# VII.3. ESSENTIAL FISH HABITATS

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## INTRODUCTION

The term "habitat" in the marine context is considered as a spatial entity and region with diffused and changing boundaries that are characterized by certain life-sustaining conditions. These regions provide fish populations with the optimum biological and environmental conditions for their survival and reproduction and constitute essential habitats for fish that otherwise cannot normally reproduce and grow to maturity.

Marine fish depend on healthy habitats to survive and reproduce. Throughout their life-cycle fish use many types of habitats including seagrass, salt marsh, coral reefs and rocky inter-tidal areas among others. Various activities on land and in the water constantly threaten to alter, damage or destroy these habitats, resulting in insufficient space for fish to carry on naturally with larval survival, growth and maturity. For example, the dependence of a species on seagrass beds for reproduction makes seagrass beds an essential habitat for that species in its specific reproduction life stage. Thus, proper designation of Essential Fish Habitat (EFH) is a highly important spatial measure in any management of fishery resources.

In this unit, the term "Essential Fish Habitat" (EFH) is defined and explained, efforts on EFH identification and mapping are presented, surveys of damaged habitats are shown and measures for EFH protection are proposed for the Hellenic Seas.

## DEFINITION OF EFH

Essential Fish Habitat (EFH) is characterised by an aggregation of abiotic and biotic parameters that are suitable for supporting and sustaining fish populations during all stages of their life cycle. A single species may use many different habitats throughout its life to support breeding, spawning, nursery, migration, feeding and protection from predators. EFH encompasses those habitats necessary to ensure healthy fish growth as well as sustainable fisheries.

The term "Essential Fish Habitat" was initially introduced by the US Congress in 1996. EFH is defined as 'those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity', a definition that includes the physical, chemical and biological properties of marine areas and the associated sediment and biological assemblages that sustain fish populations throughout their full life cycle (DOC, 1997). Species EFH include different possible status of a habitat (e.g. potential, effective, realized) as moving fish species usually do not occupy their whole distribution area every year exactly in the same conditions. Thus, EFH mapping requires continuous monitoring of fisheries' resources and updating of existing EFH maps in order to depict the environmental changes that affect species' distributions as well as the extent of different habitat use.

In the European Communities, the term EFH was only recently and indirectly introduced during the ongoing reforming of the Common Fisheries Policy (CFP) through the concerted approach to protecting species' habitats through the Habitat Directive (CEC, 1992), declaring fisheries' protection zones through the Marine Strategy Directive (CEC, 2006), thus introducing the spatialization approach in fishery management under the CFP (CEC, 2001). To this end, the Commission of the European Communities (CEC) has funded a variety of research initiatives that aim to identify and map EFH for commercial fishery resources and propose spatial measures for the facilitation of the new concepts under the CFP.

## IDENTIFICATION OF EFH IN HELLENIC WATERS

The identification of EFH is based on scientific information. In fact, latest calls for new and effective management policies (Agenda-21 1992, Fisheries Agreement 2002) require scientific information as the basis of any new management scheme of natural resources. Such information has been accumulated during the last decades for many commercially important fish species through biological and genetic research and organised in life history reports for each species. These reports are often freely available through worldwide online archives and databases, such as FishBase, CephBase, ICES and FIGIS.

Species' life history reports include information on current and historic stock sizes, stock assessments, geographic range and periods and location of major life history stages. In addition, information on the habitat requirements is provided

