DCR MEDITS Working group
Nantes (France), 15-18 March 2005 and Kavala (Greece), 2-6 April 2006

Scientific Report

Assessment of indicator trends related to exploited demersal fish populations and communities in the Mediterranean

January 2007

Abstract

Since 1994, Mediterranean research organisations have carried out yearly standardized bottom trawl surveys along the coasts of the Mediterranean Sea from Gibraltar to the Aegean Sea (Medits surveys). A dynamic indicator-based approach to the assessment of multi-stock fisheries has been applied to the data series obtained from these surveys by an international working group involving all the scientific teams contributing to the data collection process. The application was done according to the 13 GFCM geographical sub-areas sampled by the Medits surveys. While reference points for a lot of fished populations and community indicators are seldom available, reference directions are well established for some indicators, giving guidelines for fishery management. A set of simple indicators related to fishing impact on fish populations and communities were estimated from the Medits time-series data (population abundance, average length and maturity length, community total biomass and number, average length and weight). Trends in these indicators were assessed within a hypothesis testing framework. The results of the assessments were summarized in tables scoring increasing and decreasing trends to draw attention on the changes in the fish community.

Management of the report

In the frame of the European regulation related to the fishery data collection (DCR), a Medits coordination working group meet in Nantes (France) in March 2005. During this meeting, a suite of population and community indicators calculated from the Medits data and applied to areas defined according to the GFCM geographical units have been analysed. The indicators had been selected by the group before the Nantes meeting. The calculation were made with R-routines specifically developed for the meeting. The analyses done during the Nantes meeting had highlighted three main concerns. (i) Despite the effort made by the Medits partners and the systematic application of checking procedure to validate the data, the present deep analysis has revealed some residual mistakes in the data. (ii) The analyses have shown that the estimates might be affected by changes in the sampling plan. (iii) The applicability of some of the candidate indicators was doubtful due to characteristics of the data. It was particularly the case for the indices based from maturity. All these questions needed further investigations. For these reasons, the regional contributions presented in this report have been completely reviewed in the institutes after the Nantes meeting. This review included corrections of the raw data, a new calculation of the indices with the R-Sufi routine completed by the authors as suggested during the Nantes meeting, and the interpretation of the regional results. The synthesis of the report was prepared during the Medits coordination meeting which was held in Kavala (Hellas) in April 2006.

Participants

cf. annex I

For citation

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Contents

Introduction

There is an increasing interest of the scientific community and the fisheries management bodies in ecosystem-based fishery management. Among other requirements, this approach needs the development of combined indicators able to return the main characteristics of the systems under management. During the last decade, a large amount of proposals have been published in view of implementing such mechanism. Nevertheless, very few of them have been tested at real scale.

In general, multi-species and multi-gears fisheries make difficult the implementation of management processes based on single species diagnoses. In such contexts, it could be useful to develop approaches intending to take into account the complexity of the fishery systems by integrating information in comprehensive dashboards. In the Mediterranean, this concern is particularly relevant for the benthic and demersal fisheries for which the diversity of targeted and by-catch species as well as populations is particularly high, and where exploitation is split in a lot of sub areas.

When they have been defined in 1993, the standardized bottom trawl surveys Medits (International bottom trawl surveys in the Mediterranean) were particularly devoted to the production of abundance indices and biological parameters of a set of fish, crustaceans and cephalopods species of particular interest in link with fishery management. Furthermore, they gave the possibility to collect abundance data for a larger amount of species caught by the Medits sampling gear. The availability of the data collected during the yearly surveys Medits gave an opportunity to progress in testing the applicability of population and community indicators at the scale of the area covered by the survey.

The present report gathers the results obtained from a systematic analysis of a set of population and community indicators applied to the Medits data, using the whole data series (1994-2004) and covering all the Medits area. The approach has been made for 13 area units defined according to the geographical units adopted by the GFCM. The indicators have been selected from the review and proposals established by Rochet *et al.* (2003) and Trenkel *et al.* (2003). The calculations have been made with R-routines specifically developed for the project (Rochet *et al.* 2004). The results are presented by area. The synthesis introduces comparisons between the different areas. Finally, the discussion analyses the suitability of the candidate indicators in the different areas, makes proposals for improvements or new indicators, and highlights features related to survey design and potential future changes to better comply with the requirements for elaboration of community indicators.

[I] Methodology

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I.1 Material

The analyses have been done using the data coming from the Medits surveys (International bottom trawl in the Mediterranean). These surveys cover all the trawlable areas over the shelves and the upper slopes from 10 to 800 m depth in the North of the Mediterranean Sea from Gibraltar to the eastern Aegean Sea (Bertrand *et al.* 2000). The stations were distributed applying a stratified sampling scheme with random drawing inside each stratum. The target sampling rate was one station per 60 square nautical miles, but with differences between areas (e.g. only 1 station per 200 square nautical miles in the Adriatic according to the relative monotony of the bottom). About 1000 stations were sampled during each survey. The same sampling gear (GOC 73) was used for the whole surveys. Its codend mesh size is 20 mm (stretched mesh), and its vertical opening was about 2 meters (Bertrand *et al.* 2002). One Medits survey was carried out every year since 1994, during the spring-summer period.

The areas defined for the present analyses combined the stratification scheme used for the Medits surveys (Bertrand *et al.* 2000) and the geographical sub-areas adopted by the GFCM. Finally, thirteen geographical units have been designed (Figure I.1; Table I.1). Twelve units corresponded to the shelves and upper slopes of GFCM geographical units (named by the corresponding GFCM codes in the report), the last one combining the two GFCM units 15 and 16 (named 16 in the report).

During the surveys, all macrofauna species were usually identified, counted and weighted (total weight), with a special attention to a list of 56 fish, cephalopods and crustaceans (long Medits list; annex II). For thirty-six of these length frequency distribution, sex and maturity stages were recorded (short Medits list; annex II). The community indicators were calculated from the species of the long Medits list, while the population indicators were performed from the species included in the short Medits list. In order to remove rare, poorly sampled species, species with a low occurrence were excluded. An occurrence threshold of 5 % (average across years and shelf and slope area) was usually applied, with some adjustments according to the geographical unit.

Table I.1. The geographical units.

FAO SUBAREA	GFCM MANAGEMENT UNITS (SAC-GFCM, 2001)	CODES of the geographical units	MEDITS strata	Surface (km², from Medits)	Comments
	6. Northern Spain	6	112 & 113	32506	
	1. Northern Alboran Sea	1	111	12753	
	3. Southern Alboran Sea	3	114		
	7. Gulf of Lions	7	121	13860	
WESTERN	8. Corsica Island	8	131	4562	
	9. Ligurian and North Tyrrhenian Sea	9	132	42410	The boundary between the areas 9 & 10 is ~ 0.5° southern than the GFCM limit.
	10. South and Central Tyrrhenian Sea	10	134a-b	20255	
	11. Sardinia	11	133	26975	
	15. Malta Island 16. South of Sicily	16	134c & 135	59278	
CENTRAL	17. Northern Adriatic	17	211	92261	
	18. Southern Adriatic Sea	18	221e-h	24008	
	19. Western Ionian Sea	19	221a-d	13520	
	20. Eastern Ionian Sea	20	222	16823	
EASTERN	22. Aegean Sea (including Crete)	22	223, 224 & 225	155674	

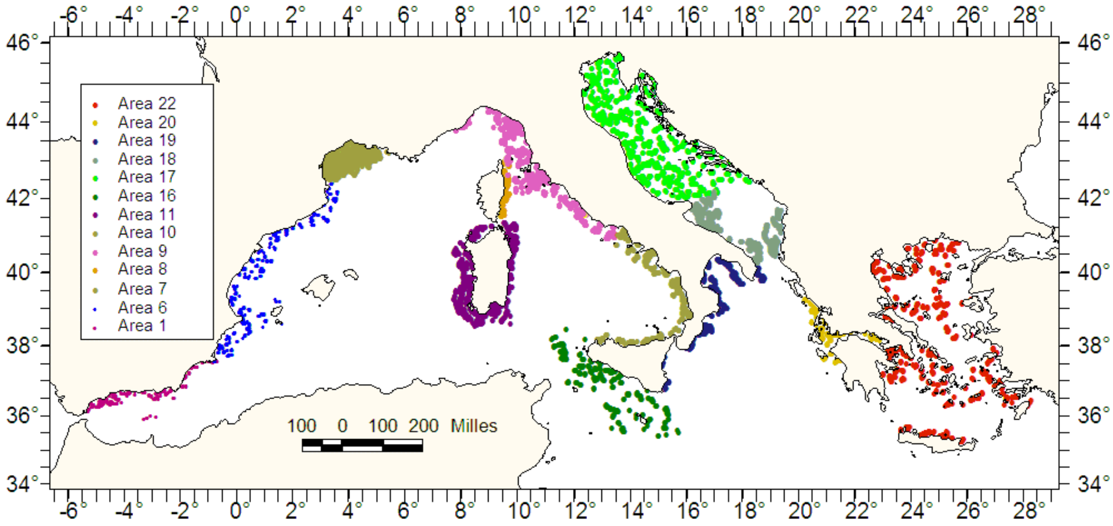


Figure I.1. Haul position of the Medits survey in the thirteen geographical units studied.

I.2 Selected indicators

The criteria for selecting the indicators for measuring fishing impacts on the population and community levels were: they should easily and reliably (high precision) be calculated with the available Medits survey information and the direction of change under the impact of fishing should be known. According to these criteria, four indicators of population state, intrinsic population growth rate, total mortality, mean length and length at maturity, and five indicators of community state, total abundance and biomass, mean individual weight and length and the proportion of large individuals (across all species) were selected (Table I.2).

All population indicators except total mortality are expected to decrease under increasing fishing impacts (Beverton & Holt 1957), hence the direction to watch out for is a declining trend and a, increasing trend for total mortality. The same interpretation of trends is assumed to apply to non-target species, most of which are taken as by-catch and hence should suffer similar impacts. Some non-target species might increase in abundance because of lower predation by depleted target predator species, or in average length due to reduced competition (Hall 1999). However, it is assumed that for a majority of species, these indirect effects of fishing would be lower in magnitude than the direct effects.

Similar direct effects of fishing are expected at the community level. Total community biomass and number might decrease under strong fishing pressures, and this decrease would impair the productivity of the dependent fisheries (Rochet & Trenkel 2003). Average length and weight (all species confounded) have been shown to decrease in exploited communities (Jennings *et al.* 1999; ICES 2001).

Table I.2. Description of selected indicators and the expected effect of fishing on them.

Level	Indicator	Description	Expected effect of fishing
	r	Intrinsic population growth rate	decrease
Population	Z	Average total mortality rate for species i	increase
	Lbar	Average length of population i	decrease
	Lmat	Length at maturity (50% mature)	decrease
	B	Total biomass in community	decrease
	N	Total abundance in community	decrease
Community	$\bar{b}$	Average individual weight in community	decrease
	$\bar{l}$	Average individual length in community	decrease
	plarge	Proportion of large individuals in total community abundance	decrease

The mathematical definition of all population indicators are provided in table I.3 and for community indicators in table I.4. A detailed description of the reasoning behind each population indicator follows below.

Table I.3. Population indicators.

a) mathematical definition.

Indicator	Required information	Model	Estimation method
r_i	$N_i(t)$	$N_i(t) = N_i(t-1)\, e^{r_i}$ $= \lambda_i \; N_i(t-1)$	$\log(\hat{N}_i(t)) = \delta_i + r_i t + \omega_{i,t}$ $\omega_{i,t} \sim N(0, \sigma_i^2)$
Z_i	$N_{l,i}(t)$, t_{0_i} k_i, L_{∞_i}	$N_a(t) = N_{a-1}(t-1)\exp(-Z)$ $Z_a = -\log(N_a(t)/N_{a-1}(t-1))$ age = t0 – 1/k log(1 – l/Linf))	$Z(t) = -\log\left(\sum_{i=a\_min}^{a\_max-1} N_i(t-1) / \sum_{i=a\_min+1}^{a\_max} N_i(t)\right)$ Var(Z) by boostrap
L_{bar_i}	$N_{l,i}(t)$	$L_{bar_i} = \frac{1}{N_i}\sum_{l=1}^{L} N_{l,i}\, l$	$\hat{L}_{bar_i} = \frac{1}{\hat{N}_i}\sum_{l=1}^{L} \hat{N}_{l,i}\, l$ $\hat{V}[\hat{L}_{bar_i}] = \hat{L}^2_{bar_i} \times \left(\frac{\sum_{l=1}^{L} l_l^2 \hat{V}[\hat{N}_{l,i}]}{\left(\sum_{l=1}^{L} l_l \hat{N}_{l,i}\right)^2} + \frac{\hat{V}[\hat{N}_i]}{\hat{N}_i^2} \right)$
L_{mat_i}	$N_{m,i}(t)$	L_{50} = length at which 50% of the population i are mature, year t.	1) Fitting a logistic model for the probability of being mature p_l as a function of body length (l), year (t): $\ell(p_{l,t}) = \log\left(\frac{p_{l,t}}{1-p_{l,t}}\right) = \mu + a_t + b_t l + \varepsilon$ 2) Estimating L50 from the parameters: $L_{50} = \frac{\ell(0.5) - \mu - a_t}{b_t}$

b) data input requirements

Data	Description
$N_i(t)$	index of total abundance of species i
$N_{l,i}$ (t)	index of abundance in length class l for species i
$N_{m,l,i}(t)$	index of abundance for maturity stage m in length class l for species i
$B_i(t)$	index of total biomass of species i
$t0_i$, k_i & L_{∞_i}	parameters of van Bertalanffy growth model
Lbig	A threshold length to be a "big" fish (usually 95% quantile of length distribution in the community)

Lotka's intrinsic population growth rate r has been suggested for fish populations (Quinn & Szarzi 1993). It can be estimated as the slope of log abundances against time. If r is significantly lower (respectively higher) than 0, the population is decreasing (increasing). The expected and undesired effect of fishing is to slow population growth - although many other factors might also have the same effect. Taking r = 0 as the target reference point assumes that without any noticeable impact of fishing the population would be stable although varying between years.

Total mortality rate Z is classically written as the sum of natural and fishing mortality rates M and F and will clearly increase under exploitation. It can be estimated from numbers at length data, and has been suggested as a robust indicator for exploited populations (Die & Caddy 1997). The proposed estimation method for total mortality is based on a simple age-structured population dynamics modelt. Pseudo-ages are obtained using the von Bertalanffy growth function. The proposed indicator consists of the total mortality for a given age range (age_min to age_max), i.e. the mortality rate of all individuals aged a_min to a_max-1 between years t-1 and t.

Average length in the population is expected to decrease in exploited stocks (Beverton & Holt 1957), and this has been observed in various situations (Haedrich & Barnes 1997; Babcock *et al.* 1999).

Age at maturity has been found to decrease under the effect of fishing (Trippel 1995; Rochet *et al.* 2000). If individual growth remains similar under the impact of fishing, length at maturity will decrease in a similar manner. Compensatory growth will to some degree reduce the impact of fishing on the observed reduction in length at maturity but strong signals should still be detectable.

Table I.4. Community indicators definition. For notation see table 2b).

Indicator	Required information	Estimator
B N	$B_i(t)$ $N_i(t)$	$\hat{B}(t) = \sum_i B_i(t)$ variance by bootstrap
$\bar{b}$	$B(t)$, $N(t)$	$\bar{b}(t) = \hat{B}(t) / \hat{N}(t)$
$\bar{l}$	$N_{l,i}(t)$	$\bar{l} = \sum l\, N_{l,i}(t) / N(t)$ variance by bootstrap
plarge	$N_l(t) = \sum_i N_{l,i}(t)$ Threshold size lbig	$plarge = \sum_{l>lbig} N_l(t) \Big/ N(t)$

The effects of fishing on total fish biomass are difficult to predict due to indirect effects along food webs, but any increasing or decreasing time trend could be a sign for changes occurring in the community.

The average weight $\bar{b}$ of an individual in the community is estimated using total biomass and total abundances. It is expected to decrease as the result of fishing as both bigger individuals and larger species are being removed. However, this indicator is sensitive to recruitment variations; it might be advantageous to only take account of individuals above a minimum length (different for each species).

The average length $\bar{l}$ of an individual in the community is estimated using abundance estimates per length class. It is expected to decrease as the result of fishing as both larger individuals and species are being removed. As the average weight, average length is sensitive to recruitment variations. Hence average length of mature individuals (>Lmat), i.e. the spawning part, was also calculated for those species that had reliable annual estimates of Lmat.

Fishing can impact the distribution of sizes in exploited communities in both direct and indirect ways. Direct fishing effects on fish communities are due to (1) high-valued, and generally larger species being targeted, (2) fishing gears being size-selective, designed to remove larger individuals and allow smaller individuals to escape, (3) older and larger fish of a population becoming fewer because cohorts accumulate fishing mortalities through time, (4) large-sized species being more vulnerable to fishing because they have lower potential rates of increase. Indirect fishing effects favour small fish by releasing predation pressure and thereby enhancing their survival. Much work has been devoted to size spectra slopes as descriptors of this distribution, however they proved deceptive because size spectra are not linear in many instances, hence the variations in estimated slopes is difficult to interpret. Instead, this indicator is intended to refine the description of changes in size distribution among individuals. plarge is expected to decrease under the effect of fishing. The only difficulty in implementing the indicator is to decide what a "large" individual is, i.e. setting a size threshold. This has to be done depending on the size distribution in the community. For Medits, the calculations were carried out for a range of threshold values (24, 26, 28 and 30 cm).

I.3 Tests for time trends

Significant linear time trends in the direction of fishing impacts were tested for all indicators. Having estimated an indicator I for a given data series, the parameters of a linear time trend in the indicator $\hat{I}_t = a + bt$ were estimated, and the null hypothesis that $b = 0$ was tested (for details see Trenkel & Rochet 2003). Two-sided tests were preferred to one-sided tests with the alternative hypothesis that the detected change is due to fishing. This is because trends in the direction opposite to fishing impacts also provide a signal, although with a different meaning (see below). Linear regression analysis assumes that indicators are normally distributed. This should be the case for all indicators that are mean values of some random variable as a result of the central limit theorem. This might also be expected to be true for total abundance or biomass in the community. Finally, ln-transformed abundance indices used as the basis for estimating the intrinsic population growth rate r are commonly found to be normally distributed. Hence the fundamental conditions for simple linear regression can be expected to be fulfilled for all indicators used in this study. The advantage of the linear regression method is that in addition to providing a test for change, the slope estimates allow to order species by intensity of trend, which is what is done when summarising results.

I.4 Preparing the diagnosis

Trends in population indicators are summarised in histograms, with one bar per species (Figure I.2). Species are ranked from the lowest to the highest slope, with significant slopes (α=5%) coloured in red for undesirable directions (usually, negative slopes, except for Z) or in green for desirable directions (positive slopes, except for Z).

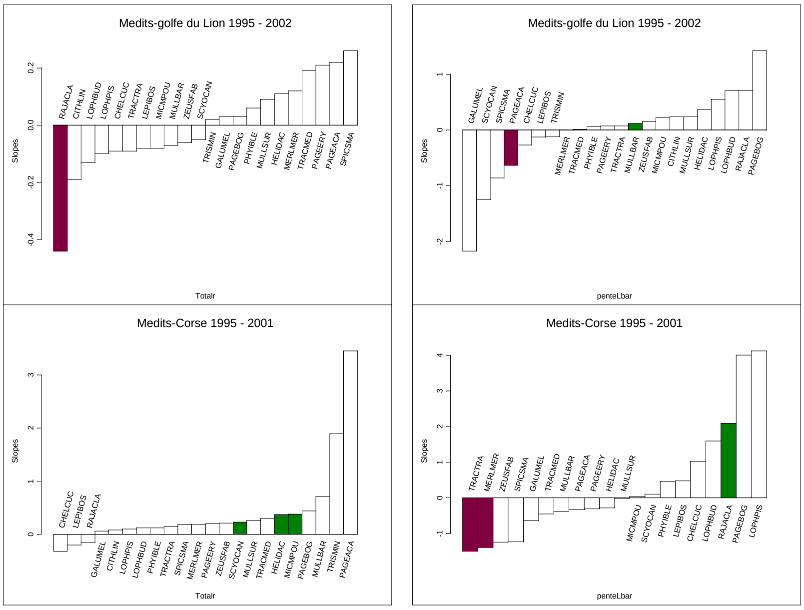


Figure I.2. Bar plots of slopes of linear time trends as summaries for population indicator.

Indicators were also summarised in tables with colouring: green if there was a significant trend in direction of decreasing fishing impact, red if towards increasing fishing impact, and red-hatched if stationary fishing impacts (no significant trend in the context of a region already known to be impacted by fishing). For population indicators, colouring was based on a proportion of species being trending, e.g. red or green were used only if more than 5% (or 10%) of populations had a significant trend, the colour depending on the dominant trend among these slopes (green if decreasing fishing impact dominant, red in the reverse case). See Table I.5 for an example.

Table I.5. Example summary table for all indicators (green= no significant change in direction of fishing impact; red= significant change, grey = significant change in opposite direction to fishing impact)

Community	$\hat{N}_{i,t}$	$\overline{L}_{i,t}$	$\hat{B}_t$	$\hat{N}_t$	$\overline{W}_t$	$\overline{L}_t$	α_t	β_t
East Corsica	–	2/22 decrease 1/22 increase	–	–	–	–	increase	increase
Gulf of Lions	1/22 decrease	1/22 decrease 1/22 increase	–	–	–	–	increase	–

All indicator calculations and the preparation of tables and figures were programmed in R (R Development Core Team 2004). These functions are available as the R-SUFI package (Rochet *et al.* 2004).

[II] Analyses according to the geographical subarea

II.1 Northern Alboran Sea (area 1)

Coordinator: Luis Gil de Sola

II.1.1 Ecological settings, geographical and environmental features

Geographical sub area (GSA) 1 includes two different regions: North Alboran Sea and Gulf of Vera. These two regions are not uniform, neither under oceanographic or under geomorphic points of view. The continuous flow of water between the Atlantic basin and the Mediterranean Sea through the strait of Gibraltar determines effects on the sedimentation on the bottom, the water temperature , the regime of winds and therefore on the living organisms (for complete information see Margalef 1985).

The most characteristic geomorphological feature in the basin of north Alborán and the gulf of Vera is the narrowness of continental shelf, apart from the exception made by the two bays of Málaga and Almería, as well as the south of the Palos Cape. The slope falls sharply toward the deep terraceof around 1200 meters in the Alborán sea and more than 2500 in the gulf of Vera. Large extend of the slope between the 200 and 800 meters is the main characteristic of this area, interruptedby numerous submarine canyons and an enormous quantity of rocky blooming that form the so-called “Secos” in the Alborán Sea. In the Gulf of Vera the slope is very sharp until 2000 meters depth and there are rough sedimentary bottom up to the south of the Palos Cape.

The oceanographic characteristics of the water column in the Alborán Sea aretypical of the Atlantic region (Margalef 1985). In the Gulf of Vera the very obvious Mediterranean convergence appears in the vicinities of Garrucha to the south of the eponymous canyon.

The presence and the distribution of the flora and marine fauna in this area as the ecological features are very well related in numerous works (Margalef 1985).

In the GSA 1 the trawablel surface area (mud and sand) up to 800 meters is approximately of 13000 km^2 and the surface of the deep stratum (200-800) m represents about 70% of the total surface.

II.1.2 Fisheries description and initial state assessment

The demersal resources of the north Alborán Sea are almost exclusively exploited by the trawler fleet of Andalusia which operates in the same stocks and grounds. he exploitation in the gulf of Vera is mainly made by fleets fromAndalusia and the rgion of Murcia.

Despite a status of over-exploitation is recognised for several resources in the North-Western Mediterranean, there are few scientifically reported cases of stocks at risk of collapse. Anchovy along the Northern Spanish coast, black spot seabream in the Alboran Sea and hake in the Gulf of Lions are among those, however. This long-term resilience of Mediterranean fisheries, without so far detected dramatic collapse of target species, except for anchovy in the mid-1980’s, is usually explained by the fact that some proportion of the adult stocks have most probably remained consistently unavailable to small mesh trawling.

This feature of the Western Mediterranean fisheries isinduced by fishing practices, gear and vessel characteristics and by the presence of several untrawlable bottoms. It has led to the creation of spatial/temporal sanctuarieswithin the normal distribution area of several species, It allows a proportion of the affected stocks to survive to maturity, thus preventing population collapse.

Globally the trawl fleet is composed by about 160 boats. The average tonnage of the boats operating over the continental shelf is around 100 HP. It is of about 250 HP for the fleet exploiting the slopes (IEO internal data). Since the year 1998, the Spanish does not fish in the South Alboran Sea (Moroccan waters). The trawler fleet operates all year long apart from a closed period of 1 or 2 months (between May and October, depending on local authorities). An important portion of the vessels with the highest horse power works more than nine months around the island of Alborán (GSA 2). The number of boats authorized to fish in this area is restricted and regulated.

The main fishery ports are (from west to east): Fuengirola, Málaga, La Caleta, Motril, Almería, Garrucha and Aguilas. Other smaller fishery harbours and numerous small scale fishery boats are located along the coast (Estepona, Marbella, Adra, Cartagena). Trawling is the most important fishery activity in the whole area. Landings are mixed and depend on season or fishing depth. Sometimes a single species or a quantity of semi-pelagic specimens (*Trachurus spp.* and *Micromesistius poutassou*) predominate in catches. Other gears targeting demersal species, such as trammel nets or *Octopus* pots are used by a lot of boats. Semi-pelagic species represent 23% of the total landings. Hake, red mullet and *Pagellus spp.* contribute to 15%.

The other relevant catches are the cephalopod species with 25% of landings (*Octopus vulgaris* 20%). Crustacean species are the most important objective in the GSA1 area. Crustaceans represent 24% of the total landings with species of high economic interest (*Parapenaeus longirostris* and *Plesionika spp.*). The fleet operating in the depeer stratum (400-800 m) is specialized in the capture of *Aristeus antennatus* (110 tons in 2003) and *Nephrops norvegicus* (22 tons in 2003). There was a considerable decrease in the fishing effort from 1995 to 2004 for the continental shelf fleet, while it increased in the deep waters.

Discards can be considered high in depths shallower than 150 m. A big amount of them is made by *Boops boops* and *Trachurus spp*.

II.1.3 Brief description of changes in survey design

The MEDITS surveys have been carried out in the northern Alboran Sea and Gulf of Vera basin (GSA1) every year from 1994 (TableII.1.1). The same ship has been used during all the series: the Spanish R/V "Cornide de Saavedra": vessel length 66.7 m, engine power 2250 HP, tonnage 1113 GT (http://www.ieo.es/buques/cornide.htm).

The sampling scheme was random stratified, according to the total Spanish area covered by the MEDITS surveys. The GSA1 area has a 12753 km^2.

Table II.1.1. MEDITS_ES GSA1 number of hauls and sampling period per year

Year	Number of stations	Sampling period
1994	28	28/05-04/06
1995	28	22/04-29/04
1996	33	02/05-09/05
1997	35	10/05-19/05
1998	34	03/05-14/05
1999	39	04/05-13/05
2000	39	22/05-01/06
2001	40	12/05-22/05
2002	46	11/05-22/05
2003	47	26/04-06/05
2004	43	06/05-16/05

II.1.4 Selection of species up to each regional team

For the analyses of population indices (mean length, L50 and total mortality value (Z), only 37 target species (list in the Appendix) with average occurrence larger than 10% were included. The "community indicators" and the "population indicator" "r" (Population growth rate) were performed on the overall 56 species of the Medits reference list (including pelagic species).

II.1.5 Results: review of indicators

II.1.5.1 Community indicators

Total biomass in community did not show any significant trend, either for the whole period 1994-2004 or for the short period (2000-2004) (Figures II.1.1 & II.1.2). With respect to the average individual weight in community a noise in the trend can be introduced by the semi-pelagic species in certain years (e.g. 1997). No trends in the average individual length in community and proportion of large individuals have been found.

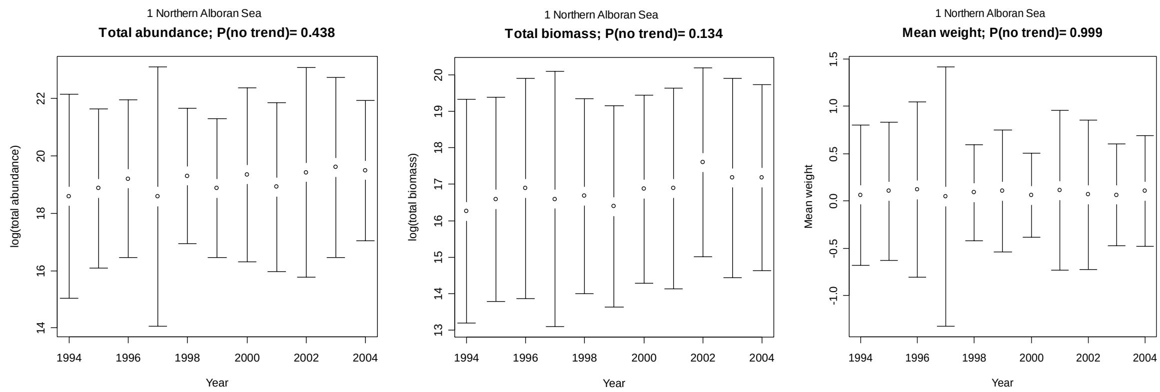


Figure II.1.1. Total abundance, biomass and mean weight in the Alboran Sea.

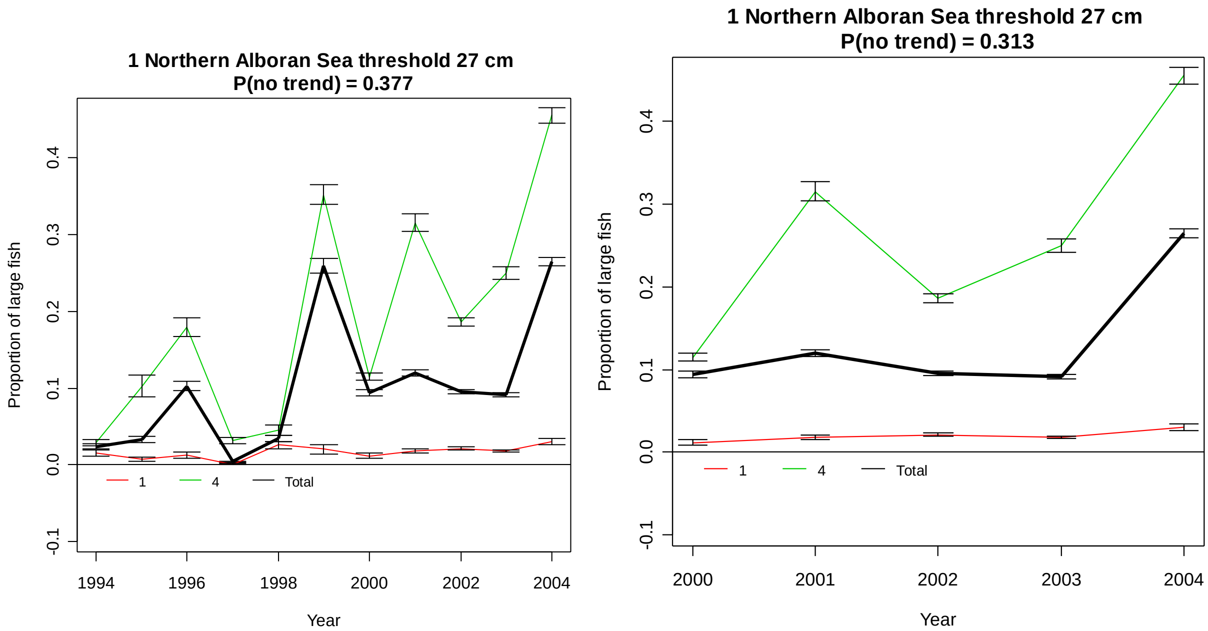


Figure II.1.2. Proportion of large fish in the Alboran Sea.

II.1.5.2 Population indicators

During the whole period, the intrinsic population growth rate "r" shows a significant increment for 4 of the 40 studied species (*Nephrops norvegicus*, *Scyliorhinus canicula*, *Illex coindetii* and *Spicara smaris*), and no decreasing trend , (f igure 1.3). During the last five years (2000-2004), only the “r” of *Sepia orbignyana* was significantly decreasing.

The trend of average length of population was significantly decreasing for 3 species (*Trachurus trachurus*, *Pagellus erythrinus* and *Lophius budegassa*) (F igure II.1.3). It was increasing only for *Mullus surmuletus*.

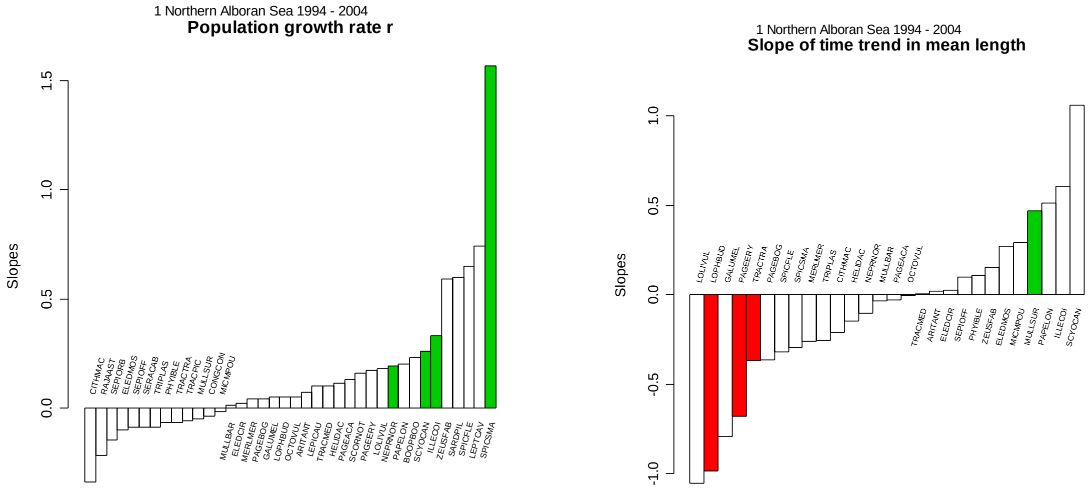


Figure II.1.3. Population growth rates and mean length in the Alboran Sea.

In the overall period the trend of the average total mortality rate (Z) was significantly increasing for *Parapenaeus longirostris* with reference to the whole period and for *Merluccius merluccius* during last five years (Figure II.1.4).

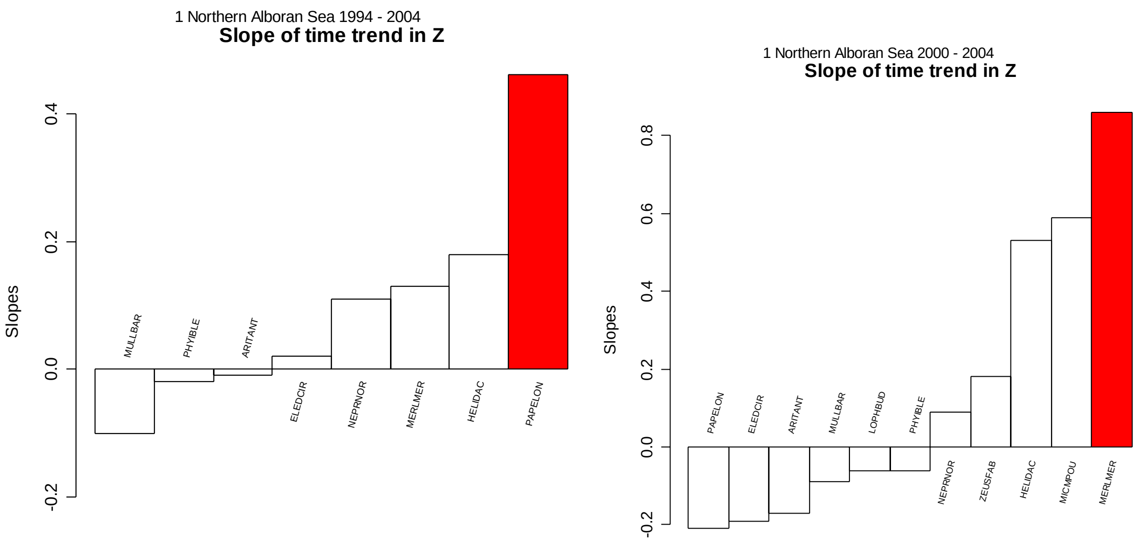


Figure II.1.4. Mortality by species in the Alboran Sea.

During the overall period the slope of time trend in L50 was decreasing significantly for 2 species (*Chelidonichthys lastoviza* and *Mullus barbatus*), and it was increasing significantly for 10 species (*Pagellus acarne*, *Spicara flexuosa*, *Galeus melastomus*, *Trachurus mediterraneus*, *Helicolenus dactylopterus*, *Merluccius merluccius*, *Phycis blennoides*, *Scyliorhinus canicula*, *Micromesistius poutassou* and *Zeus faber*). For the short period (2000-2004) 4 species presented a significant decreasing trend of mean length (*Mullus barbatus*, *Chelidonichthys lastoviza*, *Pagellus acarne* and *Micromesistius poutassou*) (Figure II.1.5). Only six species (*Galeus melastomus*, *Scyliorhinus canicula*, *Pagellus bogaraveo*, *Lophius budegassa*, *Merluccius merluccius* and *Zeus faber*) showed a significant increasing trend on mean length.

The species *Chelidonichthys lastoviza* and *Mullus barbatus* were seldom in the area in this season (Figure II.1.6). For other species that show an increasing trend, it is necessary to study certain biological details to asseverate their significance.

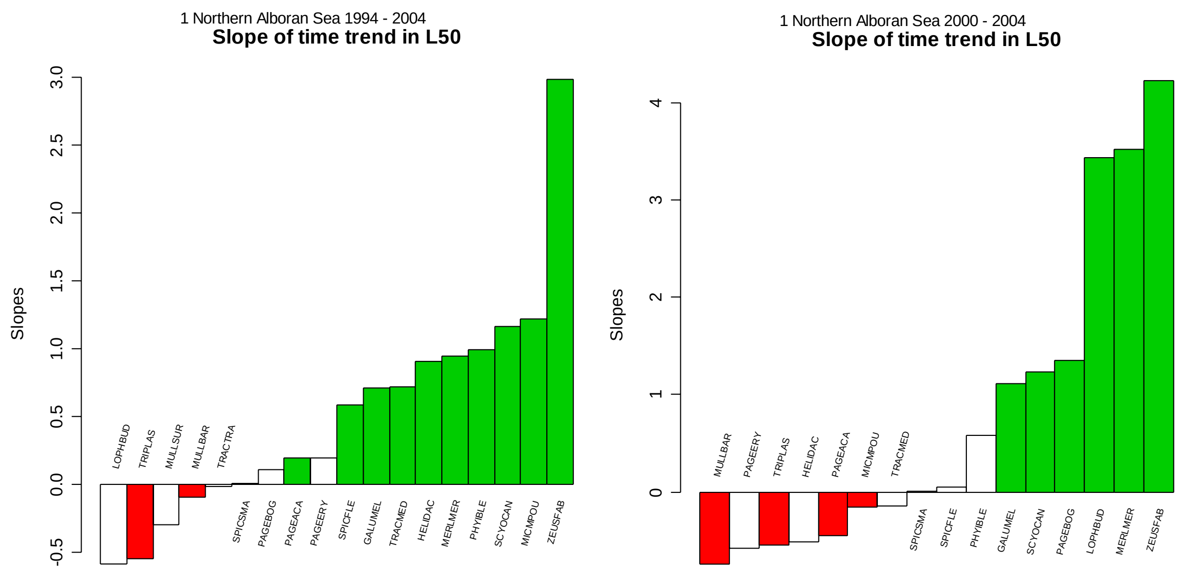


Figure II.1.5. Summary of trends in maturity size in the Alboran Sea.

In the case of *Mullus barbatus*, it is relevant to explain the scarcely quantity of females in the area during the season.

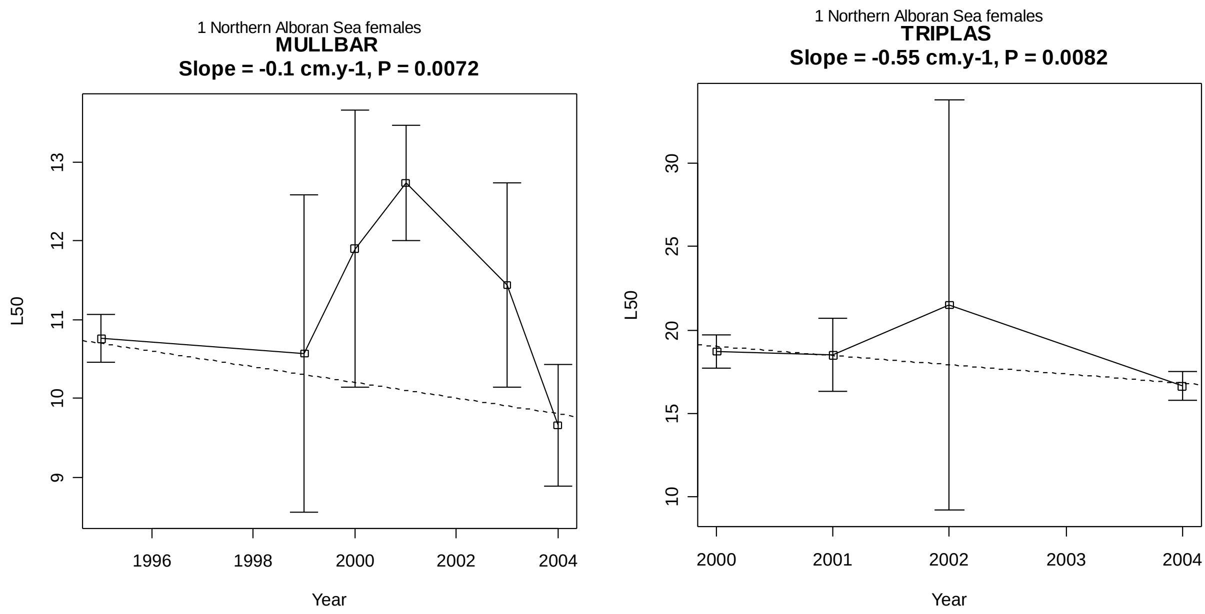


Figure II.1.6. Trends in maturity size in the Alboran Sea for *Mullus barbatus* and *Chelidonichthys lastoviza*.

II.1.6 Sensitivity analyses for Z

The results highlighted the strong influence of the growth parameters for the computation of the slope of time trend in Z. Semi-pelagic species like *Merluccius merluccius* or *Micromesistius poutassou* display different results in trends if L_{inf} or L_{max} are changed. A deep revision of the VB parameters used for computation in the whole Mediterranean area will be necessary (in one specialist Working Group) before result interpretation.

The exploratory data results for Alboran-Vera CGPM area 1 are given in Table II.1.2.

Table II.1.2. Sensitivity of the mortality values.

Species	SlopeZ	SDZ	PvalueZ	PvaluerobustZ
ARITANT	-0.01	0.11	0.93	0.055
CITHMAC	NA	NA	NA	NA
ELEDCIR	0.02	0.09	0.81	0.172

Species	SlopeZ	SDZ	PvalueZ	PvaluerobustZ
HELIDAC	0.18	0.09	0.09	0.637
LOPHBUD	NA	NA	NA	NA
MERLMER	0.13	0.13	0.34	0.055
MICMPOU	NA	NA	NA	NA
MULLBAR	-0.1	0.13	0.45	0.055
MULLSUR	NA	NA	NA	NA
NEPRNOR	0.11	0.08	0.24	0.055
PAGEACA	NA	NA	NA	NA
PAGEBOG	NA	NA	NA	NA
PAGEERY	NA	NA	NA	NA
PAPELON	0.46	0.14	0.01	0.377
PHYIBLE	-0.02	0.06	0.81	0.172
SCYOCAN	NA	NA	NA	NA
SPICFLE	NA	NA	NA	NA
SPICSMA	NA	NA	NA	NA
TRACMED	NA	NA	NA	NA
TRACTRA	NA	NA	NA	NA
TRIPLAS	NA	NA	NA	NA
ZEUSFAB	NA	NA	NA	NA

Four species show significant trends (average mortality estimates for a given age range) over the whole range of available data (1994-2004). In the case of *Aristeus antennatus*, only age 1 estimate is positive, hence the "average Z" corresponds to total mortality from age 1 to 2. For *Merluccius merluccius* only the age 0 is positive. For *Mullus barbatus* the age 1 is positive, and the estimate for age 0 is positive for *Nephrops norvegicus*.

II.1.7 Discussion

The answer of the international working group MEDITS to the request of the fishery managers of the UE in form of analysis of populations and communities would have to become a global way for all the countries implied in the study. Aaccording to the algorithms and interpretations proposed by Trenkel and Rochet (2003), the results presented for the area GSA 1 are the first model that approaches trends of the MEDITS data series including a large set ofcommunities and populationsin the context of fishing analyses. When interpreting the results, the characteristics of the fishing gear (sampling) is a factor important to consider, as well as the survey time in the year (season) and the different types of bottoms and infauna sampled.

The results obtained from this analysis show that the species sampled by the MEDITS surveys present certain stability in the trends in biomass and abundance. We must emphasize that this analysis included all the fish species (benthonic and pelagic) as well as the invertebrates included in the Medits reference list. To model the demersal communities with all these species put the problem thata incidental massive presence of, for example, some pelagic species (vertebrate and invertebrate) can mask the understanding of the abundance trends of the part of the community more strongly in link with the bottom.

On the other hand when the series of MEDITS surveys began (in 1994), several studies on assessment of demersal resources (population dynamics) in the Mediterranean emphasized the lack of global knowledge related to the studied species on so basic questions as their biogeographic distribution, reproductive biology, growing and nursery areas, habitat segregation by growing, etc. Nevetheles, mainly were spoken of overexploitation, concept that continue appearing in all the evaluations of the international agencies.

The results of the proposed model concerning the "community indicators" reveal a stability situation during the 11 years surveyed. The total abundance showed values between 18-19 ind/km^2 (log transformed). The total biomass during the period was estimated to nearly 16-18 kg/km^2 (log transformed). The mean weight showed a certain stability too. The proportion of large individual's indicator showed an anomaly during the 1997 survey, when a high quantity of *Micromesistius poutassou* recruits disturb the trend. In the short period (2000-2004) we found certain stability too, but not statistically representative.

In general the "population indicators" did not show any significant fishing impact for the most important species targeted by the fishery in the GSA n° 1. Some indicators such as the "Slope of time trend in Z" and the "Trend of L_{50}" can be strongly affected by the choice of the growth parameters and the quality and quantity of input data. Moreover, an other population indicator such as the "biomass index" could be useful to a better description of species dynamics. In fact, the species abundance values used for the estimation of the intrinsic population growth rate “r” can be strongly affected by the strength and intensity of the recruitment and give information with sound effect. The use of other estimators than the “mean” (i.e. median, percentiles) can provide additional information for most of the indicators used and help for the interpretation of the global results.

The model detected decreasing trend (mean length) in *Lophius budegassa* and *T. trachurus*. Although a significant increase of Z was observed for *Parapenaeus longirostris* (2000-2004) and *M. merluccius* (2000-2004), no consequences were observed for their populations. These results should be considered with care when interpreting fishing impact, because other factors (e.g. oceanographic variables, recruitment,) may have also affected the trends.

II.1.8 Appendix

Annex II.1.1. Von Bertalanffy parameters used

SPECIES	T0	K	LINF	AUTHORS
ASPICUC	-0.656	0.283	34.85	Gulf of Lions – (Campillo 1992)
CITHMAC	-0.430	0.257	25.70	Aegean Sea - (Stergiou *et al.* 1997)
EUTRGUR	1.990	0.219	26.40	Pagasitikos Gulf - (Stergiou *et al.* 1997) Fork Length
HELIDAC	0.850	0.210	21.20	Gulf of Lions – (Campillo 1992)
LEPMBOS	-1.060	0.236	28.05	Gulf of Lions – (Campillo 1992)
LOPHBUD	-0.921	0.130	66.75	Saronikos Gulf - (Stergiou *et al.* 1997)
LOPHPIS	0.4295	0.3435	107.55	Aegean Sea - (Stergiou *et al.* 1997)
MERLMER	0.035	0.184	126.9	Balearic area – Alemany & Oliver 1995 in Anon. 2004
MICMPOU	-1.29	0.22	40.35	Spain – (Campillo 1992)
MULLBAR	-0.37	0.580	23.97	Alboran – Del Arbol et al. 2003 in Anon. 2004
MULLSUR	-0.400	0.700	29.29	Voliani *et al.* 1998
PAGEACA	-1.36	0.270	29.62	Alboran – Baro 2000 in Anon. 2004
PAGEBOG	-0.38	0.243	39.8	Atlantic sea – (Campillo 1992)
PAGEERY	-0.0394	0.2554	54.40	Gulf of Lions – (Campillo 1992)
SPARPAG	2.830	0.118	45.10	Dodeckanisos - (Stergiou *et al.* 1997)
PHYIBLE	-0.414	0.233	46.6	Gulf of Lions – (Campillo 1992)
RAJACLA	-0.600	0.170	96.30	Atlantic sea – (Campillo 1992)
SCYOCAN	0.000	0.200	88.00	North Sea - (Froese & Pauly 2002) Jennings et al. 1999
SOLEVUL	-1.065	0.243	50.53	Gulf of Lions – Anon. 2004
SPICFLE	-1.9025	0.235	17.2	Patraikos gulf – (Stergiou *et al.* 1997) Fork length
SPICSMA	-1.626	0.404	18.90	Crete - (Stergiou *et al.* 1997)
TRACMED	-2.305	0.226	39.90	Saronikos Gulf - (Stergiou *et al.* 1997)
TRACTRA	-1.280	0.220	37.50	Adriatic – (Campillo 1992)
TRIPLAS	-0.639	0.254	38.20	(Campillo 1992)
TRISCAP	-1.867	0.179	32.3	Evvoikos gulf – (Stergiou *et al.* 1997)
ZEUSFAB	0.000	0.298	57.9	Mauritania - (Froese & Pauly 2002)
ARISFOL	0.000	0.46	69.5	Strait of Sicily – Anon. 2004 CL (mm)
ARITANT	-0.28	0.38	65.0	Gulf of Vera – Garcia Rodriguez 2002 CL (mm)
NEPRNOR	-0.039	1.02	76.41	Gulf of Lions – Campillo, In Anon. 2004
PAPELON	0.000	0.71	40.93	Strait of Sicily – Anon. 2004 CL (mm)
ELEDCIR	-0.065	1.123	12.49	Gulf of Lions – (Campillo 1992)

Other reference: (Anon. 1999)

Annex II.1.2. List of species names for population analyses

ARITANT	*Aristeus antennatus*	NEPRNOR	*Nephrops norvegicus*
ASPICUC	*Aspitrigla cuculus*	OCTOVUL	*Octopus vulgaris*
ELEDCIR	*Eledone cirrhosa*	PAGEBOG	*Pagellus bogaraveo*
ELEDMOS	*Eledone moschata*	PAGEERY	*Pagellus erythrinus*
EUTRGUR	*Eutrigla gurnardus*	PAPELON	*Parapenaeus longirostris*
GALUMEL	*Galeus melastomus*	PHYIBLE	*Phycis blennoides*
HELIDAC	*Helicolenus dactylopterus*	SCYOCAN	*Syciliorhinus canicula*
ILLECOI	*Illex coindetii*	SOLEVUL	*Solea vulgaris*
LEPMBOS	*Lepidorhombus boscii*	SPARPAG	*Sparus pagrus*
LEPTCAV	*Lepidotrigla cavillone*	SPICFLE	*Spicara flexuosa*
LOLIVUL	*Loligo vulgaris*	SPICSMA	*Spicara smaris*
LOPHBUD	*Lophius budegassa*	TRACMED	*Trachurus mediterraneus*
LOPHPIS	*Lophius piscatorius*	TRACTRA	*Trachurus trachurus*
MERLMER	*Merluccius merluccius smiridus*	TRISCAP	*Chelidonichthys lastoviza*
MICMPOU	*Micromesistius poutassou*	TRISCAP	*Trisopterus minutus capelanus*
MULLBAR	*Mullus barbatus*	ZEUSFAB	*Zeus faber*
MULLSUR	*Mullus surmuletus*		

Annex II.1.3. L_{50} per species and year

Scientific name	**MEDITS code**	**Year with good ogives**	**Lmat (cm)**
Aspitrigla cuculus	ASPI CUC	-	
Citharus linguatula	CITH MAC	-	
Eutrigla gurnardus	EUTR GUR	-	
Galeus melastomus	GALU MEL	1999-2004	46
Helicolenus dactylopterus	HELI DAC	2001-2004	20-21
Lepidorhombus boscii	LEPM BOS	-	
Lophius budegassa	LOPH BUD	-	
Lophius piscatorius	LOPH PIS	-	
Merluccius merluccius	MERL MER	-	
Micromesistius poutassou	MICM POU	-	
Mullus barbatus	MULL BAR	1999-2004	11-12
Mullus surmuletus	MULL SUR	-	
Pagellus acarne	PAGE ACA	1994-2004	14-15
Pagellus bogaraveo	PAGE BOG	-	
Pagellus erythrinus	PAGE ERY	-	
Phycis blennoides	PHYI BLE	-	
Raja clavata	RAJA CLA	-	
Scyliorhinus canicula	SCYO CAN	-	
Solea vulgaris	SOLE VUL	-	
Sparus pagrus	SPAR PAG	-	
Spicara flexuosa	SPIC FLE	-	
Spicara smaris	SPIC SMA	-	
Trachurus mediterraneus	TRAC MED	-	
Trachurus trachurus	TRAC TRA	-	
Chelidonichthys lastoviza	TRIP LAS	-	
Trisopterus minutus capelanus	TRIS CAP	-	
Zeus faber	ZEUS FAB	-	

Annex II.1.4. All estimates of trends in parameters

Species	r	SD r	P value r	Slope Lbar	SD Lbar	P value Lbar	Slope Z	SD Z	P value Z	P value Robust Z	Trend Lm	SD Lm	P value Lm
GALUMEL	0.05	0.04	0.2984	-0.791	0.463	0.163	NA	NA	NA	NA	0.711	0.136	0.000
HELIDAC	0.11	0.06	0.0960	-0.147	0.358	0.693	0.18	0.09	0.09	0.637	0.900	0.044	0.000
ILLECOI	0.33	0.14	0.0444	0.607	0.311	0.087	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	0.05	0.04	0.2762	-0.985	0.204	0.001	NA	NA	NA	NA	-0.587	0.580	0.320
MERLMER	0.04	0.06	0.4508	-0.260	0.161	0.141	0.13	0.13	0.34	0.055	0.945	0.176	0.000
MICMPOU	-0.02	0.22	0.9439	0.290	0.542	0.605	NA	NA	NA	NA	1.216	0.064	0.000
MULLBAR	0.01	0.08	0.9270	-0.032	0.073	0.667	-0.1	0.13	0.45	0.055	-0.098	0.041	0.007
MULLSUR	-0.05	0.08	0.5179	0.468	0.143	0.010	NA	NA	NA	NA	-0.298	0.618	0.609
NEPRNOR	0.19	0.06	0.0117	-0.105	0.092	0.285	0.11	0.08	0.24	0.055	NA	NA	NA
PAGEACA	0.13	0.11	0.2658	-0.028	0.181	0.880	NA	NA	NA	NA	0.188	0.031	0.000
PAGEERY	0.17	0.11	0.1568	-0.682	0.279	0.037	NA	NA	NA	NA	0.190	0.159	0.206
PAPELON	0.20	0.13	0.1521	0.512	0.337	0.164	0.46	0.14	0.01	0.377	NA	NA	NA
PHYIBLE	-0.07	0.04	0.1262	0.107	0.213	0.628	-0.02	0.06	0.81	0.172	0.992	0.148	0.000
SCYOCAN	0.26	0.09	0.0176	1.059	0.614	0.160	NA	NA	NA	NA	1.164	0.230	0.000
SPICFLE	0.65	0.56	0.2789	-0.320	0.230	0.213	NA	NA	NA	NA	0.586	0.048	0.000
SPICSMA	1.57	0.61	0.0294	-0.295	0.329	0.420	NA	NA	NA	NA	0.002	0.448	0.997
TRACMED	0.10	0.09	0.3083	0.007	0.160	0.964	NA	NA	NA	NA	0.715	0.148	0.000
TRACTRA	-0.07	0.14	0.6393	-0.371	0.125	0.016	NA	NA	NA	NA	-0.022	0.047	0.624
TRIPLAS	-0.09	0.10	0.3850	-0.257	0.653	0.714	NA	NA	NA	NA	-0.547	0.190	0.008
ZEUSFAB	0.59	0.46	0.2335	0.151	0.700	0.835	NA	NA	NA	NA	2.980	1.233	0.016

Annex II.1.5. Estimates of trends in parameters*

	Population				Community				
	r	**Z**	**Lbar**	**Lmat**	**B**	**N**	$\bar{b}$	$\bar{l}$	**P large**
GSA n° 1 1994-2004	4/34 increase	1/7 decrease	1/24 decrease	10/2 increase	No trend	No trend	decrease	No trend	No trend
Years 2000-2004	No trend	1/10 decrease	No trend	No trend					
General comment		–	–		–	–		–	–
Relationship with fishing impact		–	–		–	–		–	–

* the significant trends have been considered only.

Colours: green= positive significant trend; red= negative significant trend; white = not significant trend; grey = significant change in opposite direction to fishing impact; yellow = significant change in the same direction of fishing impact.

Legend:

Level	Indicator	Description
	r	Population growth rate for species i
Population	Z	Average total mortality rate for species i
	Lbar	Average length of population i
	Lmat	Length at maturity (50% mature)
	B	Total biomass in community
	N	Total abundance in community
Community	$\bar{b}$	Average individual weight in community
	$\bar{l}$	Average individual length in community
	plarge	Proportion of large individuals in total community abundance

II.2 Northern Spain (area 6)

Coordinator : Luis Gil de Sola

II.2.1 Ecological settings, geographical and environmental features

The Geographical sub area (GSA) 6 includes three different regions: the Gulf of Alicante, the South Ebro Delta River and the North Ebro Delta River. All these regions are not uniform, neither from an oceanographic nor from a geomorphic point of view.

Oceanographical conditions are dominated by the continuous flow of water from the North (Gulf of Lions) to the South Iberia Peninsula, through the strait of Ibiza. Sedimentation in front of the Ebro Delta gives to this wide platform intrinsic characteristics different from the ones in the rest of the area. The Gulf of Alicante is a wide area with a sedimentary platform with numerous rocks and sandy patches. The channel of Ibiza has rocky bottoms influenced by the sea current of the Balearic Sea. The deep temperature water is cold; it is usually warmer in the coastal zones (for complete information see Margalef 1985).

The most characteristic geomorphological feature in the basin of Alicante as in the Valencia and Tramontana areas (influence of Ebro river, and Gerona) is the narrowness of the continental shelf. Numerous submarine canyons interrupt the continental slope. The influence of the currents towards the coast determined by very important local upwellings induce sedimentation and oceanographic processes which are important for the flora and fauna. The slope falls strongly toward the deep terrace at around 1200 meters in Alicante, Valencia and around the Ibiza channel, and more than 2000 meters in the north of Catalonia.

The surface of the slope between 200 and 800 meters depth is very small between Valencia and Barcelona. It is a little bit wider in front of Alicante and Gerona. There are rough sedimentary bottoms in this deep stratum.

The oceanographic characteristic of the water column in the area is typical of the North West Mediterranean region (Margalef 1985). A Mediterranean convergence is located in the south of Alicante. Presence and distribution of the flora and marine fauna in this area as well as its ecological features are very well related in numerous works (Margalef 1985).

The trawlable surface area (mud and sand) up to 800 meters in the GSA 6 is approximately of 33000 km^2 and the surface of the deep stratum (200-800 m) represents about 35% of the total.

II.2.2 Fisheries description and initial state assessment

Most of the Spanish Mediterranean fishery resources, wether demersal, small pelagic or highly migratory species have long been considered overexploited. The demersal resources of the northern Spain are almost exclusively exploited by the trawler fleets of the regions of Murcia, Valencia, Baleares and Catalonia. All these fleets operate on the same stocks and grounds.

Landing statistics on demersal and small pelagic species show a negative trend in the 1990's for the most important species or groups of species. Daily catch rates per vessel have fallen dramatically when compared to catch rates of some decades ago, despite the fact that the power and efficiency of fishing vessels have increased in recent times. Furthermore, the species and size compositions of the landings have changed over time too. Indeed, long life-span species and big size specimens have practically disappeared from demersal catches in several areas and fisheries.

Despite the recognised overexploitation of several resources, there are few scientifically reported cases of stocks at risk of collapse. Anchovy along the Northern Spanish coast and hake in the Gulf of Lions are among those, however. This long-term resilience of the Mediterranean fisheries, without so far detected dramatic collapses of target resources except for anchovy in the mid-1980's, is usually explained by the fact that some proportion of the adult stocks have most probably remained consistently unavailable to small mesh trawling.

This feature of the North West Mediterranean fisheries is determined by fishing practices, gear and vessel characteristics and by the presence of several untrawlable bottoms. It has led to the preservation of spatial/temporal sanctuaries within the normal distribution range of several species. This situation allows for a proportion of individuals to survive up to the maturity stages, thus preventing the collapse of the population.

Globally the trawerl fleet is composed of about 1030 boats. The mean tonnage of the fleet exploiting the continental shelf is about 150 HP; it is about 450 HP for the component of the fleet operating along the slope (IEO internal data). Trawler fleets operate all during the year, apart from a 1 or 2 months closed period (between May and October).

The main fishing ports are (from south to north): Santa Pola, Villajoyosa, Alicante, Valencia, Castellón, Vinaroz, Tarragona, Vilanova, Barcelona, Blanes, and Palamós. Furthermore, other smaller fishing harbours and numerous small scale fishing boats are located along the coast. Trawling is the most important fishing activity in the whole area. Landings are mixed and depending on season or depth. For instance, a single pelagic and semi-pelagic species (*Engraulis encrasicolus, Trachurus spp.* or *Micromesistius poutassou*) may predominates in catches. Other gears targeting demersal species, such as trammel nets or *Octopus* cups are used aboard a lot of boats. Semi-pelagic species represent 40% of the total landings. Hake, red mullet and *Pagellus spp.* are 20%. Te other relevant catches are made by cephalopod species which represent 35% of the landings (*Octopus vulgaris* 10%). The crustacean species are the most important targets in the GSA6 area. Crustacean's landings represent 40% of the total landing value, with a few species with very high economic interest (*Aristeus antennatus* and *Nephrops norvegicus*). The fleet that works in the depth stratum (400-800 m) is specialized in catching *Aristeus antennatus* (500 tons in 2003) and *Nephrops norvegicus* (115 tons in 2003).

Discards can be considered strong in depths shallower than 150 m (Pelagic species, *Boops boops* and *Trachurus spp.*). There was a considerable fishing effort decrease from 1995 to 2004 over the continental shelf, while it had increased in the deeper waters during the period.

II.2.3 Brief description of changes in survey design

MEDITS surveys have been carried out in the northern Spain basin (GSA n° 6) from 1994 since 2004 (Table II.2.1). The same ship has always been used. The Spanish O/V "Cornide de Saavedra": vessel length 66.7 m, engine power 2250 HP, tonnage 1113 GT (http://www.ieo.es/buques/cornide.htm).

The sampling scheme was random stratified. The GSA6 surface area is 32506 km^2. During the yearly survey 1998, it had been impossible to work in the north of Barcelona due to technical problems of the vessel.

Table II.2.1. MEDITS_ES GSA6 number of hauls and sampling period per year

Year	Number of stations	Sampling period
1994	55	05/06-19/06
1995	83	30/04-21/05
1996	74	10/05-27/05
1997	67	19/05-03/06
1998	60	15/05-30/05
1999	78	14/05-03/06
2000	75	02/06-23/06
2001	85	23/05-14/06
2002	90	23/05-13/06
2003	94	07/05-26/05
2004	85	17/05-03/06

II.2.4 Selection of species

To estimate the following population indices: mean length, L50 and total mortality value (Z), 37 target species with an average occurrence larger than 10% were included (list in the Appendix). The "community indicators" analyses indices and the "population index" "r" (Population growth rate) were performed from the overall 56 species of the reference list (including pelagic species).

II.2.5 Results: review of indicators

II.2.5.1 Community indicators

Total biomass and abundance in community did not show any significant trend in the period 1994-2004, either for the whole or for the short period (2000-2004) (Figure II.2.1). With respect to the average individual weight in community, the semi-pelagic species produced sound effects in the trend in certain years (1995-96-97). No significant trends in the average individual length appeared at the community level.

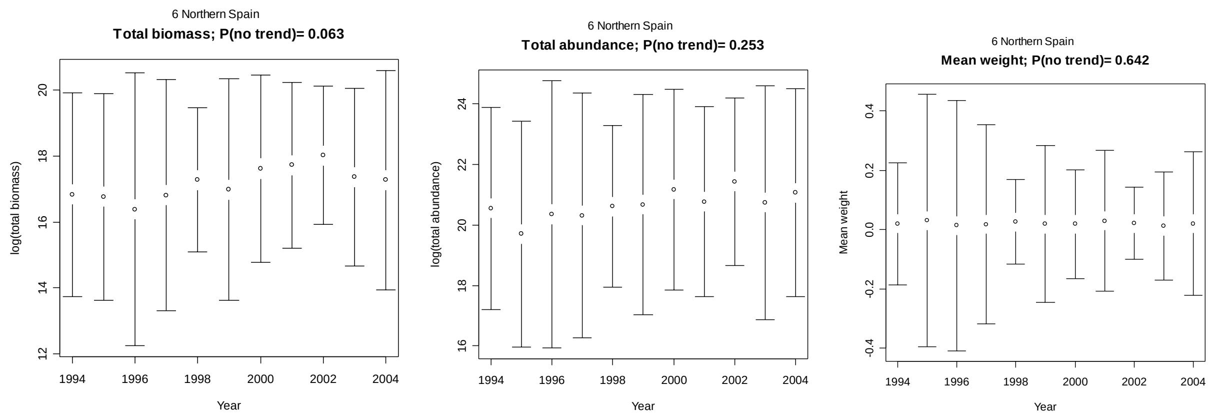


Figure II.2.1. Total abundance, biomass and mean weight in the Northern Spain.

We found a very low amount of large individuals (>27 CM) between the years 1995 and 1999. During the following years, the proportion increased to 0.02, falling again to 0.001 in 2004 (Figure II.2.2). In general, no significant trend was detected for the whole period in both areas.

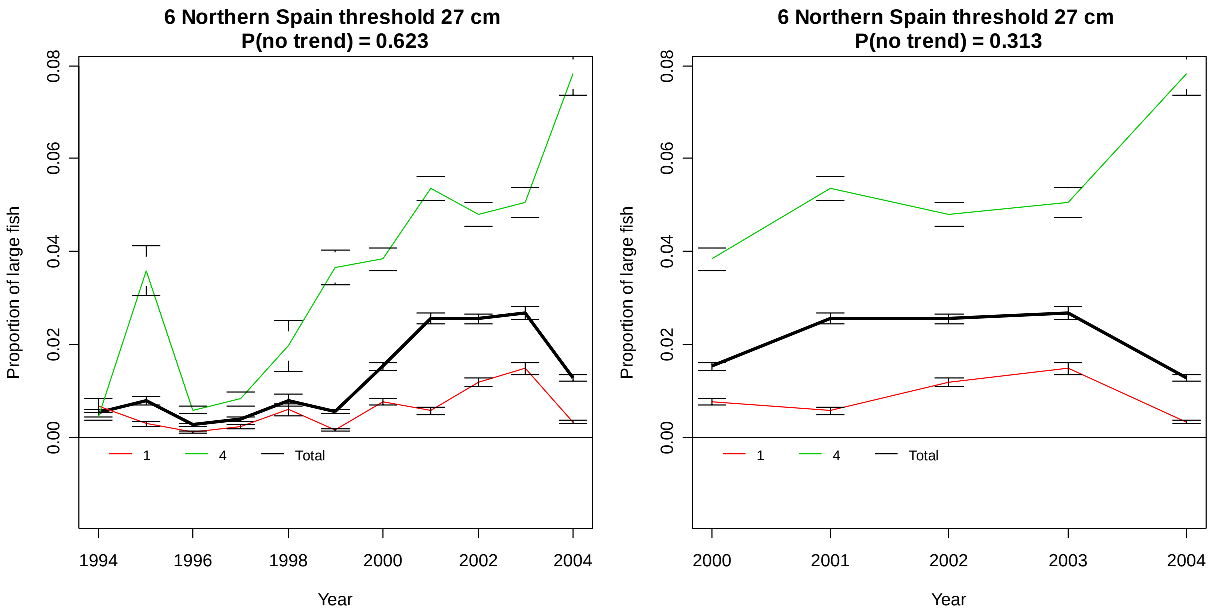


Figure II.2.2. Proportion of large fish in the Northern Spain. The green line indicates the slope area (200-800 m) and the red line the continental shelf.

II.2.5.2 Population indicators

The intrinsic population growth rate "r" showed a significant increment for 6 species (*Galeus melastomus*, *Merluccius merluccius*, *Diplodus annularis*, *Helicolenus dactylopterus*, *Boops boops* and *Pagellus erythrinus*) of the 46 species, 5 species showing a decreasing trend (*Trachurus picturatus*, *Squilla mantis*, *Sepia orbignyana*, *Lepidotrigla cavillone* and *Eledone moschata*) during the whole period (Figure II.2.3). During the last five years (2000-2004), neither species showed any significantly increasing of “r”, while 2 species (*Boops boops* and *Helicolenus dactylopterus*) shown a decreasing trend (Figure I.2.4).

The trend of average length of population was significantly increasing for 3 species (*Mullus surmuletus*, *Pagellus erythrinus* and *Lepidorhombus boscii*) during the whole period. No falling trend was identified. In the short period (2000-2004), no increase in “r” has been detected, and a lowering appeared for 1 species only (*Octopus vulgaris*).

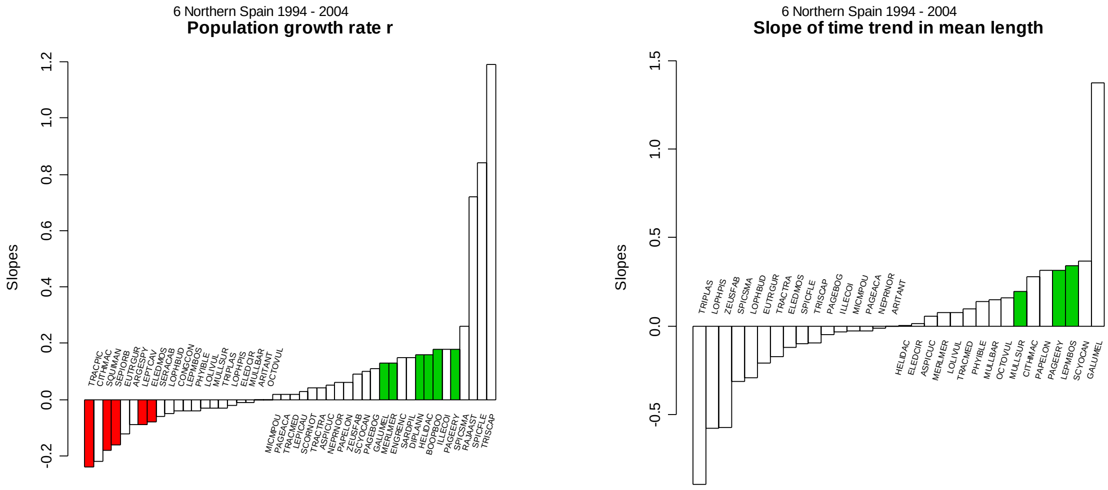


Figure II.2.3. Population growth rates and mean length in the Northern Spain.

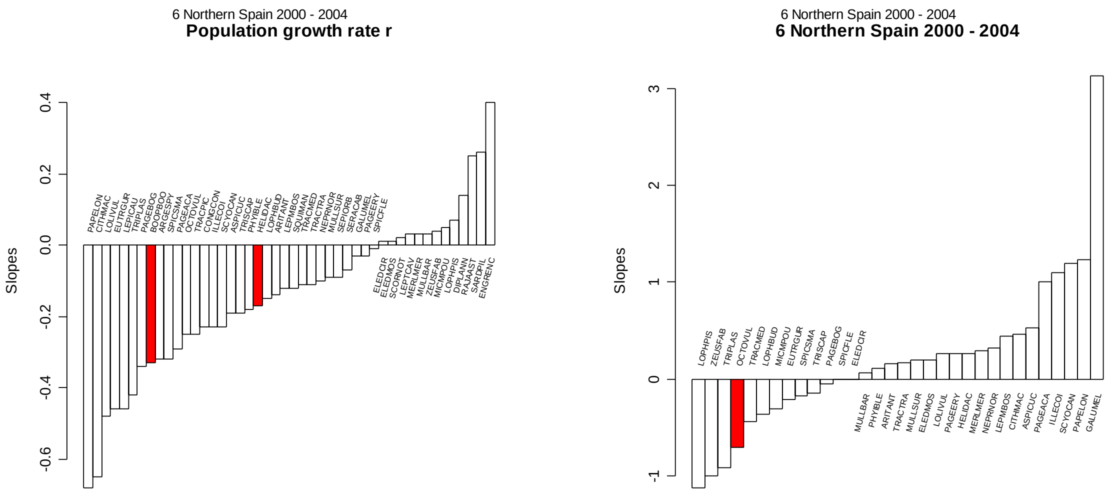


Figure II.2.4. Population growth rates and mean length in the Northern Spain.

