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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES OPINION ON

'SENSITIVE AND ESSENTIAL FISH HABITATS IN THE MEDITERRANEAN SEA'

6-10 March 2006, Rome

This report was evaluated by the Scientific, Technical and Economic Committee for Fisheries (STECF) in its plenary session of 3-7 April 2006

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

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1 INTRODUCTION

1.1 BACKGROUND

A Working Group meeting of the SGMED 06-01 was held in Rome from 6-10 March 2006. The major aims were to "identify and map marine habitats crucial for conservation of commercial fish and shellfish resources". Scientists from Italy, Spain, Greece, Turkey and Lebanon suggested approaches to determine "*Sensitive and Essential Fishery Habitats (SH and EFH)*" that should be protected in order to improve the status of exploited stocks in the Mediterranean Sea. STECF notes that in defining and identifying SH and EFH, the Sub-group did not take into account information on protected species (sea turtles, cetaceans, monk seals, etc.) and fish species with no commercial value.

Several fish resources in the Mediterranean are suffering from overfishing (see reports SEC 2002 (1374) on Mediterranean shared stocks, SEC 2004, (772) on Mediterranean fleets, SEC 2005, (266) on the state of the stocks and the reports of the GFCM-SAC). Various protection measures have been adopted in the last 15 years (fishing bans, MPAs etc.) but there is no clear evidence of a measurable reduction in fishing mortality or stock recovery. For the most important fish habitats, additional measures beyond those already implemented at national or Community level are to be considered in management plans intended to ensure the long term sustainability of the resources. At present a major problem is the standardization of a common methodology for identification and delineation of such areas.

Although measures to protect ESH and SH have already been taken elsewhere, (i.e. US and ICES areas), the approach is relatively new to the Mediterranean. The key issues that must be addressed in identifying ESH and SH are; which species should be considered, which stage of the life cycle, the extent of the area to be closed to fisheries, which actions should be implemented and what are the potential ecological and socio-economical implications of introducing any protection areas identified? The Sub-group report primarily addresses the definition and identification of SH and EFH including criteria for the selection of species and critical life stages taking into account experience gained in areas outside the Mediterranean Sea.

STECF reviewed the report of SGMED and makes the following observations and recommendations.

1.2 DEFINITIONS

For the purposes of identifying EFH and SFH in the Mediterranean, STECF has adopted the following definitions:

ESSENTIAL FISH HABITAT (EFH) is a habitat identified as essential to the ecological and biological requirements for critical life history stages of exploited fish species, and which may require special protection to improve stock status and long term sustainability.

SENSITIVE HABITATS (SH) are fragile habitats that are recognised internationally as ecologically important and which support important assemblages of commercial and non-commercial fish species and which may require special protection e.g. *Posidonia* beds

2 IDENTIFICATION OF HABITATS

2.1 IDENTIFICATION OF SENSITIVE HABITATS

In the Mediterranean Sea habitats showing the SH characteristics are widespread, both on continental shelf and slope. STECF has identified the following habitats as sensitive habitats and recommends that they should be protected:

Posidonia oceanica beds, Coralligenous and Maerl beds, Sub marine canyons, *Leptometra phalangium* and *Funiculina quadrangularis* beds, Coastal lagoons, Deep-sea coral mounds.

2.2 IDENTIFICATION OF ESSENTIAL FISH HABITATS

2.2.1 Selection of priority species and critical stages for the identification of Essential Fish Habitat

Selection of priority species was based on stock status and overall ranked value of commercial landings for each Mediterranean GSA (Geographical Sub-Areas adopted by GFCM_FAO), independent of fleet segment or fishery type.

2.2.2 Selection of life stages

The most important EFH were identified:

- **Nursery grounds** where the highest concentrations of recruits are found.
- **Spawning areas** with large seasonal concentrations of mature females. Mature females were considered as the best criterion since males of many species often appear in spawning condition outside of the main spawning season.

2.2.3 Persistency in space and time

Stability over time (seasons and years) of biological critical stages is considered strong justification to identify EFH for commercial species. Analysis of persistence using time series of abundance data should be considered a basic part of the methodological approach for EFH identification in the Mediterranean. Such estimates are available for many GSAs in the Mediterranean.

The EU funded long-term projects such MEDITS and GRUND have been identified as useful sources of time-series data to identify EFHs. The Sub-group report successfully identifies EFHs for hake and red mullet. For example, for GSA9, it suggested that a closure of 3-5% of the fishing grounds for hake would offer protection for 20-50% of hake recruits in the Tyrrhenian-Ligurian Sea.

2.2.4 Available information on Essential fish habitat

The sub-group report presents candidate EFHs for the major demersal and pelagic commercial fish species for which information was available for different areas of the Mediterranean *vis*: hake (*Merluccius merluccius*) and red mullet (either *Mullus barbatus or M. surmuletus*), the deep-sea rose shrimp (*Parapaeneus longirostris*) and Norway lobster (*Nephrops norvegicus*), anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*).

STECF notes however that information availablility is not consistent for each of these species and that the species in each of the different regions of the Mediterranean Sea are not all covered.

For some demersal fishes, the Sub-group considered that temporary protected areas seemed the best option for the protection of the young stages of some species. This was the case for red mullet in most of the GSAs. Hake is probably the best described species for the Mediterranean: nurseries and spawning areas are well known for most of the areas. Good knowledge is also available on deep-water rose shrimp (*Parapaeneus longirostris*). For small pelagic fishes some information on the location of nursery areas are presented in the report of the Sub-group. Preliminary maps of the spawning areas for large pelagics and areas with large concentrations of juveniles are also given in the report. The report also highlights the shortage of data on the location and persistence of concentrations of the youg stages of some species, notably the pelagics and this was particularly true for the southern and easternmost parts of the Mediterranean.

The Subgroup report also suggested that the failure of existing protection measure is in many cases due to a lack of cooperation among scientists, managers and fishermen and suggests that consultation among all stake-holders is desirable before decisions on the protection of EFHs are taken.

3 EUROPEAN EXPERIENCE IN HABITAT PROTECTION

3.1 EXPERIENCES FROM OUTSIDE THE MEDITERRANEAN SEA

Marine Protection Areas (MPAs) have been used widely in fisheries management, both locally nationally and internationally. The sub-group report considered some examples from the northeast Atlantic.

A common feature in most previous and existing North Sea MPAs is that they do not appear to have been very successful in reaching their management objectives. This is further complicated by the fact that, in most cases it has been difficult or impossible to identify whether changes in the stocks are due to the effects of management or due to natural variations in the stocks throughout the lifespan of the MPA. This has often been due to insufficient relevant baseline information. Nevertheless, there are some generalisations that can be made regarding the use of closed areas in management.

- If fishing effort is not strictly managed, then seasonal closures often lead to increasing effort outside the closure period, thus diluting or negating the desired effect.
- If the fisheries on the particular stocks are managed by stock specific TAC/quota system, effort is likely to increase either in adjacent areas or in the area of closure after the closure has been lifted.
- If the closure is restricted to only certain vessels or gear types, any increase in effort of vessels unaffected by the closure may also may dilute or negate any potential benefits.
- For migratory species, including cod, mackerel and herring, MPAs are probably not very effective as a primary management tool unless extensive proportions of the range of the stock can be permanently closed to fishing.
- Simulation modelling of the likely effect of closed areas on mobile fish species is desirable. However such simulation requires rather detailed information on the variation in time and space of both the species considered and the fisheries exploiting them. In many cases the information required may not be available.

3.2 COORDINATION ACTIVITY WITH OTHER RELATED SCIENTIFIC ACTIVITIES ON SH, EFH AND MPA.

The complexity of the conditions for successful results of MPA has led to initiation of 2 EU funded projects on MPAs:

- 'PROTECT' covering the NE Atlantic
- 'EMPAFISH' covering the Western Mediterranean and the Atlantic.

STECF suggests that future activities on MPAs in the Mediterranean should be coordinated with these 2 project.

4 STECF CONCLUSIONS AND RECOMMENDATIONS

1. STECF noticed that it was not possible for the sub-group to give an exhaustive answer to each of the TORS, particularly to those asking for geographical details on the location and extent of SH and EFH for all species concerned. In order to identify the location and extent of SH and EFH in the Mediterranean, there is a clear need to collect and/or collate baseline information on the distribution and abundance of the critical life history stages of overexploited species.
2. SH are habitats linked to fish assemblages and benthic communities while EFH are areas of importance for commercial species. A better understanding of the physical

processes that influence aggregation behaviour is probably more important in identifying the geographical location and extent of EFH for pelagic species.

3. Both Sensitive Habitats (SH) and Essential Fish Habitats (EFH) should be protected in order to improve the current status of both habitats and stocks in an attempt to ensure the long-term sustainability of the Mediterranean fishery resources.
4. Sensitive Habitats (SH) of major relevance for the marine ecosystem are: *Posidonia* beds, Coralligenous biocoenoses, Maerl bottom, *Leptometra phalangium* beds, *Funiculina quadrangularis* beds, *Isidella elongata* beds, deep-water corals, sea mounds and canyons, sea bottom deeper than 1000 m. Some of these habitats are locally protected (i.e. Posidonia beds and deep-water corals) in the Mediterranean Sea while for others, current legislation offers no protection.
5. The identification of EFH for demersal species should be based on the location, extent and persistency of the critical life-stages of the species identified as priority species. Therefore, nursery grounds and spawning areas with large concentration of mature females should be especially considered as EFH.
6. The species to be selected for protection of EFH should be ranked according to the status of the stock and the landing value per geographic sub-area (GSA).
7. Information on inshore EFH and SH is farily well known. In EU legislation trawling is prohibited within three miles of the coast although illegal trawling is known to take place. However, information on the identification, location and extension of offshore EFH and SH are relatively limited.
8. Hake is the most important demersal species for which EFH information has been presented for different GSA (Table 1). Insufficient information on other species presented to STECF highlights the need to collect and collate baseline information in order to progress with the identification of EFH. Potential EFHs for elasmobranches need particular attention because of their vulnerability to exploitation.
9. Closed or restricted areas and seasons are the main measures to protect EFH. Those should be considered along with other technical measures as increasing gear selectivity, improved gear design, and reduction of fishing effort in areas adjacent to the protected areas of EFHs or after re-opening following a seasonal fishing ban.
10. Research should be conducted to improve the available scientific knowledge on EFH, such as oceanographic features, benthic characteristics, ecological processes and impact of fisheries.
11. The development of pan-Mediterranean programmes is required in order to provide consistent information and criteria to designate EFH and SH. One possible way forward would be to extend the EU data collection and/or EU experimental surveys to other Mediterranean countries through an agreement within the GFCM.
12. STECF considers that international agreements are needed to better protect some EFH and SH that are located in International waters.
13. Effect of closed areas on trends in SSB, R, F, biodiversity, etc, should be quantified prior to their implementation. The objectives of the closure should be clearly defined and a monitoring programme should be put in place to assess the affect of the closure against agreed performance measures.

Table 1 **Fish habitats knowledge for hake in the Mediterranean Sea**

	Identification		Recommendations
	Nurseries	**Spawning**	
SPAIN			
GSA 1	YES	NO	Enforcement of the existing measures Extension of some closed areas
GSA 6	YES	NO	
GSA 5	YES	NO	
ITALY			
GSA 9	YES	YES	Probably the most important and large nursery grounds in the Mediterranean sea. Closed areas for 3-5% of the persistent nursery grounds
GSA 19	YES	NO	To protect the main identified persistent nurseries
GSA 15	YES	NO	Protection of two main nursery grounds (15% of stable nurseries)
GSA 16	YES	NO	
GSA 19	YES	YES	
GREECE			
GSA 20	YES		Many small areas of nurseries closed to bottom trawl fishery during all year round
GSA 22	YES		
GSA 23	YES		

ANNEX:

REPORT OF THE WORKING GROUP OF SGMED 06-01

(OF THE SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES-STECF) ON

SENSITIVE AND ESSENTIAL FISH HABITATS IN THE MEDITERRANEAN SEA

Rome 6-10 March 2006

1 INTRODUCTION

1.1 TERMS OF REFERENCE

There is a need for identification and mapping of marine habitats crucial for conservation of commercial fish and shellfish resources in the Mediterranean Sea. Therefore in selecting such areas focus should be put on the protection of the most important commercial species in the Mediterranean (ref. GFCM). 3 major species groups are considered:

1. Small pelagics
2. Large pelagics
3. Demersal species incl. shrimps

The following points should be considered during the meeting:

1. Based on the list of Mediterranean species adopted by GFCM as priority species, select the main species whose critical life history stages are well known (hatching, larval stage, spawning) as well as the areas connected to these life stages, including spawning grounds, nursery areas and other life-cycle sensitive areas.
2. Identify and review the main candidates for protected habitats fundamental for the above selected species. Concentrating on those, which are already well documented.
3. Present possible regulation measures to protect such sensitive habitats in space and time (For example: closed areas, closed seasons, gear regulations) and comment the potential impact on:
    a. the stocks
    b. the commercial fisheries
4. Propose methodology to allow evaluation of the future impact of the proposed regulations, and identify the data required by each proposed method. If appropriate provide information on the data requirements for inclusion in the Data Regulation.

1.2 PARTICIPANTS

The following scientists attended the meeting:

DI NATALE Antonio
FIORENTINO Fabio
BARICHE Michel
ARDIZZONE Giandomenico (chair)
SOMARAKIS Stylianos
ABELLO' Pere
COLLOCA Francesco
PETRAKIS Gorge
VASSILIADES Lavrendis
MUNCH-PETERSEN Sten
BARO Jorge
MASSUTTI Enric
ARNERI Enrico
SERENA Fabrizio
MAYNOU Francesc
MURENU Matteo
CHILARI Anna
GUCU Ali Cemal
D'ONGHIA Gianfranco
KIDEYS Ahmet (STECF Secretariat)

1.3 BACKGROUND INFORMATION

The degradation of aquatic habitats essential for sustainable fish population is a growing concern in these last few years everywhere in the world (Ardizzone, in Appendix).

In the Mediterranean countries scientific interest on identification of fish habitats for protection is growing in recent years, probably both under EU and national pressure.

In the NE Atlantic increasing focus on the effects of fisheries on marine ecosystems by, for instance, ICES since the early 1990, lead to commissions under OSPAR and HELCOM

(www.ospar.org/eng/html) setting up a joint program in 2003 on mapping of marine habitats in the NE Atlantic.

Approach to protect fragile habitats based on the sustainability of the fishery resources and not from the exiting knowledge of fish habitats, can be found in some European Regulations.

For example in the Council Regulation 2371/2002 a number of measures, such as recovery plans, management plans, limitation of fishing effort, zones or periods in which fishing activities are prohibited, can be established in order to obtain the sustainable exploitation of the stocks, but no mention on identification and protection of important fish habitats is given in explicit way.

Similar position can be found in the proposal for a Council Regulation concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, with articles on Protected Areas (4, 5, 6) concerning the protection of generally important areas but not linked to the protection of single fish stock habitats.

No standard procedures to identify and protect important fish habitats have yet been implemented in the European waters. In some case as for instance the deep coral reef of Darwin Mounds in the United Kingdom waters, emergency procedures were applied in 2002 (Reg.2371-2002). Subsequently, since March 2004, this area has been permanently protected.

Seasonal closures as a measure to reduce the fishing effort are present in some Mediterranean countries but cannot be considered a protection of fish habitats even if in some cases the closed period fits properly to recruitment seasons as is the case for the red mullet in Italy.

Significant closed areas experiments are outside the Mediterranean and are the so called "Boxes" of the Atlantic Ocean and the North Sea. The purposes of these large closed areas are to contribute to the recovery of single stocks as for the "cod box", "plaice box", "mackerel box" and others (Munch-Petersen, in Appendix).

The scientific experience in protection of fish habitats is different in countries outside EU, for instance the USA, which probably was the first country to adopt a strategy for management of Essential Fish Habitats (EFH). With the adoption of the Sustainable Fisheries Act in 1996, significant new opportunities and challenges to protect the habitat of marine fish emerged, through the so called Magnuson-Stevens Fishery Conservation and Management Act.

In this Act "Essential Fish Habitat" was first defined in terms of an "area" but then was expanded and clarified to refer to "waters and substrates" including also the biological communities living there. Furthermore the amount of EFH necessary to each fishery is identified as the amount of habitat necessary to sustain a stock at the Optimum Yield (the maximum long-term productivity taking into account the protection of marine ecosystem), but without considering every habitat as essential. The term "essential" suggests that these fish habitats are a subset of each species entire habitat. Moreover USA legislation considered another kind of protection on Habitat Areas of Particular Concern (HAPC) considered as broader habitats including many species and/or ecologically important communities.

1.4 DEFINITIONS

As a first step a clear distinction between Fish Habitats and Protected or Closed Areas must be made. It should be underlined that, up to now, protected areas have not been considered important fish habitats and in most of the cases the actual use of these areas has been to limit the fishing effort in space and time. The protective function on some part of the marine environment, traditionally considered as "fragile", is a by-product of this kind of intervention.

At the moment common Protected Areas for fisheries in the Mediterranean countries of the EU are:

1. *Posidonia oceanica* and other phanerogam beds where bottom trawling is prohibited
2. The three nautical miles off the coast or within the 50 m isobath, only for trawling

3. Closed season for trawling in the Mediterranean Sea are in Algeria (1/5-1/8), Cyprus (1/6-7/11), Egypt (1/4-15-5), Greece (31/5-1/10), Israel (20/6-5/8), Italy (45 days August-September), Turkey (1/4 -15/7 Aegean coast,1/4 15/9 South coast) Spain (two months at different seasons in different areas).

In the near future according to the EC Proposal for the Council Regulation on management for Mediterranean fisheries, member states will be required to draw up a list of protected areas in which fishing activities are restricted for biological reasons specific to those zones and set out the types of fishing gear that may be used therein as well as the appropriate technical rules. At the same time The Commission will designate community fishing protected areas.

At the moment, therefore, our references are the Magnuson-Stevens act with the two kind of Fish Habitat (EFH and HAPC) and the proposal EC Regulation for the Mediterranean dealing with national fishing protected areas and community fishing protected Areas. Following these two important references, we adopted a similar definition for two levels of fish habitats which need protection:

ESSENTIAL FISH HABITAT (EFH) can be defined as the most fragile and critical part of each fish habitat, in relation to the ecological and biological needs of each exploited fish species which must be protected to maintain its sustainability.

SENSITIVE HABITATS (SH) can be defined as widespread habitats important for pools of commercial and non commercial fish species (assemblages) well recognized at international level for their ecological role (i.e. *Posidonia* beds) in the Mediterranean basin.

One approach to implement the protection of fish habitats could be that of the so called CLOSED AREAS, considered in their broader sense of restricted use of a part of potential fishery grounds.

Two different criteria have been indicated to select the basis on which information on EFH could be useful in the present evaluation:

1. a geographical one based on the FAO Geographic Sub-Areas (GSA) (Figure 1-1);
2. an economic one, based on the value of the landed fish species captured in the different GSA.

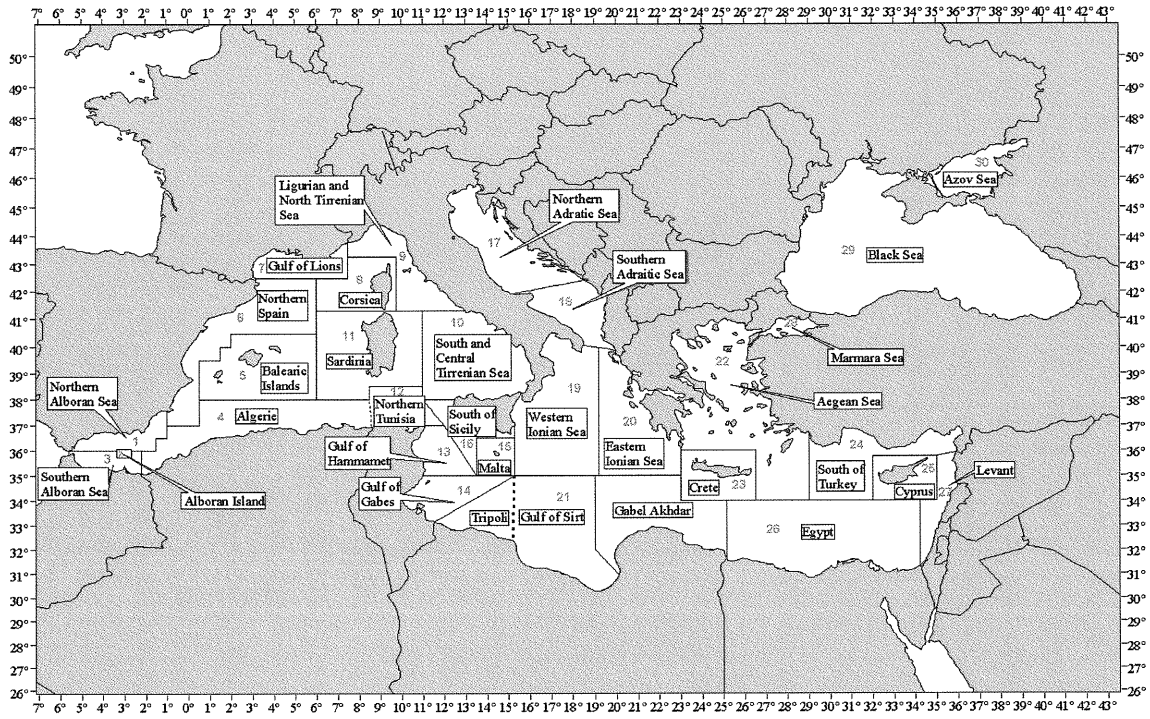

Figure 1-1 ***Map with the FAO-CFGM Geographic Sub-areas***

A rank distribution of the economic value of the fish species in each GSA will be useful at this stage to have information on the first three or four species.

1.5 PRIORITY LIST OF SPECIES

Species detection criteria suggested in this meeting was based on the ranking in order of landing value and total landing of species, independently on fleet segment or fishery type (e.g. small-scale fishery, trawling, purse seiners for small pelagics and large pelagic fishery).

Such criteria consider the importance of species for local fishery sector (GSA) rather than for their importance in terms of biodiversity conservation (e.g. endangered species or rare species) or other issues.

During the meeting several examples have been shown for different GSA (lists of commercial species). As an example the list for GSA9 is shown in below (Colloca et al.1&2, in Appendices).

Table 1-1 Landing *values of the main commercial species in GSA 9 in 2003*

	Landing value (euro)	*Total landing (tons)*
Merluccius merluccius	19,450,430.00	2079
Nephrops norvegicus	10,643,600.00	330
Mullus barbatus	9,852,680.00	1065
Loligo vulgaris	8,468,970.00	612
Sepia officinalis	6,958,060.00	738
Eledone cirrhosa	5,946,120.00	870
Parapenaeus longirostris	4,844,950.00	323

1.6 IDENTIFYING EFH FOR DEMERSALS

Taking into account the main features of demersal resources and the fishing pattern of main demersal fisheries in the Mediterranean, the most important critical stages to be considered for identifying EFH are spawning and recruitment. A strategy for identifying EFH in demersal species should be based on some steps. Firstly, the habitat must be identified as the physical space where individuals of a critical phase of a species are concentrated. This should be done through techniques of spatial analysis.

Some main definitions should be presented according to fishery research standards:

- **Recruits** can be defined as the youngest age class of the population recruited to the fishing ground, mostly 0 age group individuals(or Young of the Year = YOY)
- **Nursery** grounds could be considered as those areas where the highest concentrations of recruits are found.
- **Juveniles** can be defined as specimens before first maturity of gonads (virgin stage), regardless of their age.
- **Spawning** areas and season, those areas or periods of concentration of mature female. (Being well known that males of many species can show mature gonads also out the spawning period, for the identification of EFH it is better to consider only mature females)

After the EFH have been identified, in terms of space and time, the characterisation of abiotic and biotic factors affecting these habitats, as well as the processes developed therein, should be described, with special attention to their influence on the life history of target species. For this reason, knowledge on geomorphology, sedimentology, benthic and epi-benthic biocoenosis, hydrology and demersal resources assemblages is required.

