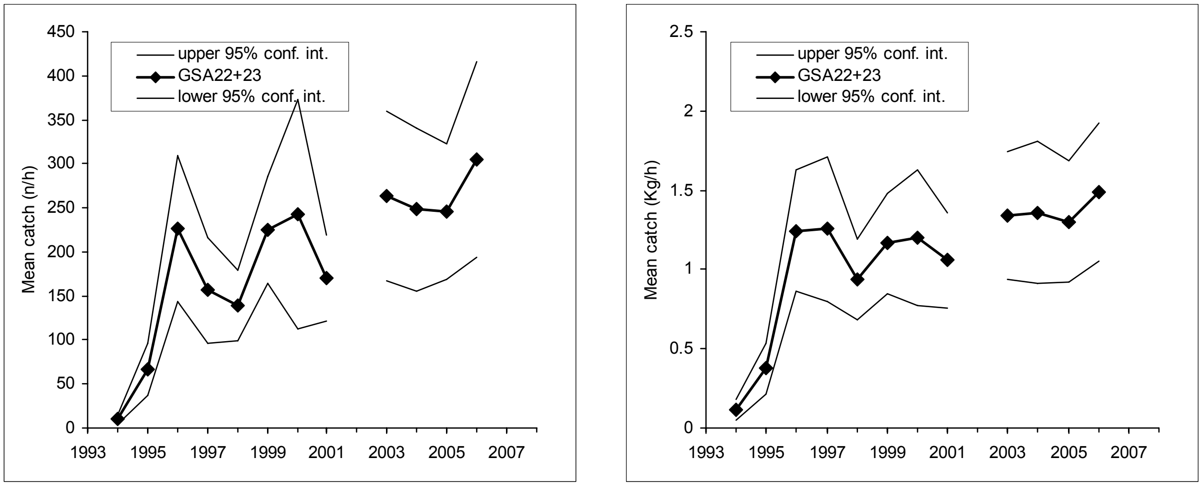


Fig. 7.38.3.1.3.1 Abundance and biomass indices of pink shrimp in GSAs 22 and 23.

7.38.3.1.4. Trends in abundance by length or age

The following Fig. 7.38.3.1.4.1 and 2 display the stratified abundance indices of GSAs 22 and 23 in 1994-2001 and 2003-2006. These size compositions are considered preliminary.

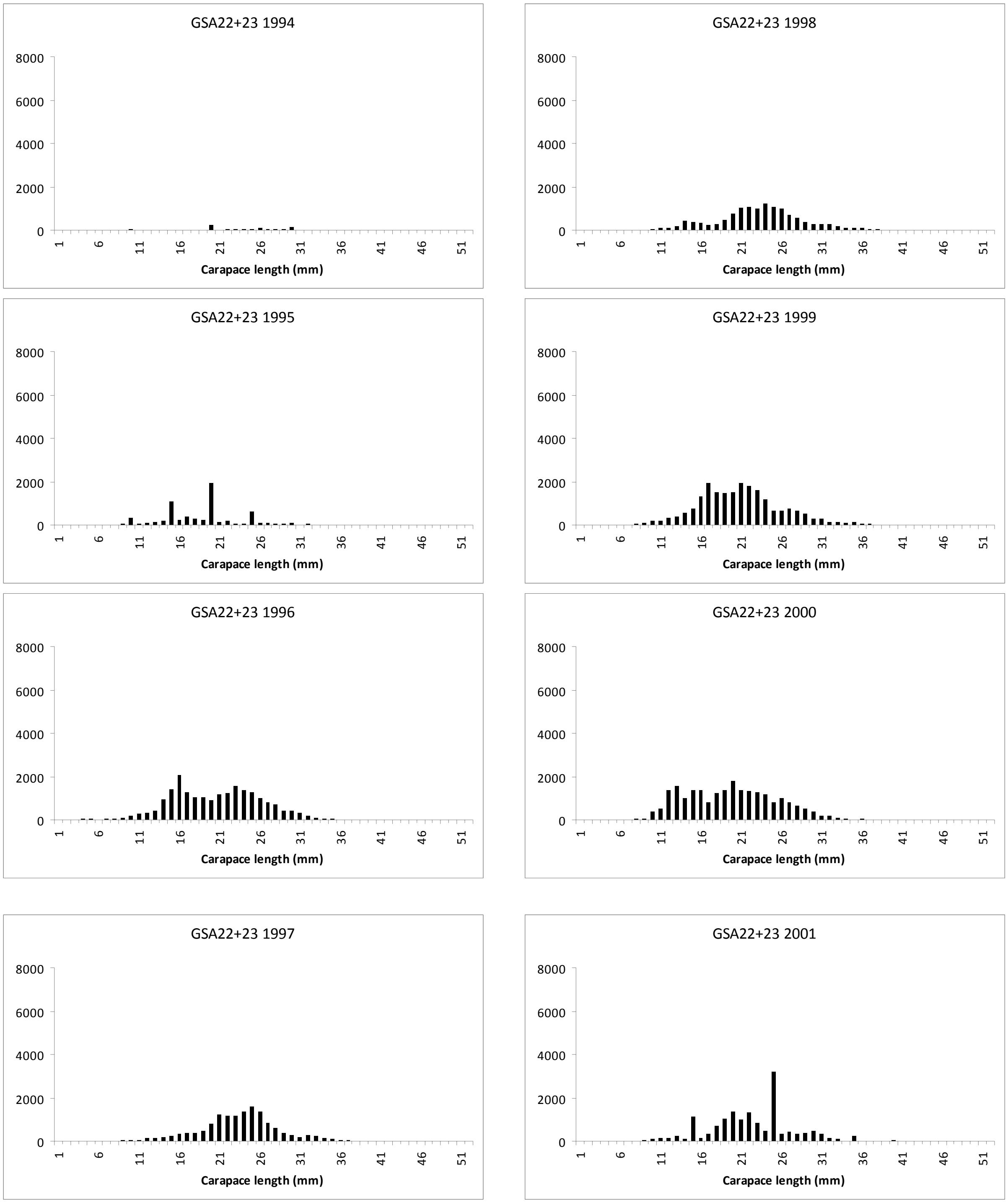


Fig. 7.38.3.1.4.1 Stratified abundance indices by size, 1994-2001.

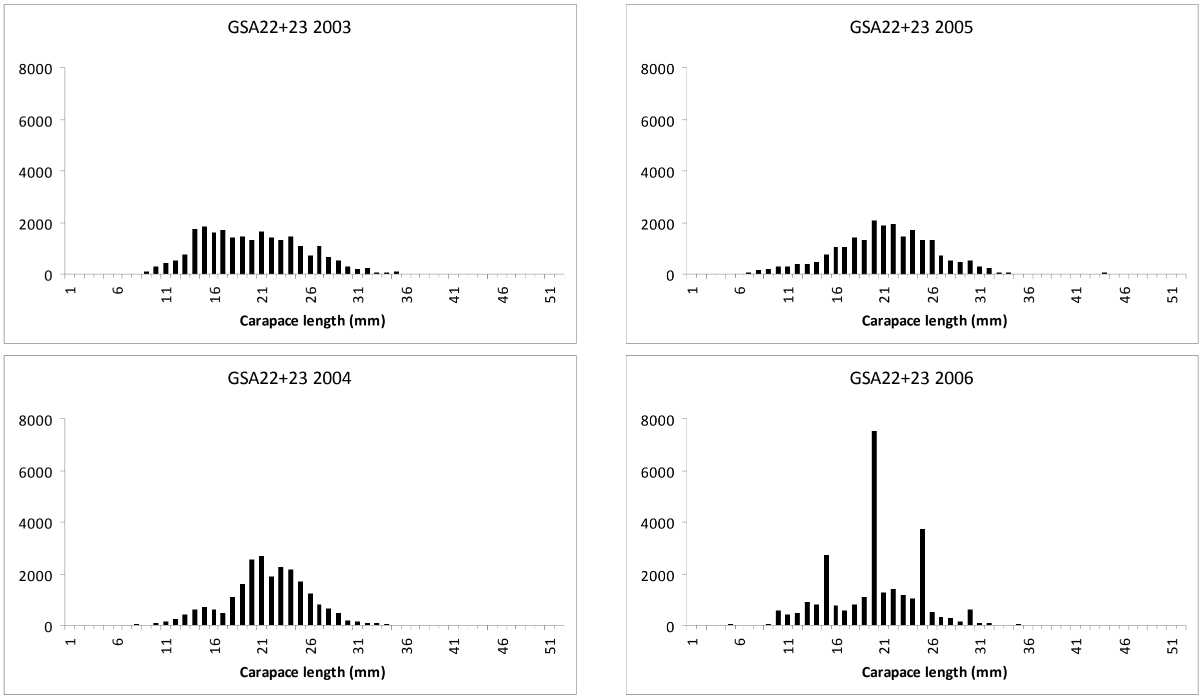


Fig. 7.38.3.1.4.2 Stratified abundance indices by size, 2003-2006.

7.38.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.38.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.38.4. Assessment of historic stock parameters

SGMED-08-3 did not undertake any analytical assessment.

7.38.5. Short term prediction for 2008 and 2009

7.38.5.1. Justification

No forecast analyses were conducted.

7.38.5.2. Input parameters

No forecast analyses were conducted.

7.38.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for pink shrimp in GSAs 22 and 23.

7.38.6. Medium term prediction

7.38.6.1. Justification

No forecast analyses were conducted.

7.38.6.2. Input parameters

No forecast analyses were conducted.

7.38.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for pink shrimp in GSAs 22 and 23.

7.38.7. Long term prediction

7.38.7.1. Justification

No forecast analyses were conducted.

7.38.7.2. Input parameters

No forecast analyses were conducted.

7.38.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for pink shrimp in GSAs 22 and 23.

7.38.8. Scientific advice

7.38.8.1. Short term considerations

7.38.8.1.1. State of the spawning stock size

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.38.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.38.8.1.3. State of exploitation

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.38.8.2. Medium term considerations

SGMED-08-04 is unable to provide any scientific advice given the preliminary state of the data and analyses.

7.39. Stock assessment of anchovy in GSA 01

7.39.1. Stock identification and biological features

7.39.1.1. Stock Identification

Little or no specific work has been focus on the biological stock delimitation of anchovy in the Western Mediterranean, but exchanges between the Northern Alboran Sea (GSA01) with both the Northern Spain (GSA06) and South Alboran Sea (GSA03) are believed non-existent. During the STECF-SGMED-08-02 the experts recommend continuing with the assessments on GFCM-GSA basis. The attached figure shows the GFCM Geographical Sub-Area GSA-01 (Northern Alboran Sea).

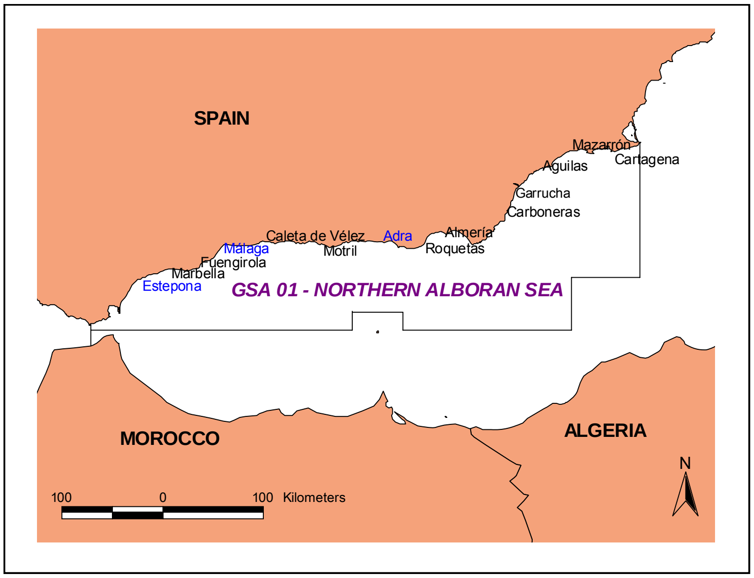


Fig. 7.39.1.1.1 Stock distribution area.

7.39.1.2. Growth

Growth parameters were estimated throughout the DCR biological sampling on a triennial basis. The method used was the Von Bertalanffy equation fit to the age (otoliths reading) and growth data using non-linear estimation with minimum least squares (Gauss-Newton algorithm) and bootstrapped precision estimates.

Table 7.39.1.2.1 Growth parameters.

PERIOD	L_INF	K	T0	A	B
2003-2004	19.0	0.3395	-1.8815	0.0029	3.3171
2005-2007	19.0	0.3419	-2.3210	0.0040	3.1945

7.39.1.3. Maturity

Maturity at age was estimated throughout the DCR biological sampling from years 2003-2007. These values were considered constant through the years of the assessed time series (2002-2007).

Table 7.39.1.3.1 Maturity ogive.

Age	0	1	2	3
Prop Matures	0.50	0.89	1.0	1.0

7.39.2. Fisheries

7.39.2.1. General description of fisheries

The current fleet in GSA 01 the Northern Alborán Sea is composed by 136 units, characterised by small vessels. 22% of them are smaller than 12 m and 78% between 12 and 24 m. The purse seine fleet has been continuously decreasing in the last two decades, from more than 230 vessels in 1980 to 136 in 2007.
Sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) are the main target species of the purse seine fleet in Northern Alboran GSA01, but other species with lower economical mackerel (*Trachurus spp.*), mackerel (*Scomber spp.*) and gilt sardine (*Sardinella aurita*).

7.39.2.2. Management regulations applicable in 2007 and 2008

- Fishing license
- Minimum landing size 11cm.
- Time at sea 12 hours per day and 5 days a week (no fishing allowed on weekend)
- Several technical measures regulations (gear and mesh size, engine, GRT, etc...).
- Temporary fishing closures (March and April).

7.39.2.3. Catches

7.39.2.3.1. Landings

The annual landings of anchovy in the Northern Alborán Sea show a strong annual fluctuation for the last six years ranged between 3268 and 245 tons. Landings decreased in 2007, reaching up 245 t (the same value found in 2003) that are the lowest of the time series.
The data were reported to SGMED-08-04 through the Data collection regulation and are listed below.

Tab. 7.39.2.3.1.1 of landings (Spanish purse seiners in GSA01).

YEAR	LANDINGS (tonnes)
2002	3268
2003	245
2004	746
2005	518
2006	637
2007	245

7.39.2.3.2. Discards

Anchovy discards in GSA01 are negligible.

7.39.2.3.3. Fishing effort

Fishing effort in GSA01 for years 2002 to 2007 were accessible to SGMED-08-04 experts through the DCR. The following figure shows the trend in different units of fishing effort for the different fleet segments.

7.39.2.3.3.1 Table of fishing effort (Spanish purse seiners by segment in GSA01).

	VL0012			VL1224			VL2440		
	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	373	3697	33352	3662	96196	480075			
2003	548	5124	40364	3949	99069	500302			
2004	445	3780	29149	3217	74599	389661			
2005	448	3656	28795	3506	89424	445675			
2006	419	3481	27732	4145	111485	552119	4	312	1295
2007	362	3422	22471	3704	103083	509196	5	390	1619

7.39.3. Scientific surveys

7.39.3.1.ECOMED Acoustic Survey

7.39.3.1.1. Methods

Estimation of abundance index with Acoustic Survey (Biomass in metric tons and abundance in number of individuals by species and sector).

The ECOMED survey provided data from 1990 onwards, although the abundance time series used for XSA tuning goes from 2003 to 2006 because of acoustic data are being reevaluated. As a result of a gradual increase in the abundance of other species (usually considered as accessory species in the pelagic system) it has been necessary to revaluate the previous data in ECOMED surveys using different values of the parameter target strength (TS).

The sampling coverage was completed only for two analysed years in GSA01 (2004 and 2005), the survey did not cover the whole area only sampling the two most representative bays in 2003 and 2006, no data for 2007 was available as weather conditions and lack of available time did not allow to sample the area.

Surveys are carried out on board the R/V Cornide de Saavedra during late autumn (November-December). A multifrequency echosounder is utilised (SIMRAD-ER60) sampling at frequencies of 38 kHz, 70 kHz, 120 kHz and 200 kHz. The ESDU is 1nm. The pulse duration is 1 msg. The software used echogram identification is *SonarData Ecoview*.

The sampling grid is comprised by parallel tracks, perpendicular to the coast. Acoustic sampling is performed during daytime. Experimental fishings with pelagic trawl for schools identification are done at nigh in the previously tracked positions.

7.39.3.1.2. Geographical distribution patterns

Anchovy in North Alborán Sea (GSA01) is concentrated in Málaga Bay. This Bay is the most important recruitment and fishery area and this represent 85% of total landings.

7.39.3.1.3. *Trends in abundance and biomass*

Both XSA and acoustics methods have the same perception of the state of the stock.
During the period from 1996-2006, the catches of anchovy stock in the Alborán Sea showed marked fluctuations. A successful recruitment, estimated by echo-acoustic tracking, was observed during 2001 (13000 tons) producing a strong increment of landings in 2002. The catch dropped in 2003, continuing at low level to 2006 (600 tons). This decline is consistent with both XSA and acoustics methods.

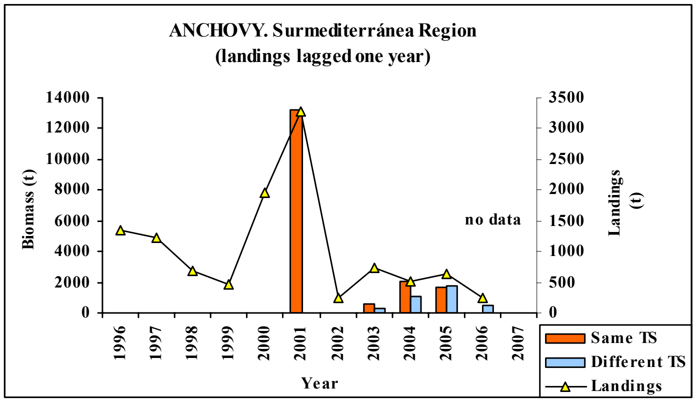


Fig. 7.39.3.1.3.1 Trends in biomass estimates and landings.

7.39.3.1.4. *Trends in abundance by length or age*

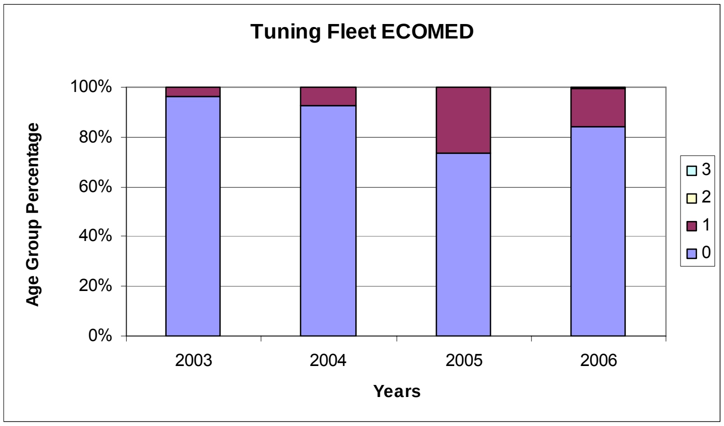


Fig. 7.39.3.1.4.1 Age compositon of the stock.

7.39.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04.

7.39.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04.

7.39.4. Assessment of historic stock parameters

7.39.4.1. Method 1: XSA

7.39.4.1.1. Justification

A previous assessment of this stock with XSA was performed and presented to the GFCM in 2004. This is the first assessment of *Engraulis encrasicolus* from GSA01 using VPA Extended Survivors Analysis (XSA) (Shepherd, 1999). A separable VPA (Pope and Sheperd, 1982) was also run as exploratory analysis for this stocks. Deterministic short term projections were also produced.

The length of the data series available (6 years, from 2002 to 2007) allowed the use of a VPA tuned with data from surveys and commercial fleet (XSA). The software used was the Lowestoft suite (Darby and Flatman 1994).

7.39.4.1.2. Input parameters

Landings time series 2002-2007 from all Fishery ports from GSA01.
Combined ALK (2003-2007) for all the years (Spanish National Data Collection).
Length Distributions 2003-2007 (Spanish National Data Collection), 2003 Length Distribution was applied for 2002.
Biological sampling 2003-2007 for Maturity at age and Weight-Length relationships (Spanish National Data Collection).
Tuning data from acoustic survey ECOMED and Commercial Fleet off Málaga for years 2003 to 2006. (ECOMED survey did not reach GSA01 in 2007 and covered the area partially in 2003 and 2006).

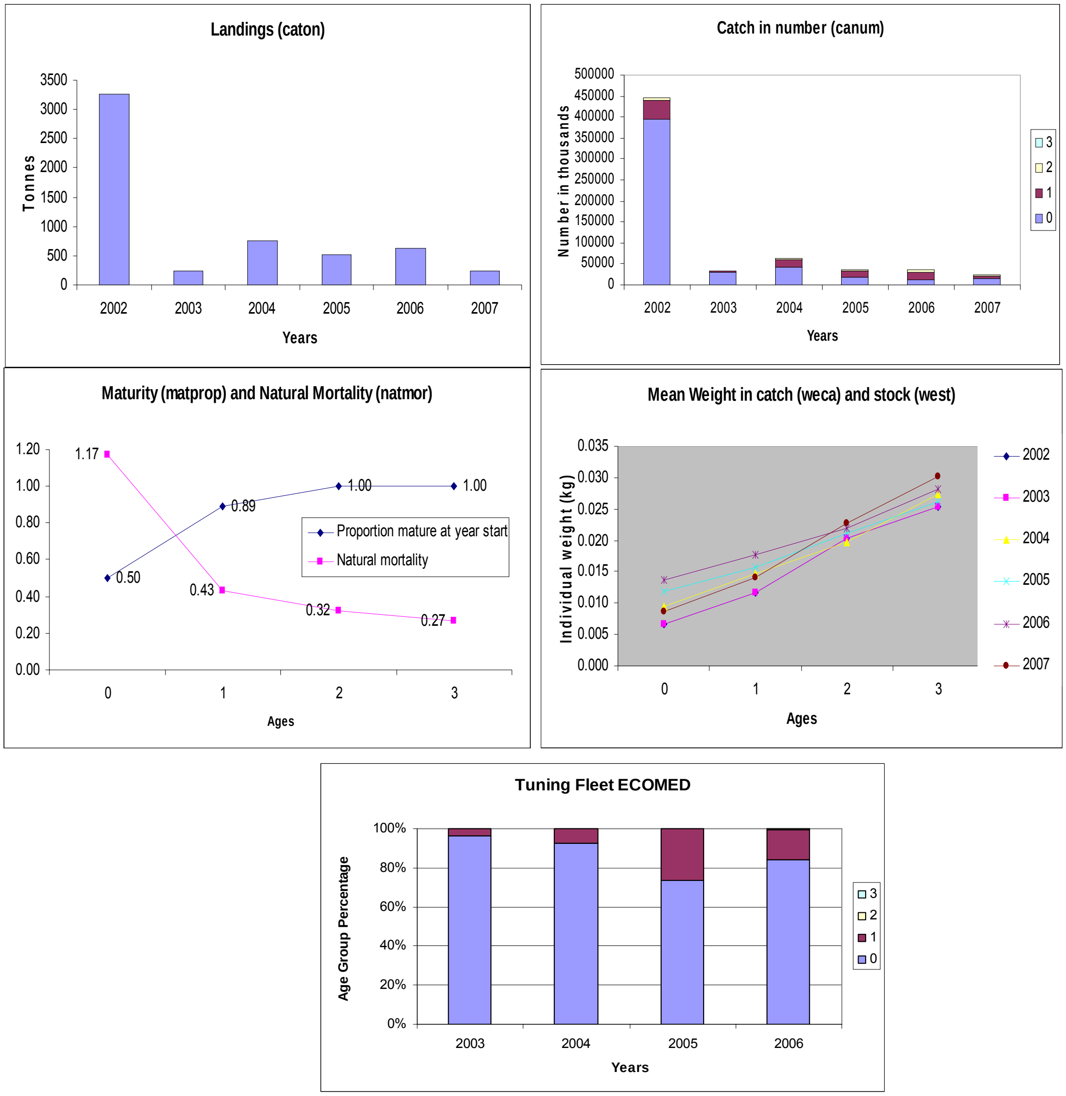


Fig. 7.39.4.1.2.1 Input parameters.

Growth parameters (Spanish National Data Collection)

PERIOD	L_INF	K	T0	A	B
2003-2004	19.0	0.3395	-1.8815	0.0029	3.3171
2005-2007	19.0	0.3419	-2.3210	0.0040	3.1945

Length-weight relationships (Spanish National Data Collection)

PERIOD	a	b
2003-2004	0.0029	0.004
2005-2007	3.3171	3.1945

Maturity at Age (Spanish National Data Collection)

Age	0	1	2	3
Prop Matures	0.50	0.89	1.0	1.0

A vector of natural mortality rate at age was estimated using the PRODBIOM spreadsheet (Abella et al. 1997):

Age	0	1	2	3	Mean 0-3	Mean 0-2 (Ages Fbar)
M	1.17	0.43	0.32	0.27	0.55	0.64

7.39.4.1.3. Results

A separable VPA was run as exploratory analysis. Log catchability residual plots were produced (see figure below) and no major conflict between ages seem to appear. The drop from 2002 to 2003 may be due to the drastic decrease in catches.

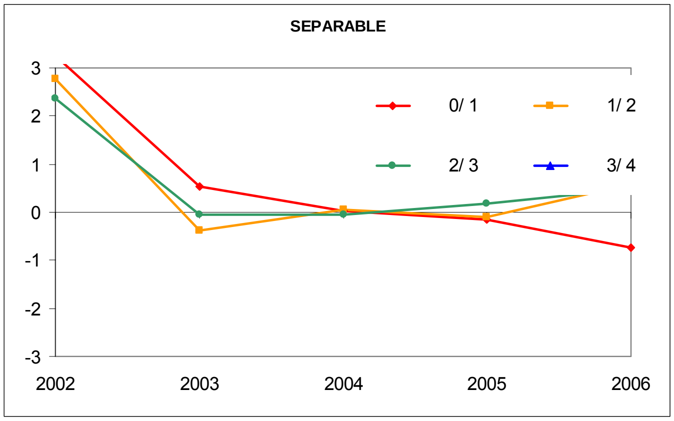


Fig. 7.39.4.1.3.1 Residulas of log catchabilities.

Then a XSA assessment was made. The main settings for the XSA are the following:

- Fbar 0-2.
- Age 1 for q stock-size independent and age 2 for q independent of age.
- Fshrinkage = 0.500 and S.E. for fleet terminal estimates ≥ 0.300

XSA Diagnostics in the form of residuals by Fleet are shown in the attached figure.

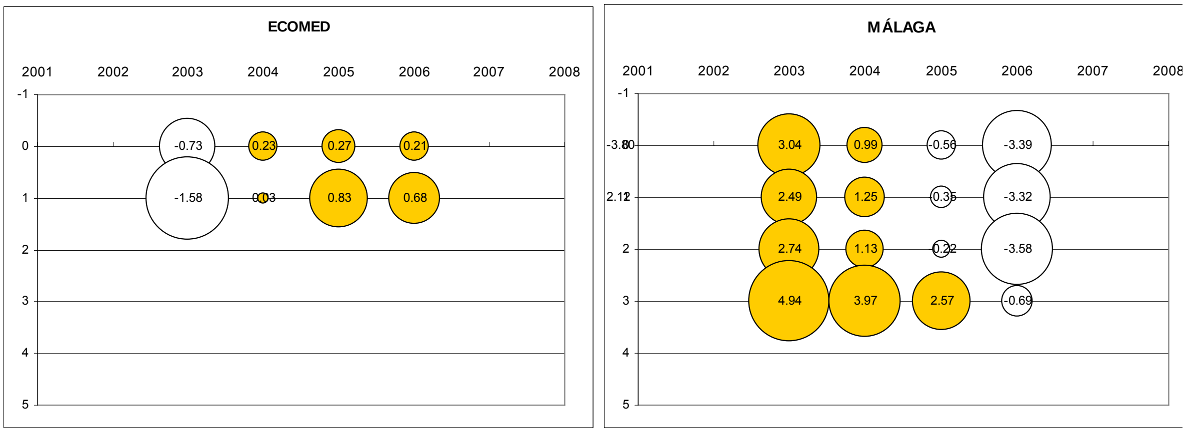


Fig. 7.39.4.1.3.2 Residulas by fleet.

Estimations of Survivors by age and fleet was produced. The most important weights are given by the Fshrinkage.

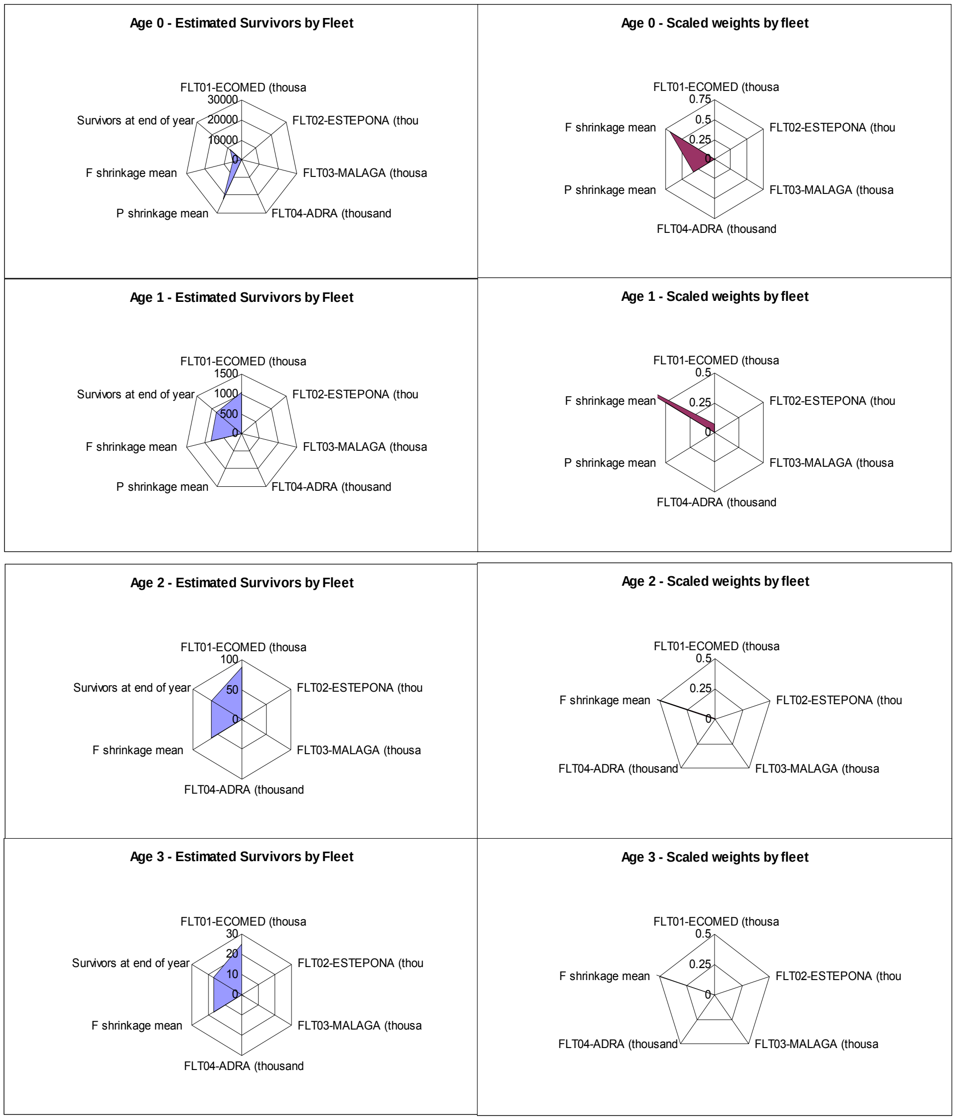


Fig. 7.39.4.1.3.3 XSA tuning diagnostics.

Following the suggestion arisen during the STECF-SGMED-08-04 meting, different runs with different tuning series included were performed. Run1 only included tuning data from acoustic surveys ECOMED, Run2 only included tuning data from commercial fleet off Málaga, and Run 3 included both ECOMED and commecial fleet tuning series. The next figure shows the comparison of XSA assessment results for anchovy in GSA01 under these alternative data inputs.

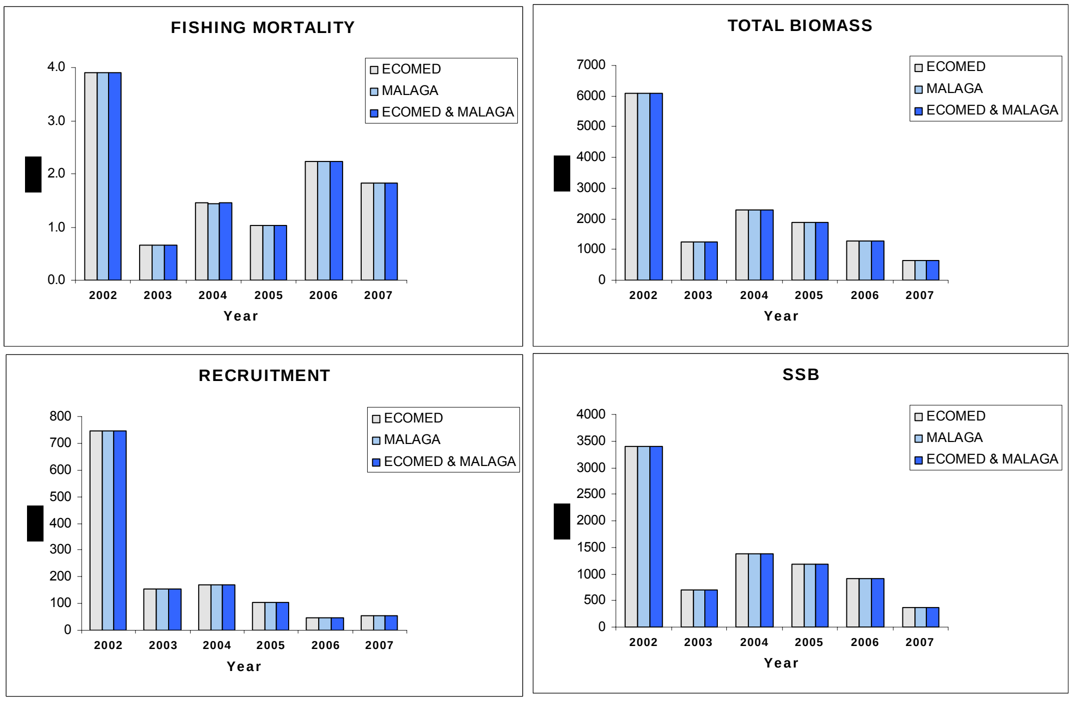


Fig. 7.39.4.1.3.4 Assessment results with diffenrend single fleet tunings.

The inclusion of tuning data from commercial fleet off Málaga do not provide additional information or different results. Therefore, the definitive assessment only included tuning data from acoustic surveys ECOMED

The figures below present the main results from the XSA: total landings, fishing mortality, recruitment, spawning stock biomass (SSB), total biomass and SSB/Recruitment relationship.

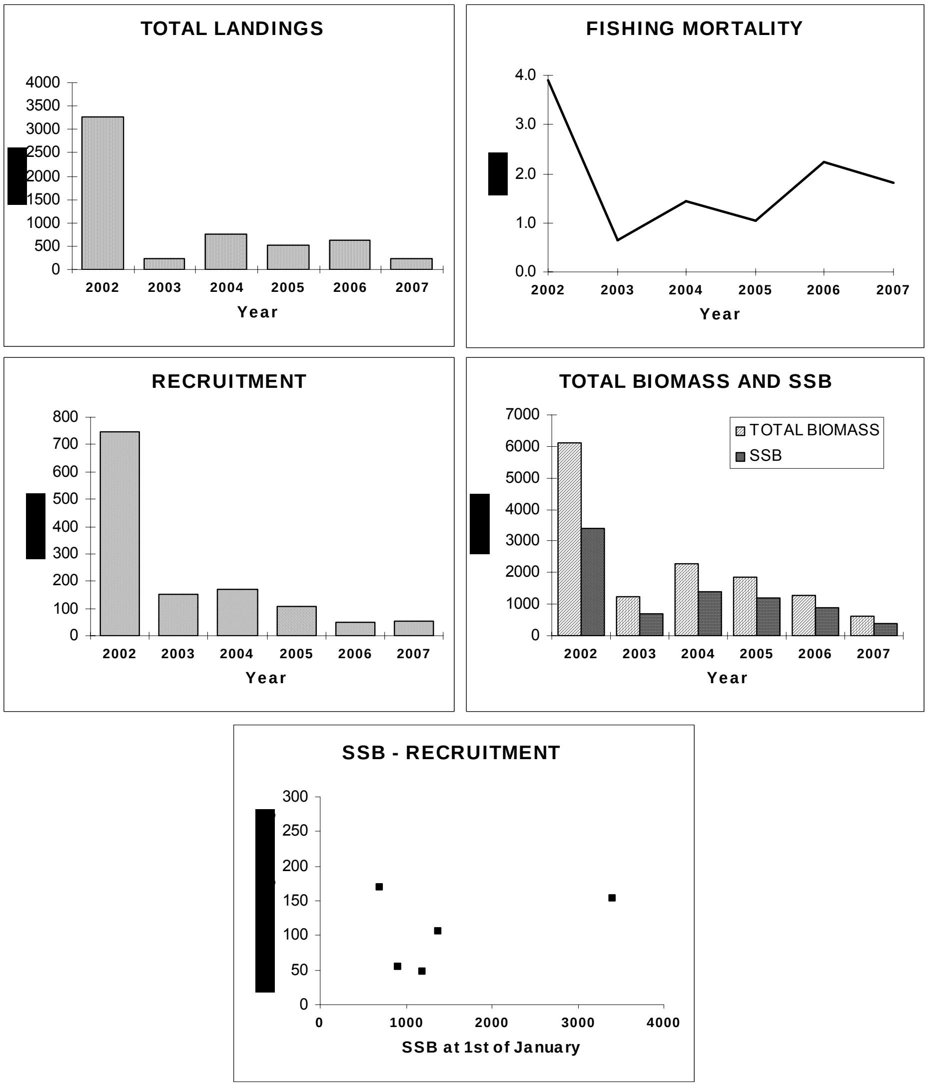


Fig. 7.39.4.1.3.5 Final assessment results.

State of exploitation: Since 2002 fishing mortality (F_{0-2}) has varied between 3.9 and 0.6. The maximum was observed in 2002, then falling down to the minimum in 2003. Since then, F shows an increasing trend (F_{07}=1.82).

State of the juvenile (recruits): Recruitment levels in 2006 and 2007 are the lowest of the time series (R_{06}=48 millions and R_{07}=54 millions). The trend of the recruitments is so important as they can affect seriously to the stock health. WG highlighted that the fishery is highly dependent of the recruitment strength.

State of the adult abundance and biomass: Both Total biomass in 2007 (TB=633 t) and Spawning Stock Biomass in 2007 (SSB=378 t) are the lowest of the series 2002-2007, continuing with the decreasing trend observed since 2004.

7.39.5. Short term prediction for 2008 and 2009

7.39.5.1. Justification

A preliminary short term projection for three years (2008 to 2010) was carried out using the MFDP software (Multi-Fleet Deterministic Projections).

The use of such projections in small pelagic fisheries was discussed because small pelagic fisheries are highly dependent on the recruitment strength. Thus, variation in the projected recruitment may have a great effect on the total biomass, SSB and landings for next years.
Preliminary short-term projection was run assuming conservative recruitments (the percentile 10% of the time series of recruitment, R_{low}).