For the overall as for the short periods, no trend appeared in the average total mortality rate (Z) (Figure II.2.5).

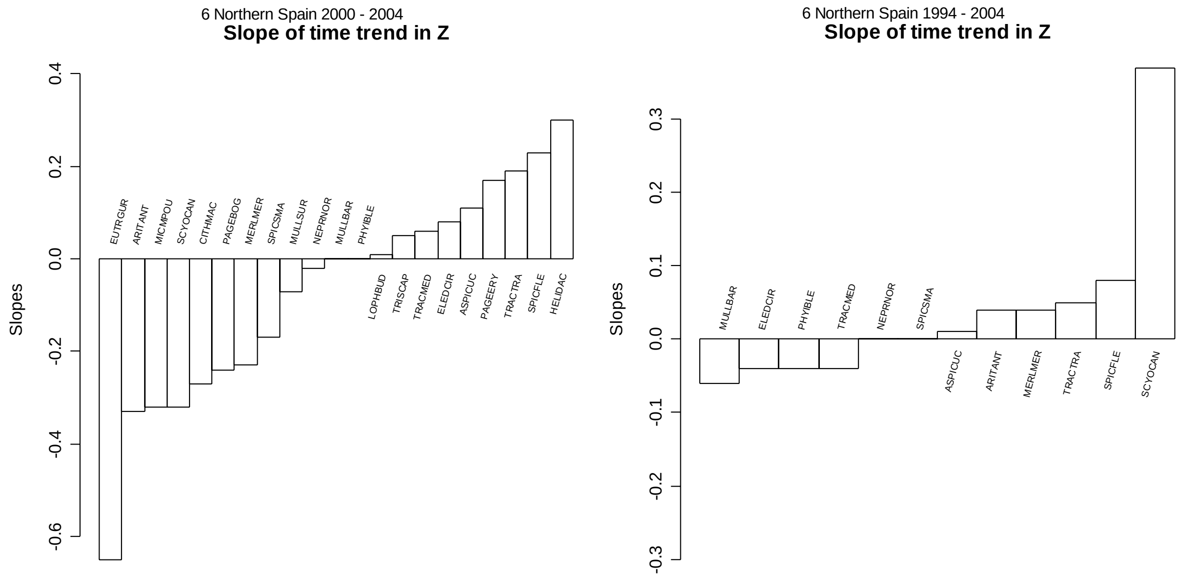


Figure II.2.5. Mortality by species in the Northern Spain.

During the overall period, the slope of time trend in L50 was significantly decreasing only for 1 of 27 species (*Spicara smaris*), and it was significantly increasing for 14 of them (Figure II.2.6). For the short period (2000-2004), 4 species presented a significant decreasing trend of mean length (*Helicolenus dactylopterus*, *Spicara smaris*, *Spicara flexuosa* and *Micromesistius poutassou*). 11 species showed a significant increasing trend on first maturity mean length (Figures II.2.6 & II.2.7).

For the two species of *Spicara*, *Helicolenus dactylopterus* and *Micromesistius poutassou*, females were rarely found in the area in this season. For the other species that have shown an increasing trend, it would be necessary to study biological details to asseverate their significance.

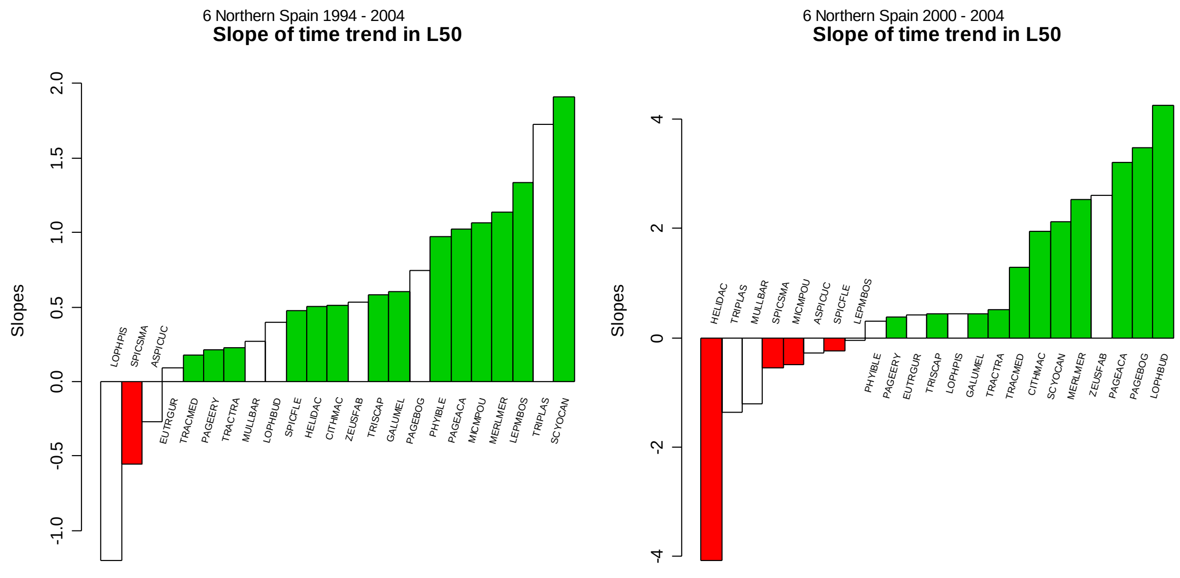


Figure II.2.6. Summary of trends in maturity size in the Northern Spain.

In the case of *Helicolenus dactylopterus*, it is relevant to explain the result by the low quantity of females in the area during the year 2000 (Figure II.2.7).

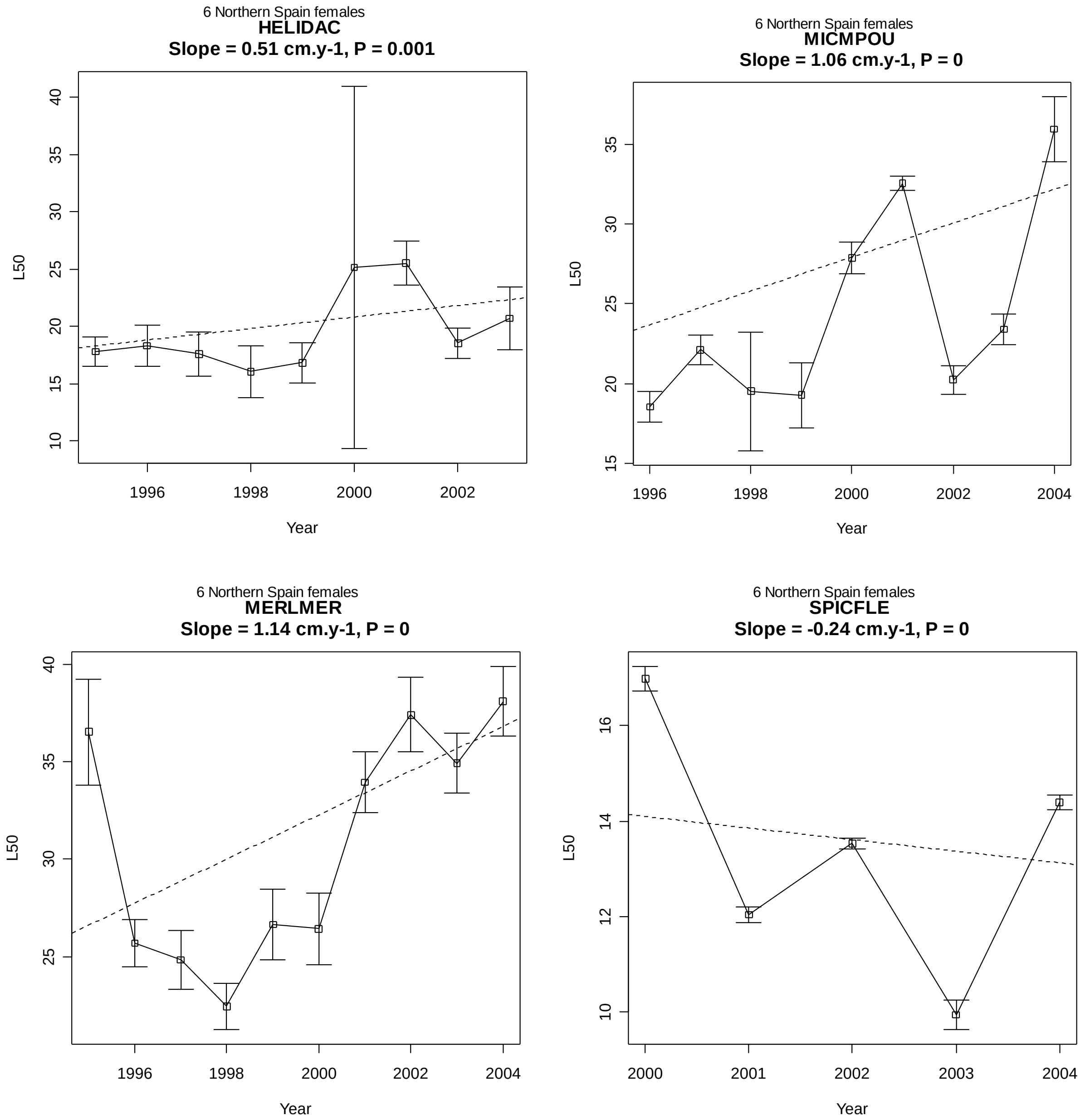


Figure II.2.7. Trends in maturity size in the Northern Spain for Helicolenus dactylopterus, Micromesistius poutassou, Merluccius merluccius and Spicara flexuosa.

II.2.6 Sensitivity analyses for Z

The results highlighted the strong influence of the growth parameters for the computation of the time trend slope in Z. Semi-pelagic species like *Merluccius merluccius* or *Micromesistius poutassou* display different results in trends if L_{inf} or L_{max} are changed. The exploratory data results for Northern Spain CGPM area 6 are given in Table II.2.2. Nevertheless, only a deep revision of the VB set of parameters for the whole Mediterranean area (to be established by a specialized Working Group) will be adequate to allow for biological interpretation.

Table II.2.2. Sensitivity of the mortality values.

Species	Slope Z	SD Z	P value Z	P value robust Z
ARITANT	0.04	0.06	0.58	0.377
ASPICUC	0.01	0.43	0.99	0.313
CITHMAC	NA	NA	NA	NA
ELEDCIR	-0.04	0.08	0.64	0.011
EUTRGUR	NA	NA	NA	NA
HELIDAC	NA	NA	NA	NA
LEPMBOS	NA	NA	NA	NA

Species	Slope Z	SD Z	P value Z	P value robust Z
LOPHBUD	NA	NA	NA	NA
LOPHPIS	NA	NA	NA	NA
MERLMER	0.04	0.08	0.67	0.055
MICMPOU	NA	NA	NA	NA
MULLBAR	-0.06	0.06	0.36	0.011
MULLSUR	NA	NA	NA	NA
NEPRNOR	0	0.07	0.96	0.055
PAGEACA	NA	NA	NA	NA
PAGEBOG	NA	NA	NA	NA
PAGEERY	NA	NA	NA	NA
PAPELON	NA	NA	NA	NA
PHYIBLE	-0.04	0.05	0.44	0.011
SCYOCAN	0.37	0.5	0.52	0.313
SPICFLE	0.08	0.07	0.34	0.055
SPICSMA	0	0.12	0.98	0.313
TRACMED	-0.04	0.05	0.46	0.011
TRACTRA	0.05	0.07	0.47	0.172
TRIPLAS	NA	NA	NA	NA
TRISCAP	NA	NA	NA	NA
ZEUSFAB	NA	NA	NA	NA

Seven species showed positive estimations (average mortality estimates for a given age range) over the whole range of available data (1994-2004). In the case of *Eledone cirrhosa*, only age 1 estimate was positive, hence the “average Z” corresponds to total mortality from age 1 to 2. For *Merluccius merluccius* only age 0 was positive. For *Mullus barbatus,* only age 1-3 was positive. For *Nephrops norvegicus*, only age 0 was positive. It was the same for age 4 of *Spicara flexuosa* and for age 0 of *Trachurus mediterraneus*.

II.2.7 Discussion

The answer of the international MEDITS working group to the request of the UE fisheries managers in form of analysis of populations and communities trends would have to become a global way for all the countries implied in the study. To save this important question for the GSA 6, estimates were done according to the algorithms and interpretations of Trenkel and Rochet (2003). This analysis is the first model that approaches the historical MEDITS data base at a communities and populations level. When interpreting the results, the fishing gear (sampling) is a factor important to consider, as well as the time of the survey in the year (season) and the different types of bottoms and fauna encountered.

The results obtained by means of this analysis show that the species studied by the MEDITS survey present certain stability in biomass and density (number of individuals by swept area). We must emphasize that for this first approach the analyses included all the reference fish species (benthonic and pelagic) and all the reference invertebrates. Modeling the demersal communities including all the species is disadvantageous as a possible massive presence of some pelagic species (vertebrate and invertebrate) can disturb the understanding of the community as well as the trend in a series of relative abundances.

On the other hand, when the MEDITS survey series began (in 1994), several specific assessments (population dynamics) emphasized the lack of global knowledge related to basic questions as biogeographic distribution, reproductive biology, growing and nursery areas, habitat segregation by stage, etc. Mainly were talking of overexploitation, valuation that continues appearing in the evaluations made in the international assessment bodies.

Concerning the “community indicators”, the results of the proposed model reveal a stability situation during the 11 years of surveys. The total abundance showed values between 19-21 ind/km^2 (log transformed). The total biomass was nearly 16-18 kg/km^2 (log transformed) during the period. The mean weight showed a certain stability state. The indicator for the proportion of large individuals showed an anomaly during the 1997 survey, when a high recruitment of *Micromesistius poutassou* had disturbed the trend. In the short period (2000-2004), we found a certain stability too, but not statistically representative.

In general the “population indicators” results did not show any significant fishing impact for the most important target species in the GSA n° 6. Some indicators such as the “Slope of time trend in Z” and the “Trend of $L_{50\%}$ values” can be strongly affected by the choice of the growth parameters as well as the quality and quantity of input data. Moreover, another population indicator such as the “biomass index” could be useful to a better description of species dynamics. In fact, the estimations of intrinsic population growth rate “r” can be strongly affected by the strength and intensity of the recruitment and can give misleading information. The use of other estimators than the “mean” (i.e. median, percentiles) could provide additional information for most of the indicators used and help for the interpretation of the global results.

Referring to the overall period, the model had detected decreasing trend (mean length) for no one species; it had detected an increase for *Pagellus erythrinus* (17 to 20.5 cm; slope: 0.32 ± 0.085), *Mullus surmuletus* (17.5 to 19 cm; slope: 0.2 ± 0.084) and *Lepidorhombus boscii* (14 to 16 cm; slope: 0.34 ± 0.091). These results must be considered with care due to the high pressure exerted on these species of high economical importance.

No significant increase of Z was observed for overall and short time. Nevertheless, these results should be considered with care when interpreting fishing impact, because other factors (e.g. oceanographic variables, recruitment, etc.) that may have also affected the trends.

[II].2 Northern Spain (area 6)

II.2.8 Appendix

Annex II.2.1. Von Bertalanffy parameters used.

SPECIES	T0	K	LINF	AUTHORS
ASPICUC	-0.656	0.283	34.85	Gulf of Lions – (Campillo 1992)
CITHMAC	-0.430	0.257	25.70	Aegean Sea - (Stergiou *et al.* 1997)
EUTRGUR	1.990	0.219	26.40	Pagasitikos Gulf - (Stergiou *et al.* 1997) Fork Length
HELIDAC	0.850	0.210	21.20	Gulf of Lions – (Campillo 1992)
LEPMBOS	-1.060	0.236	28.05	Gulf of Lions – (Campillo 1992)
LOPHBUD	-0.921	0.130	66.75	Saronikos Gulf - (Stergiou *et al.* 1997)
LOPHPIS	0.4295	0.3435	107.55	Aegean Sea - (Stergiou *et al.* 1997)
MERLMER	0.035	0.184	126.9	Balearic area – Alemany & Oliver 1995 in Anon. 2004
MICMPOU	-1.29	0.22	40.35	Spain – (Campillo 1992)
MULLBAR	-0.37	0.580	23.97	Alboran – Del Arbol et al. 2003 in Anon. 2004
MULLSUR	-0.400	0.700	29.29	Voliani *et al.* 1998
PAGEACA	-1.36	0.270	29.62	Alboran – Baro 2000 in Anon. 2004
PAGEBOG	-0.38	0.243	39.8	Atlantic sea – (Campillo 1992)
PAGEERY	-0.0394	0.2554	54.40	Gulf of Lions – (Campillo 1992)
SPARPAG	2.830	0.118	45.10	Dodeckanisos - (Stergiou *et al.* 1997)
PHYIBLE	-0.414	0.233	46.6	Gulf of Lions – (Campillo 1992)
RAJACLA	-0.600	0.170	96.30	Atlantic sea – (Campillo 1992)
SCYOCAN	0.000	0.200	88.00	North Sea - (Froese & Pauly 2002) Jennings et al. 1999
SOLEVUL	-1.065	0.243	50.53	Gulf of Lions – Anon. 2004
SPICFLE	-1.9025	0.235	17.2	Patraikos gulf – (Stergiou *et al.* 1997) Fork length
SPICSMA	-1.626	0.404	18.90	Crete - (Stergiou *et al.* 1997)
TRACMED	-2.305	0.226	39.90	Saronikos Gulf - (Stergiou *et al.* 1997)
TRACTRA	-1.280	0.220	37.50	Adriatic – (Campillo 1992)
TRIPLAS	-0.639	0.254	38.20	(Campillo 1992)
TRISCAP	-1.867	0.179	32.3	Evvoikos gulf – (Stergiou *et al.* 1997)
ZEUSFAB	0.000	0.298	57.9	Mauritania - (Froese & Pauly 2002)
ARISFOL	0.000	0.46	69.5	Strait of Sicily – Anon. 2004 CL (mm)
ARITANT	-0.28	0.38	65.0	Gulf of Vera – Garcia Rodriguez 2002 CL (mm)
NEPRNOR	-0.039	1.02	76.41	Gulf of Lions – Campillo, In Anon. 2004
PAPELON	0.000	0.71	40.93	Strait of Sicily – Anon. 2004 CL (mm)
ELEDCIR	-0.065	1.123	12.49	Gulf of Lions – (Campillo 1992)

Annex II.2.2. List of species names for population analyses.

ARITANT	*Aristeus antennatus*
ASPICUC	*Aspitrigla cuculus*
ELEDCIR	*Eledone cirrhosa*
ELEDMOS	*Eledone moschata*
EUTRGUR	*Eutrigla gurnardus*
GALUMEL	*Galeus melastomus*
HELIDAC	*Helicolenus dactylopterus*
ILLECOI	*Illex coindetii*
LEPMBOS	*Lepidorhombus boscii*
LEPTCAV	*Lepidotrigla cavillone*
LOLIVUL	*Loligo vulgaris*
LOPHBUD	*Lophius budegassa*
LOPHPIS	*Lophius piscatorius*
MERLMER	*Merluccius merluccius smiridus*
MICMPOU	*Micromesistius poutassou*
MULLBAR	*Mullus barbatus*
MULLSUR	*Mullus surmuletus*
NEPRNOR	*Nephrops norvegicus*
OCTOVUL	*Octopus vulgaris*
PAGEBOG	*Pagellus bogaraveo*
PAGEERY	*Pagellus erythrinus*
PAPELON	*Parapenaeus longirostris*
PHYIBLE	*Phycis blennoides*
SCYOCAN	*Syciliorhinus canicula*
SOLEVUL	*Solea vulgaris*
SPARPAG	*Sparus pagrus*
SPICFLE	*Spicara flexuosa*
SPICSMA	*Spicara smaris*
TRACMED	*Trachurus mediterraneus*
TRACTRA	*Trachurus trachurus*
TRISCAP	*Chelidonichthys lastoviza*
TRISCAP	*Trisopterus minutus capelanus*
ZEUSFAB	*Zeus faber*

Annex II.2.3. L_{50} per species and year.

Scientific name	MEDITS code	Year with good ogives	Lmat (cm)
Aspitrigla cuculus	ASPI CUC	2000-2001-2003-2004	15-16
Citharus linguatula	CITH MAC	-	
Eutrigla gurnardus	EUTR GUR	1995-1997	15
Galeus melastomus	GALU MEL	1999 to 2004	50
Helicolenus dactylopterus	HELI DAC	1995-1996-1997-1998-1999	17-18
Lepidorhombus boscii	LEPM BOS	1999-2004	25
Lophius budegassa	LOPH BUD	1995-1997-2000-2002	25-29
Lophius piscatorius	LOPH PIS	-	
Merluccius merluccius	MERL MER	1996-1997-1998-1999-2000	25
Micromesistius poutassou	MICM POU	all year exclude 2000 and 2001	20
Mullus barbatus	MULL BAR	1995 to 2004	11
Mullus surmuletus	MULL SUR	1995 to 2004	15
Pagellus acarne	PAGE ACA	1995 to 2002	15
Pagellus bogaraveo	PAGE BOG	-	
Pagellus erythrinus	PAGE ERY	all year exclude 2001	15-16
Phycis blennoides	PHYI BLE	all year exclude 1997, 98, 99	31-32
Raja clavata	RAJA CLA	-	
Scyliorhinus canicula	SCYO CAN	1999 to 2004	35-39
Solea vulgaris	SOLE VUL	-	
Sparus pagrus	SPAR PAG	-	
Spicara flexuosa	SPIC FLE	1999-2001 to 2004	12-13
Spicara smaris	SPIC SMA	-	
Trachurus mediterraneus	TRAC MED	all year exclude 1997, 03, 04	16
Trachurus trachurus	TRAC TRA	all year exclude 2003	16-17
Chelidonichthys lastoviza	TRIP LAS	-	
Trisopterus minutus capelanus	TRIS CAP	2000 to 2004	14-15
Zeus faber	ZEUS FAB	all year exclude 1997, 03, 04	20-21

Annex II.2.4. All estimates of trends in parameters.

Species	r	SD r	P value r	Slope Lbar	SD Lbar	P value Lbar	Slope Z	SD Z	P value Z	Pvalue Robust Z	Trend Lm	SD Lm	P value Lm
BOOPBOO	0.18	0.07	0.0273	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CITHMAC	-0.22	0.12	0.0985	0.280	0.134	0.065	NA	NA	NA	NA	0.514	0.055	0.000
DIPLANN	0.16	0.06	0.0196	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEDMOS	-0.08	0.03	0.0146	-0.119	0.237	0.635	NA	NA	NA	NA	NA	NA	NA
GALUMEL	0.13	0.04	0.0190	1.375	1.290	0.346	NA	NA	NA	NA	0.600	0.136	0.000
HELIDAC	0.16	0.06	0.0360	0.003	0.187	0.989	NA	NA	NA	NA	0.507	0.136	0.001
LEPMBOS	-0.04	0.04	0.3785	0.344	0.091	0.004	NA	NA	NA	NA	1.332	0.222	0.000
LEPTCAV	-0.09	0.04	0.0419	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERLMER	0.13	0.04	0.0061	0.078	0.073	0.312	0.04	0.08	0.67	0.055	1.135	0.096	0.000
MICMPOU	0.02	0.13	0.8465	-0.029	0.138	0.841	NA	NA	NA	NA	1.063	0.061	0.000
MULLSUR	-0.03	0.04	0.4706	0.198	0.084	0.043	NA	NA	NA	NA	NA	NA	NA
PAGEACA	0.02	0.04	0.6175	-0.027	0.297	0.930	NA	NA	NA	NA	1.024	0.133	0.000
PAGEERY	0.18	0.03	0.0005	0.317	0.085	0.005	NA	NA	NA	NA	0.211	0.059	0.001
PHYIBLE	-0.04	0.04	0.3917	0.141	0.191	0.480	-0.04	0.05	0.44	0.011	0.973	0.111	0.000
SCYOCAN	0.10	0.07	0.2339	0.367	0.665	0.610	0.37	0.50	0.52	0.313	1.910	0.111	0.000
SEPIORB	-0.16	0.06	0.0379	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPICFLE	0.84	0.63	0.2180	-0.099	0.103	0.367	0.08	0.07	0.34	0.055	0.477	0.017	0.000
SPICSMA	0.26	0.17	0.1637	-0.311	0.349	0.423	0	0.12	0.98	0.313	-0.555	0.072	0.000
SQUIMAN	-0.18	0.08	0.0411	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRACMED	0.02	0.05	0.6748	0.095	0.251	0.713	-0.04	0.05	0.46	0.011	0.176	0.030	0.000
TRACPIC	-0.24	0.07	0.0114	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRACTRA	0.04	0.06	0.5225	-0.173	0.121	0.188	0.05	0.07	0.47	0.172	0.226	0.017	0.000
TRISCAP	1.19	0.59	0.0755	-0.097	0.141	0.511	NA	NA	NA	NA	0.585	0.073	0.000

Annex II.2.5. Estimates of trends in parameters*.

	Population				**Community**				
	r	**Z**	**Lbar**	**Lmat**	**B**	**N**	$\bar{b}$	$\bar{l}$	**P large**
GSA n° 1 1994-2004	6/35 increase	No trend	3/29 increase	14/8 increase	No trend	No trend	No trend	No trend	No trend
Years 2000-2004	No trend	No trend	No trend	4/8 increase					
General comment		–	–		–	–		–	–
Relationship with fishing impact		–	–		–	–		–	–

* the significant trends have been considered only.

<u>Colours</u>: green= positive significant trend; red= negative significant trend; white = not significant trend; grey = significant change in opposite direction to fishing impact; yellow = significant change in the same direction of fishing impact.

<u>Legend</u>:

Level	**Indicator**	**Description**
	r	Population growth rate for species i
Population	Z	Average total mortality rate for species i
	Lbar	Average length of population i
	Lmat	Length at maturity (50% mature)
	B	Total biomass in community
	N	Total abundance in community
Community	$\bar{b}$	Average individual weight in community
	$\bar{l}$	Average individual length in community
	plarge	Proportion of large individuals in total community abundance

II.3 Gulf of Lions (area 7)

Coordinator : Jacques Bertrand

II.3.1 Ecological settings, geographical and environmental features

The sub area Gulf of Lions (GSA 7) is an open gulf which expands from the Cap Cerbère (western part) to the Cap Sicié (eastern part). The continental shelf of the gulf is nearly monotonous. From the coastal line to 200 meter depth, muddy deposits including pelits are dominating. In some places, sandy deposits exist along the coast and far from the shore. Very few rocky outcrops occur in this area. The upper slope is carved with a lot of canyons where bedrocks can be found around the valleys.

The most characterized water flow is the Liguro-Provencal stream which passes alongside the continental slope westward, from the Gulf of Genoa to the Catalan Sea. From spring to autumn, a well designed thermocline divides the surface waters with an average temperature of 20 °C from the deeper layer which is about 13 °C all during the year. The depth of the thermocline varies from 50 to 100 meters.

An important feature in the Gulf of Lions is the possibility of upwellings induced by the wind. Two types of wind, mistral and tramontana blow from the coast to the open sea, inducing a rising of cold deep water towards the sea surface. These winds are active mainly in winter and sometimes in summer. Within a short time, they bring about a decreasing of sea surface temperature of 5 to 10 °C. In the whole area, the salinity is high; it can reach 38.5 psu with a slight oversaltness in the deep water.

Taking into account the muddy characteristics of the seabed on the shelf, wide areas inhabited by species of concern for fishery are dominated by *Ophiotrix*. In the Gulf of Lions, there are some important populations of species like poor cod (*Trisopterus minutus capelanus*), which is lacking along the east coast of Corsica, and red mullets. A lot of cephalopods with high fishery value, as the common octopus, are living on the shelves.

Large individuals of some species able to live on the shelves and along the slopes are often more represented in the latest areas. It is particularly the case for the big anglerfishes, adults of hake, spiny lobsters and big shrimps. Finally, one important characteristic of the existing distribution of some of the main fishery target species in the Gulf of Lions is the separation of the populations into two components, the juveniles (on the upper shelves for hake and anglerfishes) and the breeding adults (mainly along the upper slope for these two species, for instance). This partition between shelf and slope has to be considered taking into account the distribution of fishing effort in the area. Indeed, as the French trawlers fishing in the Gulf are out of the port for periods of less than one day, and due to the distance from the ports to the limit of the shelves, they have not the possibility to fish along the slope where they could find bigger individuals.

II.3.2 Fisheries description and initial state assessment

Trawling has been used for fishing since a few centuries in the Gulf of Lion (Degage 1983). During the last three decades, it has been developed to such an extend that it is now one of the main components of the fishery techniques in the area (Meuriot *et al.* 1987). Indeed, owing to technical innovations (notably from bottom to pelagic trawling), the trawling fleet is able to fish in the whole water column. Nowadays, this fleet can be divided into two main components (Taquet *et al.* 1997), one directed to the catch of a few number of pelagic species (*Engraulis encrasicolus* and *Sardina pilchardus*), the other characterised by the exploitation of a great diversity of species. Finally, trawlers contribute to the exploitation of the main species caught in the area. Landings from trawlers would represent more than three quarters of the demersal species landings in the area (CGPM 1988) and close to 80 % of small pelagic caught (Ben Alaya 1996).

In the early 1970s, the demersal resources of the Gulf of Lions were still considered under-exploited (Bonnet 1973). First diagnoses of overexploitation in this area occurred after the rapid development of a bottom trawling fleet in the mid-70s (Meuriot *et al.* 1987). This conclusion was supported by global assessments (CGPM 1988) as for by single stock assessments. Indeed, most of the diagnoses available referring to single stocks have concluded to a high fishing pressure. It is particularly the case for *Merluccius merluccius* (Aldebert & Carries 1988; Aldebert *et al.* 1992; Aldebert & Recasens 1996), *Dicentrarchus labrax*, *Sparus aurata* or *Solea vulgaris* (Farrugio & Le Corre 1996).

II.3.3 Brief description of changes in survey design

The MEDITS surveys have been carried out in the Gulf of Lion every year since 1994 (Table II.3.1). The same ship, the French r/v L'Europe" has always been used. The main characteristics of this vessel are the following: vessel length 29.6 m, engine power 2 x 345 HP, tonnage 335 UMS.

The sampling scheme was stratified by depth. The haul positions were selected inside a grid defined such as to have a number of cells close to the target number of hauls. Inside each cell, the position of haul was selected randomly (one haul by cell). The same position were used every year. The GSA7 area has a surface of 13 860 km^2.

Table II.3.1. MEDITS_FR GSA7 number of hauls and sampling period per year

Year	Number of stations	Sampling period
1994	70	16/5 - 6/6
1995	68	24/6 - 10/7
1996	65	6/6 - 24/6
1997	76	8/6 - 28/6
1998	71	28/5 - 19/6
1999	66	14/5 - 7/6
2000	69	8/6 - 2/7
2001	67	10/6 - 3/7
2002	64	11/6 - 29/6
2003	73	11/6 - 4/7
2004	67	8/6 - 1/7

II.3.4 Selection of species

Among the 56 species for which information was available, 48 species (list in the Appendix) with average occurrence larger than 5 % were selected for calculation of population indices (population growth rate). Within this selection, indices based on length (mean length, L50 and total mortality value (Z)) were done only for the 35 species with length measurements. The community indicators were performed on the overall 56 species of the reference list (including pelagic species).

II.3.5 Results: review of indicators

II.3.5.1 Population indicators

II.3.5.1.1 Intrinsic Population growth rate

Over the whole period, five species (*Helicolenus dactylopterus*, *Nephrops norvegicus*, *Parapenaeus longirostris*, *Spicara flexuosa* and *Spicara smaris*) show a significant increasing trend in abundance, while four species (*Aspitrigla cuculus*, *Lepidorhombus boscii*, *Lepidotrigla cavillone* and *Scyliorhinus canicula*) exhibit a significant decreasing trend. For the last five years, only one species (*Spicara flexuosa*) show a significant trend. As for the long term for this species, this trend is directed towards an increasing abundance.

II.3.5.1.2 Mean length in population

Over the whole period, four species (*Helicolenus dactylopterus*, *Mullus surmuletus*, *Nephrops norvegicus* and *Trachurus mediterraneus*) show a significant increasing trend of the mean length, while five species including three cephalopods exhibit the reverse (*Eledone cirrhosa*, *Eledone moschata*, *Octopus vulgaris*, *Pagellus acarne* and *Spicara flexuosa*). The previous trend is confirmed only for *Trachurus mediterraneus* in the more recent period. For the last period one species (*Chelidonichthys lastoviza*) shows a decreasing trend in mean length. For *Helicolenus dactylopterus*, the increase of total abundance and mean length is associated with an increase in spawning stock abundance.

II.3.5.1.3 Average total mortality rates

In the whole period, the mortality rates have been investigated for 29 species. Nevertheless, taking into account the selection criteria based on the consistency of the series, Z estimates have been obtained for only 11 species. For each of these species, the results apply for at last one pseudo-age. A significant trend in Z was identified only for two species *Aspitrigla cuculus* (age 2) over the range of available data (1998-2004), illustrating an increasing of Z, and *Mullus surmuletus* with a negative trend of Z (period (1994-2004). For the last period, a significant trend in Z was identified only for *Lophius budegassa* (positive trend, parametric test).

II.3.5.1.4 Proportion mature

The number of females examined strongly varied according to the species and the yearly survey. Among the 35 species examined, no one exhibits any significant trend in the proportion of mature females both over the whole and the last periods.

II.3.5.1.5 Length at maturity

Among the 21 studied species, 15 showed a significant negative trend in the length at maturity (50% mature - Lmat), and five exhibit a positive trend. Nevertheless, for 11 species, the series shows a typical threshold effect between 2001 and 2002. Before going deeper in the results, it will be necessary to ensure that this threshold is not a sampling artefact. Whatever it may be, an analysis of the maturity ogives by species shows that the length distribution of the individuals is very variable here and there of the length at maturity between the years. This distribution strongly influences the length at maturity estimates.

II.3.5.2 Community indicators

No one of the community indicators tested, total biomass, total abundance, mean length, mean weight as well as the proportion of large fish show any significant trend in the period 1996-2004.

II.3.6 Sensitivity analyses for Z

The results highlighted the combined influence of the growth parameters and sampling effect for the computation of the Z values. A specific analysis has been done on *Chelidonichthys gurnardus*. The only available parameters for the Von Bertalanffy Growth Function (VBGF) related to the Mediterranean were from Stergiou *et al.* (1997), with the following values: $t0 = -1.99$, $k = 0.219$ and $L\infty = 26.4$. The application of this function suggested the existence of a number of year classes strongly higher than it can be expected from the length distribution of this species in the Gulf of Lions (Figure II.3.1). Indeed, considering the strength of the first two year classes, an assessment of the VBGF parameters has been done using the Bhattacharya and NORMSEP method (Gayanilo *et al.* 2002). The application of the new parameters drastically reduce the estimated number of year classes (from about 20 to about 10). In both the cases, with the standard selection criteria, the mortality rate is estimated for one set of ages by series (identified as 6-7 and 2-2 respectively in the first and the second series). This sliding does not affect the general trends identified. In this case, an atypical length frequency distribution in 1997 (without a clear identification of the first two year classes) hides the signal anticipated for the whole series. As for all the other species, the last series is too short to allow for a significant trend taking into account the weakness of the signal.

For *Aspitrigla cuculus*, very few yearly length distributions allow to identify the strength of year classes. Particularly, the estimates were available only for age 2. The general trend is due to the weakness of the age 2 in 2002. This year class was low in the 2003 Medits sampling too (age 3). A Bhattacharya and a NORMSEP analysis have been done (Gayanilo *et al.* 2002). The results validate the VBGF parameters used for the Z estimates.

The *Merluccius merluccius* caught during Medits in the Gulf of Lions are mainly young individuals (age 0-1). Consequently, the abundance is strongly related to the recruitment. So, the low value of Z age 0-2 in 1997 (Figure II.3.2) is related to the very high recruitment of this species in 1998.

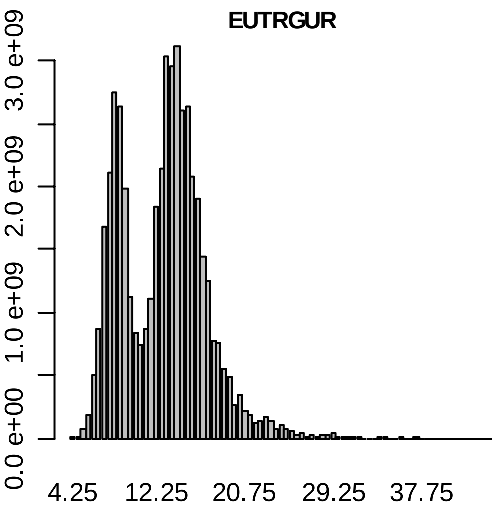


Figure II.3.1. Cumulative length distribution of *Chelidonichthys gurnardus* in the Gulf of Lions (1994-2004).

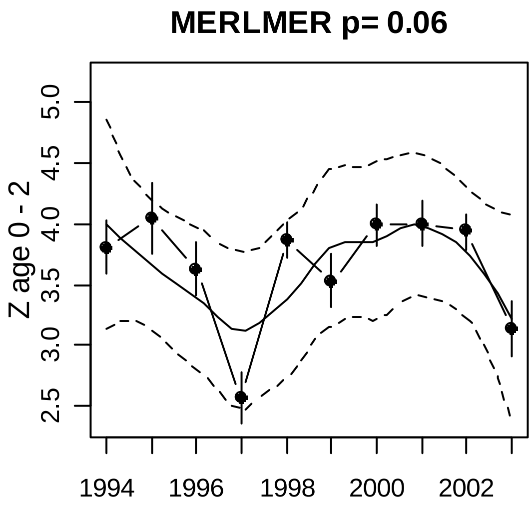


Figure II.3.2. Cumulative mortality rate of *Merluccius merluccius* for ages 0 to 2 in the Gulf of Lions(1994-2004).

II.3.7 Discussion

In the Gulf of Lions, trends in populations during the eleven last years show some contrasted situations. Indeed, nine populations exhibit significant time trends in population abundance, with almost the same number of populations decreasing (4 populations) and increasing (5 populations). The decreasing trends concerned mainly species vulnerable to trawling, like the gurnards *Aspitrigla cuculus* and LEPTCAP, and one of the last species of selacians significantly sampled in the area (*Scyliorhinus canicula*). On the other hand, most of the species whose abundance increased (*Parapenaeus longirostris*, *Spicara flexuosa*, *Spicara smaris*, *Nephrops norvegicus* and *Helicolenus dactylopterus*) are not important trawling targets in the Gulf of Lions.

Five species showed a significant increasing trend in mean length, while four species had decreasing mean length. Mean length decrease may be due to different forcing factors: impact of fishing, strong recruitment, change in survey dates. Concerning *Helicolenus dactylopterus*, an increase of mean length associated with an increase of abundance suggests a improving of the status of the population.

The large set of indices produced give various intra species signals. They highlight the dynamics of the system and the various trajectories of the different contributing species. The trends obtained may be due to different forcing factors in link with fishery and environment.

In general, within the criteria chosen for the integrated analyses, no integrated trend was identified in the Gulf of Lions, as much for the population indicators as for the community ones, apart from the length at maturity index (Table II.3.2). However, the analysis of this last index drawn the attention on the sensitivity of some results to the conditions of observation. Indeed, the interpretation of some biological parameters like maturity stages may be strongly observer dependent. Before going deeply towards ecological hypotheses from a signal given by such index, it will be important to ensure that some thresholds effects in time series are not due to an observer effect.

Furthermore, the sampling strategy allows to find some species only at their limit of representativeness. The significance of integrated signals drawn out by such species with the method used might be considered carefully.

Table II.3.2. L50 per species and year

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
ASPICUC						21.84	22.11	21.34	18.09	14.34	16.24
CITHMAC	13.26	16.30	19.97	19.22	20.60	21.29	21.30	20.68	19.65	16.61	17.97
EUTRGUR			28.11	27.76	21.45	23.53	29.17	24.88	21.57	19.81	15.87
GALUMEL							50.31	41.82	31.77	36.30	42.52
HELIDAC		26.50	31.24	27.99	26.70	27.32	24.13	22.85	23.79	20.86	17.67
LEPMBOS	21.19	26.21	24.33	25.27	25.45	23.29	30.37	22.66	20.26	20.19	19.69
LOPHBUD	41.14	47.33	50.70	51.93	51.78	50.68	52.03	46.44	32.33	35.98	37.65
LOPHPIS	49.89	54.83	51.88	52.60	49.77	49.77	48.36	57.69	49.88	43.51	35.27
MERLMER	31.38	32.32	52.17	46.37	43.05	43.16	43.87	40.12	24.81	23.38	23.28
MICMPOU	32.34	34.35	34.07	33.07	32.07	31.07	32.99	32.53	28.06	21.89	22.12
PAGEACA	16.79	20.60	23.91	18.09	22.50	22.63	24.27	28.31	25.74	26.47	16.33
PAGEBOG	30.30	31.42	32.24	33.06	33.89	35.78	35.53	35.89			
PAGEERY					21.62	20.60	18.24	18.82			
PHYIBLE	36.47	40.72	40.98	40.98	46.93	40.98	48.33	48.95	35.63	36.05	34.78
SCYOCAN	36.73	45.47	44.82	44.17	43.52	42.88	43.01	44.15	40.84	40.24	35.57
SOLEVUL		29.23	37.97	29.12	27.92	26.72	25.52	24.33	23.13		
SPICFLE					16.21	14.54	14.54	14.54	13.77	9.79	18.40
TRACMED			20.40	20.91	20.64	23.55	22.37	22.10	19.00		
TRACTRA			26.71	24.58	25.80	26.69	24.25	23.50	22.76	20.77	22.80

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TRISCAP	14.46	14.79	22.28	19.28	15.67	18.66	20.66	20.63	18.61	14.56	
ZEUSFAB	32.99	21.08	32.20	30.39	33.90	30.22	33.75	33.43			

Table II.3.3. Estimates of trends in parameters*

	Population				Community				
	r	**Z**	**Lbar**	**Lmat**	**B**	**N**	$\bar{b}$	$\bar{l}$	**P large**
GSA n° 7 **1994-2004**	4/48 ⬂ 5/48 ⬀	1/11 ⬂ 1/11 ⬀	5/35 ⬂ 4/35 ⬀	15/21 ⬂ 5/21 ⬀	No trend	No trend	No trend	No trend	No trend
GSA n° 7 **2000-2004**	0/48 ⬂ 1/48 ⬀	1/11 ⬀ 0/11 ⬂	1/35 ⬂ 1/35 ⬀	14/21 ⬂ 1/21 ⬀	No trend	No trend	No trend	No trend	No trend

* the significant trends have been considered only.

Colours: green= positive significant trend; red= negative significant trend; white = not significant trend; grey = significant change in opposite direction to fishing impact; yellow = significant change in the same direction of fishing impact.

Legend:

Level	Indicator	Description
	r	Population growth rate for species i
Population	Z	Average total mortality rate for species i
	Lbar	Average length of population i
	Lmat	Length at maturity (50% mature)
	B	Total biomass in community
	N	Total abundance in community
Community	$\bar{b}$	Average individual weight in community
	$\bar{l}$	Average individual length in community
	plarge	Proportion of large individuals in total community abundance

Annex II.3.I. synthesis of the population indicators for the GSA 7 (only for species with significant trends).

Species	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SdLm	PvalueLm
ASPICUC	-0.08	0.03	0.0268	-0.069	0.121	0.588	0.24	0.45	0.64	0.001	-1.588	0.111	0
CITHMAC	-0.13	0.06	0.0531	0.064	0.092	0.507	NA	NA	NA	NA	0.443	0.048	0
ELEDCIR	0	0.05	0.9961	-0.182	0.079	0.046	-0.03	0.09	0.78	0.172	NA	NA	NA
ELEDMOS	-0.03	0.02	0.1993	-0.109	0.039	0.028	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	-0.03	0.05	0.5754	-0.113	0.126	0.395	-0.02	0.08	0.82	0.172	-1.763	0.098	0
GALUMEL	0.02	0.02	0.4364	-0.509	0.648	0.476	NA	NA	NA	NA	-1.995	0.216	0
HELIDAC	0.11	0.04	0.0222	0.3	0.124	0.039	NA	NA	NA	NA	-1.285	0.113	0
LEPMBOS	-0.06	0.03	0.0315	0.033	0.209	0.879	-0.01	0.09	0.94	0.172	-0.316	0.065	0
LEPTCAV	-0.08	0.04	0.0478	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	0.03	0.06	0.6455	-0.659	0.534	0.249	NA	NA	NA	NA	-1.26	0.189	0
LOPHPIS	0.07	0.07	0.379	-0.454	0.491	0.379	NA	NA	NA	NA	-1.413	0.63	0.02
MERLMER	0.01	0.07	0.8637	0.126	0.176	0.494	-0.01	0.05	0.92	0.055	-1.479	0.139	0
MICMPOU	-0.07	0.19	0.7228	0.033	0.382	0.932	0.01	0.09	0.9	0.055	-1.002	0.093	0
MULLSUR	0.01	0.04	0.8984	0.285	0.1	0.019	-0.27	0.13	0.08	0.011	NA	NA	NA
NEPRNOR	0.16	0.07	0.0449	0.101	0.043	0.044	0.06	0.11	0.61	0.377	NA	NA	NA
OCTOVUL	0.05	0.04	0.304	-0.33	0.136	0.038	NA	NA	NA	NA	NA	NA	NA
PAGEACA	0.01	0.09	0.9459	-0.385	0.135	0.019	NA	NA	NA	NA	0.733	0.108	0
PAGEBOG	0.06	0.11	0.6165	0.265	0.685	0.708	NA	NA	NA	NA	0.822	0.147	0
PAGEERY	0.1	0.1	0.3293	0.116	0.334	0.737	NA	NA	NA	NA	-0.686	0.373	0.036
PAPELON	0.35	0.12	0.0181	-0.094	0.245	0.712	NA	NA	NA	NA	NA	NA	NA
SCYOCAN	-0.07	0.03	0.0478	-0.488	0.261	0.111	NA	NA	NA	NA	-0.65	0.214	0.004
SOLEVUL	-0.06	0.06	0.3313	-0.012	0.254	0.963	NA	NA	NA	NA	-1.198	0.483	0.018
SPICFLE	0.27	0.1	0.0201	-0.309	0.13	0.045	NA	NA	NA	NA	-0.118	0.11	0.307
SPICSMA	0.26	0.11	0.0411	-0.269	0.117	0.07	NA	NA	NA	NA	NA	NA	NA
TRACMED	-0.09	0.11	0.4643	0.749	0.326	0.047	NA	NA	NA	NA	-0.139	0.051	0.007
TRACTRA	0.08	0.08	0.3851	-0.074	0.118	0.546	NA	NA	NA	NA	-0.748	0.088	0
TRISCAP	0.01	0.05	0.9055	-0.033	0.176	0.853	0.01	0.06	0.9	0.172	0.265	0.014	0
ZEUSFAB	-0.02	0.06	0.6981	-0.02	0.213	0.928	NA	NA	NA	NA	1.12	0.604	0.047

II.4 Corsica (area 8)

Coordinator : Jacques Bertrand

II.4.1 Ecological settings, geographical and environmental features

The western and eastern coasts of Corsica are very contrasted. The western coast is mainly rocky. It is edges with a very narrow continental shelf. On the contrary, along the eastern coast, the shelves are larger, from about 10 km in the north (Cap Corse) towards 40 km in the south (Bonifacio). In the GSA 8, only the area located eastward of Corsica island was investigated during the Medits surveys. Therefore, only this area is considered below.

To the east of Corsica, the bottoms are sandy and mixing of sand and mud. Near the coast (up to 40 m deep), masses of fallen earth alternate with extends of sand. They meet fields of sea grass, zostera and particularly Posidonia. These areas are propitious to the growth of various fauna coming for feeding and breeding, like crustaceans, molluscs and various species of fish, mainly flatfishes.

Towards the open sea (between 40 and 100 m depth), the bottom are like a mosaic of hard and soft substratum, often settled by red algae and sea urchins (mainly *Spatangus purpureus*). Over the hard bottoms, a coral fauna grows. It is the favourite habitat of crayfish. In the numerous cracks of this area various species of fish and cephalopods are living. On the sandy substratum, the most typical species are sea fish and cephalopods (hake, red mullet, Eledone).

The slope is more muddy with some rocky outcrops. It houses species few fished by the local fleets, but of potential interest, e.g. anglerfish, John Dory and spiny lobster. The size of the individuals caught during the surveys may be an indication of the low exploitation level in this area.

The general circulation in the western Mediterranean basin is eastward, from the strait of Gibraltar, mainly along the north African coasts. Some flux of this stream rise northwards along Sicily towards the Tyrrhenian Sea, and so along the east coasts of Corsica. The water salinity is always high, often above 38 psu. The sea surface temperature often exceeds 20°C in summer, when the temperature of the deeper waters (down to 50 to 100 m) is constant all over the year (about 13 °C).

II.4.2 Fisheries description and initial state assessment

In 1993, the fishing fleet around Corsica (western and eastern coasts) was constituted by about 225 multi-system small vessels and 14 trawlers (Relini *et al.* 1999). Based on the official data, the global production was of 602 tons, with 500 tons for demersal and benthic species (Relini *et al.* 1999). Still from the official data, the production of these species was about 800 tons in the 1980s. It fell down to around 500 tons since 1990.

No assessment of the demersal resources was available concerning the eastern shelves of Corsica. Nevertheless, the available information indicates that the fishing activity along the island was still low at the beginning of the 1980s (Lebeau 1986). And no signal of expansion occurred during the following decade (Campillo 1992; Relini *et al.* 1999). Combined with the diversity of species caught by the bottom trawl surveys, this suggests that a low exploitation level of demersal species was remaining in the area in the early 1990s.

II.4.3 Brief description of changes in survey design

In the Corsica area, the MEDITS surveys have been carried out with the same conditions every year since 1994, apart from in 1997 when about half of the standard number of hauls were done, and 2002 when no campaign has been realized due to technical problems aboard the vessel (Table II.4.1). The same ship, the French r/v L'Europe has always been used. The main characteristics of this vessel are the following: vessel length 29.6 m, engine power 2 x 345 HP, tonnage 335 UMS.

The sampling scheme was stratified by depth. The haul positions were selected inside a grid defined such as to have a number of cells close to the target number of hauls. Inside each cell, the position of haul was selected randomly (one haul by cell). The same position were used every year. The GSA8 area has a surface of 4562 km^2.

Table II.4.1. MEDITS_FR GSA8 number of hauls and sampling period per year

Year	Number of stations	Sampling period
1994	24	8/6 - 16/6
1995	22	14/7 - 23/7
1996	24	28/5 - 5/6

Year	Number of stations	Sampling period
1997	13	26/5 - 30/5
1998	24	17/5 - 23/5
1999	25	6/5 - 12/5
2000	23	31/5 - 7/6
2001	22	1/6 - 9/6
2002		-
2003	23	3/6 - 9/6
2004	25	1/6 - 9/6

II.4.4 Selection of species

Among the 55 species for which information was available, 43 species (list in the Appendix) with average occurrence larger than 5 % were selected for calculation of population indices (Population growth rate). Within this selection, indices based on length (mean length, L50 and total mortality value (Z)) were done only for the 30 species with length measurements. The community indicators were performed on the overall 56 species of the reference list (including pelagic species).

II.4.5 Results: review of indicators

II.4.5.1 Population indicators

II.4.5.1.1 Intrinsic Population growth rate

Over the whole period, six species (*Galeus melastomus*, *Helicolenus dactylopterus*, *Nephrops norvegicus*, *Parapenaeus longirostris*, *Raja asterias* and *Spicara flexuosa*) show a significant increasing trend in abundance, while one species (*Loligo vulgaris*) exhibits a significant decreasing trend. For the last five years, only three species (*Mullus barbatus*, *Mullus surmuletus* and *Pagellus erythrinus*) show a significant trend. For these three species, the trend is directed towards an increasing abundance.

II.4.5.1.2 Mean length in population

Over the whole period, two species (*Helicolenus dactylopterus*, and *Pagellus acarne*) show a significant increasing trend of the mean length, while only one species (*Raja clavata*) exhibits the reverse. The previous trend is confirmed only for *Helicolenus dactylopterus* in the more recent period. For *Helicolenus dactylopterus* and *Pagellus acarne*, the increase of total abundance and mean length are associated with an increase in spawning stock abundance.

II.4.5.1.3 Average total mortality rates

In the whole period, the mortality rates have been investigated for 25 species. Nevertheless, taking into account the selection criteria based on the consistency of the series, Z estimates have been obtained for 16 species, within which no one expected a significant trend.

II.4.5.1.4 Proportion mature

The number of females examined strongly varied according to the species and the yearly survey. Among the 30 species examined, three species (*Lophius piscatorius*, *Pagellus erythrinus* and *Trachurus mediterraneus*) exhibit a significant trend in the proportion of mature females over the whole period and no one for the last period.

II.4.5.1.5 Length at maturity

Among the 15 studied species (Table II.4.2), seven (*Galeus melastomus*, *Scyliorhinus canicula*, *Helicolenus dactylopterus*, *Pagellus acarne*, *Trachurus trachurus*, *Lepidorhombus boscii* and *Pagellus erythrinus*) showed a significant negative trend in the length at maturity (50% mature - Lmat), and four (*Spicara flexuosa*, *Phycis blennoides*, *Micromesistius poutassou* and *Trachurus mediterraneus*) exhibit a positive trend. In this area, the threshold effect identified in the Gulf of Lions between 2001 and 2002 did not occurred.

Table II.4.2. L50 per species and year.

GSA	Species	1994	1995	1996	1998	1999	2000	2001	2002	2003	2004
8	ASPICUC					9.64	20.11	8.69	13.85	22.26	8.53
8	GALUMEL						49.08	40.71	40.20	37.48	

GSA	Species	1994	1995	1996	1998	1999	2000	2001	2002	2003	2004
8	HELIDAC					25.73	24.82	23.63	21.97	20.30	19.21
8	LEPMBOS	21.55	22.53	22.27	21.76	21.50	27.67	19.64	20.73	19.59	19.38
8	MERLMER	30.22	36.83	37.36	36.15	44.59	45.29	39.10	36.83	36.83	25.10
8	MICMPOU	29.92	32.10	32.57	33.52	33.99	34.78	41.73	35.40	25.73	35.26
8	MULLBAR		12.47	12.34	12.34	12.78	11.76				
8	PAGEACA		28.01	25.30	23.89	23.18	22.47	19.57	21.05	15.68	20.17
8	PAGEERY		14.63	14.22	14.72	15.01	13.71	15.14	14.04	14.51	12.54
8	PHYIBLE	22.81	28.40	43.98	30.43	42.34	31.79	32.46	33.14	31.65	31.31
8	RAJACLA							68.75	67.41	64.51	68.97
8	SCYOCAN						44.24	38.47	37.96	34.82	34.88
8	SPICFLE		10.40	6.33	8.05	10.89	9.77	10.63	11.49	12.95	
8	TRACMED	14.85	15.42	15.60	15.53	16.12	16.30	17.58	16.65	15.87	15.24
8	TRACTRA			21.87	21.07	20.89	20.32	22.52	19.17	18.60	15.39

II.4.5.2 Community indicators

No one of the following community indicators tested: total biomass, total abundance and mean weight show any significant trend in the period 1994-2004. Only the proportion of large fish gave a significant decreasing trend for the threshold sizes from 24 to 28 cm, with a strong change between 2000 and 2001in the proportion of large fish.

II.4.6 Discussion

Unlike a lot of other areas, more species tended to increase in abundance during the whole period (6 increase, 1 decrease) in the GSA 8 (Table II.4.3). The species increasing have various status in the community. *Helicolenus dactylopterus* is a typical demersal species over the shelves and the upper slopes. Two species are selacians (one small shark *Galeus melastomus* and one skate *Raja asterias*). As the other coastal skates, *Raja asterias*is potentially highly vulnerable to fishing. Two other species are benthonic crustaceans (*Nephrops norvegicus* and the deep sea *Parapenaeus longirostris*).

For *Helicolenus dactylopterus* and *Pagellus acarne*, an increase of the spawning stock biomass is associated with an increase of the mean size in the population. In return, the spawning stock biomass of *Merluccius merluccius* increased while no trend was detected in the average length.

Length at maturity indices gave a strong signal of state modification in the Corsica area with a high number of species showing significant trends. Nevertheless, this estimator is very sensitive to the observations conditions. Indeed, for each species, the relevance of the calculated estimates is strongly linked with the time of the observation period respect to the breeding season and to the size distribution of the samples here and there of the maturity size. A species by species and year by year analysis showed that maturity ogives were relevant only for a very few species and years in the area. Finally, it was practically impossible to identify any continuous time series of species maturity size relevant for applying trend analysis.

Over the shelves, the proportion of large fish is in average of one order lower than the one along the slope, due to the highest densities of small fish over the shelves. At the community level, the most notable signal for the whole area is the decreasing proportion of large fish. It would be necessary to go deeper in the characterisation of the different parts of the community (spatially and by species) to understand the meaning of the identified trend. Furthermore, it could be useful to test other metrics (like quartiles, etc.) to better identify the changes in the length distribution at the community level.

*Table II.4.3: Estimates of trends in parameters**

	Population				Community				
	r	Z	Lbar	Lmat	B	N	$\bar{b}$	$\bar{l}$	P large
GSA n° 7 **1994-2004**[1]	1/43 ↘ 6/43 ↗	0/16 ↗ 0/16↘	2/30 ↘ 1/30 ↗	7/15↘ 4/15 ↗	No trend	No trend	No trend	No trend	↘
GSA n° 7 **2000-2004**	0/43 ↘ 3/43 ↗	0/16 ↗ 0/16↘	0/30 ↘ 0/30 ↗	9/21↘ 1/21 ↗	No trend	No trend	No trend	No trend	

* the significant trends have been considered only.
[1] without 1997 (removed) and 2002 (non-existent)

Colours: green= positive significant trend; red= negative significant trend; white = not significant trend; grey = significant change in opposite direction to fishing impact; yellow = significant change in the same direction of fishing impact. Brown = calculation irrelevant with the available data.

Legend:

Level	Indicator	Description
	r	Population growth rate for species i
Population	Z	Average total mortality rate for species i
	Lbar	Average length of population i
	Lmat	Length at maturity (50% mature)
	B	Total biomass in community
	N	Total abundance in community
Community	$\bar{b}$	Average individual weight in community
	$\bar{l}$	Average individual length in community
	plarge	Proportion of large individuals in total community abundance

Annex II.4.I. synthesis of the population indicators for the GSA 8 (only for species with significant trends).

Species	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SdLm	PvalueLm
GALUMEL	0.14	0.05	0.0228	-0.203	0.11	0.163	NA	NA	NA	NA	-3.269	0.361	0
HELIDAC	0.1	0.04	0.0466	-0.365	0.091	0.005	NA	NA	NA	NA	-1.427	0.21	0
LEPMBOS	-0.01	0.04	0.8213	0.32	0.173	0.106	NA	NA	NA	NA	-0.257	0.115	0.023
LOLIVUL	-0.22	0.08	0.0292	0.026	0.2	0.902	NA	NA	NA	NA	NA	NA	NA
MICMPOU	-0.01	0.13	0.9498	0.012	0.139	0.934	NA	NA	NA	NA	0.47	0.112	0
NEPRNOR	0.13	0.02	6e-04	-0.038	0.043	0.409	NA	NA	NA	NA	NA	NA	NA
PAGEACA	0.27	0.16	0.1446	-0.559	0.216	0.036	NA	NA	NA	NA	-0.709	0.154	0
PAGEERY	0.01	0.03	0.857	-0.076	0.109	0.507	NA	NA	NA	NA	-0.169	0.04	0
PAPELON	0.17	0.06	0.0326	-0.044	0.141	0.762	NA	NA	NA	NA	NA	NA	NA
PHYIBLE	0.03	0.05	0.5221	0.13	0.211	0.558	NA	NA	NA	NA	0.678	0.363	0.045
RAJAAST	0.24	0.1	0.0415	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RAJACLA	-0.13	0.06	0.0779	2.115	0.427	0.002	NA	NA	NA	NA	-0.121	2.328	0.958
SCYOCAN	0	0.03	0.9938	0.504	0.46	0.335	NA	NA	NA	NA	-1.994	0.157	0
SPICFLE	0.19	0.06	0.0177	-0.026	0.087	0.773	NA	NA	NA	NA	0.861	0.138	0
TRACMED	0.06	0.12	0.6577	-0.047	0.056	0.428	NA	NA	NA	NA	0.174	0.024	0
TRACTRA	-0.16	0.07	0.0631	-0.122	0.425	0.783	NA	NA	NA	NA	-0.574	0.065	0

II.5 Ligurian and N. Tyrrhenian (area 9)

Coordinator: Stefano de Ranieri

II.5.1 Ecological settings, geographical and environmental features

Geographical sub area (GSA) 9 from north to south includes three different regions: Liguria, Tuscany and Lazio. All these regions make the GSA 9 not uniform neither under an oceanographic nor geo-morphological point of view.

In the northern part of the GSA, along the Ligurian coasts, the trawlable bottoms can be divided in two different zones: the western zone and the middle eastern zone.

In the former, from Capo Mortola (Imperia) to Portofino (Genoa), shelf is very narrow and approximately 35% of this area is prohibited to trawling because it is shallower than 50 m depth. Generally western fishing grounds are rougher than the middle eastern ones and this features further reduces trawlable bottoms. This particular geomorphology has limited the development in the area of a shelf demersal fishery but has improved, especially for Sanremo and Imperia Oneglia fleets, the catch of the red shrimps which represent the main target species of the mesobathyal bottoms.

In the middle eastern fishing grounds, from Portofino to Tuscany coasts, the circalittoral muddy bottoms are wider and the catch regarding also shelf species (for example white horned octopus and red mullet). In this area works the main fleet of the Ligurian (i.e. Santa Margherita Ligure).

The Northern Tuscany coasts (South-Eastern Ligurian Sea) receive the contribute of fresh water proceeding from the Magra, Serchio and Arno rivers. This fact produces an important constant input of nutrients with a consequent increase in turbidity, presence of mud and production in the area. The shelf is very wide and characterised by sandy-muddy grounds suitable for trawling; these conditions allowed the development of the Viareggio fishing fleet, that is the more important of the Tyrrhenian and Ligurian Sea. This fleet targets coastal species, on grounds at depths up to 50 m.

In the central portion of the Sub Area, the shelf is relatively enlarged and characterised by the presence of the islands of the northern portion of the Tuscan archipelago. In this area, industrial fisheries are not very important (i.e. Livorno fishing fleet).

South to Elba Island, (Southern Tuscany and Lazio) the shelf is lightly more narrow, there is the presence of different fishing (Porto Santo Stefano, Porto Ercole, Castiglione della Pescaia, Fiumicino) and many fishers target deep sea species as Norway lobster and red shrimps (Northern Tyrrhenian) and other resources such as deep-rose shrimp (Central Tyrrhenian).

The exploited area, up to 800 m depth, is approximately of 30 thousands squared kilometers; 15% of it regards the Ligurian region, 50% Tuscany and 35% Lazio. These are not only administrative boundaries but they also reflect different bathymetric and environmental features.

The surface of the depth stratum 0-100 m represents, in the whole GSA, about 25-30% of the total area.

II.5.2 Fisheries description and initial state assessment

In the last two decades a fairly constant reduction in number of these fleets of approximately 2.5% each year occurred and the current size of the fishing fleet is about 50% lower than that of twenty years ago. Due to the predominant weather conditions as well as to the enforcement of legal restrictions (i.e. fishing ban in the weekend) on average the working days along a year are about 192 in Liguria, 223 in Tuscany and 213 in Lazio.

Total annual landings of the trawl fleets are at least of 9000 tons for the whole GSA 9: 1000 tons in Liguria, 4700 in Tuscany and 3300 in Lazio, even if these evaluations can be considered as slight underestimates. Due to the different characteristics of the bottom and fishing strategies, the catch composition of the trawlers varies quite noticeably in the three regions: in Liguria the finfish landings represent around 60% while molluscs and crustaceans represent about 20% each of them. In Tuscany the finfish landings are similar to Liguria (55%), but on the other hand the cephalopods strongly predominate regarding the crustaceans (39% vs. 6%). Finally in Lazio the finfish predominate, being 78% of the catches, while molluscs represent 18% and crustaceans 4%.

Trawlers catch composition is almost always a species mix although, depending on season or depth, sometimes a single species may predominate in the catch.

The use of gears with reduced selectivity and the high fishing pressure at which most of the resources are exposed to, determine that the catch is mainly composed by juveniles.

Many species that are exploited by the trawlers are also caught with other fishing techniques. In some cases, the amount of landings of these species proceeding from fishing techniques other than trawling can not be neglected (i.e. adults of European hake caught with fixed gears south to Elba Island).

Generally speaking, the coastal species were in the early 1990's the most exploited but recently the exploitation rate lightly decreased, due to a generalised fleet reduction but at least in some regions partially due to a spatial shift in effort allocation, that moved towards deeper bottoms. The above described spatial pattern of exploitation and changes in time does not apply for the whole GSA9. In some ports, as Porto Santo Stefano, fishers were and still continue to be more interested in the exploitation of deep sea resources (red shrimps, Norway lobster) while in others, as Viareggio, the coastal resources still represent the main target and component of the total amount of the landings.

II.5.3 Brief description of changes in survey design

From 1994 to 2001 the vessel utilised in the MEDITS survey was the "Francesco Padre", the characteristic of which are in the Medits data bank. In 2002, due to the demolition of the vessel, the 2002 MEDITS survey was carried out with the "Marcantonio I", with the following characteristic: vessel length 27.0 m, engine power 474 kW, gross tonnage 155 GT, total length of the trawl warp for each winch barrel 3000 m, echo sounder, radar, GPS, plotter, radio. The vessel was rigged according to a common methodology (De Ranieri 2004).

Due to the transfer of the "Marcantonio I" in another harbor, occurred at the beginning of 2003, it was necessary to change the vessel for the realization of the 2003 MEDITS survey. After an investigation in the main fishing ports of the area the commercial fishing vessel "Ciro I" (number of registration 02Li2893) was chosen. The vessel was utilized for all the period of study and had the following technical characteristic: vessel length 25.9 m, engine power 441 kW, gross tonnage 80 GT, total length of the trawl warp for each winch barrel 2200 m, echo sounder, radar, GPS, plotter, radio. The vessel was rigged according to a common methodology.

In 2004 another change of vessel was necessary and the 2004 Medits survey was carried out with the "Libera" with the following characteristic: vessel length 25.5 m, engine power 522 kW, gross tonnage 69. The vessel was rigged according to a common methodology.

Table II.5.1 shows the allocation of the hauls for the different research group of GSA 9, according to the sampling scheme.

Table II.5.1. Number of hauls per bathymetric stratum and research group.

	MEDITS 1994-2001				MEDITS 2002-04			
	GSA9a	GSA9b	GSA9c	GSA9d	GSA9a	GSA9b	GSA9c	GSA9d
	DIPTERIS	ARPAT	CIBM	DBAU	DIPTERIS	ARPAT	CIBM	DBAU
Stratum A (10-50 m)	2	8	4	6	1	6	3	5
Stratum B (51-100 m)	3	6	6	6	3	5	4	5
Stratum C (101-200 m)	3	13	10	13	2	9	8	11
Stratum D (201-500 m)	7	10	11	12	6	7	8	10
Stratum E (501-800 m)	9	4	11	9	7	2	9	9
Total sub-area	24	41	42	46	19	29	32	40
Total G.S.A. 9				153				120

II.5.4 Selection of species

The analysis of the community indices and the elaboration of the population growth rate (r) was performed on the overall 56 species of the list of references (including pelagic species), the analysis of the population indices (i.e. mean length, L50 and total mortality value (Z)) was computed only on the 37 target species of the MEDITS project (see list of species in Appendix).

II.5.5 Results: review of indicator

II.5.5.1 Population indicator

II.5.5.1.1 Intrinsic Population growth rate

Over all the period, 6 species (*Galeus melastomus, Helycolenus dactylopterus, Mullus barbatus, Nephrops norvegicus, Parapanaeus longirostris, Phycis blennoides*) of the 56 species analysed, show a significant increasing trend in abundance. For the rest of species r is not significantly different from zero (Figure II.5.1). During the last five years only Lophius budegassa and Solea vulgaris show a positive trend.

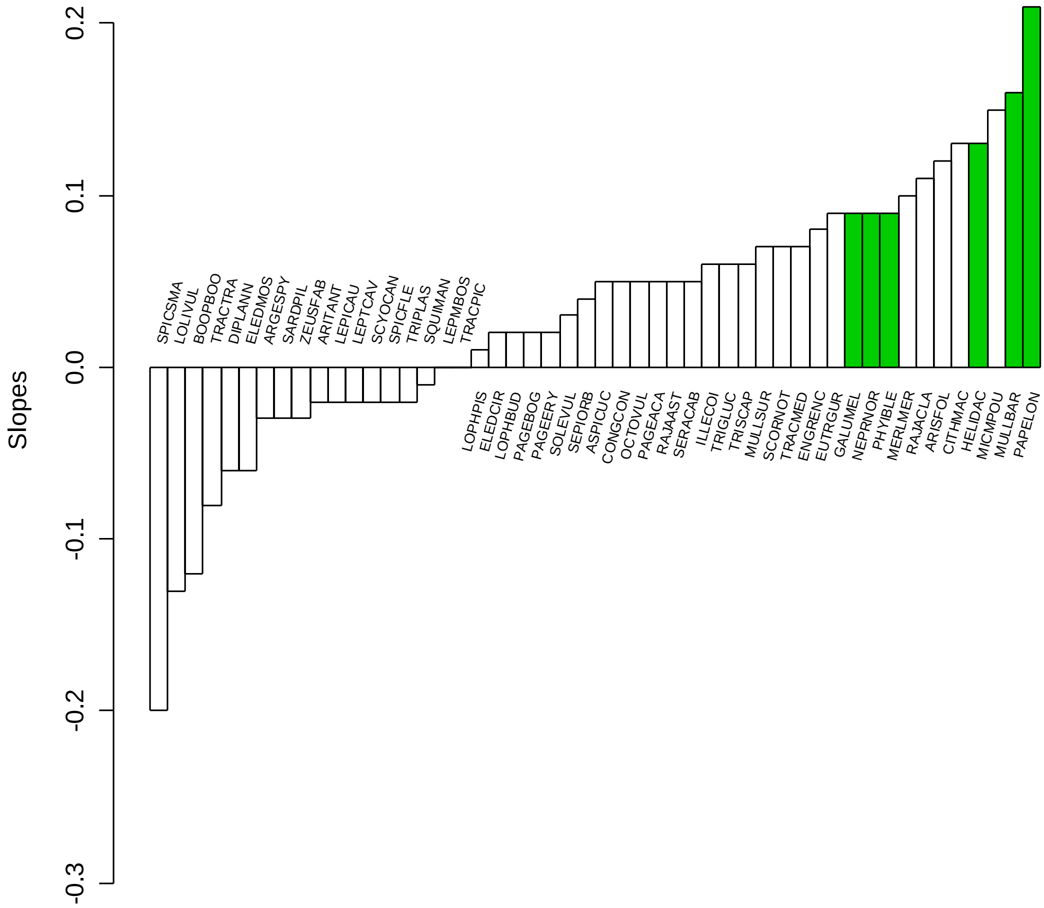


Figure II.5.1. Population growth rate (r) for the GSA9

II.5.5.1.2 Mean length in population Lbar

Over all the period only *G. melastomus* (target species since to 1999) and *N. norvegicus* (figure 9.2) show a negative trend in mean length, whereas *S. vulgaris* shows a positive trend; the rest of species show any trend. During the last five years a trend is not evident for any species.