Data collected through experimental surveys (such as MEDITS surveys) are available and the main constraint is the general need for a proper data analysis. This should be oriented towards the optimization of the available information in order to build-up a large-scale population-oriented framework of the fish habitats focusing thereafter on the selection of subset of each fish habitat to be considered as Essential and protected.

1.7 HOW EFH MUST BE IDENTIFIED AND SIZED

A right spatial scale is essential to evidence distributional patterns. Once a priority list of species has been established, the following steps should be followed at the GSA level:

- **identification of critical stages for each species**: during the meeting the importance to focus analysis on recruits and spawners has been stressed. The concentration behaviour that usually occurs during these critical life phases, can improve protection perspectives.
- **analysis of the spatial distribution of critical stages**, based on georeferenced data of abundance (standardized indexes). The number of individuals per square kilometre (n km $^{-2}$) allows also the comparison of data coming from different projects or surveys. Geostatistical techniques (e.g. ordinary kriging) can be adopted in order to achieve this task.
- **Identification of areas of significant highest abundance (hot spots).** The significance of differences between the identified areas and the remaining part of the distributional range of critical stages should be properly tested. Different approaches have been suggested during the meeting: analysis of spatial autocorrelation (e.g. G-Getis), cut-off threshold levels (e.g. values higher than the third quartile), etc. Independently of the statistical approach used, it has been stressed the importance to identify well defined areas around their maximum abundance cores in order to improve the management perspectives. Such areas should include a significant proportion of the population.
- **Exclusive use of habitat**. To detect discrete nursery habitats it is also suggested to combine density indices with an index of "Exclusiveness" by haul, calculated as the ratio between the density index of recruits and the total species density index. This latter index contributes to the identification of areas mostly occupied by recruits, excluding areas with other stages of the species, and could be useful to delimitate areas to be closed when nurseries are in trawlable bottom.
- **The stability through time** (seasons and years) of hot spot areas is a basic feature to consider hot spot areas as EFH for commercial species. Analysis of persistence during time series of abundance data should be considered as a basic part of methodological approach for EFH identification in Mediterranean.

An index of persistency of the temporal stability of the spatial patterns was given in Fiorentino et al., in Appendix.

During the meeting it has been also remarked the importance to improve the understanding of environmental features, either abiotic (oceanographic-hydrological conditions, bottom morphology, sediment type, etc.) or biotic (benthic community) that can at least partially explain the spatial distributional pattern of critical stages.

EFH size cannot be defined a priori. It must be related to the species ecology and biology. Once EFHs for the selected demersal commercial species have been identified, the proportions of individuals included yearly or seasonally into them have to be calculated.

To achieve this aim it is necessary to properly estimate the critical stages biomass or number (recruitment and spawning biomass) using geostatistical approaches.

An example for hake recruits in the GSA 9 has been shown during the meeting. In this area the proportion of the identified nursery areas ranged between 3.2 and 5.5% on the whole distributional area of hake. The number of recruits in the nurseries on the total estimated number of recruits in the GSA 9 for the four periods considered, ranged between 50% in 1985-87 and about 20% in 2000-01. Based on these data, we can conclude that the closure of 3.2-5.5% of the fishing area would produce the protection of 20-50% of total hake recruits (Colloca et al.2, in Appendix).

It has also been discussed the importance to correctly analyse the distribution of fishing effort in each GSA in order to evaluate the impact of closed areas measures on the activity of fishing fleet.

The information presented was based mainly on MEDITS survey for Spain and Greece and MEDITS and GRUND for Italy. Experimental surveys taking place once per year are not giving always complete information on the stability during the year of the main areas of recruits and spawners concentration.

2 DEMERSAL SH AND EFH

2.1 SENSITIVE HABITATS AT BASIN LEVEL

Sensitive habitats consist of complex ecosystems with endemic species, high biodiversity and high productivity (Ardizzone, in Appendix)

They represent refuge areas as well as nursery and spawning areas, important for crucial life history phases of many commercial and non commercial species. Their patches distribution allow "ecological connectivity" through dispersal mechanisms of marine organisms.

In the Mediterranean Sea several peculiar habitats showing the above mentioned characteristics are widespread, both on the continental shelf and on the slope.

In coastal waters, a fundamental habitat is represented by **Posidonia oceanica** meadows. This is a high priority habitat at EU level. Although it is in a depth range where trawling is forbidden by the law it is often affected by illegal fishing, causing impacts in the whole ecosystem. In fact, in many Mediterranean basins *P. oceanica* beds are heavily degraded.

Another phanerogam playing an important role and also affected by illegal trawl fishing in coastal waters is the eel-grass **Cymodocea nodosa.**

Coastal lagoons and brackish waters are some of the most productive ecosystems on the earth and are therefore favourable habitats for the development of juveniles of many marine species.

Recruits enter into lagoons both to enhance their growth and reduce predation risks and later they go back to the sea.

Main Mediterranean brackish water fish species are the eel *Anguilla anguilla*, the sea-bass *Dicentrarchus labrax*, the sea bream *Sparus aurata* and five mugilid species *Mugil cephalus, Liza ramada, Liza sapiens, Liza aurata, Chelon labrosus* (Ardizzone et al., 1988)

Another important SH present on the shelf is represented by the **coralligenous** biocoenosis. This habitat is impacted by several human acitivities. This biocoenosis consists of hard bottoms. Although it is not suitable to trawling, often this kind of fishing technique is carried out with modified gears. All the coastal detritic habitats can be found linked to coralligenous biocoenosis, in particular those with the facies of maërl.

Both on the shelf and slope, **seamounts** are areas of topographic elevation above the surrounding seafloor that support unique and valuable habitats. They generally show high biodiversity and high rates of endemism. Seamounts can provide refuges for complex benthic communities or be essential fish habitats for many commercial species. Several seamounts of different sizes and heights are known both in the Western and Eastern basin of the Mediterranean.

Another SH regarding both shelf and slope is represented by **submarine canyons**. They play an important role in the transport of terrigenous debris from coastal waters to deeper grounds making the presence of organic carbon content higher than in surrounding areas. Advective flux associated to the upwelling phenomena, due to the vorticity of underwater currents, provides a coupling between the shallow and deep-sea waters often resulting in an enrichment of the surface layers. Characteristic benthic *facies*, endemic species and high macro- and meiofaunal biomass have be found here. In the canyons, the occurrence of vertical displacement of macro- and megafaunal species even of commercial interest, such as *Aristeus antennatus* and *Aristeomorpha foliacea,* has been detected. These habitats can act as an "ecological refuge" for many bathyal species. In fact, they are generally unsuitable for trawling and represent a sheltered site for species during sensitive phases of their life cycle or for species well adapted to unstable environments.

On the shelf edge, an important SH is represented by the bottoms with facies of the crinoid ***Leptometra phalangium***. The peculiar biocenotic aspects of this facies can be related both to oceanographic conditions which characterise the shelf-to-slope sector and the characteristics of sediments. High concentrations of epibenthic suspensivorous organisms occur in these grounds as a result of the occurrence of bottom currents. The presence of *L. phalangium* enhances habitat heterogeneity by developing three-dimensional

communities, allowing consistent species richness and high rates of primary and secondary productivity. Moreover, this habitat can act as essential fish habitat for many commercial species such as *Merluccius merluccius, Micromesistius poutassou* and *Trisopterus minutus capelanus.*

On the shelf edge and the upper slope, bathyal mud is often covered by the facies of the cnidarian ***Funiculina quadrangularis*** throughout the Mediterranean. These bottoms represent essential habitats for some commercial crustaceans, such as *Parapenaeus longirostris* and *Nephrops norvegicus.* On deeper grounds another characteristic Mediterranean bathyal mud facies is that of the gorgonian *Isidella elongata,* which constitutes a selected habitat for the deep water shrimps *Aristeus antennatus* and *Aristaeomorpha foliacea.* Both *F. quadrangularis* and *I. elongata* facies have almost completely disappeared due to trawl fishing in many Mediterranean areas.

A rare SH in the Mediterranean Sea is represented by the **deep-sea coral** mounds, where living colonies of the scleractinian *Lophelia pertusa* and *Madrepora oculata* are present. This habitat is a hotspot of Mediterranean biodiversity and can represent an EFH for many commercial species. In January 2006 the GFCM decided on the protection from the towed gears (dredges and trawl nets) of 3 deep-sea sites in the Mediterranean High Seas: 1) the deep-water coral reefs in the Ionian Sea; 2) the chemosynthesis-based cold seep ecosystem near the Nile Delta; 3) the Eratosthene seamount, offshore of Cyprus. In order to protect these sites the GFCM has created the new legal category of "Deep-sea fisheries restricted area". The GFCM recommends members to call the attention of the appropriate authorities in order to protect these sites from the impact of any other activities jeopardizing conservation of the features that characterize these particular habitats.

Since February 2005 (GFCM 2005), trawling fishery in the Mediterranean Sea has been limited to 1000 m depth. Mediterranean fleets have not yet explored bottoms deeper than 1000 m; the precautionary prohibition (ban) aims to protect the still pristine and unknown deep-water ecosystems.

2.2 SH AND EFH IN DIFFERENT COUNTRIES AND GSA

2.2.1 Spain

2.2.1.1 SENSITIVE HABITATS

Information regarding SH in the western Mediterranean presented to this meeting come from bottom trawl surveys (see Baro et al., Maynou & Cartes, Massuti & Ordinas., Abello et al., in Appendices). Three sensitive habitats have been discussed: (i) maërl beds on the shallow shelf; (ii) *Leptometra* beds on the deep shelf; (iii) *Isidella* facies on the middle slope. In addition, *Posidonia* beds are another sensitive habitat widespread in the area, although they have not been considered, because they are protected by the trawl fishery regulation in force, which considers the isobath of 50 m as minimum depth. Other facies of circalitoral soft bottoms, such as those of the anthozoan *Funiculina quadrangularis* or areas with large brachiopods (e.g. *Gryphus vitreus*), should also be also considered, but information on these bottoms is scarce.

Maërl grounds have a high diversity and also support a high macro-benthic secondary production, which may be important for species of commercial interest. Although little is known about the distribution and ecology of maërl beds in the western Mediterranean, they have been associated with areas of moderate currents and restricted to depths shallower than 60 m. The well preserved Mediterranean maërl grounds have a high diversity and also support a high macro-benthic secondary production, which may be important for species of commercial interest.

Crinoid beds of *Leptometra phalangium* are found in the deep continental shelf and shelf-break in the western Mediterranean. *Leptometra* species are suspension-feeder organisms that thrive in shelf-break high hydrodynamic areas with a high input of organic matter and plankton. Individuals are however fragile and suffer a strong impact due to demersal trawling. In appropriate areas, high densities of *L. phalangium* develop, forming communities known as crinoid beds, where they provide shelter to small benthic and macroplanktonic organisms.

The coral *Isidella elongata* characterizes a facies of bathyal compact mud substrates between 500 and 1200 m depth. Deep-water corals form three-dimensional structures on the sea-bottom, either by forming reef structures (such as the scleractinian *Lophelia pertusa* in the North Atlantic) or as "coral meadows", where individual corals raise from the bottom forming tree-like or candelabra-like structures (many species of gorgoniacean corals, including *Isidella elongata*). Trawling over depths of the *Isidella* facies causes direct impacts on the slope assemblages, by removing the habitat-forming corals, decreasing species diversity of this habitat and increasing the diversity of benthophagous species.

GSA01 (Northern Alboran Sea)

In this area, *Leptometra* bottoms do occur, but they have not been found in so large densities as in certain sectors of the adjacent GSA06.

Seamounts are also susceptible to exploitation, but there is not much information available.

GSA02 (Alboran Island)

This GSA can be considered as an emerged seamount. In this area an important bottom trawl fishery targeting red shrimp (*Aristeus antennatus*) is developed. Some information is available for this fishery and also for coastal waters.

GSA05 (Balearic Islands)

Maërl beds are mainly distributed, up to 90 meters, on the detritic sandy and gravel bottoms of the channel between Mallorca and Menorca and neighbouring areas that are affected by strong northerly winds and offshore currents (Figure 2-1). They are mainly characterised by red hard algae Corallinacea, but also the brown algae *Laminaria rodriguezii*, echinoderms and ascidians are also found on these bottoms. Other soft red algae bottoms are widespread distributed up to 80 m depth. They are mainly characterised by the red algae *Peysonellia squamaria*, *Phyllophora nervosa* and *Osmundaria volubilis* (there is also Corallinacea, but with lower biomass indices), the green algae *Codium bursa*, echinoderms (mainly *Spatangus purpureus*), ascidians and sponges. These beds present high biomass indices, mainly due to non commercial species (up to 70% of the total biomass captured with bottom trawl, mainly echinoderms and algae) and high species richness. Some trawl fishing grounds are located on these beds, and some fishes and cephalopods, which predominate both in trawling shelf landings and demersal resources assemblage on the shelf, are associated to main macro-epibenthic species characteristic of these beds: *Serranus cabrilla*, *Scorpaena scrofa*, *Scyliorhinus canicula*, *Pagellus erythrinus*, *Scorpena notata*, *Spicara smaris*, *Octopus vulgaris* and *Loligo vulgaris*.

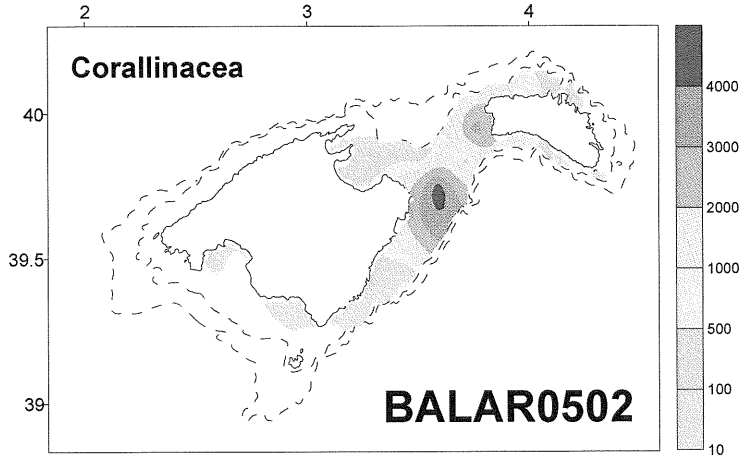

Figure 2-1 Distribution map of biomass indices (Kg/Km2) obtained during trawl survey (BALAR 0502) of red hard algae

Leptometra beds are mainly distributed on muddy-sand detritic bottoms of S and NE Mallorca and around Menorca, between 90 and 250 m depth (Figure 2-2). Contrast with other deep shelf bottoms, these crinoid beds are characterised by higher biomass of invertebrates (mainly *Echinus* spp. and *Stichopus regalis*, but also *Leptometra phalangium*).

These grounds are important for the trawl fishery, because most fishes and cephalopods, which predominate both in the demersal resources assemblages on the deep shelf and the trawling shelf landings, seem to be related to these beds: *Trisopterus minutus capelanus*, *Merluccius merluccius*, *Lepidorhombus boscii*, *Scyliorhinus canicula*, *Zeus faber* and *Raja clavata* show their higher abundance in areas of high densities of *L. phalangium*.

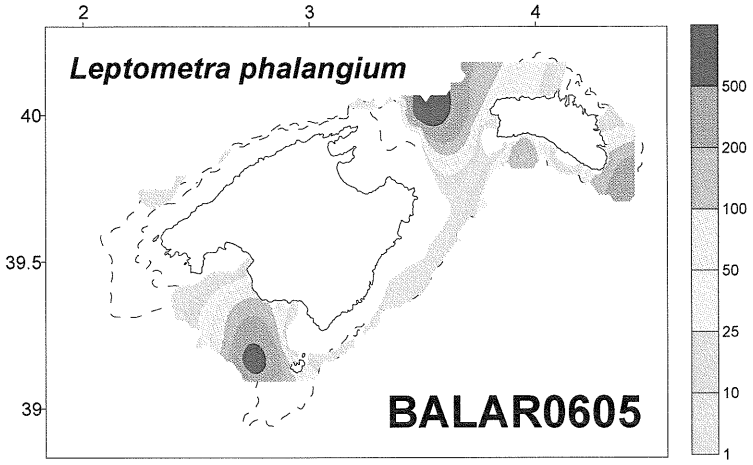

Figure 2-2 Distribution map of biomass indices (Kg/Km2) obtained during trawl survey (BALAR 0605) of Leptometra phalangium.

Concerning *Isidella* bottoms, species diversity of invertebrates and decapods crustaceans is higher in areas where live *Isidella* is found. Some commercial fishes and decapods crustaceans (*Merluccius merluccius*, *Micromesistius poutassou*, *Parapenaeus longirostris* and *Aristaeomorpha foliacea*) are more abundant in areas with live corals over this depth range. Conversely, the main commercial species on this facies, the red shrimp *Aristeus antennatus*, is more abundant in areas with dead corals. Areas of high density of *Isidella* have been reported on the continental slope off N and S Eivissa Island.

Bionomic charts should be made for a correct mapping of sensitive habitats on the continental shelf off Balearic Islands.

GSA06 (Northern Spain)

Along the Iberian peninsula Mediterranean coasts, the highest degree of occurrence of *Leptometra* beds has been found along the shelf edge of the Ebro delta – Castelló region (Figure 2-3). In this area, the permanent southwesterly-flowing Liguro-Provençal current is known to indent the continental shelf when it runs into the wide Ebro delta continental shelf and the shelf break is known to take place at depths of around 150 m. The information presented showed significantly larger densities of the commercial species *Lepidorhombus boscii* and *Helicolenus dactylopterus* in addition to several non-commercial, but ecologically important, species, such as the fish *Argentina sphyraena*, *Arnoglossus ruepelli*, *Callyonimus maculatus* or *Capros aper*, the crab *Macropipus tuberculatus* or the octopus *Pteroctopus tetracirrhus*. Information on differential size distribution showed the importance of this habitat for young of the year *Merluccius merluccius* or *Eledone cirrhosa*.

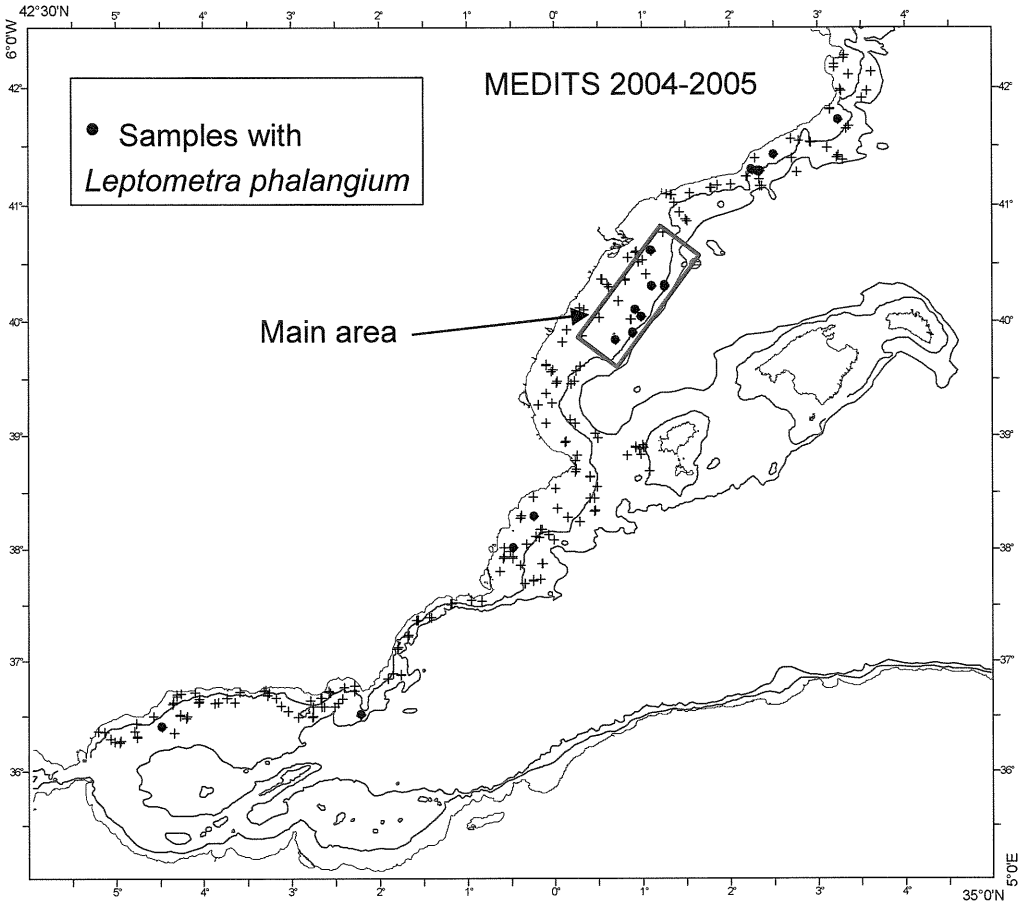

Figure 2-3 *Distribution of* Leptometra phalangium *trawl stations along Spanish Mediterranean coasts*

Concerning *Isidella* bottoms, species diversity of invertebrates and decapod crustaceans is higher in areas where live *Isidella* is found (Figure 2-4). Some commercial fishes and decapod crustaceans (*Merluccius merluccius*, *Micromesistius poutassou*, *Nephrops norvegicus* and *Parapenaeus longirostris*) are more abundant in areas with live corals over this depth range. Conversely, the main commercial species on this facies, the red shrimp *Aristeus antennatus*, is more abundant in areas with dead corals. Areas of high density of *Isidella* have been reported on the continental slope off the Ebro delta.

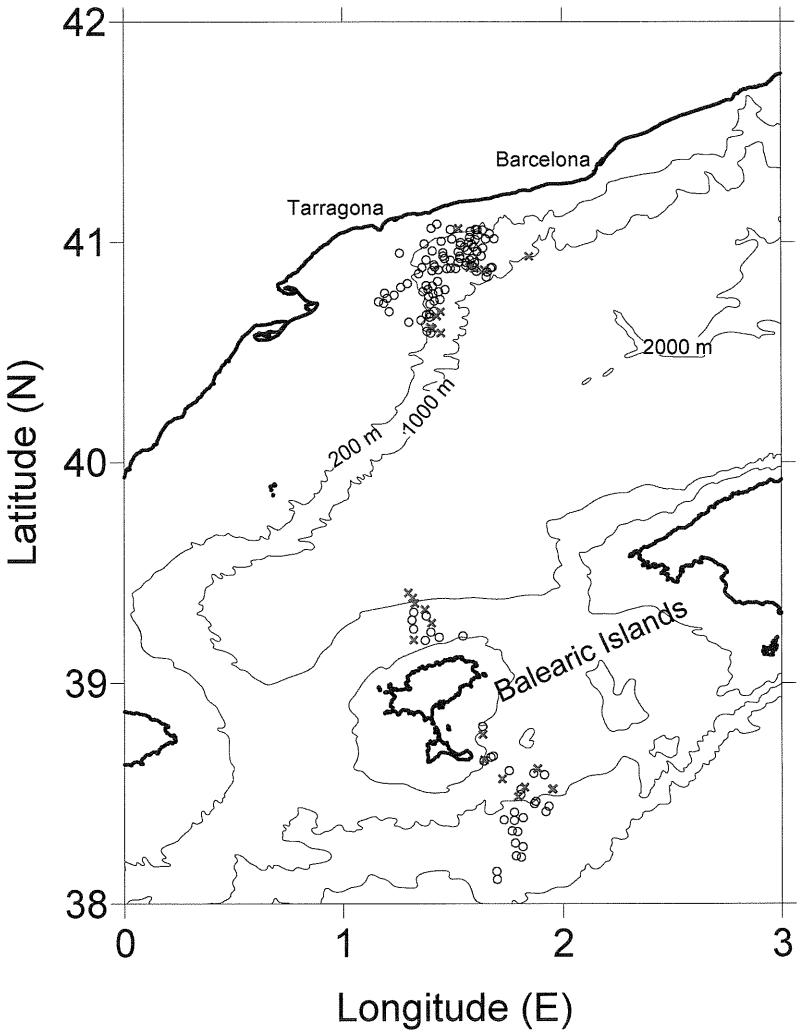

Figure 2-4 Distribution of 144 experimental trawl hauls in the Catalan sea. 24 hauls with remaining of dead (blue) *Isidella elongata* are shown

Submarine canyons are an important geomorphological feature of the northern part of GSA 06. There is abundant information on the ecological role played by canyons, which have been shown to be highly productive habitats with high species diversity and endemism, providing feeding and recruitment grounds for several commercial species.
Although not considered as sensitive habitats, sandy-muddy bottoms on the shallow shelf are exploited by artisanal fisheries, using beam trawls and dredges to catch bivalve and gastropod species. This fishing activity is known to have an impact on these benthic communities.