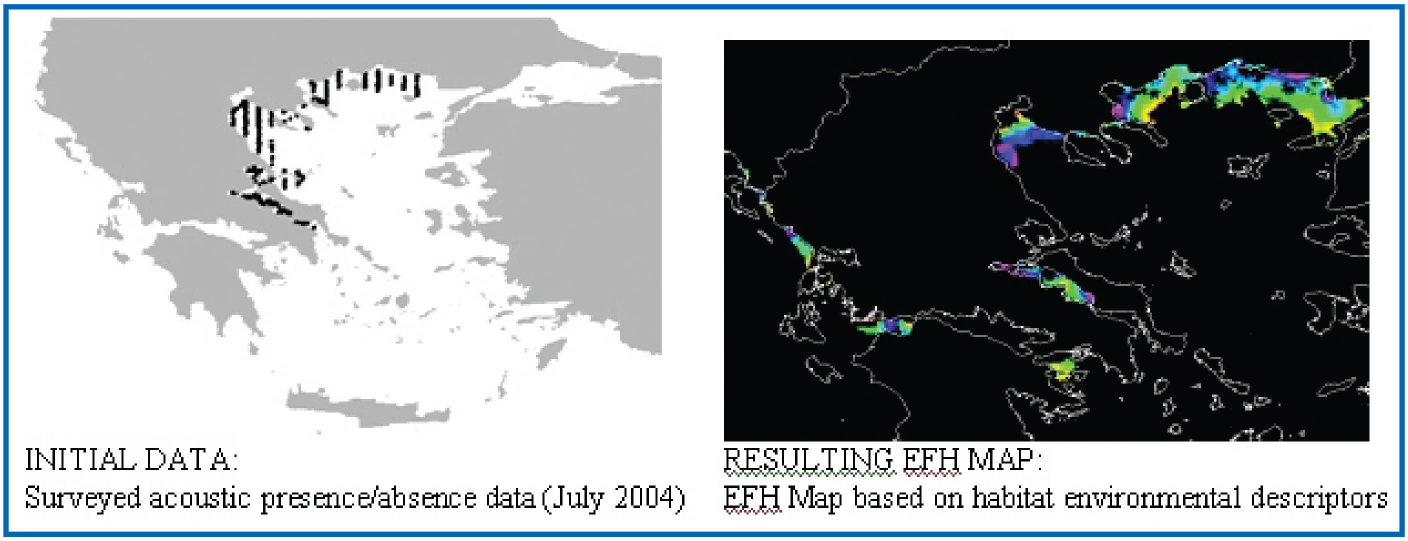


**Figure 1:** Calculation of EFH areas for European anchovy in Hellenic waters during July 2004. Environmental satellite data are analysed with surveyed acoustic data through GAMs and GIS procedures. EFH areas show anchovy's preferred environmental conditions in temperature, chlorophyll and salinity.

for each life history stage, including the range of habitat and environmental variables that control or limit distribution, abundance, growth, reproduction, mortality and productivity. Specifically, these data provide information on species type (e.g. benthic or pelagic), species preferred living ranges of temperature and salinity, recruitment periods, spawning periods and characteristics (e.g. preferred spawning sediment types and spawning temperature and depth ranges), migration habits, maximum depth of species occurrence, etc. Species' life history data may be viewed as the starting point for spatial analysis and modelling of EFH through new technologies such as Geographic Information Systems (GIS) and Remote Sensing (RS). Species' life history data are inserted into GIS as constraint parameters in the analysis of remotely sensed environmental and surveyed fisheries' data, providing integrated output on seasonal areas that are important in various stages of species life cycles. Thus, the geographic distribution of species' life history data is revealed in a spatiotemporal scale (VALAVANIS, 2002). Specific spatial and temporal patterns on species resources dynamics (e.g. spawning/nursery grounds, aggregation areas, feeding grounds) are identified and mapped with the use of GIS, RS and statistical analysis of scientific information.

The Institute of Marine Biological Resources coordinates the first CEC-funded initiative towards the identification and mapping of EFH in the Mediterranean Sea. This European effort, with participant research institutions from Spain, France and UK, aims to develop the methods and tools in order to provide EFH maps for commercially important fish species and propose spatial measures for EFH protection. This initiative, called EnviEFH (Environmental Approach to Essential Fish Habitat Designation), introduces the latest advances in EFH mapping. Through integrated analysis of species life history data using RS, GIS and statistical functions, EnviEFH is starting to produce EFH maps that are based on monitored data and scientific methods.

The main approach of EFH identification of commercial fisheries' resources in Hellenic waters is based on the integration of environmental protection requirements of EFH. Species prefer certain ranges of water properties in order to successfully breed, spawn and grow. Based on combined analysis of surveyed fisheries' data (e.g. acoustic biomass or experimental trawling) and satellite or surveyed environmental data (e.g. temperature, chlorophyll, salinity), environmental ranges for each water property are calculated through application of certain statistical methods such as Generalized Additive Models (GAMs). For example, EFH mapping for European anchovy (*Engraulis encrasicolus*) in Hellenic waters in summer is based on acoustic biomass surveys (Figure 1). Resulting EFH areas for anchovy are characterised by simultaneous environmental ranges in temperature 22.5-25.13°C, chlorophyll 0.346-2.744mg/m$^3$ and salinity 38.0-38.7‰ (GIANNOULAKI *et al.,* 2005, 2006). Similarly, EFH areas for short-finned squids (*Illex coindetii*) are based on environmental descrip-