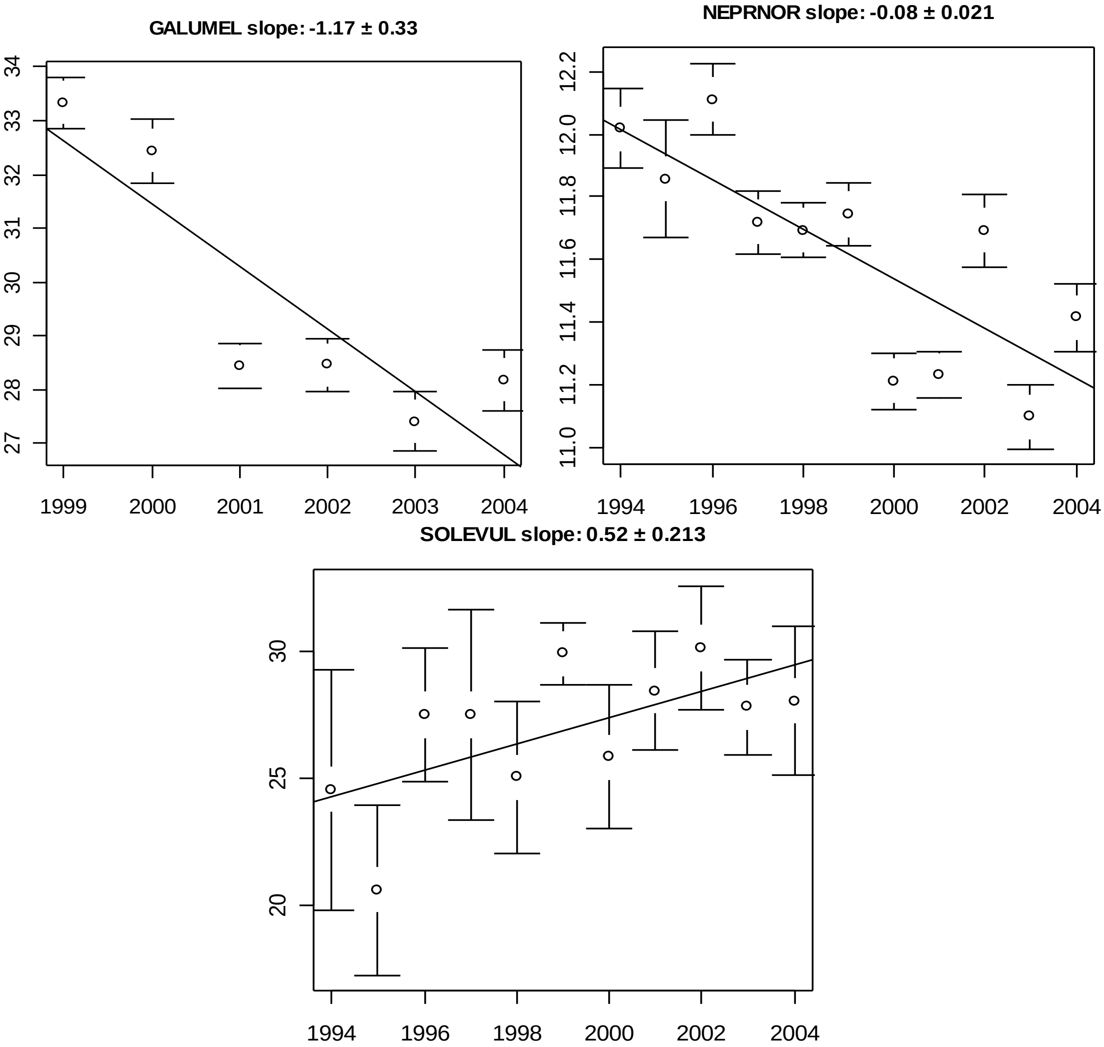


Figure II.5.2. Mean length trend in the last decade for *G. melastomus*, *N. norvegicus* and *S. vulgaris.*

II.5.5.1.3 Average total mortality rates Z

In the overall period only 3 species, *Trachurus mediterraneus*, *Micromesistius poutassou* and *Mullus barbatus*, show a significant increasing in the Z value.

In the case of the other species, the absence of statistically significant trends preclude any comment on the exploitation status (Figure II.5.3).

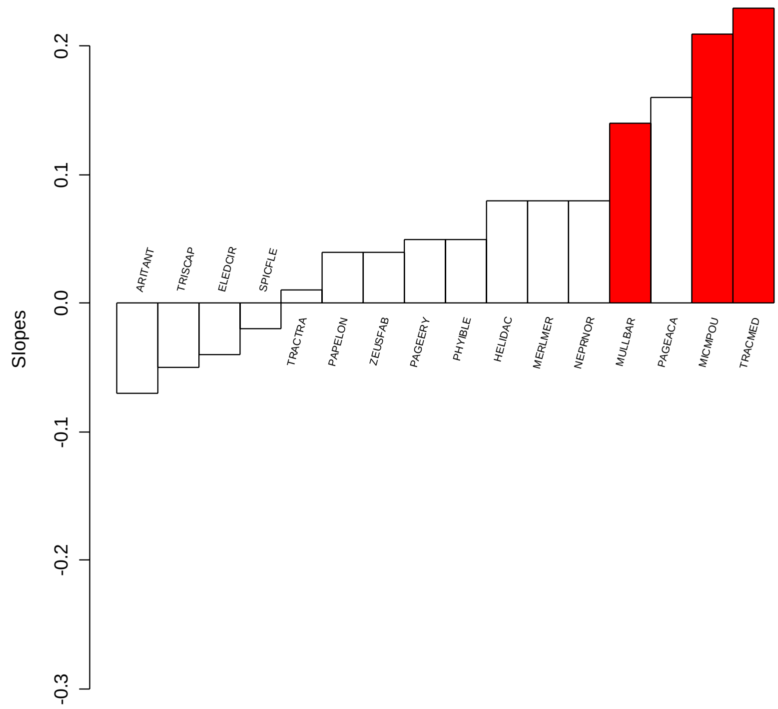


Figure II.5.3. Slope of time trend in total mortality value /Z) in the last decade.

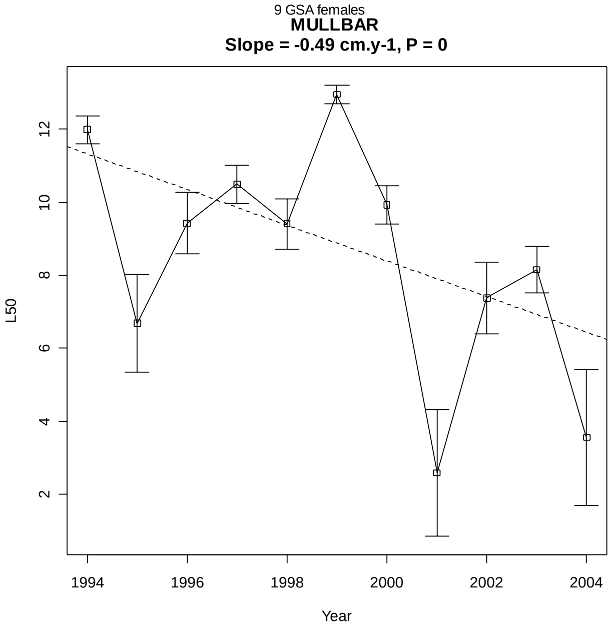
II.5.5.1.4 Length at maturity (50% mature), Lmat

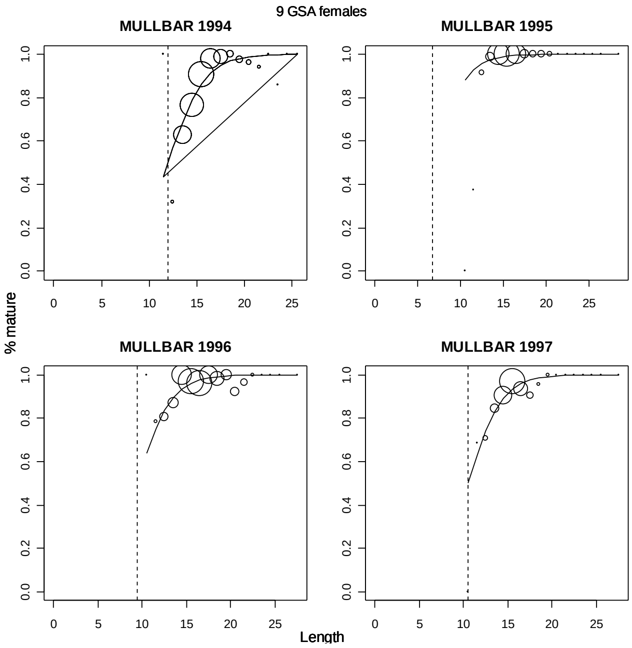
Species with an increasing trend of L_{mat} are: *Eutrigla gurnardus, M. poutassou, Pagellus acarne, Pagellus erythrinus, Raja clavata, Spicara flexuosa.*

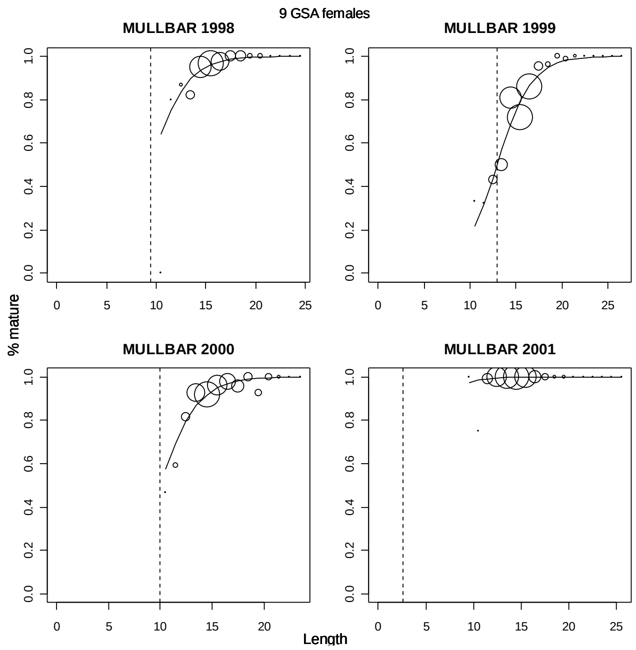
Species with decreasing trend are: *G. melastomus, Lepidorhombus boscii, M. merluccius, M. barbatus, Scyliorhinus canicula, Spicara smaris, T. mediterraneus, Trachurus tarchurus, T. minutus capelanus.* Figure II.5.6 summarized the results.

For *E. gurnardus* and *R. clavata* the total number examined per year, along the whole period is not sufficient to validate the trend. For *M. poutassou* it's necessary bearing in mind that the gear used is not suitable for a semipelagic species; in *P. acarne* only the 2001 sampling seems to be different from the rest, in our point of view no trend is evident.

This indicator is not suitable for *M. barbatus* (Figure II.5.4) and *T. minutus capelanus* that are massively mature at the first year of life; for M. *merluccius* (figure 9.5), during all the period the proportion of matures by size in the sampling never go beyond 10%; in *G. melastomus*, if we exclude the 1999, when the proportion of matures is near to 0, the trend is positive.


9 GSA females
MULLBAR
Slope = -0.49 cm.y-1, P = 0
L50
Year


9 GSA females
MULLBAR 1994
MULLBAR 1995
MULLBAR 1996
MULLBAR 1997
% mature
Length


9 GSA females
MULLBAR 1998
MULLBAR 1999
MULLBAR 2000
MULLBAR 2001
% mature
Length

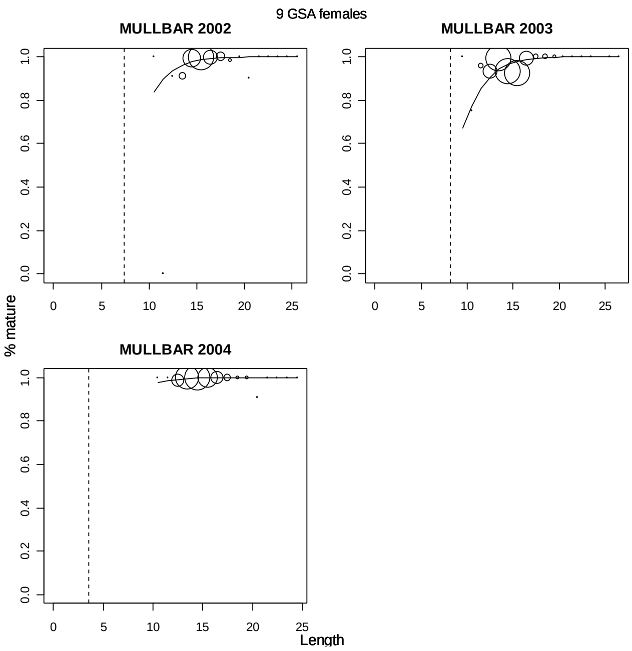

9 GSA females
MULLBAR 2002
MULLBAR 2003
MULLBAR 2004
% mature
Length

Figure II.5.4. Slope of time trend in L50 and relative ogives curve for *M. barbatus* in the last decade.

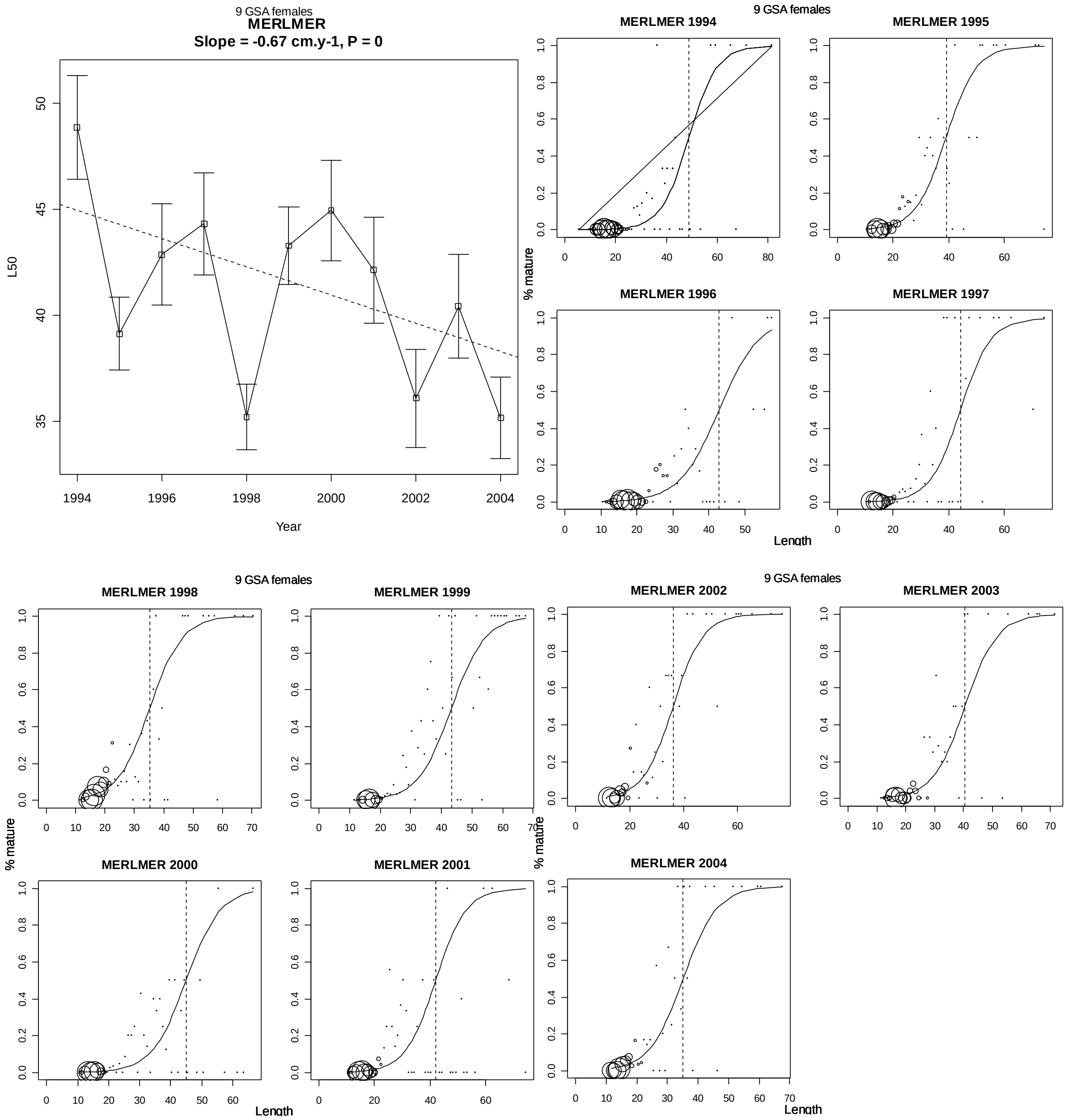


Figure II.5.5. Slope of time trend in L50 and relative ogives curve for *M. merluccius* in the last decade.

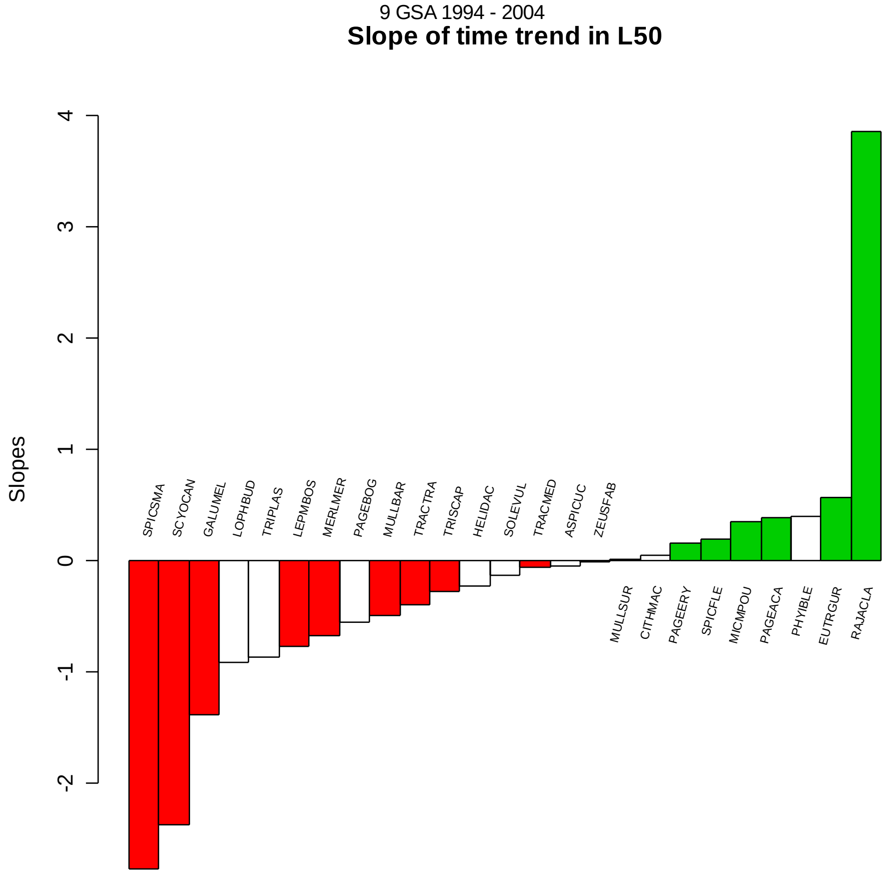


Figure II.5.6. Slope of time trend in L50 in the last decade.

II.5.5.2 Community indicator

II.5.5.2.1 Total biomass

There isn't any significant trend

II.5.5.2.2 Total abundance

There isn't any significant trend

II.5.5.2.3 Mean weight

There isn't any significant trend

II.5.5.2.4 Proportion of large fish

There isn't any significant trend (Figure II.5.7). There is a high value in 2001 maybe in relation to high catch of very large fish as *G. melastomus* (Figure II.5.8).

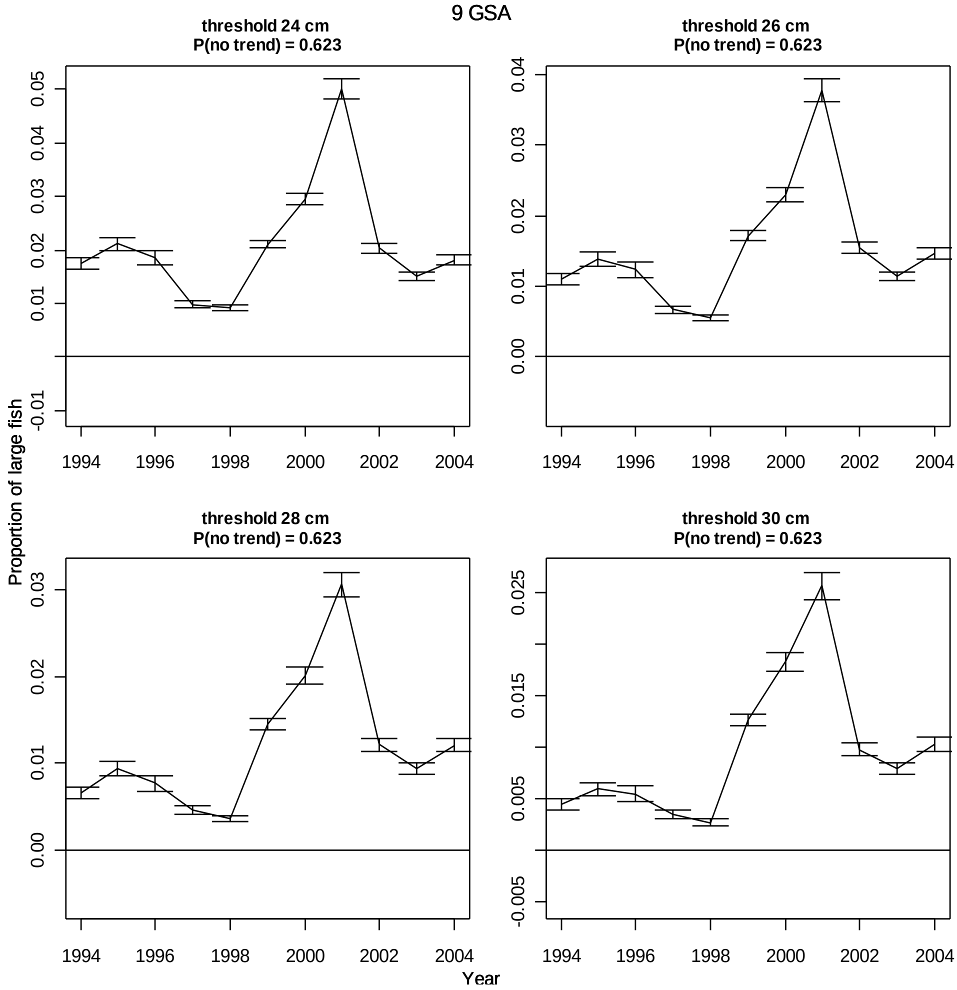


Figure II.5.7. Proportion of large fish in the last decade and abundance value of *G. melastomus.*

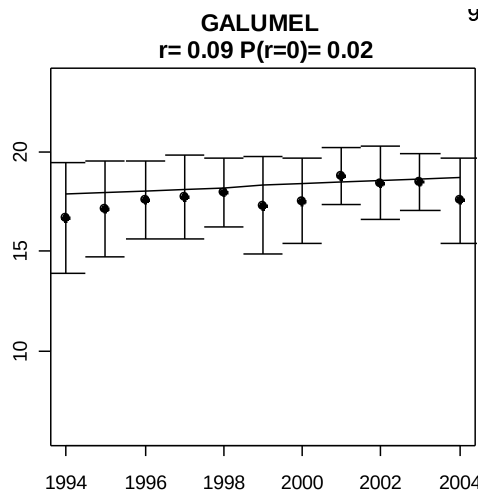


Figure II.5.8. Abundance values of *G. melastomus.*

II.5.6 Sensitivity analyses for Z and any other relevant indicator

Methodology used for this calculation can be sensitive to the growth parameters, and this can lead to a bias in the evaluation.

In the following pages we have reported as the Z value and the age estimation change using two different set of growth parameters. The species analysed are the European hake (*M. merluccius*) and the Red mullet (*M. barbatus*). In Table II.5.2 are reported the two different set of parameters used: the Working Group Nantes set and those proposed by our area.

For the hake there is a great different between the two Linf values (126.9 vs 85), while the set of the Red mullet are more similar.

Figures II.5.9 and II.5.10 show the results obtained.

For the hake there are great difference both in term of age estimation than in term of Z value.

GSA 9 set of parameters seem to be more suitable (Z value oscillate around 1.5) respect the WG one. For the Red mullet the result are more or less similar.

Table II.5.2. Different set of growth parameters used to compute the total mortality value (Z)

	WG Nantes – VBGF parameters			GSA 9 – VBGF parameters		
Species	**t0**	**k**	**Linf**	**t0**	**k**	**Linf**
M. merluccius	0.035	0.184	126.90	0.000	0.150	85.00
M. barbatus	-0.370	0.580	23.97	0.000	0.690	25.00

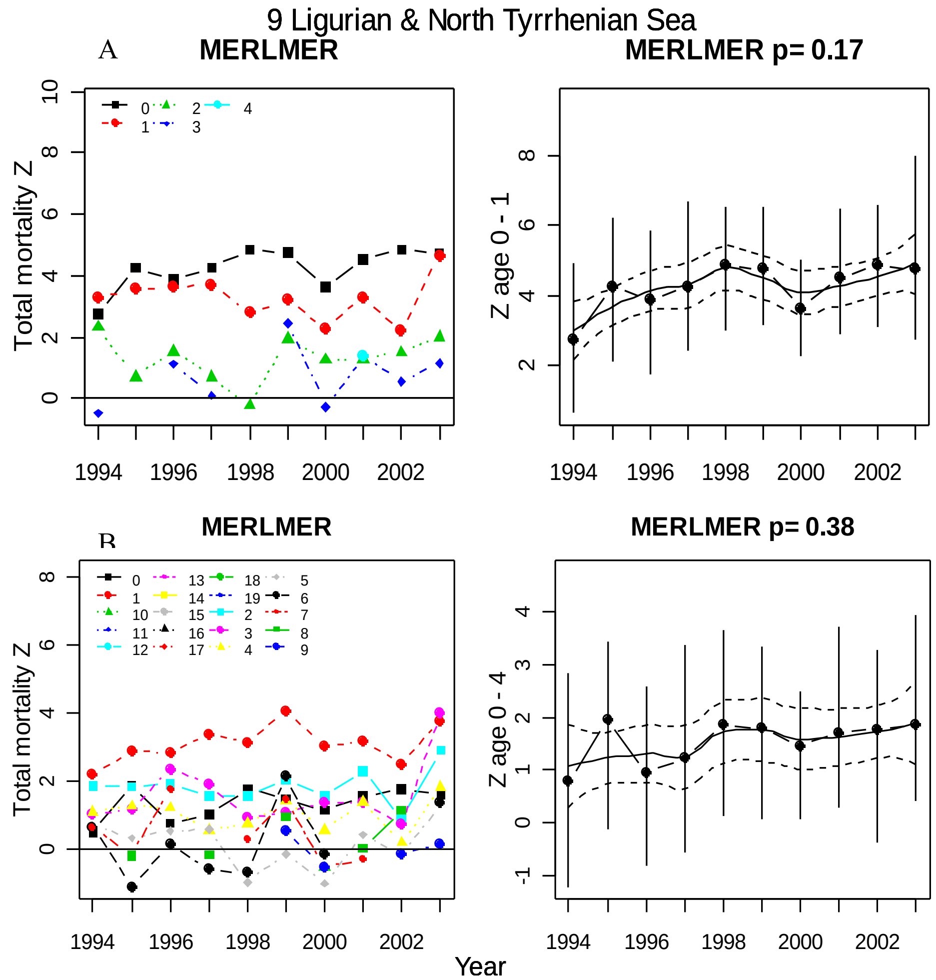


Figure II.5.9. *M. merluccius*. Z values in respect of different set of growth parameters. A) WG Nantes and B) GSA 9.

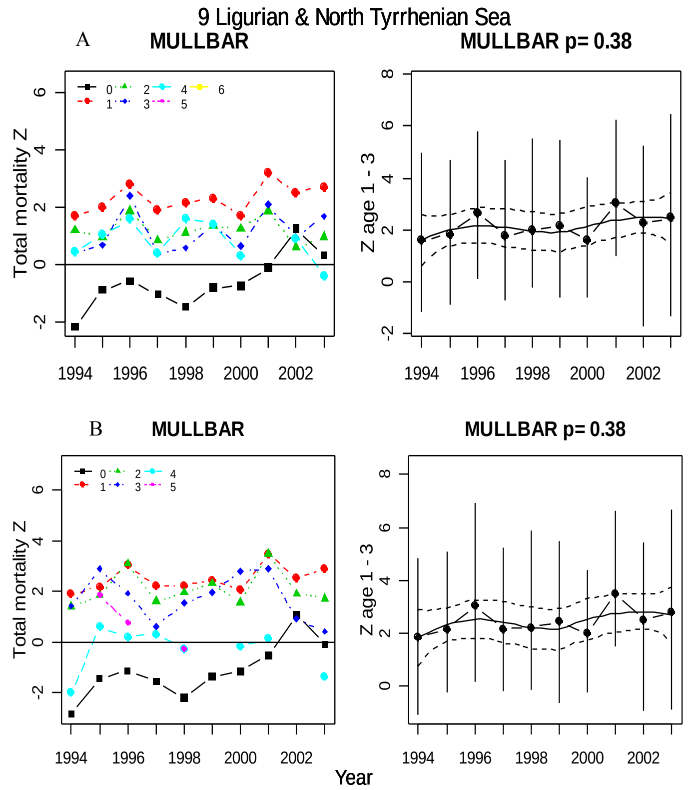


Figure II.5.10. *M. barbatus*. Z values in respect of different set of growth parameters. A) WG Nantes and B) GSA 9.

II.5.7 Additional information - Comparison with national trawl surveys GRUND

In the GSA 9 during the same years of the MEDITS surveys has been carried out, in another season (autumn), the national trawl survey called GRUND.

In the figures (II.5.11 and II.5.12) we have report the abundance trend for the main target species that resulted have a significant trend. In particular are: *M. barbatus* and *P. blennoides* among fishes and *N. norvegicus* and *P. longirostris* among crustaceans.

Only for 2 species, the Red mullet and the Deep rose shrimp the significant increasing in the catch confirmed also in autumn, while the Great fork beard and Norway lobster show a stable situation.

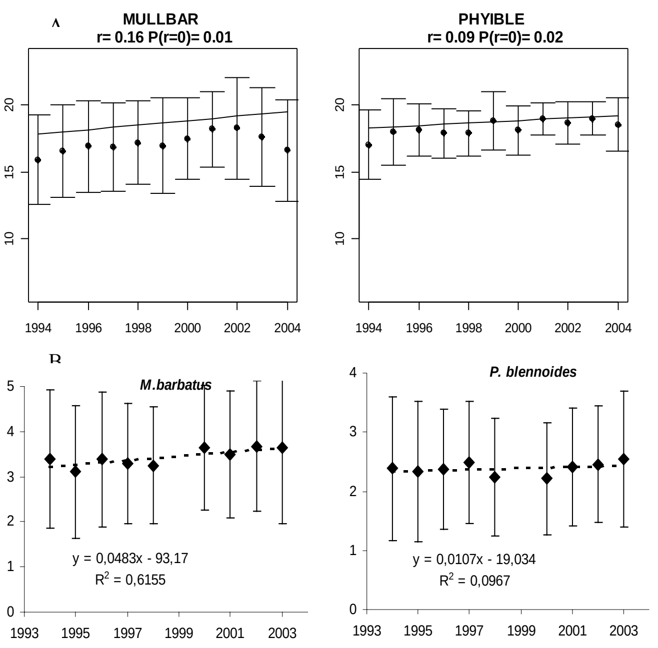


Figure II.5.11. Log-Abundance trend of *M. barbatus* and *P. blennoides* in MEDITS A) and GRUND B) surveys

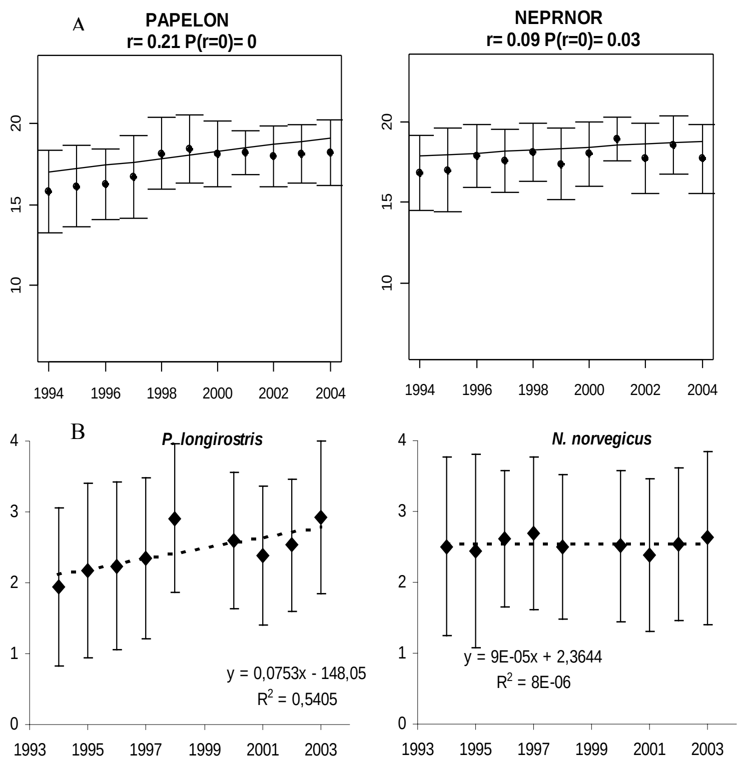


Figure II.5.12. Log-Abundance trend of *N. norvegicus* and *P. longirostris* in MEDITS A) and GRUND B) surveys

II.5.8 Discussion

Generally, both the community indicators (which don't show any trend) and the population indicators results show that the state of exploitation of the demersal resources caught in the GSA9 doesn't suggest any further element of concern.

Regarding the growth rate indicator, 18 species on 56 show a not significative negative trend (most of all are semipelagic species, as *T. trachurus*, *Sardina pilchardus*, *L. caudatus,* etc. or have a quite low commercial value, as *Boops boops*, *Argentina sphyraena*, ecc).

A lot of important commercial species show a positive trend. In particular show a significant trend the high price crustacean *N. norvegicus* and *P. longirostris* and, between fishes, *M. barbatus, P. blennoides* and *H. dactylopetus*. Moreover these positive trends are confirmed also in the national trawl surveys GRUND.

Furthermore also *G. melastomus,* shows a significant trend and this fact may be very important considering the Selachians as a biological indicator of the state of exploitation.

Moreover also the results of the analyses of the mean length of the population show no trend and, among the most important commercial species, only the Norway lobster shows, during the last decade, a significant decreasing in the mean total length (about 1.5 cm).

Concerning the analyses of the length, we suggest the use of median as indicator, because the mean, as known, is more sensitive to the extreme value.

Also the results of the total mortality value (Z) don't suggest a bad status for GSA9. Infact only 3 species have a significant increasing trend in the mortality value.

A condition for the utilisation of the length-converted catch-curve, specially for fast-growing species, is the use of a mean annual size structure, while our data regard only one season. This fact can false the computing of the total mortality value in the case of *M. barbatus* and *M. poutassou* two of the three species that show an increasing trend of Z.

Furthermore, methodology used for this calculation can be sensitive to the growth parameters, and this can lead to a bias in the evaluation.

Generally the use of the length at first maturity as indicator of the state of exploitation of the resources can be suitable but, concerning MEDITS data, the characteristics of the sampling scheme seem not to be satisfactory for the estimate of this indicator:

- Short period of sampling, this means that the proportion of mature of certain species can change depending on the period of sampling;
- Used technique doesn't allow estimating correctly L_{mat} 50% mature for species that massively mature at the first year of life (such as *M. barbatus* and *T. minutus capelanus*);
- Gear not suitable for sampling mature specimens (for example *M. merluccius*) or semi pelagic species (for example *M. poutassou*).

Concerning this point we propose that the use of the length at first maturity is not a good indicator and it could be substituted with, for example, the proportion between juveniles and adults specimens.

Appendix

Annex II.5.1. Von Bertalanffy parameters.

SPECIES	T0	K	LINF	AUTHORS
ASPICUC	-0.656	0.283	34.85	Gulf of Lions - (Campillo 1992)
CITHMAC	-0.430	0.257	25.70	Aegean Sea - (Stergiou *et al.* 1997)
EUTRGUR	1.990	0.219	26.40	Pagasitikos Gulf - Stergiou et al - 1997 Fork Length
HELIDAC	-1.460	0.127	39.20	(Ragonese & Reale 1995)
LEPMBOS	-1.060	0.193	38.00	(Mannini *et al.* 1990)
LOPHBUD	-0.921	0.130	66.75	Saronikos Gulf - (Stergiou *et al.* 1997)
LOPHPIS	0.430	0.344	107.55	Aegean Sea - (Stergiou *et al.* 1997)
MERLMER	0.000	0.150	85.00	(De Ranieri 2004)
MICMPOU	-0.422	0.400	41.30	(Orsi Relini & Peirano 1982 1983 1985)
MULLBAR	0.000	0.690	25.00	(De Ranieri 2004)
MULLSUR	-0.400	0.700	29.29	(Voliani *et al.* 1998)
PAGEACA	-1.160	0.280	30.40	(Voliani *et al.* 2003)
PAGEBOG	-1.060	0.127	59.00	(Voliani *et al.* 2003)
PAGEERY	-1.120	0.118	54.30	(Voliani *et al.* 2003)
SPARPAG	2.830	0.118	45.10	Dodeckanisos - (Stergiou *et al.* 1997)
PHYIBLE	-0.400	0.230	57.80	(De Ranieri 2004)
RAJACLA	-0.300	0.350	98.00	Auteri et al 1990
SCYOCAN	0.000	0.200	88.00	North Sea - (Jennings *et al.* 1999; Froese & Pauly 2002)
SOLEVUL	-1.065	0.243	50.53	Gulf of Lions – Anon. 2004
SPICFLE	-1.110	0.470	19.00	(Zamboni & Relini 1986)
SPICSMA	-1.626	0.404	18.90	Crete - (Stergiou *et al.* 1997)
TRACMED	-2.305	0.226	39.90	Saronikos Gulf - (Stergiou *et al.* 1997)
TRACTRA	-1.280	0.220	37.50	Adriatique – (Campillo 1992)
TRIPLAS	-0.639	0.254	38.20	? - (Campillo 1992)
TRISCAP	-0.007	0.421	24.06	GSA9 unpublished data
ZEUSFAB	0.000	0.300	69.40	(Righini & Voliani 1996)
ARISFOL	0.000	0.396	72.00	(Cau *et al.* 2002)
ARITANT	-0.289	0.197	75.60	(Cau *et al.* 2002)
NEPRNOR	-0.598	0.225	69.30	GSA9 unpublished data
PAPELON	0.000	0.600	43.50	GSA9 unpublished data
ELEDCIR	-0.040	1.163	11.63	GSA9 unpublished data

Annex II.5.2. MEDITS target species.

Scientific name	**MEDITS code**	**Scientific name**	**MEDITS code**
Aspitrigla cuculus	ASPI CUC	*Spicara flexuosa*	SPIC FLE
Citharus linguatula	CITH MAC	*Spicara smaris*	SPIC SMA
Eutrigla gurnardus	EUTR GUR	*Trachurus mediterraneus*	TRAC MED
Galeus melastomus	GALU MEL	*Trachurus trachurus*	TRAC TRA
Helicolenus dactylopterus	HELI DAC	*Chelidonichthys lastoviza*	TRIP LAS
Lepidorhombus boscii	LEPM BOS	*Trisopterus minutus capelanus*	TRIS CAP
Lophius budegassa	LOPH BUD	*Zeus faber*	ZEUS FAB
Lophius piscatorius	LOPH PIS		
Merluccius merluccius	MERL MER	*Aristaeomorpha foliacea*	ARIS FOL
Micromesistius poutassou	MICM POU	*Aristeus antennatus*	ARIT ANT
Mullus barbatus	MULL BAR	*Nephrops norvegicus*	NEPR NOR
Mullus surmuletus	MULL SUR	*Parapenaeus longirostris*	PAPE LON
Pagellus acarne	PAGE ACA		
Pagellus bogaraveo	PAGE BOG	*Eledone cirrhosa*	ELED CIR
Pagellus erythrinus	PAGE ERY	*Eledone moschata*	ELED MOS
Phycis blennoides	PHYI BLE	*Illex coindetti*	ILLE COI
Raja clavata	RAJA CLA	*Loligo vulgaris*	LOLI VUL
Scyliorhinus canicula	SCYO CAN	*Octopus vulgaris*	OCTO VUL
Solea vulgaris	SOLE VUL	*Sepia officinalis*	SEPI OFF
Sparus pagrus	SPAR PAG		

Annex II.5.3. L_{50} per species and year

Scientific name	**MEDITS code**	**Year with good ogives**	**Lmat (cm)**
Aspitrigla cuculus	ASPI CUC	1999-2000-2001-2003-2004	16-17
Citharus linguatula	CITH MAC	2000-2001	16
Eutrigla gurnardus	EUTR GUR	-	
Galeus melastomus	GALU MEL	-	
Helicolenus dactylopterus	HELI DAC	-	
Lepidorhombus boscii	LEPM BOS	1999-2004	25
Lophius budegassa	LOPH BUD	-	
Lophius piscatorius	LOPH PIS	-	
Merluccius merluccius	MERL MER	-	
Micromesistius poutassou	MICM POU	-	
Mullus barbatus	MULL BAR	-	
Mullus surmuletus	MULL SUR	-	
Pagellus acarne	PAGE ACA	-	
Pagellus bogaraveo	PAGE BOG	-	
Pagellus erythrinus	PAGE ERY	all year exclude 1994 and 1999	16
Phycis blennoides	PHYI BLE	-	
Raja clavata	RAJA CLA	-	
Scyliorhinus canicula	SCYO CAN	-	
Solea vulgaris	SOLE VUL	-	
Sparus pagrus	SPAR PAG	-	
Spicara flexuosa	SPIC FLE	-	
Spicara smaris	SPIC SMA	-	
Trachurus mediterraneus	TRAC MED	-	
Trachurus trachurus	TRAC TRA	-	
Chelidonichthys lastoviza	TRIP LAS	-	
Trisopterus minutus capelanus	TRIS CAP	-	
Zeus faber	ZEUS FAB	-	

Annex II.5.4. All estimates of trends in parameters.

Species	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SDLm	PvalueLm
EUTRGUR	0.090	0.070	0.263	0.119	0.241	0.637	NA	NA	NA	NA	0.567	0.187	0.001
GALUMEL	0.090	0.030	0.024	-1.168	0.330	0.024	NA	NA	NA	NA	-1.388	0.173	0.000
HELIDAC	0.130	0.020	0.000	-0.392	0.182	0.063	0.080	0.050	0.150	0.363	-0.226	0.171	0.178
LEPMBOS	0.000	0.040	0.964	0.222	0.115	0.085	NA	NA	NA	NA	-0.768	0.119	0.000
MERLMER	0.100	0.050	0.093	-0.074	0.058	0.240	0.080	0.050	0.130	0.377	-0.667	0.098	0.000
MICMPOU	0.150	0.140	0.286	-0.303	0.358	0.419	0.210	0.060	0.010	0.623	0.348	0.108	0.000
MULLBAR	0.160	0.050	0.009	-0.328	0.186	0.112	0.140	0.050	0.020	0.377	-0.489	0.029	0.000
NEPRNOR	0.090	0.040	0.027	-0.080	0.021	0.004	0.080	0.060	0.200	0.377	NA	NA	NA
PAGEACA	0.050	0.110	0.643	0.376	0.353	0.314	0.160	0.150	0.330	0.377	0.385	0.166	0.009
PAGEERY	0.020	0.040	0.562	0.033	0.233	0.891	0.050	0.040	0.240	0.377	0.160	0.031	0.000
PAPELON	0.210	0.050	0.003	-0.071	0.098	0.486	0.040	0.060	0.540	0.172	NA	NA	NA
PHYIBLE	0.090	0.030	0.024	-0.079	0.136	0.577	0.050	0.050	0.290	0.377	0.404	0.261	0.118
RAJACLA	0.110	0.060	0.094	0.171	0.651	0.799	NA	NA	NA	NA	3.849	1.371	0.005
SCYOCAN	-0.020	0.050	0.746	-0.092	1.471	0.953	NA	NA	NA	NA	-2.372	0.516	0.000
SOLEVUL	0.030	0.040	0.537	0.516	0.213	0.038	NA	NA	NA	NA	-0.131	0.846	0.875
SPICFLE	-0.020	0.050	0.750	-0.133	0.129	0.329	-0.020	0.080	0.790	0.055	0.189	0.059	0.001
SPICSMA	-0.200	0.100	0.090	0.227	0.374	0.576	NA	NA	NA	NA	-2.763	0.295	0.000
TRACMED	0.070	0.090	0.497	-0.255	0.192	0.217	0.230	0.100	0.050	0.377	-0.056	0.012	0.000
TRACTRA	-0.080	0.060	0.189	0.007	0.201	0.974	0.010	0.150	0.950	0.172	-0.400	0.097	0.000
TRISCAP	0.060	0.040	0.117	-0.064	0.122	0.614	-0.050	0.110	0.670	0.172	-0.270	0.029	0.000

II.6 South and Central Tyrrhenian (area 10)

Coordinator: Maria-Teresa Spedicato

II.6.1 Ecological settings, geographical and environmental features

The area explored in the MEDITS trawl survey project is delimited by the bathymetry of 10 and 800 m (total surface: 20255 km²) and is characterised by different morphological and geographical features. The most important geographic discontinuity is represented by the Strait of Messina. The whole area is thus composed by the mainland that includes the continental coasts of 3 Regions (Campania, Basilicata and Calabria) and by the north Sicily that includes the northern coasts of the Sicily Region.

The continental shelf is generally narrow in the whole area and depth decreases, depending on the zone, with fairly steep and regular slopes. Along the Campania coasts, from Garigliano River to Cape Licosa, the continental shelf (up to 200 m depth) is relatively wider, while along the Calabrian coasts and northern Sicily it becomes narrower. Along the Calabrian coasts the bathyal bottoms are generally wider, while in some zones, mainly in the Napoli Gulf and along the northern Sicily, sea-ground is irregular with submarine ridges and canyons. The surface of the no-trawlable zones is about 20% of the whole area.

In the area there are only streams characterised by autumn-winter water flow, if the Sele River flowing in the Gulf of Salerno is excluded. The chlorophyll concentration in the offshore waters is rather low, if compared with the northern Tyrrhenian Sea and if the coastal areas influenced by the highest human population density are excluded (e.g. Napoli Gulf).

In the Central-Southern Tyrrhenian Sea different subsystems of surface currents can be identified, combining linear (south-north direction) and cyclonic systems. The South Tyrrhenian Sea is a key area in which complex dynamics of water exchanges and biological fluxes between the eastern and western Mediterranean sub-basins takes place. CIESM has recently launched scientific cruises to elucidate these aspects, as a number of studies have documented recent increases in salinity and temperature in the deep Tyrrhenian Sea, with growing suggestions that this evolution is linked to the Eastern Mediterranean Climatic Transient and to the resulting recent intrusion of dense waters from the eastern sub-basin through the Sicily Strait (CIESM, Sub 1, Technical Research Information).

According to the benthic bionomic classification of Pérès and Picard (1964) the bottoms characterised by the *Posidonia oceanica* detritous are occurring up to 100 m depth, particularly in the Policastro Gulf, while the most common biocoenoses in the circalittoral zone is that of Coastal terrigenous muds (VTC), both along the mainland and northern Sicily coasts. Between 100 and 200 m depth a frequent biocoenoses is represented by the Offshore detritus bottoms (DL), characterised by the presence of *Leptometra phalangium* that sometimes occurs also deeper than 200 m (e.g. at Cape Bonifati area, along Calabrian coasts), while *P. longirostris*, *N. norvegicus* and red-shrimps typify the populations of slope and bathyal bottoms. Depending on the depth and zone, this fauna is accompanied by characteristic species as *Funiculina quadrangularis*, *Gerion longipes*, *Polycheles typhlops*, *Isidella elongata*, *Terebratula vitrea*.

Among the most important resources of the continental shelf there are the hake (*Merluccius merluccius*), the red mullet (*Mullus barbatus*), the three *Pagellus* species, and Cephalopods, whereas the deep water pink shrimp (*Parapenaeus longirostris*), the Norway lobster (*Nephrops norvegicus*) and the red shrimps (*Aristaeomorpha foliacea* and *Aristeus antennatus*) are the most important resources of the continental slope and bathyal bottoms.

II.6.2 Fisheries description and initial state assessment

Considering the number of vessels, the whole area is mainly characterised by the small scale fishery (IREPA 2003) using trammel nets, purse seine, seine nets, longlines, gillnets, harpoons, and pots. Anyhow, trawlers contribute with a higher production and production value.

To the diverse morphological features of the area correspond different characteristics of the fishery. On the northern side of the continental coasts, where the fishing port of Portici, Torre del Greco and Salerno, are localised the number of trawlers is relatively higher as well as in Porticello, Milazzo and Termini Imerese along the northern Sicily coasts.

In the mainland, small scale vessels represent about 80% of the total. In Campania, for example, trawlers (about 86) are 7% of the total number of fishing vessels and 33% of the gross tonnage

(IREPA 2003). Demersal resources are fished by artisanal fishery and trawlers, that contribute to the volume of total production for 13 and 36%, respectively and to the value of the total production for 21 and 40%, respectively (IREPA 2002). The landings from trawlers (IREPA 2002) are about 60% fish, 27% cephalopods and 13% crustaceans.

Regarding the management measures, number of fishing licences is restricted in the whole area as in the other Regions of Italy and the fishing is not permitted within 50 m depth or 3 miles from the shoreline. In the mainland, the fishing ban has not been compulsory throughout the time and the fishing is regulated by technical measure such as the size of the stretched mesh in the codend of the trawl net. The mainland coasts and the northern Sicily ones are also characterised by different regulation regimes, regarding fishing ban and mesh size. In addition, along northern Sicily coasts two main gulfs (Patti and Castellammare) have been closed to the trawl fishery up 200 m depth, since 1990.

II.6.3 Brief description of changes in survey design

In the MEDITS programs from 1994 to 2001 the whole GSA 10 was incorporated in the M3 area with the Strait of Sicily. For stratification purposes, this area was subdivided in 3 sub-units: M3a, M3b and M3c, investigated by 3 research Institutes*:* COISPA Tecnologia & Ricerca, Istituto Sperimentale Talassografico – CNR of Messina (IAMC-Messina) and IRMA-CNR of Mazara del Vallo. Thus the entire M3 MEDITS area encompassed the continental coasts from Garigliano River to the Strait of Messina, the northern coasts of Sicily and the Strait of Sicily, including Maltese waters.

After the revision of the boundaries of the geographical sub-regions of the Mediterranean (26° GFCM, Lacco Ameno, Ischia, 2001) the GSA 10 was defined as the area from the Garigliano River to Cape San Vito, thus including only the sub-units previously named M3a and M3b. Following the implementation of MEDITS project within the frame of EU Data Collection, 70 hauls were totally allocated to the GSA with a reduction of 17.6% of the tow's number.

Thus a ri-allocation frame was implemented maintaining the same sampling proportion among the strata as in the MEDITS project (Table II.6.1).

Table II.6.1. Re-allocation of the number of hauls to the depth strata (MEDITS from 2002 onwards).

	MEDITS 1994-2001	**MEDITS 2002-2004**
Stratum A (10-50 m)	8	7
Stratum B (51-100 m)	10	8
Stratum C (101-200 m)	17	14
Stratum D (201-500 m)	22	18
Stratum E (501-800 m)	28	23
Total GSA 10	85	70

The stratification scheme is reported in the Table II.6.2. The geographical sub-unit a and b (surface, sampling allocation, stratification scheme) are the same as in MEDITS project.

Table II.6.2. Stratification scheme.

GSA 10	**Stratum code**	**Depth (m)**	**Surface (km^2)**	**N° of hauls**	**Haul code/stratum**
10a	13401	10-50	1194	4	6, 21, 32, 46
	13402	50-100	1224	5	4, 5, 20, 28, 47
	13403	100-200	2095	9	2, 3, 9, 15, 16, 17, 27, 31, 34
	13404	200-500	3238	12	1, 8, 12, 13, 14, 22, 25, 26, 30, 35, 36, 45
	13405	500-800	5248	17	7, 10, 11, 18, 19, 23, 24, 29, 33, 37, 38, 39, 40, 41, 42, 43, 44
		Total	12999	47	Garigliano River- Cape Suvero
10b	13406	10-50	622	3	48, 49, 50
	13407	50-100	1003	3	51, 52, 53
	13408	100-200	1224	5	54, 55, 56, 57, 58
	13409	200-500	1966	6	59, 60, 61, 62, 63, 64
	13410	500-800	2441	6	65, 66, 67, 68, 69, 70

GSA 10	Stratum code	Depth (m)	Surface (km^2)	N° of hauls	Haul code/stratum
		Total	7256	23	Cape Suvero - Cape S. Vito
Total			20255	70	

II.6.4 Selection of species

The analysis of the single species population indices (i.e. population growth rate (r), spawning stock abundance, mean length, L_{50}, mean length of the spawning stock, and total mortality value (Z)) was performed on the 26 species that were the target since the beginning of the MEDITS project (Tab.1, Appendix). Thus a longer data series could be analyzed. Results are referred to 11 years (1994-2004) and to the last five years (2000-2004). Same data series was used for estimating the proportion of large fish.

The analysis of the community indices and the elaboration of the population growth rate (r) was performed since 2000 on all the caught species, including pelagics.

II.6.5 Results: review of indicators

II.6.5.1 Population indicator

II.6.5.1.1 Intrinsic Population growth rate

Over all the period, 3 species (*Loligo vulgaris Parapanaeus longirostris, Pagellus erythrinus*) show a significant increasing trend in abundance, while in the last five years *Lepidopus caudatus* and *Pagellus acarne* exhibit a significant decreasing trend. As regards *Pagellus erythrinus* also the spawning stock abundance was increasing along the 11 years, while seems that the increasing trend of *P. longirostris* is not confirmed in the more recent period.

II.6.5.1.2 Mean length in population Lbar

Over all the period *P. longirostris* and *Lophius budegassa* show a significant decreasing trend of the mean length, although this tendency is not revealed in the last 5 years for *P. longirostris*. It seems that for this species the low values of 2002 and 2003, probably due to the higher number of juveniles, influenced the estimate. *L. budegassa* and *Lophius piscatorius* show respectively a decreasing and increasing trend of mean length in the last 5 years. However, the number of individuals caught for both these species is generally low and size spectrum rather erratic to draw sound conclusions. The results also highlight that the mean length of the spawning stock of *Spicara flexuosa* is significantly decreasing. In this case the indicator should be more reliable, because not affected by the presence of recruits and species occurrence.

II.6.5.1.3 Average total mortality rates Z

In the overall period and in the last 5 years statistically significant trends of total mortality were not detected for the examined species.

II.6.5.1.4 Length at maturity (50% mature), Lmat

In the whole period and in the last 5 years no trend has been observed for the proportion of mature individuals in the examined 26 species.

Species with an increasing trend of L_{50} are: *Trachurus mediterraneus* and *Galeus melastomus*, while those with significantly decreasing L_{50} are *Spicara flexuosa, Citharus linguatula, Trachurus trachurus,* and *Pagellus erythrinus.* For this last species, however, the size at first maturity increases in the last 5 years.

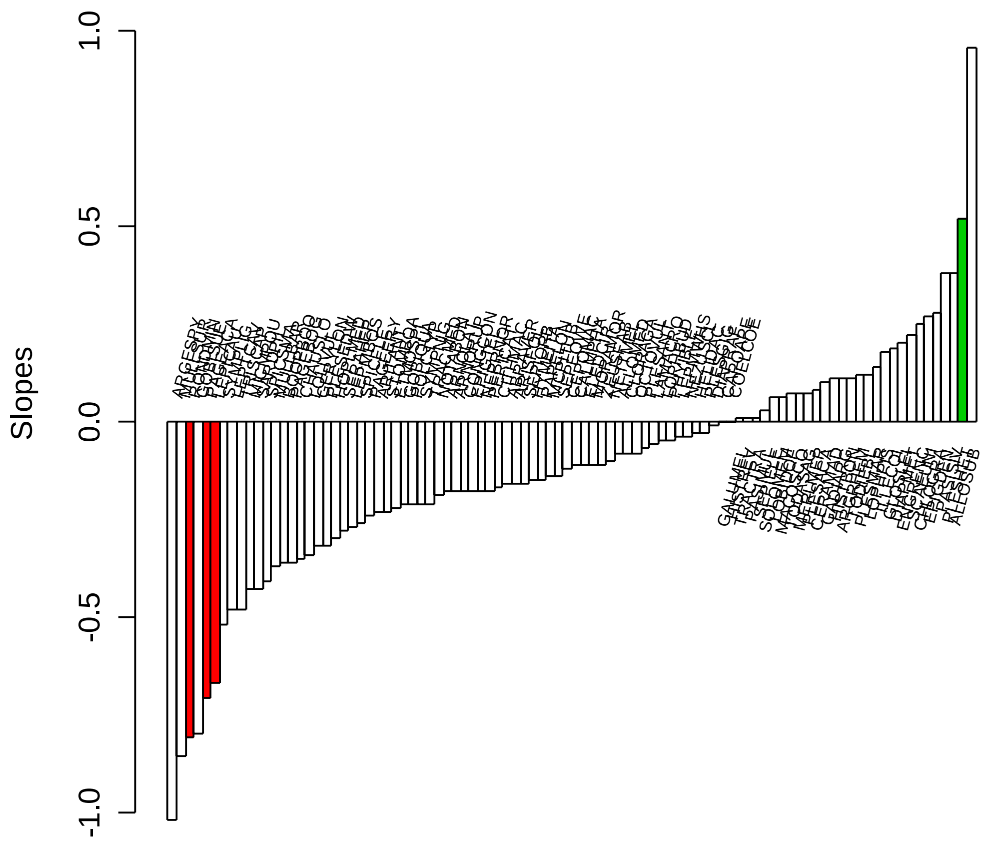
The fitting of the ogive, however, is reliable only for *P. erythrinus*, whose size at first maturity is in agreement with our previous observations (~16 cm total length).

The poor fitting observed for the other species might be attributable to the fact that the two essential components of the population (immature and mature) are not simultaneously occurring during the time of the survey (*e.g. M. barbatus*), due to diverse reasons such as the spawning season and reproductive pattern, and/or the growth process and recruitment mode. Thus, complementary information would be necessary for obtaining more reliable estimates.

The decreasing L_{50} of *P. erythrinus* in the whole period, but the increasing tendency in the last 5 years might be the consequence of sampling artefact.

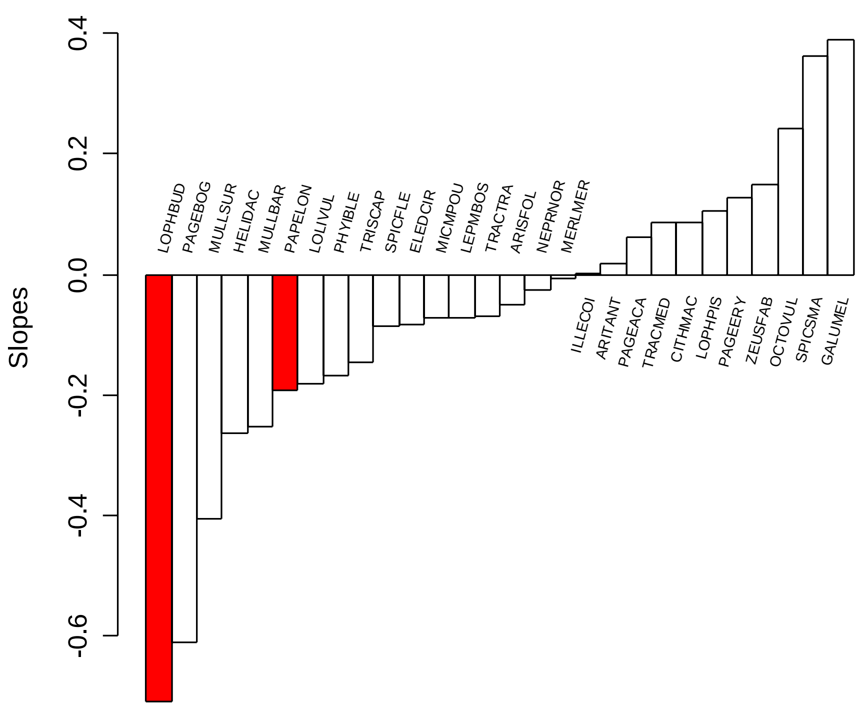
MEDITS-GSA10 C-S Tyrrhenian Sea 2000 - 2004

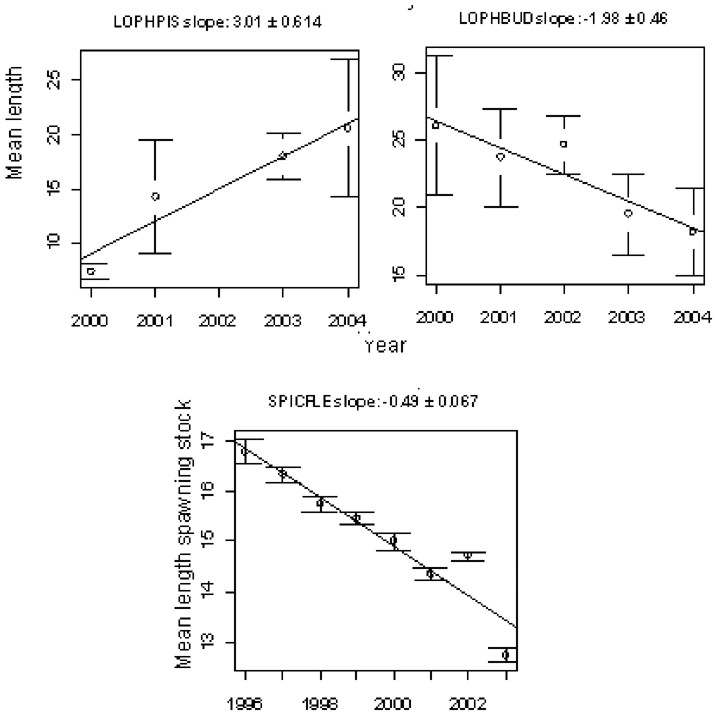
Population growth rate r



MEDITS-GSA10 C-S Tyrrhenian Sea 1994 - 2004

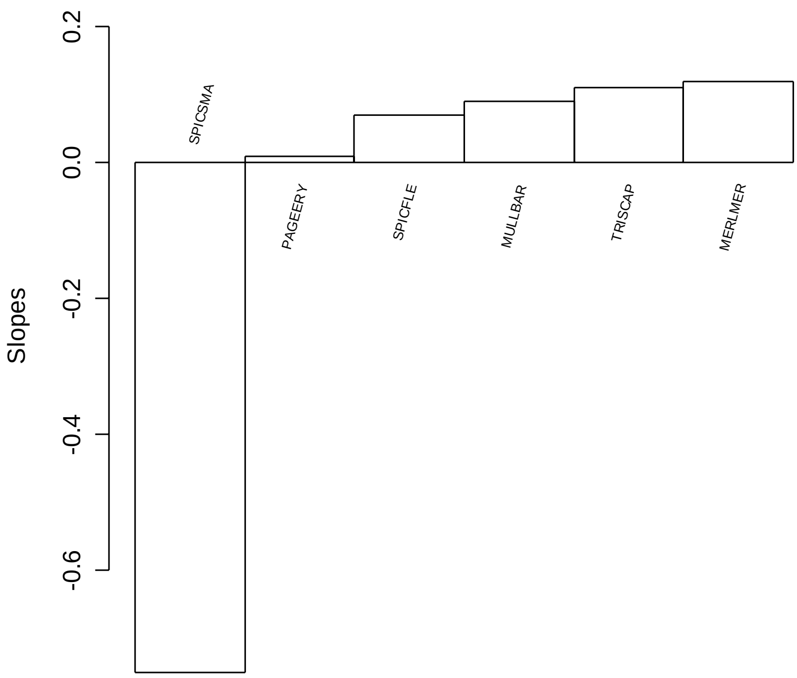
Slope of time trend in mean length

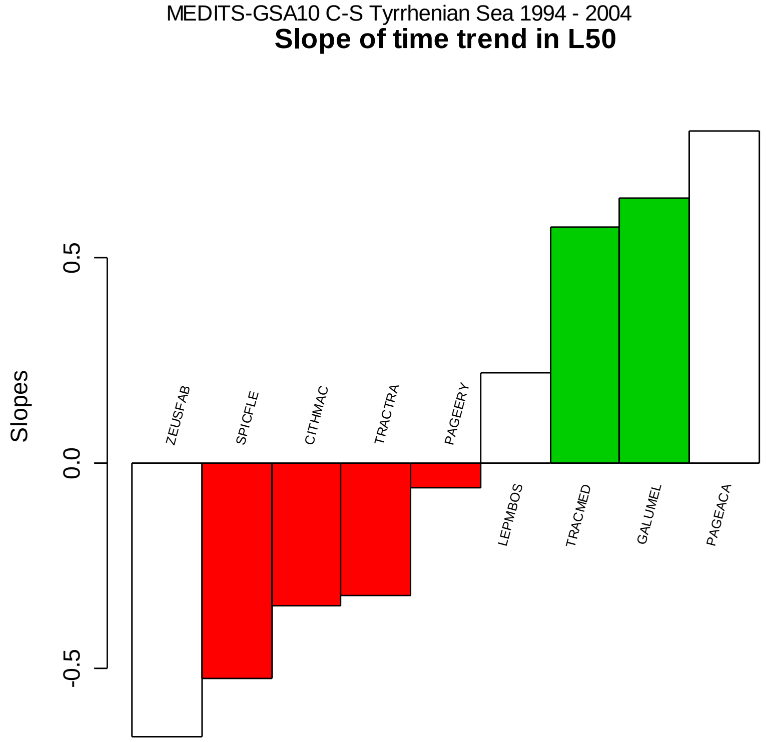


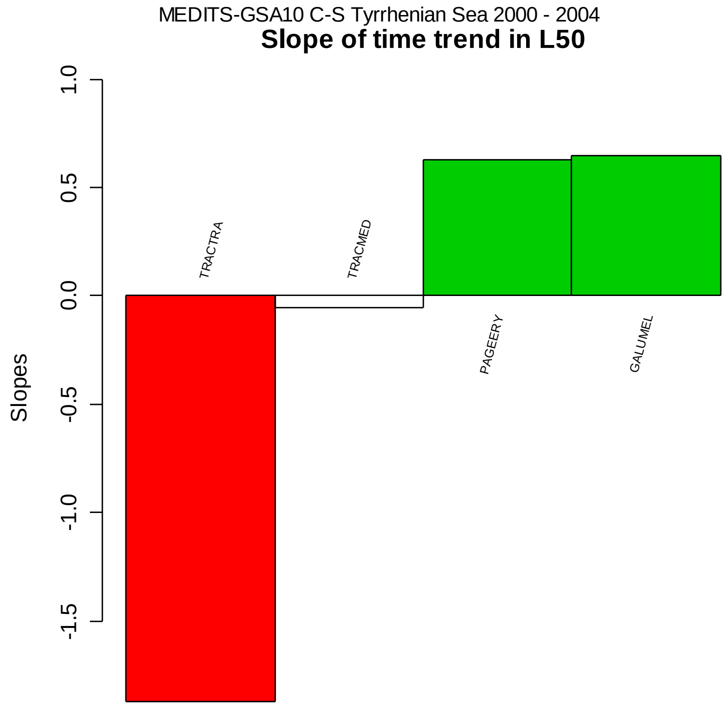


MEDITS-GSA10 C-S Tyrrhenian Sea 1994 - 2004

Slope of time trend in Z







II.6.5.2 Community indicator

II.6.5.2.1 Total biomass

There isn't any significant trend.

II.6.5.2.2 Total abundance

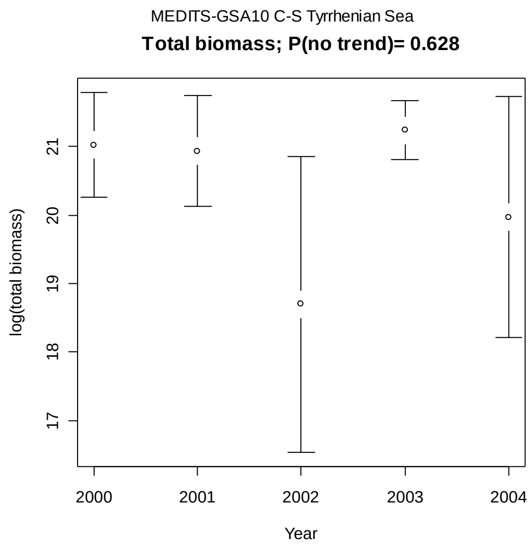
There isn't any significant trend.

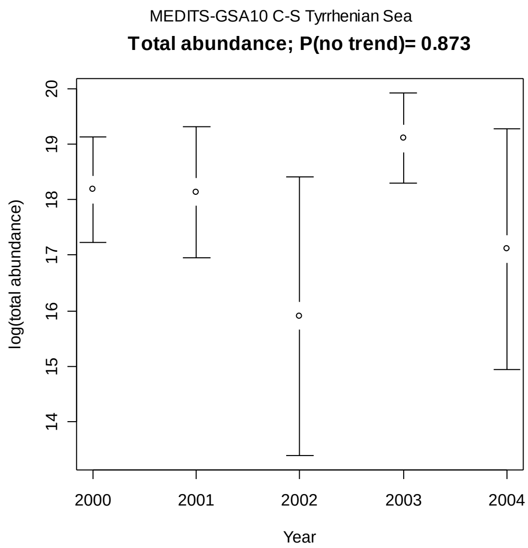
II.6.5.2.3 Mean weight

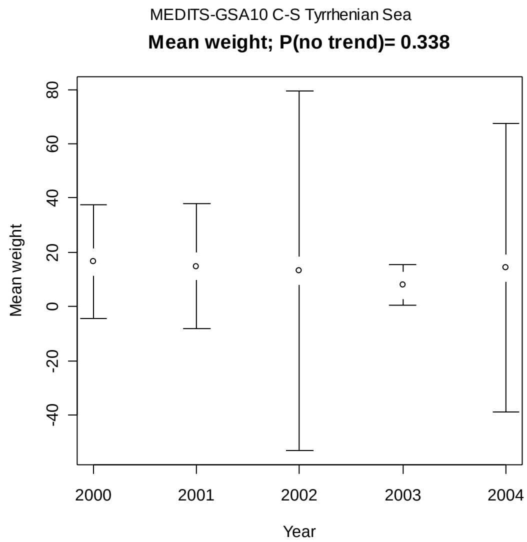
There isn't any significant trend

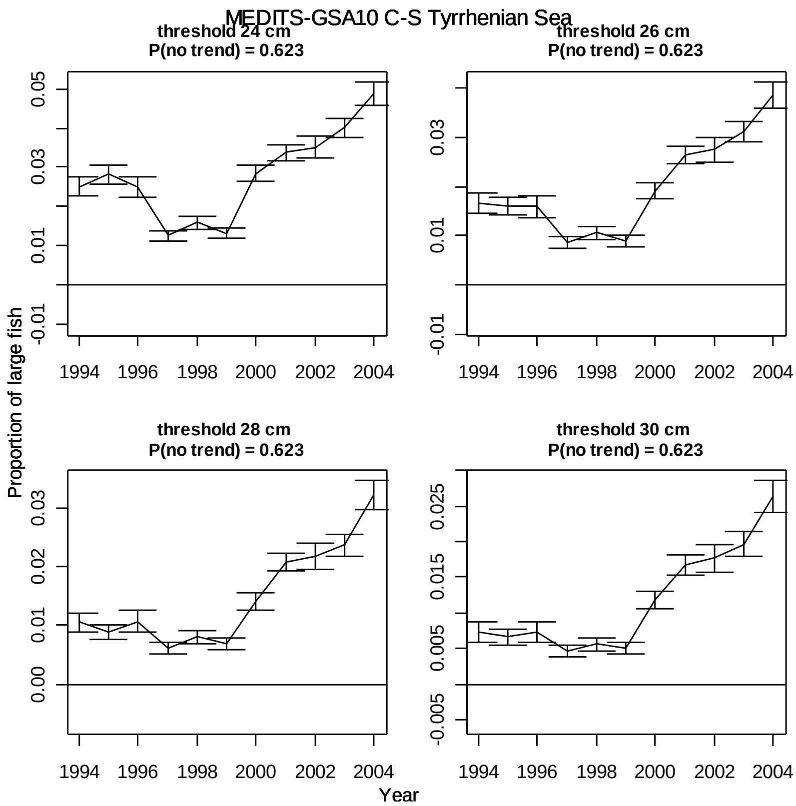
II.6.5.2.4 Proportion of large fish

There isn't any significant trend.


MEDITS-GSA10 C-S Tyrrhenian Sea
Total biomass; P(no trend)= 0.628
log(total biomass)
17
18
19
20
21
2000
2001
2002
2003
2004
Year


MEDITS-GSA10 C-S Tyrrhenian Sea
Total abundance; P(no trend)= 0.873
log(total abundance)
14
15
16
17
18
19
20
2000
2001
2002
2003
2004
Year


MEDITS-GSA10 C-S Tyrrhenian Sea
Mean weight; P(no trend)= 0.338
Mean weight
-40
-20
0
20
40
60
80
2000
2001
2002
2003
2004
Year


MEDITS-GSA10 C-S Tyrrhenian Sea
threshold 24 cm
P(no trend) = 0.623
threshold 26 cm
P(no trend) = 0.623
threshold 28 cm
P(no trend) = 0.623
threshold 30 cm
P(no trend) = 0.623
Proportion of large fish
-0.01
0.01
0.03
0.05
0.00
0.02
-0.005
0.005
0.015
0.025
1994
1996
1998
2000
2002
2004
Year

II.6.5.3 Sensitivity analyses for Z and any other relevant indicator

Methods using growth parameters for estimating total mortality are obviously all influenced by the selected set of t0, k and Linf, apart from the numerousness of the individuals in the different classes as determined using pseudoages. This influence is likely more important when the objective is the estimate of total mortality in itself, for the implications on the fishing mortality eventually derived. But, also the natural mortality is generally a life history-linked empirical estimate and, thus, the exploitation rate is correlated, if the set of parameters is consistent. When, conversely, the objective is to identify temporal trends, the influence of the potential bias on Z, due to the growth parameters, might be less important, provided that growth parameters and sampling features are kept constant along the time.