2.2.1.2 ESSENTIAL FISH HABITAT

Information regarding EFH in the western Mediterranean presented in this meeting is scarce, coming from bottom trawl surveys.
Although trawl fishery in the GSA05 (Balearic Islands) is multi-species, some priority species for the trawl fishery developed on the shelf can be identified from landings (Figure 2-5). In terms of biomass, the most important commercial categories are the picarel (*Spicara smaris*), a very appreciated fish in the local market, a mixed fishes category composed by around 20 fish species (being Triglidae, Sparidae, Scorpaenidae, Serranidae and Trachinidae the most important families), red mullets (mainly *Mullus surmuletus*) and

octopusses (mainly *Octopus vulgaris*), representing almost 50% of landings. In terms of value, the most important commercial categories are the red mullets, the mixed fishes category and hake (*Merluccius merluccius*), representing almost 45% of landings.

GSA01 and GSA06

The most important areas of *Merluccius merluccius* juveniles are located around Ebro delta (Figure 2-6), with variable dispersion both northward and southward. This river mouth could configure an area of suitable habitat for juveniles, with great availability for feeding. Other important areas are Alicante gulf and Almería bay.

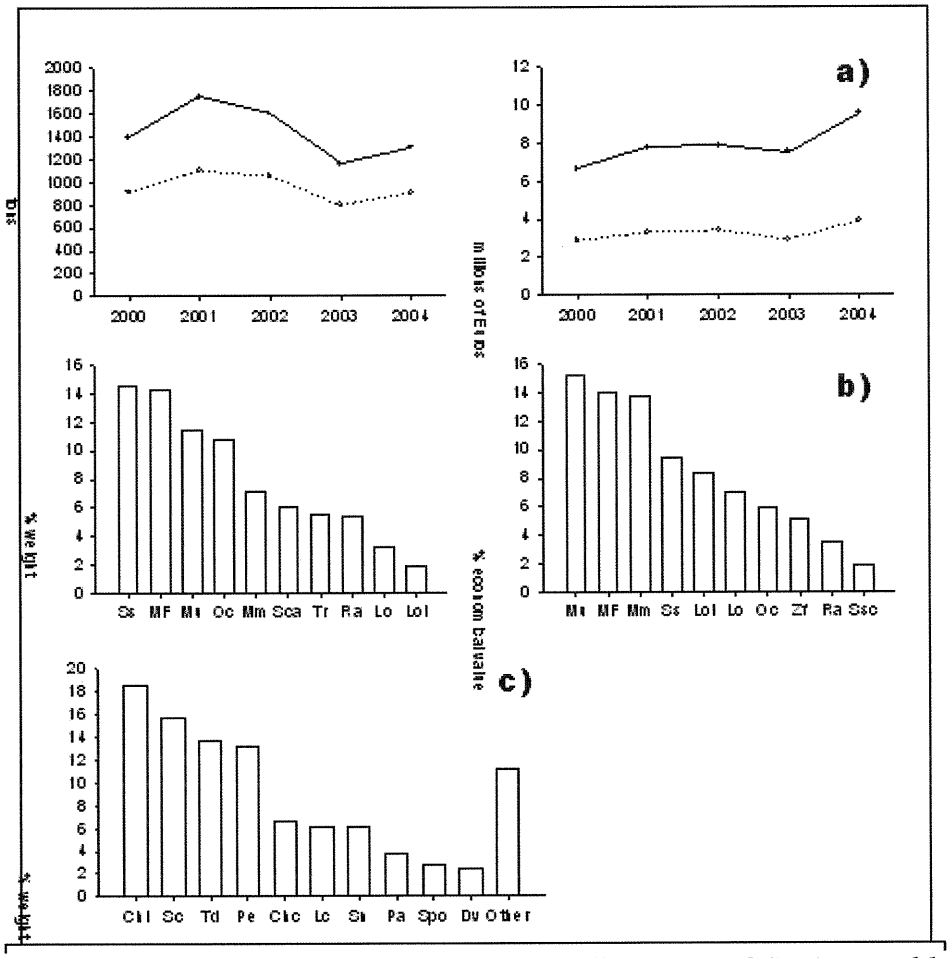

Figure 2-5 Official landings for the trawl fleet of Mallorca (GSA-05): a) annual landings and their economic value estimated for the total trawl activity (continuous line) and for the trawl developed on the shelf (dashed line); b) main species and commercial categories, in terms of weight and economic value, for the annual landings of shelf trawling; c) main species composing the mixed fishes category, estimated from landings sampling during 2001 and 2002. Ss: *Spicara smaris*; MF: mixed fishes; Mu: *Mullus* spp. (mainly *Mullus surmuletus*); Oc: octopusses (mainly *Octopus vulgaris*); Mm: *Merluccius merluccius*; Sca: *Scyliorhinus canicula*; Tr: *Trachurus* spp.; Ra: *Raja* spp.; Lo: *Lophius* spp.; Lol: *Loligo* spp. (mainly *Loligo vulgaris*); Zf: *Zeus faber*; Ssc: *Scorpanea scrofa*; Chl: *Chelidonichthys lastoviza*; Sc: *Serranus cabrilla*; Td. *Trachinus draco*; Pe: *Pagellus erythrinus*; Chc: *Chelidonichthys cuculus*; Lc: *Lepidotriglla cavillone*; Sn: *Sorpanea notata*; Pa: *Pagellus acarne*; Spo: *Scorpaena porcus*; Dv: *Diplodus vulgaris*. Other includes *Diplodus annularis*, *Uranoscopus scaber*, small specimens of *Scorpaena scrofa*, small specimens of *Pagellus bogaraveo*, *Trisopterus minutus*, *Blennius ocellaris*, small specimens of *Trachinus radiatus* and *Microchirus* spp.

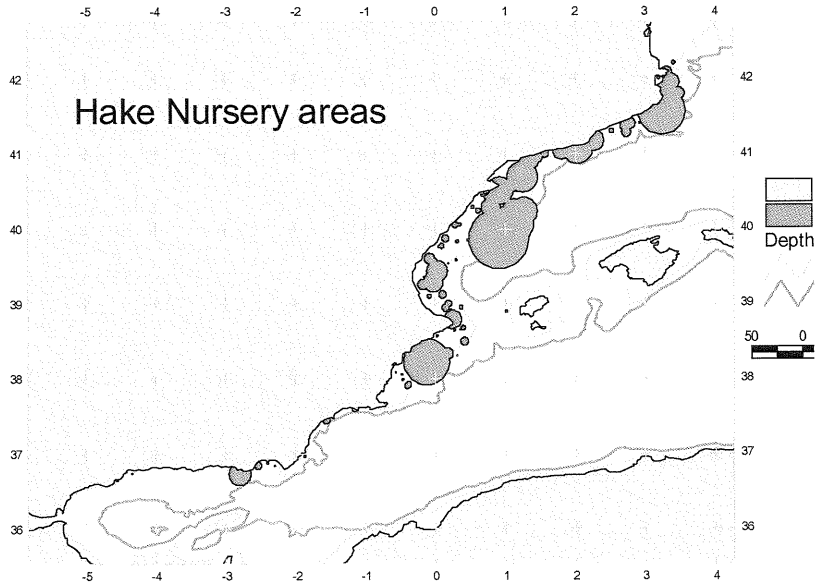

Figure 2-6 Spatial distribution of hake nurseries (grey areas) in the GSAs 01 and 06 On GSA06, *Leptometra* beds show high densities of *Merluccius merluccius* juveniles and *Mullus barbatus* adults, but similar densities are also found on muddy bottoms nearby GSA05

Some of the described SH on the trawling bottoms could act as EFH for some important resources: (i) large specimens of *Serranus cabrilla* are associated to maërl bottoms (mainly on the channel between Mallorca and Menorca); (ii) small specimens of *Scorpaena scrofa* seems to be related to maërl beds; (iii) main concentrations of juveniles *Merluccius merluccius* are found S and NE Mallorca, where *Leptometra* beds are mainly distributed; (iv) large specimens of *Zeus faber* and *Raja clavata* seems to be related to *Leptometra* beds.

2.2.1.3 SUGGESTED PROTECTION OF SH AND EFH

The aim of establishing protection measures is to guarantee sustainability of fisheries and conservation of resources. Several measures can be implemented in order to protect either SHs or EFHs. This may be done by diminishing or completely restricting (at least temporally) fishing activity or effort within the areas identified as SHs or EFHs. In particular, for habitat conservation, measures already implemented in Spanish GSAs are:

Marine protected areas: There are 17 MPAs on the Mediterranean Spanish coast (3 in Northern Alboran GSA01, 6 in the Balearic Islands GSA05 and 8 in the Northern Spain GSA06) and the National Park of Cabrera Archipelago . Although they are relatively small (between 0.01 and 2.23 km^2) and located in rocky areas or islands adjacent to the coast, in few cases (Migjorn and Cabrera in GSA05 and Columbretes in GSA06) they extend to trawling fishing grounds. The objectives of these MPAs are fisheries regulation (7 cases) and conservation of marine resources (10 cases).

1. Deep-sea protection areas: Throughout the Mediterranean, the GFCM (February 2005) recommended the prohibition of the use of towed nets and trawl nets deeper than 1000 m. This recommendation was recently adopted by the Spanish regulation in 2006.
2. Coastal protection areas: Throughout the Mediterranean trawl fishing is forbidden at depths shallower than 50 m or within 3 nautical miles.
3. *Posidonia* beds are protected by European and National legislation.

4. Temporal closures: For demersal trawlers, the fishing activity is prohibited two months (not the same in all GSAs) per year. These temporal closures are not applied in GSA05, but could be taken into account.
5. For artisanal fisheries, additional measures are adopted by autonomous governments, including both spatial and temporal closures.

The above mentioned measures contribute to the protection of some SHs and EFHs. However, the reinforcement (or extension) of some areas closed to trawling should be considered. In addition, all these regulations should be accompanied by additional technical measures, aimed at improving selectivity and diminishing fishing effort. Strict control is also necessary. As shown in other geographical areas, for closed areas and temporal closures to be effective, they should not have exemptions, and fishing effort should also be diminished in adjacent areas and after the closed period (i.e. reduction of fishing activities per day or per week when opening).

2.2.2 Italy

2.2.2.1 GSA 9: SENSITIVE HABITATS

Posidonia oceanica and *Cymodocea nodosa* meadows, coralligenous bottoms, deep sea corals and crinoid beds represent the main SH of the GSA9.

Crinoid beds (*Leptometra phalangium*) cover a significant portion of sea bottom (about 1500 km^2) between 120 and 180 m depth, around the shelf-edge.

The most important areas are located in front of the main capes (Civitavecchia, Tor Vaianica, Anzio) where the bottom steepness increased: in the northern Tyrrhenian Sea (south Tuscany) they occur around the Giglio Island and between the Elba and Montecristo islands; in the southern Ligurian Sea (north Tuscany) they are mainly present northern to the Elba Island; hot spot areas occur on the western side of Capraia Island and off the Livorno coasts; in the northern Ligurian Sea (Liguria) the shelf break off La Spezia, Portofino and Savona is colonized by high density *L. phalangium* beds (Figure 2-7).

The *L. phalangium* bottoms host well defined fish assemblages, persistent over years, characterized by high densities of many demersal species, most of which of commercial interest. High densities of newly recruited and juveniles of many commercially exploited species are present as well.

Therefore, it is clear the role of *L. phalangium* bottoms to maintain productivity of many fishery resources. Such areas can be also viewed as Essential Fish Habitats for important commercial species, such as *M. merluccius*, *M. barbatus*, *M. poutassou*, *T. minutus capelanus* and *I. coindetii* and specific management or protection plan can be implemented.

The protection of crinoid beds may have important consequences for fishery management in the Mediterranean helping to reduce fish mortality rates in crucial life history stages of fishes, such as juveniles and spawners, when they concentrate in restricted areas and are particularly vulnerable to towed gear.

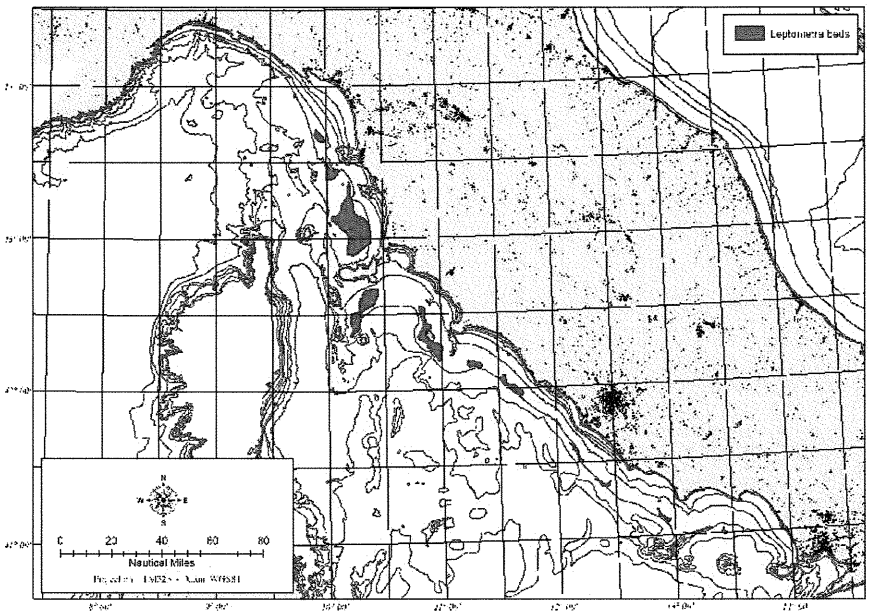

Figure 2-7 *Distribution of* Leptometra phalangium *beds in the Tyrrhenian-Ligurian Sea (GSA 9)*

2.2.2.2 GSA 9: ESSENTIAL FISH HABITATS

Data collected in the GSA9 by means of trawl surveys indicates that this geographic area includes the nurseries of many commercial species (Colloca et al.1&2, in Appendix).

M. merluccius

The GIS analysis of hake density in FAO-GSA 9 highlighted the persistency along the investigated period of four main nursery areas: off the Livorno coasts (southern Ligurian Sea), south the Elba Island, around Giglio Island (northern Tyrrhenian Sea) and southern Latium (central Tyrrhenian Sea) (Figure 2-8).

The proportion of the identified nursery areas ranged between 3.2 and 5.5% on the whole distribution area of hake in the GSA 9 according to the period considered. The number of recruits in the nurseries on the total estimated number of recruits in the GSA 9 for the four periods considered, ranged between 50% in 1985-87 and about 20% in 2000-01.

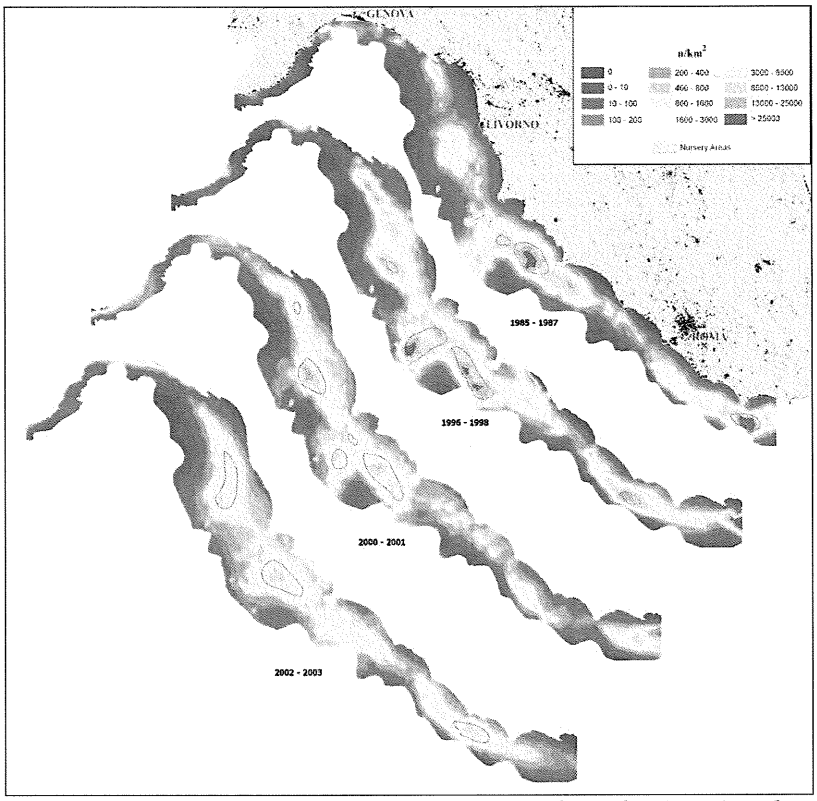

Figure 2-8*Temporal series maps of hake recruits distribution in the GSA 9. The position of the main nurseries is indicated*

Concerning the distribution of mature hake, the reduced number of mature individuals caught during the GRUND and MEDITS surveys strongly reduced the chances to find out the position of the main spawning areas. Both mature males and females are more common in trawl stations on the continental shelf, from 60-70 m to 180-190 m, but while the formers are poorly represented in deeper waters, the latter reach deeper waters and all our records on mature specimens over 500 meters depth are referred to large females. The maps of distribution, obtained pooling data of GRUND surveys conducted in the period 1996-2003, confirm the preferential shelf distribution of matures, with a possibly increased abundance of male spawners in 3 main areas: the shelf northern to Elba Island, northern Argentario and the central Latium.

M. barbatus

Previous study on the spatial distribution of red mullets in the GSA 9, based on trawl surveys carried out in September-October, showed large nurseries widespread in the coastal area. The main areas of significant highest concentration have been identified along the Tuscany and north Latium coastal shelves.

Highest density of spawners have been observed in the north Tuscany shelf.

P. longirostris

Spatial analysis on *P. longirostris* was based on GRUND data for two different periods (1996-98 and 2000-02, Figure 2-9). A significant difference in abundance between the north-central Tyrrhenian Sea and the Ligurian Sea was observed. The area northern to the Elba Island had a significant lower density of both juveniles and adults shrimps if compared with the southernmost area. The highest concentrations of juveniles (CL<20 mm) have been observed in both periods on south Tuscany and northern Latium shelves between 100 and 200 m depth.

Spawners are mostly concentrated in the North Tyrrhenian Sea, between 100 and 300 m depth, south the Elba Island.

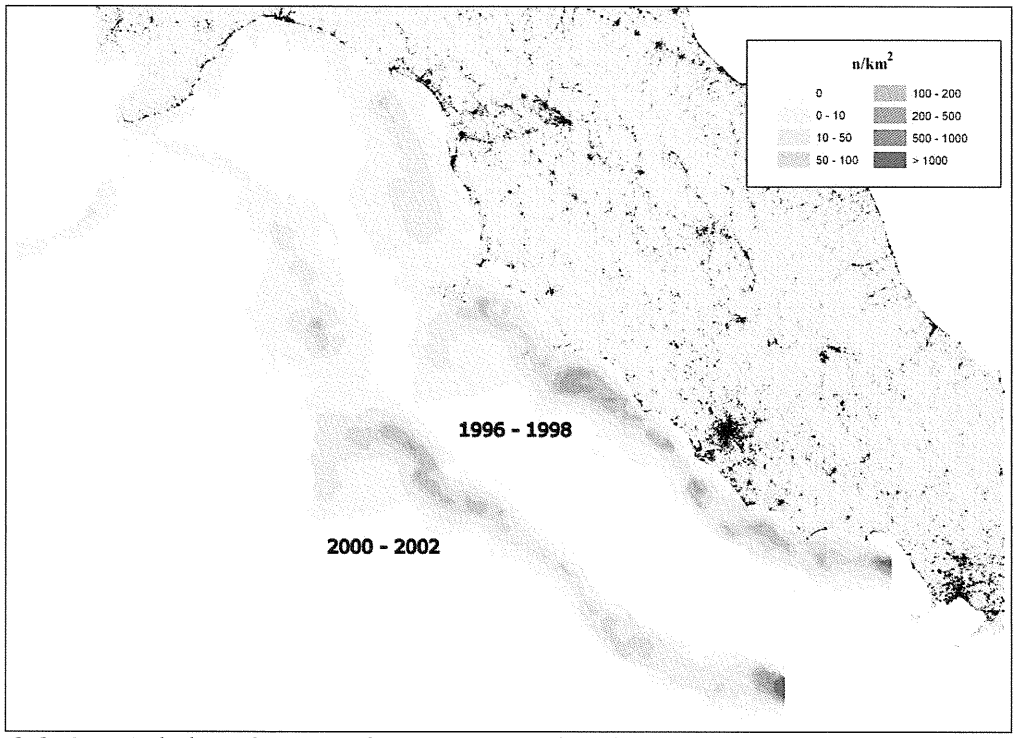

Figure 2-9 ***Spatial distribution of*** **Parapenaeus longirostris** ***recruits (CL <20 mm) in the GSA 9 for two different periods (1996-98 and 2000-02)***

N. norvegicus
Areas of highest concentration of juveniles of carapace length less than 20 mm have been identified both in spring and autumn in the Ligurian Sea offshore La Spezia and north Capraia Island and in the north Tyrrhenian offshore the Giglio Island.

E. cirrhosa
Recruits (specimen less than 3 cm ML) are widely present in the whole GSA9 mainly in spring (April-June) in the 80-120 m depth range.

Elasmobranches
An important outline of the critical condition of elasmobranches particularly in the GSA 9 has been presented during the meeting (Serena et al., in Appendix).

The knowledge of many biological features of the cartilaginous species (spatial distribution by abundance and size, growth rates, migrations, reproduction), of their demographic structures as well as the fisheries where these species are involved is very important for giving advice as regards management measures, specially for those aimed at the reduction of the by-catch. In fact, the management measures useful for the reduction of the by-catch of the cartilaginous fishes are directed to the reduction of undesired catches of these species or alternatively to guarantee the discard at sea the juvenile specimens or the adults with no commercial value when they are still alive.

The knowledge of the spatial pattern of distribution and ontogenetic movements is of primary importance. They allow to identify critical zones, such as EFH, which in certain periods or during the whole year they have to be banned. The ban can be conceived in order to avoid the fishing activities on zones of concentration of juveniles for feeding (nursery areas), generic breading areas or spawning areas, which protection is more critical in the case of oviparous species.

SUGGESTED PROTECTION OF SH AND EFH
The reduction of fishing pressure on important EFHs and SHs can be considered as one of the most urgent management measure for fisheries in the GSA 9. The current management

system, based on technical measures (e.g.: mesh size regulation, legal size for commercial species, trawling ban in the coastal area), appears inadequate, in its implementation and enforcement, to prevent the depletion of fish populations.

The main commercial species (e.g.: hake and red mullet) suffer both of a high mortality on juveniles, due to the low trawl gear selectivity, and a reduced proportion of spawners in the population.

The adoption of permanent or seasonal closure of those areas, where juveniles and spawners concentrate and are strongly exposed to fishing mortality, is one of the most promising management measure for fisheries in the GSA9.

We suggest giving a higher priority to the protection of hake recruits due to the importance of hake for local fisheries. Moreover, the GSA 9 is probably the main hake recruitment area in the western Mediterranean basin, since the abundance of hake recruits is much higher than in other fishing sectors (e.g. Strait of Sicily, Gulf of Lions, Catalan sea, etc.) (see Colloca et al.2, in the Appendix).