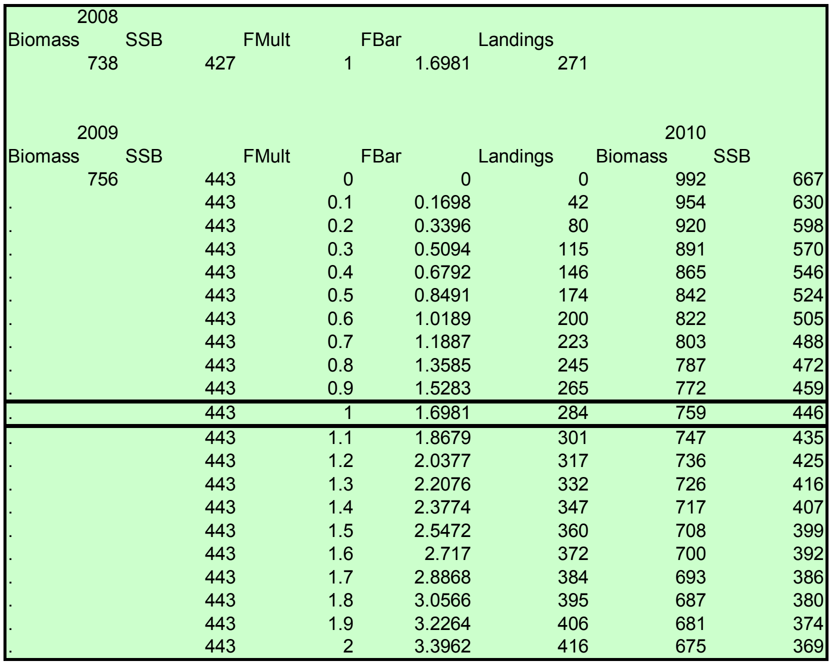
7.39.5.2. Input parameters

The same XSA imput parameters, assuming statu quo F (F_{0-2}=1.7) and recruitment is the percentil 10% of the recruitment time series (R_{low}=51 millions) as suggested by the GFCM WG on Joint Stock Assessment at Izmir (2008). We realise this option is more conservative but the most realistic and robust as recruitment follows a decreasing trend in last years.

7.39.5.3. Results

The next table shows the management options from the short term catch prediction. Status quo fishing should be sustainable in the short term: landings, total biomass and SSB is predicted to remain at the same levels under this management scenario.

- Landings are predicted to be 271 t in 2008 and 284 t in 2009.
- Total biomass are predicted to be 738 t in 2008 and 759 t in 2010.
- SSB will remain stable from 427 t in 2008 to 446 t in 2010.



2008						
Biomass	SSB	FMult	FBar	Landings		
738	427	1	1.6981	271		
2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
756	443	0	0	0	992	667
.	443	0.1	0.1698	42	954	630
.	443	0.2	0.3396	80	920	598
.	443	0.3	0.5094	115	891	570
.	443	0.4	0.6792	146	865	546
.	443	0.5	0.8491	174	842	524
.	443	0.6	1.0189	200	822	505
.	443	0.7	1.1887	223	803	488
.	443	0.8	1.3585	245	787	472
.	443	0.9	1.5283	265	772	459
.	443	1	1.6981	284	759	446
.	443	1.1	1.8679	301	747	435
.	443	1.2	2.0377	317	736	425
.	443	1.3	2.2076	332	726	416
.	443	1.4	2.3774	347	717	407
.	443	1.5	2.5472	360	708	399
.	443	1.6	2.717	372	700	392
.	443	1.7	2.8868	384	693	386
.	443	1.8	3.0566	395	687	380
.	443	1.9	3.2264	406	681	374
.	443	2	3.3962	416	675	369

7.39.6. Medium term prediction

7.39.6.1. Justification

No forecast analyses were conducted.

7.39.6.2. Input parameters

No forecast analyses were conducted.

7.39.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for anchovy in GSA 01.

7.39.7. Long term prediction

7.39.7.1. Justification

No forecast analyses were conducted.

7.39.7.2. Input parameters

No forecast analyses were conducted.

7.39.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for anchovy in GSA 01.

7.39.8. Scientific advice

It should be noted that small pelagic fishery in GSA01 is multispecies and effort on anchovy and sardine should be considered together.

Some work was done in SGMED-08-04 and some preliminary reference points were estimated based on yield-per-recruit analysis ($F_{0.1}$ & F_{max}). However the use of yield-per-recruit targets for long-term management of pelagic fisheries has been specifically discouraged (Patterson, 1992) and no reference points can be proposed at this time. Further research is aimed to produce effective Reference Points in this small pelagic fishery as well as Harvest Control Rules.

7.39.8.1. Short term considerations

7.39.8.1.1. State of the spawning stock size

Both Total biomass in 2007 (TB=633 t) and Spawning Stock Biomass in 2007 (SSB=378 t) are the lowest of the series 2002-2007, continuing with the decreasing trend observed since 2004.

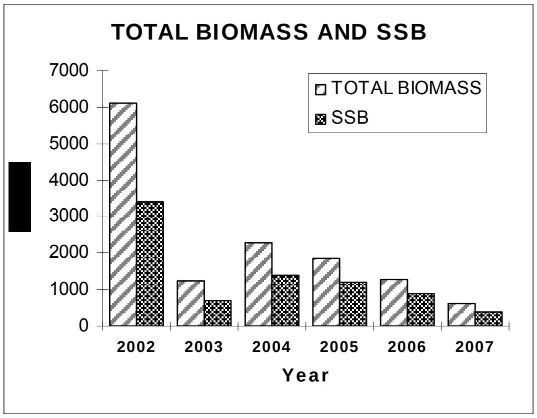


Fig. 7.39.8.1.1.1 Estimated trends in stock and spawing stock biomass, 2002-2007.

No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.

7.39.8.1.2. State of recruitment

Recruitment levels in 2006 and 2007 are the lowest of the time series (R_{06}=48 millions and R_{07}=54 millions). The trend of the recruitments is so important as they can affect seriously to the stock health. WG highlighted that the fishery is highly dependent of the recruitment strength.

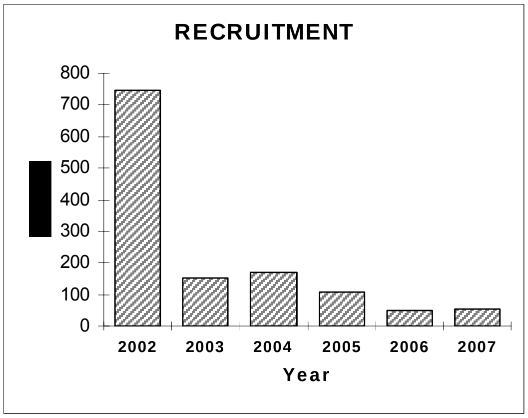


Fig. 7.39.8.1.2.1 Estimated trend in recruitment, 2002-2007.

7.39.8.1.3. State of exploitation

Since 2002 fishing mortality (F_{0-2}) has varied between 3.9 and 0.6. The maximum was observed in 2002, then falling down to the minimum in 2003. Since then, F shows an increasing trend (F_{07}=1.82).

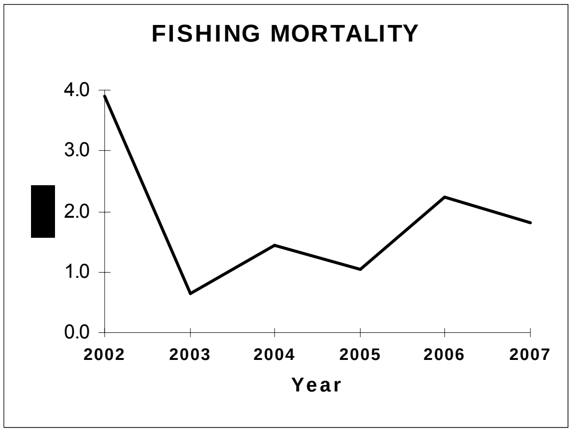


Fig. 7.39.8.1.3.1 Estimated trend in recruitment, 2002-2007.

No reference points were proposed for fishing mortality levels, and hence SGMED cannot comment on the state of the stock with this respect.

7.39.8.2. Medium term considerations

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

Monitoring of the stock should be continued. It is also recommended a complete sampling of ECOMED acoustic survey for the whole GSA01 area.

The WG considered the M vector as a good approach since it has more biological sense. WG encourages the use of such approach for natural mortality input data into the assessments.

7.40. Stock assessment of anchovy in GSA 06

7.40.1. Stock identification and biological features

7.40.1.1. Stock Identification

In the SGMED-08-04, the experts recommend continuing with the assessments on GFCM-GSA basis. The small pelagic stock assessments in the Mediterranean are accomplished by Geografical Sub-Areas (GSAs) as defined in the GFCM. Little or no specific work has been focus on the biological stock identification of small pelagic species in the Mediterranean and more study is needed.

The attached figure shows the GFCM Geographical Sub- Area GSA-06, comprising all landings ports. Sampled ports are highlighted in blue.

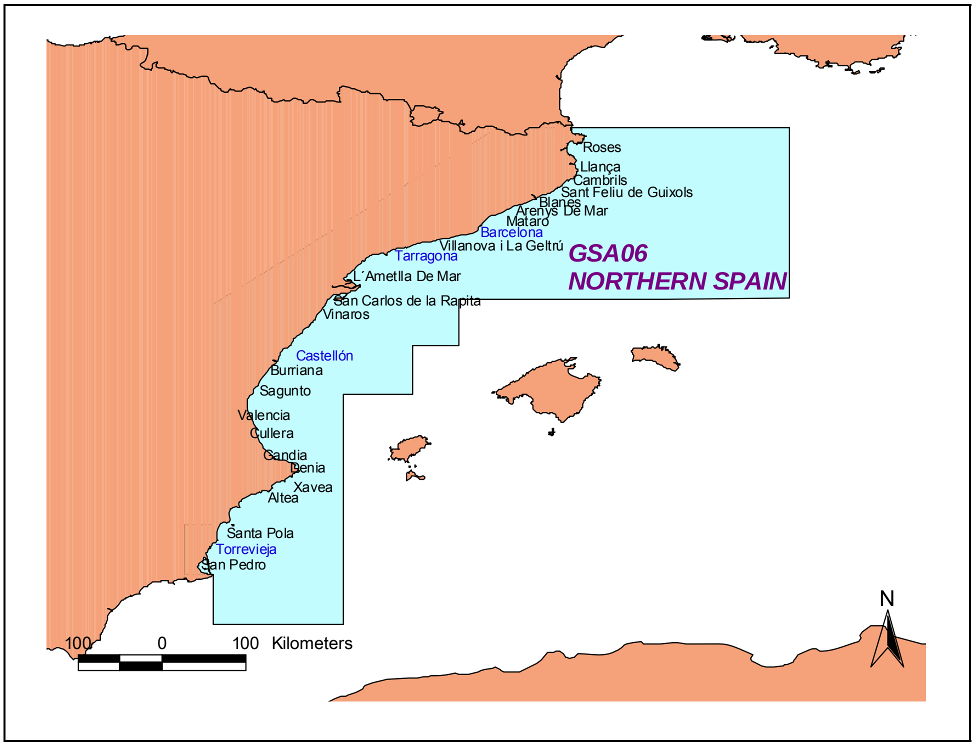


Fig. 7.40.1.1 Stock distribuition area.

7.40.1.2. Growth

Growth paramenter were estimated throughout the DCR biological sampling on a triennial basis. The growth parameters come from the anchovy off GSA01 and were applied to anchovy off GSA06. The used method was the Von Bertalanffy equation fit to the age (otolith readings) and growth data using non-linear estimation with minimum least squares (Gauss-Newton algorithm) and Bootstrapped precision estimates.

Table 7.40.1.2.1 Growth paramters.

PERIOD	L∞	K	t_0	A	B
2002-2004	19.00	0.339458	-1.88146	0.002930	3.317058
2005-2007	19.00	0.341913	-2.32099	0.004005	3.194488

7.40.1.3. Maturity

Maturity at age was estimated throughout the DCR biological sampling from years 2004-2007. These values were considered constant through the years of the assessed time series (1994-2007).

Table 7.40.1.2.1 Maturity ogive.

Age	0	1	2	3
Prop. Matures	0.50	0.89	1.00	1.00

7.40.2. Fisheries

7.40.2.1. General description of fisheries

The purse seine fleet operate in GSA 06 Northern Spain is composed by 132 units: 4% are smaller than12 m in length, 87% between 12 and 24 m and 9% bigger than 24 m. The fleet continuously decreased in the last decade, from more than 222 vessels in 1995 to 132 in 2007. This stronger reduction (59%) is possibly linked to a decreasing in anchovy catches.

Anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) are the main target species of the purse seine fleet in Northern Spain GSA06, but other species with lower economical importance are also captured, sometimes representing a high percentage of the capture: horse mackerel (*Trachurus* spp.), mackerel (*Scomber* spp.), and gilt sardine (*Sardinella aurita*).

This report is exclusively focused on fishery of anchovy.

7.40.2.2. Management regulations applicable in 2007 and 2008

- Fishing license.
- Minimum landing size 11cm.
- No fishing allowed on weekend. Time at sea 12 hours per day and 5 days a week: fully observed
- Several technical measures regulations (gear and mesh size, engine, GRT, etc...).
- Temporary fishing closures (From 1st December to 31st January).

7.40.2.3. Catches

7.40.2.3.1. Landings

The annual landings of anchovy (*Engraulis encrasicolus*) in the Northern Spain for the last six years ranged between 14340 and 2570 tons. This species is the most valuable one in pelagic fisheries off GSA 06.

Landings in 2007 were 2,570 t, showing a decrease from that of 2006 (3,100 t). The time series shows a very sharp decrease from the beginning of the times series in 2002. The lowest landings of the assessed time series is 2007.

Tab. 7.40.2.3.1.1 Landings.

Year	LANDINGS (t)
2002	14338
2003	8538
2004	8097
2005	6216
2006	3096
2007	2570

7.40.2.3.2. Discards

Discards are negliglible.

7.40.2.3.3. Fishing effort

Fishing effort for years 2002 to 2007 were accessible to SGMED-08-04 experts through the DCR. The following table shows the deployed fishing effort in the different fleet segments.

Table 7.40.2.3.3.1 Fishing effort trends by size groups of vessels.

	VL0012			VL1224			VL2440		
YEAR	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS	DAYS	GT*DAYS	KW*DAYS
2002	28	197	1896	12408	534217	2736656	178	12383	46380
2003	77	459	4337	10926	475782	2396483	196	14426	59043
2004	53	363	3514	14072	626307	3130943	1176	84527	319364
2005	44	304	2920	11403	513362	2548942	1512	108709	417447
2006	59	403	3818	11645	543460	2646176	2017	146803	558870
2007	48	344	3272	10305	466123	2242095	1895	138195	541494

7.40.3. Scientific surveys

7.40.3.1.ECOMED acoustic survey

7.40.3.1.1. Methods

The ECOMED survey provided data from 1990 onwards, although the abundance time series used for XSA tuning goes from 2003 onwards. The sampling coverage is completed for all analysed years in GSA06.

Surveys are carried out on board the R/V Cornide de Saavedra during late autumn (November-December). A multifrequency echosounder is utilised (SIMRAD-ER60) sampling at frequencies of 38 kHz, 70 kHz, 120 kHz and 200 kHz. The ESDU is 1nm. The pulse duration is 1 msg. The software used echogram identification is *SonarData Ecoview*.

The sampling grid is comprised by parallel tracks, perpendicular to the coast. Acoustic sampling is performed during daytime. Experimental fishings with pelagic trawl for schools identification are done at nigh in the previously tracked positions.

7.40.3.1.2. Geographical distribution patterns

The studied area is usually split in two regions, the Tramontana Region (from Cape Creus to Cape La Nao) and Levantine Region (from Cape La Nao to Cape Palos). This allow the use of the complete historical time series of ECOMED, which is carried out along the Tramontana Region from 1990. The time period (November – December) where the survey is conducted corresponds to the recruitment season of the anchovy and spawning season of sardine. Hence the acoustic provides an estimation of the recruitment of the anchovy. They are two recruitment areas: one located between Barcelona and the south of the Ebro River Delta (the most important) and other in Rosas Bay.

7.40.3.1.3. Trends in abundance and biomass

Anchovy biomass in year 2007 was the lowest for the past 8 years, 4,906 tons, 40% lower than in year 2006. There is not defined trend in calculated biomass since 1996, but it appears that the stock shows a dramatic decline trend since 2001. The recruitment has been low, the population consists almost exclusively of the recruits and has practically disappeared between southern Rosas Bay and Tarragona (North Ebro River Delta).

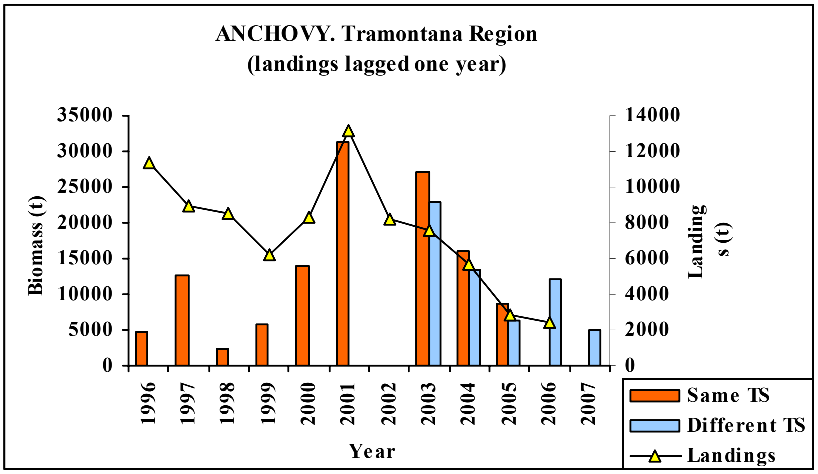


Fig. 7.40.3.1.3.1 Trends in estimated biomass and landings.

Up to date, the areas of greatest density for this species have been the two areas of recruitment: Rosas Bay and the mouth of the Ebro river. In 2007 the highest density is located in the Gulf of Valencia, where 67% of the total biomass was concentrated. This represents a change from the usual strategy of this species (see figure below).

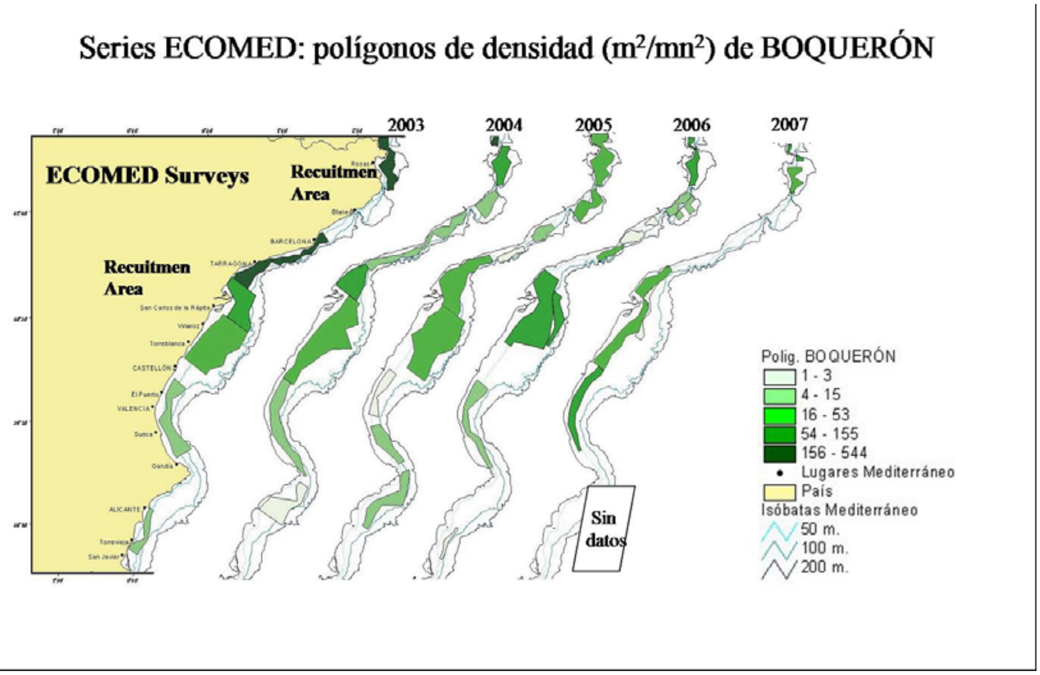


Fig. 7.40.3.1.3.2 Abundance in the survey area, 2003-2007.

- Trends in the pelagic community

Total small pelagics biomass, for all the 9 considered species, was 57,542 tons in 2007. This accounted for a half from that estimated in 2006 (116,896 t). The distribution area of small pelagics has been reduced by 50%, especially in the key areas of recruitment of anchovy where the platform is wider: Rosas and Ebro River Delta. In these areas, acoustic integration was minimal out of the 80m deep range.

It is important to note that for the last six years there was a gradual increase in the estimated biomass of other small pelagic species (mainly the three species of horse mackerel and bogue and in 2006 the Scomber scombrus) which are predators either eggs or anchovy larves as well as resources competitors. As regards 2007, the biomass of sardine and anchovy represented 44% of the total estimated biomass, in contrast to 63% and 83% in 2004 and 2003, respectively. The biomass of horse mackerel and bogue is still rising. In year 2007 accounted for 49% of the total biomass.

Other surveys: Some other surveys exists covering this area. The French survey PELMED2008 made an acoustic tracking of the area as far as the Gulf of Valencia. Some DEPM survey targeted to anchovy were also carried in 1993, 1994 and 2007. The document of the DEPM 2007 survey can be found in www.gfcm.org. The coverage of this survey was quite extensive, covering GSA07 and GSA06, although it was noted that Gulf of Alicante was not sampled. WG highlighted that DEPM results are not fitted to the management units GSA06 and encourages to re-estimate the SSB by considering those management units. This will allow to make use of this survey for tuning the assessment model.

7.40.3.1.4. Trends in abundance by length or age

7.40.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04.

7.40.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.40.4. Assessment of historic stock parameters

7.40.4.1.Method 1: XSA

7.40.4.1.1. Justification

This assessment is based on both on VPA (XSA) methods. The stock is also assessed by acoustic methods (see previous section). The ECOMED survey provided data from 1990 onwards, although the abundance time series used for XSA tuning goes from 2002 onwards. The ECOMED sampling coverage is completed for all years in GSA06. Both XSA and acoustics methods have the same perception of the state of the stock.

7.40.4.1.2. Input parameters

Fishery assessment by VPA methods of the Spanish sardine stock GSA06 is shown. VPA Lowestoft software suite was used and XSA was the assessment method. A separable VPA was also run as exploratory analysis for both stocks. Deterministic short term projections were also produced.

Data used for XSA:

- Landings from 2002-2007 from GSA06, available to experts in SGMED-08-04.
- Combined ALK (2003-2007) for all the years. Length Distributions 2003-2007, Length distribution 2003 was applied to 2002 landings.
- Biological sampling 2003-2007 for Maturity at age and Weight-Length relationships.
- Tuning data from acoustic survey ECOMED.

Input data for the assessment model are the following.

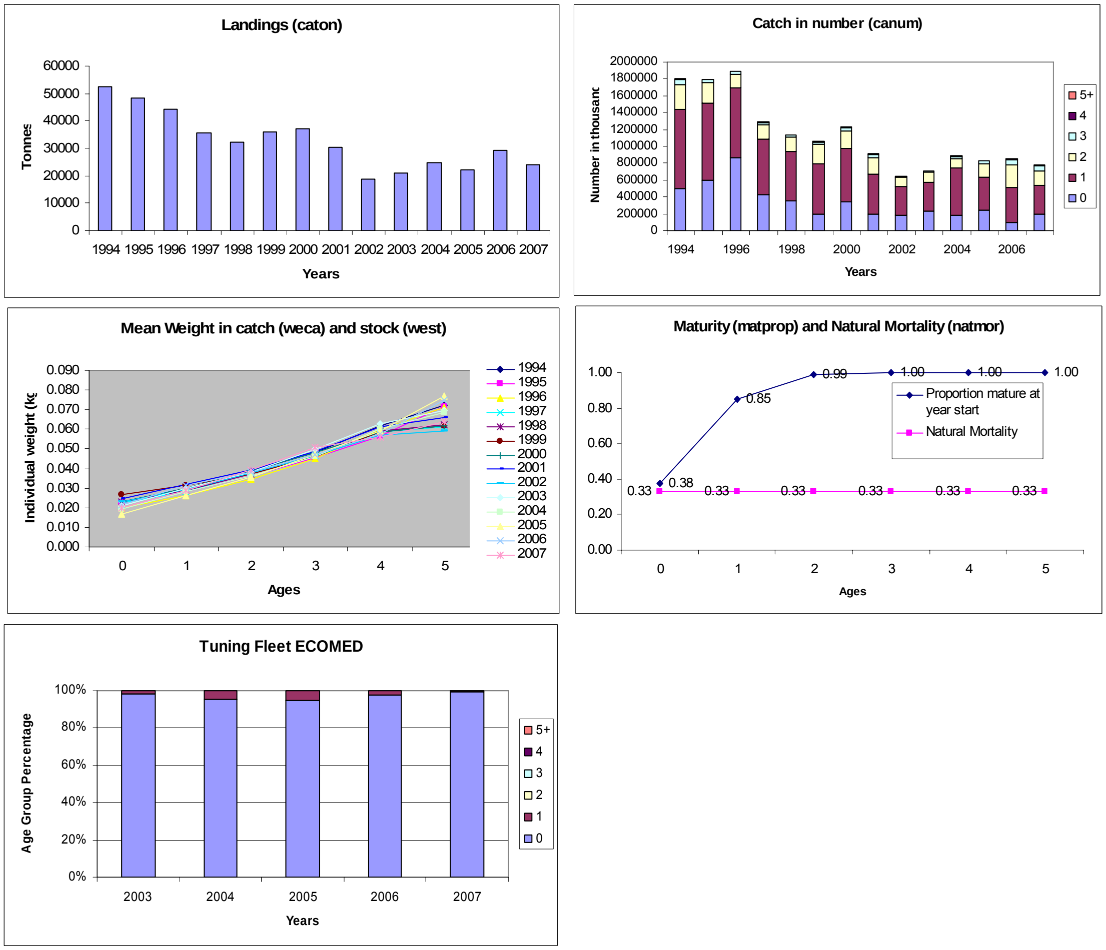


Fig. 7.40.4.1.2.1 Input parameters.

7.40.4.1.3. Results

A separable VPA was run as exploratory analysis. Log catchability residual plots were produced and no great residuals were found. The separable plot can be seen in the attached figure. According the results it seems not to be major conflicts between ages.

Then a XSA assessment was made. The main settings for the XSA are the following:

- Fbar 0-2.
- Age 1 for q stock-size independent and age 2 for q independent of age.
- Fshrinkage = 0.500 and S.E. for fleet terminal estimates ≥ 0.300

XSA Diagnostics in the form of residuals by Fleet are shown in the attached figure.

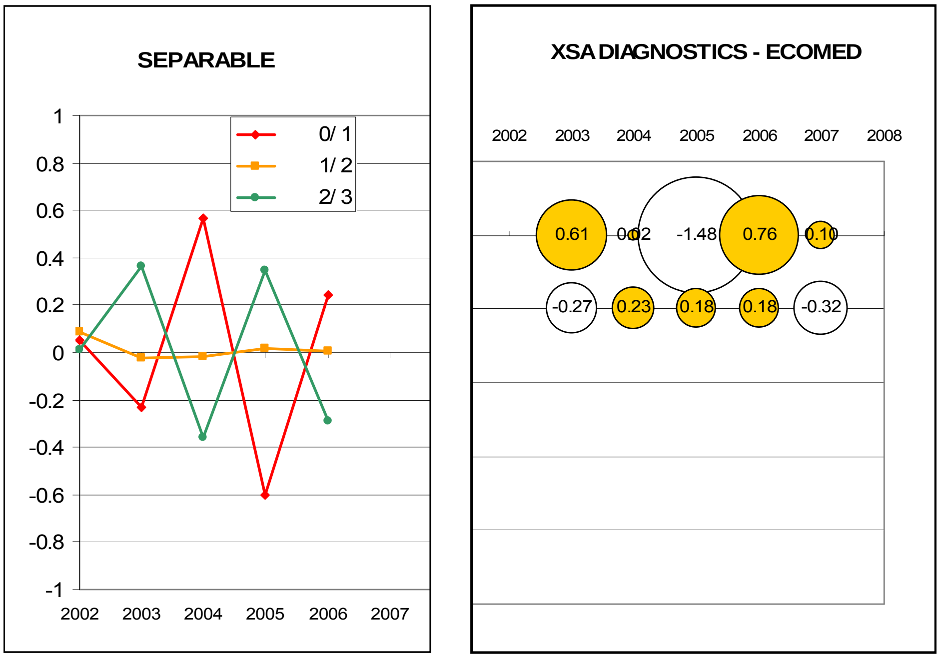


Fig. 7.40.4.1.3.1 Residuals from saparable VPA and XSA diagnostics.

Estimations of Survivors by age and fleet was produced. The most important weights are given by the Fshrinkage. It is particularly important the ECOMED survey for estimating survivors at age 1.

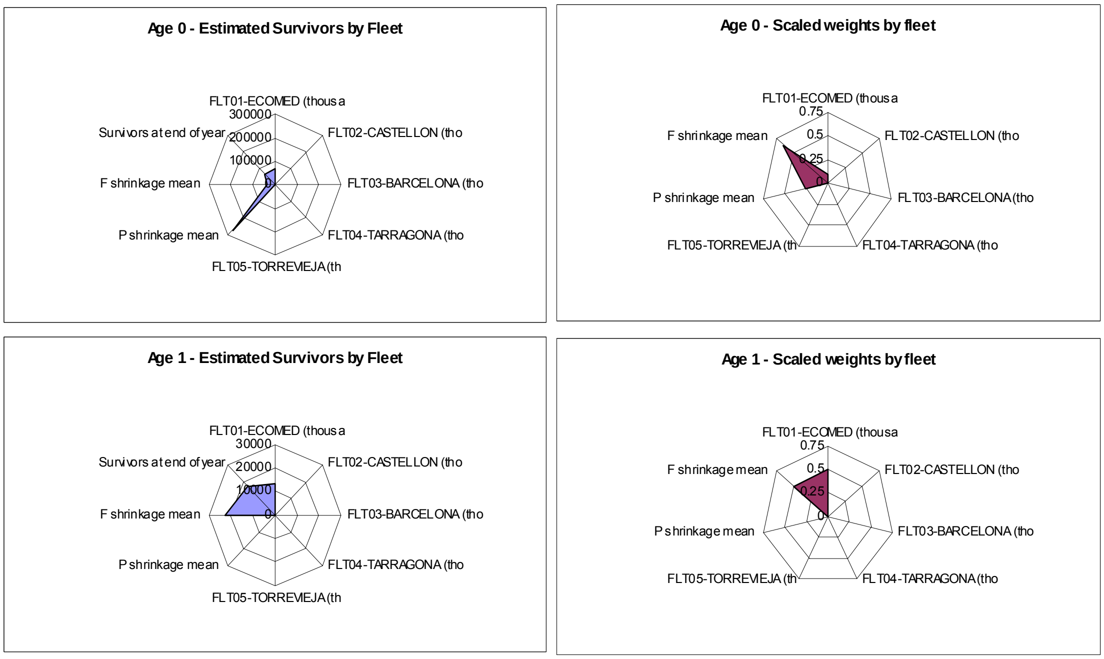


Fig. 7.40.4.1.3.2 XSA tuning diagnostics.

The figures below show the summary results from the XSA, i.e. Total Landings, Fishing Mortality (Fbar0-2) by year, Recruitment in number, Total Biomass and Spawning Stock Biomass (SSB), and the relationship SSB-Recruitment.

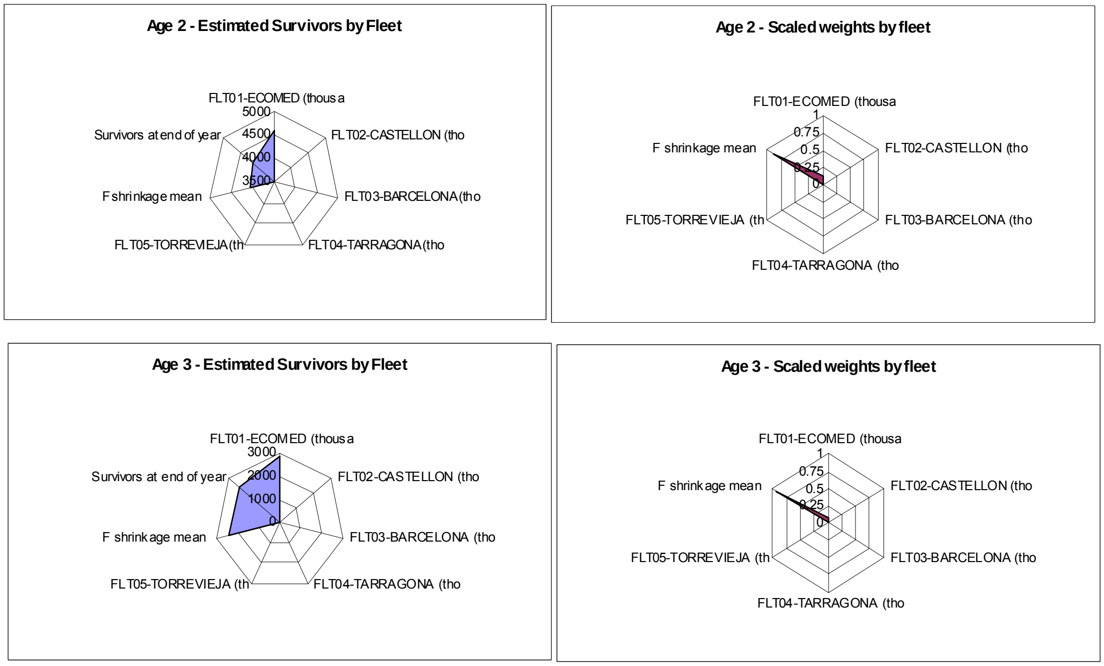
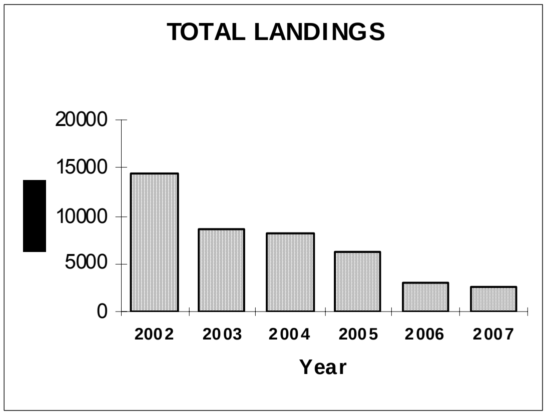
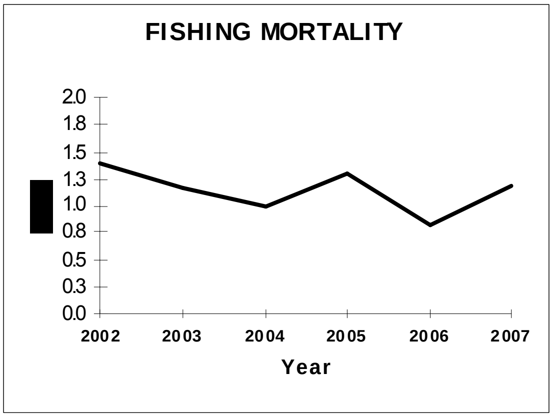
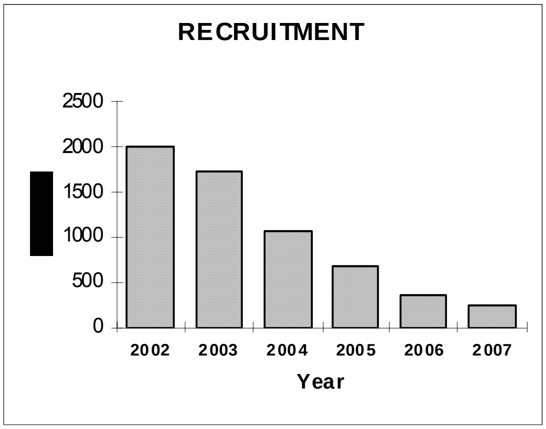


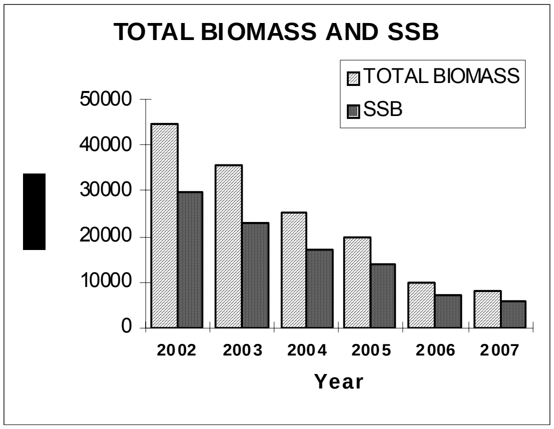
Fig. 7.40.4.1.3.3 XSA tuning diagnostics.

The figures below show the summary results from the XSA, i.e. Total Landings, Fishing Mortality (Fbar0-2) by year, Recruitment in number, Total Biomass and Spawning Stock Biomass (SSB), and the relationship SSB-Recruitment.









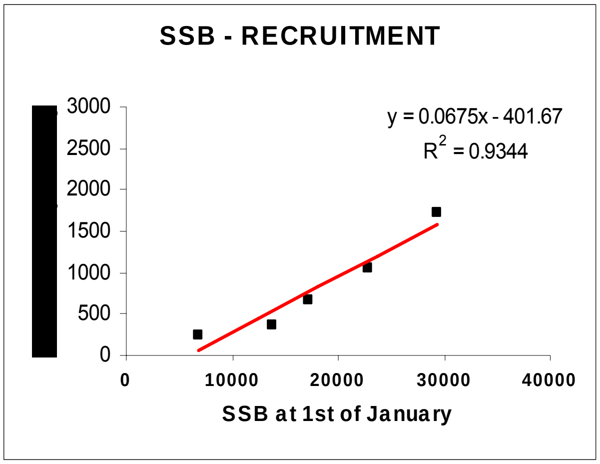


Fig. 7.40.4.1.3.4 XSA assessment results of relevant stock parameters.

As aforementioned, the landings time series shows a very sharp decrease from the beginning of the times series in 2002. The lowest landings of the assessed time series is 2007, although they have been ranging from 14340 to 2570 tons in the last six years.

Fishing mortality has been fluctuating throughout the time series, although the trend is rather consistent around 1.15. F_{0-2} in 2007 =1.17.

Recruitment in 2007 (R07=244 millions) decreases from that of 2006 (361 millions). The trend of the recruitments is so important as they can affect seriously to the stock health. WG highlighted that the fishery is highly dependent of the recruitment strength.

Both Total Biomass in 2007 (TB=7,860 t) and Spawning Stock Biomass in 2007 (SSB=5,480 t) continues the sharp decrease, apparent from the beginning of the time series. The lowest observed SSB is the most recent estimate from 2007 (Bloss=5,480 t).

The SSB-Recruitment plot shows a linear relationship with a R coefficient really high. This maybe be explained by the low state of the resource and perhaps we are looking at the beginning of any SSB-recruitment shape, maybe a curve as suggested by Ricker and Beverton and Holt. Then this linear relationship will be the slope of those possible curves.

7.40.5. Short term prediction for 2008 and 2009

7.40.5.1. Justification

A short term projection was carried out using the MFDP software (Multi-Fleet Deterministic Projections).