Considering the algorithm used for estimating Z, it might be more suitable when a discrete recruitment mode is occurring and thus the pseudoages composition is less overlapping. However, this point would require deeper investigations and specific analysis.

II.6.5.4 Additional information - Comparison with national trawl surveys GRUND

In the GSA 10 the national trawl survey (GRUND) was carried out since 1985. From 1994 to 2002 this survey was carried out in parallel with MEDITS but in a different season (autumn) and using a different gear, more similar to the commercial Italian trawl. Since 2003 GRUND survey is carried out in the frame of EU regulation on Data Collection, and the same sample allocation as in MEDITS is adopted.

In the following figures the tendency of the abundance indices (biomass and number) for the 10 project target species and for the groups of Teleosteans, Selachians, Cephalopods, Crustaceans and Total were carried out. The group aggregation of the species was adopted considering the different biological/ecological characteristics of each group and a better robustness of the analysis when fish community is considered. Also the analysis of average length throughout the time, as estimated in GRUND, is reported.

The results presented in the following figures are part of the GRUND report produced for the 2004 (Spedicato 2004).

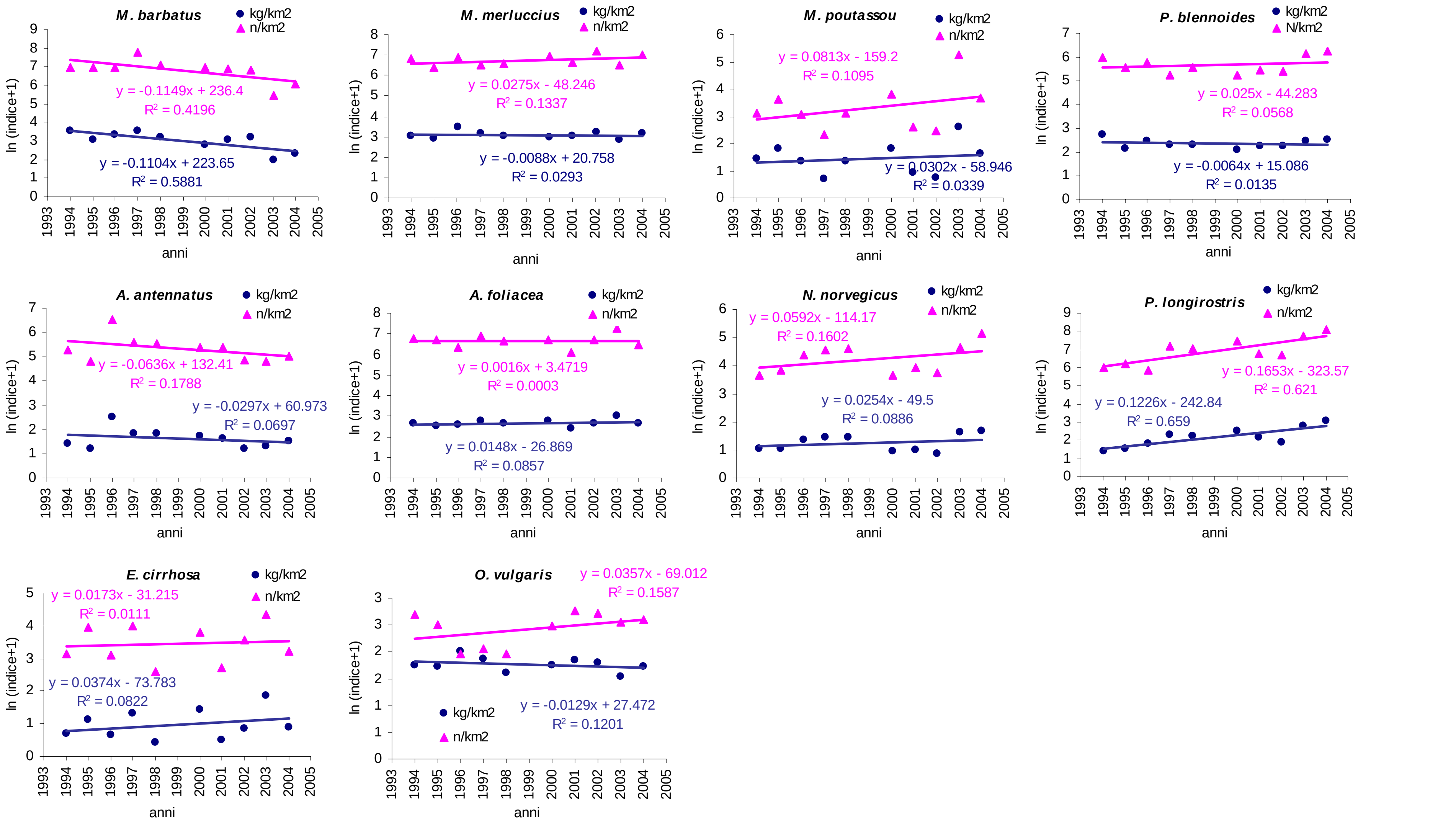
The method used for data transformation of abundance values is similar to that adopted inside R-SUFI (ln(abundance)) and the analysis is based on a linear regression.

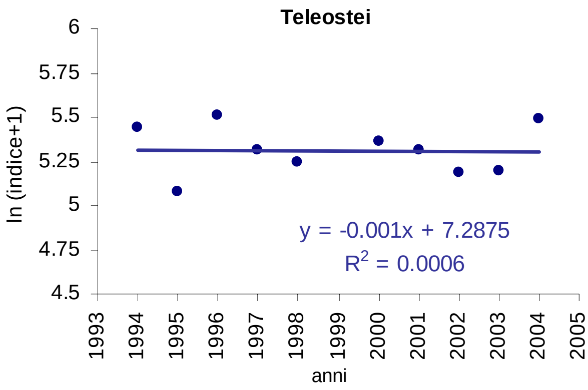
Similarly for the average size of the 10 target species reported in the figures below.

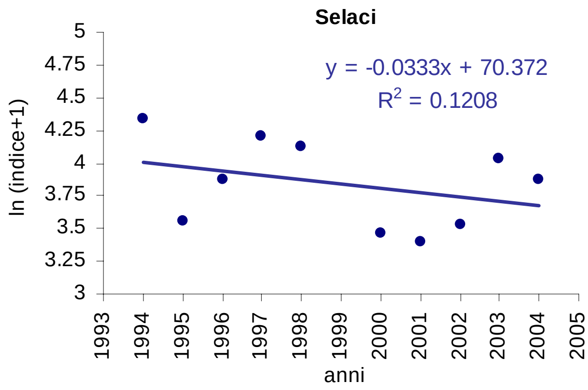
The abundance indices were fluctuating throughout the time, but significant trends were not observed either for most of the species and group of species. Only for *M. barbatus* and *P. longirostris* a significant decreasing and increasing trends were respectively observed.

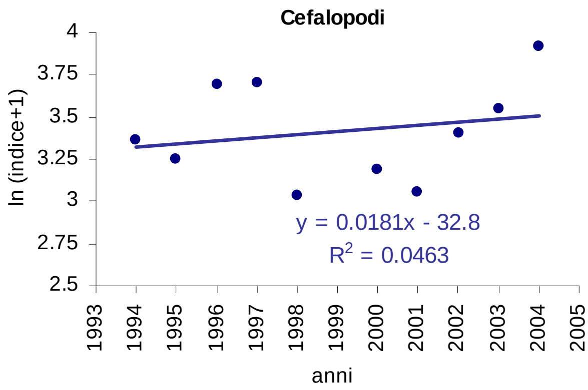
The mean length was rather stable for several species, and significantly decreasing only for *N. norvegicus* and *M. poutassou.* Comparing with MEDITS analysis, different results were obtained for *E. cirrhosa*, *A. foliacea*, *O. vulgaris* and *M. barbatus* in the sign and significance of the slope.

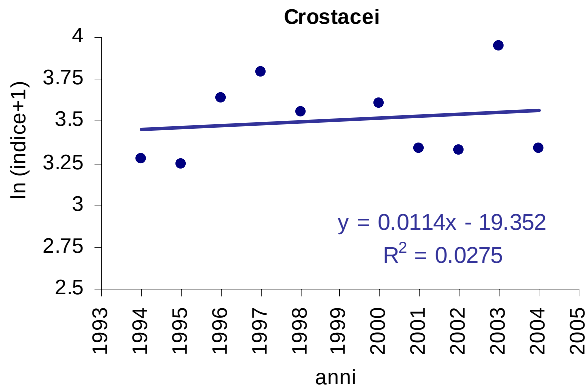
The results regarding the trend of abundance of *P. longirostris* are in agreement with the estimate performed using MEDITS data, although GRUND outcomes do not evidence a significant decreasing of the average length. At level of fish community (all the species both in MEDITS and GRUND) similar results were obtained.

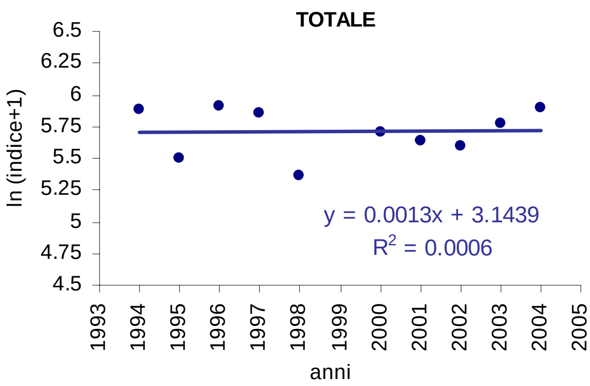

M. barbatus
kg/km2
n/km2
y = -0.1149x + 236.4
R² = 0.4196
y = -0.1104x + 223.65
R² = 0.5881
ln (indice+1)
anni
M. merluccius
kg/km2
n/km2
y = 0.0275x - 48.246
R² = 0.1337
y = -0.0088x + 20.758
R² = 0.0293
ln (indice+1)
anni
M. poutassou
kg/km2
n/km2
y = 0.0813x - 159.2
R² = 0.1095
y = 0.0302x - 58.946
R² = 0.0339
ln (indice+1)
anni
P. blennoides
kg/km2
N/km2
y = 0.025x - 44.283
R² = 0.0568
y = -0.0064x + 15.086
R² = 0.0135
ln (indice+1)
anni
A. antennatus
kg/km2
n/km2
y = -0.0636x + 132.41
R² = 0.1788
y = -0.0297x + 60.973
R² = 0.0697
ln (indice+1)
anni
A. foliacea
kg/km2
n/km2
y = 0.0016x + 3.4719
R² = 0.0003
y = 0.0148x - 26.869
R² = 0.0857
ln (indice+1)
anni
N. norvegicus
kg/km2
n/km2
y = 0.0592x - 114.17
R² = 0.1602
y = 0.0254x - 49.5
R² = 0.0886
ln (indice+1)
anni
P. longirostris
kg/km2
n/km2
y = 0.1653x - 323.57
R² = 0.621
y = 0.1226x - 242.84
R² = 0.659
ln (indice+1)
anni
E. cirrhosa
kg/km2
n/km2
y = 0.0173x - 31.215
R² = 0.0111
y = 0.0374x - 73.783
R² = 0.0822
ln (indice+1)
anni
O. vulgaris
y = 0.0357x - 69.012
R² = 0.1587
kg/km2
n/km2
y = -0.0129x + 27.472
R² = 0.1201
ln (indice+1)
anni


Teleostei
y = -0.001x + 7.2875
R² = 0.0006
ln (indice+1)
6
5.75
5.5
5.25
5
4.75
4.5
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
anni


Selaci
y = -0.0333x + 70.372
R² = 0.1208
ln (indice+1)
5
4.75
4.5
4.25
4
3.75
3.5
3.25
3
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
anni


Cefalopodi
y = 0.0181x - 32.8
R² = 0.0463
ln (indice+1)
4
3.75
3.5
3.25
3
2.75
2.5
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
anni


Crostacei
y = 0.0114x - 19.352
R² = 0.0275
ln (indice+1)
4
3.75
3.5
3.25
3
2.75
2.5
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
anni


TOTALE
y = 0.0013x + 3.1439
R² = 0.0006
ln (indice+1)
6.5
6.25
6
5.75
5.5
5.25
5
4.75
4.5
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
anni

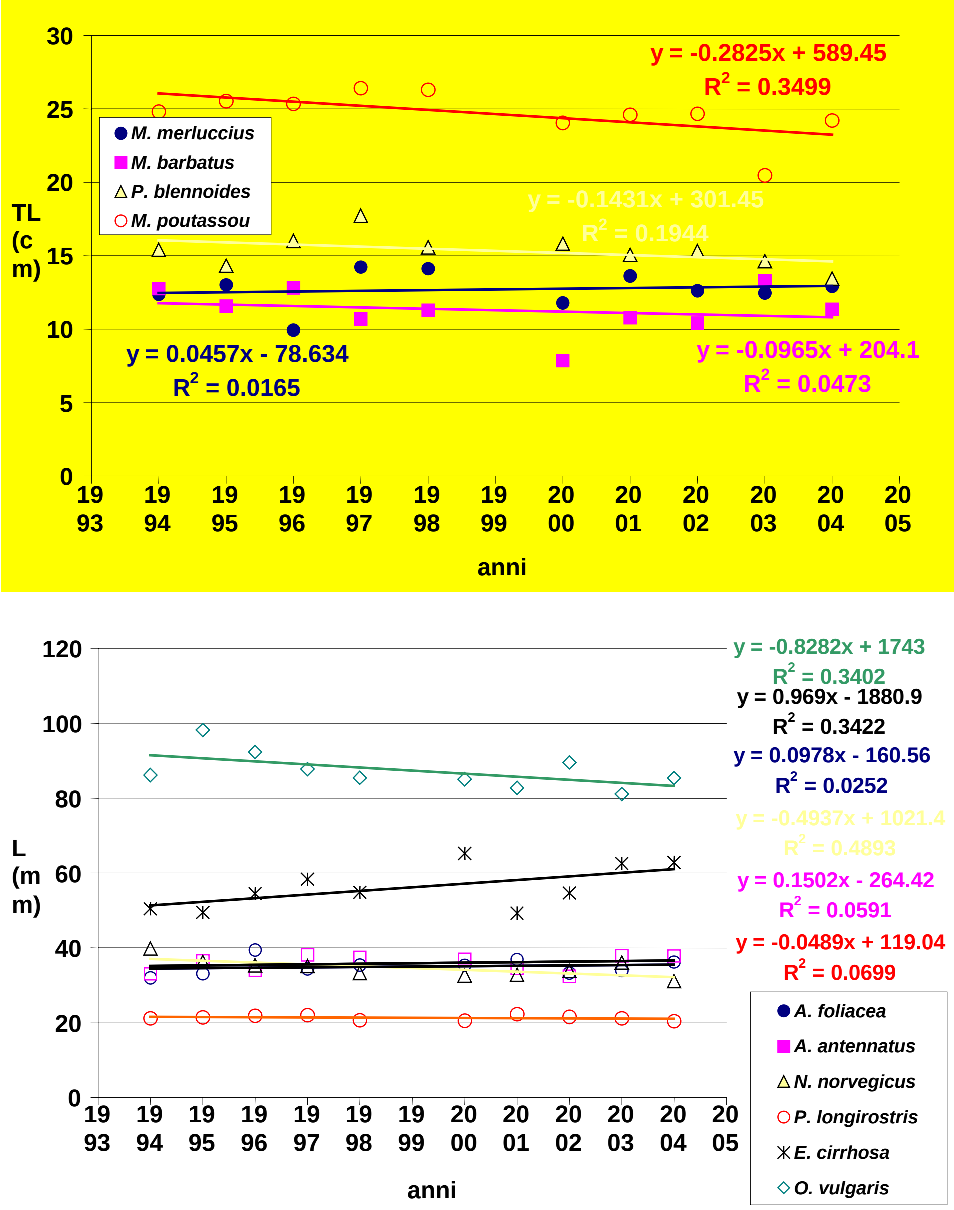


Figure . Average size of the 10 target GRUND species throughout the time.

II.6.6 Discussion

The indicator "population growth rate" used at single species level showed that a larger proportion of species was decreasing although for the most part not significantly, while a less number of species with increasing *r* was observed and only one had a significant trend. This could be interpreted as an increasing stress on the populations. At community level, however, significant trend were not detected. Probably single population are more sensitive to the exploitation, while community compensates may be over longer time the effects of changes. Species groups like Teleosteans, Selachians, Cephalopods and Crustaceans, as used in the GRUND approach, seem also useful indicators of the community state. Overall, results were in accordance using MEDITS and GRUND data series.

The indicator *r* seems to be a good descriptor of the population/community changes and decreasing tendency can be used as "warning signal" and/or a complementary tool in the assessment of fishing effect at population/community level.

Also the total mortality *Z* is potentially a powerful indicator, because tendency in increasing/decreasing could be correlated with fishing mortality, provided that the component of natural mortality *M* is assumed to be unchanging along the time and that the survey length frequency distributions reflect the population structure. As it is well known the growth parameters can influence the *Z* estimates and thus it is very important to rely upon reliable values if the objective is the estimate of the exploitation status of the population. However, if the objective is to stress time trend in the indicator the bias might be less important. It is furthermore relevant to better understand the performance of the method in case of species with discrete or continuous recruitment.

Mean length and L_{50} are potential indicators of the exploitation on fish population. Anyhow their ability in catching changes is more prone to the structure of the population intercepted at the sampling time, as trawl-surveys takes an instantaneous picture of the situation at sea. Thus, mean length might be affected for example by the presence of recruits, intercepted or not from year to year, and L_{50} by the relative proportion of mature and immature individuals. Consequently an analysis on the effect of shifting time of the survey from year to year might help in the interpretation of results. In addition, also the computation of ratios between juveniles and adults (thresholds for splitting the two population fractions to be defined) might be useful for understanding changes and eventually correcting the time series.

Mean length of the spawners should be a less sensitive descriptor, although younger fish might reproduce earlier or later and thus play a role in the indicator estimate. Computation of quartiles (25%, 50% and 75%) and median length could provide a further support to the interpretation of results, but their effectiveness need to be better understood and analysed.

At community level, proportion of large fish seems, conversely, a more robust indicator, as less influenced by seasonal/short time variation.

The comparison with GRUND data highlights that complementary information can be useful to better understand and describe phenomenon, thus a second trawl-survey in the year could give a powerful tool for more sound estimates of population status and indicators, provided that the methodology between surveys is consistent.

II.6.7 Further references

(Peres & Picard 1964; D'Onghia *et al.* 1996a; Matarrese *et al.* 1996; Karlou-Riga & Sinis 1997; Karlou-Riga 2000; Lembo 2002; Dulčić *et al.* 2003)

Appendix

Annex II.6.1. MEDITS target species since 1994.

Scientific name	MEDITS code	Scientific name	MEDITS code
Citharus linguatula	CITH MAC	*Spicara flexuosa*	SPIC FLE
Helicolenus dactylopterus	HELI DAC	*Trachurus mediterraneus*	TRAC MED
Lepidorhombus boscii	LEPM BOS	*Trachurus trachurus*	TRAC TRA
Lophius budegassa	LOPH BUD	*Trisopterus minutus capelanus*	TRIS CAP
Lophius piscatorius	LOPH PIS	*Zeus faber*	ZEUS FAB
Merluccius merluccius	MERL MER	*Aristaeomorpha foliacea*	ARIS FOL
Micromesistius poutassou	MICM POU	*Aristeus antennatus*	ARIT ANT
Mullus barbatus	MULL BAR	*Nephrops norvegicus*	NEPR NOR
Mullus surmuletus	MULL SUR	*Parapenaeus longirostris*	PAPE LON
Pagellus acarne	PAGE ACA	*Eledone cirrhosa*	ELED CIR
Pagellus bogaraveo	PAGE BOG	*Loligo vulgaris*	LOLI VUL
Pagellus erythrinus	PAGE ERY	*Illex coindetti*	ILLE COI
Phycis blennoides	PHYI BLE	*Octopus vulgaris*	OCTO VUL

Annex II.6.2. Von Bertalanffy growth parameters.

Area	Species	t_0	k	L_{inf}	source
GSA10	HELIDAC	-0.9	0.16	30.7	D'Onghia et al., 1996
GSA10	LEPMBOS	-0.405	0.215	36.2	Ungaro e Martino, 1998
GSA10	MERLMER	-0.2	0.22	63.4	Samed 2002 area 1.3.j-1.3.i average
GSA10	MICMPOU	-0.01	0.35	48	SAMED 2002
GSA10	MULLBAR	-0.423	0.463	26.1	Samed 2002 area 1.3.j-1.3.i average
GSA10	MULLSUR	0	0.48	29.3	Strait of Sicily - Anon. 2004
GSA10	PAGEACA	-0.473	0.296	28.6	SAMED 2002
GSA10	PAGEBOG	-0.38	0.243	39.8	Atlantique - Campillo 1992 for age 1 to 5
GSA10	PAGEERY	-0.05	0.2	54.7	Spedicato et al., FSBI 2004
GSA10	PHYIBLE	-0.073	0.277	53.9	Samed 2002 area 1.3.j-1.3.i average
GSA10	SPICFLE	-1.3	0.31	20.9	Mararrese et al., 1996
GSA10	SPICSMA	-0.793	0.277	22.8	Dulcic et al., 2003
GSA10	TRACMED	-0.842	0.326	37.2	Karlou Riga, 2000
GSA10	TRACTRA	-0.843	0.37	30.6	Karlou Riga, 1997
GSA10	TRISCAP	-0.09	0.365	27.6	SAMED 2002
GSA10	ZEUSFAB	0	0.298	57.9	Mauritania - Fishbase
GSA10	ARISFOL	-0.138	0.5275	60	Samed 2002 area 1.3.j-1.3.i average
GSA10	ARITANT	-0.05	0.4	60	Report GRUND 2004-GSA10 - Spedicato et al.
GSA10	NEPRNOR	-0.35	0.17	66.5	Report GRUND 2004-GSA10 - Spedicato et al.
GSA10	PAPELON	-0.225	0.6275	43	Report GRUND 2004-GSA10 - Spedicato et al.

Annex II.6.3. All estimates of trends in the population and community indicators.

Species	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SdLm	PvalueLm
CITHMAC	0.18	0.1	0.0999	0.086	0.21	0.693	NA	NA	NA	NA	-0.346	0.146	0.034
GALUMEL	2.45	0.47	0.0006	0.388	0.453	0.454	NA	NA	NA	NA	0.648	0.183	0
LOLIVUL	0.27	0.11	0.0398	-0.182	0.14	0.225	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	0.04	0.05	0.4366	-0.707	0.228	0.013	NA	NA	NA	NA	NA	NA	NA
PAGEERY	0.13	0.05	0.0437	0.126	0.152	0.429	0.01	0.15	0.93	0.011	-0.06	0.03	0.049
PAPELON	0.2	0.07	0.0153	-0.191	0.075	0.031	NA	NA	NA	NA	NA	NA	NA
SPICFLE	0.09	0.05	0.1493	-0.085	0.054	0.15	0.07	0.08	0.44	0.055	-0.526	0.028	0
TRACMED	0.05	0.13	0.6847	0.085	0.267	0.757	NA	NA	NA	NA	0.575	0.066	0
TRACTRA	0.05	0.1	0.6358	-0.069	0.162	0.682	NA	NA	NA	NA	-0.324	0.152	0.019

II.7 Sardinia (area 11)

Coordinators: Angelo Cau & Matteo Murenu

II.7.1 Ecological setting, geographical and environmental features

Geographical sub area (GSA) 11 is located in the Centre of the Western Mediterranean, in which the Island of Sardinia oceanographically belongs to the Algero-Provençal Basin and the Tyrrhenian Basin connected together by the Sardinia Channel. Sardinia is characterized by a great variety of coastal areas and bottom sea morphologies that can be distinguished by considering four main subareas in accordance to the principal cardinal points:

The west coast (Sardinian Sea) is characterized by a wide extension either of shelf or slope bottoms. The substrate is characterized by various types of sediment; muddy, sandy and hard bottoms (Cau *et al.* 1994).

The north coast coincide with the "Golfo dell'Asinara" and divides Sardinia from Corsica. The continental shelf is fairly extended while the slope is narrow and moderately steep.

The east coast is characterized by narrow and steep fishing grounds down to 1000 m of depth. Neverthless, from "Capo Carbonara" to "Bocche di Bonifacio", the continental shelf is very narrow (Chiocci & Orlando 1996) and the morphology is uneven, characterized by submarine valleys, ridges and canyons as in Gulf of Orosei (Orrù & Ulzega 1987).

The south coast belongs to the Gulf of Cagliari. The shelf is much wider (11 km) in the western part (40 km of coastline) rather than in the eastern one where its extension is very limited and very steep (500 m of depth is reached and exceeded at less than 3 km off the coast).

The surface of the depth stratum 0-200 m represents, in the whole GSA, about 36,5 % of the total area.

The surface water mass circulation of Sardinian seas is mainly characterised by the westward flow of the Atlantic Water vein which divides the Mediterranean basin into two regimes, with anticyclonic gyre systems to the south, and predominantly cyclonic flows to the north (Sardà *et al.* 2004). The Atlantic Water (AW) entering throughout the Strait of Gibraltar feeds what is known as the Algerian Current which is oriented eastwards and move along the African continental slope.

The Algerian Current, is relatively narrow (30-50 km) and deep (200-400m) in the west, but becomes wider and thinner while progressing eastwards along the Algerian slope until the Channel of Sardinia (Robinson *et al.* 1991).

Here, due to the isolated and combined action of several factors like strong winds, the presence of shelf-slope density fronts and a complex bottom topography lead to complicated circulation patterns, characterized by an intense ensemble of flow fluctuations (mesoscale phenomena) that have been detected using satellite information and current measurements (Benzohra & Millot 1995). Mesoscale activity occurs as instabilities along the coastal Algerian Current, leading to the formation of mesoscale eddies (small gyres or vortices) which can move across the basin or interact with the current itself. Among other characteristics, mesoscale eddies are able to block the general circulation, they are supposed to contribute to the exchange between the continental shelf waters and slope waters, and they are associated with vertical motions that allow water and nutrients to rise or sink, thus having strong biological, geological and chemical implications (Sarda *et al.*, 2004). The cyclonic and anticyclonic eddies along the Algerian Current develop and evolve over several months as they slowly drift eastward (a few kilometers per day). The anticyclonic eddies generally increase in size and detach from the coast. Some may drift near the continental slope of Sardinia, where some authors report a well-defined flow of LIW. Here they are able to pull fragments of LIW seaward (Robinson *et al.* 1991).

Moreover, the eastward progression of these open sea eddies (late stages of coastal eddies) is topographically constrained by the Channel of Sardinia, where such deep structures are forced to flow northwards, contributing to the unstable flow west of Sardinia and Corsica, before finally turning westwards to return into the Algerian basin.

The south Tyrrhenian, particularly the Sardinia-Sicily section, is a key place for the mixing and transformation of the water masses at sub-basin and also large scale. Worthy of note is the water masses exchange at depth between the EM and the WM (Astraldi *et al.* 2002). The LIW and EMDW enter the western Mediterranean from the eastern basin through the western side of the strait of Sicily, along the Tunisian coast (Manzella *et al.* 1988; Astraldi *et al.* 2001; Fuda *et al.* 2002). However, there no evidence of any current path from the eastern Mediterranean coming directly to the Sardinia Channel (Onken *et al.* 2003). The LIW and EMDW enter the Tyrrhenian Sea where it causes strong mixing and increases the volume of the Tyrrhenian Deep water (TDW) (Sparnocchia *et al.* 1999), which together with LIW forms the Tyrrhenian basin outflow at intermediate and deep levels toward the Sardinian Channel (Fuda *et al.* 2002).

On the southwest coast of Sardinia, the LIW and TDW shows its maximum variability and follow the same path: from being a relatively narrow vein to the south of Sardinia, it becomes wider (in horizontal direction), thinner (in depth) and cooler to the west of the island.

These changes have been attributed to the interaction with open sea Algerian eddies that migrate from the Algerian slope to open waters, and also to the inherent instabilities of the intermediate water vein, which is presumably able to generate anticyclones "Leddies" (Millot 1999).

Finally, due to its bathymetry, the Channel of Sardinia is a key place for Western Mediterranean Deep Water (WMDW) circulation. The Balearic Basin or Algero-Provençal Basin, of which maximum depth is 2600 m (Stanley 1977) or 2700 m (Rehault *et al.* 1984), is divided from the Tyrrhenian Basin, where depths exceeds 3600 m (Vanney & Gennesseaux 1985), by the sill of the Sardinia Channel (1900 m). Therefore, on their way from the Algerian basin, WMDW flowing above 2000 m depth will be able to flow into the Tyrrhenian Sea, whereas those flowing deeper than 2000 m will be forced to flow along the western continental slope of Sardinia.

II.7.2 Fisheries description and initial state assessment

The fleet operating in Sardinia (about 6,5% of Italian fleet) consists of 1327 vessels (Gross Tonnage=11537 metric tons), based in 18 ports all-around the island.

The structural characteristics of the fishing vessels and the gear utilisation is generally related to the available resources, geo-morphology of the grounds, dominant weather conditions and therefore, can be very different port by port. However, in average Sardinian vessels are 30 years old (mean construction date is 1974), have a mean length per boats of 5,74 m, a GT of 8.96 and are powered with engines of 63.5 HP.

The Sardinian fleet operates all year round with a 45 days closed period (generally Autumn for trawlers and Spring for the small scale fishery).

Information on the fleet composition, which is being collected from official sources, seem to indicate that the number of trawlers amounts to a percentage of about 14%, the remaining are small fishing vessels (~ 86% of units).

Nevertheless trawlers are numerically not relevant, economically speaking they are the most important fishery of the island. A total catch of around 3315 metric tons has been estimated for the 2003 (Source: IREPA-MIPAF census 2003).

Because the fishing activities are not generally carried out deeper than 800 m, the bottom surface potentially exploited by trawlers is about 27,000 km^2. The extension of trawlable grounds is very different coast by coast (62 % on the western and southern side, 28% on the eastern, and 10 % on the northern side) as shown in the Table II.7.1.

Table II.7.1. Extension of the trawlable groundsin area 11.

Side coast	East	North	West	South	Sardinia
Shelf (km^2)	4926	1934	8441	1822	17124
Slope (km^2)	2711	743	4139	2287	9880
Sardinia % km^2	28,3	9,9	46,6	15,2	

Regarding the number of trawlers the main port of the GSA 11 are Cagliari (55 units), Sant'Antioco (38 units), Oristano (25 units) and Alghero (7 units). The composition of this trawling fleet in terms of horsepower shows a wide degree of variation, but generally is constituted of small-medium size vessels, with a mean horsepower of 187 and a mean gross tonnage of 35.8 t; the larger and more powerful trawlers (more than 650 HP) are concentrated in the port of Cagliari.

As a general rule, small trawlers (less than 30 GT, total number 177, Table II.7.2) usually operate daily on shallow waters but occasionally within 3 miles, the coastal stripe forbidden for trawling.

Large trawlers (about 70 mean GRT, total number 74) usually employ on long fishing trips (2-5 days) within national and international waters of the Sardinian seas and Sardinia Channel. Large trawlers operate both on the continental shelf and on deep bottoms (50 m down to 700 - 800 m of depth).

Table II.7.2. The trawler fleets in area 11.

total number	Total tonnage (tons)	Mean tonnage (tons)	Mean engine power (hpa)	Mean length (m)	construction date (mean)	Trawlers
117	1420	12,1	112,8	7,5	1970	GT<30
74	5422	73,3	303,6	13,3	1978	GT>=30
191	6842	35,8	186,7	9,78	1973	Total

The Sardinian fleet evolution from 1993 to 2001 shows an increasing number of vessels inversely to the negative trend of Italian fleets (Table II.7.3). In this period the consistency of the large trawler fleet (GRT>30) has increased, especially in relation to the number of vessels. This tendency has been favoured by subventions from regional, national and from European Community Government supply with the aim of reducing the fishing effort in shallower waters. The fleet reconversion mostly interested the oldest, smaller and less equipped vessels that are usually converted in bigger boats suitable for operate on deeper fishing grounds.

Table II.7.3. Evolution of the fishing fleet in area 11.

Gross Tonnage	1991	1994	2001
30 – 70	43	47	39
70 – 100	6	7	14
> 100	10	12	17
Total	59	66	70

Most of the fish production consisted of demersal fish (almost 50%), followed by molluscs (19%), small pelagic fish (16,7%), crustaceans (7.7%) and large pelagic fish (4,9 %); the remain percentage consist of less relevant species. The most abundant demersal fish are European hake, rockfishes, red and stripped mullets; among molluscs the most abundant species is the Common octopus, *Octopus vulgaris*.

Concerning the state of fishing impact in the GSA 11 in the early 1990's it can be considered moderate (Cau *et al.* 1994). However, particularly in some localized areas (especially the shallower one) can be considered strong (Addis *et al.* 1998).

II.7.3 Brief description of changes in survey design

From 1994 to 2002 the vessel utilised in the MEDITS survey was the "Nuovo Spendore". In 2003, "Nuovo Splendore" was withdrawn and substituted with a the new "Nuovo Splendore II" (NUS2). Nevertheless, the captain and the crew of the NUS2 didn't change. In 2004, because the NUS2 was not available for the survey period a new boat and captain were chosen. However the new boat "GISELLA", was built in the same shipyard of the NUS2 using a very similar project and therefore the main characteristics are very similar (cfr technical reports).

As reported in the Table II.7.4, over all the study period the survey has been carried out mainly between June and July. The greatest variation was in 2002 when the survey occurred between July and August. Moreover the density and total number of sampling hauls were changed from n° 123 in the period 1994-2001 to n° 99 in the period 2002-2004.

Table II.7.4. Total number of the hauls and sampling period per year.

Period	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	average (%)
May		1			18	45	11					5,5
June	55	41	30	24	93	74	65	79		61	15	41,4
July	50	66	89	95	11	5	47	44	57	38	80	46,7
August	19		7	8					42			6,3
Total of hauls	124	108	126	127	122	124	123	123	99	99	95	

II.7.4 Selection of species

Because the Medits trawl net occasionally catch pelagic species, only bentonic and demersal ones were considered for the analysis. In particular community indices and the population growth rate (r) were obtained from the whole set of medits species (excluding *Lepidopus caudatus*, *Micromesistius poutassou*, *Trachurus mediterraneus* e *Trachurus trachurus*, *Trachurus picturatus*, *Sardina pilchardus*, *Engraulis encrasicolus*), while for the population indicators analysis the target species (short list) with an occurrence greater than 10% were used.

Moreover, the population indicators "$L_{50\%}$" (length at maturity) and "trend of $L_{50\%}$ values" were calculated only for a restricted set of species (*Galeus melastomus*, *Merluccius merluccius*, *Scyliorhinus canicula*, *Zeus faber*, *Aristaeomorpha foliacea*, *Aristeus antennatus*, *Nephrops norvegicus*, *Parapenaeus longirostris*, *Eledone cirrhosa*, *Eledone moschata*, *Illex coindetii*, *Loligo vulgaris*, *Octopus vulgaris*). In fact, as confirmed by the explorative analysis done with the whole set of species, the significance of the most ogives were null. This was mainly because the survey period do not coincide with the reproductive season of these species and therefore do not allow the sampling of all maturity stages.

II.7.5 Results

II.7.5.1 Community indicators

Either in the whole study period (1994-2004) or in the shorter time period (2000-2004) no significant trend in both total biomass or total abundance have been detected. The same pattern (no significant trend) is obtained considering not only the target species but all the specimens caught (in average 183 species) (Figure II.7.1).

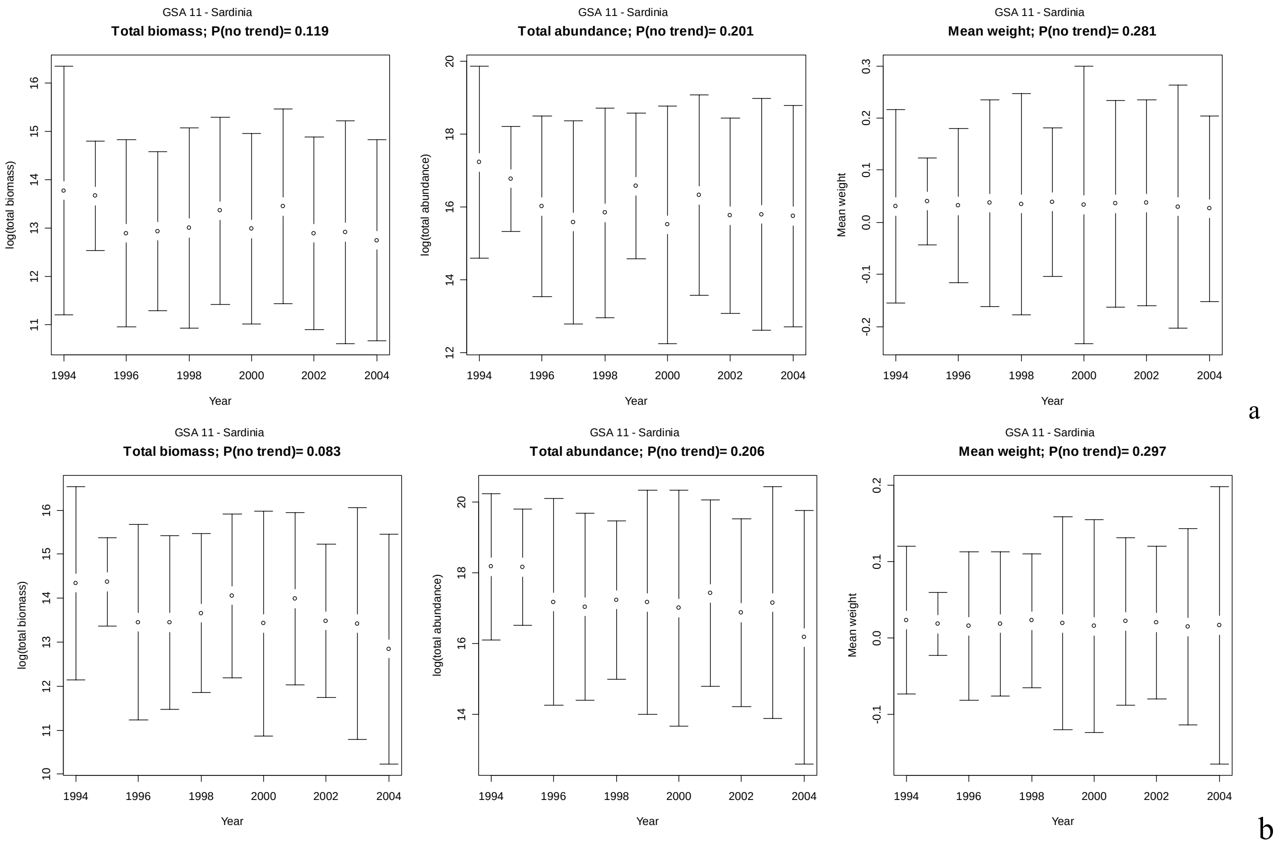


Figure II.7.1. Trend of biomass, abundance and mean length (pelagic species not included) considering the 58 MEDIT species (a) or the whole set of species caught (b).

Furthermore, the time series plot of mean weight and of the proportion of large individuals in the community didn't reveal any trend over the 11 years (Figure II.7.2).

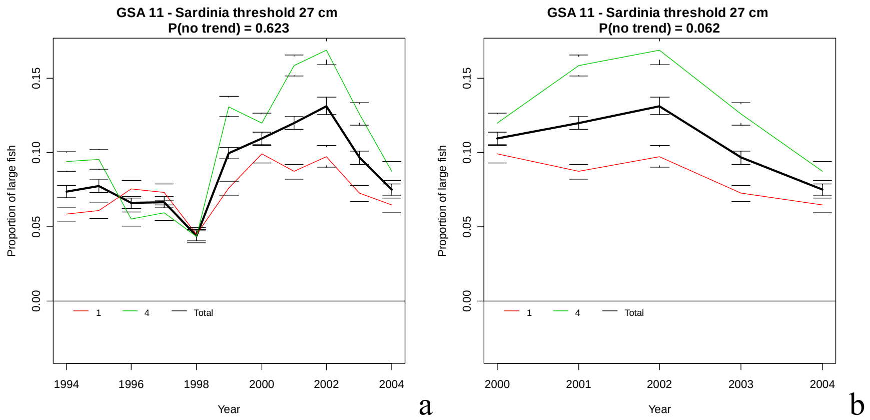


Figure II.7.2. Proportion of large fish in the last decade (a) and in the last 5 years (b).

II.7.5.1.1 Intrinsic Population growth rate

Analysing the population growth rate "r" by species over the whole period only most of the species didn't show a significant trend (Figure II.7.3). Two species (*Boops boops* and *Lophius budegassa*) showed a decreasing trend whereas not any species showed a positive value of "r". During the last five years the analysis was significant (decreasing trend) for *Scorpaena notata* and *Octopus vulgaris* only.

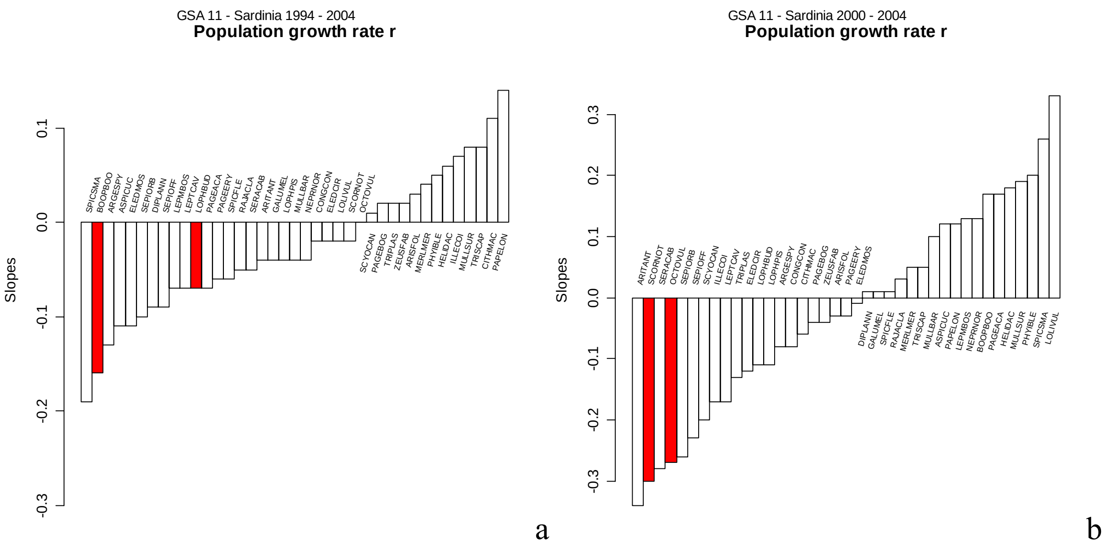


Figure II.7.3. Population growth rate (r) for the GSA11 over the period 1994-2004 (a) and the period 2001-2004 (b).

II.7.5.1.2 Mean length in population L_{bar}

Over all the period only three species have shown significant trends in mean length (Figure II.7.4). In particular for *Aristeus antennatus* and *Lepidorombus bosci* a positive trend was revealed, whereas *Galeus melastomus* has shown a decreasing trend. However, because *Galeus melastomus* was included among target species in 1999 only, for this species results should be biased. Nevertheless, during the last 5 years only *Citharus linguatula* showed a significant trend (negative) of mean length.

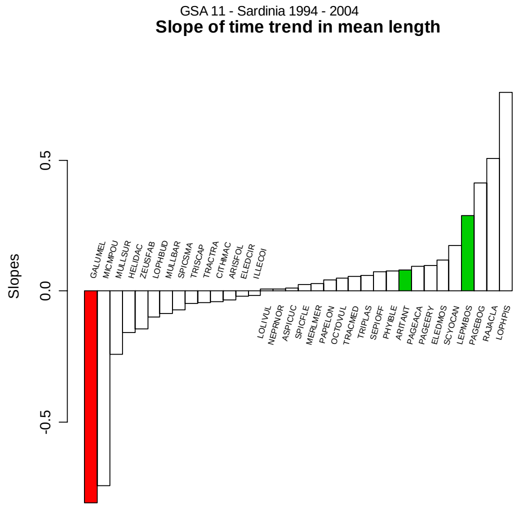


Figure II.7.4. Mean length trend in the last decade for the Medits target species (pelagic excluded).

II.7.5.1.3 Average total mortality rates Z

Concerning the total mortality rate (Z), a significant increasing trend was only detected for *Mullus surmuletus* over the last 5 years (Figure II.7.5). However, during the whole studied period no significant trend was observed for any species.

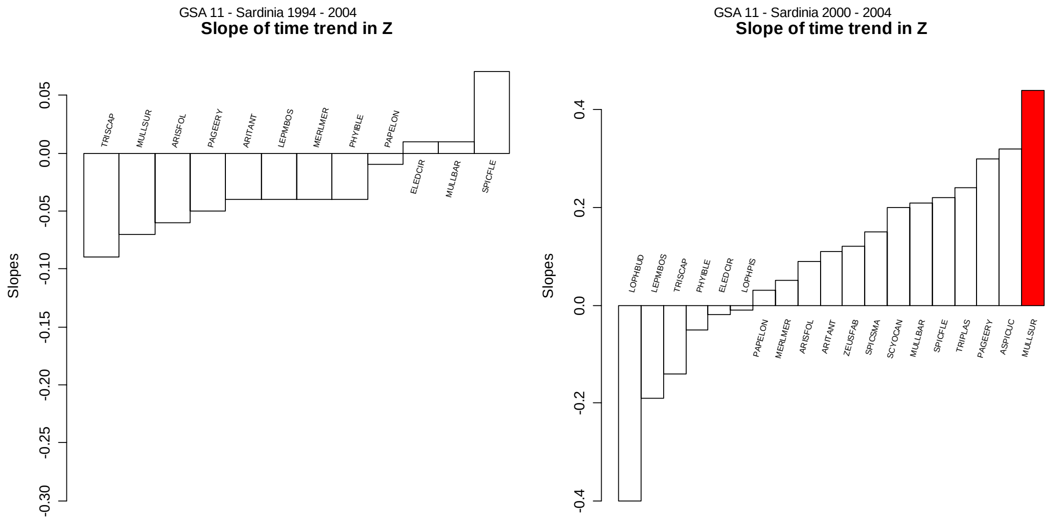


Figure II.7.5. Slope of time trend in total mortality value (Z) in the last 5 years.

II.7.5.1.4 Length at maturity

For most of the species the length at maturity (L_{50}) is not suitable either because the sampling period do not coincide with the spawning periods or because numbers of mature specimens are very low or because the gear is not adequate enough to catch the big spawners (for example *M. merluccis*) or because of bio-ecological reasons (pelagic species).

Therefore among the 37 species only crustacean, cephalopods, and some fish were considered. Over the whole study period results have shown a significant decreasing trend of length at 50% maturity for *Zeus faber*, *Scyliorhinus canicula* and *Aristaeomorpha foliacea* while L_{50} of *Galeus melastomus*, *Merluccius merluccius*, *Eledone moschata* and *Octopus vulgaris* significantly increase (Figure II.7.6). Nevertheless, in the last period (2002-2004) not any species has shown an increasing trend whilst *Scyliorhinus canicula*, *Merluccius merluccius*, *Aristaeomorpha foliacea* and *Eledone cirrhosa* showed a reduction of length at 50% over the years.

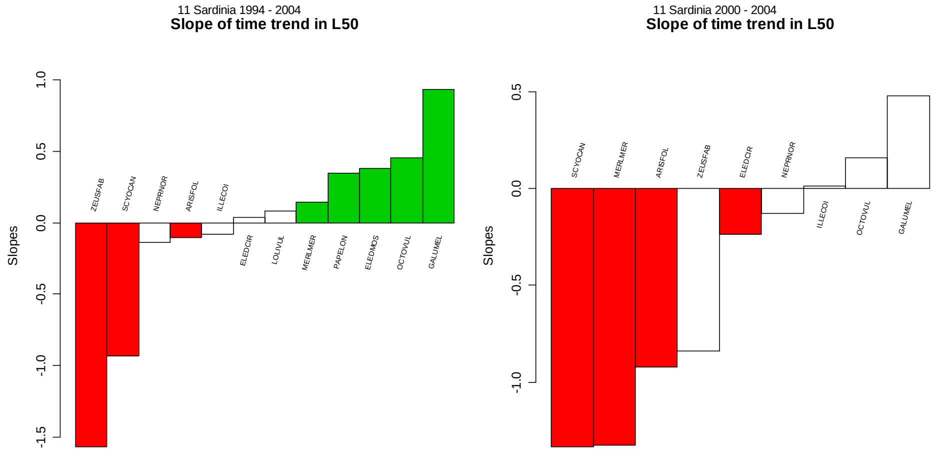


Figure II.7.6. Slope of time trend in length at maturity (L50).

II.7.6 Additional information

Other relevant information come from the analysis of data collected in the GSA 11during the national survey called GRUND (National Demersal Group).

The GRUND has been carried out in the same years of the MEDITS but generally in Autumn. The GRUND differ from the MEDITS because the net used (commercial vs sperimental) and because the total number of hauls was in average greater in the period 1996-2001 (161 vs 116) but lower either in 1994-1995 (94 vs 116) or in the last three years (76 vs 97). Moreover in 1999 the GRUND has not been carried out.

For the analysis all the pelagic and semi-pelagic species have been excluded and the same target species list have been considered.

The community indicators have shown significant trends either in the short and long considered periods. In particular the total biomass decrease in all periods, while the abundance significantly decrease only in the last 5 years (Figure II.7.7).

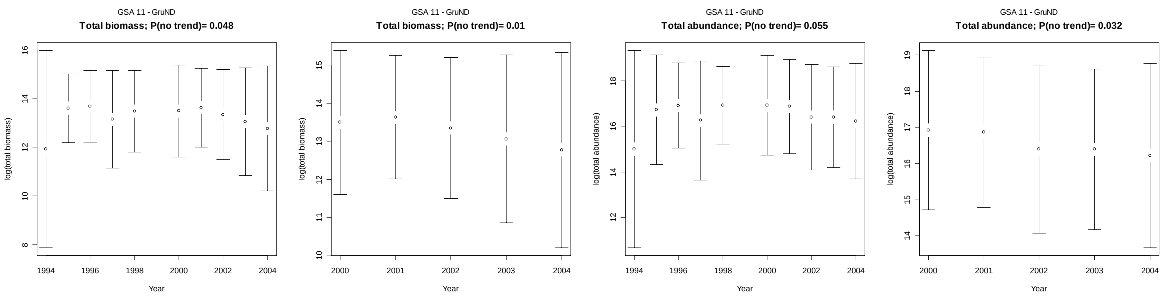


Figure II.7.7. Trend of biomass and abundance obtained from national data in the GSA 11.

The time series plot of mean weight and of the proportion of large individuals in the community didn't reveal any trend.

The number of species which have shown a negative trend of the population growth rate (r) in the decades 1994-2004 was greater of species showing a positive r (Figure II.7.8). Significant slopes were detected for *Zeus faber* and *Helicolenus dactylopterus* while significant decreasing trends were observed for *Eledone moschata*, *Argentina sphyraena*, *Aspitrigla cuculus*, *Spicara smaris*, *Lepidorhombus boscii*. The same analysis in the last 5 years (2001-2004) didn't show positive trends: five species (*Sepia officinalis*, *Solea solea*, *Mullus barbatus*, *Serranus cabrilla*, *Scorpaena notata*) significant decrease the growth rate.

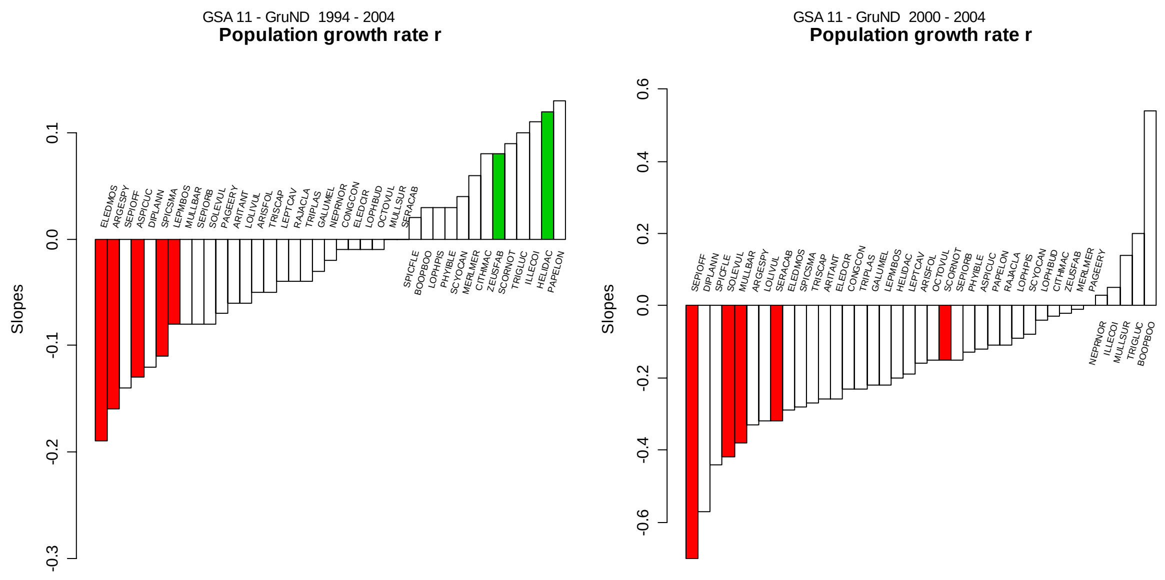


Figure II.7.8. Slope of time trend in growth rate (r) for the GSA11 using the national data survey (target species only).

Nevertheless, considering all the data set of the species caught, the number of species that showed a positive trend of the growth rate in the last period is greater (Figure II.7.9).

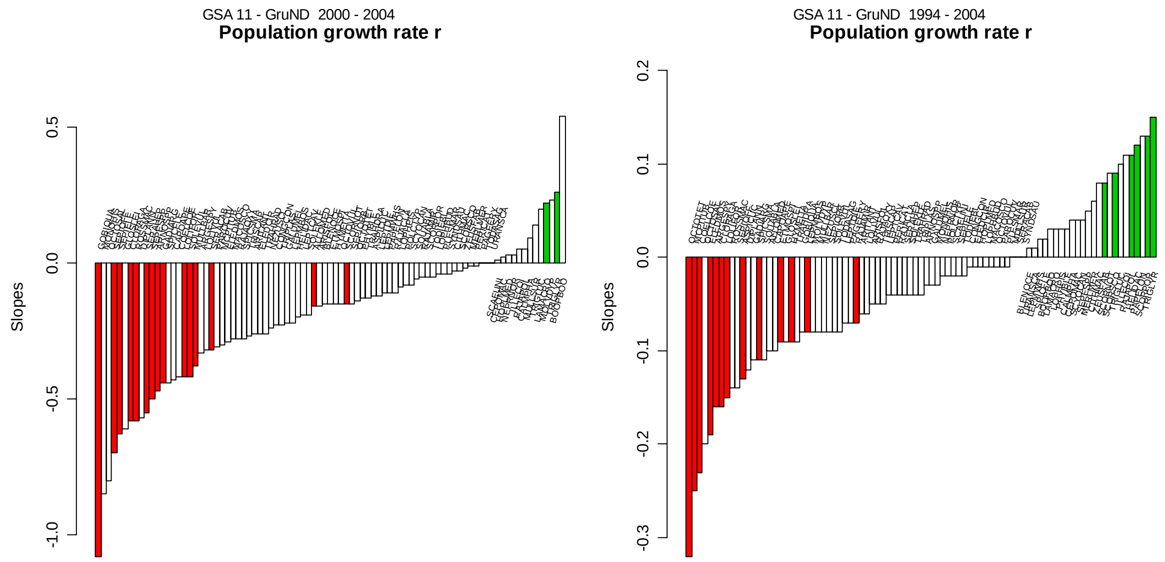


Figure II.7.9. Slope of time trend in growth rate (r) for the GSA11 using the national data survey (all the species caught).

The effect of massive recruitment in some years should be the effect of the increasing trend of the growth rate in some population (*Helicolenus dactylopterus*) as well as the slightly decrease of the mean length suggest (Figure II.7.10).

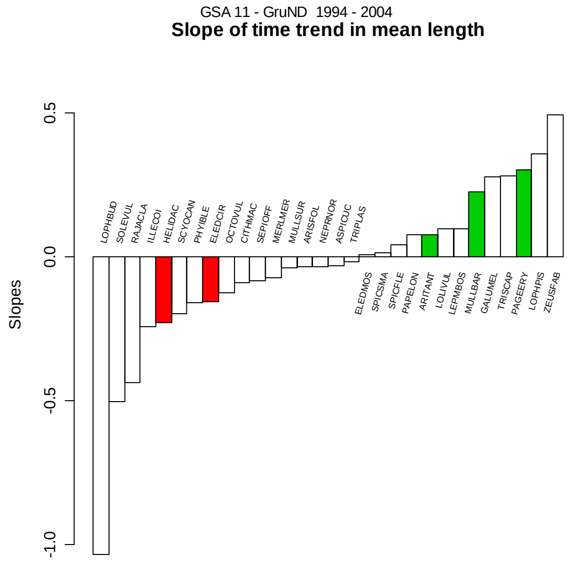


Figure II.7.10. Mean length trend of the Medits target species sampled by the GRUND survey (pelagic excluded, period 1004-2004).

Concerning the average total mortality rate (Z), either in the decade 1994-2004 or in the last years 2000-2004 significant slopes were obtained (Figure II.7.11). Inversely from the results obtained analysing the Medits data set, using the autumn data *Trisopterus minutus* has shown always a slight decreasing trend in Z, whilst only in the long period *Merluccius merluccius* and *Eledone cirrhosa* respectively have shown an increase and decrease of the slope of time trend in Z.

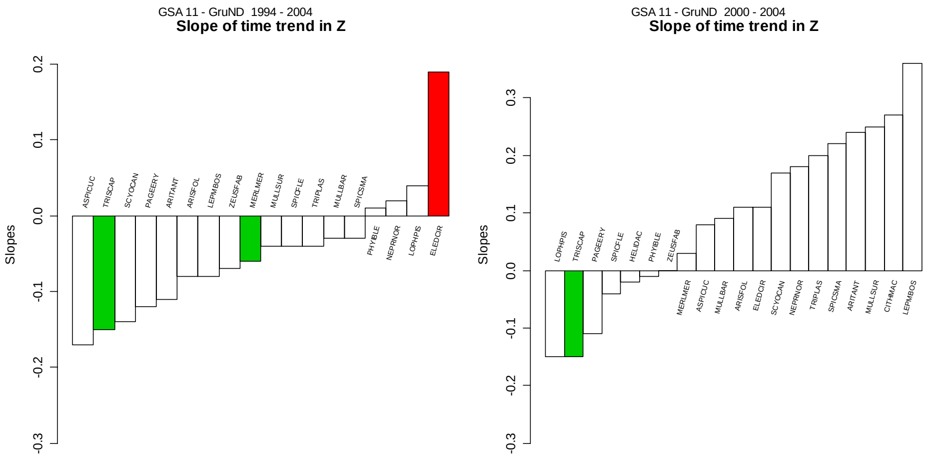


Figure II.7.11. Slope of time trend in total mortality value (Z) using the GRUND data set.

II.7.7 Discussion

As a general matter on average only the 12 % of species (n=7) belonging to the MEDITS list occurred in more than 40 % of the hauls whereas the 19% (11 species) showed occurrences lower than 5 %. Therefore, the distribution of the species has to take into account for further interpretation of community and population indicators.

Considering that in 1994 the initial state was of a moderate fishing impact (Cau *et al.* 1994), the indicators are to be interpreted not worsening if any significant trend is detected, and acceptable if a significant trend in the opposite direction of an increasing fishing impact is detected. Therefore, we can use colour to summarize the results of community and population indicator and to point out an increasing fishing impact (red), a steady fishing impact (outlined) or the absence of fishing impact (green).

As described in the following scheme, the community indicators showed a steadly state condition for the GSA 11. These results do not change if we consider all the years or the last 5 years. The same pattern is observed if the analysis is extended to all the fished species, including those of the MEDITS list (58).

Area Period	Total Abundance	Total Biomass	Mean Weight	Prop Large	r	Z	Mean Length	L50
Sardinia (GSA 11) 1994-2004	□	□	□	□	2/28 □ 0/15 □ 0/2 □	0/11 □ 0/6 □ 0 □	0/16 □ 2/18 □ 0 □	3/5 □ 5/7 □ 0 □
Sardinia (GSA 11) 2000-2004	□	□	□	□	2/22 □ 0/22 □ 0/1 □	0/8 □ 1/14 □ 0 □	0/23 □ 1/11 □ 0 □	4/6 □ 0/3 □ 0 □

Period	Total Abundance	Total Biomass	Mean Weight	r
All species 1994-2004	□	□	□	8/57 □ 0/32 □ 0/4 □
All species 2000-2004	□	□	□	5/57 □ 1/33 □ 0/3 □

When considering the population indicators the trend analysis of total mortality did not show any fishing impact for most species. In the last five years the only affected population (slope 0.41) seems to be *Mullus surmuletus*. Nevertheless, during the same period no impact was observed for its intrinsic growth rate (r) or its mean length. Moreover, for the 14 species studied the majority showed an increasing trend of length at maturity (L50) (*Eledone moschata*, *Merluccius merluccius, Parapenaeus longirostris, Octopus vulgaris, Galeus melastomus*) whereas only three (*Zeus faber, Scyliorhinus canicula, Aristaeomorpha foliacea*) showed a significant decreasing trend.

Only *Aristeus antennatus* and *Lepidorhombus boscii* showed a significant increasing trend of mean length.

Finally, the only populations which showed a significant decrease in their growth rate were *Boops boops* and *Lophius budegassa* in the whole period (1994-2004), and *Octopus vulgaris* and *Scorpena notata* in the last five years.

Nevertheless, these results should be considered with care when interpreting fishing impact because environmental factors (e.g., sea temperature) as well as biological factors (e.g., recruitment) may also have affected the community structure and population dynamics.

Moreover, some indicators such as the total mortality rate, the proportion of mature and the length at maturity can be strongly influenced by the seasonality character of the MEDITS survey.

Particularly, the analysis of the slope of Z is strongly affected by the utilized von Bertalanffy and can give misleading information either when the average of both sexes for some species (e.g., Aristeidae) is used or when, because of the survey design, the annual size structure is missing for fast-growing species (e.g., Mullidae).

Also the length at maturity (L_{50}) and the proportion of mature are strongly dependent on the season of the survey, especially when the sampling period changes during the years, when the survey period is very short, or when the condition at sea are very different years by years. In addition, particularly for species that are mainly mature in the first year of life or have a very short life-span period, the estimation of maturity based on MEDITS scales does not always allow to discriminate the proportion of immature correctly.

Finally, for some species (e.g., the European Hake) the proportion of large individuals in total abundance is underestimated because the gear used for sampling this fish population is not adequate to catch big animals.

Taking into account all these limitations, the proposed method for the populations and communities analysis should be useful to have a global view of the fish status at medium-large scale. However, they cannot reveal differences or trends at a smaller scale (local scale).

Comparing the analysis on MEDITS and GruND database seems that the fishing gear and the sampling season are relevant factor to consider, as well as the differences of bottoms and environmental condition of different areas of the GSA.

Furthermore, the result of this analysis shows the great potentiality of the MEDITS database but also highlights the need of continuing this study to increase the time series in order to be more confident and sure of the conclusions obtained.

II.7.8 Appendix

Annex II.7.1.- Von Bertalanffy parameters.

Espece	t0	k	Linf	Source
ARISFOL	0	0.39	72	(Cau *et al.* 2002)
ARITANT	-0.28	0.19	75.6	(Cau *et al.* 2002)
ASPICUC	-0.65	0.28	34.85	Gulf of Lions - (Campillo 1992)
CITHMAC	-0.43	0.25	25.7	Aegean Sea - (Stergiou *et al.* 1997)
ELEDCIR	0.22	0.9	15.43	Sardinia - Cuccu et al., 2002 - average across sexes
EUTRGUR	1.99	0.21	26.4	Pagasitikos Gulf - (Stergiou *et al.* 1997) Fork Length
HELIDAC	0	0.1	31	Kelly, C.J., P.L. Connolly and J.J. Bracken, 1999
LEPMBOS	0	0.26	43.3	Aegean Sea - Stergiou & Politou 1995
LOPHBUD	-0.92	0.13	66.75	Saronikos Gulf - (Stergiou *et al.* 1997)
LOPHPIS	0.42	0.34	107.55	Aegean Sea - (Stergiou *et al.* 1997)
MERLMER	-0.04	0.16	77.75	GSA 11, GRUND 2003 Final Report - 2004
MICMPOU	-1.55	0.24	40.5	GSA 11, GRUND 2003 Final Report - 2004
MULLBAR	-1.45	0.18	31.5	Vrgoc et al, 2004
MULLSUR	-0.4	0.7	29.29	Voliani et al, - 1998
NEPRNOR	0.84	0.44	49.88	GSA 11, GRUND 2003 Final Report - 2004 - average across sexes
PAGEACA	-1.16	0.28	30.4	Voliani et al, - 2003
PAGEBOG	-1.06	0.12	59	Voliani et al, - 2003
PAGEERY	-0.03	0.25	40.16	Gulf of Lions - (Campillo 1992)
PAPELON	0.84	0.87	37.1	GSA 11, GRUND 2003 Final Report - 2004 - average across sexes
PHYIBLE	-0.11	0.32	51.82	GSA 11, GRUND 2003 Final Report - 2004
RAJACLA	-0.6	0.17	96.3	Atlantique - (Campillo 1992), average across sexes
SCYOCAN	0	0.2	88	North Sea - (Froese & Pauly 2002) based p, Jennings et al 1999
SOLEVUL	-1.06	0.24	50.53	Gulf of Lions - Anon. 2004
SPARPAG	2.83	0.11	45.1	Dodeckanisos - (Stergiou *et al.* 1997)
SPICFLE	-1.11	0.47	19	Zamboni e Relini - 1986
SPICSMA	-1.62	0.4	18.9	Crete - (Stergiou *et al.* 1997)
TRACMED	-2.3	0.22	39.9	Saronikos Gulf - (Stergiou *et al.* 1997)
TRACTRA	-1.28	0.22	37.5	Adriatique - (Campillo 1992)
TRIPLAS	-0.63	0.25	38.2	(Campillo 1992)
TRISCAP	-1.86	0.17	32.3	Evvoikos Gulf - (Stergiou *et al.* 1997)
ZEUSFAB	0	0.3	69.4	Righini e Voliani - 1996

Annex II.7.2. List of names for population analyses.

SPECIES	L50	SPECIES	L50
ARISFOL	*	SEPIOFF	
ARITANT	*	SOLEVUL	
ASPICUC		SPARPAG	
CITHMAC		SPICFLE	
ELEDCIR	*	SPICSMA	
ELEDMOS	*	TRIPLAS	
EUTRGUR		TRISCAP	
GALUMEL	*	ZEUSFAB	*
HELIDAC		ARGESPY	
ILLECOI	*	BOOPBOO	
LEPMBOS		CENTGRA	
LOLIVUL	*	CONGCON	
LOPHBUD		DICELAB	
LOPHPIS		DIPLANN	
MERLMER	*	LEPTCAV	
MULLBAR		MUSTMUS	
MULLSUR		PENAKER	
NEPRNOR	*	RAJAAST	

SPECIES	**L50**	**SPECIES**	**L50**
OCTOVUL	*	SCOMPNE	
PAGEACA		SCORNOT	
PAGEBOG		SEPIORB	
PAGEERY		SERACAB	
PAPELON	*	SPICMAE	
PHYIBLE		SQUAACA	
RAJACLA		SQUIMAN	
SCYOCAN	*	TRIGLUC	

Annex II.7.3. L_{50} per species and year.

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ARISFOL	13.9	15.7	12.7	14.8	15.8	15.1	15.0	14.9	13.3	13.5	10.9	11.7
ELEDCIR	7.1	7.7	5.9	7.1	7.5	7.0	8.3	6.7	7.3	7.3	7.4	7.2
ELEDMOS	11.5	10.9	9.6	10.9	10.5	10.5	10.9	12.2				
GALUMEL						43.5	45.8	46.4	49.1	47.6	47.1	40.3
ILLECOI	16.8	17.3	15.6	15.4	17.2	16.2	15.6	17.3	15.6	16.0	15.6	15.0
LOLIVUL	16.9	16.8	16.8	16.8	13.5	17.5	18.2	18.7	16.8	16.8	16.8	15.8
MERLMER	29.7	25.9	37.9	35.5	31.7	30.3	34.5	28.7	38.1	28.5	32.7	32.4
NEPRNOR						9.4	9.0	10.0	10.5	8.6	8.3	8.1
OCTOVUL				11.6	11.0	11.4	12.9	14.2	10.6	14.2	14.1	11.7
PAPELON	10.4	14.8	13.5	11.5	11.7	11.4	13.2	11.0	10.8	10.6	10.3	7.0
SCYOCAN						41.6	41.7	42.5	39.7	37.6	37.0	36.8
ZEUSFAB	49.7	23.0	30.8	36.5	36.2	30.7	29.6	27.5	36.1	36.4	16.3	28.0

Annex II.7.4. All estimates of trends in parameters.