As showed during the meeting, the protection of the core of the main hake nurseries from trawling, even affecting a reduced part of the fishing area (3-5%), would protect a significant proportion (20-50%) of the hake autumnal recruitment.

Furthermore, other important demersal species and assemblages will benefit from seasonal or permanent closure measures of hake nurseries. Documents presented during the meeting showed a significant spatial overlap between crinoid beds on the shelf-break, that is one of the most important sensitive habitat in the GSA 9, and hake nurseries. Crinoids beds host a well defined assemblage of demersal organisms characterised by a high abundance either of juveniles (e.g. squid *Illex coindetii*, poor cod *Trisopterus minutus capelanus*, John Dory *Zeus faber* and anglerfish *Lophius* spp.) or spawners (e.g. red mullet *Mullus barbatus*) of other important commercial species.

2.2.2.3 GSA 11: SENSITIVE HABITATS

In the GSA 11 the main SH to be considered in the continental shelf is the *Posidonia oceanica*, which occur all around the island from 0 to 50 m (Murenu et al., in Appendix). The scale resolution (1:25000) of biocenoses up to 50 m is good.

At greater depth a rough definition of SH can be obtained from trawl survey which consent to identify benthic assemblages in the locations where hauls has been carried out. For instance it is possible to identify point were *Leptometra phalangium* beds are present (Figure 2-10).

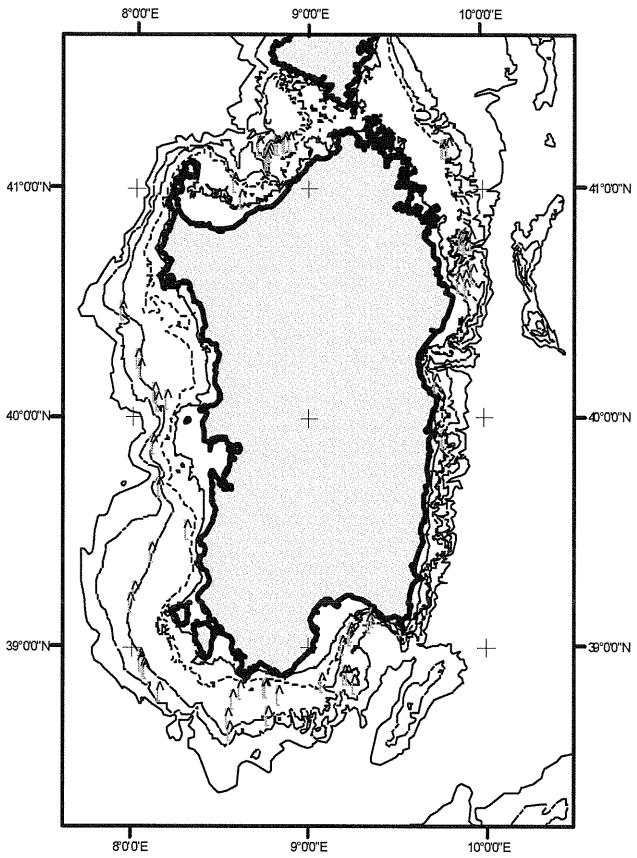

Figure 2-10 *Locations of the* Leptometra phalangium *beds in the GSA 11*

2.2.2.4 GSA 11: ESSENTIAL FISH HABITATS

The identification of EFHs was carried out studying the spatial distribution of two main fish species (*Mullus barbatus* and *Merluccius merluccius*); both show high demand on market all year. Annual data, gathered from 1994 to 2004, were explored using a combination of distribution analysis on size frequency data and geostatistical methods. The spatial autocorrelation in abundances of recruits (TL<15 cm and TL<11 cm for Hake and Red Mullet respectively) was obtained using semivariograms. Mapping was carried out by Ordinary kriging techniques by year and sampling season. Moreover a reclassification method was used to evaluate the persistence of the localized nursery areas.

Merluccius merluccius

By comparing of density maps of *Merluccius merluccius* it is possible to point out that the spatial structure of distribution of juveniles shows nuclei with higher probability generally localized along the continental shelf at depth from 150 to 300 m (Figure 2-11).

The maps reported below represent the conditional probability of finding nursery areas for each survey (Medit and Grund) carried out from 1994 to 2004. The number of hauls and sampling period are also reported for each year. The patches of recruits are preferentially localized along the Western and Northern coasts either in autumnal and summer seasons. Along these coasts a high concentrations of juveniles that ranged from 5000 to 10000 individuals km^{-2} was highlighted.

The persistence of high densities in a large area located in the west coast allows to define the main nursery for the Hake in the GSA.

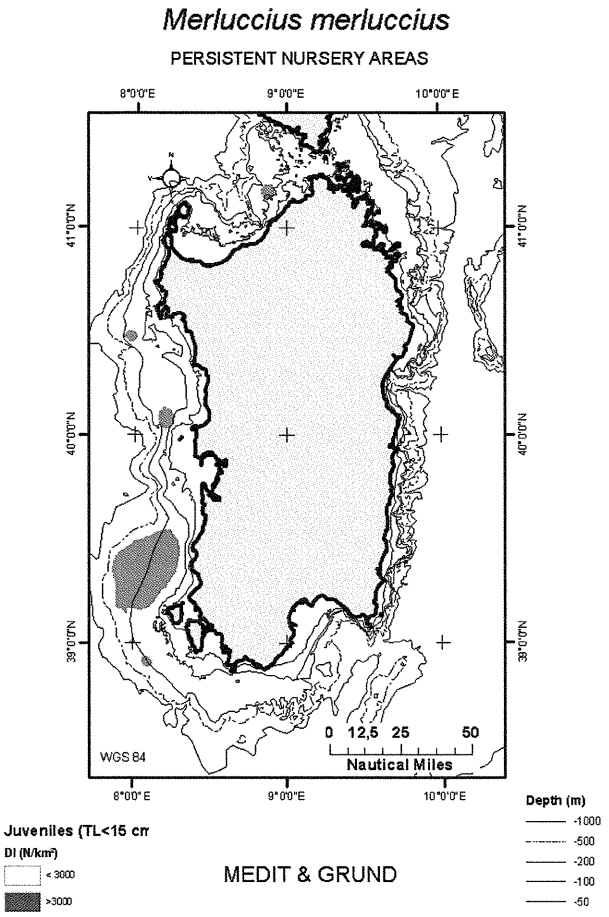

Figure 2-11 Main nursery areas of Merluccius merluccius in the GSA 11

Mullus barbatus

Figure 2-12 - Figure 2-14 represent the conditional probability of finding nursery areas from 1994 to 2004 in summer and autumn respectively.

A very high probability, with a threshold value of 10.000 individuals/km^2, is identified in many years (1995, 1996, 1998, 2000-2002) along the Southern coast and along the Western coast (1994, 1996, 1997). Nevertheless, a seasonal pattern can be recognized nurseries are generally identified in autumn (typical period of recruitment of this species). In 2004, an extremely high number of recruits (> 100.000 ind/km^2) was recorded in the Southern coast.

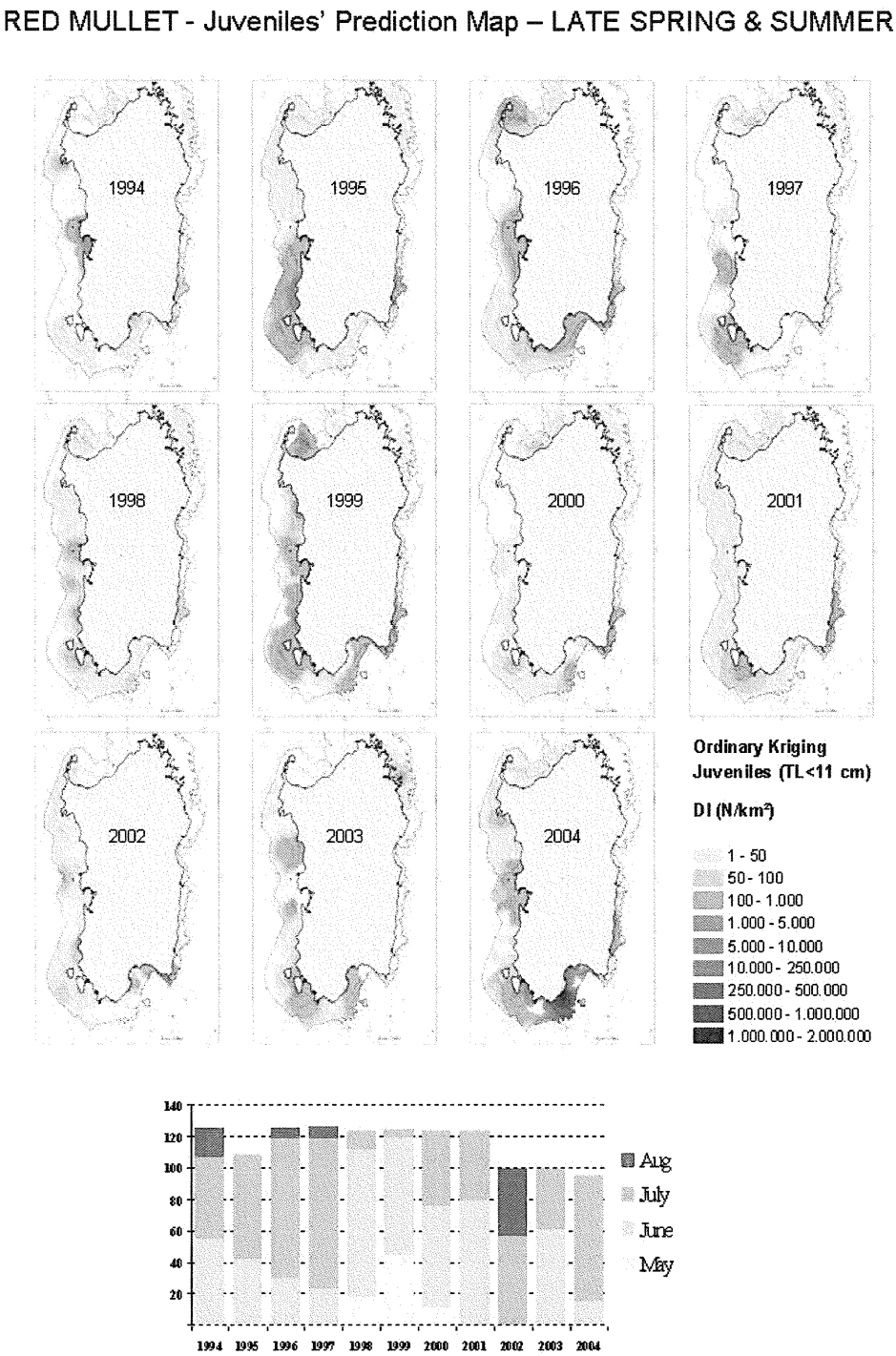

Figure 2-12 ***Ordinary kriging of the juveniles abundance of*** **Mullus barbatus** ***in summer***

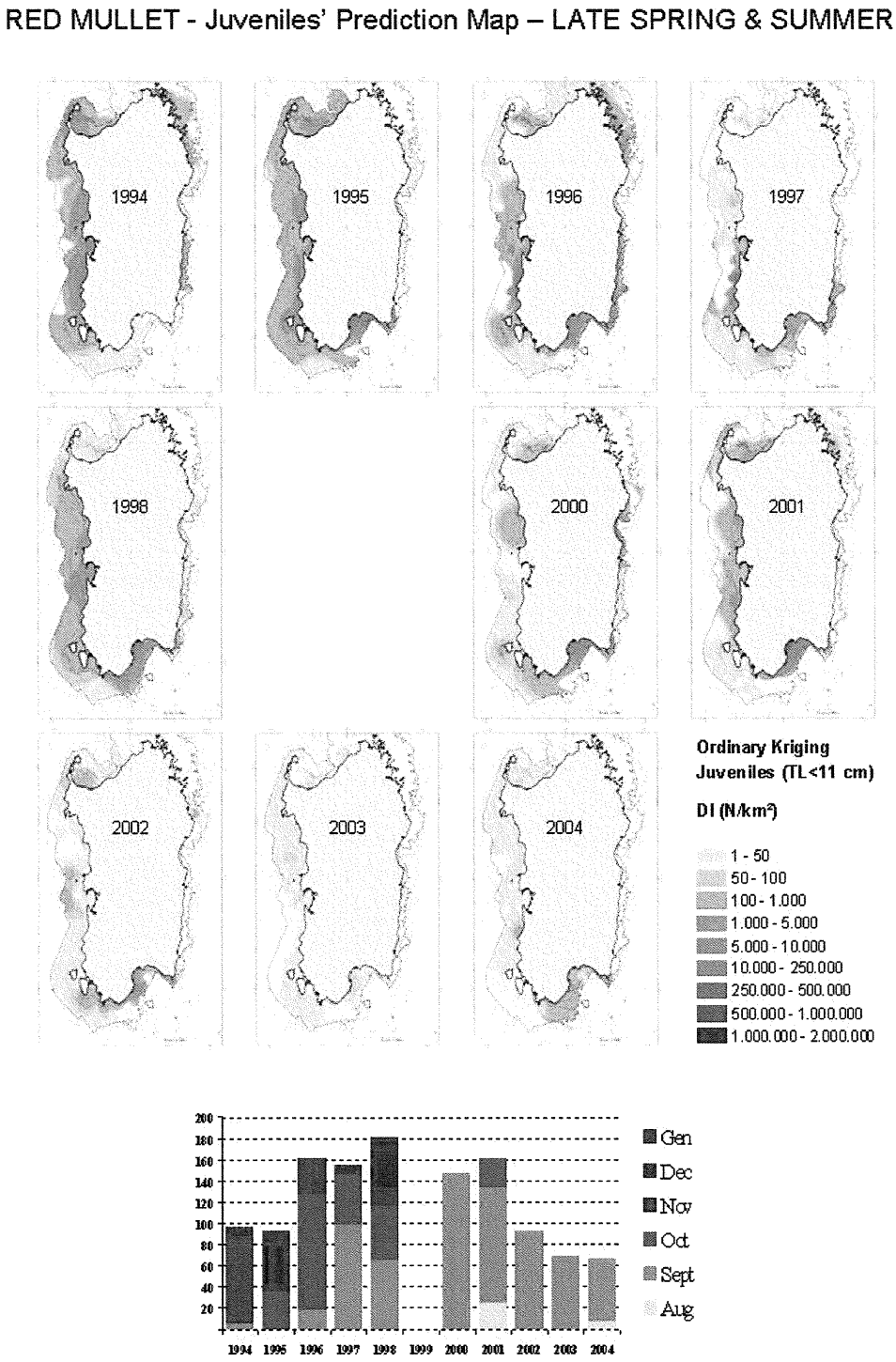

Figure 2-13 ***Ordinary kriging of the juveniles abundance of*** **Mullus barbatus** ***in autumn***

The area with highest probability of finding nurseries of *Mullus barbatus* was identified evaluating the persistence of high densities throughout the years in both sampling periods. As shown in figure 6 the nursery is preferentially located along the Southern coast.

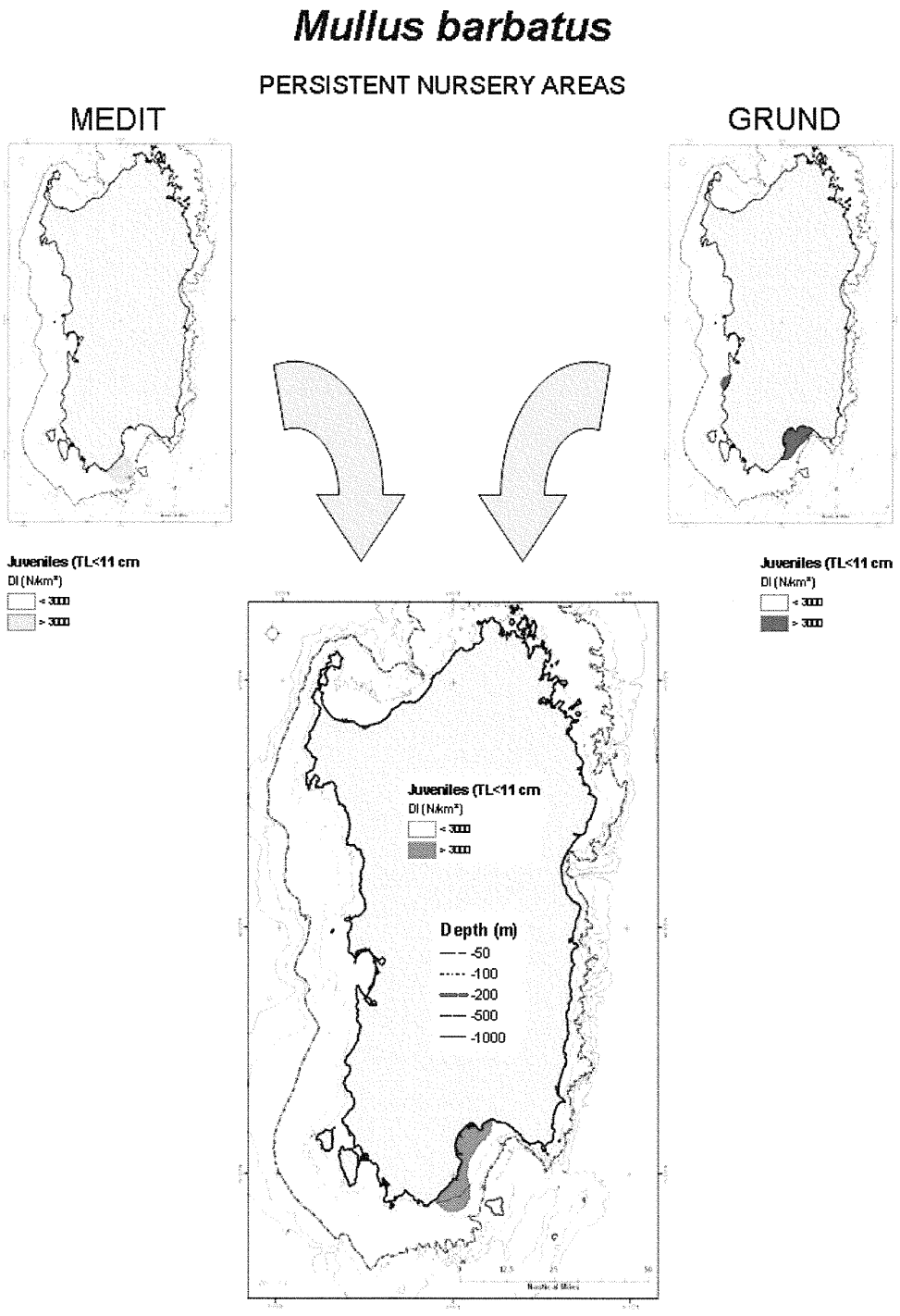

Figure 2-14 ***Main nursery areas of Mullus barbatus in the GSA 11***

2.2.2.5 GSA 15 AND 16: ESSENTIAL FISH HABITATS (Fiorentino et al., in Appendix)

Merluccius merluccius
Two discrete areas of high Young of the Year (YOY) concentration (nurseries) are observed at the eastern side of the Adventure Bank and Malta Bank respectively (Figure 2-15). However,

MEDITS densities in the Adventure Bank are largely higher than the GRUND ones. In both Banks, the nurseries extend from about 100 m to the upper slope.

Similarly to YOY, juveniles also inhabit preferentially the eastern side of the Banks (Figure 2-16). Yet, their distribution appears more spread than that of YOY and presents seasonal differences. Indeed, the highest concentration of juveniles is located along the eastern boundary of Malta Bank in autumn, whereas it is placed in Adventure Bank during spring season. Location of JUV grounds suggests a displacement of juveniles northward and westward from the nurseries towards shallower bottoms in spring season, whereas there is an overlap of the two life stages in autumn.

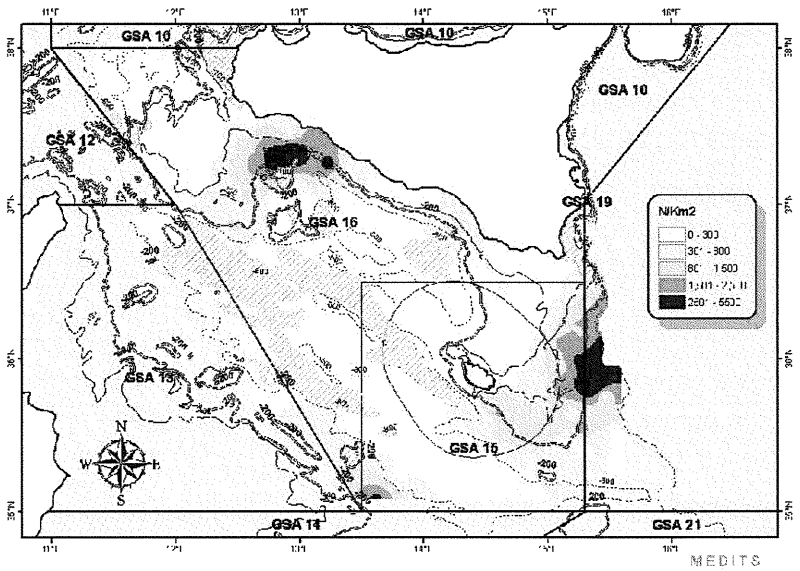

Figure 2-15 ***Mean density indices of young of the year (YOY) of hake in MEDITS surveys 2002, 2003 and 2004 (late spring -early summer). Highest concentrations were found in the eastern side of Adventure and Malta Banks.***

Finally, highest concentrations of mature females are found in the south-western break of both Adventure Bank and Malta Bank in autumn, resulting up stream to nurseries' positions (Figure 2-17). Regarding MEDITS surveys, highest concentrations are observed inside the Adventure Bank , mainly within 100m depth, and in the southern sector of GSA 15, outside the MFMZ. A nucleus of spawners aggregation is also found within 100 m depth on the Malta Bank.

Although the average distribution maps by life stage have been estimated on few years of data (2 and 3 years for GRUND and MEDITS respectively), they clearly show that hake occurs at any life stage on two distinct geographic areas, the Adventure and Malta Banks, well separated by a wide area where hake abundance is very scanty.