7.40.5.2. Input parameters

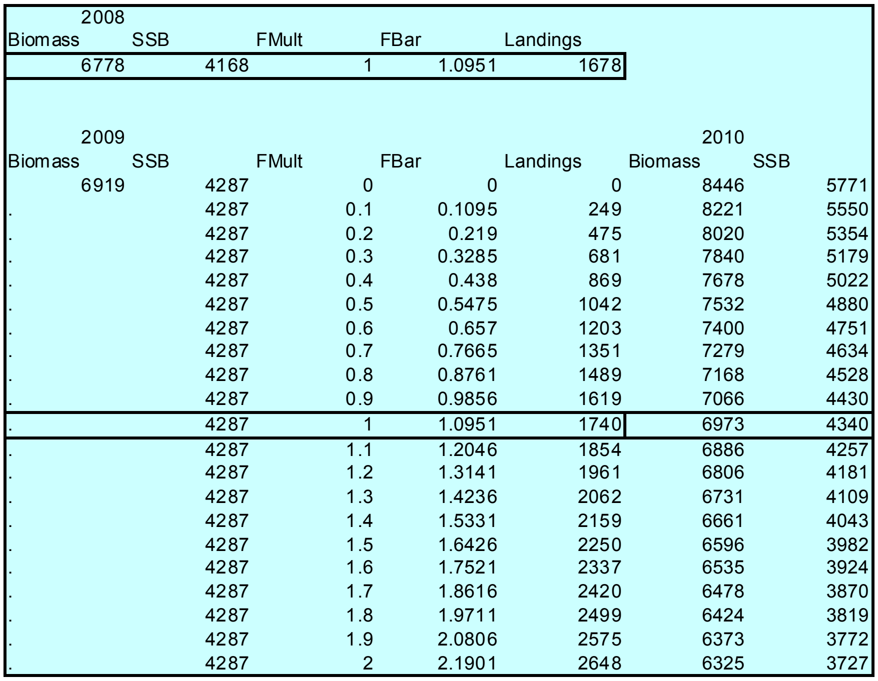
The same XSA input data plus F and N estimates from XSA. Catch prognosis was produced assuming statu quo F (F_{0-2}=1.10) and recruitment is the percentil 10% of the recruitment time series (R_{low}=302 millions). We realise this option is more conservative but the most realistic and robust as recruitment is continuously decreasing in last years.

7.40.5.3. Results

Table 7.40.5.3.1 shows the management options from the short term catch prediction. Short term predictions are the following:

- landings are predicted to be 1,680 t in 2008 and 1,740 t in 2009.
- Total biomass will be 6,780 t in 2008, 6,920 t in 2009 and 6,970 t in 2010, what account for a decrease in 2008 with respect to 2007 and a small increase on stock numbers in subsequent years.
- SSB will decrease in 2008 to 4,170 t, with a rather small increase in following years till reach 4340 t in 2010.

Table 7.40.5.3.1 Management option table.



2008				
Biomass	SSB	FMult	FBar	Landings
6778	4168	1	1.0951	1678

2009					2010	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
6919	4287	0	0	0	8446	5771
.	4287	0.1	0.1095	249	8221	5550
.	4287	0.2	0.219	475	8020	5354
.	4287	0.3	0.3285	681	7840	5179
.	4287	0.4	0.438	869	7678	5022
.	4287	0.5	0.5475	1042	7532	4880
.	4287	0.6	0.657	1203	7400	4751
.	4287	0.7	0.7665	1351	7279	4634
.	4287	0.8	0.8761	1489	7168	4528
.	4287	0.9	0.9856	1619	7066	4430
.	4287	1	1.0951	1740	6973	4340
.	4287	1.1	1.2046	1854	6886	4257
.	4287	1.2	1.3141	1961	6806	4181
.	4287	1.3	1.4236	2062	6731	4109
.	4287	1.4	1.5331	2159	6661	4043
.	4287	1.5	1.6426	2250	6596	3982
.	4287	1.6	1.7521	2337	6535	3924
.	4287	1.7	1.8616	2420	6478	3870
.	4287	1.8	1.9711	2499	6424	3819
.	4287	1.9	2.0806	2575	6373	3772
.	4287	2	2.1901	2648	6325	3727

7.40.6. Medium term prediction

7.40.6.1. Justification

No forecast analyses were conducted.

7.40.6.2. Input parameters

No forecast analyses were conducted.

7.40.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for for anchovy in GSA 01.

7.40.7. Long term prediction

7.40.7.1. Justification

No forecast analyses were conducted.

7.40.7.2. Input parameters

No forecast analyses were conducted.

7.40.7.3.Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for for anchovy in GSA 01.

7.40.8. Scientific advice

It should be noted that small pelagic fishery in GSA06 is multispecies and effort on anchovy and sardine should be considered together.

7.40.8.1.Short term considerations

7.40.8.1.1. State of the spawning stock size

Both Total Biomass in 2007 (TB=7,860 t) and Spawning Stock Biomass in 2007 (SSB=5,480 t) continues the sharp decrease, apparent from the beginning of the time series. The lowest observed SSB is the most recent estimate from 2007 (Bloss=5,480 t).

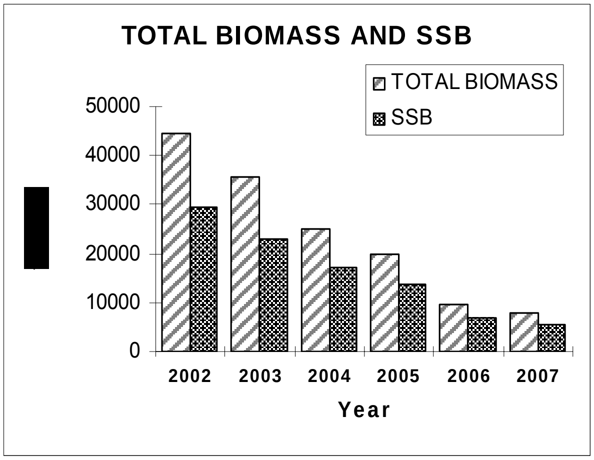


Fig. 7.40.8.1.1.1 Trend in stock and spawning stock biomass, 2002-2007.

No reference points were proposed for biomass levels, and hence SGMED cannot comment on the state of the stock with this respect.

7.40.8.1.2. State of recruitment

Recruitment in 2007 (R07=244 millions) decreases from that of 2006 (361 millions). The trend of the recruitments is so important as they can affect seriously to the stock health. WG highlighted that the fishery is highly dependent of the recruitment strength.

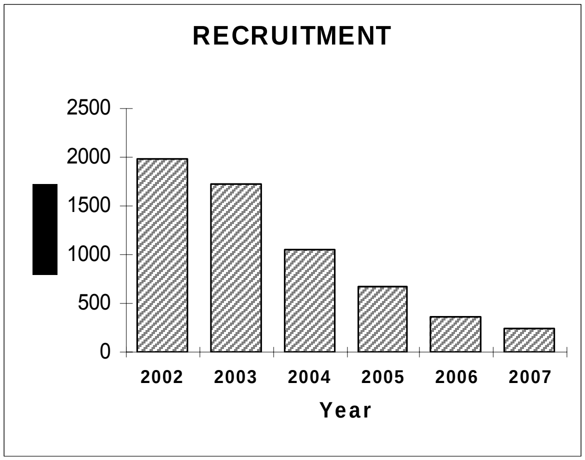


Fig. 7.40.8.1.2.1 Trend in recruitment, 2002-2007.

7.40.8.1.3. State of exploitation

Fishing mortality has been fluctuating throughout the time series, although the trend is rather consistent around 1.15. F_{0-2} in 2007 =1.17.

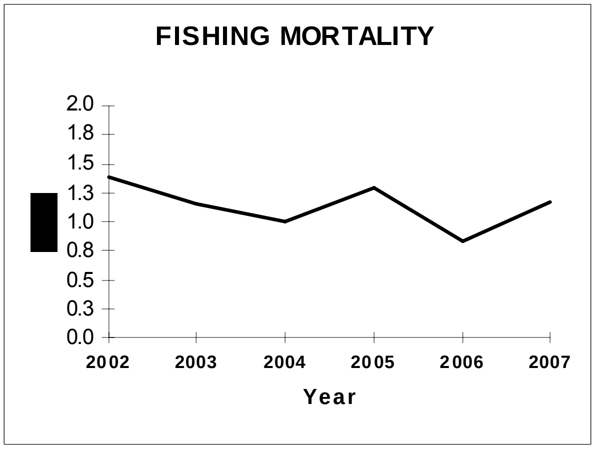


Fig. 7.40.8.1.3.1 Trend in fishing mortality, 2002-2007.

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.40.8.2.Medium term considerations

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

7.41. Stock assessment of anchovy in GSA 17

7.41.1. Stock identification and biological features

7.41.1.1. Stock Identification

The southern boundary of the GSA 17 is represented from the Gargano Promontory, as shown in the map below. However, the stock distribution area of anchovy in the Adriatic Sea extends into GSA 18. The spawning season of the Adriatic anchovy is in spring-summer. The spawning areas are mainly located in the western part of the GSA 17. On the basis of the database of CNR-ISMAR-SPM Fish Population Dynamics Unit, the maximum age recorded was 6 years while the maximum length was 19 cm.

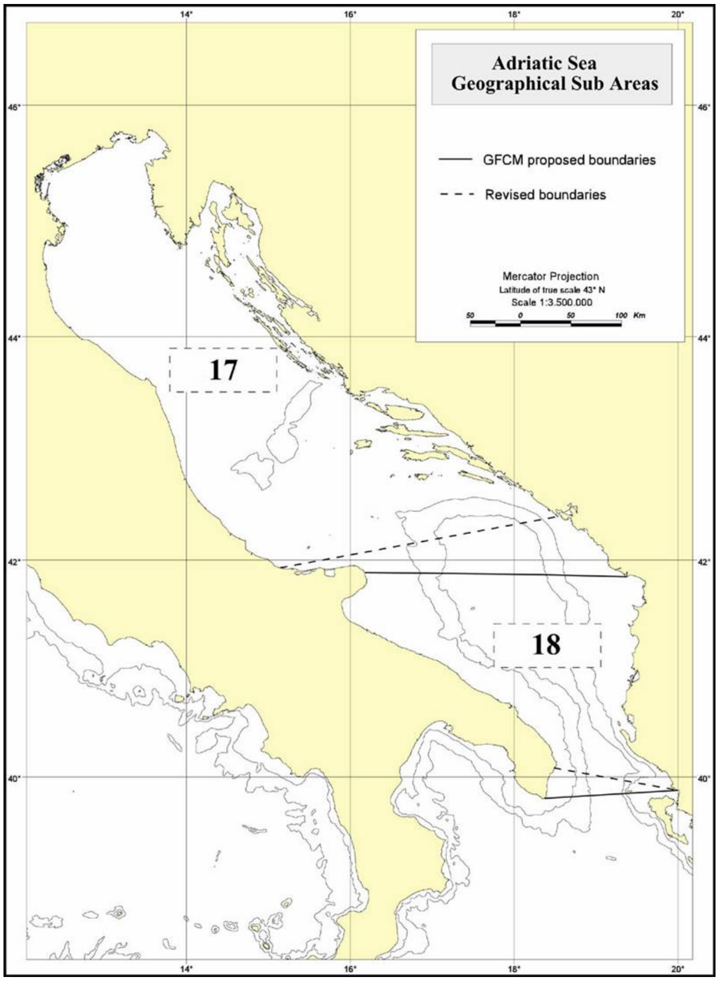


Fig. 7.41.1.1.1 Stock distribution map.

7.41.1.2. Growth

An example of age-length key expressed in number of individuals, obtained through DCR by CNR-ISMAR-SPM Fish Population Dynamics Unit, for the commercial catches of (Italian) mid-water trawlers in 2007, was reported in the table below.

Tab7.41.1.2.1 GSA 17 anchovy: age-length key (year 2007, mid-water trawlers).

L (cm)	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Total
7.5	5						5
8.0	11						11
8.5	15	1					16
9.0	21	2					23
9.5	22	11					33
10.0	27	22	10				59
10.5	32	41	10				83
11.0	29	72	14				115
11.5	31	93	31	1			156
12.0	18	74	74	8			174
12.5	4	33	104	14			155
13.0		29	129	18			176
13.5		8	105	34	3		150
14.0			47	42	6		95
14.5			31	36	4	1	72
15.0			11	23	2		36
15.5			2	16	3		21
16.0				5			5
16.5				3	1		4
Total	215	386	568	200	19	1	1389

The corresponding age-length key obtained for the commercial catches of purse-seiners was reported in the table below. Different length ranges as a function of the gear were observed: the smallest size individuals can be better represented in the catch of mid-water trawlers.

Tab7.41.1.2.2 GSA 17 anchovy: age-length key (year 2007, purse seiners).

L (cm)	Age 0	Age 1	Age 2	Age 3	Age 4	Total
9.5	1					1
10.0		1				1
10.5	2	1	1			4
11.0	1	2				3
11.5		1	2			3
12.0		1	1			2
12.5			2			2
13.0			3	3		6
13.5			1	4	1	6
14.0				2	2	4
14.5			2	2	3	7
15.0			2	2	4	8
15.5				5		5
16.0				2		2
16.5			1	2		3
17.0				2		2
Total	4	6	15	24	10	59

7.41.1.3.Maturity

According to Rampa *et al*. (2005), the first sexual maturity of Adriatic anchovy is around 8 cm.

7.41.2. Fisheries

7.41.2.1.General description of fisheries

In the GSA 17, anchovy is fished by mid-water trawlers and purse seiners attracting fish with light. Additional information was reported below in the paragraph “Catches”.

7.41.2.2.Management regulations applicable in 2007 and 2008

In Italy, the legal minimum length for anchovy is 9 cm (R.(CE) 1967/2006). The same value has been adopted in Croatia (G. Sinovčić, Institute of Oceanography and Fisheries of Split, personal communication).

7.41.2.3.Catches

7.41.2.3.1. Landings

On the basis of the database of CNR-ISMAR-SPM Fish Population Dynamics Unit, the amount of the total catch of anchovy relative to Italy, Slovenia and Croatia was plotted over years in the figure below. The average total catch was 28000 tonnes in 1976-2007 and 43000 tonnes in 2005-2007. The lowest values of the series - corresponding to the calendar year 1987 - were associated to a crisis of the Italian fishery of Adriatic anchovy really occurred. The main fraction of the total catch is usually taken by the Italian fleet but, in recent years, the fraction relative to the fleets of the eastern part of the GSA 17 increased.

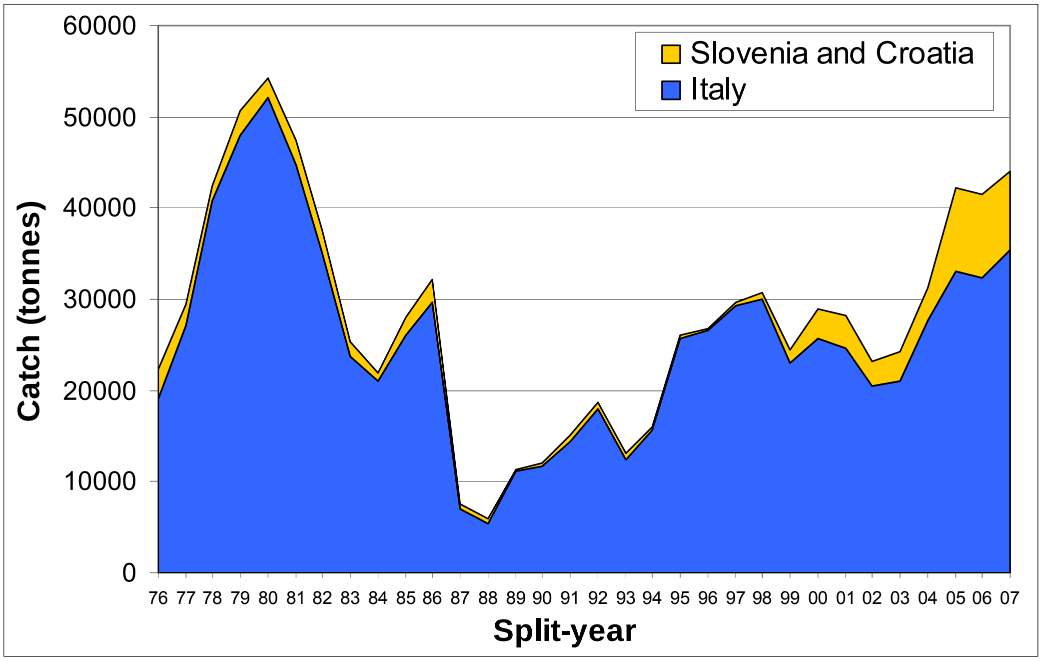


Fig. 41.2.3.1.1 GSA 17 anchovy: total catch over years.

The average length frequency distribution and the average age frequency distribution of the total catch were shown in the two figures below. The average for length was calculated including only the years from 1988 onwards as, after this date, length was measured using 0.5 cm classes, whereas 1 cm classes were used from 1975 to 1987.
A comment relative to the different length range fished by mid-water trawlers and purse seiners was reported above, in the paragraph “Growth”.

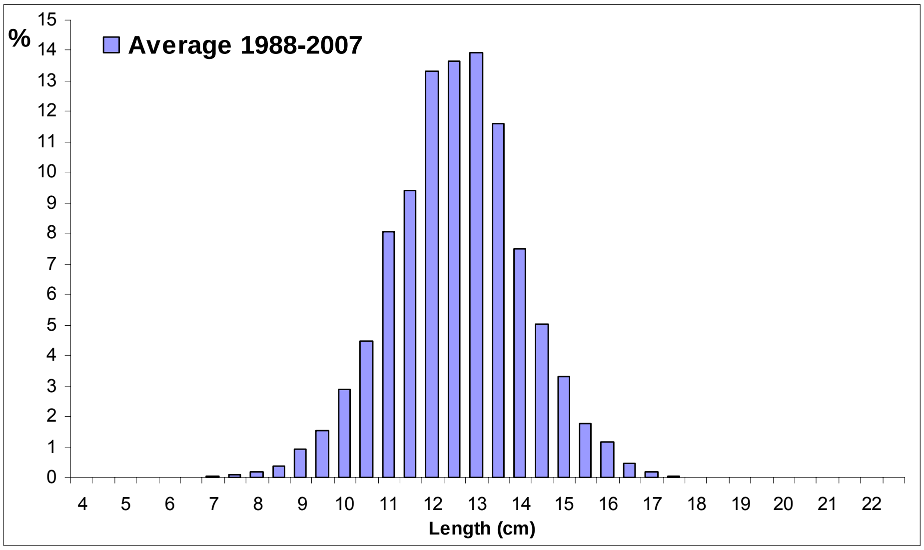


Fig. 41.2.3.1.2 GSA 17 anchovy: average length frequency distribution of the total catch.

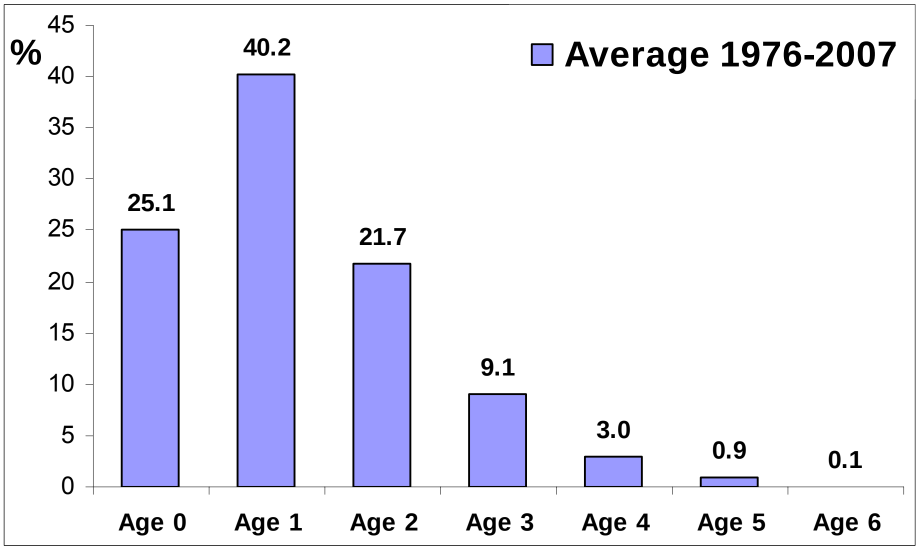


Fig. 41.2.3.1.2 GSA 17 anchovy: average age frequency distribution of the total catch.

7.41.2.3.2. Discards

This feature was investigated by CNR-ISMAR-SPM Fish Population Dynamics Unit, through an EU funded project at the end of 1990s (Santojanni *et al*., 2005) and DCR in 2005.

Discards of anchovy in the GSA 17, at least for the Italian fleet, can be considered as negligible because anchovy, usually, is strongly required by the market (more than sardine). For example, on the basis of the DCR investigation, the amount of anchovy discarded at sea by the Italian fleet was 65 tonnes and 206 tonnes in the third and fourth quarter of 2005, respectively. These quantities were very low in comparison with the corresponding landings: from 2000 to 2007, the annual amount of anchovy landed by the Italian fleet was always higher than 20000 tonnes and, in 2005-2007, it was over 30000 tonnes. In conclusion, the estimates of discards obtained for only one half of 2005, relatively low and also fluctuating among the two quarters, were not used to correct landings.

7.41.2.3.3. Fishing effort

7.41.3. *Scientific surveys*

As mentioned below in the paragraph “Method”, the results of the acoustic surveys carried out by CNR-ISMAR-SPM Marine Acoustics Unit from the mid-line to the western coast of the GSA 17, from 1976 to 2007, were used for VPA tuning.

7.41.4. *Assessment of historic stock parameters*

7.41.4.1.Method: VPA

7.41.4.1.1. Justification

The assessment of this stock was carried out by means of Virtual Population Analysis (VPA), using catch data collected for Italy, Slovenia and Croatia, from 1975 to 2007 (Cingolani *et al*., 1996; Santojanni *et al*., 2003, 2005, 2006a,b,c; 2008; Barange *et al*., in press; Santojanni, in press).
The Laurec-Shepherd tuning of VPA was performed using an abundance index series derived from echo-surveys carried out in the western part of the GSA 17.
The software developed by Darby and Flatman (1994) was used for the VPA runs.
The results of the assessment were also discussed during the last SCSA-SAC-GFCM meeting (Santojanni *et al*., 2008).
Split-year data were used assuming the first of June as the birth date of Adriatic anchovy: e.g. split-year 1976 was composed of the months from June to December of calendar 1975 and months from January to May of calendar 1976.
Given the long time series available, VPA was thought to be a suitable method. Additional trials with Integrated Catch Analysis (ICA) were also done during the last SCSA-SAC-GFCM meeting (Izmir, 22-26 September 2008), but the results were not mentioned in this document; anyway, they were quite consistent with those derived from Laurec-Shepherd tuned VPA, as shown also in the last STECF-SGMED meeting (Ponza, 6-10 October 2008).

7.41.4.1.2. Input parameters

A time series of annual total catch at age in numbers of individuals is the main data input of VPA. It was shown (expressed using proportions) in the figure below. The age class 4+ is a plusgroup: it includes the class 4 (years) along with those classes higher than 6, i.e. 5 and 6 in the present case.

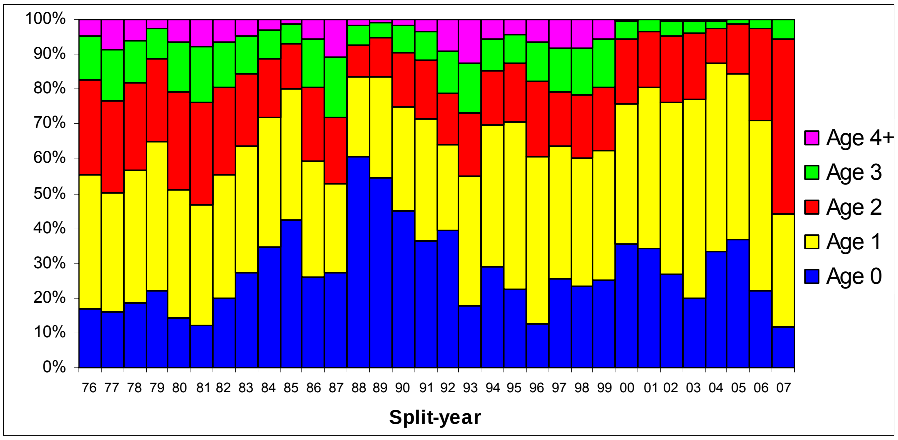


Fig. 7.41.4.1.2.1 GSA 17 anchovy: relative catch at age over years.

The annual natural mortality rates M = 0.6 and M = 0.8 (year^{-1}) were employed for VPA calculations. However, according to a precautionary approach, much more emphasis was given to the results obtained with M = 0.6.

The two values were selected taking into account the literature and the maximum life-span observed in the commercial catches from 1976 onwards, i.e. 4 and even 5 and 6 years.

About the inverse relationship between longevity and mortality, as reported by Barange (2001), Pacific sardine (*Sardinops sagax*) is usually assumed to have a relatively low annual natural mortality rate, M = 0.4, and a lifespan of about 10 years, whereas for northern anchovy (*Engraulis mordax*) M = 0.8 is associated to a lifespan of about 4 years.

Moreover, useful information was gained from the relationship between total mortality Z (= F + M) and maximum life span tmax (year), Ln Z = 1.44 **-** 0.982 Ln tmax **,** found by Hoenig (1983; see also Hewitt and Hoenig, 2005). It was "based largely on data from unexploited stocks", thus with Z being very close to M. On the basis of this equation, for example (table below), tmax = 6 is associated to Z = 0.73.

Tab. 7.41.4.1.2.1 Relationship between total mortality rate Z and maximum life-span tmax (see text).

tmax (year)	**Z (year^{-1})**
1	4.22
2	2.14
3	1.43
4	1.08
5	0.87
6	0.73
7	0.62
8	0.55
9	0.49
10	0.44
11	0.40
12	0.37
13	0.34
14	0.32
15	0.30
16	0.28
17	0.26
18	0.25
19	0.23
20	0.22

7.41.4.1.3. Results

The stock biomass estimated by means of VPA using both M = 0.6 and M = 0.8 was plotted over years in the figure below, along with the total catch.

The average stock biomass estimated by the VPA with M = 0.6 was 120000 tonnes in 1976-2007 and 210000 tonnes in 2005-2007; higher values were obtained with M = 0.8. The corresponding average ratio between total catch and stock biomass (with M = 0.6) was 0.23 in 1976-2007 and 0.20 in 2005-2007.

The collapse in the second half of 1980s after a peak in the second half of 1970s was evident as well as recent fluctuations.

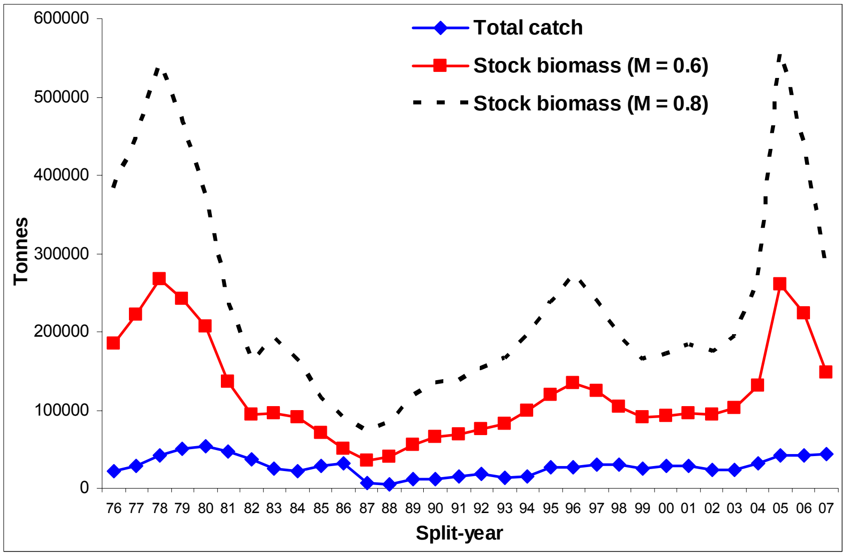


Fig. 7.41.4.1.3.1 GSA 17 anchovy: total catch and stock biomass estimated by VPA over years.

The stock biomass estimated by means of VPA using both M = 0.6 and M = 0.8 was compared over years with the stock biomass estimated by means of the echo-surveys carried out in the western part of the GSA 17. On the whole, there was agreement between the trends obtained with the two different methods: initial peak, decline, collapse and recovery. However, the recovery was more pronounced in the echo-survey data and, in the most recent years, the two series were clearly out of phase.

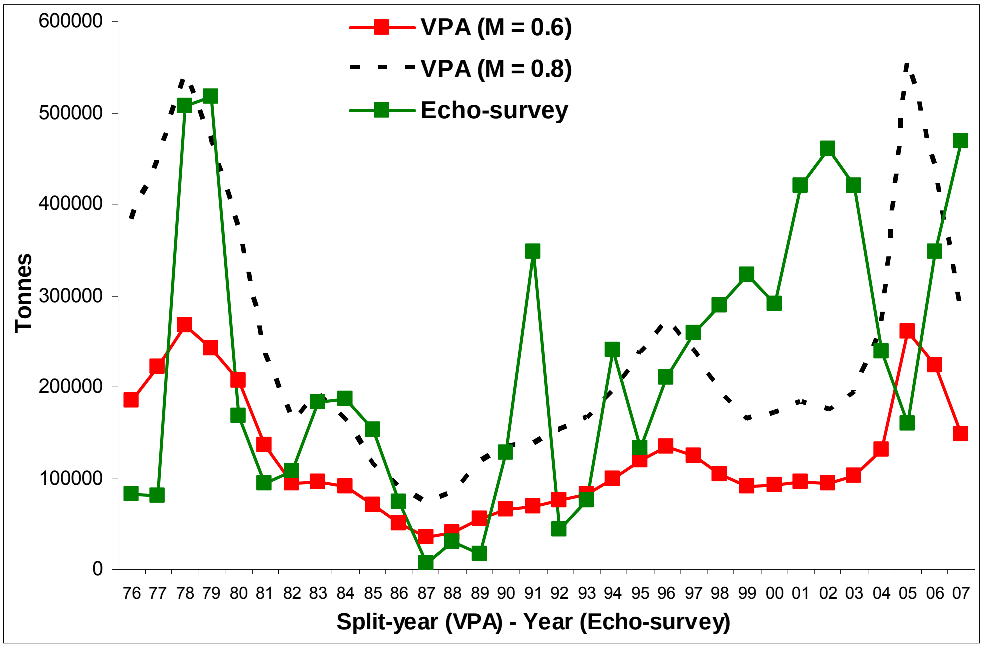


Fig. 7.41.4.1.3.2 GSA 17 anchovy: stock biomass estimated by VPA and echo-surveys over years.

The relationship between spawning stock biomass and number of recruits (age class 0) obtained from the VPA with M = 0.6 was plotted in the figure below. The current spawning stock biomass was over the values recorded immediately before the collapse in 1987.

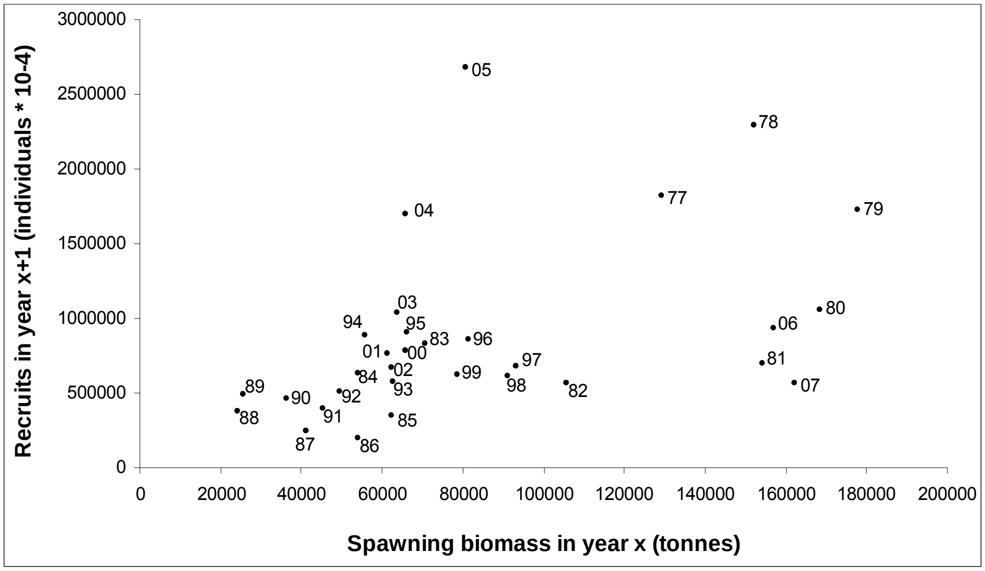


Fig. 7.41.4.1.3.3 GSA 17 anchovy: stock-recruitment relationship (VPA with M = 0.6).

The fishing mortality rate F derived from the VPA with M = 0.6 was plotted over ages and years in the figure below (left and right picture, respectively). In the former case, the average for the complete time series was calculated. In the latter case, two averages were calculated both weighting and without weighting the F at age values on the corresponding numbers of fish at sea.

Some average values over years were the following:

- unweighted F0-3 in 1976-2007 : 0.32;
- unweighted F0-3 in 2005-2007 : 0.24;
- weighted F0-4 in 1976-2007: 0.22;
- weighted F0-4 in 2005-2007: 0.19.

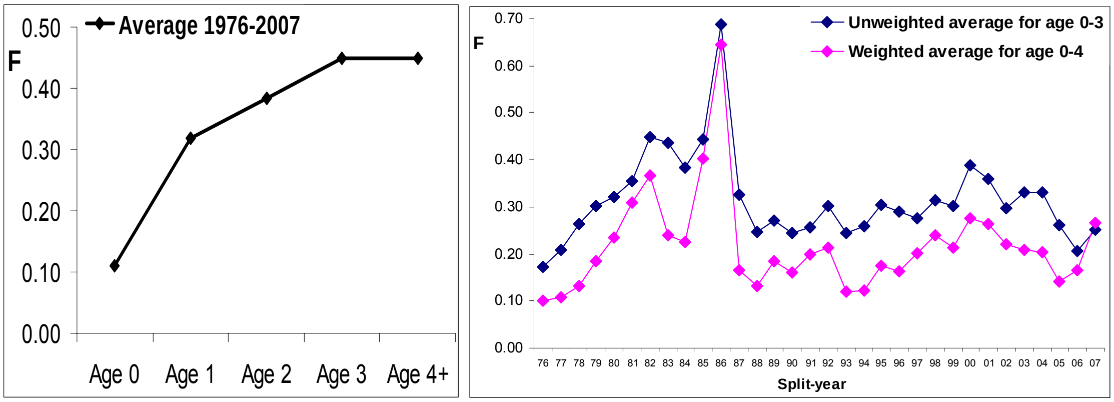


Fig. 7.41.4.1.3.4 GSA 17 anchovy: fishing mortality rate F over ages and years.

The annual exploitation rate E = F/(F+M) or F/Z was also calculated, both using the weighted and unweighted Fs mentioned above.

The values obtained were compared with the threshold F/Z = 0.4 (biological reference point), above which the stock collapse should be relatively likely, as pointed out by Patterson (1992) for small pelagics. Here, more emphasis was given to the F/Z calculated using unweighted Fs, as the author performed his statistical analysis on a data set mainly formed by unweighted Fs.

The values of F/Z were plotted over years in the figure below. Some average values over time were the following:

- F/Z in 1976-2007 with unweighted F0-3 : 0.34;
- F/Z in 2005-2007 with unweighted F0-3 : 0.28;
- F/Z in 1976-2007 with weighted F0-4 : 0.26;
- F/Z in 2005-2007 with weighted F0-4 : 0.24.

All these values are lower than 0.4. Values higher than 0.4 and even than 0.5 - which is the highest and more dangerous limit pointed by Patterson (1992) - were observed before the collapse. Likely, both fishery and some environmental factors contributed to this event (Santojanni *et al*., 2006a; Santojanni, in press).

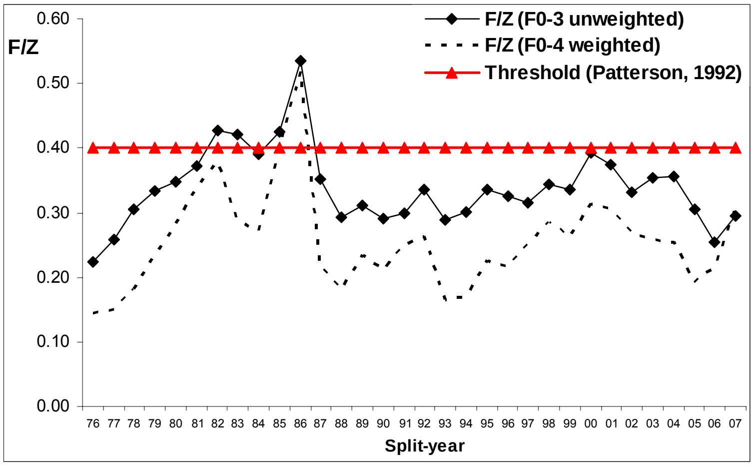


Fig. 7.41.4.1.3.5 GSA 17 anchovy: exploitation rate F/Z over years.

7.41.5. *Short term prediction for 2008 and 2009*

7.41.5.1.Justification

7.41.5.2. Input parameters

No forecast analyses were conducted.

7.41.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for anchovy in GSA 17.

7.41.6. Medium term prediction

7.41.6.1. Justification

No forecast analyses were conducted.

7.41.6.2. Input parameters

No forecast analyses were conducted.

7.41.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for for anchovy in GSA 17.

7.41.7. Long term prediction

7.41.7.1. Justification

No forecast analyses were conducted.

7.41.7.2. Input parameters

No forecast analyses were conducted.

7.41.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for for anchovy in GSA 17.

7.41.8. Scientific advice

7.41.8.1. Short term considerations

The average stock biomass estimated by the VPA with M = 0.6 was 210000 tonnes in 2005-2007, while the average total catch was 43000 tonnes; thus, the corresponding ratio between total catch and stock biomass was 0.2. Also, in the same period, the average exploitation rate F/Z was 0.28 and, thus, lower than the threshold value 0.4 suggested as a reference point for small pelagics by Patterson (1992).

As said above, the recent ratio between total and stock biomass was not high and also the exploitation rate F/Z was lower than 0.4. However, the stock biomass of anchovy dropped at a very low level in 1987. After this collapse, recovery took place, but fluctuations still occurred, in particular in recent years. It should be remembered that strong changes over time are commonly observed in the abundance of small pelagics, in particular anchovies (Jacobson *et al*., 2001). Past simulations carried out by VPA on data from 1976 to 2006 (projections for 2007-2012) pointed out the strong negative effects of poor recruitment even in two years only. Moreover, in the recent years, catches increased in both western and eastern part of the GSA 17: for example, the mentioned average total catch for the period 2005-2007, 43000 tonnes, was quite over the average for the previous years from 1995 to 2004, 27000 tonnes.

In conclusion, the stock is thought to be fully exploited. It should be noted that small pelagic fishery in the GSA 17 is multispecies and fishing effort on anchovy and sardine should be considered together. Thus, due to the stock status of both anchovy and sardine (worse than anchovy), it is recommended not to increase the fishing effort.

7.41.8.1.1. State of the spawning stock size

The current spawning stock biomass was estimated to be higher than the values immediately before the collapse. The stock-recruitment relationship was reported above in the paragraph "Method".

7.41.8.1.2. State of recruitment

SGMED-08-04 is unable to provide any scientific advice of the state of the recruitment given the preliminary state of the data and analyses.

7.41.8.1.3. State of exploitation

As mentioned above in this paragraph "Short term considerations", the estimated F/Z in 2005-2007 was under the threshold F/Z = 0.4 suggested by Patterson (1992).

7.41.8.2. Medium term considerations

As mentioned above in this paragraph "Short term considerations", the estimated F/Z in 2005-2007 was under the threshold F/Z = 0.4 suggested by Patterson (1992).

7.42. Stock assessment of anchovy in GSA 22

7.42.1. Stock identification and biological features

7.42.1.1. Stock Identification

This assessment of the anchovy stock in GSA 22 has been based on information derived from the Greek part of the Aegean Sea (GSA 22). The main distribution area of the anchovy stock in Aegean Sea is located in the continental shelf of the northern Aegean Sea (Giannoulaki et al., 2004; Somarakis et al., 2007; Giannoulaki et al., 2008a). Anchovy juveniles spatial distribution is strongly related to semi closed gulfs, shallow waters (less than 50 m depth) with high productivity, often related to areas of rivers outflows (Tsagarakis et al., 2007; Tsagarakis et al., 2008; SARDONE project interim report).

7.42.1.2. Growth

Fast growth parameter was considered and parameters are shown in Table 7.53.1.2.1. No sex discrimination was applied.

Table 7.42.1.2.1. Growth parameters (v. Bertalanffy) for anchovy in GSA 22.