PERIOD	CodEspMed	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SdLm	PvalueLm
LAST	ARGESPY	-0,08	0,17	0,6683	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	ARISFOL	-0,03	0,13	0,8163	-0,378	0,243	0,218	0,09	0,22	0,72	0,313	-0,932	0,057	0
LAST	ARITANT	-0,34	0,11	0,0563	0,135	0,066	0,132	0,11	0,04	0,11	0,688	NA	NA	NA
LAST	ASPICUC	0,12	0,21	0,6075	-0,562	0,3	0,157	0,32	0,16	0,18	0,688	NA	NA	NA
LAST	BOOPBOO	0,17	0,12	0,2414	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	CITHMAC	-0,06	0,15	0,7172	-0,662	0,165	0,028	NA	NA	NA	NA	NA	NA	NA
LAST	CONGCON	-0,08	0,08	0,3804	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	DIPLANN	0,01	0,49	0,9864	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	ELEDCIR	-0,12	0,1	0,3029	-0,458	0,292	0,214	-0,02	0,57	0,97	0,313	0,101	0,058	0,078
LAST	ELEDMOS	-0,01	0,21	0,9599	0,013	0,136	0,929	NA	NA	NA	NA	NA	NA	NA
LAST	GALUMEL	0,01	0,14	0,9625	-0,029	0,288	0,927	NA	NA	NA	NA	-0,873	0,21	0
LAST	HELIDAC	0,18	0,15	0,3091	-0,579	0,49	0,323	NA	NA	NA	NA	NA	NA	NA
LAST	ILLECOI	-0,17	0,4	0,6893	-0,867	0,732	0,322	NA	NA	NA	NA	-0,544	0,105	0
LAST	LEPMBOS	0,13	0,2	0,5571	-0,145	0,175	0,467	-0,19	0,35	0,64	0,062	NA	NA	NA
LAST	LEPTCAV	-0,17	0,38	0,6852	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	LOLIVUL	0,33	0,37	0,4382	-0,531	2,129	0,819	NA	NA	NA	NA	NA	NA	NA
LAST	LOPHBUD	-0,11	0,06	0,1862	-0,275	1,006	0,802	-0,4	0,33	0,35	0,062	NA	NA	NA
LAST	LOPHPIS	-0,11	0,21	0,6277	-3,385	2,593	0,283	-0,01	0,14	0,95	0,313	NA	NA	NA
LAST	MERLMER	0,05	0,33	0,8887	-0,449	0,495	0,431	0,05	0,25	0,85	0,313	0,667	0,203	0,001
LAST	MULLBAR	0,1	0,25	0,7178	-0,505	0,175	0,063	0,21	0,52	0,73	0,062	NA	NA	NA
LAST	MULLSUR	0,19	0,2	0,4149	-1,239	0,507	0,092	0,44	0,08	0,03	0,688	NA	NA	NA
LAST	NEPRNOR	0,13	0,19	0,5587	-0,213	0,284	0,507	NA	NA	NA	NA	-0,531	0,076	0
LAST	OCTOVUL	-0,27	0,08	0,045	0,011	0,243	0,967	NA	NA	NA	NA	-0,441	0,131	0,001
LAST	PAGEACA	0,17	0,23	0,5158	0,044	0,796	0,96	NA	NA	NA	NA	NA	NA	NA
LAST	PAGEBOG	-0,04	0,27	0,9024	0,862	0,842	0,381	NA	NA	NA	NA	NA	NA	NA
LAST	PAGEERY	-0,03	0,11	0,7917	-0,372	0,433	0,453	0,3	0,07	0,06	0,688	NA	NA	NA
LAST	PAPELON	0,12	0,16	0,504	0,072	0,111	0,564	0,03	0,29	0,92	0,062	NA	NA	NA
LAST	PHYIBLE	0,2	0,16	0,2866	-0,792	0,303	0,079	-0,05	0,2	0,84	0,062	NA	NA	NA
LAST	RAJACLA	0,03	0,15	0,8738	0,782	1,157	0,548	NA	NA	NA	NA	NA	NA	NA
LAST	SCORNOT	-0,3	0,04	0,0037	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	SCYOCAN	-0,2	0,09	0,1307	-0,044	0,505	0,936	0,2	0,05	0,06	0,688	-1,593	0,15	0
LAST	SEPIOFF	-0,23	0,11	0,1326	-0,614	0,212	0,063	NA	NA	NA	NA	NA	NA	NA
LAST	SEPIORB	-0,26	0,12	0,1136	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	SERACAB	-0,28	0,16	0,177	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LAST	SPICFLE	0,01	0,31	0,9794	-0,017	0,117	0,897	0,22	0,07	0,08	0,688	NA	NA	NA
LAST	SPICSMA	0,26	0,34	0,4907	-0,326	0,173	0,157	0,15	0,36	0,71	0,688	NA	NA	NA
LAST	TRIPLAS	-0,13	0,1	0,2813	0,186	0,208	0,439	0,24	0,24	0,42	0,313	NA	NA	NA
LAST	TRISCAP	0,05	0,28	0,8703	0,007	0,385	0,986	-0,14	0,23	0,61	0,062	NA	NA	NA

PERIOD	CodEspMed	r	SDr	Pvalue_r	penteLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendLm	SdLm	PvalueLm
LAST	ZEUSFAB	-0,04	0,1	0,702	-0,008	0,432	0,986	0,12	0,15	0,51	0,313	-0,598	0,518	0,246
FULL	ARGESPY	-0,13	0,08	0,1394	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	ARISFOL	0,03	0,04	0,4751	-0,034	0,088	0,707	-0,06	0,05	0,28	0,055	-0,165	0,018	0
FULL	ARITANT	-0,04	0,04	0,2934	0,08	0,02	0,003	-0,04	0,02	0,18	0,011	NA	NA	NA
FULL	ASPICUC	-0,11	0,07	0,1877	0,009	0,11	0,936	NA	NA	NA	NA	NA	NA	NA
FULL	BOOPBOO	-0,16	0,05	0,0079	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	CITHMAC	0,11	0,06	0,089	-0,042	0,121	0,735	NA	NA	NA	NA	NA	NA	NA
FULL	CONGCON	-0,02	0,03	0,4998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	DIPLANN	-0,09	0,11	0,4311	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	ELEDCIR	-0,02	0,02	0,3187	-0,02	0,086	0,823	0,01	0,11	0,91	0,172	0,021	0,021	0,319
FULL	ELEDMOS	-0,11	0,06	0,0796	0,118	0,052	0,051	NA	NA	NA	NA	0,126	0,117	0,278
FULL	GALUMEL	-0,04	0,03	0,2203	-0,818	0,171	0,003	NA	NA	NA	NA	0,171	0,16	0,284
FULL	HELIDAC	0,06	0,03	0,0854	-0,157	0,131	0,261	NA	NA	NA	NA	NA	NA	NA
FULL	ILLECOI	0,07	0,09	0,4714	-0,017	0,258	0,949	NA	NA	NA	NA	-0,139	0,041	0,001
FULL	LEPMBOS	-0,07	0,05	0,2069	0,287	0,089	0,01	-0,04	0,06	0,48	0,172	NA	NA	NA
FULL	LEPTCAV	-0,07	0,07	0,3838	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	LOLIVUL	-0,02	0,1	0,8241	0,008	0,418	0,985	NA	NA	NA	NA	-0,017	0,137	0,903
FULL	LOPHBUD	-0,07	0,03	0,0377	-0,1	0,198	0,627	NA	NA	NA	NA	NA	NA	NA
FULL	LOPHPIS	-0,04	0,06	0,461	0,759	0,866	0,404	NA	NA	NA	NA	NA	NA	NA
FULL	MERLMER	0,04	0,07	0,5976	0,026	0,125	0,838	-0,04	0,05	0,48	0,011	0,167	0,054	0,002
FULL	MULLBAR	-0,04	0,06	0,4814	-0,09	0,06	0,17	0,01	0,09	0,91	0,172	NA	NA	NA
FULL	MULLSUR	0,08	0,04	0,0933	-0,248	0,168	0,174	-0,07	0,08	0,4	0,172	NA	NA	NA
FULL	NEPRNOR	-0,04	0,05	0,4352	0,007	0,057	0,906	NA	NA	NA	NA	-0,218	0,052	0
FULL	OCTOVUL	0	0,04	0,9531	0,047	0,084	0,587	NA	NA	NA	NA	0,175	0,072	0,016
FULL	PAGEACA	-0,07	0,07	0,2991	0,091	0,152	0,565	NA	NA	NA	NA	NA	NA	NA
FULL	PAGEBOG	0,02	0,11	0,8608	0,415	0,282	0,175	NA	NA	NA	NA	NA	NA	NA
FULL	PAGEERY	-0,06	0,04	0,1019	0,097	0,134	0,486	-0,05	0,06	0,38	0,011	NA	NA	NA
FULL	PAPELON	0,14	0,08	0,1166	0,043	0,069	0,553	-0,01	0,06	0,86	0,377	-0,222	0,052	0
FULL	PHYIBLE	0,05	0,04	0,2155	0,077	0,12	0,537	-0,04	0,04	0,43	0,011	NA	NA	NA
FULL	RAJACLA	-0,05	0,04	0,2031	0,509	0,294	0,117	NA	NA	NA	NA	NA	NA	NA
FULL	SCORNOT	-0,02	0,04	0,6785	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	SCYOCAN	0,01	0,04	0,8611	0,171	0,144	0,263	NA	NA	NA	NA	-1,034	0,108	0
FULL	SEPIOFF	-0,09	0,06	0,1775	0,072	0,133	0,603	NA	NA	NA	NA	NA	NA	NA
FULL	SEPIORB	-0,1	0,06	0,1493	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	SERACAB	-0,05	0,04	0,2391	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FULL	SPICFLE	-0,06	0,06	0,3214	0,027	0,046	0,571	0,07	0,1	0,49	0,172	NA	NA	NA
FULL	SPICSMA	-0,19	0,1	0,0751	-0,071	0,053	0,212	NA	NA	NA	NA	NA	NA	NA
FULL	TRIPLAS	0,02	0,04	0,5954	0,055	0,052	0,316	NA	NA	NA	NA	NA	NA	NA
FULL	TRISCAP	0,08	0,07	0,2892	-0,045	0,092	0,639	-0,09	0,06	0,19	0,055	NA	NA	NA
FULL	ZEUSFAB	0,02	0,03	0,6125	-0,147	0,203	0,488	NA	NA	NA	NA	-1,42	0,198	0

[II].7 Sardinia (area 11)

II.8 South of Sicily and Malta islands (area 16)

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II.8.1 Ecological settings, geographical and environmental features

The sub-area Strait of Sicily (GSA 16 and 15) corresponds “*sensu lato*” to the fishing grounds between the southern coasts of Sicily and a “mid line” off the Tunisian and Libyan coastline; the lines joining San Vito Lo Capo and Capo Passero (Sicily) with Cape Bon (Tunisia) and Cape Misurata (Libya) represent respectively the eastern and western limits. Morphologically, the Strait of Sicily comprises the continental shelf and slope, but other morphologic sub-units such as seamounts (“guyots”) and “banks” are usually identifiable. The shelf is widest in front of Mazara (Adventure bank) and Porto Palo di Capo Passero (Malta bank). The slope shape is extremely irregular, incised by many canyons, trenches and steep declines. The seamounts are generally of volcanic origin; two of them emerge to form the islands of Pantelleria and Linosa. Banks (the typical morphologic units in the Strait of Sicily) show a sub-flattened surface with signs of abrasion. The natural roughness of the area is further enhanced by the presence of numerous wrecks.

Speaking of the hydrological pattern of just the depth interval explored by the trawl surveys (10-800 m), three main water layers are traditionally recognized: a) the Atlantic (AW; down to 50-100 m or to 150-250 m, depending on locations) with a minimum water temperature of 14-15°C in winter; b) the Levantine (LW; down to 500-700 m), where the temperature goes down to about 13-14°C); and c) a deep transitional layer (below 600-700 m; 12.8°C). Other different veins (e.g. the Modified Atlantic Waters, MAW**,** and the modified Levantine Intermediate Waters, MLIW) and special gyres or meanders (such as the Atlantic Ionian Stream**,** AIS) can be located according to their specific temperature and density parameters; the most striking modification consists in the invasion of the so-called Transitional Eastern Mediterranean Deep water (tEMDW or EMTW), a slightly warmer (13.5°C) and much denser body of water, originated some years ago in the Eastern Mediterranean. River discharges in the Strait of Sicily are negligible, whereas NW winds might determine local rising of cold deep-water towards the Sicilian coastal sea surface.

Different studies on the benthic communities in the fishing grounds of the Strait of Sicily have shown the dominance of rheophilic species, and led to identifying four basic “biological layers”: a) coastal (infralittoral); b) circalittoral (50-200 m, mainly characterized by penetration of light and the “coralligenous” and “off-shore rocks” biocoenoses”); c) epi-bathyal (200-450 m, generally muddy bottoms with a consistent fraction of fine sand, preferential habitat for the sea-pen *Funiculina quadrangularis*); and d) meso-bathyal (450-800 m, muddy bottoms with a large proportion of compacted, oxidized, yellow sediments, and smaller surfaces of reducing, gray mud, preferential habitat for the gorgonaceous *Isidella elongata*). The most distinctive features of these bathyal layers are the presence of huge scattered “buildings” produced by madrepores (*Lophelia pertusa* and *Madrepora oculata* white corals), and the piling up year after year of thousands of “mazzare” (big stones used as anchors for “cannizzati”, a device widely used in catching pelagic fish), which make extended surfaces of the grounds between 300 m and 450 m dangerous for the fishing activity, or even untrawlable altogether. From the bottom trawl fisheries point of view, three main “assemblages” are present in the Strait of Sicily: a) “Bank”, on shallow bottoms, 25-100 m, whose typical catch is made of Mediterranean hake (*Merluccius merluccius*), Striped red mullet (*Mullus surmuletus*), Red mullet (*Mullus barbatus*), Pandora (*Pagellus erythrinus*), Red scorpionfish (*Scorpaena scrofa*), Cuttlefish (*Sepia officinalis*), Octopus (*Octopus vulgaris*), Musky octopus (*Eledone moschata*); b) “Slope”, on medium-depth bottoms, 100-400 m, whose normal catch is made of Mediterranean hake (*M. merluccius*), Striped red mullet (*M. surmuletus*), Red mullet (*M. barbatus*), Rockfish (*Helicolenus dactylopterus*), Catshark (*Scyliorhinus canicula*), Pink shrimp (*Parapenaeus longirostris*), Norway lobster (*Nephrops norvegicus*); and c) “Depth”, on deep bottoms, 400-800 m, whose characteristic catch is made of Mediterranean hake (*M. merluccius*), Rockfish (*H. dactylopterus*), Norway lobster (*N. norvegicus*), Red shrimp (*Aristaeomorpha foliacea*) and the more rare Violet shrimp (*Aristeus antennatus*). It is worth noting the ubiquity of the Mediterranean hake, even if the species has almost disappeared within the meso-bathyal depths.

II.8.2 Fisheries description and initial state assessment

The turning point for bottom trawling in the Strait of Sicily can be traced at the end of the '60s, when icing, on-board freezing and chemical addictives (salts preventing the black-spot in shrimps) were introduced. The Mazara fleet became the largest bottom trawl fleet in the Mediterranean Sea; notwithstanding the typical multispecificity, fishers target: a) *Mullus surmuletus* and *M. barbatus*, the Striped red mullet and the Red mullet, which recruit in late summer-early autumn on the shallow coastal waters, and disperse thereafter up to 250 m; b) *Parapenaeus longirostris*, the Pink shrimp, which occurs between 100 m and 400 m, with the largest animals in the deeper grounds; c) *Nephrops norvegicus*, the Norway lobster, a burrowing species distributed from 200 m to 800 m (locally, almost never in shallower waters); and d) *Aristaeomorpha foliacea*, the deep-water red shrimp, occurring between 400 m and 800 m. The maximum sustainable yield (MSY) was likely reached at the end of the '70s; thereafter, the situation has continuously worsened and the sector crisis was clearly recognizable in 2000. In spite of license control, mesh regulations, season closures (fishing ban for 45 days per year) and fleet capacity restrictions implemented in the last decade, a stable growth overfishing condition (i.e., small-size recruits and juveniles are the bulk of trawl catches) characterizes almost all the exploited demersal stocks in the area. Medium-size boats go for 1-4 day trips, fishing mainly over banks, keep their catch on ice and sell it fresh; large vessels stay on the fishing grounds for 2-3 weeks continuously, and freeze all the catch (mainly shrimps). Nowadays, more than 400 bottom trawlers, with state-of-the-art fishing equipments, operate within the GSA 16 and 15, although fishing effort and intensity are not homogeneously distributed, due to structural, biological and legal constraints. Given the roughness of the bottom and the number of impediments, the trawling path requires ability and attention. Trawling is not allowed in some parts of the strait, including the coastal bed (3 nautical miles or 50 m depth) and no take areas in the Maltese Fisheries Management Zone (25 NM around the Maltese Islands). The overall stationary condition of bottom trawl fishing in the Strait of Sicily seems a paradox; indeed, the presence of natural (for example, the white corals assemblages), man-induced (wrecks and mazzare) and man-established (e.g., the MFMZ) impediments to trawling likely represent "refuges" for the residual spawning stocks. The situation, however, seems still reversible as suggested by the most recent experimental surveys; such a recovery is ascribable to a lower fishing effort, a consequence of the gradual (but consistent) displacement of large trawlers towards fishing grounds outside the Strait of Sicily.

II.8.3 Brief description of changes in survey features and study area considered

In the Medits programs from 1994 to 2001 the Marine Living Resources Assessment Group (MaLiRA-G) of the IAMC-CNR of Mazara (formerly IRMA-CNR) has explored the sub area M3c which covered the Italian side of the Strait of Sicily with the exclusion of the Maltese Exclusive Fishing Zone (25 miles around the Maltese Islands). The MEFZ is precluded to foreign trawlers and practically represents a protected area for demersal resources (Fiorentino *et al.* 2002); following an agreement between Italy, Malta and the Medits Steering Committee, the MEFZ has also been surveyed since 2000.

After the revision of the boundaries of the geographical sub-regions of the Mediterranean (FAO-GFCM 2001), the previous Italian-Maltese side of the Strait of Sicily was split in two Geographical sub areas: GSA 15 (Malta) and GSA 16 (Italy). Italian Medits surveys, however, were adjusted to the new geographical situation only one year later (2002), after the implementation of the new Italian National Fishing Plan. In this occasion, the sample size allocated in the Strait of Sicily was raised from 56 to 120 hauls (not considering the 10 hauls realised within the MEFZ) according to a new criterion of haul distribution based on the commercial landings of the GSA.

The new hauls were added to the previous Medits hauls and allocated in both GSAs, maintaining almost the same sampling proportion among the strata. It must be remarked that bureaucratic constraints have determined a delay in the time periodicity of the last three Medits surveys (see table 1) which resulted to be more "Summer" than "Spring" oriented.

In order to improve the comparability among years, the study area corresponding to the Italian-Maltese side of the Strait of Sicily has been considered in the present report (fig. 1); practically, the hauls realised within the MEFZ were not considered.

It must be remarked that all the GSA "16" Medits-hauls have been performed with the same vessel (S. Anna) throughout the period considered.

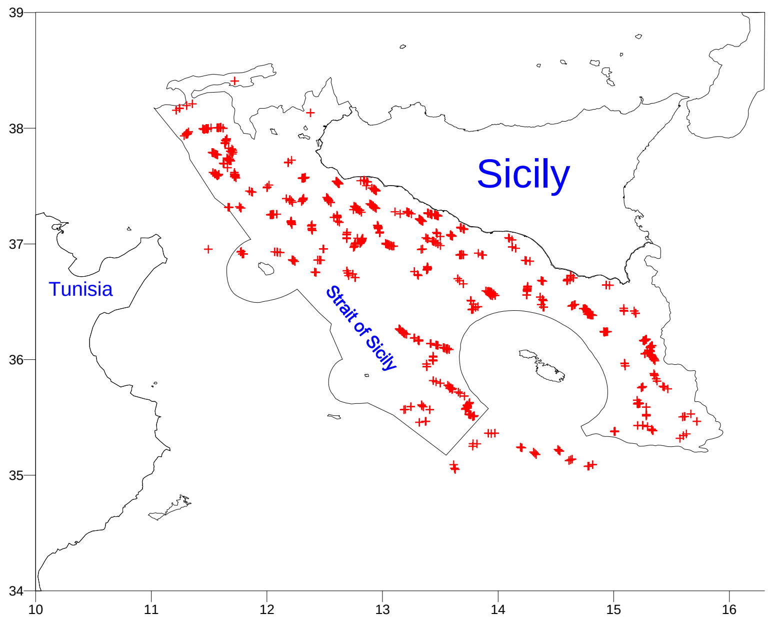


Fig. II.8.1. Study area and hauls considered in the present report.

Tab. II.8.1. Season, survey number and code, year, periods, studied area and remarks of the "Medits" surveys carried out in the Strait of Sicily. Start and end refer to the beginning and end of the survey (i.e., equipment loading included); "Nominal time" refers to the median day of the given survey period. Sp: Spring; Su: Summer.

Season	Survey N°	Survey code	Year	Start	End	Nominal time	Area	N° of hauls
Spring	1	MEDSp94	1994	11-Jun	15-Jul	28-Jun	Area A	56
Spring	2	MEDSp95	1995	3-Jun	17-Jun	10-Jun	Area A	56
Spring	3	MEDSp96	1996	31-May	12-Jun	6-Jun	Area A	56
Spring	4	MEDSp97	1997	3-Jun	14-Jun	8-Jun	Area A	56
Spring	5	MEDSp98	1998	16-Jun	27-Jun	20-Jun	Area A	56
Spring	6	MEDSp99	1999	28-May	9-Jun	2-Jun	Area A	56
Spring	7	MEDSp00	2000	26-May	8-Jun	31-May	Area A	56
Spring	8	MEDSp01	2001	19-May	1-Jun	26-May	Area A	56
Summer	9	MEDSu02	2002	11-Jul	24-Aug	2-Aug	GSA 15 - 16	120
Summer	10	MEDSu03	2003	13-Jul	13-Aug	28-Jul	GSA 15 - 16	120
Summer	11	MEDSu04	2004	10-Jun	11-Jul	25-Jun	GSA 15 - 16	120

II.8.4 Selection of species

The analysis of the single species population indices (i.e. population growth rate (*r*), spawning stock abundance, mean length in the population (L_{bar}), length at maturity (i.e., the size at onset of sexual maturity by ogive fitting; L_{mat}), mean length of the spawning stock, total mortality value (across the years; *Z)* and the proportion of large fish, were electively presented on the species reported in the short reference list (see appendix 1), if not otherwise specified. Some of them, however, were included within the short list after 1994. The analysis of the community indices was performed on all the caught species. Tables and figures produced by the programme of analysis are enclosed to this report.

II.8.5 Results: review of indicators

II.8.5.1 Population indicators

II.8.5.1.1 Intrinsic Population growth rate

Over the whole period, significant trends were found in 30 (positive) and 2 (negative) species. Considering the last years, however, the picture changes drastically, resulting only 7 (positive) and 4 (negative) cases. Considering the targets and the all period, a positive trend characterized *Citharus linguatula, Helicolenus dactylopterus, Lophius budegassa, Mullus barbatus* (but with an irregular shape), *Pagellus acarne* (but at a marginal level, p=0.05), *Pagellus erythrinus* (but at a marginal level, p=0.05), *Zeus faber, Scyliorhinus canicula* (but with an oscillating pattern), *Parapenaeus longirostris* and *Illex coindetii*. As regard the spawning stock abundance, results were obtained for only 14 of the target species; only *Phycis blennoides* and *Zeus faber* showed significant, although very variable, positive trends.

II.8.5.1.2 Mean length in population

Over the whole period, only *Spicara smaris*, *Zeus faber* and *Aristaeomorpha foliacea* showed a positive and significant trend; in all cases, however, an oscillating pattern was detected. A significant and negative trend (but always with a very irregular pattern) resulted in *Loligo vulgaris*. More or less uniform evolution in mean length resulted in *Nephrops norvegicus* and *Mullus* species, but with some outliers (very low values) in 2002 (*M. barbatus* and *M. surmuletus*) and 2003 (*M. surmuletus*), probably due to the unusual presence of precocious juveniles. Erratic or irregularly oscillating variation of mean length by year has characterised almost all the remaining target species. As concern the mean length of the estimated "spawning (adult) stock" component, no significant trend was detected.

II.8.5.1.3 Average total mortality rates

Over the whole period and in the last 5 years statistically (robust) significant trends of total mortality were detected only in *Merluccius merluccius* (ages 1-2), *Phycis blennoides* (0-2) and *Parapenaeus longirostris* (1-2).

II.8.5.1.4 Length at maturity (50% mature); Lmat

The fitting of the ogive generally looked poor and only in few species (such as *Aspitrigla cuculus* and *Merluccius merluccius*) a satisfactory agreement between observed and estimated proportions was appreciable. The estimates L_{mat} are presented in the synoptic table (appendix 3); in some species (such as *Helicolenus dactylopterus*, 21-24, *M. merluccius*, 29-39, and *Raja clavata*, 54-70 cm), they were close to the previous available estimates (20, 21-34 and 57-78 cm, respectively).

In the whole period and in the last 5 years, the most part of species showed negative trends for this parameter. Species with a significant decreasing trend of L_{mat} were: *H. dactylopterus* (last 5 years, la), *Lepidorhombus bosci* (whole period, wp, and la), *Mullus surmuletus* (la), *Pagellus erythrinus* (wp and la), *Phycis blennoides* (wp), *Scyliorhinus canicula* (wp and la), *Zeus faber* (wp and la) and *Raja clavata* (wp and la). A contrasting status, negative (whole period) and positive (last 5 years) resulted for *Citharus linguatula* and *Trachurus trachurus,* whereas *Aspitrigla cuculus* was the only species showing a consistent significant positive trend. No matter the significance of the trend, L_{mat} vs years plots were characterised by a very high irregular shape. In no case significant trend for the proportion of mature individuals by survey were found among the target species.

II.8.5.2 Community indicators

II.8.5.2.1 Total biomass

Increasing (for example, 1998->2000) and decreasing (for example, 1994->1998) series of years alternate each other without any regularity and showing a huge dispersion (wide 95% CI) especially for the lower-sample–size years (< 2002). No significant trend resulted (p=0.368).

II.8.5.2.2 Total abundance (Density)

This plot more or less mimics the corresponding biomass evolution showing, however, a higher dispersion of the mean values only partially reduced by the increased sample sizes. A minimal positive, although not significant (p=0.023), trend resulted.

II.8.5.2.3 Mean weight

A slight and strong reduction trend in both mean values and the corresponding CI were observed, respectively. No significant trend was attributed to the reduction in mean weight.

II.8.5.2.4 Proportion of large fish

An abrupt change was evidenced between Medits surveys performed before and after 1998-99. The proportion of large fish has increased after 1998, no matter the thresholds considered. This result is likely a consequence of the inclusion of new species among the targets (short list) such as the medium sized sharks *Galeus melastomus* and *Scyliorhinus canicula*. In any case, no significant trend resulted. It is worth noting that the most part of the specie fall in the 10-20 cm class of mean length.

II.8.6 Discussion

II.8.6.1 Threshold level to select "representative" species

It is a good idea to focus the attention on the most representative species for which more consistent information should be available. Frequency of occurrence (F%), i.e. the percentage of positive haul (at least

1 specimen caught) might be a suitable criterion. The threshold level, however, should be taken by analysing the specific GSA frequency of occurrence distribution within the preferential depth range and its corresponding temporal trend. In the specific case and maintaining the same criterion, for example, 10-15% and 20% for the demersal and necto-pelagic (such as the *Trachurus* spp. and *Spicara* spp.) could have likely represented more suitable threshold.

II.8.6.2 Intrinsic Population growth rate

The indicator "population growth rate" *r* represents one of the suitable rough descriptor of the population/community changes and decreasing tendency can be used as "warning signal" and/or a complementary tool in the assessment of fishing effect at population (easier) /community (harder) level (assuming random environmental fluctuactions). Single population are supposed to be more sensitive to the exploitation, while compensation phenomenon and intrinsic higher sampling and natural heterogeneity tend to mask or confound the signal (if any) at community level (for example, note the huge CI generally detected in the present case).

The indicator efficacy, however, might be negatively perturbed when used as a point estimator (single sample by year) at single species level, especially when the stock is characterised by not continuous and not uniform recruitment and spatial distribution patterns (for example, discrete time spawning aggregation). At least in the Strait of Sicily, the overall point abundance of most Medits species is severely affected by the "asynchronicity" among recruitment peak, Medits survey and commercial activities. Spring – oriented Medits surveys and bad weather in winter should result in a recruitment abundance less touched by fishing mortality; given the same recruitment pulse, summer oriented surveys and better weather would led to a quick depletion of the local abundance. In any case, it would be useful performing the analysis by separating the young of the year component from the older population fraction (estimating the thresholds for splitting by each specific GSA and survey). The present program attempted to overcome to the recruitment noise by analysing the spawning stock component and might be interesting to remark that only in two species (*P. blennoides* and *Z. faber*) a significant positive (although irregular) trend was detected.

II.8.6.3 Mean length in population

Mean length of specimens in a standing stock is generally considered one of the most powerful indicator of the rebuilding performance of a fishery. Anyhow its ability in catching changes is more prone to the dynamic (i.e. continuous vs discrete recruitment) and length structure of the population intercepted at the sampling time. Theoretically, successive instantaneous pictures of the situation at sea in a given year should result in more or less the same or different progressing length structure (LFD) shapes depending on the continuous or discrete life history pattern of the investigated species. In case of "discrete" stock the heavier the growth overexploitation (too much recruits and juveniles in the gross catch) the greater the corresponding variation among successive pictures for the same problems above mentioned.

As a matter of fact, the Medits targets length frequency distributions pooled across the years showed "almost continuous shaped LFD" only in *M. merluccius* and few shellfish (*N. norvegicus*, *P. longirostris*, and *I. coindetii*). An exploratory analysis of surveys similarity, based on a joint and synoptic representation of abundance indices and frequency of occurrence (cf. Jereb *et al.* 2005), could help in figuring out the effect of shifting time of the survey from year to year.

II.8.6.4 Average total mortality rates

The "asynchronicity" problem before described might be one of the most likely explanation of the difficulties encountered in getting consistent estimates of *Z* across the different years. A further complication is represented by the use of growth parameters to back (or inversely) calculate the pseudo ages and hence reconstruct the cohort strength. At least for the Strait of Sicily, there are evidences that the inverse VBGF is not adequate for most of the Medits species; as a matter of fact, the researcher is obliged to use parameters which fit better the old-slow-growing fraction of the population (for which less precise and accurate information exists in the samples), whereas the back fit is generally poor for the fast and variable growing recruits and juveniles. Unfortunately, there are no easy solutions. Alternatives might consist in attempting a previous separation of the length components and attribute pseudo age to the modal length (discrete stock), and separate the young of the year and perform the analysis on the older fraction of the population (almost continuous cases). Finally, aiming at getting relative and not absolute temporal trend, estimation carried out within the single survey and not across them (i.e. approximation to a steady state) may help in avoiding the "asynchronicity" incidence.

II.8.6.5 Length at maturity (50% mature)

The general poor fitting observed might be attributable to the fact that the immature and mature components might not simultaneously occur during the time of the survey (e.g. *M. barbatus* or *A. foliacea*), and/or large sized specimen (which have by-passed gonad maturation) may confound the already general scanty mature component in the sample. In fact, the distinction between "Mature" (which is generally a periodic event) and adulthood (which is permanently acquired after the "first" maturation) condition should be considered. Especially when single data set are used, the large sized specimen whit very exhausted or resting ("extra spent") gonads should be excluded from the analysis (cf. De Santi *et al.* 2005). Pooling data across years and/or consider the median/mean length of the mature specimens might be alternative paths.

II.8.6.6 Proportion of large fish

Both at single species and community level, proportion of large "fish" seems a very attractive indicator, but it is still negatively affected by the before mentioned problems. At community level, furthermore, "fish" sizes should be standardised according the specific size range and taking into account the estimated or historical observed maximum size: red shrimps or Norway lobsters of 22 cm (TL), in fact, are "giant and very old" specimens, but were not considered by the absolute threshold.

II.8.7 Further References

(Campillo 1992; Stergiou *et al.* 1997; Levi *et al.* 2001; Froese & Pauly 2002; Lembo 2002; IRMA 2003; MaLiRAG 2003, 2004; Ragonese *et al.* 2004)

Appendices

Appendix II.8.1. Species considered for the GSA "16". * denotes those species with a frequency of occurrence less than 5%. Taxon denotes boney (BF) and cartilagineous (CF) fish, crustacean (CR) and cephalopods (CE)

Taxon	Scientific name	MEDITS code
BF	*Aspitrigla cuculus*	ASPI CUC
BF	*Eutrigla gurnardus**	EUTR GUR
BF	*Citharus linguatula*	CITH MAC
BF	*Helicolenus dactylopterus*	HELI DAC
BF	*Lepidorhombus boscii*	LEPM BOS
BF	*Lophius budegassa*	LOPH BUD
BF	*Lophius piscatorius*	LOPH PIS
BF	*Merluccius merluccius*	MERL MER
BF	*Micromesistius poutassou*	MICM POU
BF	*Mullus barbatus*	MULL BAR
BF	*Mullus surmuletus*	MULL SUR
BF	*Pagellus acarne*	PAGE ACA
BF	*Pagellus bogaraveo*	PAGE BOG
BF	*Pagellus erythrinus*	PAGE ERY
BF	*Phycis blennoides*	PHYI BLE
BF	*Solea vulgaris**	SOLE VUL
BF	*Sparus pagrus**	SPAR PAG
BF	*Spicara flexuosa*	SPIC FLE
BF	*Spicara smaris*	SPIC SMA
BF	*Trachurus mediterraneus*	TRAC MED
BF	*Trachurus trachurus*	TRAC TRA
BF	*Trigloporus lastoviza*	TRIP LAS
BF	*Trisopterus minutus capelanus*	TRIS CAP
BF	*Zeus faber*	ZEUS FAB
CF	*Raja clavata*	RAJACLA
CF	*Scyliorhinus canicula*	SCYOCAN
CR	*Aristaeomorpha foliacea*	ARIS FOL
CR	*Aristeus antennatus*	ARIT ANT
CR	*Nephrops norvegicus*	NEPR NOR
CR	*Parapenaeus longirostris*	PAPE LON
CE	*Eledone cirrhosa*	ELED CIR
CE	*Loligo vulgaris*	LOLI VUL
CE	*Illex coindetti*	ILLE COI
CE	*Octopus vulgaris*	OCTO VUL

Appendix II.8.2. Growth parameters (Von Bertalanffy curve) applied in the GSA "16" to reconstruct cohort strength and estimate Z.

Since the analysis is based on sex combined and the inverse VBGF, the estimates corresponding to the long living and larger sized sex were adopted for species showing well established sex differential in growth pattern. In case of "slow" and "fast" set VBGF for the sex considered, the curve with *Linf* > *Lmax* was employed. In case of *Linf* still higher than *Lmax* in the samples, previous *Linf* and *k* (*old*) were adjusted by increasing *Linf-old* up *Lmax/0.95* and decreasing *k-old* for *1/(Linf-new/Linf-old)*, respectively. Species with a frequency of occurrence less than 5% or with a very narrow area distribution in the GSA "16" (such as *Sepia officinalis*) were excluded.

Survey	Species	t0	k	Linf	Min age	source
MEDITS	ASPICUC	-0.656	0.283	34.85	0	Gulf of Lions - (Campillo 1992)
MEDITS	CITHMAC	-0.43	0.257	25.7	0	Aegean Sea - (Stergiou *et al.* 1997)
MEDITS	HELIDAC	-0.98	0.145	41.9	0	Strait of Sicily; Ragonese and Reale, 1995 (a, b) in Ragonese et al., 2004
MEDITS	LEPMBOS	-1	0.172	40.5	0	Gulf of Lions - (Campillo 1992) average across sexes. Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old); t0=-1
MEDITS	LOPHBUD	-1.55	0.121	77	0	Strait of Sicily; Malirag, 2003
MEDITS	LOPHPIS	-0.3	0.076	135	0	Strait of Sicily; Malirag, 2003; Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old).
MEDITS	MERLMER	-1.5	0.081	110.1	0	Strait of Sicily; Malirag, 2003
MEDITS	MICMPOU	-1.29	0.22	40.35	0	Espagne - (Campillo 1992)
MEDITS	MULLBAR	-0.2	0.62	26	0	Strait of Sicily; IRMA. 2003
MEDITS	MULLSUR	-0.84	0.38	37.4	0	Strait of Sicily; Malirag, 2004; Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old)
MEDITS	PAGEACA	-1.36	0.27	29.62	0	Alboran - Baro 2000 in Anon. 2004
MEDITS	PAGEBOG	-0.38	0.243	39.8	0	Atlantique - (Campillo 1992) for age 1 to 5
MEDITS	PAGEERY	-0.0394	0.2554	40.16	0	Gulf of Lions - (Campillo 1992)
MEDITS	PHYIBLE	-0.15	0.216	68.1	0	Strait of Sicily; Samed, 2002
MEDITS	RAJACLA	-0.5	0.102	122	0	Strait of Sicily; Cannizzaro et al., 1995, in Ragonese et al., 2004; average across sexes
MEDITS	SCYOCAN	0	0.2	88	0	North Sea - FishBase based p, Jennings et al 1999
MEDITS	SPICFLE	-1.9025	0.235	22	0	Patraikos Gulf - (Stergiou *et al.* 1997) Fork Length Modified by increasing Linf-old up Lmax/0.95 (k unmodified given Lmax is expressed as TL)
MEDITS	SPICSMA	-1.626	0.404	22	0	Crete - Stergiou et al 1997 Modified by increasing Linf-old up Lmax/0.95 (k unmodified given Lmax is expressed as TL)
MEDITS	TRACMED	-2.305	0.20	45.8	0	Saronikos Gulf - Stergiou et al 1997 Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old)
MEDITS	TRACTRA	-1.28	0.182	45.3	0	Adriatique - (Campillo 1992) Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old)
MEDITS	TRIPLAS	-0.639	0.254	38.2	0	(Campillo 1992)
MEDITS	TRISCAP	-1.867	0.179	32.3	0	Evvoikos Gulf - (Stergiou *et al.* 1997)
MEDITS	ZEUSFAB	0.22	0.245	62.2	0	Strait of Sicily -; (unpublished data)
MEDITS	ARISFOL	0	0.46	69.5	0	Strait of Sicily – Malirag, 2004 CL (mm)
MEDITS	ARITANT	-0.28	0.38	65	0	Gulf of Vera - Garcia-Rodriguez 2002 in Anon. 2004; CL (mm)
MEDITS	NEPRNOR	-1.14	0.10	89	0	Average Mediterranean males stocks (Adriatic

Survey	Species	t0	k	Linf	Min age	source
						excluded); CL (mm)
MEDITS	PAPELON	0	0.71	40.93	0	Strait of Sicily - Malirag 2004 CL (mm)
MEDITS	ELEDCIR	0	0.79	15	0	Gulf of Lions - (Campillo 1992) average across sexes, transformed to annual growth curve. Modified by increasing Linf-old up Lmax/0.95 and decreasing K for 1/(Linf-new/Linf-old); t0=0

Appendix II.8.3. Synoptic table with the basic results

Species code	F(%)	Intr. rate; r	SD r	Pval._ r	PenteL bar	SD Lbar	Pval. Lbar	Slope Z	SD Z	Pval. Z	Pval. robust Z	Lmat range	Trend Lmat	Sd Lmat	Pval. Lmat
ARISFOL	33.7	0.04	0.05	0.42	0.11	0.03	0.01	-0.07	0.08	0.45	0.06	NA	NA	NA	NA
ARITANT	13.0	0.07	0.08	0.38	0.01	0.03	0.83	NA	NA	NA	NA	NA	NA	NA	NA
ASPICUC	21.8	0.13	0.06	0.06	-0.54	0.38	0.22	0.30	0.16	0.16	0.69	14-18	0.84	0.148	0
CITHMAC	19.8	0.08	0.03	0.02	0.06	0.13	0.64	NA	NA	NA	NA	12-20	-0.369	0.096	0
ELEDCIR	26.9	0	0.03	0.91	-0.13	0.09	0.18	NA	NA	NA	NA	NA	NA	NA	NA
ELEDMOS	19.8	-0.01	0.03	0.72	-0.05	0.06	0.41	NA	NA	NA	NA	NA	NA	NA	NA
HELIDAC	44.3	0.19	0.04	0.00	-0.53	0.30	0.11	NA	NA	NA	NA	21-24	0.04	0.064	0.51
ILLECOI	49.2	0.15	0.05	0.02	-0.24	0.12	0.07	NA	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	22.9	0	0.03	0.99	-0.05	0.25	0.85	NA	NA	NA	NA	22-31	-0.344	0.166	0.04
LOLIVUL	11.8	-0.01	0.09	0.87	-0.31	0.13	0.04	NA	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	29.2	0.15	0.04	0.01	-0.74	0.35	0.06	NA	NA	NA	NA	29-51	-0.883	0.455	0.05
LOPHPIS	20.3	0.03	0.07	0.68	0.18	0.77	0.82	NA	NA	NA	NA	NA	NA	NA	NA
MERLMER	76.1	0.04	0.04	0.36	-0.07	0.09	0.45	-0.07	0.03	0.02	0.00	29-39	0.03	0.057	0.56
MICMPOU	20.3	-0.14	0.18	0.47	-0.18	0.49	0.73	NA	NA	NA	NA	NA	NA	NA	NA
MULLBAR	25.9	0.27	0.05	0.00	-0.31	0.19	0.14	0.03	0.09	0.78	0.17	NA	NA	NA	NA
MULLSUR	39.1	-0.07	0.05	0.19	-0.40	0.19	0.06	NA	NA	NA	NA	13-20	-0.021	0.048	0.66
NEPRNOR	45.3	0.06	0.03	0.11	0.03	0.09	0.75	NA	NA	NA	NA	NA	NA	NA	NA
OCTOVUL	13.7	0.05	0.05	0.29	-0.13	0.17	0.47	NA	NA	NA	NA	NA	NA	NA	NA
PAGEACA	9.0	0.13	0.06	0.05	0.12	0.14	0.41	NA	NA	NA	NA	NA	NA	NA	NA
PAGEBOG	7.6	0.09	0.11	0.42	-0.45	0.34	0.23	NA	NA	NA	NA	NA	NA	NA	NA
PAGEERY	16.0	0.15	0.05	0.01	-0.23	0.19	0.27	NA	NA	NA	NA	15-20	-0.214	0.056	0.00
PAPELON	65.2	0.13	0.04	0.02	-0.08	0.05	0.15	-0.06	0.04	0.20	0.01	NA	NA	NA	NA
PHYIBLE	62.9	0.07	0.03	0.09	0.13	0.17	0.44	-0.13	0.05	0.04	0.01	33-50	-0.594	0.143	0.00
RAJACLA	19.7	0.16	0.04	0.00	0.23	0.37	0.56	NA	NA	NA	NA	54-70	-1.101	0.38	0.00
SCYOCAN	27.2	0.14	0.05	0.03	0.73	0.68	0.34	NA	NA	NA	NA	34-40	-0.73	0.118	0.00
SPICFLE	28.1	-0.08	0.06	0.24	-0.05	0.14	0.73	-0.09	0.07	0.26	0.06	NA	NA	NA	NA
SPICSMA	8.8	-0.11	0.1	0.28	0.49	0.16	0.04	NA	NA	NA	NA	12-14	0.47	0.183	0.01
TRACMED	11.8	-0.12	0.11	0.29	-0.26	0.20	0.22	NA	NA	NA	NA	16-20	-0.096	0.09	0.29
TRACTRA	46.9	-0.19	0.1	0.09	-0.35	0.16	0.06	0.14	0.11	0.25	0.06	17-28	-0.175	0.061	0.00
TRIPLAS	12.3	-0.05	0.04	0.29	-0.03	0.29	0.93	NA	NA	NA	NA	16-18	0.02	0.174	0.91
TRISCAP	17.4	0.02	0.06	0.78	-0.06	0.14	0.67	NA	NA	NA	NA	13-15	0.15	0.116	0.17
ZEUSFAB	30.9	0.06	0.03	0.05	0.59	0.22	0.03	NA	NA	NA	NA	19-34	-1.08	0.346	0.00

II.9 Northern Adriatic Sea (area 17)

Coordinator: Corrado Picinetti, Stjepan Jukic and Bojan Marceta

II.9.1 Ecological setting, geographical and environmental features

The GSA 17 area covers the whole Northern and Central Adriatic for a surface area of about 92660 km^2. The Northern and Central basins are shallow and generally not exceeding 75 m and 100 m, respectively, excluding the Pomo-Jabuka Pit where depth reaches about 260 meters. So most of the bottom is on the continental shelf and is covered with muddy and sandy sediments of various composition and granulometry. There is a large variety of biocenosi. The eastern zone shows different ecological and oceanographic features from the western one. The water masses enter from the Ionian Sea along the eastern side and go out along the western coast. The eastern coastal morphology is high, rocky and articulated with small and large islands, channels and sheltered bays. There is a low freshwater inflow. The Italian coast generally is flat and alluvial with an high freshwater inflow, mainly in the North Adriatic, that lowers salinity and produces an high primary production and high biological productivity. All these different ecological features produces a great variability in species distribution. In fact no species is distributed into the entire GSA 17 area but a great number of species lives in restricted zone smaller than 20% of the total surface. This aspect influences the weight of some species in fishery: in a restricted area a specie may be very important for local fishery while it may be negligible in other zone.

II.9.2 Fishery description

In Adriatic, fishery is a centuries-old activity; studies and researches show the presence, dates back over 150 years ago, of a big fleet and a number of fishermen greater than today. Technologies improved, fishery techniques were replaced by other, fishing operations and fishing time changed too. In the GSA 17 vessels and fishermen number lowered a lot, vessels tonnage increased and fishing time was reduced. About twenty years ago, vessels often fished during the whole week; today no boats work more than 5 days a week and the most part of the fleet works less than 4 days, weather permitting. Time fishing reduction caused strong changes in fishing areas: the large part of fishing effort is carried on along coastal zone into 12 miles while greater tonnage boats work into 30-40 miles from their ports.

Taken into account that resources are generally distributed in small areas, although seasonal migrations, it is obvious that fishing effort is distributed in a different way between species and area. During the last 20 years, catches of the most part of demersal resources showed great fluctuations and the analysis founding on catches in the most part of cases are not reliable due to reliability catches statistical data and lack of fishing effort data.

II.9.3 Description of changes in surveys design

Medits trawl-surveys were carried out in the international and Italian territorial waters from 1994.

From 1995 and from 1996, when Slovenia and Croatia respectively joined in the Medits programme, sampling was carried out also in Slovenian and Croatian territorial waters, covering all the entire Northern and Central Adriatic. In 1999 the survey was carried out only in the international and Italian territorial waters .

Throughout eleven years sampling the number of hauls incremented from 86 in 1994 to 181 stations carried out in the last three years. In each year surveys took place in different dates like in 1999 when sampling was carried out in September.

During first five surveys different vessels were used each year; from 1999 sampling was carried out with the boat “Andrea”. The same trawl net with mesh cod-end size of 20 mm was always used. Changes in survey design are summarised in Tab. 1.

II.9.4 Selection of species and description of indicators analysis

Medits trawl net catches occasionally pelagic species as *Engraulis encrasicholus*, *Sardina pilchardus*, *Boops boops, Trachurus trachurus, Trachurus mediterraneus* and *Trachurus picturatus.* Abundance and distribution are unreliable for these species. For this reason these pelagic species were excluded from the GSA 17 species list (Tab. 3). For the population indicators analysis any species with mean occurrence smaller than 5% was also removed. Population growth rate was analysed both considering only Italian and international area (1994 2004) and considering the entire GSA 17 area (1996-2004 excluding 1999). Trend of Spawning stock abundance and trend of recruits abundance was analysed considering the entire GSA 17 area and 8 years surveys.

In table 2 are reported the threshold values used to discriminate individuals defined spawners. Some species have different maturity length between males and females and in this case a mean value has been used. Tab. 2 reports also threshold values used to discriminate individuals defined recruits. For each species this value was chosen considering the mean total length of the first cohort plus standard deviation.

II.9.5 Results

First consideration concerns species distribution in the GSA 17 area. The 50 examined demersal specie show different distributions and each species is present only in a certain area. Distribution surface is very different between species. Only 4 species (*Illex coindetii, Merluccius merluccius, Mullus barbatus* and *Trisopterus minutus capelanus*) cover a surface larger than 50% of the studied area. *Merluccius merluccius* is the demersal resource with the largest distribution area in the GSA 17 (87%). 7 species have a distribution area corresponding to 5-10% of total area, 12 species to10-20% while 15 species to 20-40% of total area. This distribution aspect is very important: it points out that most part of species may have a great weight in a certain zone but they have no weight in the entire GSA. Another thought concerns fishing effort evaluation. In fact fishing effort can not be distributed in the same way on species that have different geographical distribution in the GSA. In each area of GSA, fishery catches only a species group with different composition between different area. Usually vessels, mainly boats of small or medium tonnage, works only in certain area near their port then not all species are accessible for fishery and the existing fleet in the area is not a good indicator of fishing effort on a single species. The population growth rate r calculated for the period 1994-2004 in the Italian area increases for the most part of the species and 11 species show a significant positive trend. 3 species are stable and 7 species abundance decreases although none of which shows a significant negative trend (Figure II.9.1). Also population growth rate calculated for the entire GSA 17 shows similar results: 11 species have a significant increasing trend and only one species, *Mustelus mustelus*, has a significant decreasing trend (Figure II.9.2).

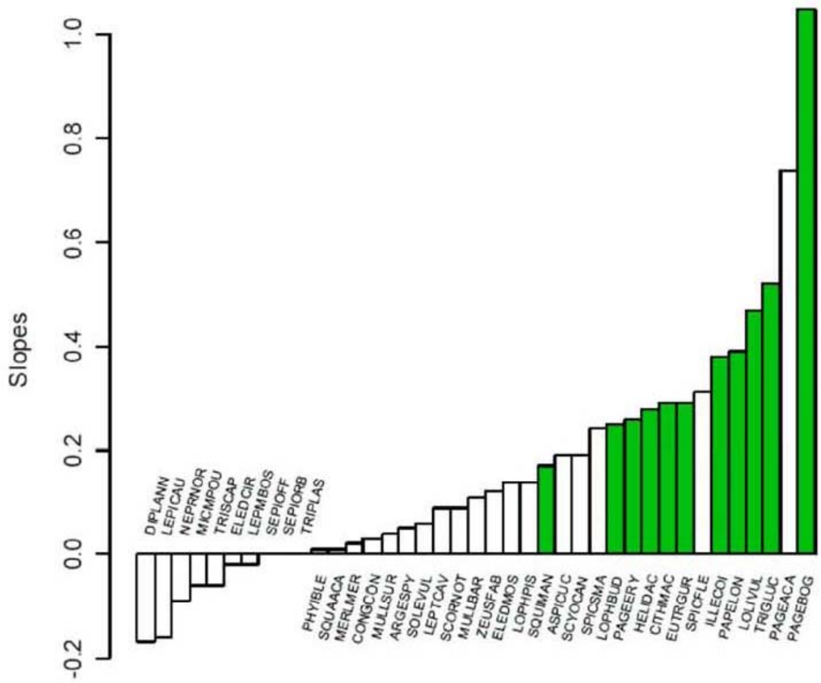


Figure II.9.1. Population growth rate in the northern Adriatic Sea (1994-2004).

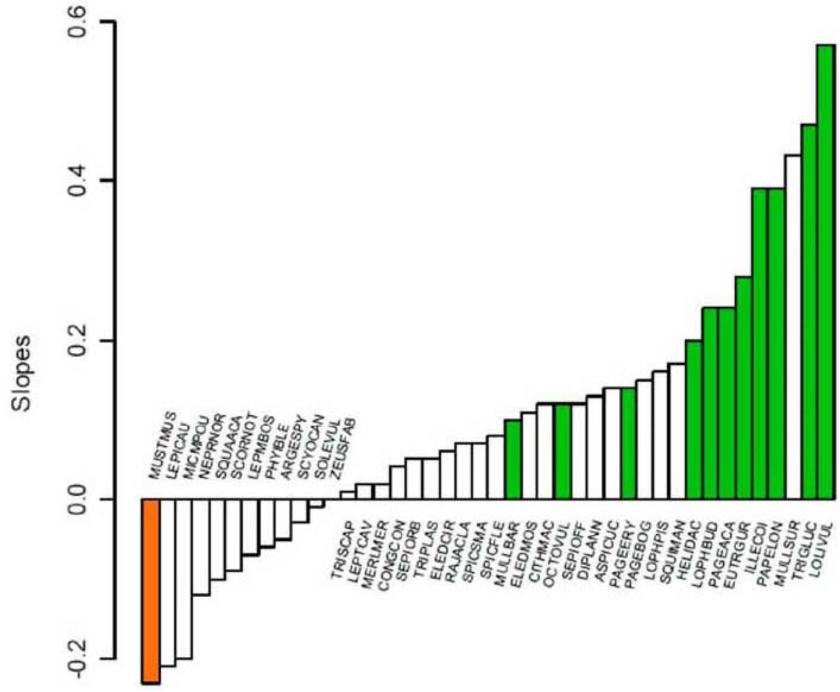


Figure II.9.2. Population growth rate in the northern Adriatic Sea (1996-2004).

Figure II.9.3 reports 8 years trends in spawning stock abundance calculated for the entire GSA 17 area. Due to the low slope values, spawners abundances seem to be rather stable. Four species, Eledone moschata, Loligo vulgaris, Lophius budegassa and Solea vulgaris, show a significant increasing trend although with low slope values. The species that shows a decrease in abundance spawners throughout the years have not a significant trend.

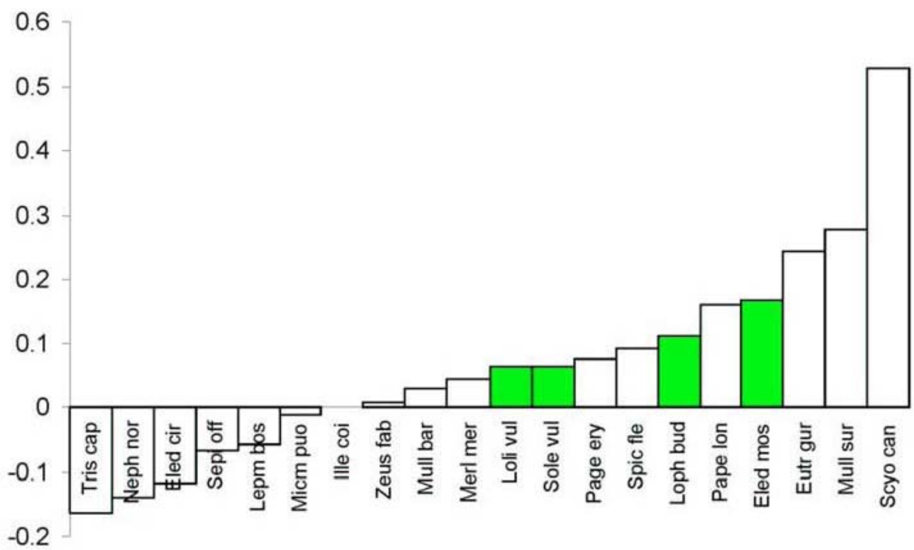


Figure II.9.3. Slope of time trend in spawners stock abundance in the northern Adriatic Sea (1996-2004).

Figure II.9.4 reports 8 years trends in recruits abundance calculated for the entire GSA 17 area. It is necessary to remember that Medits trawl net has a very low selectivity due to mesh cod-end size of 20 mm. There is a discrete variability in recruits abundance over the course of the time series. Abundance mainly increases and Loligo vulgaris has a significant increasing trend while only Micromesistious poutassou has a significant decreasing trend.

Figure II.9.5reports 8 years trends in mean length calculated for the entire GSA 17 area. Only one species shows a significant increasing trend in mean length while 5 species have significant decreasing mean length. Mean length is strongly influenced by recruitment because great recruitment lowers mean length.

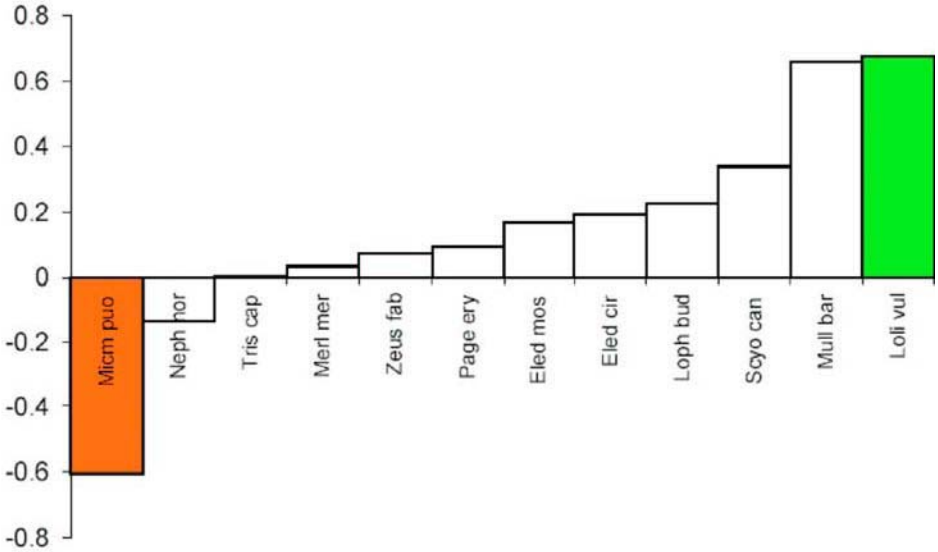


Figure II.9.4. Slope time trend in recruit abundance in the northern Adriatic Sea (1996-2004).

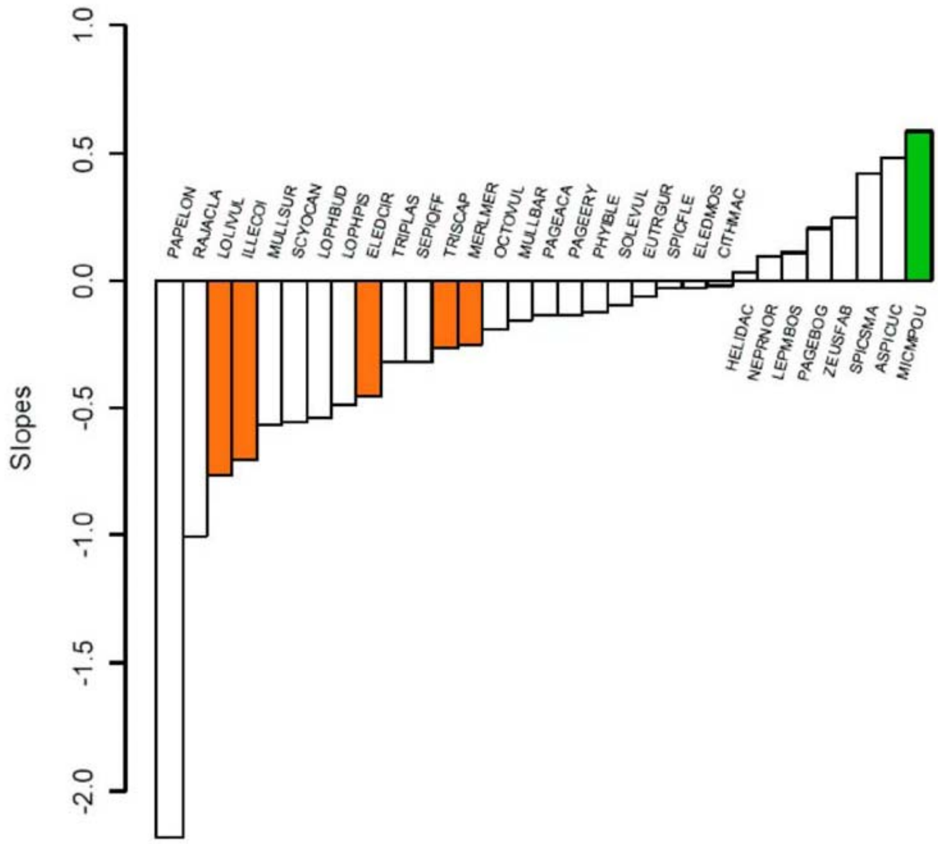


Figure II.9.5. Slope time trend in mean length in the northern Adriatic Sea (1996-2004).

Figure II.9.6 reports cumulative lengths distribution for the 4 species with a mean occurrence more than 50% (*Illex coindetii, Merluccius merluccius, Mullus barbatus* and *Trisopterus minutus capelanus*). Length distributions include very small size due to low selectivity of Medits trawl net, so these graphs describe a representative sample of population length distribution in the whole GSA 17 area.

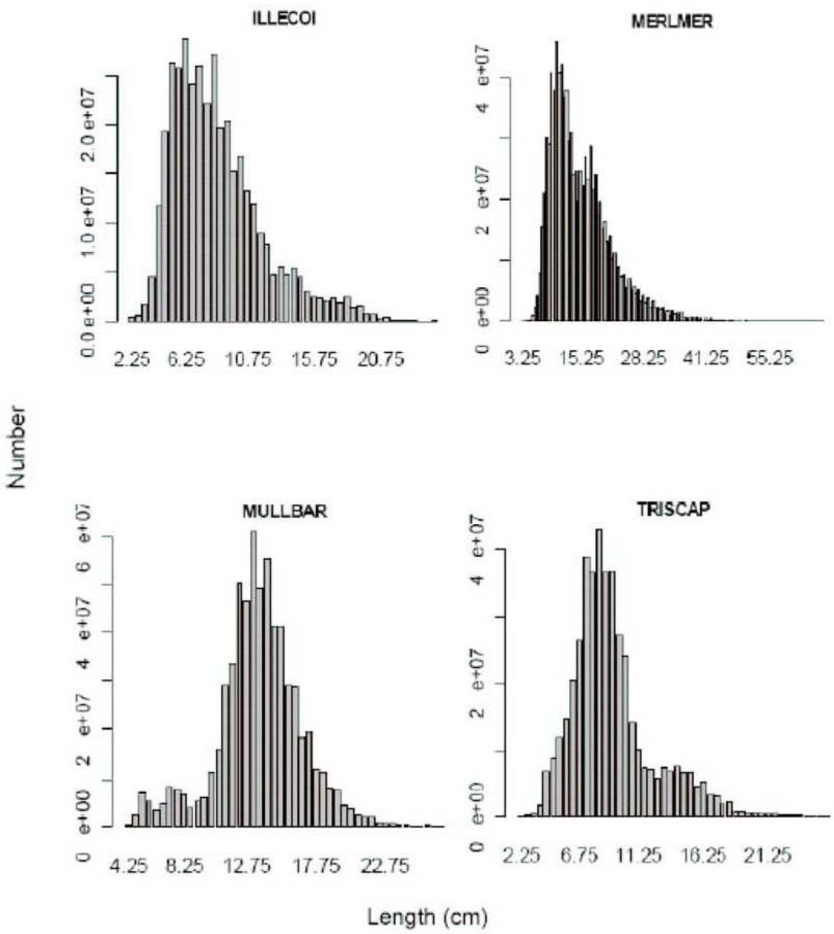


Figure II.9.6. Cumulative length distribution for *Illex coindetii, Merluccius merluccius, Mullus barbatus* and *Trisopterus minutus capelanus* in the northern Adriatic Sea (1996-2004).

II.9.6 Discussion

This first global analysis of the Medits survey results in the Northern and Central Adriatic points out some aspects that usually are not emphasized. First only 4 of 50 examined species cover an area larger than 50% of the entire GSA 17. This fact points out that some species are distributed into a restricted zone where sometimes become a great economical resource for fishermen working in that area. The same species could not interest fishermen works in other zone. This fact confirms that more information about fishing area and fishing effort is necessary. In the Adriamed project this type of work has been started: fleet was divided in "operational units" and now it will be necessary to link each operational units with species there are in the area where operational units work. The restricted distribution area of many species confirms the inefficacy of general measures for a certain species. Demersal resources assessment, as appears from the analysed indicators, seems to be in a reassuring state. The most part of examined species shows an increasing trend in population growth rate over the whole study period. This fact excludes that, in these years, resources exploitation is causing a resource reduction. Only one specie, Mustelus mustelus, shows a significant negative trend in the 8 years time series but it is known this elasmobranch has a low renovation rate. Spawning stock stability throughout years for the main species confirms that demersal resources assessment is rather stable. In addition, recruits abundance variability points out both that the current spawning stock may breed great recruitment and recruits abundance is linked to ecological factors fishery-independents that influence recruits survive more than linked to spawners stock size. Time trend in mean length points out a link with population abundance. In fact species with an increasing trend in population abundance show a decreasing trend in mean length; in addition spawning stock is rather constant, then the increase in individuals number depends on the increase in recruits number. All this factors reduce the mean length too. This fact may be observed for *Loligo vulgaris* and *Illex coindetii* while *Micromesistious poutassou* shows the opposite situation: a decreasing trend in population growth rate, recruits number decreasing throughout years and an increasing in mean length. Cumulative lengths distribution analysis points out the weight of small size fishes caught by Medits trawl net. Lengths distribution calculated year by year shows small differences between different years due to both recruits abundance and growth variability.

These Medits data may be used, at least for species with largest distribution, to calculate the number of individuals for each age and estimate total mortality. However this calculation is influenced by the difficulty to divide different age because the most part of the species often overlaps two following age for the same size. For example “Red mullet”, *Mullus barbatus*, usually reaches 13 cm of total length in October or November in the same birth year; Red mullets born from a late hatching reaches 6 - 7 cm LT in October –November. Then, after winter growth stop, red mullets of 1 year age have lengths in a range between 7 – 13 cm, the same sizes of Red mullet of age 0 . Percentage of individuals in a certain size range change year by year due to small changes in reproduction period and changes in survey dates. In addition growth individual rate is linked with seasonal ecological features. For all these factors, calculation of mortality require more investigation. The improvement in the analysis with the study of the fishing effort that works in a certain area, will allow the improvement of demersal resources management in more restricted area. Probably the local dimension is the more appropriate level for a correct management of resources.

II.9.7 Appendix

Survey	Country	Dates of sampling	Boats	Number of stations
Medits 1994	Ita	21/05/1994; 03/06/1994	Fulmine	86
Medits 1995	Ita -Slo	06/06/1995; 30/06/1995	Elisa Giudotti	88
Medits 1996	Ita - Hrv - Slo	03/06/1996; 25/06/1996	Elisa Giudotti	137
Medits 1997	Ita - Hrv - Slo	02/06/1997; 22/06/1997	Principessa I	139
Medits 1998	Ita - Hrv - Slo	10/06/1998; 04/07/1998	Igor	138
Medits 1999	Ita	04/08/1999; 14/09/1999	Andrea	86
Medits 2000	Ita - Hrv - Slo	08/06/2000; 02/08/2000	Andrea	136
Medits 2001	Ita - Hrv - Slo	25/05/2001; 02/07/2001	Andrea	136
Medits 2002	Ita - Hrv - Slo	17/07/2002; 26/09/2002	Andrea	181
Medits 2003	Ita - Hrv - Slo	17/06/2003; 12/08/2003	Andrea	181
Medits 2004	Ita - Hrv - Slo	29/06/2004; 11/08/2004	Andrea	181

Tab.1- GSA 17 Northern Adriatic Sea : Summary of changes in survey design.

Species	Maturity length	Sources	Recruitment length
Eledone cirrosa	9 cm	Soro e Piccinetti Manfrin, 1989	38 mm
Eledona moscata	9 cm	Soro e Piccinetti Manfrin, 1989	61 mm
Eutrigla gurnardus	11 cm	Dati Medits	
Illex coindetii	14 cm	Soro e Piccinetti, 1994	
Lepidorhombus boscii	23 cm	Ungaro e Martino, 1998	
Loligo vulgaris	13 cm	Dati Medits	65 mm
Lophius budegassa	34 cm	Jardas, 1987	13 cm
Merluccius merluccius	28 cm	Dati Medits	11.5 cm
Micromesistus poutassou	21 cm	Relini et al., 1999	12 cm
Mullus barbatus	11 cm	Vrgoc, 2004	9 cm
Mullus surmuletus	15 cm	Relini et al., 1999	
Nephrops norvegicus	30 mm	Dati Medits	24 mm
Pagellus erythrinus	12 cm	Vrgoc, 2004	10 cm
Parapenaeus longirostris	25 mm	Relini et al., 1999	
Schyliorhinus canicula	35 cm	Jardas, 1979	22 cm
Sepia officinalis	10 cm	Piccinetti Manfrin e Giovanardi, 1984	
Solea vulgaris	25 cm	Vrgoc, 2004	
Spicara flexuosa	12 cm	Relini et al., 1999	
Trisopterus minutus cap.	13 cm	Froglia, 1981	8 cm
Zeus faber	38 cm	Relini et al., 1999	15 cm

Tab.2- GSA 17 Northern Adriatic Sea : Maturity and recruitment length per species.

Species	1996	1997	1998	2000	2001	2002	2003	2004	MeanOccurence
ARGESPY	36.03	22.63	22.46	20.59	22.79	25.00	30.39	24.31	25.52
ARISFOL	0.74	0.73	0.00	0.74	1.47	0.00	0.55	0.55	0.60
ARITANT	0.00	0.73	0.00	0.00	0.74	0.00	0.00	0.00	0.18
ASPICUC	21.32	23.36	13.04	35.29	25.00	40.00	24.31	24.31	25.83
CITHMAC	27.21	25.55	21.74	25.74	40.44	35.00	35.91	29.28	30.11
CONGCON	14.71	18.25	11.59	8.82	8.82	13.89	9.94	14.36	12.55
DICELAB	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.55	0.14
DIPLANN	15.44	18.98	13.04	13.97	27.21	10.56	7.73	11.05	14.75
ELEDCIR	40.44	37.23	32.61	38.97	36.03	29.44	39.23	32.60	35.82
ELEDMOS	41.91	39.42	31.16	39.71	50.00	43.33	39.78	41.44	40.84
EUTRGUR	29.41	18.98	23.91	47.06	37.50	67.22	61.33	54.14	42.44
GALUMEL	2.21	2.19	2.90	2.21	1.47	1.11	2.21	2.21	2.06
HELIDAC	19.12	16.06	10.87	21.32	19.85	30.00	24.86	21.55	20.45
ILLECOI	43.38	48.18	59.42	63.97	78.68	76.11	54.14	62.98	60.86
LEPICAU	26.47	23.36	21.74	19.85	19.85	16.67	11.60	8.84	18.55
LEPMBOS	16.91	17.52	14.49	17.65	8.82	10.56	16.02	12.15	14.27
LEPTCAV	46.32	49.64	37.68	45.59	41.18	43.33	38.67	38.12	42.57
LOLIVUL	21.32	18.98	19.57	44.12	47.06	73.89	37.02	49.72	38.96
LOPHBUD	33.09	26.28	27.54	45.59	28.68	53.89	57.46	54.14	40.83
LOPHPIS	4.41	7.30	5.80	2.94	5.88	18.33	17.68	7.18	8.69
MERLMER	91.91	91.24	86.96	79.41	82.35	87.22	91.16	89.50	87.47
MICMPOU	25.74	21.17	22.46	17.65	14.71	15.00	16.57	12.71	18.25
MULLBAR	56.62	61.31	56.52	64.71	73.53	66.11	67.40	56.91	62.89
MULLSUR	1.47	5.11	13.77	12.50	2.21	15.56	10.50	23.76	10.61
MUSTMUS	9.56	11.68	8.70	3.68	10.29	7.78	10.50	3.87	8.26
NEPRNOR	50.00	36.50	44.20	31.62	25.74	35.00	35.91	40.88	37.48
OCTOVUL	7.35	7.30	4.35	8.09	8.82	8.89	7.18	9.94	7.74
PAGEACA	10.29	8.03	8.70	8.09	7.35	7.22	11.60	6.63	8.49
PAGEBOG	5.88	6.57	5.07	11.03	13.97	8.89	13.26	11.60	9.53
PAGEERY	29.41	37.96	34.78	35.29	38.24	31.11	45.86	37.57	36.28
PAPELON	18.38	17.52	15.22	25.74	27.94	38.89	34.81	35.36	26.73
PENAKER	0.00	0.73	0.00	0.00	3.68	0.56	1.10	1.66	0.97
PHYIBLE	25.00	19.71	18.84	21.32	16.18	21.67	20.44	17.68	20.11
RAJAAST	2.94	2.19	2.17	1.47	0.00	2.78	2.21	1.10	1.86
RAJACLA	7.35	10.22	13.04	8.82	5.88	6.11	8.29	9.94	8.71
SCORNOT	35.29	41.61	29.71	25.00	19.12	25.00	17.13	19.34	26.52
SCYOCAN	25.00	24.82	28.99	27.21	22.06	21.11	23.20	23.20	24.45
SEPIOFF	11.76	22.63	11.59	12.50	12.50	11.67	6.63	9.94	12.40
SEPIORB	11.03	23.36	11.59	26.47	22.06	11.67	13.26	13.26	16.59
SERACAB	4.41	5.11	2.17	2.94	3.68	5.56	5.52	2.76	4.02
SOLEVUL	8.82	4.38	5.07	5.15	1.47	4.44	8.29	3.87	5.19
SPICFLE	35.29	35.04	33.33	42.65	47.79	43.89	36.46	33.15	38.45
SPICMAE	2.21	1.46	7.25	2.94	1.47	0.56	1.66	0.00	2.19
SPICSMA	26.47	21.90	23.91	28.68	26.47	40.00	41.44	32.60	30.18
SQUAACA	17.65	16.06	20.29	13.97	11.03	11.11	7.73	12.15	13.75
SQUIMAN	16.18	13.87	11.59	16.18	11.76	20.00	19.34	27.62	17.07
TRIGLUC	6.62	6.57	7.25	29.41	19.85	28.89	25.97	21.55	18.26
TRIPLAS	19.85	14.60	15.22	22.06	21.32	20.00	17.68	24.31	19.38
TRISCAP	75.00	73.72	76.09	63.24	63.97	80.00	71.27	67.96	71.41
ZEUSFAB	32.35	29.93	23.91	31.62	35.29	23.89	18.78	25.41	27.65

Tab.3- GSA 17 Northern Adriatic Sea: List of species and mean occurrence.

II.10 Southern Adriatic (area 18)

Coordinator: Nicola Ungaro and Kastriot Osmani

II.10.1 Ecological setting, geographical and environmental features

Southern Adriatic basin is linked to the Ionian Sea trough the Otranto's Channel. The yearly water flow of 35.000. thousand millions m^3 is estimated in the same Channel. The water mass circulation in the Adriatic Sea is characterised by typical cyclonical movements (Artegiani *et al.* 1997). The northern Adriatic dense water (NADW), the Adriatic deep water (ADW) and the Levantine intermediate water (LIW) co-occur. NADW (cold water) flows from the north to the south along the western continental shelf, ADW is formed in the Southern Adriatic pit, LIW (warmer and saltier water) inflows northward along the eastern side of the Adriatic (from the Ionian Sea in the Otranto strait) (Manca *et al.* 2001). The last mentioned water mass (LIW) makes the bottom water of the eastern side of the South Adriatic warmer than the western one (Artegiani *et al.* 1997). The surface current on the western coast push the Adriatic waters in the Ionian (Zore-Armanda 1968, 1969). Thus, the Southern Adriatic basin is characterised by the mixing of Adriatic waters (lower salinity, colder waters) and Ionian ones (higher salinity, warmer waters) (Bregant *et al.* 1992a; Leder *et al.* 1995; Vilicic *et al.* 1995). Average salinity of the basin is 38.5 $^{o}/_{oo}$. South-eastern intermediate levantine waters (100-500 m depths) have a value larger than 38.75 $^{o}/_{oo}$ (temperature of 13.7°C), the deep waters have mean value of 38.65 $^{o}/_{oo}$ (temperature of 13.3°C) (Poulain 1995). Surface temperature ranges between 28-29 °C (summer time) and 9-11 °C (winter time). Nitrogen and phosphorus concentration ranges between 25 µg/l - 35 µg/l, and between 7 µg/l - 12 µg/l, respectively (Casavola *et al.* 1985; Casavola *et al.* 1995). So a generalised oligotrophy occurs in the basin, and the Chlorophyll-a concentration is estimated at 0.5-1.5 µg/1 values (Rizzi *et al.* 1994). With regard to bathymetry, the maximum depth in the Southern Adriatic is 1233 m, and it is found in the "Bari pit". Such a ground depression looks moderately asymmetric, the eastern slope steeper as a rule. Western area shows a substantial difference between the northern and southern zone. In the north (Gulf of Manfredonia) the continental shelf is wide (distance from the coastline to the 200 m depth line = 45 miles) and the slope's steepness is low. Bathymetric lines are closer each other southbound, and the 200 m depth line is found at around 9 miles off Otranto's Cape.