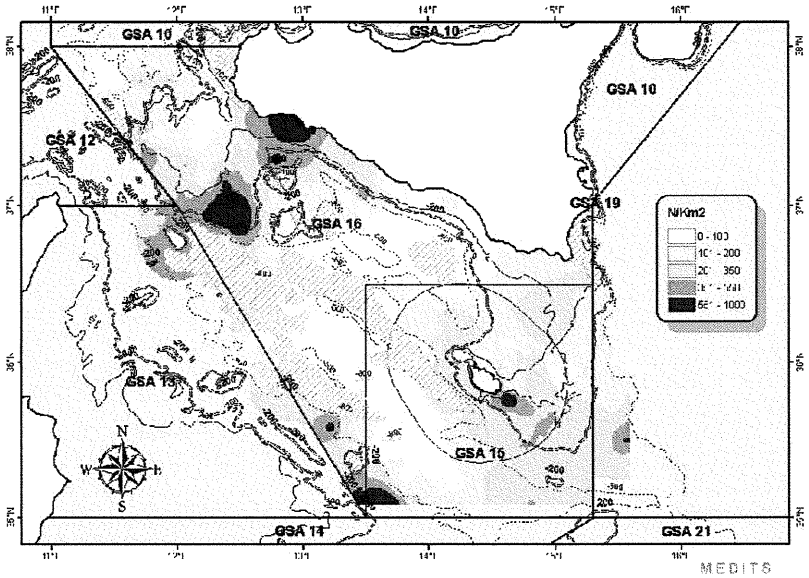

Figure 2-16 ***Mean density indices of juveniles (JUV) in MEDITS surveys 2002, 2003 and 2004 (late spring early summer). Highest concentrations were found in the eastern side of the Adventure, suggesting a displacement of juveniles north and westwards from the nurseries.***

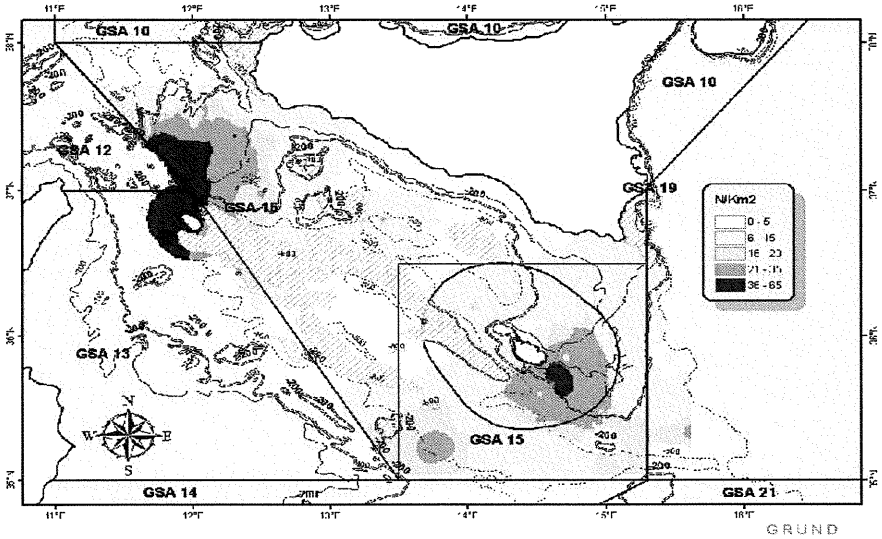

Figure 2-17 ***Mean density indices of mature females (MAT) in GRUND surveys 2003 and 2004 (late summer-autumn). Highest concentrations were found in the south-western break of the Adventure and Malta Banks, resulting counter-current nurseries' positions.***

THE STABILITY THROUGHOUT TIME AS A PREREQUISITE OF EFH IDENTIFICATION

Figure 2-18 and Figure 2-19 show the areas identified after analysing the persistence of the highest values (third quartile) of the yearly density maps of each life phase. The visualization of the persistence index was restricted to values greater than 0.8. Notably, all three life stages stably occupy definite grounds over the Adventure Bank. The nursery presents a core of maximum stability (PI≥0.8) extending from 100 m to about 200 m depth, It doesn't present great variations in both position and shape among season. On the other hand, some differences appear when comparing MEDITS and GRUND results about JUV

and FEM stability areas. Indeed, maps show a movement offshore of both life stages in late summer-autumn. While nursery resulted identified at a high level of persistence, a more weak stability was obtained for JUV and FEM which therefore are not visualized on the maps. Unfortunately, the lack of time series of data covering consistently the overall GSA 15 didn't allow to obtain full results about Malta Bank.

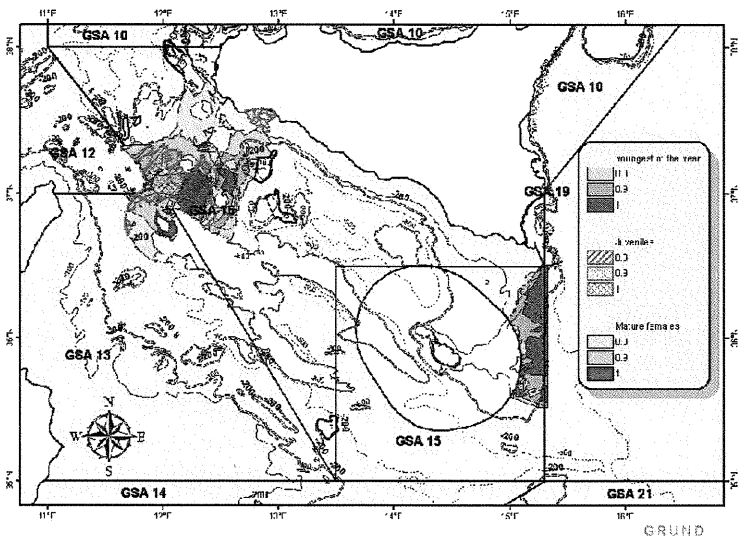

Figure 2-18 ***Stability by life phase throughout GRUND surveys (late summer-autumn 1994-2004 – 10 campaigns). Only persistence indices (PI) higher than 0.8 are reported. Nurseries (young of the year) sited on the eastern side of Adventure and Malta Bank show a high stability. Conversely stable spawning (mature females) and feeding (juveniles) are identified only in inside and around the Adventure Bank.***

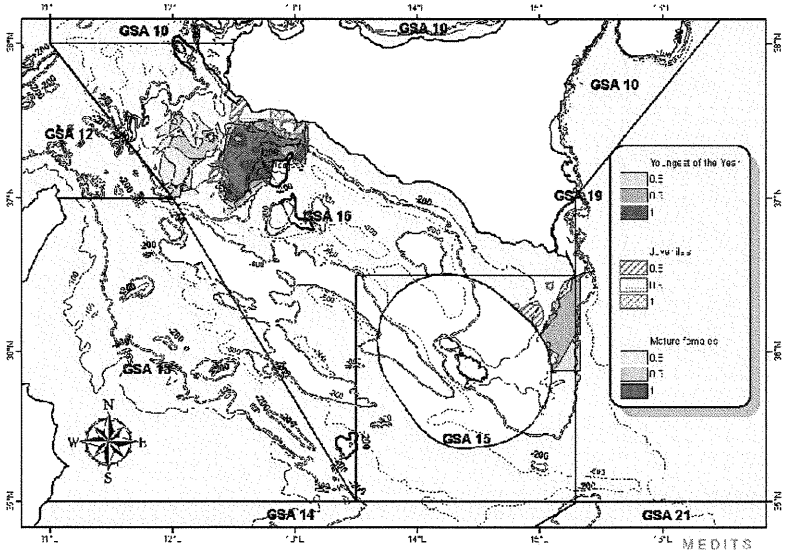

Figure 2-19 ***Stability by life phase throughout MEDITS surveys (late spring-early summer 1994-2004 – 11 campaigns). Only persistence indices (PI) higher than 0.8 are reported. Nurseries (young of the year) sited on the eastern side of Adventure and Malta Bank show a high stability. An important stable spawning area is found in the central sector of the Adventure bank, westernmost nursery and feeding areas which show some overlapping. Conversely a feeding areas is identified in the Malta Bank, westernmost the nursery.***

WHY THESE HABITATS ARE ESSENTIAL FOR HAKE BIOLOGICAL CYCLE?

After the EFH have been identified in terms of space occupied during critical phases, some environmental features of the habitat have been studied (hydrological patterns, currents and biocoenosis).

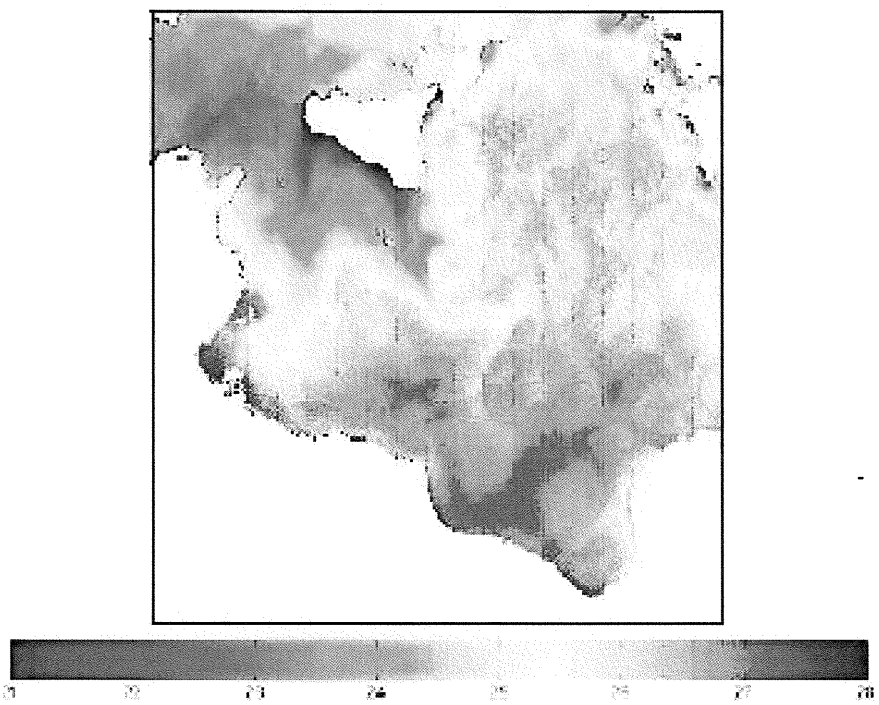

Figure 2-20 ***Sea Surface Temperature in the Strait of Sicily on 22nd July 2002. Upwelling, eddies, filaments and fronts can be easily detected.***

A large amount of literature pointed out the role of hydrological features in controlling spawning, egg and larval dispersal and recruitment processes.

In the case of the hake life cycle in the Strait of Sicily, Fiorentino et al. (2003) have discussed the major role of the upwelling, eddies, filaments and frontal systems, produced by the AIS, in influencing and maintaining the spatial structure of hake nurseries in time (Figure 2-20).

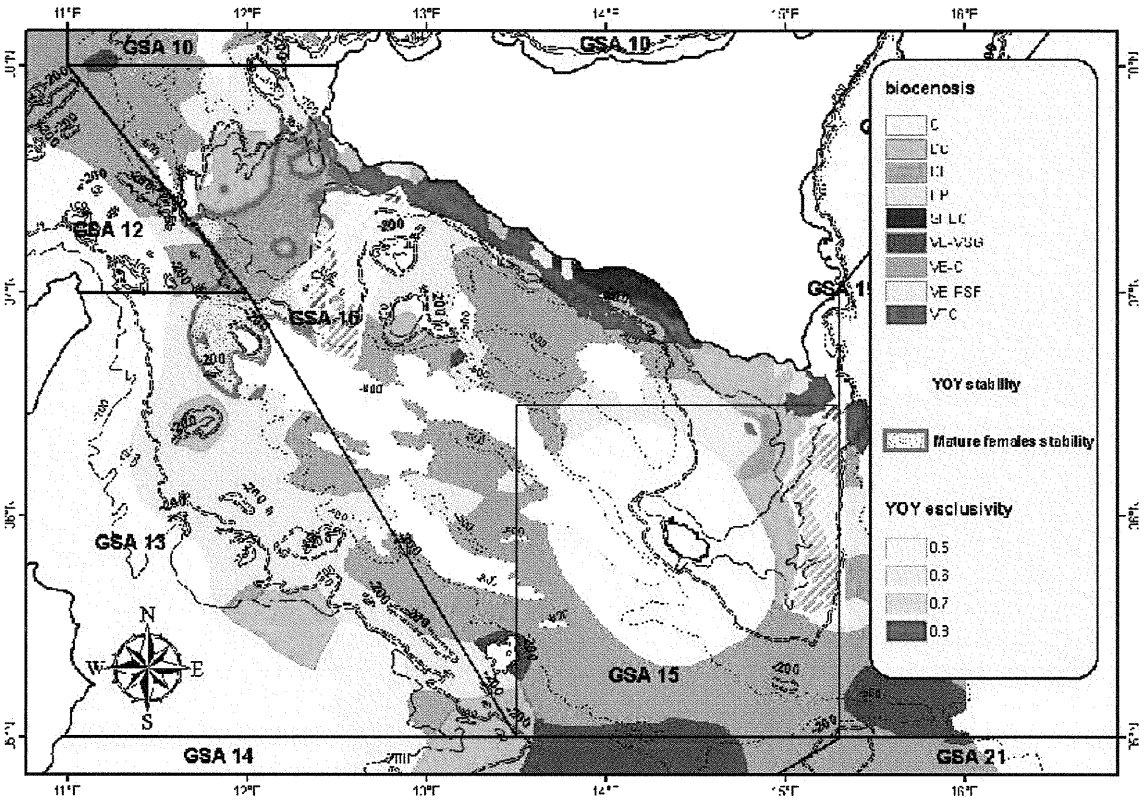

Figure 2-21 ***Benthic biocenoses occurring where the stable and exclusive nurseries areas are (GRUND surveys).***

No evident role of hydrology can be found in explaining the position of the spawners and juveniles. However, it is worth noting that spawning areas coincide with zones characterized by high mean diversity indices in demersal communities, where also total biomass indices and species richness too show the highest values (Garofalo et al., in press, see Fiorentino et al., in Appendix). Conversely, nurseries show the lowest values in diversity and species richness.

An attempt to correlate preferential habitat by life stage to information on biocoenosis highlighted that young of the year prefer deep muds (VB) bottoms while spawners inhabit preferentially coastal detritus (DC) grounds (Figure 2-21).

Difference in habitat characteristics of YOY, juveniles and spawners could be related to the different feeding behaviour and hunting of the YOY small planktonic crustacean in the water column, while, from about 15 cm TL onward, the role of benthonectonic fish, crustacean and cephalopods become more and more important

SUGGESTED PROTECTION OF EFH IN THE STRAIT OF SICILY

Mapping the areas of co-occurrence of high density and high percentage presence of YOY allowed identifying the core of the nurseries, both in Adventure Bank and Malta Bank, at useful scale for management purposes (Figure 2-22). It constitutes a rather small part of the whole nurseries (about 343 km^2 which correspond to 15 % of stable nurseries in the northern sector of Strait of Sicily) and include very low percentages of the other life stages (target of the commercial fisheries).

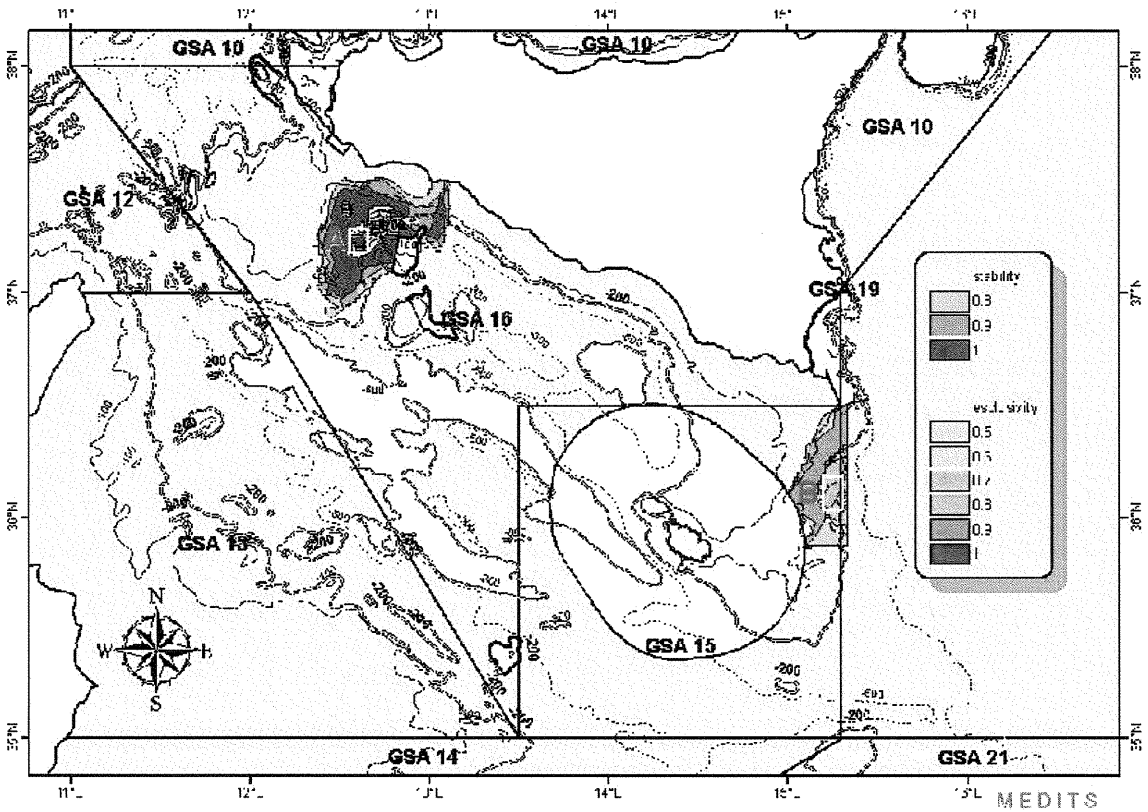

Figure 2-22 ***Areas showing stable and exclusive occurrence of young of the year (YOY) during the MEDITS surveys (spring-early summer 1994-2004 – 11 campaigns). Both the eastern side of the Adventure and Malta Banks shows co-occurrence of high and exclusive (YOY are more than 70% of total hake catch) concentration of young of the year. These two areas were used to identify zones to be closed to trawling in GSA 15 and 16.***

2.2.2.6 GSA 19: SENSITIVE HABITATS (D'Onghia et al., in Appendix)

Canyons

The North-Western Ionian is geo-morphologically divided by the Taranto Valley, an impressive NW-SE canyon exceeding 2200 m, in one Eastern sector and in a South-Western one. The former is located between the Taranto Valley and the Apulia and is represented by a broad continental shelf with abrasion terraces and bioclastic calcareous deposits with several coral rocks. The South-Western sector extends along the Lucania, Calabria and Sicily regions. Many submarine canyons are located along Calabria and Sicily coasts. During some periods of the year, after the sunset, the deep-water red shrimps can be caught together with coastal species on the continental shelf at the top of the Roccella Ionica and Caulonia canyons

Benthic biocoenoses

The type of bottom in the North-Western Ionian Sea is rather variable. Many biocoenoses are distributed along the very long Ionian arc and between depths of a few metres and the bathyal ground.

Along the Apulia *P. oceanica* and *C. nodosa* meadows are located generally within 30 m in depth alternating with rocky bottoms. In deeper waters, among isolated rocks emerging from the sediment, there are patches with coralligenous biocoenosis and with that of coastal detritic. Along the South-Western sector of GSA 19 (Lucania, Calabria and Sicily) *C.*

nodosa and *P. oceanica* meadows are present in several areas on sandy-muddy bottoms often impacted by the trawl fishing.

On the shelf edge, there are some areas, in both sectors of the North-Western Ionian Sea, with the biocoenosis of the shelf-edge detritic often characterised by the dominance of the sea-lily *Leptometra phalangium*. Over the continental slope the biocoenosis of the bathyal mud extends in the whole Ionian Sea. In the context of this biocoenosis, the *facies* characterised by the species *Funiculina quadrangularis* and *Isidella elongata* have almost completely disappeared due to trawl fishing.

Amendolara seamount

The Amendolara seamount is a sensitive area of high scientific and commercial interest on the Western side of the Taranto Gulf. It is located in the circalittoral zone, 65 nautical miles South-West of Taranto, barely South of Cape Spulico. The seamount is almost round in shape covering an area of about 31 km^2. It rises from 200 m up to about 20 m below the surface. The coralligenous and coastal detritic biocoenoses are widespread at the top, between 20 and 80 m, while terrigenous and bathyal muds can be found on deeper bottoms. The coastal detritic bottoms are characterised, in many sites, by the *facies* of "maërl". A high diversity of fishes, crustaceans and cephalopods was detected and is well known to the fishermen. Around the Amendolara seamount trawl fishing is carried out by the vessels from the Taranto and Schiavonea fisheries targeting mostly hake and deep-water rose shrimp. On the hard bottoms of the seamount, gill nets, trammel nets and pots are generally used by the local small scale fishermen to catch valuable species.

Deep-sea coral mounds

Side Scan Sonar, shallow high-resolution seismics and sampling indicate that living and dead colonies of *Lophelia pertusa* and *Madrepora oculata* are widespread within an area of about 900 km^2 South of Cape Santa Maria di Leuca, between 350 and 1100 m in depth, and characterised by a complex seabed topography. The complexity of the coral community, with the presence of many suspension feeders, is most probably linked to the energetic trophic system and hydrographic factors regarding the area. The Santa Maria di Leuca coral bank represents a rare example of living *Lophelia-Madrepora*-bearing coral mounds in the Mediterranean basin. The most important resources in the area are represented by the deep-water shrimps (*A. antennatus* and *A. foliacea*) which can constitute up to 58.60% in weight and 66.15% in economic value of the total catch (Gallipoli fishery). Other important ground-fish resources are the hake (*M. merluccius*), greater forkbeard (*P. blennoides*), deep-water rose shrimp (*P. longirostris*) and Norway lobster (*N. norvegicus*). Vessels fishing with bottom longlines target hake, greater forkbeard, blackspot seabream (*Pagellus bogaraveo*), bluntnose sixgill shark (*Hexanchus griseus*), piper (*Chelidonychtys lyra*), tub gurnard (*Chelidonychtys lucerna*), European conger (*Conger conger*) and silver scabbardfish (*Lepidopus caudatus*).

2.2.2.6 GSA 19: ESSENTIAL FISH HABITATS (D'Onghia et al., in Appendix)

RECRUITMENT AND NURSERY AREAS

Data collected in the GSA 19 by means of trawl surveys indicates that this geographic area includes the nurseries of the most important commercial demersal species.

M. merluccius

The greatest densities of juveniles have been shown between 100 and 200 m in the Otranto Channel, on the Western side of the Gulf of Taranto and along the Calabria coasts, close to Roccella Ionica Bank.

M. barbatus

The greatest densities of juveniles have been shown within 50 m barely south of Otranto, on the Western side of the Taranto Gulf and in the southernmost Calabria coast.

P. longirostris
The recruitment has been shown to occur on the shelf mostly during spring with very high densities both along the Apulia (Otranto Channel and offshore from Torre Ovo) and Calabria coasts (Taranto Gulf, Corigliano Gulf, Roccella Ionica Bank). The nurseries of this shrimp in the Otranto Channel and Taranto Gulf, generally overlap with those of hake.

A. foliacea
The greatest densities of the young-of-the-year have been identified during the spring season in the upper slope in both sectors of the Ionian Sea (offshore S. Maria di Leuca, Gallipoli, Torre Ovo along the Apulia and in the Roccella Ionica Bank in Calabria).

N. norvegicus
The greatest densities of juveniles have been found in the Apulia sector, abeam of Gallipoli, between 200 and 400 m.

REPRODUCTION AND SPAWNING AREAS
M. merluccius and *P. blennoides*
The spawners have mostly been caught using longlines in the upper slope both along the Apulia (in Gallipoli and S. Maria di Leuca fisheries) and Calabria coasts (mainly in the Gulf of Squillace). The hake spawners are generally found deeper than juveniles while in greater forkbeard the mature specimens have been collected in the same depth range as the juveniles.

M. barbatus
The spawners have frequently been collected within the shelf during late spring in the Otranto Channel, on the Western side of the Gulf of Taranto and in the southern coasts of Calabria.

P. longirostris
Ripe specimens are generally found on the shelf edge both in spring and autumn, mainly in Otranto Channel, in the Gulf of Taranto and Gulf of Corigliano as well as in Calabria (Roccella Jonica Bank) and in the southernmost Sicily coast, barely south Siracusa.

A. antennatus
Ripe females are generally caught in the upper slope (400-700 m) in both sectors of the North-Western Ionian Sea, mostly in the Gallipoli and S. Maria di Leuca fisheries.

2.2.3 **Greece: GSA 20, 22, 23**

NURSERY AREAS (Politou et al., in Appendix)
Merluccius merluccius
Areas with high densities of juvenile hake were found in
i) Aegean Sea: Argosaronikos Gulf, Thermaikos Gulf, Strimonikos Gulf and Thracian Sea, South of Sporades Islands, North of Crete Island, Dodecanese Islands (between Cos and Rhodos Islands), Cyclades Islands (mainly west of Andros Island).
ii) Ionian Sea: Patraikos Gulf, east of Cephalonia Island and between Lefkada and Corfu Islands.

High density (more than 70% of hake catch) of juveniles of hake was found in 226 out of 1,605 hauls (percentage 14.1%) in the Saronikos Gulf (44 hauls, 10 years) in Thermaikos Gulf (23 hauls, 8 years), Strimonikos Gulf (14 hauls, 7 years) and in Thracean Sea (20 hauls, 7 years), in Patraikos Gulf (13 hauls, 7 years), in the area east of Cephalonia (15 hauls, 7 years) and between Lefkada and Corfu Islands (10 hauls, 7 years).