	Fast growth Unsexed	Units
Linf	158.6	cm
K	0.626	year^{-1}
t0	-0.887	year
a	0.00004	gr
b	3.1157	
M	0.7	year^{-1}

7.42.1.3. Maturity

The following maturity at age ogive was used for assessments in GSA 22 estimated from biological sampling and the DEPM surveys (Somarakis *et al.*, 2004; Somarakis et al., 2007). Length at first maturity is estimated approximately at 105mm (Somarakis, 1993; Somarakis *et al.*, 2004; Somarakis et al., 2007) in Aegean Sea. The anchovy spawning period in GSA 22 extends from May to August with a peak in June-July. The major spawning grounds of anchovy in the Aegean Sea are located in areas characterized by wide continental shelf and enrichment processes associated with the outflow from large rivers or the Black Sea Water (BSW) in the northern Aegean Sea. Consequently, the highest egg densities have been typically observed over the northern Aegean Sea continental shelf.

Table 7.42.1.3.1 Maturity ogives at age for female anchovy in GSA 22.

Year	Age 0	Age 1	Age 2	Age 3	Age 4
2003	0	0.62	0.99	1	1
2004	0	0.67	0.99	1	1
2005	0	0.46	0.98	1	1
2006	0	0.40	0.40	1	1

7.42.2. Fisheries

7.42.2.1. General description of fisheries

Anchovy (*Engraulis encrasicolus*) is one of the most important target species for the purse seine fishery in GSA 22. Anchovy is being exploited only by the purse seine fishery. Pelagic trawls are banned and benthic trawls are allowed to fish small pelagics in percentages less than 5% of their total catch. Commonly anchovy is caught from shallow waters about 30 m to 100 m depth.

7.42.2.2. Management regulations applicable in 2007 and 2008

Regarding the management regulations enforced they concern a closed period from the mid December till the end of February and technical measures such as minimum distance from shore (300m), minimum bottom depth (30m), gear and mesh size, engine, GRT restrictions etc. There is also a minimum landing size at 9 cm.

7.42.2.3. Catches

7.42.2.3.1. Landings

The trend in reported landings (from Greek purse seiners fleet) is shown in Figs. 7.53.2.3.1.1 and 7.53.2.3.1.2. Landings were obtained within the framework of the Hellenic Centre for Marine Research data collection system that covers the entire GSA 22. The data from 2003 to 2006 were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A3.4 of Appendix 3. An increasing trend in anchovy landings has been observed. Data of the landings per vessel class indicate that small vessels (12-24 m) (Fig. 7.42.2.3.1.1) are mainly responsible for anchovy catches (>70% of anchovy catches).

Annual lengths of landings were reported to SGMED-08-04 for 2003-2006 and are shown in Fig. 7.42.2.3.1.3. Fig. 7.42.2.3.1.4 shows the landings at age in GSA 22 as reported to SGMED-08-04 for 2003-2006.

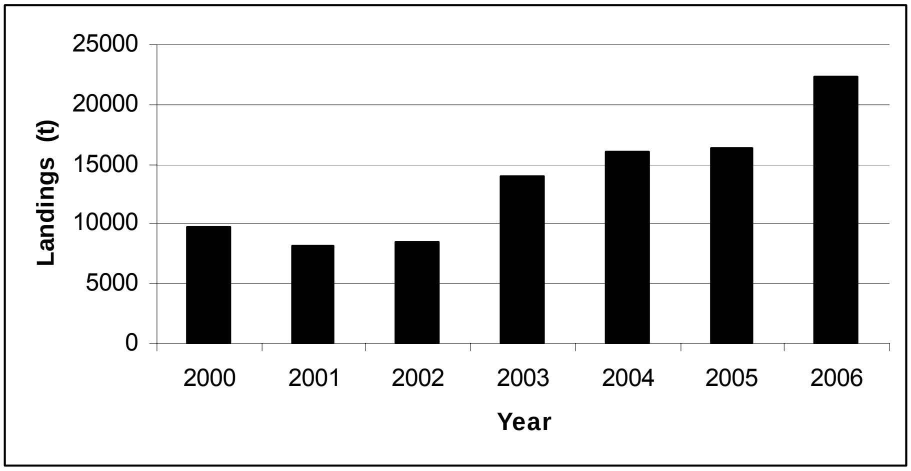


Fig. 7.42.2.3.1.1 Annual anchovy landings (t) in GSA 22 for 2000-2006.

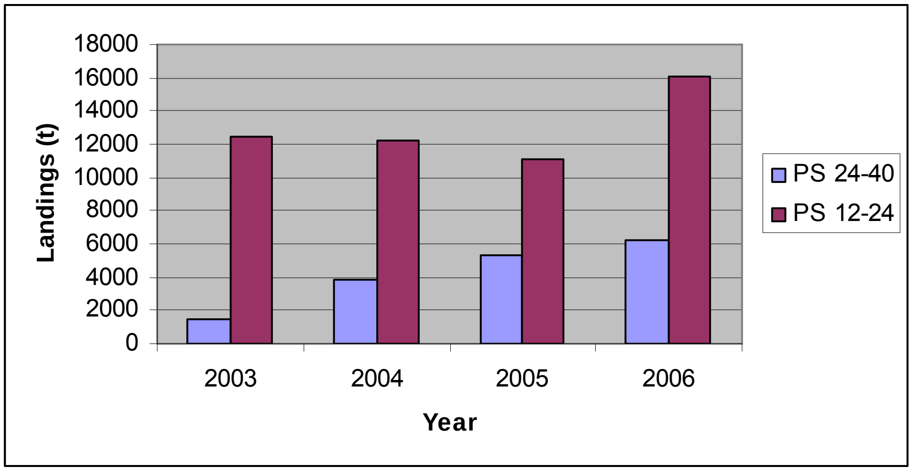


Fig. 7.42.2.3.1.2 Annual anchovy landings (t) in GSA 22 per fleet size (Greek waters).

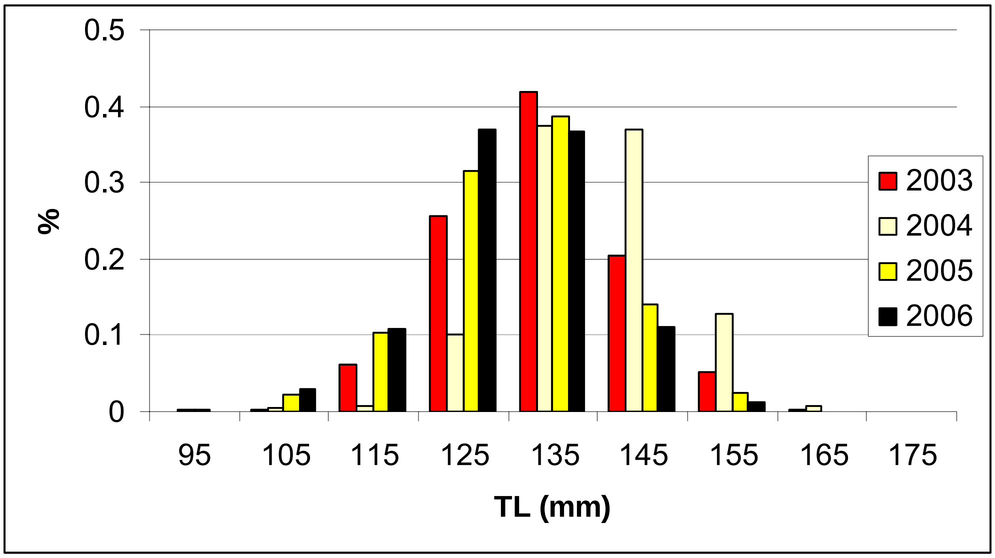


Fig. 7.42.2.3.1.3 Annual length frequency distribution of anchovy landings (t) in GSA 22 for 2003-2006.

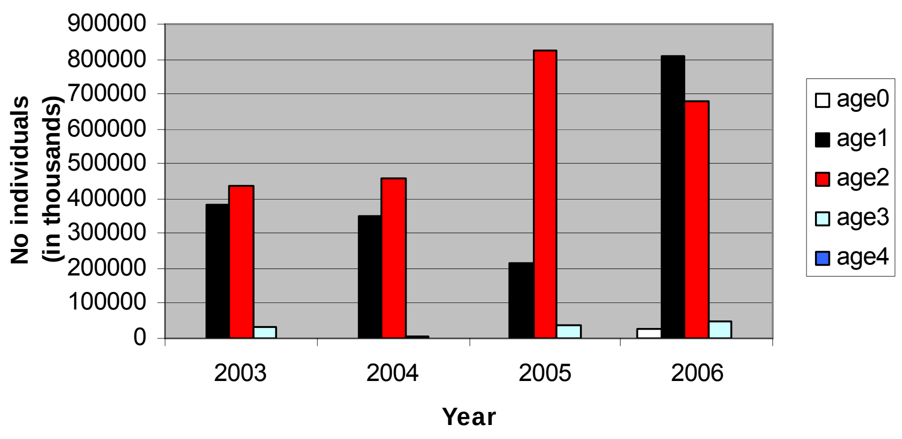


Fig. 7.42.2.3.1.4 Anchovy landings per age group (No of individuals in thousands) in GSA 22 for 2003-2006.

7.42.2.3.2. Discards

No discards data for anchovy were reported to the SGMED-08-04 and no data were reported through the Data collection regulation for 2003-2006. Discards are estimated to less than 5% of the purse seine fishery total catch, therefore considered negligible and they were not taken into account for the assessment. The fishery is multispecies and fishermen tend to avoid schools of undersized anchovies due to sorting difficulties (blocking of the mess) and low price, practically by using nets of bigger mesh size, targeting mostly mackerels or horse mackerels.

7.42.2.3.3. Fishing effort

Based on the fishing effort data for GSA 22 provided to the DCR call and being available at the meeting the following table was made.

Tab. 7.42.2.3.3.1 Effort data regarding the purse seine fleet in GSA 22. GRT=Gross tonnage, KW=engine horse power.

Year	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m
	Days at Sea	**Days at Sea**	**Days at Sea x GRT**	**Days at Sea x GRT**	**Days at Sea x KW**	**Days at Sea x KW**
2003	41539	2942	1767398	230726	8709727	679624
2004	39783	3989	1620847	366709	8111571	1029410
2005	42520	5690	1753346	542120	8123673	1532790
2006	37255	5619	1568893	539146	7386042	1606608

7.42.3. Scientific surveys

7.42.3.1. Acoustics and DEPM

7.42.3.1.1. Methods

Acoustics

SGMED was provided in the framework of the CDR call with evaluations of total biomass, abundance, length and age composition for GSA 22 as estimated by acoustic surveys.

Acoustic surveys methodology

Acoustic echoes were registered continuously along 70 pre-defined transects in the study area in June 2003, 2004, 2005 and 2006 with a Biosonics Split Beam 38 kHz DT-X echosounder. The acoustic methodology followed is described in Somarakis et al., 2007 (GFCM 2007 related WD). Hydroacoustic data analysis was performed using the Sonardata Echoview software v3.30. Echo trace classification was applied based on a) echogram visual scrutinisation and direct allocation of school marks that characterise anchovy as well as b) allocation on account of representative fishing stations that were held along transects (MacLennan and Simmonds, 1992).

In order to estimate anchovy biomass, the length-weight- relationship is required as well as species length frequency distribution per area. Therefore, 22, 23, 27 and 37 pelagic trawls were made along transects in 2003, 2004, 2005 and 2006 respectively, in the positions of high fish concentrations. A random sample of

200 specimens was obtained from each haul for further laboratory analysis. Subsequently, the length-weight-relationship was estimated from the total number of hauls according to the equation:

$$W = a\, L^{b}$$

where W is the total weight; L is the total length and a and b are constants that are estimated by regression analysis.

The mean length frequency was estimated in two sub-areas: (a) Eastern area (Thracian Sea and Strymonikos Gulf) and (b) Western area (Thermaikos and Evoikos Gulfs). In the two sub-areas, the mean frequency of each length class was estimated as follows:

$$f_j = \frac{\sum_{k=1}^{M} \left(\frac{n_{jk}}{t_k} \right)}{\sum_{k=1}^{M} \left(\frac{N_k}{t_k} \right)}$$

where f_j is the mean frequency of anchovy of length class j; n_{jk} is the number of specimens of length class j in haul k; N_k is the total number of anchovies in haul k; t_k is the duration of haul k and M is the number of hauls in the area. The above equation is appropriate even if the catches are small and the length distributions are poorly defined. It takes accounts of the haul duration, since it is supposed that on average, longer hauls will produce more fish (MacLennan and Simmonds 1992).

The density of targets (F) from the observed echo integrals were estimated according to the equation F= (K/<σ>)E, were K is the calibration factor, <σ> is the mean cross-section and E is the echo integral after partitioning (MacLennan and Simmonds 1992). The target strength (TS) – total length relationship used for anchovy was: TS=20 logL-71.2, where L is fish total length (ICES 2006). The <σ> was calculated for the mean total fish length of each area according to the equations $<\sigma>= 4\pi \sum_{\iota} f_i 10^{TS/10}$, where f_I is the corresponding length frequency as deduced from the fishing samples (MacLennan and Simmonds 1992).

The abundance Q was estimated separately for the eastern and the western part of the study area. The abundance Q in each elementary statistical sampling area was calculated from the average density within each sub-area according to the equation:

$$Q = A_k \sum_{i} F_i / N_k ,$$

where F_i is the i sample; A_k is the area of each elementary statistical sampling area and N_k is the number of transects in A_k. The variance V was estimated as

$$V= \sum_{i} \ (AF_I-Q)^2/[N_r(N_{r-1}-1)]$$

The data were log transformed and the means and variances of F estimated according to the following equations:

$$F=\exp(m)\mathbf{G_N}[0.5\ S/(n-1);\ V=F^2-\exp(2m)\ \mathbf{G_N}[S(n-2)/(n-1)^2];$$

where m = average (lnF); S= variance (lnF) and n = independent observations of F.
The total abundance Q_t and its variance were obtained by summing the results for each region $Q_t=Q_1+Q_2+\ldots$, and $V_t=V_1+V_2+\ldots$. Standard error of Q_t is the square root of V (MacLennan and Simmonds 1992).

Daily Egg Production surveys (DEPM) methodology

The methodology of the DEPM is described in detail in Somarakis et al., 2007 GFCM WD. The spawning stock biomass was estimated according to the model described by Parker (1980) and subsequently modified by Stauffer & Picquelle (1980):

$$B = (k \cdot P \cdot A \cdot W)/(R \cdot F \cdot S)$$

where, *B* = spawning stock biomass in metric tons, k = conversion factor from grams to metric tons, *P* = daily egg production (number of eggs per sampling unit, m^2), A = total survey area (in sampling units, m^2), *W* = average weight of mature females (grams), *R* = sex ratio (fraction of mature females by weight), *F* = batch fecundity (mean number of eggs per mature females per spawning), *S* = fraction of mature females spawning per day (spawning frequency).

7.42.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.42.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the anchovy stock in GSA 22 was derived from the acoustics and the DEPM surveys. Figure 7.42.3.1.3.1 displays the estimated trend in anchovy Total Biomass (estimated by acoustics) and Spawning Stock Biomass (estimated by DEPM) for GSA 22. Figure 7.42.3.1.3.2 shows the estimated trend in anchovy abundance (estimated by acoustics).

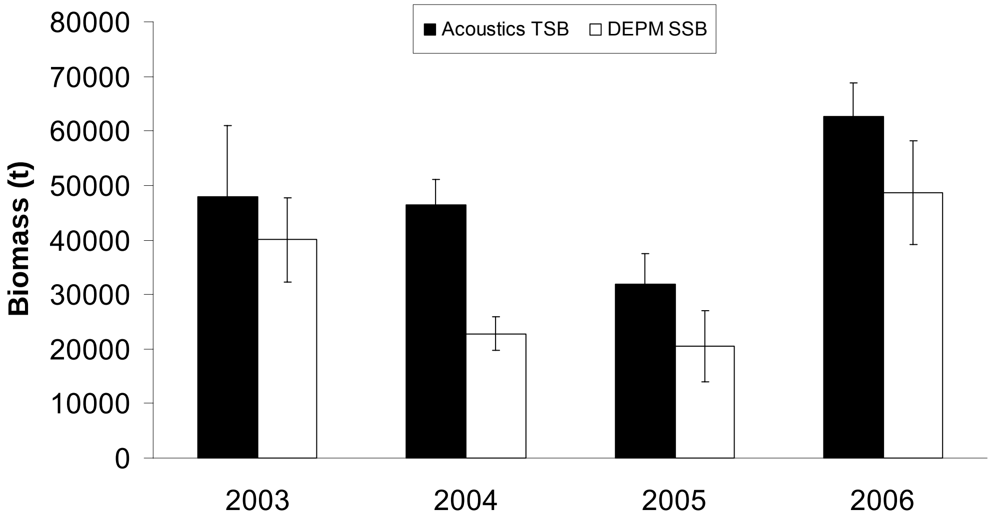


Fig. 7.42.3.1.3.1 Estimated anchovy biomass indices for GSA 22, 2003-2006.

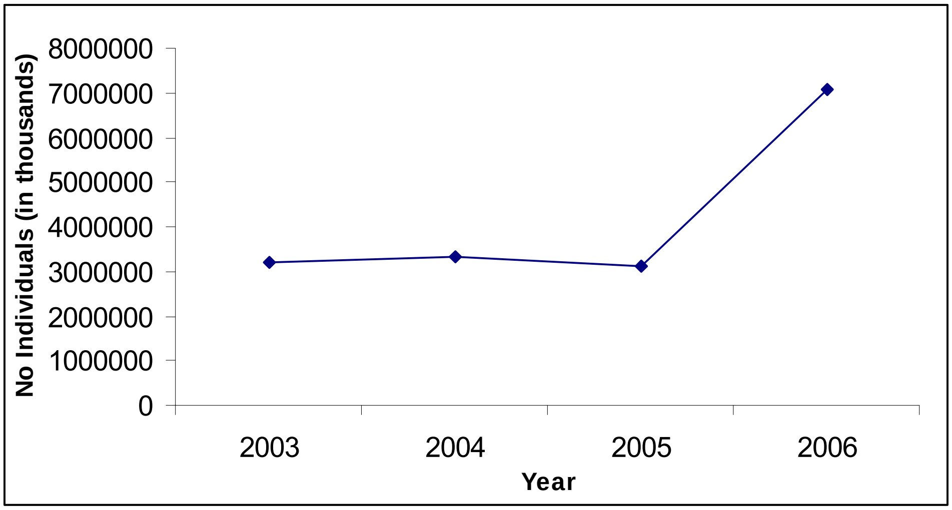


Fig. 7.42.3.1.3.2 Estimated abundance indices for GSA 22, 2003-2006.

An increasing trend was observed in both biomass and abundance indices towards 2006 (Fig. 7.42.3.1.3.1, Fig. 7.42.3.1.3.2).

7.42.3.1.4. Trends in abundance by length or age

Fig. 7.42.3.1.4.1 displays the length frequency composition of the anchovy stock as derived from the acoustic survey for GSA 22.

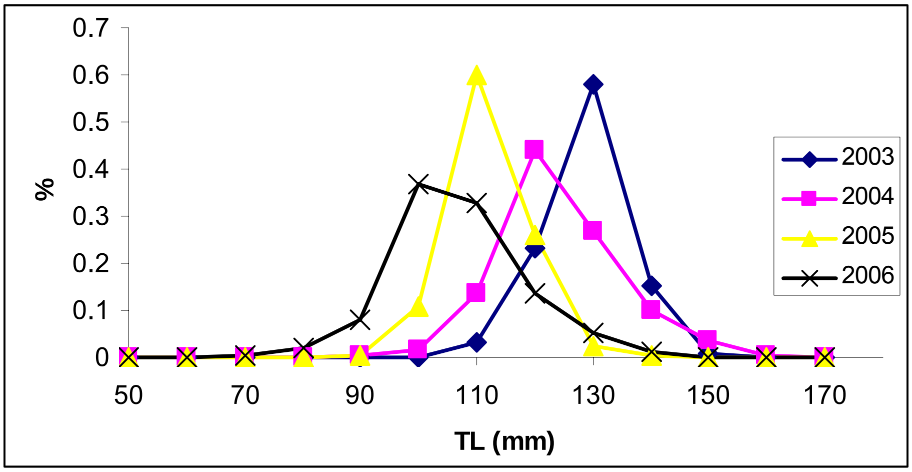


Fig. 7.42.3.1.4.1 Estimated changes in size compositions for GSA 22 for 2003-2006.

The following Fig. 7.42.3.1.4.2 and Fig. 7.42.3.1.4.3 display the abundance indices by size and age of GSA 22 in 2003-2006 from acoustic surveys.

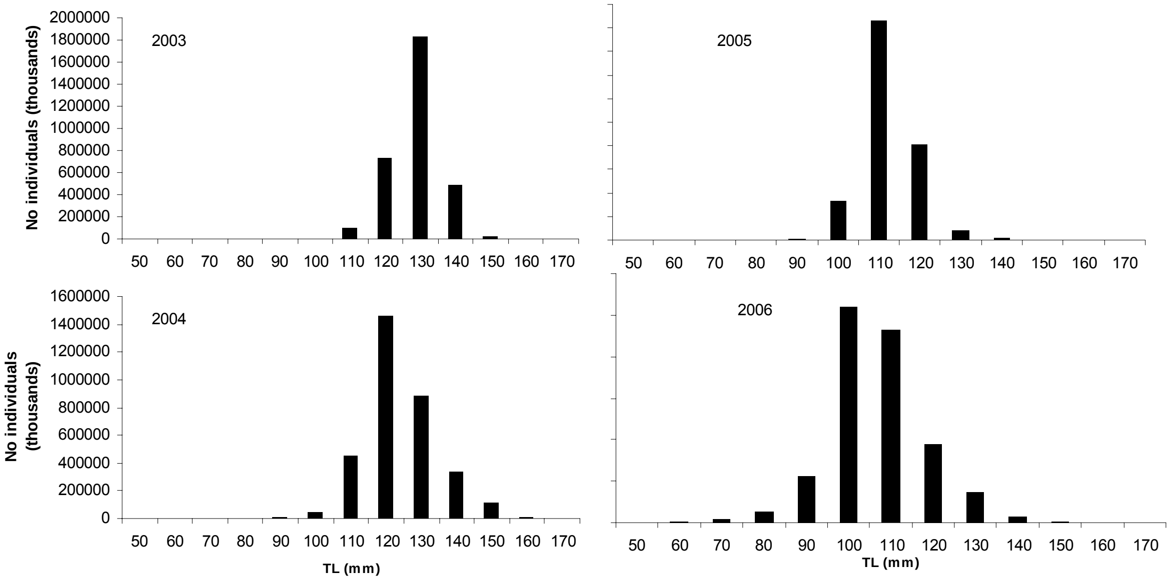


Fig. 7.42.3.1.4.2. Abundance indices by size, 2003-2006.

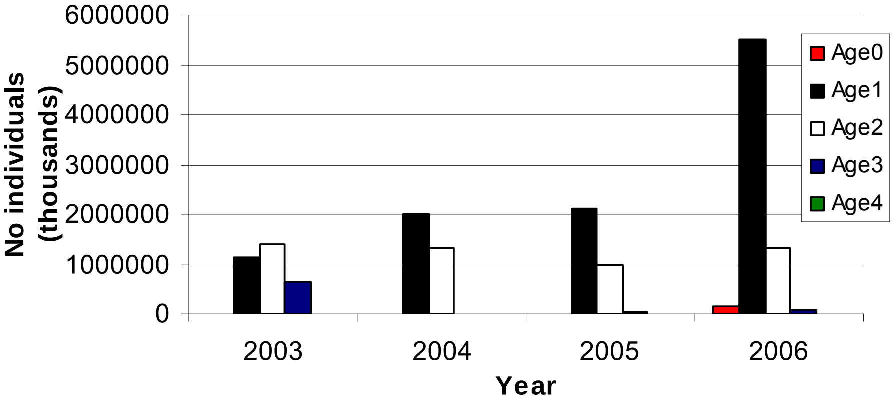


Fig. 7.42.3.1.4.3. Abundance indices by age, 2003-2006.

7.42.3.1.5. *Trends in growth*

No analyses were conducted during SGMED-08-04. Data supplied by member state based on the DCR data call were used in this report

7.42.3.1.6. *Trends in maturity*

No analyses were conducted during SGMED-08-04. Maturity ogive based on the results of the DEPM surveys was used (Table 7.42.3.1.6.1).

Table 7.42.3.1.6.1. Maturity ogive for anchovy in GSA 22 based on the results of DEPM surveys.

Age	2003	2004	2005	2006
0	0	0	0	0
1	0.62	0.67	0.46	0.4
2	0.99	0.99	0.98	0.98
3	1	1	1	1
4	1	1	1	1

7.42.4. *Assessment of historic stock parameters*

7.42.4.1. Method: ICA

7.42.4.1.1. *Justification*

Integrated Catch at Age (ICA) analysis for stock assessment (Patterson and Melvin, 1998) was applied. Integrated Catch at age analysis (Patterson and Melvin 1996) uses separable virtual population analysis (VPA) (Pope & Shepherd, 1985) with weighted tuning indices. It was applied regarding the Aegean anchovy stock within the Joint Assessment Group of the GFCM held in Izmir in September 2008 and the STECF WG adapted it as a review assessment. This assessment of the anchovy stock in GSA22 is based on a small time series of available, so results should be considered as precautionary. In addition Y/R analysis was applied during the SGMED-08-04.

7.42.4.1.2. *Input parameters*

ICA was based on commercial catch data (2000-2006) and as tuning indices were used the biomass estimates from acoustic surveys and the Daily Egg Production Method (DEPM) estimates over the period 2003-2006.

Anchovy data concerned annual anchovy landings, annual anchovy catch at age data (2000-2006), mean weights at age, maturity at age and the results of acoustic and DEPM surveys (2003-2006) presented in Tables 7.42.4.1.2.1 to 7.42.4.1.2.7. Since, acoustics and DEPM are being applied at the same time and with the same research vessel in Aegean Sea, acoustic estimates were used as an index for the numbers at age of the population and DEPM estimates as stock spawning biomass estimates. Reference age for the fishery was age group 2, as fully exploited and fully recruited. The age groups 0, 4 and 5 were underweighted in the analysis based on their percentage in the catch. Age 1 was also underweighted in the acoustic surveys (0.5). Catchability for the DEPM index is assumed as absolute indicator of Biomass, linear catchability relationship is assumed for the acoustic surveys.

Sensitivity analysis on natural mortality (presented in Giannoulaki et al., 2007 GFCM WD, Giannoulaki et al., 2008b) has showed the same trend in biomass estimates and fishing mortality estimates independently of the natural mortality value used. Therefore, it was considered more cautious to set natural mortality constant for all ages and years at 0.7, in order to obtain a standard model run.

This natural mortality value selection was based on the numbers at age estimates obtained by acoustic surveys during two successive fully recruited years to obtain an initial estimate of the annual total mortality. Catchability of acoustic surveys concerning age group 1 was considered to be 0.5 to produce unbiased estimates of the abundance at age group 1.

Consequently, two approaches were used to obtain an estimation of F and M. One approach considered the F/Z ratio constant at 0.4 based on the results of sensitivity analysis. According to the other approach, the numbers of the catch at age from landings for each respective year was used to estimate the annual fishing mortality. The difference between the total mortality and the fishing mortality provided an annual estimate of the natural mortality and a subsequent mean estimate. The latter approach relied on the following facts:

1) June, the time of sampling, coincides with the reproductive period for anchovy in Aegean Sea (Somarakis 1999)
2) Anchovy stock during June is considered fully recruited and no new individuals enter the stock

Both approaches resulted to close values as estimates of the natural mortality (0.7 and 0.62, respectively). Resulted M, was considered realistic, representative of the actual situation in the area taking into account the abundance of predators in the area and the strong dependence of the juveniles of small pelagics from environmental conditions.

Table 7.42.4.1.2.1. Catch at age (numbers in thousands) of anchovy stock in GSA 22 for 2000-2006.

Year	**0**	**1**	**2**	**3**	**4**
2000	10702	297911	313076	22655	1000
2001	13748	274624	263060	17361	1000
2002	13740	306750	290855	19726	1280
2003	102	380276	438106	31344	1000
2004	695	455705	455705	3803	1000
2005	1702	213679	824156	39914	1000
2006	26353	806985	681497	50922	2375

Table 7.42.4.1.2.2. Landings estimates (in t) of anchovy stock in GSA 22 for 2000-2006.

Year	**Anchovy**
2000	9762
2001	8232
2002	8549
2003	14002
2004	16099
2005	16347
2006	22311

Table 7.42.4.1.2.3. Weight at age in the catch of anchovy stock (in kg) in GSA 22 for 2000-2006.

				Year			
Age	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
0	0,0085	0,0093	0,0098	0,0057	0,0029	0,0036	0,0099
1	0,0125	0,0134	0,0133	0,0164	0,0146	0,0096	0,0151
2	0,0138	0,0151	0,015	0,0184	0,0184	0,0137	0,0161
3	0,0145	0,0161	0,0161	0,0188	0,0204	0,016	0,0174
4	0,0245	0,0297	0,0257	0,0398	0,0338	0,0334	0,0187

Table 7.42.4.1.2.4. Weight at age in the stock (in kg) of anchovy stock in GSA 22 for 2000-2006.

				Year			
Age	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
0	0,0050	0,0050	0,0050	0,0050	0,00300	0,0050	0,004
1	0,0110	0,0110	0,0110	0,0088	0,01310	0,0088	0,0079
2	0,0136	0,0136	0,0136	0,0145	0,0180	0,0126	0,0117
3	0,0153	0,0153	0,0153	0,0148	0,0227	0,0162	0,0150
4	0,0179	0,0179	0,0179	0,0346	0,0229	0,0350	0,0151

Table 7.42.4.1.2.5. Maturity ogive of anchovy stock in GSA 22 for 2000-2006.

Year	**0**	**1**	**2**	**3**	**4**
2003	0	.62	.99	1	1
2004	0	.67	.99	1	1
2005	0	.46	.98	1	1
2006	0	.40	.98	1	1

Table 7.42.4.1.2.6. Spawning biomass indices (SSB in t) of anchovy stock in GSA 22 for 2000-2006.

Year	SSB
2003	40042
2004	22799
2005	20533
2006	48700

Table 7.42.4.1.2.7. Age-structure indices of anchovy (numbers in thousands) stock in GSA 22 for 2000-2006. Age 3 was considered a plus age group.

Age	2003	2004	2005	2006
1	1148.1	1991.1	2109.9	5524.9
2	1395.4	1313.1	971.0	1333.4
3+	635.8	10.8	20.0	63.8

7.42.4.1.3. Results including sensitivity analyses

The graphical diagnostics of the model are shown in Figs. 7.42.4.1.3.1 to 7.42.4.1.3.5 indicating generally showed good model fit besides year 2002 and age 4 probably because they are poorly sampled. This further justifies the down weighting of age 4 in the model. Residual plots for recent years showed no strong deviations from separability. SSQ plot (Fig. 7.42.4.1.3.6) indicated moderate consistency between the model and the indices (minima fairly close to each other on x-axis, Needle 2000).

ACOUSTIC SURVEYS (ages 1 to 3+), age 1, diagnostics

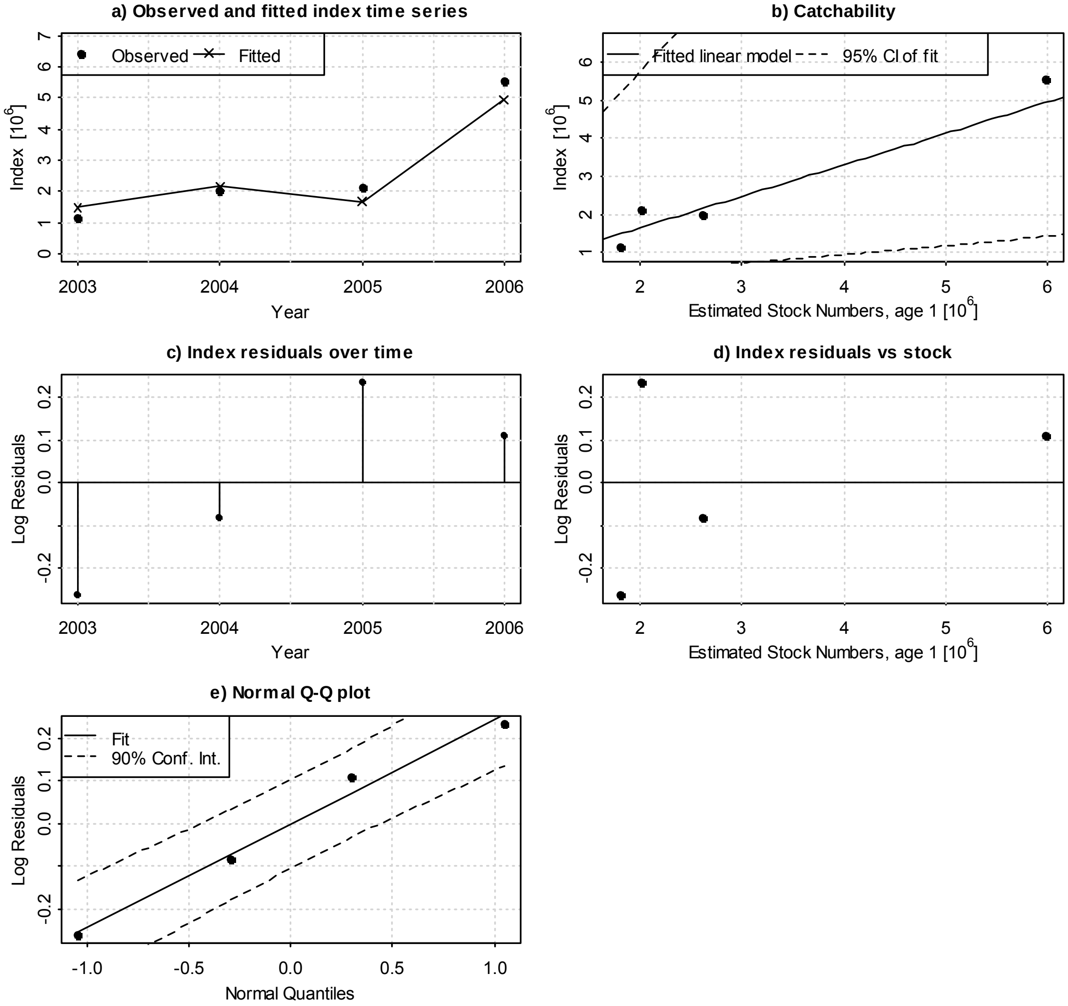


Fig. 7.42.4.1.3.1 Residual plots for age 1 indices of anchovy ICA model for GSA 22 (2000-2006)

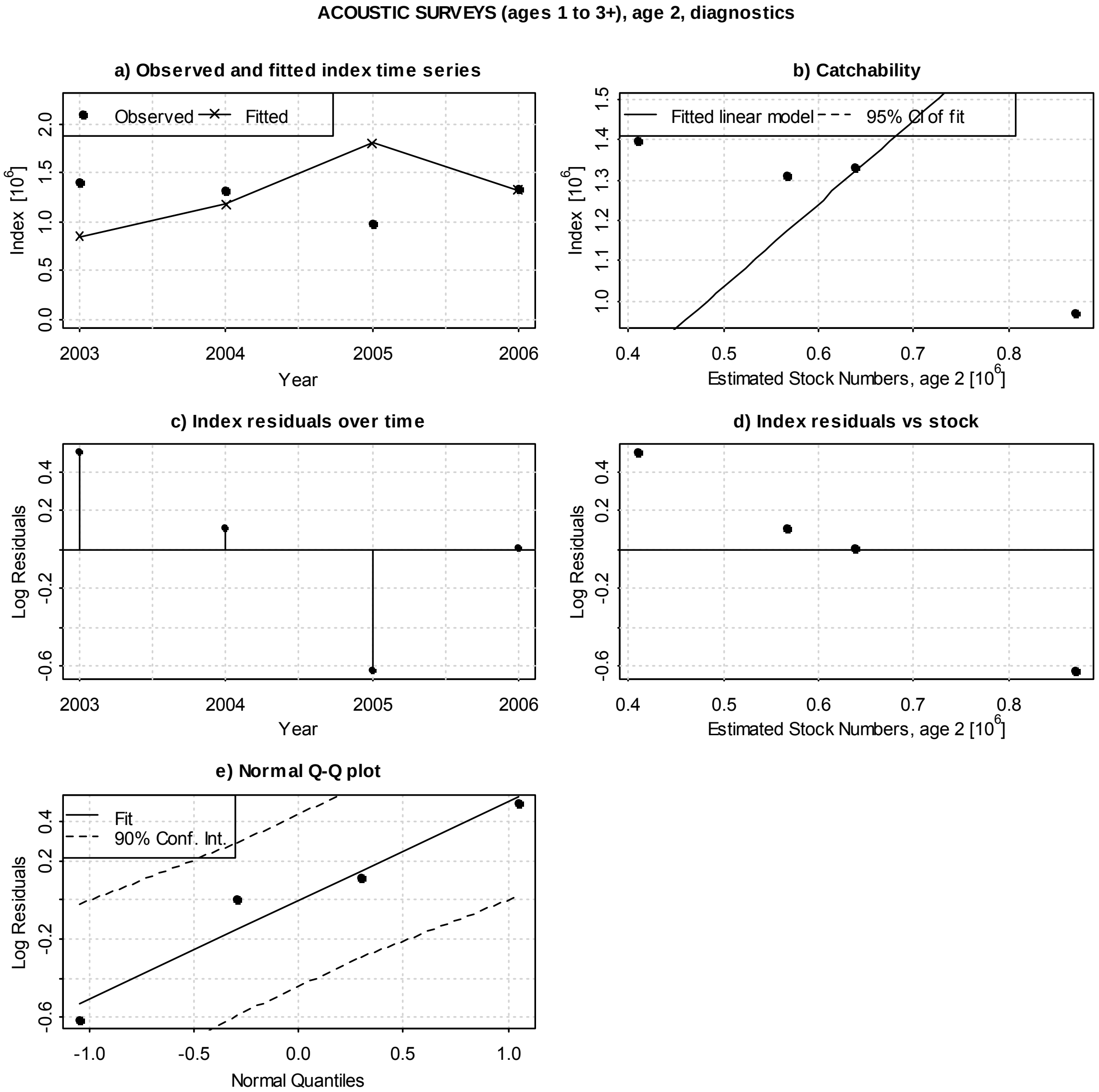


Fig. 7.423.4.1.3.2 Residual plots for age 2 indices of anchovy ICA model for GSA 22 (2000-2006)