The presence and distribution of marine flora and fauna and the main ecological features are related to the mentioned environmental features (Marano *et al.* 1998).

II.10.2 Fisheries description and initial state assessment

South-Adriatic demersal resources are exploited by both Italian and Albanian fishery fleet which often operate on the same stocks and fishing grounds.

The Italian fishery fleet in the Southern Adriatic basin consists of ≅ 1500 vessels (≅ 10 % of the total number of Italian fishery boats); the global gross tonnage in the mentioned area is ≅ 35000 tons (≅ 15 % with respect to the National total value) (ISTAT 1997).

The main fishery districts are (from North to the South) Manfredonia, Molfetta, Bari and Brindisi, while other smaller fishery harbours are located along the coast.

Trawling is the most important fishery activity on the whole area (≅ n° 900 boats, 60 % of total number of fishing vessels; 85 % of gross tonnage). Other gears targeting to demersal species, such as trammel nets or bottom long-lines, are utilised by a low number of boats (less than 10% of the whole South-western Adriatic fleet).

The Albanian fleet consists of ≅ 170 vessels. The main fishery ports are Shengjin, Durazzo, Valona and Saranda (from North to the South). The number of active trawlers is ≅ 100 (60 % of total number of fishing vessels), while ≅ 40 boats are licensed to fish by means of fixed gears (Negroni 2001). Last census, carried out within the framework of activities of the FAO-AdriaMed Project, confirms trawlers as the main fraction of the Albanian fishing fleet (Mannini *et al.* 2004).

Trawling represents the most important fishery activity in the southern Adriatic Sea and a yearly catch of around 30,000 tons could be estimated for the last decade (ISTAT 1997). 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 (Massa & Mannini 2000). With regard to trawl fishery catches, the Mediterranean hake (*Merluccius merluccius*) represents 20%, percent while Norway lobster (*N. norvegicus*), deep-water pink shrimp (*P. longirostris*), red mullet (*M. barbatus*), mackerels (*Trachurus* spp.) and octopuses (mostly *Eledone spp*) contribute 5-10% each (Ungaro *et al.* 2002). The bottom surface potentially exploited by trawlers is 15,000-17,000 km^2 (70 % on the western side, 30% on the eastern side). The extension of the trawlable area follows a latitudinal gradient, increasing from the south to the north of the basin.

II.10.3 Brief description of changes in survey design

The Medits surveys have been carried out in the southern Adriatic basin (GSA n° 18) from 1994 since 2004. The surveys' dates were included between the months of June and July as a rule, with the exception of the 1999 survey performed in July and August. The vessel "Biancamaria" (GT 112.98; Hp 408) was used from 1994 to 1997 while the vessel "Pasquale & Cristina" (GT 158.77; Hp 923) was rent from 1999 to 2004. The sampling scheme was random stratified according to a total area of 24008 km^2 for the period 1996-2004 while the surveys 1994 and 1995 were performed in the western (Italian) zone only, in the reduced area of 15273 km^2. Due to the difference in the investigated area, the surveys 1994 and 1995 will not be considered for the data analysis reported below. Moreover, the density and total number of sampling hauls in the whole GSA 18 was changed from n° 112 in the period 1996-2001 to n° 90 in the period 2002-2004.

II.10.4 Selection of species

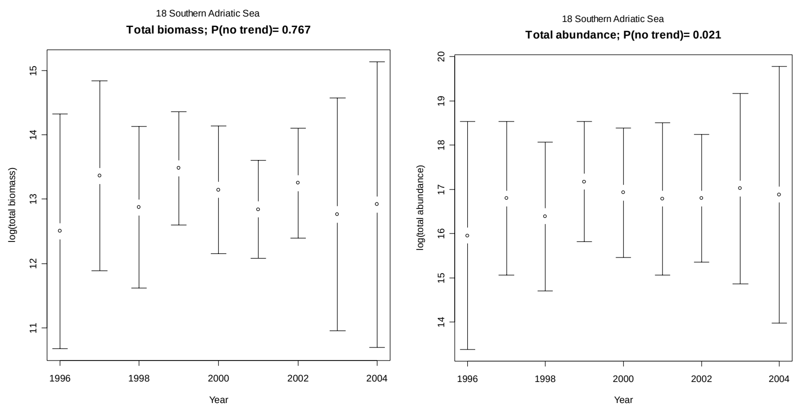
The total number of fifty-seven species, corresponding to the Medits' pool of species, was considered for the analysis of the "community" indicators and for the "population" indicator "r" (Population growth rate). The other "population" indicators have been performed for the species included in the Medits Reference List (short list, n° 37) with average occurrence larger than 10%. Moreover, the population indicators "$L_{50\%}$" (length at maturity) and "trend of $L_{50\%}$ values" weren't considered at all for the species listed below. In fact, the survey period don't allow the sampling of the full length range as well as all the maturity stages for the reported species: *Aspitrigla cuculus*, *Eledone cirrhosa*, *Eledone moschata*, *Chelidonichthys gurnardus*, *Lophius budegassa*, *Lophius piscatorius*, *Mullus barbatus*, *Mullus surmuletus*, *Pagellus bogaraveo*, *Pagellus erythrinus*, *Spicara flexuosa*, *Spicara smaris*, *Trisopterus minutus*, *Zeus faber*.

II.10.5 Results

The performed analysis gave the following results:

II.10.5.1 Community indicators

Total biomass in community didn't shown any trend in the period 1996-2004, while a significant increasing trend was detected for the total abundance (Figure II.10.1). Due to the obtained results, a decreasing trend was found for the average individual weight in community. No trends in the average individual length in community and proportion of large individuals have been found.



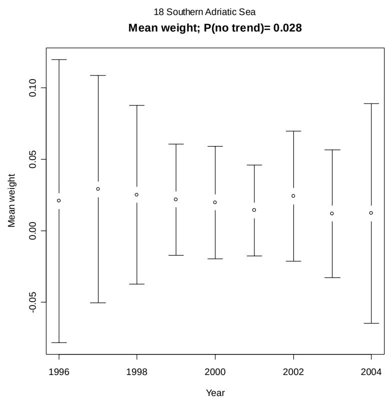


Figure II.10.1. Time trend of community indicators.

II.10.5.2 Population indicators

The population growth rate “r” was significantly increasing for 8 of 40 species and decreasing for 2 of 40 species (Figure II.10.2). The trend of average length of population was significantly decreasing for *Zeus faber* only while increasing for *Phycis blennoides* only.

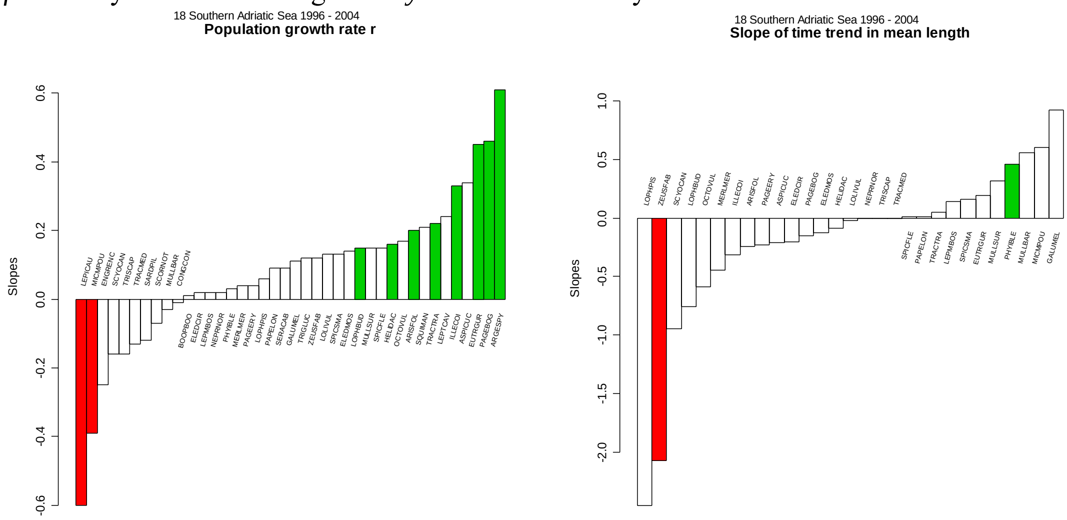


Figure II.10.2. Trends in population growth rates and in mean length.

The trend of the average total mortality rate (Z) wasn’t significant at all (Figure II.10.3), while the slope of time trend in L50% was decreasing significantly for 4 species (*Scyliorhinus canicula*, *Merluccius merluccius*, *Parapenaeus longirostris*, *Aristaeomorpha foliacea*) and increasing for 2 species (*Helicolenus dactylopterus*, *Illex coindetii*).

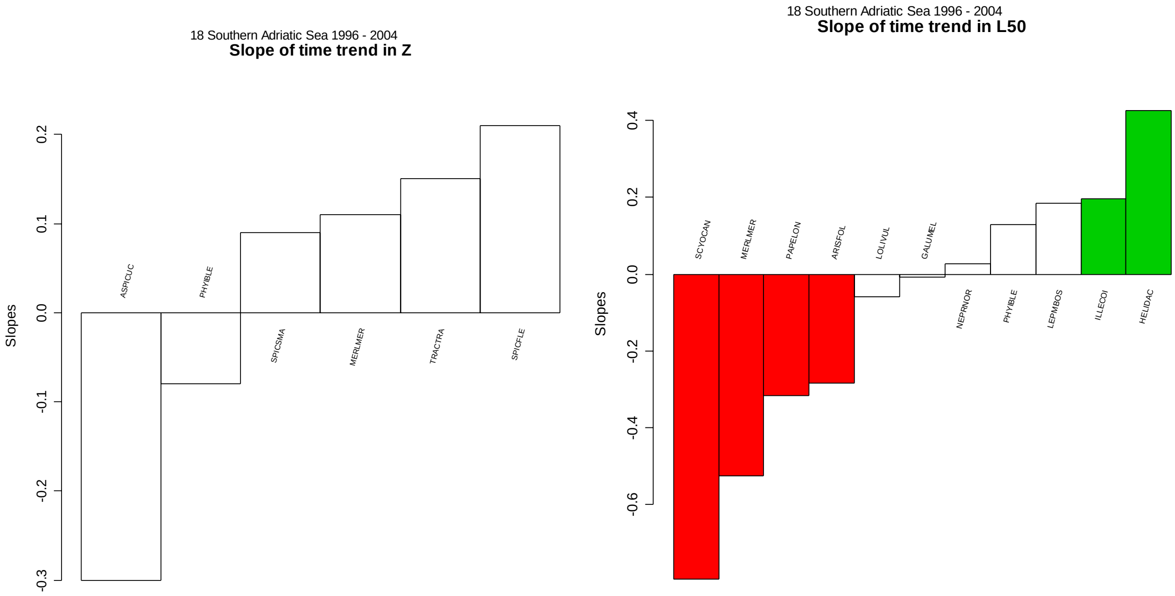


Figure II.10.3. Trends in total mortality rates and in maturity sizes.

II.10.6 Sensitivity analyses for some indicators

Some indicators such as Total abundance (Community indicator) and Slope of time trend in Z (Population indicator) have been calculated using different options.

Total abundance indicator was calculated excluding pelagic species (Families *Clupeidae*, *Carangidae*, *Engraulidae*, *Scombridae*). New results didn't highlight any significant trend (see the Figure II.10.4), while the trend was significant when the original data was processed (see the "results" paragraph).

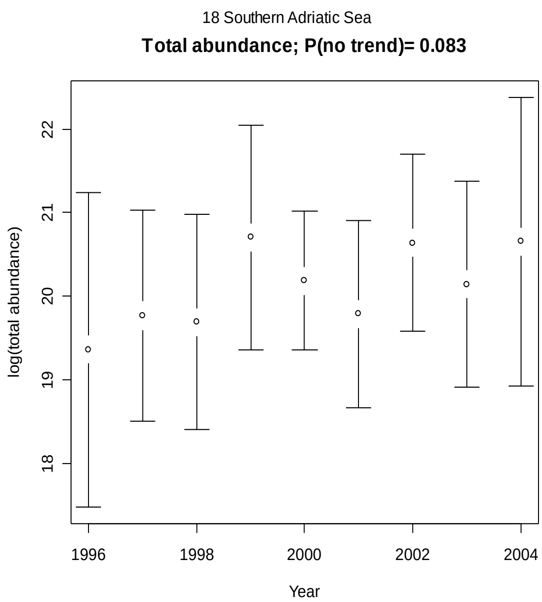


Figure II.10.4. Total abundance without pelagics.

The new Z values were calculated utilising "Adriatic" growth parameters for some species (*Merluccius merluccius*, *Mullus barbatus*, *Nephrops norvegicus*, *Pagellus erythrinus*, *Solea solea*) from the review of Vrgoc *et al*. (2004). Two different set of growth parameters have been utilised for each species, the first one referred to the maximum $L_{inf.}$ value reported for the Adriatic the other to the minimum $L_{inf.}$ (Figure II.10.5 & II.10.6; and the annexed table).

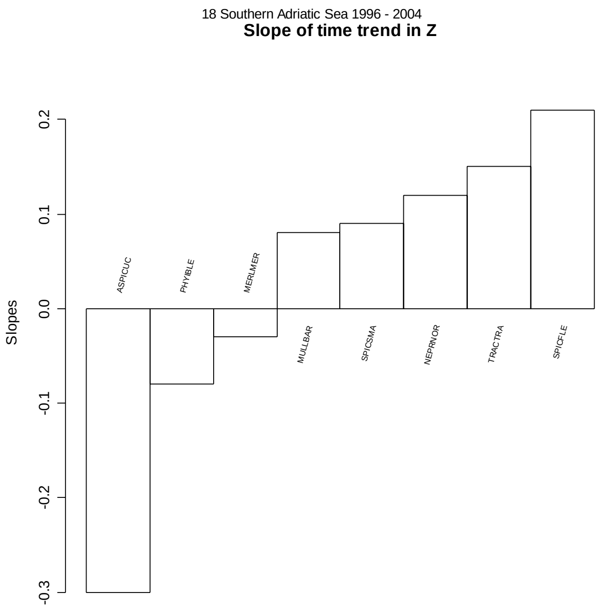


Figure II.10.5. New growth parameters: maximum $L_{inf.}$ value.

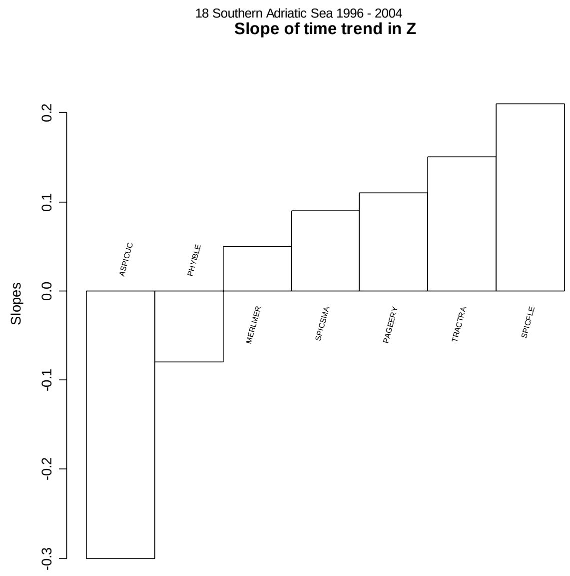


Figure II.10.6. New growth parameters: minimum $L_{inf.}$ Value.

The new results highlighted the strong influence of the growth parameters for the computation of the slope of time trend in Z. Looking at the two considered options, the trends are completely different for some species (*Merluccius merluccius*), while other species can appear or disappear in the summary figures (*Mullus barbatus*, *Nephrops norvegicus*).

Some problems can arise from the computation of "trend of $L_{50\%}$ values" also. The trend can be strongly influenced by the estimation of $L_{50\%}$ anomalous value (see the figures Figure II.10.7 & II.10.8). The anomalous value came in most of cases from unreliable resulting ogives (unbalanced data referred to the different length classes).

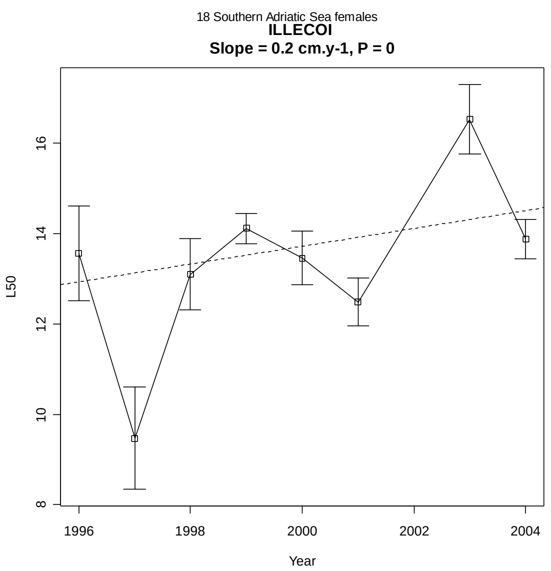


Figure II.10.7. Slope of time trend in L50 for *Illex coindetii*.

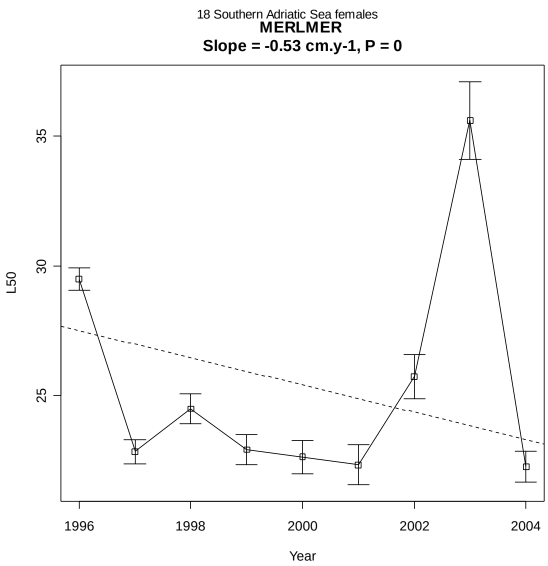
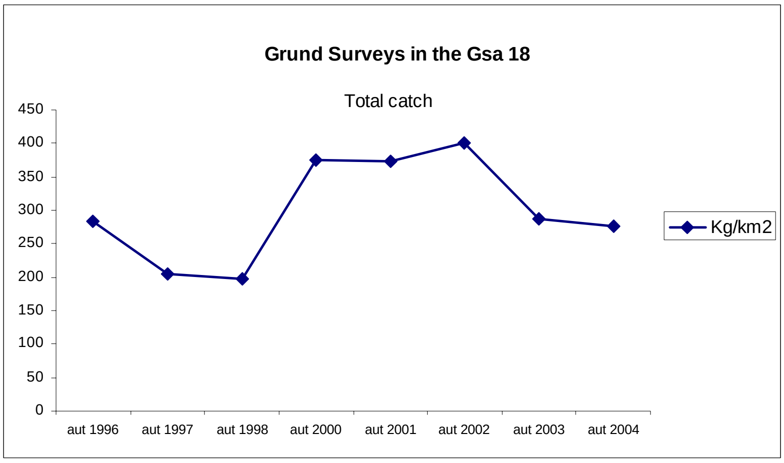


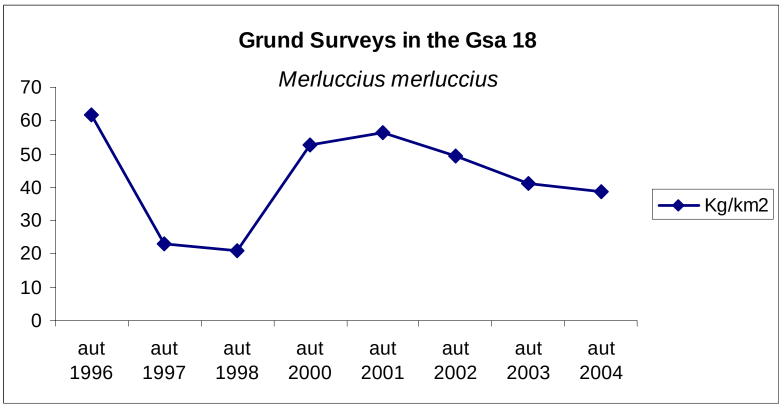
Figure II.10.8. Slope of time trend in L50 for *Merluccius merluccius*.

Looking at the above figures, removing of the *Illex coindetii* $L_{50\%}$ values estimated for the surveys 1997 and 2003 makes the trend not significant. The same occurs for the species *Merluccius merluccius* if the 1996 and 2003 values are removed.

II.10.7 Additional information - Comparison with national trawl surveys GRUND

Additional information mostly came from the Gru.N.D. Italian surveys, carried out in the same GSA 18 but in the western zones only. The Gru.N.D. results mostly confirm the Medits ones (Figure II.10.9), although a different trawl net was used as well as the surveys were performed in a different seasonal period (autumn).





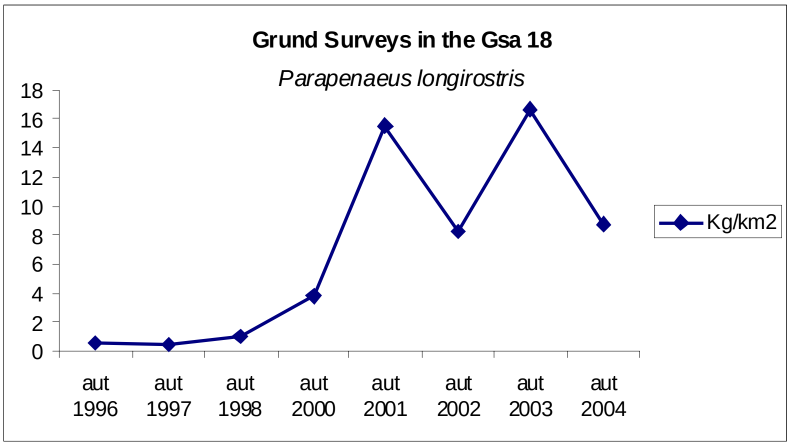


Figure II.10.9. Trends in biomass from the GRUND surveys.

Bottom temperature data have been recorded by means of MINILOG probe during the Medits surveys from 1998 up to 2004. The bottom temperature data have been analysed by means of G.I.S. techniques highlighting some variations in the investigated time period (Ungaro & Gramolini submitted).

II.10.8 Discussion

The results obtained for the community indicators seem to highlight a situation of relative stability in the short period (1996-2004) even if the average individual weight in community was decreasing. The decrease of this indicator isn't related to the presence and abundance of pelagic species because the trend is significant both including and excluding pelagics. The trend of the indicator "proportion of large individuals" wasn't significant, so the decrease of the average individual weight in community can be due to the significant increase of some small sized species (i.e. *Argentina sphyraena*) or the strong recruitment of other species.

Most of "population" indicators didn't provide any significant results for the most important fishery target species in the GSA n° 18. Some indicators such as the "Slope of time trend in Z" and the "Trend of $L_{50\%}$ values" can be strongly affected by the choice of the growth parameters and the quality and quantity of input data (see at the previous paragraphs). Moreover, an other population indicator such as the "biomass index" could be useful to a better description of species dynamics. In fact, the species abundance values used for the estimation of the Intrinsic population growth rate "r" can be strongly affected by the strength and intensity of the recruitment (Ungaro *et al.* in press) and give misleading information. The use of other estimators than the "mean" (i.e. median, percentiles) can provide additional information for most of the indicators used (Ungaro *et al.* in press) and help for the interpretation of the global results.

Nevertheless, some changes have been highlighted in the investigated period. They mostly refer to the general increase of the species characterised by short life span such as cephalopods and crustaceans (i.e. *Parapenaeus longirostris*) and the decrease of some gadiforms fish such as *Micromesistius poutassou* and *Trisopterus minutus*. The changes could be influenced by both the fishery pressure on large- sized and long-lived species (Jukic-Peladic *et al.* 2001) and the effects of the environmental conditions (i.e. increase of bottom temperature, Ungaro & Gramolini submitted). The synergy between the reported effects can produce the variation of inter-specific ratios (e.g. predator-prey relationships) also, affecting the consistency of the resources at the sea.

II.10.9 Appendix

Annex II.10.1. Von Bertalanffy parameters.

	t_0	K	Linf.	Source:
HELIDAC	-0.85	0.19	29.9	GSA 18 - Grund 2003
LEPMBOS	-0.19	0.19	37.14	GSA 18 - Grund 2003
MERLMER	-0.63	0.11	94.02	GSA 18 - Grund 2003
MERLMER*	0	0.23	62.2	Vrgoc et al. 2004
MERLMER*	-0.63	0.097	92.83	Vrgoc et al. 2004
MULLBAR	-1	0.48	20.05	GSA 18 - Grund 2003
MULLBAR*	-1.18	0.36	19.7	Vrgoc et al. 2004
MULLBAR*	-1.45	0.18	31.5	Vrgoc et al. 2004
NEPRNOR	0	0.22	57.3	GSA 18 - Grund 2003
NEPRNOR*	0	0.14	65	Vrgoc et al. 2004
NEPRNOR*	0	0.21	79.6	Vrgoc et al. 2004
PAPELON	0	0.4	29.6	GSA 18 - Grund 2003
ASPICUC	-0.656	0.283	34.85	Gulf of Lions - (Campillo 1992)
CITHMAC	-0.43	0.257	25.7	Aegean Sea - Stergiou et al 1997
EUTRGUR	1.99	0.219	26.4	Pagasitikos Gulf - Stergiou et al 1997 Fork Length
LOPHBUD	-0.921	0.13	66.75	Saronikos Gulf - Stergiou et al 1997
LOPHPIS	0.4295	0.3435	107.55	Aegean Sea - Stergiou et al 1997
MICMPOU	-1.29	0.22	40.35	Espagne - (Campillo 1992)
MULLSUR	0	0.48	29.29	Strait of Sicily - Anon. 2004
PAGEACA	-1.36	0.27	29.62	Alboran - Baro 2000 in Anon. 2004
PAGEBOG	-0.38	0.243	39.8	Atlantique - (Campillo 1992) for age 1 to 5
PAGEERY	-0.0394	0.2554	40.16	Gulf of Lions - (Campillo 1992)
PAGEERY*	-0.33	0.229	29.32	Vrgoc et al. 2004
PAGEERY*	0	0.2	60	Vrgoc et al. 2004
SPARPAG	2.83	0.118	45.1	Dodeckanisos - (Stergiou *et al.* 1997)
PHYIBLE	-0.414	0.233	46.6	Gulf of Lions - (Campillo 1992), average across sexes
RAJACLA	-0.6	0.17	96.3	Atlantique - (Campillo 1992), average across sexes
SCYOCAN	0	0.2	88	North Sea - (Froese & Pauly 2002) based p, Jennings et al 1999
SOLEVUL	-1.065	0.243	50.53	Gulf of Lions - Anon. 2004
SPICFLE	-1.9025	0.235	17.2	Patraikos Gulf - (Stergiou *et al.* 1997) Fork Length
SPICSMA	-1.626	0.404	18.9	Crete - (Stergiou *et al.* 1997)
TRACMED	-2.305	0.226	39.9	Saronikos Gulf - (Stergiou *et al.* 1997)
TRACTRA	-1.28	0.22	37.5	Adriatique - (Campillo 1992)
TRIPLAS	-0.639	0.254	38.2	? - (Campillo 1992)
TRISCAP	-1.867	0.179	32.3	Evvoikos Gulf - (Stergiou *et al.* 1997)
ZEUSFAB	0	0.298	57.9	Mauritania - (Froese & Pauly 2002)
ARISFOL	0	0.46	69.5	Strait of Sicily - Anon. 2004 CL (mm)
ARITANT	-0.28	0.38	65	Gulf of Vera - Garcia-Rodriguez 2002 in Anon. 2004
ELEDCIR	-0.0065	1.1238	12.49	Gulf of Lions - (Campillo 1992) average across sexes, transformed in annual growth

* Alternative values

Annex II.10.2. List of species names for population analyses.

ARGESPY
ARISFOL
ASPICUC*
BOOPBOO
CONGCON
ELEDCIR*
ELEDMOS*
ENGRENC
EUTRGUR*
GALUMEL
HELIDAC
ILLECOI
LEPICAU
LEPMBOS
LEPTCAV
LOLIVUL
LOPHBUD*
LOPHPIS*
MERLMER
MICMPOU
MULLBAR*
MULLSUR*
NEPRNOR
OCTOVUL
PAGEBOG*
PAGEERY*
PAPELON
PHYIBLE
SARDPIL
SCORNOT
SCYOCAN
SERACAB
SPICFLE*
SPICSMA*
SQUIMAN
TRACMED
TRACTRA
TRIGLUC
TRISCAP*
ZEUSFAB*

* species not considered for the “trend of $L_{50\%}$ values”

Annex II.10.3. L_{50} per species and year.

Species	Year	L50	SdL50	Species	Year	L50	SdL50
GALUMEL	1999	38.66182	0.428259	ARISFOL	1996	12.47493	0.321615
GALUMEL	2000	43.55451	0.775512	ARISFOL	1997	14.19437	0.397593
GALUMEL	2001	31.90731	1.296773	ARISFOL	1998	13.27427	0.39817
GALUMEL	2002	35.69012	0.749657	ARISFOL	1999	11.47979	0.156724
GALUMEL	2003	38.13951	0	ARISFOL	2000	13.65493	0.244343
GALUMEL	2004	40.8838	0.780999	ARISFOL	2001	9.65144	0.432986
HELIDAC	1996	20.10837	0.427224	ARISFOL	2002	9.816157	0.308447
HELIDAC	1997	19.45135	0	ARISFOL	2003	11.03263	0.150529
HELIDAC	1998	17.34084	0.888728	ARISFOL	2004	11.13419	0.227672
HELIDAC	1999	18.70905	0.517773	PAPELON	1996	13.26207	0.062707
HELIDAC	2000	20.42044	0.852845	PAPELON	1997	12.24703	0.121036
HELIDAC	2001	19.44084	0.749561	PAPELON	1998	13.40514	0.085608
HELIDAC	2002	26.19804	0.812211	PAPELON	1999	11.81908	0.150017
HELIDAC	2003	22.0133	0	PAPELON	2000	14.28934	0.154625
HELIDAC	2004	20.61144	0.788934	PAPELON	2001	11.97333	0
LEPMBOS	1996	20.00727	0.438398	PAPELON	2002	12.65633	0.103377
LEPMBOS	1997	20.96155	0	PAPELON	2003	10.2811	0.087482
LEPMBOS	1998	21.27244	0.779568	NEPRNOR	1996	8.423526	0.109134
LEPMBOS	1999	22.06412	0.819323	NEPRNOR	1997	8.69145	0.294851
LEPMBOS	2000	19.79883	1.117615	NEPRNOR	1998	7.68926	0.260961
LEPMBOS	2001	21.83409	1.303617	NEPRNOR	1999	7.053159	0.293193
LEPMBOS	2002	19.4478	1.0296	NEPRNOR	2000	8.141893	0.25654
LEPMBOS	2003	20.96155	0	NEPRNOR	2001	8.147264	0.233293
LEPMBOS	2004	22.30628	0.946364	NEPRNOR	2002	7.819349	0.340477
MERLMER	1996	29.48218	0.224743	NEPRNOR	2003	8.235537	0.350224
MERLMER	1997	22.83254	0.244503	NEPRNOR	2004	9.735024	0.254495
MERLMER	1998	24.48445	0.297859	ILLECOI	1996	13.56078	0.532471
MERLMER	1999	22.90575	0.291962	ILLECOI	1997	9.470166	0.578356
MERLMER	2000	22.62446	0.322907	ILLECOI	1998	13.0954	0.402287
MERLMER	2001	22.32486	0.396793	ILLECOI	1999	14.11569	0.169466
MERLMER	2002	25.73584	0.433027	ILLECOI	2000	13.45709	0.303959
MERLMER	2003	35.60582	0.766764	ILLECOI	2001	12.4842	0.270437
MERLMER	2004	22.25288	0.302755	ILLECOI	2002	14.11813	0
PHYIBLE	1996	29.37011	0.959249	ILLECOI	2003	16.53263	0.396092
PHYIBLE	1997	25.63266	1.250075	ILLECOI	2004	13.88572	0.222013
PHYIBLE	1998	32.23707	1.798445	LOLIVUL	1996	15.80224	2.04044
PHYIBLE	1999	31.10018	0.850491	LOLIVUL	1997	12.06432	1.629786
PHYIBLE	2000	27.77458	0.947787	LOLIVUL	1998	10.66527	1.213191
PHYIBLE	2001	22.64199	1.934455	LOLIVUL	1999	13.91231	0.75185
PHYIBLE	2002	30.47146	1.409019	LOLIVUL	2000	15.24597	0.729767
PHYIBLE	2003	31.10915	1.250385	LOLIVUL	2001	13.37027	0
PHYIBLE	2004	29.58025	1.20797	LOLIVUL	2002	12.34311	1.863847
SCYOCAN	1999	35.89373	0.601588	LOLIVUL	2003	16.734	1.847703
SCYOCAN	2000	38.45139	0.87249	LOLIVUL	2004	10.19495	1.46155

Annex II.10.4. Estimates of trends in parameters*.

	Population				Community				
	r	**Z**	**Lbar**	**Lmat**	**B**	**N**	$\bar{b}$	$\bar{l}$	**plarge**
GSA n° 18 **Southern Adriatic** **Years 1996-2004**	2/40 decrease	No trend	1/29 decrease	4/11 decrease	No trend	increase	decrease	No trend	No trend
	8/40 increase	No trend	1/29 increase	2/11 increase					
General comment		–	–		–			–	–
Relationship with fishing impact		–	–		–			–	–

* the significant trends have been considered only.

<u>Colours</u>: green= positive significant trend; red= negative significant trend; white = not significant trend; grey = significant change in opposite direction to fishing impact; yellow = significant change in the same direction of fishing impact.

<u>Legend</u>:

Level	Indicator	Description
	r	Population growth rate for species i
Population	Z	Average total mortality rate for species i
	Lbar	Average length of population i
	Lmat	Length at maturity (50% mature)
	B	Total biomass in community
	N	Total abundance in community
Community	$\bar{b}$	Average individual weight in community
	$\bar{l}$	Average individual length in community
	plarge	Proportion of large individuals in total community abundance

II.11 Western Ionian Sea (area 19)

Coordinator: Angelo Tursi

II.11.1 Ecological setting, geographical and environmental features

The study area in the Western Ionian Sea (eastern-central Mediterranean Sea) is along the Apulian and Calabrian coasts, between Cape of Otranto (LE, Apulia) and Cape Passero (SR, Sicily), in the eastern coast of Sicily (southern Italy). Some gulfs open out in this area, such as the Gulfs of Taranto, Corigliano and Squillace.

The Apulian sector, in the Gulf of Taranto, is characterized by a very limited platform with the shelf break located at a depth varying between 30 and 100 m. Various canyons and channels transport the material from the shelf break to an epibathyal depth (Rossi & Gabbianelli 1978). The southern part of the Ionian Sea, along the Calabrian coast, shows a more restricted platform with a lot of canyons, such as offshore from Roccella Jonica (RC).

Concerning hydrology, three main water masses are present in the Ionian Sea, as the Modified Atlantic Water (MAW), the Levantine Intermediate Water (LIW) and the Eastern Mediterranean Deep Water (EMDW). The Ionian Sea receives MAW from the Western Mediterranean through the Sicilian Channel, with salinity increasing from 37.5 in the Sicilian Channel to 38.6 ‰ near the Cretan Passage (Theocharis *et al.* 1993). The temperature of this mass reaches its lowest value, 13.5-14° C, in the Northern Ionian Sea. LIW is easily traced in the Ionian Sea by the subsurface salinity maximum. Its depth increases from 20 m to the South, to 350 m to the North. Its salinity decreases as it flows towards the Ionian Sea. As a result, the salinity in the Southern Ionian Sea is 38.97‰ whereas in the Northern part is 37.78‰. Finally, the Ionian Sea is also influenced by waters coming from the Aegean Sea. Recent studies showed an important and continuous flow of water masses from the Cretan Sea towards the Ionian Sea. These masses are warm, saline, and dense and reach in oxygen.

Neither temperature nor salinity differed significantly beyond a depth of 190-200 m in the North-Western Ionian Sea. Temperature only changed according to the seasons from the surface to 200 m; beyond this depth there are homeothermic conditions in the water column around 13.5 - 13.8° C. In the uppermost layers the temperature can change from 12.8° C in winter to 27.5° C in summer (D'Onghia *et al.* 1996b).

Salinity also shows significant variability in the first 100 m of depth up to 38.8 ‰, but below this depth values are steady at around 38.5 ‰ (Magazzù & Cavallaro 1972; Rabitti *et al.* 1994).

Concerning productivity, the oligotrophic conditions of the Ionian basin within the Italian waters are confirmed both by some primary production data reported by (Magazzù & Decembrini 1992) and by observations made during the POEM project (Artegiani *et al.* 1990; Bregant *et al.* 1992b; Rabitti *et al.* 1994). Recently, values of primary productivity ranging from 19.2 to 55.44 mgC/m^3/day have been detected along the Apulia coast (Basset *et al.* 2000).

The type of bottom in the Western Ionian Sea is rather variable. Along the coast the bottoms are sandy, rocky, with coarse sand, coarse detritics, sandy-mud and muddy. Proceeding off-shore they are gradually replaced by bottoms characterized by hard mud and then by soft slime with shells of heteropods and pteropods (Vatova 1974). At depths greater than 200 m the biocoenosis of the bathyal mud (VP *sensu* Pérès & Picard, 1964) are widespread in the whole Gulf of Taranto.

In the context of the biocoenosis of the bathyal mud, the most widespread *facies* in the North-West Ionian Sea are: a) that of the viscous mud with a very fluid superficial layer characterized by the big sea pen *Funiculina quadrangularis* and the crustaceans *Parapenaeus longirostris* and *Nephrops norvegicus*; b) that of firm and compact muds where the greatest abundance of the crustaceans *Aristeus antennatus, Aristaeomorpha foliacea, Plesionika edwardsi, Plesionika martia, Munida intermedia* together with the cephalopods *Sepietta oweniana, Neorossia caroli, Pteroctopus tetracirrhus* is commonly found. A broad biocoenosis of white-corals has been identified off-shore Cape S. Maria di Leuca at depths between 450 and 1100 m during July 2000. The branched species *Madrepora oculata* and *Lophelia pertusa* with the solitary species *Desmophyllum cristagalli* were found to be associated in dense calcareous clumps, showing white and living branches at the top and dead darkened corals at the base (Mastrototaro *et al.* 2002).

II.11.2 Fisheries description and initial state assessment

In the Ionian Sea, from Cape Otranto (LE) to Cape Spartivento (RC), there are seven principal harbours and some lesser landing sites along about 800 km of coast. The principal harbours are:

Gallipoli, Taranto, Trebisacce, Schiavonea, Cariati, Crotone, Catanzaro. Some information about trawlers was collected for the various marine districts of the Ionian Sea during the EC research programs "Mapping of Italian Demersal Resources" and only for the Gallipoli fishery during the projects "Mediterranean Landings pilot project" (AA.VV. 2000b) and "Analysis of the Mediterranean (including North Africa) deep sea shrimps fishery: catches efforts and economics" (AA.VV. 2000a). The mean annual catch due to the three main Italian fisheries of the North-West Ionian Sea (Crotone, Gallipoli and Taranto) is about 3% of the whole Italian production (in the period 1985-90 it was around 5000 t according to ISTAT data). In the Italian side of the Ionian Sea fishing occurs from coastal waters to 700-750 m. Fish, crustaceans and cephalopods make up about 70%, 20% and 10% of the mean catch, respectively. Commercial fish and cephalopods are mostly caught on the continental shelf while crustaceans with high market value are mainly fished on the slope (between 200 and 400 m mostly *Parapenaeus longirostris*; between 400 and 700 m *Aristeus antennatus* and *Aristaeomorpha foliacea*).

The largest fisheries are in Crotone and Gallipoli, which present the highest total tonnage and engine power. The first is represented by trawlers of different gross tonnage operating with fishing trips of different duration. In the Crotone district, fishing occurs 24 hours a day. Many large trawlers (over 50 tons gross tonnage), coming from Molfetta (Bari) and Messina (Sicily), operate in this area and have Roccella Ionica as a base port (Tursi *et al.* 2000).

The Gallipoli fishery is made up of small gross tonnage vessels (<10 GRT). Although different fishing gears, such as trawl nets, gillnets and longlines, are used, trawling is the main method employed in the fishery. The actual number of trawlers (73) is greater than that reported in the official statistics (as for the production) and appears to have stabilized in recent years. The fishery is characterized by vessels mostly smaller than 10 tons of gross tonnage (total of 874.5 GRT) and with engine power between 100 and 220 kW (total of 9056.6 kW). The trawlers are provided of trawl net Italian type, with 40 mm stretched mesh size in codend (legal mesh size).

Fishing occurs from Monday to Friday only during day-light hours. Trawlers work generally by daily trips. The commercial haul may have a varying duration, from 1 to about 4 hours and they regard different depths (e.g. from 300 to 600 m). Fishing is not allowed during night and weekend.

The most important resources in the area are represented by hake, deep water rose shrimps, Norway lobster and particularly by deep-sea shrimps (Tursi *et al.* 1993, 1994; D'Onghia *et al.* 1998; D'Onghia *et al.* 2005).

Some other important commercial species in the area are the red and striped mullet (*Mullus barbatus* and *Mullus surmuletus*), angler (*Lophius piscatorius* and *Lophius budegassa*), rockfish (*Helicolenus dactylopterus*), mackerel (*Trachurus trachurus*), blue whiting (*Micromesistius potassou*), greater forkbeard (*Phycis blennoides*) and the shrimps *Plesionika heterocarpus* and *Plesionika martia*. The cephalopods provide a small contribution to total commercial catches; the horned octopus (*Eledone cirrhosa*) and the squids, such as *Illex coindetii* and *Todaropsis eblanae*, are the main cephalopod species caught by trawl net (Tursi *et al.* 1993, 1994). Other species only marketable for big sizes, such as blackmouth dogfish (*Galeus melastomus*), and non-marketable species, such as silver roughy (*Hoplostethus mediterraneus*) and macrourids fish (*Hymenocephalus italicus*, *Nezumia sclerorhynchus*, *Coelorhynchus coelorhynchus*) are very abundant in discards obtained from the deepest fishing grounds investigated (Tursi *et al.* 2000).

The catches from trawling often contain juveniles, confirming that the Ionian Sea is a nursery area for many species. Since 1988 a 45 days "closed season" for trawling has been carried out in late summer-early autumn, as a management measure imposed by Italian government.

II.11.3 Brief description of changes in survey design

The Medits surveys have been carried out in the Western Ionian basin (GSA 19) from 1994 since 2004. In the context of the spring-summer season, the surveys were generally performed in May and June, apart from the 1999 when the survey was shifted in July, such as in all the Italian areas.

The first three surveys (from 1994 to 1997) were carried out using the fishing vessel "Biancamaria" (GT 112.98; Hp 408), while the trawler "Pasquale e Cristina" (GT 158.77; Hp 923) was chartered in the next years (from 1998 to 2004).

The experimental sampling plan was random stratified. A total of 74 hauls were performed in the whole study area of the GSA 19 (16347 km^2), from 1994 to 2001; later, as requested by the revised protocol, the total number was reduced to 70 hauls from 2002 and in the next years (2003-2004).

II.11.4 Selection of species

A total number of 58 species, corresponding to the long list of Medits reference species, has been considered both for the community analyses and population growth rate (r). The other population parameters were computed for the species of the Medits Reference List (short list) which occurred in more than 10% of the hauls (Table I).

Moreover, considering that the survey period don't allow the sampling of the full length range as well as all the maturity stages, the population indicators “L_{50}” (length at maturity) and “trend of L_{50} values” weren’t considered for all the species presented in Table I; thus, *Aspitrigla cuculus*, *Lepidorhombus boscii*, *Lophius budegassa*, *Micromesistius poutassou*, *Mullus barbatus*, *Mullus surmuletus*, *Pagellus acarne*, *Pagellus erythrinus*, *Spicara maena*, *Spicara smaris*, *Trachurus mediterraneus*, *Trachurus trachurus*, *Aristaeomorpha foliacea*, *Eledone cirrhosa* were not included in this analysis.

II.11.5 Results

The performed analysis gave the following results.

II.11.5.1 Population indicators

The estimated intrinsic population growth rates (r) were significantly different from zero for 10 of the 44 species analysed in the 1994-2004 period (Figure II.11.1). The time trends detected were increasing for nine species (*Aristaeomorpha foliacea*, *Sepia orbignyana*, *Eledone cirrhosa*, *Spicara smaris*, *Helicolenus dactylopterus*, *Trigla lucerna*, *Aspitrigla cuculus*, *Pagellus acarne* and *Loligo vulgaris*) and decreasing for *Lepidopus caudatus* only. The highest significant value for r was found for *Loligo vulgaris* (1.55 y^{-1}), while the lowest one was estimated for *Lepidopus caudatus* (-0.29 y^{-1}). During the last five years the values of r were found significantly different from zero for eight species (two negative and six positive values).

During the whole study period, only *Helicolenus dactylopterus* showed a significant time trend in mean length, with a decreasing slope equal to -0.49±0.18 (Figure II.11.2).

Starting from the species reported in Table II, the total mortality rates by age class were computed for 11 species only, selected by the program procedures; then, the computation of average Z values was only possible for nine species. A significant positive time trend on the period 1994-2004 (Pvalue Z=0.05; slope Z=0.25) was detected for *Pagellus erythrinus* only (Figure II.11.3).

The results obtained from the analysis of time series of length at which 50% of females are mature (L_{50}) are shown in Figure II.11.4. Among the 8 selected species (Table I), the estimation of the time trend was performed on six of them; three species showed a decreasing trend in L_{50} (*Galeus melastomus*, *Illex coindetii* and *Nephrops norvegicus*) and one an increasing trend in time (*Parapenaeus longirostris*).

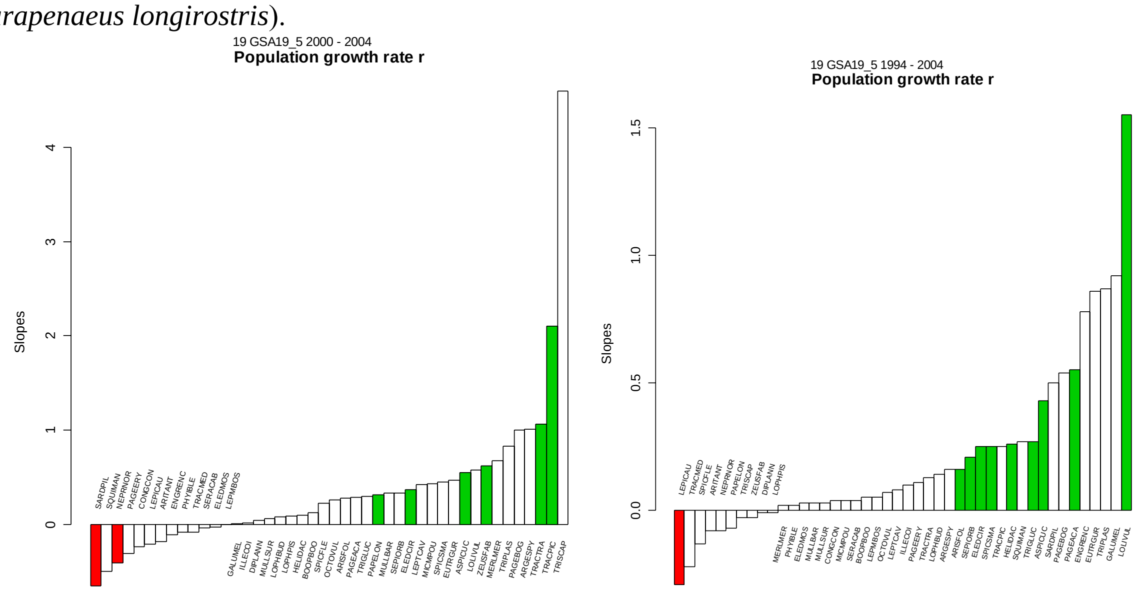


Figure II.11.1. Histogram of the population growth rates estimated for GSA 19 in the period 1994-2004 (on the left) and for the last five years (on the right).

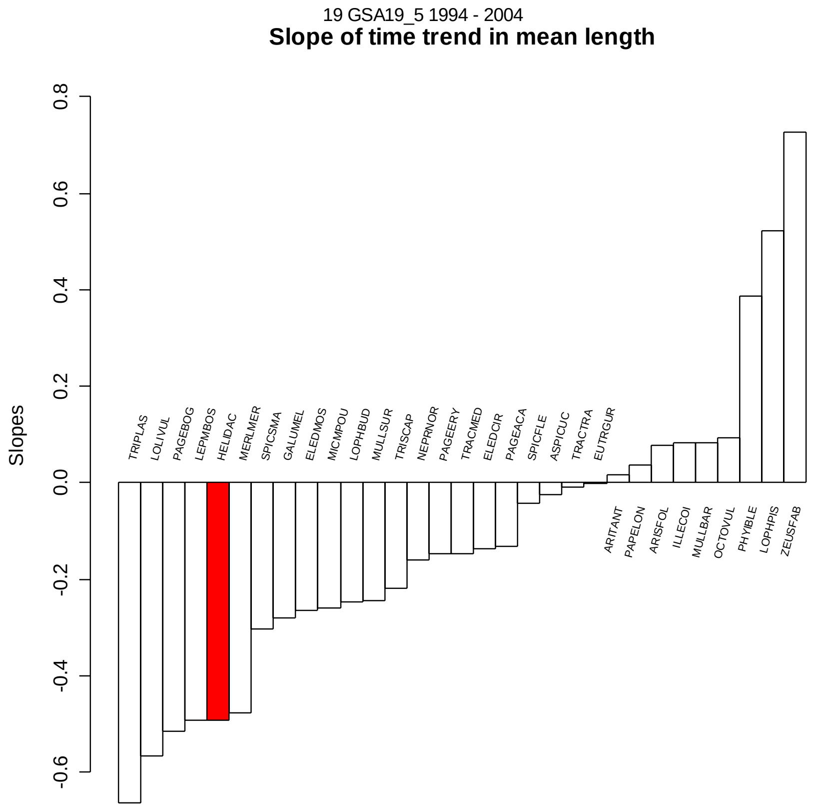


Figure II.11.2. Histogram of the slopes of time trend in mean length for GSA 19 in the period 1994-2004.

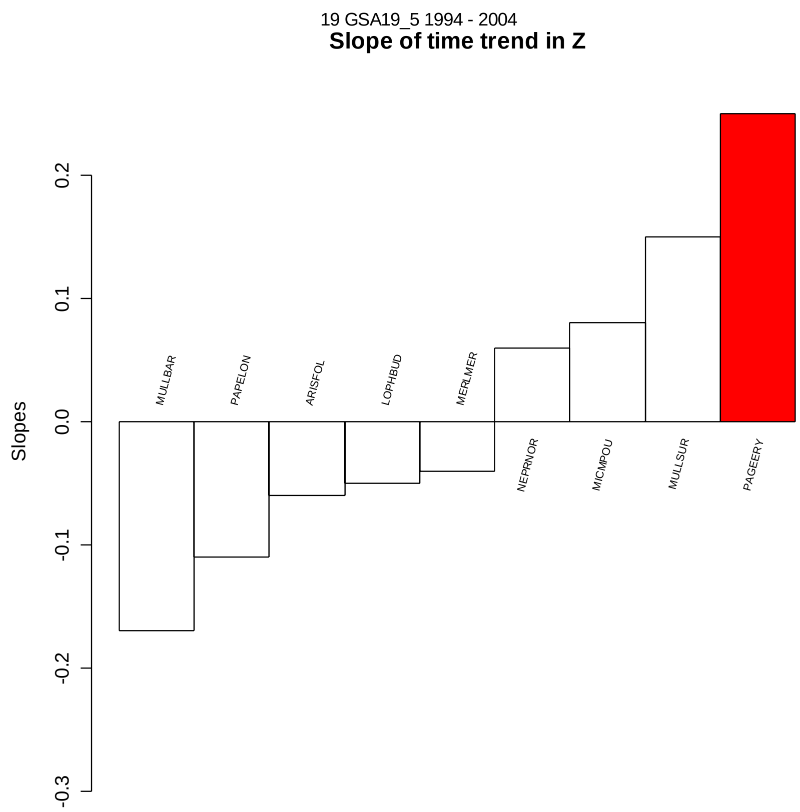


Figure II.11.3. Slopes of time trend in average Z values estimated for GSA 19 in the period 1994-2004.

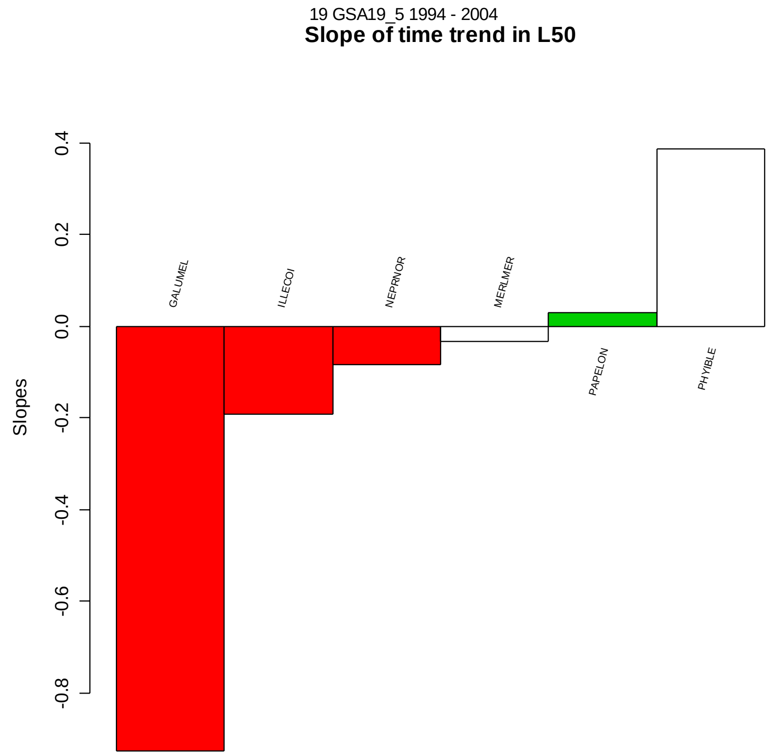


Figure II.11.4. Slopes of time trend in length at 50% maturity (L_{50}) estimated for GSA 19 in the period 1994-2004.

II.11.5.2 Community indicators

Oscillation of total biomass and total abundance in community were observed during the 1994-2004 period, although no significant trend was detected during the investigated period (Figure II.11.5). Average individual weight in community didn't show any significant trend with time; nevertheless the observed values were more similar throughout the analysed time span (Figure II.11.6). In both cases a high variability around the mean estimated values was detected in each year. Any significant trend was found also during the last five years for the computed community indicators.

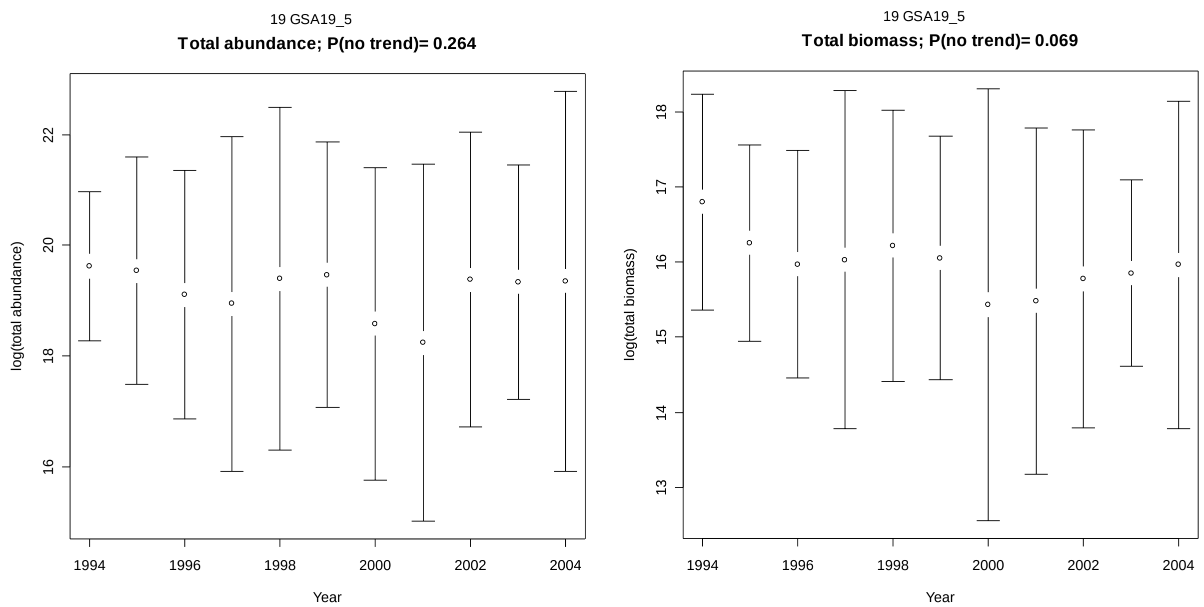


Figure II.11.5. Annual estimates of log-transformed total biomass (on the left) and total abundance (on the right) with relative 95% confidence intervals in the period 1994-2004 for GSA 19.

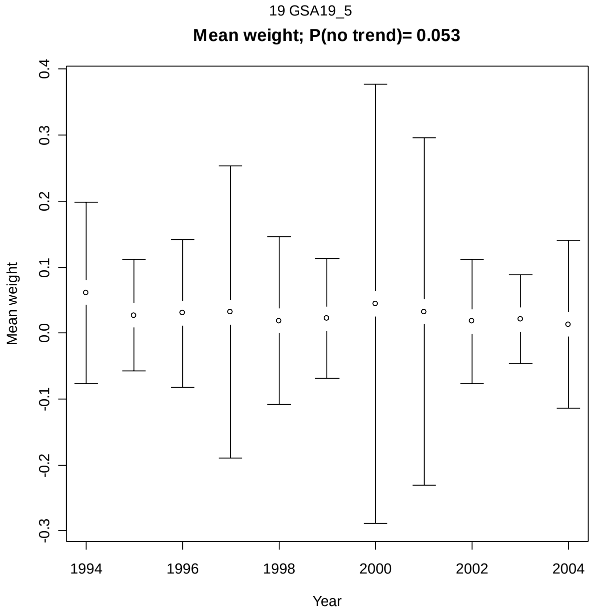


Figure II.11.6. Average annual individual weight in community estimated in the period 1994-2004 for GSA 19.

The proportion of large individuals (>27 cm) in community, estimated in the overall study period, showed a remarkable increase starting from 1999, although no significant trend was detected (Figure II.11.7). It is important to underline that, starting from the same year, a change in the experimental procedures was introduced; in particular, the length of *Galeus melastomus* as target species was also recorded. Thus, the increment of proportion of large fish recorded in the slope could be due to the addition of this species, considering its large size and deep bathymetric distribution.

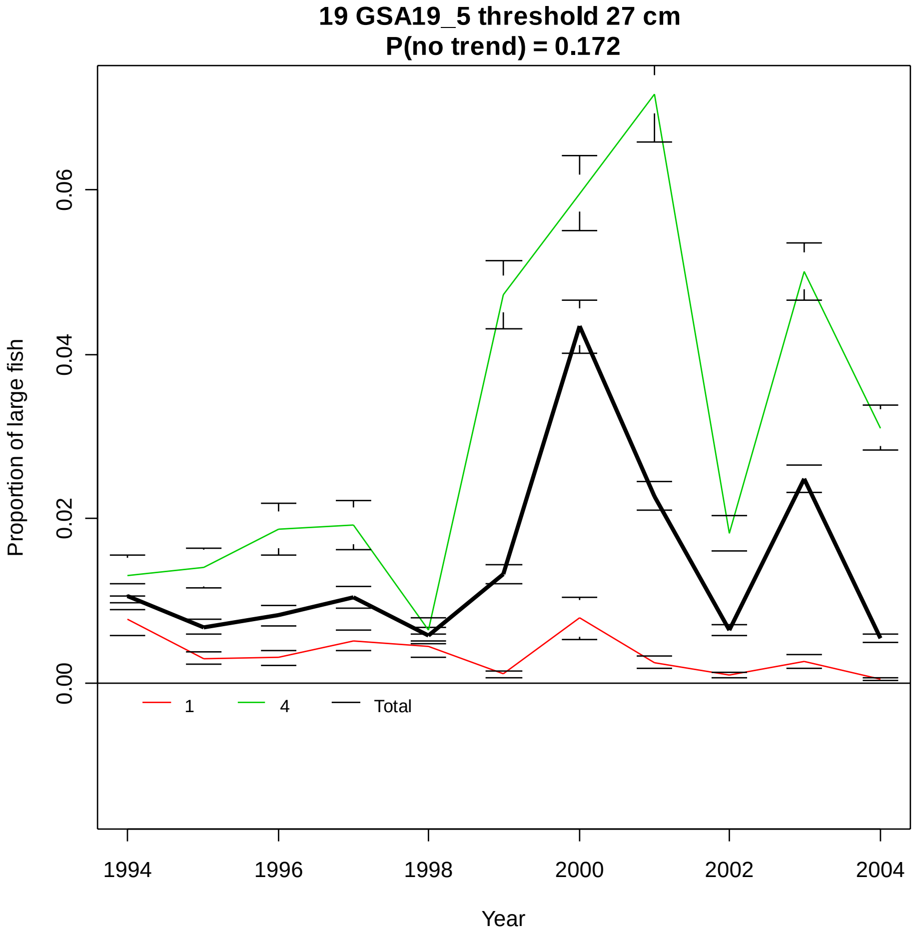


Figure II.11.7. Proportion of large individuals in community using a fixed threshold value of 27 cm estimated in the period 1994-2004 for GSA 19.

II.11.6 Sensitivity analyses for Z

To test the sensitivity of the estimation of Z with regard to the choise of the input VBGF parameters, a new set of growth parameters was adopted for a new estimation procedure of average Z values. In particular, alternative values were used for the following species: *Aristaeomorpha foliacea*, *Aristeus antennatus*, *Helicolenus dactylopterus*, *Lepidorhombus boscii*, *Lophius budegassa*, *Merluccius merluccius*, *Nephrops norvegicus*, *Parapenaeus longirostris*, *Phycis blennoides* and *Trachurus trachurus*. Where possible, alternative parameters estimated in the same area were adopted; otherwise, available values in other areas were used.

According to the results, the computation of average Z values was carried out for a different set of species (Figure II.11.8). Moreover, different values of the slope of time trend in Z were detected for the common species in the two analysis. The new analysis showed significant increasing trends for average Z both for *Pagellus erythrinus* and *Aristaeomorpha foliacea* in the whole study period.

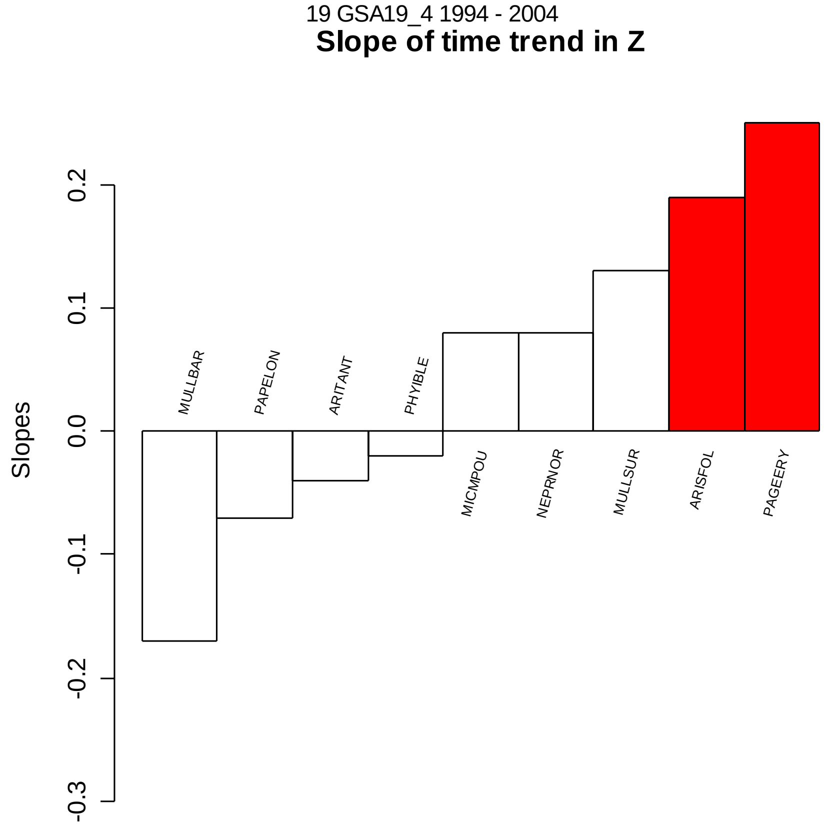


Figure II.11.8 – Slopes of time trend in average Z values estimated for GSA 19 in the period 1994-2004 using the alternative growth parameters.

II.11.7 Additional information: Comparison with GRU.N.D. national project

The log-abundance trend obtained in this analysis have been compared with abundance data coming from the GRU.N.D. trawl surveys, carried out in the autumn season of the same period. *A. foliacea* and *A. antennatus* were considered for comparison purposes, since they are the most important commercial species for the Ionian fishery (Figure II.11.9 and Figure II.11.10).

An increase in the abundance of *A. foliacea* was observed in both considered seasons, although a significant increasing trend was detected only during the MEDITS surveys. On the other hand, a decrease in the abundance of *A. antennatus* was registered in both seasons, without any significant trend.

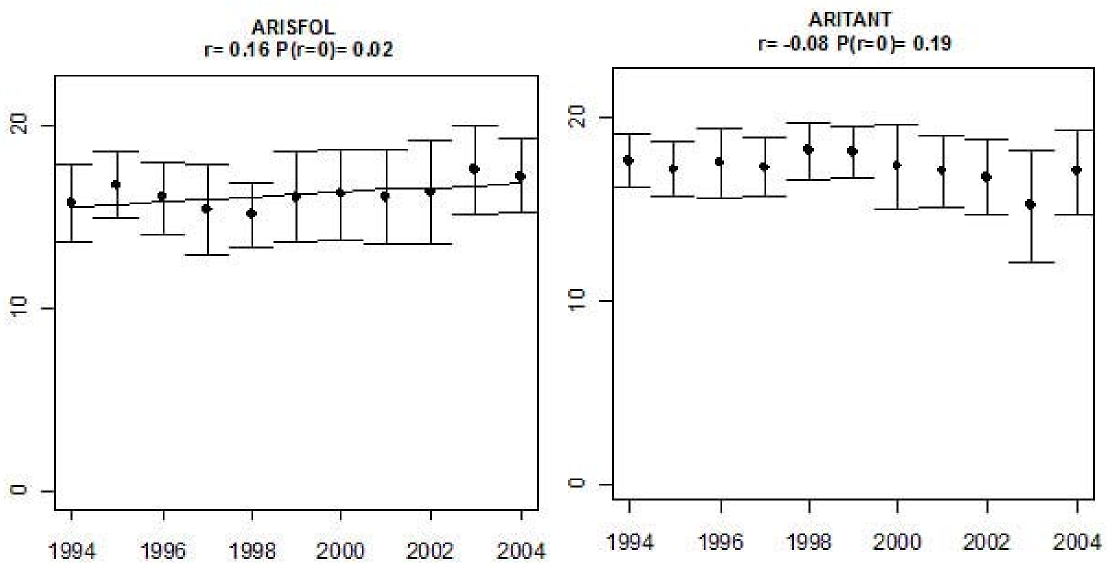


Figure II.11.9. Log-abundance trend of A. foliacea and A. antennatus computed for GSA 19 in the period 1994-2004 during the MEDITS project.

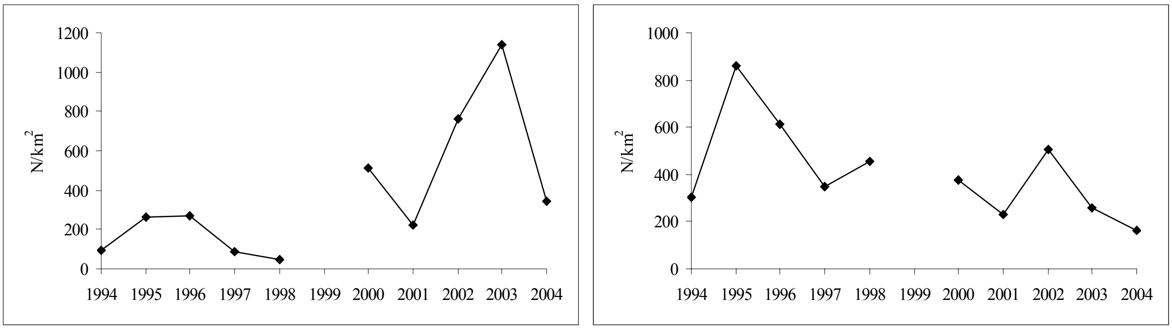


Figure II.11.10 – Abundance trend of A. foliacea and A. antennatus computed for GSA 19 in the period 1994-2004 during the GRU.N.D. project.

II.11.8 Discussion

The results presented in this report seem to show a relative stability of the community in the Western Ionian Sea (GSA 19) during the investigated period from 1994 to 2004.

Considering the population indicators, the intrinsic growth rates (r) depicted a negative trend for one species only, *Lepidopus caudatus,* for which the pelagic *habitus* makes less remarkable the result. A positive trend was observed for a lot of commercial species, such as the red shrimp *Aristaeomorpha foliacea*, the rockfish *Helicolenus dactylopterus* and the cephalopods *Sepia orbignyana*, *Eledone cirrhosa* and *Loligo vulgaris*. Moreover, a significant decreasing trend in mean length was detected only for *Helicolenus dactylopterus* in the overall investigated period, while the most important commercial species didn't highlight any trend. Anyway, the use of an alternative indicator, such as the median length, could improve the analysis of the size distribution, considering the effect of the extreme value.

In addition, the analysis on total mortality rates didn't stress any particular exploited condition for the considered stocks, a part from *Pagellus erythrinus*, for which a positive time trend of Z was observed on the period 1994-2004. However, the "Slope of time trend in Z" indicator can be strongly affected by the choice of the growth parameters and by the available data for only one season.

As regards to the "Trend of $L_{50\%}$ values", the results showed a decreasing trend in time for *Galeus melastomus*, *Illex coindetii* and *Nephrops norvegicus* and an increasing one for *Parapenaeus longirostris*. Anyway, even if the use of the $L_{50\%}$ values could be a good indicator for the exploitation condition of the resources, it's important to perform the analysis with different dataset, where more seasons could be available. In this way the MEDITS surveys, only performed during the spring-summer season, represent only one aspect of the problem.

Considering the total biomass and abundance, the fluctuations observed during the analysed period 1994-2004 confirmed the general trend previous recorded for the national trawl surveys GRU.N.D. They also reflect the high variations in the recruitment for most of the target species, which is a peculiarity of the aquatic organisms. Moreover, the size and intensity of recruitment also affected the computation of the intrinsic population growth rate "r" and could give misleading information.

Generally, some evident fluctuations in the abundance of target species are common to the GRU.N.D surveys, although they were different computed. In particular, for the most commercial target species of the Western Ionian Sea, the red shrimps *A. foliacea* and *A. antennatus*, the inverse trend observed in the 1994-2004 period was recorded by the analysis of both MEDITS and GRU.N.D data. The trend showed a general increase of *A. foliacea* and a decrease of *A. antennatus* in the last years, probably affected by the increasing temperature of the water, related to the transient. This trend seems to be stopped in the last year, according to the last recorded data.

II.11.9 Appendix

Annex II.11.1. List of the species for population analyses.

MEDITS Code	Name
ASPICUC *	*Aspitrigla cuculus* (Linnaeus, 1758)
GALUMEL	*Galeus melastomus* Rafinesque, 1810
HELIDAC	*Helicolenus dactylopterus dactylopterus* (Delaroche, 1809)
LEPMBOS *	*Lepidorhombus boscii* (Risso, 1810)
LOPHBUD *	*Lophius budegassa* Spinola, 1807
MERLMER	*Merluccius merluccius* (Linnaeus, 1758)
MICMPOU *	*Micromesistius poutassou* (Risso, 1827)
MULLBAR *	*Mullus barbatus* Linnaeus, 1758
MULLSUR *	*Mullus surmuletus* Linnaeus, 1758
PAGEACA *	*Pagellus acarne* (Risso, 1827)
PAGEERY *	*Pagellus erythrinus* (Linnaeus, 1758)
PHYIBLE	*Phycis blennoides* (Brünnich, 1768)
SPICFLE *	*Spicara maena* (Linnaeus, 1758)
SPICSMA *	*Spicara smaris* (Linnaeus, 1758)
TRACMED *	*Trachurus mediterraneus* (Steindachner, 1868)
TRACTRA *	*Trachurus trachurus* (Linnaeus, 1758)
ARISFOL *	*Aristaeomorpha foliacea* (Risso, 1827)
ARITANT	*Aristeus antennatus* (Risso, 1816)
NEPRNOR	*Nephrops norvegicus* (Linnaeus, 1758)
PAPELON	*Parapenaeus longirostris* (Lucas, 1846)
ELEDCIR *	*Eledone cirrhosa* (Lamarck, 1798)
ILLECOI	*Illex coindetii*

* species not considered for the “trend of $L_{50\%}$ values”

Annex II.11.2. Von Bertalanffy parameters.