Parapaeneus longirostris
In similar areas with hake juveniles. However the persistence was lower than hake (2.6% of the hauls surveyed), probably because the survey period is not so appropriate for shrimp as for hake.

Mullus barbatus
No information presented because the time of the survey is not appropriate to define nursery grounds for the species.

Nephrops norvegicus
No information presented because the time of the survey is not appropriate to define nursery grounds for the species.

CLOSED AREAS
There is a general banning for bottom trawl fishery in Greek waters during summer (1st of June to 30th of September) since 1966.

There are closed gulfs to bottom trawl fishery all year round (Amvrakikos Gulf, Pagassitikos Gulf, South Euboikos gulf, part of Saronikos and Corinthiakos Gulfs and some other small gulfs).

Additionally, in other gulfs bottom trawl fishing is closed from 7 to 9 months.

There are not closed areas for bottom trawl fishing in open seas.

COMMENTS ON THE GREEK EFH
Red mullet: although no data were included in the presentation, is well known that the juveniles of red mullet are concentrated in swallow waters along the coast were there is suitable substrate.
When the fishing period of bottom trawl starts (1st of October) the young of the year become accessible to the gear and high fishing mortality has been observed.
The young of the year would be well protected if the current regulations (prohibited use of trawls within three nautical miles of the coast or within the 50m isobath and the use of 40 mm mesh size) were fully enforced.
Hake: areas showing high densities of juvenile hake are much dispersed making difficult the implementation of a general rule. Many small areas should be closed during all year round or at least for a longer period than the existing 4 months banning. The existing technical measures (closed season: June to September and closed areas, e.g. Pagassitikos Gulf) provide some protection to the juveniles of the species.

SUGGESTED PROTECTION OF EFH
Red mullet: An expansion of the depth prohibition to 75 m from August to November will benefit the recruits of red mullet, because it will let the recruits to grow and will reduce the fishing mortality.
Hake: for the improvement of the protection of juvenile hake the extension of closed season in areas of high density of juveniles and the implementation of new closed areas should be considered. So far, the additional time restrictions cover only, more or less, closed gulfs and the extension is expected to generate strong reactions. A no take zone for all the gears targeting demersal species in open sea could be accepted by the fishing sector aiming to the protection not only of the juvenile hake but the juveniles of other co-occurred species (shrimps, *Nephrops*, *Lepidorhombus boscii*, etc.) as well as the spawning stocks. However, the zone has to be implemented after consultation and in close collaboration with the fishing sector and following a thorough study on the biological and economical consequences.
Deep-water pink shrimps: from the available data the nursery grounds of deep-water pink shrimp are not so-well defined as for hake. However, it is clear that there is an overlapping of the nurseries of the two species. Any new measure concerning closed areas targeting to protect the juvenile hake would also serve the protection of juvenile shrimps.
Nephrops: no information was available on the nurseries of the species. However, the closure of areas for the protection of the juveniles of the species should be considered in relation with the closure of areas for the protection of juvenile hake and shrimp.

2.2.4 Turkey: GSA-24

Turkey has coast to Black Sea, Marmara Sea, Aegean Sea and Levant Sea (Gucu, in Appendix). Among them Levant Sea, greatly influenced by Lessepsian species, represents

rather dissimilar faunal structure than the rest of the eastern Mediterranean. The priority list given by GFCM, therefore does not perfectly cover the species having commercial and ecological importance in the Levant Sea. For instance, *Saurida undosquamis*, *Upeneus moluccensis*, *U. pori*, are among the most important teleosts which together make almost 20% of the landings of the trawlers, as well as some highly commercial shrimps, such as *Penaeus kerathurus*, *P. semisulcatus*, *Metapenaeus stebingii* are not included. These species will eventually be important for the other basins in the eastern Mediterranean when their fast expanding trend towards west is considered.

For the selection of the priority list of species four criteria should be considered. These are;

i) landing / commercial value of landing (commercial price times the landing),
ii) commercial price (kg price)
iii) ecological value (prey species),

Commercial price: The total landing of species like gilthead bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*) is relatively low compared to the other demersal species, however these are among the most preferred species, especially on the Aegean coast of Turkey. The species having traditional value may be disregarded if only landings are considered. The commercial price of a species however may be used as an indicator of its preference.

Ecological value: The species, especially main prey species, such (*Leiognathus klunzingeri* or *Upeneus pori*) having no or very low commercial value, may be critically important from ecological point of view.

2.2.4.1 GSA 24: SENSITIVE HABITATS

Very little is known about the sensitive habitats in the Levant Sea. *Posidonia oceanica* does not exist in the region. The important habitats like Corallingenous and Maerl bottoms and other which are classified as sensitive fish habitat for the western Mediterranean species has not been identified yet in the Levant Sea. Furthermore the possible fishing grounds beyond the continental shelf is almost intact, since trawl fishery in the area is coastal and confined to continental shelf.

The lagoons and estuarine areas neighboring Seyhan, Ceyhan and Goksu rivers, however, are important nursery grounds for commercially and traditionally important species, such as *Sparus aurata* and *Dicentrarchus labrax*. In late 1980's during fish farming outbreak, the postlarvae of gilthead bream (*Sparus aurata*) has experienced intense harvesting during their migration towards the lagoons near to Seyhan, Ceyhan and Goksu rivers. Consequently, natural stocks of many sparids, including *Sparus aurata* as well as many others which were not targeted by the fish farms, have experienced a sharp decline. Some of the species totally disappeared. Later in 2000s, following the ban on larvae harvesting several species, such as *Sparus aurata* and *Lithognathus mormyrus* re-appeared in the catch. This single example indicates that lagoons are not only sensitive but also essential fish habitats requiring protection in the Levant Sea.

2.2.4.2 GSA 24: ESSENTIAL FISH HABITATS

As the spatial distribution of the newly recruited specimens of the major targeted species are considered two areas emerge as the most important nurseries for the majority of the targeted teleosts in the Turkish part of the Levant Sea. These are near coastal strip around Goksu and Seyhan Rivers. The latter, besides its importance for teleost fishes, appears as a critical habitat for the major shrimp species fished in the region.

2.3 PROTECTION MEASURES FOR DEMERSAL EFH

Within the current framework of reduction of overcapacity of Communitarian fishing fleet in the Mediterranean, the protection of EFH represents one of the suitable measures to move fisheries towards a more sustainable exploitation.

After identification of the spatial-temporal characteristics of nursery and spawning areas, adequate protection measures could be enforced. Considering multi-species and multi-gears characteristics of the Mediterranean fisheries together with high environmental

complexity, different management measures, all oriented to a general improvement of fishing pattern, should be integrated.

Since it is recognised that many demersal stock are in a growth over-fishing situation, the spatial closures in the nurseries, with high priority, and, at lesser extent, in the spawning areas are recommended. In this respect there are strictly coastal nurseries, such as that of *Mullus barbatus*, that are already protected by law and for which protection is mainly an enforcement problem. For these species some experiences proved that benefits at short term can be obtained adopting a closed season in late summer-early autumn, when young fish move from the protected coastal areas to deeper bottoms where trawling is allowed. However, as in other Atlantic areas, these benefits do not extend in time.

On the other hand, some species, such as *Merluccius merluccius* or *Parapenaeus longirostris,* show deeper nurseries which are sited in currently exploited in fishing grounds not regulated by a closed areas strategy.

Thus, the more urgent problem is to adopt protection measures for this latter type of "offshore" nurseries, which have to be extended to all over the years, due to the long recruitment period of these two species in most of the Mediterranean areas.

There are some evidences that a trawling ban lasting 45 days in autumn, enforced for coastal resources, could also provide positive effects for *Parapenaeus longirostris,* at least for Tyrrhenian and Strait of Sicily, but it is not enough.

Furthermore the closure of offshore nursery areas should be adopted together with the implementation of a more selective mesh size (e.g. square mesh panel or in the cod-end) than the current diamond 40 mm opening for trawling mostly for grounds deeper than 400 m.

To ensure the efficiency of these closed seasons, it is necessary to apply complementary measures to reduce fishing effort to be added to the closure of areas and seasons: i.e. reduce fishing activity, per day o per week, after opening the closed areas. It could be also considered stopping fishing activity during the week-end and festivities. This measure, which is adopted in Spanish and many Italian fisheries, could be extended to all fishing boats which fish within 40 nautical miles from the coasts.

A closed season should be identified on the basis of biological characteristics of resources and the target species and operative modality of the fisheries. For those GSAs in which a relevant role in the fisheries is due to deep-water red shrimps, the time closure should be adopted in the late spring-early summer when young of the year and spawners occurs in the same fishing grounds. Particularly in this case, a further adoption of a large mesh size together with the week-end closure appear to be relevant for improving exploitation pattern of the resources.

According to the presence of different localised nurseries of the same species in each GSA and the extension of many GSA, a "network" of small no-take areas should be also considered. This would hedge against the variability of the population processes and unpredictable events due to environmental complexity. In any case, it must be taken into consideration that presently the minimum extension of protected areas to be efficient is under discussion.

2.4 DATA REQUIRED TO EVALUATE THE PROTECTION OF DEMERSAL EFH

In order to evaluate the impact of protection of EFH the following actions are recommended:

- Analysis of the persistence trough time of the a given species in a given habitat;
- Analysis of the co-occurrence in a given EFH of critical phases of other commercial species;
- Monitoring recruitment, juveniles and spawners indices and total mortality derived from trawl surveys;
- Monitoring quantities and size structure of commercial catches, both in terms of landings and discards;
- Monitoring what catches are going to be lost with the closure and what benefits we expect by biomass transfer from the closed area to the others.
- Monitoring of spatial distribution of fishing effort;

- In order to make more effective management measure based on EFH approach, specific programmes to study fish displacements among spawning, nurseries and growing areas in the whole area are recommended. In this sense, meta-populations studies should be promoted, since there are areas of high concentration that can be unfavourable to the growth and reproduction processes. Nurseries which are close to feeding and spawning areas should be selected for the protection.
- Priority in protection must be given to those EFH which overlaps with peculiar sensitive habitats.

3 PELAGIC SH AND EFH

3.1 PRIORITY SPECIES

Due to remarkable differences in the various fisheries taken into account, the list of priority species has been established on the base of the species having a certain commercial importance at the Mediterranean level. The selection of priority species includes also some lessepsian species, locally important in some eastern Mediterranean areas.

3.1.1 Small pelagics:

Priority species:

- ✓ Anchovy (*Engraulis encrasicolous*)
- ✓ Sardine (*Sardina pilchardus*)
- ✓ Other species for which information is partial or local: *Sardinella aurita, Sardinella maderensis, Trachurus* spp., *Scomber* spp., *Boops boops, Belone belone, Sprattus sprattus Dussumeria elongates.*

Other non-priority small pelagic species for which information is not sufficient:

- ✓ *Gymnamodites cicerellus, Alosa* spp., *Scomberesox saurus, Exocoetus* spp., *Cypselurus heterurus, Etrumeus teres, Herklotsichthys punctatus*

3.1.2 Large and medium pelagics:

Priority list:

- ✓ Bluefin Tuna (*Thunnus thynnus*)
- ✓ Swordfish (*Xiphias gladius*)
- ✓ Albacore (*Thunnus alalunga*)

Other species for which information is partial or local:

- ✓ Mediterranean spearfish (*Tetrapturus belone*), Atlantic bonito (*Sarda sarda*), Frigate tuna (*Auxis thazard*), Bullet tuna (*Auxis rochei*), Yellowtail (*Seriola dumerilii*), Dolphin fish (*Coryphaena hippurus*), Bluefish (*Pomatomus saltatrix*).

Other non-priority large and medium pelagic species for which information is not sufficient:

- ✓ Little tunny (*Euthynnus alletteratus*), Skipjack tuna (*Katsuwonus pelamis*), Plain bonito (*Orcynopsis unicolor*), Obtuse barracuda (*Sphyraena chrysotaenia*), Luvar (*Luvarus imperialis*), *Scomberomorax* spp., *Tetrapturus* spp., Istiophoridae, Pilot fish (*Naucrates ductor*), Narrow barred king mackerel (*Scomberomorus commersoni*), Shrimp scad (*Alepes djedaba*), Pompanus (*Trachinotus ovatus*), Guelly jack (*Pseudocaranx dentex*), Carangidae (*Caranx* spp.), Learfish (*Lichia amia*), Vadigo (*Campogramma glaycos*), Opah (*Lampris guttatus*), Sunfish (*Mola mola*), Slender sunfish (*Ranzania laevis*).

Pelagic sharks (*Alopias* spp. *Carcharhinus* spp., *Prionace glauca, Cetorhinus maximus, Heptranchias perlo, Hexanchus griseus, Charcarodon carcharias, Isurus oxyrinchus, Lamna nasus, Sphyrna* spp., *Galeorhinus galeus*) and Batoidea (*Dasyatis violacea, Mobula mobular, Myliobatis aquila, Pteuromylaeus bovinus*), have not been taken into account during the meeting.

3.2 MEANING OF EFH AND SH FOR SMALL AND LARGE PELAGICS

The EU Habitat Directives 92/43 defines "natural habitat" as "terrestrial or aquatic distinguished by geographic abiotic and biotic features", and when specifically addressing a species habitat it is referred as the "environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle".

The Magnuson Act of Fishery Conservation of the USA defines "Essential Fish Habitat (EFH)" as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Furthermore, to clarify the definition: the term "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, whereas the term "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. By "necessary", it is meant as the habitat required to support continued productivity in a sustainable fishery, and the managed species' contribution to a healthy ecosystem, and by habitat of a species, it is implicitly covering the whole spectrum of their life cycle by "spawning, breeding, feeding, or growth to maturity".

From these EFH definitions, it can be inferred that EFHs are distinguished by specific abiotic and biotic factors and the associated natural hydrographic processes occurring in water masses. This issue is crucial when dealing with small and large pelagic fish species whose natural habitat is within the upper layers of the water column. While anchovies are influenced during their reproductive period by the influence of river runoff and its associated enrichment processes, large pelagics as bluefin tuna (BFT) seem to be influenced by anticyclonic gyres, fronts and the characteristics of the water mass, and more particularly by surface layer temperature and the formation of a sharp thermocline gradient during the spawning season.

Therefore, the role of environmental factors and its associated biological, physical and chemical properties of a water mass and their intrinsic variability is indispensable to define the EFH of pelagic species in a spatio-temporal scale.

3.3 HOW TO IDENTIFY EFH AND WHAT TO PROTECT

Small and large pelagics have partially different problems concerning defining EFH and consequent management actions.

However, unlike demersal or benthonic species whose EFH may be defined in function of the substrate, pelagic species develop their life cycle within a pelagic column subject to hydrographic regime variability, posing certain difficulties in defining a particular EFH through fixed and permanent geographical limits. Therefore, to consider a specific pelagic habitat for an EFH, a combination of particular oceanographic features and/or the presence of hydrographic processes should be taken into account. In some instances, the function is more important than the form in defining and describing an EFH in small pelagic species.

On the other hand, the hydrographic circulation and its associated processes are subject to climatic variability that can bring about spatial changes which consequently affect the distribution pattern of these species, thereby complicating a precise spatial delimitation of EFH boundaries. An added problem is the mobility of these species, inhabiting different areas during different life stages. Their displacement capacity is also a function of their particular life stage; while eggs and early life stages of larvae drift passively, juveniles and adults are highly mobile in the open sea.

Notwithstanding, these difficulties in defining EFH for sardines and anchovy off the Mediterranean coasts and with the intention of defining areas linked to single species needs inside the different GSA where species concentrate for different purposes aiming to provide conservation measures, there is sufficient information to define and characterize some EFH for sardine and anchovy off some Mediterranean areas: data on their distribution, reproductive biology and exploitation pattern.

The adults of these species are in general distributed over the continental shelf where the main effort of the fishery is exerted. Although, the eggs and larvae of sardine and anchovy

may be found widespread in many coastal areas, species as anchovy show in general highest concentrations of eggs and larvae are found off river outflows and regions of fresh water influence (ROFI).

Generally, near shore coastal areas are extremely important habitats for the development of post-larval and juvenile life stages of anchovy and sardines and could be regarded as the main nurseries. The spatio-temporal persistence of these nurseries as well as their very likely strong influence on the recruitment processes qualifies these areas as EFH.

Fry-based fisheries information may be particularly relevant and useful to the establishment of small pelagic EFH. Such types of fisheries bear witness on the accumulation or aggregation of larvae in the near shore waters of many Mediterranean areas, as a result of the circulation pattern. Larval accumulation and retention areas may have important implications in the design of marine reserves and essential fish habitats.

Alternatively, establishing EFH for large pelagic species is undoubtedly a challenging task due to their highly migratory nature, ranging widely in the open ocean, both in terms of area and depth. As top predators, their role in pelagic ecosystems is highly important. As open sea pelagic species, tuna and tuna-like species cannot be associated with the typical features of fish habitats. Their habitat should be contemplated by oceanographic features, such as, temperature range, salinity, oxygen levels, currents, fronts, shelf edges and a proper food chain.

Their life cycle presents many unknown aspects and only in recent times, using sophisticated and expensive technologies it was possible to get some additional information. Sometimes, the new information added new important questions and rarely responded to previous ones. Several large pelagic species are believed to belong to specific stocks, even if the genetic evidence is sometimes weak or not definitive. Some species are believed to have "spawning site fidelity", a sort of homing behaviour related to some large geographical areas during the breeding season.

The behavioural evidence is essential to confirm biological and physiological information, particularly on spawning, and this fact is not always taken into account. All large pelagic species have floating eggs and free-swimming larvae. Their distribution is mainly driven by marine currents and sea-fronts. Juveniles are mostly concentrated over the continental shelf in many Mediterranean areas, but their presence and abundance is strictly linked to the availability of a proper food chain in the same area and time.

Due to all these practical problems, even if it is possible to geographically define some EFH and "hot spots" for juveniles and spawners of the most relevant species of large pelagics, because of the yearly variability and the difficulties to enforce conservation measures, a time closure or a reduction of the total fish effort in some periods appears more practical and effective than other protection measures in EFHs.

3.4 EFH FOR SMALL PELAGIC SPECIES IN DIFFERENT COUNTRIES AND GSA

3.4.1 Spain

The adults of anchovy and sardine are in general distributed over the shelf of the W Mediterranean where the main effort of the fishery is exerted ((Garcia et al., in Appendix)). However, the main bulk of the stocks of both species are distributed along the Catalonian shelf, possibly due to the fact that the extension of the shelf is much wider than the Alborán Sea shelf, especially off the Ebro river coastal region and its southern boundaries.

Although, the eggs and larvae of sardine and anchovy may be found widespread over the Catalonian shelf, the highest concentrations of eggs and larvae of sardine and anchovy are found off the Ebro river outflow and its shelf break (Figure 3-1). These stocks are shared with the anchovy and sardine stocks off the Gulf of Lions (N of Catalonia), and their influence on the southern population cannot be disregarded.

In contrast, the northern Alborán Sea coasts have a much narrower shelf, which

conditions the distribution pattern. Most of the adult fraction of the stocks of both species is exploited in the mid-shelf, around depths of 80-100 m, mainly concentrated over areas where higher concentrations are found, such as the Bay of Málaga, especially the Alborán Sea anchovy, which suffered a drastic decline during the mid-eighties. In spite of the fact that fishing effort applied by the purse seine fishery has decreased during the last two decades, from 203 vessels in 1980 to 120 in 2001, the anchovy resource has not recovered to the biomass levels prior to its decline. Actually, the main bulk of the anchovy resource from the northern coasts of the Alborán Sea is concentrated in the Bay of Málaga, whose port lands on average as much as 85% of the total catch from the South Mediterranean region.

The most important period for larvae and juveniles along the Spanish Mediterranean coast is September to November for anchovy, while for sardines there is a peak between March to May but it could be a much wider period due to its protracted spawning period. *Anchovy and sardine **nursery** essential fish habitats off the Alborán Sea coasts are shown in* Figure 3-2.

3.4.2 Italy

In Northern and Central Adriatic (GSA 17, (Arneri et al., in Appendix)) anchovy post-larvae are mainly concentrated in the western Adriatic inshore areas from September to January in relation to waters of lower salinity and high nutrient content (see map). Situation is less clear for sardine which is found also concentrated in some inshore areas on the western side (but in lesser quantities than anchovy) from December to March. High concentration of sardine post-larvae are found in GSA 18 (Southern Adriatic) in the Gulf of Manfredonia from January to April. The situation for the Adriatic points out that these nursery areas for small pelagics along the Italian coast should be defined on a spatial and temporal basis for each GSA. It appears that the link to freshwater river output is more important for anchovy than for sardine where other retention mechanisms could play a major role. More precise information is needed from some other Italian areas.

The fry fishery is still important in many southern Italian areas, particularly in winter, when special permits are given to local vessels for this fishery.

3.4.3 Greece

The most important anchovy and sardine stocks in the Greek Seas (GSA 20, 21, 22) occur in the Aegean Sea (GSA 22), especially in the northern Aegean Sea. The main spawning grounds of anchovy are located in the NE Aegean Sea continental shelf (Thracian Sea), the Thermaikos Gulf and the North Evoikos Gulf, waters influenced by the advection of the less saline Black Sea Water in the Aegean Sea and the outflow of large rivers in the area. Much less is known of the spawning grounds of sardines which, in the central Aegean and Ionian Seas, spawn during winter in inshore (< 90m) waters.

With regard to location of nursery areas, there is lack of any scientific knowledge. However, it is likely, based on spawning periods (anchovy: May-August, sardine: November-March), reports of fishermen and information from other areas of the Mediterranean, that anchovy juveniles recruit in near shore waters during autumn (probably from September to December) and sardine during spring (probably from March-May). Fishermen do not generally target juvenile fish except in years/seasons/areas when/where larger fish are not accessible due to low biomass or bad whether conditions. In National acoustic surveys conducted during June, smaller/immature fish are always found in swallow waters (< 50 m) at least in areas where the continental shelf is wide. No recommendation on spatial closures, in order to protect the juveniles, can be made, unless more research highlights the distribution and characteristics of nursery areas.

In Greek waters, there is a closed season for purse-seiners from 15 December to end of February. It seems likely that a shift of this closed season from winter (a period of anyhow reduced fishing effort due to adverse weather conditions) to autumn (to protect anchovy juveniles) or spring (to protect sardine juveniles) would be more effective.