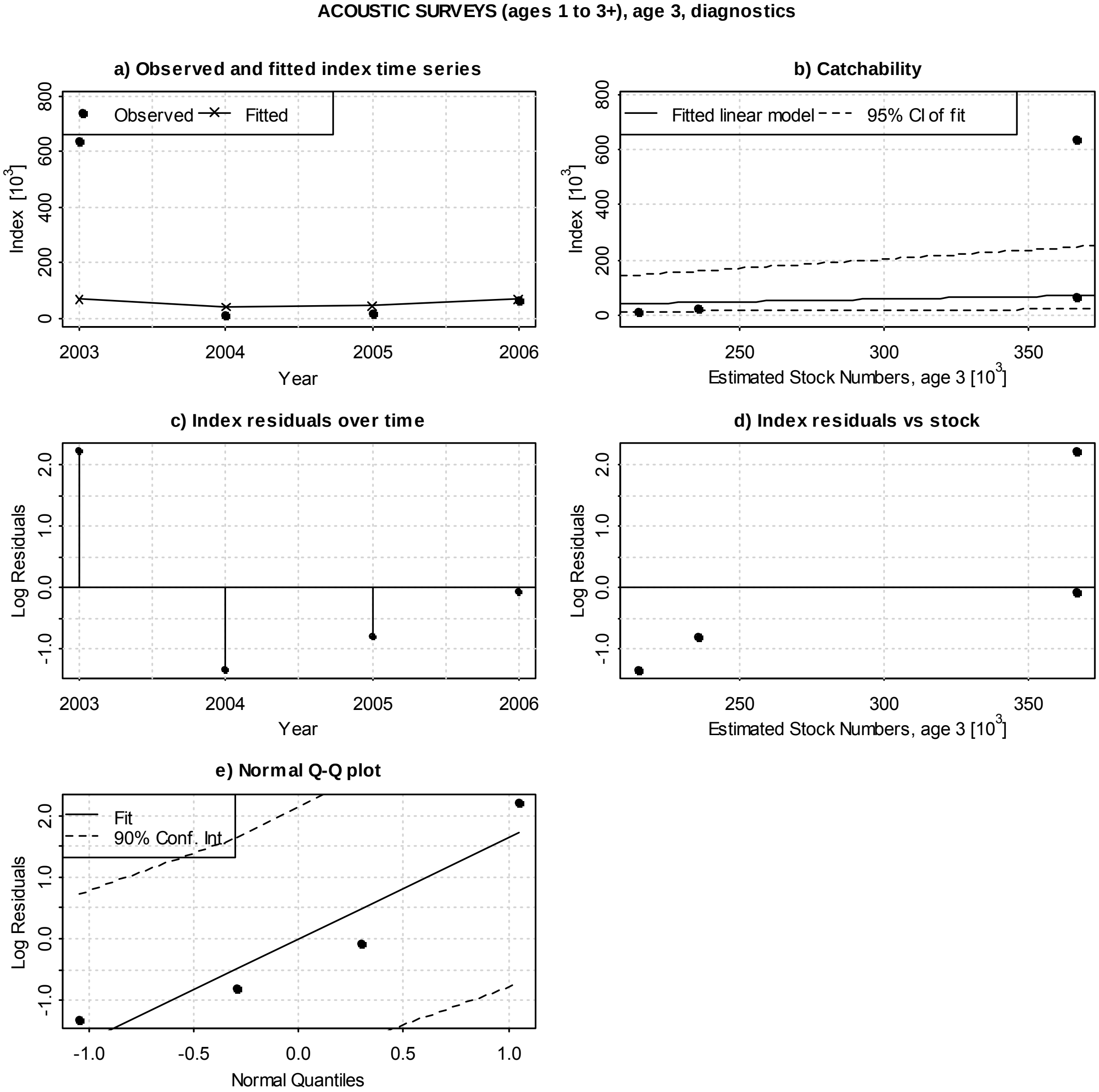


Fig. 7.42.4.1.3.3 Residual plots for age 3 indices of anchovy ICA model for GSA 22 (2000-2006)

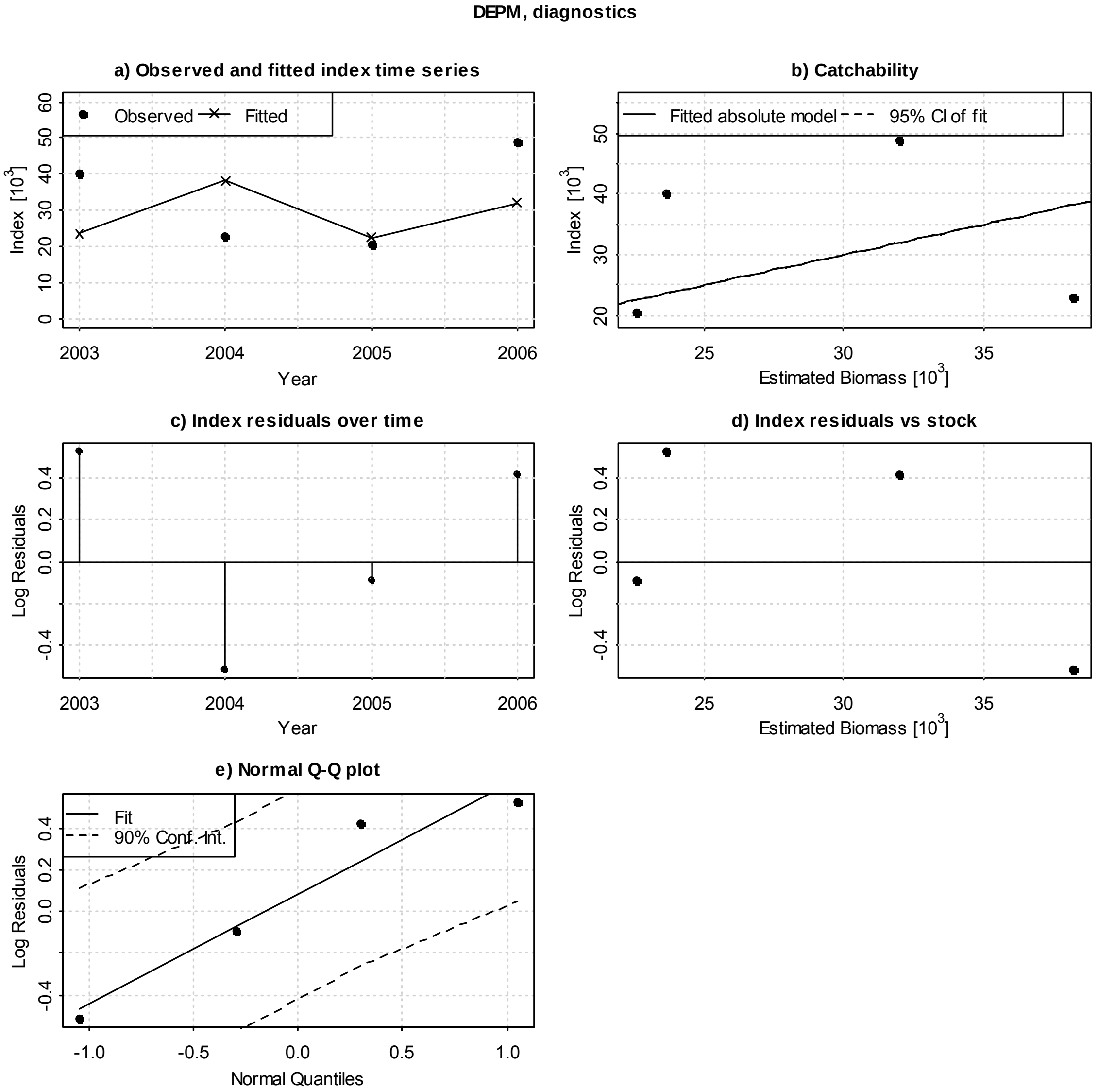


Fig. 7.42.4.1.3.4 Residual plots for SSB indices of anchovy ICA model for GSA 22 (2000-2006)

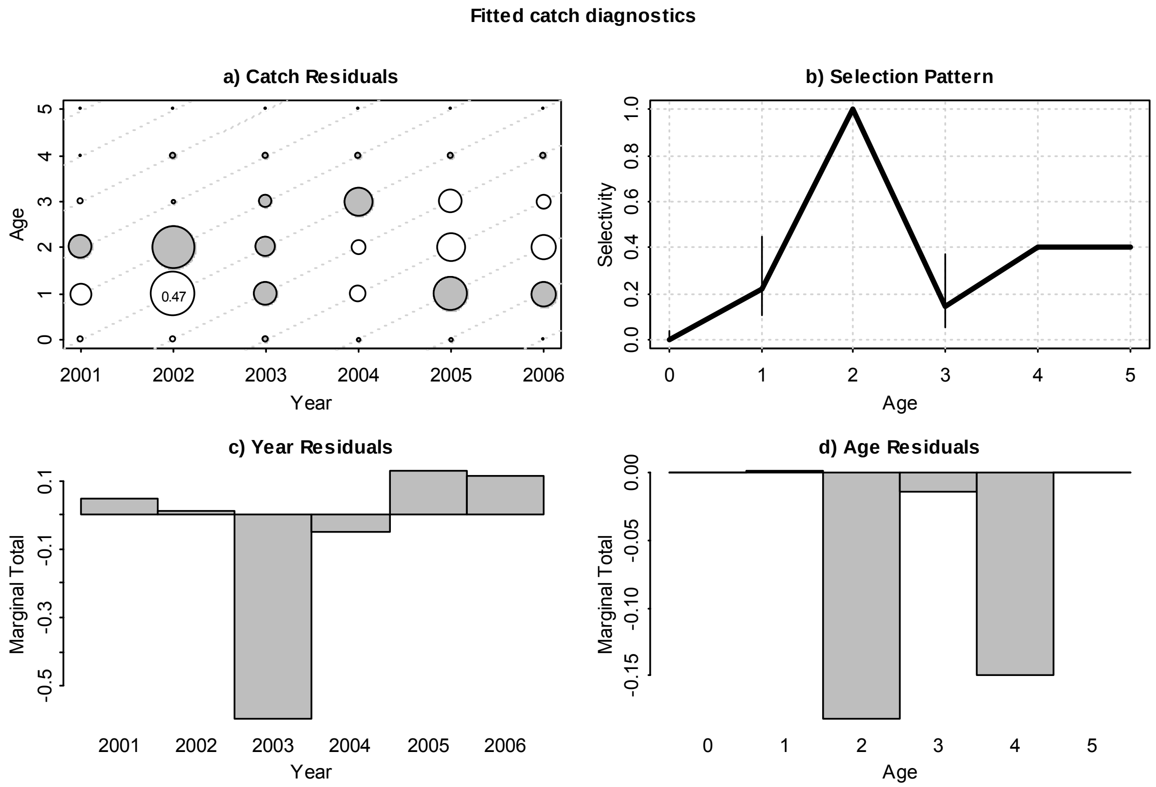


Fig. 7.424.1.3.5 The catch at age residuals Residual plots for catch of anchovy ICA model for GSA 22 (2000-2006)

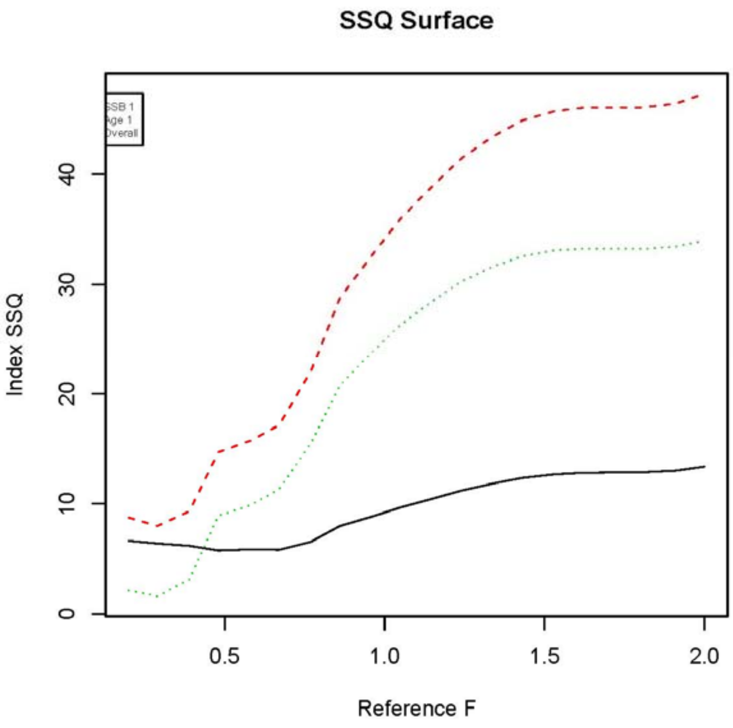


Fig. 7.42.4.1.3.6 Anchovy ICA Model (M=0.7, DEPM absolute indicator, Acoustics linear). Sum of Squares (SSQ) surface plot.

ICA model results for anchovy stock in GSA 22 are shown in Fig. 7.42.4.1.3.7, indicating an increasing trend for recruitment in 2006 as well as in biomass estimates. Fishing mortality at age 2 (reference age for the fishery) as well as F mean (ages 1to 3) shows a decrease since 2003, stabilizing in a lower level for 2004 to 2006. The landings to total biomass ratio decreases, approximating on average 15%.

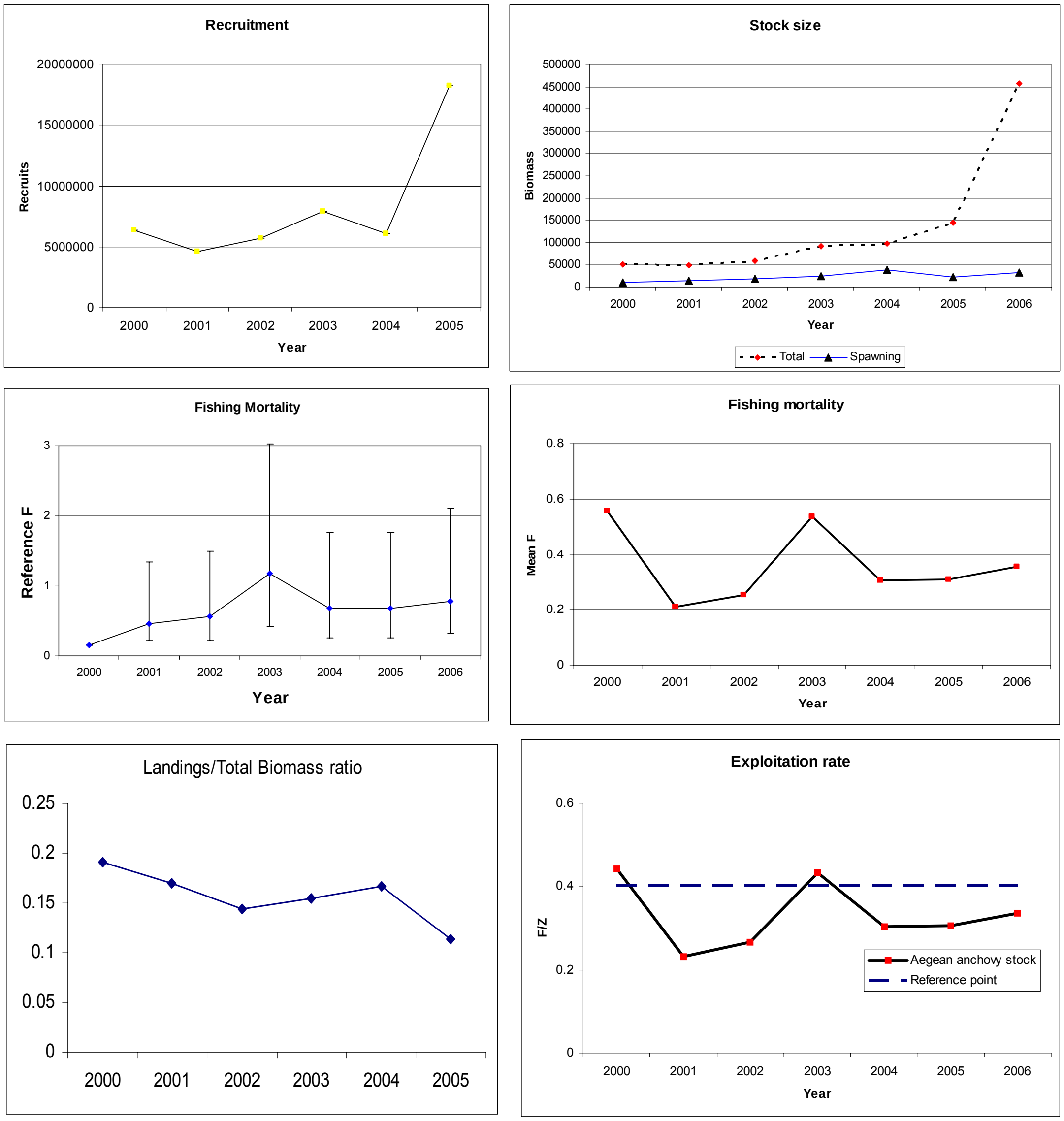


Fig. 7.42.4.1.3.7 Anchovy ICA Model (M=0.7, DEPM absolute indicator, Acoustics linear) results: Total biomass, SSB, recruitment Reference F at age 2, Fmean for ages 1-3, ratio of landings to total biomass and exploitation rate (F/Z).

Retrospective analysis was applied in the ICA model for the Aegean anchovy 2000-2006with one year backward analysis. Applying the analysis with more than one year backward was not possible due to the short time series available. Results are presented in Fig. 7.53.4.1.3.7. showing no retrospective problematic estimate for last year.

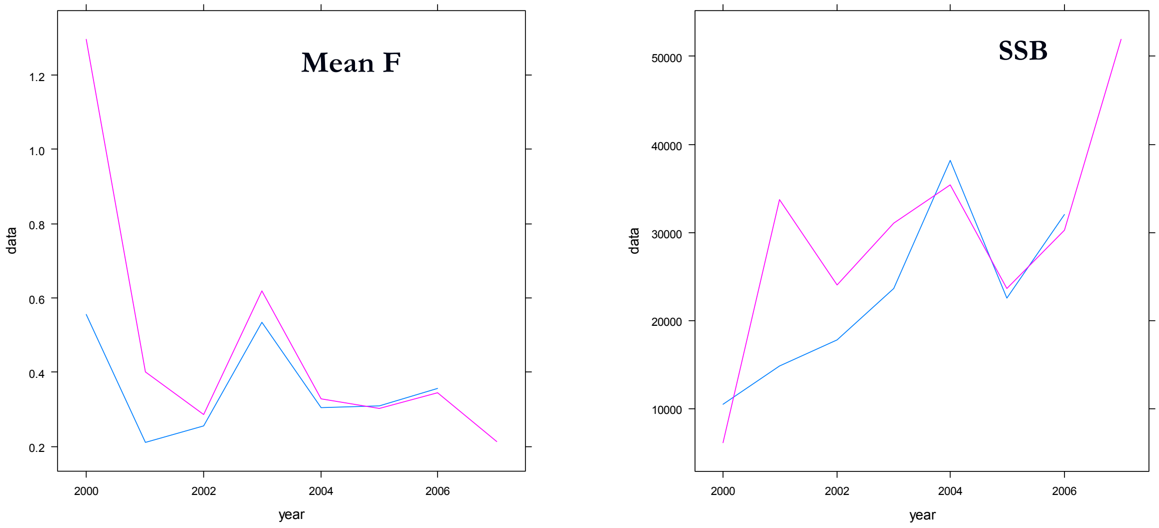


Fig. 7.424.1.3.7. The results of retrospective analysis in the Aegean Sea anchovy ICA model 2000-2006, concerning F mean 1-3 and SSB.

7.42.5. Short term prediction for 2008 and 2009

7.42.5.1. Justification

No forecast analyses were conducted.

7.42.5.2. Input parameters

No forecast analyses were conducted.

7.42.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for anchovy in GSA 22.

7.42.6. Medium term prediction

7.42.6.1. Justification

No forecast analyses were conducted.

7.42.6.2. Input parameters

No forecast analyses were conducted.

7.42.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for anchovy in GSA 22.

7.42.7. Long term prediction

7.42.7.1. Justification

Yield per recruit analysis was conducted in the SGMED-08-04 assuming equilibrium conditions.

7.42.7.2. Input parameters

Based on the exploitation pattern resulting from the ICA model and its population parameters, yield per recruit analyses were formulated. Minimum and maximum age for the analysis were considered to be age group 0 and 4, respectively. Stock weight at age, catch weight at age and maturity ogive were estimated as mean values in a long term basis (2000-2006). Natural mortality was considered constant for all ages. Fishing mortalities were estimated in a short term basis (2004-2006). Reference F was considered to be mean F for ages 1 to 3. Input parameters are shown in Table 7.42.7.2.1.

Table 7.42.7.2.1. Input parameters for Y/R analysis

age group	stock weight	catch weight	maturity	F	M
0	0.005	0.007	0	0.0004	0.70
1	0.006	0.014	0.51	0.1569	0.70
2	0.014	0.016	0.98	0.7127	0.70
3	0.016	0.017	1	0.1011	0.70
4	0.019	0.029	1	0.2851	0.70

7.42.7.3. Results

Y/R analyses were performed (Fig. 7.53.7.3.1) but were not considered reliable due to its flat-topped shape. Therefore the use of $F_{0.1}$ (1.0) and F_{max} (1.9) as a reference point requires further analysis before acceptance. These high values practically imply no significant SSB reduction due to high F values. $F_{0.1}$ estimate is also high implying no conflict with sustainable high productivity. Further research is aimed to produce Reference Points. Precautionary the F_{pa} might be set as the fishing mortality that assures exploitation rate below the empirical level for stock decline (E<0.4, Patterson 1992) for small pelagic.

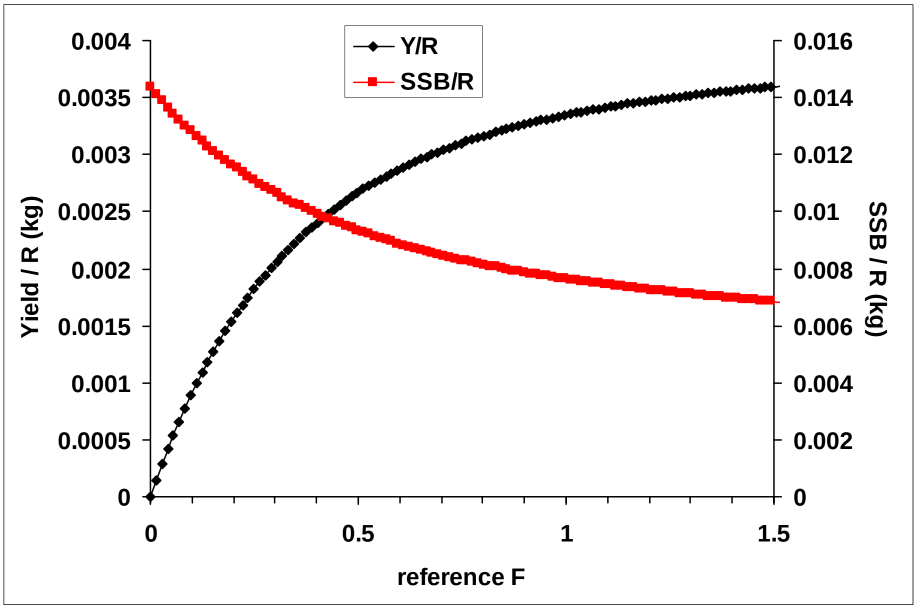


Fig. 7.42.7.3.1. Yield per recruit for the anchovy stock in GSA 22.

7.42.8. Scientific advice

7.42.8.1. Short term considerations

No short, medium or long term scenarios have been applied. The absence of 2007 data prevents SGMED from providing any short or medium term projections.

7.42.8.1.1. State of the spawning stock size

Estimates of fishery independent surveys for anchovy in GSA 22 indicated a slight recovery concerning both Total Biomass (62604 t in 2006 estimated by acoustics) and SSB (48700 t in 2006 estimated by DEPM) from the previous 2005 lower level. Similarly, results of the Integrated Catch at Age analysis indicated an increasing trend in total biomass and in SSB showing a slight recovery in 2006 from the 2005 lower level. The stock is characterized by intermediate abundances. The spawning biomass in relation to precautionary limits is practically undefined since there are no reference points and there is a small series of data available to set a reference point. However the level of anchovy SSB in 2006 is well above the lowest SSB level (in 2005) observed.

The absence of 2007 data prevents SGMED from providing any short or medium term projections of biomass.

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide any scientific advice in relation to them..

7.42.8.1.2. State of recruitment

ICA model estimates had showed an increase in the number of recruits towards 2006.

7.42.8.1.3. State of exploitation

Based on ICA results the mean F (for ages 1 to 3) showed a decrease since 2003 showing a rather plane pattern at a lower level (mean at 0.32) and being below the empirical level of stock decline (E<0.4, Patterson 1992) for small pelagics (Fig. 5).

Conclusions based on this assessment should be considered preliminary and cautionary, as they are based on a short time series of data, not suitable to suggest reference points of Blim. Taking into account that anchovy is a short lived species characterized by high fluctuations in abundance and recruitment strongly depending on environmental conditions, it is advisable that current results only precautionary should be used for management advice.

Furthermore, due to the high values of natural mortality used Y/R analysis indicated overestimated high values practically imply no significant SSB reduction due to high F values. Therefore the use of Fmax as a reference point is not considered appropriate. $F_{0.1}$ estimate is also high implying no conflict with sustainable high productivity. Precautionary the use of $F_{(E0.4)}$ that assures exploitation rate below the empirical level for stock decline (E<0.4, Patterson 1992) for small pelagics was suggested as preferable by the SGMED-08-04 as F reference point.

Based on this assessment results and the aforementioned parameters this stock is considered to be harvested sustainably, operating below but close to an optimal yield level, with no expected room for further expansion. However this has to be confirmed in following years and the anchovy stock should be monitored in an annual basis with direct assessment surveys.

We consider fishing effort should not increase beyond the current levels. This should allow maintaining the current levels of fishing mortality.

For precautionary reasons the possibility of changing the closed period should be examined. Since the fishery is considered a multispecies fishery targeting both anchovy and sardine, a shift of the closed period (present: mid December to end of February) towards the recruitment period of anchovy (e.g. October to December) / or the recruitment period of sardine (e.g. February to April) could be suggested that would allow the fishery to recover and more individuals of anchovy and sardine to enter the fishery at an older age.

7.42.8.2. Medium term considerations

We consider fishing effort should not increase beyond the current levels. This should allow maintaining the current levels of fishing mortality.

7.43. Stock assessment of sardine in GSA 17

7.43.1. Stock identification and biological features

7.43.1.1. Stock Identification

The southern boundary of the GSA 17 is represented from the Gargano Promontory, as shown in the map below. However, the stock distribution area of sardine in the Adriatic Sea extends into GSA 18. The spawning season of the Adriatic sardine is in autumn-winter. The spawning areas are mainly located in the eastern part of the GSA 17, in less rich waters than anchovy. On the basis of the database of CNR-ISMAR-SPM Fish Population Dynamics Unit, the maximum age recorded was 12 years while the maximum length was 22.0 cm.

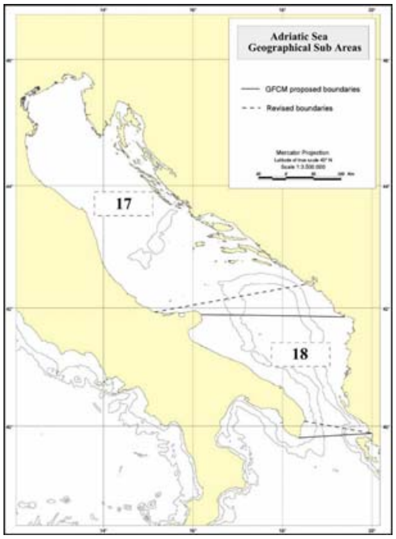


Fig. 7.43.1.1.1 Boundaries of the GSA 17.

7.43.1.2. Growth

An example of age-length key expressed in number of individuals, obtained through DCR by CNR-ISMAR-SPM Fish Population Dynamics Unit, for the commercial catches of (Italian) mid-water trawlers in 2007, was reported in the table below.

Tab. 7.43.1.2.1 GSA 17 sardine: age-length key (year 2007, mid-water trawlers).

L (cm)	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Total
11.5	8										8
12.0	19										19
12.5	22	9	1								32
13.0	25	12									37
13.5	40	19	3								62
14.0	33	28	5								66
14.5	13	53	7	1							74
15.0	3	10	52	8							73
15.5	1	3	57	14	1						76
16.0			34	28	8						70
16.5			14	40	10	2					66
17.0			2	6	14	7					29
17.5				2	12	9	1				24
18.0						1	3	2			6
18.5					1	1	1	3	1	1	8
19.0								1		1	2
19.5					1						1
Total	**164**	**134**	**175**	**99**	**47**	**20**	**5**	**6**	**1**	**2**	**653**

The corresponding age-length key obtained for the commercial catches of purse-seiners was reported below. Different length ranges as a function of the gear were observed: the smallest size individuals can be better represented in the catch of mid-water trawlers. However, such a difference is more typical for anchovy than sardine.

Tab. 7.43.1.2.2 GSA 17 sardine: age-length key (year 2007, mid-water trawlers).

L (cm)	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Total
14.0	3								3
14.5	3								3
15.0	1	5							6
15.5		4	1						5
16.0		1	5						6
16.5			1	2	1				4
17.0			2		1				3
17.5				2	2				4
18.0				1		1	1	1	4
18.5					1	1	1		3
19.0					1	1	1		3
19.5						1	1	1	3
Total	**7**	**10**	**9**	**5**	**6**	**4**	**4**	**2**	**47**

7.43.1.3.Maturity

According to Sinovčić et al. (2003), the first sexual maturity of sardine in Krka River estuary, in the eastern Adriatic Sea, is around 8 cm. Also, Sinovčić (1984) mentioned a study from literature reporting 14 cm.

7.43.2. Fisheries

7.43.2.1.General description of fisheries

In the GSA 17, sardine is fished by mid-water trawlers and purse seiners attracting fish with light. Additional information was reported below in the paragraph “Catches”.

7.43.2.2.Management regulations applicable in 2007 and 2008

In Italy, the legal minimum length for sardine is 11 cm (R.(CE) 1967/2006). The value 10 cm has been adopted in Croatia (G. Sinovčić, Institute of Oceanography and Fisheries of Split, personal communication).

7.43.2.3.Catches

7.43.2.3.1. Landings

On the basis of the database of CNR-ISMAR-SPM Fish Population Dynamics Unit, the amount of the total catch of sardine relative to Italy, Slovenia and Croatia was plotted over years in the figure below.
The average total catch was 44000 tonnes in 1975-2007 and 17000 tonnes in 2005-2007.
A decrease was observed after the peak in the middle of 1980s, particularly in the Italian catches. The fractions of the total catch due to the fleets of the Italy and Slovenia-Croatia were quite similar, but the latter one accounted for higher fractions in recent years. That is at least partially related with the mentioned stronger decrease in the Italian catches.

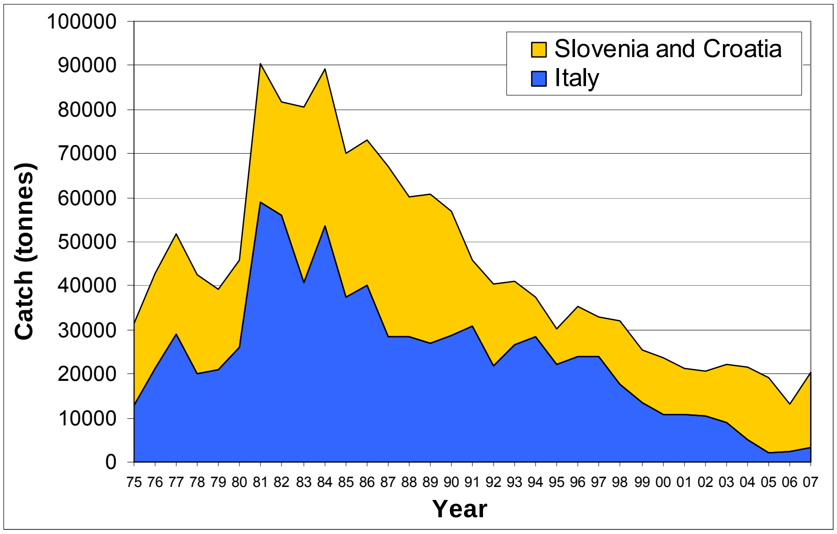


Fig. 7.43.2.3.1.1 GSA 17 sardine: total catch over years.

The average length frequency distribution and the average age frequency distribution of the total catch were shown in the two figures below. The average for length was calculated including only the years from 1988 onwards as, after this date, length was measured using 0.5 cm classes, whereas 1 cm classes were used from 1975 to 1987.
A comment relative to the different length range fished by mid-water trawlers and purse seiners was reported above, in the paragraph "Growth".

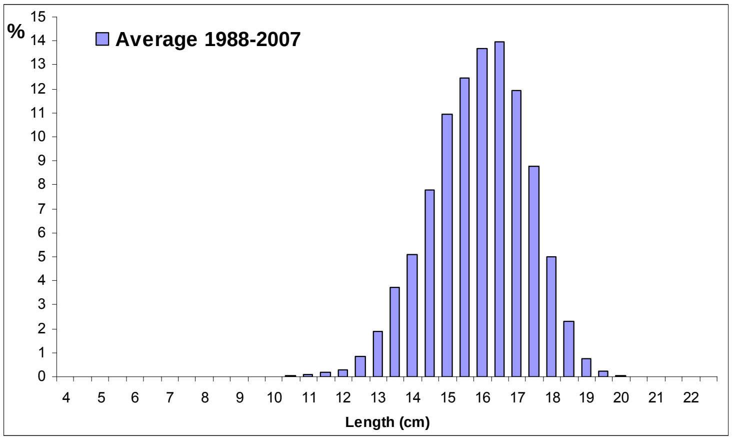


Fig. 7.43.2.3.1.2 GSA 17 sardine: average length frequency distribution of the total catch.

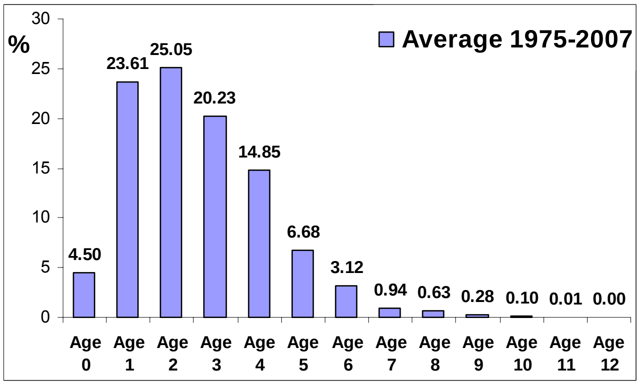


Fig. 7.43.2.3.1.3 GSA 17 sardine: average age frequency distribution of the total catch.

7.43.2.3.2. Discards

This feature was investigated by CNR-ISMAR-SPM Fish Population Dynamics Unit, through an EU funded project at the end of 1990s (Santojanni *et al.*, 2005) and DCR in 2005.

Discards of sardine in the GSA 17, at least for the Italian fleet, were not considered as negligible in 1987-1999 and landings were corrected by adding amounts of smallest size sardine ranging from 1000 to 4000 tonnes; in fact, for the Italian fleet, this species is required at a lower degree than anchovy.

On the basis of the DCR investigation, the amount of sardine discarded at sea by the Italian fleet was 126 tonnes and 11 tonnes in the third and fourth quarter of 2005, respectively. These quantities were low in comparison with the corresponding landings: from 2000 to 2007, the annual amount of sardine landed by the Italian fleet ranged from 2000 to 11000 tonnes. Moreover, it is possible that, due the lower availability of sardine at sea, the proportion of the discarded catch in recent years was lower than in 1987-1999. In conclusion, the estimates of discards obtained for only one half of 2005, relatively low and also strongly fluctuating among the two quarters, were not used to correct landings.

7.43.2.3.3. Fishing effort

On the basis of the database of CNR-ISMAR-SPM Fish Population Dynamics Unit, in the calendar year 2007, the Italian fleet was composed of about 130 (65 pairs) pelagic trawlers (*volante*), mainly operating from Trieste (extreme north harbour) to Ancona (average GRT 43, average engine power 290 kW) and about 45 purse seiners attracting fish with light (*lampara*), operating in the Gulf of Trieste (24 small *lampara*, average GRT 9, average engine power 110 kW) and south of Ancona (21 big *lampara*, average GRT 97, average engine power 390 kW). In 2007, the Slovenian fleet was composed of 1 pelagic trawler pair and 7 purse seiners; no updated data are available for the Croatian fleet.

7.43.3. Scientific surveys

As mentioned below in the paragraph "Method", the results of the acoustic surveys carried out by CNR-ISMAR-SPM Marine Acoustics Unit from the mid-line to the western coast of the GSA 17, from 1976 to 2007, were used for VPA tuning.

7.43.3.1.1. Trends in growth

No analyses were conducted during SGMED-08-04.

7.43.3.1.2. Trends in maturity

No analyses were conducted during SGMED-08-04.

7.43.4. Assessment of historic stock parameters

7.43.4.1.Method 1: VPA

7.43.4.1.1. Justification

Given the long time series available, VPA was thought to be a suitable method.

7.43.4.1.2. Input parameters

A time series of annual total catch at age in numbers of individuals is the main data input of VPA. It was shown (expressed using proportions) in the figure below. The age class 6+ is a plusgroup: it includes the class 6 (years) along with those classes higher than 6, thus up to 12 in the present case.

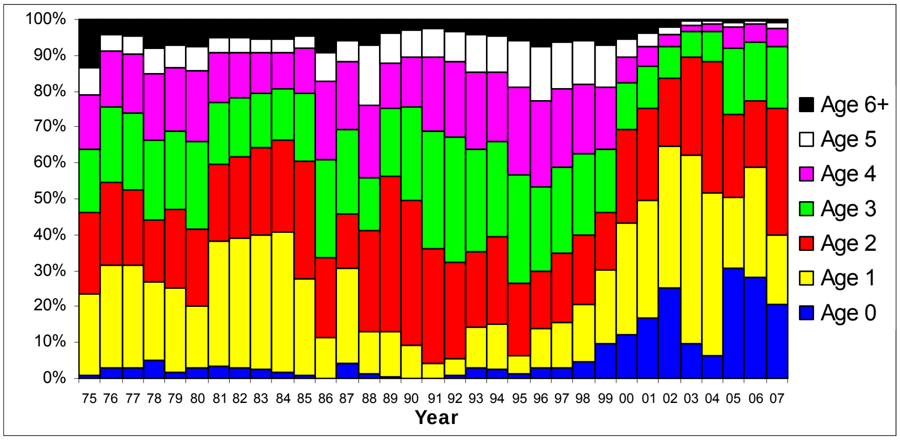


Fig. 4.43.4.1.2.1 GSA 17 sardine: total catch at age over years.

The annual natural mortality rates M = 0.5 (year^{-1}) was employed for VPA calculations.
This value was selected taking into account the literature and the maximum life-span observed in the commercial catches from 1975 onwards, i.e. higher even than 8 years.
About the inverse relationship between longevity and mortality, as reported by Barange (2001), Pacific sardine (*Sardinops sagax*) is usually assumed to have a relatively low annual natural mortality rate, M = 0.4, and a lifespan of about 10 years, whereas for northern anchovy (*Engraulis mordax*) M = 0.8 is associated to a lifespan of about 4 years.
Moreover, useful information was gained from the relationship between total mortality Z (= F + M) and maximum life span tmax (year), Ln Z = 1.44 **-** 0.982 Ln tmax **,** found by Hoenig (1983; see also Hewitt and Hoenig, 2005). It was "based largely on data from unexploited stocks", thus with Z being very close to M. On the basis of this equation, for example (table below), tmax = 8 is associated to Z = 0.55.

Tab. 4.43.4.1.2.1 Relationship between total mortality rate Z and maximum life-span tmax (see text).

tmax (year)	**Z (year^{-1})**
1	4.22
2	2.14
3	1.43
4	1.08
5	0.87
6	0.73
7	0.62
8	0.55
9	0.49
10	0.44
11	0.40
12	0.37
13	0.34
14	0.32
15	0.30
16	0.28
17	0.26
18	0.25
19	0.23
20	0.22

7.43.4.1.3. Results

The stock biomass estimated by means of VPA was plotted over years in the figure below, along with the total catch.

The average stock biomass estimated by VPA was 440000 tonnes in 1975-2007 and 90000 tonnes in 2005-2007. The corresponding average ratio between total catch and stock biomass was 0.10 in 1975-2007 and 0.19 in 2005-2007.

A strong decline of stock biomass occurred after the peak in the first half of 1980s; this decline was continuous till the end of 1990s: then, biomass was quite stable around values slightly lower than 100000 tonnes, which corresponded to the lowest abundance of the series.

In the same picture, the stock biomass estimated by means of the echo-surveys carried out in the western part of the GSA 17 was reported: also this series showed (most of) the lowest values after the end of 1990s.