Species Code	t0	k	Linf	minage	source
ASPICUC	-0.656	0.283	34.85	0	Gulf of Lions - (Campillo 1992)
HELIDAC	-0.933	0.156	30.72	0	Western Ionian Sea - D'Onghia et al. 1996
HELIDAC*	-1.413	0.195	29.99	0	Western Ionian Sea - D'Onghia et al.1992
LEPMBOS	-0.99	0.113	48.46	0	Western Ionian Sea - Carlucci et al.2002
LEPMBOS*	-0.19	0.19	37.14	0	GSA18 – GRUND 2003
LOPHBUD	-0.88	0.118	73.7	0	Saronikos Gulf – Tsimenides 1980 PhD thesis
LOPHBUD*	-0.921	0.13	66.75	0	Saronikos Gulf – Stergiou et al.1997
MERLMER	-1.03	0.11	78.22	0	Western Ionian Sea - Anon 2003
MERLMER*	-0.726	0.14	69.56	0	Western Ionian Sea - D'Onghia et al.1995
MICMPOU	-1.32	0.22	44.27	0	Western Ionian Sea – Anon 1996
MULLBAR	-0.25	0.5	27.49	0	Adriatic Sea – Scaccini in Levi et al.1992
MULLSUR	0	0.48	29.29	0	Strait of Sicily - Anon. 2004
PAGEACA	-1.36	0.27	29.62	0	Alboran - Baro 2000 in Anon. 2004
PAGEERY	-0.039	0.255	40.16	0	Gulf of Lions - (Campillo 1992)
PHYIBLE	-0.77	0.13	70.3	0	Western Ionian Sea - Anon 2003
PHYIBLE*	-0.414	0.233	46.6	0	Gulf of Lions - (Campillo 1992), average across
SPICFLE	-1.903	0.235	17.2	0	Patraikos Gulf - Stergiou et al. 1997 Fork Length
SPICSMA	-1.626	0.404	18.9	0	Crete - Stergiou et al. 1997
TRACMED	-2.305	0.226	39.9	0	Saronikos Gulf - Stergiou et al. 1997
TRACTRA	-0.912	0.169	47.27	0	Western Ionian Sea - Matarrese et al. 1998
TRACTRA*	-1.28	0.22	37.5	0	Adriatique - (Campillo 1992)
ARISFOL	-0.18	0.45	69.78	0	Western Ionian Sea - D'Onghia et al. 1998 CL
ARISFOL*	0	0.46	69.5	0	Strait of Sicily - Anon. 2004 CL (mm)
ARITANT	-0.23	0.22	79.9	0	Western Ionian Sea - Capezzuto et al. 2004 CL
ARITANT*	-0.36	0.35	77.18	0	Western Ionian Sea - Matarrese et al. 1997
NEPRNOR	-0.31	0.16	84	8	Western Ionian Sea - Anon 2003 CL (mm)
NEPRNOR*	-0.64	0.2	79.8	0	Western Ionian Sea - Anon 1999 CL (mm)
PAPELON	-0.19	0.74	47.7	0	Western Ionian Sea - D'Onghia et al. 1998 CL
PAPELON*	-0.13	0.74	44.4	0	Thyrrenian Sea – Ardizzone 1990
ELEDCIR	-0.079	0.094	12.49	0	Gulf of Lions - (Campillo 1992) average across sexes, transformed to annual growth curve

* Alternative values

Annex II.11.3. Estimates of L50 per species and year.

Species	Year	L50	SdL50
Galeus melastomus	1999	41.045	0.424
	2000	47.789	0.625
	2001	47.172	0.620
	2002	36.473	1.063
	2003	38.866	0.615
	2004	38.918	0.626
Merluccius merluccius	1994	27.392	0.479
	1995	33.140	0.000
	1996	35.527	0.977
	1997	40.870	1.291
	1998	33.140	0.000
	1999	41.242	1.635
	2000	33.140	0.000
	2001	32.809	1.058
	2002	30.344	0.938
	2003	28.008	0.734
	2004	28.932	0.726
Phycis blennoides	1994	35.934	2.881
	1995	39.545	0.000
	1996	39.545	0.000
	1997	39.545	0.000
	1998	39.545	0.000
	1999	39.545	0.000
	2000	39.545	0.000
	2001	39.545	0.000
	2002	43.051	2.589
	2003	39.195	1.876
	2004	39.999	1.875
Illex coidetii	1994	14.378	1.208
	1995	16.104	0.535
	1996	15.715	0.517
	1997	16.480	0.531
	1998	16.275	0.446
	1999	17.128	0.317
	2000	16.987	0.457
	2001	13.541	0.676
	2002	12.885	0.607
	2003	15.038	0.819
	2004	14.578	0.655
Nephrops norvegicus	1994	9.342	0.205
	1995	10.110	0.270
	1996	8.449	0.312
	1997	8.198	0.266
	1998	8.556	0.182
	1999	8.550	0.223
	2000	8.795	0.120
	2001	7.999	0.270
	2002	8.202	0.269
	2003	8.967	0.262
	2004	8.840	0.446
Parapenaeus longirostris	1995	11.838	0.076
	1996	12.398	0.000
	1997	13.332	0.086
	1998	12.474	0.073
	1999	12.484	0.000
	2000	12.513	0.000
	2001	12.541	0.000
	2002	12.241	0.101
	2003	12.626	0.081

Annex II.11.4. Estimates of trends in parameters.

Species	r	SDr	Pvalue_r	slopeLbar	SDLbar	PvalueLbar	SlopeZ	SDZ	PvalueZ	PvaluerobZ	trendLm
ARGESPY	0.16	0.16	0.357	NA	NA	NA	NA	NA	NA	NA	NA
ARISFOL	0.16	0.06	0.021	0.077	0.06	0.23	-0.06	0.08	0.47	0.011	NA
ARITANT	-0.08	0.05	0.186	0.016	0.032	0.626	NA	NA	NA	NA	NA
ASPICUC	0.43	0.09	0.001	-0.026	0.389	0.95	NA	NA	NA	NA	NA
BOOPBOO	0.05	0.13	0.697	NA	NA	NA	NA	NA	NA	NA	NA
CONGCON	0.04	0.06	0.510	NA	NA	NA	NA	NA	NA	NA	NA
DIPLANN	-0.01	0.08	0.944	NA	NA	NA	NA	NA	NA	NA	NA
ELEDCIR	0.25	0.06	0.002	-0.138	0.2	0.507	NA	NA	NA	NA	NA
ELEDMOS	0.03	0.04	0.527	-0.264	0.293	0.407	NA	NA	NA	NA	NA
ENGRENC	0.78	0.63	0.252	NA	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	0.86	0.45	0.088	-0.001	0.224	0.995	NA	NA	NA	NA	NA
GALUMEL	0.92	0.56	0.137	-0.28	0.52	0.619	NA	NA	NA	NA	-0.925
HELIDAC	0.26	0.05	0.000	-0.492	0.182	0.027	NA	NA	NA	NA	NA
ILLECOI	0.1	0.05	0.090	0.081	0.176	0.655	NA	NA	NA	NA	-0.192
LEPICAU	-0.29	0.11	0.021	NA	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	0.05	0.09	0.558	-0.492	0.264	0.096	NA	NA	NA	NA	NA
LEPTCAV	0.08	0.13	0.546	NA	NA	NA	NA	NA	NA	NA	NA
LOLIVUL	1.55	0.43	0.006	-0.566	0.402	0.202	NA	NA	NA	NA	NA
LOPHBUD	0.14	0.06	0.051	-0.247	0.681	0.725	-0.05	0.08	0.57	0.011	NA
LOPHPIS	-0.01	0.1	0.956	0.523	1.188	0.67	NA	NA	NA	NA	NA
MERLMER	0.02	0.09	0.857	-0.478	0.29	0.133	-0.04	0.06	0.47	0.055	-0.032
MICMPOU	0.04	0.15	0.778	-0.26	0.441	0.57	0.08	0.07	0.27	0.172	NA
MULLBAR	0.03	0.07	0.655	0.083	0.099	0.422	-0.17	0.1	0.14	0.011	NA
MULLSUR	0.03	0.09	0.792	-0.244	0.333	0.483	0.15	0.08	0.12	0.377	NA
NEPRNOR	-0.08	0.05	0.102	-0.16	0.121	0.216	0.06	0.06	0.38	0.377	-0.084
OCTOVUL	0.07	0.07	0.324	0.093	0.205	0.66	NA	NA	NA	NA	NA
PAGEACA	0.55	0.18	0.013	-0.133	0.223	0.567	NA	NA	NA	NA	NA
PAGEBOG	0.54	0.71	0.465	-0.515	0.702	0.49	NA	NA	NA	NA	NA
PAGEERY	0.11	0.08	0.215	-0.148	0.236	0.547	0.25	0.11	0.05	0.172	NA
PAPELON	-0.07	0.05	0.209	0.036	0.041	0.401	-0.11	0.05	0.08	0.011	0.029
PHYIBLE	0.02	0.07	0.827	0.387	0.214	0.103	NA	NA	NA	NA	0.387
SARDPIL	0.5	0.6	0.422	NA	NA	NA	NA	NA	NA	NA	NA
SEPIORB	0.21	0.06	0.004	NA	NA	NA	NA	NA	NA	NA	NA
SERACAB	0.04	0.11	0.745	NA	NA	NA	NA	NA	NA	NA	NA
SPICFLE	-0.13	0.06	0.069	-0.043	0.086	0.63	NA	NA	NA	NA	NA
SPICSMA	0.25	0.07	0.004	-0.304	0.113	0.055	NA	NA	NA	NA	NA
SQUIMAN	0.27	0.51	0.610	NA	NA	NA	NA	NA	NA	NA	NA
TRACMED	-0.22	0.16	0.199	-0.148	0.332	0.667	NA	NA	NA	NA	NA
TRACPIC	0.25	0.24	0.324	NA	NA	NA	NA	NA	NA	NA	NA
TRACTRA	0.13	0.11	0.272	-0.011	0.153	0.946	NA	NA	NA	NA	NA
TRIGLUC	0.27	0.06	0.001	NA	NA	NA	NA	NA	NA	NA	NA
TRIPLAS	0.87	0.64	0.206	-0.663	0.554	0.298	NA	NA	NA	NA	NA
TRISCAP	-0.03	0.57	0.953	-0.219	0.185	0.275	NA	NA	NA	NA	NA
ZEUSFAB	-0.03	0.09	0.699	0.726	0.771	0.371	NA	NA	NA	NA	NA

II.12 Eastern Ionian Sea (area 20)

Coordinator: Chrissi Yianna Politou

II.12.1 Ecological setting, geographical and environmental features

The Eastern Ionian Sea extends along the western coast of Greece and it is characterized by its deep waters and the existence of the deep Hellenic Trench, with a maximum depth of 5121 m (maximum depth in the Mediterranean), just southwestwards of Peloponnissos. The main water masses of the area are the following: a) Modified Atlantic Water (MAW): near surface water mass (down to 60-140 m depth) from the western Mediterranean of low salinity, increasing from 37.5 in the Sicily Strait to 38.6‰ in the E. Ionian, with a minimum of temperature of 13.5-14º C in the northern part; b) Levantine Intermediate Water (LIW): subsurface water mass (down to 800-900 m in winter) of high salinity decreasing from south to north (39.1 to 37.78‰) accompanied by a temperature decrease of about 1º C; c) Eastern Mediterranean Deep Water (EMDW): cold and less saline water mass coming from the Adriatic Sea, underlying LIW and extending down to the bottom, considered uniform with a temperature of 13.6º C and salinity of 38.7‰. Finally, the Eastern Ionian Sea is also influenced by water masses coming from the Aegean Sea (Georgopoulos & Theocharis 1989), while a continuous flow of water masses from Cretan Sea (warm, saline, dense and rich in oxygen) to the deep and bottom waters of the Ionian Sea was observed currently (Velegrakis *et al.* 1996).

Recent studies have confirmed the oligotrophic character of the Ionian Sea and a nutrient gradient decreasing from the western to the eastern part of the Mediterranean (Stergiou *et al.* 1997). The concentration of nutrients in the Ionian Sea is three times higher that that of the Aegean Sea and four times lower than that of the Atlantic Ocean.

The fish fauna of the E. Ionian is predominated by Atlanto-Mediterranean forms, whereas eastern Mediterranean species of tropical/subtropical nature and Lessepsian migrants are very scarce (Papaconstantinou 1988).

II.12.2 Fisheries description and initial state assessment

The mean annual landings of the Eastern Ionian Sea (Greece) for the period 1990-1999 are 11230 tons representing 8% of total Greek landings. The types of gears operating in the area are the following: 34 trawlers (HP=12311), 72 purse-seiners (HP=5163), 29 beach-seiners (HP=209) and 2551 small scale fishery boats (HP=1856) (Source: Ministry of Agriculture-CENSUS 2001). The demersal stocks are mainly fished by trawlers. Trawl fishery operates all year round with a 4-month closed period (June-September). Recently, the legal stretched cod-end mesh size changed from 28 mm to 40 mm. The trawl fishing activities in the E. Ionian are not generally carried out deeper than 500 m. The trawl catches represent 26.4% of the total annual catches. The trawl catches are mixed and the main commercially important species are: hake, red mullets, anglers, blue whiting, deep-water pink shrimp and broadtail squid.

Concerning the fishing impact in the area in the early 1990’s it can be considered strong in depths shallower than 500 m. There was a considerable increase in the fishing effort from 1964 to 1989 and Stergiou et al. (1997) applying the fox model between catches and fishing effort found that F>Fopt at the end of that period. Also, Papacostantinou et al. (1988) estimated E>0.5 for the main species and especially for hake. However, after 1993, there was a gradual decrease of the number of boats operating in the area, because fishers were subsided for laying up their boats. The fishing impact deeper than 500 m is almost null, since no trawl activities take place in these depths and there are only limited activities related mainly to hake and wreckfish fishing with long-lines and net fishing of hake during summer.

II.12.3 Brief description of changes in survey design

The MEDITS surveys were carried out in the E. Ionian Sea every summer from 1994 to 2004. However, in 2002 (beginning of national program), no survey took place in Greek waters because of a delay in signing the project contract by the Greek Ministry of Agriculture. During 1994 and 1995, the survey in the E. Ionian was carried out in a small number of stations (Table 1) by the team of Crete. From 1996 onwards, the survey in the area was carried out by the team of Athens. During the four first years, the commercial trawl “Ioannis Rossos” was used, whereas after 1998 the commercial trawl “Demetrios” was hired, since the first vessel was withdrawn. Furthermore, after 1998 the number of stations was almost doubled. For these reasons, the data analysis is also performed for the 1998-2004 period separately. The sampling period could not be kept exactly the same from year to year due to different administrative constraints (Table II.12.1).

Table II.12.1. MEDITS-GSA 20 number of stations and sampling period per year.

Year	Number of stations	Sampling period
1994	12	17/8-22/8
1995	15	22/7-28/7
1996	22	26/7-3/8
1997	18	7/8-14/8
1998	32	24/6-10/7
1999	32	20/6-10/7
2000	31	25/6-8/7
2001	31	10/6-24/6
2003	32	25/7-9/8
2004	32	25/6-9/7

II.12.4 Selection of species

The community analyses were performed on the species of the large MEDITS list with mean occurrence >5% in the area (47 species), whereas the population analyses were performed on the species of the short MEDITS list with mean occurrence >5% in the area (34 species).

II.12.5 Results: review of indicators

II.12.5.1 Community indicators

The total biomass did not show any significant trend either for the whole period or for the period 1998-2004. The total abundance showed an increasing trend and the mean weight a decreasing one in both cases. The result of the proportion of large individuals, although showing a decreasing trend for the whole period, is not reliable, because it is based on the high values of the first two years. The same indicator did not show any trend for the period 1998-2004.

None of the community indicators showed any significant trend for the last 5 years (Table II.12.2 & II.12.2).

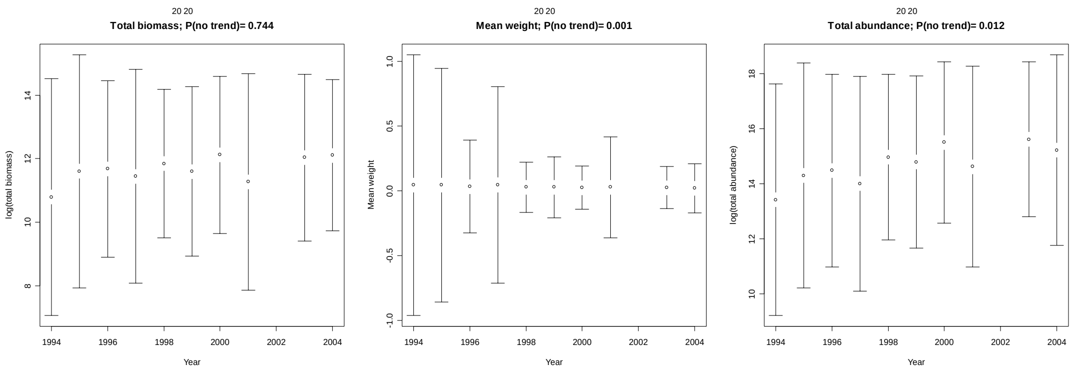


Figure II.12.1. Trends in community indicators.

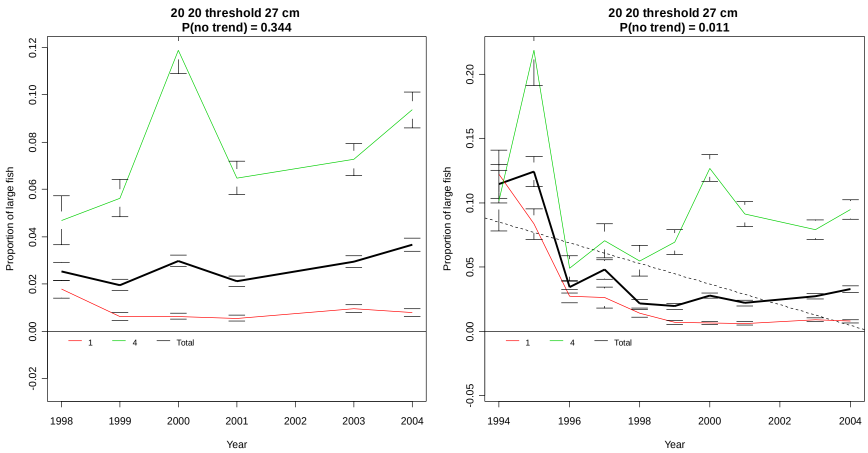


Figure II.12.2. Proportions of large fish.

II.12.5.2 Population indicators

For the whole period, the intrinsic population growth rate (r) of *Nephrops norvegicus* showed a significant decreasing trend, whereas that of 11 species was significantly increasing (Figure II.12.3). For the period 1998-2004, only the r of *Diplodus annularis* was significantly decreasing, whereas that of 4 species (*Parapenaeus longirostris, Illex coindetii, Zeus faber, Merluccius merluccius*) kept on increasing significantly. During the last 5 years, the only significant trend was an increase of the r of *Illex coindetii.*

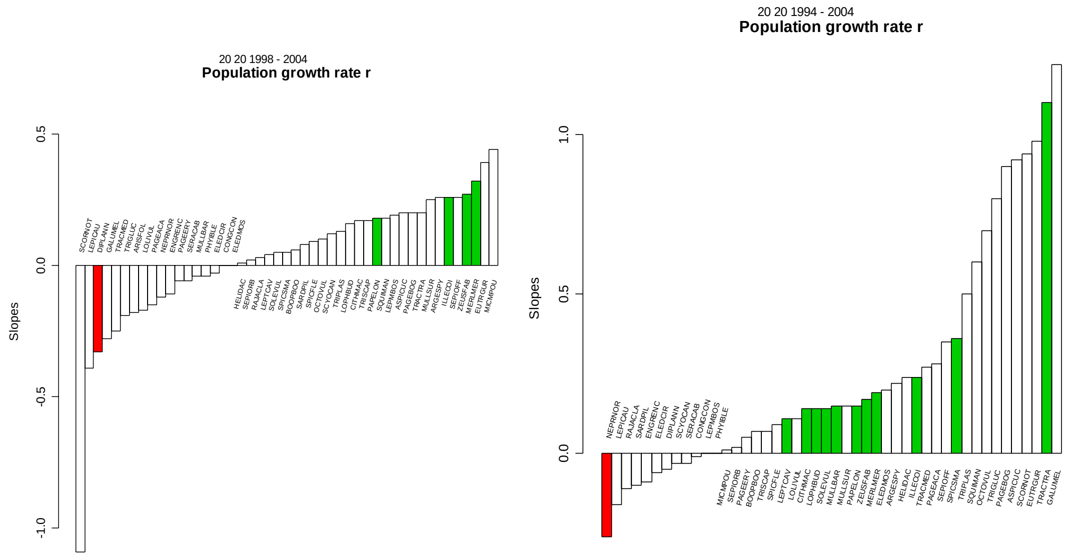


Figure II.12.3. Trends in population growth rates.

Concerning the total mortality rate (Z), it was significantly increasing for *Parapenaeus longirostris* during the period 1994-2004 and for *Raja clavata* during the period 1998-2004 (Figure II.12.4). However, no significant trend was found for any species during the last 5 years.

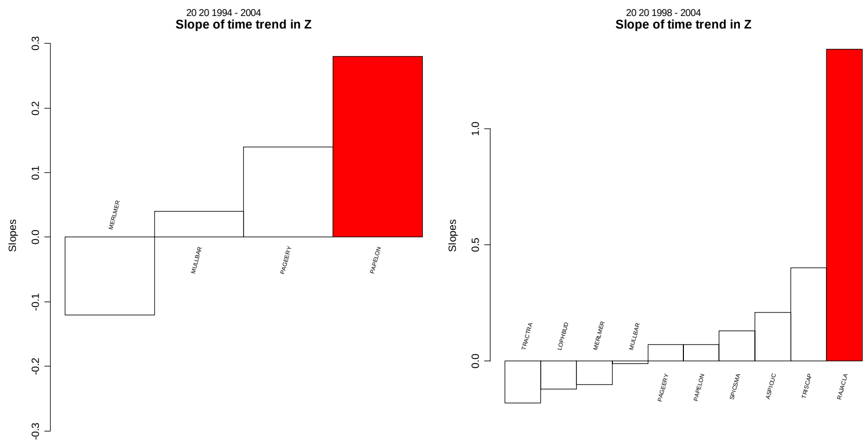


Figure II.12.4. Trends in total mortality rate.

The mean length of 4 species (*Lophius budegassa, Solea vulgaris, Octopus vulgaris, Spicara flexuosa*) was decreasing significantly and of one (*Scyliorhinus canicula*) was increasing significantly during the whole studied period (Figure II.12.5). For the period 1998-2004, only *Loligo vulgaris* showed a significant increasing trend of mean length, whereas during the last 5 years 2 species (*Pagellus erythrinus, Chelidonichthys lastoviza*) presented a significant increasing trend of mean length.

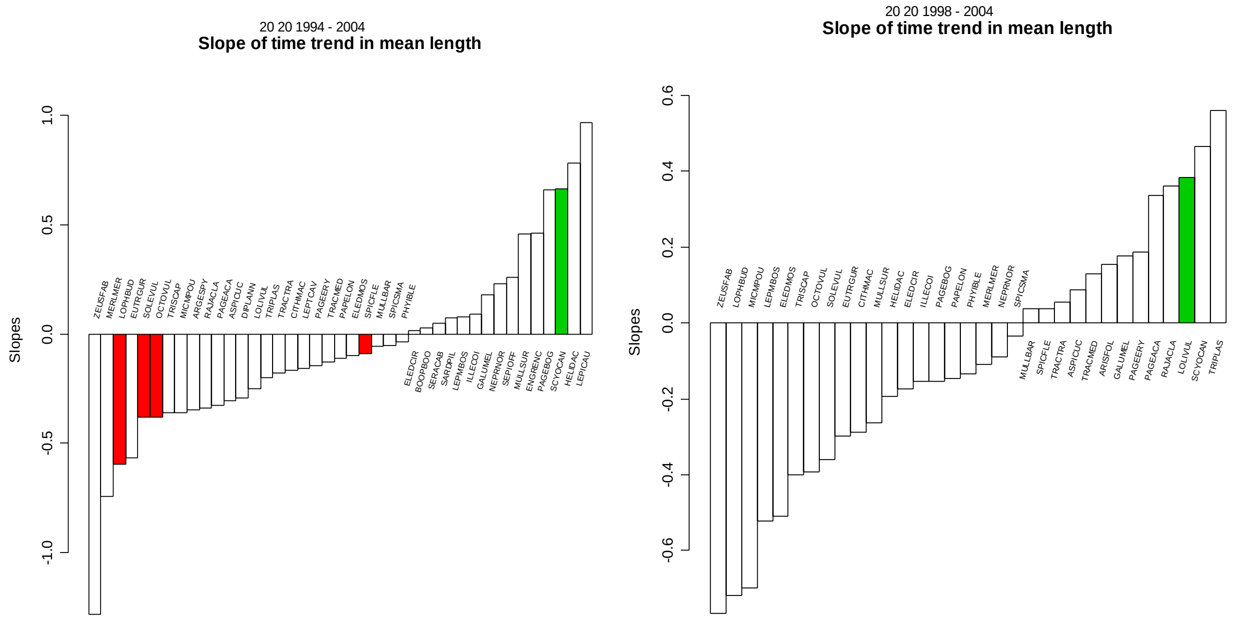


Figure II.12.5. Trends in mean length.

The results concerning the length at maturity (L_{50}) were not taken into consideration since, besides the inherent problems of this estimation for MEDITS (e.g. sampling period), maturity stage 1 was not always taken correctly: only virgin specimens, due to the unclear definition of this stage in the instructions manual.

II.12.6 Sensitivity analyses for Z

Two different sets of growth parameters were used to estimate Z for some species: the ones already used for the WG of Nantes and new ones deriving from researches in Greek waters (Table II.12.2). The overall results for Z did not change significantly from the first case to the other (see particularly *Mullus barbatus*).

Table II.12.2. Different sets of VBGP used and total mortality (Z) results for species of GSA20.

	HELIDAC		LEPMBOS		MULLBAR		PHYIBLE		ELEDCIR	
	Nantes	New	Nantes	New	Nantes	New	Nantes	New	Nantes	New
L_{inf}	21.2	31.2	28.05	43.3	23.97	24.5	46.6	57.7	12.49	24
k	0.21	0.1172	0.2365	0.26	0.58	0.27	0.233	0.168	0.09365	0.36
t_o	0.85	-2.1	-1.06	0	-0.37	-1.85	-0.414	-0.66	-0.07875	0.3
slopeZ	NA	NA	NA	NA	0.05	0.04	NA	NA	NA	NA
sdZ	NA	NA	NA	NA	0.09	0.09	NA	NA	NA	NA
PvalueZ	NA	NA	NA	NA	0.6	0.66	NA	NA	NA	NA
PvaluerobustZ	NA	NA	NA	NA	0.011	0.011	NA	NA	NA	NA

On the other hand, there was a great difference between the first and the second analysis in the case of *Parapenaeus longirostris*, where the VBGP were not changed. In the Nantes WG this species was not analysed, whereas in the present analysis it showed a significantly positive Z. This is probably due to some corrections made in some very large length values detected.

II.12.7 Discussion

The overall situation in the Eastern Ionian Sea according to the results of the indicators used and considering the previous fishing status of the area is described in the following scheme.

increasing fishing impact, reversal actions to be taken
steady fishing impact, restoration actions to be taken
no fishing impact detected

Area Period	Total Abundance	Total Biomass	Mean Weight	PropLarge	r	Z	Mean Length
E.Ionian Sea (GSA 20) 1994-2004	↑	→	↓	→	1/46 ↓ 11/46 ↑	1/4 ↑	4/41 ↓ 1/41 ↑
E.Ionian Sea (GSA 20) 1998-2004	↑	→	↓	→	1/47 ↓ 4/47 ↑	1/10 ↑	1/33 ↑
E.Ionian Sea (GSA 20) 2000-2004	→	→	→	→	1/47 ↑	→	2/33 ↑

Concerning the community indicators the results do not change if we consider all the years or from 1998 on, when the sampling changed. The total abundance indicator showed encouraging results, the total biomass and proportion of large individuals indicators showed a steady state, whereas the mean weight indicator showed an increasing fishing impact. However, during the last 5 years, no trend was observed, showing a slightly ameliorated situation.

As long as it concerns the population indicators the results did not show any fishing impact for most species in any period considered. The only affected populations seemed to be *Nephrops norvegicus* (1994-2004) and *Diplodus annularis* (1998-2004), which showed a decreasing r and for which the situation ameliorated during the last years. Also, although a significant increase of Z was observed for *Parapenaeus longirostris* (1994-2004) or *Raja clavata* (1998-2004), no consequences were observed for their populations. More specifically, the first species showed a significantly increasing r of its population and a non-significant decrease of mean length, and the second species presented a non-significant increase of both indicators. Finally the mean length of most species did not show any significant trend. Although when the whole period was considered, four species showed a significant decrease of mean length, this was not observed for the period 1998-2004 or 2000-2004. Inversely, in the two last cases only significant positive trends for three species were obtained.

Although these results should be considered with care when interpreting fishing impact, because other factors (e.g. environmental, recruitment) may have also affected the trends, an amelioration of the situation can be deduced during the last years. Probably, the gradual reduction of fishing effort after 1993 and the recent application of a larger cod-end mesh size had a positive effect on fisheries resources. However, a longer time series and more investigations are needed in order to arrive to safer conclusions.

II.12.8 Appendix

Annex II.12.1. Growth parameters (Von Bertalanffy curve) used to estimate Z for GSA20.

Species	t_0	k	Linf	source
ASPICUC	-0.656	0.283	34.85	Gulf of Lions - (Campillo 1992)
CITHMAC	-0.43	0.257	25.7	Aegean Sea - Stergiou et al 1997
EUTRGUR	1.99	0.219	26.4	Pagasitikos Gulf - Stergiou et al 1997 Fork Length
HELIDAC	-2.1	0.1172	31.2	E. Ionian Sea – (Anon. 1999)
LEPMBOS	0	0.26	43.3	Aegean Sea - Stergiou & Politou 1995
LOPHBUD	-0.921	0.13	66.75	Saronikos Gulf - Stergiou et al 1997
MERLMER	0.035	0.184	126.9	Balearic – Alemany & Oliver 1995 in Anon. 2004
MICMPOU	-1.29	0.22	40.35	Espagne - (Campillo 1992)
MULLBAR	-1.85	0.27	24.5	E. Ionian Sea - (Papaconstantinou *et al.* 1998)
MULLSUR	0	0.48	29.29	Strait of Sicily - Anon. 2004
PAGEACA	-1.36	0.27	29.62	Alboran - Baro 2000 in Anon. 2004
PAGEBOG	-0.38	0.243	39.8	Atlantique - (Campillo 1992) for age 1 to 5
PAGEERY	-0.0394	0.2554	40.16	Gulf of Lions - (Campillo 1992)
PHYIBLE	-0.66	0.168	57.7	N. Aegean Sea - Papaconstantinou et al. 1993
RAJACLA	-0.6	0.17	96.3	Atlantique - (Campillo 1992), average across sexes
SCYOCAN	0	0.2	88	North Sea - FishBase based p, Jennings et al 1999
SOLEVUL	-1.065	0.243	50.53	Gulf of Lions - Anon. 2004
SPICFLE	-1.9025	0.235	17.2	Patraikos Gulf - Stergiou et al 1997 Fork Length
SPICSMA	-1.626	0.404	18.9	Crete - Stergiou et al 1997
TRACMED	-2.305	0.226	39.9	Saronikos Gulf - Stergiou et al 1997
TRACTRA	-1.28	0.22	37.5	Adriatique - (Campillo 1992)
TRIPLAS	-0.639	0.254	38.2	? - (Campillo 1992)
TRISCAP	-1.867	0.179	32.3	Evvoikos Gulf - Stergiou et al 1997
ZEUSFAB	0	0.298	57.9	Mauritania - Fishbase
ARISFOL	0	0.46	69.5	Strait of Sicily - Anon. 2004 CL (mm)
NEPRNOR	-0.47	0.085	76.41	Lions ? - (Campillo 1992) Lorb (mm), transformed to annual growth curve
PAPELON	0	0.71	40.93	Strait of Sicily - Anon. 2004 CL (mm)
ELEDCIR	-0.3	0.36	24	Thermaikos Gulf - Thracian Sea, Papaconstantinou et al. 1994

Annex II.12.2. List of species used for community/population analyses.

1994-2004	1994-2004	1998-2004	1998-2004
ARGESPY	PAGEACA	ARGESPY	OCTOVUL
ASPICUC	PAGEBOG	ARISFOL	PAGEACA
BOOPBOO	PAGEERY	ASPICUC	PAGEBOG
CITHMAC	PAPELON	BOOPBOO	PAGEERY
CONGCON	PHYIBLE	CITHMAC	PAPELON
DIPLANN	RAJACLA	CONGCON	PHYIBLE
ELEDCIR	SARDPIL	DIPLANN	RAJACLA
ELEDMOS	SCORNOT	ELEDCIR	SARDPIL
ENGRENC	SCYOCAN	ELEDMOS	SCORNOT
EUTRGUR	SEPIOFF	ENGRENC	SCYOCAN
GALUMEL	SEPIORB	EUTRGUR	SEPIOFF
HELIDAC	SERACAB	GALUMEL	SEPIORB
ILLECOI	SOLEVUL	HELIDAC	SERACAB
LEPICAU	SPICFLE	ILLECOI	SOLEVUL
LEPMBOS	SPICSMA	LEPICAU	SPICFLE
LEPTCAV	SQUIMAN	LEPMBOS	SPICSMA
LOLIVUL	TRACMED	LEPTCAV	SQUIMAN
LOPHBUD	TRACTRA	LOLIVUL	TRACMED
MERLMER	TRIGLUC	LOPHBUD	TRACTRA
MICMPOU	TRIPLAS	MERLMER	TRIGLUC
MULLBAR	TRISCAP	MICMPOU	TRIPLAS
MULLSUR	ZEUSFAB	MULLBAR	TRISCAP

NEPRNOR	MULLSUR	ZEUSFAB
OCTOVUL	NEPRNOR	

Annex II.12.3. L50 per species and year.

GSA	Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
20	CITHMAC			12.41	15.55	14.32	20.87	11.87	10.64	9.42	14.67	9.33
20	GALUMEL								41.83	36.95	32.32	31.33
20	HELIDAC					19.01	18.20	18.20	16.25	18.20	19.34	
20	LOPHBUD						27.05	30.89	30.89	30.89	40.29	25.34
20	MERLMER	40.69	37.39	41.70	40.31	19.84	24.69	16.71	20.34	17.38	21.98	
20	PAGEERY		14.65	15.81	15.45	12.57	14.30	12.43	10.70	12.05	12.43	
20	PHYIBLE						31.97	28.71	24.75	28.71	29.41	
20	RAJACLA						41.45	30.84	29.18	36.56	51.99	29.35
20	SCYOCAN						36.72	27.08	29.80	33.37	41.18	32.01
20	TRACMED		15.54	14.91	15.73	15.20	13.99	15.20	15.20	15.20	15.85	

Annex II.12.4. Estimates of trends in parameters.

1994-2004

Species	r	SDr	Pvaluer	$penteL_{bar}$	SDL_{bar}	$PvalueL_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	$trendL_m$	SdL_m	$PvalueL_m$
ARGESPY	0.22	0.1	0.0569	-0.349	0.09	0.161	NA	NA	NA	NA	NA	NA	NA
ASPICUC	0.92	0.43	0.0667	-0.304	0.279	0.338	NA	NA	NA	NA	NA	NA	NA
BOOPBOO	0.07	0.08	0.3828	0.027	0.31	0.939	NA	NA	NA	NA	NA	NA	NA
CITHMAC	0.14	0.05	0.0255	-0.168	0.118	0.192	NA	NA	NA	NA	-1.227	0.471	0
CONGCON	-0.01	0.06	0.8572	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIPLANN	-0.05	0.08	0.4977	-0.292	0.123	0.254	NA	NA	NA	NA	NA	NA	NA
ELEDCIR	-0.06	0.06	0.3445	0.015	0.165	0.932	NA	NA	NA	NA	NA	NA	NA
ELEDMOS	0.2	0.45	0.6651	-0.1	0.155	0.545	NA	NA	NA	NA	NA	NA	NA
ENGRENC	-0.09	0.13	0.5197	0.462	0.183	0.241	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	0.98	0.52	0.0969	-0.565	0.572	0.369	NA	NA	NA	NA	NA	NA	NA
GALUMEL	1.22	0.57	0.0646	0.178	0.496	0.754	NA	NA	NA	NA	-4.202	1.585	0.006
HELIDAC	0.24	0.13	0.1095	0.782	0.344	0.057	NA	NA	NA	NA	0.066	0.249	0.791
ILLECOI	0.24	0.05	0.0021	0.09	0.13	0.506	NA	NA	NA	NA	NA	NA	NA
LEPICAU	-0.16	0.11	0.1969	0.968	3.036	0.804	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	0	0.06	0.9989	0.077	0.313	0.811	NA	NA	NA	NA	NA	NA	NA
LOLIVUL	0.11	0.14	0.4628	-0.251	0.199	0.243	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	0.14	0.05	0.0205	-0.596	0.246	0.042	NA	NA	NA	NA	0.292	0.778	0.702
MERLMER	0.19	0.06	0.011	-0.742	0.356	0.07	-0.12	0.15	0.43	0.011	-2.953	0.238	0
MICMPOU	0.01	0.19	0.9624	-0.361	0.448	0.444	NA	NA	NA	NA	NA	NA	NA
MULLBAR	0.15	0.05	0.0127	-0.055	0.147	0.717	0.04	0.09	0.66	0.011	NA	NA	NA
MULLSUR	0.15	0.12	0.2374	0.458	0.322	0.228	NA	NA	NA	NA	NA	NA	NA
NEPRNOR	-0.26	0.06	0.0022	0.232	0.119	0.087	NA	NA	NA	NA	NA	NA	NA
OCTOVUL	0.7	0.39	0.1126	-0.382	0.127	0.02	NA	NA	NA	NA	NA	NA	NA
PAGEACA	0.28	0.52	0.6045	-0.325	0.261	0.253	NA	NA	NA	NA	NA	NA	NA
PAGEBOG	0.9	0.4	0.0549	0.661	0.501	0.236	NA	NA	NA	NA	NA	NA	NA
PAGEERY	0.05	0.05	0.3854	-0.143	0.209	0.516	0.14	0.18	0.47	0.035	-0.457	0.04	0
PAPELON	0.15	0.03	0.0011	-0.11	0.081	0.209	0.28	0.09	0.02	0.172	NA	NA	NA
PHYIBLE	0	0.09	0.9959	-0.035	0.418	0.935	NA	NA	NA	NA	-0.712	0.705	0.302
RAJACLA	-0.11	0.07	0.1715	-0.34	0.505	0.52	NA	NA	NA	NA	0.425	0.756	0.579
SARDPIL	-0.1	0.12	0.4189	0.075	0.112	0.626	NA	NA	NA	NA	NA	NA	NA
SCORNOT	0.94	0.53	0.1173	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCYOCAN	-0.03	0.06	0.6672	0.663	0.137	0.005	NA	NA	NA	NA	1.253	0.391	0.001
SEPIOFF	0.35	0.39	0.3983	0.259	0.25	0.348	NA	NA	NA	NA	NA	NA	NA
SEPIORB	0.02	0.06	0.7366	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SERACAB	-0.03	0.09	0.7179	0.05	0.192	0.839	NA	NA	NA	NA	NA	NA	NA
SOLEVUL	0.14	0.04	0.0155	-0.382	0.157	0.041	NA	NA	NA	NA	NA	NA	NA

Species	r	SDr	Pvaluer	penteL$_{bar}$	SDL$_{bar}$	PvalueL$_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendL$_m$	SdL$_m$	PvalueL$_m$
SPICFLE	0.09	0.04	0.0934	-0.089	0.036	0.037	NA	NA	NA	NA	NA	NA	NA
SPICSMA	0.36	0.09	0.0037	-0.053	0.063	0.445	NA	NA	NA	NA	NA	NA	NA
SQUIMAN	0.6	0.37	0.1456	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRACMED	0.27	0.13	0.0708	-0.13	0.102	0.241	NA	NA	NA	NA	-0.188	0.17	0.233
TRACTRA	1.1	0.45	0.04	-0.18	0.174	0.335	NA	NA	NA	NA	NA	NA	NA
TRIPLAS	0.5	0.48	0.325	-0.202	0.239	0.446	NA	NA	NA	NA	NA	NA	NA
TRISCAP	0.07	0.11	0.5295	-0.361	0.237	0.167	NA	NA	NA	NA	NA	NA	NA

1998-2004

Species	r	SDr	Pvaluer	penteL$_{bar}$	SDL$_{bar}$	PvalueL$_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	trendL$_m$	SdL$_m$	PvalueL$_m$
ARGESPY	0.26	0.09	0.0506	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARISFOL	-0.18	0.21	0.423	0.155	0.233	0.542	NA	NA	NA	NA	NA	NA	NA
ASPICUC	0.2	0.08	0.08	0.088	0.459	0.86	0.21	0.21	0.5	0.313	NA	NA	NA
BOOPBOO	0.06	0.13	0.6588	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CITHMAC	0.17	0.09	0.1125	-0.288	0.252	0.317	NA	NA	NA	NA	-1.917	0.289	0
CONGCON	0	0.15	0.9836	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIPLANN	-0.33	0.1	0.0338	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEDCIR	-0.03	0.12	0.8131	-0.175	0.296	0.587	NA	NA	NA	NA	NA	NA	NA
ELEDMOS	0	0.22	0.983	-0.509	0.207	0.069	NA	NA	NA	NA	NA	NA	NA
ENGRENC	-0.11	0.16	0.5455	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	0.39	0.23	0.1603	-0.297	0.819	0.735	NA	NA	NA	NA	NA	NA	NA
GALUMEL	-0.28	0.14	0.1235	0.178	0.496	0.754	NA	NA	NA	NA	-4.202	1.585	0.006
HELIDAC	0.01	0.07	0.946	-0.193	0.428	0.675	NA	NA	NA	NA	-0.078	0.207	0.703
ILLECOI	0.26	0.04	0.0042	-0.153	0.269	0.6	NA	NA	NA	NA	NA	NA	NA
LEPICAU	-0.39	0.17	0.0893	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	0.19	0.08	0.0713	-0.523	0.773	0.536	NA	NA	NA	NA	NA	NA	NA
LEPTCAV	0.04	0.03	0.2141	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOLIVUL	-0.17	0.42	0.7114	0.384	0.125	0.038	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	0.16	0.1	0.1896	-0.719	0.617	0.309	-0.12	0.2	0.61	0.109	0.292	0.778	0.702
MERLMER	0.32	0.05	0.0035	-0.108	0.366	0.782	-0.1	0.15	0.59	0.016	0.404	0.143	0.006
MICMPOU	0.44	0.43	0.3699	-0.7	1.161	0.579	NA	NA	NA	NA	NA	NA	NA
MULLBAR	-0.04	0.1	0.7259	0.038	0.118	0.766	-0.01	0.24	0.96	0.109	NA	NA	NA
MULLSUR	0.25	0.15	0.1742	-0.263	0.325	0.477	NA	NA	NA	NA	NA	NA	NA
NEPRNOR	-0.12	0.13	0.4071	-0.09	0.164	0.615	NA	NA	NA	NA	NA	NA	NA
OCTOVUL	0.1	0.1	0.412	-0.392	0.152	0.061	NA	NA	NA	NA	NA	NA	NA
PAGEACA	-0.15	0.23	0.5567	0.337	0.159	0.101	NA	NA	NA	NA	NA	NA	NA
PAGEBOG	0.2	0.08	0.0641	-0.153	0.449	0.751	NA	NA	NA	NA	NA	NA	NA
PAGEERY	-0.06	0.07	0.4757	0.187	0.118	0.188	0.07	0.1	0.55	0.016	-0.084	0.039	0.029
PAPELON	0.18	0.03	0.0035	-0.147	0.173	0.442	0.07	0.06	0.35	0.016	NA	NA	NA
PHYIBLE	-0.04	0.15	0.789	-0.133	0.759	0.869	NA	NA	NA	NA	-0.712	0.705	0.302

[II].12 Eastern Ionian Sea (area 20)

Species	r	SDr	Pvaluer	$penteL_{bar}$	SDL_{bar}	$PvalueL_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	$trendL_m$	SdL_m	$PvalueL_m$
RAJACLA	0.03	0.02	0.2003	0.361	0.889	0.706	1.34	0.1	0.05	0.016	1.736	0.494	0
SARDPIL	0.08	0.29	0.8029	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCORNOT	-1.09	1.01	0.339	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCYOCAN	0.12	0.09	0.2493	0.466	0.376	0.303	NA	NA	NA	NA	0.772	0.363	0.034
SEPIOFF	0.26	1.3	0.8492	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEPIORB	0.02	0.06	0.7092	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SERACAB	-0.06	0.07	0.435	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOLEVUL	0.05	0.12	0.6964	-0.36	0.239	0.206	NA	NA	NA	NA	NA	NA	NA
SPICFLE	0.09	0.06	0.1963	0.038	0.06	0.565	NA	NA	NA	NA	NA	NA	NA
SPICSMA	0.05	0.14	0.7561	-0.034	0.147	0.829	0.13	0.15	0.54	0.313	NA	NA	NA
SQUIMAN	0.18	0.21	0.4261	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRACMED	-0.25	0.18	0.2321	0.13	0.214	0.576	NA	NA	NA	NA	NA	NA	NA
TRACTRA	0.2	0.16	0.2694	0.055	0.238	0.829	-0.18	0.34	0.65	0.109	NA	NA	NA
TRIGLUC	-0.19	0.12	0.1849	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRIPLAS	0.13	0.07	0.1231	0.561	0.19	0.06	NA	NA	NA	NA	NA	NA	NA
TRISCAP	0.17	0.2	0.462	-0.401	0.461	0.433	0.4	0.16	0.13	0.109	NA	NA	NA
ZEUSFAB	0.27	0.05	0.008	-0.765	0.984	0.48	NA	NA	NA	NA	NA	NA	NA

2000-2004

Species	r	SDr	Pvaluer	$penteL_{bar}$	SDL_{bar}	$PvalueL_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	$trendL_m$	SdL_m	$PvalueL_m$
ARGESPY	0.36	0.14	0.1329	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ASPICUC	0.19	0.06	0.0908	0.533	0.599	0.468	0.38	NA	NA	0.062	NA	NA	NA
BOOPBOO	0.1	0.26	0.7322	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CITHMAC	0.16	0.16	0.4297	0.087	0.284	0.789	NA	NA	NA	NA	0.433	0.249	0.108
CONGCON	0.12	0.2	0.6178	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DIPLANN	-0.01	0.07	0.8775	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEDCIR	-0.15	0.24	0.5914	-0.369	0.663	0.633	NA	NA	NA	NA	NA	NA	NA
ELEDMOS	0.08	0.09	0.4637	0.216	0.182	0.358	NA	NA	NA	NA	NA	NA	NA
ENGRENC	0.03	0.22	0.8908	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	0.07	0.35	0.8632	0.256	0.508	0.664	NA	NA	NA	NA	NA	NA	NA
GALUMEL	-0.41	0.29	0.2885	0.178	0.496	0.754	NA	NA	NA	NA	-4.202	1.585	0.006
HELIDAC	0.11	0.07	0.2324	-0.72	0.415	0.225	0.24	NA	NA	0.062	NA	NA	NA
ILLECOI	0.33	0.07	0.0464	0.186	0.45	0.72	NA	NA	NA	NA	NA	NA	NA
LEPICAU	-0.52	0.36	0.2814	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	0.02	0.06	0.7636	-1.263	1.646	0.523	NA	NA	NA	NA	NA	NA	NA
LEPTCAV	0.08	0.06	0.3068	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LOLIVUL	-0.53	0.4	0.32	0.429	0.236	0.211	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	-0.05	0.09	0.6451	0.541	0.473	0.372	-0.22	NA	NA	0.062	NA	NA	NA
MERLMER	0.28	0.1	0.1024	0.426	0.527	0.504	-0.35	NA	NA	0.062	NA	NA	NA
MICMPOU	-0.46	0.6	0.526	1.688	0.683	0.132	0.87	NA	NA	0.062	NA	NA	NA
MULLBAR	0.23	0.12	0.209	-0.47	0.147	0.086	0.44	NA	NA	0.062	NA	NA	NA

[II].12 Eastern Ionian Sea (area 20)

Species	r	SDr	Pvaluer	$penteL_{bar}$	SDL_{bar}	$PvalueL_{bar}$	SlopeZ	SDZ	PvalueZ	PvaluerobustZ	$trendL_m$	SdL_m	$PvalueL_m$
MULLSUR	0.03	0.14	0.8718	-0.191	0.729	0.817	NA	NA	NA	NA	NA	NA	NA
NEPRNOR	-0.12	0.2	0.6005	-0.323	0.22	0.279	NA	NA	NA	NA	NA	NA	NA
OCTOVUL	0.03	0.16	0.8523	-0.557	0.261	0.167	NA	NA	NA	NA	NA	NA	NA
PAGEACA	-0.12	0.49	0.8356	0.14	0.85	0.884	NA	NA	NA	NA	NA	NA	NA
PAGEBOG	0.18	0.13	0.2963	0.876	0.222	0.059	-0.08	NA	NA	0.062	NA	NA	NA
PAGEERY	0.01	0.12	0.9209	0.33	0.061	0.033	0.05	NA	NA	0.062	0.01	0.089	0.908
PAPELON	0.17	0.05	0.0831	-0.349	0.165	0.168	-0.06	NA	NA	0.062	NA	NA	NA
PHYIBLE	-0.16	0.13	0.357	-2.024	0.501	0.056	0.62	NA	NA	0.062	NA	NA	NA
RAJACLA	0.01	0.02	0.6715	-0.191	1.589	0.915	-0.33	NA	NA	0.062	2.121	0.776	0.007
SARDPIL	-0.2	0.43	0.6912	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCORNOT	0.1	0.24	0.7237	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCYOCAN	-0.05	0.11	0.6663	0.199	0.526	0.741	-0.09	NA	NA	0.062	2.285	0.351	0
SEPIOFF	-0.26	0.4	0.5757	1.026	0.344	0.206	NA	NA	NA	NA	NA	NA	NA
SEPIORB	0.07	0.13	0.6633	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SERACAB	-0.08	0.11	0.5645	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOLEVUL	-0.08	0.16	0.6534	0.052	0.262	0.86	NA	NA	NA	NA	NA	NA	NA
SPICFLE	0	0.04	0.9587	0.012	0.087	0.901	-0.1	NA	NA	0.062	NA	NA	NA
SPICSMA	-0.28	0.09	0.1004	-0.012	0.225	0.964	0.2	NA	NA	0.062	NA	NA	NA
SQUIMAN	-0.06	0.13	0.6786	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRACMED	-0.36	0.39	0.4571	0.125	0.364	0.764	NA	NA	NA	NA	NA	NA	NA
TRACTRA	0.02	0.24	0.9479	-0.203	0.444	0.693	0.56	NA	NA	0.062	NA	NA	NA
TRIGLUC	-0.44	0.3	0.2809	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRIPLAS	0.07	0.04	0.1949	0.534	0.055	0.01	NA	NA	NA	NA	NA	NA	NA
TRISCAP	-0.34	0.18	0.2027	0.252	0.145	0.224	0.09	NA	NA	0.062	NA	NA	NA
ZEUSFAB	0.27	0.05	0.0343	-1.348	1.288	0.405	NA	NA	NA	NA	NA	NA	NA

[II].12 Eastern Ionian Sea (area 20)

II.13 Aegean Sea (area 22)

Coordinator: Argiris Kallianotis

II.13.1 Ecological setting, geographical and environmental features

The Aegean Sea is one of the four major basins of the Eastern Mediterranean Sea, covering an area of 240,000 km2. The Aegean Sea displays a complicated physiography and appears morphologically divided by the extensive Cyclades Plateau into the North and the South Aegean parts (Lykousis *et al.* 2002). The North Aegean Sea is characterized by an extended continental shelf (prodelta platform) and irregular bottom topography with SW-NE deep trenches and troughs (Yuce 1995; Poulos *et al.* 1997). The general circulation in the North Aegean Sea is cyclonic. The main water masses of the area are: a) Black Sea Water (BSW): low salinity rich in nutrients surface layer with variable thickness (0 to 40-50 m depth), depending on river discharges flowing into Black Sea and the wind regime prevailing in the area (Yuce 1995; Zodiatis *et al.* 1996); b) Levantine Intermediate Water (LIW) subsurface warmer and more saline water forming a layer between 50 and 400 m, and c) the locally formed by shelf and open sea convection processes very dense deep water, which fills the bottom of the various sub-basins (Zervakis *et al.* 2000).

The South Aegean Sea (the Cretan Sea included) is the largest in volume and the deepest (2500 m) basin of the Aegean Sea. The typical water mass structure of the Cretan Sea includes: a) in the upper layer the saline surface waters of Levantine origin (LSW; S~39 psu) and the less saline (S<38.9) surface waters of Black Sea origin (BSW), transported from the North Aegean; b) the Cretan Intermediate Water (CIW), formed locally and located between 50 and 250 m, with physical characteristics similar to those of LIW, but still warmer and slightly saltier, c) the Transitional Mediterranean Water (TMW), a mixture between the LIW and the Eastern Mediterranean Deep Water of Adriatic origin found at depths of up to 700 m, and, d) the Cretan Deep Water (CDW) in the deepest/ bottom parts of the basin (800-2500 m), formed by open sea convection and/or in the surrounding shelf areas (Theocharis *et al.* 1999; Lykousis *et al.* 2002).

Recent studies confirmed the oligotrophic character of the entire Aegean Sea and the presence of higher levels of nutrients, POC, chlorophyll-a, phytoplankton and mesozooplankton abundance in the North as compared to the South Aegean Sea.

II.13.2 Fisheries description and the initial state assessment

A typically multi-gear and multi-species fishery exists in the Aegean, where coastal and offshore fishing boats are included. Aegean has long and complicated coastlines, and a large number of bays and harbors characterize the area. These characteristics favor the diffusion of the fleet in many small or medium harbors, where almost 17,000 professional fishing boats with different characteristics of size and activity are found. Even today shore fishing continues to be one of the most important activities of the coastal zone, in economic and social terms. In distant islands or isolated areas fishing is the main economic activity. In these areas, where usually there is not the alternative of agricultural employment, fishing and tourism support each other and allow many families to live in areas that otherwise would be abandoned.

Development of the bottom trawl and purse-seine fisheries (the so-called “offshore fisheries”) started in early 1970’s but even more in the 1980’s after the admission of Greece in the European Community. Both the capacity and horsepower of the fishing vessels increased after this period but, after 90’s when measures for the limitation of licenses were enforced, became stable. The offshore fishing fleet accounts for 60 % of the national fish production.

The main fishing gears used in the Aegean Sea are bottom trawls, purse seines, and a big variety of gillnets, trammel nets, longlines, traps and trolls in the coastal fisheries.

Apart from some types of specific fisheries, such as purse-seines, large pelagic fisheries and some types of small scale coastal fisheries, the Aegean fisheries are characterized by multi-species composition where many commercial species appear seasonally in the catches. The main species caught are anchovy, sardine, hake, red mullets, picarels, sea breams, horse mackerel, shrimps, and squids.

The main fish stocks assessed in the area, such as hake and anchovy, are considered overfished. However landings are stable or slowly increased depended probably on the increasing effective effort applied in the area.

II.13.3 Brief description of changes in survey design

The MEDITS surveys took place every year from 1994 to 2004 except of 2002, when MEDITS was included in the National Fisheries Data Collection Programs and due to administrative problems it was not possible to be realized in Greece. In 1994 and 1995, two scientific teams from the two Institutes involved were conducting the survey in the whole Aegean area, using the same fishing vessel. From 1996 and onwards an expansion of the sampling scheme took place, involving more sampling stations than the previous years. Three Institutes, and accordingly three scientific teams were realizing the survey in the Aegean area (North, South and Argosaronikos) from 1996 to 2004. During 1996 and 1997, two commercial vessels were employed for the survey and afterwards 3 vessels were employed.

Table II.13.1. MEDITS-GSA 22. Sampling period and number of vessels involved in the sampling campaign per year.

Year	Period (day/month)	Number of vessels
1994	4/6 - 16/8	1
1995	17/5 - 19/7	1
1996	3/6 - 29/7	2
1997	9/6 - 4/8	2
1998	12/6 -27/7	3
1999	8/6 - 26/7	3
2000	10/6 - 1/7	3
2001	30/5 - 13/6	3
2002	-	-
2003	6/7 - 17/9	3
2004	15/6 - 3/7	3

Table II.13.2. MEDITS-GSA 22. Number of stations per year, depth zone and in total.

	Depth zone					
Year	10-50 m	50-100 m	100-200 m	200-500 m	500-800 m	Total
1994	10	20	18	31	19	98
1995	9	21	26	35	14	105
1996	10	25	37	44	19	135
1997	10	27	37	51	21	146
1998	13	23	37	51	22	146
1999	12	25	34	53	22	146
2000	12	23	37	51	19	142
2001	11	26	36	47	19	139
2003	11	27	36	50	18	142
2004	13	23	43	52	18	149

II.13.4 Selection of species

The community and population analysis were performed for the species that belong in the Medits lists of 57 and 36 species, respectively, with mean occurrence greater than 5 % in the study area,.

II.13.5 Results: review of indicators

II.13.5.1 Community indicators

The total abundance and the total biomass did not show any significant trend for the period 2000-2004. However for the whole period 1994-2004 the total abundance and the total biomass indicate significant increasing trend (Figure II.13.1).

The mean weight did not show any significant trend for the period 2000-2004, while for the whole period 1994-2004 the mean weight indicates significant decreasing trend.

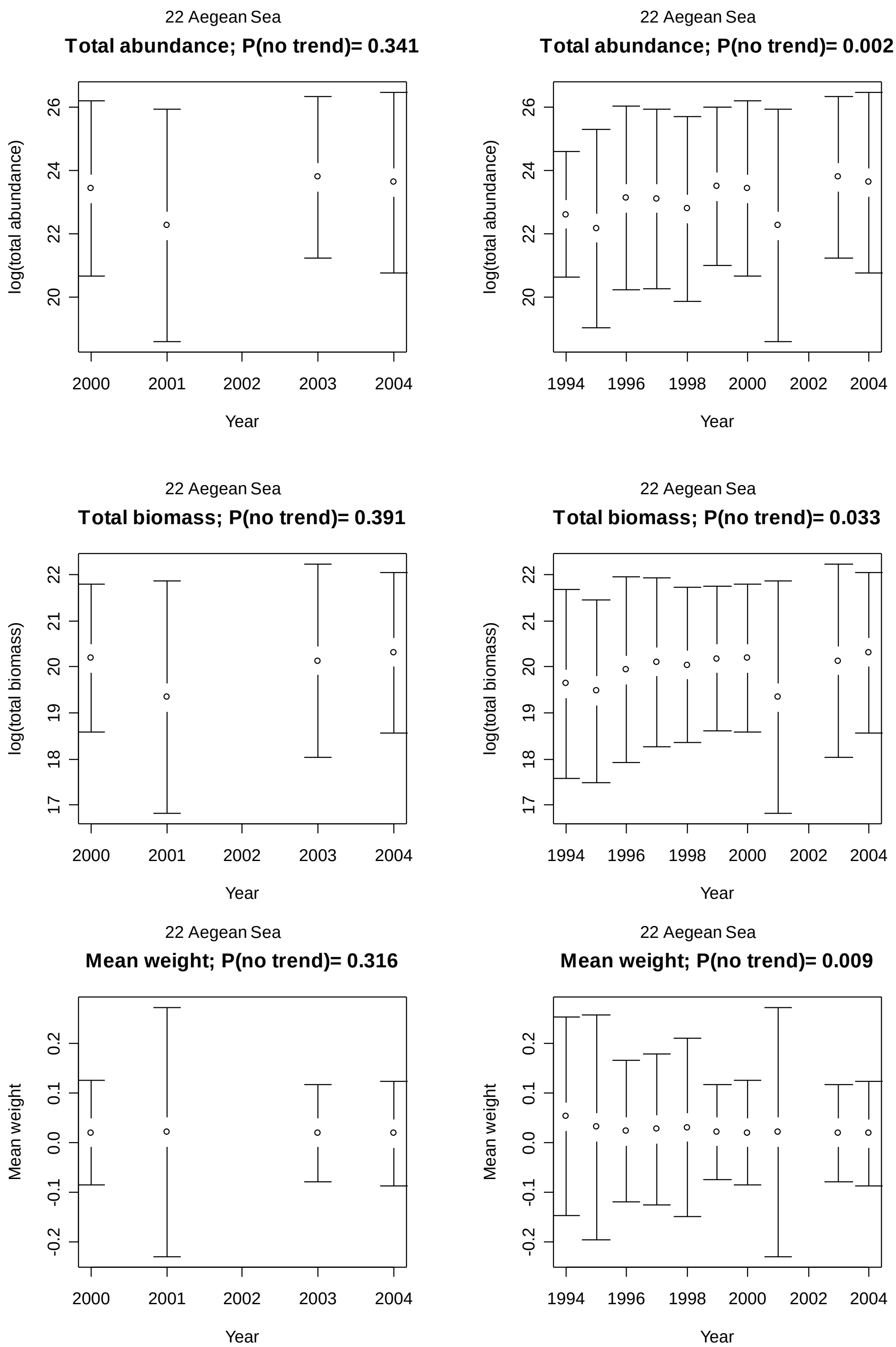


Figure II.13.1. Trends in community indicators.

The result of the proportion of large individuals did not show any significant trend for the period 2000-2004 (with threshold 27 cm). For the whole period (1994-2004) it appears to have a significant decreasing trend (Figure II.13.2).

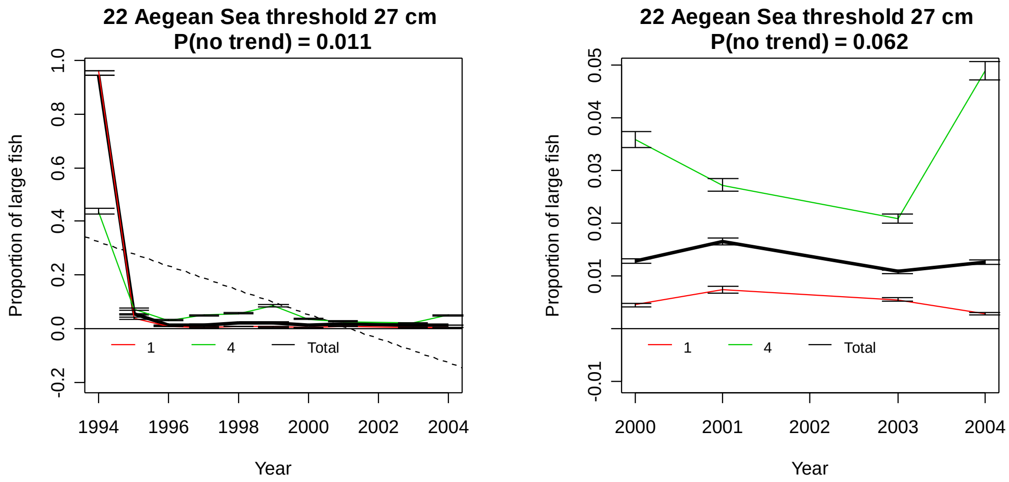


Figure II.13.2. Proportions of large fish.

II.13.5.2 Population indicators

II.13.5.2.1 Intrinsic population growth rate (r)

For the whole period, 1994-2004, the intrinsic population growth rate (r) of *Raja asterias*, *Nephrops norvegicus* and *Lepidorhombus boscii* showed significant decreasing trends, whereas that of 13 species was significantly increasing (Figure II.13.3). For the period, 2000-2004, two species *Sepia orbignyana* and *Spicara maena* showed significant increasing trend, whereas no other significant trends were found.

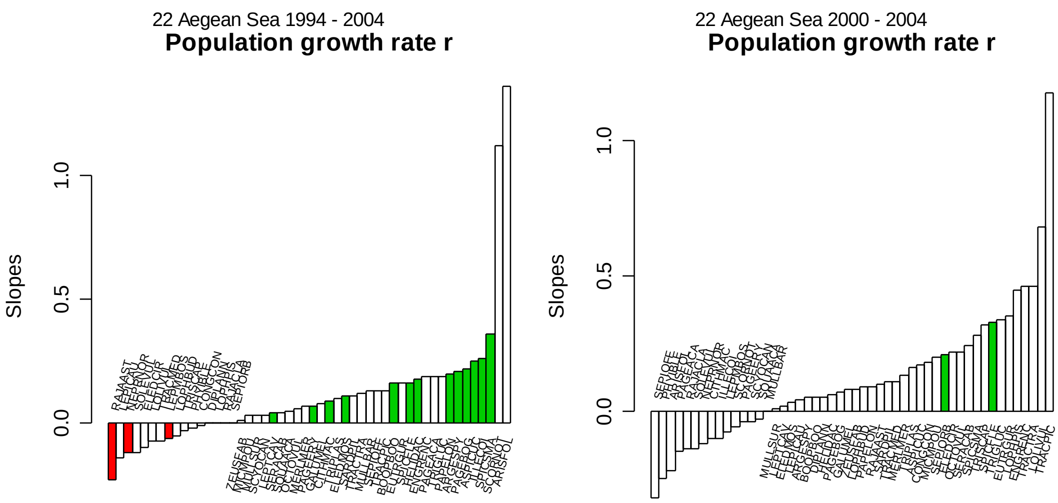


Figure II.13.3. Trends in population growth rates.

II.13.5.2.2 Mean length

For the whole period (1994-2004) the mean length of 6 species, *Lophius budegassa, Aspitrigla cuculus, Sardina pilchardus, Spicara smaris, Engraulis encrasicolus* and *Sepia officinalis,* was showed significant decreasing trend (Figure II.13.4), while the mean lengths of three species: *Raja clavata*, *Solea vulgaris* and *Sepia orbignyana*, showed significant increasing trend. However, concerning the last five years period (2000-2004), no significant trend was found for any species apart from *Eledone moschata* which show significant increasing trend.

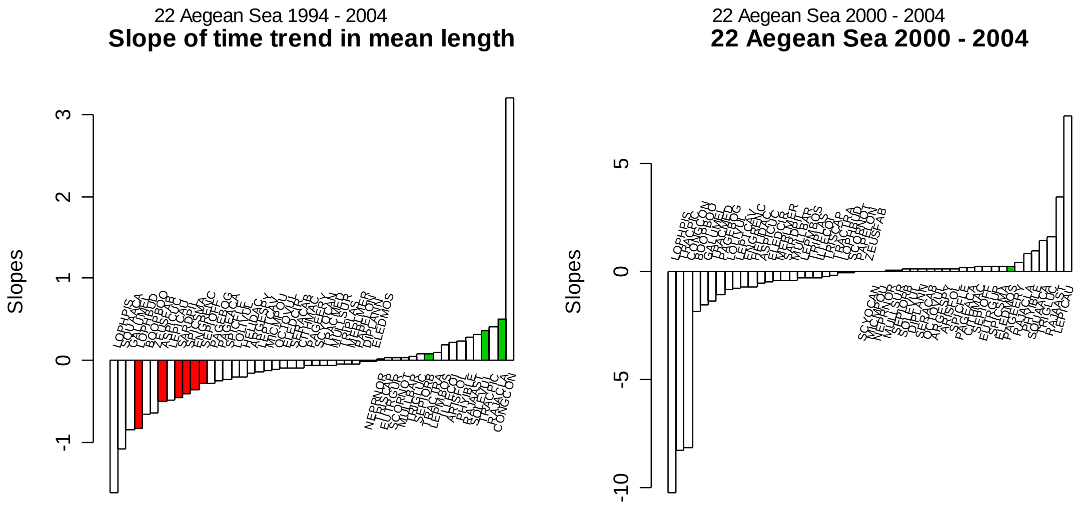


Figure II.13.4. Trends in mean length.

II.13.5.2.3 Mortality rate (Z)

During the period 1994-2004, the total mortality rate (Z) was significantly increasing for *Pagellus bogaraveo* (Figure II.13.5). Concerning the last five years (2000-2004), no significant trend was found for any species.

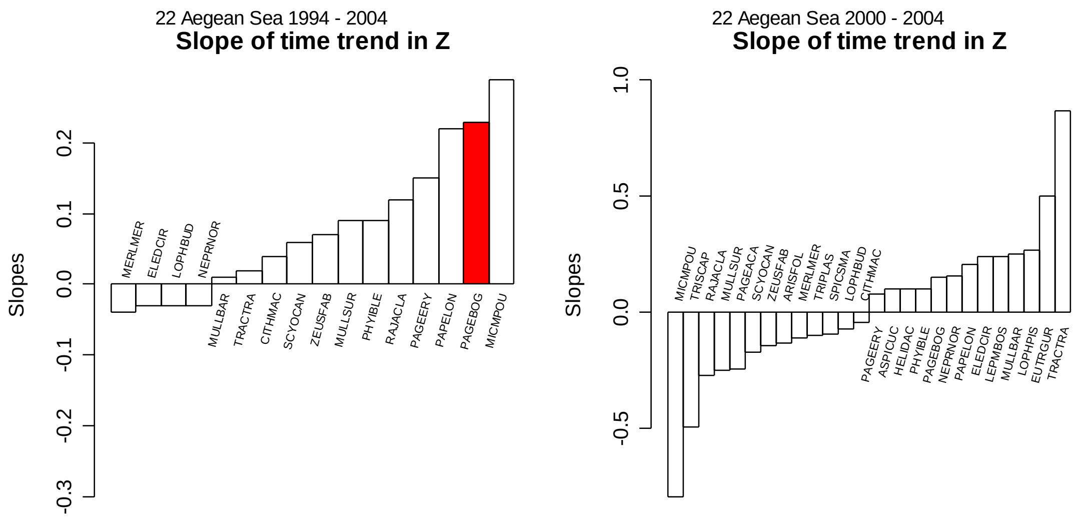


Figure II.13.5. Trends in total mortality.

The indicator L_{50} was not estimated due to several uncertainties in the sampling:

- The sampling season provide some bias on the sampled lengths as not all the length classes are represented in the sample (e.g. recruits of red mullets have not yet settled in the area).
- As in the zone 10-50 m only a few sampling stations occure, may not all the year classes are representative sampled, especially for the species of which recruitment take place in this zone.
- The maturity stage 1 (virgin specimens) was not always correctly identified due either to uncertain definitions or subjectivity in the interpretation of macroscopic maturity stages.

II.13.6 Discussion

The summary results of the statistical analysis are presented in the table II.13.3.

Table II.13.3. MEDITS-GSA 22. Summary of the community indicators.

Period	Total Abundance	Total Biomass	Mean Weight	PropLarge	r	Z	Mean Length
GSA 22 (1994-2004)	↑	↑	↓	-	13/50 ↑ 3/50 ↓	1/16 ↑	3/50 ↑ 6/50 ↓
GSA 22 (2000-2004)	no trend	no trend	no trend	no trend	2/50 ↑	no trend	1/50 ↑

Generally, the situation of the examined populations seems to be stable at least for the recent years (2000-2004). Some trends found in the overall analysis (1994-2004) must be considered very carefully, as the first two years of sampling (before the expansion and the consequent changes of the sampling scheme), may introduce bias in the estimations.

More specifically:

- The total abundance and the total biomass did not show any significant trend for the period 2000-2004. However for the whole period 1994-2004 the total abundance and the total biomass indicate significant increasing trends, which could be explained by the significant temporal variability of *E. encrasicolus* and *T. trachurus*. Kallianiotis *et al*. (2004) mention that both species have lower abundance indices during the survey of 1996 and 1997 in comparison to the years 1998 and 2000 in the Northern Aegean Sea.
- The mean weight did not show any significant trend for the period 2000-2004. However for the whole period 1994-2004 the mean weight indicates significant decreasing trend, which could be partly explained by the temporal variability of the small pelagic species *E. encrasicolus* and *T. trachurus* as well (Kallianiotis *et al.* 2004).
- *The mortality rates (Z*) did not show a significant trend.
- For the whole period, 1994-2004, the intrinsic population growth rate (r) of *Raja asterias*, *Nephrops norvegicus* and *Lepidorhombus boscii*, showed significant decreasing trend. However, no significant trends of Z and mean lengths were observed.
- For the whole period (1994-2004) the mean length of 6 species, *Lophius budegassa, Aspitrigla cuculus, Sardina pilchardus, Spicara smaris, Engraulis encrasicolus, Sepia officinalis,* was decreasing significantly.