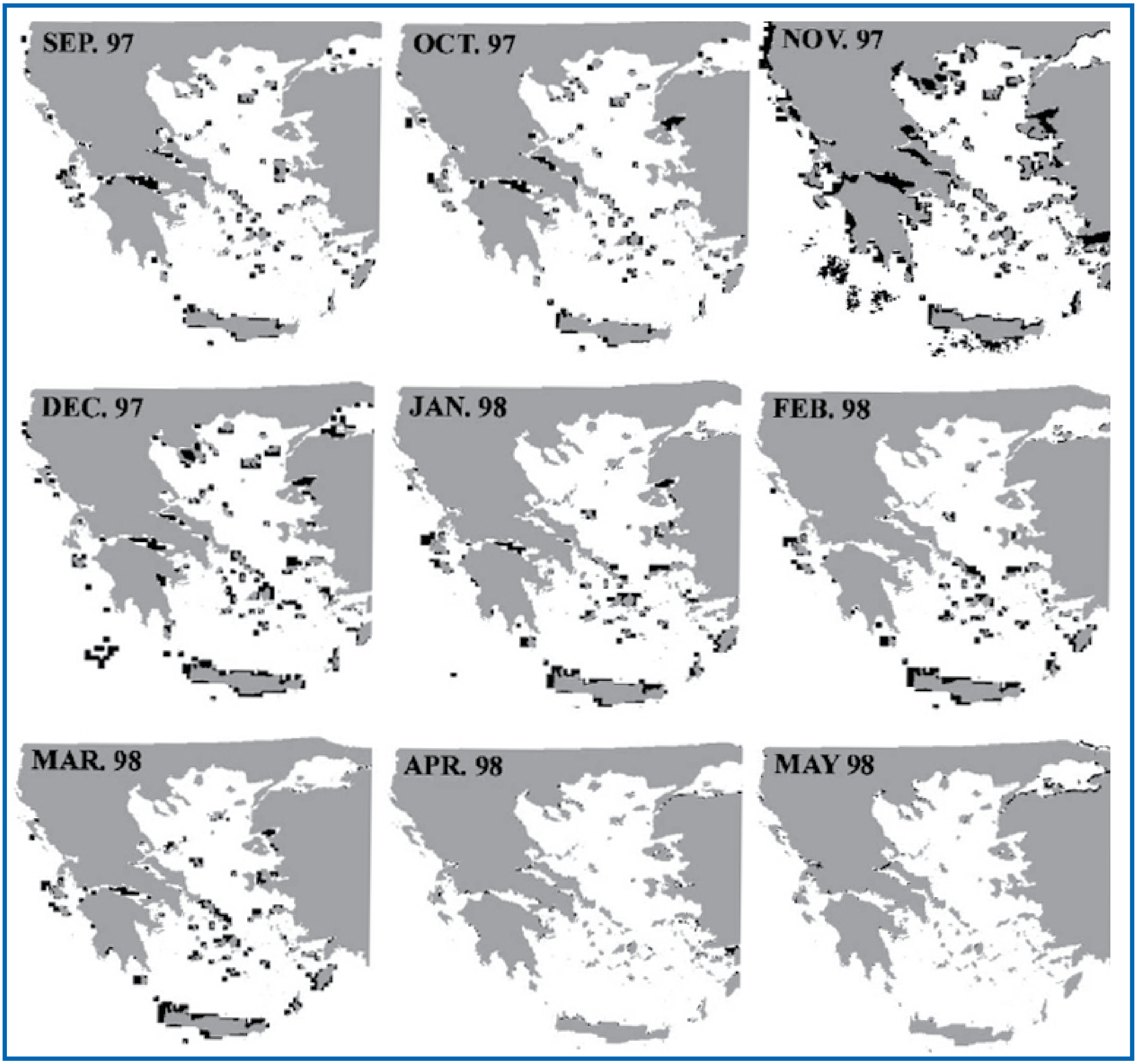


**Figure 2:** Essential Fish Habitat (EFH) mapping for short-finned squid in Hellenic Seas during 1997-98. Environmental habitat descriptors are derived from satellite images through extensive spatial integrations among georeferenced fishery data, catch distribution, bathymetry and fishing fleet major activity areas.

tors of their major concentration areas and are characterised by temperature 13-29°C, chlorophyll 0.30-15.60mg/m³ and salinity 36.12-38.51‰ (VALAVANIS *et al.,* 2002, 2004) (Figure 2).