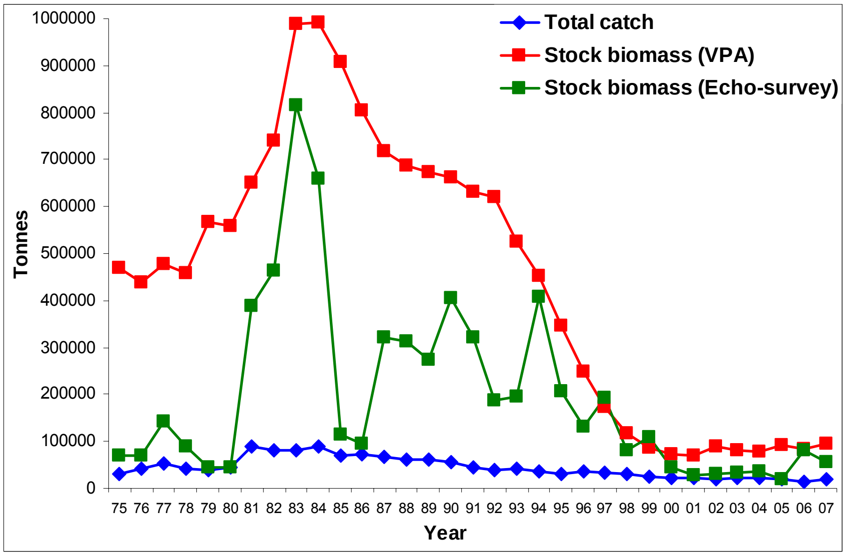


Fig. 7.43.4.1.3.1 GSA 17 sardine: total catch and stock biomass estimated by VPA (entire GSA 17) and echo-surveys (western part of GSA 17) over years.

The relationship between spawning stock biomass and number of recruits (age class 0) obtained from VPA was plotted in the figure below. The values of current spawning stock biomass were the lowest of the series as well as the recruitment level.

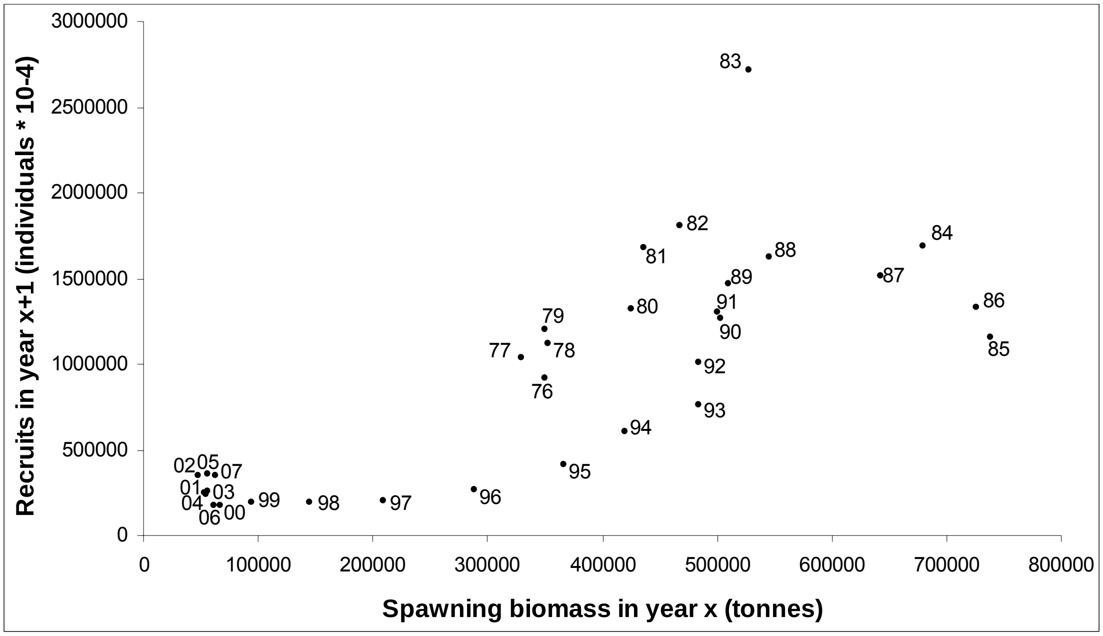


Fig. 7.43.4.1.3.2 GSA 17 sardine: stock-recruitment relationship.

The fishing mortality rate F derived from VPA was plotted over ages and years in the figure below (left and right picture, respectively). In the former case, the average for the complete time series was calculated. In the latter case, two averages were calculated both weighting and without weighting the F at age values on the corresponding numbers of fish at sea.

Some average values over years were the following:

- unweighted F0-5 in 1975-2007 : 0.27;
- unweighted F0-5 in 2005-2007 : 0.48;
- weighted F0-6 in 1975-2007: 0.12;
- weighted F0-6 in 2005-2007: 0.17.

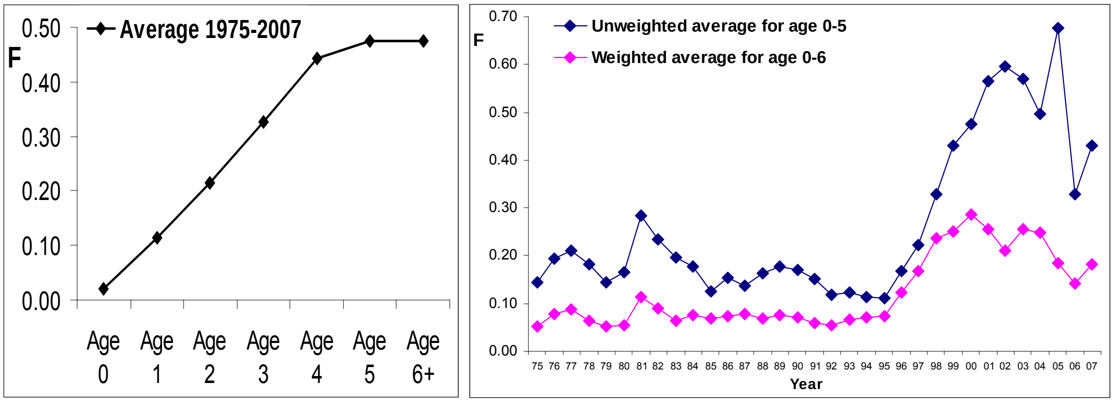


Fig. 7.43.4.1.3.3 GSA 17 sardine: fishing mortality rate F over ages and years.

The annual exploitation rate E = F/(F+M) or F/Z was also calculated, both using the weighted and unweighted Fs mentioned above.

The values obtained were compared with the threshold F/Z = 0.4 (biological reference point), above which the stock collapse should be relatively likely, as pointed out by Patterson (1992) for small pelagics. Here, more emphasis was given to the F/Z calculated using unweighted Fs, as the same author performed his statistical analysis on a data set mainly formed by unweighted Fs.

The values of F/Z were plotted over years in the figure below. Some average values over time were the following:

- F/Z in 1975-2007 with unweighted F0-5 : 0.32;

- F/Z in 2005-2007 with unweighted F0-5 : 0.48;
- F/Z in 1975-2007 with weighted F0-6 : 0.19;
- F/Z in 2005-2007 with weighted F0-6 : 0.25.

Hence, in 2005-2007, the value of F/Z based on F0-5 unweighted was estimated to be higher than 0.4 and close to 0.5 (0.48), which is the highest and more dangerous limit pointed by Patterson (1992). When the unweighted F1-3 was used instead of F0-5, F/Z in 2005-2007 was still higher than 0.4 (0.42).

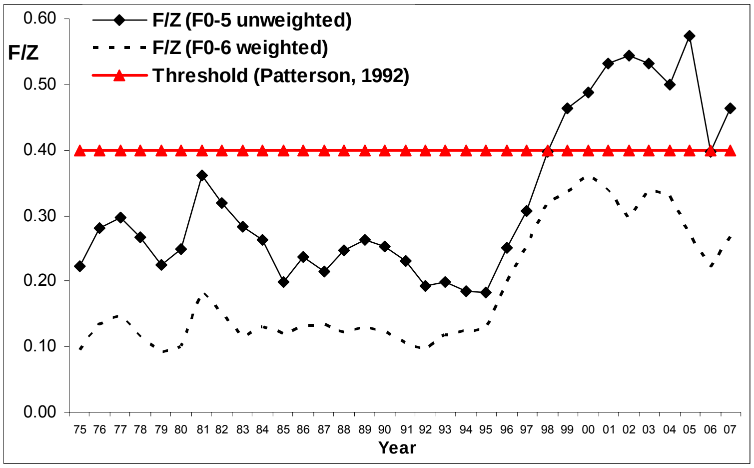


Fig. 7.43.4.1.3.4 GSA 17 sardine: exploitation rate F/Z over years.

7.43.5. Short term prediction for 2008 and 2009

7.43.5.1. Justification

No forecast analyses were conducted.

7.43.5.2. Input parameters

No forecast analyses were conducted.

7.43.5.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a short term prediction of catch and stock biomass for sardine in GSA 17.

7.43.6. Medium term prediction

7.43.6.1. Justification

No forecast analyses were conducted.

7.43.6.2. Input parameters

No forecast analyses were conducted.

7.43.6.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for sardine in GSA 17.

7.43.7. Long term prediction

7.43.7.1. Justification

No forecast analyses were conducted.

7.43.7.2. Input parameters

No forecast analyses were conducted.

7.43.7.3. Results

Given the preliminary state of the data and analyses SGMED-08-04 is not in the position to provide a long term prediction of catch and stock biomass for sardine in GSA 17.

7.43.8. Scientific advice

7.43.8.1. Short term considerations

The average stock biomass estimated by VPA was 90,000 tonnes in 2005-2007, while the average total catch was 17,000 tonnes; thus, the corresponding ratio between total catch and stock biomass was 0.19; however, in the same period, the average exploitation rate F/Z was 0.48 and, thus, higher than the threshold value 0.4 suggested as reference point for small pelagics by Patterson (1992).

As said above, the recent average ratio between total and stock biomass was not high but the exploitation rate F/Z was higher than 0.4. In addition, a decline of stock biomass was observed after the peak in the first half of 1980s and the lowest values of this series corresponded just to recent years. A quite similar pattern was also observed in the echo-survey abundance. It should be remembered that strong changes over time are commonly observed in the abundance of small pelagics. Past simulations carried out by VPA on data from 1975 to 2006 (projections for 2007-2012) pointed the strong negative effects of poor recruitment even in two years only.

In conclusion, the stock is thought to be over-exploited. It should be noted that small pelagic fishery in the GSA 17 is multispecies and fishing effort on sardine and anchovy should be considered together. Thus, due to the stock status of both species (in particular of sardine), it is recommended not to increase the fishing effort.

7.43.8.1.1. State of the spawning stock size

Both spawning stock biomass and recruitment level showed the lowest levels just in recent years. The stock-recruitment relationship was reported above in the paragraph “Method”.

7.43.8.1.2. State of recruitment

The ratio between the average number of recruits in 2005-2007 and 1975-2007 was 0.3.

7.43.8.1.3. State of exploitation

As mentioned above in this paragraph “Short term considerations”, the estimated F/Z in 2005-2007 was over the threshold F/Z = 0.4 suggested by Patterson (1992).

7.43.8.2. Medium term considerations

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

The negative effects on the stock due to a low number of poor recruitment was pointed out by means of simulations, as mentioned above in the paragraph “Short term considerations”.

7.44. Stock assessment of sardine in GSA 22

7.44.1. Stock identification and biological features

7.44.1.1. Stock Identification

This assessment of the sardine stock in GSA 22 has been based on information derived from the Greek part of the Aegean Sea (GSA 22). In Aegean Sea the main distribution area of the sardine stock of GSA22 is located in the continental shelf of the northern Aegean Sea (Giannoulaki et al., 2004; Giannoulaki et al., 2007; Machias et al, 2007; Tsagarakis et al., 2008). Sardine juveniles spatial distribution is strongly related to semi closed gulfs, shallow waters (less than 30 m depth) with high productivity, influenced by the presence of rivers outflows (Tsagarakis et al., 2007; SARDONE project interim report).

7.44.1.2. Growth

Fast growth parameter was considered and parameters are shown in Table 7.44.1.2.1. No sex discrimination was applied.

Table 7.44.1.2.1. Growth parameters (v. Bertalanffy) for sardine in GSA 22.

	Fast growth	
	Unsexed	Units
Linf	147.8	cm
K	0.9	year^{-1}
t0	-0.936	year
a	0.00003	gr
b	3.2144	
M	0.8	year^{-1}

7.44.1.3. Maturity

The following maturity at age ogive was used for sardine assessments in GSA 22 as estimated from biological sampling based on length at first maturity estimated approximately at 115mm (Machias et al., 2001; Machias et al., 2007) in Aegean Sea. The sardine spawning period in GSA 22 extends from November to April with maximum in December-January.

Table 7.44.2.1.3.1 Maturity ogives at age for female sardine in GSA 22.

Year	Age 0	Age 1	Age 2	Age 3	Age 4
2003	0	0.5	1	1	1
2004	0	0.5	1	1	1
2005	0	0.5	1	1	1
2006	0	0.5	1	1	1

7.44.2. Fisheries

7.44.2.1. General description of fisheries

Sardine (*Sardina pilchardus*) is one of the most important target species for the purse seine fishery in GSA 22. Sardine is being exploited only by the purse seine fishery. Pelagic trawls are banned and benthic trawls are allowed to fish small pelagics in percentages less than 5% of their total catch. Commonly sardine is caught from shallow waters about 30 m to 100 m depth.

7.44.2.2. Management regulations applicable in 2007 and 2008

Regarding the management regulations enforced they concern a closed period from the mid December till the end of February and technical measures such as minimum distance from shore (300m), minimum bottom depth (30 m), gear and mesh size, engine, GRT restrictions etc. There is also a minimum landing size at 11 cm.

7.44.2.3. Catches

7.44.2.3.1. Landings

The trend in reported landings is shown in Figs. 7.44.2.3.1.1 and 7.44.2.3.1.2. Landings were obtained within the framework of the Hellenic Centre for Marine Research data collection system that covers the entire GSA 22. The data from 2003 to 2006 were reported to SGMED-08-04 through the Data Collection Regulation and are listed in Table A.3.4 of Appendix 3. A decreasing trend in sardine landings has been observed in the long term (2000-2006), showing however an increasing short term trend from 2003 to 2006. Landings per vessel class indicate that small vessels (12-24 m) (Fig. 7.44.2.3.1.2) are mainly responsible for sardine catches (> 88% of the total catches).

Annual lengths of landings were reported to SGMED-08-04 for 2003-2006 and are shown in Fig. 7.44.2.3.1.2. Fig. 7.44.2.3.1.3 shows the landings at age in GSA 22 as reported to SGMED-08-04 for 2003-2006.

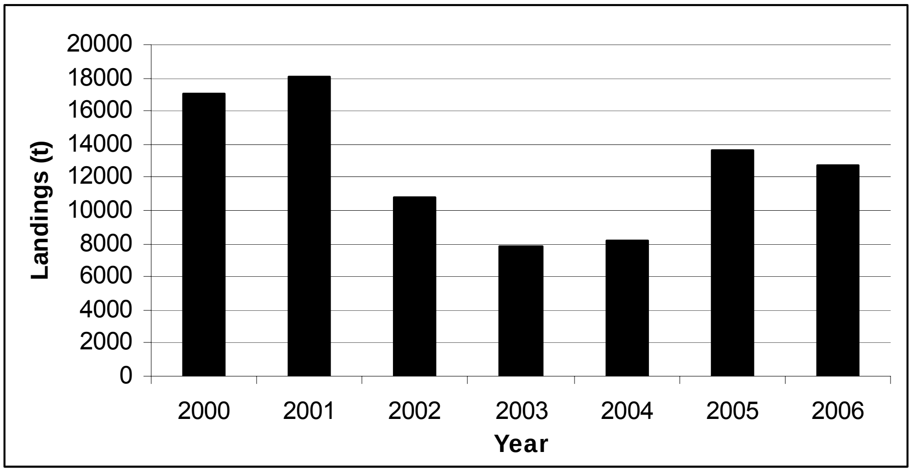


Fig. 7.44.2.3.1.1 Annual sardine landings (t) in GSA 22 for 2000-2006.

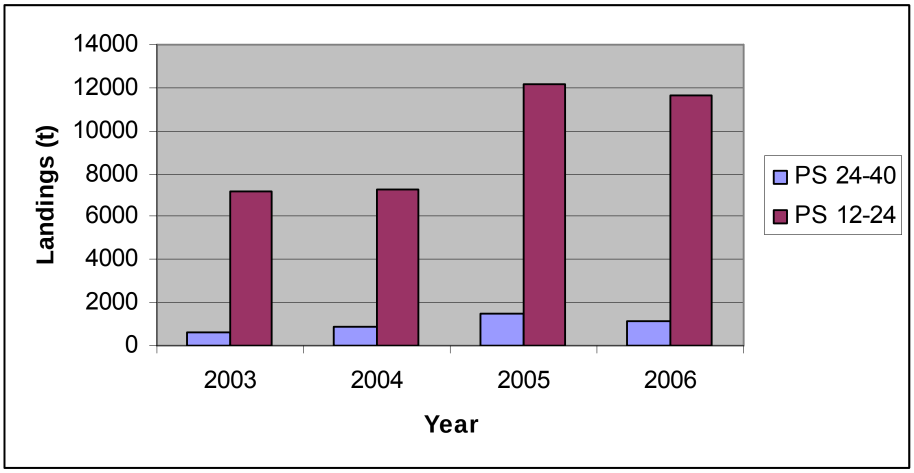


Fig. 7.44.2.3.1.2 Annual sardine landings (t) in GSA 22 per fleet size (purse seine fleet in Greek waters).

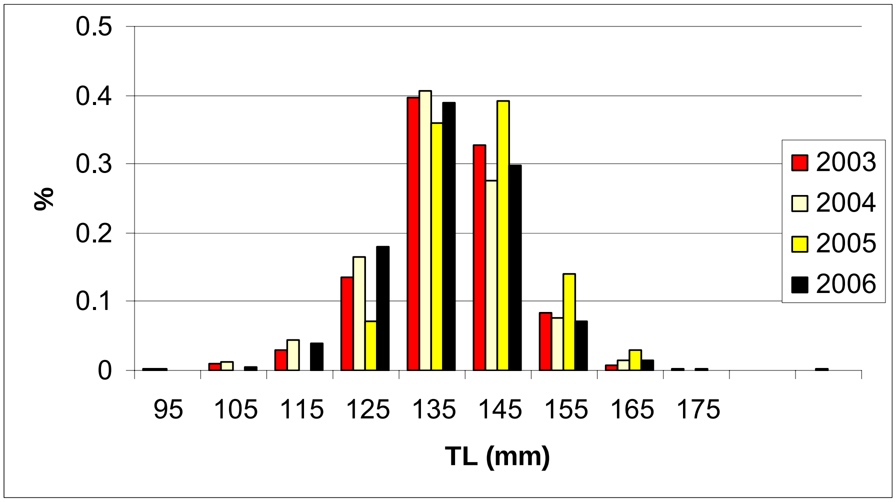


Fig. 7.44.2.3.1.3 Annual length frequency composition of sardine landings (t) for 2003-2006.

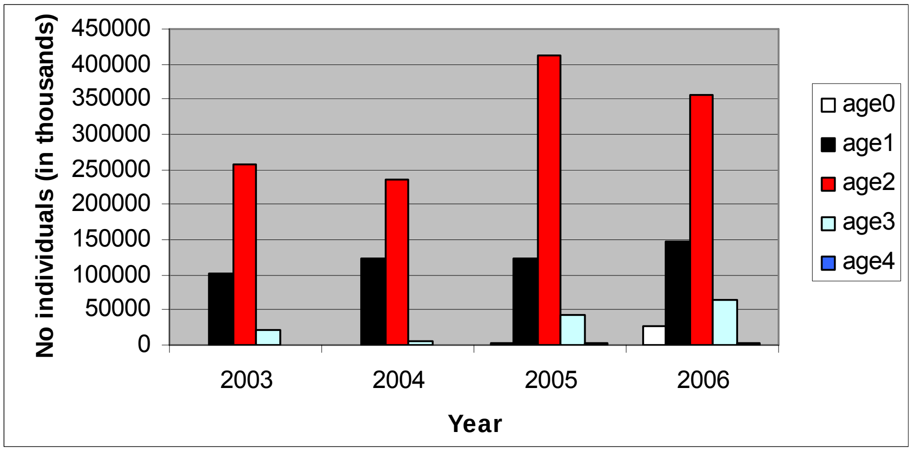


Fig. 7.44.2.3.1.4 Sardine landings per age group (No of individuals in thousands) for GSA 22 for 2003-2006.

7.44.2.3.2. Discards

No discards data for *Sardina pilchardus* were reported to the SGMED-08-04 and no data were reported through the Data collection regulation for 2003-2006. Discards are estimated at less than 5% of the total catch, therefore considered negligible and they were not taken into account for the assessment. Since sardine juveniles are mainly distributed to shallow waters (< 30m), they are not fished due to the existing technical measures (minimum distance from shore at 300 m, minimum bottom depth at 30 m). In addition as the fishery is multispecies, fishermen practically tend to avoid schools of undersized fish due to sorting difficulties (blocking of the nets) and low price.

7.44.2.3.3. Fishing effort

Based on the fishing effort data for GSA 22 provided to the DCR call and being available at the meeting the following table was made.

Table 7.44.2.3.3.1 Effort data regarding the purse seine fleet in GSA 22. GRT=Gross tonnage, KW=engine horse power.

Year	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m	PS 12-24 m	PS 24-40 m
	Days at Sea	**DAYS AT SEA**	**Days at Sea x GRT**	**Days at Sea x GRT**	**Days at Sea x KW**	**Days at Sea x KW**
2003	41539	2942	1767398	230726	8709727	679624
2004	39783	3989	1620847	366709	8111571	1029410
2005	42520	5690	1753346	542120	8123673	1532790
2006	37255	5619	1568893	539146	7386042	1606608

7.44.3. Scientific surveys

7.44.3.1. Acoustics and DEPM

7.44.3.1.1. Methods

Acoustics

SGMED was provided with evaluations of total biomass, abundance, length and age composition for GSA 22 as estimated by acoustics.

Acoustic surveys methodology

Acoustic echoes were registered continuously along 70 pre-defined transects in northern Aegean Sea in June 2003, 2004, 2005 and 2006 with a Biosonics Split Beam 38 kHz DT-X echosounder. The acoustic methodology followed is described in Machias et al., 2007 (see GFCM 2007 related WD). Hydroacoustic data analysis was performed using the Sonardata Echoview software v3.30. Echo trace classification was applied based on a) echogram visual scrutinisation and direct allocation of school marks that characterise sardine as well as b) allocation on account of representative fishing stations that were held along transects (MacLennan and Simmonds, 1992).

In order to estimate sardine biomass, the length-weight- relationship is required as well as species length frequency distribution per area. Therefore, 22, 23, 27 and 37 pelagic trawls were made along transects in 2003, 2004, 2005 and 2006 respectively, in the positions of high fish concentrations. A random sample of 200 specimens was obtained from each haul for further laboratory analysis. Subsequently, the length-weight-relationship was estimated from the total number of hauls according to the equation:

$$W = a\ L^b$$

where W is the total weight; L is the total length and a and b are constants that are estimated by regression analysis.

The mean length frequency was estimated in two sub-areas: (a) Eastern area (Thracian Sea and Strymonikos Gulf) and (b) Western area (Thermaikos and Evoikos Gulfs). In the two sub-areas, the mean frequency of each length class was estimated as follows:

$$f_j = \frac{\sum_{k=1}^{M}\left(\frac{n_{jk}}{t_k}\right)}{\sum_{k=1}^{M}\left(\frac{N_k}{t_k}\right)}$$

where f_j is the mean frequency of sardine of length class j; n_{jk} is the number of specimens of length class j in haul k; N_k is the total number of sardines in haul k; t_k is the duration of haul k and M is the number of hauls in the area. The above equation is appropriate even if the catches are small and the length distributions are poorly defined. It takes accounts of the haul duration, since it is supposed that on average, longer hauls will produce more fish (MacLennan and Simmonds 1992).

The density of targets (F) from the observed echo integrals were estimated according to the equation F= (K/<σ>)E, were K is the calibration factor, <σ> is the mean cross-section and E is the echo integral after partitioning (MacLennan and Simmonds 1992). The target strength (TS) – total length relationship used for sardine was: TS=20 logL-72.6, where L is fish total length (ICES 2006). The <σ> was calculated for the mean total fish length of each area according to the equations $<\sigma>= 4\pi\sum_{\iota} f_i 10^{TS/10}$, where f_ι is the corresponding length frequency as deduced from the fishing samples (MacLennan and Simmonds 1992).

The abundance Q was estimated separately for the eastern and the western part of the study area. The abundance Q in each elementary statistical sampling area was calculated from the average density within each sub-area according to the equation:

$$Q = A_k \sum_{i} F_i / N_k,$$

where F_i is the i sample; A_k is the area of each elementary statistical sampling area and N_k is the number of transects in A_k. The variance V was estimated as

$$V= \sum_{i} (AF_I-Q)^2/[N_r(N_{r-1}-1)]$$

The data were log transformed and the means and variances of F estimated according to the following equations:

$$F=\exp(m)\mathbf{G}_{\mathbf{N}}[0.5\ S/(n-1);\ V=F^2-\exp(2m)\ \mathbf{G}_{\mathbf{N}}[S(n-2)/(n-1)^2];$$

where m = average (lnF); S= variance (lnF) and n = independent observations of F.

The total abundance Q_t and its variance were obtained by summing the results for each region $Q_t=Q_1+Q_2+\ldots$, and $V_t=V_1+V_2+\ldots$. Standard error of Q_t is the square root of V (MacLennan and Simmonds 1992).

7.44.3.1.2. Geographical distribution patterns

No analyses were conducted during SGMED-08-04.

7.44.3.1.3. Trends in abundance and biomass

Fishery independent information regarding the state of the sardine stock in GSA 22 was derived from the acoustics surveys. Figure 7.44.3.1.3.1 displays the estimated trend in sardine Total Biomass (estimated by acoustics) for GSA 22. Figure 7.44.3.1.3.2 shows the estimated trend in sardine abundance (estimated by acoustics).

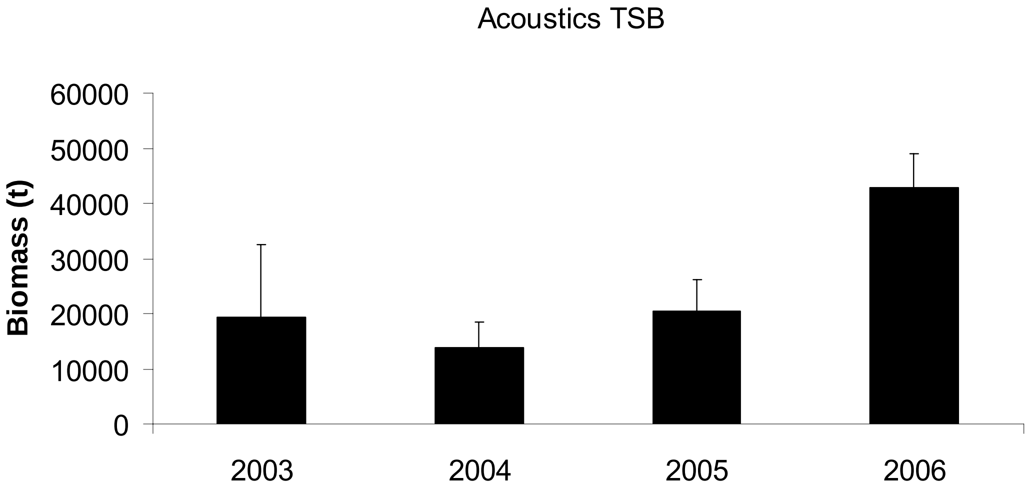


Fig. 7.44.3.1.3.1 Estimated sardine biomass indices for GSA 22, 2003-2006.

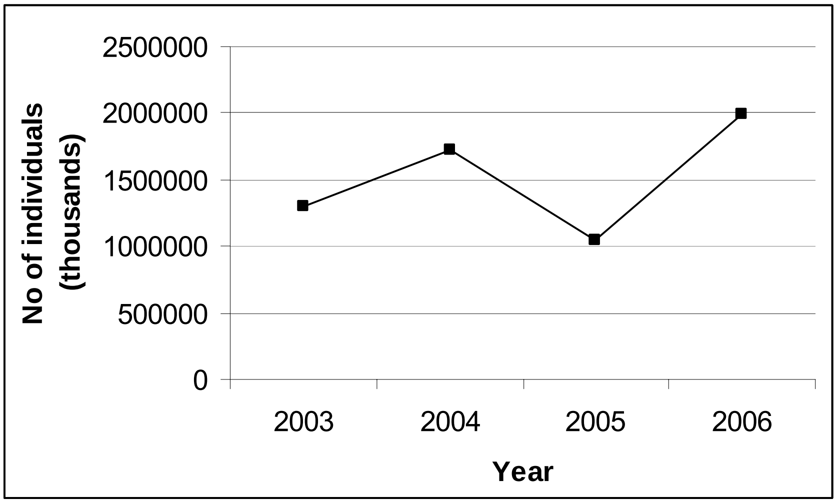


Fig. 7.44.3.1.3.2 Estimated sardine abundance indices from acoustic surveys for GSA 22, 2003-2006.

An increasing trend was observed in both biomass and abundance indices towards 2006 based on acoustic surveys estimates (Fig. 7.44.3.1.3.1, Fig. 7.44.3.1.3.2).

7.44.3.1.4. Trends in abundance by length or age

Fig. 7.44.3.1.4.1 displays the length frequency composition of the sardine stock as derived from the acoustic survey for GSA 22.

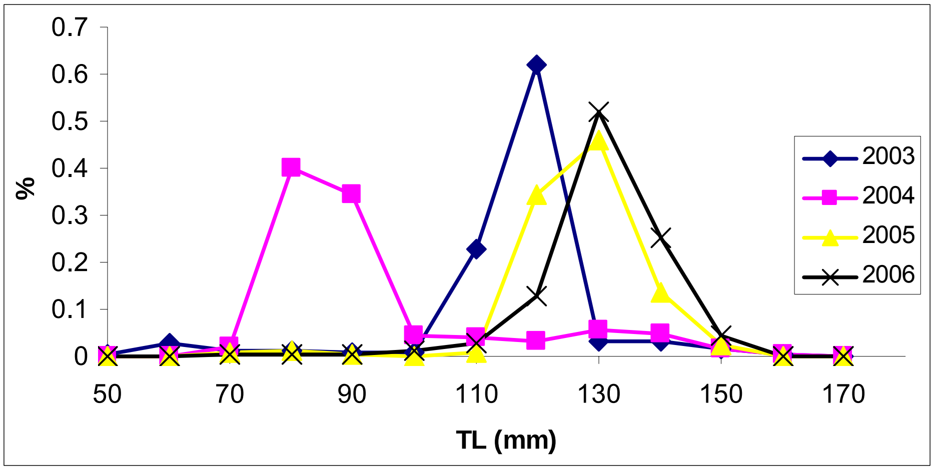


Fig. 7.44.3.1.4.1 Estimated changes in size compositions for GSA 22 for 2003-2006.

The following Fig. 7.44.3.1.4.2 and Fig. 7.44.3.1.4.3 display the abundance indices by size and age of GSA 22 in 2003-2006 from acoustic surveys.

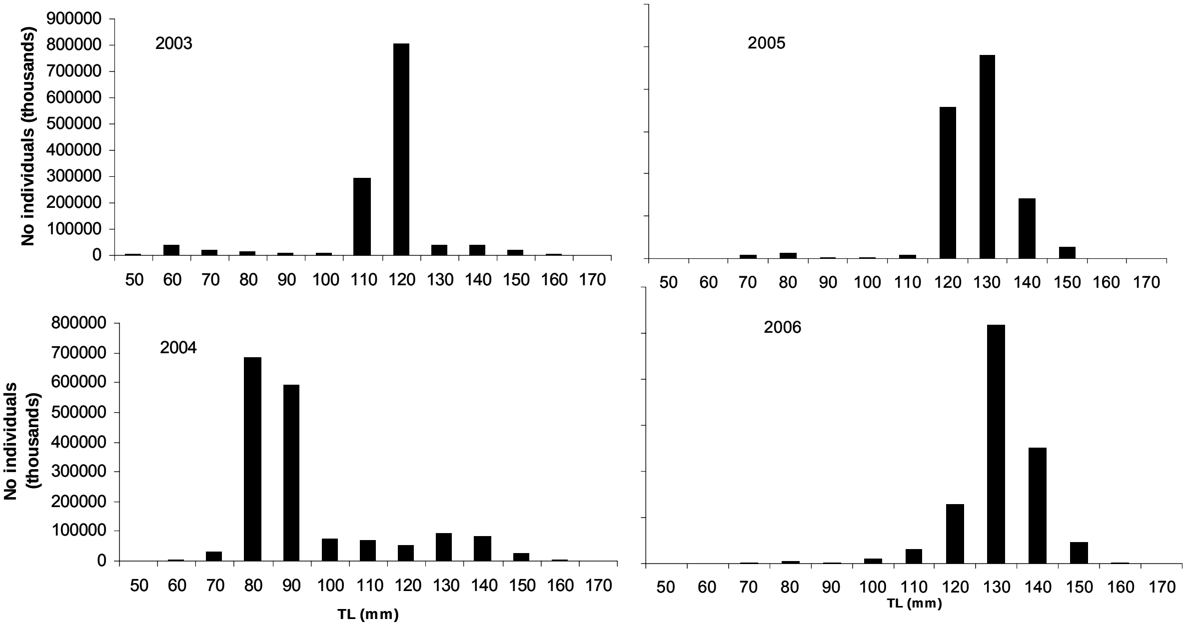


Fig. 7.44.3.1.4.2. Abundance indices by size for sardine in GSA 22 based on acoustic surveys for 2003-2006.

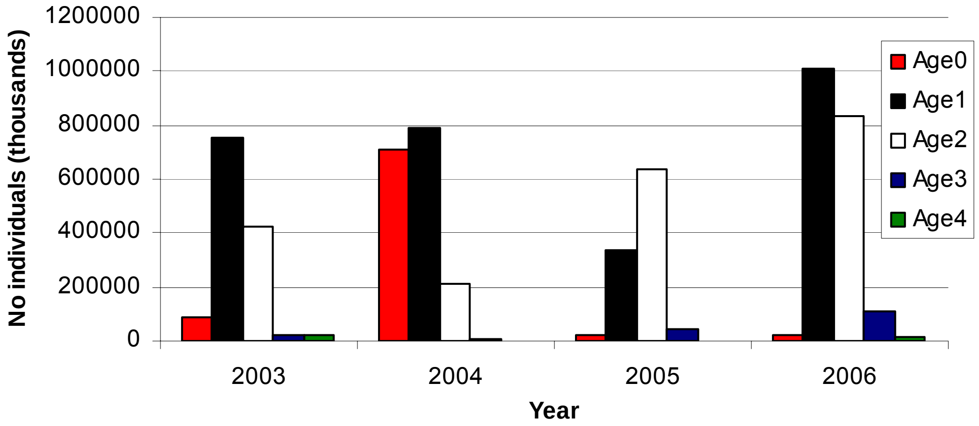


Fig. 7.44.3.1.4.3. Abundance indices by age for sardine in GSA 22 based on acoustic surveys for 2003-2006.

7.44.3.1.5. Trends in growth

No analyses were conducted during SGMED-08-04. Data supplied by member state based on the DCR data call were used in this report

7.44.3.1.6. Trends in maturity

No analyses were conducted during SGMED-08-04. Maturity ogive based on biological sampling and length at first maturity estimates were used (Table 7.449.3.1.6.1).

Table 7.44.3.1.6.1. Maturity ogive for sardine in GSA 22.

Age	2003	2004	2005	2006
0	0	0	0	0
1	0.5	0.5	0.5	0.5
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1

7.44.4. Assessment of historic stock parameters

7.44.4.1. Method: ICA

7.44.4.1.1. Justification

Integrated Catch at Age (ICA) analysis for stock assessment (Patterson and Melvin 1996; Patterson, 1998) was applied. Integrated Catch at age analysis uses separable virtual population analysis (VPA) (Pope & Shepherd, 1985) with weighted tuning indices. It was applied regarding the Aegean sardine stock within the Joint Assessment Group of the GFCM held in Izmir and the SGMED-08-04 adapted it as a review assessment. This assessment of the sardine stock in GSA22 is based on a small time series of data available, so results should be considered as precautionary. In addition Y/R analysis was applied during the SGMED-08-04.

7.44.4.1.2. Input parameters

ICA was based on commercial catch data (2000-2006) and as tuning indices were used the biomass estimates from acoustic surveys estimates over the period 2003-2006.

Sardine data concerned annual sardine landings, annual sardine catch at age data (2000-2006), mean weights at age, maturity at age and the results of acoustic and DEPM surveys (2003-2006) presented in Table 7.44.4.1.2.1 to 7.44.4.1.2.6. Reference age for the fishery was age group 2, as fully exploited and fully recruited. The age groups 0, 4 and 5 were underweighted in the analysis based on their percentage in the catch. Age 1 was also underweighted in the acoustic surveys (0.5). Linear catchability relationship was assumed for the acoustic surveys. Sensitivity analysis on natural mortality (Giannoulaki et al., 2008) has showed the same trend in biomass estimates and fishing mortality estimates independently of the natural mortality value used. Therefore, it was considered more cautious to set natural mortality constant for all ages and years at 0.8, in order to obtain a standard model run.

This natural mortality value selection was based on the numbers at age estimates obtained by acoustic surveys during two successive fully recruited years in order to obtain an initial estimate of the annual total mortality. Catchability of acoustic surveys concerning age group 1 was considered to be 0.5 to produce unbiased estimates of the abundance at age group 1. The F/Z ratio was considered constant at 0.5 based on the results of sensitivity analysis with different M (Giannoulaki *et al.*, 2008). The difference between the total mortality and the fishing mortality provided an annual estimate of the natural mortality and a subsequent mean estimate. Resulted M, was considered realistic, representative of the actual situation in the area taking into account the abundance of predators in the area and the strong dependence of the juveniles of small pelagics from environmental conditions.

Table 7.44.4.1.2.1. Catch at age (numbers in thousands) of sardine stock in GSA 22 for 2000-2006.

Year	0	1	2	3	4
2000	542000	167063000	545713000	53729000	2803000
2001	757000	271776000	593377000	47206000	2875000
2002	2112000	210186000	340393000	23117000	1662000
2003	1124000	102214000	257926000	21728000	1088000
2004	1165000	123086000	234820000	5952000	1247000
2005	629000	122114000	411857000	42586000	2264000
2006	492000	146366000	356388000	65384000	2100000

Table 7.44.4.1.2.2. Landings estimates (in t) of sardine stock in GSA 22 for 2000-2006.

Year	Sardine
2000	17052
2001	18032
2002	10832
2003	7792
2004	8169
2005	13626
2006	12784

Table 7.44.4.1.2.3. Weight at age in the catch of sardine stock (in kg) in GSA 22 for 2000-2006.

	Year						
Age	2000	2001	2002	2003	2004	2005	2006
0	0.0032	0.0108	0.0275	0.0386	0.0534	0.0032	0.0108
1	0.0047	0.0097	0.0274	0.0398	0.0938	0.0047	0.0097
2	0.0072	0.0108	0.0274	0.0386	0.0471	0.0072	0.0108
3	0.0019	0.0082	0.0274	0.0386	0.0534	0.0019	0.0082
4	0.0026	0.0042	0.0045	0.0468	0.0591	0.0026	0.0042

Table 7.44.4.1.2.4. Weight at age in the stock (in kg) of sardine stock in GSA 22 for 2000-2006.

	Year						
Age	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
0	0.0026	0.0133	0.0256	0.0408	0.0413	0.0026	0.0133
1	0.0026	0.0133	0.0256	0.0408	0.0413	0.0026	0.0133
2	0.0026	0.0133	0.0256	0.0408	0.0413	0.0026	0.0133
3	0.0032	0.0019	0.0273	0.0465	0.0206	0.0032	0.0019
4	0.0027	0.0102	0.0234	0.0409	0.0516	0.0027	0.0102

Table 7.44.4.1.2.5. Maturity ogive of sardine stock in GSA 22 for 2000-2006.

Year	**0**	**1**	**2**	**3**	**4**
2003	0	.5	1	1	1
2004	0	.5	1	1	1
2005	0	.5	1	1	1
2006	0	.5	1	1	1

Table 7.44.4.1.2.6. Age-structure indices of sardine (numbers in thousands) stock in GSA 22 for 2000-2006. Age 3 was considered a plus age group.