  According to the present regulation for the mesh size of codend of trawl nets (20 mm bar length), trawl fishery cannot be selective for the species *L. budegassa.* As it is a slow growing-late mature species, this finding may be considered carefully as a possible indication of overfishing.

  The results for small pelagic species *S. pilchardus* and *E. encrasicolus* should be also considered with care as there is also evidence of declining of the commercial catches.

  Concerning the species *S. smaris,* fluctuations in the abundance of recruits have been observed among years, as the time of appearance of recruitment is strongly influenced by the prevalent environmental conditions. This may produce some bias in the estimations of the mean length, due to the specific season the survey takes place.

  Cephalopods, which have a very short life span, may show annual fluctuations which cannot easily attributed to the fishery.

  Concerning the species *A. cuculus*, it is mentioned that even if there is a decreasing trend in mean length no significant decreasing trends were calculated for the Z and r values

In general, the situation could be considered stable for the majority of the target species. However the decreasing of mean weigth or mean length for a small number of species may be an indication of overfishing for some of them. It is expected that analysis of the presented indicators may give information useful for management advice. However, further analysis of the results of the Medits surveys may give additional information for the impact of fishery on the environment and vice versa, towards a better management approach.

II.13.7 Appendix

Annex II.13.1. Species lists used for the calculation of community and population indicators.

Species list for community indicators		Species list for population indicators	
ARGESPY	PAGEACA	ARGESPY	SPICFLE
ARISFOL	PAGEBOG	ASPICUC	SPICSMA
ARITANT	PAGEERY	BOOPBOO	TRACMED
ASPICUC	PAPELON	CITHMAC	TRACTRA
BOOPBOO	PENAKER	ELEDMOS	TRIPLAS
CENTGRA	PHYIBLE	ENGRENC	TRISCAP
CITHMAC	RAJAAST	EUTRGUR	ZEUSFAB
CONGCON	RAJACLA	GALUMEL	
DIPLANN	SARDPIL	HELIDAC	
ELEDCIR	SCOMPNE	ILLECOI	
ELEDMOS	SCORNOT	LEPMBOS	
ENGRENC	SCYOCAN	LEPTCAV	
EUTRGUR	SEPIOFF	LOPHBUD	
GALUMEL	SEPIORB	MERLMER	
HELIDAC	SERACAB	MICMPOU	
ILLECOI	SOLEVUL	MULLBAR	
LEPICAU	SPICFLE	MULLSUR	
LEPMBOS	SPICMAE	NEPRNOR	
LEPTCAV	SPICSMA	PAGEBOG	
LOLIVUL	SQUAACA	PAGEERY	
LOPHBUD	SQUIMAN	PAPELON	
LOPHPIS	TRACMED	PHYIBLE	
MERLMER	TRACPIC	RAJAAST	
MICMPOU	TRACTRA	RAJACLA	
MULLBAR	TRIGLUC	SARDPIL	
MULLSUR	TRIPLAS	SCYOCAN	
MUSTMUS	TRISCAP	SEPIOFF	
NEPRNOR	ZEUSFAB	SEPIORB	
OCTOVUL		SOLEVUL	

Annex II.13.3. Population indicators.

Species	R	SDr	Pvalue_r	PenteL Lbar	SDLbar	Pvalue Lbar	Slope Z	SDZ	Pvalue Z	Pvalue robustZ	TrendLm	SDLm	PvalueLm
ARGESPY	0.21	0.07	0.0148	-0.158	0.098	0.150	NA	NA	NA	NA	NA	NA	NA
ASPICUC	0.25	0.05	0.0005	-0.512	0.137	0.006	NA	NA	NA	NA	-3.141	0.347	0.000
BOOPBOO	0.16	0.06	0.0288	-0.660	0.525	0.249	NA	NA	NA	NA	NA	NA	NA
CITHMAC	0.09	0.03	0.0307	-0.095	0.085	0.293	0.04	0.05	0.44	0.011	-1.135	0.060	0.000
ELEDMOS	0.11	0.03	0.0066	-0.013	0.120	0.919	NA	NA	NA	NA	NA	NA	NA
ENGRENC	0.19	0.11	0.1195	-0.357	0.070	0.001	NA	NA	NA	NA	NA	NA	NA
EUTRGUR	0.16	0.09	0.0989	0.023	0.181	0.904	NA	NA	NA	NA	-1.270	0.251	0.000
GALUMEL	0.08	0.05	0.1628	-0.858	0.427	0.115	NA	NA	NA	NA	-6.834	1.027	0.000
HELIDAC	0.18	0.04	0.0010	-0.204	0.184	0.299	NA	NA	NA	NA	-1.476	0.273	0.000
ILLECOI	0.26	0.06	0.0029	0.223	0.204	0.308	NA	NA	NA	NA	NA	NA	NA
LEPMBOS	-0.06	0.02	0.0291	0.188	0.160	0.274	NA	NA	NA	NA	-3.520	0.280	0.000
LEPTCAV	0.04	0.02	0.0348	-0.148	0.110	0.238	NA	NA	NA	NA	NA	NA	NA
LOPHBUD	-0.05	0.03	0.1444	-0.841	0.242	0.008	-0.03	0.04	0.48	0.011	-0.767	0.038	0.000
MERLMER	0.07	0.03	0.0790	-0.048	0.240	0.845	-0.04	0.04	0.39	0.001	-6.236	0.353	0.000
MICMPOU	0.03	0.11	0.7945	-0.127	0.276	0.656	0.29	0.13	0.07	0.055	-2.340	0.036	0.000
MULLBAR	0.13	0.07	0.1117	0.050	0.299	0.871	0.01	0.07	0.87	0.011	-2.512	0.293	0.000
MULLSUR	0.03	0.11	0.7867	-0.061	0.279	0.833	0.09	0.09	0.33	0.055	-1.644	0.165	0.000
NEPRNOR	-0.12	0.03	0.0017	0.013	0.042	0.761	-0.03	0.09	0.71	0.001	NA	NA	NA
PAGEBOG	0.22	0.06	0.0074	-0.290	0.248	0.276	0.23	0.09	0.04	0.055	-1.470	0.092	0.000
PAGEERY	0.07	0.02	0.0208	-0.070	0.086	0.442	0.15	0.06	0.06	0.011	-0.470	0.019	0.000
PAPELON	0.20	0.07	0.0295	-0.042	0.066	0.544	0.22	0.14	0.16	0.055	NA	NA	NA
PHYIBLE	-0.02	0.05	0.6775	0.282	0.156	0.108	0.09	0.07	0.26	0.055	-10.232	7.753	0.005
RAJAAST	-0.23	0.09	0.0299	0.307	1.063	0.782	NA	NA	NA	NA	NA	NA	NA
RAJACLA	0.00	0.04	0.9391	0.502	0.185	0.026	0.12	0.09	0.24	0.055	-3.570	0.390	0.000
SARDPIL	0.11	0.09	0.2580	-0.465	0.176	0.034	NA	NA	NA	NA	NA	NA	NA
SCYOCAN	0.03	0.04	0.4819	-0.066	0.165	0.701	0.06	0.08	0.51	0.172	-0.644	0.214	0.003
SEPIOFF	0.13	0.08	0.1376	-0.290	0.120	0.042	NA	NA	NA	NA	NA	NA	NA
SEPIORB	0.00	0.05	0.9871	0.083	0.031	0.032	NA	NA	NA	NA	NA	NA	NA
SOLEVUL	-0.12	0.06	0.0730	0.357	0.146	0.044	NA	NA	NA	NA	1.388	0.631	0.019
SPICFLE	0.16	0.05	0.0102	-0.246	0.108	0.052	NA	NA	NA	NA	NA	NA	NA
SPICSMA	0.36	0.07	0.0011	-0.410	0.120	0.009	NA	NA	NA	NA	-0.104	0.019	0.000
TRACMED	-0.07	0.09	0.4847	-0.063	0.328	0.854	NA	NA	NA	NA	-1.020	0.106	0.000
TRACTRA	0.12	0.07	0.1228	0.099	0.139	0.495	0.02	0.13	0.89	0.001	-1.714	0.128	0.000
TRIPLAS	0.10	0.05	0.0827	-0.057	0.090	0.563	NA	NA	NA	NA	-2.422	0.386	0.000
TRISCAP	-0.03	0.07	0.6950	0.022	0.113	0.849	NA	NA	NA	NA	-0.885	0.073	0.000
ZEUSFAB	0.01	0.03	0.6866	-0.652	0.307	0.066	0.07	0.04	0.14	0.172	-2.965	0.266	0.000

II.14 Cyprus (area 25)

Coordinator: Nikos Hajistefanou

II.14.1 General Information

Cyprus is situated at the northeastern part of the Levantine Basin, and is the third largest island in the Mediterranean. Cyprus waters have a total surface of about 11 100km^2, though since 1974 the 55% of it, among which the most important fishing grounds, is not under government control.

Despite its relatively small contribution to the Gross National Product (GNP), (which does not exceed 0.3%), the fisheries sector in Cyprus is an important activity for the economy of several coastal areas, since it generates income and work opportunities, contributing to the social and economic welfare of the residents of these areas.

The authority responsible for the fishery matters of Cyprus is the Department of Fisheries and Marine Research (DFMR) of the Ministry of Agriculture, Natural Resources and Environment. The DFMR is responsible for the development of fisheries and the rational management of marine resources in general. Its activities include the preparation and implementation of programmes and research projects concerning the rational management and exploitation of fishery resources, the conservation of the marine environment, aquaculture, and the preparation and enforcement of policy and legislation regarding the fisheries sector and the protection of the marine environment.

II.14.2 Ecological setting, geographical and environmental features

The continental shelf around Cyprus is very narrow. The slope between 500 and 1000m depth is steep at the north- and south-west side of the island, as well as the area between cape Kiti and cape Greco (at the southeastern side).

The main characteristics of the broader bottom topography, i.e. the eastern Levantine Basin are the Eratosthenes seamount (extending 700m from the seafloor), the Hecateus Ridge (extending 400 m), both south of Cyprus, and the depressions of Cyprus basin southeast (1900 m), Lattakia basin (1500 m) northeast, and Cilicia Basin north of Cyprus.

The substrate is characterized by various types of sediment; hard bottom predominates in the south-western 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 general circulation of surface waters in the eastern Mediterranean is characterized by a complicated flow pattern with strong currents and several eddies. The main features of circulation are the cyclonic Rhodes gyre, in the northwestern part of the Levantine Basin, the Mersa Matruch and Shikmona anticyclonic gyres in the southern part, the mid-Mediterranean jet (MMJ), which moves eastward, and the Asia Minor current in the Cilician Basin, in the north part (POEM group 1992 in Zodiatis *et al.* 2003). In a smaller scale, additional significant features that affect circulation around Cyprus are the Cyprus Basin cyclonic eddy and the Cyprus anticyclonic eddy, which is the northernmost extension of the Shikmona gyre (Zodiatis *et al.* 1998).

Generally, the mid-Mediterranean jet moves eastward between the three gyres, transferring water mass from the western Levantine basin. To the southwest of Cyprus, a division of the current moves northwards along the western coast of Cyprus, while the main flow continues to move eastward between the Cyprus Basin cyclonic eddy and the Cyprus anticyclonic eddy. Occasionally it meets the Cyprus Coastal current, a semi-permanent current which flows from the east, along the southeastern coast of Cyprus (Zodiatis *et al.* 1998). After passing south of Cyprus, MMJ moves to the north, through the Lattakia and Cilician Basin, and then to the west, where it joins the Asia Minor Current.

II.14.3 Fisheries description and initial state assessment

The Cyprus Fishery consists of the Inshore Fishery, the Trawl Fishery (Cyprus and International Waters), and the Polyvalent Fishery.

The Inshore Fishery is practiced with small wooden boats of 6 to 12m (OAL), which mainly fish with bottom set nets and bottom long-lines. According to Cyprus Fisheries Law, each year a limited number of 500 licenses is given. In 2003 one license was given to a purse seiner for operating in Cyprus waters, (with a capacity of 52 GT and 367 H.P.), while the rest were given to the inshore boats, with a capacity of 23 723 H.P. (DFMR 2004).

The Trawl Fishery consists of 21 trawlers, with a total capacity of 2347 GT and 6690 H.P. (DFMR 2004)). Eight of them are licensed to operate in Cyprus waters (total capacity of 718 GT and 2379 H.P.), while the rest operate only in international waters (eastern and central Mediterranean).There is a closed period for the trawlers fishing in territorial waters, from the 1st of June until the 7th of November. Up to the accession of Cyprus in the EU, the minimum mesh size of the cod end was 34 mm. Since the 1st of May 2004, Cyprus has increased the minimum size to 40 mm, according to the EU regulations. Trawlers operate mainly in the continental shelf, though some experimental trials have been conducted, for trawling in deeper waters.

The Polyvalent Fishery is practiced with boats of about 16m OAL, using mainly pelagic long-lines, but also bottom set nets and bottom long-lines. There are 33 licensed polyvalent vessels, operating both in territorial and international waters, with a total capacity of 9185 H.P. (DFMR 2004).

The number of vessels operating in Cyprus waters has been relatively constant over the years (1994-2003), due to the limited number of licenses that is given each year. A reduction in the number of polyvalent vessels has occurred since 2001, when the maximum number of licenses for the polyvalent fishery was reduced from 60 to 35. The only purse seiner operating in Cyprus waters has been a part of the Cyprus fishing fleet since 2000.

According to records of the DFMR, the total yield of the fishing fleet operating in Cyprus waters was approximately 1500 metric tons in 2003 (DFMR 2004). Most of this production (77.8%) consisted of demersal fish, followed by large pelagic fish (11%), molluscs (9.8%), small pelagic fish (0.9%) and crustaceans (0.5%). The most abundant demersal fish were *Spicara smaris* (35.9% of total demersal catches), *Boops boops* (12.4%), *Mullus surmuletus* (9.7%) and *M. barbatus* (5.3%).

The statistical series from 1994 to 2003 show that there has been a decreasing trend on total landings from Cyprus waters. Total landings have been over 2000 metric tons until 1998; the lowest production was recorded in 2003. The most significant decrease in catches has been recorded in the inshore fishery, with maximum yield in 1996 (1700 tons) and minimum yield in 2003 (970 tons).

[III] Synthesis

Author: Marie-Joëlle Rochet

Across sub-areas and species, over the study period 1994-2004 there was a general pattern of increase in population numbers and decrease in average length (Table III.1). Although to be taken more cautiously due to observation problems (see subareas sections), there was also a consistent decreasing trend in length at maturity. Seemingly there has been increasing numbers of smaller fish in the North-western Mediterranean over this period. The two noticeable exceptions were Sardinia where some abundances decreased while average length increased in two populations, and Northern Spain with a majority of indicators increasing, except Z which was stationary.

The trends at community level are consistent with the population trends: total abundance significantly increased in 5 out of 13 regions, and total biomass increased in 2 regions. In addition, in two regions mean weight decreased, and in another one the proportion of large fish decreased. This confirms the trends in population indicators: overall, an increasing number of smaller fish in Mediterranean communities. Signal was especially strong in the Northern and Southern Adriatic, Eastern Ionian and Aegean Seas.

Table III.1. Summary of trends in population and community indicators in Medits sub-areas, 1994-2004. Uncoloured: no change (less than 5% populations with significant trends, or number of increasing populations equal to number of decreasing populations). Hatched: changes consistent with increasing impact of fishing (more than 5% populations with significant trends, and more populations with significant trends towards the fishing impact direction than in the opposite direction). Light grey: changes consistent with decreasing impact of fishing (more than 5% populations with significant trends, and less populations with significant trends towards the fishing impact direction than in the opposite direction).

Population indicators	Alboran	N Spain	Lions	Corsica	Ligurian	Tyrrhenian	Sardinia	Sicily	N Adriatic	S Adriatic	W Ionian	E Ionian	Aegean
logN ↘	0	5	0	2	0	1	3	3	0	2	1	1	3
LogN ↗	4	6	6	6	6	2	0	13	22	11	9	13	13
LogN →	34	35	42	35	44	42	43	32	26	31	34	32	34
MeanL ↘	3	0	4	1	3	2	1	3	7	6	1	4	6
meanL ↗	1	3	4	1	1	0	2	1	0	0	0	1	3
meanL →	24	29	27	28	35	30	32	30	26	26	30	34	41
Z ↘	0	0	0	1	0	0	0	1	0	0	0	0	0
Z ↗	1	0	0	0	0	0	0	0	0	0	2	0	1
Z →	7	12	11	3	16	9	17	8	5	8	8	4	15
Lmat ↘	2	1	14	10	9	4	7	11	16	9	4	12	22
Lmat ↗	10	14	5	2	4	4	4	6	4	3	2	5	1
Lmat →	6	8	6	6	11	11	5	6	4	8	6	4	1
Community indicators													
Total Ab					↗				↗	↗		↗	↗
Total Biom				↗	↗								
Mean Weight												↘	↘
Prop. Large									↘				

To summarise these trends, the combination trend method (Rochet *et al.* 2005) was used. The first step of this method consists of assessing the initial status (called here: the reference state) of the community relative to its desirable state. If a community was considered to start in a non-impacted state, absence of time trends (stationarity) is acceptable. However, if a community was already impacted, no change is not good news. Then, combinations of pairs of indicators at the population and community levels are interpreted by setting up diagnostic tables or trees. Which indicator trend combinations were acceptable was decided based on the interpretation tables and depended on the initial state assessment. Based on a precautionary principle, we qualified 'deteriorating' any combination of trends in population indicators for which one of the potential mechanisms was increased fishing mortality, or the situation requires reducing fishing pressure to reverse the trends, even if not caused by fishing. Results at the population and community levels were finally combined into a final diagnostic using a simple rule: as soon as one level was found deteriorating, so was the system. Conversely, improvement at the two levels was necessary to conclude that the system was recovering.

The difficulty in implementing this method for the Medits sub-areas is the assessment of the reference states, which requires summarising various information about fishing activities and the state of resources, which might be not easily available or accessible for this region. We then performed the assessment, based on two hypotheses: what is the indicator-based diagnostic on the dynamics over the 1994-2004 period if the reference (early 90's) state was first, lightly impacted by fishing, or second, highly impacted by fishing? The results are summarised in Table III.2 and Figure III.1. Under the lightly impacted reference state hypothesis, fishing impacts were found to have increased over the study period in the Gulf of Lions (7), South and Central Thyrrhenian Sea (10), Northern and Southern Adriatic Sea (17 and 18), Western and Eastern Ionian Sea (19 and 20) and Aegean Sea (22). Under the highly impacted reference state hypothesis, no sufficient signs of recovery were found in any sub-area. Thus, according to this rather conservative approach, the many observed changes in populations and communities cannot be interpreted as a decreasing impact of fishing, even if many populations increased in abundance. The observed changes might rather be due to changes in the environment. This should be further investigated.

Table III.2: Summary assessment of population and community trends for each MEDITS sub-area, 1994-2004, depending on the assumption about reference state. Ref, Reference State (NI low impact of fishing, I high impact of fishing); Pop, trends in population indicators; Comm, trends in community indicators.

Area	1	6	7	8	9	10	11	16	17	18	19	20	22
Ref	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Pop	→	→	↘	→	→	→	↗	↗	↘	↘	↗	↘	↘
Comm	→	→	→	→	→	↘	→	→	→	→	↘	↘	↘
Ref	I	I	I	I	I	I	I	I	I	I	I	I	I
Pop	→	→	↘	→	→	→	→	→	↘	↘	→	↘	↘
Comm	→	→	→	→	→	↘	→	→	→	→	↘	↘	↘

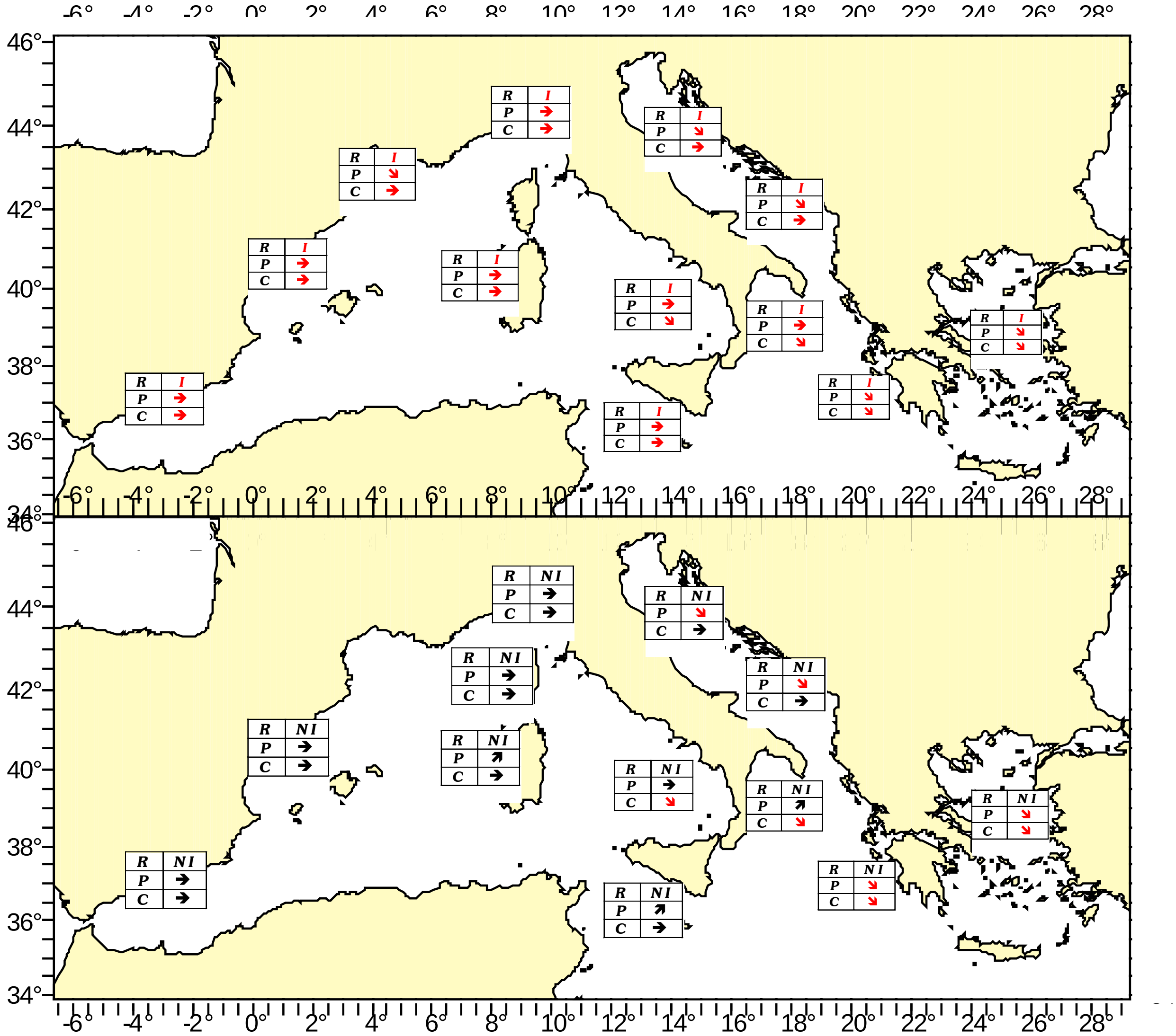


Figure III.1: Summary assessment of population and community trends for each MEDITS sub-area, depending on the assumption about reference state. Ref, Reference State (NI low impact of fishing, I high impact of fishing); Pop, trends in population indicators; Comm, trends in community indicators.

By contrast, over the last five years, there was no general pattern in population or community indicators trends, and generally no sign of an increasing impact of fishing on the short term (Table III.3).

Table III.3. Summary of trends in population and community indicators in Medits regions, 2000-2004. Colours as in Table 1.

Population indicators	Alboran	N Spain	Lions	Corsica	Ligurian	Tyrrhenian	Sardinia	Sicily	N Adriatic	S Adriatic	W Ionian	E Ionian	Aegean
logN ↘	1	2	0	0	0	3	2	2	1	0	2	0	0
LogN ↗	0	0	5	4	2	0	0	1	5	1	6	1	2
LogN →	37	44	43	39	48	42	44	45	42	43	36	45	48
MeanL ↘	0	1	1	1	0	0	1	2	0	0	2	0	0
meanL ↗	0	0	1	0	0	1	0	0	1	0	0	2	1
meanL →	28	31	32	28	38	31	34	32	32	32	29	31	49
Z ↘	0	0	1	0	0	0	0	0	0	0	0	0	0
Z ↗	1	0	1	0	1	0	0	0	0	0	0	0	0
Z →	10	21	19	0	17	12	19	17	11	12	13	0	0
Lmat ↘	4	4	21	13	7	2	10	5	11	2	2	3	11
Lmat ↗	6	11	0	1	4	4	1	9	5	6	0	7	1
Lmat →	6	8	3	3	10	11	4	8	6	7	0	4	2
Community indicators													
Total Abund													
Total Biom									↗				
Mean Weight					↘						↘		
Prop. Large													

Aggregation by species over 1994-2004

A large number of populations either increased in abundance or remained stationary (Table III.4). Only two exceptions were found, namely *Lepidorhombus boscii* and *Trachurus picturatus*, which decreased in respectively 3 out of 13 and 2 out of 8 regions, and increased nowhere. The patterns in average length are less clear, with 12 species decreasing in mean size in a majority of regions, whereas only 4 increased in a majority of regions. Overall the picture is consistent with the analysis by region: there was a general trend towards more smaller fish in many species.

Table III.4: Summary of trends in population indicators, by species. In each cell, the number of sub-areas with the corresponding trend is indicated. Colours as in Table 1.

	ARGESPY	ARISFOL	ARITANT	ASPICUC	BOOPBOO	CENTGRA	CITHMAC	CONGCON	DIPLANN	ELEDCIR	ELEDMOS	ENGRENC	EUTRGUR	GALUMEL	HELIDAC	ILLECOI	LEPICAU	LEPMBOS	LEPTCAV	LOLIVUL	LOPHBUD	LOPHPIS	MERLMER	MICMPOU	MULLBAR	MULLSUR	MUSTMUS	NEPRNOR	OCTOVUL	PAGEACA	PAGEBOG	PAGEERY	PAPELON
logN ↘	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	3	1	1	0	1	0	0	1	0	0	0	2	0	0	0	0	0
LogN ↗	3	2	0	4	2	0	5	1	1	1	2	2	1	4	8	6	0	0	3	3	4	1	2	0	4	1	0	5	0	1	3	4	8
LogN →	9	6	8	8	9	2	6	12	8	12	10	10	7	8	5	7	10	11	9	10	8	10	11	12	9	12	2	6	13	12	10	9	5
meanL ↘	0	0	0	1	0	0	0	0	0	2	1	1	0	0	3	1	0	0	0	1	4	1	2	0	0	3	0	1	2	2	1	1	1
meanL ↗	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	1	0	0	0	0	0	3	0	1	0	0	0	1	0
meanL →	3	8	7	11	3	0	11	1	2	11	12	0	8	12	9	12	1	10	3	11	9	10	11	13	13	7	0	11	11	11	12	11	12
Z ↘	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Z ↗	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Z →	0	4	4	5	0	0	2	0	0	6	0	0	1	0	1	0	0	0	0	0	2	0	11	4	12	6	0	13	0	1	0	7	7
Lmat ↘	0	0	0	4	0	0	5	0	0	0	0	0	3	6	5	0	0	8	0	0	4	1	8	4	8	4	0	0	0	4	3	6	0
Lmat ↗	0	0	0	3	0	0	2	0	0	0	0	0	1	4	4	0	0	1	0	0	0	0	3	4	2	1	0	0	0	4	1	2	0
Lmat →	0	0	0	3	0	0	3	0	0	0	0	0	2	1	3	0	0	3	0	0	8	3	2	2	2	5	0	0	0	2	4	5	0

	PHYIBLE	RAJAAST	RAJACLA	SARDPIL	SCOMPNE	SCORNOT	SCYOCAN	SEPIOFF	SEPIORB	SERACAB	SOLEVUL	SPICFLE	SPICSMA	SQUAACA	SQUIMAN	TRACMED	TRACPIC	TRACTRA	TRIGLUC	TRIPLAS	TRISCAP	ZEUSFAB
logN ↘	0	1	1	0	0	1	0	0	1	0	1	0	0	0	1	0	2	1	0	0	0	0
LogN ↗	2	1	1	0	1	0	3	0	1	0	1	5	5	0	2	0	0	2	2	1	0	3
LogN →	11	4	6	13	0	9	9	6	11	12	4	8	8	3	5	13	6	10	7	12	11	10
meanL ↘	0	0	0	1	0	0	0	1	0	0	1	3	1	0	0	1	0	2	1	0	1	1
meanL ↗	0	0	2	0	0	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1
meanL →	13	2	6	1	0	1	11	5	0	2	4	10	12	1	0	11	1	11	1	13	10	11
Z ↘	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z ↗	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z →	10	0	1	0	0	0	3	0	0	0	0	3	2	0	0	4	0	6	0	1	3	4
Lmat ↘	4	0	2	0	0	0	6	0	0	0	0	5	6	0	0	6	0	6	0	4	5	4
Lmat ↗	2	0	2	0	0	0	3	0	0	0	2	4	4	0	0	6	0	3	0	1	3	2
Lmat →	5	0	2	0	0	0	2	0	0	0	3	2	1	0	0	1	0	4	0	4	3	7

[IV] References

AA.VV., 2000a. Analysis of the Mediterranean (including North Africa) deep sea shrimps fishery: catches efforts and economics. EC DG XIV N. 97/0018, Final Report.

AA.VV., 2000b. Mediterranean Landings pilot project. Project 97/0066, Final Report 2000.

Addis P., S. S. Campi, D. Cuccu, M. C. Follesa, M. Murenu, A. Sabatini, E. Secci & A. Cau, 1998. Mari di Sardegna: sintesi delle ricerche sulla pesca a strascico negli anni 1985-97. *Biol. Mar. Medit.* **5** (3): 85-95.

Aldebert Y. & C. Carries, 1988. Problèmes d'exploitation du merlu dans le golfe du Lion. *In* Rapp. Pêches. FAO, Rome **395**: 87-91.

Aldebert Y. & L. Recasens, 1996. Comparison of methods for stock assessment of European *Merluccius merluccius* in the Gulf of Lions (Northwestern Mediterranean). *Aquat. Living Resour.* **9**: 13-22.

Aldebert Y., L. Recasens & J. Lleonart, 1992. Analysis of gear interactions in a hake fishery: the case of the Gulf of Lions (NW Mediterranean). *Sci. Mar.* **57**: 207-217.

Anon., 1999. Developing deep-water fisheries: data for the assessment of their interaction with and impact on a fragile environment. FAIR CT 95 0655. Coordinator: Dr John D.M. Gordon.

Artegiani A., R. Azzolini, A. Boldrin, D. Bregant, M. Morbidoni, E. Paschini & S. Rabitti, 1990. Idrologia del Bacino Ionico. Crociera POEM V. Agosto-Settembre 1987. *In* Atti VIII Congr. AIOL: 83-93.

Artegiani A., D. Bregant, E. Paschini, N. Pinardi, F. Raicich & A. Russo, 1997. The Adriatic Sea General Circulation. Part II: Baroclinic Circulation Structure. *J. Physic. Ocean.* **27**: 1515-1532.

Astraldi M., G. P. Gasparini, L. Gervasio & E. Salusti, 2001. Dense water dynamics along the Strait of Sicily (Mediterranean Sea). *J. Phys. Oc.* **31**: 3457-3475.

Astraldi M., G. P. Gasparini, A. Vetrano & S. Vignudelli, 2002. Hydrographic characteristics and interannual variability of water masses in the central Mediterranean: A sensivity test for long-term changes in the mediterranean. *Deep Sea Res.* **49**: 661-680.

Babcock R. C., S. Kelly, N. T. Shears, J. W. Walker & T. J. Willis, 1999. Changes in community structure in temperate marine reserves. *Marine Ecology Progress Series* **189**: 125-134.

Basset A., F. Vignes, A. Fiocca & A. Semeraro, 2000. Distribuzione in taglia della biomassa fitoplanctonica e della produzione primaria. Abstract Risul. Att.Prog. Ric. Reg. Puglia INTERREG Italia/Grecia- Misura 3.1. Protezione ambiente marino: 18.

Ben Alaya H. ed 1996. Rapport 7ème consultation technique du Conseil général des pêches pour la Méditerranée sur 'évaluation des stocks dans les divisions statistiques Baléares et Golfe du Lion. Sète, France, 19-23 sept. 1994. Rapp. Pêches. Vol. 537. FAO: 244 p.

Benzohra M. & C. Millot, 1995. Characteristics and circulation of the surface and intermediate water masses off Algeria. *Deep Sea Res. I* **42** (10): 1803-1830.

Bertrand J. A., L. Gil de Sola, C. Papaconstantinou, G. Relini & A. Souplet, 2000. An international bottom trawl survey in the Mediterranean: the Medits programme. *In* Demersal resources in the Mediterranean. Proceedings of the symposium held in Pisa, 18-21 March 1998. J.A. Bertrand & G. Relini eds. Ifremer, Plouzané. *Actes de Colloques* **26**: 76-93.

Bertrand J. A., L. Gil de Sola, C. Papaconstantinou, G. Relini & A. Souplet, 2002. The general specifications of the Medits surveys. *In* Mediterranean Marine Demersal Resources: The MEDITS International Trawl Survey (1994-1999). P. Abelló, J. Bertrand, L. Gil de Sola, C. Papaconstantinou, G. Relini & A. Souplet eds. Sc. Mar. **66 (Suppl. 2)** (Suppl. 2): 9-17.

Beverton R. J. H. & S. J. Holt, 1957. On the dynamics of exploited fish and populations. Her Majesty's Stationery Office, London, Fishery Investigations, Series II, 19: 533 p.

Bonnet M., 1973. Les pêches maritimes sur les côtes françaises de Méditerranée. Actualité, perspectives. *Science et Pêche, Bull. Inst. Pêches Marit.* **122**: 1-18.

Bregant D., F. Azzaro, A. Bonaccorso, G. Civitarese, E. Crisafi, R. Laferla, M. Leonardi, A. Luchetta, R. Polimeni & F. Racich, 1992a. Condizioni idrobiologiche nell'Adriatico Meridionale. *In* Atti X A.I.O.L., Alassio, 4-6/11/1992: 37-46.

Bregant D., G. Civitarese & A. Luchetta, 1992b. Chemical parameters distribution in the Ionian Sea during POEM-06 cruise (October 1991). *Rapp. Comm. int. Mer Médit.* **33**: 395.

Campillo A., 1992. Les pêcheries françaises de Méditerranée. Synthèse des connaissances. Ifremer, *Rapport interne* RIDRV-92/019-RH-Sète. 206 p.

Casavola N., G. Marano, L. De Marino & C. Saracino, 1985. Caratteristiche oceanografiche del Basso Adriatico: nutrienti e batteri eterotrofi. *Oebalia* **XI** (3): 871-873.

Casavola N., G. Martino & E. Hajderi, 1995. Caratteristiche trofiche delle acque del Basso Adriatico. *Biol. Mar. Medit.* **2** (2): 573-574.

Cau A., A. Carbonell, M. C. Follesa, A. Mannini, G. Norrito, L. Orsi Relini, C. Y. Politou, S. Ragonese & P. Rinelli, 2002. MEDITS-based information on the deep-water red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* (Crustacea: Decapoda: Aristeidae). *In* Mediterranean Marine Demersal Resources: The MEDITS International Trawl Survey (1994-1999). P. Abelló, J. Bertrand, L. Gil de Sola, C. Papaconstantinou, G. Relini & A. Souplet eds. Sc. Mar. **66 (Suppl. 2)**: 103-124.

Cau A., A. Sabatini, M. Murenu, M. C. Follesa & D. Cuccu, 1994. Considerazioni sullo stato di sfruttamento delle risorse demersali (Mari di Sardegna). *Biol. Mar. Medit.* **1** (2): 67-76.

CGPM, 1988. Rapport du groupe de travail *ad hoc* sur l'aménagement des stocks dans la Méditerranée occidentale. Rome, 24-25 juin 1986 et Sète, 10-11 février 1987. FAO, *Fish. Rep.* 386. 48 p.

Chiocci F. L. & L. Orlando, 1996. Lowstand terraces on Tyrrhenian Sea steep continental slopes. *Marine Geology* **134**: 127-143.

D'Onghia G., P. Maiorano, A. Matarrese & A. Tursi, 1998. Distribution, biology and population dynamics of *Aristaeomorpha foliacea* (Risso, 1827) (Crustacea, Decapoda) from the north-western Ionian Sea (Mediterranean Sea). *Crustaceana* **71** (5): 518-544.

D'Onghia G., F. Mastrototaro & M. Panza, 1996a. On the growth and mortality of rockfish, *Helicolenus dactylopterus* (Delaroche 1809), from the Ionian Sea. *FAO Fish. Rep.* **533** (Suppl.): 143-152.

D'Onghia G., A. Tursi & M. Basanisi, 1996b. Reproduction of macrourids in the upper slope of the north-western Ionian Sea. *J. Fish Biol.* **49** (Suppl. A): 311-317.

D'Onghia G., F. Capezzuto, C. Mytilineou, P. Maiorano, K. Kapiris, R. Carlucci, L. Sion & A. Tursi, 2005. Comparison of the population structure and dynamics of Aristeus antennatus (Risso, 1816) between exploited and unexploited areas in the Mediterranean Sea. *Fisheries Research* **76**: 22-38.

De Ranieri S. ed 2004. Programma nazionale raccolta dati alieutici, modulo: campagna scientifica di valutazione degli stock: GRUND anno 2003; GSA9. Ministero delle Politiche Agricole e Forestali, Relazione finale (Luglio 2004): 70 p.

De Santi A., F. Fiorentino, M. Camilleri, M. L. Bianchini & S. Ragonese, 2005. Seatrim: software for the exploratory analysis of trawl information in the Mediterranean. MedSudMed, Occasional Pap. + CD-Rom (in press). 50 p.

Degage A., 1983. L'Amirauté de Cette et la flotte sétoise de 1691 à 1735. *Etudes sur l'Hérault* **14** (3): 5-23.

DFMR, 2004. Annual Report on the Cyprus Fisheries for the year 2003. Department of Fisheries and Marine Research, Ministry of Agriculture and Natural Resources, Republic of Cyprus.

Die D. J. & J. F. Caddy, 1997. Sustainable yield indicators from biomass : are there appropriate reference points for unse in tropical fisheries? *Fisheries Research* **32**: 69-79.

Dulčić J., A. Pallaoro, P. Cetinić, M. Kraljević, A. Soldo & I. Jardas, 2003. Age, growth and mortality of picarel, *Spicara smaris* L. (Pisces: Centracanthidae), from the eastern Adriatic (Croatian coast). *Journal of Applied Ichthyology* **19** (1): 10-14.

FAO-GFCM, 2001. Working group on management units. Alicante, 23-25 January 2001. GFCM, SAC 4/2001/Inf.7 http://www.fao.org/fi/meetings/gfcm/gfcmsac/4-fourth/default.asp. 27 p.

Farrugio H. & G. Le Corre, 1996. Diagnostics à l'équilibre de quelques stocks halieutiques démersaux euryhalins du golfe du Lion: Analyses de pseudocohortes et rendements par recrue. *In* Rapport de la septième consultation technique du Conseil général des pêches pour la Méditerranée sur l'évaluation des stocks dans les divisions statistiques Baléares et golfe du Lion. Sète, France, 19-23 septembre 1994. H.B. Alaya ed. FAO, Rome. *Rapp. Pêches* **537**: 113-120.

Fiorentino F., G. Norrito, S. Ragonese, M. Camilleri & M. L. Bianchini, 2002. An attempt to compare the status of the groundfish resources within the Maltese Exclusive Fishing Zone and the surrounding bottoms of the Strait of Sicily. *In* Management Regime for Maltese 25 mile Conservation Zone. Ministry for Agriculture and Fisheries, Malta.

Froese R. & D. Pauly eds, 2002. FishBase. World Wide Web electronic publication. www.fishbase.org.

Fuda J.-L., G. Etiope, C. Millot, P. Favali, M. Calcara, G. Smriglio & E. Boschi, 2002. Warming, salting and origin of the Tyrrhenian Deep Water. *Geophys. Res. Letters* **29** (18): 1886.

Gayanilo F. C., P. J. Sparre & D. Pauly, 2002. FiSAT II User's GUIDE. FAO, Rome.

Georgopoulos D. & A. Theocharis, 1989. Remotely sensed mesoscale circulation patterns in the Eastern Mediterranean. EGS XIV General Assembly, Barcelona, March 13-17 1989. Annales Geophysicae, Special Issue 126.

Haedrich R. L. & S. M. Barnes, 1997. Changes over time of the size structure in a exploited shelf fish community. *Fisheries Research* **31**: 229-239.

Hall S. J., 1999. The effect of fishing on marine ecosystems and communities. Blackwell, Oxford, Fish Biology and Aquatic Resources Series: 274 p.

ICES, 2001. Report of the working group on ecosystem effects of fishing activities. ICES C.M. 2001 / ACME: 09. 102 p.

IREPA, 2002. Osservatorio economico sulle strutture produttive della pesca marittima in Italia, 2001-2002. Franco Angeli editore, Milano: 343 p.

IREPA, 2003. Osservatorio economico sulle strutture produttive della pesca marittima in Italia, 2003. Franco Angeli editore, Milano: 237 p.

IRMA, 2003. Valutazione delle Risorse Demersali Grund 3. Mazara (TP). V Piano Nazionale Triennale (2000/03). Tematica A (Risorse Biologiche). Rapporto Finale Unità Operativa n° 11 (Stretto di Sicilia - Mar Mediterraneo). 141 p.

ISTAT, 1997. Statistiche della pesca e della caccia, anni 1994-95. Annuario, 10.

Jennings S., J. Lancaster, A. Woolmer & J. Cotter, 1999. Distribution, diversity and abundance of epibenthic fauna in the North Sea. *J. Mar. Biol. Assoc. U.K.* **79**: 385-399.

Jereb P., D. Cuccu, D. Giordano, P. Maiorano & S. Ragonese, 2005. Using historical series of trawl surveys data to investigate cephalopods: a new method of exploratory analysis. *Biol. Mar. Medit.* **12** (1): 526-530.

Jukic-Peladic S., N. Vrgoc, S. Krstulovic-Sifner, C. Piccinetti, G. Piccinetti-Manfrin, G. Marano & N. Ungaro, 2001. Long-term changes in demersal resources of the Adriatic Sea: comparison between trawl surveys carried out in 1948 and 1998. *Fish. Res.* **53**: 95-104.

Kallianiotis A., P. Vidoris & G. Sylaios, 2004. Fish species assemblages and geographical sub-areas in the North Aegean Sea, Greece. *Fisheries Research* **68**: 171-187.

Karlou-Riga C., 2000. Otolith morphology and age and growth of *Trachurus mediterraneus* (Steindachner) in the eastern Mediterranean. *Fish. Res.* **46** (1-3): 69-82.

Karlou-Riga C. & A. Sinis, 1997. Age and growth of horse mackerel, *Trachurus trachurus* (L.), in the Gulf of Saronikos (Greece). *Fisheries Research* **32**: 157-171.

Lebeau A., 1986. Apercu de l'activité des petits métiers en Corse. *In* Rapport de la consultation technique du CGPM sur les méthodes d'évaluation de la pêche aux petits métiers dans la Méditerranée occidentale, Sète, France. D. Charbonnier & J.F. Caddy eds. FAO, Rome. *FISH. REP./RAPP. PECHES* **362**: 97-98.

Leder N., A. Smircic & Z. Grzetic, 1995. Seasonal variability of dynamical and Thermohaline properties in the Otranto Strait area - 1989/1990. *Rapp. Comm. int. Mer Médit.* **34**: 187.

Lembo G. ed 2002. SAMED Stock assessment in the Mediterranean. EC project n° 99/047. COISPA, Italy, CD Rom.

Levi D., S. Ragonese & F. Fiorentino, 2001. Analisi dello stato di sfruttamento delle principali risorse demersali dello Stretto di Sicilia (Mediterraneo Centrale) ed indicazioni per l'attuazione di misure gestionali di "rientro" verso situazioni di maggiore sostenibilità bio-economica. ED/TN/DL-SR-FF/22/0501/REL.1. 39 p.

Lykousis V., G. Chronis, A. Tselepides, N. B. Price, A. Theocharis, I. Siokou-Fragkou, F. van Wambeke, R. Danovaro, S. Stavrakakis, G. Duineveld, D. Georgopoulos, L. Ignatiades, A. Souvermetzoglou & F.

Voutsinou-Taliadouri, 2002. Major outputs of the recent multidisciplinary biogeochemical researches undertaken in the Aegean Sea. *Journal of Marine Research* **33-34**: 313-334.

Magazzù G. & G. Cavallaro, 1972. Contributo alla conoscenza delle condizioni idrologiche e della produzione primaria nelle acque costiere dell'alto Jonio. *Mem. Biol. Mar. Ocean.* **2** (4): 99-118.

Magazzù G. & F. Decembrini, 1992. Biomasse et Production primaire du picoplancton phototrophe en Mer Méditerranée. *Rapp. Comm. int. Mer Médit.* **33**: 259.

MaLiRAG, 2003. Rapporto finale sulle specie demersali nello Stretto di Sicilia (Sub Area Geografica 16; Mar Mediterraneo). Programma nazionale Italiano per la raccolta di dati alieutici - modulo CAMP-BIOL 2003. 47 p.

MaLiRAG, 2004. Campagna scientifica di valutazione degli stock - Grund 2003 - GSA 16. Relazione finale. IRMA-CNR, Mazara (TP). Programma nazionale Italiano per la raccolta di dati alieutici, EX REG. CE 1543/2000 E 1639/2001 - modulo CAMP- BIOL 2003. 66 p.

Manca B., P. Franco & E. Paschini, 2001. Seasonal variability of the hydrography in the Adriatic Sea: water mass properties and circulation. *In* Mediterranean Ecosystems Structures and Processes. F.M. Faranda, L. Guglielmo & G. Spezie eds. Springer-Verlag, Milano: 45-60.

Mannini P., F. Massa & N. Milone, 2004. Adriatic Sea fisheries: outline of some main facts. *In* AdriaMed Seminar on Fishing Capacity: Definition, Measurement and Assessment, FAO-MiPAF Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea. GCP/RER/010/ITA/TD-13. AdriaMed Technical Documents. Vol. 13: 13-33.

Mannini P., B. Reale & P. Righini, 1990. Osservazioni sulla biologia e la pesca di Lepidorhombus boscii (Risso) (Osteichthyes, Scopthalmidae) nel Tirreno Settentrionale. *Oebalia* **16** (suppl. 1): 245-255.

Manzella G. M. R., G. P. Gasparini & M. Astraldi, 1988. Water exchange between the eastern and western Mediterranean through the Strait of Sicily. *Deep Sea Res.* **35** (6): 1021-1034.

Marano G., A. M. Pastorelli & N. Ungaro, 1998. Canale d'Otranto: ambiente e comunità biologiche. *Biol. Mar. Medit.* **5** (1): 1-11.

Margalef R., 1985. Western Mediterranean. Pergamon press Ltd., London: 374 p.

Massa F. & P. Mannini eds, 2000. Report of the First Meeting of the Adriamed Coordination Committee FAO-MiPAF Scientific Coperation to Support Responsible Fisheries in the Adriatic Sea. GCP/RER/010/ITA/TD-01: 64 p.

Mastrototaro F., A. Matarrese & A. Tursi, 2002. Un mare di coralli nel Mar Ionio. *Biol. Mar. Medit.* **9** (1): 616-619.

Matarrese A., M. Panza & F. Mastrototaro, 1996. Accrescimento di *Spicara flexuosa* (Rafinesque, 1810) nel Mar Ionio. *Biol. Mar. Medit.* **3** (1): 553-556.

Meuriot E., P. Y. Dremière & J. Capelle, 1987. Le chalutage en Méditerranée : le port de Sète. Evolution économique 1970-1984. Ifremer, Rapp. économ. jurid. 3: 147 p.

Millot C., 1999. Circulation in the Western Mediterranean sea. *J. Mar. Sys.* **20** (1-4): 423-442.

Negroni G., 2001. Albania: descrizione del settore della pesca con particolare riguardo per l'acquacoltura. *Il Pesce* **1** (01): 35-43.

Onken R., A. R. Robinson, P. F. J. Lermusiaux, P. J. Haley Jr. & L. A. Anderson, 2003. Data-driven simulations of synoptic circulation and transports in the Tunisia-Sardinia-Sicily region. *J. Geophys. Res.* **108** (C9): 8123.

Orrù P. & A. Ulzega, 1987. Rilevamento geomorfologico costiero e sottomarino applicato alla definizione delle risorse ambientali (Golfo di Orosei, Sardegna orientale). *Mem. Soc. Geol. It.* **37**: 471-479.

Orsi Relini L. & A. Peirano, 1982 Osservazioni sull'accrescimento prematurativo del Potassolo del Mar Ligure (*Micromesistius poutassou*, Risso 1826, Osteichthyes, Gadidae). *Boll. Mus. Ist. Biol. Univ. Genova* **50** (suppl.): 280-286.

Orsi Relini L. & A. Peirano, 1983 A length-age key for *Micromesistius poutassou* Risso, Osteichthyes, Gadidae, of the Ligurian Sea. *Rapp. Comm. int. Mer Médit.* **28** (3): 281-284.

Orsi Relini L. & A. Peirano, 1985. Biological notes on the blue whiting, *Micromesistius poutassou* Risso, of the Ligurian Sea. *FAO Fish. Rep.* **336**: 113-117.

Papaconstantinou C., 1988. Fauna graeciae IV. Check-list of marine fishes of Greece. NCMR - Hellenic Zoological Society, Athens: 257 p.

Papaconstantinou C., E. Karagitsou, K. Stergiou, V. Vassilopoulou, G. Petrakis, C. Mytilineou & T. Panou, 1998. Population dynamics of demersal fishes in Korinthiakos, Patraikos and Ionian Sea. Part II: Dynamics of commercially important species (hake, red mullet, red pandora and blue whiting). National Centre for Marine Research, Special Issue No 13.

Peres J. M. & J. Picard, 1964. Nouveau manuel de bionomie benthique de la Mer Méditerranée. Rec. Trav. Mar. Endoume 31 (47): 137 p.

Poulain P. M., 1995. OGEX1 Cruise. Cruise report. 21 p.

Poulos S. E., P. G. Drakopoulos & M. B. Collins, 1997. Seasonal variability in sea surface oceanographic conditions in the Aegean Sea (Eastern Mediterranean): an overview. *Journal of Marine Systems* **13**: 225-244.

Quinn T. J. I. & N. J. Szarzi, 1993. Determination of sustained yield in Alaska's recreational fisheries. *In* Proceedings of the international symposium on management strategies for exploited fish populations. G. Kruse, D.M. Eggers, R.J. Marasco, C. Pautzke & T.J.I. Quinn eds. Alaska Sea Grand College Program Report, 93-02, University of Alaska, Fairbanks, Alaska.

R Development Core Team, 2004. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, ISBN 3-900051-07-0, URL http://www.R-project.org.

Rabitti S., F. Bianchi, A. Bolfrin, L. Da Ros, G. Socal & C. Totti, 1994. Particulate matter and phytoplankton in Ionian Sea. *Oceanologica Acta* **17** (3): 297-307.

Ragonese S., M. G. Andreoli, G. Bono, G. B. Giusto, P. Rizzo & G. Sinacori, 2004. Overview of the available biological information on demersal resources of the Strait of Sicily. (Sintesi delle conoscenze sulle risorse demersali dello Stretto di Sicilia). *In* Report of the Expert Consultation on the Spatial distribution of Demersal Resources in the Straits of Sicily and the Influence of Environmental Factors and Fishery Characteristics. MedSudMed. *GCP/RER/010/ITA/MSM-TD-02. MedSudMed Technical Documents* **2**: 67-74.

Ragonese S. & B. Reale, 1995. Distribuzione e crescita dello scorfano di fondale, *Helicolenus dactylopterus dactylopterus* (Delaroche, 1809), nello Stretto di Sicilia (Mar Mediterraneo). *Biol. Mar. Medit.* **2** (2): 269-273.

Rehault J.-P., G. Boillot & A. Mauffret, 1984. The western Mediterranean basin geological evolution. *Mar. Geol.* **55**: 447- 477.

Relini G., J. Bertrand & A. Zamboni eds, 1999. Sintesi delle conoscenze sulle risorce da pesca dei fondi del Mediterraneo centrale (Italia e Corsica). Synthesis of the knowledge on bottom fishery resources in central Mediterranean (Italy and Corsica). Biol. Mar. Medit. Vol. 6: 868 p.

Righini P. & A. Voliani, 1996. Distribuzione e stima dei parametri di crescita di *Zeus faber* L. nell'Arcipelago Toscano. *Biol. Mar. Medit.* **3** (1): 567-568.

Rizzi E., P. Paparella, G. Marano & G. Martino, 1994. Popolamenti fitoplanctonici nell'Adriatico meridionale. *Biol. Mar. Medit.* **1** (1): 195-199.

Robinson A. R., M. Golnaraghi, W. G. Leslie, A. Artegiani, A. Hecht & E. Lazzoni, 1991. The Eastern Mediterranean general circulation: features, structure and variability. *Dynamics of Atmospheres and Oceans* **15**: 215-240.

Rochet M. J. & V. Trenkel, 2003. Which community indicators can measure the impact of fishing? A review and proposals. *Can. J. Fish. Aquat. Sci.* **60**: 86-99.

Rochet M. J., V. Trenkel, J. C. Poulard & I. Péronnet, 2000. Using discards estimates for assessing the impact of fishing on biodiversity. ICES CM 2000/Mini:06. 13 p.

Rochet M. J., V. M. Trenkel, R. Bellail, F. Coppin, O. Le Pape, J.-C. Mahé, A. Morin, J.-C. Poulard, I. Schlaich, A. Souplet, Y. Vérin & J. A. Bertrand, 2005. Combining indicator trends to assess ongoing changes in exploited fish communities: diagnostic of communities off the coasts of France. *ICES Journal of Marine Science* **62**: 1647-1664.

Rochet M. J., V. M. Trenkel, J. A. Bertrand & J.-C. Poulard, 2004. R routines for survey based fisheries population and community indicators (R-SUFI). Ifremer, Nantes. Limited distribution.

Rossi S. & G. Gabbianelli, 1978. Geomorfologia del Golfo di Taranto. *Boll. Soc. Geol. It.* **97**: 423-437.

Sardà F., A. Calafat, M. Flexas, A. Tselepides, M. Canals, M. Espino & A. Tursi, 2004. An introduction to Mediterranean deep-sea biology. *Sci. Mar.* **68** (Suppl. 3): 7-38.

Sparnocchia S., G. P. Gasparini, M. Astraldi, M. Borghini & P. Pistek, 1999. Dynamics and mixing of the Eastern Mediterranean outflow in the Tyrrhenian basin. *Journal of Marine Systems* **20**: 301-317.

Spedicato M. T. ed 2004. GRUND 2004 – Relazione finale. Internal report: 38 p.

Stanley D. J., 1977. Post-Miocene depositional patterns and structural displacement in the Mediterranean. *In* The oceans basins and margins: the Eastern Mediterranean. A.E.M. Nairn, W.H. Kanes & F.G. Stheli eds. Plenum Press, New York: 77-128.

Stergiou K. I., E. D. Christou, D. Georgopoulos, A. Zenetos & C. Souvermezoglou, 1997. The Hellenic Seas: physics, chemistry, biology and fisheries. *In* Oceanogr. Mar. Biol. Annual Review. A.D. Ansell, R.N. Gibson & M. Barnes, eds. Vol. 35: 415-538.

Taquet M., J. C. Gaertner & J. Bertrand, 1997. Typologie de la flottille chalutière du port de Sète par une méthode de segmentation. *Aquat. Living Resour.* **10** (3): 137-148.

Theocharis A., D. Georgopoulos, A. Lascaratos & K. Nittis, 1993. Water masses and circulation in the central region of the Eastern Mediterranean: Eastern Ionian, South Aegean and Northwest Levantine, 1986-1987. *Deep Sea Res.* **II** (40): 1121-1142.

Theocharis A. N. K., H. Kontoyiannis, E. Papageorgiou & E. Balopoulos, 1999. Climatic changes in the Aegean Sea influence the Eastern Mediterranean thermohaline circulation (1986-1997). *Geophysical Research Letters* **26** (11): 1617-1620.

Trenkel V. & M. J. Rochet, 2003. Performance of indicators derived from abundance estimates for detecting the impact of fishing on a fish community. *Can. J. Fish. Aquat. Sci.* **60**: 67-85.

Trippel E. A., 1995. Age at maturity as a stress indicator in fisheries. *Bioscience* **45**: 759-771.

Tursi A., P. Maiorano, G. D'Onghia & R. Carlucci, 2000. Analysis of trawls' discard operation in the central and eastern Mediterranean sea. EC DG XIV, Contract 97/0044. Final Report.

Tursi A., A. Matarrese, G. D'Onghia, M. Panza, L. Sion & P. Maiorano, 1993. Sintesi dell'attività svolta dall'Unità Operativa "I10": Mare Ionio Settentrionale. *In* Atti Seminario Unità Operative Valutazione Risorse Demersali, Mazara del Vallo, N.T.R. - I.T.P.P., Special Publication, 2: 163-168.

Tursi A., A. Matarrese, G. D'Onghia, M. Panza, L. Sion & P. Maiorano, 1994. Considerazioni sullo stato di sfruttamento delle risorse demersali (Capo d'Otranto - Capo Spartivento). *Biol. Mar. Medit.* **1** (2): 95-104.

Ungaro N., L. Ceriola, C. A. Marano, K. Osmani & P. Mannini, in press. On the suitability of some indicators from trawl surveys data. Mediterranean Geographical Sub-Area n° 18. *In* Proceedings of the Seminar on Reference Points, 20-21 April 2004. Rome.

Ungaro N. & R. Gramolini, submitted. Possible effect of bottom temperature on distribution of *Parapenaeus longirostris* (Lucas, 1846) in the Southern Adriatic (Mediterranean Sea). *Turkish Journal of Fisheries and Aquatic Sciences*.

Ungaro N., G. Marano, L. Ceriola, G. Bertoldi & L. Di Turi, 2002. Lo sbarcato del porto peschereccio di Molfetta (Basso Adriatico): aree di pesca, catture e sforzo in un anno di osservazioni. *Biol. Mar. Medit.* **9** (1): 290-294.

Vanney J.-R. & Gennesseaux, 1985. Mediterranean Seafloor Features: Overview and Assessment. *In* Geological evolution of the Mediterranean Basin. D.J. Stanley & F.C. Wezel eds. Spring-Verlag Inc., New York: 3-32.

Vatova A., 1974. Caratteristiche della fauna bentonica della costa occidentale del Golfo di Taranto. *Atti Accad. Naz. Lincei. Serie VIII* **LV** (5): 565-570.

Velegrakis A. F., H. Kontayannis, G. Vourgaris, V. Papadopoulos, S. Christianidis, S. Wells, S. Goa & M. B. Collins, 1996. Water flow through the Cretan Arc Straits. *In* PELAGOS second annual progress Report. E. Balopoulos, ed. National Centre for Marine Research, Hellas, Athens: 97-121.

Vilicic D., N. Leder, Z. Grzetic & N. Jasprica, 1995. Phytoplankton and oceanographic conditions in the strait of Otranto (Eastern Mediterranean). *Rapp. Comm. int. Mer Médit.* **34**: 218.

Voliani A., A. Abella, R. Auteri & R. Silvestri, 1998. Nota sui parametri biologici di *Mullus surmuletus* L.,1758 nell'Arcipelago Toscano. *Biol. Mar. Medit.* **5** (1): 864-868.

Voliani A., A. Abella & C. Mancusi, 2003. Accrescimento di tre specie di *Pagellus* nel Mar Ligure sud-orientale. *Biol. Mar. Medit.* **10** (2): 971-974.

Yuce H., 1995. Northern Aegean water masses. *Estuarine, coastal & shelf science* **41**: 325-343.

Zamboni A. & G. Relini, 1986. Note di biologia di *Spicara flexuosa* (Osteichthyes, Centracanthidae) del Mar Ligure. *Boll. Mus. Ist. Biol. Univ. Genova* **52** (suppl.): 251-265.

Zervakis V., D. Georgopoulos & P. G. Drakopoulos, 2000. The role of the North Aegean in triggering the recent Eastern Mediterranean climatic changes. *Journal of Geophysical Research* **105 (C11)** (23): 103-116.

Zodiatis G., S. Alexandri, P. Pavlakis, L. Jonsson, G. Kallos, A. Demetropoulos, G. Georgiou, A. Theodorou & E. Balopoulos, 1996. Tentative study of flow patterns in the North Aegean Sea using NOAA – AVHRR images and 2D model simulation. *Annales Geophysicae* **14**: 1221-1231.

Zodiatis G., A. Lascaratos, G. Georgiou, G. Korres & M. Syrimis, 2003. High resolution nested model for the Cyprus, NE Levantine Basin, eastern Mediterranean Sea: implementation and climatological runs. *Annales Geophysicae* **21**: 221-236.

Zodiatis G., A. Theodorou & A. Demetropoulos, 1998. Hydrography and circulation in the area south of Cyprus in late summer 1995 and in spring 1996. *Oceanologica Acta* **21**: 447-458.

Zore-Armanda M., 1968. The system of currents in the Adriatic Sea. *Rev. Fish. Counc. Medit.* **34**: 1-48.

Zore-Armanda M., 1969. Water exchange between the Adriatic and Eastern Mediterranean. *Deep Sea Res.* **16**: 171-178.

[V] Annexes

Annex I: List of participants

NAME	INSTITUTION	COUNTRY
ABELLA Alvaro	ARPAT	Italy
BEKAS Petros	HCMR	Greece
BELCARI Paola	Univ. Pisa	Italy
BERTRAND Jacques (chairman)	Ifremer. Nantes	France
BIANCHINI Marco L.	IBAF-CNR	Italy
CAMILLERI Matthew	MRAE	Malta
CARPENTIERI Paolo	Dip. BAU Univ. Rome-	Italy
CHARILAOU Charis	DFMR	Cyprus
DE RANIERI Stefano		Italy
DIMECH Mark	IAMC-CNR	Italy
DOKOS John	HCMR	Greece
FOLLESA M. Cristina	DBAE-Cagliari-	Italy
GAERTNER Jean-Claude	Univ. Marseille	France
GIL DE SOLA Luis	IEO	Spain
GITARAKOS Giorgos	FRI	Greece
HADJISTEFANOU Nikos	DFMR	Cyprus
ISAJLOVIČ Igor	IOF-Split	Croatia
JUKIC Stjepan	IOF-Split	Croatia
KALLIANIOTIS Argyris	NAGREF-FRI	Greece
KAVADAS Stephanos	HCMR	Greece
LAZARAKIS Giorgos	HCMR	Greece
LEFKADITOU Evgenia	HCMR	Greece
LEKKAS Vasilis	FRI	Greece
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MANFREDI Chiara	Univ. Bologna	Italy
MANNINI Alessandro	DIPTERIS-Genova	Italy
MARCETA Bojan		Slovenia
MOSTEIRO Alicia	MRAE	Malta
MURENU Matteo	DBAE-Cagliari	Italy
NORRITO Giacomo	IAMC-CNR	Italy
OSMANI Kastriot		Albania
PAPACONSTANTINOU Costas	HCMR	Greece
PERISTERAKI Panagiota (Nota)	HCMR	Greece
PERTIERRA Juan Pablo	CE	Belgium
PICCINETTI Corrado	Univ. Bologna, LBMP	Italy
PINAKIS Elfterios	HCMR	Greece
POLITOU Chrissi-Yianna	HCMR	Greece
POULARD Jean-Charles	Ifremer. Nantes	France
RAGONESE Sergio	IAMC-CNR	Italy
RELINI Giulio	SIBM DIPTERIS. Genova	Italy
RINELLI Paola	IAMC-CNR. Messina	Italy
ROCHET Marie-Joelle	Ifremer. Nantes	France
RODRIGUEZ Mariano Garcia	IEO	Spain
SERENA Fabrizio	ARPAT	Italy
SION Letizia	Dep. Zoology. Univ. Bari	Italy
SKARVELIS Kostas	HCMR	Greece
SOUPLET Arnauld	Ifremer. Sète	France
SPEDICATO Maria Teresa	COISPA	Italy
TRENKEL Verena	Ifremer. Nantes	France
TSAMIS Evaggelos	HCMR	Greece
TURSI Angelo	Dep. Zoology. Univ. Bari	Italy
UNGARO Nicola	Univ. Bari	Italy
VIDORIS Pavlos	FRI Kavala	Greece

Annex II. List of the species for population analyses by GSA.

L_VALIDE	CodeEsp	1	6	7	8	9	10	11	17	18	19	20	22
Argentina sphyraena	ARGESPY			1	1			1	1	1		1	1
Aristaeomorpha foliacea	ARISFOL				1	1	1	1		1	1		
Aristeus antennatus	ARITANT	1	1	1		1	1	1			1		
Aspitrigla cuculus	ASPICUC	1	1	1	1	1		1	1	1	1	1	1
Boops boops	BOOPBOO			1	1			1		1		1	1
Centrophorus granulosus	CENTGRA				1			1					
Citharus linguatula	CITHMAC			1		1	1	1	1			1	1
Conger conger	CONGCON			1	1			1	1	1		1	
Dicentrarchus labrax	DICELAB							1					
Diplodus annularis	DIPLANN			1				1	1			1	
Eledone cirrhosa	ELEDCIR	1	1	1	1	1	1	1	1	1	1	1	
Eledone moschata	ELEDMOS	1	1	1	1	1		1	1	1		1	1
Engraulis encrasicolus	ENGRENC			1	1					1		1	1
Chelidonichthys gurnardus	EUTRGUR	1	1	1		1		1	1	1		1	1
Galeus melastomus	GALUMEL	1	1	1	1	1		1		1	1	1	1
Helicolenus dactylopterus dactylopterus	HELIDAC	1	1	1	1	1	1	1	1	1	1	1	1
Illex coindetii	ILLECOI	1	1	1	1	1	1	1	1	1	1	1	1
Lepidopus caudatus	LEPICAU			1	1				1	1		1	
Lepidorhombus boscii	LEPMBOS	1	1	1	1	1	1	1	1	1	1	1	1
Lepidotrigla cavillone	LEPTCAV	1	1	1	1			1	1	1		1	1
Loligo vulgaris	LOLIVUL	1	1	1	1	1	1	1	1	1		1	
Lophius budegassa	LOPHBUD	1	1	1	1	1	1	1	1	1	1	1	1
Lophius piscatorius	LOPHPIS	1	1	1	1	1	1	1	1	1			
Merluccius merluccius	MERLMER	1	1	1	1	1	1	1	1	1	1	1	1
Micromesistius poutassou	MICMPOU	1	1	1	1	1	1		1	1	1	1	1
Mullus barbatus	MULLBAR	1	1	1	1	1	1	1	1	1	1	1	1
Mullus surmuletus	MULLSUR	1	1	1	1	1	1	1	1	1	1	1	1
Mustelus mustelus	MUSTMUS							1	1				
Nephrops norvegicus	NEPRNOR	1	1	1	1	1	1	1	1	1	1	1	1
Octopus vulgaris	OCTOVUL	1	1	1	1	1	1	1	1	1		1	
Pagellus acarne	PAGEACA			1	1	1	1	1	1		1	1	
Pagellus bogaraveo	PAGEBOG	1	1	1	1	1	1	1	1	1		1	1
Pagellus erythrinus	PAGEERY	1	1	1	1	1	1	1	1	1	1	1	1
Parapenaeus longirostris	PAPELON	1	1	1	1	1	1	1	1	1	1	1	1
Penaeus kerathurus	PENAKER							1					
Phycis blennoides	PHYIBLE	1	1	1	1	1	1	1	1	1	1	1	1
Raja asterias	RAJAAST			1	1			1					1
Raja clavata	RAJACLA			1	1	1		1	1			1	1
Sardina pilchardus	SARDPIL			1	1					1		1	1
Scomber japonicus	SCOMPNE							1					
Scorpaena notata	SCORNOT			1				1	1	1		1	
Scyliorhinus canicula	SCYOCAN	1	1	1	1	1		1	1	1		1	1
Sepia officinalis	SEPIOFF					1		1	1			1	1
Sepia orbignyana	SEPIORB			1	1			1	1			1	1
Serranus cabrilla	SERACAB			1	1			1		1		1	
Solea solea	SOLEVUL	1	1	1		1		1	1			1	1
Pagrus pagrus	SPARPAG	1	1			1		1					
Spicara maena	SPICFLE	1	1	1	1	1	1	1	1	1	1	1	1
Spicara maena	SPICMAE							1					
Spicara smaris	SPICSMA	1	1	1	1	1		1	1	1	1	1	1
Squalus acanthias	SQUAACA				1			1	1				
Squilla mantis	SQUIMAN			1				1	1	1		1	

L_VALIDE	CodeEsp	1	6	7	8	9	10	11	17	18	19	20	22
Trachurus mediterraneus	TRACMED	1	1	1	1	1	1			1	1	1	1
Trachurus picturatus	TRACPIC				1								
Trachurus trachurus	TRACTRA	1	1	1	1	1	1			1	1	1	1
Chelidonichthys lucernus	TRIGLUC			1				1	1	1		1	
Chelidonichthys lastoviza	TRIPLAS			1	1	1		1	1			1	1
Trisopterus minutus	TRISCAP	1	1	1		1	1	1	1	1		1	1
Zeus faber	ZEUSFAB	1	1	1	1	1	1	1	1	1		1	1

Annex III. L50 per species and year by GSA.

L_VALIDE	CodeEsp	1	6	7	8	9	10	11	17	18	19	20	22
Argentina sphyraena	ARGESPY												
Aristaeomorpha foliacea	ARISFOL							*			*		
Aristeus antennatus	ARITANT							*					
Aspitrigla cuculus	ASPICUC		*	*	*	*				*	*		*
Boops boops	BOOPBOO												
Centrophorus granulosus	CENTGRA												
Citharus linguatula	CITHMAC			*		*						*	*
Conger conger	CONGCON												
Dicentrarchus labrax	DICELAB												
Diplodus annularis	DIPLANN												
Eledone cirrhosa	ELEDCIR							*		*	*		
Eledone moschata	ELEDMOS							*		*			
Engraulis encrasicolus	ENGRENC												
Chelidonichthys gurnardus	EUTRGUR		*	*						*			*
Galeus melastomus	GALUMEL	*	*	*	*			*				*	
Helicolenus dactylopterus dactylopterus	HELIDAC	*	*	*	*							*	*
Illex coindetii	ILLECOI							*					
Lepidopus caudatus	LEPICAU												
Lepidorhombus boscii	LEPMBOS		*	*	*	*					*		*
Lepidotrigla cavillone	LEPTCAV												
Loligo vulgaris	LOLIVUL							*					
Lophius budegassa	LOPHBUD		*	*						*	*	*	*
Lophius piscatorius	LOPHPIS			*						*			
Merluccius merluccius	MERLMER		*	*	*			*				*	*
Micromesistius poutassou	MICMPOU		*	*	*						*		*
Mullus barbatus	MULLBAR	*	*		*					*	*		
Mullus surmuletus	MULLSUR		*							*	*		*
Mustelus mustelus	MUSTMUS												
Nephrops norvegicus	NEPRNOR							*					
Octopus vulgaris	OCTOVUL							*					
Pagellus acarne	PAGEACA	*	*	*	*						*		*
Pagellus bogaraveo	PAGEBOG		*	*						*			*
Pagellus erythrinus	PAGEERY		*	*	*	*	*			*	*	*	*
Parapenaeus longirostris	PAPELON							*					
Penaeus kerathurus	PENAKER												
Phycis blennoides	PHYIBLE		*	*	*							*	*
Raja asterias	RAJAAST												
Raja clavata	RAJACLA				*							*	*
Sardina pilchardus	SARDPIL												
Scomber japonicus	SCOMPNE												
Scorpaena notata	SCORNOT												
Scyliorhinus canicula	SCYOCAN		*	*	*			*				*	
Sepia officinalis	SEPIOFF												
Sepia orbignyana	SEPIORB												
Serranus cabrilla	SERACAB												
Solea solea	SOLEVUL			*									
Pagrus pagrus	SPARPAG												
Spicara maena	SPICFLE		*	*	*					*	*		
Spicara maena	SPICMAE												
Spicara smaris	SPICSMA									*	*		*
Squalus acanthias	SQUAACA												
Squilla mantis	SQUIMAN												
Trachurus mediterraneus	TRACMED		*	*	*						*	*	*

L_VALIDE	CodeEsp	1	6	7	8	9	10	11	17	18	19	20	22
Trachurus picturatus	TRACPIC												
Trachurus trachurus	TRACTRA		*	*	*						*		*
Chelidonichthys lucernus	TRIGLUC												
Chelidonichthys lastoviza	TRIPLAS												
Trisopterus minutus	TRISCAP		*	*						*			
Zeus faber	ZEUSFAB		*	*				*		*			*

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