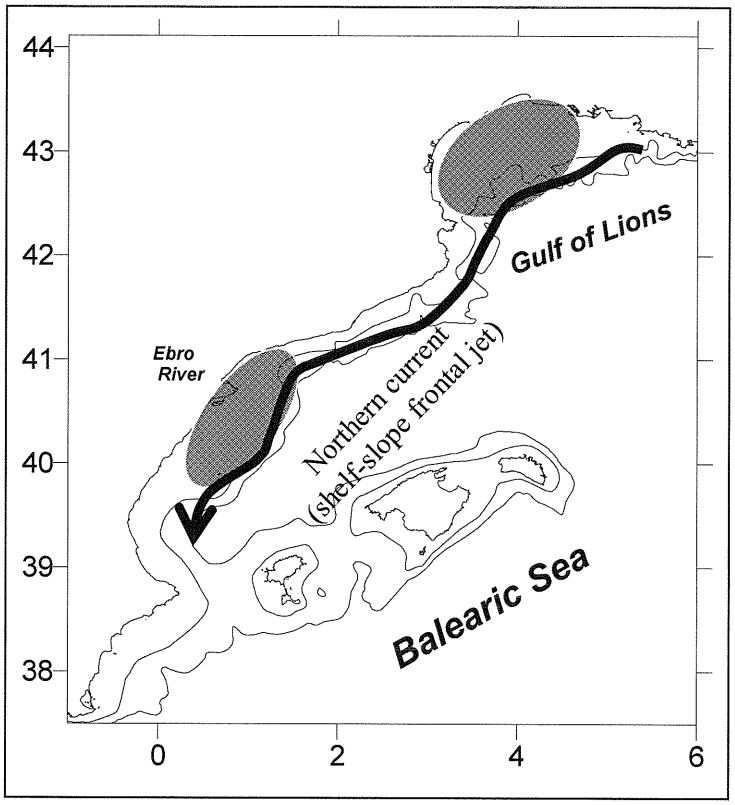

Figure 3-1 ***Anchovy and sardine spawning essential fish habitat off the Catalonian coasts and the Gulf of Lions.***

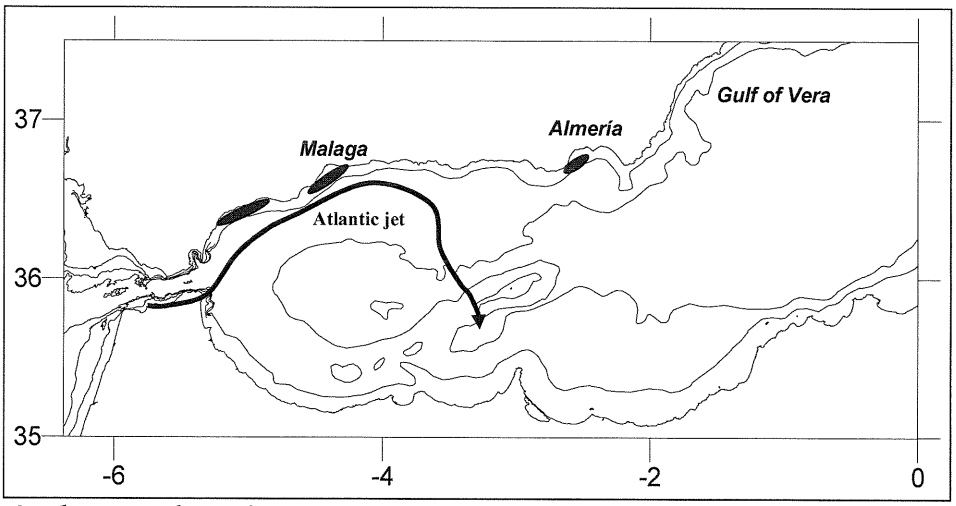

Figure 3-2 ***Anchovy and sardine*** *nursery* ***essential fish habitats off the Alborán Sea coasts***

3.4.4 Turkey

River mouths and lagoons in the Turkish Aegean and Levantine coasts are most important spawning regions for most of the small pelagic species reported. Major rivers are Gediz, Menderes, Goksu, Seyhan and Ceyhan.

3.4.5 Lebanon

The Lebanese coast represents a nursery zone for many fishes, which corresponds to about 50 species of pelagic and demersal species (Bariche, in Appendix). Recruits of Sardines (*S. pilchardus* and *S. aurita*), the anchovy (*E. encrasicolus*) and the chub mackerel (*S. japonicus*) dominate the purse seine catches during summer and autumn seasons. Other species such as *B. boops*, *T. mediterraneus*, *T. trachurus* and the Lessepsian *E. teres* and *H. punctatus* are common but with a lesser importance for fishery. The location of the spawning grounds of most of these species is completely unknown.

3.5 EFH FOR LARGE PELAGICS IN THE MEDITERRANEAN SEA

As stated before, it should be likely to regard EFH for large pelagics in a broader manner compared to small pelagics, using a Mediterranean scale to try to identify "hot spots" that might be considered as EFH in relation to the main spawning grounds or juvenile concentration areas, always taking into account that spawning can occur in most of the open sea Mediterranean waters, at least for the first two species (Di Natale, in Appendix).

3.5.1 Bluefin tuna

According to the current knowledge, spawning usually takes place from late May to July, with a peak from June to July; a time shift could be noticed from year to year according to climate and oceanographic conditions.

The most relevant spawning areas are SW of the Balearic Sea, the central and southern Tyrrhenian Sea, the central Mediterranean Sea SW of Malta, the eastern Mediterranean Sea in the south Aegean to the area north of Cyprus, particularly the area between Anamur and Mersin in the Levantine Sea (Figure 3-3). Important spatial changes in some of the most relevant spawning areas have been noticed in the last 10 years, particularly in the south Tyrrhenian and central Mediterranean.

Mature specimens are reported from most of the Mediterranean areas, with the only exception of the Gulf of Lions and the northern Adriatic Sea. Larvae are found as well in most of the Mediterranean surface waters, with a major concentration in areas where gyres and fronts are present, particularly in the second part of summer.

Juvenile bluefin tunas (immature of age 0) are found mostly in coastal areas over the continental shelf, whenever a proper food chain is present. Most of the available information reports a major presence along the coasts of Croatia, south Adriatic Sea, western Ionian Sea, Tyrrhenian Sea, all the north-western Mediterranean coast, in some areas of Morocco and Tunisia, in a few Aegean areas and in the Levantine Sea (between Anamur and Mersin) (**Figure 3-4**). Remarkable shifting of areas where juveniles are concentrated has been noticed from year to year. Juveniles are mostly present in feeding aggregations or schools during fall, from September to December.

A minimum weight of 10 kg has been adopted in the Mediterranean Sea, following a specific ICCAT recommendation to protect juveniles.

3.5.2 Swordfish

The spawning activity of the Mediterranean swordfish appears strictly related to climate and oceanographic features. Observations at sea confirms that having a surface layer at about 22°C or over is sometimes enough to induce spawning even for a short period and the hypothesis that the swordfish is a multi-spawner during the same season is to be seriously taken into account, This hypothesis, at the same time, could explain the recruitment success of this species for long times.

Usually spawning takes place from the second half of May to July, but in some years spawning was reported even in late April or up to the first week of September, due to climate influence. The peak is always in June to July.

Theoretically, the swordfish could spawn in most of the Mediterranean Sea and mature specimens have been reported more or less everywhere in late spring and summer, but the

major spawning activity seems to take place in the area around the Balearic Isles, close to the south-western part of Sardinia, in the central and southern Tyrrhenian Sea, in the Strait of Messina and in the surrounding western Ionian Sea, in the Strait of Sicily and the central Mediterranean between Malta and the Pelagie isles, in the southern Adriatic Sea, in the eastern Ionian Sea, in the Aegean Sea and around the isles of Crete and Cyprus (Figure 3-5). In the past, a spawning activity was reported even for the area close to the Bosphorus, maybe linked to seasonal movements of the Black Sea swordfish population existing at that time and not existing anymore since the late '60s. It seems that only two Mediterranean areas are known for the absence of any report about mature or spawning swordfish: the northern Adriatic Sea and the area in front of the Nile delta.

Swordfish larvae are found in most of the Mediterranean surface waters, moved by surface currents, particularly in the second part of summer.

Juvenile swordfish is also distributed in most of the Mediterranean Sea, either close to the coast or off-shore, particularly from late August or the beginning of September to December.

The major concentrations are linked to the availability of a proper food chain and can change their geographical distribution substantially from one year to the other, according to oceanographic features. According to the available knowledge, juvenile swordfish is usually more present along the Spanish Mediterranean coast and the Balearic Isles, the Ligurian coast the entire Tyrrhenian coasts, the southern part of Sardinia, the entire Sicilian coasts including small isles, the area around Malta, the Ionian coasts, the south Adriatic sea, the Aegean coasts, the Eastern Mediterranean, particularly along the Turkish coast and around Crete and Cyprus, and the Mediterranean coast of Morocco (**Figure 3-6**), but juvenile individuals are reported everywhere in the surface longline fishery, mostly in longlines using medium-small hooks.

Anyway, juvenile swordfish (age 0 to 1) are reported in the fishery all the year round, with peaks in fall. Feeding aggregations of swordfish are reported only in the early stages of its life, while in other stages of juvenile life swordfish seems more dispersed in large areas.

3.5.3 Albacore

Albacore spawning usually occurs late in summer, from the last part of June to the first part of September, with small variation yearly, due the influence of climate and oceanographic factors. The spawning areas known so far are only a few: the south-eastern Tyrrhenian Sea, the Strait of Messina, the Ionian Sea, the southern Adriatic Sea, the Balearic area and, more recently, a small area off the Cirenaica coast (Figure 3-7), but spawning activity have been reported even along the south Turkish coast, in the area between Anamur and Mersin in the Levantine Sea, during the meeting (Figure 3-9).

The Mediterranean distribution of juvenile albacores is even less known: presence of juveniles is reported in the Balearic area, in south-eastern Tyrrhenian Sea, in the western Ionian Sea and in the southern area of Apulia (W Ionian Sea and S. Adriatic Sea) (Figure 3-8). Juvenile albacores are mostly reported in late August and September, sometimes in schools concentrated for feeding purposes close to small pelagic species, sharing the same feeding ground.

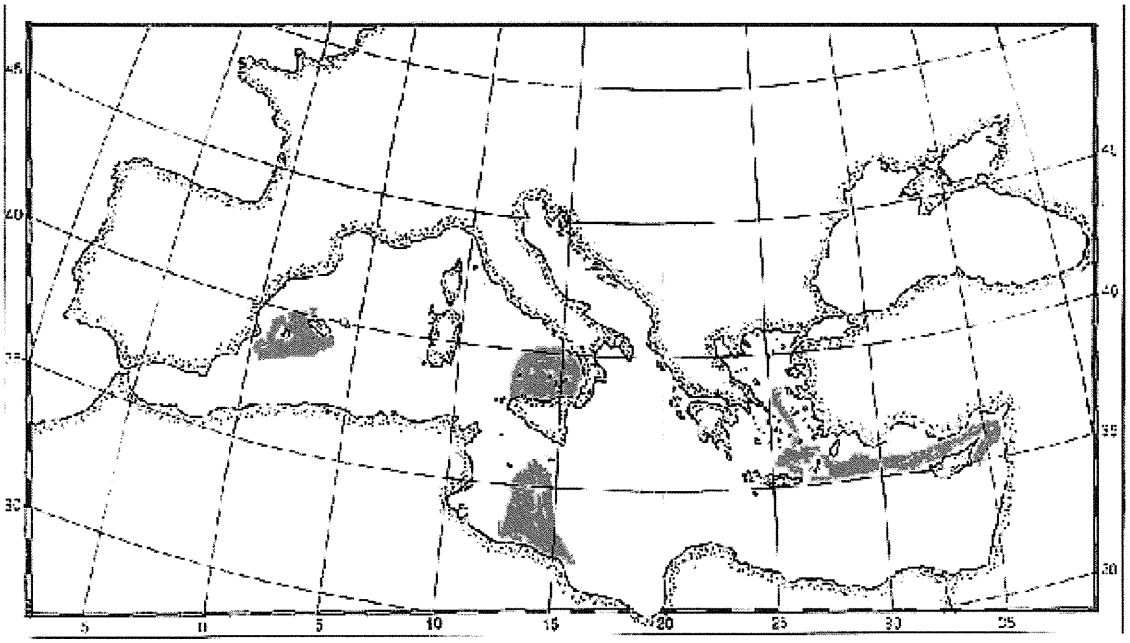

Figure 3-3 Major spawning areas for the bluefin tuna (*Thunnus thynnus*) in the Mediterranean.

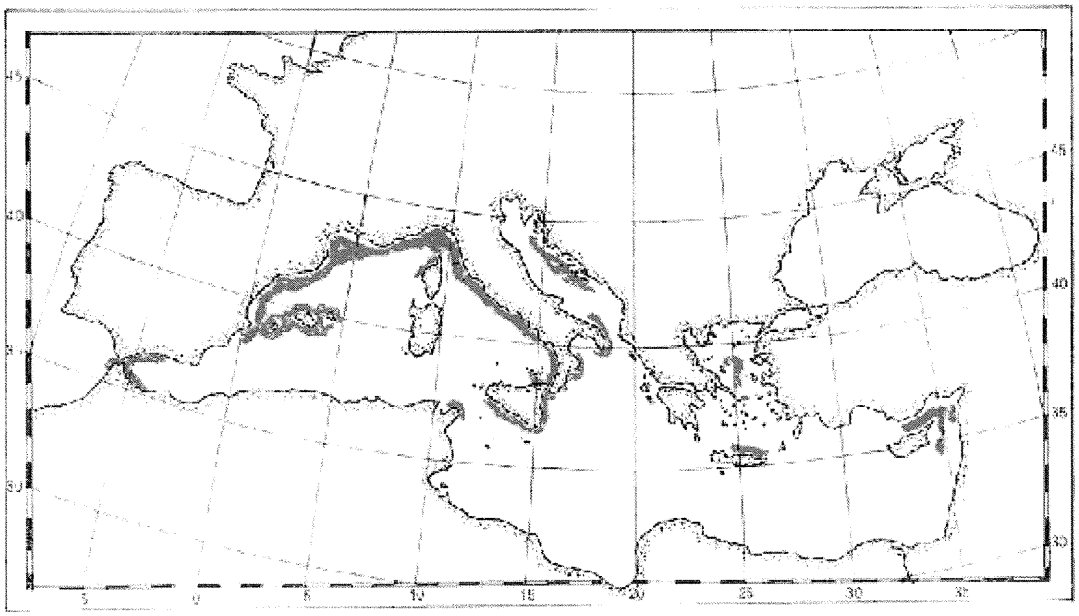

Figure 3-4 Major areas where juvenile bluefin tuna (*Thunnus thynnus*) occurs in the Mediterranean.

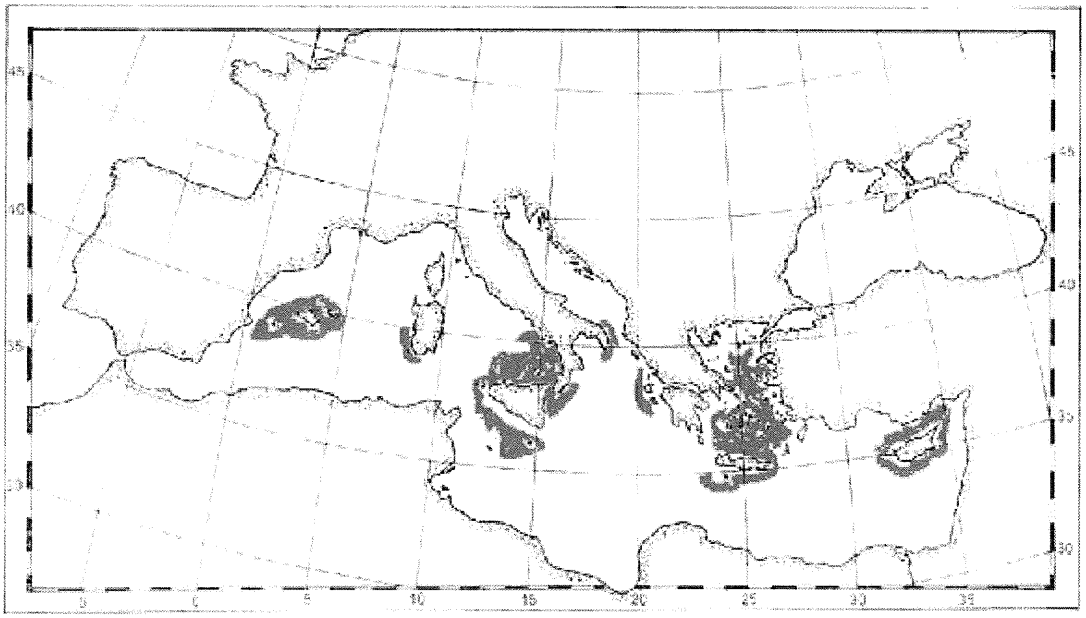

Figure 3-5 Major spawning areas for the swordfish (*Xiphias gladius*) in the Mediterranean.

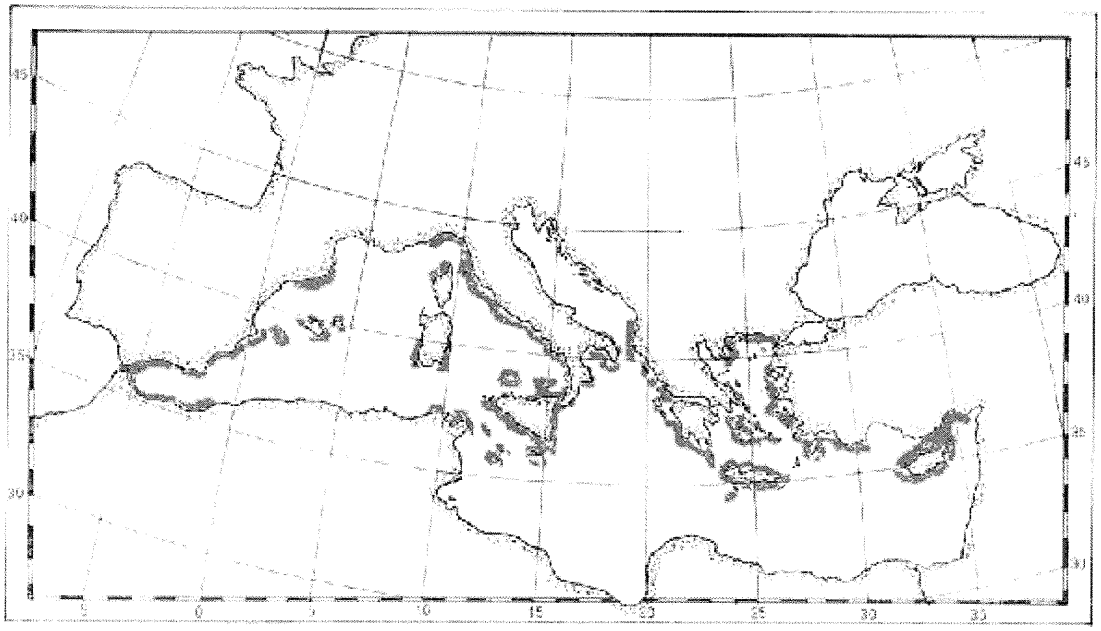

Figure 3-6 Major areas where juvenile swordfish (*Xiphias gladius*) occurs in the Mediterranean.

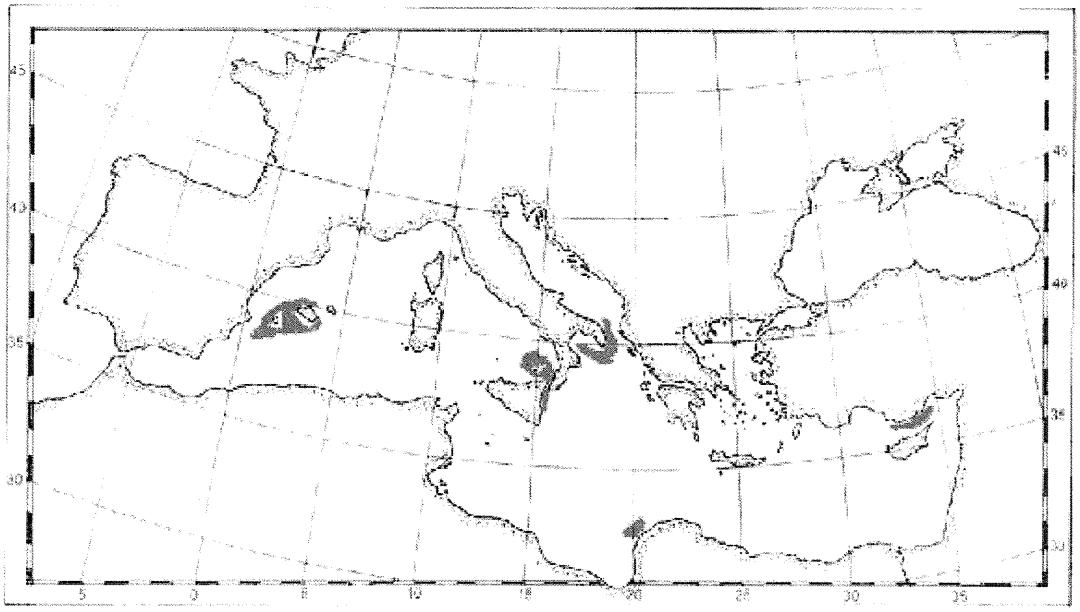

Figure 3-7 Major spawning areas for the albacore (*Thunnus alelunga*) in the Mediterranean.

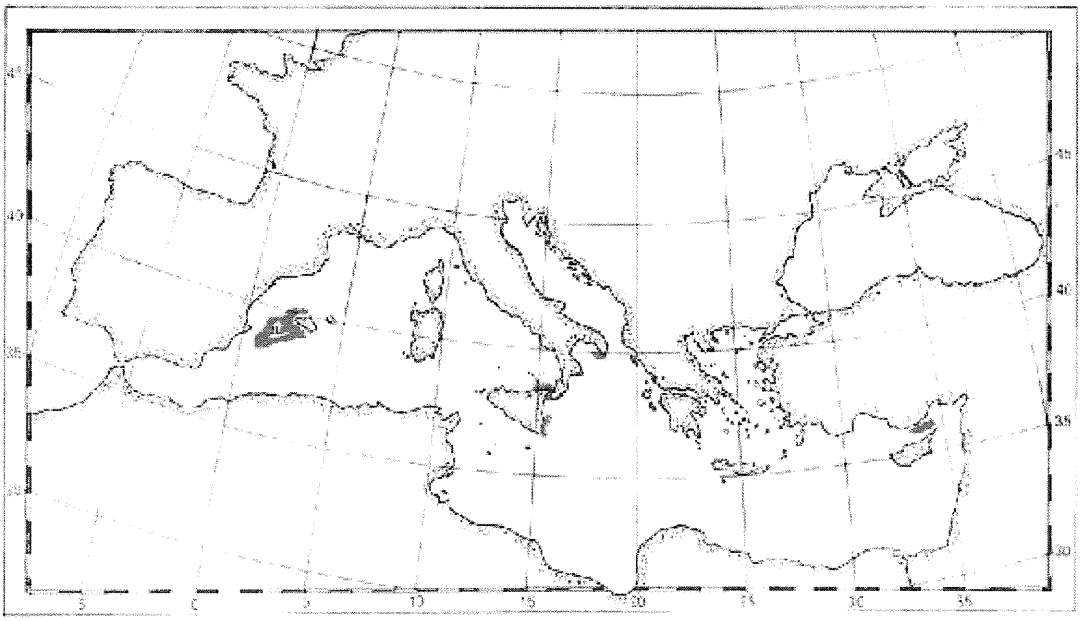

Figure 3-8 Major areas where juvenile albacore (*Thunnus alalunga*) occurs in the Mediterranean.