These EFH map products become invaluable in any fisheries' management plan because they are based on scientific and monitored information. They provide basic information for the design and designation of marine protected areas or seasonal fishing-closure areas (no take zones), a spatial measure that has been already used worldwide as part of fisheries' management policies. In addition, EFH products are used in combination with other GIS-based products, such as mapping of marine productivity hotspots (KAPANTAGAKIS *et al.,* 2002, KATARA *et al.,* 2005, VALAVANIS *et al.,* 2004) in order to identify alternative fishing activity grounds that are still unexploited (Figure 3). The

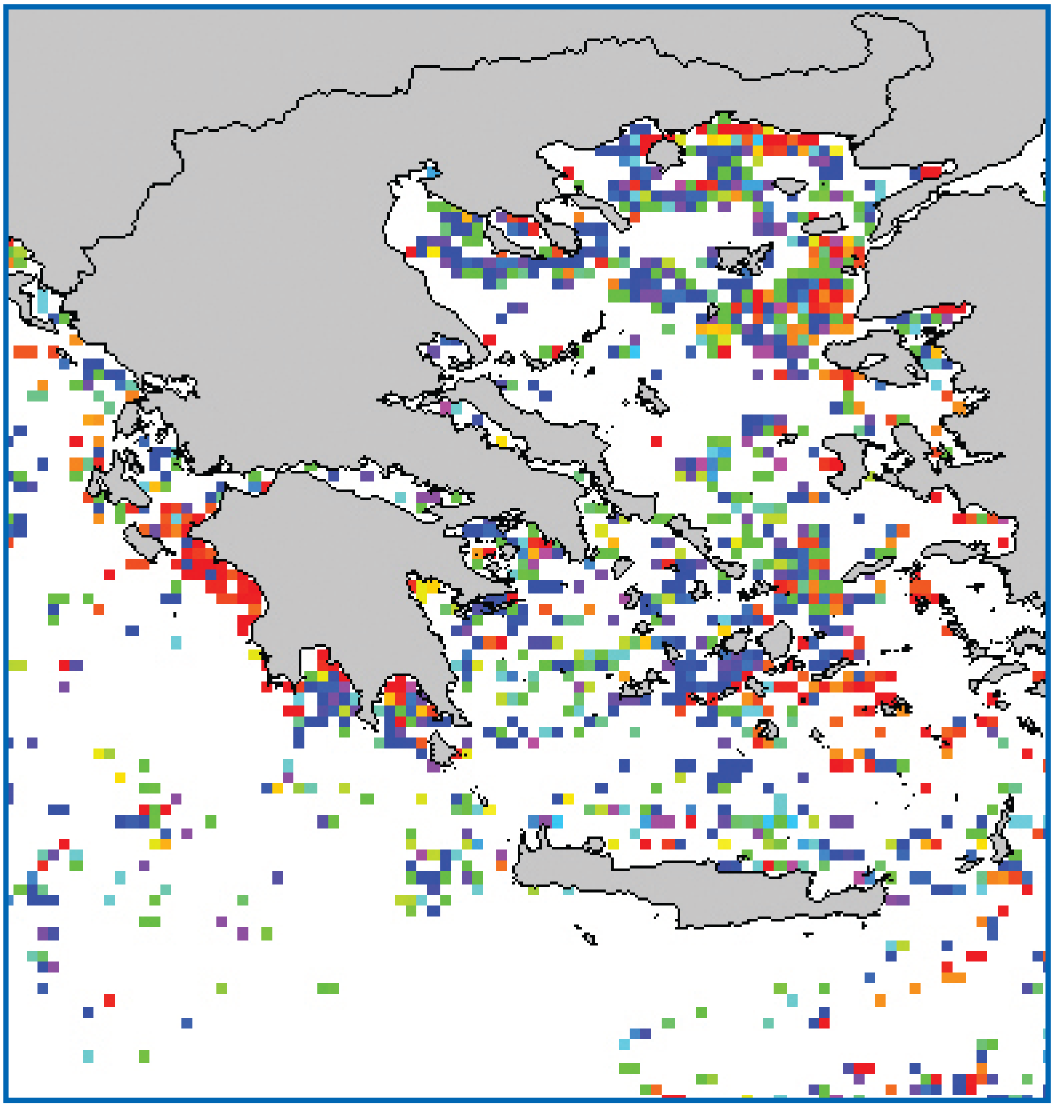

**Figure 3:** Spatial distribution of marine productivity hotspots (MPH) during December 2004. These areas are characterized by persistent and simultaneous high chlorophyll-a and low temperature pattern and may sustain several species populations. MPH areas reveal known fishing activity grounds (e.g. in the North Aegean and Kyklades Plateau) as well as unexploited regions that may be used as alternative fishing activity grounds.

ultimate goal of current multidisciplinary research on EFH mapping is to provide a clear picture of where species EFH are located and where fishing fleets may alternatively operate in order to allow the regeneration of traditional and over-exploited fishing grounds.