Age	2003	2004	2005	2006
1	752287	790094	338866	1035201
2	422307	208857	636420	859368
3+	39859	7771	44215	133311

7.44.4.1.3. Results including sensitivity analyses

The graphical diagnostics of the model are shown in Figs. 7.44.4.1.3.1 to 7.44.4.1.3.4 indicating generally showed good model fit besides year 2002 and age 4 probably because they are poorly sampled. This further justifies the down weighting of age 4 in the model. Residual plots for recent years showed no strong deviations from separability. SSQ plot (Fig. 7.44.4.1.3.5) indicated moderate consistency between the model and the indices (minima fairly close to each other on x-axis, Needle 2000).

ICA model results for sardine stock in GSA 22 are shown in Fig. 7.44.4.1.3.6, indicating an increasing trend for recruitment in 2006 as well as in biomass estimates. Fishing mortality at age 2 (reference age for the fishery) as well as F mean (ages 1to 3) shows a decrease since 2003, stabilizing in a lower level for 2004 to 2006. The landings to total biomass ratio decreases, approximating on average 15%.

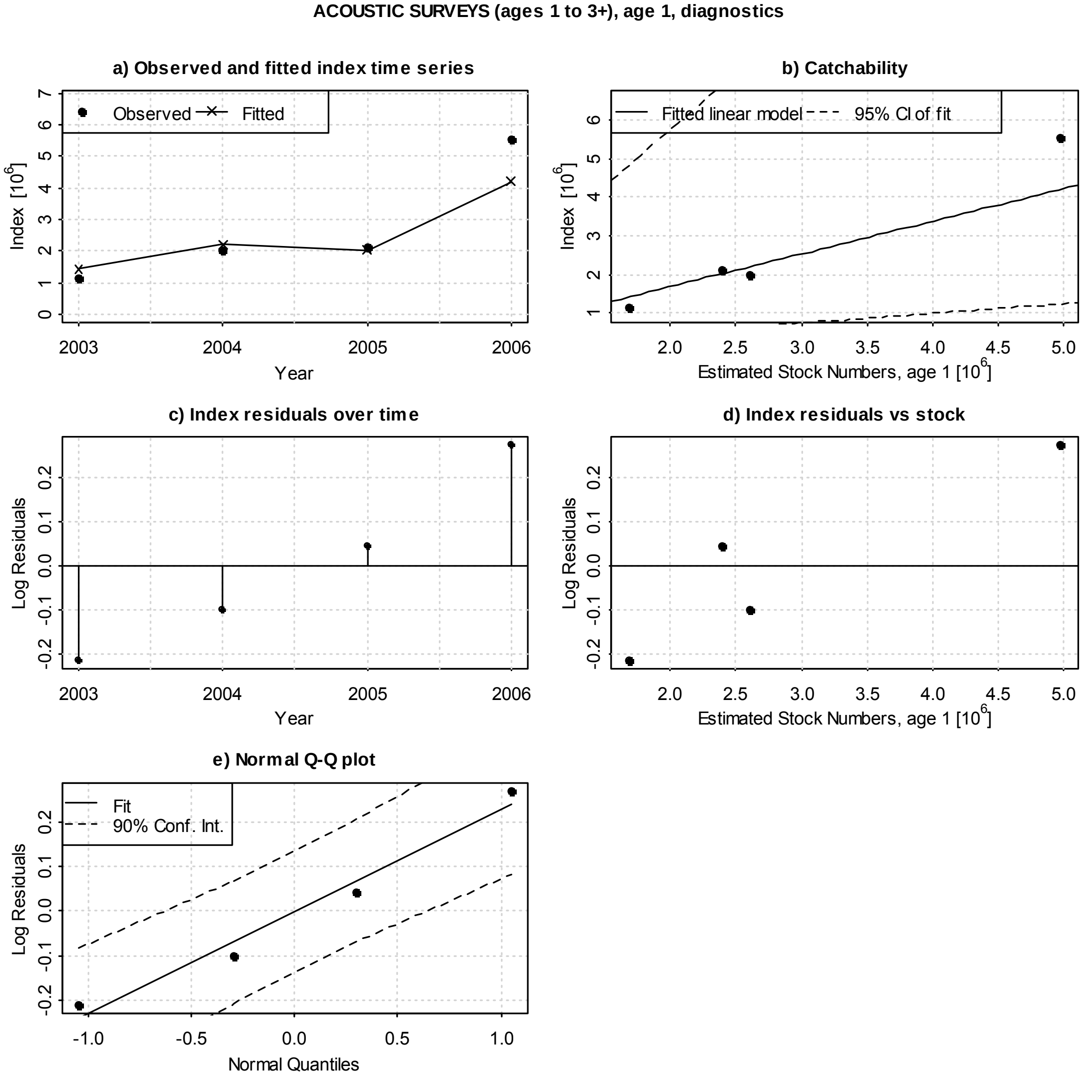


Fig. 7.44.4.1.3.1 Residual plots for age 1 indices of sardine ICA model for GSA 22 (2000-2006)

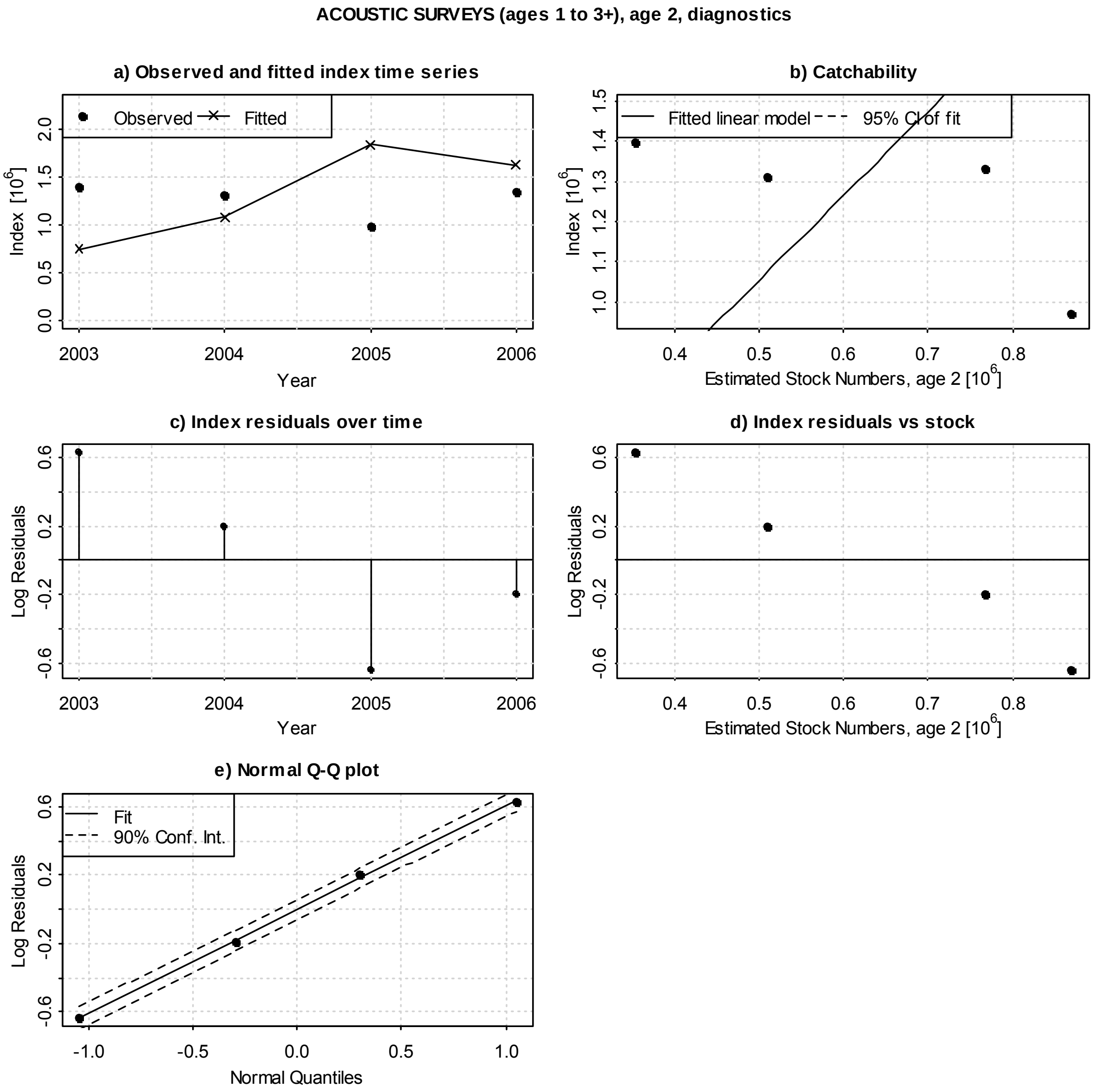


Fig. 7.44.4.1.3.2 Residual plots for age 2 indices of sardine ICA model for GSA 22 (200-2006)

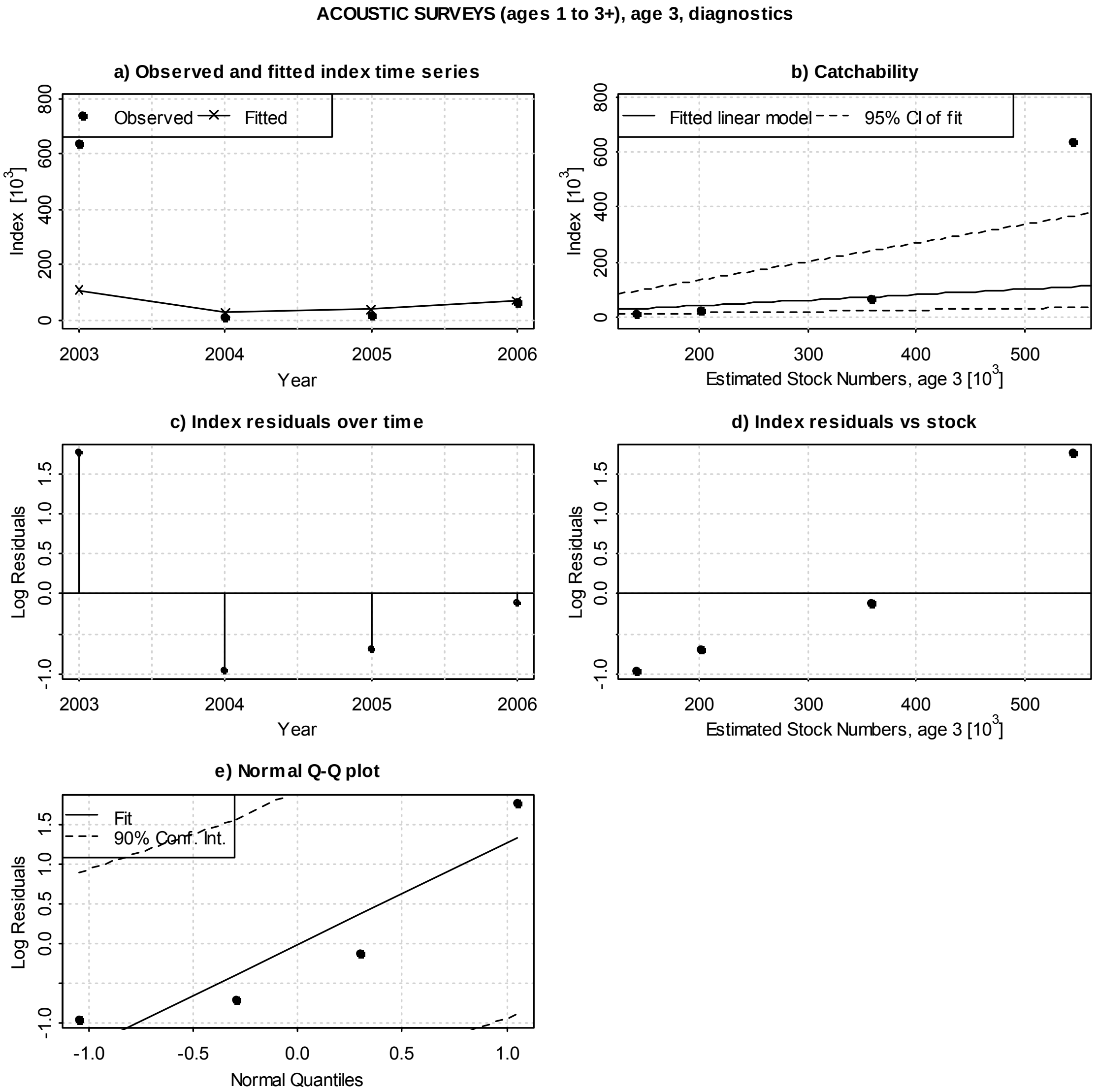


Fig. 7.44.4.1.3.3 Residual plots for age 3 indices of sardine ICA model for GSA 22 (2000-2006)

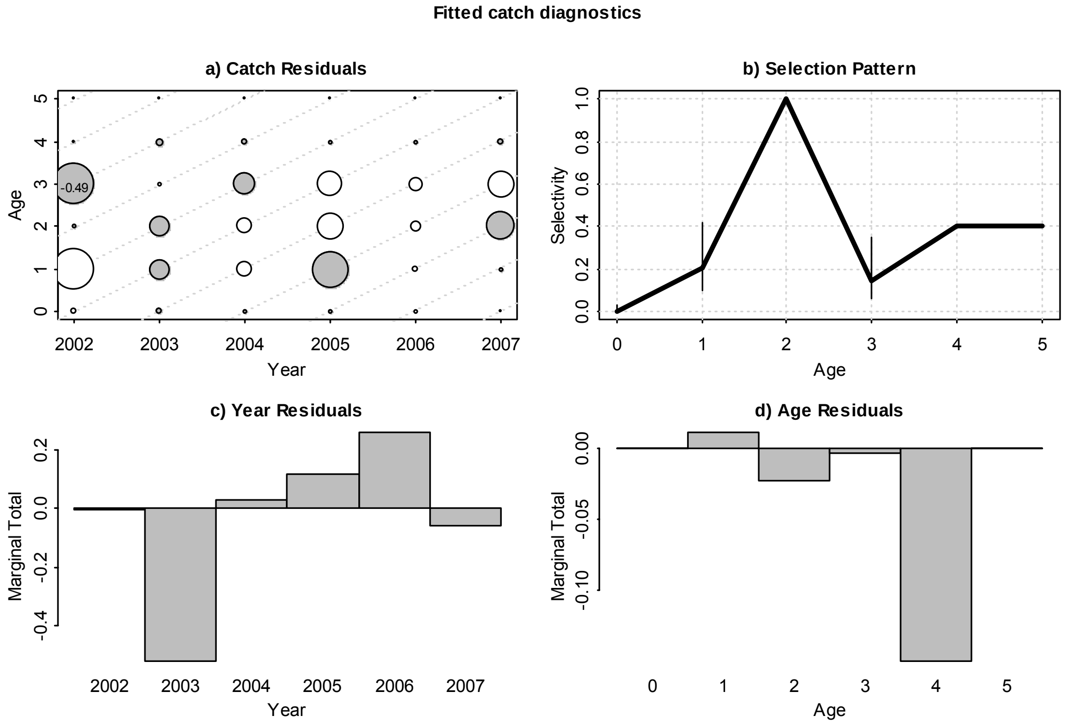


Fig. 7.44.4.1.3.4 The catch at age residuals Residual plots for catch of sardine ICA model for GSA 22 (2000-2006)

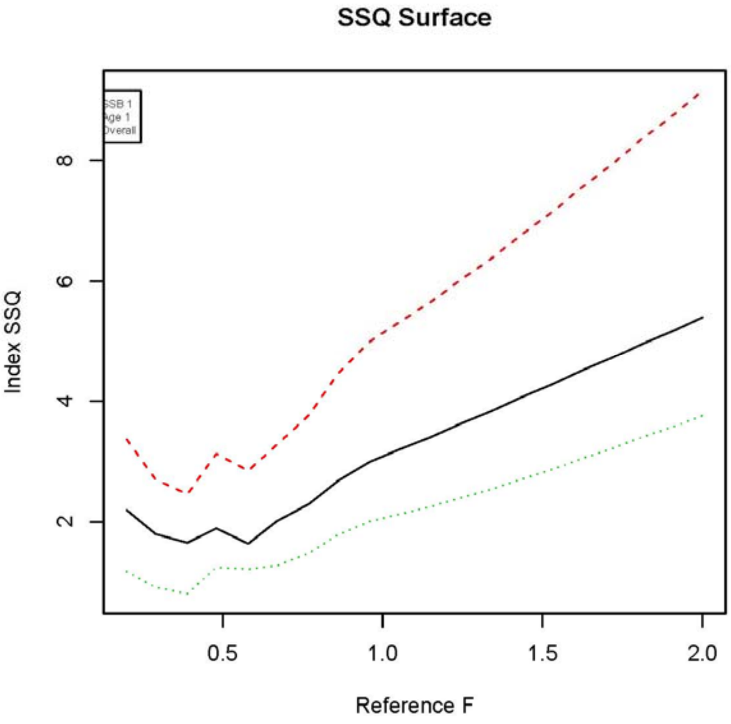


Fig. 7.44.4.1.3.5 Sardine ICA Model (M=0.8, Acoustics linear indicator). Sum of Squares (SSQ) surface plot.

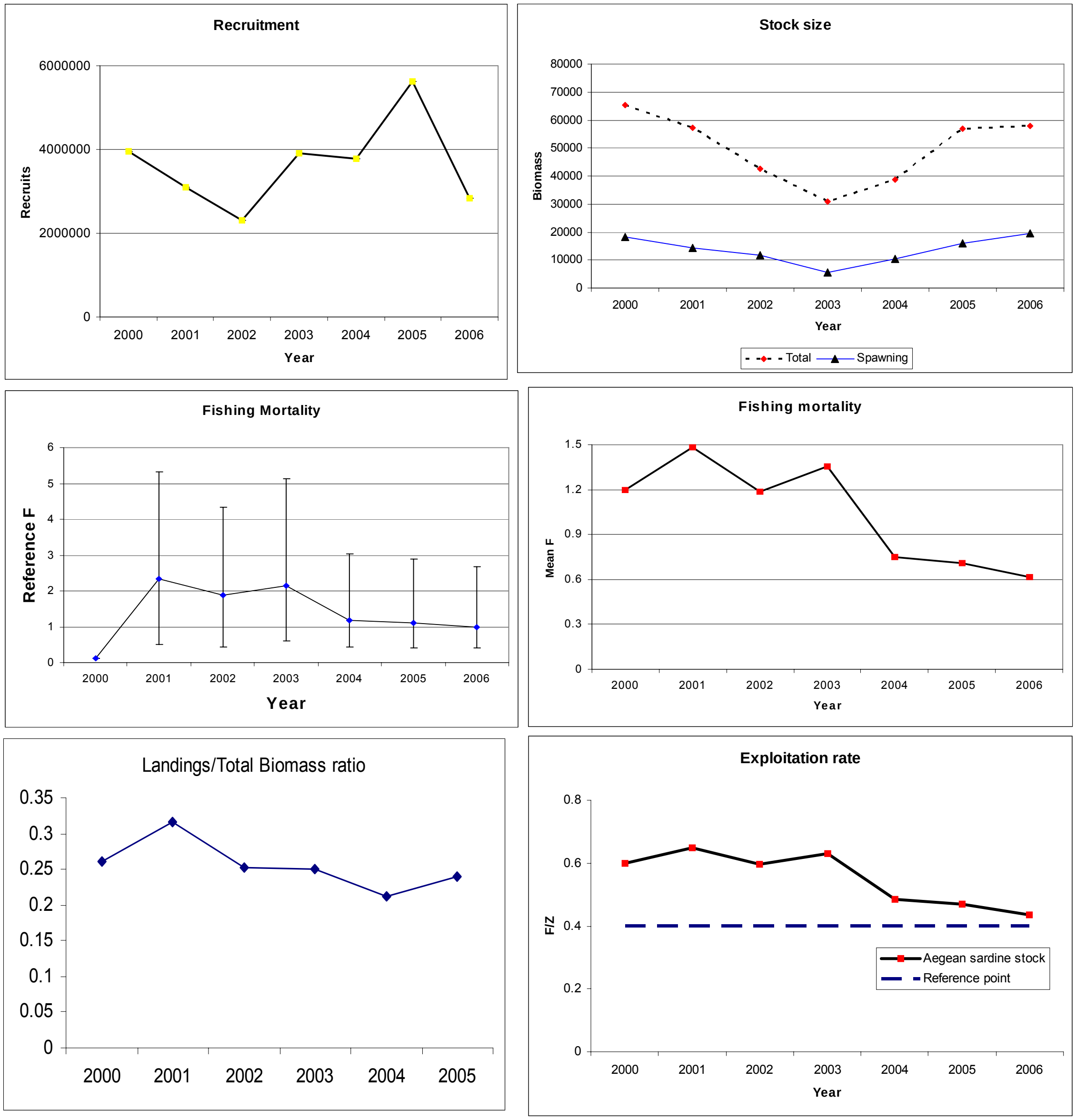


Fig. 7.44.4.1.3.6 Sardine ICA Model (M=0.8, Acoustics linear) results: Total biomass, SSB, recruitment Reference F at age 2, Fmean for ages 1-3, landings to total biomass ratio and exploitation rate (F/Z).

Retrospective analysis was applied in the ICA model for the Aegean sardine 2000-2006 with one year backward analysis. Applying the analysis with more than one year backward was not possible due to the short time series available. Results are presented in Fig. 7.44.4.1.3.7. showing no retrospective problematic estimate for last year.

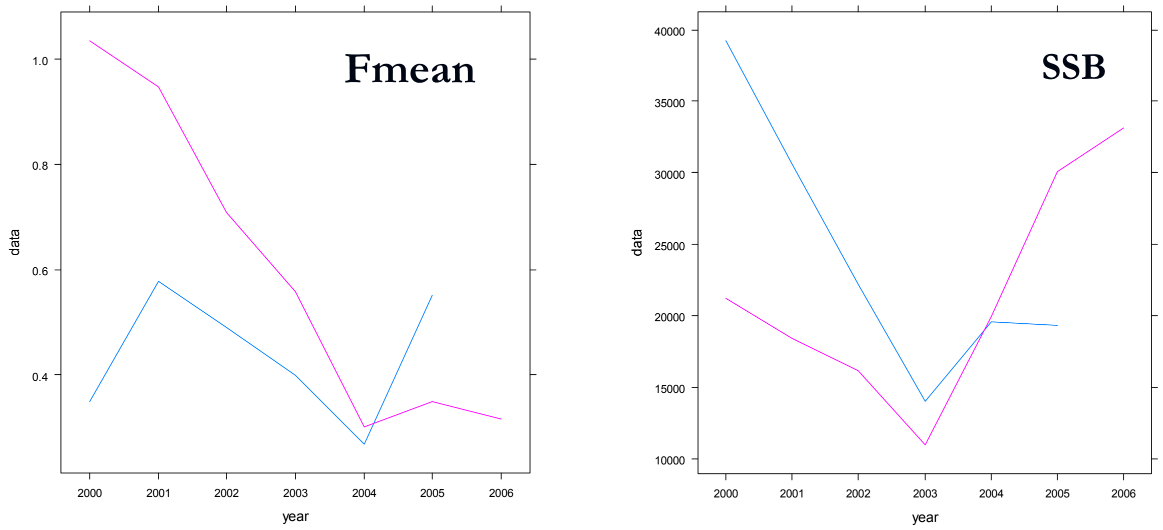


Fig. 7.44.4.1.3.7. The results of retrospective analysis in the Aegean Sea sardine ICA model 2000-2006, concerning F mean 1-3 and SSB.

7.44.5. Short term prediction for 2008 and 2009

7.44.5.1. Justification

No forecast analyses were conducted.

7.44.5.2. Input parameters

No forecast analyses were conducted.

7.44.5.3. Results

Given the small time series of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for sardine in GSA 22.

7.44.6. Medium term prediction

7.44.6.1. Justification

No forecast analyses were conducted.

7.44.6.2. Input parameters

No forecast analyses were conducted.

7.44.6.3. Results

Given the small time series of the data and analyses SGMED-08-04 is not in the position to provide a medium term prediction of catch and stock biomass for sardine in GSA 22.

7.44.7. Long term prediction

7.44.7.1. Justification

Yield per recruit analysis was conducted in the SGMED-08-04 assuming equilibrium conditions.

7.44.7.2. Input parameters

Based on the exploitation pattern resulting from the ICA model and its population parameters, yield per recruit analyses were formulated. Minimum and maximum age for the analysis were considered to be age group 0 and 4, respectively. Stock weight at age, catch weight at age and maturity ogive were estimated as mean values in a long term basis (2000-2006). Natural mortality was considered constant for all ages. Fishing mortalities were estimated in a short term basis (2004-2006). Reference F was considered to be mean F for ages 1 to 3. Input parameters are shown in Table 7.44.7.2.1.

Table 7.44.7.2.1. Input parameters for Y/R analysis

age group	stock weight	catch weight	maturity	F	M
0	0.003	0.004	0	0.0003	0.80
1	0.011	0.010	0.5	0.1045	0.80
2	0.026	0.024	1	1.0953	0.80
3	0.041	0.040	1	0.8748	0.80
4	0.041	0.057	1	0.4381	0.80

7.44.7.3. Results

Y/R analyses were performed (Fig. 7.69.7.3.1) but were not considered reliable due to its flat-topped shape. Therefore the use of $F_{0.1}$ (0.8) and F_{max} (2.8) as reference points requires further analysis before acceptance. These high values practically imply no significant SSB reduction with increasing F values. The high $F_{0.1}$ estimate also implys the current high fishing mortality being sustainable.

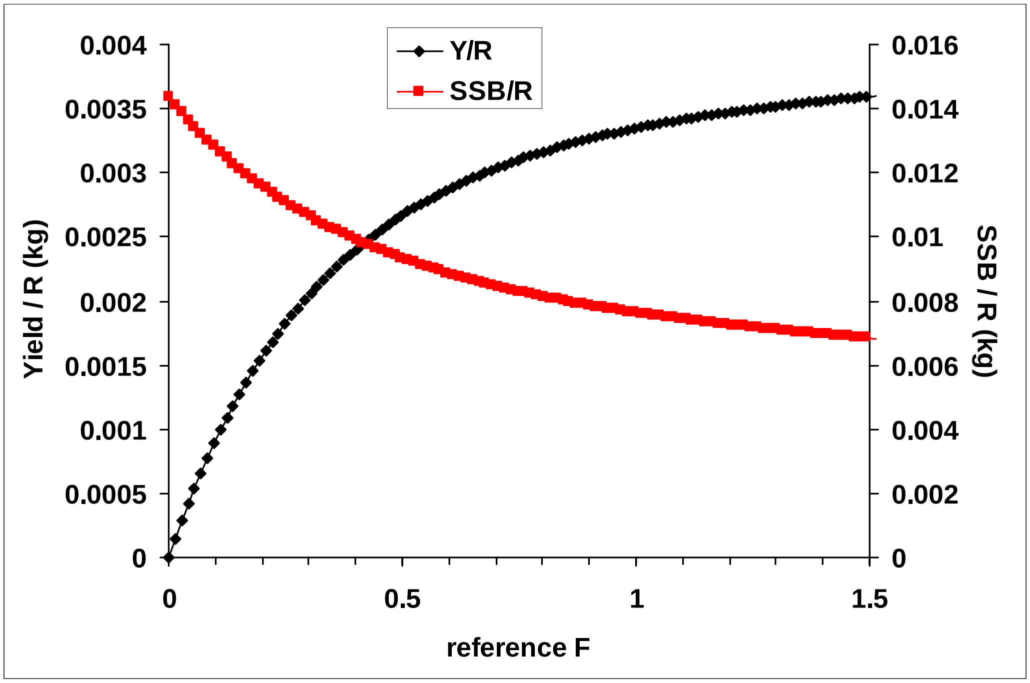


Fig. 7.44.7.3.1. Yield per recruit for the sardine stock in GSA 22.

7.44.8. Scientific advice

7.44.8.1. Short term considerations

7.44.8.1.1. State of the spawning stock size

Estimates of fishery independent surveys for sardine in GSA 22 indicated an increase concerning total biomass estimates (42856 t in 2006 estimated by acoustics). Similarly, results of the Integrated Catch at Age analysis indicated an increasing trend in total biomass and in SSB showing a slight recovery in 2006 from the 2003 lower level.

The absence of 2007 data prevents SGMED from providing any short or medium term projections of biomass.

In the absence of proposed or agreed references, SGMED-08-04 is unable to fully evaluate the state of the stock and provide scientific advice.

7.44.8.1.2. State of recruitment

ICA model estimates had showed an increase in the number of recruits towards 2005 with a decrease in 2006.

7.44.8.1.3. State of exploitation

Based on ICA results, the mean fishing mortality (averaged over ages 1 to 3) showed a clear decreasing trend, and has remained below 0.75 since 2004. The mean F/Z has declined from 2003 but remains above the empirical level of sustainability (E<0.4, Patterson 1992) for small pelagics.

Given the fact that current estimated exploitation rate is in excess of E=0.4, effort should be decreasaed so that the exploitation rate falls below this level. This requires consideration of the mixed fisheries nature of the fleets.

7.44.8.2. Medium term considerations

Fishing mortality should be reduced in order to allow future recruitment contributing to stock recovery. This requires consideration of the mixed fisheries nature of the fleets.

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9. APPENDIX 1. SGMED OVERALL TERMS OF REFERENCE

The European Community is expected to establish long-term management plans (LTMP) for relevant Mediterranean demersal and small pelagic fisheries based on precautionary approach and adaptive management in taking measures designed to protect and conserve living aquatic resources, to provide for their sustainable exploitation and to minimise the impact of fishing activities on marine eco-systems.

The plans shall include conservation reference points such as targets against which measuring the recovery to or the maintenance of stocks within safe biological limits for fisheries exploiting stocks at/or within safe biological limits (e.g. population size and/or long-term yields and/or fishing mortality rate and/or stability of catches). The management plans shall be drawn up on the basis of the precautionary approach to fisheries management and take account of limit reference points as identified by scientists. The quantitative scientific assessment should provide sufficiently precise and accurate biological and economic indicators and reference points to allow also for an adaptive management of fisheries.

Stating clearly how stocks and fisheries will be assessed and how decision will be taken is fundamental for proper and effective implementation of management plans as well as for transparency and consultations with stakeholders.

Demersal and small pelagic stocks and fisheries in the Mediterranean are evaluated both at national and GFCM level; however these evaluations are often not recurring, are spatially restricted to only some GFCM geographical sub-areas (see attached reference map), covering only partially the overall spatial range where Community fishing fleets and stocks are distributed, and address only few stocks out of several that may be exploited in the same fisheries. Limited attention is also given to technical interactions between different fishing gears exploiting the same stocks.

A limited, although fundamental, scientific contribution of EU fishery scientists to the GFCM assessment process is increasingly affecting the capacity of this regional fisheries management organization to identify harvesting strategies and control rules and to adopt precautionary and adaptive fisheries management measures based on scientific advice.

Anyhow, GFCM and most of the riparian countries consider that management measures to control the exploitation rate and fishing effort, complemented by technical measures, are the most adequate approach for multi-species and multiple-gears Mediterranean fisheries.

Nevertheless, provided that scientific advice underlines to do so, also output measures may be conceivable to manage fisheries particularly for both small pelagic and benthic fish stocks.

Coherence and certain level of harmonization between Community and multilateral framework measures are advisable for effective conservation measures and to enhance responsible management supported by all concerned Parties and stakeholders in the Mediterranean.

STECF can play an important role in focusing greater contributions of European scientists towards stocks and fisheries assessment, in identifying a common scientific framework regarding specific analyses to advise on Community plans and to be then channeled into or completed by the GFCM working groups[15].

STECF was requested at its November plenary session to set up an operational work-programme for 2008, beginning in the 1st quarter of 2008, with a view to update the status of the main demersal stocks and evaluate the exploitation levels with respect to their biological and economic production potentials and the sustainability of the stock by using both trawl surveys and commercial catch/landing data as collected through the Community Data Collection regulation N° 1543/2000 as well as other scientific information collected at national level.

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[15] STECF is requested to take into account the GFCM stock assessment forms as available at the web site http://www.gfcm.org/fishery/nems/36406/en

Within this work-programme STECF is also requested to provide its advice on the status of the main small pelagic stocks and to evaluate the exploitation levels with respect to their biological and economic production potentials and the sustainability of the stock by using both echo and/or DEPM surveys and commercial catch/landing data as collected through the Community Data Collection regulation N° 1543/2000 as well as other scientific information collected at national level.

STECF should take into consideration the data that Member States have been collecting on a regular basis both via monitoring fishing activities and carrying out direct surveys[16]. STECF, in replying at the following terms of reference, should also take into consideration chapter 7 of the 26th STECF Plenary session of 5-9 November 2007[17], as well as the report of the STECF working group on balance between fishing capacity and fishing opportunities[18].

STECF shall contribute to identify and setup an advisory framework regarding low risk adaptive management by identifying and using appropriate risk assessment methods in order to understand where we stand with respect to sustainable exploitation of ecologically and economically important stocks and what additional management actions need to be taken.

On the basis of the STECF advice the Commission will launch official data calls to EU Member States requesting submission of data collected under the Community Data Collection regulation N° 1543/2000.

STECF is requested in particular:

- to advice whether the data availability may allow the development of a precautionary conceptual framework within which develop specific harvesting strategies and decision control rules for an adaptive management of demersal and small pelagic fisheries in the Mediterranean;

- to set up a conceptual, methodological and operational assessment framework which will allow STECF to carry out in a standardized way both stocks assessment analyses and detailed reviews of assessments done by other scientific bodies in the Mediterranean. The selected assessment methods shall allow estimating indicators for measuring the current status of demersal and small pelagic fisheries and stocks, the sustainability of the exploitation and to measure progress towards higher fishing productivity (MSY or other proxy) with respect to precautionary technical/biological reference points relating to MSY or other yield-based reference points, to low risk of stock collapse and to maintaining the reproductive capacity of the stocks;

- to set up a conceptual, methodological and operational assessment framework which will allow STECF to identify economic indicators and reference points compatible with economic profitability of the main fisheries while ensuring sustainable exploitation of the stocks in the Mediterranean;

- to indicate whether age/length-based VPA or statistical catch-at –age/length methods are adequate modelling tools to estimate precautionary indicators and reference points measuring the current status and future development of multispecies/multigears Mediterranean fisheries. STECF shall also provide a conceptual and operational framework to use, if advisable, these methods for demersal and small pelagic Mediterranean fisheries;

- to identify adequate empirical modelling approaches that are adequate to estimate precautionary indicators and reference points measuring the current status and future development of multispecies/multigears Mediterranean fisheries. STECF shall also provide a conceptual and operational framework to use, if advisable, these methods for demersal and small pelagic Mediterranean fisheries;

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[16] Council Regulation (EC) No **1343/2007** of 13 November 2007 amending Regulation (EC) No 1543/2000 establishing a Community framework for the collection and management of the data needed to conduct the common fisheries policy

Commission Regulation (EC) No **1581/2004** of 27 August 2004 amending Regulation (EC) No 1639/2001 establishing the minimum and extended Community programmes for the collection of data in the fisheries sector and laying down detailed rules for the application of Council Regulation (EC) No 1543/2000

[17] http://stecf.jrc.ec.europa.eu/38

[18] Report of the STECF Working Group on The Balance between Capacity and Exploitation SGRST-SGECA-07-05 Working group convened in the margin of SGECA-SGRST-SGECA-07-02 (Review of Scientific advice II), 22-26th Oct 2007. Evaluated and endorsed at the November plenary session.

- to identify the decision-making support modelling tools that are adequate for the Mediterranean fisheries and that will produce outputs that support sustainable use of fishery resources recognizing the need for a precautionary framework in the face of uncertainty and that may allow to provide projections of alternative scenarios for short-medium and long term management guidance;

- to provide either a qualitative or quantitative understanding of the level of precision and accuracy attached to the estimation of indicators and reference points through the different modelling tools;

- to identify which decision-making support modelling tools may help in setting up stock-size dependent harvesting strategies and respective decision control rules;

- to provide information on the data and standardised format needed for each of the decision-making support modelling tool which will be used to launch official data calls under the DCR n° 1543/2000. STECF should also indicate criteria to ensure quality cross- checks of the data received upon the calls.

10. APPENDIX 2. SGMED-08-04 PARTICIPANTS LIST

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11. APPENDIX 3. SUMMARY OF THE LANDING, DISCARDS AND EFFORT DATA OBTAINED THROUGH THE DCR CALL BY GSA, COUNTRY AND SPECIES.