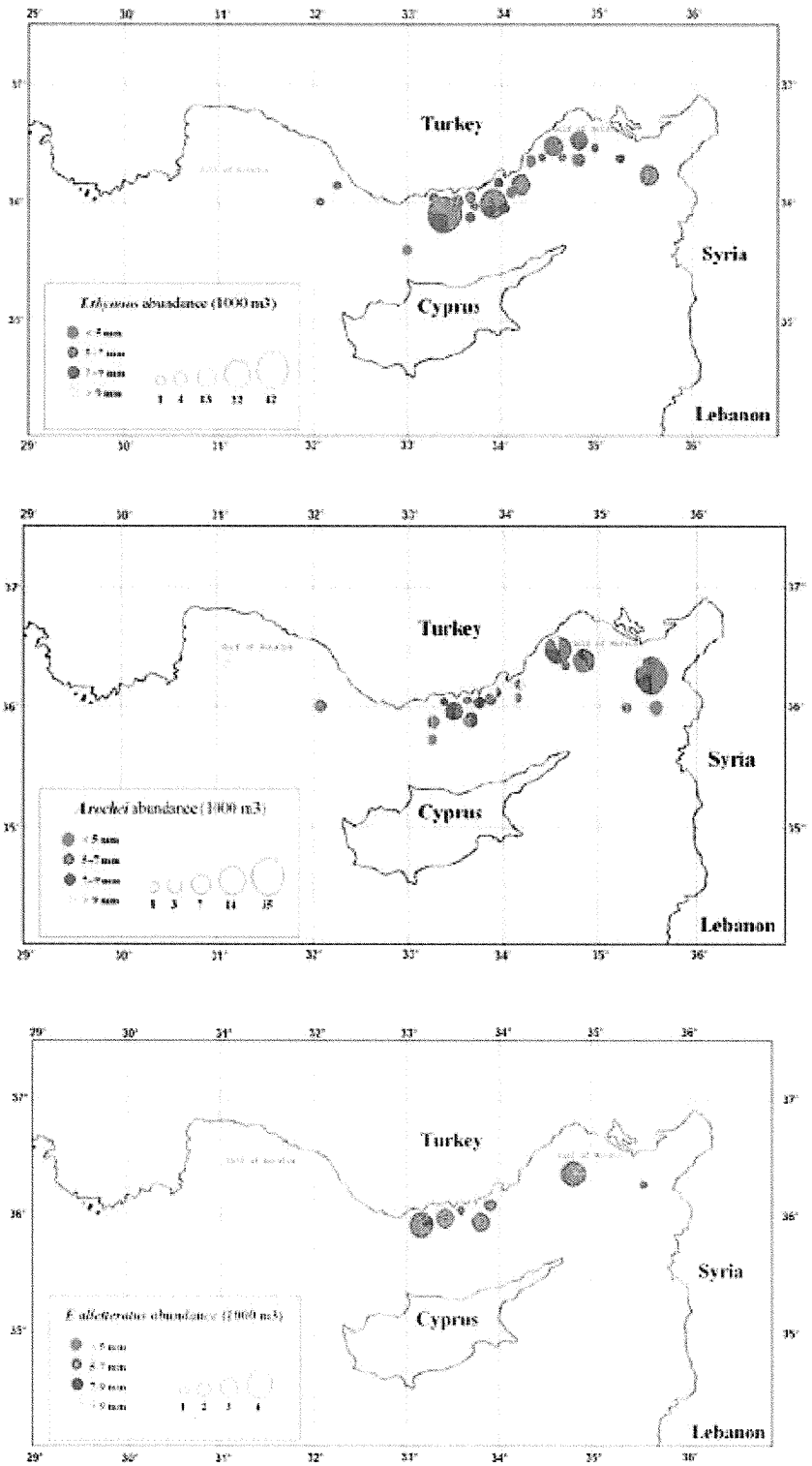

Figure 3-9 ***Larval tuna abundances in the Levantine Sea (Gucu, in Appendix)***

3.6 PROTECTION MEASURES FOR PELAGIC EFH

3.6.1 Small Pelagics

Although researchers from some countries/regions were not present in the meeting, the participating small pelagic experts agreed that time closure of inshore waters for providing protection measures on juveniles constitute the most appropriate management measures for the conservation of the stocks.

The exact timing of these closures will depend on the specificities of each region or GSA. In principle, the anchovy recruitment could be protected from late summer to end of autumn (October- December), with local shifting in some Mediterranean areas.

As regards to the sardine, the peak spawning in general is during winter, and therefore, time closures should be set towards early spring to early summer, with local shifting in specific GSA.

In Turkey, the area west of Goksu river is already closed to all sorts of fishing activities, due to the last reproducing population of monk seal of Turkey.

3.6.2 Large Pelagics

Some protection measures to limit the fishing activity on spawning bluefin tuna have been adopted so far by ICCAT for the whole Mediterranean Sea. These include the ban of purse-seine fishery in August and the prohibition to use aircrafts in June.

A reduction of the total fishing effort during the peak of spawning season of the bluefin tuna (mostly June to July) should work much better than a closed area, because the "hot spots" vary in time and space. The prohibition to catch immature bluefin tuna should be adopted all over the Mediterranean Sea, with a complete ban during fall.

The prohibition to use driftnets in the Mediterranean can be regarded also as an effective measure to protect swordfish spawners and it will be relevant if widely enforced. The Pelagos sanctuary for the protection of cetaceans in the northern Mediterranean Sea (Corse-Ligurian-Provençal basin) is the example of an off-shore protected area also useful for other large pelagic species.

A general reduction of the fishing effort during the peak of the spawning season (late May-middle June) should certainly help the conservation of the swordfish stock.

A ban of the surface longline fishery already exists in Greece, between September to December, with the purpose to protect juvenile large pelagic species, but the effects of this ban are possibly undermined by the possibility to carry on the fishery in the nearest international waters by other longline fleets. The prohibition to catch immature specimens should be adopted all over the Mediterranean sea, with a complete ban of drifting longlines during fall for at least two months, according to ICCAT-SCRS (2002) proposal.

No specific measures are requested for the Albacore.

3.7 DATA REQUIRED TO EVALUATE THE PROTECTION OF PELAGIC EFH

3.7.1 Small pelagics

Monitoring programs of post-larval and recruit distribution abundance
Monitoring of the principal environmental parameters influencing recruitment
Recruitment estimates.
Monitoring of adult reproductive potential.
Trophic web information.

Information and catch data on the new fisheries to provide food for farmed bluefin tuna and data on the fishing fleet and related effort for the fisheries allowed to catch fry should be integrated in the EC Data Collection Regulation.

Annual Stock assessment through direct and/or indirect methods.

3.7.2 Large pelagics

The impact of the reduction of juvenile bluefin tuna fishery was assessed by ICCAT in 2004.

BFT larval surveys in at least three different spawning areas of the Mediterranean, to assess the relative larval contribution of each site jointly with the monitoring of the main environmental parameters and oceanographic features.

Monitoring of adult reproductive potential.

Trophic web information.

Reliable catch data, particularly for bluefin tuna.

Catch data from all Mediterranean countries for all the species in the priority list.

3.8 EXPECTATIONS FROM PROTECTIONS MEASURES

A more conservative approach, protecting spawners and/or juvenile stages can be useful particularly for those stocks showing effects from overfishing, either for small and large pelagic species.

Limiting or banning the fry fishery should certainly help the recruitment of anchovies and sardines.

A reduction of fishing efforts on spawning bluefin tuna and swordfish should improve the stock status of both species. Positive results can be obtained by enhancing the recruitment of both species through a ban of the juvenile fishery in fall. This ban should be applied for at least two months.

4 THE USE OF CLOSED AREAS IN THE NORTH ATLANTIC FISHERIES MANAGEMENT

Below is a brief overview of some of the more important closures (Boxes) in the North Atlantic (Munch-Petersen, in Appendix). Several of those were established for political reasons and in such cases preparatory scientific investigations have been poor resulting in difficulties in evaluation of the effects of the measures.

As management tools these 'boxes' have had varying success regarding the intentions of the closures. Some have completely failed the intentions, while others seem to have had some effect corresponding to the intensions. Some of the boxes can be seen now as political decisions and in some cases the resulting effect of the measures has never been evaluated scientifically. The table below shows the current "boxes" used as a fisheries management tool within the North Sea and adjacent areas. However, a common feature of most of these closed areas is that insufficient fisheries or ecological data for the area before the closures has rendered it very difficult or even impossible to carry out a proper scientific evaluation of the effect of the closures. Few of the boxes have been subject of systematic evaluations. Of these only the effects of Plaice box is described more closely below.

4.1 THE PLAICE BOX

The North sea plaice box (ICES) is an example of establishing a MPA covering the main nursery area for mainly plaice in the North sea. The Idea of protecting juvenile plaice from exploitation dates back to 1912 and is thus the first international initiative by ICES in this direction. However, due to two world wars the actual MPA "North Sea Plaice box" was not established until 1994.

The recent back ground for establishment of the North Sea Plaice box was that North Sea Plaice is mainly taken in a mixed flatfish fishery in the southern and south-eastern North Sea by beam trawlers using 80 mm meshes in the gear. This fishery results in much discard, where the survival is poor, and ICES (1987) advised a closure of areas with high concentrations of juvenile plaice to reduce discarding.

The scientific basis for the current closure (Plaice box) is the notion that by a reduction in fishing effort in areas with a high abundance of undersized plaice, discard mortality rates will be reduced, so a larger proportion of each cohort of 0-group fish will recruit to the fisheries and to the adult population. Thus the Plaice Box was established to reduce discards of undersized plaice (and sole) on their main nursery grounds and thus enhance the adult stock.

The actual effects of the box were a reduction of the Dutch Beam trawl effort by more than 90%, however, no reductions in the discards have been observed. Furthermore, no real improvement of the stock can be ascribed to the plaice box.

As a side effect the Plaice Box has probably contributed to the apparent increase in the fishing efficiency of some of the exemption fleets fishing on the grounds where management has been implemented.

4.2 THE COD BOX IN THE NORTH SEA

This can be considered an example of a mainly political (EU) demonstration of awareness of the severe problem of the continuing decline of the cod stock in the North sea and the willingness to do something 'here and now' about it. The EU Commission had already in 1993 investigated the possible effects of establishing 'cod boxes' in the North Sea but realised at that time, that the scientific basis for such was insufficient. Although ICES in the preceding years had advised a drastic reduction of the fisheries for cod in the North Sea, no actual proposals for closed areas had been scientifically presented or prepared.

As only one of 3 components of the 'Cod Recovery Plan' the establishment of the cod box in 2001 was an emergency measure with the aim of reducing fishing mortality on spawning cod on the spawning grounds. However, the time period probably only covered part of the spawning season. According the ICES (2004) the closure did not meet the objectives. Inappropriate timing and positioning of the area resulted in that no positive effects of the closure were achieved. Furthermore, according to Rijnsdorp et al. (2001) there was no overall effort reduction during closure, only displacement of fishing effort.

In conclusion: The cod box was poorly designed, and did not achieve the intentions. Furthermore, the closure may even have had some negative effects on the ecosystem because of increase of effort on vulnerable species in adjacent waters.

4.3 THE MACKEREL BOX

The closure aims to protect high concentrations of juvenile mackerel. Pelagic fishing is effectively banned by having a maximum 15% by-catch limit of mackerel. Other trawling is permitted.

Following the introduction of the mackerel box, mortality on fish aged 0, 1 and 2 years was reduced by 83%, 60% and 20% respectively and the state of the stock has benefited significantly from the closure (Horwood, 2000).

4.4 THE SHETLAND BOX

Established 1983 to protect "species of special importance...which are biologically sensitive by reason of their exploitation characteristics." (NAFC 2004). This area has played an important role in attempts to achieve a balance between the different fleets and fishing communities.

No system was ever established to monitor the Shetland Box or to collect the data that would be needed to demonstrate its effectiveness (NAFC 2004).

It seems unlikely that the management regime for the box has ever effectively restricted the level of fishing effort. Effects of this box are questionable.

4.5 THE NORWAY POUT BOX

The aim is to reduce levels of fishing mortality on juvenile gadoids such as haddock and whiting, and hence increase the recruitment of these species to the stock biomass for sustainability and for future fisheries.

The effects of the Norway pout Box are unknown and not yet thoroughly evaluated. Earlier attempts have proven it impossible to differentiate the effects of the box from the effects of e.g. technological advances and selectivity of gear (Anon. 1987). The scientific basis for an evaluation of the effect of the box and the consequences of reopening the box does not exist

4.6 THE SPRAT CLOSED AREA / BOX

Although it is called the Sprat Closed Area, it was actually established to reduce mortality of juvenile (0-group) herring (*Clupea harengus*). Establishment of Sprat Box was expected to lead to a significant decrease in the levels of by-catch of juvenile (especially 0-group) herring in the entire ICES IVb-area.

There have been increases in Herring biomass since the mid-1990s. However it is difficult to ascribe all to the boxes.

4.7 CLOSED AREAS IN THE BALTIC (COD "BOXES")

The rapid decline of the eastern Baltic cod stock in early 1990's lead to the enforcement of two actions in 1995 by the International Baltic Sea Fishery Commission (IBSFC) to preserve this stock, a summer ban covering the entire Baltic and a temporary closure of cod fishery on the main cod spawning ground in the Baltic.

However, due to continuing lack of recovery of Baltic cod stocks and due to serious risk of stock collapse, new closures were enforced from 1.1.2005 by the EU (these closures are not binding Russian). These closures were enforced mainly to reduce the overall fishing mortality of Baltic cod, but they also aimed to protect the spawning:

Extended summer ban: Fishing for cod prohibited in Sub-divisions 25-32 (Central Baltic) from 1st May to 15th September.

Spring ban (a new measure): Fishing for cod prohibited in Sub-divisions 22-24 (Western Baltic) from 1st March to 30th April.

All cod fishing prohibited within three historical spawning areas in the Central Baltic (Fig. 2) for the entire year (EU fleet).

The closures in the mid-90s do not seem to have had any effect on the cod stocks. It is yet too early to have any observations of the effects of the recent expansion of the closures.

The closed areas on Georges Bank (North West Atlantic)

The closed areas on Georges Bank (see also Table) were introduced by the US federal government in 1994 and cover more that 20000 km^2. The background for this measure was a long time continuing decline of the more important demersal stocks since the 1960s along with increasing fishing effort in the area. Exempted from the closure was the use of static gear, hooks and dredges (limited).

Significant limitations of the bottom trawl effort outside the closures were introduced along with the closed area measures.

In the evaluation it has been difficult to separate the effects of the fishery closure from reduction in days at sea. However, since the closure in 1994 cod abundance increased only 18% in the Georges Bank area, while it increased by 50% in the Gulf of Maine, see Fig. 3 (Murawski et al., 2005, see Munch-Petersen, in Appendix).

A distinct effect of the closures has been that large trawlers tend to concentrate their effort around the edges of the closures.

Analyses confirm that these large-scale year-round closed areas, in effect now for more than a decade, affect the abundance and spatial distribution of some target species, and the allocation of trawling effort. The year-round closures have generated build-up of some, but not most, of the ground fish stocks within the boundaries of the closed areas. An unintended side-effect was a large increase in scallop abundance.

4.8 EXPERIENCES FROM EXISTING MPAS AND CLOSED AREAS.

Common to most of the existing North Sea MPAs is that they have not been very successful in reaching their management objectives.

In most cases it is difficult or impossible to separate effects of management and natural variations on the stocks throughout the lifespan of the MPA. However, there are some fair generalisations that can be made on the use of closed areas in management up to now.
For instance, regarding the Plaice Box and other established fisheries closures in the North Sea, smaller, there were derogations for less powerful vessels (including beam trawlers), as well as vessels targeting other fisheries. Thus, such vessels were still permitted to fish in the closed area(s). Lack of recorded reference data on the specific aims of the closures prior to the closure, renders it difficult to establish whether or not the use of fisheries closures/MPAs has been a successful strategy. The experience learned from many past and existing MPA as fisheries management tools can be summarised as follows:

- If not fishing effort is strictly managed, then seasonal closures often lead to increasing effort outside the closure period, thus diluting the desired effect.
- If the fisheries on the particular stocks are managed by stock specific TAC/quota system, effort will increase either in adjacent area or after the lift of the closure.
- If not totally closed for all vessels, increasing effort of non-banned vessels may dilute the desired effect.
- For migratory species, including cod, mackerel and herring, MPAs are probably not very effective as a primary management tool unless extensive proportions of the range of the stock can be fully closed to fishing permanently.
- Scientific evaluation of the actual effect of closed areas on mobile fish species requires rather detailed information on the variation in time and space of both the species considered and the fisheries exploiting them before the closure.

5 RECOMMENDATIONS

Many Mediterranean fish resources are internationally (FAO-GFCM, EC-STECF) recognized to be overfished. Therefore the protection of the most important fish habitats by closures, permanently or seasonal, should be considered in management plans for stock improvement or stock recovery . However, at present a major problem is the standardization of a common methodology of identification and delineation of such areas.

In this meeting fragile species without a commercial value (sea turtles, cetaceans, monk seals, and others) were not considered, while cartilagineous fishes were specifically considered (Serena et al., in Appendix).

The recommendations below reflect a main purpose of establishing EFH and SH protection but the implementation and enforcement of technical measures already existing in the Mediterranean Sea should be considered a priority.

1) Both Sensitive Habitats (SH) and Essential Fish Habitats (EFH) should be considered for protection in the management of the Mediterranean fishery resources. SH as broader fish habitat linked to fish assemblages and benthic communities, EFH for single species of great economic value.

2) The species to be selected for protection of EFH should be ranked according to the landing value per geographic sub-area (GSA).

3) The identification of EFH should be based on the spatial distribution, and their persistency in space and time, of the species during its critical life stages. Therefore, especially nursery and spawning areas should be considered as EFH.

4) Sensitive Habitats (SH) of major relevance to be protected in all Mediterranean GSA and therefore of Community interest are: Posidonia beds, Coralligenous biocoenoses, Maerl bottom, *Leptometra phalangium* beds, *Funiculina quadrangularis* beds, *Isidella elongata* beds, Deep-water corals, Sea mounds and canyons, sea bottom deeper than 1000 m.

5) For pelagic species EFH, processes rather than physical spaces should be considered in order to better understand and identify the critical phase of aggregation.

6) At the moment a better identification of the offshore EFH and SH is needed. Inshore habitats are better known and are protected by laws but often not enforced.

7) Hake is the most important demersal species for which EFH information has been presented for different GSA in this meeting. Some information on other species like red mullet, deep-sea shrimp, and others was also presented and needs to be considered for protection of EFH. Cartilagineous species EFH need a particular concern because of their fragility.

8) Closed or protected areas and seasons are the main measures to protect EFH. A general plan of protection per GSA and per fish species should be implemented in the next regulation of the Mediterranean fisheries.

9) The failure of protection measure is in many cases due to a lacking of co-operation among scientists, managers and fishermen. An active consultation of the involved stake-holders must be always considered in the implementation of actions to protect EFH.

10) Closed or protected areas for EFH should be considered along with other technical measures as wider mesh-size in deeper waters and reduction of the fishing effort in the nearby areas of protection or at the re-opening.

11) Important research activities should be implemented to improve the available scientific knowledge on EFH, such as oceanographic features, benthic characteristics, ecological processes, impact of fisheries.

12) Developing pan-Mediterranean programmes should be necessary to provide comparable data. For example the EC data collection, or EC experimental surveys should be extended to other Mediterranean countries by an agreement with GFCM.

6 SUMMARY AND CONCLUSIONS

The fisheries resources of the Mediterranean are suffering from overfishing, and there are efforts targeting sustainable fishery in this region. Protection measures earlier mainly based on single fishery has been, in last decades, supported others, most notably with a network of small sized ecosystem protection areas (e.g. MPAs) and even more recently with general ecosystem approach, that takes into account all driving and pressurizing factors in the environment, including the climate change.

It is clear that all these efforts, though extremely useful, are not sufficient in protecting the commercial fishery resources in the Mediterranean. In this Rome meeting during 6-10 March 2006, scientists from Italy, Spain, Greece, Turkey and Lebanon suggested another approach, to determine "Sensitive and Essential Fishery Habitats (SH and EFH)" for protection to increase fishery resources at the Mediterranean scale. The major aim was to "identify and map of marine habitats crucial for conservation of commercial fish and shellfish resources". Although similar action has been taken elsewhere, as in US waters and in the ICES region, such concerted approach is relatively new to the Mediterranean. Which species, what stage of its life, how much area, how to protect, and what would be the implications were the key questions for which answers sought in the meeting.

In this report, SH and EFH were discussed for the major demersal and pelagic commercial fish species in different Geographical Fishing Areas (GSA) of the Mediterranean. The hake (*Merluccius merluccius*) and red mullet (either *Mullus barbatus or M. surmuletus*) among demersal fishes, the Mediterranean Sea or Rose shrimp (*Parapaeneus longirostris*) and scambi or Norwegian lobster (*Nephrops norvegicus*) among shellfishes, and anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) among small pelagics appeared as the major fish species having information on this respect.

In general some areas could be suggested for some demersal fishes, a temporal protection seemed a better option for the protection of young stages of pelagic fishes. One major problem in this exercise was limitation of data on the whereabouts and stability of young stages of fishes, which were more inherent for the pelagics. Data situation was even worse for the southern and very eastern Mediterranean.

Participants noted to several other problems in this exercise, such as effort displacement, protection of prey organisms of important fish species, impact of climate change in destabilization of SH/EFTs, role of large oceanographic features, difficulties of suggesting SH/EFT for certain fish species, some "legal" devastating traditional fishery practices as fry fishery, in addition to illegal fishery. The increasing role of Lessepsian fishes was pointed out in the Mediterranean basin, in particular with respect to climate change.

It was appeared that EU funded long-term projects such MEDITS and GRUND provided very good, somewhat longer-term, data from which some useful applications could be suggested. It is shown in this report that EFH for some fish species (in most cases for the hake and red mullet) could be identified successfully, to increase fishery on this species. For example, for the GSA9, it suggested that a closure of 3-5% fishing area for the hake would produce the protection of 20-50% of recruits in the Tyrrhenian-Ligurian Sea.

Several areas for special protection of some commercially important fish/shellfish are identified and recommendations presented in the report.

7 APPENDICES: Papers presented during the meeting

1) **Abello P. & L.G. de Sola.** Population Characteristics Of Decapod Crustaceans Associated To *Leptometra Phalangium* Bottoms Off The Iberian Peninsula Mediterranean Coasts (Pages 49-66)
2) **Ardizzone G.** An Introduction To Sensitive And Essential Fish Habitats Identification And Protection In The Mediterranean Sea (Pages 67-83)
3) **Arneri E. &N. Cingolani.** Essential Fish Habitats For Small Pelagics In Northern And Central Adriatic Sea GSA 17 (Pages 84-93)
4) **Bariche M.** Larval And Juvenile Fish Assemblages Of Small Pelagics In The Coastal Waters Of Lebanon (Pages 94-113)
5) **Baro J., L. Gil de Sola & J. M. Bellido.** Essential Demersal Fish Habitats Off Spanish Mediterranean. A case study for *Merluccius merluccius* off the Spanish Mediterranean Waters (Pages 114-127)
6) **Colloca F., P. Sartor, R. Baino, A. Mannini, A. Criscoli, G. Ardizzone.** Crinoid Beds As Essential Fish Habitat In The Tyrrhenian – Ligurian Sea Area (Fao Geographical Sub-Area 9) (Pages 128-146)
7) **Colloca F., L. Maiorano, P. Carpentieri, R. Baino , A. Belluscio, A. Mannini, P. Sartor, F. Serena, G. Ardizzone.** Identification Of Essential Fish Habitat In The GSA 9 For Hake (*Merluccius Merluccius*) And Deep Water Pink Shrimp (*Parapenaeus Longirostris*) (Pages 147-164)
8) **Di Natale A. et al.** Sensitive And Essential Areas For Large Pelagic Species In The Mediterranean Sea (Pages 165-180)
9) **D'Onghia G., Maiorano P., Sion L., Carlucci R., Mastrototaro F., Capezzuto F., Costantino G., & Tursi A.** Sensitive And Essential Fish Habitats In The North-Western Ionian Sea: Problems And Perspectives For Fishery Management (Pages 181-202)
10) **Fiorentino F., G. Garofalo, T. Fortibuoni, T. Bahrib, M. Camilleri, A. Drago, M. Gristina & F. Massa.** Delineating Habitats Used By Different Life Phases Of Hake In The Strait Of Sicily (Pages 203-234)
11) **García A., L. Quintanilla1 and F. Alemany.** Defining Small And Large Pelagic Essential Habitats Off The Spanish Mediterranean (Pages 234-250)
12) **Gucu A. C.** Essential Fish Habitats In The NE Levant Sea (Pages 251-270)
13) **Massuti M. & F. Ordinas.** Demersal resources and sensitive habitats on trawling grounds along the continental shelf off Balearic Islands (western Mediterranean) (Pages 271-288)
14) **Maynou F. & J. Cartes.** Fish And Invertebrate Assemblages From *Isidella Elongata* Facies In The Western Mediterranean (Pages 289-307)
15) **Munch-Petersen S.** Overview of Some Important MPAs In The North Atlantic (ICES and NAFO areas) (Pages 308-316)
16) **Murenu M., A. Ortu, C. Follesa & A. Cau.** Sensitive Habitats And Nursery Areas For M*erluccius merluccius* And M*ullus* spp. In the Central Mediterranean (GSA 11) (Pages 317-340)
17) **Politou C.-Y., A. Chilari, J. Dokos, A. Kallianiotis, G. Tserpes, P. Peristeraki.** Identification Of The Nurseries Of Hake And Deep-Water Pinkshrimp In The Greek Waters Using Trawl Survey Data (Pages 340-357)
18) **Serena F., A. Abella, R. Baino, C. Mancusi, A. Voliani & G. Relini.**Sensitive Habitats For Elasmobrach Fishes In The Italian Seas Through The Analysis Of Trawl Surveys Data (Pages 358-378)