## SENSITIVITY OF SEABED DOMINATED HABITATS

A variety of sea grounds are affected by routine anthropogenic activities, particularly in coastal areas. Activities may include engineering works, transport, recreational activities, fish farming, dumping, aggregate extraction and fishing. Knowledge of where EFHs are located is not enough to institute spatialized management plans. A very important piece of additional information concerns how sensitive/robust these habitats are. One of the best known biotopes in the Mediterranean are *Posidonia* meadows. These are found in coastal waters typically at depth ranges of 10-40 m. The system is complex with various habitats in the sediment, roots, between the leaf fronds and over the top of the meadows. For a large number of fish species meadows provide shelter, food resources and aggregating areas, and act as spawning, nursery and on-growing areas. A variety of research has been carried out on *Posidonia* meadows, but unfortunately little has been carried out on the associated fish communities. Meadows are extremely sensitive to physical disturbance and once plant cover has been removed, it may not return for a considerable time. Their sensitivity has been recognised and they have been protected across the Mediterranean with specific laws under the European Union, to ban trawling activities within the 50 m depth contour or the 3 mile limit whichever is nearest the coast. Specific sites (67 in total in Hellas) have been further designated and recorded under the Natura 2000 Programme (SIAKAVARA *et al.,* 2000).

Maerl reefs and maerl sands can be common at 50-100 m, are comprised of coralline algae that play a very similar role to *Posidonia* meadows, providing food, shelter and aggregation grounds. These habitats have a different type of fish community including commercial species such as red fish, groupers, sparids and lobsters. They are currently exploited both by active (trawls) and passive fishing gears (bottom nets and longlines). Like seagrasses, maerl habitats are also very sensitive because the corals are slow growing, long lived and very fragile. Trawlers have been damaging this habitat for some time, but with the recent adoption of northern European gears (rockhoppers and wheels on the ground ropes), reef areas that could not be fished before can now be accessed and are in more danger. As yet, there are no management/protection measures for maerl habitats, although this may change in the future because of their importance and sensitivity.

Excluding the two habitats mentioned above, sedimentary habitats in general provide spawning, nursery, feeding and on-growing areas for a large number of commercially important species. These areas are generally largely unmapped and there are no habitat specific regulations – although there are general spatio-temporal regulations aimed at stock protection and some specific closures on certain gulfs and bays. The majority of these areas are accepted as "fishing grounds" where fishing (fish removals and impacts with the seabed) is an acceptable practice. These areas are not uniformly affected by trawling, and effort tends to be concentrated in specific areas and tracks (known clear areas or areas previously fished that have given high returns). Trawling leaves persistent marks on the seabed that can be imaged over wide areas with side scan sonar. By using this technique over wider areas, the impacted areas can be initially identified and then monitored over time with repeat data collection (Figure 4) (SMITH *et al.*, 2000, 2003; SMITH & RUMOHR, 2005).

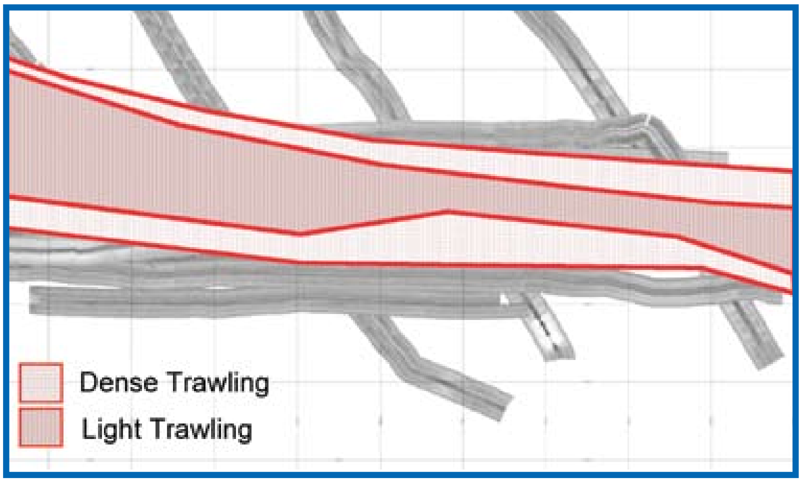


**Figure 4**: Trawling lane mapped out from side scan records in Irakleio Bay, Kriti (approximately 3 x 2 km).

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