Table A3.1 Landings data (tons) for hake by GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
HKE	1	ESP	OTB	353	201	374	208	212	220
HKE	5	ESP	OTB	91	44	57	86	102	72
HKE	6	ESP	OTB	3195	3411	3441	3363	3864	3701
HKE	7	FRA	GNS	177	248	99	255	299	168
HKE	7	FRA	LLS	5					
HKE	7	FRA	OTB	2163	2029	1018	995	1011	1277
HKE	9	ITA	DTS	508	1148	540	1040	1180	1026
HKE	9	ITA	HOK			1	2	38	
HKE	9	ITA	PGP	154	659	626	858	1112	727
HKE	9	ITA	PMP	236	258	16	19		
HKE	9	ITA	PTS	7	15	12			
HKE	10	ITA	DTS	515	425	446	595	758	638
HKE	10	ITA	HOK			58	96	111	41
HKE	10	ITA	PGP	225	329	694	484	663	578
HKE	10	ITA	PMP	246	322	123	303	12	12
HKE	10	ITA	PTS	27	21	17	7		
HKE	11	ITA	DTS	167	592	597	768	595	447
HKE	11	ITA	PGP	4	26	114	160	229	103
HKE	11	ITA	PMP	190	279				
HKE	15	MLT	[LHP] [LHM]				0		
HKE	15	MLT	[SB] [SV]						0
HKE	15	MLT	GNS				0		
HKE	15	MLT	GTR				0	0	0
HKE	15	MLT	LA						1
HKE	15	MLT	LLD				0		0
HKE	15	MLT	LLS				2	1	2
HKE	15	MLT	LTL				0		
HKE	15	MLT	OTB				4	5	6
HKE	15	MLT	Other gear				0		
HKE	16	ITA	DTS	1716	1960	1927	1713	1597	1599
HKE	16	ITA	HOK			22	9	2	9
HKE	16	ITA	PGP	92	12		67	27	111
HKE	16	ITA	PMP	52	23				
HKE	16	ITA	PTS	13	18	0	1		0
HKE	17	ITA	DRB	56				0	
HKE	17	ITA	DTS	2339	2387	2884	3403	4212	3586
HKE	17	ITA	PGP	1	7	57	45	55	28
HKE	17	ITA	PMP	216	179	6	34		
HKE	17	ITA	PTS	26	33	12	12	1	1
HKE	17	ITA	TBB			86	115	128	150
HKE	18	ITA	DTS	2006	2899	2798	3275	4613	3497
HKE	18	ITA	HOK			140	439	721	607
HKE	18	ITA	PGP	26	199	175	70	172	51
HKE	18	ITA	PMP	277	1353	84			
HKE	18	ITA	PTS			7			
HKE	19	ITA	DTS	688	668	852	1077	1330	572
HKE	19	ITA	HOK			139	72	81	54
HKE	19	ITA	PGP	263	367	145	122	218	257
HKE	19	ITA	PMP	390	478	163	1		
HKE	19	ITA	PTS	16	1				
HKE	20	GRE	GNS		1370	2796	3195	2568	
HKE	20	GRE	LLS		73	295	207	199	
HKE	20	GRE	OTB		307	403	515	753	
HKE	20	GRE	SV		11	3	0		
HKE	22	GRE	GNS		1793	2732	3187	3771	
HKE	22	GRE	LLS		712	1305	1460	1469	
HKE	22	GRE	OTB		2443	3572	3856	3821	
HKE	22	GRE	SV		13	4	7	15	
HKE	25	CYP	GTR				0	0	0
HKE	25	CYP	LLS				1	2	1
HKE	25	CYP	OTB				1	1	2

Table A3.2 Landings data (tons) for red mullet by GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
MUT	1	ESP	OTB	68	81	109	94	109	138
MUT	5	ESP	OTB	14	11	20	13	11	14
MUT	6	ESP	OTB	1159	1004	958	1027	1437	1232
MUT	7	FRA	OTB					183	172
MUT	9	ITA	DTS	454	839	514	682	1033	1075
MUT	9	ITA	HOK				2		
MUT	9	ITA	PGP	14	44	49	28	17	22
MUT	9	ITA	PMP	150	174	16	3		
MUT	9	ITA	PTS	3	7	4			
MUT	10	ITA	DTS	446	265	370	249	289	265
MUT	10	ITA	HOK			2		0	
MUT	10	ITA	PGP	195	83	110	116	104	237
MUT	10	ITA	PMP	189	71	41	56		0
MUT	10	ITA	PTS	10		1			
MUT	11	ITA	DTS	38	253	333	264	244	345
MUT	11	ITA	PGP	0		14	1	18	9
MUT	11	ITA	PMP	77	68				
MUT	15	MLT	GTR						0
MUT	15	MLT	OTB				2	7	0
MUT	16	ITA	DTS	1924	3306	1541	1340	1086	1343
MUT	16	ITA	HOK			27	37	1	
MUT	16	ITA	PGP	169	27	58	29	37	37
MUT	16	ITA	PMP	52	47	0			
MUT	16	ITA	PTS	4	4				0
MUT	17	ITA	DRB	29					
MUT	17	ITA	DTS	2475	2394	3620	3553	3180	3357
MUT	17	ITA	PGP	209	214	153	45	12	7
MUT	17	ITA	PMP	374	487	27	14		
MUT	17	ITA	PTS	11	16	4	5	1	
MUT	17	ITA	TBB			80	79	33	61
MUT	18	ITA	DTS	3114	1750	1817	1350	1804	1680
MUT	18	ITA	HOK				0		
MUT	18	ITA	PGP	90	312	205	99	130	123
MUT	18	ITA	PMP	1707	308	40			
MUT	18	ITA	PTS			2			
MUT	19	ITA	DTS	782	427	321	294	566	288
MUT	19	ITA	HOK			69	70		
MUT	19	ITA	PGP	243	1152	508	747	321	253
MUT	19	ITA	PMP	1242	870	53	2		
MUT	19	ITA	PTS	6	2				
MUT	20	GRE	GNS		2103	722	513	432	
MUT	20	GRE	OTB		163	179	225	153	
MUT	20	GRE	SV		86	26	36	24	
MUT	22	GRE	GNS		2364	1125	1587	1688	
MUT	22	GRE	OTB		1769	2152	1679	1179	
MUT	22	GRE	SV		184	166	285	218	
MUT	25	CYP	GTR				25	18	25
MUT	25	CYP	OTB				18	16	23

Table A3.3 Landings data (tons) for pink shrimp by GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DPS	1	ESP	OTB	173	123	117	81	37	58
DPS	5	ESP	OTB	36	22	6	2	1	1
DPS	6	ESP	OTB	380	190	117	63	49	41
DPS	9	ITA	DTS	133	308	367	430	462	215
DPS	9	ITA	PGP		3	8	1		2
DPS	9	ITA	PMP	19	12	0			
DPS	9	ITA	PTS	9	0	1			
DPS	10	ITA	DTS	1452	416	488	695	1086	533
DPS	10	ITA	HOK			0		1	
DPS	10	ITA	PGP	2		0	0	1	
DPS	10	ITA	PMP	373	71	63	80	1	2
DPS	10	ITA	PTS	34		0			
DPS	11	ITA	DTS	38	13	232	551	124	79
DPS	11	ITA	PGP	1			1	6	
DPS	11	ITA	PMP	47					
DPS	15	MLT	LA						1
DPS	15	MLT	OTB				1	11	7
DPS	16	ITA	DTS	7463	7388	6606	8355	8455	5966
DPS	16	ITA	HOK			57	224		0
DPS	16	ITA	PGP	1	23	2		1	
DPS	16	ITA	PMP	101					
DPS	16	ITA	PTS	20	55		5		
DPS	17	ITA	DRB	6					
DPS	17	ITA	DTS	49	49	58	77	67	67
DPS	17	ITA	PGP	1				1	
DPS	17	ITA	PMP	3		0			
DPS	17	ITA	PTS	25	1	0	1		
DPS	17	ITA	TBB			4	4	1	
DPS	18	ITA	DTS	903	1253	1742	1181	1473	863
DPS	18	ITA	PGP		67	95			
DPS	18	ITA	PMP	244	496	20			
DPS	18	ITA	PTS			0			
DPS	19	ITA	DTS	738	646	1037	1242	1245	608
DPS	19	ITA	HOK			34			
DPS	19	ITA	PGP	3		77	1		
DPS	19	ITA	PMP	365	745	53	1		
DPS	19	ITA	PTS	20					
DPS	20	GRE	GNS		4	3	7	13	
DPS	20	GRE	OTB		272	418	93	306	
DPS	20	GRE	SV		5				
DPS	22	GRE	GNS		206	97	71	123	
DPS	22	GRE	OTB		865	3257	3925	4052	

Table A3.4 Landings data (tons) for anchovy by GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
ANE	1	ESP	PS	3268	245	746	518	637	245
ANE	5	ESP	PS	6	14	13	18	17	1
ANE	6	ESP	PS	14338	8538	8097	6216	3096	2570
ANE	7	FRA	OTB		271	1063	204	83	285
ANE	7	FRA	OTM		6803	3435	2045	2042	3823
ANE	9	ITA	DTS	36	43				
ANE	9	ITA	GNS			2	27	13	16
ANE	9	ITA	LLD					3	
ANE	9	ITA	MIS			0			
ANE	9	ITA	OTB			59	119	81	84
ANE	9	ITA	PGP	13	59				
ANE	9	ITA	PMP	55	465				
ANE	9	ITA	PS			1432	1956	3616	2193
ANE	9	ITA	PTS	7071	4263				
ANE	9	ITA	SV				5		
ANE	10	ITA	DTS	49	24				
ANE	10	ITA	GND			128	197	111	87
ANE	10	ITA	GNS				2		
ANE	10	ITA	GTR				8	1	
ANE	10	ITA	MIS				4	9	
ANE	10	ITA	OTB			63	37	85	37
ANE	10	ITA	PGP	569	18				
ANE	10	ITA	PMP	483	96				
ANE	10	ITA	PS			3298	4437	8170	3875
ANE	10	ITA	PTS	2153	1270				
ANE	10	ITA	SV					2	2
ANE	11	ITA	OTB				0		1
ANE	11	ITA	PGP	18					
ANE	11	ITA	PMP	38					
ANE	11	ITA	PS			18			
ANE	16	ITA	DTS	381	0				
ANE	16	ITA	OTB				0	33	3
ANE	16	ITA	PGP	582					
ANE	16	ITA	PMP	473	239				
ANE	16	ITA	PS			2789	2606	3177	2022
ANE	16	ITA	PTM				413	842	896
ANE	16	ITA	PTS	2729	2852				
ANE	17	ITA	DTS	492	170				
ANE	17	ITA	FPO			0			1
ANE	17	ITA	FYK			0	0		
ANE	17	ITA	GNS			0			
ANE	17	ITA	MIS			11	8		15
ANE	17	ITA	OTB			3368	1563	386	105
ANE	17	ITA	PGP	27	224				
ANE	17	ITA	PMP	2025	153				
ANE	17	ITA	PS			4185	1215	8338	5626
ANE	17	ITA	PTM			28604	35008	34897	32604
ANE	17	ITA	PTS	17487	29498				
ANE	17	ITA	TBB			45	39		0
ANE	18	ITA	DTS	36	37				
ANE	18	ITA	OTB			28	23	72	38
ANE	18	ITA	PMP	1	71				
ANE	18	ITA	PS			5066	6086	4680	3868
ANE	18	ITA	PTM			7821	4927	11223	8912
ANE	18	ITA	PTS	13977	12085				
ANE	19	ITA	DTS	46	34				
ANE	19	ITA	GND			270	363	554	186
ANE	19	ITA	OTB				2		
ANE	19	ITA	PGP	455	185				
ANE	19	ITA	PMP	953	1236				
ANE	19	ITA	PS			1412	1873	1731	646
ANE	19	ITA	PTM					6	
ANE	19	ITA	PTS	1037	351				
ANE	19	ITA	SV			0	2	6	
ANE	20	GRE	PS		1820	108	924	628	
ANE	22	GRE	PS		14002	16099	16347	22311	

Table A3.5 Landings data (tons) for sardine by GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
PIL	1	ESP	PS	5348	8244	3964	7208	10002	6766
PIL	5	ESP	PS	477	280	152	67	71	30
PIL	6	ESP	PS	18762	20817	24874	22081	29381	23984
PIL	7	FRA	OTB		557	812	926	665	1261
PIL	7	FRA	OTM		6555	6682	8546	10306	11996
PIL	9	ITA	DTS	18	37				
PIL	9	ITA	GNS			0	1	1	0
PIL	9	ITA	GTR			0			
PIL	9	ITA	MIS			1			
PIL	9	ITA	OTB			71	98	43	41
PIL	9	ITA	PGP		13				
PIL	9	ITA	PMP	15	117				
PIL	9	ITA	PS			4486	2967	4337	5112
PIL	9	ITA	PTS	3110	4016				
PIL	9	ITA	SV			26			
PIL	10	ITA	DTS	43					
PIL	10	ITA	GND					84	64
PIL	10	ITA	GTR				14	2	
PIL	10	ITA	MIS				9		
PIL	10	ITA	OTB			22	12	6	4
PIL	10	ITA	PGP	225	62				
PIL	10	ITA	PMP	363	754				
PIL	10	ITA	PS			3796	1615	1720	1439
PIL	10	ITA	PTS	1245	1261				
PIL	11	ITA	OTB				1	0	1
PIL	11	ITA	PGP	5					
PIL	11	ITA	PMP	11					
PIL	11	ITA	PS			27			
PIL	15	MLT	PS					2856	526
PIL	16	ITA	DTS	239	1				
PIL	16	ITA	OTB			1	14	9	6
PIL	16	ITA	PGP	153					
PIL	16	ITA	PMP	209					
PIL	16	ITA	PS			889	904	1717	1559
PIL	16	ITA	PTM				332	500	610
PIL	16	ITA	PTS	1664	1184				
PIL	17	ITA	DTS	435	95				
PIL	17	ITA	GNS			0	2	8	0
PIL	17	ITA	MIS					0	1
PIL	17	ITA	OTB			318	251	160	87
PIL	17	ITA	PGP	7	128				
PIL	17	ITA	PMP	1706	133				
PIL	17	ITA	PS			1214	304	261	412
PIL	17	ITA	PTM			6019	2807	2718	3454
PIL	17	ITA	PTS	13709	12560				
PIL	17	ITA	TBB			9	0	0	
PIL	18	ITA	DTS	0	5				
PIL	18	ITA	GNS					15	
PIL	18	ITA	GTR					1	
PIL	18	ITA	OTB			4	23	47	33
PIL	18	ITA	PGP		0				
PIL	18	ITA	PMP		8				
PIL	18	ITA	PS			995	157	81	88
PIL	18	ITA	PTM			1962	751	568	715
PIL	18	ITA	PTS	3329	2403				
PIL	19	ITA	DTS	37	54				
PIL	19	ITA	GND			35		148	31
PIL	19	ITA	GTR			6			
PIL	19	ITA	OTB				24		0
PIL	19	ITA	PGP	215	33				
PIL	19	ITA	PMP	398	1358				
PIL	19	ITA	PS			2541	1286	1186	472
PIL	19	ITA	PTM					9	
PIL	19	ITA	PTS	542	404				
PIL	19	ITA	SB					39	6
PIL	19	ITA	SV				5	0	
PIL	20	GRE	PS		1862	734	1925	1377	
PIL	22	GRE	PS		7792	8169	13626	12784	

Table A3.6 Discards data (tons) by species and GSA.

SPECIES	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
ANE	1	ESP	PS				0	0	
ANE	6	ESP	PS			17			
ANE	7	FRA	OTM						61
DPS	1	ESP	OTB				1		
DPS	5	ESP	OTB	0	0		0		
DPS	6	ESP	OTB				0		
DPS	9	ITA	OTB					9	
DPS	10	ITA	OTB					1	
DPS	16	ITA	OTB					25	
DPS	19	ITA	OTB					4	
DPS	20	GRE	OTB		441	15	6		
DPS	22	GRE	OTB		83	455	188		
DPS	25	CYP	OTB					0	
HKE	1	ESP	OTB				6		
HKE	5	ESP	OTB	10	5		6		
HKE	6	ESP	GNS						0
HKE	6	ESP	OTB				80		
HKE	7	FRA	GNS			7			
HKE	7	FRA	OTB		16		33	56	31
HKE	9	ITA	OTB					467	
HKE	10	ITA	OTB					6	
HKE	11	ITA	LLS				15		
HKE	11	ITA	OTB					63	
HKE	16	ITA	OTB					54	
HKE	17	ITA	OTB					70	
HKE	19	ITA	OTB					10	
HKE	20	GRE	GNS				679		
HKE	20	GRE	OTB		28	20	42		
HKE	22	GRE	GNS		0	9	179		
HKE	22	GRE	OTB		147	244	360		
HKE	25	CYP	OTB					0	
MUT	1	ESP	OTB				0		
MUT	5	ESP	OTB	0	0		0		
MUT	6	ESP	GTR						0
MUT	6	ESP	OTB				9		
MUT	7	FRA	OTB						8
MUT	9	ITA	OTB					158	
MUT	10	ITA	OTB					3	
MUT	11	ITA	OTB					7	
MUT	16	ITA	OTB					94	
MUT	17	ITA	OTB					147	
MUT	19	ITA	GTR				7		
MUT	19	ITA	OTB					0	
MUT	20	GRE	GNS		38	3	38		
MUT	20	GRE	OTB		6	3	0		
MUT	22	GRE	GNS		0	6	21		
MUT	22	GRE	OTB		70	6	20		
MUT	25	CYP	OTB					0	
PIL	1	ESP	PS				115	71	
PIL	6	ESP	PS			383			
PIL	7	FRA	OTM						90

Table A3.7 Effort in days by GSA and fleet.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	1	ESP	GND					5	
DAYS	1	ESP	GTR		4			3	4
DAYS	1	ESP	LA	11	5	1		11	9
DAYS	1	ESP	LH					4	54
DAYS	1	ESP	LLD				1	1	
DAYS	1	ESP	LLS		3	1		7	8
DAYS	1	ESP	OTB	322	251	164	126	162	208
DAYS	1	ESP	PS	4035	4497	3662	3954	4568	4071
DAYS	1	ESP	PTM			2			
DAYS	1	ESP	SPR					6	
DAYS	10	ITA	DRB	658	205	830	1776	1985	1040
DAYS	10	ITA	DTS	37949	38134	44087	46547	43848	40724
DAYS	10	ITA	HOK			20929	20418	8064	7043
DAYS	10	ITA	PEL				11206	9332	8189
DAYS	10	ITA	PGP	357895	311474	325523	268441	346849	311693
DAYS	10	ITA	PMP	105705	143062	62225	64177	10532	7261
DAYS	10	ITA	PTS	8258	9780	11792			
DAYS	11	ITA	DTS	14539	18957	28840	31993	26532	27374
DAYS	11	ITA	PGP	102826	126272	165945	151720	156269	155243
DAYS	11	ITA	PMP	57543	30879				
DAYS	15	MLT	[LHP] [LHM]				28		
DAYS	15	MLT	[SB] [SV]					73	59
DAYS	15	MLT	GNS				51		
DAYS	15	MLT	GTR				200	152	320
DAYS	15	MLT	LA					1117	1096
DAYS	15	MLT	LLD				3164	3159	2827
DAYS	15	MLT	LLS				1197	1466	1624
DAYS	15	MLT	LTL				263		
DAYS	15	MLT	OTB				421	404	688
DAYS	15	MLT	Other gear				64		
DAYS	15	MLT	PS					3	1
DAYS	16	ITA	DTS	87300	76233	81853	82557	89319	89164
DAYS	16	ITA	HOK			14856	11450	10272	9284
DAYS	16	ITA	OTM						3214
DAYS	16	ITA	PEL				5476	7926	2549
DAYS	16	ITA	PGP	146019	118660	118425	97285	85556	85298
DAYS	16	ITA	PMP	26655	34956	6939			
DAYS	16	ITA	PTS	8778	8568	4899			
DAYS	17	ITA	DRB	58297	69126	64120	54047	59099	70261
DAYS	17	ITA	DTS	124529	125106	134776	126013	114903	102270
DAYS	17	ITA	HOK			641	595	610	487
DAYS	17	ITA	OTM				17647	18353	13670
DAYS	17	ITA	PEL				4806	4752	4142
DAYS	17	ITA	PGP	335599	272040	287886	260459	233846	217661
DAYS	17	ITA	PMP	96386	98110	15512	12743		
DAYS	17	ITA	PTS	23522	25649	23387			
DAYS	17	ITA	TBB			12395	13166	12440	10901
DAYS	18	ITA	DRB	11081	5890	3865	5776	7562	8132
DAYS	18	ITA	DTS	85424	71203	80259	84207	88418	73637

Table A3.7 continued.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
DAYS	18	ITA	HOK			1799	3053	4397	3190
DAYS	18	ITA	OTM				2798	4010	3597
DAYS	18	ITA	PEL				1629	1280	972
DAYS	18	ITA	PGP	110621	63332	67232	80648	88583	68253
DAYS	18	ITA	PMP	53475	35980	3667			
DAYS	18	ITA	PTS	4140	4526	4679			
DAYS	19	ITA	DTS	31381	31586	37234	42413	42976	40423
DAYS	19	ITA	HOK			39190	43898	25644	17695
DAYS	19	ITA	PEL				5554	5507	3349
DAYS	19	ITA	PGP	233718	254881	225109	193806	217447	168411
DAYS	19	ITA	PMP	100208	122225	20325	6905		
DAYS	19	ITA	PTS	3458	7302	6605			
DAYS	20	GRE	GNS		717773	634540	655783	588850	
DAYS	20	GRE	LLS		114160	79657	84159	73790	
DAYS	20	GRE	OTB		7810	7284	6279	6682	
DAYS	20	GRE	PS		5386	4646	6132	5559	
DAYS	20	GRE	SV		13429	10902	10883	11363	
DAYS	22	GRE	GNS		1499507	1445880	1529002	1479134	
DAYS	22	GRE	LLS		381095	295005	315854	253335	
DAYS	22	GRE	OTB		52536	53389	56580	52831	
DAYS	22	GRE	SV		36266	31987	33200	30098	
DAYS	22+23	GRE	PS		44481	43772	48211	42874	
DAYS	25	CYP	GTR				84706	89375	100103
DAYS	25	CYP	LLS				306	378	407
DAYS	25	CYP	OTB				1018	726	752
DAYS	5	ESP	OTB	231	237	226	107	74	31
DAYS	5	ESP	PS	157	161	140	64	82	37
DAYS	6	ESP	GNS	4					1
DAYS	6	ESP	GTR	3		19	2	19	26
DAYS	6	ESP	LA	2678	3284	52			
DAYS	6	ESP	LLD				1		
DAYS	6	ESP	LLS	3			1	1	2
DAYS	6	ESP	OTB	8529	7910	7218	6065	6482	7017
DAYS	6	ESP	OTM	38	4	8	1	1	2
DAYS	6	ESP	OTT			3			3
DAYS	6	ESP	PS	12614	11199	15301	12959	13721	12248
DAYS	7	FRA	GNS			81460	76785	93193	
DAYS	7	FRA	LLS			6459	6593	5028	
DAYS	7	FRA	OTB			20561	19327	16104	
DAYS	7	FRA	OTM			7559	9112	14040	
DAYS	9	ITA	DRB	1856	3332	2660	2635	3182	2177
DAYS	9	ITA	DTS	62616	63331	64870	65657	63141	61710
DAYS	9	ITA	HOK			2568	1921	1821	
DAYS	9	ITA	PEL				4739	5242	4672
DAYS	9	ITA	PGP	212455	182159	196758	189052	183435	175888
DAYS	9	ITA	PMP	52193	75479	16960	6655		
DAYS	9	ITA	PTS	5453	6242	4728			

Table A3.8 Effort in GT*days by GSA and fleet.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
GT*DAYS	1	ESP	GND					32	
GT*DAYS	1	ESP	GTR		40			19	16
GT*DAYS	1	ESP	LA	434	197	39		342	264
GT*DAYS	1	ESP	LH					168	1905
GT*DAYS	1	ESP	LLD				88	61	
GT*DAYS	1	ESP	LLS		43	14		66	180
GT*DAYS	1	ESP	OTB	28128	20308	13732	8751	9376	14130
GT*DAYS	1	ESP	PS	99893	104193	78379	93080	115278	106895
GT*DAYS	1	ESP	PTM			50			
GT*DAYS	1	ESP	SPR					187	
GT*DAYS	10	ITA	DRB			7968	17128	19136	9939
GT*DAYS	10	ITA	DTS			1337882	1622062	1331071	1266460
GT*DAYS	10	ITA	HOK			157882	143835	103111	82342
GT*DAYS	10	ITA	PEL				855243	689570	547879
GT*DAYS	10	ITA	PGP			661958	534880	800036	693057
GT*DAYS	10	ITA	PMP			336053	333845	152717	110850
GT*DAYS	10	ITA	PTS	482834	536460	390096			
GT*DAYS	11	ITA	DTS			1598912	1881952	1437559	1486500
GT*DAYS	11	ITA	PGP			501550	484820	493411	495670
GT*DAYS	15	MLT	[LHP] [LHM]				170		
GT*DAYS	15	MLT	[SB] [SV]					192	139
GT*DAYS	15	MLT	GNS				135		
GT*DAYS	15	MLT	GTR				1174	477	1023
GT*DAYS	15	MLT	LA					23999	29596
GT*DAYS	15	MLT	LLD				82011	72364	60606
GT*DAYS	15	MLT	LLS				16866	18866	18072
GT*DAYS	15	MLT	LTL				2539		
GT*DAYS	15	MLT	OTB				24878	34527	69268
GT*DAYS	15	MLT	Other gear				226		
GT*DAYS	15	MLT	PS					129	86
GT*DAYS	16	ITA	DTS			6673029	6864030	7429483	7322198
GT*DAYS	16	ITA	HOK			764595	403669	507862	370612
GT*DAYS	16	ITA	OTM						301886
GT*DAYS	16	ITA	PEL				443236	661814	235418
GT*DAYS	16	ITA	PGP			249032	206056	192811	212519
GT*DAYS	16	ITA	PMP			20134			
GT*DAYS	16	ITA	PTS	585964	327460	224188			
GT*DAYS	17	ITA	DRB			858864	697091	792375	959807
GT*DAYS	17	ITA	DTS			5624744	5429766	4656664	4283788
GT*DAYS	17	ITA	HOK			9492	10510	10983	9150
GT*DAYS	17	ITA	OTM				2044966	2152750	1668039
GT*DAYS	17	ITA	PEL				525237	552850	506558
GT*DAYS	17	ITA	PGP			518165	429665	444329	427962
GT*DAYS	17	ITA	PMP			73495	66778		
GT*DAYS	17	ITA	PTS	1349466	1277088	1516671			
GT*DAYS	17	ITA	TBB			673656	701874	812298	747714
GT*DAYS	18	ITA	DRB			41347	62244	81590	87740
GT*DAYS	18	ITA	DTS			2568868	2592741	2632767	2275442
GT*DAYS	18	ITA	HOK			27800	58254	79940	58026
GT*DAYS	18	ITA	OTM				428966	609058	529109

Table A3.8 continued.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
GT*DAYS	18	ITA	PEL				237426	206539	160442
GT*DAYS	18	ITA	PGP			120701	146182	147150	115612
GT*DAYS	18	ITA	PMP			40920			
GT*DAYS	18	ITA	PTS	278115	270956	369877			
GT*DAYS	19	ITA	DTS			782163	884513	835267	800971
GT*DAYS	19	ITA	HOK			1015534	1091913	850691	710177
GT*DAYS	19	ITA	PEL				419043	337285	178098
GT*DAYS	19	ITA	PGP			473727	438792	555916	483882
GT*DAYS	19	ITA	PMP			111129	34967		
GT*DAYS	19	ITA	PTS	188356	320037	195882			
GT*DAYS	20	GRE	GNS		2885125	2548709	2611649	2210227	
GT*DAYS	20	GRE	LLS		436107	268489	203140	228351	
GT*DAYS	20	GRE	OTB		574443	580909	435054	565011	
GT*DAYS	20	GRE	PS		105429	123580	230265	189582	
GT*DAYS	20	GRE	SV		83099	62465	58441	57058	
GT*DAYS	22	GRE	GNS		5837915	5675508	5782002	5610405	
GT*DAYS	22	GRE	LLS		1762101	1660263	1602486	1323112	
GT*DAYS	22	GRE	OTB		4927349	4971783	5553804	5554194	
GT*DAYS	22	GRE	SV		294896	269645	276265	257271	
GT*DAYS	22+23	GRE	PS		1998124	1987556	2295466	2108039	
GT*DAYS	25	CYP	GTR				256436	275468	301864
GT*DAYS	25	CYP	LLS				2022	5245	6421
GT*DAYS	25	CYP	OTB				94561	72422	75036
GT*DAYS	5	ESP	OTB	11850	12325	12090	5923	3975	1746
GT*DAYS	5	ESP	PS	3376	2959	2219	952	1531	452
GT*DAYS	6	ESP	GNS	155					9
GT*DAYS	6	ESP	GTR	33		1725	92	1087	1679
GT*DAYS	6	ESP	LA	149492	187368	2685			
GT*DAYS	6	ESP	LLD				88		
GT*DAYS	6	ESP	LLS	124			7	55	19
GT*DAYS	6	ESP	OTB	560461	539917	509752	439045	466001	497605
GT*DAYS	6	ESP	OTM	2912	173	367	49	49	168
GT*DAYS	6	ESP	OTT			160			122
GT*DAYS	6	ESP	PS	546797	490667	711197	622375	690666	604662
GT*DAYS	7	FRA	GNS			329230	305685	315704	
GT*DAYS	7	FRA	LLS			23742	23436	17232	
GT*DAYS	7	FRA	OTB			1610963	1480834	1311101	
GT*DAYS	7	FRA	OTM			1045791	1303832	1628954	
GT*DAYS	9	ITA	DRB			24050	23915	28878	20772
GT*DAYS	9	ITA	DTS			2410544	2448143	2325295	2289820
GT*DAYS	9	ITA	HOK			22784	16701	13580	
GT*DAYS	9	ITA	PEL				309887	384616	345289
GT*DAYS	9	ITA	PGP			521225	493611	507794	485784
GT*DAYS	9	ITA	PMP			62599	24894		
GT*DAYS	9	ITA	PTS	193726	181590	143490			

Table A3.9 Effort in kW*days by GSA and fleet.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
KW*DAYS	1	ESP	GND					147	
KW*DAYS	1	ESP	GTR		118			88	88
KW*DAYS	1	ESP	LA	1991	905	181		1710	1166
KW*DAYS	1	ESP	LH					773	8734
KW*DAYS	1	ESP	LLD				269	177	
KW*DAYS	1	ESP	LLS		298	99		490	1122
KW*DAYS	1	ESP	OTB	63910	46101	32174	22741	23522	31826
KW*DAYS	1	ESP	PS	513427	540666	418810	474470	581146	533286
KW*DAYS	1	ESP	PTM			180			
KW*DAYS	1	ESP	SPR					1015	
KW*DAYS	10	ITA	DRB	94663	29540	110899	244013	272628	142455
KW*DAYS	10	ITA	DTS	7344089	7231486	7883881	8467144	7596783	7105075
KW*DAYS	10	ITA	HOK			1654352	1413547	925244	794816
KW*DAYS	10	ITA	PEL				2434470	2016508	1452739
KW*DAYS	10	ITA	PGP	6440217	7222145	7056306	6018600	9486681	8397010
KW*DAYS	10	ITA	PMP	12686947	8003452	3588004	3728376	1404642	1003285
KW*DAYS	10	ITA	PTS	2631242	2930380	2308589			
KW*DAYS	11	ITA	DTS	3679604	4652647	6711626	7736040	6017232	6340429
KW*DAYS	11	ITA	PGP	2865738	5099814	7105771	6996350	7234881	7398923
KW*DAYS	11	ITA	PMP	7159338	3245118				
KW*DAYS	15	MLT	[LHP] [LHM]				1880		
KW*DAYS	15	MLT	[SB] [SV]					3805	2507
KW*DAYS	15	MLT	GNS				2121		
KW*DAYS	15	MLT	GTR				13889	8391	20724
KW*DAYS	15	MLT	LA					203361	208456
KW*DAYS	15	MLT	LLD				554562	483437	449900
KW*DAYS	15	MLT	LLS				140846	159692	160914
KW*DAYS	15	MLT	LTL				26318		
KW*DAYS	15	MLT	OTB				129838	143909	240858
KW*DAYS	15	MLT	Other gear				3394		
KW*DAYS	15	MLT	PS					739	492
KW*DAYS	16	ITA	DTS	23952310	20951845	21381964	21772464	23699835	23644626
KW*DAYS	16	ITA	HOK			3153486	1758722	2076446	1695903
KW*DAYS	16	ITA	OTM						614764
KW*DAYS	16	ITA	PEL				1063031	1592930	559014
KW*DAYS	16	ITA	PGP	3133993	4603457	2691324	2302777	2207660	2378933
KW*DAYS	16	ITA	PMP	2792612	2761842	223470			
KW*DAYS	16	ITA	PTS	2510582	1750128	962786			
KW*DAYS	17	ITA	DRB	6381241	7517860	6982982	5884599	6421392	7575921
KW*DAYS	17	ITA	DTS	27568094	27486393	26771813	25026709	22118619	20619962
KW*DAYS	17	ITA	HOK			153794	148821	150195	121827
KW*DAYS	17	ITA	OTM				5670402	5824357	4453187
KW*DAYS	17	ITA	PEL				1108381	1153935	1032224
KW*DAYS	17	ITA	PGP	9297244	7646003	9120053	8011107	8568762	8638666
KW*DAYS	17	ITA	PMP	7989134	7039902	1072033	1032751		
KW*DAYS	17	ITA	PTS	7841347	7636049	6955633			
KW*DAYS	17	ITA	TBB			3419642	3622199	3943318	3463256

Table A3.9 continued.

TYPE	AREA	COUNTRY	FT_LVL4	2002	2003	2004	2005	2006	2007
KW*DAYS	18	ITA	DRB	1100225	584801	381968	570792	746921	807073
KW*DAYS	18	ITA	DTS	17112022	14530793	14369490	14621928	14929696	12904532
KW*DAYS	18	ITA	HOK			284535	514377	778355	567996
KW*DAYS	18	ITA	OTM				1223222	1736260	1547658
KW*DAYS	18	ITA	PEL				562566	485345	379447
KW*DAYS	18	ITA	PGP	1722336	1002933	1180371	1442219	1394671	1311109
KW*DAYS	18	ITA	PMP	7277279	4416994	351689			
KW*DAYS	18	ITA	PTS	1480945	1464793	1842716			
KW*DAYS	19	ITA	DTS	5125805	5002396	5802023	6562337	6460683	6063817
KW*DAYS	19	ITA	HOK			6809150	7299195	5575566	4053202
KW*DAYS	19	ITA	PEL				1026897	1008813	513544
KW*DAYS	19	ITA	PGP	4669873	9192254	4881153	4698292	6141378	5333724
KW*DAYS	19	ITA	PMP	13116917	9143878	1188078	341008		
KW*DAYS	19	ITA	PTS	978457	1629677	1105203			
KW*DAYS	20	GRE	GNS		29609039	22529478	21758835	17272519	
KW*DAYS	20	GRE	LLS		3247285	1435103	1823114	1448109	
KW*DAYS	20	GRE	OTB		2374841	2447515	1729664	2024955	
KW*DAYS	20	GRE	PS		725384	874064	747375	626335	
KW*DAYS	20	GRE	SV		863066	709465	604098	623628	
KW*DAYS	22	GRE	GNS		48227268	53304432	54981971	52423637	
KW*DAYS	22	GRE	LLS		14158502	11416302	10631705	8283337	
KW*DAYS	22	GRE	OTB		15792715	15877180	17730748	16402915	
KW*DAYS	22	GRE	SV		2775797	2206815	2193550	2022231	
KW*DAYS	22+23	GRE	PS		9389351	9140980	9656463	8992650	
KW*DAYS	25	CYP	GTR				3305514	3526850	3896835
KW*DAYS	25	CYP	LLS				21790	51626	57561
KW*DAYS	25	CYP	OTB				327617	231816	240182
KW*DAYS	5	ESP	OTB	36179	36707	36344	17305	13322	3940
KW*DAYS	5	ESP	PS	16282	18527	12217	5557	5396	3198
KW*DAYS	6	ESP	GNS	799					66
KW*DAYS	6	ESP	GTR	175		7976	427	3979	5703
KW*DAYS	6	ESP	LA	705409	834710	12547			
KW*DAYS	6	ESP	LLD				140		
KW*DAYS	6	ESP	LLS	692			55	268	227
KW*DAYS	6	ESP	OTB	2090040	2080209	1863359	1604041	1740464	1811610
KW*DAYS	6	ESP	OTM	5313	730	1689	240	240	640
KW*DAYS	6	ESP	OTT			419			589
KW*DAYS	6	ESP	PS	2784932	2459863	3453821	2969309	3208864	2786861
KW*DAYS	7	FRA	GNS			7007171	5908142	88698170	
KW*DAYS	7	FRA	LLS			669338	716765	385004	
KW*DAYS	7	FRA	OTB			6361248	5923540	6003467	
KW*DAYS	7	FRA	OTM			2835543	3118789	4983160	
KW*DAYS	9	ITA	DRB	187147	335521	268423	265359	320437	225526
KW*DAYS	9	ITA	DTS	14583556	14671042	14130070	14265309	13484321	13096031
KW*DAYS	9	ITA	HOK			376470	275809	262696	
KW*DAYS	9	ITA	PEL				1013627	1174295	1049348
KW*DAYS	9	ITA	PGP	6504001	6925653	7060573	6946213	7399313	7300451
KW*DAYS	9	ITA	PMP	4715565	4051809	984241	396631		
KW*DAYS	9	ITA	PTS	1312412	1333245	947166			

12. APPENDIX 4. FLEET SEGMENTATION IN THE MEDITERRANEAN SEA

(copied from SGMED-08-01 report).

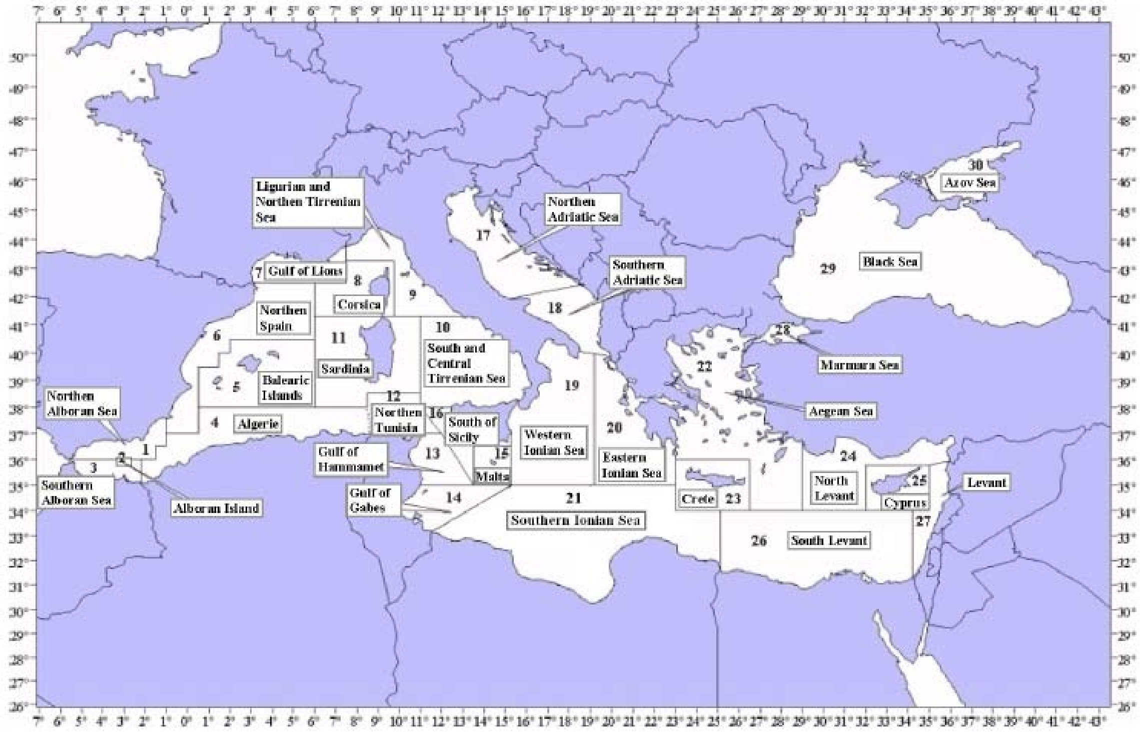
Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	LOA classes					
Activity	Gear classes	Gear groups	Gear type	Target assemblage	Mesh size and other selective devices	< 6	6-12	12-18	18-24	24-40	> 40
Fishing activity	Dredges	Dredges	Boat dredge [DRB]	Molluscs	(a)						
	Trawls	Bottom trawls	Bottom otter trawl [OTB]	Demersal species	(a)						
				Deep water species (b)	(a)						
				Mixed demersal species and deep water species (b)	(a)						
			Multi-rig otter trawl [OTT]	Demersal species	(a)						
			Bottom pair trawl [PTB]	Demersal species	(a)						
			Beam trawl [TBB]	Demersal species	(a)						
		Pelagic trawls	Midwater otter trawl [OTM]	Mixed demersal and pelagic species	(a)						
			Pelagic pair trawl [PTM]	Small pelagic fish	(a)						
	Hooks and Lines	Rods and Lines	Hand and Pole lines [LHP] [LHM]	Finfish	(a)						
				Cephalopods	(a)						
			Trolling lines [LTL]	Large pelagic fish	(a)						
		Longlines	Drifting longlines [LLD]	Large pelagic fish	(a)						
			Set longlines [LLS]	Demersal fish	(a)						
	Traps	Traps	Pots and Traps [FPO]	Demersal species	(a)						
			Fyke nets [FYK]	Catadromous species	(a)						
				Demersal species	(a)						
			Stationary uncovered pound nets [FPN]	Large pelagic fish	(a)						
	Nets	Nets	Trammel net [GTR]	Demersal species	(a)						
			Set gillnet [GNS]	Small and large pelagic fish	(a)						

				Demersal species	(a)						
			Driftnet [GND]	Small pelagic fish	(a)						
				Demersal fish	(a)						
	Seines	Surrounding nets	Purse seine [PS]	Small pelagic fish	(a)						
				Large pelagic fish	(a)						
			Lampara nets [LA]	Small and large pelagic fish	(a)						
		Seines	Fly shooting seine [SSC]	Demersal species	(a)						
			Anchored seine [SDN]	Demersal species	(a)						
			Pair seine [SPR]	Demersal species	(a)						
			Beach and boat seine [SB] [SV]	Demersal species	(a)						
	Other gear	Other gear	Glass eel fishing	Glass eel	(a)						
	Misc. (Specify)	Misc. (Specify)			(a)						
Other activity than fishing				Other activity than fishing							
Inactive				Inactive							
Recreational fisheries (non registered vessels or no vessels)				To be specified	Not applicable	All vessel classes (if any) combined					

(a) Not spelled out in DCR but defined with reference to relevant EU Regulation(s)

(b) Refering only to red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus*, species not included in the definition of deep sea species given by Council Regulation (EC) 2347/2002.

13. APPENDIX 5. GFCM GSAS



14. ANNEX-EXPERT DECLARATIONS

Declarations of invited experts are published on the STECF web site on https://stecf.jrc.ec.europa.eu/home together with the final report.

European Commission

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Abstract

SGMED-08-04 was held on 6-10 October 2008 in Ponza (Italy). The meeting was the last of a series of four meetings convened in 2008 with the aim of strengthening scientific cooperation and improving scientific advice on the management of stocks of demersal and small pelagics in the Mediterranean. STECF reviewed the report during its Plenary meeting on 3-7 November 2008.

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